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GEOLOGY OF GRANISLE COPPER DEPOSIT

by Keith C. Fahrni

ABSTRACT

The Granisle Copper deposit is an old property, discovered early in the century. Present operators began active development in 1955 and brought the property into production in 1966. Mineralization is chiefly chalcopyrite but appreciable bornite also occurs in the current mining area. The ore minerals occur principally in quartz veinlets filling fractures but a little dissemination occurs in coarser grained rocks. Ore fractures are concentrated in a metamorphic zone between parallel NNE trending faults at the contact of a porphyry intrusive with Takla volcanics. Geophysical studies over the ore zones have shown responses to I.P., S.P. and magnetic surveys. Geochemical surveys showed positive for copper adjacent to ore exposures or float blocks.

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Introduction

The Granisle property is a 5,000 ton-per-day open-pit copper mine and treatment plant owned by Granisle Copper Limited, which is associated with The Granby Mining Company Limited. The name "Granisle" is formed from "Granby" and "island".

The Granisle ore body and plant site are located on Copper Island (McDonald Island) in Babine Lake in north-central British Columbia. The closest town is Topley, which is on the Canadian National Railway and Highway 16, a distance of 290 miles east of Prince Rupert and 175 miles west of Prince George. Access to the property from Topley is by 35 miles of gravelled Provincial road to a ferry landing on the west shore of Babine Lake. From here the route is over a two-mile ferry crossing served by a Company-owned and-operated ferry and then by three miles of private road to the plant.

The climate of the Babine Lake area is typical of the interior of British Columbia, although the lake exerts a certain moderating influence. Winter temperatures drop to well below zero for short periods but prolonged periods of low temperature are uncommon. Annual precipitation averages about 20 inches and normal snow depth is about three feet. Babine Lake usually freezes over late in December and remains frozen until mid-May.

The elevation of the lake is approximately 2300 feet above sea level. The area has been glaciated and in general the topography is round with fairly low relief. The ore outcrop is at the highest point on Copper Island, about 300 feet above the level of the lake.

History

The earliest record of work on the copper mineralization of Copper Island is in the Annual Report to the B. C. Minister of Mines for the year 1913. Chas. Newman and H. J. McDonald were the discoverers and by that time two short tunnels, a shaft and several open cuts had been put in. The property was visited by N. W. Emmons, Provincial Mineralogist, who took several samples from the workings. Grades of around 1% copper were obtained with small values in gold and silver.

The following years give scant information but in 1927 Douglas Lay visited the property and under the name Richmond Group describes the showings in the Report to the Minister. On his recommendation the property was bonded by C. M. & S. the following year.

*Chief Geologist for The Granby Mining Company Limited

In 1928 C. M. & S. carried out a program of trenching and drilling. This work was directed on the ground by H. C. Giegerich. Several long holes were drilled to test the extent of the mineralization. Further work was planned but did not develop, possibly due to the recession of 1929. The option was dropped and the property reverted to McDonald and Newman.

The property was examined by Dr. Victor Dolmage in 1943. At that time work had been done by E. E. Campbell and the prospect was described as the Newman property. On the basis of favorable geology and mineralogy, Dolmage recommended work in spite of the obvious low tenor of the ore. The hope was that higher-grade bands, which had not been intersected by the limited earlier drilling, might be found.

Soon after Dolmage's report, a small company was organized with work being directed in the field by B. I. Nesbitt. Four holes were drilled but when it was found that the average of almost 1700 feet of core, believed in the ore zone, only came to 0.60% copper, work was stopped.

In the following years the property was examined by several companies but no further work was carried out.

In August, 1955 the property was examined by Granby engineers. Before freeze-up additional claims had been staked and eight drill holes had been put down following a grid pattern on 200-foot centres. This work was continued as soon as winter relaxed, a larger drill being taken in over the ice in March. By summer's end a total of 49 holes had been drilled on the grid pattern and the remarkable continuity of values in copper had been demonstrated, extending far beyond the limits of previous drilling in a north-easterly direction.

