Box 8

GEOCHEMICAL REPORT ON THEODOSIA GROUP I MINERAL CLAIMS

Vancouver, M.D.
N.T.S. 92-K-2
Lat. 50°03' N Long 124°40' W

Vancouver, B. C.
August 31, 1970
R. B. Band

GEOCHEMICAL REPORT

ON

THEODOSIA GROUP I

MINERAL CLAIMS

Vancouver, M.D.

N.T.S. 92-K-2

Lat. 50°03' N Long. 124°40' W

Vancouver, B. C.

August 31, 1970

R. B. Band

CONTENTS

LOCATION MAP
THEODOSIA GROUPS

SCALE— 1" = 4 mi.

N.T.S. 92 K.

GEOCHEMICAL REPORT ON THE
THEODOSIA GROUP I MINERAL CLAIMS

INTRODUCTION

During the late summer of 1969, a reconnaissance silt sampling programme was undertaken on and around mineral claims covering the Okeover Arm copper - molybdenum prospect. The survey revealed a previously unsuspected strongly anomalous zone in the north of the property and in October 1969, a detailed soil grid was established to evaluate this anomaly. As an aid in interpreting the soil survey results shallow pits were sunk at selected localities and profile samples collected though the exposed overburden.

Copper, total molybdenum, silver, iron, manganese, cobalt and cold-extractable copper and cold-extractable molybdenum values for the soil samples are plotted on maps 154E - 2/70 to 154E - 9/70.

LOCATION AND ACCESS

The geochemical soil survey described in this report was carried out as shown on the accompanying map 154E - 1/70.

The following mineral claims of the Theodosia Group I were involved:

OK 21, 22, 23, 24, 26,35, 37, 38.

IN 154, 156, 161, 162.

These claims are located to the south of Theodosia Inlet, approximately 14 miles north-north-west of the town of Powell River. A gravelled logging road leading off Highway 101 gives access to the south portion of the property and to the camp from which the soil sampling programme was carried out. The north portion of the property, including the soil grid under discussion, is reached by a constructed trail two miles in length.

The soil grid occupies the floor of a cirque-like feature bounded to the east by the steep slopes of Rusty mountain and to the north by precipitous slopes leading down to Theodosia Inlet. Relief within the gridded area is moderate, elevations ranging from 2200 ft. in the deepest creek bed to a maximum of 2900 feet.

METHOD OF SURVEY

A 3000 ft. by 3000ft. grid was laid out with chain and compass to cover a strongly anomalous zone revealed by the earlier silt sampling programme. The base-line for this grid was aligned in a north-westerly direction parallel to a grid system covering the southern portion of the property. Grid lines were spaced 200 ft. apart and soil samples were collected at intervals of 100 ft. and 200 ft. on alternate grid lines, giving a total of 275 samples.

Soil samples were taken from the B horizon, at a depth of approximately 12 inches using grub hoes. At selected localities pits were sunk through the overburden to evaluate certain of the soil anomalies. Samples were taken from each distinct soil horizon exposed by the pits and subsequently at depth intervals of approximately 12 inches to the pit bottom. All soil samples were placed in water-resistant paper packets on which the following information was recorded: sample number, line number and footage, date, sampling depth, horizon, colour and moisture content. The samples were shipped to Vancouver for analysis by the Falconbridge Laboratory.

LABORATORY TECHNIQUES

The samples were dried in a gas-fired hot air drier and hand screened through 80 mesh standard nylon screens.

The minus 80 mesh portion of the dried sample was analysed for copper and molybdenum by standard geochemical techniques. In addition soil samples from the main grid were analysed for silver, cobalt, manganese and iron, and for cold-extractable copper and molybdenum using standard geochemical methods.

Copper, silver, cobalt, iron and manganese were determined by standard atomic absorption techniques, following digestion of the sample with boiling 10% nitric acid. Total molybdenum was determined by fusing 250 m.g. of sample with alkaline flux to render the molybdenum soluble. The fusion was leached with demineralized water and an aliquot of the leach liquor treated with 2.5 percent solution of hydroxylamine hydrochloride in hydrochloric acid and one percent zinc dithiol solution. After shaking to develop the coloured molybdenum complex, the samples were compared with previously prepared standards to obtain the molybdenum concentration.

Cold extractable copper and molybdenum were determined after shaking 1.0 g of sample with 10 ml of buffer solution for two minutes in a mechanical shaker. The buffer solution has a pH of 4.0 and consists of 100 g of ammonium citrate and 100 g of hydroxylamine hydrochloride dissolved in 1 litre of demineralized water. The copper content of the leach solution was determined by standard atomic absorption methods. Molybdenum was determined on an aliquot of the leach solution using the same colorimetric method as for total molybdenum.

GEOLOGY

Geologically, the Okeover Arm property consists of a porphyritic granite plug intruding a late Mesozoic (?) granodiorite-monzonite complex. A distinct zonal alteration sequence has been recognized in the granodiorite-monzonite country rock, centred on the granite plug. Copper mineralization is closely related to the alteration sequence, the best copper values being found in a zone adjacent to the granite contact. This zone is characterized by intense sericitisation and a strongly developed quartz stockwork. The area is cut by post-mineralization dyke swarms ranging from dacite to diorite in composition.

Due to poor outcrop the geology of the gridded area is incompletely known. The southermost lines of the soil grid overly the northern tip of the porphyritic granite plug, however, and by inference the south-central portion of the grid should overly the favourable quartz stockwork-sericite alteration zone. Relatively unaltered granodiorite-monzonite is reported in the extreme north of the gridded area.

RESULTS

(a) Soils - concentration ranges for the various metals are summarised below: -

	Regional bkgd.	Local bkgd.	Anom.	Very Anom.	Range	Mode
Cu ppm	<50	50-100	100-500	>500	5-11, 750	11-20
Mo ppm	<5	5-10	10-25	>25	<2-100	<2
Ag ppm	<0.7	0.7-1.0	>1.0	N.A.	0.2-1.6	0.4-0.6
Co ppm	<10	10-15	15-50	>50	1-162	<5
Fe pct	<1.0	1.0-1.5	1.5-2.5	>2.5	0.07-3.34	1.0-1.1
Mn ppm	<80	80-150	150-300	>300	5-9, 340	31-40
CxCu ppm	<10	10-15	15-50	>50	3-6, 600	<5
CxMo ppm	<2	2-3	>3	N.A.	<2-8	<2

The soil samples were initially analyzed for copper and molybdenum. This revealed extensive areas with anomalous copper and molybdenum contents, the copper content of the soil exceeding 0.5% at several localities (Map 154E-2/70 and 154E-3/70).

The soil samples were then analyzed for cold-extractable copper and molybdenum to determine the significance of saline disperson and secondary accumulation in the development of the soil anomalies. Cold extractable molybdenum values are low, only three samples exceeding 3 ppm (Map 154E-4/70). This is taken as indicating the minor role of secondary accumulation in the case of molybdenum soil anomalies. Cold extractable copper on the other hand shows a wide range of values (3 to 6,600 ppm, Map 154E-5/70), and it is evident that secondary accumulation from metal-enriched ground water is locally a significant factor in the development of copper anomalies.

The soils were later analyzed for manganese, iron, silver and cobalt. Manganese shows a wide range of values and several clearly defined anomalies. (Map 154E-6/70). Iron has a smaller spread of values (Map 154E-7/70) and the contrast between anomalous and background values is not so clearly marked. Silver also shows a limited range (Map 154E-8/70); there are, however, extensive anomalous areas with silver contents greater than 1 ppm. Cobalt shows a relatively wide spread of values, but most samples lie in the background range and the anomalous areas are of very restricted extent (Map 154E-9/70).

(b) Overburden profiles - overburden profiles were collected from eight prospect pits in an attempt to differentiate between transported and superjacent soil anomalies. The profile samples were collected several days after the pits were dug and unfortunately seeping groundwater had filled some pits to the level of the water table, preventing complete sampling of the pit walls. Results for the profile sampling study are summarised in Table I. Pit locations are shown on Maps 154E-2/70 to 154E-9/70.

OVERBURDEN PROFILE RESULTS FOR PITS I TO VIII

Sampling Depth (ins.)	Horizon	Cu ppm	Mo ppm	Remarks
PIT I				
4	Ah	17	6	Minor mineralization with bornite, pyrite, chalcopyrite and molybdenite in nearby outcrop
18	B	19	8	
30	B	202	6	
PIT II				
30	B	69	7	Pit filled with water
PIT III				
18	B	1540	45	Pit filled by seeping groundwater
30	C	1480	20	
PIT IV				
12	B	1050	50	Steep, well-drained slope.
24	B-C	830	18	
36	C	600	12	
48	C	460	2	
PIT V				
36	B	400	35	Steep slope. Ground water seapage at depth of 78 inches.
42	B-C	480	25	
60	C	230	25	
78	C	202	38	
PIT VI				
24"	B-C	960	168	Water logged soil sloughed into pit
PIT VII				
2	Ah	29	∠2	
6	B	170	4	
14	B	188	5	
36	B-C	164	7	

Sampling Depth (ins.)	Horizon	Cu ppm	Mo ppm	Remarks
PITT VIII				
4	Ah	74	2	Trace of pyrite in bedrock exposed by pit.
12	B	75	12	
24	B	76	14	
40	B-C	105	18	
48	B-C	120	13	

Pit I provides the only clear example of a superjacent anomaly over mineralized bedrock. The most striking features are the marked increase in copper content with depth and the fact that both copper and molybdenum are present in only moderately anomalous amounts. Pit VIII, over weakly pyritic bedrock, shows essentially the same features.

