2022 ANNUAL REPORT

QUARTZ MINING LICENSE QML-0009

April 2023

Prepared by:

Hecla Yukon

Prepared for:

ALEXCO KENO HILL MINING CORP.

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Keno City Library	1 original bound

QML-0009 SCHEDULE D – ANNUAL REPORTING REQUIREMENTS CONCORDANCE TABLE

Area	#	Requirement	Where addressed
1 Mine Development and Operations	a)	a map showing the status of all engineered structures, works, and installations associated with the Undertaking; and	Figure 1-2
	b)	an overlay map showing the underground mining areas	Figures 2-1 and 2-2
1.1 Underground Mining	a)	a map showing the extent of all underground mining areas;	Figure 1-2
	b)	as-built drawings of the underground mining area(s) and associated engineered structures, works or installations constructed or altered at the Undertaking during the reporting year;	Figures 2-5, 2-6, 2-10 and 2-11
	c)	a summary of any exploration activities conducted to support underground mining;	Section 2.2
	d)	summary of changes made to the underground mine development and operations plans that were authorized through an inspector's variation notice and any minor modifications from final designs submitted pursuant to condition 7.3 of the License	Section 2.2
	e)	updated drawings for electrification and ventilation of underground development areas if variations from the approved mine plan occurred;	Figures 2-7, 2-8, 2-12 and 2-13
	f)	provide the results and interpretation from all quality assurance and quality control programs related to underground mining activities; and	Section 2.2.4
	g)	a table indicating the amount of ore extracted, from each underground ore body mined during the year.	Table 2-1
1.2 Ore Processing and Concentration Production	a)	as-built drawings of the processing facilities and associated engineered structures, works or installations constructed or altered at the Undertaking during the reporting year;	Not Applicable
	b)	types and amounts of reagents used during ore processing throughout the year, and a comparison of the annual consumption versus the average annual consumption totals for each reagent throughout the operating life;	Table 2-2
	c)	provide the results and interpretation from all quality assurance and quality control programs related to ore processing and production activities; and	Section 2.3
	d)	provide the following summary table with respect to milling and production of concentrate. Provide information on each commodity of interest produced.	Tables 2-3 and 2-4
1.3 Ore Stockpiles	a)	the total amount, type and the average grade of ore in each stockpile as of December 31st of the reporting year;	Not Applicable
	b)	map(s) showing the location, designated name, footprint size (m2) and storage limit (m3) of each stockpile; and	Figure 2-15
	c)	a table depicting the monthly totals of ore added to and removed from each stockpile throughout the reporting year	Table 2-5
1.4 Waste Rock and Overburden	a)	as-built drawings of the waste rock management facilities and associated engineered structures, works or installations constructed or altered at the Undertaking during the reporting year;	Figures 2-16 and 2-17
	b)	a summary of changes made to the waste rock and overburden management plans that were authorized through an inspector's variation notice or minor modifications from final designs submitted pursuant to condition 7.3 of the License;	Section 2.5

Area	#	Requirement	Where addressed
	c)	the results and interpretation from all quality assurance and quality control programs related to waste rock management activities; and	Section 2.3.3
	d)	the following table summarizing the total amount of waste rock excavated at the Undertaking and stored in each waste rock management facility. If there are multiple storage locations, each must be reported in a separate row.	Table 2-6 and 2-7
1.5 Tailings	a)	as-built drawings of the tailings management facilities and associated engineered structures, works or installations constructed or altered at the Undertaking during the reporting year;	Figure 2-18
	b)	a summary of changes made to the tailings management plan that were authorized through an inspector's variation notice and any minor modifications from final designs submitted pursuant to condition 7.3 of the License;	Section 2.6
	c)	a summary of long term humidity cell tests of co-mingled tailings results;	Section 2.6
	d)	a table summarizing the amount of tailings deposited in each tailings management facility throughout the reporting year, the cumulative total from the License Effective Date and the remaining storage capacity in the facility;	Table 2-8
	e)	the amount of pyritic and other tailings disposed of underground and the location of its deposition.	Not Applicable
	f)	the updated Operations, Maintenance and Surveillance Manual: i. as vacant positions are filling and on an ongoing bases to reflect current status/conditions; and ii. as the result of practical operational experience or where any additional monitoring or operational modifications are recommended pursuant to condition 13.4 of the License;	Section 2.6
	g)	provide the results and interpretation from all quality assurance and quality control programs related to tailings storage and management activities.	Section 2.6.4
2 Emergency Response Plan	a)	a report on the implementation of the emergency response and health and safety plan that includes triggered events, responses, plan updates and training opportunities. This report must include: i. number of days incident free; ii. number and summary of incidents during the reporting year, the responses to these events, and any resulting amendments to emergency procedures; and iii. number and summary of near misses	Section 3.0
	b)	number of times onsite health care attendants responded to non-life-threatening injuries or illnesses;	Section 3.0
	c)	number of times onsite health care attendants responded to life-threatening injuries or illnesses; and	Section 3.0
	d)	number of times that the Licensee had to seek outside health care services for urgent and non-urgent medical needs.	Section 3.0
3 Camp and Ancillary Infrastructure	a)	as-built drawings of the camp and any associated engineered structures, buildings, works or installations constructed or altered at the Undertaking during the reporting year; and	Section 4.0
	b)	remedial actions taken as a result of inspections by territorial or federal agencies.	Not Applicable
	a)	an up to date map showing all roads and trails, associated with the Undertaking;	Section 5.0
	b)	as-built drawings of transportation infrastructure constructed or altered at the Undertaking during the reporting year;	Figure 5-1

Area	#	Requirement	Where addressed
4 Access and Transportation Management	c)	a summary of the volume of traffic, access control issues, wildlife incidents and other accidents, and any upgrade or maintenance work conducted during the reporting year;	Section 5.0
	d)	a summary of any upgrade or maintenance work planned for the upcoming year;	Section 5.0
	e)	a summary of the previous and projected use of mine site and access roads; and	Section 5.0
	f)	the results and interpretation from all quality assurance and quality control programs related to the construction and management of the transportation infrastructure under the Licensee's control.	Section 5.0
5 Physical Monitoring	a)	a report on the execution of the physical monitoring program that includes data from monitoring instrumentation, copies of internal and external inspections, and copies of supporting audits and evaluations undertaken throughout the reporting year	Section 6.0
	b)	summary report on the performance of engineered structures in service during the reporting year, including: i. any operational deficiencies or failures to achieve operational requirements; ii. a detailed record of any major maintenance work carried out; iii. plans to conduct major maintenance work for the following year; iv. a status report on any backup equipment and supplies for emergency management of the engineered structure, including records of exercising such equipment; and v. records of any leakage from the engineered structure;	Section 6.0
	c)	a summary of any physical instability incidents in the underground mining areas, waste rock storage facilities or tailings facilities;	Section 6.0
	d)	details respecting any action taken as a result of the recommendations made by the independent engineer in relation to the inspection referred to in 13.2 of the License;	Section 6.0
	e)	details respecting the results of the ground conditions and support audit, for each mine area; and	Section 6.0
	f)	any remaining activities related to recommendations that could not be completed during the reporting year and a timeline for their completion.	Not Applicable
6 Environmental Monitoring and Management	a)	a summary of the programs undertaken for environmental protection, monitoring, surveillance and environmental management as outlined by the License, including an analysis of these data and any action taken or adaptive management strategies implemented to monitor or address any changes in environmental performance;	Section 7.0
	b)	include a summary of any changes to monitoring instrumentation, methodologies or frequencies;	Section 7.1
	c)	a report on the implementation of the Adaptive Management Plan that includes triggered events, responses, plan updates and engagement activities. This report must include: i. a table of thresholds that were exceeded and the responses to these exceedances; ii. an analysis of trends being seen in relation to the indicators, thresholds and exceedances; iii. identification of performance thresholds that are continually exceeded; and iv. a review of the site load and water balance model, updates to the model must be provided if necessary;	Section 7.2 Table 7-1

Area	#	Requirement	Where addressed
	d)	a summary and interpretation of geochemical tests undertaken on mine waste materials and ore, including humidity cells and kinetic tests, including the assumptions and conclusions of the geochemical predictions and the effectiveness of existing mitigation measures;	Section 7.3.7
	e)	the results of any long-term column tests to study the geochemistry of mine waste materials, ore or water treatment residuals, and implications on the physical stability of facilities prone to geochemical weathering of such materials;	Section 7.3.7
	f)	a summary of results on the DSTF cover performance: specifically addressing seeps collected from the toe of the DSTF, volume of the seeps monitored, and an estimate of the reduction in precipitation infiltration from the area of the DSTF that was covered;	Section 6.0
	g)	a summary of invasive plants that have been identified on the site and measures taken to control or remove invasive plants;	Not Applicable
	h)	a summary of spills and accidents that occurred at the site and measures taken to respond to any spills or accidents, whether reported to the Yukon spills line or another Yukon government authority;	Table 7-3
	i)	a summary of all dust, noise, and traffic related incidences as reported by the public and residents of Keno City;	Section 5.0 and 7.3
	j)	a summary of any site improvements undertaken to address sediment and erosion control;	Section 7.0
	k)	an inventory of hazardous substances stored on-site and a description of storage environments and locations;	Section 7.5 Table 7-2
	l)	provide the results and interpretation from all quality assurance and quality control programs related to environmental protection, monitoring, surveillance and management of the Undertaking; and	Section 7.9
	m)	a summary of all engineered structures, works or installations constructed or altered during the reporting year that are used to support the environmental protection, monitoring, surveillance and management at the Undertaking (i.e. solid waste disposal, sediment and erosion control measures).	Section 7.0
7 Socio-Economic Monitoring	a)	a summary of action taken by the Licensee with respect to implementation of "Keno City Socio- Economic Mitigation Plan" described in YESAB 2013-0161 Decision Document condition 33; and	Section 8.0
	b)	a summary of action taken by the Licensee with respect engagement with Keno City residents in developing the Noise Monitoring and Mitigation Plan.	Section 8.0
8 Greenhouse Gas Emissions and Climate Change	a)	provide the following information on fuel use throughout the reporting year. Where it is reasonable to do so, please distinguish between fuel volumes used for mining and production operations, exploration activities, and closure activities	Table 9-1
	b)	provide the following information for electricity purchased or generated on site	Table 9-2
	c)	report the hectares of land clearing undertaken throughout the reporting year attributed to exploration, production and closure;	Section 9.0
	d)	describe activities undertaken throughout the reporting year to reduce project emissions; i. describe future options to reduce greenhouse gas emissions; and ii. describe how you will evaluate options for greenhouse gas reductions;	Section 9.0
	e)	provide projections for greenhouse gas emissions for the next 10-years. Identify the expected stage(s) of operations throughout the 10-year projection period;	Section 9.0

Area	#	Requirement	Where addressed
	f)	identify any federal or territorial incentive programs that have been accessed to assist in the reduction of emissions; and	Not Applicable
	g)	identify any financial or other support provided by the Licensee to help community or territorial efforts to reduce emissions	Section 9.0
9 Reclamation Activities	a)	a map showing the status of all reclamation and closure activities;	Figure 10-1
	b)	a summary of any care and maintenance activities that occurred during the reporting year;	Section 10.1
	c)	a summary of any temporary closure periods that occurred during the reporting year, including the duration of the temporary closure, and any activities undertaken during this time;	Section 10.2
	d)	a summary of progressive reclamation activities undertaken throughout the reporting year;	Section 10.2
	e)	a summary of results from progressive reclamation undertaken in previous years, including an interpretation of the effectiveness of closure measures implemented to date;	Section 10.2
	f)	a summary of reclamation research programs initiated during the reporting year;	Section 10.2
	g)	a summary of results from reclamation research programs undertaken in previous years, including an interpretation of the effectiveness of closure measures implemented to date;	Section 10.2
	h)	a summary of final reclamation activities undertaken throughout the reporting year;	Section 10.2
	i)	if permanent closure occurred during the reporting year, provide the date permanent closure commenced and the closure activities undertaken throughout the reporting year to implement the approved closure plan as it pertains to permanent closure; and	Not Applicable
	j)	a summary of proposed development, production, and reclamation activities for the coming year.	Section 10.3
10 Associated Authorizations		provide a table of all authorizations from other agencies, both territorial and otherwise, that are required to support mine development and operations, including the expiry date of these authorizations	Table 11-1
Appendices		All raw data and reports must be appended to the Annual Report.	Appendices

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1 INTRODUCTION

This document serves to fulfill the annual reporting requirement for Alexco Keno Hill Mining Corp. (AKHM) under Quartz Mining License (QML) QML-0009 for 2022. On September 7, 2022, Alexco Resource Corp. (doing business as Hecla Yukon), the parent company of AKHM, was acquired by Hecla Mining Company.

AKHM owns and operates of a series of small underground silver/lead/zinc mines with a centralized mill, the Keno Hill Silver District (KHSD) Mining Operations. The site is 354 km north of Whitehorse, near Keno City in the central Yukon (Figure 1-1). The Bellekeno Mine is located about 3 km east of Keno City. The Flame & Moth Mine, District Mill site and Dry Stack Tailings Facility (DSTF) are approximately 1 km west of Keno City. The New Bermingham Mine is located approximately 6.8 km east of Keno City. An overview of the mining operations is provided in Table 1-1 and Figure 1-2.

Table 1-1: Keno Hill Silver District mine operations timeline

2006 – 2008	Alexco Resource Corp. acquires Keno Hill mining camp and begins aggressive surface exploration programs, focus on expansion of Bellekeno resource
2009	Underground development at the Bellekeno Mine
2010	Comprehensive Cooperation and Benefits Agreement signed with FNNND AKHM constructs the mill and surface facilities, and establishes the DSTF
2011	Production at Bellekeno Mine and District Mill Surface exploration at Flame & Moth begins
2012	Development and rehabilitation of Lucky Queen adit Development of new Onek 990 decline
2013	Temporary suspension of Bellekeno Mine operations and milling AKHM monitors KHSD mine sites during care and maintenance
2014 – 2020	Permitting and development of Flame & Moth and New Bermingham mines Continued surface exploration; advanced underground exploration at New Bermingham deposit Decline development at Flame & Moth and New Bermingham mines Care and maintenance and water treatment
2021	Ore production from Bellekeno and New Bermingham Camp, surface facilities, and mill upgrades Mine development at Flame & Moth and New Bermingham Temporary suspension of Bellekeno Mine operations. Continued surface exploration and water treatment
2022	Ore production at New Bermingham and Flame & Moth mines temporarily suspended June 26, 2022 Continued mine development at Flame & Moth and New Bermingham Continued surface exploration and water treatment Hecla Mining Company acquires Alexco Resource Corp.

Hecla Yukon's wholly owned subsidiary Elsa Reclamation & Development Company Ltd. (ERDC) undertakes care and maintenance, district-wide closure planning, and reclamation of the KHSD historic environmental liabilities. ERDC work and associated monitoring for 2022 is reported to the Yukon Water Board under Type B Water Licence QZ17-076.

KENO HILL SILVER DISTRICT

FIGURE 1-1
PROJECT LOCATION

DECEMBER 2022

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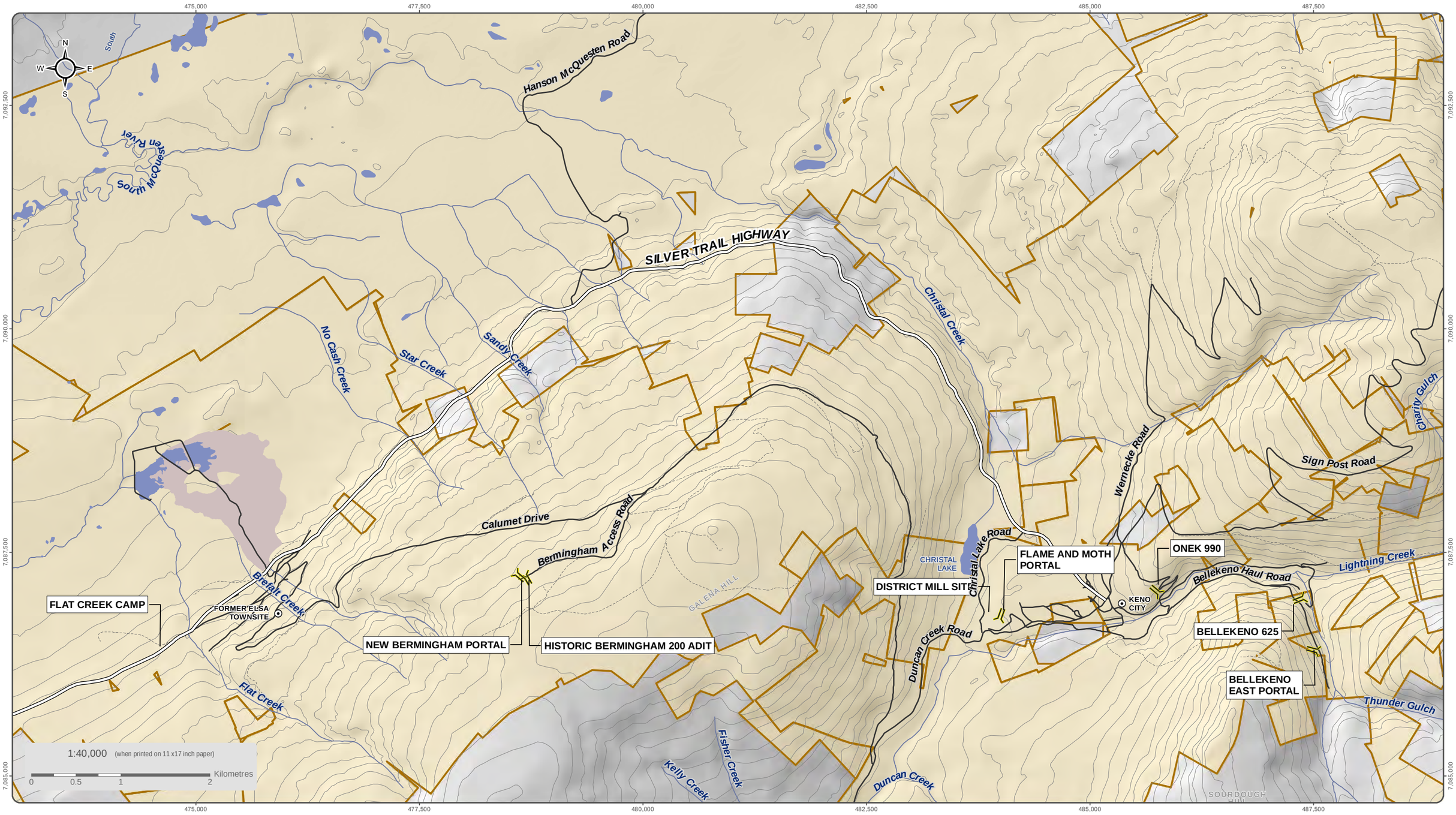

National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced underlicense from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

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

- Adit
- AKHM/ERDC Quartz Claims
- Silver Trail Highway
- Other Road
- Limited-Use Road
- Tailings Area
- Waterbody
- Watercourse
- Contours (100 ft intervals)

Hecla YUKON

ENSERO solutions

KENO HILL SILVER DISTRICT
MINING OPERATIONS

FIGURE 1-2
KENO HILL SILVER DISTRICT MINING OPERATIONS OVERVIEW

APRIL 2023

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2 MINE DEVELOPMENT AND OPERATIONS

2.1 MINE SURFACE INFRASTRUCTURE

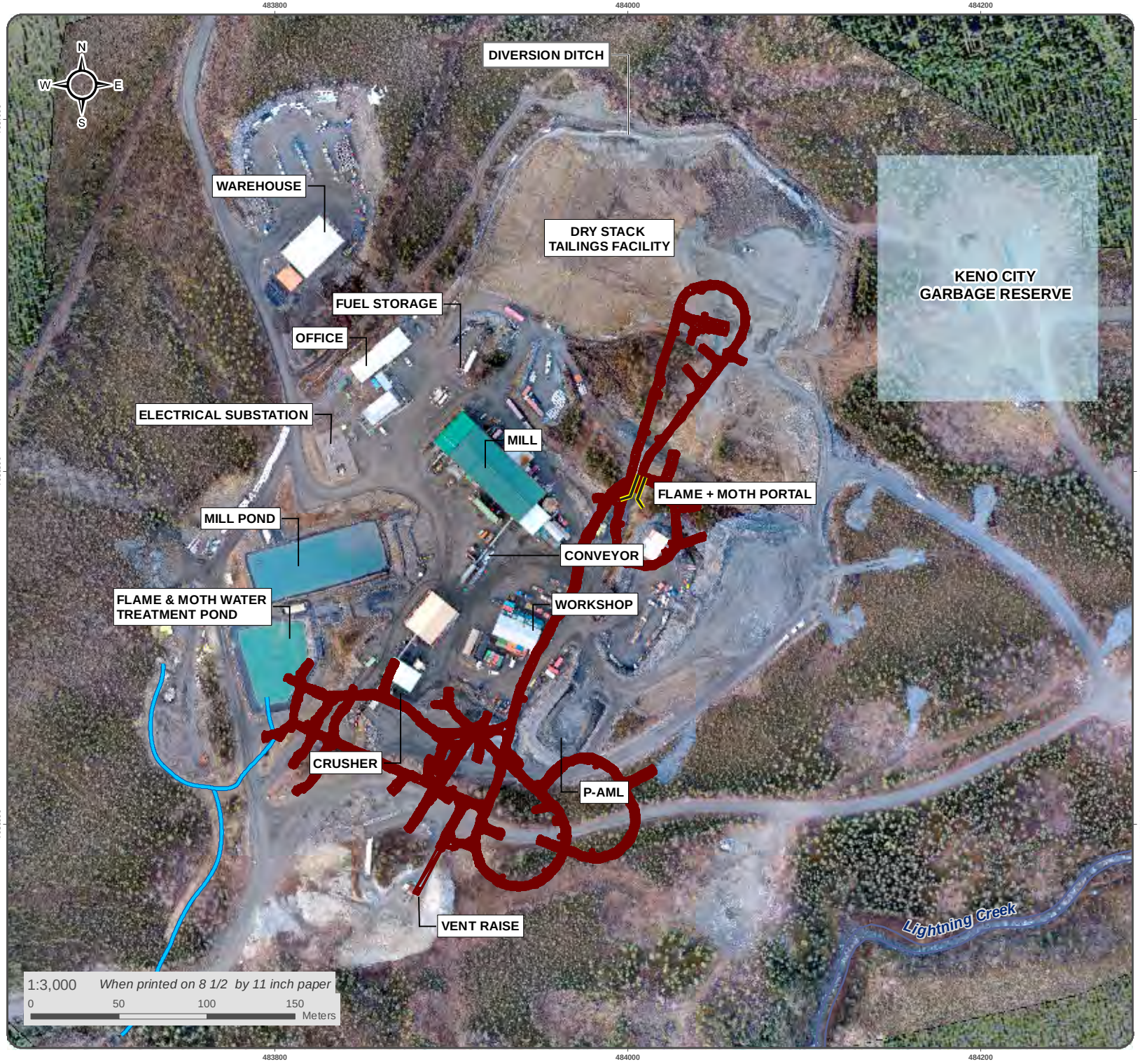
2.1.1 Flame & Moth

The Flame & Moth portal was established in 2016. Ramp development was undertaken in 2018 and resumed in 2020. The Flame & Moth Mine utilizes surface infrastructure at the District Mill site. The associated mill facilities and mine surface infrastructure is shown on Figure 2-1, which consists of the following:

- a miners' office trailer and miners' dry facility,
- lunchroom and washroom trailer with septic storage,
- mobile maintenance shop and office trailers,
- electricians' shop,
- warehouse containers,
- P-AML waste rock facility,
- N-AML waste rock facility,
- portal and fresh air ventilation raise fans and heaters,
- propane storage,
- air compressors,
- District Mill warehouse,
- clarifier inside the District Mill for water treatment, and
- the Flame & Moth settling pond.

In 2022 additional mine surface infrastructure installed included: the fresh air ventilation raise, a new mine office trailer, an electrician's shop with warehouse containers, lube storage container, hazardous waste container, and used oil containment for the waste oil burner that was commissioned in the Flame & Moth mobile maintenance shop.

Two ore bodies are being developed at the Flame & Moth Mine, the Lightning Zone and the Christal Zone. Production from the Lightning Zone commenced in Q1 2022. The surface expression of the underground workings at Flame & Moth as of the end of 2022 are shown in Figure 2-1.



KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 2-2

FLAME + MOTH SITE SHOWING UNDERGROUND MINING AREAS

APRIL 2023

- Adit
- Land Disposition
- Underground Workings, As-Built End of 2022
- Pipeline

Aerial Imagery aquired on August, 2022.

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

Hecla YUKON

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2.1.2 New Bermingham

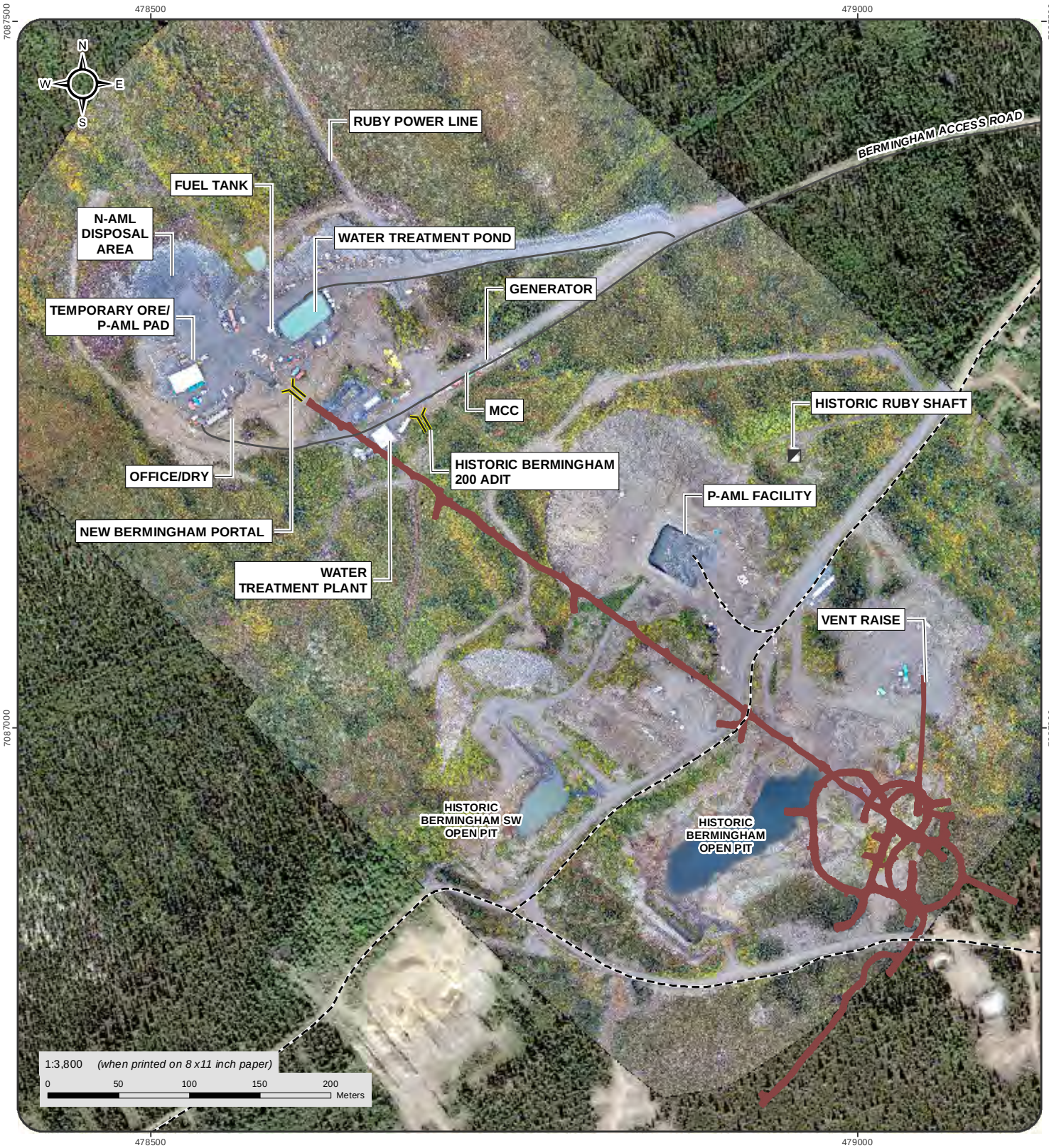
In 2017 the New Bermingham portal was collared and included the development of the ramp to undertake an underground exploration drill program. Underground development resumed in Q3 2020, and ore production commenced in Q3 2021.

The surface infrastructure constructed for the advanced exploration ramp was expanded to facilitate development and production at the New Bermingham Mine in 2020 and with new facilities constructed/commissioned in 2021 and 2002. The surface infrastructure at the New Bermingham Mine is shown on Figure 2-2, and consists of the following:

- a miners' office trailer and miners' dry facility,
- lunchroom and washroom trailer with septic storage,
- mobile maintenance garage,
- warehouse containers,
- temporary ore and P-AML storage pad near portal,
- P-AML waste rock storage facility,
- N-AML waste rock disposal area,
- portal and fresh air ventilation raise fans and heaters,
- air compressors,
- propane storage,
- diesel fuel facility,
- backup generators,
- water treatment system (includes clarifier, reagent addition, surge tanks, ammonia treatment plant, sludge bag containment and settling pond), and
- sludge disposal pit (historic Bermingham SW Pit).

In 2022 the mobile maintenance shop was upgraded to include lube storage, the diesel fuel facility was relocated from the WTP to the portal area, and the sludge bag containment facility was expanded for increased capacity.

At the New Bermingham Mine, the Arctic Zone and the Bear Zone are being developed. There was production from both ore bodies in 2022. The surface expression of the underground workings as of the end of 2022 are shown in Figure 2-2.



Adit/Portal

Shaft

Underground Workings, As-Built End of 2022

Drone Imagery aquired in August 2022
Satellite imagery obtained from ESRI ArcGIS map service https://services.arcgisonline.com/ArcGIS/rest/service on April 27 2023.

Datum: NAD 83; Projection: UTM Zone 8N

Hecla YUKON

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 2-4
NEW BERMINGHAM MINE SITE SHOWING UNDERGROUND WORKINGS

APRIL 2023

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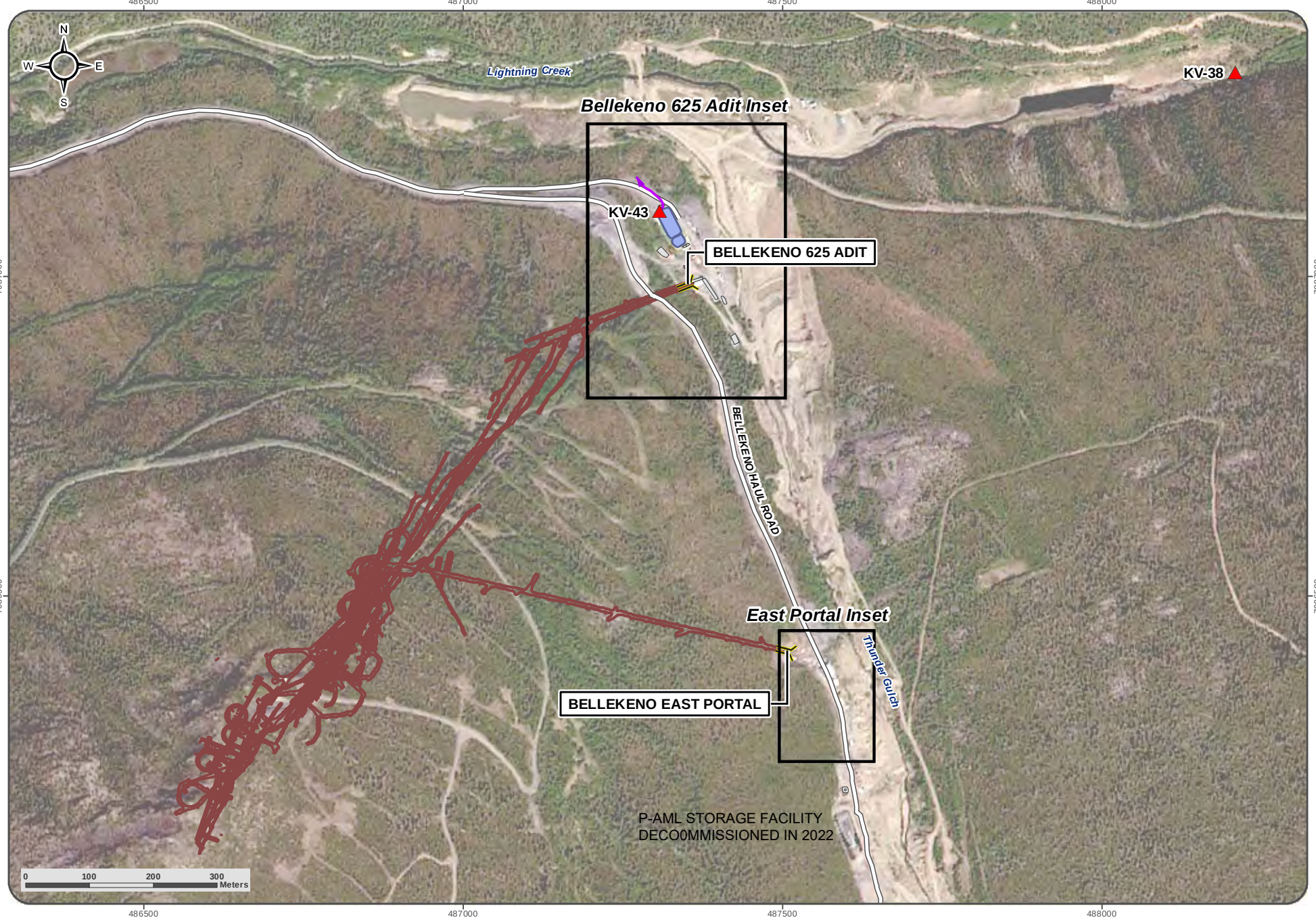
2.1.3 Bellekeno

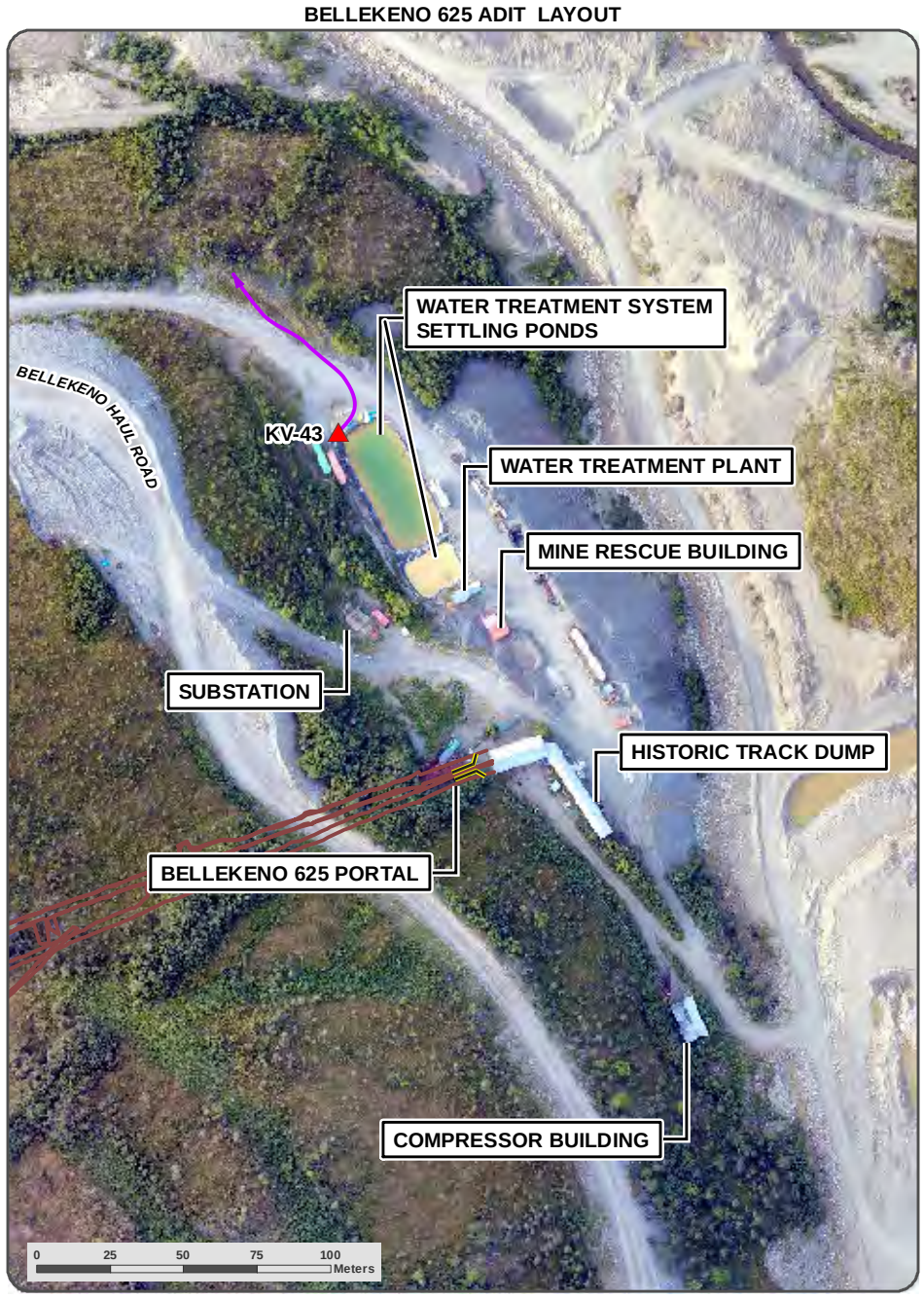
In 2008, Alexco undertook the development of a new ramp (Bellekeno East Portal) to access the central area of the historic Bellekeno Mine, and the rehabilitation of the Bellekeno 625 Adit. AKHM commenced production from the Bellekeno Mine in Q3 2011. Underground development at Bellekeno was placed under temporary closure in Q3 2013. In 2020, dewatering commenced in Q2 and mine production resumed in Q4. Mine production ceased Q4 2021, and the mine was again placed under temporary closure. The surface expression of the underground workings is also shown on Figure 2-3.

