Reclamation and Closure Planning for Quartz Mining Projects

Plan requirements and closure costing guidance

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Yukon Water Board

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Executive Summary

A Reclamation and Closure Plan (RCP) describes how a quartz mine will be reclaimed and closed to return the mine site to an environmentally stable condition suitable for future land uses. RCPs also provide the basis for estimating the financial liability associated with a mining project. This guide is intended to assist proponents with the development of RCPs and appropriate liability estimates for quartz mining projects. RCPs should be considered as living, dynamic documents that will be refined throughout mine planning, development and operation. RCPs will be updated as more information and certainty becomes available about end-of-mine conditions and as monitoring, research, analysis and design are advanced.

Mining projects in Yukon usually require both a Quartz Mining License (QML) and a Water Licence (WL). Both licenses which each consider and address reclamation and closure. Reclamation and closure activities are inherently integrated across all environmental disciplines and regulatory requirements. As a result, this guide describes requirements for RCPs to meet the needs for both QML and WL processes.

In general, the guide does not prescribe reclamation and closure methods. Instead, it provides overall guidance about expected processes for developing RCPs and performance outcomes for reclamation and closure. This approach is intended to provide flexibility for proponents to identify and optimize reclamation and closure measures for specific sites and components. The guide provides direction about the types and levels of detail of information that should be included in RCPs to demonstrate that the proposed methods will achieve the desired performance outcomes. The flexibility provided by the performance-based approach in the guide should not be interpreted as sanctioning RCPs founded on performance outcomes but lacking specific details about proposed reclamation and closure measures — all RCPs must identify proposed reclamation and closure measures and demonstrate how they will achieve stated objectives.

This guide includes three main components: (1) the cover document that provides context for the guide and describes expectations, principles and approaches for reclamation and closure planning processes; (2) Annex 1, which is an annotated RCP outline, describing the types and level of detail of information that will be expected for specific reclamation and closure activities; and (3) Annex 2, which describes expectations for liability estimates.

The specific information expectations, principles and approaches described in this guide are intended to establish a framework for preparation of RCPs and liability estimates. They should not be considered all-inclusive, and the contents of the guide should be interpreted and applied along with other important sources of information, including

ongoing discussions with governments, communities and regulatory agencies. Proponents should note that additional information may be required as a result of an environmental assessment, or as a result of applications for or permits issued under the *Quartz Mining Act*, the *Environment Act*, the *Waters Act*, the *Public Health and Safety Act*, or any other applicable federal, First Nation, municipal, or territorial acts.

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1.0 Purpose and Objectives

The purpose of this guide is to assist mining proponents in preparing RCPs and liability estimates that achieve expectations for plans submitted in accordance with Water Licence and Quartz Mine License processes. By describing the contents and expectations for RCPs and liability estimates, the guide will help to define closure planning processes for proponents including timing, research, data collection, engagement, design requirements and risk management.

To achieve its purpose, the guide has the following objectives:

- Describe the context for mine closure planning in Yukon, and the rationale for requirements to submit RCPs and liability estimates.
- Describe the principles, philosophy and broad objectives for closure planning for Yukon mining projects.
- Describe the information expectations for RCPs and liability estimates.
- Identify key sources of additional guidance for preparing RCPs and liability estimates.

2.0 Regulatory Context

Quartz mining projects in Yukon usually require both a QML issued by the Yukon Department of Energy Mines and Resources (EMR) under the *Quartz Mining Act* and a Water Licence issued by the Yukon Water Board (YWB) under the *Waters Act*. Both regulators' interests in reclamation and closure begin during consideration of initial approvals for the project and continue throughout the mine development, operation, reclamation, closure and post-closure stages of development. They evaluate reclamation and closure requirements within their jurisdictions when they issue licences, consider amendments, or grant approvals in relation to licences. The RCP must address the needs of both key regulators.

With respect to QMLs, this guide applies within the context of the "Yukon Mine Site Reclamation and Closure Policy." A key principle of the policy is that "*every mine will have an approved reclamation and closure plan that has been approved by the Yukon government before proceeding with development*" (p.4). While QMLs may be issued without detailed RCPs, approval to begin mining activities will not be granted until approval of an RCP. In accordance with the Mine Site Reclamation and Closure Policy, EMR requires submission of RCP updates at least every two years. These updated plans must present the best available information and be based upon reclamation research programs and monitoring programs taking place on site. Updated plans must demonstrate how the findings from these programs affect closure planning. As part of all RCP updates, EMR requires estimates of financial liability associated with the site

throughout the life of the project. In each case, liability must be broken into three categories: current liability, liability two years hence and liability at end of mine life. These liability estimates provide EMR with information to implement its policy requirement to: “ensure that security held will be commensurate with the outstanding mine reclamation and closure liability at any time during the 24-month period” (p.12).

With respect to WLs, this guide supplements the guidance provided in “Type A and B Quartz Mining Undertakings, Information Package for Applicants” (Yukon Water Board, February 2012), including the portion of Appendix B describing requirements for Decommissioning and Reclamation. The YWB emphasizes the importance of robust reclamation and closure planning in its licensing principles, stating that it will endeavour to “*issue licences only when there is a reasonable certainty that an acceptable level of reclamation of the site can be achieved during mining and/or following cessation of mining*” (p.6). The “Information Package for Applicants” describes licence conditions that may be applied in WLs, including conditions requiring submission of updated RCPs and liability estimates. In general, water licences will establish update requirements that are consistent with the two-year cycle used by EMR. This consistent cycle will provide an opportunity for the YWB and interested parties to review RCPs and liability estimates. If necessary, the YWB can re-engage its processes for considering and evaluating the updated RCPs and liability estimates.

The YWB recognizes that the potential long-term effects from mining projects are often related to water quality, and that the water quality conditions at mine sites can evolve over very long periods of time. It also recognizes that water conveyance, containment and collection facilities need long-term monitoring and maintenance if they are to perform as planned. As a result, the YWB expects to maintain active interest in monitoring and responding to changes at closed mine sites long after RCPs have been implemented, even if site management responsibility changes or closure certificates are issued.

3.0 Reclamation and Closure Planning Schedule

To achieve suitable mine closure outcomes, planning for reclamation and closure at mine sites must be initiated in conjunction with mine planning and continue throughout mine development and operation. Mines must be designed and operated for closure as decisions about mine development and operations will both define and constrain options for reclamation and closure and may affect the achievability of mine closure objectives. Identifying and evaluating potential constraints and effects on mine closure is a critical component of well informed decision making during mine planning, development and operation.

While early initiation of reclamation and closure planning is critical, an RCP will be refined throughout the mine life as specific information is gathered and lessons are learned through reclamation research programs and monitoring programs. Early versions of an RCP, like those prepared during pre-feasibility stages of project planning, may be conceptual in nature and be based upon closure options and assumptions for these options provided that these are based upon the best available information and have sufficient reasoning. This guide however, focuses on RCPs that will be provided in accordance with QML and WL processes. Such RCPs must identify suitable reclamation and closure measures for the proposed project and include sufficient site-specific data, analysis and design to demonstrate that the proposed measures will be effective for achieving proposed objectives.

There are several stages in the reclamation and closure phase, and RCPs will need to address each of these stages. The distinctions between stages will vary for each site, but often include reclamation implementation, intensive monitoring/adaptive management and post-closure activity. Post-operational transitional care and maintenance may also be an important consideration for some sites, requiring actions that may be similar to those undertaken during temporary closures.

Even within the context of QML and WL processes, RCPs will be refined during the life of the project. Detailed plans will initially be required in order to receive authorization to develop and operate the mine – i.e., a Water Licence and approval of a RCP under a QML. Additional data, analysis and design must be incorporated into updated plans periodically throughout mine development and operation, addressing for example, changing site conditions, improved understanding of physical and chemical performance and results of reclamation research programs.

4.0 Temporary and Permanent Closure

RCPs submitted for QML and WL processes must address both temporary and permanent closures.

- Temporary closure is a closure in which mining related activities cease with the intent of resuming activities in the near future. Temporary closures may be planned or unplanned and could arise from a variety of circumstances including financial challenges, design failures, extreme climatic conditions, etc. Temporary closures may last for weeks, or could extend for years. Maximum durations of temporary closure periods are frequently defined in QMLs and WLs. At the conclusion of a defined temporary closure period, proponents will be required to implement permanent closure measures. In the event of a temporary closure, a full review of the RCP as well as liability estimate and security may be undertaken.

- Permanent closure is a closure in which there is no intent to resume mining activities at the site and the mine project proceeds to the reclamation and closure phase.

5.0 Principles and Approaches for Reclamation and Closure Planning

5.1 Fundamental Reclamation and Closure Objectives

Detailed objectives for reclamation and closure will be site-specific, defined by factors that include environmental conditions, site conditions and community expectations. However, all RCPs must be developed to address fundamental objectives for important values. Detailed objectives should be developed in specific RCPs to clarify interpretation of the fundamental objectives, considering specific circumstances and projects. Each RCP submitted for QML and WL processes must demonstrate how the objectives described in Table 1 will be achieved during all stages of reclamation and closure.

Table 1: Fundamental Mine Reclamation and Closure Objectives

Value	Reclamation and Closure Objectives
Physical Stability	• All mine-related structures and facilities are physically stable and performing in accordance with designs. • All mine-related structures, facilities and processes can withstand severe climatic and seismic events.
Chemical Stability	• Release of contaminants from mine related waste materials occurs at rates that do not cause unacceptable exposure in the receiving environment.
Health and Safety	• Reclamation eliminates or minimizes existing hazards to the health and safety of the public, workers and area wildlife by achieving conditions similar to local area features. • Reclamation and closure implementation avoids or minimizes adverse health and safety effects on the public, workers and area wildlife.
Ecological Conditions and Sustainability	• Reclamation and closure activities protect the aquatic, terrestrial and atmospheric environments from mine-related degradation and restore environments that have been degraded by mine-related activities. • The mine site supports a self-sustaining biological community that achieves land use objectives.
Land Use	• Lands affected by mine-related activities (e.g., building sites, chemical and fuel storage sites, roads, sediment ponds,

Table 1: Fundamental Mine Reclamation and Closure Objectives

Value	Reclamation and Closure Objectives
	tailings storage facilities, waste rock storage areas, underground workings, etc.) are restored to conditions that enable and optimize productive long-term use of land. Conditions are typical of surrounding areas or provide for other land uses that meet community expectations. • Site access is consistent with community land use expectations.
Aesthetics	• Restoration outcomes are visually acceptable.
Socio-economic Expectations	• Reclamation and closure implementation avoids or minimizes adverse socio-economic effects on local and Yukon communities, while maximizing socio-economic benefits. • Reclamation and closure activities achieve outcomes that meet community and regulatory expectations.
Long-term Certainty	• Minimize the need for long-term operations, maintenance and monitoring after reclamation activities are complete.
Financial Considerations	• Minimize outstanding liability and risks after reclamation activities are complete.

5.2 Community and Regulatory Engagement

Engagement with the community, including governments (First Nation, federal, territorial), local communities, assessment/regulatory authorities and non-government organizations is an essential component of reclamation and closure planning. Proponents need to understand the views and expectations of all parties, and RCPs should demonstrate how the proponent has considered and addressed these throughout the planning process. For the YWB, this information will be important for understanding how the proposed RCP helps to achieve the Board's Objectives: "to provide for the conservation, development and utilization of waters in a manner that will provide the optimum benefit from them for all Canadians and for the residents of the Yukon in particular."

In general, mining is a temporary land use, and local people will be active in the area after mining and reclamation are complete and will have expectations about how they will use the land. Reclamation and closure objectives must respect the values and expectations of these future land users, so seeking and incorporating input about the long-term objectives is essential. Engagement with governments and regulators will also be needed to confirm that objectives will fulfil their expectations. Once parties have reached an understanding about the objectives, continued engagement will be required throughout the planning process to refine and interpret objectives and develop

understandings about all aspects of the closure plan, for example reclamation research, reclamation methods, modeling results, prediction of effects and other elements.

Understanding community issues, concerns and expectations requires a variety of different communication and engagement approaches that must be tailored to meet the needs of each project, ranging from detailed technical discussions to input from the general public and local land users.

5.3 Reclamation and Closure Principles

There are several global principles that apply to reclamation and closure planning for mining projects in in Yukon. These principles are consistent with achieving the fundamental objectives described in Section 5.1 and should be considered in preparing all RCPs.

5.3.1 Design for closure

Reclamation and closure planning must begin during planning and design for the mining project, so that mine development and operational decisions provide for effective closure opportunities and do not unduly constrain reclamation and closure options or objectives. Mine components should be designed and constructed to meet closure needs. Costs of reclamation and closure must be incorporated into development and operational decision-making.

5.3.2 Reducing Impacted Water

Projects should be designed to avoid mixing of unaffected water with mine-related contaminants. Unaffected water should be routed through or around the site.

5.3.3 Source control

Source control is the first priority for managing contaminants. Long-term, or post mining, effluent capture and treatment are not acceptable substitutes for source and mitigation control, and may only be relied upon after all reasonable source and mitigation control methods have been employed. Source control begins with the first placement of waste material and can include a combination of approaches, for example, waste segregation, waste storage locations, liners, covers, amendments, surface diversions and others.

