38 Follow-up Program

Under Section 16(2)(c) of the *Canadian Environmental Assessment Act* (CEAA; 1992), a follow-up program is required to be considered for a comprehensive study type of environmental assessment (EA), which the KSM Project is being assessed as. Pursuant to the Operational Policy Statement for Follow-Up Programs under CEAA (CEA Agency 2009), the objectives of implementing a follow-up program are to:

a) verify the accuracy of the conclusions of the EA of a designated project; and

b) determine the effectiveness of any measures taken to mitigate the adverse effects of the Project.

In other words, a follow-up program is used to verify the predictions of environmental effects made during the EA of the Project and to confirm whether mitigation measures have achieved the desired outcomes. A follow-up program is essential in identifying whether mitigation measures or monitoring methodologies need to be modified or adapted as the Project proceeds in order to continue to be effective and to address previously unanticipated adverse environmental effects. Follow-up programs can also help to support the overarching Environmental Management System used to manage the environmental effects of the Project.

38.1 Introduction

Minimizing the environmental effects of all phases of the Project is a continuum whereby processes and management strategies are implemented throughout the life of the mine. Environmental Management Plans (EMPs) for the Project are designed to minimize impacts on the biophysical environment, when implemented, such that significant adverse environmental effects do not occur. EMPs from construction through to operation and closure are described in Chapter 26 of this document. In addition to permit and licence requirements, a variety of compliance monitoring programs will be used to verify whether mitigation measures are implemented, as described in the EMPs or associated technical appendices. Compliance monitoring is undertaken to ensure that mitigation measures are appropriately applied according to requirements laid out in authorizations, including those listed in Schedule B of the Environmental Assessment Certificate that the British Columbia Environmental Assessment Office (BC EAO) may issue for the Project. Failure to comply with required mitigation would be reported as required under associated authorizations, and actions would be required to bring the Proponent back into compliance. This systematic implementation of mitigation measures or best management practices (BMPs) is appropriate in situations in which environmental effects of the Project are well understood, and mitigation strategies have been standardized or successfully implemented in the past. Although compliance monitoring achieves the objective of ensuring that mitigation measures are implemented, on its own, compliance monitoring does not satisfy the requirements for a follow-up program.

A flexible approach or follow-up program is required when sensitive receptors have the potential to be affected, new mitigation technologies are being implemented, additional adaptive management measures may be needed, effects are uncertain, or the Project has the potential to

result in significant adverse effects. Unlike compliance monitoring, a follow-up program involves monitoring the response of environmental receptors with the purpose of determining whether a desired outcome is achieved and, if not, applying an adaptive management approach to develop and test strategies until a successful approach is identified. When making a decision under Section 23 (1)(b) of the CEAA (1992), the Minister of the Environment is required to "set out any mitigation measures or follow-up program that the Minister considers appropriate" in an EA decision statement for referral back to the responsible authority for action under Section 37 of the CEAA (1992). For adverse environmental effects where there is no accompanying authorization (e.g. wildlife or vegetation), the EA Decision Statement may be one of few legal instruments available to ensure that no significant adverse environmental effects occur.

38.1.1 Adaptive Management

The Canadian Environmental Assessment Agency's 2009 Operational Policy Statement on Adaptive Management Measures under the CEAA (1992) notes that a strategy or plan should be developed that identifies when or how adaptive management measures can be used. Adaptive Management is an effective tool for minimizing the effects of the Project, and it forms an integral part of a successful follow-up program.

The process for carrying out adaptive management must be applied systematically, including continuous monitoring, to enhance understanding and to reduce uncertainty over time. Figure 38.1-1 lays out a process for implementing an adaptive management approach.

Adaptive management will be applied if:

- a required threshold is not achieved;
- the condition of the environmental receptor becomes unacceptable, or
- new issues arise.

To facilitate this adaptive management approach, targets and/or thresholds are presented, where applicable, in each of the EMPs in Chapter 26. Objectives and targets may identify limits of acceptable change, consider permit and authorization requirements, and will require further refinement in discussions with regulatory agencies. Predetermined corrective action will be undertaken to prevent further effects if negative environmental trends warrant a response. Such action or change would continue to be monitored to determine whether objectives have been achieved, or whether further corrective action is required.

38.2 Valued Components Excluded from a Follow-up Program

In the Application Information Requirements (AIR) document (BC EAO 2011), a number of issues (e.g., geotechnical stability) and valued components (VCs; e.g., air quality) were proposed to be included for consideration in a follow-up program. In Chapter 26 of the Application for an Environmental Assessment Certificate / Environmental Impact Statement (Application/EIS), a description of the EMPs for each assessment topic is included, along with an overview of the approach, objectives, timing, proposed methodologies, and reporting that will be used in the monitoring programs for these issues and VCs.

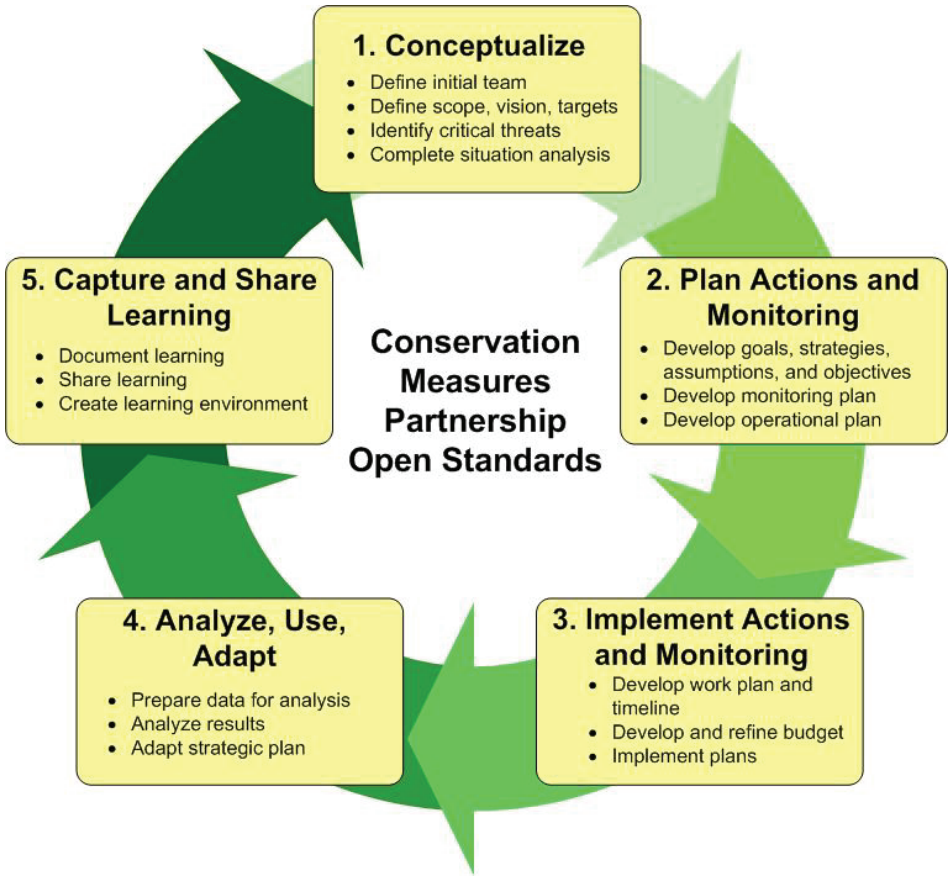

Figure 38.1-1

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KSM PROJECT

Adaptive Management Process

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The EMPs are designed to assist both operational decisions (e.g., adjust flows for discharge) as well as to ensure mitigation measures are implemented throughout the construction, operation, closure, and post-closure phases. With the implementation of adaptive Project design and supporting EMPs, follow-up programs are not required where effects are well understood; standard mitigation and monitoring strategies are being implemented; and the potential for adverse effects is less of a concern. For these reasons, the VCs listed below will be excluded from the requirement to develop a follow-up program:

- geotechnical stability of pit walls and waste;
- geochemical stability of waste rock, tailing, and pit walls (metal leaching/acid rock drainage [ML/ARD] monitoring);
- post-construction requirements;
- air quality;
- noise;
- glacier monitoring;
- vegetation; and
- archaeology (heritage sites).

