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BOSS MOUNTAIN MINE  
OPEN PIT PROPOSAL  
E.W. Grove, Ph.D., P.Eng.  
March 8th, 1975.

# PROPERTY FILE

## BOSS MOUNTAIN OPEN PIT PROPOSAL

An investigation of feasibility studies

submitted to the British Columbia Department of Mines

and Petroleum Resources

E.W. Grove, Ph.D., P.Eng.,

D. Tidsbury, P.Eng.,

G. Klein, P.Eng.,

J. Rohwedder

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## Object

The situation at the Boss Mountain mine has been examined regarding geological, technical, environmental and social aspects. The object of the exercise was to analyse the present and future viability of the operation as outlined in various feasibility studies recently presented to the Department of Mines by Noranda. These studies have suggested that in order to extend the life of the mine and community the B. C. government should:

- (1) waive royalties in order to allow Boss to fund exploration and metallurgical testing
- (2) consider purchasing Noranda Mines investment in Boss Mountain
- (3) consider a deep hole exploration project

## Scope of the Study

On the basis of investigating an open pit feasibility study presented by Noranda an evaluation team including Mr. D. Tidsbury P. Eng., Inspection Branch; Mr. G. Klein P. Eng., President Geologist, Mr. J. Rohwedder, Research Officer, Operations Branch; and E. W. Grove Ph.D., P. Eng., Senior Geologist, Mineral Resources Branch, travelled to the Boss Mountain mine pit February 24, 1975. The members of the team met with the mine staff during February 25 and 26 who cordially answered all questions and supplied all the material requested.

Although snow covered the open pit area it was viewed, and both the underground and mill operation were visited for purpose of orientation.

On arrival at the mine it was found that the terms of reference, the feasibility reports of January 30 and February 17, had been updated. As a result the submission which outlined costs, equipment and material requirements became a frame of reference from which to discuss the current direction of mine planning.

## Summary

1. The Boss proposals of January 30 and February 17, 1975 have become a frame of reference only because of increased tonnage estimates.

2. Beneficiation of the stringer zone mineralization by crushing and screening which was the main thrust of the feasibility studies has been augmented by autogenous grinding studies.

3. In order to delineate the tonnage and grade of the proposed larger pit proposal core drilling footage on a 100 foot grid is required and will exceed the early estimates by a factor of at least two.

4. The tailing disposal problem currently facing Boss Mountain mine has not been solved to the Pollution Control Board's satisfaction.

5. The current tailing disposal area is adequate for the life of the underground operation only - a new area capable of handling open pit production and agreed on by the various government agencies concerned and Boss Mountain has not been negotiated.

6. Generally the planning and cost estimates first proposed are redundant in view of the new larger tonnage proposals.

7. The Boss concentrator is inadequate at present in view of the larger tonnage proposal.

8. A large expenditure on housing is required if the open pit operation is undertaken.

9. The total feasibility study will have to be repeated in more detail when the results of the metallurgical testing and the exploration drilling are completed - if these tests and drilling appear favourable.

10. The present underground mine has a projected life of less than two years - unless the tailings effluent problem is solved before the heavy Spring runoff the mine operation will be suspended in 1975.

