Appendix 8

Logistics Report

for a

DETAILED AIRBORNE MAGNETIC, RADIOMETRIC AND DIGITAL TERRAIN SURVEY

for the

NABARLAK AND KUKALAK CHINA PROJECTS

carried out on behalf of

Cameco Australia Pty Ltd

by

UTS GEOPHYSICS

(UTS Job #A709)

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1 GENERAL SURVEY INFORMATION

In August 2005, UTS Geophysics conducted a low level airborne geophysical survey for the following company:

Cameco Australia Pty Ltd
66 Winnellie Rd
WINNELLIE, NT 0820

Acquisition for this survey commenced on the 9th August 2005 and was completed on the 15th August 2005.

2 SURVEY LOCATION

The areas surveyed were locatd near Jabiru in the Northern Territory.. Survey boundary coordinates are provided in Appendix C of this report.

The survey was flown using the AMG84 coordinate system (a Universal Transverse Mercator projection) derived from the Australian Geodetic Datum and was contained within zone 53 with a central meridian of 135 degrees. Details of the datum and projection system are provided in Appendix B of this report.

3 AIRCRAFT AND SURVEY EQUIPMENT

The UTS navigation flight control computer, data acquisition system and geophysical sensors were installed into a specialised geophysical survey aircraft.

The list of geophysical and navigation equipment used for the survey is as follows:

General Survey Equipment

- FU24 – 954 fixed wing survey aircraft.
- UTS proprietory flight planning and survey navigation system.
- UTS proprietory high speed digital data acquisition system.
- Novatel 3951R, 12 channel precision navigation GPS.
- RACAL MK IV real time differential GPS system.
- UTS LCD pilot navigation display and external track guidance display.
- UTS post mission data verification and processing system.
- Bendix King KRA-405 radar altimeter.

Magnetic Data Acquisition Equipment

- UTS tail stinger magnetometer installation.
- Scintrex Cesium Vapour CS-2 total field magnetometer.
- Fluxgate three component vector magnetometer.
- RMS Aeromagnetic Automatic Digital Compensator (AADC II).
- Diurnal monitoring magnetometer (Scintrex Envimag).

Radiometric Data Acquisition Equipment

- Exploranium GR-820 gamma ray spectrometer.
- Exploranium gamma ray detectors.
- Barometric altimeter (height and pressure measurements).
- Temperature and humidity sensor.

3.1 Survey Aircraft

The aircraft used for this survey was a FU24 – 950 series fixed wing survey aircraft, owned and operated by UTS Geophysics, registration VH-UTR. The specifications are as follows:

Power Plant

- Engine Type — Single engine, Lycoming, IO-720
- Brake Horse Power — 400 bhp
- Fuel Type — AV-GAS

Performance

- Cruise speed — 105 Kn
- Survey speed — 100 Kn
- Stall speed — 45 Kn
- Range — 970 Km
- Endurance (no reserves) — 5.6 hours
- Fuel tank capacity — 490 litres

3.2 Data Positioning and Flight Navigation

Survey data positioning and flight line navigation was derived using real-time differential GPS (Global Positioning System).

Navigation was provided through a UTS designed and built electronic pilot navigation system providing computer controlled digital navigation instrumentation mounted in the cockpit as well as an externally mounted track guidance system.

GPS derived positions were used to provide both aircraft navigation and survey data location information.

The GPS systems used for the survey were:

- Aircraft GPS Model — Novatel 3951R
- Sample rate — 0.5 Seconds (2 Hz)
- GPS satellite tracking channels — 12 parallel
- Typical differentially corrected accuracy — 1-2 metres (horizontal)
3-5 metres (vertical)

3.3 UTS Data Acquisition System and Digital Recording

All geophysical sensor data and positional information measured during the survey was recorded using a UTS developed, high speed, precision data acquisition system. Survey data was downloaded onto magnetic tape on completion of each survey flight.

Instrument synchronisation times were measured and removed in real-time by the UTS data acquisition system.

3.4 Altitude Readings

Accurate survey heights above the terrain were measured using a King radar altimeter installed in the aircraft. The height of each survey data point was measured by the radar altimeter and stored by the UTS data acquisition system.

- Radar altimeter models — King KRA- 405 twin antenna altimeter
- Accuracy — 0.3 metres
- Resolution — 0.1 metres
- Range — 0 - 500 metres
- Sample rate — 0.1 Seconds (10Hz)

The digital terrain model is calculated by subtracting the terrain clearance (radar altimeter) from the GPS height (interpolated to 0.1 Hz), and as such the accuracy is constrained by the differentially corrected GPS position.

