NORTHERN AFFAIRS PROGRAM

MT. NANSEN MINE

REPORT
ON
1989 INSPECTION

Prepared by:

geo-engineering (M.S.T.) LTD.

March 1990

B.Y.G. NATURAL RESOURCES INC.
CHEVRON MINERALS LTD.

REPORT

ON

1989 SITE INSPECTION

OF

MT. NANSEN MINE AREA

Prepared for:
NORTHERN AFFAIRS PROGRAM
Whitehorse, Y.T.

Prepared by:
GEO-ENGINEERING (M.S.T.) LTD.
Calgary, Alberta

March 1990
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1.0 INTRODUCTION

Water Resources Division of Northern Affairs Program requested Mr. M. Stepanek, P. Eng., of Geo-Engineering (M.S.T.) Ltd. to visit and evaluate geotechnical conditions of the terrain at the proposed Mt. Nansen Gold Mine. The work was authorized by means of a letter dated May 29, 1989.

The Mt. Nansen Property, located about 60 km west of Carmacks, is owned by B.Y.G. Natural Resources Inc. and has been explored under option agreements with Chevron Minerals Ltd. since 1985.

Gold and silver occur in a series of sub-parallel, moderately to steeply-dipping quartz-sulphide veins, most of which are strongly oxidized to depths of 5 to 30 m below surface. The most developed veins (Brown-McDade, Huestis, Webber and Flex Zones) lie within a 3 by 1.8 km area in the south-central part of the Mt. Nansen Property.

The site was visited on June 20, 1989, in the company of Mr. H.F. McAlpine, P. Eng. The following reports, prepared by others, were reviewed prior to the site visit:

- Report on the Geology and Mineral Inventory of the Mt. Nansen and Tawa Properties; by Archer, Cathro & Associates (1951) Ltd., dated January 1989.

- Feasibility Study of Mill and Surface Facilities; by Melis Engineering Ltd., dated January 6, 1989.

- Tailings Dam - Preliminary Design Report; by Klohn Leonoff, dated December 1988.

Information contained in these reports was considered when evaluating the geotechnical aspects of the proposed development.

2.0 PROPOSED MINE

Access to the proposed gold mine is by gravel road, starting on the northwest side of the town of Carmacks. The mine was operated from 1968 to 1969 and in 1975 by a syndicate.

The underground workings, mill buildings, two tailings ponds, and a water reclaim pond are in the various stages of destruction scattered throughout the headwater area of the east-trending Dome Creek valley. Chevron Minerals Ltd. and B.Y.G. Natural Resources Inc. undertook an extensive exploration program between 1985 and 1988. The following is a summary of facilities still on the property:

- The mill comprised of a crushing building, a mill building (containing ore bins, ball mills, flotation cells, and scrubbers), a large warehouse, conveyors, a steam building, an electrical building with diesel generators and compressors, and several empty buildings. In 1988, Melis Engineering examined the mill and concluded that the buildings plus the crushing, grinding and flotation circuits could be rehabilitated, but that the electrical and heating systems would probably have to be replaced (Melis, 1988).

- Two very small tailings ponds are located immediately below the mill and are still intact. They are much too small for any conceivable operation deteriorating and cannot be easily expanded.

- The camp consists of a number of Atco-type trailers (destroyed beyond repair) near the mill plus an office and cookhouse approximately 400 m away.

- The water system includes wells in the Victoria Creek valley, a 100 mm diameter pipeline extending 4.5 km from the wells to the mill and a water storage shed uphill from the mill.

- Underground workings have been developed on two levels at the Huestis and Webber Zones and on one level at the Brown-McDade Zone. Both levels at Webber are blocked with ice, while the lower level adit at Huestis is blocked by an ice plug and is partially caved. The Brown-McDade workings are accessible, but there are several small caves. The upper Huestis adit level, which is connected to the lower level by a raise, was rehabilitated in 1988. There is relatively little timber underground, aside from the adit portals (Archer, Cathro, January 1989).

The current proposal considers a 270-tonne per day mill feed and estimates the duration of the mining operation to be at least six years. Initial production would come from open pits on the Brown-McDade Zone and then progress to other zones with open pittable oxidized material (Flex and possibly Webber Zones), underground deposits that are amenable to cyanidization (parts of Brown-McDade and Webber Zones) and finally to underground deposits that would require flotation to produce a sulphide concentrate that could be oxidized and treated by cyanidization or shipped to a smelter.

