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REPORT ON THE
INDUCED POLARIZATION SURVEY
ON THE
KITIMAT RIVER GROUP,
KITIMAT AREA, B.C.
FOR
AMAX EXPLORATION INC.

103I/1E

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McPHAR GEOPHYSICS LIMITED

REPORT ON THE
INDUCED POLARIZATION SURVEY
ON THE
KITIMAT RIVER GROUP,
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FOR
AMAX EXPLORATION INC.

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1. INTRODUCTION

At the request of Mr. Wm. Shaw, geophysicist for the Company, an induced polarization and resistivity survey has been carried out on the Kitimat River Mo S_2 Property in the Kitimat Area of British Columbia for Amax Exploration Inc. The property is in the Skeena Mining Division, in the S/E quadrant of the 1° quadrilateral whose southeast corner is at 54°N, 128° W.

The property lies immediately west of the Kitimat River and is underlain in the north by the Hazelton volcanics and in the south by acid to intermediate intrusives. There are several molybdenum occurrences on the property and the purpose of the survey was to search for any extensive zones of mineralization. Because of the rugged nature of the terrain, lines were run along the principal valleys and ridges rather than on a regular grid.

A McPhar frequency-type IP unit was employed with station intervals of 300 and 600 feet, taking three receiver readings from each transmitter location; (i.e. n=1, 2 and 3.)

2. PRESENTATION OF RESULTS

The Induced Polarization and Resistivity results are shown on the following data plots in the manner described in the notes preceding this report.

Line No.	Electrode Intervals	Dwg. No.
Base Line; South Part	600-ft. spreads	IP 2312-1
Base Line; North Part	600-ft. spreads	IP 2312-2
Gossan Creek Line	300-ft. spreads	IP 2312-3
Barb Line	300-ft. spreads	IP 2312-4
Ridge #2 Line	300-ft. spreads	IP 2312-5
Ridge #1 Line	300-ft. spreads	IP 2312-6
Mantle Creek Line	300-ft. spreads	IP 2312-7
Line 26S (ELL)	300-ft. spreads	IP 2312-8

Enclosed with this report is Dwg. Misc. 4186. a plan map of the property at a scale of 1" = 500'. The definite and possible induced polarization anomalies are indicated by solid and broken bars respectively on this plan map as well as the data plots. These bars represent the surface projection of the anomalous zones as interpreted from the location of the transmitter and receiver electrodes when the anomalous values were measured.

Since the induced polarization measurement is essentially an averaging process. as are all potential methods. it is frequently difficult to exactly pinpoint the source of an anomaly. Certainly no anomaly can be located with more accuracy than the spread length; i. e. when using 200' spreads the position of a narrow sulphide body can only be determined to lie between two stations 200' apart. In order to locate sources at some depth, larger spreads must be used, with a corresponding increase in the uncertainties of location. Therefore, while the center of the indicated anomaly probably corresponds fairly well with source, the length of the indicated anomaly along the line should not be taken to represent the exact edges of the anomalous material.

3. DISCUSSION OF RESULTS

Base Line

The Base Line was surveyed in two sections using 600-foot spreads. On the southern section there is a possible weak anomaly at 24S-30S. On the north part weak anomalies occur at 18N-24N and 42N-48N. In both instances the frequency effects are very small and the resistivity data suggest thick valley-fill, so that the anomalies are probably not important.

Gossan Creek Line

A traverse was run along Gossan Creek using 300-foot spreads. The results show a definite anomaly at 9E, a probable weak source at 27E-30E, a broad zone from 36E to 45E and a possible weak anomaly at 60E-63E. The sources at 9E and 60E-63E appear to be at some depth whereas the other two are shallow.

Barb Line

No significant values were measured on this line.

Ridge #2 Line

Above background effects were measured from 24E to 30E suggesting a possible weak source at moderate depth.

Ridge #1 Line

Shallow, weak effects were found at 9E and 57E-60E on this line.

Mantle Creek Line

No significant values were measured on this line.

Line 26S (ELL)

Anomalous effects were measured at the west end of this line but the pattern is incomplete. Also there are anomalies at 46W-49W and 13W-16W but unfortunately it was not possible to obtain all of the readings at these locations hence their importance is uncertain.

4. SUMMARY AND RECOMMENDATIONS

No strong anomalies were encountered during the survey but there are weak anomalies on several of the traverses. Because of the limited amount of data and wide line spacing these effects cannot be correlated into definite zones. The strongest anomalies are at 9E and 39E-42E on the Gossan Creek Line in the north part of the property underlain by the Hazelton volcanics.

Anomalies of the magnitude encountered here are generally not considered to be important since they are probably caused by very small amounts of sulphides. However, recent test surveys over disseminated molybdenite deposits have shown that weak effects can be significant. This is because of a fairly complete separation of pyrite and molybdenite in some deposits although in these cases the pyrite zones may give rise to strong IP anomalies marginal to weak anomalies over the molybdenite zones.

McPHAR GEOPHYSICS LIMITED

Robert A. Bell.

Robert A. Bell, Geologist

D. B. Sutherland per RA

D. B. Sutherland, Geophysicist.

Dated: November 24, 1965

ASSESSMENT DETAILS

PROPERTY: Kitimat Area (Project 241)

SPONSOR: American Metal Climax Inc.

PROVINCE: B. C.

