



42A03NE0050 2.13776 BARTLETT

010

**2.13776**

**REPORT ON  
COMBINED HELICOPTER-BORNE  
MAGNETIC AND VLF SURVEY  
SOUTH PORCUPINE  
TIMMINS, ONTARIO**

Block 6  
42 Claims  
Bartlett/Geikie Townships

**FOR  
TIMMINS NICKEL INC.  
BY  
AERODAT LIMITED  
September 25, 1990**

**J9071**

**Adriana Carbone  
Geologist**



42A03NE0050 2.13776 BARTLETT

010C

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APPENDIX I - Personnel

APPENDIX II - General Interpretive Considerations

List of Maps  
(Scale 1:10,000)

Basic Maps: (As described under Appendix B of the Contract)

1. **PHOTOMOSAIC BASE MAP;**  
Prepared from available photos from the National Photo Library (Ottawa).
2. **FLIGHT LINE MAP;**  
Showing all flight lines and fiducials with the base map.
3. **TOTAL FIELD MAGNETIC CONTOURS;**  
Showing magnetic values corrected of all diurnal variation with flight lines, fiducials, and base map.
4. **VERTICAL MAGNETIC GRADIENT CONTOURS;**  
Showing magnetic gradient values calculated from the total field magnetics with flight lines, fiducials and base map.
5. **VLF-EM TOTAL FIELD CONTOURS;**  
Showing VLF total field response from the line transmitter with flight lines, fiducials, and base map.

## 1. INTRODUCTION

This report describes an airborne geophysical survey carried out on behalf of Timmins Nickel Inc. Equipment operated during the survey included a high sensitivity cesium vapour magnetometer, a two frequency VLF-EM system, a video tracking camera, radar altimeter, and an electronic positioning system. Magnetic and altimeter data were recorded both in digital and analog forms. Positioning data was stored in digital form, encoded on VHS format video tape and recorded at regular intervals in local UTM coordinates, as well as being marked on the flight path mosaic by the operator while in flight.

The survey areas are located near South Porcupine, Ontario, and are referred to as Block 1 - Block 7 inclusive. Blocks 1, 2 and 3 were flown on September 3, 1990. Block 4 was flown on September 4, 1990. Block 5 was flown on September 5, 1990. Block 6 was flown on September 8, 1990, and Block 7 was flown on September 7, 1990. Data from twelve flights were used to compile the survey results. The flight lines were oriented at an angle of 90 degrees, with a nominal line spacing of 100 metres (according to Appendix "A" of the contract) for Blocks 2, 5 and Block 6. Blocks 1, 3 and 7 were oriented at an angle of 0 degrees, with a nominal line spacing of 100 metres (according to Appendix "A" of the contract). Block 4 consisted of bi-directional flight lines, a detailed area oriented at an angle of 0 degrees, with a nominal line spacing of 50 metres, while the remaining areas of Block 4 was oriented at 90 degrees with a nominal line spacing of 100 metres (according to Appendix "A" of the contract). Geophysical information is provided in the form of maps at 1:10,000. Coverage and data quality were

considered to be well within the specifications described in the service contract.

The purpose of the survey was to record airborne geophysical data over ground that is of interest to Timmins Nickel Inc.

The survey encompasses approximately 1100 line kilometres of the recorded data that were compiled in a map form at a scale of 1:10,000. The maps are presented as part of this report according to specifications laid out by Timmins Nickel Inc.

**2. SURVEY AREA LOCATION**

The survey areas are depicted on the following index maps.

Block 1 is centred at approximate geographic latitude 48 degrees 22 minutes North, longitude 81 degrees 01 minutes West.

Block 2 is centred at approximate geographic latitude 48 degrees 19 minutes North, longitude 81 degrees 01 minutes West.

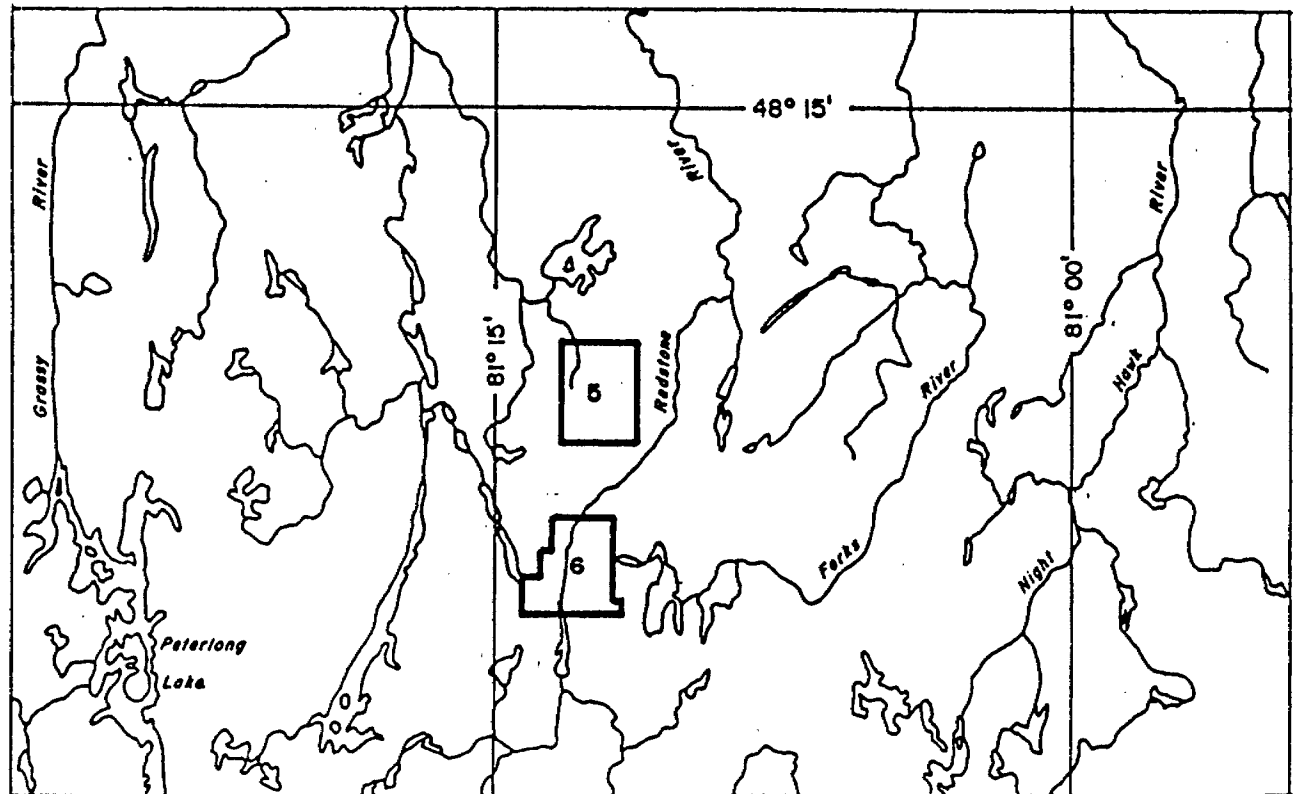
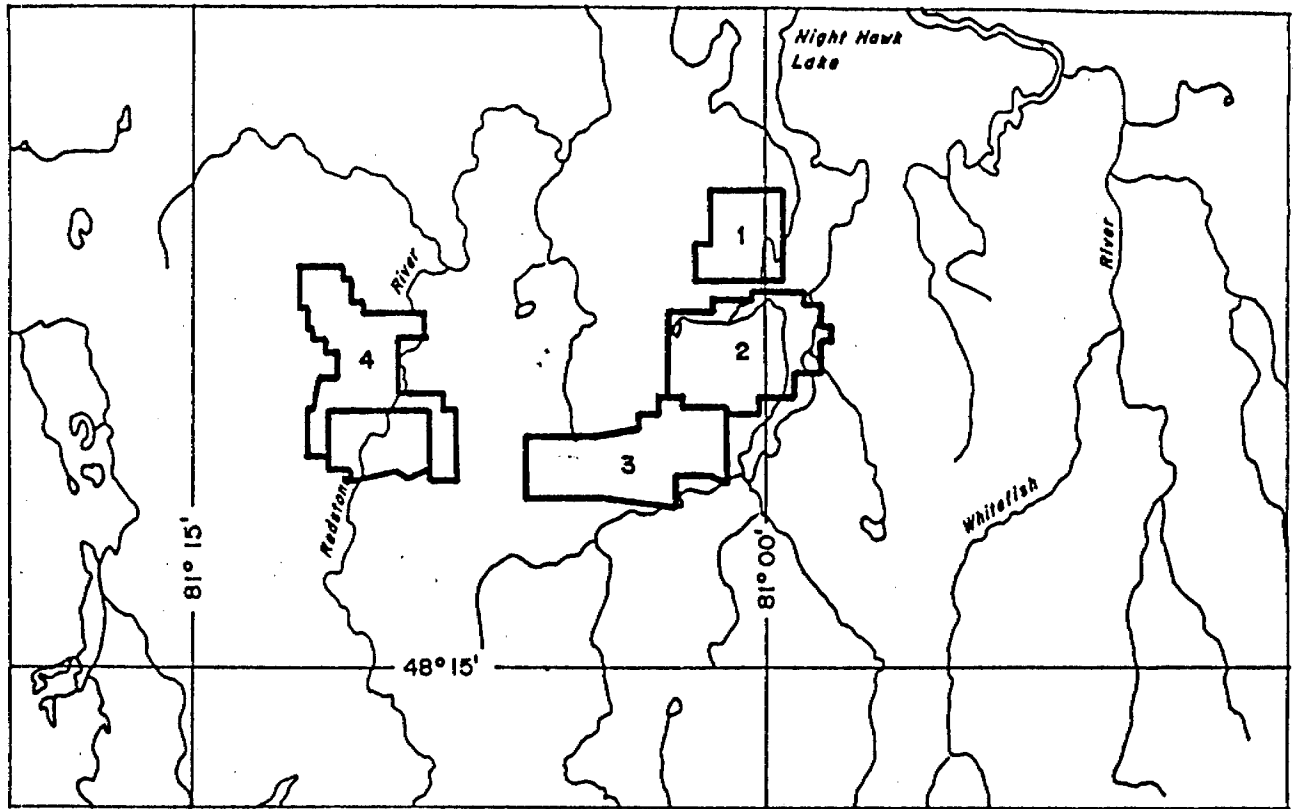
Block 3 is centred at approximate geographic latitude 48 degrees 18 minutes North, longitude 81 degrees 04 minutes West.