More detail on the rationale for excluding each VC is provided below.

38.2.1 Geotechnical Stability of Pit Walls and Waste

Geotechnical stability of pit walls and waste is required under the Health, Safety, and Reclamation Code for Mines in British Columbia (BC MEMPR 2008) pursuant to the *Mines Act* (1996); facilities must be constructed to all required engineering design standards.

Geotechnical stability of pit walls and waste is affected by the design of pit slopes, based on stability criteria. The pit slope design for the Mitchell Pit was created using the results of a geotechnical site investigation, which included drilling of core holes (BGC 2011). Photogrammetric mapping of sections of the north and south valley walls was undertaken to provide additional data on the rock mass fabric.

Selected drill core samples were tested in the laboratory to determine uniaxial compressive strength, Brazilian tensile strength, small scale direct shear strength, grain size, index properties, and specific gravity.

As described in Chapter 4, Section 4.5.1.2.1, the Mitchell Pit has been divided into four geotechnical domains of homogeneous rock mass fabric based on discontinuity sets and geotechnical units identified by the results of the site investigation. The slope design criteria, including bench height, catch bench width, bench face angle, interramp angle, interramp height, and overall angle, have been developed for design sectors for each domain. The domains are divided into a total of 19 design sectors based on likely pit wall orientations and major geological structure controls on slope stability. Slope stability analyses have been conducted using industry

standard computer methods, including limit-equilibrium and finite element analyses and also in-house proprietary BGC Engineering Inc. (see Sub-Appendix F-2 of Appendix 4-C) tools. The required minimum factor of safety for slopes controlled by discontinuities is 1.2, and the minimum factor of safety for slopes controlled by rock mass is 1.3.

Most importantly, deformation rates of the pit wall will be monitored in select areas to provide advance warning of potential slope instability for safety reasons and to provide geotechnical information for the optimization of slope design; the design will be adjusted if a need is identified. Following the implementation of standard design protocols and safety monitoring procedures, risks to geotechnical stability of pit walls and waste is expected to be minimized, and a follow-up program is not required.

38.2.2 Geochemical Stability of Waste Rock, Tailing, and Pit Walls (Metal Leaching and Acid Rock Drainage Monitoring)

The proposed ML/ARD Management Plan (described in detail in Chapter 26, Section 26.14) will be implemented in the construction, operation, closure, and post-closure phases of the Project to monitor, mitigate, and adaptively manage the potential effects of ML/ARD on surface water quality, groundwater quality, fish and fish habitat, wildlife, and human health. The ML/ARD Management Plan covers the following deposit and non-deposit geological materials and wastes produced during construction and operation:

- Mine Site deposit rock including pit walls, waste rock, and ore;
- non-deposit rock including bedrock and overburden excavated or exposed during construction of surface diversion channels, tunnels, access roads, borrow areas, quarries, and construction of buildings and laydown areas; and
- tailing.

A key objective of this plan is to ensure that ML/ARD prediction, prevention, and mitigation methods are in compliance with legislation and British Columbia (BC) provincial and federal ML/ARD policies. Many of these conditions will be included in the *Mines Act* (1996) permit and *Environmental Management Act* (2003) effluent permit. By implementing the standard geochemical testing procedures outlined in Section 26.14, additional follow-up monitoring is deemed unnecessary.

38.2.3 Post-construction Requirements

The approaches to closing various Project components are described in Chapter 27, Closure and Reclamation Plan. Most closure activities will occur during the closure phase; some facilities will be closed, but not reclaimed, such as the Mitchell and Kerr pits. Many areas will be reclaimed using standard procedures or BMPs, such as covering areas with topsoil and using native seed, if available.

The EMPs for vegetation establishment (Chapter 26, Section 26.20) and soil erosion and compaction (Chapter 26, Section 26.13), for example, outline the management and monitoring programs that will be followed during post-construction activities. The closure of the Tailing

Management Facility (TMF) includes the development of beaches that will be covered with soil and that will be vegetated for wildlife habitat. The beach edges will be planted to encourage the re-establishment of wetland vegetation. Once water quality in the TMF reaches discharge permit conditions, the TMF beaches and water will be suitable as wildlife habitat. A monitoring program for the reclaimed TMF pond water is described in Chapter 27. If wildlife is able to access the pond water, and water quality standards for the protection of wildlife are not met, an adaptive management approach will be required to alleviate the risk to wildlife. Similarly, a monitoring program will be conducted to confirm that metals related to the tailing are not leaching into the soil and the vegetation. If metals do affect the vegetation, an adaptive management approach will be required to reduce the risk to wildlife.

The North Slope collection ditch, which will be located on the northern edge of the Mitchell Rock Storage Facility, will contain contact water. This ditch will contain large rock fragments placed so that no open water will be accessible to wildlife. The ditch will require monitoring to ensure that the rocks do not move and expose open water.

The benches and top of the Kerr waste rock in the Sulphurets Pit Backfill will be lined with a high-density polyethylene liner. The objective of using the liner is to reduce water infiltration into the waste rock to reduce the potential for ML/ARD. Over time, the liner may deteriorate (which may be accelerated due to the cold climate) necessitating monitoring; if the liner fails, it will require replacement or mending.

Because the post-construction requirements described above and in Chapters 26 and 27 are typical permitting conditions under the *Mines Act* (1996) and the *Environmental Management Act* (2003), a follow-up program is not required.

38.2.4 Air Quality

The Air Quality Management Plan (Chapter 26, Section 26.11) includes the Emissions Management Plan, the Fugitive Dust Emissions Management Plan, and the Meteorological Monitoring Plan. Standard mitigation and BMPs will be applied during construction, operation, closure, and post-closure of the Project. Briefly, these measures include:

- installing emission control systems (e.g., wet scrubbers, baghouses, and filters) on crushers, Mitchell-Treaty Twinned Tunnels, and relevant ventilation systems;
- applying water on access roads and Mine Site roads; and
- covering or enclosing ore stockpiles.

The mitigation described above will be included as conditions in the air permit issued under the *Environmental Management Act* (2003), and monitoring will be required to determine whether permit conditions are met. With the application of these mitigation measures combined with compliance monitoring, the effects on air quality are predicted to be minor overall, and a follow-up program pursuant to the CEAA (1992) is not required.

38.2.5 Noise

The Noise Management Plan (Chapter 26, Section 26.23) incorporates standard mitigation and BMPs to be applied during construction, operation, and closure of the Project. Briefly, these measures include following the Environmental Code of Practice for Metal Mines R418 (Environment Canada 2009) to target the British Standards Institute BS 5228 Code of Practice (BSI 2008) for noise and vibration control on construction and open sites in order to ensure compliance with Health Canada and World Health Organization standards. Operation of on-site vehicles and equipment maintenance will follow these codes to the extent possible. Helicopter over-flights will be timed to avoid the kidding period for mountain goats and the Ungulate Winter Range (UWR) while mountain goats are present, whenever possible. Following implementation of these measures, the impact of noise is predicted to be minor and a follow-up program is not considered necessary.

