

**KENO HILL PROPERTY**  
**PHYSICAL HAZARD REDUCTION PROGRAM**

**2006**

Prepared for:



by:



**Access Consulting Group Inc.**

**January 2007**

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## 1.0 INTRODUCTION

Over the course of 75 years of active mining on the Keno Hill Properties, there is a substantial number of older workings on the former United Keno Hill Mine (UKHM) sites. Many of these abandoned sites are accessible to the public and in some instances local literature even encourages tourists to visit these sites. The public is exposed to human health and safety hazards such as open shafts and stopes, instable pit walls, open or partially accessible adits and buildings. These types of hazards can result in persons being injured, even fatally wounded, if the right precautions are not in place to protect the public from these hazards.

The Government of Canada, along with the Yukon Territorial Government and the Yukon First Nations, commissioned a comprehensive Baseline Environmental Study project in the summer/fall of 1999, for the Keno Valley and Dublin Gulch area by Public Works and Government Services Canada (PWGSC)<sup>1</sup>. This project's key objectives were to:

- Compile the available and current information describing the physical setting and resources of Keno Valley and Dublin Gulch;
- Describe traditional and other non-mining land uses in the study area; and
- Identify mine tenure status, historical mine exploration development and operational activities, potential or acid rock drainage conditions, and health/safety risks associated with specific Keno Valley and Dublin Gulch exploration and mining sites.

Recently, Alexco Resource Corporation was selected as the preferred purchaser of the UKHM property. A condition in the Request for Offers and purchase of the assets of UKHM was for the selected purchaser to undertake a Baseline Environmental Assessment of the property. SRK Consulting was contracted by Alexco Resource Corporation to conduct site inspections as part of this assessment.

SRK attended the Keno Hill property and documented a number of sites in September 2005, but ran short of time and could not complete the inspection of all the sites indicated in the PWGSC Environmental Baseline Assessment until the following year. In August and September 2006, SRK Consulting returned to the property to continue the Baseline Environmental Assessment, and was accompanied by Access Consulting Group (ACG) to complete the inspection and documentation .

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<sup>1</sup> Public Works and Government Services Canada, "Keno Valley/Dublin Gulch Environmental Baseline Assessment", March 2000

This document outlines the methodology to identify and rank the risks associated with each site and contains a listing of all the physical hazards that were observed at each site that was inspected in 2005 and 2006. Recommendations for the higher priority hazards to ensure that public health and safety, as well as Alexco Resource Corporation interests are protected against injury or death that may have result due to exposure to one or more of these of these hazards at the site, are proposed.

## 2.0 METHODOLOGY

The following methodology was used:

1. Review of previously documented physical hazard information on the Keno Hill Property, including the PWGSC Environmental Baseline Assessment, the SRK Preliminary Baseline Assessment Report, and discussions with site caretakers and historic operators possessing historical knowledge of site operations;
2. Comprehensive physical hazard site investigation and documentation of hazards not currently identified on the Keno Hill Property;
3. Preparation of a physical hazard risk register including all risks at all locations showing location, description of hazard, accessibility, and priority for risk reduction;
4. Consultation with local Yukon Government offices to review the risk registry and hazard ratings;
5. Recommendations to either eliminate or limit access to the hazards, including but not limited to signage, fences, locked gates, and public education;
6. Additional field investigation as necessary to develop design;
7. Develop construction designs and cost estimates for elimination of the hazards;
8. Implement the recommended actions; and
9. Prepare a final project report.

## 2.1 BACKGROUND REVIEW

In March 2000, as part of a joint initiative by the Government of Canada, Yukon Government and Yukon First Nations, the Environmental Services Department of Public Works and Government Services Canada conducted baseline environmental assessments of areas in the Yukon generally associated with exploration, mining or industrial activities and operations. One such assessment included in its study area the Keno Hill Mining Properties, and the findings of this study are presented in *Keno Valley/Dublin Gulch Environmental Baseline Assessment*, (Environmental Services – Public Works and Government Services Canada, March 2000.)

This assessment included inventories of mine openings and excavations, and of infrastructure at each of the identified sites based on physical site inspections conducted in 1999 and 2000. This provided the foundation for further site investigations and follow-up. The pertinent information (workings descriptions, maps, site locations) from the PWGSC document was extracted and compiled in a brief field reference manual for site investigators. This information was qualified with many years of site experience on the part of ACG principals and sub-contractors. Known data gaps and erroneous information from the PWGSC report were reviewed and corrected, augmenting the background data and presented a more complete picture of the existing nature and locations of physical hazards on the Keno Hill Properties.

