GRANULAR RESOURCE INVESTIGATION
LAC DE GRAS, NWT
GEOPHYSICAL REPORT

Submitted To:

INDIAN AND NORTHERN AFFAIRS CANADA

Prepared By:

EBA ENGINEERING CONSULTANTS LTD.
YELLOWKNIFE, NWT

0701-96-12174

NOVEMBER, 1996

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EXECUTIVE SUMMARY

This report documents the results of a geophysical survey program on the Misery Esker at Lac de Gras, NWT. The objective of the geophysical program was to compliment a concurrent geotechnical drilling program at the same site. Both GPR and EM-34 data was collected. The GPR system was configured to collect information in the top 40 to 50 metres. The EM-34 system was used to obtain data in the top 50 meters.

A 2000 metre section of the esker was surveyed with one crest line and 10 transverse GPR lines and 1 transverse EM-34 line being profiled. The GPR surveys were conducted using 100 MHz antennas and 400 and 1000V transmitters.

Good quality GPR data was obtained on all profile lines, although weather conditions necessitated repeat surveying of all lines until adequate quality data was collected. The GPR data detected considerable layering variations and some potential variation in ice contents within the esker material.

The EM-34 data was not effective in providing any information as all of the data collected was out-of-range, with the exception of two stations with a 40 meter transmitter - receiver coil separation.

Based on the data collected the following recommendations are made:

- Consideration should be given to funding a study to combine the available information collected at a number of esker study sites. This data combined with information from other sources may provide a more generalized understanding of the eskers, their structure and characteristics. This information could be useful in developing guidelines for the management and selection of borrow sources within this development region.

- Using both GPR and GPS systems simultaneously shows great promise in being able to efficiently survey large areas in a cost effective fashion. Some further development in synchronizing the two systems will improve the efficiency of the data reduction portion of the work.

- The reliability and performance of the GPR system used severely degrades at temperatures below -20°C. Although data collection is still possible, it is more efficient to collect the data at times when low temperature conditions are not a concern.

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1.0 INTRODUCTION

In the last five years the Lac De Gras region of the North West Territories has seen increasing activity as a result of the discovery of diamond-bearing kimberlite pipes in the area. With the imminent development of at least one production mining facility, and the potential future development of several more, Indian and Northern Affairs (INAC) has been collecting information regarding the availability, type, quality and handling requirements of borrow source material in the region. EBA Engineering Consultants Ltd. (EBA) was contracted by INAC to provide geotechnical borehole logging and geophysical data collection services. Both the geotechnical and geophysical data collected and reported by EBA is part of a larger data - set collected by INAC at several sites during the 1995 - 1996 winter season.

The geotechnical data has been reported in a separate report. The data contained in this report only covers the data collected as part of the geophysical program. Some work has been done in correlating the GPR data in a general sense with the borehole data contained in the geotechnical report.

The survey area covers a 2000 meter section of the Misery Esker with the south-east end of the study area being bounded by Lac De Gras. Figure 1 shows the location of the Misery Esker study area in relation to the Lac De Gras Region. Figure 2 shows the immediate study area at the Misery Esker. Plate 1 and Plate 2 show a general view of the Misery Esker. The geophysical data collected consisted of both GPR and EM-34 data. A total of approximately 8000 metres of GPR data was collected of which 4738 metres is considered of adequate quality to be included in the report. A further 300 metres of EM-34 data was collected centred on borehole INAC 6, but all of the data was out of range and nothing useful could be derived from the data set.

2.0 OBJECTIVES

The primary objective of this program was to collect background information on the surficial soil stratigraphy at the Misery Esker at Lac de Gras. This geophysical data is complimented by geotechnical boreholes also at the Misery Esker. The geotechnical data has been reported under a separate report. These data sets are part of a larger database of esker location data collected by INAC in the Lac de Gras, Contowyto Lake Region comprising of both geophysical and geotechnical data. The intent of this report is to simply document the geophysical data collected and organize the data for

subsequent reference. A preliminary interpretation has been made, although it is recognized that significantly more work could be done in interpreting the significance of the information presented.

3.0 AUTHORIZATION

Between March 20 and 27, 1996 EBA Engineering Consultants Ltd. (EBA) conducted a Geophysical Survey for Indian and Northern Affairs Canada (INAC) along the Misery Esker at Lac De Gras in the Northwest Territories. This work was carried out under Contract 95-50170. The work was carried out by Mr. Neil Parry and Mr. Vlad Roujanski of EBA. The contract administrator for INAC was Mr. Stephan Traynor.

4.0 EQUIPMENT SPECIFICATIONS

4.1 GROUND PENETRATING RADAR SYSTEM

The GPR system used was a Pulse EKKO IV System with 100 and 50 MHz antennas and a 400 V and 1000 V transmitter system. Technical Specifications and descriptions of the system are included in Appendix A.

4.2 GLOBAL POSITIONING SYSTEM

The GPS system used was a pair of Trimble, 8 channel ProXLs. One unit was used as a base station and the second unit was used as a roving unit. Technical Specifications and descriptions of the system are included in Appendix A.

5.0 METHODOLOGY

The surveying methodology used was tailored to efficiently combine data collection with the GPS unit and the GPR and EM-34 unit. A field log of all activities is included in Appendix B.

5.1 GPR SURVEY METHODOLOGY

In the case of the GPR unit all data was collected using a Snow-machine configuration as shown in Figure 3 and Plate 3. Two operators were required, one to monitor the data collection in the equipment sled, and the second to operate the snow-machine and

control the GPS unit. This allowed the GPR data to be collected in continuous mode at a rapid pace while also recording the x,y,z coordinates of the track lines and minimizing the exposure of the equipment to the cold temperatures. This was particularly important at Misery Esker due to the cold weather conditions encountered during the course of the program and the fact that some of the survey locations were up to 2000 meters away from the truck, should equipment require warming. The speed of the snow-machine was adjusted during the course of the survey to achieve a GPR horizontal sampling rate of approximately 0.5 to 1.5 meters/scan. Intersection points with transverse lines and borehole locations were specifically annotated to both GPR and GPS records in order to correlate the two data sets and to provide cross-reference locations for elevation corrections and positioning purposes.

5.2 GPS SURVEY METHODOLOGY

The survey methodology consisted of three steps:

- Set up one of the ProXL GPS units in base station mode over a known survey location. The base station unit was configured to calculate correction factors for up to eight satellites at 5 second intervals and also to log the satellite signal strengths in order to provide diagnostic information should the differentially corrected GPS data exhibit large data errors or anomalies.

- Configure the second ProXL GPS system to operate in rover mode and configure it to collect a line feature location every second. Where reference points such as the start and end of profile lines, boreholes, intersection points with other survey lines, and claim markers were encountered they were specifically added to the GPS data file as multiple reading stationary feature points.

- Configure the GPR system to run in continuous sample mode with approximately 1 reading being taken every second. Reference locations were specifically annotated in the GPR data files so they could be cross referenced with the GPS data.

Each GPR profile line was collected with the GPS and GPR systems simultaneously acquiring data to separate digital data files. At the end of each day the GPS and GPR data was reviewed and data sets repeated as necessary until adequate quality data was acquired.

5.3 EM-34 SURVEY METHODOLOGY

The EM-34 data was collected in two stages. The first stage involved two operators collecting readings using a separate transmitter and receiving coil. Readings were taken with the coils at either 10 m or 20 m station intervals. The profile line was walked three times with coil separations of 10 m, 20 m and 40 m. Station intervals of 10 m were used for the first two coil separations and 20 m for the 40 m coil separation. After the EM-34 data had been collected, the station locations were surveyed in using a GPS receiver by walking the line a fourth time. GPS data was not collected at the same time as collecting the EM-34 data as it was felt that there was a risk that there might be interference between the GPS receiver and the induced EM field created and measured by the EM-34.

6.0 DATA RESULTS

Preliminary interpreted profiles are shown in Figures 4, 5, 6, and 7. Topographically corrected raster scan images of the digital data is presented in Appendix C. The best data sets for each line and the GPS location files are included in this report in digital form in Appendix D. Data quality varied from poor to very good. Virtually all of the lines had to be surveyed several times until sufficient quality was obtained.

There were two reasons for these difficulties. The primary reason for many of the problems was the cold weather encountered during the course of the survey. Misery Esker is a remote and exposed location. The only source of shelter during the course of the geophysical survey program was the truck used to travel between the BHP Koala camp and the site. In addition approximately 2 hours of every day was spent in transit between camp and the study area reducing the amount of time available for work. Finally, the end of the study area was approximately 2000 metres from the nearest truck access. These factors coupled with the cold weather complicated the operation of the equipment. Problems encountered on a daily basis included broken cables internal wires and connectors as a result of cold temperature brittleness, poor battery performance, (on some days batteries would only last 30 minutes), and operator fatigue and exposure. These factors combined to ensure that data collection was relatively slow with a total of approximately 8000 meters of data being collected over the course of the program with only 4738 metres of useful data.

The second problem encountered during the course of the survey was a technical one and was identified on the second day of the field work but the source of the problem was only determined in the evening of March 26 and then fixed. This problem concerned incomplete correction of the GPS data files when combining the field files with the base station file. Not all of the data would be corrected leaving unacceptable gaps in the location information for the GPR lines. This problem was eventually identified to be a result of the base station not always seeing the same satellite constellation the field rover unit. When the field unit satellite constellation was not a subset of the base station's constellation, the differential correction software would not perform corrections. The original base station location was at the BHP Koala Camp and it was discovered that the Tank Farm at the camp was blocking the line of sight to some of the satellites at certain times. The solution to this problem was to move the base station to a location near the Misery Esker and to log the base station differential corrections using a survey control point placed by Sub-Arctic Surveyors between Lac de Gras and Misery Lake. Once this was done, no further problems were encountered with the GPS systems and reliable data was collected. At no time were there fewer than 4 satellites visible and frequently up to eight satellites were being tracked. This ensured that 3 dimensional positioning was possible at all times during the course of the survey

7.0 TECHNICAL CONCLUSIONS

7.1 GPR DATA

The data quality of the GPR data collected ranged from poor to very good. The poor quality data was repeated until good quality data was obtained. Problems in the data quality was largely caused by intermittent cable problems and poor battery performance These problems were addressed as they occurred.

Effective horizontal sampling rates were a function of the snow-machine speed and the processing speed of the computer used to control the GPR system. In this survey horizontal sampling rate varied from 0.5 to 1.5 meters/trace typically. A horizontal sampling rate of 0.5 metres/trace was considered ideal and a sampling rate of 1.0 metre/trace was adequate given the stratigraphic variations in the survey site. The minimum processing speed for the computer controlling the GPR unit should be 100 MHz in order to maintain an acceptable profiling speed that does not cause undue wear on the snow-machine.

7.2 POSITIONING ACCURACY

The absolute location repeatability of the differentially corrected GPS data was ±0.3 metres with a final smoothed repeatability of ±0.1 metres. The GPS data was corrected using control points located by Sub-Arctic Surveys.

8.0 RECOMMENDATIONS

Data collection proceeded relatively smoothly once an allowance had been made for the cold temperature problems associated with the start of the program. The following recommendations are made regarding both the data collected and future technical improvements in collecting GPR data.

- As mentioned previously, only a preliminary effort has been made in this report to analyze the GPR data from a geological perspective. The quality of the data warrants a more extensive analysis, as it clearly shows layering within the esker and provides some indication of ice content variations.

- EBA is aware of at least five esker locations within the "Corridor of Hope" region where digital GPR and other geophysical data exists and EBA has collected GPR data at four of these sites on various projects. The data at the four sites that EBA has been involved with, all show stratigraphic layering and varying degrees of ice. It may be worth while studying this data in conjunction with information from other sources (both North American, and Russian studies) in order to gain a more generalized understanding of the eskers, their structure and characteristics. This information may be useful in developing guidelines for the management and selection of borrow sources within this development region.

- The reliability and performance of the GPR system used, severely degrades at temperatures below -20°C. Although data collection is still possible, it is more efficient to collect the data at times when low temperature conditions are not a concern.

- When using GPS systems to collect location information it is critical to set up the base station unit at a location where the same satellite constellation as the roving unit is recorded or the differential correction will fail.