38.2.6 Glacier Monitoring

In 2008, glacier monitoring was initiated in the KSM Project area to achieve three main objectives: (1) glacier delineation, (2) quantification of glacier mass balance, and (3) characterization of glacier dynamics (see Appendix 13-C). Glacier monitoring is an important aspect of mine and water management planning (e.g., access to the eastern edge of the Mitchell deposit is currently obstructed by the Mitchell Glacier, and glacier melt will supply substantial runoff over the area of the proposed Mitchell open pit, posing design implications for diversion channels). As glacier monitoring is already proposed as a standard risk reduction measure for the KSM Project (see the Glacier Monitoring Plan, Section 26.16), an additional follow-up program is not required.

38.2.7 Vegetation

Vegetation is discussed as part of Chapter 17, Terrestrial Ecosystems. The Terrestrial Ecosystems Management and Monitoring Plan (Chapter 26, Section 26.20) includes the Vegetation Clearing Management Plan, the Invasive Plant Management Plan, the Transmission Line Management Plan, and the Terrestrial Plant Tissue Metal Concentrations Monitoring Plan. These plans incorporate standard mitigation and BMPs to be applied during construction, operation, closure, and post-closure of the Project. Briefly, these measures include:

- minimizing clearing of vegetation and promptly re-vegetating with native species;
- inspecting for, and removing, noxious weeds on roads, transmission lines, and other travel corridors during the growing season for the first 10 years;
- encouraging a healthy vegetation layer along rights-of-way by maintaining shrub vegetation and by avoiding herbicides for invasive species control; and
- developing strategic risk assessments if plant metal concentrations increase over time.

Following implementation of these measures, most of the effects of the Project on vegetation are predicted to be minor, with the exception of vegetation loss, which is predicted to be moderate in some cases (e.g., loss of vegetation in the pits). However, as this effect is confirmed (i.e., there is high confidence in the conclusions) and mitigation is being applied where possible to ameliorate

other potential effects, the utility of a follow-up program is questionable, and is therefore not required.

38.2.8 Archaeology

Archaeology is discussed as part of the chapter on Heritage (Chapter 21). The Heritage Management and Monitoring Plan (Chapter 26, Section 26.24), including archaeology, incorporates standard mitigation and BMPs to be applied during construction, operation, closure, and post-closure of the Project. Briefly, these measures include:

- designing Project components to avoid known archaeological and/or heritage sites when possible;
- marking archaeological and/or heritage sites as a "No Work Zone" on Project construction maps;
- implementing an archaeological chance-find procedure prior to the commencement of ground altering activities;
- reviewing any revisions to the Mine Site layout or infrastructure using a qualified archaeologist, and conducting an archaeological impact assessment, if necessary; and
- designing mitigation measures prior to construction in consultation with the Archaeology Branch, and carrying them out under a *Heritage Conservation Act* (1996) permit.

Following implementation of these measures, the impact of the Project on heritage (and archaeology) is predicted to be minor or negligible, and a follow-up program is not deemed necessary.

38.3 Valued Components Included in a Follow-up Program

Section 38.3 considers VCs for which a follow-up program is required (see Table 38.3-1); the VCs identified are those that may be at risk because the effects of the Project are generally predicted to be at least moderate, there may be uncertainty associated with the significance conclusions reached, or mitigation techniques are being used that require monitoring to confirm the effectiveness of the performance (in particular for compensation works). The efficacy of mitigation measures and the predictions of the significance of environmental effects will be confirmed through the implementation of follow-up programs. Modifications to the program design (i.e., applying adaptive management techniques) will be made as necessary over time and in consultation with regulatory agencies.

The following eight assessment topics require a follow-up program because there may be an enhanced risk of residual adverse effects on a VC:

- geohazards;
- groundwater quantity;
- groundwater quality;
- surface water quantity;

Table 38.3-1. Summary of Valued Components Requiring a Follow-up Program

Valued Component	Timing of Effect	Potential Effect	Environmental Management Plans, Compensation Plans, Technical Reports	Significance/Risk Rating (minor, moderate, major)	Follow-up
Geohazards	• Construction • Operation	Terrain instability and subsequent effects on geohazards	• Terrain, Surficial Geology, and Soil Management Plan • Avalanche Management Plan • Appendices 9-A to 9-H for Chapter 9	• Moderate	Required
Groundwater Quality and Quantity	• Construction • Operation	Alteration of groundwater levels and flow patterns due to artificial reservoirs and implementation of associated seepage control mechanisms	• Groundwater Management Plan	• Moderate	Required
	• Construction • Operation • Closure	Degradation of groundwater quality due to seepage of contact water	• Groundwater Management Plan	• Moderate	Required
	• Post-closure	Overall Residual Effect (Quality & Quantity)	• Groundwater Management Plan	• Moderate	Required
Surface Water Quantity	• Operation • Closure	Increase/decrease in annual, peak, and low flow volumes on streamflows in the PTMA	• Water Management Plan	• Moderate	Required
	• All phases	Increase/decrease in annual, peak, and low flow volumes on streamflows in the Mine Site; overall residual effect on streamflows in the Mine Site	• Water Management Plan	• Moderate	Required
Surface Water Quality	• Construction	ML/ARD leachates from materials entering waterbodies (tunnel, road, transmission line)	• Metal Leaching / Acid Rock Drainage Management Plan	• Moderate	Required

(continued)

Table 38.3-1. Summary of Valued Components Requiring a Follow-up Program (continued)

Valued Component	Timing of Effect	Potential Effect	Environmental Management Plans, Compensation Plans, Technical Reports	Significance/Risk Rating (minor, moderate, major)	Follow-up
Surface Water Quality (*cont'd*)	• Construction • Operation • Closure • Post-closure	Contaminants of potential concern in discharge (TMF, Mine Site)	• Metal Leaching / Acid Rock Drainage Management Plan • Water Management Plan	• Moderate	Required
Fish and Aquatic Habitat	• Operation • Closure • Post-closure	Sublethal toxicity due to metals or process chemical exposure downstream of the TMF associated with scheduled discharge from the TMF	• MMER Compensation Plan • Fish and Aquatic Habitat Management Plan • Water Management Plan • ML/ARD Management Plan	• Minor (Pacific salmon, bull trout, Dolly Varden, rainbow trout/steelhead, aquatic habitat)	Required
	• Operation • Closure • Post-closure	Sublethal toxicity due to metals or process chemical exposure downstream of the Mine Site WTP associated with scheduled discharge from the Mine Site WTP	• MMER Compensation Plan • Fish and Aquatic Habitat Management Plan • Water Management Plan • ML/ARD Management Plan	• Moderate (Dolly Varden, rainbow trout/steelhead, Pacific salmon) • Minor (aquatic habitat)	Required

(continued)

Table 38.3-1. Summary of Valued Components Requiring a Follow-up Program (completed)

Valued Component	Timing of Effect	Potential Effect	Environmental Management Plans, Compensation Plans, Technical Reports	Significance/Risk Rating (minor, moderate, major)	Follow-up
Fish and Aquatic Habitat (*cont'd*)	• Construction • Operation • Closure • Post-closure	Loss of instream and riparian habitat and productive capacity at stream crossings and infrastructure	• Fish Habitat Compensation Plan • Fish and Aquatic Habitat Management Plan	• Minor	Required (compensation effectiveness)
Wetlands	• Construction	Loss of wetland habitat and function	• Wetland Compensation Plan • Wetland Management Plan	• Minor	Required (compensation effectiveness)
Wildlife	• Construction	Habitat loss; Sensory disturbance; Overall residual effect	• Wildlife Management Plan • Noise Management Plan	• Moderate (mountain goat only)	Required
	• Operation	Chemical hazard	• Wildlife Management Plan	• Moderate (wetland birds only)	Required
	• Construction	Overall residual effect Overall cumulative residual effect: Likely development scenario Overall cumulative residual effect: Unlikely development scenario	• Wildlife Management Plan	• Moderate (moose only) • Moderate (moose only) • Major (moose only)	Required
	• Construction	Overall residual effect	• Wildlife Management Plan	• Moderate (grizzly bear only)	Required

- surface water quality;
- fish and aquatic habitat;
- wetlands; and
- wildlife.

