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Appendices

10 ACCIDENTS OR MALFUNCTIONS

10.1 Introduction

This section identifies potential accidents, malfunctions, and unplanned events that could occur during the construction, operations, closure, and post-closure phases of the proposed Blackwater Gold Project (the Project) involving any project component or activity. This section assesses the likelihood and circumstances under which these events could occur, and the environmental effects and/or consequences that may result from such events, considering mitigation or contingency plans in place and risk if they are not fully effective. This section also describes how each potential accident, malfunction, or unplanned event would be managed or mitigated.

New Gold Inc. (Proponent) acknowledges the management of risks and preparation for unexpected events (accidents and malfunctions) are integral to the effective governance of the organization. The Proponent's Corporate Health, Safety, Environment and Corporate Social Responsibility Committee is responsible for ensuring that principal areas of health, safety, environmental, and community risk and impacts are identified and that sufficient resources are allocated to ensure that environmental and social impacts are moderated.

The risks associated with accidents and malfunctions were first identified; then these risks were analyzed by means of evaluating their likelihoods and consequences. For credible accidents and malfunctions, the effects were assessed based on a reasonable worst-case scenario. Occurrences where environmental effects are only likely to arise through situations that are practically impossible to attain (such as the failure of multiple back-up systems) were not assessed. For example, medical and similar emergencies, while important, are unlikely to have an environmental impact. Such cases will be addressed through the Emergency Spill Preparedness and Response Plan (ESPRP) (**Section 12.2.1.18.4.13**). At a high level, health and safety are addressed corporately under the Proponent's Health and Safety Management System, discussed in **Section 12.2.1.15.3**. The mine will also establish a mine emergency response and rescue plan as will be required by the Project's *Mines Act* permit.

This section supports the Proponent's commitments to full public disclosure of potential accidents and malfunctions that may arise during all phases of the Project lifecycle.

10.2 Purpose and Scope

Section 10 will serve as a supplement to the ESPRP to meet the terms of the objectives of the Mine Emergency Response Plan Guidelines for the Mining Industry (BC MEMNG, 2013) as required by the Health, Safety, and Reclamation Code for Mines in British Columbia (HSRC) (BC MEMPR, 2008).

The ESPRP provides guidance for responding to all types of mine emergencies and identifies roles and responsibilities in discovery of and response to emergencies. The ESPRP includes development of component plans, including the Mine Rescue Emergency Response Plan, Emergency Response Procedures Plan, and Emergency and Spill Response Plan.

10.3 Environmental Management System Considerations

This section forms part of the Environmental Management System (EMS), including a series of environmental management plans for the Project. The EMS considers current international best practices for environmental management such as ISO 14001 and appropriate elements of other internationally recognized standards and best management practices as the basis for the EMS. These would include, for example, the International Finance Corporation Performance Standards, UNEP (2001) APELL, EC (2009) Environmental Code of Practice for Metal Mines, and the European Bank for Reconstruction and Development Performance Requirements.

The EMS helps mitigate accidents and malfunctions that might impact the environment by:

- Identifying potential accidents and malfunctions and evaluating the probabilities of their occurrence and consequences;
- Identifying applicable legal, regulatory, and other requirements for controlling accidents and malfunctions;
- Setting objectives and targets for accidents and malfunctions and putting controls in place to eliminate these events;
- Defining resources, roles, responsibilities, and authorities for preventing accidents and malfunctions;
- Providing suitable training and awareness programs for Project employees;
- Establishing effective internal and external communication networks;
- Creating the necessary standard operating procedures (SOPs) to reduce the probability of accidents and malfunctions, including a document and records management framework for the Project;
- Implementing effective monitoring and measurement activities for critical areas of the Project, including critical pieces of equipment; and
- Establishing and maintaining regular compliance evaluation and environmental auditing programs, including corrective and preventive action elements.

The risk register developed to support this document will be subject to periodic review and updates throughout the life of the Project in response to internal and external reviews, regulatory changes, changes in operating processes, stakeholder consultation, internal environmental performance reviews, senior management review, and other factors.

Each version of the risk register will be subject to the controlled document requirements, and to the evaluation of compliance and internal audit requirements of the EMS.

10.4 Definitions

Accident – an undesired and unplanned event that results in harm to persons, property, or the environment (Canadian Standards Association (CSA), 2003).

Malfunction (noun) – a failure to function properly (dictionary.com, 2013).

Malfunction (verb) – to fail to function properly (dictionary.com, 2013).

10.5 Health, Safety, Environment and Corporate Social Responsibility Policy

The Proponent's Health, Safety, Environment and Corporate Social Responsibility (HSE & CSR) Policy (New Gold, 2013) states that:

> *"New Gold is committed to excellence in the management of health, safety, environment, labour practices, and community engagement and development. We consider our ability to make a lasting and positive contribution toward sustainable development through environmental stewardship, community development, and the protection of the health and well-being of our people and our host communities a key driver to achieving a productive and profitable business."*

This policy should be read in conjunction with the Proponent's Code of Business Conduct and Ethics, as well as the Proponent's Human Rights and Anti-Corruption Policy, and the Proponent's 15 Health, Safety, Environment and Corporate Social Responsibility Guiding Principles.

The Proponent makes the following commitments to:

- Comply in full with the laws and regulations in each country it operates, and will aspire to achieve a culture of avoiding harm by adopting the highest international standards;
- Regularly conduct assessments and external audits of its operations to ensure continuous improvement of HSE & CSR performance, as well as consistency with the HSE & CSR Policy and the following management systems:
  - The Proponent's health and safety management system (H&S Management System), and
  - The Proponent's environment and corporate social responsibility management system (E&CSR Management System).

10.5.1 Health and Safety

The Proponent is committed to promoting and protecting the welfare of its employees through safety-first work practices and providing a healthy workplace, and committed to leading industry practices and systems in health and safety. To achieve this, the Proponent will implement the H&S Management System that will, among other things:

- Identify and eliminate or mitigate occupational health and safety hazards/risks;
- Report, manage, and learn from injuries, illnesses, and high potential incidents;

- Encourage and support employees to participate in programs which enhance their health, safety, and well-being;
- Foster and maintain a positive safety culture, behaviour, and awareness within the workplace;
- Prepare for and effectively respond to emergencies and crises; and
- Actively engage with and monitor contractors and suppliers so that they understand and respect the occupational health and safety standards.

10.5.2 Environment

The Proponent is committed to preserving the long-term health and viability of the natural environment affected by its operations. To achieve this, the Proponent will implement the E&CSR Management System that will, among other things:

- Apply a proactive risk-management approach to minimizing impacts and safeguarding the environment;
- Foster and maintain an environmentally responsible culture, behaviour, and awareness within the workplace; and
- Prepare and regularly update closure plans, which take into consideration the sustainability of host communities.

10.5.3 Labour Practices

The Proponent is committed to upholding fair employment practices and encouraging a diverse workforce, where people are treated with respect and are supported to realize their full potential. To achieve this, the Proponent's Human Resources policies and procedures do not tolerate any discrimination or harassment and treat all employees and contractors fairly, and provide appropriate training and development opportunities.

10.5.4 Community Engagement and Development

The Proponent is committed to establishing relationships based on mutual benefit and active engagement with its host communities to contribute to healthy communities and sustainable community development. To achieve this, the Proponent will implement the E&CSR Management System that will, among other things:

- Identify the communities and other stakeholders associated with project sites, work to understand their interests and concerns and the extent to which they are affected by the Proponent's business;
- Actively engage with communities and other stakeholders in a culturally appropriate and transparent manner as early as possible and throughout the life cycle of the Proponent's operations;

- Respect the culture, customs, interests, and rights of host communities, including Aboriginal peoples; and
- Work with governments, host community representatives, and other organizations to promote local sustainable development both during and after mining operations.

10.6 Regulatory and Voluntary Guidance

A general discussion of regulatory requirements potentially applicable to the management of accidents and malfunctions at the Project is presented in this section. The Proponent is committed to meeting or exceeding all applicable regulatory requirements for management of accidents and malfunctions at its mine sites in British Columbia (BC).

The EMS includes a process for regular review of regulatory changes that may affect the Project. A register of applicable federal, provincial, and municipal regulatory requirements will be maintained and this document will be updated, as necessary, to reflect the applicable changes in the legal and regulatory framework.

10.6.1 Summary of Regulatory and Voluntary Guidance

The primary pieces of legislation, regulations, and voluntary guidance governing the management of accidents and malfunctions at the Project are as follows:

- Federal:
  - *Canadian Environmental Assessment Act, 2012* (CEAA) (Government of Canada, 2012); and
  - *Fisheries Act* (Government of Canada, 1985) (indirectly through prohibition of unauthorized discharges).
- Provincial:
  - *Environmental Management Act, Spill Reporting Regulation* (Government of British Columbia 1990).
- Municipal:
  - None identified.
- Voluntary:
  - Environment Canada (EC). 2009, Environmental Code of Practice for Metal Mines;
  - UNEP (2001), APELL for mining (Awareness and Preparedness for Emergencies at Local Level);
  - CAN/CSA Z731-03 (R2014) Emergency Preparedness and Response (CAN/CSA Z731-03) (CSA, 2014);
  - ISO 31000:2009 Risk Management – Principles and Guidelines (ISO 31000) (ISO, 2009); and
  - ISO 14001:2004 Environmental Management Systems (ISO 14001) (ISO, 2004).

10.6.2 Federal Requirements

Section 19 (1) of *CEAA* requires that the environmental assessment of a designated project must take into account "the environmental effects of the designated project, including the environmental effects of malfunctions or accidents that may occur in connection with the designated project."

10.6.3 Provincial Requirements

Spill Reporting Regulation requires mandatory reporting of spills over amounts listed in Schedule 1 of the Regulation.

10.6.4 Voluntary Guidance

The EC Environmental Code of Practice for Metal Mines recommends site-specific environmental risk management procedures should be developed and implemented in a manner consistent with guidance provided in:

- CAN/CSA-Q634-M91 - Risk Analysis Requirements and Guidelines; and
- CAN/CSA-Z763-96 - Introduction to Environmental Risk Assessment Studies.

UNEP 2001 APELL (Awareness and Preparedness for Emergencies at the Local Level) recommends a ten-step process which is followed in a general sense by the Project EPSRP:

- Step 1 Identify the emergency response participants and establish their roles, resources and concerns;
- Step 2 Evaluate the risks and hazards that may result in emergency situations in the community and define options for risk reduction;
- Step 3 Have participants review their own emergency plan for adequacy relative to a coordinated response, including the adequacy of communication plans;
- Step 4 Identify the required response tasks not covered by the existing plans;
- Step 5 Match these tasks to the resources available from the identified participants;
- Step 6 Make the changes necessary to improve existing plans, integrate them into an overall emergency response and communication plan and gain agreement;
- Step 7 Commit the integrated plan to writing and obtain approvals from local governments;
- Step 8 Communicate the integrated plan to participating groups and ensure that all emergency responders are trained;
- Step 9 Establish procedures for periodic testing, review and updating of the plan; and
- Step 10 Communicate the integrated plan to the general community.

Section 4.4 of *CAN/CSA Z731-03* provides guidance on a hazard identification and evaluation process that assesses probabilities and consequences connected with hazards arising from human activities, technological events, and natural perils. Annex C of *CAN/CSA Z731-03* includes a risk estimation grid.

For each type of potential event that an organization identifies, it is important to assess the degree or level of risk, i.e., the effect that the event would have on the organization combined with the probability of the event occurring. Combining these two pieces of information allows an organization to rank these events based on the level of risk assigned to each potential event.

ISO 31000 provides guidance for organizations wishing to evaluate their risk management process. All activities of an organization involve risk as it applies to the achievement of its organizational objectives. *ISO 31000* describes the risk management process in terms of identifying risk, analyzing it, and then evaluating whether the risk should be modified by risk treatment in order to satisfy the risk criteria.

ISO 31000 also describes the stakeholder communication and consultation processes and the monitoring and review of the risk and risk controls that occur throughout the risk process to ensure that no further risk treatment is required.

10.7 Risk Assessment Process

10.7.1 Risk Assessment Framework

10.7.1.1 Temporal Boundaries

The temporal boundaries for the risk assessment align with the construction, operation, closure, and post-closure phases of the Project. The preliminary temporal boundaries for the risk assessment are as follows:

- The construction phase is scheduled to occur over two years, starting immediately following receipt of the required permits. Up to approximately 1,500 personnel will be housed in an on-site camp for two years during construction of the mine and processing facility. Many subcontractors will be operating on site during construction, and specific procedures will be developed to ensure that appropriate emergency planning and safety precautions are adhered to by all personnel involved in the construction of the mine and processing facility.
- The operations phase is scheduled for a duration of approximately 17 years, starting once the process plant site is constructed, commissioned, and ready for ore processing. An operations camp will provide accommodation for up to 500 personnel during operations.
- The closure phase includes initial decommissioning that occurs during the three years following the cessation of mining and ore processing activities, when the mine site buildings and infrastructure will no longer be needed. Activities will include

decommissioning of plant facilities and infrastructure and their abandonment/removal from the mine site, and implementing the site reclamation plan. The closure phase also includes filling the pit lake estimated to take 18 years after the cessation of mill operations. The number of employees on site and the support services available will be reduced dramatically to about 50 people for the three years of initial decommissioning and reduced further for the remaining closure period.

- The post-closure phase is estimated to start immediately after completion of the closure activities and pit lake filling.

10.7.1.2 Spatial Boundaries

The spatial boundaries for the risk assessment were selected to cover the geographic extent in which the potential adverse effects of accidents and malfunctions associated with the Project are expected to be measurable. For the purposes of the risk assessment, the Project footprint includes the land where any proposed facilities or infrastructure will be developed and includes the rights-of-way (ROWs) for the transmission line, the freshwater supply pipeline, the existing Kluskus Forest Service Road (FSR) that will serve as the main access route, and the mine site access road.

The spatial boundaries selected for the risk assessment are the same as those for terrestrial valued components: the footprint of the Project's mine components and a 1-km wide corridor centred on the footprints of the transmission line, freshwater supply pipeline, FSR, and mine site access road.

10.7.2 Methodology

A Qualitative Risk Assessment (QRA) was carried out for the potential events (accidents and malfunctions) and is discussed in this section. QRA, though lacking the ability to account for dependencies between events, is effective in identifying potential hazards and associated environmental effects.

QRA using the concepts described in methods such as Potential Problem Analysis (PPA), Failure Modes, and Effects Analysis and Hazard and Operability (HAZOP) studies etc. are being increasingly used for all stages of projects to allow proactive risk management of those projects. For the Project risk workshop, the PPA nomenclature was adopted.

The PPA framework is an engineering reliability technique used to systematically identify, analyze, and evaluate risks that derive from the failure of an engineered system to operate or perform as intended. Although PPA does not reduce risk in itself, the systematic risk characterization it provides can be essential to designing risk management and mitigation strategies.

The meaning of "risk," which is defined as "the effect of uncertainty on objectives," is fundamental to PPA (ISO 31000 section 2.1). An effect is a deviation from the expected—either negative (a threat) or positive (an opportunity). Risk is often characterized by reference to potential events that may occur in the future and the consequences of those events.

This concept of risk embodies two components: an uncertain state of knowledge about the possible occurrence of an event and the adverse or positive consequences or effects produced by the event should it occur. Expressed more simply:

Risk = Likelihood x Consequence

Consequently, for the PPA to characterize risk appropriately, the relative likelihood of a failure event and its associated consequence(s) must be accounted. As a qualitative technique, likelihood and consequences are evaluated in PPA using professional judgement and opinion. This judgement and opinion should be from as broad-based a background as possible.

For any complex system, risks can arise from many sources. Upset and/or failure conditions within any one component can affect other components of the system directly. PPA evaluates the failure likelihood and consequences for each individual component, allowing those with the highest risk to be identified for further analysis or targeted for risk reduction measures. The PPA qualitative approach applied to the assessment of project systems allows:

- Systematic identification and cataloguing of those components the failure of which to operate or perform as intended would pose risk to the environmental or social aspects of the Project overall;
- Identification of those features and potential occurrences that are the dominant risk contributors and distinguish them from those that produce comparatively lesser risk; and
- Development of a sense of the overall reliability of the protection or mitigation features incorporated in planning, design, construction, operations, and closure of the Project and its ancillary components.

The PPA is carried out within the context of the following assumptions and limitations:

- A PPA does not serve as a quality assurance device. It assumes that the facilities are constructed in a way that meets the intent of their design. Human operating error becomes implicit in the risk evaluation process although the more “imaginative” human errors are typically not considered;
- A PPA is different from regulatory compliance or environmental audits and it does not fulfill their specific purposes. However, the process can readily identify where “fatal flaws” may arise by not addressing specific aspects of such potential audits. This can be crucial during a project permitting stage; and
- A PPA seeks to characterize risk in a systematic way, but it is not intended to identify every conceivable risk or failure mode. PPA reflects the information available, as well as judgement and professional opinion at the time it was performed. These factors may change over time, and the assessment of risk is expected to vary according to additional information of the evaluation by others.