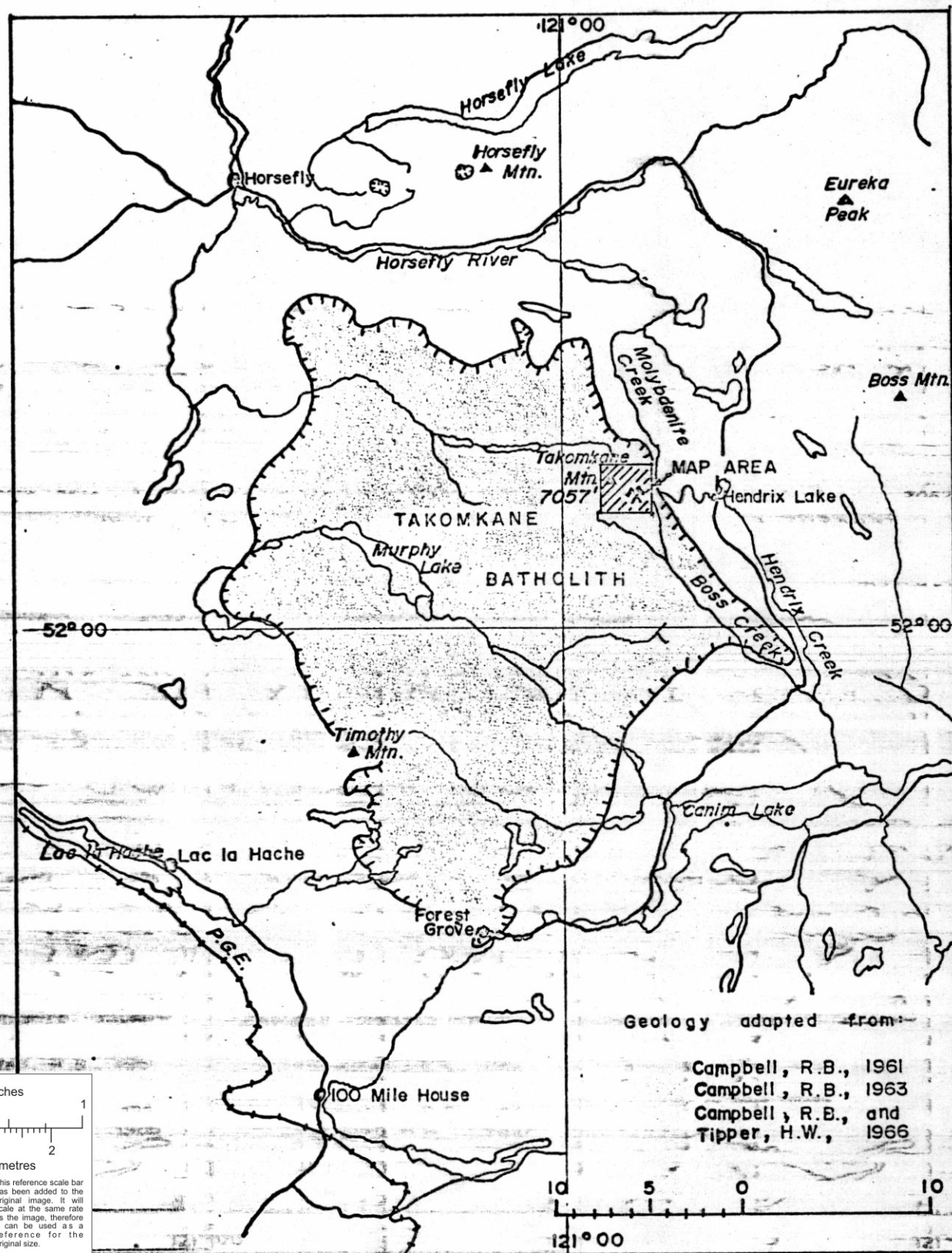


Figure 1. Location of area of study showing surface distribution of Takomkane Batholith.

## Boss Mountain Mine

### Location & Physical Features

The Boss Mountain mine, mill and townsite are located 57 miles by road northeast of 100 Mile House in the Prince George management district (Fig. 1). The main adit, mill, and office are at the 5,045 foot elevation on the east slope of Takomkane (Boss) Mountain. Underground mining has been active above this level to the surface at about 5,600 feet. The mine lies within a narrow cirque with walls rising steeply on the west to ridges and peaks at 7,000 foot elevation. The cirque is drained by Molybdenite Creek which flows easterly, then into the Horsefly River, a tributary of the Quesnel River. Boss Creek and Hendrix Creek which drain the surface camp area flow southerly into the Clearwater-North Thompson drainage. Both the Quesnel and Thompson are major tributaries of the Fraser River.

Rock outcrops are sparse in the cirque below 6,000 feet except in the small canyons along Molybdenite Creek. The geology and mineralization at the mine are best known from the underground workings and from core drilling.