5.3.4 Progressive Reclamation

Progressive reclamation entails reclamation activities that are completed during mine operations. Proponents should maximize progressive reclamation, taking advantage of all opportunities for operational implementation of reclamation activities.

5.3.5 Minimize long-term activities

Ideally there should be no ongoing intervention or operating activities after completion of mine reclamation and closure activities, other than periodic inspections and minimal maintenance. Reliance on the long-term use of active effluent collection and treatment facilities to meet the water quality objectives should be avoided wherever possible. While "passive" water treatment methods are preferred over active water treatment due to their lesser requirements for long-term operations, they must be capable of achieving water quality standards on a consistent and long-term basis, and they usually also require periodic maintenance.

5.3.6 Plan for long-term monitoring and maintenance

Anthropogenic structures (e.g., dams, diversions, waste rock dumps, spillways, covers and passive treatment facilities) require long-term monitoring and maintenance. RCPs should describe proposed long-term monitoring and maintenance activities, and should not focus on complete walk-away plans.

5.3.7 Adaptive management is not a reclamation plan

Adaptive management is an important approach for addressing uncertainty about reclamation and closure outcomes, but it must not be the basis for management of the project. RCPs must identify robust methods for achieving reclamation and closure objectives. Where uncertainty remains about performance, adaptive management plans should clearly describe the decision-making processes that will be undertaken to continually achieve objectives. For each area of uncertainty or triggering event, an adaptive management plan should clearly identify indicators, monitoring, thresholds and specific response actions.

5.4 Principles for Estimating Liability

There are several global principles that apply to estimating reclamation and closure liability for mining projects in Yukon. These principles should be considered in preparing all liability estimates. Annex 2 of this document provides additional detail on preparing liability estimates for mining projects.

5.4.1 Include all reclamation and closure stages

Liability estimates must address all costs associated with reclaiming and closing the mine project. For example, this includes costs for activities that will be undertaken during progressive reclamation, transitional care and maintenance, reclamation implementation, adaptive management, long-term operations and post-closure monitoring and maintenance.

5.4.2 Assume proponent does not implement reclamation and closure

Liability estimates must assume that all reclamation and closure activities are undertaken by a third party and that none of the proponent's equipment or operational resources are available for conducting the activities.

5.4.3 Mobilization/demobilization costs

Consistent with the assumption that the proponent's equipment and resources may be unavailable to conduct reclamation and closure activities, appropriate mobilization and demobilization costs must be included in liability estimates.

5.4.4 No credit for salvage of on-site resources

The removal of buildings and other fixed infrastructure generally should be considered as a closure cost and therefore a liability at 100% of the cost of removal. There may be circumstances where this liability amount could be reduced. For example, the buildings or equipment may be subject of a lien or some other arrangement where its removal at no cost to government in the event of a mine closure can be documented. Any such discounting of liability would require firm and clear documentation. Whether or not the liability can be reduced, it is a general rule that no financial security will be accepted by the Yukon government for "salvage value" of the assets.

5.4.5 Liability is not eliminated by completion of reclamation activities

Completion of progressive reclamation or other reclamation activities does not immediately equate to elimination of liability. Monitoring must demonstrate that reclamation activities are effective before liability can be reduced.

6.0 Guidance, Best Management Practices and Policy Documents

The following documents can provide further guidance to support preparation of RCPs.

Byer, Dr. Phillip H. et al. for Canadian Environmental Assessment Agency. 2011. Decision Making under Uncertainties for Adapting to Climate Change in Project Environmental Assessments.

Canadian Council of Ministers of the Environment. Canada Wide Standards.

Canadian Council of Ministers of the Environment. Canadian Water Quality Guidelines for the Protection of Aquatic Life.

Canadian Dam Association. Dam Safety Guidelines.

Coastech Research Inc. for Canmet MSL Division, 2008. MEND Project 1.16.1b, June 2008 Electronic Revision. Acid Rock Drainage Prediction Manual.

Dawson, R.F., AGRA Earth & Environmental Limited and K.A. Morin, Morwijk Enterprises Ltd., 1996. MEND Report 1.61.2, July 1996. Acid Mine Drainage in Permafrost Regions: Issues, Control Strategies and Research Requirements.

Golder Associates, Dec 2011. Guidance Document on Water and Mass Balance Models for the Mining Industry.

International Network for Acid Prevention, 2009. Global Acid Rock Drainage (GARD) Guide.

Mining Association of Canada, 1998. A Guide to the Management of Tailings Facilities.

Mining and Petroleum Environment Research Group, 2012. Yukon Revegetation Manual: Practical Approaches and Methods.

Ministry of Energy, Mines and Petroleum Resources (B.C.), 1991. Operation and Monitoring of Mine Dumps – Interim Guidelines.

Ministry of Energy, Mines and Petroleum Resources (B.C.), 1991. Investigation and Design of Mine Dumps: Interim Guidelines.

Ministry of Energy Mines and Petroleum Resources (B.C.), 1995. Mined Rock and Overburden Piles Consequence Assessment for Mine Waste Dump Failures.

Northern Climate Exchange, Yukon Research Centre. 2011. Compendium of Yukon Climate Change Science. 2003-2011.

Okane Consultants Inc. July 2012. MEND Report 1.61.5c, 2012. Cold Regions Cover System Design Technical Guidance Document.

Price, William A., Canmet Mining and Mineral Sciences Laboratory, 2009. MEND Report 1.20.1, Dec. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials.

Stratos Inc. and Brodie Consulting. 2011. MEND Report 1.61.7. Climate Change and Acid Rock Drainage – Risks for the Canadian Mining Sector.

Yukon Government, 2006. Yukon Mine Site Reclamation and Closure Policy Technical Guidelines.

Yukon Government, 2008. Yukon Mine Site Reclamation and Closure Policy, Financial and Technical Guidelines.

Yukon Government, yet to be published. Guidelines for Reclamation and Closure Plans: Contingency Held Amounts for Cost Uncertainties and Equipment Unit Rates.

Yukon Government and Yukon Environmental and Socio-economic Assessment Board, Feb. 2012. Dam Guide, Design Expectations and Required Information.

ANNEX 1: ANNOTATED OUTLINE FOR RECLAMATION AND CLOSURE PLANS

Annex 1

Annotated Outline for Reclamation and Closure Plans

This annotated outline provides a suggested table of contents for a RCP and describes the information that may be included in each proposed section. Because this guide provides direction for a variety of mine types, not all sections will be relevant to every mining project. Also, some relevant components may not be included for certain sites and circumstances. Each RCP for a mine site must describe the closure planning processes, reclamation and closure objectives, environmental conditions, site conditions, temporary closure measures, final closure measures, reclamation and closure schedule, and execution strategies that are relevant for the specific site and circumstances. All relevant mine components, activities and appurtenant undertakings must be addressed in sufficient detail to demonstrate expected performance and allow for accurate estimates of liability.

Contents

1.0 Introduction

Provide a brief project summary including the closure philosophy and guiding principles for the reclamation and closure plan (RCP). Summarize the project schedule from the current status through to completion of reclamation and closure.

2.0 Reclamation and Closure Planning

Summarize the processes and approaches used to develop the RCP.

Describe the sequence and phases of reclamation and closure planning for the mine, and where this RCP fits in a continuum of reclamation and closure planning. Identify the extent of additional research, planning and design required to complete a final, detailed plan ready for construction.

Describe processes for integrating reclamation and closure planning into development and operational decision-making.

Summarize reclamation research completed to date. Include results from reclamation research programs as appendices if appropriate. Provide a summary of any plans for additional reclamation research. Include a detailed reclamation research plan as an appendix if appropriate.

Summarize community (e.g., governments, local communities, regulatory agencies and non-government organizations) engagement activities undertaken to support the development of the RCP.

Describe methods used to identify, characterize, evaluate and select closure alternatives. Include descriptions of specific tools like risk assessment, failure modes effects analysis, multi-attribute analysis, etc. that were applied, and why these approaches were selected.

3.0 Closure Objectives and Design Criteria

3.1 Reclamation and Closure Objectives

Describe specific reclamation and closure objectives, including objectives that meet or exceed the fundamental objectives described in Section 5.1 of this guide. Describe any constraints to achieving the fundamental objectives.

Provide rationales for selection of specific objectives. Describe how the objectives address community (e.g., governments, local communities, regulatory agencies, and non-government organizations) expectations.

3.2 Design Criteria

Provide the design criteria that guide the design for the reclamation and closure activities, including project constraints, regulatory and guidance-based criteria and other criteria. These are the criteria that will define the effectiveness of the design.

Identify and describe design criteria for all components of the project and RCP, recognizing that criteria may vary depending on risks associated with specific components or processes. Include rationales for selection of all criteria. Where criteria are developed in accordance with regulatory requirements or guidance documents, rationales must clearly demonstrate how the proposed criteria meet these requirements or guidance.

Design criteria must be supported with data and analyses that quantify the criteria for the site. For example, summarize seismic analysis, flood-frequency analysis and site-specific water quality analysis. Provide detailed reports as appendices.

Some common types of criteria that are normally reflected in a RCP are identified below with key reference documents included:

- Geotechnical criteria – seismic design events, factors of safety, slope angles, material strengths and seepage rates. Include hazard classification for all dams and the rationale for the classification. ("Dam Safety Guidelines." "Operation and Monitoring of Mine Dumps – Interim Guidelines." "Interim Guidelines for Investigation and Design of Mine Dumps.")
- Hydrologic criteria – flood design events, inflow hydrographs, erosion control, sediment removal, freeboard, flood routing capacity, emergency water storage capacity. ("Dam Safety Guidelines.")
- Tailings storage conditions – constraints on tailings storage; e.g., saturated, unsaturated, etc. ("Guidelines for Metal Leaching and Acid Rock Drainage at mine sites in British Columbia." "Prediction Manual for Drainage Chemistry from Sulphidic Geological Materials.")
- Water quality criteria – identify contaminants of concern and proposed water treatment, discharge and receiving water quality criteria. ("Canadian Water Quality Guidelines for the Protection of Aquatic Life." "Guidelines for Metal Leaching and Acid Rock Drainage at mine sites in British Columbia." "Prediction Manual for Drainage Chemistry from Sulphidic Geological Materials.")

- Climate change – scenarios that will be addressed for changing climatic conditions, recognizing the long-term performance requirements for reclamation and closure. ("Compendium of Yukon Climate Change Science. 2003-2011.")
- Re-vegetation criteria – describe criteria that will be used to evaluate effectiveness of re-vegetation activities

4.0 Environment Description

Summarize environmental conditions for areas that are, or will be, affected by the mine. This should include footprint areas as well as environmental components that will be affected (e.g., watersheds, airsheds – the geographical area affected by air from the mine site, wildlife ranges). Address both pre-disturbance and existing conditions and include descriptions of relevant reference areas. Provide references for supporting data and analyses that demonstrate a suitable understanding of site-specific environmental conditions.

While the "Environment Description" and the "Site and Mine Plan Description" are addressed as separate sections in this outline, it may be more effective for some RCPs to combine these descriptions, especially for sites that are already under development. With either approach, it will be important to characterize both pre-development and current conditions.

4.1 Climate

Describe climate conditions at the site, including but not limited to temperature, rainfall, snowfall, snow accumulation and evaporation. Describe the climate change scenarios that will be considered in designing closure features.

4.2 Surface Water

Describe the hydrology of the site including high, low and mean flows for various seasonal conditions. Describe the water quality in water courses affected by mining, including the seasonal variability. Identify contaminants of concern as well as any parameters that may be appropriate indicators.

4.3 Groundwater

Describe the groundwater conditions at the site, including a summary of elevations, flow directions, permeabilities, water quality, and interactions with surface water.

4.4 Vegetation and Wildlife

Describe the vegetation and wildlife in the area. Characterize species distributions and habitats.

4.5 Soil and Bedrock

Describe soil and bedrock conditions, including both surface and subsurface conditions. Summarize the site data from geotechnical testing, site investigation programs, and overburden investigations. Include a discussion of the geology of the area, including geomorphic features, bedrock composition and thermal conditions.

4.6 Seismicity

Summarize seismic hazard conditions for the project site.

5.0 Project Description

Provide a description of the project that includes the project location, history of the site, mining activities, and the operational phases. Describe the facilities and features that have already been constructed and the activities that have been undertaken. Also describe facilities, features and activities that are proposed as part of the mine plan and provide a schedule for their completion. Descriptions of all facilities and features should include both narratives and design drawings showing plan views, layouts, cross-sections and profiles. For the purpose of liability estimates, discrete descriptions are required for current, two-years forward, and end-of-mine conditions.

5.1 Mine Features, Facilities and Equipment

Provide detailed descriptions of mine features, facilities and equipment for current, two-years hence and end-of-mine conditions. This should include information on the quantity and size of all components with narrative descriptions and/or design drawings showing plan views, layouts, cross-sections and profiles. Descriptions require sufficient detail to estimate reclamation and closure liability for all mine components.

Provide maps and drawings, at appropriate scales and contours for the information displayed, showing all features and facilities identified in the mine plan, including related and off-site facilities that are associated with the mine plan or reclamation. The maps should include, or be accompanied by, information about each feature such as area, volume, tonnage, slope angles, and other dimensions as needed to quantify reclamation and closure tasks.

