SOUTH SIMCOE COUNTY AREA

Ontario Airborne Geophysical Surveys
Magnetic and Electromagnetic Data
Geophysical Data Set 1070

Ontario Geological Survey
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CREDITS

List of accountabilities and responsibilities:

- Jack Parker, Senior Manager, Precambrian Geoscience Section, Ontario Geological Survey (OGS), Ministry of Northern Development and Mines (MNDM) – accountable for the airborne geophysical survey projects, including contract management
- Tom Watkins, Team Leader, Information & Marketing Services Section, Ontario Geological Survey, MNDM – managed the project-related hard copy products
- Desmond Rainsford, Geophysicist, Precambrian Geoscience Section, Ontario Geological Survey, MNDM – responsible for the airborne geophysical survey project management, quality assurance (QA) and quality control (QC)
- Data acquisition, compilation and map production by Aeroquest Surveys, Mississauga, Ontario.

DISCLAIMER

To enable the rapid dissemination of information, this digital data has not received a technical edit. Every possible effort has been made to ensure the accuracy of the information provided; however, the Ontario Ministry of Northern Development and Mines does not assume any liability or responsibility for errors that may occur. Users may wish to verify critical information.

Users of OGS products are encouraged to contact those Aboriginal communities whose traditional territories may be located in the mineral exploration area to discuss their project.

CITATION

Information from this publication may be quoted if credit is given. It is recommended that reference be made in the following form:

Ontario Geological Survey 2012. Ontario airborne geophysical surveys, magnetic and electromagnetic data, south Simcoe County Area; Ontario Geological Survey. Geophysical Data Set 1070.

1.0 INTRODUCTION

Airborne geophysics is an integral part and core function of the Ontario Geological Survey's ("OGS") geoscience activities. The Ministry's objective is to evaluate the Time-Domain EM method for delineating subsurface sand and gravel aquifers, some of which are associated with buried bedrock valleys in southwestern Ontario as part of its groundwater mapping activities. The area chosen was selected as a) it is within an on-going aquifer mapping project area, b) there is relatively good subsurface information as a result of recent drilling and c) it includes a variety of bedrock and surficial materials. This report describes a helicopter-borne geophysical survey carried out by Aeroquest Surveys in the south Simcoe County area.

The principal geophysical sensor used was an Aeroquest Surveys AeroTEM™ IV helicopter-borne time-domain electromagnetic system which was employed in conjunction with a high-sensitivity caesium vapour magnetometer, differential GPS navigation, radar altimeter, video recording device and a base station magnetometer.

The AeroTEM™ IV system records full-waveform streaming EM data with final outputs of X and Z components and on and off time data sets. Auxiliary data streams are recorded and correlated with the EM data using UTC time synchronization.

The total delivered survey coverage was 1898.6 line-km, of which 1846.7 line-km fell within the defined project area (Figure 1a, 1b). The survey was flown over one block named as *south Simcoe County Area*. The traverse line direction is North 72° East (72°/252°) with a line spacing of 200 m, the control (tie) lines flown perpendicular at 1500 m line spacing

All survey flying described in this report took place between March 13th and 18th, 2012. Prior to the survey system calibration and accuracy tests were conducted from March 11th to 18th, 2012. This report describes all aspects of the contracted survey, including details of the testing, acquisition and processing procedures involved in this project.

2.0 SURVEY LOCATION AND GEOLOGY

The south Simcoe County survey area is located in the southern part of Simcoe County in an area that is largely agricultural (Figures 1a, 1b). Depth to bedrock ranges between approximately 70 and 180 m with greatest thicknesses being present in uplands on the northern and southern parts of the survey area. Broad, southwest- and north-trending valleys following the courses of Innisfil Creek and the Nottawasaga River, respectively are incised into the uplands resulting in a total surface relief of about 100 m across the survey area.
The survey area is underlain by relatively flat-lying carbonate and fine-grained terrigenous lithologies of Upper to Middle Ordovician age. The northeastern half of the survey area is underlain by very fine- to coarse-grained fossiliferous limestones and argillaceous limestones of the Lindsay Formation. To the southwest are black shales of the Blue Mountain Formation and interbedded grey-green to grey-blue shales, siltstone and limestone of the Georgian Bay Formation. Current understanding of the contact between these 2 distinct bedrock domains is based on limited