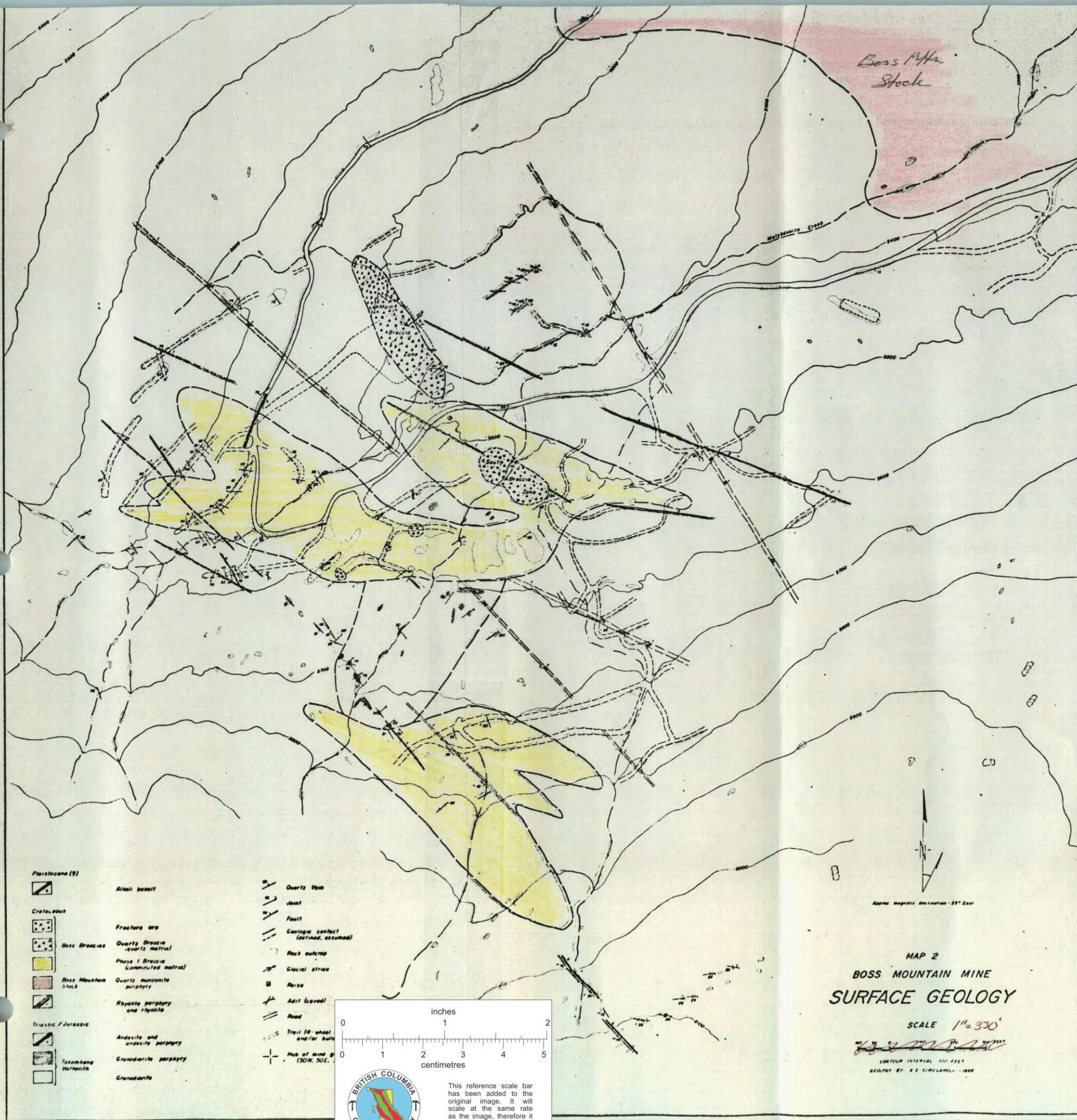
### General Geology

The mine area lies on the eastern margin of the composite Takomkane batholith which has intruded Triassic volcanic and sedimentary rocks correlated to the Nicola Group. The batholithic complex has been cut by numerous younger dikes, breccias, and the Boss Mountain stock. Takomkane Mountain partly comprises basalts of probable Pleistocene age that form the prominent peaks.

### Local Geology

In the vicinity of the Boss Mountain mine the massive Takomkane granodiorite exhibits a number of elongate to irregular breccia zones, known as the Boss breccias, which are composed mainly of granodiorite





Pleistocene (?)

Alkali basalt

Cretaceous

Fracture zone

Boss Breccias

Phase I Breccia (conglomerate matrix)

Phase II Breccia (quartz matrix)

Boss Mountain Stock

Rhyolite porphyry and rhyolite

Andesite and andesite porphyry

Tasmanian Batholith

Granodiorite

Fracture zone

Phase I Breccia (conglomerate matrix)

Phase II Breccia (quartz matrix)

Quartz monzonite porphyry

Rhyolite porphyry and rhyolite

Andesite and andesite porphyry

Granodiorite porphyry

Granodiorite

Quartz vein

Joint

Fault

Geologic contact (defined, assumed)

Rock outcrop

Glacial stream

Rise

Adit (covered)

Road

Trail (wheel and/or built)

Hub of mine (150N. 50E.)





but include various dike and other rock types as well (Fig. 2). About 1,200 feet northeast of the breccia zones the Takomkane granodiorite has been intruded by the younger (80 m.y.) Boss Mountain stock. The breccia zones appear to lie within an inner, apparently annular, biotite alteration zone presumed to be related to the Boss Mountain stock. Underground and surface drilling information has suggested that the stock extends or dips southwesterly under the breccia zones at about 20 degrees. The exact relationship between these breccias and the stock is not known but it has generally been assumed in the past that the stock has also transected the breccias at depth. This point of contention is significant when molybdenite mineralization is confined to the quartz breccia zones.