Describe mine-related land disturbance in detail, to accompany and explain the information provided on maps and drawings. Describe any current or potential stability issues or other issues affecting on-site features and facilities.

5.2 Mining Operations

Describe the mining operations including rates, types of equipment, processing, metal recovery, material segregation, hauling, waste disposal, tailings disposal, heap

leaching, concentrate storage, etc. Describe how mining activities and decisions have considered reclamation needs. Quantify mining activities that have occurred as well as those that are proposed within the next two years, and by the end-of-mine.

5.3 Water Management

Describe the current and proposed management of surface water and groundwater at the site. Include narratives and design drawings for all water management facilities and activities including diversions, ponds, intake structures, dams, storage facilities, pumps, water collection wells, sumps, pipelines, etc. Describe management of solutions used for processing or metal recovery. Address quantities, flow rates and paths, quality, storage requirements, groundwater/surface water interactions, etc.

Characterize geochemical effects associated with mining activities. Describe results from monitoring and testing programs. Provide predictions of geochemical loading and effects from mine-related sources, using appropriate modeling tools (e.g., water balance models, groundwater models, contaminant load models, conceptual site models). Modeling tools should be of sufficient granularity to evaluate seasonal conditions.

Describe water treatment operations and facilities, including the types of processes used (physical, chemical, biological), nominal and maximum capacity, maintenance and availability requirements, and any unique or special operating features. If the water treatment system is currently operating, provide monitoring results to demonstrate performance. If the treatment system is proposed, describe the results of water treatment testing programs that demonstrate performance of the proposed treatment methods for site-specific water quality, flow rate, climate and receiving environment conditions.

5.4 Monitoring

Describe monitoring activities and results, including monitoring schedules and analytical requirements for surface water quality and flow, groundwater quality and flow, physical stability, vegetation, wildlife and air.

5.5 Risk Assessment, Contingency Planning and Adaptive Management

Describe any risk assessment or contingency planning processes undertaken to support decision making for mine development and operations. Include risk assessment results or contingency plans as appendices as appropriate.

Provide details about any adaptive management plans that are being implemented to address uncertainties about mine development or operation.

6.0 Temporary Closure

Temporary closure – closure in which mining related activities cease, with the intent of resuming activities in the near future – can present unique challenges for mining projects. Most frequently, these challenges relate to water management issues that arise when ongoing operations cease and the level of active site management decreases. Conditions and durations for temporary closure may be specified in a WL or QML.

The Temporary Closure Plan section of a RCP must describe the measures and activities that will be undertaken in the event of a temporary closure. During any temporary closure, facilities on site must remain substantially intact and maintained in good working order. Site maintenance and monitoring and reporting must continue uninterrupted throughout temporary closure. In the event of an unplanned temporary closure, a full review of the RCP as well as the liability estimate and security may be undertaken. This review will consider any increases in liability associated with the temporary closure, or costs incurred for implementing the temporary closure.

While the fundamental and site-specific reclamation and closure objectives are relevant to temporary closures, there are some key objectives that are paramount during temporary cessations of operations. In general, temporary closure plans must focus on ensuring public health and safety, protecting the environment and managing risks associated with potential abandonment of a site. To demonstrate how these objectives will be achieved, each temporary closure plan must include at a minimum the following information.

6.1 Site Security, Monitoring and Maintenance

Describe the locations where equipment will be stored, storage methods for chemicals, reagents and fuel, and how infrastructure will be maintained during temporary closure.

Summarize the ongoing monitoring and maintenance activities that will be required and any processes that will be used to make decisions about these requirements. Provide an environmental monitoring, management and reporting plan that will be implemented to ensure that the site remains secure and stable, and to demonstrate that the site continues to meet performance expectations.

Describe how site access will be restricted, the onsite security that will be in place, how access to open pits and underground working will be restricted, and how buildings and infrastructure will be secured.

Describe how all landfills, waste management areas, tailings facilities, ore stockpiles, heap leach pads, and impoundments will be geochemically and physically stabilized and secured. Describe how increased durations of exposure during temporary closure

may affect acid rock drainage or metal leaching predictions for ore or waste materials. Describe measures that will be taken to minimize exposure of susceptible materials.

Quantify labour, materials, energy, and other requirements to conduct temporary closure activities and provide details that will be required to estimate costs of temporary closure activities.

6.2 Interim Water and Solution Management Plan

Describe plans for the management of clean water, contaminated water, and process solutions during any temporary closure.

Describe water and solution management processes, protocols and activities including managing water levels in open pits, underground workings, tailings impoundments, heap leach pads, pregnant and barren solution ponds, storm water ponds, or other water holding, conveyance or treatment facilities on-site. Include a description of ongoing water treatment processes and management of discharge streams.

Include descriptions of the facilities and processes for conveyance of clean water through or around the site, including their maximum capacities. Address any special requirements for maintaining or operating these during temporary closures.

Provide flow diagrams and drawings for water management programs including control or shut off switches for all tanks, pumps, pipelines, and ponds. Include an equipment list of essential fluid management system components and describe spare parts and back-up systems that will be maintained on site.

Provide schedule of water management activities to be undertaken during periods of temporary closure. Describe inspections needed to ensure suitable water and solution management performance and outcomes.

Provide an emergency fluid management protocol that includes by-pass procedures if over-topping of water holding facilities may occur, and by-pass or containment procedures if water treatment facilities are damaged or unable to keep up with demand.

7.0 Final Reclamation and Closure Measures

The Final Reclamation and Closure Measures section of the RCP should provide details on proposed reclamation and closure for all components of the mine site. Each section should describe the disturbance on site, the proposed closure methods, and alternative closure options associated with that closure aspect. Provide designs and detailed descriptions for reclamation and closure measures and activities that will be undertaken for all mine features and facilities.

Describe what will be done to achieve the reclamation and closure objectives and meet the design criteria. Provide sufficient detail and supporting analyses to demonstrate how the proposed measures and activities will meet the performance expectations.

Also provide sufficient detail to support accurate estimates of reclamation and closure liabilities. A table that shows the total area of disturbance for all project components must be provided, addressing current, two-years forward, and end-of-mine conditions.

Identify and describe any alternatives that were considered for reclamation and closure of specific mine components or to address specific issues. Provide details about the characterization, evaluation and selection of alternatives, including the use of tools like risk assessment, failure modes effects analysis, multi-attribute analysis, etc. Describe the benefits and drawbacks associated with the alternatives and provide rationale for the options selected.

7.1 Underground Workings and Openings to Surface

The objective for closure of underground workings and openings to surface is to meet water quality objectives, prevent inadvertent or intentional underground access, and prevent subsidence or other changes in the topography that may result in a hazard to humans and wildlife. *For underground workings and openings to surface, RCPs should contain the following information.*

Describe how all surface openings to underground workings (raises, shafts, excavations, tunnels, chutes) will be blocked utilizing a suitable method as designed by a qualified professional engineer and capped to meet requirements specified in the Occupational Health and Safety Regulations of the *Occupational Health and Safety Act*.

Where there is a demonstrated risk, and potentially significant consequence, that mine water pressures are likely to build to dangerous levels, describe how long-term drainage of excess mine water will be achieved.

Describe long-term water management for underground workings. Identify expected long-term water levels, and describe any management requirements for discharge. Quantify any potential discharges including those to both surface and groundwater. Characterize interactions between underground workings and local groundwater. Provide predictions of underground water quality, based on monitoring data and geochemical analyses. Describe water treatment requirements associated with long-term drainage or water management from underground facilities. Identify any contingency treatment facilities to address uncertainty about water quality or underground water levels. Provide predictions of water quality, based on monitoring data and site-specific testing programs. Include predictions of loading to receiving water, using water quality and contaminant loading models.

Provide stability analyses for underground workings and demonstrate how workings are designed to minimize any surface expression of underground subsidence. Describe any underground support structures that are to remain in place to provide long-term structural stability. Provide analysis to demonstrate how the support structures will sustain anticipated loads for the long term, including static and dynamic loading. Stability calculations must be based on current standards and designs certified by qualified professional engineers must be provided.

Identify areas where safety issues may arise, and describe how access to areas of unsafe drop-offs will be blocked and notices will be appropriately posted. Include measures to address requirements of the Occupational Health and Safety Regulations as set out in the *Occupational Health and Safety Act*.

If underground backfill will be used, describe how the mine workings will be backfilled, what materials will be used, and the timing of the backfill. Include a description of any material or equipment that will be left underground and how it will be decontaminated. Provide schematics of underground workings, including ramps, adits and other openings to surface and any remaining related structures, equipment or materials to be left in place.

Describe reclamation and re-vegetation activities that will be taken at any surface openings.

7.2 Open Pits

The performance targets for closure of open pits are to meet water management objectives, protect humans and wildlife from topographic hazards, and prevent subsidence. For open pits, RCPs should contain the following information.

Provide stability analyses for pits and describe any measures to stabilize open pits, including any re-sloping, grading, buttressing, etc. Provide designs to demonstrate expected performance. Stability analysis reports may be provided in appendices.

Describe any pit backfilling, including quantities and types of materials, handing and transportation methods, placement methods, and criteria for final fill. If pits will be left to fill with water, prepare a pit water balance that predicts pit filling conditions and timing.

Identify areas where safety issues may arise, and describe how access to areas of unsafe drop-offs will be blocked and posted appropriately. Include measures to address requirements of the Occupational Health and Safety Regulations as set out in the *Occupational Health and Safety Act*.

Provide predictions of pit water quality based on monitoring data, operational uses of the pit and materials stored in pits. Address both transitional and long-term water quality. Provide a characterization of interactions between pits and local groundwater. Include groundwater model reports as appendices. Describe water treatment requirements associated with pit water, for both transitional and long-term conditions. Describe transitional and long-term management of pit water including both water levels and water quality based on monitoring data and site-specific testing programs. Include long-term predictions of loading to receiving water, using water balance analysis and contaminant loading models. Address water storage requirements for both normal and emergency circumstances, and identify conditions in which pit storage may be used for site water management. Quantify any potential discharges including those to both surface and groundwater.

Provide designs for surface water management and sediment control facilities at pits and infrastructure including layout, sizing, material and construction specifications, and erosion control.

Describe reclamation and re-vegetation activities for pit areas. Provide details about landscape design, describing how the area will provide long-term ecosystem services once mine activities are complete.

7.3 Heap Leach Pads and Process Ponds

The performance targets for closure of heap leach facilities are to effectively control transitional solution management and draindown, achieve suitable final heap quality conditions, and ensure long-term physical stability. For heap leach pads and process ponds, RCPs should contain the following information.

7.3.1 Detoxification, Rinsing and Solution Management

Transitional stages between operations and final draindown present unique challenges for solution management at heap leach facilities. This section of the RCP should describe the management of process solutions beginning when ore loading ceases through to completion of draindown.

Describe proposed processes, sequences and scheduling for any residual leaching, rinsing, detoxification and/or neutralization of heap materials. The proposed processes should be supported by site-specific test work that demonstrates the effectiveness of proposed rinsing, detoxification and neutralization methods.

Provide a complete physical and chemical characterization of the residual heap leach materials, providing evidence that rinsing will be physically practical and can achieve neutralization. Include predictions of water quality from the heap leach pad, based on

monitoring data, and/or site-specific testing programs. Include long-term predictions of loading to receiving water, using water quality and contaminant loading models.

Identify water quality criteria that will be used to start and end rinsing, detoxification and/or neutralization activities.

Provide a solution management plan that describes expected flows, storage and handling of process and rinsing solutions. Describe the water balance for the heap leach facility, including leaching and rinsing sequences, areas and volumes of ore under leach/rinse, application rates, and percolation characteristics of the ore. Provide test results to demonstrate ore performance at the neutralization stage, considering multiple leach cycles and full heap depth. Describe the overall solution storage capacity, and how the capacity will be used during detoxification, rinsing and draindown. Include the sequence and plan for final draindown of the heap leach facility, considering the total quantity of solution, expected draindown rate, and the capacity of proposed water treatment systems. Provide designs for the pumping and piping facilities for conveying leach solution to and from the heap leach pad, including layout and sizing.

Describe water treatment processes that will be used during rinsing, detoxification and post-closure. Provide as appendices the results of water treatment test programs that demonstrate expected performance of treatment systems. Provide designs for water treatment facilities including flow sheets, sizing, capacities, process controls, containment systems, reagent use and discharge conditions. Describe amounts and characteristics of any water treatment sludge and provide designs for containment facilities/approaches, both temporary and permanent. Describe scheduling for construction of water treatment facilities, including any variations or additions that may be required for specific closure phases.

7.3.2 Physical Stability and Reclamation

Describe the results of stability analyses for the heap leach pad and any reclamation measures required to meet long-term stability requirements. Analyses must be supported by site-specific sampling and testing of materials, providing realistic and defensible material strengths and properties. Provide stability analyses and design reports as appendices.

Provide designs for cover systems that will be used for heap leach pads. Include detailed descriptions and specifications for proposed covers and provide modeling to demonstrate how the proposed covers will achieve infiltration criteria, to support water balance and contaminant load modeling. Identify materials and sources for cover construction. Describe any proposed re-grading of heap surfaces.