- In addition to the standard guidelines used in configuring GPS base stations, the following points should be applied in northern locations:

  - Ensure a clear line-of-site to the southern horizon.
  - Try to place the base station at a higher elevation.
  - If more than 5 hours of work is planned do not take base station readings at a rate faster than 1 reading every 5 seconds, or the base station may run out of memory with a resulting loss of data.
  - Try to place the base station unit in a location that is somewhat sheltered from the weather.

- The data processing and linking of the GPS and the GPR data will be significantly improved if the GPS unit is synchronized with the GPR unit, thereby ensuring that there is a GPS location for each GPR shot point.

9.0 CLOSURE

The data collected in this program has been fully documented and referenced. Only data considered usable has been included in this report. If data that has not been included is required, it has been archived and can be retrieved upon request. Minimal interpretation and correlation with the geotechnical data has been done to date. EBA hopes that the data presented is informative and acknowledges the cooperation and assistance provided by Mr. S. Traynor of INAC and both BHP and Kennecott Canada Inc. who provided logistical support.

Respectfully submitted,
EBA Engineering Consultants Ltd.

N.S. Parry
Senior Geophysical Scientist

Reviewed by:

REGISTERED PROFESSIONAL ENGINEER
Dec 10/96
T. E. HOEVE
N.W.T.

THE ASSOCIATION OF PROFESSIONAL ENGINEERS, GEOLOGISTS and GEOPHYSICISTS OF THE NORTHWEST TERRITORIES
PERMIT NUMBER
P 018
EBA ENGINEERING CONSULTANTS LTD.

T.E. Hoeve, P.Eng.
Project Director, Yellowknife

NSP/tr

PLATES

Plate 1

Misery esker, near southwest end of Misery 08, looking north.

Plate 2

Misery esker, near Borehole INAC 7, looking south.

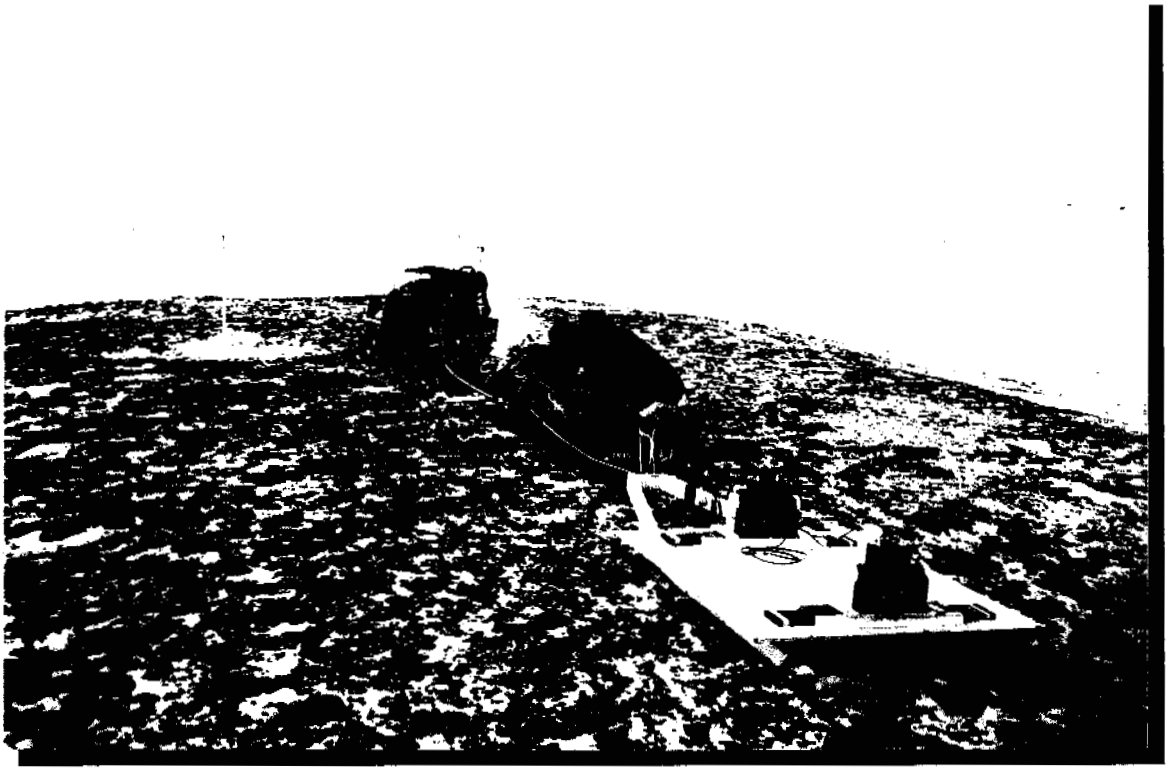
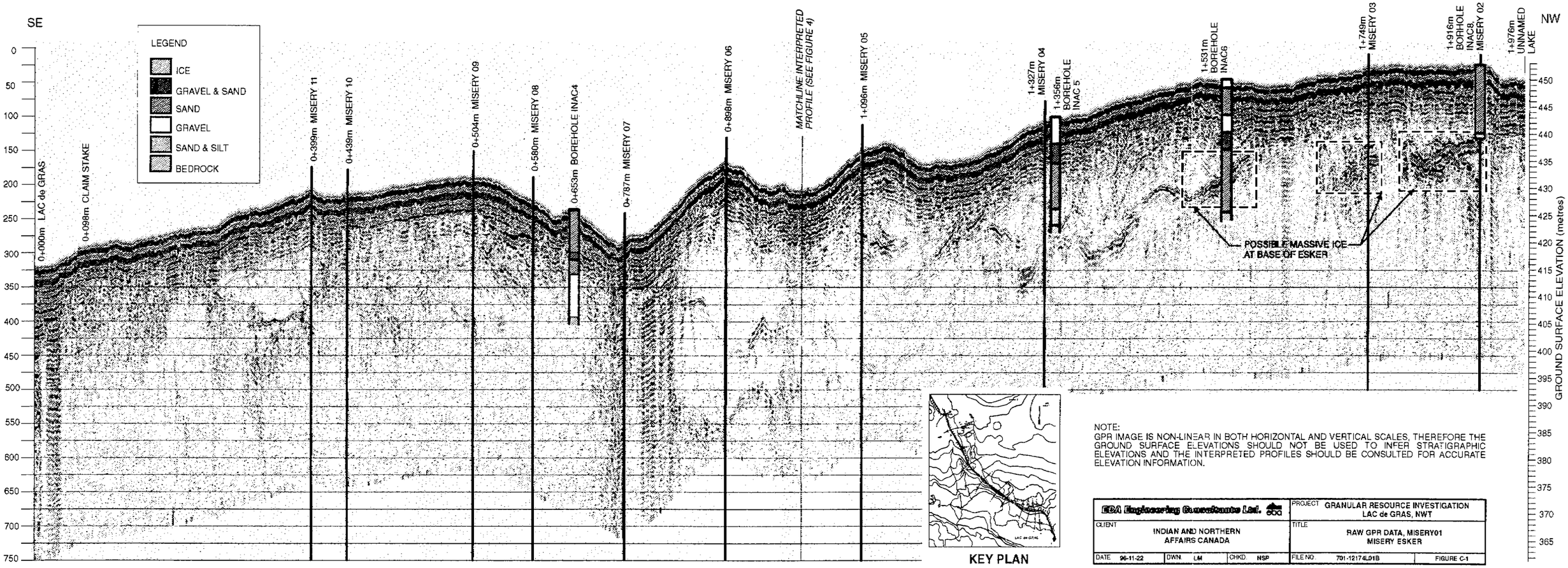


Plate 3

Equipment configuration showing 100 MHz antennas and sled.

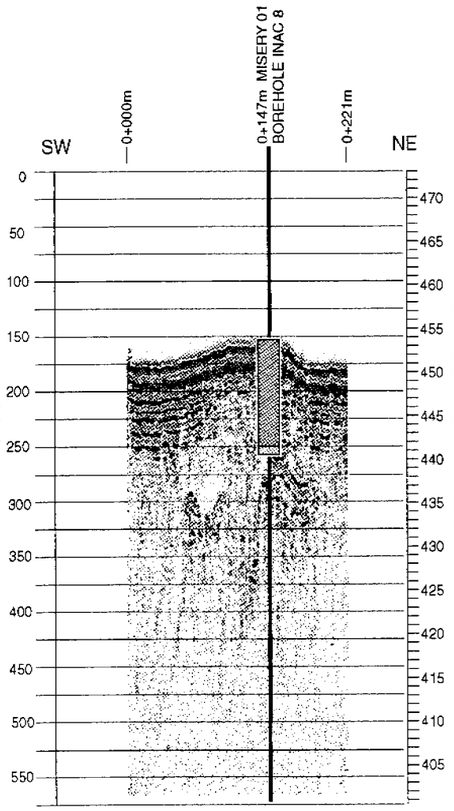
FIGURES



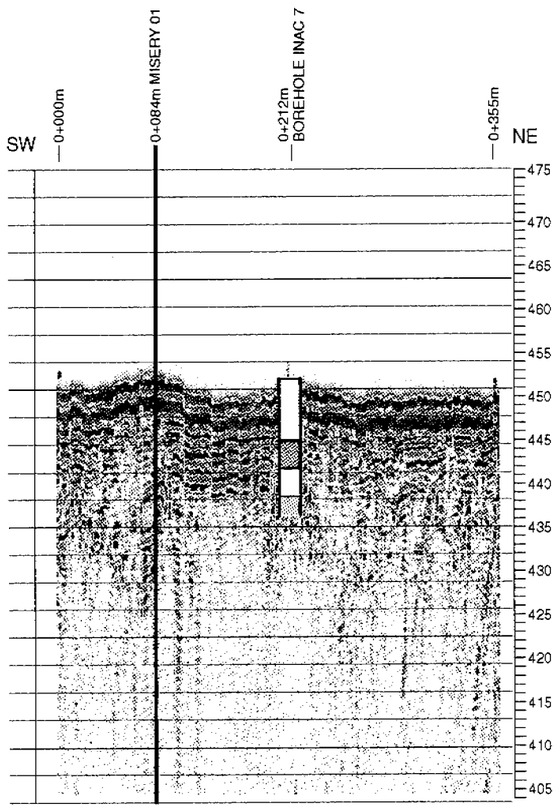
KEY PLAN

NOTE:
GPR IMAGE IS NON-LINEAR IN BOTH HORIZONTAL AND VERTICAL SCALES, THEREFORE THE GROUND SURFACE ELEVATIONS SHOULD NOT BE USED TO INFER STRATIGRAPHIC ELEVATIONS AND THE INTERPRETED PROFILES SHOULD BE CONSULTED FOR ACCURATE ELEVATION INFORMATION.