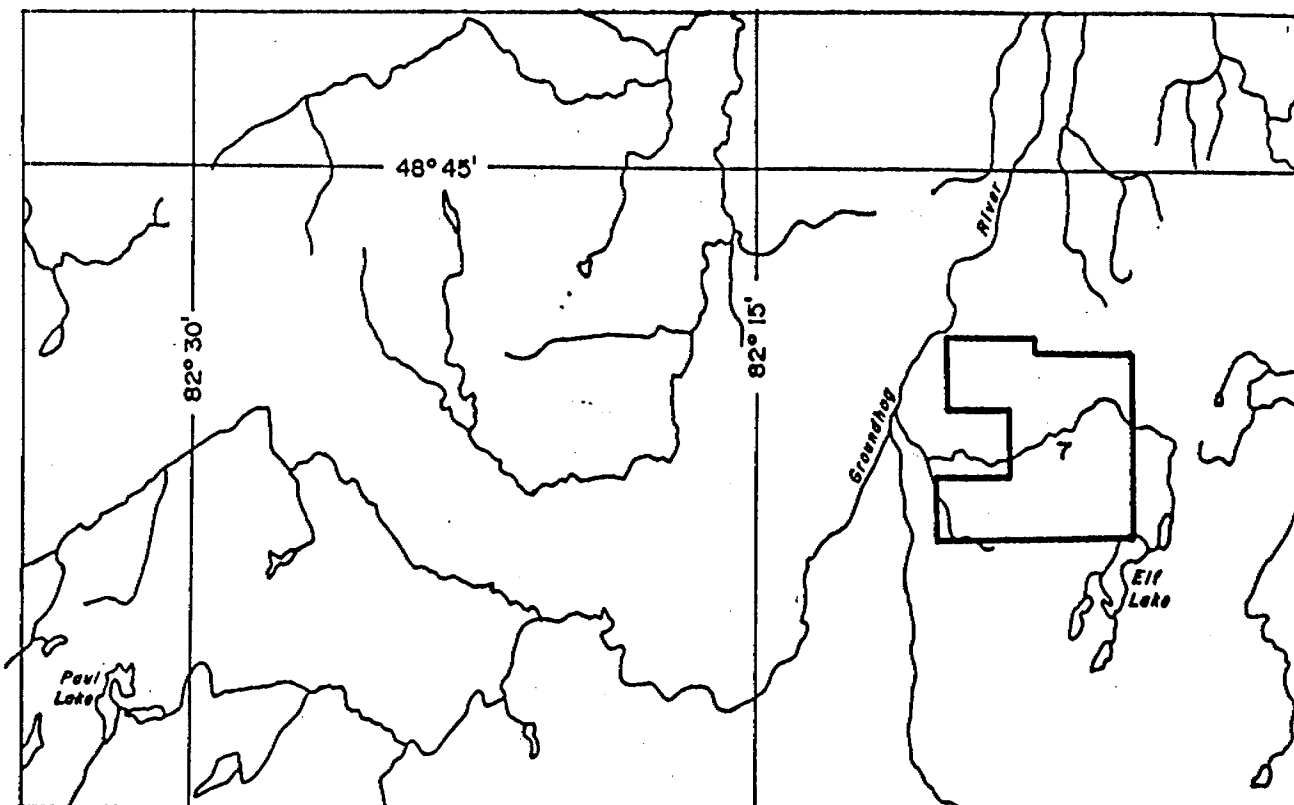
Block 4 is centred at approximate geographic latitude 48 degrees 20 minutes North, longitude 81 degrees 10 minutes West.

Block 5 is centred at approximate geographic latitude 48 degrees 10 minutes North, longitude 81 degrees 14 minutes West.

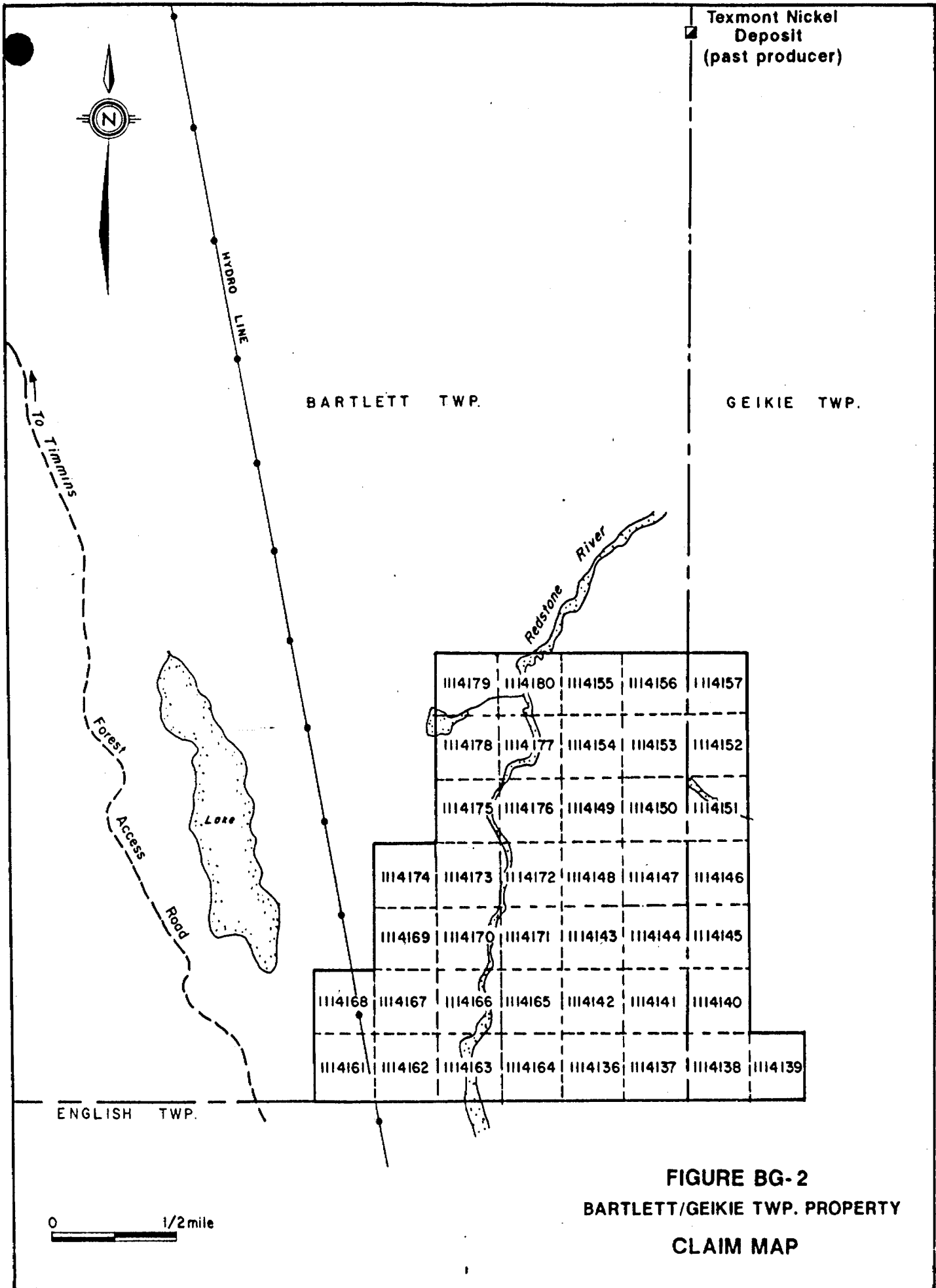
Block 6 is centred at approximate geographic latitude 48 degrees 07 minutes North, longitude 81 degrees 14 minutes West.

Block 7 is centred at approximate geographic latitude 48 degrees 41 minutes North, longitude 82 degrees 8 minutes West.