Provide designs for surface water management and sediment control facilities and infrastructure for heap leach pads, including layout, sizing, material and construction specifications, and erosion control.

Describe how liner systems for heap leach pads and process ponds will be decommissioned. Demonstrate measures to ensure that liners do not remain as long-term containment facilities unless designed for this purpose.

Identify areas where safety issues may arise, and describe methods for addressing safety issues by reclamation, controlling access or posting notice.

Describe reclamation and re-vegetation activities for heap leach pads and pond areas. Provide details about landscape design, describing how the area will provide long-term ecosystem services once mine activities are complete.

7.4 Tailings Facility Areas

The performance targets for reclaiming tailings are to ensure physical and chemical stability, avoid unacceptable release of contaminants to the receiving environment, and avoid risks to humans and wildlife. The type of information required in RCPs for tailings facilities will vary depending on the type of storage used at each site (e.g., slurry tailings impoundments, dry-stacks, in-pit storage, and underground storage) The tailings facilities section of the RCP should include the following information as appropriate for the tailings storage methods at the site.

Describe the materials that will be contained in any tailings facilities on site, including sample selection, mineralogical analyses, static testing, and kinetic testing. Also describe the water quality and quantity conditions associated with the tailings, including porewater, seepage and runoff. Provide results of monitoring and site-specific testing programs. Include long-term predictions of loading to receiving water, using water quality and contaminant loading models. Describe the results of stability analyses for tailings facilities and any reclamation measures required to meet long-term stability requirements. Analyses must be supported by site-specific sampling and testing of materials, providing realistic and defensible material strengths and properties. Provide supporting reports for characterization of tailings conditions as appendices.

Provide designs for covers that will be used to reclaim tailings surfaces. Include detailed descriptions and specifications for proposed covers and provide modeling to demonstrate how the proposed covers will achieve infiltration criteria, to support water balance and contaminant load modeling. Identify any requirements for water covers, saturation of tailings materials, or maintenance of dry tailings, and provide designs for achieving these outcomes.

Provide detailed designs for the closed tailings facility, along with management approaches for long-term maintenance and monitoring. Describe how the proposed

closure measures will achieve the overall closure objectives. Identify specific design components and operational requirements that will affect or constrain closure options. Include the results of stability analyses for any proposed upgrades or changes to tailings facilities and any reclamation measures required to meet long-term stability requirements.

For any permanent structures that will remain as part of a tailings facility, describe long-term care and maintenance activities required to ensure the integrity of the tailings facility.

Describe any tailings relocation activities, including where the tailings will be placed, how they will be moved, and reclamation requirements for both existing and new storage locations. Identify any water management implications of tailings relocation and describe how these have been incorporated into water management strategies

Describe water treatment requirements associated with tailings storage facilities and locations including surface water, seepage, and groundwater. Identify any contingency treatment facilities to address uncertainty related to tailings water quality or flows. Provide predictions of seepage, runoff and groundwater quality, based on monitoring data and site-specific testing programs. Include long-term predictions of loading to receiving water, using water balance analysis and contaminant loading models.

Describe the requirements for surface water management for tailings areas including transitional and long-term surface water management and sediment control. Provide designs for surface water management and sediment control facilities and infrastructure, including layout, sizing, material and construction specifications, and erosion control. Include descriptions and diagrams of the pipelines, diversion ditches, spillways, and seepage recovery systems, including those that will be removed or decommissioned at closure and those that will remain permanently.

Identify areas where safety issues may arise, and describe methods for addressing safety issues by reclamation, controlling access or posting notice.

Describe reclamation and re-vegetation activities for tailings areas. Provide details about landscape design, describing how the area will provide long-term ecosystem services once mine activities are complete.

7.5 Waste Rock and Overburden Dumps

The performance targets for reclaiming waste rock and overburden dumps are to ensure physical stability, avoid unacceptable release of contaminants to the receiving environment, and avoid risks to humans and wildlife. Proposed reclamation and closure methods should demonstrate how the principle of source control has been addressed. For waste rock and overburden dumps, RCPs should contain the following information.

Describe the materials that will be contained in each waste rock and overburden storage facility on site, including sample selection, mineralogical analyses, and the results of other testing programs. Also describe the water quality and quantity conditions associated with the waste rock and overburden materials including porewater, seepage and runoff. Provide results of monitoring and site-specific testing programs. Include long-term predictions of loading to receiving water, using water quality and contaminant loading models.

Describe the results of stability analyses for the waste rock and overburden dumps, and any reclamation measures required to meet long-term stability requirements. Analyses must be supported by site-specific sampling and testing of materials, providing realistic and defensible material strengths and properties.

Describe proposed reclamation methods for waste rock and overburden dumps, including re-grading, covering and re-vegetation. Include figures and drawings that show plan views, layouts, cross-sections and profiles. Describe how the proposed closure measures will achieve the overall closure objectives. Also provide designs for covers that will be used for waste rock and overburden materials. To support water balance and contaminant load modeling, include detailed descriptions and specifications for proposed covers and provide modeling to demonstrate how the proposed covers will achieve infiltration criteria. Identify materials and sources for cover construction. Identify any requirements for water covers, saturation of waste materials, or maintenance of dry conditions, and provide designs for achieving these outcomes.

Describe any waste rock or overburden relocation activities, including where the materials will be placed, how they will be moved, and reclamation requirements for both existing and new storage locations. Identify any water management implications of waste relocation and describe how these have been incorporated into water management strategies, water balance and contaminant load predictions.

Describe water treatment requirements associated with waste rock and overburden storage facilities and locations, including surface water, seepage, and groundwater. Identify any contingency treatment facilities to address uncertainty related to waste rock and overburden water quality or flows. Provide predictions of seepage, runoff and groundwater quality, based on monitoring data and site-specific testing programs. Include long-term predictions of loading to receiving water, using water balance analysis and contaminant loading models.

Provide designs for any contaminated water collection and conveyance facilities, including details about how the designs have addressed foundation conditions and requirements for long-term performance if needed.

Describe the requirements for surface water management for waste rock and overburden areas including transitional and long-term surface water management and sediment control. Provide designs for surface water management and sediment control facilities and infrastructure including layout, sizing, material and construction specifications, and erosion control. Include descriptions and diagrams of the pipelines, diversion ditches, spillways, and seepage recovery systems, including those that will be removed or decommissioned at closure and those that will remain permanently.

Identify areas where safety issues may arise, and describe methods for addressing safety issues by reclamation, controlling access or posting notice.

Describe reclamation and re-vegetation activities for waste rock and overburden areas. Provide details about landscape design, describing how the proposed design will provide long-term ecosystem services once mine activities are complete.

7.6 Ore Stockpiles and Pads

The performance targets for reclaiming ore stockpiles and pads are the same as those for waste rock and overburden dumps – to ensure physical stability, avoid unacceptable release of contaminants to the receiving environment, and avoid risks to humans and wildlife. Ore stockpiles and pads present additional challenges due to increased potential for contaminant release because these materials contain higher concentrations of contaminants of concern. Concentrate storage areas may also need to be considered. Proposed reclamation and closure methods should demonstrate how the principle of source control has been addressed.

Current and two-year forward status, size and reclamation requirements for ore stockpiles are particularly important because the liabilities for these facilities can be larger during operations than at planned mine closure. The RCP must quantify these materials for current and interim periods. For ore stockpiles and pads, RCPs should contain the following information.

Describe the materials that will be contained in each ore stockpile or the remaining pads. Include details about sample selection, mineralogical analyses, and the results of other testing programs. Provide predictions of seepage, runoff and groundwater quality, based on monitoring data and site-specific testing programs. Include long-term predictions of loading to receiving water, using water balance and contaminant loading models.

Describe any plans for milling of ores stockpiles and the costs associated with the milling activities. Provide test work that demonstrates feasibility of milling the materials.

Provide designs for any re-grading, covering and re-vegetation of ore stockpiles or pads. Include figures and drawings that show plan views, layouts, cross-sections and profiles. Describe how the proposed closure measures will achieve the overall closure objectives.

Provide designs for covers that will be used for ore stockpiles and pads. Include detailed descriptions and specifications for proposed covers and provide modeling to demonstrate how the proposed covers will achieve infiltration criteria. Identify materials and sources for cover construction. Performance of covers should be incorporated into water balance and water quality modeling, to predict long-term contaminant effects. Identify any requirements for water covers, saturation of ore materials, or maintenance of dry conditions, and provide designs for achieving these outcomes.

Describe ore stockpile relocation activities, including where the materials will be placed, how they will be moved, and reclamation requirements for both existing and new storage locations. Identify any water management implications of stockpile relocation and describe how these have been incorporated into water management strategies.

Describe the requirements for surface water management for ore stockpile areas, including transitional and long-term surface water management and sediment control. Provide designs for surface water management and sediment control facilities and infrastructure including layout, sizing, material and construction specifications, and erosion control. Include descriptions and diagrams of the pipelines, diversion ditches, spillways, and seepage recovery systems, including those that will be removed or decommissioned at closure, and those that will remain permanently.

Describe water treatment requirements associated with ore stockpiles and pads, including surface water, seepage, and groundwater. Identify any contingency treatment facilities to address uncertainty related to ore stockpiles water quality or flows. Provide predictions of seepage, runoff and groundwater quality based on monitoring data and site-specific testing programs. Include long-term predictions of loading to receiving water, using water balance analysis and contaminant loading models.

Describe reclamation and re-vegetation activities for ore stockpile areas. Provide details about landscape design, describing how the area will provide long-term ecosystem services once mine activities are complete.

7.7 Water Management Structures and Systems

Water management structures include structures for collection, conveyance and storage of water. Water management systems include the plans for managing all types of water at the site including surface water, ground water, seepage, runoff, etc. The key performance targets for reclamation and closure water management are to ensure stable drainage at, and adjacent to, the site for a variety of climatic conditions, to ensure physical stability, and to avoid unacceptable release of contaminants to the receiving environment. Proposed reclamation and closure methods should demonstrate how principles of keeping clean water clean and minimizing long-term maintenance have been addressed. Water management requirements will likely vary significantly for different reclamation and closure phases. For example, sediment and erosion control will be most challenging during reclamation activities. Water management requirements for all phases must be addressed in the RCP. For water management structures and systems, RCPs should contain the following information.

Provide detailed geotechnical and hydraulic designs for all water management structures and facilities including dams, diversions, ponds, passive treatment systems, spillways, collection systems, etc. Include designs for any upgrades or changes required during reclamation and closure. Demonstrate how the proposed facilities meet the design criteria.

Describe the results of stability analyses for the water management structures, and any reclamation measures required to meet long-term stability requirements. Analyses must be supported by site-specific sampling and testing of materials, providing realistic and defensible material strengths and properties. Analyses should also address permafrost conditions and long-term performance.

Provide an overall water management plan that addresses surface water, groundwater and seepage, the management of clean water and contaminated water, water treatment requirements, and sediment and erosion control. This management plan must address regular conditions, flood events, and low-flow events. Provide description and diagrams of closure period water management processes and protocols. Include decision diagrams if relevant.

Provide designs for any contaminated water collection and conveyance facilities, including the location and capacity of water collection wells, pumps, slurry walls, pipelines, etc. Describe how these facilities will operate in a variety of climatic and flow conditions.

Describe treatment systems that will be used during reclamation implementation or long-term closure to address contaminated water from all sources at the site. Provide results of water treatment test programs that demonstrate expected performance of treatment systems, whether passive or active. Provide designs for water treatment facilities, including flow sheets, sizing, capacities, process controls, containment systems, reagent use and discharge conditions. Describe amounts and characteristics of any water treatment sludge and provide designs for containment facilities/approaches, both temporary and permanent. Describe scheduling for construction of water treatment facilities, including any variations or additions that may be required for specific closure phases.

Describe the requirements for overall site surface water management, including transitional and long-term surface water management and sediment control. Provide designs for surface water management and sediment control facilities and infrastructure including layout, sizing, material and construction specifications, and erosion control. Include descriptions and diagrams of the pipelines, diversion ditches, spillways, and seepage recovery systems, including those that will be removed or decommissioned at closure and those that will remain permanently.

Describe long-term monitoring and maintenance requirements for water management structures that will remain on site (e.g., dams, diversions). Describe the role of professional engineers in the long-term management of these structures. If dams will be removed, provide detailed designs for dam removal. Dams that are to remain in place must meet the provisions of the Canadian Dam Safety Guidelines and must be certified by a qualified professional engineer with respect to their long-term physical and chemical stability.

Describe proposed methods for reclaiming and closing any water storage, water treatment or process ponds on site. Characterize any sediments remaining in the ponds (e.g., ABA, ICP-MS, XRD, TCLP, SWEP, etc.). Describe relocation or reclamation of sediments contained in ponds. Address any water management implications associated with pond or sediment reclamation.

All aspects of the water management plan should be based on the results of water balance analyses and contaminant load modelling. Provide an overall site water balance with at least a monthly time step that incorporates water balances from all major site components and predicts water deficits and surpluses. Provide an overall site contaminant load balance that integrates source loading from all mine related sources and predicts interactions with local groundwater and surface water. Document

or predict past, present or future predicted discharges from individual source facilities including location, volume, and water quality.