PPA characteristically includes several steps performed in logical sequence. These are described below for the PPA of the Project.

The PPA methodology essentially consists of the following steps:

- **Identify the Potential Problems/Events**. Create a list of potential events/problems associated with different areas of the Project, including human-caused hazards. Other natural hazards such as forest fires (non-human caused), earthquakes, tornadoes etc. are included in the Effects of the Environment on the Project;
- **Evaluate the Likelihood of the Event Occurring**. Assign a probability or likelihood that the problem will occur. Probability ranges from conceivable but only in extreme circumstances/less than one event per 100 years (within the life of the Project) to happens often/more than one event per month;
- **Evaluate the Consequence of Event Should it Occur**. Assign a consequence or severity resulting from the event occurring that best describes the effects of a worst-case scenario given the existing controls that are known to be incorporated in the design of the facility. Environmental consequences, for example, range from limited damage to minimal area of low significance or previously disturbed areas (e.g., low dollar value damage to the environment) to irreparable damage and very serious long-term impairment of ecosystems (e.g., high dollar value damage to the environment). Consequences are considered individually for the following elements: reputation, business, environment, damage/loss, and people; and
- **Evaluate the Level of Risk**. A risk criteria matrix of likelihood against consequence is used to assign an overall risk value associated with the event (e.g., extreme to low) based on a ranking derived from the values assigned to the likelihood and consequence of the event occurring.

Table 10.7.2-1 includes the definitions for likelihoods used for the risk assessment.

Table 10.7.2-1: Definitions for Likelihood of Occurrence of an Accident or Malfunction

Likelihood Score	Descriptor		Frequency
1	Almost certain	Happens often	More than one event per month
2	Likely	Could easily happen	More than one event per year
3	Possible	Could happen and has happened here or elsewhere	One event per 1–10 years
4	Unlikely	Has not happened yet but could	One event per 10–100 years (within a single mine life)
5	Very rare	Conceivable but only in extreme circumstances	Less than one event per 100 years (within the life of the Project)

Table 10.7.2-2 includes the definitions for consequences used for the risk assessment.

Table 10.7.2-2: Definitions for Consequence of Occurrence of an Accident or Malfunction

Consequence Score	Descriptor	Reputation	Business	Environment	Damage/ Loss	People
A	Catastrophic	Major damage to reputation receiving national or international negative media OR production to cease as a result of statutory body concerns	>48 h production delay	Irreparable damage, very serious long-term impairment of ecosystem	>$500k	Fatality(ies)
B	Major	Major damage to reputation receiving province wide negative media OR non-compliance with statutory requirements	>24 h <48 h production delay	Serious medium-term environmental impact affecting whole ecosystem	>$100k <$500k	Permanent and total disability
C	Moderate	Moderate damage to reputation localized to the regional media OR non-compliance with statutory requirements resulting in minor fine	>12 h <24 h production delay	Moderate short-term effects affecting part but not affecting whole of ecosystem	>$50k <$100k	Lost time injury
D	Minor	Minor effect on reputation localized to community near mine OR technical divergence that may attract attention from statutory authorities	>6 h <12 h production delay	Little short-term effect on biological or physical environment	>$5k <$50k	Disabling injury
E	Insignificant	No effect on stakeholders or reputation	<6 h production delay	Limited damage to minimal area of low significance or previously disturbed areas	<$5K	First Aid/Medical Treatment injury with no time lost or change of duties

Table 10.7.2-3 includes the definitions for overall risk values used for the risk assessment.

Table 10.7.2-3: Definitions for Overall Risk Scores

Risk Score	Descriptor	Definition
1 to 5	Extreme	Risks that have a serious negative effect that cannot be endured. Urgent management attention required to reduce likelihood and consequence.
6 to 13	High	Risks that have major negative effect. Management attention required to reduce likelihood and consequence.
14 to 20	Medium	Risks that have a moderate negative effect that can be managed. Management attention should be applied to reduce the likelihood and consequence. However, for those risks with a 'major impact/very rare likelihood (B5)' rating a robust fallback/contingency plan may suffice, plus early warning mechanisms to detect any increase in likelihood so that appropriate management action can be taken.
21 to 25	Low	Risks that have a minor or negligible negative effect. They are unlikely to warrant specific management action as they are usually addressed through 'good housekeeping,' but should be reviewed periodically to confirm that there is no change. Risks with a 'minor impact/likely likelihood (D2)' rating may require some mitigation to reduce likelihood if this can be done cost effectively with sufficient management action to ensure the impact remains low.

Figure 10.7.2-1 shows the risk matrix using the values for likelihood and consequence.

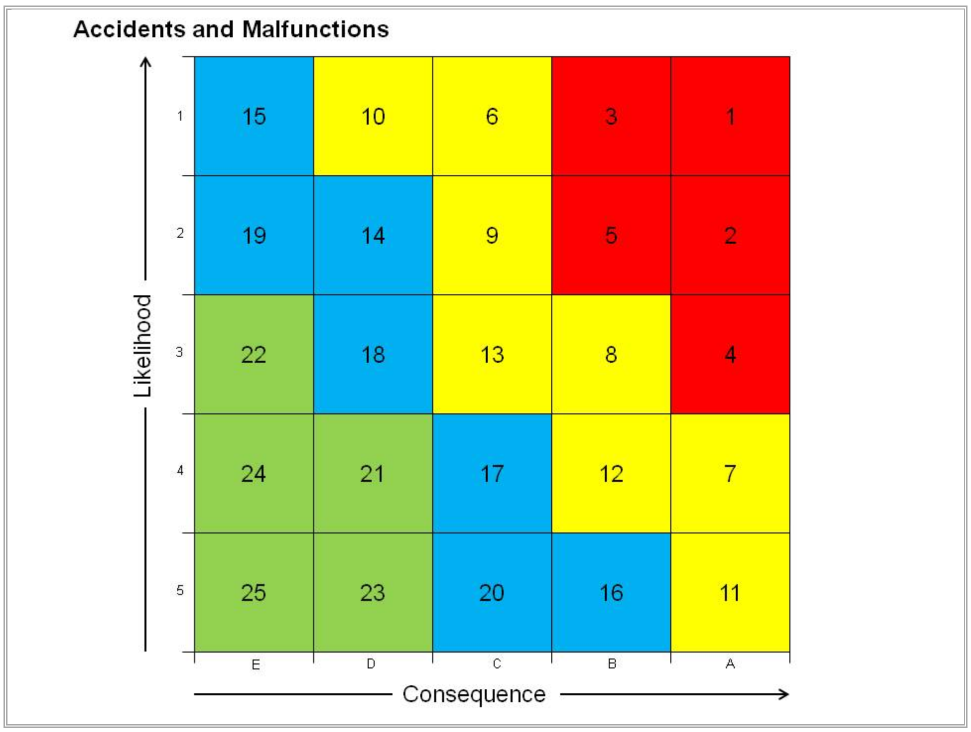


Figure 10.7.2-1: Risk Matrix

Where a range of risk scores could occur, a conservative approach, whereby only the highest ranking is associated with a credible occurrence, has been used and listed. Risk ratings greater than 14 (low or medium) are considered acceptable. Risk ratings of 6 to 13 (high) require further consideration, and risk ratings of 5 or less (extreme) are considered unacceptable and require immediate corrective action.

Table 10.7.2-4 provides a summary of the risk assessment for events associated with accidents and malfunctions, with the highest risk identified associated with an event that is possible and has a major consequence. The likelihood scores assume mitigation is effective as designed. This is a reasonable assumption, because monitoring and adaptive management are integral features of the Project EMS and non-performance of implemented mitigation will be corrected as soon as noted, with particular attention being paid to high consequence risks.

Table 10.7.2-4: Accidents and Malfunctions Risk Summary

Accident or Malfunction	Issue of Concern	Likelihood	Consequence	Risk Score
Open pit slope failure	Damage to habitat and limited flooding of open pit	Rare – 5	Insignificant – E	Environment – 25 – Low
East waste rock dump failure	Damage to terrestrial and aquatic habitat	Unlikely – 4	Minor – D	Environment – 21 – Low
West waste rock dump failure	Damage to terrestrial and aquatic habitat	Unlikely – 4	Insignificant – E	Environment – 24 – Low
Low-grade ore stockpile failure	Damage to terrestrial and aquatic habitat	Unlikely – 4	Minor – D	Environment – 21 – Low
Topsoil stockpile failure	Damage to terrestrial and aquatic habitat	Unlikely – 4	Minor – D	Environment – 21 – Low
TSF dam failure	Damage to terrestrial and aquatic habitat; wildlife kill; human fatality	Rare – 5	Catastrophic – A	Environment – 11 – High
ECD failure	Damage to terrestrial and aquatic habitat; change in water quality in freshwater reservoir	Rare – 5	Major – B	Environment – 16 – Medium
Freshwater reservoir failure	Erosion in Davidson Creek from sudden, large volume release	Rare – 5	Minor – D	Environment – 21 - Low
Sedimentation pond failure (accidental sediment releases into water courses)	Damage to terrestrial aquatic habitat	Unlikely – 4	Moderate – C	Environment – 17 – Medium
Seepage collection system failure	Damage to terrestrial and aquatic habitat	Unlikely – 4	Minor – D	Environment – 21 – Low
Water supply system (pump failure)	Production delay	Unlikely – 4	Moderate – C	Business – 17 – Medium
Water pipeline failure	Damage to terrestrial and aquatic habitat	Unlikely – 4	Moderate – C	Environment – 17 – Medium
Explosives accident	Damage to terrestrial and aquatic habitat	Rare – 5	Insignificant – E	Environment – 25 – Low
Tailings pipeline failure	Damage to terrestrial and aquatic habitat	Unlikely – 4	Minor – D	Environment – 21 – Low
Major fuel release during transport to Project	Damage to aquatic habitat and downstream human environment, if release is near surface water; damage to terrestrial habitat if on land	Unlikely – 4	Moderate – C	Environment – 17 – Medium
Transportation accident – hazardous materials, excluding fuel	Damage to aquatic life and downstream human environment	Possible – 3	Major – B	Environment – 8 – High

Accident or Malfunction	Issue of Concern	Likelihood	Consequence	Risk Score
Transportation accident – non-hazardous materials and work crews	Damage to terrestrial and aquatic habitat if release is near surface water	Likely – 2	Moderate – C	Environment – 9 – High
Fuel releases from storage facilities and dispensing areas	Damage to terrestrial habitat	Almost certain – 1	Insignificant – E	Environment – 15 – Medium
Spills of hazardous substances in contained areas	None	Almost certain – 1	Insignificant – E	Environment – 15 – Medium
Fly rock from blasting	Health and safety issue	Possible – 3	Insignificant – E	Environment – 22 – Low
Aircraft accidents on site	Damage to terrestrial and aquatic habitat	Unlikely – 4	Insignificant – E	Environment – 24 – Low
Accidental discharge of effluent streams (sewage treatment plant)	Damage to aquatic life	Possible – 3	Minor – D	Environment – 18 – Medium
Forest fire (Project-related)	Human environment and local terrestrial habitat loss, if fire is controlled without delay	Possible – 3	Moderate – C	Environment – 13 – High
Power outages	Damage to aquatic habitat due to failure of fresh water supply system	Possible – 3	Minor – D	Environment – 18 – Medium

Note: ECD = Environmental Control Dam; TSF = Tailings Storage Facility

10.7.3 Risk Summary

There were no extreme risks identified during the risk workshop that require additional safeguards.

The majority of the risks identified in the risk workshop are classified as low risk, i.e., they will have a minor or negligible negative effect.

The accidents and malfunctions with the highest risk values are:

- Tailings Storage Facility (TSF) dam failure;
- Transportation accidents involving hazardous and non-hazardous materials; and
- Forest fire (Project-related).

10.8 Description of Accident and Malfunction Scenarios

Project design and operational performance are key to ensuring a safe and environmentally sound operation. The risks associated with accidents and malfunctions are first identified; then these risks are analyzed by means of evaluating likelihood and consequence.

The risk of potential accidents and malfunctions for the Project was identified from a variety of sources, including experience with other similar mining projects (directly and through the literature), internal risk assessment discussions, workshops, and comments received from stakeholders and Aboriginal groups. It is possible additional areas will arise through review and consultation associated with the Application that may require revision.

For credible accidents and malfunctions, the effects were assessed based on a reasonable worst-case scenario. Occurrences where environmental effects are only likely to arise through situations that are practically impossible to attain (such as the failure of multiple back-up systems) were not assessed. Medical and similar emergencies, while important, are unlikely to have an environmental effect. These are not addressed herein but will be addressed in the ESPRP.

The following potential accidents and malfunctions were identified for effects assessment:

- Structural failures: open pit slope failure, waste rock/overburden and low-grade ore (LGO) stockpiles slope failure, TSF dam failure, environmental control dam (ECD) failure, freshwater reservoir failure, and sedimentation pond failure;
- Accidents: failure of seepage collection system, water pipeline failure, explosives accident, tailings pipeline failure, major fuel release (>100 L) during transport, transportation accidents involving movements of work crews and hazardous and non-hazardous materials, fuel releases from storage facilities and dispensing areas on site, spills of hazardous substances in contained areas, fly rock from blasting, and aircraft accidents; and

- Other malfunctions: accidental discharge of effluent from sewage treatment system, accidental sediment release into watercourses, forest fire (Project-related) caused by clearing, during construction or operations and closure activities, excessive disturbance of wildlife, and power outages.

Each identified credible accident and malfunction is described below, as well as potential environmental concerns and associated risk. Proposed design, mitigation measures, and operations safeguards, as well as proposed contingency and emergency response procedures are also provided, as relevant.

Emergency response procedures will be established as part of the EMS. After an incident, a review will be conducted to ensure that the required design changes and procedures and appropriate monitoring measures are in place to ensure that the incident is not repeated. A reporting procedure will be established to ensure all incidents are recorded and appropriate ones are investigated. This will allow for the monitoring of trends, determining the effectiveness of controls, and continual improvement of the mine site.

10.8.1 Structural Failures

10.8.1.1 Open Pit Slope Failure

The open pit will be excavated through overburden and into the ore-bearing bedrock. The geotechnical stability of the rock and overburden in the proposed open pit area was assessed by Knight Piésold as part of the Feasibility Study and discussed in **Section 2.2.3.2.4.2** of the Project Overview chapter. This information was used to develop a preliminary pit slope design and to establish allowable overall slope angles.

Four major geotechnical domains were defined for the pit slope geotechnical assessment:

- Overburden;
- Felsic Volcanics;
- Andesite; and
- Broken Zone.

The overburden thickness typically ranges from 5 metres (m) to 10 m but increases to 50 m to 80 m along the east side of the deposit. The intact strength of all rock types was found to be “medium strong” to “strong” with average unconfined compressive strength (UCS) values between 50 megapascal (MPa) and 180 MPa. The rock mass quality appears to be “very poor” for the broken zone unit with an average rock quality designation (RQD) value of 15. The rock mass quality for the rest of the geological units was characterized as “fair” to “good” with an average RQD value of over 50.

Groundwater levels were near surface in the lower elevation areas of the deposit. Artesian flows were encountered in some drill holes on lower slopes. The groundwater table was found at approximately 35 m depth in drill holes on the higher elevation south side of the deposit. Given the presence of broken rock in the deposit area, the rock mass permeability is expected to be high.

The open pit will reach a maximum depth of 400 m. Pit development will use bench heights of 10 m. Inter-ramp slopes will be 27° in the overburden and range from 38.5° to 46° in rock, depending on the pit wall orientation. The overall slope angles, including flattening for the overburden, range from 34° to 43°, depending on the pit design sector. The inter-ramp and overall slope angles by pit design sector were incorporated into the pit definition floating cone runs and in the mining phase and final pit designs.

10.8.1.1.1 Potential Environmental Concerns

Two primary slope failures were considered:

- Failure of the bedrock slopes caused by improper mine design and operational procedures; and
- Failure of the overburden slopes caused by pre-shearing or uncontrolled erosion.

Improperly designed and operated open pits can pose a safety hazard to workers during construction and operations and potentially the surrounding environment, if a pit slope failure (e.g., bedrock triggering overburden failure or overburden failure alone) enlarges the open pit footprint.

Unlike some underground mines, open pits are not subject to catastrophic release of rock pressures, such as rock bursts. In an open pit environment, due to the open nature of the excavation, strain energy is dissipated with blasting instantaneously such that rock bursts do not occur. Buckling and heaving of rock floors can occur in regions of horizontally oriented geological structure, but such movements of any appreciable magnitude are unlikely at the Project open pit due to the extensive broken zones within the deposit area. Some stress-induced damage to the rock mass may occur as the open pit approaches the completion depth; however, this damage is manageable and of the same order of magnitude as the damage created through back break following blasting.

