REPORT ON:

KETZA RIVER MINE
CLOSURE COST ASSESSMENT

Prepared for:
Water Resources Division
Indian Affairs and Northern Development Canada
Whitehorse, Yukon

Prepared by:

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KETZA RIVER MINE
CLOSURE COST ASSESSMENT

1.0 Introduction

As per the instructions from Water Resources, the objectives of the work described in this report are to: estimate and/or update previous estimates of mine abandonment costs and accumulated site liability of the Ketza River gold mine.

Fulfilling the project objectives has included the following steps:

- conduct a site inspection,
- review available information,
- characterize the existing mine condition and expected reclamation measures,
- compile a reclamation cost estimate using the RECLAIM cost estimating model, and,
- prepare this report describing the above steps.

2.0 Site Inspection

A site inspection was conducted on October 28, 1998, with Mr. Bud McAlpine of the Water Resources Division. There was no representative of the mine present at the site. Snow accumulations at the site ranged from about 5 cm at the elevation of the tailings pond to greater than 25 cm at about 1550 m elevation, which is just below the 1550 adit. Snow at this elevation prevented inspection of the waste dumps, pits, the 1550 adit and roads connecting these components.

3.0 Information Sources

The following information was reviewed for this project:

- Report to Canamax Resources Inc. on Geotechnical Investigation Proposed Tailings Pond Camp and Mill Site, ..., Ketza River Project, Yukon, Golder Associates, rev. Dec. 1986,
- Report to Canamax Resources Inc. on Geotechnical Design of Tailings Disposal Facilities, ..., Ketza River Project, Yukon, Golder Associates, 1986,
- Ketza Gold Mine, Results of Field Reconnaissance; Geo-Engineering (M.S.T.) Ltd., Sept. 1987,
- Screening Report, Canamax Resources Inc. Ketza River Mine Sulphide Ore Development and Decommissioning Plan, Jan. 1991.
- Water Use Licence, issued to Canamax Resources June 1991 and subsequently assigned to Wheaton River Minerals Ltd. Nov. 1992 and then to Ketza River Holdings Ltd. in Feb. 1994.
- Ketza River Mine Abandonment Plan, Steffen Robertson & Kirsten (SRK), Feb. 1994.
- EARP Screening Report - Ketza River Mine abandonment Plan, Nov. 1994.
- Ketza River Mine Assessment of Risks Associated With Tailings Dams, SRK 1994,
- Ketza River Mine Tailings Testing Report, SRK, 1995,
- Review of Report: Ketza River Mine Assessment of Risks Associated With Tailings Dams, by M.J. Brodie, P.Eng., 1996,

- Ketza River Mine, Addendum to the 1994 Decommissioning Plan, Tailings Management Facility, 1996.

4.0 Existing Mine Condition

The Ketza River Mine has been inactive since Nov. 1990 due to the oxide ore reserves being exhausted and low gold prices. Non-oxide (sulphide) reserves exist at the site, however, they have not been economic to recover. A caretaker is present on the site during the summer months only.

Mine Workings

There are five adits at the mine. One has been collapsed and backfilled and the others are temporarily closed with wooden barricades. A heater and mine ventilation fan are installed in one of the 1510 adits. The 1994 Abandonment plan indicates a transformer located on the 1510 level about 50 m from the portals. Mine water drains out the 1430 portal. An internal dam on the 1510 level directs drainage to the lower level.

There are five open pits at the mine. All are side-hill excavations without a significant depression. The pits are located above tree line.

Water draining from the 1430 portal has an arsenic concentration of 0.326 mg/l. This concentration exceeds the Water Licence grab sample limit for arsenic of 0.3 mg/l in the discharge from the portal settling pond (ref. SRK 1995, Table 2). Elevated arsenic, 0.122 mg/l is also present in the Tarn pit drainage (ref. SRK 1995, Table 2).

Water draining from the Gully pit has a pH of 2.74, elevated sulphate (1940 mg/l) and arsenic concentration of 2.6 mg/l, copper concentration of 43.8 mg/l and zinc concentration of 2.99 mg/l (ref. SRK 1995, Table 2). The impacts from water draining from the Gully pit and associated waste rock are not incorporated in the sampling conducted at station KR8 because this station is upstream of the confluence with Peel Creek.

The water quality in the Gully Pit appears to be affected by acid rock drainage; the concentration of sulphate, arsenic, copper and zinc are all elevated and the pH is 2.68 (ref. SRK 1995, Table 2). It is not known if the water draining from the other mine workings meets water licence criteria. The results of a single sampling (ref. SRK 1995, Table 2) indicate that the water quality is probably acceptable.

Waste Dumps

Side-hill waste dumps are located adjacent to all pits. Several of these dumps are unstable and creep deformation is ongoing. Most of the waste dumps are located above tree line.

Sampling of water emanating from the waste dumps has not been conducted. However, it is believed that there are no water quality issues associated with the waste dumps.

Low Grade Stockpile

A stockpile of low grade ore is located uphill of the crusher. The stockpile has an irregular terraced configuration.

Sampling of water emanating from the stockpile has not been conducted. The stockpile could contain elevated concentration of arsenic or other metals.