## 2.2 SITE INVESTIGATION

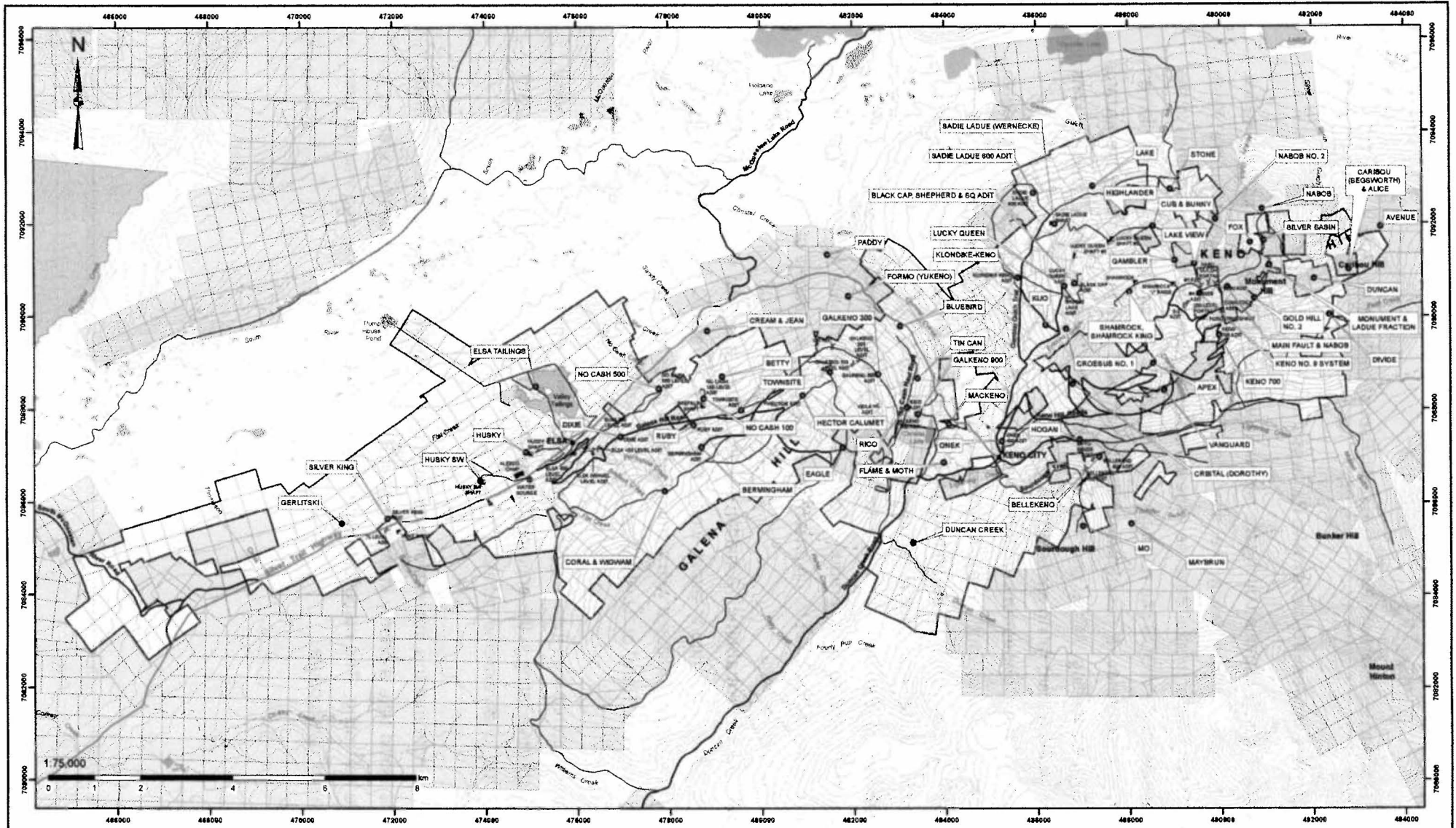
An initial site investigation was conducted in September 2005, which included verifying and documenting existing physical hazards. Darryl Hockley, Bruce Murphy, and Dylan McGregor of SRK Consulting, were accompanied by Ken Nordin of Laberge Environmental Services and Peter Johnson of Alexco Resources Corp. in conducting this initial investigation, which covered a number of accessible sites. The sites were examined in a manner directed initially at verifying prior documentation, and then more exhaustively to produce a definitive inventory of the particular hazards at that location.

As the initial investigation took place late in the year, not all of the concerned sites were examined at that time. Dylan MacGregor of SRK Consulting, accompanied by the author, was on site from August 16 to August 25, 2006, and documented 32 of the remaining sites, as indicated on the Project Area Overview map, as well as reviewing two high priority sites including Bellekeno 600 (Eureka shafts), and the Lucky Queen adit. Inspections were carried out on foot, by pickup truck, and by All-Terrain Vehicle. Sites included in these inspections were those known to be on UKHM claim blocks and those that were within one claim block of a known UKHM claim. The workings associated with these sites were located with a GPS unit in order to verify that the workings were either on or off UKHM claim blocks. One site, Gold Queen, could not be located based on the coordinates and description given in the PWGSC document, and therefore could not be documented.

Dylan MacGregor completed the inspection and documentation of the four remaining sites on September 18, 2006, including the Keno No. 9, Cream & Jean, Dragon & Miller, and Coral & Wigwam sites, which concluded our documentation of all relevant sites. A diagram showing all the sites inspected in both 2005 and 2006 is shown in Figure 1



**Photo 1: D. MacGregor of SRK Consulting examines an abandoned shaft on Keno Hill.**



Legend		Topography		Mine Workings		Quartz Claims		First Nation Settlement Land	
● 2005 Inspection	● 2006 Inspection	● Town	— Trail	▭ Valley Tailings	▭ Limited Keno Hill Mine	▭ Limited Quartz Claim	▭ Other Quartz Claim	▭ First Nation Settlement Land	<p>Notes: This map is for illustrative purposes only. This is not a legal document. National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Coloured area controlled by Natural Resources Canada. Reproduction under license from the copyright owner to the Government of Canada, Department of Natural Resources Canada. All rights reserved. Quartz Claim boundaries are current as of October 14, 2005. Data source: MR Information/Information of Production, UTM Zone 8 NAD83, NTS Sheet 5004 (13 and 1304-14)</p>
— Silver Trail	— Secondary Road	— Waterbody	▭ Shaft (to surface - connection to underground not determined)						
— Limited-use road									

**PRELIMINARY ENVIRONMENTAL BASELINE ASSESSMENT, UNITED KENO HILL MINES PROPERTY**

**2005/2006 Site Inspection**

Drawn By: HD    Date: January 2007    **FIGURE 1**

Checked by: RM

### 2.3 PHYSICAL HAZARD RISK REGISTRY AND RATINGS

All of the physical hazards identified during the site visits were compiled in a comprehensive list, organized in numerical order, using the site identifications numbers used in the Keno Valley/Dublin Gulch Environmental Baseline Assessment (see Appendix I). The columns in the risk registry included the PWGCS site numbers and site names, a description of the location as well as the UTM coordinates, a description of the hazard and who last identified the hazard (ie. PWGCS, SRK Consulting, ACG), and mitigation measures taken to date. Three columns used to determine the hazard rating are listed below:

1. **Severity of the Consequence:** If the hazard could result in serious injury or death (ie. Falling down a vent raise), it received a "Critical" rating, whereas accessible abandoned buildings with no underground workings received a "Low" rating as this hazard would not likely result in serious harm to a person.
2. **Likelihood of Exposure:** A site located on a main thoroughfare that is easily accessible would receive "Frequent" or "Continuous" exposure as opposed to a site located in the dense bush far up on a hillside, in which the prospect of human encounter would likely be remote.
3. **Likelihood of Probability:** A hidden hazard, where a person may not perceive the hazard until it is too late to avoid, would receive an "Almost Certain" or "Likely" rating, whereas a hazard indicated with warning signs or gates bringing it's attention to a person would receive a "Rare" or "Unlikely" rating.

