4013

MINING RECORDER
DEC 27 1972
KAMLOOPS, B.C.

REPORT ON THE
INDUCED POLARIZATION
AND RESISTIVITY SURVEY
ON THE
WALLENDER LAKE PROPERTY
PROJECT 1035, KAMLOOPS AREA
KAMLOOPS MINING DIVISION, B.C.
FOR
HIGHLAND MERCURY MINES LTD. (N.P.L.)

92I/9W

BY

PHILIP G. HALLOF, Ph.D.

AND

PETER K. SMITH, B.Sc.

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 4013 MAP

NAME AND LOCATION OF PROPERTY:

WALLENDER LAKE PROPERTY, KAMLOOPS AREA, B.C.

KAMLOOPS MINING DIVISION, B.C. 50°38'N, 120°26'30" W

DATE STARTED: MAY 24, 1972

DATE FINISHED: JUNE 10, 1972

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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

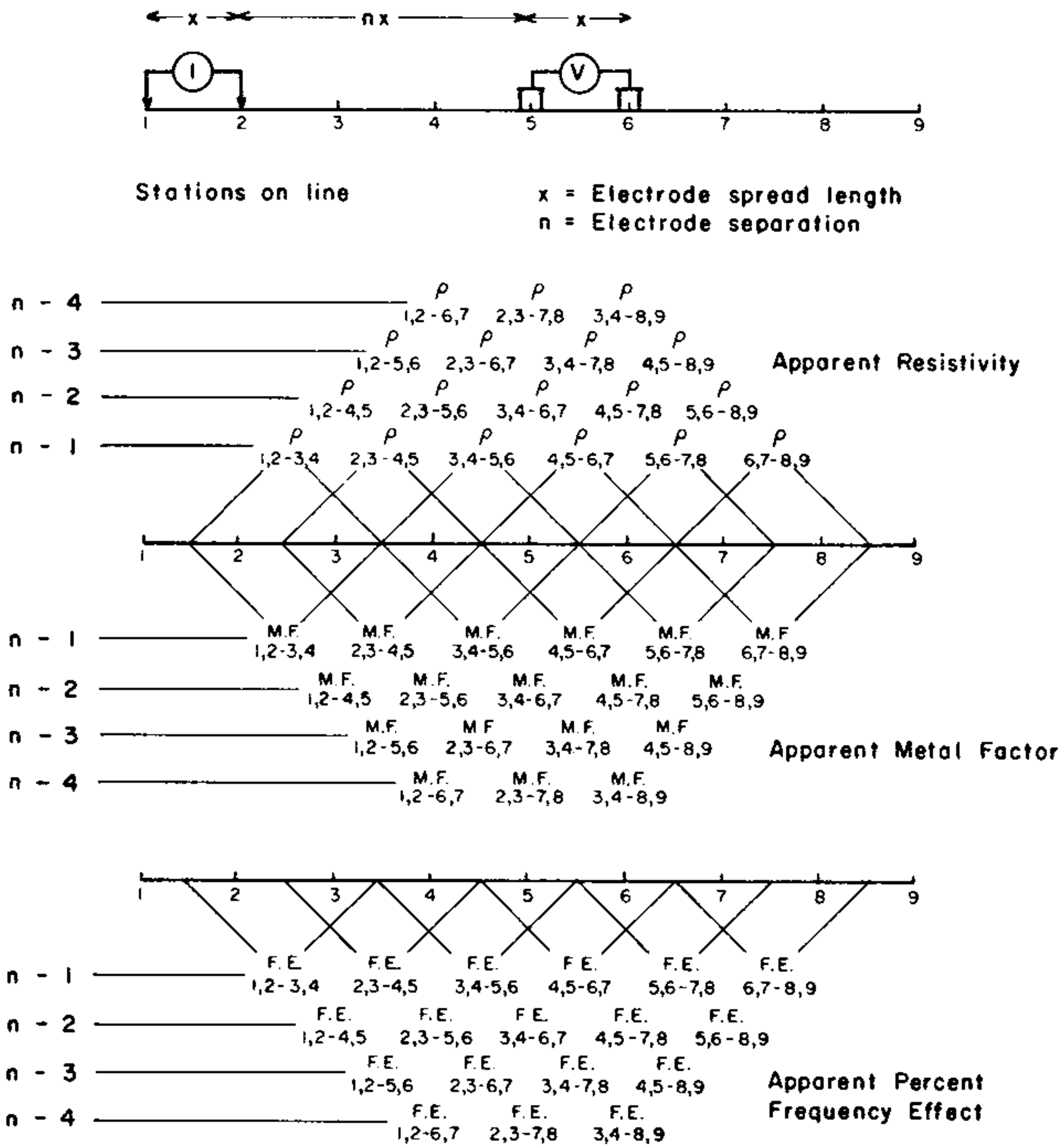

Fig. A

McPHAR GEOPHYSICS LIMITED

REPORT ON THE
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1. INTRODUCTION

At the request of the company, McPhar Geophysics Limited have completed an Induced Polarization and Resistivity survey on the Wallender Lake Property, Kamloops Area, in the Kamloops Mining Division of British Columbia for Highland Mercury Mines Ltd. The survey was carried out during May and June of 1972. The purpose of the survey was to locate zones of sulphide mineralization which may be of economic significance.

The area lies approximately five miles southwest of Kamloops, British Columbia at 50°38' north latitude and 120°26'30" west longitude and access to the grid is by secondary road from the Trans Canada Highway.

A McPhar P660 frequency IP unit was used for the survey, operating at 0.3 Hz and 5.0 Hz. Readings on three dipole separations (n = 1, 2 and 3) were taken using 300' dipoles.

The survey was conducted over the following claims; as shown on the claim map supplied by Highland Mercury Mines Ltd.

Claim Name	
Caddie	1, 2, 3, 4, 5, 6
Rocket	8, 10
X No.	2, 3, 4, 5, 7, 9, 16, 18, 20
H No.	1, 2, 3, 4, 6
Lee	2 FR, 3, 4, 5, 10 FR
Tar	2, 4
Rainbow	4, 20, 23
RO	36, 38
Venus	8
Joseph	-
Mask	1 FR, 3 FR
Jim	2
Carol	2 FR

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	Electrode Intervals	Dwg. No.
Base Line (Southern Portion)	300 feet	IP 5979-1
Base Line (Northern Portion)	300 feet	IP 5979-2
24N	300 feet	IP 5979-3
0	300 feet	IP 5979-4
8S	300 feet	IP 5979-5
16S	300 feet	IP 5979-6

Line	Electrode Intervals	Dwg. No.
24S	300 feet	IP 5979-7
32S	300 feet	IP 5979-8
40S	300 feet	IP 5979-9
48S	300 feet	IP 5979-10
56S	300 feet	IP 5979-11

Also enclosed with this report is Dwg. I.P.P. 4859, a plan map of the Wallender Lake Property at a scale of 1" = 400'. The definite, probable and possible Induced Polarization 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 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 electrode interval length; i.e. when using 300' electrode intervals the position of a narrow sulphide body can only be determined to lie between two stations 300' 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 claim boundary information shown on Dwg. I.P.P. 4859 has been taken from maps made available by the staff of Highland Mercury Mines Ltd. (N.P.L.)

3. DISCUSSION OF RESULTS

Apparent resistivities recorded in the Wallender Lake area are variable; however, a zone of higher conductivity extending along the western grid boundary, south of Line 0 was outlined. Generally, resistivities are higher than those recorded on the Iron Mask Property, to the northwest, which may be due to less sulphate concentration in the overburden. Background frequency effect values are of similar magnitude and several anomalies show characteristics similar to those recorded over the known mineralization of the Iron Mask Property.

A north-south trending anomalous IP zone of interest south of Line 8N and in the general vicinity of Base Line I has been outlined.

Base Line (Southern Portion)

A probable anomaly extends from 8+00S to 7+00N, with a possible extension to 10+00N and a section interpreted as possible between 4+00S and 5+00S. A shallow source of disseminated mineralization at a depth of less than half an electrode interval is indicated.

Base Line (Northern Portion)

A weak anomaly extending from 77+00N to the end of the Base Line, where it is incomplete, is due to a resistivity low such as would be expected across a fault zone.

Line 24N

A weak anomaly extends west of 18+00W to the end of the line where it is incomplete. The anomaly is possible from 18+00W to 23+00W and probable from 23+00W to 29+00W. Line 24N passes near the northwest corner of Wallender Lake in this vicinity. The weak frequency effect and resistivity low may be due to clay particles within the lake bottom sediments and increased moisture in the area.

Line 0+00

A near-surface, definite anomaly between 9+00W and 2+00W is flanked by a probable anomaly extending east to 5+00E and extending west to 14+00W. A possible anomaly continues west to the end of the line, where it is incomplete. A near-surface zone of disseminated mineralization, which continues to depth, is interpreted as the source of the definite anomaly. The barbed wire fence in the vicinity of 9+00W does not appear to have enhanced the frequency effect results.

A distinct decrease in background apparent resistivity is outlined west of 14+00W.

Line 8S

A definite anomaly from 5+00W to 2+00E has a near surface source which shows evidence of continuation to depth. This anomaly is flanked by probable anomalies, both east and west, to 6+00E and 9+00W respectively and could be attributed to a broad zone of disseminated mineralization.

A possible anomaly extends west of 21+00W to the end of the line, where it is incomplete. The low apparent resistivities may be due to changes in the properties of the overburden and/or bedrock rather than sulphide mineralization.

The background apparent resistivity decreases by a factor of three or more west of station 15+00W.

Line 16S

A probable anomaly between 2+00W and 3+00E is flanked by possible extensions to 4+00W and to 6+00E, the eastern end of the line, where it is incomplete. The source of this anomaly is shallow and continues to depth. Disseminated sulphide mineralization may account for this response and the concentration of sulphides appears to increase with depth.

A possible anomaly extends west of 10+00W to the end of the line. The anomaly is due to a resistivity low.

Line 24S

Probable anomalies are outlined from 6+00W to 3+00W and between 0+00 and 13+00E, with a possible extension to 15+00E. The anomaly pattern suggests sporadic weak mineralization over the extent of this anomaly.

A possible anomaly, due to low surface resistivities, extends west of 16+00W to the end of the line, where it is incomplete.

Higher apparent resistivities are noted east of 15+00E.

Line 32S

An anomaly, interpreted as possible from 1+00W to 1+00E and probable between 1+00E and 9+00E, indicates a shallow source of disseminated mineralization which continues to depth.

A possible weak anomaly is outlined between 16+00E and 20+00E which shows evidence of continuing to depth.

West of 12+00W to the end of the line, where it is incomplete, a possible anomaly has been recorded. The frequency effect results may have been enhanced by the barbed wire fences on either side of the road at 12+50W.

A decrease in the apparent resistivity west of 24+00E may outline a change in geologic environment.

Line 40S

A probable anomaly is outlined from 6+00E to 18+00E, flanking possible anomalies extending from 0+00 to 6+00E and from 18+00E to 23+00E. A shallow source extending to depth is indicated by the relatively strong frequency effect results. Similar frequency effect response has proven diagnostic of sulphide mineralization in this environment and general vicinity.

A possible anomaly extends west of 11+00W to the end of the line, where it is incomplete. Barbed wire fences at approximately 16+00W and 18+50W have influenced the IP results and make anomaly interpretation difficult.

Possible weak anomalies are indicated between 34+00E and 37+00E and between 43+00E and 47+00E.

A distinct decrease in apparent resistivity has been outlined to the west of 9+00W on Line 40S.

Line 48S

An anomaly probable from 9+00E to 21+00E with a possible extension to 24+00E may outline a near-surface zone of disseminated sulphides which extends to depth.

A weak, possible anomaly extends from 3+00W to 2+00E; however, the wire fence crossing the line at approximately 3+00E appears to have influenced the response.

Possible anomalies between 9+00W and 12+00W and from 15+00W to 18+00W are interpreted as representing low resistivity surficial features.

Line 56S

A probable anomaly from 21+00E to 24+00E is flanked on either side by possible extensions from 18+00E to 21+00E and from 24+00E to 30+00E. A zone of disseminated mineralization extending to depth is indicated.

A weak, possible anomaly extends from 6+00W to 3+00E and may represent a weakly mineralized disseminated sulphide zone with the sulphide content increasing to the east.

A possible anomaly extending from 44+00E to 48+00E is shallow relative to the electrode interval and appears to continue to depth.

4. CONCLUSIONS AND RECOMMENDATIONS

The Induced Polarization and Resistivity survey over the southern portion of the Wallender Lake property has outlined a number of weak to moderate IP anomalies. These anomalies have been indicated on the plan map, Dwg. I.P.P. 4859 and discussed individually. From previous experience in this area, we have found that even very weak IP anomalies can be of potential significance. An example of typical results over porphyry copper-type mineralization is illustrated in Appendix A.

The survey has outlined a broad north-south trending IP zone in the general vicinity of Base Line 1 extending south of Line 8N.