Mill, Camp and Buildings

Buildings at the Ketza River mine site include: the 1510 dry, the mill complex (crusher, metallurgical plant, water treatment tanks), mill dry, five wooden cold storage sheds, man camp (partially dismantled), sewage treatment plant, and numerous pump station sheds (~ 15). In addition, there are five fuel storage tanks (four empty and one with about 90,000 l of diesel fuel), one sulphur dioxide tank and a fuel storage tank at the 1510 portals.

Virtually all of the salvageable equipment and materials have been removed from the mill. There are minor quantities of hazardous materials located in the mill and adjacent storage sheds.

Roads
Due to the snow cover, it is difficult to estimate the extent of road development at the mine site. However, it appears that there is at least 5 kilometers of roads providing access to the pits. All of these roads have been constructed using the lateral cut to fill method. It is understood that there are few culverts in these roads.

Tailings Pond
Oxide tailings are currently contained by two dams, the north dam which is about 20 m high and the south dam which is about 10 m high. A beach of exposed tailings is located by the south dam. The tailings have been deposited such that the deepest area of the pond is against the north dam.

There is very soft soil at the toe of the north dam. The soft soil is exposed over an area up to 10 m wide and 20 m long (parallel to the crest of the dam). It appears that seepage passing through or under the dam is the source of water flowing through the soil. This soil was "spongy" to walk on and could be easily liquefied by "pumping" it by foot or jumping up and down. There is no information regarding the depth or extent of this soft soil under the dam. There is no quantification of any changes in this soft soil, however, DIAND inspectors indicate this area has become softer in the last few years. The site investigation report (Golder Assoc. 1986) indicated that a 1.2 m layer of loose to compact silty sand and gravel overlies compact sand and gravel with a STP blow count of at least 20 per foot. It is understood that a subsequent investigation by SRK found a greater thickness of loose material under the dam.

Treatment and discharge of tailings pond water was ceased in Aug. 1991. From that date until 1998 the pond level fluctuated within a 1.5 m range. This implies that all water entering the pond (groundwater from the north side of the pond, leakage from the

diversion ditches and incident precipitation) escaped by seepage through or under the dams. The shallower thickness of tailings against the north dam results in the seepage path at this location being the shortest and having the highest gradient out of the pond. Consequently, it is believed that most of the seepage is passing through or under the north dam. Trends in seepage volume are not available because the seepage monitoring weirs located below the north dam have not been in service for several years.

The concentration of arsenic in the tailings pond water has remained in the range of 1.5 to 2 mg/l for the period 1993 to 1996. The concentration of arsenic in the pore water of the tailings is much higher and ranges from 2.54 to 39.7 mg/l.

There is no natural revegetation of the tailings beach and there are no measures in place to control erosion by wind.

A report by SRK in 1995 concludes that arsenic release from the tailings occurs at about the same rate for submerged and exposed tailings.

There is one seepage collection pond located downstream of the south dam and three located downstream of the north dam.

Diversion Channels
Four channels route runoff around the tailings pond; the northwest runoff interceptor ditch, the Subsidiary Creek diversion and the Cache Creek diversion. Subsidiary Creek diversion drains into the Cache Creek diversion through a culvert. Thawing of the slope on the south side of the Cache Creek diversion is resulting in creep deformation of the slope into the channel and reducing its cross-section. Erosion of the soil and bedrock in the base of the Cache Creek diversion is occurring downstream of the point where it passes the south dam.

Landfill
A site for disposal of refuse is located to the west of the Ridge zone pit. This site does not have sufficient capacity for demolition waste.

Miscellaneous Wastes
There are two primary laydown areas at the site. Unusable lime is stored in the cold storage by the mill. Waste oil is stored in about 110 barrels (45 gallon) by the tailings area. About 2000 m3 of organic waste (coconut rinds from the carbon adsorbent used in the gold recovery process) is located near the tailings pond.

Receiving Water Quality
Receiving water quality, as measured at station KR8 located about a kilometer downstream of the tailings pond consistently meets permit criteria and standards for protection of aquatic life.

Site water quality data (SRK, 1994 page 2-27 and figure 2-13) indicate the following parameters for flows and arsenic concentration:

Location	Flow, 1000 m^3/yr.	Arsenic, mg/l	Arsenic annual loading, kg
KR1, Cache Creek upstream of mine	2677	0.0165	44.17
Oxo Creek	1940	0.0005	0.97
KR4 & 5, Tailings seepage	152	0.007	1.06
KR8, estimated from mass balance using above data	4770	0.0097	46.2
KR8, actual as measured in the field	4770	0.0056	26.71

The flows appear to be reasonable in relation to the respective watersheds from which they flow and the mean annual precipitation of 520 mm/year.

Mine areas are typically sources of heavy metals, not areas where concentrations are reduced. Curiously, the elevated arsenic levels at KR1 appear to be reduced by passing through the mine area. The water quality data indicates a reduction in arsenic concentration, despite flowing through the mine area where additional arsenic is added to the water from some or all of: the pits, waste dumps, portal drainage, ore stockpile and tailings. Approximately 19.5 kg per year (46.2-26.7) of arsenic is removed from the waters by passing through the mine area.

