3986

REPORT ON 104G/6E
INDUCED POLARIZATION
AND RESISTIVITY SURVEY
PROJECT 124, COLUMBIA RIVER GRID
(ARC & ROSE CLAIMS)
SCHAFT CREEK AREA
LIARD MINING DIVISION, B.C.
FOR
PHELPS DODGE CORPORATION OF CANADA LTD.

BY

ASHTON W. MULLAN, B.Sc.

and

ROBERT A. BELL, Ph.D.

NAME AND LOCATION OF PROPERTY:

PROJECT 124, COLUMBIA RIVER GRID
(ARC & ROSE CLAIMS)
SCHAFT CREEK AREA
LIARD MINING DIVISION, B.C. 51° N - 131° W - SE

DATE STARTED: JULY 14, 1972

DATE FINISHED: AUGUST 12, 1972

TABLE OF CONTENTS

McPHAR GEOPHYSICS

NOTES ON THE THEORY, METHOD OF FIELD OPERATION, AND PRESENTATION OF DATA FOR THE INDUCED POLARIZATION METHOD

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 appreciably reduce the amount of 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 per cent frequency effect or F. E. are a measurement of the polarization in the rock mass. However, since the measurement of the degree of polarization is related to the apparent resistivity of the rock mass it is found that the metal factor values or M. F. are the most useful values in determining the amount of polarization present in the rock mass. The MF values are obtained by normalizing the F. E. values for varying resistivities.

The induced polarization measurement is perhaps the most powerful geophysical method for the direct detection of metallic sulphide mineralization, even when this mineralization is of very low concentration. The lower limit of volume per cent sulphide necessary to produce a recognizable IP anomaly will vary with the geometry and geologic environment of the source, and the method of executing the survey. However, sulphide mineralization of less than one per cent by volume has been detected by the IP method under proper geological conditions.

The greatest application of the IP method has been in the search for disseminated metallic sulphides of less than 20% by volume. However, it has also been used successfully in the search for massive sulphides in situations where, due to source geometry, depth of source, or low resistivity of surface layer, the EM method can not be successfully applied. The ability to differentiate ionic conductors, such as water filled shear zones, makes the IP method a useful tool in checking EM anomalies which are suspected of being due to these causes.

In normal field applications the IP method does not differentiate between the economically important metallic minerals such as chalcopyrite, chalcocite, molybdenite, galena, etc., and the other metallic minerals such as pyrite. The induced polarization effect is due to the total of all electronic conducting minerals in the rock mass. Other electronic conducting materials which can produce an IP response are magnetite, pyrolusite, graphite, and some forms of hematite.

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 in distance (X) apart. The potentials are measured at two other points (X) feet apart, in line with the current 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, apparent per cent frequency effect, 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. (See Figure A.) The resistivity values are plotted above the line as a mirror image of the metal factor values below. On a second line, below the metal factor values, are plotted the values of the per cent frequency effect. In some cases the values of per cent frequency effect are plotted as superscripts of the metal factor value. In this second case the frequency effect values are not contoured. 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. The 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 results, model study results and theoretical investigations. The position of the electrodes when anomalous values are measured is important 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 25 feet to 2000 feet for (X). In each case, the decision as to the distance (X) and the values of (n) to be used 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 A demonstrates the method used in plotting the results. Each value of the apparent resistivity, apparent metal factor, and apparent per cent frequency effect 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. When the F.E. values are plotted as superscripts to the MF values the third section of data values is not presented and the F.E. values are not contoured.

The actual data plots included with the report are prepared utilizing an IBM 360/75 Computer and a Calcomp 770/763 Incremental Plotting System. The data values are calculated, plotted, and contoured according to a programme developed by McPhar Geophysics. Certain symbols have been incorporated into the programme to explain various situations in recording the data in the field.

The IP measurement is basically obtained by measuring the difference in potential or voltage (ΔV) obtained at two operating frequencies. The voltage is the product of the current through the ground and the apparent resistivity of the ground. Therefore in field situations where the current is very low due to poor electrode contact, or the apparent resistivity is very low, or a combination of the two effects; the value of (ΔV) the change in potential will be too small to be measurable. The symbol "TL" on the data plots indicates this situation.

In some situations spurious noise, either man made or natural, will render it impossible to obtain a reading. The symbol "N" on the data plots indicates a station at which it is too noisey to record a reading. If a reading can be obtained, but for reasons of noise there is some doubt as to its accuracy, the reading is bracketed in the data plot ( ).

In certain situations negative values of Apparent Frequency Effect are recorded. This may be due to the geologic environment or spurious electrical effects. The actual negative frequency effect value recorded is indicated on the data plot, however the symbol "NEG" is indicated for the corresponding value of Apparent Metal Factor. In contouring negative values the contour lines are indicated to the nearest positive value in the immediate vicinity of the negative value.

The symbol "NR" indicates that for some reason the operator did not attempt to record a reading although normal survey procedures would suggest that one was required. This may be due to inaccessible topography or other similar reasons. Any symbol other than those discussed above is unique to a particular situation and is described within the body of the report.

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

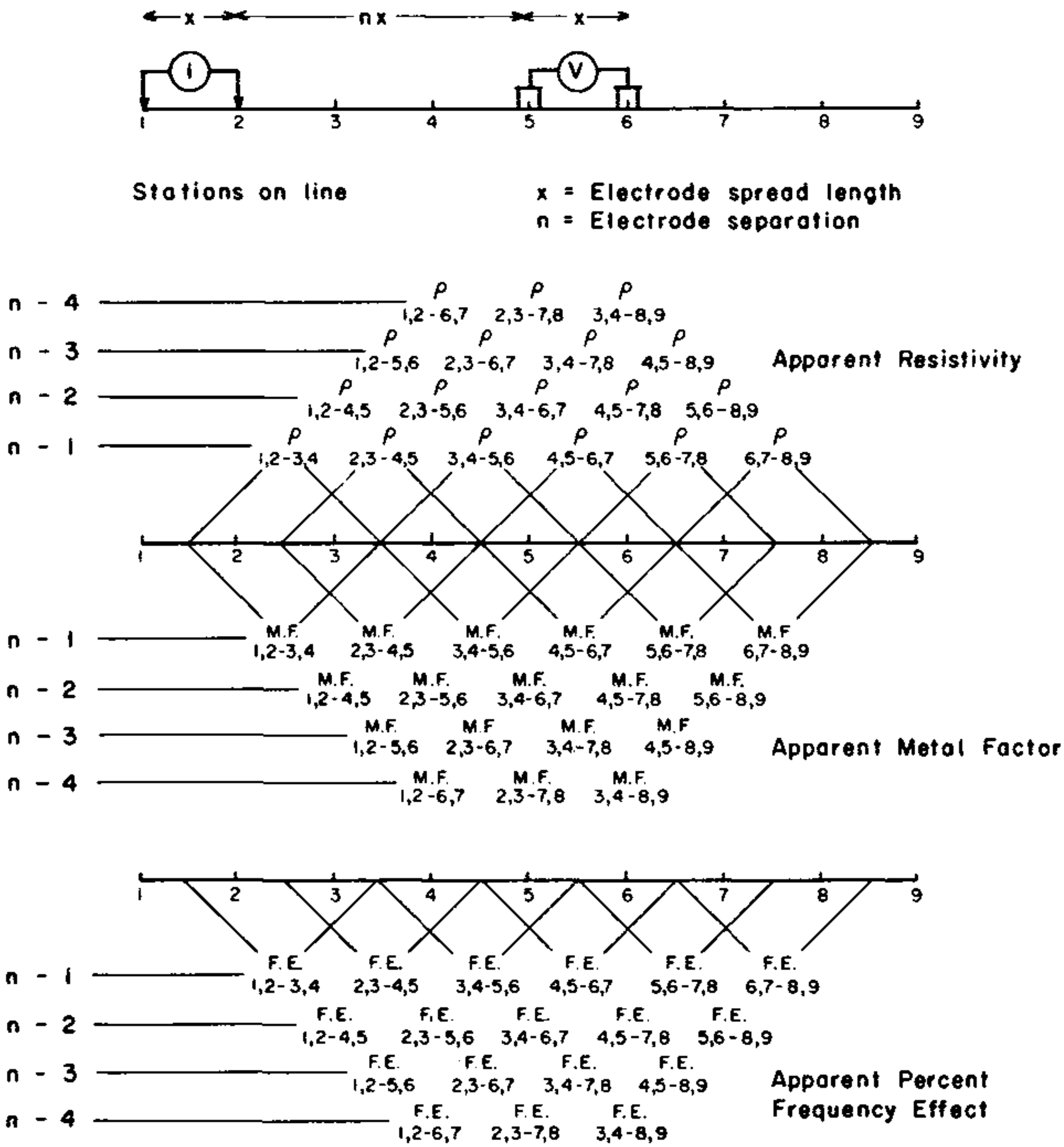

Fig. A

McPHAR GEOPHYSICS LIMITED

REPORT ON INDUCED POLARIZATION AND RESISTIVITY SURVEY PROJECT 124, COLUMBIA RIVER GRID (ARC & ROSE CLAIMS) SCHAFT CREEK AREA, LIARD MINING DIVISION, B.C. FOR PHELPS DODGE CORPORATION OF CANADA LIMITED

1. INTRODUCTION

During August of 1972 we carried out a reconnaissance Induced Polarization survey on the Arc and Rose claim groups for Phelps Dodge Corporation of Canada Limited. The claims are located in the Schaft Creek area of British Columbia, approximately 30 miles south of Telegraph Creek; this location is in Liard Mining Division, in the southeast quadrant of the one-degree quadrilateral whose southeast corner is at 57°N latitude and 131°W longitude.

