

RECLAMATION AND CLOSURE PLAN
KENO DISTRICT MINE OPERATIONS
KENO HILL SILVER DISTRICT

REVISION 5

FEBRUARY 2018

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1. INTRODUCTION

Alexco Resource Corp. (Alexco), through its wholly owned subsidiary Alexco Keno Hill Mining Corp., owns and operates the Keno Hill Mine Operations located in the Keno Hill Silver District (the KHSD). The Keno Hill Mine Operations include the Keno Hill District mill, district infrastructure and multiple underground silver/lead/zinc mines. The Bellekeno, Lucky Queen, Onek and Flame and Moth mines and the Keno Hill District mill are currently licenced for production under Quartz Mining License QML-0009 and Water Licence QZ09-092. The Bermingham deposit is licensed for advanced underground exploration under Mining Land Use Approval LQ00240. This Reclamation and Closure Plan (RCP) Revision 5 represents an update to the currently approved RCP Revision 4 and is a condition of QML-0009 and Water Licence QZ09-092 to be updated every two years.

This Keno Hill Mine Operations RCP Revision 5 includes the most recent envisioned mine plan outlined in the company's March 2017 Preliminary Economic Assessment and includes production from Bellekeno, Flame and Moth, Bermingham and Lucky Queen over an eight-year period. Although the Bermingham deposit is not permitted for production as of the date of this RCP Rev 5, it is included as it represents the most up to date plan of operations for the Keno Hill Mine Operations.

Note that the Bermingham, Lucky Queen, Onek and Flame and Moth Production Unit Areas included in this RCP have not been fully delineated pursuant to the Amended and Restated Subsidiary Agreement between Alexco and Indigenous and Northern Affairs Canada (INAC) as these deposits have not moved into production. The scope of reclamation and closure planning provided in this RCP Revision 5 consequently may be modified. Determination of the final Production Unit Areas will be made at the time of development and any changes to the RCP will be made during the next RCP update.

Figure 1-1 shows the general project location within Yukon, while Figure 1-2 shows the location on a smaller scale proximate to Keno City.

The Keno District Mine Operations Reclamation and Closure Plan addresses the following mine area components:

- Underground mining activities at the Bellekeno, Onek, Lucky Queen, Flame and Moth and Bermingham deposits, surface support infrastructure and activities, miners' dry area, offices, trailers and portals;
- Conventional flotation mill & supporting infrastructure, coarse ore stockpile, plant services, fuel storage area, employee dry area, offices, trailers and mill ponds;
- Dry-stack tailings facility (DSTF), Phase I-II;
- Bellekeno, Onek, Lucky Queen, Flame and Moth and Bermingham N-AML waste rock disposal areas (WRDA) and P-AML waste rock storage facilities (WRSF);
- Temporary coarse ore stock piles;
- Site access roads; Bellekeno Haul Road from Mill to Bellekeno East (including the Lightning Creek bridge), Christal Lake Road (from Silver Trail Highway to the mill), Keno City Bypass Road from Bellekeno Haul Road to Wernecke Road (including the Lightning Creek bridge #2), Bermingham access road from Bermingham portal to Calumet Drive;

- Power distribution system (power poles, transformers);
- Water treatment plants and facilities; and
- Flat Creek Camp accommodations.

Please refer to Figure 1-3 for the location and summary of reclamation components under this RCP.

The closure measures that are expressed herein are consistent with the *Reclamation and Closure Planning for Quartz Mining Projects August 2013 Guidance Document (YG and YWB, 2013)*, general approach and best management practices used by the mining industry today, which has in recent years developed a great deal of experience in different climates and physical conditions. The overall outline and table of contents of this RCP differs slightly from the guidance document for purposes of report flow and site- specific mine area components but all the sections of the guidance document have been addressed.





AKHM

ALEXCO KENO HILL MINING CORP.

FIGURE 1-1
PROJECT LOCATION

JANUARY 2018

D:\Project\All\Projects\ALEX-05-01\gis\mxd\Overview_Maps\Project-Location\Project_Location_ESRI_LAYERS_20170612.mxd (*Last edited by: amatlashevska; 11/01/2018/14:18 PM*)

1.1 ALEXCO'S ACTIVITIES IN THE KHSD

Alexco and its subsidiaries undertake a variety of activities within the Keno Hill Silver District, including care and maintenance, environmental monitoring and water treatment of historic adit drainages, district closure planning and studies for the historic environmental liabilities, exploration and development and production of ore deposits. These activities are authorized under a suite of project approvals. Table 1-1 lists the relevant existing approvals.

Ongoing development and production of the Flame and Moth deposit and additional future ore deposits will require amendments of the existing mine production Water Licence QZ09-092 and Quartz Mining License QML-0009. Additional minor approvals will also be required. Coordination of mining and care and maintenance activities will be determined through the Water Licencing and QML processes. The Yukon Water Board will determine under which Water Licence activities will be included.

Table 1-1 Relevant KHSD Assessment and Regulatory Approvals

Purpose	YESAA Approval	Quartz Mining Act Approval	Water Licence
Mine Production	Project # 2009-0030, 2011-0315, 2013-0161, Decision Documents	Quartz Mining Licence (QML-0009, expires 2031)[a]	Type A Water Licence QZ09-092 (amendment 2, QZ09-092-2), expires 2020[b]
Advanced Exploration	Project # 2008-0039, 2017-0086 Decision Documents	Class 4 Mining Land Use Approval (LQ00240, expires 2018)	Incorporated into QZ09-092[b]
Care & Maintenance	Project #2006-0293 and 2012-0141 Decision Documents	N/A	Type B Water Licence QZ17-084[b]

Notes: [a] http://www.emr.gov.yk.ca/mining/pdf/mml_keno_qml-0009_flamemoth_amendment.pdf
[b] http://www.yukonwaterboard.ca/WATERLINE/ [c]

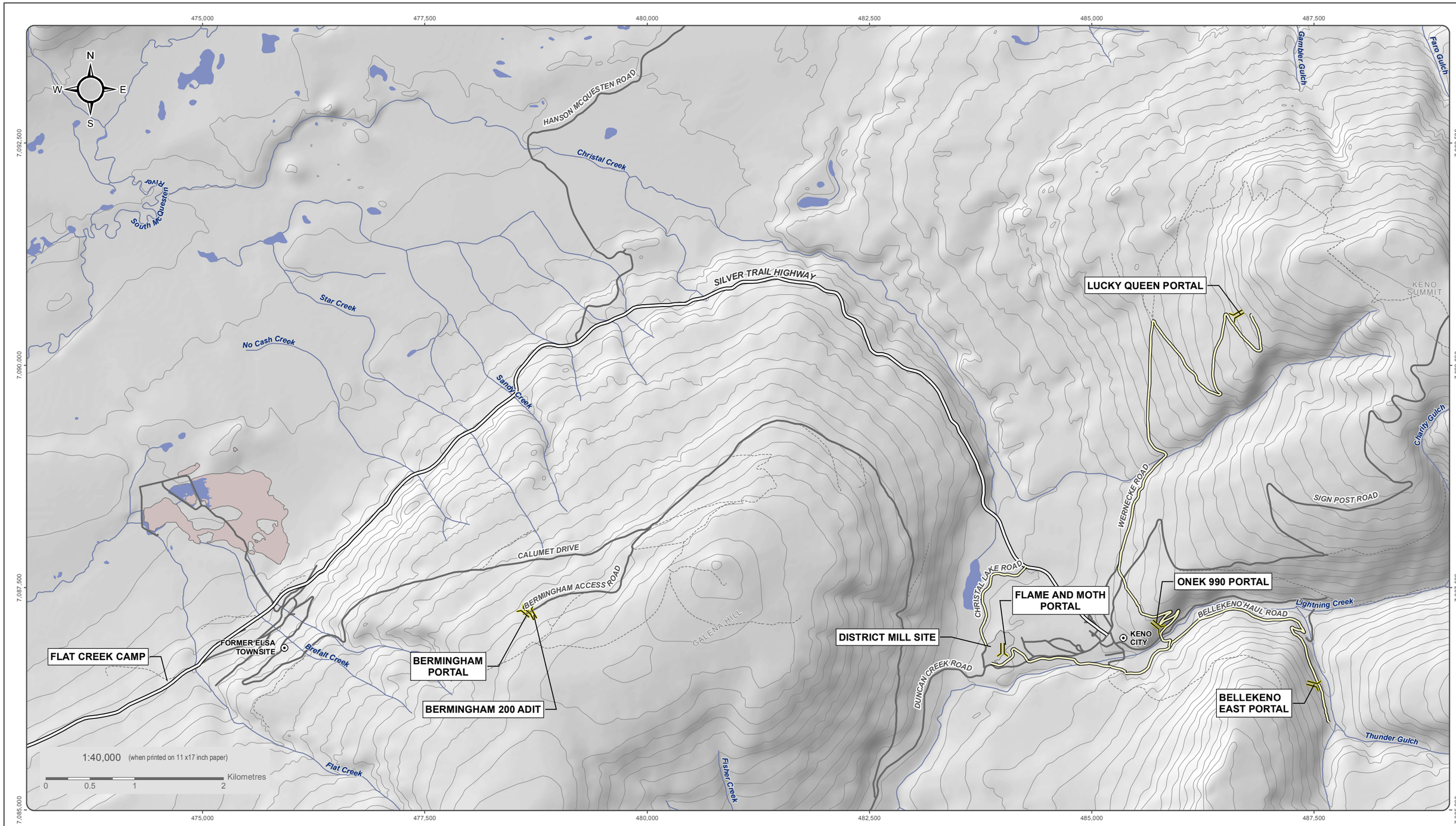
Closure and reclamation planning for the entire KHSD (District Closure Plan – Existing State of Mine (ESM) Reclamation Plan) is currently being developed in accordance with the Amended and Restated Subsidiary Agreement (ARSA) between Alexco and INAC; once approved and permits received this plan will be implemented.

1.2 PROJECT SCHEDULE

Active mining and milling operations are currently suspended at the Keno Hill Mine Operations. Table 1-2 summarizes the project schedule from its current status through the completion of the Life of Mine (LOM) plan. A more detailed project schedule is included as Table 5-3.

Table 1-2 Project Overview

Year	Summary of Main Project Activity
2013	• Suspension of mine/mill operations • District care and maintenance • QML-0009 and QZ12-053 amended for Lucky Queen and Onek Production
2014	• Flame and Moth YESAB assessment and decision document • Surface exploration • District care and maintenance
2015	• Surface exploration, Flame and Moth, Bermingham • District care and maintenance
2016	• QML-0009 amended for Flame and Moth development • Begin development of Flame and Moth underground portal, surface facilities construction • Surface exploration Bermingham • District care and maintenance
2017	• WL QZ12-053 amended for Flame and Moth production • Class IV amended for Bermingham advanced underground exploration • Commence Bermingham advanced underground exploration • District care and maintenance



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Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on January 2018

Datum: NAD 83; Map Projection: UTM Zone 8N

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- Place of Interest
- Adit
- Valley Tailings
- Silver Trail Highway
- Haul Road
- Road
- Limited-Use Road
- Watercourse
- Waterbody

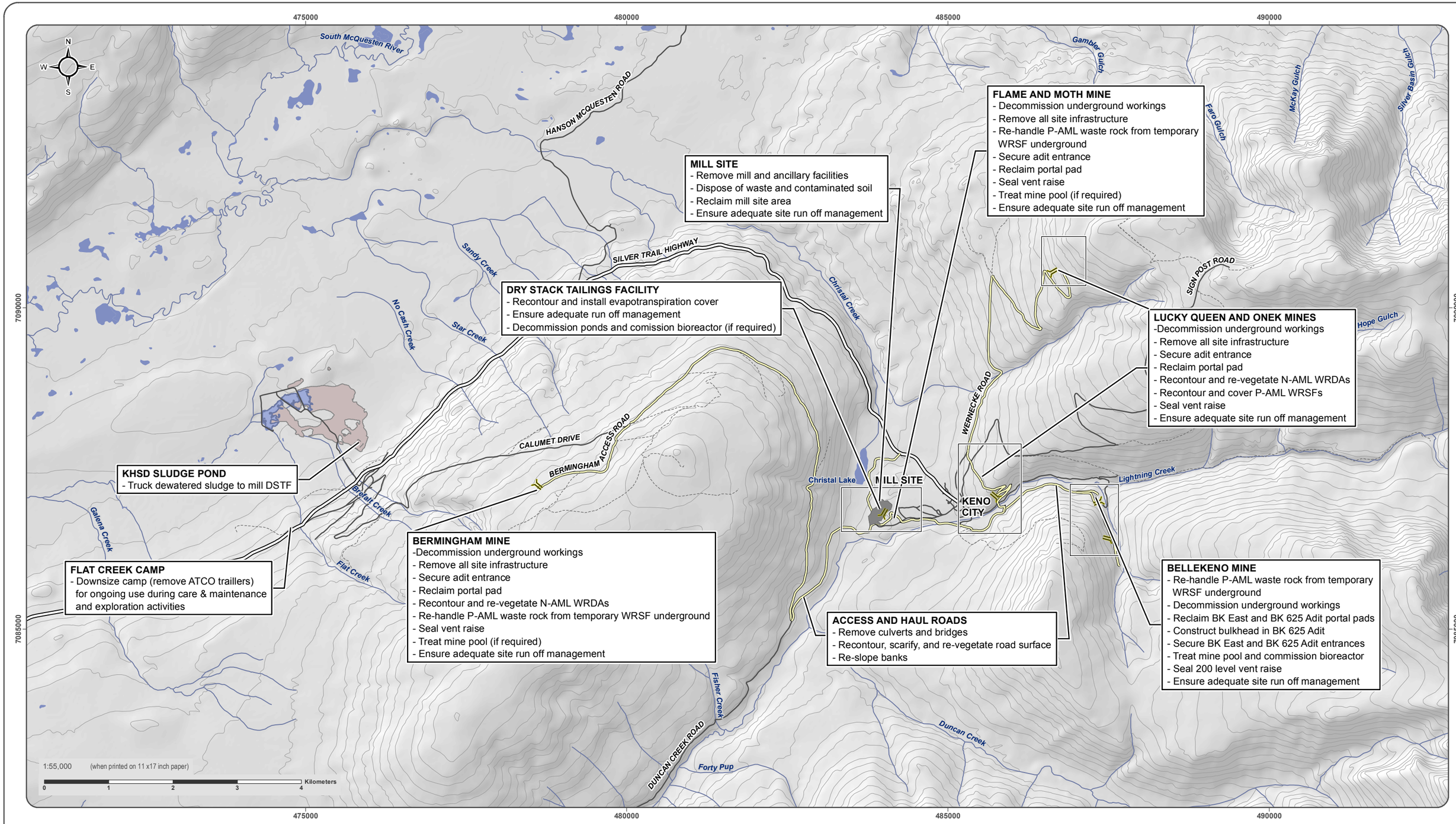
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ALEXCO KENO HILL MINING CORP.
RECLAMATION AND CLOSURE PLAN

FIGURE 1-2
PROPOERTY OVERVIEW

JANUARY 2018

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- MineFeaturesPoint
- Mill Site
- KSSD Sludge Pond
- Waterbody
- Watercourse
- Contours (100 ft intervals)
- Silver Trail Highway
- Other Road
- Limited-Use Road
- Haul Road

AKHM
AEG

KENO HILL SILVER DISTRICT MINING OPERATIONS
RECLAMATION AND CLOSURE PLAN

FIGURE 1-3

SITE RECLAMATION AND DECOMMISSIONING PLAN COMPONENTS

JANUARY 2018

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2. RECLAMATION AND CLOSURE PLANNING

A significant responsibility of Alexco is to develop and implement a closure plan for the historic environmental liabilities (District Closure Plan) associated with past mining practices in the Keno Hill Silver District. This unique agreement and relationship between Alexco/INAC/First Nation of Nacho Nyak Dun (FNNND) provides for significant consultation and collaboration on closure objectives and final options for the development of the District Closure Plan. The knowledge, science and consultation gained from development of the District Closure Plan provides guidance for developing a Reclamation and Closure Plan for the activities associated with Alexco's modern Keno Hill Mine Operations.

Alexco recognizes the importance of developing an RCP for the Keno District Mine Operations that is synchronized and integrated with the District Closure Plan that is currently being developed by the company in conjunction with INAC, Yukon Government and FNNND. Closure objectives, issues, and options are being developed by these four parties in a thorough process that involves field investigations, pilot studies and test work to identify appropriate closure options, supplemented by public/stakeholder consultation, in order to ensure that closure measures with the best potential for success, as viewed by all stakeholders, are selected for implementation.

Alexco acknowledges Yukon Government's mandate and specifications for mine site closure and reclamation. As such, Alexco has developed this RCP to address regulatory and government policy for mine closure. In keeping with its high standards for environmental and social responsibility, Alexco intends to implement environmentally sound and technically feasible decommissioning and reclamation measures for the mining and milling operations included in this RCP. Closure planning and implementation will be undertaken with appropriate environmental care while respecting local laws, First Nations agreements, and the public interest and ensuring that the Company's high environmental standards are achieved. Necessary environmental protection measures have been adopted in the development of this RCP to ensure that a healthy environment exists after closure.

The Mineral Resources Branch outlined requirements to be included in the RCP in a letter to Alexco dated November 18th, 2009 (re: Bellekeno Mine Project QML-0009 – Plan Requirements), consistent with the *Yukon Mine Site and Reclamation Closure Policy* Technical Guidelines. These guidelines also provide direction on reclamation and closure objectives for key features of a mine.

In addition, principles and approaches for reclamation planning from the recently published *Reclamation and Closure Planning for Quartz Mining Projects Guidance Document* (YG and YWB, 2013) are incorporated into the RCP. To achieve its purpose, the guide has the following objectives:

- Describing the context for mine closure planning in the 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; and
- Identify key sources of additional guidance for preparing RCPs and liability estimates.

The guidance document includes: methods for developing fundamental reclamation and closure objectives, methods for conducting community and regulatory engagement, reclamation and closure principles and principles for estimating liability.

2.1 COMPREHENSIVE COOPERATION AND BENEFITS AGREEMENT

Alexco and the FNNND have in place (signed June 2010, updated May 2016) a Comprehensive Cooperation and Benefits Agreement (CCBA).

The CCBA provides a modern, reasonable and fair platform upon which to maximize mutual benefits from our relationship. Importantly, the CCBA both acknowledges the FNNND aboriginal rights and title, and recognizes the legitimacy of our mining leases and grants and other property rights at Keno Hill. Equally important, the CCBA also provides significant social and financial components, including regular business liaison meetings, a full time FNNND Liaison Officer, scholarships, funding to hire consultants so they can participate in environmental permitting reviews such as the RCP and more.

As a result, FNNND is well informed about our applications, and their input is reflected in our project proposals. This is the hallmark of effective voluntary consultation in action, helping us achieve timely permitting of new projects; and through exposure to increasing opportunities brought about by our operations as well as other mining activities in their Traditional Territory.

2.2 CONSULTATION AND ENGAGEMENT

Alexco conducts on going consultation and stakeholder engagement with respect to all of our activities within the Keno Hill Silver District. Consultation and engagement is conducted in a variety of forms, including;

- Community meetings (Whitehorse, Mayo, Keno City);
- FNNND Chief and Council meetings;
- Technical meetings with multiple stakeholders and consultants;
- Site tours; and
- Meetings with regulators.

Often times, consultation and engagement will include a variety of topics and activities within the KHSD, including permitting of new mines, development of the Keno District Closure Plan or general updates.

2.3 RECLAMATION RESEARCH

Reclamation research and field validation of reclamation designs (hereafter collectively referred to as “research”) are an important part of the closure planning process. The results are used to support the site specific refinement of closure measure designs implemented at sites during final closure. There are currently a number of reclamation research and field validation programs underway as part of the District Closure Plan that are co-funded and managed by Alexco as well as reclamation research and progressive reclamation directly related to the Keno Hill Mine Operations. These current programs

have direct application to the reclamation and closure of the Keno Hill Mine Operations and Alexco will continue to utilize the research programs underway within the District Closure Plan for planning and optimization of the Keno Hill Mining Operations RCP. The following reclamation research programs are currently in progress and the results will be utilized for reclamation and closure planning of the Keno Hill Mine Operations:

- Progressive reclamation on the DSTF;
- Cover system design and field trials;
- Site revegetation field trials;
- Bioreactor trials;
- Natural attenuation studies (Appendix 1.5); and
- In situ mine pool demonstration at Silver King.

Details and summary reports of the ongoing and completed reclamation research programs are included in Appendix 1. Alexco will continue to pursue both new research and field validation programs of reclamation during the ongoing update and optimization to the Keno Hill Mine Operations RCP. Details on any reclamation research programs will be included in subsequent revisions to this RCP.

2.4 DATA COLLECTION PROGRAMS AND DEVELOPMENT OF DESIGN PARAMETERS

Data collection programs are currently underway at the Keno Hill District to assist in delineating site conditions and defining design parameters for closure measures. These data include:

- Surface water quality and hydrology;
- Groundwater quality and quantity;
- Waste rock geochemistry;
- Tailings geochemistry;
- Meteorology;
- Sediment quality; and
- Benthic community health.

Numerous studies have been completed on the vast quantity of data that has been collected under the data collection programs. Of them, many have been carried out in an effort to support closure of the Keno Hill District (the former United Keno Hill Mines). Much of this work can be carried over to support operation and closure of the Keno Hill Mine Operations. Moreover, much of the data that has been collected will be reassessed separately to define design parameters.

Data collected to-date as a part of both baseline and production monitoring programs has been compiled and is presented in Appendix 2.

3. CLOSURE OBJECTIVES AND DESIGN CRITERIA

Yukon Government EMR has developed a schedule which details specific objectives for the RCP to achieve in closure. The objectives of that schedule are reproduced here and referenced according to where in the RCP they are adhered to (Table 3-1). A schedule outlining requirements for terrestrial performance standards has also been developed and is summarized in Table 3-2.

Closure objectives can be considered in terms of the following key areas:

a. (geo)chemical stability;

b. water quality;

c. physical stability; and

d. land use, aesthetics and public health and safety.

Closure principles and objectives work to ensure both physical stability and chemical stability of the site in the long term and are reflective of the guidelines derived from YG's Reclamation and Closure Policy. The effectiveness of closure measures implemented from this RCP will be the subject of review by regulatory agencies and under the Quartz Mining Act, the company would be able to apply for a certificate of closure from the Yukon Government once there is agreement with their effectiveness. The following primary closure objectives were emphasized during the development of this plan.

1 **Protect Public and Worker Health and Safety**

2 **Protect and Restore the Environment by:**

   i. incorporating progressive reclamation where possible;

   ii. providing slope stabilization and erosion control on linear and non-linear disturbances;

   iii. ensuring long-term chemical stability of the N-AML waste rock disposal areas and components constructed from waste rock to minimize effects to downstream aquatic resources;

   iv. ensuring the long term chemical stability of materials placed into the dry stack tailings facility;

   v. ensuring the long-term physical stability of key structures such as the dry stack tailings facility, Bellekeno, Bermingham, Flame and Moth, Onek 990 and Lucky Queen portals, P-AML waste rock storage facilities, and access roads; and

   vi. conducting post closure monitoring of the site and adaptive management to assess effectiveness of closure measures for the long term.

3 **Ensure Land Use Commensurate with Surrounding Lands**

4 **Ensure Meaningful Participation of the FNNND**

5 **Ensure Cost Effectiveness**

6 **Realize a Walk-away Closure Scenario**

Table 3-1 EMR RCP Requirements Reference List

Closure Plan Requirement	Document Location
(a) A statement of the objectives to be achieved as a result of reclamation and closure of the site;	**Section 3**
(b) an analysis of the measures required to be implemented to ensure the ongoing physical and chemical stability of the site;	Bellekeno Mine (**Section 7.1.2**) Onek Mine (**Section 7.1.4**) Lucky Queen Mine (**Section 7.1.6**) Flame and Moth (**Section 7.1.8)** Bermingham (Section **(7.1.10)** Dry Stack Tailings Facility (**Section 7.2**) Waste Rock (**Section 7.3**) Mill and Infrastructure (**Section 7.5.5**) Camp (**Section 7.5.6**) Roads (**Section 7.7**)
(c) a description of how the Licensee will meet the performance standards set out in Schedule 1 (attached to this letter) unless other standards are agreed to in writing by the Chief in advance of submission of the plan;	**Table 3-2**
(d) target indicators to ensure that reclamation objectives have been met;	**Table 3-3**
(e) engineered (stamped or sealed) designs for the closure of all engineered structures, works, and installations associated with the Undertaking, including embankments and other containment structures, dry stack tailings facility, spillways, diversion ditches, waste rock and overburden dumps, the Bellekeno Haul Road and any other roads at the site, and ore stockpiles	**Section 7 and appendices**
(f) a program and implementation schedule for the removal of all infrastructure at the site, including the mill and all infrastructure, camp and roads	**Section 7.5**
(g) a program and implementation schedule for ensuring the long term stability and closure of the dry stack tailings facility and waste rock storage facilities	Dry Stack Tailings Facility (**Section 7.2**) Waste Rock Storage Areas (**Sections 7.3**)
(h) a program and implementation schedule for progressive reclamation to be carried out during development and production	**Section 6.1**
(i) a program for revegetation of disturbed areas, including a description of how soils will be tested for quality and quantity of nutrients and organic matter to support plant growth and a description of the seed mix to be utilized;	**Section 7.9**
(j) details of the covers (if any) to be placed over the non acid generating or metal leaching and the potentially acid generating or metal leaching waste rock storage facilities and dry stack tailings facility;	**Section 7.9**
(k) a monitoring and maintenance program and implementation schedule to obtain surface and hydrogeological information adequate to verify that the reclamation objectives and discharge requirements applicable for all engineered structures, works and installations are met at closure and post-closure;	Closure Monitoring and Maintenance (**Section 7.10**) Adaptive Management (**Section 7.11.3**)
(I) a cost estimate to implement the plan, including a cost estimate for post closure monitoring, inspections, interim care and maintenance;	**Section 9**
(m)details respecting maintenance of security at the site, including any requirements for continuous care by an on-site caretaker, during reclamation and closure and post closure;	**Section 8**
(n) updates on the collection and interpretation of hydrogeological information, related geochemical effects and water discharge from the mine;	**Section 7.1.2**
(o) a program and implementation schedule for determining the effects on the receiving environment during closure and post-closure, including details of monitoring of geochemical and physical stability of all facilities at the Site and other matters as appropriate;	**Section 7.2**
(p) description of the quantity and quality of available organic material and borrow material stockpiles for use in reclamation;	**Section 7.8**
(q) list of equipment required to be on-site to ensure that the Licensee can provide an adequate response to an unexpected water flow or level, a spill or a release of a hazardous substance;	**Section 8**
(r) details of how technological developments and best management practices will be incorporated into the plan over time;	**Section 6.4**
(s) details respecting management of a temporary closure, including the following:	**Section 6**
(i) how the Licensee will secure the site during a temporary closure and ensure that all engineered structures, works and installations remain stable;	**Section 6.2**
(ii) how all engineered structures, works, and installations required to resume mining, milling, hauling and waste treatment will be maintained in good order on the site during a temporary closure;	**Section 6.1**
(iii) how the various roads under the control of the Licensee at the site will be monitored and controlled to prevent public use where appropriate and ensure public safety;	**Section 9.1**
(iv) a list equipment required to be on-site ensure that any unexpected water flows or levels or other contingencies are properly managed by the Licensee to protect the environment and human safety;	**Section 7.1.2**
(vi) monitoring and reporting schedules for ensuring the geochemical and physical stability of all engineered structures, works, and installations associated with the Undertaking, and	**Sections .10**
(vii) a cost estimate to implement (i) to (vi), as well as any other activities to be undertaken for a temporary closure of five years.	**Section 9**

Table 3-2 Schedule 1 Requirements for Terrestrial Performance Standards

Technical Guideline #	Theme	Closure Objective	Document Reference
T-01	Water Retention and Sediment Control Structures	Ensure decommissioning of water retention and sediment control structures, and their appurtenances, in such a way that drainage at, and adjacent to the site, is stable in the long term.	Existing water treatment ponds will be decommissioned and reclaimed (see Section 7.4 for the Bellekeno Mine water treatment facility; Section 7.5.5 for the Mill Pond; Section 7.5.1 for Bellekeno East water storage ponds; Section 7.5.2 for Onek water storage ponds; Section 7.5.3 for Lucky Queen water storage ponds. 7.5.4 Flame and Moth Treatment Pond and 7.5.5 for Bermingham water ponds
T-02	Watercourses	Restore watercourses to meet current water management objectives (in accordance with the approved reclamation and closure plan).	Watercourses have not been physically altered by mining activities
T-03	Water Quality	Prevent contamination of receiving environments. Following decommissioning, water quality must consistently meet the requirements of applicable territorial and federal legislation. Recognition will be given to background levels of substances occurring prior to start of operations	A bioreactor will be installed in the current water treatment ponds at the Bellekeno Mine for treatment of mine discharge (see Section 7.4.2). If monitoring indicates seepage from the DTSF requires treatment, a bioreactor will be installed.
T-04	Site Contamination	Prevent exposure to and mobilization of substances that pose a risk to human health and the environment through physical and chemical stability	Section 7
T-05	Potential Acid Rock Drainage	Walk-away solution	P-AML and AML waste rock is being stored in a temporary lined facility during operations, and will be rehandled back to the underground below the long-term static water level of the mine at closure. Additional permanent PAML storage facilities will be constructed according to approved engineering designs, if necessary (see Section 7.3)
T-06	Tailings Management	Ensure physical and chemical stability in the long term and eliminate the need for active treatment	The DSTF will be constructed in a manner that is physically stable and covered with a water shedding cover at closure to prevent infiltration and promote vegetation (see Section 7.2)
T-07	Underground Workings and Openings to Surface	Meet water quality objectives Except for authorized access, prevent inadvertent or intentional underground access that may be a hazard to humans and wildlife Prevent subsidence or changes in the topography that may result in a hazard to humans or wildlife	A rock pile will be constructed to close access to the Bellekeno East Adit (Section 7.1.2), Onek 990 adit (Section 7.1.4), Bermingham (Section 7.1.10) and Flame & Moth adit (Section 7.1.8); an adit bulkhead will be installed at the Bellekeno 625 Adit and Lucky Queen Adit to prevent access and provide the ability to manage water discharge (Sections 7.1.5 and 7.1.6); an engineered cap will be placed at the 200 Level Vent Raise (Section 7.1.3)
T-08	Terrain Hazards	Terrain hazards at the site should be no more significant hazard to people and wildlife than is present in the surrounding vicinity	Section 7
T-09	Mine Rock Piles	Rock piles and dumps must be physically and chemically stable in the long term to prevent erosion, subsidence or collapse, and such that dump runoff and surface drainage meet legal requirements	Waste Rock will be stored in approved, engineered facilities and covered and revegetated at closure (see Section 7.3)
T-10	Roads and Other Access	Protect public safety. In decommissioning linear infrastructure, enable pre-mining human and wildlife utilization of the area. If however, an alternative future land use is identified, alternative objectives may be identified	Road decommissioning will occur in a manner commensurate with EMR's Yukon Mine Site and Reclamation Closure Policy (see Section 7.7.1)
T-11	Erosion Control	Physical stability such that upon closure, slopes, excavations and other disturbed lands are in a condition that will limit the incidence of soil erosion, slumping and other instabilities that are likely to impede revegetation of a reclaimed site, pose a threat to public safety, lead to wildlife mortality or because excessive sediment loads to enter nearby water bodies	Slopes will be regraded to at least 2.5H:1V or better, for physical stability
T-12	Re-vegetation	Ensure physical stability and prevent a temporary loss of wildlife habitat utilization from becoming permanent by re-establishing a vegetative mat (food source, hide, etc.) leading to self-sustaining natural revegetation	Revegetation will occur in a manner that meets or exceeds EMR's Yukon Mine Site and Reclamation Closure Policy (see Section 2.4)
T-13	Mine Infrastructure	Ensure physical stability and to remove potential threats to public health and safety, including identification and removal of hazards and hazardous materials	All infrastructural buildings and equipment will be removed and transported offsite for salvage at the end of mine life (see Section 7.5)
T-15	Temporary Closure Site Conditions	Ensure public health and safety and protection of the environment in the event of a temporary closure and to manage risks associated with potential abandonment of the site	Section 6
T-16	Geological Values and Heritage	Ensure post-closure access to geological information obtained both leading up to and during mineral development and production at a mine site	Not applicable

3.1 INTEGRATION WITH DISTRICT-WIDE CLOSURE PLANNING

Closure Objectives that were developed with and agreed to by Alexco/ERDC, Canada (INAC), FNNND, and Yukon to guide the development of the District Closure Plan are further presented in this section. These objectives will guide the selection of preferred closure options and the implementation of the final ESM Reclamation Plan. The final version of the ESM Reclamation Plan has been submitted to INAC for approval and will enter the environmental assessment process in Q1 2018. The intent of the Keno District Mine Operations RCP is to ensure that the site-specific objectives are aligned with the ESM Reclamation Plan objectives. There are six primary objectives that have been finalized to guide the ESM Reclamation Plan, which have a number of sub-objectives that are intended to help define how the specific primary objective they relate to will be achieved.

1 **Protect Public and Worker Health and Safety**

   i. Prevent, minimize or mitigate any adverse effects on the health and safety of people using the land and water.

   ii. Prevent, minimize or mitigate any adverse effects on the health and safety of people working at the site.

2 **Protect and Restore the Environment**

   i. Prevent, minimize or mitigate adverse effects on the aquatic environment.

   ii. Prevent, minimize or mitigate adverse effects on the terrestrial environment.

3 **Restore Mine Site to a State that Supports Community and Traditional Land Uses**

   i. Minimize access restrictions.

   ii. Reclaim disturbed areas to support future community and traditional land use.

   iii. Preserve identified historical resources.

4 **Maximize First Nation, Local, and Yukon Socio-economic Benefits**

   i. Maximize training, capacity building, and employment and business opportunities for First Nation citizens.

   ii. Maximize training, capacity building, and employment and business opportunities for local residents and Yukoners.

5 **Minimize Project Related Liability and Risk**

   i. Minimize risks associated with project implementation.

   ii. Minimize post-closure residual liabilities.

   iii. Minimize post-closure risks.

6 **Minimize Cost**

   i. Minimize project implementation costs.

   ii. Minimize post-closure operations and maintenance costs.

3.2 CLOSURE AND DESIGN CRITERIA

Reclamation completion criteria will be used to assess the final reclamation obligations for the Keno District Mine Operations closure. These criteria will establish benchmarks to be used in determining when decommissioning, reclamation and monitoring programs have been completed and passive management has been implemented and maintained. The three stages of reclamation used to reach closure criteria are:

1. Decommissioning – removal of structures and creation of safe geotechnical structures, removal of contaminants, implementation of water management/treatment facilities and recontouring/revegetation.
2. Rehabilitation - the return of the disturbed site to a form and productivity level that is consistent with the closure objectives. Water management/treatment facilities are in place and operational, revegetation is complete and post closure maintenance and monitoring is underway.
3. Completion Criteria Conformance - monitoring and demonstration of establishment of sustainable reclamation features.

3.3 SITE CONDITIONS FOR COMPLETION CRITERIA

Completion criteria presented for the Keno District Mine Operations ensure that the closure measures meet overall objectives of mine site reclamation. The objectives of the completion criteria can be considered under the following three site conditions: physical stability, chemical stability, and biological stability.

3.4 PHYSICAL STABILITY

Physical stability is ensured by protecting the surface against wind and water erosion, providing for surface drainage, minimizing hazardous conditions, and contouring the surface to meet land capability objectives. Physical structures such as underground openings, sedimentation and treatment ponds, spillways, surface openings and waste rock storage areas will meet the following requirements:

- Be physically stable and designed in accordance with acceptable design criteria;
- Pose minimal hazard to the public and wildlife health and safety as a result of failure or physical deterioration;
- Continue to perform the function for which they were designed; and
- Have stable land surfaces with minimal surface erosion.

3.4.1 Chemical Stability

The reclaimed mine sites within the Keno Hill District will be chemically stable. This means surface waters and groundwater will be protected against significant adverse environmental effects resulting from discharges. In addition, discharges will not endanger public and wildlife health and safety, nor result in unacceptable deterioration of environmental resources.

Aspects to be monitored closely will include short-term and long-term changes in underground mine pool water quality seepage and runoff from the DSTF and waste rock storage areas and the chemistry of surface water draining from the site. Potential effects due to any acid rock drainage via surface or ground water will be mitigated. The success of physical reclamation will influence chemical and physical stability.

3.4.2 Biological Stability

The biological stability of the closed sites and potential effects on the surrounding environment are closely related to methods of reclamation, the end land use, and the physical and chemical characteristics of the site. Biological stability to vegetation and wildlife habitats is reached when these habitats are stable, self-sustaining, and productive, and meet the closure objectives.

3.5 COMPLETION CRITERIA FOR MINE AREA COMPONENTS

Each of the Mine Area Components will reach their completion criteria at varying times in the operations and post-mining period, but all will follow the same three stages of reclamation in systematic order. In addition, adjustments to the reclamation schedule will be expected due to modifications made from new innovations in reclamation practices, seasonal climate variability and/or geotechnical setbacks. Table 3-3 provides a general overview of each Mine Area Component and the site conditions associated with meeting completion criteria.

Table 3-3 Keno Hill Mining Operations Reclamation Units Completion Criteria

Reclamation Units		Completion Criteria Conditions		
		Physical Stability Requirements	Chemical Stability Requirements	Biological Stability Requirements
Underground Mines				
	Bellekeno Onek Lucky Queen Flame and Moth Bermingham	Salvageable equipment removes. All other equipment cleaned of hydrocarbons Infilling of underground stopes with P-AML waste rock and tailings material Mine openings stabilized, barricaded and free-flowing with respect to water, where applicable	All chemicals and contaminants remediated or removed	N/A
Waste Rock Storage Facilities and Disposal Areas				
	Bellekeno Benched N-AML WRDA Bellekeno Temporary P-AML Facility Onek Permanent P-AML Facility Lucky Queen Permanent P -AML Facility Lucky Queen N-AML WRDA Flame and Moth Temporary P-AML Facility Bermingham Temporary P-AML Bermingham WRDA	Stable slopes WRSFs covered where applicable No significant wind or water erosion	No acid rock drainage or metal leachate seepage concerns	Safe wildlife access
Water Management Structures				
	Treatment Facility Settling Ponds Mill Process Pond	All impediments to normal hydrologic conditions broken down to re-establish hydrologic flow BK 625 ponds converted to geotechnically-stable bioreactors; mill pond liner removed and stable	All chemicals and contaminants remediated or removed	Safe ingress/egress for wildlife

Reclamation Units		Completion Criteria Conditions		
		Physical Stability Requirements	**Chemical Stability Requirements**	**Biological Stability Requirements**
Water Diversion Structures				
	DSTF diversion berms	No significant erosion along channel banks and banks of dam structures	All chemicals and contaminants removed	
Sedimentation Pond				
		No exposed sedimentation areas No significant wind erosion	Effluent quality requirements as required by the Water License	
Mill Site				
	Mill Building Mill Office and Dry Electrical Substation Crushing Plant Fine Ore Stockpile Crusher MCC Assay Lab Mill Motor Control Centre Fresh Water Tank Diesel Storage Tanks Propane Tank Mill Wastes Buried Infrastructure	All infrastructure disassembled and removed Infrastructure supports and foundations removed or buried and berms broken down	All processing chemicals, contaminants and ore stockpiles removed	Sustainable vegetation cover
Dry Stack Tailing Facility				
	DSTF Phase I DSTF Phase II	DSTF covered with evapo-transpirative cover and vegetation No significant erosion or infiltration Tailings geotechnically stable	Any seepage reporting to Christal Creek watershed will not exhibit an adverse (measurable?) impact	Wildlife access

Reclamation Units		Completion Criteria Conditions		
		Physical Stability Requirements	**Chemical Stability Requirements**	**Biological Stability Requirements**
Bridges and Culverts				
	Lightning Creek Bridge (Keno City Bypass Road) Lightning Creek Bridge (Bellekeno Haul Road) Culverts	Stream and cut banks are stable and have no significant erosion Lightning Creek bridge is removed	All chemicals and contaminants remediated or removed	
Flat Creek Camp				
		Camp downsized to pre-production level Areas where camp buildings have been removed are stable with no significant wind or water erosion	All chemicals and contaminants remediated or removed	Sustainable vegetation cover
Linear Disturbances				
		No significant erosion along road banks and areas where culverts have been removed	All chemicals and contaminants remediated or removed	Sustainable vegetation cover

4. ENVIRONMENTAL AND SOCIO-ECONOMIC DESCRIPTION

The Keno Hill Mine Operations are within the traditional territory of the First Nation of Nacho Nyak Dun (FNNND) and near the communities of Keno City and Mayo. The area has been shaped by mineral development over the past hundred years. Silver and lead ore deposits were discovered on Keno Hill in the early 1900s and the area has since seen fluctuating levels of ongoing quartz and placer mining and exploration. Today, the area supports not only mineral development, but also tourism, recreation, traditional pursuits, as well as the local people.

Table 4-1 summarizes existing environmental conditions in the Keno Hill Mine Operations project area. The Keno Hill Silver District lies within the Yukon Plateau – North Ecoregion, just south of the Wernecke Mountains. The terrain consists of concordant, rolling, upland areas separated by wide valleys. Alpine mountain peaks extend above the uplands locally. Many valleys include peatlands, palsas, fens and meadows of sedge tussocks. Upper slopes may be covered with scree material, with treeline occurring at 1,350 to 1,500 metres above sea level (masl). The area has been influenced by the latest glaciation but shows more subtle evidence of an earlier event as well.

Table 4-1 Keno Hill Silver District Environmental Setting Summary

Drainage Region	Stewart River drainage region
Significant Watersheds	McQuesten River, Lightning Creek and Stewart River Watershed, Mayo River
Ecoregion	Yukon Plateau (North)
Study Area Elevation	900-1350 masl
Vegetation Communities	Northern boreal forests occupy lower slopes and valley bottom; spruce, pine and alder; grasses and sedges, mosses occupy forest floor; heavy moss and lichen growth resident as ground cover understory of shrub willow; open and forest fringe areas of willow and scrub birch, and various flowering plant species.
Wildlife Species	Moose, grizzly and black bear, caribou, beaver, wolf, lynx, marten, wolverine, western tanager, magnolia warbler, white-throated sparrow, bald eagle, furbearers and small animals. Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed species include: Common Nighthawk (Threatened); Rusty Blackbird and Olive-Sided Flycatcher (Special Concern).
Fish Species	Bering and Beaufort Sea salmonids and freshwater species, including: Arctic grayling, Arctic char, lake trout, trout perch, lake whitefish, broad whitefish, burbot, inconnu, Arctic Cisco, Northern pike, slimy sculpin

4.1 CLIMATE

The Keno Hill Silver District and central Yukon climate is characterized by a subarctic continental climate with cold winters and warm summers. Average temperatures in the winter are between -15 and -20 degrees Celsius (°C) but can reach -60°C. The summers are moderately warm with average temperatures in July around 15°C. Mine and mill operations can be carried out year-round.

Because of its northern latitude, winter days are short with the sun low on the horizon such that north facing slopes can experience ten weeks without direct sunlight around the winter solstice. Conversely, summer days are very long, especially in early summer around the summer solstice. Annual precipitation averages 270 millimeters (mm); it is estimated that about 46% of this amount falls as snow, which starts to accumulate in October and remains into May or June.

Site meteorological data are collected at three meteorological stations: one located on Galena Hill above the Hector adit (elevation of 1,280 masl), one located adjacent to the District Mill and DSTF (at an elevation of 936 masl) and one located near the valley Tailings (elevation of 718 masl). Table 4-2 summarizes data collected to date at the Keno District Mill Campbell Scientific meteorological station, which is the station with the most complete data record at site. The sensors on this station include air temperature, relative humidity, total precipitation, pyranometer, and wind speed and direction.

Table 4-2 Monthly Statistics for the Keno District Mill Meteorological Station, 2011-2017

Month	Extreme Maximum Temperature (°C)	Average Maximum Temperature (°C)	Average Temperature (°C)	Average Minimum Temperature (°C)	Extreme Minimum Temperature (°C)	Average Relative Humidity (%)	Total Precip (mm) [10]	Average Wind Speed (m/s) [1]	Extreme Maximum Wind Speed (m/s) [1]	Average Solar Radiation (W/m²)	Total Evapo-transpiration (mm)[8]
Jun - 11[2]	24.72	18.59	11.96	6.30	-2.56	n/a	n/a	1.35	9.14	n/a	n/a
Jul-11	25.67	18.50	12.91	8.00	5.09	n/a	n/a	1.15	8.02	n/a	n/a
Aug-11	22.32	15.58	9.78	5.37	1.93	n/a	n/a	1.18	9.15	n/a	n/a
Sep-11	17.97	11.29	6.07	1.85	-2.47	n/a	n/a	1.43	11.36	n/a	n/a
Oct-11	7.20	0.20	-2.74	-5.41	-9.84	n/a	*2.60*[3]	0.94	13.12	n/a	n/a
Nov-11	-4.23	-16.79	-19.54	-22.47	-34.99	n/a	0.00	0.58	12.05	n/a	n/a
Jan-12	-0.96	-19.10	-23.13	-26.79	-37.32	n/a	0.00	*0.59*	*9.51*	n/a	n/a
Feb-12	2.77	-6.77	-10.00	-13.07	-26.78	n/a	0.10 [4]	*1.38*	*15.62*	n/a	n/a
Mar-12	5.33	-7.69	-13.37	-18.00	-27.80	n/a	0.00	*0.97*	*9.24*	n/a	n/a
Apr-12	9.69	6.13	0.96	-3.87	-15.92	n/a	0.60 [4]	1.37	10.27	n/a	n/a
May-12	17.78	10.73	6.31	1.91	-3.47	*51.81* [5]	18.30	1.78	10.60	n/a	n/a
Jun-12	27.62	18.41	13.46	8.29	4.42	56.35	21.70	1.44	10.26	n/a	n/a
Jul-12	25.14	18.07	12.75	7.73	1.64	69.26	85.80	1.36	12.99	n/a	n/a
Aug-12	21.72	16.31	11.25	6.56	-0.89	67.79	47.00	1.62	9.41	n/a	n/a
Sep-12	20.24	10.33	5.90	2.08	-5.22	69.51	36.40	1.84	14.27	n/a	n/a
Oct-12	7.60	-3.95	-7.35	-10.32	-20.62	79.54	7.60	1.13	10.37	n/a	n/a
Nov-12	-8.98	-19.55	-21.90	-24.32	-33.36	81.43	0.00	0.94	9.36	n/a	n/a
Dec-12	-3.36	-21.30	-23.44	-25.58	-36.32	81.34	0.00	*0.26*	*5.93*	*1.01* [6]	*0.05* [7]
Jan-13	-1.59	-17.06	-20.01	-23.08	-41.48	82.92	0.00	*0.76*	*14.48*	1.06	0.81
Feb-13	1.54	-9.10	-12.52	-15.46	-23.74	88.36	0.30 [4]	*0.85*	*12.25*	10.26	1.27
Mar-13	3.26	-7.52	-13.16	-17.99	-29.96	64.08	3.90	1.59	12.47	95.82	6.33

Month	Extreme Maximum Temperature (°C)	Average Maximum Temperature (°C)	Average Temperature (°C)	Average Minimum Temperature (°C)	Extreme Minimum Temperature (°C)	Average Relative Humidity (%)	Total Precip (mm) [10]	Average Wind Speed (m/s) [1]	Extreme Maximum Wind Speed (m/s) [1]	Average Solar Radiation (W/m²)	Total Evapo-transpiration (mm)[8]
Apr-13	6.07	-2.76	-7.94	-13.69	-25.07	54.50	8.20	2.44	12.93	190.02	14.48
May-13	23.31	10.20	5.27	0.23	-9.46	61.83	39.60	1.77	11.76	215.44	21.70
Jun-13	30.51	19.97	14.27	8.30	1.84	58.72	57.30	1.82	12.87	234.69	29.79
Jul-13	24.93	19.40	14.01	8.60	2.25	62.67	46.90	1.75	16.14	211.00	27.10
Aug-13	27.34	18.54	12.98	8.01	-0.38	66.30	51.90	1.49	11.05	156.25	21.38
Sep-13	16.11	9.69	5.81	2.26	-3.74	77.52	59.70	1.54	10.99	79.69	10.88
Oct-13	8.25	1.61	-1.32	-4.21	-10.10	86.75	44.60	1.11	11.62	35.75	4.26
Nov-13	0.18	-13.41	-16.68	-20.08	-37.96	84.26	10.60	*1.02*	*10.96*	4.93	*1.08*
Dec-13	-1.73	-21.23	-23.91	-26.70	-35.29	78.77	4.90	*0.75*	*9.47*	0.57	*0.62*
Jan-14	3.74	-9.33	-12.16	-15.10	-32.22	89.44	24.9	*0.72*	*10.03*	2.42	*0.641*
Feb-14	-1.93	-15.25	-19.40	-23.02	-33.55	75.20	2.9	0.87	10.85	31.34	1.988
Mar-14	4.57	-5.31	-11.29	-16.16	-26.79	54.77	0.7	1.57	11.98	115.54	9.174
Apr-14	10.93	4.09	-0.96	-5.78	-17.33	57.54	5.1	1.64	12.05	171.28	15.77
May-14	21.30	12.70	7.64	2.03	-3.03	52.18	12.8	2.09	19.21	217.91	29.81
Jun-14	24.93	16.21	11.39	5.95	-0.13	56.14	40.4	1.78	10.43	217.90	28.58
Jul-14	23.44	18.49	13.68	8.73	-0.04	65.01	31.0	1.63	13.38	187.31	23.84
Aug-14	22.09	15.57	10.87	6.93	0.06	74.59	67.7	1.44	11.85	139.84	15.72
Sep-14	17.70	8.76	4.28	0.49	-6.74	70.54	36.4	1.37	11.32	93.38	11.56
Oct-14	7.47	-0.91	-3.79	-6.33	-15.42	88.21	15.7	1.24	12.80	24.83	3.39
Nov-14	-2.21	-12.15	-14.34	-16.59	-30.16	88.64	1.40	*0.59*	*6.27*	3.12	*0.60*
Dec-14	-0.09	-11.05	-13.67	-16.31	-26.66	89.06	1.40 [9]	*0.51*	*8.87*	0.33	*0.40*
Jan-15	-0.34	-13.74	-16.50	-19.13	-34.86	85.85	1.9	*0.49*	*5.488*	1.30	*0.431*
Feb-15	2.87	-12.95	-15.93	-18.78	-39.39	84.95	12.7	0.75	10.36	9.06	0.859

Month	Extreme Maximum Temperature (°C)	Average Maximum Temperature (°C)	Average Temperature (°C)	Average Minimum Temperature (°C)	Extreme Minimum Temperature (°C)	Average Relative Humidity (%)	Total Precip (mm) [10]	Average Wind Speed (m/s) [1]	Extreme Maximum Wind Speed (m/s) [1]	Average Solar Radiation (W/m²)	Total Evapo-transpiration (mm)[8]
Mar-15	5.54	-4.76	-9.83	-14.37	-28.70	70.52	4.1	1.45	12.6	86.48	6.292
Apr-15	10.90	5.36	0.56	-3.89	-10.48	61.71	4.2	1.75	12.37	163.45	16.03
May-15	26.51	16.95	10.96	4.60	-7.00	45.35	1.4	1.89	10.64	246.80	34.67
Jun-15	23.18	16.65	11.37	5.81	0.52	61.05	26.3	1.85	12.62	219.18	26.46
Jul-15	25.43	17.54	12.54	7.72	4.73	68.63	72.4	1.48	12.62	190.74	19.98
Aug-15	24.63	14.03	9.35	5.08	-3.09	75.14	54.9	*1.47*	*9.86*	146.76	*13.87*
Sep-15	13.57	7.07	2.77	-0.72	-7.72	79.33	32.6	1.71	15.64	83.01	10.12
Oct-15	7.32	0.88	-1.78	-4.16	-13.22	89.14	19.4	*1.08*	*10.07*	32.52	*2.92*
Nov-15	0.83	-11.17	-13.75	-17.16	-31.38	89.09	22.8	*0.71*	*12.15*	4.03	*0.60*
Dec-15	0.18	-12.38	-14.60	-16.93	-31.06	89.01	4.0	*4.59*	*14.24*	0.63	*0.13*
Jan-16	1.17	-8.96	-11.14	-13.58	-21.91	88.06	24.9	*0.83*	*15.35*	1.67	*1.45*
Feb-16	2.04	-7.63	-10.94	-14.27	-26.68	82.96	2.3	0.86	9.55	22.80	2.32
Mar-16	12.35	-0.55	-4.96	-8.72	-16.96	73.13	7.1	1.26	8.11	82.81	7.12
Apr-16	13.50	7.12	2.28	-2.23	-12.45	63.20	3.8	1.64	10.66	159.95	15.86
May-16	22.80	13.61	8.44	3.04	-1.59	54.73	14.7	1.89	11.89	210.96	25.97
Jun-16	25.98	18.36	12.88	7.17	2.27	56.52	40.0	1.76	13.37	234.99	29.78
Jul-16	23.73	17.71	13.37	9.07	1.71	73.05	63.4	1.46	12.54	173.59	17.36
Aug-16	24.42	16.67	11.92	7.82	1.22	70.86	42.2	1.50	10.69	152.32	17.72
Sep-16	17.42	10.00	5.01	0.90	-6.18	71.05	28.9	1.50	10.81	100.94	14.02
Oct-16	2.43	-3.20	-7.07	-9.99	-17.15	79.60	11.4	1.12	8.29	50.66	4.15
Nov-16	4.05	-8.20	-10.89	-13.45	-25.46	86.45	7.6	*0.80*	*9.57*	5.70	*1.99*
Dec-16	-4.20	-17.39	-19.62	-21.89	-32.16	83.76	1.3	*0.62*	*8.45*	0.56	*0.51*
Jan-17	-0.10	-13.10	-16.04	-18.97	-33.59	82.95	0.8	*1.06*	*11.03*	1.64	*1.76*

Month	Extreme Maximum Temperature (°C)	Average Maximum Temperature (°C)	Average Temperature (°C)	Average Minimum Temperature (°C)	Extreme Minimum Temperature (°C)	Average Relative Humidity (%)	Total Precip (mm) [10]	Average Wind Speed (m/s) [1]	Extreme Maximum Wind Speed (m/s) [1]	Average Solar Radiation (W/m²)	Total Evapo-transpiration (mm)[8]
Feb-17	5.04	-11.47	-15.17	-18.42	-28.26	78.03	21.6	1.12	11.61	26.93	3.17
Mar-17	9.56	-9.61	-15.23	-19.49	-32.14	64.03	8.4	1.72	8.83	100.75	6.51
Apr-17	12.09	4.09	-1.17	-6.23	-16.26	57.70	7.1	1.81	10.50	173.66	15.44
May-17	19.93	12.98	8.06	2.94	-2.30	54.38	16.8	1.92	11.54	211.85	27.95
Jun-17	25.34	17.47	12.39	6.78	-0.90	54.93	20.2	1.73	13.32	225.93	28.61
Jul-17	28.09	20.67	14.99	9.44	4.21	64.01	39.4	1.57	13.65	212.94	25.50
Aug-17	28.31	18.20	12.83	8.12	1.95	64.85	16.7	1.46	11.01	156.87	21.67
Sep-17	19.06	11.19	6.94	3.36	-2.32	77.06	48.7	1.34	11.06	78.21	10.37
Oct-17	10.14	-0.31	-3.41	-6.38	-12.54	87.16	28.0	*1.05*	*8.65*	31.26	*3.40*
Nov-17	-5.89	-17.87	-20.14	-22.26	-33.90	83.46	0.0	*0.45*	*5.47*	5.37	*0.45*
Dec-17	*4.27*	-9.99	-12.29	-14.69	-31.16	86.62	19.8	*1.78*	*12.28*	0.74	*2.00*

Notes: *Values in grey italics indicate a partial month*

[1]January 2012 has 25 days of complete wind data
February 2012 has 28 days of complete wind data
March 2012 has 30 days of complete wind data
December 2012 has 15 days of complete wind data
January 2013 has 21 days of complete wind data
February 2013 has 26 days of complete wind data
November 2013 has 24 days of complete wind data
December 2013 has 20 days of complete wind data
January 2014 has 9 days of complete wind data
November 2014 has 23 days of complete wind data
December 2014 has 6 days of complete wind data
January 2015 has 24 days of complete wind data
August 2015 has 28 days of complete wind data
October 2015 has 29 days of complete wind data
November 2015 has 9 days of complete wind data
December 2015 has 0 days of complete wind data
January 2016 has 16 days of complete wind data
November 2016 has 23 days of complete wind data
December 2016 has 22 days of complete wind data
January 2017 has 25 days of complete wind data
October 2017 has 28 days of complete wind data
November 2017 has 19 days of complete wind data
December 2017 has 9 days of complete wind date
[2] June 2011 has 29 days of complete data (station commissioned on June 2)
[3] 16 days of complete rain data
[4] Rainfall recorded at temperatures below zero may be due to snowmelt
[5] 25 days of complete RH data
[6] 18 days of complete solar radiation data
[7] 7 days of complete evapotranspiration data
[8] Evapotranspiration is invalid where wind is invalid
[9]Total precipitation likely underestimated due to partial freezing in snowfall conversion adaptor
[10] Only rainfall reported until October 2013 when a snowfall adaptor was installed

4.2 SURFACE WATER

Christal Creek and Lightning Creek are the two primary and important surface water drainages within the Keno Hill Silver District that have influence on reclamation and closure planning as well as active mine operations. Water quality, flow, aquatic and benthic resources have been extensively studied and documented for Christal and Lightning Creeks as part of the District closure planning and field investigations.