Mining at the Brown-McDade pits will be done at a rate of approximately 1000 tonnes/day during the summer months and the material will be stockpiled near the mill. It is expected that most of the excavation will be done using a backhoe excavator with a minimum of drilling and blasting. A bulldozer will be used to push away much of the waste, i.e. no major waste dumps appear to be planned.

The proposal considers refitting of the mill, construction of a new camp and support facilities. The material processed by the mill will be, almost entirely, reduced into tailings. The tailings will be pumped to the tailings pond at about 35 percent pulp density, and process water will be reclaimed for re-use in the mill. The tailings will be permanently stored. The required tailings pond capacity is approximately 600,000 tonnes.

Klohn Leonoff studied, in 1988, possible sites for a tailings pond. Three sites were examined but only two were recommended for further consideration. One selected site is located 400 m northwest of the mill and is centered on the old campsite, approximately 60 m higher than the mill. The second site lies 500 m east of the mill and covers the floor of the Dome Creek valley.

3.0 GEOTECHNICAL CONSIDERATIONS

The Mt. Nansen property lies on the eastern margin of the Dawson Range of the Yukon Plateau Physiographic Region. The ground surface elevations range from 1030 to 1500 m a.s.l. It is located northwest of the maximum advance of the Wisconsin ice sheet, outside of the Pleistocene Continental glaciation. The terrain is characterized by broad, rounded ridge tops flanked by gentle slopes (Photo 1). Bedrock is weathered to a ignificant depth.

The pre-Wisconsin glacial till forms localized pockets in the valley.

The major drainages in the area are the Klaza River and Nansen and Victoria Creeks which occupy wide, flat-bottomed valleys fed by tributaries flowing through V-shaped valleys with steeper gradients. Broad terraces, comprised of poorly-sorted glacial outwash sand, are encountered in the broader valley segments.

The bedrock, exposed on the ridges surrounding the site (Photo 2) and in exploration trenches, consists of igneous rocks of the Mt. Nansen Group which have intruded into the Pelly Formation metamorphic rocks. The metamorphic rocks have been mapped as undifferentiated schists, gneisses, quartzites, and marbles (Archer, Cathro, 1986). As mentioned above, the bedrock is deeply-weathered and badly fractured.

Permafrost is widespread, with north-facing slopes remaining frozen throughout the year and south-facing slopes thawing to a depth of 1 to 2 m by late summer.

Visible ice was reported in most recovered soil samples in the form of ice lenses or discrete inclusions. All boreholes, drilled by Klohn Leonoff, showed visible ice in the samples, which may amount to roughly 5 to 10 percent ice volume of a representative column of soil within the total borehole depth. Apprently, no layers of pure ice were encountered in the boreholes, but layers of ice with soil as thick as 10 cm were encountered.

Our field reconnaissance confirmed the findings of the geotechnical consultants reviewing the siting of the proposed tailings pond.

The valley slopes are apparently bedrock-controlled. Their colluvial cover was, at some time in the geologic past, subjected (at least locally) to shallow movements, likely of a solifluction type.

The valley bottom is covered with organic deposits covering ice-rich materials. The old ponds are deteriorating (Photo Nos. 3 and 4). Their embankments exhibit widely-opened cracks and their slopes, locally as steep as 1.5(H):1(V), are sloughing.

3.1 TAILINGS POND - SITE 1

The designated area is approximately 150 m x 250 m in size and has been previously cleared. There are two minor intermittent drainage courses directing surface runoff into the proposed pond area (Figure 1).

No test holes were drilled in this area and the site evaluation is based on a reconnaissance walkover and examination of nearby exploration trenches only.

Terrain features and nearby exploration trenches indicate that a shallow colluvial layer rests directly on weathered and fractured bedrock.

There are no obvious signs of permafrost in this area. However, the extent of old exploration works is such that the position of old adits relative to the proposed tailings pond area cannot be clearly determined.