The immediate area of the claim group is believed to be underlain by a monzonite intrusive, although outcrops are sparse throughout most of the grid. At least locally the monzonite is well fractured, altered and mineralized with chalcopyrite, bornite and minor molybdenite. The IP survey was carried out to search for concentrations of metallic minerals that might be of economic value. Measurements were made with a McPhar P660 variable frequency IP system operating at 0.3 and 5.0 Hz over the following claims believed to be owned or held under option by Phelps Dodge Corporation of Canada Limited.

Arc 9, 11, 12, 13, 14, 23, 24, 25, 26, 27, 28

Rose 4, 5, 6, 7, 8, 10

2. PRESENTATION OF RESULTS

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

Line	Electrode Intervals	Dwg. No.
100N	200 feet	IP 6011-1
800N	200 feet	IP 6011-2
1600N	200 feet	IP 6011-3
2400N	200 feet	IP 6011-4
3200N	200 feet	IP 6011-5
4000N	200 feet	IP 6011-6
4800N	200 feet	IP 6011-7
5600N	200 feet	IP 6011-8
A	200 feet	IP 6011-9

Also enclosed with this report is Dwg. I.P.P. 3554, a plan map of the Columbia River Grid at a scale of 1" = 400'. The definite, probable and possible Induced Polarisation anomalies are indicated by bars, in the manner shown on the legend, on this plan map as well as on 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 Polarisation 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 electrode interval length; i.e. when using 200' electrode intervals the position of a narrow sulphide body can only be determined to lie between two stations 200' apart. In order to definitely locate, and fully evaluate, a narrow, shallow source it is necessary to use shorter electrode intervals. In order to locate sources at some depth, larger electrode intervals must be used, with a corresponding increase in the uncertainties of location. Therefore, while the centre 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.

The grid information shown on Dwg. I.P.P. 3554 has been taken from maps made available by the staff of Phelps Dodge Corporation of Canada Limited.

3. DISCUSSION OF RESULTS

Line 100N

No strong anomalies were located on this traverse but there is a probable anomaly centred at station 8E. Anomalies of this magnitude are normally caused by very small amounts of metallic mineralisation and hence are unlikely to be of economic importance unless the source contains a high ratio of ore sulphides to pyrite. This is the case in a few deposits, such as

Brenda Mines, when the total sulphide content is only about 1.5% (see accompanying appendix).

Throughout most of the traverse there is a small but distinct increase in the apparent Frequency Effect with increasing electrode separation, but this is accompanied by only a small increase in the Metal Factor values.

There appears to be a change in rock type or character (i.e. alteration) at the Base Line, judging from the increased resistivity level on the west half of the line.

Line 800N

There is a possible weak anomaly centred at 12E to 14E and a distinct F.E. high at 20W to 22W. Again there is a high resistivity zone on the western part of the traverse but the level decreases with increasing separation, suggesting an edge effect.

Line 1600N

The resistivity level is low to moderate throughout Line 1600N and the background M.F. values are higher, except for n = 1. Probable anomalies have been shown at 10W and 13E; in both instances there is a small but distinct increase in the Frequency Effects.

Line 2400N

These results are similar to those obtained on Line 1600N, with a minor increase in the M.F. and F.E. values between 3E and 9E.

Line 3200N

No significant variations in IP response were measured on this line.

The resistivity level is somewhat higher than on Line 2400N.

Line 4000N

These results are blank except for a slight increase in M.F. and F.E. values at the extreme eastern end of the line.

Line 4800N and Line 5600N

No anomalies have been identified on either of these traverses. The only variation in the IP response is a slight increase in F.E. with increasing separation.

Line A

These results are essentially blank.

4. SUMMARY AND RECOMMENDATIONS

No definite anomalies, indicative of either narrow concentrated sources or widespread disseminated sources, were located by the IP survey. Weak responses were obtained on Line 100N, Line 800N, Line 1600N and Line 2400N forming an irregular zone. However, the magnitude of the anomalies suggests rather sparse mineralisation that is unlikely to be of economic interest unless there is a high proportion of ore minerals, such as bornite and molybdenite. Unless the geological and geochemical data indicate that this would be the case, further work does not appear to be warranted.

McPHAR GEOPHYSICS LIMITED

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA A. W. MULLAN

A.W. Mullan,
Geologist.

Robert A. Bell,
Geologist.

Dated: November 2, 1972

ASSESSMENT DETAILS

PROPERTY: Project 124		MINING DIVISION: Liard
SPONSOR: Phelps Dodge Corporation of Canada Limited		PROVINCE: British Columbia
LOCATION: Schaft Creek Area		
TYPE OF SURVEY: Induced Polarization		
OPERATING MAN DAYS:	38	DATE STARTED: July 14, 1972
EQUIVALENT 8 HR. MAN DAYS:	57	DATE FINISHED: Aug. 12, 1972
CONSULTING MAN DAYS:	1	NUMBER OF READINGS: 1536
DRAUGHTING MAN DAYS:	4	NUMBER OF STATIONS: 170
TOTAL MAN DAYS:	62	MILES OF LINE SURVEYED: 6.1

CONSULTANTS:

A. W. Mullan, 1440 Sandhurst Place, West Vancouver, B. C.
Robert A. Bell, 33 Deepwood Crescent, Don Mills, Ontario.

FIELD TECHNICIANS:

J. MacNeil, 14 Gail Street, Apt. 2, Galt, Ontario.
E. Lalonde, 18 Chapel Street South, Thorold, Ontario.
Plus 2 Helpers: Supplied by Client

DRAUGHTSMEN:

Rosemarie Koenig, 508 Cosburn Avenue, Toronto 6, Ontario.
Barbara Boden, 58 Glencrest Blvd. Toronto 16, Ontario.
Nora Lade, 299 Jasper Avenue, Oshawa, Ontario.

McPHAR GEOPHYSICS LIMITED

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — A. W. MULLAN

A. W. Mullan,
Geologist.

Dated: November 2, 1972

STATEMENT OF COST

Phelps Dodge Corporation of Canada Limited - IP Survey
Project 124, Columbia River Grid (Arc & Rose Claims)
Schaft Creek Area, Liard Mining Division, B.C.

Crew: J. MacNeil & E. Lalonde

9½ days	Operating		@ $250.00 per day	$2,375.00
2 days	Travel	) 3½ days	@ $100.00 per day	350.00
1½ days	Preparation	)		

Expenses prorated @ 9½/21-3/4

Air Fare	$ 97.41	
Air Lift	203.18	
Taxis	14.93	
Meals & Accommodation	49.41	
Freight	98.93	
Supplies	21.74	
	485.60	
Plus 10%	48.56	
		534.16
		$3,259.16

Note: Helicopter transport, food and room and 2 helpers supplied by Phelps Dodge Corporation of Canada Limited.

McPHAR GEOPHYSICS LIMITED

A. W. Mullan,
Geologist.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
A. W. MULLAN

Dated: November 2, 1972

Declared before me at the of VANCOUVER, B.C., in the Province of British Columbia, this day of NOV 28 1972, A.D.

Sub - Mining Recorder

A Commissioner for taking Affidavits within British Columbia or A Notary Public in and for the Province of British Columbia

CERTIFICATE

I, Ashton W. Mullan, of the City of Vancouver, in the Province of British Columbia, hereby certify:

1. That I am a geologist and a fellow of the Geological Association of Canada with a business address at Suite 811, 837 West Hastings Street, Vancouver, B.C.

2. That I am registered as a member of the Association of Professional Engineers of the Provinces of Ontario and British Columbia.

3. That I hold a B.Sc. degree from McGill University.

4. That I have been practising my profession as a geologist for about twenty 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 Phelps Dodge Corporation of Canada Limited or any affiliate.

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

7. Permission is granted to use in whole or in part for assessment and qualification requirements but not for advertising purposes.

Dated at Toronto

This 2nd day of November 1972

PROFESSIONAL
PROVINCE OF
A. W. MULLAN
BRITISH COLUMBIA
ENGINEER

A. W. Mullan, B.Sc., P.Eng.

CERTIFICATE

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

1. I am a geologist residing at 33 Deepwood Crescent, Don Mills, Ontario.

2. I am a graduate of the University 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. (1953).

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 fifteen 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 Phelps Dodge Corporation of Canada Limited or any affiliate.

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

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Dated at Toronto

This 2nd day of November 1972.

Robert A. Bell
Robert A. Bell, Ph.D.

APPENDIX

EXPECTED IP ANOMALIES FROM "PORPHYRY COPPER" TYPE ZONES OF DISSEMINATED SULPHIDE MINERALIZATION

Our experience in other areas has shown that the induced polarization method can be successfully used to locate, and outline, zones of disseminated sulphide mineralization of the "porphyry copper" type. In most cases the interpretation of the IP results is simple and straightforward. The results shown in Figure 1 and Figure 2 are typical.

