c. 1

KLOHN LEONOFF YUKON
CONSULTING ENGINEERS

Our File: PB 5314 0201
WP 544

May 4, 1990

B.Y.G. Natural Resources Inc.
801 - 602 West Hastings Street
Vancouver, British Columbia
V6B 1P2

Attention: Mr. Thornton J. Donaldson, P.Eng.
President

Re: Mt. Nansen Gold Project
Tailings Facility
Preliminary Design Report

Dear Sir:

We are pleased to enclose eight copies of our Tailings Facility Preliminary Design Report for the Mt. Nansen Gold Project. Should you have any questions concerning the report, please contact either the undersigned, or Mr. Harvey McLeod, Manager of our Mining Services Division.

Yours very truly,

KLOHN LEONOFF YUKON LTD.

Robert J. Lorimer, P.Eng.
Engineering Manager

RJL:tp
Encl.

TAILINGS FACILITY
PRELIMINARY DESIGN REPORT

PROJECT: MT. NANSEN GOLD PROJECT

LOCATION: DAWSON RANGE, YUKON TERRITORY

CLIENT: B.Y.G NATURAL RESOURCES INC.

OUR FILE: PB 5314 0201 MAY 1990

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1. INTRODUCTION

This report presents the results of a site investigation and preliminary design of the tailings facility for the proposed Mt. Nansen Gold Project, located near Carmacks, Yukon. This work is further to the Klohn Leonoff report titled " Tailings Dam Preliminary Design Report", dated December 7, 1988 and additional site drilling carried out in September 1989. Relevant sections of the previous report are included herein for purposes of completeness.

B.Y.G Natural Resources Inc. is currently proceeding with a staged implementation program and we understand that this report will be used in support of applications to regulatory agencies for approval to proceed.

2. PROJECT DESCRIPTION

The proposed gold mine is located about 60 km west of Carmacks, Yukon Territory (Drawing D-2001). Access is by gravel road from Carmacks. A number of placer mining properties are located in this area. The mine was operated by others in the past and the underground workings, mill buildings, two tailings ponds, a water reclaim pond and many bulldozer trenches are still present. Site details are shown in plan on Drawing B-2002.

The proposed project will refurbish and utilize the existing mill. The present plan is to develop an open pit over the Brown McDade ore zone, followed by underground mining. The mill will be designed to process 300 tons of ore per day, and almost all of this will represent tailings when the gold is removed. The tailings will be pumped to the tailings pond at about 35% pulp density, and process water will be reclaimed for re-use in the mill. The gold extraction will be by the carbon-in-pulp recovery method. Tailings will contain some cyanide.

3. SITE INVESTIGATIONS

Ground conditions in the vicinity of proposed tailings Damsite No. 1 were investigated between September 12 and 17, 1989. The investigation comprised a ground surface reconnaissance, performed by Mr. Mark Olsen, P.Eng. and Mr. Bob Lorimer, P.Eng., and a subsurface drilling and sampling program carried out by Mr. Robert Bowden of Klohn Leonoff.

The drilling program consisted of five augured boreholes to depths between 7.75 and 14.02 m. The locations of the boreholes are shown in Drawing B-2002, and detailed descriptions of subsurface conditions are presented in borehole logs in Appendix I.

Drilling was performed by Midnight Sun Drilling Co. Ltd. of Whitehorse using a CME 750 truck-mounted drill rig and both hollow and solid stem augers. Drilling and sampling operations were supervised by a Klohn Leonoff engineer. Soil samples were recovered at regular intervals in each borehole, identified in the field, sealed in plastic bags, and returned to Klohn Leonoff's Richmond office for further examination and laboratory testing. Samples were obtained using two methods: standard penetration testing with a split spoon sampler and the removal of material from the flights of augers.

Upon the completion of drilling, groundwater monitoring wells were installed in boreholes DH89-01 (two wells) DH89-02 (one well) and DH89-03 (one well) by a hydrogeologist from Norecol Environmental Consultants Ltd. of Vancouver. Each well consisted of solid and slotted segments of 50 mm diameter PVC pipe surrounded with backfill. Details of each installation, the types of materials used to backfill each borehole, and water level data are presented in Appendix I. Boreholes DH89-04 and 05 were not instrumented.

On September 15, 1989 a falling head test was carried out in the shallower of the two wells installed in borehole DH89-01. The objective of the test was to assess the permeability of surrounding soils.

The site reconnaissance discovered a drill hole located approximately 25 m west of Klohn Leonoff borehole DH89-04. Soundings revealed that the drill hole is open to a depth of approximately 8.0 m below the surrounding ground surface. The depth to the groundwater was 5.1 m on September 15, 1989. The origin, purpose and date of the hole is not known.

4. SITE CONDITIONS

4.1 TOPOGRAPHY

The minesite is located within the physiographic region known as the Yukon Plateau. The area has typically rounded mountain tops with broad valleys and gentle topographic features. Side slopes of the valleys in the vicinity of the mine vary from 2H:1V to as flat as 6H:1V. Drainage from the minesite and tailings dam locations flows into Dome Creek, a tributary of Victoria Creek, which is part of the Nisling River system. The Nisling River ultimately flows into the Yukon River. The mine elevation is about 1250 m (about 4,100 ft).

Elevations have been determined from an orthophoto provided by B.Y.G Natural Resources Inc. The orthophoto, which is undated, has a contour interval of 10 m. An approximate survey check was carried out by Klohn Leonoff on two sections through the proposed tailings pond using a cloth tape and an inclinometer. The survey check agreed with the orthophoto contours.

4.2 SURFICIAL GEOLOGY

Surficial soils in the proposed tailings pond area consist mainly of colluvial, residual and granular glacial outwash soils overlying bedrock.

The soil cover is generally about 5 to 8 m deep. Some recent organic and colluvial soils occur near surface.

Four glacial advances have been defined across the central Yukon Territory. These are, from oldest to youngest, the Nansen, Klaza, Reid and McConnell advances. The Mt. Nansen minesite is situated within the Nansen drift. At least 2,000 years ago, Volcanic ash fell on this area up to a foot in depth. Some glacial till has been noted at depth in the main valley bottom downstream of the proposed tailings pond.

The soils vary from a sandy gravel to a fine sandy silt. The material is generally medium dense with some pockets of loose material. Standard penetration blow counts vary from four to over 125 blows/ft. Some organic fibres were noted in the upper 2 to 4 m and suggest some reworking and colluvial activities. A falling head permeability test carried out in borehole DH89-01 indicated a permeability of about 10^{-7} m/s. The probable range of permeabilities is estimated to vary from 10^{-4} 10^{-8} m/s.

4.3 BEDROCK GEOLOGY

The bedrock at the site appears to consist 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. The bedrock is highly shattered and broken at the ground surface as observed in exploration trenches. We understand that the degree of shattering does decrease with depth, but the rock is considered to be shattered within the zone of influence of the tailings pond. The bedrock is a purplish to brown colour. Bedrock is exposed on the ridge tops where there is very little tree or vegetation cover.

4.4 PERMAFROST

The site lies within the discontinuous permafrost zone, close to the southern boundary of widespread areas of permafrost islands, and is at a high elevation. This location corresponds roughly to the -4°C mean annual air isotherm. The proposed tailings pond site is relatively free of permafrost. Traces of ice were noted in Borehole DH89-01. No evidence of ice was observed in the other boreholes. A visual study of surface conditions on the east side of the natural gully east of Borehole DH89-04 suggested the possibility of some permafrost. This belief is based on the presence of a thick ground cover of moss, stunted conifers and a surface geomorphology that is commonly associated with permafrost areas.

4.5 SEISMICITY

The Mt. Nansen minesite lies within a seismically active area of the Canadian north in Seismic Zone 2, as defined by the National Building Code of Canada, 1985. The site lies within the Northern British Columbia (NBC) source zone between the McKenzie (MKZ) zone and the Denali Shakwak (DSK) zone.

A probabilistic assessment of the seismic risk at the site has been undertaken by the Pacific Geoscience Centre for the Mt. Nansen site (October 1988). The results are enclosed in Appendix II. A peak horizontal ground acceleration of approximately 10% g is expected with probability of exceedance no greater than 0.0021, or one in 475 years, while a peak horizontal acceleration of 12% g is expected with a return period of .001, or one in 1,000 years.

The tailings dam will be founded on medium dense granular soils overlying bedrock. Extensive deposits of loose soils, if they exist, will be removed from the foundation to minimize any potential for liquefaction under earthquake loading.

4.6 CLIMATE

The mean annual precipitation for the project site is about 270 mm. Snow begins falling in October or November and usually remains on the ground until May. The typical snowpack is about 1m. Approximately 40% of the precipitation falls as snow. Some rainfall occurs as early as April, but the majority of rainfall occurs from June to August. The most intense rainfall occurs in July.

Details on the climatic data and hydrology assessment were carried out for the December 1988 Klohn Leonoff report and are included in Appendix III.

5. EXISTING FACILITIES

5.1 MILLSITE

An underground mine operated at this site between September 1968 and April 1969, and again between April and November of 1976 (Environment Canada, 1984). The mine buildings with some existing equipment are located on the existing millsite shown on Drawing B-2002. The mill structures appear to be founded on a cut excavated into the hillside, with the excavated material pushed out to form an area for smaller buildings for packing and storage. The present mill will be refurbished to process about 300 tons per day, or about 100,000 tons per year. For the first two years of operation, the ore would be obtained from an open pit downstream across the valley, about 1 km northeast of the millsite. The approximate open pit outline is shown on Drawing B-2002. About 10 000 tonnes of waste rock will be moved to develop the open pit. Another 90 000 tonnes of waste rock will be available over the first two years of operation.