4.2.1 Christal Creek

Christal Creek flows northwest from Christal Lake for approximately 22 km before it flows into the South McQuesten River. Water chemistry and aquatic resources in the creek have been influenced by previous mine and milling operations including tailings deposition and adit discharge. Christal Creek receives treated input water from the Galkeno 900 adit and Galkeno 300 adit, in addition to seepages (surface and groundwater) from workings on the west face of Keno Hill. Although no discharge has occurred from the mill during operations, any treated discharge from the mill and the Flame and Moth mine would be directed to the upper reach of Christal Lake and eventually flow into Christal Creek. Historically, Christal Lake has been a receptor for effluent from various mines including Galkeno 900 and the Mackeno Mill area and Mackeno tailings, contributing to metal loading in Christal Creek.

Monitoring in this watershed begins at Christal Creek before its confluence with Hinton Creek (KV-50) and ends at the mouth of Christal Creek where it enters the South McQuesten River (KV-8). There are no significant tributaries to Christal Creek upstream of Hinton Creek; however, it is unknown to what degree mine-related discharges may have an influence on the drainage above KV-50 as there are known to be historical workings upstream of this sampling location. It is reasonable to assume that water quality at KV-50 reflects some degree of mine-related influence as a result of its proximity to mining areas, but could also reflect naturally mineralized seep areas. Table 4-3 summarizes the surface water monitoring stations on Christal Creek.

Table 4-3 Christal Creek Catchment Surface Water Monitoring Stations

SITE	SITE DESCRIPTION	MONITORING FREQUENCY
KV-6	Christal Creek at Keno Highway	Weekly when discharging/Monthly
KV-7	Christal Creek at Hanson Road	Monthly
KV-8	Christal Creek at mouth	Monthly
KV-48	Hinton Creek u/s Calumet Drive	Quarterly
KV-49	Hinton Creek u/s Christal Creek	Quarterly
KV-50	Christal Creek u/s Hinton Creek	Weekly when discharging/Monthly
KV-51	Christal Creek d/s Hinton Creek	Quarterly
KV-52	Natural spring to Christal Lake at Old Mackeno pumphouse	Monthly
KV-54	Erickson Gulch at Road to Lucky Queen	Quarterly
KV-79	Christal Creek d/s of Mackeno Tailings	Quarterly
KV-80	Christal Creek u/s of Mackeno Tailings	Quarterly

4.2.2 Lightning Creek

Lightning Creek is situated within a narrow valley with a steep gradient flowing from the north side of Sourdough Hill into Duncan Creek, which drains into the Mayo River. Hope and Thunder Gulches flow into Lightning Creek within the bounds of the KHSD. Lightning Creek has also been the site of extensive placer mining upstream of Keno City both historically and at the present time. Mine adit drainages from Bellekeno 625 (north side of Sourdough Hill) and Keno 700 (south side of Keno Hill) eventually report to the Lightning Creek drainage.

Lightning Creek is notable as it is the only large watershed in the KHSD not connected to the South McQuesten River. There are nine regularly monitored sites within the Lightning Creek drainage under Water Licence QZ09-092; eight sites between the background baseline station at KV-37, to the station at the Lightning Creek Bridge near Keno (KV-41), and a recently added site downstream, station KV-81, southwest of the Keno District mill site. Table 4-4 summarizes the surface water monitoring stations along Lightning Creek.

Table 4-4 Lightning Creek Catchment Surface Water Monitoring Stations

SITE	SITE DESCRIPTION	MONITORING FREQUENCY
KV-37	Lightning Creek upstream Hope Gulch	Quarterly
KV-38	Lightning Creek upstream Thunder Gulch	Quarterly
KV-39	Hope Gulch upstream Lightning Creek	Quarterly
KV-40	Charity Gulch upstream Lightning Creek	Quarterly
KV-41	Lightning Creek upstream bridge at Keno City	Monthly
KV-65	Thunder Gulch upstream of Bellekeno	Monthly
KV-76	Thunder Gulch downstream of Bellekeno 625 Adit	Quarterly
KV-77	Thunder Gulch upstream of Bellekeno East	Quarterly
KV-81	Lightning Creek Southwest of Mill Site	Weekly when discharging/Monthly

Alexco provides regular monitoring data, analysis and discussion of trends in our monthly and annual reports submitted as a condition of WL QZ09-092 and QML-0009.

4.3 GROUNDWATER

Several groundwater monitoring studies have been conducted in the District, primarily around Keno City, and the Dry Stack Tailings and Flame & Moth areas. Groundwater in the Keno City area flows northwest towards Christal Lake. Adit discharge from the Onek 400 portal does not appear to impact groundwater supply wells in Keno City. The Flame & Moth area and Dry Stack Tailings Facility are downgradient of groundwater flow from Keno City, thus mining activities at these sites are not expected to affect groundwater quality beneath Keno City.

A district wide groundwater investigation was initiated in 2013, with single monitoring wells installed at a Keno 700, Sadie Ladue, Onek, Galkeno 900, Galkeno 300, Bermingham, Ruby 400, Husky, Husky SW, and Silver King. Groundwater quality data were collected from these wells which showed elevated concentrations of constituents related to mineralization (sulphate, cadmium, zinc, and arsenic).

4.4 VEGETATION AND WILDLIFE

The Keno Hill Silver District supports a variety of wildlife including ungulates, fur-bearers, small mammals, upland game birds and waterfowl. Moose are the most important subsistence animal in the area. Repeated survey work over the last 15 years indicates a healthy, stable moose population that has in recent years reached a maximum level of harvest (Lortie, 2009). Woodland caribou are not presently found in the immediate study area with the exception of the appearance in summer of fewer than 10-12 caribou scattered in very small groups in the Mt. Hinton and Bunker Hill areas. Sheep are not known to inhabit the Keno Hill area.

4.5 SOIL AND BEDROCK

The Keno Hill Silver District is located in the northwestern part of the Selwyn Basin in an area where the northwest-trending Robert Service Thrust Sheet and the Tombstone Thrust Sheet overlap. The area is underlain by Upper Proterozoic to Mississippian rocks that were deposited in a shelf environment during the formation of the northern Cordilleran continental margin. The area underwent regional compressive tectonic stresses during the Jurassic and the Cretaceous, producing thrusts, folds and penetrative fabrics of various scales.

The Robert Service Thrust Sheet in the south is composed of Late Proterozoic to Devonian clastic sandstone, minor limestone, siltstone, argillite, chert, and conglomerate. The Tombstone Thrust Sheet to the north consists of Devonian phyllite, felsic meta-tuffs and metaclastic rocks, overlain by Carboniferous quartzite, which is the main host for the silver mineralization in the Keno Hill camp.

Except for a few localized areas, the soils are not strongly weathered or deeply leaching. They also exhibit a poor profile development, particularly those underlain by permafrost. The soils in the area can be conveniently classified into two general types: 1) residual and 2) muck peat/half bog. Residual soils were formed principally from the weathering of the various types of bedrocks, or as is evident in some places, from the decomposition of a till that predates the last glaciation.

Regional permafrost is irregularly distributed and its occurrence is dependent upon the elevation, hillside exposure, depth of overburden, soil types, amount of vegetative cover, and presence of flowing underground and surface water. At high elevations and on slopes with a northern exposure it is generally present.

Soil and bedrock considerations in reclamation and closure planning are importantly linked to long-term geotechnical stability of the DSTF foundation. Design criteria for the DSTF considers the potential for permafrost degradation over time.

5. PROJECT DESCRIPTION

5.1 HISTORY

The Keno Hill Silver District is located in central Yukon (63° 54' 32" N, 135° 19’ 18” W; NTS 105M/14 & 105M/13), 354 km due north of Whitehorse. Access to the property is via the Alaska, Klondike and Silver Trail Highways from Whitehorse to Mayo (407 km) and an all-weather gravel road northeast from Mayo to Elsa (45 km); a total distance of 452 km. Figure 1-1 shows the location of the Keno Hill Silver District and Mine Operations.

The Keno Hill Silver District and mining operations has a rich history of exploration and mining with 21 deposits having documented silver production in excess of 3,110 kilograms (100,000 ounces). Silver was first found in 1901 but small-scale mining only began during 1913. High silver prices at the end of the First World War led to renewed and ultimately successful exploration activity in the area. Since then, at least 65 deposits and prospects have been identified within the area. Many small silver deposits were mined independently of each other, throughout the area between 1914 and 1925.

The Treadwell Yukon Company Limited (TYCL) in 1925 consolidated a number of small mines and properties in the area. TYCL continued to be the dominant company in the mining camp until it ceased operations in 1942 upon the untimely death of its founder, Livingston Wernecke.

Keno Hill Mining Company Limited (KHM) acquired the interests formerly controlled by TYCL in 1945. KHM was reorganized in November 1947 as United Keno Hill Mines Limited (UKHM) and by 1958 UKHM had acquiring several properties, interests in properties and other companies, including the assets of Galkeno Mines Limited and Canadian Northwest Mines and Oil.

Ventures Limited (later Falconbridge Nickel Mines Limited and Falconbridge Limited) acquired a controlling interest in the UKHM in 1960 when it merged with Frobisher Limited and acquired the Conwest interest. Falconbridge Nickel Mines Ltd. acquired 48.2% of UKHM in 1962 and assumed management control of UKHM.

UKHM ceased all production in the area in 1989 and placed the active mines on care and maintenance, but continued to conduct limited underground exploration and development at the Bellekeno and Silver King mines. On Feb 18, 2000, UKMH was granted bankruptcy protection with PricewaterhouseCoopers Inc. being court-appointed as the interim receiver and receiver-manager of UKMH in 2001.

In June 2005, Alexco was selected as the preferred purchaser of the assets of UKHM by PricewaterhouseCoopers Inc. In February 2006, Alexco's purchase of UKHM's assets through a wholly-owned subsidiary, Elsa Reclamation & Development Company Ltd. (ERDC), was approved. Under the Keno Hill Amended and Restated Subsidiary Agreement, Alexco and ERDC are indemnified against all historical liability, has property access for exploration and future development, and is not required to post security against pre-existing liabilities. ERDC received a water license from the Yukon government in November 2007, giving Alexco free and clear title to surface and subsurface claims,

leases, free-hold land, buildings and equipment at Keno Hill. Since Alexco acquired the assets of the Keno Hill Silver District, the following major milestones have been achieved:

2006 - 2008: Alexco acquires KHSD and begins aggressive surface exploration programs, focus on expansion of Bellekeno resource;

2009: Underground development and construction at Bellekeno begins;

2010: Comprehensive Cooperation and Benefits Agreement (CCBA) signed with First Nation of Nacho Nyak Dun (FNNND). Construction of mill and surface facilities begins;

2011: Production at Bellekeno mine and Keno District Mill. Surface exploration at Flame and Moth begins;

2012: Development and rehab of Lucky Queen adit. Development of new Onek decline;

2013: Temporary suspension of Bellekeno mine operations and milling, district care and maintenance;

2014 – 2018: Permitting and development of Flame and Moth mine. Continued surface exploration, advanced underground exploration decline at Bermingham deposit. Care and maintenance and water treatment.

The Keno Hill Silver District and Mine Operations are located on and around Galena Hill, Keno Hill and Sourdough Hill and are collectively known as the Keno Hill Silver District. The property lies along the broad McQuesten River valley with three prominent hills to the south of the valley. The Keno District Mine Operations principal mine activities and infrastructure include underground mining and development operations and a conventional flotation mill and dry stack tailings facility (DSTF) located at the Keno District Mill site for the processing and production of minerals from the active, developed and future underground deposits including Bellekeno, Lucky Queen, Onek, Flame and Moth and Bermingham. The RCP incorporates underground mines and deposits that are in a variety of phases including active mines (Bellekeno), permitted and developed (Lucky Queen, Onek), permitted and under development (Flame and Moth) and future mines that are in the permitting and development phase (Bermingham). Table 5-1 presents an overview of the Keno Hill Mine Operations project that is subject to this RCP.

Table 5-1 Keno District Mine Operations Overview

Location	0.5 to 4 km from Keno City, 45 km northeast of Mayo, 354 km north of Whitehorse, YT.
Land Position	Alexco Resource Corp. and its wholly owned subsidiary Elsa Reclamation and Development Corp. owns 1,563 claims and leases covering an area of approximately 24,262 ha within the Keno Hill Silver District including the Bellekeno, Onek, Lucky Queen, Flame and Moth and Bermingham deposits. Two Fee Simple lots within KHSD total 59 ha (Lot 960 and Lot 956)
Mines/Ore Deposits	Bellekeno (Active 2010 – 2013, suspended 2013)

	Lucky Queen, Onek (permitted, developed, not active) Flame and Moth (permitted, under development) Bermingham (permitted for advanced exploration)
Mining Method	Year round underground narrow vein cut and fill/long hole mining
Current Mine(s) Plan Life	8 years including initial development
Current Total Project Life	8 years construction/development/operations/progressive reclamation 2 year final decommissioning and reclamation 10 years closure monitoring and maintenance.
Ore Production Rate	400 tonnes/day (annual average), across 4 mines/deposits (Bellekeno, Lucky Queen, Flame and Moth, Bermingham) ~1,300,000 tonnes of ore in LOM plan
Mine Waste Rock	786,000 tonnes of waste rock produced from underground development, 443,500 tonnes backfilled underground
Ore Mining Schedule	Ore mining for 365 days/year Milling operations 365 day/year
Mill Recovery Process	Conventional flotation process producing separate lead/silver concentrate and zinc concentrate shipped off site for smelting. District Mill location at historic Flame and Moth pit area. Tailings placed in Dry Stack Tailings Facility or underground as backfill.
Work Force	~ 175 employees and contractors during active mine operations
Airstrip	Mayo, YT
Power	Hydro grid power Yukon Energy, diesel power backup
Water Supply and Use	Water use and discharge within 3 drainages, No Cash Creek, Lightning Creek and Christal Creek. Conventional lime precipitation water treatment at Bellekeno 625, Flame and Moth, Bermingham
First Nations	First Nation of Na-Cho Nyak Dun

5.2 MINING AND MILLING OPERATIONS

5.2.1 Project Schedule

The Life of Mine (LOM) Plan that forms the basis of the RCP represents the current plan for development and production of the Keno Hill Mine Operations as per the March 2017 PEA. Mine operating plans are continuously reviewed and optimized depending on a variety of factors including metals prices, exchange rates, underlying operating costs (fixed and variable), ore grades, etc. As these and other factors change, both positively and negatively, ore production profiles from each of the mines will change. The Keno Hill Mine Operations are unique in terms of mine planning as they consist

of a series of small underground mines. Depending on the various parameters, mines may come in and out of the LOM plan as factors change.

The historic mine operations that operated in the Keno Hill Silver District consisted of multiple smaller underground narrow vein mines that provided ore to a centralized mill. Alexco is operating in a similar approach whereby more than one underground mine is necessary to provide ample mill feed to a centralized mill (Keno District Mill). The Keno District Mill is designed for 400 tpd and the current LOM mine plan includes a combination of Bellekeno, Flame and Moth, Bermingham and Lucky Queen operating over an 8 year period. Table 5-2 presents the current LOM plan that is the basis for the RCP. The LOM plan assumes that recommencement of mine development and operations would begin in 2018.

Table 5-2 Keno Hill Mine Operations LOM Plan

Consolidated Mine Plan		2018	2019	2020	2021	2022	2023	2024	2025
Ore Tonnes	1,021,053	64,683	145,992	145,992	145,992	145,992	111,715	142,344	118,343
Development Meters (Ramp, Level Access, Vent Drive, Sump/pump)	9,305	3,264	1,729	844	1,294	311	1,466	397	-
Access Drift Meters (xcut)	9,070	741	1,768	1,666	1,507	985	922	740	741
Cut & Fill Meters	14,190	903	2,517	2,602	2,382	1,387	1,321	1,490	1,588
LH Meters	885	185	-	-	-	230	150	220	100
Raise Meters	984	272	316	76	113	-	208	-	-
Development Tonnes (Ramp, Level Access, Vent Drive, Sump/pump)	364,940	143,860	76,923	36,414	56,829	12,579	34,900	3,435	-
Access Drift Tonnes (xcut)	368,477	31,032	73,683	69,170	62,622	40,678	49,427	18,362	23,503
LH Tonnes	235,231	5,084	-	-	2,856	63,905	48,204	85,287	29,895
Cut & Fill Tonnes	724,741	59,600	146,082	146,082	143,136	82,087	60,741	20,403	66,610
Raise Tonnes (tonnes/m)	19,670	6,491	7,517	1,804	2,695	5	1,149	5	5
Waste Rock Broken (tonnes)	730,781	187,292	160,554	107,790	122,547	53,256	65,782	10,057	23,503
Backfill Required	649,916	37,148	90,242	93,612	90,859	96,124	98,375	80,744	62,810

Table 5-3 LOM Plans for Individual Mines

Bellekeno	Total	2018	2019	2020	2021	2022	2023	2024	2025
Ore Tonnes	37,144	37,144	-	-	-	-		-	-
Ag, gpt	747	747	-	-	-	-	-	-	-
Au, gpt		-	-	-	-	-	-	-	-
Pb, %	10.55	10.55	-	-	-	-	-	-	-
Zn, %	5.88	5.88	-	-	-	-	-	-	-
Development Meters (Ramp, Level Access, Vent Drive, Sump/pump)	-	-	-	-	-	-	-	-	-
Access Drift Meters (Xcut)	52	52	-	-	-	-	-	-	-
Cut & Fill Meters	396	396	-	-	-	-	-	-	-
LH Meters	185	185	-	-	-	-	-	-	-
Raise Meters	-	-	-	-	-	-	-	-	-
Development Tonnes (Ramp, Level Access, Vent Drive, Sump/pump)	-	-	-	-	-	-	-	-	-
Access Drift Tonnes (Xcut)	2,279	2,279	-	-	-	-	-	-	-
LH Tonnes	5,084	5,084	-	-	-	-	-	-	-
Cut & Fill Tonnes	32,061	32,061	-	-	-	-	-	-	-
Raise Tonnes (tonnes/m)	-	-	-	-	-	-	-	-	-
Waste Rock Broken (tonnes)	2,279	2,279	-	-	-	-	-	-	-
Backfill Required	21,904	21,904	-	-	-	-	-	-	-

Flame & Moth		2018	2019	2020	2021	2022	2023	2024	2025
Ore Tonnes	682,921	20,328	94,896	94,896	94,896	94,896	94,896	94,896	93,217
Ag, gpt	666	678	743	743	703	500	687	588	693
Au, gpt	0.50	0.31	0.44	0.56	0.59	0.39	0.47	0.54	0.54
Pb, %	2.75	2.58	2.86	2.70	3.00	2.09	3.76	1.88	2.98
Zn, %	5.78	6.71	5.62	6.21	6.45	6.90	5.12	4.30	5.63
Development Meters (Ramp, Level Access, Vent Drive, Sump/pump)	5,803	2,288	1,283	202	902	285	775	68	-
Access Drift Meters (X-cut)	4,554	536	1,007	691	635	464	498	159	564
Cut & Fill Meters	7,840	397	1,556	1,570	1,494	595	898	298	1,032
LH Meters	700	-	-	-	-	230	150	220	100
Raise Meters	433	88	222	26	50	-	48	-	-
Development Tonnes (Ramp, Level Access, Vent Drive, Sump/pump)	260,222	102,884	58,120	9,316	40,069	12,142	34,256	3,435	-
Access Drift Tonnes (Xcut)	189,816	22,420	42,121	28,765	26,381	19,234	20,770	6,622	23,503
LH Tonnes	210,458	-	-	-	2,856	63,905	42,597	74,493	26,607
Cut & Fill Tonnes	472,643	20,328	94,986	94,986	92,040	30,991	52,299	20,403	66,610
Raise Tonnes (tonnes/m)	10,322	2,105	5,279	613	1,181	-	1,144	-	-
Waste Rock Broken (tonnes)	469,576	132,567	107,956	39,099	68,037	31,375	56,981	10,057	23,503
Backfill Required	422,675	10,866	59,973	61,613	56,725	57,250	58,263	57,932	60,053

Bermingham		2018	2019	2020	2021	2022	2023	2024	2025
Ore Tonnes	220,037	7,211	51,096	51,096	51,096	51,096	8,442	-	-
Ag, gpt	1,276	2,591	1,732	1,245	945	1,019	1,142	-	-
Au, gpt	0.20	0.25	0.21	0.18	0.19	0.20	0.22	-	-
Pb, %	4.09	7.69	4.08	3.74	3.96	4.22	3.18	-	-
Zn, %	2.05	2.19	2.53	1.91	1.79	2.01	1.59	-	-
Development Meters (Ramp, Level Access, Vent Drive, Sump/pump)	2,513	976	446	642	392	26	31	-	-
Access Drift Meters (xcut)	3,404	153	761	975	872	521	122	-	-
Cut & Fill Meters	3,964	110	961	1,032	888	792	181	-	-
LH Meters	-	-	-	-	-	-	-	-	-
Raise Meters	391	184	94	50	63	-	-	-	-
Development Tonnes (Ramp, Level Access, Vent Drive, Sump/pump)	104,718	40,976	18,803	27,098	16,760	437	644	-	-
Access Drift Tonnes (xcut)	141,165	6,333	31,562	40,405	36,241	21,444	5,180	-	-
LH Tonnes	-	-	-	-	-	-	-	-	-
Cut & Fill Tonnes	220,037	7,211	51,096	51,096	51,096	51,096	8,442	-	-
Raise Tonnes (tonnes/m)	9,310	4,381	2,233	1,187	1,509	-	-		-
Waste Rock Broken (tonnes)	255,949	52,446	52,598	68,690	54,509	21,881	5,824		-
Backfill Required	147,115	4,378	30,270	31,999	34,134	38,874	7,461		-

Lucky Queen		2018	2019	2020	2021	2022	2023	2024	2025
Ore Tonnes	80,951	-	-	-	-	-	8,377	47,448	25,126
Ag, gpt	1,206	-	-	-	-	-	977	1,259	1,184
Au, gpt	0.12	-	-	-	-	-	0.13	0.13	0.11
Pb, %	2.63	-	-	-	-	-	1.85	2.72	2.72
Zn, %	1.32	-	-	-	-	-	2.53	1.21	1.13
Development Meters (Ramp, Level Access, Vent Drive, Sump/pump)	989	-	-	-	-	-	660	329	-
Access Drift Meters (Xcut)	1,060	-	-	-	-	-	302	581	177
Cut & Fill Meters	1,990	-	-	-	-	-	242	1,192	556
LH Meters	-	-	-	-	-	-	-	-	-
Raise Meters	160	-	-	-	-	-	160	-	-
Slashing Meters	-	-	-	-	-	-	-	-	-
Development Tonnes (Ramp, Level Access, Vent Drive, Sump/pump)	35,217	-	-	-	-	-	23,477	11,740	-
Access Drift Tonnes (Xcut)	19,689	-	-	-	-	-	5,607	10,794	3,288
LH Tonnes	-	-	-	-	-	-	-	-	-
Cut & Fill Tonnes	80,951	-	-	-	-	-	8,377	47,448	25,126
Raise Tonnes (tonnes/m)	2,977	-	-	-	-	-	2,977	-	-
Waste Rock Broken (tonnes)	58,221	-	-	-	-	-	32,652	22,812	2,757
Backfill Required	60,544	-	-	-	-	-	7,085	36,909	16,550

Table 5-4 Keno Hill Mine Operations LOM Plan Decommissioning and Reclamation Plan Closure Schedule

Phase / Activity	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	→	2037
	Suspension/CM				Mine Development/Operations								Active Closure		Post Closure Monitoring and Maintenance		
Progressive Reclamation																	
Closure and Reclamation Optimization/Research																	
Bellekeno Production Unit Area																	
- Underground Development/Operations	Suspension/CM																
- Reclaim Bellekeno East Portal Site																	
- Reclaim Bellekeno 625 Adit Site																	
- Bulkhead 625 Installation																	
- Bellekeno Mine Flooding and Insitu Treatment																	
- Bellekeno 625 Bioreactor Construction/Operation																	
- 200 Level Vent Raise																	
Flame and Moth Production Unit Area																	
- Underground Development/Operations																	
- Portal Closure																	
- Mine Flooding/In Situ Treatment																	
- Vent Raise																	
Lucky Queen Production Unit Area																	
- Underground Development Operations																	
- Reclaim Lucky Queen 500 Level Portal Site																	
- Vent Raise																	
Onek Production Unit Area																	
- Underground Development Operations																	
- Reclaim Onek 990 Portal Area																	
- Vent Raise																	
Bermingham Production Unit Area																	
- Underground Development/Operations																	
- Portal Closure																	
- Mine Flooding/In Situ Treatment																	
- Vent Raise																	
Waste Rock Storage																	
- Temporary P-AML WRSF - Bellekeno East																	
- Permanent P-AML WRSFs																	
- N-AML WRDAs																	
- Reclaim Borrow Areas																	
Roads																	
- Access Road Extension Bellekeno East to Bellekeno 625																	
- Bellekeno Haul Road																	
- Keno City Bypass																	
- Christal Lake Road																	
- Bermingham Access Road																	
- Other Roads and Trails																	
Camp Downsize																	
Mill & Facilities																	
- Active Milling Operations	Suspension/CM																
- Mill and Ancillary Facilities																	
- Mill Pad																	
- Ore/Tailings Stockpile Pads																	
- Runoff Collection Pond(s)																	
- Diversion Ditches to Collection Pond																	
Dry Stack Tailings Facility Cover																	
- Progressive Reclamation																	
- Final Cover Reclamation																	
Closure Site Management (monitoring & maintenance)																	

Active Operations
Reclamation and Closure
Water Treatment/Management

5.2.2 Mining Methods

The mining methods employed at the underground mines associated with the Keno Hill Mine Operations are common and well proven mining methods and are selected based on deposit geometries, geotechnical conditions, production rates and other constraints. The mining methods are predominantly longhole and cut and fill and a brief description of the mining methods used are further summarized.

Cut and Fill (CF) mining is a method of short hole mining used in a wide range of deposit geometries. There are two main methods of cut and fill (CF) mining; overhand cut and fill (OCF) and underhand cut and fill (UCF). In the case of Flame and Moth, only OCF is anticipated.

OCF typically uses uncemented fill and mining begins at the bottom of a mining block and advances in "slices" of "lifts" upwards. Stoping begins from an access ramp driven off the main level to the bottom of the mineralized zone to be accessed. Using development mining techniques, a drift is driven through the mineralized zone to the defined limit of mining. Upon completion, the drift (or "cut") is filled with cemented back-fill, which would consist of tailings or waste rock. Once the stope is filled the ore access off the main haulage ramp is driven down to access the next lift on top of filled cut. This process continues until the top of the stope is reached. See Figure 5-1 for a typical CF schematic. The majority of ore mined from the Bellekeno mine to date has been through OCF and cemented rock fill mining methods and is well demonstrated.

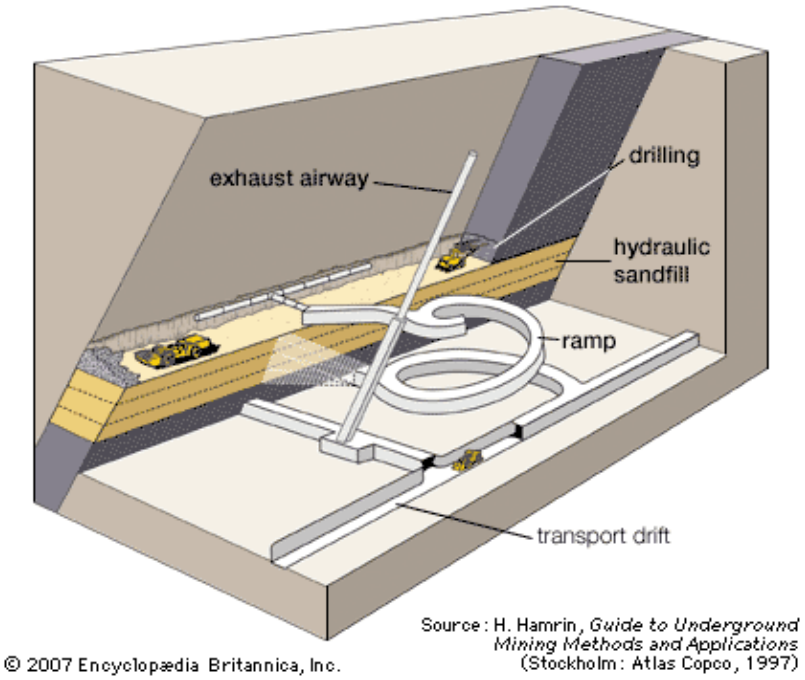


Figure 5-1 Overhand, Mechanized Cut & Fill Mining Methods (Source: Atlas Copco)

Long hole stoping ("LH") is normally used where large blocks of continuous mineralization can be identified and the surrounding rock is reasonably strong (Figure 5-2). Access to the top and bottom of the mineralized

block is provided with drifts. A vertical opening (slot raise) is created within the stope block from the top of the block to the bottom. Long holes are drilled to blast vertical slabs off the mineralized block which is then scooped from a lower drawpoint by an LHD loader.

The depth on blast holes in the production sequence will be approximately 10-15 metres long. Blind raises or slot raises will be drilled with the LH drill unit, blasted and the stope block will be retreated out by drilling and blasting successive rings. Typically, LH blocks will be pulled last unless they are in an area that would not conflict with ongoing operations. They could also be filled if they are located too close to mine infrastructure.

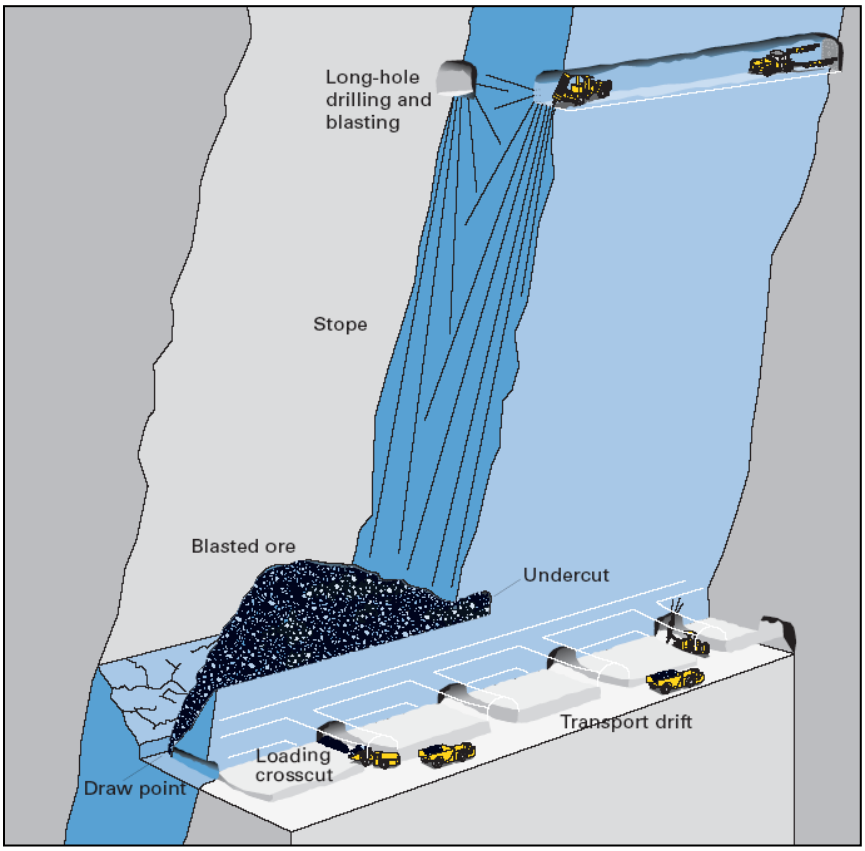


Figure 5-2 Long Hole Mining Method (Source: Atlas Copco)

5.2.3 Backfill

Backfill materials consisting of development waste rock (N-AML and P-AML) and dry filtered tailings are placed into empty stopes by Load Haul Dump (LHD) or 15-tonne trucks. The mix of these materials is flexible and vary be each mine to minimize the surface environmental impact while optimizing the most efficient and cost effective back filling sequence. For cut and fill stopes, the backfill will be pushed up tight to the back using an LHD equipped with a rammer jammer.

Cemented backfill at approximately 5% cement by weight will be used in longhole stopes. The cement, rock and water will be mixed by LHD bucket in a small sump-like cut out near the empty stope. Cement will be transported underground in bulk bags.

All waste rock will be inspected and tested as per the updated Waste Rock Management Plan, which segregates all waste rock as either potentially acidic/metal leaching (P-AML) or not (N-AML).

Cemented Tailings/Waste Rock Backfill

Cemented tails and waste rock back fill are the preferred backfill methods. Where sill pillars are required, a cemented fill will be used to provide a stable back to mine up to from beneath. Extraction of the vein from the final lift requires that the pillar is self-supporting and maintains integrity while the heading is active. The quality and the placement of the fill are both important factors in this application. An increased cement content of between four and five percent will be required to provide the required strength of the pillar. In areas where additional caution is required during final lift extraction, the lift will be mined using up-holes and remote mucking.

Careful preparation of the excavation where cemented fill is to be placed will be required, including blasting beyond the vein contacts to provide a clean, rough surface for the fill to hang on. The floor should be cleaned prior to placement to prevent material falling from the back following mining. An appropriate lead time should be provided to allow set-up and cure for the cemented fill. Standard quality control procedures (e.g. unconfined compressive strength and slump tests) should be completed during batching and following placement of cemented tailing fill materials. Table 5-2 summarizes the amount of backfill required during the LOM Plan schedule.

5.2.4 Ground Control

A third party geotechnical ground control management plan (GCMP) was developed for the Bellekeno mine (SRK 2009) and is updated to reflect site specific conditions at each new mine as necessary. The GCMP addresses underground geotechnical stability and the required ground control measures to be used to ensure safe working conditions and the long term stability of underground infrastructure. Crown pillar thicknesses have been assessed at each mine to address potential for surface subsidence and ground classes have been defined for the development headings. Mine infrastructure has been designed to avoid areas with potential poor ground conditions and the support is designed to provide long term stability.

In addition to the ground support designs in waste development headings, stopes are backfilled with cemented waste rock and/or filtered tailings. The combination of stope backfilling and the ground control management plan and measures addresses any concerns with long term underground stability and subsidence that needs to be considered in the RCP.

5.2.5 Milling Process Description

The Keno District Mill is a conventional differential flotation facility producing two separate metal concentrates that are shipped offsite for final processing. Preparatory construction including the mill concrete foundation began in September 2009 while full scale construction of the mill facilities began in earnest in April 2010 and initial mill commissioning commenced in December 2010. An overview of the District Mill and supporting infrastructure is shown in Figure 5-3.

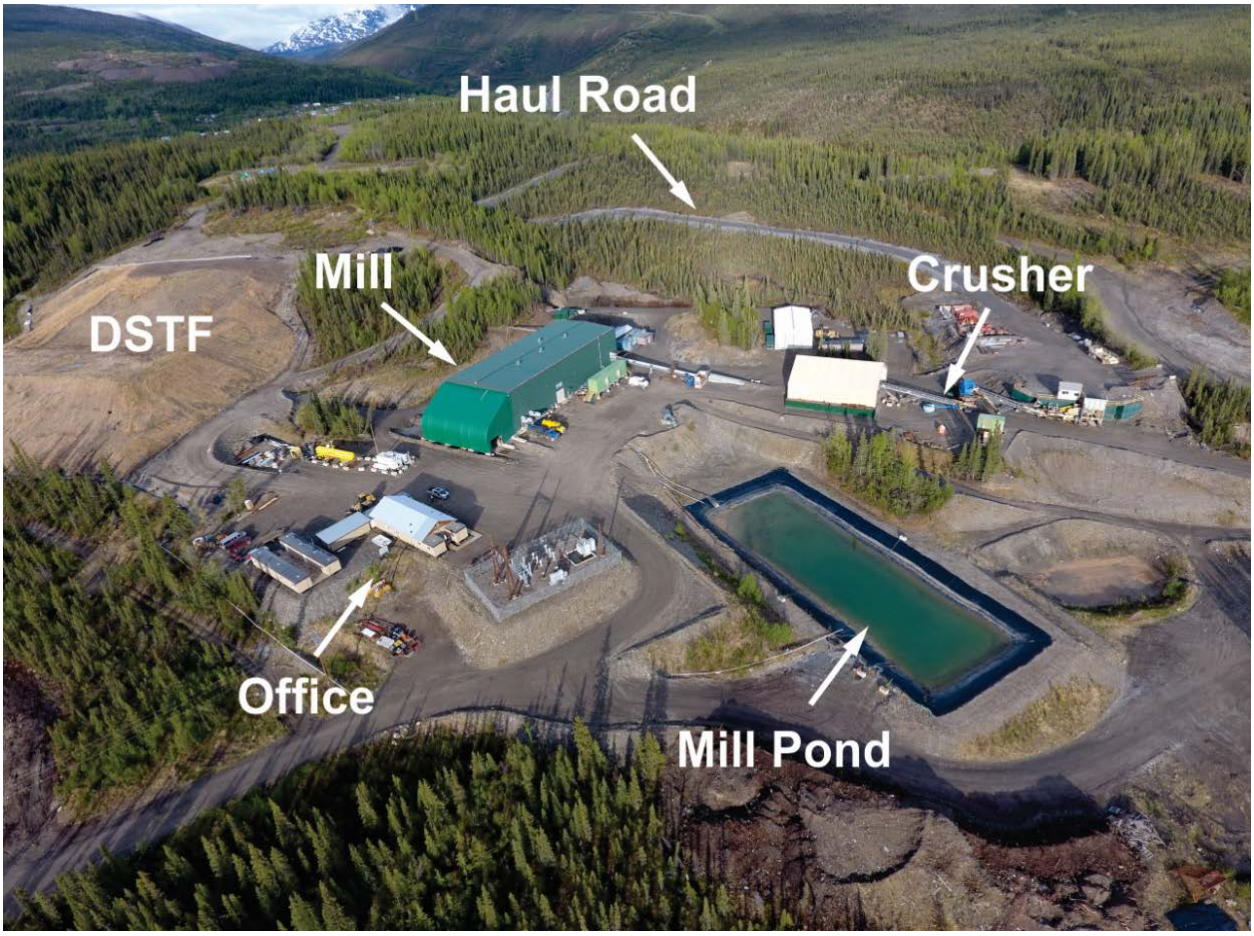
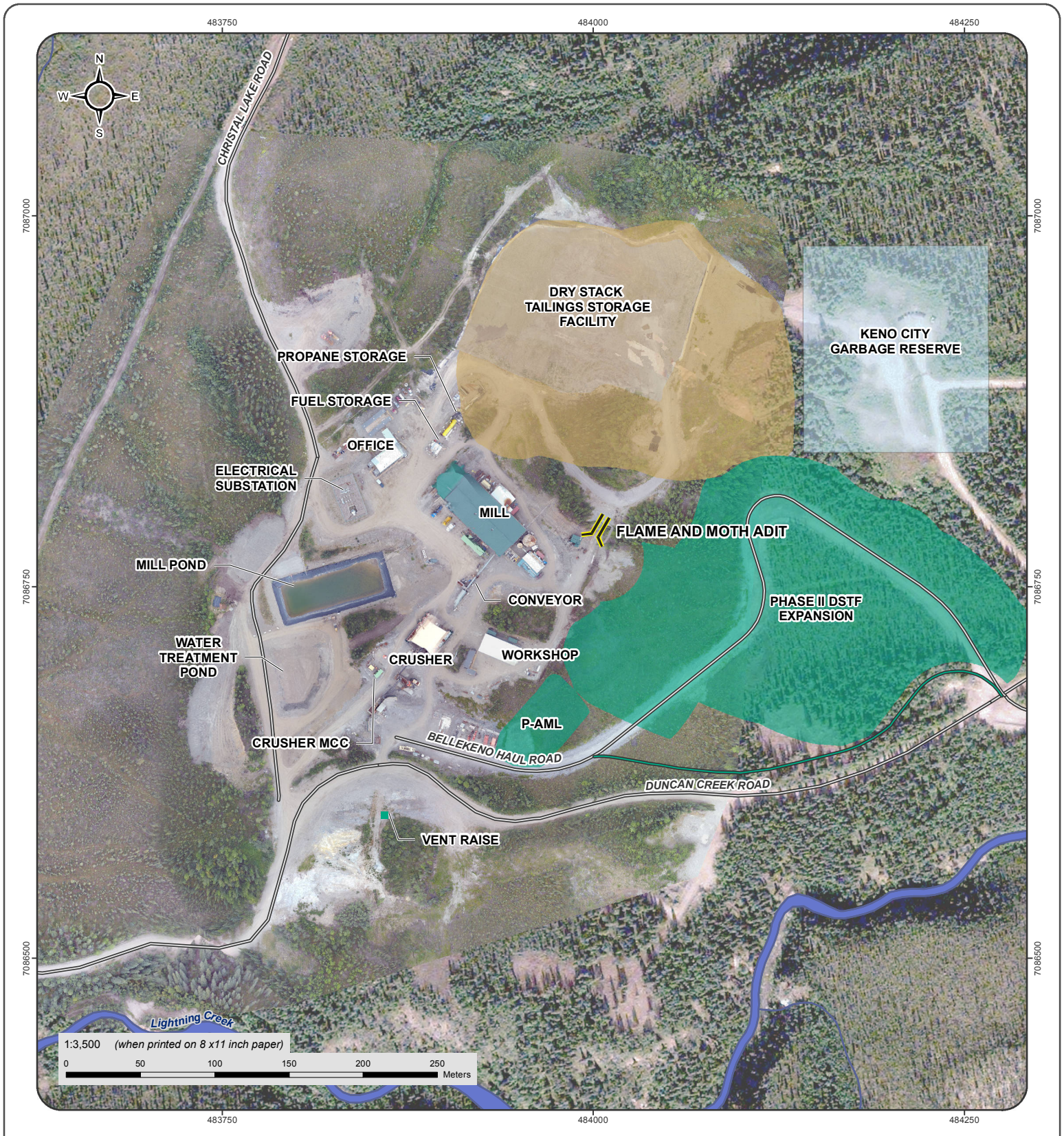


Figure 5-3 District Mill Infrastructure Overview

Mill Design Criteria

The overall mill site layout is shown in Figure 5-4. Design criteria for the mill operations are summarized in Table 5-5.



Current DSTF
DSTF 322k Tonnes Design
To Be Constructed Features

Adit
Road
Proposed Road
Watercourse

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on February 2018

Datum: NAD 83; Projection: UTM Zone 8N

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AKHM

AEG

KENO DISTRICT MINE OPERATIONS RECLAMATION AND CLOSURE PLAN

FIGURE 5-4
DISTRICT MILL AND FLAME AND MOTH LAYOUT

FEBRUARY 2018

D:\Project\AllProjects\Keno_Area_Mines\ALL-SITES\02-Map\01_Overview\02-District Mill\F_M_letter_20180129.mxd
(Last edited by: amatlashevska; 12/02/2018/15:02 PM)

Table 5-5 District Mill Design Criteria

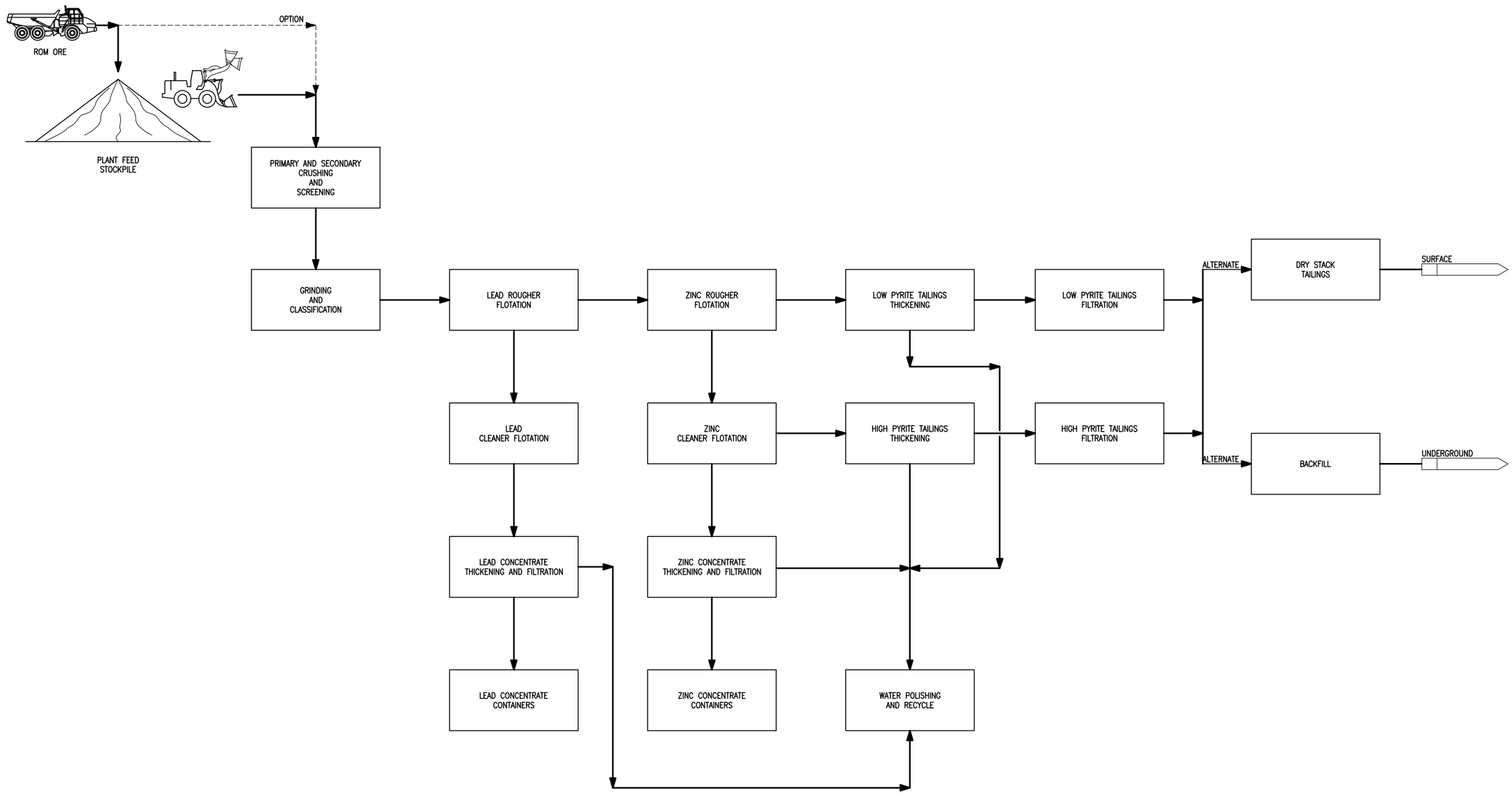
Description	Unit	Value
Type of Ore Processed		
Silver/Lead/Zinc sulphide mineralization Bellekeno/Lucky Queen/ Onek Mines		
Ore Characteristics		
Specific Gravity	g/cm³	3.46
Bulk Density	t/m³	2.1
Moisture Content	%	3-5
Operating Schedule		
Crusher Plant		
Shift/Day		1
Hours/Shift	h	12
Hours/Day	h	12
Grinding and Flotation Plant		
Shift/Day		2
Hours/Shift	h	12
Hours/Day	h	24
Days/Year	day	365
Plant Availability/Utilization		
Overall Plant Feed	mt/a	149,000
Overall Plant Feed	mt/d	250 - 400
Crusher Plant Availability	%	80.0
Grinding and Flotation Plant Availability	%	92.0
Crushing Process Rate	mt/h	63.8
Grinding/Flotation Process Rate	mt/h	18.5
Head Grades (LOM)	% Pb	2 - 10
	% Zn	3 -12
	g/t Au	0.25 – 0.5
	g/t Ag	500 – 1,250
Recovery (LOM)	Pb %	93
	Zn %	75
Recovery (LOM) including in Pb & Zn concentrates	Au %	70
Recovery (LOM) including in Pb & Zn concentrates	Ag %	92
Silver-Lead Concentrate Grade (LOM)	% Pb	65
	% Zn	2.3
	g/t Au	1.5
	g/t Ag	5,500
Zinc Concentrate Grade (LOM)	% Pb	0.5
	% Zn	45
	g/t Au	1.1
	g/t Ag	300
Silver-Lead Concentrate Mass Recovery (LOM)	%	13
Silver-Lead Concentrate Production (LOM)	t/a	12,000
Zinc Concentrate Mass Recovery (LOM)	%	9
Zinc Concentrate Production (LOM)	t/a	8,000

5.2.6 Process Overview

The Keno District Mill consists of the following process circuits;

- primary and secondary crushing circuits with a belt conveyor to transport the crushed ore to the covered fine ore stockpile;
- fine ore reclaim system feeding crushed ore from the covered fine ore stockpile;
- primary and secondary ball milling in a closed circuit with a high frequency screen and cyclone to produce a grinding product of 80% passing 174 µm;
- the ground high frequency screen underflow feeding to lead rougher scavenger flotation circuit to recover lead and silver minerals; the lead rougher flotation concentrate being upgraded in three stages of cleaner flotation;
- the zinc rougher flotation concentrate being upgraded in three stages of cleaner thickening and pressure filtration of the lead and zinc concentrates; and
- thickening and pressure filtration of tailings, disposed either at underground as backfill or at the surface dry stack tailings facility.

