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**Logistics Report** 

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for a

Helicopter Magnetic and Gamma-Ray Spectrometer Survey

of the

# Monster Property, Yukon Territory

carried out on behalf of

Equity Engineering Limited and Blackstone Resources Incorporated

by

High-Sense Geophysics Limited 960610 - 1



Toronto, Canada September, 1996

96-057

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#### 1. INTRODUCTION

In June of 1996, High-Sense Geophysics Ltd. was contracted by Equity Engineering Limited to provide a helicopter borne magnetic and radiometric survey for Blackstone Resources Incorporated over the Monster property situated in northern Yukon Territory, Canada. Flight operations commenced on July 12, 1996 and were completed by July 18, 1996 after a total of seventeen (17) sorties. Approximately 1659 line kilometers of total field magnetic and radiometric data, flown along north-south traverse lines, were collected, processed and plotted.

The technical objective of the survey was to provide high resolution magnetic and radiometric maps, suited for anomaly definition, detailed structural evaluation and identification of lithologic trends. All magnetic, radiometric, positioning, and altimeter data were recorded in a digital format. Fully corrected magnetic and radiometric maps were prepared by High-Sense's Toronto office after completion of survey activities.

The remainder of this report discusses survey location, logistics, equipment, personnel and parameters, plus flight operations and data processing/presentation, in more detail under the appropriate headings.

#### 2. LOCATION

The survey area, identified as the Monster Property, was situated in Yukon Territory, approximately 80 kilometres due north of Dawson City. Terrain was predominantly mountainous and rugged. The area was flown in three separate stages : an initial reconnaissance survey grid (1000m line spacing), an inset detail survey grid (250m line spacing) and an additional coarse spaced grid (1000m line spacing) attached to the south central border of the original reconnaissance grid. Additional details are provided below, using UTM coordinates for a central meridian of 141°W - Zone 7 (see also accompanying map):

**Reconnaissance Grid** (REG) - approx. 80km north of Dawson City, Yukon Ter.

Corner No.	Easting (m)	Northing (m)
1	545000	7182000
2	545000	7194000
3	594000	7206000
4	594000	7182000
5	583000	7175000
6	572000	7175000
7	572000	7182000

# Detail Grid (DET) -

Corner No.	Easting (m)	Northing (m)
1	547000	7183500
2	547000	7189000
3	554000	7194000
4	560000	7194000
5	566000	7193000
6	566000	7189000
7	555000	7183500

# Extension Grid (XTRA) -

Corner No.	Easting (m)	Northing (m)
1	558000	7172000
2	558000	7182000
3	572000	7182000
4	572000	7175000
5	575000	7175000
6	575000	7172000





## 3. AIRCRAFT AND EQUIPMENT

#### 3.1 Aircraft

The aircraft used was a Bell 206B Jet Ranger helicopter (C-GTNY), owned and operated by Trans North Helicopters, Whitehorse, Yukon Territory. Installed equipment is detailed below.

#### 3.2 Airborne Geophysical System

#### 3.2.1 Magnetometer

A Scintrex H8 Optically Pumped Cesium Split Beam Sensor was mounted in a towed 'bird'. The Larmor frequency output was processed by a High-Sense magnetometer counter board that provides a resolution, without filtering, of 10 ppb ten times per second (in a magnetic field of 50,000 nT this resolution is equivalent to 0.005 nT).

#### 3.2.2 Radiometric Equipment

An High-Sense Geophysics Limited KS-16 digital differential gamma spectrometer coupled to a 1024 in<sup>3</sup> NaI (Tl) crystal detector package was carried in the rear cargo area of the helicopter. Detector crystals were housed in a special heat stabilized container. The four primary channels of total count, potassium (K) uranium (U) and thorium (Th) were recorded once per second, together with the corresponding 256 channel radiometric spectrum.

#### 3.2.3 GPS Navigation

A Novatel 751 ten channel GPS receiver, which is an integral component of the HS-GFCS-II flight control system, provided precise positioning information. The GPS antenna was mounted on the top tail-fin of the towed bird, ensuring accurate reported positioning of the magnetic sensor at all times.