**FIGURE BG-2**  
**BARTLETT/GEIKIE TWP. PROPERTY**  
**CLAIM MAP**

Block 6  
42 Claims  
Bartlett/Geikie Townships

P 1114136 Bartlett  
P 1114137 Bartlett  
P 1114138 Geikie  
P 1114139 Geikie  
P 1114140 Geikie  
P 1114141 Bartlett  
P 1114142 Bartlett  
P 1114143 Bartlett  
P 1114144 Bartlett  
P 1114145 Geikie  
P 1114146 Geikie  
P 1114147 Bartlett  
P 1114148 Bartlett  
P 1114149 Bartlett  
P 1114150 Bartlett  
P 1114151 Geikie  
P 1114152 Geikie  
P 1114153 Bartlett  
P 1114154 Bartlett  
P 1114155 Bartlett  
P 1114156 Bartlett  
P 1114157 Geikie

P 1114161 Bartlett  
P 1114162 Bartlett  
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P 1114177 Bartlett  
P 1114178 Bartlett  
P 1114179 Bartlett  
P 1114180 Bartlett

## PROPERTY LOCATION AND ACCESS

The Bartlett/Geikie Townships property (Block 6) is located in the southeast and southwest corners of Bartlett and Geikie townships respectively. The property lies approximately 35 km south of the city of Timmins, Ontario.

The property is comprised of 42 contiguous unpatented mining claims, 38 of which are in Bartlett Township and the remaining 4 occurring in Geikie Township. The entire group is wholly-owned by TNI.

The past-producing Texmont nickel deposit, currently held by New Texmont Explorations Ltd. (85%) and Inco Ltd. (15%), is located along the Bartlett-Geikie township boundary, approximately 3.5 km north of the Bartlett/Geikie property boundary.

Access to the property is readily gained by four-wheel-drive vehicle during both the summer and winter months via an all-weather, gravel; forest access road extending south from Timmins to the southeastern part of Bartlett Township. South of Scott Lake, a bush road runs east onto the property and terminates at the Redstone River. Old bush roads provide access over much of the western portions of the property.

### **3. AIRCRAFT AND EQUIPMENT**

#### **3.1 Aircraft**

An Aerospatiale A-Star 350 B helicopter, (C-GYHT), piloted by Roger Morrow, owned and operated by Peace Helicopters Limited, was used for the survey. Pierre Moisan of Aerodat acted as navigator and equipment operator. Installation of the geophysical and ancillary equipment was carried out by Aerodat. The survey equipment was flown at a mean terrain clearance of 60 metres.

#### **3.2 Equipment**

##### **3.2.1 VLF-EM System**

The VLF-EM System was a Herz Totem 2 A. This instrument measures the total field and quadrature component of the selected frequency. The sensor was towed in a bird 30 metres below the helicopter.

##### **3.2.2 Magnetometer System**

The magnetometer employed a Scintrex Model VIW 2321 H8 cesium, optically pumped magnetometer sensor. The sensitivity of this instrument was 0.1 nanoTeslas. The sensor was towed in a bird 30 metres below the helicopter.

### 3.2.3 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.

### 3.2.4 Altimeter System

A King KRA 10 radar altimeter was used to record terrain clearance. The output from the instrument is a linear function of altitude for maximum accuracy.

### 3.2.5 Tracking Camera

A Panasonic video flight path recording system was used to record the flight path on standard VHS format video tapes. The system was operated in continuous mode and the flight number, real time and manual fiducials were registered on the picture frame for cross-reference to the analog and digital data.

### 3.2.6 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
VLT	VLF-EM Total Field, Line	25 %/cm
VLQ	VLF-EM Quadrature, Line	25 %/cm
VOT	VLF-EM Total Field, Ortho	25 %/cm
VOQ	VLF-EM Quadrature, Ortho	25 %/cm
RALT	Radar Altimeter	100 ft./cm
MAGF	Magnetometer, fine	25 nT/cm
MAGC	Magnetometer, coarse	250 nT/cm

### 3.2.7 Digital Recorder

A DGR 33:16 data system recorded the survey on magnetic tape. Information recorded was as follows:

<u>Equipment</u>	<u>Recording Interval</u>
VLF-EM	0.20 seconds
Magnetometer	0.20 seconds
Altimeter	0.20 seconds
Nav System	0.20 seconds

### 3.2.8 Radar Positioning System

A Mini-Ranger MRS-III radar navigation system was used for both navigation and flight path recovery. Transponders sited at fixed locations were interrogated several times per second and the ranges from these points to the helicopter were measured to a high degree of accuracy. A navigational computer triangulated the position of the helicopter and provided the pilot with navigation information. The range/range data was recorded on magnetic tape for subsequent flight path determination.

## **4. DATA PRESENTATION**

### **4.1 Base Map**

A photomosaic base map at a scale of 1:10,000 was prepared from available photos from the National Photo Library (Ottawa).

### **4.2 Flight Path Map**

The flight path was derived from the Mini-Ranger radar positioning system. The distance from the helicopter to two established reference locations was measured several times per second and the position of the helicopter was calculated by triangulation. It is estimated that the flight path is generally accurate to about 10 metres with respect to the topographic detail on the base map.

The flight lines have the time and the navigator's manual fiducials for cross reference to both analog and digital data.

### **4.3 Magnetics**

#### **4.3.1 Total Field Magnetic Contours Map**

The magnetic data from the high sensitivity cesium magnetometer provided virtually a continuous magnetic reading when recording at 0.2 second intervals.

The system is also noise free for all practical purposes.



A sensitivity of 0.1 nanoTesla (nT) allows for the mapping of very small inflections in the magnetic field, resulting in a contour map that is equal to or exceeds ground data in quality and accuracy.

The aeromagnetic data was corrected for diurnal variations by adjustment with the digitally recorded base station magnetic values. No correction for regional variation was applied. The corrected data was interpolated onto a regular grid at a 25 metre true scale interval using an Akima spline technique. This grid provided the basis for threading the presented contours at a 2 nT interval.

The contoured aeromagnetic data has been presented on a Cronaflex copy of the base map with flight lines.

#### 4.3.2 Vertical Gradient Contour Map

The vertical magnetic gradient was calculated from the total field magnetic data. Contoured at a 0.2 Nt/m interval, the data was presented on a cronaflex copy of the base map with flight lines.

#### 4.4 VLF-EM Total Field Contours

The VLF data was interpolated onto a regular grid at a 25 metre true scale interval using an Akima spline technique. This grid provided the basis for threading the contours at a 2% interval.

The VLF-EM signal from the line transmitting station was compiled as contours in map form on cronaflex copies of the base map with flight lines.

The VLF stations used for Blocks 1, 2, 3 6 and 7 were NAA, Cutler Maine, broadcasting at 24.0 Khz, and NSS, Annapolis, Md., broadcasting at 21.4 kHz. NAA was used as the line transmitting station for Blocks 1, 3, 6 and 7. NSS was used as the orthogonal station for Blocks 1, 3, 6 and 7. NSS was used as the line transmitting station for Block 2 and NAA was used as the orthogonal station.

The VLF stations used for Blocks 4 and 5 were NLK, Seattle, Washington, broadcasting at 24.8 kHz, and NAA, Cutler, Maine, broadcasting at 24.0 kHz. NLK was used as the line transmitting station for Blocks 4 and 5 and NAA was used as the orthogonal station.

Respectfully submitted,

September 24, 1990

Adriana Carbone  
Geologist

*R Sprankle*  
*For*  
*A Carbone*

**APPENDIX I**

**PERSONNEL**

**FIELD**

Flown                      September, 1990

Pilot                        Roger Morrow

Operator                    Pierre Moisan

**OFFICE**

Processing                 A. Carbone  
                                  G. McDonald

Report                      A. Carbone

## APPENDIX II

### GENERAL INTERPRETIVE CONSIDERATIONS

#### Magnetics

A digital base station magnetometer was used to detect fluctuations in the magnetic field during flight times. The airborne magnetic data was levelled by removing these diurnal changes. The Total Field Magnetic map shows the levelled magnetic contours, uncorrected for regional variation.

The Calculated Vertical Gradient map shows contours of the magnetic gradient as calculated from the total field magnetic data. The zero contour shows changes in the magnetic lithologies and will coincide closely with geologic contacts assuming a steeply dipping interface. Thus this data may be used as a pseudo-geologic map.

#### 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

measurable 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 to 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 cross-over 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**  
**CERTIFICATE OF QUALIFICATIONS**

I, Adriana Carbone, certify that:

1. I hold a B.Sc., in Geological Sciences from the University of Windsor, Ontario.
2. I reside at 2041 Banbury Crescent, in the Town of Oakville, Ontario.
3. I have been engaged in a professional role in the minerals industry in Canada for the past three years. I have been employed by Aerodat Limited since May 1990, and I currently hold a position as a Geologist.
4. I have been a member of the Prospectors' and Developers' Association since 1987.
5. The accompanying report was prepared from a review of the proprietary airborne geophysical survey flown by Aerodat Limited for Timmins Nickel. I have not personally visited the property.
6. I have no interest, direct or indirect, in the property described nor do I hold securities in Timmins Nickel.