3.2 TAILINGS POND - SITE 2

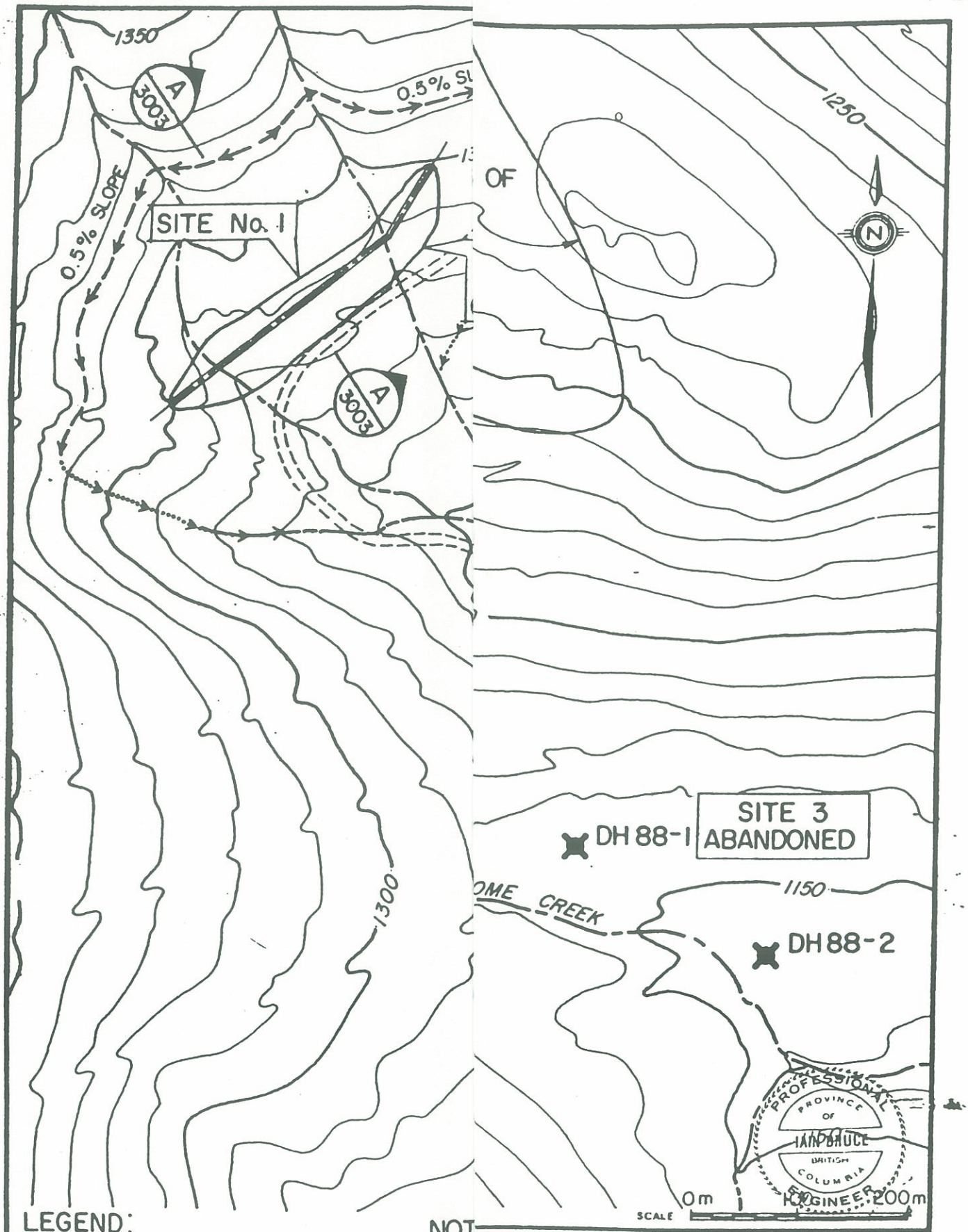
The designated area is approximately 200 m x 300 m in size and is covered with low shrubs and black spruce.

The site was selected by Klohn Leonoff and two boreholes were drilled to investigate the subgrade conditions.

According to the test hole results, the soil profile consists of approximately 9 to 12 m of fine, poorly-graded sand overlying 2 to 4 m of silty sand and gravel overlying 4.5 m to greater than 12 m of glacial till over weathered bedrock. Lenses of ice with soil as thick as 10 cm were described. Klohn Leonoff estimates that as much as 5 to 10 percent of the soil above bedrock could consist of ice.

3.3 PROPOSED DESIGN CONCEPTS

The Klohn Leonoff report considers both sites suitable for the proposed tailings pond and recommends to construct a zoned embankment with a bentonite-enhanced upstream low



LEGEND:

- DIVERSION DITCH
- LINED DIVERSION DITCH (TO BE DESIGNED LATER)
- DRILL HOLE LOCATION (NOT SURVEYED)

NOT

1. S
2. C

MOUNT NANSEN GOLD PROJECT

LOCATION OF BOREHOLES AND DAM OUTLINES

PJE	PROJECT No	DWG No	REV
A988	PB 3574 03	FIG. 1	

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permeability blanket and a toe drainage blanket. For Site 1, the upstream and downstream slopes of the embankment are proposed to be 3(H):1(V) and 2(H):1(V), respectively. The downstream slope for the embankment at Site 2 is proposed to be flattened to 3(H):1(V). The preliminary design assumes 16 to 18 m height of these structures.