Surface infrastructure remaining at the Bellekeno Mine includes historical infrastructure, the Bellekeno 625 water treatment plant and associated ponds, the former mine rescue trailers (which have been repurposed for EMM study office), tanks for the EEM studies and an outhouse adjacent to the water treatment plant and some stores on the laydown yard (Figure 2-3).

In 2022, the underground workings were in the process of flooding. The Bellekeno 625 Adit water treatment facility remains in place to treat mine effluent once it reaches the Bellekeno 625 Adit level. This treated effluent is discharged to ground prior to reaching Lightning Creek.



BELLEKENO 625 ADIT LAYOUT



EAST PORTAL LAYOUT

- Surface Water Quality Stations
- Adit
- Building/Structure
- Pond
- Underground Workings, As-Built End of 2021
- Pipeline
- Haul Road

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on April 2023. Aerial imagery aquired on August 2017

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

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 2-5

BELLEKENO MINE SURFACE FACILITIES

APRIL 2023

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2.1.4 Lucky Queen

There have been no mining or development activities at Lucky Queen 2014 to 2022. The existing Lucky Queen portal pad, developed on a historic waste dump, will be used to support mining operations at Lucky Queen. The existing surface infrastructure includes a shop and office as seen in Photo 2-1.

Photo 2-1: Lucky Queen Surface View from 2018.

2.1.5 Onek 990

There have been no mining or development activities at Onek 990 from 2014 to 2022. Photo 2-2 shows the surface view of the Onek 990 Deposit.

Photo 2-2: Onek 990 Surface view from 2018

2.2 UNDERGROUND MINING

In 2022 ore was extracted from both the Flame & Moth and New Bermingham mines as indicated in Table 2-1. Mining occurred in 2022 from January 1 thru June 26, at which time the decision was made to cease ore production and focus on the development of mine headers at the Flame & Moth and New Bermingham mines.

Table 2-1: Ore extracted in 2022

UNDERGROUND MINING ORE BODY	ORE EXTRACTED FROM AREA IN 2022 (TONNES)	ORE EXTRACTED THROUGHOUT OPERATING LIFE (TONNES)
Bellekeno East	0	20,170 [1] 262,316 [2]
Flame & Moth Lightning Zone	8,563	8,563
New Bermingham Arctic & Bear Zone	10,439	16,549

1. *Production since the Licence QML-0009 Effective Date, November 27, 2019.*
2. *Production since the initial issuance of QML-0009, November 17, 2009.*

There was no underground mine exploration in 2022. The underground diamond drill program was infill drilling only.

2.2.1 Flame & Moth Mine

In 2022, the mine development and ore production continued until June 26, 2022, at which time the ore production was shut down and mine development occurred for the remaining portion of the year. An overview of the infrastructure underground at Flame & Moth is provided in Figure 2-4. Figure 2-5 shows a cross section of underground development. An as-built plan of the workings at Flame & Moth as of the end of 2022 is provided in Figure 2-6. A schematic of the Flame & Moth Mine electrical system is provided in Figure 2-7. Figure 2-8 provides ventilation details as they existed at year end.

Mine water management along with regular maintenance continued to support safe mine production throughout the year. Improvements and optimization of the mine water management system was conducted throughout the year to ensure adequate handling and capacity of the systems.

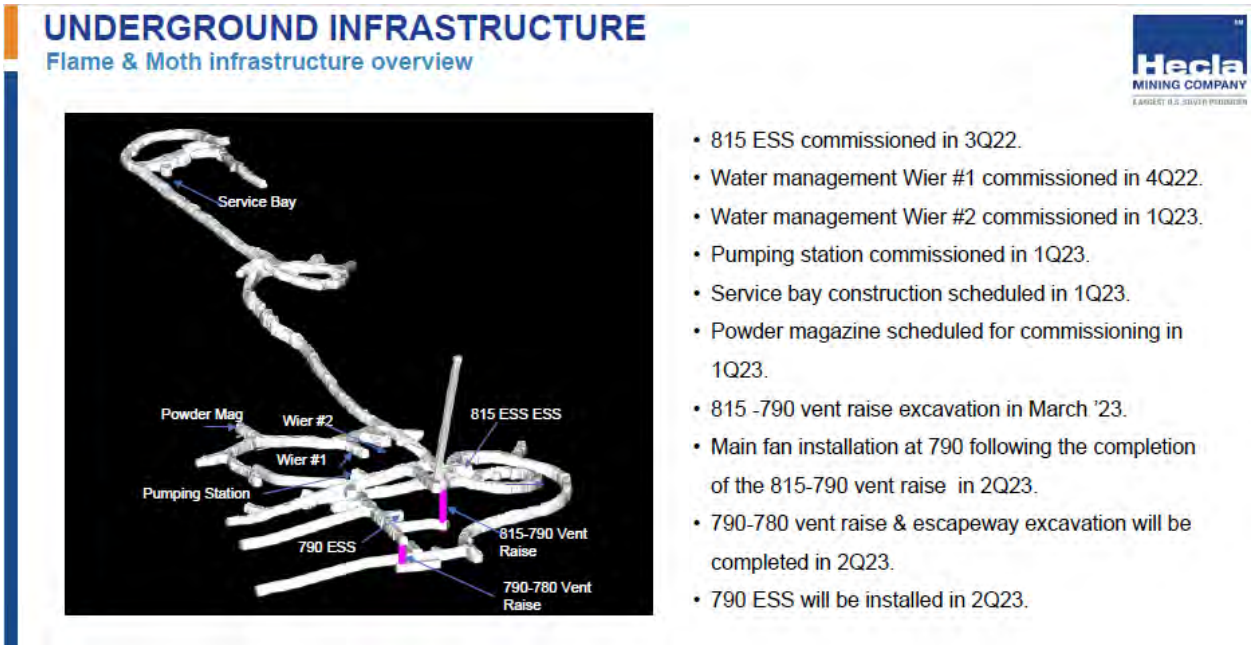


Figure 2-4: Flame & Moth Mine underground infrastructure overview

Figure 2-5: Flame & Moth Mine cross-section as of year-end 2022

484,200E

7,086,800N

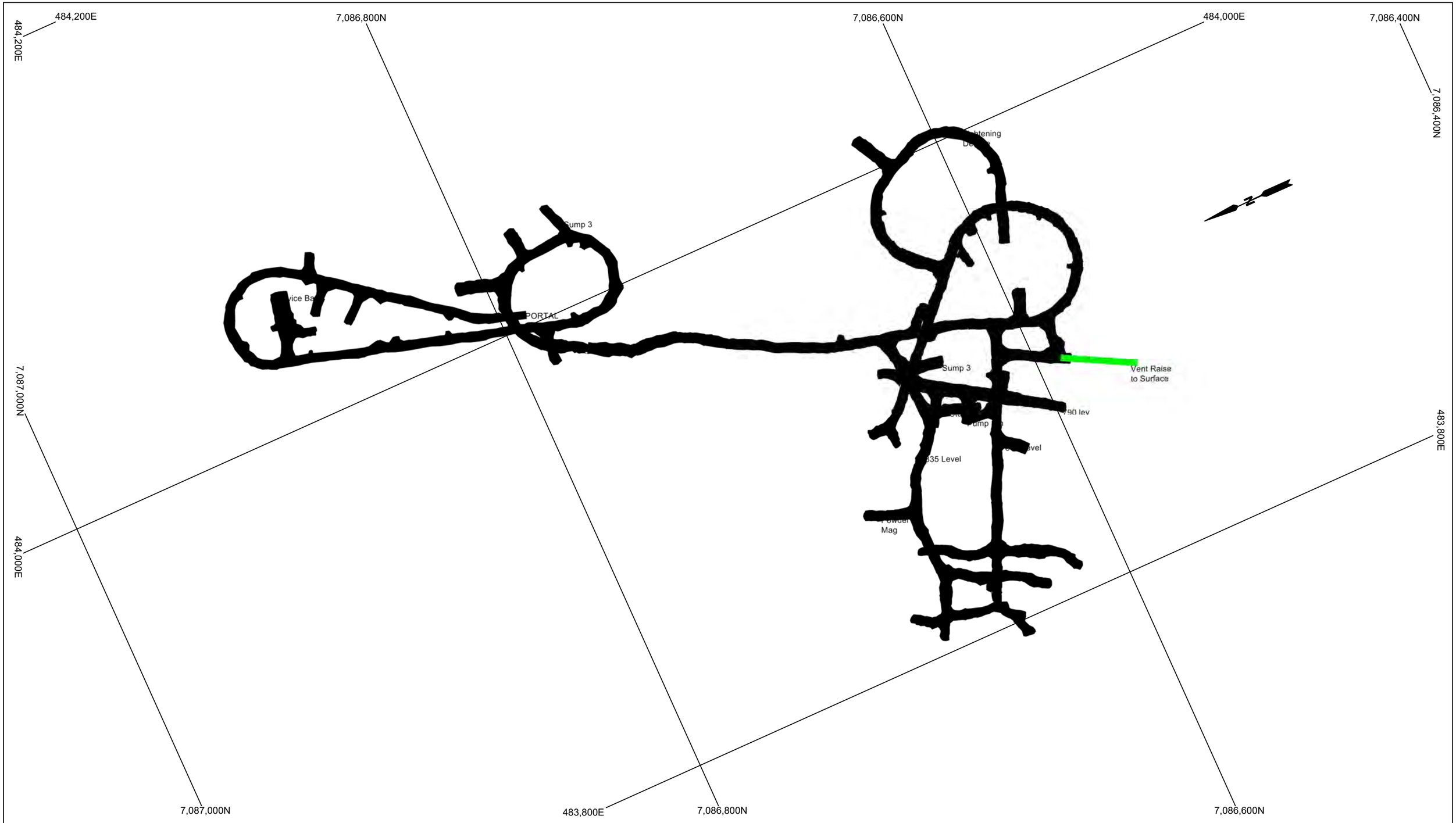
7,086,600N

484,000E

7,086,400N

7,087,000N

483,800E



				☐ DESIGN			
				☐ GEOLOGY			
				☐ MECH./ELEC.			
				☐ GROUND CTR.			
				☐ OPERATIONS			
				☐ ENGINEERING			
REV	DESCRIPTION	DATE	BY	DEPARTMENT	INITIALS	DATE	SIGNATURE
REVISIONS				APPROVAL			

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DRAWN BY		DATE	TITRE / TITLE
CHECKED BY		DATE	**FLAME & MOTH MINE AS-BUILT (END OF 2022)**
APPROVED BY		DATE	
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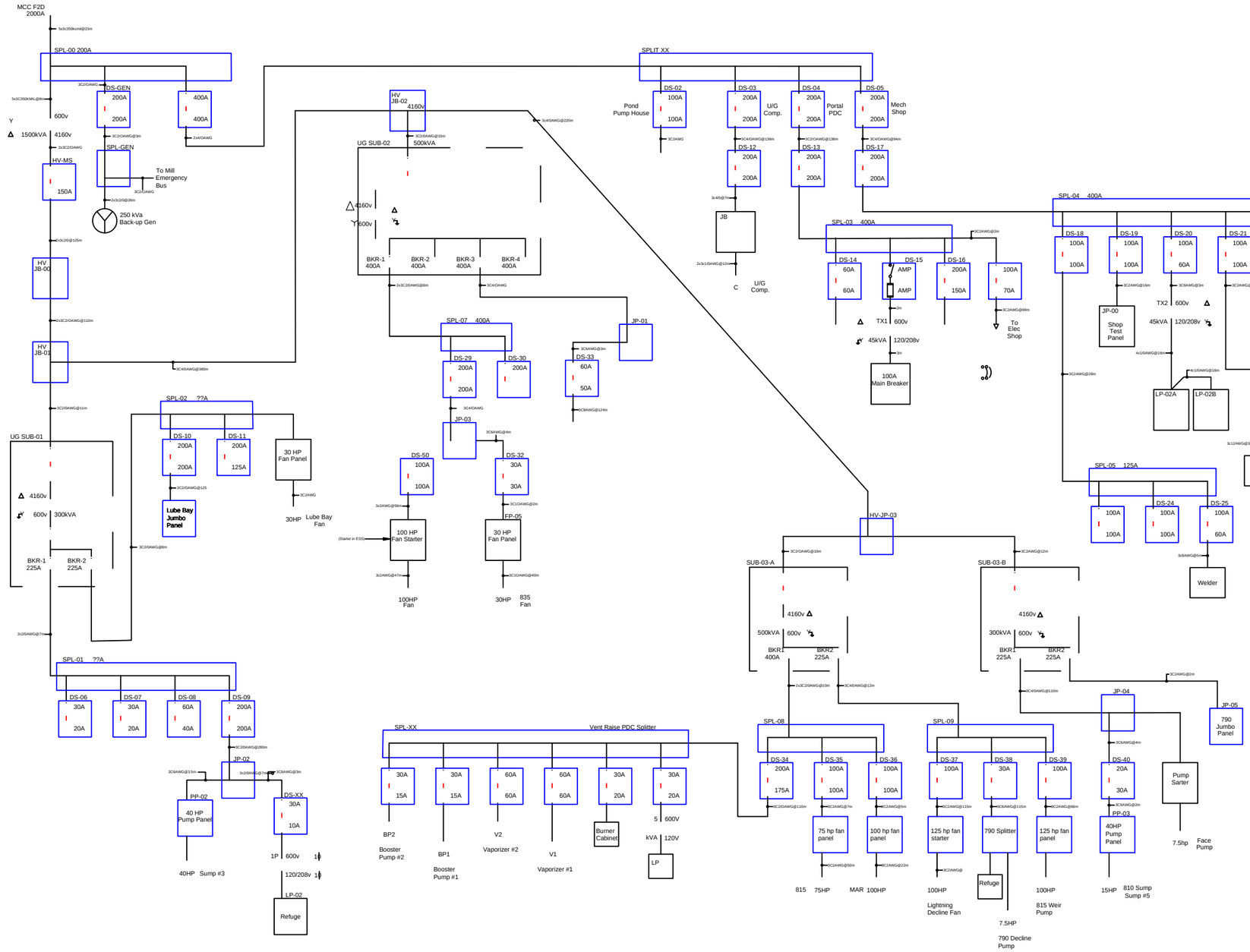

Comments	Rev.	Date	Keno Hill, Yukon Territory, Canada		FIGURE 2-7.
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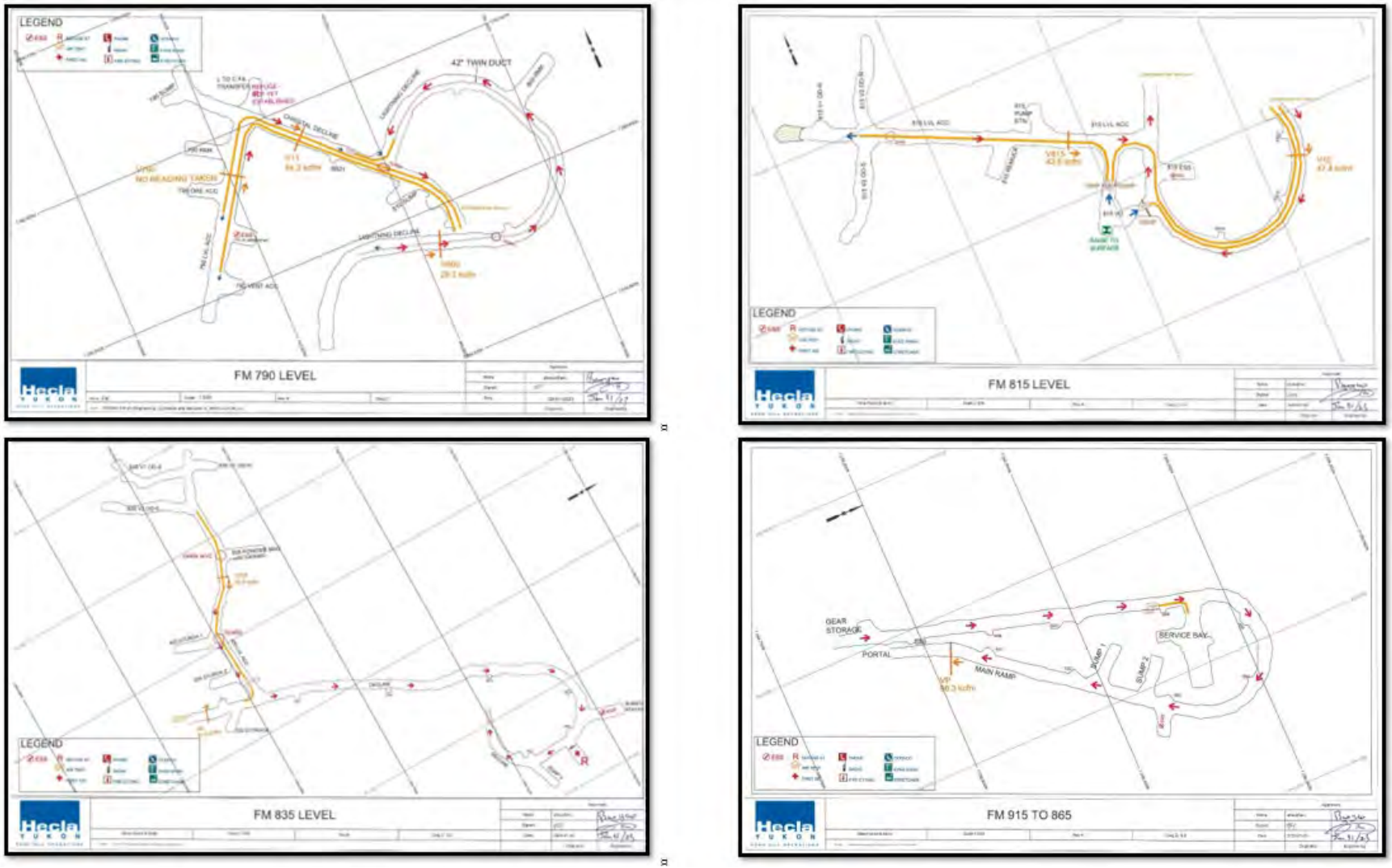


Figure 2-8: Flame & Moth Mine ventilation survey as of year-end 2022

2.2.2 New Bermingham Mine

In 2022, the mine development and ore production continued until, June 26, 2022 at which time the ore production was shut-down and mine development occurred for the remaining portion of the year. An overview of the infrastructure underground at New Bermingham is provided in Figure 2-9. Figure 2-10 shows a cross section of underground development. An as-built plan of the workings at New Bermingham as of the end of 2022 is provided in Figure 2-11. A schematic of the Flame & Moth Mine electrical system is provided in Figure 2-12. Figure 2-13 provides ventilation details as they existed at year end. Mine water management along with regular maintenance continued to support safe mine production throughout the year. Improvements and optimization of the mine water management system was conducted throughout the year to ensure adequate handling and capacity of the systems.

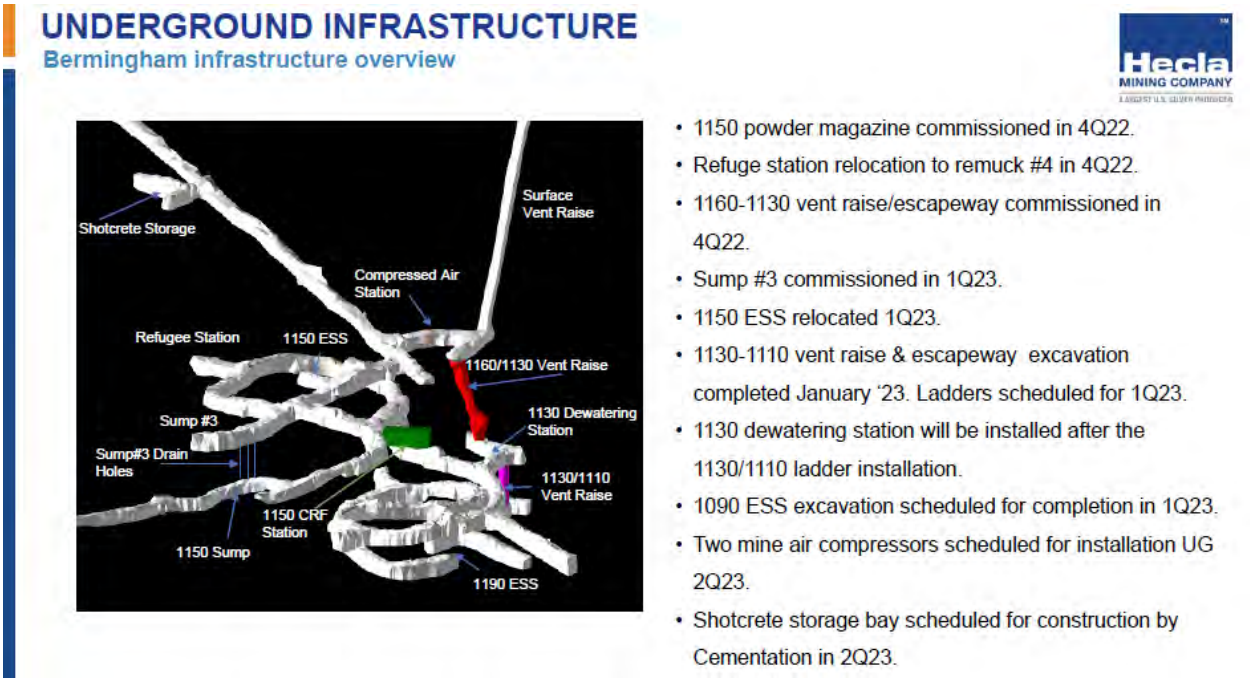


Figure 2-9: New Bermingham Mine underground infrastructure overview

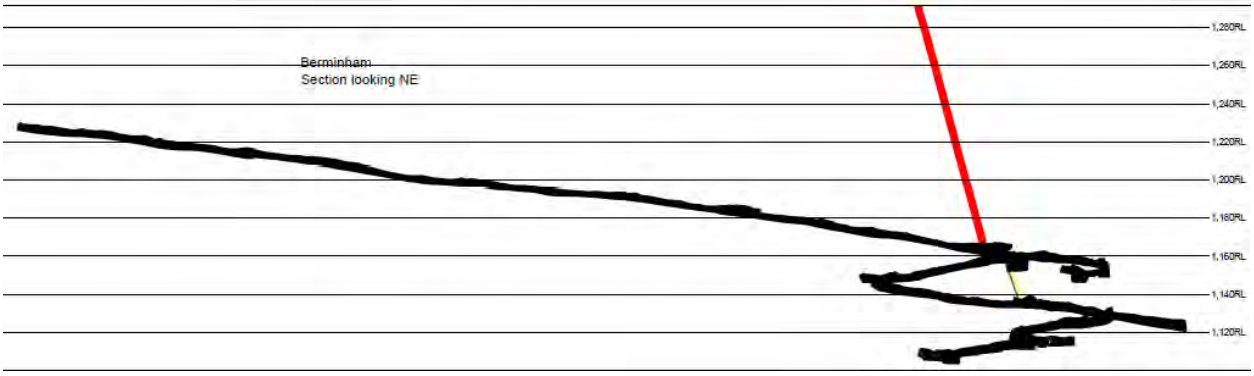
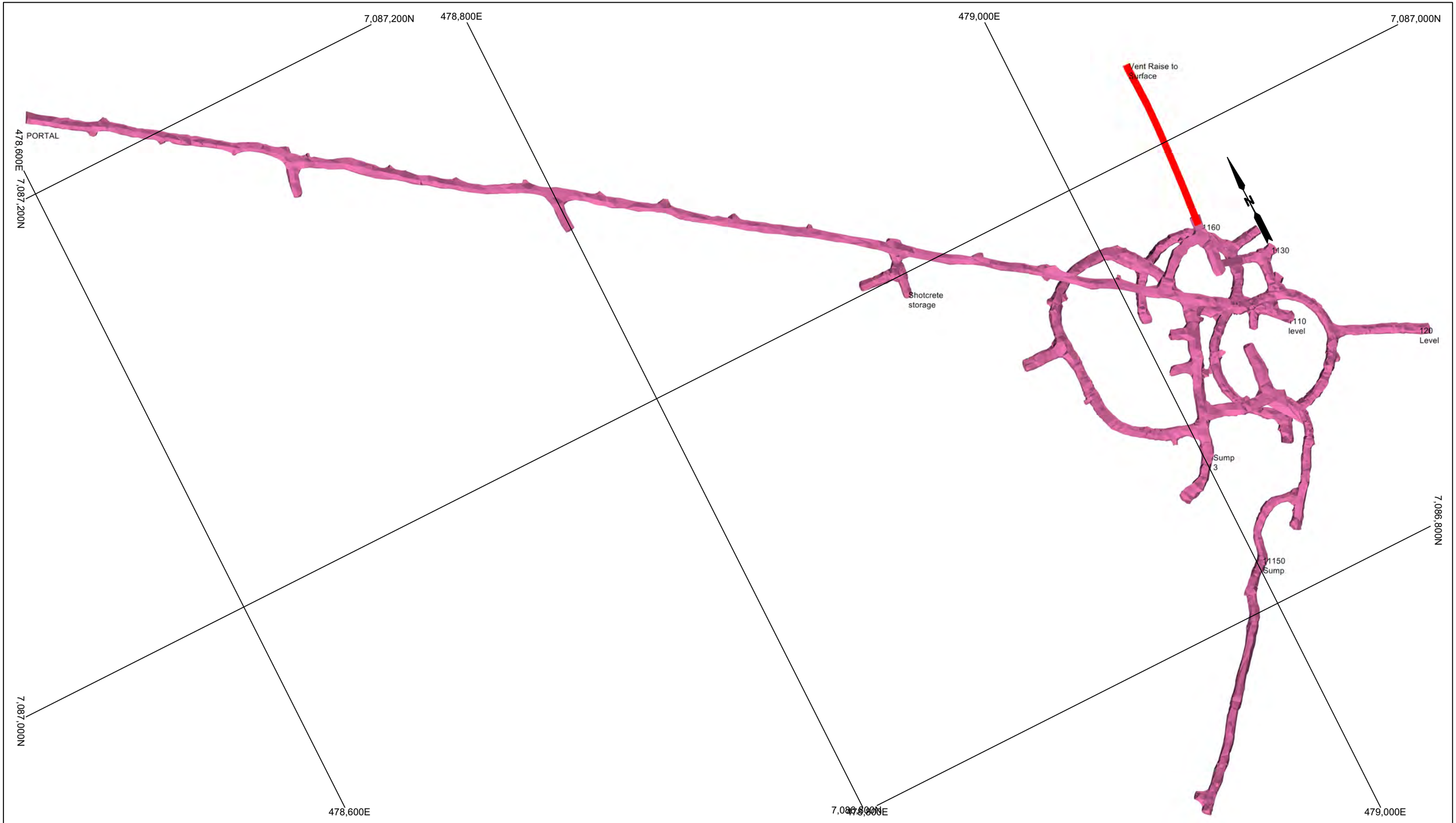


Figure 2-10: New Bermingham Mine cross-section as of year-end 2022



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REVISIONS				APPROVAL			

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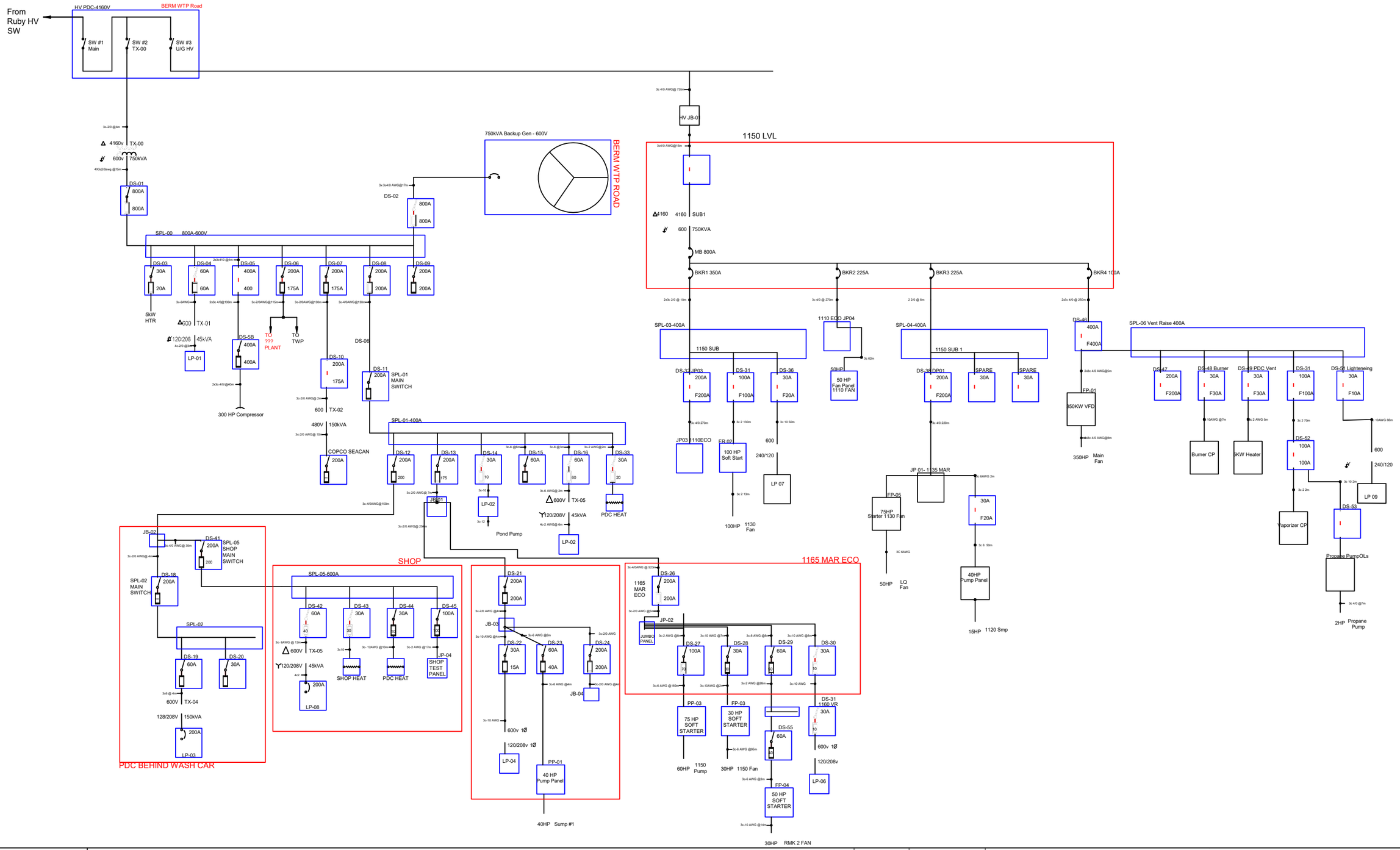

Comments	Rev.	Date		
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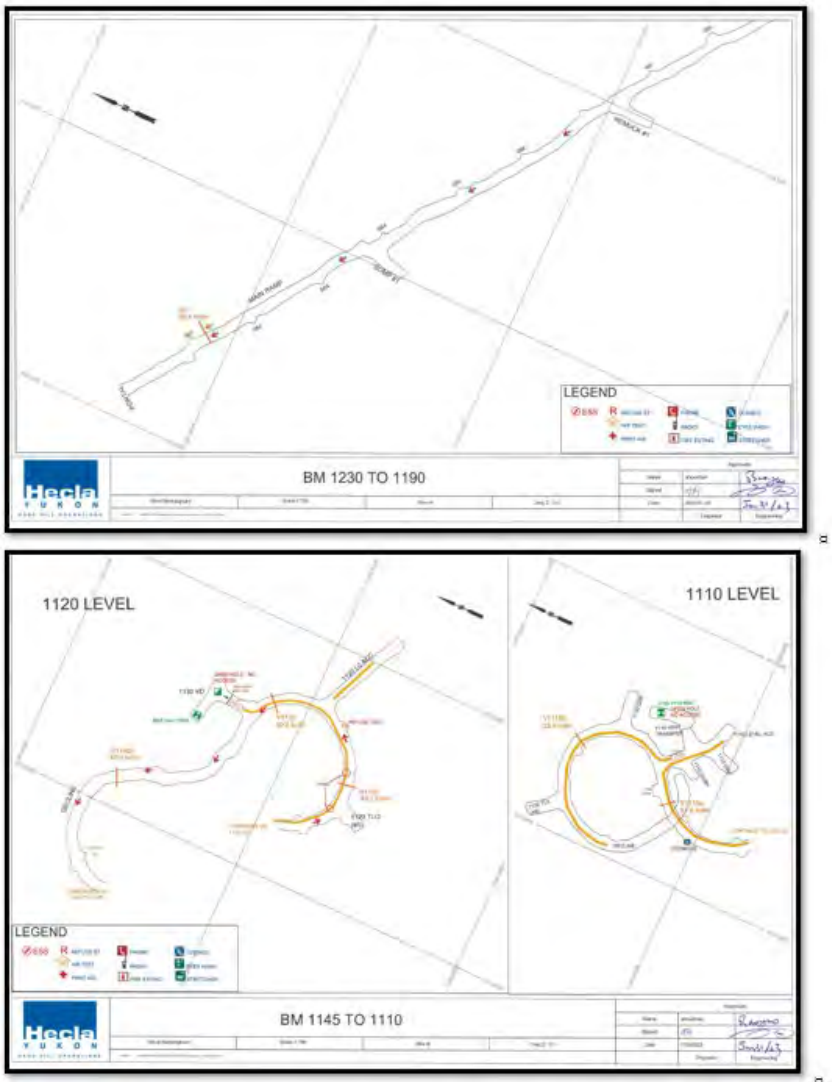

Figure 2-13: New Bermingham Mine ventilation survey as of year-end 2022

2.2.3 Bellekeno East Mine

No mining occurred in the Bellekeno Mine during 2022. The Bellekeno Mine was put on temporary closure on November 15, 2021. A coffer dam was installed at the BK 625 adit and on-going monitoring of the site continued throughout 2022 (

Figure 2-14). In-situ water treatment operations occurred during the year with the addition of molasses to the underground workings as a carbon source to develop the biological community (the sulphate reducing organisms) within the mine water.

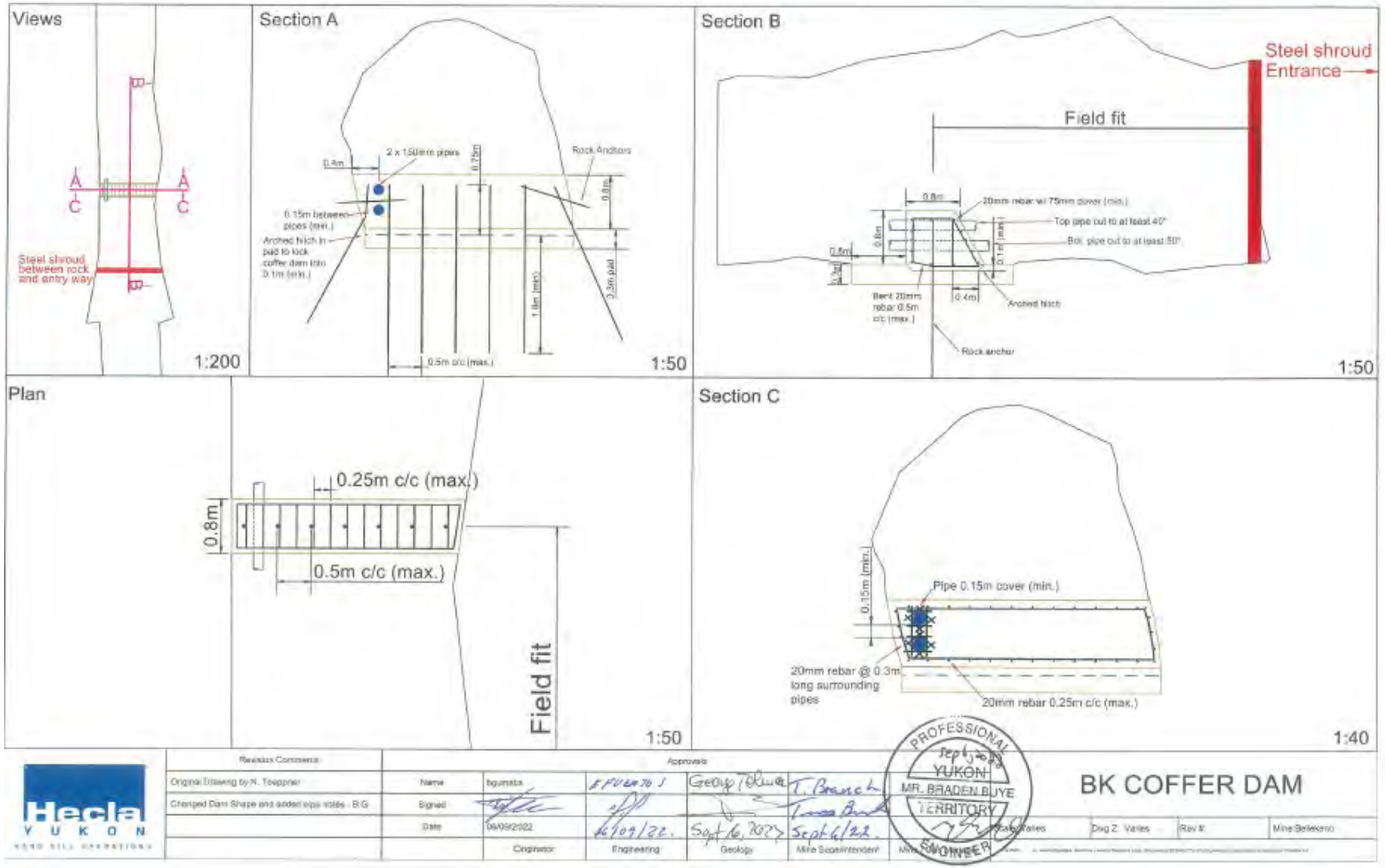

Figure 2-14: Bellekeno 625 Adit coffer dam issued for construction

2.2.4 Underground Mining Quality Assurance and Quality Control

Quality assurance and quality control programs related to underground mining activities of AKHM covering ground control, ventilation, and survey are listed below.