### History

Mineral claims were first staked on Takomkane Mountain in 1914. In 1917 the molybdenite showings along Molybdenite Creek were located and a bulk sample shipped to Lac La Hache. No further activity ensued until 1930 when the Consolidated Mining Smelting and Refining Company of Canada Ltd. explored the creek stringer zone as well as a breccia zone.

In 1942 Dr. John S. Stevenson of the B. C. Department of Mines mapped the area and supervised the drilling of a total of 1323 feet of x-ray core. He recommended further exploration of the breccia zones but the project was terminated.

In 1955 the Climax Molybdenum Company optioned the claims from H. H. Heustis and associates. Between 1957 and 1960 this company and associates completed 37,000 feet of drilling as well as other surface work. Noranda optioned the property in 1961 from Heustis and the property was re-examined. In 1962-63 Noranda drove the main adit at the 5045 level elevation, initiated underground development and decided in late 1963 to bring the property into production. The camp and mill was constructed in 1964 and production commenced in March 1965 at 1000 tons per day.

### Production

During 1966, the first full year of production, the concentrator treated an average of 1190 tons per day at a 95.8% recovery rate to

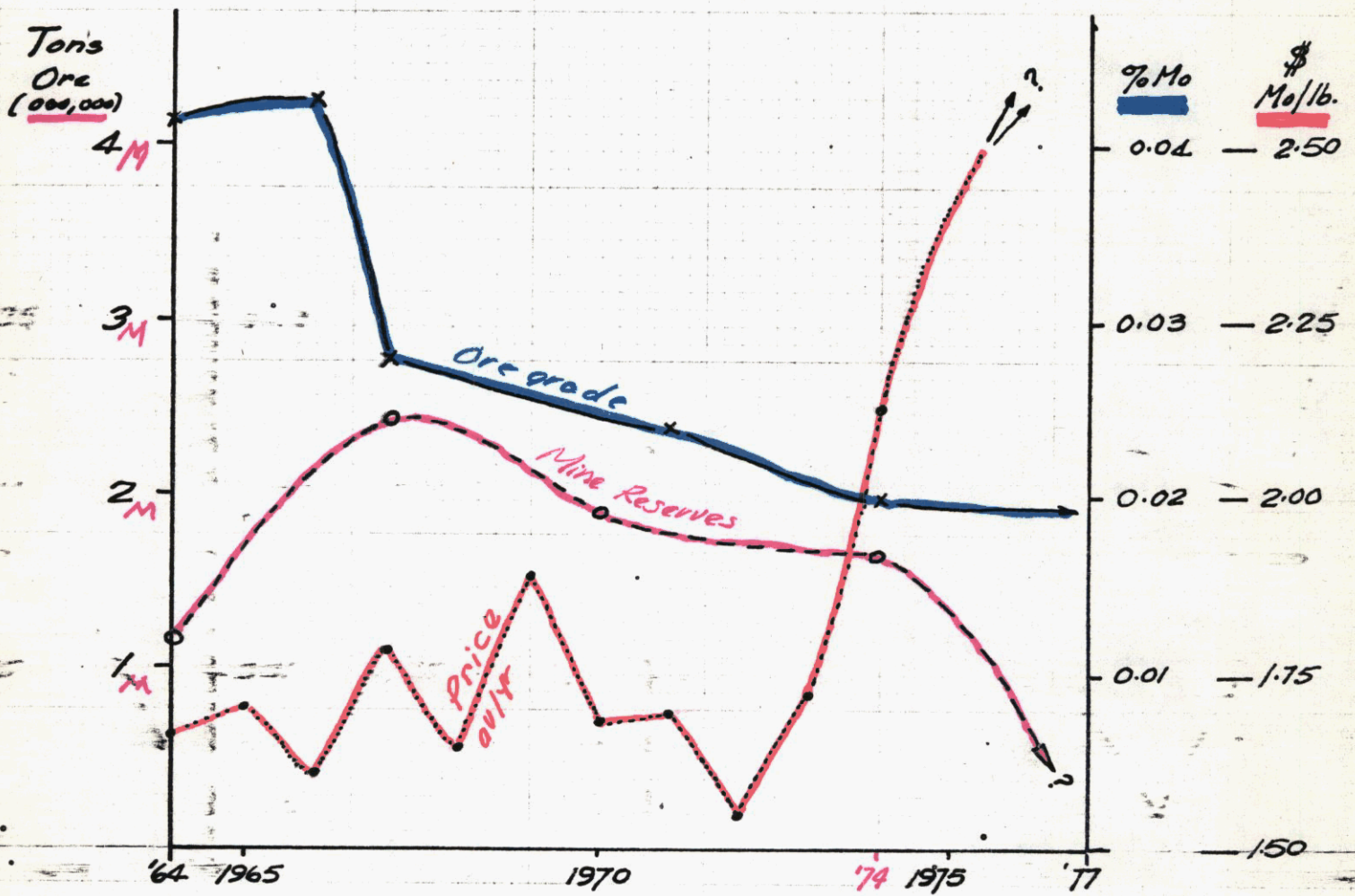
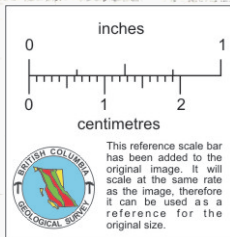