No significant IP anomalies or anomalous zones were detected to the north of Line 24N along the Base Line.

A zone of low apparent resistivity has been outlined to the extreme west in the southern portion of the grid.

The IP survey was carried out using relatively large electrode intervals of 300'. Since a large volume is averaged into each reading, it is desirable to detail areas of contemplated diamond drilling with shorter spacing to ensure that blank areas do not exist (see Appendix B).

It is recommended that a limited program of test diamond drilling be initiated to check the source of several IP anomalies within the central zone. Several drill targets are suggested based on the IP results. Priority for the listed diamond drill holes must be chosen based on any correlating favourable geologic and/or geochemical information which may be available.

Eleven diamond drill holes are suggested for the initial test. If possible, confirmation of the IP anomalies with detail profiles, using 200' electrode dipoles (n = 1, 2, 3 and 4) should be carried out prior to drilling to ensure best results.

<u>Suggested Drill Locations</u>

Base Line	-	a vertical hole at 1+00N to a depth of at least 150'
Line 0	-	a vertical hole at 5+50W to a depth of at least 150'
Line 8S	-	a vertical hole at 3+00W to a depth of approximately 300'

Suggested Drill Locations (contd.)

Line 16S	-	a vertical hole at 1+50E to a depth of at least 300'
Line 32S	-	an inclined hole at 45 degrees, collared east of 6+00E, such that it intersects below 7+50E at a depth of 300'
Line 40S	-	a vertical hole at 7+50E to a depth of at least 300'
	-	a vertical hole 15+00E to a depth of approximately 200'
Line 48S	-	a vertical hole at 15E to a depth of at least 300'
Line 56S	-	an inclined hole collared west of 21+00E at 45 degrees, such that it intersects below 22+50E at a depth of approximately 300'.

PROFESSIONAL PROVINCE OF BRITISH COLUMBIA

McPHAR GEOPHYSICS LIMITED

Philip G. Hallof,
Geophysicist.

Expiry Date: February 28, 1973

Peter K. Smith per mls

Peter K. Smith,
Geophysicist.

Dated: September 6, 1972

ASSESSMENT DETAILS

PROPERTY: Wallender Lake

MINING DIVISION: Kamloops

SPONSOR: Highland Mercury Mines Ltd. (N.P.L.)

PROVINCE: British Columbia

LOCATION: Kamloops Area

TYPE OF SURVEY: Induced Polarization

OPERATING MAN DAYS:	34	DATE STARTED:	May 24, 1972
EQUIVALENT 8 HR. MAN DAYS:	51	DATE FINISHED:	June 10, 1972
CONSULTING MAN DAYS:	4	NUMBER OF STATIONS:	230
DRAUGHTING MAN DAYS:	5	NUMBER OF READINGS:	1674
TOTAL MAN DAYS:	60	MILES OF LINE SURVEYED:	12.5

CONSULTANTS:
Philip G. Hallof, 15 Barnwood Court, Don Mills, Ontario.
Peter K. Smith, 650 Parliament Street. Apt.2212, Toronto, Ontario.

FIELD TECHNICIANS:
G. Trefenanko, Box 923, Lac La Biche, Alberta
R. Mertens, 304 Holmes Avenue, Willowdale, Ontario.
Plus Extra Labour:
J. Addlington, 1025 Turner Street, Victoria, B.C.
G. Silver, 1025 Turner Street, Victoria, B.C.

DRAUGHTSMEN:
B. Marr, 58 Glencrest Blvd. Toronto 16, Ontario.
F.R.Peer, 38 Torrens Avenue, Toronto 6, Ontario.

McPHAR GEOPHYSICS LIMITED

Philip G. Hallof,
Geophysicist.

DATED: September 6, 1972

Expiry Date: February

STATEMENT OF COST

Highland Mercury Mines - IP Survey
Wallender Lake Area, Project 1035, Kamloops Mining Division, B.C.

Crew: G. Trefenanko & R. Mertens

Total Survey Cost

$12\frac{1}{2}$ miles	@	$350.00 per mile =	$4,375.00

Breakdown of Cost

$8\frac{1}{2}$ days	Operating		@ $305.00/day	$2,592.50
1 day	Preparation)	$1\frac{1}{2}$ days	@ $100.00/day	150.00
$\frac{1}{2}$ day	Standby)			
				$2,742.50

Crew Expenses

Meals and Accommodation		$286.93	
Vehicle Expense		145.12	
Field Expense		9.61	
		441.66	
Plus 10%		44.17	
		485.83	$ 485.83
Extra Labour	$955.36		
Plus 20%	191.07		
	1,146.43		$1,146.43
			$4,374.76

McPHAR GEOPHYSICS LIMITED

Philip G. Hallof,
Geophysicist

Dated: September 6, 1972

CERTIFICATE

I, Philip George Hallof, of the City of Toronto, Province of Ontario, do hereby certify that:

1. I am a geophysicist residing at 15 Barnwood Court, Don Mills, Ontario.

2. I am a graduate of the Massachusetts Institute of Technology with a B.Sc. Degree (1952) in Geology and Geophysics, and a Ph.D. Degree (1957) in Geophysics.

3. I am a member of the Society of Exploration Geophysicists and the European Association of the Exploration Geophysicists.

4. I am a Professional Geophysicist, registered in the Province of Ontario, the Province of British Columbia and the State of Arizona.

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 Highland Mercury Mines Ltd. N.P.L. 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 6th day of September 1972

Philip G. Hallof, Ph.D.

PROFESSIONAL ... PROVINCE OF ...

Expiry Date: February ...

CERTIFICATE

I, Peter K. Smith, of the city of Toronto, in the Province of Ontario, hereby certify:

1. That I am a geologist/geophysicist with a business address at 139 Bond Avenue, Don Mills, Ontario.

2. I am a graduate of the University of British Columbia with a B.Sc. degree in Honours geology and geophysics (1970).

3. I am a member of the Society of Exploration Geophysics.

4. I have been practising my profession for 2 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 Highland Mercury Mines Ltd. N.P.L. 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 6th day of September 1972

Peter K. Smith per [signature]

Peter K. Smith, B.Sc.

APPENDIX A

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.

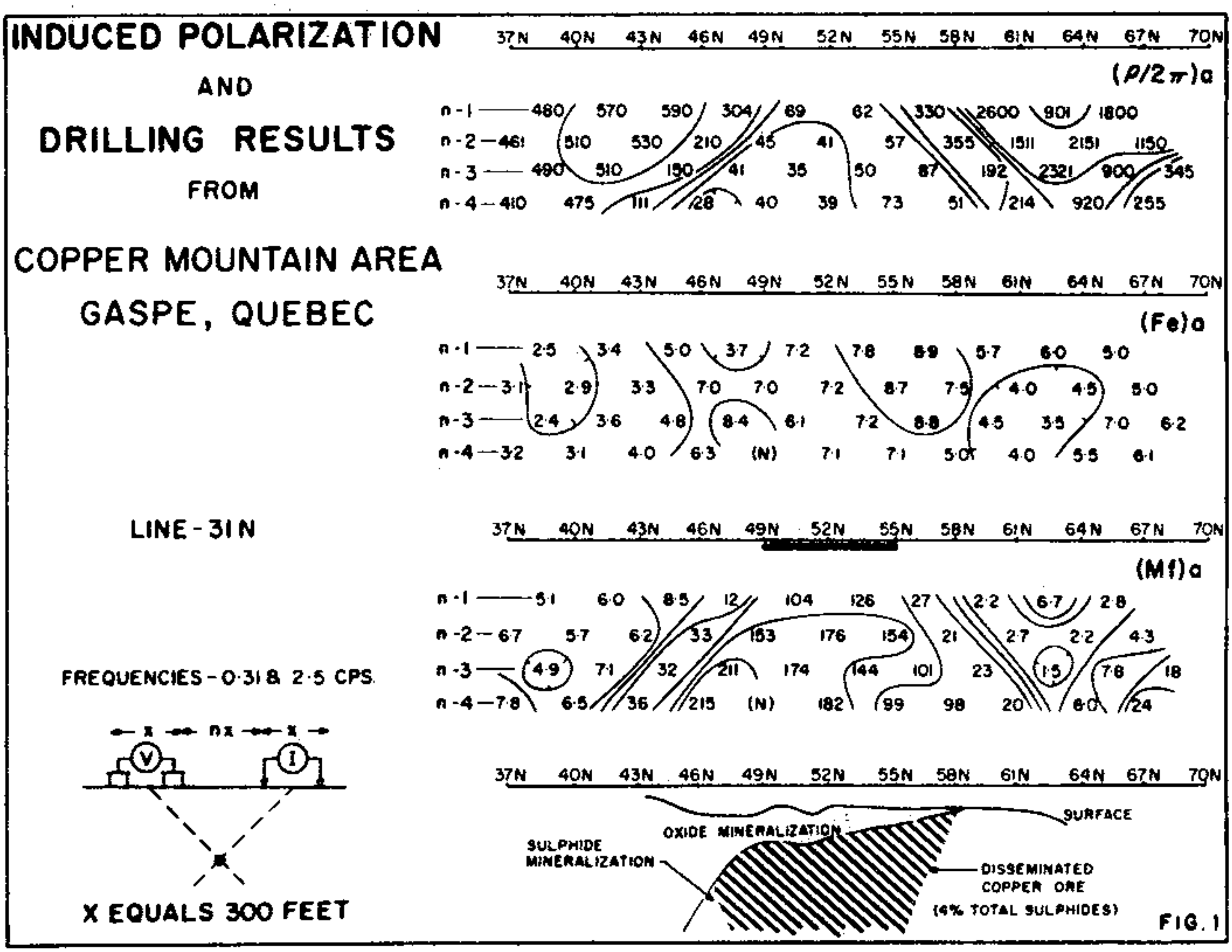


FIG. 1

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.

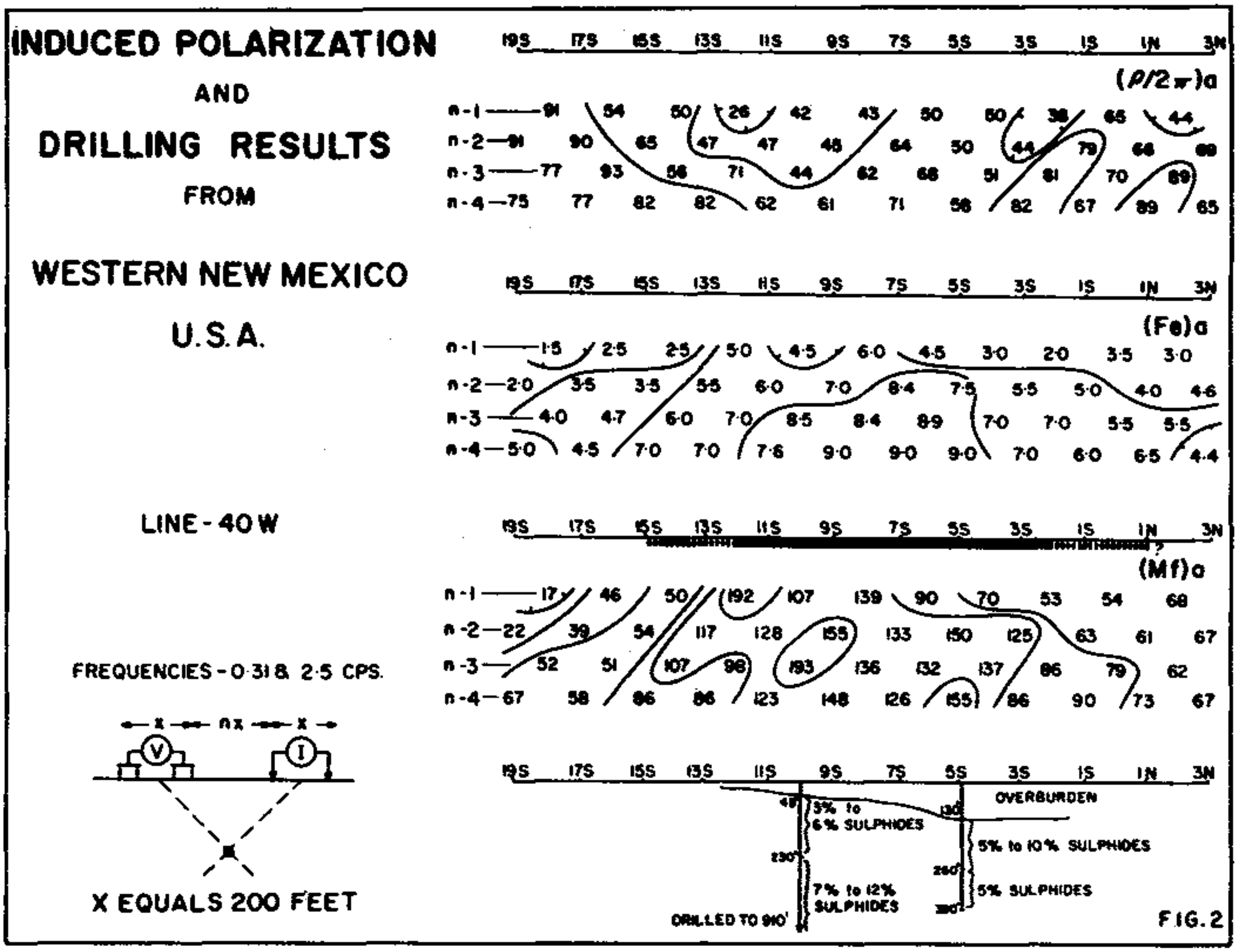


FIG. 2

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.

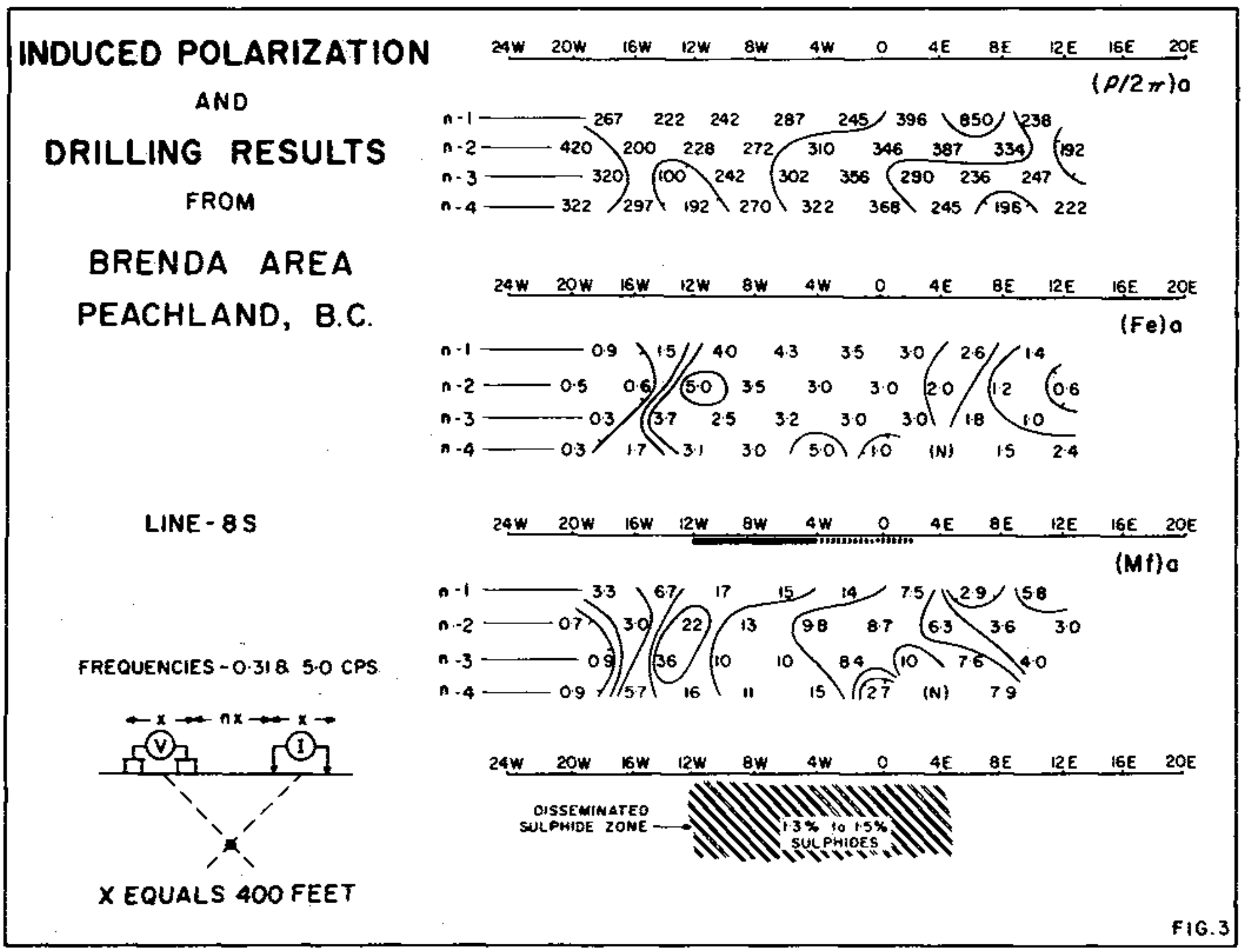


FIG. 3

APPENDIX B

THE INTERPRETATION OF INDUCED POLARIZATION ANOMALIES FROM RELATIVELY SMALL SOURCES

The induced polarization method was originally developed to detect disseminated sulphides and has proven to be very successful in the search for "porphyry copper" deposits. In recent years we have found that the IP method can also be very useful in exploring for more concentrated deposits of limited size. This type of source gives sharp IP anomalies that are often difficult to interpret.

The anomalous patterns that develop on the contoured data plots will depend on the size, depth and position of the source and the relative size of the electrode interval. The data plots are not sections showing the electrical parameters of the ground. When the electrode interval (X) is appreciably greater than the width of the source, a large volume of unmineralized rock is averaged into each measurement. This is particularly true for the large values of the electrode separation (n).

The theoretical scale model results shown in Figure 1 and Figure 2 indicate the effect of depth. If the depth to the top of the source is small compared to the electrode interval (i. e. d X) the measurement for n = 1 will be anomalous. In Figure 1 the depth is 0. 5 units (X = 1. 0 units) and the n = 1 value is definitely anomalous; the pattern on the contoured data plot is typical for a relatively shallow, narrow, near-vertical tabular source. The results in Figure 2 are for the same source with the depth increased to 1. 5 units. Here the n = 1 value is not anomalous; the larger values of (n) are anomalous but the magnitudes are much lower than for the source at less depth.

When the electrode interval is greater than the width of the source, it is not possible to determine its width or exact position between the electrodes. The true IP effect within the source is also indeterminate; the anomaly from a very narrow source with a very large true IP effect will be much the same as that from a zone with twice the width and 1/2 the true IP effect. The theoretical scale model data shown in Figure 3 and Figure 4 demonstrate this problem. The depth and position of the source are unchanged but the width and true IP effect are varied. The anomalous patterns and magnitudes are essentially the same, hence the data are insufficient to evaluate the source completely.

The normal practise is to indicate the IP anomalies by solid, broken, or dashed bars, depending upon their degree of distinctiveness. 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. As illustrated in Figure 1, Figure 2, Figure 3 and Figure 4, no anomaly can be located with more accuracy than the spread length. While the centre of the solid bar indicating the anomaly corresponds fairly well with the source, the length of the bar should not be taken to represent the exact edges of the anomalous material.

If the source is shallow, the anomaly can be better evaluated using a shorter electrode interval. When the electrode interval used approaches the width of the source, the apparent effects measured will be nearly equal to the true effects within the source. When there is some depth to the top of the source, it is not possible to use electrode intervals that are much less than the depth to the source. In this situation, one must realize that a definite ambiguity exists regarding the width of the source and the IP effect within the source.

Our experience has confirmed the desirability of doing detail. When a reconnaissance IP survey using a relatively large electrode interval indicates the presence of a narrow, shallow source, detail with shorter electrode intervals is necessary in order to better locate, and evaluate, the source. The data of most usefulness is obtained when the maximum apparent IP effect is measured for n = 2 or n = 3. For instance, an anomaly originally located using X = 300' may be checked with X = 200' and then X = 100'. The data with X = 100' will be quite different from the original reconnaissance results with X = 300'.

The data shown in Figure 5 and Figure 6 are field results from a greenstone area in Quebec. The expected sources were narrow (less than 30' in width) zones of massive, high-grade, zinc-silver ore. An electrode interval of 200' was used for the reconnaissance survey in order to keep the rate of progress at an acceptable level. The anomalies located were low in magnitude.

The very weak, shallow anomaly shown in Figure 5 is typical of those located by the X = 200' reconnaissance survey. Several anomalies of this type were detailed using shorter electrode intervals. In most cases the detail measurements suggested broad zones of very weak mineralization. However, in the case of the source at 20N to 22N, the measurements with shorter electrode intervals confirmed the presence of a strong, narrow source. The X = 50' results are shown in Figure 6. Subsequent drilling has shown the source to be 12.5' of massive sulphide mineralization containing significant zinc and silver values.

The change in the anomaly that results when the electrode interval is reduced is not unusual. The X = 50' data more accurately locates the narrow source, and permits the geophysicist to make a better evaluation of its importance. The completion of this type of detail is very important, in order to get the maximum usefulness from a reconnaissance IP survey.

McPHAR GEOPHYSICS LIMITED

Theoretical Induced Polarization and Resistivity Studies

Scale Model Cases

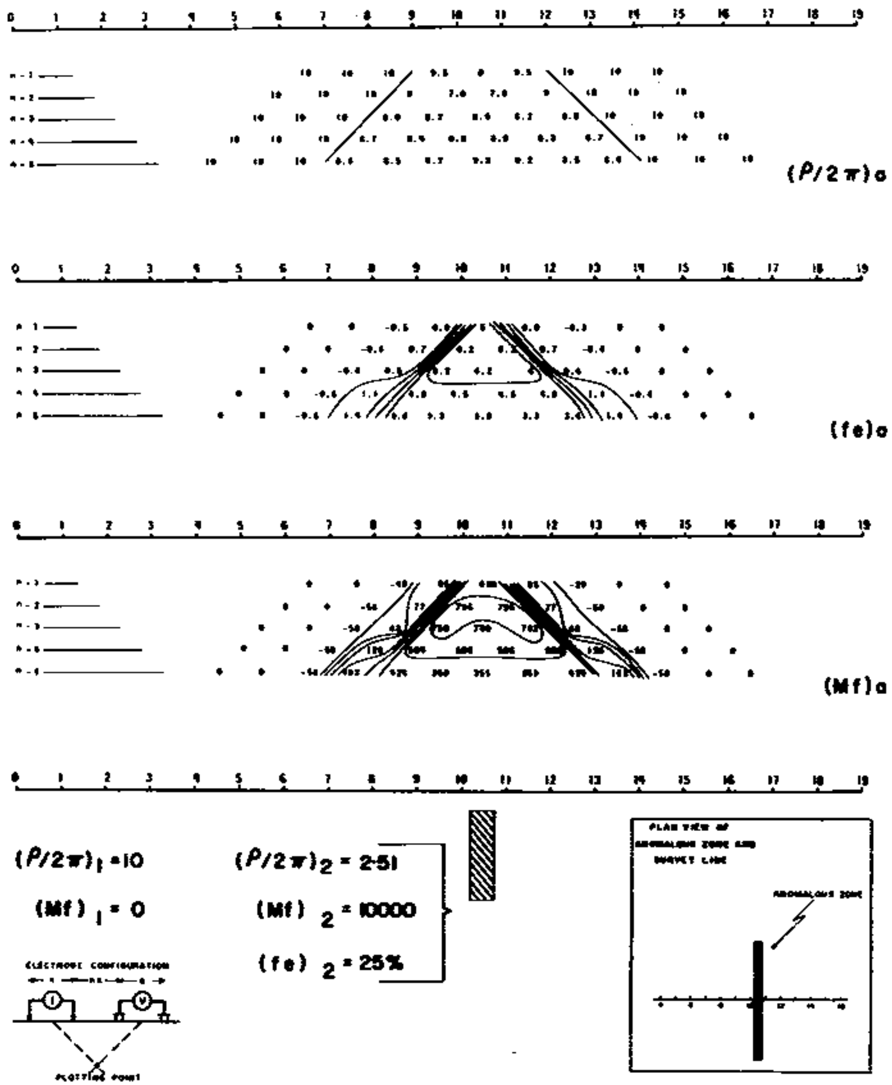


FIG 1

CASE II-0.5-BU-10-a

McPHAR GEOPHYSICS LIMITED

Theoretical Induced Polarization and Resistivity Studies

Scale Model Cases

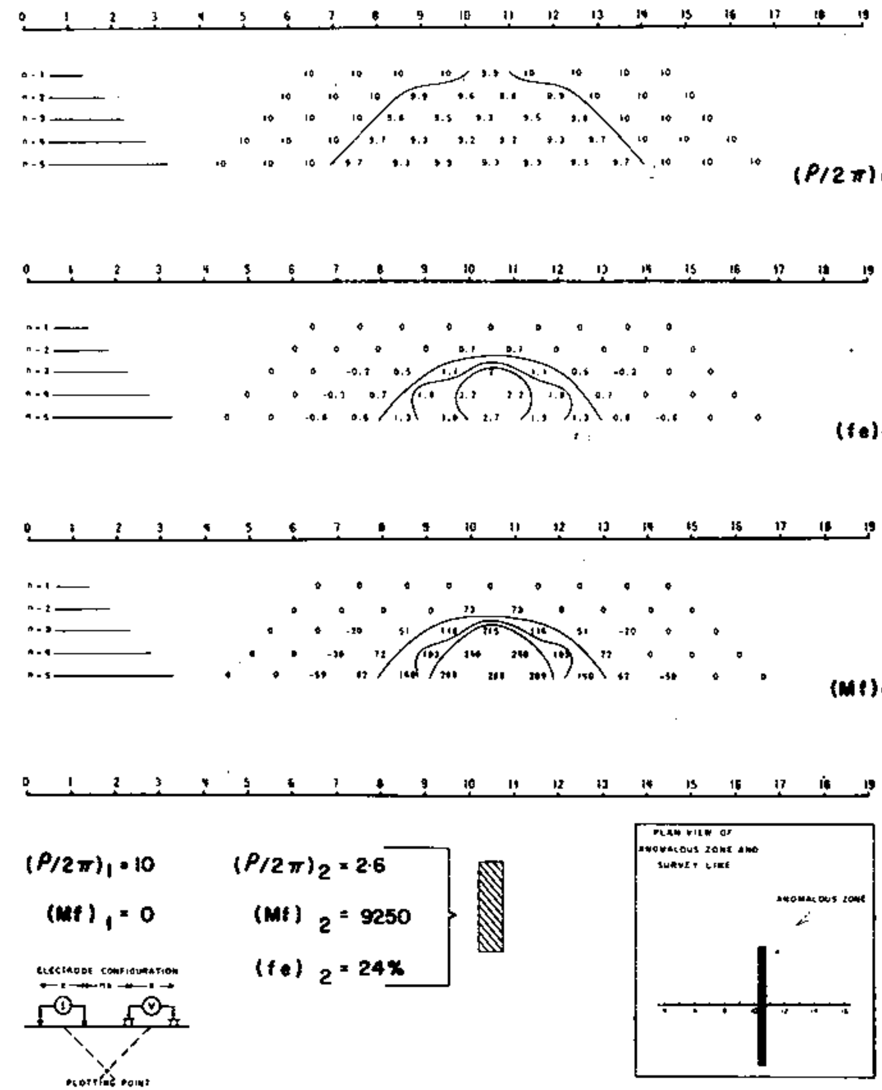
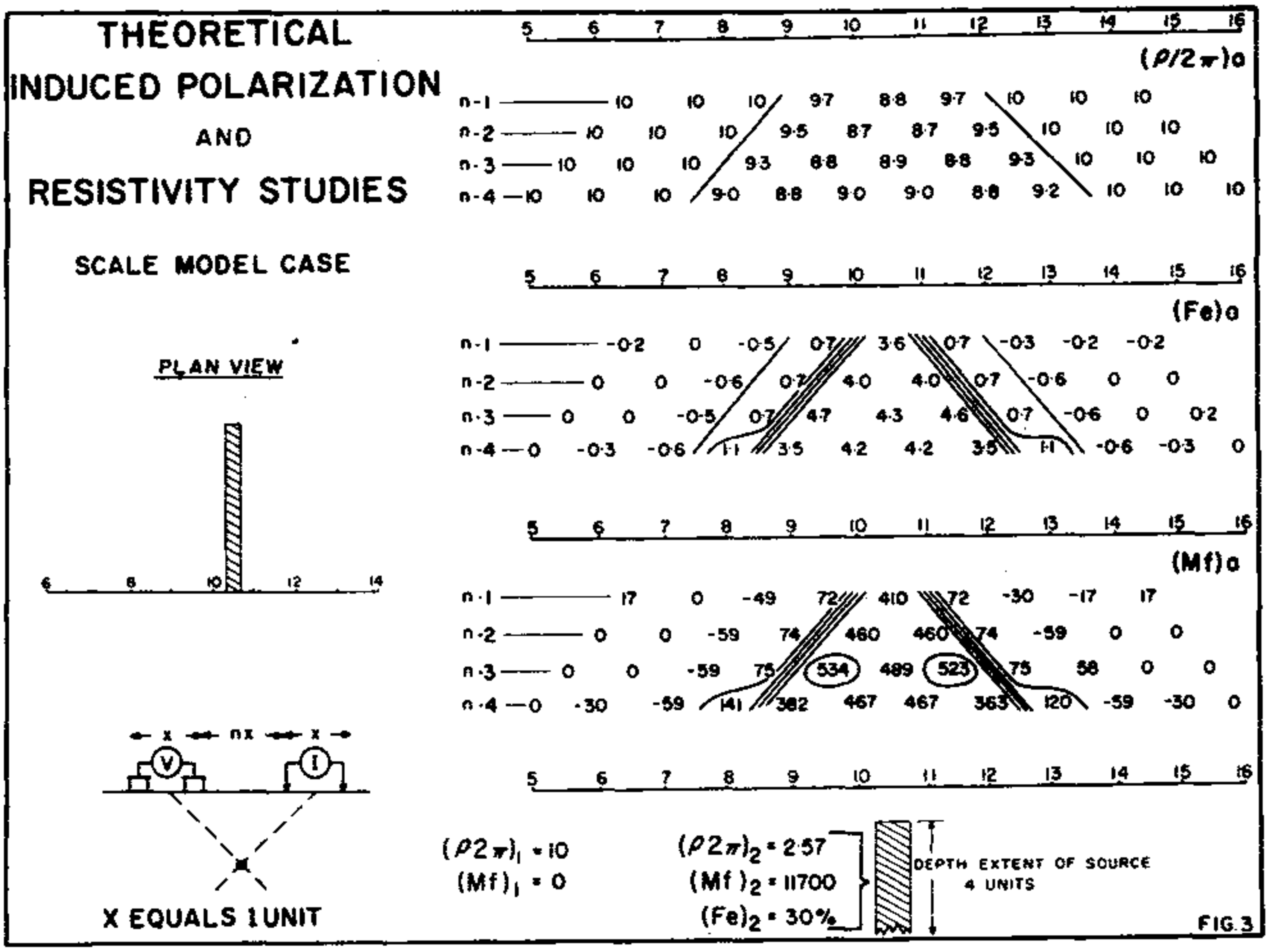
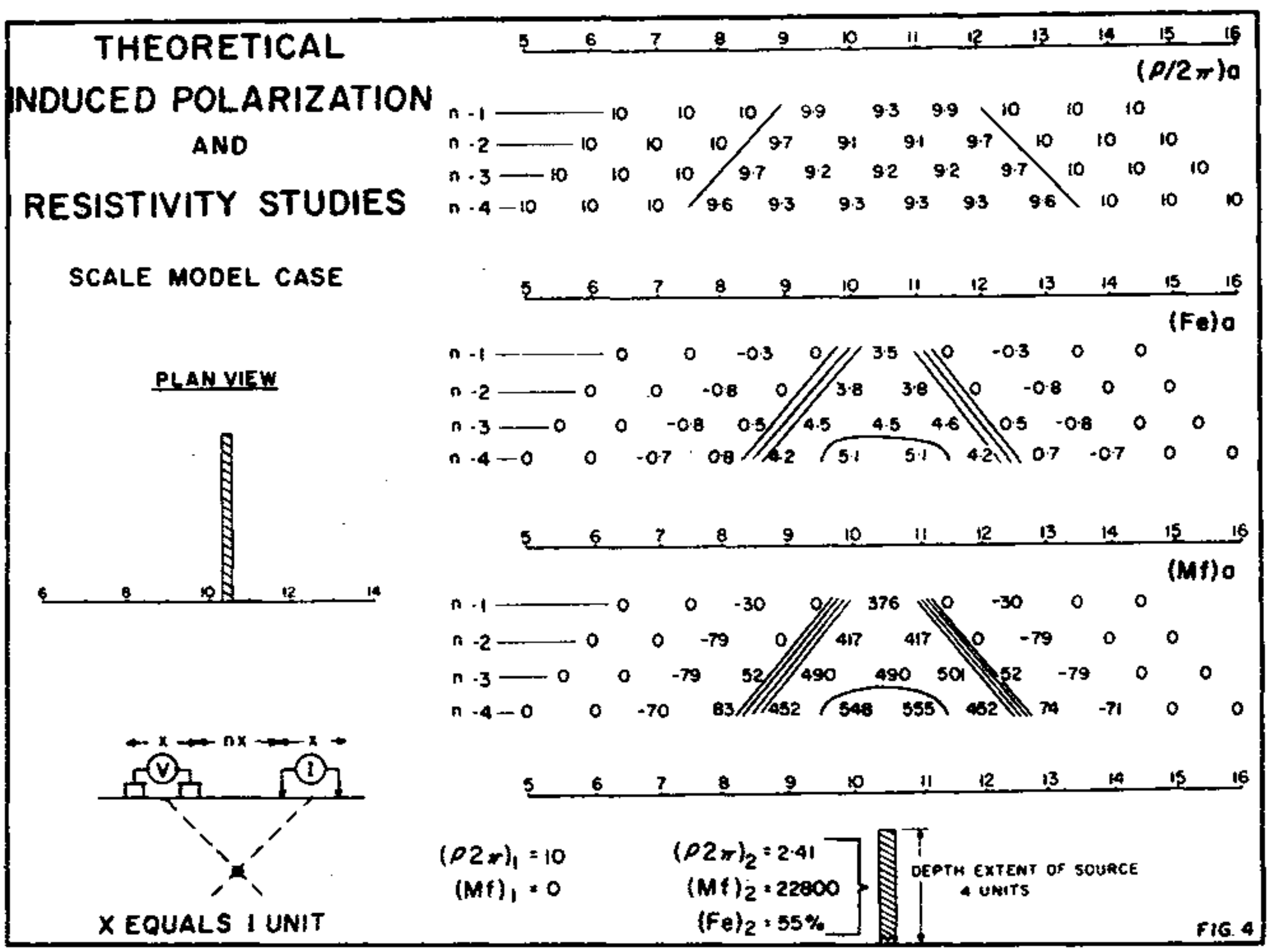


FIG 2

CASE II-1.5-BU-10-a


THEORETICAL
INDUCED POLARIZATION
AND
RESISTIVITY STUDIES
SCALE MODEL CASE
PLAN VIEW
6 8 10 12 14
X EQUALS 1 UNIT
5 6 7 8 9 10 11 12 13 14 15 16
(ρ/2π)a
n-1 10 10 10 9.7 8.8 9.7 10 10 10
n-2 10 10 10 9.5 8.7 8.7 9.5 10 10 10
n-3 10 10 10 9.3 8.8 8.9 8.8 9.3 10 10 10
n-4 10 10 10 9.0 8.8 9.0 9.0 8.8 9.2 10 10 10
(Fe)a
n-1 -0.2 0 -0.5 0.7 3.6 0.7 -0.3 -0.2 -0.2
n-2 0 0 -0.6 0.7 4.0 4.0 0.7 -0.6 0 0
n-3 0 0 -0.5 0.7 4.7 4.3 4.6 0.7 -0.6 0 0.2
n-4 0 -0.3 -0.6 1.1 3.5 4.2 4.2 3.5 1.1 -0.6 -0.3 0
(Mf)a
n-1 17 0 -49 72 410 72 -30 -17 17
n-2 0 0 -59 74 460 460 74 -59 0 0
n-3 0 0 -59 75 534 489 523 75 58 0 0
n-4 0 -30 -59 141 382 467 467 363 120 -59 -30 0
(ρ2π)1 = 10
(Mf)1 = 0
(ρ2π)2 = 2.57
(Mf)2 = 11700
(Fe)2 = 30%
DEPTH EXTENT OF SOURCE
4 UNITS
FIG. 3


THEORETICAL
INDUCED POLARIZATION
AND
RESISTIVITY STUDIES
SCALE MODEL CASE
PLAN VIEW
6 8 10 12 14
X EQUALS 1 UNIT
5 6 7 8 9 10 11 12 13 14 15 16
(ρ/2π)a
n-1 10 10 10 9.9 9.3 9.9 10 10 10
n-2 10 10 10 9.7 9.1 9.1 9.7 10 10 10
n-3 10 10 10 9.7 9.2 9.2 9.2 9.7 10 10 10
n-4 10 10 10 9.6 9.3 9.3 9.3 9.3 9.6 10 10 10
(Fe)a
n-1 0 0 -0.3 0 3.5 0 -0.3 0 0
n-2 0 0 -0.8 0 3.8 3.8 0 -0.8 0 0
n-3 0 0 -0.8 0.5 4.5 4.5 4.6 0.5 -0.8 0 0
n-4 0 0 -0.7 0.8 4.2 5.1 5.1 4.2 0.7 -0.7 0 0
(Mf)a
n-1 0 0 -30 0 376 0 -30 0 0
n-2 0 0 -79 0 417 417 0 -79 0 0
n-3 0 0 -79 52 490 490 501 52 -79 0 0
n-4 0 0 -70 83 452 548 555 452 74 -71 0 0
(ρ2π)1 = 10
(Mf)1 = 0
(ρ2π)2 = 2.41
(Mf)2 = 22800
(Fe)2 = 55%
DEPTH EXTENT OF SOURCE
4 UNITS
FIG. 4

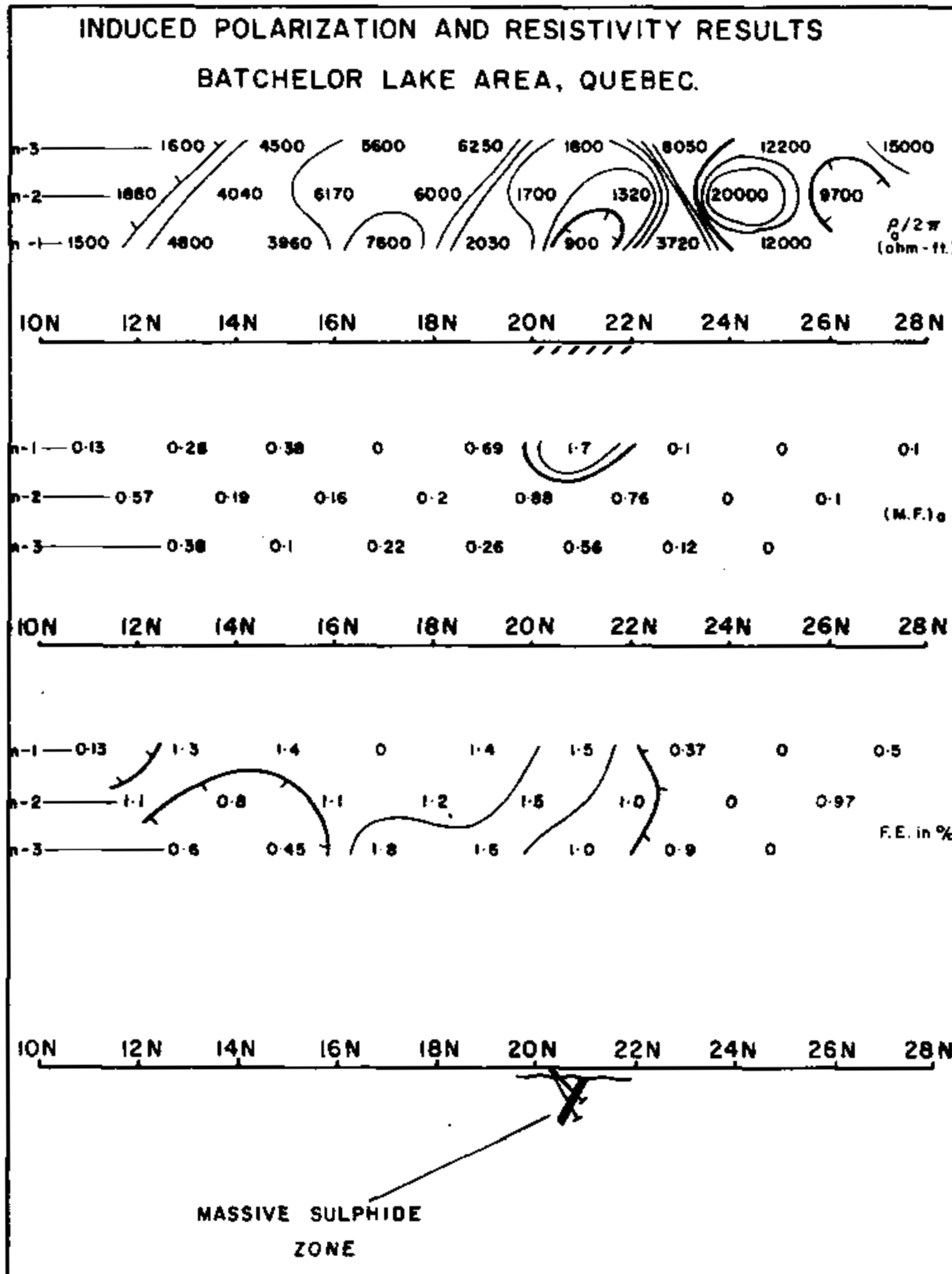

INDUCED POLARIZATION AND RESISTIVITY RESULTS
BATCHELOR LAKE AREA, QUEBEC.
n-3
n-2
n-1
$\rho_a/2\pi$ (ohm-ft.)
10N 12N 14N 16N 18N 20N 22N 24N 26N 28N
(M.F.)a
F.E. in %
MASSIVE SULPHIDE ZONE

FIG. 5

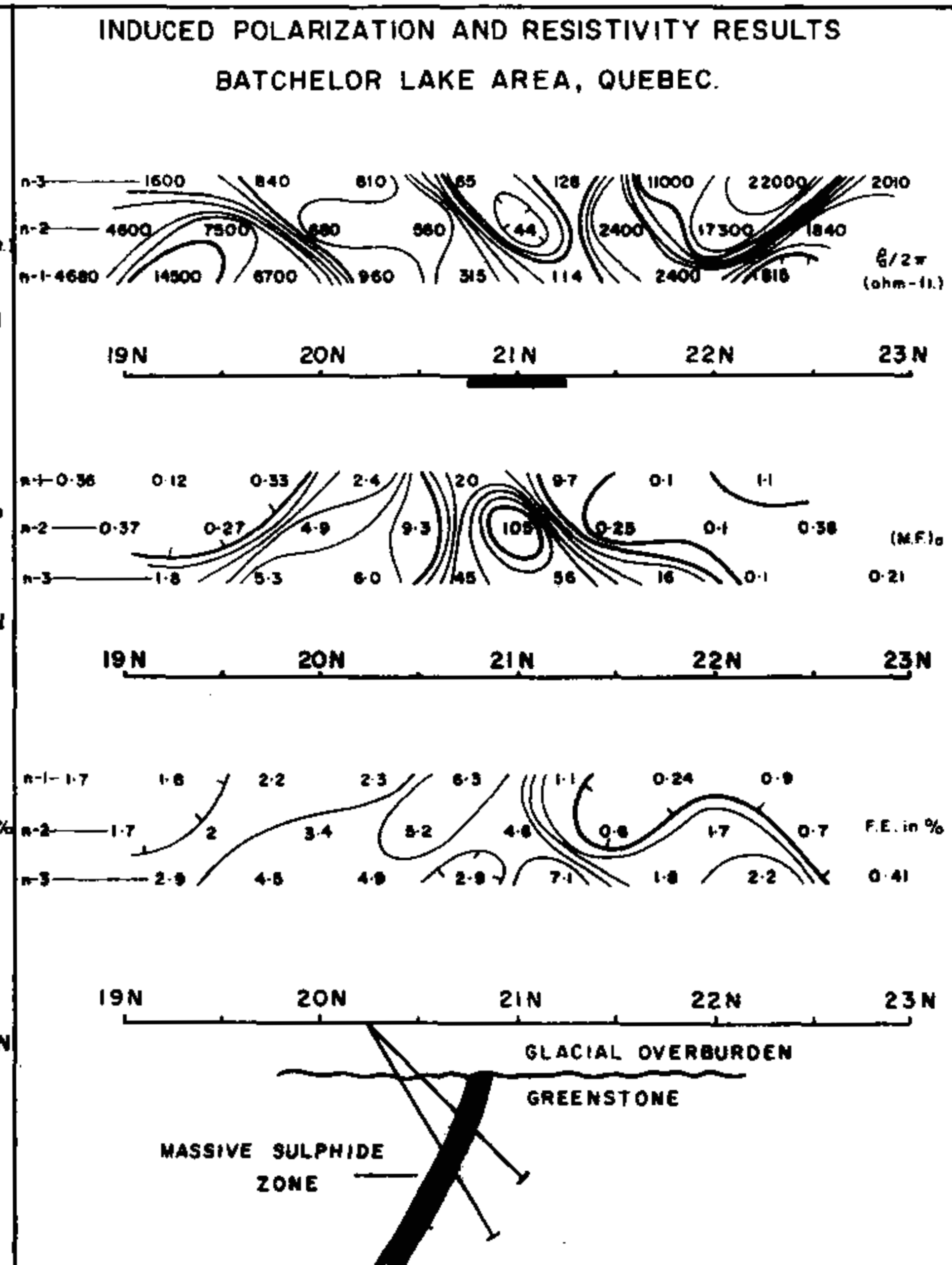
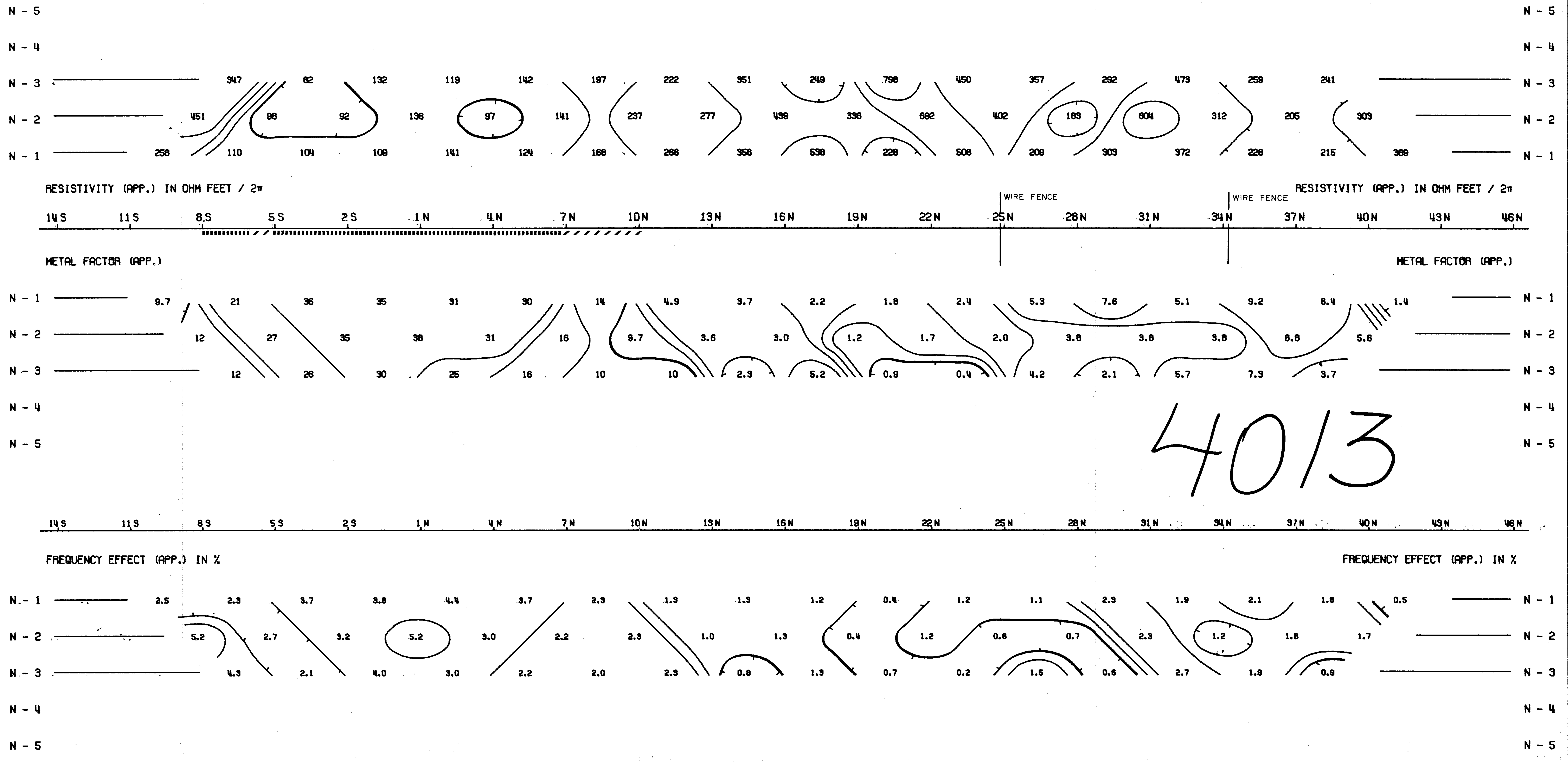

INDUCED POLARIZATION AND RESISTIVITY RESULTS
BATCHELOR LAKE AREA, QUEBEC.
n-3
n-2
n-1
$\rho_a/2\pi$ (ohm-ft.)
19N 20N 21N 22N 23N
(M.F.)a
F.E. in %
GLACIAL OVERBURDEN
GREENSTONE
MASSIVE SULPHIDE ZONE

FIG. 6



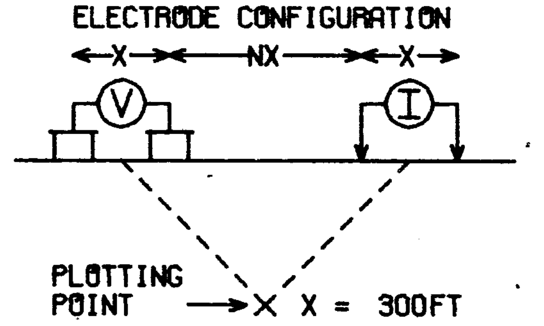
DWG. NO.- I.P.-5979-1

HIGHLAND MERCURY MINES LTD., (N.P.L.)