Ground Control

- Ground control inspection / assessments of a fresh blasted area done on daily base – records kept on Ground Control Book at each mine.
- Ground control instruction to remediate the deficiencies are issued by technical services as need – records kept on hard copy and electronically.
- Pull test for rock bolts done for 0.5% of installed bolts. This is completed along the year as the face advance to ensure the installation is done properly. Electronically documented and submitted yearly to the Mine inspectors.
- Previews excavated area inspection done periodically and remediation plans for action issued.

Ventilation

- Ventilation surveys are done each week on regular bases or whenever significant change in ventilation system occurs to ensure the quality and quantity requirements. Ventilation reports are issued on hard copy and kept electronically records.
- Vent instruction issued for each ventilation work update. Records are oh hard copy and electronically.

Survey

- All UG excavation are surveyed or CMS on daily base as the excavation progress, to construct "as built" solids and compared with the plan and reported figures. Quantities of different categories of material mined out are crosschecked between operation/ technical services and mill.

Quality assurance and quality control programs related to underground geological activities of AKHM include the following:

Ore / Waste Call

- Every blast will be mucked out to a remuck bay where a geologist will inspect the mucked-out sill and washed face, walls, and back to determine accurate ore or waste calls. If the face is waste, then the geologist will determine if the muck is PAML or NAML depending on the sulfide content.
- All waste calls in ore sills will be called as PAML or incremental ore only depending on ore mineral amounts.
- Waste calls in development will be called NAML or PAML depending on sulfide content.

Face Mapping

- Every blast will be mapped to scale (1:100) by a geologist.

- Detail mapping of lithologies, structures, mineralization, veining and alterations will be recorded on the face map which will be scanned and copied to the tech services server.
- Four photos of every face will be taken, one of the face, left wall (LW), right wall (RW) and one of the back of the round. All photos are downloaded and stored in the tech services server.

Face Sampling

- Every ore face will be sampled by marking up the lithological contacts and sampling "chips taken from the face between the marked-up contacts.
- Certified standards will be selected to match rock types and submitted along with all face sample to validate the internal assay lab QA/QC results. If the standard fails, then a re-assay will be requested.

a. Test Hole Sludges

- Two test holes will be completed on every ore drive round, one in the LW and the second in the RW. Depths of test holes will depend on mineralization haloes, but the standard depth will be eight feet.
- The test hole sludges will be collected by the mine department while installing ground support and will be submitted to the internal lab daily.

Mid-Lift Mapping

- Mid-Lift mapping will be completed routinely at a scale of 1:250. Mapping is to be completed in all areas of the mine at mid chest level.
- Maps will include lithological contacts, structural measurements, mineralization amounts, veining and alteration intensities.
- All underground maps will be drafted onto final level maps which will be accessible to all departments.

Stockpile Inspections

- Start of shift and end of shift stockpile visits will be done routinely to make sure the number of piles match what was recorded during the previous shift.
- When inspecting the Ore Pad, the geologist will meet with the mill feed operator (loader operator) to inform them of any expected irregularities in the ore grades.

Stope Inspections

- Stopes will be inspected routinely to pick up muck samples from the operators and to inspect the stopes of any hazards, such as:
    - Brow conditions
    - Over breaking or under breaking
    - Sloughing
    - Water Hazards
    - Digging
- Photos of the stope will be taken along with each inspection and reported in a inspection report which will be saved in the tech services server.

- Before stopes are taken, geology will mark up a 5-foot reference line along the walls to prevent scope operators from digging into the backfill.

Production Mucking Tracking

- Operations will fill out muck sheets which includes the date, name of operator, location where the muck was taken from and location where the muck was taken too. These reports will be entered into a muck movement tracker to assist the geology department in tracking stockpile amounts.

Recording and Reviewing Data

2.3 ORE PROCESSING AND CONCENTRATE PRODUCTION

2.3.1 Infrastructure Projects

The reagent laydown yard is located between the mill and the DSTF on a lined pad. Sea containers are used to store those reagents that must be sheltered from light exposure and/or rain (Photo 2-3).

In 2022, routine maintenance of the mill continued, and the zinc and lead regrind circuit upgraded to improve recovery. Ditches and culverts at the mill yard continued to be maintained to facilitate channeling melt water in the spring and storm events into to sediment basins.

Photo 2-3: Reagent Laydown Yard

2.3.2 Reagents

Table 2-2 summarizes the reagents used in ore processing, the primary purpose of each reagent and the annual consumption rate. Reagent consumption in 2022 is below average as production ceased on June 26, 2022.

Table 2-2: Floatation process reagents and annual consumption

REAGENT NAME	CHEMICAL FORMULA NAME	PURPOSE	2022 CONSUMPTION (kg)	AVERAGE ANNUAL CONSUMPTION (kg)
3418A	$C_8H_{18}PS_2Na$ Aerophine Promoter	Collector for the sulphide minerals to attach to the air bubbles	853	6,850
Copper Sulphate	$CuSO_4$	Activates zinc in the zinc floatation process	1,550	12,400
Flocculant A2501	Polyclear	Concentrate dewatering aid	178	350
Lime	$Ca(OH)_2$	Increases pH of the floatation slurry	2,600	20,800
MIBC[1]	Methyl Isobutyl Carbinol	Frother to make bubbles in floatation circuit	1,288	10,300
SIPX	Sodium Isopropyl Xanthate	Collector for the sulphide minerals to attach to the air bubbles	180	1,450
Sulfuric Acid	H_2SO_4	Reduces pH of the floatation slurry	13,950	111,600
Zinc Sulphate	$ZnSO_4$	Suppresses zinc from floating in the lead floatation process	5,975	47,800

1. *Alternative frothers include PAX (Potassium Amyl Xanthate), KAX51 (mix of isoamyl alcohol, potassium amyl xanthate, and potassium hydroxide), and W22 (mix of polyoxyalkylene alkyl ether 4-methylpentan-2-ol propylene carbonate)*

2.3.3 Ore Processing and Concentrate Quality Assurance and Quality Control

The following activities are the quality assurance and quality control programs related to the ore processing facility.

- The mill feed belt scale is calibrated once a month.
- The truck scale is calibrated annually; last calibration was June 08, 2022.
- In the assay lab six certified reference materials are used to check the quality and validate analytical measurement methods. Every batch of samples are checked.

2.3.1 District Mill Operating Results

The tonnes of ore milled and average head grade for each year to the end of 2022 from the effective date (November 27, 2019) of QML-0009 is provided in Table 2-3. The quantity and grade of concentrate produced during this period is listed in Table 2-4.

Table 2-3: Milling and head grade

YEAR	MILL FEED (dmt)	HEAD GRADE			CONCENTRATE PRODUCED	
		Ag (g/t)	Pb-Ag (dmt)	Zn (dmt)	Pb (%)	Zn (%)
2019	0					
2020	310					
2021	29,113	720	3,103	1,570	8.5	3.9
2022	19,927	455	578	746	1.3	2.5
CUMMULATIVE TOTAL	**49,350**	**608**	**3,681**	**2,316**	**5.6**	**3.3**

Table 2-4: Concentrate production and grade

YEAR	AVERAGE LEAD-SILVER CONCENTRATE GRADE			AVERAGE ZINC CONCENTRATE GRADE			TOTAL CONCENTRATE REMOVED FROM SITE (dmt)	
	AG (g/t)	Pb (%)	Zn (%)	Ag (g/t)	Pb (%)	Zn (%)	Pb-Ag	Zn
2019								
2020	0	0	0	463.7	5.2	47.9	3,106	1,460
2021	5996.4	69.8	2.0	764.7	2.5	47.9	585	740
2022	13681.2	37.5	4.8	560.6	4.3	47.9	3691	2201
CUMMULATIVE TOTAL	**7203.5**	**64.7**	**2.5**	**463.7**	**5.2**	**47.9**	**3,106**	**1,460**

2.4 ORE STOCKPILES

The following table describes the ore stockpile volumes at the district mil ore pad during 2022. The design for a new ore pad at the District Mill is provided in Figure 2-15. Construction is to commence in Q1 2023 to enable the resumption of milling Q2 2023.

Table 2-5: District Mill ore stockpile movement

2022	VOLUME (m^3) OF ORE PLACED IN STOCKPILES	VOLUME (m^3) OF ORE REMOVED FROM STOCKPILES
January	613	515
February	1,460	703
March	1,684	2,323
April	1,723	2,244
May	2,565	2,674
June	774	796
July	0	0
August	0	0
September	0	0
October	0	0
November	0	0
December	0	0
2022 CUMULATIVE TOTAL	**8,819**	**9,255**

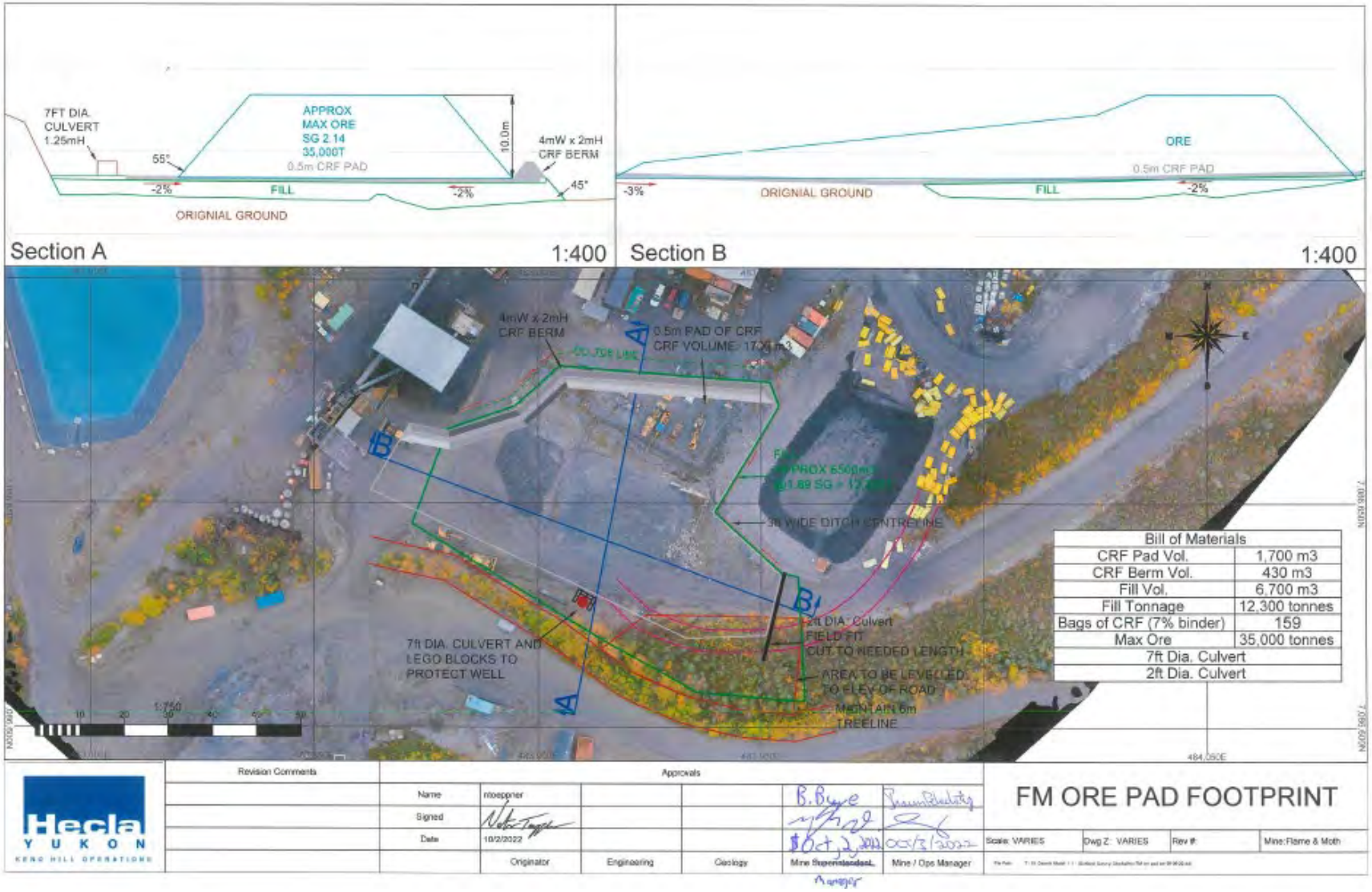

Figure 2-15: District Mill Ore Pad issued for construction

2.5 WASTE ROCK AND OVERBURDEN

All waste rock brought to surface was identified as Non-Acid Metal Leaching (N-AML) or Potentially-Acid Metal Leaching (P-AML) based on field screening criteria developed for the individual deposits as described in the Waste Rock Management Plan (Ensero, 2021). Table 2-6 provides a summary of the total waste rock excavated and where it has been stored since the effective date of QML-0009 (November 27, 2019). Figure 2-16 and Figure 2-17 illustrate where N-AML waste was place in 2022.

Table 2-6: Waste rock excavation, storage, and construction use

LOCATION	2019	2020	2021	2022	CUMULATIVE TOTAL
WASTE ROCK EXCAVATED					
Bellekeno Mine (tonnes)	0	0	0	0	0
New Bermingham Mine (tonnes)	0	4,545	10,452	32,270	47,267
Flame & Moth Mine (tonnes)	0	8,837	18,066	39,507	66,410
WASTE ROCK USED FOR CONSTRUCTION					
Construction of Bellekeno Haul Road (m^3)	0	0	0	0	0
Construction District Mill yard (m^3)	0	4,676	9,559	850	15,079
Construction of DSTF (m^3)	0	0	0	0	0
Construction of New Bermingham pad (m^3)	0	2,405	0	0	2,405
WASTE ROCK STOCKPILED FOR CONSTRUCTION					
Bellekeno Mine (m^3)	0	0	0	0	0
Flame & Moth Mine (m^3)	0	0	0	0	0
New Bermingham Mine (m^3)	0	0	0	0	0
WASTE ROCK IN MANAGEMENT FACILITIES					
New Bermingham Waste Dump (m^3)	0	0	4,342	16,466	20,808
New Bermingham P-AML Facility (m^3)	0	0	1,188	608	1,796
Flame & Moth Waste Dump (m^3)	0	0	0	18,255	18,255
Flame & Moth P-AML Facility (m^3)	0	0	0	1,798	1,798
Bellekeno Waste Dump (m^3)	0	0	0	0	0
Bellekeno P-AML Facility (m^3)	0	0	-600	0	-600
WASTE ROCK PLACE IN TEMPORARY AREAS					
Bellekeno Mine (m^3)	0	0	0	0	0
Flame& Moth Mine (m^3)	0	0	0	0	0
New Bermingham Mine (m^3)	0	0	0	0	0
WASTE ROCK RELOCATED UNDERGROUND AND/OR USED FOR BACKFILL					
Bellekeno Mine (m^3) (not backfill)	0	0	600	0	600
Flame & Moth Mine (m^3)	0	0	0	0	0
New Bermingham Mine (m^3)	0	0	0	0	0

Prior to the effective date of QML-0009, approximately 3,000 m^3 remained in the overburden stockpile below the Mill Pond from the development of the DSTF and District Mill site. Table 2-7 provides an estimate of the organics recovered from site activities and where it is store or used from the effective date of QML-0009. The volumes below reflect the uncompacted nature of the organics handled.

Table 2-7: Overburden storage, and reclamation use

LOCATION	2019	2020	2021	2022	CUMULATIVE TOTAL
OVERBURDEN STOCKPILED					
Bellekeno Mine (m^3)	0	0	0	0	0
District Mill (m^3)	0	0	5	0	5
New Bermingham Mine (m^3)	0	0	0	0	0
OVERBURDEN USED FOR RECLAMATION					
DSTF (m^3)	0	0	10	5	15

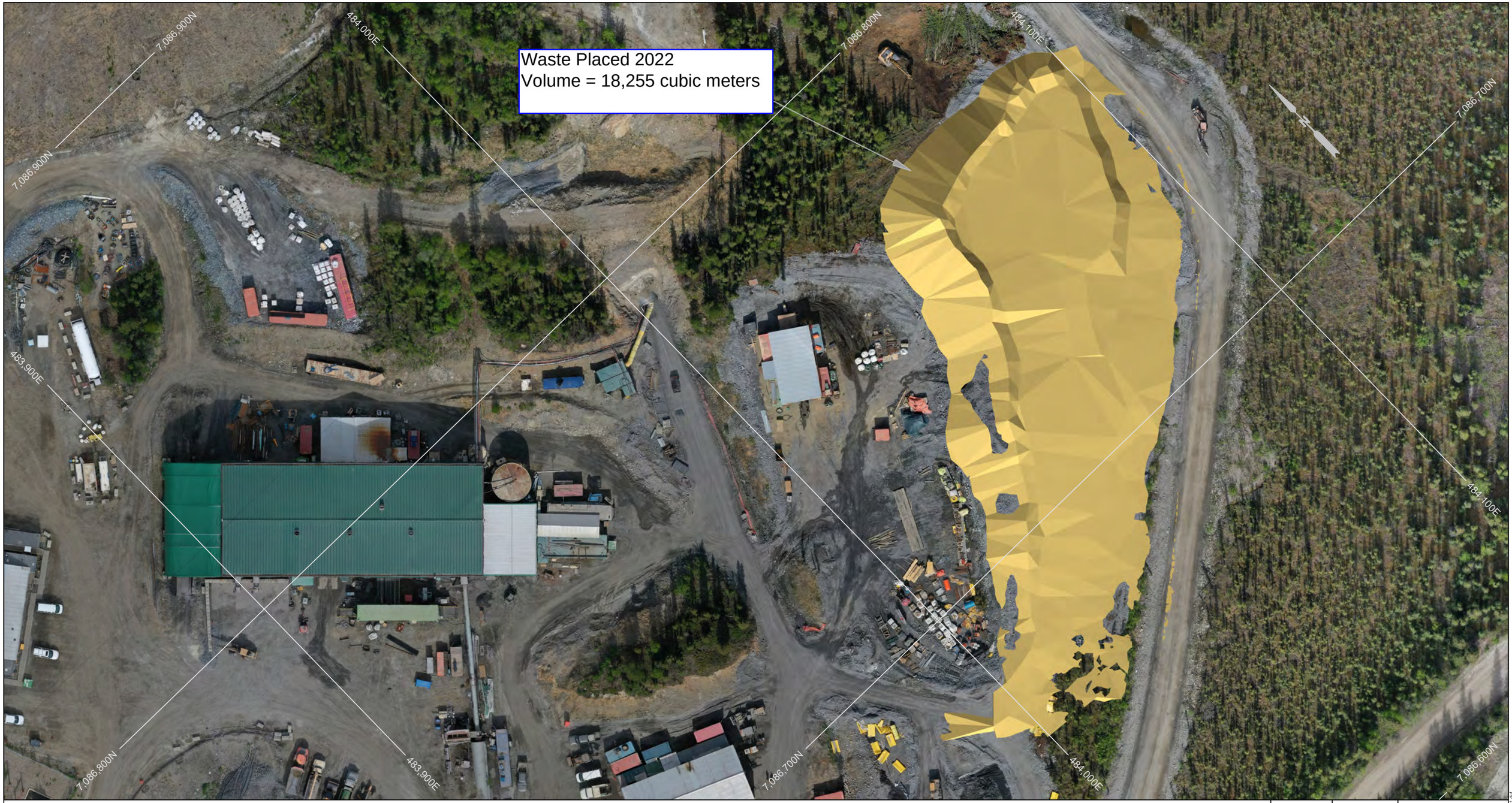

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FIGURE 2-1ê

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Waste Dump

Flame & Moth

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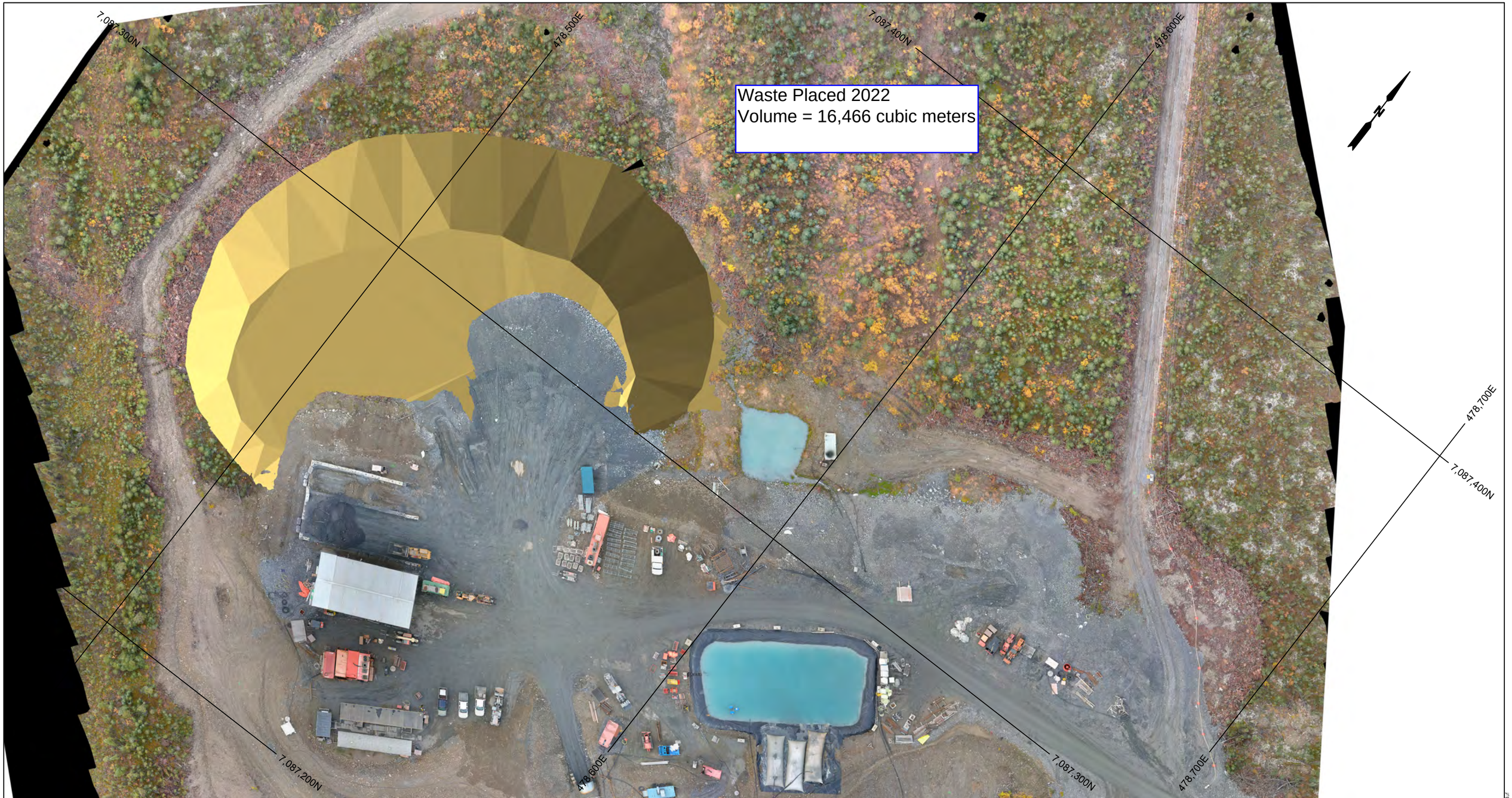

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Waste Dump

BERMINGHAM

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2.6 TAILINGS

2.6.1 Dry Stack Tailings Facility Construction

In 2022, liner was laid for the placement of additional tailings in accordance with the phase 1 DSTF design. Maintenance of the ditches and sumps were undertaken in preparation for winter. Additional maintenance activities were completed in response to recommendations from the annual geotechnical inspection.

Geotechnical studies and detailed engineering design for phase 2 of the DSTF is scheduled to be conducted in 2022. Tailings were placed in the DSTF as directed in the DSTF *Operation, Maintenance, and Surveillance Manual* (OMS), which forms part of the DSTF *Construction and Operation Plan*. Geotechnical investigation is required to advance the phase 2 DSTF design. An update of the OMS Manual will be required to incorporate the findings of the investigation in support of the detailed design of the expansion.

No changes were made to the tailings management plan during 2022. Tailings were placed in the DSTF as directed in the DSTF Operation, Maintenance, and Surveillance Manual (OMS). The DSTF OMS is being updated with the Phase 2 DSTF design and is planned to be submitted for review in the second quarter of 2023.

2.6.2 Humidity Cell Tests

No testing of co-mingled tailings was conducted in 2022. The testing of co-mingled tailings is planned to be conducted in 2023.

2.6.3 Tailings Deposition

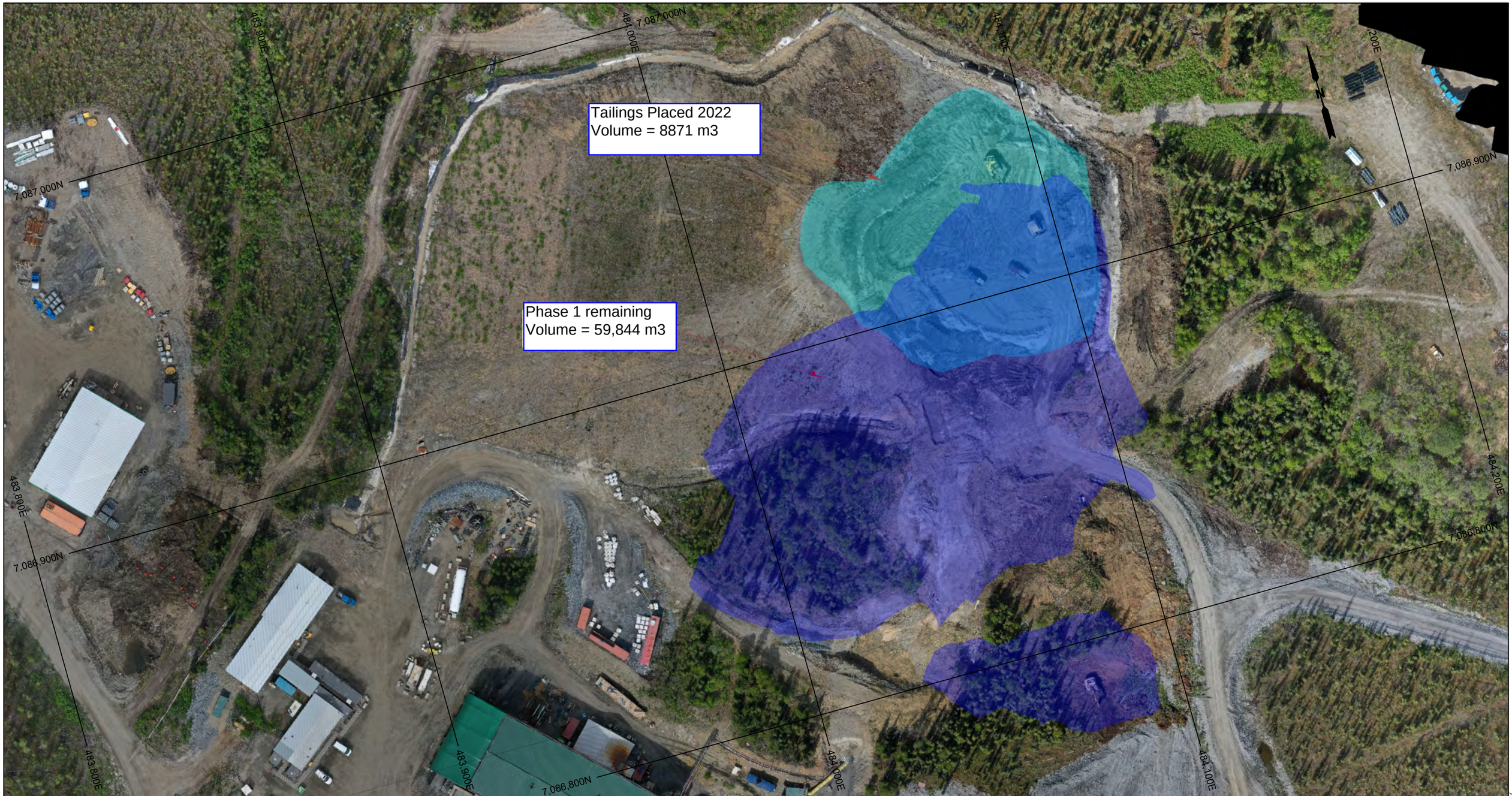
Approximately 18,600 dry metric tonnes (dmt) of tailings were generated from New Bermingham (11,370 dmt) and Flame & Moth (7,230 dmt) in 2022. No tailings were generated from Bellekeno in 2022 owing to the end of mining at Bellekeno in 2021. Deposition of tailings ceased at the end of June 2022, after milling was temporarily suspended. The volume of tailings deposited into the DSTF to the end of 2022 from the effective date (November 27, 2019) of QML-0009 is provided in Table 2-8 and shown on Figure 2-18. No tailings were deposited underground during this period.

Table 2-8: Tailings deposition Phase 1 DSTF

	2021 VOLUME (m^3)	2022 VOLUME (m^3)	CUMULATIVE TOTAL (m^3)	REMAINING STORAGE CAPACITY (m^3)
Volume of tailings produced	11,694	8,871	20,757	Not Applicable
Volume of tailings placed as dry stacked tailings	11,694	8,871	20,757	327,180
Volume of tailings placed as a slurry	0	0	0	Not Applicable

2.6.4 Tailings Storage and Management Quality Assurance and Quality Control

The quality assurance and quality control measures are provided in the DSTF *Operation, Maintenance, and Surveillance Manual* (OMS), which forms part of the DSTF *Construction and Operation Plan*. An update of the OMS Manual will be required to incorporate the findings of the investigation in support of the detailed design of the expansion.



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DSTF as-built year-end 2022

FIGURE 2-18

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3 EMERGENCY RESPONSE, AND HEALTH AND SAFETY

All incidents, including injuries, property damages and near misses are required to be reported to the Health and Safety Department. An investigation is completed in the case of all incidents, and controls are implemented to prevent reoccurrence of the incident. In the case of a significant incident or near miss a full investigation with root cause analysis is completed. Table 3-1 provides a breakdown of the types of incidents that occurred.

Table 3-1: 2022 health and safety incident reporting

TYPE OF INCIDENT	
Near Miss	66
First Aid Injury	45
Medical Treatment Injury	3
Restricted Work Injury	5
Lost Time Injury	1
Property Damage	77

There were no life-threatening occupational injuries or illnesses in 2022. Table 3-2 provides a summary of both occupational and non-occupational injuries and illnesses that were reported to the Health and Safety Department.

Table 3-2: 2022 utilization of health care

	OCCUPATIONAL	NON-OCCUPATIONAL
Number of times onsite health care attendants responded to non-life-threatening injuries or illnesses	64 times	169 times
Number of times onsite health care attendants responded to life-threatening injuries or illnesses	none	2
Number of times that the Licensee had to seek outside health care services for urgent and non-urgent medical needs	9 times	20 times

The programs/processes that were the areas of focus in 2022 to reduce incidents in the workplace are listed below.

- Implementation of an Occupational Health and Safety Committee to gain input from the workforce along with assist with identifying hazards in the workplace.
- Hazard and Near Miss Reporting was a focus during 2022 to identify and mitigate hazards in the workplace.
- Job Hazard Analysis (JHA) process was implemented as a formal process to identify potential hazards and effects and recommended procedures and controls to mitigate the potential hazards for job tasks.
- Incident Investigation reporting and root cause analysis to ensure corrective actions are implemented to prevent incidents from re-occurring in the future.

The KHSD Mining Operations Emergency Response Plan (ERP) has been developed to ensure that clear, precise, and effective guidelines are established for the personnel responsible for the management of emergency

events, and to ensure persons are kept well informed and capable of performing those requirements. The ERP was updated January 2023 and is currently under review by the Yukon Government.

AKHM is currently in the process of adopting the Hecla Mining Health and Safety Management System. This process includes an evaluation of the effectiveness of the current Safety Management System processes, policies, and procedures to identify gaps and employ a strategy and action plan to ensure continual improvement. Full and effective implementation of the Health and Safety Management Plan is expected to take approximately three years. AKHM will take a risk-based approach to determine and detail how the system will be implemented to ensure risk is being adequately managed. This following is a summary of the strategy being utilized and the areas of focus:

2023

Operational Risk Management

- Compiling and implementing processes to develop a health and safety risk register for site.
- Improve the utilization of the Job Hazard Analysis Tool for planning tasks and controlling hazards in the workplace
- Improve the effectiveness of the Field Level Risk Assessment tool which is required to be used by each individual in the workplace to identify and control hazards.

Operational Controls

- Utilizing the risk register ALHM will review the policies, procedures and critical risk control protocols to ensure they are adequate to effectively manage risk. An action plan will be developed and prioritized based on risk to support the development, review and implementation of any missing or deficient documents.
- Keno Hill is implementing improved controls to ensure all workers are Fit for Duty. This includes the implementation of a new Alcohol and Drug Policy, Fit for Duty training for front line supervisors and utilization of canine drug detection services provider.
- In addition to the improvement of the controls we also will be implementing a process for document control to ensure accessibility and management of these documents in the future.

Workplace Inspections

- Increase the frequency and quality of workplace inspections on site. Managers are required to perform one formal documented workplace inspection per month and front-line supervisors are required to perform one formal documented workplace inspection per week.
- Incident Investigations and Reporting
- Continual improvement in the quality of investigations and reporting. The site is preparing to utilize software systems in 2024 to improve the management of Incident investigation and reporting processes.

Training

- Utilizing the risk register Keno Hill will review the training program to ensure the training content is adequate to manage risk. A full gap analysis of the training program will look at the training methods and resources to ensure they are adequate to support the Keno Hill Operation. An action plan will be developed and prioritized based on risk to support the development, review and implementation of any missing or deficient training modules.

Emergency Response

- AKHM is currently reviewing and working on an action plan to ensure emergency procedures are current and effective, the required emergency equipment is available and well maintained, and the emergency response team is adequately trained to respond to emergencies at Keno Hill Operation.
- AKHM has identified the need for increased level of medical support on site and has established a contract with Iridia Medical to establish Registered Nurses onsite.

2024

In 2024 AKHM plans to continue with action plans to improve the Operational Risk Management, Operational Controls, Training and Emergency Response Systems. In addition, there is a plan to implement processes and controls to improve Safety Leadership and Contractor and Supplier Management.

2025

In 2025 AKHM plans to continue improvement around operational risk management by implementing a formal process for Management of Change.

4 CAMP AND ANCILLARY INFRASTRUCTURE

The Flat Creek camp facilities include a trailer camp, kitchen facility, welcoming centre and dry. In addition, there are four refurbished houses located nearby the townsite of Elsa and a bunkhouse. The entire capacity of the camp facilities (effective December 31, 2022) is 172 rooms.

In 2022, upgrades included: the installation of additional boardwalks and the construction of a smoking shelter.

5 ACCESS AND TRANSPORTATION MANAGEMENT

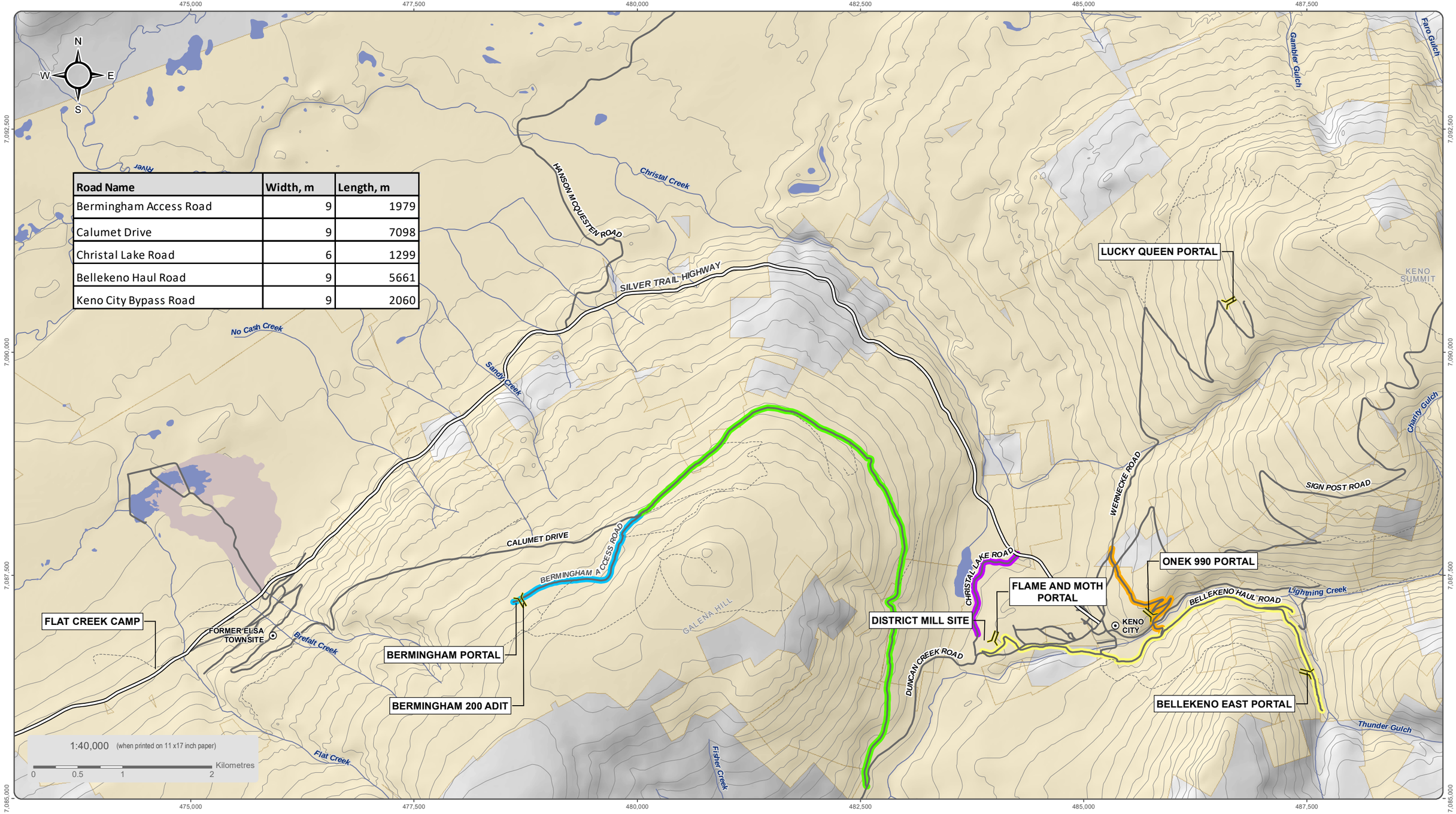
The procedures and protocols for site access, traffic routing management, and company policy with respect to vehicle and employee transportation during the KHSD Mining Operations are outlined in the October 2021 *Traffic Management Plan* (approved December 2021). There were no traffic disturbance claims made to AKHM in 2022.