The tailings testing report concludes that the removal is achieved through adsorption onto native soils. This reduction is surprisingly large considering that the majority of the flow past the mine is confined to the stream channels and does not pass through a large volume of soil. If the reduction were occurring through adsorption onto crystalline ferrihydrite, then the iron deposited would be visible in the stream channel. Even if the flows were inaccurate by a factor of two it would imply that essentially 100% of the arsenic released by the mine is being retained or adsorbed before reaching the KR8 water station.

The Tailings Testing report (SRK 1995) indicates that the ability of one soil sample, NS4, to retain arsenic is high and a second soil sample, NS2, to be less effective in retaining arsenic. Sample NS4 is from the valley side whereas sample NS 2 is from the valley bottom where most of the arsenic bearing water would pass. After 200 pore volumes of water passing over the sample its capacity to retain arsenic decreases.

The tailings testing report does not propose a mechanism for the adsorption of arsenic onto the native soils. No geotechnical data or hydrogeologic analyses are presented to identify which soils the mine waters may be passing through. The concern here is the representativeness of the samples tested compared to the soils along seepage pathways.

At this time there is nothing to support the implied conclusion that there is little or no potential for future water quality problems associated with either release of arsenic or ARD problems in the Gully Pit.

5.0 Reclamation Measures

A list of proposed reclamation items is summarized in the Addendum to the Decommissioning Plan, (SRK 1996). The proposed modifications deal with upgrades to the diversion channels and construction of a permanent spillway.

In general, the proposed measures for all mine components except the tailings pond and diversion structures are acceptable. The comments provided below for these items are to add any minor tasks which may have been omitted and to characterize the quantities of work involved to develop the reclamation cost estimate.

The proposed measures for the tailings pond and diversion channels are not considered to be acceptable at this time because of concern for the long term stability of the north dam. This matter is described further below.

Mine Workings

Reclamation measures for the mine workings should include:

- remove mine air heater, ventilation fan and transformer from the 1510 level portal area,
- backfill four portals
- contour area around 1490 portal
- construct a concrete cap anchored to bedrock over the backfill raise (opening 2 m x 2 m) to the 1510 level, cap is 5 m by 5 m and 1 m thick,
- conduct an assessment of the ARD potential for the rocks in the Gully Pit.

Waste Dumps

Reclamation measures for the waste dumps should include:

- removal of material from the crest area of dumps which are creeping.

Low Grade Stockpile

Reclamation measures for the low grade stockpile should include:

- conduct an assessment of the potential for arsenic release from the stockpile,
- if the stockpile is not a point of release for arsenic then re-contour the stockpile, this activity may be incorporated with burial of the demolition waste from the mill,
- if the stockpile is a source of arsenic release then it may be necessary to construct a cover to reduce infiltration of water, (the cost of this cover is not included in this reclamation cost estimate),
- revegetate the area.

Mill, Camp and Buildings

Reclamation measures for the mill, camp and other buildings should include:

- removal of all hazardous materials for disposal at an approved site,
- demolish and burn all wooden buildings,
- demolish and bury all steel buildings,
- crack and bury all concrete foundations,
- assume that the camp, mine and mill dry buildings, fuel tank at the 1510 portal, and sewage treatment plant can be sold for a dollar and removed by others, clean-up around these buildings and burial of concrete foundations would still be required,
- revegetate the areas.

Roads

Reclamation measures for the roads should include:

- pull-back of fill sections of roads onto the road bed
- revegetation of road surfaces.

Tailings Pond

Stability of the north dam during a seismic event is in question because soft and liquefiable soils are present at the toe of the dam. Ensuring the stability of this structure is essential for providing long term containment of the tailings. In the absence of data and analyses to show that the factor of safety under seismic conditions is acceptable, it is assumed here that remedial measures are necessary.

An evaluation of the liquefaction potential of the soil at the toe of the dam has been made using assumed soil parameters and the "Simplified Procedure for Evaluating Soil Liquefaction Potential" by Seed et al, 1971. This analysis and the calculation of toe buttress size is presented as Appendix I of this report. The analysis shows that liquefaction of the soil is very likely to occur in the existing condition. Construction of a buttress 15 feet high over the toe area of the dam may improve the stability sufficient to withstand a 1000 year seismic event. A more severe event could still result in failure, although failure may be limited to slumping without regressive failure back through the crest of the dam.

An investigation into the nature and extent of the soft soils at the toe of the dam should be conducted. The results of the investigation should then be incorporated in an rigorous analysis of liquefaction potential and dam stability. It is assumed that the investigation would consist of three or four drill holes and laboratory analysis. Engineering effort could consist of four days for field personnel and five days for office personnel.

Improving the stability of the dam should consist of reducing the seepage and pore pressure in the toe of the dam, and constructing a toe buttress to consolidate the loose soils and increase resistance to liquefaction.

Reducing seepage and pore pressure can be achieved by relocating tailings from the beach on the south side of the pond into the deep pond area upstream of the north dam.

Permanently lowering the pond elevation by constructing a spillway with an invert below the current pond elevation will further reduce the pore pressure in the toe of the dam.

Reclamation measures for the tailings dams and pond area should include:

- conduct investigation and analysis for design of toe buttress for north dam
- construction of north dam toe buttress, assume the buttress is 5 m high by 9 m wide by 25 m long for a total volume of 1125 m^3, use granular rock material from low grade stockpile area (assuming that this material is not leaching arsenic), assume the bottom 1 m of the buttress is select sand and gravel to provide a filter against migration of fines, cautious construction methods will be needed to avoid liquefaction of the soil by movement of heavy equipment,
- relocate up to 80,000 m^3 of tailings to the north side of the pond using hydraulic mining method,
- addition of ferric sulphate to the tailings slurry to immobilize any arsenic in the pore water of the redeposited tailings,
- lowering the pond elevation would require treating the existing pond water, the current volume of water in the pond is about 270,000 m^3, assume that 200,000 m^3 of water would be treated and released,
- reconstruction of the water treatment plant, at this time the work required for this task is not identified so a provisional amount of $50,000 is suggested.
- revegetation of the exposed native soils after the tailings beach has been removed.

Diversion Channels

Permanently lowering the pond elevation will influence the proposed measures for the diversion channels.

Reclamation measures for the diversion channels should include:

- breaching of the south dam,
- breaching of the Cache Creek diversion to allow the creek to flow into the tailings pond,
- breaching of the Subsidiary Creek diversions,
- construction of a permanent erosion resistant spillway from the breach in South dam to a point about 150 downstream of the dam, this spillway should have a capacity of at least 33 m^3/sec which is estimated to equivalent to the 3000 year return period flood,
- placement of erosion resistant boulders in the section of Cache Creek diversion below the point where the new spillway would enter.

Landfill

Reclamation measures for the landfill should include:

- the landfill should be capped with local native material.

Miscellaneous Wastes

Reclamation measures for the miscellaneous wastes should include:

- collection and removal of all hazardous wastes and shipment to an approved disposal site.

Receiving Water Quality
Two aspects of the site water quality need to be further addressed;

- the anomalous reduction in arsenic concentration in waters upstream of Station KR8 including: the mechanism for arsenic adsorption, the breakthrough point at which the adsorption ceases to be effective, and the potential for future release of currently immobilized arsenic, and,
- the water quality and associated impacts from potentially acid generating materials located in the Peel Creek watershed.

Monitoring & Contingency Plan
Post-closure monitoring measures should include:

- water quality monitoring in years 1, 2, 3, 5 and 10,
- geotechnical inspection in years 1, 2, 3, 5 and 10.

At this time water quality criteria are being met. Therefore, no post-closure contingency measures for water treatment are recommended. However, additional measures could be required for treatment of arsenic or acid rock drainage from the Gully Zone pit. It is recommended that these concerns be addressed as soon as possible. If necessary, this closure cost estimate can be amended.

6.0 Conclusions & Reclamation Cost Estimate

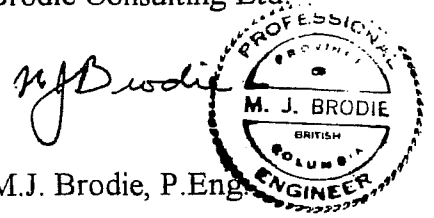
The main conclusions from this work are:

- Potentially liquefiable soils are present at the toe of the north dam. Ensuring long term containment of the tailings will require measures to improve the stability of the dam.
- Measures to improve the stability of the north dam will include lowering the tailings pond water level. Consequently, the proposed up-grading of the Cache Creek diversion are precluded in favor of breaching the South dam and constructing a new spillway from the breach towards Oxo Creek.
- Water quality criteria are currently being met at the receiving water Station KR8. However, the documentation regarding mechanism for removal of arsenic and the potential for ongoing removal are inadequately described. Additional evaluations should be conducted to demonstrate that receiving water quality will continue to be acceptable. Otherwise it will be necessary to provide for perpetual post-closure water treatment.
- Acid generation appears to be occurring in the Gully Zone pit. Characterization of potential impacts from this source and if necessary, design of additional reclamation should be conducted.
- The estimated cost for complete reclamation of the Ketza River Mine is $1,094,196.

A summary of the reclamation cost estimate is attached as the lead page in the output from RECLAIM cost estimating model.

I trust that this report addresses your current requirements. Please call if you have any questions.

Yours truly,
Brodie Consulting Ltd.



M.J. Brodie, P.Eng.

PROJECT NAME: **KETZA RIVER MINE** DATE: 04-Dec-98

COMPONENT TYPE: OPEN PIT

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
A	OBJECTIVE: CONTROL ACCESS					
	Fence	m		NA	0	$0
	Signs	each		NA	0	$0
	Ditch, mat'l A	m3		NA	0	$0
	, mat'l B	m3		NA	0	$0
	Berm	m3		NA	0	$0
	Block roads	m3		NA	0	$0
	Other			NA	0	$0
				NA		
B	OBJECTIVE: STABILIZE SLOPES			NA		
	Off-load crest, mat'l A	m3		NA	0	$0
	, mat'l B	m3		NA	0	$0
	extend dam	m3		NA	0	$0
	, fill mat'l A	m3		NA	0	$0
	, fill mat'l B	m3		NA	0	$0
		m		NA	0	$0
	Pumping, pumps	each		NA	0	$0
	, pipes	m		NA	0	$0
	, power	kWh		NA	0	$0
	Other			NA	0	$0
				NA		
C	OBJECTIVE: COVER/CONTOUR SLOPES			NA		
	Fill, mat'l A	m3		NA	0	$0
	, mat'l B	m3		NA	0	$0
	Rip rap	m3		NA	0	$0
	Vegetate	ha		NA	0	$0
	Other			NA	0	$0
				NA		
D	OBJECTIVE: SPILLWAY			NA		
	Excavate channel, mat'l A	m3		NA	0	$0
	, mat'l B	m3		NA	0	$0
	Concrete	m3		NA	0	$0
	Rip rap	m3		NA	0	$0
	Other			NA	0	$0