Mississauga, Ontario  
February 14, 1991

Signed,



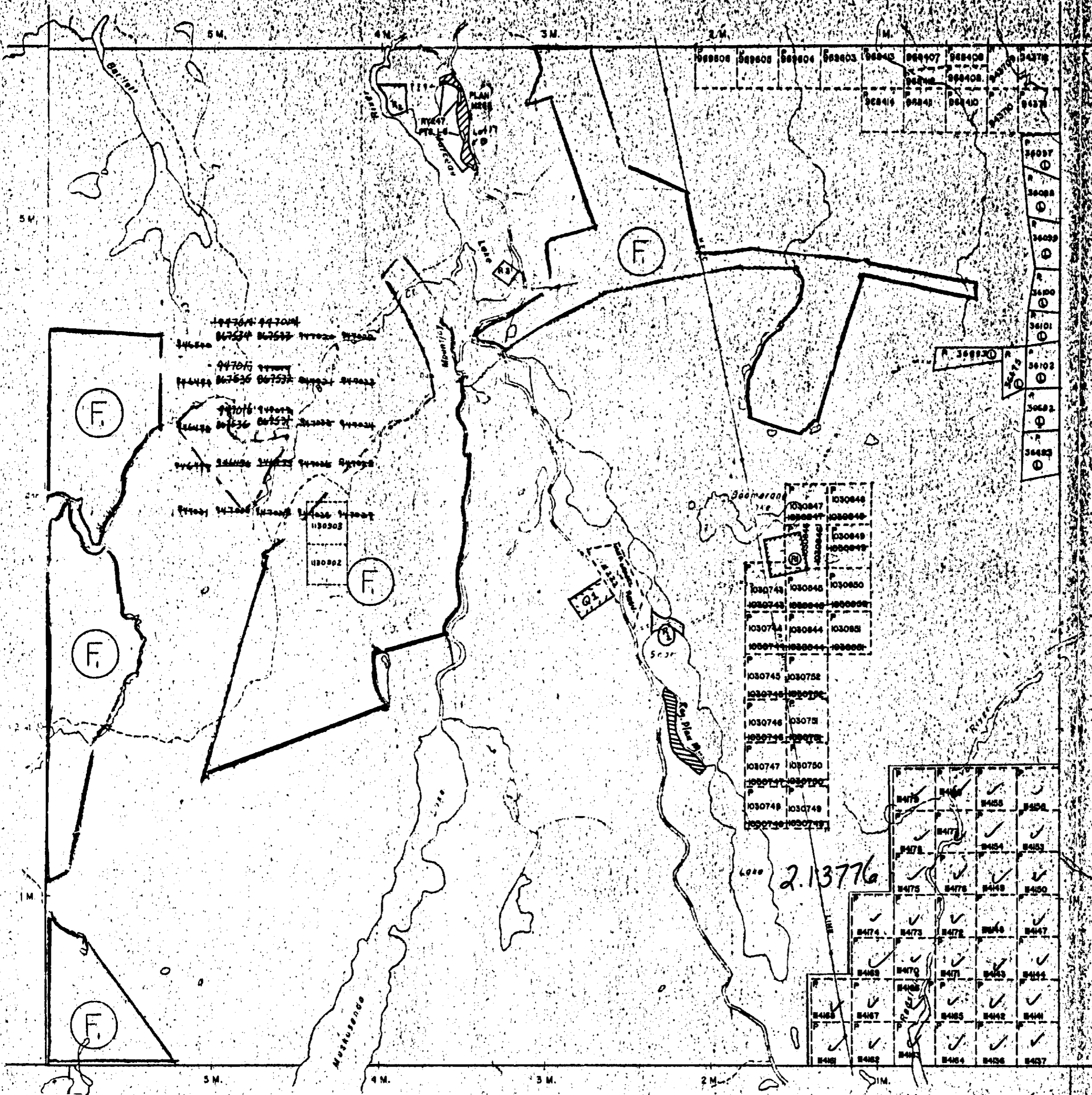
Adriana Carbone  
Geologist







McArthur Tp. - M. 299



THE TOWNSHIP  
OF  
**BARTLETT**  
DISTRICT OF  
TIMISKAMING  
PROVINCIAL  
MINING DIVISION  
SCALE 1 INCH = 40 CHAINS

**LEGEND**

- PATENTED LAND
- CROWN LAND SALE
- LEASES
- LOCATED LAND
- LICENSE OF OCCUPATION
- MINING RIGHTS ONLY
- SURFACE RIGHTS ONLY
- ROADS
- IMPROVED ROADS
- KING'S HIGHWAYS
- RAILWAYS
- POWER LINES
- MARSH OR MUSKOGEE
- MINES
- CANCELLED
- PATENTED S.R.O.

RECEIVED  
NOV 22 1990  
S.R.O.

**NOTES**

(F) THIS TWP. IS SUBJECT TO FOREST ACTIVITIES IN 1990. FURTHER INFORMATION AVAILABLE ON FILE.

400 Surface Rights Reservation along the shores of all lakes and rivers

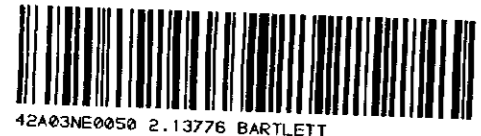
**AREAS WITHDRAWN FROM DISPOSITION**

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(R3)	W 9/77	1/3/77	S.R.O.	17408
(R1)	GRAVEL RESERVE, M.A.A.			
(Q)	PROPOSED GRAVEL PERMIT AREA - JUNE 85/86			

Received July 2/86  
Checked July 2/86 LP HB

PLAN NO. M-262

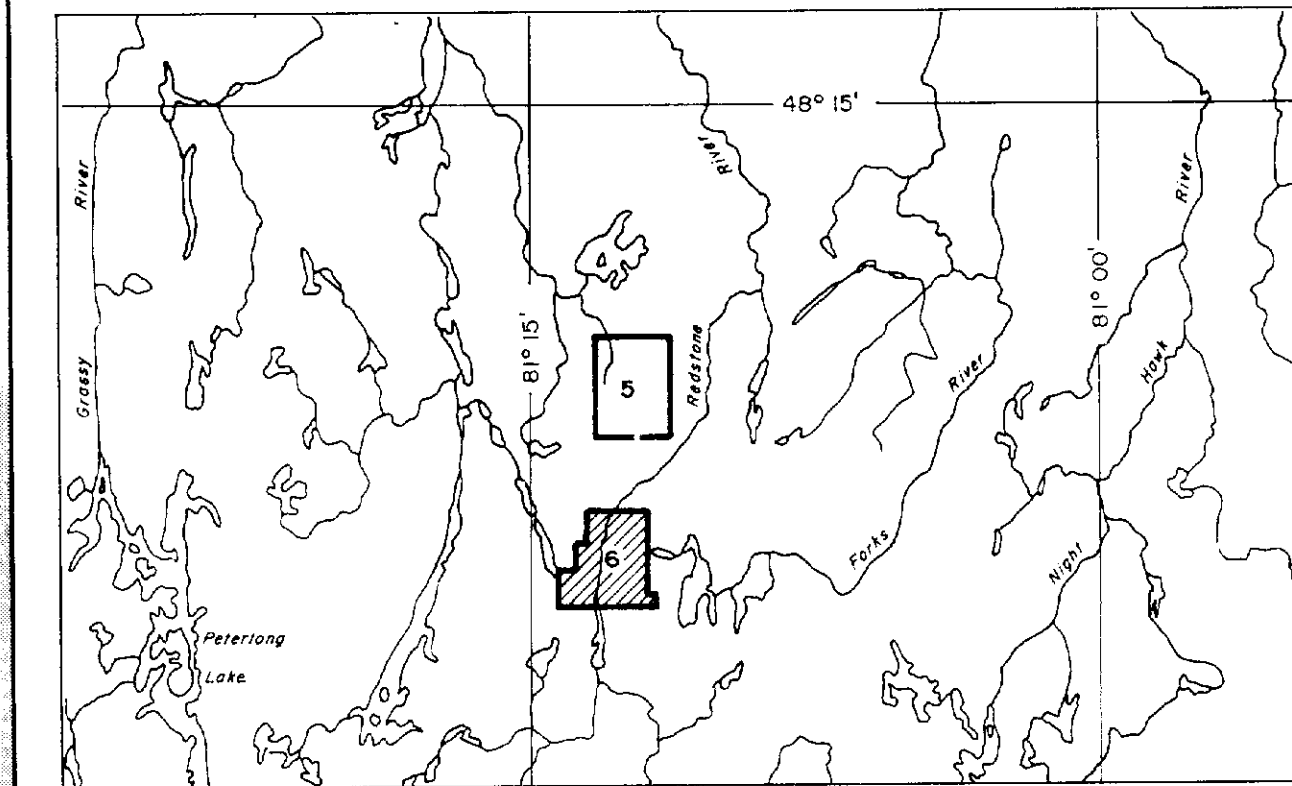
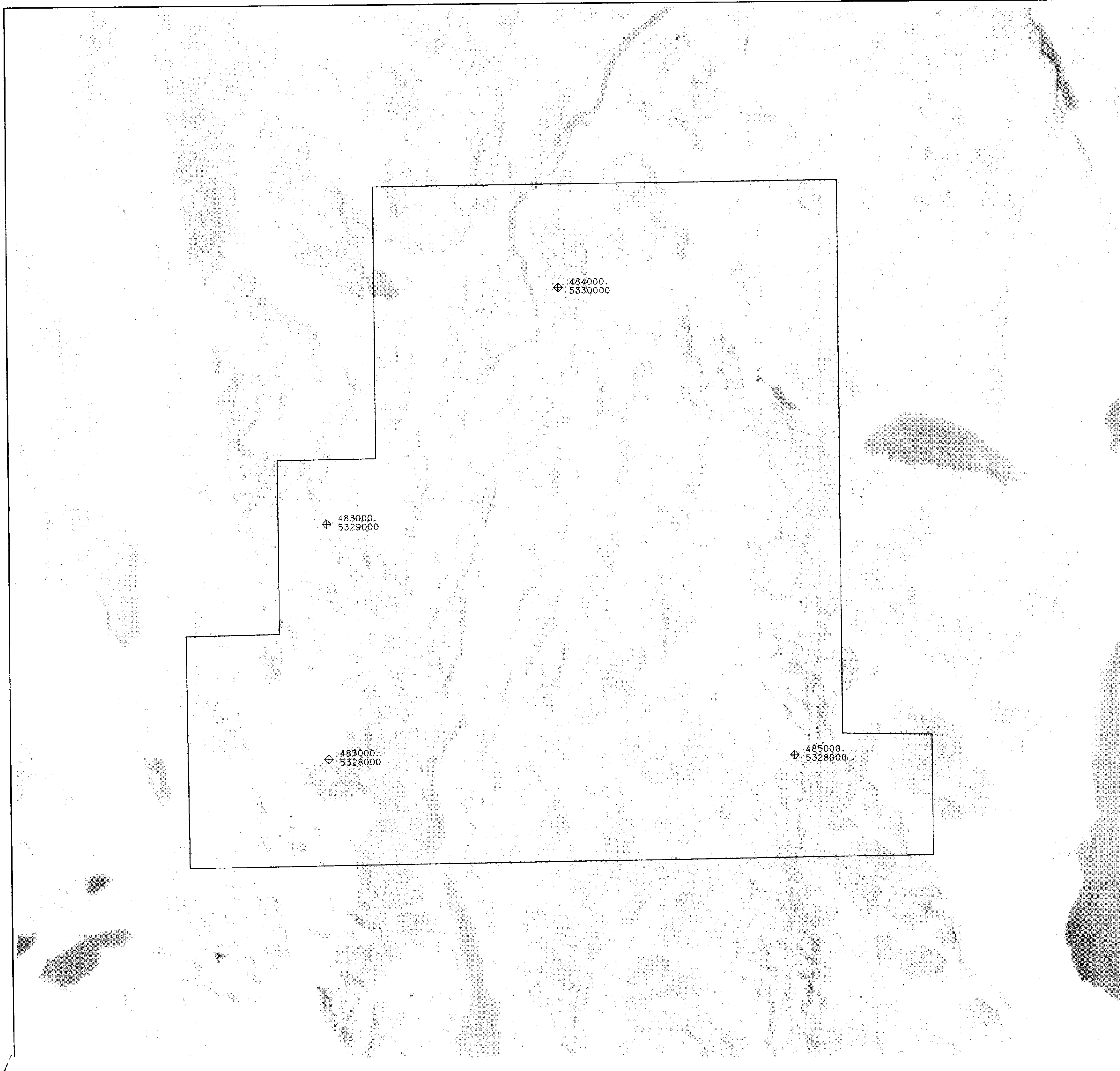
ONTARIO  
MINISTRY OF NATURAL RESOURCES  
SURVEYS AND MAPPING BRANCH