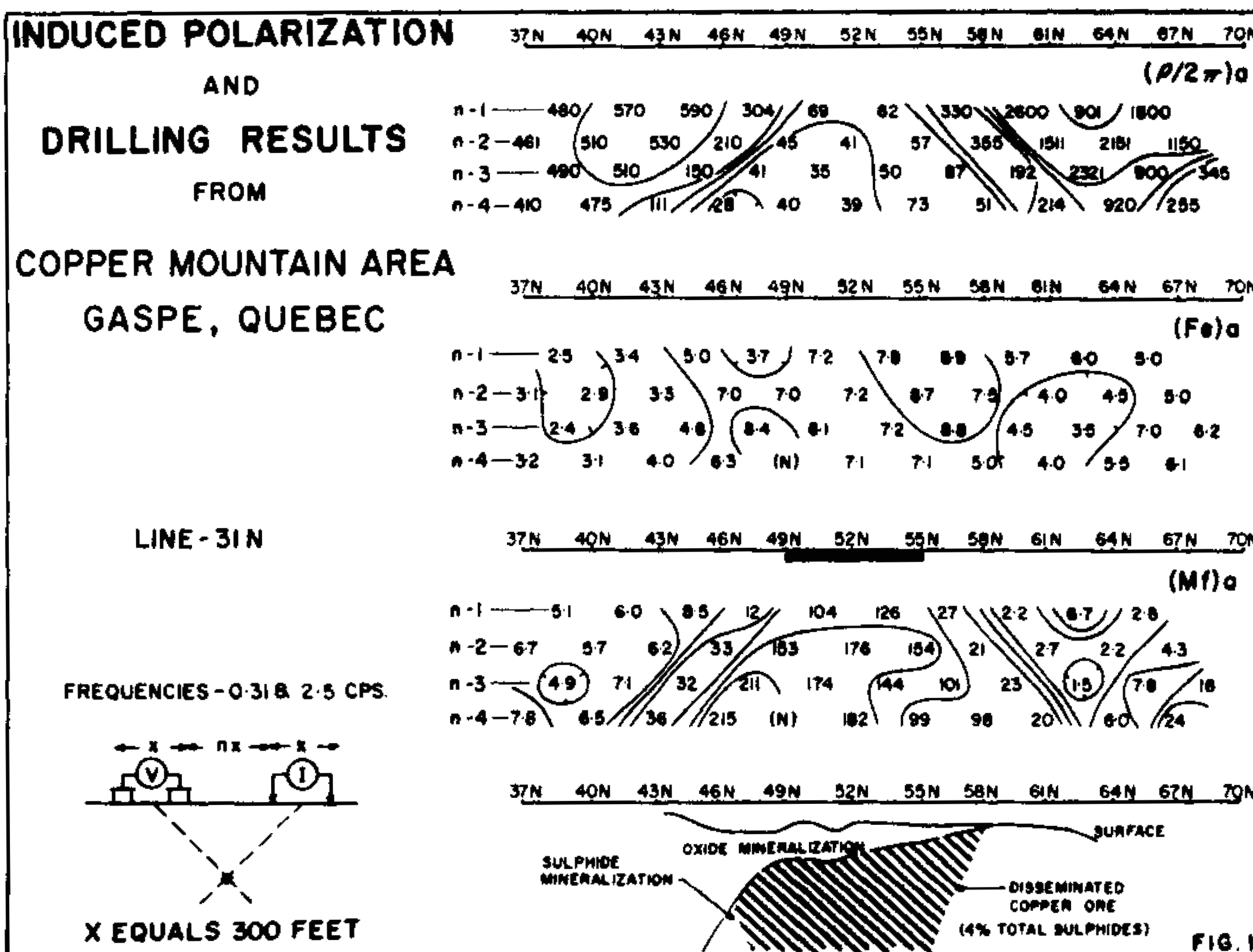
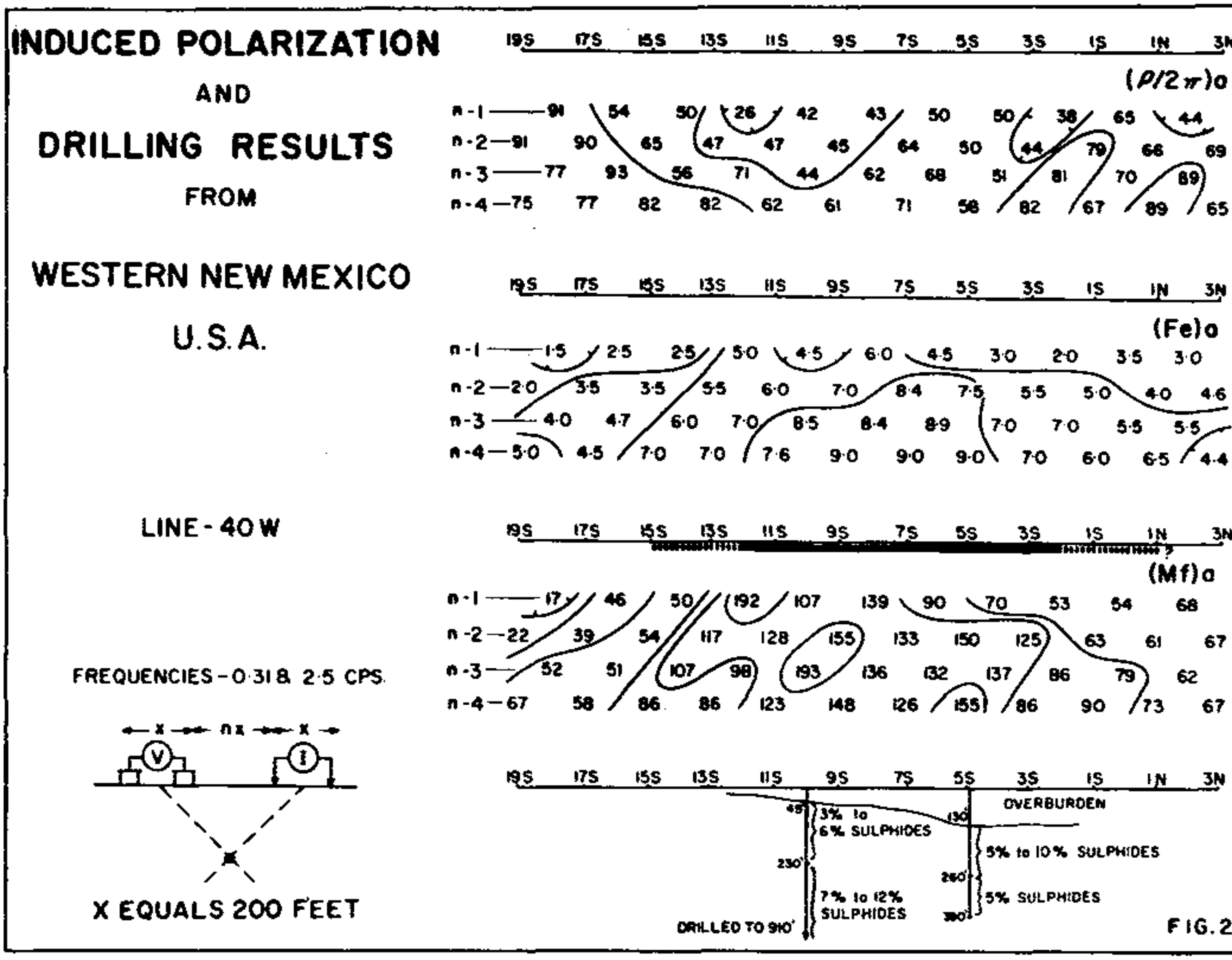


FIG. 1

The source of the moderate magnitude IP anomaly shown in Figure 1 contains approximately 4% metallic mineralization. The zone is of limited lateral extent and enough copper is present to make the mineralization "ore grade". The presence of the surface oxidation can be seen in the fact that the apparent IP effects increase for n = 2.



The IP anomaly shown in Figure 2 has about the same magnitude as that described above. It should be noted that appreciably greater concentrations of metallic mineralization are present; further, there is little or no copper present. These results illustrate the fact that IP results can not be used to determine the exact amount of metallic mineralization present or to determine the economic importance of a mineralized zone. In some geologic situations zoning is present; the zones of mineralization of greatest economic value may contain less total metallic mineralization than other zones in the same general area.

In the proper geologic environment, the method will detect even very low concentrations of metallic mineralization. The IP results shown in Figure 3 located the ore zone at the Brenda Property near Peachland, B. C. The zone contains 1.0 to 1.5 per cent metallic mineralization; however, the mineralization is "ore grade" because only molybdenite and chalcopyrite are present.