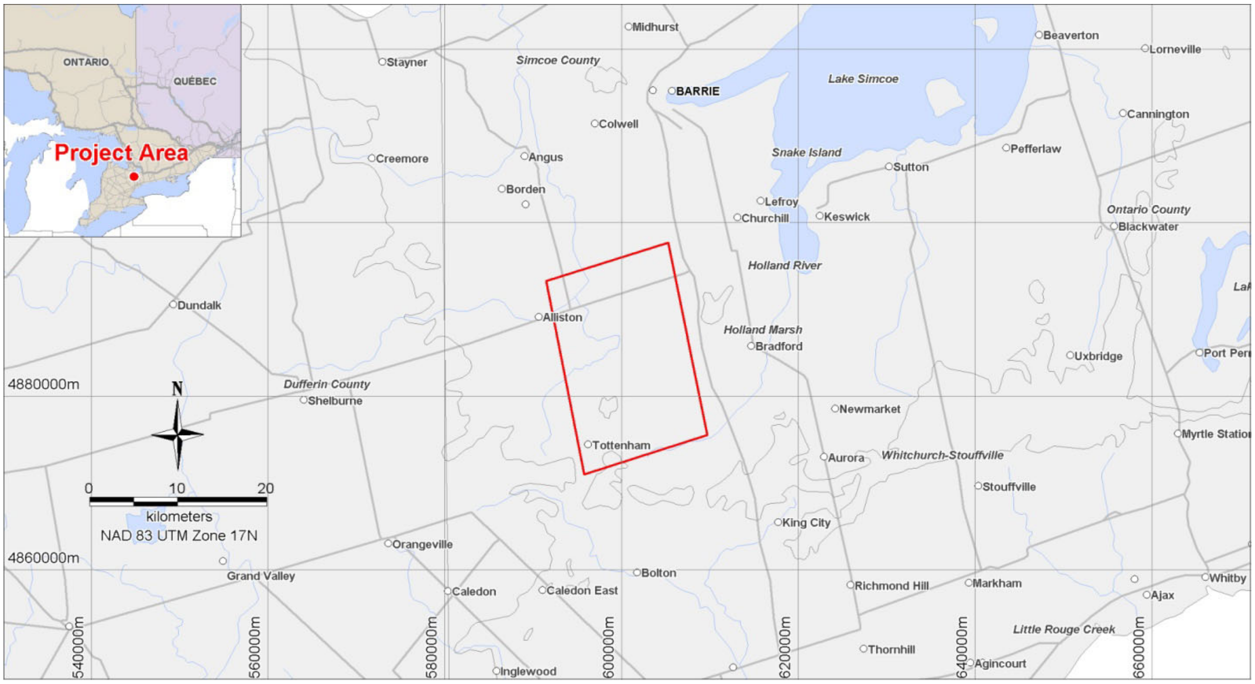

Figure 1a. Survey area associated with surrounding region and location within Ontario.