Throughout 2022, AKHM maintained and utilize the haul roads between the Bellekeno East Portal and Bellekeno 625 Adit, the Bellekeno Haul Road, the Lightning Creek Bypass Road (also referred to as the Bellekeno Bypass Road), the Christal Lake Road, the Flame & Moth Access Road, the New Bermingham Access Road, a section of the Calumet Road (between Duncan Creek Road and the New Bermingham Access Road), and a section of the Duncan Creek Road (between the District Mill and Calumet Drive). The Keno City Bypass Access Road, the Wernecke Road and the Lucky Queen Road were inactive. The roads are illustrated on Figure 5-1.

Christal Lake Road was resurfaced in 2022. No major upgrades occurred on the roads to New Bermingham, Lucky Queen, or the Lightning Creek Bypass, or the Bellekeno Haul Road in 2022. Standard maintenance occurred throughout the year.

There have been no encounters between AKHM vehicles and wildlife from 2014 to date.

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



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

- Chistal Lake Road
- Bellekno Haul Road
- Keno City ByPass
- Calumet Drive
- Bermingham Access Road

- Place of Interest
- Adit

- Tailings Area
- Waterbody
- Silver Trail Highway
- Road
- Limited-Use Road

Hecla YUKON

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 5-1
ACCESS ROADS

OCTOBER 2021

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(Last edited by: amalashevska;2021-10-25/15:15 PM)

6 PHYSICAL MONITORING

The approach for the Physical Inspection and Monitoring Plan is noting changes to any physical conditions and reporting as required. No seepage and no changes were found from any water retaining structure in 2020. Any seepage or changes to conditions would be escalated to Senior Management to determine if a change in performance or physical conditions has occurred. No such changes were observed in 2022.

An annual geotechnical inspection of Bellekeno, New Bermingham, and Flame & Moth mines related earth structures including the P-AML waste rock storage facility, the water conveying and retaining structures at the District Mill and DSTF, and the Lightning Creek bridges was carried out by NELPCo Limited Partnership August 28, 2022. A copy of the *2022 Annual Physical Inspection Report* which includes surface inspections is included as Appendix A.

Below is the summary table (Table 6-1) showing the mining related earth structures inspected and the concerns, recommended action required, and plan to address the concern if applies.

Table 6-1: Geotechnical inspection concerns and response

AREA	CONCERNS	RECOMMENDED ACTION REQUIRED	PLAN TO ADDRESS
Bellekeno 625 Water Treatment Ponds	Some erosion around the discharge	Continue monitoring	If conditions change, options to be evaluated
Lightning Creek Bridge Abutments (Bellekeno Haul Road)	Some erosion noted	Backfill formed erosion with coarse grained material	Backfill in the summer
Mill Water Storage Ponds	Erosion gully in the area above the fill water pond	Repair the gully	Repair in the summer
Dry Stacked Tailings Facility	Loose placement, small sinkholes	Properly place loose material following procedure. Fix any identified sinkholes	Completed following the inspection

Any seepage or changes to conditions are reported to AKHM management and evaluated to determine if a change in performance or physical conditions has occurred. Remedial actions were taken as required.

Underground ground control conditions are inspected by AKHM management on a routine basis. The reviews found that the Ground Control Management Plan in general, complied with the minimum requirements defined by the mine regulations and industry-accepted best practice.

There were no major operational deficiencies and no major maintenance that occurred in 2022.

7 ENVIRONMENTAL MONITORING AND MANAGEMENT

Modifications to the monitoring program in 2022 included the transition of some of the new groundwater wells installed in late 2020 from monthly to quarterly once 12 months of monthly data has been collected.

Site environmental monitoring was carried out in accordance with the Monitoring and Surveillance Plan. A revision to the Plan (December 2021). The plan was updated in 2023 to reflect the new ownership and revised reporting structure. The revised plan was submitted to EMR in January 2023. The plan includes monitoring and surveillance to reflect requirements of WL QZ18-044 and to reflect updates to dust, noise, and waste rock monitoring.

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.

7.1 ENVIRONMENTAL MONITORING PROGRAM CHANGES

Modifications to the monitoring program in 2022 included the transition of some of the new groundwater wells installed in late 2020 from monthly to quarterly once 12 months of monthly data has been collected. No additional environmental monitoring changes occurred in 2022.

7.2 ADAPTIVE MANAGEMENT

In May 2022, an update to the AMP was submitted for review and comment to the Yukon Government. Further amendments are required prior to this update being finalized. A revised document was submitted in December 2022 which included several revisions to the action level triggers. Comments were received on the December 2022 report and the plan was revised and submitted back for review in April 2023. Upon approval the revised plan will be submitted the Water Board for approval.

Table 7-1 provides a summary of triggers and associated corrective actions that occurred in 2022.

Table 7-1: AMP triggers followed by corrective actions

Report Date	Description of Event/Incident	Reported by	Response Plan Summary	External Notification Needed?	Root cause of Incident	Corrective actions	Evaluation
5/7/2022	SK adit discharge - increase in flow as compared to 2 days ago observered	Caden Nickel	increase sampling frequency of Galena Creek, including upstream sampling	Yes	Galena Creek culvert on Silver Trail frozen	reported to AKHM site management	
5/8/2022		Caden Nickel				added polymer pucks to help with TSS from increased flow	checked adit, small leak plugged with bentonite water level in pond above Silver King Trail at 1913 adit raising
5/10/2022	adit water is bypassing intake to the WTP and reporting to Galena Creek above KV-60	Derrick Colquhoun Caden Nickel					WTP pond effluent pH 9.1, Zn 0.01 mg/L; adit pH 9.10, Zn 0.04 mg/L; above highway pH 9.12, Zn 0.01 mg/L; Contact YG Highways
5/11/2022		Linda Broughton		advise CIRNAC and YG CMI inspectors			search for previous communications regarding plugged culvert a few years ago
5/12/2022		Tim Flanagan				adit inlet pipe screen checked and cleared of restrictions	excess flow from adit continues to bypass WTP
5/12/2022		Linda Broughton					advises AKHM management that Galena Creek does lose water into the Silver King workings at normal flows
5/12/2022		Cory Schmidt					depth of water in adit approximately 30 cm
5/14/2022		Tim Flanagan				AKHM site services attempt to steam culvert steamer fails 10 m into culvert	
5/15/2022		Ensero					quarterly water samples collected at KV-60
5/16/2022		Tim Flanagan					lime addition stopped in WTP
5/18/2022	culvert no longer blocked floor of adit entry eroded water continues to report to Galena Creek above KV-60	Tim Flanagan Arlene Stearman					staff guage at KV-60 3.6 (photographed)
19-May-22	bypass of intake pipe in adit ceases by 14:40	Seb Tolgyesi Shawn Pelechaty	plan to resample KV-60 and also to collect a sample at KV-60A			adit intake screen cleared lime treatment resumed	structual intergity of adit entry acessed 1913 adit is now above water line of pond
22-May-22		Arlene Stearman					samples collected at KV-60, KV-60A, KV-13 20% of adit flow is bypassing WTP intake pipe

Report Date	Corrective actions	Evaluation	Internal Zn mg/L	Internal pH
5/31/2022	Discharge routed through sludge bag. Vac trucked some sludge from the pond		2.03	10.4
6/1/2022	New bag is online and running.	Low pH this morning due to lime dosing issues yesterday	3.3	9.05
6/2/2022	Probe reclaibrated	pH probe out of calibration lead to low pH and higher zincs. The bag is slowly filling which will help with zinc removal.	3.52	8.73
6/3/2022			3.24	8.72
6/4/2022	Will continue to monitor this site to ensure that it is operating correctly	Seeing a slow reduction of zinc levels. Confirmed proper lime, floc and ferric dosing in the treatment plant.	3	9.4
6/5/2022			3.12	9
6/6/2022	took ferric offline	Discussion on an Iron complex formed with check valve failure on the Ferric Sulphate drum. Decision made to shut off Ferric. Further testing to be performed to confirm if the Ferric is the issue.	3.18	8.81
6/7/2022		Huge reduction in Zn's	0.41	8.9
6/8/2022			0.1	9
6/9/2022		Flow from adit has decreased enough to close the bypass and resume flow through flow meter (2") line	0.09	8.9
6/10/2022			0.17	9.01
6/11/2022			0.06	8.85
6/12/2022			0.07	8.99
6/13/2022		System has returned to normal flows and operation	0.13	8.64
6/14/2022			0.07	8.92
6/15/2022			0.18	9.16
6/16/2022			0.18	9.11

7.3 ENVIRONMENTAL MONITORING AND SURVEILLANCE

Site environmental monitoring was carried out at the site in accordance with the *Monitoring and Surveillance Plan*. A revision to the plan was submitted in January 2023 to the Yukon Government. Comments were received and a revised plan is under development to incorporate the comments into the plan. The revised plan will be submitted to both the Yukon Government and the Yukon Water Board for approval. The updated plan included sampling requirements for petroleum hydrocarbons and glycol in the raw mine water discharge at Bellekeno 625 Adit.

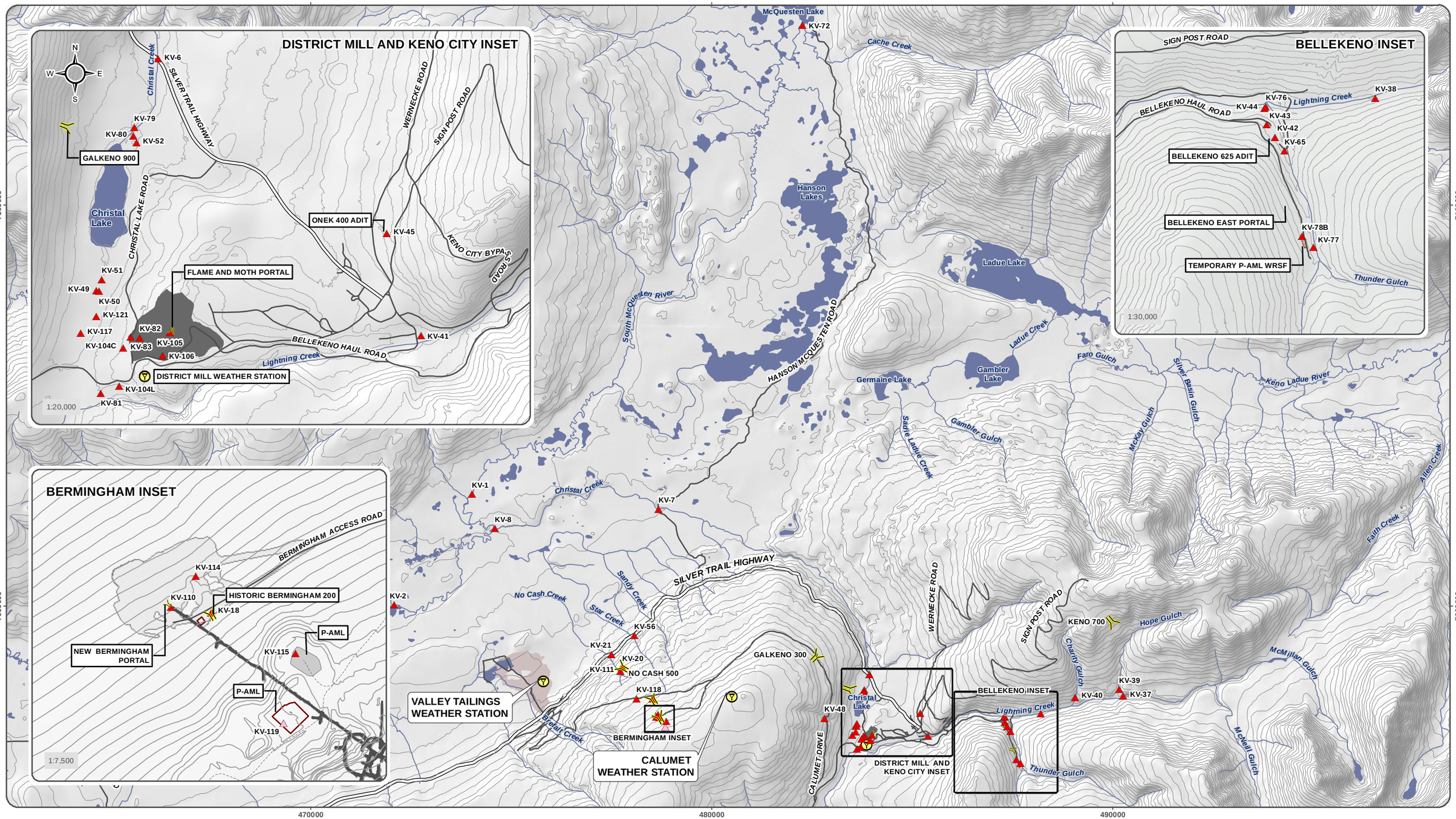
If monitoring indicates that physical structures, treatment systems or mitigative measures are not performing, then maintenance or contingency plans can be implemented following an adaptive management approach.

7.3.1 Water Quality Surveillance Network

AKHM WL QZ18-044 provides Effluent Quality Standards which dictate maximum concentrations of specific parameters allowed to be discharged from the Bellekeno, Flame & Moth, New Bermingham and the District Mill water treatment systems. In addition to the monitoring of treated effluent discharge; discharge from associated adits, seepage from waste rock storage facilities, background surface water stations upstream of facilities are monitored along with the receiving environment.

The water quality monitoring locations, parameters to be tested and the frequency of testing are provided in Schedule B of WL QZ18-044, WL QZ18-044 along with stream flow and water level monitoring requirements. Groundwater wells are scheduled for monthly monitoring for both water level and quality after installation for the first twelve months; followed by quarterly sampling thereafter. Surface and groundwater monitoring locations are shown on Figure 7-1, Figure 7-2, and Figure 7-3. **Error! Reference source not found.**

Results of the monitoring program have been compiled into a Site Characterization Report issued in February 2023 (Appendix B).



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

1:90,000 (when printed on 11 x17 inch paper)

0 1 2 3 4 5 Kilometers

- Active Surface Water Quality Station
- Pending/Proposed Water Quality Station
- Weather Station
- Adit
- As Built Mine Feature
- Valley Tailings
- Silver Trail Highway
- Other Road
- Watercourse
- Waterbody

Hecla YUKON

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 7-1
SURFACE WATER QUALITY STATION LOCATIONS

APRIL 2023

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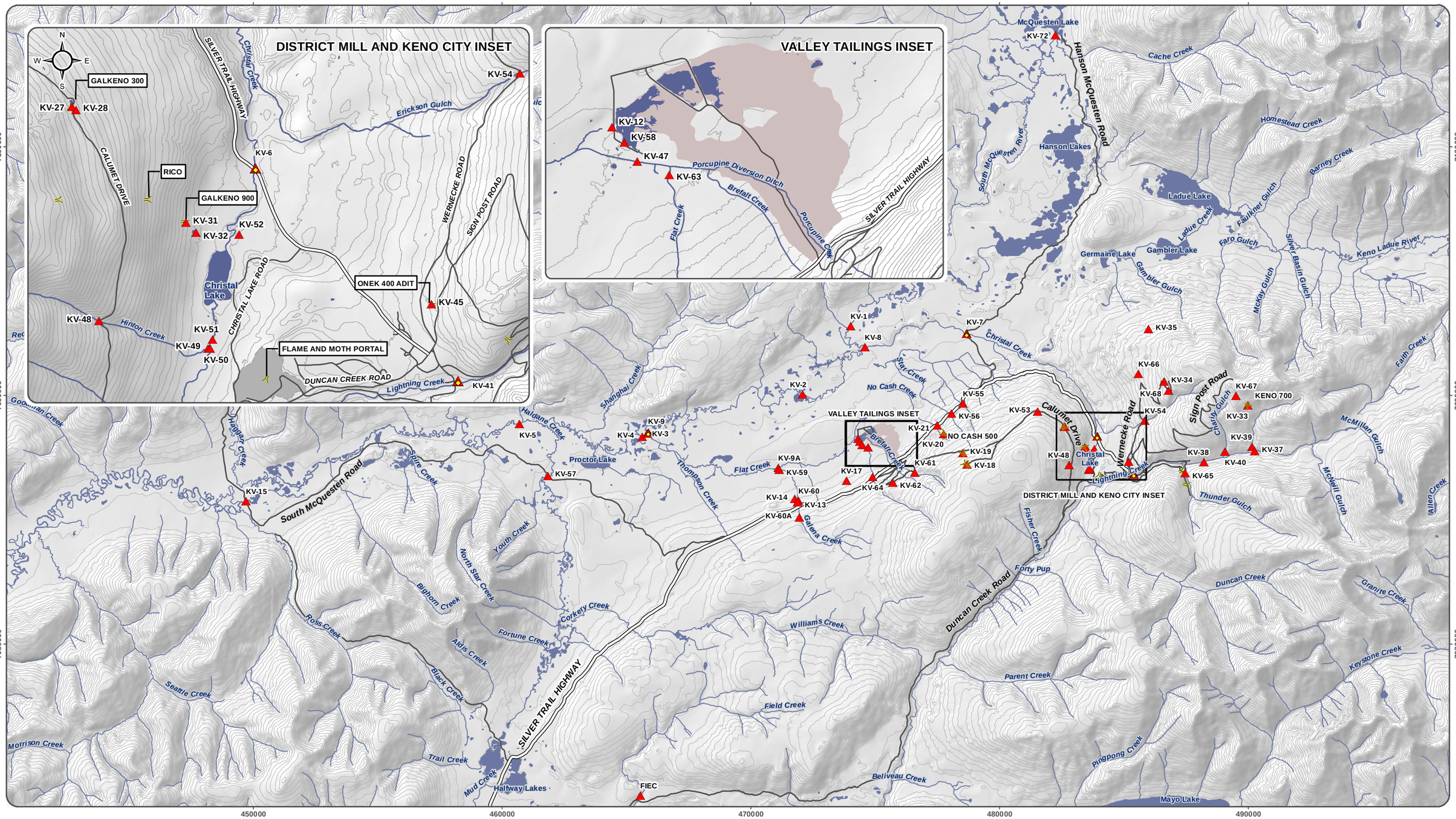

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Datum: NAD 83; Map Projection: UTM Zone 8N

1:145,000
0 1 2 3 4 5 Kilometers

- Automatic Hydrometric Monitoring Stations with Barologger
- Instantaneous Hydrometric Monitoring Stations
- Adit
- Valley Tailings
- Silver Trail Highway
- Other Road
- Watercourse
- Waterbody

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KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 7-2

DISTRICT WIDE HYDROLOGY AND SURFACE WATER MONITORING LOCATIONS

APRIL 2023

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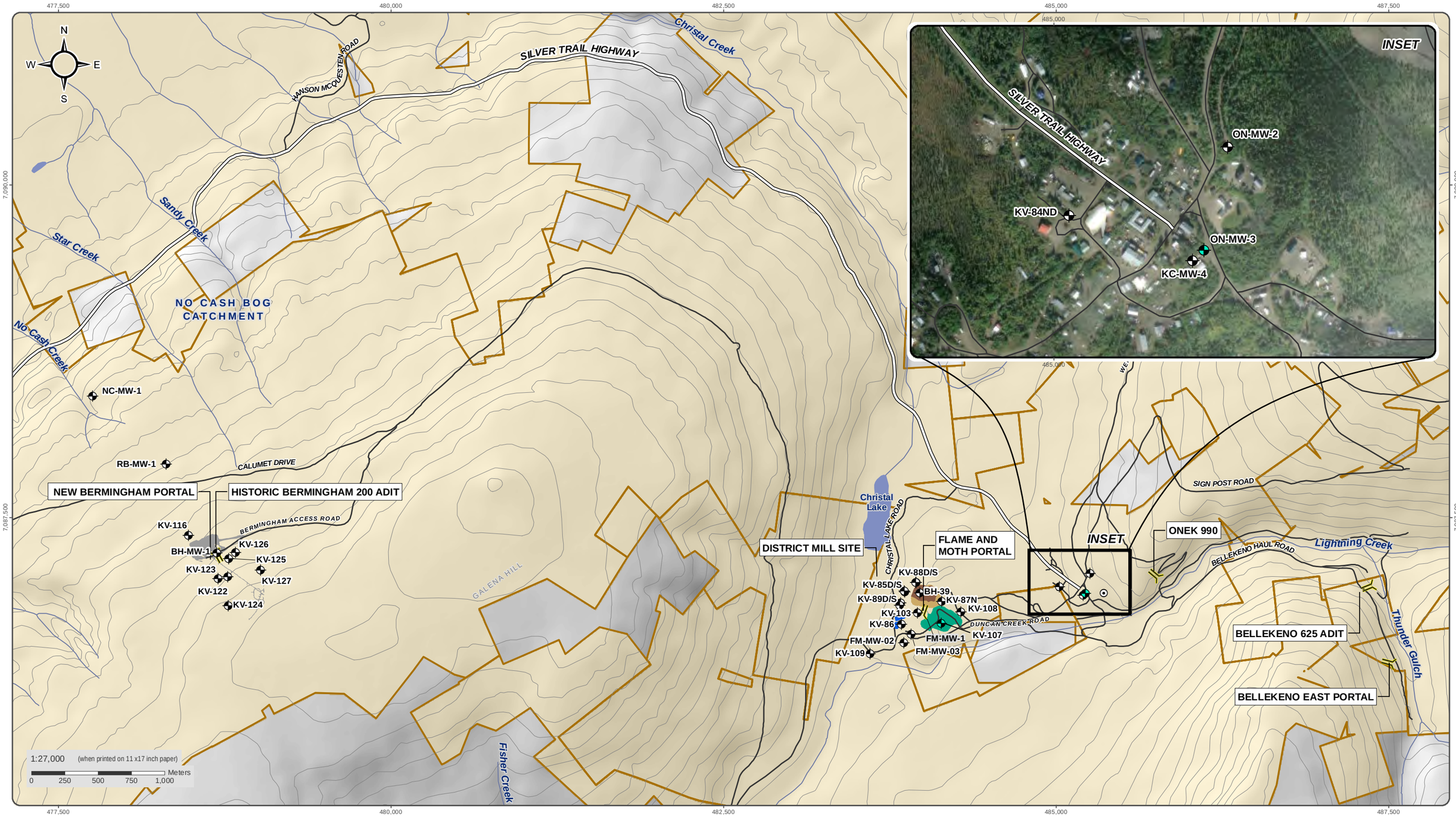

Datum: NAD 83; Map Projection: UTM Zone 8N

- Proposed Monitoring Well
- Monitoring Well
- Adit
- Pond
- DSTF 322k Tonnes Design
- Current DSTF
- To Be Constructed Mine Features
- AKHM/ERDC Quartz Claims
- Silver Trail Highway
- Other Road

Hecla YUKON

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 7-3
GROUNDWATER MONITORING LOCATIONS

APRIL 2023

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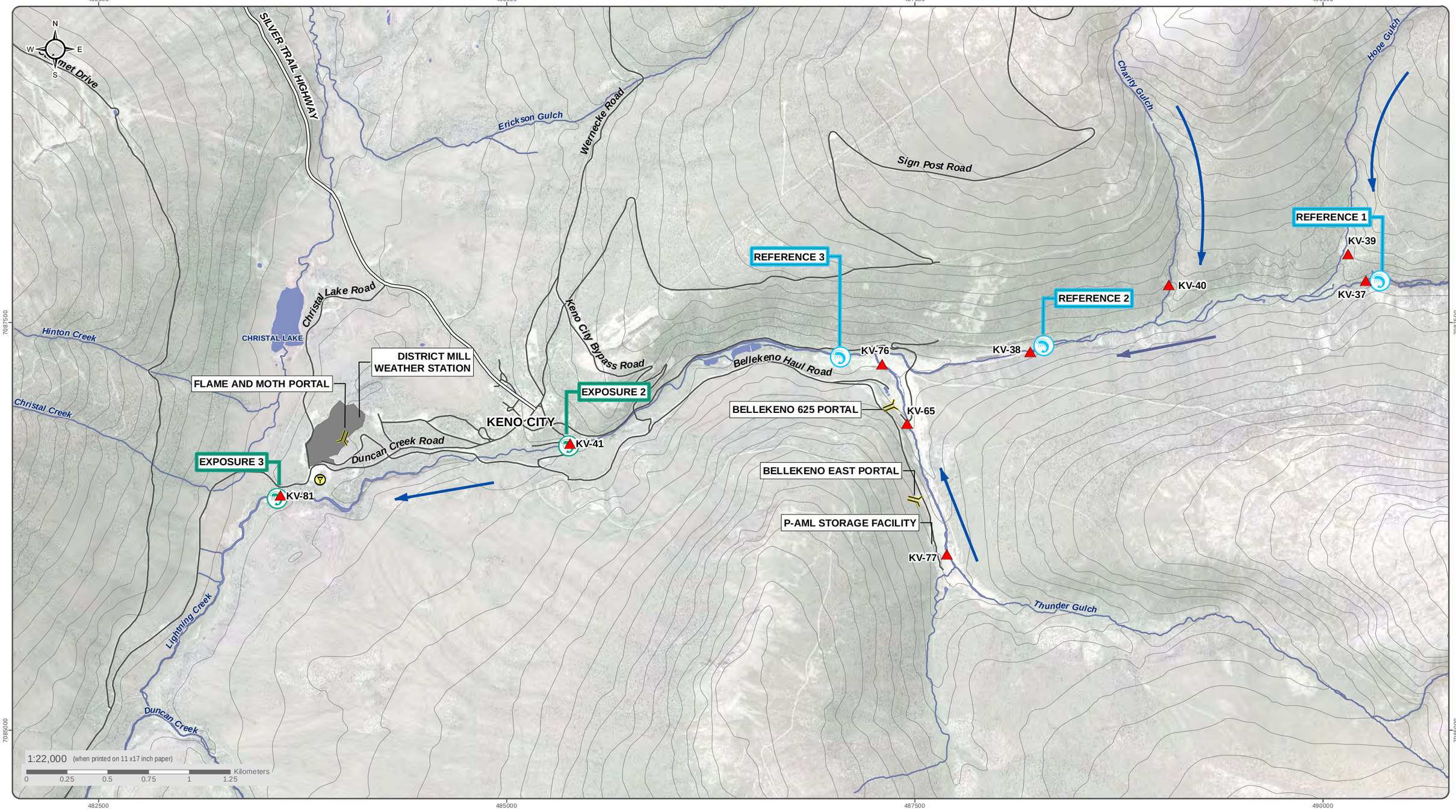
7.3.2 Environmental Effects Monitoring

The Bellekeno Mine became subject to the MDMER September 7, 2010 when the treated effluent flow rate from Bellekeno 625 water treatment facility exceeded 50 m^3 per day. Under the MDMER of the Fisheries Act, Environmental Effects Monitoring (EEM) must be conducted to determine whether mine effluent contributes to effects on benthic invertebrate communities, fish populations and/or fish tissues.

The Bellekeno Mine Cycle 1 EEM Study Design was developed in 2011 and implemented in 2012; a second cycle in 2015, and a third cycle in 2018. The Cycle 4 EEM Study Design was finalized in March 2021 and the Cycle 4 EEM study was initiated in August 2021 and completed in October 2021. The *Bellekeno Mine Environmental Effects Monitoring Cycle 4 Interpretive Report* (Ensero 2022) describes results and interpretations of the Cycle 4 EEM study and was submitted to Environment Canada and Climate Change in March 2022. The EEM sample locations are illustrated on Figure 7-4.

The Flame & Moth Mine triggered the MDMER November 30, 2020. In accordance with the MDMER, a Cycle 1 EEM Study Design was developed. The benthic study was implemented in 2022 and the fish study is to be implemented in 2023.



Topographic Data (CANVEC) data at a scale of 1:50,000 and crown grant (land parcels and mineral survey claims) data compiled by the Department of Natural Resources Canada.
Satellite Imagery obtained from Yukon Geomatics web service http://mapservices.gov.yk.ca/ArcGIS/services on January 2018

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

- Adit
- Surface Water Quality Station of Interest
- District Mill Weather Station
- Exposure Location
- Reference Location
- AKHM District Mill
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road

Hecla YUKON

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 7-4

ENVIRONMENTAL EFFECTS MONITORING AQUATIC SAMPLE LOCATIONS

APRIL 2023

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7.3.3 Permafrost Monitoring

Permafrost monitoring through geotechnical programs installed at the DSTF is monitored routinely by the engineers of record (Tetra Tech EBA Inc.) in accordance with the DSTF OMS Manual, which forms part of the DSTF *Construction and Operation Plan*. Ground temperature and permafrost monitoring is currently in place at these locations. Results of the 2022 permafrost monitoring can be seen in the Tetra Tech EBA Inc. monitoring report in Appendix A.

7.3.4 Meteorological Monitoring

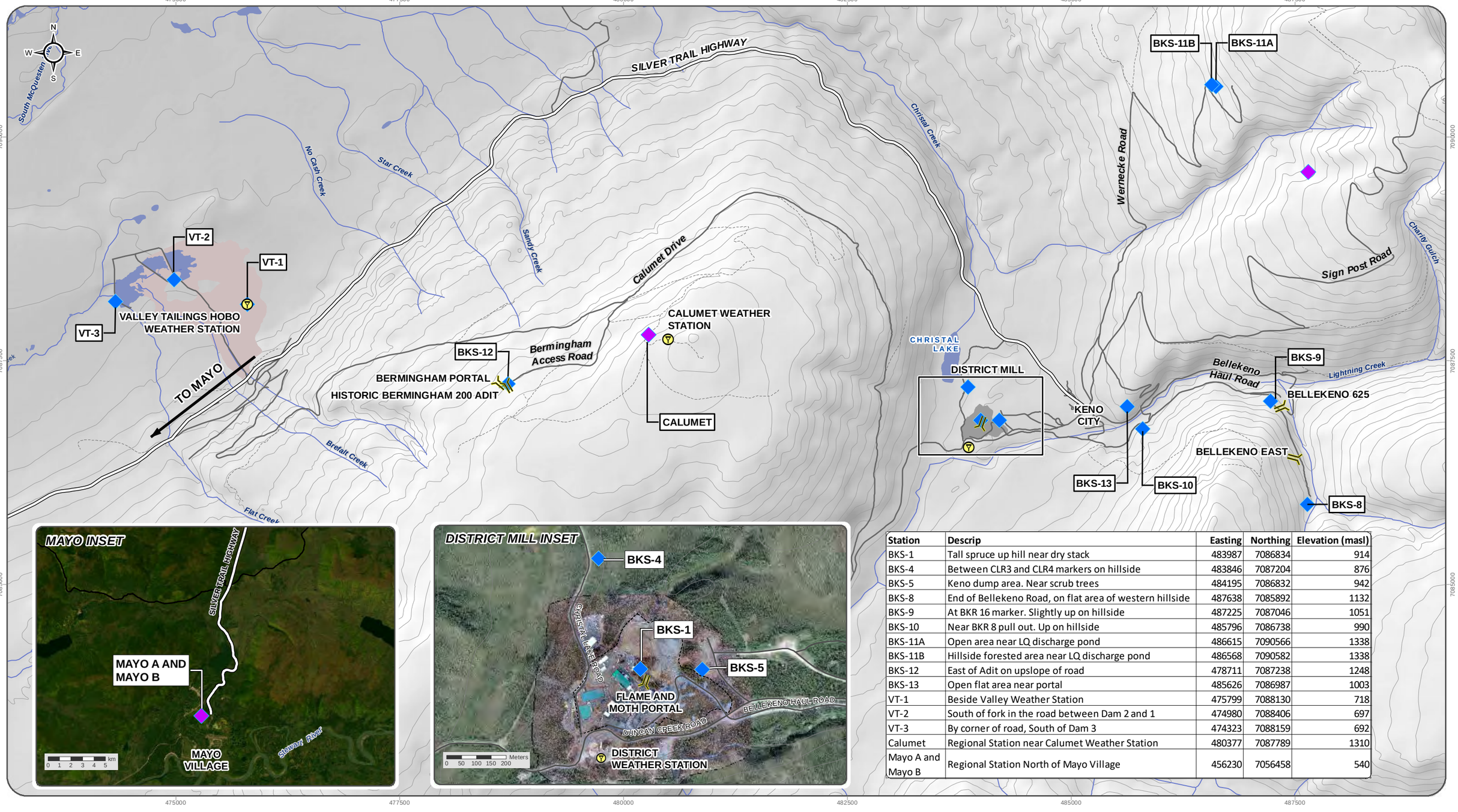
The Calumet meteorological station was established on Galena Hill in summer 2007. The station measures air temperature, relative humidity, barometric pressure, rainfall, wind speed and direction, solar radiation, and soil temperature.

The District Mill meteorological station was installed above the DSTF in 2011. In May 2022 the station was disassembled, and components sent to the manufacturer for maintenance, replacement, and calibration. The station was moved to Flame & Moth vent raise when it was reinstalled in November 2022, as its original location was within the phase 1 of the DSTF footprint. The station measures air temperature, daily maximum temperature, daily minimum temperature, relative humidity, total precipitation, wind speed, maximum wind speed, barometric pressure, and solar radiation. A pyranometer was installed in December 2012 and evapotranspiration rates are calculated in the datalogger program from local meteorological parameters.

The Valley Tailings meteorological station is located near the Valley Tailings. It was commissioned in 2012. The station measures temperature, daily maximum temperature, daily minimum temperature, relative humidity, rainfall, wind speed, gust speed, barometric pressure, and solar radiation.

There are three regional snow survey sites that are monitored by the Yukon Government: Mayo Airport A, Mayo Airport B, and Calumet on Galena Hill. In 2022, surveys were conducted by AKHM on February 17-22, March 30, and April 27-28 at six stations as shown on Figure 7-5.

Results of the meteorological monitoring program are summarized in the Site Characterization Report (Appendix B).



Station	Descrip	Easting	Northing	Elevation (masl)
BKS-1	Tall spruce up hill near dry stack	483987	7086834	914
BKS-4	Between CLR3 and CLR4 markers on hillside	483846	7087204	876
BKS-5	Keno dump area. Near scrub trees	484195	7086832	942
BKS-8	End of Bellekeno Road, on flat area of western hillside	487638	7085892	1132
BKS-9	At BKR 16 marker. Slightly up on hillside	487225	7087046	1051
BKS-10	Near BKR 8 pull out. Up on hillside	485796	7086738	990
BKS-11A	Open area near LQ discharge pond	486615	7090566	1338
BKS-11B	Hillside forested area near LQ discharge pond	486568	7090582	1338
BKS-12	East of Adit on upslope of road	478711	7087238	1248
BKS-13	Open flat area near portal	485626	7086987	1003
VT-1	Beside Valley Weather Station	475799	7088130	718
VT-2	South of fork in the road between Dam 2 and 1	474980	7088406	697
VT-3	By corner of road, South of Dam 3	474323	7088159	692
Calumet	Regional Station near Calumet Weather Station	480377	7087789	1310
Mayo A and Mayo B	Regional Station North of Mayo Village	456230	7056458	540

1:40,000 (when printed on 11 x17 inch paper)

0 500 1,000 1,500 2,000 Meters

- ERDC Snow Monitoring Station
- Regional Snow Monitoring Stations
- Audit
- AKHM District Mill
- Tailings Area
- Waterbody
- Watercourse
- Silver Trail Highway
- Other Road
- Limited-Use Road
- Contours (100 ft)

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KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 7-5

METEOROLOGICAL STATIONS AND SNOW SURVEY STATIONS LOCATION

APRIL 2023

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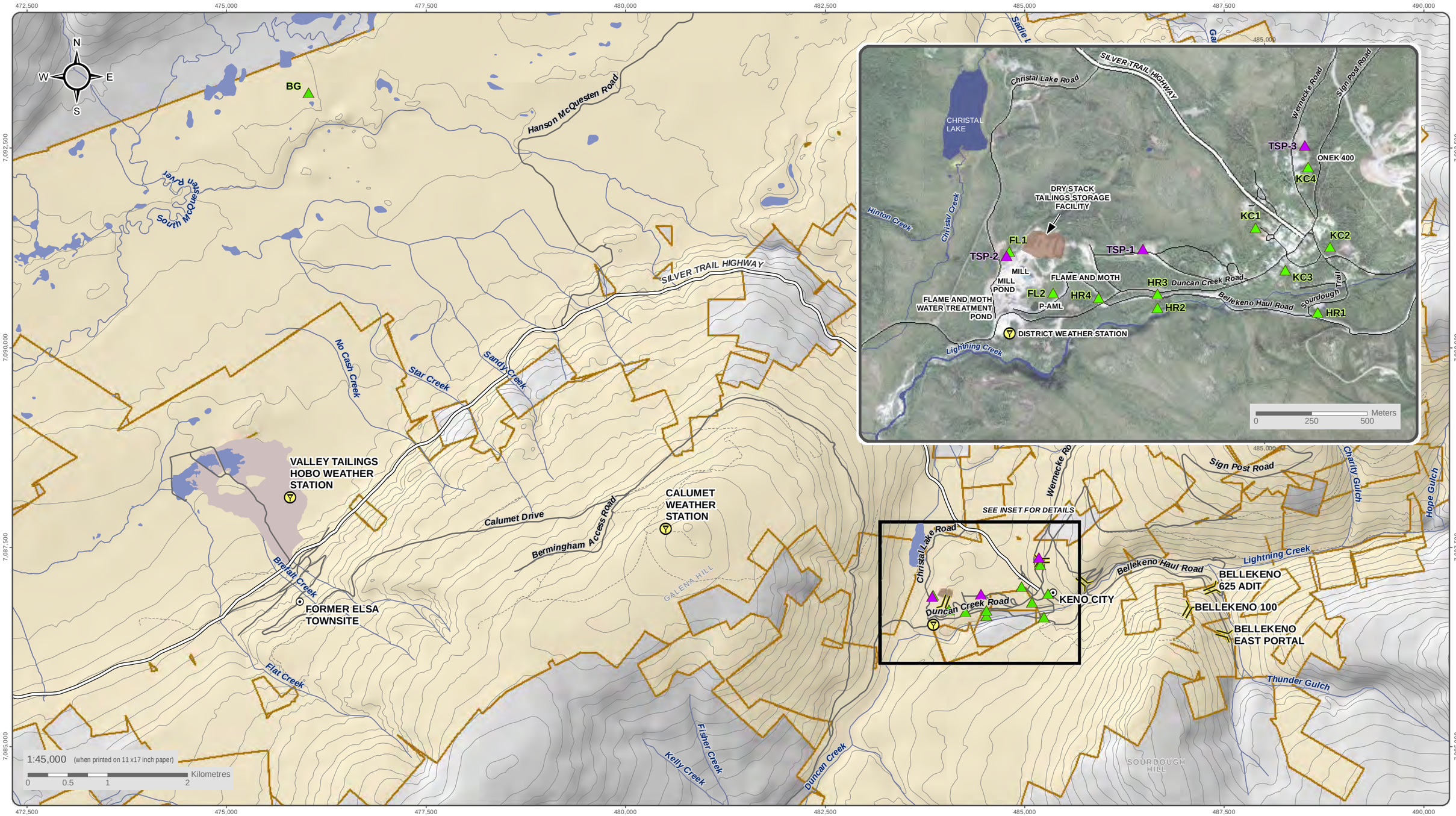
(Last edited by: amatlashevska; 2023-04-27(13:51 PM))

7.3.5 Air Quality Monitoring

The air quality monitoring program was established in 2009. In 2011 air quality was monitored using dustfall monitoring stations installed at four locations near the District Mill. The monitoring program was amended in 2012 to include the measurement of total particulates per volume of air for select size fractions (total suspended particulates [TSP]). Additional sampling for coarse (PM_{10}) and fine ($PM_{2.5}$) fractions of particulate matter began in August 2015. An updated *Dust Abatement and Monitoring Plan* was submitted to EMR in January 2023. The air quality sampling stations were used in 2022 are shown on Figure 7-6. Dust suppression measures were implemented as required along Christal Lake Road and when the Bellekeno Haul Road was in routine use. The TSP, PM_{10} and $PM_{2.5}$ monitoring, and total metals analysis of the TSP filters results are summarized in the Site Characterization Report (Appendix B).