LOCATION: Kitimat River

TYPE OF SURVEY: Induced Polarization

OPERATING MAN DAYS:	60	DATE STARTED:	Sept. 1, 1965
EQUIVALENT 8 HR. MAN DAYS:	90	DATE FINISHED:	Sept. 30. 1965
CONSULTING MAN DAYS:	2	NUMBER OF STATIONS:	139
		NUMBER OF READINGS:	612
DRAUGHTING MAN DAYS:	3	MILES OF LINE SURVEYED:	9.5
TOTAL MAN DAYS:	155		

CONSULTANTS:
D. B. Sutherland, Apt. 604, 412 Eglinton Ave. East, Toronto 12, Ontario.
R. A. Bell, 50 Hemford Crescent, Don Mills, Ontario.

FIELD TECHNICIANS:
J. Parker, Box 340, Choiceland, Saskatchewan.
P. Belleheumeur, Box 72, Ramore, Ontario.
5 ~~3~~ Helpers - supplied by client.
DRAUGHTSMEN:
K. Bingham, 78 Hubbard Blvd., Toronto 13, Ontario.
B. Marr, 19 Kenewan Court, Toronto 16, Ontario.

McPHAR GEOPHYSICS LIMITED

Robert A. Bell

Robert A. Bell,
Geologist.

Dated: November 24, 1965

SUMMARY OF COST

Amax Exploration Inc. - Kitimat

Crew (2 men)

12 days Operating		@ $175.00/day	$2,100.00
3 days Travel)			
10 days Standby - Sept.)			
3 days Standby - Aug. 28-31)			
2 days Preparation)	18 days	@ $ 75.00/day	1,350.00
			$3,450.00

Expenses

Fares - Tor-Van - 2 men	78.00	
Meals and Accommodation	177.55	
Freight and Brokerage 2/3	172.60	
Excess Baggage	19.00	
Taxi	16.50	
Laundry	12.00	
Tel & Tel	2.00	
Supplies	7.01	484.66
		$3,934.66

McPHAR GEOPHYSICS LIMITED

Robert A. Bell

Robert A. Bell,
Geologist.

Dated: November 24, 1965

CERTIFICATE

I, Robert Alan Bell, of the City of Toronto, Province of Ontario, do hereby certify that:

1. I am a geologist residing at 50 Hemford Crescent, Don Mills (Toronto) Ontario.

2. I am a graduate of the Univeristy of Toronto in Physics and Geology with the degree of Bachelor of Arts (1949); and a graduate of the University of Wisconsin in Economic Geology with the degree of Ph. D. (1952).

3. I am a member of the Society of Economic Geologists and a fellow of the Geological Association of Canada.

4. I have been practising my profession for over ten years.

5. I have no direct or indirect interest, nor do I expect to receive any interest directly or indirectly, in the property or securities of The Amax Exploration Inc.

6. The statements made in this report are based on a study of published geological literature and unpublished private reports.

Dated at Toronto

This 24 day of November 1965.

Robert A. Bell.

Robert A. Bell, Ph. D.

McPHAR GEOPHYSICS LIMITED

NOTES ON THE THEORY OF INDUCED POLARIZATION AND THE METHOD OF FIELD OPERATION

Induced Polarization as a geophysical measurement refers to the blocking action or polarization of metallic or electronic conductors in a medium of ionic solution conduction.

This electro-chemical phenomenon occurs wherever electrical current is passed through an area which contains metallic minerals such as base metal sulphides. Normally, when current is passed through the ground, as in resistivity measurements, all of the conduction takes place through ions present in the water content of the rock, or soil, i.e. by ionic conduction. This is because almost all minerals have a much higher specific resistivity than ground water. The group of minerals commonly described as "metallic", however, have specific resistivities much lower than ground waters. The induced polarization effect takes place at those interfaces where the mode of conduction changes from ionic in the solutions filling the interstices of the rock to electronic in the metallic minerals present in the rock.

The blocking action or induced polarization mentioned above, which depends upon the chemical energies necessary to allow the ions to give up or receive electrons from the metallic surface, increases with the time that a d.c. current is allowed to flow through the rock; i. e. as ions pile up against the metallic interface the resistance to current flow increases. Eventually, there is enough polarization in the form of excess ions at the interfaces to effectively stop all current flow through the metallic particle. This polarization takes place at each of the infinite number of solution-metal interfaces in a mineralized rock.

When the d. c. voltage used to create this d. c. current flow is cut off, the Coulomb forces between the charged ions forming the polarization cause them to return to their normal position. This movement of charge creates a small current flow which can be measured on the surface of the ground as a decaying potential difference.

From an alternate viewpoint it can be seen that if the direction of the current through the system is reversed repeatedly before the polarization occurs, the effective resistivity of the system as a whole will change as the frequency of the switching is changed. This is a consequence of the fact that the amount of current flowing through each metallic interface depends upon the length of time that current has been passing through it in one direction.

The values of the "metal factor" or "M. F. " are a measure of the amount of polarization present in the rock mass being surveyed. This parameter has been found to be very successful in mapping areas of sulphide mineralization, even those in which all other geophysical methods have been unsuccessful. The induced polarization measurement is more sensitive to sulphide content than other electrical measurements because it is much more dependent upon the sulphide content. As the sulphide content of a rock is increased, the "metal factor" of the rock increases much more rapidly than the resistivity decreases.

Because of this increased sensitivity, it is possible to locate and outline zones of less than 10% sulphides that can't be located by E. M. Methods. The method has been successful in locating the disseminated "porphyry copper" type mineralization in the South-western United States.