A catastrophic rock failure of the open pit could increase the open pit diameter of the top of the bedrock face. The toe of the overburden slope will be set back from the top of the bedrock face of the open pit on the order of 20 m, within which would be the expected maximum extent of a catastrophic rock failure. Therefore, in either case the surface is not expected to be affected by a bedrock slope failure. No environmental effects will result unless the overburden slope requires subsequent re-contouring outward to maintain pit access.

A failure of the overburden slope within the pit could be caused by pre-shearing conditions. An overburden slope failure that extends beyond the open pit boundary could increase the ultimate pit footprint by causing the adjacent ground surface to slump into the open pit. Any ground that slumps into the open pit would be damaged. If surface waters are located in the slumped ground, the water would be diverted to the open pit.

Depending on the location, a slump could disrupt haul and other roads used to access the open pit. After stabilization, the roads would be re-established. Other site infrastructure is sufficiently set back from the open pit boundary and would not be affected by an open pit slope failure. No environmental effects would occur from slope failures along the west, north, and east faces given that these areas are already to be disturbed, in addition to the damaged land immediately adjacent to the open pit. The cone of depression caused by development of the pit will already result in groundwater flowing to the pit and requiring pump-out to the TSF. Any credible slope failure is unlikely to affect seepage into the pit.

The potential environmental effects of pit slope failure on the south side depends on timing. Prior to extension of the pit boundary to the ultimate pit and mining on the south side of the pit, the slope failure would have no incremental environmental effects beyond the planned disturbance. Thus up until about Year 8, there would be no incremental effects from slope failure. Once the final pit boundary is reached, additional pit slope failure at the top of the pit causing overburden slumping could potentially affect the whitebark pine (*Pinus albicaulis*) in that area. Whitebark pine is a provincial Blue-listed species and a management plan has been developed to mitigate planned Project effects.

The potential amount of slumping cannot be predicted but major slumping will be prevented by pit slope design based on geotechnical characterization of the open pit ground through an extensive drilling program and engineering evaluation (**Section 2.2.3.2.4.2**).

10.8.1.1.2 Design and Operations Safeguards

Geotechnical monitoring of pit wall stability directed by qualified geotechnical engineers will be continuous during pit excavation. Surface monitors will be installed at strategic locations to monitor ground movement. Should any substantial slope movement occur, a review will be conducted by qualified geotechnical engineers to assess whether design changes are needed to ensure safe mining operations. Minor sloughing is expected to occur and catch berms and geotechnical berms will be periodically cleaned to maintain effectiveness.

10.8.1.1.3 Contingency and Emergency Response Procedures

The bedrock pit wall angles were established using a conservative approach. Falling rocks will generally be captured by the safety berms. The safety berms will be designed to catch falling rock; however, in some instances, falling rock could reach the open pit floor. Safety berms, or catch benches, will be spaced (vertically and horizontally) to collect the different types of rock (e.g., overburden or bedrock). For example, catch benches could be placed every 24 m vertically and may be between 12 m and 20 m wide. If a catch bench fills up, it will be cleaned out. The

Proponent will adhere to requirements of the Health, Safety and Reclamation Code for Mines in British Columbia (BC MEMPR, 2008) as it pertains to catch benches. In the unlikely event workers are injured by slope failure, emergency response procedures, which will be developed as part of the EMS, will be followed.

10.8.1.2 Slope Failure of Waste Rock/Overburden, Low-Grade Ore, and Topsoil Stockpiles

Five types of waste rock have been classified at the Project: overburden, three types of non-acid generating waste rock (NAG5, NAG4, and NAG3), and two types of potentially acid generating rock (PAG2 and PAG1). Some of the material types will be used for the construction of the TSF embankments during the mine life, and the rest will be stored as follows:

- Overburden and NAG5 and NAG4 waste rock: east and west waste rock dumps adjacent to pit;
- NAG3 waste rock: subaqueous storage in TSF pond;
- PAG2 waste rock: subaqueous storage in TSF pond; and
- PAG1 waste rock: subaqueous storage in TSF pond.

The West waste rock dump will have a footprint of approximately 172 hectares (ha) and will store 87 million tonnes (Mt) of overburden, NAG5, and NAG4 with an elevation of 1,535 metres above sea level (masl) (160 m high). The East waste rock dump will have a footprint of approximately 158 ha to store 50 Mt of NAG5 and overburden with an elevation of 1,590 masl (105 m high).

The waste dumps will be developed with 2H:1V (horizontal:vertical ratio) overall slopes to facilitate reclamation at closure. The open pit is located above the East waste rock dump and a ditch will be constructed above the West waste rock dump.

The LGO stockpile will be north of the open pit, between the two waste rock dumps. It will have a footprint of approximately 76 ha and will store 50 Mt of LGO. Water that infiltrates through the LGO stockpile will be collected in a drainage system, neutralized, and directed to the TSF.

The topsoil stockpile will be east of the TSF and will have a footprint of approximately 10 ha. Surface water runoff will be diverted around the topsoil stockpile and directed to the ECD structure.

10.8.1.2.1 Potential Environmental Concerns

The aquatic and terrestrial resources in the area of dumps and stockpiles are described below, followed by a discussion of the potential environmental concerns.

10.8.1.2.2 Aquatic Habitat

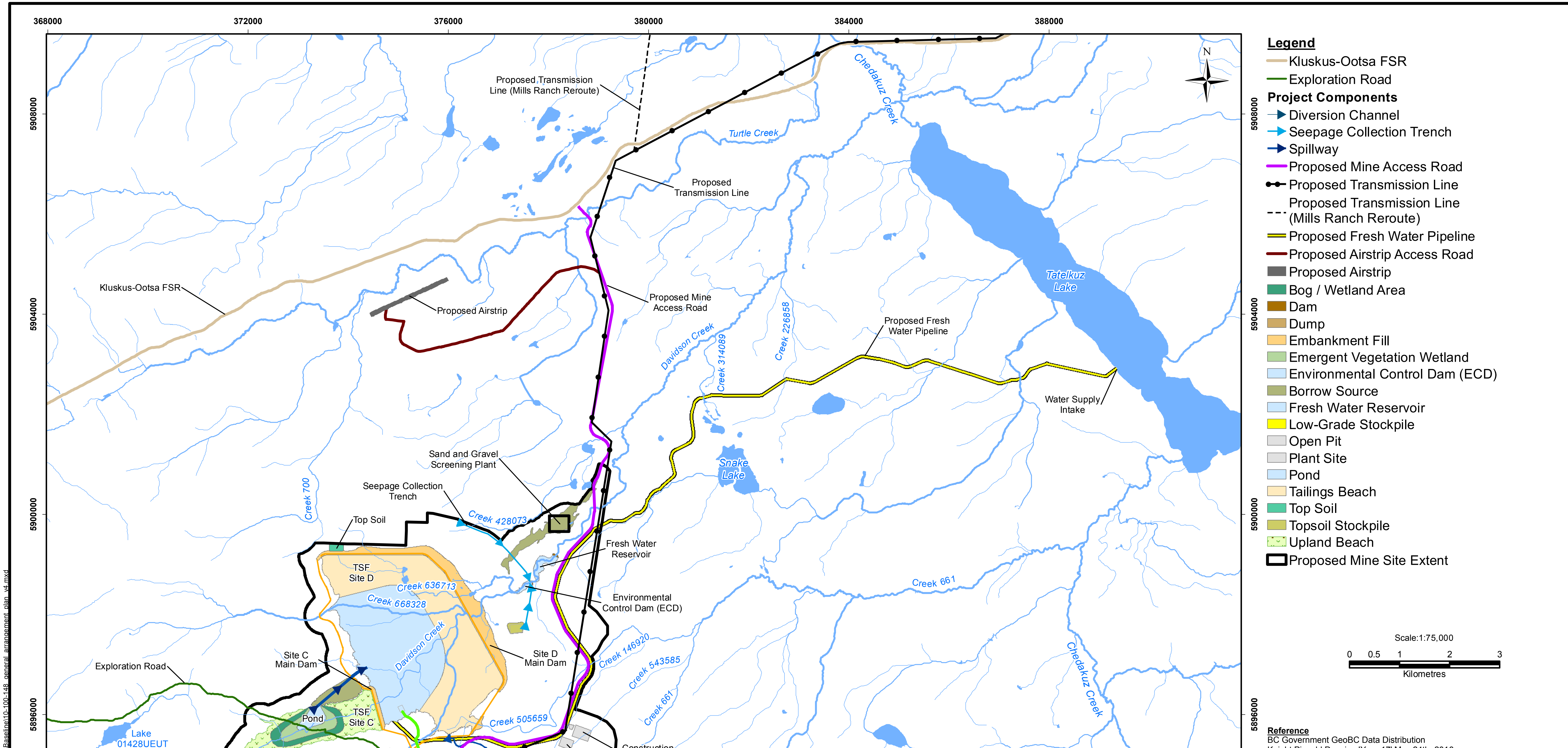
Site infrastructure, including the fuel site, warehouses and materials storage buildings, administrative buildings, construction lay-down area, truck stop, explosives facility, construction camp and maintenance buildings, camp land-fill and domestic sewage system, haul roads, and ore-processing facilities (i.e., plant site, mill and processing area, core logging area, crusher and conveyor) and the LGO stockpile will be located in the headwaters of the Davidson Creek and Creek 661 watersheds. Construction of these facilities will require clearing and grading of land, and preparation of foundations. Where these facilities will over-lie streams, the streams will be dammed, diverted or dewatered, and eventually covered with fill as foundations for these buildings, lay-down areas, and rock storage areas. These streams will be permanently lost and include headwater portions of:

- Creek 704454 and its tributaries in the Davidson Creek watershed;
- Creek 505659 and its tributaries in the Creek 661 watershed; and
- Creek 146920 and its tributaries in the Creek 661 watershed.

The mine pit area will be stripped of top-soil and overburden during the construction phase. Streams within the footprints of the open pit and two waste rock facilities that will be permanently lost include:

- Headwater tributaries of Creek 704454 in the Davidson Creek watershed;
- Creek 704454 mainstem; and
- Headwater portions of Creek 543585 in the Creek 661 watershed.

Figure 10.8.1-1 shows the waterbodies affected by the proposed mine development.



Reference
BC Government GeoBC Data Distribution
Knight Piesold Drawing 'Year 17' May 24th, 2013

CLIENT: newgold

PROJECT: Blackwater Gold Project

Location of the Blackwater Mine Site And Associated Infrastructure

DATE: April, 2014	ANALYST: KA	Figure 10.8.1-1
JOB No: VE52277	QA/QC: BM	PDF FILE: 10-100-148_general_arrangement_plan_v4_minsite.pdf
GIS FILE: 10-100-148_general_arrangement_plan_v4.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	amec

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10.8.1.2.3 Terrestrial Resources

10.8.1.2.3.1 Ecosystems Affected by Mine Site Development

Site infrastructure, including construction camp, construction laydown, conveyor, crusher, east dump, LGO stockpile, open pit, operation camp, pit lake pond, process plant site, plunge pool, truck shop, buildings, and west dump will be located in the high elevation Engelmann Spruce – Subalpine Fir Nechako Moist Very Cold (ESSFmv1) biogeoclimatic variant and to a minor extent in the Engelmann Spruce – Subalpine Fir Moist Very Cold Parkland (ESSFmvp) variant.

The ESSFmv1 variant is characterized by the presence of young (40 to 80 years) and mature (80 to 250 years) subalpine fir and Engelmann spruce forests. Lodgepole pine is more common on drier sites, and as a seral species in young stands and on warm exposures. Whitebark pine is a co-dominant species that occurs with lodgepole pine at higher elevations, particularly south and east of the open pit.

Characteristic understory species on average moisture sites include black huckleberry (*Vaccinium membranaceum*), five-leaved bramble (*Rubus pedatus*), heart-leaved arnica (*Arnica cordifolia*), bunchberry (*Cornus canadensis*), and red-stemmed feathermoss (*Pleurozium schreberi*). White-flowered rhododendron (*Rhododendron albiflorum*), black huckleberry, crowberry (*Empetrum nigrum*), and liverworts are dominant in areas of cool exposure, while lichens occur on warm slopes. Moist site indicators include willows (*Salix* spp.), sitka valerian (*Valeriana sitchensis*), common horsetail (*Equisetum arvense*), Indian hellebore (*Veratrum viride*), and leafy mosses. Wetlands such as bogs, fens, and swamps are also present in the ESSFmv1 variant.

Figure 10.8.1-2 shows the terrestrial ecosystems that will be affected by mine development in the open pit and waste rock dump area.

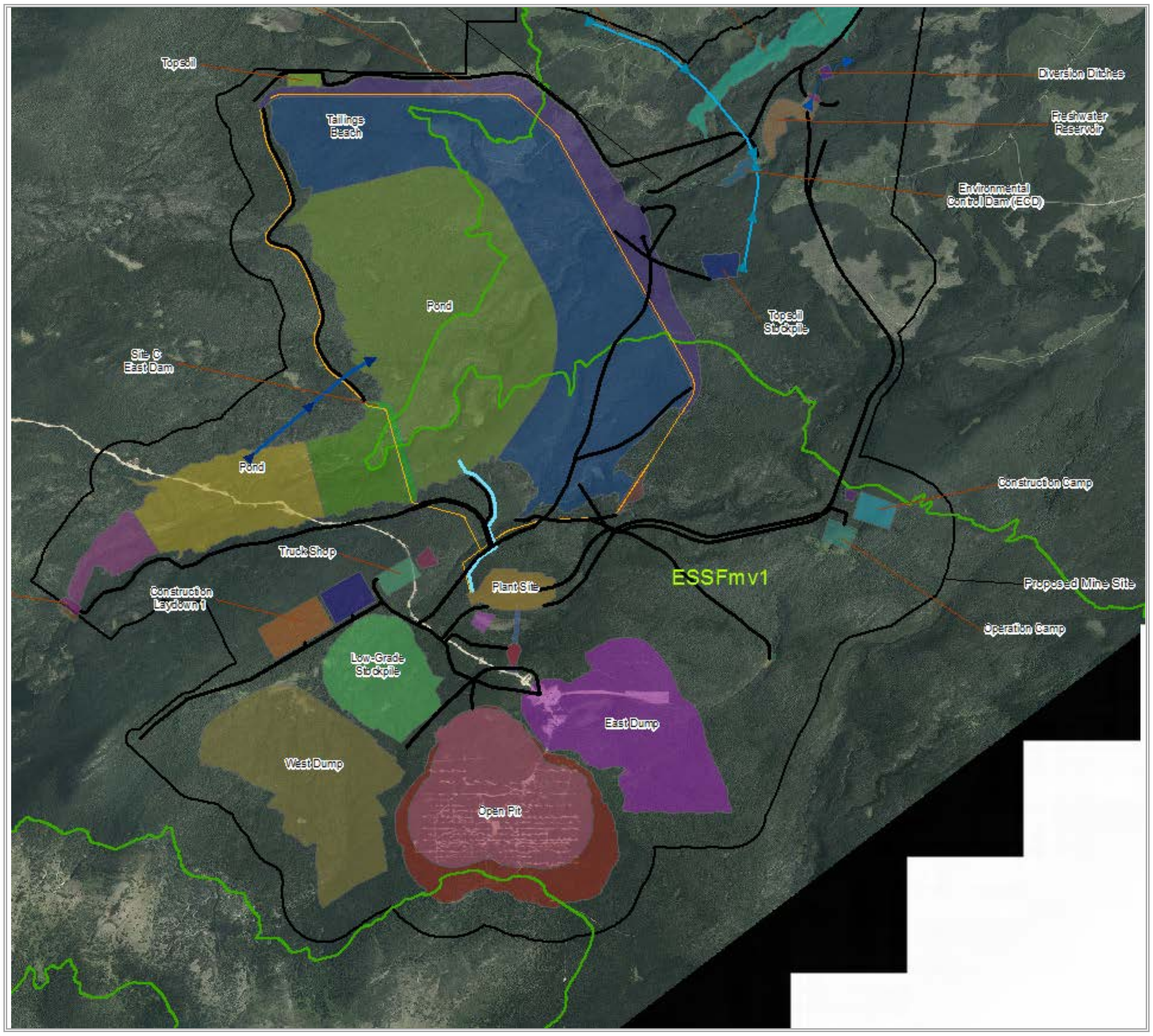

Figure 10.8.1-2: Terrestrial Ecosystems Affected by Mine Site Development

10.8.1.2.4 Potential Concerns

A major slope failure of the waste rock or LGO stockpiles could result in the release of rock and, if progressively reclaimed, overburden that will pose a safety hazard to any facilities in the immediate vicinity. The west waste rock stockpile and the LGO stockpile will drain to the TSF. The east waste rock stockpile is well above the collection ditch that flows to the TSF.

The rock stored in the stockpiles is sized for transport and is blocky in nature, and therefore generally unlikely to roll or slide. The most likely, yet improbable, slope failure would occur during a pre-shearing event where part of the stockpile sinks into the ground and the toe of the stockpile is raised. No material would run from stockpile in this case and no environmental effects are expected. Local remediation and monitoring of the failure will be appropriate.

