Questor Surveys Limited

FINAL REPORT
and
LOGISTICS

prepared for the

NATIONAL ENERGY BOARD of CANADA

PROJECT #08502

ACQUISITION OF HIGH RESOLUTION AEROMAGNETIC DATA
August 19 - September 24, 1995

in the

LIARD BASIN
N.W.T.

Ron Sheldrake, Geophysicist
Questor Surveys Limited

January 1996

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APPENDICES

1. INTRODUCTION

Questor Surveys Limited (Questor) a division of World Geoscience Corporation (WGC), undertook an airborne magnetic survey over portions of the Lizard Basin, N.W.T. The survey was flown during the period August 19, 1995 through September 24, 1995. The aircraft used was mobilized from Questor's operational base located in Brantford, Ontario. This report summarizes the procedures used by Questor in acquiring, validating and processing the airborne geophysical data.

2. SURVEY AREAS

Area :	Lizard Basin N.W.T.
Survey Co-ordinates :	NW Corner : 61 degrees N, 124 degrees W NE Corner : 61 degrees N, 122 degrees W SE Corner : 60 degrees N, 122 degrees W SW Corner : 60 degrees N, 124 degrees W

3. SURVEY PARAMETERS

Aircraft Speed:	130kts / 240kph (nominal)
Mag Cycle Rate:	10Hz / 01.sec
Mean Sample Interval:	less than 15 metres
Mean Terrain Clearance:	150 metres
Mag Resolution:	0.001 nT
Total System Noise:	0.10 nT (Maximum)
Navigation Cycle Rate:	1Hz / 1.0sec
Radar Alt. Cycle Rate:	1Hz / 1.0sec
Barometric Alt. cycle rate:	1Hz / 1.0sec
Ground Mag. Cycle Rate:	5 sec
Tracking Method:	Real-time differential GPS / Video camera

In-field Processing:	486 PC / printer
Flight Line Spacing:	400 metres
Tie Line Spacing:	1200 metres

4. EQUIPMENT SPECIFICATIONS

Aircraft:	Cessna C208.
Magnetometer:	Scintrex Cesium Vapor H8.
Data Acquisition:	Picodas PDAS 1000 (with realtime compensation).
Acquisition Software:	Picodas
3 Axis Fluxgate Mag.	Develco 9200 series.
Navigation Method:	NOVATEL 10-channel GPS Receiver / PNAV 2001.
Differential Nav. Method:	STARFIX Real-time Differential Transmission.
Radar Altimeter:	Sperry 100
Barometric Altimeter:	Rosemount Transducer.
Visual Tracking System:	Video camera, and video recorder.
Ground Mag (BSTN)	Geometrics G-856 Memory Magnetometer

5. SURVEY DETAILS

Survey Base:	Fort Nelson, British Columbia
Fuel Base(s):	Fort Liard, N.W.T
Ground Mag Location:	Airport, Fort Nelson
In-field Tests:	Heading Error / Parallax Error / Dynamic Compensation.

6. OPERATIONAL FIELD CREW

Crew Chief:	Jami Monsalve
Pilots:	Jamie Monsalve, Andre Roy, Bryan Patterson
Operators:	Philip Bell, Adam Barrett

Processor:	Lori Moore
Technicians:	Bob Taylor

7. NAVIGATION

Aircraft navigation was provided using a Novatel GPS receiver unit. This unit was coupled to a STARFIX Real-time differential GPS system and the resulting, corrected positions data fed to both the PNAV 2001 navigation computer and to the PDAS 1000 data acquisition computer.

The PNAV 2001 is designed specifically for geophysical airborne surveys and has both a heads-up pilots display (left/right of track) and a moving map representation of where the aircraft is in relation to the survey area. The raw position and ephemeris data from the GPS satellite constellation together with the STARFIX corrected GPS positional information was recorded on a the PDAS 1000 in real time. The Raw GPS satellite information was restored onto DC2000 data tapes and then used in conjunction with the recorded GPS Base Station to provide a GPS post processed differentially corrected flight path using C3-NAV software. As a quality control measure the post-processed differentially corrected GPS positions are compared against the Real-time STARFIX positions.

The accuracy obtained was ± 5 meters or better, with a position fix recorded once per second.

8. TERRAIN CLEARANCE

The terrain clearance was a mean 150 metres above ground.

In conjunction with the Radar Altimeter, a Barometric Altimeter Transducer was also recorded.

9. DIURNAL VARIATION

The earth's natural magnetic field was monitored and recorded during the survey. The tolerance for diurnal activity was 10 nT over a linear cord in ten minutes.

10. MAGNETIC BASE STATION

A Geometrics G-856 memory magnetometer recorded diurnal activity during the day. This unit was located at F. Nelson airport. The magnetometer was set up in a known magnetically quiet location - free from cultural interference.

Type:	Geometrics G-856 memory magnetometer
Resolution:	0.1nT
Sample rate:	5 seconds
Noise Envelope:	0.5nT (Maximum)

The magnetometer records the Julian Day / Time in the local time zone, the reading number and the corresponding magnetic value. Time was synchronized daily to the aircraft acquisition system which is in turn synchronized to the GPS receiver which is in turn synchronized to the GPS satellites Atomic clock.

11. AIRCRAFT

The data acquisition platform used was, a Cessna 208, single engine, registration No: N9464F. This aircraft is owned and operated by Questor and complies to all Department of Transport regulations and is secured and insured accordingly.

12. AIRBORNE MAGNETOMETER

The magnetometer sensor is located at the end of a tail stinger. The signal received by the magnetometer travels through a pre-amplifier located at the base of the tail stinger then through an interface board into the acquisition system (PDAS 1000).

Type:	Scintrex V-201 H-8 cesium vapour
Resolution:	0.001nT
Operating Range:	20,000 - 95,000nT

13. ALTIMETERS

The sensor height was recorded using both a Radar Altimeter and Barometric Altimeter. The radar altimeter has a circular analog indicator of the typical aircraft type which the pilot uses to maintain a constant ground clearance. The readout is also digitally recorded. This altimeter was calibrated by recording data at different heights over a flat surface and then determining the voltage output for a given height. This voltage is recorded and displayed to the operator on the acquisition display as a converted height to indicate feet AGL (above ground level).
The Barometric Altimeter (which is a simple pressure transducer) records the pressure altitude above sea level. It is also both recorded digitally and displayed for the operator.

14. VIDEO TRACKING

The aircraft uses a VHS type video recorder and camera. The camera is mounted inside the belly of the aircraft with a clear perspex window, enabling full ground view for the Auto Iris Lens.

The acquisition system (PDAS 1000) overlays the line number and fiducial values onto the video image. Each video tape was numbered sequentially and annotated with flight number before being filed and stored for future reference.

15. ACQUISITION SYSTEM

The Picodas PDAS 1000 data acquisition system computer is the heart of the airborne acquisition system. All data acquired in the aircraft is stored onto a hard disk contained within the PDAS 1000. This data is then transferred at the end of each flight or days production onto a DC2000 magnetic data cartridge, which in turn is transferred to the field office PC, then onward to the Sun Systems Sparc II.

The software used in this system has been developed in-house by Questor. Most of the hardware involved is commercially available, however some printed circuit boards, power supplies etc. have been specifically designed and manufactured by Questor.

16. ACQUISITION FORMAT

Parameters	Units
Line number and heading:	String up to 9 characters
Flight Number:	Signed integer
Year:	Signed integer
Day:	Signed integer
Hour:	Unsigned byte 0 to 23
Minute:	Unsigned byte 0 to 59
Fiducial (event in time):	Integer
Seconds:	Sec.
Fractional seconds:	.01s
Event:	.01s
X fluxgate Mag. axis:	mV
Y fluxgate Mag. axis:	mV
Z fluxgate Mag. axis:	mV
Barometric altimeter:	ft
Radar Altimeter:	ft
Raw magnetic's:	nT (nano Teslas)
Compensated magnetic's:	nT (nano Teslas)
GPS time:	sec.
Latitude/Longitude:	WGS-84 decimal degrees
Easting:	Meters
Northing:	Meters
GPS height: (height above spheroid)	Meters
GPS PDOP: (satellite quality)	Integer
GPS status:	Integer
GPS error:	Integer

17. RMS GRAPHIC CHART RECORDER

During data acquisition an analog record is produced by the RMS GR-33. A list of information is printed at the start of each recording session (first start-up) a complete list of parameters is printed as follows;

Questor Surveys Limited, header

Year, date and time

Acquisition system used, Mag. channel and number of Mags.

Manufacturer and program version number

Flight number

Job number

Client

Aircraft

Operator

Magnetometer type

Survey altitude

RMS chart speed

REM (any remarks relevant to that recording session input by the operator).

DOS path and ASCII file name (recording note pad).

RMS channel numbers and labels FSD (full scale deflection) and the units displayed.

Once the system has been initialized, the information printed at each line start is as follows,

Line number, i.e. 1001, attempt number, i.e. 1001.0, direction flown i.e. 1001.0N.

Start fiducial (Fid.) number

Video number

Year Date, Time at start

Fid numbers are displayed at the top of the chart, while time is printed at the bottom.

Labels are printed for each trace starting from the top as follows,

FDD1	-	Fourth digital difference (displayed over 1")
MAG1	-	Raw Mag. course scale (displayed over 5")
MAG1	-	Raw Mag. fine scale (displayed over 5")
DMAG	-	Trace indicating difference between the raw and compensated Mag. This trace shows how hard the dynamic compensation file is having to work to correct for aircraft maneuver and air turbulence (displayed over 5").
CMA1	-	Compensated Mag. fine scale (displayed over 5")
FGAT	-	Fluxgate magnetometer, total of all 3 axis, X, Y, and Z. Indicates aircraft maneuver and attitude.

RAD	-	Radar altimeter (displayed over 1")
BARO	-	Barometric altimeter (displayed over 1")

At the end of each line there is a comments prompt into which the operator can enter anything unusual that occurred during the line. The file name, line number, time at end and last Fid are printed, also the operator can select to print the last values recorded for each channel

18. SYSTEM CHECK AND CALIBRATIONS

18.1 Heading Check (static compensation)

To compensate the magnetometer data for the effect of the aircraft's magnetic field on the readings both static and dynamic compensation are used. This compensation was done prior to commencement of the first survey flight and then each time after that when it was considered that a possible change to the magnetic field of the aircraft had occurred.

Static Compensation

Winglets are mounted on either side of the magnetic sensor housing. A thin strip of a highly permeable amorphous glass metal, trade name Vitrovac, about 4 cm long and 0.25 cm wide has been taped to each winglet. The purpose of these metal strips is to equalize the magnetometer readings in the north/south directions to the readings obtained in the east/west directions.

The diurnal base station is recording during this time to allow for magnetic variations while recording these heading in the aircraft. This diurnal is then applied to the raw magnetic aircraft data to obtain a true indication of heading error. Any residual heading error can be determined by processing and removed by adding an accurate constant offset value.

18.2 Dynamic Compensation

The basis of this compensation is the reduction of motion induced noise on the measured magnetic field. This motion noise comes from the complex three dimensional magnetic signature of the airframe as it changes attitude with respect

to the earth's magnetic vector. The noise comes from permanent, induced and eddy current effects of the airframe plus additional heading effects of the Cesium vapor sensor itself.

The approach used by Questor has been developed by Picodas Group Inc. and consists of using four individual sets of coefficients, one for each heading flown on the survey.

A Develco three axis fluxgate magnetometer mounted in the aircraft stinger is used to measure the coupling of the three axes with the background magnetic field. This sensor is very sensitive to attitude changes and is used to accurately monitor the aircraft reference frame. The frequency response and sample rate of the Picodas Analog Processor card used to measure the fluxgate signals is the same as that of the Picodas Magnetometer Processor card. This ensures that there is no phase distortion of these synchronized measurements. This leads to improved compensation throughout the passband of the system.

A series of Pitch, Roll and Yaw maneuvre motions are carried out on each of the survey directions to vary this coupling and gather fluxgate and measured raw magnetic field data. This data is then processed using a ridge regression technique to find a stable set of coefficients for the model. When the compensation algorithm is run using the model and coefficients, either in real-time or post-processing, a magnetically compensated data set is generated.

The compensation maneuvre "bones" are flown at high altitude over magnetically quite area. The pitch, roll and yaw maneuvres are approximatley 12° to 15° in amplitude of about 30 seconds duration each. A set of maneuvres is carried out in each survey line direction as well as ~15° either side of each direction. A compensation "box" is flown each time re-compensation is required.
The reduction of the data to calculate the coefficients was carried out on a 486 based personal computer using a program developed by Questor.

18.3 **System Parallax**

One of the processing parameters required to process the digital data is the parallax or offset in time, between the time the digital reading was taken by the instrument and the time the position fix for the fiducial of the reading was obtained. Each instrument - magnetometer, and altimeter may have a different parallax so the parallax must be computed for each instrument. A position fix may be obtained either by GPS position or by using the video to determine location. The parallax between the instrument and the GPS and the instrument and the video may be different.

To obtain this parameter two lines are flown in opposite directions over an anomaly. Stacked profiles of the lines are then done and the parallax adjusted till the anomaly position is the same for each line.

The parallax correction derived is the correction to be applied to each survey line. A positive parallax indicates the instrument reading is ahead of the position for the fiducial. Each integer fiducial occurs every second so the parallax can be expressed in either fiducials or seconds.

The correct fiducial is computed by

Fc = Fr - Ip

where

Fc = Parallax corrected fiducial

Fr = Fiducial for recorded reading

Ip = Instrument parallax

For this project, as the GPS was the prime position source and the video was not used at all for positioning, no parallax was worked out between instrument and video. Previous experience with video positioning would suggest that the parallax derived using the GPS will be a good approximation.

The parallax to be applied when using the analogue charts will be the same as that used for the digital data. If an anomaly is identified on the chart and a fiducial number recorded then the corrected fiducial will be as per the above formula.

19. MONITORING FLIGHT PATH

GPS flight path was recovered and plotted daily to ensure it was within specifications. Any data not within specification was re-flown at the earliest possible opportunity. This data used was the differentially corrected flight path, and the system is set up such that it shows the number of satellites used, the quality of positioning and the amount of definite position fix's.

20. FLIGHT SUMMARY

Start of production:	August 19, 1995
End of production:	September 24, 1995

21. FLIGHT CONDITIONS

Over the survey period a variety of climatic and atmospheric conditions were experienced. Cloud cover in the mountains and turbulence were experienced at times, some days of excessive winds, caused adverse flying conditions.

22. DOWNTIME

A moderate amount of downtime was encountered during the operation due to severe weather conditions or diurnal activity. Downtime due to aircraft or equipment problems was minimal, amounting to just a few days over the course of the survey.

23. DAILY OPERATIONS REPORT

A daily operations report was compiled by the crew chief for the duration of the survey. The report documents the date, flight number, flight times, kilometres flown and accepted, and reasons for any downtime, and a comments column stating weather condition, equipment condition.

24. PROCESSING EQUIPMENT USED IN FIELD

For the duration of the survey, a field office was established by Questor at Fort Nelson. The equipment listed below was transported and set up on location.

1 x 486 IBM compatible computer
1 x Epson dot matrix printer
1 x Telebit modem

25. VALIDATION AND VERIFICATION PROCEDURES

Each evening or after the day's production the data was transferred onto the field office computer system for verification of the day's flying. This consisted of the following;

1. Checking the statistics for each line.
2. Plotting the day's diurnal to ensure the variation was within specifications.
3. Plotting profiles of any lines that could have potential problems.
4. Noise plots were created and profiled for each line.
5. Calibration test line data were plotted to ensure equipment was operating within tolerances.

26. DATA PROCESSING PROCEDURE

Magnetic Diurnal Data

All magnetic diurnal data was obtained from the Geometric magnetometer base station set up at the airstrip in Fort Nelson. Data from the magnetometer was recorded every 5 seconds. The data was downloaded from the magnetometer to a 486 based personal computer. It was transferred by modem to the Sun processing computer, at the data processing centre in Calgary. The data were checked and corrected for spikes. Single reading spikes were either manually or automatically edited and replaced with an interpolated result. The diurnal data were also checked to see that the change in diurnal readings during the course of the survey flight did not exceed survey specifications. When this occurred the affected survey lines or line segments were reflown.

Radar Altimeter Data

The height of the aircraft above the ground was recorded every 0.1 second using a radar altimeter. A fourth difference program was used to identify spikes prior to either manual or automatic correction. The altimeter data was used as a validation control of each crossover during tie line levelling of the magnetic data and to correct the radiometric data for atmospheric attenuation effects above or below the nominated survey height.

Barometric Altimeter Data

The height of the aircraft above sea level was recorded every 0.1second using a barometric altimeter. A fourth difference program was used to identify spikes prior to either manual or automatic correction. The barometric altimeter data was not used in the basic processing.

Flight Path Location

The aircraft's position was determined using a Novatel GPS navigation system. GPS positions were recorded every second. A colour VHS video camera was used for verification but was not used in any stage of the processing. The GPS data was recorded in the WGS84 geodetic datum. During the first processing stage the GPS data were transformed into eastings and northings of the local geodetic datum. A speed check was then run on the data. The resulting velocities were checked and any data causing abnormal speeds were deleted and reflown.

Magnetic Data Processing

Real-time compensated and uncompensated magnetic data, were recorded digitally every 0.1 of a second. Both channels were transferred from the aircraft to the processing computer system where the fourth difference program for the identification of possible spikes. Single reading spikes were either manually or automatically edited. Multiple reading spikes were flagged as invalid and if necessary that section of the line was reflown. The same digital compensation co-efficients as used in the aircraft were then applied to the edited uncompensated magnetic data to produce a post flight compensated magnetic data channel.

The following correction and levelling procedures were then applied to the raw edited compensated data to produce preliminary levelled magnetic data.

a) Diurnal

The synchronized digital diurnal data was first subtracted from a base level of 58,780 nT. The resultant values were then added to the airborne magnetic readings by synchronizing the time from the start and end of each line, to produce a diurnally corrected reading.

b) Parallax

A parallax correction of 0.3 seconds was then applied to the diurnally corrected data.

c) International Geomagnetic Reference Field (IGRF)

The International geomagnetic reference field was calculated at every recovery point.

d) Tie Line Levelling

A crossover program was then used to compute the magnetic difference between each tie line and the traverse line intersection. These differences were the applied to the traverse line data to level the traverse lines to the tie lines. A crossover difference was automatically rejected if the total gradient (G=sqrt(Gtie^2 + Gtra^2)) of the tie line and traverse line at the crossover exceeded 0.15 nT/fid.

e) Preliminary Gridding and Inspection

The data was then gridded and from the computed grid image enhancements were displayed on the processing computer screen. These were inspected for inconsistencies and /or errors which were investigated by the on-site data processor and geophysicist. Appropriate corrections and / or adjustments were made if required.

f) Micro Levelling

After corrections had been applied to the data, a correction was applied to remove some remaining sub-nano tesla distortions evident only after applying image enhancing algorithms to the gridded data. These disturtions are usually the residual noise of the crossover corrections.

g) Gridding

The corrected and levelled magnetic data was gridded to interpolate along line to obtain grid column intersection values. These were then sorted into columns and a polynomial interpolation was used to determine row values along each column.

Gridding parameters were as follows:

Grid cell size - 130 metres

27 SUMMARY

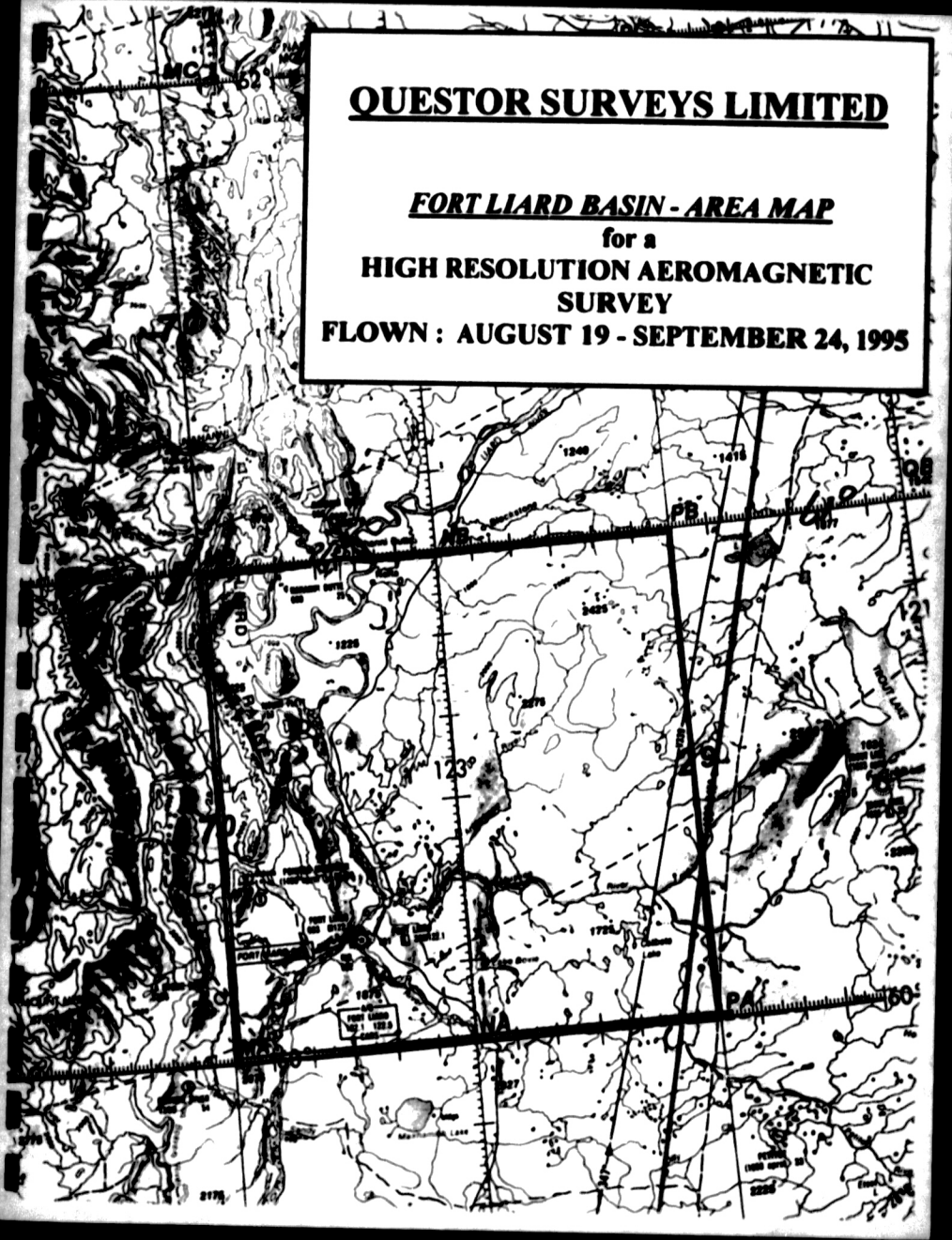
A High Resolution Survey of 44,000 km was flown over the Fort Liard Mapsheet 95B. The aeromagnetic survey results indicate broad regional basement features as well as structures within the sedimentary section. Fault traces can be seen in the data, which may provide useful information in hydrocarbon exploration programs.

Respectfully submitted,

[redacted]
Geophysicist

APPENDIX A

SURVEY AREA MAP



QUESTOR SURVEYS LIMITED

FORT LIARD BASIN - AREA MAP

for a

HIGH RESOLUTION AEROMAGNETIC SURVEY

FLOWN : AUGUST 19 - SEPTEMBER 24, 1995

APPENDIX B

FLIGHT LINE MAP

APPENDIX C

TOTAL MAGNETIC INTENSITY CONTOUR MAP

APPENDIX D

TOTAL MAGNETIC INTENSITY
Stacked Second Vertical Derivative

APPENDIX E

DAILY REPORTS

QUESTOR SURVEYS LIMITED
Fort Nelson Hotel
P.O. Box 240, Fort Nelson B.C. Canada
Phone: (604)774 6811 Fax: (604)774 6711

DAILY OPERATIONS REPORT

Job #Q8502
N9464F

WEEK ENDING
Aug. 20 1995

DATE	BASE	FLT	AREA	FLIGHT TIMES FRWY	TEST	PROD	TOTAL	KILOMETRAGE FLOWN	ACCEP	UNSERVICEABILITY * A/C	EQUP	DIUR	WX	COMMENTS
MON	Job													
Aug.														
14	B.C. Canada													
TUE	Job													
Aug.	Fort Nelson													
15	B.C. Canada													
WED	Job Q8502		1	2.0			2.0						100	Packed up equip. & departed for Ft.Nelson
Aug.	Fort Nelson		1											I.F.R. weather on route and at Ft.Nelson
16	B.C. Canada													Set up office and base stations.
THU	Job Q8502		1										100	Poor weather all day with reduced visibility to
Aug.	Fort Nelson		1											1 mile in smoke in the survey area.
17	B.C. Canada													
FRI	Job Q8502		1										100	Poor weather all day. No flights.
Aug.	Fort Nelson		1											
18	B.C. Canada		1											
SAT	Job Q8502	1	1	1.4	0.4	2.4	4.2	1227	1227					Flew a compensation box on the way to area.
Aug.	Fort Nelson	1	1	1.4		2.7	4.1							Followed by 5 lines of production.
19	B.C. Canada													Refueled and flew another 6 lines prod.
SUN	Job Q8502	2	1	1.4		3.6	5.0	1333	1333		25		25	Problems with Base GPS Power Unit.
Aug.	Fort Nelson	2	1	1.4		2.6	4.0							We will use GPS data from 205 crew for Flt.
20	B.C. Canada													Problems with PNAV in flight
	TOTAL FOR WEEK							2,560	2,560					Kilometres remaining: 40,004
	TOTAL FOR JOB Q8502							2,560	2,560					

COMMENTS:

* Reported as a percentage of survey day. * Tests & reflights in the same column

PILOT : J. Monsalve
PILOT : Andre Roy

OPERATOR: Adam Barrett
OPERATOR: Phil Bell

PROCESSOR: A.B. / P.B. / J.M.
CREW CHIEF: Jaime Monsalve

QUESTOR SURVEYS LIMITED
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P.O. Box 240, Port Nelson B.C. Canada
Phone: (604)774 6811 Fax: (604)774 6711

DAILY OPERATIONS REPORT

Job #Q8502
N9464F

WEEK ENDING
Aug. 27. 1995

				FLIGHT TIMES				KILOMETRAGE		UNSERVICEABILITY *				
DATE	BASE	FLT	AREA	FERY	TEST	PROD	TOTAL	FLOWN	ACCEP	A/C	EQUP	DIUR	WX	COMMENTS
MON	Job Q8502	3	1	1.4		3.2	4.6	1551	1551					8 lines of production in area 1 in am.
Aug.	Port Nelson	3	1	1.4		3.1	4.5							5 tie lines and 1 traverse in afternoon flight.
21	B.C. Canada													Using Pence River Base GPS data.
TUE	Job Q8502	4	1	1.2			1.2	1488	1488					Mountains covered in cloud waited for wx.
Aug.	Port Nelson	4		0.4		3.2	3.6							Flew 9 traverse lines and 3 tie lines
22	B.C. Canada		1	1.2		3.0	4.2							Still using Pence River Base GPS data
WED	Job Q8502									100				Aircraft in for Phase inspection.
Aug.	Port Nelson													
23	B.C. Canada													
THU	Job Q8502	5	1	1.2		3.8	5.0	1896	1896				25	Attempted tie lines in mountains. WX poor.
Aug.	Port Nelson	5	1	1.2		3.4	4.6							Flew 8 tie lines in am and 8 tie lines in pm.
24	B.C. Canada													Still using Pence River GPS data.
FRI	Job Q8502	6	1	1.2		3.9	5.1	1790	1790				25	Early morning wx and Baro Alt. problem.
Aug.	Port Nelson	6	1	1.2		3.5	4.7							Production flight. 8 tie lines am & 8 in pm.
25	B.C. Canada													Base GPS now operational
SAT	Job Q8502	7	1	1.2		4.1	5.3	1957	1957				25	Fog and low clouds in the mountains.
Aug.	Port Nelson	7	1	1.2		4.1	5.3							Flew 7 tie lines and 2 traverse lines in am.
26	B.C. Canada													Flew 7 tie lines and 18 traverse lines in pm.
SUN	Job Q8502	8	1	1.4		4.0	5.4	1376	1376					
Aug.	Port Nelson	8	1	0.2			0.2				25			Production flights in am & pm.
27	B.C. Canada			1.8		2.6	4.4							L.Moore departed, P.Bell arrived
	TOTAL FOR WEEK			16.2	0	41.9	58.1	9,968	9,968		COMMENTS:			Kilometres remaining: 30,036
	TOTAL FOR JOB Q8502			23.8	0.4	53.2	77.4	12,528	12,528					

* Reported as a percentage of survey day. * Tests & reflights in the same column

PILOT : J. Monsalve
PILOT : B. Patterson

OPERATOR: Adam Barrett
OPERATOR: L. Moore

PROCESSOR: A.B / L.M. / J.M.
CREW CHIEF: Jaime Monsalve

QUESTOR SURVEYS LIMITED
Fort Nelson Hotel
P.O. Box 240, Fort Nelson B.C. Canada
Phone: (604)774 6811 Fax: (604)774 6711

DAILY OPERATIONS REPORT

Job #Q8502
N9464F

WEEK ENDING
Sept 3, 1995

				FLIGHT TIMES				KILOMETRAGE		UNSERVICEABILITY *				
DATE	BASE	FLT	AREA	FERY	TEST	PROD	TOTAL	FLOWN	ACCEP	A/C	EQUIP	DIUR	WX	COMMENTS
MON	Job Q8502	9	1	1.2		3.9	5.1	1710	1710				25	B Traverse lines in am. Weather poor in
Aug.	Fort Nelson													mountains. 6 traverse lines in pm.
28	B.C. Canada													B. Patterson departed today.
TUE	Job Q8502	10	1	1.4		3.9	5.3	1653	1653					Mountains covered in cloud.
Aug.	Fort Nelson	10	1	1.4		3.4	4.8							Flew traverse lines in am and pm.
29	B.C. Canada													K Harrington in town
WED	Job Q8502	11	1	1.3		4.0	5.3	1728	1728				25	Flt. attempt in mountains. Excessive winds.
Aug.	Fort Nelson	11	1	1.3		3.7	5.0							Continued with traverse lines.
30	B.C. Canada													
THU	Job Q8502	12	1	1.3		3.5	4.8	1785	1785		25		25	Flt. attempts in mountains. Too turbulent.
Aug.	Fort Nelson	12	1	1.2		3.4	4.6							Continued with traverse lines.
31	B.C. Canada													B56 Base Mag inoperable. Using Peace River
FRI	Job Q8502	13	1	1.3		-	1.3				25		25	Flt. attempt. Returned from area due to fog.
Sept	Fort Nelson	13	1	0.4		2.2	2.6	1170	1107					Flew out to continue with traverse lines.
1	B.C. Canada	13	1	1.2		3.1	4.3							Using mag base station from Peace River.
SAT	Job Q8502	14	1	1.3	0.5	3.0	4.8	1686	1686		25		25	Very strong winds in survey area.
Sept	Fort Nelson	14	1	1.3		4.2	5.5							Comp box in am. Continued with trv. lines.
2	B.C. Canada													Using mag base station from Peace River
SUN	Job Q8502	15	1	0.8			0.8				25		25	Landed at Ft. Liard to wait out weather.
Sept	Fort Nelson	15	1	0.4		4.1	4.5	1882	1882					Continued with traverse lines.
3	B.C. Canada	15	1	1.0		4.1	4.1							Using mag base station from Peace River.
TOTAL FOR WEEK				18.0	0.5	49.9	68.4	11,614	11,614					COMMENTS:
TOTAL FOR JOB Q8502				41.8	0.9	103.1	145.8	24,142	24,142					Kilometres remaining: 18,422

* Reported as a percentage of survey day. * Tests & reflights in the same column

PILOT : J. Monsalve
PILOT : Andre Roy

OPERATOR: Adam Barrett
OPERATOR: Phil Bell

PROCESSOR: A.B./P.B./J.M.
CREW CHIEF: Jaime Monsalve

QUESTOR SURVEYS LIMITED
Fort Nelson Hotel
P.O. Box 240, Fort Nelson B.C. Canada
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DAILY OPERATIONS REPORT

Job #Q8502
N9464F

WEEK ENDING
Sept 10, 1995

				FLIGHT TIMES				KILOMETRAGE		UNSERVICEABILITY *				
DATE	BASE	FLT	AREA	FERY	TEST	PROD	TOTAL	FLOWN	ACCEP	A/C	EQUP	DIUR	WX	COMMENTS
MON	Job Q8502									100		25		Aircraft in for 100hr. phase inspection
Sept	Fort Nelson													Active diurnal overnight
4	B.C. Canada													
TUE	Job Q8502	16	1	1.4		3.8	5.2	1247	1247					Waited on diurnal to calm down in am.
Sept	Fort Nelson	16	1	1.1		0.7	1.8							Production flight in late morning.
5	B.C. Canada											50		Afternoon flt. attempt aborted due to diurnal
WED	Job Q8502	17	1	1.3		3.5	4.8	1148	1148			25	25	Waited on diurnal and fog in the morning.
Sept	Fort Nelson	17	1	0.8		1.4	2.2							Continued with traverse lines.
6	B.C. Canada													Still using Peace River Mag base station
THU	Job Q8502	18	1	1.3		4.1	5.4	1575	1575			25	25	Waited on diurnal in the morning.
Sept	Fort Nelson	18	1	1.1		2.4	3.5							Production flights in late am and pm.
7	B.C. Canada													Set up and ran new 856 Base mag console.
FRI	Job Q8502	19	1	1.8		3.8	4.9	893	893			50	25	Waited on diurnal in the morning.
Sept	Fort Nelson													Production flights in afternoon.
8	B.C. Canada													
SAT	Job Q8502	20	1	1.3		3.0	4.3	1293	1293			25	25	Waited on diurnal in the morning.
Sept	Fort Nelson	20	1	1.3		2.4	3.7							Attempted lines in the mountains. Too turbul.
9	B.C. Canada													Changed mag base station sensor & cable.
SUN	Job Q8502	21	1	1.4		4.0	5.4	1862	1862			25	25	Turb. in mountains. Continued traverse lines.
Sept	Fort Nelson	21	1	1.4		4.0	5.4							Diurnal became active in late afternoon.
10	B.C. Canada													Missing part base GPS. Logging problem
	TOTAL FOR WEEK			14.2	0	32.4	46.6	7,928	7,928					COMMENTS: Kilometres remaining: 10,494
	TOTAL FOR JOB Q8502			56.0	0.9	135.5	192.4	32,870	32,870					

* Reported as a percentage of survey day. * Tests & reflights in the same column

PILOT : J. Monsalve
PILOT : Andre Roy

OPERATOR: Adam Barrett
OPERATOR: Phil Bell

PROCESSOR: A.B / P.B / J.M.
CREW CHIEF: Jaime Monsalve

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DAILY OPERATIONS REPORT

Job #Q8502
N9464F

WEEK ENDING
Sept 17, 1995

				FLIGHT TIMES				KILOMETERAGE		UNSERVICEABILITY *				
DATE	BASE	FLT	AREA	FERY	TEST	PROD	TOTAL	FLOWN	ACCEP	A/C	EQUP	DIUR	WX	COMMENTS
MON	Job Q8502	22	1	1.4		4.1	5.5	961	961			75		Production flight in am. Ft.Nelson base tried
Sept	Fort Nelson													unsuccessfully to contact us to stop production
11	B.C. Canada													due to increased diurnal.
TUE	Job Q8502	23	1	1.4		3.9	5.3	920	920			50	50	Production flight in am. No afternoon flight
Sept	Fort Nelson													due to diurnal and turbulence.
12	B.C. Canada													
WED	Job Q8502	24	1	1.4		3.8	5.2	1816	1816			25	25	Waited on diurnal in the morning.
Sept	Fort Nelson	24	1	1.4		3.6	5.0							Continued traverse lines.
13	B.C. Canada													
THU	Job Q8502		1	1.1			1.1			50		25	25	Flight attempt in the morning.
Sept	Fort Nelson													Returned due to low clouds and fog.
14	B.C. Canada													AC down for maintenance in the afternoon.
FRI	Job Q8502	25	1	1.8		3.6	5.4	899	899	50		25	25	Waited on AC and diurnal in the morning.
Sept	Fort Nelson													Production flights in afternoon.
15	B.C. Canada													
SAT	Job Q8502	26	1	1.4		2.3	3.7	385	385				50	Poor weather in survey area.
Sept	Fort Nelson	26	1	1.4		3.3	4.7	697	697					Broke traverse lines at mountain edge due to
16	B.C. Canada													mountain tops in cloud.
SUN	Job Q8502	27	1	1.4		3.9	5.3	857	857				50	Poor weather in the morning.
Sept	Fort Nelson													Production flight in the afternoon
17	B.C. Canada													B.Patterson arrived today
	TOTAL FOR WEEK			12.7	0	28.5	41.2	6,535	6,535					COMMENTS: Kilometres remaining: 3,989
	TOTAL FOR JOB Q8502			69.0	0.9	166.7	236.6	38,605	38,605					

* Reported as a percentage of survey day. * Tests & reflights in the same column

PILOT : J. Monsalve
PILOT : Andre Roy

OPERATOR: Adam Barrett
OPERATOR: Phil Bell

PROCESSOR: A.B/P.B/J.M.
CREW CHIEF: J. Monsalve

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DAILY OPERATIONS REPORT

Job #Q8502
N9464F

WEEK ENDING
Sept 24 1995

				FLIGHT TIMES				KILOMETRAGE		UNSERVICEABILITY *				
DATE	BASE	FLT	AREA	FERRY	TEST	PROD	TOTAL	FLOWN	ACCEP	A/C	EQUP	DIUR	WX	COMMENTS
MON	Job Q8502		1	1.3		3.3	4.6	931.2	931.2					Production flight in am/pm
Sept	Fort Nelson			1.4		2.9	4.3							Good weather, no problems
18	B.C. Canada													Jamie Monsalve departs for Houston
TUE	Job Q8502		1	1.4		3.9	5.3	1694.9	1694.9					Production flight in am/pm
Sept	Fort Nelson			1.4		3.6	5.0							Goog weather no problems
19	B.C. Canada													Andre Roy leaves for Calgary
WED	Job Q8502		1				0	0	0	100%				Aircraft in shop for 100 hour
Sept	Fort Nelson													No Production
20	B.C. Canada													
THU	Job Q8502		1							50%	15%		35%	Aircraft is completed
Sept	Fort Nelson			2.1		1.9	4.0	373.1	373.1					PM flight-Turbulence bad in hills
21	B.C. Canada													some problems with PNAV
FRI	Job Q8502		1	1.3		3.2	4.5				15%			Weather was great finished area
Sept	Fort Nelson			1.2		1.3	2.5	850	850					Problems with RMS and PNAV
22	B.C. Canada													All reflights completed
SAT	Job Q8502		1					0	0	100%				No flying, waiting for any re-flights
Sept	Fort Nelson													preparing to move to Peace River
23	B.C. Canada													
SUN	Job Q8502			2.0		0.5	2.5	110	110	100%				Finished assigned re-flights
Sept	Fort Nelson			0		0	2.2	0	0					Ferry aircraft to Peace River
24	B.C. Canada													Crew moves to Peace River
	TOTAL FOR WEEK			9.4	0	20.6	34.9	3,959.2	3,959.2					COMMENTS: Kilometres remaining: 0
	TOTAL FOR JOB			115.6	63.3	224.6	348.4	42,564.2	42,564.2					

* Reported as a percentage of survey day. * Tests & reflights in the same column

PILOT : Bryan Patterson
PILOT : Andre Roy

OPERATOR: Adam Barrett
OPERATOR: Phil Bell

PROCESSOR: Adam Barrett
CREW CHIEF: Bryan Parrerson

APPENDIX F

TOTAL MAGNETIC INTENSITY IMAGE