7.8 Mine Infrastructure

The performance objectives for reclamation and closure of mine infrastructure are to ensure physical stability, remove potential threats to public health and safety and provide for appropriate future land use. For mine infrastructure, RCPs should contain the following information.

Describe how mill and processing buildings and facilities will be dismantled and how the foundation will be removed. Describe plans for revegetation. Include details for the removal of processing equipment, presses, crushing and ore handling facilities, concentrate storage sheds and any other ancillary structures that are used in the milling process**.**

Describe how machinery, equipment, and storage tanks will be cleaned and removed from the mine site. Provide a list of all fixed and mobile equipment that will be removed from the site for sale or salvage.

Provide the proposed measures for reclamation and closure of buried support infrastructures (tanks, pipes, underground services, etc.). Provide detailed maps that show all buried foundations, equipment or infrastructure that will remain on site once mine reclamation activities are complete.

Describe how the camp will be dismantled, including how sewage treatment facilities, water supply wells, and pump houses will be decommissioned. Include the proposed measures for reclamation and closure of airstrips, power transmission lines, pipelines and railways.

Describe in detail how all landfills, land treatment facilities, and waste storage areas will be decommissioned and reclaimed. Provide a figure that shows the locations of all landfills and waste storage areas.

Describe how any power generation facilities, transmission towers and poles' right of way will be decommissioned and dismantled.

Describe reclamation and re-vegetation activities for infrastructure sites. Provide details about landscape design, describing how the area will provide long-term ecosystem services once mine activities are complete.

7.9 Hazardous Materials

The performance targets for hazardous materials are to eliminate risks to human and wildlife health and safety, avoid environmental contamination, and restore existing

contamination. For hazardous materials, RCPs should contain the following information.

Provide an inventory of hazardous materials on the site, including reagents, explosives, fuels, lubricants, etc. Include estimates of expected hazardous material quantities to be addressed during reclamation and closure and describe plans for completion of environmental site assessments to be conducted early in the reclamation and closure implementation phase to confirm quantities and types. Also provide estimates of hydrocarbon contaminated soils that will require reclamation, and provide designs and operation plans for any contaminated soil treatment facilities.

Describe how explosives, reagents and other hazardous materials will be removed from site and/or disposed of in an approved facility. Describe reclamation plans for operational storage areas and facilities.

Describe the investigation, reclamation and revegetation activities that will be required at all areas where fuel was stored. Include in this description how all waste fuel or unused fuel will be removed from the site.

7.10 Roads and Other Access

The performance targets for roads and access are to establish conditions that support future land use objectives, ensure public safety, and eliminate risks to wildlife while providing for long-term operations, monitoring and maintenance requirements. Decisions about site access should be made in conjunction with the community to ensure that access at closure meets community expectations. Unless otherwise agreed to by Yukon government and affected First Nations and other land users, all on-site roads, trails and access corridors shall be decommissioned, including the removal of bridges, culverts and pipes, ramps and landings at the mine site. For roads and other access, RCPs should contain the following information.

Describe access requirements for site operations, monitoring and maintenance, including any measures for control of access to the site during reclamation and closure, and the expected duration of any restrictions on access.

Provide a detailed description of methods and timing for reclamation of access roads, site roads, airstrips and other access. Include methods and timing for removal of bridges, culverts and drainage ditches, including re-establishment of streambeds. Provide designs for long-term erosion and sediment control, demonstrating how the closed facilities will handle flood events.

Describe scarification, re-grading, landscape design and re-vegetation activities, including areas where specific prescriptions will be applied. Identify any indicators that will be used to determine if revegetation is warranted.

Describe any measures to address specific requirements for reclamation of access that is subject to an easement, right of way or lease under the *Lands Act*. Also describe any specific reclamation requirements for access that is located on First Nation settlement land.

7.11 Borrow Materials Planning

Mine site reclamation usually relies heavily on borrow materials to achieve effective source control, meet future land use objectives, and meet hydraulic and geotechnical design criteria. Understanding borrow requirements and sources is critical to demonstrating the practicality and feasibility of the RCP. RCPs should contain the following information about borrow requirements and sources.

Provide a site wide compilation of borrow requirements for the RCP, identifying quantities, material specifications, and proposed locations for use.

Provide an inventory of available borrow materials (e.g., overburden, growth media, granular, rip-rap, low permeability), showing sources for the required borrow materials. Provide quantities and properties of available materials, including site-specific test work to demonstrate that the proposed sources will meet the required specifications and quantities. Provide detailed borrow source investigation reports as appendices.

Describe any measures that will be required to refine or amend borrow materials so that they will achieve specifications.

Mining activities often produce materials that can be used for implementation of reclamation works – e.g., overburden for covers. If mined materials are needed for reclamation activities, describe how the mine plan will be implemented to segregate appropriate materials and place them in easily accessible locations.

7.12 Monitoring and Maintenance

Monitoring, maintenance and reporting will be an important component of all RCPs. Monitoring and maintenance activities will vary for different stages of reclamation and closure, and specific requirements will often be specified in WLs and QMLs. Plans for monitoring and maintenance should address the principle that these activities will be required for the long term. The RCP should include a proposed maintenance, monitoring and reporting plan that addresses the following.

Describe maintenance and monitoring programs that will be undertaken during reclamation and closure. Monitoring may include water quality, water quantity, vegetation performance, terrestrial contamination, wildlife usage, physical integrity, air quality, etc. Include detailed schedules that describe monitoring locations, parameters, frequencies and analytical requirements. Describe how schedules may change during different stages of reclamation and closure, including any monitoring triggers for adjustments to monitoring locations, parameters or frequencies. Describe the access requirements for operation, maintenance, and monitoring.

Describe re-vegetation maintenance requirements and expectations. Fertilization, weed control, and replanting or additional planting schedules should be provided. Include cover repair activities and decision-making protocols for evaluating cover performance and making decisions about maintenance needs. Describe any constraints on expected cover life, especially for synthetic covers. Include measures and schedules for replacing or repairing covers.

Describe expected life for passive or active water treatment facilities, and measures and schedules for replacing or repairing those facilities.

Describe other site maintenance requirements such as storm water conveyances, water storage facilities, passive treatment facilities, and dams.

7.13 Performance Uncertainty and Risk Management

While the RCP must describe robust measures and demonstrate how those are expected to achieve the reclamation and closure objectives and design criteria, there are often uncertainties and risks that may lead to unacceptable performance outcomes. The RCP should identify and characterize key risks and uncertainties, and provide measures for addressing them where possible, while recognizing the reclamation and closure principle that adaptive management must not form the basis of the RCP.

7.13.1 Risk Assessment

Describe processes undertaken to identify and characterize risks associated with the site and the reclamation and closure plan. Describe how these processes have incorporated perspectives of various parties with different perspectives about mine related risks. Provide results of these risk assessment processes.

Describe mitigation measures and contingency plans established to address risks identified in the risk assessment.

7.13.2 Adaptive Management Plans

Describe any proposed adaptive management plans that are designed to address unexpected performance of the mine closure facilities and systems. To meet the intent of the "Type A and B Quartz Mining Undertakings, Information Package for Applicants" (Paragraph 5.11), adaptive management plans should provide: descriptions of specific events associated with uncertain performance, identification of appropriate indicators for measuring performance, detailed descriptions of monitoring requirements, definitions of specific thresholds for responding to unexpected performance, clear processes for evaluating monitoring results and comparing to thresholds, and descriptions of specific actions that will be taken in response the threshold exceedences. Decision diagrams should be included for adaptive management protocols.

8.0 Reclamation and Closure Schedule and Execution Strategy

The "Reclamation and Closure Schedule and Execution Strategy" section of the RCP describes when and how the reclamation and closure measures will be conducted. The schedule should address all reclamation and closure activities from progressive reclamation through to long-term monitoring and maintenance. The execution strategy should identify how the reclamation and closure activities will be completed – who is expected to carry them out, and how they will be funded.

8.1 Reclamation and Closure Schedule

Provide a detailed reclamation and closure schedule, describing the timing, sequencing, and duration for all reclamation and closure activities.

Describe the current design status for the RCP, and provide schedules for completion of remaining reclamation research and design activities required to prepare a for-construction RCP.

Describe any progressive reclamation activities that have been completed or are proposed.

8.2 Execution Strategy

Describe the human resource requirements for completion of the RCP. Provide a table which summarizes the number and type of personnel required to implement each of the reclamation and closure activities. Include personnel requirements for the initial (i.e., with active work underway) closure phase and the long-term post-closure phase.

Describe any institutional controls necessary to protect human health and environment (e.g., prohibition on excavation into cap/cover, prohibition on use of ground water, closure of all open adits/shafts, limitation of site access to treatment process units and reclaimed area).

Describe who will carry out each stage of reclamation and closure activities. Identify plans for conducting any long-term operations, maintenance and monitoring activities, including who will carry out these activities and how they will be funded.

9.0 Reclamation and Closure Liability

The RCP must summarize estimates of liability associated with completion of reclamation and closure measures and activities. Quantify liabilities for current conditions, two-years hence and end-of-mine. Describe the approach and assumptions for estimating liabilities, including demonstrating how the approaches have addressed the principles described in this guide. Details of costs estimation methods and models must be provided as appendices, in accordance with direction provided in Annex 2 of this guide.

Glossary of Terms

A glossary of all terms and acronyms in the RCP must be provided. A list of standard acronyms and definitions of terms is included below; any deviations to these definitions must be described.

Decommissioning: The period following the cessation of operations, involving the removal of equipment from active service.

Temporary Closure: A closure in which mining related activities cease with the intent of resuming activities in the near future.

Note that conditions and durations for temporary closure may be defined in QMLs or WLs. In this case, the specific definitions should be provided.

Permanent Closure: A closure in which there is no intent to resume mining activities at the site, and the mine project proceeds to the reclamation and closure phase

Post Closure: The period following closure where all reclamation activities are complete and the site is subject to ongoing operations, maintenance and monitoring.

ABA ..... acid base accounting
ARD ..... acid rock drainage
BMP ..... Best management practice
CCME ..... Canadian Council of Ministers of the Environment
CSR ..... Contaminated Sites Regulation
NPV ..... net present value
PAG ..... potentially acid generating
QMA ..... *Quartz Mining Act*
QML .....Quartz Mining License
UFA ..... Umbrella Final Agreement
WA ..... *Waters Act*
WL.....Water License
YESAA ..... *Yukon Environmental and Socio-economic Assessment Act*
YESAB ..... Yukon Environmental and Socio-economic Assessment Board
YG ..... Yukon government
YWB ..... Yukon Water Board
YWBS ..... Yukon Water Board Secretariat

ANNEX 2: LIABILITY ESTIMATE GUIDANCE

Annex 2

Liability Estimate Guidance

This annex describes approaches that should be used and components that should be considered when preparing estimates of liability for RCP activities. At the end of the annex is a series of tables that can serve as a checklist for the types of activities that should be addressed in a liability estimate. Because this guide provides direction for a variety of mine types, not all tables will be relevant to every mining project. Also, some relevant components may not be included for certain sites and circumstances. Each RCP for a mine site must provide cost estimates for all mine components, activities and appurtenant undertakings for the current liability at site, peak liability within the next two-year period, and liability at the end of mine life. Liability will be reviewed a minimum of every two years after a Quartz Mining License is issued.

Contents

1.0 Introduction

Each RCP must be accompanied by estimates of Reclamation and Closure Liability for three separate conditions:

1. Current status, to provide a benchmark for comparison with any previous estimates.
2. Peak liability within the two-year period for which the RCP approval will apply (peak two-year liability).
3. End-of-mine life.

The liability estimates must be consistent with the components and activities described in the RCP, and must address the principles for estimating liability as described in this guide.

Appropriate cost estimating models may be used for developing liability estimates (e.g., Standard Reclamation Cost Estimator, Reclaim Model). Spreadsheet-based models developed for specific sites may also be used. Whatever models or approaches are used, liability estimates must consider local conditions and costs, and meet appropriate standards for engineering costs estimates. The methodology and assumptions for estimating costs must also be transparent for reviewers.

For the purposes of QMLs, RCP approvals follow a two-year cycle where each update of the RCP applies for a two-year period. Security bonding will be established after considering the peak liability for the two-year period. Depending on the stage of mining and the types of activities being undertaken, the peak liability could occur any time during the two-year period and will be specific to each RCP submission. For example, peak liability may be at the end of the two-year period due to ongoing mining and associated increases in waste quantities and areas of disturbance. On the other hand, the peak liability may occur at some other time in the two-year period if, for example, a project leads to exposure of acid-generating material, followed by isolation of that material through later mining activities. A clear understanding of mine sequencing will be required in order to determine when peak liability will occur within the two-year period. The peak liability will normally occur when some combination of the following exists:

1. Greatest area of disturbance.
2. Most equipment, facilities or materials onsite.
3. Largest volume of and/or greatest distance that materials have to be moved in backfilling/re-grading.
4. Greatest volume or exposure of materials, facilities or equipment needing special handling, covers, or treatment (i.e., potentially acid-generating material, chemicals, barrels, etc.).
5. Greatest disturbance of resources requiring high cost reclamation or mitigation such as diversions, stream channels, floodplains, wetlands or treatment facilities.