WALLENDER LAKE PROPERTY, PROJECT 1035, KAMLOOPS AREA, KAMLOOPS M.D., B.C.

LINE NO.- BASELINE (SOUTH)

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUN 1972

APPROVED:

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

DATE: 9/6/72

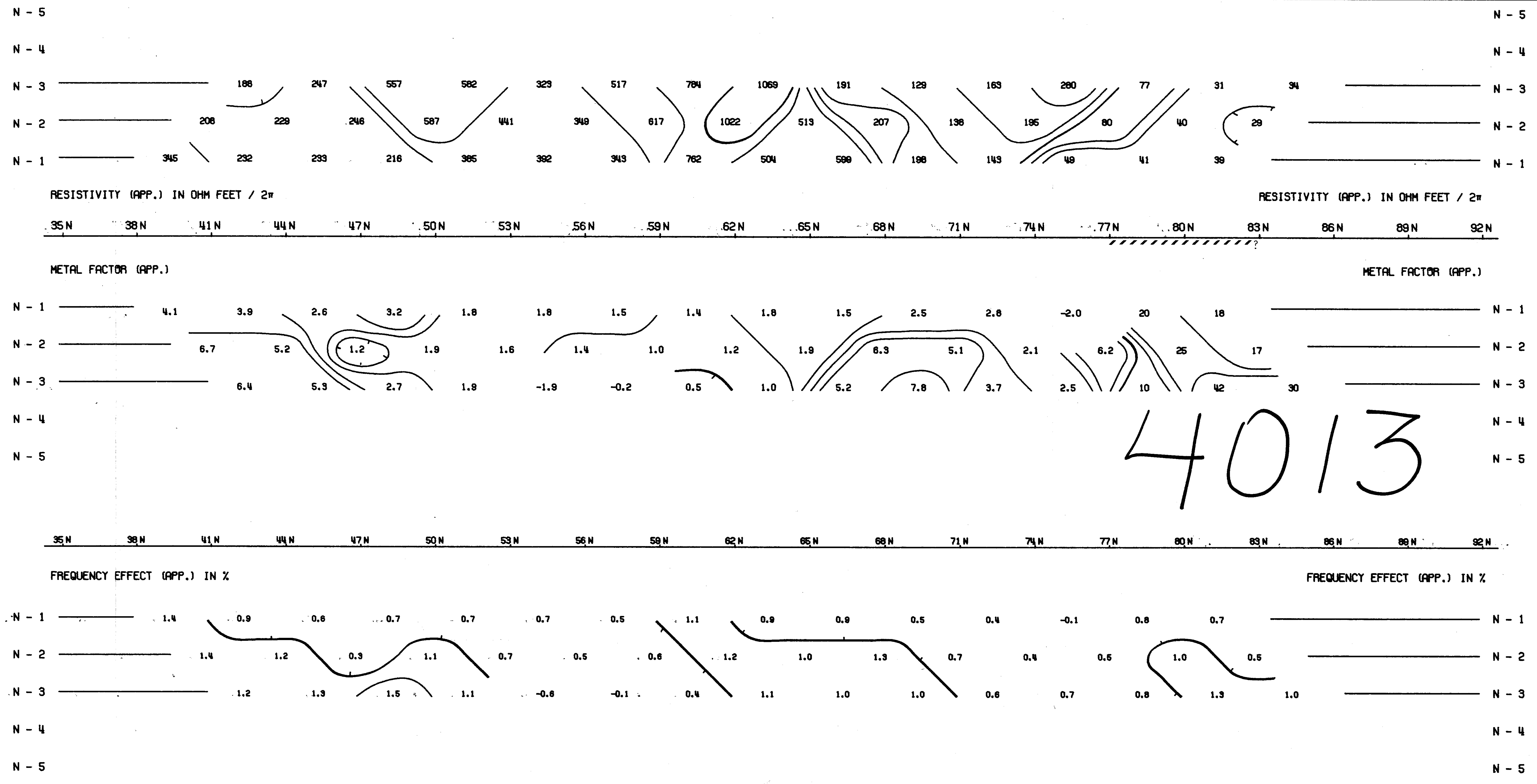
PROFESSIONAL ENGINEER PROVINCE OF ... PHILIP G. HALLOF

Expiry Date: February 25, 1973

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY McPHAR COMPUTER DIVISION



4013

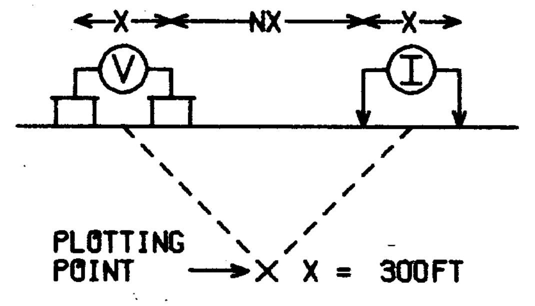
DWG. NO.- I.P.-5979-2

HIGHLAND MERCURY MINES LTD., (N.P.L.)

WALLENDER LAKE PROPERTY, PROJECT 1035, KAMLOOPS AREA, KAMLOOPS M.D., B.C.

LINE NO.- BASELINE (NORTH)

ELECTRODE CONFIGURATION



PLOTTING POINT X = 300FT

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUN 1972

APPROVED:

DATE: 9/6/72

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

PROVINCE OF BRITISH COLUMBIA PROFESSIONAL ENGINEER

Expiry Date: February 25, 1973

McPHAR GEOPHYSICS

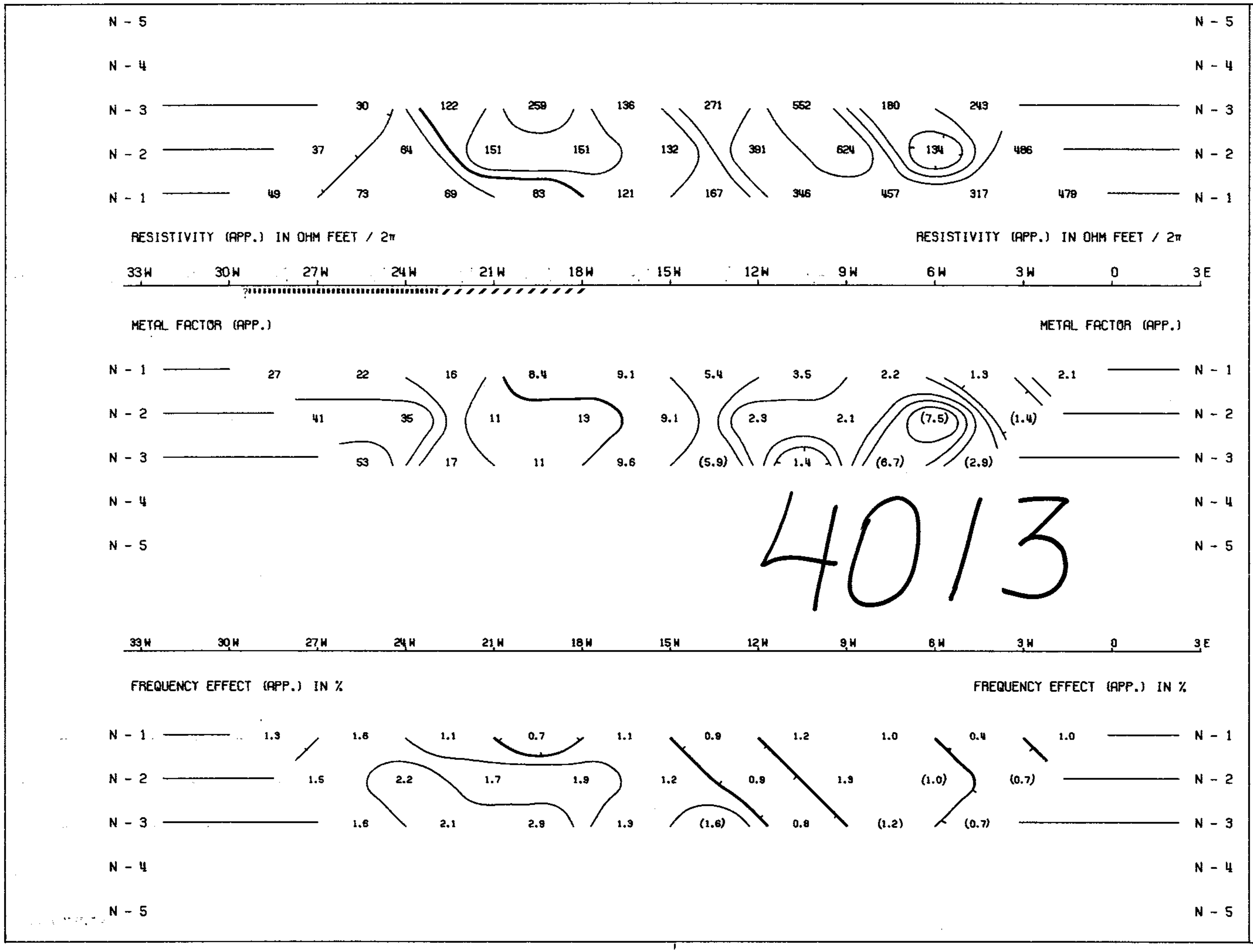
INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION

DWG. NO.- I.P.-5979-3

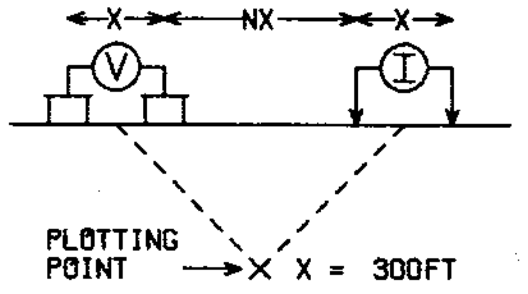
HIGHLAND MERCURY MINES LTD., (N.P.L.)

WALLENDER LAKE PROPERTY, PROJECT 1035, KAMLOOPS AREA, KAMLOOPS M.D., B.C.



LINE NO.- 2400N

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUN 1972

APPROVED:

DATE: 9/6/72

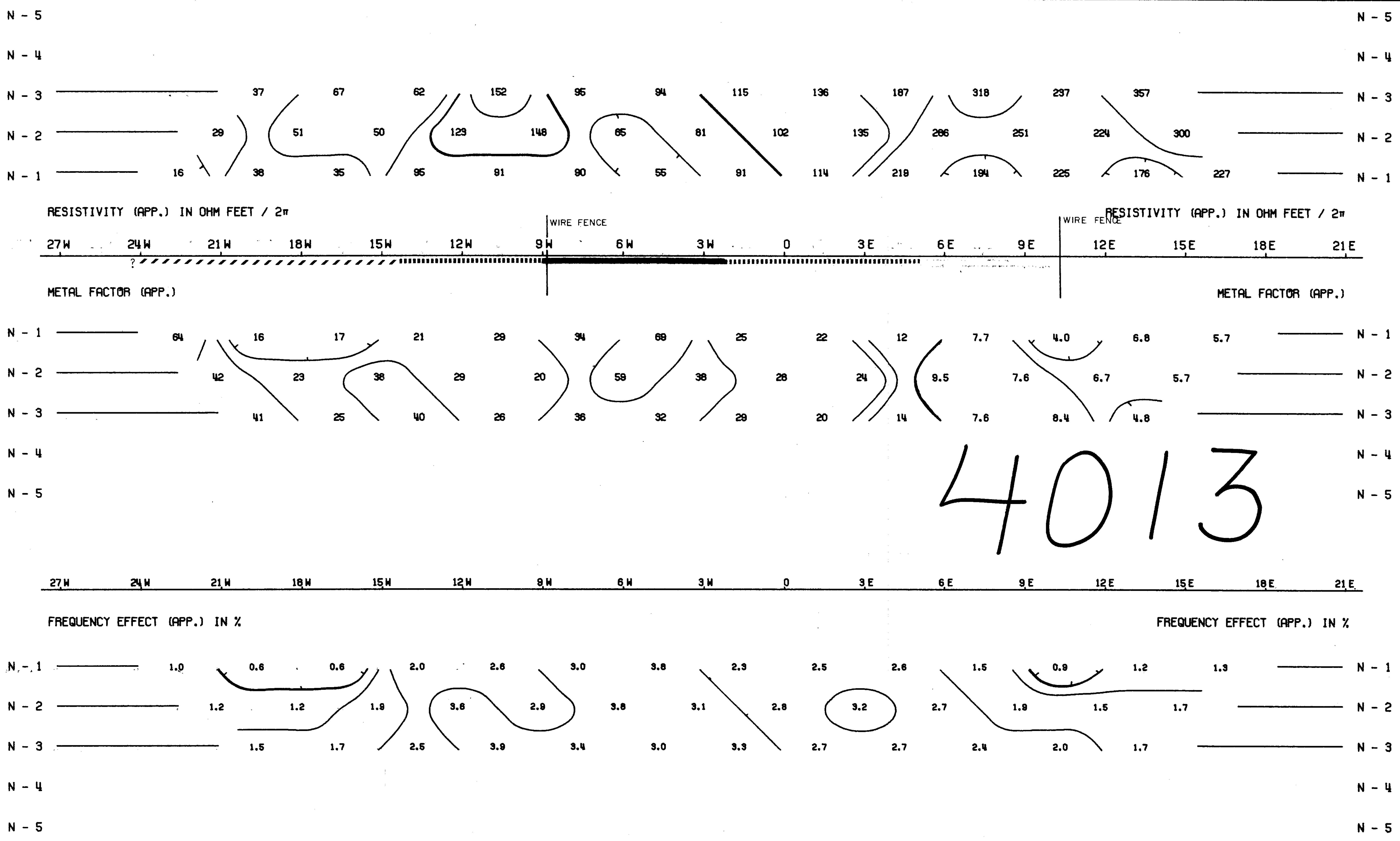
Expiry Date: February 25, 1973

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.-5979-4

HIGHLAND MERCURY MINES LTD., (N.P.L.)