Each of the three columns was then used in a risk rating matrix, which would assign a numerical rating and a descriptive rating in the appropriate columns, signifying it to be either a low hazard, a moderate hazard, or an extreme hazard.

It is important to note that this information was used by Alexco Resources Corp. to determine which hazards would take a priority in the Physical Hazard Reduction Program by referring to the descriptive risk rating. The numerical rating is there only as a reference, and was not used to quantify the risk or exposure.



**Meeting with Yukon Government Officials**

A meeting was held at the offices of ACG on December 13, 2006, and was attended by Bill Leary, the Mayo district Natural Resources Officer, and Hugh Copland, Project Manager for the Assessment and Abandoned Mines Branch of the Yukon Government, Rob McIntyre and Dan Cornett of ACG, as well as the author. During this meeting, the attendees reviewed individual site inspections and discussed at length the appropriate rating that each individual hazard should receive. At the conclusion of the meeting, a definitive rating was given to each hazard identified in the comprehensive risk registry that satisfied all attendees. The following week, the risk registry was updated to reflect the conclusions reached during the meeting.

### 3.0 HAZARD REDUCTION TO DATE

During the summer/fall of 2006, action was taken to eliminate certain high priority hazards as the public exposure to these hazards was significant and the need to address these sites in a timely manner was of the utmost importance. SRK Consulting was tasked with developing an effective and long term deconstruction design for these high priority sites. SRK's remedial design criteria is included in Appendix II.

#### 3.1 SHAMROCK J VENT RAISE

The most significant site remediated during the 2006 season was the Shamrock J vent raise. This site contained a building that was partially collapsed over an open vent raise, and vehicle track evidence in the past had provided indication that this site represented the highest priority danger for personal injury, particularly as tourists regularly frequented the area. A fence to prevent access had been previously installed but evidence suggested that tourists and the public were still able to access the site and a significant risk remained. The Shamrock J site is within a published tourist destination. Based on the design criteria provided by SRK, the building was first removed and stacked next to the vent raise. Prior to building removal, the fence was dismantled and transported offsite and is stored in Elsa for future use.



**Photo 2: View of Shamrock J building partially collapsed over open vent raise.**

Upon removal of the building, it was evident that the vent raise was collapsed with overburden material. A 325 excavator was used to assess if the vent raise was bridged with material. The excavator dug approximately 20 feet into the material and it continued to be competent and not bridged. The hole was then filled with local borrow material as per SRK specifications (see Appendix II). The top of the filled hole was capped with growth media and mounded to promote water runoff. The building material was burned and the remaining metal debris was loaded and transported to dump site at Elsa. A burn permit was secured prior to burning the remnant building.



**Photo 3: View of Shamrock J vent shaft filled and mounded with building removed.**

### **3.2 BELLEKENO EUREKA VENT RAISES AND SHAFTS**

As part of the Bellekeno workings on Sourdough Hill, seven open holes and one trench were identified in the immediate vicinity of the road leading to the Bellekeno mine. All of the holes were mound filled with material as per SRK specifications (see Appendix II) as tourists and local residents frequently travel this road and the holes and shafts were easily accessible.



**Photo 4: Open hole along side of road to Bellekeno mine.**



**Photo 5: Excavator filling open Bellekeno hole.**

### 3.3 SADIE LADUE WERNECKE SHAFT AND COLLAPSED STOPE

At the Sadie Ladue site, also sometimes referred to as the Wernecke Camp, two specific hazards were identified. An open shaft was located on the flat, excavated area at the base of the slope below the manager's house, and a collapsed stope resulting from underground failure was present approximately 75 metres southwest of the open shaft. This site was considered a high priority danger for personal injury, as there was a defined trail leading directly to the site from the town of Keno.

The shaft (commonly referred to as the Wernecke shaft) was timber lined and was open below the surface a significant distance. The remediation for this shaft followed the SRK general backfilling guidelines (see Appendix II), which consisted of filling the shaft with adequately sized material that would compact enough to lessen the likelihood of a future subsidence over the shaft.



**Photo 6: View of Wernecke shaft building located below the manager's house at the base of the hill.**



**Photo 7: View of Wernecke shaft being filled.**

The collapsed stope was approximately 7 metres long by 4 metres wide, with the opening extending approximately 5 metres underground. Loose slabs in the back of the opening had fallen and could have posed a serious risk to persons exploring near the entrance of the collapse. Remediation of the collapsed stope consisted of excavating around the cavity, allowing the slab roof to collapse inward on itself and provide partial fill for the cavity. Then additional material was added from the surrounding soil to fill the remaining cavity.



**Photo 8: Excavator starting to fill collapsed stope.**



**Photo 9: Collapsed stope nearly filled to completion.**

#### 4.0 2007 REMEDIATION WORK

Upon commencement of the 2007 season, the primary objective will be to address the high priority sites identified in the risk register to date. Once again, SRK Consulting will be tasked with developing remedial designs for those sites requiring it. Alexco Resources Corp. will use these supplied design criteria to ensure that the threat to the public safety presented by these hazards is eliminated. Below is a table of the highest priority sites (those given an "Extreme" rating) that will be addressed in 2007.