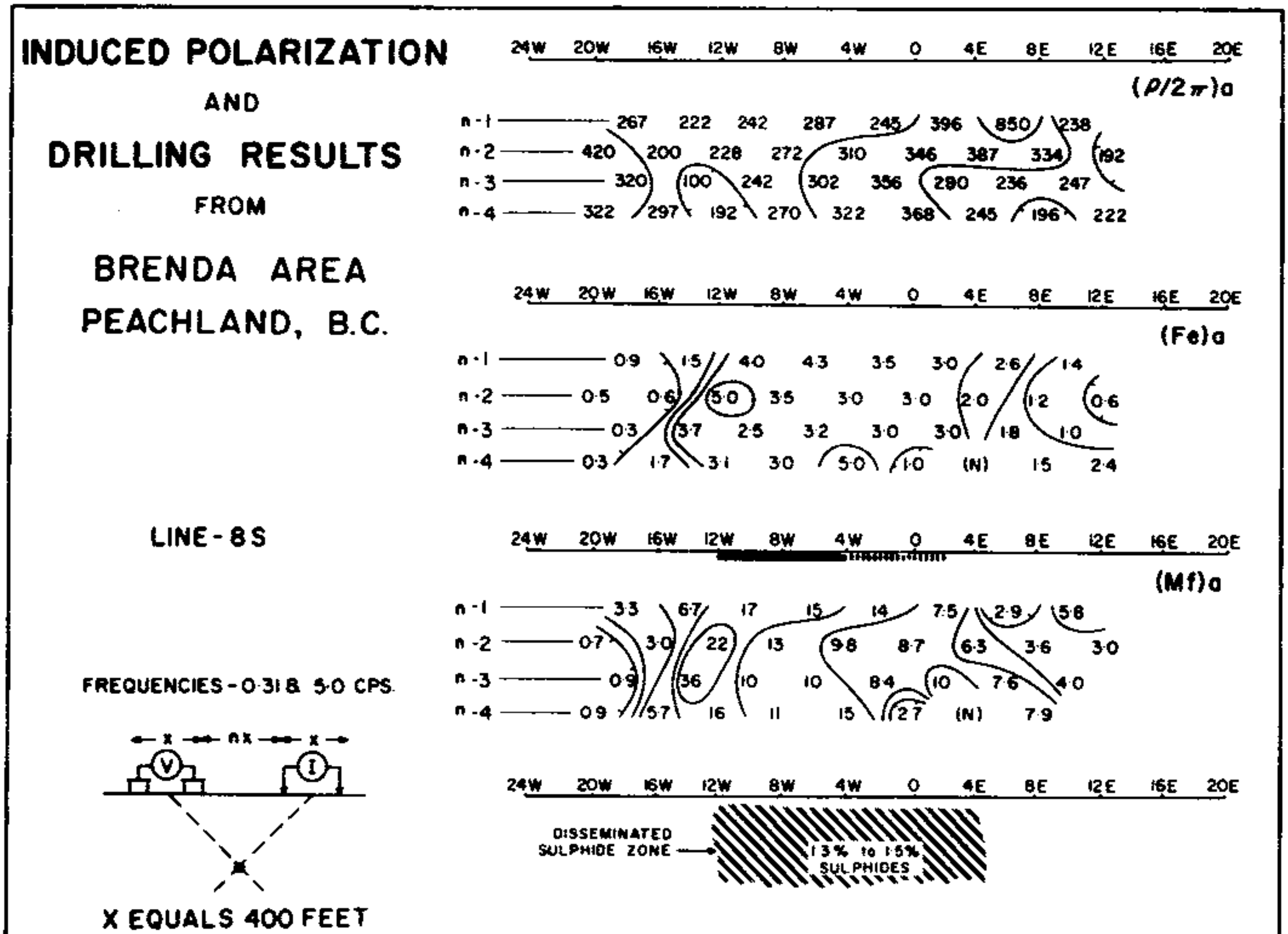
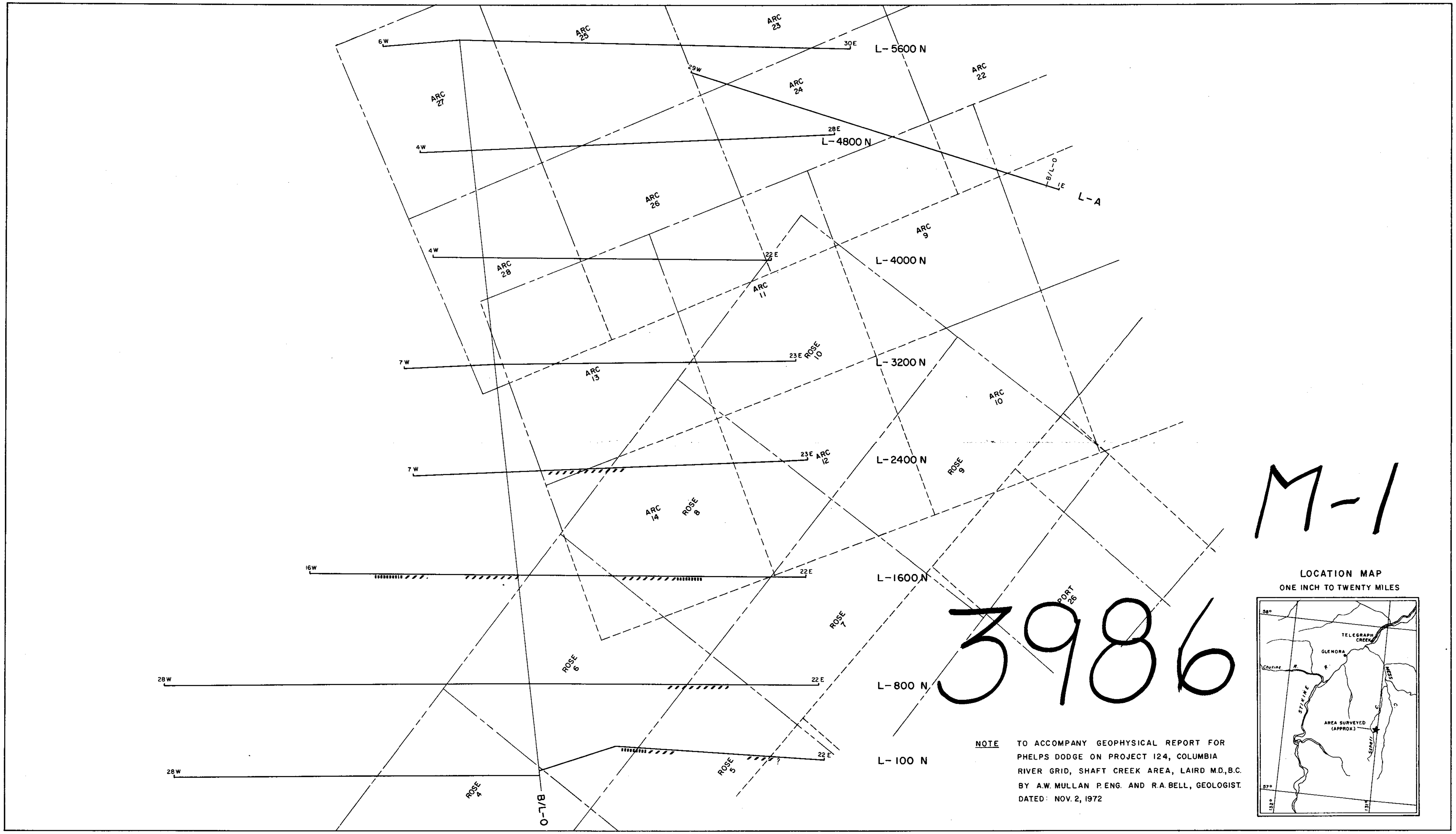


FIG. 3

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

PLAN MAP



NOTE TO ACCOMPANY GEOPHYSICAL REPORT FOR PHELPS DODGE ON PROJECT 124, COLUMBIA RIVER GRID, SHAFT CREEK AREA, LAIRD M.D., B.C. BY A.W. MULLAN P. ENG. AND R.A. BELL, GEOLOGIST. DATED: NOV. 2, 1972

SURFACE PROJECTION OF ANOMALOUS ZONES

- DEFINITE
- PROBABLE
- POSSIBLE

Number of the end of anomaly indicates spread used.

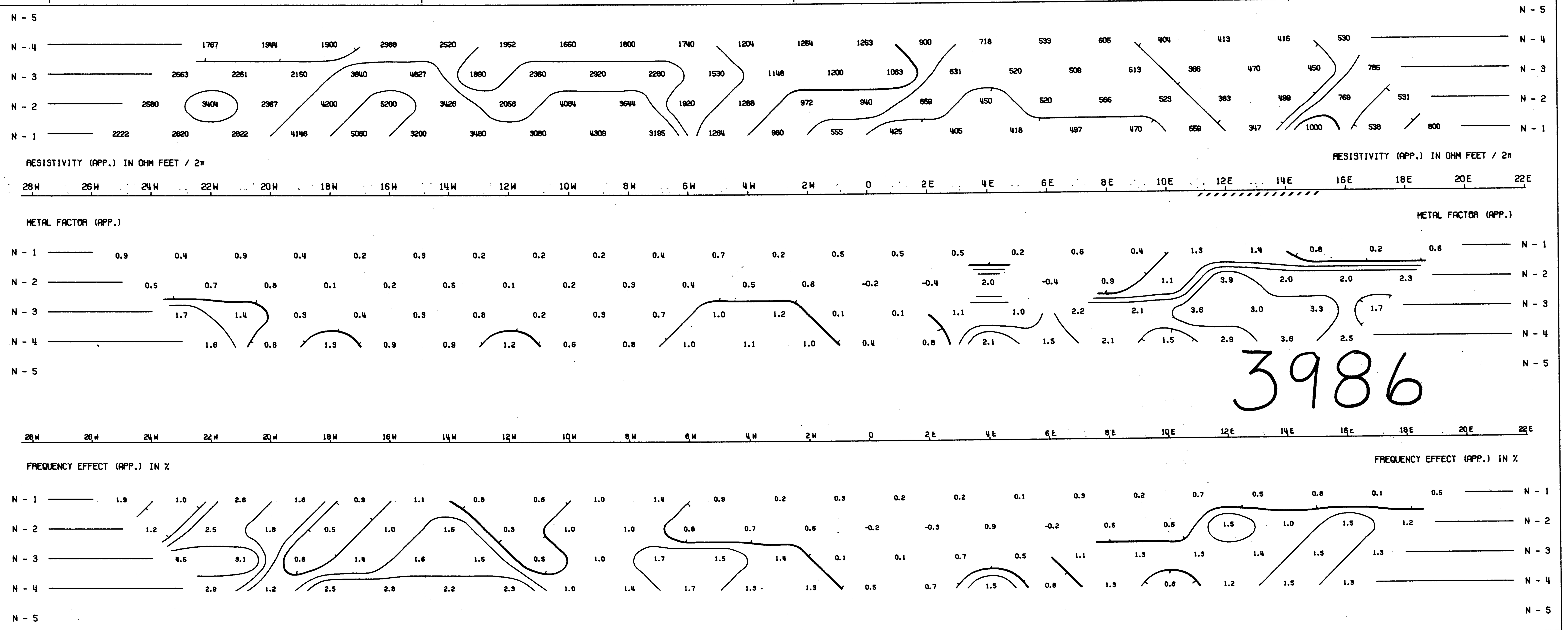
PHELPS DODGE CORPORATION OF CANADA LTD.