- AKHM TSP Monitoring Stations
- YG PM10 Monitoring Sites 2013
- Weather Station
- Adit
- Mine Feature Footprint
- Current DSTF
- Tailings Area
- Waterbody
- AKHM/ERDC Quartz Claims
- Watercourse
- Silver Trail Highway
- Other Road
- Limited-Use Road

Hecla YUKON

ENSERO solutions

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 7-6

AIR QUALITY AND METEOROLOGICAL MONITORING STATIONS LOCATION

APRIL 2023

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7.3.6 Noise Impacts and Sound Monitoring

The objective of noise impact monitoring is to reduce and mitigate impacts to local residents and the environment resulting from noise produced during the development and operations of the Bellekeno and Flame & Moth mines and District Mill. To achieve this goal, AKHM identified potential noise sources and receivers in the *Noise Monitoring and Management Plan*. Details are be found in the *Noise Monitoring and Management Plan* submitted under QML-0009. An update to this plan was approved on December 9, 2021.

During 2022 there were no noise complaints made to AKHM. All surface heavy duty surface equipment has been outfitted with low frequency back up alarms, crushing and ore haulage activities continue to be limited to dayshift only. The crusher building is now fully enclosed with in an insulated steel building. No significant noise impacts were recorded in Keno City as a result of operations in 2022. The results for the noise monitoring program up to 2022 are presented in the Site Characterization Report (Appendix B). The locations at which recordings were made is shown on Figure 7-7.

484000 484500 485000 485500

7087500 7087000 7086500

N W E S

CHRISTAL LAKE

CHRISTAL LAKE ROAD

Christal Creek

DRY STACK TAILINGS FACILITY

MILL

FLAME AND MOTH

MILL POND

CRUSHER

FLAME & MOTH WATER TREATMENT POND

P-AML

DUNCAN CREEK ROAD

Lightning Creek

SILVER TRAIL HIGHWAY

SIGN POST ROAD

ONEK 400

R04

WERNECKE ROAD

R03

R02

KENO CITY BYPASS ROAD

ONEK 990 PORTAL

R05

R01

KENO CAMPGROUND

BELLEKENO HAUL ROAD

SOURDOUGH TRAIL

484000 484500 485000 485500

Satelite imagery obtained from Yukon Geomatics map service http://mapservices.gov.yk.ca/ArcGIS/services on April 2023

Datum: NAD 83; Projection: UTM Zone 8N

1:6,000 *(when printed on 11 x17 inch paper)*

0 50 100 150 200 250 Meters

- Noise Monitoring Station
- Adit
- Current DSTF
- Pond
- Mine Feature Footprint
- Watercourse
- Silver Trail Highway
- Secondary Road

Hecla YUKON

ENSERO solutions

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 7-7

NOISE MONITORING STATIONS

APRIL 2023

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(Last edited by: amatlashevska;2023-04-27/14:23 PM)

7.3.7 Geochemical Characterization

AKHM conducted waste rock geochemical characterization studies throughout the KHSD and specifically within each of the mineralized target zones (Bellekeno, Onek 990, Lucky Queen, Flame & Moth, and New Bermingham) to understand the weathering behavior and potential for acid rock drainage and metal leaching (ARD/ML) potential related to the rocks. These characterization studies have been ongoing since AKHM initiated exploration in 2006. In 2022, representative samples were collected from development at Flame & Moth and New Bermingham mines and sent to an accredited laboratory for confirmatory testing as per the *Waste Rock Management Plan – Revision 6.5*. The results of these studies results are summarized in the Site Characterization Report (Appendix B).

AKHM also carried out geochemical characterization of the tailings from each of the mineralized target zones in order to understand their potential ARD/ML. These characterization studies have been ongoing for several years and continue to date. The results of the characterizations are summarized in the Site Characterization Report (Appendix B).

Geochemical assessment of water treatment sludge is carried out by AKHM. The results of static tests on sludge samples from Bellekeno, Flame & Moth, and New Bermingham water treatment plants indicated that the sludges had low potential for long-term acid generation due to their high carbonate buffering capacity and low sulphide sulphur contents. The assessment of the results and data are included in Appendix C.

7.4 EXPLOSIVES MANAGEMENT

Explosives are trucked to the site and stored in approved magazines located away from any other infrastructure meeting the distance requirements under the *Explosives Act* and Regulations and the Quantity Distance Principles – User's Manual (BNQ, 2015) Access to the magazine and explosives storage areas will be restricted and only authorized personnel will be permitted to enter these areas. All personnel involved with handling explosives receive training on safe and appropriate use as per Workplace Hazardous Materials Information Systems Regulations (WHMIS) of the Occupational Health and Safety Act.

Personnel will also be trained on spill containment and emergency procedures relevant to explosives and to general mine site operations.

7.5 HAZARDOUS MATERIALS MANAGEMENT

The following table (Table 7-2) provides a summary of the Hazardous Substances at AKHM.

Table 7-2: Common hazardous substances

COMMON NAME (SYNONYMS)	PHASE	REPORTING THRESHOLD	SPECIAL PRECAUTIONS
Acetone	Liquid	200 L	Extremely Flammable
Acetylene	Gas	any if container larger than 100 L	Extremely flammable, pressurized gas dissolved in an extremely flammable liquid (Acetone)
Ammonium Nitrate Emulsion	Liquid	any if spilled out of blasting pattern	Oxidizing material, does not burn but may contribute to combustion of materials that can burn

COMMON NAME (SYNONYMS)	PHASE	REPORTING THRESHOLD	SPECIAL PRECAUTIONS
Antifreeze/Coolant	Liquid	25 L	may be fatal by ingestion
Caustic Soda (solid)	Solid	50 kg	very corrosive solid
Caustic Soda (solution)	Liquid	50 L	very corrosive liquid
Diesel	Liquid	200 L	
Gasoline	Liquid	200 L	Extremely Flammable, Vapors are harmful and can be explosive. Non-sparking tools required. Vapors will pool in low areas and travel along the ground.
Grease	Semi-Solid	200 L	
Hydraulic Oil	Liquid	200 L	
Lime (Solution)	Liquid	50L	Will cause severe caustic burns. Avoid strong acids, and aluminum
Motor Oil	Liquid	200 L	
Propane	Gas	any if container larger than 100 L	Extremely flammable. Liquefied gas, will produce extreme cold when released.
Waste Oil	Liquid	500 mL or 500 g within a 5 day period	
Waste Batteries	Solid	500 g within a 5 day period	
Waste Solvents	Liquid	5 L within a 30 day period	
Waste Aerosol Cans	Solid	500 g within a 5 day period	
Waste Fluorescent Tubes	Solid	500 g within a 5 day period	Contains Mercury
Reagents	Liquid	500 mL within a 5 day period	

7.6 SPILL CONTINGENCY

No reportable spill occurred in 2022. Minor spills that occurred in 2022 have been documented and are summarized in Table 7-3.

Table 7-3: Non-reportable spills

DATE	PRODUCT/ SUBSTANCE	APPROXIMATE AMOUNT	LOCATION OF SPILL	REMEDIAL ACTION TAKEN
2022-02-18	Oil	7 Litres	Flame Mine Portal	Oil-cooler failure. Oil absorbent mats were placed on the oil spill and all oil absorbed. Soiled pads were placed in the lined mega bag at the surface shop.
2022-02-20	Hydraulic Oil	80 Litres	Flame Lube Bay (underground)	Crews utilized a spill kit (oil absorbent pads) x 3 bundles. Soiled pads were placed in the lined mega bag at the surface shop. Lock-out procedure training/review.
2022-02-27	Oil	40 Liters	NW corner of Flame shop	Eliminated the source of oil. Move cube to new location. Clean up contaminated area and put waste into containers. Lay down absorb pads and floor dry material.
2022-04-10	Hydraulic Oil	75 Litres	Warehouse Yard	Put leaking tote on a containment pallet and sealed leak. Transferred oil into an empty tote. Utilized absorbent pads to soak up spill. Soiled pads were placed in the lined mega bag at the surface shop
2022-04-18	Diesel	10 Litres	F&M fueling station	A miner was fueling up his truck when the fuel hose slipped out of the fueling hole on the truck and spilled an estimated 10 litres of diesel onto the ground. Absorbents were utilized to clean-up the diesel
2022-04-22	Oil	<0.5 Litres	F & M Vent Raise	Generator leaking oil at vent raise. Equipment shut down. Pads placed and area cleaned up
2022-04-27	Copper Sulphate	2 kg	Reagents Yard	Torn bags of copper sulphate in the reagents yard. The mill cleaned up the area.
2022-05-06	Oil	5 Litres	Berm Haul Road	Punctured oil pan on vehicle resulted in oil leaking on the Bermingham to Duncan Creek Road. Road inspected for spill. Site where puncture occurred spill pads were utilized to clean-up the spilled oil
2022-05-07	Antifreeze	<2 Liters	F&M office parking lot	Leaking antifreeze observed from parked light duty vehicle. Spills pads were put down to clean the antifreeze and vehicle serviced. Approximately 2 Litres of melted snow and coolant recovered.
2022-05-07	Oil	3 Litres	F&M Dump	PHC observed on water ponding. The spill was contained. Spill pads were put down and used cleaned up to clean the spill. Pads disposed of with other oily pads in a lined mega bag
2022-05-31	Hydraulic Oil	0.5 Litres	Underground Electricians Area	Piece of heavy equipment observed to be leaking hydraulic oil. Put a drip tray under piece of machinery to ensure leak was contained and reported issue to mechanical depart to follow up and repair source.
2022-06-01	Oil	5 Litres	Behind F&M Maint Shop	Oil spilled on the ground likely from a TOTE that has some oil dripping from the top. Put the TOTE on secondary containment. Transfer procedures reviewed with mechanics
2022-06-01	Zinc Sulphide	1 kg	Reagent Yard	Pallet of Zinc Sulfate that was breached and leaking. Contents of container were pumped into a new container and the zinc sulfate was cleaned up with absorbents.
2022-06-03	Hydraulic Oil	40L	Tailings pad at mill	Equipment hydraulic line failed which resulted in hydraulic oil spilling. spill pads were put down to absorb the spill
2022-06-26	oil	<0.5 Litres	Flat Creek Camp	Ambulance had a slow leak of oil. Absorbent pads were placed to catch and absorb the leak. The vehicle has now been repaired and the absorbent pads disposed of in a lined mega bag

DATE	PRODUCT/ SUBSTANCE	APPROXIMATE AMOUNT	LOCATION OF SPILL	REMEDIAL ACTION TAKEN
2022-07-04	Diesel	1.5 Litres	Crusher	Safety vehicle had a puncture in the fuel cooler resulting in 1.5 litres of diesel to spill. A drip tray was put down very quickly and the area was cleaned with white spill pads
2022-07-09	Diesel	5 litres	Between bridge and BKR 3	Management noticed a spill on the road which had been cleaned up but the spill pads used to clean the area were left behind. Spill pads were then cleaned
2022-07-24	Hydraulic Oil	5 litres	Bellekeno Laydown	An unlined megabag was filled with oily debris and left at Bellekeno allowing hydraulic oil to seep out and contaminate underlying ground. Megabags were placed into lined bags and removed from area.
2022-07-27	Hydraulic Oil	<1 litres	Bellekeno Laydown	Crew was cleaning up megabags full of oily debris when one of them broke and spilled hydraulic oil on the ground. Oil and oily debris was cleaned up and contaminated soil was shoveled up
2022-08-12	Hydraulic Oil	100 litres	F&M main access ramp (underground)	Blown/leaking hose on bolting machine. Soaker pads and dams around the pump suction hose to minimize the amount of oil entering the mine sump system. Recovered 9 pails of oil/water.
2022-08-24	Oil	20 Litres	Warehouse Yard	A contractor trucking company was bringing a vehicle up on a trailer and they pulled into the warehouse yard and ran over a piece of wood puncturing the oil pan and spilling 20 litres of oil onto the ground
2022-09-24	Hydraulic Oil	4 Litres	F&M Laydown area	A hydraulic hose blew and released hydraulic oil in the surrounding area. Absorbents were utilized to clean-up the spilled hydraulic oil.
2022-10-19	Antifreeze	250ml	F&M Shop	A mechanic was getting antifreeze behind the F&M shop and a small amount leaked onto the ground. The area was then cleaned up with absorbent pads.
2022-11-05	Coolant	< 500 ml	F&M office parking lot	A worker was proceeding back to their vehicle and observed that coolant was present underneath the vehicle's undercarriage. Upon visual inspection of the vehicle's undercarriage, the Mobile Maintenance department observed that a clamp was loose on the coolant line. The vehicle was then brought to the Mobile Maintenance shop for further investigation. Upon the vehicle being moved, it was observed that approximately 500 ml of coolant had leaked from the coolant line, and the coolant cleaned-up.
2022-11-08	Coolant	< 500 ml	Flat Creek Camp	The coolant was cleaned up and disposed of accordingly. The vehicle was seen by the Mobile Maintenance Department, the coolant line clamps were rotated, the vehicle was released to be driven again, and a spill tray will be utilized to prevent a spill from reoccurring.
2022-12-09	Copper Sulphate	70kg	F&M Electrician Shop	Site services with the help of the miners were moving the copper sulfate from the old Procon shop over to the mill. When the operator picked up one of the pallets, the pallet broke, and it tipped over spiling a few bags. It was cleaned up and placed in a plastic drum right away.
2022-12-31	Soda Ash Dense	2kg	Warehouse Yard	When unloading a damaged pallet a bag of soda ash spilled onto the ground. The warehouse technicians cleaned up the soda ash. Provided to drillers for used, as uncontaminated.

7.7 WASTE MANAGEMENT

Indoor waste bins and recycling containers are in high foot traffic areas for segregating wastes as food waste, paper and cardboard, refundable drink containers, batteries/electronics, and general landfill waste. Transparent bags are used in the food waste, refundable drink containers and general landfill waste bins.

Food waste, including food containers and wrappings, is currently deposited into designated waste bins inside the kitchen, dining hall, lunchrooms, and office areas. All food waste from the kitchen and dining hall is relocated throughout the day to a bear-proof container at Flat Creek camp. Food waste generated at the Elsa houses, surface exploration drill sites, and other mobile jobsites is stored in a bear-proof container (a repurposed former explosives magazine) inside an electric fence at the Elsa townsite. Durable metal tipping bins with lids are utilized on site and described in the Waste Management Plan. The metal tipping bins are emptied two or three times a week during the winter and daily in warm weather and when wildlife is active.

Hook lift waste bins are distributed across the site: red bins are used for cardboard and wood waste; blue bins are used for steel/metal and green bins are used for general landfill waste. The hook lift bins are for non-hazardous, non-putrescible materials only. The bins are located throughout the AKHM Mining Operations as described in the Waste Management Plan.

Industrial waste is waste arising from operations in the mill, mobile maintenance shops, water treatment plants, and warehouse. Each work area has specially marked bins for segregating waste for cardboard and wood, steel, or landfill disposal. Special containers are established for the common special waste produced in a work area. Large and heavy non-hazardous waste items are consolidated into designated bins, totes, onto pallets or stockpiled in an assigned laydown area.

Used engine oil, hydraulic fluids, and fuels that do not meet specifications for their designated use are stored in compliance with Yukon Special Waste Regulations, prior to being shipped to KBL for treatment and disposal.

A composter has been purchased for use by AKHM in 2023. For the composter operation, waste is to be segregated at the source to ensure non-compostable waste streams do not enter the composter. All compostable waste is to be collected in transparent bags and placed in waste containers labelled “Compost Waste” located throughout the AKHM Mining Operations.

7.8 WILDLIFE PROTECTION

Any encounters between vehicles, employees and contractors and wildlife are reported to both the Safety and Environmental departments for documentation and if required, incident investigation. There have been no encounters between AKHM vehicles and wildlife from 2014 to date. Between May and July 2022 there were several sightings of black bears proximal to the Flat Creek Camp. No other significant wildlife encounters were reported in 2022.

7.9 ENVIRONMENTAL MONITORING AND MANAGEMENT QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance and quality control (QA/QC) protocols are implemented during collection, storage, and shipping of samples. Standard QA/QC procedures conducted by site, consultants and laboratory staff include

duplicate, relative percent difference analysis, analytic matrix spikes, spike blanks, and field, trip and method blanks.

External laboratory sample results are evaluated upon receipt by the Environment Department. In addition, a qualified professional completes quality checks and uploads water quality monitoring results weekly into the EQWin database where set point triggers and trends are programmed to be flagged for notification and action.

Laboratory quality control analysis includes method blanks, laboratory duplicates, matrix spikes and blank spikes which are required to be reported by the laboratory showing acceptability criteria prior to issuing AKHM the data.

One field blank is collected per monthly water quality event and is completed by taking de-ionized water (analyte free media) to the sample station, opening it and exposing it to ambient air and 'collecting' it in the sample bottles. Dust monitoring field blanks are also collected and submitted for analysis. These samples are treated the same as the actual water or dust samples, preserved and filtered as necessary, and their analysis provide an indication of contamination that may affect the actual samples. Additionally, one travel blank accompanies the samples for each monthly water quality event and is analysed for the same parameters as the routine samples.

Field duplicates are collected at a rate of 10% or 1 for every 10 water quality samples. Relative Percent Difference (RPD) is used to determine field variability and is the difference between the sample result and replicate result, divided by the average of the sample result and replicate result and expressed as a percentage. Where analyte results have RPD greater than 25% a subsequent check is done against the laboratory detection limit (DL) to establish if the practical quantitation limit (PQL) was met. The PQL is five times the DL and is defined as the minimum concentration that can be measured within specified limits of precision and accuracy. Both results need to be above the PQL for the analyte to be considered as 'meeting the PQL'. If one result from the sample or duplicate is greater than five times the DL and the other result is less than five times the DL then the 'PQL is not met'. An analyte with results not meeting the PQL indicates that the constituent being analyzed is not present in a sufficient amount to be reliably quantified. Typically, as parameters approach their detection limit, high variability is more likely to occur. The RPD of 25% can be used as a benchmark whereby an RPD greater than 25% warrants further comment or consideration.

All water quality data is stored in an EQWin database and additional QA/QC steps to determine potential outliers are identified. A variance report is generated on at least a quarterly basis for sitewide information that outlines the comparison off field vs laboratory pH and conductivity, and comparison to recent samples collected (i.e., RPD compared to samples from last 12 months).

8 SOCIO-ECONOMIC MONITORING

8.1 IMPLEMENTATION OF THE KENO CITY SOCIO-ECONOMIC MITIGATION PLAN

The Keno city Socio-Economic Mitigation plan was under development in 2022 and planned to be completed in 2023.

8.2 ENGAGEMENT WITH KENO CITY RESIDENTS

Throughout 2022, AKHM was in discussions with Keno City residents and the office of the YG Director of Operations and Programs, Department of Community Services to enable AKHM to provide a household refuse haulage service to a community landfill elsewhere in the Yukon Territory for Keno City residents following the closure of the community's transfer station.

AKHM met with the Fire Marshal and Director of Fire and Life Safety, Department of Community Services to discuss how AKHM might mitigate the loss of emergency services in Keno City. Several action items were discussed and implemented:

- AKHM will be added to the government emergency notification system. When 911 calls for Keno City are initiated, AKHM will be notified to respond. AKHM does not have fire fighting capabilities but will provide emergency medical support, heavy equipment and water tenders and other support. AKHM efforts will be coordinated with the Village of Mayo fire department.
- AKHM has created a 24-hour emergency call out number for the citizens of Keno until the 911 notification system has been enabled for AKHM. The 24-Hour AKHM emergency call out system has been implemented and tested with Keno City residents.
- AKHM has procured and supplied the residents of Keno City an automated external defibrillator (AED) to replace the unit which had previously been damaged.
- AKHM has procured and supplied the residents of Keno City two wheeled fire extinguishers to attempt to offset the loss of a community fire truck.
- AKHM held standard first aid classes open to participation for the residents of Keno City in 2022.

In 2022, a compliant about the noise produced by the dust monitoring device installed on the east side of the community a month earlier was received. The monitoring device was relocated to the ball diamond area (further distal to resident's homes). No other noise and no dust complaints were received from the Keno City residents in 2022.

9 GREENHOUSE GAS EMISSIONS AND CLIMATE CHANGE

Greenhouse gas emissions at the mine are primarily the result of on-site mobile equipment diesel usage as illustrated in Table 9-1. The District Mill and ancillary facilities and both Flame & Moth Mine and New Bermingham mines are primarily powered with grid electricity (see Table 9-2) which reduces greenhouse gas emissions for the site.

Table 9-1: Fuel use in 2022

	VOLUME DELIVERED TO SITE (LITRES)	RENEWABLE FUEL CONTENT (%)	DEVELOPMENT/ PRODUCTION ACTIVITIES (LITRES)	EXPLORATION ACTIVITIES (LITRES)	CLOSURE ACTIVITIES (LITRES)
Heating Fuel (oil)	not applicable	not applicable	not applicable	not applicable	not applicable
Heating Fuel (propane)	1,117,142	0%	1,114,354	2,788	0
Heating Fuel (other)	not applicable	not applicable	not applicable	not applicable	not applicable
Aviation Fuel (Jet A)	not applicable	not applicable	not applicable	not applicable	not applicable
Aviation Fuel (Jet B)	not applicable	not applicable	not applicable	not applicable	not applicable
On-site transportation (diesel)	1,609,121	2%	1,395,205	213,916	0
On-site transportation (gasoline)	172,941	10%	159,632	13,309	0
Off-road transportation (diesel)[1]	not applicable	not applicable	not applicable	not applicable	not applicable
Off-road transportation (gasoline) [1]	not applicable	not applicable	not applicable	not applicable	not applicable
Off-site transportation (diesel)[2]	not applicable	not applicable	not applicable	not applicable	not applicable
Off-site transportation (gasoline) [2]	not applicable	not applicable	not applicable	not applicable	not applicable
Electricity production (diesel)	1,880	2%	1,880	not applicable	not applicable

[1] *Exploration activities*
[2] *personnel/supplies transport to and from site; concentration/product transport on Yukon roadways*

Table 9-2: Electricity purchased or generated on site

SOURCE	kWh ENERGY
Purchased from grid	11,688,327
Produced using diesel	10,800
Produced using LNG	not applicable

In 2023, diesel usage from mobile equipment is expected to be similar to 2022 as the mine is not planned to begin commissioning until May 2023 and full production is planned to begin in the third quarter of 2023. This operating schedule is similar in timeframe as what occurred in 2022. Diesel usage and associated greenhouse gas emissions are expected to increase in 2024 as the result of the mine in commercial production for the entire

year of 2024. Little opportunities exist for greenhouse gas emission reductions for the mobile equipment. The underground mine does not have the infrastructure for a transition to electric underground haulage equipment.

In 2022, about 0.45 hectares of land was cleared at the Flame & Moth Mine/District Mill site. Organic material recovered was deposited the DSTF (see Table 2-7).

10 RECLAMATION ACTIVITIES

10.1 CARE AND MAINTENANCE ACTIVITIES

Maintaining safe access to the Bellekeno Mine continued for 2022. On-going routine monitoring and maintenance of the site infrastructure and facilities will continue until mining recommences or full closure is initiated at the mine site.

10.2 RECLAMATION ACTIVITIES

10.2.1 Temporary Closure Activities

In November 2021 the Bellekeno Mine entered the temporary closure. On-going routine monitoring and maintenance of the site infrastructure and facilities will continue until mining recommences or full closure is initiated. Progressive reclamation of the site continued in 2022.

During temporary closure of the Bellekeno Mine the lined ponds at Bellekeno 625 water treatment plant are being converted into a bioreactor and serve as a contingency treatment system.

10.2.2 Progressive Reclamation Activities

In 2022 progressive reclamation of the DSTF was implemented to maintain site stability and control dust. Progressive reclamation of the DSTF occurs through recontouring the side slopes to the final design slope angle and placing granular/organic material as a cover. Observations of the physical conditions of the cover system and vegetation field trials continued. The most recent formal documentation was completed in 2019 (AEG, 2020).

At the Bellekeno Mine, waste in the laydown yard and at the mine portal was removed and equipment salvaged. Unusable inert products from the surface laydown area were disposed of in the underground workings. The decommissioned fuel tank was recovered from the lined containment area with the intent of it being repurposed for use as a modified burn barrel. The liner from the P-AML facility was relocated underground, the berm breached, and site run off conveyance ditches installed. Sludge was removed from the Bellekeno 625 Adit water treatment ponds and the adjacent decant area, and relocated underground in the Bellekeno Mine.

10.2.3 Reclamation Research

The following reclamation research and field validation programs are currently in progress and the results will be utilized for reclamation and closure planning of the KHSD Mine Operations:

- DSTF cover system and vegetation field trials,
- natural attenuation studies, and
- in situ treatment demonstration at Silver King.

There is an extensive program of monitoring and data collection in the KHSD. The data programs that are particularly important to closure planning and monitoring include:

- surface water quality and hydrology,
- groundwater quality and quantity,
- waste rock geochemistry,
- tailings geochemistry, and
- meteorology.

The implementation of the reclamation measures for the temporary closure of the Bellekeno Mine provides an opportunity for applied reclamation research on the *in situ* water treatment in the underground mine. Data collection during flooding and as the natural biological processes are established will provide further information on the time to establish *in situ* treatment, reagent requirements to develop the biological community (the sulphate reducing organisms), and management requirements. The Bellekeno mine provides an excellent research site as the mine waters are contained and the system for conventional lime water treatment remains in place.

The Bellekeno reclamation also provides an opportunity to observe natural revegetation rate and extent. Upon removal of remnant equipment and material at the east portal the area will be scarified to allow vegetation to establish. Observation of the growth will be added to the information collected at test plots noted above.

The implementation of reclamation measures of the historic mines in the KHSD by ERDC provides an additional opportunity for applied reclamation research for the KHSD Mining Operations.

10.3 UPCOMING DEVELOPMENT, PRODUCTION AND RECLAMATION ACTIVITIES

10.3.1 Development Activities

Several construction projects are planned during 2023 to support the KHSD Mining Operation. The specific construction projects and timing may change during the year due to several factors including limited availability of qualified contractors and long delivery times for equipment and supplies required for the construction projects.

The following is a summary of the Flat Creek Camp expansion activities planned for construction in 2023:

- a 38-bedroom modular dormitory is to be installed to the north of the existing bunkhouses,
- a containerized membrane bioreactor (MBR) sewage treatment plant is to be installed near the existing absorption bed to expand the system,
- existing mine dry facilities currently located at the Flat Creek Camp is to be relocated to the New Bermingham site,
- installation of a new modular kitchen and dining facility to the south of the existing bunkhouses, and
- installation of a composter at the Flat Creek Camp.

The following is a summary of the planned site construction at the Flame & Moth Mine / District Mill:

- upgrade to the ore storage pad,

- construction of the Phase 2 DSTF,
- construction of an additional/new maintenance shop,
- improvements to the tailings & feed conveyor in the mill facility,
- construction of a new lime tank at the mill facility,
- installation of septic systems, and
- enclosure structures for the compressor and concrete batch plant.

The following is a summary of the planned site construction at the New Bermingham Mine:

- installation of mine dry facilities and offices,
- installation of septic systems, and
- commissioning of a waste oil burner at the maintenance shop.

10.3.2 Production Activities

Mine production is to resume in the Q2 of 2023 and continue through the remaining portion of 2023. Commissioning of the mill is to begin in May 2023 with full production through the milling facility planned for Q3 of 2023.

10.3.3 Reclamation Activities

An update to the Reclamation and Closure Plan (Revision 6) was issued in November 2021. Revision 6 of the Reclamation and Closure Plan was approved under QML-0009 on December 22, 2022, by the Yukon Government. The Yukon Water Board is still reviewing Revision 6 of the Reclamation and Closure Plan. In accordance with QML-0009, Revision 7 of the Reclamation and Closure Plan is to be issued in November 2023.

In 2022, the Bellekeno Mine P-AML facility was decommissioned, its berm breached, and site run off conveyance ditches installed.

Figure 10-1 provides a summary of the status of various final reclamation activities described in the updated Reclamation and Closure Plan.

475000 480000 485000 490000

7090000 7085000

N W E S

South McQuesten River

HANSON McQUESTEN ROAD

MILL SITE
- *Remove mill and ancillary facilities*
- *Dispose of waste and contaminated soil*
- *Reclaim mill site area*
- *Ensure adequate site run off management*

FLAME AND MOTH MINE
- *Decommission underground workings*
- *Remove all site infrastructure*
- *Re-handle P-AML waste rock from temporary WRSF underground*
- *Secure adit entrance*
- *Reclaim portal pad*
- *Seal vent raise*
- *Treat mine pool (if required)*
- *Ensure adequate site run off management*

Gambler Gulch
Faro Gulch
McKay Gulch
Silver Basin Gulch

KHSD SLUDGE POND
- *Truck dewatered sludge to mill DSTF*

No Cash Creek
Star Creek
Sandy Creek
Chrisal Creek

DRY STACK TAILINGS FACILITY
- *Recontour and install evapotranspiration cover*
- *Ensure adequate run off management*
- *Decommission ponds and comission bioreactor (if required)*

LUCKY QUEEN AND ONEK MINES
- *Decommission underground workings*
- *Remove all site infrastructure*
- *Secure adit entrance*
- *Reclaim portal pad*
- *Remove liner and recontour Onek P-AML WRSF*
- *Ensure adequate site run off management*

WERMECKE ROAD
SIGN POST ROAD
Charity Gulch
Hope Gulch
CALUMET DRIVE
BERMINGHAM ACCESS ROAD
Christal Lake
MILL SITE
KENO CITY
Lightning Creek

FLAT CREEK CAMP
- *Downsize camp (remove ATCO traillers) for ongoing use during care & maintenance and exploration activities*

Brefalt Creek
Flat Creek
SILVER TRAIL HIGHWAY
Thunder Gulch

BELLEKENO MINE
- Construct coffer dam in BK 625 Adit
- Treat mine pool and commission bioreactor
- P-AML pad decommissioned
- *Reclaim BK East and BK 625 Adit portal pads*
- *Secure BK East and BK 625 Adit entrances*
- *Seal 200 level vent raise*
- *Ensure adequate site run off management*

Galena Creek
Kelly Creek
Fisher Creek

ACCESS AND HAUL ROADS
- *Remove culverts and bridges*
- *Recontour, scarify, and re-vegetate road surface*
- *Re-slope banks*

BERMINGHAM MINE
- *Decommissionundergroundworkings*
- *Remove all site infrastructure*
- *Secure adit entrance*
- *Reclaim portal pad*
- *Recontour and re-vegetate N-AML WRDAs*
- *Re-handle P-AML waste rock from temporary WRSF underground*
- *Seal vent raise*
- *Treat mine pool (if required)*
- *Ensure adequate site run off management*

DUNCAN CREEK ROAD
Duncan Creek
Forty Pup

1:55,000 (when printed on 11 x17 inch paper)

Kilometers 0 1 2 3 4

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

Adit
KHSD Mill
Waterbody
Watercourse
Contours (100 ft intervals)
Silver Trail Highway
Road
Limited-Use Road
Haul Road

BlackText - Reclamation Activities in Progress at End of 2022
Grey Italic Text - *Proposed Reclamation Activities at Final Closure*

Hecla YUKON

KENO HILL SILVER DISTRICT MINING OPERATIONS

FIGURE 10-1
STATUS OF RECLAMATION ACTIVITIES

APRIL 2023

D:\Project\AllProject\Keno_Area_Mines\ALL-SITES\02-Map\01_Overview\02-Specific_Topics\ReclamationSite_Reclamation_Plan_20230427.mxd
(Last edited by: amatlashevska; 2023-04-27 09:12 AM)

11 ASSOCIATED AUTHORIZATIONS

The existing authorizations, licences and permits from other regulatory agencies for KHSD mining activities are summarized in Table 11-1.

Table 11-1: Associated regulatory authorizations

Authorization Number	Authorization Permit	Effective Date	Expiry Date
Bellekeno Mine	Authorization to deposit effluent (MDMER)	September 7, 2020	None Stated
Flame & Moth Mine	Authorization to deposit effluent (MDMER)	November 30, 2020	None Stated
QZ18-044	Type A Water Use Licence	July 23, 2020	August 1, 2037
LQ00476	Class 4 Mining Land Use Approval	June 17, 2018	June 16, 2028
Permit No: 81-067	Commercial Dump Permit	January 1, 2022	December 31, 2026
Permit No: 14133	Burning Permit – Bellekeno Site	May 30, 2022	September 30, 2022
Permit No: 14134	Burning Permit – Bermingham Site	May 30, 2022	September 30, 2022
Permit No: 4202-22-047 Permit No: 4202-22-057	Relocation Permit (small volumes)	July 21, 2022 January 18, 2023	December 31, 2022 December 31, 2023
Permit No: YT-556 Permit No. YT 557	Explosives Magazine Permit Detonator Magazine Permit Flame & Moth	June 10, 2020	June 10, 2025
Permit No: YT-558 Permit No. YT-559	Explosives Magazine Permit Detonator Magazine Permit Bermingham	June 29, 2020	June 29, 2025
Permit No. YT-581 UG	Explosives Magazine Permit Flame & Moth	June 16, 2022	June 16, 2027
Permit No. YT-580 UG	Explosives Magazine Permit Bermingham	June 16, 2022	June 16, 2027
60738-1-25.0	Nuclear Substances and Radiation Devices License	March 7, 2023	May 31, 2025

12 REFERENCES

Alexco Environmental Group (AEG). 2020. FY2019-20-12_02 Vegetation and Cover Trials Data Memo. Prepared for Elsa Reclamation and Development Company Ltd. March 20, 2020.

Bureau de normalization du Quebec (BNQ). 2015. *National Standard of Canada, CAN/BNQ 2910-510/2015, Explosives – Quantity Distances.* Prepared for Standards Council of Canada. April 2015.

Ensero, *Bellekeno Mine Environmental Effects Monitoring Cycle 4 Interpretive Report* submitted to Environment Canada and Climate Change in March 2022

APPENDIX A

2022 ANNUAL PHYSICAL INSPECTION (SUBMITTED UNDER SEPARATE COVER JANUARY 6, 2023)

APPENDIX B

SITE CHARACTERIZATION REPORT (SUBMITTED UNDER SEPARATE COVER FEBRUARY 28, 2023)

APPENDIX C

GEOCHEMICAL ASSESSMENT OF WATER TREATMENT SLUDGE

Memorandum

To: Arlene Stearman and Kevin Eppers, Hecla Yukon

From: Collin Burelle and Andrew Gault, Ensero Solutions Canada, Inc.

CC: Kai Woloshyn, Ensero Solutions Canada, Inc.

Date: March 28, 2023

Re: Geochemical Assessment of AKHM Water Treatment Sludge – 2022 Update

Attachments: Appendix A: Laboratory Analysis Reports

1 INTRODUCTION

Alexco Keno Hill Mining Corp. (AKHM) currently operates and maintains water treatment plants (WTPs) under Type A Water Licence QZ18-044 at the Bellekeno, Flame & Moth, and New Bermingham mines. The treatment systems operated comprise one or more of the following processes:

- Metals removal with the addition of air, lime for pH adjustment, flocculant, coagulant; and
- Particle removal via a multimedia filter, clarifier/thickener, and/or settling pond.