Both dykes would require an emergency spillway. It is suggested, by Klohn, that liners to control seepage loss would likely be required. A bentonite-enhanced soil liner or plastic liner is considered for either case. Preliminary cost estimates indicate the plastic liner is likely cost-prohibitive for Site 2.

4.0 EVALUATIONS AND RECOMMENDATIONS

Our review of geotechnical conditions indicate that neither of the proposed sites is entirely suitable for a permanent storing of tailings expected to be produced by the mine.

Site 1 is located in an area which should not experience significant ground deformations (because of apparent absence of segregated ice in the foundation). However, it is located in the head of the valley where it would obstruct natural drainage. Without maintenance, this obstruction would be eroded and the pond eventually destroyed. In addition, consideration should be given to the seepage from the pond since the fracture permeability of the subgrade could be quite high.

The recommended sand-bentonite liner may be difficult to construct due to foundation and weather conditions.

Site 2 is believed to be unsuitable for the proposed tailings pond. The considered pre-thawing of the ground prior to construction is believed to be unrealistic. In general, this concept has not received wide acceptance, due mostly to time and cost constraints.

To evaluate the suitability of the proposed procedure for a given subsoil condition, a very crude analysis was undertaken. The depth of thaw for the continuously cleared site can be approximately related to the square root of time by equation shown below:

When a frozen soil of uniform properties is subjected to a sudden "step" increase in surface temperature, the depth of thaw, X, is related to the elapsed time, t, by

$$X = \alpha\sqrt{t}$$

Where: α = a constant = $\sqrt{(2k_u T_s/L)}$
k_u = the thermal conductivity of thawed soil
T_s = the surface temperature
L = the latent heat of the soil.

Evaluating the thaw parameter α as approximately 4.3 ft/yr$^{1/2}$ (1.3 m/yr$^{1/2}$) for fine-grained soils, it may be demonstrated that the thaw process is slow. In coarser-grained soils, α might be larger due to a lower latent heat term and higher thawed conductivity. According to this relationship, thaw depths of 9 ft. (2.7 m) might occur in a 4 year period, indicating that this approach clearly requires a long lead time to achieve rather nominal thaw depths.

The durability of plastic liners is recently considered to be in the range of 30 to 50 years. It is, therefore, not considered suitable to apply these liners in situations where permanent seepage control is required.

We are in agreement with the conclusion of the Klohn Leonoff study regarding the better suitability of Site 1 (than Site 2) for the required tailings pond. The feasibility of Site 1 is, in our opinion, not well established.

The geotechnical engineer retained by the mining company feels some discomfort regarding this project and recommends:

- "Additional foundation information will be required if Site 1 is selected. This was proposed late in the study, and no definitive on-site information was obtained.

- Borrow material will have to be confirmed with test pits, and a source of filter/bedding sand and gravel will have to be defined.

- The sand-bentonite liner, if selected, will require testing with some on-site sand to define the appropriate material proportions, the optimum water content and the resulting permeability.

- Construction of embankment structures is influenced by weather conditions. Rockfill should not be placed in freezing weather, to avoid irregular settlements in the reservoir lining. A bentonite-sand liner is moisture and freezing weather-sensitive. These operations should be scheduled for the brief summer months."

It is recommended to re-consider the proposed tailings pond locations. Since the objective is to locate the facility in an area where it could remain indefinitely, consideration should be given to a site which would meet this objective.

It is our opinion that the proposed diversions of existing drainage courses around the pond area cannot be permanent without periodic maintenance.

It would also be prudent to consider handling and deposition of overburden materials from the proposed open pit areas relative to their long-term physical stability.

Respectfully submitted,

GEO-ENGINEERING (M.S.T.) LTD.