3.5 UTS Stinger Mounted Magnetometer System

The installation platform used for the acquisition of magnetic data was a tail mounted stinger. This proprietory stinger system was constructed of carbon fibre and designed for maximum rigidity and stability.

Both the total field magnetometer and three component vector magnetometer were located within the tail stinger.

3.6 Total Field Magnetometer

Total field magnetic data readings for the survey were made using a Scintrex Cesium Vapour CS-2 Magnetometer. This precision sensor has the following specifications:

- Model — Scintrex Cesium Vapour CS-2 Magnetometer
- Sample Rate — 0.1 seconds (10Hz)
- Resolution — 0.001nT
- Operating Range — 15,000nT to 100,000nT
- Temperature Range — -20^{o}C to +50^{o}C

3.7 Three Component Vector Magnetometer

Three component vector magnetic data readings for the survey were made using a Develco Fluxgate Magnetometer. This precision sensor has the following specifications:

- Model — Develco Fluxgate Magnetometer
- Sample Rate — 0.1 seconds (10Hz)
- Resolution — 0.1nT
- Operating Range — -100,000nT to 100,000nT
- Temperature Range — -20^{o}C to +50^{o}C

3.8 Aircraft Magnetic Compensation

At the start of the survey, the system was calibrated for reduction of magnetic heading error. The heading and manoeuvre effects of the aircraft on the magnetic data was removed using an RMS Automatic Airborne Digital Compensator (AADC II).

Calibration of the aircraft heading effects were measured by flying a series of pitch, roll and yaw manoeuvres at high altitude while monitoring changes in the three axis magnetometer and the effect on total field readings. A 26 term model of the aircraft magnetic noise covering permanent, induced and eddy current fields was determined. These coefficients were then applied to the data collected during the survey in real-time. The coefficients are listed in Appendix F

UTS static compensation techniques were also employed to reduce the initial magnetic effects of the aircraft upon the survey data.

3.9 Diurnal Monitoring Magnetometer

Two base station magnetometers were located in a low gradient area beyond the region of influence of any man made interference to monitor diurnal variations during the survey.

The specifications for the magnetometers used are as follows:

- Model — Scintrex Envimag
- Resolution — 0.1 nT
- #1 Sample interval — 5 seconds (0.5 Hz)
- #2 Sample interval — 5 seconds (0.2 Hz)
- Operating range — 20,000nT to 90,000nT
- Temperature — -20^{o}C to +50^{o}C

3.10 Barometric Altitude

An Air DB barometric altimeter was installed in the aircraft so as to record and monitor barometric height and pressure. The data was recorded at 0.10 second intervals and is used for the reduction of the radiometric data.

- Model — Air DB barometric altimeter
- Accuracy — 2 metres
- Height resolution — 0.1 metres
- Height range — 0 - 3500 metres
- Maximum operating pressure: — 1,300 mb
- Pressure resolution: — 0.01 mb
- Sample rate — 10 Hz

3.11 Temperature and Humidity

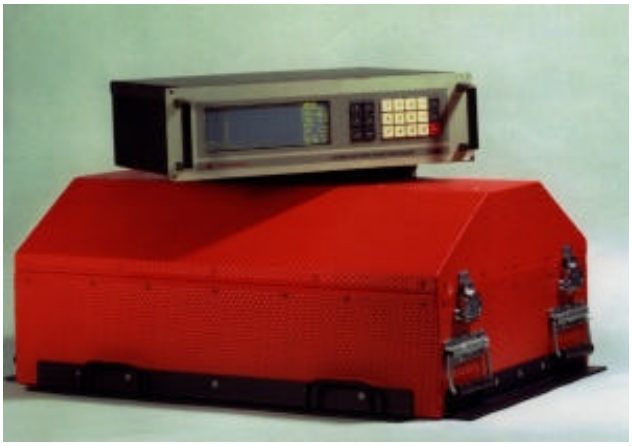
Temperature and humidity measurements were made during the survey at a sample rate of 10Hz. Ambient temperature was measured with a resolution of 0.1 degree Celsius and ambient humidity to a resolution of 0.1 percent.

3.12 Radiometric Data Acquisition

The gamma ray spectrometer used for the survey was capable of recording 256 channels and was self stabilising in order to minimise spectral drift. The detectors used contain thallium activated sodium iodide crystals.