5.2 TAILINGS PONDS AND SEEPAGE RECOVERY POND

Two existing tailings storage ponds and a seepage recovery pond are located downslope from the existing millsite. The ponds appear to have been constructed by excavating into the hillside, perhaps by bulldozer, and by pushing the slightly silty sand and gravel into the form of dykes. The two tailings ponds have almost no watershed.

The three existing ponds show signs of structural distress. This may be due to poor compaction of the embankments which may have been constructed simply by bulldozing soil from the side slopes. Alternatively, there may have been buried ice in the foundation which has subsequently melted and deformed the dykes.

5.2.1 Upper Tailings Pond

The upper tailings pond was probably used first, and the smaller downstream pond was developed later. The upper dyke had a wood flume spillway. Seepage presently flows downstream through a naturally eroded channel in the dyke. A September 1985 reconnaissance of the upper dam embankment showed cracks in the crest indicating partial slope failure upstream and downstream. Water was ponded and tailings were just visible at the upstream edge of the pond. The dyke is grass-covered, with some bushes. There appears to be a relatively small volume of tailings stored in this pond.

5.2.2 Lower Tailings Pond

The lower tailings pond was also apparently constructed by slope material bulldozed to form a dyke. There is some indication of upstream slope instability with longitudinal cracks in the crest noted during the September 1985 reconnaissance. The dyke has grass cover, and some bushes. Some water is ponded, and surplus water drains through a pipe in the dyke.

We have the impression from air and other photographs of the tailings pond area that a very small volume of tailings is stored in the existing ponds.

5.2.3 Seepage Recovery Pond

The seepage recovery pond dyke appears to have been constructed from material from an exploration trench on the right slope. The spillway is collapsed in the dyke.

A pipeline from the seepage recovery pond appears to have been a water source for the mill. However, we understand that the existing plant obtained make-up water from wells in another valley. Water supply for the present project is being studied by others.

6. TAILINGS STORAGE

6.1 GENERAL

The plant is expected to process approximately 300 tons of ore per day. This will be (ground) milled to a sand-silt slurry for gold extraction by cyanide leaching and carbon-in-pulp recovery. Virtually all the sand-silt slurry will be sent to tailing storage. No thickeners are planned, so the tailing slurry will be approximately 35% pulp density.

The tailings water will contain some cyanide and, consequently, the storage facility will be operated as a closed system. Clarified process water will be returned to the mill for re-use. In addition, we understand that B.Y.G. will provide for a cyanide destruction system, if required.

The ore is believed to contain significant fines, which will require time to settle adequately in solution. We assume a minimum retention time of seven days will be required. If the fines contain excessive clay particles, the required retention time may be longer. This implies that the volume of free water in the pond must be increased, or flocculent agents may have to be added to the tailings to cause the clay particles to settle quickly.

Make-up water will be supplied at the mill, from existing wells near Victoria Creek. Diversion ditches will be provided to divert runoff around the pond. However, in the event that the ditches become plugged, flood freeboard will be supplied in the tailings pond to accommodate an extreme storm event.

6.2 SITE SELECTION

Two potential damsite locations shown in plan on Drawing B-2002 have been assessed. Site No. 2 was drilled in October 1988. A major constraint of Site No. 2 is the presence of extensive deposits of loose to medium dense, frozen sand in the dam foundations. The deposits could thaw during dam construction and pond operation, and could lead to excessive deformation of the dam. The deposits are also potentially liquefiable under earthquake loading.

In our report of December 1988, Site No. 1 was selected as an alternative, and the drilling of September 1989 has confirmed that the foundation conditions at the site are favourable. The site is estimated to be capable of providing storage of mine tailings for up to three years. We understand that future storage could utilize the depleted open pit.

7. IMPOUNDMENT DESIGN

7.1 GENERAL

The tailings impoundment will be formed by construction of a homogeneous earthfill dam at Site No. 1 as shown on Drawing D-2003. The dam will be built in two stages to an ultimate height of about 20 m. The site is at about elevation 1290 m, approximately 400 m northwest of and 60 m above the existing mill grade. The ultimate dam and reservoir site was cleared for the original Mt. Nansen mine campsite and an access road, and has an area of approximately 150 m x 250 m.

Material for dam construction will be borrowed from the pond interior. Surface runoff water will be diverted around the impoundment area and an emergency spillway will be constructed near the dam crest. Tailings will be pumped from the millsite up to the pond and excess water will be decanted for reuse in the mill.

7.2 DAM DESIGN

The dam will consist of a homogeneous earth/rock fill structure constructed from borrow materials obtained from the pond interior. The material consists of silty sand and gravel, and fractured bedrock, and will form a competent fill structure. The material will be placed in lifts and compacted. A downstream filter blanket will consist of selected fractured rockfill "sandwiched" within sand and gravel.

The dam slopes are set at 2H:1V downstream and 3H:1V upstream and are expected to have suitable stability factors of safety. Dam foundations consist of competent granular materials with relatively high shear strengths. The potential exists for some small settlement due to traces of ice in the foundations. The dam however should accommodate such settlements without distress to the structure.

7.3 SEEPAGE AND LINER REQUIREMENTS

Seepage through the dam will be controlled by placement of an impervious liner on the dam face and over the impoundment area. Several options are available for liner systems. These including a mixed soil-bentonite layer, a "Claymax" type of liner or a plastic membrance liner.

The preferred alternative is the "Claymax" liner system. "Claymax" is a commercially available product which consists of a bentonite layer sandwiched between sheets of filter fabric. The liner is easily installed by unrolling sheets in the field. Seaming is achieved merely by overlapping the material. The liner is then covered with about 300 mm of granular material to provide protection and confinement. The bentonite swells upon exposure to water and has an overall permeability of about 10^{-10} m/s. The system has been well proven and is accepted by regulatory authorities in the United States as an alternative to a soil clay liner. The liner is marketed by Armtec Construction Products. The system has the advantage of offering a very simple installation procedure, and quality control is very good as the product can be directly observed in the field. Weather constraints would also be less severe than with a plastic or mixed soil liner.

A second alternative is a mixed soil/bentonite layer. Fine sand and gravel could be mixed with about 5% by weight of bentonite to provide a permeability of about 10^{-9} m/s. A soil layer of about 300 mm is considered adequate. The liner would need to be kept moist and be protected from erosion during operation.

A small potential exists that the mill effluent water could react with bentonite causing it to disperse. This should be checked with a test section using a typical effluent solution.

A third alternative is to use a HDPE or PVC plastic liner. This option would be limited to a summer installation and would require a suitable sand bedding.

Seepage from a pond lined with "Claymax" is expected to be less than from one lined with soil-bentonite. This is mainly due to the quality control problems associated with soil mixing. The estimated seepage from a "Claymax" lined pond is expected to be less than about 0.2 L/s. Seepage from a bentonite-soil lined pond could be in the order of up to 2 L/s.

Groundwater and potential seepage flows from the impoundment should be monitored with groundwater wells located downstream of the dam.

7.4 POND OPERATION

The tailings pond will be operated as a closed system. Details of the proposed operation and criteria for storage are presented in Appendix IV. Decant of excess water from the pond may be by siphon or pump barge. Diversion ditches will be constructed to divert surface runoff around the pond. An emergency spillway will be constructed in in situ soil near one of the dam abutments.

8. ENVIRONMENTAL ASPECTS

8.1 ACID MINE DRAINAGE

A detailed assessment of Acid Mine Drainage (AMD) is being undertaken by others. It is our understanding from preliminary results that the tailings have only a slight potential to create AMD (Environmental Protection Service 1982). The existing tailings ponds show no signs of AMD either at the pond or downstream in any seepage water. Vegetation downstream of the existing tailings pond shows no visible signs of distress.

8.2 RECLAMATION

Abandonment and reclamation of the tailings pond is not considered to be a significant problem at Mt. Nansen. The ponds have a very small catchment area, hence water flows into the area will be limited.

Following completion of mining, all water remaining in the pond will be pumped to the mill, treated to acceptable standards and released. A spillway will be cut in bedrock on one of the abutments to allow snowmelt or precipitation water to drain, and the tailings will be allowed to dry for one season. The dried pond surface will then be scarified and seeded to ensure stabilization of the fine sand.

9. CONCLUSIONS AND RECOMMENDATIONS

The drilling program of September 1989 provided information to confirm the feasibility of Site No. 1 for tailings storage and its preferability over Site No. 2. The main conclusions and recommendations are summarized as follows:

1. Extensive permafrost (frozen soil) is not present at Site No. 1 and the dam foundation conditions consist of about 5 m of silty sand and gravel overlying fractured bedrock. While some traces of ice were encountered in one borehole we do not believe it is extensive enough to affect the integrity of the dam.
2. Good quality construction materials are available from inside the pond area to construct the dam. The dam will consist of a homogeneous earth/rock fill dam with a downstream toe blanket and an upstream impervious liner.
3. A field hand survey check was carried out which confirmed the general accuracy of the available topographic plans. Site No. 1 appears to have adequate capacity to provide tailings storage for up to three years at a production rate of 300 tons per day. We understand that future storage may utilize an abandoned open pit.
4. The recommended pond lining system is to utilize "Claymax" with a protective layer of sand and gravel. "Claymax" is a commercially available product which consists of a bentonite layer "sandwiched" between layers of filter fabric. The product is easily installed and has been accepted by regulatory authorities in the United States as an alternative to clay soil liners. Groundwater seepage from a pond lined with "Claymax" is estimated to be below 0.2 l/s.
5. The tailings pond will be operated as a closed system, with all excess water returned to the mill for reuse. Surface water will be diverted around the pond and an emergency spillway will be provided for extreme flood events.