Measurements and experiments also indicate that it should be possible to locate most massive sulphide bodies at a greater depth with induced polarization than with E. M.

Since there is no I. P. effect from any conductor unless it is metallic, the method is useful in checking E. M. anomalies that are suspected of being due to water filled shear zones or other ionic conductors. There is also no effect from conductive overburden, which frequently confuses E. M. results. It would appear from scale model experiments and calculations that the apparent metal factors measured over a mineralized zone are larger if the material overlying the zone is of low resistivity.

Apropos of this, it should be stated that the induced polarization measurements indicate the total amount of metallic constituents in the rock. Thus all of the metallic minerals in the rock, such as pyrite, as well as the ore minerals chalcopyrite, chalcocite, galena, etc. are responsible for the induced polarization effect. Some oxides such as magnetite, pyrolusite, chromite, and some forms of hematite also conduct by electrons and are metallic. All of the metallic minerals in the rock will contribute to the induced polarization effect measured on the surface.

In the field procedure, measurements on the surface are made in a way that allows the effects of lateral changes in the properties of the ground to be separated from the effects of vertical changes in the properties. Current is applied to the ground at two points a distance (X) apart. The potentials are measured at two other points (X) feet apart, in line with the current electrodes. The distance between the nearest current and potential electrodes is an integer number (N) times the basic distance (X).

The measurements are made along a surveyed line, with a constant distance (NX) between the nearest current and potential electrodes. In most surveys, several traverses are made with various values of (N); i. e. (N) = 1, 2, 3, 4, etc. The kind of survey required (detailed or reconnaissance) decides the number of values of (N) used.

In plotting the results, the values of the apparent resistivity and the apparent metal factor measured for each set of electrode positions are plotted at the intersection of grid lines, one from the center point of the current electrodes and the other from the center point of the potential electrodes. The resistivity values are plotted above the line and the metal factor values below. The lateral displacement of a given value is determined by the location along the survey line of the center point between the current and potential electrodes. The distance of the value from the line is determined by the distance (NX) between the current and potential electrodes when the measurement was made.

The separation between sender and receiver electrodes is only one factor which determines the depth to which the ground is being sampled in any particular measurement. These plots then, when contoured, are not section maps of the electrical properties of the ground under the survey line. The interpretation of the results from any given survey must be carried out using the combined experience gained from field, model and theoretical investigations. The position of the electrodes when anomalous values are measured must be used in the interpretation.

In the field procedure, the interval over which the potential differences are measured is the same as the interval over which the electrodes are moved after a series of potential readings has been made. One of the advantages of the induced polarization method is that the same equipment can be used for both detailed and reconnaissance surveys merely by changing the distance (X) over which the electrodes are moved each time. In the past, intervals have been used ranging from 100 feet to 1000 feet for (X). In each case, the decision as to the distance (X) and the values of (N) is largely determined by the expected size of the mineral deposit being sought, the size of the expected anomaly and the speed with which it is desired to progress.

The diagram in Figure 1 below demonstrates the method used in plotting the results. Each value of the apparent resistivity and the apparent "Metal factor" is plotted and identified by the position of the four electrodes when the measurement was made. It can be seen that the values measured for the larger values of (n) are plotted farther from the line indicating that the thickness of the layer of the earth that is being tested is greater than for the smaller values of (n); i. e. the depth of the measurement is increased.

METHOD USED IN PLOTTING DIPOLE-DIPOLE
INDUCED POLARIZATION AND RESISTIVITY RESULTS

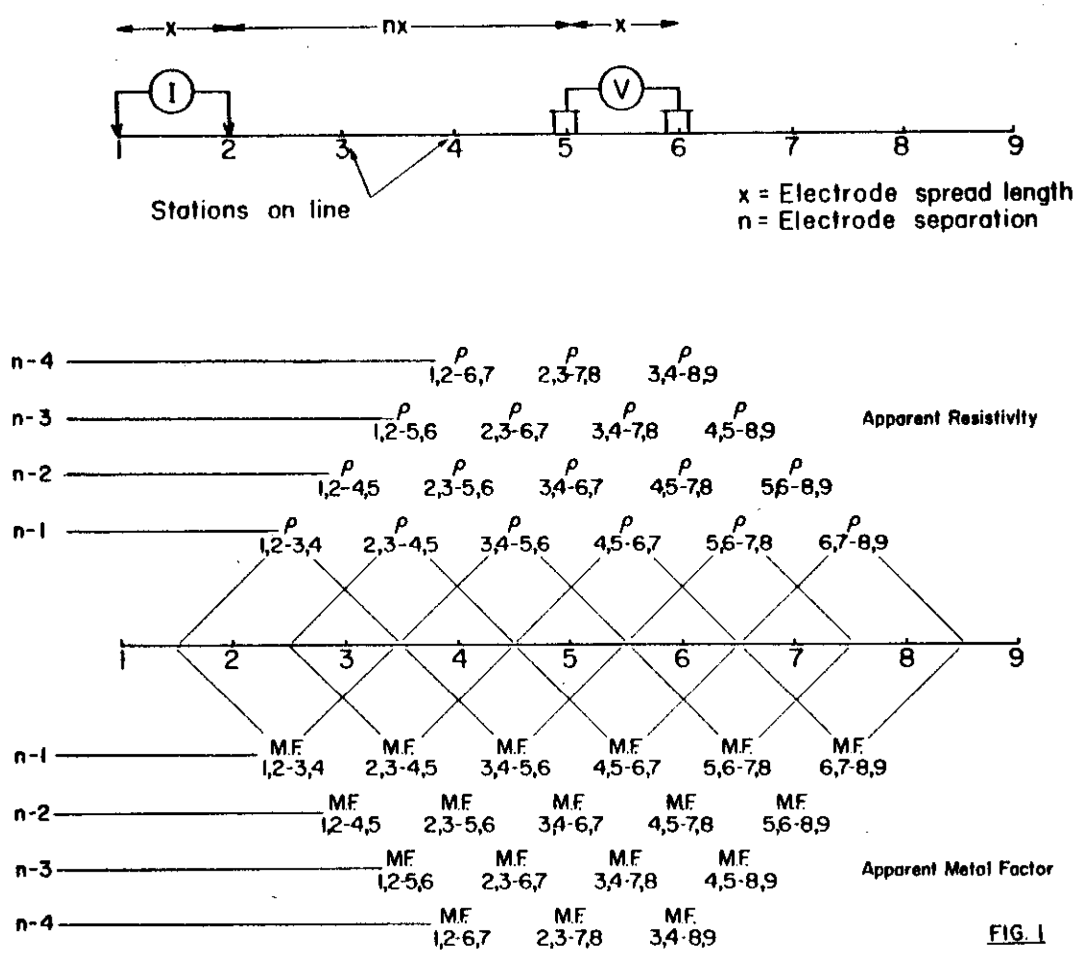

FIG. 1

DWG. NO.-I.P.-2312-1

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INDUCED POLARIZATION AND RESISTIVITY SURVEY

ELECTRODE CONFIGURATION

x - 600

PLOTTING POINT

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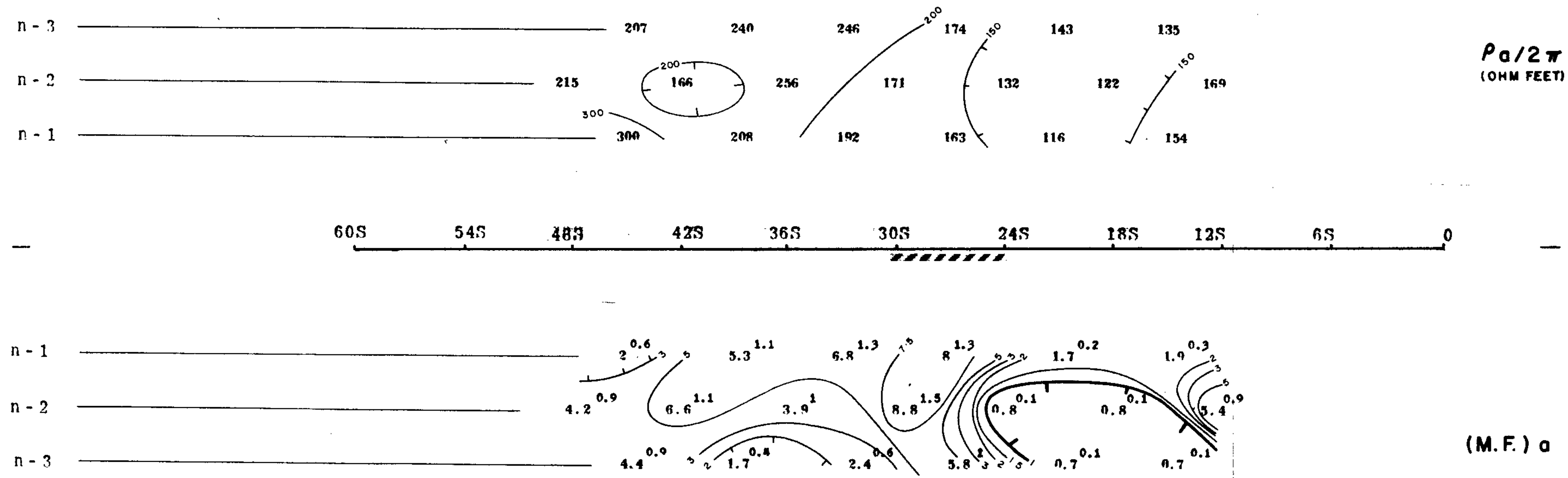
ASSESSMENT REPORT
NO. 775 MAP #2

LINE NO.- BASE LINE; (SOUTH PART)



AMERICAN METAL CLIMAX, INCORPORATED

775

(PROJECT 241)

KITIMAT RIVER AREA - B.C.

Scale-One inch= 600 Feet

NOTE: LOGARITHMIC CONTOUR INTERVAL

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCY 0.3 & 5.0 C.P.S.

DATE SURVEYED OCT/65

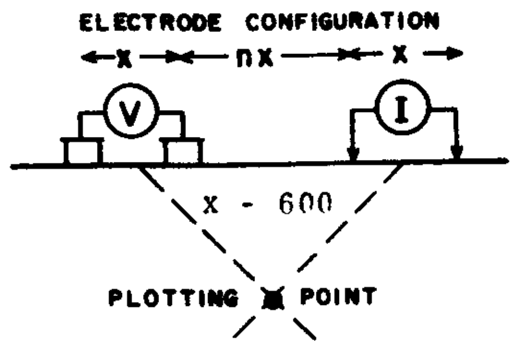
APPROVED RAA

DATE

DWG. NO.-I.P.- 2312 -2

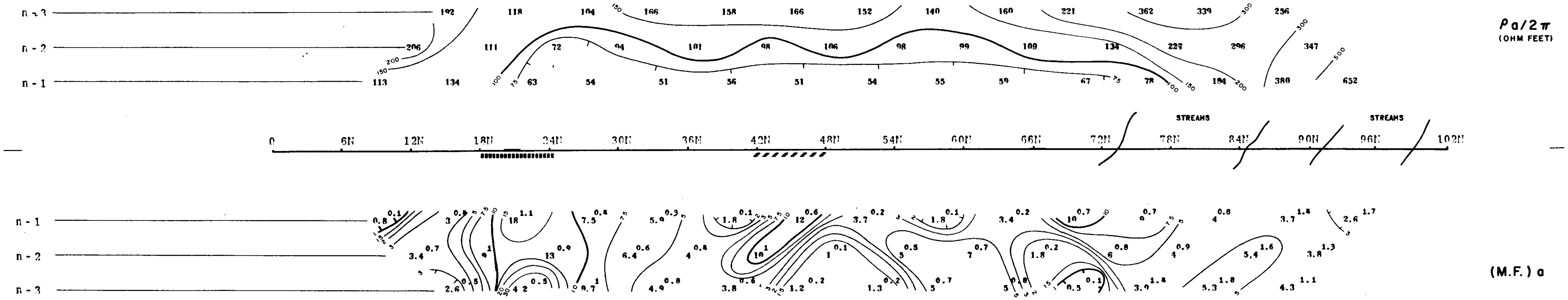
McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY



Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 775 MAP #3

LINE NO.- BASE LINE, (NORTH PART)



775

AMERICAN METAL CLIMAX, INCORPORATED

(PROJECT 241)

KITIMAT RIVER AREA - B.C.

Scale-One inch= 600 Feet

NOTE LOGARITHMIC CONTOUR INTERVAL

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCY 0.3 & 5 c.p.s.

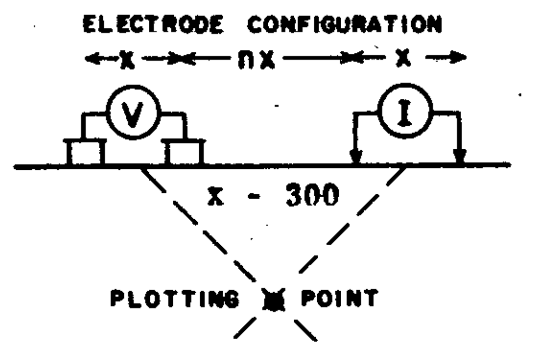
DATE SURVEYED OCT/65

APPROVED RAB

DATE

McPHAR GEOPHYSICS LIMITED

DWG. NO.–I.P.– 2312-3



McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 775 MAP #4

SURFACE PROJECTION
OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

AMERICAN METAL CLIMAX, INCORPORATED

(PROJECT 241)

KITIMAT RIVER AREA – B.C.

Scale—One inch= 300 Feet

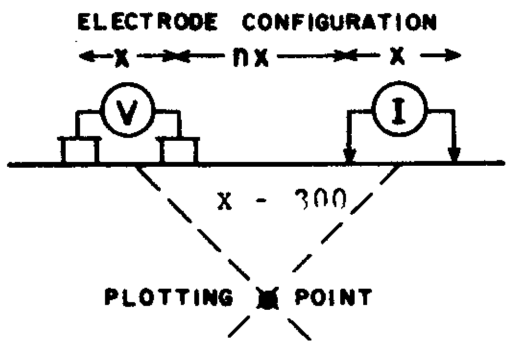
NOTE: LOGARITHMIC CONTOUR INTERVAL

775

FREQUENCY 0.31 & 5.0 C.P.S.
DATE SURVEYED OCT/69
APPROVED
DATE

McPHAR GEOPHYSICS LIMITED

DWG. NO.-I.P.-2312-4



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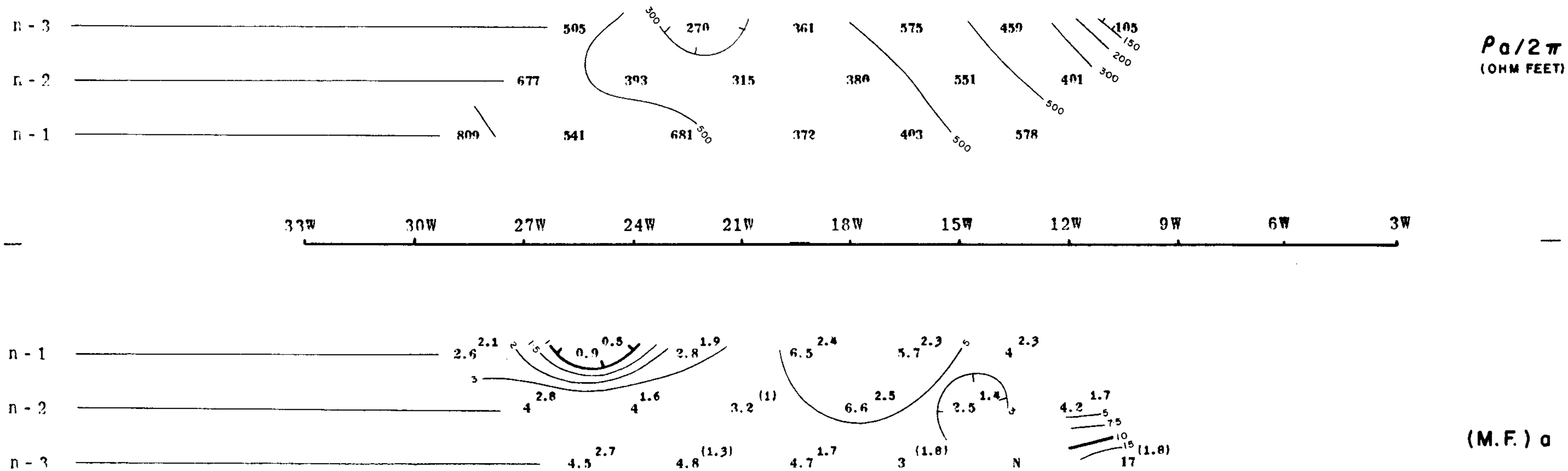
INDUCED POLARIZATION AND RESISTIVITY SURVEY

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 775 MAP #5



LINE NO.- "BARB"

AMERICAN METAL CLIMAX, INCORPORATED

775

(PROJECT 241)

KITIMAT RIVER AREA - B.C.

Scale- One inch = 300 Feet

NOTE: LOGARITHMIC CONTOUR INTERVAL

FREQUENCY 0.31 & 5.0 C.P.S.
DATE SURVEYED OCT/65
APPROVED RAB
DATE

SURFACE PROJECTION OF ANOMALOUS ZONES
DEFINITE
PROBABLE
POSSIBLE

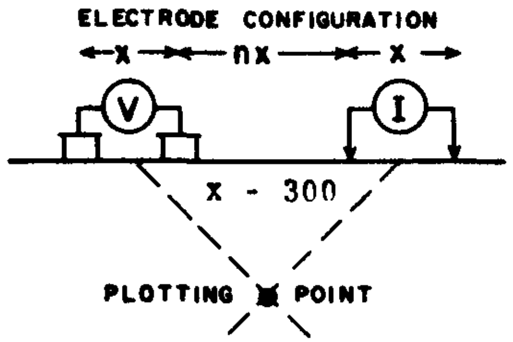
McPHAR GEOPHYSICS LIMITED

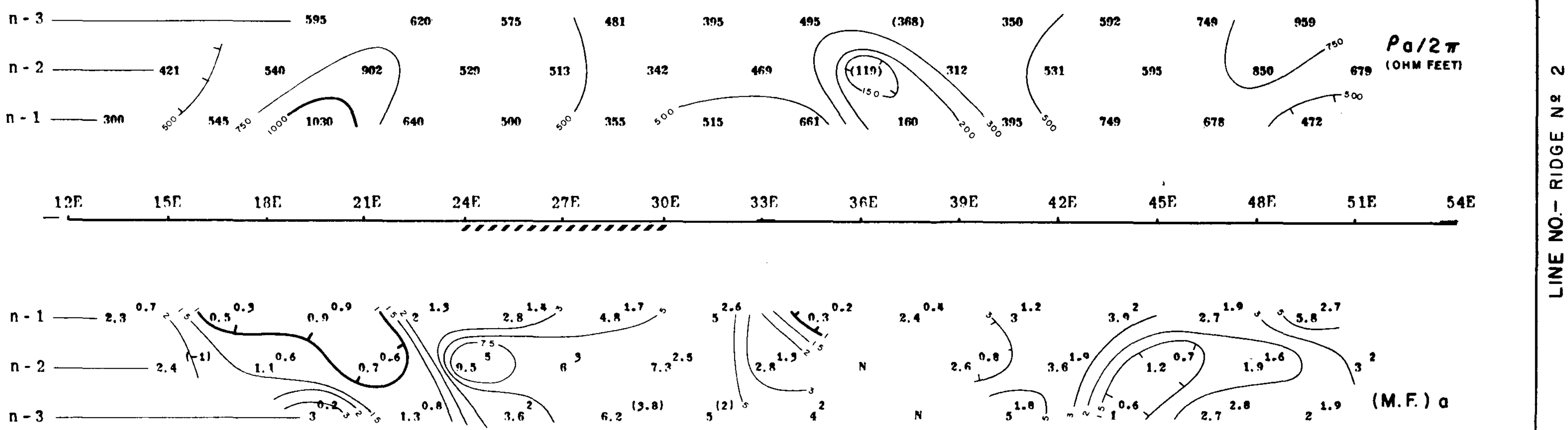
DWG. NO.–I.P.– 2312–5

McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY

Department of Mines and Petroleum Resources ASSESSMENT REPORT NO. 775 MAP #6





AMERICAN METAL CLIMAX, INCORPORATED

(PROJECT 241)

KITIMAT RIVER AREA – B.C.

Scale–One inch = 300 Feet

NOTE LOGARITHMIC CONTOUR INTERVAL

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

775

FREQUENCY 0.3 & 5.0 c.p.s.

DATE SURVEYED OCT / 65

APPROVED RAB

DATE

DWG. NO.–I.P.–2312-6

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INDUCED POLARIZATION AND RESISTIVITY SURVEY

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 775 MAP #7

AMERICAN METAL CLIMAX, INCORPORATED

(PROJECT 241)

KITIMAT RIVER AREA – B.C.

Scale–One inch= 300 Feet

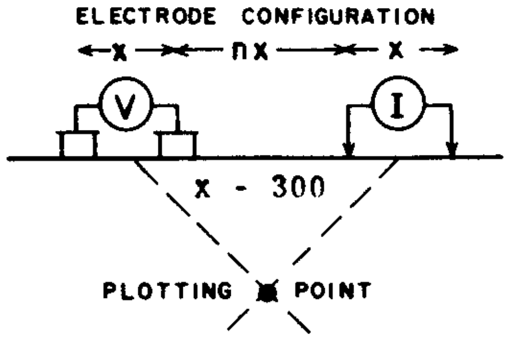
NOTE: LOGARITHMIC CONTOUR INTERVAL

775

FREQUENCY 0.31 & 5 CPS.
DATE SURVEYED OCT/65
APPROVED
DATE

McPHAR GEOPHYSICS LIMITED

DWG. NO.-I.P.-2312-7

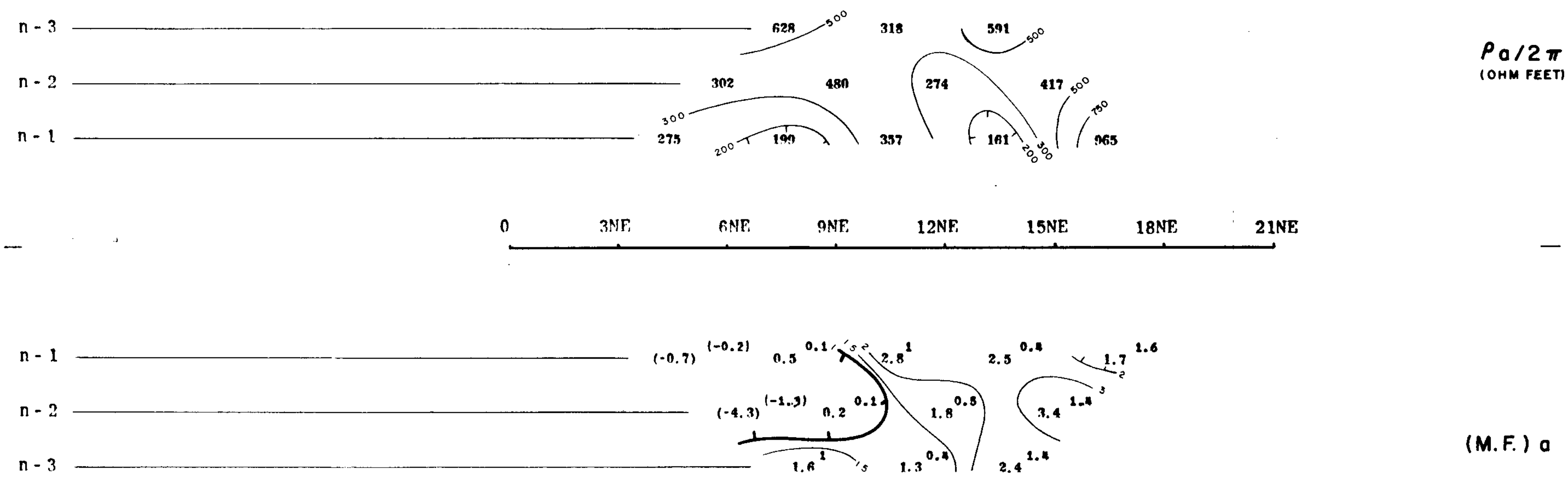


McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 775 MAP #8

LINE NO.-" MANTLE CREEK "



AMERICAN METAL CLIMAX, INCORPORATED

(PROJECT 241)

KITIMAT RIVER AREA - B.C.

Scale-One inch = 300 Feet

NOTE LOGARITHMIC CONTOUR INTERVAL

775

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCY 0.31 & 5.0 C.P.S.

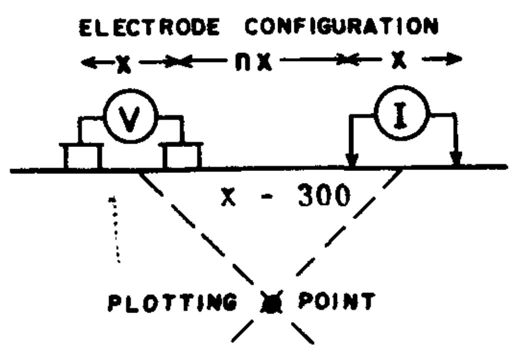
DATE SURVEYED OCT/66

APPROVED RAB

DATE

McPHAR GEOPHYSICS LIMITED

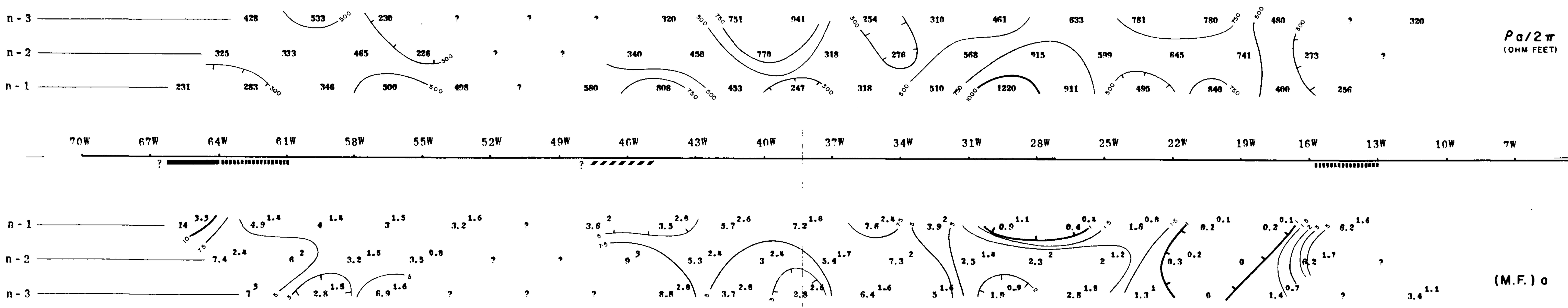
DWG. NO.-I.P.- 2312-8



McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 775 MAP #9



LINE NO.- "ELL" (26 S)

AMERICAN METAL CLIMAX, INCORPORATED

(PROJECT 241)

KITIMAT RIVER AREA - B.C.