38.3.1 Objectives of the Follow-up Program

Knowing that some environmental components are at greater risk than others, may not respond as predicted, or do not have applicable standards, a follow-up program has been developed for the Project. The follow-up program has been designed for specific at-risk environmental components to:

- compare results of monitoring with predictions in the EA;
- determine the effectiveness of mitigation measures;
- aid in detecting unanticipated adverse environmental effects; and
- identify the possible need for adjustments through adaptive management or post-construction requirements.

38.3.2 Planned Follow-up Programs

The scope of the proposed follow-up programs for each of the eight VCs is described briefly below.

38.3.2.1 Geohazards

Geohazards, such as landslides, avalanches, glacier movement, and seismic events have the potential to have major effects on Project infrastructure, especially access roads. Geohazards will be managed as described in Chapters 9 and 34 (Tables 34.3-1 and 34.3-3). The Soil Salvage and Handling Plan (Chapter 26, Section 26.13.1), the Erosion Control Plan (Chapter 26, Section 26.13.2), the Vegetation Clearing Management Plan (Chapter 26, Section 26.20.1), and the Coulter Creek and Treaty Creek Access Road Construction Erosion and Sediment Control Plan all contain general prescriptions for mitigating surface soil erosion, which can help avoid the development of future geohazards. The risk of a major debris flow in the area of access roads is identified for a follow-up program due to terrain instability.

Terrain instability created by road construction in steep terrain is addressed mainly by engineering designs, management measures, and effective maintenance. The proposed risk reduction options for particular sites will vary according to operational requirements. For example, measures described for the Ore Preparation Complex consider the need for uninterrupted operation, whereas strategies for access roads may tolerate temporary closures for active avalanche control. In other cases, strategies include adjustments to mine planning, such as consideration of the Snowfield Landslide in the excavation staging of the Mitchell Pit. Monitoring of geohazards during construction and operation will alert the Proponent to the risk of immediate danger due to geohazards. Infrastructure has been strategically located to avoid geohazards; as well, construction techniques and activities will be timed to minimize the

potential for geohazards. A primary strategy is to avoid excavation during heavy rainfall events and freshet. Slumping and debris flows due to surface soil erosion will be avoided using the standard BMPs and guidelines for road construction developed by the BC Ministry of Forests, Lands, and Natural Resource Operations (BC MFLNRO).

With these measures implemented, the risk associated with potential geohazard scenarios is reduced to an acceptable level. While the entire Project requires detailed design in order to mitigate potential effects on terrain stability, the following can be undertaken as part of the follow-up program:

- confirming the effectiveness of grading and contouring in reducing terrain instability for road construction;
- applying adaptive management strategies for road access based on a risk assessment related to debris flows and avalanche control and an assessment of its effectiveness;
- determining the effectiveness of removing the Snowfield Landslide in improving safety; and
- verifying that lowering the diversion ditches and increasing Water Storage Facility (WSF) height is successful in mitigating potentially induced terrain instability on the west side of the McTagg Valley.

Follow-up reports for Geohazards (terrain instability) will be prepared annually during construction and every five years after that, or as required by government agencies.

38.3.2.2 Groundwater Quantity and Quality

Moderate (not significant) localized effects on groundwater quantity (assessed in detail in Chapter 11) will occur from the alteration of groundwater levels and flow patterns due to mine dewatering and water level management required for various Project components, including the Mitchell Pit and the Mitchell Block Cave Mine, and the Sulphurets and Kerr pits during the construction and operation phases of the Project. A moderate (not significant) localized effect will also occur related to the alteration of groundwater levels and flow patterns due to artificial reservoirs and the installation of seepage control mechanisms in the WSF during construction, and from the TMF during operation. An overall finding of a moderate (not significant), localized residual effect is predicted during post-closure to groundwater quantity from all of the above Project components.

The KSM Project will affect groundwater quality as a result of seepage of degraded water from mine waste disposal sites (TMF, Rock Storage Facility) and the WSF. This seepage would occur for the duration of the mine life, and would continue for an uncertain amount of time following the end of operation. The magnitude of degradation would be high, because elevated levels of chemicals of potential concern (COPC) would enter the groundwater environment, resulting in exceedances of guidelines for human consumption and the protection of freshwater aquatic life. However, degradation of groundwater quality will be extremely localized, within the immediate vicinity of the footprints of the TMF and Mitchell Valley mine components up-stream of the WSF. Mitigation measures included in infrastructure designs in these areas will prevent seepage

of degraded water into the receiving environment. No exceedances of accepted provincial water quality guidelines have been predicted beyond the mine footprint.

A follow-up program (described in Chapter 26, Section 26.15) to monitor the effects on groundwater quality and quantity is recommended to:

- track degradation of groundwater quality arising from seepage of contact water from mine components;
- track changes in groundwater levels arising from mine components;
- identify occurrence of adverse effects on surface water quantity and quality arising from alteration of groundwater conditions; and
- establish criteria so that a need for adaptive management action can be identified.

The monitoring plan is an extension of the predictions, whereby action is taken to ensure that adverse effects are not greater than those predicted, and adaptive management is initiated in the event that adverse effects exceed thresholds.

38.3.2.3 Surface Water Quantity

Residual effects on surface water quantity (i.e., hydrology) related to changes in annual, peak, and low flow in streams and subcatchments in the Processing and Tailing Management Area will result from the construction, operation, and closure of diversions, tunnels, and the TMF. Residual effects on surface water quantity will also result in a change to annual and peak flows to streams and subcatchments in the Mine Site, including an overall residual effect. The surface water quantity VC will require a follow-up program as identified in Table 38.3-1.

An extensive system of water management facilities will be constructed and maintained throughout the life of the Project to divert non-contact water away from disturbed areas and to collect water that has contacted disturbed areas (contact water) for treatments before release to the environment (for additional details see Chapter 4). The primary water management structures and facilities for the Mine Site include:

- the WSF, the Water Storage dam, the WSF seepage dam, and the Water Treatment Plant (WTP);
- the Mitchell and McTagg rock storage facilities;
- the Mitchell Diversion Tunnels and the McTagg Twinned Diversion Tunnels;
- the Mitchell Pit north wall dewatering adits;
- the Mitchell Valley Drainage Tunnel;
- the Mitchell underground drainage tunnels;
- secondary diversion ditches and pipelines implemented within the Mine Site during operation to reduce contact water volumes and to direct open pit contact water and discharge from pit dewatering wells to the WSF;

- temporary water treatment facilities (construction phase only);
- closure channels (closure and post-closure phases only); and
- erosion and sediment control measures for the facilities listed above.