There are two primary concerns with a mine rock or LGO stockpile failure: release of metal leaching / acid rock drainage (ML/ARD) runoff and overprinting of habitat. Both waste rock stockpiles contain only NAG rock. If the LGO stockpile failed, ran out, and infilled a perimeter ditch, ML/ARD runoff (if present) could potentially overflow or otherwise exit the ditch and would drain toward the TSF.

The two primary environmental concerns associated with a failure of the topsoil stockpile are overprinting of habitat and sediment entering a watercourse. Terrestrial habitat is predominantly trees; aquatic habitat affected would be Creek 146920 (**Figure 10.8.1-1**), which supports rainbow trout.

10.8.1.2.5 Design and Operations Safeguards

A slope stability assessment was carried out for the east and west waste rock dumps and LGO stockpile in accordance with the interim guidelines provided by the BC Mine Waste Rock Pile Research Committee (Piteau, 1991). The results of the stability analyses satisfy the requirements for factors of safety as indicated in the guidelines. The seismic analyses indicate that any dump deformations during earthquake loading from the operations basis earthquake (OBE) and double design earthquake (DDE) would be minor and would not result in significant displacement of the piles. All three of these facilities have been classified as “Class II” low failure hazard dumps (Knight Piésold, 2013).

10.8.1.2.6 Contingency and Emergency Response Procedures

When the failure area is secured, the stockpile slope will be re-contoured in place depending on the scale of the failure. If any material from the waste rock or LGO stockpile migrated as far as the creek south of the plant site (i.e., Creek 146920), it would be excavated and returned to the stockpile and the creek rehabilitated.

If the slope failure caused a liquid spill, silt fencing or other erosion and sediment control measures such as a temporary sediment retention pond would be deployed downslope of the spill to prevent sediment-laden waters from entering a watercourse.

10.8.1.3 Tailings Storage Facility Dam Failure

Annual average water quality in the TSF was estimated for both a best estimate (**Table 5.3.3-14**) and a worst case (**Table 5.3.3-15**). The worst case estimate is shown in **Table 10.8.1-1**. The TSF will have a footprint of approximately 1,117 ha comprising Cell C (192 ha) and Cell D (925 ha). The maximum elevation of the main dam for Cell C will be 1,360 masl; for Cell D it will be 1,339 masl.

Table 10.8.1-1: TSF Summary Annual Average Water Quality Predictions: Worst Case

Parameter	Unit	Construction Background Year -1	Operation Last Year of Open Pit Mining Year 13	Closure Pit Filling / TSF Pumping Year 18	Post-Closure Pit Overflow Year 37
pH	pH unit	7.7	9.1	8.5	7.6
Conductivity	mS/cm	84	231	145	78
TDS	mg/L	68	180	122	56
TSS	mg/L	3.3	6.5	4.7	2.5
Turbidity	mg/L	1.8	4.0	2.6	1.1
Total_hardness	mg $CaCO_3$/L	38	76	58	34
Total_alkalinity	mg/L	43	83	64	38
Fluoride	mg/L	0.058	0.11	0.085	0.050
Sulphate	mg/L	2.8	41	14	2.3
Chloride	mg/L	0.44	0.91	0.62	0.29
Ammonia	mg/L	0.021	1.8	0.010	0.011
Nitrate	mg/L	0.035	14	0.08	0.022
Nitrite	mg/L	0.004	0.33	0.010	0.003
TOC	mg/L	7.5	15	11	5.8
T_Aluminum	mg/L	0.161	0.45	0.102	0.083
T_Antimony	mg/L	0.000052	0.093	0.058	0.000054
T_Arsenic	mg/L	0.00067	0.012	0.0073	0.00048
T_Barium	mg/L	0.0080	0.079	0.051	0.0071
T_Beryllium	mg/L	0.00010	0.00020	0.00016	0.00010
T_Boron	mg/L	0.0015	0.040	0.024	0.0012
T_Cadmium	mg/L	0.000017	0.0054	0.0032	0.000016
T_Calcium	mg/L	11	51	20	10
T_Chromium	mg/L	0.00040	0.0019	0.0012	0.00033
T_Cobalt	mg/L	0.000042	0.093	0.058	0.000031
T_Copper	mg/L	0.00037	0.026	0.014	0.00024
T_Iron	mg/L	0.130	0.67	0.41	0.084
T_Lead	mg/L	0.0001	0.0047	0.00055	0.000067
T_Lithium	mg/L	0.0017	0.022	0.013	0.0012
T_Magnesium	mg/L	2.3	5.4	4.2	2.1
T_Manganese	mg/L	0.0078	0.54	0.33	0.0044
T_Mercury	mg/L	0.0000088	0.000017	0.000013	0.0000080
T_molybdenum	mg/L	0.00065	0.16	0.10	0.00060
T_Nickel	mg/L	0.00018	0.0056	0.0034	0.00013
T_Phosphorus	mg/L	0.022	0.10	0.040	0.013

Parameter	Unit	Construction Background Year -1	Operation Last Year of Open Pit Mining Year 13	Closure Pit Filling / TSF Pumping Year 18	Post-Closure Pit Overflow Year 37
T_Potassium	mg/L	0.52	101	63	0.51
T_Selenium	mg/L	0.00060	0.0015	0.0011	0.00060
T_Silicon	mg/L	6.4	11	9.0	6.0
T_Silver	mg/L	0.000053	0.000036	0.000033	0.000033
T_Sodium	mg/L	3.0	20.4	11.2	2.8
T_Strontium	mg/L	0.076	0.80	0.52	0.070
T_Thallium	mg/L	0.00005	0.00015	0.00010	0.000050
T_Tin	mg/L	0.00010	0.026	0.016	0.00010
T_Titanium	mg/L	0.0027	0.0048	0.0022	0.0015
T_Uranium	mg/L	0.00023	0.0032	0.0020	0.00020
T_Vanadium	mg/L	0.00033	0.00065	0.00034	0.00020
T_Zinc	mg/L	0.0038	0.14	0.072	0.0022
D_Aluminum	mg/L	0.077	0.42	0.078	0.060
D_Iron	mg/L	0.067	0.63	0.38	0.052
Cyanide_T	mg/L	ND	0.01	ND	ND
Cyanide_WAD	mg/L	ND	0.0075	0.0044	ND

Note: TDS = total dissolved solids; TSS = total suspended solids; TSF = tailings storage facility; LGS = low grade ore stockpile; T = total; D = dissolved; WAD = weak acid dissociable; ND = non detect mg/L = milligram per litre; mS/cm = microSiemens per centimetre

The total fill requirement for the TSF embankment will be 78.1 Mm^3, of which 5.9 Mm^3 will be required for Stage 1 construction. Construction materials will be sourced from pit stripping (75.4 Mm^3, equivalent to 166 Mt) and external borrow sources (2.7 Mm^3). The embankment will be raised using the centreline method of construction once the tailings beaches have been established. Construction of each embankment stage will be scheduled every year.

The TSF dams were designed to meet criteria in the Canadian Dam Association (CDA) Dam Safety Guidelines (CDA, 2007) and further referenced in the Draft Technical Bulletin: Mining Dams – Application of 2007 Dam Safety Guidelines to Mining Dams (CDA, 2013). The design for the TSF dams also incorporated the probable maximum flood and maximum credible earthquake in accordance with the *Mines Act* (Government of BC, 1996a) permit requirements. TSF geotechnical design parameters were developed from an extensive geotechnical database, which incorporates geological and geotechnical data from the 2012 and 2013 site investigations to support tailings facility dam and disposal area design. The designs are supported by geotechnical investigations of sub-surface conditions conducted in 2012 by Knight Piésold (New Gold, 2014).

The CDA consequence classification of the TSF is very high. It has been designed for the inflow design flood (IDF) of 2/3 of the way between the 1/1,000 year and Probable Maximum Flood, calculated in accordance with CDA guidelines. It has been designed with an Earthquake Design Motion of a 1/5,000 year event. Permanent embankment slopes would be built not to exceed 2H:1V, to achieve a long-term (at closure and post-closure) factor of safety of 1.5 (Knight Piésold, 2013).

Tailings dam design is discussed in **Section 2.2.3.4**. Results of the stability analyses satisfy the requirements for factors of safety and indicate that the proposed design is adequate to maintain both short-term (operational) and long-term (post-closure) stability. The seismic analyses indicate that any embankment deformations during earthquake loading from the operating basis earthquake (OBE), maximum design earthquake (MDE), and 1:10,000 year event would be minor and would not have a significant effect on the available embankment freeboard or result in any loss of embankment integrity. The results also show that the embankments are not dependent on tailings strength to maintain overall stability and integrity. Dams are designed for IDF and OBE for operations and PMF and MDE for closure and post closure, however, the design was checked and will meet PMF and MDE during all phases.

Geotechnical instrumentation will be installed along one plane through the Site C West Dam, Site C Main Dam, and freshwater reservoir, and in five planes through the Site D Main Dam. The instrumentation will be installed during construction and over the life of the Project. The geotechnical instrumentation will consist of vibrating wire piezometers, slope inclinometers, and movement monuments, and will be installed in the foundations, embankment fill, and embankment crests.

Instrumentation monitoring will be carried out routinely during construction and operations. Daily measurements will be taken and analyzed during construction to monitor the response of the embankment fill and the foundation from the loading of the embankment fill. The frequency of monitoring for the piezometers and inclinometers may be decreased to bi-monthly readings once the effects of initial construction have dissipated. Surface monuments will be surveyed at least twice per year during operations.

10.8.1.3.1 Potential Environmental Concerns

A number of scenarios are considered since catastrophic failure of the tailings dam is an extremely unlikely event (0.3 x 10^{-5} worldwide for upstream constructed dams) (Fell et al., 1999):

- A small amount of tailings supernatant loss from overtopping;
- A moderate amount of tailings supernatant loss from overtopping;
- A moderate amount of tailings solids and supernatant loss from overtopping; and
- A catastrophic main dam failure from massive slope failure, piping leading to complete dam washout or extreme earthquake related failure.

10.8.1.3.1.1 Small and Moderate Volume Tailings Supernatant Loss

The ECD, which will be 1 km downstream of Dam D, will create a reservoir for pumping water back to the TSF (**Figure 10.8.1-3**). The reservoir will have a total capacity of approximately 300,000 m^3 and operationally will have a minimum of about 100,000 m^3 of water at any time. Therefore, a loss of up to approximately 200,000 m^3 of tailings supernatant would be contained and could be pumped back to the TSF once dam repairs had been completed. Any release of tailings supernatant above the volume, which could not be contained above the ECD, would flood into the freshwater reservoir. Under normal operation, the freshwater reservoir will function to supply instream fish needs water volume to Davidson Creek and for makeup water for the process plant. If the freshwater reservoir is contaminated by tailings supernatant, there is design provision for the reservoir to be bypassed and freshwater to be pumped directly to Davidson Creek and the freshwater reservoir pumped out.

The probability of overtopping of the main dam is very small as the TSF is designed to contain the probable maximum flood. A minor slope failure of the main dam could theoretically result in release of tailings supernatant. Such a failure might be caused by a very high water level in the main dam. The level of water in the main dam (phreatic water level) will be monitored. A water level above design will be a trigger for remedial action by the mine to lower the level, e.g., by lowering the water level in the TSF, spigotting more tailings against the upstream side to force water away from the dam.

Therefore, a release of a small or moderate amount of tailings supernatant has a very low risk of resulting in a contamination of Davidson Creek.

10.8.1.3.1.2 Moderate Volume of Tailings Supernatant and Tailings Solids Loss

Under the scenario of tailings solids loss, the combined volume of solids and water would have to be less than the capacity of the ECD to prevent loss to the freshwater reservoir and Davidson Creek. There are three possible scenarios:

- Total volume lost is enough to discharge from the ECD into the freshwater reservoir but not enough to be released from the reservoir;
- Release volume is great enough that tailings supernatant overtops the freshwater reservoir and flows down Davidson Creek; and
- Release volume is great enough that both tailings supernatant and tailings solids overtop the freshwater reservoir.

The first case would be treated as previously described and instream fish needs would be supplied directly from Tatelkuz Lake. In the second case, some contamination of Davidson Creek would occur. Water would move down the creek as a slug and contamination would be temporary; some effects on fish would be expected. In the third case, fish habitat below the freshwater reservoir would be affected and tailings solids would have to be remediated. A moderate release of tailings solids would not extend the full length of Davidson Creek, but tailings solids could be washed down the creek. Effects on fish and fish habitat would occur.

10.8.1.3.1.3 Catastrophic Failure of the Main Dam

Under extreme and highly improbable circumstances, a partial or complete breach of a TSF dam will result in a release of tailings solids, waste rock, and associated effluent into the surrounding environment. The risk of a flow slide from a TSF dam failure is negligible because of the tailings and dam material characteristics that prevent liquefaction.

In a worst-case scenario, the breach could involve a portion of the contained solids and virtually all of the associated ponded effluent being released into the environment.

The uncontained discharge of a tailings slurry and waste rock spill could smother any terrestrial habitat it overprints, thereby damaging or destroying vegetation in the path. Animals (if any) caught in the slurry could be killed by the impact or by drowning. Any aquatic habitat could be coated with tailings, destroying any aquatic vegetation. A sudden large release of tailings slurry could lead to scouring of the natural channel of Davidson Creek in higher gradient areas and deposition of tailings solids in lower gradient areas. Tailings solids could be recovered but it is unlikely scouring effects could be easily reversed, thus leading to a permanent change in Davidson Creek channel morphology, i.e., fish habitat. Water quality in the watercourse would be degraded by the slurry such that in the near term it could not support aquatic life. A spill could also affect groundwater because leachate could infiltrate the ground underlying the tailings spill. The environmental effect of a tailings spill could increase with time if not remediated because some of the tailings and waste rock stored in the TSF are PAG in nature.

If the breach occurred under frozen ground conditions, the effect would be lessened as the tailings and frozen water could be readily removed prior to the snowmelt, thereby limiting the smothering effect on vegetation, although the removal process itself, involving backhoes and trucks, would have an effect on vegetation. If waterways are frozen, tailings slurry would not be able to enter a watercourse, which could negate the aquatic impact and prevent rapid downstream transport. Its removal, however, would have a negative effect on the watercourse. Effects would be long lasting. Although tailings supernatant water would pass down Davidson Creek and into Chedakuz Creek as a slug, any large kill of fish would entail a number of years for the population to recover once cleanup was completed. Immediate effects from tailings solids would last until the majority of the tailings was cleaned up. Any extensive damage to stream bed habitat would likely require natural regeneration to recover since extensive instream works would likely add to the spill and cleanup impact rather than alleviate the impact.

The immediate course of action for the mine will be to notify residents at the foot of Davidson Creek and surroundings about the dam breach and the possibility of flooding. The second action will be to notify government authorities of the spill through the spill hot line. The Proponent's corporate senior management will then be notified. An immediate assessment of the damage will be undertaken and any remaining water in the TSF pumped to the open pit. Repairs to the dam and removal of downstream tailings solids will then be undertaken.

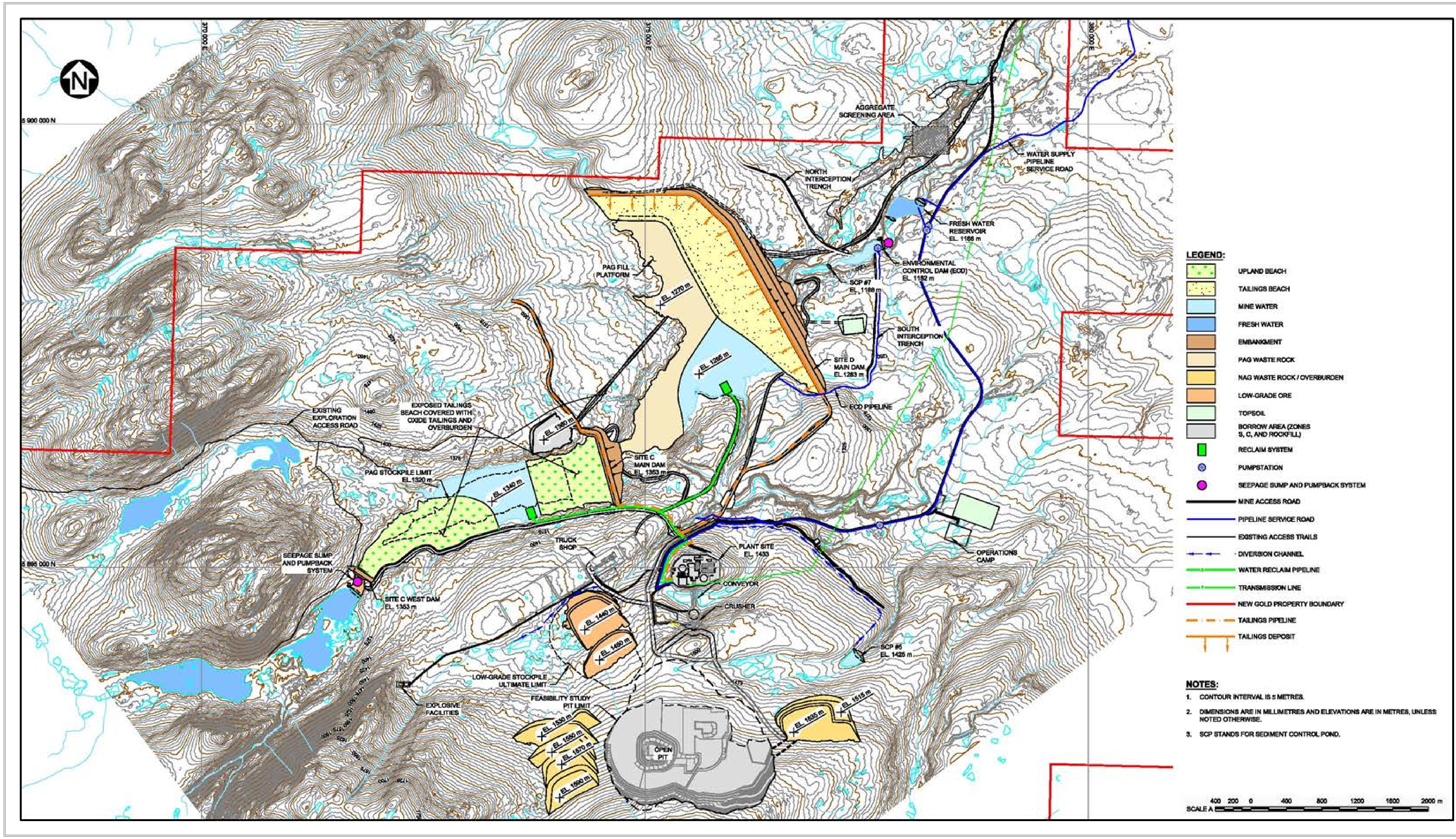

Figure 10.8.1-3: Site General Arrangement Showing TSF and Downstream Water Control

Full internal and external enquiries as to root causes and the extent of the damage will follow.

