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## **MINTO PHASE V/VI RECLAMATION AND CLOSURE**

### **PRELIMINARY ADAPTIVE MANAGEMENT PLAN**

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# **Version 1.0**

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Prepared for:



**MINTO EXPLORATIONS LTD.**

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## 1 INTRODUCTION

Minto Explorations Ltd. (Minto), a wholly owned subsidiary of Capstone Mining Corp. (Capstone), owns and operates the Minto copper mine. Minto Mine is located within Selkirk First Nation (SFN) Category-A Settlement Land (Parcel R-6A), and is approximately 240 km northwest of Whitehorse, Yukon Territory. The Minto mine commenced commercial operations in October 2007.

Minto copper mine has progressed completely through three phases of mine operations. Currently, the mine is operating in Phase IV and Phase V/VI is being planned and is proceeding through the regulatory process. As part of the planning for Phase VI/V, a Reclamation and Closure Plan (RCP) is being developed. The RCP is a key Management Plan for Phase V/VI development.

An Adaptive Management Plan (AMP) is required as part of the RCP several regulatory bodies. These include: Environment Canada's Environmental Code of Practice for Metal Mines; Energy, Mines and Resources' Yukon Mine Site Reclamation and Closure Policy; and Yukon Water Board's Reclamation and Closure Planning for Quartz Mining Projects. The following statement is taken from YG's Annotated Outline for Reclamation and Closure Plan:

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", 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.

AMPs are tools used to address the inherent uncertainty in closure planning. AMPs outline a range of possible, unexpected outcomes and the responses that will be undertaken to curb possible negative impacts associated with these unexpected situations.

An AMP is a flexible, iterative process that emphasises learning while doing. This implies that an AMP is never complete in nature, but in a continuous state of refinement in response to feedback from monitoring, analysis of data and changing conditions. The ideas presented within this document build on information gathered through operations and environmental monitoring at Minto. Phase V/VI is part of a sequence of stages in the evolution of the Minto mine site. Until final closure, the project is anticipated to continue to evolve and change. For example, as mining and development of Phase V/VI commences, Phase IV mining components will be proceeding into the reclamation and closure process. The various components and activities related to the phases do not occur in isolation, and plans such as this AMP must be dynamic in order to effectively deal with change. As a result, any future developments that occur at the Minto mine site will necessitate updates to the AMP. Thus the AMP is considered a "living document". Subsequent iterations of the closure AMP will take these changes into account.

## 1.1 ADAPTIVE MANAGEMENT PLANNING

Adaptive management is an approach to environmental management that, according to the Canadian Environmental Assessment Agency, is appropriate when a mitigation measure may not function as intended or when broad-scale environmental change is possible. Mine closure planning includes both of these potentialities due to the long term planning horizon and associated uncertainty. Adaptive management plans are precautionary in nature, and provide a level of security in long term environmental planning. Adaptive management plans also allow for the inclusion of improved science into mitigation measures as they are continually revised.

Adaptive management has been evolving since its emergence in the 1970s. Adaptive approaches include an ability to incorporate knowledge into the management plan as the knowledge is gleaned and circumstances change. Eberhard et al. described the categories of knowledge that may trigger changes to water quality management plans; system understanding, measuring progress and anticipating changes. These categories allow for the inclusion of knowledge and adaptation of management to changed conditions. Embedding adaptation into environmental plans involves thinking about how the results of monitoring will change management actions. Adaptive management plans are a way to accept uncertainties and build a structured framework to respond to changing conditions.

Adaptive management conducts a flexible path with actions to take when specific triggers occur. AMPs are a formalization of a plan for performance monitoring and project re-evaluation in the future. The general structure of adaptive management can be described by the following steps:

1. Identify risk triggers associated with vulnerabilities or uncertainties;
2. Quantify impacts and uncertainties
3. Evaluate strategies and define implementation path that allows for multiple options at specific triggers;
4. Monitor the performance and critical variables in the system; and
5. Implement or re-evaluate strategies when triggers are reached.

Although there are no widely used AMP terms, the steps listed above are representative of typical AMP processes. Within AMPs, triggers provide decision points in a stepwise decision-making framework that identifies how and when management action should be taken. A key characteristic of adaptive management is monitoring, which is used to advance scientific understanding and to adjust management policies in an iterative process. Adaptive management is a rigorous method for addressing uncertainties in ecosystem management.

Access Consulting Group (ACG) has used the general steps listed above to establish a set of adaptive management terms and apply them to the ongoing Minto closure planning process.

## 1.2 AMP OBJECTIVES

An AMP is a management tool wherein a framework is provided to make quick and effective decisions to guide responses to unforeseen events. This document identifies areas of uncertainty within the Phase V/VI RCP and its predictive elements and provides an AMP framework for each. For each component the AMP describes monitoring commitments, thresholds, triggers and responses to underperforming elements or emerging risks

within the component. The steps laid out in the AMP framework are precautionary, and therefore they provide the confidence that action will be taken before adverse environmental impacts are observed.

Response planning, and results for anticipated events are contained within site management plans while AMPs guide responses to unforeseen or contingency events. This AMP provides a framework to guide responses to unanticipated monitoring results and to potential but low probability events where uncertainty exists.

It is difficult to predict the specific environmental condition that may arise which requires a response from management and, therefore, the AMP does not provide specific detailed descriptions of responses to a situation. The AMP provides a range of possible responses to use as a guide to respond to specific environmental conditions encountered. Management should use the information provided in the AMP and undertake the appropriate response.

### 1.3 AMP APPROACH

In addition to the conclusions drawn from research, the approach presented in this AMP follows the Environmental Code of Practice for Metal Mines, Section 4.1.17 on Adaptive Management:

“Mine owners/operators should use adaptive management methods to revise and refine the environmental management strategy. Adaptive management should consider a wide range of factors, including:

- the results of environmental audits or other evaluation activities;
- the results of environmental monitoring;
- the results of monitoring of the performance or condition of environmental infrastructure, such as containment structures, water management systems or treatment facilities;
- technological developments; and
- changing environmental conditions.” (Environment Canada 2009)

### 1.4 AMP COMPONENTS

The activities associated with the Phase V/VI mining life cycle may contribute to future environmental conditions requiring the implementation of an adaptive management plan. Two primary AMP components have been identified for AMP development:

- Surface water quality and quantity; and
- Water collection and conveyance structures.

The specific AMP framework for each of these components are described in subsequent sections. Additional components are anticipated to be added to this preliminary AMP, and will be included as additional FMEA and stakeholder consultation initiatives advance during continued closure planning.

### 1.5 AMP FRAMEWORK

The AMPs for each component are laid out using a common element approach to create consistency in implementation of the AMP protocol for all components. The common elements are:

1. Description of the component
  - *Description* including the engineering design associated with the component. Thorough description and understanding of the component leads to narrative risk triggers and specific performance thresholds.
  - *Risk Narrative* describe the possible environmental impacts and environmental conditions that implementation of the AMP will prevent. Narrative triggers are used to establish early warning indicators.
2. Monitoring the component
  - *Specific Indicators* are the environmental or physical parameters to be monitored and assessed. Specific indicators are measurable or observable, and are indicative of changes from the designed or expected condition.
  - *Monitoring Requirements* describes the monitoring regime for the component including frequency, type of data required and interpretation of results.
  - *Specific Performance Thresholds* define the conditions, in terms of specific indicators, when action is triggered. Performance thresholds are staged to accommodate levels of concern and a diversity of actions. To the extent possible, specific performance thresholds will include early warning thresholds.
3. Responding to unexpected conditions of the component
  - *Specific Responses* are staged according to specific performance thresholds describes the actions to be implemented if specific performance thresholds are crossed. Specific responses were developed through various means including, consultation with SFN and their agents, site operations such as monitoring and management, and input from ACG as well as other consultants.
4. Annual Reporting and Review
  - *Annual Report* reflects annual changes made to the AMP as the site conditions change. The AMP should be modified whenever unexpected circumstances are encountered and the protocol is implemented or when additional proven science or technology becomes available.

A schematic of how these elements interact in adaptive management is presented following in Figure 1-1.

## 1.6 ANNUAL REVIEW AND ANNUAL REPORTING

An annual review of the AMP will be performed and any necessary amendments or updates to the AMP elements will be made. The annual review will include a review of the relevant monitored data and AMP elements.

Updates, amendments, performance thresholds crossed, and trigger(s) activated will be provided to the appropriate governmental (including SFN) organizations as required and will be part of the annual report.

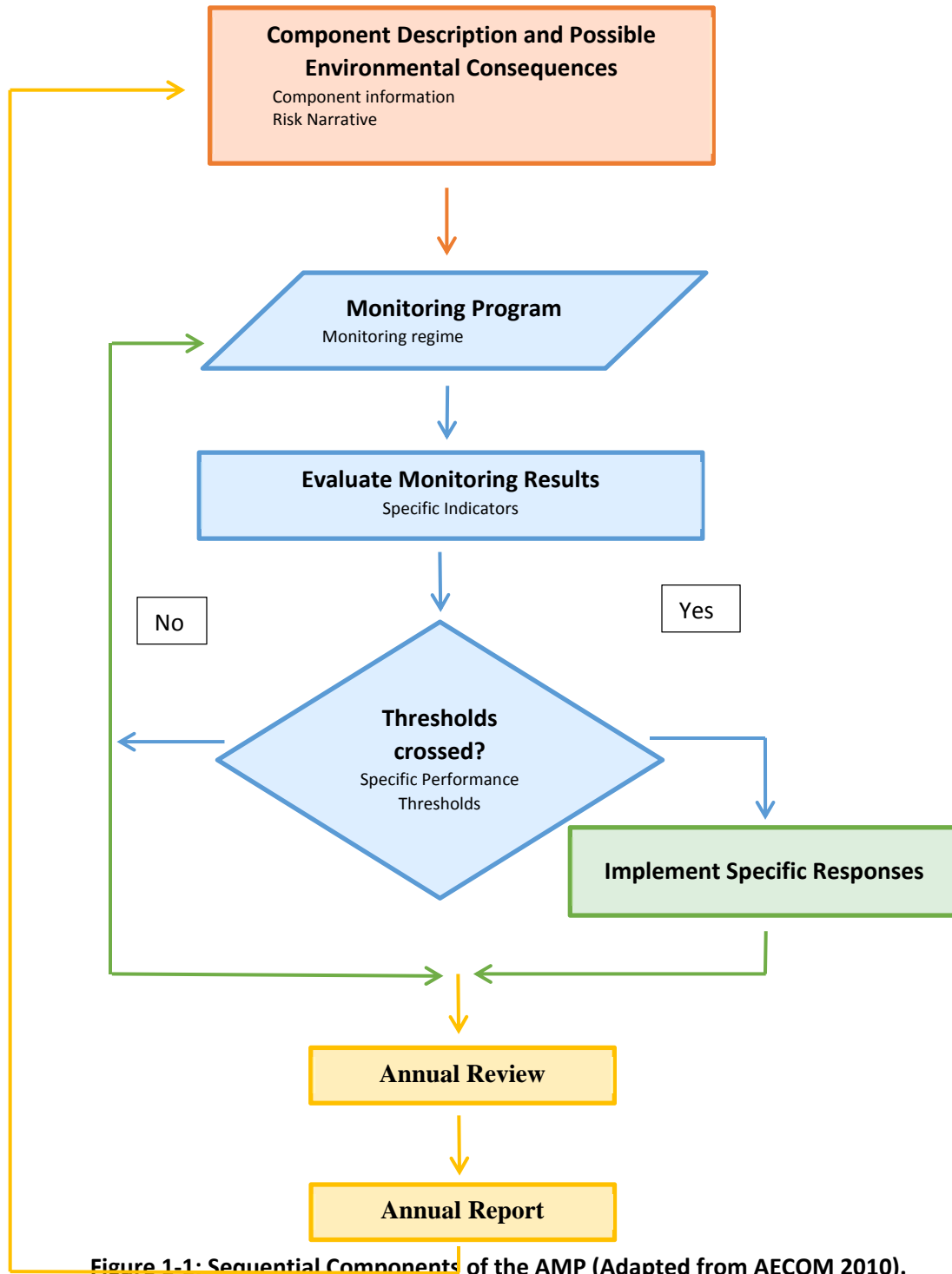


Figure 1-1: Sequential Components of the AMP (Adapted from AECOM 2010).

## 2 SURFACE WATER QUALITY

### 2.1 DESCRIPTION

Station W3 is to be considered the main control point on Minto Creek. It is also the last surface monitoring point on the mine site property and is considered a discharge compliance point under the current water licence.

Additional key surface water monitoring locations up gradient of W3 and within the mine footprint are located at W37, W35, and W15. It is anticipated that all mine site surface drainage will flow through at least one of the monitoring stations mentioned above, with all surface water reporting through monitoring station W3.

Phase V/VI mining and construction includes development of the Minto North Pit. It is anticipated that at closure, no discharge from the Minto North Pit and related disturbances will report to the McGinty Creek drainage. Baseline conditions and monitoring in McGinty Creek has been conducted, and ongoing monitoring will be conducted during the operational Phase V/VI. In combination with the ongoing development plans, closure designs, and groundwater studies, this data will be used to better understand if any drainage or effects to McGinty Creek are anticipated and help determine what monitoring and/or AMP considerations and responses are appropriate.

It is recognized that the W2 (lower Minto Creek) monitoring point is well beyond the final mine water discharge point controlled by Minto, and is subject to a broad range of influences from tributaries and catchment areas that are beyond Minto's control; however, Minto is committed to monitoring the water quality at W2 and working collaboratively with SFN to develop a series of progressive triggers by which Minto would respond proactively to unanticipated changes.

### 2.2 RISK NARRATIVE

Increase in contaminant concentrations/loadings from mine cause adverse effects to aquatic resources in receiving environment.

### 2.3 SPECIFIC INDICATORS

Concentrations of contaminants of potential concern (COPCs) are listed in table 2-1 below. These are consistent with identified COPCs for which operational water quality objectives have been proposed for Phase V/VI:



**Table 2-1 Proposed Water Quality Objective for Lower Minto Creek (W2)**

Parameter	Proposed Water Quality Objective for Lower Minto Creek (W2)	Rationale
Dissolved Aluminium	0.1 mg/L	Equal to BC MOE guideline
Dissolved Cadmium	0.0001 mg/L	Equal to BC MOE guideline
Dissolved Chromium	0.001 mg/L	95th Percentile of background and equal to CWQG for total hexavalent chromium
Dissolved Copper	0.020 mg/L	Based on reasonably conservative result of chronic BLM model, supported by WER testing
Dissolved Selenium	0.005 mg/L	US EPA guideline for lotic systems
Ammonia-N	0.25 mg/L	Concentration not expected to result in exceedance of CWQG for unionized ammonia under conservative temperature and pH conditions
Nitrate-N	10 mg/L	Protective in aquaculture systems
Nitrite-N	0.06 mg/L	CWQG

## 2.4 SPECIFIC PERFORMANCE THRESHOLDS AND RESPONSES

Table 2-2 below presents specific performance thresholds and associated responses to water quality monitoring results in Lower Minto Creek. This framework is intended to be sensitive to emerging contaminant concentration issues, particularly those related to mining influences. The lower Minto Creek water quality predictions are utilized as ‘early warning’ thresholds which trigger action prior to reaching or exceeding water quality objectives.

**Table 2-2. Specific Indicators, Performance Thresholds and Responses for Surface Water Quality**

Specific Indicators	Specific Performance Thresholds	Specific Responses
<p>Aqueous Concentrations at Station W2 for:</p> <ul style="list-style-type: none"> <li>• Dissolved Aluminum;</li> <li>• Dissolved Cadmium;</li> <li>• Dissolved Chromium;</li> <li>• Dissolved Copper;</li> <li>• Dissolved Selenium;</li> <li>• Ammonia-N;</li> <li>• Nitrate-N; and</li> <li>• Nitrite-N.</li> </ul>	<p><b>Specific Threshold 1</b></p> <ul style="list-style-type: none"> <li>• Exceedance of predicted expected case maximum for dissolved concentrations</li> </ul>	<p><b>Notification</b></p> <ul style="list-style-type: none"> <li>• Minto Management</li> <li>• Include in annual report</li> </ul> <p><b>Review</b></p> <ul style="list-style-type: none"> <li>• Follow QA/QC investigative protocol:             <ul style="list-style-type: none"> <li>○ Review laboratory QA/QC report</li> <li>○ Verify original result, or re-run sample if laboratory error indicated</li> </ul> </li> </ul> <p><b>Evaluation</b></p> <ul style="list-style-type: none"> <li>• Compare with W3 results</li> </ul> <p><b>Action</b></p> <ul style="list-style-type: none"> <li>• If comparison with W3 result indicates mine loadings responsible for exceedance; and verification confirms original result, then:             <ul style="list-style-type: none"> <li>○ Re-sample both W2 and W3 within <b>one month</b> of original sample</li> </ul> </li> </ul>
	<p><b>Specific Threshold 2</b></p> <ul style="list-style-type: none"> <li>• Exceedance of predicted expected case maximum for dissolved concentrations in <b>2 consecutive samples (scheduled or re-sample)</b> where evaluation confirmed mine loading responsible for first exceedance</li> </ul>	<p><b>Notification</b></p> <ul style="list-style-type: none"> <li>• Minto Management</li> <li>• Include in annual report</li> </ul> <p><b>Review</b></p> <ul style="list-style-type: none"> <li>• Follow QA/QC investigative protocol:             <ul style="list-style-type: none"> <li>○ Review laboratory QA/QC report</li> <li>○ Verify original result, or re-run sample if laboratory error indicated</li> </ul> </li> </ul> <p><b>Evaluation</b></p> <ul style="list-style-type: none"> <li>• Compare with W3 results. If comparison with W3 result indicates mine loadings responsible for exceedance; and verification confirms original result, then:             <ul style="list-style-type: none"> <li>○ Evaluate candidate causes for load contributions and develop investigation plan,</li> </ul> </li> </ul> <p><b>Action</b></p> <ul style="list-style-type: none"> <li>• Implement investigation plan, including at a minimum:             <ul style="list-style-type: none"> <li>○ Re-sampling both W2 and W3 within <b>one month</b> of original sample; and</li> <li>○ Site investigation of candidate load contributions.</li> </ul> </li> <li>• Review results of investigation and prepare recommendations if appropriate</li> <li>• Implement recommendations</li> </ul>
	<p><b>Specific Threshold 3</b></p>	<p><b>Notification</b></p>

Specific Indicators	Specific Performance Thresholds	Specific Responses
	<ul style="list-style-type: none"> <li>Exceedance of predicted <b>worst case</b> maximum for dissolved concentrations</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>WQO exceeded at W2 in a single sample</li> </ul>	<ul style="list-style-type: none"> <li>Minto Management, SFN, YG Inspector</li> <li>Include in annual report</li> </ul> <p><b>Review</b></p> <ul style="list-style-type: none"> <li>Follow QA/QC investigative protocol             <ul style="list-style-type: none"> <li>Review laboratory QA/QC report</li> <li>Verify original result, or re-run sample if laboratory error indicated</li> </ul> </li> </ul> <p><b>Evaluation</b></p> <ul style="list-style-type: none"> <li>Compare with W3 results. If comparison with W3 result indicates mine loadings responsible for exceedance – and verification confirms original result – then:             <ul style="list-style-type: none"> <li>Evaluate candidate causes for load contributions and develop investigation plan (or review/revise as appropriate)</li> </ul> </li> </ul> <p><b>Action</b></p> <ul style="list-style-type: none"> <li>Increase monitoring frequency to monthly (if not already implemented)</li> <li>Implement investigation plan, including any reviews/revisions, and at a minimum:             <ul style="list-style-type: none"> <li>Re-sampling both W2 and W3 within <b>one month</b> of original sample; and</li> <li>Site investigation of candidate load contributions; and</li> <li>Evaluation of potential effects to aquatic resources (i.e. Compare to PNEC and apply BLM for D-Cu, invertebrate tissue for Se)</li> </ul> </li> <li>Review results of investigation and prepare recommendations if appropriate</li> <li>Implement recommendations</li> </ul>
	<p><b>Specific Threshold 4</b></p> <ul style="list-style-type: none"> <li>Exceedance of predicted worst case maximum for dissolved concentrations in <b>2 consecutive samples (scheduled or re-sample)</b> where evaluation confirmed mine loading responsible for first exceedance</li> </ul>	<p><b>Notification</b></p> <ul style="list-style-type: none"> <li>Minto Management, SFN, YG Inspector</li> <li>Include in annual report</li> </ul> <p><b>Review</b></p> <ul style="list-style-type: none"> <li>Compare with W3 results</li> <li>Follow QA/QC investigative protocol</li> </ul> <p><b>Evaluation</b></p> <ul style="list-style-type: none"> <li>Compare with W3 results. If comparison with W3 result indicates mine loadings responsible for exceedance; and verification confirms original result, then:             <ul style="list-style-type: none"> <li>Evaluate candidate causes for load contributions and develop investigation plan (or review/revise as appropriate)</li> <li>Provide investigation plan to SFN/YG Inspector</li> </ul> </li> <li>Evaluate potential for mine loadings to cause adverse effects to aquatic resources (i.e. redo BLM modeling)</li> </ul> <p><b>Action</b></p>

Specific Indicators	Specific Performance Thresholds	Specific Responses
		<ul style="list-style-type: none"> <li>• Increase monitoring frequency to monthly (if not already implemented)</li> <li>• Implement investigation plan, including at a minimum:               <ul style="list-style-type: none"> <li>○ Re-sampling both W2 and W3 within <b>one month</b> of original sample; and</li> <li>○ Site investigation of candidate load contributions</li> <li>○ Evaluation of potential effects to aquatic resources</li> </ul> </li> <li>• Review results of investigation and prepare recommendations</li> <li>• Implement recommendations</li> </ul> <p><b>If threshold consistently exceeded for 2 years, then:</b></p> <ul style="list-style-type: none"> <li>○ Develop forecast for near-term water quality in Minto Creek</li> <li>○ prepare Mitigation Plan to reduce loading from mine site which is informed by water quality forecast</li> </ul>
	<p><b>Specific Threshold 5</b></p> <ul style="list-style-type: none"> <li>• Exceedance of predicted worst case maximum for dissolved concentrations consistently <b>for 3 years</b> where evaluation confirmed mine loading responsible for exceedances</li> </ul>	<p><b>Notification</b></p> <ul style="list-style-type: none"> <li>• Minto Management, SFN, YG Inspector and Regulators</li> <li>• Include in annual report</li> </ul> <p><b>Review</b></p> <ul style="list-style-type: none"> <li>• Compare with W3 results</li> <li>• Follow QA/QC investigative protocol</li> </ul> <p><b>Evaluation</b></p> <ul style="list-style-type: none"> <li>• Compare with W3 results. If comparison with W3 result indicates mine loadings responsible for exceedance; and verification confirms original result, then:               <ul style="list-style-type: none"> <li>○ Evaluate candidate causes for load contributions and develop investigation plan (or review/revise as appropriate)</li> <li>○ Provide investigation plan to SFN/YG Inspector</li> </ul> </li> <li>• Evaluate potential for mine loadings to cause adverse effects to aquatic resources (i.e. redo BLM modeling)</li> </ul> <p><b>Action</b></p> <ul style="list-style-type: none"> <li>• Increase monitoring frequency to monthly (if not already implemented)</li> <li>• Implement investigation plan, including at a minimum:               <ul style="list-style-type: none"> <li>○ Re-sampling both W2 and W3 within <b>one month</b> of original sample; and</li> <li>○ Site investigation of candidate load contributions</li> <li>○ Evaluation of potential effects to aquatic resources</li> </ul> </li> <li>• Review results of investigation and prepare Mitigation Plan if appropriate</li> <li>• Implement Mitigation Plan with appropriate regulatory approvals</li> </ul>

Specific Indicators	Specific Performance Thresholds	Specific Responses
	<p><b>Specific Threshold 6</b></p> <ul style="list-style-type: none"> <li>WQO or PNEC exceeded in <b>2 consecutive samples (scheduled or re-sample)</b> where evaluation confirmed mine loading responsible for first exceedance</li> </ul> <p><b>AND</b></p> <ul style="list-style-type: none"> <li>Follow up investigation suggests mine loadings are causing adverse effects to aquatic resources</li> </ul>	<p><b>Notification</b></p> <ul style="list-style-type: none"> <li>Minto Management, SFN, YG Inspector and Regulators</li> <li>Include in annual report</li> </ul> <p><b>Review</b></p> <ul style="list-style-type: none"> <li>Compare with W3 results</li> <li>Follow QA/QC investigative protocol</li> </ul> <p><b>Evaluation</b></p> <ul style="list-style-type: none"> <li>All evaluation measures for ST4 and:             <ul style="list-style-type: none"> <li>Consider ongoing WQ monitoring results in development of investigation plan</li> </ul> </li> <li>Evaluate potential for mine loadings to cause adverse effects to aquatic resources (i.e. redo BLM modeling)</li> </ul> <p><b>Action</b></p> <ul style="list-style-type: none"> <li>All action measures for ST5 and:</li> <li>Implement all reasonable and practical measures to reduce contaminant loading from mine to Minto Creek</li> </ul>

### 3 WATER COLLECTION AND CONVEYANCE STRUCTURES

#### 3.1 DESCRIPTION

The water collection and conveyance structures consist of the infrastructure that assists in drainage from waste rock and tailings piles and include pipes, ditches and armored channels. Conveyance and collection structures are also used to convey drainage from the major waste infrastructure to treatment systems prior to release.

These are passive systems, which are designed to require little to no maintenance and to function up to a certain design event (see performance objectives/design criteria in the Phase V/VI RCP).

The major water diversion and conveyance structures for Phase V/VI closure and reclamation and detailed descriptions of these structures are provided in the Phase V/VI RCP.

#### 3.2 RISK NARRATIVE

- Failure or blockage of conveyance structures resulting in changed flow paths and/or overtopping of drainage ditches.
- Expected flows cause damage to conveyance structures resulting in excessive maintenance costs.
- Uncollected/unconveyed flows cause erosion and sedimentation downstream
- Failure of Tailings Diversion Ditch leads to excessive infiltration into upgradient base of Dry Stack Tailings Facility, resulting in increased flows and/or metal loads and unacceptable water quality conditions downstream.

#### 3.3 SPECIFIC INDICATORS

Specific indicators identified for monitoring of conditions related to the water collection and conveyance system are:

- conveyance channel blockages,
- physical damage,
- evidence of overtopping and associated erosion,
- major precipitation event
- formation of a new flow path or channel
- increased sediment load in ditch flow and/or downstream (TSS)

### 3.4 MONITORING REQUIREMENTS

In addition to water quality monitoring, other monitoring of the water diversion and conveyance structures will consist of periodic physical and/or geotechnical inspections. Closure monitoring of the physical stability of the water diversion and conveyance structures is discussed in the RCP.

- Routine site inspections will include the conveyance and water retaining structures
- Physical inspection of entire conveyance system will be a component of the Physical Monitoring Program

### 3.5 SPECIFIC PERFORMANCE THRESHOLDS

Specific performance thresholds are observable/measurable conditions related to the specific indicators. They are tiered to provide early indications of potential problems with water collection and conveyance systems, and are accompanied by specific responses.

### 3.6 SPECIFIC RESPONSES

Appropriate corrective actions should take place if the water collection and conveyance structures performance fails to meet objectives. Repairs or modifications should be performed on the collection and conveyance structures where applicable. Increased monitoring and the evaluation of the monitored results should be conducted as part of a response plan.

Specific Indicators, performance thresholds and responses are presented in Table 3-1 following.

**Table 3-1 Specific Indicators, Performance Thresholds and Responses for Water Collection and Conveyance Structures**

Specific Indicators	Specific Performance Thresholds	Specific Responses
Blockages	<ul style="list-style-type: none"> <li>• Partial obstruction – water flows around obstacle but stays within ditch</li> <li>• Excessive vegetation growing within water conveyance structures</li> </ul>	<ul style="list-style-type: none"> <li>• Remove partial obstruction (may be a significant build-up of sediment)</li> <li>• Remove vegetation as required</li> <li>• Increase monitoring</li> <li>• Investigate source of partial obstruction and potential for repeated obstruction</li> <li>• Make preventative repairs</li> </ul>
	<ul style="list-style-type: none"> <li>• Complete obstruction – ditch is completely blocked and flow has moved somewhere else</li> </ul>	<ul style="list-style-type: none"> <li>• Remove complete obstruction when safe to do so</li> <li>• Repair any damage to conveyance structure that may have occurred</li> <li>• Re-establish design longitudinal slopes</li> <li>• Repair any damage caused elsewhere by unconstrained flows</li> <li>• Investigate source of complete obstruction and potential for repeated obstruction</li> <li>• Make preventative repairs</li> </ul>
Physical Damage	<ul style="list-style-type: none"> <li>• Turbulent flow is observed where laminar flow is expected or is normal</li> <li>• Cracks, slumping or significant settlements are observed in ditch walls or base</li> <li>• Downstream movement of ditch bedding materials (rip rap or synthetic liner) is observed</li> <li>• Minor seeps are observed</li> </ul>	<ul style="list-style-type: none"> <li>• Report observations to Engineer of Record</li> <li>• Inspect area of concern to determine cause</li> <li>• Increase monitoring frequency</li> </ul>



Specific Indicators	Specific Performance Thresholds	Specific Responses
	<ul style="list-style-type: none"> <li>• Substantial movement/sloughing of ditch walls and/or base is observed</li> <li>• Ditch walls or base are non-uniform</li> <li>• Flow is partially constricted</li> <li>• There are obvious gaps or missing sections in the ditch walls</li> <li>• Seeps are observed and/or flows obviously short circuit the ditch</li> <li>• Energy dissipation basin is not slowing down flows or major wave (hydraulic jump) forms outside of stilling basin</li> </ul>	<ul style="list-style-type: none"> <li>• Report observations to Engineer of Record</li> <li>• Inspect area of concern to determine cause</li> <li>• Implement repairs as required by engineering inspection</li> <li>• Restore ditch to full capacity</li> <li>• Re-establish designed longitudinal slope</li> <li>• Modify design to account for changes in flow patterns</li> <li>• Increase monitoring frequency</li> </ul>
	<ul style="list-style-type: none"> <li>• Catastrophic failure of conveyance structure</li> <li>• Complete compromise of functionality</li> </ul>	<ul style="list-style-type: none"> <li>• Immediately notify Engineer of Record and company representative</li> <li>• Report failure if required</li> <li>• Implement emergency repairs if safe to do so</li> <li>• Re-establish structural integrity of structures</li> <li>• Re-establish design longitudinal slopes</li> <li>• Inspect area of concern to determine cause</li> <li>• Implement repairs as required by engineering inspection</li> <li>• Restore ditch to full capacity</li> <li>• Evaluate source of failure and modify structure if required</li> <li>• Increase monitoring frequency</li> </ul>
<p>Overtopping and associated erosion</p>	<ul style="list-style-type: none"> <li>• Flow surface is less than 50cm from the top of the ditch walls (freeboard design criteria)</li> <li>• Water marks over the top of the structures</li> <li>• Erosion over the top of the structures</li> </ul>	<ul style="list-style-type: none"> <li>• Observe for potential obstructions in the conveyance structure that could cause backwater effects</li> <li>• Review precipitation record from site to determine if a large event may be responsible for the overtopping</li> <li>• Notify Engineer of Record</li> <li>• Restore ditch to full capacity, or increase the ditch hydraulic capacity if warranted (raised ditch walls)</li> </ul>

Specific Indicators	Specific Performance Thresholds	Specific Responses
		<ul style="list-style-type: none"> <li>Add additional riprap to the water conveyance and adjust construction of the ditch to reduce flow velocity at the location of concern</li> </ul>
Precipitation	<ul style="list-style-type: none"> <li>Precipitation is excessive as observed by duration or intensity of rainfall</li> <li>High temperatures and/or rainfall on snowpack at spring freshet</li> <li>Significant snowfall accumulation in ditch and/or accumulation remaining after site-wide snowmelt</li> </ul>	<ul style="list-style-type: none"> <li>Increase conveyance system monitoring frequency/intensity</li> <li>Report any signs of erosion, overtopping or other functions due to high volume flows</li> </ul>
Formation of new flow path or channel	<ul style="list-style-type: none"> <li>Erosion channels are observed where flow is not expected/designed</li> <li>Water is observed flowing across the ground surface outside the designed water conveyance structures</li> </ul>	<ul style="list-style-type: none"> <li>Notify Engineer of Record</li> <li>Inspect the area of concern and determine upstream causes of changed flow path</li> <li>Correct any upstream malfunctions and return flow to designed channel or redesign/rebuild conveyance structure or engineer natural flow path</li> </ul>
Increased sediment load in ditch flow and/or downstream (TSS)	<ul style="list-style-type: none"> <li>Water flowing in conveyance structures looks turbid/cloudy/muddy</li> </ul>	<ul style="list-style-type: none"> <li>Investigate potential upstream sources of turbidity (full sediment basin, malfunctioning energy dissipation basin)</li> <li>Remove built-up sediment</li> <li>Repair damage where possible</li> <li>Built additional sediment ponds if warranted</li> </ul>
	<ul style="list-style-type: none"> <li>TBD Downstream WQ exceeds TSS criteria</li> </ul>	<ul style="list-style-type: none"> <li>Notify Engineer of Record</li> <li>Investigate sources of TSS in downstream water</li> <li>Redesign and rebuild water conveyance structures as required to remove excess sediment</li> <li>Document activities</li> </ul>

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