Site Number	Name	Description of Hazard
4	Dixie	<ul style="list-style-type: none"> <li>• Shaft is partially collapsed and filled with water to a depth of approximately 3m below ground level.</li> <li>• Two collapsed raises show evidence of subsidence.</li> </ul>
6	Birmingham and Ruby	<ul style="list-style-type: none"> <li>• Ruby shaft area has collapsed on skip; area in front of shaft has failed also.</li> <li>• Birmingham 200 level Adit has collapsed somewhat but is still accessible.</li> </ul>
7	No Cash	<ul style="list-style-type: none"> <li>• No Cash 100 Level adit partially collapsed.</li> <li>• Befault shafthouse is accessible.</li> </ul>
9	Hector Calumet	<ul style="list-style-type: none"> <li>• Underground opening present in west corner.</li> <li>• No berming around the open pits and possible wall failure in some areas.</li> <li>• Sinkholes present in pit floor.</li> </ul>
11	Galkeno	<ul style="list-style-type: none"> <li>• 200 Level adit is open and unsafe.</li> </ul>
19	Onek	<ul style="list-style-type: none"> <li>• Collapsed rock above 400 Level adit; timbers of 400 Level in poor shape.</li> <li>• Lone Star shaft inaccessible except for 5m deep hole within open pit.</li> </ul>
25	Black Cap, Shepherd, and Lucky Queen Adit	<ul style="list-style-type: none"> <li>• Black Cap adit accessible.</li> <li>• Lucky Queen adit accessible through broken timbers.</li> <li>• Two shafts present that are open and accessible.</li> </ul>
26	Lucky Queen	<ul style="list-style-type: none"> <li>• Doors unlocked on Shaft #1 head frame.</li> </ul>
27	Lake	<ul style="list-style-type: none"> <li>• Large head frame present above shaft, access to descent ladder nailed shut, however, access can be gained from side of shaft as ground has collapsed. Shaft may be approximately 5m deep.</li> </ul>
29	Highlander	<ul style="list-style-type: none"> <li>• One caved in adit with a small opening that still allows accessibility.</li> </ul>

\*Site number refers to the number assigned in PWGSC (2000).



**KENO HILL PROPERTY PHYSICAL HAZARD REDUCTION PROGRAM - 2006**

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<b>Site Number</b>	<b>Name</b>	<b>Description of Hazard</b>
32	Keno	<ul style="list-style-type: none"> <li>• Keno 200 Adit collapsed some approx. 3m deep; accessible from door at front.</li> <li>• Comstock 150 Adit door sealed but has some damage which may allow accessibility.</li> <li>• Comstock 200 Adit door sealed but accessible from smaller door on west side.</li> </ul>
36	Keno No. 9 System	<ul style="list-style-type: none"> <li>• Faro Gulch Portal not inspected. Unsure of condition.</li> <li>• Open pits on top of Keno Hill summit.</li> <li>• Two open holes are present just east of the Signpost.</li> </ul>
76	Townsite	<ul style="list-style-type: none"> <li>• Rock overhang has caved in at adit entrance and is considered a safety hazard.</li> </ul>
77	Sadie Ladue 600 adit	<ul style="list-style-type: none"> <li>• One adit present; still accessible.</li> </ul>

\*Site number refers to the number assigned in PWGSC (2000).

## 5.0 TERMS OF LIMITATIONS AND CERTIFICATION

Although a thorough field survey was carried out to locate, identify and assess the physical hazards on the Keno Hill Property, the potential remains for additional hazards to exist on-site. Note, however, that the investigation was focused on known historical sites where previous workings or mining had occurred. With any area which has seen decades of historic underground and surface mining, there are bound to be new physical hazards that arise from time to time. Our program of regular inspections and monitoring should be successful in discovering any new physical hazards and this document will be revised accordingly. Additional workings may be hidden in the dense bush areas or in locations that are not clearly visible either from the roadways or aerial views, and were never staked as claims or reported by locals in the vicinity. However, the field investigation, UKHM Site Characterization Report, and PWGSC documentation is thought to capture the majority of the sites known to be located on or near the Keno Hill Property.

This report was prepared for the exclusive use of the Yukon Government, and is based on data and information collected from the Keno Valley/Dublin Gulch Environmental Baseline Assessment, (Environmental Services – Public Works and Government Services Canada, March 2000.), the United Keno Hill Mines Site Characterization (Access Consulting Group), and during the on location site assessments performed in August and September of 2006. The Project Team has followed standard professional procedures have been followed in conducting the inventory and consolidation and in preparing the contents of this report. The material in this report reflects the Project Team's best judgment in light of the information available at the time of the preparation of this report.

Any use that a third party makes of this report, or any reliance on decisions to be made based on it, is the responsibility of the third parties. The Project Team accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. The Project Team believes that the contents of this report are substantively correct.

The information and data contained in this report are based solely on the conditions observed at the time of the field assessment and have been developed or obtained through the exercise of the Project Team's professional judgment and are set to the best of the Project Team's knowledge, information, and belief. Although every effort has been made to confirm that all such information and data is factual, complete and accurate, the Project Team offers no guarantees or warranties, either expressed or implied, with respect to such information or data.

The Project Team shall not, by the act of issuing this report, be deemed to have represented that any investigations conducted by it have been exhaustive or will identify all the physical hazards on the Keno Hill Property, and persons relying on the results thereof do so at their own risk.

## 6.0 CERTIFICATION

Should you have any questions regarding this report, or if you require further information, please contact the undersigned at Access Consulting Group in Whitehorse, Yukon, at (867) 668-6463.

Respectfully submitted,

### ACCESS CONSULTING GROUP

A registered trade name for Access Mining Consultants Ltd.

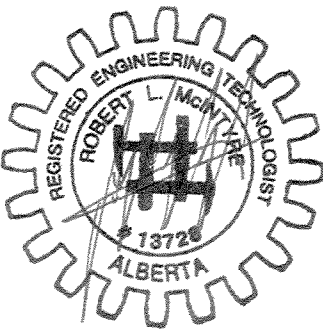
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**KENO HILL PROPERTY  
PHYSICAL HAZARD REDUCTION PROGRAM  
2006**