The mill process flowsheet is presented in Figure 5-5.



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CLIENT, PROJMNG, PROLDNG, PROCESS, ELECTR., INSTR., PIPING, MECH., STRUCT., SEISMOS, ARCH., LAYOUT

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YUKON TERRITORY

ALEXCO

WARDROP | Engineering Inc.

TITLE

BELLEKENO PROJECT (EP)

SIMPLIFIED FLOWSHEET
PROCESS FLOWSHEET No.1

Figure 5-5

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
A0009001.DWG	09539602.00	A00-09-001	D

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A1

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5.3 DRY STACK TAILINGS FACILITY

Alexco employs Dry Stack Tailings technology for management and longterm storage of tailings. Following dewatering through plate and frame filter presses located inside the mill building, the tailings (~10% M) are deposited onto a storage location outside the mill building via a conveyor belt. The tailings stockpile has a live capacity of approximately 4 – 6 hours and on a periodic basis the tailings are rehandled and loaded into a 30-tonne articulating haul truck and transported to the DSTF (or alternatively to the underground mines for use as underground paste backfill and cemented tailings). A photo of the placement of tailing lift on the DSTF is shown in Figure 5-6. The detailed design of the DSTF phase I is presented in Figure 5-7 and Figure 5-8.

The dewatered tailings are transported onto a liner system designed to capture any residual porewater that may leave the pile. The tailings are laid down in 0.5 meter lifts and compacted with a vibratory roller compactor.



Figure 5-6 Compacted DSTF Lift

The DSTF will be developed in phases. Phase 1 of the DSTF footprint has a current design capacity of 322,000 tonnes. Once Phase 1 is exhausted, the DSTF will be expanded in an adjacent area near the mill (Phase 2) and will accommodate the remaining tailings that are generated during the LOM plan. The design for Phase 2 (not yet constructed) is shown in Figure 5-9.

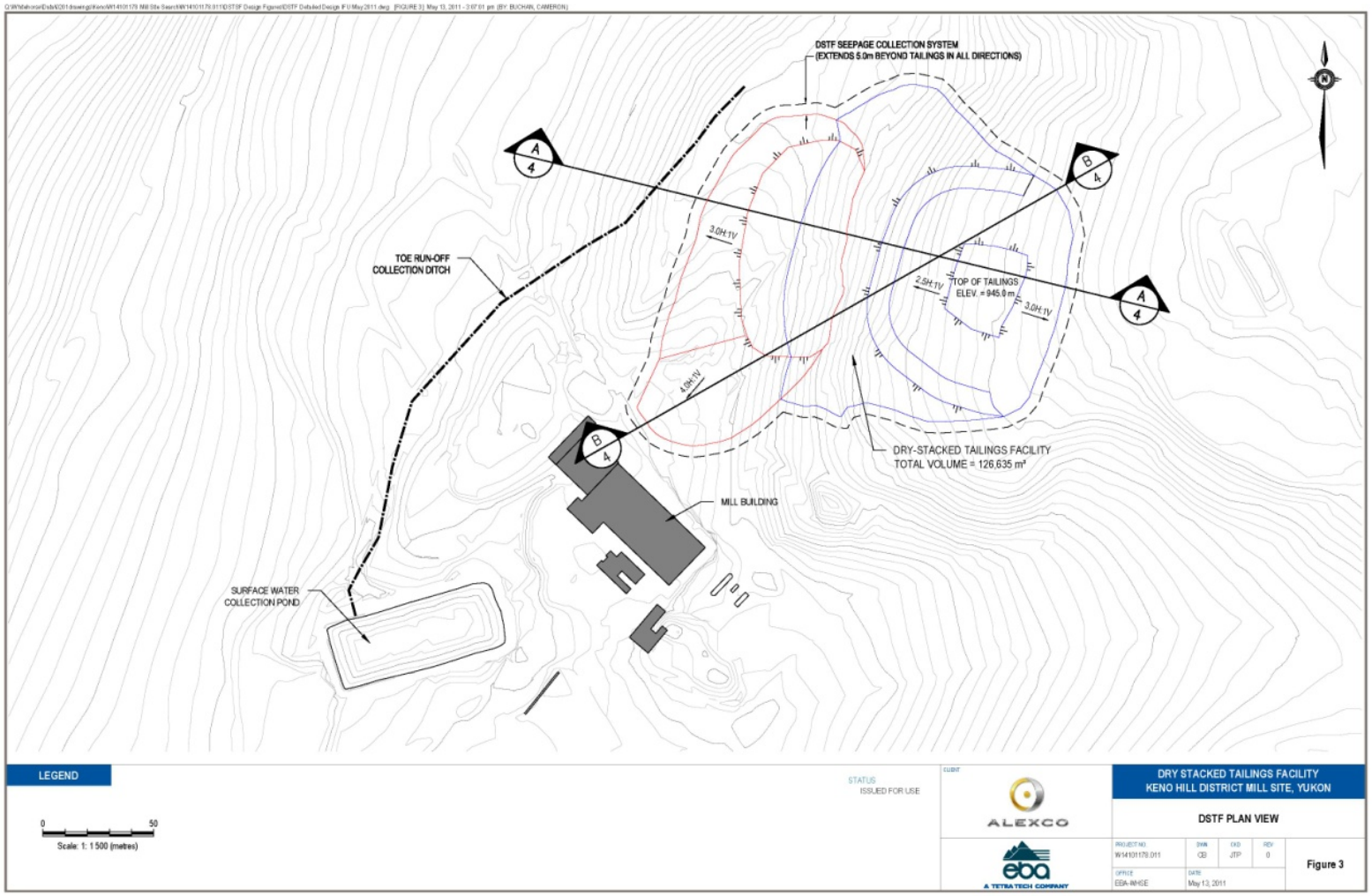


Figure 5-7 DSTF Phase I Plan View

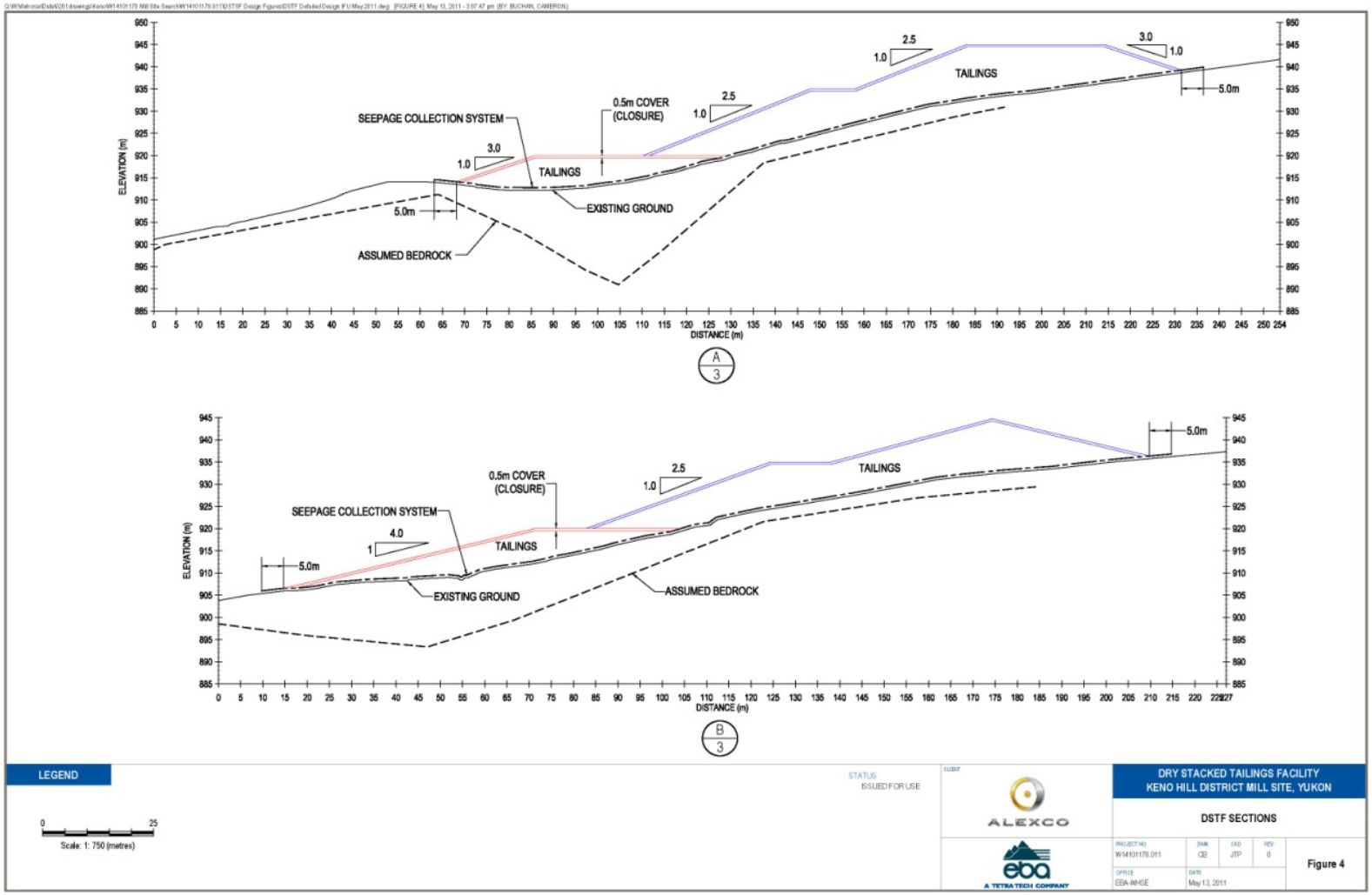


Figure 5-8 DSTF Phase I Sections

KENO CITY DUMP AREA

UPHILL RUN-OFF DIVERSION BERM

TOE RUN-OFF COLLECTION DITCH

TOE RUN-OFF COLLECTION SUMP

EXISTING DSTF ULTIMATE DESIGN FOOTPRINT

CONVEYANCE PIPE

MILL BUILDING

TOE RUN-OFF COLLECTION DITCH

UPHILL RUN-OFF DIVERSION BERM

TP36

SURFACE WATER COLLECTION POND

CONVEYOR

A

A

TP37

PHASE II EXPANSION ULTIMATE DESIGN FOOTPRINT STORAGE VOLUME: 295,000 m³

2H:1V

3H:1V

3H:1V

B

ELEV = 940 m

TP35

TP38

ORE BIN

CONVEYANCE PIPE

TOE RUN-OFF COLLECTION SUMP

3H:1V

TOE STRUCTURE

ELEV = 920 m

ELEV = 936 m

TP43

TP33

CRUSHER

COARSE ORE STOCKPILE CEMENT PADS

TP32

TP39

TP41

TP42

TP34

TP40

B

TOE RUN-OFF COLLECTION DITCH

DUNCAN CREEK ROAD

EXISTING BELLEKENO HAUL ROAD

RE-ROUTED BELKENO HAUL ROAD

LEGEND:

- TESTPIT LOCATION (PHASE II EXPANSION)

- DSTF PHASE II EXPANSION FOOTPRINT

0 100

Scale: 1 : 1750 (metres)

CLIENT

ALEXCO

TETRA TECH EBA

DRY-STACKED TAILINGS FACILITY EXPANSION - PHASE II
KENO HILL DISTRICT MILL SITE, YUKON

DSTF PHASE II EXPANSION

PROJECT NO.	DWN	CKD	REV
W14103548-01	CB	JTP	1

OFFICE: EBA-WHSE

DATE: May 15, 2015

Figure 5-9

Q:\Whitehorse\Data\0201drawings\Keno\W14103548-01 DSTF Phase II Liner Stability\W14103548-01 Figs 1.3 R0.dwg [FIGURE 11 May 20, 2015 - 3:25:16 pm (BY: BUCHAN, CAMERON)]

5.4 OPERATIONS WATER MANAGEMENT

Water treatment and management during active operations includes a water treatment plant at Bellekeno 625 and a planned water treatment plant for the Flame and Moth mine. At Bellekeno 625, mine in-flow water is pumped to surface into a lime based metals precipitation water treatment plant located near the 625 adit. Bellekeno mine water treatment is primarily associated with zinc contamination. Lime slurry is mixed with underground mine water, mixed in a reactor tank and then flows through two lined settling ponds to allow precipitation of zinc hydroxide sludge along with other hydroxide based metal precipitates. The water treatment plant at Bellekeno has operated successfully for over 8 years and is well demonstrated and proven. The water encountered during the development and operation of the Flame and Moth underground workings will either be utilized in the milling process as makeup water or discharged. Discharged water will meet the effluent quality standards to achieve the water quality objectives presented within Water Licence QZ09-092. Treated and released water for Flame and Moth will be managed using new water management facilities located within the current Mill footprint including a water treatment plant and storage/settling pond. Tailings produced will be deposited on the permitted and existing DSTF, as well as in an expanded area of the DSTF, which will be lined.

Given the close proximity of the Flame and Moth deposit and portal to the existing infrastructure at the Keno District Mill, a number of common facilities and infrastructure will be used which will improve the overall efficiency of the operation and reduce any potential environmental and socio-economic effects. Figure 5-4 shows the Flame and Moth project site.

The Flame and Moth mine will require common surface support facilities including a dedicated mine office, dry/lunch room, maintenance shop, fuel storage tanks and laydown yard. A water management settling pond will also be constructed adjacent to the Mill pond. The portal location is shown in Figure 5-10.



Figure 5-10 Flame and Moth Portal Location

The Waste Rock Management Plan has been updated to incorporate waste rock generated from the Flame and Moth development (AEG, 2018a). An increase in the licenced total tonnage of waste rock stored on surface will not be required. Waste rock generated from the Flame and Moth Mine will be used for underground backfill, construction of laydown pads, access roads to the crusher, a toe abutment for the DSTF expansion, base layer for the DSTF expansion and for general construction purposes.

A comprehensive hydrogeological investigation was completed at the Flame and Moth deposit to assess the hydrological conditions associated with development of the deposit. The hydrogeological investigation estimates that up to 35 lps of groundwater inflow could be expected and encountered during the operation of the Flame and Moth mine. Management of mine inflows at Flame and Moth is planned to be via underground sumps and pumps, similar to the water management program at the Bellekeno Mine.

A main dirty water sump is planned for the 660 m elevation near the fresh air raise and main ramp. A dirty water centrifugal pump(s) are planned in two parallel banks of three pumps each in series, capable of up to 70 lps or twice the anticipated mine inflows. Two steel cased 150 mm diameter boreholes are planned to deliver dirty water from the main sump to a sump near the portal for additional settling prior to be pumped to water treatment plant.

Area sumps are planned as follows: two sumps at the lowest areas of Lightning and one at the lowest area of Christal. These sumps will be equipped with 45 kW dirty water submersible pumps to pump to the main sump at the 660 m elevation.

Figure 5-11 presents the issued for construction Engineering design drawing for the Flame and Moth Water Treatment Pond. The pond has been designed to have a capacity of 6,500 m^3.

In terms of contingency water storage, the contingency plan is the same as is currently in place and successfully used at Bellekeno which is to temporarily store water underground during any water treatment upset conditions. Since the Bellekeno water treatment plant has been upgraded and in operation, the longest period of an upset condition requiring temporary cessation of underground pumping and intentionally holding back water underground is approximately 24 hours. In the event there were a temporary upset of the Flame and Moth water treatment plant, a similar contingency plan would be initiated. Operational freeboard is also maintained in the water treatment pond to allow for treatment upset conditions and temporarily suspend discharge.

Static and kinetic testing was conducted on Flame and Moth drill core samples, spanning all the major lithologies expected to encounter during excavation. The results and interpretation of this testing are summarised in Appendix 3.3. Briefly, ABA, ICP aqua regia digested metals, and shake flask extraction testing indicated that the samples are non-acid generating and the majority have low metal leaching capacity. Similar results were obtained from testing of waste rock from Bellekeno, Lucky Queen, and Onek deposits.

A 30 m waterbody setback has been established for deposition of N-AML waste rock in consideration of its zinc content (1100 ppm Zn threshold), in accordance with the WRMP.

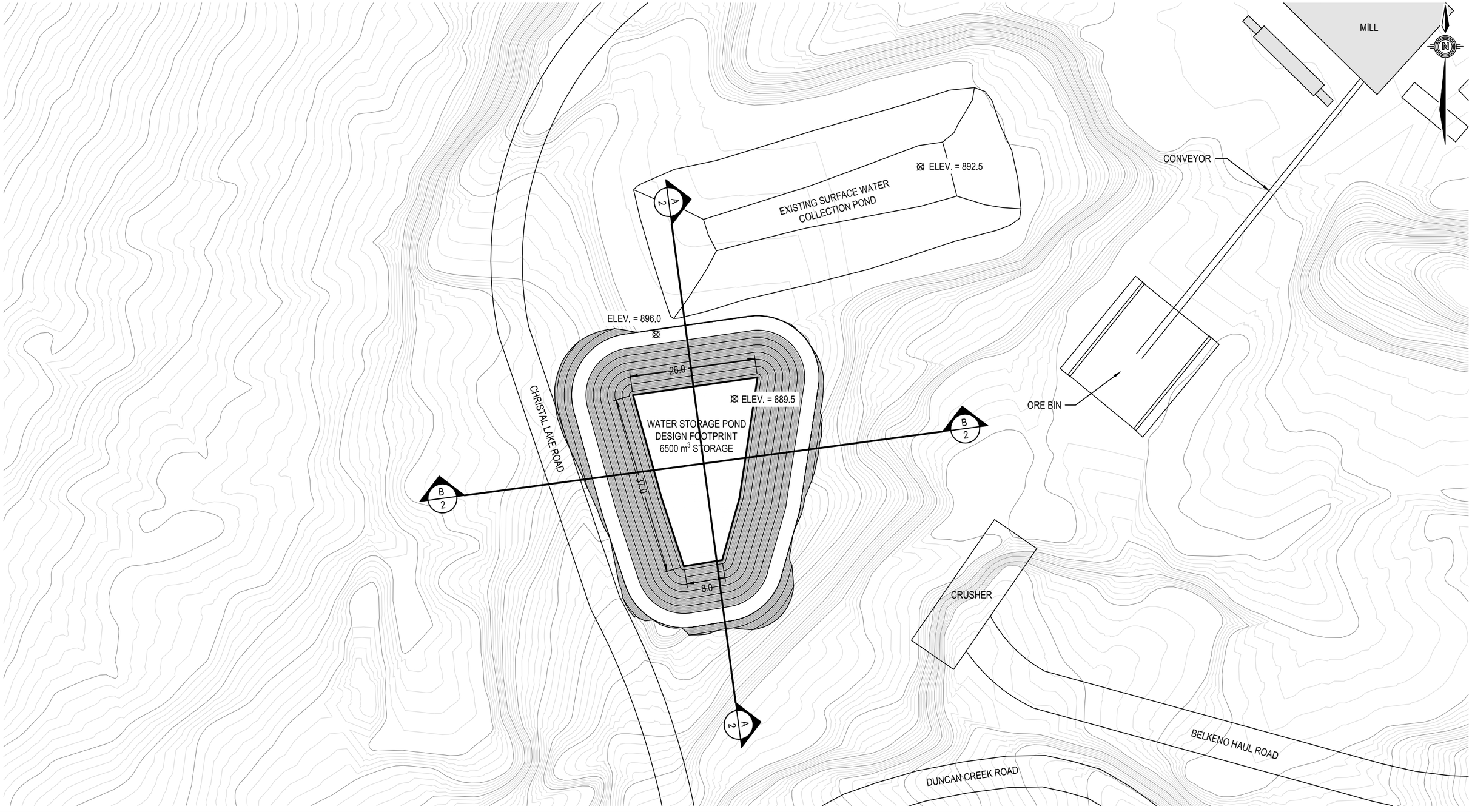
Water management structures, including berms, ditches and temporary water storage ponds, will be established to convey water around N-AML and P-AML waste rock dumps and direct water to appropriate locations to be discharged to ground.

The AMP includes an “event” for monitoring N-AML waste rock piles and their seepages, and stipulates adaptive management measures to be undertaken if an increasing trend in acid generation or metal leaching is detected.

As observed in actively discharging adits throughout the KHSD, the pH of Flame and Moth adit water is expected to be circumneutral to slightly alkaline. Based on the Bellekeno adit water, elevated total concentrations of zinc (BK625 median 1.8 mg/L), lead (BK625 median 1.61 mg/L), cadmium (BK625 median 0.017 mg/L), and silver (BK625 median 0.012 mg/L) are anticipated, with freshet extremes generally an order of magnitude higher.

The Bellekeno water treatment plant (WTP) uses basic metal hydroxide precipitation technology and particulate removal technology including coagulation, settling, and filtration. In general, lime solution is added to the underground mine collected waters and a zinc hydroxide precipitate (sludge) is formed and settles to the bottom of two lined ponds. The suspended solids in the mine discharge and the zinc hydroxide particulates are removed by coagulation with lime, settling in ponds, and filtration in a multimedia filtration process.

Q:\Whitehorse\Data\0201drawings\Keno\ENG.WARC032-0-01 WATER STORAGE POND - BELLEKENO\ENG.WARC032-0-01 Fig.1-R0.dwg [FIGURE 1 July 12, 201 - 2:08:43 pm (BY: PASLOSKI, TAYLOR



APPROXIMATE CONSTRUCTION VOLUMES (m^3)
CUT = 5300 m^3
FILL = 500 m^3

NOTE
CONTOURS FROM LIDAR DATA
(DATED NOVEMBER 2014)

0 25m
Scale: 1:750 @ 11"x17"

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
SIGNATURE
Date July 12/17
PERMIT NUMBER PP003
Association of Professional
Engineers of Yukon

PROFESSIONAL ENGINEER YUKON TERRITORY J. RICHARD TRIMBLE July 12/17

PROFESSIONAL ENGINEER YUKON TERRITORY TAYLOR PASLOSKI July 12, 2017

ISSUED FOR CONSTRUCTION

CLIENT
ALEXCO

TETRA TECH EBA

WATER STORAGE POND DESIGN KENO HILL DISTRICT MILL SITE

Flame and Moth Water Treatment Pond

PROJECT NO.	DWN	CKD	REV
ENG.WARC03290-01	KF	RT	0
OFFICE: EBA-WHSE	DATE: July 12, 201		

Figure 5-11

The proposed Flame & Moth treatment plant design builds on Alexco's experience of successfully treating water over the past eight years in the Keno Hill Silver District as part of care and maintenance of the Silver King, Galkeno 300, and Galkeno 900 sites and mining operations at the Bellekeno mine. The new Flame & Moth treatment facility would be located adjacent to and within the Keno District Mill, and the processes used in the treatment plant will be comprised of the following general processes:

1) Particle removal via a hydrocyclone, multimedia filter, clarifier/thickener, and/or settling pond;

2) Metals removal as needed with the addition of air, pH adjustment, a polymer, and settling in a clarifier/thickener;

3) Ammonia removal via biological oxidation/degradation processes (with the addition of air and organic carbon) and an optional ion exchange (IX) system for final polishing.

Mass load model for Christal Creek and Lightning Creek were developed by Interralogic, Inc./ Hatch using Goldsim simulation framework. The models were initially prepared for simulating metal loads in Christal Creek and Lightning Creek, and to evaluate the reclamation options (currently being developed) for the Keno Hill Silver District Type 2 Abandoned Mines. Hatch's revised draft reports, Chemical Mass Load Model for Christal Creek: Description and results: 2016 update (Hatch, 2016a) and Chemical Mass Load Model for Lightning Creek: Description and results: 2016 update (Hatch, 2016b), provide a detailed description of the development of the models, including the loading sources, key assumptions, stochastic parameters and model calibration. The model has been recalibrated up to September 2015. The GoldSim model has also been updated to include potential loadings from the proposed Flame and Moth Mine including N-AML waste rock, expanded dry stack tailings facility, mine discharge and groundwater flow from the mine pool or bioreactor at closure for cadmium and zinc, the contaminants of concern, plus the additional parameters with effluent quality standards in Water Licence QZ09-092-2, which are ammonia (NH_3), arsenic (As), copper (Cu), lead, (Pb), nickel (Ni) and silver (Ag). Additional parameters for the model were not included as the N-AML waste rock humidity cell leaching rates and the deep ground water sampled from the three deep wells (FM-MW-1, FM-MW-2, FM-MW-3) did not identify any additional parameters of potential concern.

The load models calculated metal loadings for three phases of the project: pre-mining development, operations, and reclamation and post-closure. The load model calculates metal loading results for Christal Creek and Lightning Creek from 2008 to December 31, 2014 without any potential loading from the proposed mining activities from the Flame and Moth Mine. The models then accounts for operating the Flame and Moth Mine from January 1 to March 31, 2021 at the maximum mining rate of 400 tonnes per day (tpd). The loading models incorporate potential loadings for the reclamation and post closure phase (2021 to 2031).

The largest proposed loading source, Flame and Moth Mine discharge, is only of short duration and will cease at the end of the mine life. The model results present the predicted concentrations for the Flame and Moth discharge at both the average anticipated concentrations and the proposed effluent quality standards for the complete life of mine. The comparison of the results using the EQS discharge for the complete life of the mine is overly conservative based on Alexco's track record for operating five water treatment plants in the Keno District and the scenario presented for average expected

discharge concentrations is more representative of anticipated monthly concentrations. The modelling results also show that the long term concentrations in Christal Creek and Lightning Creek ameliorated by the District Closure Plan currently under development will not be impacted by the Flame and Moth project.

5.5 MONITORING

The Monitoring, Surveillance and Reporting Plan (AEG, 2018b) describes the framework used to manage mining operations in the KHSD. The plan includes monitoring and reporting of:

- The local and receiving environment through scheduled inspections and sample programs;
- Effluent discharge points and treatment system performance;
- Site facilities and incorporated design measures to ensure structural stability and prevention of accidents and malfunctions;
- Remediation success; and
- Adaptive management responses.

If monitoring indicates that physical structures, treatment systems or mitigative measures are not performing then maintenance or contingency plans can be implemented following an adaptive management approach.

Prior to mine development in the KHSD, a number of monitoring programs and a surveillance networks were already in place as per care and maintenance activities (Water Licence QZ06-074), advanced exploration and preliminary development activities at the Bellekeno mine (Water Licence QZ07-078) as well as district-wide closure and new mine permitting studies. These programs include but are not limited to physical inspections, a water quality surveillance network, old mine workings monitoring, aquatic resources monitoring for benthic invertebrate and fisheries populations, sediment monitoring, waste rock and mine wall sampling and the Adaptive Management Plan. Monitoring, surveillance and reporting applicable to Bellekeno, Flame and Moth, Onek 990 and Lucky Queen Mines are presented in the Monitoring, Surveillance and Reporting Plan (AEG, 2018b).

Alexco provides regular monitoring data, analysis and discussion of trends in our monthly and annual reports submitted as a condition of QZ09-092 and QML-0009.

6. TEMPORARY CLOSURE

In the event of a premature closure, the following monitoring and care and maintenance activities (focused on a temporary closure scenario occurring after mine start-up) will be implemented. Alexco's priority during any temporary closure scenario will be to ensure that the site remains geochemically and physically stable, secure and safe, monitored and in compliance with applicable licences and legislation. This will include initial stabilization and on-going routine monitoring and maintenance of the site infrastructure and facilities until mining recommences or full closure is initiated.

Table 6-1 provides a summary of the various project components and associated inspection and maintenance activities during any temporary cessation of mining activities. Alexco's ongoing care and maintenance activities in the District are currently scheduled to continue beyond the next 6 years which means that there would be minimal additional costs related to a temporary closure of the Keno Hill Mine Operations.

6.1 PHYSICAL STABILITY AND GEOCHEMICAL STABILITY

Stabilization of site works during any temporary closure will be addressed initially well in advance of any closure scenario through the Company's commitment to progressive reclamation and stabilization measures. Progressive reclamation will be implemented on an ongoing basis (Section 2.3) to fulfil the Company's commitment to maintaining site stability and reclaiming areas as soon as operationally possible, therefore reducing both financial and operational liability.

Site infrastructure, including primarily buildings, equipment and machinery, will be emptied/drained of hazardous reagents and process fluids where appropriate and stabilized for temporary closure based on recommendations from mechanical and chemical suppliers, contractors and engineers. This includes the removal of all hazardous wastes, including waste hydrocarbons, coolants, lubricants, mill reagents and process chemicals. Depending on the anticipated length of a temporary closure, mill reagents and chemicals may remain on site in a secure condition for reuse once active operations recommence. The bulk explosives inventory will be removed from site and explosives storage containers and facilities will be inspected regularly. In the event of suspended operations, the onsite water treatment facilities will be maintained by the existing district care and maintenance crew.

This temporary closure will be conducted to a level whereby the infrastructure and mine components are ensured to be stable in the short term (less than 5 years) and whereby mining and milling operations can be resumed in a timely manner should the decision be made to transition back into operations. This will include:

- the retention of essential equipment/assets onsite to maintain infrastructure; and
- the storage of hazardous materials (not waste) in competent primary and secondary containment ensuring compliance with applicable legislation.

Table 6-1 Summary of Care and Maintenance Activities and Surveillance during Temporary Cessation of Mining Activities

Project Component	Objectives	Care & Maintenance Activities	Monitoring	Monitoring Responsibility	Monitoring Timing/ Frequency
Bellekeno Mine	Water Management	Maintain Bellekeno 625 water treatment facility and related water management infrastructure.	WL Water Quality Surveillance Program	Care & Maintenance Crew	As per WL
	Physical Stability	Restrict access to hazardous areas with physical barriers.	QML Physical Monitoring Program	Care & Maintenance Crew	As per QML
Onek Mine	Water Management	Maintain Onek 400 water treatment facility and related water management infrastructure.	WL Water Quality Surveillance Program	Care & Maintenance Crew	As per WL
	Physical Stability	Restrict access to hazardous areas with physical barriers.	QML Physical Monitoring Program	Care & Maintenance Crew	As per QML
Lucky Queen Mine	Water Management	Maintain Lucky Queen water management infrastructure.	WL Water Quality Surveillance Program	Care & Maintenance Crew	As per WL
	Physical Stability	Restrict access to hazardous areas with physical barriers.	QML Physical Monitoring Program	Care & Maintenance Crew	As per QML
Flame and Moth Mine	Water Management	Maintain Flame and Moth water management infrastructure.	WL Water Quality Surveillance Program	Care & Maintenance Crew	As per WL
	Physical Stability	Restrict access to hazardous areas with physical barriers.	QML Physical Monitoring Program	Care & Maintenance Crew	As per QML
Bermingham Mine	Water Management	Maintain Bermingham water management infrastructure.	WL Water Quality Surveillance Program	Care & Maintenance Crew	As per WL
	Physical Stability	Restrict access to hazardous areas with physical barriers.	QML Physical Monitoring Program	Care & Maintenance Crew	As per QML
Waste Rock Storage	Physical stability	Runoff/Erosion/Sediment control. Progressive reclamation will occur during operations.	QML Physical Monitoring Program	Care & Maintenance Crew	As per QML
			Geotechnical Inspection	Engineer	Annual
	Geochemical Stability	Cover P-AML WRSFs with HDPE Monitor WRSF & WRDA for seepage.	WL Water Quality Surveillance Program	Care & Maintenance Crew	As per WL
Roads	Physical Stability	Surface grading and granular amendments, ditch and culvert maintenance.	Visual inspection periodically for signs of instability/erosion	Care & Maintenance Crew	Weekly and after heavy precipitation events
Mill	Buildings, Equipment and Infrastructure	Secure buildings and retain necessary equipment for site maintenance.	Visual inspection for signs of instability.	Care & Maintenance Crew	Monthly
		Concentrate removed from site.			
	Physical Stability	Inspect for site stability.	Structural Inspection	Engineer	Twice Annually
		Reduce ore stockpile inventory.			
	Water Management	Maintain water treatment system and related water management infrastructure.	WL Water Quality Surveillance Program	Care & Maintenance Crew	As per WL
Dry Stack Tailings Facility	Physical stability	Surface water diversion structure repair/ maintenance.	Monitoring Program from DSTF Operating Plan; & QML Physical Monitoring Program	Care & Maintenance Crew	As per Monitoring Programs & QML
		Runoff/Erosion/Sediment control.			
		Dust Control.			
		Progressive reclamation will occur during operations.	Geotechnical Inspection from QML and DSTF Operating Plan	Engineer	Annual
	Geochemical Stability	Monitor for seepage and water quality.	WL Water Quality Surveillance Program; & Monitoring Program from DSTF Operating Plan	Care & Maintenance Crew	As per WL
Entire Site	Physical stability	Runoff/Erosion/Sediment control.	QML Physical Monitoring Program	Care & Maintenance Crew	As per QML
		Road/culvert maintenance.			
		Progressive reclamation will occur during operations.			
	Security	Full time site care & maintenance crew will check, repair and replace as required: · precautionary signage · security gates – installed to restrict access to the mill	Care & Maintenance Monitoring of all infrastructure and site elements	Care & Maintenance Crew	Daily: Inspection Sheets included in Annual Reporting
	Miscellaneous Infrastructure	Minimize camp size.			
		Inspect power line	Care & Maintenance monitoring of all infrastructure and site elements	Care & Maintenance Crew	Daily: Inspection Sheets included in Annual Reporting
	Reporting	Prepare and submit annual report to Yukon Water Board pursuant to WL, including details of temporary closure activities and monitoring.		Alexco	Annually
		Prepare and submit annual report to YG Mineral Resources Branch pursuant to the QML, including details of temporary closure activities and monitoring.			
		Prepare and submit quarterly monitoring reports to Environment Canada under MMER.			Quarterly, Online RISS Registry

6.2 SECURITY AND MONITORING

Uncontrolled access to the mine components and facilities could pose a risk to the public and to the site assets. As such, the full-time care and maintenance crew will conduct daily monitoring of all infrastructure and site elements. Equipment and vehicles will be available onsite for the staff should more intensive earthworks be required during the temporary closure period.

During temporary closure gates may be required and locked with warning signs erected at the gates and key locations around the site indicating the risks of entry. Site buildings will be locked and secured. Roads will be maintained as required.

The care and maintenance crew will be responsible for:

- Regular inspections of the site to observe and document the condition of, and any changes to: site security and public safety measures, infrastructure, mine components, etc., as well as to document potential emerging environmental or public health and safety objectives;
- Conducting routine physical monitoring activities;
- Regular water quality and flow monitoring;
- Submitting inspection and monitoring reports to managers on a regular basis;
- Responding to any security/safety objectives as required; and
- Conducting routine site maintenance and basic repairs to infrastructure and works as required (snow removal, culvert and road maintenance, building maintenance).

Site inspections and monitoring will be conducted by vehicle when seasonally possible. Some sites may be difficult to access in winter as snow removal would not be reasonable at all locations. Inspection results will be documented on a form and submitted to management on a regular basis. Reports of changes to physical status of any part of the site may warrant a follow-up investigation by managers and/or professional personnel.

The Company's Environmental Monitoring Program and detailed design reports further commit to structural monitoring, which will continue in the event of temporary closure.

Some elements of the monitoring program (geotechnical and structural inspections and non-routine water quality and biological monitoring) will be conducted by appropriate professional personnel, and results of these inspections will be included in annual reports and other required submissions.

6.3 REPORTING

Monitoring and inspection data collected will be compiled and submitted according to the required annual reporting timeframes for both the Quartz Mining and Water Licences.

7. FINAL RECLAMATION AND CLOSURE MEASURES

This section of the Reclamation and Closure Plan provides the details on the proposed reclamation and closure measures for each mine component in the Keno Hill Mine Operations. The approach to each subsection is to present a brief description of each component and related facilities with reclamation and closure objectives and measures.

The following mine components specific to the Keno Hill Mine Operations are addressed:

1. Underground Workings and Opening to Surface
    - Bellekeno Production Unit Area – including consideration of waste rock disposal areas/ storage facilities; water management; and surface facilities.
      (Appendix 3.1, Drawings: C-2401, C-2402, B-2101, B-2102, D-2102, D-2301, D-2601)
    - Onek Production Unit Area – including consideration of waste rock disposal areas/ storage facilities; water management; and surface facilities.
      (Appendix 3.1, Drawings: C-4401, B-4101, B-4301)
    - Lucky Queen Production Unit Area – including consideration of waste rock disposal areas/ storage facilities; water management; and surface facilities.
      (Appendix 3.1, Drawings: C-3401, B-3101, B-3301)
    - Flame and Moth Deposit – including consideration of waste rock disposal areas/ storage facilities; water management; and surface facilities.
      (Appendix 3.1, Drawing: C-1401)
    - Bermingham Deposit - including consideration of waste rock disposal areas/ storage facilities; water management; and surface facilities.
      (Appendix 3.1, Drawings: C-5401, B-5101, B-5301)
2. Dry Stack Tailings Facility – Phases I – II
   (Appendix 3.1, Drawings: C-7401)
3. District Mill, Ancillary Facilities, Flat Creek Camp
   (Appendix 3.1, Drawings: C-6401, B-6101, B-6301, C-9401, B-9101, B-9301)
4. Roads and Linear Disturbances
   (Appendix 3.1, Drawings: B-0301)

Development of the mines in the Keno District Mine Operations progress through the life cycle of the LOM Plan. The RCP addresses reclamation and closure cost liabilities at the different times, including current disturbance, end of Year 2 and End of Mine life. Table 7-1 summarizes the disturbance by Mine Area Component at these different stages in the LOM Plan.

Table 7-1 Summary of Disturbance Area by Mine Component

Mine Component	Units	Current (February 2018)	Year 2 LOM Plan	End of LOM Plan
Mill Facilities				
Ore Mined/Milled	tonnes	248,644	440,824	907,715
Dry Stack Tailings Facility	tonnes	180,722	282,112	553,692
Dry Stack Tailings Facility Area (unreclaimed)	ha	0.6	2.5	5.5
Mill Pad area	ha	4.79	4.79	4.79
Bellekeno				
BK East Yards/Portal/Laydown Areas	ha	2.04	2.04	2.04
BK 625 Yards/Portal/Laydown Areas	ha	1.29	1.29	1.29
N-AML WRDA	tonnes	0	0	0
N-AML WRDA	ha	0	0	0
Temporary P-AML WRSF	ha	0.20	0.20	0.20
Temporary P-AML WRSF	tonnes	425	1,105	1,105
Temporary P-AML WRSF	m^3	250	650	650
Onek				
Yards/Portal/Laydown Areas	ha	0.35	0.35	0.35
N-AML WRDA	tonnes	0	0	0
N-AML WRDA	ha	0	0	0
P-AML WRSF	ha	0.48	0.48	0.48
P-AML WRSF	tonnes	0	0	0
P-AML WRSF	m^3	0	0	0
Lucky Queen				
Yards/Portal/Laydown Areas	ha	0.63	0.63	0.63
N-AML WRDA	tonnes	0	0	80,000
N-AML WRDA	ha	0	0	0.4
P-AML WRSF	tonnes	0	0	44,000
P-AML WRSF	ha	0	0	0.43
P-AML WRSF	m^3	0	0	25,882
Flame and Moth				
Yards/Portal/Laydown Areas	ha	0	0.1	0.1
N-AML WRDA	tonnes	0	75,000	125,193
N-AML WRDA	ha	0	4.1	6.9
P-AML WRSF	tonnes	0	6,000	12,000
P-AML WRSF	ha	0	0.12	0.23
P-AML WRSF	m^3	0	2000	4000
Bermingham				
Yards/Portal/Laydown Areas	ha	0.66	0.66	0.66
N-AML WRDA	tonnes	11,175	70,000	195,000

Mine Component	Units	Current (February 2018)	Year 2 LOM Plan	End of LOM Plan
N-AML WRDA	ha	0	0.68	1.86
P-AML WRSF	tonnes	0	2,500	10,000
P-AML WRSF	ha	0	0.4	0.13
P-AML WRSF	m^3	0	800	3,000
Roads and Other				
Camp Accommodations	ha	2.2	2.2	2.2
Sludge Volume	m^3	150	225	350
BK Haul Road length	metres	5,661	5,661	5,661
Christal Lake Road	metres	1,299	1,299	1,299
Keno City Bypass Road	metres	2,060	2,060	2,060
Bermingham Access Road	metres	0	1,979	1,979

7.1 UNDERGROUND WORKINGS AND OPENINGS TO SURFACE

The underground workings and openings to surface that are addressed in the RCP include the following:

- Bellekeno Mine
  - Bellekeno East Portal
  - Bellekeno Mine Decline and Underground Workings
  - Bellekeno 625 Adit/Secondary Escape
  - Bellekeno 200 Vent Raise
- Lucky Queen Mine
  - Lucky Queen Portal
  - Lucky Queen Underground Adit and Workings
  - Lucky Queen Vent Raise/Secondary Escape
- Onek Mine
  - Onek Portal
  - Onek Decline and Underground Workings
  - Onek Vent Raise/Secondary Escape
- Flame and Moth Mine
  - Flame and Moth Portal
  - Flame and Moth Decline and Underground Workings
  - Flame and Moth Vent Raise/Secondary Escape
- Bermingham Deposit
  - Bermingham Portal
  - Bermingham Decline and Underground Workings
  - Bermingham Vent Raise/Secondary Escape

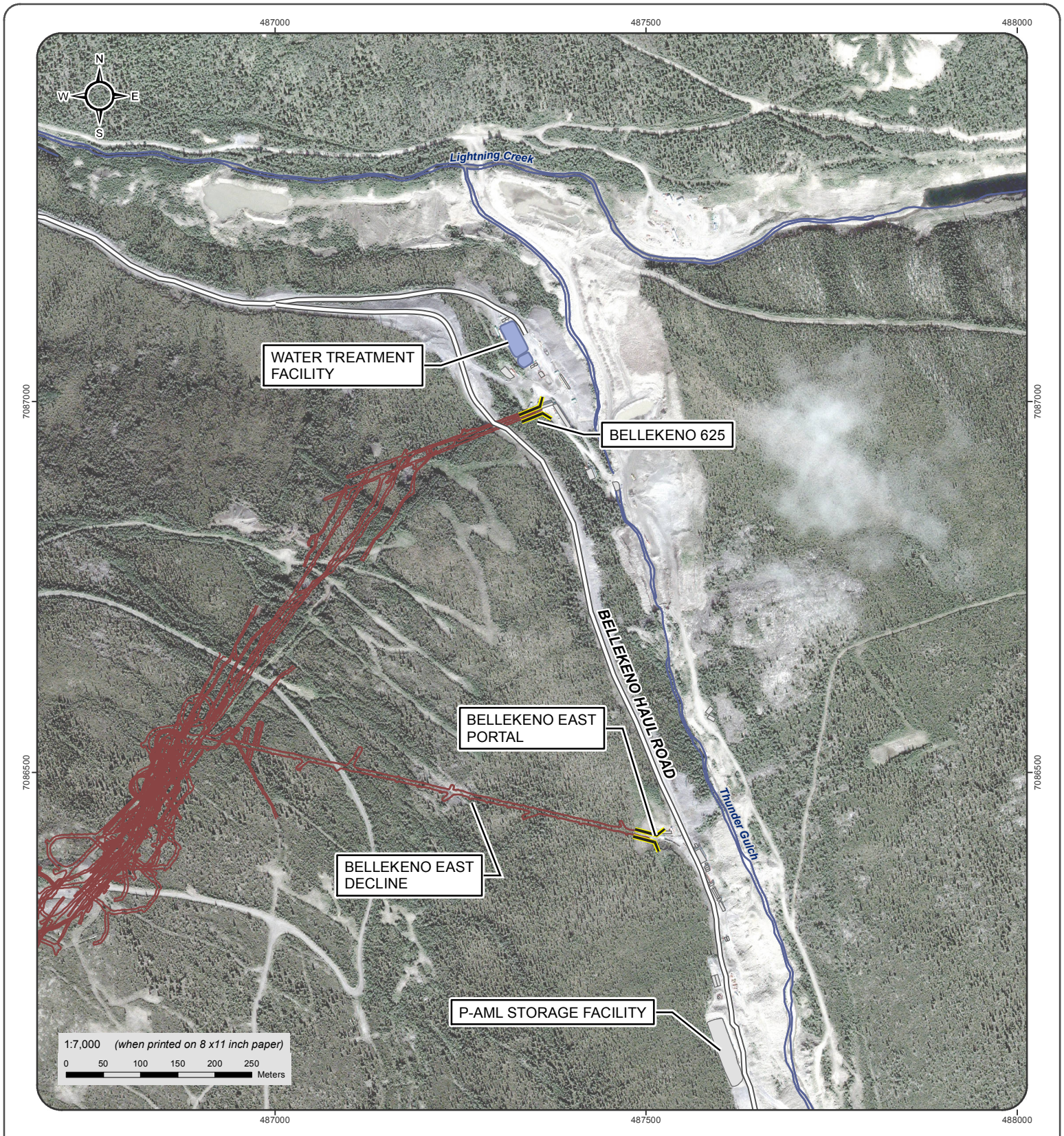
7.1.1 Closure Objectives

The objectives for closing the underground workings and openings to surface are to:

1. Ensure physical and geochemical stability of the site;
2. Achieve passive management and treatment of the mine pool;
3. Minimize safety risks to people and wildlife; and
4. Reclaim the site to an aesthetically acceptable level.

7.1.2 Bellekeno Mine

The Bellekeno Mine consists of the underground workings and surface adit entrances (Bellekeno East portal and decline and the Bellekeno 625 adit), water treatment facility and associated buildings and infrastructure (Figure 7-1). The Bellekeno East portal is the primary ingress/egress point for the Bellekeno Mine (Figure 7-2 and Figure 7-3). An as built of the Bellekeno Mine underground workings as of September 2013 when operations were suspended is shown in Figure 7-4. The Bellekeno Life for Mine Plan is provided in Figure 7-5. The Bellekeno 625 adit provides secondary escape and ventilation intake for the mine and discharges mining-impacted water requiring treatment for suspended solids, zinc and occasionally other metals and ammonia, on a continuous basis. The 200-level vent raise is not a component of the Bellekeno mine operations (it is a historic liability not used in Bellekeno operations) but is included in the RCP given its proximity to the Bellekeno mine. Figure 7-2 shows the remaining surface buildings at Bellekeno East that will require removal.



Adit

Mine Feature Footprint

Pond

Underground Workings

Haul Road

Watercourse

AKHM

AEG

KENO DISTRICT MINE OPERATIONS
RECLAMATION AND CLOSURE PLAN

FIGURE 7-1

BELLEKENO MINE OVERVIEW

FEBRUARY 2018

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on February 2018

Datum: NAD 83; Projection: UTM Zone 8N

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(Last edited by: amatlashevska; 12/02/2018/15:04 PM)



Figure 7-2 Bellekeno East Portal and Site Facilities



Figure 7-3 Bellekeno East Portal

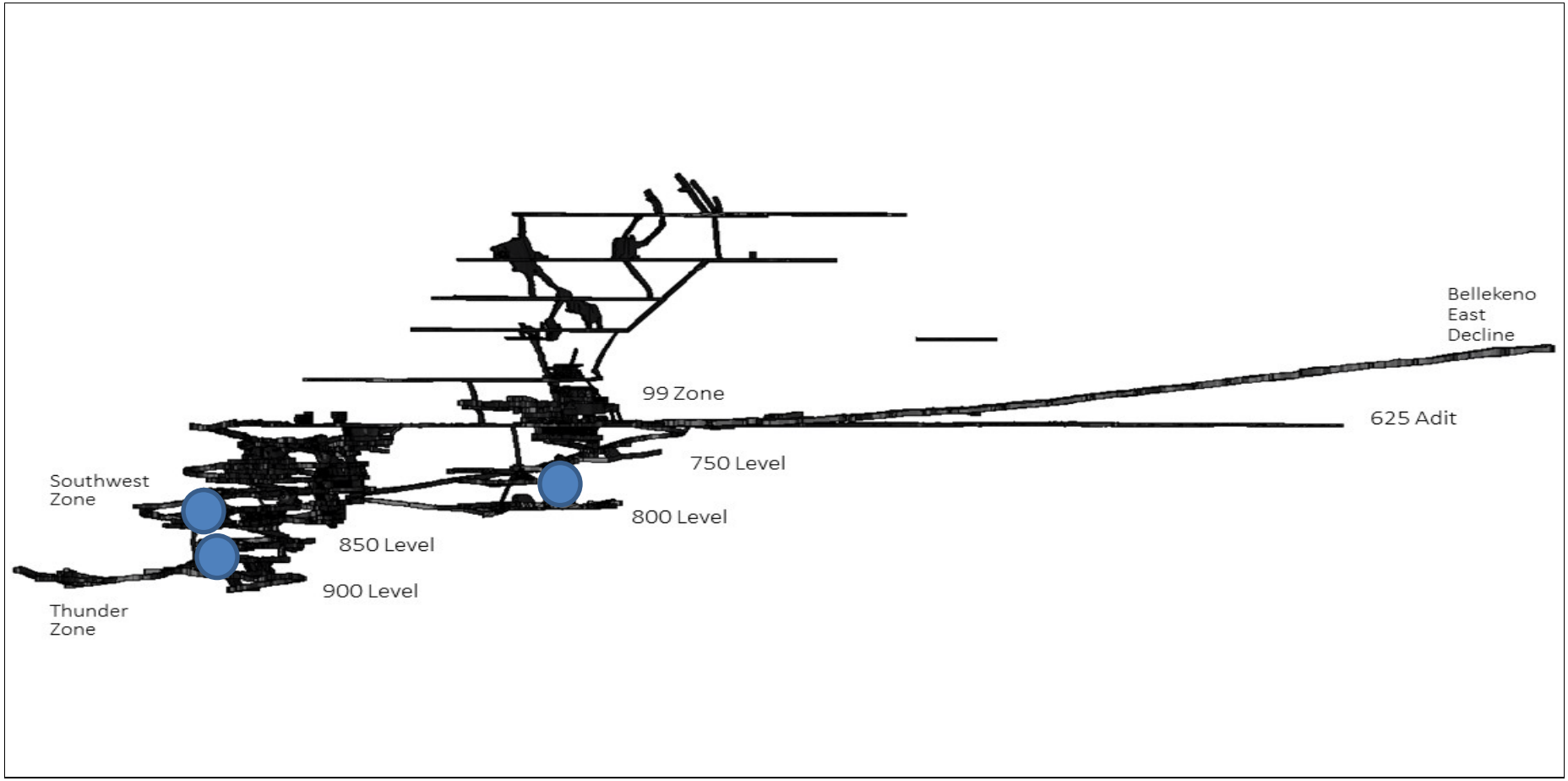


Figure 7-4 Bellekeno Mine As-Built Current Conditions January 2018

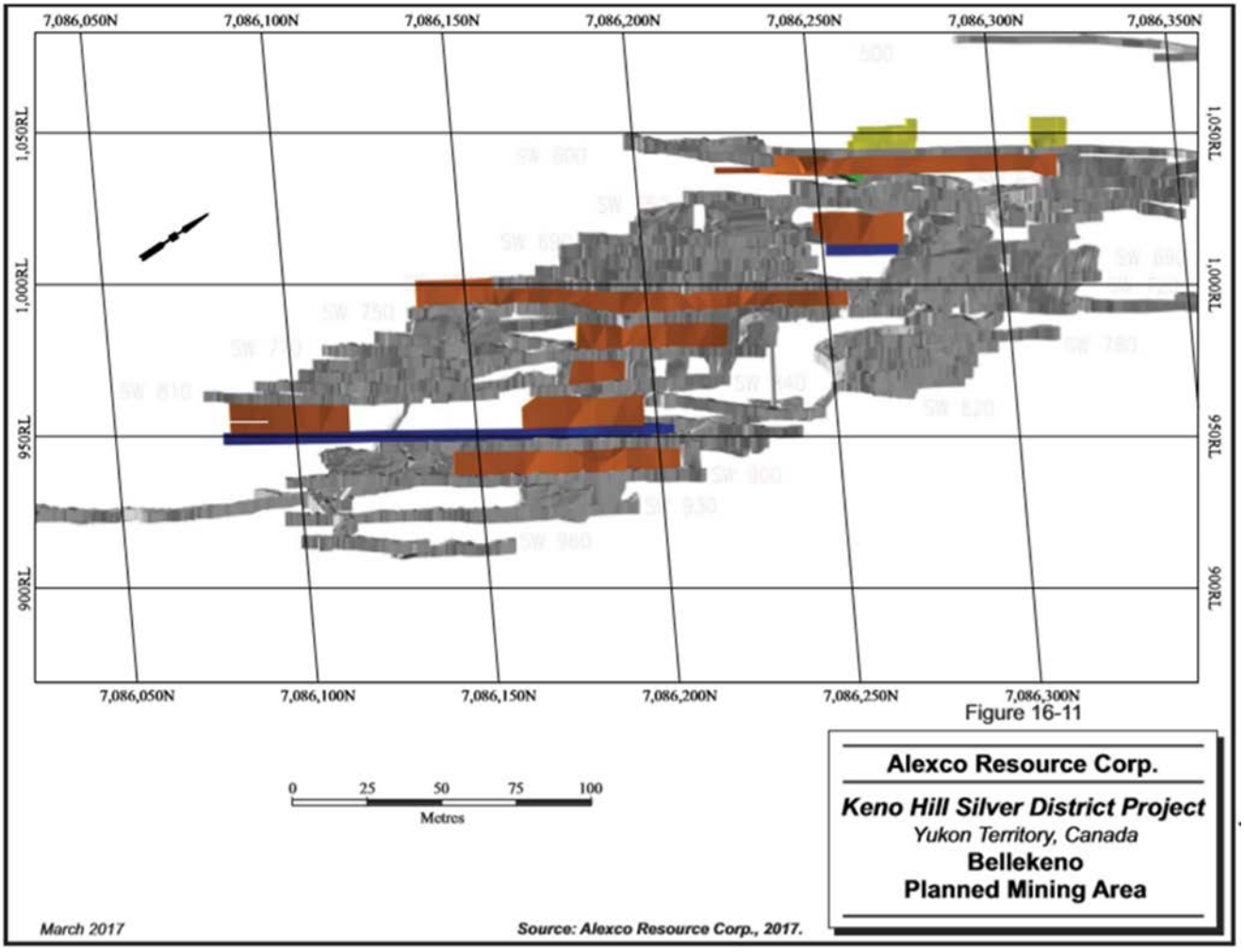


Figure 7-5 Bellekeno LOM Plan

7.1.3 Bellekeno Mine Closure Measures

The steps and measures required for closure of the Bellekeno Mine include:

1. Stabilize or backfill any remaining stopes as necessary to ensure long-term geotechnical stability underground;
2. Backfill any remaining P-AML waste rock on surface to underground. *Note – 250 m³ of P-AML waste rock remained in the lined facility adjacent to Bellekeno East upon temporary suspension of operations.*
3. Remove/salvage underground assets and equipment;
4. Remove/salvage surface facilities and infrastructure;
5. Remove any hazardous materials;
6. Install mine pool treatment infrastructure; and

7. Install rock pile portal cover at Bellekeno East.

Removal of underground equipment upon closure includes mining equipment such as trucks, LHD's, drills, etc. Mining fleet equipment will be brought to surface and either transported offsite or salvaged. There will be some equipment left underground that has either minimal salvage value or the cost to remove exceeds any salvage value. The following equipment may be left underground at each mine:

- Electrical cable;
- Electrical junction boxes;
- Steel piping;
- Hoses; and
- Vent tubing.