In the remaining profiles the content of both copper and molybdenum is much higher. Molybdenum shows a relatively uniform distribution through the individual profiles whereas copper decreases markedly with depth, the highest copper values occuring in the uppermost levels of the B horizon. These differences suggest that apart from Pits I and VIII the anomalous profiles are largely of transported origin.

INTERPRETATION AND CONCLUSIONS

The main problem in a highly anomalous area such as that under discussion is to distinguish between soil anomalies directly related to mineralized bedrock and those due to secondary accumulation from metal enriched groundwater. Cold-extraction techniques are widely used to detect saline dispersion patterns, and the present results clearly indicate the importance of saline dispersion in the case of copper.

In the near surface environment accumulation of metals from groundwater solution is most likely to occur in response to changes in Eh or pH rendering the metal-rich groundwater unstable. Some metals, e.g. iron and manganese, are present in the groundwater in sufficient concentration that a change in Eh-pH conditions leads to the precipitation of their hydrous oxides. Trace metals, on the other hand, are unlikely to be present in sufficient concentration to be directly precipitated and their accumulation results from the scavenging action of these freshly precipitated iron and manganese hydrous oxides. Theoretical considerations suggest, therefore, that areas of secondary accumulation will be characterized by anomalous concentrations of iron, manganese and cold extractable trace metals. In many areas, it has been shown that secondary precipitates of manganese oxide are characterized by high contents of cobalt, and this suggested a further criterion for the recognition of areas of secondary accumulation.

Maps 154E-5/70 and 154E-6/70 reveal a good corelation between the distribution of anomalous manganese and cold-extractable copper values. The distribution of anomalous iron values is erratic and there is no good corelation with either manganese or cold-extractable copper. The reason for this is thought to lie in the great vertical variation in iron content within the B soil horizon, which to a large extent masks inter-samplesite differences.

The two highest cobalt values coincide with high manganese and cold extractable copper contents, but in general, cobalt values are low throughout the whole area. It appears therefore that, in the present case, areas of secondary accumulation are best defined by a conjunction of high cold-extractable copper and manganese contents. The extent of the areas judged to be affected by secondary accumulation is shown on Map 154E-11/70.

Copper-molybdenum anomalies outside the areas of secondary accumulation result from mechanical dispersion of anomalous material or, in the case of superjacent anomalies, from limited saline dispersion. Such anomalies are more closely linked with the bedrock metal source than secondary accumulation anomalies and, therefore, provide more reliable exploration targets.

Anomalous copper and molybdenum values unaffected by secondary accumulation are contoured on Map 154E-10/70. Coincident copper and molybdenum are considered to be the most favourable indication of bedrock mineralisation and are shown on Map 154E-10/70 as "type A targets". The extensive zone trending north between lines 154N and 168N is clearly a prime target for more detailed examination. Smaller type "A" targets in the north of the grid also warrant further examination.

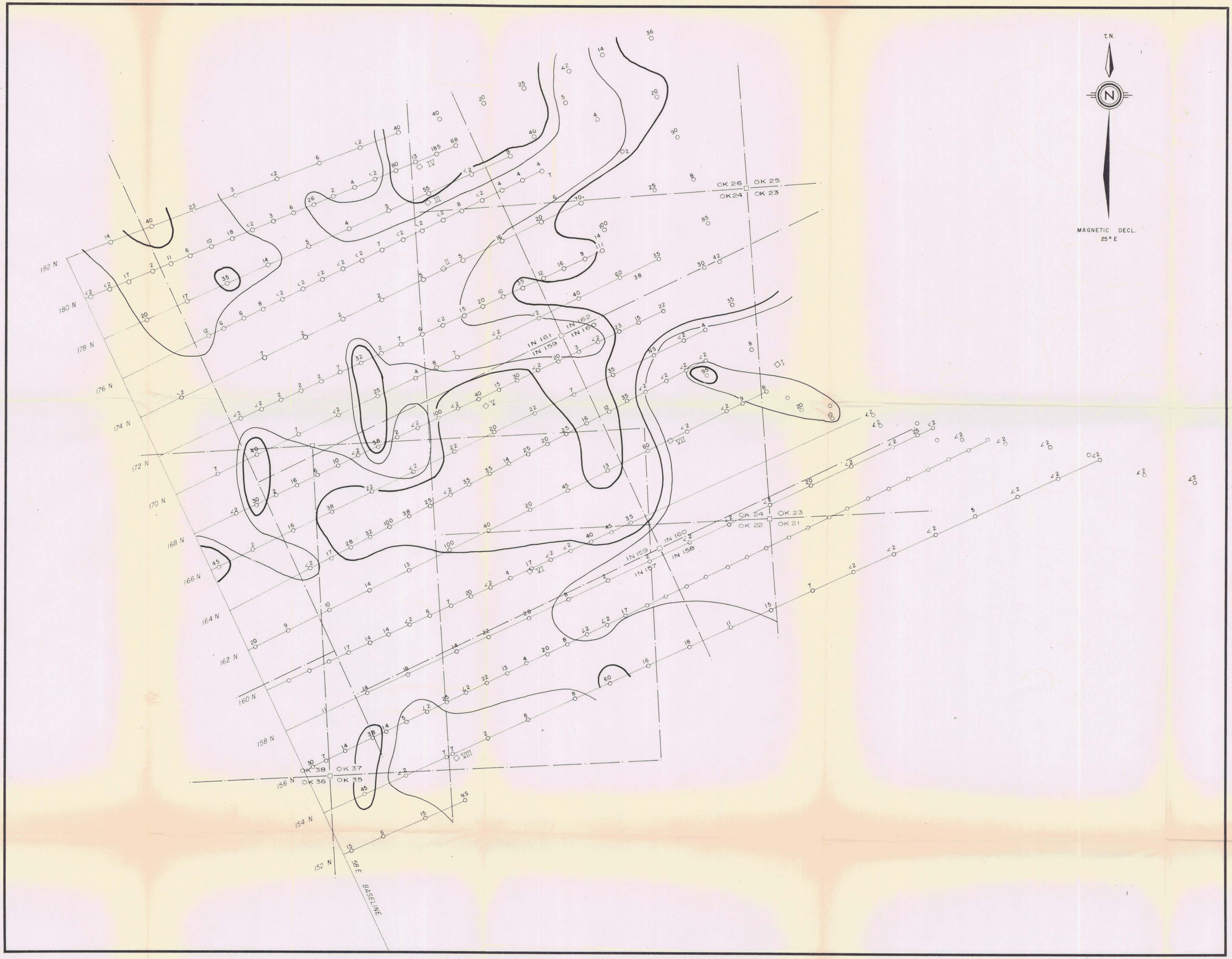
The relationship between secondary accumulation anomalies and the bedrock metal source is more tenuous, the link being the pattern of groundwater into the anomalous area. Map 154E-11/70 shows the relationship between secondary accumulation copper anomalies and the generalised topography. As is to be expected anomalies of this type occur in low-lying areas where groundwater crops out as springs or seepages. Three areas ~~of~~ higher ground have been tentatively indicated on map 154E-11/70 as possible source areas for the anomalous copper. Area I is directly upslope from an extensive secondary accumulation anomaly. It coincides with the principal type "A" target shown on map 154-1-/70, offering additional evidence that this particular target warrants further investigation.

R. B. Band

Vancouver, B. C.
August 1970

R. B. Band

MAP REF. NO.: 154-E 3/70
N.T.S. · 92-K-2



LEGEND:

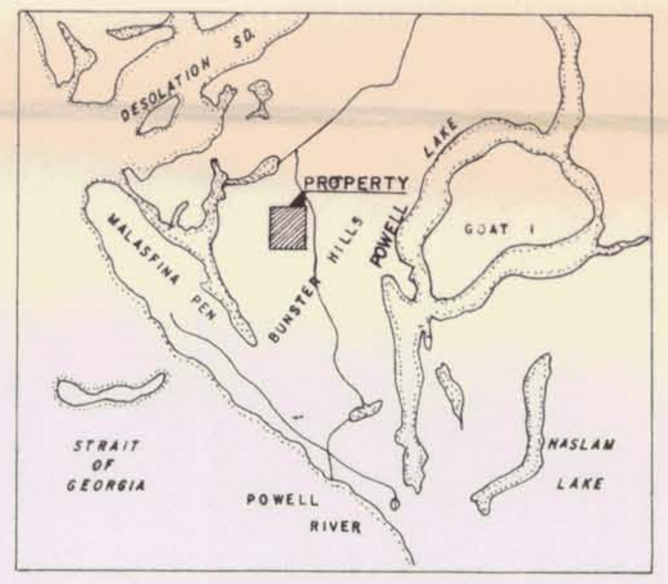
— 10 ppm Mo

— 25 ppm Mo

IN 157 CLAIM POST AND NUMBER

◇ I PIT LOCATION AND NUMBER

LOCATION MAP



200 0 200 400 600 800 1000 1200 1400 1600 1800

SCALE: 1 INCH TO 200 FT.