WALLENDER LAKE PROPERTY, PROJECT 1035, KAMLOOPS AREA, KAMLOOPS M.D., B.C.

LINE NO.- 0

ELECTRODE CONFIGURATION

X = 300FT

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: MAY 1972

APPROVED:

DATE: 9/6/72

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

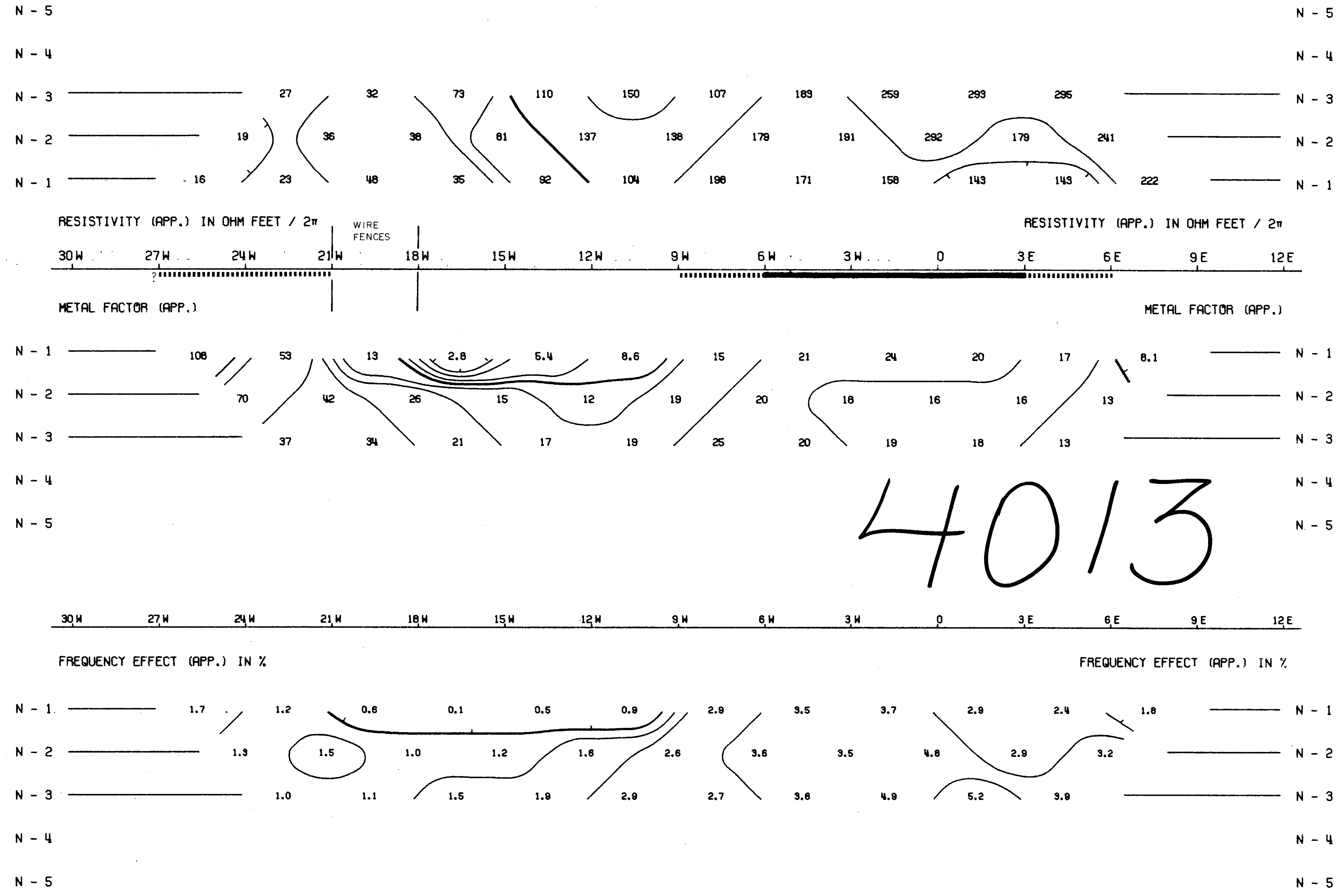
PROVINCE OF BRITISH COLUMBIA PROFESSIONAL ENGINEER

Expiry Date: February 25, 1973

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION



DWG. NO.- I.P.-5979-5

HIGHLAND MERCURY MINES LTD., (N.P.L.)

WALLENDER LAKE PROPERTY, PROJECT 1035, KAMLOOPS AREA, KAMLOOPS M.D., B.C.

LINE NO.- 800S

ELECTRODE CONFIGURATION

X NX X

V I

PLOTTING POINT X = 300FT

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: MAY 1972

APPROVED:

DATE: 9/6/72

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

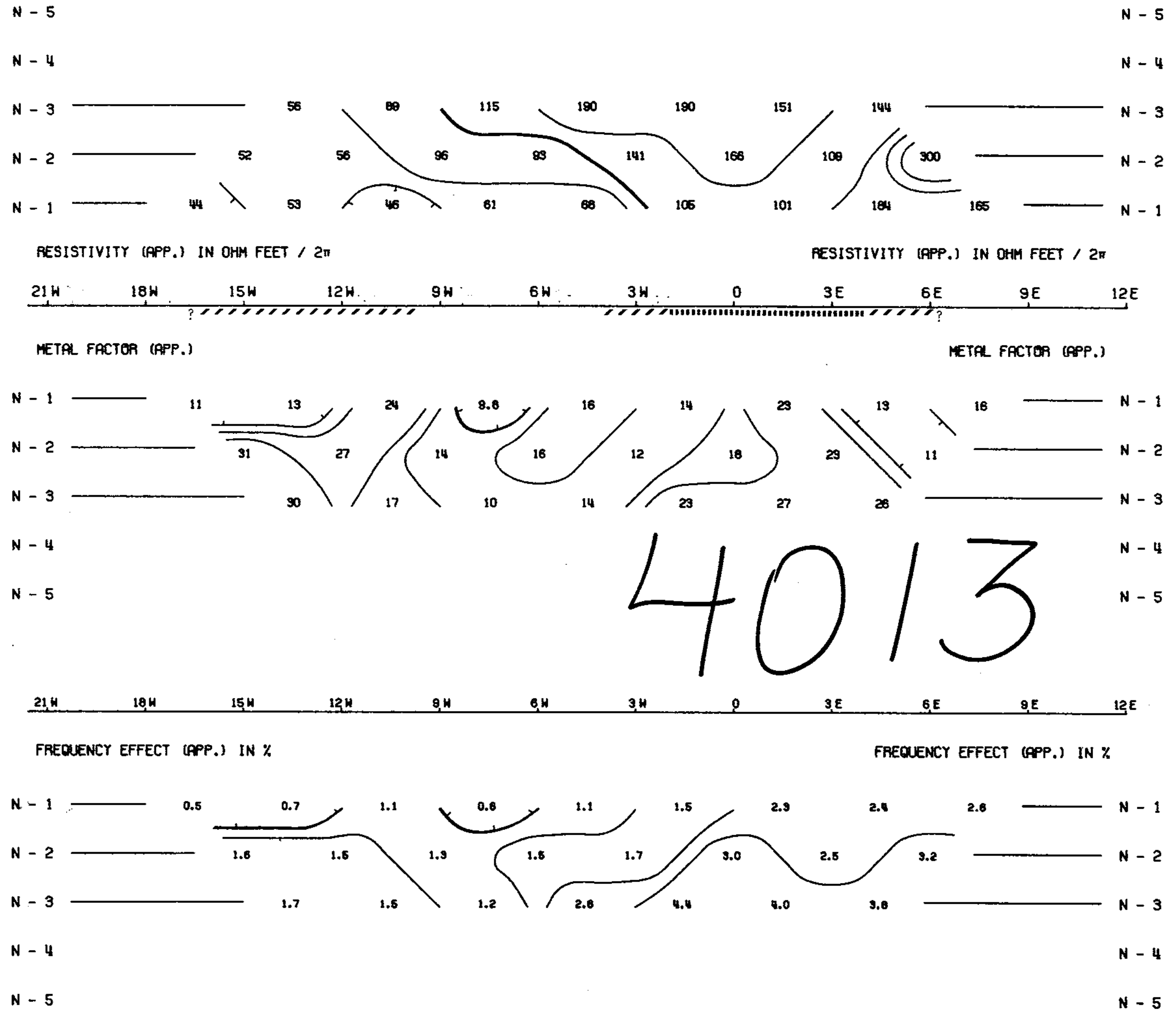
PROVINCE OF BRITISH COLUMBIA PROFESSIONAL ENGINEER PHILIP G. HALLOF

Expiry Date: February 25, 1973

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY McPHAR COMPUTER DIVISION



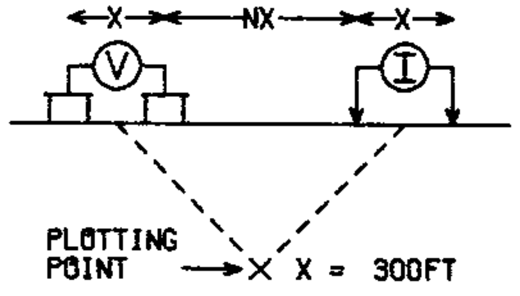
DWG. NO.- I.P.-5979-6

HIGHLAND MERCURY MINES LTD., (N.P.L.)

WALLENDER LAKE PROPERTY, PROJECT 1035, KAMLOOPS AREA, KAMLOOPS M.D., B.C.

LINE NO.- 1600S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: MAY 1972

APPROVED:

DATE: 9/6/72

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — PHILIP G. HALLOF

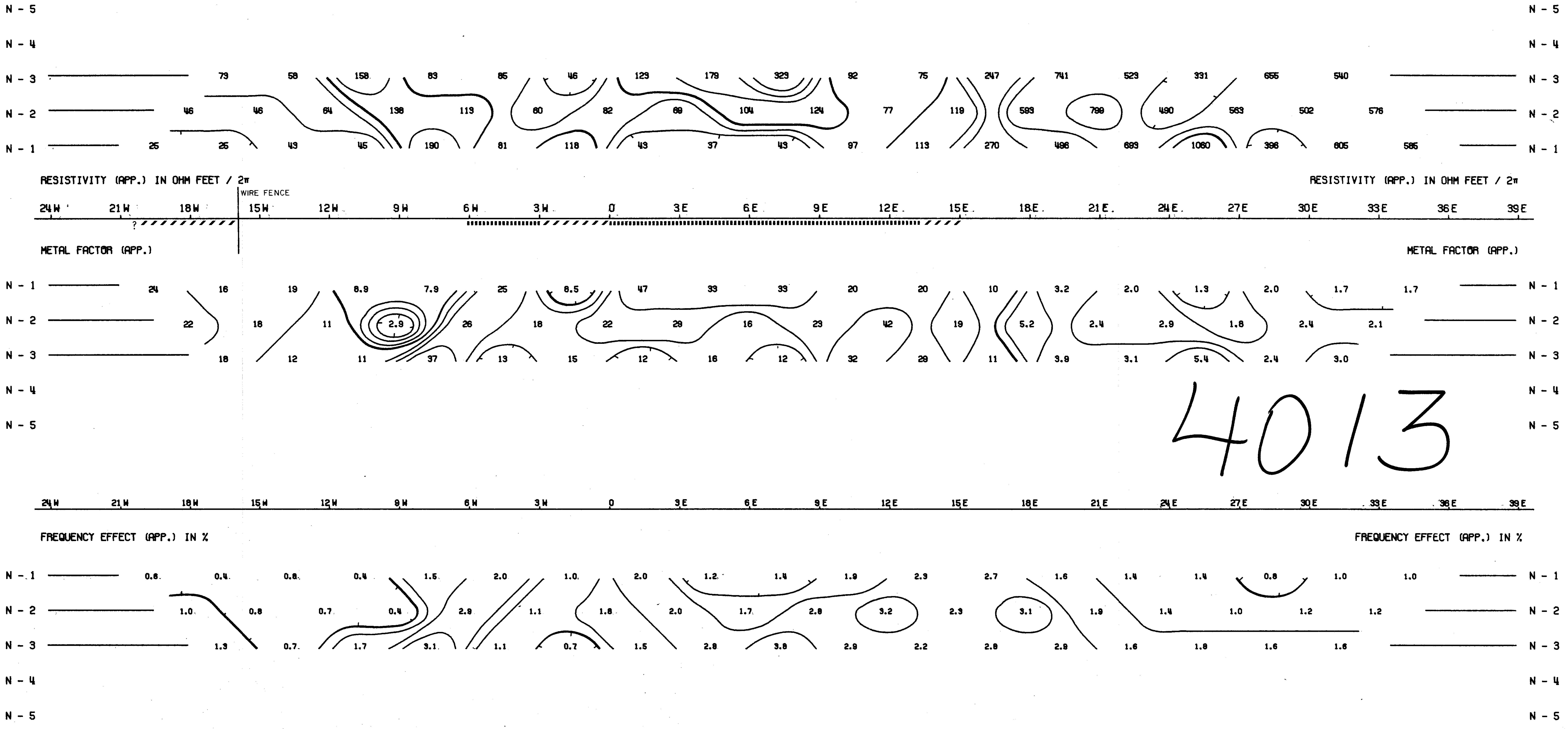
Expiry Date: February 25, 1973

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.-5979-7

HIGHLAND MERCURY MINES LTD., (N.P.L.)

