REPORT ON
COMBINED HELICOPTER-BORNE MAGNETIC AND ELECTROMAGNETIC SURVEY
HAWKINS TOWNSHIP PROPERTY
HAWKINS, TWP., NORTHERN ONTARIO

RECEIVED
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MINING LANDS SECTION

for
GOLD FIELDS CANADIAN MINING, LIMITED
by
AERODAT LIMITED
October 1986

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(Scale: 1:15,840)

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1. INTRODUCTION

This report describes an airborne geophysical survey carried out on behalf of Gold Fields Canadian Mining, Limited by Aerodat Limited. Equipment operated included a three-frequency electromagnetic system, a proton precession magnetometer, a two frequency VLF-EM system, a tracking system, a proton precession magnetometer, a two-frequency VLF-EM system, a tracking camera, an altimeter and a radar positioning system. Electromagnetic, magnetic and altimeter data were recorded both in digital and analog form. Positioning data were stored in digital form and on film as well as being recorded manually by the operator in flight.

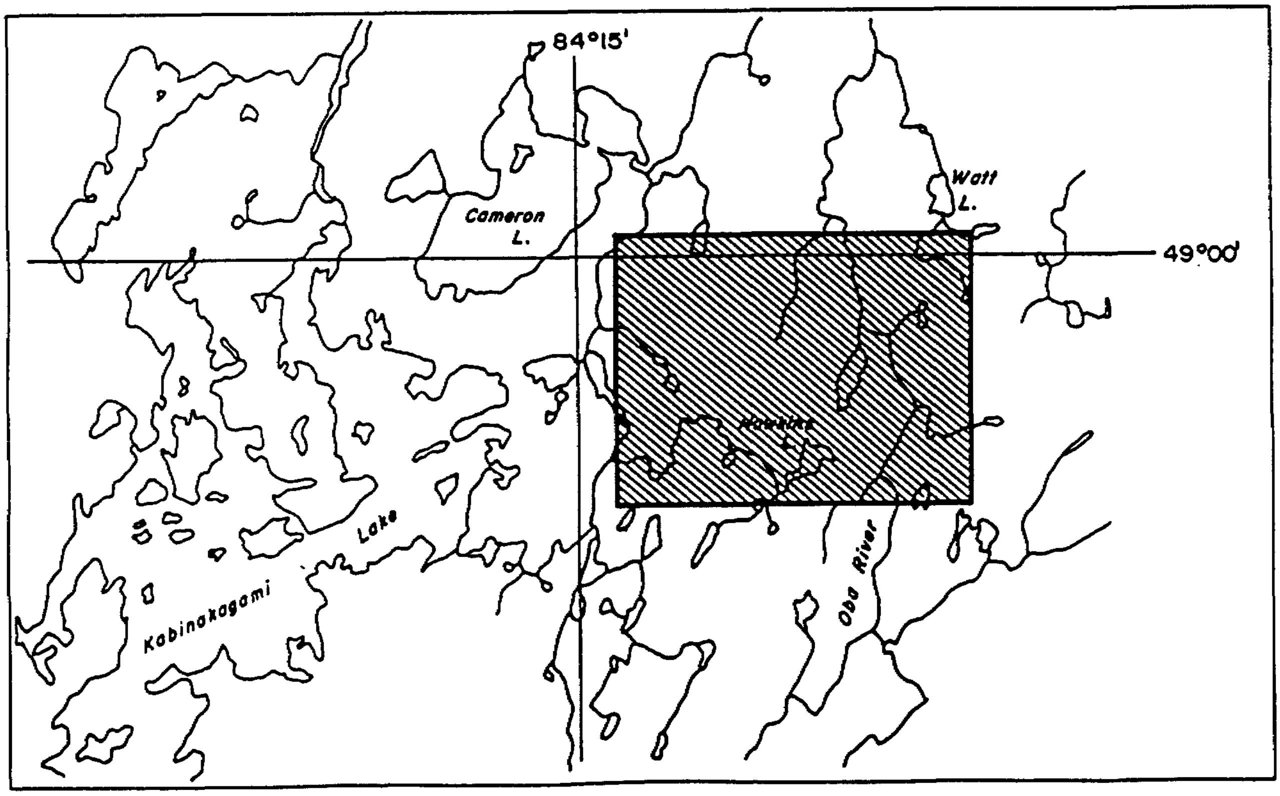
The survey area, covering a portion of Hawkins Township in the Porcupine Mining Division, was flown during the period of July 21st to 23rd, 1986. Five flights were required to complete the survey with flight lines oriented at an Azimuth of 000 degrees and flown at a nominal spacing of 100 metres. Coverage and data quality were considered to be well within the specifications described in the contract.

The purpose of the survey was to record airborne geophysical data over and around ground that is of interest to Gold Fields Canadian Mining, Limited.

A total of 471 kilometres of the recorded data were compiled in map form and are presented as part of this report according to specifications outlined by Gold Fields Canadian Mining, Limited.

2. SURVEY AREA LOCATION

The survey area is depicted on the index map shown below. It is centred at Latitude 48 degrees 58 minutes north, Longitude 84 degrees 08 minutes west, approximately 65 kilometres south-southeast of the town of Hearst (NTS Reference Map Mo. 42 C/16). The area is accessed by all weather roads and bush trails off Highway 11 to the north. The Algoma Central Railway also cuts the area in a north-south direction toward the eastern edge of the survey. The village of Oba, at the crossing of the Algoma Central and Canadian National Railways is less than 8 kilometres from the northern boundary.



3. AIRCRAFT AND EQUIPMENT

3.1 Aircraft

The helicopter used for the survey was an Aerospatiale A-Star 350B owned and operated by Lakeland Helicopters Limited (C-RGK). Installation of the geophysical and ancillary equipment was carried out by Aerodat. The survey aircraft was flown at a mean terrain clearance of 60 metres.

3.2 Equipment

3.2.1 Electromagnetic System

The electromagnetic system was an Aerodat 3-frequency system. Two vertical coaxial coil pairs were operated at 935 and 4600 Hz and a horizontal coplanar coil pair at 4175 Hz. The transmitter-receiver separation was 7 metres. Inphase and quadrature signals were measured simultaneously for the 3 frequencies with a time constant of 0.1 seconds. The electromagnetic bird was towed 30 metres below the helicopter.

3.2.2 VLF-EM System

The VLF-EM system was a Herz Totem 2A. This instrument measures the total field and quadrature components of the selected frequencies. The sensor was towed in a bird 12 metres below the helicopter. The transmitting stations used were NAA (Cutler, Maine, 24.0 kHz) for the line channels and NSS (Annapolis, Maryland, 21.4 kHz) for the ortho channels.

3.2.3 Magnetometer

The magnetometer was a Scintrex Cesium optically pumped high sensitivity type. The sensitivity of the instrument was 0.02 nT at a 0.2 second sampling rate. The sensor was towed in a bird 12 metres below the helicopter.

3.2.4 Magnetic Base Station

An IFG proton precession magnetometer was operated at the base of operations to record diurnal variations of the earth's magnetic field.

The clock of the base station was synchronized with that of the airborne system to facilitate later correlation.

3.2.5 Radar Altimeter

A Hoffman HRA-100 radar altimeter was used to record terrain clearance. The output from the instrument is a linear function of altitude for maximum accuracy.

3.2.6 Tracking Camera

A Geocam tracking camera was used to record flight path on 35mm film. The camera was operated in strip mode and the fiducial numbers for cross-reference to the analog and digital data were imprinted on the margin of the film.

3.2.7 Analog Recorder

An RMS dot-matrix recorder was used to display the data during the survey. In addition to manual and time fiducials, the following data was recorded:

Channel	Input	Scale
ALT	Altimeter (500 ft. at top of chart).	10 ft./mm
CXI1	Low Frequency Inphase	2 ppm/mm
CXQ1	Low Frequency Quadrature	2 ppm/mm
CXI2	High Frequency Inphase	2 ppm/mm
CXQ2	High Frequency Quadrature	2 ppm/mm
CPI1	Mid Frequency Inphase	4 ppm/mm
CPQ1	Mid Frequency Quadrature	4 ppm/mm
VLT	VLF-EM Total Field	2.5 %/mm
VLQ	VLF-EM Quadrature	2.5 %/mm

Channel	Input	Scale
VOT	VLF-EM Ortho Total Field	2.5 %/mm
VOQ	VLF-EM Ortho Quadrature	2.5 %/mm
MAGF	Magnetometer	2.5 nT/mm
MAGC	Magnetometer Coarse	25 nT/mm
MAGN	Magnetometer Noise	.025 nT/mm

3.2.8 Digital Recorder

A Perle DAC/NAV data system recorded the survey on magnetic tape. Information recorded was as follows:

Equipment	Interval
EM	0.1 seconds
VLF-EM Totem 2A	0.5 seconds
Magnetometer	0.2 seconds
Altimeter	0.5 seconds
MRS III	0.5 seconds

3.2.9 Radar Positioning System

A Motorola Mini-Ranger (MRS III) radar navigation system was utilized for both navigation and track recovery. Transponders located at fixed locations were interrogated several times per second and the ranges from these points to the helicopter measured to an accuracy of about 10 metres. A navigational computer triangulates the position of the helicopter and provides the pilot with navigational information. The range/range data were recorded on magnetic tape for subsequent flight path determination.

4. DATA PRESENTATION

4.0 Base Map

A photomosaic base at a scale of 1:15,840 was prepared by enlargement of aerial photographs of the survey area.

The flight path was derived from the Mini-Ranger radar positioning system. The distances from the helicopter to two established reference locations were measured several times per second, and the position of the helicopter calculated by triangulation. It is estimated that the flight path is generally accurate to about 10 metres with respect to the topographic detail of the base map. The flight path was presented with fiducials for cross-reference to both the analog and digital data.

4.1 Airborne Electromagnetic Survey Interpreation

An interpretation map was prepared showing flight lines, fiducials, peak locations of anomalies and axes of any possible bedrock conductors. The data were presented on a greyflex copy of the photo base map.

4.2 Electromagnetic Profiles

The electromagnetic data was recorded digitally at a sample rate of 10 per second with a time constant of 0.1 seconds. A two stage digital filtering process was carried out to reject major sferic events, and to reduce system noise.

Local sferic activity can produce sharp, large amplitude events that cannot be removed by conventional filtering procedures. Smoothing or stacking would reduce their amplitude but would leave a broader residual response that could be confused with a geological phenomenon. To avoid this possibility, a computer algorithm searched out and rejected the major sferic events.

The signal to noise ratio was further enhanced by the application of a low pass digital filter. It has zero phase shift which prevented any lag or peak displacement from occurring, and it suppressed only variations with a wavelength less than about 0.25 seconds. This low effective time constant permits maximum profile shape resolution.

Following the filtering processes, a base level correction was made. The correction applied was a linear function of time that ensured that the corrected amplitude of the various inphase and quadrature components was zero when no conductive or permeable source was present. The filtered and levelled data were then presented in profile map form.

The inphase and quadrature responses of the 4600 Hz and 935 Hz coaxial and the 4175 Hz coplanar configurations have been presented along with the flight path, and fiducials.

4.3 Apparent Resistivity Contours

The electromagnetic information was processed to yield a map of the apparent resistivity of the ground.

The approach taken in computing apparent resistivity was to assume a model of a 200m thick conductive layer (i.e. effectively a half space) over a resistive bedrock. The computer then generated, from nomograms for this model, the resistivity that would be consistent with the bird elevation and recorded amplitude for the coaxial high frequency pair.

The apparent resistivity profile data were interpolated onto a regular grid at a 25m true scale interval using a cubic spline technique.

The contoured apparent resistivity data were presented on a greyflex copy of the photo base map with the flight path.

4.4 Total Field Magnetic Contours

The aeromagnetic data were corrected for diurnal variations by subtraction of the digitally recorded base station magnetic profile.

The corrected profile data were interpolated onto a regular grid at a 25m true scale interval using a cubic spline technique. The grid provided the basis for threading the presented contours at a 2 nT interval.

The aeromagnetic data were presented with flight path information on a greyflex copy of the photo base map.

4.5 Vertical Gradient Magnetic Contours

The vertical magnetic gradient was calculated from the gridded total field magnetic data. Contoured at a .2 nT/m interval, the gradient data were presented on the photomosaic base with the flight path.

5. INTERPRETATION AND RECOMMENDATIONS

Geology

No geologic data was supplied to Aerodat by the client and no published data was available to the writer. Also, types of targets sought have not been identified although it is assumed that the primary interest is in gold mineralization that is known to occur in the general area.

Magnetics

The magnetic data from the high sensitivity magnetometer provide virtually a continuous magnetic reading when recording at one-fifth second intervals. The system is also practically noise free.

The sensitivity of 0.1 nT allows for the mapping of very small inflections in the magnetic field resulting in a contour map that is comparable in quality to good ground data. Both the fine and coarse magnetic traces were recorded on the analog charts.

The Total Field Magnetic map is characterized by a maze of narrow, dike-like trends, presumably diabase, that cut the area at various angles. The dominant and probably younger trend, is north-northwesterly with over twelve such distinct features identified across the width of the survey.