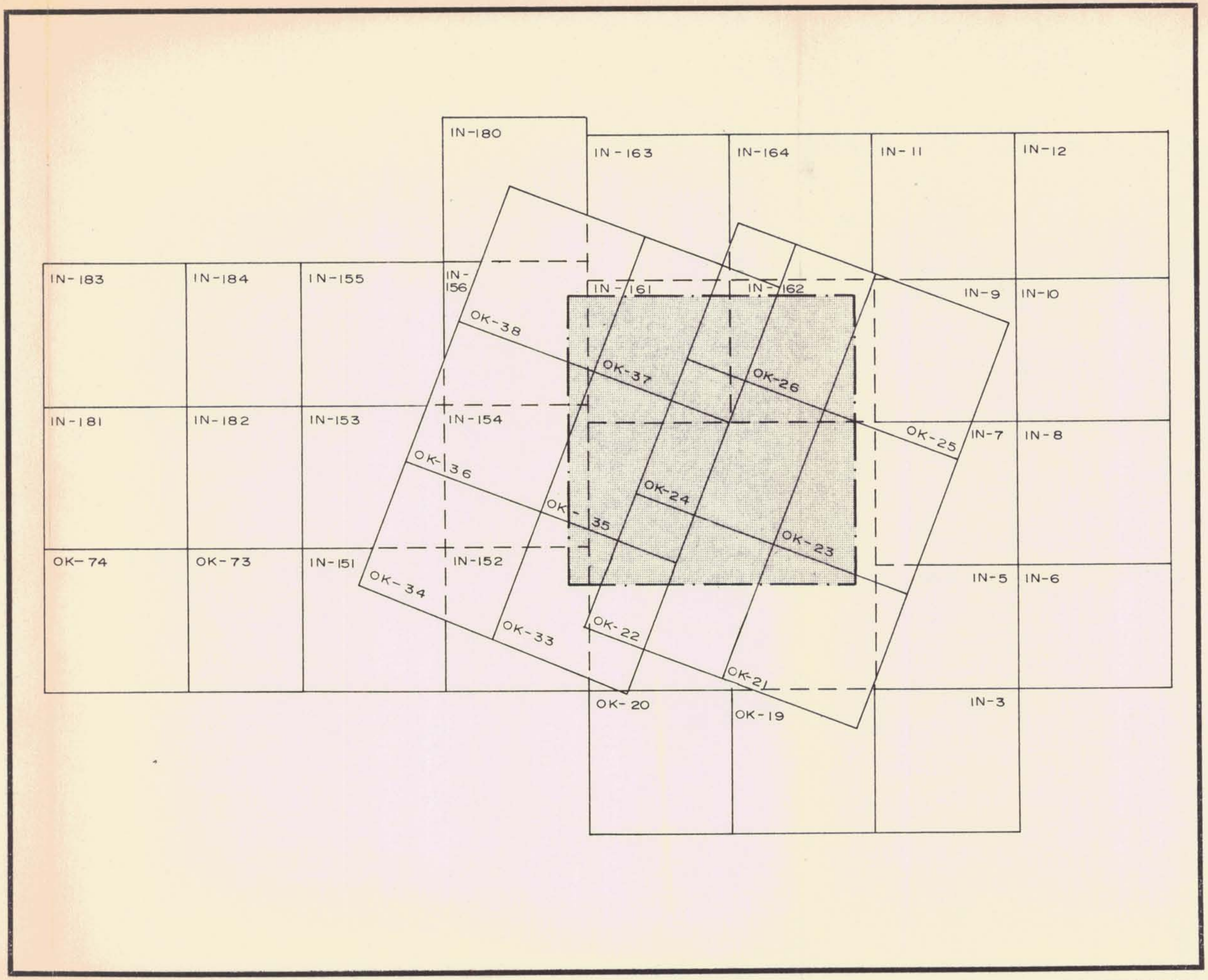
COMPANY . . FALCONBRIDGE NICKEL MINES LTD.
PROPERTY . . OKEOVER ARM
LOCATION . . POWELL RIVER, B.C.

WORKING PLACE . . NORTH PART OF GRID
TYPE OF MAP . . TOTAL Mo IN SOILS
BASED ON . .

DATE . . JULY 1970
DRAWN BY . . R.B. BAND
DATE OF WORK . . OCTOBER 1969

MAP REF. No.: 154 E 1/70

N.T.S.: 92–K–2



LEGEND

▨ SOIL GRID

FALCONBRIDGE NICKEL MINES LTD.

PROPERTY: OKEOVER ARM

LOCATION: POWELL RIVER, B.C.

TYPE OF MAP: SKETCH MAP SHOWING RELATIONSHIP OF SOIL GRID TO THEODOSIA GROUP I CLAIMS

BASED ON:

DATE OF WORK: OCTOBER 1969

DATE: SEPTEMBER 1970

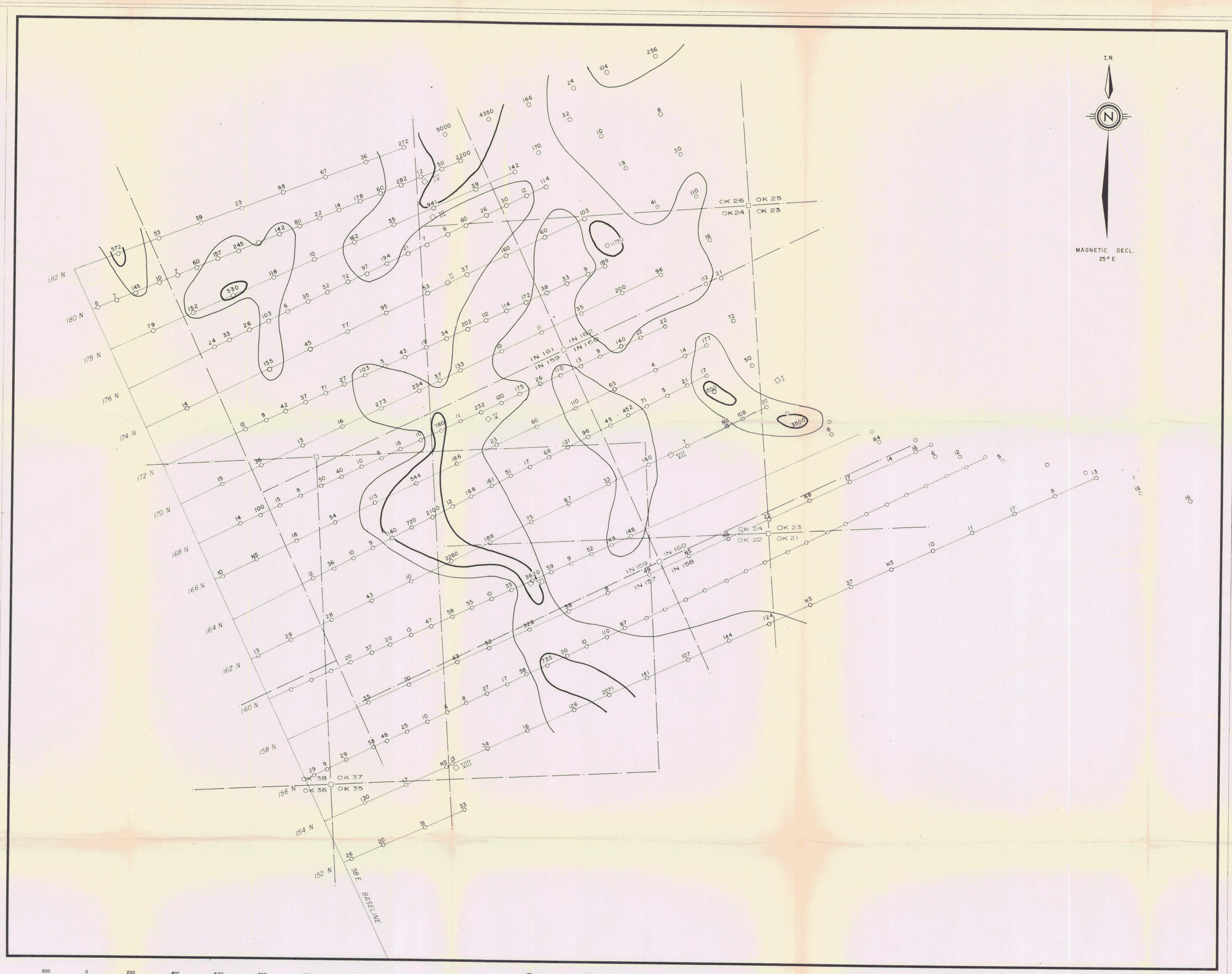
DRAWN BY:

1000 0 1000 2000

SCALE: 1 INCH TO 1000 FEET

SOIL - 2547 - F.N.M.