A Fish Habitat Compensation Plan for the loss of fish habitat associated with water quantity reductions in North Treaty and South Teigen creeks downstream of the TMF dams has also been developed (and is described below in Section 38.3.2.5, Fish and Aquatic Habitat). A follow-up program to determine the effectiveness of the compensation works is proposed.

A follow-up program is required to ensure that operational procedures to adjust water levels are implemented as needed, and to confirm the accuracy of the EA predictions given that some of the conclusions had a medium level of uncertainty.

38.3.2.4 Surface Water Quality

Surface water quality and water management facilities are discussed in Chapter 14. Management of effects on surface water quality is covered by the Water Storage Facility Management and Monitoring Plan (Chapter 26, Section 26.5); the Domestic and Industrial Waste Management Plan (Chapter 26, Section 26.6); the Dangerous Goods and Hazardous Materials Management Plan (Chapter 26, Section 26.7); the Spill Prevention and Emergency Response Plan (Chapter 26, Section 26.10); the Erosion Control Plan (Chapter 26, Section 26.13.2); the Metal Leaching and Acid Rock Drainage Management Plan (Chapter 26, Section 26.14); the Water Management Plan (Chapter 26, Section 26.17); and the Aquatic Effects Monitoring Plan (Chapter 26, Section 26.19.2). Following implementation of these plans, impacts on surface water quality are predicted to result in moderate but not significant effects.

38.3.2.4.1 Potential Effects on Surface Water Quality

The effect on water quality from Project components remains a concern due to the potential for ML/ARD into the receiving environment and subsequent effects on fish and fish habitat, wildlife and wildlife habitat, and human health. The results of water quality modelling on the WSF and TMF indicate a risk of degradation of surface water quality due to ML/ARD and COPC (Chapter 14, Section 14.7.1).

During construction, there is potential for ML/ARD from waste rock storage piles and temporary water treatment facilities in the vicinity of the tunnel portals, access roads, and transmission line. During operation, closure, and post-closure, the Selenium Treatment Plant will reduce selenium in drainage from Kerr waste rock. Contact water stored in the WSF will be pumped to the WTP, which will use a conventional, high-density sludge lime water treatment process to reduce concentrations of COPC and acidity in effluent prior to release into the receiving environment (Metal Leaching and Acid Rock Drainage Management Plan, Section 26.14). Predictions indicate that elevated selenium will be released in the effluent from the Mine Site.

The main water quality concern is associated with selenium due to the potential for effects on aquatic life and wildlife in the receiving environments of Treaty Creek and the Unuk River downstream of Sulphurets Creek. Selenium is predicted to be elevated relative to baseline

conditions in these waters during the operation, closure, and post-closure phases (Section 14.7.3).

38.3.2.4.2 Surface Water Quality Follow-up Program

A follow-up program will be established to confirm the predictions of the EA and to ensure that water treatment mitigation measures are performing effectively.

Metal Leaching and Acid Rock Drainage (tunnels, roads, and transmission line)

The Metal Leaching and Acid Rock Drainage Management Plan (Section 26.14) and the Water Management Plan (Section 26.17) describe the protocol for dealing with potentially acid generating (PAG) rock and sludge from the tunnel portals. Briefly, during construction of tunnels and access roads, rock surfaces on the tunnel walls will be lined, and drainage and temporary stockpiles of PAG material and water will be treated at 10 temporary water treatment facilities. These facilities will reduce concentrations of total suspended solids, ammonia, acidity, and dissolved metals.

An on-site laboratory will be established to allow for timely ARD characterization and management of waste rock. Material used for construction will be sampled and analyzed to ensure that only not potentially acid generating (NPAG) material is used where drainage may reach the receiving environment.

ML/ARD that may result from tunnel, road, or transmission line construction will be monitored, mitigated, and adaptively managed to avoid adverse effects on surface water quality. The follow-up program will assess whether mitigation measures designed to segregate NPAG and PAG were successful in removing the risk of ML/ARD seepage. This will include evaluating the success of the engineered rock storage facilities and lined pads where PAG material was stored. The success of the on-site lab to ensure that only NPAG material is used where drainage may reach the receiving environment will also be reported, including any adaptive management that was employed.

Water Treatment

COPCs in the effluent discharged to Sulphurets Creek are expected to meet discharge permit limits as per BC Pollution Control Objectives (Pollution Control Board 1979), and are predicted to meet BC water quality guidelines (BC MOE 2006), except selenium. The Proponent intends to construct and operate an ion-exchange selenium treatment plant to remove selenium from drainage from the Kerr waste rock. Drainage water from the Sulphurets Pit will report to the Selenium Treatment Plant feed tank for pre-treatment before being discharged to the WSF for the conventional effluent treatment process (the Selenium Treatment Plant is described in detail in Appendix 4-V).

Monitoring of water treatment facilities will be conducted to determine whether objectives for removing acidity and dissolved metals are achieved prior to releasing effluent to the receiving environment. Discharge from sampling sites is an important factor in determining loading calculations as required by Metal Mining Effluent Regulations (MMER; SOR/2002-222) and downstream water concentrations, allowing comparison with ambient guidelines.

Effluent quality will comply with requirements under the *Environmental Management Act* (1996) and the MMER (SOR/2002-222), and is described in the Water Storage Facility Management and Monitoring Plan (Section 26.5) and the Effluent Quality Monitoring Plan (Section 26.18). Water treatment activities at the Mine Site will continue during the post-closure phase. Monitoring to determine the success of selenium removal will be undertaken and results will be reported.

Surface water quality will be monitored as part of the Aquatic Effects Monitoring Plan (Section 26.19.2), the Water Management Plan (Section 26.17), and as a requirement of the permits and licences under which the Project will operate, particularly the MMER (SOR/2002-222). The follow-up program will be implemented to:

- ensure temporary water treatment facilities are effective, and, if not, apply adaptive management measures;
- verify the effectiveness of the Selenium Treatment Plant in reducing selenium in the drainage from Kerr waste rock;
- verify whether the geochemical inventory of tailing material successfully validated ML/ARD predictions developed during the environmental effects assessment process and the contribution of this procedure in assuring geochemical (ML/ARD) stability of waste rock, tailing, and pit walls;
- verify the predictions of environmental effects assessments;
- detect any unforeseen effects as measured against the baseline established as part of the initial environmental assessment;
- ensure that discharge limits and other criteria to be set at the permitting stage are effective in minimizing environmental effects;
- help identify cause-effect relationships between Project activities and any environmental changes, with reference to selenium levels in effluent; and
- comment on the effectiveness of any adaptive management measures undertaken and success in achieving receiving environment water quality standards.

38.3.2.5 Fish and Aquatic Habitat

Fish and other aquatic resources are discussed in the Application/EIS in Chapter 15, Fish and Aquatic Habitat. Standard mitigation and BMPs to be applied during construction, operation, closure, and post-closure of the Project are described in the Fish and Aquatic Habitat Management Plan (Section 26.18), including the Fish and Aquatic Habitat Effects Protection and Mitigation Plan, the Aquatic Effects Monitoring Plan, and the Fish Salvage Plan. Two fish habitat compensation plans are proposed to comply with requirements under Sections 35(2) of the *Fisheries Act* (1985) and 27(1) of the MMER (SOR/2002-222). These plans have been developed with input from Fisheries and Oceans Canada (DFO), Environment Canada, the BC MFLNRO, and Aboriginal groups.