#### 3.2.4 Altimeter

A Terra Model TRA 3500 radar altimeter was used. The 'low-profile' transmitting and receiving antennae were mounted on the underside of the towed bird's lateral tail fins. This instrument operates over a range of 0 to 765m (2500') with a precision of 0.3m (1').

#### 3.2.5 Geophysical Flight Control System

The High-Sense GFCS-II geophysical flight control system monitored and recorded magnetometer, spectrometer, altimeter and GPS equipment. Input from the various sensors were monitored and time stamped every 0.005 seconds for precise coordination of geophysical and position measurements.

GPS position coordinates and terrain clearance were presented to the pilot by means of LCD touch screen display. The magnetometer response, 4th difference, spectrometer response (4 channel profiles, 256 channel spectrum) and altimeter profile were also shown on the LCD touch screen display for real time monitoring of equipment performance.

#### 3.2.6 Digital Recording

The output of the magnetometer, spectrometer and altimeter as well as uncorrected GPS coordinates were recorded digitally on disk at a sample rate of ten times per second by the HS-GFCS-II system. Line number, GPS time and system time were also recorded for use during subsequent differential GPS correction.

#### 3.3 Ground Monitoring System

#### 3.3.1 Magnetometer

A GEM Systems Overhauser magnetometer (GSM19W) was operated as a base station to record diurnal variations of the earth's magnetic field. Readings with a resolution of 0.1 nT were recorded digitally every second, and synchronized with GPS time ('time stamped') for accurate correction of the airborne data.

#### 3.3.2 GPS Monitor

A Novatel 751 ten channel receiver with a fixed antenna was also active at the base of operations. Raw satellite data was digitally recorded to enable differential correction of the corresponding airborne data.

#### 3.3.3 Recording

The output of the magnetic and GPS monitors was recorded digitally on a dedicated 486 'LunchBox' computer. A visual record of the last forty minutes of activity is graphically maintained on the computer screen to provide an up to date appraisal of significant activity. At the conclusion of each production flight raw GPS and magnetic data were transferred to the main compilation computer.

#### 3.4 Field Compilation System

A 586 ('Pentium') PC computer and a Hewlett Packard colour printer/plotter were used for field data processing and presentation. Processing software and procedures were developed by High-Sense Geophysics Limited, and include the Geopak RTICAD imaging system. Profile plots, contours and colour/shadow images were generated on-site as required.

All digital data was verified at the project site to confirm that data recording took place within survey specifications. All digital data was duplicated on-site to help prevent loss.

#### 4. PERSONNEL

#### 4.1 Field Operations

Equity Engineering representative	: David Caulfied
High-Sense geophysicist	: Allen Duffy
Pilot, Trans North Heli.	: Andrew Page

#### 4.2 Project Management

Equity Engineering Ltd. : Dave Caulfied, Henry Awmack

High-Sense, Toronto office : Zybnek Dvorak

#### 5. SURVEY PARAMETERS

Traverse Line spacing	: 250 and 1000 meters (see Appendix A)
Control Line spacing	: not flown (see Appendix A)
Nominal Terrain clearance : bird	: 50 metres (150 feet)
Nominal Terrain clearance : heli.	: 70 metres (210 feet)
Navigation	: Global Positioning System
Traverse Line direction	: north-south
Measurement interval	: 0.1 second magnetics
	1.0 second radiometrics
Airspeed (nominal)	: 80 km/hr
Measurement spacing (nominal)	: 2.5 meters
Airborne Digital Record	: Radar Altimeter
	Total Field Magnetics
	Gamma Ray Spectrometry
	Time (Local and GPS)
	Raw Global Positioning System (GPS) data
Base Station Record	: Ambient Total Field Magnetics
	Raw Global Positioning System (GPS) data
	Time (Local and GPS)

#### 6. OPERATIONS AND PROCEDURES

### 6.1 Flight Planning

Outline of the survey blocks was specified by Equity Engineering Limited (section 2.0), and the coordinates used to generate pre-calculated navigation files. These, in turn, were used by the airborne data acquisition system to plan flights at the designated line spacing and orientation.