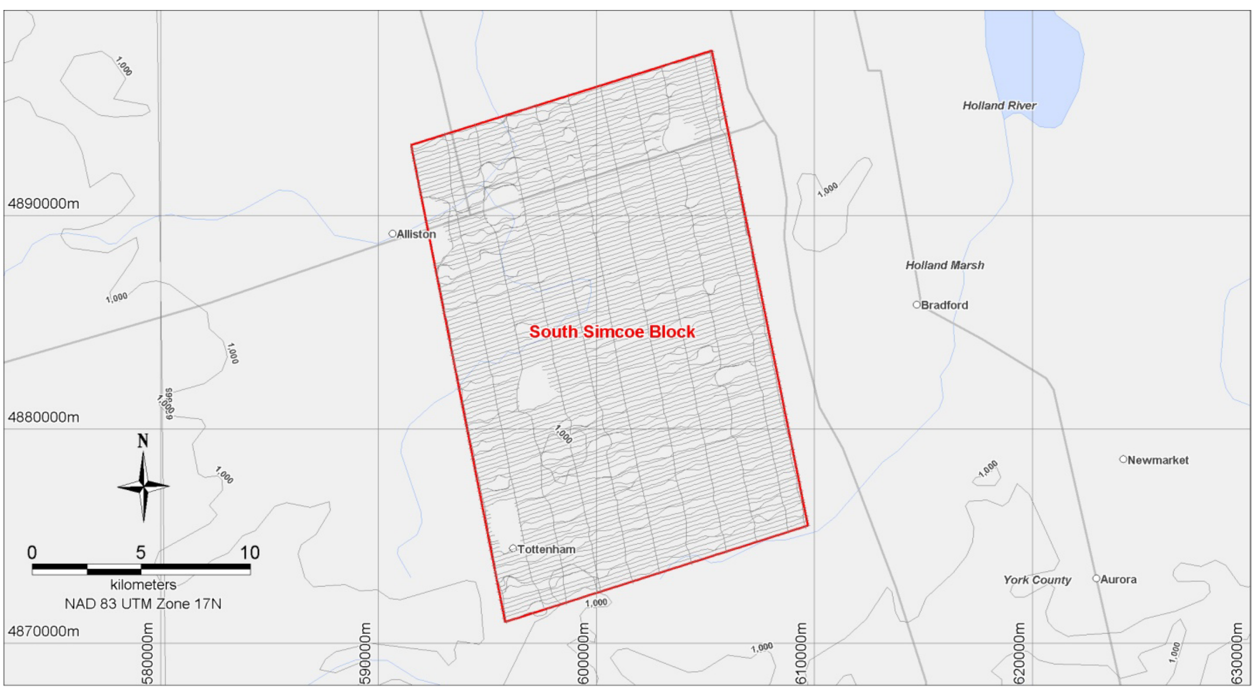

Figure 1b. Focused survey area – south Simcoe County area with traverse and control lines.

subsurface information. Incised into the bedrock surface are a series of channels the most notable of which extends north-south through the central portion of the study area (Laurentian channel). Estimated depths of this channel could exceed 30 m. The Quaternary sediments, overlying the bedrock, comprise glacial and fluvial deposits ranging in composition from coarse gravels to clays. The distribution of these surficial deposits is shown in Figure 2.

A first phase of overburden drilling has been undertaken within the south Simcoe County study area and provides some insight on the stratigraphic units overlying bedrock. The stratigraphic sequence encountered in upland boreholes is generally consistent across the study area and consists of an upper package of silty to sandy tills with discontinuous clay cover capping a thick sequence of well laminated silts and clays. Older, well bedded deposits of sand and gravel, silt and clay and till have been encountered at depth in most upland boreholes and suggest some continuity in the subsurface. A coarse gravel unit overlying bedrock in borehole SS-11-02 appears to be spatially associated with the Laurentian buried bedrock channel. Mapping these lower aquifers is of interest to the survey.

Boreholes drilled within the incised lowlands crossing the study area generally contain a stratigraphic record quite different from that observed in the uplands. The lowlands contain a significantly younger sediment fill. An erosive event followed by a period of sedimentation resulted in a thick, fining-upward sequence of sand and gravel followed by fine-grained silt and clay being inset into the older strata. To the west, along the valley of the Nottawasaga River, these silts and clays are overlain by variable thicknesses of stratified sands. The depth of incision into the older upland deposits is not known at this time. It is hoped that the results of this survey will assist with determining depth of incision as well as the distribution of deeply buried aquifers within the confines of the valleys.