PROJECT NAME: **KETZA RIVER MINE** DATE: 04-Dec-98

COMPONENT TYPE: OPEN PIT

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
				NA		
E	OBJECTIVE: FLOOD PIT			NA		
	Ditch, mat'l A	m3		NA	0	$0
	, mat'l B	m3		NA	0	$0
	Embankment, mat'l A	m3		NA	0	$0
	, mat'l B	m3		NA	0	$0
	Pumping, pumps	each		NA	0	$0
	, pipes	m		NA	0	$0
	, power	kWh		NA	0	$0
	Other (lime addition)	tonne		NA	0	$0
				NA		
F	OBJECTIVE: BACKFILL PIT			NA		
	Fill, mat'l A	m3		NA	0	$0
	, mat'l B	m3		NA	0	$0
	Other			NA	0	$0
				NA		
G	OBJECTIVE: DEVELOP WETLAND			NA		
	Earthworks, mat'l A	m3		NA	0	$0
	, mat'l B	m3		NA	0	$0
	Vegetate	ha		NA	0	$0
	Other			NA	0	$0
				NA		
H	Conduct ARD assess. @ Gully Pit		1	NA	12000	$12,000
	Subtotal					$12,000

COMMENTS:

PROJECT NAME: **KETZA RIVER MINE** DATE: 04-Dec-98

COMPONENT TYPE: OPEN PIT

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: UNDERGROUND MINE

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
A	OBJECTIVE: CONTROL ACCESS					
	Fence	m		NA	0	$0
	Signs	each		NA	0	$0
	Ditch, mat'l A	m3		NA	0	$0
	, mat'l B	m3		NA	0	$0
	Berm	m3		NA	0	$0
	Block adits, 4 @ 224 m3	m3	896	SB1H	4.15	$3,718
	Cap shaft	m3		NA	0	$0
	Cap raise #1	each	1	NA	25000	$25,000
	Cap raise #2	m3		NA	0	$0
	Backfill adits	m3		NA	0	$0
	Backfill shaft	m3		NA	0	$0
	Backfill raise #1	m3		NA	0	$0
	Backfill raise #2	m3		NA	0	$0
	Backfill open stopes	m3		NA	0	$0
	Remove fan, heater, transformer	each	1	NA	2000	$2,000
				NA		
B	OBJECTIVE: STABILIZE GROUND SURFACE			NA		
	Backfill mine	m3		NA	0	$0
	Collapse mine	m3		NA	0	$0
	Contour, mat'l A	m3	200	DSH	2.67	$534
	, mat'l B	m3		NA	0	$0
	Maintain dewatering (see "MONITORING/MAINTENA			NA		
	Other			NA	0	$0
				NA		
C	OBJECTIVE: FLOOD MINE			NA		
	Plug adits	m3		NA	0	$0
	Plug drillholes to surface	each		NA	0	$0
	Grouting	m3		NA	0	$0
	Other			NA	0	$0
				NA		
D	OBJECTIVE: DEVELOP WETLAND			NA		
	Earthworks, mat'l A	m3		NA	0	$0

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: UNDERGROUND MINE

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
	, mat'l B	m3		NA	0	$0
	Vegetate	ha		NA	0	$0
	Other			NA	0	$0
				NA		
E	SPECIALIZED ITEMS			NA	0	$0
	Subtotal					$31,252

COMMENTS:

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: TAILINGS IMPOUNDMENT

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
A	OBJECTIVE: CONTROL ACCESS					
	Fence	m		NA	0	$0
	Signs	each		NA	0	$0
	Ditch, mat'l A	m3		NA	0	$0
	, mat'l B	m3		NA	0	$0
	Berm	m3		NA	0	$0
	Block roads	m3		NA	0	$0
	Other			NA	0	$0
				NA		
B	OBJECTIVE: STABILIZE EMBANKMENT			NA		
	Toe buttress, filter mat'l	m3	175	SB1S	8.45	$1,479
	, fill mat'l A	m3	950	SB1H	4.15	$3,943
	, fill mat'l B	m3		NA	0	$0
	Rip rap	m3		NA	0	$0
	Vegetate	ha		NA	0	$0
	Raise crest	m3		NA	0	$0
	Flatten slopes	m3		NA	0	$0
	Other			NA	0	$0
				NA		
C	OBJECTIVE: RELOCATE TAILINGS			NA		
	Hydraulic mine tailings	m3	80,000	NA	2.5	$200,000
	add ferric sulphate	kg	4000	NA	2	$8,000
	Vegetate	ha	0.8	VHFH	3000	$2,400
	Other			NA	0	$0
				NA		
D	OBJECTIVE: FLOOD TAILINGS			NA		
	Ditch, mat'l A	m3		NA	0	$0
	, mat'l B	m3		NA	0	$0
	Raise crest	m3		NA	0	$0
	Other			NA	0	$0
				NA		
E	OBJECTIVE: DEVELOP WETLAND			NA		
	Earthworks, mat'l A	m3		NA	0	$0

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: TAILINGS IMPOUNDMENT

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
	, mat'l B	m3		NA	0	$0
	Vegetate	ha		NA	0	$0
	Other			NA	0	$0
				NA		
F	OBJECTIVE: UPGRADE SPILLWAY			NA		
	Excavate channel, mat'l A	m3		NA	0	$0
	, mat'l B	m3		NA	0	$0
	Concrete	m3		NA	0	$0
	Rip rap	m3		NA	0	$0
	Other			NA	0	$0
				NA		
G	OBJECTIVE: STABILIZE DECANT SYSTEM			NA		
	Remove	m3		NA	0	$0
	Plug/backfill	m3		NA	0	$0
	Other			NA	0	$0
				NA		
H	OBJECTIVE: REMOVE TAILINGS DISCHARGE			NA		
	Cyclones	m3		NA	0	$0
	Pipe	m3		NA	0	$0
	Other			NA	0	$0
				NA		
I	Drilling investigation	each	1	NA	8000	$8,000
	Engineering, analysis & design	hours	72		100	$7,200
	Subtotal					$231,021

COMMENTS:

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: TAILINGS IMPOUNDMENT

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: ROCK PILE

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
A	OBJECTIVE: STABILIZE SLOPES					
	Contour, low grade stockpile area	m3	3800	DSH	2.67	$10,146
	Divert runon, ditch mat'l A	m3		NA	0	$0
	, ditch mat'l B	m3		NA	0	$0
	Toe buttress, drain mat'l	m3		NA	0	$0
	, fill mat'l A	m3		NA	0	$0
	, fill mat'l B	m3		NA	0	$0
	Off-load crest, mat'l A	m3	5000	DSH	2.67	$13,350
				NA		
B	OBJECTIVE: COVER DUMP			NA		
	Mat'l A	m3		NA	0	$0
	Mat'l B	m3		NA	0	$0
	Rip rap	m3		NA	0	$0
	Vegetate	ha		NA	0	$0
	Other			NA	0	$0
				NA		
C	OBJECTIVE: UNDERWATER DISPOSAL			NA		
	Move material	m3		NA	0	$0
	Add lime	m3		NA	0	$0
	Add crushed limestone	m3		NA	0	$0
	Other			NA	0	$0
				NA		
D	OBJECTIVE: COLLECT AND TREAT			NA		
	See "ONGOING TREATMENT" costing component			NA		
				NA		
E	OBJECTIVE: DEVELOP WETLAND			NA		
	Earthworks, mat'l A	m3		NA	0	$0
	, mat'l B	m3		NA	0	$0
	Vegetate	ha		NA	0	$0
	Other			NA	0	$0
				NA		
F	SPECIALIZED ITEMS			NA	200	$0

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: ROCK PILE

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
Subtotal					$23,496

COMMENTS:

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: BUILDINGS AND EQUIPMENT

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
A	OBJECTIVE: DISPOSE MOBILE EQUIPMENT					
	Sell equipment 1	each		NA	0	$0
	Sell equipment 2	each		NA	0	$0
	Sell equipment 3	each		NA	0	$0
	Decontaminate and dispose 1	each		NA	0	$0
	Decontaminate and dispose 2	each		NA	0	$0
	Decontaminate and dispose 3	each		NA	0	$0
	Other			NA	0	$0
				NA		
B	OBJECTIVE: DISPOSE STATIONARY EQUIPMENT			NA		
	Sell equipment 1	each		NA	0	$0
	Sell equipment 2	each		NA	0	$0
	Sell equipment 3	each		NA	0	$0
	Decontaminate and dispose 1	each		NA	0	$0
	Decontaminate and dispose 2	each		NA	0	$0
	Decontaminate and dispose 3	each		NA	0	$0
	Other			NA	0	$0
				NA		
C	OBJECTIVE: DISPOSE ORE CONCENTRATION EQU			NA		
	Autoclave - sell	each		NA	0	$0
	Decontaminate tanks & plumb.	each		NA	0	$0
	Remove tanks & plumbing	each		NA	0	$0
	Other			NA	0	$0
				NA		
D	OBJECTIVE: DISPOSE WATER TREATMENT EQUIP			NA		
	Decontaminate tanks & plumb.	each		NA	0	$0
	Remove tanks & plumbing	each		NA	0	$0
	Other			NA	0	$0
				NA		
E	OBJECTIVE: DECONTAMINATE BUILDINGS & TANK			NA		
	Buildings, all , chemicals	m3	1	NA	2000	$2,000
	, asbestos	m2		NA	0	$0
	Building, fuel tanks sludge removal	m3	4800	ORH	0.88	$4,224