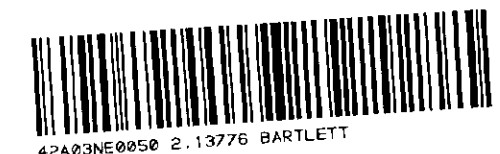
English Tp. - M. 787







<b>TIMMINS NICKEL</b>	
<b>BASE MAP</b>	
<b>BLOCK 6</b> 2.13776	
TIMMINS ONT	
SCALE 1:10,000	
	DATE: SEPTEMBER 1990
	NTS No: 42 A/3
	MAP No: 1 <span style="float: right;">J9071 - 1</span>



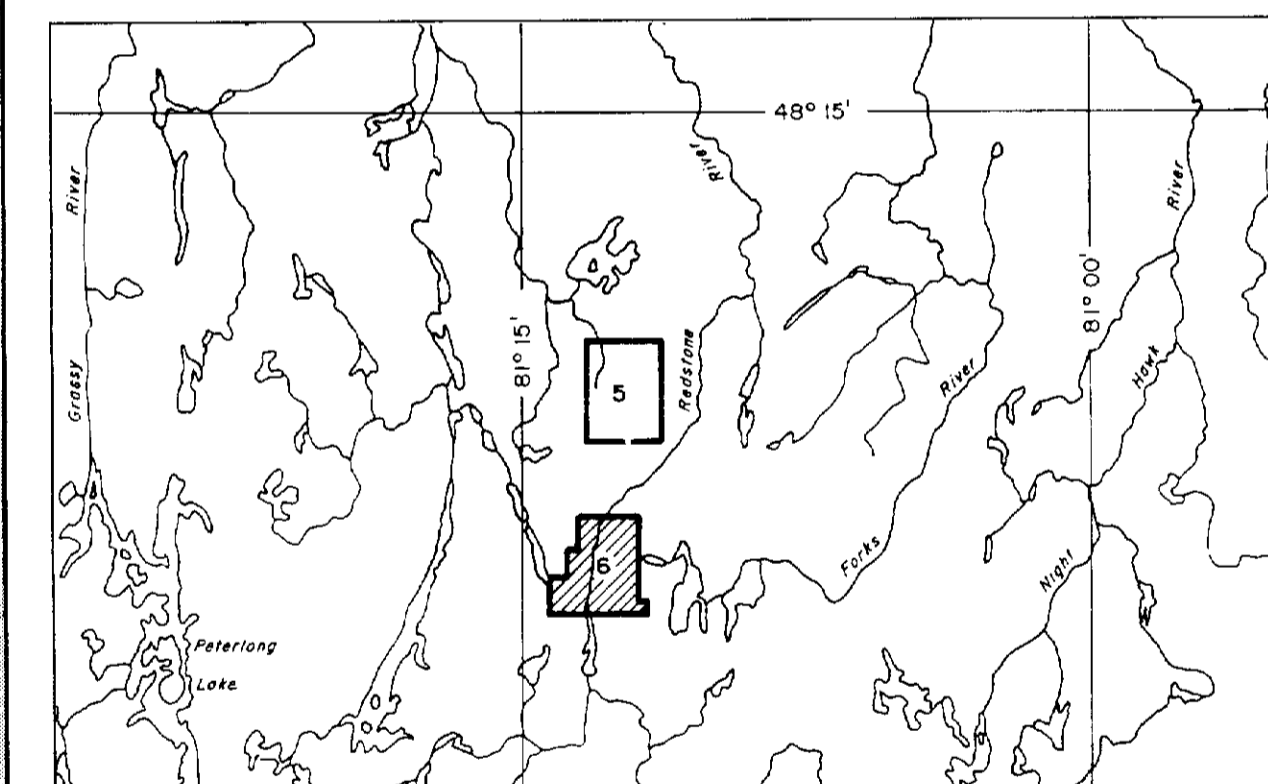
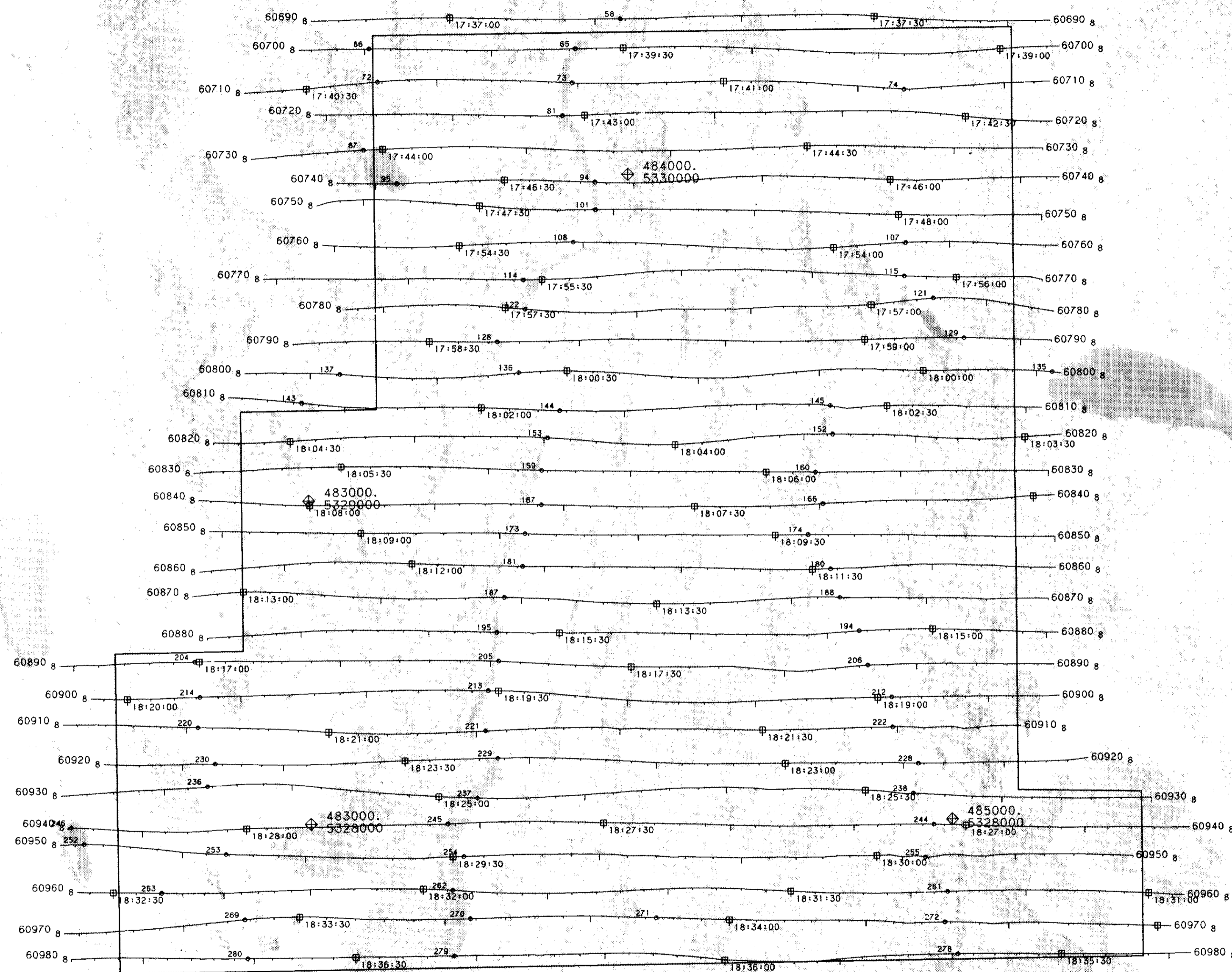




### Flight Path

Navigation and recovery using a Motorola Mini-Ranger (MRS III) navigation system.

Average terrain clearance 60m  
Average line spacing 100m



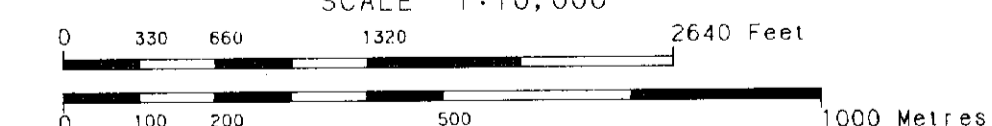
TIMMINS NICKEL

FLIGHT PATH

BLOCK 6 **2.13776**

TIMMINS ONT

SCALE 1:10,000



DATE: SEPTEMBER 1990

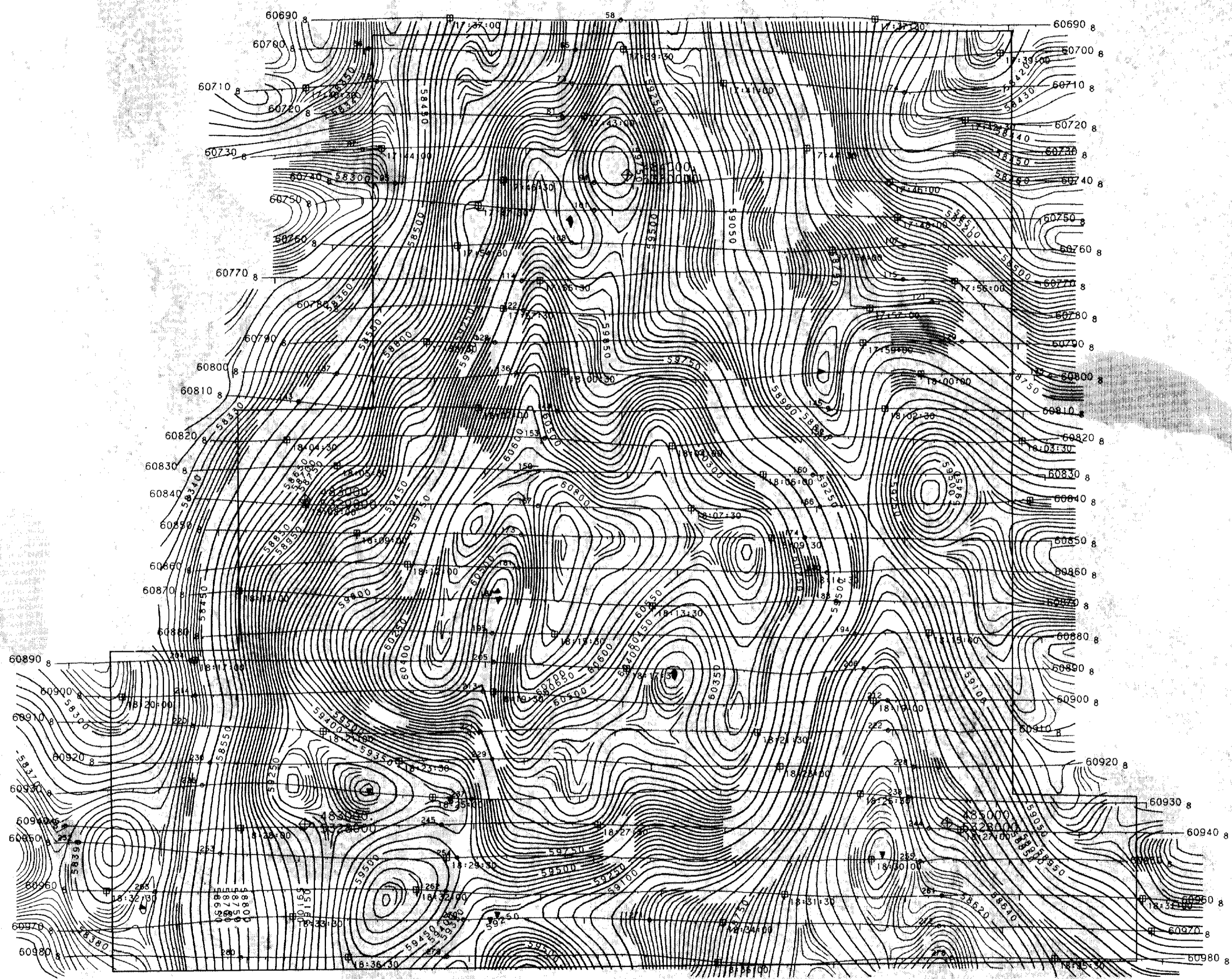
NTS No: 42 A/3

MAP No: 2

J9071 - 1







**Flight Path**

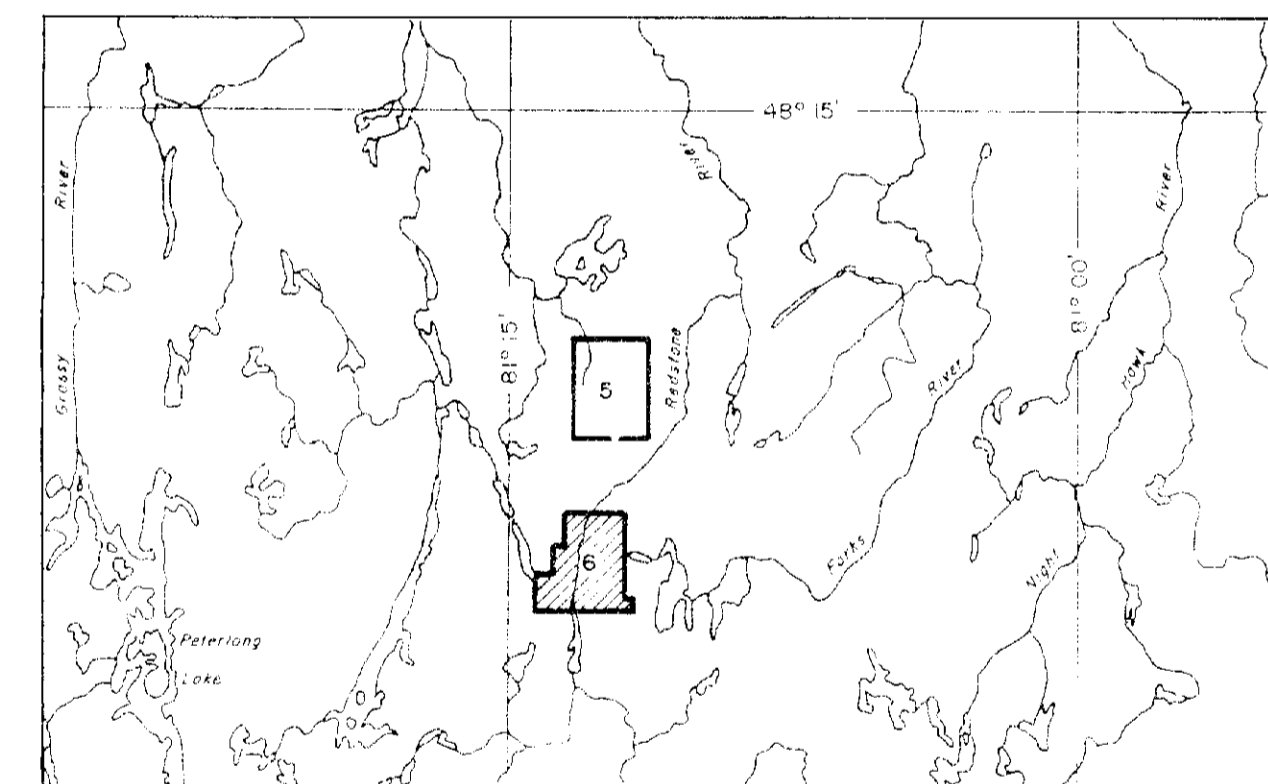
Navigation and recovery using a Motorola Mini-Ranger (MRS III) navigation system.  
Average terrain clearance 60m  
Average line spacing 100m

**Magnetics**

Total Field Magnetic Intensity Contours in nT.  
Cesium high sensitivity magnetometer.  
Sensor elevation 45m

Map contours are multiples of those listed below

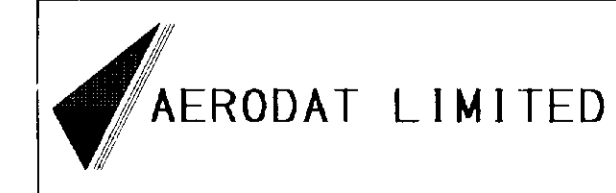
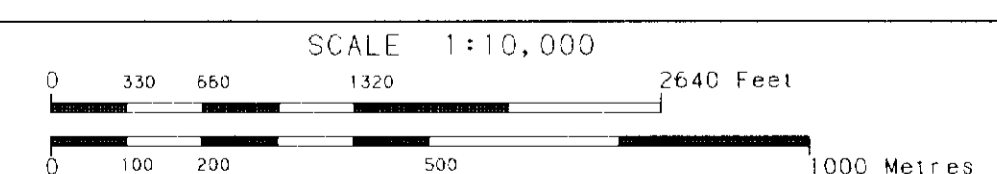
- 2 nT
- 10 nT
- 50 nT
- 250 nT
- 1000 nT



**TIMMINS NICKEL**

**TOTAL FIELD MAGNETIC CONTOURS**

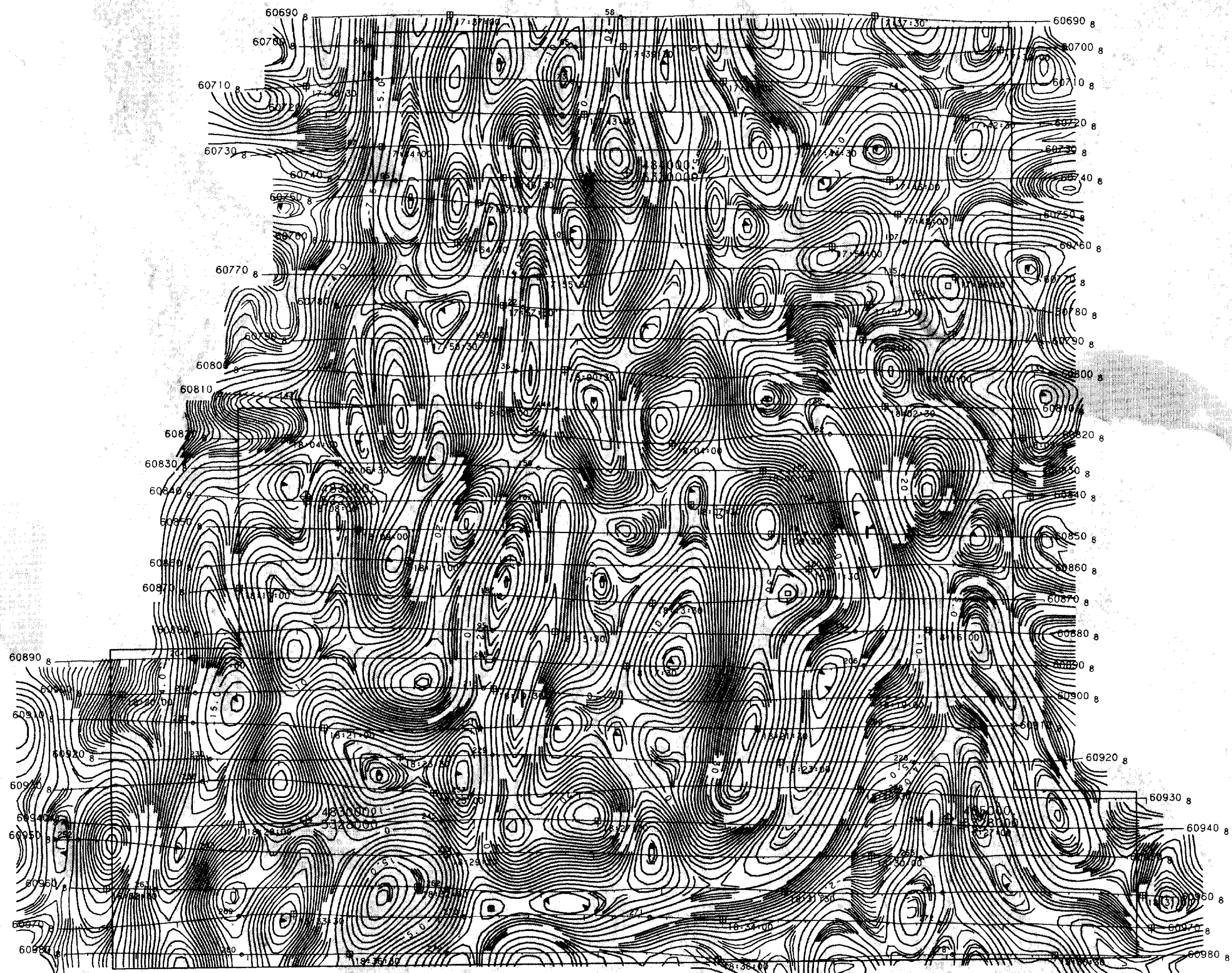
**BLOCK 6** 2, 137, 10  
TIMMINS ONT



DATE: SEPTEMBER 1990  
NTS No: 42 A/3  
MAP No: 33 J9071 - 1







**Flight Path**

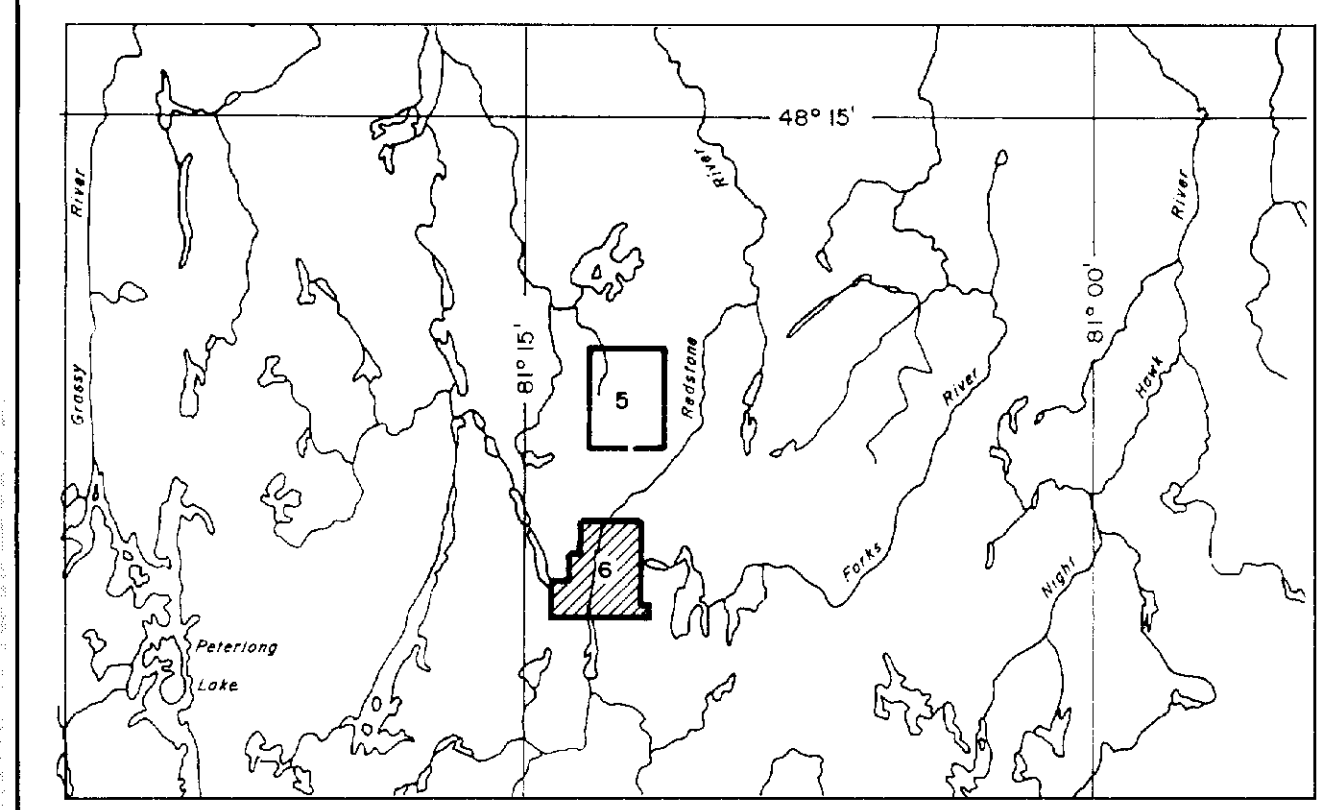
Navigation and recovery using a Motorola Mini-Ranger (MRS III) navigation system.  
 Average terrain clearance 60m  
 Average line spacing 100m

**Vertical Gradient**

Vertical Magnetic Gradient calculated from the total field magnetic intensity in nT/m.  
 Cesium high sensitivity magnetometer.  
 Sensor elevation 45m

Map contours are multiples of those listed below

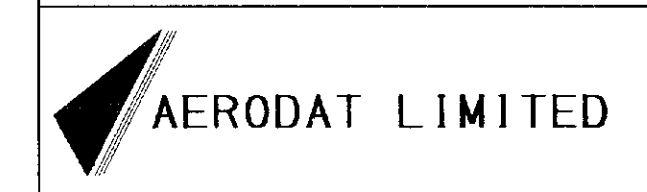
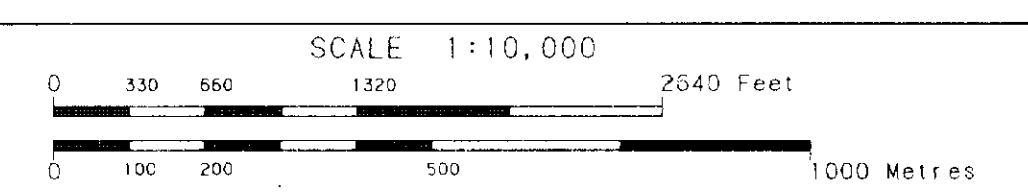
- 0.02 nT
- 0.10 nT
- 0.50 nT
- 2.50 nT
- 10.00 nT