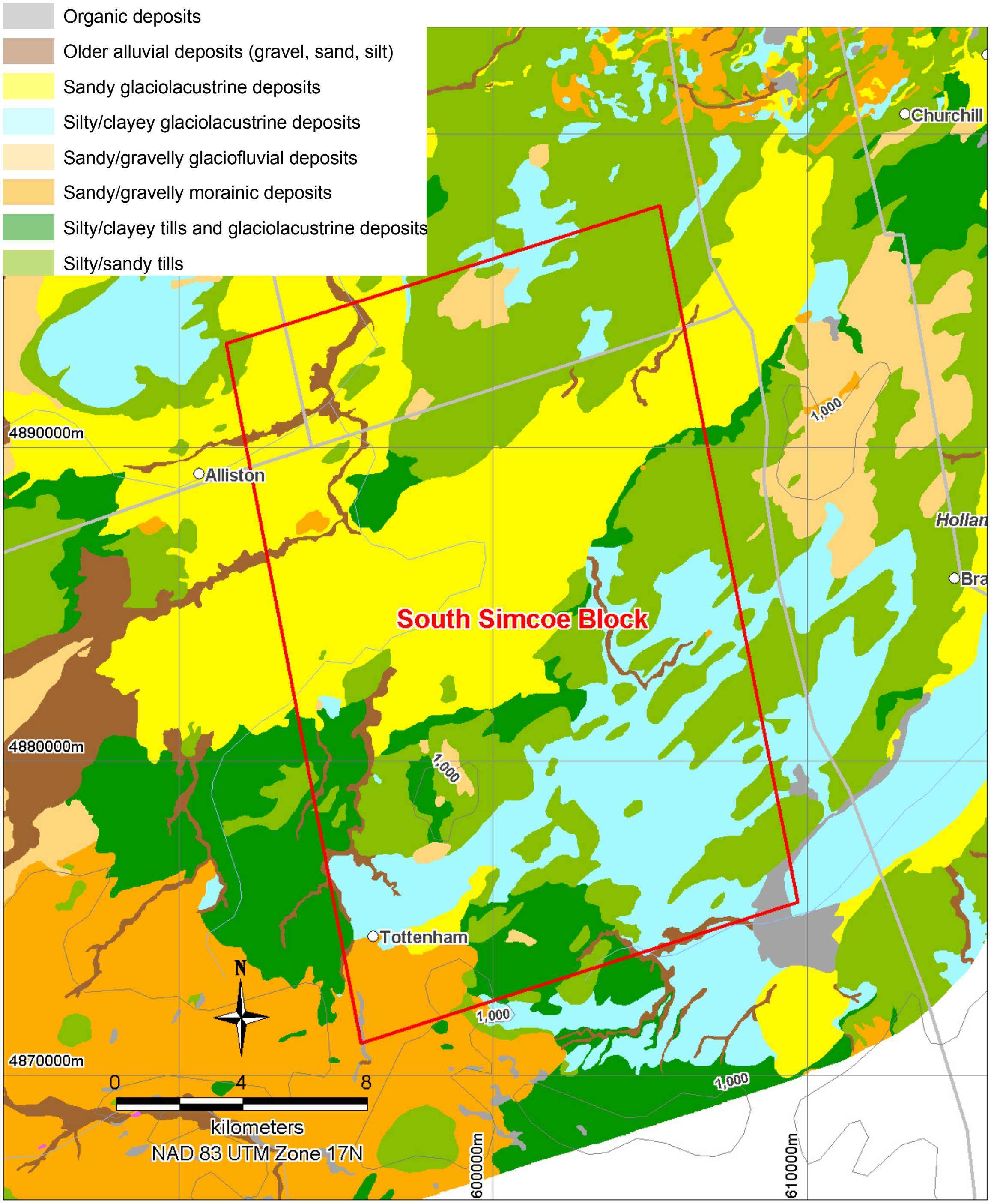

Figure 2. Limits of survey area superimposed on Quaternary geology of the south Simcoe County area.

3.0 SURVEY SPECIFICATIONS

The survey flight and noise specifications for the south Simcoe County area follows.

3.1 FLIGHT SPECIFICATIONS

The total line kilometres flown of the survey area along with extended boundary were calculated by adding up the along-line distance of the survey lines, control (Tie) lines and boundary lines presented in the final binary database (i.e. 1898.6 line-km).

Traverse line spacing and direction:

- flight line spacing was 200 m
- flight line direction was 072° to 252° azimuth from true north

Control line spacing and direction:

- control line spacing was at regular 1500 m intervals
- control line direction was 169° to 349° azimuth from true north

Boundary lines:

- boundary lines were flown parallel with and approximately 100 m in from the edges of the survey area

Nominal terrain clearance of the EM receiver bird:

- terrain clearance of the EM system was 44 m

3.2 NOISE SPECIFICATIONS

Magnetic diurnal variation:

- no control line data were accepted within 5 minutes of those periods of change where the change in the diurnal field exceeded 3.0 nT peak-to-peak deviation from a long chord equivalent to a period of one minute.
- base station noise levels were required to not exceed 0.1 nT

Magnetometer noise envelope:

- toleration of a maximum fourth difference calculation of 0.2 nT of the unfiltered magnetic data
- this excludes areas where the above specification is exceeded due to natural and man-made anomalies

4.0 AIRCRAFT, EQUIPMENT AND PERSONNEL

All data acquisition, including logistics, aircraft, personnel and equipment for this project was contracted to Aeroquest Surveys.