**Appendix I**

**PHYSICAL HAZARD RISK REGISTRY**



# Keno Hill Physical Hazard Risk Register

Assigned Site No.	Site Name	Location Description	UTM Coordinates	Description of Existing Physical Hazards	Hazard Identified By	Consequence	Likelihood	Likelihood	Risk Rating	Mitigation Measures	Actions Complete
						Severity	Exposure	Probability	Numerical		
1	Silver King	Straddles the Silver Trail Highway at Galena Creek, approximately 4km southwest of Elsie town site	473050E, 7065275N	Open Pit has no barriers to prevent access; temporary barriers have fallen down.	SRK 2005 Site Inspection	Moderate	Remote	Unlikely	0.3	Moderate	The site is gated and locked, and is actively treated by Alexco employees.
				Compressor building accessible to the public.	SRK 2005 Site Inspection	Low	Remote	Unlikely	0.03	Low	
2	Husky & Husky SW	12km west of Keno City on Silver Trail Highway, past the first turnoff for the Elsie townsite, downhill via an access road for 0.5km.	474740E, 709677N	Power pole and power line west of headframe.	SRK 2005 Site Inspection	Low	Remote	Unlikely	0.03	Low	Site is actively treated and thereby, continually monitored by Alexco employees.
				Boiler House accessible.	PWGSC Baseline Assessment	Low	Remote	Unlikely	0.03	Low	
				Storage Shed accessible.	PWGSC Baseline Assessment	Low	Remote	Unlikely	0.03	Low	
				Workshop accessible.	PWGSC Baseline Assessment	Low	Remote	Unlikely	0.03	Low	
				Shaft House and Headframe were accessible at Husky SW.	PWGSC Baseline Assessment	Low	Remote	Unlikely	0.03	Low	
				Hoist House accessible.	PWGSC Baseline Assessment	Low	Remote	Unlikely	0.03	Low	
3	Elsie	Located within the Elsie townsite on the north-facing slope of Galena Hill.	478000E, 7067000N	Powderhouse corner vent raise appears to be subsiding with a linear depression crossing Calumet Drive.	PWGSC Baseline Assessment	Moderate	Occasional	Possible	10	Moderate	The site is gated, and is continually monitored and used by Alexco employees.
				Adit has an ice plug	ACG Site Characterization	Low	Remote	Unlikely	0.03	Low	
4	Dise	3.6km along Calumet Drive from the junction with Wernecke Road.	477000E, 7067200N	Ditch running along side of Garage/Office building could be subject to erosion during peak flows, which could result in the structure collapsing, accessible.	PWGSC Baseline Assessment	Low	Occasional	Possible	1	Low	Entrance has been blocked off with timber cribbing to prevent access.
				Shaft is partially collapsed and filled with water to a depth of approximately 3m below ground level.	PWGSC Baseline Assessment	Critical	Occasional	Possible	100	Potential	
				Two collapsed raises show evidence of subsidence.	PWGSC Baseline Assessment	Critical	Occasional	Possible	100	Potential	
				200 Level Adit is blocked with timber cribbing.	PWGSC Baseline Assessment	Low	Remote	Rare	0.01	Low	
5	Corel & Wgwan	Follow the Birmingham Road for 2.8km from the Hector Portal to a cat trail that leads northwest for 100m to adit.	477900E, 7096250N	Two shafts present that are open and accessible.	PWGSC Baseline Assessment	Critical	Unusual	Possible	30	Potential	
6	Birmingham & Ruby (Arocl & MesdR)	Near the summit of Galena Hill, approximately 1.5km southwest of Calumet town site via the gravel road from Calumet.	474740E, 709677N	Ruby shaft area has collapsed on skip, area in front of shaft has failed also; shaft house accessible.	PWGSC Baseline Assessment	Critical	Occasional	Possible	100	Potential	
				One of the dumps is open without any berming.	SRK 2005 Site Inspection	Moderate	Occasional	Possible	10	Moderate	
				Ruby 400 Level adit accessible	ACG Site Characterization	Moderate	Occasional	Possible	10	Moderate	
				Birmingham 200 level Adit has collapsed somewhat but is still accessible.	PWGSC Baseline Assessment	Critical	Occasional	Possible	100	Potential	
				Explosives magazine and Detonator House accessible.	PWGSC Baseline Assessment	Low	Occasional	Possible	1	Low	
				Water Shack accessible.	PWGSC Baseline Assessment	Low	Occasional	Possible	1	Low	
7	No Cash	Located on the mid-northwest slope of Galena Hill via a road leading from the Elsie-Calumet road.	477230E, 7098058N	No Cash 100 Level Adit partially collapsed.	PWGSC Baseline Assessment	Critical	Occasional	Possible	100	Potential	Doors are locked.
				No Cash 500 adit inaccessible	ACG Site Characterization	Low	Occasional	Possible	1	Low	
				Briefit shafthouse is accessible	PWGSC Baseline Assessment	Critical	Occasional	Possible	100	Potential	
				Garage accessible.	PWGSC Baseline Assessment	Low	Occasional	Possible	1	Low	
8	Betty	Old trailheads extend northeast from the No Cash mine towards the Betty mine site.	479251E, 7098632N	One shaft collapsed due to permafrost, retaining approximately 1ft of water.	ACG 2006 Site Inspection	Low	Remote	Rare	0.01	Low	
				9	Hector Calumet	Located on the northwest slope of Galena Hill, on the Calumet Road.	460900E, 7088300N	Underground opening present in west corner.	SRK 2005 Site Inspection	Critical	Occasional
Other concern would be berming the open pits and wall failure in some areas.	SRK 2005 Site Inspection	Critical	Occasional					Possible	100	Potential	
Sinkholes present in pit floor.	SRK 2005 Site Inspection	Critical	Occasional					Possible	100	Potential	
				Shacks, bunk house, and water storage building all accessible.	PWGSC Baseline Assessment	Low	Occasional	Possible	1	Low	