FIG. 3 BOSS MOUNTAIN MINE

Production, Ore grade, Mo price



produce 3,069 tons of concentrate containing 3,576,000 pounds of Mo. The operation was suspended December 3, 1971 after producing during the year a total of 534,500 tons averaging 0.203% Mo and concentrates containing 2,010,000 pounds of Mo.

The mine reopened in late 1973. During 1974 the mine produced 493,904 tons averaging 0.20% Mo. Mine production to the end of 1974 totals 3,792,505 tons with an average grade of 0.27% Mo. (Fig. 3).

### Mineral Deposits

The bulk of the molybdenite ore mined at Boss Mountain has been produced from the crudely elliptical Main Breccia Zone and the smaller South Breccia Zone. These are nearly vertical pipe-like diatremes that are known to extend to a depth of at least 1100 feet below the surface. In these breccias the molybdenite occurs as segregations outlining the rock fragments, as discrete segregations within the breccia matrix, and as ribbons or streaks in brecciated quartz veins. The breccia zone ore has been veined by younger quartz veins which are typically barren.

Molybdenite mineralization also occurs in quartz veins which permeate the granodiorite surrounding the breccia zones. These veins comprise what has been termed the stringer zones in part mined underground and which now form the mineralized zone having the greatest potential for open pit mien production.

The potential for open pit mining of the stringer mineralization at Boss Mountain was recognized some time ago, and Noranda has made a number of feasibility studies in this regard since August 1973.

### Open Pit Mining Proposals

#### General

Surface as well as some underground drilling has indicated the widespread occurrence of near surface molybdenite bearing quartz veins surrounding the Main and South breccia zones. This rock mass includes at least three or four of the stringer zones outlined underground. Early work at the mine suggested these quartz veins represented fracture filling and comprised



an umbrella-shaped halo surrounding the two main breccia bodies. More recently a northwest trending linear zone of breccia pipes has been indicated along which quartz-molybdenite veins are concentrated in east and west dipping sub-parallel fractures or stringer zones. Exploration diamond drilling along this zone has been mainly limited to the vicinity of the glory hole (mine area) and has not delimited the full extent of the stringer zone mineralization.

## Development and Exploration

### Pit Proposal

The initial 12 million ton proposal indicated that in order to complete the geological evaluation of the tonnage and grade of the pit stringer mineralization that 22 core drill holes totalling 4500 feet at 200 foot centres would be required. In view of the proposed increase in pit extent, both in area and depth, more holes on a 100 grid are required. The number, length, core size, and location of these drill holes was not completed at the time of the interview.

Because of timing the decision on drilling in the pit area will have to be made fairly soon. Costs of this drilling can be estimated crudely but would be meaningless at this point.

### Deep Hole Proposal

Geological studies of the Boss Mountain mineralization and apparent controls have suggested to the Noranda geologists that a similarity to Henderson-Climax ore exists. Because of these assumed similarities Noranda geologists suggest that at least one deep (2500 feet) core hole be drilled to test their concept. The various pros and cons of the geological concept were discussed in some detail with the mine geologist Mr. Arnie Pollmer and Noranda exploration geologist Dr. D. Carson.