6. Final design activities should be carried out prior to construction of the facility. These should include a detailed ground survey and a series of excavated test pits to confirm the foundation and borrow conditions. The ground survey is required to finalize the dams alignment and to confirm the storage capacity and dam volumes.

KLOHN LEONOFF YUKON LTD.

Harvey McLeod
Manager, Mining Services Division

Robert J. Lorimer, P.Eng.
Project Manager

PROFESSIONAL ENGINEER
YUKON TERRITORY
R.J. LORIMER

APPENDIX I

BOREHOLE LOGS

DH89-01
DH89-02
DH89-03
DH89-04
DH89-05

TEST HOLE LOG

VERTICAL SCALE : 2 cm = 1 m
DATE DRILLED : September 13, 1989
DRILL TYPE : CME 750, Hollow Stem Augers
ELEV. GROUND (m) : ~1273 m, from Orthophoto
CO-ORDINATES (m) : not surveyed (Refer to DWG B-4001)

SAMPLE DATA

HAMMER MASS : 63.5 kg
DROP HEIGHT : .762 m

DEPTH (m)	O.D. / I.D.	BLOWS 0.3m	SAMPLE NO.
		6	SS1
		4	SS2
		23	SS3
		85	SS4
		125	SS5
		50 / 8cm	SS6

Depth scale (m): 1, 2, 3, 4, 5, 6, 7, 8, 9

DESCRIPTION OF MATERIALS

SAND, fine to medium
- some gravel, subangular, up to 20 mm dia.
- trace silt
- loose
- trace roots
- 10 mm white volcanic ash layer at 1.52 m depth
- dark brown and black colour

2.40

SAND, fine to medium
- trace angular to subangular green and white gravel
- some organic fibres, bark and wood fragments; content decreasing with depth
- medium dense to very loose
- SS2 and SS33 black; SS4 grey, green, brown and black
- trace amounts of ice shards up to 5 mm long
- trace amounts of ice crystals up to 2 mm dia.
- (Vx)

7.00

SAND, fine to medium
- some angular to subangular gravel up to 25 mm diameter
- very dense
- no visible ice or organic material
- oxide stains on gravel particles
- brown

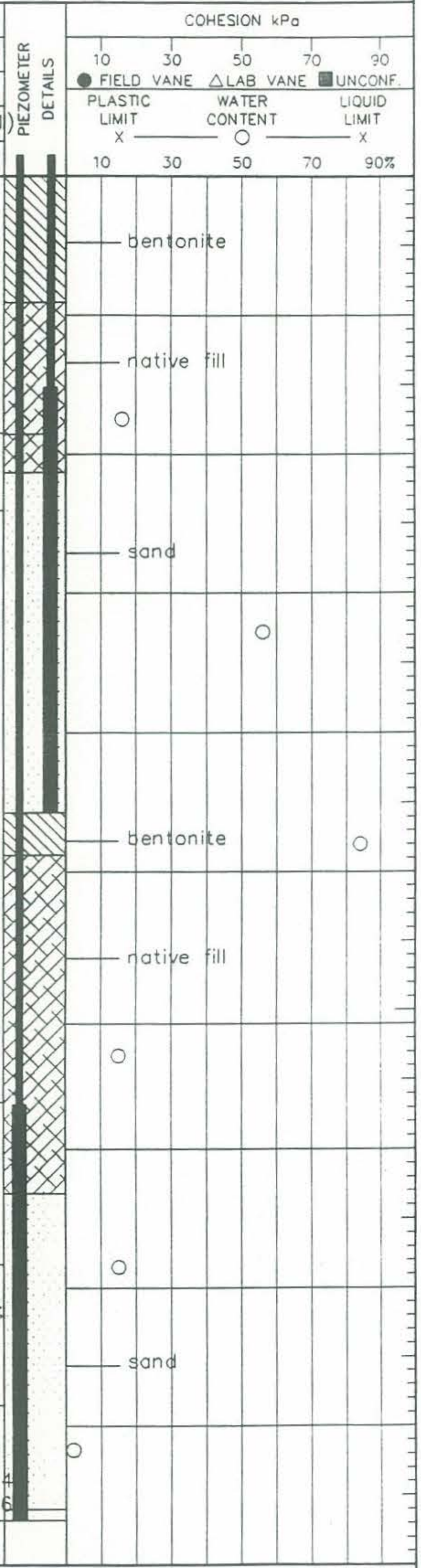
8.50

GRAVEL
- angular to subangular; several mineralogies; no oxide stains
- no visible ice

General Notes:
Borehole terminated at 9.68 m depth.
Resistance to auger advance; bedrock presumed
Waterlevel depths: Deep/Shallow Well

9.15	1.85 m	1000 hrs	Sept. 14
8.85	1.50 m	1100 hrs	Sept. 16

9.68



KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No. : PB 5314 02
PROJECT : Mt. Nansen Gold Mine
LOCATION : Yukon Territory
HOLE No. : DH89-01
DATE : Sept. 20, 1989 PLATE : 1 of 1

TEST HOLE LOG

VERTICAL SCALE : 2 cm = 1 m

DATE DRILLED : September 14, 1989

DRILL TYPE : CME 750, Hollow Stem Augers

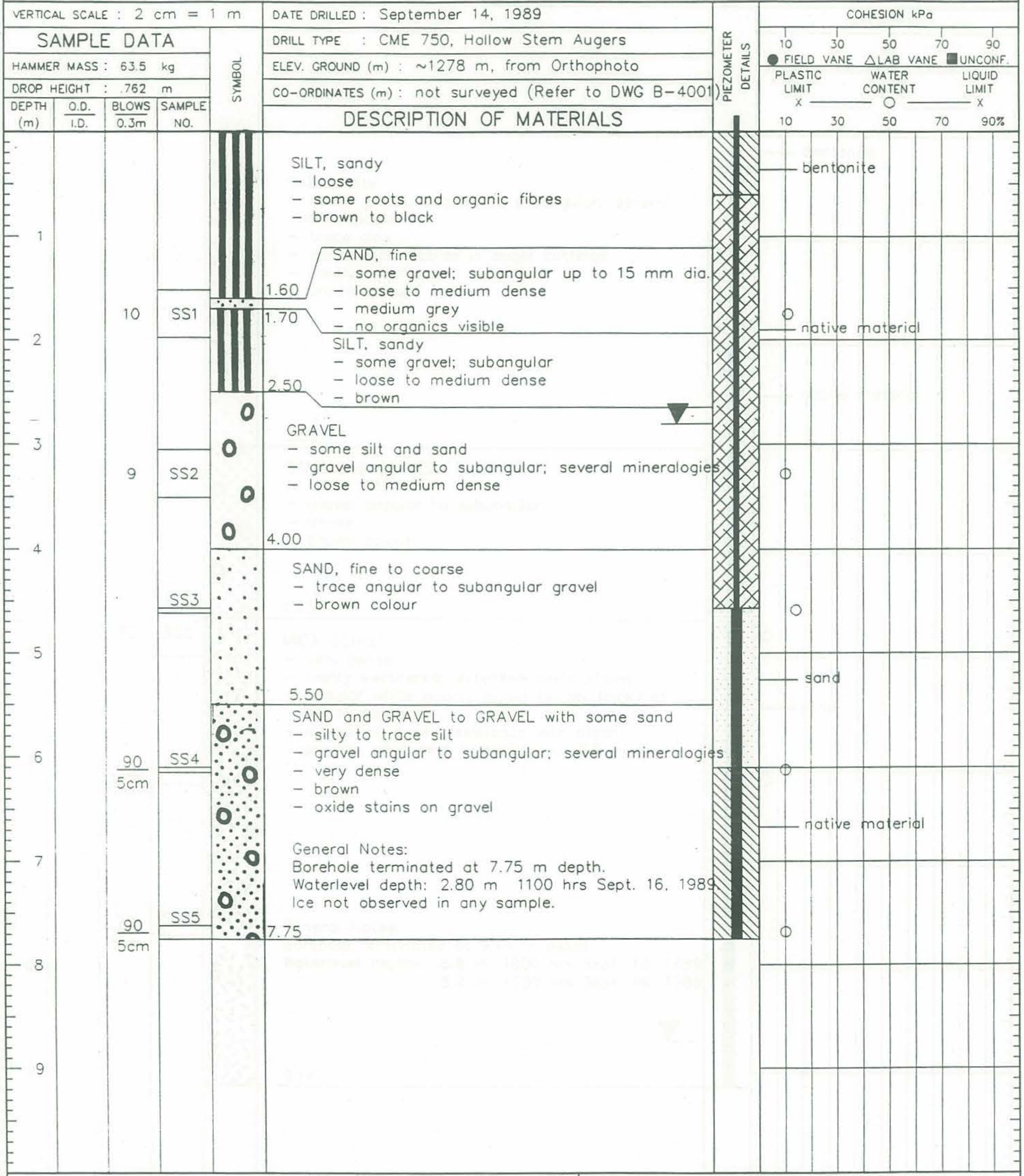
ELEV. GROUND (m) : ~1278 m, from Orthophoto

CO-ORDINATES (m) : not surveyed (Refer to DWG B-4001)

SAMPLE DATA

HAMMER MASS : 63.5 kg

DROP HEIGHT : .762 m



SILT, sandy
- loose
- some roots and organic fibres
- brown to black

1.60

SAND, fine
- some gravel; subangular up to 15 mm dia.
- loose to medium dense
- medium grey
- no organics visible

1.70

SILT, sandy
- some gravel; subangular
- loose to medium dense
- brown

2.50

GRAVEL
- some silt and sand
- gravel angular to subangular; several mineralogies
- loose to medium dense

4.00

SAND, fine to coarse
- trace angular to subangular gravel
- brown colour

5.50

SAND and GRAVEL to GRAVEL with some sand
- silty to trace silt
- gravel angular to subangular; several mineralogies
- very dense
- brown
- oxide stains on gravel

General Notes:
Borehole terminated at 7.75 m depth.
Waterlevel depth: 2.80 m 1100 hrs Sept. 16, 1989
Ice not observed in any sample.