Total combined flying for all blocks was 1659 km. Areal coverage and data collection are both considered to be of good quality and within standard survey specifications. Line kilometers for individual blocks are summarized in Appendix A.

### 6.2 Base Station

A geophysical base station was established at the Trans North field hangar located at Dawson City. GPS and magnetic diurnal records were recorded covering all airborne production data, and time synchronised with the remote data based on GPS time.

The base station GPS antenna should be located at an accurately surveyed position point, since position errors are carried through to the differentially corrected data. Because no control point was available, the location of the

GPS antenna was determined by recording several hours of GPS data and averaging the resulting antenna coordinates (the assumption being that deliberate errors introduced by military 'selective availability' satellite signal distortion will average to zero over an extended period of time). The position fixes determined for the base station site were:

Dawson City (set up : July 12, 1996)

64 <sup>0</sup>	03'	01.5354" N	319.54 m asl
1390	25'	53.7655" W	(WGS 84 spheroid)

#### 6.3 Data Compilation

Data recorded by the airborne and base station systems was transferred to the field compilation system. As each flight was completed, the following compilation operations were carried out.

#### 6.3.1 Flight Path Correction

GPS data was differentially corrected to remove errors introduced by 'selective availability', an intentional accuracy degradation method used by the military. The correction process uses the known fixed location of the base station to calculate the error associated with each satellite. These errors are then removed from the survey GPS data enabling a position to be calculated with an accuracy in the order of three meters, with four or more satellites in view. Satellite visibility and coverage was generally good throughout field operations, however the mountainous terrain typical in the survey area occasionally interfered with reception. Both GPS receivers were generally tracking a minimum of six satellites. The navigational correction process yields a flight path expressed in WGS 84 Latitude-Longitude coordinates. Transformation to local Clarke 1866 (NAD 27) UTM coordinates used the following projection parameters :

	Semi-major axis (a)	Semi-minor axis(b)	
WGS 84	6378216.4	6356752.3142	
Clarke 1866	6378206.4	6356583.8000	

Local datum shift applied :

Delta X	:	7
Delta Y	:	-139
Delta Z	:	-181

UTM central meridian =  $141^{\circ}$  W (Zone 7)

False Easting	:	500,000
False Northing	:	0

#### 6.3.2 Magnetic Corrections

Diurnal variations recorded by the base station were subtracted directly from the aeromagnetic measurements to provide a first order diurnal correction. When the magnetic variations are noted to occur due to manmade causes, such as equipment passing by the sensor, they are edited out prior to applying the diurnal correction

Optically pumped magnetic sensors have an inherent heading error, typically several nanoTeslas peak-to-peak, as the sensor is rotated through 360 degrees. On reciprocal flight line directions the heading error is reasonably predictable; corresponding correction was made on the basis of aircraft heading.

#### 6.3.3 Radiometric Corrections

Radiometric data, recorded in the raw state as a 256 channel spectrum, are separated into five energy windows representing contributions from total count, potassium, uranium, thorium and cosmic sources (see Appendix B for details). To determine fully corrected radiometric results, the data is subjected to additional reduction steps.

Airborne background components, caused by airborne radon daughter products, aircraft airframe, etc., were removed using data from 2500 foot background measurement lines. *Compton Stripping* corrections remove cross-channel effects due to the radiometric phenomena of Compton Scatter. *Altitude attenuation* corrections are required to compensate for variations in terrain clearances. Finally, a *sample interaction (or Savitsky-Golay') filter* is applied to reduce sample overlap. Final corrected data was presented in corrected counts-per-second.

#### 6.3.4 Map Products and Digital Data

Following processing of all survey data in the Toronto office, two(2) copies of the final map products (see below), plus digital data (CD-ROM), extraction software and this logistics report were delivered to Equity Engineering Limited, Vancouver, Canada.