EBA Engineering Consultants Ltd.				PROJECT	GRANULAR RESOURCE INVESTIGATION LAC de GRAS, NWT
CLIENT	INDIAN AND NORTHERN AFFAIRS CANADA			TITLE	RAW GPR DATA, MISERY01 MISERY ESKER
DATE 96-11-22	DWN LM	CHKD NSP		FILE NO 701-12174L01B	FIGURE C-1



MISERY 02



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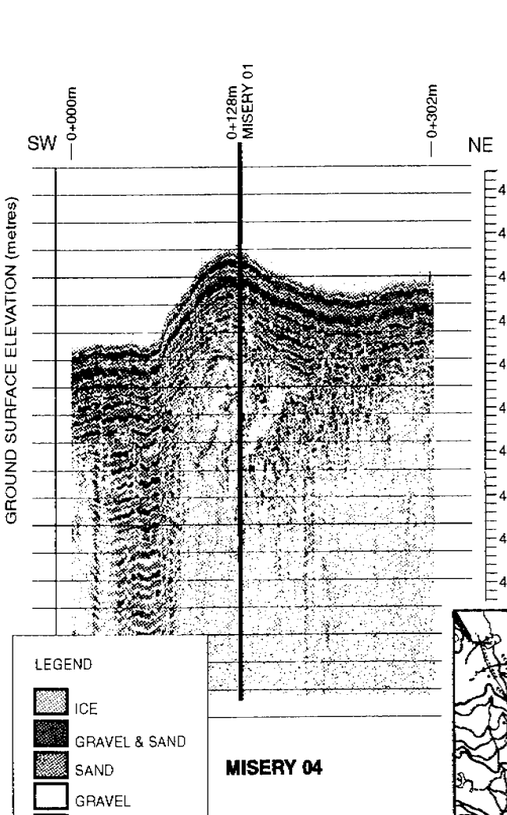
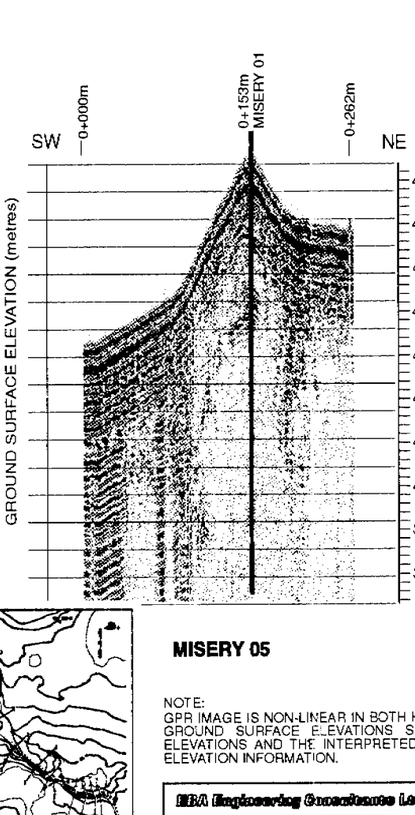
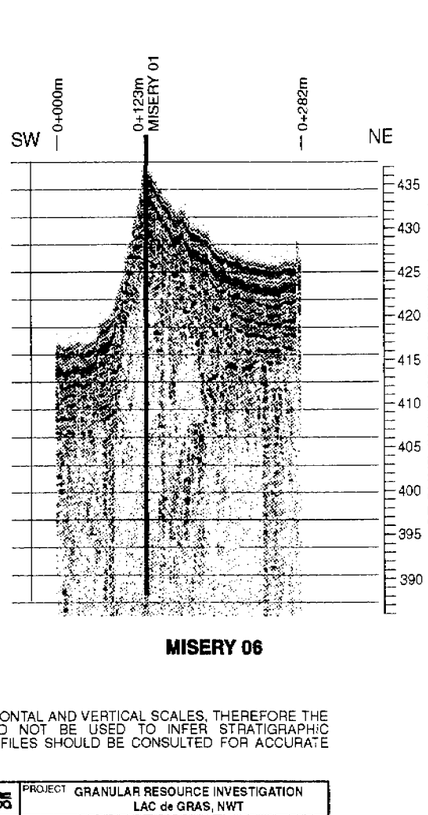


MISERY 04



MISERY 05

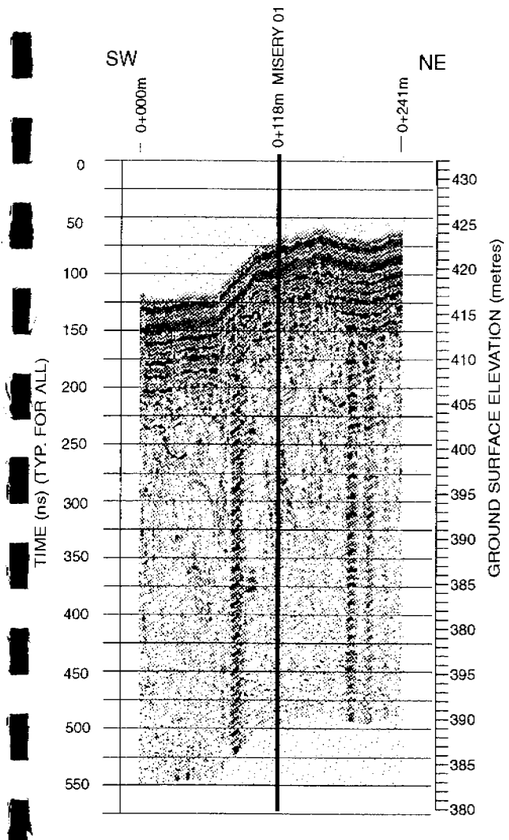


MISERY 06

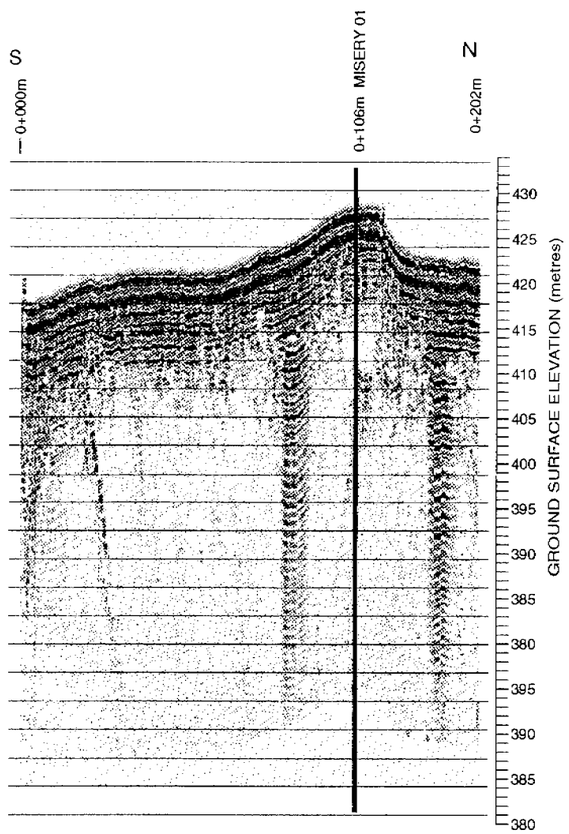
KEY PLAN

NOTE:
GPR IMAGE IS NON-LINEAR IN BOTH HORIZONTAL AND VERTICAL SCALES, THEREFORE THE GROUND SURFACE ELEVATIONS SHOULD NOT BE USED TO INFER STRATIGRAPHIC ELEVATIONS AND THE INTERPRETED PROFILES SHOULD BE CONSULTED FOR ACCURATE ELEVATION INFORMATION.

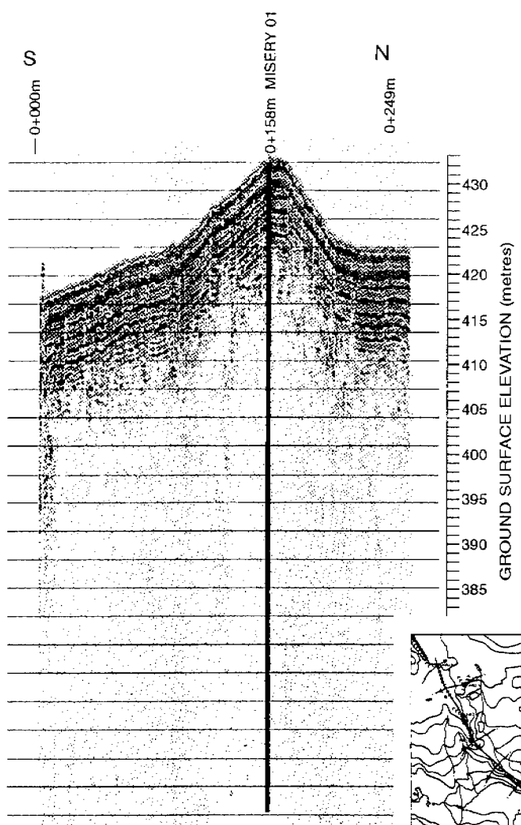
EBA Engineering Consultants Ltd.				PROJECT	GRANULAR RESOURCE INVESTIGATION LAC de GRAS, NWT
CLIENT	INDIAN AND NORTHERN AFFAIRS CANADA			TITLE	RAW GPR DATA, MISERY02,03,04,05,06 MISERY ESKER
DATE 96-11-22	DWN. LM	CHKD. NSP		FILE NO. 701-12174L02B	FIGURE C-2



MISERY 07

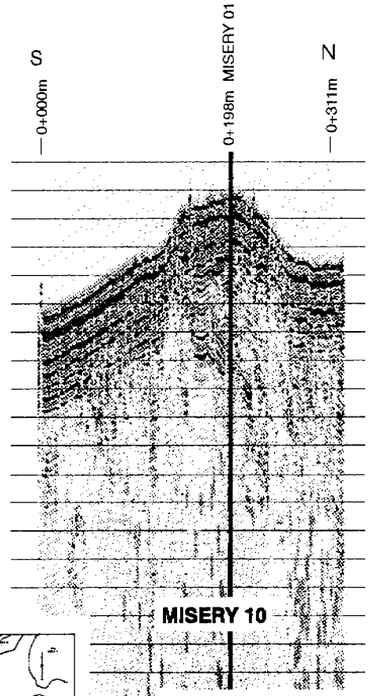


MISERY 08



MISERY 09

KEY PLAN



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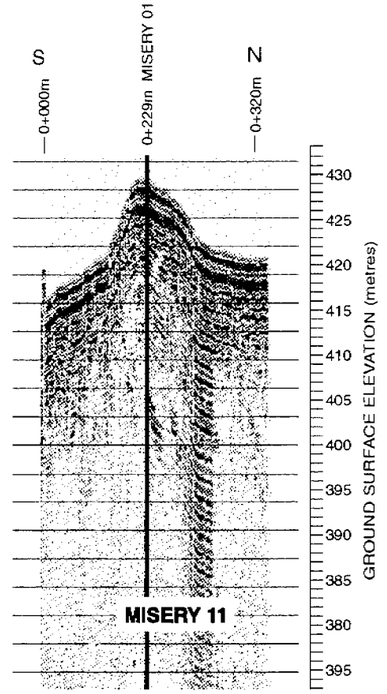

MISERY 11

NOTE:
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ERA Engineering Consultants Ltd. eoc		PROJECT	GRANULAR RESOURCE INVESTIGATION LAC de GRAS, NWT
CLIENT	INDIAN AND NORTHERN AFFAIRS CANADA	TITLE	RAW GPR DATA, MISERY07, 08, 09, 10, 11 MISERY ESKERS
DATE 96-11-22	DWN. LM / CHKD. NSP	FILE NO.	701-12174L03A / FIGURE C-3

APPENDIX A

EQUIPMENT SPECIFICATIONS

APPENDIX A
TECHNICAL OVERVIEW

Ground Penetrating Radar (GPR) is a non-destructive geophysical technique that is capable of delineating materials that have contrasting dielectric properties. GPR is an established geophysical technique for such applications as detection of subsurface anomalies and voids, profiling geological stratigraphic components and the mapping of natural phenomena (ice wedges in permafrost soils).

Operationally, a pulsed electromagnetic signal is transmitted into the ground and the reflected return is sampled over a short period of time to produce a digital record representative of the stratification beneath the antenna.

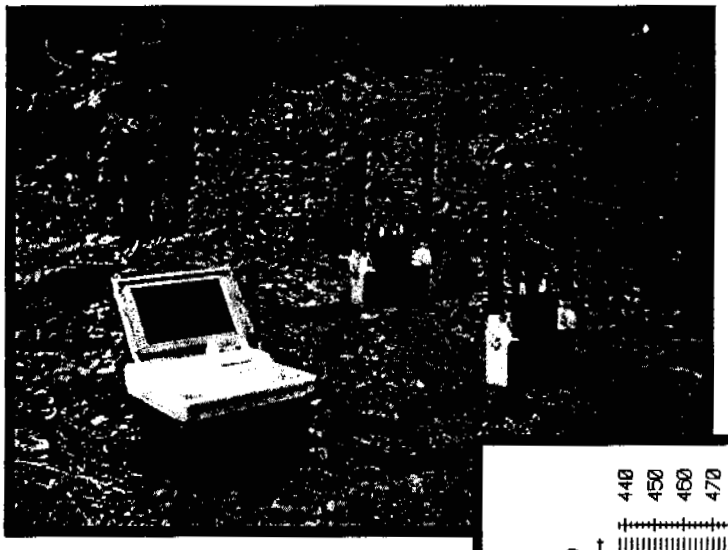
The system comprises five essential components: a square wave trigger generator, a high frequency pulse generator, a transmit/receive antenna, decoder circuits and a controlling computer.