# Keno Hill Physical Hazard Risk Register

Assigned Site No.	Site Name	Location Description	UTM Coordinates	Description of Existing Physical Hazards	Hazard Identified By	Consequence		Likelihood		Risk Rating		Mitigation Measures	Actions Complete
						Severity	Exposure	Frequency	Probability	Numerical	Descriptive		
10	Dragon & Miller (UN Adit; Miller separate workings)	Located on the north slope of Galena Hill along the Calumet Back Road.	481500E, 7088800E	UN Adit open but blocked by ice year round.	PWGSC Baseline Assessment	Moderate	Occasional	Possible	10	Moderate			
11	Galkeno 200	Located on the northwest slope of Galena Hill via the Calumet Back road, approximately 3.9km from the Duncan Creek road.	482600E, 7088600N	100 Level Adit timbers have collapsed making access difficult, but still possible.	SRK 2005 Site Inspection	Moderate	Occasional	Possible	10	Moderate			
				200 Level Adit is open and unsafe.	PWGSC Baseline Assessment	Critical	Occasional	Possible	100	Extreme			
				Unmanned Adit has collapsed.	ACG Site Characterization	Moderate	Occasional	Possible	10	Moderate			
				Unmanned shaft is inaccessible.	PWGSC Baseline Assessment	Moderate	Occasional	Possible	10	Moderate			
				Blocked shaft is partially collapsed and inaccessible.	PWGSC Baseline Assessment	Moderate	Occasional	Possible	10	Moderate			
14	Bluebird	Northeast slope of Galena Hill, approximately 4km northwest from Keno City, 70m upslope from Silver Trail	482750E, 708825N	Three shafts were located east of cabin, two with ladders. Shafts filled in but still relatively deep (approx. 1-2m). One small shaft located north of other shafts only 0.5m deep. Log cabin accessible: in poor condition.	ACG 2006 Site Inspection	Moderate	Remote	Unlikely	0.3	Moderate			
15	Tin Can	250m uphill of Silver Trail Highway.	483743E, 7088748N	One partially caved shaft found further down slope; still somewhat accessible however, not too deep (approx 2.5m)	ACG 2006 Site Inspection	Moderate	Remote	Unlikely	0.03	Low			
16	Rico	Northwest slope of Galena Hill, 450m upslope of Galkeno 900 site via old dirt road that branches off Calumet Back road roughly 2.2km north of junction with Duncan Creek Road.	483300E, 7087700N	One open shaft above adit, collapsed inward approximately 4m in depth, water retained in bottom.	ACG 2006 Site Inspection	Moderate	Remote	Unlikely	0.3	Moderate			
19	Onk	Located on the south slope of Keno Hill immediately northeast of Keno City.	487406E, 7087196N	Open pits in the south end have no berms on them (location is vehicle accessible).	SRK 2005 Site Inspection	Moderate	Continuous	Likely	300	Moderate			
				Collapsed rock above 400 Level Adit; timbers of 400 Level in poor shape.	SRK 2005 Site Inspection	Major	Continuous	Likely	900	Extreme			
				Long Star shaft inaccessible except for 5m deep hole within open pit.	PWGSC Baseline Assessment	Major	Continuous	Likely	900	Extreme			
20	Klondike-Keno	Northwest slope of Keno Hill, approximately 1.5km southwest of Wernecke town site.	484700E, 708700N	Subsidence has occurred behind collapsed adit.	ACG 2006 Site Inspection	Low	Occasional	Unlikely	0.3	Low			
				Drillers shack located north of adit roof structure on it's way to collapsing	ACG 2006 Site Inspection	Low	Occasional	Unlikely	0.3	Low			
21	Sadie Ladue	Located on the northwest slope of Keno Hill at the Wernecke Camp.	486400E, 7082000N	Collapsed slope located between Shaft #2 and PR #1; loose slabs in roof a hazard.	PWGSC Baseline Assessment	Major	Frequent	Likely	270	Extreme	Slope was mound filled with surrounding material and recontoured with backhoe.	✓	
				Raise below manager's house open.	PWGSC Baseline Assessment	Major	Frequent	Likely	270	Extreme	Top of raise was excavated and adequately sized material was used to fill and contour.	✓	
				A number of buildings in various states of repair are present on the site.	PWGSC Baseline Assessment	Low	Frequent	Possible	3	Low			
22	Bellekeno	South side of Sourdough Hill Road at the 100 level adit site	487126E, 7086385N	Open shaft along right side of road partially covered by collapsing frame	SRK 2005 Site Inspection	Major	Continuous	Almost certain	3000	Extreme	Shaft was filled with adequately sized material and recontoured with backhoe.	✓	
				Further up road along right side, another open log-lined vent about 3m deep	SRK 2005 Site Inspection	Major	Continuous	Almost certain	3000	Extreme	Shaft was filled with adequately sized material and recontoured with backhoe.	✓	
				Minor tension cracks along edge of pond and along crest of waste rock slope.	SRK 2006 Site Inspection	Low	Frequent	Unlikely	0.9	Low			
				Eureka: 2 open shafts located west of cabin; one overgrown and one is fishy deep	SRK 2005 Site Inspection	Critical	Occasional	Possible	100	Extreme	Workings were filled with adequately sized material and recontoured with backhoe.	✓	
				1 large slope failure in the middle of road									
				1 large open vent raise									
23	Kijo	Located on the mid-southwest slope of Keno Hill, roughly 500m north of Erickson Gulch via Blackcap Road which branches off Wernecke Road, 80m down the slope.	486200E, 7089600N	Powder mag is in poor condition and accessible.	PWGSC Baseline Assessment	Low	Occasional	Possible	1	Low			
				Wash house is in poor condition and accessible.	PWGSC Baseline Assessment	Low	Occasional	Possible	1	Low			
24	Croesus No. 1	Midway up the western slope of Keno Hill, extending roughly 350m along an azimuth of 5 degrees up the north side of Erickson Gulch from the creek via the Blackcap Road which branches off of Wernecke Road, 1.3km to the northwest.	486655E, 7089425N	One shallow caved in shaft found up the hill from the adits.	ACG 2006 Site Inspection	Low	Remote	Unlikely	0.03	Low			
						Low	Occasional	Unlikely	0.3	Low			