In the next couple of years a drop in copper price discouraged work, but Granisle Copper Limited was formed and in 1959 further drilling was done to check continuity between the 200-foot grid holes, an additional 30 holes being drilled. In 1963 planning had advanced to the stage of mill testing and surveys for suitable mill sites.

A feasibility study was completed in April, 1964, by The Granby staff, and using a copper price of 28.5¢ U.S., (a price at which copper had been stabilized for about two years), it appeared economically attractive to place the property into production. Arrangements were made for financing and the decision to go ahead was made in February, 1965. Design of the plant was started immediately, construction was carried out during 1965 and 1966, and production started in mid-November of 1966.

Recent Mapping

During the summer of 1965 a field party was assigned to the Babine area by the Provincial Government Mines Branch. Mr. N. C. Carter under the direction of Dr. Mike Carr visited Copper Island and mapped it with much of the adjoining territory. His report with accompanying maps give an excellent

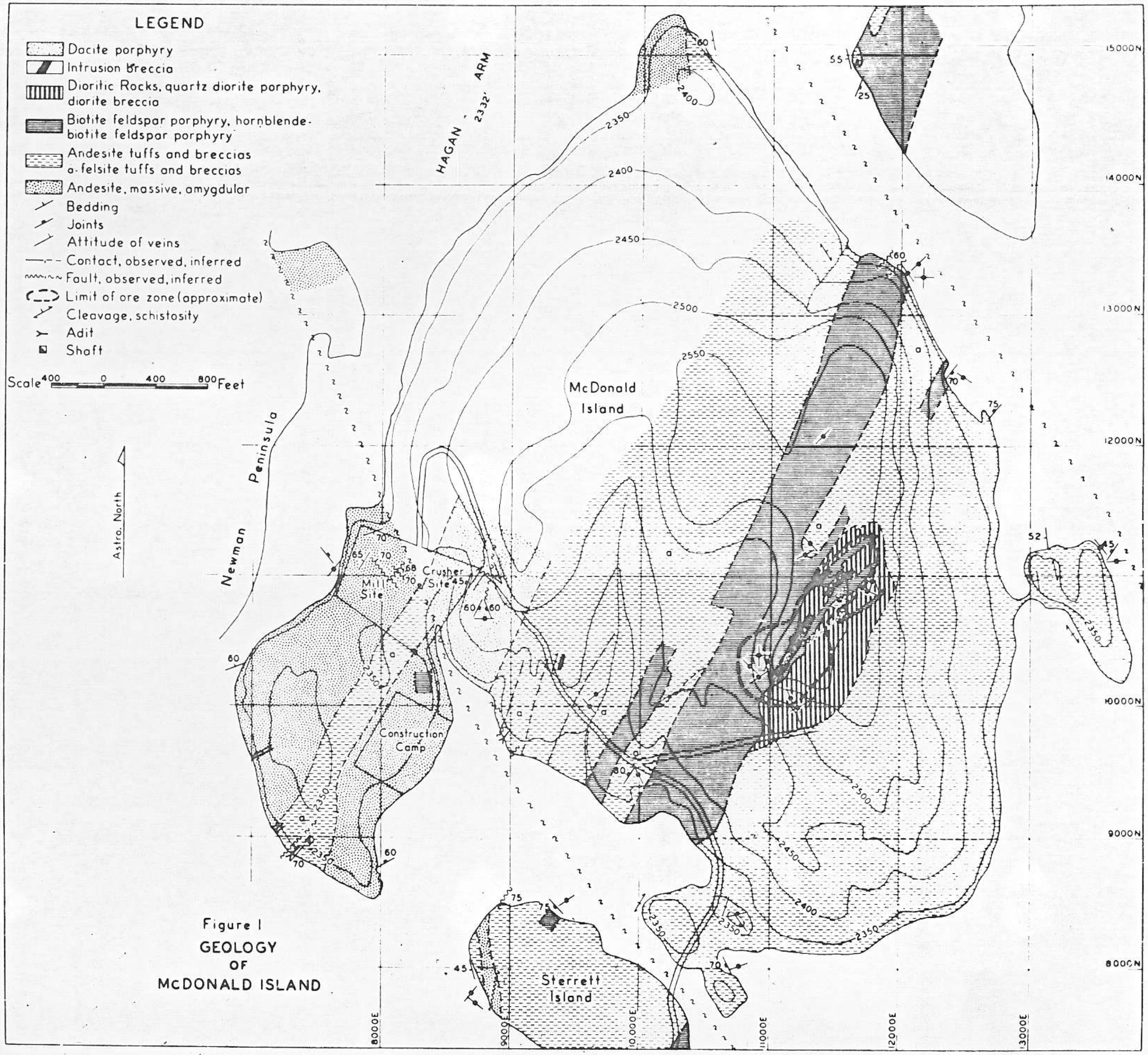

Figure I
GEOLOGY
OF
McDONALD ISLAND

picture of the local geological setting of the property. It is to be found in the 1965 Report to the Minister of Mines and Petroleum Resources of B. C. The map of Copper Island accompanying Carter's report is reprinted herewith since it shows the most recent ideas of the local geology as Figure 1.

In the summer of 1966, construction at the mine was approaching completion and the entire pit area was stripped to bedrock in preparation for mining. Advantage of this ideal situation was seized and a Granby crew mapped the exposed rock surface. This map is reproduced as Figure 2. It illustrates the detailed geology in the immediate vicinity of the ore.

Regional Geology

The island upon which the ore body occurs lies between two north-westerly-trending faults, spaced about 4000 feet apart. They have been mapped by the B. C. Department of Mines geologists and are proven to extend over at least 10 miles, reaching to the north-west across Newman Peninsula.

Correlations across the faults have not been made. The south-east segment which occurs on the western tip of Copper Island and most of Sterrett Island is largely stratified, being composed of thick bedded sediments and limey tuffs with some interbedded andesitic and felsitic flows. The central segment in which the ore body occurs is largely volcanic with thick bands of felsitic and andesitic flow material. The north-east segment is not well known but thin bedded sandy and limey sediments occur in a creek exposure about a mile and a half north-east of the mine.