No hazardous material such as explosives, oils, lubes will be left underground at closure. The equipment left underground is not expected to have any hazardous material associated with it that would require any decontamination.

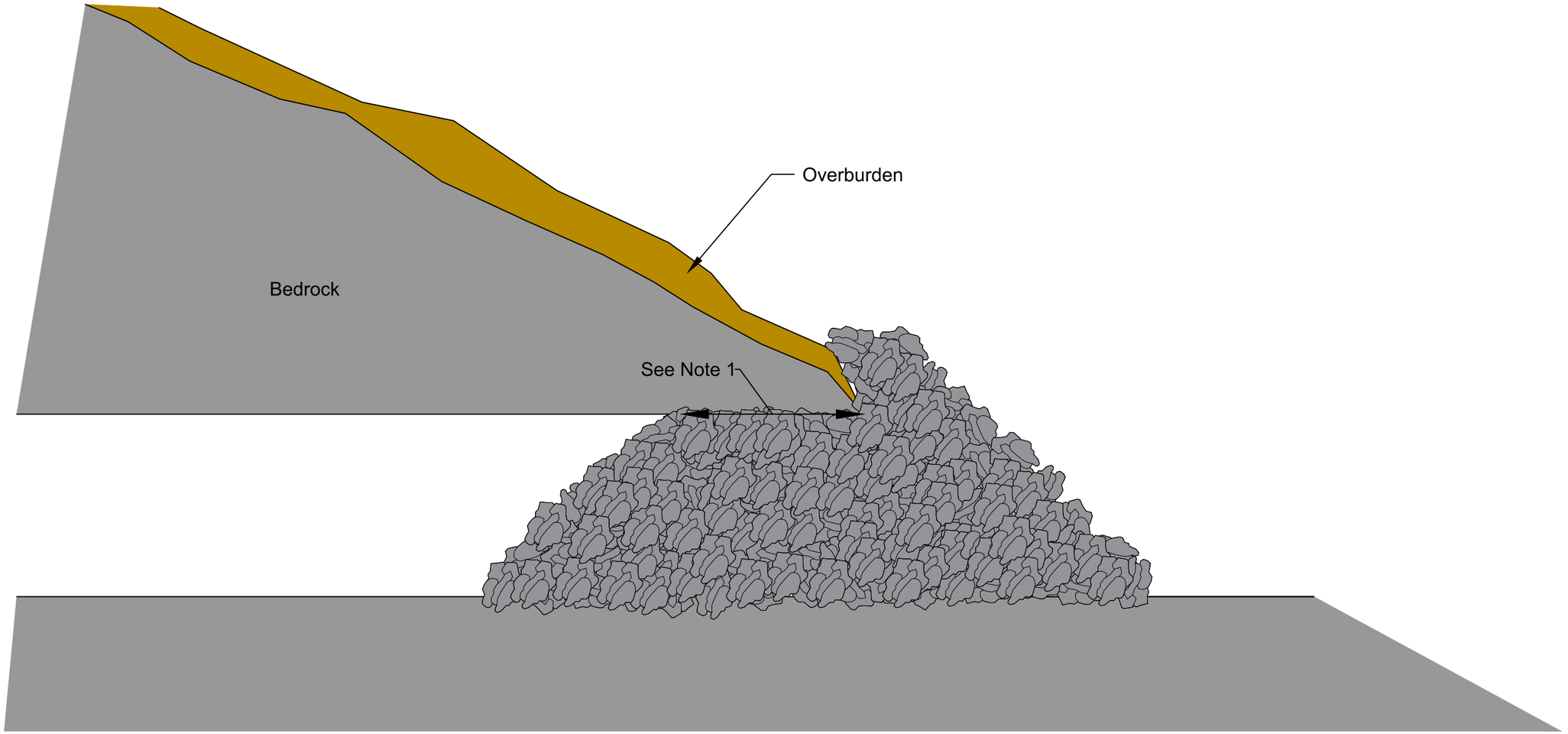
The mine pool will be managed by transitioning from actively treating adit discharge to sealing the 625 adit with a hydraulic bulkhead, implementing in situ mine pool treatment and installing a passive treatment system (bioreactor). Further discussion on the closure measures associated with long-term water management at Bellekeno is presented in Section 7.4.2.

At closure, underground equipment will be removed from the underground mine through Bellekeno East. The portal will remain temporarily accessible at closure for the rehandling of P-AML waste rock back into the underground (see Section 7.4). The Bellekeno East adit opening will then be blocked by inserting rock fill to protect human health and safety and prevent wildlife access (Figure 7-6). This method, in use at other northern Canadian mines, allows for movement of water and air through the opening, as well as allowing for any movement of rock walls, to prevent failure as would occur with a concrete plug for example. An adit decant channel will not be constructed as any water leaving the mine workings will flow via the Bellekeno 625 adit which is connected to the Bellekeno East decline. Reclamation measures for the Bellekeno Mine are predicated on the fact that the static water elevation will not reach the elevation of the Bellekeno East portal and therefore this portal will not discharge water. As such the sediment ponds constructed at Bellekeno East for development of the decline will be progressively reclaimed prior to mine closure.

Reclamation measures for the Bellekeno East, and Bellekeno 625 adit areas are described on Drawings C-2401 and C-2402 respectively located in Appendix 3.1.

200 Level Vent Raise

The 200 level vent raise is an historic vent raise to surface that connected to the 99 zone of the Bellekeno mine. The 200 vent raise will be capped with an engineered concrete cap similar to what is used at mines elsewhere in Canada. This cement plug will restrict physical entry and prevent air movement and possible ice plug formation at the adit. A preliminary design for a concrete cap is included in Figure 7-7.



Notes:

1. Backfill should extend to a minimum length equal to the largest opening dimension.
2. Backfill material should consist of well graded, durable rock fill and coarse rip-rap.
3. The use of well graded rock intermixed with large boulders will discourage people from digging into the backfill.
4. Backfill should be inert, or material that poses no additional threat to mine water quality.
5. Backfill should extend past the opening and mound over the top of the entrance to completely seal the opening and compensate for settlement.
6. Backfill outside the entrance should be covered with either coarse rip-rap to reduce erosion, or a native till, to permit vegetation.

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Not to scale

DATE	ISSUE/REVISION	REV No.	DRW.	APP.
2018-01-02	Draft for review	A	KAB	–

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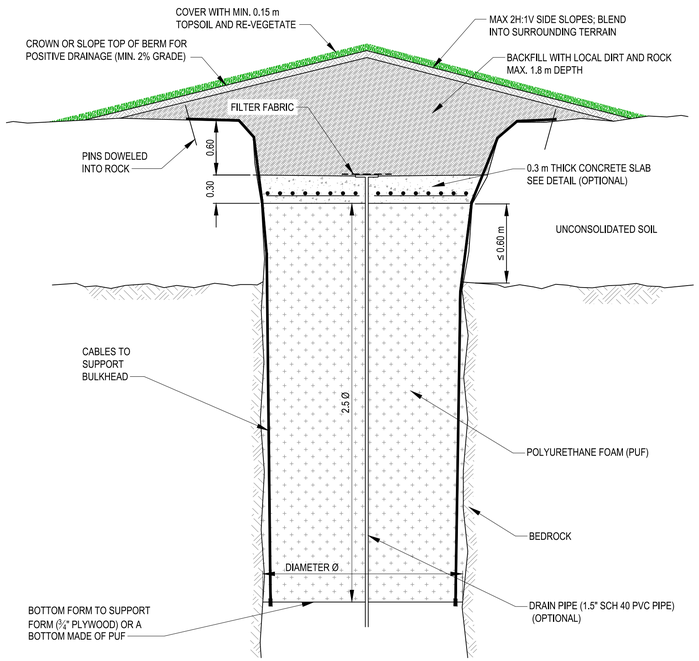
Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-S-0301

Figure 7-6

Portal Closure
Typical Rock Pile Closure Design

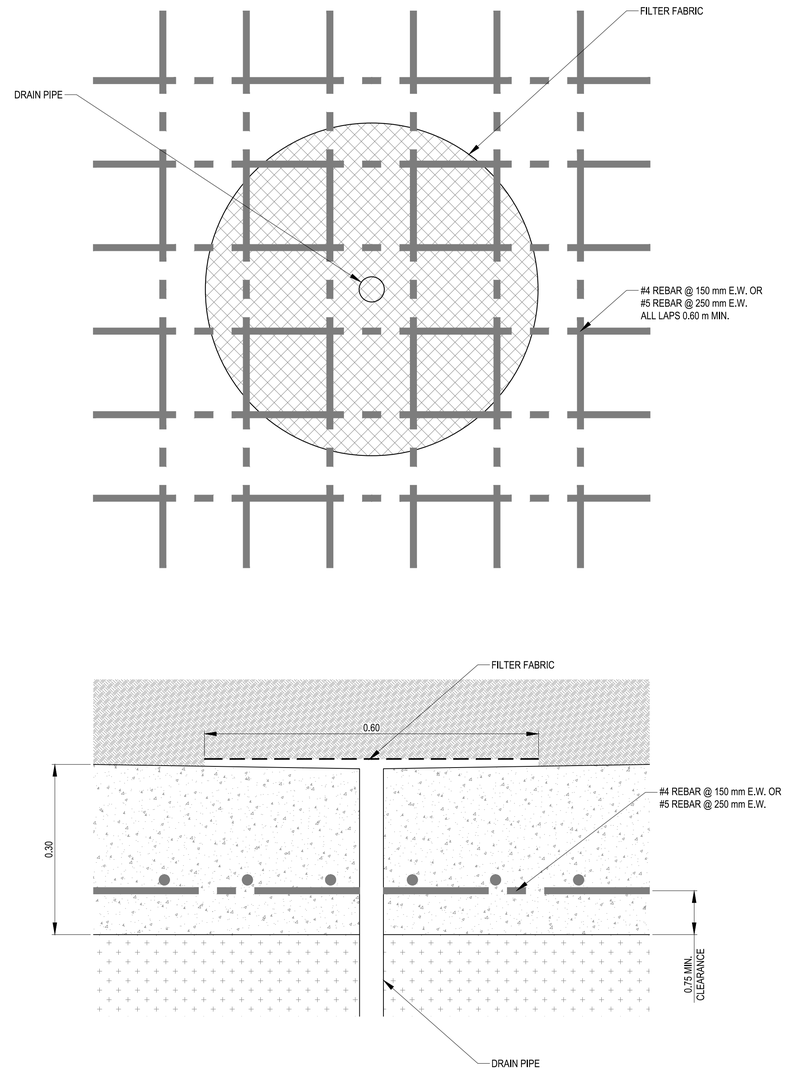
REVISION: A	2018-01-02	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: KAB	REVIEWED BY: KSW

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SHAFT PUF WITH CONCRETE SLAB CLOSURE

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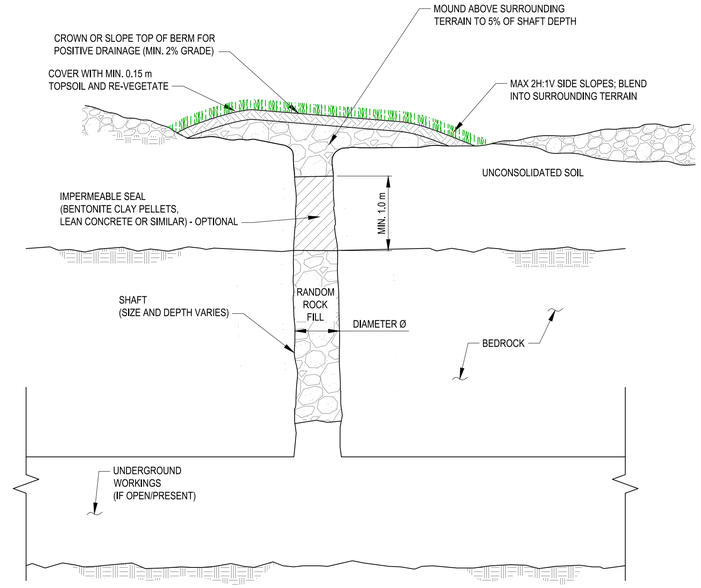


CONCRETE SLAB DETAILS

NOT TO SCALE

NOTES

1. Safety protocols related to working near or in the shaft should be followed during the project implementation.
2. Lower the bottom form into the shaft to the final depth of the Polyurethane foam (PUF)
3. Install drain pipe (1.5 " SC 40 PVC) extending from below the bottom form to planned top of concrete cap.
4. Place seals into the cracks between the edges of the bottom form to prevent foam from falling down the shaft.
5. Pour the mixed PUF foam onto the bottom form to form the plug.
6. Construct the 0.3 m concrete slab. Concrete slab sloped outwards to drain (2%)
7. Back fill on top of the concrete slab with local dirt and rock.
8. Concrete shall have a minimum 20 MPa compressive strength at 28 days
9. The Sub-Contractor will retain an independent testing agency recommended by the Consultant for the testing of concrete to establish that minimum strength required for concrete slab has been obtained.



SHAFT BACKFILL (DRY SEAL) CLOSURE

NOT TO SCALE

NOTES

1. Safety protocols related to working near or in the shaft should be followed during the project implementation.
2. Quantities will vary with shaft depth, connection to underground workings, and other conditions.
3. Mobile equipment must never operate on ground that shows signs of subsidence without taking adequate precautions.
4. Remove as practical, if present, and dispose of timber, trash, brush, topsoil and other debris in and around shaft area, prior to backfilling. Strip down to bedrock surface at collar where practical.
5. Existing steel pipe, concrete rubble (if present) should be removed or incorporated into backfill as directed by engineer.
6. Random rock fill must be:
   a. Non-acid generating rock fill
   b. Sized to contain no rocks greater than ¼ the diameter of the shaft.
7. Every effort should be made to keep all debris other than rock fill from going underground.

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TETRA TECH EBA

Keno District Mine Operations
Reclamation and Closure Plan
Drawing No:
AKHM-13-01-S-0303-ShaftCap

Figure 7-7

Shaft/Raise to Surface
Typical Concrete Cap Design

REVISION: A	2018-02-05	PROJECT No.: AKHM-13-01
DRAWN BY: Tetra Tech EBA	DESIGNED BY: Tetra Tech EBA	REVIEWED BY: KSW

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7.1.4 Onek Mine

The Onek mine was developed in 2012 and currently consists of 220 meters of a primary decline and surface facilities (office building, storage containers, and ventilation fan). P-AML WRSFs, N-AML WRDAs, and the vent raise have not yet been constructed. The Onek mine is not currently included in the Keno Hill Mine Operations LOM plan and these additional facilities would not be constructed until Onek becomes part of the LOM plan. An overview of the Onek mine is shown in Figure 7-8 and Figure 7-9. An as built of the Onek mine underground workings is shown in Figure 7-10.



Figure 7-8 Onek Mine Surface Overview



Adit

Existing Mine Feature Footprint

To Be Completed Mine Feature Footprint

Underground Workings Footprint

Secondary Road

Limited-Use Road

Watercourse

Aerial Imagery aquired on August 2017

Datum: NAD 83; Projection: UTM Zone 8N

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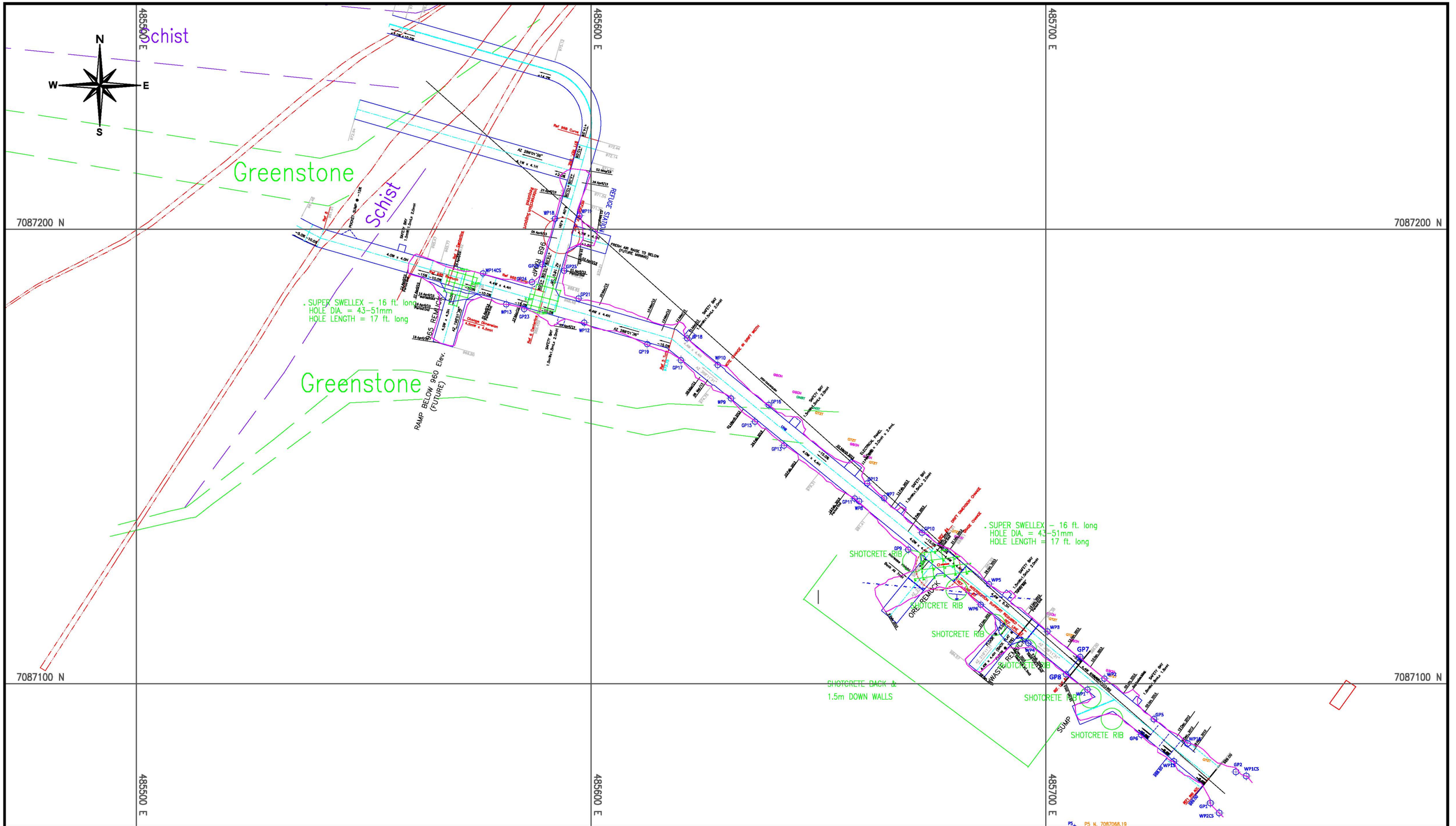
KENO DISTRICT MINE OPERATIONS RECLAMATION AND CLOSURE PLAN

FIGURE 7-9

ONEK 990 MINE LAYOUT

JANUARY 2018

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(Last edited by: amatlashevska; 26/01/2018/14:45 PM)



ALEXCO RESOURCE CORP BELLEKENO MINE	DEPT.	APPROVED BY	DATE	COMMENTS
ALEXCO	SURVEY			
	ENGINEERING			
	GEOLOGY			
	ALEXCO MANAGER			
	PROCON SUPER			

TITLE: **ONEK**
ASBUILT 30 May 2013

Figure 7-10

Drawn by: DARIN BAKER | Scale: 1:750
Date: 05/30/2013 | Approval: | Date:
File: H:\Bellekeno Underground\Development-Planning\Promine\promine draw

7.1.5 Onek Mine Closure Measures

The closure measures associated with the Onek mine include the following steps:

1. Remove/salvage underground assets and equipment;
2. Remove any hazardous materials;
3. Remove/salvage surface facilities and infrastructure; and
4. Install rock pile portal cover at the Onek 990 portal.

The Onek mine is not expected to produce any water during operations or closure. This is evidenced by groundwater modelling presented during the environmental assessment and licensing process as well as the Onek decline development project that demonstrated no water was encountered or produced underground at Onek. Since the Onek decline was developed in September 2012 and suspended, no water has pooled at the bottom of the decline after nearly 3 years, again supporting the closure design for Onek that no long term water management features are required for the Onek mine for closure since no water is expected to flood the underground workings and exit the Onek 990 portal.

A rock pile cover similar to Bellekeno East (Figure 7-6) will be constructed to close the Onek 990 portal face and prevent inadvertent access from wildlife or people.

The grading plan and the reclamation measures for the Onek mine are described and presented on Drawings B-4101, B-4301 and C-4401 located in Appendix 3.1.

7.1.6 Lucky Queen Mine

The Lucky Queen mine adit was rehabilitated in 2011/2012 including installation of new ground support over the 1,200 metres of historic adit. This adit will provide primary ingress/egress to the Lucky Queen mine (Figure 7-11). The Lucky Queen mine will consist of the underground workings (rehabilitated historic 500 level adit and new workings), surface facilities and features at the Lucky Queen Portal Pad (portal, surface buildings and infrastructure), a new P-AML WRSF, a new N-AML WRDA, and the vent raise. The current status of the Lucky Queen mine includes the portal, a portable office trailer, shop maintenance building and a storage building (Figure 7-12). An unlined settling pond is in place to manage water flowing from the Lucky Queen mine. The historic waste rock dumps associated with the new P-AML WRSF and N-AML WRDA are historic liabilities; however, they are included in the RCP because they are a component of the Lucky Queen Production Unit Area once it is declared. A P-AML WRSF has not been constructed yet for the Lucky Queen mine. An as built of the Lucky Queen underground workings is shown in Figure 7-13. The Lucky Queen life of Mine plan is presented in Figure 7-14.

INSET

DIVERSION DITCH

WATER SETTLING AND STORAGE PONDS

CONTINGENCY WATER TREATMENT PLANT

WATER COLLECTION POND

LUCKY QUEEN ADIT

0.40 HA

PROPOSED N-AML WASTE ROCK DISPOSAL AREA

LUCKY QUEEN ACCESS ROAD

0.63 HA

LUCKY QUEEN PORTAL AND PAD

GENSET

PORTAL HEATER

SHOP

OFFICE

DUMP TRESTLE

FUEL TANK

GATE

0 25 50 100 150 Meters

VENT RAISE COLLAR

NEW UNDERGROUND WORKINGS (FOOT WALL DRIFT)

INSET

RADIO BOOSTER TOWER

LQ-MW-1

ACCESS

PROPOSED P-AML WASTE ROCK STORAGE FACILITY

0.43 HA

EXPLOSIVE CAP MAGAZINE

LUCKY QUEEN ACCESS ROAD

POWDER MAGAZINE

Erickson Gulch

1:6,000 (when printed on 11 x 17 inch paper)

0 50 100 200 300 400 Meters

486500 487000 487500

7092000 7091500 7091000 7090500 7090000

Adit
As Built Mine Features
Proposed Mine Features
Pond
Revegetation Area

Ditch/Pipeline
Existing Underground Workings
Proposed Underground Workings

Other Road
Limited-Use Road
Watercourse
Contour (5 m interval)

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on February 2018

Datum: NAD 83; Projection: UTM Zone 8N

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ALEXCO KENO HILL MINING CORP.

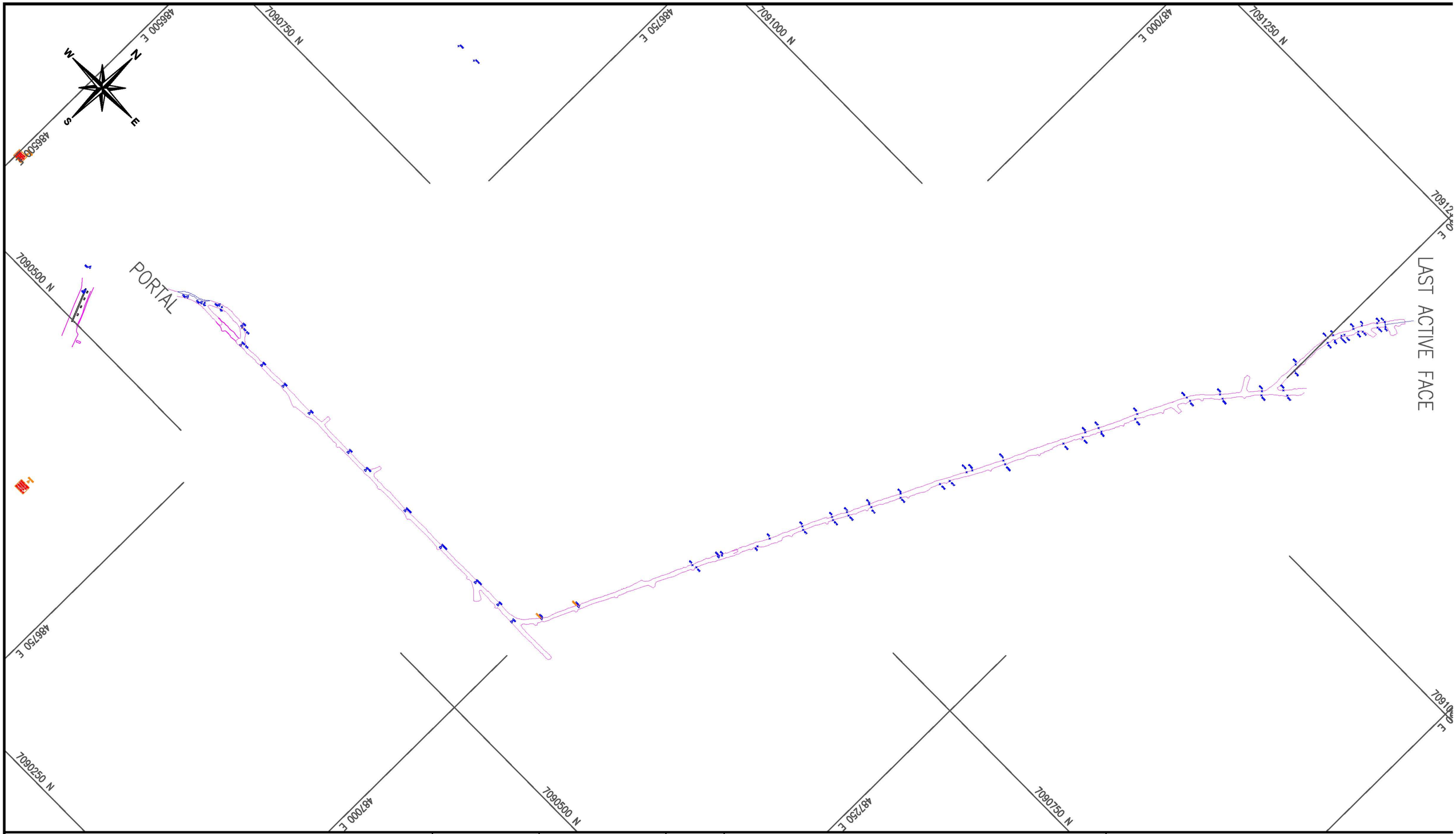
FIGURE 7-11
LUCKY QUEEN MINE LAYOUT

FEBRUARY 2018

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Figure 7-12 Lucky Queen Portal



ALEXCO RESOURCE CORP BELLKENO MINE	DEPT.	APPROVED BY	DATE	COMMENTS	TITLE: LUCK QUEEN MINE Asbuilt March 8, 2013 Figure 7-13	
ALEXCO	SURVEY					
	ENGINEERING					
	GEOLOGY				Drawn by: DARIN BAKER	Scale: 1:2500
	ALEXCO MANAGER				Date: 03/08/2013	Approval: Date:
	PROCON SUPER				File: C:\Users\Darin Baker\Documents\Drawing1.dwg	

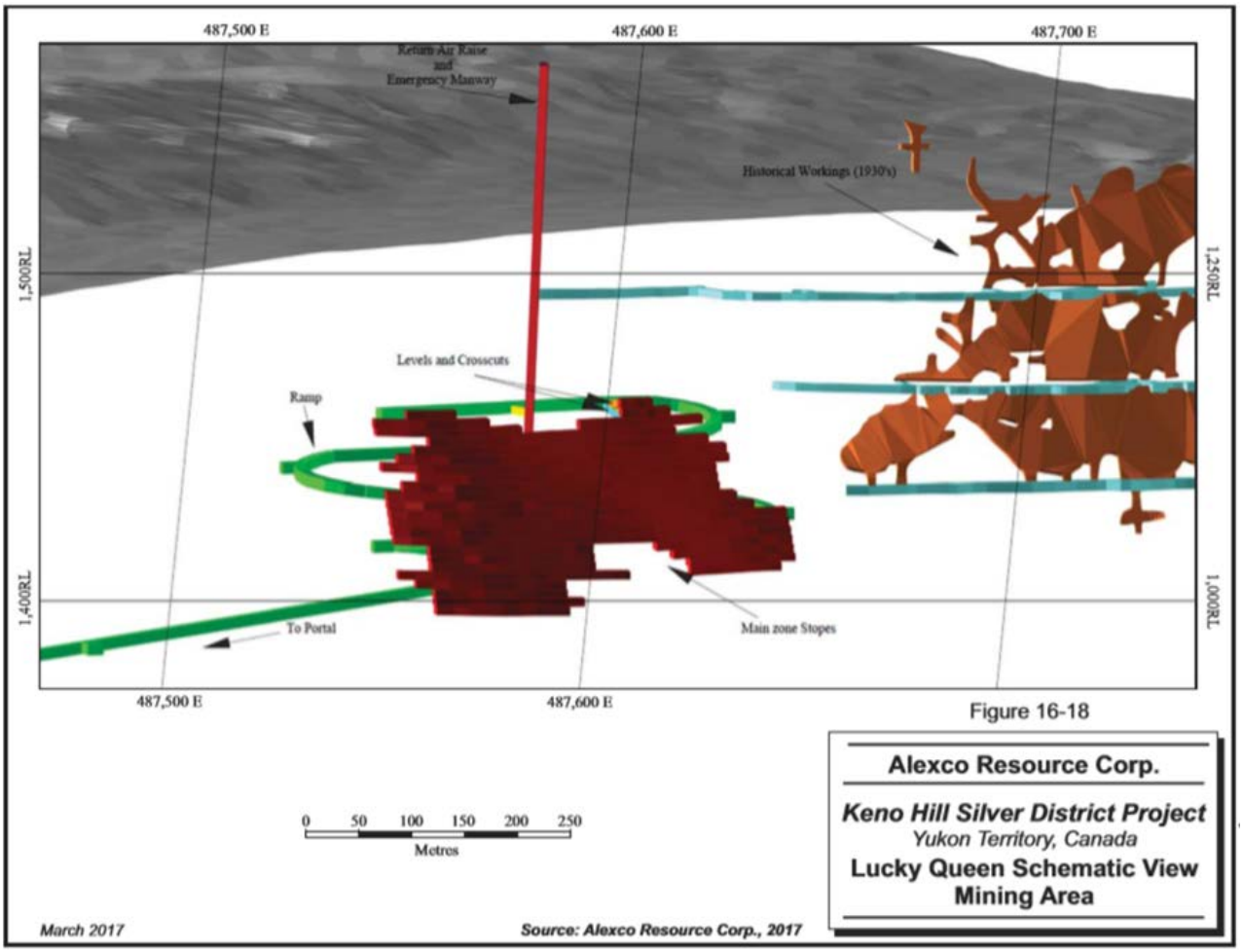


Figure 7-14 Lucky Queen Mine LOM Plan

7.1.7 Lucky Queen Mine Closure Measures

The steps and measures required for closure of the Lucky Queen Mine include:

1. Stabilize or backfill any remaining stopes as necessary to ensure long-term geotechnical stability underground;
2. Backfill any remaining P-AML waste rock on surface to underground;
3. Remove/salvage underground assets and equipment;
4. Remove/salvage surface facilities and infrastructure;
5. Remove any hazardous materials; and
6. Construct concrete adit bulkhead

The Lucky Queen mine drift is currently draining groundwater at a rate of approximately 1 lps. This water is predominantly clean groundwater that does not require treatment and meets direct effluent quality standards. The water from Lucky Queen is managed through an insulated bulkhead that collects water into a pipe and directs it to an unlined settling pond located outside the portal.

A concrete bulkhead will be constructed at Lucky Queen, similar to the design proposed for the Bellekeno 625 adit (Figure 7-31). The bulkhead is not designed for high pressure but will serve to collect water draining from the adit, prevent air movement and potential for ice formation inside the adit and prevent inadvertent access.

The grading plan and the reclamation measures for the Lucky Queen mine are described and presented on Drawings B-3101, B-3301 and C-3401 located in Appendix 3.1.

7.1.8 Flame and Moth Mine

The Flame and Moth deposit was outlined by surface exploration drilling in 2010 through 2013 with ongoing surface exploration. The Flame and Moth mine portal location is approximately 50 metres from the District Mill and will utilize common infrastructure (offices, power, water, compressed air, etc) associated with the mill. The location of the Flame and Moth mine in relation to the District mill is shown in Figure 7-15 and in Figure 5-4. The as-built of the Flame and Moth portal is shown in Figure 7-16. The Flame and Moth underground workings design is shown in Figure 7-17.

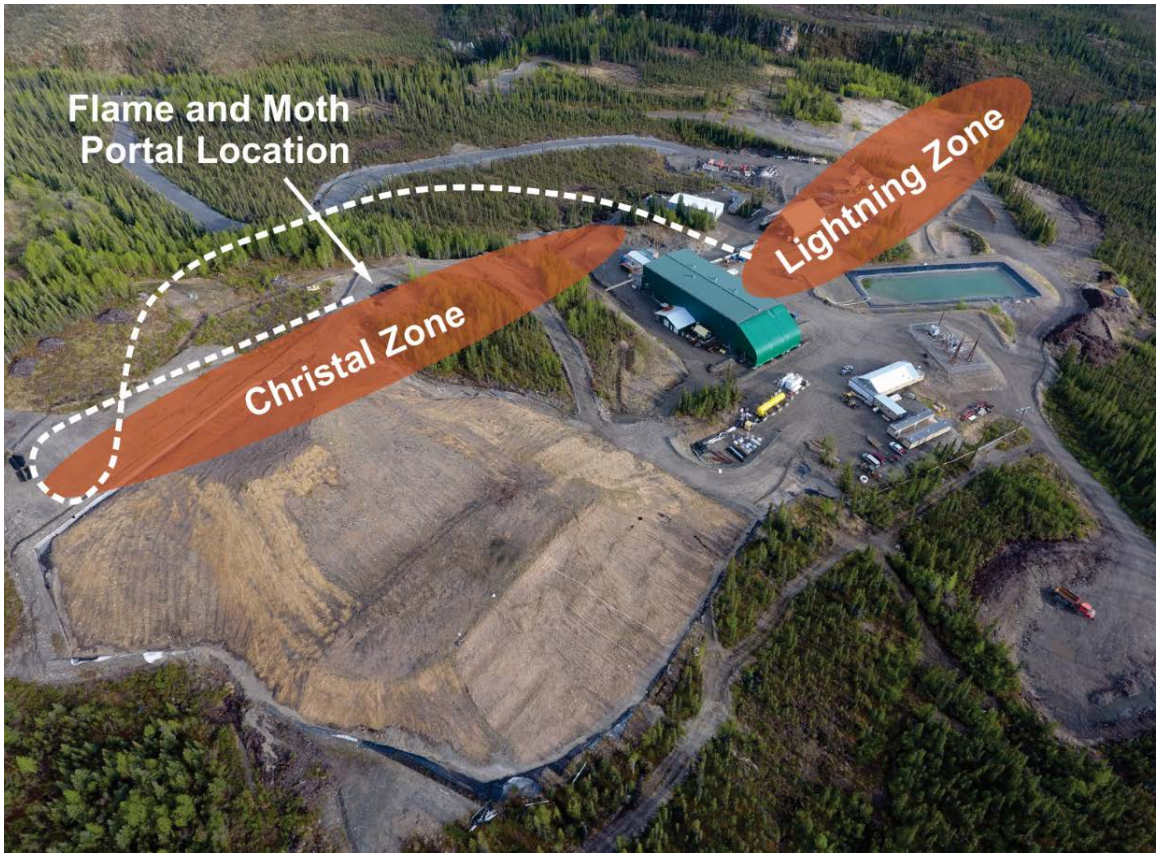


Figure 7-15 Flame and Moth Portal and Decline Layout



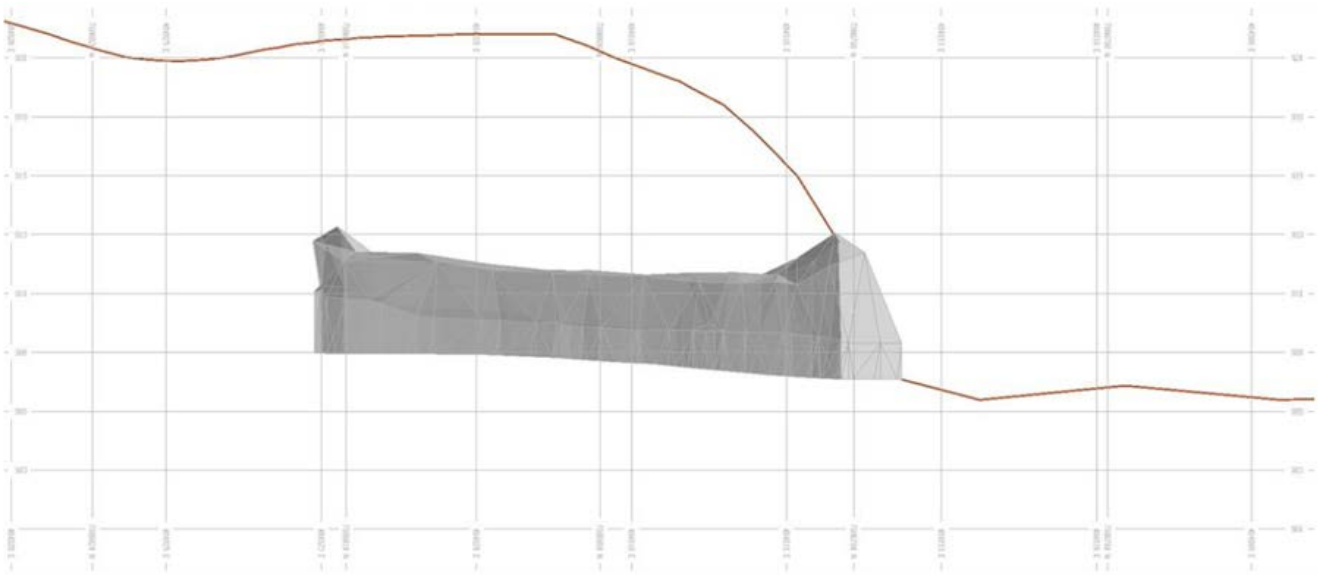


Figure 7-16 Flame and Moth As Built Conditions

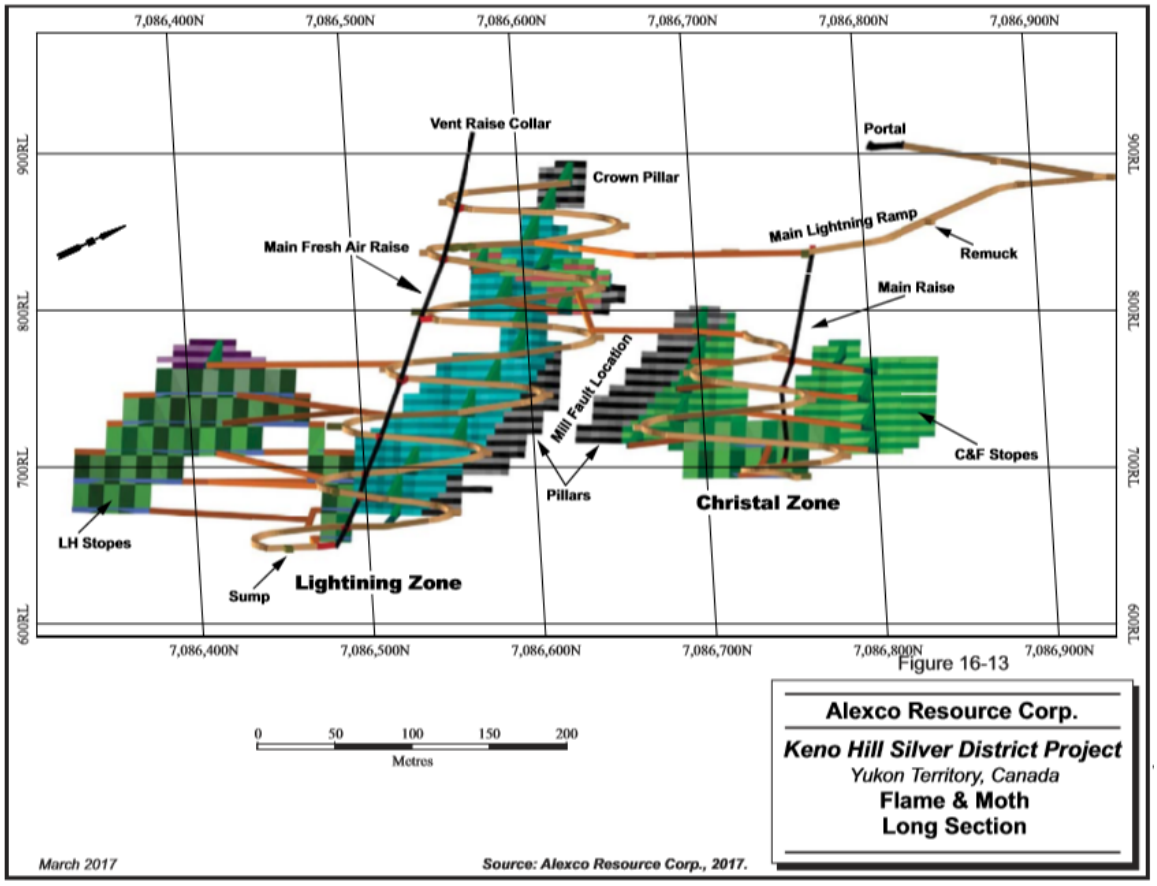


Figure 7-17 Flame and Moth LOM Plan

7.1.9 Flame and Moth Mine Closure Measures

The steps and measures required for closure of the Flame and Moth include:

1. Stabilize or backfill any remaining stopes as necessary to ensure long-term geotechnical stability underground; Backfill any remaining P-AML waste rock on surface to underground;
2. Remove/salvage underground assets and equipment;
3. Remove/salvage surface facilities and infrastructure not included in the mill area mine area component;
4. Remove any hazardous materials; and
5. Install rock pile portal cover.

During operations, the Flame and Moth mine is expected to produce up to 35 lps at the deepest level of the mine. The current static water elevation of groundwater table within the Flame and Moth deposit is ~20 metres below surface. Once active mining operations cease, it is expected that the underground workings will flood overtime from groundwater infiltration. The elevation of groundwater is expected to return to current static elevations which is below the elevation of the Flame and Moth portal (906

masl) and therefore no water is expected to discharge the Flame and Moth mine requiring any ongoing water management at closure.

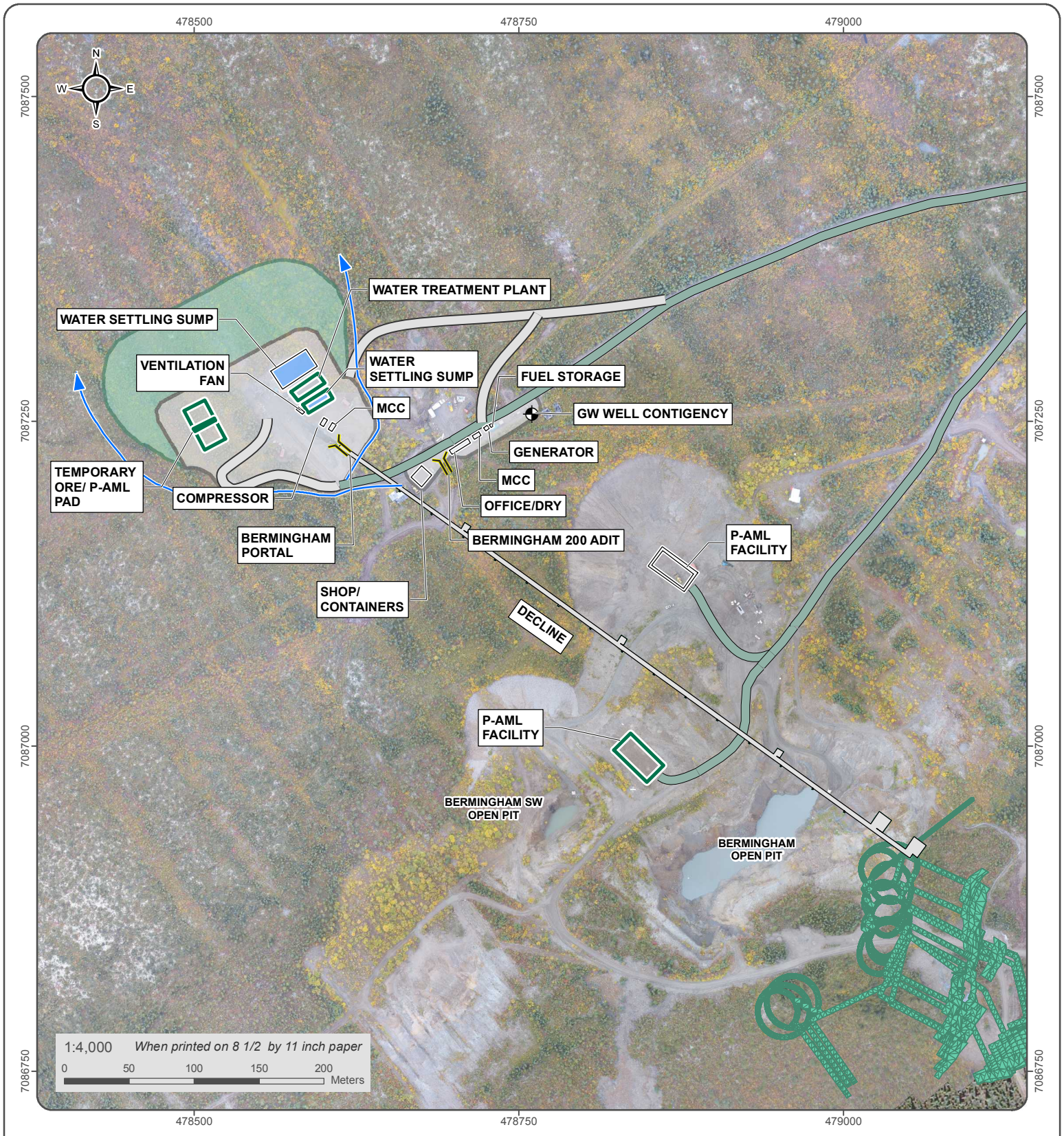
Reclamation measures for the Flame and Moth mine are described on Drawing C-1401 located in Appendix 3.1.

7.1.10 Bermingham Deposit

The Bermingham deposit was outlined by surface exploration drilling in 2010 through 2017. The Bermingham deposit is currently in an advanced underground exploration phase to better define the deposit for mine planning and engineering requirements (Figure 7-18). A total of ~ 9,400 m^3 of rock (670 meters @ 3.75m x 3.75m, ~25,300 tonnes) of waste rock will be brought to surface during the Bermingham underground exploration program. The Bermingham portal location is approximately 150 metres from the historic Bermingham 200 adit and infrastructure (offices, power, water, compressed air, etc) has been established for the advanced exploration program. The location of the Bermingham Portal is shown in Figure 7-18 and in Figure 7-19. The Bermingham advanced exploration surface layout is presented in Figure 7-20 and the advanced exploration decline as of December 31, 2017 is presented in Figure 7-21. The Bermingham underground workings life of mine design is shown in Figure 7-22.