PROJECT 124, COLUMBIA RIVER GRID
SCHAFT CREEK AREA, LIARD M.D., B.C.

SCALE
ONE INCH EQUALS FOUR HUNDRED FEET

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3986 MAP #1

PROFESSIONAL ENGINEER — A. W. MULLAN — PROVINCE OF BRITISH COLUMBIA
APPROVED
NOV. 2, 1972



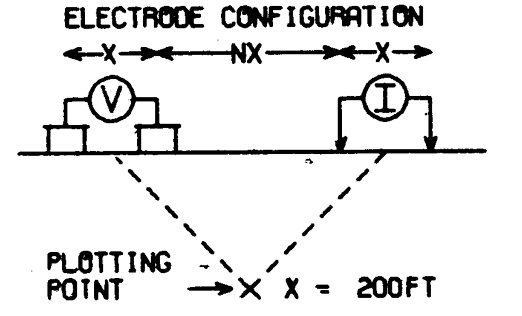
DWG. NO.- I.P.- 6011-2

PHELPS DODGE CORPORATION OF CANADA LTD.

PROJECT 124, COLUMBIA RIVER GRID,
SCHAFT CREEK AREA, LIARD M.D., B.C.

LINE NO.- 800N

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1972

APPROVED

DATE: Nov. 2, 1972

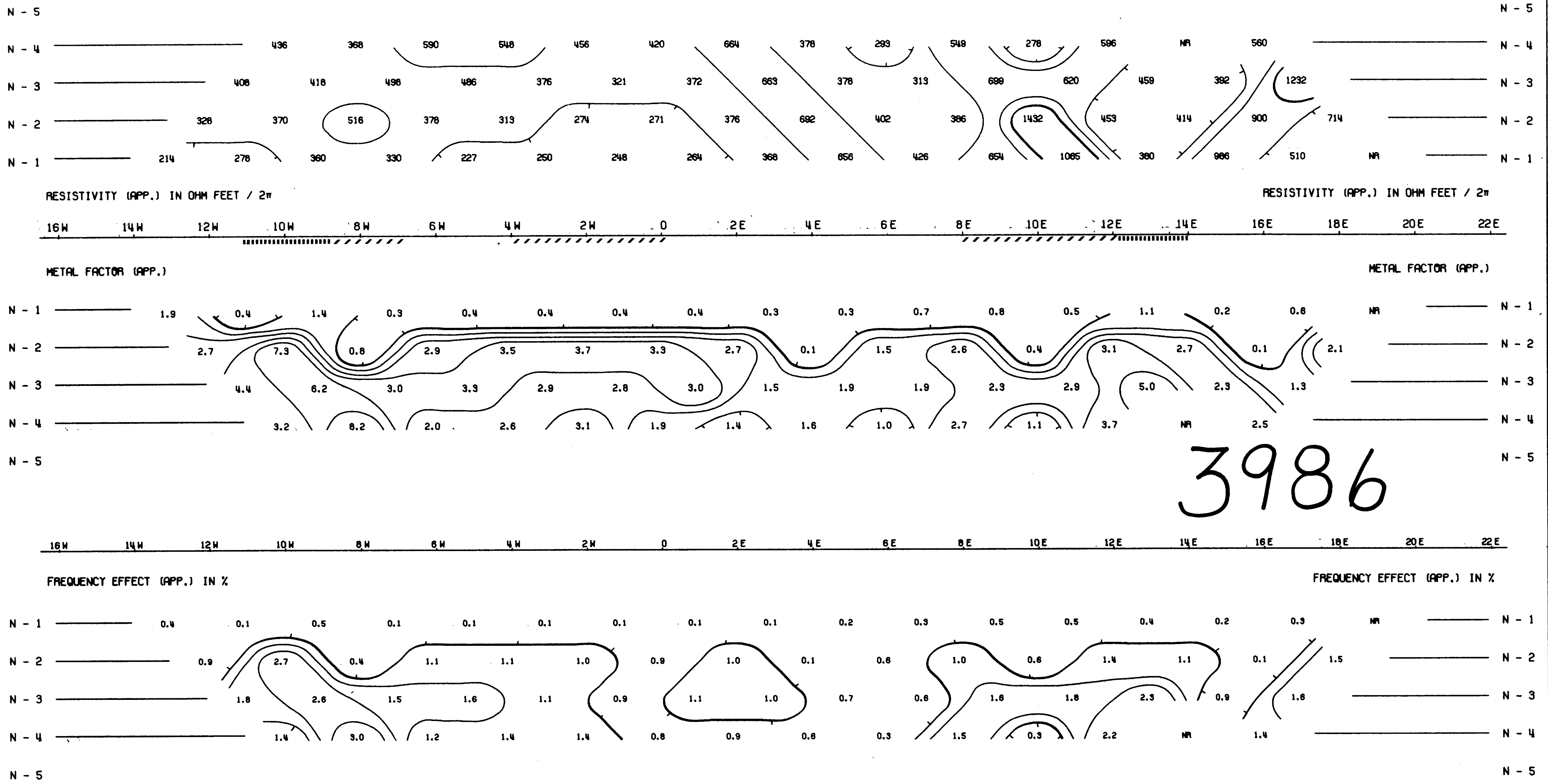
PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
A. W. MULLAN

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION



DWG. NO.- I.P.-6011-3

PHELPS DODGE CORPORATION OF CANADA LTD.

PROJECT 124, COLUMBIA RIVER GRID, SCHAFT CREEK AREA, LIARD M.D., B.C.

LINE NO.- 1600N

ELECTRODE CONFIGURATION

X = 200FT

PLOTTING POINT

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1972

APPROVED:

DATE:

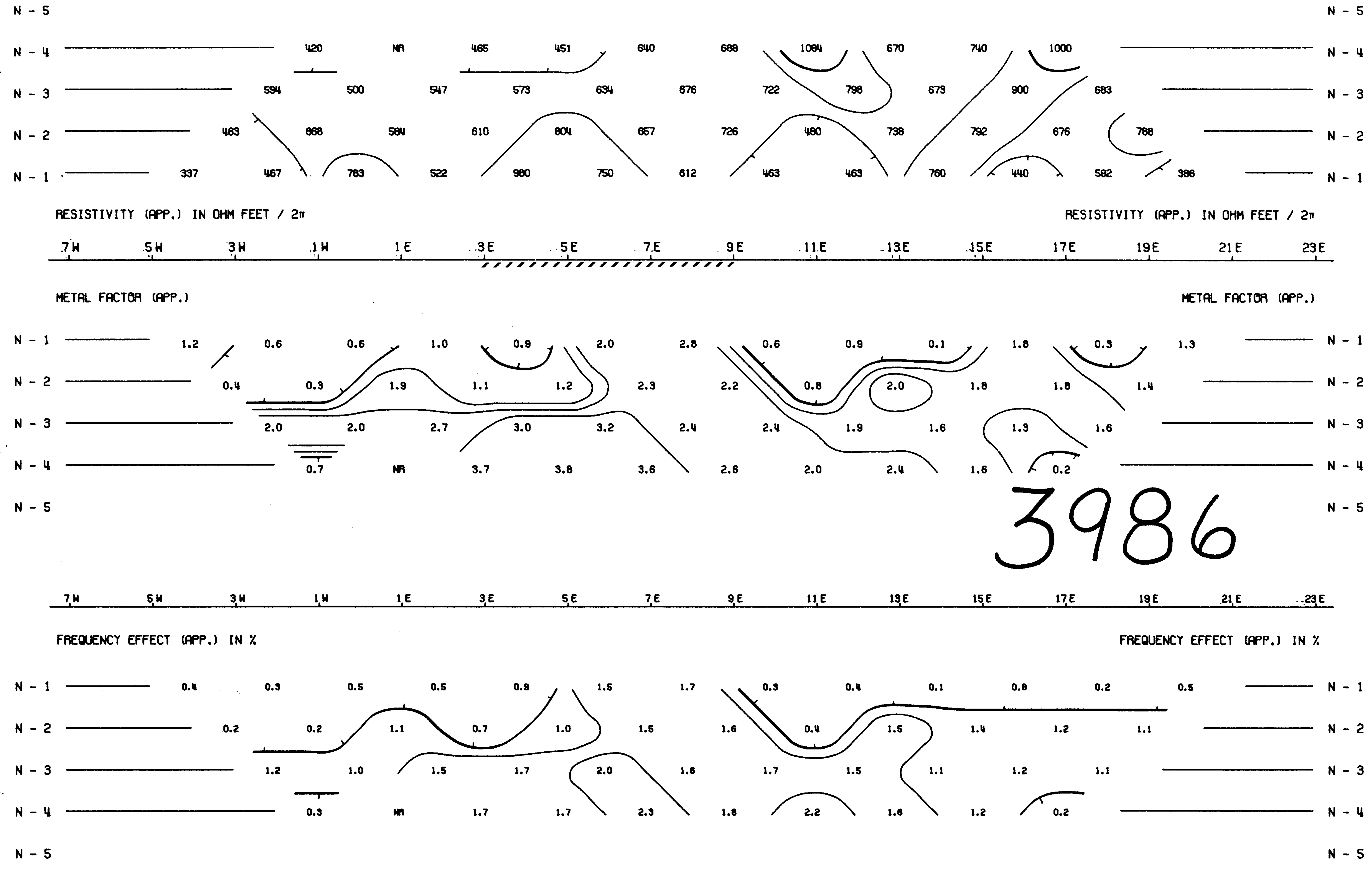
NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

PROFESSIONAL ENGINEER, PROVINCE OF BRITISH COLUMBIA

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY McPHAR COMPUTER DIVISION



DWG. NO.- I.P.- 6011-4

PHELPS DODGE CORPORATION OF CANADA LTD.