MAP REF. NO.: 154-E 2/70
N.T.S. : 92 - K - 2



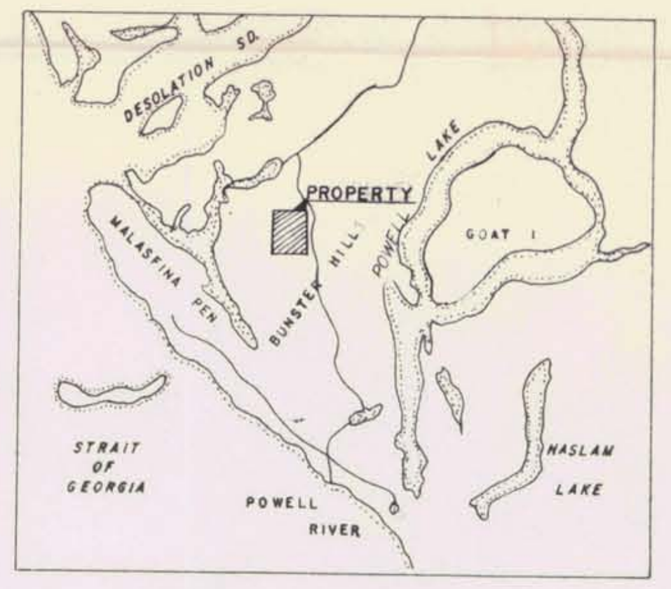
200 0 200 400 600 800 1000 1200 1400 1600 1800

SCALE: 1 INCH TO 200 FT.

LEGEND:

—	100 ppm Cu
━	500 ppm Cu
IN 157 ⊡	CLAIM POST AND NUMBER
◇ I	PIT LOCATION AND NUMBER

LOCATION MAP

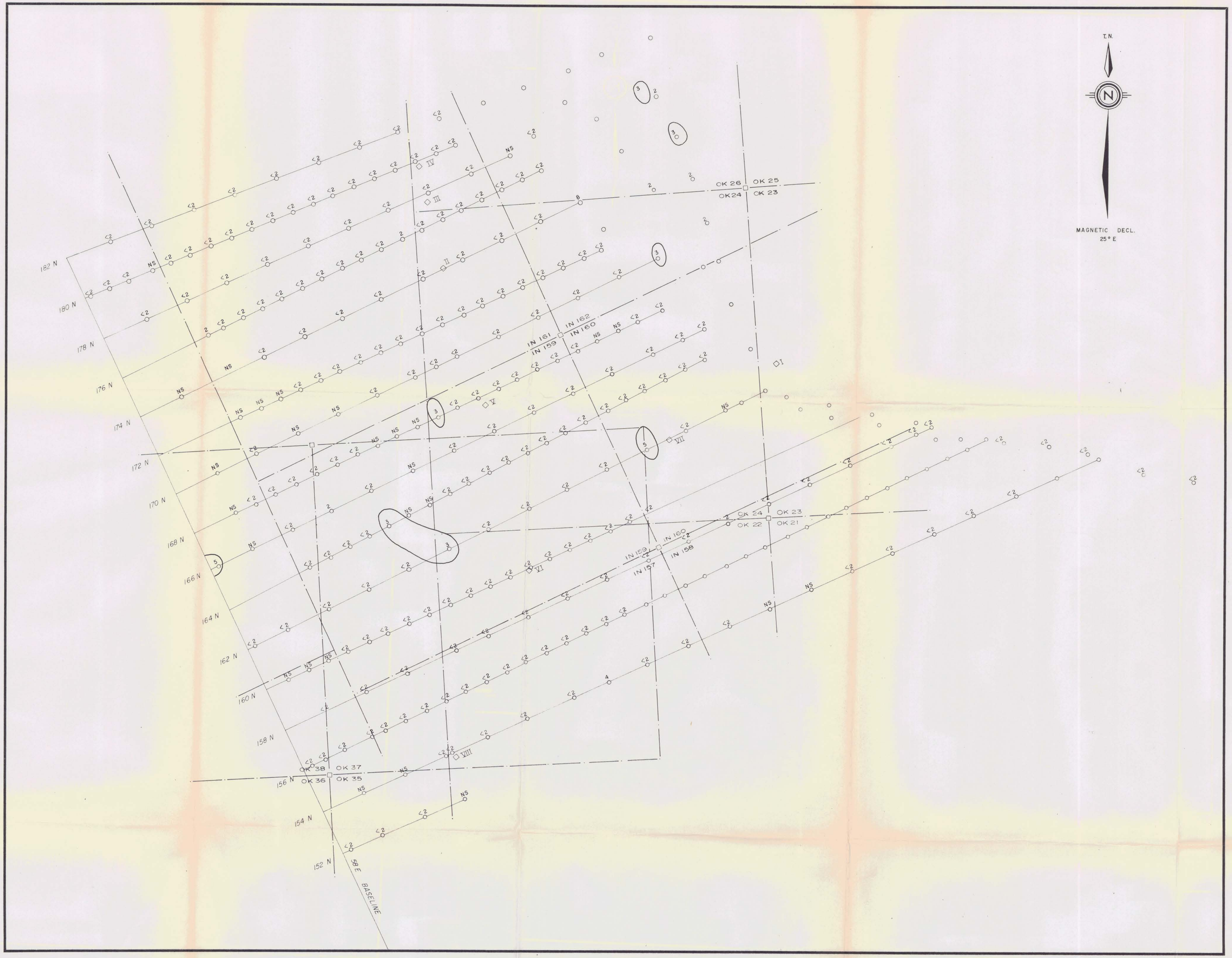


COMPANY . . FALCONBRIDGE NICKEL MINES LTD.
PROPERTY . . OKEOVER ARM
LOCATION . . POWELL RIVER, B.C.

WORKING PLACE . . NORTH PART OF GRID
TYPE OF MAP . . HOT EXTRACTABLE Cu IN SOILS
BASED ON . .

DATE . . JULY 1970
DRAWN BY . . R.B. BAND
DATE OF WORK . . OCTOBER 1969

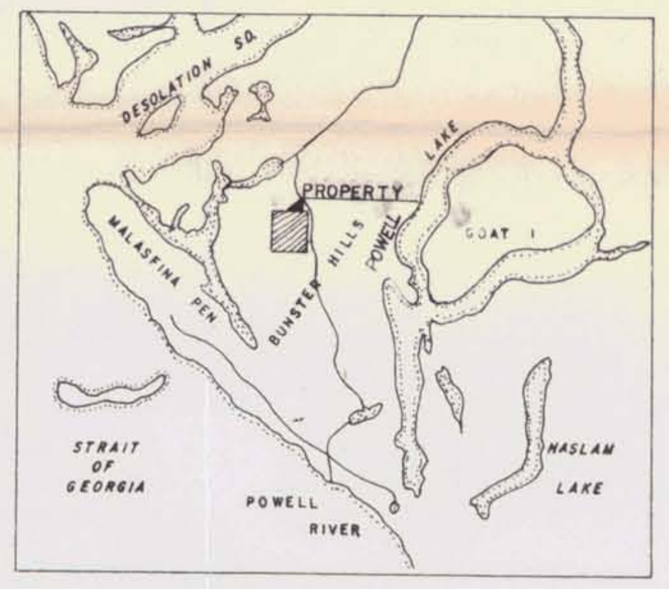
MAP REF. NO.: 154-E 4/70
N.T.S. · 92 - K - 2

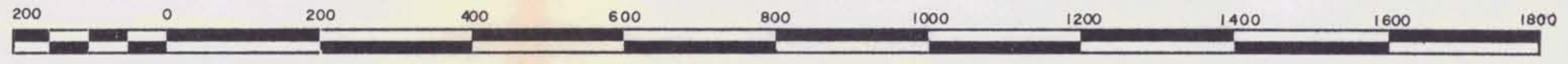


LEGEND:

—	3 ppm COLD EXTRACTABLE Mo
IN 157 □	CLAIM POST AND NUMBER
◇ I	PIT LOCATION AND NUMBER

LOCATION MAP





SCALE: 1 INCH TO 200 FT.