Given the design of the dam, annual independent geotechnical inspections, and constant monitoring by mine staff, this scenario is extremely unlikely as discussed at the beginning of this section.

10.8.1.3.1.4 Resources at Risk

Davidson Creek supports populations of rainbow trout throughout and Kokanee in the lower portions of the creek. Any release of contaminants to the creek will potentially affect these populations. The extent of the effects will depend on the extent and nature of the contaminant release as previously discussed. **Section 5.3.8** provides a full discussion of the fish populations, and **Section 5.3.9** provides the same level of discussion of fish habitat potentially affected by mine operations.

10.8.1.3.2 Design and Operations Safeguards

The TSF dams will meet strict regulatory requirements, including the requirements of the *Mines Act*, and will be constructed to withstand the probable maximum flood and maximum credible earthquake. The probable maximum flood is the largest flood that could occur at the TSF dam, while the maximum credible earthquake is the largest earthquake that could reasonably occur, as applied following the CDA Dam Safety Guidelines (CDA, 2007). The TSF dams will be designed to contain the IDF, assuming diversions are not working at the time of the event.

Operational safeguards will include visual inspections of the TSF dams. Geotechnical instrumentation will be installed along one plane through the Site C West Dam, Site C Main Dam, and freshwater reservoir and in five planes through the Site C Main Dam. The instrumentation will be installed during construction and will operate over the life of the Project, and will consist of vibrating wire piezometers, slope inclinometers, and surface movement monuments, installed in the foundations, in embankment fill, and on the embankment crests. Geotechnical inspections of the TSF dams will be conducted annually.

An operations, maintenance, and surveillance manual will be developed for the TSF and will describe monitoring and surveillance requirements for the structure.

10.8.1.3.3 Contingency and Emergency Response Procedures

The initial response to any failure at the TSF will be to protect worker human health and safety and shutdown pumping of tailings to the TSF.

In the event of a failure or imminent failure of the TSF dams, the ESPRP will be initiated. The ESPRP includes emergency repair procedures, if safe to do so. The spill will be contained to the extent possible using temporary earthen or snow dams, silt fences, sandbags, and other available equipment. Appropriate spill control equipment will be maintained at the Project site. Tailings cleaned up from a spill will likely need to be placed in the open pit unless solid enough to place on one of the on-land waste dumps.

The Proponent will work closely with local residents and authorities to ensure the needs of downstream residents are met should any such event occur. Due to the implementation of the EMS and the numerous operational controls to be put in place, the likelihood of a failure of the TSF is very rare.

A remedial action plan will be developed in consultation with appropriate government agencies in the event of TSF dam failure. Spilled tailings and waste rock will need to be effectively contained because of the ARD characteristics. This means that the Proponent will need to excavate spilled tailings and haul them back to the repaired TSF. Alternatively, a cover could be engineered over the deposited material, if feasible. All areas where tailings are removed will be restored and revegetated to the extent practical.

A surface water and groundwater monitoring program will be created to monitor the movement of aqueous parameters and the success of rehabilitation measures.

10.8.1.4 Environmental Control Dam Failure

Figure 10.8.1-3 shows the location of the ECD.

10.8.1.4.1 Potential Environmental Concerns

Under extreme and highly improbable circumstances, a partial or complete breach of the ECD structure could be possible resulting in a release of surface water and materials used to construct the ECD into the freshwater reservoir. The risk of a flow slide is negligible because of the ECD construction material characteristics, which prevent liquefaction.

Because the ECD is upslope of the freshwater reservoir, water quality in the freshwater reservoir could be affected in the short term, such that the water could not be used for fisheries management downstream.

10.8.1.4.2 Design and Operations Safeguards

The ECD structure will meet applicable regulatory requirements, including the requirements of the *Mines Act*. The dam is designed to contain continuous seepage and runoff from events up to the one in 100-year, 24-hour storm. The spillway is designed to pass the one in 200-year, 24-hour storm. Downstream and upstream dam slopes will be 2H:1V (Knight Piésold, 2013).

An operations, maintenance, and surveillance manual will be developed for the ECD and will describe monitoring and surveillance requirements for the structure.

10.8.1.4.3 Contingency and Emergency Response Procedures

The initial response to any failure at the ECD will be to protect human health and safety. In the event of a failure or imminent failure of the ECD, the ESPRP will be initiated. The ESPRP could include emergency repairs, if safe to do so. The spill will be contained to the extent possible using temporary earthen or snow dams, silt fences, sandbags, and other available equipment. Appropriate spill control equipment will be maintained at the Project site.

A water monitoring program will be developed to monitor aqueous concentrations of any contaminants and determine when the freshwater could be used for fisheries management purposes. In the event the water in the freshwater reservoir is contaminated and cannot be directly discharged to Davidson Creek, instream fish needs water can be provided by directly pumping to Davidson Creek from Tatelkuz Lake. There is adequate pumping capacity in the design to provide for the required flows at any time of year.

10.8.1.5 Freshwater Reservoir Failure

Figure 10.8.1-3 shows the location of the freshwater reservoir. Freshwater requirements for the Project will be met by pumping water from Tatelkuz Lake via an approximately 20-km long pipeline to a receiving area within the mine site. This water will be used for flow maintenance in Davidson Creek and also as supplemental water for ore processing and flooding of PAG tailings and waste rock in the TSF. The pipeline will be placed adjacent to a road approximately 5 m to 10 m wide, depending on local ground conditions. The pumping station will be on the shore of Tatelkuz Lake and during construction, a laydown area will be required to support the construction activities. It is anticipated that the area required will be approximately 100 m x 100 m.

10.8.1.5.1 Potential Environmental Concerns

The freshwater reservoir will contain only freshwater drawn from Tatelkuz Lake. If the reservoir failed, a large volume of water may be released at a high velocity, and the down-gradient environment, including Davidson Creek, could be damaged by scour and erosion.

A major failure in the freshwater reservoir could damage vegetation, result in a temporary loss of aquatic habitat, and harm any wildlife caught in the flow path. No long-term environmental effects are expected from a water reservoir failure.

10.8.1.5.2 Design and Operational Safeguards

The freshwater reservoir structure will meet applicable regulatory requirements, including the requirements of the *Mines Act*. The dam is designed to contain continuous seepage and runoff from events up to the one in 100-year 24-hour storm in accordance with the CDA Dam Safety Guidelines (CDA, 2007) for a significant consequence dam. The spillway is designed to pass the one in 200-year 24-hour storm.

An operations, maintenance, and surveillance manual will be developed for the ECD and will describe monitoring and surveillance requirements for the structure.

10.8.1.5.3 Contingency and Emergency Response Procedures

In the event of a failure or imminent failure of the freshwater reservoir, an emergency repair will occur once if is safe to do so. Pumping from Tatelkuz Lake will immediately cease. A bypass line will already be in place to maintain flow to Davidson Creek.

Silt fences, sandbags, and other erosion and sediment control measures will be deployed to prevent the entry of surface materials into downstream watercourses. Appropriate spill control equipment will be maintained at the Project site.

Maintenance of instream flow needs for fish is discussed in **Section 10.8.1.4.3**.

10.8.1.6 Sedimentation Pond Failure (Accidental Sediment Releases into Watercourses)

Construction phase activities will require the construction of sedimentation ponds at strategic locations to prevent sediment-laden surface water entering watercourses. Each of these sedimentation ponds will require a BC *Environmental Management Act* permit for discharge. A break in a containment dike would constitute a spill and would be reported per permit requirements. Spills could occur from extraordinary precipitation events or precipitation coupled with rapid snowmelt events. With sufficient warning sediment pond dykes, which will all be low structures, can be quickly raised to accommodate flood conditions.

10.8.1.6.1 Potential Environmental Concerns

Sediment carried into a watercourse could smother aquatic organisms if of sufficient volume or of long enough duration. Any fish-bearing streams could be negatively impacted by sedimentation, particularly spawning redds containing eggs, which could be killed due to lack of oxygen in interstitial water. Sediment control ponds would not likely operate during winter when streams are ice covered.

No sedimentation ponds discharging to waterbodies would be present during the operations phase.

10.8.1.6.2 Design and Operations Safeguards

The design and operation of the sedimentation ponds will follow the Guidelines for Assessing the Design, Size and Operation of Sedimentation Ponds Used in Mining (BC MOELP, 1996). The principal preventive action will be to inspect all sedimentation ponds regularly to detect any signs of failure early and make repairs immediately before a break or spill occurs. It will be particularly important to conduct inspections after rainstorms or during spring melt when the capacity of the ponds could be exceeded. To prevent in-filling of ponds over time, thereby decreasing pond volume during rainstorms or spring melt, ponds will be checked regularly for sediment accumulation. As needed, ponds will be dredged to reduce sediment accumulation and maintain design capacity.

10.8.1.6.3 Contingency and Emergency Response Procedures

Immediately after a spill is detected, corrective actions would be implemented to contain the spill and preserve downstream water quality. Appropriate sedimentation control and spill response supplies will be maintained at the Project site. Ongoing monitoring of downstream surface water quality monitoring stations will provide indication of potential undesired releases further upslope.

10.8.2 Accidents

10.8.2.1 Failure of Seepage Collection System

The TSF seepage collection system is described in **Section 2.2.3.4.8.6**. Seepage will be controlled primarily by the low-permeability Zone S constructed prior to developing of the tailings beach, the cut-off trenches, and the low-permeability foundation materials. TSF seepage will result from infiltration of ponded water directly through the embankment fill and the natural ground, and from expulsion of pore water as the tailings mass consolidates.

Special design provisions to minimize tailings dam seepage losses include developing extensive tailings beaches to isolate the supernatant pond from the dam, hydraulic barriers, embankment drainage collection systems, and toe drains at the downstream toe of the dams to reduce seepage gradients. Additional seepage collection ditches constructed along the toe of the embankments will direct seepage and surface runoff to the pump-back systems.

Secondary seepage collection at the ECD will be achieved by constructing a collection dam approximately 1 km downstream at a topographic low point in Davidson Creek. A pump-back system will manage seepage and stormwater inflows. Recovered water will be pumped to TSF Site D, and the collection pond will be kept dewatered to the maximum extent practical. Seepage through this dam will be captured in an embankment drain system and sump and be pumped back to the ECD pond.

Two seepage interception trenches, one on each side of Davidson Creek, will be excavated through the surficial sand and gravel terraces downstream of the Site D Main Dam and will report to the ECD pond. Locations of the seepage interception trenches are based on the results of geotechnical drilling along the proposed alignments. The trenches will be excavated and keyed into the low-permeability overburden horizon, and will be approximately 3.3 km long and typically 5 m to 15 m deep. **Figure 10.8.2-1** shows the ECD and interception trench layout.

10.8.2.1.1 Potential Environmental Concerns

Seepage from the TSF is predicted to contain elevated concentrations of metals and other parameters during operations and will be collected and pumped back to the TSF. Water quality and aquatic life in downstream watercourses could be impacted by an undesired release of seepage to the environment.

10.8.2.1.2 Design and Operations Safeguards

The principal preventive action will be to inspect the seepage collection system regularly to detect any leakage early and to make repairs immediately before a break or release occurs.

Surface water and groundwater monitoring sites will be established as part of the mine's effluent permit. Background water quality data downstream of the Project site was collected. Similarly, groundwater monitoring was performed for background data.

If seepage control mechanisms fail or are less effective than designed, seepage will still flow to the ECD. Pump-back capacity for the ECD is designed to handle a 1:100 year storm event and therefore will be more than adequate to handle any possible seepage increases.

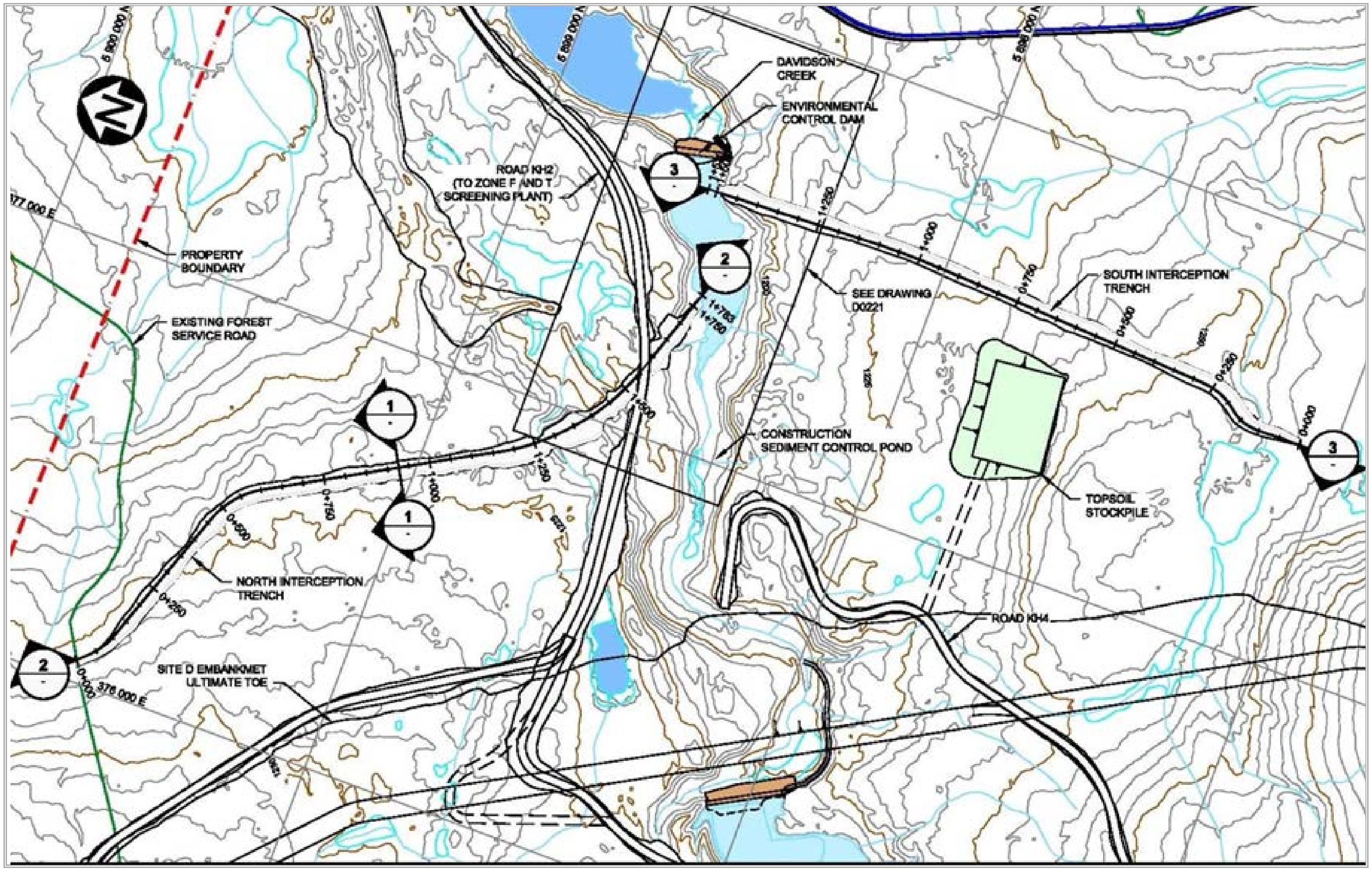

Figure 10.8.2-1: Environmental Control Dam and Interception Trenches

10.8.2.1.3 Contingency and Emergency Response Procedures

The initial response to any failure at the seepage collection system will be to protect worker health and safety. In the event of a failure or imminent failure of the seepage collection system, the Emergency Response Plan will be initiated. The Emergency Response Plan would include emergency repairs, if safe to do so.