Scale-One inch= 300 Feet

NOTE LOGARITHMIC CONTOUR INTERVAL

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

775

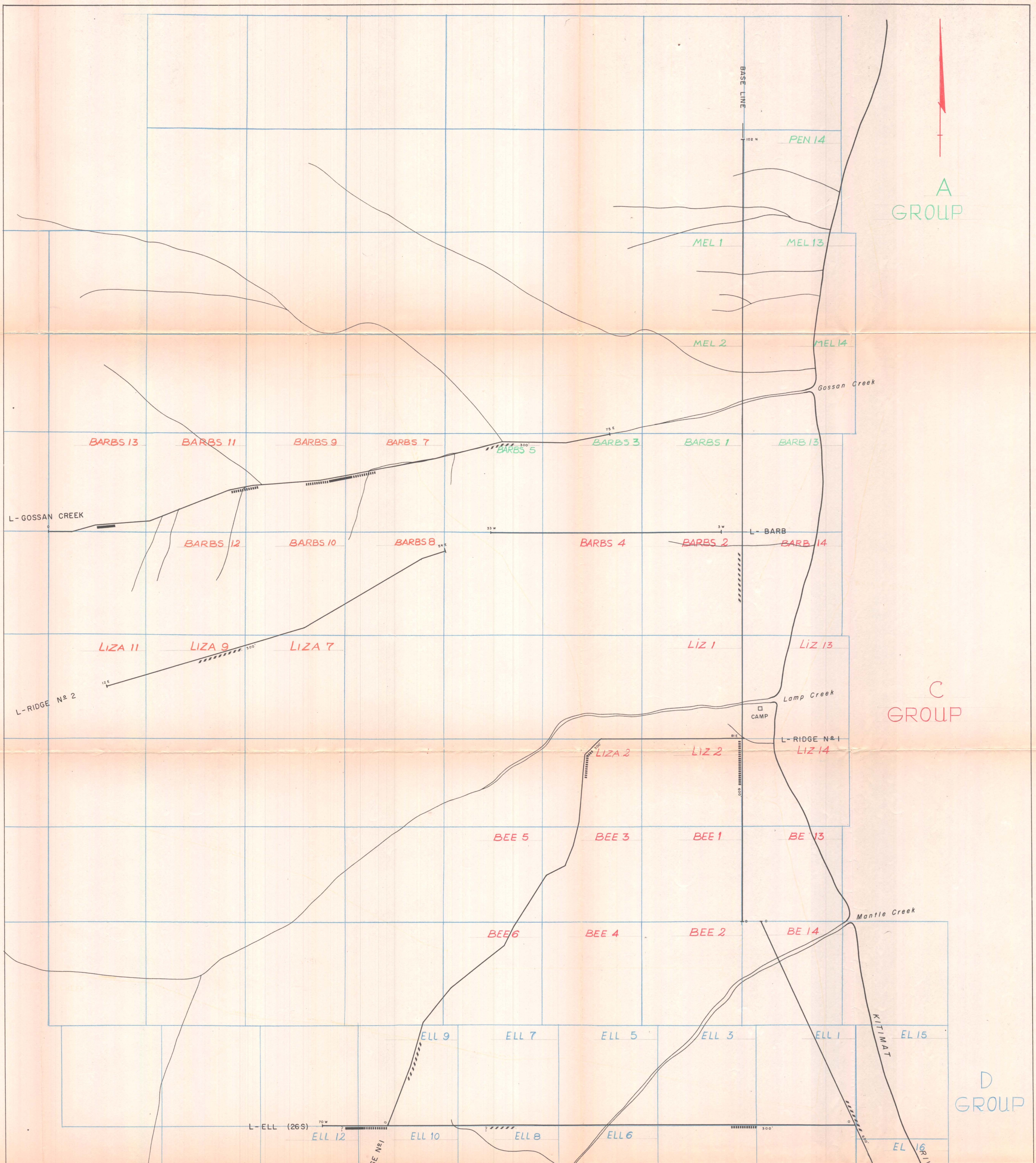
FREQUENCY .031 & 5.0 C.P.S.
DATE SURVEYED OCT/65
APPROVED RAB
DATE Nov 22/65

McPHAR GEOPHYSICS LIMITED

McPHAR GEOPHYSICS LIMITED

INDUCED POLARIZATION AND RESISTIVITY SURVEY

LOCATION MAP



To accompany report by: R.A. Bell (McPhar Geophysics Ltd).

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

NUMBERS AT END OF ANOMALIES INDICATE SPREAD USED

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 775 MAP #1

AMERICAN METAL CLIMAX, INCORPORATED

(PROJECT 241)

KITIMAT RIVER AREA - B.C.

SCALE

One Inch = Five Hundred Feet

775

DRAWN: K.B.
DATE: NOV. 1965
APPROVED:
McPHAR GEOPHYSICS LIMITED
DATE:

DWG. MISC. 4186