As indicated in this report the zone of stringer mineralization is much more extensive than previously considered and is still known in only a cursory manner. In general surface exploration of the mine area has been very limited because the costs are directly borne by the mine, and because of the more immediate requirement of maintaining underground reserves.

Because of the topographic restrictions (the cirque) imposed upon any pit depth in the mine area the occurrence of ore grade mineralization at depth becomes both academic and a problem for underground mining.

If, and when the mine can afford deep drilling the program should be instituted to test at depth along the length of the breccia zone. Prerequisites for the near surface pit mineralization are more important at this stage and should be completed first.

#### Tonnage and Grade

##### Underground

The Boss Mountain ore reserves at start of production were estimated at 1,200,000 tons averaging 0.42% Mo. In 1967 the ore reserves above the 5045 adit level were maintained at 2,475,000 tons with an average grade of 0.28% Mo. At shutdown in December 31, 1971 the reserves were estimated at 1,900,000 tons averaging 0.24% Mo. Ore reserves at the end of 1974 are now estimated at 1,674,000 with an average grade of 0.20% Mo. At the present rate of production of 624,000 tons per year the underground reserves will be exhausted in mid 1977, that is, assuming no significant discoveries before that date (Fig. 3).

##### Open Pit

Noranda's estimates of surface mineralization have increased significantly between the presentation of the January 30, 1975 report and the present time. In the first report to the B. C. Department of Mines the company indicated the presence of 12,000,000 tons of drill-indicated (and possible) mineralization with an estimated grade of about 0.088% Mo. In the February 17, 1975 report the estimate was increased to 14,560,000 tons at 0.088% Mo. More recent calculations by the mine geologist suggests a possible 30 million tons with an estimated grade of from 0.07 to 0.08% Mo between the 5200 level elevation and surface. If the zone between the 5045 level adit 5200 is included the possible tonnage is increased to at least 40 million at an estimated similar grade. Of the 30 million plus potential tonnage approximately one half can be classified as drill-indicated (Noranda) tonnage with the remainder classified as possible (inferred).





In view of the very irregular spacing of the exploration drilling only the block immediately adjacent to the east side of the glory hole can be said to have been sufficiently drilled to give a reasonable estimate of grade and tonnage. This block is estimated to contain about 7.0 million tons at an estimated average grade of 0.09% Mo and would on the basis of the available incomplete information constitute the highest grade portion of the proposed open pit (Fig 4). 0.09%

The available results do not indicate the presence of any significant tonnage of underground ore grade mineralization (0.20% Mo) within the limits of the pit proposal.

### Beneficiation

A. The Boss mine proposal to upgrade stringer zone mineralization to mill-head feed grade by screening has been outlined in detail in the report submitted January 30, 1975 (Brand, April, 1974). The proposal suggests that because of the nature of the stringer mineralization about half the tonnage containing less than 10% of the available MoS<sub>2</sub> could be discarded by crushing and screening prior to primary mill treatment. The feasibility of this concept remains to be proven by testing at least 25,000 tons of stringer mineralization from a surface test pit.

B. A second method of beneficiation has now been proposed by the mine staff. This involves autogenous, or semi-autogenous grinding of the mill feed after crushing as part of the primary mill circuit. A four ton sample of stringer zone ore from the underground mine has been shipped to the Ontario Research Council for autogenous grinding tests. The results of this test are expected to be completed and available to the mine staff by the end of March.

C. The results of the autogenous grinding and the proposed crushing/screening tests will determine the feasibility of beneficiation of stringer zone mineralization and will in part determine the future of the open pit proposal.

### Waste Removal

The removal of at least 2 million tons of overburden was indicated in the first pit proposal. With the recent increase of the proposed pit size from the original 4.5 acres to at least 5.4 acres the estimate

of overburden has approximately doubled to about 4 million tons.

With the increase in tonnage from 12 to 30 (+) million tons the amount of waste rock has increased to at least 5 million tons or more depending on the ultimate pit depth.

Most of the proposed pit limit has already been logged but the fringe areas would require further work again depending upon the pit limits.

The problem of overburden and waste rock storage has been considered but has not been solved. It is possible that part of the waste could be used to raise the height of the present tailings disposal dams. But there is no reasonable flat area near at hand and ready for dump use as yet.

#### Tailings Disposal

The present tailing disposal system has adequate storage for the remaining life of the underground mine. But the method has been termed inadequate by Pollution Control. The mine has been warned that unless the tailings effluent is not brought up to Pollution Control Board standards (Mo, Cu, Fe content, with 20:1 dilution rate the guideline) the mine will be closed.