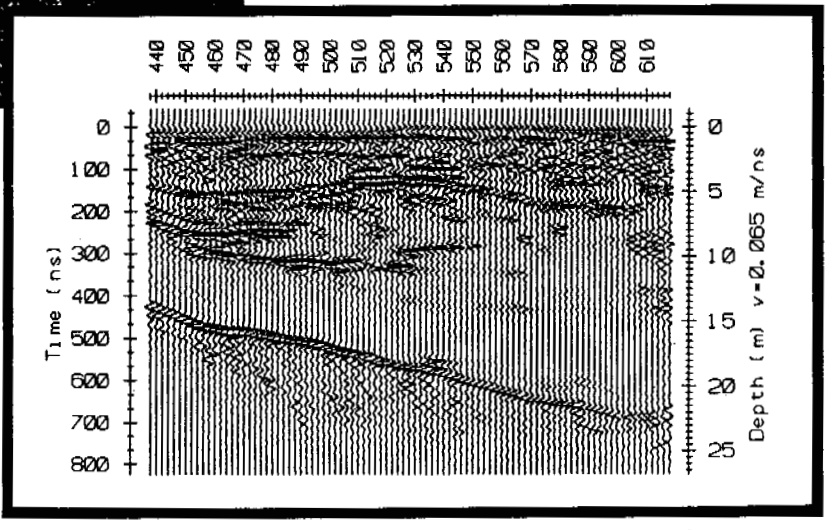
The square wave generator triggers the high frequency pulse generator causing a single high frequency pulse (100 to 1000 MHz) to be transmitted at the beginning of the individual square wave. Each pulse is fed into the transmitting antenna which directs the pulse into the ground. Upon encountering the interface between dielectric properties, some of the signal is reflected and the remainder is transmitted through the interface. The ratio of the reflected signal to the incident signal is proportional to the dielectric contract, as well as the geometric properties of the interface. The reflected signal received by the antenna is processed by the decoder circuits and digitized and stored to disk. The recording of the data digitally enables the reproduction of records at a later date for inventory purposes. It also provides a data base from which the raw digital signal can be analyzed further using modelling and signal processing techniques.

Depth of penetration and resolution of the signal are controlled by the material properties and signal frequency. Higher frequencies provide better resolution but less penetration.

pulseEKKO™ IV

GROUND PENETRATING RADAR TECHNOLOGY





Sensors & Software Inc.

Sensors & Software Inc.

Introduces

pulseEKKO™ IV

The **Ground Penetrating Radar** designed
to exploit **Seismic Processing.**

Years of practical experience in rugged field conditions have created the **lightweight, modular** and totally **battery powered** pulseEKKO™ IV system. The **fully digital** system with **fibre optic** data links guarantees the highest possible performance available.

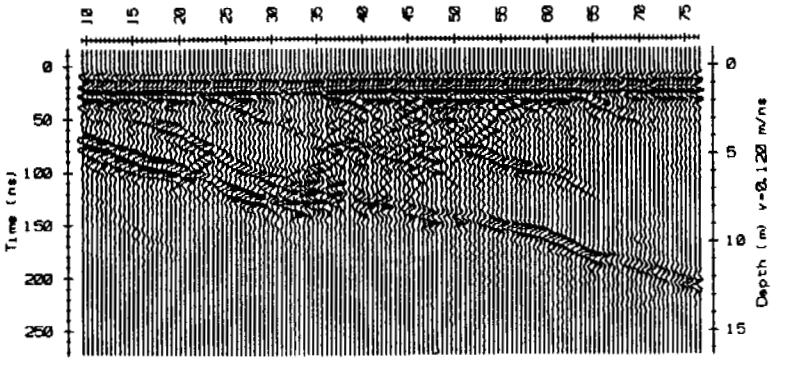
Modular design using **interchangable antennas** to select operating frequency provides you with a **cost effective** route to system enhancement.

With **advanced control software** you can operate the system from any MS-DOS* computer and exploit the latest advances in **PC† technology**. Full **digital data storage** gives you instant access to your data and the ability to exploit proven **seismic processing** techniques.

The **advanced user interface** combines simplicity with total system control. **Non-volatile** configuration parameters, and **automatic configuration** maximize data quality, minimize set up time, and assure survey repeatability.

*MS-DOS Trademark of Microsoft Corp.
†PC Trademark of International Business Machines Corp.

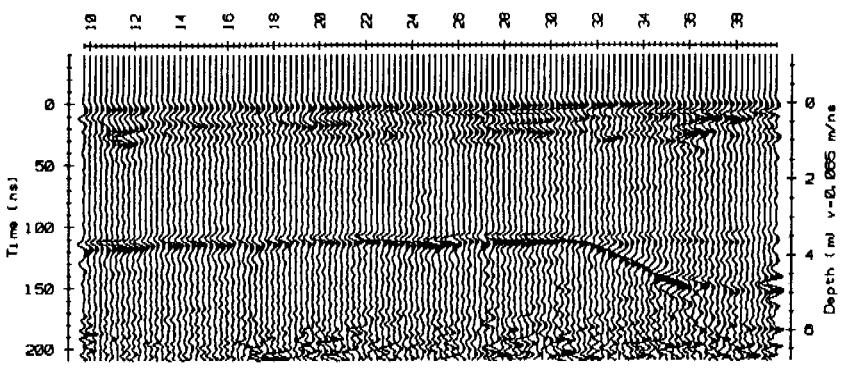
Fracture Mapping in Rock



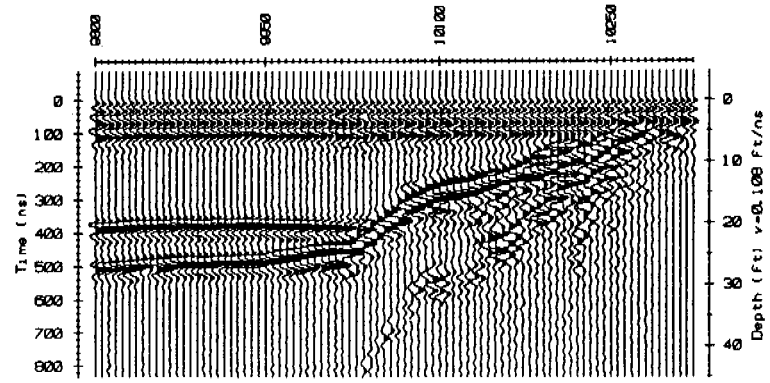
pulseEKKO™ Features

- Digital acquisition
- Light weight
- Fibre optics
- Signal averaging
- Computer controlled
- Interchangable antennas
- Seismic software compatible

Mapping Soil Stratigraphy



Lake Bottom Mapping



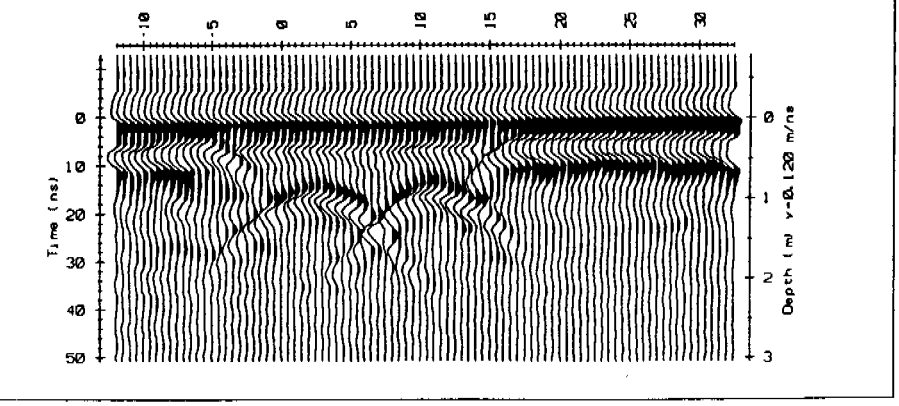
pulseEKKO™ Processing

- Wiggle trace display
- FFT filtering
- AGC and SEC gains
- Seismic processing software
- Topographic compensation
- Processing history

pulseEKKO™ Application

- Bedrock depth
- Buried tanks or drums
- Rock fractures
- Mine workings
- Mineralized zones
- Glacier thickness
- Archaeological sites

Detection of Buried Tanks



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Sensors & Software Inc.

pulseEKKO™ IV EQUIPMENT SPECIFICATIONS

RADAR PARAMETERS

System Performance	155 dB
Programmable Time Window	32 - 2048 ns
Programmable Sampling Interval	800 - 8000 ps
Programmable Stacking Range	1 - 2048 stacks

CONTROL CONSOLE

Size	35 x 26 x 15 cm
Weight	3 Kg
Power	12V DC (0.6 Amp)
Control and Data Port	RS232 Serial Port

TRANSMITTER ELECTRONICS

Output Voltage	400V (1000V - optional)
Repetition Rate	30kHz
Size	28 x 28 x 11 cm
Weight	3 Kg (battery included)
Power	12V DC (0.5 Amp)

RECEIVER ELECTRONICS

Size	28 X 28 X 11 cm
Weight	3 Kg (battery included)
Power	12V DC (0.5 Amp)

CABLES

Control Console Power	1.5m power cable
Transmitter Trigger	20m fibre optic
Receiver Timing and Data	20m dual fibre optic
Computer Interface	2m RS232 cable

CONTROL & DISPLAY

Computer	MS-DOS* PC†, 640Kbytes RAM, RS232 port.
Data Storage	PC floppy, hard, or RAM disk
Hard Copy	Most PC printers
Software	EKKO_RUN EKKO_PLOT EKKO_EDIT EKKO_SEGY EKKO_RANG EKKO_FILT EKKO_CMP EKKO_SYNTH

ANTENNAS

25 MHz	50 MHz	100 MHz	200 MHz
10.5 x 368 x 0.8 cm	10.5 x 184 x 0.8 cm	10.5 x 92 x 0.8 cm	10.5 x 46 x 0.8 cm
4 Kg	2 Kg	1.5 Kg	1 Kg

* MS-DOS Trademark of Microsoft Corp. † PC Trademark of International Business Machines Corp.

5566 Tomken Road, Mississauga, Ontario, Canada L4W 1P4, Phone (416) 624-8909 Fax (416) 624-9365

Trimble

SURVEYING AND MAPPING PRODUCTS

GPS Pathfinder® Pro XL

Sub-meter GPS mapping system

Precision geographic data capture system for mapping and GIS.

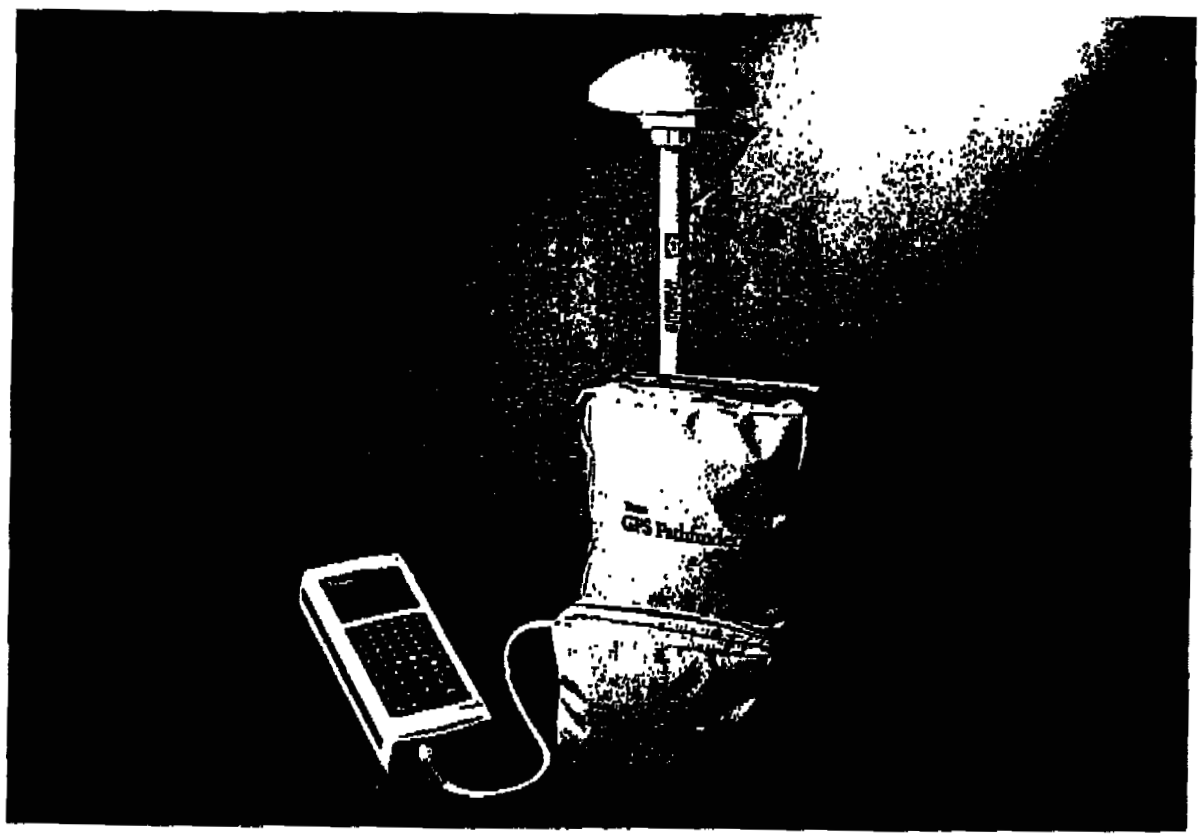
The GPS Pathfinder Pro XL is a GIS data capture system that provides sub-meter accuracy on a second-by-second basis. The Pro XL utilizes the most advanced GPS technology available—Trimble's Maxwell chip—in conjunction with powerful data capture and mapping software. This provides you with a system for gathering GIS data that is fast, accurate, and easy to use.