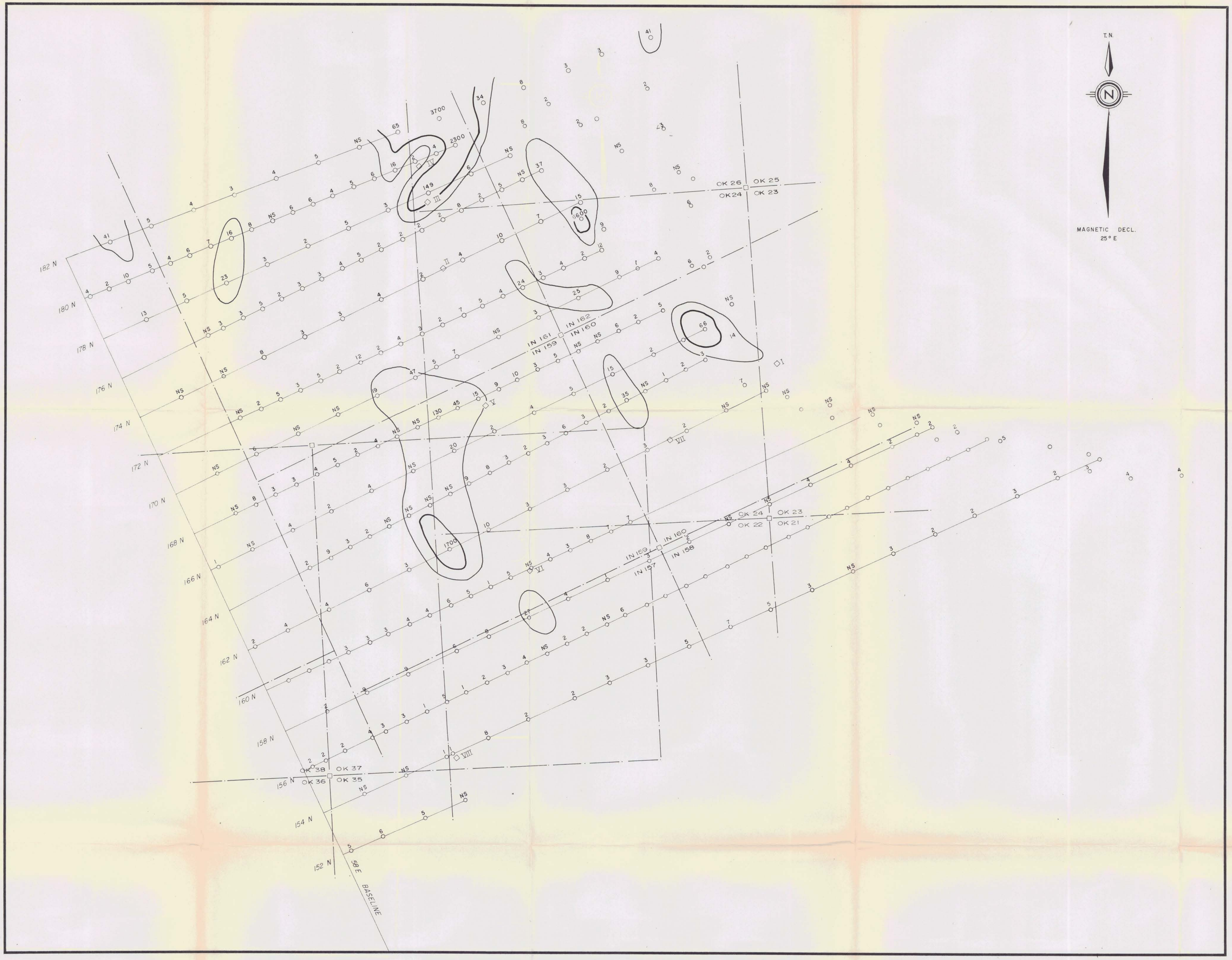
COMPANY . . FALCONBRIDGE NICKEL MINES LTD.
PROPERTY . . OKEOVER ARM
LOCATION . . POWELL RIVER, B.C.

WORKING PLACE . . NORTH PART OF GRID
TYPE OF MAP . . COLD EXTRACTABLE Mo IN SOIL
BASED ON . .

DATE . . JULY 1970
DRAWN BY . . R.B. BAND
DATE OF WORK . . OCTOBER 1969

8CIL - 742 - F.N.M.

MAP REF. NO.: 154-E 5/70
N.T.S. : 92 - K - 2



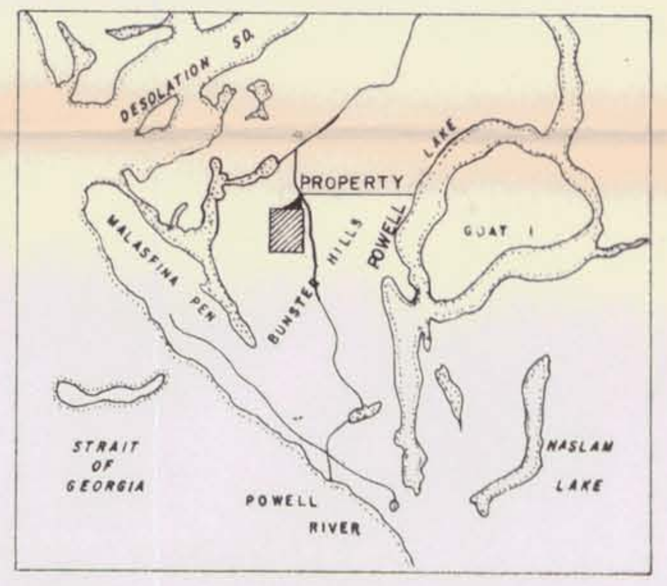
200 0 200 400 600 800 1000 1200 1400 1600 1800

SCALE: 1 INCH TO 200 FT.

LEGEND:

—	15 ppm COLD EXTRACTABLE Cu
━	50 ppm COLD EXTRACTABLE Cu
☐ IN 157	CLAIM POST AND NUMBER
◇ I	PIT LOCATION AND NUMBER

LOCATION MAP

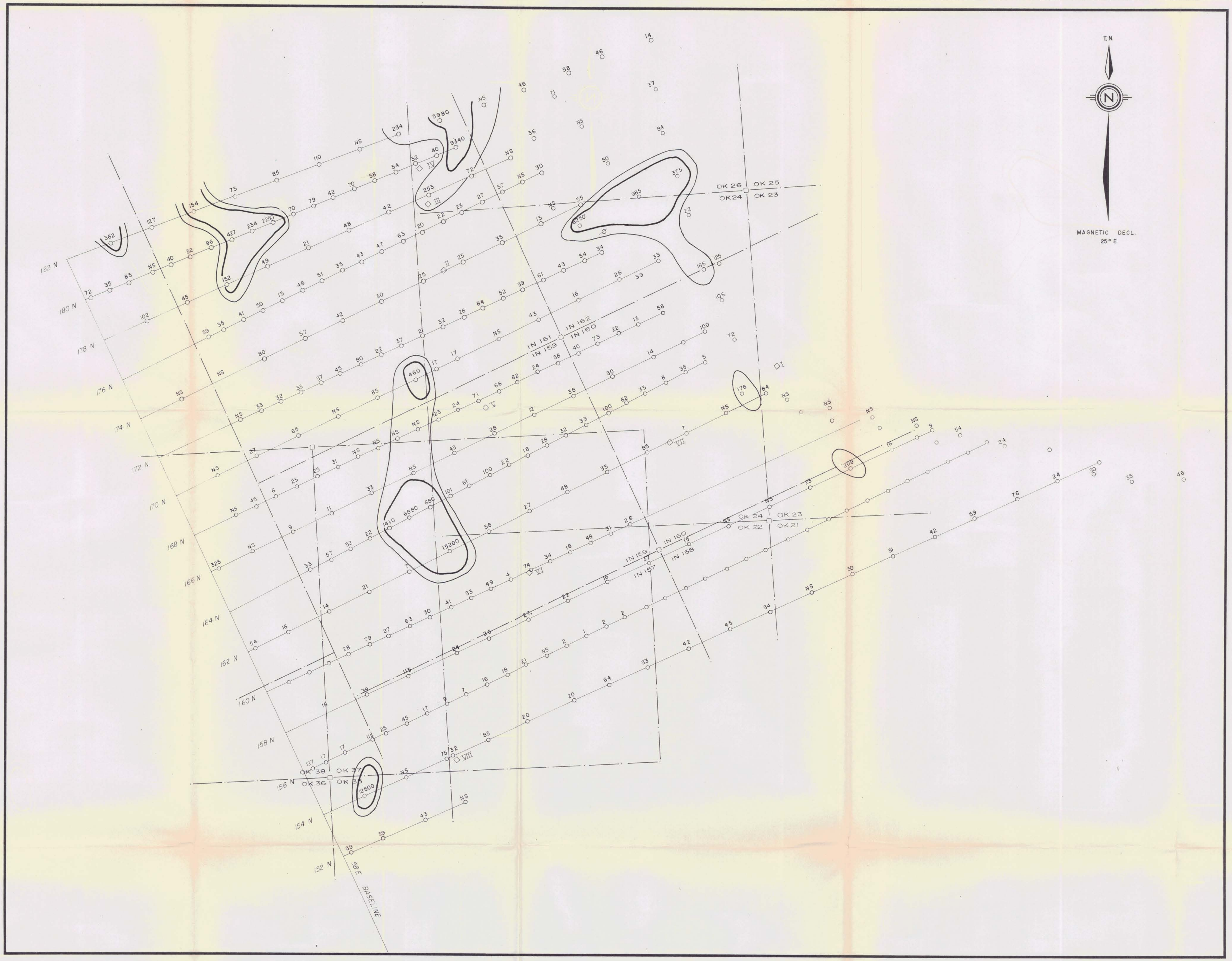


COMPANY . . FALCONBRIDGE NICKEL MINES LTD.
PROPERTY . . OKEOVER ARM
LOCATION . . POWELL RIVER, B.C.

WORKING PLACE . . NORTH PART OF GRID
TYPE OF MAP . . COLD EXTRACTABLE Cu IN SOIL
BASED ON . .