The release will be contained to the extent possible using temporary earthen or snow dams, silt fences, sandbags, and other available equipment as well as by using auxiliary pumping systems. Appropriate spill control equipment will be maintained at the Project site. Seepage will occur year-round and is not season-specific.

10.8.2.2 Failure of Freshwater Supply System

10.8.2.2.1 Potential Environmental Concerns

The primary environmental issue arising from the failure of the freshwater supply would be the lack of water flow to support fisheries in Davidson Creek. Four types of failures to the system are considered that would result in a lack of flow to Davidson Creek: pipeline damage, failure of a pump, intake obstruction, and loss of power supply. In a worst case with total lack of flow augmentation, fish could be extirpated from Davidson Creek. This scenario would only occur if the mine was completely abandoned after the TSF was built and there was no third party intervention, which is an unrealistic scenario.

Section 5.3.8 discusses effects of reduced flows on fish in Davidson Creek.

10.8.2.2.2 Design and Operations Safeguards

The water supply pumps will be inspected regularly and maintenance completed to make any repairs prior to pump failure. Backup water supply pumps will be maintained on site.

The freshwater supply reservoir has been sized based on a reasonable estimate of contingency storage required for a reasonable range of possible malfunctions in the freshwater supply system. The reservoir will have approximately 400,000 m^3 of storage. There will be six pump stations on the water supply pipeline and a break would be relatively quickly located and could be repaired in one to two days. Minimum instream flow needs for fish in Davidson Creek could be maintained over that time period for any required discharges throughout the year. Instream flow needs for fish in Davidson Creek are discussed at length in the aquatics effects assessment (**Section 5.3.8.3.2.2.2**).

The 400,000 m^3 storage will maintain the average winter baseline flow of 115 L/s (9,936 m^3/day) for approximately 40 days. Flushing flows, normally experienced in Davidson Creek during spring freshet, of 560 L/s (48,384 m^3/day) could be maintained for 8 days and would likely not be attempted until the pipeline was repaired. Instream flow needs and calculations required are discussed in the Instream Flow Study (**Appendix 5.1.2.6D**).

10.8.2.2.3 Contingency and Emergency Response Procedures

The freshwater supply pipeline is proposed to be buried, reducing the risk of failure as a result of a vehicle collision or fire. Contingency pipe will be maintained at site in the event of pipe damage. Installed stand-by pumps are included in the design as back-up. A twin intake structure is proposed to reduce the likelihood of an obstruction rendering the system useless. A backup power system will be in place to maintain power supply to pumps in the event of a disruption in the primary power system. The facilities will be in a balance or surplus condition throughout operations, as the water accumulated within the supernatant ponds in TSF Sites C and D as well as open pit dewatering will satisfy the process requirements under average precipitation conditions. There will be a constant requirement in the process plant for fresh (unrecycled) water of 1,051,200 m^3 per year or 2,880 m^3 per day. From the calculation shown above, it is clear that for an expected repair response time of one to two days, all freshwater supply requirements will be easily met from the freshwater reservoir.

10.8.2.3 Pipeline Failure

External pipelines at the proposed Project site will be required to convey fresh water and liquid wastes. Pipelines will be above or below ground. Primary piping systems outside of secondary containment will include:

- Freshwater supply from Tatelkuz Lake;
- ECD seepage pump-back line;
- Tailings line;
- Pit dewatering line; and
- Sewage lines.

Drinking water for the Project will be from wells drilled on site. Pipeline failures will only be possible due to physical damage to the pipeline, given each of the lines will be designed and constructed of materials suitable for their applications.

10.8.2.3.1 Potential Environmental Concerns

Rupture or a significant leak from any water pipeline could cause erosion downslope from the force and volume of water being released. This could result in a short-term sediment plume to be released if there is a nearby watercourse, which could affect aquatic life.

A break or leak from a freshwater or treated water pipeline will not have any other discernible environmental effect.

A break or leak from the untreated water pipelines may lead to an undesired environmental release. With the exception of the ECD pump-back pipeline and some of the sewage system pipelines, all contact water pipelines, including tailings pipeline leakage, will drain by gravity to the TSF which is the primary contaminant containment structure for the proposed Project. The ECD pump-back pipeline will drain by gravity back to the ECD.

10.8.2.3.2 Design and Operations Safeguards

Standard operating procedures will be developed for the pipeline systems and will include inspection and monitoring programs. Incidental observations could provide notice in the event of a visible leak or failure as a considerable length of the pipelines (and in particular those containing untreated effluent) run through frequented areas of the site.

10.8.2.3.3 Contingency and Emergency Response Procedures

In the event of a leak or failure, pumps will be shut down and the pipeline repaired. If required, erosion and sediment control measures such as matting or silt fencing will be employed to prevent overland runoff containing sediments from directly entering a watercourse. Solid releases such as tailings will be recovered when practical and safe to do so and deposited in the TSF.

10.8.2.4 Explosives Accident

It is anticipated that explosives will be manufactured at the Project site. Explosives used at the Project are expected to be ammonium nitrate/fuel oil (ANFO) and emulsion or emulsion-blend explosives types.

10.8.2.4.1 Potential Environmental Concerns

Explosive components are not individually explosive and cannot be inadvertently detonated. Explosives will only explode if mixed in the correct proportions, placed under certain confined conditions, and detonated with an external device. Pre-packaged explosives also require an external detonation device.

Environmental concerns associated with potential accidents during explosives storage and usage include:

- Excessive disturbance of nearby receptors, including wildlife, due to associated sound; and
- Damage to Project infrastructure or facilities.

10.8.2.4.2 Design and Operations Safeguards

Any on-site explosives magazines or explosives manufacturing area will be located in accordance with the guidelines set out in the Quantity Distance Principles User's Manual published by the Explosives Regulatory Division (Natural Resources Canada (NRCan), 2011) with respect to the nearest inhabited building, airstrip, transmission line, road, and blast site. This manual dictates locations of facilities, in part to ensure public safety.

The transportation of explosives is controlled by the Explosives Regulatory Division of NRCan and the Transportation of Dangerous Goods Directorate of Transport Canada. All companies that transport explosive materials for the Project will be required to comply with the requirements of these agencies.

Explosive handling and storage are highly regulated in Canada and compliance is mandatory. The Project will use an explosives company that is well versed in the Canadian requirements, as dictated by the federal *Explosives Act* (Government of Canada, 1985) and associated regulatory instruments, as enforced by NRCan.

A blasting plan will be developed describing all proposed blasting operations at the Project and will address:

- Personnel responsibilities;
- Type of equipment and materials to be utilized;
- Safety requirements, including pre- and post-blast notification and notices for site personnel, and pre- and post-blast pit inspections;
- Periphery signs;
- Dust suppression; and
- Spillage control and clean-up.

All personnel who handle explosives will have appropriate training; all other individuals will be restricted from access to blasting areas.

Destruction of explosives (such as those unfit for use) and misfires will be handled according to applicable regulatory instruments. Deteriorated explosives are potentially more hazardous than explosives in good condition and will be handled under strict, carefully controlled conditions. All destruction will be completed by experienced personnel.

By contracting an experienced explosives company, having well-trained employees, following regulatory requirements, and using good housekeeping practices, explosives will be appropriately managed at the Project, with minimal potential of inadvertent detonation or other accidents.

10.8.2.4.3 Contingency and Emergency Response Procedures

The worst possible scenario would involve improper handling of explosives causing bodily harm. Damage to facilities and infrastructure may be possible but would generally only occur in association with the explosives storage, where used at the open pit, and potentially at a quarry or other blasting location. There is some potential for forest fires to occur (**Section 10.8.3.2**). Some minor blasting may be required during Project construction for excavations in bedrock areas. Any damage envisioned will be recoverable, except for issues associated with worker injuries.

Explosives will not be stored or used close to the process plant or any other structure, and as a result, excessive damage and injuries to workers not involved in explosives preparation and use are not expected.

10.8.2.5 Tailings Pipeline Failure

Tailings from the process plant will be thickened and delivered by gravity through a pipeline from the thickener to the TSF. The pipeline will be laid in parallel to a service road from the process plant to the TSF. The majority of the tailings distribution lines will be 30-inch high density polyethylene (HDPE).

Prior to piping, the tailings slurry will be treated for the destruction of cyanide and the precipitation of dissolved heavy metals. Despite this treatment, the tailings effluent is expected to retain a low level of toxicity due to the presence of residual levels of cyanide and dissolved heavy metals in the treated slurry, as well as to the presence of cyanate and ammonia (both breakdown products of the SO_2/air cyanide destruction process).

10.8.2.5.1 Potential Environmental Concerns

The environmental effects of a tailings slurry spill will vary depending on the time of the year, location of the spill, and volume spilled. If a spill occurred when the ground was frozen, spilled material could be readily cleaned up and no environmental effect would be expected, although the removal process itself, involving backhoes and trucks, would have an effect on the vegetation. During the remainder of the year, the spill would have a smothering effect on the immediate surroundings. The tailings pipeline will be entirely within the gravity containment of the TSF or ECD, and as a result, the effects of a failure will be minimal as they would occur within the mine working area.

10.8.2.5.2 Design and Operations Safeguards

The ECD will be located directly downstream of the pipeline route across the Site D TSF embankment. Therefore, the ECD will capture any deleterious substances and return the liquids to the TSF facility in the event of a pump-back pipeline rupture.

The tailings pipeline, as previously mentioned, will be completely within the mine site containment area and there could be no loss to any land or waterbody outside the containment area. A break in the tailings line would result in the immediate shutdown of the pumping system and repair of the pipeline. Since shutdown of the tailings line would require cessation of ore processing, the repairs would be made as quickly as possible, or an alternate, temporary tailings pipeline would be installed.

An operations, maintenance, and surveillance program will be developed and will define monitoring and surveillance programs for the tailings pipeline system.

10.8.2.5.3 Contingency and Emergency Response Procedures

If a leak or failure is detected in the tailings pipeline, flow to the faulty pipeline will cease. Heavy equipment will be used along with spill containment materials to contain or limit the discharge of tailings and effluent in an uncontrolled manner to the environment.

Depending on the amount of tailings spilled and whether tailings enter Davidson Creek, a remedial action plan may be developed in consultation with appropriate regulatory agencies. Spilled tailings will be excavated and loaded on a haul truck, or vacuumed, and transported to the TSF.

10.8.2.6 Major Fuel Release (>100 L) during Transport

Fuel will be transported to the Project along the regional road network and the FSR by tanker trucks. Tanker trucks are generally compartmentalized, such that if there was an accident, only a portion of the load will be lost except in a catastrophic incident. The principal type of fuel used at the site will be diesel for generator power supplementation during the construction phase and heavy equipment operation during construction, operations, and closure phases.

Fuel is transported safely throughout the region and across Canada routinely, by licensed and trained drivers, and the risk of incident involving a serious collision where fuel is released into the environment is small.

Smaller quantities of gasoline will be trucked to site by tanker truck or container on truck, also using licensed and trained drivers.

10.8.2.6.1 Potential Environmental Concerns

Despite all reasonable safeguards, there is a small potential for spills from tanker trucks due to accidents related to poor weather conditions, collisions, or other mishaps. A diesel spill from a truck travelling to site would affect the soil (or snow in winter) near the spill and could enter a waterbody if the accident occurred on or near a water crossing including streams, lakes, and wetlands.

Diesel fuel and gasoline are toxic to aquatic life. A tanker truck spill will have the greatest environmental effect if the spill reached a major watercourse that supports aquatic life. The slick would move downstream or spread across a stationary waterbody, potentially impacting riverbanks over the length of the watercourse until the spill could be contained or it naturally degrades. A spill on land would be easier to contain and clean up, particularly during frozen ground conditions. Groundwater would be unlikely to be affected except in the case of a large spill on very permeable soils where petroleum could seep into the underlying shallow aquifer. Under some circumstances, this could result in petroleum being carried by the aquifer to its first surface discharge point downslope.

10.8.2.6.2 Design and Operations Safeguards

Regular maintenance of fuel trucks can significantly reduce the possibility of an accident caused by equipment failure. The need for compliance with the federal and provincial *Transportation of Dangerous Goods Act* and associated *Transportation of Dangerous Goods Regulations* will be enforced in all applicable contracts and vendor agreements (Government of BC, 1996b; Government of Canada, 1992, 2001).

The potential for environmental effects associated with accidents and malfunctions on the trucking route will be minimized by effective road maintenance and thorough use of the following operational procedures, which will be incorporated into the EMS where possible, and into trucking/supply contracts, as reasonable:

- Radio control of all traffic on the Kluskus FSR and mine access road;
- Strict adherence to speed limits;
- Strict adherence to national trucking hour limits and other applicable requirements;
- Requirement that oversized loads will travel only during daylight to reduce the potential for collision;
- Transportation of materials during times of limited visibility will be avoided where possible;
- Requirement that materials that pose a potential hazard will be shipped only in sealed containers;
- Requirement that drivers will meet all applicable regulatory training requirements, be trained in spill response procedures for the materials they transport, and will carry the appropriate Material Safety Data Sheets and spill kits;
- Requirement for all vehicles transporting materials to site to maintain a supply of basic emergency response equipment, including communication equipment, first aid materials, and a fire extinguisher;
- Guidelines on waste management and littering; and
- Regular vehicle maintenance.

The Emergency Response Plan will address the primary hazardous materials on site including procedures for spill response on the trucking route to the Project site. Materials to be maintained in vehicles and training requirements for drivers will be identified in the Emergency Response Plan but will include absorbent materials and equipment to contain spilled material.

At the Project site, additional controls will be in place to reduce the potential for or the severity of accidents involving hazardous materials. These include:

- The FSR and mine access road will be radio-controlled;
- 2-way radios will be used on mine site haul roads;
- Speed limits will be posted and strictly enforced by Project security personnel;
- ROW procedures will be defined and haul trucks and loaded vehicles will be given preference;
- Traffic will be required to yield to wildlife; and
- Where possible, heavy traffic will be limited to mine site haul roads and other traffic limited to access roads.

10.8.2.6.3 Contingency and Emergency Response Procedures

Emergency response procedures will be established as part of the EMS, including: emergency spill response training, medical response, notification, containment of spill, removal of spill, treatment of affected environment, monitoring of environment, and learning from the accident.

The primary goal in any accident resulting in a fuel spill will be to ensure public and worker health and safety. Potential ignition sources will be removed in the event of a spill of flammable or combustible materials, if safely possible, and the spill will be stopped or slowed using available equipment. Appropriate corporate and external personnel will be notified, including the Provincial Emergency Program, and an assessment will be conducted to determine the best means to limit immediate environmental impacts.

Spill countermeasures may include the use of absorbent materials, establishment of a collection trench, and setting containment booms on water. When fuel is contained by booms, berms, or other means, it may be pumped, skimmed, or mopped with absorbent matting and disposed of in an approved facility designed to manage such wastes. If a spill were to directly enter a fast moving watercourse, it may not be possible to completely contain and remediate the spill.

Clean-up, and potentially remediation, will reduce long-term environmental impacts to the extent practical. After any spill, a review will be conducted to ensure that the required design changes, procedures, and appropriate monitoring measures are in place to prevent a repeated incident.

10.8.2.7 Transportation Accident (Hazardous Materials)

Various chemicals and materials in addition to fuel, including hazardous substances, will be transported to and from the Project site. The quantities and packaging details for the reagents are described in **Section 2.2.3.8**. During the construction and operations phases, cement, paints, oils, and solvents will also be transported to site.

10.8.2.7.1 Potential Environmental Concerns

Consumables will be transported to the Project site by road. Access to the Canada-wide rail and freight transport network is available in Prince George (Canadian National Railway) and other locations along the Highway 16 corridor. All dangerous goods will be shipped in sealed containers with secondary containment as appropriate, but as a minimum, in compliance with regulatory requirements, including the federal and provincial *Transportation of Dangerous Goods Act* and associated regulations.

Transport vehicle accidents en route to the Project site could result in a spill of the materials in shipment, including hazardous materials. The consequences of a spill will depend on the type and quantity of material spilled and on the location and timing of the spill. Transported quantities of hazardous and other materials are discussed in the Hazardous Materials Management Plan (HMMP), **Section 12.2.1.18.4.12**, and the Emergency Preparedness and Spill Response Plan (ESPRP), **Section 12.2.1.18.4.13**. Maximum single vehicle transport quantities of large volume hazardous substances will include:

- Bulk fuel: 70,000 L
- Sodium cyanide: 20 t
- Caustic soda: 35 t
- Ammonium nitrate: 40 t

Spills on land, where the material will not immediately enter a watercourse, will unlikely have environmental consequences beyond the immediate footprint of the spill, since the spilled material and any associated soil (or snow) can be collected. Any spills to soil will be completely cleaned up following contaminated sites protocols. Large spills will likely result in the death of vegetation and soil organisms in the immediate area of the spill. Larger animals would be kept from the site with temporary fencing, and signage would be used to warn people until the spill was cleaned up.