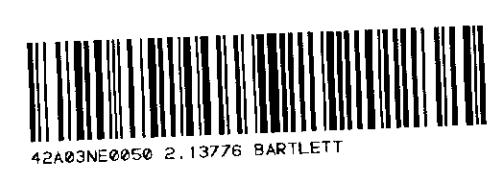
**TIMMINS NICKEL**

**CALCULATED VERTICAL MAGNETIC GRADIENT**

**BLOCK 6**  
 TIMMINS ONT. 13710



DATE: SEPTEMBER 1990  
 NTS No: 42 A/3  
 MAP No: 4 J9071 - 1







### Flight Path

Navigation and recovery using a Motorola Mini-Ranger (MRS 111) navigation system.  
Average terrain clearance 60m  
Average line spacing 100m

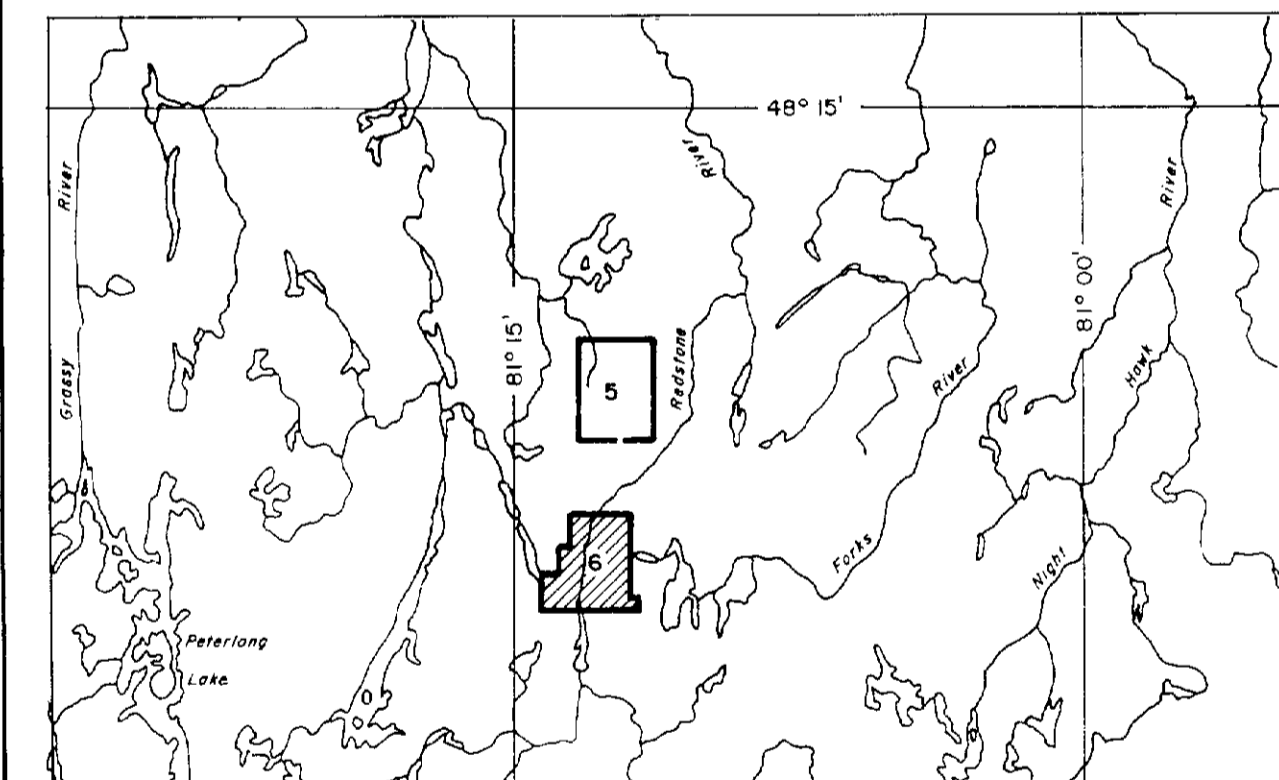
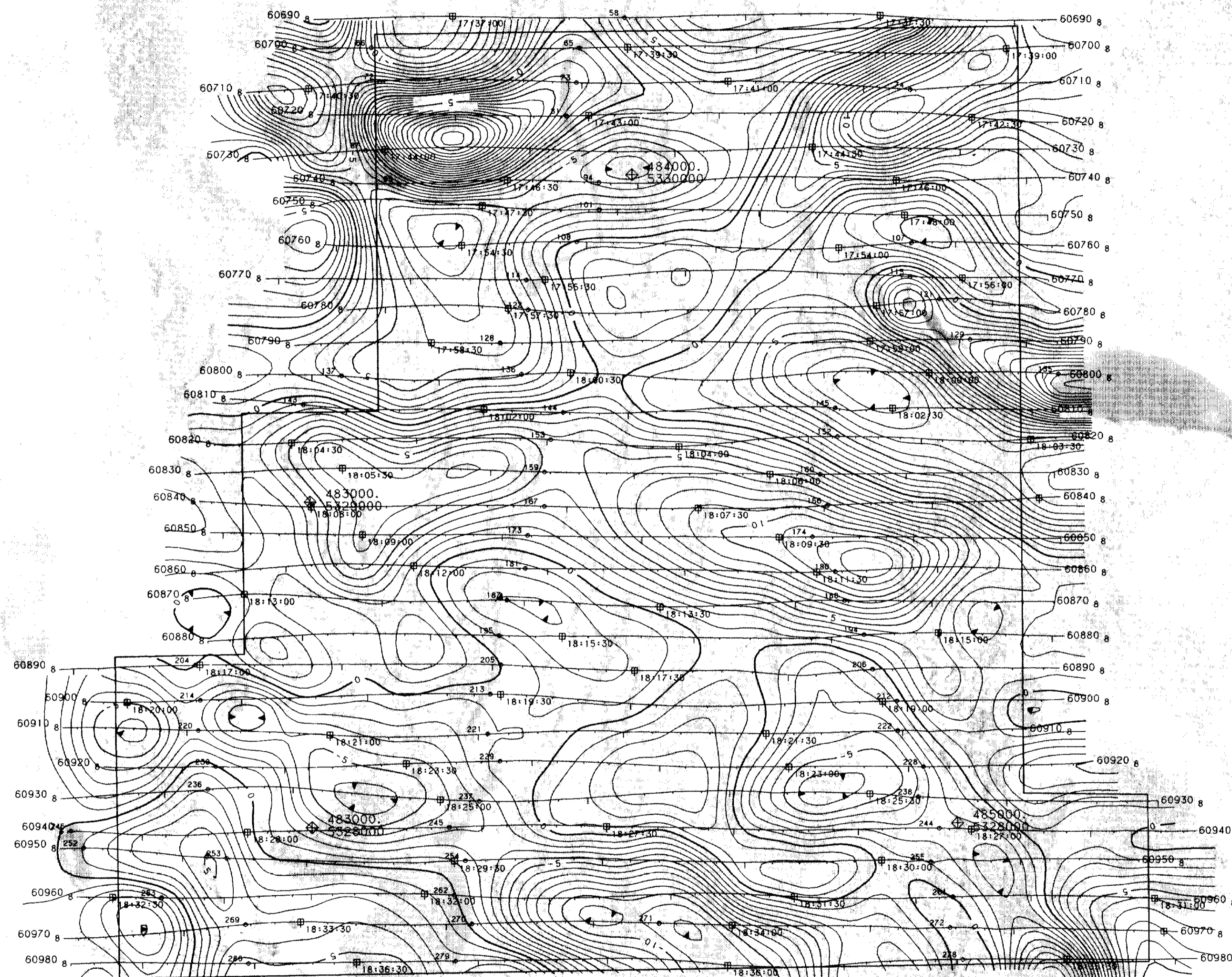
### VLF-EM

VLF-EM Total Field Intensity in percent:

Station: NSS  
Annapolis, Maryland  
21.4 kHz  
Sensor elevation 45m

Map contours are multiples of those listed below

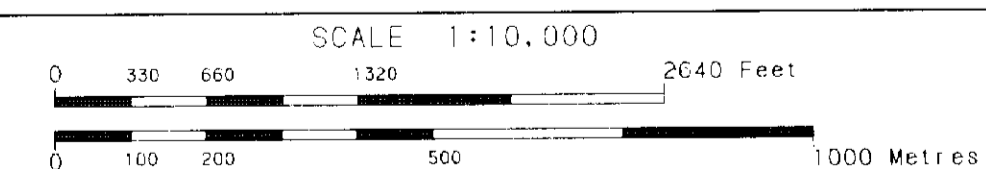
- 1 %
- 5 %
- 25 %
- 100 %



### TIMMINS NICKEL

VLF-EM TOTAL FIELD CONTOURS ( LINE CHANNEL )

BLOCK 6 2, 13, 16  
TIMMINS ONT



DATE:	SEPTEMBER 1990
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