6. Requirement for the operation, monitoring and maintenance costs of mine facilities that are needed in both the short and long-term to ensure public safety and prevent environmental damage are most costly.

Because mines do not plan on closing early, RCPs generally describe the measures required for reclamation and closure at the end of mine life. As a result, RCPs often provide a basis for estimating end-of-mine life liability, but should be applied with caution when developing estimates of current and peak two-year liability. For these estimates, it is critical to consider what changes to reclamation and closure measures would be required if implementation of the RCP occurred earlier.

Progressive reclamation activities planned for implementation during a two-year period should not be included as credits when estimating peak two-year liability unless they can be demonstrated to actually reduce liability. Carrying out the physical work required for progressive reclamation does not necessarily lead to complete elimination of the liability. Also, changes in mine sequencing and priorities frequently lead to delays or changes in progressive reclamation plans. As a result, peak two-year liability estimates should assume that progressive reclamation activities in that time period do not diminish liability. The benefits of progressive reclamation undertaken in previous two-year periods can be addressed in estimates, recognizing that liability is not fully addressed until monitoring demonstrates that the reclamation measures have achieved suitable reclamation outcomes.

Initial liability estimates for QMLs will likely be based on conceptual design narratives, drawings and maps. As the project proceeds through the water licensing phase, and then into development and operations, more detailed information will become available to support development of liability estimates. These later estimates will also be informed by actual on-site and as-built conditions. Thus, updates of liability estimates need to consider current site conditions and real data about mine performance.

Estimates of reclamation and closure liability must include both direct and indirect costs of reclaiming and closing the mine site. Direct costs are the costs for completing the works described in a RCP, including costs for all phases of activities once mining activities cease: interim care-and-maintenance, active reclamation, post-closure operations and maintenance, and monitoring/adaptive management. Indirect costs are the fees and charges in excess of the actual direct reclamation costs that accrue for all reclamation projects. These costs are associated with activities that include design, permitting, and ongoing operations during planning/permitting. Also, estimates of reclamation and closure liability must assume that work is undertaken by a third party contractor. For instances in which governments assume responsibility for reclamation projects there are additional management costs that may accrue and may be taken into account in establishing any reclamation security bonds.

2.0 Direct Costs

For each reclamation or closure activity described in the RCP, estimates of direct costs for a third party contractor to complete the work must be provided. When estimating direct costs, utilize the best available information relying on sources that may include actual as-built costs, bid prices from contracts for similar type work in the area, contractors, equipment dealers, rental shops, CAT Handbook, and engineers. Cost estimates for equipment necessary to perform reclamation may be based on the reference sources or handbooks that reflect regional costs of equipment operation. Where possible, use information that is based on real-time and real-life experiences and sound professional judgment.

In some cases, information from other projects may provide guidance about costs. However, this information should be used with caution, and rationale should be provided about its applicability to the proposed reclamation and closure activities. Using costs from other projects should be done only after a careful review of the assumptions and cost factors used in that estimate. For example, assumptions about haul profiles, equipment types, and unit costs may be specific to the site. Cost estimates should be developed for the specific conditions at the site.

Consistency is important in estimating direct costs in order to avoid missing or double counting some costs. Consistent approaches should be applied for all activities addressed in a liability estimate. For example, unit costs are often applied for equipment use. Clear and consistent approaches are needed for what is included in these unit rates; e.g., fuel, maintenance, replacement, insurance, sales tax, ownership and operating costs, etc.

Typically reclamation and closure activities fall into the following broad categories, though this is not intended as an exhaustive list. Some guidance is provided below about estimating direct costs for each of these categories.

- Interim operation, maintenance and monitoring
- Security and safety
- Hazardous materials
- Water management, including surface water management, contaminated water management, collection/conveyance/storage, water treatment, and diversions/flood routing
- Demolition, removal and disposal of uncontaminated structures, equipment and materials
- Earthwork and civil works
- Roads, access and borrow areas
- Re-vegetation
- Habitat compensation
- Long-term operation, maintenance and monitoring

2.1 Interim Operation, Maintenance and Monitoring

Operation, monitoring and maintenance activities will be required after mining ceases during final closure planning/permitting and transitional periods as well as during reclamation and closure implementation. Costs for these interim activities need to be included in liability estimates. If a mine site is abandoned, governments will incur these interim operation, maintenance and monitoring costs at the site before and during any reclamation and closure activities. Site operators would also incur much of these costs during transition from mining to reclamation activities. Interim costs are likely to be higher for projects where mining ceases earlier than planned because designs for reclamation and closure activities will be less well defined.

For most sites, the majority of interim operation, maintenance and monitoring costs accrue from:

- Public safety issues that may require immediate action, for example, signing, fencing, gates or berms to warn the public of hazards associated with open pit highwalls, underground mine openings and unsafe buildings or facilities where chemicals, petroleum products or reagents are stored.
- Requirements for maintaining access routes and utilities to provide continued services to the site.
- Water management activities will likely be required in order to maintain suitable conditions at the site. This will often include maintaining diversions, ditches, pipelines, sediment control systems and water treatment systems. Water management needs can be immediate and costly for certain types of projects, for example, heap leach projects if they are abandoned during operations.
- Monitoring and reporting requirements.

2.2 Security and Safety

Cost estimates should include costs for measures that must be taken to ensure long-term security and safety at the site. This includes any measures for blocking access to certain facilities (e.g., underground workings), posting warnings, building fences or other deterrents to access (e.g., pit safety berms).

2.3 Hazardous Materials

Cost estimates should address the investigation and remediation for hazardous materials. This should include required phases of site assessments, as well as the costs for decontaminating, neutralizing, disposing, treating or isolating hazardous materials used, produced, or stored at the project site.

Good records will be required to demonstrate the amount of hazardous materials present at the site. Where amounts are not known or are uncertain during mine

operation (e.g., quantities of contaminated soils), conservative estimates should be used.

Estimates for activities related to hazardous materials should consider specific regulatory requirements for assessment and remediation of such materials.

Costs for stabilization and remediation of process residues and sludges should be included. This should include residues and sludges accumulated during mining activities and those that may be produced during the closure and reclamation period.

Costs for removal and disposal of any explosives or associated materials should be included.

2.4 Water Management

Long-term water management can be a substantial cost for mine closure projects. Liability estimates should address water management related costs including those for surface water management (conveyance, storage, sediment control, erosion control), contaminated water management (collection, conveyance, storage), water treatment and flood routing. Cost estimates for water management requirements should be supported with sufficient water balance, geochemistry and water quality modeling to predict volumes and qualities during various closure phases.

Cost estimates for water treatment must conservatively identify expected flows, qualities and durations. Where water treatment is identified as an expectation for post-closure activities, durations of 100 years to perpetuity must be addressed unless the proponent can demonstrate that water treatment can be discontinued earlier.

For all types of water treatment systems (e.g., mechanical, passive), cost estimates must address both capital costs for facility construction and operating costs. They also must include costs for long-term maintenance and replacement requirements.

2.5 Demolition, Removal and Disposal of Structures, Equipment and Materials

Costs should be estimated for the demolition, removal and disposal of all mine facilities, equipment and materials, including buildings, crushers, storage facilities, tanks, fences, culverts, bridges, signs, explosive magazines, conveyor systems, foundations, septic systems, retaining walls, pipelines, power lines, electrical substations, miscellaneous debris, etc. Include all disposal costs, such as on-site burial (if allowed), loading, hauling and fees at appropriate landfills or other disposal sites. Include any costs for cleaning of equipment or facilities that may be required prior to disposal. For equipment, the costs should generally assume that it is inoperable, and that heavy equipment will be needed

in order to load and remove it from the site. Liability for removal of buildings and other fixed infrastructure may be reduced if their removal at no cost to government in the event of mine closure can be documented.

2.6 Earthwork and Civil Works

Earthwork and civil works are usually the most significant task category for RCPs because the reclamation of tailings and waste rock facilities usually entails earthworks including construction of cover materials. Similarly, diversions, dams and other water management facilities entail earthworks and civil works.

Generally, estimating costs for earthwork will require the following information:

- Material volumes and types (specifications) to be excavated, pushed, or applied.
- Type and size of equipment.
- Haul or push distances and elevations.
- Grades and slope angles.
- Any special construction methods such as crushing, sorting, compaction, use of geosynthetic materials, etc.

Material volumes should be estimated by using scaled drawings and cross sections of facilities showing pre-reclamation and post-reclamation topography. Volume estimates should take into account factors that may affect the overall volume of material that must be handled, for example, volume differences between in place material and loose material (swell factor) and the amount of material that may be re-handled. When estimating costs for re-grading it is important to remember that productivity falls as push distances expand. Calculations should therefore be based on shorter push distances. Also, with re-grading, estimates should not assume that cut and fill balance of material will lead to single handling. With longer slopes, it is likely that some material will be rehandled during re-grading, leading to greater actual volumes of material moved.

Haul distances and grades affect equipment selection and efficiency and cost of all excavation, backfilling and grading operations. Haul distances can be determined from the mine plan maps and drawings. Grades can be estimated from the road design drawings, as-built drawings, cross-sections and detailed site maps.

Estimates for earthwork should not be limited to minimal re-grading, but must also include activities and material volumes associated with development of suitable landscape conditions to achieve long-term land use objectives and ecosystem services.

2.7 Roads, Access and Borrow Areas

Costs for roads, access and borrow areas must be addressed in estimating direct costs of reclamation and closure activities. This includes the reclamation activities for existing

roads, access and borrow areas, and also any costs for developing and reclaiming any additional roads, access and borrow areas that will be needed to complete the reclamation and closure activities. Where materials will be used from existing mine stockpiles (e.g., overburden), costs should be identified for reclamation of those areas once borrow activities are complete.

2.8 Re-Vegetation

Re-vegetation is usually an important component of RCPs, helping to achieve a variety of objectives by reducing water infiltration, providing habitat, preventing erosion, and meeting aesthetic expectations. Re-vegetation activities may include subsoil preparation, topsoil placement, seedbed preparation, soil amendments (e.g., fertilizer, nutrient sources), erosion and sediment control, placement of woody debris, seeding, planting (e.g., willow stakes), etc. Costs for all of these activities should be included where they will be part of a re-vegetation program.

Costing for re-vegetation must be based on realistic expectations about how long it will take, and the level of effort required to establish self-sustaining vegetative systems, and how long it will take for these systems to develop into climax communities. Yukon's cold, dry climate makes re-vegetation challenging, especially in combination with the moisture retention and nutrient characteristics that are typical of mine waste materials, which generally do not support vigorous plant growth. As a result, cost estimates should include rigorous monitoring programs for any re-vegetation, as well as realistic estimates of maintenance and replacement costs that are likely to be incurred. Estimates for maintenance activities should also include costs for weed control or other activities to maintain suitable plant communities. Unless site-specific research work demonstrates otherwise, cost estimates should include maintenance and replacement activities for at least 10 years after re-vegetation occurs, and monitoring for longer periods.

2.9 Habitat Compensation

Mine reclamation projects often require special measures to create or re-establish fish or wildlife habitat. For example, any harmful alteration, destruction or disruption of fish habitat can lead to requirements for compensation of lost habitat by restoring affected habitat or creating new habitat in other locations. Costs for all habitat compensation activities should be included in liability estimates, whether that compensation will be at the site or in another location.

2.10 Long-Term Operation, Maintenance and Monitoring

Estimates for long-term operation, maintenance and monitoring should address activities with a finite life, and those that are expected to continue indefinitely.

Costs for monitoring programs may assume that the frequency of monitoring will decrease over time, but rationale should be provided for any decreased frequencies or elimination of any monitoring components. Decreased monitoring requirements should be based on specific triggers that rely on demonstrated achievement of reclamation and closure objectives. Where cost estimates assume that certain monitoring programs will be discontinued, then the estimates should include costs for decommissioning of the monitoring facilities at that time.

If the closed site will include water conveyance or containment facilities, then estimates should include costs for permanent monitoring and maintenance of these facilities (including access costs) unless it can be demonstrated that they pose no environmental, social or economic risk should they fail in the long-term. Assume that some level of periodic maintenance will be necessary for all engineered facilities whose continued function is essential to achieve reclamation objectives. When estimating costs for these facilities, include any costs that would be associated with continued maintenance of permits and licences in the long-term.

3.0 Indirect Costs

There are a range of indirect costs that arise during planning and implementation of any RCP. Generally, these are costs related to the planning, design, contracting, administration or actual performance of reclamation work. Some of these costs may vary depending on whether the proponent or the government implements the RCP. Recognizing that in the worst case government may need to implement the RCP, the indirect costs must be addressed in each liability estimate on the basis of the assumption that work will be directed by government and conducted by a third party contractor.

Estimates of indirect costs are often calculated as percentages of direct costs, based on industry wide averages and past experience. These costs need to be validated based on locality, size of operation, and other site-specific information. Several categories of indirect costs are discussed in more detail below.

3.1 Reclamation Research

Reclamation research provides valuable input for the development of RCPs and is a tool to demonstrate expected performance and advance the level design for reclamation measures and activities. Costs for reclamation research must be included in estimates of liability. These costs will be higher during earlier stages of mine development when

the level of detail available for the design of reclamation and closure measures is lower. Costs for reclamation research can be estimated directly on the basis of a reclamation research plan. Otherwise, costs should be incorporated by increasing the costs for engineering design.

3.2 Engineering Design

RCPs typically do not contain sufficient design detail to support construction and implementation of the plan. Carrying out the RCP usually requires additional site characterization to develop the engineering specifications and drawings required for contracting. This additional characterization often includes:

- Preparation of maps and plans to show the extent of required reclamation and collect detailed information for quantities.
- Survey of topsoil and waste stockpiles to determine amount of material available.
- Sampling and analysis of waste rock, tailings, heap material, surface and ground water, etc.
- Sampling and analysis of topsoil and waste piles to determine whether special handling or treatment is necessary.
- Evaluation of structures to determine requirements for demolition and removal.
- Evaluation of storm water facilities and process solutions or water impoundments to determine if upgrades, expansions, treatment, clean out, or other improvements are necessary.
- Assessment of previously reclaimed areas to determine whether standards have been met.

Once the characterization is complete, engineering design work can be done to finalize designs for construction. Engineering design costs once RCPs are in place are usually estimated in the range of 5% to 10%. Higher costs would be identified for RCPs with less design detail available.

3.3 Mobilization and Demobilization

Mobilization and demobilization are indirect costs for moving personnel, equipment, and supplies to and from the reclamation site. Because of the remote nature of most Yukon mine sites, mobilization and demobilization costs can be substantial. Estimates should assume that no equipment is available on site to carry out reclamation and closure activities. Any restrictions on road use, or special access challenges (e.g., river crossings) should also be addressed in cost estimates.

Mobilization and demobilization costs can be estimated on the basis of specific activities and equipment requirements, but in some instances can be 10% or more of the direct costs of specific activities.

Mobilization and demobilization costs can often increase the costs of characterization programs to support engineering design.

3.4 Contractors' Costs

Because liability estimates must be developed on the assumption that work will be carried out by third party contractors, the cost estimate needs to include contractors' costs. These are costs that the contractor will pass on to the project proponent, including profit and overhead. Examples of contractors' costs include: project management (managers, superintendents, etc.), construction office and storage trailers, safety/personal protective equipment, temporary sanitary utilities, quality control, subcontracting costs, overtime costs, employment costs, workers' compensation, clerical support wages, office rent and utilities, insurance, performance bonds and owner's compensation (profit).

Profit and overhead costs for contractors can range from 15% to 30% of direct project costs. Generally, as the overall cost of a project increases, the applicable percentage for contractor costs falls.

3.5 Permitting and Assessment Costs

Implementing most RCPs requires completion of additional regulatory processes, including both environmental/socio-economic assessment and permits/licences. In Yukon this usually entails a YESAA assessment and a water licence because operating licences usually have terms that apply only to the operational phase of mine projects. Amendments of QMLs may also be required. YESAA assessments for initial projects often consider reclamation and closure only at a conceptual level, and changes during mine operations often lead to substantial changes in the activities and approaches proposed in the final RCP. Liability estimates for RCPs should assume that approval to proceed with the plan requires specific YESAA assessment and water licence processes. Estimates should include costs for all aspects of these assessment and regulatory processes from preparation of applications through to participation in public hearings if needed. Requirements for public consultation and engagement should be addressed, and all estimates should assume that the permitting work is completed by third party contractors.

3.6 Contingencies

The Association for the Advancement of Cost Engineering (AACE) defines contingency as "*An amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect is uncertain and that experience shows will likely result,*

in aggregate, in additional costs" (AACE International Certified Cost Technician Primer, Supporting Skills And Knowledge Of A Cost Engineer. 1st Edition – January 2011).

Estimates should include contingency costs that are intended to address the errors arising from the use of assumptions and conceptual information during project design and planning. This type of contingency is intended to address uncertainty in the cost estimates, not uncertainty about the adequacy of proposed measures, or uncertainty related to worst-case outcomes. It is a contingency that should be expected to be expended. If there is significant uncertainty about performance of proposed reclamation and closure measures, such costs should be addressed separately as risk contingencies.

Uncertainty about cost estimates arises primarily from two areas; scope and bid uncertainties. Scope uncertainties relate to the level of understanding of what specific activities will be required, while bid uncertainty relates to the actual costs for construction and implementation of the project.

For schematic or feasibility level designs which are typical for early versions of RCPs, accuracy ranges can be 30% or more on the high side, indicating that contingencies up to 30% of direct project costs would be warranted to address cost uncertainties. As the level of design progresses, the contingency percentages may be reduced, but such reductions should be supported by demonstrated achievement of greater detail in designs.

Contingencies should never be removed entirely because cost estimate uncertainties continue even once the project is under construction. However, once detailed designs for construction are in place, contingency costs may be reduced to as low as 5% to 10%.

3.7 Inflation

Inflation costs are likely to be important for all reclamation and closure projects. When calculating inflation, it should be applied to the combined total of all other direct and indirect costs.

With the exception of long-term operation and maintenance activities, cost estimates for reclamation and closure activities should account for the timing of completion by incorporating cost escalations due to inflation because security bonds are usually held in forms that do not account for inflation (e.g., letters of credit). Cost estimates should apply appropriate price indices or estimates of inflation when escalating these costs.

For long-term operation and maintenance activities, government may determine that financial security should be in a form that provides for a rate of return to at least offset the impact of inflationary costs. Otherwise, for longer term programs, the straight addition of annual costs could result in an extremely large security amount. For these

long-term expenditures, provide estimates of annual costs as well as periodic costs for maintenance or replacement value (e.g., water treatment plan replacement). These costs should be discounted to determine a net present value of funds required to be held. Net present value should be calculated using conservative estimates of long-term net rates of return that consider both nominal rates of return and expected inflation. Where net present value is included in liability estimates, it should include rationale for selection of net rates of return, as well as sensitivity analysis to demonstrate the effects that different rates of return may have on the estimates.

3.8 Government Project Management

If a site is abandoned, government will incur substantial project management costs associated with implementing reclamation and closure activities. For example, these costs would include personnel time and agency overhead for project oversight, contract administration, permitting, and project management. While estimates prepared by proponents do not need to include these costs, it is important to recognize that they may be included in overall estimates of liability completed by government agencies.

4.0 Reclamation and Closure Costing Tables

The tables following this section can serve as a checklist for the types of activities that should be addressed in a liability estimate. They also outline some considerations that may be relevant when developing liability estimates. In all cases, cost estimates should be consistent with the content of the reclamation and closure plan document.

The liability estimates themselves should be supported by additional descriptions that describe assumptions and approaches, including references on where specific third-party unit cost rates were sourced, be they from the generally accepted equipment rental rate books or others and any mark-ups included to consider the Yukon's northern location and/or the site's specific location, and especially for any proposed "custom" rates used in the costing tables. Cost estimates should include all relevant direct and indirect costs as described above.

4.1 Cost Summary

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	1.General & Administration		
	2. Exploration Disturbances		
	3. Closure Planning		
	4. Mine Workings-Underground		
	5. Mine Workings-Open Pit		
	6. Heap Leach Pads		
	7. Waste Rock Dumps		
	8. Surface Facilities-Mine Area		
	9. Surface Facilities-Mill Area		
	10. Tailings Facility		
	11. Major Water Storage Ponds		
	12. Infrastructure		
	13.Waste Disposal/Remediation		
	14. Landfills		
	15. Roads & Trails		
	16. Water & Solution Management		
	17. Quarries & Borrow Pits		
	18. Sediment & Erosion Control		
	19. Monitoring and Reporting		
	Sub-Totals, % Contingency and Total Closure Cost		Single page summary sheet should include costs from each of the individual sheets, an appropriate percent contingency and net present value calculation (as required) to determine a total

			closure cost.
	Cost Escalation		Amount present value estimate of financial assurance is increased by to ensure adequacy over the life of the review term (e.g., 3% per year over 3 years).

4.2 Unit Rates and Costs

Note: All rates are to be based on the use of third-party, independent contractors.

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Labour		Includes contractor's burdens as well as factors for overtime & shift differential
	Equipment Rental Rates		Include equipment required to complete tasks (wet rate)
	Material Costs		Include all major supplies required for the project
	Revegetation Rates		Include application rates and costs for supplies
	Other	Freight Truck Transport	Include costing for moving supplies between site & nearest town/city
	"	Barge Transport	
	"	Helicopter/Fixed Wing Support	
	"	Camp Costs	Daily charge-out rate per staff-day in on-site camp
	"	Contractor's Rates	Provide costs for specific tasks quoted by a third-party contractor
	Water Quality Analyses	Surface water	
	Water Quality Analyses	Ground water	
	Geo-textile/erosion barrier		
	Fencing		

4.3 General and Administration

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Contractor Profit & Home Office Overhead		Often 10-15% of direct costs
	Insurance		Typically 1% of direct costs
	Bonding		Typically 3% of direct costs
	Taxes		Often 7% of direct & indirect costs
	Government Bonding		Costs to establish & maintain specified bond with gov't agency(ies) overseeing site
	Property Holding Costs		Costs to continue to hold all lands making up site
	Agency Administration		Typically 6% of direct costs
	Site Security Costs		
	Engineering and Surveying		Often 6-10% of relevant tasks
	Project Management (off-site), Site Manager and Supervision		Often 12-15% of direct costs (excludes camp & vehicle costs)
	"	Vehicles	Consider vehicles for Mgr., Engineer, and Supervisors
	Camp Costs	Daily Costs	Total cost per staff-day in camp. All-inclusive.
	Living Out Allowance		For senior project staff: Site Manager, Project Engineer, etc.
	Establishment of Site Project Office(s)		Moving onto site and establishing a project office or downsizing of existing office facilities. As required for closure work
	Power & Heat		For site office as well as

			other required buildings during closure phase, but excluding camp
	Establishment of Camp		Moving to site and establishing a new camp or downsizing of existing camp. As required for closure work.
	Mobilization & Demobilization	Heavy Equipment	Bringing required equipment to site and later removing back to contractor's base
	"	Worker Transportation	For all employees
	Access to Site	Construct Road to Site	$/km of gravel road
	"	Construct Winter Road to Site	$/km of annual winter road, for as many winters as required
	"	Construct Airstrip	As required
	Road Maintenance		Routine maintenance (e.g., grading, snow removal) of all roads required during closure and post-closure, as required

4.4 Exploration Disturbances

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Roads and Trails	Re-grading	
		Revegetation	
	Pads and Trenches	Removal of any Residues and Debris	
	"	Backfilling and Re-grading areas	
	"	Revegetation	
	Temporary Ore/Waste Rock Stockpiles	Relocation to Secure Site	As required
	"	Re-sloping of Remaining Piles	
	"	Cover Placement	As required
	"	Revegetation	As required
	Drill-hole Abandonment	Capping	Includes removal of casing, backfilling of hole, and capping top portion with grout/cement, as required

4.5 Closure Planning

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Technical Studies and Investigations		
	Engineering Designs for Civil Structures (tailings dams, spillways, etc.)		
	Permitting		
	Other		

4.6 Mine Workings - Underground

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Securing Underground Workings	Removal of Materials	Removal of assets as well as all hazardous materials including chemicals and explosives to surface staging areas. Removal of hazardous materials to off-site licensed landfill is covered under Waste Disposal/Remediation section.
	Equipment Decontamination	Cleaning of Salvaged Equipment	Cleaning of equipment being brought to surface, as required. Includes mobile & fixed equipment
	Removal of Assets to Off-Site		Costs (as appropriate) to remove saleable/salvageable/ scrap materials to off-site
	Underground Bulkheads		As required to seal off areas, control water flows, etc.
	Access Control	Adits, Portals and Declines Plugging	Built to appropriate standards
	"	Shaft/Raise Capping	For shafts as well as vent raises. Built to appropriate standards.
	"	Fencing	
	"	Signage	
	Mine Workings De-watering		Install/upgrade as required to enable closure work. (Permanent system is included in Solutions Management heading)

4.7 Mine Workings – Open Pit

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	General	Removal of Mobile equipment	Stockpiling equipment (e.g., drills, shovels) to surface staging area
	"	Removal of Fixed Equipment	Stockpiling materials in surface staging area (e.g., electrical equipment, conveyors, pumping systems)
	Equipment Decontamination	Cleaning of Salvaged Equipment	Cleaning of equipment being removed from pit, as required. Includes mobile & fixed equipment.
	Removal of Assets to Off-Site		Costs (as appropriate) to remove saleable/salvageable/ scrap materials to off-site
	Access Control	Perimeter Safety Berms/Trenches	Includes revegetation
	"	Block Roads	
	"	Perimeter Fencing	
	"	Signage	
	Geotechnical Control	Pit Wall Stabilization	
	"	Unloading Pit Crest	
	Filling of Pit	Flooding with Water	Need to include: Pumping costs; costs to construct spillways in & out; possible water treatment in-situ or of discharge once pit fills
	"	Backfilling	
	Revegetation	Vegetation of Pit Areas	Includes slopes, floor and crest, as required