The Pro XL offers instaneous sub-meter accuracy that dramatically increases the number of locations that can be gathered while maintaining the accuracy needed for maps with a scale of 1:5000 or less. The Pro XL system's large memory allows the user to download data less frequently. User-definable data entry systems with data validation serve to reduce the chance of entering incorrect information about features. The data gathering capabilities of the Pro XL can also be enhanced by combining GPS locations with measurements from sensors such as echo-sounders, chemical detectors, and magnetometers.

The GPS Pathfinder Pro XL system includes a precision 8-channel receiver (factory upgradeable to 12-channels), a lightweight GPS antenna, a field carrying system, a high capacity, rugged data collector with software, and PFINDER software for differential correction and processing of data.

An optional radio link between the Pro XL and a GPS base station supplies real-time differential correction for sub-meter accuracy in the field. With this level of accuracy, users can easily navigate directly to features that cannot be seen, such as buried pipelines. Waypoints can be stored in the system to help users navigate back to sites visited previously.

The Pro XL system includes powerful PFINDER software for differential correction and editing of data. With a point-and-click graphic user interface, PFINDER software allows the user to easily display, edit, and plot features at any scale. Over 140 GIS systems are supported including ARC/INFO, AutoCAD, Intergraph MGE, ERDAS, and GRASS. The optional Decimeter Processor software can provide accuracy as precise as ten centimeters when ten minutes of data is collected at each site.



GPS Pathfinder™ Pro XL

Sub-meter GPS Mapping System

Standard Features

- PFINDER™ software
- Eight-channel GPS receiver
- Handheld datalogger with Asset Surveyor™ software
- Base/rover datalogging modes
- Remote compact dome antenna kit
- Five-meter antenna cable
- Rechargeable system batteries (provide 8 hours of field use)
- OSM-PF (Office Support Module) battery charger and AC power supply
- System carrying pouch
- Rugged hard-shell carrying case
- Automobile power adapter
- Vehicle mount for antenna
- Quick-release antenna mount

Options

- Decimeter Processor™ software and receiver upgrade
- Barcode wand for quick feature and attribute data entry
- Rangepole bipod system
- Annual software/firmware/hardware support agreements
- System training
- Rigid-frame backpack
- 12-channel upgrade
- Trimble NavBeaconXL™ (for broadcast DGPS reception)
- Short-range license-free radio systems for real-time differential correction (not available in all countries)

PFINDER Software Capabilities

- Download data to IBM PC or compatible
- Output in UTM or LAT/LON/ALT, U.S. State Plane coordinates or user-defined local coordinate systems and datums
- Differential correction using data from a GPS base station either with post-processing technique or in real-time
- Plot to HP GL-compatible plotters at user-specified map scales
- GIS conversion and interface to ARC/INFO®, GRASS, AutoCAD®, Intergraph MGE™, MOSS, ERDAS® and others
- Mission planning for satellite availability
- Data editing

Ordering Information

GPS Pathfinder Pro XL

For specific ordering information about the GPS Pathfinder Pro XL system, please contact Trimble or an authorized Trimble Distributor. Trimble has more than 200 distributor locations worldwide.

Pro XL with MC-V, 8-channel	Part Number 16951-40
Pro XL with MC-V, 12-channel	Part Number 16851-50
Pro XL with TDC1, 8-channel	Part Number 16851-60
Pro XL with TDC1, 12-channel	Part Number 16851-70

Decimeter Processor

Includes Windows®-based software and manuals for sub-meter postprocessed GPS positions. Part Number 24551-00

GPS Receiver Specifications

Receiver:

General:	8-channel parallel, tracks up to eight satellites, L1/CA code with carrier smoothing
Update rate:	1 sec.
Accuracy:	Accuracy with differential correction is better than 1 meter (RMS) +10 ppm times the distance between base and rover given the following conditions: • PDOP ≤ 4 • Signal to noise ratio ≥ 6 • Satellite elevation mask of 15 degrees • Synchronized measurements with Pro XL, Community Base Station™ or Series 4000 base station data *Impact of local environmental conditions:* Ionospheric conditions, multipath signals or obstructions of the sky by buildings or heavy tree canopy may degrade accuracy by interfering with signal reception. Optimal accuracy is obtained by collecting data in an environment that is devoid of large reflective surfaces and also has a clear view of the sky. *For more information on GPS accuracy, please refer to Trimble's application and technical note, "Factors Affecting GPS Accuracy."*
Autonomous accuracy:	100 meters (2dRMS)
Time to first fix:	30 seconds, typical
Size:	15.9cm x 7.0cm x 21.9cm (6.25" x 2.75" x 8.63")
Weight:	1.10 kg (2.43 lbs.)
Power:	4 watts typical, 10 to 32 VDC
Operating temp:	-40°C to +70°C (-40°F to + 160°F)
Storage temp:	-40°C to +85°C (-40°F to + 185°F)
Humidity:	100% non-condensing
Casing:	Dust proof, splash proof, shock resistant

Antenna:

General:	Right-hand, circular polarized; omnidirectional; hemispherical coverage
Size:	15.4 cm dia x 8.9 cm H (6"dia x 3.5"H)
Weight:	0.25 kg (0.55 lb.)
Operating temp:	-40°C to +70°C
Storage temp:	-40°C to +70°C
Humidity:	Will operate at 100% humidity
Casing:	Dust proof, waterproof, shock-resistant

Datalogger Specifications

Trimble TDC1

Logging Memory:	640 KB standard; 4 MB optional
Size:	20.8cm x 8.9cm x 4.5cm (8.2" x 3.5" x 1.75")
Weight:	0.64 kg (1.40 lbs.), including batteries
Operating Temp:	-12°C to +50°C (+10°F to +122°F)
Storage Temp:	-20°C to +66°C (-4°F to +150°F)
Humidity:	Up to 99% non-condensing
Casing:	Dustproof, waterproof to Milspec 810D
Display:	8 lines x 20 characters, backlit supertwist LCD

Corvallis MicroTechnology MC-V

Logging Memory:	1 MB standard; expandable to 4 MB
Size:	24cm x 10.5cm x 5cm (9.43" x 4.06" x 1.97")
Weight:	0.94 kg (2.07 lbs.), including batteries
Operating Temp:	-10°C to +40°C (+14°F to +104°F)
with heater option:	-40°C to +40°C (-40°F to +104°F)
Storage Temp:	-25°C to +45°C (-13°F to +113°F)
Casing:	Dustproof, waterproof, shock-resistant
Display:	8-lines, 21-character, with backlight

Specifications subject to change without prior notice.

Trimble

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APPENDIX B

FIELD LOGS

DAILY FIELD REPORT
March - April 1996 GPR Survey, Lac De Gras Region, N.W.T.

EBA PERSONNEL: Neil S. Parry (NSP) and Vlad E. Roujanski (VER)

March 20, 1996

NSP and VER arrived Yellowknife, and met by Ed Hoeve,
drove by truck to the EBA office.
NSP and VER collected survey gear from air cargo air.
NSP and VER rented a truck.
Ice road to Lac De Gras closed, therefore, NSP and VER overnight in YK at the Discovery Hotel.

March 21, 1996

8:00 - 10:00 - NSP and VER prepared to leave, loaded gear and personal effects into the truck;
18:00 - 18:30 - arrived the Koala Camp. Met with S.Traynor (DIAND), Pavel Kurfurst (GSC) et al.;
18:30 - 22:00 - unloading, storing and checking equipment.

March 22, 1996

WEATHER: clear skies, no wind, air temperature about - 30°C

7:30 - NSP started setting up a base station and VER started building a wooden sled.
8:30 - NSP finished setting up a base station;
9:30 - VER completed building a sled;
9:45 - NSP and VER depart by truck to Box Camp to check out other sleds;
10:45 - depart Box Camp by truck to Koala Camp;
11:15 - Finish loading truck, NSP and VER depart by truck to Misery Esker;
12:10 - arrive Misery Esker;
12:57 - finish exploring the Misery Esker area and start setting up sled;
5.73 m - distance between GPS antenna and the middle of the antennas;
1.24 m - the height of the GPS antenna to ground;
15:15 - break at the end of the first Crest Line;
15:30 - started setting up first traverse (NMT6);
16:00 - equipment problem. Stopped the survey;
17:36 - headed back to Koala camp for repair;
18:31 - arrived Koala camp, collect base station, unload the truck;
19:30 - repair equipment;
22:00 - end day

March 23, 1996

WEATHER: clear skies, light breeze from the North; air temperature about -25°C

7:30 - mobilize equipment;
8:00 - set up a base station;
8:15 - NSP and VER depart by truck to Misery Esker;
9:00 - arrive on site;
9:20 - depart by snow machine to the northern end of the Esker;
10:00 - start NMT6;
10:30 - batteries dead. Replace batteries, and restart NMT6
10:45 - data quality poor stop line
11:45 - identify problem. depart for truck to repair
12:30 - lunch break;
13:30 - continue fixing broken wires;
14:15 - restart NMT6;
14:30 - receiver's dead. NSP and VER decided to go back to the Koala camp to repair the receiver;
15:15 - depart for Koala camp;
16:05 - removed a base station and start to unload;
16:30 - VER started working on sled repairs and modifications, NSP start reviewing printing out GPS/GPR data;
19:00 - VER finished working on the sleds. NSP and VER headed for supper;
20:15 - NSP continued printing out GPR data;
22:00 - end day.

March 24, 1996

WEATHER: whiteout, high winds

7:00 - VER reducing and downloading GPS data and printing out GPR data. NSP analyzing the results.
19:00 - end day

March 25, 1996

WEATHER: overcast, very light breeze from the South, air temperature about - 20°C

7:00 - loaded truck;
7:30 - NSP calling EBA Edmonton;
8:00 - set up a base station;
8:10 - NSP and VER depart by truck to Misery;
8:56 - set up GPR on site;

9:30 - start MT1;
10:10 - start MT2;
10:50 - start MT3;
11:30 - start MT4;
12:00 - completed MT1-4. Lunch break.
12:30 - start NMT1;
13:00 - start NMT2;
13:30 - start NMT3;
14:00 - start NMT4;
14:30 - start NMT5;
15:00 - start NMT6;
15:30 - completed all lines, strip equipment;
16:10 - finished packing and depart by truck to Koala camp;
17:00 - arrive Koala, collect base station, unload the truck;
19:00 - review data;
22:00 - end day.

March 26, 1996

WEATHER: clear skies, light wind (cold breeze); air temperature about -20°C

7:00 - waiting for Rob to finish thermistor reading, reviewing GPS data;
9:00 - set up a base station;
9:09 - NSP and VER depart by truck to Misery Esker;
10:00 - arrive Misery Esker;
10:05 - NSP started GPS lines;
12:00 - NSP finished GPS lines; Lunch break;
12:30 - NSP and VER preparing EM-34;
13:00 - NSP and VER started EM-34 survey;
15:34 - NSP and VER finished EM-34 survey;
16:00 - depart by truck to the camp;
17:00 - arrive Koala,collect base station, unload the truck;
19:00 - review GPS and GPR data;
22:00 - end day.