The Sludge Management Plan for the Keno Hill Silver District (KHSD) Mining Operations (AKHM, 2022) stipulates that the measures listed below will be implemented during the duration of water treatment and sludge generation at the Bellekeno, New Bermingham, and Flame & Moth WTPs:

- Recording of the volume of each load of sludge pulled from the water treatment retention ponds in the Operator's Log Book;
- Collection and testing of sludge samples annually. The tests will at least include acid-base accounting (ABA) and elemental analysis; and
- Provision of the information above in AKHM's Annual Report to the Yukon Water Board.

This memorandum summarizes the results of static testing on sludge samples collected in November 2022. The results of samples collected in previous years from AKHM WTPs are also provided, and a comparative assessment done, where appropriate. The memorandum includes results for the 2022 sludge samples collected from the Flame & Moth (November 1) and New Bermingham (November 14) WTPs. Sludge samples were not collected for the Bellekeno WTP in 2022 since mining halted at Bellekeno in 2021. Following the end of mining operations, dewatering of the Bellekeno workings ended and the mine was allowed to flood. As such, no mine water was pumped or

discharge from Bellekeno in 2022; therefore, the Bellekeno WTP did not operate and produce sludge in 2022. Nevertheless, historical data is referenced in this memorandum for each site where appropriate.

2 SAMPLING AND LABORATORY TESTING

Sludge samples collected in 2022 from the clarifier underflow at the Flame & Moth and New Bermingham WTPs were sent to ALS laboratories in Vancouver, BC, for testing (Table 2-1). The geochemical laboratory tests were based on methods outlined in Price (2009) and consisted of:

- ABA including: paste pH, total inorganic carbon, bulk neutralization potential by the Modified Sobek neutralization potential method, and sulphur speciation with the sulphide sulphur determined by difference between total sulphur (Leco) and sulphate sulphur (HCl extraction);
- Ultra trace elemental analysis by aqua regia digestion followed by inductively coupled plasma mass spectrometry (ICP-MS); and
- Shake Flask Extraction (MEND SFE) test at 3:1 water-solid ratio.

Other tests performed on the samples included moisture content and particle size distribution.

Table 2-1: Description of Water Treatment Plant Sludge Samples

Sample ID	Location	Sample Weight (kg)	Laboratory Test
F&M_2022	Flame & Moth	3.22	ABA, Elemental Analysis, Moisture Content and Particle Size Distribution
BH 2022	New Bermingham	0.52	ABA, Elemental Analysis, Moisture Content and Particle Size Distribution

ABA – acid base accounting.

3 RESULTS

The results of laboratory test results are summarized in Table 3-1 to Table 3-4 and laboratory reports are provided in Appendix A. For comparison purposes, the results of similar geochemical tests conducted on sludge samples collected from the same WTPs between 2018 and 2021 and reported in AEG (2019 and 2020) and Ensero (2021 and 2022) are also provided.

3.1 PARTICLE SIZE DISTRIBUTION

The results of particle size distribution (PSD) showed that the 2022 New Bermingham and Flame & Moth WTP sludge samples primarily comprised silt-sized material (80-82%), supplemented by a finer-grained clay fraction (17-18%) and trace sand (2%; Table 3-1).

Table 3-1: Results of Particle Size Distribution Test of Water Treatment Plant Sludge Samples

Grain Size	Units	Detection Limit	F&M	BH
Clay (<0.00 4mm)	%	1.0	18.4	16.5
Silt (0.063 mm - 0.004 mm)	%	1.0	79.6	81.7
Sand (0.2 mm - 0.063 mm)	%	1.0	-	-

Grain Size	Units	Detection Limit	F&M	BH
Sand (2.0 mm - 0.2 mm)	%	1.0	-	-
Sand (2.0 mm - 0.063 mm)	%	1.0	2	1.8
Gravel (>2 mm)	%	1.0	<1.0	<1.0

Notes: F&M: Flame & Moth; BH: New Bermingham

3.2 ACID BASE ACCOUNTING

ABA provides an indication of the acid generation and neutralization potentials of geologic materials by determining the content and ratio of potentially acid producing and consuming minerals in a sample. The results of the ABA testing of the 2022 sludge samples are presented in Table 3-2 along with the results of the 2018, 2019, 2020, and 2021 tests. This was done to provide context for the other WTP (Bellekeno) while also reporting the updated ABA values for the Flame & Moth and New Bermingham WTPs.

The 2022 results show that the samples had neutral paste pH (8.3), consistent with the mildly alkaline paste pH observed in previous years (8.0 to 8.6 for Flame & Moth and 8.9 for New Bermingham).

A marked continuous decrease of carbonate-NP (from 870 to 113 kg $CaCO_3$/t) was observed in the Flame & Moth WTP sludge from 2019 to 2022. Similar decreases in carbonate-NP can also be noted in the New Bermingham sludge (from 201 to 111 kg $CaCO_3$/t) from 2021 to 2022. This is likely due to lower lime addition over the years at both WTPs. The carbonate-NP remained the main contributor to the bulk neutralization potential for all samples (2018-2022), suggesting that most NP is from reactive carbonates.

The sulphate content (reported as HCl extractable sulphur) of the Flame & Moth sludge was much lower in 2021 than in 2019 and 2020 and only represented 4% of total sulphur compared to 66% in 2020 and 100% in 2019 (Ensero, 2022). This was likely due to lower addition of lime (i.e., less precipitation of the calcium sulphate mineral gypsum that forms as calcium from the lime reacts with sulphate in the mine water). Total sulphur also exhibited a decrease in 2021 (0.47 wt.%), but rebounded in 2022 (0.72 wt.%), The 2022 sludge sample from the Flame & Moth WTP also had low sulphate-sulphur content (0.06 wt.%). Both the 2021 and 2022 New Bermingham sludge samples had low sulphate sulphur content (less than 0.01 and 0.02 wt.%, respectively).

The elevated carbonate-NP coupled with a very low acid generation potential (acid potential of 22.5 kg $CaCO_3$/t and 10.9 kg $CaCO_3$/t, respectively) for the 2022 Flame & Moth and New Bermingham sludge suggests that the potential for acid generation from both sludge samples is low. The carbonate neutralization potential ratio (NPR) was calculated conservatively as a ratio of carbonate-NP to acid potential and confirmed a low potential for acid generation (i.e., NPR greater than 2). Sludge samples from all WTPs had an NPR greater than 2 and were classified as non-potentially acid generating (non-PAG).

Table 3-2: Results of Acid Base Accounting of Water Treatment Plant Sludge Samples

Parameter	Units	Detection Limit	BK				F&M				BH	
			2018	2019	2020	2021	2019	2020	2021	2022	2021	2022
Paste pH	pH unit	0.1	9.0	8.5	8.6	8.8	8.3	8.0	8.6	8.3	8.9	8.3
Inorganic Carbon (C)	wt.%	0.05	10.05	9.91	8.39	7.38	10.4	6.62	2.41	1.4	2.41	1.32
Inorganic Carbon Dioxide (CO_2)	wt.%	0.2	36.7	36.3	30.8	27	38.2	24.2	8.8	5.1	8.9	4.9
Total Sulphur	wt.%	0.01	1.01	1.11	1.22	1.67	0.75	0.68	0.47	0.72	0.46	0.35
HCl Extractable Sulphur	wt.%	0.01	0.98	1.09	0.72	0.64	0.77	0.45	0.02	0.06	<0.01	0.02
Sulphide Sulphur (by diff.)	wt.%	0.01	0.03	0.02	0.5	1.03	<0.01	0.23	0.45	0.66	0.46	0.33
Carbonate Equivalent Neutralization Potential (NP)	kg $CaCO_3$/t	1	835	826	700	615	869	550	201	113	201	111
Acid Generation Potential (AP)	kg $CaCO_3$/t	0.3	0.9	0.6	15.6	32.2	0.3	7.2	14.1	22.5	14.4	10.9
Modified Sobek Neutralization Potential (NP)	kg $CaCO_3$/t	1	837	868	695	600	902	520	195	91	202	100
Neutralization Potential Ratio (NPR)	NA	0.1	890	1321	45	19	2780	77	14	5.02	14	10.15
Acid Rock Drainage Classification	NA	-	non-PAG	non-PAG	non-PAG	non-PAG	non-PAG	non-PAG	non-PAG	non-PAG	non-PAG	non-PAG

BK: Bellekeno 625; F&M: Flame & Moth; BH: New Bermingham
NP: neutralization potential
NA: not available

3.3 METAL CONTENT

The bulk metal concentration of an element provides a preliminary indication of constituents that could be solubilized and remobilized when exposed to leaching, depending on the speciation of the metal. However, the enrichment (or depletion) of a constituent in a sample is not a direct measure of its potential mobility or bioavailability because several factors including hydrogeology, biogeochemistry, climate, pH, and redox conditions which together ultimately determine the mobility and bioavailability of an element in the environment. In the case of sludge, climate, pH, and redox conditions are the primary controls on the potential elemental mobility.

The historical trace elemental concentrations for the WTP sludge samples are presented in Table 3-3. The discussion herein is focused on the metal(loid)s related to the KHSD mineralization such as arsenic, cadmium, copper, lead, nickel, manganese, iron, silver, and zinc. The results of the elemental analysis showed high metal(loid) concentrations in the sludges as expected from a treatment system (Table 3-3). The metalloid content of the Bellekeno sludge largely reflected the metal(loid) load supplied by the adit discharge to the WTP. The elevated manganese (7,800 ppm), lead (>10,000 ppm), and zinc (>10,000 ppm) concentrations in the Bellekeno sludge compared to the Flame & Moth and New Bermingham sludge in 2021 reflected the high loading of these metal(loid)s supplied by the adit (Table 3-3). The New Bermingham sludge sample in 2021 also contained elevated silver, arsenic, cadmium, manganese, and lead. The high acid buffering capacity of the sludges create favorable conditions for the precipitation of metal oxyhydroxides that scavenge and coprecipitate these metals(loids), limiting their solubility and mobility in the environment. The concentrations of some metals (e.g., silver, copper, nickel, lead) in the Flame & Moth sludge also increased modestly in 2021 compared to 2019 and 2020 (Table 3-3), while arsenic and manganese decreased. The concentrations of many metal(loids) including arsenic, cadmium, copper, lead, silver, and zinc in the sludge samples increased significantly from 2019 to 2021 at each site (Table 3-3).

The elemental analysis data collected in 2022 showed some variation in concentration of metal(loid)s at each WTP (Table 3-3).

In 2022, the Flame & Moth sludge exhibited approximately one order of magnitude increased concentrations for arsenic, cadmium, silver, and zinc and an approximately doubling of lead, nickel, manganese, and iron concentrations compared to the 2021 sample (Table 3-3). This reflects the marked increase in constituent concentrations in the Flame & Moth adit discharge in 2022 compared to 2021, likely related to increased mine development activity including greater excavation of mineralized rock in the Flame & Moth workings in 2022.

The 2022 New Bermingham sample showed some increases in the concentrations for metal(loids) of focus (cadmium, iron, lead, zinc) but also showed decreases in concentrations for other metal(loids) (arsenic, copper, nickel, manganese, silver).

Table 3-3: Results of Elemental Analysis of WTP Sludge Samples

Parameter	Units	BK				F&M					BH	
		2018	2019	2020	2021	2018	2019	2020	2021	2022	2021	2022
Silver (Ag)	ppm	0.86	0.46	102	>100	0.99	0.06	1.21	4.18	33.7	>100	67.9
Aluminum (Al)	%	0.03	0.03	0.18	0.18	0.67	0.03	0.68	0.73	1.19	0.83	1.08
Arsenic (As)	ppm	36.3	21.9	242	308	38.6	89.2	73	30.8	321	248	121
Boron (B)	ppm	10	<10	<10	<10	<10	<10	<10	10	<10	10	<10
Barium (Ba)	ppm	20	20	30	30	70	10	40	120	420	90	90
Beryllium (Be)	ppm	<0.05	<0.05	0.06	0.11	0.59	<0.05	0.24	0.45	0.30	0.64	0.58
Bismuth (Bi)	ppm	0.03	0.02	1.75	3.32	0.34	0.01	0.36	0.74	4.54	0.18	0.38
Calcium (Ca)	%	>25.0	>25.0	>25.0	22.7	12.9	>25.0	22.6	7.96	4.05	8.04	4.46
Cadmium (Cd)	ppm	21.9	10.25	100.5	140.5	0.67	0.13	2.24	2.81	29.4	21.1	24.6
Cobalt (Co)	ppm	19.2	13.1	12.1	11.6	3.8	3.1	3.2	5.1	12	8.1	10.3
Chromium (Cr)	ppm	6	<1	4	5	19	2	15	19	20	18	22
Copper (Cu)	ppm	12.1	2.8	109	210	16	3	15.1	33	133	55.3	47.1
Iron (Fe)	%	2.46	1.86	2.72	2.89	1.6	1.31	1.94	1.71	3.17	2.36	3.02
Mercury (Hg)	ppm	0.01	<0.01	0.14	0.25	0.02	<0.01	0.04	0.05	.13	0.09	0.11
Potassium (K)	%	0.01	0.01	0.03	0.02	0.04	<0.01	0.04	0.04	0.06	0.06	0.06
Lithium (Li)	ppm	1.3	1.5	1.5	2.3	9.9	1.4	8	14	34.6	11.4	15.6
Magnesium (Mg)	%	1.13	0.6	0.77	0.49	0.67	0.37	0.44	0.5	0.81	0.44	0.47
Manganese (Mn)	ppm	7130	4980	7030	7800	759	1220	1150	595	1315	4280	3320
Molybdenum (Mo)	ppm	1.07	0.12	0.95	1.57	1.96	0.12	0.86	4.84	8.08	3.07	4.44
Sodium (Na)	%	0.03	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.01
Nickel (Ni)	ppm	68.1	46.4	44.3	34.2	20.6	8.9	16.2	25.4	46.5	30.6	40.7
Phosphorus (P)	ppm	50	40	160	180	640	40	510	500	470	660	700
Lead (Pb)	ppm	111	52.1	9750	>10000	50.4	7.7	116	523	962	1815	1850
Sulfur (S)	%	1.07	1.14	1.38	1.73	0.69	0.78	0.79	0.49	0.67	0.48	0.36
Antimony (Sb)	ppm	2.14	1.06	95.4	174	3.44	2.83	4.57	4.68	31.6	66.1	36

Parameter	Units	BK				F&M					BH	
		2018	2019	2020	2021	2018	2019	2020	2021	2022	2021	2022
Selenium (Se)	ppm	0.4	0.7	1.3	1.4	0.5	0.4	0.7	0.9	1.0	0.7	1
Tin (Sn)	ppm	1	<0.2	8.9	14.8	2.2	9.5	1.9	2.2	29.8	3.5	2.7
Strontium (Sr)	ppm	758	683	655	520	310	730	578	188	106	129	75.5
Thallium (Tl)	ppm	0.13	0.04	0.14	0.15	0.06	0.02	0.21	0.1	0.10	0.2	0.16
Uranium (U)	ppm	13.7	12.65	10.2	7.07	5.71	7.86	5.3	3.56	3.17	2.17	1.75
Vanadium (V)	ppm	8	9	31	15	11	7	15	13	18	18	27
Zinc (Zn)	ppm	8380	5150	>10000	>10000	133	169	361	331	3090	1500	1670
Zinc (Zn)*	%	-	-	1.195	-	-	-	-	-	-	-	-

Notes: BK: Bellekeno 625; F&M: Flame & Moth; BH: New Bermingham
**: ore grade aqua regia*

3.4 LEACHABLE METALS

The results of the SFE conducted on the Flame & Moth and New Bermingham 2022 sludge samples are provided in Table 3-4. The results show that 41% (Flame & Moth) and 30% (New Bermingham) of constituents in the leach solution were below the detection limit. Leachable sulphate was moderate (398 and 201 mg/L for Flame & Moth and New Bermingham, respectively). The SFE leachate concentrations for both 2022 samples were lower than the effluent quality standards (EQS) for the parameters with an established EQS (arsenic, cadmium, copper, lead, nickel, silver, zinc).

Table 3-4: Results of Shake Flask Extraction on Flame & Moth and New Bermingham Sludge

Parameter	Detection Limit	Units	Flame & Moth EQS for KV-104L (flow <10 L/s)	New Bermingham EQS	Flame & Moth (2022)	New Bermingham (2022)
pH	0.1	pH units	6.5 to 9.5	6.5 to 9.5	7.42	7.41
Sulphate	0.5	mg/L			398	201
Dissolved hardness (as $CaCO_3$)	0.6	mg/L			426	225
Aluminum	0.005	mg/L			0.0204	0.03
Antimony	0.0001	mg/L			0.0676	0.117
Arsenic	0.001	mg/L	0.035	0.061	0.0054	0.0091
Barium	0.001	mg/L			0.0444	0.0316
Beryllium	0.0005	mg/L			<0.00050	<0.00050
Bismuth	0.0005	mg/L			<0.00050	<0.00050
Boron	0.01	mg/L			0.050	0.095
Cadmium	0.00005	mg/L	0.0012	0.01	0.000177	0.00022
Calcium	0.1	mg/L			104	51.8
Chromium	0.0005	mg/L			<0.00050	<0.00050
Cobalt	0.0001	mg/L			<0.00010	0.00018
Copper	0.001	mg/L	0.043	0.024	<0.0010	<0.0010
Iron	0.03	mg/L			<0.030	<0.030
Lead	0.0001	mg/L	0.036	0.048	0.00094	0.00093
Lithium	0.005	mg/L			0.0205	0.0291
Magnesium	0.05	mg/L			40.5	23.3
Manganese	0.0005	mg/L			0.0345	0.138
Mercury	0.00005	mg/L			<0.000050	<0.00050
Molybdenum	0.0001	mg/L			0.0187	0.0200
Nickel	0.0005	mg/L	0.5	0.37	0.00075	0.0015
Phosphorus	0.3	mg/L			<0.30	<0.30
Potassium	0.05	mg/L			5.27	4.58

Parameter	Detection Limit	Units	Flame & Moth EQS for KV-104L (flow <10 L/s)	New Bermingham EQS	Flame & Moth (2022)	New Bermingham (2022)
Selenium	0.0005	mg/L			0.00083	0.00225
Silicon	0.05	mg/L			2.62	5.18
Silver	0.00005	mg/L	0.0029	0.00062	<0.000050	0.000214
Sodium	0.05	mg/L			10.7	9.66
Strontium	0.0005	mg/L			0.887	0.367
Sulphur	0.5	mg/L			146	78.7
Thallium	0.0001	mg/L			0.00017	<0.00010
Tin	0.0005	mg/L			<0.00050	<0.00050
Titanium	0.01	mg/L			<0.10	<0.010
Uranium	0.00001	mg/L			0.000661	0.00104
Vanadium	0.001	mg/L			<0.0010	0.0012
Zinc	0.01	mg/L	0.23	0.5	<0.010	<0.010

Notes: DL: detection limit

4 SUMMARY

The results of past static tests on KHSD sludge samples from Bellekeno, Flame & Moth, and New Bermingham WTPs indicated that the sludges had low potential for long-term acid generation due to their high carbonate buffering capacity and low sulphide sulphur contents. Flame & Moth and New Bermingham 2022 sludge analyses confirm the continued high carbonate buffering capacity and low sulphide sulphur content at both WTPs, indicating low potential for long-term acid generation. Furthermore, while the sludge exhibited increases in bulk trace element concentrations (Flame & Moth), the SFE leachate test demonstrated low potential for re-mobilization of the metal(loids) of concern.

Tessier Sequential Extraction testing was conducted in 2018 on Bellekeno and Flame & Moth sludge samples(AEG, 2019) and showed that the precipitated metal(loid)s were largely bound to the residual and reducible phases. The precipitated metal(loid)s were predominantly in stable forms and unlikely to be re-mobilized unless exposed to acidic or reducing conditions. The sludge management practices outlined in the sludge management plan (Ensero, 2020 and AKHM, 2022), including underground disposal, co-disposal with dry stack tailings, and in open-pit disposal, combined with the elevated NP are expected to prevent the onset of metal re-mobilizing conditions.

5 REFERENCES

AEG (Alexco Environmental Group Inc.). (2019). Geochemical Assessment of KHSD Water Treatment Sludge Keno Hill Silver District Mining Operations, Yukon. Report prepared for Alexco Keno Hill Mining Corp. March 2019.

AEG (Alexco Environmental Group Inc.). (2020). Geochemical Assessment of KHSD Water Treatment Sludge Keno Hill Silver District Mining Operations, Yukon. Report prepared for Alexco Keno Hill Mining Corp. March 2020.

AKHM (Alexco Keno Hill Mining Corp.). (2022). Keno Hill Silver District Mining Operations Sludge Management Plan. June 2022.

ERDC (Elsa Reclamation and Development Company Ltd.). (2013). *Keno Hill Water Treatment Systems Sludge Management Plan QZ12-057, Revision 4*. September 2013.

Ensero (Ensero Solutions Canada, Inc.). (2020). *Sludge Management Plan, Keno Hill Silver District Mining Operations, Yukon*. Report prepared for Alexco Keno Hill Mining Corp. October 2020.

Ensero (Ensero Solutions Canada, Inc.). (2021). Geochemical Assessment of KHSD Water Treatment Sludge -2020 Update. Memorandum prepared for Alexco Keno Hill Mining Corp. March 29, 2021.

Ensero (Ensero Solutions Canada, Inc.). (2022). *Geochemical Assessment of KHSD Water Treatment Sludge -2021 Update*. Memorandum prepared for Alexco Keno Hill Mining Corp. March 28, 2022.

Price, W.A. (2009). Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report 1.20.1. CANMET – Mining and Mineral Science Laboratories, Smithers, BC.

APPENDIX A:
LABORATORY ANALYSIS REPORTS

ALS Canada Ltd.

right solutions. right partner.

CERTIFICATE OF ANALYSIS

Work Order	: **WR2201485**	Page	: 1 of 6
Client	: **Alexco Keno Hill Mining Corp**	Laboratory	: Whitehorse - Environmental
Contact	: YK Environment	Account Manager	: Heather McKenzie
Address	: Suite 1225, Two Bentall Centre 555 Burrard Street, Box 216 Vancouver BC Canada V7X 1M9	Address	: #12 151 Industrial Road Whitehorse YT Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: Type A WL Tx	Date Samples Received	: 16-Nov-2022 16:20
PO	: 05562	Date Analysis Commenced	: 23-Nov-2022
C-O-C number	: ----	Issue Date	: 30-Jan-2023 15:27
Sampler	: ----		
Site	: AKHM		
Quote number	: WR22-AKHM100-04 (Keno/Hecla)		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Hedy Lai	Team Leader - Inorganics	Inorganics, Saskatoon, Saskatchewan
Janice Leung	Supervisor - Organics Instrumentation	Organics, Burnaby, British Columbia
Kevin Duarte	Supervisor - Metals ICP Instrumentation	Metals, Burnaby, British Columbia
Miles Gropen	Department Manager - Inorganics	Inorganics, Burnaby, British Columbia
Paolo Obillo	Account Manager Assistant	Internal Subcontracting, North Vancouver, British Columbia
Qammar Almas	Lab Assistant	Metals, Burnaby, British Columbia

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances

LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	no units
%	percent
µS/cm	microsiemens per centimetre
kg	kilograms
mg/L	milligrams per litre
pH units	pH units
ppm (w/w)	parts per million (weight/weight)
tCaCO□/kt	tons CaCO□ per kiloton

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Sample Comments

Sample	Client Id	*Comment*
WR2201485-001	BH	Sample(s) F1: Limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.

Analytical Results

Sub-Matrix: **Sludge**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID: BH	----	----	----	----
					Client sampling date / time: 14-Nov-2022 15:00	----	----	----	----
					WR2201485-001	--------	--------	--------	--------
					Result	----	----	----	----
Physical Tests									
Conductivity, leachable	----	E103	2.0	µS/cm	522	----	----	----	----
Moisture	----	E144	0.25	%	77.6	----	----	----	----
pH	----	E116	0.10	pH units	7.41	----	----	----	----
Particle Size									
Clay (<0.004mm)	----	EC184E	1.0	%	16.5	----	----	----	----
Silt (0.063mm - 0.004mm)	----	EC184E	1.0	%	81.7	----	----	----	----
Sand (2.0mm - 0.063mm)	----	EC184E	1.0	%	1.8	----	----	----	----
Gravel (>2mm)	----	EC184E	1.0	%	<1.0	----	----	----	----
Acid Base Accounting									
Carbon dioxide	124-38-9	C-GAS05	0.2	%	4.9	----	----	----	----
Carbon, total inorganic [TIC]	----	C-GAS05	0.05	%	1.32	----	----	----	----
Fizz rating	----	OA-VOL08m	1	-	3	----	----	----	----
Maximum potential acidity [MPA]	----	OA-VOL08m	0.3	tCaCO□/kt	10.9	----	----	----	----
Net neutralization potential [NNP]	----	OA-VOL08m	1	tCaCO□/kt	100	----	----	----	----
Neutralization potential [NP]	----	OA-VOL08m	1	tCaCO□/kt	111	----	----	----	----
Neutralization potential ratio [NPR], (NP/MPA)	----	OA-VOL08m	0.01	-	10.15	----	----	----	----
pH (1:1 soil:water)	----	OA-ELE07	0.10	pH units	8.30	----	----	----	----
Sulfate (as S), HCl leach	14808-79-8	S-GRA06A	0.01	%	0.02	----	----	----	----
Sulfide (as S), total minus HCl leach	18496-25-8	S-CAL06a	0.01	%	0.33	----	----	----	----
Sulfur, total	7704-34-9	S-IR08	0.01	%	0.35	----	----	----	----
Weight, sample received	n/a	WEI-21	0.02	kg	0.52	----	----	----	----
Metals									
Aluminum	7429-90-5	ME-MS41	0.01	%	1.08	----	----	----	----
Antimony	7440-36-0	ME-MS41	0.05	ppm (w/w)	36.0	----	----	----	----
Arsenic	7440-38-2	ME-MS41	0.1	ppm (w/w)	121.0	----	----	----	----
Barium	7440-39-3	ME-MS41	10	ppm (w/w)	90	----	----	----	----
Beryllium	7440-41-7	ME-MS41	0.05	ppm (w/w)	0.58	----	----	----	----
Bismuth	7440-69-9	ME-MS41	0.01	ppm (w/w)	0.38	----	----	----	----
Boron	7440-42-8	ME-MS41	10	ppm (w/w)	<10	----	----	----	----

Analytical Results

Sub-Matrix: Sludge (Matrix: Soil/Solid)					Client sample ID	BH	----	----	----	----
					Client sampling date / time	14-Nov-2022 15:00	----	----	----	----
Analyte	CAS Number	Method	LOR	Unit		WR2201485-001	--------	--------	--------	--------
						Result	----	----	----	----
Metals										
Cadmium	7440-43-9	ME-MS41	0.01	ppm (w/w)		24.6	----	----	----	----
Calcium	7440-70-2	ME-MS41	0.01	%		4.46	----	----	----	----
Cerium	7440-45-1	ME-MS41	0.02	ppm (w/w)		23.4	----	----	----	----
Cesium	7440-46-2	ME-MS41	0.05	ppm (w/w)		1.55	----	----	----	----
Chromium	7440-47-3	ME-MS41	1	ppm (w/w)		22	----	----	----	----
Cobalt	7440-48-4	ME-MS41	0.1	ppm (w/w)		10.3	----	----	----	----
Copper	7440-50-8	ME-MS41	0.2	ppm (w/w)		47.1	----	----	----	----
Gallium	7440-55-3	ME-MS41	0.05	ppm (w/w)		3.12	----	----	----	----
Germanium	7440-56-4	ME-MS41	0.05	ppm (w/w)		0.06	----	----	----	----
Gold	7440-57-5	ME-MS41	0.02	ppm (w/w)		<0.02	----	----	----	----
Hafnium	7440-58-6	ME-MS41	0.02	ppm (w/w)		0.15	----	----	----	----
Indium	7440-74-6	ME-MS41	0.005	ppm (w/w)		0.267	----	----	----	----
Iron	7439-89-6	ME-MS41	0.01	%		3.02	----	----	----	----
Lanthanum	7439-91-0	ME-MS41	0.2	ppm (w/w)		11.8	----	----	----	----
Lead	7439-92-1	ME-MS41	0.2	ppm (w/w)		1850	----	----	----	----
Lithium	7439-93-2	ME-MS41	0.1	ppm (w/w)		15.6	----	----	----	----
Magnesium	7439-95-4	ME-MS41	0.01	%		0.47	----	----	----	----
Manganese	7439-96-5	ME-MS41	5	ppm (w/w)		3320	----	----	----	----
Mercury	7439-97-6	ME-MS41	0.01	ppm (w/w)		0.11	----	----	----	----
Molybdenum	7439-98-7	ME-MS41	0.05	ppm (w/w)		4.44	----	----	----	----
Nickel	7440-02-0	ME-MS41	0.2	ppm (w/w)		40.7	----	----	----	----
Niobium	7440-03-1	ME-MS41	0.05	ppm (w/w)		0.14	----	----	----	----
Phosphorus	7723-14-0	ME-MS41	10	ppm (w/w)		700	----	----	----	----
Potassium	7440-09-7	ME-MS41	0.01	%		0.06	----	----	----	----
Rhenium	7440-15-5	ME-MS41	0.001	ppm (w/w)		0.004	----	----	----	----
Rubidium	7440-17-7	ME-MS41	0.1	ppm (w/w)		4.9	----	----	----	----
Scandium	7440-20-2	ME-MS41	0.1	ppm (w/w)		3.0	----	----	----	----
Selenium	7782-49-2	ME-MS41	0.2	ppm (w/w)		1.0	----	----	----	----
Silver	7440-22-4	ME-MS41	0.01	ppm (w/w)		67.9	----	----	----	----
Sodium	7440-23-5	ME-MS41	0.01	%		0.01	----	----	----	----

Analytical Results

Sub-Matrix: Sludge (Matrix: Soil/Solid)					Client sample ID	BH	----	----	----	----
					Client sampling date / time	14-Nov-2022 15:00	----	----	----	----
Analyte	CAS Number	Method	LOR	Unit		WR2201485-001	--------	--------	--------	--------
						Result	----	----	----	----
Metals										
Strontium	7440-24-6	ME-MS41	0.2	ppm (w/w)		75.5	----	----	----	----
Sulfur	7704-34-9	ME-MS41	0.01	%		0.36	----	----	----	----
Tantalum	7440-25-7	ME-MS41	0.01	ppm (w/w)		0.01	----	----	----	----
Tellurium	13494-80-9	ME-MS41	0.01	ppm (w/w)		0.03	----	----	----	----
Thallium	7440-28-0	ME-MS41	0.02	ppm (w/w)		0.16	----	----	----	----
Thorium	7440-29-1	ME-MS41	0.2	ppm (w/w)		9.8	----	----	----	----
Tin	7440-31-5	ME-MS41	0.2	ppm (w/w)		2.7	----	----	----	----
Titanium	7440-32-6	ME-MS41	0.005	%		<0.005	----	----	----	----
Tungsten	7440-33-7	ME-MS41	0.05	ppm (w/w)		1.73	----	----	----	----
Uranium	7440-61-1	ME-MS41	0.05	ppm (w/w)		1.75	----	----	----	----
Vanadium	7440-62-2	ME-MS41	1	ppm (w/w)		27	----	----	----	----
Yttrium	7440-65-5	ME-MS41	0.05	ppm (w/w)		5.80	----	----	----	----
Zinc	7440-66-6	ME-MS41	2	ppm (w/w)		1670	----	----	----	----
Zirconium	7440-67-7	ME-MS41	0.5	ppm (w/w)		8.5	----	----	----	----
Leachable Anions & Nutrients										
Sulfate, leachable	14808-79-8	E243.SO4	0.50	mg/L		201	----	----	----	----
Leachable Metals										
Aluminum, leachable	7429-90-5	E446	0.0050	mg/L		0.0300	----	----	----	----
Antimony, leachable	7440-36-0	E446	0.00010	mg/L		0.117	----	----	----	----
Arsenic, leachable	7440-38-2	E446	0.0010	mg/L		0.0091	----	----	----	----
Barium, leachable	7440-39-3	E446	0.0010	mg/L		0.0316	----	----	----	----
Beryllium, leachable	7440-41-7	E446	0.00050	mg/L		<0.00050	----	----	----	----
Bismuth, leachable	7440-69-9	E446	0.00050	mg/L		<0.00050	----	----	----	----
Boron, leachable	7440-42-8	E446	0.010	mg/L		0.095	----	----	----	----
Cadmium, leachable	7440-43-9	E446	0.000050	mg/L		0.000220	----	----	----	----
Calcium, leachable	7440-70-2	E446	0.10	mg/L		51.8	----	----	----	----
Chromium, leachable	7440-47-3	E446	0.00050	mg/L		<0.00050	----	----	----	----
Cobalt, leachable	7440-48-4	E446	0.00010	mg/L		0.00018	----	----	----	----
Copper, leachable	7440-50-8	E446	0.0010	mg/L		<0.0010	----	----	----	----
Hardness (as CaCO3), dissolved	----	E446	0.60	mg/L		225	----	----	----	----

Analytical Results

Sub-Matrix: Sludge (Matrix: Soil/Solid)					Client sample ID	BH	----	----	----	----
					Client sampling date / time	14-Nov-2022 15:00	----	----	----	----
Analyte	CAS Number	Method	LOR	Unit		WR2201485-001	--------	--------	--------	--------
						Result	----	----	----	----
Leachable Metals										
Iron, leachable	7439-89-6	E446	0.030	mg/L		<0.030	----	----	----	----
Lead, leachable	7439-92-1	E446	0.00010	mg/L		0.00093	----	----	----	----
Lithium, leachable	7439-93-2	E446	0.0050	mg/L		0.0291	----	----	----	----
Magnesium, leachable	7439-95-4	E446	0.050	mg/L		23.3	----	----	----	----
Manganese, leachable	7439-96-5	E446	0.00050	mg/L		0.138	----	----	----	----
Mercury, leachable	7439-97-6	E515	0.000050	mg/L		<0.000050	----	----	----	----
Molybdenum, leachable	7439-98-7	E446	0.00010	mg/L		0.0200	----	----	----	----
Nickel, leachable	7440-02-0	E446	0.00050	mg/L		0.00150	----	----	----	----
Phosphorus, leachable	7723-14-0	E446	0.30	mg/L		<0.30	----	----	----	----
Potassium, leachable	7440-09-7	E446	0.050	mg/L		4.58	----	----	----	----
Selenium, leachable	7782-49-2	E446	0.00050	mg/L		0.00225	----	----	----	----
Silicon, leachable	7440-21-3	E446	0.050	mg/L		5.18	----	----	----	----
Silver, leachable	7440-22-4	E446	0.000050	mg/L		0.000214	----	----	----	----
Sodium, leachable	7440-23-5	E446	0.050	mg/L		9.66	----	----	----	----
Strontium, leachable	7440-24-6	E446	0.00050	mg/L		0.367	----	----	----	----
Sulfur, leachable	7704-34-9	E446	0.50	mg/L		78.7	----	----	----	----
Thallium, leachable	7440-28-0	E446	0.00010	mg/L		<0.00010	----	----	----	----
Tin, leachable	7440-31-5	E446	0.00050	mg/L		<0.00050	----	----	----	----
Titanium, leachable	7440-32-6	E446	0.010	mg/L		<0.010	----	----	----	----
Uranium, leachable	7440-61-1	E446	0.000010	mg/L		0.00104	----	----	----	----
Vanadium, leachable	7440-62-2	E446	0.0010	mg/L		0.0012	----	----	----	----
Zinc, leachable	7440-66-6	E446	0.010	mg/L		<0.010	----	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

ALS Canada Ltd.