Rock Types

Volcanic rocks are the oldest rocks mapped. Andesitic types are generally fine-grained and fragmental texture is common. Felsitic types make well-defined contacts with the andesites and are massive fine-grained, light grey to pinkish in colour. Their strike appears to be about N 25^{o} E. No dips were determined. The volcanics have been correlated with the Takla group of Upper Triassic system on the basis of composition.

The other rock type encountered is a system of andesine biotite porphyry intrusives, closely related to the ore occurrence. A large well-defined dyke with widths of from 400 to 600 feet and with a strike of N 15^{o} E crosses Copper Island between the two north-westerly-trending faults which bracket the island. About midway between the two faults there is a swell in the dyke due to a bulge on the east side to give the maximum width of 600 feet. This is the centre of a radial system of smaller dykes with widths of from one to 25 feet. This point is also the centre of alteration silicification and mineralization of the volcanics and the dykes. It corresponds with the knoll which is the highest point of the island and the outcropping of the ore zone.

A metamorphic rock called "diorite" at the mine has resulted from the alteration accompanying the porphyry intrusion. This rock extends over a zone about 400 feet wide along the large porphyry-dyke contact. It shows its fine-grained origin as a volcanic under the microscope but has been re-crystallized with development of felspars a little more basic than the porphyry and with a mesh work of biotite which gives it a dark brown, silky appearance in the field. Relict fragmental texture and bands of unaltered volcanics occur within the "diorite". Bands of "diorite" with related copper mineralization extend to the east from the main diorite mass as fingers along smaller porphyry dykes. Only the andesitic volcanics appear to have been subject to the dioritization since it stops abruptly at felsite contacts.

Structure

At least two periods of faulting must be part of the geological history of the area to account for dyke intrusion and discontinuities in formations. The earlier faults follow a north-east direction and the latter, a north-west direction. On a regional scale there is evidence of large displacement on the north-westerly-trending faults since no definite continuations of the large porphyry dyke have been found beyond Copper Island.