DATE . . JULY 1970
DRAWN BY . . R.B. BAND
DATE OF WORK . . OCTOBER 1969

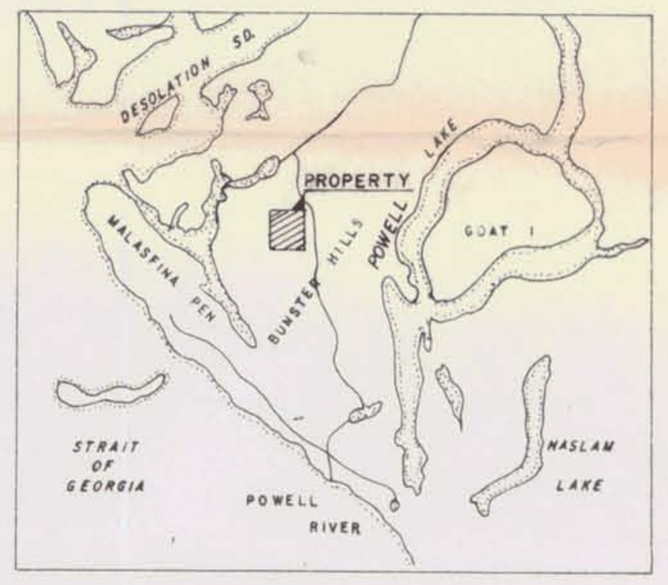
MAP REF. NO.: 154-E 6/70
N.T.S. : 92-K-2



LEGEND:

- 150 ppm Mn
- 300 ppm Mn
- IN 157 CLAIM POST AND NUMBER
- ◇ I PIT LOCATION AND NUMBER
- NS — NO SAMPLE

LOCATION MAP



200 0 200 400 600 800 1000 1200 1400 1600 1800

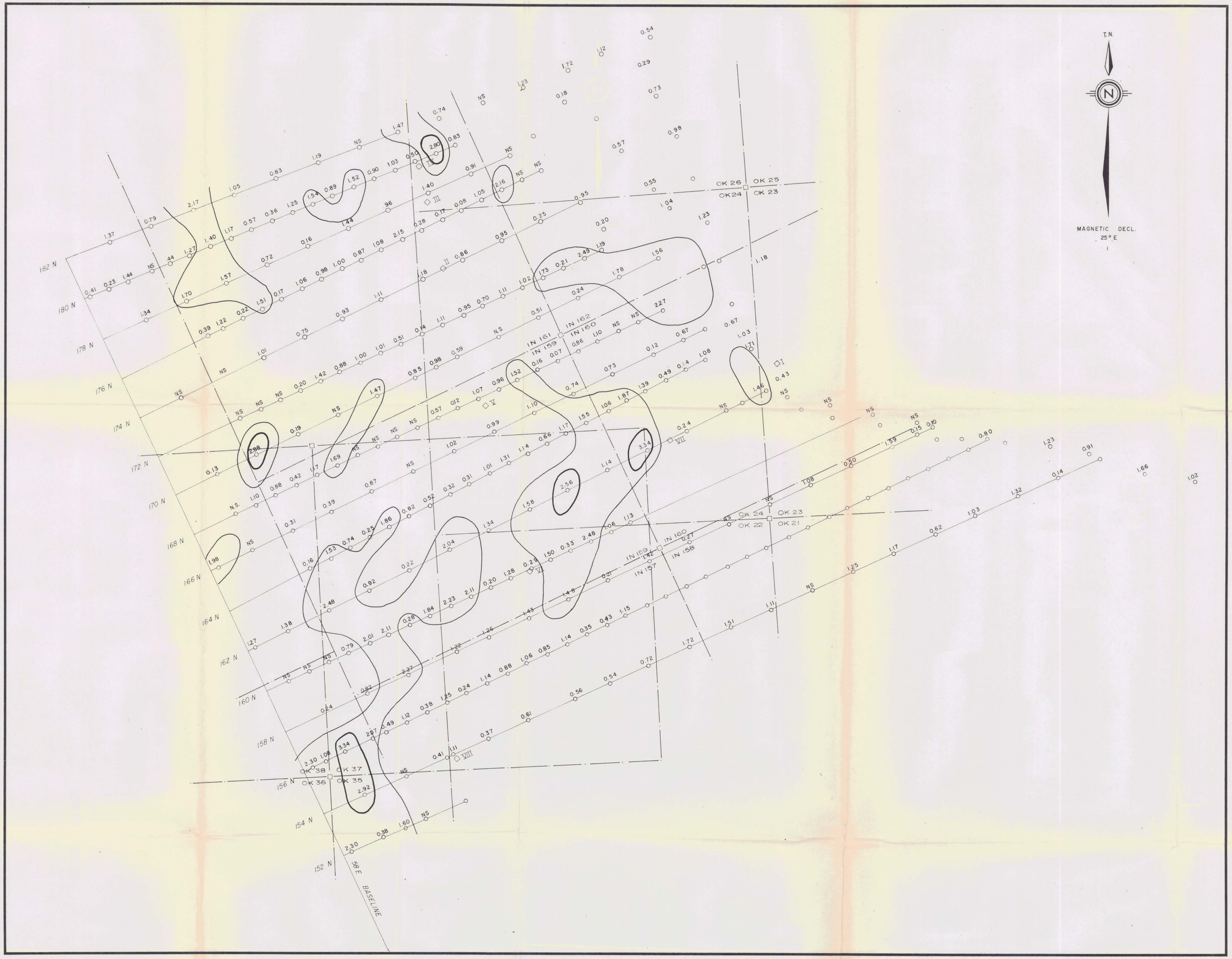
SCALE: 1 INCH TO 200 FT.

COMPANY .. FALCONBRIDGE NICKEL MINES LTD.
PROPERTY .. OKEOVER ARM
LOCATION .. POWELL RIVER, B.C.

WORKING PLACE .. NORTH PART OF GRID
TYPE OF MAP .. Mn IN SOIL
BASED ON ..

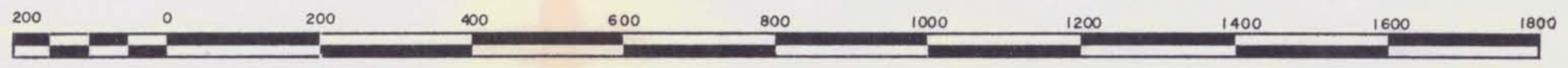
DATE .. JULY 1970
DRAWN BY .. R.B. BAND
DATE OF WORK .. OCTOBER 1969

MAP REF. NO.: 154-E 7/70
N.T.S. : 92 - K - 2



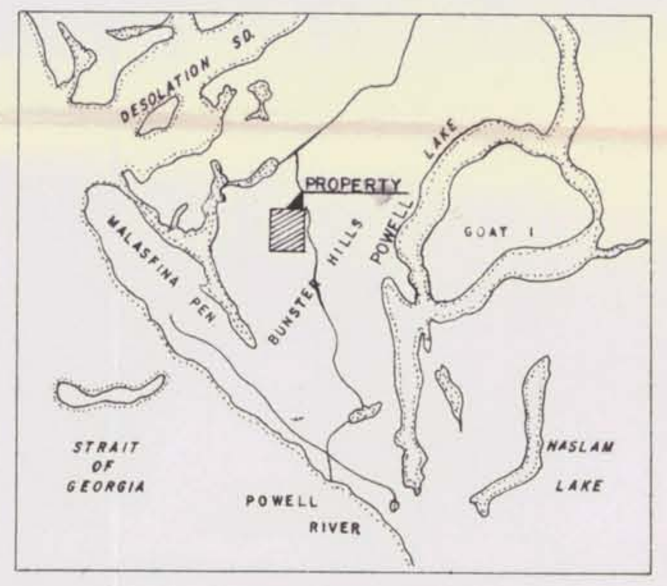
LEGEND:

—	1.5 PER CENT Fe
━	2.5 PER CENT Fe
IN 157 ⌖	CLAIM POST AND NUMBER
◇ I	PIT LOCATION AND NUMBER



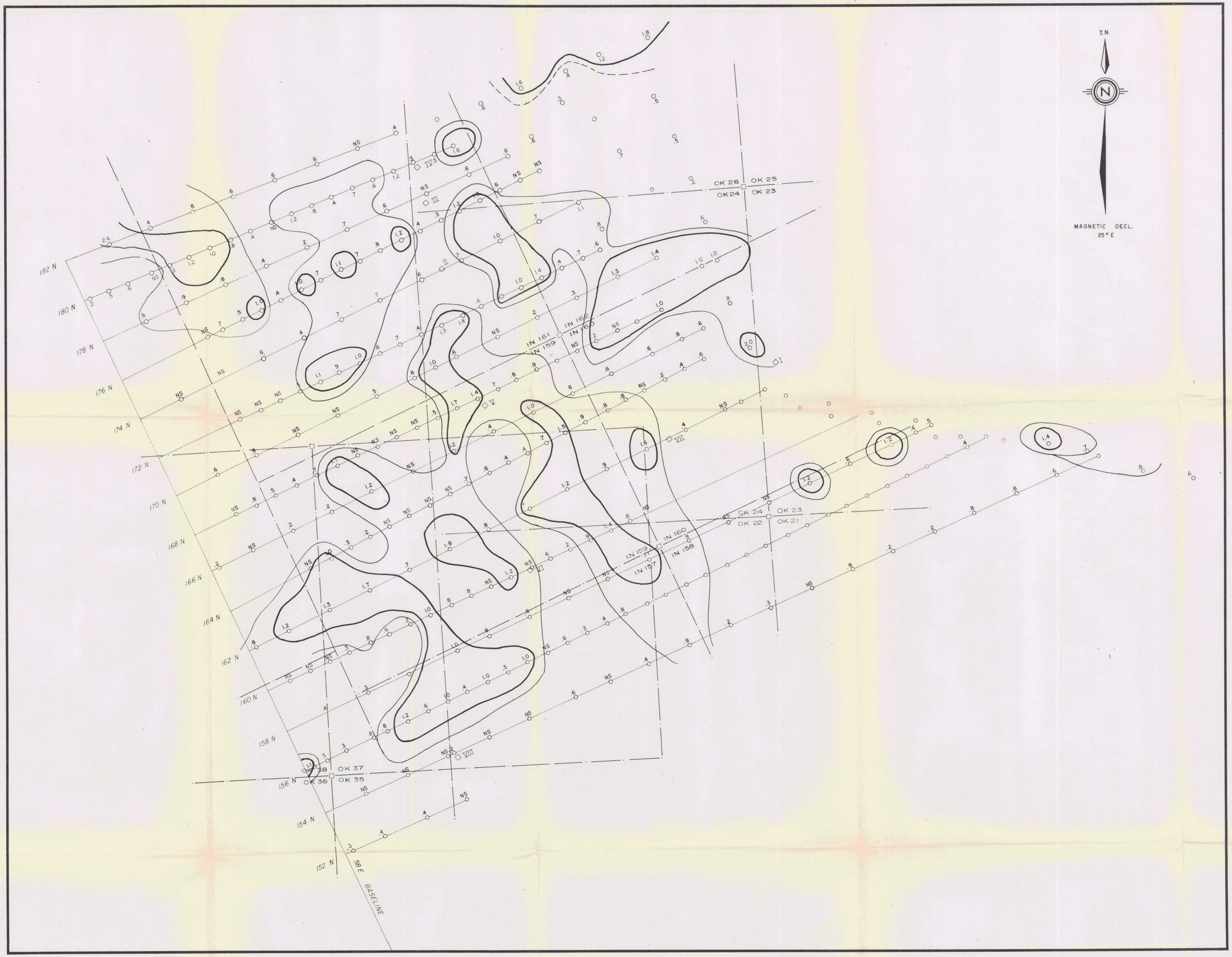
SCALE: 1 INCH TO 200 FT.