M. Stepanek

Milos Stepanek, M.Sc., P. Eng.
Principal Consultant

MS/jlw

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PHOTOGRAPHS

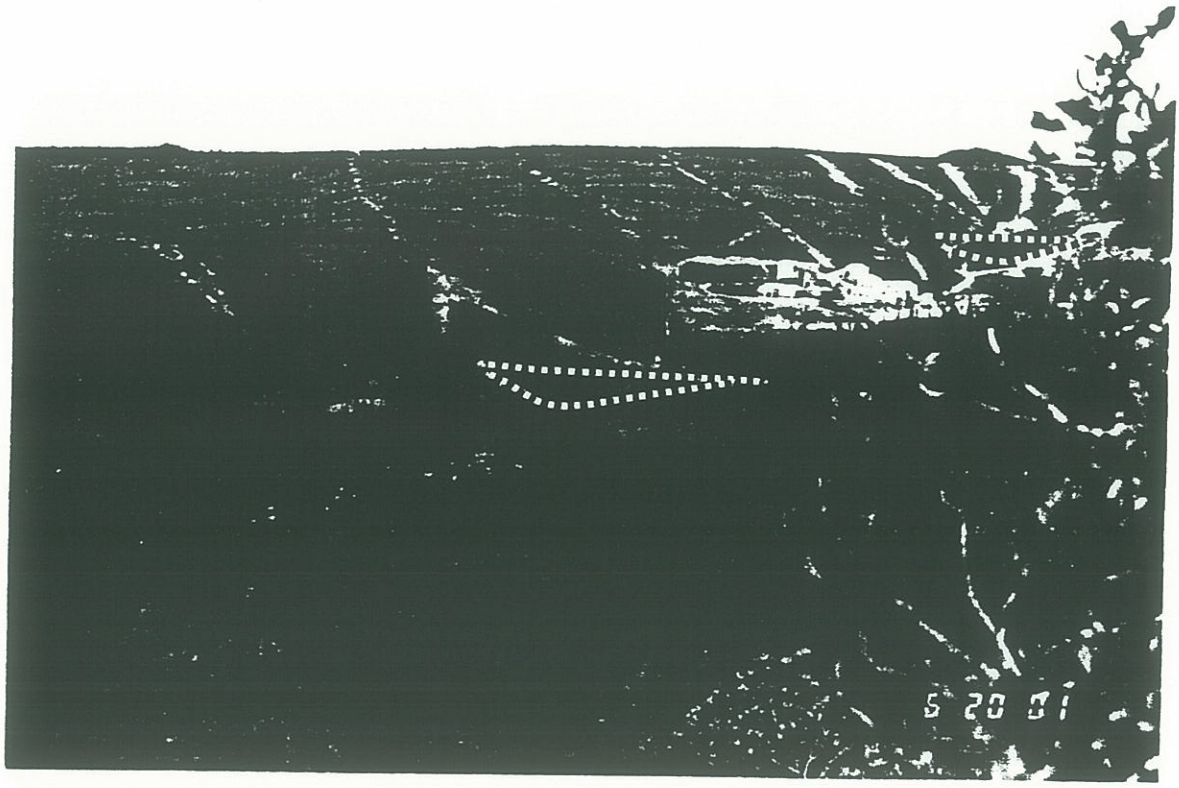

Photo 1: Dome Creek valley, looking west towards the existing mill. Pond Sites 1 and 2 are approximately outlined.

Photo 2: View of Site 1 tailings pond area, currently partly occupied by old facilities.