Several ways of upgrading the mill effluent have been examined. These include complete or partial recycling of mill effluent as well as perimeter drainage to reduce runoff movement and resultant overflow, and the raising of the two storage dams to impound the overflow. Dam raising would involve engineering studies of the site and a considerable capital expense.

It is thought highly unlikely that the present tailings disposal area could be used to impound the volume of mill waste anticipated by an open pit operation. A new site will have to be found which will meet the approval of the government agencies concerned. Tailings disposal is a serious problem because of the unique location of the mine at the headwaters of two major streams.

Mr. Tidsbury has indicated that even under the present B. C. Department of Mines reclamation regulations abandonment of the mine will involve considerable expenditure for spillways and collection canals for groundwater. In view of the many agencies and requirements now involved tailings disposal poses a major impediment to extended and increased mine production.

## Pit Mining Considerations

### Equipment

The initial equipment and other related proposals are inadequate in view of the possible expansion of tonnage from 12 to 30 (to 50) million tons. Groundwater diversion in the pit has not been considered and would be a major problem as well as an added cost.

### Labour

In view of recent contract settlements the suggested \$72.00 per man shift is probably optimistic.

### Costs

These are only a preliminary estimate and would require detailing when the exploration drilling, mill testing, mill design, pit design, production and other factors are more realistic. Market forecasts are difficult in the best times but must be considered in view of the rapidly changing world conditions.

### Roads & Hydro

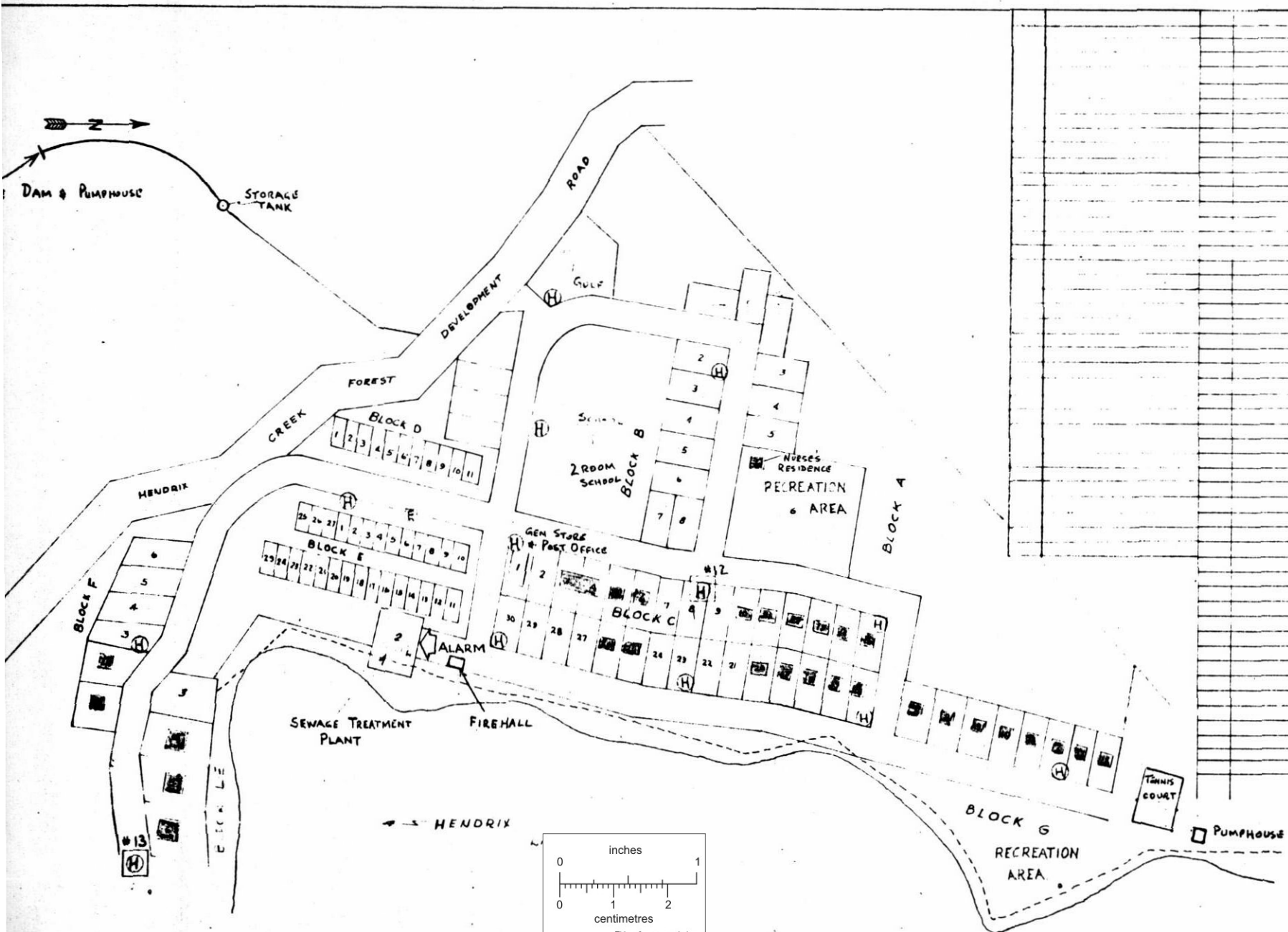
As indicated in the Boss feasibility studies the pit planning was in a very preliminary stage. Items not considered such as roads for waste removal, road relocation, ramps, runaway lanes, stockpiling, sorting if required, all have to be considered on the basis of the tonnage to be handled and with strict regard to safety and environmental standards.