7.75

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JOB No. : PB 5314 02
PROJECT : Mt. Nansen Gold Mine
LOCATION : Yukon Territory
HOLE No. : DH89-02
DATE : Sept. 20, 1989 PLATE : 1 of 1

TEST HOLE LOG

VERTICAL SCALE : 2 cm = 1 m

DATE DRILLED : September 16, 1989

DRILL TYPE : CME 750, Hollow and Solid Stem Augers

ELEV. GROUND (m) : ~1292 m, from Orthophoto

CO-ORDINATES (m) : not surveyed (Refer to DWG B-4001)

SAMPLE DATA

HAMMER MASS : 63.5 kg

DROP HEIGHT : .762 m

DEPTH (m)	O.D. / I.D.	BLOWS / 0.3m	SAMPLE NO.
		11	SS1
		14	SS2
		33 / 8cm	SS3
		50 / 8cm	SS4
		50 / 10cm	SS5

DESCRIPTION OF MATERIALS

SAND, silty
- some gravel; angular to subangular; several mineralogies; weathered
- medium dense
- trace roots and organic fibres
- tan, brown, dark brown, and black colour

2.50

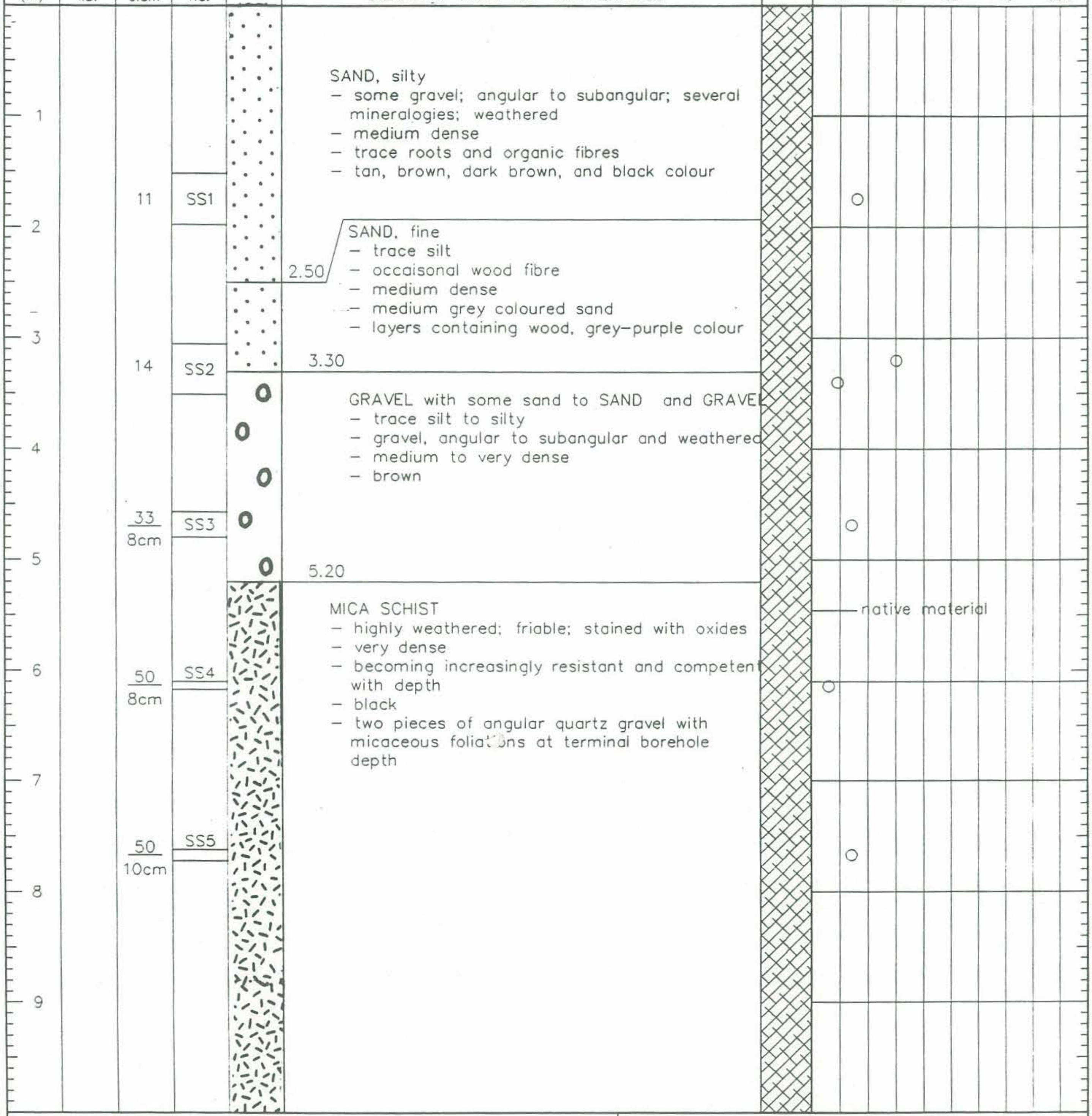
SAND, fine
- trace silt
- occaisonal wood fibre
- medium dense
- medium grey coloured sand
- layers containing wood, grey-purple colour

3.30

GRAVEL with some sand to SAND and GRAVEL
- trace silt to silty
- gravel, angular to subangular and weathered
- medium to very dense
- brown

5.20

MICA SCHIST
- highly weathered; friable; stained with oxides
- very dense
- becoming increasingly resistant and competent with depth
- black
- two pieces of angular quartz gravel with micaceous foliations at terminal borehole depth



JOB No. : PB 5314 02

PROJECT : Mt. Nansen Gold Mine

LOCATION : Yukon Territory

HOLE No. : DH89-04

DATE : Sept. 20, 1989 PLATE : 1 of 2

KLOHN LEONOFF
CONSULTING ENGINEERS

TEST HOLE LOG

VERTICAL SCALE : 2 cm = 1 m

DATE DRILLED : September 16, 1989

DRILL TYPE : CME 750, Hollow and Solid Stem Augers

ELEV. GROUND (m) : ~1292 m, from Orthophoto

CO-ORDINATES (m) : not surveyed (Refer to DWG B-4001)

SAMPLE DATA

HAMMER MASS : 63.5 kg

DROP HEIGHT : .762 m

COHESION kPa: 10 30 50 70 90

● FIELD VANE △LAB VANE ■UNCONF.

PLASTIC LIMIT X — WATER CONTENT ○ — LIQUID LIMIT X: 10 30 50 70 90%

DEPTH (m)	O.D. / I.D.	BLOWS / 0.3m	SAMPLE NO.	SYMBOL	DESCRIPTION OF MATERIALS	PIEZOMETER DETAILS
					MICA SCHIST – highly weathered; friable; stained with oxides – very dense – becoming increasingly resistant and competent with depth	native material
11		60 / 8cm	SS6		1.05 – black – two pieces of angular quartz gravel with micaceous foliations at terminal borehole depth	
12						
13						
14						
15						
16						
17						
18						
19						

General Notes:
Ice not observed in any sample.
Waterlevel not recorded. Indirect evidence of water at a depth of 2 to 3 m.
Borehole terminated at 11.05 m depth.

KLOHN LEONOFF
CONSULTING ENGINEERS

JOB No. : PB 5314 02
PROJECT : Mt. Nansen Gold Mine
LOCATION : Yukon Territory
HOLE No. : DH89-04
DATE : Sept. 20, 1989 PLATE : 2 of 2

APPENDIX II

SEISMIC EVALUATION

ENERGY, MINES AND
RESOURCES CANADA
GEOLOGICAL SURVEY OF CANADA

ENERGIE, MINES ET
RESSOURCES CANADA
COMMISSION GEOLOGIQUE DU CANADA

SEISMIC RISK CALCULATION *

CALCUL DE RISQUE SEISMIQUE *

REQUESTED BY/ DEMANDE PAR IAN BRUCE / KLOHN LEONOFF CONSULTANTS MU

SITE MT. NANSEN, YUKON

LOCATED AT/ SITUE AU 62.05 NORTH/NORD 137.17 WEST/OUEST

PROBABILITY OF EXCEEDENCE PER ANNUM/ PROBABILITE DE DEPASSEMENT PAR ANNEE	0.010	0.005	0.0021	0.001
PROBABILITY OF EXCEEDENCE IN 50 YEARS/ PROBABILITE DE DEPASSEMENT EN 50 ANS	40 %	22 %	10 %	5 %
PEAK HORIZONTAL GROUND ACCELERATION (G) ACCELERATION HORIZONTALE MAXIMALE DU SOL (G)	0.057	0.074	0.095	0.117
PEAK HORIZONTAL GROUND VELOCITY (M/SEC) VITESSE HORIZONTALE MAXIMALE DU SOL (M/SEC)	0.126	0.163	0.217	0.262

* REFERENCES

1. NEW PROBABILISTIC STRONG SEISMIC GROUND MOTION MAPS
OF CANADA: A COMPILATION OF EARTHQUAKE SOURCE ZONES, METHODS AND RESULTS.
P.W. BASHAM, D.H. WEICHERT, F.M. ANGLIN, AND M.J. BERRY
EARTH PHYSICS BRANCH OPEN FILE NUMBER 82-33, OTTAWA, CANADA 1982.