A northwesterly trend, in the western half of the block, appears to be the youngest diabase of those detected within the survey area.

Two strong, narrow, sub-parallel east-west trending bands extend across the survey area at about the northern quarter of the block. A somewhat similar feature occurs across the southern quarter except that the bands are highly contorted in the west central section of this trend. This magnetic complexity tends to extend to the south boundary of the survey.

All these magnetic features appear to have been superimposed on a relatively quiet magnetic background. The east-west magnetic trends appear to be a reflection of metasedimentary/metavolcanic lithology and likely represent lean iron formation, at least along the northern quarter. The strongest magnetic responses were recorded in the area of Line 760 for the north zone and Lines 290 and 390 for the south zone. The anomalous values along Line 290 are of the order of 3000 nanoTeslas above a 59,500 nT background.

The Vertical Magnetic Gradient map in its present form lends little to the magnetic interpretation, particularly in the south central portion of the area. Some additional processing might be considered to enhance the data long preferred orientations through the use of de-corrugation filtering.

Reference map G.S.C. 1:250,000 Aeromagnetic Series sheet 42C 'White River'.

Electromagnetics

The electromagnetic data were first checked by a line-by-line examination of the analog records. Record quality was good to excellent with strong sferic interference noted only during the initial part of Flight '3', primarily on the high frequency coaxial traces. At no time was the sferic activity of an intensity or frequency such that it could not be readily removed from the final profiles by a proprietary de-spiking filter. Instrument noise was well within specifications. Geologic noise, in the form of strong surficial conductors, primarily over the lakes and swamps, dominates the higher frequency (quadrature) responses.

Anomalies were intially picked off the analog records, with reference to all three channels. These selections were checked with a proprietary computerized selection program on both the low and high frequency coaxial responses and were further compared to the coplanar profile data.

Conductor axes were then marked using line to line correlations of the electromagnetic profiles. These conductors were grouped into conductive zones on the bases of magnetic (and lithologic) correlations. In the description of the results, the terms "apparent conductivity" and "conductance" may have been used interchangeably. Strictly speaking, this is incorrect as 'Conductance' refers to a computed quantity (i.e., product of Conductivity X Thickness) whereas 'Apparent Conductivity' is the property of the bedrock or overburden being measured.

Results

Three separate bedrock conductors are shown on the Interpretation Map. In fact, only three distinct conductive zones exist within the survey area. Conductors I, IV and V are intimately tied in with the two east-west magnetic bands across the north quarter of the survey. They are all either directly coincident with or otherwise very closely related to the magnetic anomalies. Vertical to north dip is interpreted along these two electromagnetic/magnetic zones.

In contrast, no conductors are coincident with the southern magnetic feature.

Conductances are generally very low but the values may have been distorted by the fairly thick, slightly conductive overburden. The calculated thicknesses vary from zero to about fifty metres with shallower values tending toward the northeast corner and thicker values along the south.

None of the conductors can be attributed to massive sulphide occurrences. Conductors I, IV and V are likely due to minor sulphide/graphite mineralization within the iron formation bands. Conductor IX was intially selected without benefit of the photomosaic response from the railroad tracks.

Apparent Resistivity

The Apparent Resitivity map gives a good depiction of the overburden conductivity (i.e., conductivity X thickness) over the area of the survey. Bedrock relief is indicated where the conductivity trends conform to the magnetic patterns, particularly relative to the diabase dikes.

Discussion

The northerly zones of coincident magnetic and electromagnetic anomlies appear to be weakly mineralized, relatively lean, narrow bands of iron formation, within a metasedimentary assemblage of rocks. The southerly magnetic trend appears to mark a transition to amphibolites with the intervening zone either massive metasediments or felsic metavolcanics.

Recommendations

Conductors I and V are recommended as priority follow-up targets based on slight decreases in apparent magnetic susceptibility (alteration ?) corresponding to the conductivity. The remaining conductor along this magnetic band may be tested depending on the results of the initial tests. Intersections of magnetic zones and cross-cutting diabase were not regarded as a significant mineralization loci based on experience in the Porcupine Gold Camp to the southeast, but could be worthy of consideration here.

Reprocessing of the magnetic data is suggested to minimize the diabase responses in the south central portion of the area. De-corrugation filters may be used to more or less eliminate the effects from the northeasterly and northwesterly diabase.

Respectfully submitted,
AERODAT LIMITED

George Podolsky
Geophysical Consultant

REGISTERED PROFESSIONAL ENGINEER
G. PODOLSKY
PROVINCE OF ONTARIO

December, 1986
J8628

STATEMENT OF QUALIFICATIONS

GEORGE PODOLSKY

1. I reside at 172 Dunwoody Drive, OAKVILLE, Ontario.

2. I hold a B.Sc. in Engineering Physics from Queen's University (1954) and am a member of the Association of Professional Engineers of the Province of Ontario.

3. I am a professional geophysicist, have been an active member of the Society of Exploration Geophysicists since 1960, and have worked in the minerals industry since 1954.

4. I have examined all the data obtained by Aerodat in the course of their survey and this report is based on that examination.

5. I am an independent consultant and have no direct or indirect interest in Gold Fields Canadian Mining, Limited or in any properties lying within the surveyed area.

George Podolsky

G. PODOLSKY

Geopod Associates Inc.

October, 1986

J8628

APPENDIX I

GENERAL INTERPRETIVE CONSIDERATIONS

Electromagnetic

The Aerodat three frequency system utilizes two different transmitter-receiver coil geometries. The traditional coaxial coil configuration is operated at two widely separated frequencies and the horizontal coplanar coil pair is operated at a frequency approximately aligned with one of the coaxial frequencies.

The electromagnetic response measured by the helicopter system is a function of the "electrical" and "geometrical" properties of the conductor. The "electrical" property of a conductor is determined largely by its electrical conductivity, magnetic susceptibility and its size and shape; the "geometrical" property of the response is largely a function of the conductor's shape and orientation with respect to the measuring transmitter and receiver.

Electrical Considerations

For a given conductive body the measure of its conductivity or conductance is closely related to the measured phase shift between the received and transmitted electromagnetic field. A small phase shift indicates a relatively high conductance, a large phase shift lower conductance. A small phase shift results in a large inphase to quadrature ratio and a large phase shift a low ratio. This relationship is shown quantitatively for a non-magnetic vertical half-plane model on the accompanying phasor diagram. Other physical models will show the same trend but different quantitative relationships.

The phasor diagram for the vertical half-plane model, as presented, is for the coaxial coil configuration with the amplitudes in parts per million (ppm) of the primary field as measured at the response peak over the conductor. To assist the interpretation of the survey results the computer is used to identify the apparent conductance and depth at selected anomalies. The results of this calculation are presented in table form in Appendix II and the conductance and inphase amplitude are presented in symbolized form on the map presentation.

The conductance and depth values as presented are correct only as far as the model approximates the real geological situation. The actual geological source may be of limited length, have significant dip, may be strongly magnetic, its conductivity and thickness may vary with depth and/or strike and adjacent bodies and overburden may have modified the response. In general the conductance estimate is less affected by these limitations than is the depth estimate, but both should be considered as relative rather than absolute guides to the anomaly's properties.

Conductance in mhos is the reciprocal of resistance in ohms and in the case of narrow slab-like bodies is the product of electrical conductivity and thickness.

Most overburden will have an indicated conductance of less than 2 mhos; however, more conductive clays may have an apparent conductance of say 2 to 4 mhos. Also in the low conductance range will be electrolytic conductors in faults and shears.

The higher ranges of conductance, greater than 4 mhos, indicate that a significant fraction of the electrical conduction is electronic rather than electrolytic in nature. Materials that conduct electronically are limited to certain metallic sulphides and to graphite. High conductance anomalies, roughly 10 mhos or greater, are generally limited to sulphide or graphite bearing rocks.

Sulphide minerals, with the exception of such ore minerals as sphalerite, cinnabar and stibnite, are good conductors; sulphides may occur in a disseminated manner that inhibits electrical conduction through the rock mass. In this case the apparent conductance can seriously underrate the quality of the conductor in geological terms. In a similar sense the relatively non-conducting sulphide minerals noted above may be present in significant consideration in association with minor conductive sulphides, and the electromagnetic response only relate to the minor associated mineralization. Indicated conductance is also of little direct significance for the identification of gold mineralization. Although gold is highly conductive, it would not be expected to exist in sufficient quantity to create a recognizable anomaly, but minor accessory sulphide mineralization could provide a useful indirect indication.

In summary, the estimated conductance of a conductor can provide a relatively positive identification of significant sulphide or graphite mineralization; however, a moderate to low conductance value does not rule out the possibility of significant economic mineralization.

Geometrical Considerations

Geometrical information about the geologic conductor can often be interpreted from the profile shape of the anomaly. The change in shape is primarily related to the change in inductive coupling among the transmitter, the target, and the receiver.

In the case of a thin, steeply dipping, sheet-like conductor, the coaxial coil pair will yield a near symmetric peak over the conductor. On the other hand, the coplanar coil pair will pass through a null couple relationship and yield a minimum over the conductor, flanked by positive side lobes. As the dip of the conductor decreased from vertical, the coaxial anomaly shape changes only slightly, but in the case of the coplanar coil pair the side lobe on the down dip side strengthens relative to that on the up dip side.

As the thickness of the conductor increases, induced current flow across the thickness of the conductor becomes relatively significant and complete null coupling with the coplanar coils is no longer possible. As a result, the apparent minimum of the coplanar response over the conductor diminishes with increasing thickness, and in the limiting case of a fully 3 dimensional body or a horizontal layer or half-space, the minimum disappears completely.

A horizontal conducting layer such as overburden will produce a response in the coaxial and coplanar coils that is a function of altitude (and conductivity if not uniform). The profile shape will be similar in both coil configurations with an amplitude ratio (coplanar:coaxial) of about 4:1*.

In the case of a spherical conductor, the induced currents are confined to the volume of the sphere, but not relatively restricted to any arbitrary plane as in the case of a sheet-like form. The response of the coplanar coil pair directly over the sphere may be up to 8* times greater than that of the coaxial pair.

In summary, a steeply dipping, sheet-like conductor will display a decrease in the coplanar response coincident with the peak of the coaxial response. The relative strength of this coplanar null is related inversely to the thickness of the conductor; a pronounced null indicates a relatively thin conductor. The dip of such a conductor can be inferred from the relative amplitudes of the side-lobes.

Massive conductors that could be approximated by a conducting sphere will display a simple single peak profile form on both coaxial and coplanar coils, with a ratio between the coplanar to coaxial response amplitudes as high as 8*.

Overburden anomalies often produce broad poorly defined anomaly profiles. In most cases, the response of the coplanar coils closely follows that of the coaxial coils with a relative amplitude ratio of 4*.

Occasionally, if the edge of an overburden zone is sharply defined with some significant depth extent, an edge effect will occur in the coaxial coils. In the case of a horizontal conductive ring or ribbon, the coaxial response will consist of two peaks, one over each edge; whereas the coplanar coil will yield a single peak.

* It should be noted at this point that Aerodat's definition of the measured ppm unit is related to the primary field sensed in the receiving coil without normalization to the maximum coupled (coaxial configuration). If such normalization were applied to the Aerodat units, the amplitude of the coplanar coil pair would be halved.

Magnetics

The Total Field Magnetic Map shows contours of the total magnetic field, uncorrected for regional variation. Whether an EM anomaly with a magnetic correlation is more likely to be caused by a sulphide deposit than one without depends on the type of mineralization. An apparent coincidence between an EM and a magnetic anomaly may be caused by a conductor which is also magnetic, or by a conductor which lies in close proximity to a magnetic body. The majority of conductors which are also magnetic are sulphides containing pyrrhotite and/or magnetite. Conductive and magnetic bodies in close association can be, and often are, graphite and magnetite. It is often very difficult to distinguish between these cases. If the conductor is also magnetic, it will usually produce an EM anomaly whose general pattern resembles that of the magnetics. Depending on the magnetic permeability of the conducting body, the amplitude of the inphase EM anomaly will be weakened, and if the conductivity is also weak, the inphase EM anomaly may even be reversed in sign.

VLF Electromagnetics

The VLF-EM method employs the radiation from powerful military radio transmitters as the primary signals. The magnetic field associated with the primary field is elliptically polarized in the vicinity of electrical conductors. The Herz Totem uses three coils in the X, Y, Z configuration to measure the total field and vertical quadrature component of the polarization ellipse.

The relatively high frequency of VLF (15-25) kHz provides high response factors for bodies of low conductance. Relatively "disconnected" sulphide ores have been found to produce measureable VLF signals. For the same reason, poor conductors such as sheared contacts, breccia zones, narrow faults, alteration zones and porous flow tops normally produce VLF anomalies. The method can therefore be used effectively for geological mapping. The only relative disadvantage of the method lies in its sensitivity to conductive overburden. In conductive ground the depth of exploration is severely limited.

The effect of strike direction is important in the sense of the relation of the conductor axis relative to the energizing electromagnetic field. A conductor aligned along a radius drawn from a transmitting station will be in a maximum coupled orientation and thereby produce a stronger response than a similar conductor at a different strike angle. Theoretically, it would be possible for a conductor, oriented tangentially to the transmitter to produce no signal. The most obvious effect of the strike angle consideration is that conductors favourably oriented with respect to the transmitter location and also near perpendicular to the flight direction are most clearly rendered and usually dominate the map presentation.

The total field response is an indicator of the existence and position of a conductivity anomaly. The response will be a maximum over the conductor, without any special filtering, and strongly favour the upper edge of the conductor even in the case of a relatively shallow dip.

The vertical quadrature component over steeply dipping sheet-like conductor will be a cross-over type response with the cross-over closely associated with the upper edge of the conductor.

The response is a cross-over type due to the fact that it is the vertical rather than total field quadrature component that is measured. The response shape is due largely to geometrical rather than conductivity considerations and the distance between the maximum and minimum on either side of the cross-over is related to target depth. For a given target geometry, the larger this distance the greater the depth.

The amplitude of the quadrature response, as opposed to shape is function of target conductance and depth as well as the conductivity of the overburden and host rock. As the primary field travels down to the conductor through conductive material it is both attenuated and phase shifted in a negative sense. The secondary field produced by this altered field at the target also has an associated phase shift. This phase shift is positive and is larger for relatively poor conductors. This secondary field is attenuated and phase shifted in a negative sense during return travel to the surface. The net effect of these 3 phase shifts determine the phase of the secondary field sensed at the receiver.

A relatively poor conductor in resistive ground will yield a net positive phase shift. A relatively good conductor in more conductive ground will yield a net negative phase shift. A combination is possible whereby the net phase shift is zero and the response is purely in-phase with no quadrature component.

A net positive phase shift combined with the geometrical crossover shape will lead to a positive quadrature response on the side of approach and a negative on the side of departure. A net negative phase shift would produce the reverse. A further sign reversal occurs with a 180 degree change in instrument orientation as occurs on reciprocal line headings. During digital processing of the quadrature data for map presentation this is corrected for by normalizing the sign to one of the flight line headings.

APPENDIX II

ANOMALY LIST

J8628 HEARST LAKE PROJECT

						CONDUCTOR		BIRD
				AMPLITUDE (PPM)		CTP	DEPTH	HEIGHT
FLIGHT	LINE	ANOMALY	CATEGORY	INPHASE	QUAD.	MHOS	MTRS	MTRS
1	170	A	0	3.3	4.5	0.4	35	32
2	250	A	0	-0.9	2.7	0.0	0	17
2	260	A	0	3.3	4.1	0.4	38	31
2	330	A	0	-0.2	0.8	0.0	0	32
2	340	A	0	-0.2	1.2	0.0	0	27
4	790	A	0	0.4	5.2	0.0	7	25
4	800	A	0	1.0	2.8	0.0	34	32
4	810	A	0	0.6	3.5	0.0	19	29
4	820	A	0	1.1	3.5	0.0	18	40
4	830	A	0	-0.1	5.0	0.0	0	37
4	840	A	0	1.3	1.8	0.2	57	35
4	850	A	0	0.2	2.2	0.0	22	24
4	850	B	0	1.1	2.2	0.1	46	32
4	860	A	0	1.1	1.7	0.1	43	47
4	860	B	0	0.4	2.4	0.0	19	35
4	870	A	0	0.0	2.2	0.0	0	35
4	870	B	0	2.5	3.2	0.3	48	28
4	880	A	0	2.4	5.0	0.1	32	26
4	880	B	0	-0.2	2.6	0.0	0	39
4	890	A	0	-0.7	3.3	0.0	0	33
4	930	A	0	0.2	3.1	0.0	4	32
4	940	A	0	1.4	1.9	0.2	57	32
4	940	B	0	0.4	3.1	0.0	4	42
4	950	A	0	-0.1	3.1	0.0	0	30
4	950	B	0	0.4	4.2	0.0	0	42

Estimated depth may be unreliable because the stronger part of the conductor may be deeper or to one side of the flight line, or because of a shallow dip or overburden effects.

2.9411

Ministry of Northern Development and Mines
Ontario

Report of Work
(Geophysical, Geological, Geochemical and Expenditure)

2407-86

42C16NE8213 2.9646 HAWKINS

900

Type of Survey(s)	Helicopter, magnetic, electromagnetic, VLF-EM
Township or Area	Hawkings Township
Claim Holder(s)	Gold Fields Canadian Mining Ltd.
Prospector's Licence No.	T-1195
Address	123 Front St. W. Suite 909, Toronto, Ontario M5J 2M2
Survey Company	Aerodat Ltd.
Date of Survey (from & to)	21 07 86 23 07 86 (Day Mo. Yr. Day Mo. Yr.)
Total Miles of line Cut	
Name and Address of Author (of Geo-Technical report)	George Podolsky c/o 3883 Nashua Dr. Mississauga, Ontario

Credits Requested per Each Claim in Columns at right

Special Provisions		Days per Claim
For first survey: Enter 40 days. (This includes line cutting)	Geophysical	
	- Electromagnetic	
	- Magnetometer	
For each additional survey: using the same grid: Enter 20 days (for each)	- Radiometric	
	- Other	
	Geological	
	Geochemical	

Man Days		Days per Claim
Complete reverse side and enter total(s) here	Geophysical	
	- Electromagnetic	
	- Magnetometer	
	- Radiometric	
	- Other	
	Geological	
	Geochemical	

Airborne Credits		Days per Claim
Note: Special provisions credits do not apply to Airborne Surveys.	Electromagnetic	40
	Magnetometer	40
	Radiometric	

Expenditures (excludes power stripping)

Type of Work Performed

Performed on Claim(s)

Calculation of Expenditure Days Credits

Total Expenditures				Days Credits
S	÷	15	=	

Instructions
Total Days Credits may be apportioned at the claim holder's choice. Enter number of days credits per claim selected in columns at right.

PORCUPINE MINING DIVISION
RECEIVED
DEC 15 1986

Mining Claims Traversed (List in numerical sequence)

Mining Claim Prefix	Mining Claim Number	Expend. Days Cr.	Mining Claim Prefix	Mining Claim Number	Expend. Days Cr.
See	Attached				
List					

RECORDED
DEC 15 1986

Total number of mining claims covered by this report of work. 251

Date	Recorded Holder or Agent (Signature)
Dec. 11, 1986	P. Lougheed

For Office Use Only		
Total Days Cr. Recorded	Date Recorded	Mining Recorder
20080	Dec. 15/86	
	Date Approved as Recorded	Branch Director
	8/1/87	

Certification Verifying Report of Work

I hereby certify that I have a personal and intimate knowledge of the facts set forth in the Report of Work annexed hereto, having performed the work or witnessed same during and/or after its completion and the annexed report is true.

Name and Postal Address of Person Certifying
Peter Lougheed - Geologist c/o Gold Feilds Canadian Mining Ltd.
123 Front St. W. Suite 909 Toronto, Ont

Date Certified	Certified by (Signature)
Dec. 11, 86	

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Ministry of
Northern Development
and Mines
Ontario

Geophysical-Geological-Geochemical Technical Data Statement

File __________

**TO BE ATTACHED AS AN APPENDIX TO TECHNICAL REPORT
FACTS SHOWN HERE NEED NOT BE REPEATED IN REPORT
TECHNICAL REPORT MUST CONTAIN INTERPRETATION, CONCLUSIONS ETC.**

Type of Survey(s) Helicopter, magnetic, electromagnetic, VLF-EM
Township or Area Hawkins Township
Claim Holder(s) Gold Fields Canadian Mining Ltd.
Survey Company Aerodat Ltd.
Author of Report George Podolsky
Address of Author c/o 3883 Nashua Dr. Mississauga, Ont
Covering Dates of Survey July 21, to July 23, 1986 (linecutting to office)
Total Miles of Line Cut __________

MINING CLAIMS TRAVERSED
List numerically

See attached list
(prefix) (number)

If space insufficient, attach list

TOTAL CLAIMS 251

SPECIAL PROVISIONS CREDITS REQUESTED

ENTER 40 days (includes line cutting) for first survey.

ENTER 20 days for each additional survey using same grid.

	DAYS per claim
Geophysical	
–Electromagnetic	
–Magnetometer	
–Radiometric	
–Other	
Geological	
Geochemical	

AIRBORNE CREDITS (Special provision credits do not apply to airborne surveys)

Magnetometer 40 Electromagnetic 40 ~~Radiometric~~ VLF-EM
(enter days per claim)

DATE: Dec. 10, 1986 SIGNATURE: __________
Author of Report or Agent

OFFICE USE ONLY

Res. Geol. __________ Qualifications 63,2038

Previous Surveys

File No.	Type	Date	Claim Holder

837 (85/12)

GEOPHYSICAL TECHNICAL DATA

GROUND SURVEYS – If more than one survey, specify data for each type of survey

Number of Stations ____ Number of Readings ____
Station interval ____ Line spacing ____
Profile scale ____
Contour interval ____

MAGNETIC

Instrument ____
Accuracy – Scale constant ____
Diurnal correction method ____
Base Station check-in interval (hours) ____
Base Station location and value ____

ELECTROMAGNETIC

Instrument ____
Coil configuration ____
Coil separation ____
Accuracy ____
Method: ☐ Fixed transmitter ☐ Shoot back ☐ In line ☐ Parallel line
Frequency ____
(specify V.L.F. station)
Parameters measured ____

GRAVITY

Instrument ____
Scale constant ____
Corrections made ____
Base station value and location ____
Elevation accuracy ____

INDUCED POLARIZATION
RESISTIVITY

Instrument ____
Method ☐ Time Domain ☐ Frequency Domain
Parameters – On time ____ Frequency ____
– Off time ____ Range ____
– Delay time ____
– Integration time ____
Power ____
Electrode array ____
Electrode spacing ____
Type of electrode ____

SELF POTENTIAL

Instrument Range

Survey Method

Corrections made

RADIOMETRIC

Instrument

Values measured

Energy windows (levels)

Height of instrument Background Count

Size of detector

Overburden

(type, depth — include outcrop map)

OTHERS (SEISMIC, DRILL WELL LOGGING ETC.)

Type of survey

Instrument

Accuracy

Parameters measured

Additional information (for understanding results)

AIRBORNE SURVEYS

Type of survey(s) Helicopter/magnetic/electromagnetic/VLF-EM

Instrument(s) Aerodat 3-Frequency/Hertz Totem 2A/Scintrex Cesium

(specify for each type of survey)

Accuracy 1ppm / 1% / 0.02 nT

(specify for each type of survey)

Aircraft used Aerospatiale A-star 350B

Sensor altitude 30 metres/48 metres/48 metres

Navigation and flight path recovery method Mini-Ranger MRS111 Positioning

Aircraft altitude 60 metres mean terrain clearance Line Spacing 100 metres

Miles flown over total area 394 miles Over claims only

GEOCHEMICAL SURVEY – PROCEDURE RECORD

Numbers of claims from which samples taken ____________________

Total Number of Samples ____________________

Type of Sample ____________________
(Nature of Material)

Average Sample Weight ____________________

Method of Collection ____________________

Soil Horizon Sampled ____________________

Horizon Development ____________________

Sample Depth ____________________

Terrain ____________________

Drainage Development ____________________

Estimated Range of Overburden Thickness ____________________

SAMPLE PREPARATION

(Includes drying, screening, crushing, ashing)

Mesh size of fraction used for analysis ____________________

General ____________________

ANALYTICAL METHODS

Values expressed in: per cent ☐ p. p. m. ☐ p. p. b. ☐

Cu, Pb, Zn, Ni, Co, Ag, Mo, As,-(circle)

Others ____________________

Field Analysis (__________ tests)

Extraction Method ____________________

Analytical Method ____________________

Reagents Used ____________________

Field Laboratory Analysis

No. (__________ tests)

Extraction Method ____________________

Analytical Method ____________________

Reagents Used ____________________

Commercial Laboratory (__________ tests)

Name of Laboratory ____________________

Extraction Method ____________________

Analytical Method ____________________

Reagents Used ____________________

General ____________________

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GOLD FIELDS CANADIAN MINING, LTD.
A Consolidated Gold Fields Group Company

University Place
123 Front Street West, Suite 909
Toronto, Ontario M5J 2M2
(416) 865-0945

RECEIVED
DEC 23 1986
MINING LANDS SECTION

December 23, 1986

Mr. J. C. Smith
Mining Recorder
Office of the Mining Recorder
Mining Lands Section
Whitney Block, 6th Floor
Queen's Park
Toronto, Ontario

Dear Mr. Smith:

In accordance with the Mining Act of Ontario, we respectfully wish to submit the results of an Airborne Geophysical Survey performed by Aerodat Ltd. of Mississauga, Ontario for Gold Fields Canadian Mining Ltd. Gold Fields are applying for assessment credits totalling 80 days per claim to be granted to a group of 251 contiguous claims in Hawkins Township.

I trust the enclosed reports, plans and Technical Data Statement will fully meet the requirements for the assessment credits.

Respectfully yours,

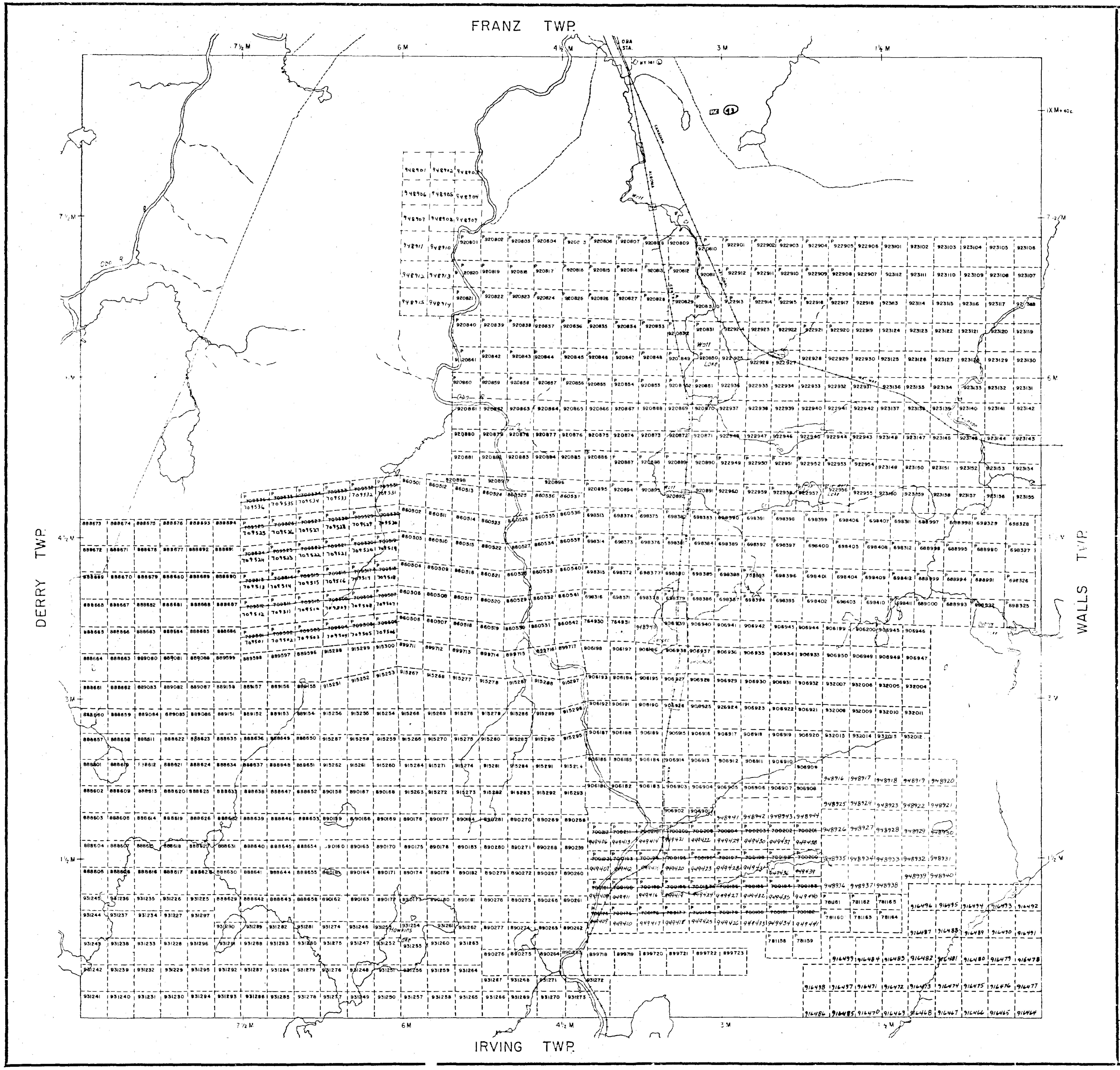
GOLD FIELDS CANADIAN MINING, LTD.

Peter Lougheed

P. Lougheed
Geologist

PL/lm

TRIM LINE



REFERENCES

AREAS WITHDRAWN FROM DISPOSITION

M.R.O. – MINING RIGHTS ONLY
S.R.O. – SURFACE RIGHTS ONLY
M.+ S. – MINING AND SURFACE RIGHTS

Description	Order No.	Date	Disposition	File
(43)		4/10/72		64585 [illegible]

LEGEND

- HIGHWAY AND ROUTE No.
- OTHER ROADS
- TRAILS
- SURVEYED LINES:
  - TOWNSHIPS, BASE LINES, ETC.
  - LOTS, MINING CLAIMS, PARCELS, ETC.
- UNSURVEYED LINES
  - LOT LINES
  - PARCEL BOUNDARY
  - MINING CLAIMS ETC.
- RAILWAY AND RIGHT OF WAY
- UTILITY LINES
- NON PERENNIAL STREAM
- FLOODING OR FLOODING RIGHTS
- SUBDIVISION OR COMPOSITE PLAN
- RESERVATIONS
- ORIGINAL SHORELINE
- MARSH OR MUSKEG
- MINES ⚒
- TRAVERSE MONUMENT ⊕

DISPOSITION OF CROWN LANDS

TYPE OF DOCUMENT	SYMBOL
PATENT, SURFACE & MINING RIGHTS	●
" , SURFACE RIGHTS ONLY	◒
" , MINING RIGHTS ONLY	○
LEASE, SURFACE & MINING RIGHTS	■
" , SURFACE RIGHTS ONLY	⬒
" , MINING RIGHTS ONLY	⬓
LICENCE OF OCCUPATION	▼
ORDER-IN-COUNCIL	OC
RESERVATION	[illegible]
CANCELLED	
SAND & GRAVEL	

NOTE: MINING RIGHTS IN PARCELS PATENTED PRIOR TO MAY 1913 VESTED IN ORIGINAL PATENTEE BY THE PUBLIC LANDS ACT, R.S.O. 1970, CHAP. 380, SEC. 63, SUBSEC. 1

SCALE: 1 INCH = 40 CHAINS

FEET 0 1000 2000 4000 6000 8000
METRES 0 200 1000 (1 KM) 2000 (2 KM)

TOWNSHIP

HAWKINS

PORCUPINE MINING DIVISION
RECEIVED
[illegible] 1986

M.N.R. ADMINISTRATIVE DISTRICT

HEARST

MINING DIVISION

PORCUPINE

LAND TITLES / REGISTRY DIVISION

ALGOMA

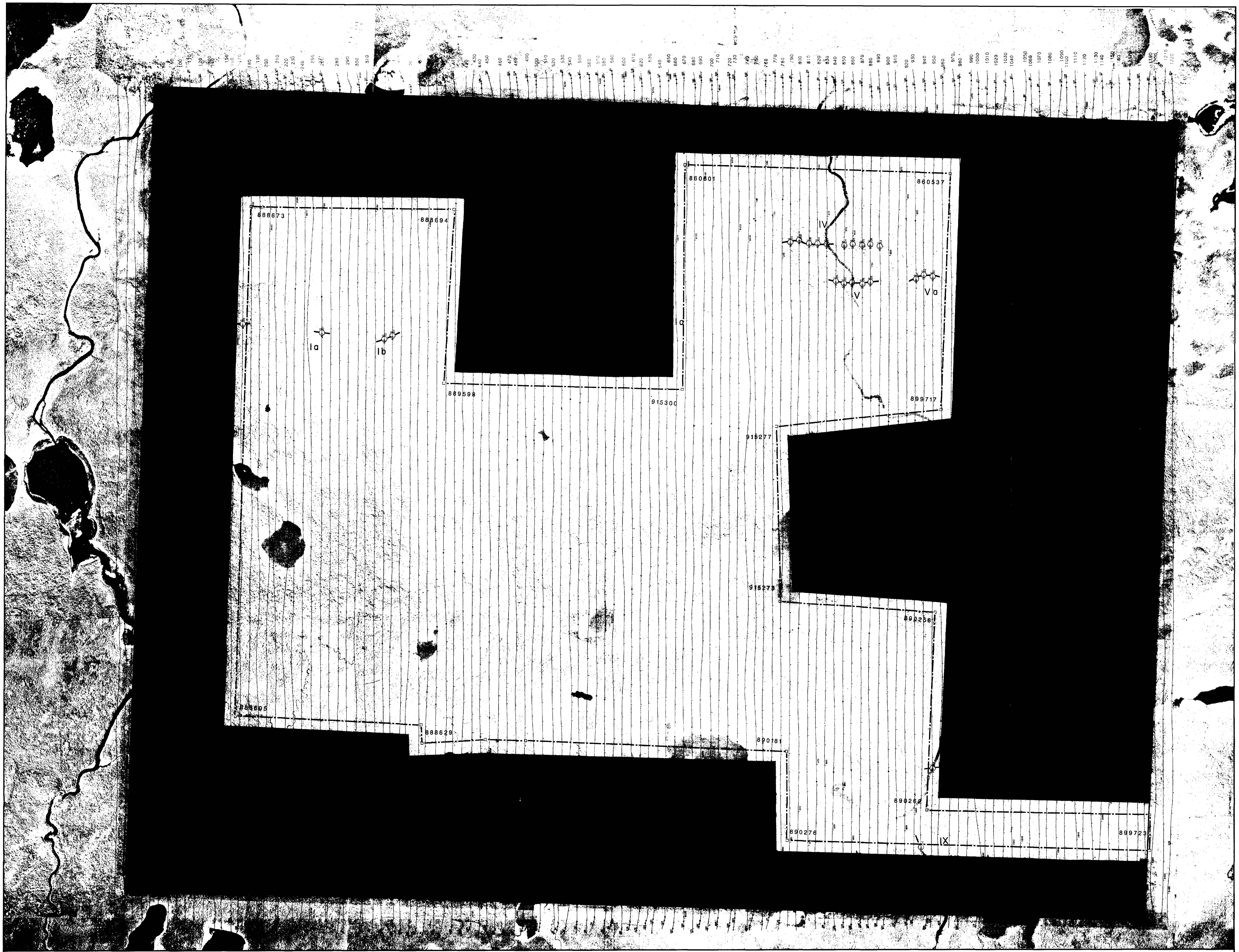
Ministry of Natural Resources
Land Management Branch
Ontario

Date MARCH 3, 1983
Checked by L.P.

Number G-2316

TRIM LINE

200



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INTERPRETATION LEGEND

—○—	EM Anomaly A in-phase amplitude 7 ppm Conductivity thickness of 2 mhos
VI —○—	Interpreted bedrock conductor axis

Positioning ..... MOTOROLA MINI-RANGER MRS III

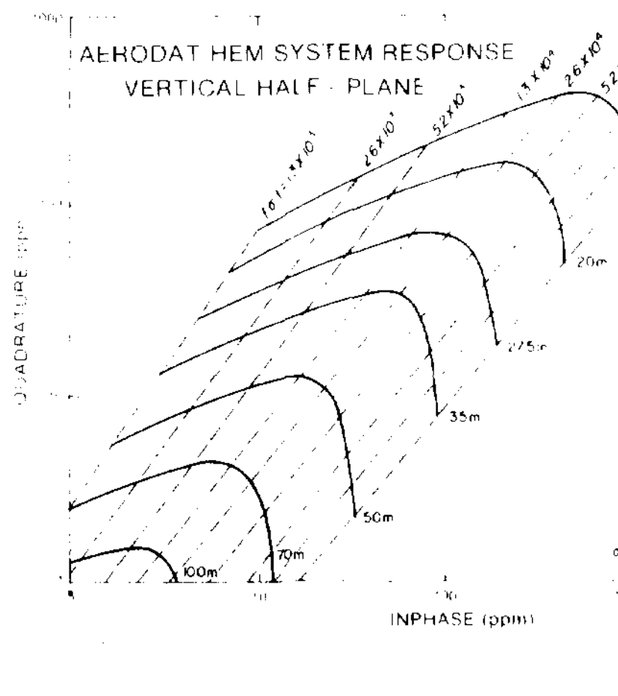
Mean EM sensor elevation .... 30 metres

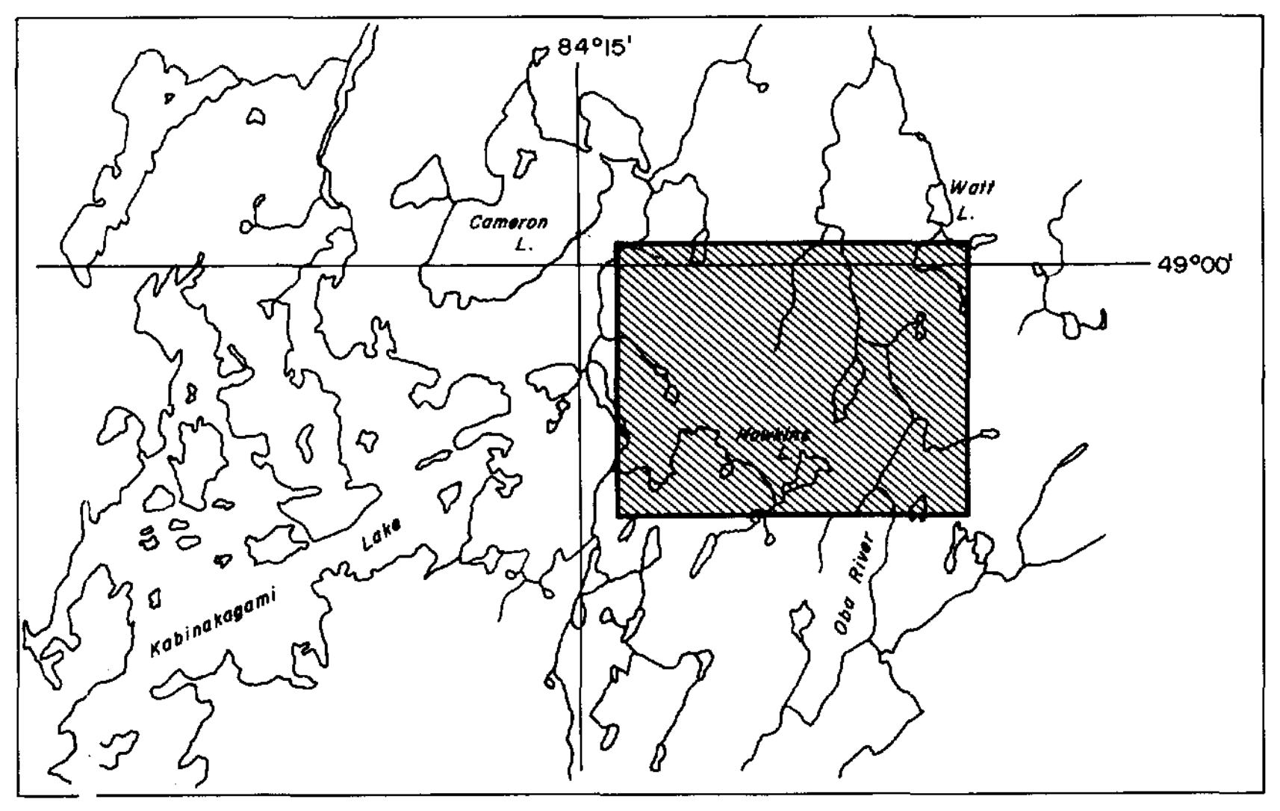
Mean flight line spacing .... 125 metres

EM RESPONSE

Conductivity thickness in mhos

⑦	60 - 120
⑥	30 - 60
⑤	15 - 30
④	8 - 15
③	4 - 8
②	2 - 4
①	1 - 2
○	0 - 1


AERODAT HEM SYSTEM RESPONSE
VERTICAL HALF - PLANE



GOLD FIELDS CANADIAN MINING, LIMITED

ELECTROMAGNETIC SURVEY INTERPRETATION

29646

HAWKINS TOWNSHIP

ONTARIO

SCALE 1/15,840

1/2 0 1/2 Mile

1 0 1 Kilometre

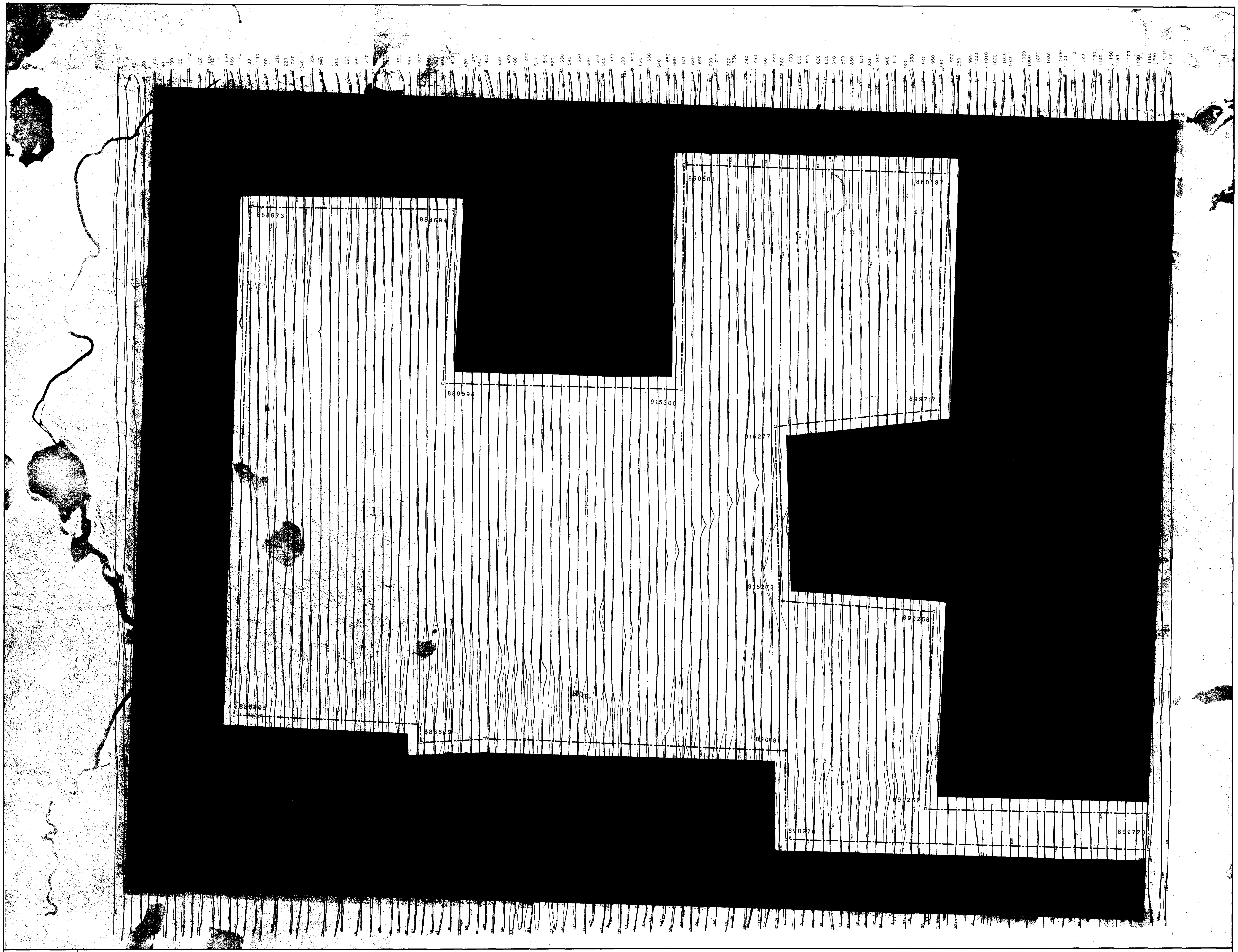
AERODAT LIMITED

DATE:	July 1986
N.T.S. No:	42C, 42F
MAP No:	1

REGISTERED PROFESSIONAL ENGINEER
G. PODOLSKY
18628
PROVINCE OF ONTARIO

42C16NE6213 2.9646 HAWKINS

210



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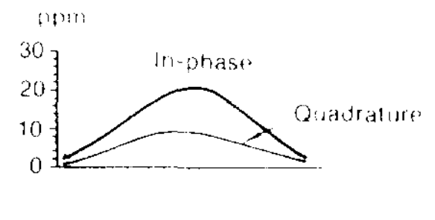
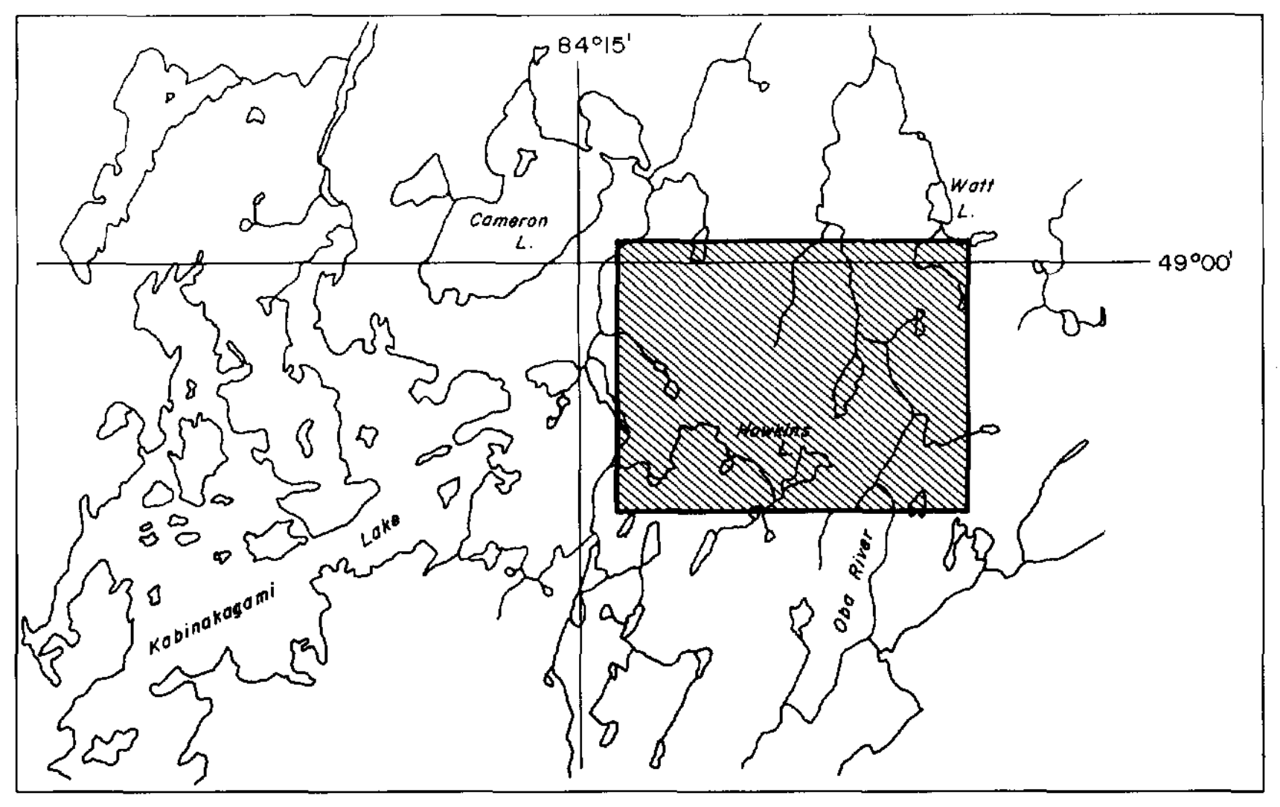
ELECTROMAGNETIC PROFILES-COAXIAL

Coil Separation	7 metres
Frequency	935 Hz
Sensor Elevation	30 metres
Vertical Scale	2 ppm mm





GOLD FIELDS CANADIAN MINING, LIMITED

ELECTROMAGNETIC SURVEY PROFILES
935 Hz COAXIAL

HAWKINS TOWNSHIP

ONTARIO

SCALE 1/15,840

1/2 0 1/2 Mile

1 0 1 Kilometre

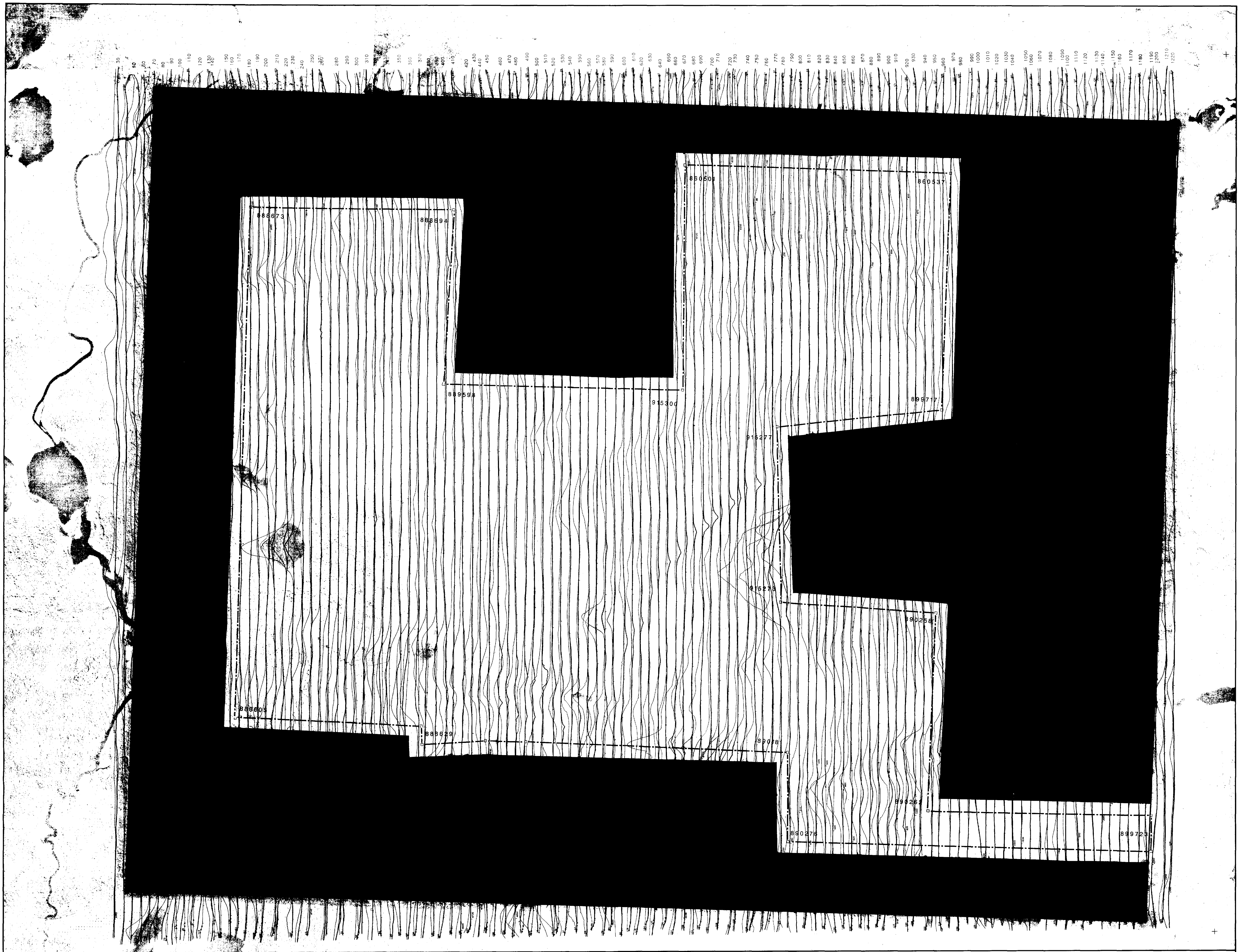
AERODAT LIMITED

DATE:	July 1986
N.T.S. No:	42C, 42F
MAP No:	2a

G. PODOLSKY
18628

42C16NE8213 2.9646 HAWKINS

220



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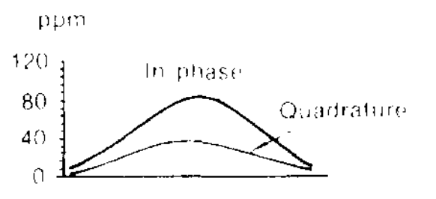
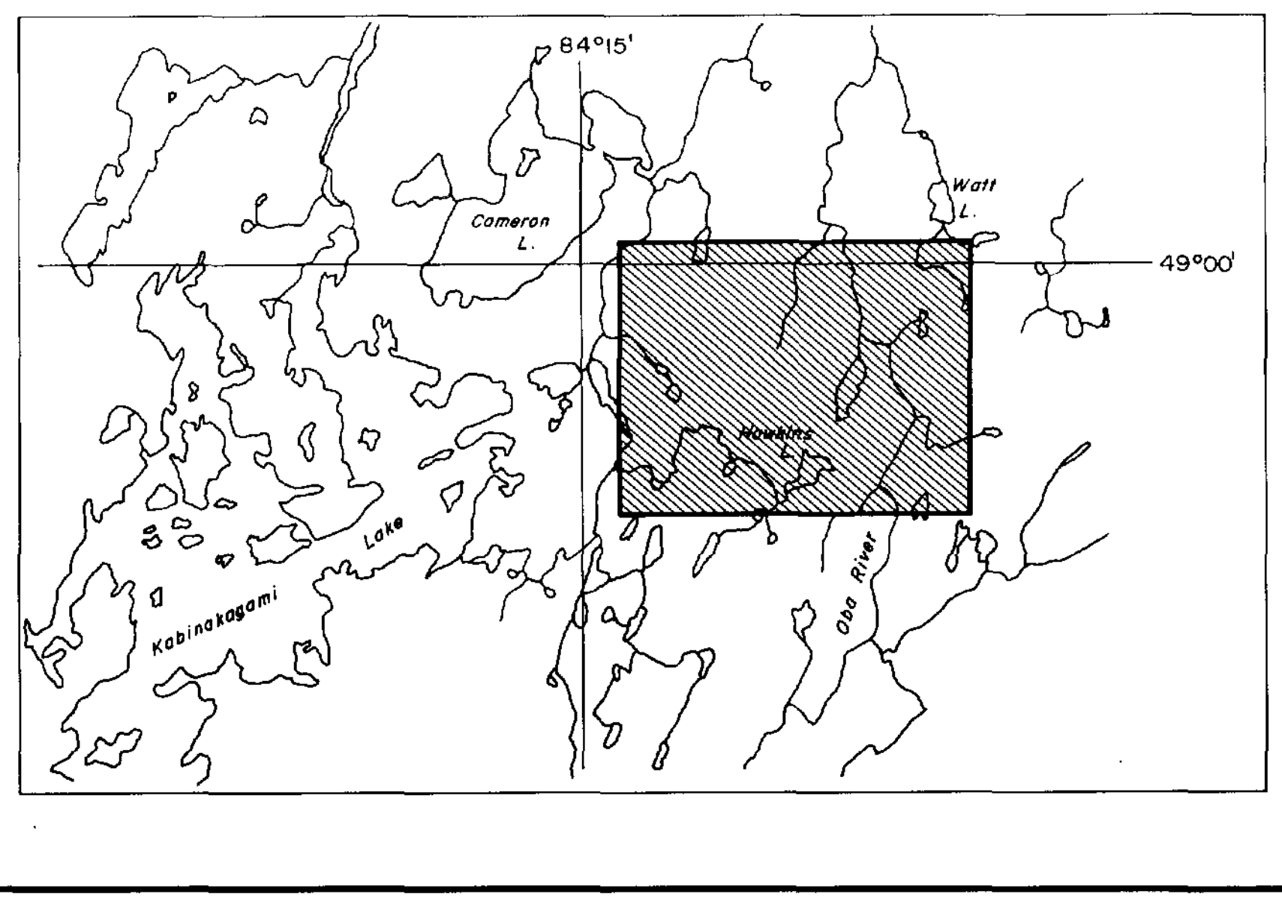
ELECTROMAGNETIC PROFILES-COPLANAR

Coil Separation — 7 metres
Frequency — 4175 Hz
Sensor Elevation — 30 metres
Vertical Scale — 8 ppm/mm





GOLD FIELDS CANADIAN MINING, LIMITED

ELECTROMAGNETIC SURVEY PROFILES
4175 Hz COPLANAR

HAWKINS TOWNSHIP

ONTARIO

SCALE 1/15,840

1/2 — 0 — 1/2 Mile

1 — 0 — 1 Kilometre

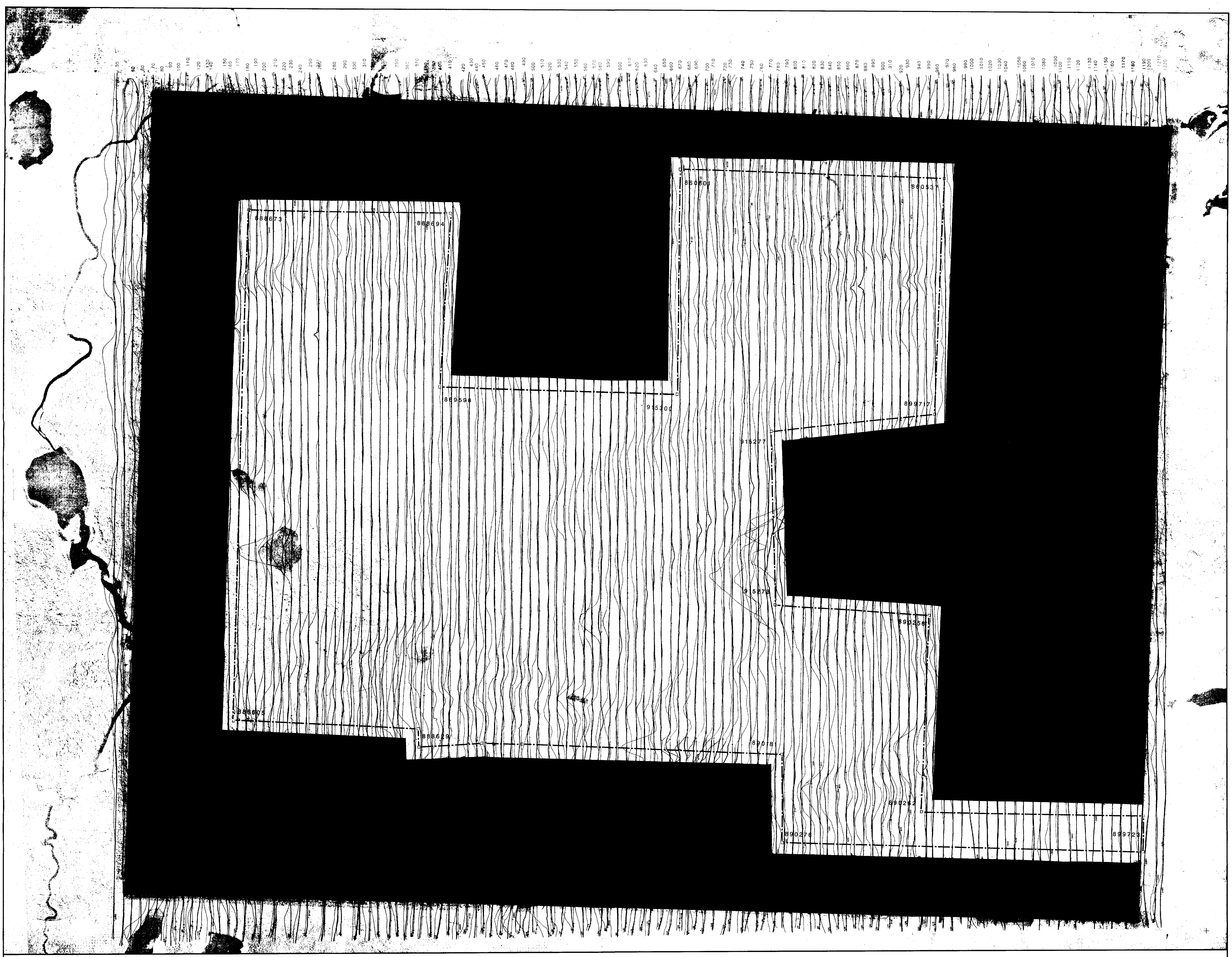
AERODAT LIMITED

DATE:	July 1986
N.T.S. No:	42C, 42F
MAP No:	2b

G. PODOLSKY

42C16NE8213 2.9646 HAWKINS

230



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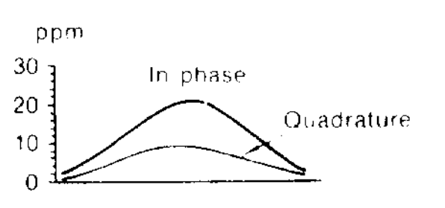
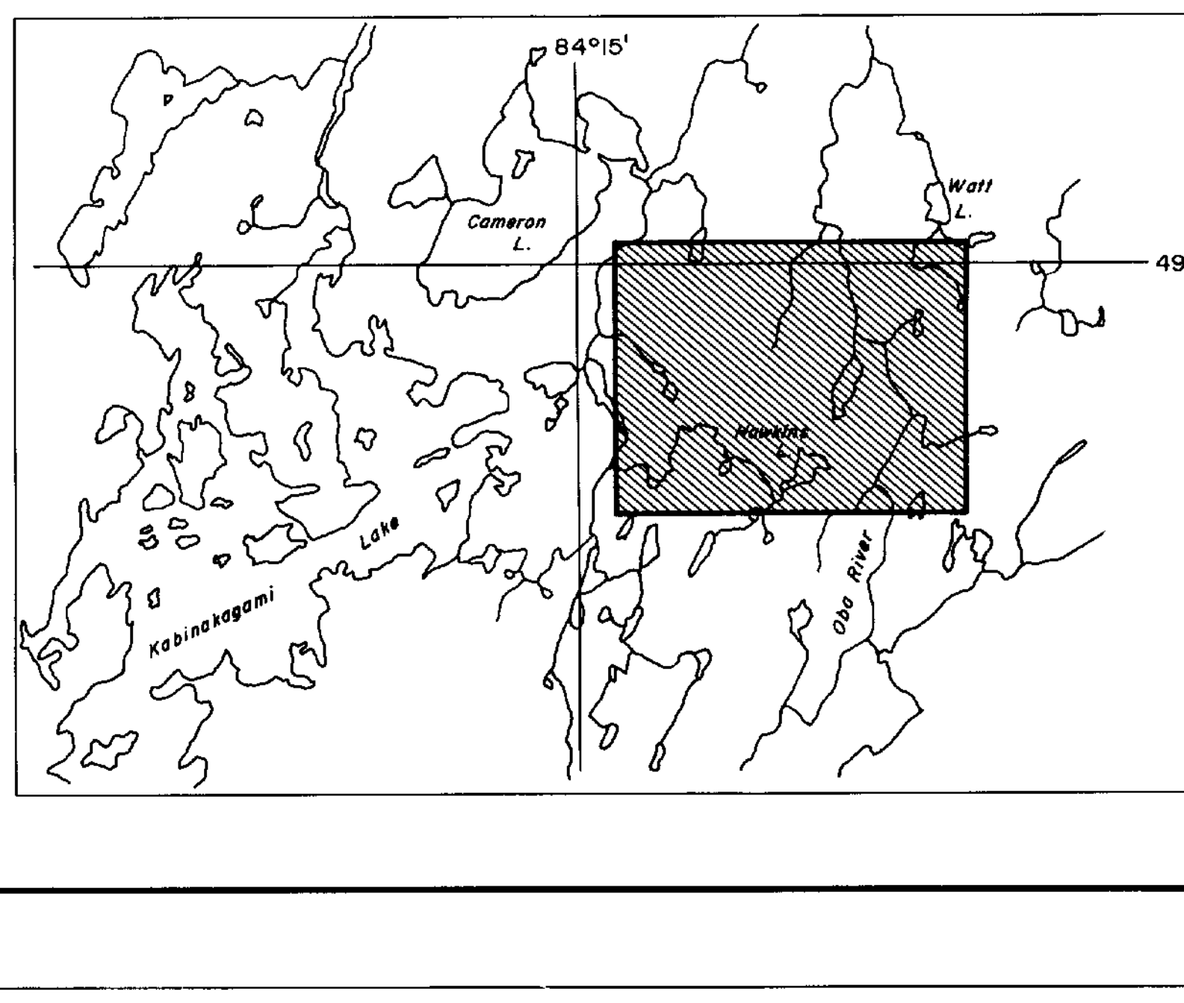
ELECTROMAGNETIC PROFILES-COAXIAL

Coil Separation	7 metres
Frequency	4600 Hz
Sensor Elevation	30 metres
Vertical Scale	2 ppm/mm





GOLD FIELDS CANADIAN MINING, LIMITED

ELECTROMAGNETIC SURVEY PROFILES
4600 Hz COAXIAL

HAWKINS TOWNSHIP

29646

ONTARIO

SCALE 1/15,840

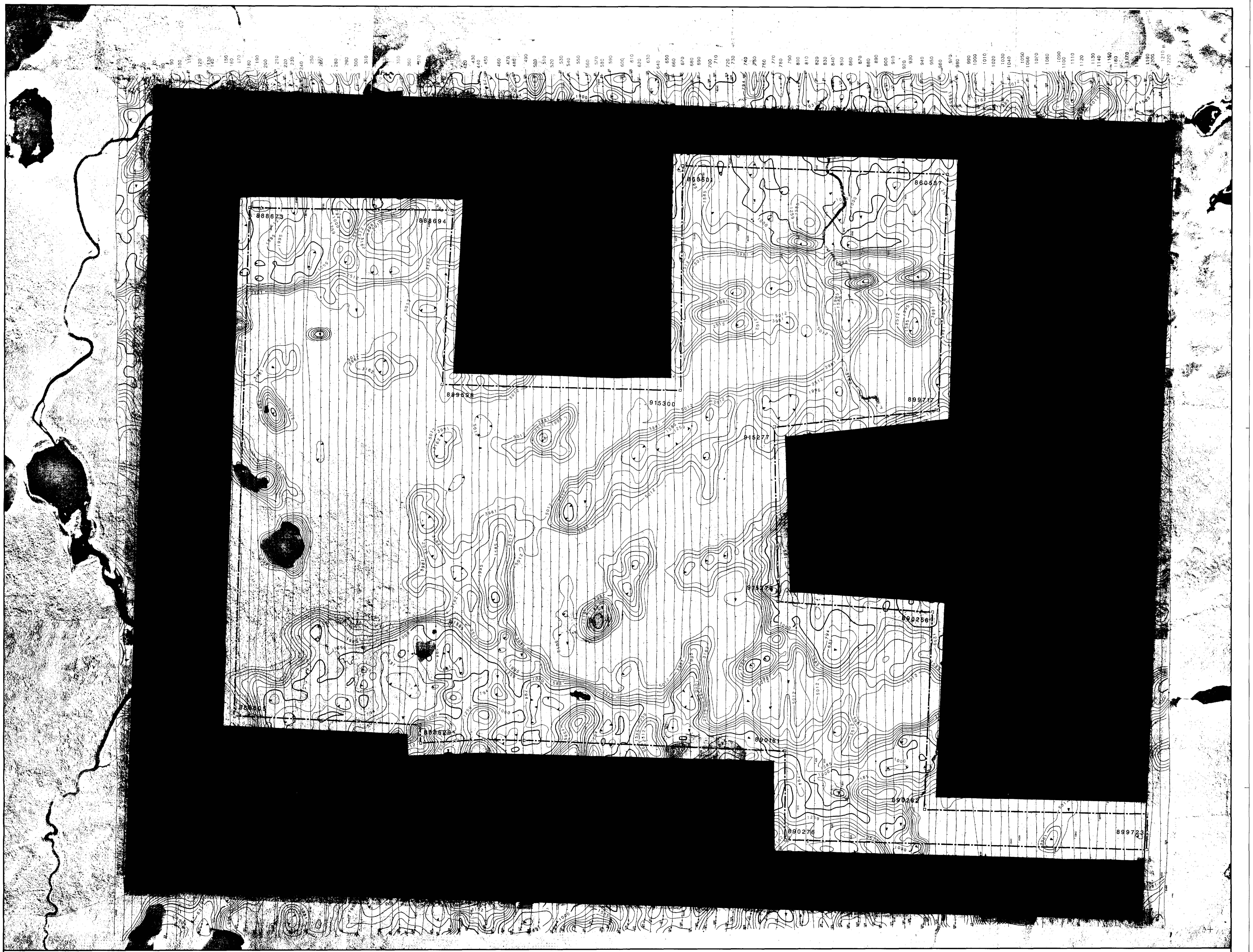
1/2 0 1/2 Mile

1 0 1 Kilometre

AERODAT LIMITED

DATE:	July 1986
N.T.S. No:	42C, 42F
MAP No:	2c

REGISTERED PROFESSIONAL ENGINEER
G. PODOLSKY
J8628
PROVINCE OF ONTARIO



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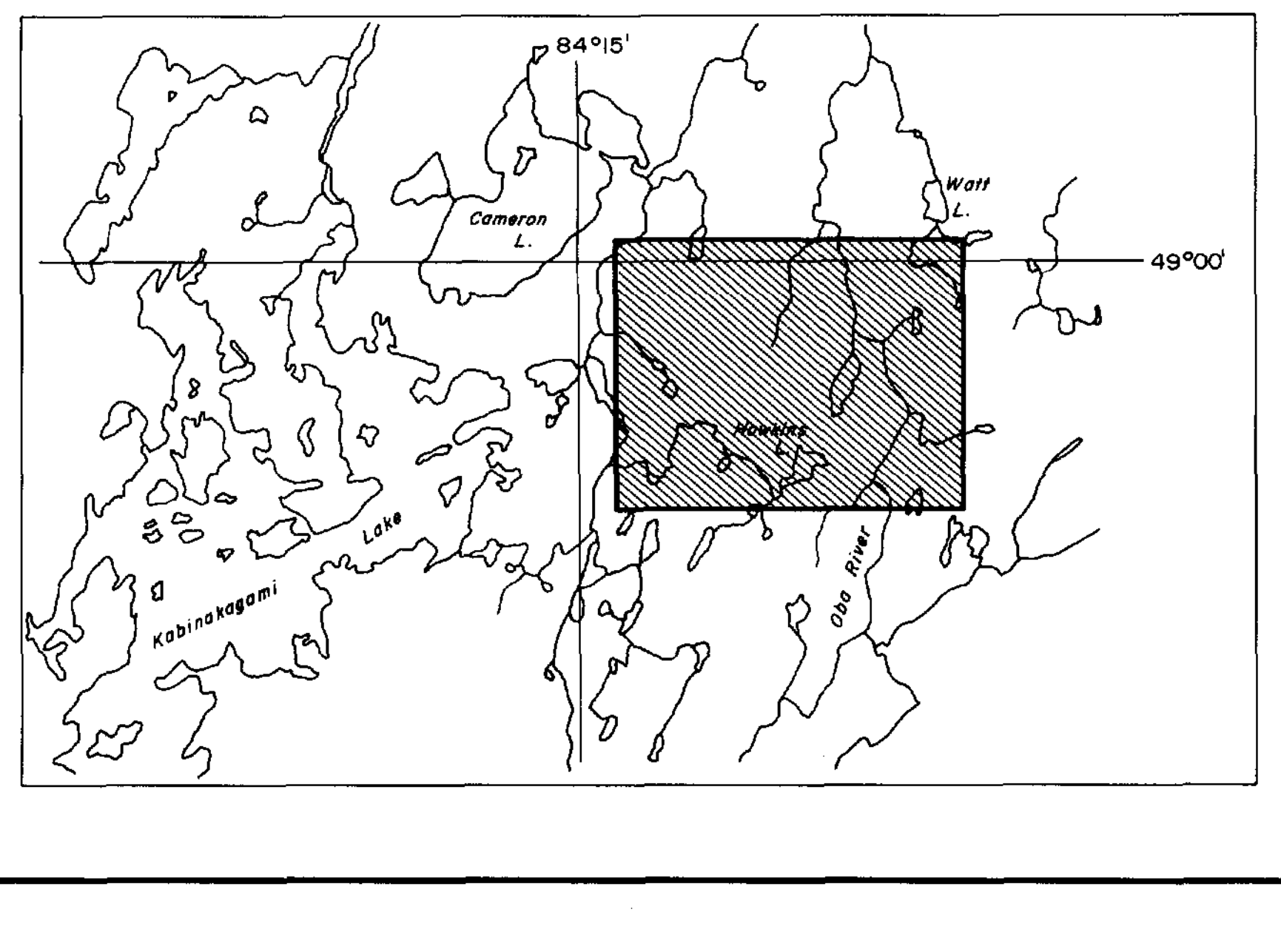
N

APPARENT RESISTIVITY CONTOURS

Calculated assuming 200 m conductive layer
(using 4600 Hz coaxial data)

———	10^N OHM-M	N 123 9
———	10^N.M OHM-M	M 123 9



GOLD FIELDS CANADIAN MINING, LIMITED

APPARENT RESISTIVITY CONTOURS

HAWKINS TOWNSHIP

2 9646

ONTARIO

SCALE 1/15,840

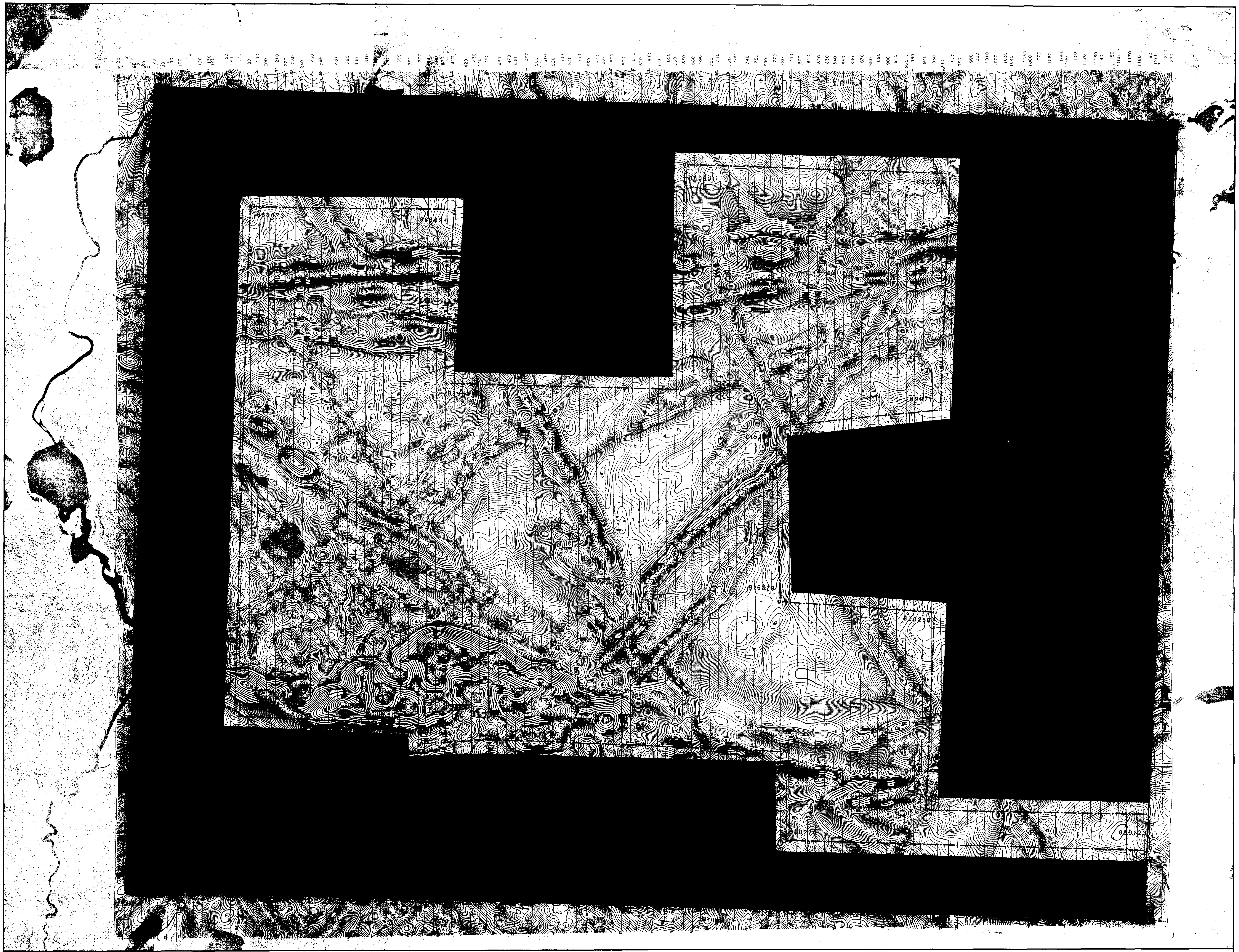
1/2 0 1/2 Mile

1 0 1 Kilometre

AERODAT LIMITED

DATE:	July 1986
N.T.S. No:	42C, 42
MAP No:	3

G. PODOLSKY
12-22-86



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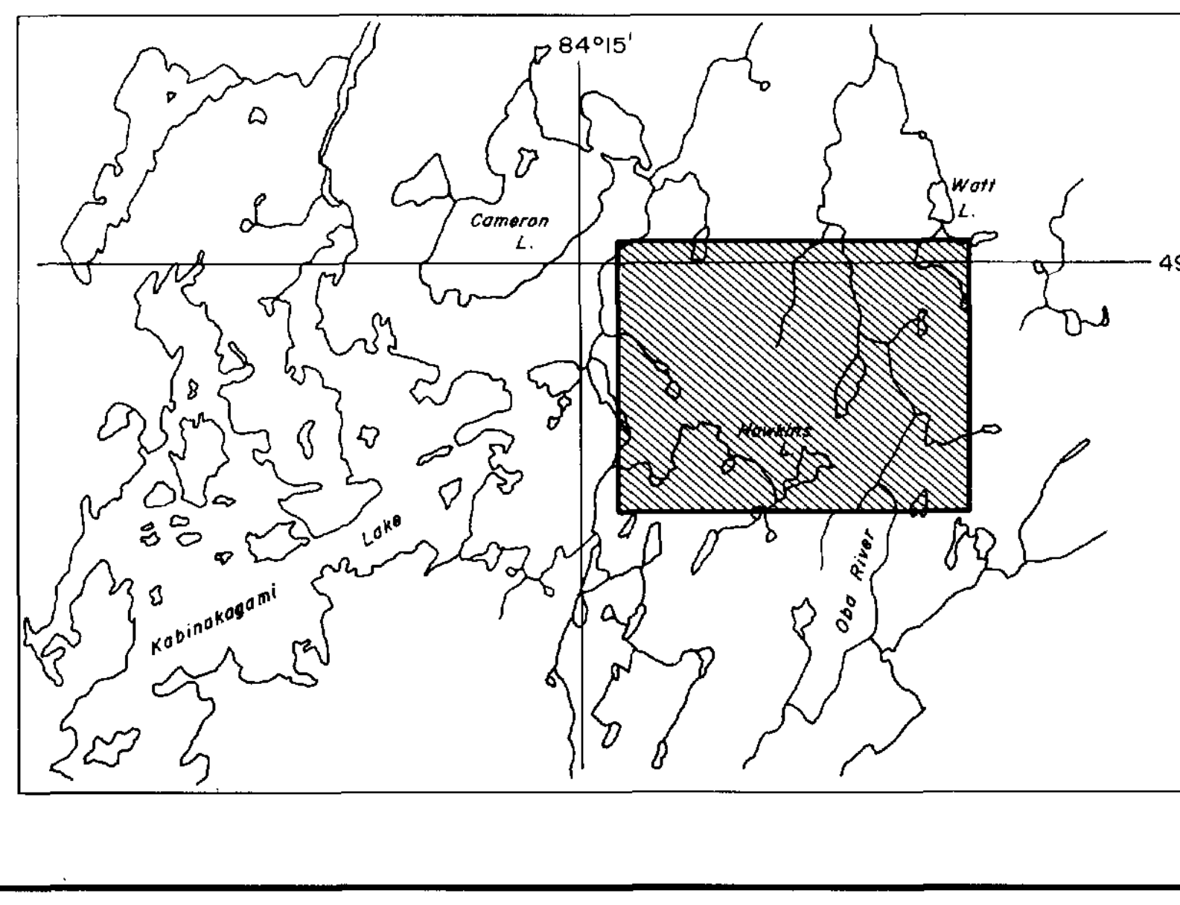


TOTAL FIELD MAGNETIC CONTOURS

MEAN MAGNETOMETER SENSOR ELEVATION 48 metres

CONTOUR INTERVAL 5 gammas

125 gammas ━

25 gammas —

5 gammas ─

GOLD FIELDS CANADIAN MINING, LIMITED

TOTAL FIELD MAGNETIC CONTOURS

HAWKINS TOWNSHIP 2.9646

ONTARIO

SCALE 1/15,840

1/2 0 1/2 Mile

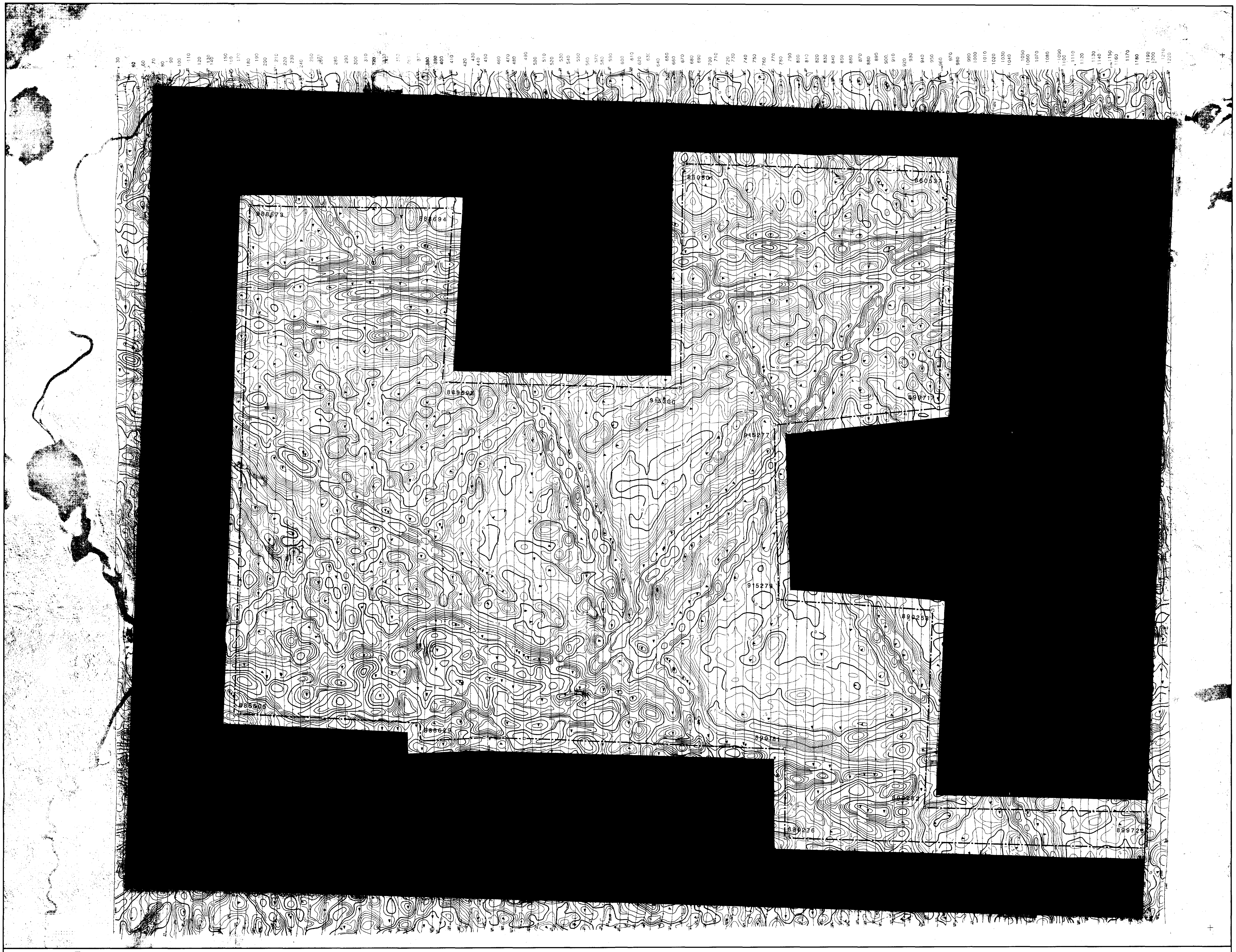
1 0 1 Kilometre

AERODAT LIMITED

DATE:	July 1986
N.T.S. No:	42C, 42F
MAP No:	4

REGISTERED PROFESSIONAL
G. PODOLSKY
12-22-86
PROVINCE OF ONTARIO

42C16NE8213 2.9646 HAWKINS



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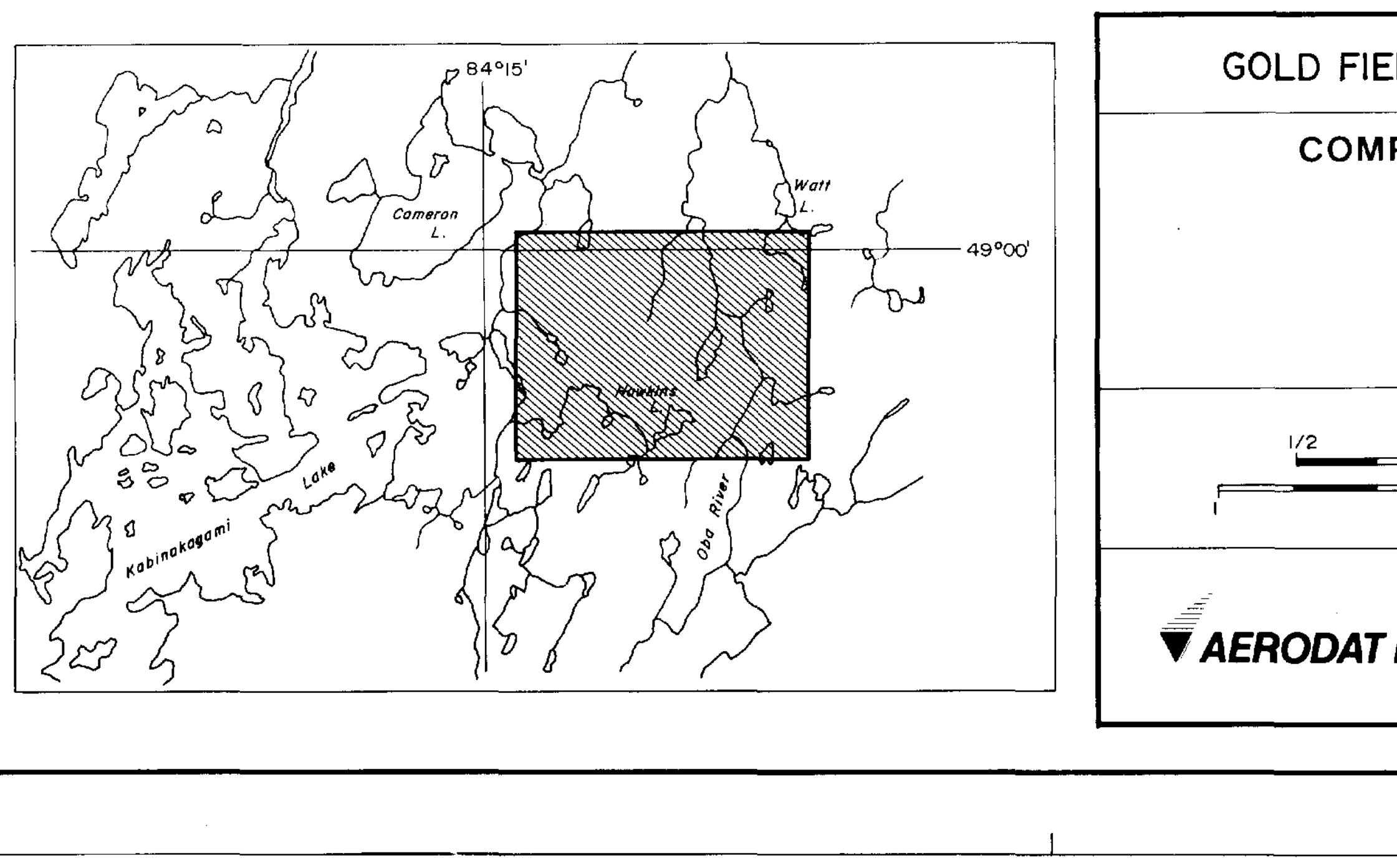

N

VERTICAL MAGNETIC GRADIENT

GOLD FIELDS CANADIAN MINING, LIMITED

COMPUTED VERTICAL MAGNETIC GRADIENT CONTOURS

HAWKINS TOWNSHIP 29646

ONTARIO

SCALE 1/15,840

1/2 0 1/2 Mile

1 0 1 Kilometre

AERODAT LIMITED

DATE: July 1986

N.T.S. No: 42C, 42

MAP No: 5

REGISTERED PROFESSIONAL ENGINEER
G. PODOLSKY
12-22-86
18628
PROVINCE OF ONTARIO

42C16NE8213 2.9646 HAWKINS

270