PROJECT 124, COLUMBIA RIVER GRID,
SCHAFT CREEK AREA, LIARD M.D., B.C.

LINE NO.- 2400N

ELECTRODE CONFIGURATION
X — NX — X

PLOTTING POINT → X X = 200FT

SURFACE PROJECTION OF ANOMALOUS ZONES
DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1972

NOTE: CONTOURS AT LOGARITHMIC INTERVALS
1.-1.5-2.-3.-5.-7.5-10

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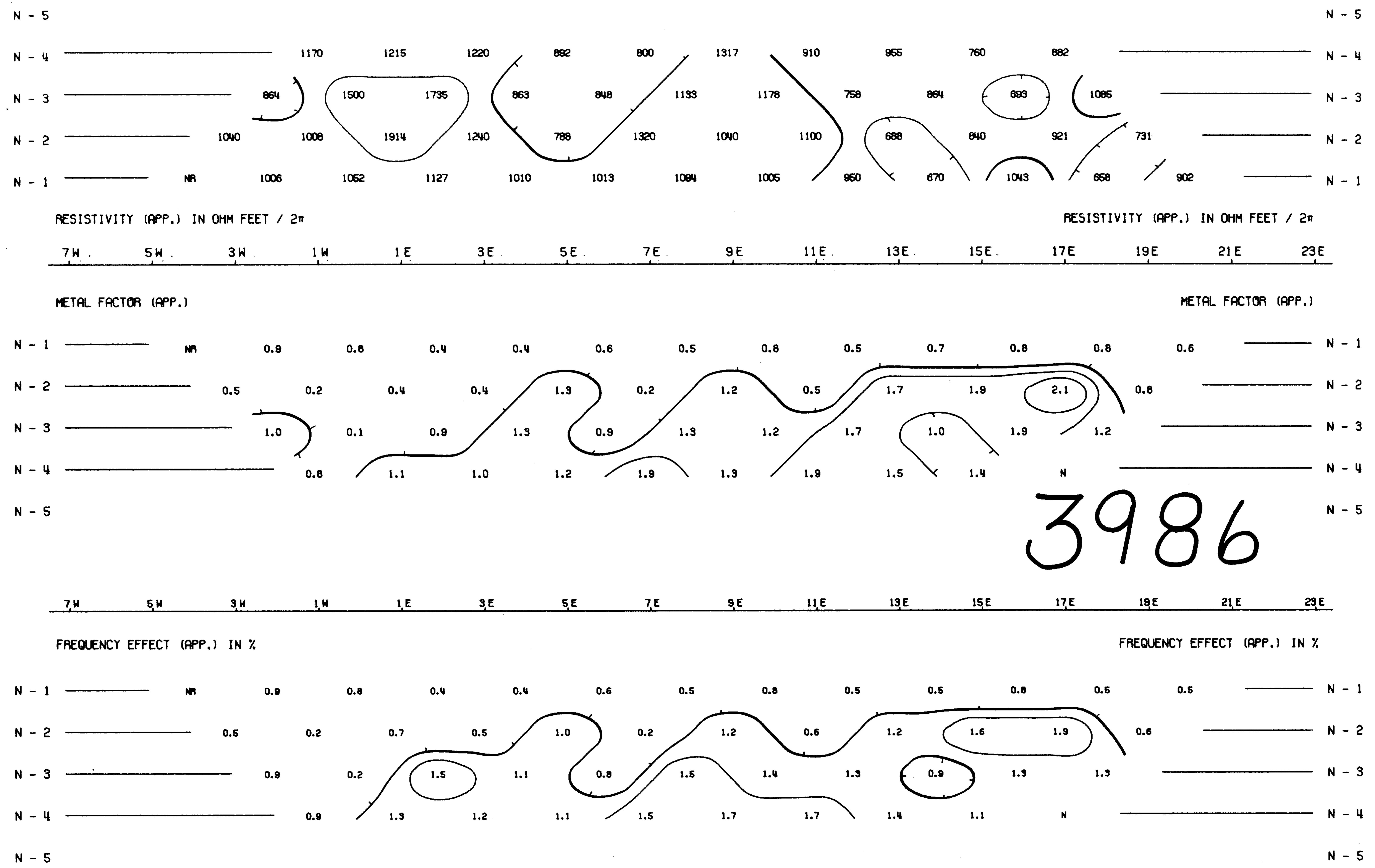
APPROVED: [signature]

DATE: Nov. 2, 1972

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION

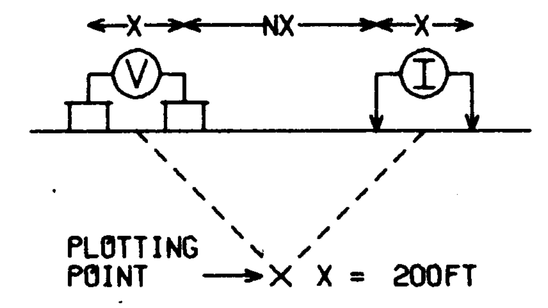


DWG. NO.- I.P.-6011-5

PHELPS DODGE CORPORATION OF CANADA LTD.

PROJECT 124, COLUMBIA RIVER GRID,
SCHAFT CREEK AREA, LIARD M.D., B.C.

LINE NO.- 3200N



SURFACE PROJECTION OF ANOMALOUS ZONES
DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1972

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

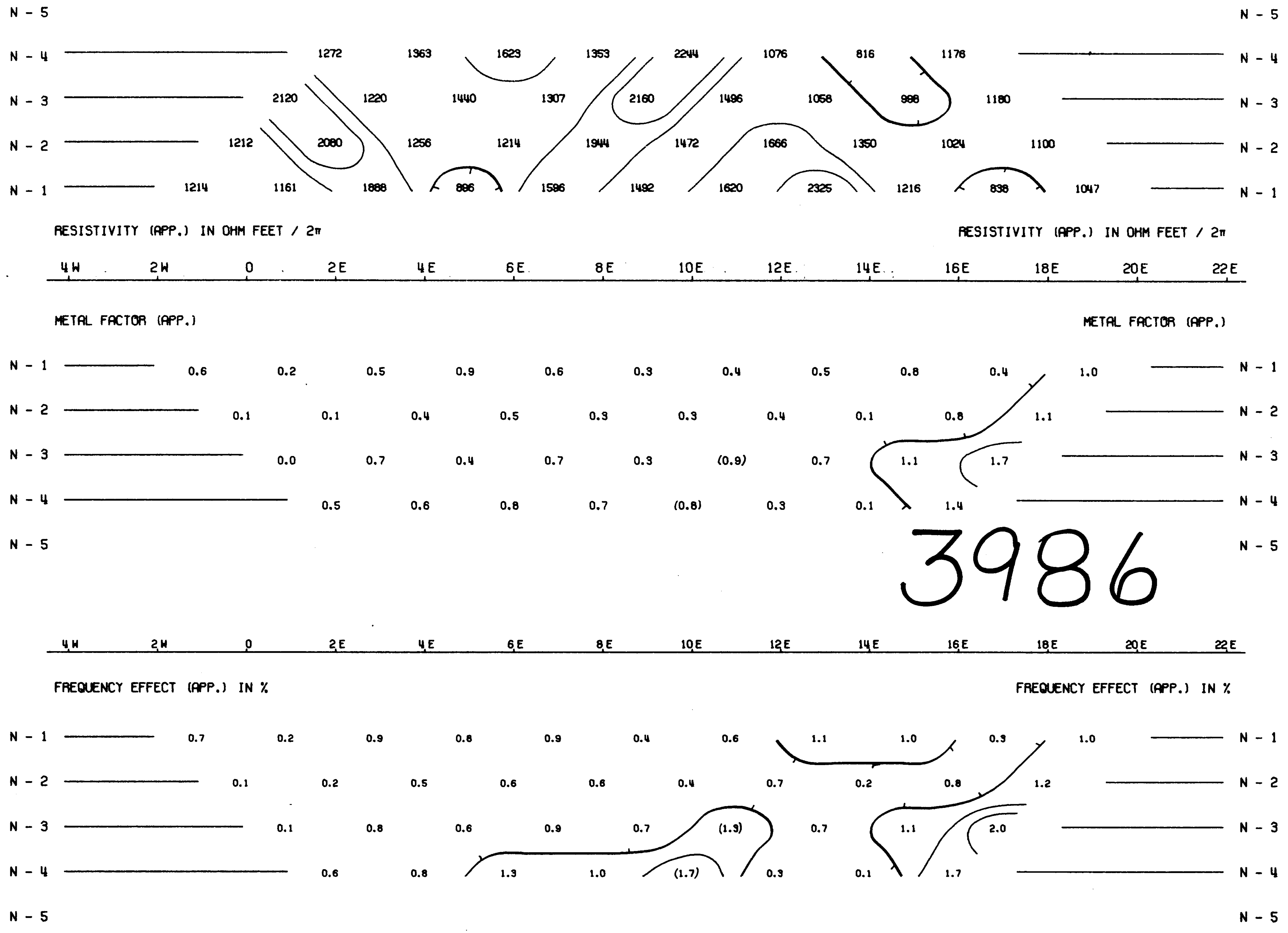
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA A. W. MULLAN

DATE ... 2 1972

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY McPHAR COMPUTER DIVISION



DWG. NO.- I.P.-6011-6

PHELPS DODGE CORPORATION OF CANADA LTD.