2. ENGINEERING APPLICATIONS OF NEW PROBABILISTIC
SEISMIC GROUND-MOTION MAPS OF CANADA
A.C. HEIDEBRECHT, P.W. BASHAM, J.H. RAINER, AND M.J. BERRY
CANADIAN JOURNAL OF CIVIL ENGINEERING, VOL. 10, NO. 4, P. 670-680, 1983.

3. NEW PROBABILISTIC STRONG GROUND MOTION MAPS OF CANADA.
P.W. BASHAM, D.H. WEICHERT, F.M. ANGLIN, AND M.J. BERRY, BULLETIN OF
THE SEISMOLOGICAL SOCIETY OF AMERICA, VOL. 75, NO. 2, P. 563-595, 1985.

4A. SUPPLEMENT TO THE NATIONAL BUILDING CODE OF CANADA 1985, NRCC NO. 23178.
CHAPTER 1: CLIMATIC INFORMATION FOR BUILDING DESIGN IN CANADA.
CHAPTER 4: COMMENTARY J: EFFECTS OF EARTHQUAKES.

4B. SUPPLEMENT DU CODE NATIONAL DU BATIMENT DU CANADA 1985, CNRC NO 23178F.
CHAPITRE 1: DONNEES CLIMATIQUES POUR LE CALCUL DES BATIMENTS AU CANADA.
CHAPITRE 4: COMMENTAIRE J: EFFETS DES SEISMES.

19-OCT-88 18:57:40

SITE MT. ANSEN, YUKON

ZONING FOR ABOVE SITE/ ZONAGE DU SITE CI-DESSUS

1985 NBCC/CNBC: ZA = 2; ZV = 4; V = 0.20 M/S

ACCELERATION ZONE/ ZONE D'ACCELERATION ZA=2
ZONAL ACCELERATION/ ACCELERATION ZONALE 0.10 G

VELOCITY ZONE/ ZONE DE VITESSE ZV=4
ZONAL VELOCITY/ VITESSE ZONALE 0.20 M/S

1985 NBCC/CNBC **
SEISMIC ZONING MAPS/ CARTES DU ZONAGE SEISMIQUE

PROBABILITY LEVEL: 10% IN 50 YEARS
NIVEAU DE PROBABILITE: 10% EN 50 ANNEES

```
 ---------------------------------------
  G OR M/S    ZONE       ZONAL VALUE/
                        VALEUR ZONALE
 ---------------------------------------
   0.00
               0            0.00
   0.04
               1            0.05
   0.08
               2            0.10
   0.11
               3            0.15
   0.16
               4            0.20
   0.23
               5            0.30
   0.32
               6*           0.40
 ---------------------------------------
```

* ZONE 6: NOMINAL VALUE/ VALEUR NOMINALE 0.40;
SITE-SPECIFIC STUDIES SUGGESTED FOR IMPORTANT PROJECTS/
ETUDES COMPLEMENTAIRES SUGGEREES POUR DES PROJETS D'IMPORTANCE.

** FOR NBCC APPLICATIONS, CALCULATED ZONE VALUES AT A SITE SHOULD BE REPLACED BY EFFECTIVE ZONE VALUES [ZA(EFF) OR ZV(EFF)] AS SHOWN BELOW/ POUR APPLICATIONS SELON LE CNBC, ON DOIT REMPLACER LES VALEURS ZONALES CALCULEES POUR UN SITE PAR LES VALEURS EFFECTIVES [ZA(EFF) OU ZV(EFF)] COMME MONTRE CI-DESSOUS:

1. IF/SI (ZA - ZV) > 1, ===> ZA(EFF) = ZV + 1.
OR/OU
2. IF/SI (ZA - ZV) < 1, ===> ZA(EFF) = ZV - 1.
OR/OU
3. IF/SI ZV=0 AND/ET ZA > 0, ===> ZV(EFF) = 1.

(SEE REFERENCE 2 CITED ABOVE, PAGE 677)
(VOIR PAGE 677 DE LA REFERENCE 2 CI-DESSUS)

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III2. EXTREME CLIMATIC EVENTS

III2.1 GENERAL

Precipitation from a one in 200-year return period storm, a one in 200-year wet period and a one in 10-year return period dry year were appraised for the site. The storm event and wet year are required to design adequate freeboard for the selected tailing storage facility. The drought event is required to determine the maximum amount of make-up water required to maintain the mill operations.

III2.2 NORMAL PRECIPITATION

Precipitation for an average year is about 271 mm. Precipitation for a 10-year return period dry year is about 200 mm, while for the 200-year return period wet year precipitation is about 370 mm.

III2.3 EXTREME STORM EVENT

High-intensity, short-duration storms occur in July. For purposes of storm freeboard design, a 24-hour, 200-year period storm was estimated to be 40 mm. For specific design such as diversion ditch capacity, a one-hour, 200-year return period storm was estimated. The intensities are presented in Table III.3 below and represent a total depth of 200 mm.

TABLE III.3

ONE-HOUR 200-YEAR RETURN PERIOD STORM

Time (minutes)	Intensity (mm/hr)
5	5.2
10	5.2
15	5.2
20	5.2
25	5.6
30	30.6
35	121.2
40	30.6
45	5.6
50	5.6
55	5.2
60	5.2

APPENDIX III

CLIMATE AND HYDROLOGY

(REFERENCE: KLOHN LEONOFF "TAILINGS DAM PRELIMINARY DESIGN REPORT", DECEMBER 7, 1988)

PB 5314 0201
WP 544

May 4, 1990

APPENDIX III
CLIMATE AND HYDROLOGY

IIII. CLIMATOLOGICAL AND HYDROLOGICAL DATA

Climatological data has been obtained from the nearest Environment Canada meteorological station, No. 2100300, which is located 60 km east of the site at Carmacks. The weather station is at an elevation of 524 m, 776 m below the minesite elevation of 1300 m. Snowfall and rainfall data from this station were used for the water balance studies. Evaporation data was obtained from Fort Selkirk, Environment Canada Station No. 2100600, located approximately 80 km northwest of the minesite at elevation less than 600 m.

Precipitation at Mt. Nansen falls in the form of both rain and snow. Snow begins falling in November and remains on the ground until May. We understand that typically, a snowpack of 1 m occurs. Approximately 40% of the annual precipitation falls as snow. Some rainfall occurs as early as April, but the majority of rainfall occurs from June to August. The most intense rainfall occurs in July. Mean annual precipitation values on a monthly basis are summarized on Table III.1.

The highest evaporation rate occurs at the site in June. Water losses due to evaporation drop off significantly in the winter as temperature drops. During the summer months of May through August, evaporation is nearly five times the value of the local precipitation.

Site-specific data in the form of stream flow measurements, obtained from Norecol Environmental Consultants Ltd., were also reviewed. The flow measurements summarized on Table III.2 are presented in terms of l/km^2 to normalize the data for various sized catchments.

TABLE III.1

SUMMARY OF PRECIPITATION AND EVAPORATION DATA
MEAN ANNUAL VALUES
SUMMARY OF HYDROLOGY DATA

MONTH	EVAPORATION	PRECIPITATION		
	MEAN ANNUAL (mm/month)	10-YEAR RETURN PERIOD DRY YEAR (mm/month)	MEAN YEAR (mm/month)	200-YEAR RETURN PERIOD WET YEAR (mm/month)
January	0.0	14.0	19.0	25.9
February	0.0	10.0	13.6	18.5
March	0.0	8.0	10.8	14.8
April	0.0	6.0	8.1	11.1
May	107.6	12.0	16.3	22.2
June	120.3	30.0	40.7	55.5
July	108.0	34.0	46.1	62.9
August	79.8	26.0	35.2	48.1
September	37.2	20.0	27.1	37.0
October	0.0	14.0	19.0	25.9
November	0.0	14.0	19.0	25.9
December	0.0	12.0	16.3	22.2
Total	452.9	200.0	271.0	370.0

TABLE III.2

FLOW DISCHARGE RATES - DOME CREEK*

DATE	FLOW $l/s/km^2$
May 26, 1988	3.48
May 27, 1988	3.15
May 29, 1988	7.20
June 2, 1988	5.74
June 12, 1988	3.19
July 4, 1988	10.90
August 4, 1988	15.30
September 22, 1988	2.70

*Measured on Dome Creek in a V-notch weir approximately 2 km downstream of the minesite. Data supplied by Norecol Environmental Consultants Ltd.