Figure 7-18 Bermingham Advanced Exploration Decline and Surface Layout



Adit/Portal
Proposed Groundwater Well
Diversion Ditch
Decline
Proposed Underground Workings
Permitted Mine Footprint
Proposed Mine Footprint
Permitted Mine Infrastructure
Proposed Mine Infrastructure
Permitted New Road
Proposed Road Upgrades

KENO DISTRICT MINE OPERATIONS
RECLAMATION AND CLOSURE PLAN

FIGURE 7-19
BERMINGHAM MINE
PROJECT LAYOUT

FEBRUARY 2018

National topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Reproduced under license from Her Majesty the Queen, as represented by the Minister of Natural Resources Canada. All rights reserved.
Datum: NAD 83; Projection: UTM Zone 8N

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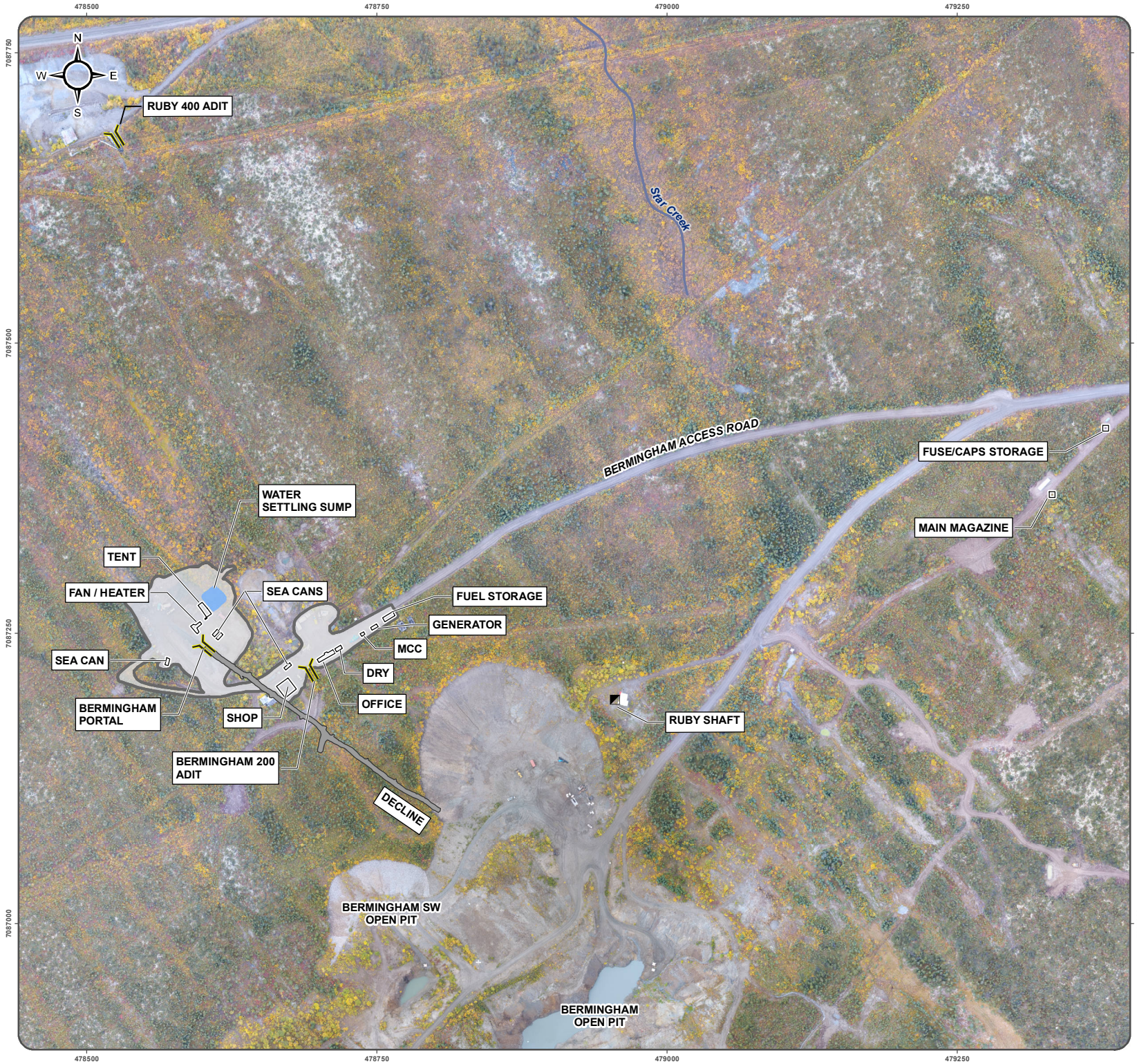
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KENO DISTRICT MINE OPERATIONS
RECLAMATION AND CLOSURE PLAN

FIGURE 7-20
BERMINGHAM SURFACE LAYOUT AS-BUILT

FEBRUARY 2018



- Adit/Portal
- Shaft
- Site Buildings
- Decline
- As Built Mine Footprint
- Pond

0 50 100 150 Meters

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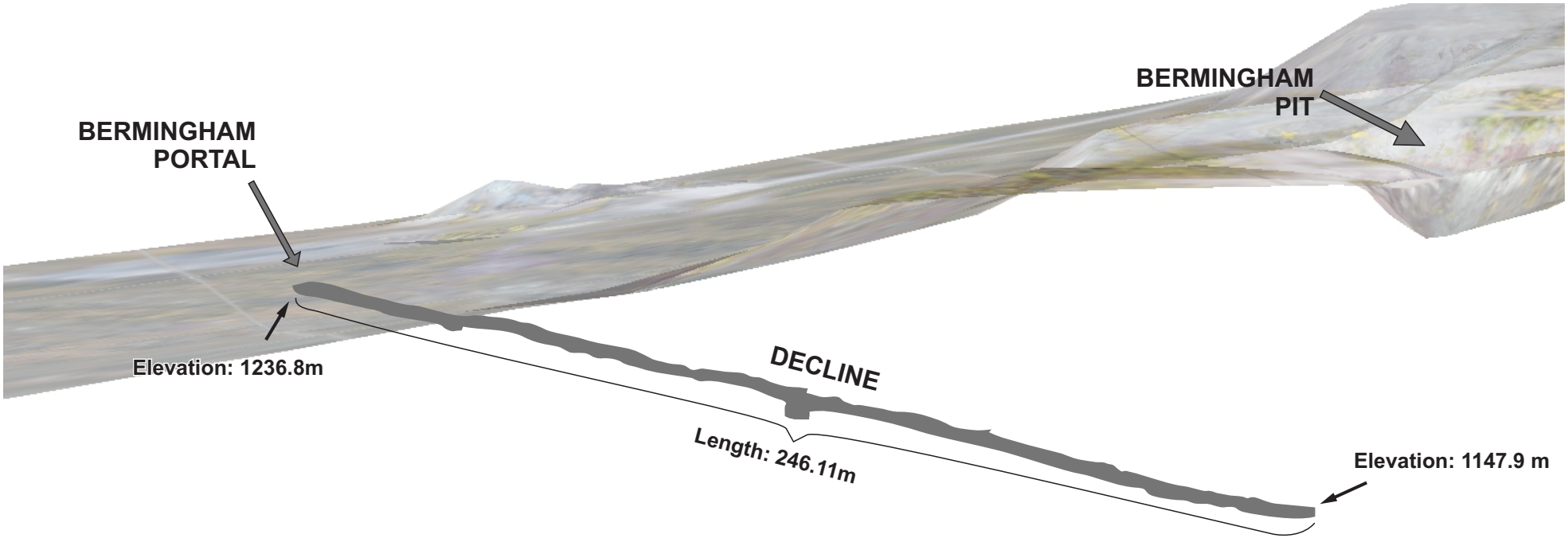
Datum: NAD 83; Map Projection: UTM Zone 8N

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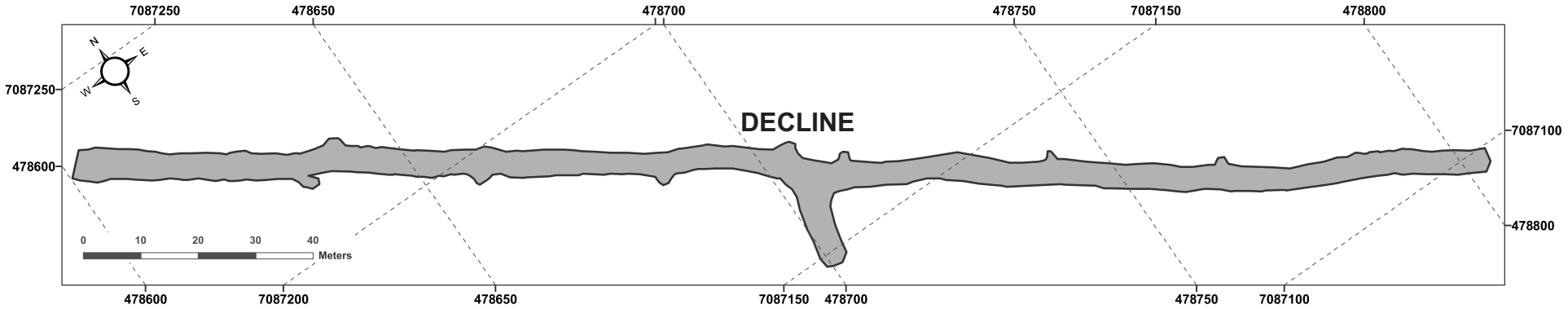
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VERTICAL SECTION VIEW



PLANAR VIEW



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CONCEPTUAL DRAWING; FEATURES ARE NOT TO SCALE

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KENO DISTRICT MINE OPERATIONS RECLAMATION AND CLOSURE PLAN

FIGURE 7-21
BERMINGHAM DECLINE AS BUILT

FEBRUARY 2018

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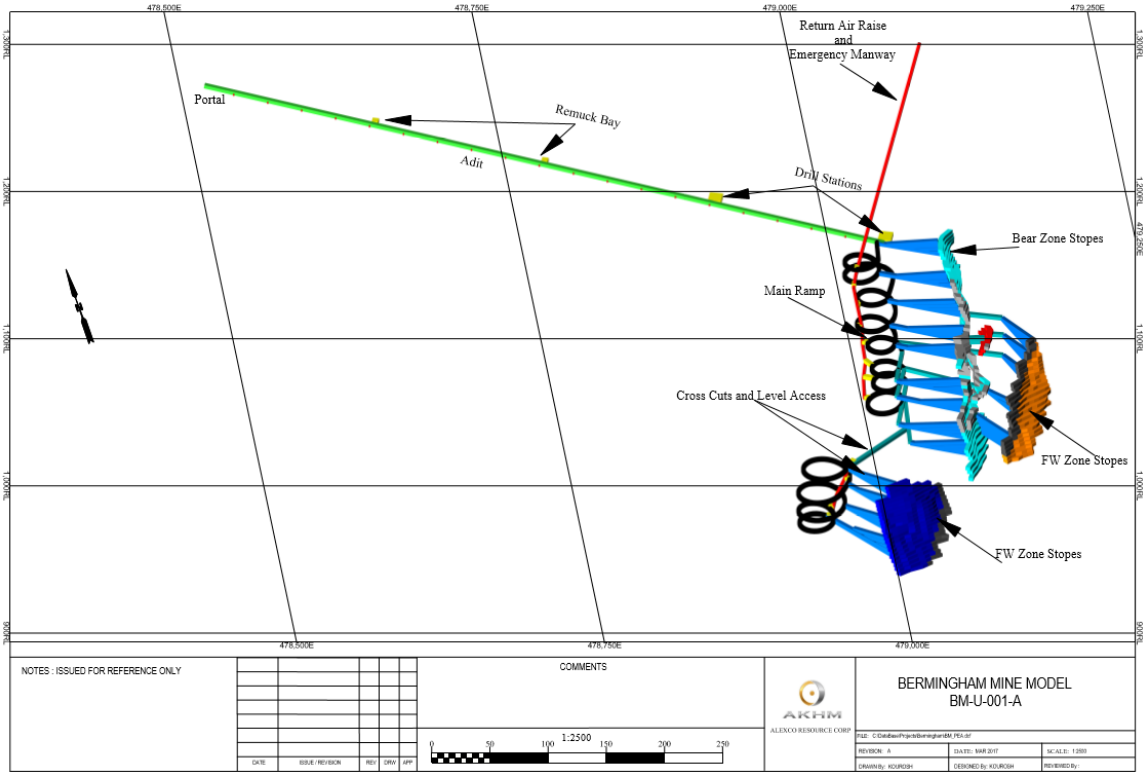


Figure 7-22 Bermingham LOM Plan

7.1.11 Bermingham Mine Closure Measures

The steps and measures required for closure of the Bermingham deposit and mine include:

1. Stabilize or backfill any remaining stopes as necessary to ensure long-term geotechnical stability underground; Backfill any remaining P-AML waste rock on surface to underground;
2. Remove/salvage underground assets and equipment;
3. Remove/salvage surface facilities and infrastructure;
4. Remove any hazardous materials;
5. Recontour N-AML WRSA, scarify and revegetate; and
6. Install rock pile portal cover.

During operations, the Bermingham mine is expected to produce up to 13 lps at the deepest level of the mine. Once active mining operations cease, it is expected that the underground workings will flood overtime from groundwater infiltration. For the basis of long-term water management designs, it is assumed that the flooded Bermingham mine will discharge out of the portal and then infiltrate into the ground. Because of this assumption, mine pool treatment is included in the water management design for the closure of the Bermingham mine. The grading plan and the reclamation measures for the Bermingham mine are described and presented on Drawings B-5101, B-5301 and C-5401 located in Appendix 3.1.

7.2 DRY STACK TAILINGS FACILITY

The dry stack tailings facility (DSTF) is located adjacent to the District mill site and the most recent as-built of the facility is shown in Figure 7-23 Dry Stack Tailings Facility Layout Current Conditions.

The closure objectives for the DSTF are to:

1. Ensure physical and geochemical stability of the DSTF;
2. Minimize erosion;
3. Effectively manage runoff;
4. Reduce water infiltration into the DSTF;
5. Minimize safety risks to people and wildlife; and
6. Reclaim the site to an aesthetically acceptable level.

Water Licence QZ09-092 and QML-0009 authorizes 907,000 tonnes of tailings can be placed on surface in both the phase 1 and phase 2 expansion area. As of September 2013, approximately 179,811 tonnes of tailings have been placed on the DSTF representing approximately 20% of the overall permitted capacity. The placement of tailings on surface is currently being conducted under an approved Phase 1 design and DSTF Operations and Monitoring Plan. Additional detailed designs will be required to ultimately expand the DSTF to the currently authorized 907,000 tonne volume. The DSTF will be progressively constructed and has been progressively reclaimed over the life of the facility as tailings are generated by the mill. A portion of the DSTF will be built on an on-going basis each year. In the summer of each year or as the progression of the facility allows, progressive reclamation will occur through recontouring the side slopes to the final design slope angle (3:1) and placing granular/organic material as a cover.

7.2.1 DSTF Geochemical Performance

Geochemical characterization of the tailings is being conducted as part of the Bellekeno Mine Tailings Characterization Plan which was submitted in December 2010 as a requirement under Water Licence QZ09-092. A humidity cell test was completed (212 week duration) for a composite sample of Bellekeno tailings produced and stored on the DSTF. The results of the kinetic testing for Bellekeno tailings are presented in Appendix 3.3. The results of this program are also included in the Annual Reporting submitted for QZ09-092. Static geochemical characterization of the Onek and Lucky Queen tailings have been previously presented as part of the environmental assessment and water licence permitting stage for deposition of tailings from these deposits into the DSTF. Static and kinetic testing data from Flame and Moth waste rock and tailings are presented in Appendix 3.3.

7.2.2 DSTF Soil Cover

Closure measures for the DSTF are included in the final design report for the facility. Although the DSTF will be built in compacted 0.3 – 0.6 m lifts to limit water penetration, closure measures will include covering the recontoured stack with a 0.25 m thick soil cover consisting of sandy loam growth media and granular material that is locally stored in stockpiles. The cover will limit water migration through the stack. The DSTF has been progressively reclaimed in 2 phases. The first phase of reclamation was completed in June 2012 and included the western slope of the DSTF with recontouring to a 3:1 slope, placement of a 0.25 – 0.5 m cover and seeding/fertilization. Figure 7-24 shows the reclamation underway on the DSTF during June 2012. The second phase of progressive

reclamation was completed in August 2013 (Figure 7-25) and included recontouring the western slope of the upper bench and north and south slopes, placement of a 0.25 m cover and seeding/fertilization. A photo from the DSTF from September 2016 is presented in Figure 7-26. A summary report on the progressive reclamation on the DSTF completed in 2012 is included in Appendix 1.1. A similar evapotranspiration cover was constructed at the Brewery Creek Mine both on the heap leach pad (0.25 m cover) and a waste rock storage dump (0.5 m cover). The actual performance results of the Brewery Creek covers indicate precipitation infiltration rates between 7% – 22% with the variation related to differences in cover thickness and topography. Given the performance of the Brewery Creek covers over a seven-year period, the similarities in soil properties and climate conditions and the highly compacted nature of the DSTF, the reclamation measures proposed for the DSTF are expected to result in <10% infiltration through the DSTF. The climate conditions at Brewery Creek are very similar to the Keno Hill Silver District and the actual performance results of the Brewery Creek cover are a supporting reference to the expected performance results on the DSTF.



Adit

Current Dry Stack Storage Facility Liner

Road

Watercourse

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on January 2018

Datum: NAD 83; Projection: UTM Zone 8N

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KENO DISTRICT MINE OPERATIONS
RECLAMATION AND CLOSURE PLAN

FIGURE 7-23
DRY STACK TAILINGS FACILITY LAYOUT
CURRENT CONDITIONS

FEBRUARY 2018

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Figure 7-24 DSTF Progressive Reclamation, June 2012



Figure 7-25 DSTF Progressive Reclamation, August 2013



Figure 7-26 DSTF Progressive Reclamation, September 2016

The primary objective of the soil cover for the DSTF is to minimize erosion of the compacted tailings. Physical inspections from 2013 – 2017 demonstrate that the soil cover has been effective in doing so and has established vegetative cover as shown in Figure 7-26.

Alexco has proposed a reclamation and revegetation program that meets the EMR technical guidelines for erosion control and revegetation. The Yukon Mine Site and Reclamation Closure Policy includes establishment of stable slopes that prevent surface erosion and are conducive to successful re-vegetation by native plant species or other species adaptable to that environment (EMR, 2008).

Appendix 1.1 provides soil properties and nutrient analysis for the DSTF cover material. To maximize the efficacy of the cover, an engineering evaluation of the constructed 0.25 m cover will be carried out using information collected at the site as a part of the environmental monitoring programs designed by Alexco and prescribed in Water Licence QZ09-092. This includes hydrologic information available for the site, as well as precipitation and snowpack data, together with laboratory soil properties and in-situ measurements of the hydraulic conductivity for the DSTF and identified cover material.

If monitoring during operations indicates that treatment will be required for meteoric water after final closure, a passive bioreactor treatment system will be constructed at the site immediately down slope from the DSTF. The area at the toe of the DSTF occupied by the runoff collection pond and polishing pond during operations can be reconstructed and used for the development of a gravel infiltration gallery, ethanol-based bioreactor cell (similar to that piloted at the Galkeno 900 adit across Christal Lake and proposed for the Bellekeno mine).

Reclamation measures for the DSTF are described on Drawing C-7401 located in Appendix 3.1.

7.3 WASTE ROCK STORAGE AND OVERBURDEN AREAS

Waste rock extracted from the deposits is characterized and managed according to the Waste Rock Management Plan. Waste rock is identified as being one of the following types: potentially acid metal leaching (P-AML) or non-acid metal leaching (N-AML).

The closure objectives for the waste rock storage facilities/disposal areas are to:

1. Ensure geotechnical and geochemical stability of the site;
2. Minimize erosion;
3. Minimize safety risks to people and wildlife, and
4. Reclaim them to an aesthetically acceptable level.

7.3.1 Bellekeno Waste Rock Storage Facilities/Disposal Areas

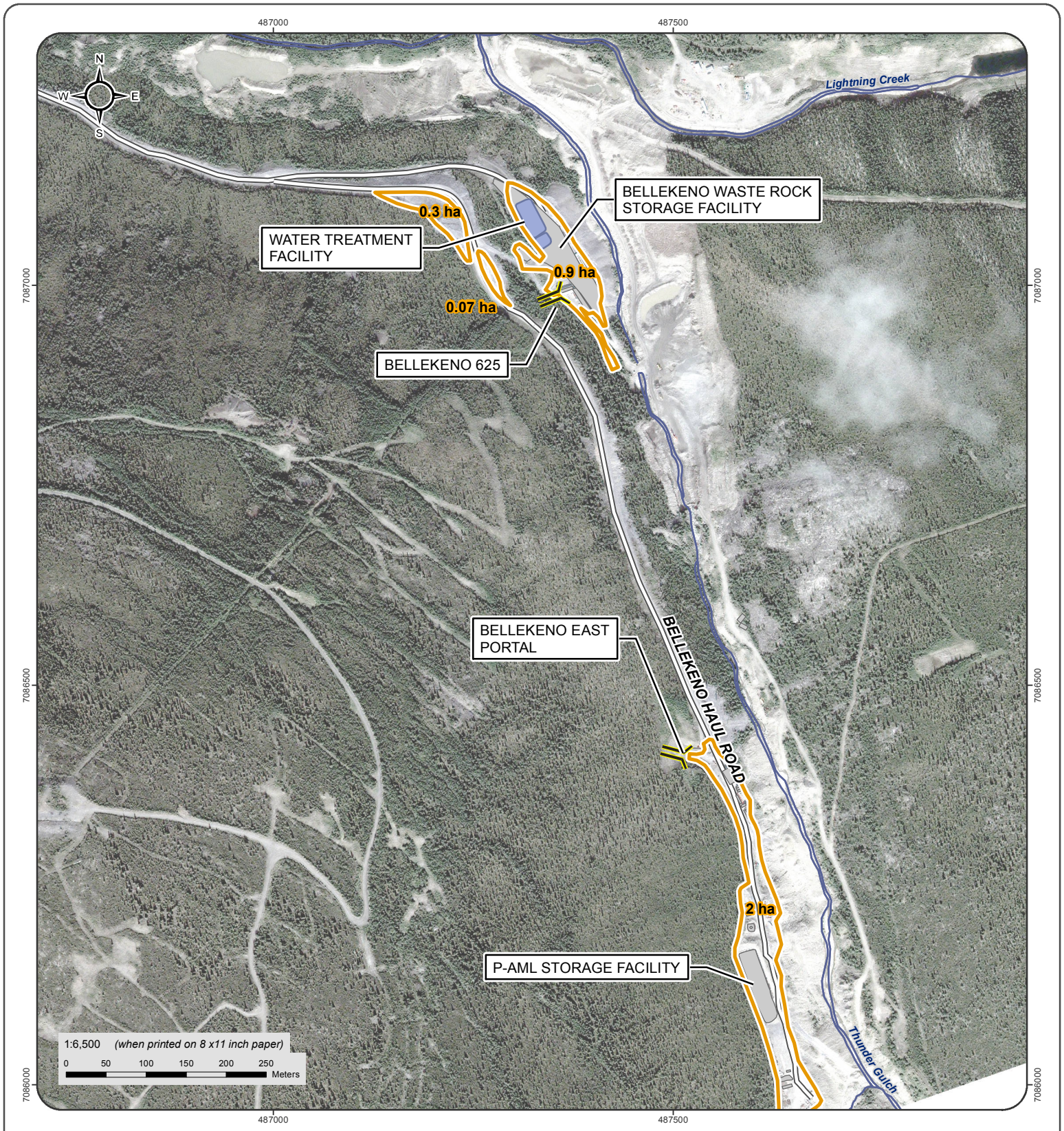
P-AML Waste Rock Storage Facilities

P-AML waste rock from the Bellekeno mine is currently being placed in a lined temporary Waste Rock Storage Facility (WRSF) located south of the Bellekeno East portal (Figure 7-27). The facility was designed according to the approved generic design (EBA, 2008) Appendix 3.2. At closure, any remaining P-AML waste rock stored in the temporary facility will be placed underground as mine backfill below the long-term static water level of the mine to limit oxygen contact with the P-AML waste rock. The temporary WRSF liner will be removed and the area recontoured and revegetated to be commensurate with the surrounding natural terrain. Revegetation will take place with appropriate growth media and seed mixes.

N-AML Waste Rock Disposal Area

A Waste Rock Disposal Area (WRDA) was proposed to be constructed along the northeast flank of Sourdough Hill, northwest of the current Bellekeno 625 waste rock storage areas. The Bellekeno WRDA has not yet been constructed because the majority of the N-AML waste rock currently generated from the Bellekeno mine has been used for road construction material with a lesser amount as underground backfill. With the current LOM plan for Bellekeno, there is no scheduled requirement for construction of a Bellekeno WRDA.

If, however a WRDA is constructed for Bellekeno, reclamation and closure will include pulling the crests back with an excavator followed by scarification and revegetation of the flat surface of the WRDA. The final overall (crest to crest) slope of the WRDA will be 3H:1V. Based on the results of the reclamation research discussed, organics materials may be blended and scarified into the top surface of the WRDA to promote and enhance revegetation.



Adit

Mine Feature Footprint

Pond

Revegetation Area

Haul Road

Watercourse

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on February 2018

Datum: NAD 83; Projection: UTM Zone 8N

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KENO DISTRICT MINE OPERATIONS RECLAMATION AND CLOSURE PLAN

FIGURE 7-27

LOCATION OF EXISTING BELLEKENO WASTE ROCK STORAGE FACILITY

FEBRUARY 2018

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(Last edited by: amatlashevska; 06/02/2018/09:02 AM)

Bellekeno 625 Waste Rock Dump

The Bellekeno 625 waste rock dump (Figure 7-27) is a historic facility that is included in this RCP under the designation of the Bellekeno Production Unit. Reclamation and closure of the Bellekeno 625 WRDA will include cleanup of equipment on the top surface of the WRDA, pulling back the crests with an excavator followed by scarification and revegetation of the flat surface of the WRDA. Long term road access will remain for pickup traffic to the Bellekeno 625 adit given it will drain and inspections will be required during the post closure monitoring and maintenance period.

Bellekeno East and Bellekeno 625 area regrading plans are described in Drawings B-2101 and B-2102 respectively, located in Appendix 3.1.

7.3.2 Onek Waste Rock Storage Facilities/Disposal Areas

P-AML Waste Rock Storage Facilities

The Onek mine is not currently in the Keno Mine Operations LOM plan so no Onek P-AML or N-AML waste facilities are included in the RCP. A P-AML WRSF was constructed on the historic Onek waste rock dump to the north of the Onek historic open pit for the purposes of advanced exploration and production at Bellekeno. Although constructed, no P-AML rock has been brought to surface and stored from development of the Onek decline. Closure of the Onek P-AML WRSF therefore includes removal of the liner and recontouring the outside containment berms followed by scarification of the surface and seeding/fertilization.

N-AML Waste Rock Disposal Area

N-AML will be used for general construction and access road repairs and surface capping, or placed into onsite N-AML WRDAs (Figure 7-9). N-AML material may also be placed underground as mine backfill as required. No N-AML WRDA has been constructed and development rock from Onek was used for construction of the portal area laydown yard and haul road switch backs.

If the Onek N-AML WRDA is built, it will be recontoured by pulling the crests back with an excavator followed by scarification and revegetation of the flat surface of the WRDA. The final overall (crest to crest) slope of the WRDA will be 3H:1V.

Onek area regrading plan is described in Drawings B-4101 and B-4301, located in Appendix 3.1.

Onek Historic Waste Rock Dumps

Terrestrial reclamation of historic liabilities at Onek is currently under the scope of the District Closure Plan and is not included in the RCP.

7.3.3 Lucky Queen Waste Rock Storage/Disposal Areas

P-AML Waste Rock Storage Facilities

A new P-AML WRSF will be constructed at the Lucky Queen site as per EBA's generic facility design. P-AML waste rock will be placed in the WRSF or underground as mine backfill, as required.

At closure, the P-AML WRSF will be recontoured by pulling the crests back with an excavator followed by scarification and revegetation of the flat surface of the WRSF. The final overall (crest to crest) slope of the WRSF will be 3H:1V. The WRSF will be covered with a total 0.5 m depth cover consisting of low-permeability borrow material in the bottom portion to minimize infiltration of meteoric water. The top potion of the cover shall consist of growth medium that will be seeded to promote vegetative growth.

N-AML Waste Rock Disposal Area

N-AML will be used for general construction and access road repairs and surface capping, or placed into the onsite N-AML WRDA (Figure 7-11). N-AML material may also be placed underground as mine backfill, as required.

The Lucky Queen N-AML WRDA will be recontoured by pulling the crests back with an excavator followed by scarification and revegetation of the flat surface of the WRDA. The final overall (crest to crest) slope of the WRDA will be 3H:1V.

Lucky Queen area regrading plan is described in Drawings B-3101 and B-3301, located in Appendix 3.1.

Lucky Queen Historic Waste Rock Dumps

Terrestrial reclamation of historic liabilities at Lucky Queen is currently under the scope of the District Closure Plan. At present, District Closure planning proposes pulling back crests, resloping dump slopes, and scarifying and revegetating the top surface. The preliminary Lucky Queen historic waste rock dump recontouring design will be developed through final determination of the Production Unit Area and the mine licencing process.

7.3.4 Flame and Moth Waste Rock Storage/Disposal Areas

Flame and Moth P-AML Waste Rock Storage Facilities

A lined temporary P-AML storage facility will be constructed as per EBA's generic facility design near the portal entrance (up to 12,000 tonnes) (Figure 5-4 and Appendix 3.5). This will be used during the initial development (137,000 tonnes) after which the development schedule will enable all P-AML development rock to remain underground, and the P-AML rock stored within the temporary facility will be moved back underground as backfill. All P-AML waste rock will be rehandled back underground prior to closure.

Flame and Moth N-AML Waste Rock Storage Facilities

A N-AML waste rock disposal area will not be built for Flame and Moth Mine as the rock will either be used for construction or used as backfill. N-AML materials may be used for construction of portal pad and laydown area, expanded coarse ore stockpile, mill yard expansion, new haul road to crusher and construction of the toe berm and base layer for DSTF expansion.

7.3.5 Bermingham Waste Rock Storage/Disposal Areas

Bermingham P-AML Waste Rock Storage Facilities

A temporary P-AML storage facility will be constructed as per EBA's generic facility design near the portal entrance (up to 10,000 tonnes). This will be used during the initial development (165,000 tonnes) after which the development schedule will enable all P-AML development rock to remain underground, and the P-AML rock stored within the temporary facility will be moved back underground as backfill. All P-AML waste rock will be rehandled back underground prior to closure.

Bermingham N-AML Waste Rock Storage Facilities

A N-AML waste rock disposal area will be built for the Bermingham Mine (Figure 7-19) or rock will either be used for construction or used as backfill. N-AML materials may be used for construction of portal pad and laydown area, and roads.

Bermingham area regrading plan is described in Drawings B-5101 and B-5301, located in Appendix 3.1.

7.4 WATER MANAGEMENT STRUCTURES AND SYSTEMS

7.4.1 Closure Objectives and Design Criteria

The primary closure objectives for the water management and treatment sites are in regards to chemical stability and environmental protection, including:

1. Prevent, minimize or mitigate adverse effects on the aquatic environment by removing constituents of concern prior to discharge to the aquatic or terrestrial environment.

2. Minimize effects on the terrestrial environment by reducing sources of metals that could affect soil quality.

3. Prevent the discharge of water to the environment that could cause human health effects.

A summary of the water management and treatment plan for each of the four mines and adits associated with the RCP is shown in Table 7-2.

Table 7-2 Mine Water Management Summary

Mine	Units
Bellekeno East	• No water discharges from Bellekeno East • Rock fill in front of adit
Bellekeno 625	• Mine floods and discharges from the 625 adit • Concrete hydraulic bulkhead (non-pressurized) • In situ treatment of Bellekeno mine pool as primary treatment • Convert lined WTP ponds to bioreactor as contingency
Lucky Queen	• Groundwater infiltration exits the Lucky Queen mine/portal • No treatment required • Concrete hydraulic bulkhead (non-pressurized)
Onek	• No water discharges from Onek 990 portal • Rock fill in front of adit
Flame and Moth	• Mine floods and reaches pre-mining static groundwater elevation (20 metres below surface and portal elevation, no portal discharge) • Rock fill in front of adit
Bermingham	• Mine floods and assumed to discharge out of Bermingham portal • In situ treatment of Bermingham mine pool as primary treatment • No secondary contingency measures as discharge goes to ground and no connection to surface water • Rock fill in front of adit

7.4.2 Bellekeno 625 Adit

Without continued dewatering and pumping after closure, the static water elevation of the Bellekeno Mine will rise to and discharge from the Bellekeno 625 adit. A concrete adit bulkhead will be constructed to allow management of the mine pool long term. The bulkhead is not designed as a high head pressurized structure that will allow increased flooding above the 625 elevation, but rather as a water management tool and feature that will allow consistent flow to the secondary bioreactor contingency treatment system if it is required for treatment. As part of the District Wide Closure Planning process, preliminary and indicative designs for concrete bulkheads for numerous mines in the district have been developed. Appendix 3.5 provides preliminary design information excerpted from the ESM Reclamation Plan for the Keno Hill District (Keno Hill Adit and Shaft Closure, Tetra Tech EBA March 2015). A preliminary design for the Bellekeno 625 adit concrete bulkhead is shown in Figure 7-31. The size of the Bellekeno 625 adit opening is approximately 2.5 m x 2.5 m.

A stainless steel grate will be installed at the adit entrance to restrict access by humans or wildlife. A padlocked door within the grate will allow for access to the bulkhead for closure monitoring and maintenance as needed.

The long-term water management and treatment approach for the Bellekeno Mine is summarized as follows:

- A detailed hydrogeological study of the Bellekeno Mine is on-going during mine operations, and is required to determine the final flow and flooding rates to be expected from the Bellekeno mine. The information to date supports a long-term mine inflow rate of ~2.85 lps. As noted above, based on the existing mine plan, the final elevation of the static water in the mine will be controlled by the Bellekeno 625 adit.
- Final detailed design engineering will be required to construct a concrete bulkhead at Bellekeno 625. A preliminary design is shown in Figure 7-31 (Appendix 3.1, Drawing S-0302). The bulkhead would be put in place as the mine pool is allowed to flood (currently estimated to take 6-8 months).
- In situ mine pool treatment to reduce soluble metals (zinc) loads using a carbon source such as molasses will be implemented immediately upon commencing Bellekeno mine pool flooding. Alexco has implemented this technology at several mine sites throughout North and South America and it has proven highly successful in reducing soluble metal loading. This technology is also undergoing a full-scale demonstration at Silver King as part of the District Closure project. The mine pool would be accessed through the Bellekeno East decline which would not be blocked until Bellekeno 625 has been adequately decommissioned. In situ treatment of the mine pool for at least 12 months prior to the mine pool discharging at 625 is expected to produce acceptable water quality discharge criteria. Evidentiary information to support the expected success of the in mine pool treatment of Bellekeno 625 is included in Appendix 1.2.
- Once active treatment and pumping of the mine pool ceases, the mine workings are allowed to flood and *in situ* treatment begins, conversion of the current water treatment ponds at Bellekeno 625 into bioreactors would take place. Bioreactor conceptual design described in Drawings D-2102 and D-2301, located in Appendix 3.1.

- The overall water management approach for Bellekeno is to have the bioreactor constructed and commissioned prior to when the mine pool is fully flooded and discharging out of the 625 adit. It is expected that the *in situ* mine pool treatment will obtain acceptable discharge water quality but in the event it does not then the bioreactor will already be fully commissioned by the time the mine pool reaches the elevation of the 625 level and can serve as a polishing step to the mine pool primary treatment if necessary. Bioreactor commissioning will be performed by recirculating water in the bioreactor so as water begins to come from the mine the bioreactor will transition from recirculated water to adit discharge, if further treatment is required.

Bellekeno Mine In Situ Treatment Design

Design information required for in situ treatment at Bellekeno includes retention time, mine in flow volumes and mine water chemistry. The estimated volume of openings in the Bellekeno mine versus the mine elevation is shown in Table 7-3. Mine inflow is measured on a daily basis and the litres per second of pumping is shown in Figure 7-28. The average water inflow since mine operations were suspended in January 2015 – January 2017 is less than 2 lps. The measured mine inflow is used for water treatment and management design purposes and represents the long-term expected inflow to the Bellekeno mine. This is a conservative estimate since dewatered mines typically have a greater groundwater capture efficiency than a flooded mine because a dewatering cone develops around a dewatered mine, while when flooded the mine dewatering cone is minimized, essentially becoming a preferential flow path for localized groundwater seepage to surface.

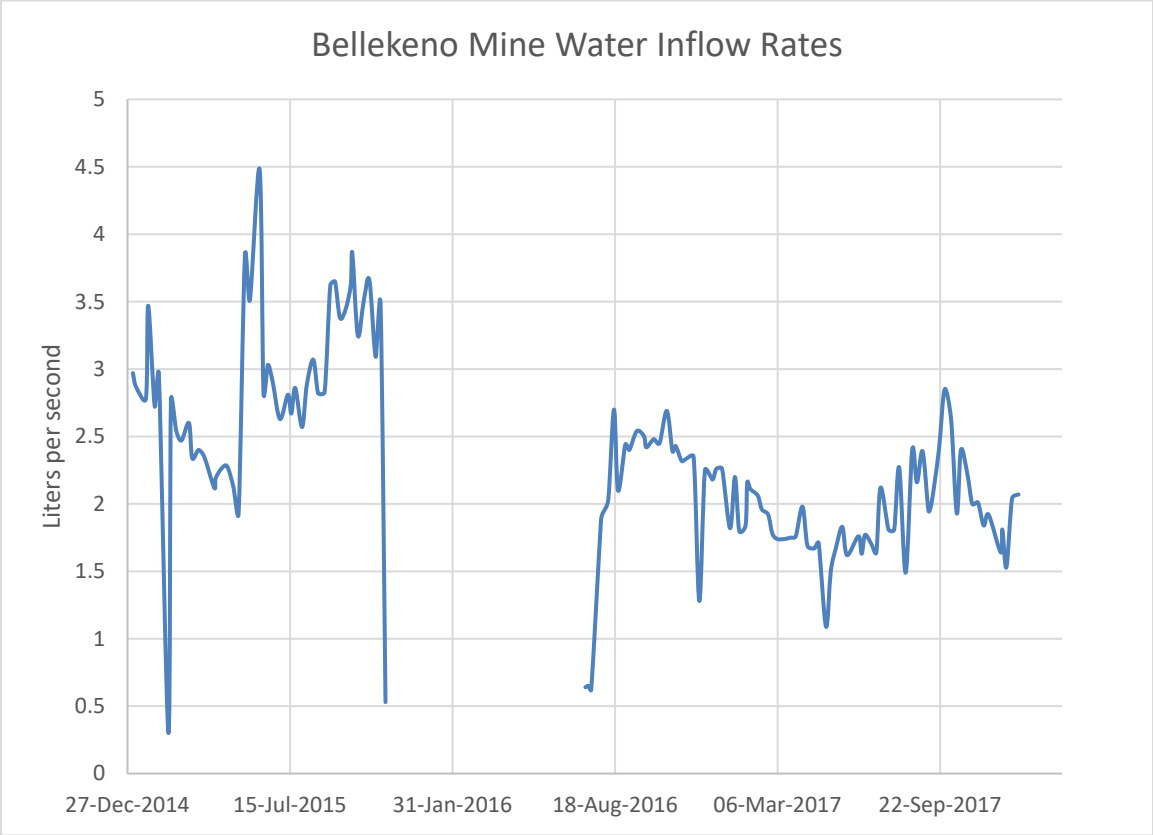


Figure 7-28. Bellekeno Mine Adit Discharge 2015 – Apr 2017

Zn concentrations in the Bellekeno mine water have remained relatively constant over the period August 2013 – January 2018 and represent the long term expected chemistry of the Bellekeno mine under closure conditions. Figure 7-29 shows the Zn concentration at Bellekeno since the mine has been in suspension and has had no mining related impacts (i.e. material movement, blasting, mucking, etc.). This is also a conservative design basis, as flooded mines typically have reduced metals leaching compared to dewatered mines because oxygen transfer is minimized where air is excluded. If anything, in the long term metals leaching, specifically zinc, should be expected to decrease as the mine is flooded and many of the voids become saturated. Some metals leaching is still expected for the mine voids that are above the flooded level (Bellekeno 625).

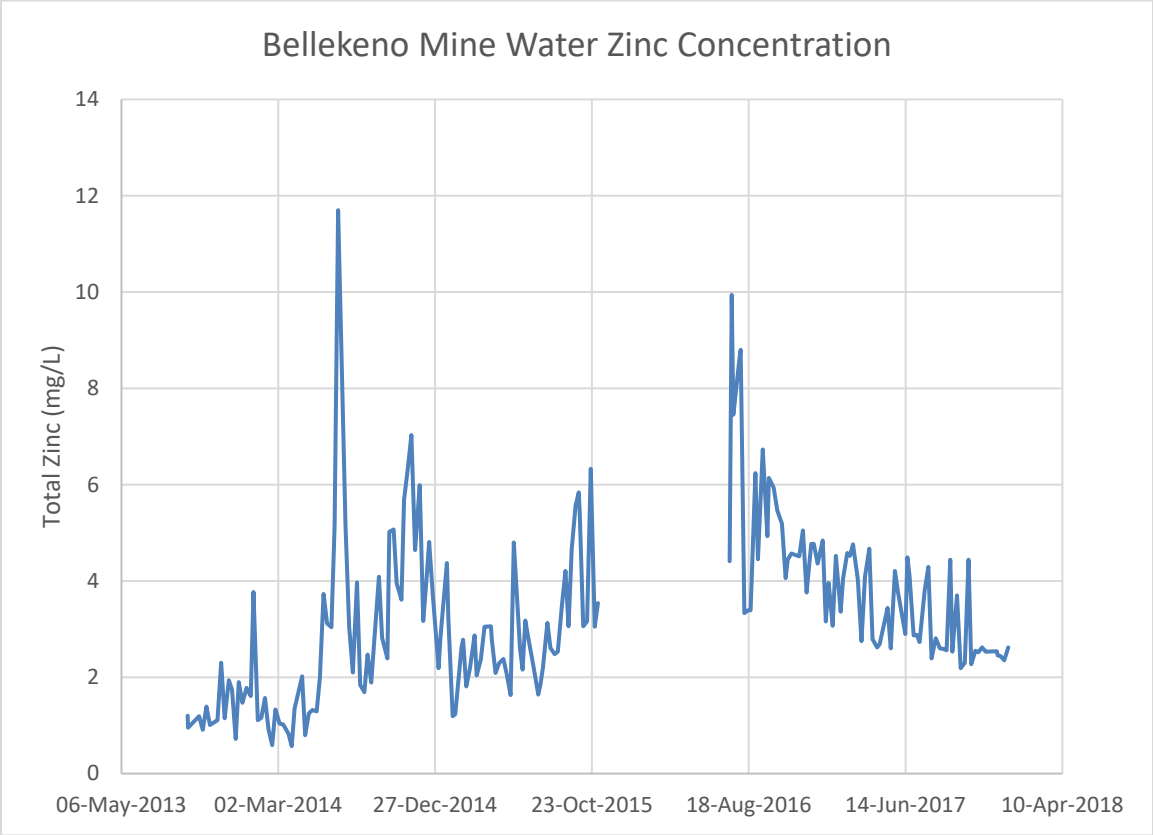


Figure 7-29 Total Zinc Concentration Bellekeno Mine Discharge

Table 7-3 Cumulative Mine Volume vs Elevation

Bellekeno Mine Elevations	Cumulative Mine Voids – m^3
625-650	67,633
650-700	50,685
700-750	38,556
750-800	36,994
800-850	21,467
850-900	4,290
900-950	2,730

A comparison of mine inflow and retention time is shown in Figure 7-30.

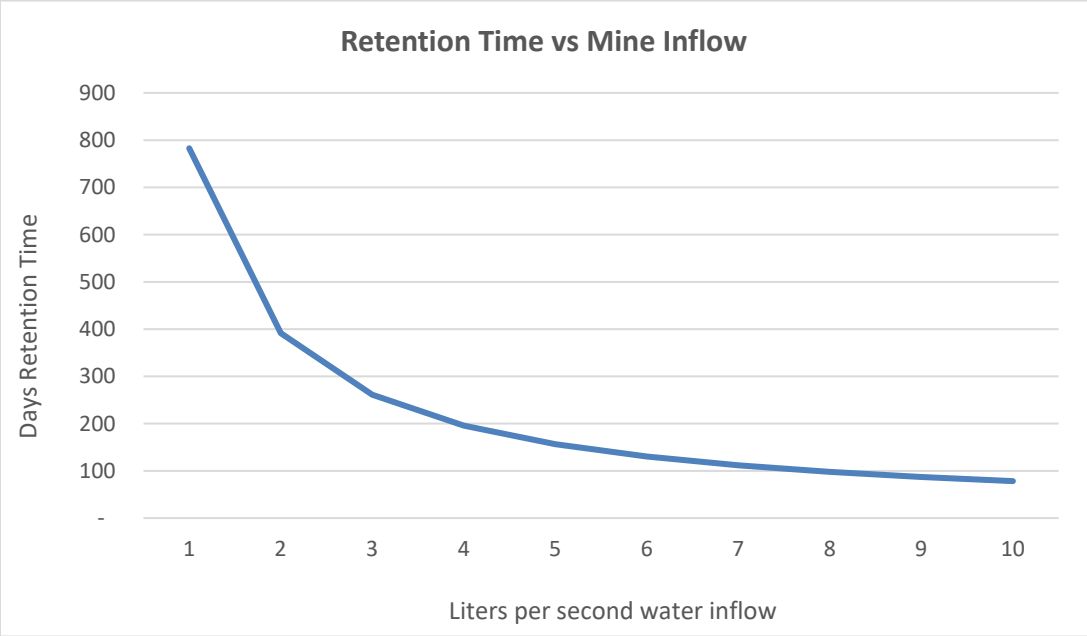


Figure 7-30 Bellekeno Retention Time vs Mine Water Inflow

The design parameters for in situ treatment of Bellekeno mine water is presented in Table 7-4.

Table 7-4 Bellekeno In Situ Treatment Design Parameters

Design Parameter	Unit	
Mine Inflow	Base Flow: 4 lps	Max Flow: 6 lps
Zn Untreated	Average: 4 mg/l	Max: 8 mg/l
Zn Treated	Discharge Criteria: 0.5 mg/l	
Mine Volume	67,600 m^3	
Retention Time	Average Retention: 200 days	Minimum Retention: 130 days

Based on the design flow of 4 lps and void openings of 67,600 m^3, it is calculated that there is approximately 200 days of retention time in the Bellekeno mine pool which is more than ample for effective in situ treatment.

The following summarizes the main design features of the Bellekeno in situ treatment system. The process flow and instrumentation diagram for the Bellekeno is situ treatment system is shown in Figure 7-35.

An adit concrete bulkhead at 625 will collect and manage water stored in the mine and provide hydraulic retention time (HRT), as well as providing access control. Figures 7-31 present a preliminary design for a concrete bulkhead applicable to Bellekeno 625. The bulkhead will consist of pressure

monitoring instrumentation, clean out conduit (4") for removal of built up sediments behind the bulkhead and upper and lower discharge lines to gravity drain water from behind the bulkhead to the bioreactor.

A pipeline and recirculation pump to inject reagents and water recirculation to various levels of the mine. The Bellekeno mine is equipped with both air and water lines from surface to all levels throughout the mine and will be used as the recirculation and reagent addition pipeline upon closure. The discharge location of the injection pipe is planned to be in the stopes on the 850 level of the Southwest Zone (see blue dots in Figure 7-4). Water from the 625 level will be collected, amended with the design dose of reagents, and injected in the discharge location as illustrated, using the existing water lines.

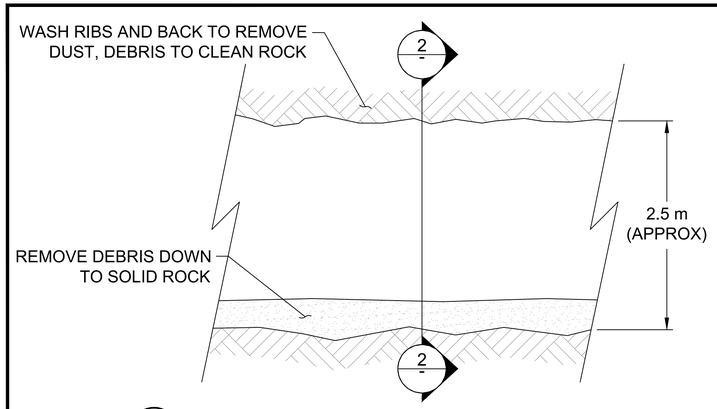
Site power will be supplied by current grid power connected at the Bellekeno 625 substation.

A process control and monitoring shed will be used to house the controls and monitoring systems for each site. This system will allow for the observation of the mine pool levels, in situ water chemistry parameters (pH, ORP, specific conductivity, and water temperature), flow rates, bulkhead pressures, and reagent tank levels. The collected information will be data logged, which allows for the review of the collected data over time. A sampling port will also be available to sample each site for lab water chemistry parameters. The current water treatment shed at 625 will be repurposed for this requirement.

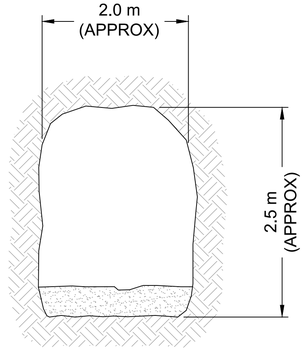
A reagent storage tank will be used to store site reagents. In most cases, an alcohol-based reagent will be utilized and stored in a tank sized to hold up to 12 months of reagent demand. The current lime tank inside the treatment shed at Bellekeno 625 will serve this purpose.

A reagent dosing pump with variable speed controls will be used to transfer reagents from the storage tank to the system pipeline for static mixing and conveyance for injection. The reagent dosing pump will be controlled by a Programmable Logic Controller located within the process control and monitoring shed, which allows reagent additions to be proportional to system flow rates.

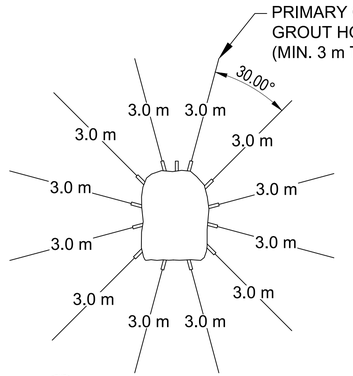
A Programmable Logic Controller (PLC) will be located in the process control and monitoring shed. This system is capable of monitoring up to eight 4-20 mA inputs from pressure gauges, flow meters, level sensors, and other monitoring equipment. In addition, it includes up to four 4-20 mA outputs that can control metering pumps, proportional flow valves, and other control equipment. The PLC system currently designed for each site will be connected to the internet allowing for real-time process monitoring and remote alarm notifications. This will also allow for in situ treatment experts to evaluate treatment data in real time and make adjustments.