With a larger tonnage factor and the resultant increased hydro demand the question of availability, line costs, and unknown costs become important. For example the sub-station at 100 Mile House may not be capable of delivering the required or proposed mine load.

### Concentrator Expansion

The results from the autogenous grind tests, proposed screening





BRYNNOR MINES &  
BOSS MOUNTAIN  
MINING DEPARTMENT

HENDRIX LAKE -  
LOCATION OF FIRE HYDRANT

Scale 1" = 200' Date ..... Dwn. by .....  
APPROV.  
 Acct. No. .... Dwg. No. ....  
 Ch. Eng. .... Mine Supt. ....

TOWNSITE PLAN  
 SUBDIVISION OF LOT 12046 - CARIBOO DISTRICT  
 PLAN No 14605 KAMLOOPS LAND REGISTRY OFFICE

inches  
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This reference scale bar has been added to the original image. It will scale at the same ratio as the image, therefore it can be used as a reference for the original size.

tests and the tailings problems are significant factors in determining mill design and capacity. In the reports submitted only design changes with respect to the present plant were considered. Again the results of the testing, and the pit output will determine the suitability of the present mill (if at all) and the operating costs.

#### Townsite

The suitability of the present townsites was discussed in some detail by Mr. Tidsbury and the property manager Mr. Cromie. It is apparent that the present facilities which in large part date to 1964 require upgrading. A major undertaking is implicit in this regard and would include expanded sewage disposal, and replacement of 35 company owned trailers. The costs of this project would probably exceed the initial proposal.

#### The Community

The Boss Mountain mine directly employs about 150 at the site. At present there are about 250 people living at the Hendrix Lake camp and 85 at the mine site in single trailer accommodation. There are 31 houses, 50 trailers, a recreation hall, curling rink, other recreational facilities, library, and lunch counter owned and maintained by the mine in Hendrix Lake. The service station is owned and operated by Gulf Oil (with a mine subsidy) and the local store is family owned and operated. The school, housed in a school board owned trailer unit, handles 40 pupils through grade 8. About 8 to 10 of the mine employees reside at Eagle Creek which has a 50/50 logging-mining employment base. Two employees commute from Williams Lake, 6 from Forest Grove, and one from Lac La Hache.

Virtually all the mine purchases are through Vancouver with the exception of minor available local items. Fuel and gasoline are mainly handled by the subsidized Gulf station. Family food stuffs are purchased at the local store or in bulk in the larger centers.

There is some potential for recreational development such as skiing but apart from the local residents this use is light.

#### A. Mine Closure

On the basis of a very cursory study of the mine community it

appear that the main effect of mine closure would be the displacement of, or the transfer of, the employees and their families. Transfer from one mine to another on short notice is an expected part of mining. The turnover rate of labour at the mine has stabilized in recent months but this is typical of the industry in B. C. in general.

It would appear that only a small number of the mine employees own property in the area. Closure would effect the garage and store but it is likely that the local logging and resort concerns would take over the Hendrix Lake camp for their own use.

#### B. Open Pit Operation

Should the mine convert from underground to open pit operation contractors would be required for pit development, tailings disposal preparation, possible mill construction, townsite reparation, and other ancillary projects. Equipment purchases for the pit operation would require a significant capital outlay. Pit operation would probably mean only a small increase in personnel.