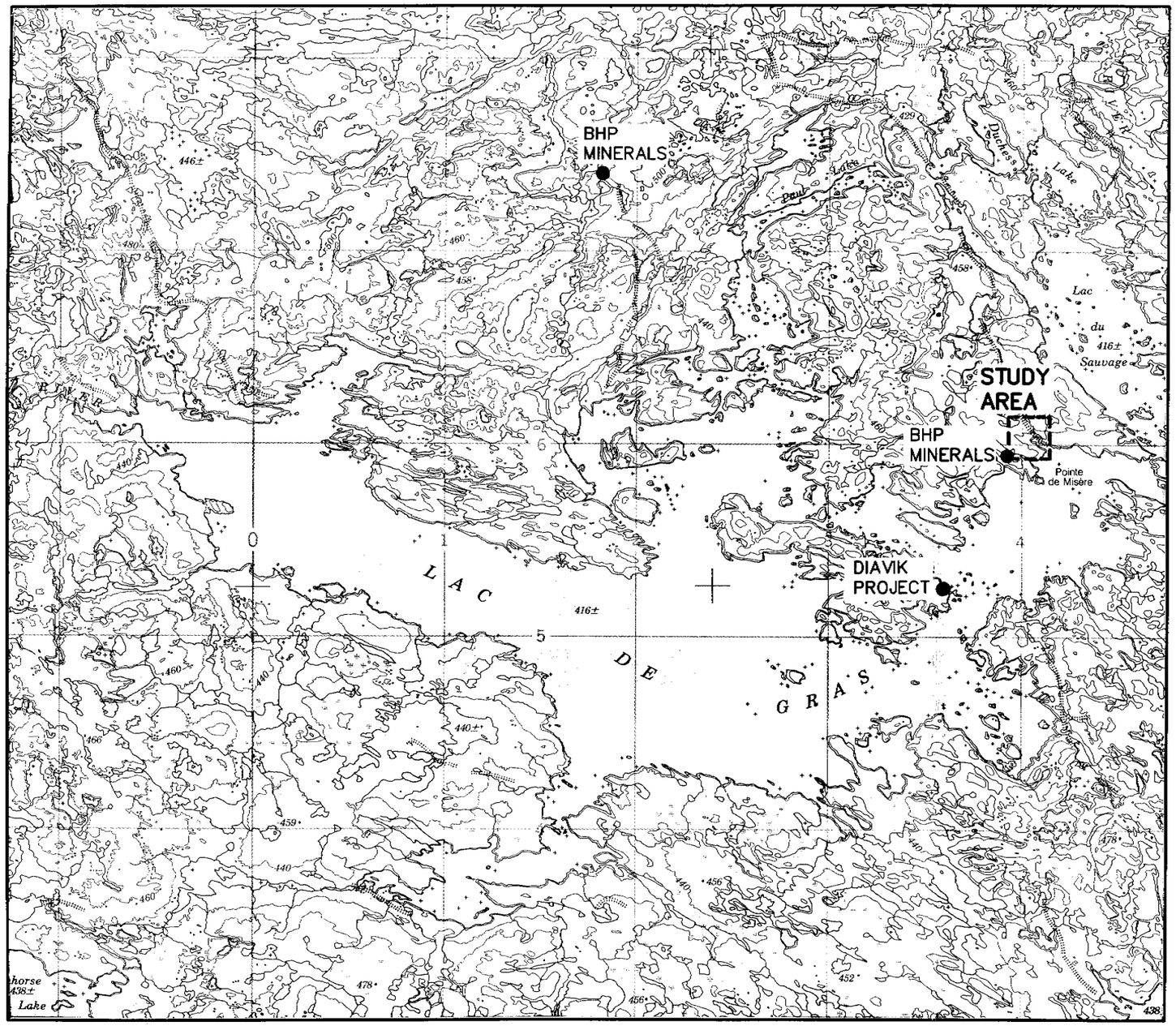
March 27, 1996

WEATHER: clear skies, sunny, very bright

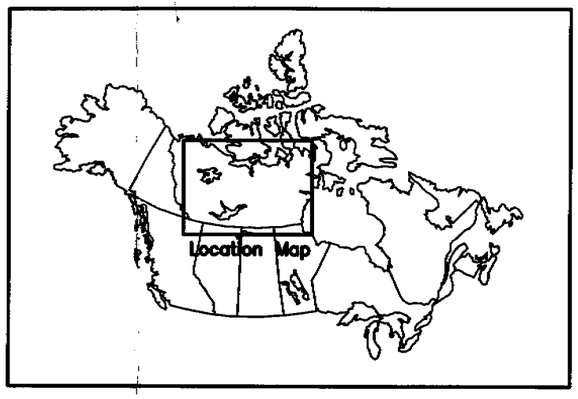
7:00 - depart Misery Esker NSP and VER redo all GPR and GPS lines using local GPS base station location between Lac de Gras and Misery Lake reviewing data at night;
24:00 - end day.

APPENDIX C

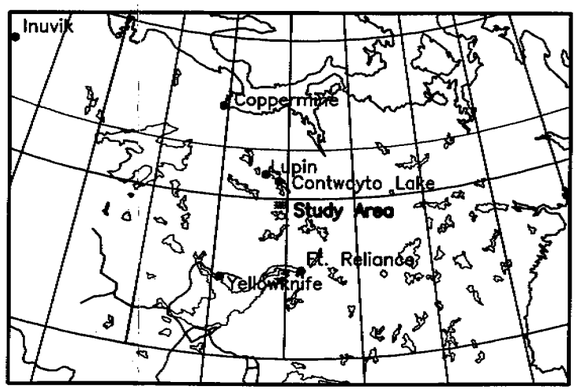
RASTER SCAN IMAGE TOPOGRAPHICALLY CORRECTED GPR PROFILES



0 2 4 6 8 10
kilometres

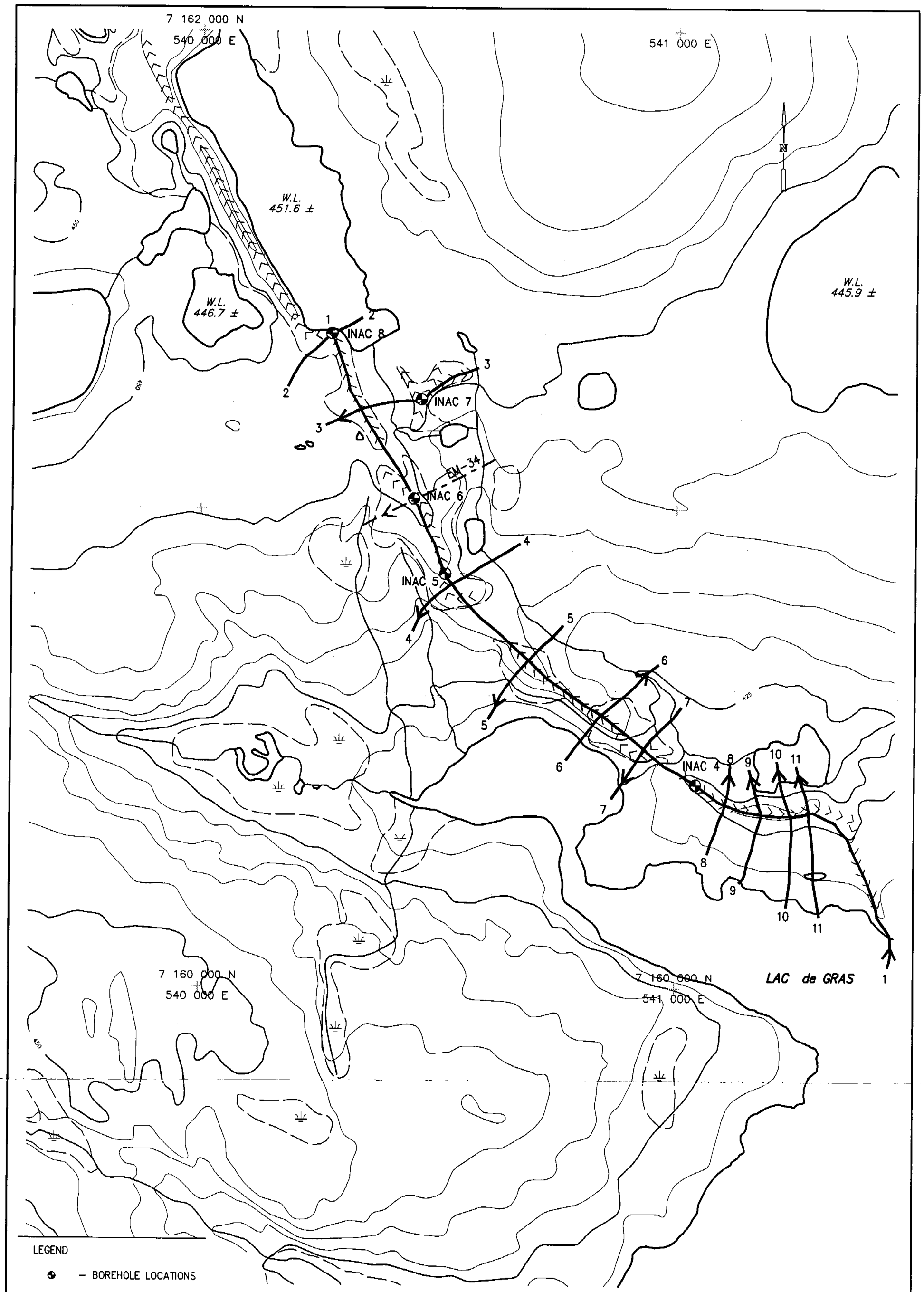


INDEX MAP
N.T.S.

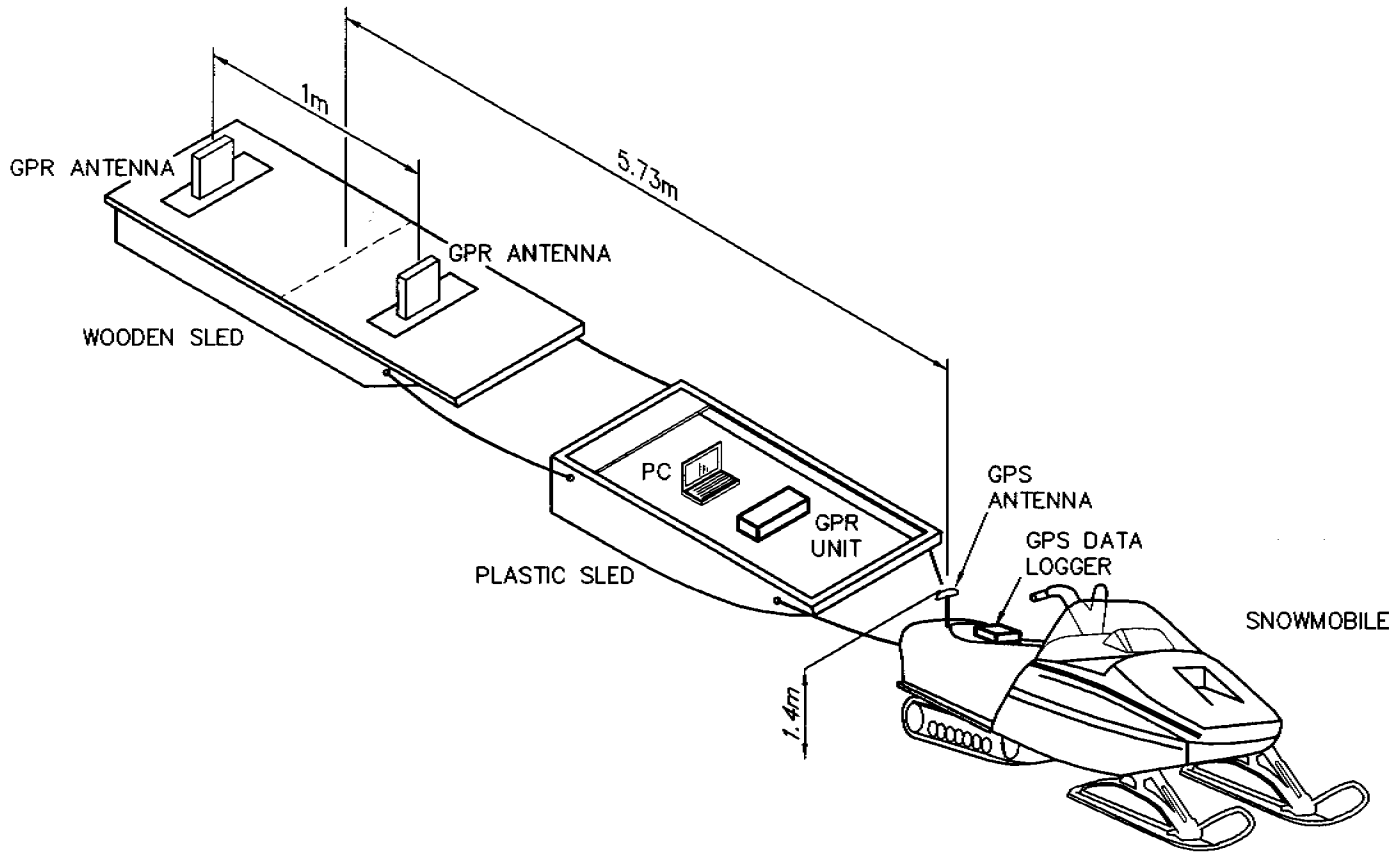


LOCATION MAP
N.T.S.