LOCATION MAP



COMPANY . .	FALCONBRIDGE NICKEL MINES LTD.	WORKING PLACE . .	NORTH PART OF GRID	DATE . .	JULY 1970
PROPERTY . .	OKEOVER ARM	TYPE OF MAP . .	PERCENT Fe IN SOIL	DRAWN BY . .	R.B. BAND
LOCATION . .	POWELL RIVER, B.C.	BASED ON . .		DATE OF WORK . .	OCTOBER 1969

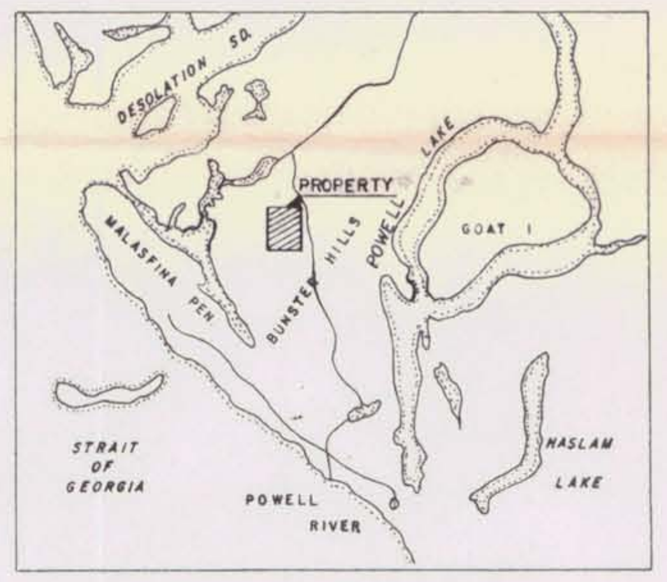
MAP REF. NO.: 154-E 8/70
N.T.S.: 92-K-2



LEGEND:

—	0.7 ppm Ag
—	1.0 ppm Ag
IN 157 ⊡	CLAIM POST AND NUMBER
◇ I	PIT LOCATION AND NUMBER

LOCATION MAP



200 0 200 400 600 800 1000 1200 1400 1600 1800

SCALE: 1 INCH TO 200 FT.

COMPANY .. FALCONBRIDGE NICKEL MINES LTD.
PROPERTY .. OKEOVER ARM
LOCATION .. POWELL RIVER, B.C.

WORKING PLACE .. NORTH PART OF GRID
TYPE OF MAP .. Ag IN SOIL
BASED ON ..

DATE .. JULY 1970
DRAWN BY .. R.B. BAND
DATE OF WORK .. OCTOBER 1969

MAP REF. NO.: 154-E 9/70
N.T.S. : 92-K-2

LEGEND:

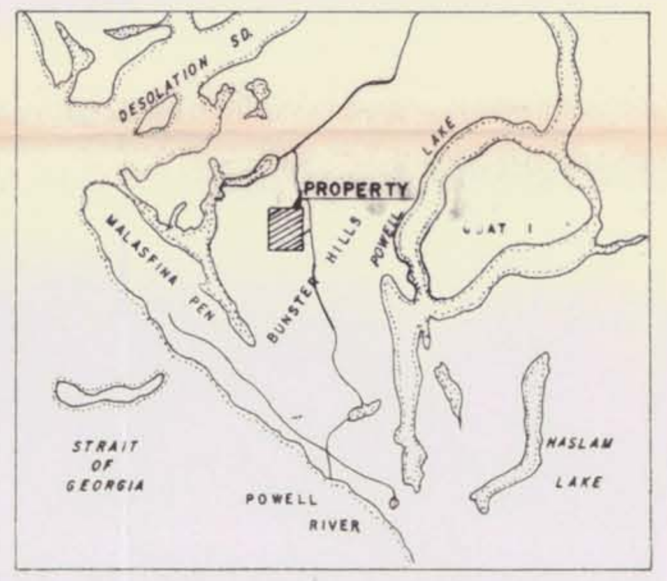
—— 15 ppm Co

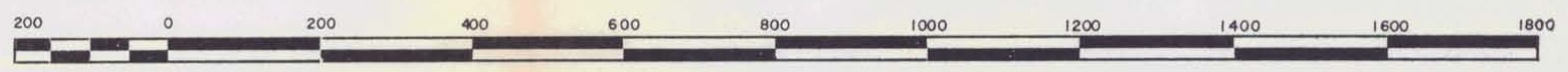
━━ 50 ppm Co

IN 157 CLAIM POST AND NUMBER

◇ I PIT LOCATION AND NUMBER

LOCATION MAP





SCALE: 1 INCH TO 200 FT.

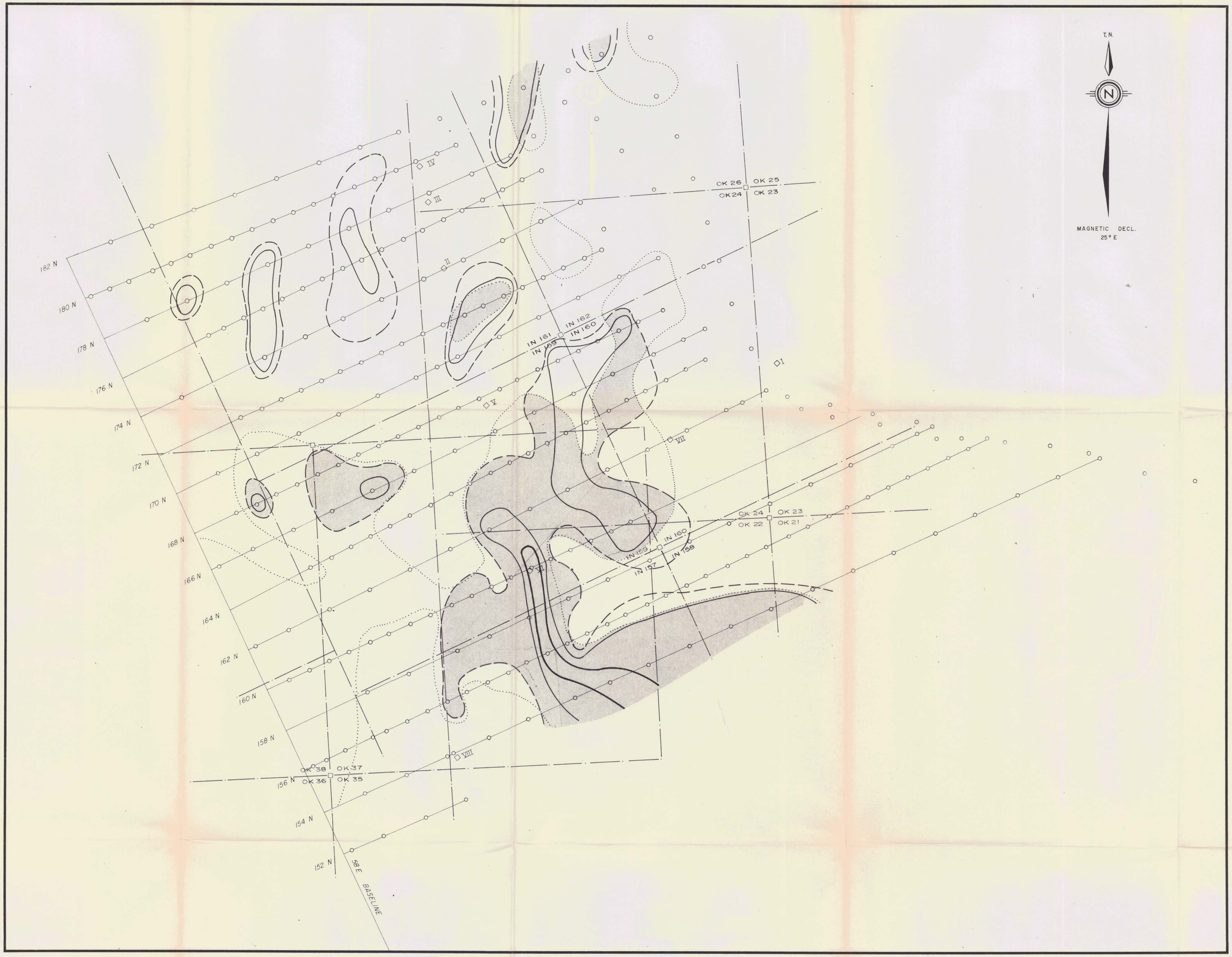
COMPANY . . FALCONBRIDGE NICKEL MINES LTD.
PROPERTY . . OKEOVER ARM
LOCATION . . POWELL RIVER, B.C.