- 1. Colour image of total field magnetics with contours, flight path and Lat-Long/UTM reference grid,
- 2. Colour image of total count radiometrics with contours, flight path and Lat-Long/UTM reference grid,
- 3. Colour image of potassium with contours, flight path and Lat-Long/UTM reference grid,
- 4. Colour image of uranium with contours, flight path and Lat-Long/UTM reference grid,
- 5. Colour image of thorium with contours, flight path and Lat-Long/UTM reference grid, and,
- 6. Colour ternary image combining potassium, uranium and thorium (scaled by Total Count) with flight path and Lat-Long/UTM reference grid.

Respectfully submitted,

Allen Duffy, BSc. High-Sense Geophysics Limited September 9, 1996 APPENDIX A: MONSTER PROPERTY SURVEY BLOCK SUMMARY

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APPENDIX B: Radiometric Data Reduction

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## ADDENDUM B/1: Altitude Attenuation Coefficients

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APPENDIX C: Digital Data Archives



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		Nominal Terrain Clearance (Helicopter) 1 210 ft (70 m)
	64° 7182 000 45 N	Nominal Terrain Clearance (Bird) : 150 ft (50 m) Line Spacings : 1000 m, 250 m
	7181.000	EQUIPMENT
		Aircraft Type : Bell 206 "Jet Ranger" Configuration : Towed Bird Digital Acquisition System : High Sense HS=GECS=II
	7 180 000	GPS Navigation : Novatel 751 10 channel Radar Altimeter : Terra 3500 Magnetometer : Sciptrov H8 Cosium
3		Spectrometer : High Sense KS-16 Crystal Package : 1024 cu. in Nal (TI) downward
1	7 179 000	COMPILATION
	7178.000	FLIGHT PATH: GPS data recorded during the flight has been differentially
		corrected and transformed to correspond to the NAD 27 (Clarke 1866) UTM coordinate system.
	7 177 000	MAGNETICS:
		The magnetic data has been corrected for diurnal variation and heading error.
	7176 000	Grid interval : 50 metres
	7175 cm	Contour intervals : 5, 25, 100 nT
	11/3 000	BLACKSTONE RESOURCES INC
	7 174 000	MONSTER PROJECT
		TOTAL FIELD MACHETICS
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	7181 000       EQUIPMENT         Aircraft Type :       Bell 206 "Jet Ranger"         Configuration :       Towed Bird         Digital Acquisition System :       High Sense HS-GFCS-II         Novatel 751 10 channel       Radar Altimeter :         Radar Altimeter :       Terra 3500         Magnetometer :       Scintrex H8 Cesium         Spectrometer :       High Sense KS-16         Crystal Package :       1024 cu. in Nal (TI) downward         7179 000       COMPILATION         RADIOMETRICS :       Integral windows were extracted from the 256 channel radiometric spectrum using the following energy thresholds :         Total Count       410 - 2810 keV
	<ul> <li>7177 co</li> <li>Potassium 1370 - 1570 keV Uranium 1660 - 1860 keV Thorium 2410 - 2810 keV</li> <li>Data was subsequently corrected for ambient background radiation, "Compton" effect and altitude attenuation. Radiometric data is presented in corrected counts per second.</li> <li>The grid interval is : 50 metres Contour intervals : 50, 250, 1000 cps</li> <li>7175 co</li> <li>BLACKSTONE RESOURCES INC.</li> <li>7174 co</li> <li>MONSTER PROJECT</li> <li>TOTAL COUNT</li> </ul>
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	7177 000       Total Count       410       - 2810 keV         7177 000       Total Count       410       - 2810 keV         7177 000       Wannium       1370       - 1570 keV         7175 000       Date was subsequently corrected for ambient background radiation. "Compton" effect and altitude attenuation. Radiometric data is presented in corrected counts per second         7175 000       The grid interval is :       50 metres         7175 000       BLACKSTONE RESOURCES INC.         7175 000       MONSTER PROJECT         7173 000       MAP SCALE       1 : 50 000         7172 000       MAP SCALE       1 :