APPENDIX IV

POND OPERATION AND WATER BALANCE

(REFERENCE: KLOHN LEONOFF "TAILINGS DAM PRELIMINARY DESIGN REPORT", DECEMBER 7, 1988)

APPENDIX IV

POND OPERATION AND WATER BALANCE

IV1. SUMMER OPERATION

Tailings will be deposited in the pond utilizing a discharge system of a series of spigot points along the upstream slope of the tailings dam. During the summer months, the tailings are expected to discharge from spigots, creating a beach close to the dam. Sand discharged at the dam is expected to slope away from the dam at approximately 1%.

Water separated from the tailings slurry will form a pond where it can be reclaimed for use at the mill. We estimate a minimum water depth of 2.0 m, to be maintained in the pond to allow enough depth to float the pump station and allow the fines in the reclaim water to settle.

Due to the limited pond area behind the proposed tailings dam at Site No. 1 and the need for 2.0 m of water reclaim, it may happen that tailings are discharged underwater without the formation of a beach. Sand densities may be less than those assumed, and excess water loss to the voids may result. Additional tailings volume may be required under these conditions.

IV2. WINTER OPERATION

During winter operations, ice lens formation or glaciation will interfere with the tailings discharge. This may lead to a reduction in the reclaim water as ice freezes into the beach and a decrease in the in situ density of the tailings deposit. Single-point, subaqueous deposition of the tailings through the ice covered pond will likely be required during the winter months.

Placement of the tailings sub-aqueously in the water will reduce the average in situ density of the tails. The solids will tend to build up a flat cone in the pond area, reducing the depth of reclaimable water and reducing the beach areas. Controlled spigotting in the summer will be necessary to re-create the beaches for the following year.

IV3. WATER BALANCE

IV3.1 GENERAL

An assessment of the water balance for a tailings pond is an important part of the design. When water has to be conveyed some distance at a significant cost, the maximum use is made of reclaim water from the pond. In this design, all effort is being made to minimize the inflow of runoff water into the tailings pond, hence minimizing the quantity of water which may later require treatment and discharge. This means that precipitation into the pond occurs over the pond area only. Water loss by evaporation from the surface of the free water in the pond occurs noticeably during the summer.

During tailing deposition, there is a regular water loss into the tailings voids. An estimated 18% of the volume of tailing water will be lost into the voids of the settled tailings. This is an estimate based on average conditions. A higher percentage of water can be trapped, particularly if a significant volume of colloids (clay particles) is present.

IV3.2 MAKE-UP WATER REQUIREMENTS

At start-up, the pond should contain about seven days volume of operating water to start the tailing water clarification process. In addition, the make-up water supply will not be capable of providing the mill water requirements.

Make-up water requirements have been calculated for all three cases outlined in Appendix III. These assume precipitation for a dry year, a mean year and a wet year. It has been assumed that tailings transport water volume will be constant at 4.2 l and that precipitation over the pond area will be the only other inflow. Precipitation inflow is assumed to be zero over the winter months, but water equivalent of the stored snow is calculated to enter the pond in May of each year.

Outflow is assumed to consist of seepage loss, loss to the voids and evaporation. The amount of water available for reclaim has been estimated on a monthly basis and is shown in Table IV.1. If for any reason less make-up water is used in the mill process, excess water may accumulate in the pond. In this case, water would have to be treated to destroy cyanide and released, or the Stage II construction phase would have to be advanced.

Glaciation of water in the tailings during the winter can trap a considerable volume of water, and rapidly fill the tailings reservoir. During operations and particularly the first year, the tailings pond level must be measured and compared with projected levels. This will warn the operators if the pond is not working correctly. Glaciation occurs when tailings are spigotted on a beach during freezing weather. The tailings and most of the water freeze on the beach; alternatively, the tailing slurry runs out onto the ice in the pond and freezes on the surface. Either way, tailings and frozen water are locked in a mass that thaws very slowly, particularly at 1200 m elevation in the Yukon.

Glaciation is avoided by dumping the tailings directly into the pond, avoiding beach construction. Beach construction can be performed in the summer months.

TABLE IV.1

SUMMARY OF AVAILABLE RECLAIM WATER

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
CASE I												
NET INFLOW	4.2	4.2	4.2	4.2	5.9	4.7	4.8	4.6	4.5	4.2	4.2	4.2
NET OUTFLOW	2.8	2.8	2.8	2.8	3.1	3.2	3.2	3.8	2.4	2.8	2.8	2.8
AVAILABLE RECLAIM	1.4	1.4	1.4	1.4	2.8	1.5	1.6	0.8	1.6	1.4	1.4	1.4
CASE II												
NET INFLOW	4.2	4.2	4.2	4.2	6.5	4.9	5.0	4.8	4.6	4.2	4.2	4.2
NET OUTFLOW	2.8	2.8	2.8	2.8	3.1	3.2	3.1	2.9	2.8	2.8	2.8	2.8
AVAILABLE RECLAIM	1.4	1.4	1.4	1.4	3.4	1.7	1.9	1.9	1.8	1.4	1.4	1.4
CASE III (1 in 10 year period dry year)												
NET INFLOW	4.2	4.2	4.2	4.2	5.4	4.5	4.6	4.5	4.4	4.2	4.2	4.2
NET OUTFLOW	2.8	2.8	2.8	2.8	4.2	4.4	4.2	3.8	3.3	2.8	2.8	2.8
AVAILABLE RECLAIM	1.4	1.4	1.4	1.4	1.2	0.1	0.4	0.7	1.1	1.4	1.4	1.4

IV3.3 SURFACE RUNOFF

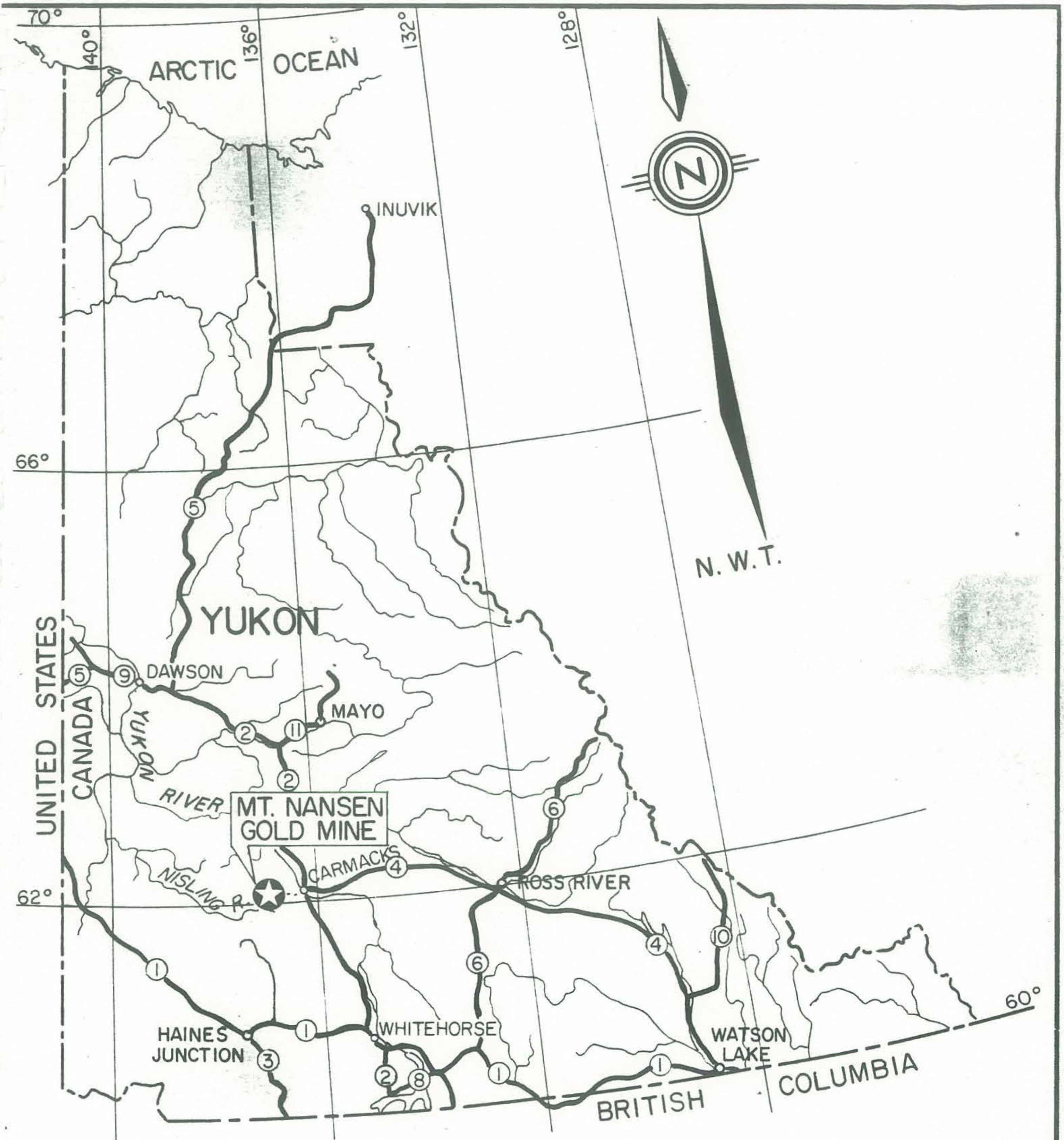
Surface runoff will be controlled by placing cutoff ditches to redirect water around the tailings pond area. Due to the small upslope drainage areas, only minor ditches need be constructed. The locations and design sections for the ditches are shown on Drawing B-2002. The ditches were designed for the one-hour 200-year return period storm presented in Appendix III. This high intensity storm is expected to occur in July when no snow is on the ground. Thus no allowance was made for snowmelt during this event. Rain or snow events are not expected to be as severe.