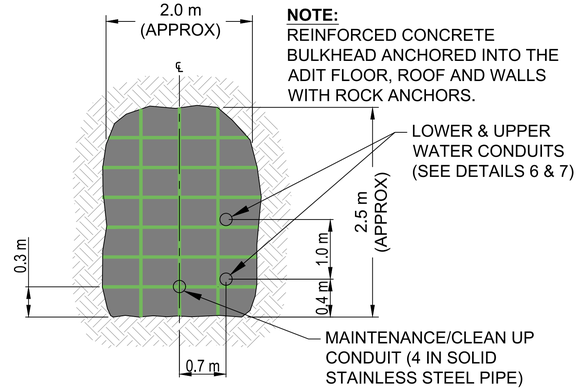
1 - PREPARE PLUG LOCATION - LONGITUDINAL SECTION VIEW
NOT TO SCALE



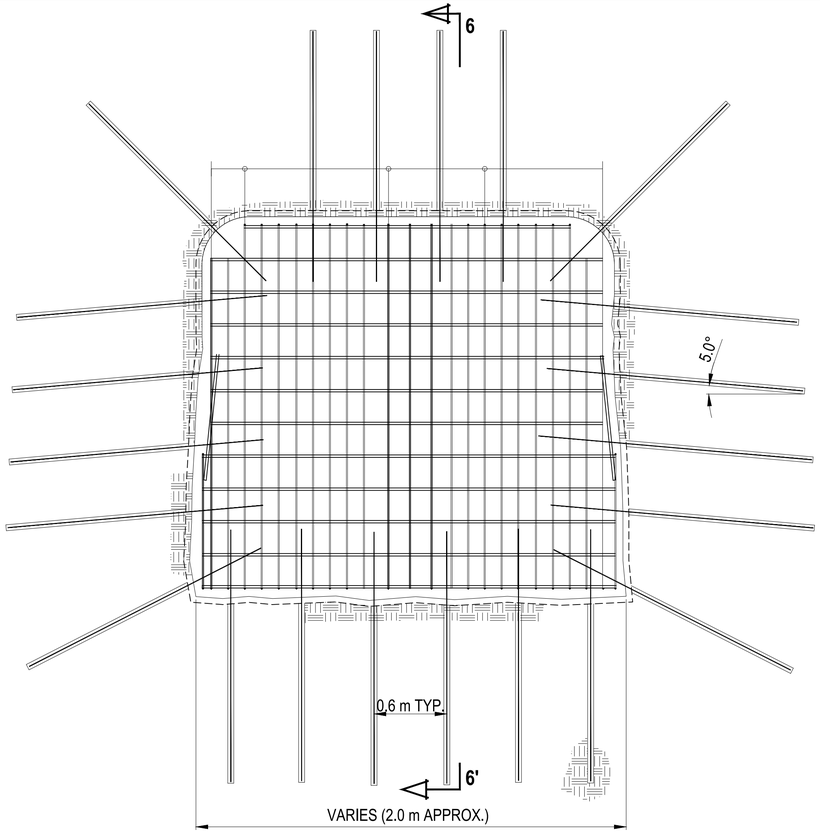
2 - ADIT CROSS SECTION
NOT TO SCALE



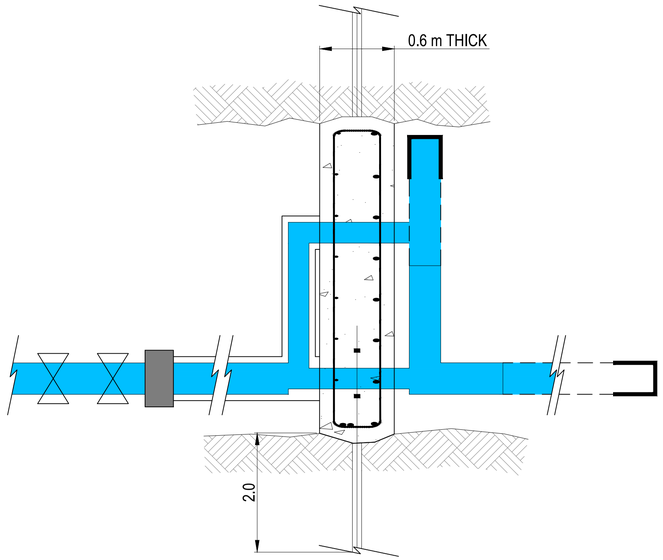
3 - PRESSURE GROUTING
NOT TO SCALE



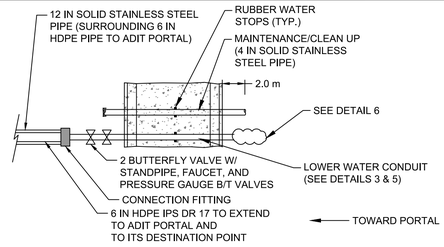
4 - BULKHEAD SITE - TRANSVERSAL SECTION VIEW
NOT TO SCALE



5 - BULKHEAD DOWNSTRAM ELEVATION
NOT TO SCALE



6 - BULKHEAD SITE - LONGITUDINAL SECTION VIEW
NOT TO SCALE



7 - BULKHEAD SITE - PLAN VIEW
NOT TO SCALE

NOTES:

1. Bulkhead designed in accordance with CSA Standard A23.3-04 Design of Concrete Structures.
2. Bulkhead designed to retain 6.0 m of hydrostatic head of fresh water factored by 1.5 for Ultimate Strength Design
3. Consequence of failure is high.
4. Concrete shall have a minimum 40 MPa compressive strength at 28 days.
5. Steel reinforcement shall have a minimum yield strength of 415 MPa (60ksi) and be weldable type.
6. Site preparation shall remove loose rock and weathered rock from the walls, roof and invert of the adit from the footprint of the concrete bulkhead to a depth where the bulkhead will be in contact with and keyed into competent rock. This work shall be performed by hand using suitable scaling bars and may include scaling by compressed air in a controlled manner, or by means of hydraulic splitters. Competency of final rock face shall be reviewed by a professional engineer or geologist. Final rock face shall be fresh, unaltered (not faulty), and with a minimum intact compressive strength of 40 MPa.
7. Rock Anchors shall be hot dip galvanized 32 mm (1 1/4 inch) Ø Williams R-61-6R75 all thread (or equivalent).The boreholes shall be 63 mm Ø to a depth of 2000 mm below the surface on the walls, roof and floor. The wall anchors shall be drilled at 5 degrees from the horizontal, the floor and roof anchors shall be installed vertical.
8. The mine owner/operator shall seal any leaks immediately upon detection with approved quick seal grout on the downstream side or de-water and seal upstream.
9. Grout – Cemented Grout Bolts
   - Cement grout shall be used for all rock anchors installed as part of the water retention bulkhead.
   - Cement grouting for rock anchors shall be a non-shrink, non-sanded grout mixed with the proportion 0.4 water:cement by weight, capable of achieving a minimum compressive strength of 28 MPa at 7 days and 40 MPa at 28 days when tested in accordance with CAN/CSA A23.2-1B.
   - Equipment for mixing and pumping grout shall be capable of satisfactorily mixing and agitating grout and pumping it into the holes at the required water cement ratio.
10. Installation – Cemented Grout Bolts
    - Completely clean holes of all drill cuttings, sludge, debris and water using clean water and air.
    - Grout shall be placed in the hole from the bottom up using a grout tube extending to the lower end of the hole.
    - Rock bolts shall be fully encapsulated in grout to the drill hole collar.
    - If seepage of grout into cracks in the rock prevents the hole from being filled with grout, the hole shall be sealed with an approved grout material, and then redrilled. This sequence shall be repeated until the hole is sealed.
11. Grout and Concrete Testing
    - The Sub-Contractor will retain an independent testing agency recommended by the Consultant for the testing of grout and concrete to establish that minimum grout strength required for anchors and minimum concrete strength for bulkhead has been obtained.
    - The testing agent shall (i) Review and confirm that the grout mix submitted by the Contractor will provide the properties specified herein, (ii) take sample of grout from each continuous mix (Contractor can cast the grout samples under the directions of the testing agency) and (iii) test grout samples to determine compressive strength. The contractor shall provide a minimum of 48 hours notice to the testing agency.

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Keno District Mine Operations
Reclamation and Closure Plan
Drawing No:
AKHM-13-01-S-0302-Bulkhead

Figure 7-31

Portal Closure
Typical Concrete Bulkhead Design

REVISION: A	2018-02-05	PROJECT No.: AKHM-13-01
DRAWN BY: Tetra Tech EBA	DESIGNED BY: Tetra Tech EBA	REVIEWED BY: KSW

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Bellekeno 625 Existing Water Treatment Facility

The Bellekeno 625 Water Treatment Facility (WTF) (Figure 7-34) includes a lime-addition circuit for metals removal, multi-media filtration system for TSS and an ion exchange system for ammonia removal. The ammonia removal system is only operated when blasting residuals are present in the system, and the filtration system is primarily required only while active rock breaking and/or diamond drilling is occurring underground. In a closure scenario, the Bellekeno 625 WTP is shut down and decommissioned and the lined ponds and tanks are used for the construction of the bioreactor and in situ treatment system.

Sludge from the Bellekeno 625 WTF is currently disposed of into a cell on the surface of the Valley Tailings as per the current Sludge Management Plan and as authorized under QML-0009. Bellekeno water treatment sludge is also authorized for disposal in the DSTF. The sludge from Bellekeno 625 that is stored in the valley tailings cell is kept separate from the sludge generated at the other treatment facilities. The sludge containment cells are not lined in order to allow water to exfiltrate from the cells.



Figure 7-32 Bellekeno 625 WTP Area Overview

Upon closure, the sludge from the Bellekeno 625 treatment plant will be excavated from the storage cell in the valley tailings and transported either back underground in Bellekeno East decline or placed in the DSTF.

The discharge criteria currently authorized in Water Licence QZ09-092 for the Bellekeno 625 water treatment plant is protective of the receiving environment. The proposed discharge criteria for the

Bellekeno mine for closure and long-term is the same as the current effluent quality levels during operations and are summarized in Table 7-6.

Bellekeno 625 Bioreactor

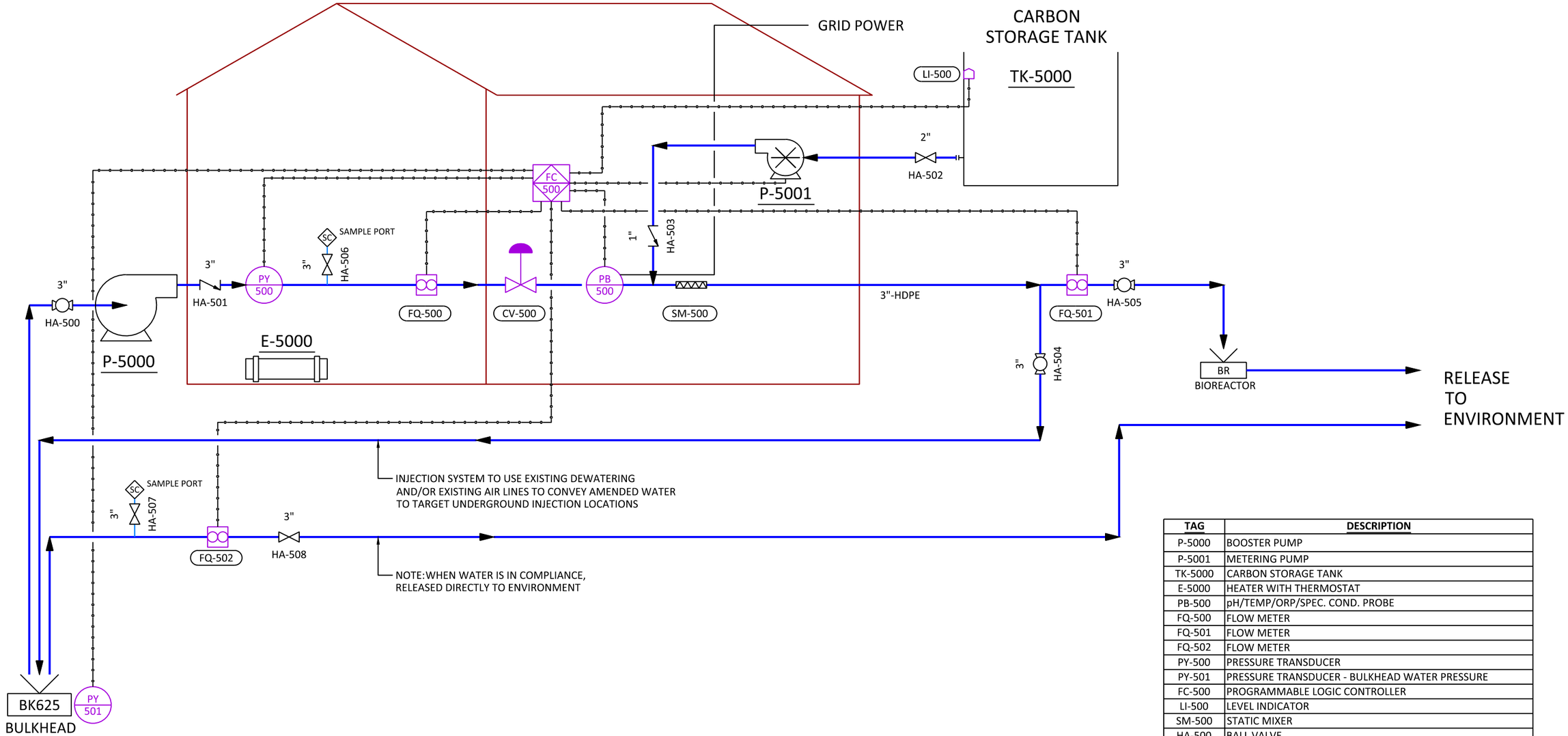
A preliminary design of the bioreactor at 625 is shown in Figures 7-33 and 7-34.

The lined ponds at Bellekeno 625 will be converted into a bioreactor and serve as a contingency treatment system. Although the in situ treatment of Bellekeno is expected to produce direct discharge complaint water, an additional contingency treatment system in the form of a bioreactor adds additional confidence and conservatism in the water management plan for Bellekeno upon closure.

The bioreactor design and construction consists of the following steps:

1. Remove (vacuum truck) remaining sludge in Bellekeno lined ponds.
2. Install piping distribution system in bottom of ponds.
3. Fill ponds with clean gravel sourced from adjacent placer miner.
4. Install geotextile barrier over surface of gravel.
5. Place 2 meter soil cover over top of geotextile.
6. Recirculate mine pool water through bioreactor and commission.

A water treatment and management schedule for Bellekeno 625 is included in Table 7-5. Water from the flooding mine pool would be pumped to the bioreactor constructed at 625 and commissioning and optimization of the bioreactor would take place. Once the treated mine pool reaches the static elevation of the 625 adit and begins to gravity flow out of the adit, pumping to the bioreactor for commissioning would cease and passive flow and treatment through the bioreactor would continue. This approach allows construction and commissioning of the bioreactor to have already been completed by the time the Bellekeno 625 mine pool floods and reaches static water elevation and discharges out the 625 adit. A bioreactor was constructed and operated from 2009-2011 at Galkeno 900 as part of the District closure planning process. The results of the Galkeno 900 bioreactor performance is included in Appendix 1.3 as support for this approach in closure of the Bellekeno mine.



TAG	DESCRIPTION
P-5000	BOOSTER PUMP
P-5001	METERING PUMP
TK-5000	CARBON STORAGE TANK
E-5000	HEATER WITH THERMOSTAT
PB-500	pH/TEMP/ORP/SPEC. COND. PROBE
FQ-500	FLOW METER
FQ-501	FLOW METER
FQ-502	FLOW METER
PY-500	PRESSURE TRANSDUCER
PY-501	PRESSURE TRANSDUCER - BULKHEAD WATER PRESSURE
FC-500	PROGRAMMABLE LOGIC CONTROLLER
LI-500	LEVEL INDICATOR
SM-500	STATIC MIXER
HA-500	BALL VALVE
HA-501	CHECK VALVE
HA-502	ISOLATION VALVE
HA-503	CHECK VALVE
HA-504	BALL VALVE
HA-505	BALL VALVE
HA-506	GATE VALVE
HA-507	GATE VALVE
HA-508	GATE VALVE
CV-500	THROTTLING VALVE

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NOTES:

1) Treatment will be performed in treatment campaigns periodically as necessary to maintain low redox potential, and low zinc.
2) A centrifugal booster pump will be installed near the bulkhead, allowing for water to be pumped from the mine, amended with carbon, and injected back underground
3) A throttling valve will control the pump speed.
4) System's flow rate and pressure will be monitored, with carbon injection proportional to flow rate. Monitoring information of all adit discharge will be continuously monitored with datalogging field parameters: specific conductivity, temperature, ORP, pH, and pressure behind the bulkhead.
5) When in compliance, water will be released to the environment.

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Keno District Mine Operations
Reclamation and Closure Plan
Drawing No.: AKHM-13-01-D2601

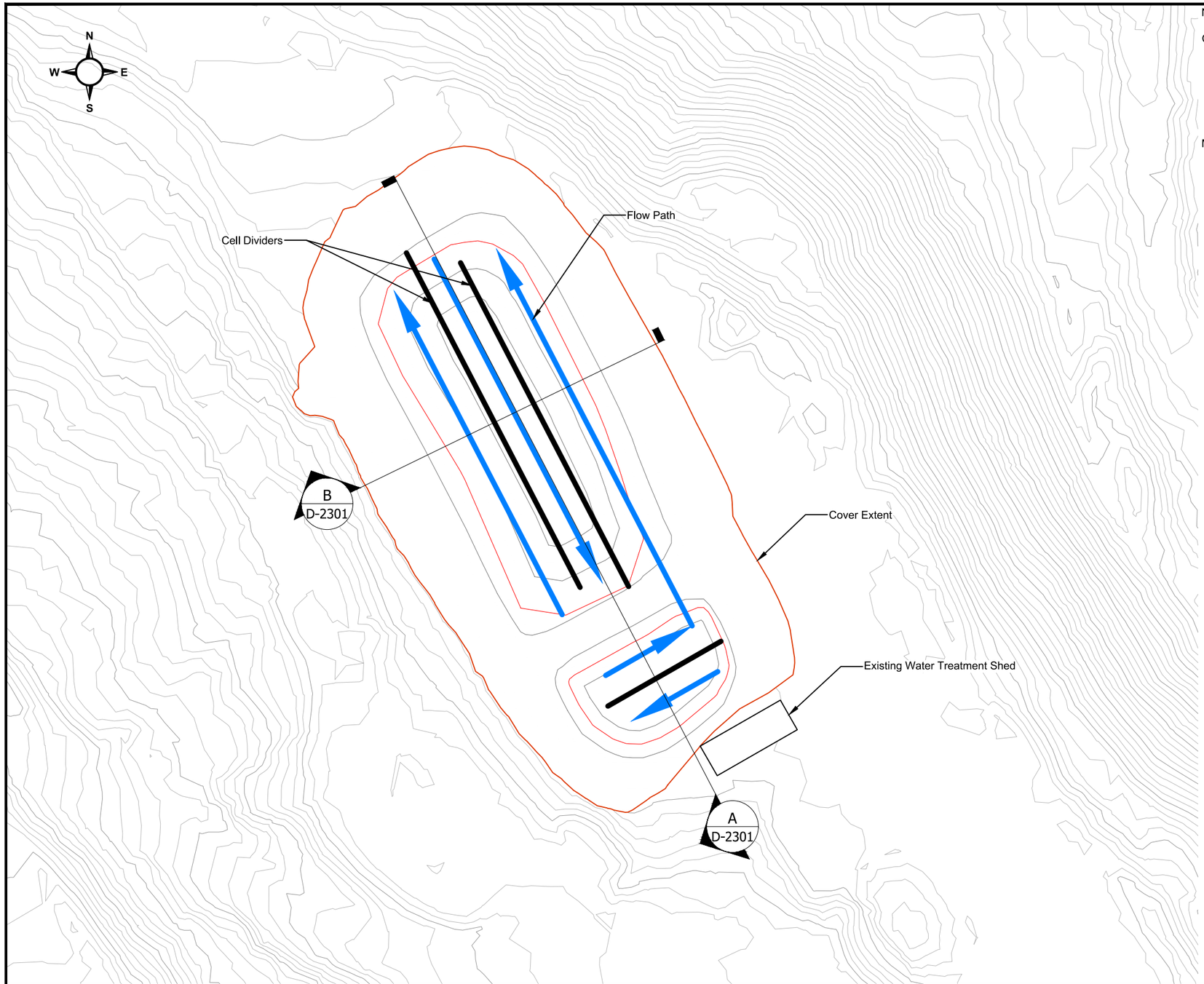
Bellekeno Closure Treatment System

Piping & Instrumentation Diagram

Figure 7-33

REVISION A	2018-02-05	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: EJL	REVIEWED BY: JMH

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Notes:

Conceptual Design Assumptions:

1. Divide Pond 1 in to two zones with an HDPE liner divider. Two cells of approximately 6 m x 15 m
2. Divide Pond 2 in to three zones with HDPE liner dividers. Three cells of approximately 5.3 m x 42 m
3. Total Volume = 2,800 m^3
4. Porosity = 40%
5. Flowrate = 4 lps
6. Retention Time = (2800 m^3 x 0.40)/4 lps = 3.1 days

Material Quantities:

Placer Gravel Rock Substrate:	2,800 m^3
Geotextile Barrier:	1,410 m^2
Soil Cover:	4,010 m^3

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Keno District Mine Operations
Reclamation and Closure Plan

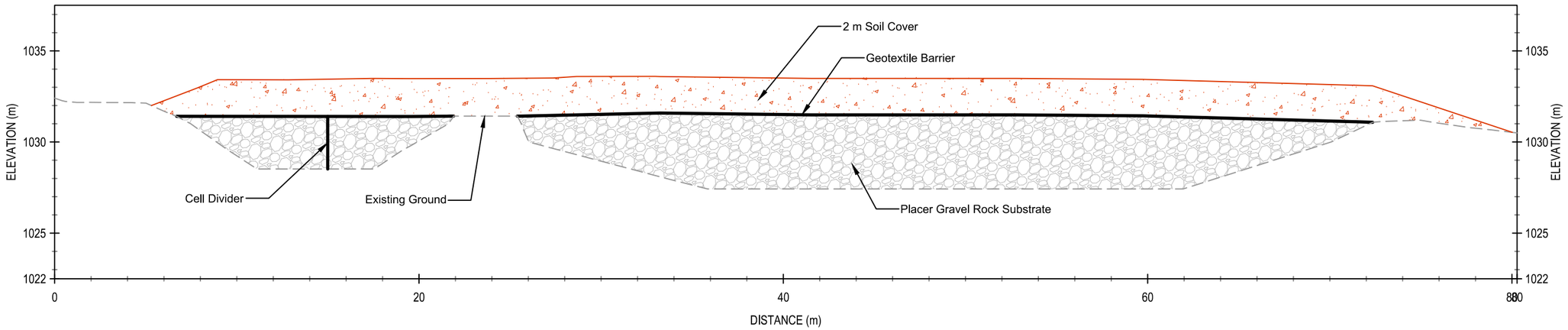
Drawing No: AKHM-13-01-D-2102

Figure 7-34

Bellekeno 625
Bioreactor Design

REVISION: A	2018-02-01	PROJECT No.: AKHM-13-01
DRAWN BY: KAB	DESIGNED BY: –	REVIEWED BY: KSW

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Section A

Section B

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Keno District Mine Operations
Reclamation and Closure Plan
Drawing No: AKHM-13-01-D-2301

Figure 7-35

Bellekeno 625
Bioreactor Design Sections

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DRAWN BY: KAB	DESIGNED BY: –	REVIEWED BY: KSW

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Table 7-5: Underground Mines Water Management Schedule

	Months following cessation of mining activities																
Bellekeno Water Management Task	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**	**M12**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6 +**
Cessation of mining																	
Pump shutdown and mine workings flooding																	
In Situ Mine Pool Treatment																	
Construct bioreactor																	
Commission bioreactor with mine pool water																	
Passive feed of bioreactor from mine pool																	

	Months following cessation of mining activities																
Lucky Queen Water Management Tasks	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**	**M12**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6 +**
Cessation of mining																	
Construct bioreactor (if required)																	
Commission bioreactor with adit discharge (if required)																	
Passive feed of bioreactor from adit discharge (if required)																	

	Months following cessation of mining activities																
Flame and Moth Water Management Task	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**	**M12**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6 +**
Cessation of mining																	
Pump shutdown and mine workings flooding																	
In Situ Mine Pool Treatment																	

	Months following cessation of mining activities																
Bermingham Water Management Task	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**	**M12**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6 +**
Cessation of mining																	
Pump shutdown and mine workings flooding																	
In Situ Mine Pool Treatment																	

Table 7-6 Bellekeno, Lucky Queen, Bermingham and Flame and Moth Mine Closure Effluent Quality Standards

Parameter	Maximum Concentration in a Grab Sample
pH	6.5 to 9.5 pH Units
Total Suspended Solids	25 mg/L
Ammonia Nitrogen (as N)	5 mg/L
Arsenic (total)	0.1 mg/L
Cadmium (total)	0.01 mg/L
Copper (total)	0.1 mg/L
Lead (total)	0.2 mg/L
Nickel (total)	0.5 mg/L
Radium 226	0.37 BQ/L
Silver (total)	0.01 mg/L
Zinc (total)	0.5 mg/L
Acute Toxicity Testing	
96-hour Rainbow Trout	Non-Toxic, LC_{50} (100%)

7.4.3 Bermingham In Situ Treatment

The mine will flood at closure due to its design of being accessed via a decline and will always remain flooded to the local groundwater table which is located approximately 20 vertical meters down the exploration decline. At closure, discharge from the flooded Bermingham mine (up to 2.5 lps) will infiltrate to ground. The adit discharge chemistry is expected to be similar to that of the nearby historical Bermingham 200 adit, which has an average total zinc concentration of 2.2 mg/L. Given the success of the Silver King in situ treatment pilot test (Appendix 1.2), the relatively low zinc concentration, and the infiltration of discharge to ground, in situ treatment is considered an appropriate closure technology for primary treatment of the Bermingham adit discharge.

The in situ treatment design will be refined prior to the Water Licence application for the Bermingham mine; however, the conceptual in situ treatment configuration envisages pumping water from the Bermingham adit discharge as a water source to dilute and deliver soluble organic carbon (e.g., alcohol and/or molasses) back to the flooded workings via an injection well installed in the vent raise or a drill hole. If required, a submersible pump will recirculate water within the flooded mine workings to achieve the optimal conditions for treatment within the workings. Injection of organic carbon stimulates indigenous microbes present in the flooded workings to produce sulphate-reducing conditions, converting the dissolved sulphate to sulphide, which in turn reacts with metals to form insoluble metal sulphide precipitates. These phases are retained in the mine workings as coatings on the walls, floors and broken rock present in the flooded workings.

Such injections would occur continuously over a period of a few weeks to ensure adequate carbon is delivered to the workings alongside dispersion throughout the workings. Following discharge from the Bermingham adit, the water may need pH adjustment and/or total suspended solids (TSS) control. This would be achieved via a passive aeration system (e.g., tumbling the discharge over rip rap

channel) to promote equilibration with the atmosphere and raise pH via degassing of carbon dioxide. The rip rap channel would then flow into a retention pond to promote settling of TSS and further equilibration with the atmosphere, prior to discharge to the environment.

7.5 MINE, MILL AND SURFACE INFRASTRUCTURE

The closure objectives for mine, mill and surface infrastructure are to:

1. Remove potential sources of environmental contamination;
2. Minimize erosion;
3. Minimize safety risks to people and wildlife, and
4. Reclaim the site to an aesthetically acceptable level.

7.5.1 Bellekeno Surface Infrastructure

Bellekeno East Surface Facilities

Various surface support buildings and facilities (Figure 7-1) are in place near the entrance to the Bellekeno mine and include:

- Surface maintenance shop;
- Sea container storage units (5 each);
- Skid mounted washroom trailer;
- Skid mounted mine office;
- Skid mounted miners dry/lunchroom;
- Skid mounted explosives magazine; and
- Skid mounted double walled fuel tank.

All of the surface buildings at Bellekeno East are portable structures that will be removed and transported offsite for salvage at the end of the mine life.

Figure 7-2 and Figure 7-3 show the current state of the Bellekeno East portal. The decline collar is a multi-plate culvert 4 meters in diameter extending from the surface into the competent bedrock.

At closure, underground equipment will be removed from the underground mine through the Bellekeno East portal. The portal will remain temporarily accessible at closure for the rehandling of P-AML waste rock back into the underground. The Bellekeno East adit opening will then be blocked by inserting rock fill to limit access by humans and wildlife (Figure 7-6). Reclamation measures for the Bellekeno Mine are predicated on the fact that the static water elevation will not reach the elevation of the Bellekeno East portal and therefore this portal will not discharge water. As such the sediment

ponds constructed at Bellekeno East for development of the decline will be progressively reclaimed prior to mine closure.

Reclamation of the Bellekeno East portal site will include removal of the shop and other buildings (e.g. explosives and cap magazine). Fuel tanks will be cleaned and removed along with liners for reuse or landfilling. Any additional debris will also be removed for reuse or proper disposal. All solid waste will be disposed of in accordance with the *Yukon Environment Act* Solid Waste Regulations. Alexco has a permitted commercial solid waste facility located in Elsa. All waste petroleum products and any other special waste, as defined in the Special Waste Regulations will be disposed of in accordance with the Regulations. Any soils contamination will be documented through a final site contamination assessment. Contaminated soil will be removed and/or remediated in an approved manner. A land treatment facility has been constructed near the Elsa Valley Tailings Facility for remediation of such soils for district closure, and can be used for remediation of any hydrocarbon contamination at the Bellekeno Mine. The portal site would then be recontoured and scarified to facilitate revegetation and establish drainage (revegetation at the Bellekeno East portal site has already been started). Signage will be installed to indicate the portal presence.

Surface water diversion infrastructure (berms, ditches) will be maintained to prevent surface runoff inflows into the adit and limit erosion. Water storage ponds will be filled in and contoured to match surrounding environmental features.

Compacted areas will be scarified to promote natural revegetation or selected areas will be reseeded with native vegetation.

Bellekeno 625 Adit Surface Facilities

The primary facilities in place at the Bellekeno 625 location include:

- Historic loadout and snow shed facility;
- Compressor shack;
- Ventilation fan and propane tank;
- Water treatment buildings (will be converted to treat shed for in situ);
- Sea container storage units; and
- Electrical substation (will remain until power not required at Bellekeno in situ).

7.5.2 Onek Surface Infrastructure

Various surface support buildings and facilities (Figure 7-8 and Figure 7-12) are in place near the entrance to the Onek 990 portal and include:

- Sea container storage units;
- Contractor offices; and
- Ventilation fan container.

Reclamation of the 990 Portal will include removal of the shop and other buildings. Fuel tanks will be cleaned and removed along with liners for reuse or landfilling. Any additional debris will also be removed for reuse or proper disposal. All solid waste will be disposed of in accordance with the *Yukon Environment Act* Solid Waste Regulations. Alexco has a permitted commercial solid waste facility located in Elsa. All waste petroleum products and any other special waste will be disposed of in accordance with the Special Waste Regulations. Any soils contamination will be documented through a final site contamination assessment. Contaminated soil will be removed and/or remediated in an approved manner. A land treatment facility has been constructed near the Elsa Valley Tailings Facility for remediation of such soils for district closure, and can be used for remediation of any hydrocarbon contamination at the 990 Portal. The portal site will be recontoured and scarified to facilitate revegetation and establish drainage. Signage will be installed to indicate the portal presence.

Surface water diversion infrastructure (berms, ditches) will be maintained as appropriate to manage surface runoff from entering the decline and limit erosion on site. Water storage ponds will be filled in and contoured to match surrounding environmental features. Compacted areas will be scarified to promote natural revegetation or selected areas will be reseeded with native vegetation.

The new Onek vent raise will be capped with an engineered concrete cap. This cement plug will restrict physical entry and prevent air movement and possible ice plug formation at the adit. A preliminary design for a concrete cap is included in Figure 7-7.

7.5.3 Lucky Queen Surface Infrastructure

Reclamation of the Lucky Queen Portal Pad will include removal of the shop and other buildings. Fuel tanks will be cleaned and removed along with liners for reuse or landfilling. Any additional debris will also be removed for reuse or proper disposal. All solid waste will be disposed of in accordance with the Yukon Environment Act Solid Waste Regulations. Alexco has a permitted commercial solid waste facility located in Elsa. All waste petroleum products and any other special waste will be disposed of in accordance with the Special Waste Regulations. Any soils contamination will be documented through a final site contamination assessment. Contaminated soil will be removed and/or remediated in an approved manner. A land treatment facility has been constructed near the Elsa Valley Tailings Facility for remediation of such soils for district closure, and can be used for remediation of any hydrocarbon contamination at the Lucky Queen site. The portal pad will be recontoured and scarified to facilitate revegetation and establish drainage. Signage will be installed to indicate the portal presence.

Surface water diversion infrastructure (berms, ditches) will be maintained as appropriate to manage runoff and limit erosion. Water storage ponds will be filled in and contoured to match surrounding environmental features.

Compacted areas will be scarified to promote natural revegetation or selected areas will be reseeded with native vegetation.

The new Lucky Queen vent raise will be capped with an engineered concrete cap. This cement plug will restrict physical entry and prevent air movement and possible ice plug formation at the adit. A preliminary design for a concrete cap is included in Figure 7-7.

7.5.4 Flame and Moth Surface Infrastructure

The Flame and Moth portal and mine surface facilities sit within the current mill area footprint and disturbance and will utilize as much existing infrastructure as possible. Figure 5-4 and Figure 7-36 shows the location of the Flame and Moth portal in relation to the mill. Surface infrastructure that is new to Flame and Moth and not already included in the mill facilities and infrastructure includes:

- Sea container storage units;
- Maintenance shop; and
- Mine office.



Figure 7-36 Flame and Moth Surface Facilities

An overview of the layout of the Flame and Moth mine surface infrastructure is shown in Figure 5-4. The water treatment plant (WTP) for the Flame and Moth mine will be constructed inside the mill building and closure measures associated with the WTP are included in the mill facilities. The ventilation fan for Flame and Moth will be installed inside the portal to reduce noise emissions.

All of the surface buildings associated with Flame and Moth are portable structures that will be removed and transported offsite for salvage at the end of the mine life.

7.5.5 Bermingham Surface Infrastructure

The Bermingham advanced underground exploration project and associated surface facilities and infrastructure consists of the following:

- Office trailer, miners dry/wash car;
- Generator, MCC, fuel storage tank;
- Sea container storage units;
- Maintenance shop; and
- Compressor, ventilation containers.

A view of the Bermingham surface facilities (current and proposed) and layout is shown in Figures 7-18, 7-19 and 7-20.

7.5.6 Mill Surface Infrastructure

The Keno District Mill is a conventional differential flotation facility producing two separate metal concentrates that are shipped offsite for final processing. A layout of the mill facilities is shown in Figure 5-4 and 7-37.

Reclamation measures for the Mill area are described on Drawing C-6401, and grading details are described on Drawings B-6101 and B-6301, located in Appendix 3.1.

The following mill infrastructure and facilities comprise the main facilities constructed over the 2010/2011 mill construction and commissioning period and comprise the facilities that require removal under the closure plan (Figure 5-4 and 7-37):

- Mill building;
- Mill office and dry;
- Electrical substation;
- Mill process pond;
- Crusher plant;
- Crusher MCC;
- Fine ore stockpile;
- Mill feed conveyor;
- Mill MCC;
- Assay lab;
- Process water tank;
- Diesel storage tank;
- Propane tank; and
- Lightning Creek bridge.

Mill Buildings and Infrastructure

The buildings at the Keno District Mill site can be broken into three categories for dismantling and salvage purposes:

- modular, prefabricated trailer style buildings, such as the offices and dry;
- rigid, steel frame construction buildings with steel wall sheeting, such as the mill building; and
- non-rigid prefabricated steel frame "fold-away" or containerized buildings.

The modular prefabricated trailer style buildings will, wherever economically feasible, be removed from the site and sold for their salvage value. Generally disassembly involves removing the underlying wood skirting, water, electrical and septic piping and cabling and then breaking the units into their respective prefabricated units. The individual units are then placed on axle dollies and removed from the site to be reused elsewhere following refurbishing. The remaining service piping, cabling and skirting lumber is removed and disposed of as either scrap or as salvageable material. The gravel pad beneath the trailer units will be scarified with a grader to enhance the re-establishment of natural vegetation.

In the event that it is found at the time of decommissioning that any such unit(s) cannot be removed or sold for their salvage value, then the unit(s) will be inspected for hazardous materials, the hazardous materials removed and units demolished on site. The materials with salvage value will be removed and sold for their respective value. Non-hazardous materials that have no salvage value will be disposed of in an approved landfill site on the mine site. Combustible wastes such as lumber-based building materials will be burned and the residue buried in the landfill site.

The rigid steel frame buildings will be dismantled on site with the support steel being sold for salvage value wherever economically feasible. Prior to disassembly, the buildings will be stripped of all non-attached equipment and materials such as shelving units, office furniture, equipment, etc. Wherever feasible, materials with salvage value will be sold for its value. Non-hazardous materials that have no salvage value will be disposed of in the approved on-site landfill area. As indicated earlier, all buildings will be inspected for hazardous materials, such as hydrocarbons, reagents, etc. Any such material will be removed and disposed of in a manner approved by regulatory authorities for the Yukon Territory. Generally disassembly of these buildings involves removing all of the steel sheet roof and wall panels and internal insulation. The steel support structure is then disassembled and where feasible sold for its salvage value either as an intact building or as high quality steel scrap. Internal steel structures would then be removed and treated in a similar fashion.

Above grade concrete footings, foundations concrete floor slabs and below grade concrete foundations will be covered by a minimum thickness of 1 m of overburden and scarified. These covered slabs will be seeded with an appropriate vegetation mix to establish vegetative growth over these areas. The specific details of each of the mill area buildings are further described in the following sections and closure measures identified.



Figure 7-37 Aerial View of Mill Site Infrastructure and Layout

Mill Building

The mill building is a pre-engineered steel building containing all of the processing equipment used for the milling, flotation and recovery of Ag, Pb and Zn from the Bellekeno mine underground ore. The mill building is 22.5 x 54 meters in dimension (Figure 7-38).

Closure measures for the mill building include salvage and removal of the process equipment, dismantling of the engineered building, breaking the concrete slab to allow percolation of water and covering of the footprint with growth media.



Figure 7-38 Mill Building

Mill Office and Dry

The mill office and dry facility is comprised of two skid mounted trailer units and one skid mounted wash car with a wooden truss constructed over the top of the 3 units. The two office units are 3.05 x 8.3 meters in dimension and the dry/shower facility is 3.35 x 11.58 meters (Figure 7-39).

Closure measures for the mill office include dismantling the roof truss structure and removing the building from site. Since the office is a portable structure there is no demolition required.



Figure 7-39 Mill Office and Dry

Electrical Substation

An electrical substation is located adjacent to the mill office/dry facility and houses a primary 69 KV – 600 V step down transformer and electrical distribution infrastructure. The substation is enclosed by a 28 m x 15.5 m fence (Figure 7-40). The step down transformer will be removed and salvaged and the remaining equipment will be removed and either salvaged or buried. The same decommissioning measures will be applied to the Onek substation.



Figure 7-40 Electrical Substation

Mill Process Pond

The mill process pond is located downgradient from the mill building and contains and manages the process water balance required for the milling operation (Figure 7-41). Thickener overflow water from inside the mill building gravity flows via a 6" yellomine pipe into the mill process pond. Process makeup water is pumped from the pond to the process water tank for makeup and recycling in the milling process. The mill process pond is 32 x 79 meters in dimension with a total design capacity of 3,500 m^3.

Since the mill process pond was not constructed with an engineered fill embankment there is no long term stability concern that needs to be addressed at closure. Closure of the pond consists of removing and burying the HDPE liner, scarification of the side slopes and revegetation. The pond will serve as a sedimentation pond during closure for capture of surface water if necessary until revegetation is stabilized. Although not a component of the closure for the mill area, the pond could also serve as a bioreactor facility if the DSTF produces seepage requiring treatment.



Figure 7-41 Mill Process Pond

Crushing Plant

Coarse ore from the Bellekeno, Bermingham, Onek, Lucky Queen and Flame & Moth underground mines is transported to a crushing plant (Figure 7-42) where the coarse ore is crushed and reduced in size to nominally 3/8". The crushing plant is a portable two-stage closed circuit plant containing a jaw crusher, single deck screen and cone crusher. The crushers, screen deck and conveyors are all portable tire mounted units that can be easily removed from site. Once the material is crushed it is transported to the adjacent fine ore stockpile via a radial stacker conveyor.

Since the crushing plant is a portable unit on wheels, closure consists of transporting the crusher offsite for salvage value. The crusher retaining wall is constructed of 6 stacked sea- containers that likewise can be removed and salvaged.



Figure 7-42 Crushing Plant

Fine Ore Stockpile

Fine ore produced from the crushing plant is stored on a fine ore stockpile covered by a fabric membrane structure to isolate the ore from snow, rain and windy conditions (Figure 7-43). The fabric membrane structure is 11.35 meters tall, 18.3 x 24.5 meters in dimension and is supported by an aluminium support structure sitting on 4 (ea) 40' steel containers that provide containment of the fine ore as well as storage units for the crushing plant and mill spare parts inventory.

Closure of the stockpile includes excavation and milling of any residual fine ore remaining on surface, removal and salvage of the sprung structure and sea-containers. The buried tunnel will be removed and salvaged for steel scrap value.



Figure 7-43 Fine Ore Stockpile

Crusher MCC

A Motor Control Centre (MCC) for the crusher (Figure 7-44) is located adjacent to the crushing plant and provides electrical distribution for the various motors located in the crushing plant. The main electrical substation distributes 600 V electrical power directly to the crusher MCC and then individual motor starters within the MCC distribute power to the motors. The crusher MCC is a portable skid mounted steel insulated building with dimensions of 2.4 x 6.1 meters.

Closure measures for the crusher MCC consist of transporting the unit offsite for salvage value.



Figure 7-44 Crusher MCC

Assay Lab

The assay lab is located immediately adjacent to the mill building and consists of 3 skid mounted trailer units separated by a wooden deck and winter roof truss (Figure 7-45). The sample prep trailer is a skid mounted trailer used for preparation of mill and underground samples. The trailer is 13.47 x 3.05 meters in dimension.

The assay lab trailers consist of 2 separate skid mounted units that are joined together with assay capability for AA digestion and fire assay. The two assay trailers are 2.4 x 6.1 meters in dimension.

Closure measures for the assay lab consist of transporting the units offsite for salvage.



Figure 7-45 Assay Lab

Mill Motor Control Centre

A Motor Control Centre (MCC) for the mill building (Figure 7-46) is located immediately adjacent to the mill and contains the motor control starters and distribution for the mill equipment. The main electrical substation distributes 600 V electrical power to the mill MCC. The mill MCC is a skid mounted unit mounted on a steel support structure and has a dimension of 15.24 x 3.04 meters.

Closure measures for the mill MCC consist of transporting the unit offsite for salvage.

Fresh Water Tank

A steel fresh water tank is located next to the mill building and sits on a compacted gravel pad. Fresh water is delivered to the fresh water tank via a water truck and the fresh water is used in eye wash stations located throughout the mill building, for reagent mixing and for pump gland water. The fresh water tank has a capacity of 50.26 m^3 and is 4 meters tall and 4 meters in diameter.

Closure of the fresh water tank consists of dismantling and cutting up for salvage value.



Figure 7-46 Mill MCC

Diesel Storage Tanks

Two skid mounted double walled diesel storage tanks are located adjacent to the concentrate loadout area and are used for general fuelling of mobile equipment and vehicles. The tanks each have a storage capacity of 3.78 m^3.

The diesel storage tanks are supplied by the diesel supply vendor and closure consists of returning the tanks to the supplier.

Propane Tank

A tire mounted portable propane storage tank sits near the mill building with a capacity of 45,425 litres of propane. Propane is used at the mill for heating the mill building during winter conditions.

The propane tank is supplied by the vendor and closure consists of returning the tanks to the supplier.

Buried Infrastructure

All buried piping and electrical cabling will be de-energized, drained and truncated where they break surface with the buried portions left remaining in the ground. The ends of all buried piping and cable runs will be cut off at 1 m below grade with the resulting excavations backfilled. Prior to abandonment all possible piping will be drained and washed to remove its contents.

The location of all known buried piping and cabling to be left in the ground will be marked on a site plan to be submitted to regulatory authorities for future reference.

Where appropriate, surface piping will be decontaminated by flushing the respective section of pipe with water and then removing the pipe for disposal. Large diameter piping will be sold for salvage where feasible. Piping with no salvage value will be disposed of in the site landfill area.

All above ground electrical cabling will be de-energized and removed. In most cases the cable will be recovered for its salvage value. Cable with no salvage value will be disposed of in the site landfill area.

7.5.7 Flat Creek Camp

Employees and contractors directly related to the Keno Hill Mine Operations are housed in the Flat Creek camp as well as in four staff houses that are located in Elsa (Figure 7-47). Additional personnel and camp accommodation requirements are on-going beyond Bellekeno, Onek, Lucky Queen and Flame & Moth deposits production operations including exploration, care and maintenance and district closure planning and implementation. Given these ongoing activities, removal and closure of the entire camp facility is not envisioned as part of the Bellekeno, Onek, Lucky Queen and Flame & Moth deposits production closure plan and requirement.

Closure measures include dismantling and removal of the excess trailer units to Lot 960 which is a private lot owned by Alexco in Keno City. The expanded septic system, along with the increased freshwater supply will remain in place for continued use by the downsized camp.

Reclamation measures for the Flat Creek Camp area are described on Drawing C-9401, and grading details are described on Drawings B-9101 and B-9301, located in Appendix 3.1.



Figure 7-47 Flat Creek Camp

7.6 HAZARDOUS MATERIALS

Mill Wastes

Extra reagents or chemicals will be loaded up and returned to the supplier where possible. Concrete footings will be demolished and buried *in situ*. Any additional debris will also be removed for reuse or proper disposal. All solid waste will be disposed of in accordance with the *Solid Waste Regulations*. All waste petroleum products and any other special waste, as defined in the *Special Waste Regulations* will be disposed of in accordance with the Regulations. Any soils contamination will be documented through a final site contamination assessment. Contaminated soil would be removed and/or remediated in an approved manner (i.e. land treatment facility in Mayo or Elsa if one is developed there or buried and covered). The pad area will have its embankment shoulders re-graded to prevent water ponding, and the surface will be scarified and reseeded to promote vegetative cover.

It is expected that at closure the material beneath the ore stockpiles will be processed through the mill to remove any remaining economic values as well as eliminating any potential contaminant of concern from the material. The impermeable rehandling pads will be demolished and buried once cleaned of all metal contaminants.

7.7 ROADS AND OTHER ACCESS

The closure objectives for linear disturbances, including roads, other access and transmission lines, are to:

1. Achieve long term physical stability of the disturbed areas; and
2. Reclaim the areas such that it is aesthetically acceptable.

7.7.1 Roads

All roads either newly developed or reconstructed/upgraded from existing roads will be subject to standard road decommissioning and reclamation measures at closure. Site roads include (Figure 7-49):

- Bellekeno Haul Road (5.7 km L x 9 m W);
- Christal Lake Road (1.3 km L x 6 m W);
- Bermingham Access Road (2.0 km L x 9 m W); and
- Keno City Bypass Road (2.1 km L x 9 m W).

The roads identified for closure range in width from 6-9 meters depending on their primary use. Standard road decommissioning and reclamation measures at closure include: culvert removal, re-sloping banks and removal of the safety berm to reflect the natural topography as well as provide stability, and surface scarification to encourage natural revegetation (Figure 7-49). Re-grading/contouring the roads will ensure that runoff sheds off the road surface. Localized seeding with native vegetation will take place where erosion control is necessary. Compacted areas will be scarified to promote revegetation. Figure 7-48 illustrates a typical section of the haul road between the mine and mill, and shows the bridge crossing at Lightning Creek.

A typical cross-section of road reclamation is described in Drawing B-0301, located in Appendix 3.1.

Alexco will consult EMR Client Services & Inspections and Highways & Public Works, Transportation Branch, to determine appropriate methods for limiting access to the sites. The Wernecke road from Keno City to Lucky Queen is not included in the RCP as this is a designated public road that provides access to private residence and will not be reclaimed or closed.

7.7.2 Transmission Lines

Transmission lines constructed or to be constructed include the Bellekeno, Onek and Lucky Queen transmission lines. All transmission lines constructed will be subject to standard decommissioning and reclamation measures at closure, including removing power poles and lines, and undertaking measures to promote natural revegetation. Any compacted areas will be scarified.



Figure 7-48 Lightning Creek Bridge and Typical Bellekeno Haul Road Section

Road Name	Width, m	Length, m
Bermingham Access Road	9	1979
Calumet Drive	9	7098
Christal Lake Road	6	1299
Bellekeno Haul Road	9	5661
Keno City Bypass Road	9	2060

National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced underlicense from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on January 2018

Datum: NAD 83; Map Projection: UTM Zone 8N

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- Chistal Lake Road
- Bellekno Haul Road
- Keno City ByPass
- Calumet Drive
- Bermingham Access Road
- Place of Interest
- Adit
- Valley Tailings
- Alexco/ERDC Quartz Claims
- Silver Trail Highway
- Road
- Limited-Use Road

AKHM
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ALEXCO KENO HILL MINING CORP.
RECLAMATION AND CLOSURE PLAN

FIGURE 7-49

ROADS SUBJECT TO STANDARD DECOMISSIONING AND RECLAMATION

JANUARY 2018

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7.8 BORROW MATERIALS PLANNING

7.8.1 Borrow and Cover Sources

Borrow material will be required for cover systems. Any borrow areas used will be reclaimed through slope stabilization and revegetation.

There are four existing borrow storage sites located at the mill area (Figure 7-43) that are suitable for cover construction and reclamation purposes. There are also a number of known granular deposits on the hill slope above the Bellekeno Haul Road which have old access trails which could be sourced for the required borrow materials. The total volume of growth media stored in the piles shown in Figure 7-52 is approximately 4,225 m^3.

7.9 COVER DESIGN AND REVEGETATION

7.9.1 Cover Engineering Design Parameters

The use of growth media for revegetation will be prioritized in the following order:

1. Sufficient growth media will be identified from existing borrow stockpiles in the DSTF and Mill areas and left in place to construct a 0.25 m soil cover over the DSTF.
2. Sufficient growth media will be identified and used to construct the soil/vegetative cover over the waste rock disposal areas containing N-AML material. The volume of material that will be required is yet to be determined as this material will be used for road and other construction purposes insofar as possible over the life of the mine.
3. Sufficient growth media will be identified and used to construct the soil/vegetative cover over the waste rock storage facilities, in the case that additional facilities are required after the rehandling of P-AML to the underground. All P-AML WRSFs will be covered with growth media, the volume of which will be determined upon design and construction of the facilities.
4. Growth media will be spread in those recontoured slopes that do not contain the necessary fines content to promote successful revegetation.
5. The growth media if any that remains in stockpiles will be recontoured and revegetated.

It is important to note that not all the growth media placement requires a loader and truck mode of operation. Some of the growth media placement can be completed by dozer push alone.

7.9.2 Revegetation Design Characteristics

A revegetation research program will be carried out over the life of the mine to determine the seed mix characteristics to be used in seeding and revegetating the covered waste rock dumps and DSTF. This program will be commensurate with research investigations carried out for waste rock dumps under District closure, and will also be sensitive to the desired level of infiltration prevention into mine facilities. As a starting point, Alexco has used the experience and applicable results from the reclamation and closure performance at the Brewery Creek Mine. The seed mixture recommended

for the leach pad at Brewery Creek was tailored around the objective of limiting infiltration by using plant species that maximize water uptake through evapotranspiration and consisted of the following:

50% Violet Wheatgrass

20% Kentucky Bluegrass

20% Red Fescue

10% Alfalfa

This seed mix provides a denser growth and therefore results in a higher water uptake. The seed mix used on the progressive reclamation of the DSTF over two periods consists of the following:

40% Violet Wheatgrass

13.5% Glaucous Bluegrass

23.5% Sheep Fescue

23% Rocky Mountain Fescue

The DSTF seed mix is consistent with the objective of slope stabilization and prevention of soil erosion in the short-term, and returning the site in the longer-term to an environment that closely resembles pre-mining conditions.

Appropriate diversions will be in place to meet erosion prevention objectives. Alexco's revegetation program includes resloping to 3H:1V, providing growth media material where it is necessary and active fertilization and seeding.

Assessment of revegetation programs carried out as a part of the Keno Hill District closure will be carried out to ensure that Bellekeno, Onek and Lucky Queen Production Unit Areas closure is commensurate with the overall plan for the district. Progressive reclamation has taken place on the DSTF and a summary report on the activities completed in 2012 are included in Appendix 1.1

7.9.3 Cover System Design and Field Trials

The Cover Systems Field Trials is an ongoing research program that began in 2013. The program consists of constructing vegetation plots and seeding/fertilizing followed by monitoring/maintenance of the progress of the vegetation. The results of this program will have closure application in designing suitable covers for any waste rock and tailings facilities in the RCP. The cover field trials consist of 12 cells (5 m x 5m).

With cover plots constructed, a scheduled maintenance program to retain the plots is ongoing including instrumentation and logging, and monitoring activities such as water quality sampling of the infiltration water, seasonal data downloads, and additional reporting.

Typically monitoring tasks include:

- Regularly scheduled data capture;
- Bi-annual water quality sampling of cover trial discharge (where possible);
- Equipment and site inspection;
- Field observations; and

- Vegetation monitoring (percent cover, and biodiversity).

Short growing seasons along with cool temperatures can inhibit successful establishment of agronomic, non-native plant species limiting long term persistence of vegetation and sustainability of vegetation on engineered covers. Collection and monitoring of above-ground biomass will determine if revegetation seed mixture or other agronomic adjustments are required to ensure that prescribed performance objectives are being met. The program includes three years of monitoring cover and vegetation performance. Sampling will take place at the end of the first growing season and repeated again in years two and three. This schedule corresponds with the timing of the cover trials operation, so that after the first summer of the cover trials, the first round of biomass sampling can take place. This data will be collected in conjunction with the planned schedule, and the results will be available for inclusion as an appendix in the annual reports.

Maintenance on the plots will be required periodically to ensure that proper data collection and cover plots are not compromised. Typical maintenance activities will include:

- Inspection of the solar panel system;
- Seasonal repair/thawing of the tipping buckets due to ice/freezing damage;
- Replacing worn or damaged parts; and
- Repairing cover damage by animals, water/ice flow, etc.