545 000         546 000         547 000         548 000         550 000         551 000         552 000           140°00'W         139°56'W         139°56'W         139°56'W         139°56'W           7206 000         7206 000         100         100         100         100	553 oo         554 oo         555 oo         556 oo         559 oo         560 oo         561 oo         563 oo         564 oo         565 oo           139"50 W         139"50 W         139"40 W         139"40 W         139"40 W         139"40 W	565 000 567 000 368 000 569 000 570 000 571 000 572 000 573 000 574 000 575 000 575 000 576 000 577 000 57 139°35°¥ 139°36°¥ 139°25°¥ 139°25°¥	000 579 000 580 000 581 000 582 000 583 000 584 000 585 000 586 000 587 000 588 000 589 000 139°20°34 139°15°3
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	900 toi 1	SURVEY SPECIFICATIONS Nominal Terrain Clearance (Helicopter) : 210 # (20
	4° 7182-000 5'N	Nominal Terrain Clearance (Bird) : 210 ft (70 m) Line Spacings : 150 ft (50 m)
	7181 000	EQUIPMENT Aircraft Type : Bell 206 "Jet Ranger" Configuration : Towed Rind
A	7180 000	Digital Acquisition System : High Sense HS-GFCS-II GPS Navigation : Novatel 751 10 channel Radar Altimeter : Terra 3500 Magnetometer : Scintrex H8 Cesium
	7179 000	Spectrometer : High Sense KS-16 Crystal Package : 1024 cu. in Nal (TI) downward
	7178 000	COMPILATION RADIOMETRICS ':
	7.77	radiometric spectrum using the following energy thresholds : Total Count 410 - 2810 keV
	/ 1// 000	Potassium 1370 - 1570 keV Uranium 1660 - 1860 keV Thorium 2410 - 2810 keV Data was subsequently corrected for ambient backgroup
	7176 cao	radiation, "Compton" effect and altitude attenuation. Radiometric data is presented in corrected counts per second.
	7175 000	Contour intervals : 50 metres 5, 25, 100 cps
	7174 000	MONSTER PROJECT
	7173 000	URANIUM
	7172.000	MAP SCALE1:50:000PROJECT REF #906:10-1MAP SHEETDATE FLOWNJULY, 1996MAP PROJECTIONNAD 27DATE SOMPHIES
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		Nominal Terrain Clearance (Helicopter) : 210 ft (70 m)         Nominal Terrain Clearance (Bird) : 150 ft (50 m)         Line Spacings : 1000 m, 250 m         7181 co         Rater of Type : EQUIPMENT         Aircraft Type : Bell 206 "Jet Ranger"         Configuration : Towed Bird         Digital Acquisition System : High Sense HS-GFCS-II         GPS Navigation : Novatel 751 10 channel         Radar Altimeter : Terra 3500         Magnetometer : High Sense KS- 16         Crystal Package : 1024 cu. in Nal (TI) downward         A179 co         RADIOMETRICS :
		Integral windows were extracted from the 256 channel radiometric spectrum using the following energy thresholds : Total Count 410 - 2810 keV Potassium 1370 - 570 keV Uranium 1660 - 1860 keV Thorium 2410 - 2810 keV Data was subsequently corrected for ambient background radiation, "Compton" effect and altitude attenuation. Radiometric data is presented in corrected counts per second. The grid interval is : 50 metres Contour intervals : 5, 25, 100 cps BLACKSTONE RESOURCES INC. MONSTER PROJECT
7173 000 7172 000 64 <sup>2</sup> N 	130°45° 139°40	7173 000       MAP SCALE       1:50 000       PROJECT REF # 90610-1         MAP SHEET       DATE FLOWN       JULY, 1996         MAP PROJECTION       NAD 27       DATE COMPILED       AUG, 1996         SURVEY FLOWN AND GEOPHYSICS LIMITED COMPILED BY