Water may infiltrate into ditches excavated in the fractured bedrock. Lining of the ditches may be required to ensure that runoff is diverted away from the pond.

In the spring, when snowmelt begins or when infrequent rainstorms may occur, excessive snow and snow drifts must be cleared from the ditches to allow for the safe diversion of surface runoff. Every spring and fall, the ditch must be checked for vegetation build-up and subsidence due to frost action. Both of these may render the ditches useless for runoff control.

A longitudinal ditch slope of .5%, as shown on Drawing B-2002, is considered necessary to maintain safe conveyance of the storm water runoff within the ditches. Steeper gradients would result in excessively high velocities, leading to scour and possible loss of the ditches. The ditch dimensions shown on Drawing A-2005 may be exceeded without detrimental effects. The material removed from the ditches should be piled on the downslope side of the ditch to assist in surface water diversion.

<u>LIST OF DRAWINGS</u>



SCALE 0 50 100 miles

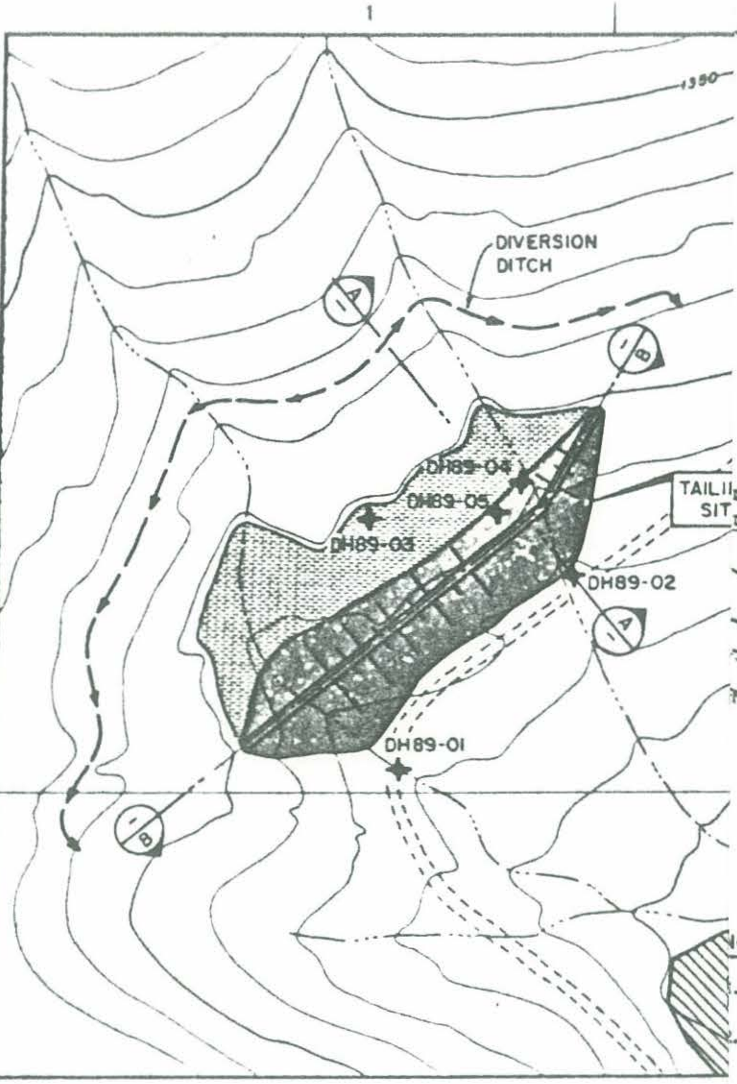
KLOHN LEONOFF YUKON
CONSULTING ENGINEERS

PROJECT
MOUNT NANSEN GOLD PROJECT

TITLE
SITE LOCATION

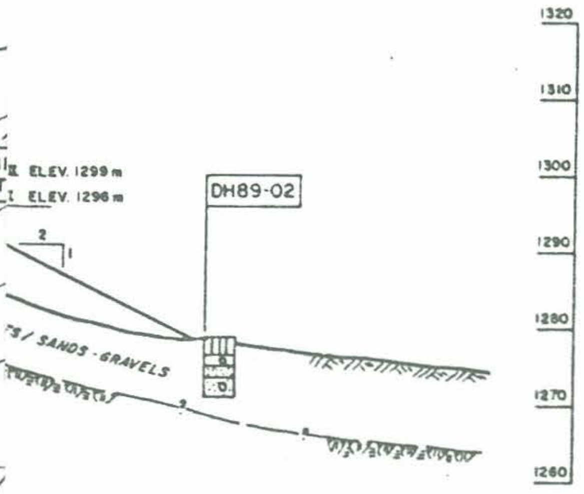
CLIENT:
B.Y.G. NATURAL RESOURCES INC.

DATE OF ISSUE	PROJECT No.	DWG. No.	REV.
MAY 4, 1990	PB 5314 02	A-2001	
APPROVED			



PLAN

25 0 50 100 150 200 m



NOTES

FOUNDATION PREPARATION WILL CONSIST OF REMOVING ALL LOOSE AND DELETERIOUS MATERIALS.

THE EARTHFILL DAM WILL BE A HOMOGENEOUS STRUCTURE BUILT WITH GRANULAR MATERIAL BORROWED FROM THE POND INTERIOR. MATERIAL WILL BE PLACED IN 300 mm LIFTS AND COMPACTED TO 98% OF THE STANDARD PROCTOR DENSITY.

THE POND AND DAM WILL BE LINED TO PREVENT SEEPAGE. THE LINER SYSTEM COULD CONSIST OF ONE OF THE FOLLOWING OPTIONS:

- CLAYMAX (BENTONITE FABRIC REINFORCED LINER SYSTEM) WITH 300 mm OF PROTECTIVE SAND AND GRAVEL PLACED OVER IT; OR
- FIELD MIXED 300 mm to 1200 mm THICK LIFT OF BENTONITE/SAND-GRAVEL. FILTERS MAY BE REQUIRED TO PREVENT PIPING.

THE POND WILL BE OPERATED AS A CLOSED SYSTEM. SURFACE WATER WILL BE DIVERTED AROUND THE POND. A PUMP BARGE OR SIPHON SYSTEM WILL BE USED FOR WATER RECLAIM.

LEONOFF REPORT DATED MAY 4, 1990

20 30 40 m

HN LEONOFF YUKON
SULTING ENGINEERS

RAL RESOURCES INC.