38.3.2.5.1 Potential Effects on Fish and Aquatic Habitat

Following implementation of these plans and the development of fish compensation works, the potential effects of the Project on fish and aquatic habitat are predicted to be not significant (minor) in the Processing and Tailing Management Area. Some uncertainties were identified in the significance determinations of the potential effects on fish due to predicted water flow reductions and possible temperature increases downstream of the TMF. Concentrations of selenium are predicted to remain below water quality guidelines for the protection of aquatic life (BC MOE 2006; Chapter 14) downstream of the TMF. However, there are a few sporadic months in South Teigen or North Treaty creeks in which selenium concentrations in water may be higher during various Project phases compared to baseline concentrations (Chapter 14); this could lead to increased bioaccumulation of selenium in aquatic organisms (Chapter 15), and will require follow-up monitoring.

Similarly, for Project-related residual effects downstream of the Mine Site, most potential effects were assessed to be not significant (minor). However, selenium water concentrations are predicted to be greater than the BC Ministry of Environment (BC MOE; 2006) guideline for the protection of aquatic life (2.0 µg/L) at the SC2 (Sulphurets Creek above the cascades; non-fish bearing), SC3 (Sulphurets Creek below the cascade; fish-bearing), and UR1 (Unuk River, downstream of the confluence with Sulphurets Creek; fish-bearing) monitoring locations (Chapters 14 and 15). Selenium water concentrations are expected to meet water quality guidelines at the UR2 monitoring site on the Unuk River, near the United States border. Selenium water concentrations are predicted to be greater than baseline selenium water concentrations at all sites, suggesting that increased bioaccumulation by aquatic organisms may occur in these areas.

Downstream of the Mine Site WTP, the potential for bioaccumulation and toxicity due to selenium in fish species in Lower Sulphurets Creek (below the cascades) and the Unuk River was identified as a residual effect during the significance determination (not significant - moderate; Chapter 15). There is uncertainty in predicting the magnitude of metal uptake and the toxicological implications of potentially increased residues in fish tissue (i.e., uncertainty about the threshold concentration for toxicity in fish). Primary and secondary producers are often more tolerant of higher selenium tissue residues (i.e., toxicity thresholds may be higher in some of these organisms) compared to fish. Therefore, potential residual effects due to selenium downstream of Mine Site WTP discharge were assessed as not significant (minor) to aquatic habitat and non-fish aquatic life. However, the need for follow-up monitoring was identified for both fish and aquatic habitat.

38.3.2.5.2 Fish and Aquatic Habitat Follow-up Monitoring Programs

The MMER (SOR/2002-222) requires sampling of effluent and receiving water quality (water chemistry), acute and chronic toxicity testing, and biological monitoring (e.g., of benthic invertebrates and fish), as described in the Aquatic Effects Monitoring Plan (Section 26.18.2.2). As part of the requirements of the MMER (SOR/2002-222), fish must be sampled once every three to five years.

In addition to MMER (SOR/2002-222) requirements, the Aquatic Effects Monitoring Plan (AEMP, Section 26.18.2) outlines a number of follow-up programs that were identified in the EA process. A chinook salmon monitoring program will be conducted for at least 10 years, to confirm the assessment of potential effects (not significant - minor) on chinook salmon (*Oncorhynchus tshawytscha*) due to the predicted reduction of flows in South Teigen and Teigen creeks (Section 26.18.2.5.7). The AEMP also addresses the uncertainty associated with potential impacts on fish and aquatic habitat due to changes in stream temperature (Section 26.18.2.5.8); a stream temperature monitoring program will be conducted for six years. Should adverse effects be identified through these two monitoring programs, adaptive measures will be discussed with the DFO, for example modifying fish and aquatic habitat compensation requirements. The AEMP also outlines programs to support assessment of the potential for metal bioaccumulation through the food chain, and the potential for toxicity in aquatic organisms (Section 26.18.2.5). Monitoring will include measurement of water quality and quantity, sediment quality, periphyton and benthic invertebrate density and community structure, and tissue metal residues in both benthic invertebrates and fish. As an adjunct to this monitoring, an ecological risk assessment for fish and aquatic life in the Lower Unuk River is proposed.

The overall goal of the aquatic follow-up monitoring program described in the AEMP is to ensure that adequate data are collected to confirm the effectiveness of mitigation measures, address uncertainties, and confirm the accuracy of predictions in significance determination. The data collected under the follow-up monitoring program can be used to identify any potential effects to fish and aquatic habitat, and to determine if additional mitigation or other measures are required to minimize potential effects (i.e., adaptive management). Such measures may include the development of a food chain model to predict fish tissue residues, a risk assessment to determine the actual ecological/toxicological risk and implications of potential effects, new or altered water treatment methods or mitigation strategies, or other adaptive management strategies designed to decrease the extent, magnitude, or cause of the effect.

38.3.2.5.3 Fish Habitat Compensation Plans

Two compensation plans are required associated with the loss of fish habitat in the TMF footprint. The MMER Fish Habitat Compensation Plan (Appendix 15-Q) will be implemented to construct replacement habitat for 8.96 ha of fish habitat lost due to the deposit of deleterious substances into the proposed TMF and seepage collection ponds. The HADD Fish Habitat Compensation Plan (Appendix 15-R) will be implemented to construct replacement habitat for 5.37 ha of fish habitat lost beneath the TMF and seepage pond dams, access road crossings and transmission line crossings, as well as associated with water quantity reductions in North Treaty and South Teigen creeks downstream of the TMF dams.

A total of 37.8 ha of habitat will be created to offset the losses associated with the construction of the Project. The compensation plan focuses on creating rearing and overwintering habitat for Dolly Varden (*Salvelinus malma*), and coho salmon (*Oncorhynchus kisutch*) through the creation of off-channel ponds on Treaty, Taft, Teigen, and Glacier creeks. Suitability, reliability, and effectiveness of the compensation works for fish habitat will be included in the follow-up program. Habitat compensation works will be monitored against criteria specified in the two fish habitat compensation plans to determine success.

As part of the follow-up program, detailed design of compensation works will be carried out to confirm the soils, hydrology, water quality, and groundwater influences in the proposed fish habitat compensation sites; final compensation plans will be adjusted as required by the DFO. These plans will consider the effects of altered stream flows on fish and aquatic habitat during operation, closure, and post-closure associated with the Project. Construction of fish habitat compensation works will proceed following the mitigation strategies outlined in the Fish and Aquatic Habitat Protection and Mitigation Plan. After site construction is completed, post-construction monitoring will be carried out according to the plan detailed in Compliance and Effectiveness Monitoring (Section 9 of Appendices 15-Q and 15-R) of the MMER and HADD Fish Habitat Compensation Plans.

As habitat changes over time, additional post-Project surveys will be conducted following construction in years 2 and 5. All monitoring programs will have a rating system graded on a four-point scoring of performance (i.e., success to failure) in meeting both physical and biological program objectives, structural stability and condition, and maintenance needs (BC MWLAP 2001). Furthermore, informal visual inspections of structural integrity will be conducted as part of intensive effectiveness monitoring (Section 9.2). If a compensation program is not functioning optimally, program changes and additional construction may be required. The results of the compliance and Routine Effectiveness Evaluation monitoring will be provided to regulatory agencies, Aboriginal groups, and other stakeholders.