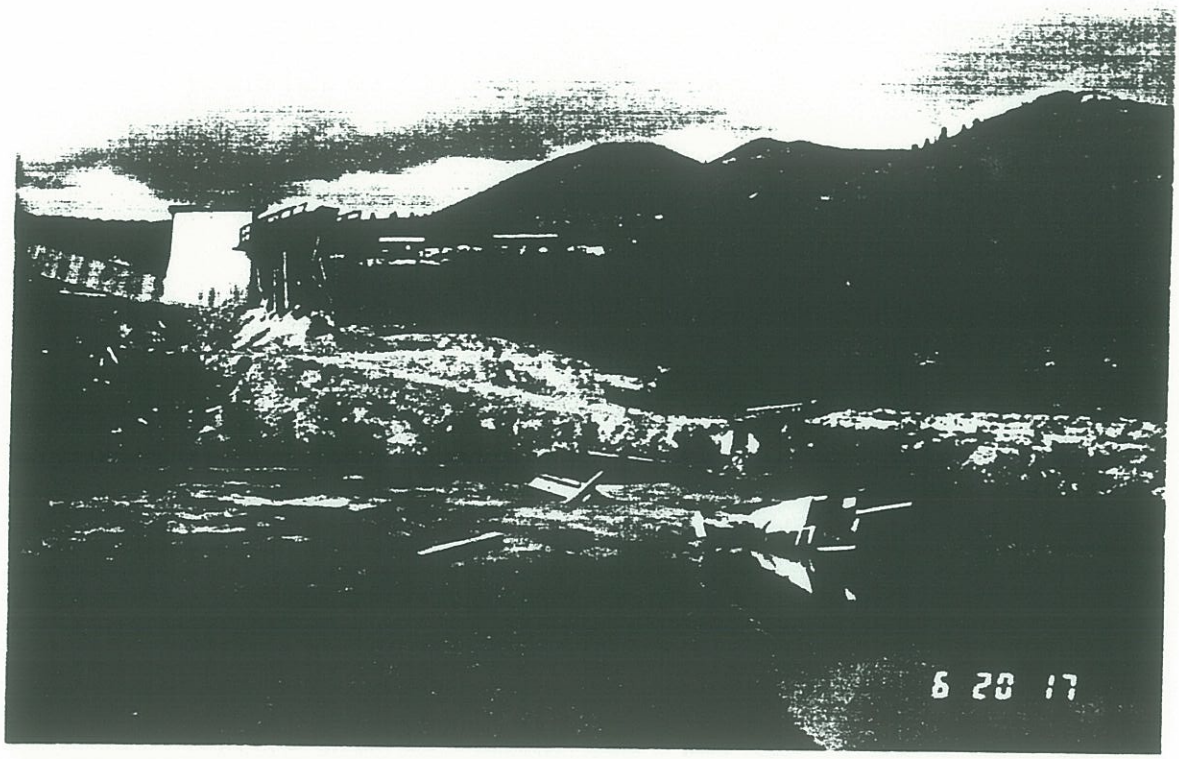

Photo 3: Existing tailings pond, immediately adjacent to the mill.

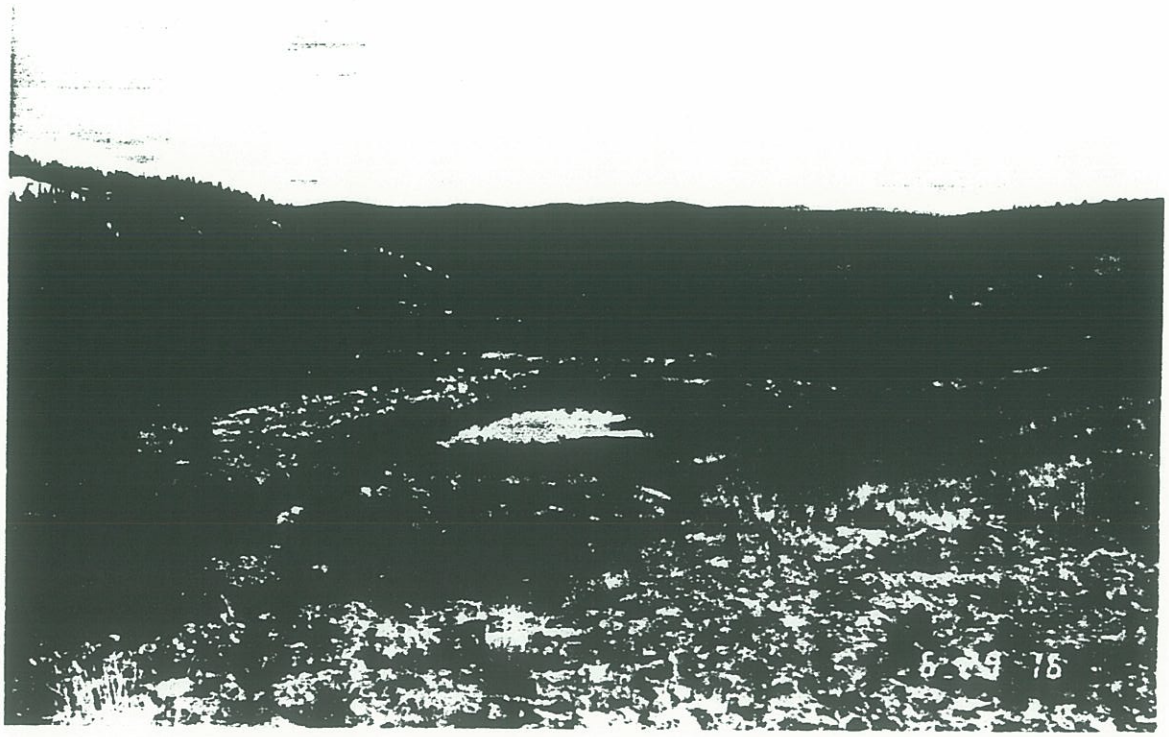

Photo 4: Second tailings pond, looking towards Site 2 area.