WALLENDER LAKE PROPERTY, PROJECT 1035, KAMLOOPS AREA,
KAMLOOPS M.D., B.C.

LINE NO.- 2400S

ELECTRODE CONFIGURATION

PLOTTING POINT → X X = 300FT

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: MAY 1972

APPROVED:

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

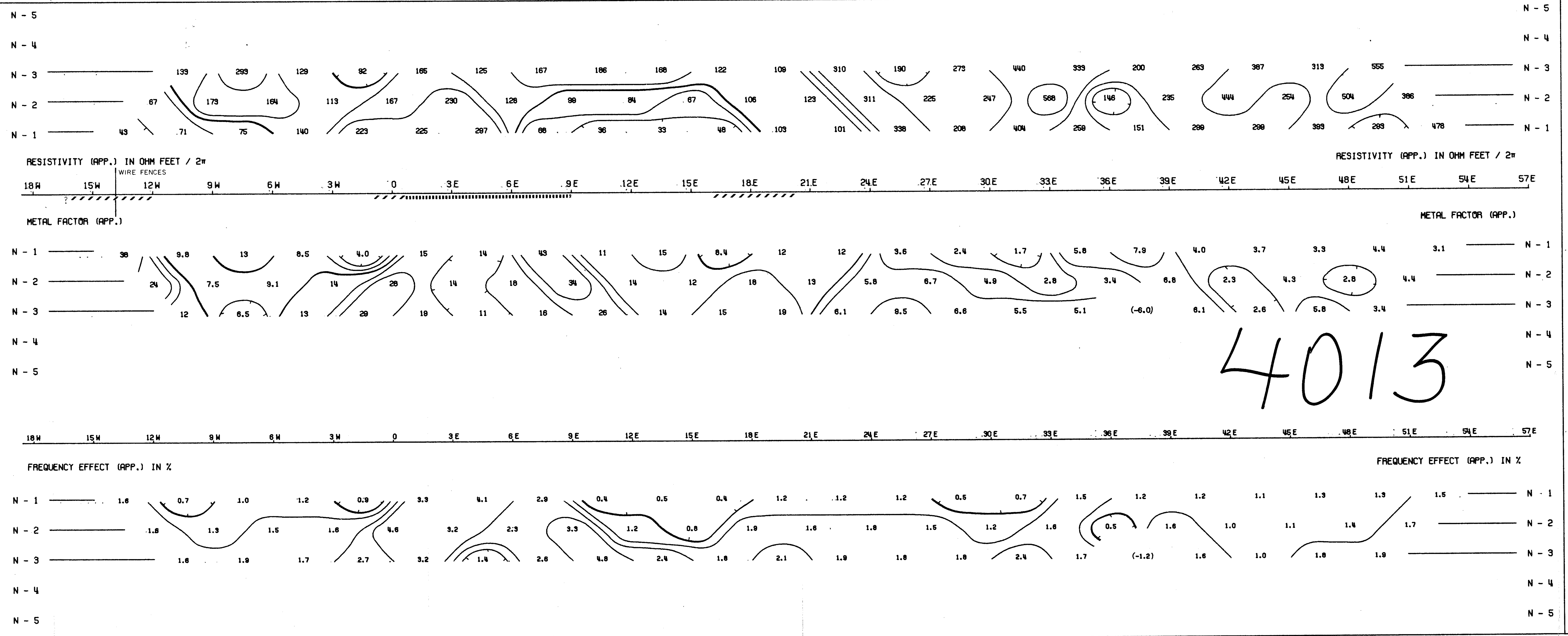
DATE:

Expiry Date: February 25, 1973

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION



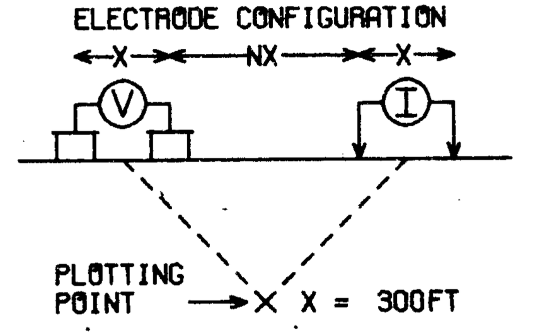
DWG. NO.- I.P.-5979-8

HIGHLAND MERCURY MINES LTD., (N.P.L.)

WALLENDER LAKE PROPERTY, PROJECT 1035, KAMLOOPS AREA, KAMLOOPS M.D., B.C.

LINE NO.- 3200S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE ▬▬▬
PROBABLE ||||||||||||
POSSIBLE /////

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: MAY 1972

APPROVED:

DATE: 9/6/72

PROFESSIONAL ENGINEER, PROVINCE OF BRITISH COLUMBIA, PHILIP G. HALLOF

Expiry Date: February 25, 1973

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

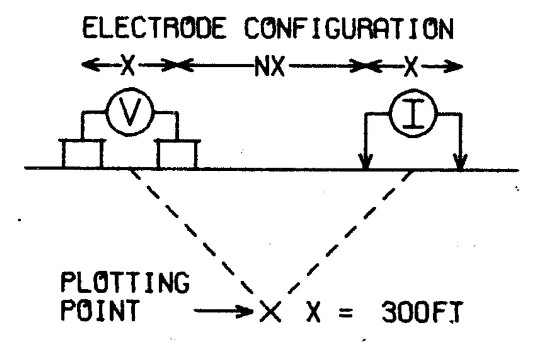
DWG. NO.- I.P.-5979-9

HIGHLAND MERCURY MINES LTD., (N.P.L.)

WALLENDER LAKE PROPERTY, PROJECT 1035, KAMLOOPS AREA, KAMLOOPS M.D., B.C.

LINE NO.- 4000S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: MAY 1972

APPROVED:

DATE:

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — PHILIP G. HALLOF

Expiry Date: February 25, 1973

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.-5979-10

HIGHLAND MERCURY MINES LTD., (N.P.L.)

WALLENDER LAKE PROPERTY, PROJECT 1035, KAMLOOPS AREA, KAMLOOPS M.D., B.C.

LINE NO.- 4800S

ELECTRODE CONFIGURATION

PLOTTING POINT → X X = 300FT

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: MAY 1972

APPROVED:

DATE: 9/6/72

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — PHILIP G. HALL

Expiry Date: February 25, 1973

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.-5979-11

HIGHLAND MERCURY MINES LTD., (N.P.L.)

WALLENDER LAKE PROPERTY, PROJECT 1035, KAMLOOPS AREA, KAMLOOPS M.D., B.C.

LINE NO.- 5600S

ELECTRODE CONFIGURATION

PLOTTING POINT

X = 300FT

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 HZ

DATE SURVEYED: JUN 1972

APPROVED

DATE

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

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA PHILIP G. HALLOF

Expiry Date: February 25, 1973

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

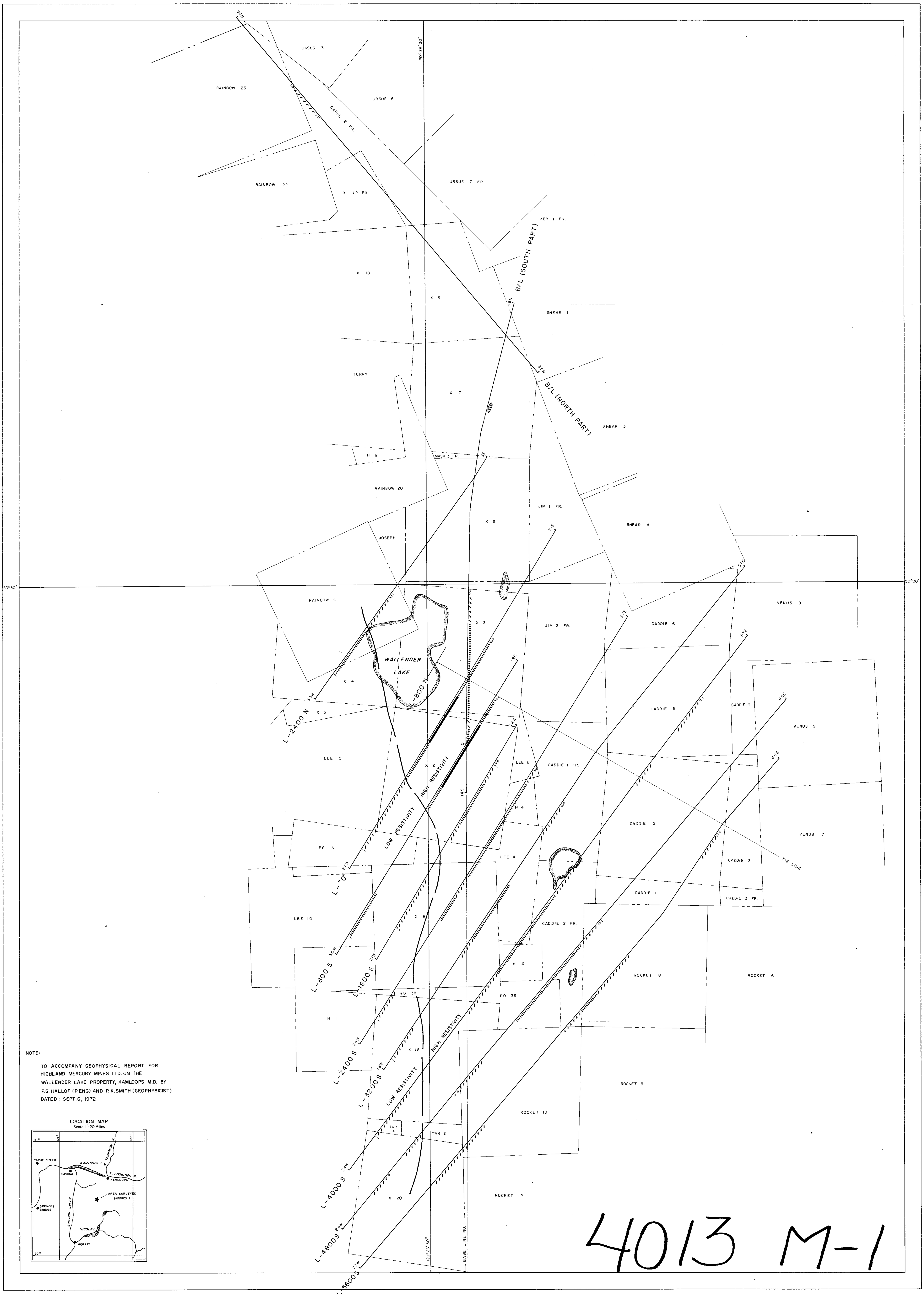
NOTE: THIS PLOT WAS PRODUCED BY MCPHAR COMPUTER DIVISION

DWG. IP-4859

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

PLAN MAP



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE
PROBABLE
POSSIBLE

Number at the end of anomaly indicates electrode interval

HIGHLAND MERCURY MINES LIMITED (N.P.L.)

WALLENDER LAKE PROPERTY, PROJECT 1035

KAMLOOPS AREA, KAMLOOPS M.D. - B.C.

SCALE

One Inch = 400 Feet

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 4013 MAP #1

DRAWN: F.R.P.
DATE: AUG. 1972
APPROVED: P.G. Hallof
DATE: 9/6/72

DWG. IP-4859