The data collected throughout the program will be analyzed to determine the effectiveness of the different covers at each location based in the year's data for both the hydrological and vegetation trials. This will include updating the infiltration modelling conducted during the design phase.

Cover Modelling

As part of the development of the ESM Reclamation Plan for the District, preliminary cover performance modelling for WRSA cover options has been completed by O'Kane Consultants Inc. The modelling report is attached as Appendix 1.4. The results of the cover modelling for the District Closure Plan are applicable to the Keno District Mine Operations RCP and presented here for support of the preliminary closure measures proposed. It should be noted, however, that the design basis for control of infiltration on waste rock is different than would be required for a DSTF, where the dry stacked tailings themselves provide the primary control on infiltration and seepage.

The DSTF cover is an additional control on infiltration, as well as providing erosion control and a vegetated surface. The modelling approach shown in Appendix 1.4 will be applied to the DSTF over the next two years as field data are available to quantify boundary conditions for this facility; this is not critical to evaluating closure performance since the primary control on infiltration is the surface configuration and the tailings permeability and unsaturated flow characteristics.

Four reclamation scenarios were evaluated and modeled namely, two cover system types as well as two revegetation options of which one is a 'do-nothing' scenario (i.e. bare waste rock with no revegetation effort). A description of the modelled scenarios is as follows:

Type 1a – Very Low Net Percolation Cover System: 0.3 m of compacted silty-clay material underlying a 1.0 m well-graded local soil layer. Surface re-graded to promote runoff, then revegetated with native plants;

Type 1b – Lower Net Percolation Cover System: 0.3 m well-graded local soil layer as modelled for the waste rock; this cover is comparable to the DSTF cover. The surface re-graded to promote runoff, then revegetated with native plants;

Type 3 – Surface treatment to enhance revegetation: this include a range of surface preparation and limited amendment to promote vegetation on the rock surface, ranging from direct seeding of waste rock to promote revegetation (assumes sufficient fines content to support plant growth). Scarifying and contouring of surface to promote vegetation and enhance physical stability of landform is also included.

Type 4 – Bare Waste Rock Surface: no cover system or site preparation.

Note the terms Type 1a, 1b etc. were used for comparison purposes within the ESM Reclamation Plan for different surface treatments.

Figure 7-50 shows the different soil covers and surface treatment modelled.

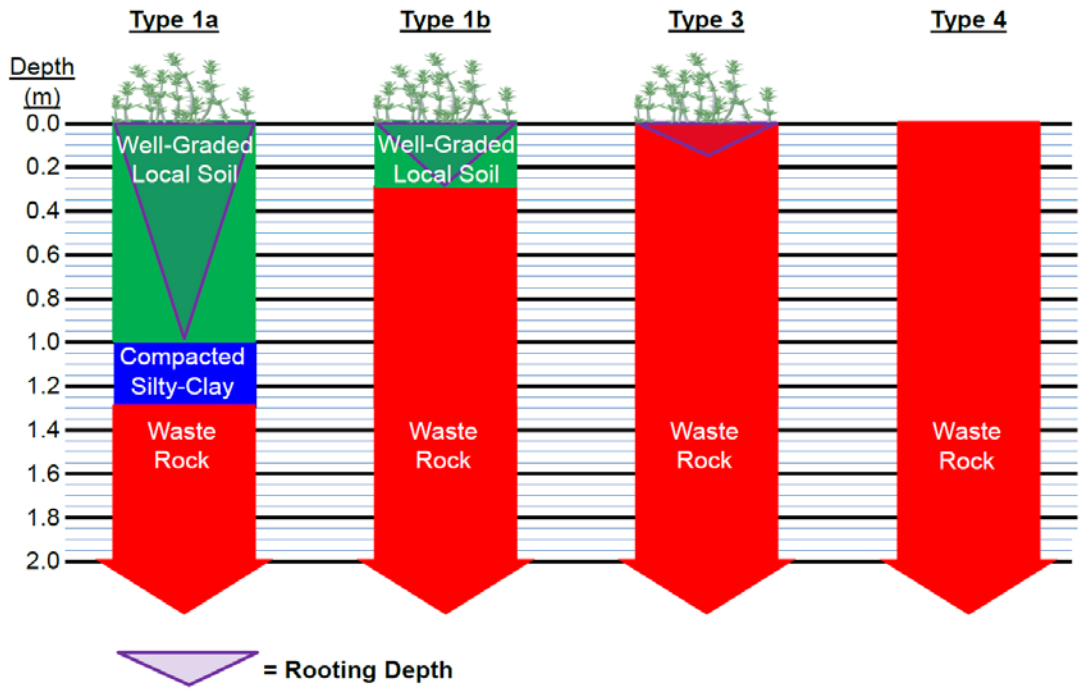


Figure 7-50 Cover Types Modelled

All modelling completed for this project used the computer modelling program VADOSE/W9. The estimated net percolation rates are summarized in Figure 7-51 for the scenarios modelled in the ESM Reclamation Plan. It must be emphasized that the values provided in Figure 7-51 are averages; the components of the water balance will vary greatly from year-to-year, and during any given year. For

example, run off (RO) averages 175 mm/yr for the Type 1a cover system at 1,000 masl, but ranges from 40 to 360 mm/yr with most of the RO occurring during spring-melt.

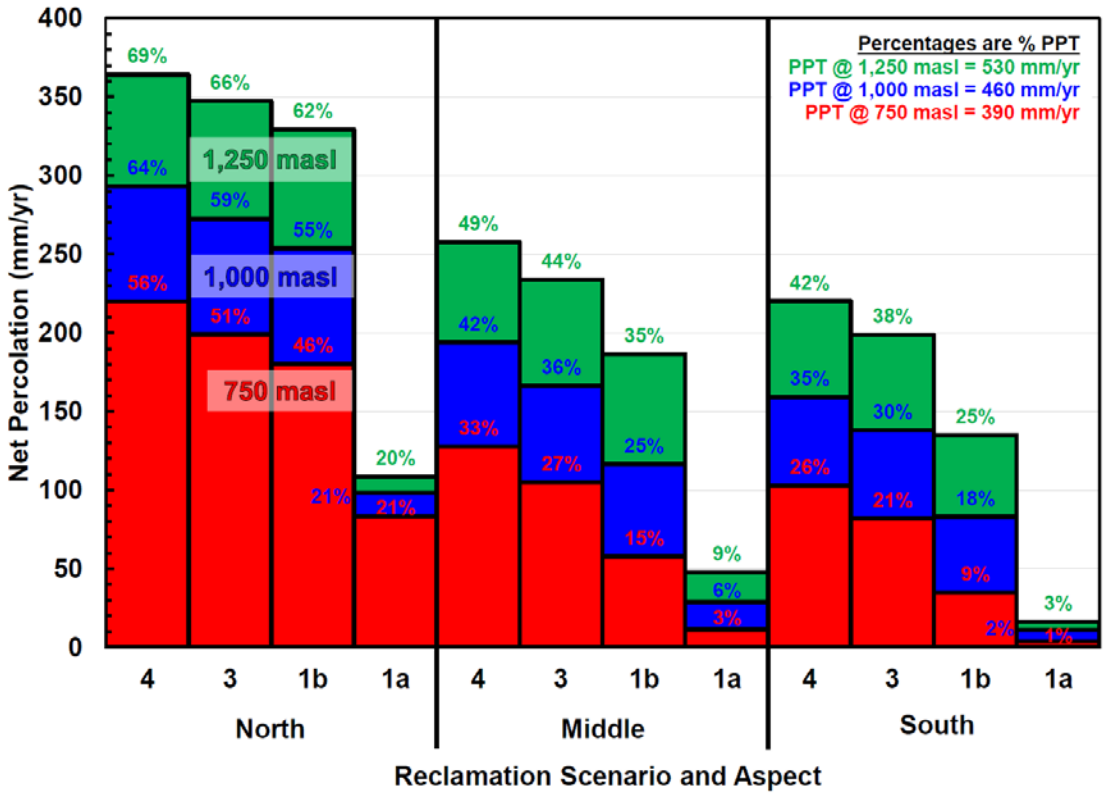


Figure 7-51 Annual Average net percolation rates estimated for range of reclamation scenarios, elevations and slope aspects

7.9.4 Site Revegetation Field Trials

Terrestrial reclamation of mine sites requires an understanding of environmental conditions to develop prescriptions that will have a better chance of success. To date, significant reclamation research has been completed on the ecosystem mapping program at the former UKHM site to understand successional, soil, and nutrient regimes, data collection on soil metals and metals uptake by vegetation, seed collection workshops, biochar amendment trials in the valley tailings and biomass sampling while continuing to develop a clear understanding of successional relationships with disturbed soils and metals uptake.

Additional research in revegetation will include the collection of native plant species seeds and establishing propagules to be used for terrestrial reclamation of sites requiring revegetation. Native plants species are desirable for reclamation efforts because they are adapted to local conditions and

suitable candidates for long-term restoration success. Given the complexity and varying degree of degradation of disturbed areas, reclamation designs will be based on site specific needs. Seeds from a total of seventeen different species were collected during the 2013/14 season and germination trials are currently being conducted for thirteen selected grasses and forbs. One hundred seeds per species are being used for the germination trials which will also determine the amount of pure live seed of each species. Depending on the species, seeds collected range from approximately one hundred to several thousand. Ongoing germination trials will give insight as to which species have the highest rates of germination and therefore desirable for future seed collection efforts. Working closely with the FNNND on plant identification and seed collection training ensures there will be sufficient propagules to cultivate in the field for future seed collection.



- Growth Media Stockpiles
- Mill Pond
- Current DSTF
- DSTF 322k Tonnes Design
- DSTF Future Expansion Phase III
- To Be Constructed Features
- Adit
- Road
- Watercourse

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on January 2018

Datum: NAD 83; Projection: UTM Zone 8N

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KENO DISTRICT MINE OPERATIONS RECLAMATION AND CLOSURE PLAN

FIGURE 7-52
GROWTH MEDIA SITES IN DISTRICT MILL AREA

FEBRUARY 2018

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7.10 MONITORING AND MAINTENANCE

Prior to commencement of mining operations in the Keno Hill Silver District by Alexco, a number of monitoring programs and a surveillance network were already in place for care and maintenance activities and for advanced exploration and preliminary development activities at the KHSD. These programs include physical inspections, effluent treatment systems and flow monitoring, a water quality surveillance network, old mine workings monitoring, aquatic effects monitoring for benthic invertebrate populations, sediment monitoring, waste rock and mine wall sampling and the Adaptive Management Plan.

When mining commenced at Bellekeno, several more monitoring programs came on line to assess the efficacy of the environmental measures implemented for mining and to determine environmental impacts of mining, if any. These programs will be tailored to assess closure measures and continue as necessary with cessation of mining. The scope of the required amendments to the existing monitoring programs would be determined at Closure. The following existing programs will continue in modified form after closure:

a) Surface water quality monitoring (as per Table 7-7);

b) Hydrological monitoring;

c) Groundwater monitoring;

d) Physical and engineered structures monitoring (geotechnical assessment);

e) Sediment, benthic and aquatic resources monitoring; and

f) Climate monitoring (as required for assessment of other resources).

Monitoring activity will be required to determine the on-going and continued success of closure measures in meeting the closure objectives for a period of 10 years. The adaptive management approach will be used to determine thresholds identifying when remedial actions have been triggered, and then the success of the remedial measures will need to be incorporated into the monitoring and surveillance regime.

During closure, an Environmental Monitor will continue water quality sampling at some of the monitoring stations identified in the Type A Water Licence.

Table 7-7 Keno Hill Mine Operations Reclamation and Closure Plan Surveillance Network Monitoring Schedule

Surface Water Monitoring Stations

Monitoring Stations QZ09-092	Additional Stations	Stations duplicated in QZ17-084	Proposed closure monitoring station	Easting	Northing	Description	Rationale	Total Metals	Dissolved Metals	Ammonia	Nitrite	Nitrate	Phosphorous	Sulphate	DOC	Hardness	Alkalinity	pH	Conductivity	TSS	Radium	LC50
KV-1		✔		4742790	7092790	South McQuesten River u/s Christal Creek	Not monitored as South McQuesten River will be stable in Closure if Christal Creek is stable and will be monitored	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-2		✔		472076	7090036	South McQuesten River @ Pumphouse		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-6		✔	✔	483909	7088242	Christal Creek at Keno Highway	Monitoring proposed	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-
KV-7		✔	✔	478657	7092413	Christal Creek at Hanson Road	Monitoring proposed	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-
KV-8		✔		465836	7088410	Christal Creek @ Mouth	Monitoring at KV-6 and KV-7 provides near and far field monitoring	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	KV-21	✔	✔	477500	7088750	No Cash Creek at Silver Trail Highway	Monitoring proposed	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-
KV-34		✔	✔	486562	7090614	Lucky Queen 500 Level Adit	Monitoring proposed	M	M	M	M	M	M	M	M	M	M	M	M	M	-	-
KV-37		✔		490315	7087776	Lightning Creek u/s Hope Gulch	Monitoring at KV-38 proposed which captures KV-37, which is upstream of Bellekeno	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-38		✔		488193	7087341	Lightning Creek u/s Thunder Gulch	Monitoring proposed	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-
KV-39		✔		490252	7087783	Hope Gulch u/s Lightning Creek	Station contributes to KV-38 which will be monitored, and no AKHM mine features in this catchment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-40		✔		488982	7087503	Charity Gulch u/s Lightning Creek	Station contributes to KV-38 which will be monitored, and no mine features in this catchment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-41		✔	✔	485429	7086764	Lightning Creek u/s bridge at Keno City	Monitoring proposed	M	M	M	M	M	M	M	M	M	M	M	M	M	-	-
KV-42			✔	487363	7087062	Bellekeno 625 Adit	Monitoring proposed	M	M	M	M	M	M	M	M	M	M	M	M	M		
KV-43			✔	487318	7087147	Bellekeno 625 Treatment Pond Decant	Monitoring proposed	M	M	M	M	M	M	M	M	M	M	M	M	M	Q	Q
KV-44			✔	487361	7087195	Bellekeno 625 Seep	Monitoring proposed	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-
KV-45		✔		485101	7087288	Onek 400 Adit	No connection between Onek 990 and Onek 400, therefore no monitoring proposed.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-49		✔		483582	7087009	Hinton Creek u/s Christal Creek	Monitoring upper Christal Creek will be at KV-50 and KV-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-50		✔	✔	483575	7086897	Christal Creek u/s Hinton Creek	Monitoring proposed	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-
KV-51		✔		483600	7087010	Christal Creek d/s Hinton Creek	Monitoring upper Christal Creek will be at KV-50 and KV-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-52		✔		483756	7087869	Natural Spring to Chrital Lake at Mackeno pump house	Monitoring upper Christal Creek will be at KV-50 and KV-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-65		✔		487464	7086873	Thunder Gulch Upstream of Bellekeno	KV-76 will be monitored on Thunder Gulch upstream of Bellekeno	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-72				482492	7104476	South McQuesten River at McQuesten Lake	Not monitored as South McQuesten River will be stable in Closure if Christal Creek is stable and will be monitored	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-76			✔	487414	7087118	Thunder Gulch d/s of Bellekeno 625 adit	Monitoring proposed	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-
KV-77			✔	487742	7086013	Thunder Gulch upstream of Bellekeno East	KV-76 will be monitored on Thunder Gulch upstream of Bellekeno	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-78a				485690	7087474	Onek Waste Rock Storage Facility	P-AML facility will be removed at closure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-78b				487126	7087052	Bellekeno Temporary Waste Rock Storage Facility	P-AML facility will be removed at closure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-79				483796	7087919	Christal Creek d/s MacKeno Tailings	Christal Creek to be monitored at KV-6 and KV-50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-80				483790	7087869	Christal Lake u/s Mackeno Tailings	Christal Creek to be monitored at KV-6 and KV-50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-81			✔	483548	7086423	Lightning Creek, South of Mill Site	Monitoring proposed	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-
KV-82				483839	7086769	District Mill Pond	Pond will be decommissioned at closure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-83			✔	483787	7086750	District Mill Pond Discharge	Monitoring proposed	M	M	M	M	M	M	M	M	M	M	M	M	M	Q	Q
KV-96				TBD	TBD	Onek Settling Pond Decant	No discharge from Onek anticipated at closure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-97				TBD	TBD	Lucky Queen Settling Pond Decant	Montoring will be at KV-34 for Lucky Queen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-98			✔	TBD	TBD	Lucky Queen N-AML WRDA Seep Survey	Monitoring proposed	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-
KV-99				TBD	TBD	Lucky Queen P-AML WRSF	P-AML facility will be removed at closure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-100				TBD	TBD	Onek Settling Pond	No water from Onek adit will be generated at closure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-101				TBD	TBD	Lucky Queen treatment plant discharge	Treatment plant will be decommissioned at closure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-102			✔	TBD	TBD	Lucky Queen settling pond	Monitoring proposed	M	M	M	M	M	M	M	M	M	M	M	M	M	Q	Q
KV-104				TBD	TBD	Flame and Month Water Treatment Pond Decant	Flame and Moth adit not predicted to produce water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-105			✔	TBD	TBD	Flame and Moth Adit Discharge	Monitoring proposed for the case adit does produce water	M	M	M	M	M	M	M	M	M	M	M	M	M	Q	Q
KV-106				TBD	TBD	Flame and Moth Temporary P-AML Waste Rock Storage Facility	Site is temporary and will be removed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	KV-110		✔	478612	7087231	Bermingham Adit Discharge	Monitoring proposed	M	M	M	M	M	M	M	M	M	M	M	M	M	Q	Q

Groundwater Monitoring Stations

Monitoring Stations QZ09-092	Additional Stations	Stations duplicated in QZ12-084	Proposed closure monitoring station	Easting	Northing	Description	Rationale	Total Metals	Dissolved Metals	Ammonia	Nitrite	Nitrate	Phosphorous	Sulphate	DOC	Hardness	Alkalinity	pH	Conductivity	TSS	Radium	LC50
KV-84Nd			✔	484925	7087117	Keno City Well #1	Monitoring proposed	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-
KV-85D			✔	483864	7086952	District Mill Site Groundwater Well #1 PH2	Monitoring proposed	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-
KV-85S				483858	7086952	District Mill Site Groundwater Well #2 shallow	KV-85d will be monitored	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-86			✔	483836	7086707	District Mill Site Groundwater Well #3 PH5	Monitoring proposed	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-
KV-87			✔	484104	7086854	District Mill Site Groundwater Well #4 PH6	Monitoring proposed	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-
KV-88d			✔	483946	7087016	District Mill Site Groundwater Well #4	Monitoring proposed	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-
KV-88s				483942	7087016	District Mill Site Groundwater Well #4	KV-88d will be monitored	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-89d			✔	483831	7086864	District Mill Site Groundwater Well #5	Monitoring proposed	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-
KV-89s				483825	7086864	District Mill Site Groundwater Well #5	KV-89d will be monitored	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-91				TBD	TBD	Bellekeno Waste Rock Disposal Area Well #1	No intention on constructing BK WRDA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-92				TBD	TBD	Bellekeno Waste Rock Disposal Area Well #2	No intention on constructing BK WRDA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-93				TBD	TBD	Bellekeno Waste Rock Disposal Area Well #3	No intention on constructing BK WRDA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-94				TBD	TBD	Bellekeno Waste Rock Disposal Area Well #4	No intention on constructing BK WRDA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ON-MW-02			✔	485244	7087083	Keno City Well #2	Monitoring proposed	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-
KC-MW-4			✔	485201	7086919	Keno City Well #3	Monitoring proposed	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-
LQ-MW-01			✔	486426	7090576	Lucky Queen Waste Rock Disposal Area Well	Monitoring proposed	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-
LQ-MW-02			✔	TBD	TBD	Lucky Queen d/g of P-AML Waste Rock Disposal Area	Monitoring proposed	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-
KV-107			✔	TBD	TBD	DSTF Phase 2 Expansion Area	Monitoring proposed	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-
BH-39			✔	486973	7086938	DSTF Phase 1 Area	Monitoring proposed	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-
FM-MW-01				483854	7086562	Flame and Moth Well #1 (KAR-01)	Only currently monitored for level	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FM-MW-02				484025	7086770	Flame and Moth Well #2 (KAR-02)	Only currently monitored for level	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FM-MW-03				483910	7086628	Flame and Moth Well #3 (KAR-16)	Only currently monitored for level	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KV-108			✔	TBD	TBD	Upgradient of DSTF Phase 2 Expansion Area	Monitoring proposed	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-
KV-109			✔	TBD	TBD	Lightning Creek near KV-81	Monitoring proposed	-	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-

Tables 5-4 shows the proposed closure monitoring schedule used as the basis for cost estimating. The schedule includes those sites that are relevant to post closure monitoring and monitored under other licences:

- Monitoring of road bank and drainage along access road;
- Physical inspection of dry stack tailings facility area;
- Physical inspection of the passive water treatment systems;
- Physical stability of all waste rock disposal areas;
- Success of revegetation measures (principally portal area and mill pad area, DSTF);
- Monitoring of cover system integrity (P-AML and DSTF); and
- Physical inspection of impacted earthen surfaces for evidence of erosion, gullying, or sediment transport to watercourses.

The condition of permafrost beneath the WRDAs and DSTF will be monitored throughout operation and during the 10-year post closure monitoring period. The requirement for ground temperature monitoring will be reviewed 10 years after closure, depending on the status of the construction of the Bellekeno, Onek and Lucky Queen WRDAs. An annual geotechnical inspection should be conducted on the WRDA, DSTF and sedimentation/treatment ponds for at least five years after closure. The requirement for an annual geotechnical inspection will be reviewed five years after closure.

7.11 PERFORMANCE UNCERTAINTY AND RISK MANAGEMENT

7.11.1 Risk Assessment

Management of risk is fundamental to Alexco's business model, operations approach and philosophy. Alexco's risk assessment system has been tailored from other well proven systems and models. It is the objective of Alexco that any major project, expansion or undertaking should undergo a risk assessment process. The benefits of a risk assessment process include:

- Develops a risk profile for the major risks of a project;
- Provides a recognition and documentation of project uncertainties prior to commencing the project;
- Provides common understanding, objectives and direction for projects;
- Provides the framework for an action plan to manage and reduce project risks;
- Enhances project economics; and
- Enhances employee and environmental safety.

The risk assessment process can be summarized in the following steps outlined in Figure 7-53:

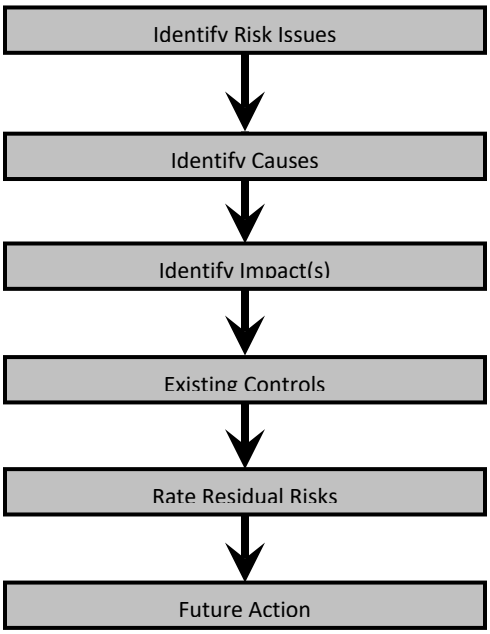


Figure 7-53 Risk Assessment Process Flow Chart

Identify Risk Issue

An area of concern is raised and the questions asked "what would happen if" or "is it possible that". This identifies a particular risk issue that forms the basis for assessment.

Identify Causes

The potential causes of the risk issue are identified and recorded.

Identify Impacts

The nature and extent of the impact of the risk issue if it were to occur are discussed and agreed to.

Identify Existing Controls

Any existing controls that are currently in place to counter or mitigate the risk issue and impacts are identified.

Rate Residual Risks

The residual risks are rated based on the assumption that the existing controls are in place. The risk rating tools and scoring matrix used for rating the risks are presented in the following tables.

Future Actions

If the current controls are not adequate to reduce the risk then future actions and controls are identified.

Risk Categories

For the purposes of the risk assessment process, risks are categorized into 5 broad categories. The risk categories used in the risk assessment process include:

- Project NPV Reduction (NPV);
- Health and Safety (HS);
- Natural Environment (NE);
- Reputation/Brand (RB); and
- Legal (L).

Guidelines for Assessing Likelihood

The likelihood of a risk occurring must be estimated in order to determine the potential severity of the risk. Table 7-8 summarizes a guideline for determining the potential likelihood of a risk.

Table 7-8 Risk Likelihood

Likelihood	Site is continuously exposed to the risk, and the outcome …	Outcome is almost certain to happen, but only …
Almost certain	Happens often	All the time
Likely	Could easily happen	Once a month or so
Possible	Could happen and has occurred here or elsewhere	Once or twice a year
Unlikely	Hasn't happened yet but could	Once or twice every 10 years
Very Unlikely	Is conceivable, but only in extreme circumstances	Once or twice every 100 years

Table 7-9 Risk Severity

Severity Level	Consequence Types				
	Reduction Project $ NPV	Health and Safety	Natural Environment	Reputation/Brand	Legal
Extreme	$3M +	Single fatality and/or severe irreversible disability (>30%) to one or more persons	Long-term impairment of ecosystem function	Serious public or media outcry (international coverage)	Major breach of regulation and litigation, prosecution and fines.
High	$1M - $3M	Irreversible disability or impairment (>30%) to one or more persons	Serious medium-term environmental effects	Significant adverse national media/public/NGO attention	Major breach of regulation and litigation
Moderate High	$200K – $1M	Disability or impairment (>30%) to one or more persons	Moderate short-term effects but not affecting ecosystem	Attention from media and/or heightened concern by local community. Criticism by NGO's.	Non-compliance and breaches of regulation
Moderate	$75K – $200K	Injury requiring medical attention and resulting in lost time accident	Minor effects on biological or physical environment	Minor adverse local public or media attention and complaints	Minor legal issue
Low	< $75K	No medical treatment required	Limited damage to minimal area of low significance	Public concern restricted to local complaints	Low-level legal issue

Guidelines for Assessing Severity

Once the likelihood of a risk has been determined, the severity if it were to occur is determined based on a description of the outcome of the risk shown in Table 7-9. The following severity levels were used for the Bellekeno assessment.

RISK SEVERITY AND CONSEQUENCE TYPES

Risk Matrix

The likelihood and severity are combined to determine a risk rating for each of the particular risks. The risk rating matrix is shown in the Figure 7-54.

Likelihood	Consequence Severity				
	Low	***Moderate***	***Moderate High***	***High***	***Extreme***
Almost Certain	High	High	Extreme	Extreme	Extreme
Likely	Moderate	Moderately High	High	Extreme	Extreme
Possible	Low	Moderate	High	High	Extreme
Unlikely	Low	Low	Moderate	Moderately High	High
Very Unlikely	Low	Low	Low	Moderate	High

Figure 7-54 Risk Matrix

7.11.2 DSTF Risk Assessment

With respect to the RCP and risks to reclamation and closure of mine area components, the long-term stability of the DSTF has been expressed by FNNND as one of the areas of consideration and concerns from a risk perspective. In response, Alexco and FNNND and respective technical consultants conducted a risk assessment specific to the DSTF and long-term performance and stability. The results of the DSTF risk assessment are included in Appendix 3.6. These risks and mitigations are incorporated into both the operations and maintenance phase of the facility as well as the final reclamation and closure of the DSTF.

7.11.3 Adaptive Management Plans

Adaptive management planning is a recognized and effective tool to ensure that changing site conditions are subject to appropriately responsive reclamation actions, and that closure measures can be adapted to changing conditions to achieve desired performance.

In accordance with Clause 115 of Water Licence QZ09-092, an Adaptive Management Plan (AMP) is required for the District Mining operations. An updated Adaptive Management Plan that includes the Bellekeno, Bermingham, Onek, Lucky Queen and Flame & Moth Production Unit Areas has been prepared and will be refined as necessary.

8. RECLAMATION AND CLOSURE SCHEDULE AND EXECUTION STRATEGY

The closure phase of the Bellekeno, Onek, Lucky Queen and Flame & Moth mines will commence with the cessation of economic mining at each respective operation. Closure management and monitoring of the site will be guided by licence requirements, the performance of physical structures remaining on site and the ability to achieve and demonstrate long-term compliance with effluent quality standards. Once overall closure performance has been demonstrated through the completion criteria for all aspects of decommissioning, the necessity of maintaining licences or permits would be examined. At this point, a Certificate of Closure, under the *Quartz Mining Act* would be requested. The following sections provide a general outline of the site management approach that will be taken at the Bellekeno, Onek, Lucky Queen and Flame & Moth mines during the closure phase.

Implementation of the RCP will be accomplished through Alexco site management and supervision, a combination of contractors and in-house employees and equipment and the integration of care & maintenance personnel on-site to implement decommissioning and reclamation tasks. Generally, these tasks entail closure of mine components, salvage and removal of infrastructure, equipment and reagents, maintaining contingency water treatment facilities, decommissioning of roads and reclamation and revegetation of disturbed lands. A Site Contamination Assessment Plan will be prepared leading up to closure which:

- Locates through a site investigation program all contaminated material, if any, on the mine sites arising from any operation, transportation, storage, handling or processing;
- Characterizes the type, concentration, and horizontal and vertical extent of the contamination; and
- Proposes methods for dealing with the contamination.

These activities would be undertaken on a seasonal basis and directed by an on-site manager responsible for implementation of the Keno District Mine Operations RCP.

During site decommissioning, camp accommodations would be available to support site personnel. As other activities are currently scheduled to be undertaken in the District, a project specific site caretaker or security personnel will not be required.

8.1 RECLAMATION AND CLOSURE SCHEDULE

Progressive reclamation will begin during operations to promote slope stabilization and reduce erosion during the life of the mine. Disturbed slopes will be stabilized and revegetated as required. Construction areas not able to be progressively reclaimed due to the onset of winter will be targeted for the following snow-free period.

Progressive reclamation of the DSTF cover will occur for the most part during operations; however, the installation of the final closure cover system will be conducted in the next snow-free period following the end of commercial milling unless there is additional milling of ore from other Production Units which may be permitted during the life of the currently active mine operations.

Mine decommissioning and reclamation including removal of equipment and infrastructure will mainly take place during the first year of mine closure. The Bellekeno 625 water treatment facilities

will be transitioned from active to passive treatment. The schedule for implementation of water management and treatment at Bellekeno, Bermingham, Flame and Moth and Lucky Queen is shown in Table 7-5 and 7-8 shows the project decommissioning and reclamation schedule.

8.2 SUPERVISION AND DOCUMENTATION OF WORK

All decommissioning and reclamation works will be supervised to ensure that works are constructed according to their design and that this work is properly carried out and documented. The project manager or construction supervisor would supervise all closure works. Regular inspection procedures would be completed to document work progress, deficiencies and completion.

Upon completion of the decommissioning and reclamation works, a final site plan report will be prepared that will outline the facilities or works remaining on the site following closure including the locations of subsurface features. It is expected that this plan would be used to support an Application for a Certificate of Closure under the *Quartz Mining Act.*

8.3 SITE PRESENCE AND DISTRICT-WIDE CLOSURE

Currently, the Keno Hill Silver District is undergoing planning for full-scale district-wide closure to address the historic environmental liabilities. ERDC and INAC are in partnership to reclaim the abandoned former United Keno Hill Mine (UKHM) mines. The tenure of this project is on the order of decades, and as such there will be a site presence for many years to come. Decommissioning and reclamation of the Bellekeno, Bermingham, Onek, Lucky Queen and Flame & Moth Production Unit Areas will occur in tandem with closure of the UKHM sites and therefore can be orchestrated together with district monitoring programs over the long term.

9. RECLAMATION AND CLOSURE LIABILITY

Costing of the proposed decommissioning and reclamation measures is the basis for the provision of security held by Yukon Government (YG). YG currently holds a security bond (100% cash Letter of Credit) to cover the potential liabilities arising from the operation of the Keno Hill Mine Operations. Revision 5 of the RCP includes the Bermingham advanced exploration program and the future Bermingham mine that is not yet permitted. Alexco has completed a cost estimate to implement this RCP for the Keno Hill Mine Operations and the estimated cost to implement the reclamation and closure plan at the End Of Mine Life (EOM) is **$6,566,730** (Table 9-1). Alexco also has estimated the reclamation and closure costs for the current operations at **$5,304,964** and after two years of operations for the current mine plan at **$5,678,488**. The amount of security currently held by YG for reclamation and closure of the Keno Hill Mine Operations is **$6,304,508** and **$194,192** for Bermingham advanced exploration for a total of **$6,498,700.** It is important to note that not all of the liabilities included in the cost estimate have yet been realized or created.

Closure liability cost estimate summary tables are provided below in Table 9-1 to 9-13. Where possible, cost estimates were made using unit cost per volume. Where the use of unit costs proved difficult, then an estimation of equipment and labour hours were used. The unit costs and job hours were derived from AEG's and Alexco's operational and professional experience with other closure program costing estimates prepared for Yukon Government. Table 9-1 summarizes closure liability cost estimates for the current conditions (Year 0), after Year 2 of operations and at the end of mine life (EOM). Cost estimates for the separate reclamation components including site management are provided in the remaining tables.

As the mine(s) continue to operate and development of the District advances, this Reclamation and Closure Plan will be reviewed every two years and closure costs updated based on more detailed engineering plans and relevant operating experience. Assumptions for the current closure liability cost estimates are based on current site conditions, as well as Alexco retaining the contract to perform site care and maintenance. Alexco maintains a constant presence on site fulfilling the care and maintenance contract and obligations, and this is reflected in closure costs for site management, the incremental costs of water treatment, as well as camp costs.

Table 9-1

Summary Table of Estimated Closure Costs - Keno Hill Mine Operations

Description of Cost	Proposed Cost Current - AKHM 2018	Proposed Cost Year 2 - AKHM 2018	Proposed Cost EOM - AKHM 2018
Closure Implementation			
General & Administration	$673,010	$673,010	$673,010
Waste Rock Dumps/Storage Facilities	$60,563	$73,366	$96,274
Underground Mines	$492,007	$543,927	$650,382
Water and Solutions Management	$436,762	$479,562	$479,562
DSTF	$6,875	$108,252	$337,756
Mill and Infrastructure/Facilities	$526,820	$526,820	$526,820
Haulage and Access Roads	$144,102	$153,254	$153,254
Supporting Studies	$57,000	$67,000	$90,000
Reclamation and Closure Research Program (during operations)	$50,000	$50,000	$150,000
Interim Care and Maintenance	$339,860	$339,860	$339,860
Sub-total	$2,786,999	$3,015,051	$3,496,918
Indirect Costs (%)	15%	15%	15%
Indirect Costs	$418,050	$452,258	$524,538
Cost Inflation [1]	$64,101	$140,079	$507,357
Total Closure Implementation Costs	**$3,269,150**	**$3,607,388**	**$4,528,812**
Post Closure Care, Maintenance, and Monitoring Costs			
Onsite Management	$224,000	$224,000	$224,000
Mobilization and Demobilization	$82,600	$82,600	$82,600
Transport Costs	$50,000	$50,000	$50,000
Water Treatment Costs			
Active Treatment			
Capital Costs	$0	$0	$0
Capital Replacement Costs	$0	$0	$0
Operating Costs	$0	$0	$0
Passive Treatment			
Capital Costs	$65,000	$65,000	$65,000
Operation and Maintenance Costs	$55,000	$55,000	$55,000
Reclamation & Closure Research Plan (Post Closure)	$0	$0	$0
Monitoring & Reporting	$807,240	$807,240	$807,240
Sub-Total	$1,283,840	$1,283,840	$1,283,840
Sub-Total NPV (2.0% DROR)	$1,120,200	$1,102,100	$962,055
Indirect Costs (%)	15%	15%	15%
Indirect Costs	$168,030	$165,315	$144,308
Total (NPV)	$1,288,230	$1,267,415	$1,106,364
Total Financial Security (incl. Indirect Costs)	**$4,557,380**	**$4,874,804**	**$5,635,176**
Contingency Allowance on "Monitoring and Reporting"	10%	10%	10%
Contingency Amount on "Monitoring and Reporting"	$72,559	$71,523	$62,526
Contingency Allowance on All Remaining Items	18.0%	18.0%	18.0%
Contingency Amount	$675,025	$732,161	$869,028
Total Financial Security (Plus Contingency)	**$5,304,964**	**$5,678,488**	**$6,566,730**

[1] Cost inflation is calculated at a rate 2% per year to the midpoint of active closure

Table 9-2

Keno Hill Mine Operations Unit Rates

Equipment Rates		
Equipment	**Unit Rates**	**Per Unit**
D9H Dozer	$350	per hr
D8K Dozer	$325	per hr
A30 Haul Truck	$300	per hr
Tandem Dump Truck	$150	per hr
Cat 235 Excavator	$225	per hr
Cat 235 Excavator w hammer	$275	per hr
Cat 14H grader	$250	per hr
988B Loader	$300	per hr
Tractor Trailer (lowbed)	$195	per hr
Vacuum Truck	$150	per hr
30 ton Crane	$190	per hr
Hiab Flatdeck truck	$180	per hr
3.5 yd LHD	$150	per hr
Cat 950 loader	$180	per hr
Vibratory Roller (84" packer)	$170	per hr
Pickup Truck	$2,500	per mo

Personnel Rates		
Personnel	**Unit Rates**	**Per Unit**
Blaster	$68	per hr
General Labourer	$52	per hr
Trades Labourer	$85	per hr
Site Supervisor	$110	per hr
Design Engineer	$150	per hr
Environmental Scientist	$110	per hr
Project Manager	$10,670	per mo
Camp Labourer	$4,400	per mo
Site Caretaker	$6,710	per mo
Environmental Monitor	$110	per hr
Environmental Monitor	$7,000	per mo

Revegetation Rates		**Per Unit**
Revegetation Seed Mix	$17.50	per kg
Revegetation Seed Mix - 50kg/ha	$875	per ha
Fertilizer	$1.10	per kg
Fertilizer - 250kg/ha	$275	per ha
Tree Seedlings (1,000 seedlings per ha)	$2,000	per ha
Seed/Fertilizer Application	$1,700	per ha
Erosion Barrier	$3	per sq.m
Revegetation cost per ha. Including application cost	**$2,850.00**	**per ha**

Contractor Unit Rates & Camp Costs	**Unit Rates**	**Per Unit**
Custom Rate A (Load, haul and place overburden cover on P-AML Waste Rock)	$4.64	per cu.m
Custom Rate B (Load, haul and dump mineralized rock stockpile in BK East Decline)	$4.77	per cu.m
Compact and Contour Cover	$2.00	per cu.m
Excavation of Soil	$5.00	per cu.m
Supply and place Geotextile	$7.00	per cu.m
Load, haul and place soil cover	$8.00	per cu.m
Haul & Place rock cover	$8.00	per cu.m
Drill, Blast and Screen Rip Rap	$22.00	per cu.m
Load and Haul and Place Rip Rap	$13.00	per cu.m
HDPE Liner Install	$12.00	per sq. m
Erosion barriers	$3.00	per sq. m
Freight run to Whitehorse	$1,000	per load
Camp Cost	$65	per day per person
Power and Heat	$5,500	per month
Employee Transport Costs	$2,250	per month
		per month

Table 9-3

General and Administration Costs

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
3.1	**Onsite Management**							
	Project Management and Engineering - Included in PME Costs in each Closure Component							
	Pre-closure planning and organization	Project Manager	monthly	3	$10,670	$32,010	$32,010	$32,010
	Pickup truck (2 trucks, 7 months per year, 2 years)	Pickup Truck	monthly	28	$2,500	$70,000	$70,000	$70,000
	Seasonal shutdown/startup costs Y1-Y2	Unit Cost Basis	annually	2	$7,500	$15,000	$15,000	$15,000
	Sundry equipment maintenance	Unit Cost Basis	annually	2	$5,000	$10,000	$10,000	$10,000
	Power and heat (7 months per year, 2 years)	Power and Heat	monthly	14	$5,500	$77,000	$77,000	$77,000
	General Administrative expenses (7 months per year, 2 years)	Unit Cost Basis	monthly	14	$2,000	$28,000	$28,000	$28,000
	Geotechnical Inspections (included in T16)		annually	-		$0	$0	$0
	Reclamation Inspections (Active Closure 1 time)		annually	-		$0	$0	$0
	Camp Costs (2 year period)	Camp Cost	man-day	6,300	$65	$409,500	$409,500	$409,500
					Sub-Total	**$641,510**	**$641,510**	**$641,510**
3.2	**Transport Costs**							
	Employee transport costs (7 months per year, 2 years)	Employee Transport Costs	monthly	14	$2,250	$31,500	$31,500	$31,500
					Sub-Total	**$31,500**	**$31,500**	**$31,500**
Total Estimated Cost for General & Administration During Closure						**$673,010**	**$673,010**	**$673,010**

Table 9-4

Waste Rock and Borrow Pits

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
4.1	**Bellekeno East Temporary P-AML WRSF**	**7.3.1.1**	**7-17**	**0.33**							
	Rehandle underground:										
	250 m3 from exploration program @ 24m3/hr cycle time				3.5 yd LHD	hrs.	10	$150	$1,563	$1,563	$1,563
	Remove liner and haul to solid waste facility				A30 Haul Truck	hrs	2	$300	$600	$600	$600
					Cat 235 Excavator	hrs	4	$225	$900	$900	$900
					General Labourer	hrs	8	$52	$416	$416	$416
	Site Recontouring		C-2401, B-2101		D8K Dozer	hrs	10	$325	$3,267	$3,267	$3,267
			C-2401, B-2101		Cat 235 Excavator	hrs	9	$225	$2,058	$2,058	$2,058
	Revegetation		C-2401		Revegetation cost per ha. Including application cost	ha	0.3	$2,850	$941	$941	$941
	Project Management & Engineering				7% of Total Cost	%		7.00%	$682	$682	$682
								Sub-Total	**$10,426**	**$10,426**	**$10,426**
4.2	**Bellekeno N-AML WRDA**	**7.3.1.2**									
	This has not been constructed and there is no plan or requirement for a Bellekeno WRDA in the LOM Plan										
								Sub-Total	**$0**	**$0**	**$0**
4.3	**Bellekeno Historic WRDAs**	**7.3.1.3**	**7-19**	**3.00**							
	Recontour crests		C-2401, C-2402, B-2101, B-2102		Cat 235 Excavator	hrs	25	$225	$5,662	$5,662	$5,662
	Toe Buttress				D8K Dozer	hrs	6	$325	$1,950	$1,950	$1,950
	Up-slope Diversion Ditch-no lining specified				Cat 235 Excavator	hrs	8	$225	$1,800	$1,800	$1,800
	Downslope Diversion Ditch-armoring Thunder Gulch w riprap (250mx8mx1m)				Cat 235 Excavator	hrs	-	$225	$0	$0	$0
					Drill, Blast and Screen Rip Rap	cu.m.	-	$22	$0	$0	$0
					Load and Haul and Place Rip Rap	cu.m.	-	$13	$0	$0	$0
	Place soil cover (0.5m thickness)				Load, haul and place soil cover	cu.m.	-	$8	$0	$0	$0
	Revegetation (Incl. in Portal reclamation [Table 5])		C-2401, C-2402		Revegetation cost per ha. Including application cost	ha	-	$2,850	$0	$0	$0
	Project Management & Engineering				7% of Total Cost	%		7.00%	$659	$659	$659
								Sub-Total	**$10,071**	**$10,071**	**$10,071**
4.4	**Onek P-AML WRSF**	**7.3.2**	**7-8**	**0.48**							
	Remove impounded water (no water liner not complete)				Vacuum Truck	hrs	2	$150	$0	$0	$300
					General Labourer	hrs	4	$52	$0	$0	$208
	Remove P-AML rock and place underground at Onek				D8K Dozer	hrs	6	$325	$0	$0	$1,950
	Remove liner and haul to solid waste facility				A30 Haul Truck	hrs	2	$300	$600	$600	$600
					Cat 235 Excavator	hrs	4	$225	$900	$900	$900
					General Labourer	hrs.	8	$52	$416	$416	$416
	Recontour for drainage		C-4401, B-4101		D8K Dozer	hrs	15	$325	$4,858	$4,858	$4,858
	Revegetation		C-4401		Revegetation cost per ha. Including application cost	ha	0.48	$2,850	$1,368	$1,368	$1,368
	Project Management & Engineering				7% of Total Cost	%		7.00%	$570	$570	$742
								Sub-Total	**$8,712**	**$8,712**	**$11,342**
4.5	**Onek N-AML WRDA**	**7.3.2**									
	This has not been constructed and Onek is not in the current LOM plan and therefore no plan to construct an Onek N-AML WRDA					hrs			$0	$0	$0
						hrs			$0	$0	$0
						%			$0	$0	$0
								Sub-Total		**$0**	**$0**
4.6	**Lucky Queen P-AML WRSF**	**7.3.3**		**0.43**							
	Remove impounded water				Vacuum Truck	hrs	2	$150			$300
					General Labourer	hrs	4	$52			$208
	Recontour P-AML rock inside lined WRSF (no rock placed)		C-3401, B-3101		D8K Dozer	hrs	11	$325			$3,639
	Place soil cover				Custom Rate A (Load, haul and place overburden cover on P-AML Waste Rock)	cu.m.	-	$4.64			$0
	Revegetation		C-3401		Revegetation cost per ha. Including application cost	ha	0.43	$2,850			$1,226
	Project Management & Engineering				7% of Total Cost	%		7.00%			$376
								Sub-Total	**$0**	**$0**	**$5,749**
4.7	**Lucky Queen N-AML WRDA**	**7.3.3**		**0.40**							
	Recontour crests		C-3401, B-3101		Cat 235 Excavator	hrs	2	$225			$419
	Scarify surface		C-3401		D8K Dozer	hrs	6	$325			$2,016
	Revegetation		C-3401		Revegetation cost per ha. Including application cost	ha	0.40	$2,850			$1,140
	Project Management & Engineering				7% of Total Cost	%		7.00%			$250
								Sub-Total	**$0**	**$0**	**$3,825**
4.8	**Flame and Moth Temporary P-AML WRSF**	**7.3.4**		**0.23**							
	Rehandle underground										
	1500 m3 @ 24m3/hr cycle time to underground (vol estimate based on Alexco LOM Plan)					hrs.	63	$150		$3,125	$9,375
	Remove liner and haul to solid waste facility				A30 Haul Truck	hrs	2	$300		$600	$600
					Cat 235 Excavator	hrs	12	$225		$2,700	$2,700
					General Labourer	hrs	8	$52		$416	$416
	Site Recontouring		C-1401, B6101		D8K Dozer	hrs	7	$325		$757	$2,272
	Revegetation		C-1401		Revegetation cost per ha. Including application cost	ha	0.23	$2,850		$219	$656
	Project Management & Engineering				7% of Total Cost	%		7.00%		$547	$1,121
								Sub-Total		**$8,364**	**$17,139**
4.9	**Flame and Moth N-AML WRDA**	**7.3.4**									
	All of the Flame and Moth N-AML waste is scheduled to be used for construction purposes or backfill therefore there is no N-AML WRDA					hrs					
						hrs					
						cu.m.					
						cu.m.					
					7% of Total Cost	%		7.00%	$0	$0	$0
4.10	**Bermingham N-AML WRDA**	**7.3.5**		**0.68**							
	Recontour crests		C-5401, B-5101		Cat 235 Excavator	hrs.	3	$225	$752	$752	$752
	Scarify surface		C-5401		D8K Dozer	hrs.	11	$325	$1,714	$3,428	$3,428
	Revegetation		C-5401		Revegetation cost per ha. Including application cost	ha	1	$2,850.00	$969	$1,938	$1,938
	Project Management & Engineering				7% of Total Cost	%		$0	$240	$428	$428
								Sub-Total		**$6,546**	**$6,546**
4.11	**Bermingham P-AML WRSF**	**7.3.5**		**0.13**							
	Recontour crests		C-5401, B-5101		Cat 235 Excavator	hrs	4	$225	$0	$879	$879
	Place soil cover			0.13	Custom Rate A (Load, haul and place overburden cover on P-AML Waste Rock)	cu.m.	628	$5	$0	$2,912	$2,912
	Revegetation		C-5401		Revegetation cost per ha. Including application cost	ha	0.13	$2,850	$0	$358	$358
	Project Management & Engineering				7% of Total Cost	%		7.00%	$0	$290	$290
								Sub-Total	**$0**	**$4,438**	**$4,438**
4.12	**Borrow Areas (2ha currently, 3ha by EOM)**	**7.8.1**		**2.00**							
	Stabilize slopes				Cat 235 Excavator	hrs	12	$225	$1,782	$1,782	$2,700
					D8K Dozer	hrs	8	$325	$1,716	$1,716	$2,600
	Revegetation				Revegetation cost per ha. Including application cost	ha	2.0	$2,850	$5,700	$5,700	$5,700
	Project Management & Engineering				7% of Total Cost	%		7.00%	$644	$644	$770
								Sub-Total	**$9,842**	**$9,842**	**$11,770**
4.13	**Coarse Ore Pad**	**7.5.6**		**0.30**							
	Concrete Demolition and Burial				Cat 235 Excavator w hammer	hrs	16	$275	$4,400	$4,400	$4,400
					D8K Dozer	hrs	16	$325	$5,200	$5,200	$5,200
	Dismantle Sprung Structure over fine ore stockpile				Misc.	l.s.	1	$6,500	$6,500	$6,500	$6,500
	Haul contaminated soils/materials to DSTF or underground				Cat 235 Excavator	hrs	6	$225	$1,350	$1,350	$1,350
					A30 Haul Truck	hrs	6	$300	$1,800	$1,800	$1,800
	Revegetation				Revegetation cost per ha. Including application cost	ha	0.3	$2,850	$855	$855	$855
	Project Management & Engineering				7% of Total Cost	%		7.00%	$1,407	$1,407	$1,407
								Sub-Total	**$21,512**	**$21,512**	**$21,512**
Total Estimated Cost in Reclaiming Overburden and Waste Rock Dumps									**$60,563**	**$73,366**	**$96,274**

Note:

Table 9-5

Mine Workings - Underground

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
5.1	**Bellekeno East Portal and Underground**	**7.1.2**	**7-1, 7-2**	**1.71**							
	Remove underground equipment				3.5 yd LHD	hrs	60	$150	$9,000	$9,000	$9,000
					A30 Haul Truck	hrs	60	$300	$18,000	$18,000	$18,000
					Trades Labourer	hrs	120	$85	$10,200	$10,200	$10,200
					General Labourer	hrs	120	$52	$6,240	$6,240	$6,240
	Remove shop and other buildings (trailers, explosives and cap magazine, etc					lump sum	1	$15,000	$15,000	$15,000	$15,000
	Load/Haul and place rip rap for portal cover					cu.m.	700	$13	$9,100	$9,100	$9,100
	Screen rip rap					cu.m.	700	$5	$3,500	$3,500	$3,500
	Labour for portal barrier				General Labourer	hrs	40	$52	$2,080	$2,080	$2,080
	Characterize settling ponds sediments analytical costs					unit cost	2	$300	$600	$600	$600
	Remove pond water/sediments				Vacuum Truck	hrs	4	$150	$600	$600	$600
					General Labourer	hrs	6	$52	$312	$312	$312
	Remove settling ponds liners to landfill				A30 Haul Truck	hrs	2	$300	$600	$600	$600
					Cat 235 Excavator	hrs	4	$225	$900	$900	$900
					General Labourer	hrs	8	$52	$416	$416	$416
	Clean out fuel tank residue					lump sum	1	$1,000	$1,000	$1,000	$1,000
	Haul fuel tank and liner for reuse or landfil				Cat 235 Excavator	hrs	6	$225	$1,350	$1,350	$1,350
					A30 Haul Truck	hrs	6	$300	$1,800	$1,800	$1,800
					General Labourer	hrs	16	$52	$832	$832	$832
	Area cleanup and haul debris to landfil				Cat 235 Excavator	hrs	20	$225	$4,500	$4,500	$4,500
					A30 Haul Truck	hrs	20	$300	$6,000	$6,000	$6,000
					General Labourer	hrs	40	$52	$2,080	$2,080	$2,080
	Test area soils for contamination				Environmental Monitor	hrs	8	$110	$880	$880	$880
	Laboratory Analysis for soils testing					unit cost	2	$300	$600	$600	$600
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$225	$3,600	$3,600	$3,600
					A30 Haul Truck	hrs	16	$300	$4,800	$4,800	$4,800
	Recontour and scarify area and slopes to establish drainage		C-2401, B-2101	1.71	D8K Dozer	hrs	27	$325	$8,684	$8,684	$8,684
			C-2401, B-2101		Cat 14H grader	hrs	2	$250	$500	$500	$500
	Revegetation		C-2401		Revegetation cost per ha. Including ap	ha	1.71	$2,850	$4,874	$4,874	$4,874
	Install Signage				Misc.	lump sum	1	$500	$500	$500	$500
	Project Management & Engineering				7% of Total Cost	%		7.00%	$8,298	$8,298	$8,298
									Sub-Total	**$126,845**	**$126,845**	**$126,845**
5.2	**Bellekeno 625 Adit Area**	**7.5.1.2**	**7-1**	**1.29**							
	Remove electrical substation				Misc.	lump sum	1	$15,000	$15,000	$15,000	$15,000
	Remove electrical transmission line (Keno City to BK 625)				Misc.	lump sum	1	$25,000	$25,000	$25,000	$25,000
	Remove shop/loadout facility, compressor station				Misc.	lump sum	1	$20,000	$20,000	$20,000	$20,000
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	20	$225	$4,500	$4,500	$4,500
					A30 Haul Truck	hrs	20	$300	$6,000	$6,000	$6,000
					General Labourer	hrs	40	$52	$2,080	$2,080	$2,080
	Test area soils for contamination				Environmental Monitor	hrs	8	$110	$880	$880	$880
	Laboratory Analysis for soils testing					unit cost	2	$300	$600	$600	$600
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$225	$3,600	$3,600	$3,600
					A30 Haul Truck	hrs	16	$300	$4,800	$4,800	$4,800
	Recontour and scarify area and slopes to establish drainage		C-2402, B-2102	1.29 ha	D8K Dozer	hrs	20	$325	$6,551	$6,551	$6,551
			C-2402, B-2102		Cat 14H grader	hrs	2	$250	$500	$500	$500
	Revegetation		C-2402		Revegetation cost per ha. Including ap	ha	1.29	$2,850	$3,677	$3,677	$3,677
	Install Signage				Misc.	lump sum	1	$500	$500	$500	$500
									$0		
	Project Management & Engineering				7% of Total Cost	%		7.00%	$6,558	$6,558	$6,558
									Sub-Total	**$100,245**	**$100,245**	**$100,245**
5.3	**Bellekeno 200 Level Vent Raise**	**7.1.2**	**S-0303**								
	Engineering for Concrete Cap				Misc.	l.s.	1	$10,000	$10,000	$10,000	$10,000
	Concrete Batch				Misc.	l.s.	1	$10,000	$10,000	$10,000	$10,000
					Cat 950 loader	hrs	12	$180	$2,160	$2,160	$2,160
					Tractor Trailer (lowbed)	hrs	48	$195	$9,360	$9,360	$9,360
	Labour for cap				General Labourer	hrs	40	$52	$2,080	$2,080	$2,080
	Project Management & Engineering				7% of Total Cost	%		7.00%	$2,352	$2,352	$2,352
									Sub-Total	**$35,952**	**$35,952**	**$35,952**
5.4	**Onek 990 Portal and Underground**	**7.1.5**	**S-0301**								
	Remove underground equipment (no material underground after suspension)				3.5 yd LHD	hrs	10	$150			
					A30 Haul Truck	hrs	10	$300			
					Trades Labourer	hrs	20	$85			
					General Labourer	hrs	20	$52			
	Project Management & Engineering				7% of Total Cost	%		7.00%	$0	$0	$0
									Sub-Total	**$0**	**$0**	**$0**

Table 9-5

Mine Workings - Underground

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
5.5	**Onek 990 Portal Site and Infrastructure**	**7.5.2**	**7-9**	**0.35**							
	Remove shop and other buildings (explosives and cap magazine)				Misc.	l.s.	1		$0	$0	$0
	Supply rockfill for portal barrier				Load and Haul and Place Rip Rap	m3	700	$13	$9,100	$9,100	$9,100
	Labour for portal barrier				General Labourer	hrs	40	$52	$2,080	$2,080	$2,080
	Clean out fuel tank residue (no tank at site)				Misc.	l.s.					
	Haul fuel tank and liner for reuse or landfill (no tank at site)				Cat 235 Excavator	hrs					
					A30 Haul Truck	hrs					
					General Labourer	hrs					
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	20	$225	$4,500	$4,500	$4,500
					A30 Haul Truck	hrs	20	$300	$6,000	$6,000	$6,000
					General Labourer	hrs	40	$52	$2,080	$2,080	$2,080
	Sample and test area soils for contamination				Environmental Monitor	hrs	8	$110	$880	$880	$880
	Laboratory Analysis for soils testing				Analytical Costs	Unit Cost	4	$300	$1,200	$1,200	$1,200
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$225	$1,800	$3,600	$3,600
					A30 Haul Truck	hrs	16	$300	$2,400	$4,800	$4,800
	Recontour and scarify area and slopes to establish drainage		C-4401, B-4101	0.35 ha	D8K Dozer	hrs	5	$325	$1,777	$1,777	$1,777
			C-4401, B-4101		Cat 14H grader	hrs	1	$250	$250	$250	$250
	Recontour crests of pad		C-4401, B-4101		Cat 235 Excavator	hrs	1	$225	$251	$251	$251
	Install Signage				Misc.	l.s.	1	$500	$500	$500	$500
	Remove electrical substation (not yet constructed, not part of LOM Plan)				Misc.	l.s.	1				
	Remove electrical transmission line (not yet constructed, not part of LOM Plan)				Misc.	l.s.	1				
	Characterize settling pond sediments/sludge (not yet constructed)				Analytical Costs	Unit Cost					
	Remove sludge from settling pond (not yet constructed)				Vacuum Truck	hrs					
					General Labourer	hrs					
	Remove settling ponds liners to landfill (not yet constructed)				A30 Haul Truck	hrs					
					General Labourer	hrs					
	Scrap hauled to solid waste facility				Cat 235 Excavator	hrs	8	$225	$1,800	$1,800	$1,800
					A30 Haul Truck	hrs	12	$300	$3,600	$3,600	$3,600
	Revegetation		C-4401		Revegetation cost per ha. Including ap	ha	0.35	$2,850	$998	$998	$998
	Project Management & Engineering				7% of Total Cost	%		7.00%	$2,745	$3,039	$3,039
								Sub-Total	**$41,961**	**$46,455**	**$46,455**
5.6	**Onek 990 Vent Raise**	**7.5.2**	**S-0303**								
					Misc.	l.s.					
	Not constructed and not in the LOM Plan				Misc.	l.s.					
					Cat 950 loader	hrs					
					Tractor Trailer (lowbed)	hrs					
					General Labourer	hrs					
	Project Management & Engineering				7% of Total Cost	%		7.00%			
								Sub-Total	**$0**	**$0**	**$0**
5.7	**Lucky Queen Underground/Laydown Areas**	**7.1.6**	**7-11**	**0.63**							
	Remove shop and other buildings (explosives and cap magazine)				Misc.	hrs	1	$5,000			$5,000
	Supply rockfill for portal barrier				Load and Haul and Place Rip Rap	m3	700	$13	$9,100	$9,100	$9,100
	Labour for portal barrier				General Labourer	hrs	40	$52	$2,080	$2,080	$2,080
	Clean out fuel tank residue				Misc.	l.s.	1	$1,000	$0	$1,000	$1,000
	Haul fuel tank and liner for reuse or landfill				Cat 235 Excavator	hrs	6	$225	$0	$1,350	$1,350
					A30 Haul Truck	hrs	6	$300	$0	$1,800	$1,800
					General Labourer	hrs	16	$52	$0	$832	$832
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	20	$225	$2,250	$2,250	$4,500
					A30 Haul Truck	hrs	20	$300	$3,000	$3,000	$6,000
					General Labourer	hrs	40	$52	$1,040	$1,040	$2,080
	Sample and test area soils for contamination				Environmental Monitor	hrs	8	$110	$880	$880	$880
	Laboratory Analysis for soils testing				Analytical Costs	Unit Cost	3	$300	$900	$900	$900
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$225	$1,800	$1,800	$3,600
					A30 Haul Truck	hrs	16	$300	$2,400	$4,800	$4,800
	Recontour and scarify area and slopes to establish drainage		C-3401, B-3101	0.63	D8K Dozer	hrs	10	$325	$3,225	$3,225	$3,225
			C-3401, B-3101		Cat 14H grader	hrs	1	$250	$250	$250	$250
	Recontour crests		C-3401, B-3101		Cat 235 Excavator	hrs	4	$225	$971	$971	$971
	Remove electrical substation (not yet upgraded)				Misc.	l.s.	1	$15,000	$0	$0	$15,000
	Remove electrical transmission cable (not yet constructed)				Misc.	l.s.	1	$15,000	$0	$0	$15,000
	Remove loadout facility				Misc.	l.s.	1	$5,000	$5,000	$5,000	$5,000
	Install Signage				Misc.	l.s.	1	$500	$500	$500	$500
	Characterize settling pond sediments/sludge				Analytical Costs	Unit Cost	2	$300	$600	$600	$600
					Environmental Monitor	hrs	8	$110	$880	$880	$880
	Remove sludge from settling pond				Vacuum Truck	hrs	40	$150	$1,500	$3,000	$6,000
					General Labourer	hrs	40	$52	$2,080	$2,080	$2,080
	Remove settling ponds liners to landfill (not yet constructed)				A30 Haul Truck	hrs	4	$300	$0	$0	$1,200
	Scrap hauled to solid waste facility				Cat 235 Excavator	hrs	8	$225	$1,800	$1,800	$1,800
					A30 Haul Truck	hrs	12	$300	$3,600	$3,600	$3,600
	Revegetation		C-3401	0.63	Revegetation cost per ha. Including ap	ha	0.63	$2,850	$1,796	$1,796	$1,796
	Install Signage				Misc.	l.s.	1	$500	$500	$500	$500
	Misc. Supplies & Tools				Misc.	l.s.	1	$5,000	$5,000	$5,000	$5,000
	Project Management & Engineering				7% of Total Cost	%		7.00%	$3,581	$4,202	$7,513
								Sub-Total	**$54,732**	**$64,236**	**$114,836**

Table 9-5

Mine Workings - Underground

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
5.8	**Lucky Queen Vent Raise**	**7.5.3**	**S-0303**								
	Engineering for Concrete Cap				Misc.	l.s.	1	$10,000			$10,000
	Concrete Batch				Misc.	l.s.	1	$10,000			$10,000
					Cat 950 loader	hrs	12	$180			$2,160
					Tractor Trailer (lowbed)	hrs	48	$195			$9,360
	Labour for cap				General Labourer	hrs	40	$52			$2,080
	Project Management & Engineering				7% of Total Cost	%		7.00%			$2,352
								Sub-Total	**$0**	**$0**	**$35,952**
5.9	**Flame and Moth Underground**	**7.1.8**									
	Remove shop and other buildings (explosives and cap magazine)				Misc.	hrs	1	$5,000	$5,000	$5,000	$5,000
	Supply rockfill for portal barrier				Load and Haul and Place Rip Rap	m3	700	$13	$9,100	$9,100	$9,100
	Labour for portal barrier				General Labourer	hrs	40	$52	$2,080	$2,080	$2,080
	Clean out fuel tank residue				Misc.	l.s.	1	$1,000	$1,000	$1,000	$1,000
	Haul fuel tank and liner for reuse or landfill				Cat 235 Excavator	hrs	6	$225	$1,350	$1,350	$1,350
					A30 Haul Truck	hrs	6	$300	$1,800	$1,800	$1,800
					General Labourer	hrs	16	$52	$832	$832	$832
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	10	$225	$2,250	$2,250	$2,250
					A30 Haul Truck	hrs	10	$300	$3,000	$3,000	$3,000
					General Labourer	hrs	40	$52	$2,080	$2,080	$2,080
	Sample and test area soils for contamination				Environmental Monitor	hrs	8	$110	$880	$880	$880
	Laboratory Analysis for soils testing				Analytical Costs	Unit Cost	4	$300	$1,200	$1,200	$1,200
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$225	$1,800	$3,600	$3,600
					A30 Haul Truck	hrs	16	$300	$2,400	$4,800	$4,800
	Recontour and scarify area and slopes to establish drainage (Incl. with Mill)		C-1401		D8K Dozer	hrs		$325	$0	$0	$0
			C-1401		Cat 14H grader	hrs		$250	$0	$0	$0
	Remove electrical substation (included in mill facilities)				Misc.	l.s.	1				
	Install Signage				Misc.	l.s.	1	$500	$500	$500	$500
	Characterize settling pond sediments/sludge				Analytical Costs	Unit Cost	2	$300		$600	$600
	Remove sludge from settling pond				Vacuum Truck	hrs	30	$150		$4,500	$4,500
					General Labourer	hrs	30	$52		$1,560	$1,560
	Remove settling ponds liners to landfill				A30 Haul Truck	hrs	4	$300		$1,200	$1,200
	Scrap hauled to solid waste facility				Cat 235 Excavator	hrs	8	$225	$900	$1,800	$1,800
					A30 Haul Truck	hrs	12	$300		$3,600	$3,600
	Misc. Supplies & Tools				Misc.	l.s.	1	$7,500	$3,750	$7,500	$7,500
	Project Management & Engineering				7% of Total Cost	%		7.00%	$2,795	$4,216	$4,216
								Sub-Total	**$42,717**	**$64,448**	**$64,448**
5.10	**Flame and Moth Vent Raise**	**7.5.4**	**S-0303**								
	Engineering for Concrete Cap				Misc.	l.s.	1	$10,000		$10,000	$10,000
	Concrete Batch				Misc.	l.s.	1	$10,000		$10,000	$10,000
					Cat 950 loader	hrs	12	$180		$2,160	$2,160
					Tractor Trailer (lowbed)	hrs	48	$195		$9,360	$9,360
	Labour for cap				General Labourer	hrs	40	$52		$2,080	$2,080
	Project Management & Engineering				7% of Total Cost	%		7%		$2,352	$2,352
5.11	**Bermingham Underground Portal and Surface Site**	**7.1.10 & 7.5.5**	**19-Jul**	**0.92**							
	Remove underground equipment				3.5 yd LHD	hrs	60	$150	$2,250	$4,500	$9,000
					A30 Haul Truck	hrs	60	$300	$4,500	$9,000	$18,000
					Trades Labourer	hrs	120	$85	$2,550	$5,100	$10,200
					General Labourer	hrs	120	$52	$6,240	$6,240	$6,240
	Load/Haul and place rip rap for portal cover				Load and Haul and Place Rip Rap	cu.m.	700	$13	$9,100	$9,100	$9,100
	Screen rip rap					cu.m.	700	$5	$3,500	$3,500	$3,500
	Labour for portal barrier				General Labourer	hrs	40	$52	$2,080	$2,080	$2,080
	Remove shop and other surface facilities				Misc.	ls	1	$5,000	$5,000	$10,000	$10,000
	Scrap hauled to solid waste facility				Cat 235 Excavator	hrs	8	$225	$1,800	$1,800	$1,800
					A30 Haul Truck	hrs	12	$300	$3,600	$3,600	$3,600
	Clean out fuel tank residue				Misc.	l.s.	1	$1,000	$1,000	$1,000	$1,000
	Haul fuel tank for reuse				988B Loader	hrs	6	$300	$1,800	$1,800	$1,800
					Tractor Trailer (lowbed)	hrs	6	$195	$1,170	$1,170	$1,170
					General Labourer	hrs	16	$52	$832	$1,664	$1,664
	Area cleanup and haul debris to landfill				Cat 235 Excavator	hrs	20	$225	$4,500	$4,500	$4,500
					A30 Haul Truck	Unit Cost	40	$300	$12,000	$12,000	$12,000
					Cat 235 Excavator	hrs	16	$225	$3,600	$3,600	$3,600
	Test area for soils for contamination				Environmental Monitor	hrs	8	$110	$880	$880	$880
	Laboratory analysis for soils testing					unit cost	2	$300	$600	$600	$600
	Haul contaminated soils to LTF				Cat 235 Excavator	hrs	16	$225	$3,600	$3,600	$3,600
					A30 Haul Truck	hrs	16	$300	$4,800	$4,800	$4,800
	Recontour and scarify area and slopes to establish drainage		C-5401, B-5101		D8K Dozer	hrs	14	$325	$4,672	$4,672	$4,672
			C-5401, B-5101		Cat 14H grader	hrs	2	$250	$500	$500	$500
	Revegetation		C-5401	0.92	Revegetation cost per ha. Including ap	ha	0.92	$2,850	$2,622	$2,622	$2,622
	Install signage				Misc.	lump sum	1	$500	$500	$500	$500
	Project Management & Engineering				7% of Total Cost	%		7.00%	$5,859	$6,918	$8,220
								Sub-Total	**$89,555**	**$105,746**	**$125,648**
Total Estimated Cost in Reclaiming Underground Mines									**$492,007**	**$543,927**	**$650,382**

Table 9-6

Water and Solutions Management

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
6.1	**Mill Runoff Collection & Process Pond**	**7.5.6**									
	Pump down collected water				General Labourer	hrs	36	$52	$1,872	$1,872	$1,872
					Pump	daily	3	$100	$300	$300	$300
	Misc. Supplies and Tools				Misc.	l.s.	1	$750	$750	$750	$750
	Characterize pond sediments/sludge				Analytical Costs	Unit Cost	2	$300	$600	$600	$600
					General Labourer	hrs	2	$52	$104	$104	$104
	Remove pond sediments/sludge				Vacuum Truck	hrs	16	$150	$2,400	$2,400	$2,400
					General Labourer	hrs	16	$52	$832	$832	$832
	Breach dyke				D8K Dozer	hrs	4	$325	$1,300	$1,300	$1,300
	Remove & bury HDPE liner				General Labourer	hrs	40	$52	$2,080	$2,080	$2,080
					Cat 235 Excavator	hrs	12	$225	$2,700	$2,700	$2,700
					A30 Haul Truck	hrs	4	$300	$1,200	$1,200	$1,200
	Recontour area				D8K Dozer	hrs	30	$325	$9,750	$9,750	$9,750
	Stabilize slopes with erosion barriers				Cat 235 Excavator	hrs	30	$225	$6,750	$6,750	$6,750
	Remove discharge pipeline				General Labourer	hrs	30	$52	$1,560	$1,560	$1,560
	Project Management & Engineering				7% of Total Cost	%		7.00%	$2,254	$2,254	$2,254
								Sub-Total	**$34,452**	**$34,452**	**$34,452**
6.2	**Diversion Ditches**										
	Recontour Diversion Ditch to Mill Pond			525	D8K Dozer	hrs	20	$325	$6,500	$6,500	$6,500
					Cat 235 Excavator	hrs	10	$225	$2,250	$2,250	$2,250
	Recontour Diversion Ditch above Mill Area			285	D8K Dozer	hrs	10	$325	$3,250	$3,250	$3,250
					Cat 235 Excavator	cu.m.	5	$225	$1,125	$1,125	$1,125
	Enhance Diversion Ditch above DSTF, to closure criteria			300	D8K Dozer	hrs	10	$325	$3,250	$3,250	$3,250
					Cat 235 Excavator	cu.m.	5	$225	$1,125	$1,125	$1,125
	Revegetate			1	Erosion barriers	m	500	$3	$1,500	$1,500	$1,500
	Project Management & Engineering				7% of Total Cost	%		7.00%	$1,330	$1,330	$1,330
								Sub-Total	**$20,330**	**$20,330**	**$20,330**
6.3	**Bellekeno 625 WTP - Mine Pool Treatment Transition**	**7.4.2**									
	625 Adit Bulkhead (S.7.1.3)		S-0302								
	Hydrogeologic study & engineering for concrete bulkhead				Misc.	lump sum	1	$35,000	$35,000	$35,000	$35,000
	Underground Rehab for bulkhead				Misc.	lump sum	1	$30,000	$30,000	$30,000	$30,000
	Construct concrete plug				General Labourer	hrs	120	$52	$6,240	$6,240	$6,240
					Trades Labourer	hrs	120	$85	$10,200	$10,200	$10,200
	Concrete Batch				Misc.	cu.m	31	$1,750	$54,880	$54,880	$54,880
					Cat 950 loader	hrs	80	$180	$14,400	$14,400	$14,400
	Misc for concrete plug (anchors, drainage pipe, etc)				Misc.	lump sum	1	$7,500	$7,500	$7,500	$7,500
	Install Instrumentation (e.g pressure gauge)				Misc.	lump sum	1	$10,000	$10,000	$10,000	$10,000
	Remove salvageable equipment				Cat 235 Excavator	hrs	16	$225	$3,600	$3,600	$3,600
					Trades Labourer	hrs	16	$85	$1,360	$1,360	$1,360
	Load & return extra reagents/chemicals				General Labourer	hrs	8	$52	$416	$416	$416
					Misc.		1	$2,000	$2,000	$2,000	$2,000
			D-2601								
	In mine pool treatment implementation				Misc.	l.s.	1	$40,000	$40,000	$40,000	$40,000
	Characterize settling ponds sediments/sludge				Analytical Costs	Unit Cost	2	$300	$600	$600	$600
	Remove sludge from settling ponds (to DSTF)				Vacuum Truck	hrs	40	$150	$6,000	$6,000	$6,000
					General Labourer	hrs	40	$52	$2,080	$2,080	$2,080
	Remove sludge from Valley Tailings Production Unit Cell to underground				Cat 235 Excavator	hrs	40	$225	$9,000	$9,000	$9,000
					Tandem Dump Truck	hrs	40	$150	$6,000	$6,000	$6,000
	Remove settling ponds liners to landfill (liners remain in place for bioreactor)				Haul Truck D250E	hrs					
					General Labourer	hrs					
	Complete final design of bioreactor		D-2102		Misc.	lump sum	1	$10,000	$10,000	$10,000	$10,000
	Construct Bellekeno 625 bioreactor		D-2301		A30 Haul Truck	hrs	80	$300	$24,000	$24,000	$24,000
					Cat 950 loader	hrs	60	$180	$10,800	$10,800	$10,800
					General Labourer	hrs	60	$52	$3,120	$3,120	$3,120
					Environmental Monitor	hrs	8	$110	$880	$880	$880
	Operate Bellekeno 625 bioreactor (included in Post Closure)				Misc.	years	10				
	Site levelling				D8K Dozer	hrs	25	$325	$8,125	$8,125	$8,125
	Scrap hauled to solid waste facility				A30 Haul Truck	hrs	8	$300	$2,400	$2,400	$2,400
					Cat 235 Excavator	hrs	12	$225	$2,700	$2,700	$2,700
	Haul BK 625 sludge from Valley Tailings to BK East UG or DSTF				Cat 235 Excavator	hrs	30	$225	$6,750	$6,750	$6,750
					A30 Haul Truck	hrs	40	$300	$12,000	$12,000	$12,000

Table 9-6

Water and Solutions Management

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
	Misc. Supplies & Tools				Misc.	l.s.	1	$5,000	$5,000	$5,000	$5,000
	Project Management & Engineering				7% of Total Cost	%		7.00%	$22,754	$22,754	$22,754
								Sub-Total	**$347,805**	**$347,805**	**$347,805**
6.4	**Mill Pond - Bioreactor Transition**										
	Discharge mill pond inventory (3,500 m3)				Analytical Costs	Unit Cost	2	$300	$600	$600	$600
					General Labourer	hrs	10	$52	$520	$520	$520
	Construct bioreactor in mill pond if necessary (DSTF runoff + Flame and Moth if necessary). Costs included in post closure care and maintenance (T.11.3.2)										
	Operate mill bioreactor if necessary (10 years) costs included in Care and Maintenance (T.11.3.2)										
	Construct outlet channel				Cat 235 Excavator	hrs	20	$225	$4,500	$4,500	$4,500
					D8K Dozer	hrs	20	$325	$6,500	$6,500	$6,500
					Place rip rap	cu.m.	5	$1,250	$6,250	$6,250	$6,250
					General Labourer	hrs	30	$52	$1,560	$1,560	$1,560
	Project Management & Engineering				7% of Total Cost	%		7.00%	$1,395	$1,395	$1,395
								Sub-Total	**$21,325**	**$21,325**	**$21,325**
6.4	**Flame and Moth Water Management**										
	In Mine Pool treatment implementation - not considered necessary										
	Project Management & Engineering				7% of Total Cost	%		7.00%	$0	$0	$0
								Sub-Total	**$0**	**$0**	**$0**
6.1	**Bermingham Water Storage / Settling Pond**	**7.4.3**									
	Pump down collected water				General Labourer	hrs	10	$52	$520	$520	$520
					Pump	daily	2	$100	$200	$200	$200
	Misc. Supplies and Tools				Misc.	l.s.	1	$750	$750	$750	$750
	Characterize pond sediments/sludge				Analytical Costs	Unit Cost	2	$300	$600	$600	$600
					Environmental Monitor	hrs	8	$110	$880	$880	$880
	Remove pond sediments/sludge				Vacuum Truck	hrs	8	$150	$1,200	$1,200	$1,200
					General Labourer	hrs	12	$52	$624	$624	$624
	Remove & bury HDPE liner				General Labourer	hrs	12	$52	$624	$624	$624
					Cat 235 Excavator	hrs	8	$225	$1,800	$1,800	$1,800
					A30 Haul Truck	hrs	4	$300	$1,200	$1,200	$1,200
	In mine pool treatment implementation				Misc.	l.s.	1	$40,000	$0	$40,000	$40,000
	Recontour area				D8K Dozer	hrs	6	$325	$1,950	$1,950	$1,950
	Stabilize slopes with erosion barriers				Cat 235 Excavator	hrs	6	$225	$1,350	$1,350	$1,350
	Remove discharge pipeline				General Labourer	hrs	6	$52	$312	$312	$312
	Project Management & Engineering				7% of Total Cost	%		7.00%	$841	$3,641	$3,641
								Sub-Total	**$12,851**	**$55,651**	**$55,651**
Total Estimated Cost in Constructing Primary Drainage Ditches									**$436,762**	**$479,562**	**$479,562**

Table 9-7

Dry Stack Tailings Facility

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
7.1	**DSTF - Current**	**7.2**		**0.5**							
	Recontour slopes to final design and compact			Equipment hours and productivities from 2014 progressive reclamation tracking	D8K Dozer	hrs	4	$325	$1,300		
					Vibratory Roller (84" packer)	hrs	2	$170	$340		
	Place soil cover and spread				A30 Haul Truck	hrs	4	$300	$1,200		
					Cat 235 Excavator	hrs	6	$225	$1,350		
					D8K Dozer	hrs	6	$325	$1,950		
	Revegetation				Revegetation Seed Mix - 50kg/ha	ha	0.1	$875	$88		
					Fertilizer - 250kg/ha	ha	0.1	$275	$28		
					Seed/Fertilizer Application	ha	0.1	$1,700	$170		
	Project Management & Engineering				7% of Total Cost	%		7.00%	$450		
								Sub-Total	**$6,875**		
7.2	**DSTF - Year 2**	**7.2**		**2.0**							
	Recontour slopes to final design and compact				D8K Dozer	hrs	40	$325		$13,000	
					Vibratory Roller (84" packer)	hrs	16	$170		$2,720	
	Place soil cover and spread				A30 Haul Truck	hrs	100	$300		$30,000	
					Cat 235 Excavator	hrs	120	$225		$27,000	
					D8K Dozer	hrs	70	$325		$22,750	
	Revegetation				Revegetation Seed Mix - 50kg/ha	ha	2.0	$875		$1,750	
					Fertilizer - 250kg/ha	ha	2.0	$275		$550	
					Seed/Fertilizer Application	ha	2.0	$1,700		$3,400	
						hrs	-				
	Project Management & Engineering				7% of Total Cost	%		7.00%		$7,082	
								Sub-Total		**$108,252**	
7.3	**DSTF - EOM**	**7.2**		**7.3**							
	Recontour slopes to final design and compact		C-7401		D8K Dozer	hrs	115	$325			$37,223
					Vibratory Roller (84" packer)	hrs	59	$170			$9,969
	Place soil cover and spread		C-7401		A30 Haul Truck	hrs	367	$300			$109,950
					Cat 235 Excavator	hrs	440	$225			$98,955
					D8K Dozer	hrs	119	$325			$38,673
	Revegetation		C-7401		Revegetation Seed Mix - 50kg/ha	ha	7.3	$875			$6,414
					Fertilizer - 250kg/ha	ha	7.3	$275			$2,016
					Seed/Fertilizer Application	ha	7.3	$1,700			$12,461
	Project Management & Engineering				7% of Total Cost			7.00%			$22,096
								Sub-Total			**$337,756**
Total Estimated Cost in Reclaiming Tailings Area									**$6,875**	**$108,252**	**$337,756**

Table 9-8

Mill & Ancillary Facilities

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (m)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
8.1	**Mill and Ancilliary Facilities**	**7.5.5**	**04-May**								
	Remove equipment (crusher, conveyors, mill equipment, trailer units, other ancillary facilities - fine ore bin)				General Labourer	hrs	600	$52	$31,200	$31,200	$31,200
					Trades Labourer	hrs	400	$85	$34,000	$34,000	$34,000
					Cat 950 loader	hrs	150	$180	$27,000	$27,000	$27,000
					Cat 235 Excavator	hrs	50	$225	$11,250	$11,250	$11,250
					Tractor Trailer (lowbed)	hrs	120	$195	$23,400	$23,400	$23,400
	Load and return extra chemicals/reagents				General Labourer	hrs	75	$52	$3,900	$3,900	$3,900
					Misc.	l.s.	1	$5,000	$5,000	$5,000	$5,000
	Dismantle Mill Building				Cat 950 loader	hrs	70	$180	$12,600	$12,600	$12,600
					Tractor Trailer (lowbed)	hrs	70	$195	$13,650	$13,650	$13,650
					Trades Labourer	hrs	300	$85	$25,500	$25,500	$25,500
					General Labourer	hrs	1000	$52	$52,000	$52,000	$52,000
	Concrete Demolition				Cat 235 Excavator w hammer	hrs	40	$275	$11,000	$11,000	$11,000
					D8K Dozer	hrs	40	$325	$13,000	$13,000	$13,000
	Elec. Substation (disconnect, remove from site)				Misc.	Unit Cost	1	$17,500	$17,500	$17,500	$17,500
	Dismantle/remove other area bldgs (dry, lab, MCCs, etc)				Misc.	Unit Cost	5	$5,000	$25,000	$25,000	$25,000
	Disconnect services				Misc.	Misc.	4	$1,000	$4,000	$4,000	$4,000
	Decommission buried infrastructure				Misc.	Misc.	1	$1,500	$1,500	$1,500	$1,500
	Dismantle/remove fresh water tank				Misc.	Misc.	1	$5,000	$5,000	$5,000	$5,000
	Remove diesel & propane Tanks (owned by vendors)										
	Disconnect services				Misc.	Misc.	2	$1,000	$2,000	$2,000	$2,000
	Crane Support				30 ton Crane	hrs	200	$190	$38,000	$38,000	$38,000
	Haul Scrap to Solid Waste Facility				Cat 235 Excavator	hrs	50	$225	$11,250	$11,250	$11,250
					A30 Haul Truck	hrs	100	$300	$30,000	$30,000	$30,000
	Misc. Supplies and Tools				Misc.	l.s.	1	$5,000	$5,000	$5,000	$5,000
	Project Management & Engineering				7% of Total Cost	%		7.00%	$28,193	$28,193	$28,193
								Sub-Total	**$430,943**	**$430,943**	**$430,943**
8.2	**Mill Pad**	**7.5.5**		**4.8**							
	Test area soils for contamination				Environmental Monitor	hrs	16	$110	$1,760	$1,760	$1,760
	Laboratory Analysis for soils testing				Analytical Costs	Unit Cost	20	$300	$6,000	$6,000	$6,000
	Haul any contaminated soils to nearest Land Treatment Facility				Cat 235 Excavator	hrs	16	$225	$3,600	$3,600	$3,600
					A30 Haul Truck	hrs	16	$300	$4,800	$4,800	$4,800
	Regrade embankment shoulders		C-6401, B-6101		D8K Dozer	hrs	7	$325	$2,370	$2,370	$2,370
	Haul & place soil cover (1 m aver. thickness) S.7.5.5.1		C-6401, B-6101		Load, haul and place soil cover	cu.m.	1800	$4.50	$8,100	$8,100	$8,100
	Recontour area to bury any footings & provide drainage, in prep for revegetation		C-6401, B-6101		D8K Dozer	hrs	75	$325	$24,324	$24,324	$24,324
	Revegetate		C-6401		Revegetation cost per ha. Including application cost	ha	4.8	$2,850	$13,652	$13,652	$13,652
	Project Management & Engineering				7% of Total Cost	%		7.00%	$4,522	$4,522	$4,522
								Sub-Total	**$69,128**	**$69,128**	**$69,128**
8.3	**Camp Downsize**	**7.5.6**									
	Dismantle 5 trailer units and transport to Lot 960				Misc.	l.s.	1	$25,000	$25,000	$25,000	$25,000
	Project Management & Engineering				7% of Total Cost	%		7.00%	$1,750	$1,750	$1,750
								Sub-Total	**$26,750**	**$26,750**	**$26,750**
Total Estimated Cost in Reclaiming Mill and Ancillary Facilities									**$526,820**	**$526,820**	**$526,820**

Table 9-9

Haulage and Access Roads

Item No.	Work Item Description	RCP Section #	RCP Drawing/Figure #	Area (ha) / Length (km)	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
9.1	**Bellekeno East Portal to Upper Laydown**	**7.7**	**B-0301 & Fig 7-49**								
	Culvert Excavation and install swales (2 ea)				Cat 235 Excavator	hrs	4	225	$900	$900	$900
					General Labourer	hrs	4	52	$208	$208	$208
	Reslope banks/remove safety berms				Cat 235 Excavator	hrs	16	225	$3,600	$3,600	$3,600
	Scarify road surface			0.5	Cat 14H grader	hrs	16	$250	$4,000	$4,000	$4,000
	Erosion barrier (50% of length)				Erosion Barrier	m2	500	$3	$1,500	$1,500	$1,500
	Project Management & Engineering				7% of Total Cost	%		7.00%	$715	$715	$715
								Sub-Total	**$10,923**	**$10,923**	**$10,923**
9.2	**Bellekeno 625 Access**	**7.7**	**B-0301 & Fig 7-49**								
	Culvert Excavation and install swales (3 ea)				Cat 235 Excavator	hrs	6	$225	$1,350	$1,350	$1,350
					General Labourer	hrs	6	$52	$312	$312	$312
	Reslope banks/remove safety berms				Cat 235 Excavator	hrs	12	$225	$2,700	$2,700	$2,700
	Scarify road surface			0.25	Cat 14H grader	hrs	16	$250	$4,000	$4,000	$4,000
	Erosion barrier (50% of length)				Erosion Barrier	m2	250	$3	$750	$750	$750
	Project Management & Engineering				7% of Total Cost	%		7.00%	$638	$638	$638
								Sub-Total	**$9,750**	**$9,750**	**$9,750**
9.3	**Bellekeno Haul Road**	**7.7**	**B-0301 & Fig 7-49**								
	Culvert Excavation and install swales (15 ea)				Cat 235 Excavator	hrs	30	$225	$6,750	$6,750	$6,750
					General Labourer	hrs	30	$52	$1,560	$1,560	$1,560
	Reslope banks/remove safety berms				Cat 235 Excavator	hrs	40	$225	$9,000	$9,000	$9,000
	Scarify road surface			5.7	Cat 14H grader	hrs	30	$250	$7,500	$7,500	$7,500
	Erosion barrier (50% of length)				Erosion Barrier	m2	5,700	$3	$17,100	$17,100	$17,100
	Project Management & Engineering				7% of Total Cost	%		7.00%	$2,934	$2,934	$2,934
								Sub-Total	**$44,844**	**$44,844**	**$44,844**
9.4	**Keno City Bypass Road**	**7.7**	**B-0301 & Fig 7-49**								
	Culvert Excavation and install swales (5 ea)				Cat 235 Excavator	hrs	10	$225	$2,250	$2,250	$2,250
					General Labourer		10	$52	$520	$520	$520
	Reslope banks/remove safety berms				Cat 235 Excavator		24	$225	$5,400	$5,400	$5,400
	Scarify road surface			2.1	Cat 14H grader	hrs	16	$250	$4,000	$4,000	$4,000
	Erosion barrier (50% of length)				Erosion Barrier	hrs	12	$3	$36	$36	$36
	Remove Lightning Creek Bridge (Bellekeno)				Cat 235 Excavator	hrs	20	$225	$4,500	$4,500	$4,500
					Tractor Trailer (lowbed)	hrs	12	$195	$2,340	$2,340	$2,340
	Erosion barrier (50% of length)				Erosion Barrier	m2	2,100	$3	$6,300	$6,300	$6,300
	Project Management & Engineering				7% of Total Cost	%		7.00%	$1,774	$1,774	$1,774
								Sub-Total	**$27,120**	**$27,120**	**$27,120**
9.5	**Christal Lake Road**	**7.7**	**B-0301 & Fig 7-49**								
	Culvert Excavation and install swales (5 ea)				Cat 235 Excavator	hrs	10	$225	$2,250	$2,250	$2,250
					General Labourer	hrs	30	$52	$1,560	$1,560	$1,560
	Reslope banks/remove safety berms				Cat 235 Excavator	hrs	12	$225	$2,700	$2,700	$2,700
	Scarify road surface			1.3	Cat 14H grader	hrs	16	$250	$4,000	$4,000	$4,000
	Erosion barrier (50% of length)				Erosion Barrier	m2	1,300	$3	$3,900	$3,900	$3,900
	Project Management & Engineering				7% of Total Cost	%		7.00%	$1,009	$1,009	$1,009
								Sub-Total	**$15,419**	**$15,419**	**$15,419**
9.6	**Keno City Bypass Road**	**7.7**	**B-0301 & Fig 7-49**								
	Culvert Excavation and install swales (5 ea)				Cat 235 Excavator	hrs	10	$225	$2,250	$2,250	$2,250
					General Labourer	hrs	20	$52	$1,040	$1,040	$1,040
	Reslope banks/remove safety berms				Cat 235 Excavator	hrs	10	$225	$2,250	$2,250	$2,250
	Scarify road surface			2.1	Cat 14H grader	hrs	20	$250	$5,000	$5,000	$5,000
	Erosion barrier (50% of length)				Erosion Barrier	m2	2,060	$3	$6,180	$6,180	$6,180
	Remove Lightning Creek Bridge (Onek)				Cat 235 Excavator	hrs	20	$225	$4,500	$4,500	$4,500
					Tractor Trailer (lowbed)	hrs	12	$195	$2,340	$2,340	$2,340
	Project Management & Engineering				7% of Total Cost	%		7.00%	$1,649	$1,649	$1,649
								Sub-Total	**$25,209**	**$25,209**	**$25,209**
9.7	**Lucky Queen Haul and Access Road**	**7.7**	**B-0301 & Fig 7-49**								
	Culvert Excavation and install swales (2 ea)				Cat 235 Excavator	hrs	20	$225	$4,500	$4,500	$4,500
					General Labourer	hrs	16	$52	$832	$832	$832
	Reslope banks/remove safety berms				Cat 235 Excavator	hrs	10	$225	$2,250	$2,250	$2,250
	Scarify road surface			1.2	Cat 14H grader	hrs	12	$250	$3,000	$3,000	$3,000
	Erosion barrier (50% of length)				Erosion Barrier	m2	1,200	$3	$3,600	$3,600	$3,600
	Project Management & Engineering				7% of Total Cost	%		7.00%	$993	$993	$993
									$15,175	**$15,175**	**$15,175**
9.9	**Bermingham Haul and Access Road**	**7.7**	**B-0301 & Fig 7-49**								
	Culvert Excavation and install swales (2 ea)				Cat 235 Excavator	hrs	16	$225	$900	$3,600	$3,600
					General Labourer	hrs	16	$52	$416	$832	$832
	Reslope banks/remove safety berms				Cat 235 Excavator	hrs	10	$225	$563	$2,250	$2,250
	Scarify road surface			2.0	Cat 14H grader	hrs	4	$250	$250	$1,000	$1,000
	Erosion barrier (50% of length)				Erosion Barrier	m2	2,000	$3	$3,000	$6,000	$6,000
	Project Management & Engineering				7% of Total Cost	%		7.00%	$359	$958	$958
								Sub-Total	**$5,487**	**$14,640**	**$14,640**
9.10	**Other Roads and Trails**	**7.7**	**B-0301 & Fig 7-49**								
	Scarify road surface			3.0	Cat 14H grader	hrs	20	$250	$5,000	$5,000	$5,000
	Project Management & Engineering				7% of Total Cost	%		7.00%	$350	$350	$350
								Sub-Total	**$5,350**	**$5,350**	**$5,350**
Total Estimated Cost for Haulage and Access Road Closure									**$144,102**	**$153,254**	**$153,254**

Table 9-10

Supporting Studies

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Current Total	Year 2 Total	EOM Total
10.1	**Kinetic Tailings and Waste Rock Materials Testing**							
	Field bin ARD/metal leaching studies/tests	Misc.	l.s.	5	$2,500	$12,500	$12,500	$25,000
	Humidity cells	Misc.	l.s.	3	$3,500	$10,500	$10,500	$21,000
					Sub-Total	**$23,000**	**$23,000**	**$46,000**
10.2	**Other Adaptive Management Plans Required**							
	Inclusion of additional triggers and updating of overall plan as per directives (YWB, YESAB	Misc.	l.s.	1	$0	$10,000	$20,000	$20,000
					Sub-Total	**$10,000**	**$20,000**	**$20,000**
10.3	**Contaminated Site Assessment Plan**							
	Develop Plan	Misc.	l.s.	1	$4,000	$4,000	$4,000	$4,000
	Site Reportng	Misc.	l.s.	1	$5,000	$5,000	$5,000	$5,000
					Sub-Total	**$9,000**	**$9,000**	**$9,000**
10.4	**Reclamation & Closure Research Plan**							
	Resesarch to finalize closure plan ($25K per year)	Misc.	l.s.	1	$25,000	$50,000	$50,000	$150,000
					Sub-Total	**$50,000**	**$50,000**	**$150,000**
10.5	**Passive Treatment Design**							
	Design for mill pond bioreactors	Misc.	l.s.	1	$15,000	$15,000	$15,000	$15,000
					Sub-Total	**$15,000**	**$15,000**	**$15,000**
Total Estimated Cost for Supporting Studies						**$107,000**	**$117,000**	**$240,000**

Table 9-11

Post Closure Care, Maintenance, and Monitoring

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Annual Cost	Full Cost	NPV Current	NPV Year 2	NPV EOM
11.1	**Onsite Management**									
	Project Management and Engineering - Included in PME Costs in each Closure Component									
	Pickup trucks									
	Post Closure 10 Years (1 truck for Environmental Monitor , 6 mo/yr))			10		$15,000	$150,000			
	Sundry equipment maintenance									
	Post Closure 10 Years			10		$2,500	$25,000			
	Power and heat (na)									
	Post Closure 10 Years			10						
	General Administrative expenses									
	Post Closure 10 Years			10		$2,500	$25,000			
	Camp Costs									
	Post Closure 10 Years	Unit Cost Basis	man-day	600	$40	$2,400	$24,000			
					Subtotal - Post Closure 10 Years	**$22,400**	**$224,000**	**$236,888**	**$232,243**	**$202,181**
11.2	**Transport Costs**									
	Employee transport costs									
	Post Closure 10 Years	Unit Cost Basis	Years	10		$5,000	$50,000			
					Subtotal - Post Closure 10 Years		**$50,000**	**$45,421**	**$44,530**	**$38,766**
11.3	**Water Treatment Costs**									
11.3.1	Active Treatment (no active treatment at BK 625, ponds are bioreactors)	Misc	monthly							
	Capital Costs	Misc.	annually							
	Capital Replacement Costs	Misc.	annually							
	Operating Costs	Misc.	annually	-	$0	$0	$0	$0	$0	$0
11.3.2	Passive Treatment (BK 625 In situ + bioreactor)									
	Capital Costs	Misc.	ls	10			$65,000	$62,476	$61,251	$53,323
	Operation and Maintenance Costs	Misc.	annually	10		$5,500	$55,000	$49,828	$48,851	$42,528
					Subtotal - Post Closure 10 Years		**$120,000**	**$112,304**	**$110,102**	**$95,850**
11.4	**Reclamation & Closure Research Plan**									
	Reclamation & Closure Research Plan	Misc.	annually	-	$0	$0	$0			
					Subtotal - Post Closure 10 Years		**$0**		**$0**	**$0**
11.5	**Monitoring & Reporting (Sec 7.9)**									
11.5.1	Disbursements (non-labour/non-analytical)	Misc.	annually	12		$4,792	$57,500	$51,576	$50,564	$44,019
11.5.2	Water Quality Monitoring									
	Active Closure 2 year + Post Closure Years 1-5	Misc.	each	188		$60,000	$420,000	$388,319	$380,705	$331,427
	Post Closure Years 6-10	Misc.	each	126		$20,000	$100,000	$82,067	$80,458	$70,043
11.5.3	**EEM Monitoring**									
	Biological Monitoring (Sediment, Benthos, Toxicity):									
	Active Closure 2 year + Post Closure Years 1-5	Misc.	annually	7	$4,000	$4,000	$35,000	$32,360	$31,725	$27,619
	Post Closure Years 6-10	Misc.	annually	5	$4,000	$4,000	$10,000	$8,205	$11,909	$10,368
	Radiums- (Quarterly at 4 mines for 2 Years Active Closure)		each	16	$130	$2,080	$6,240	$3,059	$2,999	$5,221
11.5.4	Geotechnical Inspections									
	Active Closure + Post Closure Years 1-10	Misc.	annually	12		$3,750	$45,000	$40,565	$39,770	$34,622
11.5.5	Reclamation Inspections:									
	Active Closure + Post Closure Years 1-10	Misc.	annually	12		$3,750	$45,000	$40,565	$39,770	$34,622
11.5.6	Site Maintenance									
	Active Closure + Post Closure Years 1-10	Misc.	each	12		$3,375	$40,500	$36,570	$35,853	$31,212
11.5.7	Annual Inspection + report - Active and Post Closure yrs 1-10	Misc.	annually	12		$0	$48,000	$42,301	$41,472	$36,104
						Sub-Total	**$807,240**	**$725,588**	**$715,226**	**$625,258**
Total Estimated Cost for Post Closure Site Management							**$1,201,240**	**$1,120,200**	**$1,102,100**	**$962,055**

Note:

B-625 Active Water Treatment	
Manpower: as per Alexco	**2,500**
Vacuum truck:every 3d for 3hrs@ $120/hr	3,600
Camp costs: 1/4 manday/d, 30d/mo @ $65/d	488
Lime: as per Alexco	1,800
Ferric chloride	**1,200**
Power: as per Alexco	2,500
Mntce of facilities: as per Alexco	600
Replacement of equipment & parts @ $4k/yr	333
WQ analyses, internal 2/wk @ $200 each	1,600
Winter road access: grader 3h/wk x 6mo/yr @$270/hr	1,620
Misc Supplies: consumables	**200**
Treatment Operation at BK 625 / month	**$16,441**

Table 9-12

Interim Care and Maintenance

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Annual Cost	Full Cost
12.1	**Personnel**						
	On-site Caretaker						
	Utilize current ERDC operators - cost share 20%	Site caretaker	$/manmonth	6	$1,342	$8,052	$8,052
	Extra Personnel						
	Electrician (3 days every other month)	Trades Labourer	$/hr	90	$91	$8,190	$8,190
	Mechanic (3 days every other month)	Trades Labourer	$/hr	90	$91	$8,190	$8,190
	Supervisor (5 days/month on site)	Unit Cost Basis	$/hr	300	$110	$33,000	$33,000
	Camp Costs						
	for above personnel (365+30+30+60)	Unit Cost Basis	mandays	360	$65	$23,400	$23,400
	Employee Transport Costs						
	Driving in allowance (4 roundtrips per mo)	Unit Cost Basis	monthly	6	$2,500	$15,000	$15,000
						Sub-Total - Personnel	**$95,832**
12.2	**Equipment**						
	Small Excavator (1)	Misc.	monthly	6	$1,000	$6,000	$6,000
	Small Dozer (1)	Misc.	monthly	6	$1,000	$6,000	$6,000
	Small Loader (1)	Misc.	monthly	6	$1,000	$6,000	$6,000
	Pick-Up Truck (1)	Misc.	monthly	6	$2,500	$15,000	$15,000
	Snow Machine & ATV	Misc.	monthly	6	$350	$2,100	$2,100
						Sub-Total - Equipment	**$35,100**
12.3	**Tasks**						
	SNP/AEMP water sampling	Misc.	monthly	6	$7,756	$46,535	$46,535
	Interim water treatment (active BK-625)	Misc.	monthly	6	$16,441	$98,643	$98,643
	Geotechnical Assessments	Misc.	each	1	$15,000	$15,000	$15,000
	Enhanced Groundwater/Foundation monitoring	Misc.	each	1	$15,000	$15,000	$15,000
	Monitoring of piezometers and thermistors	Misc.	each	2	$3,000	$6,000	$6,000
	Communications & reporting	Misc.	monthly	6	$1,000	$6,000	$6,000
						Sub-Total - Tasks	**$187,178**
12.4	**Miscellaneous**						
	Misc Supplies	Misc.	monthly	6	$3,000	$18,000	$18,000
	Monthly Fuel	Misc.	$/litre	3,000	$1.25	$3,750	$3,750
						Sub-Total - Miscellaneous	**$21,750**
						Cost for ICM	**$339,860**

Table 9-13

Mobilization and Demobilization

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Rates	Annual Cost	Full Cost
13.1	**Mobilize Equipment & Fuel**						
	Heavy Equipment						
	3.5 yd LHDUnderground scooptram (1)	Equipment	hrs	10	$300	$3,000	$3,000
	Excavators (2)	Equipment	hrs	10	$150	$1,500	$1,500
	Rock Trucks (2)	Equipment	hrs	20	$200	$4,000	$4,000
	Dozer-large (1)	Equipment	hrs	10	$350	$3,500	$3,500
	Dozer-medium (1)	Equipment	hrs	5	$300	$1,500	$1,500
	Grader-large (1)	Equipment	hrs	10	$250	$2,500	$2,500
	Loader-large (1)	Equipment	hrs	10	$300	$3,000	$3,000
	Loader-medium (1)	Equipment	hrs	5	$180	$900	$900
	Compactor (1)	Equipment	hrs	10	$190	$1,900	$1,900
	Crane (1)	Equipment	hrs	10	$190	$1,900	$1,900
	Light-duty Vehicles (2)	Light truck	hrs	10	$100	$1,000	$1,000
	Misc. Equipment						
	Other						
	Fuel						
	Fuel Freight	Unit Cost Basis	l.s.	1	$5,000	$5,000	$5,000
						Sub-Total - Mobilize Equipment & Fuel	**$29,700**
13.2	**Mobilize Workers & Camp**						
	Workers (15men)						
	Travel costs-bus	Unit Cost Basis	ea	15	$200	$3,000	$3,000
	Workers wages during mob (8hr trip)	Unit Cost Basis	hrs	120	$80	$9,600	$9,600
						Sub-Total - Mobilize Workers & Camp	**$12,600**
13.3	**Demobilize Equipment**						
	Heavy Equipment						
	6 yd LHDUnderground scooptram (1)	Equipment	hrs	10	$300	$3,000	$3,000
	Excavators (2)	Equipment	hrs	10	$150	$1,500	$1,500
	Rock Trucks (2)	Equipment	hrs	20	$200	$4,000	$4,000
	Dozer-large (1)	Equipment	hrs	10	$350	$3,500	$3,500
	Dozer-medium (1)	Equipment	hrs	5	$300	$1,500	$1,500
	Grader-large (1)	Equipment	hrs	10	$250	$2,500	$2,500
	Loader-large (1)	Equipment	hrs	10	$300	$3,000	$3,000
	Loader-medium (1)	Equipment	hrs	5	$180	$900	$900
	Compactor (1)	Equipment	hrs	10	$190	$1,900	$1,900
	Crane (1)	Equipment	hrs	10	$190	$1,900	$1,900
	Light-duty Vehicles (2)	Light truck	hrs	10	$100	$1,000	$1,000
	Misc. Equipment						
	Sea Containers (supplies, mobile offices) (6)	Equipment	hrs	60	$50	$3,000	$3,000
	Other						
						Sub-Total-Demobilize Equipment	**$27,700**
13.4	**Demobilize Wokers & Camp**						
	Workers (15men)						
	Travel costs-bus	Unit Cost Basis	ea.	15	$200	$3,000	$3,000
	Workers wages during demob (8hr trip)	Unit Cost Basis	hrs	120	$80	$9,600	$9,600
	Demob camp (N/A-decommissioned as part of site closure)						
						Sub-Total - Demobilize Workers & Camp	**$12,600**
Total Estimated Cost for Mobilization and Demobilization							**$82,600**

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