Copper mineralization is closely related to a system of quartz-filled fractures. Widths vary from knife-edge widths to several inches but in most cases they are less than one-eighth inch wide. An average of over 50 measurements suggests that there are three principal directions. The most prominent direction is N 75^{o} W in strike with a dip of about 80^{o} NE. This direction accounts for about 60% of the fractures measured. A less prominent set striking N 10^{o} E and dipping 80^{o} SE accounts for 30%. A set of horizontal fractures account for 10% of readings but is probably much more important, being poorly exposed for measurement in surface rocks. These fractures are usually well-developed veinlets but in thin sections, silicified zones can be seen where no well-defined fractures appear to the unaided eye. These ore fractures occur in all rocks so far described.

No evidence of important folding of formations has been found on Copper Island.

Mineralization

The principal economic mineral of the mine is chalcopyrite but significant bornite occurs in the upper and southern part of the ore body where the higher-grade ore which is now being produced lies. Bornite occurs under equivalent conditions with chalcopyrite and there is no indication of a secondary origin. Grains of bornite and chalcopyrite occur together with mutual boundaries in silicified areas. Gold and silver in small but significant amounts are associated with the copper minerals. Traces of molybdenite occur but amounts have been too small to consider separation in milling. Galena and sphalerite have been noted in drill-cores but the amounts of these minerals are very small. Metallic-gangue minerals occur to a limited degree with the ore. Magnetite is present, being found especially near the borders of the ore zone where it is sufficient to give a significant magnetic anomaly. This mineral occurs as vein material which may be primary in origin and as rims of magnetic grains surrounding biotite crystals which may be a metamorphic effect. Pyrite occurs as a wide halo in surrounding rocks, particularly in the felsites to the east which contain several percent. Within pit limits, the north end carries much more pyrite than the south end. The fact that copper grade drops off there may indicate a zoning effect. A corresponding pyrite zone has not been found at the south end of the ore, but faulting may have shifted it out of the range of exploration. To the west the large porphyry dyke is not significantly pyritized, but felsitic flows beyond show widespread pyrite.

Timetable of Geological Events

Epoch	Events
Omineca Intrusives	Faulting on N.W. lines with development of auxiliary N.S., E.W. ore fractures, silification and mineralization by copper.
Topley Intrusives	Faulting on NNE lines with porphyry dyke intrusion and metamorphism of volcanic rocks.
Takla	Deposition of andesites and felsites of the volcanic sequence.

Geophysics

With indications of the presence of magnetite in association with the Granisle ore, a magnetic survey of the island was run in late 1963 and early 1964. A good "thumb print" anomaly of intensity about 5,000 gammas above background was centred upon the knoll corresponding with the best part of the ore body. To the north-east where copper content decreases and increasing pyrite comes in, there is a lower intensity elongation to the magnetic contour lines.

Along the west and north-west shore of Copper Island, high magnetic values of erratic nature represent a zone of magnetite bearing amygdular andesite. This horizon may provide a marker which will assist in correlations across the faults and through covered areas as geological studies are extended from the pit area.

Electromagnetic readings were taken over the grid established for the magnetics using a small portable EM outfit. Some faint indications possibly due to conductivity of faults were obtained in the vicinity of the ore body.

Spontaneous polarization readings were taken over the Copper Island grid in the summer of 1964. Some indications seemed to be coming up but difficulties with dry ground conditions put results in question so the following year the area was surveyed by Geocal of Vancouver. This survey found eight small areas of negative polarity. All showed marked north-easterly trends. Five were grouped along the syenite porphyry contact and above the ore body. No indications were obtained elsewhere on the island.

During the past season, with an Induced Potential Survey crew and equipment in the area, several lines were run over the proven Granisle ore body. Very high readings were obtained but lines were not long enough to give background levels. This data is still to be finalized.

Geochemistry

During the 1959 field season, a geochemistry survey was carried out over the ore zone and extended across Newman Peninsula, adjoining islands and a large section of the mainland on the east shore of the lake. The rubeanic acid method of testing was used.

As would be expected, good results were obtained over the exposed ore body and adjoining drainage zone. A few other indications were obtained nearby and on Sterrett Island. These were found to be due to large transported blocks of copper-bearing material.