QUALITY CONTROL REPORT

Work Order	: **WR2201485**	Page	: 1 of 10
Client	: Alexco Keno Hill Mining Corp	Laboratory	: Whitehorse - Environmental
Contact	: YK Environment	Account Manager	: Heather McKenzie
Address	: Suite 1225, Two Bentall Centre 555 Burrard Street, Box 216 Vancouver BC Canada V7X 1M9	Address	: #12 151 Industrial Road Whitehorse, Yukon Canada Y1A 2V3
Telephone	:	Telephone	: +1 867 668 6689
Project	: Type A WL Tx	Date Samples Received	: 16-Nov-2022 16:20
PO	: 05562	Date Analysis Commenced	: 23-Nov-2022
C-O-C number	: ----	Issue Date	: 30-Jan-2023 15:27
Sampler	: ---- ----		
Site	: AKHM		
Quote number	: WR22-AKHM100-04 (Keno/Hecla)		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Hedy Lai	Team Leader - Inorganics	Saskatoon Inorganics, Saskatoon, Saskatchewan
Janice Leung	Supervisor - Organics Instrumentation	Vancouver Organics, Burnaby, British Columbia
Kevin Duarte	Supervisor - Metals ICP Instrumentation	Vancouver Metals, Burnaby, British Columbia
Miles Gropen	Department Manager - Inorganics	Vancouver Inorganics, Burnaby, British Columbia
Paolo Obillo	Account Manager Assistant	ALS Minerals (Vancouver) Internal Subcontracting, North Vancouver, British Columbia
Qammar Almas	Lab Assistant	Vancouver Metals, Burnaby, British Columbia

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 758913)											
FJ2203292-001	Anonymous	Moisture	----	E144	0.25	%	1.82	1.86	0.03	Diff <2x LOR	----
Physical Tests (QC Lot: 768734)											
VA22C9472-001	Anonymous	pH	----	E116	0.10	pH units	8.65	8.64	0.116%	5%	----
Leachable Anions & Nutrients (QC Lot: 768725)											
VA22C9472-001	Anonymous	Sulfate, leachable	14808-79-8	E243.SO4	0.50	mg/L	1.87	1.92	0.04	Diff <2x LOR	----
Leachable Metals (QC Lot: 768732)											
VA22C9472-001	Anonymous	Aluminum, leachable	7429-90-5	E446	0.0050	mg/L	23.5	15.6	40.6%	30%	DUP-H
		Antimony, leachable	7440-36-0	E446	0.00010	mg/L	0.00070	0.00065	7.14%	30%	----
		Arsenic, leachable	7440-38-2	E446	0.0010	mg/L	0.0115	0.0096	18.0%	30%	----
		Barium, leachable	7440-39-3	E446	0.0010	mg/L	0.0179	0.0108	49.7%	30%	DUP-H
		Beryllium, leachable	7440-41-7	E446	0.00050	mg/L	0.0120	0.00632	62.1%	30%	DUP-H
		Bismuth, leachable	7440-69-9	E446	0.00050	mg/L	0.00166	0.00078	0.00087	Diff <2x LOR	----
		Boron, leachable	7440-42-8	E446	0.010	mg/L	0.306	0.235	26.3%	30%	----
		Cadmium, leachable	7440-43-9	E446	0.000050	mg/L	0.00202	0.00120	51.2%	30%	DUP-H
		Calcium, leachable	7440-70-2	E446	0.10	mg/L	1.17	0.63	59.8%	30%	DUP-H
		Chromium, leachable	7440-47-3	E446	0.00050	mg/L	0.00354	0.00288	0.00066	Diff <2x LOR	----
		Cobalt, leachable	7440-48-4	E446	0.00010	mg/L	0.00227	0.00111	68.4%	30%	DUP-H
		Copper, leachable	7440-50-8	E446	0.0010	mg/L	0.117	0.0612	63.0%	30%	DUP-H
		Iron, leachable	7439-89-6	E446	0.030	mg/L	3.90	2.20	55.7%	40%	DUP-H
		Lead, leachable	7439-92-1	E446	0.00010	mg/L	0.378	0.176	72.7%	30%	DUP-H
		Lithium, leachable	7439-93-2	E446	0.0050	mg/L	0.0380	# 0.0256	0.0124	Diff <2x LOR	DUP-H
		Magnesium, leachable	7439-95-4	E446	0.050	mg/L	4.02	2.58	43.8%	30%	DUP-H
		Manganese, leachable	7439-96-5	E446	0.00050	mg/L	0.125	0.0659	62.3%	30%	DUP-H
		Molybdenum, leachable	7439-98-7	E446	0.00010	mg/L	0.869	0.874	0.647%	30%	----
		Nickel, leachable	7440-02-0	E446	0.00050	mg/L	0.00089	<0.00050	0.00039	Diff <2x LOR	----
		Phosphorus, leachable	7723-14-0	E446	0.30	mg/L	<0.30	<0.30	0	Diff <2x LOR	----
		Potassium, leachable	7440-09-7	E446	0.050	mg/L	27.1	22.8	17.6%	30%	----
		Selenium, leachable	7782-49-2	E446	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Silicon, leachable	7440-21-3	E446	0.050	mg/L	76.4	47.5	46.5%	40%	DUP-H
		Silver, leachable	7440-22-4	E446	0.000050	mg/L	0.00216	0.00121	56.1%	30%	DUP-H

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Leachable Metals (QC Lot: 768732) - continued											
VA22C9472-001	Anonymous	Sodium, leachable	7440-23-5	E446	0.050	mg/L	18.2	17.7	2.84%	30%	----
		Strontium, leachable	7440-24-6	E446	0.00050	mg/L	0.00712	0.00355	66.8%	30%	DUP-H
		Sulfur, leachable	7704-34-9	E446	0.50	mg/L	0.60	0.50	0.10	Diff <2x LOR	----
		Thallium, leachable	7440-28-0	E446	0.00010	mg/L	0.00053	# 0.00030	0.00023	Diff <2x LOR	DUP-H
		Tin, leachable	7440-31-5	E446	0.00050	mg/L	0.00687	0.00437	44.4%	30%	DUP-H
		Titanium, leachable	7440-32-6	E446	0.010	mg/L	0.103	0.061	50.6%	40%	DUP-H
		Uranium, leachable	7440-61-1	E446	0.000010	mg/L	0.0857	0.0528	47.4%	30%	DUP-H
		Vanadium, leachable	7440-62-2	E446	0.0010	mg/L	0.0230	0.0196	16.1%	30%	----
		Zinc, leachable	7440-66-6	E446	0.010	mg/L	0.588	0.311	61.6%	30%	DUP-H
Leachable Metals (QC Lot: 768733)											
VA22C9472-001	Anonymous	Mercury, leachable	7439-97-6	E515	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----

Qualifiers

Qualifier	*Description*
DUP-H	*Duplicate results outside ALS DQO, due to sample heterogeneity.*

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 758913)						
Moisture	----	E144	0.25	%	<0.25	----
Physical Tests (QCLot: 768735)						
Conductivity, leachable	----	E103	2	µS/cm	<2.0	----
Leachable Anions & Nutrients (QCLot: 768725)						
Sulfate, leachable	14808-79-8	E243.SO4	0.5	mg/L	<0.50	----
Leachable Metals (QCLot: 768732)						
Aluminum, leachable	7429-90-5	E446	0.005	mg/L	<0.0050	----
Antimony, leachable	7440-36-0	E446	0.0001	mg/L	<0.00010	----
Arsenic, leachable	7440-38-2	E446	0.001	mg/L	<0.0010	----
Barium, leachable	7440-39-3	E446	0.001	mg/L	<0.0010	----
Beryllium, leachable	7440-41-7	E446	0.0005	mg/L	<0.00050	----
Bismuth, leachable	7440-69-9	E446	0.0005	mg/L	<0.00050	----
Boron, leachable	7440-42-8	E446	0.01	mg/L	<0.010	----
Cadmium, leachable	7440-43-9	E446	0.00005	mg/L	<0.000050	----
Calcium, leachable	7440-70-2	E446	0.1	mg/L	<0.10	----
Chromium, leachable	7440-47-3	E446	0.0005	mg/L	<0.00050	----
Cobalt, leachable	7440-48-4	E446	0.0001	mg/L	<0.00010	----
Copper, leachable	7440-50-8	E446	0.001	mg/L	<0.0010	----
Iron, leachable	7439-89-6	E446	0.03	mg/L	<0.030	----
Lead, leachable	7439-92-1	E446	0.0001	mg/L	<0.00010	----
Lithium, leachable	7439-93-2	E446	0.005	mg/L	<0.0050	----
Magnesium, leachable	7439-95-4	E446	0.05	mg/L	<0.050	----
Manganese, leachable	7439-96-5	E446	0.0005	mg/L	<0.00050	----
Molybdenum, leachable	7439-98-7	E446	0.0001	mg/L	<0.00010	----
Nickel, leachable	7440-02-0	E446	0.0005	mg/L	<0.00050	----
Phosphorus, leachable	7723-14-0	E446	0.3	mg/L	<0.30	----
Potassium, leachable	7440-09-7	E446	0.05	mg/L	<0.050	----
Selenium, leachable	7782-49-2	E446	0.0005	mg/L	<0.00050	----
Silicon, leachable	7440-21-3	E446	0.05	mg/L	<0.050	----
Silver, leachable	7440-22-4	E446	0.00005	mg/L	<0.000050	----
Sodium, leachable	7440-23-5	E446	0.05	mg/L	<0.050	----
Strontium, leachable	7440-24-6	E446	0.0005	mg/L	<0.00050	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Leachable Metals (QCLot: 768732) - continued						
Sulfur, leachable	7704-34-9	E446	0.5	mg/L	<0.50	----
Thallium, leachable	7440-28-0	E446	0.0001	mg/L	<0.00010	----
Tin, leachable	7440-31-5	E446	0.0005	mg/L	<0.00050	----
Titanium, leachable	7440-32-6	E446	0.01	mg/L	<0.010	----
Uranium, leachable	7440-61-1	E446	0.00001	mg/L	<0.000010	----
Vanadium, leachable	7440-62-2	E446	0.001	mg/L	<0.0010	----
Zinc, leachable	7440-66-6	E446	0.01	mg/L	<0.010	----
Leachable Metals (QCLot: 768733)						
Mercury, leachable	7439-97-6	E515	0.00005	mg/L	<0.000050	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 758913)									
Moisture	----	E144	0.25	%	50 %	99.5	90.0	110	----
Physical Tests (QCLot: 768734)									
pH	----	E116	----	pH units	7.04 pH units	99.7	95.0	105	----
Physical Tests (QCLot: 768735)									
Conductivity, leachable	----	E103	2	µS/cm	146.9 µS/cm	98.9	90.0	110	----
Leachable Anions & Nutrients (QCLot: 768725)									
Sulfate, leachable	14808-79-8	E243.SO4	0.5	mg/L	25 mg/L	102	70.0	130	----
Leachable Metals (QCLot: 768732)									
Aluminum, leachable	7429-90-5	E446	0.005	mg/L	0.2 mg/L	96.6	70.0	130	----
Antimony, leachable	7440-36-0	E446	0.0001	mg/L	0.1 mg/L	96.3	70.0	130	----
Arsenic, leachable	7440-38-2	E446	0.001	mg/L	0.1 mg/L	102	70.0	130	----
Barium, leachable	7440-39-3	E446	0.001	mg/L	0.025 mg/L	90.8	70.0	130	----
Beryllium, leachable	7440-41-7	E446	0.0005	mg/L	0.01 mg/L	97.6	70.0	130	----
Bismuth, leachable	7440-69-9	E446	0.0005	mg/L	0.1 mg/L	90.4	50.0	130	----
Boron, leachable	7440-42-8	E446	0.01	mg/L	0.1 mg/L	91.7	70.0	130	----
Cadmium, leachable	7440-43-9	E446	0.00005	mg/L	0.01 mg/L	95.8	70.0	130	----
Calcium, leachable	7440-70-2	E446	0.1	mg/L	5 mg/L	90.9	70.0	130	----
Chromium, leachable	7440-47-3	E446	0.0005	mg/L	0.025 mg/L	94.6	70.0	130	----
Cobalt, leachable	7440-48-4	E446	0.0001	mg/L	0.025 mg/L	93.2	70.0	130	----
Copper, leachable	7440-50-8	E446	0.001	mg/L	0.025 mg/L	94.0	70.0	130	----
Iron, leachable	7439-89-6	E446	0.03	mg/L	0.1 mg/L	91.3	70.0	130	----
Lead, leachable	7439-92-1	E446	0.0001	mg/L	0.05 mg/L	98.4	70.0	130	----
Lithium, leachable	7439-93-2	E446	0.005	mg/L	0.025 mg/L	102	70.0	130	----
Magnesium, leachable	7439-95-4	E446	0.05	mg/L	5 mg/L	102	70.0	130	----
Manganese, leachable	7439-96-5	E446	0.0005	mg/L	0.025 mg/L	96.0	70.0	130	----
Molybdenum, leachable	7439-98-7	E446	0.0001	mg/L	0.025 mg/L	97.3	70.0	130	----
Nickel, leachable	7440-02-0	E446	0.0005	mg/L	0.05 mg/L	96.0	70.0	130	----
Phosphorus, leachable	7723-14-0	E446	0.3	mg/L	1 mg/L	105	70.0	130	----
Potassium, leachable	7440-09-7	E446	0.05	mg/L	5 mg/L	103	70.0	130	----
Selenium, leachable	7782-49-2	E446	0.0005	mg/L	0.1 mg/L	95.0	70.0	130	----
Silicon, leachable	7440-21-3	E446	0.05	mg/L	1 mg/L	98.4	70.0	130	----

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Leachable Metals (QCLot: 768732) - continued									
Silver, leachable	7440-22-4	E446	0.00005	mg/L	0.01 mg/L	85.6	50.0	130	----
Sodium, leachable	7440-23-5	E446	0.05	mg/L	5 mg/L	96.9	70.0	130	----
Strontium, leachable	7440-24-6	E446	0.0005	mg/L	0.025 mg/L	94.7	70.0	130	----
Sulfur, leachable	7704-34-9	E446	0.5	mg/L	5 mg/L	96.0	70.0	130	----
Thallium, leachable	7440-28-0	E446	0.0001	mg/L	0.11 mg/L	87.4	70.0	130	----
Tin, leachable	7440-31-5	E446	0.0005	mg/L	0.05 mg/L	92.5	50.0	130	----
Titanium, leachable	7440-32-6	E446	0.01	mg/L	0.025 mg/L	91.6	50.0	130	----
Uranium, leachable	7440-61-1	E446	0.00001	mg/L	0.0005 mg/L	97.1	70.0	130	----
Vanadium, leachable	7440-62-2	E446	0.001	mg/L	0.05 mg/L	97.4	70.0	130	----
Zinc, leachable	7440-66-6	E446	0.01	mg/L	0.05 mg/L	96.0	70.0	130	----
Leachable Metals (QCLot: 768733)									
Mercury, leachable	7439-97-6	E515	0.00005	mg/L	0.0005 mg/L	89.6	50.0	130	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Soil/Solid**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Leachable Anions & Nutrients (QCLot: 768725)										
VA22C9472-002	Anonymous	Sulfate, leachable	14808-79-8	E243.SO4	103 mg/L	100 mg/L	103	60.0	140	----
Leachable Metals (QCLot: 768732)										
VA22C9472-002	Anonymous	Aluminum, leachable	7429-90-5	E446	ND mg/L	0.2 mg/L	ND	70.0	130	----
		Antimony, leachable	7440-36-0	E446	0.0408 mg/L	0.04 mg/L	102	70.0	130	----
		Arsenic, leachable	7440-38-2	E446	0.0393 mg/L	0.04 mg/L	98.4	70.0	130	----
		Barium, leachable	7440-39-3	E446	ND mg/L	0.02 mg/L	ND	70.0	130	----
		Beryllium, leachable	7440-41-7	E446	0.0778 mg/L	0.08 mg/L	97.3	70.0	130	----
		Bismuth, leachable	7440-69-9	E446	0.0196 mg/L	0.02 mg/L	98.1	70.0	130	----
		Boron, leachable	7440-42-8	E446	ND mg/L	0.1 mg/L	ND	70.0	130	----
		Cadmium, leachable	7440-43-9	E446	0.00779 mg/L	0.008 mg/L	97.3	70.0	130	----
		Calcium, leachable	7440-70-2	E446	ND mg/L	4 mg/L	ND	70.0	130	----
		Chromium, leachable	7440-47-3	E446	ND mg/L	0.04 mg/L	ND	70.0	130	----
		Cobalt, leachable	7440-48-4	E446	0.0384 mg/L	0.04 mg/L	96.1	70.0	130	----
		Copper, leachable	7440-50-8	E446	0.0384 mg/L	0.04 mg/L	96.0	70.0	130	----
		Iron, leachable	7439-89-6	E446	ND mg/L	2 mg/L	ND	70.0	130	----
		Lead, leachable	7439-92-1	E446	ND mg/L	0.02 mg/L	ND	70.0	130	----
		Lithium, leachable	7439-93-2	E446	0.193 mg/L	0.2 mg/L	96.5	70.0	130	----
		Magnesium, leachable	7439-95-4	E446	ND mg/L	1 mg/L	ND	70.0	130	----
		Manganese, leachable	7439-96-5	E446	ND mg/L	0.02 mg/L	ND	70.0	130	----
		Molybdenum, leachable	7439-98-7	E446	ND mg/L	0.02 mg/L	ND	70.0	130	----
		Nickel, leachable	7440-02-0	E446	0.0789 mg/L	0.08 mg/L	98.6	70.0	130	----
		Phosphorus, leachable	7723-14-0	E446	20.2 mg/L	20 mg/L	101	70.0	130	----
		Potassium, leachable	7440-09-7	E446	ND mg/L	4 mg/L	ND	70.0	130	----
		Selenium, leachable	7782-49-2	E446	0.0774 mg/L	0.08 mg/L	96.7	70.0	130	----
		Silicon, leachable	7440-21-3	E446	ND mg/L	10 mg/L	ND	70.0	130	----
		Silver, leachable	7440-22-4	E446	0.00773 mg/L	0.008 mg/L	96.6	70.0	130	----
		Sodium, leachable	7440-23-5	E446	ND mg/L	2 mg/L	ND	70.0	130	----
		Strontium, leachable	7440-24-6	E446	0.0427 mg/L	0.04 mg/L	107	70.0	130	----
		Sulfur, leachable	7704-34-9	E446	38.7 mg/L	40 mg/L	96.7	70.0	130	----
		Thallium, leachable	7440-28-0	E446	0.00726 mg/L	0.008 mg/L	90.7	70.0	130	----
		Tin, leachable	7440-31-5	E446	0.0392 mg/L	0.04 mg/L	97.9	70.0	130	----

Sub-Matrix: **Soil/Solid**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Leachable Metals (QCLot: 768732) - continued										
VA22C9472-002	Anonymous	Titanium, leachable	7440-32-6	E446	ND mg/L	0.04 mg/L	ND	70.0	130	----
		Uranium, leachable	7440-61-1	E446	ND mg/L	0.004 mg/L	ND	70.0	130	----
		Vanadium, leachable	7440-62-2	E446	0.203 mg/L	0.2 mg/L	101	70.0	130	----
		Zinc, leachable	7440-66-6	E446	0.763 mg/L	0.8 mg/L	95.3	70.0	130	----
Leachable Metals (QCLot: 768733)										
VA22C9472-002	Anonymous	Mercury, leachable	7439-97-6	E515	0.000090 mg/L	0.0001 mg/L	89.6	70.0	130	----

ALS Canada Ltd.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WR2201485**	Page	: 1 of 10
Client	: **Alexco Keno Hill Mining Corp**	Laboratory	: Whitehorse - Environmental
Contact	: YK Environment	Account Manager	: Heather McKenzie
Address	: Suite 1225, Two Bentall Centre 555 Burrard Street, Box 216 Vancouver BC Canada V7X 1M9	Address	: #12 151 Industrial Road Whitehorse, Yukon Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: Type A WL Tx	Date Samples Received	: 16-Nov-2022 16:20
PO	: 05562	Issue Date	: 30-Jan-2023 15:27
C-O-C number	: ----		
Sampler	: ----		
Site	: AKHM		
Quote number	: WR22-AKHM100-04 (Keno/Hecla)		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- Duplicate outliers occur - please see following pages for full details.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **Soil/Solid**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Duplicate (DUP) RPDs								
Leachable Metals	Anonymous	Anonymous	Aluminum, leachable	7429-90-5	E446	40.6 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Barium, leachable	7440-39-3	E446	49.7 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Beryllium, leachable	7440-41-7	E446	62.1 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Cadmium, leachable	7440-43-9	E446	51.2 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Calcium, leachable	7440-70-2	E446	59.8 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Cobalt, leachable	7440-48-4	E446	68.4 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Copper, leachable	7440-50-8	E446	63.0 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Iron, leachable	7439-89-6	E446	55.7 % DUP-H	40%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Lead, leachable	7439-92-1	E446	72.7 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Lithium, leachable	7439-93-2	E446	0.0124 % DUP-H	Diff <2x LOR	Low Level DUP DQO exceeded (difference > 2 LOR).
Leachable Metals	Anonymous	Anonymous	Magnesium, leachable	7439-95-4	E446	43.8 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Manganese, leachable	7439-96-5	E446	62.3 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Silicon, leachable	7440-21-3	E446	46.5 % DUP-H	40%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Silver, leachable	7440-22-4	E446	56.1 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Strontium, leachable	7440-24-6	E446	66.8 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Thallium, leachable	7440-28-0	E446	0.00023 % DUP-H	Diff <2x LOR	Low Level DUP DQO exceeded (difference > 2 LOR).
Leachable Metals	Anonymous	Anonymous	Tin, leachable	7440-31-5	E446	44.4 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.

Matrix: **Soil/Solid**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Duplicate (DUP) RPDs - Continued								
Leachable Metals	Anonymous	Anonymous	Titanium, leachable	7440-32-6	E446	50.6 % DUP-H	40%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Uranium, leachable	7440-61-1	E446	47.4 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	Zinc, leachable	7440-66-6	E446	61.6 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.

Result Qualifiers

Qualifier	*Description*
DUP-H	*Duplicate results outside ALS DQO, due to sample heterogeneity.*

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Acid Base Accounting : Acid Base Accounting (Modified Sobek)										
Glass soil jar/Teflon lined cap										
BH	OA-VOL08m	14-Nov-2022	----	----	----		22-Jan-2023	----	----	
Acid Base Accounting : Inorganic Carbon by Coulometer										
Glass soil jar/Teflon lined cap										
BH	C-GAS05	14-Nov-2022	----	----	----		22-Jan-2023	----	----	
Acid Base Accounting : Received Sample Weight										
Glass soil jar/Teflon lined cap										
BH	WEI-21	14-Nov-2022	----	----	----		22-Jan-2023	180 days	69 days	✓
Acid Base Accounting : Saturated Paste pH										
Glass soil jar/Teflon lined cap										
BH	OA-ELE07	14-Nov-2022	----	----	----		22-Jan-2023	----	----	
Acid Base Accounting : Sulfates by HCl Leaching and Gravimetry										
Glass soil jar/Teflon lined cap										
BH	S-GRA06A	14-Nov-2022	----	----	----		22-Jan-2023	----	----	
Acid Base Accounting : Sulfide S (as S) Calc. (Total-S - SO4-S)										
Glass soil jar/Teflon lined cap										
BH	S-CAL06a	14-Nov-2022	----	----	----		22-Jan-2023	----	----	
Acid Base Accounting : Total Sulfur by Combustion and IR										
Glass soil jar/Teflon lined cap										
BH	S-IR08	14-Nov-2022	----	----	----		22-Jan-2023	----	----	

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Leachable Anions & Nutrients : Sulfate by IC (Shakeflask, 3:1 Ratio with Water)										
Glass soil jar/Teflon lined cap										
BH	E243.SO4	14-Nov-2022	06-Dec-2022	----	----		07-Dec-2022	28 days	23 days	✓
Leachable Metals : Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)										
Glass soil jar/Teflon lined cap										
BH	E515	14-Nov-2022	06-Dec-2022	----	----		07-Dec-2022	28 days	23 days	✓
Leachable Metals : Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)										
Glass soil jar/Teflon lined cap										
BH	E446	14-Nov-2022	06-Dec-2022	----	----		08-Dec-2022	180 days	24 days	✓
Metals : 51 Elements by Aqua Regia digestion and ICP-AES/MS										
Glass soil jar/Teflon lined cap										
BH	ME-MS41	14-Nov-2022	----	----	----		22-Jan-2023	----	----	
Physical Tests : Conductivity by Electrode (Shakeflask, 3:1 Ratio with Water)										
Glass soil jar/Teflon lined cap										
BH	E103	14-Nov-2022	06-Dec-2022	----	----		07-Dec-2022	28 days	23 days	✓
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap										
BH	E144	14-Nov-2022	----	----	----		26-Nov-2022	----	----	
Physical Tests : pH by Electrode (Shakeflask, 3:1 Ratio with Water)										
Glass soil jar/Teflon lined cap										
BH	E116	14-Nov-2022	06-Dec-2022	----	----		07-Dec-2022	30 days	23 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515	768733	1	20	5.0	5.0	✓
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446	768732	1	20	5.0	5.0	✓
Moisture Content by Gravimetry	E144	758913	1	14	7.1	5.0	✓
pH by Electrode (Shakeflask, 3:1 Ratio with Water)	E116	768734	1	20	5.0	5.0	✓
Sulfate by IC (Shakeflask, 3:1 Ratio with Water)	E243.SO4	768725	1	20	5.0	5.0	✓
Laboratory Control Samples (LCS)							
Conductivity by Electrode (Shakeflask, 3:1 Ratio with Water)	E103	768735	1	20	5.0	5.0	✓
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515	768733	1	20	5.0	5.0	✓
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446	768732	1	20	5.0	5.0	✓
Moisture Content by Gravimetry	E144	758913	1	14	7.1	5.0	✓
pH by Electrode (Shakeflask, 3:1 Ratio with Water)	E116	768734	1	20	5.0	5.0	✓
Sulfate by IC (Shakeflask, 3:1 Ratio with Water)	E243.SO4	768725	1	20	5.0	5.0	✓
Method Blanks (MB)							
Conductivity by Electrode (Shakeflask, 3:1 Ratio with Water)	E103	768735	1	20	5.0	5.0	✓
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515	768733	1	20	5.0	5.0	✓
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446	768732	1	20	5.0	5.0	✓
Moisture Content by Gravimetry	E144	758913	1	14	7.1	5.0	✓
Sulfate by IC (Shakeflask, 3:1 Ratio with Water)	E243.SO4	768725	1	20	5.0	5.0	✓
Matrix Spikes (MS)							
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515	768733	1	20	5.0	5.0	✓
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446	768732	1	20	5.0	5.0	✓
Sulfate by IC (Shakeflask, 3:1 Ratio with Water)	E243.SO4	768725	1	20	5.0	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Inorganic Carbon by Coulometer	C-GAS05 ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals C-GAS05	Determine Total Inorganic Carbon (TIC) by using diluted perchloric acid to react with metal carbonate and yield carbon dioxide. Concentration of CO_2 is determined by coulometer.
Conductivity by Electrode (Shakeflask, 3:1 Ratio with Water)	E103 Vancouver - Environmental	Soil/Solid	MEND (mod)/APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into an extract from a soil sample that has been added in a 3:1 ratio of deionized water to soil, then leached and the extract filtered prior to analysis. Conductivity measurements are temperature-compensated to 25°C.
pH by Electrode (Shakeflask, 3:1 Ratio with Water)	E116 Vancouver - Environmental	Soil/Solid	MEND (mod)/APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) on an extract from a soil sample that has been added in a 3:1 ratio of deionized water to soil, then leached and the extract filtered prior to analysis. The pH is then measured by a standard pH probe. .
Moisture Content by Gravimetry	E144 Vancouver - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Sulfate by IC (Shakeflask, 3:1 Ratio with Water)	E243.SO4 Vancouver - Environmental	Soil/Solid	MEND (mod)/EPA 300.1 (mod)	Inorganic anions are analyzed by obtaining an extract from a soil sample that has been added in a 3:1 ratio of deionized water to soil, then leached and the extract filtered prior to analysis, which is then analyzed by Ion Chromatography with conductivity and/or UV detection.
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446 Vancouver - Environmental	Soil/Solid	BC MINISTRY OF ENERGY AND MINES/EPA 6020B (mod)	A sample is extracted with water at a 3:1 liquid to solid ratio for 24 hours, then filtered through a 0.45 micron membrane filter. Analysis is by Collision/Reaction Cell ICPMS. This extraction is an empirical procedure with pre-defined characteristics. Recovery of some elements (Ag, Bi, and Sn) by this method can be variable due to the neutral pH of the extraction fluid, and therefore the LCS DQOs has been established at 50-130% for these elements.
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515 Vancouver - Environmental	Soil/Solid	BC MINISTRY OF ENERGY AND MINES/EPA 1631E (mod)	A sample is extracted with water at a 3:1 liquid to solid ratio for 24 hours, then filtered through a 0.45 micron membrane filter. Analysis is by CVAAS. This extraction is an empirical procedure with pre-defined characteristics. Recovery of mercury can be variable due to the neutral pH of the extraction fluid, and therefore the LCS DQO has been established at 50-130%.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Particle Size Analysis (Pipette) - MMER Classification	EC184E Saskatoon - Environmental	Soil/Solid	Metal Mining Technical Guidance for Environmental Effects Monitoring (2012)	The particle size determination is performed by various methods to generate a Grain Size curve. The data from the curve is then used to produce particle size ranges based on the Metal Mining Effluent Regulations (MMER) classification system for Environmental Effects Monitoring.
51 Elements by Aqua Regia digestion and ICP-AES/MS	ME-MS41 ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals ME-MS41	A prepared sample is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by ICP-AES. Samples are then analyzed by ICP-MS for the remaining suite of elements.
Saturated Paste pH	OA-ELE07 ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals OA-ELE07	Sample mix with water in 1:1 ratio to make a paste, pH is then determined.
Acid Base Accounting (Modified Sobek)	OA-VOL08m ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals OA-VOL08m	Determine the acid generation power of a sample as tonne $CaCO_3$ per kilo-tonne using modified Sobek method
Sulfide S (as S) Calc. (Total-S - SO4-S)	S-CAL06a ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals:S-CAL06a	Sulfide Sulfur (as S) is calculated by subtracting the HCL Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.
Sulfates by HCl Leaching and Gravimetry	S-GRA06A ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals S-GRA06A	A prepared sample is heated with dilute HCl and then filtered. The sulfate in the filtrate is precipitated with $BaCl_2$ in a dilute HCl. The $BaSO_4$ precipitate is filtered, ignited, weighed and the Sulfate Sulfur is determined (as S).

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Total Sulfur by Combustion and IR	S-IR08 ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals S-IR08	A prepared sample is heated to approximately 1350°C in an induction furnace with oxygen stream. Sulfur dioxide released from the sample are measured by IR (Leco analyzer) and the Total Sulfur result is provided.
Received Sample Weight	WEI-21 ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals WEI-21	Weigh out sample received.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Shakeflask Leachate Preparation (3:1 Ratio with Water)	EP446 Vancouver - Environmental	Soil/Solid	BC MINISTRY OF ENERGY AND MINES	A sample is extracted with water at a 3:1 liquid to solids ratio for 24 hours, then filtered through a 0.45 micron membrane filter.
Dry and Grind in Soil/Solid <60°C	EPP442 Saskatoon - Environmental	Soil/Solid	Soil Sampling and Methods of Analysis, Carter 2008	After removal of any coarse fragments and reservation of wet subsamples a portion of homogenized sample is set in a tray and dried at less than 60°C until dry. The sample is then particle size reduced with an automated crusher or mortar and pestle, typically to <2 mm. Further size reduction may be needed for particular tests.

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # _____

Page 1 of 1

Report To		**Report Format / Distribution**				**Service Requested** (Rush for routine analysis subject to availability)
Company:	Alexco Keno Hill Mining	☑ Standard	☐ Other			◉ Regular (Standard Turnaround Times - Business Days)
Contact:	Environment Department	☑ PDF	☑ Excel	☐ Digital	☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	Suite 1225 - 555 Burrard Street Vancouver BC V7X 1M9	Email 1:	YK-Environment@hecla.com			○ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
		Email 2:	nspeiss@ensero.com			○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	867-995-3113 X5960 Fax:	Email 3:	kwoloshyn@ensero.com			**Analysis Request**
Invoice To	Same as Report ? ☑ Yes ☐ No	**Client / Project Information**				
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #:	**Type A WL Tx**			
Company:	Alexco Keno Hill Mining	PO / AFE:	PO#05562			
Contact:	Derek Meneghin; YK-AccountsPayable@hecla.com	LSD:	**AKHM**			
Address:	Suite 1225 - 555 Burrard Street Vancouver BC V7X 1M9					
Phone:	604.633.4888 Fax: 604.633.4887	Quote #:				
Lab Work Order # (lab use only)		**ALS Contact:**	Heather McKenzie	**Sampler:**	TF	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	time	Sample Type	ABA w modified Sobek	Aqua regia digestion w ICP	Shakeflask metals ICPMS	Shakeflask sulphate, pH, EC	Grain size >2mm, pipette	mber of Containers
	BH	14-Nov-22	16:00	Other	X	X	X	X	X	

Environmental Division
Whitehorse
Work Order Reference
WR2201485

Telephone : +1 867 668 6689

Yukon EQWin and ACC200 digital formats. General A: pH, EC, TSS (low) **General B:** pH, EC, TSS (low), anions-all
General C: pH, EC, TSS (low), anions-all, ion balance, alkalinity **General D:** pH, EC, TSS (low), SO4, ion balance, alkalinity **Other:** Samples are sludge.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
TF	15-Nov-22	12:00	HA	11/17	9:40	1.5 °C				

ALS Canada Ltd.

right solutions. right partner.

CERTIFICATE OF ANALYSIS

Work Order	: **WR2201414**	Page	: 1 of 6
Client	: **Alexco Keno Hill Mining Corp**	Laboratory	: Whitehorse - Environmental
Contact	: Environment	Account Manager	: Heather McKenzie
Address	: #2 Calcite Business Centre - 151 Industrial Road Whitehorse YT Canada Y1A 2V3	Address	: #12 151 Industrial Road Whitehorse YT Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: Type A WL Tx	Date Samples Received	: 02-Nov-2022 10:20
PO	: 05562	Date Analysis Commenced	: 08-Nov-2022
C-O-C number	: ----	Issue Date	: 07-Feb-2023 12:18
Sampler	: TF		
Site	: AKHM		
Quote number	: WR22-AKHM100-04 (Keno/Hecla)		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Caitlin Macey	Team Leader - Inorganics	Inorganics, Burnaby, British Columbia
Hedy Lai	Team Leader - Inorganics	Inorganics, Saskatoon, Saskatchewan
Kaitlyn Gardner	Account Manager Assistant	Internal Subcontracting, North Vancouver, British Columbia
Kevin Duarte	Supervisor - Metals ICP Instrumentation	Metals, Burnaby, British Columbia
Ophelia Chiu	Department Manager - Organics	Organics, Burnaby, British Columbia
Qammar Almas	Lab Assistant	Metals, Burnaby, British Columbia

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances

LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	no units
%	percent
µS/cm	microsiemens per centimetre
kg	kilograms
mg/L	milligrams per litre
pH units	pH units
ppm (w/w)	parts per million (weight/weight)
tCaCO□/kt	tons CaCO□ per kiloton

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical Results

Sub-Matrix: **Sludge**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID: F&M	----	----	----	----
					Client sampling date / time: 01-Nov-2022 09:30	----	----	----	----
					WR2201414-001	--------	--------	--------	--------
					Result	----	----	----	----
Physical Tests									
Conductivity, leachable	----	E103	2.0	µS/cm	789	----	----	----	----
Moisture	----	E144	0.25	%	66.6	----	----	----	----
pH	----	E116	0.10	pH units	7.42	----	----	----	----
Particle Size									
Clay (<0.004mm)	----	EC184E	1.0	%	18.4	----	----	----	----
Silt (0.063mm - 0.004mm)	----	EC184E	1.0	%	79.6	----	----	----	----
Sand (2.0mm - 0.063mm)	----	EC184E	1.0	%	2.0	----	----	----	----
Gravel (>2mm)	----	EC184E	1.0	%	<1.0	----	----	----	----
Acid Base Accounting									
Carbon dioxide	124-38-9	C-GAS05	0.2	%	5.1	----	----	----	----
Carbon, total inorganic [TIC]	----	C-GAS05	0.05	%	1.40	----	----	----	----
Fizz rating	----	OA-VOL08m	1	-	3	----	----	----	----
Maximum potential acidity [MPA]	----	OA-VOL08m	0.3	tCaCO□/kt	22.5	----	----	----	----
Net neutralization potential [NNP]	----	OA-VOL08m	1	tCaCO□/kt	91	----	----	----	----
Neutralization potential [NP]	----	OA-VOL08m	1	tCaCO□/kt	113	----	----	----	----
Neutralization potential ratio [NPR], (NP/MPA)	----	OA-VOL08m	0.01	-	5.02	----	----	----	----
pH (1:1 soil:water)	----	OA-ELE07	0.10	pH units	8.30	----	----	----	----
Sulfate (as S), HCl leach	14808-79-8	S-GRA06A	0.01	%	0.06	----	----	----	----
Sulfide (as S), total minus HCl leach	18496-25-8	S-CAL06a	0.01	%	0.66	----	----	----	----
Sulfur, total	7704-34-9	S-IR08	0.01	%	0.72	----	----	----	----
Weight, sample received	n/a	WEI-21	0.02	kg	3.22	----	----	----	----
Metals									
Aluminum	7429-90-5	ME-MS41	0.01	%	1.19	----	----	----	----
Antimony	7440-36-0	ME-MS41	0.05	ppm (w/w)	31.6	----	----	----	----
Arsenic	7440-38-2	ME-MS41	0.1	ppm (w/w)	321	----	----	----	----
Barium	7440-39-3	ME-MS41	10	ppm (w/w)	420	----	----	----	----
Beryllium	7440-41-7	ME-MS41	0.05	ppm (w/w)	0.30	----	----	----	----
Bismuth	7440-69-9	ME-MS41	0.01	ppm (w/w)	4.54	----	----	----	----
Boron	7440-42-8	ME-MS41	10	ppm (w/w)	<10	----	----	----	----

Analytical Results

Sub-Matrix: Sludge (Matrix: Soil/Solid)					Client sample ID	F&M	----	----	----	----
					Client sampling date / time	01-Nov-2022 09:30	----	----	----	----
Analyte	CAS Number	Method	LOR	Unit		WR2201414-001	--------	--------	--------	--------
						Result	----	----	----	----
Metals										
Cadmium	7440-43-9	ME-MS41	0.01	ppm (w/w)		29.4	----	----	----	----
Calcium	7440-70-2	ME-MS41	0.01	%		4.05	----	----	----	----
Cerium	7440-45-1	ME-MS41	0.02	ppm (w/w)		22.0	----	----	----	----
Cesium	7440-46-2	ME-MS41	0.05	ppm (w/w)		1.93	----	----	----	----
Chromium	7440-47-3	ME-MS41	1	ppm (w/w)		20	----	----	----	----
Cobalt	7440-48-4	ME-MS41	0.1	ppm (w/w)		12.0	----	----	----	----
Copper	7440-50-8	ME-MS41	0.2	ppm (w/w)		133.0	----	----	----	----
Gallium	7440-55-3	ME-MS41	0.05	ppm (w/w)		3.63	----	----	----	----
Germanium	7440-56-4	ME-MS41	0.05	ppm (w/w)		0.06	----	----	----	----
Gold	7440-57-5	ME-MS41	0.02	ppm (w/w)		<0.02	----	----	----	----
Hafnium	7440-58-6	ME-MS41	0.02	ppm (w/w)		0.19	----	----	----	----
Indium	7440-74-6	ME-MS41	0.005	ppm (w/w)		5.15	----	----	----	----
Iron	7439-89-6	ME-MS41	0.01	%		3.17	----	----	----	----
Lanthanum	7439-91-0	ME-MS41	0.2	ppm (w/w)		10.4	----	----	----	----
Lead	7439-92-1	ME-MS41	0.2	ppm (w/w)		962	----	----	----	----
Lithium	7439-93-2	ME-MS41	0.1	ppm (w/w)		34.6	----	----	----	----
Magnesium	7439-95-4	ME-MS41	0.01	%		0.81	----	----	----	----
Manganese	7439-96-5	ME-MS41	5	ppm (w/w)		1315	----	----	----	----
Mercury	7439-97-6	ME-MS41	0.01	ppm (w/w)		0.13	----	----	----	----
Molybdenum	7439-98-7	ME-MS41	0.05	ppm (w/w)		8.08	----	----	----	----
Nickel	7440-02-0	ME-MS41	0.2	ppm (w/w)		46.5	----	----	----	----
Niobium	7440-03-1	ME-MS41	0.05	ppm (w/w)		<0.05	----	----	----	----
Phosphorus	7723-14-0	ME-MS41	10	ppm (w/w)		470	----	----	----	----
Potassium	7440-09-7	ME-MS41	0.01	%		0.06	----	----	----	----
Rhenium	7440-15-5	ME-MS41	0.001	ppm (w/w)		0.003	----	----	----	----
Rubidium	7440-17-7	ME-MS41	0.1	ppm (w/w)		4.7	----	----	----	----
Scandium	7440-20-2	ME-MS41	0.1	ppm (w/w)		2.4	----	----	----	----
Selenium	7782-49-2	ME-MS41	0.2	ppm (w/w)		1.0	----	----	----	----
Silver	7440-22-4	ME-MS41	0.01	ppm (w/w)		33.7	----	----	----	----
Sodium	7440-23-5	ME-MS41	0.01	%		0.02	----	----	----	----