PROJECT 124, COLUMBIA RIVER GRID,
SCHAFT CREEK AREA, LIARD M.D., B.C.

LINE NO.- 4000N

ELECTRODE CONFIGURATION

PLOTTING POINT X = 200FT

SURFACE PROJECTION OF ANOMALOUS ZONES
DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1972

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

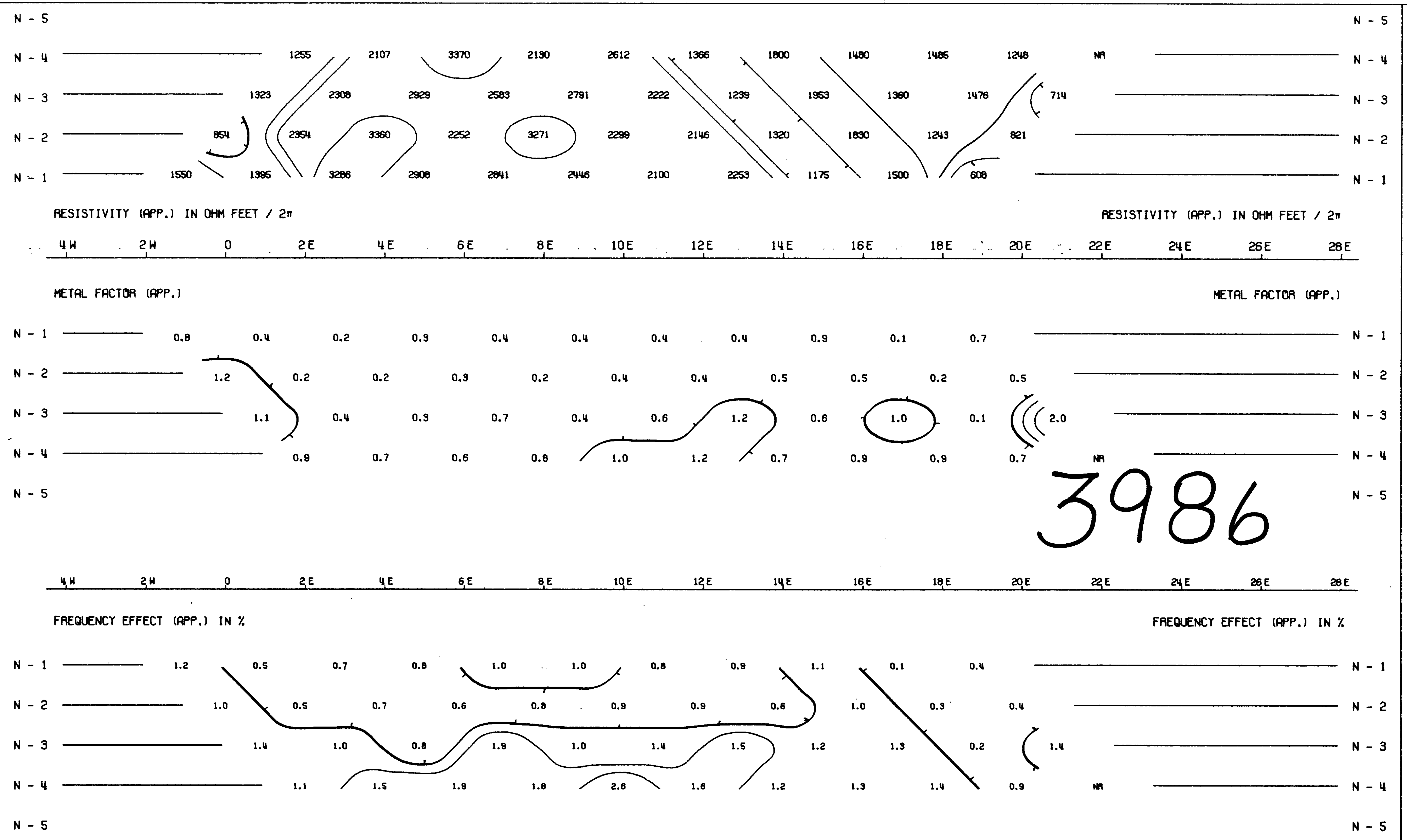
PROFESSIONAL ENGINEER, PROVINCE OF BRITISH COLUMBIA, A. W. MULLAN

DATE: Nov 2, 1972

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY McPHAR COMPUTER DIVISION



DWG. NO.- I.P.-6011-7

PHELPS DODGE CORPORATION OF CANADA LTD.

PROJECT 124, COLUMBIA RIVER GRID,
SCHAFT CREEK AREA, LIARD M.D., B.C.

LINE NO.- 4800N

ELECTRODE CONFIGURATION

PLOTTING POINT X = 200FT

SURFACE PROJECTION OF ANOMALOUS ZONES
DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1972

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

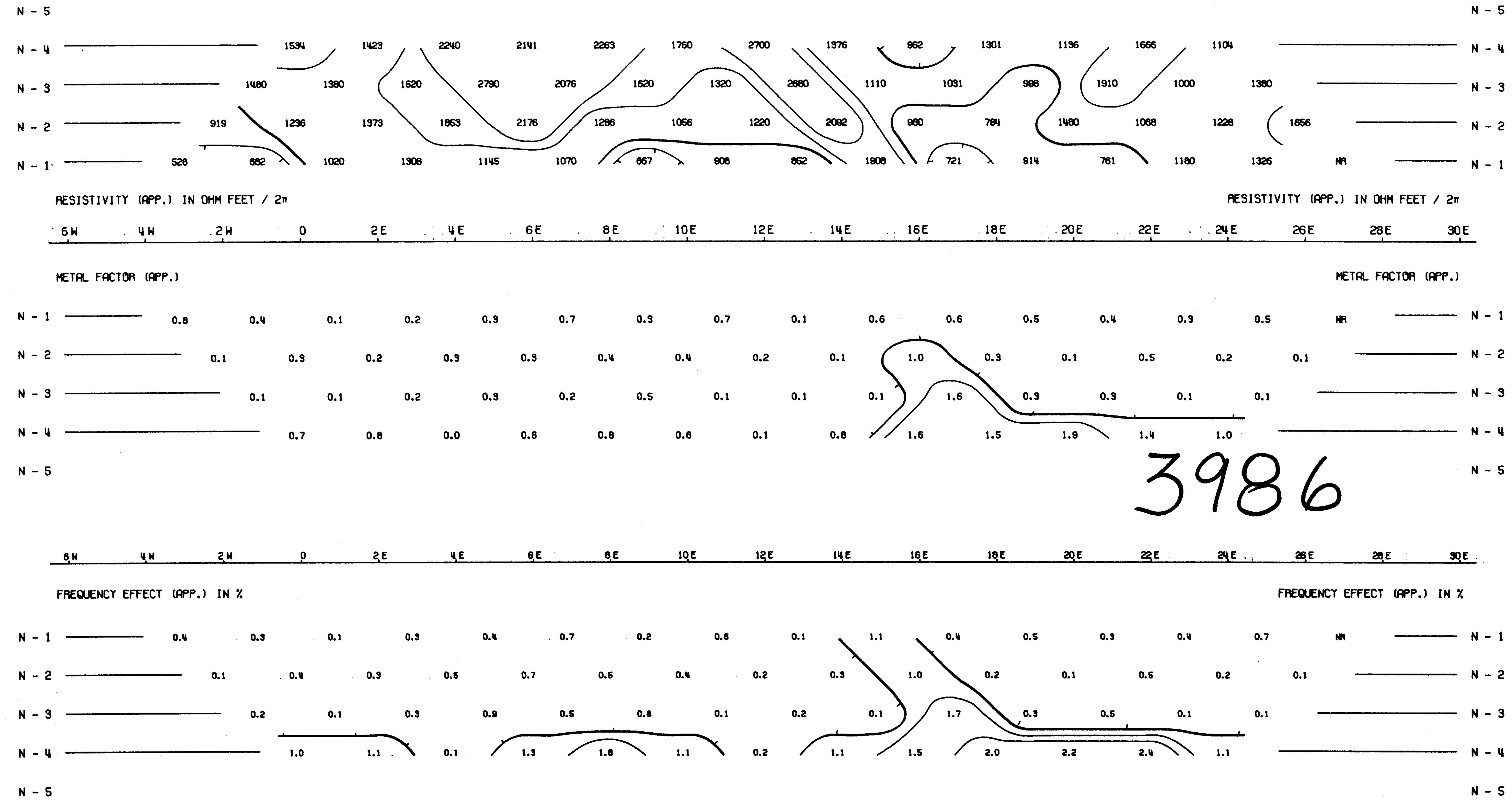
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA A. W. MULLAN

DATE: 2, 1972

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION



DWG. NO.- I.P.- 6011-8

PHELPS DODGE CORPORATION OF CANADA LTD.