The aquatic environment will be far more sensitive to a spill. The worst, but least likely, spill scenario will involve a collision or accident in which the entire shipment is spilled and enters a waterbody. The worst location of a spill, in terms of potential impact, is the Big Bend Creek crossing where contaminants (if of sufficient volume) could flow into Nechako Reservoir. The second worst location for a large spill of hazardous materials is the bridge across Chedakuz Creek because of the proximity of settlements. The third worst location is the bridge on the mine access road across Davidson Creek because of the potential toxic effects on fish, other aquatic organisms, and terrestrial wildlife that use Davidson Creek. In general, any creek crossing has the potential for greater impact from a spill than upland areas.

The impact of such a spill will depend on the material spilled. Spills of large amounts of hazardous materials in waterbodies would almost certainly result in toxicity to aquatic organisms including fish, if present. In streams, toxic effects would be carried downstream until dilution reduced the contaminant concentrations below toxic levels. Large quantity spills of insoluble or slowly dissolving solids would result in smothering effects, even if not producing toxicity.

Materials transported by rail over the existing tracks and transferred to trucks will be enclosed in sealed containers. Should an accident occur, there may be an impact to a localized area if containers break open and leak.

10.8.2.7.2 Design and Operations Safeguards

All dangerous goods will be shipped in sealed containers, so that in the event of an accident, an uncontrolled spill will not occur unless the containers break open. Types of shipment containers will include tanker trucks, containers, shipment cubes (1,000 L), sealed bulk bags, sealed drums (205 L), and smaller containers on pallets.

All shipments will comply with regulatory requirements, including the federal and provincial *Transportation of Dangerous Goods Act* and associated regulations, as outlined in all applicable contracts and vendor agreements.

The potential for environmental impacts associated with accidents and malfunctions on the trucking route will be minimized by the operational procedures that will be incorporated into trucking contracts, where possible, and into the EMS. The operational procedures will include:

- Radio control of all vehicles on the FSR and mine access road;
- Strict adherence to speed limits;
- Strict adherence to national trucking hour limits and other applicable requirements;
- Requirement that oversized loads will travel only during daylight to reduce the potential for collision;
- Requirement that transportation of material during times of limited visibility will be avoided where possible;
- Requirement that materials that pose a potential hazard will be shipped only in sealed containers;
- Requirement that drivers will meet all applicable regulatory training requirements, be trained in spill response procedures for the materials they transport, and will carry the appropriate Material Safety Data Sheets and spill kits;

- Requirement that all vehicles transporting materials to site will maintain a supply of basic emergency response equipment, including communication equipment, first aid materials, and a fire extinguisher;
- Guidelines on waste management and littering; and
- Regular vehicle maintenance.

A portion of the Kluskus-Ootsa FSR will be upgraded in the section from KM 100 to KM 125. Pursuant to any safety inspections, the Proponent will enter discussions with the principal road users about ways to address concerns, including but not limited to warning signs and lowered speed limits at the areas of concerns. The Proponent's objectives for this upgrade include:

- Re-gravelling the road from 101+650 to 123+973 km (mine access road junction);
- Maintaining the current road width, horizontal alignment, and vertical alignment of the existing road;
- Realigning the road from 104+900 to 106+738 km corner and establishing an 8-m running surface and 60 km/h design speed;
- Determining the design speed of the final design (this information will be used by the Proponent to post new speed limits on the upgraded road);
- Improving the existing ditch line or establishing a new ditch line where required; and
- Replacing damaged culverts or establishing culverts where required.

Local forest licensees are, and will continue to be, the principal users of the roads accessing the Project site.

During breakup, the FSR has load restrictions that occur every year and are well understood and planned for. Critical supplies for operation of the mine are kept at a minimum of at least one week's supply. Prior to the breakup period, on hand supplies of critical supplies will be increased as a matter of course.

The ESPRP included in the EMS will address the primary hazardous materials on site including procedures for spill response on the trucking route to the Project. Materials to be maintained in vehicles will be identified in the ESPRP, and will include absorbent materials and equipment to contain spilled material.

At the Project site, the same controls identified in **Section 10.8.2.6** related to fuel transport will be in place to reduce the potential for or the severity of accidents involving hazardous materials.

10.8.2.7.3 Contingency and Emergency Response Procedures

The first goal will be to ensure public and worker health and safety. Residents nearby a spill will be notified by the Mine General Manager or designate and apprised of the nature and extent of the spill. Potential ignition sources will be removed in the event of a spill of flammable or combustible materials if safely possible, and the spill will be stopped. Appropriate corporate and external personnel will be notified, and an assessment will be conducted to determine the best means to prevent immediate environmental impacts.

Spill countermeasures will include the use of absorbent materials, establishment of a collection trench downslope, and setting collection booms on water if effective for the spilled material. The Proponent will work closely with local authorities, including the Provincial Emergency Program, to ensure public health and safety is maintained at all times. Clean-up and remediation will ensure long-term environmental impacts are reduced to the extent practical. Following any hazardous material spill, a review will be conducted and a report issued to ensure that the required design changes and/or procedures are in place to avoid a repeated spill.

10.8.2.8 Transportation Accident (Non-Hazardous Materials and Work Crews)

Most of the material transported to and from the Project site will not be hazardous. Non-hazardous materials will follow the same distribution networks as hazardous materials. Aircraft (fixed wing and helicopters) may also be used to transport non-hazardous materials to the Project site.

Work crews will be transported to site by means of crew buses.

10.8.2.8.1 Potential Environmental Concerns

A vehicular accident on site could happen at any time of the year. On-site accidents are most likely to involve personnel vehicles such as light trucks or haul trucks transporting coarse materials (e.g., ore, mine rock, or overburden). Off-site accidents could include work crews, construction materials, and other non-hazardous materials needed for the Project.

Accidents involving strictly Project personnel and the public will have a detrimental impact on the families, communities, and the Project. Notification and/or reporting will follow provincial requirements (Ministry of Environment) and other applicable requirements.

Any spill of non-hazardous material or an accident involving crew buses is not expected to cause a significant environmental disturbance, except within the immediate footprint of the accident site. Heavy materials such as mine rock would crush vegetation and compact any soil in the area of the spill.

10.8.2.8.2 Design and Operations Safeguards

The potential for environmental impacts associated with accidents and malfunctions on the trucking route will be minimized by the following operational procedures, which will be incorporated in trucking contracts, where possible, and in the EMS. These procedures are expected to include:

- Strict adherence to speed limits;

- Strict adherence to national trucking hour limits and other applicable requirements;
- Requirement that oversized loads will travel only during daylight to reduce the potential for collision;
- Requirement that transportation of material during times of limited visibility will be avoided where possible;
- Requirement that materials that pose a potential hazard will be shipped only in sealed containers;
- Requirement that drivers will meet all applicable regulatory training requirements, be trained in spill response procedures for the materials they transport, and will carry the appropriate Material Safety Data Sheets and spill kits;
- Requirement for all vehicles transporting materials to site to maintain a supply of basic emergency response equipment, including communication equipment, first aid materials, and a fire extinguisher;
- Guidelines on waste management and littering; and
- Regular vehicle maintenance.

At the Project site, the same controls identified in **Section 10.8.2.6** related to fuel transport will be in place to reduce the potential for or the severity of accidents involving non-hazardous materials or crew buses.

10.8.2.8.3 Contingency and Emergency Response Procedures

For accidents involving non-hazardous materials or crew buses, the first goal will be to ensure public and worker health and safety. Thereafter, appropriate corporate and external personnel will be notified as appropriate, and spilled material will be removed. The affected environment will be rehabilitated as needed. After any major accident, a review will be conducted to ensure that the required design changes and/or procedures are in place to avoid a repeated spill.

The Proponent will work closely with local authorities to ensure public health and safety is maintained at all times.

10.8.2.9 Fuel Releases from Storage Facilities and Dispensing Areas

Diesel fuel and gasoline will be stored at the fuel storage facility in double-walled Enviro tanks, or other equivalent storage with secondary containment such as a bermed facility with a petroleum resistant liner designed to contain 110% of the volume of the largest tank. The fuel storage facility will include a refuelling area for heavy and support mining equipment and for light trucks.

10.8.2.9.1 Potential Environmental Concerns

The risk of a major environmental event associated with fuel storage and dispensing areas is less than that from truck transport because of the secondary containment, fixed locations selected to be isolated from watercourses and other sensitive environmental features, the presence of collision protection barriers, the proximity to spill response and containment equipment, and training on fuelling procedures.

Environmental impacts associated with fuel storage and dispensing will depend in part on final fuel storage facility design but could include:

- A catastrophic failure of a tank and/or a major collision involving an Enviro tank resulting in the failure of both walls of the tank at the fuel storage facility;
- An accident resulting in a catastrophic failure of the tank of the remote fuelling truck;
- Valve malfunction; and
- Operator error with refuelling or damage to the dispensing system (such as a ruptured fuel line).

Impacts will likely be limited to the immediate terrestrial environment except in the case of a major spill or a spill during a rainfall event or during spring runoff. The main fuel storage facility for the mine will be located east of the LGO stockpile. There will be other smaller fuel storage facilities, including one for light vehicles near the mill. Aircraft fuel will be stored at the airstrip and there will be small fuel storage at tanks for backup generators for mine equipment and the freshwater supply system.

All main fuel tanks at the mine site will be within the containment of the TSF.

Because of the location of fuel tanks, spills to waterbodies will not be physically possible. Spills to soil could cause very local death of vegetation if on a vegetated area and of large enough volume.

10.8.2.9.2 Design and Operations Safeguards

The potential for environmental impacts associated with accidents involving on-site fuel storage facilities and dispensing areas will be minimized by the following design and construction features:

- All tankage and storage areas will be constructed to recognized industry standards and conform to provincial leak detection requirements;
- Storage areas will be distant from watercourses and sensitive habitat (except where impractical, such as the pump houses for the water intake);
- Bollards (collision protection poles) and other measures (Jersey barriers) will be used to prevent collision;
- Containment berms will be placed around all permanent tanks that do not have internal secondary containment; and
- Enviro tanks will be situated to minimize the risk from collision and puncturing of both walls, and will be protected using bollards or similar.

Operational procedures to minimize the potential for accidents or malfunctions will be incorporated into the EMS and will include:

- No smoking will be permitted in the vicinity of the fuel storage facility or refuelling areas;
- Fuel spill containment kits will be available at all fuel transfer points;
- Formal daily inspections of all fuel storage locations will be performed;
- Formal weekly inspections using a checklist to check for leakage and other operational problems will be performed;
- Volumes will be confirmed daily at all tanks containing petroleum products using a dip check or other method, with the result logged for comparison; any measurements different from anticipated volumes will immediately be investigated; and
- Fuel tanks will not be filled above 95% capacity, to allow for expansion due to temperature changes, and will be vented.

Operational procedures will be regularly reviewed as part of the EMS. All spills will be cleaned up using contaminated sites protocols; additional discussion is provided in the EPSRP (**Section 12.2.1.18.4.13**).

10.8.2.9.3 Contingency and Emergency Response Procedures

If fuel escapes from the secondary containment, the ESPRP will be implemented. The primary focus will be ensuring human health and safety. When the area is secured, the leak or failure will be sealed, if feasible, by trained workers. Absorbent materials and a downstream berm (earthen or snow) will be constructed to contain the spill. A large spill kit will be located at the fuel storage facility and will include absorbent material.

Spilled fuel will be collected and hauled off site for disposal. Used absorbent material would be sent off site to be disposed at a licensed facility. Notification and/or reporting will follow provincial requirements (Ministry of Environment) and other applicable requirements.

Soils in the vicinity of the spill will be tested for hydrocarbons and the affected soils delineated. Impacted soil will either be treated on site in a bioremediation area or hauled off site for treatment and disposal.

10.8.2.9.4 Spills of Hazardous Substances within Contained Areas

All chemicals such as cyanide and other liquid and solid reagents that pose a potential risk to the environment will be stored and, as practical, used within containment areas, with sealed floors and sumps or drains reporting to facilities that will provide for retrieval of the spilled materials. Transfer of hazardous wastes to transport containers will also be within fully contained areas. Therefore, there is no reasonable potential for such materials to be released directly to the environment or to have an environmental effect.

All chemicals used at the Project site will have a Material Safety Data Sheet, in order to comply with applicable legislation and to provide relevant regulatory standards for the safe use of these materials. The Hazardous Materials Management Plan will have continual reviews and updates to remain current, and will also be used in the training programs conducted by health and safety department personnel on safe use of hazardous materials in the workplace. The Cyanide Management Plan (CYMP) (**Section 12.2.1.18.4.19**) conforms to the International Cyanide Management Code and, similar to the HMMP (**Section 12.2.1.18.4.12**), will update Material Safety Data Sheets on a regular basis.

10.8.2.10 Fly Rock from Blasting

10.8.2.10.1 Potential Environmental Concerns

No environmental concerns are associated with fly rock within the open pit. Small pieces of fly rock may be released from the open pit to the areas immediately surrounding the pit, a safety concern mitigated by controlling access during blasting.

10.8.2.10.2 Design and Operations Safeguards

No mine facilities other than the equipment working in the pit will be within the blast zone. Prior to blasting, per mine safety procedures, the open pit and areas within the range of fly rock will be cleared, access roads blocked, and all mine staff warned that a blast will occur. A sweep of all areas within the blast zone will be conducted by the pit foreman or designate prior to the blast.

Regulations require signage on all roads leading into the blast zone the day blasting will occur giving the time of the blast. Typical warnings for all staff in radio contact will include several count-down warnings before the blast is set off, as per safety regulations.

10.8.2.10.3 Contingency and Emergency Response Procedures

With these controls in place and with only certified employees setting off blasts, no accidents are expected. Road blocks set up prior to blasting as a safety measure for fly rock will be removed immediately after the blast by mine services personnel, if required.

10.8.2.11 Aircraft Accidents Involving Work Crews near the Mine Site

Aircraft (fixed wing and helicopters) will only be used to transport personnel and non-hazardous materials. Aircraft will carry fuel in the operating fuel tanks. Small amounts of fuel for refuelling aircraft will be maintained at the airstrip, primarily for helicopters.

An aircraft accident could potentially result in loss of life and could cause a fire but would not directly cause a significant environmental impact at the crash site. A forest fire caused by flames spreading from the crash site would, however, create a significant environmental effect (**Section 10.8.3.2**).

10.8.3 Other Malfunctions

10.8.3.1 Accidental Discharge of Effluent Streams

The Project will require management of the following effluent streams:

- Mine water (elevated total suspended solids (TSS) and ammonia);
- LGO and live ore stockpile runoff (elevated TSS, potentially ARD, and dissolved metals);
- Process plant and site area runoff (elevated TSS and potentially other constituents);
- Tailings slurry from the process plant (elevated TSS, dissolved metals, residual ammonia, residual cyanide, and reagents); and
- Treated sewage (elevated TSS and biological components).

All effluents will be discharged to the TSF, with the exception of some of the treated sewage discharges. The proposed strategy for sewage treatment and disposal includes:

- Modification of the sewer system servicing the existing exploration camp in support of increasing camp capacity from 250 persons to 400 persons, with continued discharge of effluent to the existing buried septic field;
- Future relocation of the two rotating biological contactor packaged treatment plants servicing the truck shop, administrative buildings, and process plant site, with discharge of Class C effluent (with disinfection) from these buildings to the TSF via a 1.65 km long gravity outfall pipe;
- Construction of parallel aerated lagoons, each with capacity for 500 persons, to provide service to the 500-person operations camp, with discharge of Class C effluent to ground via Rapid Infiltration Basins or to the TSF;
- Installation of a twin train of packaged treatment plants, each with a capacity of 500 persons to provide treatment capacity for an additional 1,000 persons for the two-year duration of construction, with effluent discharge to ground via Rapid Infiltration Basins or to the TSF; and
- Installation of a 150-mm diameter ductile iron/HDPE forcemain for pumping treated effluent from the 1,500-person work camps to the Rapid Infiltration Basins or to the TSF.

Discharge of mine effluent from the TSF will occur post-closure once the open pit has filled and only when TSF water quality meets applicable discharge guidelines.

Further information regarding water management for the Project is provided in **Section 2.2.3.5**.

Discharge from the sewage treatment plant will be to a rapid infiltration basin and to ground. The rapid infiltration basin will be designed to not affect surface waters (further discussion can be found in the Water Quality and Liquid Discharges Management Plan (WQLDMP) **Section 12.2.1.4.18.10**). Discharge quality will be monitored periodically as will be specified in the operations manual developed for the sewage treatment plant. Off-specification effluent discharge will be corrected as soon as detected. Off-specification effluent discharge will be corrected as soon as detected and would be ameliorated via natural processes and dilution as it percolates through the ground.