Analytical Results

Sub-Matrix: Sludge (Matrix: Soil/Solid)					Client sample ID	F&M	----	----	----	----
					Client sampling date / time	01-Nov-2022 09:30	----	----	----	----
Analyte	CAS Number	Method	LOR	Unit		WR2201414-001	--------	--------	--------	--------
						Result	----	----	----	----
Metals										
Strontium	7440-24-6	ME-MS41	0.2	ppm (w/w)		106.0	----	----	----	----
Sulfur	7704-34-9	ME-MS41	0.01	%		0.67	----	----	----	----
Tantalum	7440-25-7	ME-MS41	0.01	ppm (w/w)		<0.01	----	----	----	----
Tellurium	13494-80-9	ME-MS41	0.01	ppm (w/w)		0.06	----	----	----	----
Thallium	7440-28-0	ME-MS41	0.02	ppm (w/w)		0.10	----	----	----	----
Thorium	7440-29-1	ME-MS41	0.2	ppm (w/w)		7.4	----	----	----	----
Tin	7440-31-5	ME-MS41	0.2	ppm (w/w)		29.8	----	----	----	----
Titanium	7440-32-6	ME-MS41	0.005	%		<0.005	----	----	----	----
Tungsten	7440-33-7	ME-MS41	0.05	ppm (w/w)		2.35	----	----	----	----
Uranium	7440-61-1	ME-MS41	0.05	ppm (w/w)		3.17	----	----	----	----
Vanadium	7440-62-2	ME-MS41	1	ppm (w/w)		18	----	----	----	----
Yttrium	7440-65-5	ME-MS41	0.05	ppm (w/w)		4.35	----	----	----	----
Zinc	7440-66-6	ME-MS41	2	ppm (w/w)		3090	----	----	----	----
Zirconium	7440-67-7	ME-MS41	0.5	ppm (w/w)		10.4	----	----	----	----
Leachable Anions & Nutrients										
Sulfate, leachable	14808-79-8	E243.SO4	0.50	mg/L		398	----	----	----	----
Leachable Metals										
Aluminum, leachable	7429-90-5	E446	0.0050	mg/L		0.0204	----	----	----	----
Antimony, leachable	7440-36-0	E446	0.00010	mg/L		0.0676	----	----	----	----
Arsenic, leachable	7440-38-2	E446	0.0010	mg/L		0.0054	----	----	----	----
Barium, leachable	7440-39-3	E446	0.0010	mg/L		0.0444	----	----	----	----
Beryllium, leachable	7440-41-7	E446	0.00050	mg/L		<0.00050	----	----	----	----
Bismuth, leachable	7440-69-9	E446	0.00050	mg/L		<0.00050	----	----	----	----
Boron, leachable	7440-42-8	E446	0.010	mg/L		0.050	----	----	----	----
Cadmium, leachable	7440-43-9	E446	0.000050	mg/L		0.000177	----	----	----	----
Calcium, leachable	7440-70-2	E446	0.10	mg/L		104	----	----	----	----
Chromium, leachable	7440-47-3	E446	0.00050	mg/L		<0.00050	----	----	----	----
Cobalt, leachable	7440-48-4	E446	0.00010	mg/L		<0.00010	----	----	----	----
Copper, leachable	7440-50-8	E446	0.0010	mg/L		<0.0010	----	----	----	----
Hardness (as CaCO3), dissolved	----	E446	0.60	mg/L		426	----	----	----	----

Analytical Results

Sub-Matrix: Sludge (Matrix: Soil/Solid)					Client sample ID	F&M	----	----	----	----
					Client sampling date / time	01-Nov-2022 09:30	----	----	----	----
Analyte	CAS Number	Method	LOR	Unit		WR2201414-001	--------	--------	--------	--------
						Result	----	----	----	----
Leachable Metals										
Iron, leachable	7439-89-6	E446	0.030	mg/L		<0.030	----	----	----	----
Lead, leachable	7439-92-1	E446	0.00010	mg/L		0.00094	----	----	----	----
Lithium, leachable	7439-93-2	E446	0.0050	mg/L		0.0205	----	----	----	----
Magnesium, leachable	7439-95-4	E446	0.050	mg/L		40.5	----	----	----	----
Manganese, leachable	7439-96-5	E446	0.00050	mg/L		0.0345	----	----	----	----
Mercury, leachable	7439-97-6	E515	0.000050	mg/L		<0.000050	----	----	----	----
Molybdenum, leachable	7439-98-7	E446	0.00010	mg/L		0.0187	----	----	----	----
Nickel, leachable	7440-02-0	E446	0.00050	mg/L		0.00075	----	----	----	----
Phosphorus, leachable	7723-14-0	E446	0.30	mg/L		<0.30	----	----	----	----
Potassium, leachable	7440-09-7	E446	0.050	mg/L		5.27	----	----	----	----
Selenium, leachable	7782-49-2	E446	0.00050	mg/L		0.00083	----	----	----	----
Silicon, leachable	7440-21-3	E446	0.050	mg/L		2.62	----	----	----	----
Silver, leachable	7440-22-4	E446	0.000050	mg/L		<0.000050	----	----	----	----
Sodium, leachable	7440-23-5	E446	0.050	mg/L		10.7	----	----	----	----
Strontium, leachable	7440-24-6	E446	0.00050	mg/L		0.887	----	----	----	----
Sulfur, leachable	7704-34-9	E446	0.50	mg/L		146	----	----	----	----
Thallium, leachable	7440-28-0	E446	0.00010	mg/L		0.00017	----	----	----	----
Tin, leachable	7440-31-5	E446	0.00050	mg/L		<0.00050	----	----	----	----
Titanium, leachable	7440-32-6	E446	0.010	mg/L		<0.010	----	----	----	----
Uranium, leachable	7440-61-1	E446	0.000010	mg/L		0.000661	----	----	----	----
Vanadium, leachable	7440-62-2	E446	0.0010	mg/L		<0.0010	----	----	----	----
Zinc, leachable	7440-66-6	E446	0.010	mg/L		<0.010	----	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

ALS Canada Ltd.

QUALITY CONTROL REPORT

Work Order	: **WR2201414**	Page	: 1 of 10
Client	: Alexco Keno Hill Mining Corp	Laboratory	: Whitehorse - Environmental
Contact	: Environment	Account Manager	: Heather McKenzie
Address	: #2 Calcite Business Centre - 151 Industrial Road Whitehorse YT Canada Y1A 2V3	Address	: #12 151 Industrial Road Whitehorse, Yukon Canada Y1A 2V3
Telephone	:	Telephone	: +1 867 668 6689
Project	: Type A WL Tx	Date Samples Received	: 02-Nov-2022 10:20
PO	: 05562	Date Analysis Commenced	: 08-Nov-2022
C-O-C number	: ----	Issue Date	: 07-Feb-2023 12:18
Sampler	: TF ----		
Site	: AKHM		
Quote number	: WR22-AKHM100-04 (Keno/Hecla)		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Caitlin Macey	Team Leader - Inorganics	Vancouver Inorganics, Burnaby, British Columbia
Hedy Lai	Team Leader - Inorganics	Saskatoon Inorganics, Saskatoon, Saskatchewan
Kaitlyn Gardner	Account Manager Assistant	ALS Minerals (Vancouver) Internal Subcontracting, North Vancouver, British Columbia
Kevin Duarte	Supervisor - Metals ICP Instrumentation	Vancouver Metals, Burnaby, British Columbia
Ophelia Chiu	Department Manager - Organics	Vancouver Organics, Burnaby, British Columbia
Qammar Almas	Lab Assistant	Vancouver Metals, Burnaby, British Columbia

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 734959)											
VA22C7017-005	Anonymous	Moisture	----	E144	0.25	%	10.5	11.7	10.6%	20%	----
Physical Tests (QC Lot: 735591)											
WR2201414-001	F&M	pH	----	E116	0.10	pH units	7.42	7.48	0.806%	5%	----
Leachable Anions & Nutrients (QC Lot: 735594)											
WR2201414-001	F&M	Sulfate, leachable	14808-79-8	E243.SO4	0.50	mg/L	398	411	3.15%	30%	----
Leachable Metals (QC Lot: 735590)											
WR2201414-001	F&M	Mercury, leachable	7439-97-6	E515	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
Leachable Metals (QC Lot: 735592)											
WR2201414-001	F&M	Aluminum, leachable	7429-90-5	E446	0.0050	mg/L	0.0204	0.0200	0.0004	Diff <2x LOR	----
		Antimony, leachable	7440-36-0	E446	0.00010	mg/L	0.0676	0.0655	3.23%	30%	----
		Arsenic, leachable	7440-38-2	E446	0.0010	mg/L	0.0054	0.0053	0.00007	Diff <2x LOR	----
		Barium, leachable	7440-39-3	E446	0.0010	mg/L	0.0444	0.0437	1.61%	30%	----
		Beryllium, leachable	7440-41-7	E446	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Bismuth, leachable	7440-69-9	E446	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Boron, leachable	7440-42-8	E446	0.010	mg/L	0.050	0.050	0.000009	Diff <2x LOR	----
		Cadmium, leachable	7440-43-9	E446	0.000050	mg/L	0.000177	0.000149	0.000028	Diff <2x LOR	----
		Calcium, leachable	7440-70-2	E446	0.10	mg/L	104	100	3.96%	30%	----
		Chromium, leachable	7440-47-3	E446	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Cobalt, leachable	7440-48-4	E446	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Copper, leachable	7440-50-8	E446	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
		Iron, leachable	7439-89-6	E446	0.030	mg/L	<0.030	<0.030	0	Diff <2x LOR	----
		Lead, leachable	7439-92-1	E446	0.00010	mg/L	0.00094	0.00096	2.26%	30%	----
		Lithium, leachable	7439-93-2	E446	0.0050	mg/L	0.0205	0.0205	0.00002	Diff <2x LOR	----
		Magnesium, leachable	7439-95-4	E446	0.050	mg/L	40.5	38.2	5.63%	30%	----
		Manganese, leachable	7439-96-5	E446	0.00050	mg/L	0.0345	0.0325	5.88%	30%	----
		Molybdenum, leachable	7439-98-7	E446	0.00010	mg/L	0.0187	0.0182	2.82%	30%	----
		Nickel, leachable	7440-02-0	E446	0.00050	mg/L	0.00075	0.00071	0.00004	Diff <2x LOR	----
		Phosphorus, leachable	7723-14-0	E446	0.30	mg/L	<0.30	<0.30	0	Diff <2x LOR	----
		Potassium, leachable	7440-09-7	E446	0.050	mg/L	5.27	5.03	4.53%	30%	----
		Selenium, leachable	7782-49-2	E446	0.00050	mg/L	0.00083	0.00074	0.00009	Diff <2x LOR	----

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Leachable Metals (QC Lot: 735592) - continued											
WR2201414-001	F&M	Silicon, leachable	7440-21-3	E446	0.050	mg/L	2.62	2.42	7.69%	40%	----
		Silver, leachable	7440-22-4	E446	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		Sodium, leachable	7440-23-5	E446	0.050	mg/L	10.7	10.4	3.44%	30%	----
		Strontium, leachable	7440-24-6	E446	0.00050	mg/L	0.887	0.844	4.94%	30%	----
		Sulfur, leachable	7704-34-9	E446	0.50	mg/L	146	138	5.55%	30%	----
		Thallium, leachable	7440-28-0	E446	0.00010	mg/L	0.00017	0.00016	0.000006	Diff <2x LOR	----
		Tin, leachable	7440-31-5	E446	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Titanium, leachable	7440-32-6	E446	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	----
		Uranium, leachable	7440-61-1	E446	0.000010	mg/L	0.000661	0.000612	7.73%	30%	----
		Vanadium, leachable	7440-62-2	E446	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
		Zinc, leachable	7440-66-6	E446	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 734959)						
Moisture	----	E144	0.25	%	<0.25	----
Physical Tests (QCLot: 735593)						
Conductivity, leachable	----	E103	2	µS/cm	<2.0	----
Leachable Anions & Nutrients (QCLot: 735594)						
Sulfate, leachable	14808-79-8	E243.SO4	0.5	mg/L	<0.50	----
Leachable Metals (QCLot: 735590)						
Mercury, leachable	7439-97-6	E515	0.00005	mg/L	<0.000050	----
Leachable Metals (QCLot: 735592)						
Aluminum, leachable	7429-90-5	E446	0.005	mg/L	<0.0050	----
Antimony, leachable	7440-36-0	E446	0.0001	mg/L	<0.00010	----
Arsenic, leachable	7440-38-2	E446	0.001	mg/L	<0.0010	----
Barium, leachable	7440-39-3	E446	0.001	mg/L	<0.0010	----
Beryllium, leachable	7440-41-7	E446	0.0005	mg/L	<0.00050	----
Bismuth, leachable	7440-69-9	E446	0.0005	mg/L	<0.00050	----
Boron, leachable	7440-42-8	E446	0.01	mg/L	<0.010	----
Cadmium, leachable	7440-43-9	E446	0.00005	mg/L	<0.000050	----
Calcium, leachable	7440-70-2	E446	0.1	mg/L	<0.10	----
Chromium, leachable	7440-47-3	E446	0.0005	mg/L	<0.00050	----
Cobalt, leachable	7440-48-4	E446	0.0001	mg/L	<0.00010	----
Copper, leachable	7440-50-8	E446	0.001	mg/L	<0.0010	----
Iron, leachable	7439-89-6	E446	0.03	mg/L	<0.030	----
Lead, leachable	7439-92-1	E446	0.0001	mg/L	<0.00010	----
Lithium, leachable	7439-93-2	E446	0.005	mg/L	<0.0050	----
Magnesium, leachable	7439-95-4	E446	0.05	mg/L	<0.050	----
Manganese, leachable	7439-96-5	E446	0.0005	mg/L	<0.00050	----
Molybdenum, leachable	7439-98-7	E446	0.0001	mg/L	<0.00010	----
Nickel, leachable	7440-02-0	E446	0.0005	mg/L	<0.00050	----
Phosphorus, leachable	7723-14-0	E446	0.3	mg/L	<0.30	----
Potassium, leachable	7440-09-7	E446	0.05	mg/L	<0.050	----
Selenium, leachable	7782-49-2	E446	0.0005	mg/L	<0.00050	----
Silicon, leachable	7440-21-3	E446	0.05	mg/L	<0.050	----
Silver, leachable	7440-22-4	E446	0.00005	mg/L	<0.000050	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Leachable Metals (QCLot: 735592) - continued						
Sodium, leachable	7440-23-5	E446	0.05	mg/L	<0.050	----
Strontium, leachable	7440-24-6	E446	0.0005	mg/L	<0.00050	----
Sulfur, leachable	7704-34-9	E446	0.5	mg/L	<0.50	----
Thallium, leachable	7440-28-0	E446	0.0001	mg/L	<0.00010	----
Tin, leachable	7440-31-5	E446	0.0005	mg/L	<0.00050	----
Titanium, leachable	7440-32-6	E446	0.01	mg/L	<0.010	----
Uranium, leachable	7440-61-1	E446	0.00001	mg/L	<0.000010	----
Vanadium, leachable	7440-62-2	E446	0.001	mg/L	<0.0010	----
Zinc, leachable	7440-66-6	E446	0.01	mg/L	<0.010	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 734959)									
Moisture	----	E144	0.25	%	50 %	99.8	90.0	110	----
Physical Tests (QCLot: 735591)									
pH	----	E116	----	pH units	7.04 pH units	99.1	95.0	105	----
Physical Tests (QCLot: 735593)									
Conductivity, leachable	----	E103	2	µS/cm	146.9 µS/cm	95.1	90.0	110	----
Leachable Anions & Nutrients (QCLot: 735594)									
Sulfate, leachable	14808-79-8	E243.SO4	0.5	mg/L	25 mg/L	99.2	70.0	130	----
Leachable Metals (QCLot: 735590)									
Mercury, leachable	7439-97-6	E515	0.00005	mg/L	0.0005 mg/L	92.5	50.0	130	----
Leachable Metals (QCLot: 735592)									
Aluminum, leachable	7429-90-5	E446	0.005	mg/L	0.2 mg/L	96.4	70.0	130	----
Antimony, leachable	7440-36-0	E446	0.0001	mg/L	0.1 mg/L	106	70.0	130	----
Arsenic, leachable	7440-38-2	E446	0.001	mg/L	0.1 mg/L	98.9	70.0	130	----
Barium, leachable	7440-39-3	E446	0.001	mg/L	0.025 mg/L	96.8	70.0	130	----
Beryllium, leachable	7440-41-7	E446	0.0005	mg/L	0.01 mg/L	98.0	70.0	130	----
Bismuth, leachable	7440-69-9	E446	0.0005	mg/L	0.1 mg/L	97.2	50.0	130	----
Boron, leachable	7440-42-8	E446	0.01	mg/L	0.1 mg/L	90.6	70.0	130	----
Cadmium, leachable	7440-43-9	E446	0.00005	mg/L	0.01 mg/L	96.2	70.0	130	----
Calcium, leachable	7440-70-2	E446	0.1	mg/L	5 mg/L	100	70.0	130	----
Chromium, leachable	7440-47-3	E446	0.0005	mg/L	0.025 mg/L	94.3	70.0	130	----
Cobalt, leachable	7440-48-4	E446	0.0001	mg/L	0.025 mg/L	93.9	70.0	130	----
Copper, leachable	7440-50-8	E446	0.001	mg/L	0.025 mg/L	93.7	70.0	130	----
Iron, leachable	7439-89-6	E446	0.03	mg/L	0.1 mg/L	96.9	70.0	130	----
Lead, leachable	7439-92-1	E446	0.0001	mg/L	0.05 mg/L	100.0	70.0	130	----
Lithium, leachable	7439-93-2	E446	0.005	mg/L	0.025 mg/L	89.9	70.0	130	----
Magnesium, leachable	7439-95-4	E446	0.05	mg/L	5 mg/L	99.1	70.0	130	----
Manganese, leachable	7439-96-5	E446	0.0005	mg/L	0.025 mg/L	94.8	70.0	130	----
Molybdenum, leachable	7439-98-7	E446	0.0001	mg/L	0.025 mg/L	107	70.0	130	----
Nickel, leachable	7440-02-0	E446	0.0005	mg/L	0.05 mg/L	93.4	70.0	130	----
Phosphorus, leachable	7723-14-0	E446	0.3	mg/L	1 mg/L	90.8	70.0	130	----
Potassium, leachable	7440-09-7	E446	0.05	mg/L	5 mg/L	92.3	70.0	130	----

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Leachable Metals (QCLot: 735592) - continued									
Selenium, leachable	7782-49-2	E446	0.0005	mg/L	0.1 mg/L	100	70.0	130	----
Silicon, leachable	7440-21-3	E446	0.05	mg/L	1 mg/L	100	70.0	130	----
Silver, leachable	7440-22-4	E446	0.00005	mg/L	0.01 mg/L	93.9	50.0	130	----
Sodium, leachable	7440-23-5	E446	0.05	mg/L	5 mg/L	95.1	70.0	130	----
Strontium, leachable	7440-24-6	E446	0.0005	mg/L	0.025 mg/L	102	70.0	130	----
Sulfur, leachable	7704-34-9	E446	0.5	mg/L	5 mg/L	101	70.0	130	----
Thallium, leachable	7440-28-0	E446	0.0001	mg/L	0.11 mg/L	89.5	70.0	130	----
Tin, leachable	7440-31-5	E446	0.0005	mg/L	0.05 mg/L	98.2	50.0	130	----
Titanium, leachable	7440-32-6	E446	0.01	mg/L	0.025 mg/L	93.1	50.0	130	----
Uranium, leachable	7440-61-1	E446	0.00001	mg/L	0.0005 mg/L	107	70.0	130	----
Vanadium, leachable	7440-62-2	E446	0.001	mg/L	0.05 mg/L	95.9	70.0	130	----
Zinc, leachable	7440-66-6	E446	0.01	mg/L	0.05 mg/L	90.5	70.0	130	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Soil/Solid**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Leachable Metals (QCLot: 735590)										
VA22C5131-002	Anonymous	Mercury, leachable	7439-97-6	E515	0.000096 mg/L	0.0001 mg/L	96.5	70.0	130	----
Leachable Metals (QCLot: 735592)										
VA22C5131-002	Anonymous	Aluminum, leachable	7429-90-5	E446	ND mg/L	0.2 mg/L	ND	70.0	130	----
		Antimony, leachable	7440-36-0	E446	0.0210 mg/L	0.02 mg/L	105	70.0	130	----
		Arsenic, leachable	7440-38-2	E446	0.0192 mg/L	0.02 mg/L	95.8	70.0	130	----
		Barium, leachable	7440-39-3	E446	0.0190 mg/L	0.02 mg/L	95.0	70.0	130	----
		Beryllium, leachable	7440-41-7	E446	0.0394 mg/L	0.04 mg/L	98.5	70.0	130	----
		Bismuth, leachable	7440-69-9	E446	0.00963 mg/L	0.01 mg/L	96.3	70.0	130	----
		Boron, leachable	7440-42-8	E446	0.094 mg/L	0.1 mg/L	94.4	70.0	130	----
		Cadmium, leachable	7440-43-9	E446	0.00386 mg/L	0.004 mg/L	96.5	70.0	130	----
		Calcium, leachable	7440-70-2	E446	4.02 mg/L	4 mg/L	100	70.0	130	----
		Chromium, leachable	7440-47-3	E446	0.0382 mg/L	0.04 mg/L	95.4	70.0	130	----
		Cobalt, leachable	7440-48-4	E446	0.0192 mg/L	0.02 mg/L	96.1	70.0	130	----
		Copper, leachable	7440-50-8	E446	0.0194 mg/L	0.02 mg/L	96.9	70.0	130	----
		Iron, leachable	7439-89-6	E446	1.91 mg/L	2 mg/L	95.6	70.0	130	----
		Lead, leachable	7439-92-1	E446	0.0203 mg/L	0.02 mg/L	101	70.0	130	----
		Lithium, leachable	7439-93-2	E446	0.0655 mg/L	0.1 mg/L	65.5	70.0	130	MES
		Magnesium, leachable	7439-95-4	E446	0.996 mg/L	1 mg/L	99.6	70.0	130	----
		Manganese, leachable	7439-96-5	E446	0.0194 mg/L	0.02 mg/L	97.0	70.0	130	----
		Molybdenum, leachable	7439-98-7	E446	0.0209 mg/L	0.02 mg/L	104	70.0	130	----
		Nickel, leachable	7440-02-0	E446	0.0382 mg/L	0.04 mg/L	95.4	70.0	130	----
		Phosphorus, leachable	7723-14-0	E446	9.24 mg/L	10 mg/L	92.4	70.0	130	----
		Potassium, leachable	7440-09-7	E446	3.73 mg/L	4 mg/L	93.2	70.0	130	----
		Selenium, leachable	7782-49-2	E446	0.0396 mg/L	0.04 mg/L	99.1	70.0	130	----
		Silicon, leachable	7440-21-3	E446	10.3 mg/L	10 mg/L	103	70.0	130	----
		Silver, leachable	7440-22-4	E446	0.00414 mg/L	0.004 mg/L	104	70.0	130	----
		Sodium, leachable	7440-23-5	E446	ND mg/L	2 mg/L	ND	70.0	130	----
		Strontium, leachable	7440-24-6	E446	0.0201 mg/L	0.02 mg/L	100	70.0	130	----
		Sulfur, leachable	7704-34-9	E446	20.2 mg/L	20 mg/L	101	70.0	130	----
		Thallium, leachable	7440-28-0	E446	0.00391 mg/L	0.004 mg/L	97.8	70.0	130	----
		Tin, leachable	7440-31-5	E446	0.0194 mg/L	0.02 mg/L	97.1	70.0	130	----

Sub-Matrix: **Soil/Solid**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Leachable Metals (QCLot: 735592) - continued										
VA22C5131-002	Anonymous	Titanium, leachable	7440-32-6	E446	0.039 mg/L	0.04 mg/L	97.4	70.0	130	----
		Uranium, leachable	7440-61-1	E446	0.00400 mg/L	0.004 mg/L	100.0	70.0	130	----
		Vanadium, leachable	7440-62-2	E446	0.0972 mg/L	0.1 mg/L	97.2	70.0	130	----
		Zinc, leachable	7440-66-6	E446	0.383 mg/L	0.4 mg/L	95.8	70.0	130	----

Qualifiers

Qualifier	Description
MES	*Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).*

ALS Canada Ltd.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WR2201414**	Page	: 1 of 9
Client	: **Alexco Keno Hill Mining Corp**	Laboratory	: Whitehorse - Environmental
Contact	: Environment	Account Manager	: Heather McKenzie
Address	: #2 Calcite Business Centre - 151 Industrial Road Whitehorse YT Canada Y1A 2V3	Address	: #12 151 Industrial Road Whitehorse, Yukon Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: Type A WL Tx	Date Samples Received	: 02-Nov-2022 10:20
PO	: 05562	Issue Date	: 07-Feb-2023 12:18
C-O-C number	: ----		
Sampler	: TF		
Site	: AKHM		
Quote number	: WR22-AKHM100-04 (Keno/Hecla)		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- Matrix Spike outliers occur - please see following pages for full details.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers occur - please see following pages for full details.

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **Soil/Solid**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Matrix Spike (MS) Recoveries								
Leachable Metals	Anonymous	Anonymous	Lithium, leachable	7439-93-2	E446	65.5 % MES	70.0-130%	Recovery less than lower data quality objective

Result Qualifiers

Qualifier	Description
MES	*Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).*

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Acid Base Accounting : Acid Base Accounting (Modified Sobek)										
HDPE F&M	OA-VOL08m	01-Nov-2022	----	----	----		05-Feb-2023	----	----	
Acid Base Accounting : Inorganic Carbon by Coulometer										
HDPE F&M	C-GAS05	01-Nov-2022	----	----	----		05-Feb-2023	----	----	
Acid Base Accounting : Received Sample Weight										
HDPE F&M	WEI-21	01-Nov-2022	----	----	----		05-Feb-2023	180 days	96 days	✓
Acid Base Accounting : Saturated Paste pH										
HDPE F&M	OA-ELE07	01-Nov-2022	----	----	----		05-Feb-2023	----	----	
Acid Base Accounting : Sulfates by HCl Leaching and Gravimetry										
HDPE F&M	S-GRA06A	01-Nov-2022	----	----	----		05-Feb-2023	----	----	
Acid Base Accounting : Sulfide S (as S) Calc. (Total-S - SO4-S)										
HDPE F&M	S-CAL06a	01-Nov-2022	----	----	----		05-Feb-2023	----	----	
Acid Base Accounting : Total Sulfur by Combustion and IR										
HDPE F&M	S-IR08	01-Nov-2022	----	----	----		05-Feb-2023	----	----	

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Leachable Anions & Nutrients : Sulfate by IC (Shakeflask, 3:1 Ratio with Water)										
Glass soil jar/Teflon lined cap F&M	E243.SO4	01-Nov-2022	08-Nov-2022	----	----		09-Nov-2022	28 days	8 days	✓
Leachable Metals : Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)										
Glass soil jar/Teflon lined cap F&M	E515	01-Nov-2022	08-Nov-2022	----	----		09-Nov-2022	28 days	8 days	✓
Leachable Metals : Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)										
Glass soil jar/Teflon lined cap F&M	E446	01-Nov-2022	08-Nov-2022	----	----		09-Nov-2022	180 days	8 days	✓
Metals : 51 Elements by Aqua Regia digestion and ICP-AES/MS										
HDPE F&M	ME-MS41	01-Nov-2022	----	----	----		05-Feb-2023	----	----	
Physical Tests : Conductivity by Electrode (Shakeflask, 3:1 Ratio with Water)										
Glass soil jar/Teflon lined cap F&M	E103	01-Nov-2022	08-Nov-2022	----	----		09-Nov-2022	28 days	8 days	✓
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap F&M	E144	01-Nov-2022	----	----	----		08-Nov-2022	----	----	
Physical Tests : pH by Electrode (Shakeflask, 3:1 Ratio with Water)										
Glass soil jar/Teflon lined cap F&M	E116	01-Nov-2022	08-Nov-2022	----	----		09-Nov-2022	30 days	8 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: ✗ = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515	735590	1	4	25.0	5.0	✓
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446	735592	1	4	25.0	5.0	✓
Moisture Content by Gravimetry	E144	734959	1	3	33.3	5.0	✓
pH by Electrode (Shakeflask, 3:1 Ratio with Water)	E116	735591	1	4	25.0	5.0	✓
Sulfate by IC (Shakeflask, 3:1 Ratio with Water)	E243.SO4	735594	1	1	100.0	5.0	✓
Laboratory Control Samples (LCS)							
Conductivity by Electrode (Shakeflask, 3:1 Ratio with Water)	E103	735593	1	1	100.0	5.0	✓
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515	735590	1	4	25.0	5.0	✓
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446	735592	1	4	25.0	5.0	✓
Moisture Content by Gravimetry	E144	734959	1	3	33.3	5.0	✓
pH by Electrode (Shakeflask, 3:1 Ratio with Water)	E116	735591	1	4	25.0	5.0	✓
Sulfate by IC (Shakeflask, 3:1 Ratio with Water)	E243.SO4	735594	1	1	100.0	5.0	✓
Method Blanks (MB)							
Conductivity by Electrode (Shakeflask, 3:1 Ratio with Water)	E103	735593	1	1	100.0	5.0	✓
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515	735590	1	4	25.0	5.0	✓
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446	735592	1	4	25.0	5.0	✓
Moisture Content by Gravimetry	E144	734959	1	3	33.3	5.0	✓
Sulfate by IC (Shakeflask, 3:1 Ratio with Water)	E243.SO4	735594	1	1	100.0	5.0	✓
Matrix Spikes (MS)							
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515	735590	1	4	25.0	5.0	✓
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446	735592	1	4	25.0	5.0	✓
Sulfate by IC (Shakeflask, 3:1 Ratio with Water)	E243.SO4	735594	0	1	0.0	5.0	✗

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Inorganic Carbon by Coulometer	C-GAS05 ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals C-GAS05	Determine Total Inorganic Carbon (TIC) by using diluted perchloric acid to react with metal carbonate and yield carbon dioxide. Concentration of CO_2 is determined by coulometer.
Conductivity by Electrode (Shakeflask, 3:1 Ratio with Water)	E103 Vancouver - Environmental	Soil/Solid	MEND (mod)/APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into an extract from a soil sample that has been added in a 3:1 ratio of deionized water to soil, then leached and the extract filtered prior to analysis. Conductivity measurements are temperature-compensated to 25°C.
pH by Electrode (Shakeflask, 3:1 Ratio with Water)	E116 Vancouver - Environmental	Soil/Solid	MEND (mod)/APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) on an extract from a soil sample that has been added in a 3:1 ratio of deionized water to soil, then leached and the extract filtered prior to analysis. The pH is then measured by a standard pH probe. .
Moisture Content by Gravimetry	E144 Vancouver - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Sulfate by IC (Shakeflask, 3:1 Ratio with Water)	E243.SO4 Vancouver - Environmental	Soil/Solid	MEND (mod)/EPA 300.1 (mod)	Inorganic anions are analyzed by obtaining an extract from a soil sample that has been added in a 3:1 ratio of deionized water to soil, then leached and the extract filtered prior to analysis, which is then analyzed by Ion Chromatography with conductivity and/or UV detection.
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446 Vancouver - Environmental	Soil/Solid	BC MINISTRY OF ENERGY AND MINES/EPA 6020B (mod)	A sample is extracted with water at a 3:1 liquid to solid ratio for 24 hours, then filtered through a 0.45 micron membrane filter. Analysis is by Collision/Reaction Cell ICPMS. This extraction is an empirical procedure with pre-defined characteristics. Recovery of some elements (Ag, Bi, and Sn) by this method can be variable due to the neutral pH of the extraction fluid, and therefore the LCS DQOs has been established at 50-130% for these elements.
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515 Vancouver - Environmental	Soil/Solid	BC MINISTRY OF ENERGY AND MINES/EPA 1631E (mod)	A sample is extracted with water at a 3:1 liquid to solid ratio for 24 hours, then filtered through a 0.45 micron membrane filter. Analysis is by CVAAS. This extraction is an empirical procedure with pre-defined characteristics. Recovery of mercury can be variable due to the neutral pH of the extraction fluid, and therefore the LCS DQO has been established at 50-130%.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Particle Size Analysis (Pipette) - MMER Classification	EC184E Saskatoon - Environmental	Soil/Solid	Metal Mining Technical Guidance for Environmental Effects Monitoring (2012)	The particle size determination is performed by various methods to generate a Grain Size curve. The data from the curve is then used to produce particle size ranges based on the Metal Mining Effluent Regulations (MMER) classification system for Environmental Effects Monitoring.
51 Elements by Aqua Regia digestion and ICP-AES/MS	ME-MS41 ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals ME-MS41	A prepared sample is digested with aqua regia in a graphite heating block. After cooling, the resulting solution is diluted to with deionized water, mixed and analyzed by ICP-AES. Samples are then analyzed by ICP-MS for the remaining suite of elements.
Saturated Paste pH	OA-ELE07 ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals OA-ELE07	Sample mix with water in 1:1 ratio to make a paste, pH is then determined.
Acid Base Accounting (Modified Sobek)	OA-VOL08m ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals OA-VOL08m	Determine the acid generation power of a sample as tonne $CaCO_3$ per kilo-tonne using modified Sobek method
Sulfide S (as S) Calc. (Total-S - SO4-S)	S-CAL06a ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals:S-CAL06a	Sulfide Sulfur (as S) is calculated by subtracting the HCL Leachable Sulfate Sulfur (as S) from the Total Sulfur (as S) obtained from combustion.
Sulfates by HCl Leaching and Gravimetry	S-GRA06A ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals S-GRA06A	A prepared sample is heated with dilute HCl and then filtered. The sulfate in the filtrate is precipitated with $BaCl_2$ in a dilute HCl. The $BaSO_4$ precipitate is filtered, ignited, weighed and the Sulfate Sulfur is determined (as S).

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Total Sulfur by Combustion and IR	S-IR08 ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals S-IR08	A prepared sample is heated to approximately 1350°C in an induction furnace with oxygen stream. Sulfur dioxide released from the sample are measured by IR (Leco analyzer) and the Total Sulfur result is provided.
Received Sample Weight	WEI-21 ALS Minerals (Vancouver) - 2103 Dollarton Hwy North Vancouver British Columbia Canada V7H 0A7	Soil/Solid	ALS Minerals WEI-21	Weigh out sample received.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Shakeflask Leachate Preparation (3:1 Ratio with Water)	EP446 Vancouver - Environmental	Soil/Solid	BC MINISTRY OF ENERGY AND MINES	A sample is extracted with water at a 3:1 liquid to solids ratio for 24 hours, then filtered through a 0.45 micron membrane filter.
Dry and Grind in Soil/Solid <60°C	EPP442 Saskatoon - Environmental	Soil/Solid	Soil Sampling and Methods of Analysis, Carter 2008	After removal of any coarse fragments and reservation of wet subsamples a portion of homogenized sample is set in a tray and dried at less than 60°C until dry. The sample is then particle size reduced with an automated crusher or mortar and pestle, typically to <2 mm. Further size reduction may be needed for particular tests.

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC #

Environmental Division
Whitehorse
Work Order Reference
WR2201414

Telephone : +1 867 668 6689

Report To		Report Format / Distribution	Service Requested (Rush for routine analysi
Company:	Alexco Keno Hill Mining	☑ Standard ☐ Other	◉ Regular (Standard Turnaround Times - Business D
Contact:	Environment Department	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Co
Address:	Suite 1225 - 555 Burrard Street Vancouver BC V7X 1M9	Email 1: YK-Environment@hecla.com	○ Emergency (1-2 Bus. Days) - 100% Surcharge - C
		Email 2: nspeiss@ensero.com	○ Same Day or Weekend Emergency - Contact ALS t
Phone:	867-995-3113 X5960 Fax:	Email 3: kwoloshyn@ensero.com	Analysis Rec
Invoice To	Same as Report ? ☑ Yes ☐ No	**Client / Project Information**	
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: **Type A WL Tx**	
Company:	Alexco Keno Hill Mining	PO / AFE: PO#05562	
Contact:	Derek Meneghin; YK-AccountsPayable@hecla.com	LSD: **AKHM**	
Address:	Suite 1225 - 555 Burrard Street Vancouver BC V7X 1M9		
Phone:	604.633.4888 Fax: 604.633.4887	Quote #:	
Lab Work Order # (lab use only)		**ALS Contact:** Heather McKenzie	**Sampler:** TF

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	time	Sample Type	ABA w modified Sobek	Aqua regia digestion w ICP	Shakeflask metals ICPMS	Shakeflask sulphate, pH, EC	Grain size >2mm, pipette	Number of Containers
	F&M	01-Nov-22	9:30	Other	x	x	x	x	x	1

Yukon EQWin and ACC200 digital formats. **General A:** pH, EC, TSS (low) **General B:** pH, EC, TSS (low), anions-all
General C: pH, EC, TSS (low), anions-all, ion balance, alkalinity **General D:** pH, EC, TSS (low), SO4, ion balance, alkalinity **Other:** Samples are sludge.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.

Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
TF	1-Nov-22	12:00		NOV 2	1020	6 °C				