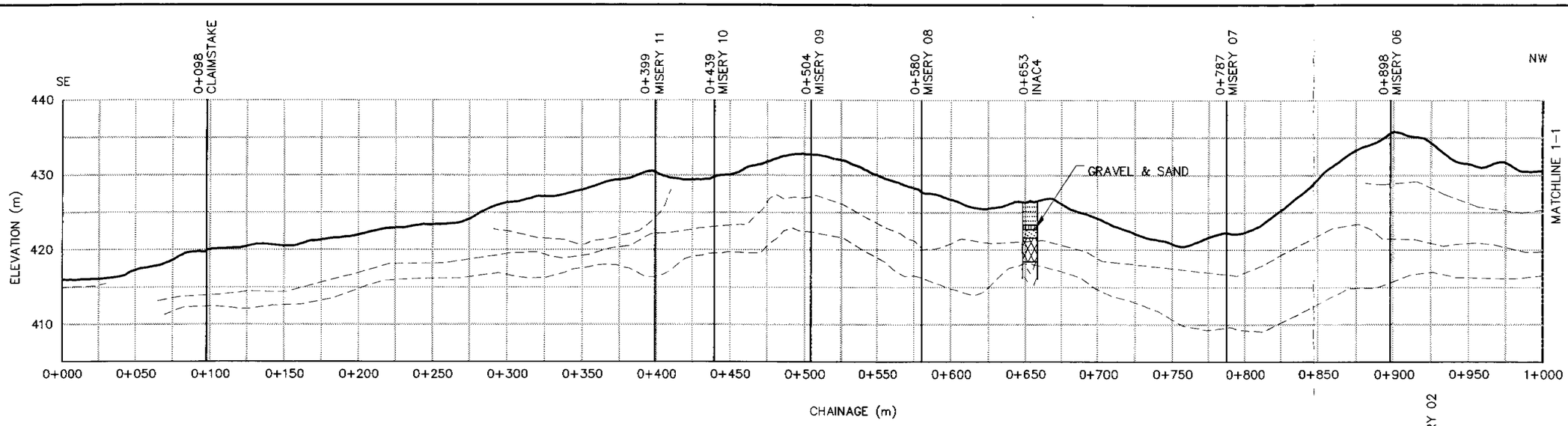
EBA Engineering Consultants Ltd.				PROJECT	GRANULAR RESOURCE INVESTIGATION LAC de GRAS, NWT
CLIENT	INDIAN AND NORTHERN AFFAIRS CANADA			TITLE	GENERAL LOCATION PLAN
DATE 96-11-10	DWN. LM	CHKD. NSP		FILE NO. 701-12174L15A	FIGURE 1

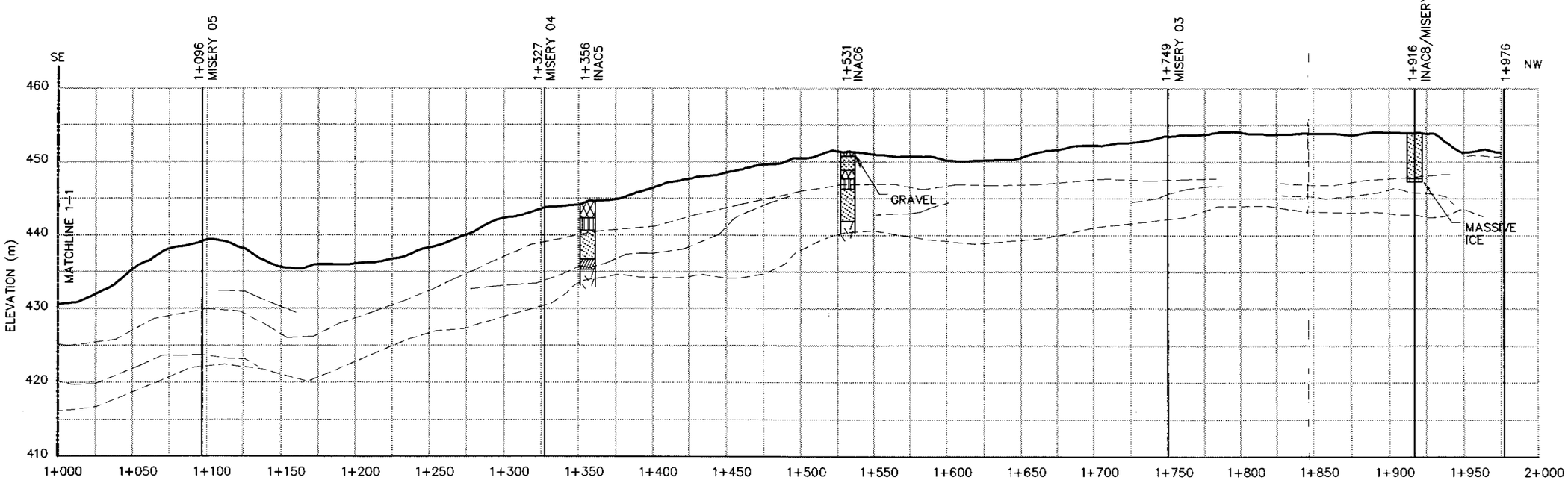


EBA Engineering Consultants Ltd.			PROJECT: GRANULAR RESOURCE INVESTIGATION LAC de GRAS, NWT
CLIENT: INDIAN AND NORTHERN AFFAIRS CANADA			TITLE: GPR SURVEY LINES MISERY ESKER
DATE: 96-11-15	DWN.: LM	CHKD.: NSP	FILE NO.: 701-12174L05B — FIGURE 2



EBA Engineering Consultants Ltd.				PROJECT	PROJECT GRANULAR RESOURCE LAC de GRAS, NWT
CLIENT	INDIAN AND NORTHERN AFFAIRS CANADA			TITLE	PROFILING SYSTEM CONFIGURATION
DATE 96-06-07	DWN. LM	CHKD. NSP		FILE NO. 701-12174L14A	FIGURE 3





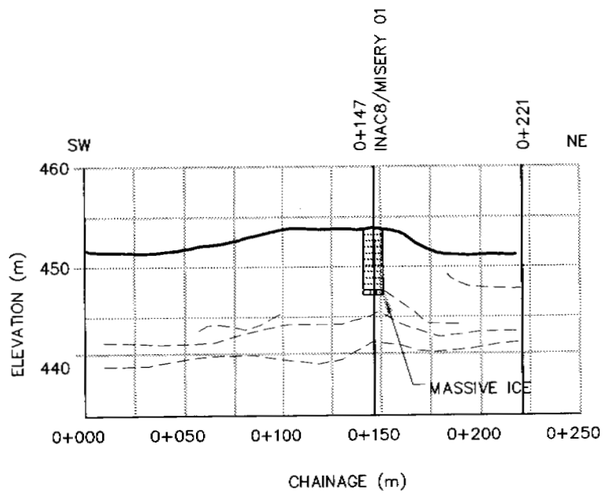
LEGEND

- ORGANIC
- SAND & SILT
- TILL
- GRAVEL AND SAND
- BEDROCK
- SAND
- SILT
- GRAVEL
- ICE
- SIGNIFICANT REFLECTORS

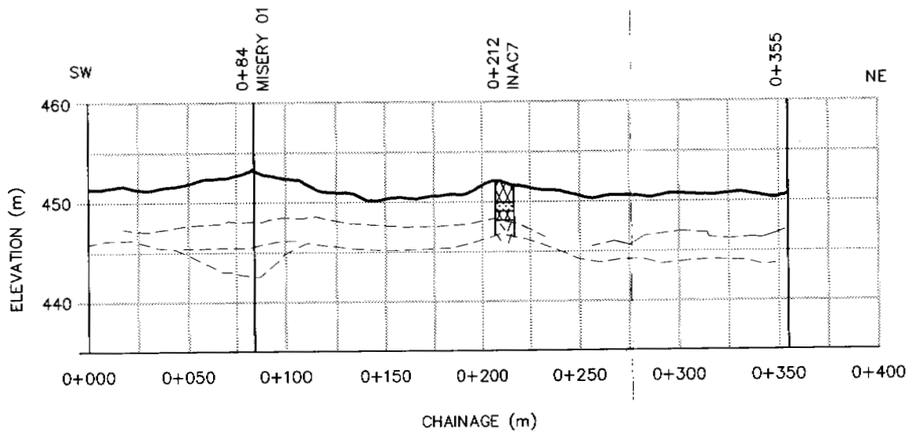
AVERAGE MATERIAL:- 0.1277m/ns
VELOCITY USED

PROFILE MISERY01

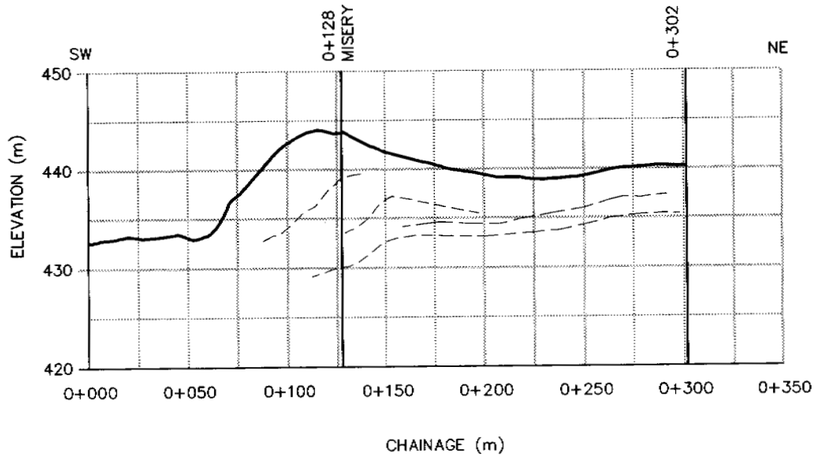
EBA Engineering Consultants Ltd.				PROJECT	GRANULAR RESOURCE INVESTIGATION LAC de GRAS, NWT
CLIENT	INDIAN AND NORTHERN AFFAIRS CANADA			TITLE	GPR PROFILE MISERY 01
DATE 96-06-07	DWN. LM	CHKD. NSP		FILE NO. 701-12174L10C	FIGURE 4