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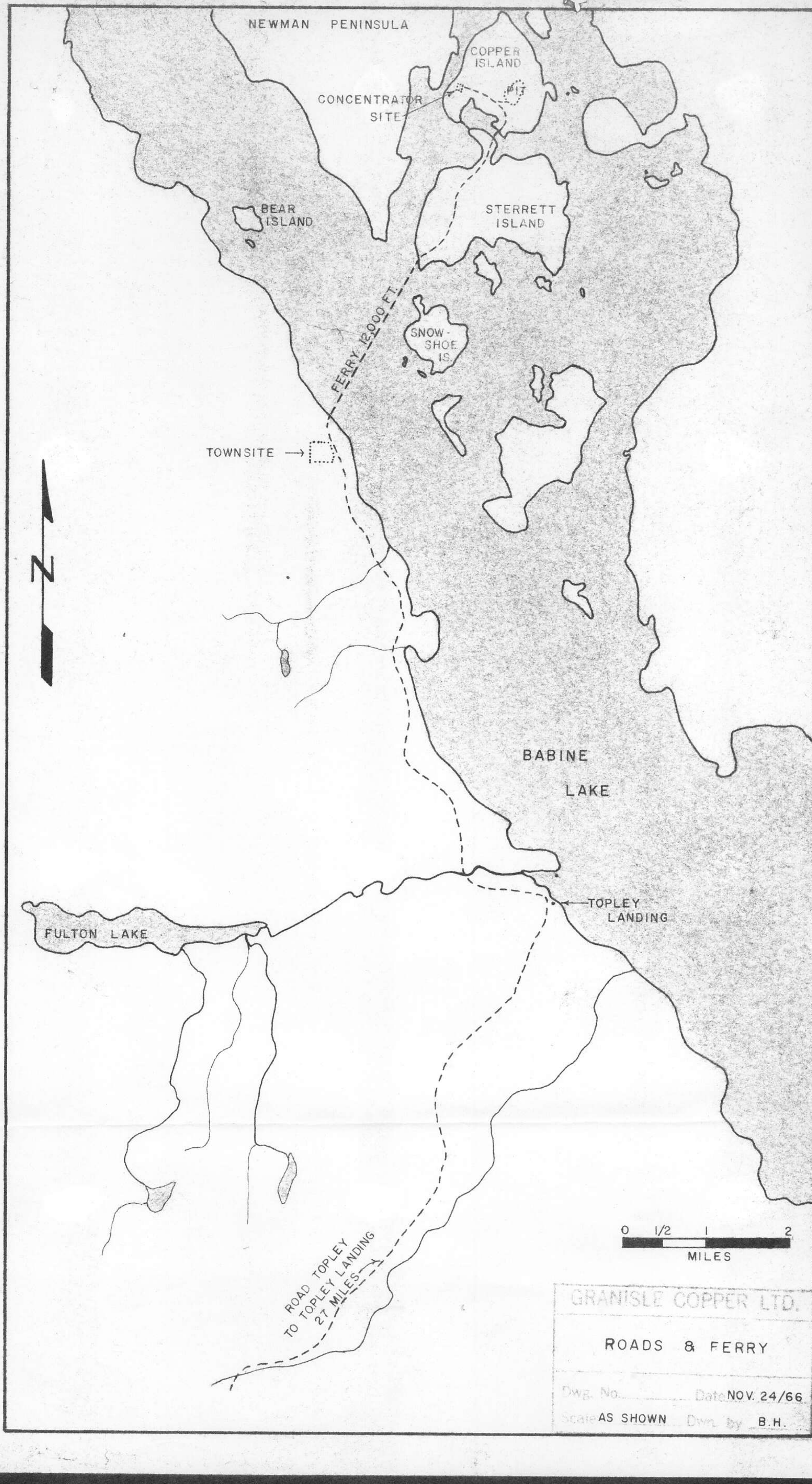
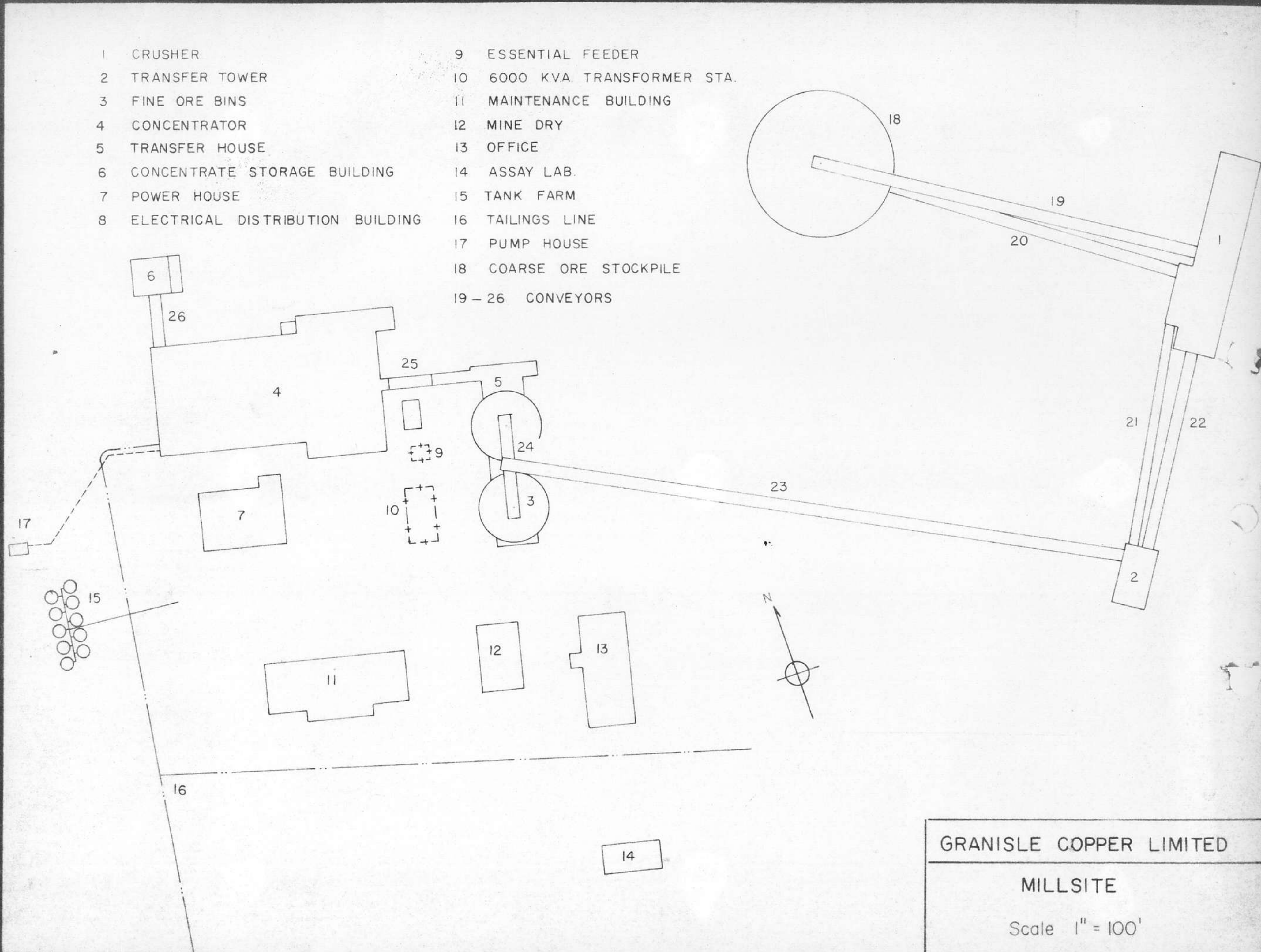
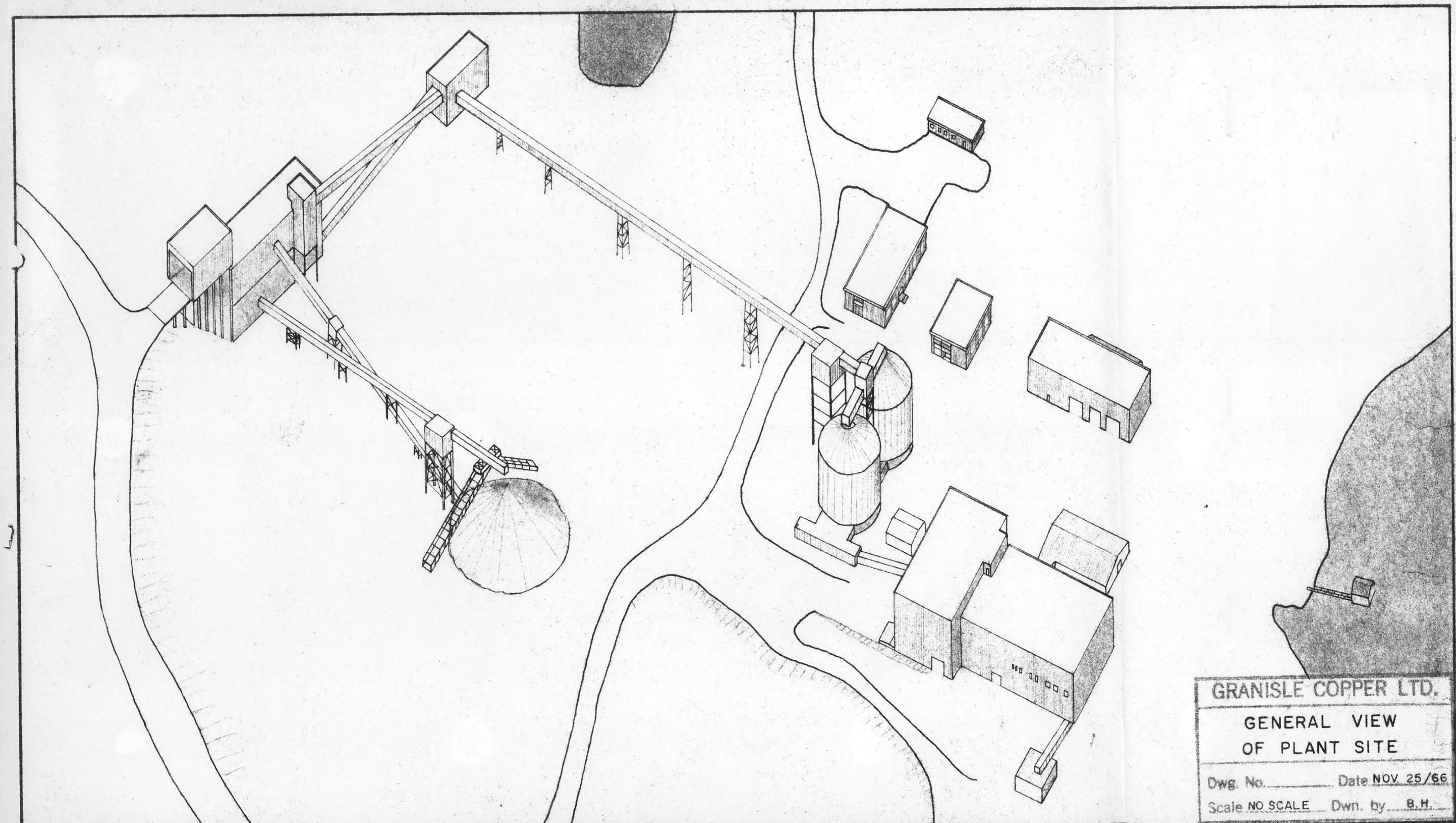

NEWMAN PENINSULA
COPPER ISLAND
CONCENTRATOR SITE
STERRETT ISLAND
BEAR ISLAND
FERRY 12000 FT.
SNOW-SHOE IS.
TOWNSITE
N
BABINE LAKE
TOPLEY LANDING
FULTON LAKE
ROAD TOPLEY TO TOPLEY LANDING 27 MILES
0 1/2 1 2
MILES
GRANISLE COPPER LTD.
ROADS & FERRY
Dwg. No. Date NOV. 24/66
Scale AS SHOWN Dwn. by B.H.



GRANISLE COPPER LIMITED

MILLSITE

Scale 1" = 100'



GRANISLE COPPER LTD.

GENERAL VIEW
OF PLANT SITE

Dwg. No. ________ Date NOV. 25/66

Scale NO SCALE Dwn. by B.H.