REV	DATE	REVISION DETAILS	

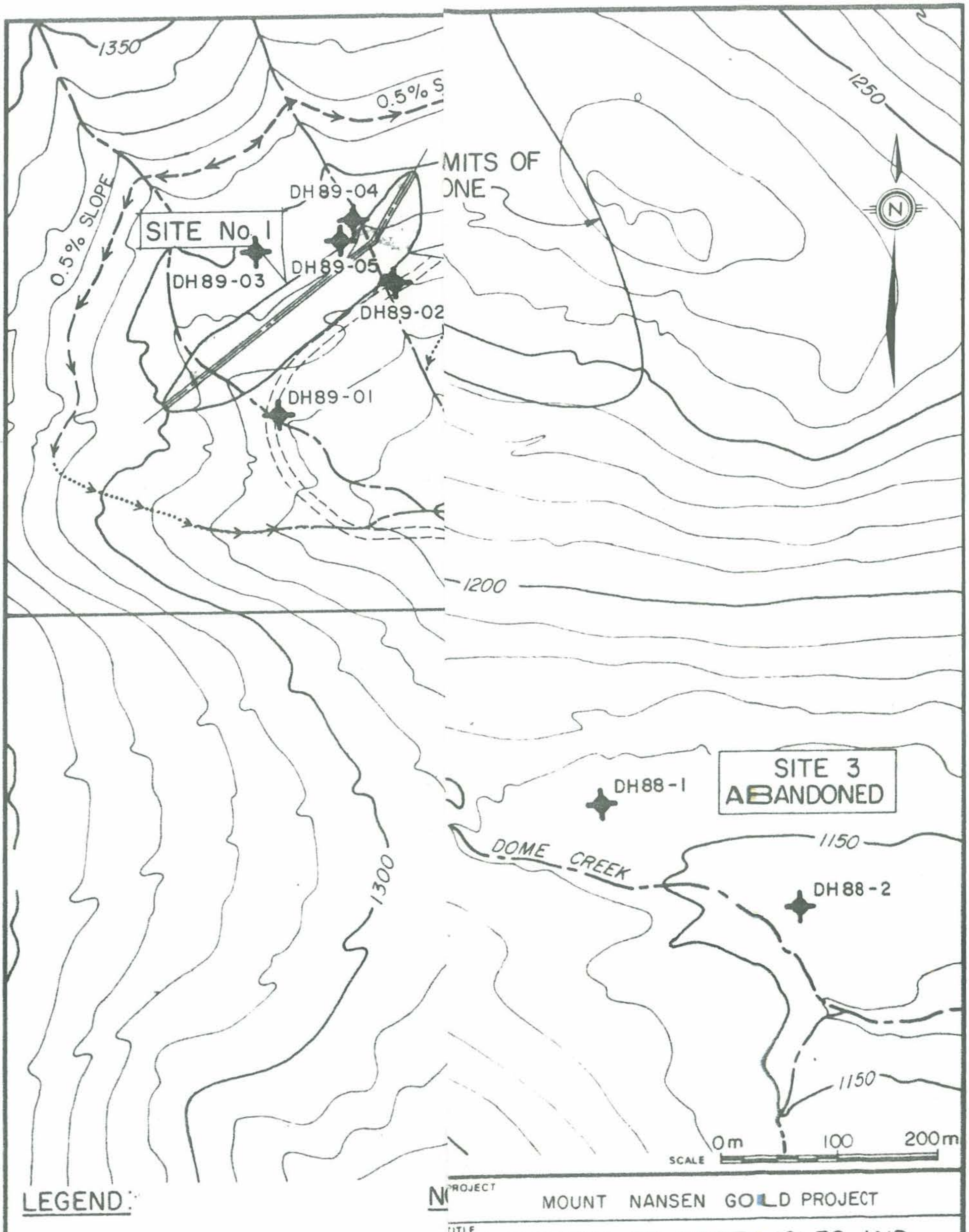
DESIGN	DRAWN	DATE	SCALES
	F C	MAR. 1990	AS SHOWN

PROJECT MOUNT NANSEN GOLD PROJECT

TITLE TAILINGS FACILITY
PLAN AND SECTIONS

DATE OF ISSUE	PROJECT No.	DWG. No.	REV.
MAY 4, 1990	PB 5314 02	D-2003	

APPROVED



LEGEND:

- - → DIVERSION DITCH

····→ LINED DIVERSION DITCH (TO BE DESIGNED LATER)

✚ DRILL HOLE LOCATION (NOT SURVEYED)

N

1.

2

PROJECT
MOUNT NANSEN GOLD PROJECT

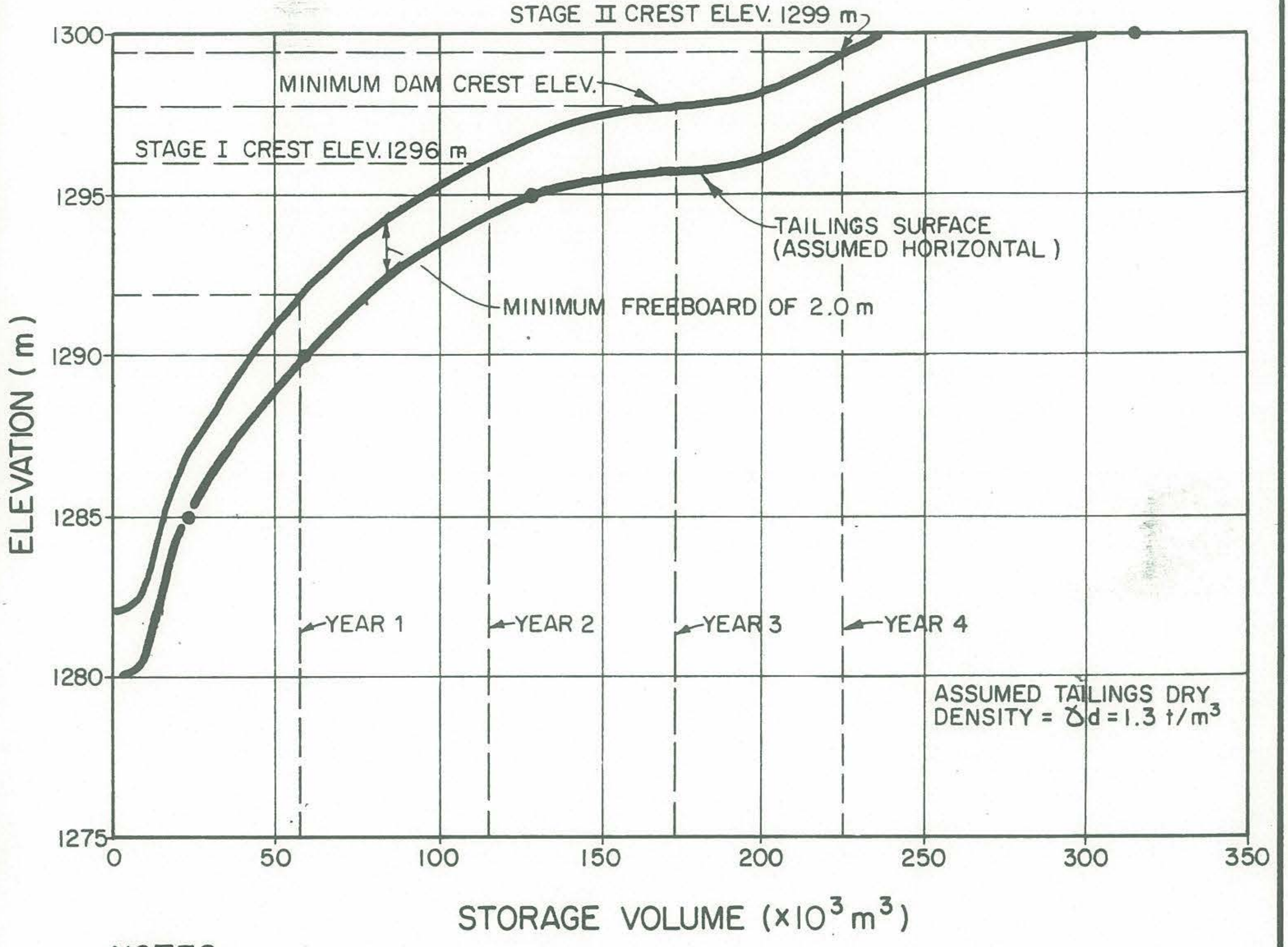
TITLE
LOCATION OF BOREHOLES AND
DAM OUTLINES

DATE OF ISSUE	PROJECT No	DWG No.	REV.
MAY 4, 1990	PB 5314 02	B-2002	

APPROVED

NCI-802 KL

SITE No. 1
MILLSITE TAILINGS DAM



NOTES

1. CREST ELEVATIONS SHOWN ASSUME THAT ROCK FILL OBTAINED FOR THE DYKE COMES FROM WITHIN THE POND AREA.
2. THIS CURVE IS BASED ON LIMITED TOPOGRAPHY AND WILL REQUIRE REVISION UPON RECEIPT OF DETAILED GROUND SURVEY AND DAM ALIGNMENT DETAILS.
3. STORAGE VOLUME IS BASED ON PRODUCTION RATE OF 200 tpd.

SCALE

KLOHN LEONOFF YUKON
CONSULTING ENGINEERS

PROJECT
MOUNT NANSEN GOLD PROJECT

TITLE
SITE No. 1
STORAGE / ELEVATION CURVE

CLIENT:
B.Y.G. NATURAL RESOURCES INC.

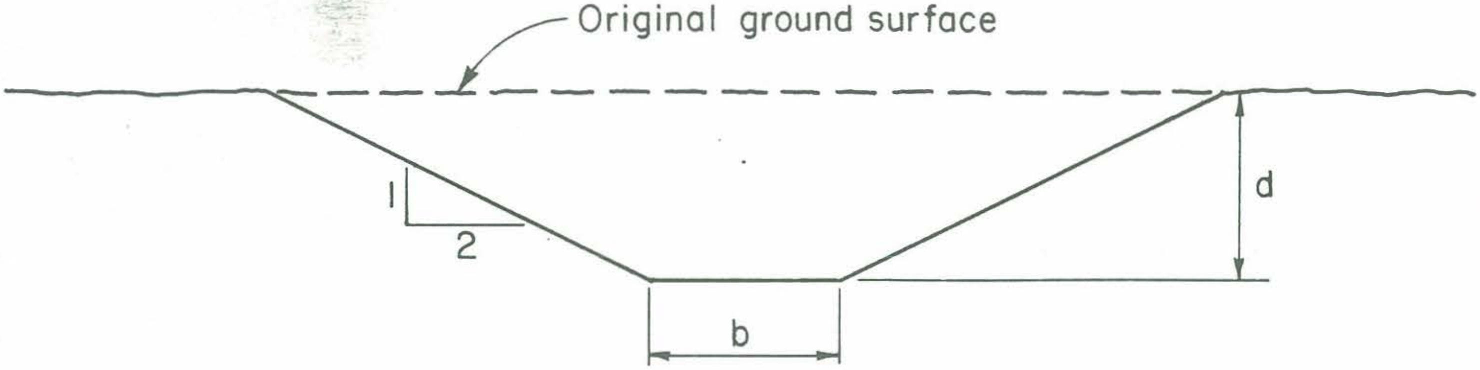
DATE OF ISSUE
MAY 4, 1990

APPROVED

PROJECT No.
PB 5314 02

DWG. No.
A-2004

REV.



TYPICAL DIVERSION DITCH SECTION

MINIMUM DIVERSION DITCH DIMENSIONS			
	b (m)	d (m)	slope (%)
SITE No. 1	1.0	1.0	0.50
SITE No. 2	3.0	1.6	0.25

SCALE

KLOHN LEONOFF YUKON
CONSULTING ENGINEERS

PROJECT
MOUNT NANSEN GOLD PROJECT

TITLE
MINIMUM DIVERSION DITCH DIMENSIONS

CLIENT:
B.Y.G. NATURAL RESOURCES INC.

DATE OF ISSUE
MAY 4, 1990

APPROVED

PROJECT No.
PB 5314 02

DWG. No.
A - 2005

REV.