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: BUILDINGS AND EQUIPMENT

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
	, asbestos	m2		NA	0	$0
	Building 3 , chemicals	m3		NA	0	$0
	, asbestos	m2		NA	0	$0
	Building 4 , chemicals	m3		NA	0	$0
	, asbestos	m2		NA	0	$0
	Building 5 , chemicals	m3		NA	0	$0
	, asbestos	m2		NA	0	$0
	Other			NA	0	$0
				NA		
F	OBJECTIVE: REMOVE/MOTHBALL BUILDINGS			NA		
	Building 1, mill	m2	1271	BRS1S	50	$63,550
	Building , water treatment plant	m2	137	BRS1L	20	$2,740
	Building, assorted wooden	m2	635	BRW2	5	$3,175
	Building, fuel tanks	m2	48	BRS1H	20	$960
	Building 5	m2		NA	0	$0
	Other			NA	0	$0
				NA		
G	OBJECTIVE: BREAK BASEMENT SLABS			NA		
	Building 1, mill	m2	635	BRCL	10	$6,350
	Building , mill & mine dry	m2	160	BRCL	10	$1,600
	Building 3	m2		NA	0	$0
	Building 4	m2		NA	0	$0
	Building 5	m2		NA	0	$0
	Clear laydown areas	each	2	NA	2500	$5,000
				NA		
H	OBJECTIVE: REMOVE BURIED TANKS			NA		
	Tank 1, decontaminate	m3		NA	0	$0
	, excavate & dispose	m3		NA	0	$0
	Tank 2, decontaminate	m3		NA	0	$0
	, excavate & dispose	m3		NA	0	$0
	Tank 3, decontaminate	m3		NA	0	$0
	, excavate & dispose	m3		NA	0	$0
	Other			NA	0	$0

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: BUILDINGS AND EQUIPMENT

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
				NA		
I	OBJECTIVE: GRADE AND CONTOUR			NA		
	Grade mill area	ha	2.85	SCFYL	3215	$9,163
	Place soil cover	m3		NA	0	$0
	Rip rap on ditches	m3		NA	0	$0
	Vegetate	ha	2.85	VHFL	1100	$3,135
	Other			NA	0	$0
J	OBJECTIVE: RECLAIM ROADS			NA		
	Scarify and install water breaks	ha	1	SCFYL	3215	$3,215
	Vegetate	ha	1	VHFL	1100	$1,100
	Excavate fill back onto road	m3	6000	SC1H	6.54	$39,240
K	Remove power poles & lines	km	5	NA	600	$3,000
	Subtotal					$148,452

COMMENTS:

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: CHEMICALS & CONTAMINATED SOILS

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
	Note: The procedures, equipment and packaging for clean up and removal of chemicals or contaminated soils are highly dependent on the nature of the chemicals and their existing state of containment. Government guidelines should be consulted on an individual chemical basis. Any estimate made here should be considered very rough unless specific evaluations have been conducted.					
A	LABORATORY CHEMICALS	pallet	2	LCRL	1500	$3,000
				NA		
B	PCB	kg		NA	0	$0
				NA		
C	FUEL			NA		
	Type 1	kg		NA	0	$0
	Type 2	kg		NA	0	$0
				NA		
D	OIL			NA		
	Waste oil	litre	22550	ORL	0.12	$2,706
	Type 2	kg		NA	0	$0
				NA		
E	PROCESS OR TREATMENT CHEMICALS			NA		
	Type 1	pallet	5000	PCRS	0.5	$2,500
	Type 2	kg		NA	0	$0
	Type 3	kg		NA	0	$0
	Type 4	kg		NA	0	$0
				NA		
F	EXPLOSIVES	kg		NA	0	$0
				NA		
G	CONTAMINATED SOILS			NA		
	Type 1	m3		NA	0	$0
	Type 2	m3		NA	0	$0
	Subtotal					$8,206

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: CHEMICALS & CONTAMINATED SOILS

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST

COMMENTS:

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: WATER MANAGEMENT

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
A	OBJECTIVE: STABILIZE EMBANKMENT					
	Toe buttress, drain mat'l	m3		NA	1	$0
	, fill mat'l A	m3		NA	0	$0
	, fill mat'l B	m3		NA	0	$0
	Rip rap	m3		NA	0	$0
	Vegetate	ha		NA	0	$0
	Raise crest	m3		NA	0	$0
	Other			NA	0	$0
				NA		
B	OBJECTIVE: UPGRADE SPILLWAY			NA		
	Excavate channel, mat'l A	m3	1950	SC1H	6.54	$12,753
	, mat'l B	m3		NA	0	$0
	Concrete	m3		NA	0	$0
	Rip rap	m3	1950	SBSH	10.92	$21,294
	Other			NA	0	$0
				NA		
C	OBJECTIVE: TREAT POND WATER			NA		
	pumping	m3	200000	NA	0.02	$4,000
	arsenic removal	m3	200000	NA	1.09	$218,000
	Other			NA	0	$0
				NA		
D	OBJECTIVE: BREACH EMBANKMENT			NA		
	Remove Fill, South Dam	m3	2135	SB1L	2.74	$5,850
	Remove Fill, Cache Cr. diversion	m3	600	SB1L	2.74	$1,644
				NA		
E	OBJECTIVE: STABILIZE DITCHES			NA		
	Flatten side slopes	m3		NA	0	$0
	Rip rap	m3	100	SBSH	10.92	$1,092
	Vegetate	ha		NA	0	$0
	Other			NA	0	$0
				NA		
F	OBJECTIVE: BREACH DITCHES			NA		
	Excavate	m3	100	SB1L	2.74	$274