The mine operating life is estimated at 51.5 years. Site effectiveness monitoring will be conducted for all compensation programs until they are deemed effective. The approach to effectiveness monitoring will follow the designs below:

- the Before After Control Impact (BACI) experimental design for sites with existing habitat to be enhanced (e.g., Treaty Creek Site 1 and Teigen Creek Site 1). Two years of pre-construction monitoring data will be gathered to account for inter-annual variances in the BACI experimental design; and
- post-treatment experimental design for sites that create new habitat because there are no baseline data with which to compare (e.g., Taft Creek Site 1 and Glacier Creek Site 1).

Post-construction effectiveness monitoring will follow two periods:

- short-term - years 1 and 2; and
- medium-term - years 5 and 6.

After Year 6, compensation Project effectiveness will be evaluated, and the necessity of future monitoring will be determined.

Monitoring will assess the productive capacity of fish habitat, compared to existing conditions. To quantify a net change in habitat productive capacity, multiple key performance criteria will be evaluated and will depend upon the program specific objectives, target habitats, fish species, and life history stages. The results will be summarized in a review of compensation effectiveness after three years. Should it be determined that the compensation habitat is not functioning

properly, remedial action will be taken in consultation with the DFO, which may include modification of the compensation sites.

38.3.2.5.4 Reporting on Fish and Aquatic Habitat

Reporting will be undertaken in the form and at the frequency required under the MMER (SOR/2002-222) and the *Mines Act* (1996) and *Environmental Management Act* (2003) waste discharge authorizations. A summary of the data collected in the monitoring programs for fish habitat compensation works outlined in the Fish Habitat Compensation Plans will be included in an annual report. Trend analysis of these data will be conducted for the detailed report completed every three years and will include a discussion of the monitoring of habitat compensation works under the *Fisheries Act* (1985). These reports will comment on the success of compensation works, the need for any adaptive management or further compensation, and the implications of any conclusions reached during an ecological risk assessment. Reporting will be provided to the regulatory authorities as required.

38.3.2.6 Wetlands

Wetlands within the Project footprint constitute fens, marshes, swamps, and shallow open-water pools. The majority of direct impacts to wetlands are in the wetland located in the watershed of the upper tributaries of Teigen and Treaty creeks. The total direct loss of wetland extent is expected to be 59.3 ha, with greatest impacts on fen and swamp wetlands due mainly to the TMF and access corridors (Chapter 16). A Wetland Management Plan (Section 26.19) was developed to mitigate potential effects to wetlands adjacent to, but not directly within, Project infrastructure. The impact of the Project on wetland extent and function was considered not significant (minor) for all areas except within the TMF, where it was considered not significant (moderate). A wetland compensation plan (Appendix 16-B) was developed to mitigate the loss of wetland function and extent.

38.3.2.6.1 Wetland Compensation Plan

As part of the Application/EIS, the Proponent plans to compensate for the impacts on wetlands by creating new wetlands. A conceptual wetland compensation plan was developed (Appendix 16-B) to meet the Federal Policy on Wetland Conservation (Environment Canada 1991) to minimize adverse Project-related effects on wetland extent and function.

Wetland compensation efforts will focus on providing wetland ecosystems predicted to provide similar functions to those that will be lost, i.e., “like for like” compensation. The Wetland Compensation Plan will follow established protocols of creation, restoration, and enhancement of sites to deliver wetland area and function. The final year of compensation is expected to be six years following the initiation of the last compensation phase at Teigen Creek. Site selection for wetland compensation identified four preferred options (Figure 16.7-2):

- three fish compensation sites: Teigen, Treaty, and Taft creeks; and
- a Smithers-area wetland along Highway 37 (to facilitate educational awareness and research about wetlands).

Each zone is targeted to provide different wetland functions. Compensation success will be based upon a greater than 1.25:1 area ratio of all compensation wetlands to affected wetlands at the end of the five-year regulatory monitoring period for each site. Additional reclamation at closure will increase the post-Project wetland ratio to in excess of 2.5:1.

38.3.2.6.2 Wetlands Follow-up Program

The primary focus of monitoring wetland compensation success will be on the maintenance of wetland hydrology and development of wetland ecology.

It is expected that monitoring will be conducted annually for a minimum period of 10 years, with long-term monitoring continuing throughout the life of the mine at reduced frequencies. This effectively enables adaptive management strategies such as site specific siltation/erosion control measures, dust reduction strategies, and targeted invasive plant management as well as ongoing maintenance. At Year 11, monitoring intensity and frequency will be reduced to once every 5 years, for the next 20 years, and then once every 10 years, for the remainder of the Project (until closure).

This monitoring strategy will enable the Proponent to improve efficiency of plan delivery as well as the efficacy of future compensation activities that may arise. This will also ensure that wetland ecosystems persist in these compensation areas for as long as the Project is in operation. The follow up program will focus on conducting vegetation surveys, biomass, and photopoint monitoring at compensation sites.

Net wetland extent will be assessed and considered successful if:

- prevalence index of hydrophytic wetland species within compensation areas have significantly increased over baseline measurements;
- ratio of non-native and invasive species to native species has decreased over baseline measurements;
- presence of hydric soil indicators, such as depleted soils and mottles, occur in areas where previous indicators did not exist; and
- observed wildlife use has increased over baseline measurements.

Monitoring goals will be established to ensure that the survival rate of planted trees and shrubs exceeds 80% each year and 80% by the end of the monitoring period. Additional long-term monitoring will continue at decreasing frequencies throughout the life of the mine to ensure wetlands persist in the compensation sites throughout the mine life.

It is predicted that sign-off of “success” by regulators will be requested at Year 5 of the fully implemented compensation plan with the attainment of a stable wetland area with wetlands of sufficient size to potentially provide wetland functions within the compensation landscape.

38.3.2.7 Wildlife

Habitat loss and alteration, disruption of movement, sensory disturbance, direct mortality, indirect mortality (access), attractants, and health effects (chemical hazards) may affect wildlife in the regional study area (RSA) and potentially beyond, depending on the range and mobility of the species being affected. The impact of the Project on the majority of wildlife VCs is predicted to be minor, with mitigation. Medium magnitude effects for moose (overall additive effect), mountain goats (habitat loss, sensory disturbance, and overall additive effect), grizzly and black bears (overall additive effect), and wetland birds (chemical hazards) are predicted. Through a process of design changes and with the implementation of the mitigation and monitoring outlined in the Wildlife Management Plan (Chapter 26, Section 26.21), all, except one Project-related residual effect are assessed as not significant.

38.3.2.7.1 Potential Effects on Wildlife

Mountain Goat

Habitat loss and alteration may potentially affect mountain goats. A total of 1,703 ha of high-quality winter and summer mountain goat habitat may be lost or altered, mainly due to development of the Mine Site, including the pits, waste rock storage, and access roads. Additionally, 547 ha of an approved provincial Ungulate Winter Range (UWR u-06-002) may be lost or altered. Noise disturbance (e.g., helicopter flight paths or blasting) can result in mountain goats avoiding habitat, creating a functional loss of habitat.

Sensory disturbance (noise) can affect access to suitable wildlife habitat for foraging, reproduction, and denning. Mountain goats are particularly susceptible to helicopter or blasting noise which can disrupt behaviour such as kidding and foraging. Helicopter noise can create a barrier between habitats for mountain goats.

Moose

Access to high-quality moose habitat is available from Highway 37 along the Bell-Irving River and along forestry roads near Bowser Lake. Approximately 2,765 ha of high quality moose winter habitat will be lost or altered. Increased traffic volumes from 6 vehicles per day to 3.5 vehicles per hour along the access roads and Highway 37 due to the Project, added to traffic from other planned projects in the RSA, may create a barrier to crossing roads to access habitat, or may increase mortality rates for moose.