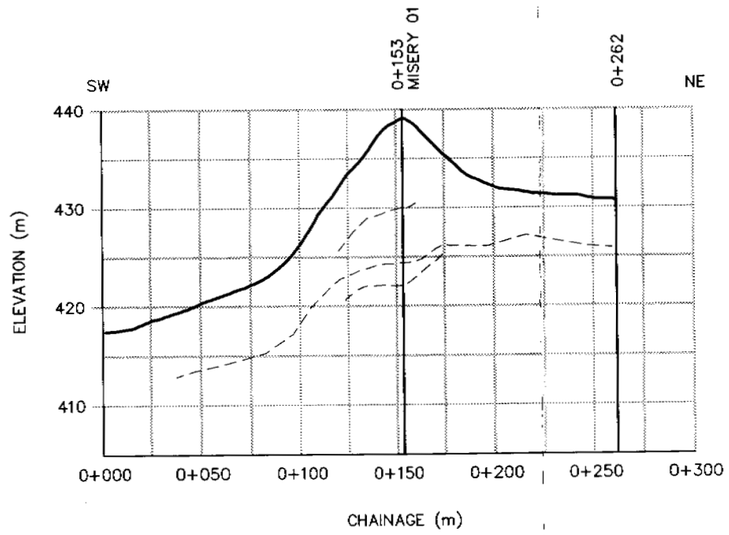
PROFILE MISERY02



PROFILE MISERY03



PROFILE MISERY04



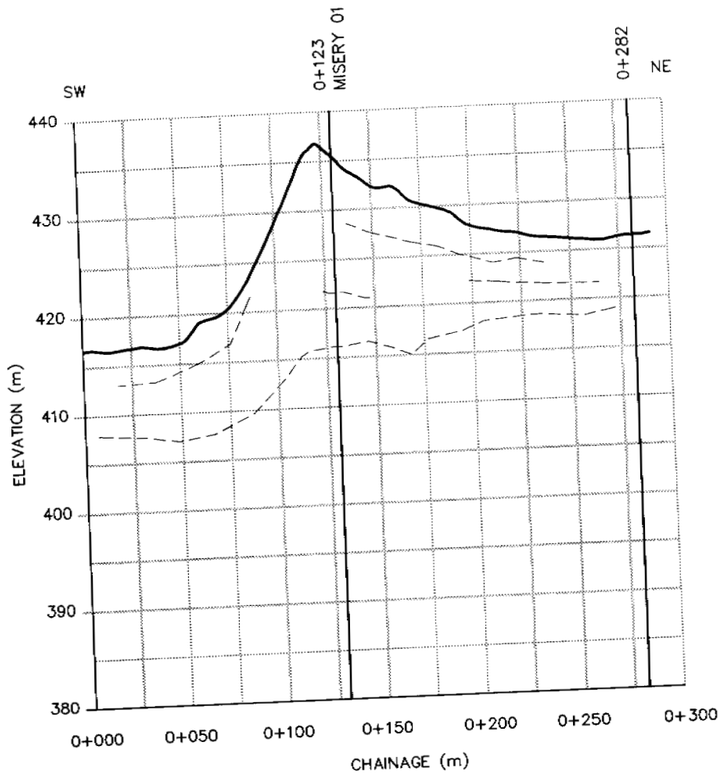
PROFILE MISERY05

LEGEND

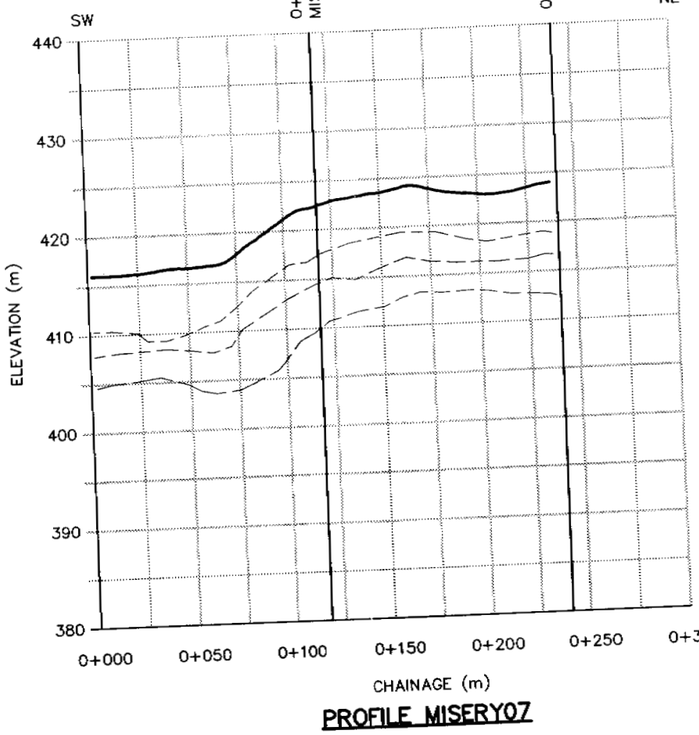
- ORGANIC
- SAND & SILT
- TILL
- GRAVEL AND SAND
- BEDROCK
- SAND
- SILT
- GRAVEL
- ICE
- SIGNIFICANT REFLECTORS

AVERAGE MATERIAL:- 0.1277m/ns
VELOCITY USED

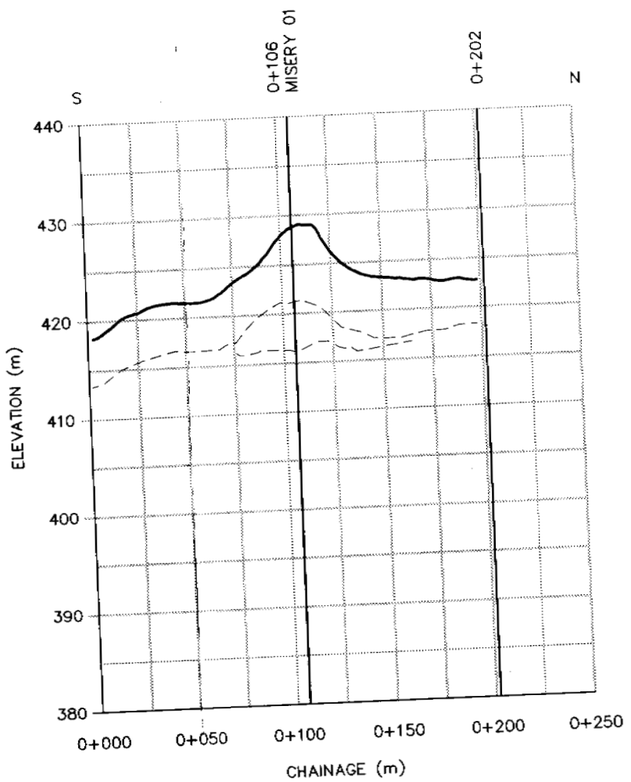
EBA Engineering Consultants Ltd.		PROJECT	GRANULAR RESOURCE INVESTIGATION LAC de GRAS, NWT
CLIENT	INDIAN AND NORTHERN AFFAIRS CANADA	TITLE	GPR PROFILES MISERY 02 TO MISERY 05
DATE 96-06-10	DWN. LM CHKD. NSP	FILE NO. 701-12174L11C	FIGURE 5



PROFILE MISERY06



PROFILE MISERY07



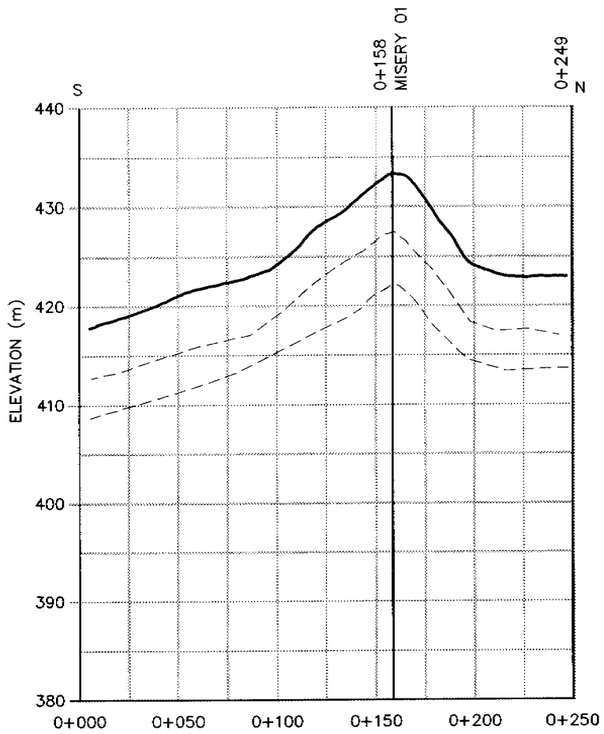
PROFILE MISERY08

LEGEND

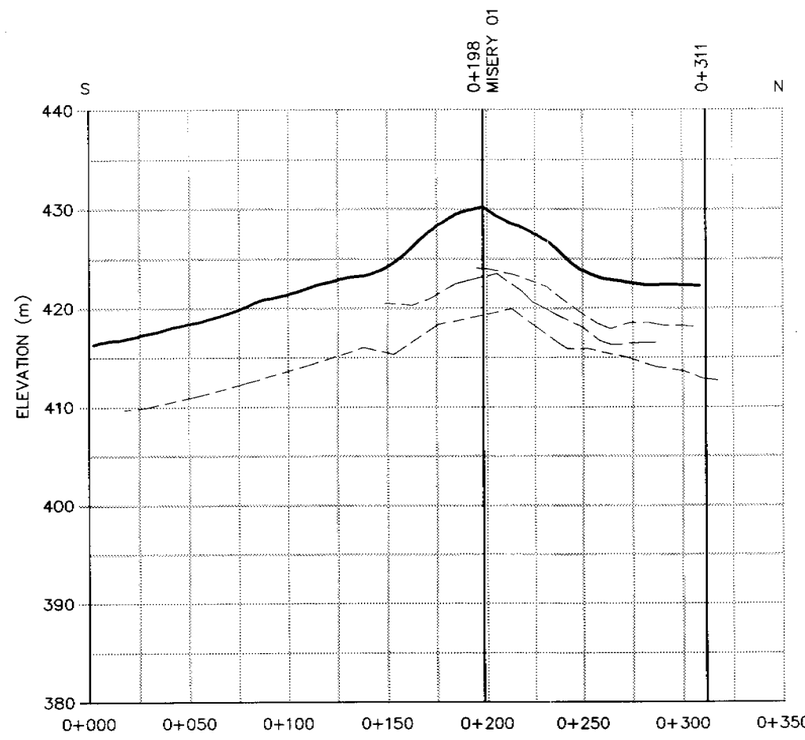
SIGNIFICANT REFLECTORS

AVERAGE MATERIAL: – 0.1277m/ns
VELOCITY USED

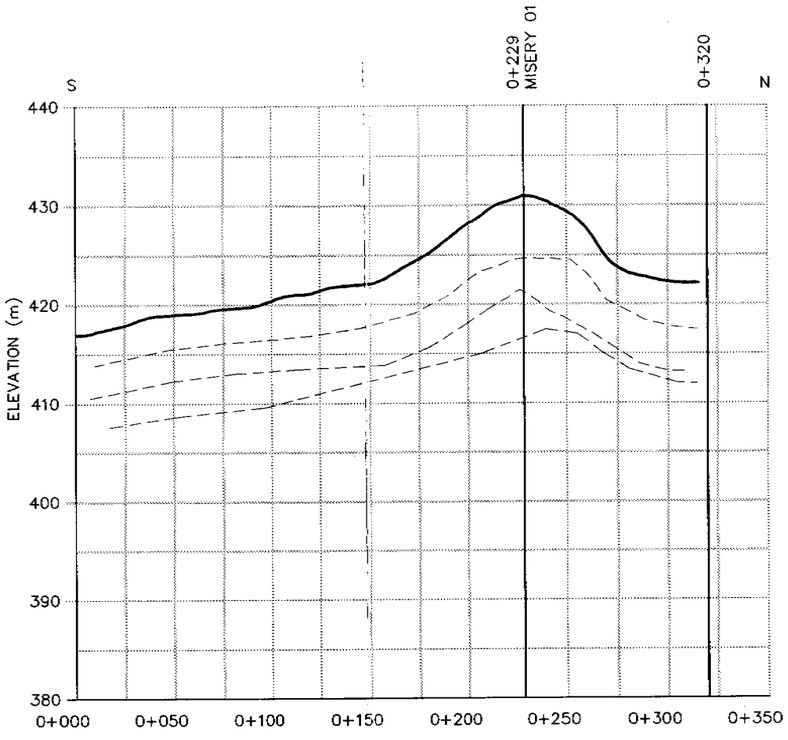
EBA Engineering Consultants Ltd.		PROJECT	GRANULAR RESOURCE INVESTIGATION LAC de GRAS, NWT
CLIENT	INDIAN AND NORTHERN AFFAIRS CANADA	TITLE	GPR PROFILES MISERY 06 TO MISERY 08
DATE 96-06-10	DRN LM CHKD NSP		701-12174L12C FIGURE 6



PROFILE MISERY09



PROFILE MISERY10



PROFILE MISERY11

LEGEND

SIGNIFICANT REFLECTORS

AVERAGE MATERIAL:- 0.1277m/ns
VELOCITY USED

EBA Engineering Consultants Ltd.		PROJECT	GRANULAR RESOURCE INVESTIGATION LAC de GRAS, NWT
CLIENT	INDIAN AND NORTHERN AFFAIRS CANADA	TITLE	GPR PROFILES MISERY 09 TO MISERY 11
DATE 96-06-10	LM / NSP	701-12174L13C	FIGURE 7

APPENDIX D

DATA DISKS