4.8 Heap Leach Pads

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Drain Installation/Upgrading		
	Reclaim Channels-Construction		
	Detoxification		
	Drain down		
	Rinsing		
	Pad Physical Stabilization	Re-Sloping /Grading of Slopes	Consider number of required dozer passes and increase in footprint area of dump to achieve specified final slope. Also consider reduction in productivity due to steepness of slope and different material types and sizes.
	"	Toe buttress - Construction	As required, to stabilize over-steepened perimeter slope
	"	Crest - Re-grading	To encourage controlled shedding of any surface water
	"	Cover placement	May be required to be an engineered cover including several material types
	"	Ripping/Scarifying	
	"	Topsoil/Growth Media Placement	May be required to help establish vegetation
	"	Revegetation	Vegetation of entire dump or portion, as required
	Processing Ponds		Removal of pregnant, barren & any other process ponds
	Monitoring Instrumentation-Installation		For measuring phreatic level, infiltration/moisture content, seepage,

			movement, etc.
	Post-Closure Diversion Ditching		Cost for new or upgraded long-term diversions around pad

4.9 Waste Rock Dumps

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Dump Physical Stabilization	Re-Sloping /Grading Dump Slopes	Consider number of dozer passes required and increase in footprint area of dump to achieve specified final slope. Also consider reduction in productivity due to steepness of slope and different material types and sizes.
	"	Toe Buttress – Construction	As required, to stabilize over-steepened perimeter slope.
	"	Crest - Re-grading	To encourage controlled shedding of any surface water
	"	Ripping	
	"	Cover Placement	May be either a basic cover or engineered low-permeability cover (i.e., with various materials types, geo-membrane, etc.) On all surfaces or just flat areas, as specified.
	"	Topsoil/Growth Media Placement	May be required to help establish vegetation
	"	Ripping/Scarifying	
	"	Revegetation	Alternatives include aerial or machine broadcast seeding, hydroseeding, and woody species
	Access Control	Block Access Roads	
	"	Perimeter Fencing	
	"	Signage	
	Monitoring Instrumentation-Installation		For measuring phreatic level, infiltration/moisture content, seepage, movement, etc.

	P-C diversion Ditching		Cost for new or upgraded long-term diversions around the dump
	Dump Relocation	Relocation to Alternate Site	As required.
	"	Additional amendments (e.g., lime)	
	"	Restoration of Original Site	All costs associated with final reclamation of original dump site.
	"	Restoration of New Dump	As required, as new site will likely be within another larger dump, unless it's back into underground mine.

4.10 Surface Facilities – Mine Area

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Ore Stockpiles	Removal of Remaining material	Removal to mine area (underground or open pit), as specified
	Process Residues-Clean-up		Includes costs to remove all residues and then decontaminate all mine rock processing areas
	Removal of Equipment From Within Buildings		May be for purpose of assets recovery or to simplify building demolition
	Demolition/Salvage of Buildings and Structures		Need to consider all building and structures. Includes concrete walls and foundations, as required
	Removal of Assets to Off-Site		Costs (as appropriate) to remove saleable/salvageable/scrap materials to off-site
	Disposal Costs	To On-site Landfill	Need to include load, haul and dump (LHD) costs
	"	To Off-site Landfill	Need to include LHD costs & a likely $/T tipping fee
	Cover Placement		
	Growth Media Placement		
	Ripping/Scarifying		
	Revegetation		

4.11 Surface Facilities – Mill Area

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Clean-up of Ore/Tailings Stockpile Pads		Includes relocation of materials to appropriate location(s), as specified
	Clean-up of Process Residues		Includes costs to remove all residues and then decontaminate all mill processing areas, including laboratory/assay lab
	Removal of Equipment From Within Buildings		May be for purpose of assets recovery or to simplify building demolition
	Demolition/Salvage of Buildings and Structures		Need to consider all mill area buildings and structures. Includes concrete walls and foundations, as required
	Removal of Assets to Off-Site		Costs (as appropriate) to remove saleable/salvageable/scrap materials to off-site
	Disposal costs	To On-Site Landfill	Need to include load, haul and dump (LHD) costs
		To Off-Site Landfill	Need to include LHD costs & a likely $/T tipping fee
	Process Ponds	Emptying & Disposal of Contents	Water portion to be treated as required, prior to release. Sludges/sediments to be disposed of, as appropriate.
	"	Reclamation	Typically includes folding & burying or removal of liner and backfilling area
	Cover Placement		
	Growth Media Placement		

	Ripping/Scarifying Pad Areas		
	Revegetation		

4.12 Tailings Facility

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Dams/Embankments	Upgrade for Post-Closure	Work may include lowering/raising crest, re-sloping and/or armoring faces, construction of downstream toe berm, upstream beach, etc.
	Decants	Remove/Seal Permanently	Includes all costs to stabilize them for the long-term
	Spillways	Replace/upgrade for Post-Closure	Include costs for excavation, concrete work, any armoring, etc.
	Tailings Relocation		Consider dozing, dredging, load/haul/dump or moving using slusher
	Tailings Discharge/Reclaim Water Systems	Removal of Pumping Systems	Includes tailings slurry, reclaim water systems. Tailings discharge line may also include cyclones. Reclaim system may also include reclaim barge & pumps.
	Tailings Surface Grading		Required to make for a level surface in preparation for cover placement
	Cover Placement	Basic Cover	For erosion protection & revegetation. Include geo-textile, as required.
	"	Engineered Cover	For minimizing water/air entry, as required. May include geo-textile and/or geo-membrane.
	"	Topsoil/Growth Media Placement	
	"	Ripping/Scarifying of Tailings Surface	Depending on material, this may not be required

	Flooding of Tailings Surface	Filling with water	To fill with water to desired elevation. With existing or upgraded water supply system, as required.
	Revegetation	Dams	
	"	Tailings Surface	
	"	Tailings Facility Roads	
	"	Pipeline/Service Corridors to Tailings Facility	
	Install Monitoring Instrumentation		To monitor phreatic profile, pore pressures, seepage, movement, etc. Includes costs to purchase, prep/drill hole(s) & install.
	Access Control	Block Access Roads	
	"	Perimeter Fencing	
	"	Signage	
	Long-Term Effluent Water Treatment		For supernatant discharge, seepage, etc. Construct new or upgrade existing treatment system (TS).
	"		Cost for short-term water treatment including pumping, reagents, TS operation, as required
	"		Cost for long-term P-C water treatment including pumping, reagents, TS operation
	P-C Diversion Ditching		Cost for new or upgraded long-term diversions around tailings facility

4.13 Major Water Storage Ponds

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Dams/Embankments /Spillways/Channels	Removal for Post-Closure Phase	Include costs to remove water, relocation of borrow materials
	Re-establishment of Smaller Watercourse		Construction of new small channel through area, along original watercourse, if pond was built on top of original watercourse
	Restoration of Original Ground Surface	Re-contouring	To conform to previous area landform
	"	Growth Media Placement	As required
	"	Revegetation	

4.14 Infrastructure

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Miscellaneous Buildings (Administration, Warehouse, etc.)	Clean-Up of Buildings and Contents	Excludes mill area buildings. Includes decontamination.
	"	De-construction	Excludes mill area buildings. Includes concrete walls & foundations, as required. To landfill and/or surface staging area.
	Removal of Camp Facilities		Includes water supply & sewage systems (surface and sub-surface). To landfill and/or surface staging area.
	Removal of Bulk Explosives Plant and Caps magazines		Includes cost for decontamination. Includes concrete walls & foundations, as required. To landfill and/or surface staging area.
	De-construction of Miscellaneous Buildings and Structures		Includes concrete walls & foundations, as required. To landfill and/or surface staging area.
	Dismantling of Site Pipelines		Includes process and potable/grey/black waters, process reagents, fuels, etc., but excludes lines to & from tailings facility. To landfill and/or surface staging area.
	Removal of Surface Conveyor Systems		Includes transfer houses & their concrete walls & foundations, as required. To landfill and/or

			surface staging area.
	De-construction of Electrical Systems		Includes on-site power systems, powerlines, connection to main grid, gensets, etc. To landfill and/or surface staging area.
	Airstrip	Removal and Area Restoration	Includes any structures associated with the airstrip
	Removal of Assets Off-Site		Costs (as appropriate) to remove saleable/salvageable/ scrap materials off-site

4.15 Waste Disposal / Remediation

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Solid Wastes Disposal	To Off-Site Landfill	Only for removal to off-site landfill from surface staging area. Costs to move to site landfill were covered in individual sections, above.
	Hazardous Materials Disposal	Off-Site Disposal	To licensed landfill, from surface staging area.
	Hydrocarbon Contaminated Soils	Off-Site Disposal	To licensed landfill, as required. From surface staging area.
	"	On-Site Land Treatment Farm (LTF)	Construct new or expand existing LTF. Also include costs for operation.
	"	Final Decommissioning of LTF	
	Process Residue Contaminated Soils	Off-Site Disposal	To licensed landfill

4.16 Landfills

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Expansion of Facility to Accommodate Closure Phase Debris		Include cost for additional monitoring wells, as required
	Operation During Closure Phase		
	Final Closure	Final Compaction & Grading	
	"	Cover Placement	
	"	Growth Media Placement	
	"	Revegetation	

4.17 Roads and Trails

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Removal of Culverts		Include construction of swale, erosion protection, disposal of removed items
	Removal of Bridges		Include shoreline and in-stream environmental restoration work, disposal of removed items
	Roads & Trails	Re-grading	
	"	Slope Stabilization	Includes stabilizing any cut banks and fill slopes
	Ripping/Scarifying		
	Cover placement		Placement of topsoil/growth media, as required
	Revegetation		

4.18 Water and Solutions Management

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Reclaim Site Diversions		(i.e., those not required for p-c phase)
	Groundwater Wells-Decommissioning	Production Wells	
	"	De-Watering Wells	
	"	Infiltration Wells	
	Pumping		
	Ponds		For surge capacity, sediment control, aeration, UV exposure, evaporation, etc.
	Site Effluents and/or ML/ARD Treatment System(s)-Temporary & Permanent		From open pit, underground, groundwater wells & waste rock dumps. Separate listing for each treatment system.
	"	Active Treatment System-Capital Cost	Includes for all equipment and all other direct and indirect costs
	"	Active Treatment System-Operating Cost	Typically $/m3 water treated and detailed breakdown
	"	Active Treatment System-Sludge Management	Cost for periodic removal and disposal to licensed disposal facility
	"	Passive Treatment System-Capital Cost	Includes for all equipment and all other direct and indirect costs
	"	Passive Treatment System-Capital Cost for Replenishing Amendment Materials	Includes cost to dispose of spent/loaded materials
	"	Final Decommissioning of Treatment System	Includes removal of materials, re-contouring and revegetation of area

4.19 Quarries and Borrow Pits

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Stabilize Slopes/Walls	Buttressing of Walls	
	"	Re-Sloping	
	Cover Placement		
	Topsoil/Growth Media Placement		
	Ripping/Scarifying		
	Revegetation		
	Access Control	Block Access Roads	
	"	Perimeter Safety Berm/Trench and Revegetation	
	"	Perimeter Fencing	
	"	Signage	

4.20 Sediment and Erosion Control

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Diversion Ditches		Construction of ditches and channels to move surface waters around remaining site features
	Sediment Ponds		Construction of ponds, to minimize sediment transport, as required

4.21 Compliance Monitoring and Reporting

Worksheet Titles	Headings	Sub-Headings	Notes & Comments
	Water Quality	Surface Waters	As specified in permits/licenses; Including a QA/QC program
	"	Ground Water	As sampled in monitoring wells. As specified in permits/licenses Including a QA/QC program.
	Pre-Closure Site Environmental assessment	Contamination Surveys	To determine areas requiring clean-up based on applicable standards (e.g., BC CSR). Costs for remediation is covered elsewhere.
	Post-Closure Environmental Assessment	Follow-Up	To confirm final clean-up criteria have been met
	Monitoring	Air	As specified in permits/licenses Including QA/QC programs.
	"	Waste Rock	"
	"	Permafrost	"
	"	Soils	"
	"	Biological	"
		EEM Program	"
	"	Reclamation	"
	Environmental Monitor		Person(s) to undertake environmental programs, routine site monitoring, etc.
	Instrumentation	Water Quality	Parameter specific in-stream probes, as required
	"	Flowrate	To enable continuous in-stream flow measurements, as required

		Meteorological	Cost to install met station for as long as required.
	Geo-technical Monitoring	Instrumentation Upgrades/Replacement	Includes items such as extensometers, movement monuments, not covered elsewhere in costing tables.
	"	Regular Inspections	By site personnel, and by professional, as specified
	Vegetation Maintenance		P-C maintenance of revegetated areas includes re-application of seed, fertilizer, hydroseed, seedlings, etc.
	Erosion Maintenance		P-C maintenance of on-site sloped areas
	Structures Maintenance		P-C maintenance (and clean-out) of remaining structures (ditches/channels, dams, spillways, sediment basins, etc.)
	Regular Reporting		To specific regulatory agencies and stakeholders. To extend through closure and post-closure periods.
	Document Control		System to ensure secure storage of site files and drawings