The level of future industrial development along the Highway 37 corridor is uncertain. When considering future projects that may interact cumulatively with the Project, it is unlikely that all currently proposed mine projects will be developed at the same time. Therefore, two possible future scenarios were evaluated for potential overall cumulative effects on moose, primarily driven by increased mortality from traffic accidents: (1) a “likely development” scenario, with one to three mining projects being concurrently in production, and (2) an “unlikely development” scenario where all or most projects go ahead as planned.

The **likely development scenario** has a medium probability of occurring and a medium confidence, as it is more likely that one to three projects occur, rather than all projects considered

in the cumulative effects assessment. The overall cumulative effect on moose under the likely development scenario is **not significant (moderate)**.

The **unlikely development scenario**, in contrast, has a low probability of occurring, as it is unlikely that all projects will occur simultaneously, and the confidence is low due to the difficulty in knowing how many proposed projects will go forward and the precise timing of each project. The overall cumulative effect on the moose population under the unlikely scenario of high development is predicted to result in a **significant (major)** effect due to increased mortality due to traffic accidents. However, this assessment has relatively low certainty because the likelihood of all proposed projects occurring simultaneously is low and the model structure is posited to cause it to be overly sensitive to small reductions in survival.

Grizzly Bear

Grizzly bears are considered a species of special concern by the Committee on the Status of Endangered Wildlife in Canada, and are blue-listed in BC. The area near the TMF and Treaty Creek has been proposed as a potential Wildlife Habitat Area for grizzly bear (i.e., under consideration for protection). Total grizzly bear habitat that will be lost or altered is 10,886 ha, the equivalent of 58% of the home range of a single male bear in the interior of BC (or 188 ha per bear). Increased traffic volumes from 6 vehicles per day to 3.5 vehicles per hour along the access roads and Highway 37 due to the Project, added to traffic from other planned projects in the RSA, may create a barrier to crossing roads to access habitat or may increase mortality rates for grizzly bear.

Wetland Birds

Wetland birds, protected under the *Migratory Birds Convention Act*, *1994* (1994) will be exposed to chemical hazards in the TMF. This exposure could lead to indirect or direct mortality effects from the Project.

38.3.2.7.2 Wildlife Compensation

Ungulate Winter Range Compensation Plan

As part of the Ungulate Winter Range Compensation Plan for mountain goats (Chapter 26.21.2), the Proponent plans to provide "like-for-like" habitat by compensating for impacts due to the potential loss or alteration of UWR u-06-002. A total of 547 ha of protected Ungulate Winter Range (UWR u-06-002) in the Mitchell/Sulphurets drainage may be lost or altered due to development of the Mine Site.

Using a habitat suitability model, a total of 58,511 ha of high-quality winter habitat was identified in the RSA. A "like-for-like" UWR to compensate for the potential impact to UWR u-06-002 will be selected using the following four criteria:

- Proximity to the existing UWR: Suitable mountain goat winter habitat within the same drainage or watershed as the existing UWR.
- Habitat use: Areas with the most goat use observed during winter will be rated highest.

- Contiguity of compensation areas: Contiguous units of greater than 100 ha (1 km^2) and proximal to other seasonal habitats (e.g., summer range).
- Distance from development area: Optimally greater than 2 km from any development that may degrade mountain goat winter habitat.

The goal of the compensation plan is to create or enhance habitat that has the same natural integrity, structure, and function, and is in the same ecological unit of the mountain goat habitat that was adversely affected.

As part of the environmental monitoring program for the Project, a Wildlife Management and Monitoring Plan (Chapter 26, Section 26.21.3) will be implemented to document changes in wildlife abundance, behaviour, health, and habitat use resulting from Project construction, operation, closure, and post-closure. It includes objectives for meeting legislative requirements as well as actions to avoid, control, and mitigate the effects of the Project. The Wildlife Effects Monitoring Program (WEMP, Section 26.21.3) outlines the goals of the monitoring program, depending on the species, and identifies the frequency of monitoring activities. The WEMP provides information to direct the actions of the Proponent in minimizing potential effects of the proposed Project on wildlife. Consistent with the Proponent's commitment to continual improvement, wildlife management for the Project will take an adaptive management approach. In addition to design changes made following the outcome of baseline studies, further design and management changes would be implemented during the construction and operation phases of the Project as the results of monitoring from the WEMP become available. Examples of adaptive management actions that could be undertaken include:

- avoiding vegetation clearing near identified moose calving areas, and consulting BC MFLNRO to develop appropriate strategies when avoidance cannot be achieved;
- revising construction activities in occupied winter range to avoid sensitive periods based on monitoring of wildlife activity;
- modifying helicopter buffer distances from mountain goat habitat in accordance with the Management Plan for the Mountain Goat in British Columbia (BC MOE 2010) to minimize sensory disturbance; and
- revising the Traffic and Access Management Plan (Section 26.25) to minimize wildlife/vehicle collisions and movement barrier effects of access roads.

Loss of moose, mountain goat, and grizzly bear habitat will be modelled at various stages of operation to ensure that total loss does not exceed the amount identified in the Application/EIS. Corrective measures will be taken to remain within targets.

38.3.2.7.3 Wildlife Follow-up

The suitability and effectiveness of measures implemented to mitigate or compensate for impacts on moose, mountain goats, grizzly bear, and wetland birds are subject to a follow-up program, which will be conducted as described in the WEMP. As an adjunct to the objectives identified in the WEMP, the follow-up program will evaluate the implementation and effectiveness of mitigation measures, verify the predictions of the EA, and identify opportunities for adaptive

management. This program will also define meaningful and relevant (if any) indicators, thresholds, and/or clear definitions of acceptable change to facilitate adaptive management and aid in determining when additional mitigation, monitoring, or reporting is necessary.

38.4 Follow-up Program Reporting

The Proponent will report the results of the follow-up programs in a technical summary report, at a frequency to be agreed to in consultation with provincial and federal government agencies. Reporting under individual EMPs and compensation plans will be undertaken according to the schedule outlined in those plans. The follow-up report will summarize how mitigation measures were implemented, and will comment on the effectiveness of these measures in reducing environmental effects of the Project. It will also identify areas where adaptive management strategies were applied, whether those measures were effective, and if alternate measures were needed to reduce effects on the environment.

For each VC subject to a follow-up program, the follow-up reports will:

- Describe and assess the effectiveness of the methodology and actions the Proponent has taken to implement the follow-up program.
- Provide the results of related EMPs (e.g., the Water Management Plan, the Groundwater Management Plan, the Fish and Fish Habitat Management Plan, the MMER Compensation Plan, the Aquatic Effects Monitoring Plan, the Wetlands Compensation Plan, and the Wildlife Effects Monitoring Plan) to assist in tracking and verifying environmental trends, and in verifying the accuracy of EA conclusions related to significance.
- Describe and assess the effectiveness of any additional mitigation measures taken to eliminate or reduce impacts unforeseen during the EA but identified by monitoring carried out as part of either the standard EMPs or follow-up program.
- Describe and assess any significant adverse effects that the follow-up program and/or additional mitigation measures have failed to eliminate or reduce.
- Identify any emerging negative environmental trends likely attributable to the Project identified by monitoring, carried out as part of the standard EMPs or follow-up program.
- Describe proposed revisions to the follow-up programs to address emerging negative trends, or to adjust monitoring programs, if required.
- Verify the accuracy of the conclusions of the EA.

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