Thorium source measurements were made each survey day to monitor system resolution and sensitivity. A calibration line was also flown at the start and end of each survey day to monitor ground moisture levels and system performance. The source measurement results are presented in Appendix E.

- Spectrometer model Exploranium GR820
- Detector volume 32 litres
- Sample rate 1 Hz



4 PERSONNEL

4.1 Field Operations

UTS Geophysics operators and data processors	M. Truu
UTS Geophysics Survey Pilots	N. West S. Bindley

4.2 Project Management

Cameco Australia Pty Ltd	G. Beckitt
UTS Geophysics Perth Office	D. Abbott

5 SURVEY PARAMETERS

The survey data acquisition specifications for each area flown are specified in the following table:

PROJECT NAME	LINE SPACING	LINE DIRECTION	TIE LINE SPACING	TIE LINE DIRECTION	SENSOR HEIGHT	TOTAL LINE KM
Nabarlak	50m	090-270	500m	000-180	30m	405
Kukalak China	50m	090-270	500m	000-180	30m	976
TOTAL						**1,381**

The total number of line kilometres of survey data collected over the survey areas specified in the above table was 1,381.

The specified sensor height for the magnetic samples is as stated in the above table. This sensor height may be varied where topographic relief or laws pertaining to built up areas do not allow this altitude to be maintained, or where the safety of the aircraft and equipment is endangered.

The coordinate boundaries for the survey areas flown are detailed in Appendix C.

6 SURVEY LOGISTICS

The base location used for operating the aircraft and performing in-field quality control and data processing of the survey data was Jabiru in the Northern Territory. The aircraft was operated from the Jabiru airstrip.

6.1 Diurnal Magnetometer Locations

The following table contains the approximate locations where the diurnal base station magnetometers were located for the survey duration.

Area Name	Period	Base Station ID	Location
Nabarlak and Kukalak	09/08/05 – 15/08/05	51,52	Jabiru airstrip

7 DATA PROCESSING PROCEDURES

7.1 Data Pre-processing

The raw survey data was loaded from the field tapes and the recorded data trimmed to the correct survey boundary extents. Any survey lines subsequently reflown were removed from the dataset.

At the commencement of each acquisition flight, all the instrumentation clocks were synchronized to local time, and the error and latency of each instrument in providing its data measurement calculated. The results of these latency measurements were recorded into a synchronisation file, and the results used to assign GPS positions to the magnetic, radiometric and elevation data. As a result of the physical separation of the sensors, a small residual offset still exists between instrument timings.

To compensate for this residual parallax error, an adjustment was made to the instrument clocks. The magnetic and radar altimeter data was adjusted by 0.600 seconds, and the radiometric data was adjusted by 1.375 seconds for each flight.

The synchronized, parallax corrected data was then exported as located ASCII data.

7.2 Magnetic Data Processing

The filtered diurnal measurements were subtracted from the diurnal base field and the residual corrections applied to the survey data by synchronising the diurnal data time and the aircraft survey time. The average diurnal base station value was added to the survey data.

An eighth difference filter was run on the raw magnetic survey data in order to identify any remaining spikes in the data, which were manually edited from the data.

The X and Y positioning of the data was then checked for spikes before applying the IGRF correction. Any spikes in the positions were manually edited. The updated IGRF 2000 correction was calculated at each data point (taking into account the height above sea level).

This regional magnetic gradient was subtracted from the survey data points.

Tie line levelling was applied to the data by least squares minimisation, using a polynomial fit of order 0, of the differences in magnetic values at the crossover points of the survey traverse and tie line data.

In order to remove any residual long wavelength variations in the tie line levelled data along the traverse lines, polynomial levelling was then applied.

Final micro-levelling techniques were then selectively applied to the tie line levelled data to remove minor residual variations in profile intensity

Located and gridded data were generated from the final processed magnetic data.

7.3 Radiometric Data Processing

The energy spectrum between the potassium and thorium peaks was recalibrated from the noise-cleaned 256 channel measurements.

The aircraft background spectrum and the scaled unit cosmic spectrum were then subtracted from the 256 channel data. This 256 channel data was then windowed to the 5 primary channels of total count, potassium, uranium, thorium and low-energy uranium. Dead time corrections were then applied to the data. Radon background removal was performed using the Minty Spectral Ratio method (1992).

The radar altimeter data was corrected to standard temperature and pressure, and height corrected spectral stripping was then applied to the windowed data. Height attenuation corrections based on the STP radar altimeter were then performed to remove any altitude variation effects from the data.

The corrected count rate data was then converted to ground concentrations for potassium, uranium and thorium (sensitivity coefficients are supplied in Appendix F).

Final micro-levelling techniques were then selectively applied to the tie line levelled data to remove minor residual variations in profile intensities. Located and gridded data were generated from the final processed radiometric data.

7.4 Digital Terrain Model Data Processing

The raw radar altimeter data was checked for spikes, and any found were manually edited. The GPS altimeter data was checked for spikes and steps, and any found were manually edited.

The radar altimeter data was then subtracted from the GPS altimeter data. The separation distance between the GPS antenna and the radar altimeter of 1.4 metres was subtracted from the digital terrain data.

The digital terrain data thus derived was tie line levelled and gridded. Tie line levelled data was then examined and selectively microlevelled to produce a grid without line dependent artifacts.

For further information concerning the survey flown, please contact the following office:

Head Office Address:

UTS Geophysics
Fauntleroy Avenue, Perth Airport
REDCLIFFE WA 6104

Tel: +61 8 9479 4232
Fax: +61 8 9479 7361

Postal Address:

UTS Geophysics
P.O. Box 126
BELMONT WA 6984

Quoting reference number: A709

APPENDIX A - LOCATED DATA FORMATS

MAGNETIC LOCATED DATA

FIELD	FORMAT	DESCRIPTION
1	I8	Line number
2	I4	Flight number
3	I9	Date
4	F10.1	Time
5	I8	Fiducial number
6	I4	UTM Zone
7	F12.2	AMG84 Easting
8	F12.2	AMG84 Northing
9	F12.6	WGS84 Latitude
10	F12.6	WGS84 Longitude
11	F12.2	MGA94 Easting
12	F12.2	MGA94 Northing
13	F8.1	Radar Altimeter
14	F8.1	GPS Height
15	F8.1	Digital elevation model
16	F10.2	Raw total magnetic intensity
17	F10.2	Diurnal correction
18	F10.2	IGRF correction
19	F10.2	Diurnal And IGRF corrected tmi
20	F10.2	Final microlevelled tmi

RADIOMETRIC LOCATED DATA

FIELD	FORMAT	DESCRIPTION	UNITS
1	I8	Line number	
2	I4	Flight number	
3	I9	Date	
4	F10.1	Time	
5	I8	Fiducial number	
6	I4	AMG Zone	
7	F12.2	AMG84 Easting	
8	F12.2	AMG84 Northing	
9	F12.6	Latitude	
10	F12.6	Longitude	
11	F12.2	MGA94 Easting	
12	F12.2	MGA94 Northing	
13	F8.1	Altitude	
14	F8.1	GPS Height	
15	I5	Live time	
16	F8.1	Baro pressure	
17	F6.1	Temperature	
18	F6.1	Humidity	
19	I6	Raw Total count	
20	I6	Raw K40	
21	I6	Raw Bi214	
22	I6	Raw Tl208	
23	I6	Cosmic	
24	F8.1	Corrected Total count	
25	F8.1	Corrected Potassium	
26	F8.1	Corrected Uranium	
27	F8.1	Corrected Thorium	
28	F9.4	Dose rate	
29	F9.4	K40_percent	
30	F9.4	Bi214 ppm	
31	F9.4	Tl208 ppm	

GRIDDED DATASET FORMATS

Gridding was performed using a bicubic spline algorithm.

The following grid formats have been provided:

- ER-Mapper format

LINE NUMBER FORMATS

Line numbers are identified with a six digit composite line number and have the following format - ALLLLB, where:

A	Survey area number
LLLL	Survey line number
	0001-8999 reserved for traverse lines
	9001-9999 reserved for tie lines
B	Line attempt number, 0 is attempt 1, 1 is attempt 2 etc..

UTS FILE NAMING FORMATS

Located and gridded data provided by UTS Geophysics uses the following 8 character file naming convention to be compatible with PC DOS based systems.

File names have the following general format - JJJJAABB.EEE, where:

JJJJ UTS Job number

AA Area number if the survey is broken into blocks

BB
- M Magnetic data
- R Radiometric data
- TC Total count data
- K Potassium counts
- U Uranium counts
- Th Thorium counts
- DT Digital terrain data

EEE File name extension
- LDT Located digital data file
- FMT Located data format definition file
- ERS Ermapper gridded data header file
- Ermapper data portion has no extension
- GRD Geosoft gridded data file

APPENDIX B - COORDINATE SYSTEM DETAILS

Locations for the survey data are provided in both geographical latitude and longitude and Universal Transverse Mercator metric projection coordinate systems.

WGS84	World Geodetic System 1984
Coordinate Type	Geographical
Semi Major Axis	6378137m
Flattening	1/298.257223563
AMG84	Australian Map Grid 1984
Coordinate Type	Universal Transverse Mercator Projection Grid
Geodetic datum	Australian Geodetic Datum
Semi Major Axis	6378160m
Flattening	1/298.25
MGA94	Map Grid of Australia 1994
Coordinate type	Universal Transverse Mercator Projection Grid
Geodetic datum	Geocentric Datum of Australia
Semi major axis	6378137m
Flattening	1/298.257222101

APPENDIX C - SURVEY BOUNDARY DETAILS

COORDINATES REPORT

Job ID code: A7090201
Client: Cameco Australia Pty Ltd
Job: Nabarlak
Coordinates AMG84 Zone: 53

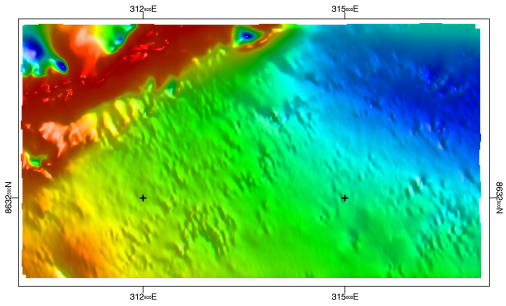
311050.000	8634650.000
316600.000	8634650.000
316600.000	8631500.000
311050.000	8631500.000

Job ID code: A7090301
Client: Cameco Australia Pty Ltd
Job: Kukalak China
Coordinates AMG84 Zone: 53

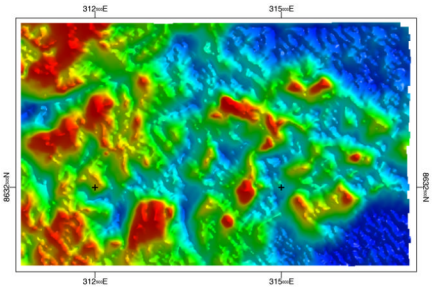
327900.000	8614300.000
329900.000	8611100.000
339000.000	8605850.000
341000.000	8605850.000
341000.000	8607800.000
334200.000	8611150.000
332750.000	8612500.000
332750.000	8617100.000
330750.000	8617100.000
330750.000	8614300.000

APPENDIX D - PROJECT DATA OVERVIEW

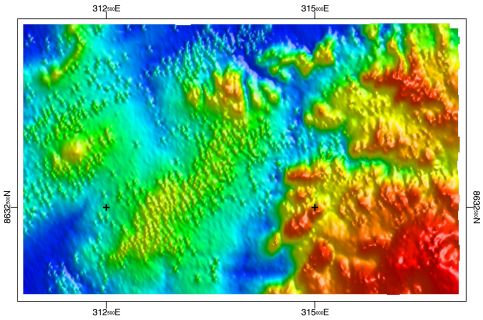
Nabarlak Project



Total Magnetic Intensity

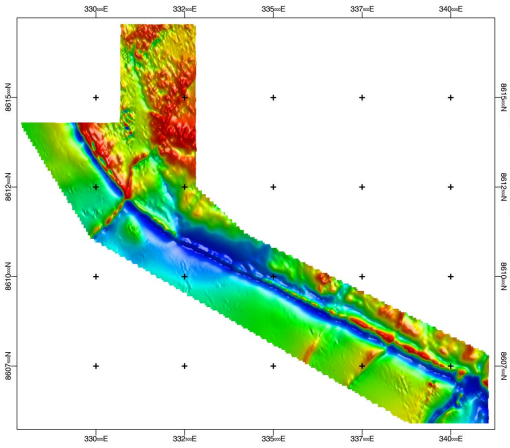


Radiometric Total Count

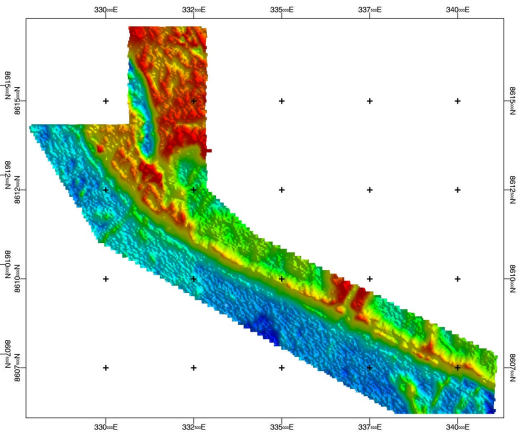


Digital Terrain Model

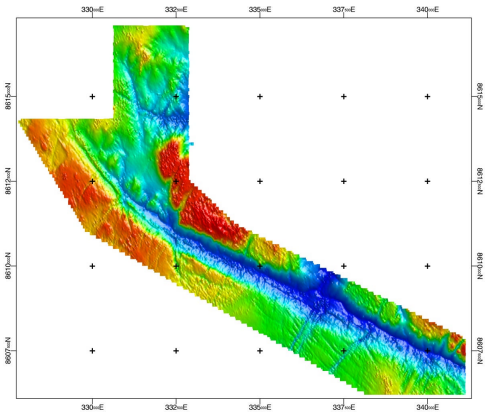
Kukalak China Project



Total Magnetic Intensity



Radiometric Total Count

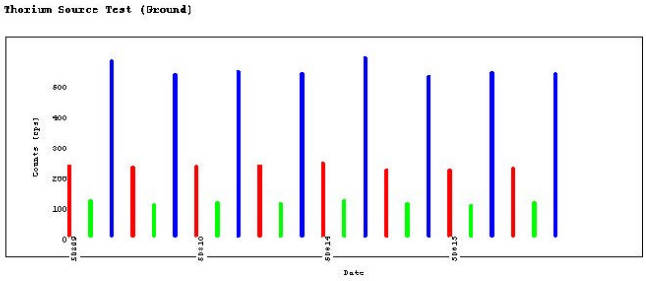


Digital Terrain Model

APPENDIX E – RADIOMETRIC CALIBRATION RESULTS

These charts show the results of the daily thorium source tests for each aircraft at all locations occupied during the course of the survey.

Date	K	U	Th	% Error
5D809	225.0	110.9	568.2	5.1
5D809	218.8	96.9	524.2	-2.3
5D810	222.6	103.5	532.5	-0.1
5D810	223.7	99.1	527.5	-1.1
5D814	231.6	112.2	576.6	7.0
5D814	211.3	100.1	515.6	-3.8
5D815	209.9	94.6	530.2	-2.9
5D815	216.7	101.6	526.0	-1.8
Avrg	**219.9**	**102.4**	**537.6**	**0.0**



APPENDIX F – ACQUISITION AND PROCESSING PARAMETERS

Magnetic Data

Nabarlak Project

IGRF date - 2005.62
IGRF mean value - 46140.56 nT
Magnetic inclination - -39.32
Magnetic declination - 3.95
Diurnal base value - 46315 nT

Kukalak China Project

IGRF date - 2005.62
IGRF mean value - 46247.75 nT
Magnetic inclination - -39.63
Magnetic declination - 4.00
Diurnal base value - 46315 nT

Radiometric Data

Height Attenuation Coefficients

Total Count:	-0.0061869
Potassium:	-0.0074044
Uranium:	-0.0069523
Thorium:	-0.0061239

Aircraft Background Coefficients

Total Count:	61.09
Potassium:	10.23
Uranium:	1.44
Thorium:	1.53

Cosmic Correction Coefficients

Total Count:	0.867
Potassium:	0.055
Uranium:	0.039
Thorium:	0.045

Sensitivity Coefficients

Total Count:	45.4 cps/dose rate
Potassium:	191.5 cps/%k
Uranium:	16.9 cps/ppm
Thorium:	9.0 cps/ppm

Final Reduction - All data reduced to STP height datum 30m

APPENDIX G – SURVEY FLIGHT LOGS

Flight Date	Area No	Flight No	Area Name / Survey Details	Lines Flown	Line Km Flown
10/08/05	03	01	Jabiru 50m Project Trav Lines: 300010-300300	30	100
14/08/05	03	02	Jabiru 50m Project Trav Lines: 300310-301200	89	425
14/08/05	03	03	Jabiru 50m Project Trav Lines: 301210-302240	99	303
15/08/05	03	T1	Jabiru 50m Project Tie Lines: 390010-390260	26	84
15/08/05	03	04	Jabiru 50m Project Trav Lines: 301220-302200	4	15
15/08/05	02	01	Jabiru 50m Project Trav Lines: 300200-300640	45	250
15/08/05	02	02	Jabiru 50m Project Trav Lines: 300010-300190	19	105
15/08/05	02	T1	Jabiru 50m Project Tie Lines: 390010-390110	11	35