WORKING PLACE . . NORTH PART OF GRID
TYPE OF MAP . . Co IN SOIL
BASED ON . .

DATE . . JULY 1970
DRAWN BY . . R.B. BAND
DATE OF WORK . . OCTOBER 1969

BCIL - 742 - F.H.M.

MAP REF. NO.: 154-E 10/70
N.T.S. 92-K-2



200 0 200 400 600 800 1000 1200 1400 1600 1800

SCALE: 1 INCH TO 200 FT.

LEGEND:

IN 157 □ CLAIM POST AND NUMBER

◇ I PIT LOCATION AND NUMBER

.... 10 ppm Mo

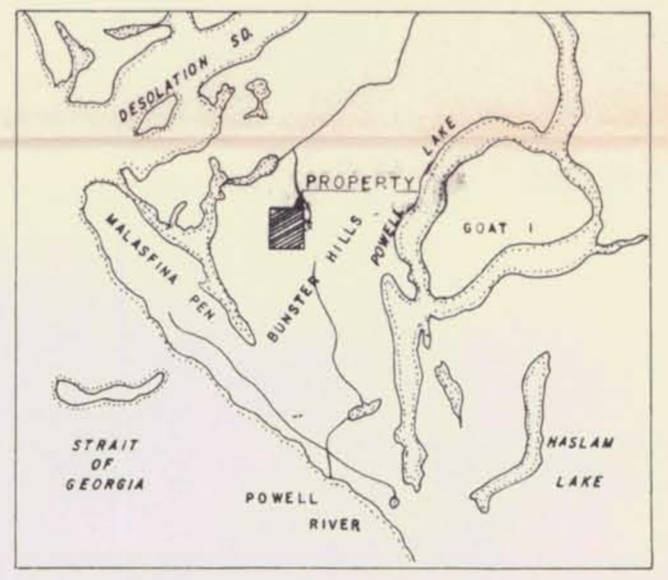
— — 50 ppm Cu

—— 100 ppm Cu

━━ 500ppm Cu

▨ type A ANOMALIES

LOCATION MAP



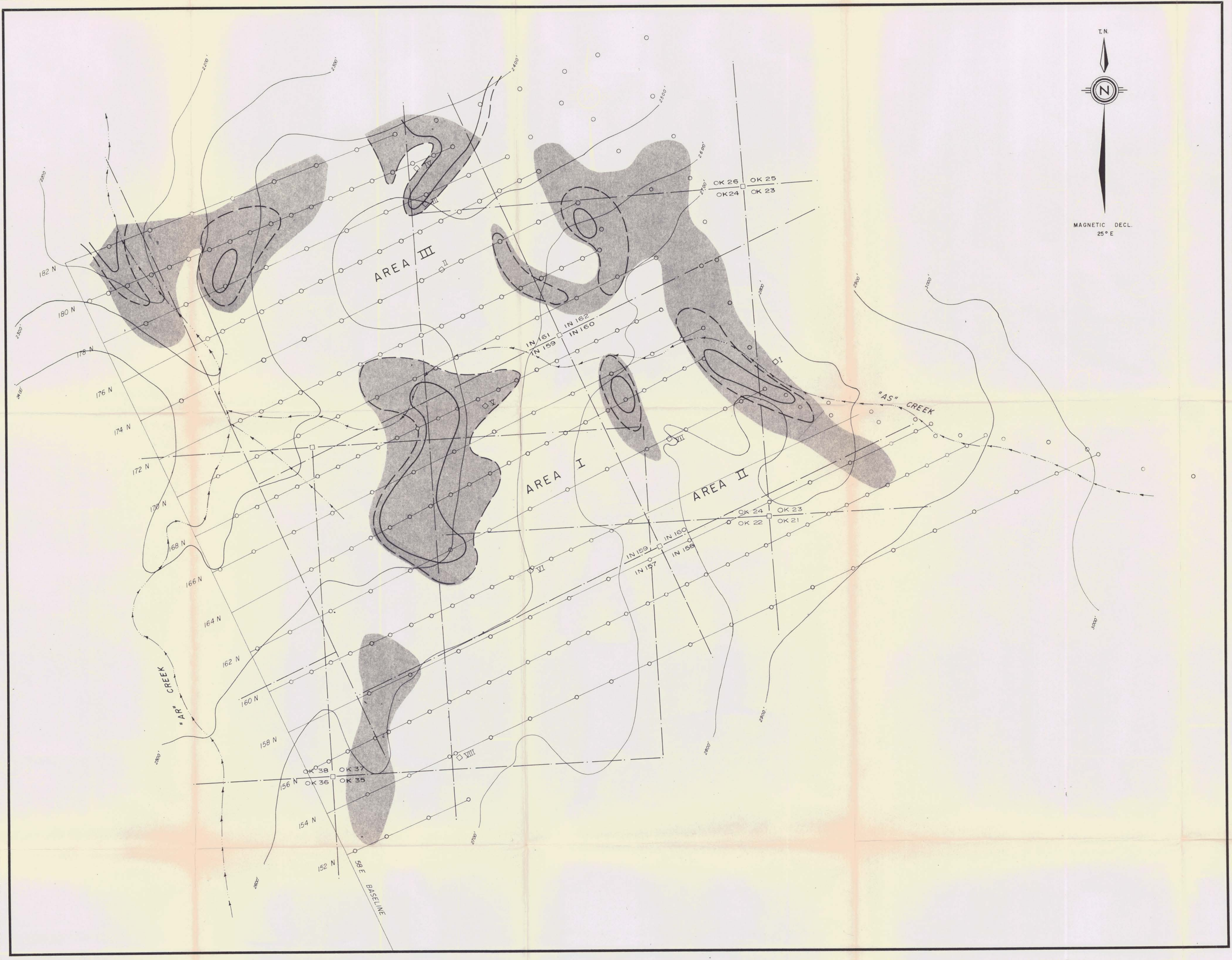
COMPANY . . FALCONBRIDGE NICKEL MINES LTD.
PROPERTY . . OKEOVER ARM
LOCATION . . POWELL RIVER, B.C.

WORKING PLACE . . NORTH PART OF GRID
TYPE OF MAP . . Cu-Mo ANOMALIES NOT DUE TO SECONDARY ACCUMULATION
BASED ON . .

DATE . . JULY 1970
DRAWN BY . . R.B. BAND
DATE OF WORK . . OCTOBER 1969

BCIL - 742 - F.N.H.

MAP REF. NO.: 154-E 11/70
N.T.S. : 92 - K - 2



LEGEND:

⌖ IN 157 — CLAIM POST AND NUMBER

◇ I — PIT LOCATION AND NUMBER

TOPOGRAPHIC CONTOUR

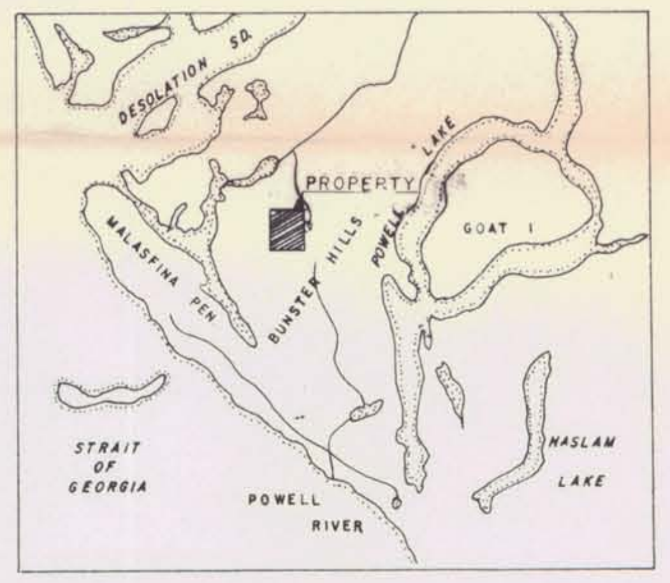
STREAM

— — — 150 ppm Cu

——— 300 ppm Cu

▨ AREA OF SECONDARY ACCUMULATION

LOCATION MAP



200 0 200 400 600 800 1000 1200 1400 1600 1800

SCALE: 1 INCH TO 200 FT.

COMPANY . .	FALCONBRIDGE NICKEL MINES LTD.	WORKING PLACE . .	NORTH PART OF GRID
PROPERTY . .	OKEOVER ARM	TYPE OF MAP . .	Cu IN AREAS OF SECONDARY ACCUMULATION
LOCATION . .	POWELL RIVER, B.C.	BASED ON . .	

DATE . . JULY 1970
DRAWN BY . . R.B. BAND
DATE OF WORK . . OCTOBER 1969