# Keno Hill Physical Hazard Risk Register

Assigned Site No.	Site Name	Location Description	UTM Coordinates	Description of Existing Physical Hazards	Hazard Identified By	Consequence		Likelihood		Risk Rating		Mitigation Measures	Actions Complete
						Severity	Frequency	Probability	Numerical	Descriptor			
25	Black Cap, Shepherd & LG Adit	Three adits located on the western slope of Keno Hill, roughly a kilometre north of Erickson Gulch, all within 450m of each other.	486950E, 7091675N	Black Cap Adit accessible.  Lucky Queen Adit accessible through broken timbers. Shepherd (Brewe's Red Lake) Adit bulldozed, inaccessible. Two shafts present that are open and accessible. Open pits with no berming present. Workshop accessible.	SRK 2006 Site Inspection	Major	Occasional	Likely	90	Extreme			
					ACG 2006 Site Inspection	Major	Frequent	Likely	270	Extreme			
					PWGSC Baseline Assessment	Low	Occasional	Rare	0.1	Low			
					ACG Site Characterization	Major	Occasional	Likely	90	Extreme			
					SRK 2006 Site Inspection	Moderate	Occasional	Possible	10	Moderate			
					PWGSC Baseline Assessment	Low	Occasional	Possible	1	Low			
26	Lucky Queen	Located on the northwest slope of Keno Hill, roughly 1.25km east and uphill of the Werneck Camp.	487700E, 7092700N	Doors unlocked on Shaft #1 headframe.	ACG 2006 Site Inspection	Major	Occasional	Almost certain	300	Extreme			
27	Lake	250m west of Gambler Gulch, midway down the northwestern slope of Keno Hill, via the Lower Faro Gulch Trail.	480150E, 7090640N	Large headframe present above shaft, access to descent ladder nailed shut, however, access can be gained from side of shaft as ground has collapsed. Shaft may be approximately 5m deep.	ACG 2006 Site Inspection	Critical	Remote	Possible	10	Extreme			
28	Shamrock	Near the summit on the southwest side of Keno Hill, can be seen from Keno City	488018E, 7090536N	Shamrock J headframe is collapsing into the shaft and ground subsidence is occurring on the east side of the shaft.  Main Site Building accessible. Generator Shed accessible.	ACG 2006 Site Inspection	Critical	Continuous	Almost certain	10000	Extreme	Material was removed and burned; top of shaft was accreted and filled with adequately sized material and recontoured with backhoe.	✓	
					PWGSC Baseline Assessment	Low	Frequent	Possible	3	Low			
29	Highlander	2km northwest of Keno Hill Summit on the south side of Gambler Gulch.	487900E, 7092100N	One cavern in adit with a small opening that still allows accessibility.  Ore processing building accessible. Bunkhouse accessible. Cabin accessible.	ACG 2006 Site Inspection	Critical	Occasional	Possible	100	Extreme			
					ACG 2006 Site Inspection	Low	Occasional	Possible	1	Low			
31	Stone	2.3km north of Keno Summit in Faro Gulch, south of Faro Gulch Trail.	488900E, 7092500N	One adit partially caved and difficult to access.  Dry Building accessible.	ACG 2006 Site Inspection	Low	Unusual	Unlikely	0.09	Low			
					ACG 2006 Site Inspection	Low	Remote	Unlikely	0.03	Low			
32	Keno Mine	Sites occur across a broad, relatively gentle slope above Hope Gulch southeast of the Keno Summit on Keno Hill via the Keno 700 Road.	490250E, 7089350N	Keno 200 Adit collapsed some approx. 3m deep, accessible from door at front.  Comastock 150 Adit door sealed but has some damage. Comastock 200 Adit door sealed but accessible from smaller door on west side. Porcupine PR Portal is blocked by wood planks and has collapsed along a majority of its length. Garage building subjected to erosion at base from being positioned on waste rock pile. Drill equipment shop was unstable, slipping into the erosion channel. The mining/geologist office was unstable and slipping into the erosion channel. All buildings on the site were accessible.	PWGSC Baseline Assessment	Major	Continuous	Almost certain	3000	Extreme			
					PWGSC Baseline Assessment	Major	Continuous	Almost certain	3000	Extreme			
					PWGSC Baseline Assessment	Major	Continuous	Almost certain	3000	Extreme			
					PWGSC Baseline Assessment	Minor	Continuous	Unlikely	9	Low			
					PWGSC Baseline Assessment	Low	Continuous	Possible	10	Low			
					PWGSC Baseline Assessment	Low	Continuous	Possible	10	Low			
					PWGSC Baseline Assessment	Low	Continuous	Possible	10	Low			
					PWGSC Baseline Assessment	Low	Continuous	Possible	10	Low			
					PWGSC Baseline Assessment	Low	Continuous	Possible	10	Low			
					PWGSC Baseline Assessment	Low	Continuous	Possible	10	Low			
38	Keno No. 9 System	Located on the Keno Hill summit via the Keno Signpost road.	487300E, 7090200N	Faro Gulch Portal not inspected. Unknown condition.  Open pits on top of Keno Hill summit. Two open holes are present just east of the Signpost.	SRK 2006 Site Inspection	Critical	Frequent	Possible	300	Extreme			
					SRK 2006 Site Inspection	Major	Continuous	Likely	900	Extreme			
47	Monument & Ladue Fraction	Northwest facing slope of Monument Hill summit, approximately 1.5km past the signpost via the Silver Basin Gulch Trail.	460600E, 7060900N	One collapsed adit located on east facing slope of Silver Basin Gulch just below summit of Monument Hill, not accessible. Trenching present on top of cirque.	ACG 2006 Site Inspection	Low	Occasional	Possible	1	Low			
48	Apex	Located approximately 250m south of 4th switchback past the intersection of Signpost Road and Keno 700 Road.	488840E, 7088620N	One lined shaft located in Trench #3, a couple of meters deep. Possible subsidence immediately west of the hole.  Wood cabin accessible.	ACG 2006 Site Inspection	Low	Unusual	Possible	0.3	Low			
					ACG 2006 Site Inspection	Low	Occasional	Possible	1	Low			
71	Christal (Dorothy)	Located on the western slope of Keno Hill south of Erickson Gulch via a foot trail departing Keno Road about 2.5km out of Keno City.	496780E, 7088540N	One timber lined shaft approximately 2.5m deep with approximately 6" of water.  One shaft located north of first shaft, approx. 1m deep with approx. 0.5ft of water in it.	ACG 2006 Site Inspection	Moderate	Remote	Possible	1	Moderate			
					ACG 2006 Site Inspection	Moderate	Remote	Possible	1	Moderate			
73	Gambler	Located in the cirque at the headwaters of Faro Gulch on the north slope of Keno Hill.	488182E, 7091184N	One upper adit caved in about 8ft in depth with ground subsidence just east of the opening. Two other adits are collapsed and inaccessible. Cabin & outhouse accessible.	ACG 2006 Site Inspection	Moderate	Occasional	Possible	10	Moderate			
					ACG 2006 Site Inspection	Low	Occasional	Possible	1	Low			
76	Townsite Mine	8.2km along Calumet Drive from the junction of Werneck Road.	479500E, 7087800N	Rock overhanging has caved in at adit entrance and is considered a safety hazard.	PWGSC Baseline Assessment	Critical	Frequent	Possible	300	Extreme			