PROJECT 124, COLUMBIA RIVER GRID,
SCHAFT CREEK AREA, LIARD M.D., B.C.

LINE NO.- 5600N

ELECTRODE CONFIGURATION

X — NX — X

V I

PLOTTING POINT → X X = 200FT

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1972

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

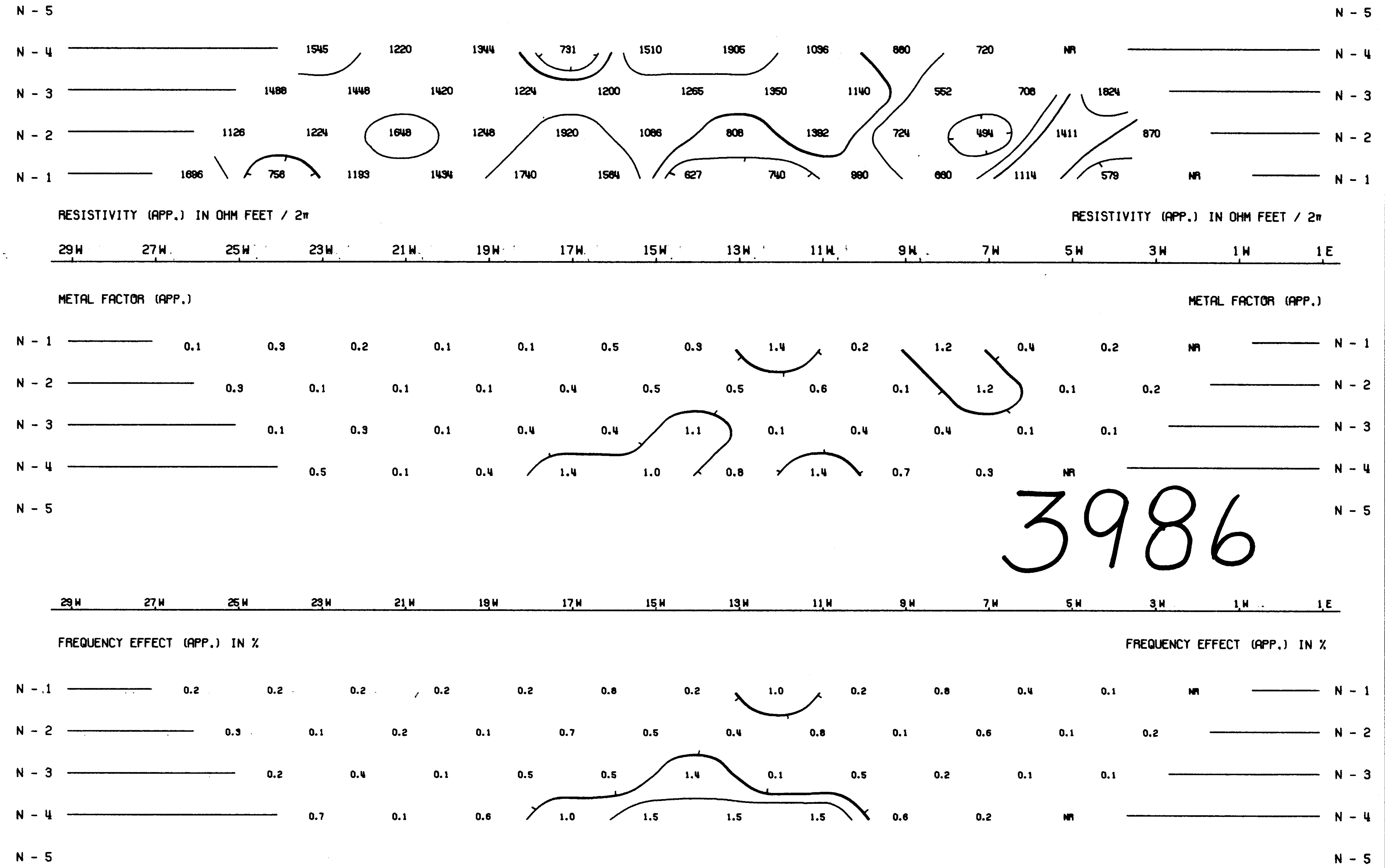
PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — A. W. MULLAN

DATE: ..., 1972

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY McPHAR COMPUTER DIVISION



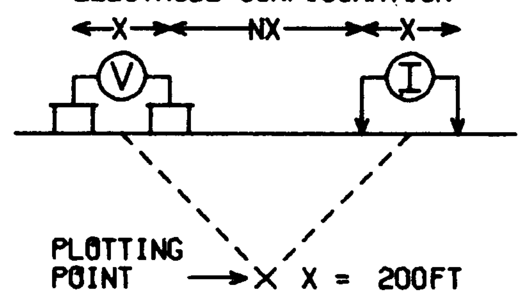
DWG. NO.- I.P.-6011-9

PHELPS DODGE CORPORATION OF CANADA LTD.

PROJECT 124, COLUMBIA RIVER GRID,
SCHAFT CREEK AREA, LIARD M.D., B.C.

LINE NO.- A

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1972

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

APPROVED:

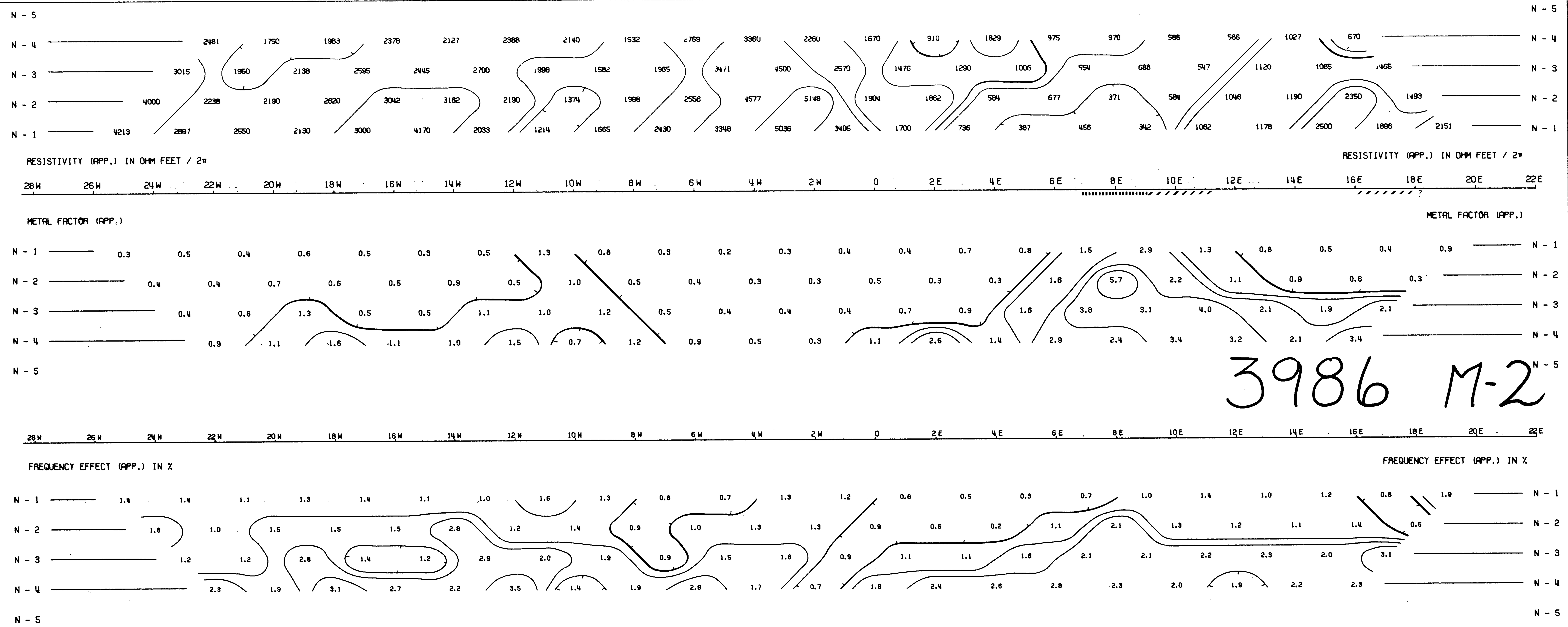
PROFESSIONAL ENGINEER, PROVINCE OF BRITISH COLUMBIA, A. W. MULLAN

DATE: Nov. 2, 1972

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION



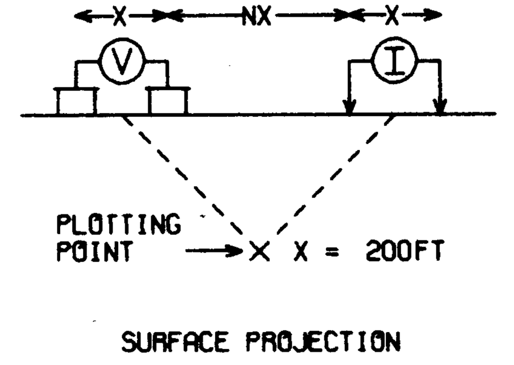
DWG. NO.- I.P.-6011-1

PHELPS DODGE CORPORATION OF CANADA LTD.

PROJECT 124, COLUMBIA RIVER GRID,
SCHAFT CREEK AREA, LIARD M.D., B.C.

LINE NO.- 100N

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: AUG 1972

APPROVED:

DATE:

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — A. W. MULLAN

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION