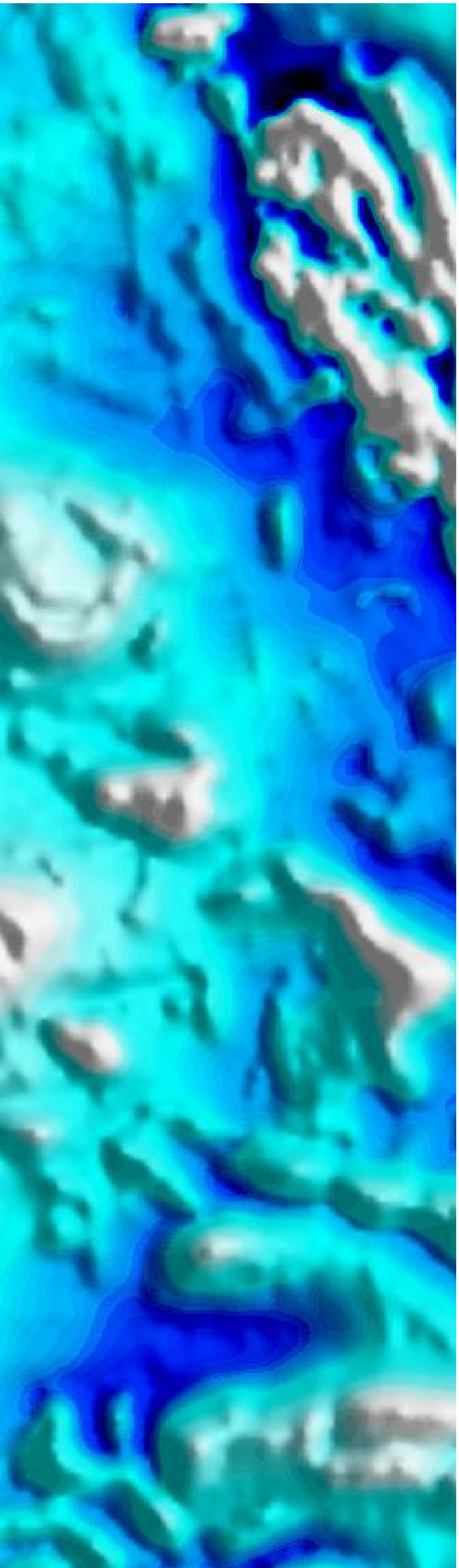
GM 72027

Final technical report, high-resolution helicopter-borne magnetic survey, Quebec's Eeyou Istchee James Bay project



FINAL TECHNICAL REPORT

HIGH-RESOLUTION HELICOPTER-BORNE MAGNETIC SURVEY

QUEBEC'S EEYOU ISTCHEE JAMES BAY PROJECTS

FOR:
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Project# P21004 **APRIL 2021**

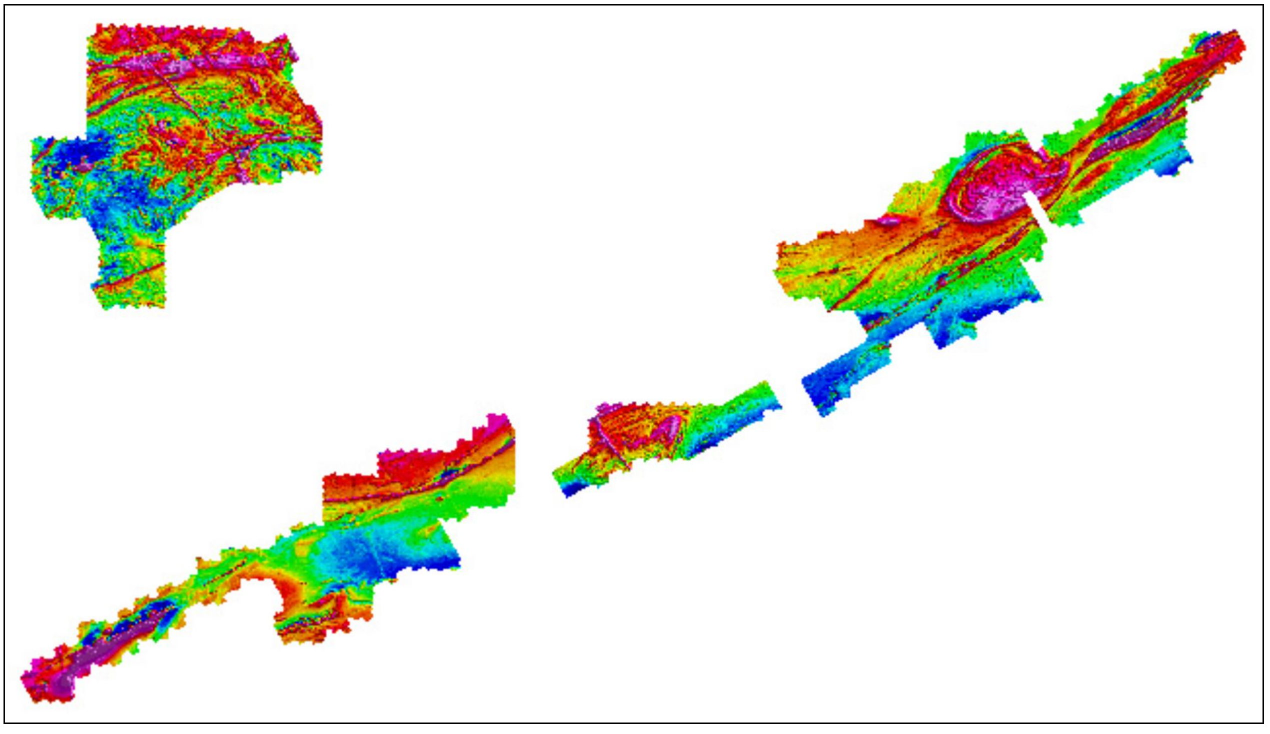


TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

On February 18, 2021, **Géo Solutions Données GDS/Geo Data Solutions GDS Inc. (GDS)** was awarded project P21004 by **Critical Elements Lithium Corp**. (**CELCORP**). The contract required the execution and compilation of digitally-recorded, high-sensitivity, helicopter-borne magnetic survey consisting of **15 508 l-km** over four blocks, to the east, south, and north of Nemiscau airport, QC.

The data were recorded using a split-beam cesium vapour magnetometer mounted in a stinger fixed to the helicopter.

The nominal traverse line spacing was 50m while control line spacing was 500m for each survey block. The survey was flown following a pre-determined flight surface having a rate of climb and descent of 20% and a minimum ground clearance of 35 m.

This report describes the survey procedures and data verification, which were carried out in the field, followed by data processing in the office.

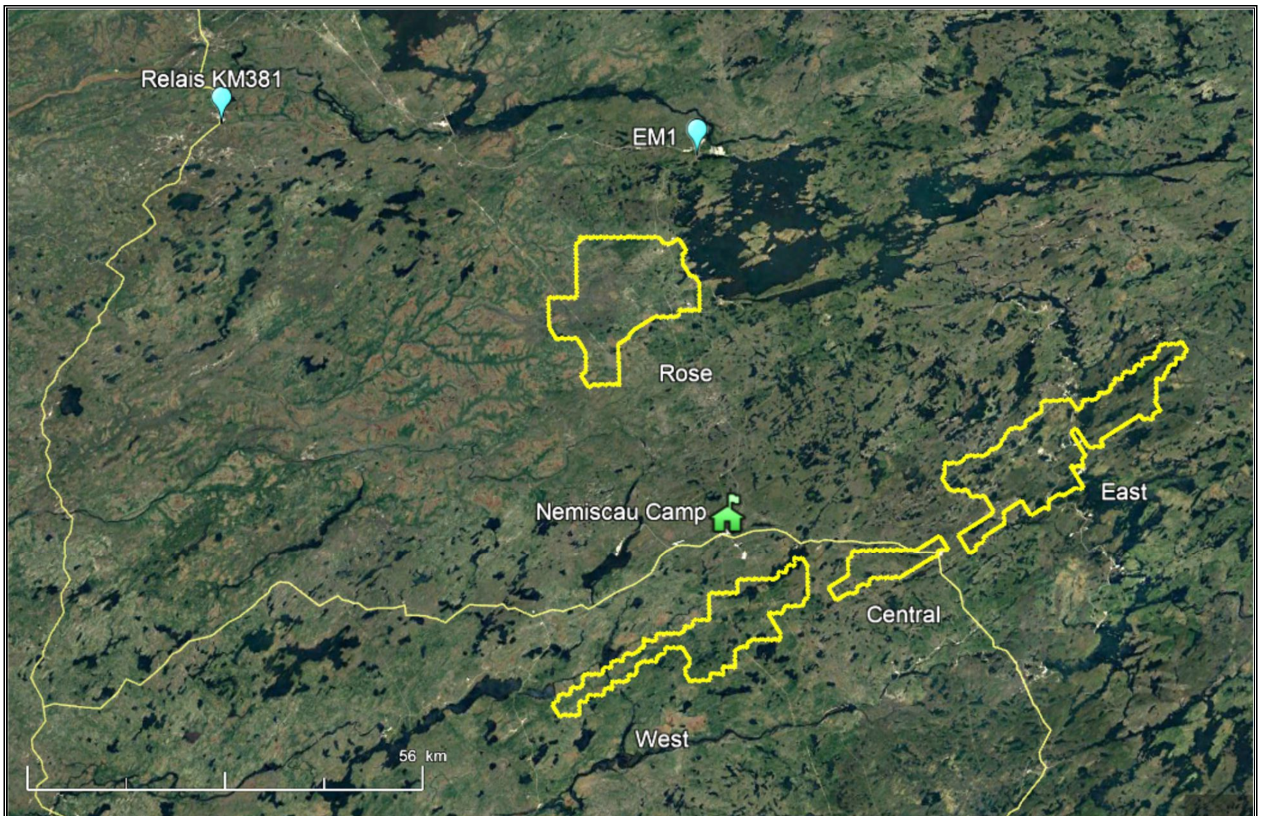


Figure 1: Survey areas and base of operations

2 LOGISTICS AND SURVEY SPECIFICATIONS

Winter weather conditions were present during the execution of the survey, which was completed on March 29, 2021. The daylight period was approximately 11 hours.

In terms of topography, the terrain may be classified as gentle to moderate. **GDS** used 3D Drape navigation software to fly a smooth drape surface with a rate of climb of 20%. The use of this technique minimizes the high intersection differences between control lines and traverses in order to achieve optimal ground clearance in some areas of steep topography. The surface was created using Shuttle Radar Topography Mission (SRTM) along with software from the Geological Survey of Canada (Drape dtm).

GDS set up its base of operations at Camp Nemiscau, QC. A magnetic base station was set up nearby in a magnetic noise-free location, away from magnetic objects, vehicles, and DC electrical power lines.

The nominal spacing and directions of survey lines, requested by **CELCORP** are summarized in table 1 along with the number of line-kms needed to complete the survey areas. The boundaries for the survey block in **NAD83, UTM zone 18 coordinates** can be found below, in table 2.

Table 1: Flight path specification

Area	Traverse Line			Tie Line			Total
	Azimuth	Line-km	Spacing	Azimuth	Line-km	Spacing	
Block 1 (West)	N150°E	3 618 l-km	50 m	N060°E	364 l-km	500 m	**3 982 l-km**
Block 2 (Centre)	N150°E	882 l-km	50 m	N060°E	89 l-km	500 m	**971 l-km**
Block 3 (East)	N150°E	4 759 l-km	50 m	N060°E	480 l-km	500 m	**5 239 l-km**
Rose	N150°E	4 832 l-km	50 m	N060°E	484 l-km	500 m	**5 316 l-km**
						Total	**15 508 l-km**

Table 2: Survey area coordinates – Block Rose

#	Easting	Northing	#	Easting	Northing	#	Easting	Northing	#	Easting	Northing
1	409150	5769321	**7**	425063	5764405	**13**	413980	5755229	**19**	404462	5761963
2	409178	5770316	**8**	425628	5763412	**14**	413980	5749717	**20**	408411	5761878
3	420340	5770010	**9**	425572	5759718	**15**	409349	5749774	**21**	408589	5769315
4	420794	5769085	**10**	422674	5759804	**16**	409491	5756252			
5	423412	5769066	**11**	422645	5758894	**17**	405319	5756399			
6	423412	5764406	**12**	418497	5758951	**18**	404412	5757957			

Table 3: Survey area coordinates – Block 1 (West)

#	Easting	Northing	#	Easting	Northing	#	Easting	Northing	#	Easting	Northing
1	415048	5710774	**23**	410392	5709000	**45**	436578	5722512	**67**	430687	5713323
2	415017	5708920	**24**	410409	5709927	**46**	436587	5723439	**68**	430677	5712390
3	413861	5708940	**25**	411564	5709906	**47**	437744	5723427	**69**	429519	5712410
4	413845	5708013	**26**	411581	5710833	**48**	437750	5724352	**70**	429532	5713337
5	411532	5708053	**27**	413314	5710803	**49**	438908	5724338	**71**	428956	5713343
6	411516	5707126	**28**	413330	5711730	**50**	438896	5723414	**72**	428946	5712420
7	410359	5707146	**29**	415641	5711691	**51**	439468	5723402	**73**	428900	5709639
8	410343	5706220	**30**	415656	5712618	**52**	439441	5720623	**74**	427169	5709666
9	408029	5706261	**31**	416234	5712608	**53**	437135	5720650	**75**	427163	5708736
10	408013	5705334	**32**	416250	5713535	**54**	437123	5719725	**76**	425418	5708751
11	406856	5705355	**33**	417982	5713506	**55**	439429	5719695	**77**	425411	5707823
12	406822	5703502	**34**	417997	5714433	**56**	439418	5718768	**78**	422412	5707876
13	403930	5703555	**35**	422040	5714369	**57**	438840	5718775	**79**	421948	5708655
14	403943	5704485	**36**	422054	5715296	**58**	438830	5717848	**80**	421963	5709749
15	403367	5704493	**37**	423209	5715278	**59**	435949	5717887	**81**	422544	5709739
16	403385	5705420	**38**	423205	5716200	**60**	435931	5716957	**82**	422551	5710667
17	403963	5705409	**39**	425537	5716177	**61**	433627	5716986	**83**	423138	5710667
18	403981	5706336	**40**	425596	5719898	**62**	433602	5715123	**84**	423166	5712498
19	405716	5706303	**41**	429629	5719824	**63**	434746	5715115	**85**	419123	5712561
20	405733	5707230	**42**	429650	5721679	**64**	434746	5714197	**86**	419108	5711634
21	407468	5707198	**43**	435413	5721605	**65**	435320	5714188	**87**	417952	5711654
22	407502	5709052	**44**	435426	5722527	**66**	435310	5713262	**88**	417937	5710726

Table 4: Survey area coordinates – Block 2 (Centre)

#	Easting	Northing	#	Easting	Northing	#	Easting	Northing	#	Easting	Northing
1	445209	5720556	**8**	459092	5725425	**15**	454454	5722317	**22**	443471	5719648
2	445242	5724267	**9**	459087	5725060	**16**	452720	5722337	**23**	443459	5718721
3	445816	5724270	**10**	457936	5725069	**17**	452717	5721410	**24**	443227	5718724
4	445833	5725184	**11**	457934	5724953	**18**	448103	5721453	**25**	442888	5719307
5	456782	5725083	**12**	457801	5724953	**19**	448092	5720520	**26**	442896	5720582
6	456789	5726009	**13**	457810	5724143	**20**	446368	5720549			
7	458788	5725988	**14**	454467	5724175	**21**	446351	5719617			

Table 5: Survey area coordinates – Block 3 (East)											
#	**Easting**	**Northing**	**#**	**Easting**	**Northing**	**#**	**Easting**	**Northing**	**#**	**Easting**	**Northing**
1	481060	5745327	**15**	489683	5751780	**29**	489152	5744376	**43**	479705	5738838
2	481063	5746252	**16**	489685	5752707	**30**	489665	5743489	**44**	479325	5738858
3	482786	5746238	**17**	493140	5752719	**31**	489666	5743439	**45**	479404	5739763
4	482789	5747165	**18**	493120	5750847	**32**	488521	5743439	**46**	479891	5739763
5	483363	5747163	**19**	491974	5750849	**33**	488516	5742515	**47**	479895	5740687
6	483366	5748089	**20**	491972	5749922	**34**	487366	5742521	**48**	478185	5740696
7	484513	5748086	**21**	490826	5749924	**35**	487371	5742367	**49**	477778	5741367
8	484516	5749013	**22**	490824	5748997	**36**	487199	5742268	**50**	477871	5741459
9	486236	5749008	**23**	490250	5748998	**37**	486756	5743043	**51**	477271	5742191
10	486239	5749934	**24**	490249	5748071	**38**	481048	5739692	**52**	477435	5743353
11	487385	5749931	**25**	489102	5748074	**39**	481541	5738829	**53**	478582	5744403
12	487388	5750858	**26**	489101	5745288	**40**	479891	5738833	**54**	478761	5744403
13	489108	5750854	**27**	488529	5745293	**41**	479887	5738632	**55**	478762	5745333
14	489110	5751781	**28**	488523	5744382	**42**	479845	5738608			
1	476877	5741327	**25**	473371	5733303	**49**	465458	5729681	**73**	463771	5735217
2	476558	5740547	**26**	470802	5733319	**50**	465481	5729645	**74**	466066	5735204
3	476298	5739762	**27**	469470	5731973	**51**	466031	5729639	**75**	466085	5737975
4	477009	5739510	**28**	469539	5731858	**52**	466039	5730571	**76**	465534	5737987
5	477014	5738850	**29**	470476	5731856	**53**	466615	5730566	**77**	465519	5738016
6	478219	5738839	**30**	470474	5731466	**54**	466626	5731491	**78**	465523	5738915
7	478525	5736106	**31**	467774	5731484	**55**	467233	5731489	**79**	467239	5738901
8	478252	5735955	**32**	467764	5730556	**56**	467243	5731847	**80**	467249	5739834
9	478094	5736221	**33**	467192	5730562	**57**	467774	5731848	**81**	467826	5739829
10	474130	5736226	**34**	467180	5728933	**58**	467782	5732412	**82**	467829	5740757
11	474121	5734077	**35**	467406	5728544	**59**	462721	5732445	**83**	468404	5740752
12	477990	5734085	**36**	467178	5728415	**60**	462601	5732651	**84**	468413	5741677
13	478141	5733842	**37**	467012	5728708	**61**	462606	5733374	**85**	470705	5741663
14	478138	5733280	**38**	464877	5728723	**62**	459739	5733395	**86**	470710	5742587
15	475838	5733295	**39**	464865	5726866	**63**	459163	5734406	**87**	471860	5742579
16	475835	5732364	**40**	464286	5726874	**64**	459184	5737107	**88**	471867	5743506
17	473532	5732377	**41**	464281	5725942	**65**	462057	5737076	**89**	473018	5743502
18	473524	5730522	**42**	463127	5725956	**66**	462057	5738016	**90**	473029	5745351
19	471222	5730538	**43**	463122	5725025	**67**	465469	5737988	**91**	477101	5745338
20	471215	5729609	**44**	461968	5725036	**68**	465512	5737918	**92**	477818	5744233
21	470936	5729609	**45**	461973	5725965	**69**	465499	5736139	**93**	476966	5743473
22	470639	5730114	**46**	461400	5725969	**70**	461484	5736158			
23	470641	5730477	**47**	461412	5727431	**71**	461469	5734314			
24	471841	5731701	**48**	465459	5729811	**72**	463762	5734296			
1	476722	5740212	**2**	477023	5740532	**3**	477021	5739845			

3 TESTS AND CALIBRATIONS

The lag test was performed before and after the survey, while the FOM (Figure of Merit) test was performed at the beginning of the survey. Results are presented in appendix A.

FOM Magnetometer Test:

The effects of aircraft manoeuvres (roll, pitch and yaw) were determined by performing the test over a magnetically quiet zone, at a high altitude. It consisted of flying ±10º rolls, ±5º pitches and ±5º yaws peak to peak along North, South, East and West headings over periods of 4-5 seconds. A compensation FOM for the aircraft was calculated by summing up the peak-to-peak amplitudes of the 12 magnetic signatures.

Lag Test:

The helicopter performed a lag test to ascertain the time difference between the magnetometer readings and the positioning devices. The test was carried out by flying in opposite directions at the normal survey height over a distinct anomaly to determine any lag in the digitally-recorded navigational data.

4 AIRCRAFT AND EQUIPMENT

4.1 HELICOPTER

During field work, an Astar 350 D from Panorama Helicopters was used. Figure 2 shows the helicopter and the stinger.

Figure 2: Eurocopter Astar 350 D helicopter

4.2 MAGNETOMETER

The cesium G-822 sensor is a versatile and highly sensitive means of accurately measuring the Earth's total magnetic field intensity.

Based on the principle of optical pumping and monitoring, the cesium sensor is capable of resolving millisecond variations as small as 0.005 nT (gamma) or 1 part of 10,000,000 of the Earth's magnetic field. This unique process involves the interaction of the magnetic moment and angular momentum of the valence electron of cesium with the ambient magnetic field to produce an oscillation, whose frequency is dependent on the magnetic field intensity. The sensor, operating on an atomic process (using a split-beam design), contains no moving parts and is inherently simple, rugged, and accurate.

The following table describes the airborne magnetometer, which was mounted in a stinger, rigidly attached to the helicopter.

Magnetometer	
Manufacturer	Geometrics
Type and Model	Cesium G-822A
Ambient Range	20 000 - 100 000 nT
Sensitivity	± 0.003 nT
Absolute Accuracy	± 10 nT
Noise Envelope	0.10 nT
Sampling Rate	10 Hz

4.3 DIGITAL ACQUISITION SYSTEMS AND MAGNETIC COMPENSATOR

The magnetic field generated by the aircraft was compensated using DAARC500, an Automatic Aeromagnetic Digital Compensator system manufactured by RMS Instruments. The DAARC500 incorporates a sophisticated and flexible data acquisition system.

The DAARC500 is an instrument used to compensate or correct in real time the magnetic interference caused by the aircraft itself and aircraft maneuvering in the Earth's magnetic field, when using mounted, high-sensitivity magnetometers. The compensation accounts for the effects of permanent magnetism, induced magnetism, Eddy currents and also removes the heading errors caused by the sensors themselves. It provides a frequency bandwidth of DC to 0.9 Hz, the frequencies of interest for the geophysicist. Other bandwidths are optionally available. The signal from the magnetometer is digitized faithfully without aliasing or phase distortion.

Figure 3: RMS DAARC500 unit and its Graphical User Interface

The DAARC500 is based on many years of research and development on automatic aeromagnetic compensation by the National Aeronautical Establishment (NAE), a division of the National Research Council of Canada. Following the transfer of technology, RMS Instruments continued with the development resulting in an instrument that is not only extremely reliable, but is also capable of accepting the Larmor frequencies of up to four high-sensitivity magnetometers. Moreover, it is based on a highly sophisticated and equally robust compensation algorithm.

Geophysical instruments and sensors may be directly connected to the DAARC500, via 8 Outputs and Inputs, including high-speed RS232 digital ports and 16 analog Input ports as well as an ethernet port. Incoming data are processed in real time via serial ports. All acquired data are synchronized through a GPS receiver with a pulse-per-second (PPS) output.

4.4 GROUND BASE STATION MAGNETOMETER

A GEM Systems Inc. Overhauser ground magnetometer with a combined GPS system was used as ground base station. It provided synchronized GPS time and recorded the total intensity of the Earth's magnetic field with a resolution of 0.01 nT.

The magnetic base station was set up at a magnetic noise-free location, away from magnetic objects, vehicles and DC electrical power lines. The magnetometer sampled at a rate of once per second. Base station records, including GPS time, were dumped digitally on a computer, merged with airborne data, displayed and verified thoroughly.

The following table describes the base station magnetometer:

Mag. base station	
Manufacturer	GEM Systems Inc.
Type	Overhauser
Model	GSM-19 with GPS
Dynamic Range	20 000 - 120 000 nT
Sensitivity	± 0.01 nT
Sampling Rate	1 Hz
Noise Level	0.10 nT

Figure 4: Base station magnetometer and console

4.5 DIFFERENTIAL GPS AND NAVIGATION SYSTEM

A dual-frequency GPS antenna was mounted on the helicopter's tail. The following table describes the airborne GPS system, which obtained complete coverage and provided both real-time navigation and flight-path recovery:

Navigation system	
GPS Manufacturer & Model	Novatel DL-V3 L1/L2
Number of Channels	12
Sampling Interval	1 Hz
Differential System	SBAS
Navigation system	Agnav Guia LiNav 3D

Figure 5: GPS receiver and Navigation System

4.6 LASER ALTIMETER

A laser altimeter was used for measuring the distance between aircraft and ground accurately. The following table presents its technical characteristics:

Laser altimeter	
Manufacturer	Renishaw
Model	ILM-1200-R
Minimum Range	10 to 1200 meters
Accuracy	± 10 cm
Sampling rate	10 Hz

5 SURVEY SCHEDULE

The total number of line-km flown to cover the survey areas was 15,508. The helicopter (registration: C-GBOP) and field crew arrived on site on February 25, 2021. Data acquisition began on February 26.

Excluding calibration and test flights, 48 flights were flown to complete the four survey blocks.

6 FIELD AND OFFICE CREW

The general management of the project was handled offsite by Mr. Mouhamed Moussaoui. Mr. Saleh Elmoussaoui was in charge of data quality control to ensure the work was carried out according to contractual specifications. Mr. Mouhamed Moussaoui was also responsible for final data processing.

Field and office personnel are listed in the following table.

Table 6: Field and Office Crew

Function	Name
Project Manager	Mr. Mouhamed Moussaoui, P.Eng.
Data Quality Control	Mr. Saleh Moussaoui
Field Manager & instrument operator	Mr. Pierre Filion Mr. Pierre Gagnon
Professional Pilot	Mr. Stéphane Caron Mr. Francis Mathieu
Final Processing	Mr. Mouhamed Moussaoui, P.Eng.
CAD and final products	Mr. Khorram Khan, P.Geo.
Survey Technical Report	Mr. Khorram Khan, P.Geo.

7 QUALITY CONTROL - FIELD

The acquired data was sent to the office to maintain quality control. The processing system consisted of a computer equipped with commercial and custom software for GPS processing, profile and flight path plots and all processing software necessary to calculate intersections, and to carry out preliminary levelling and gridding (Geosoft Montaj).

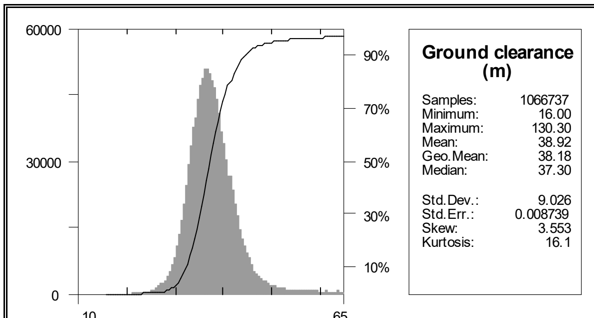
Digital data were verified to ensure the recorded parameters met the contract specifications. Positional data were analyzed to verify the accuracy of the differentially-corrected flight path.

7.1 GPS DATA

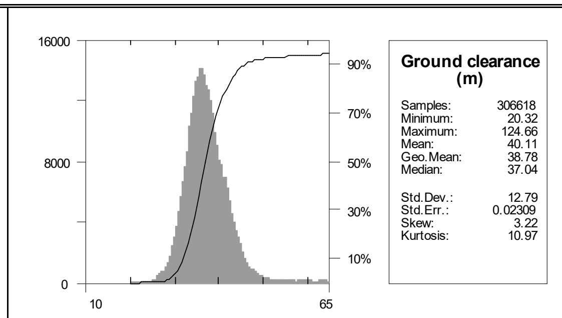
Survey navigation and positioning employed differential GPS. Following production, data including GPS positions were transferred to the office computer systems and merged into a database. The actual surveyed flight path was displayed and compared to the planned flight path (digitally). Errors were noted, and re-flights called, when necessary.

7.2 FLIGHT PATH SPECIFICATIONS

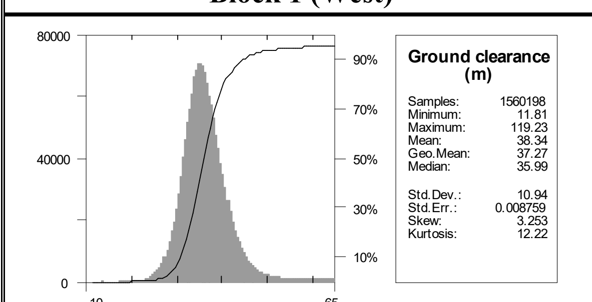
The survey height was controlled according to a pre-defined smooth drape surface. The average terrain clearance was 38.5 metres except in areas where Transport Canada regulations prevent flying at this height. In areas where obstacles or topography conflicted with the drape surface, the pilot's judgement prevailed within reason.



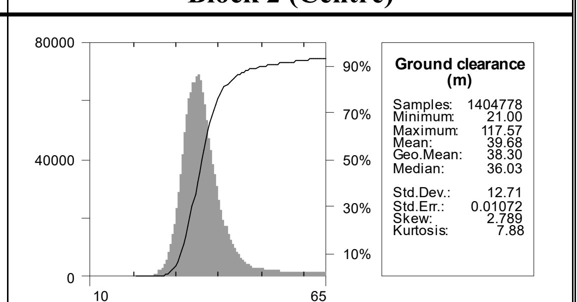
Block 1 (West)



Block 2 (Centre)



Block 3 (East)



Block Rose

Figure 6: Ground clearance

7.3 DIURNAL MONITORING

Diurnal magnetic variations were monitored and recorded using a base station. Base station and aircraft acquisition time were synchronized via GPS time.

A maximum tolerance of 3.0 nT (peak-to-peak) deviation from a long chord equivalent to a period of 30 seconds was respected. These specifications were verified in the field prior to demobilization.

The base station magnetometer was located at the following coordinates in WGS84:

Installation date	Longitude	Latitude	Mean value
February 24, 2021	76° 2'32.97"W	51°41'57.51"N	56 295nT

7.4 MAINTENANCE OF SPEED AND SAMPLING

The survey was flown at an average ground speed of 147 km/hour. As the data is recorded at a rate of 10 Hz, the density is equivalent to one sample data every 4.1 meters on the ground.

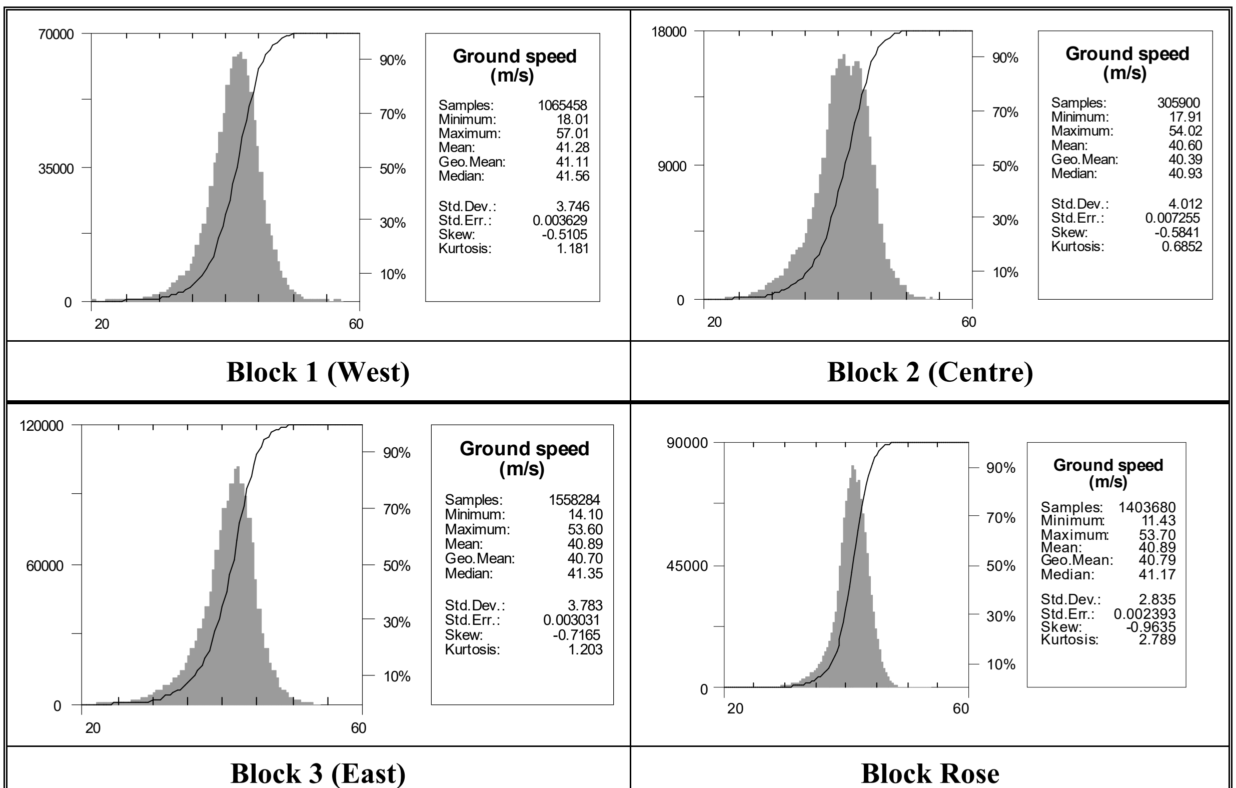


Figure 7: Aircraft ground speed statistics

7.5 MAGNETIC DATA

All magnetic data recorded in flight were checked for noise by an inspection of the fourth difference trace.

Magnetic values for traverse/tie line intersections were calculated and preliminary magnetic levelling was then carried out. Finally, preliminary magnetic grids were produced to ensure completeness and accuracy of data.

8 FINAL DATA PROCESSING

Since preliminary checks and corrections had already been made, it was not expected that any additional serious problems would be encountered afterward. Nevertheless, further correction and compilation procedures were carried out to detect and correct for any remaining isolated errors. The processing stages, such as position refinement, levelling and gridding through to final contours, are shown in figures 8 and 9. The processing was monitored closely by the Project Leader.

8.1 POSITIONING DATA (GPS AND ALTIMETERS)

The raw GPS data from the aircraft were recovered and corrected using Natural Resources Canada's online GPS processing service, CSRS-PPP (Canadian Spatial Reference System – Precise Point Positioning). The latitudes and longitudes were converted from WGS84 spheroid to local map projection and datum in UTM coordinates. A point-to-point speed calculation was then done from the final X, Y, Z coordinates and reviewed as part of quality control. The flight data was then trimmed to the proper survey line limits and a preliminary plot of the actual flight path was created and compared to the planned flight path to verify the navigation.

The positional data, which includes the laser altimeter and post-processed, corrected GPS elevation values, were checked and corrected for spikes using a fourth difference-editing routine. Some subtle noise filters, such as a non-linear filter of 3sec and a low-pass one of 3 sec, were then applied to the data. The filtered laser altimeter data were also lagged to account for system parallax.

A digital terrain model (DTM) was then computed by subtracting the altimeter values from the differentially corrected GPS elevation values.

8.2 MAGNETIC BASE STATION DATA

The recorded magnetic base station data were loaded into the flight database based on common GPS time stamps. Following initial verification, the data were checked and corrected for small DC shifts and cultural events.

8.3 AIRBORNE MAGNETIC DATA

The RMS DAARC500 binary raw data (mag., analog and serial inputs) were reformatted and loaded into the Geosoft Montaj database.

A detailed check of the magnetic data was completed. The magnetic data were lagged to correct for system parallax. The noise removed had a wavelength cut-off of 0.9sec.

The airborne magnetic data were corrected for diurnal drift by subtracting the ground magnetic base station data.

Magnetic data was corrected for altitude using the drape surface and Zgps values. The correction was calculated using the First Vertical Derivative grid of the pre-levelled magnetic data, then sampled into the database and multiplied by the differences between Zgps and drape surface.

Tie-line levelling process was applied to the data. This consisted of calculating the positions of the control points (intersections of traverses and tie lines), calculating the magnetic differences at the control points and analyzing them to produce a smooth pattern of adjustments to the levelling network to reduce the misclosures to zero. In areas of steep magnetic gradient and/or of rugged topographic relief, the intersection adjustments have been deleted or an appropriate adjustment assigned to a traverse line. A new grid was then created and checked for residual errors. Any gross errors detected were corrected in the profile database and the levelling process was repeated.

A standard micro-levelling procedure was also applied in order to remove minor imperfections visible on shadow images:

Area	Clipping*
Block 1 (West)	±3.0 nT
Block 2 (Centre)	±2.0 nT
Block 3 (East)	±2.0 nT
Block Rose	±2.0 nT

* Clipping values higher than specified here were locally used near powerlines.

To produce the Residual Magnetic Field, the International Geomagnetic Reference Field (IGRF) channel was first calculated from the year 2020 model with a constant survey date and a constant elevation, as shown in table 7. Subsequently, the IGRF was removed from the levelled magnetic data.

Table 7: IGRF calculation parameters			
Area	Model Year	Survey Date	Elevation (m)
Block 1 (West)	2020	01/03/2021	331m
Block 2 (Centre)	2020	13/03/2021	380m
Block 3 (East)	2020	16/03/2021	348m
Block Rose	2020	25/03/2021	317m

8.4 GRIDDING OF THE RESIDUAL MAGNETIC FIELD AND FIRST VERTICAL DERIVATIVE

The grid of the Residual Magnetic Field and its First Vertical Derivative were calculated by using the minimum curvature algorithm of Geosoft Montaj and gridded with a cell size equivalent to one quarter of the line spacing. i.e. 12.5m. Minimum curvature gridding provides the smoothest possible grid surface that also fits the profile line data.

The First Vertical Derivative of the magnetic field is the rate of change of the magnetic field in the vertical direction. Computation of the first vertical derivative removes long-wavelength features of the magnetic field and significantly improves the resolution of closely spaced and superposed anomalies. The grid of the First Vertical Derivative was computed from the gridded Residual Magnetic Field data using a fast Fourier transform.

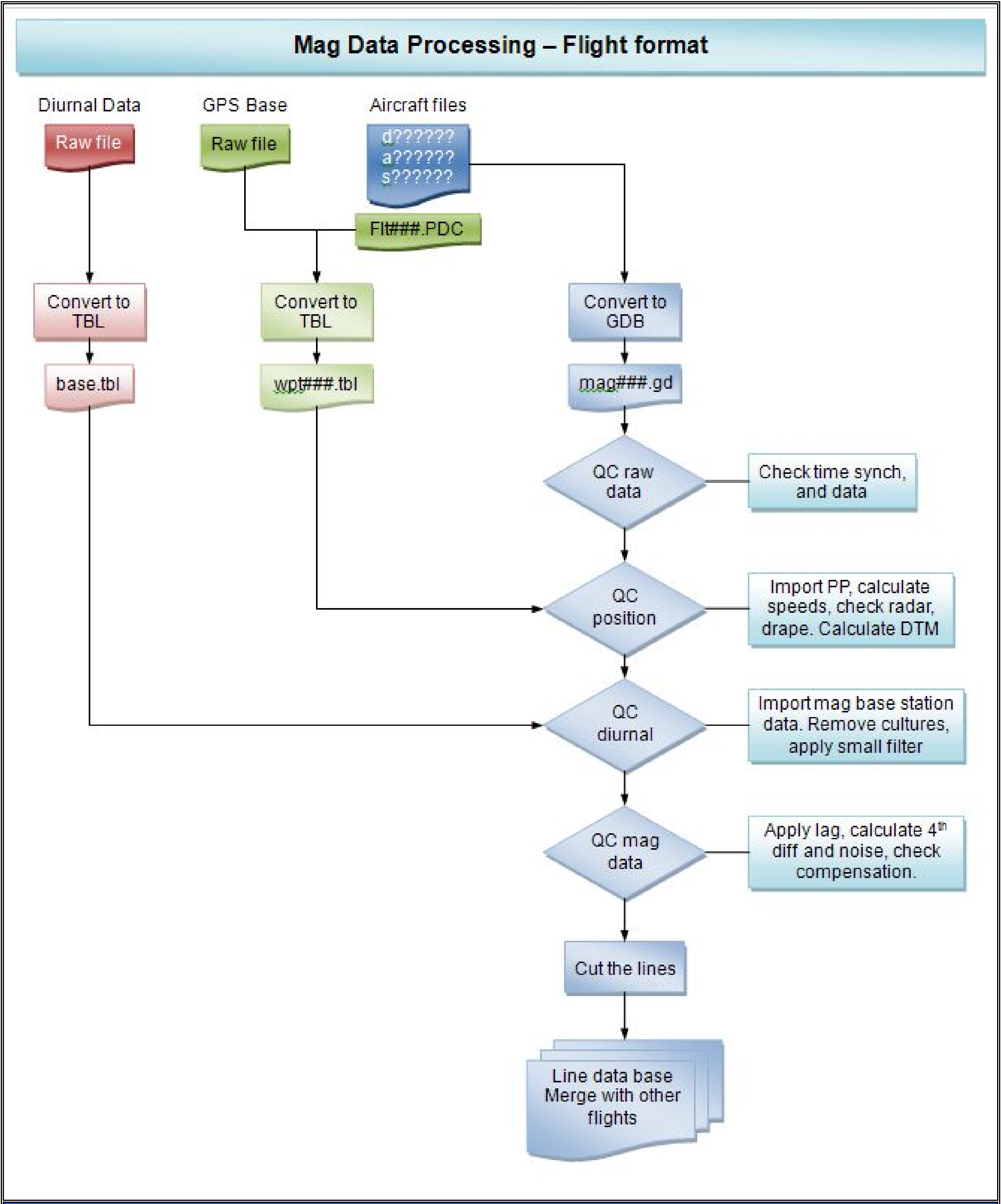


Figure 8: Magnetic data processing flowchart – Flight format

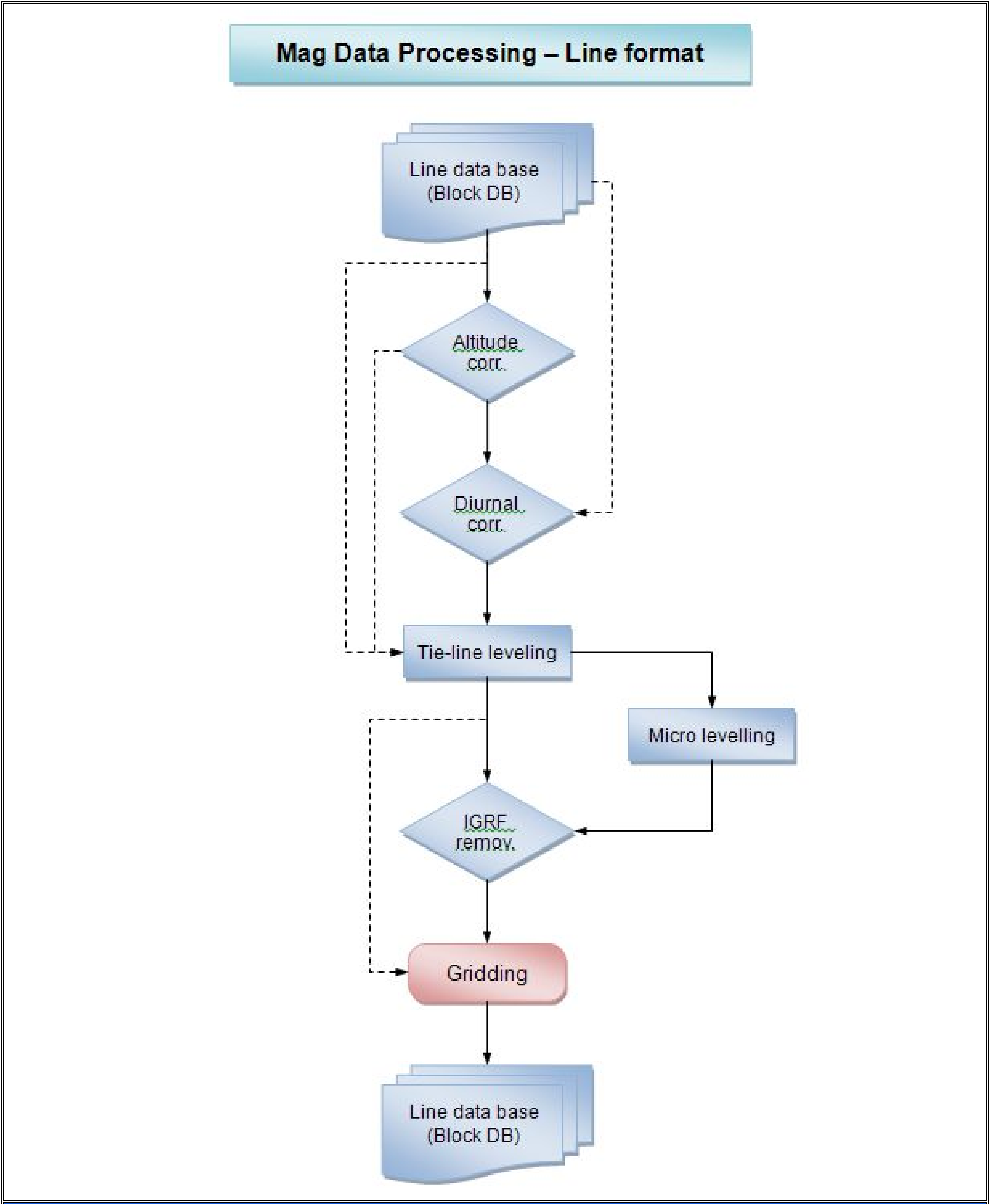


Figure 9: Magnetic data processing flowchart – Line format

9 FINAL PRODUCTS

9.1 COMPILATION SPECIFICS

Map Scale and projection:	1:50 000, NAD83 UTM zone 18
Map Scale and projection:	1:25 000, NAD83 UTM zone 18
Grid cell size:	12.5m

9.2 FINAL PRODUCTS

The following parameters were processed:

- Residual Magnetic Field data of the Magnetic Field data;
- First Vertical Derivative of the Magnetic Field data;
- Digital Terrain Model.

Data archives (table 8)

- One Geosoft format digital archive (GDB) of the final line data for each block (table 9);
- One Geosoft format grid file (GRD) of each processed parameter for each block;
- Maps of Residual Magnetic Field and its 1st vertical derivative in PDF and GeoTiff;
- Final technical report in PDF format.

Final Technical Report (2 paper copies)

Table 8: Digital archive content	
File	Description
\	
Archive content.pdf	Archive content description
GDS21004_HeliMag_C_E_Lithium_Report	Technical report (pdf)
\Database (Geosoft GDB format), where "area" is West, Centre, East or Rose	
Bloc "area"_Final_CELC.gdb / .pdf	Magnetic Database and channel description
\Grids (Geosoft GRD format, NAD83 UTM 18N), where "area" is West, Centre, East or Rose	
Magres_Bloc_"area".grd	Residual Magnetic Field Intensity
FVD_Bloc_"area".grd	First Vertical Derivative grid of the Magnetic Field
SVD_Bloc_"area".grd	Second Vertical Derivative grid of the Magnetic Field
DTM_Bloc_"area".grd	Digital Terrain Model from Laser Altimeter
West\Maps (NAD83 UTM 18N) PDF and GeoTiff	
RMFCE_BLOCK1_50K.pdf / .tif	Residual Magnetic Field Intensity for Block 1 (West)
FVDCE_BLOCK1_50K.pdf / .tif	First Vertical Derivative of the Magnetic Field for Block 1 (West)
RMFCE_BLOCK1_EAST_25K.pdf / .tif	Residual Magnetic Field Intensity for Block 1 (West) eastern section
FVDCE_BLOCK1_EAST_25K.pdf / .tif	First Vertical Derivative of the Magnetic Field for Block 1(West) eastern section
RMFCE_BLOCK1_WEST_25K.pdf / .tif	Residual Magnetic Field Intensity for Block1 (West) western section
FVDCE_BLOCK1_WEST_25K.pdf / .tif	First Vertical Derivative of the Magnetic Field for Block 1(West) western section
West\ Maps\ Lambert (NAD83, Quebec-Lambert) GeoTiff	
RMFCE_BLOCK1_Lambert.tif	Residual Magnetic Field Intensity for Block 1 (West)
FVDCE_BLOCK1_Lambert.tif	First Vertical Derivative of the Magnetic Field for Block 1 (West)
Centre\Maps (NAD83 UTM 18N) PDF and GeoTiff	
RMFCE_BLOCK2_25K.pdf / .tif	Residual Magnetic Field Intensity for Block 2 (Centre)
FVDCE_BLOCK2_25K.pdf / .tif	First Vertical Derivative of the Magnetic Field for Block 2 (Centre)
Centre\ Maps\ Lambert (NAD83, Quebec-Lambert) GeoTiff	
RMFCE_BLOCK2 _Lambert.tif	Residual Magnetic Field Intensity for Block 2 (Centre)
FVDCE_BLOCK2 _Lambert.tif	First Vertical Derivative of the Magnetic Field for Block 2 (Centre)
East\ Maps (NAD83 UTM 18N) PDF and GeoTiff	
RMFCE_BLOCK3_50K.pdf / .tif	Residual Magnetic Field Intensity for Block 3 (East)
FVDCE_BLOCK3_50K.pdf / .tif	First Vertical Derivative of the Magnetic Field for Block 3 (East)
RMFCE_BLOCK3_EST_25K.pdf / .tif	Residual Magnetic Field Intensity for Block 3 (East) eastern section
FVDCE_BLOCK3_EST_25K.pdf / .tif	First Vertical Derivative of the Magnetic Field for Block 3 (East) eastern section
RMFCE_BLOCK3_WEST_25K.pdf / .tif	Residual Magnetic Field Intensity for Block 3 (East) western section
FVDCE_BLOCK3_WEST_25K.pdf / .tif	First Vertical Derivative of the Magnetic Field for Block 3(East) western section
East\ Maps\ Lambert (NAD83, Quebec-Lambert) GeoTiff	
RMFCE_BLOCK3_Lambert.tif	Residual Magnetic Field Intensity for Block 3 (East)
FVDCE_BLOCK3_Lambert.tif	First Vertical Derivative of the Magnetic Field for Block 3 (East)
Rose\ Maps (NAD83 UTM 18N) PDF and GeoTiff	
RMFCE_ROSE_25K.pdf / .tif	Residual Magnetic Field Intensity for Block Rose
FVDCE_ROSE_25K.pdf / .tif	First Vertical Derivative of the Magnetic Field for Block Rose
Rose\Maps\Lambert (NAD83, Quebec-Lambert) GeoTiff	
RMFCE_Rose_Lambert.tif	Residual Magnetic Field Intensity for Block Rose
FVDCE_Rose_Lambert.tif	First Vertical Derivative of the Magnetic Field for Block Rose
CELC_name of block-Maps.xlsx .pdf	Map description file

Where "area" is "West", "Centre", "East" or "Rose"

Table 9: Final database channels			
Channel Name	Description	Units	Sample rate
UTC	UTC time in second after midnight	sec	0.1
Line	Line number		0.1
Flt	Flight number		0.1
Date	Date of flight line	yyyy/mm/dd	0.1
Lon	Differentially Corrected Longitude (WGS84)	Degree	0.1
Lat	Differentially Corrected Latitude (WGS84)	Degree	0.1
X	Differentially Corrected Easting (NAD83, UTM zone 18N)	Meter	0.1
Y	Differentially Corrected Northing (NAD83, UTM zone 18N)	Meter	0.1
Z	Differentially Corrected GPS Altitude (MSL)	Meter	0.1
Drape	Flight Surface	Meter	0.1
Laser_Final	Laser altimeter	Meter	0.1
DTMlaser	Digital Terrain Model from laser altimeter	Meter	0.1
BaseA	Magnetic base station data	nT	0.1
Magu	Raw uncompensated, unlagged mag	nT	0.1
Magul	Raw uncompensated, lagged mag	nT	0.1
Magc	Compensated, unlagged mag	nT	0.1
Magclc	Compensated, lagged and corrected mag	nT	0.1
Drift_LF	Diurnal correction	nT	0.1
Magbc	Diurnal corrected mag (Magclc - Drift_LF)	nT	0.1
Coralt	Altitude correction values (using drape surface as reference)	nT	0.1
Magalt	Altitude corrected mag (Magbc + Coralt)	nT	0.1
Corlvl	Tie-line levelling corrections to mag	nT	0.1
Maglvl	Tie-line levelled mag (Magalt + Corlvl)	nT	0.1
Cormicro	Microlevelling corrections	nT	0.1
Magmicro	Microlevelled mag (Maglvl - Cormicro)	nT	0.1
IGRF	IGRF correction	nT	0.1
Magres	Levelled residual magnetic field	nT	0.1
FVD_f	First Vertical Derivative (final)	nT/m	0.1
SVD_f	Second Vertical Derivative (final)	nT/m^2	0.1

Magres = Magclc - Drift_LF + Coralt + Corlvl - Cormicro - IGRF

10 CONCLUSION

On February. 18, 2021, **GDS** was awarded this project, P21004, by **CELCORP**. The contract entailed GDS to carry out a high-resolution helicopter-borne magnetic survey on their Quebec's Eeyou Istchee James Bay properties.

The survey was flown between February 26 and March 29, 2021.

All airborne and ground-based records were of excellent quality. Using the fourth difference of the lagged and corrected airborne magnetic data, the noise level for the measured Total Magnetic Field was determined to be well within acceptable limits.

GPS results proved to be of high quality. The flight path was verified accurately according to the available digital elevation model. The speed checks showed no abnormal jumps in the data.

It is hoped that the information presented in this report, and in the accompanying products, will be useful both in planning and leading subsequent exploration efforts and in the interpretation of related exploration data.

Respectfully Submitted,

Khorram Khan, P.Geo. (OGQ #2152)
Geo Data Solutions GDS Inc.

April 15, 2021
(Date)

APPENDIX A

CALIBRATION AND TEST

FOM Test

Geo Data Solutions GDS Inc.

Location: Nemiscau,Baie James,QC
Pilot: Stephane Caron
Operator: Pierre Filion
Compiled by: Saleh Elmoussaoui

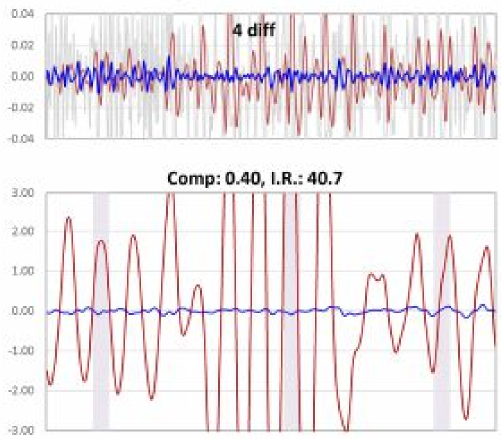
Date: 26-Feb-21
Aircraft: C-GBOP
Config: Stinger
Altitude: 8,970.4 ft

FOM Results:
Uncomp. Mag: 48.99 nT
Comp. Mag: 1.28 nT
Improv. Ratio: 38.33

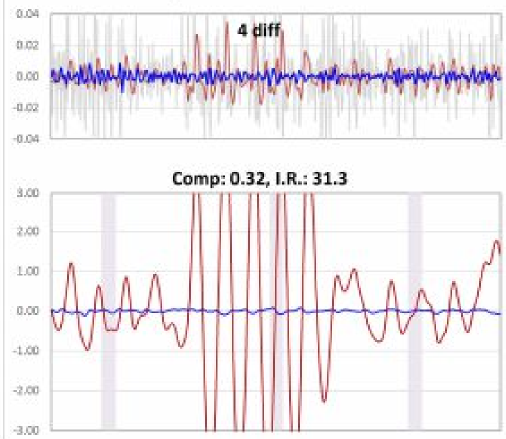
Manoeuvres	90°	180°	280°	360°	Total
Pitch	1.36	0.75	4.27	2.76	**9.13**
Roll	11.74	8.62	7.37	4.38	**32.11**
Yaw	3.34	0.79	3.15	0.47	**7.75**
Total	**16.44**	**10.16**	**14.79**	**7.60**	**48.99**

Manoeuvres	90°	180°	280°	360°	Total
Pitch	0.10	0.09	0.18	0.07	**0.43**
Roll	0.09	0.18	0.08	0.08	**0.43**
Yaw	0.22	0.06	0.05	0.09	**0.42**
Total	**0.40**	**0.32**	**0.31**	**0.24**	**1.28**

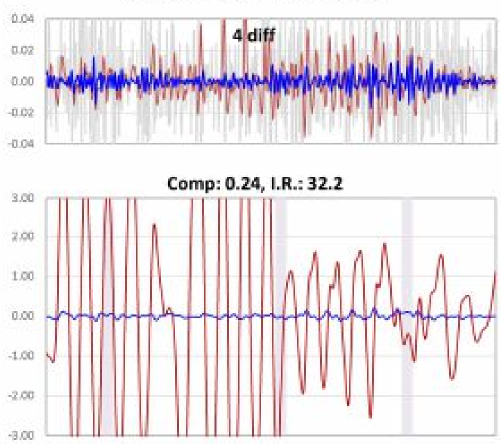
Compensation on dir 90°



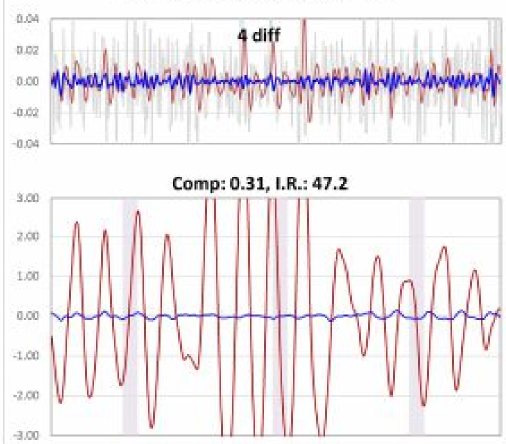
Compensation on dir 180°



Compensation on dir 360°



Compensation on dir 280°

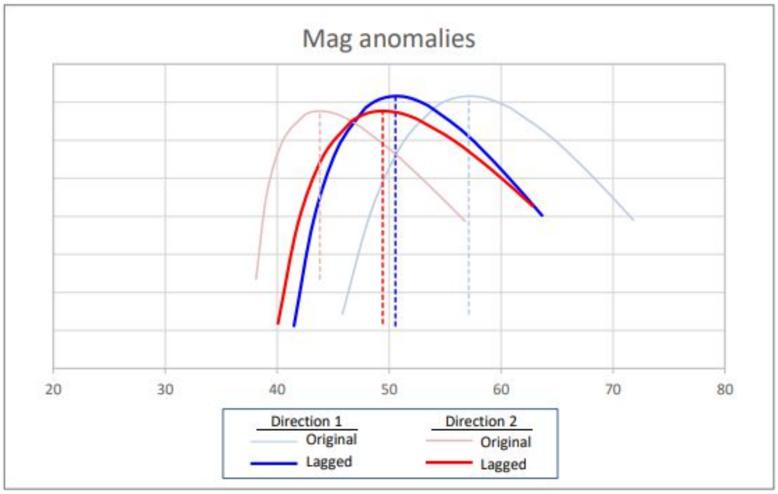


Lag Test

Geo Data Solutions GDS Inc.

Test Location: Camp Relais 381km (Baie James)
Date: 28-Jan-21
Compile: Saleh Elmoussaoui

Aircraft: C-GBOP
Configuration: Stinger
Apply Tail Lag: **+0.2**



	Line	Fiducial (sec)	X (m)	Y (m)	Z (m)	Mag Field (nT)	Vx (m/s)	Vy (m/s)	Speed (m/s)
A)	10010	66500.30	652276.58	5552893.89	292.16	55950.847	42.65	1.12	42.68
B)	10011	66567.00	652291.49	5552896.75	289.56	55960.836	-41.83	-1.08	41.87

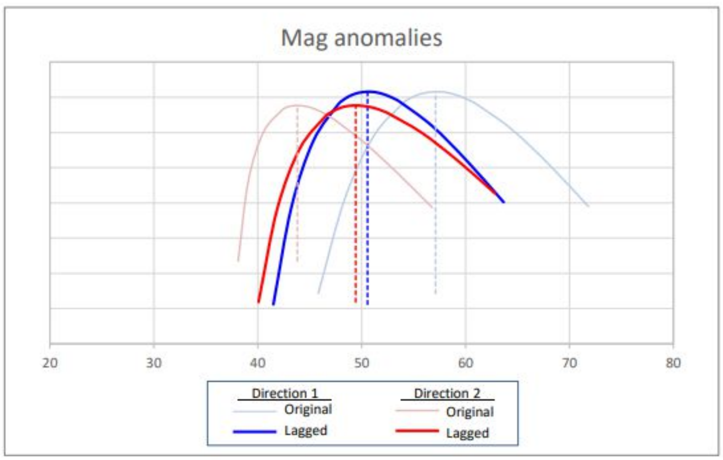
$$Lag = \frac{\sqrt{(X_2 - X_1)^2 + (Y_2 - Y_1)^2}}{V_1 + V_2}$$

Ave Speed = **42.28 m/s**
Distance = **15.18 m**
Tail Lag = **+0.18 sec**

Lag Test
Geo Data Solutions GDS Inc.

Test Location: CAMP NEMISCAU (Baie James)
Date: 26et28/03/2021
Compile: Saleh Elmoussaoui

Aircraft: C-GBOP
Configuration: Stinger
Apply Tail Lag: **0.17**



	Line	Fiducial (sec)	X (m)	Y (m)	Z (m)	Mag Field (nT)	Vx (m/s)	Vy (m/s)	Speed (m/s)
A)	11570	69652.60	409630.66	5764505.95	317.96	56363.650	19.80	-33.43	38.88
B)	11571	60740.00	409633.89	5764493.08	309.34	56417.129	-19.48	34.73	39.95

$$Lag = \frac{\sqrt{(X_2 - X_1)^2 + (Y_2 - Y_1)^2}}{V_1 + V_2}$$

Ave Speed = **39.42 m/s**
Distance = **13.27 m**
Tail Lag = **+0.17 sec**