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: WATER MANAGEMENT

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
	Backfill/recontour	m3		NA	0	$0
	Vegetate	ha		NA	0	$0
	Other			NA	0	$0
				NA		
G	OBJECTIVE: REMOVE PIPELINES			NA		
	Remove pipes	m	5000	PPLL	1	$5,000
	Concrete plug deep pipes	m3		NA	0	$0
	Other			NA	0	$0
				NA		
H	OBJECTIVE: WATER QUALITY ASSESSMENT			NA		
	arsenic adsorption assessment	each	1	NA	25000	$25,000
	Gully Zone ARD	each	1	NA	5000	$5,000
	Other			NA	0	$0
				NA		
I	OBJECTIVE: COLLECT DRAINAGE FOR TREATMEN			NA		
	Excavate collection ditches	m3		NA	0	$0
	Rip rap ditches	m3		NA	0	$0
	Pipes	m		NA	0	$0
	Pumps	each		NA	0	$0
	Collect'n pond, exc. mat'l A	m3		NA	0	$0
	, exc. mat'l B	m3		NA	0	$0
	Collect'n pond, fill mat'l A	m3		NA	0	$0
	, fill mat'l B	m3		NA	0	$0
	Collect'n pond, liner	m2		NA	0	$0
				NA		
J	OBJECTIVE: TREAT DRAINAGE (see "ONGOING TR			NA		
	Build treatment plant	lump sum	1	NA	50000	$50,000
	Subtotal					$349,907

COMMENTS:

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: WATER MANAGEMENT

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: MOBILIZATION/DEMOBILIZATION

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST
A	MOBILIZE HEAVY EQUIPMENT					
	Machine, 2 excavators, 430 km each way		1720	MHER	2.4	$4,128
	Machine 2 trucks, 430 km each way	each	1720	MHER	2.4	$4,128
	Machine 3	each		NA	0	$0
B	MOBILIZE CAMP			NA	0	$0
C	MOBILIZE WORKERS	each	6	MM<L	175	$1,050
D	MOBILIZE MISC. SUPPLIES	each	1	NA	2000	$2,000
E	HOUSE WORKERS	person-month	6	NA ACCM	1200	$7,200
F	BONDING	lump sum	1	NA	16000	$16,000
G	TAXES	lump sum		NA	0	$0
H	INSURANCE	lump sum	1	NA	16000	$16,000
	Subtotal					$50,506

COMMENTS:

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: MOBILIZATION/DEMOBILIZATION

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

ACTIVITY/MATERIAL	UNIT	QUANTIT	COST CODE	UNIT COST	COST

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: MONITORING AND MAINTENANCE

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

	ACTIVITY/MATERIAL	UNIT	QUANTIT PER YEA	COST CODE	UNIT COST	COST
A	OBJECTIVE: INSPECTIONS					
	Visual inspection, geotech.	each	5	VIL	100	$500
	Survey inspection	each		NA	0	$0
	Water sampling, 5 years, 4 per year	each	20	WSL	4500	$90,000
	Reporting	each		NA	0	$0
	Other			NA	0	$0
				NA		
B	OBJECTIVE: MAINTENANCE			NA		
	Security guard	month		NA	0	$0
	Accomodation	month		NA	0	$0
	Maintain pumping	month		NA	0	$0
	Clear spillway	each		NA	0	$0
	Other			NA	0	$0
				NA		
C	OBJECTIVE: ONGOING WATER TREATMENT			NA		
	Note: The cost of water treatment can vary widely depending on the nature of the influent and the effluent objectives. The size of a water treatment plant depends on the peak inflow rate which can be many times greater than the mean. Therefore, an estimate of water treatment costs made here should be considered very rough unless chemical testing and hydraulic modelling has been conducted.					
	Operate treatment plant	m3		NA	0	$0
	Subtotal					$90,500

COMMENTS:

PROJECT NAME: KETZA RIVER MINE DATE: 04-Dec-98

COMPONENT TYPE: MONITORING AND MAINTENANCE

COMPONENT NAME:

COMPONENT No.: 1

BEST ESTIMATE FOR UNIT COSTS

ACTIVITY/MATERIAL	UNIT	QUANTIT PER YEA	COST CODE	UNIT COST	COST

RECLAMATION COST SUMMARY

PROJECT NAME: KETZA RIVER MINE

BEST ESTIMATE FOR UNIT COSTS 04-Dec-98

CAPITAL COST COMPONENT NAME	COMPONENT TYPE		TOTAL COST
	OPEN PIT		$12,000
	UNDERGROUND MINE		$31,252
	TAILINGS IMPOUNDMENT		$231,021
	ROCK PILE		$23,496
	BUILDINGS AND EQUIPMENT		$148,452
	CHEMICALS & CONTAM. SOILS		$8,206
	WATER MANAGEMENT		$349,907
	MOBILIZATION/DEMOBILIZATION		$50,506
SUBTOTAL			**$854,840**
PROJECT MANAGEMENT		3 % of subtotal	$25,645
ENGINEERING		% of subtotal	$0
CONTINGENCY		25 % of subtotal	$213,710
GRAND TOTAL - CAPITAL COSTS			**$1,094,196**
	MONITORING & MAINTENANCE		$90,500
CONTINGENCY		25 % of subtotal	$22,625
TOTAL - ANNUAL ONGOING COSTS			**$113,125**
ESTIMATED SALVAGE VALUE			**NA**