10.8.3.1.1 Potential Environmental Concerns

Effluent to be released to the TSF could have related water quality concerns if:

- In-plant treatment of the tailings slurry for cyanide destruction is insufficient;
- Treatment of LGO stockpile or live ore stockpile runoff is insufficient;
- Acid generation in waste rock stored in the TSF occurs at a rate faster than projected; and/or
- Water management systems are temporarily disrupted to manage an emergency.

Water quality concerns with respect to the TSF will be minimal, given that it will be operated with no surface water discharge during operations and early closure as a zero surface discharge facility.

10.8.3.1.2 Design and Operations Safeguards

For initial construction activities, the existing exploration camp sewage treatment facilities will be employed. Additional sewage treatment facilities as described in **Section 10.8.3.1** will be commissioned during early construction.

Operation of the sewage treatment plants and aeration lagoons will be monitored and any off-specification discharge addressed immediately. An SOP will be developed prior to construction, and mine service employees will be designated and trained to operate the treatment plants.

Ongoing monitoring of site contact water quality will identify potential issues related to water quality.

10.8.3.1.3 Contingency and Emergency Response Procedures

In the event that the sewage treatment plant operator cannot address the off-specification discharge, a manufacturer’s engineer will be brought to site to resolve the sewage treatment plant water quality issue. The source of the poor water quality will be determined and operational or design changes made as appropriate.

The Proponent will work closely with local authorities to ensure public and environmental health and safety is maintained at all times.

For any chronic effluent quality issues, a review will be conducted to ensure that the required design changes and procedures are in place to ensure that poor effluent quality will not be repeated.

10.8.3.2 Forest Fires (Project-Related)

Fires can result from either natural (e.g., lightning) or human causes (e.g., human error, equipment malfunctions, or accidents). Effects related to natural fires are addressed in **Section 11**. Planning and prevention of fires caused by Project activities is discussed in the Wildfire Management Plan (**Section 12.2.1.18.4.20**).

10.8.3.2.1 Potential Environmental Concerns

Fires present a hazard to health and property, with the extent of concern dependent on the location and severity of the fire, and on nearby facilities. A major fire at the Project site could pose serious health and safety concerns and could cause property damage and operations interruptions. Environmental impacts will include a temporary reduction of air quality and loss of localized terrestrial habitat.

10.8.3.2.2 Design and Operations Safeguards

The Project has been designed to meet all applicable fire protection system requirements and codes. This includes fire detection and suppression systems, sprinkler and standpipe systems, and a fire hydrant system.

Remote buildings such as the explosives storage, explosives plant, temporary construction buildings, lighting plant, pump house buildings, and fuel storage tanks will be equipped with portable extinguishers as required. All light trucks and haul vehicles on site will carry a portable fire extinguisher.

A fire pumper truck will be present at the site for use as required.

Regular fire drills will occur to ensure that all workers are familiar with fire response procedures, as dictated within the EMS. All workers and visitors to the Project site will receive an orientation that includes fire reporting and response procedures.

10.8.3.2.3 Contingency and Emergency Response Procedures

Priorities for fire response will include protecting human health and ensuring that the fire does not spread. A trained site fire response crew will provide the initial firefighting response, with assistance from local municipal volunteer firefighting services potentially being requested. If local assistance is not sufficient, firefighting resources from Prince George will be called upon for assistance.

The Proponent will work closely with local authorities to ensure public health and safety are maintained at all times.

10.8.3.3 Power Outages

Until the transmission line to the Project is established, power will be provided by diesel generator units.

10.8.3.3.1 Potential Environmental Concerns

Potential environmental concerns associated with failure of the freshwater supply system and accidental discharge of effluent from the sewage treatment plant are discussed in **Section 10.8.3.1**. Water supply and accidental discharge serve as examples of potential environmental concerns that would be related to a power outage.

10.8.3.3.2 Design and Operations Safeguards

Standby generators will be maintained for system critical facilities including but not limited to:

- Communications equipment;
- Electric fire and other water pumps, including the freshwater supply system for Davidson Creek;
- Fire alarm systems;
- Emergency lighting that is non-battery operated;
- Process plant controllers;
- Emergency heating; and
- Sewage treatment plant.

Periodically, on a schedule set by the Mine Services Manager (or designate), all emergency power systems will be checked and tested. Emergency equipment will be placed on the master equipment testing schedule maintained by the mine maintenance department. All emergency tests will be logged and reviewed regularly by the mine superintendent or designate.

10.8.3.3.3 Contingency and Emergency Response Procedures

Backup generators will be available in the event of a shutdown or mechanical failure.

10.8.4 Summary of Design and Operational Safeguards

The TSF dams will meet strict regulatory requirements, including the requirements of the *Mines Act* (Government of BC, 1996a) and the CDA Dam Safety Guidelines (CDA, 2007; CDA, 2013). The TSF dams will be designed to hold the IDF over the maximum operating water level of the TSF dam. An operations, maintenance, and surveillance program will be developed for the TSF and will consist of, at minimum, the safeguards described in **Section 10.8.1.3**. Geotechnical inspections of the TSF dams will be conducted annually.

All dangerous goods will be shipped in sealed containers so that in the event of an accident, an uncontrolled spill will not occur unless the containers break open. All shipments will comply with regulatory requirements, including the federal and provincial *Transportation of Dangerous Goods Act* and associated regulations (Government of BC, 1996b; Government of Canada, 1992, 2001), as outlined in all applicable contracts and vendor agreements. The potential for environmental impacts associated with transportation will be minimized by the following operational procedures:

- Strict adherence to speed limits;
- Strict adherence to national trucking hour limits and other applicable requirements;
- Requirement that oversized loads will travel only during daylight to reduce the potential for collision;
- Requirement that transportation of materials during times of limited visibility will be avoided where possible;
- Requirement that materials that pose a potential hazard will be shipped only in sealed containers;
- Requirement that drivers will meet all applicable regulatory training requirements, be trained in spill response procedures for the materials they transport, and will carry the appropriate Material Safety Data Sheets and spill kits;
- Requirement that all vehicles transporting materials to site will maintain a supply of basic emergency response equipment, including communication equipment, first aid materials, and a fire extinguisher;
- Guidelines on waste management and littering; and
- Regular vehicle maintenance.

The Project has been designed to meet all applicable fire protection system requirements and codes, including fire detection and suppression systems, sprinkler and standpipe systems, and a fire hydrant system. Remote buildings such as the explosives storage, explosives plant, temporary construction buildings, lighting plant, pump house buildings, and fuel storage tanks will be equipped with portable extinguishers as required. All light trucks and haul vehicles on site will carry a portable fire extinguisher. A fire pumper truck will be present at the site and equipped with a foam generation system for use as required. Regular fire drills will occur to ensure that all workers are familiar with fire response procedures, as dictated within the EMS. All workers and visitors to the Project site will receive an orientation that will include fire reporting and response procedures.

10.9 Route Survey/Risks of Cyanide Transportation

As part of the evaluation of the risks associated with the transport of cyanide from Prince George to the Project site, AMEC conducted a survey in July 2013 of the two main sections of the route from (i) the proposed warehouse location in Prince George to the Canfor Plateau site near

Engen via Highway 16 and (ii) the Canfor Plateau location via the Kluskus FSR and the Kluskus-Ootsa FSR to the Davidson Mainline intersection (**Appendix 10A**).

The primary purpose was to complete surveys of the two alternate locations (Prince George and Engen) under consideration by the Proponent for the Project transfer facility. The surveys of the selected routes consisted of driving each route at posted speeds; identifying and describing the critical points such as general road conditions, water crossings, waterbodies, sharp curves, inclines and declines, residential areas and other road hazards; assessing the environmental risk of a spill event associated with each 10 km section of each route; and collecting relevant photographs. The report is attached in **Appendix 10A**). In summary, the principal issues from a traffic safety perspective occur along the Forest Service Road and not on the Highway 16 segment. Given the additional risk of an additional transfer facility in Engen the base case for the Project was Prince George where facilities already exist.

10.10 Potential for Cumulative Effects

The majority of the risks identified in the risk workshop are classified as low risk, i.e., they will have a minor or negligible negative effect. There were no extreme risks identified during the risk workshop that require additional safeguards. **Table 10.7.2-4** provides a summary of the risk assessment for the 24 identified accidents and malfunctions events, with the highest risk identified associated with an event that is possible and has a major consequence.

The accidents and malfunctions with the highest risk values are:

- Tailings Storage Facility (TSF) dam failure;
- Transportation accidents involving hazardous and non-hazardous materials; and
- Forest fire (Project-related).

The projects or activities in the Project Inclusion List (PIL) (**Appendix 19A**) that could have residual effects were reviewed to fully understand the context of potential residual adverse effects interacting with potential effects arising from these four possible accidents or malfunctions associated with the Project. The spatial boundary for this assessment is the RSA. The most relevant land uses in the RSA that could potentially interact with accidents and malfunctions events include forestry, mining, and agriculture activities. None of the four specific projects on the PIL were identified as having potential to overlap in time or space with these possible events.

10.10.1 Tailings Storage Facility Dam Failure

A failure of the TSR dam was considered to have a rare likelihood but a catastrophic consequence. Overall, it was rated as having a high risk score for environmental consequences (see **Table 10.7.2-4**).

The TSF dams were designed to meet criteria in the CDA Dam Safety Guidelines (CDA, 2007) and the Draft Technical Bulletin: Mining Dams – Application of 2007 Dam Safety Guidelines to Mining Dams (CDA, 2013). A catastrophic failure of the main dam could result in a portion of the contained solids and virtually all of the associated ponded effluent being released into the environment. Solids would be transported downstream Davidson Creek and liquids would flow downstream Davidson Creek and could enter Chedakuz Creek. In addition to potential for flooding downstream, such an event would alter downstream channel morphology, water quality, and could affect the populations of rainbow trout and kokannee in the creeks.

Contingency and emergency response procedures would be implemented to protect worker human health and safety, notify downstream residents and first control, then clean up the spill. A remedial action plan would implement actions to contain the spilled tailings and waste rock because of ARD characteristics. Once tailings are removed, the streambed habitat would be restored and revegetated. Fish populations could take several years to recover, depending on the extent and nature of contaminant release.

Current and future land use activities of forestry and mining exploration identified on the PIL are not anticipated to have residual effects that would act cumulatively on the aquatic environment within Davidson and Chedakuz creeks with these potential effects, if such an accident were to occur. This occurs principally because these activities will not generate substances that could spill into water bodies potentially affected by a Blackwater TSF dam failure except possibly a petroleum spill with the potential for a spill from mining and forestry operations into the same water body very remote. Therefore a cumulative effects assessment is not required.

10.10.2 Transportation Accidents and Malfunctions

Discussion of potential transportation accidents ranging from a major fuel release (>100 L) and accidents involving hazardous materials and non-hazardous materials has been presented in **Section 10.8.2.6, 10.8.2.7, and 10.8.2.8**, respectively.

Transportation will occur along the regional road network and the FSR. While materials are transported safely throughout the region and across Canada routinely, by licensed and trained drivers, accidents can occur. Transportation accidents or malfunctions were rated as possible (hazardous materials) and likely (non-hazardous materials and work crews) with moderate consequences. Overall accidents involving non-hazardous materials had a slightly higher risk score than ones with hazardous materials, although both were deemed to have a high risk score for environmental consequences (**Table 10.7.2-4**)

The quantities and packaging details for the reagents used at the mine site are described in **Section 2.2.3.8**. Most of the materials to be transported to site will not be hazardous, and will follow the same distribution networks as hazardous materials. Airplanes and helicopters may also be used to transport non-hazardous materials.

The effects of a spill will depend on the type and quantity of material spilled and on the location and timing of the spill. Spills on land will have fairly localized effects, and the spilled material and any associated soil or snow can be contained, collected and remediated. Groundwater is unlikely to be affected unless a large spill occurs on very permeable soils with an underlying shallow aquifer. It is possible in such a situation the spilled material would be carried by the aquifer to its first surface discharge point downslope. Aquatic environments are more sensitive to a spill, with the worst case scenario involving a collision or accident in which an entire shipment is spilled and enters a waterbody. Three locations, the Big Bend Creek crossing where contaminants could flow into the Nechako Reservoir; bridge across Chedakuz Creek because of its proximity to settlements, and the bridge across Davidson Creek on the mine access road because of potential to affect aquatic organisms, if present, are the most likely sites where spill could have a relatively greater effect.

On land, the effect of a spill would be limited to the footprint, and could result in the death of vegetation and contamination of soil. Clean-up protocols would be implemented to contain the spill, and temporary fencing and signage would keep larger animals away from the site and warn people. In aquatic environments toxic effects would be carried downstream until dilution reduced the contaminant concentrations below toxic levels. A fuel spill would move downstream or spread across a stationary waterbody, potentially affecting shorelines. If materials were insoluble or dissolved slowly, spills could create smothering effects, even if non-toxic.

Project design and operations safeguards have been developed to minimize the likelihood of spills. All goods will be shipped in compliance regulatory requirements, including the federal and provincial *Transportation of Dangerous Goods Acts* and associated regulations. Drivers of vehicles carrying materials into the mine site will be appropriately licensed and trained, and will comply with all safety requirements. The FSR and the mine access road will be radio controlled, speed limits will be enforced, and dangerous goods will be shipped in sealed containers with secondary containment, as appropriate. Contingency and emergency response procedures would be implemented to protect worker human health and safety. Spill countermeasures including training and materials to be maintained in vehicles (e.g. absorbent materials) will be in place. If a spill were to directly enter a fast moving watercourse, it may not be possible to completely contain and remediate the spill. Clean-up and remediation will ensure long-term environmental effects are reduced to the extent practical.

Activities that have potential to act cumulatively with the effects of transportation accidents or malfunctions include forestry and mining activities. Both types of activities involve the transportation of materials on the FSR, including fuel. Operations safeguards that apply to all traffic on the FSR include:

- Radio control of all traffic on the Kluskus FSR and mine access road;
- Strict adherence to speed limits;
- Strict adherence to national trucking hour limits and other applicable requirements;
- Requirement that oversized loads will travel only during daylight to reduce the potential for collision;
- Transportation of materials during times of limited visibility will be avoided where possible;

- Requirement that materials that pose a potential hazard will be shipped only in sealed containers;
- Requirement that drivers will meet all applicable regulatory training requirements, be trained in spill response procedures for the materials they transport, and will carry the appropriate Material Safety Data Sheets and spill kits;
- Requirement for all vehicles transporting materials to site to maintain a supply of basic emergency response equipment, including communication equipment, first aid materials, and a fire extinguisher; and
- Regular vehicle maintenance.

Furthermore, trucks transporting materials that are hazardous (i.e., reagents, fuel) for any of these activities would be travelling in-bound, so the probability of two loaded trucks colliding is extremely low as they would both be travelling in the same direction. As a result, the activities of forestry and mining are not anticipated to have residual effects that would act cumulatively on the terrestrial or aquatic environments with the potential effects of a transportation accident from the Project, if such an accident were to occur. Therefore a cumulative effects assessment is not required.

10.10.3 Forest Fire (Project-related)

The potential for project-related forest fires was determined to be possible with a moderate consequence and high environmental risk score (**Table 10.7.2-4**). They are discussed in **Section 10.8.3.2**.

A major fire, started by either natural or human causes, presents a hazard to health and property at the mine site and nearby facilities. Its environmental effects include a temporary reduction of air quality and a loss of local terrestrial habitat and possible death of wildlife.

Planning and prevention of fires caused by Project activities is discussed in the Wildfire Management Plan (**Section 12.2.1.18.4.20**). Priorities for fire response include protecting human health and ensuring that the fire does not spread. A trained site fire response crew, Ministry of Forests, Lands and Natural Resource Operations trained fire response crews, the local municipal volunteer firefighting services, and, firefighting resources from Prince George will be deployed if needed.

Forestry, mining and potentially agriculture activities in the RSA have the potential to act cumulatively with these environmental effects. Any residual effects on air quality from forestry, mining and agriculture activities are typically small and localized. However, for there to be a cumulative effect the mine and at least one other land use or a wildfire would have to start at the same time, and further, both would have to be out of control and spread to areas adjacent to the origin. Forestry activities occur proximate to the Project mine site and both the Project and forest companies will share the FSR. There is a remote possibility that mining- and forestry-caused fires could simultaneously occur and simultaneously burn out of control. The possibility is considered extremely remote and unquantifiable as to extent. Forestry, mining and agriculture activities can all result in a loss of terrestrial habitat. Forestry and mining activities typically implement reclamation measures, so residual effects are mitigated. Agricultural activities in the RSA are some distance away from the mine site and occur at lower elevations, so a localized fire at the site will not act cumulatively with current or future agricultural activities. A cumulative effects assessment is not required.