# Keno Hill Physical Hazard Risk Register

Assigned Site No.	Site Name	Location Description	UTM Coordinates	Description of Existing Physical Hazards	Hazard Identified By	Consequence	Likelihood	Likelihood	Risk Rating		Mitigation Measures	Actions Complete
						Severity	Exposure	Probability	Numerical	Descriptive		
77	Sadie Ladue 600 Adit	6km north of Keno City via a 1km trail leading north from Wernecke Camp.	485950E, 7062700N	One adit present, still accessible.	PWGSC Baseline Assessment	Critical	Occasional	Possible	100	Extreme		
78	Elsa Village	Located on the south side of Silver Trail Highway, 11.5km west of Keno City.	476000E, 7067000N	Green shack accessible.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Shack #1 & 2 beside sawmill accessible.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Carpentry shop accessible.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				No. 5 burthouse accessible.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Union shop building accessible, in poor condition.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Snack bar accessible through a back door.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Dining hall accessible.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Wooden walkways are in poor condition at Mill site.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Access available to the grizzly bay at Mill site.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Unfklidar collapsing at mill site.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Retaining wall falling on south side of Mill site.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Light vehicle shop accessible.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Rescue building accessible.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Swimming pool building accessible.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Heavy Equipment Warehouse accessible through unlocked door on the north side.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Mens staffhouse accessible.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Apartment building accessible.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Single car garage building accessible.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Church building in poor condition; accessible.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Elsa School was accessible.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		
				Flat Creek residences #1 & 2 accessible.	PWGSC Baseline Assessment	Low	Unusual	Possible	0.3	Low		

**KENO HILL PROPERTY  
PHYSICAL HAZARD REDUCTION PROGRAM  
2006**

**Appendix II**

**SRK CONSULTING REMEDIAL  
DESIGN CRITERIA**

## Memo

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<b>To:</b>	Brad Thrall and Peter Johnson, Alexco Resource Corp.	<b>Date:</b>	September 6, 2006
<b>cc:</b>	Daryl Hockley, SRK	<b>From:</b>	Gordon Doerksen, Dylan MacGregor
<b>Subject:</b>	Physical hazard reduction: Backfilling of open holes and areas of subsidence	<b>Project #:</b>	1CA009.001.0200

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Several sites have been identified as priorities for mitigation of risks to public safety. The following recommendations outline a general methodology for minimizing public safety risks by backfilling open holes and areas of subsidence. Priority sites are listed in Table 1; open pits were not considered in this assessment of risk mitigation priorities.

While the recommended measures may well result in stable ground conditions that are acceptable for closure, the intent of these recommendations is primarily to minimize the immediate risks to public safety. Monitoring will be required to establish the permanence of remedial work carried out on this basis.

These recommendations are based on surface inspections and on review of available sections of underground workings. Cross-sections showing as-built underground workings, thickness of crown pillars and overburden, and dimensions of stopes were typically not located, and inspections of backfilled areas will be necessary to monitor settlement in future.

### General Backfilling Guidelines:

1. Mobile equipment must never operate on ground that shows signs of subsidence without taking adequate precautions.
2. Equipment should work, whenever possible, from the footwall side of the opening.
3. Waste rock backfill must be:
  - a. relatively free of fines. The use of waste rock fill from previous mining periods is likely suitable.
  - b. non-acid generating.
  - c. mounded at least 1m above topography at the void to keep water from flowing underground and potentially washing away fill material.
  - d. sized to contain no rocks greater than 1/4 the size of the void.  
e.g. when filling a 2m x 2m raise, the backfill rocks should be less than 0.5m in size.
4. Every effort should be made to keep all debris other than rock fill from going underground.

The Shamrock 'J' site represents a uniquely challenging case, in that it has a combination of high accessibility and also the potential for ongoing subsidence. The Shamrock 'J' headframe structure is collapsing into the subsiding area; removal of the headframe structure and related debris is necessary to allow inspection of the condition of the raise and to allow backfill with clean material that is free of debris. Recommendations regarding backfilling of raise will be developed once the structure and debris have been removed and the near-surface condition of the raise is known. Anecdotal reports indicate that ground

conditions were poor (as per Bob Wagner, former underground miner who worked in the Shamrock 'J' area, and current employee of Ewing Transport) and that the Shamrock 'J' raise is likely collapsed.

Removal of the headframe structure and related debris should be carried out via methods agreed upon by the contractor and by Alexco, with full consideration given to safe conduct of work. Primary considerations are that heavy equipment be positioned on the footwall side of the area to be filled and be well back from the area of subsidence. This guideline likely precludes the use of all types of equipment except an excavator for the filling of the shaft. The excavator can sit on the edge of the subsidence area and cast material into the void. The excavator operator has an excellent view of the material being handled and can separate any large rocks or debris prior to placement in the void. The area on trend with the NE-SW strike of the collapse should be avoided by heavy equipment, and in particular the linear subsidence feature to the southwest of the headframe structure should be avoided by people and equipment.

Similar considerations should be given to removal of structures at the Ruby site prior to backfilling areas of subsidence.

**Table 1 Priorities and recommendations for mitigation of risks to public safety due to open holes and areas of subsidence at the former UKHM site**

<u>Location</u>	<u>Hazard</u>	<u>Nature of subsidence</u>	<u>Mitigation Recommendation</u>
<b>Bellekeno</b>			
Eureka Shaft 3	Collapsed building and open shaft	n/a	Removal of old building Backfilling with waste rock
Eureka 1 raise	Open raise	n/a	Backfilling with waste rock
Raise NE of Eureka Shaft 2	Open raise	n/a	Backfilling with waste rock
Open Stope NE of Eureka Shaft 1	Open stope	Possible crown pillar collapse	Backfilling with waste rock
<b>Birmingham</b>			
Ruby shaft	Raise and hoist collapse	Unknown	Removal of old building Backfilling with waste rock
Sinkhole SE of Ruby Shaft	Sinkhole	Unknown	Backfilling with waste rock
<b>Keno 700</b>			
Shamrock 'J' Shaft	Collapsed building and subsidence around shaft	Unknown	Removal of buildings Backfilling with waste rock