4.1 AIRCRAFT

Aircraft	Eurocopter AS 350 B3 helicopter
Operator	Kelner Helicopters
Registration	C-FVFK

Installation of the geophysical and ancillary equipment was carried out by a licensed aircraft engineer in conjunction with Aeroquest Surveys personnel.

4.2 EQUIPMENT

4.2.1 TOWED GEOPHYSICAL EQUIPMENT

Time Domain EM system:

- Transmitter
    - Waveform: Bipolar symmetric triangular pulse, 1.75 ms duration typical
    - Tx Loop: 12 m nominal diameter, vertical dipole
    - Peak Current: 393A
    - Peak dipole moment: 222 kNIA
    - Base frequency: 90 Hz
- Receiver
    - Type: Vertical "Z" axis and horizontal in-line "X" axis coils
    - Configuration: Mechanically bucked, rigidly attached to Tx
- Recording
    - Raw Streaming Data: Full sampling of Z and X component data at 36,000 Hz
    - Final output: 10 Hz sampling
    - At normal survey speed data are recorded approximately every 2.2 m
- Physical Characteristics
    - Sling Weight: 650 Kg
    - Tow cable length: 50.3 m
    - Nominal survey height 30 to 50 m
    - Nominal survey speed of 80 km/h

Figure 3 shows the typical waveform and response with the 33 time gates.

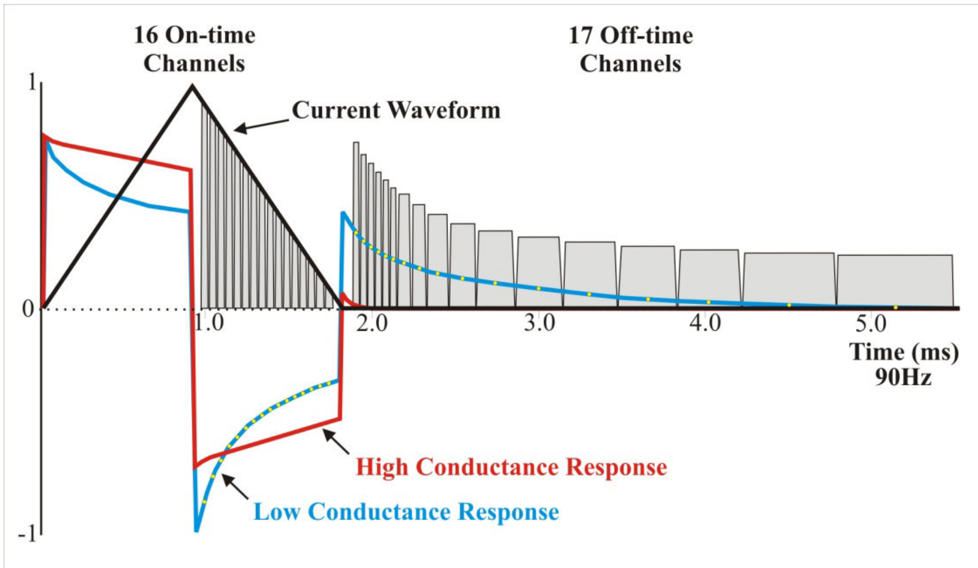

Figure 3: The AeroTEM™ waveform and response.

Airborne Magnetometer:
The airborne survey system employs a Geometrics G-823A caesium vapour magnetometer sensor installed in a two metre towed bird attached 17 m below the helicopter to the main tow line. The sensitivity of the magnetometer is 0.002 nT. The nominal ground clearance of the magnetometer bird is 80 m. The magnetic data is recorded at 10 Hz by the AeroDAS acquisition system.

GPS Antenna:
The GPS antenna was mounted on the magnetometer bird on the tow cable and connected through to a Mid-Tech RX400p GPS receiver carried on board. This data is streamed to the pilot for displayed real time spatial information as well as to the AeroDAS acquisition system where it is stored.

4.2.2 ON BOARD AND MOUNTED EQUIPMENT

Digital Data Recorder:
The full AeroTEM™ received waveform sampled during on and off-time at 200 channels per decay, 180 times per second and is logged by the proprietary AeroDAS data acquisition system. The channel sampling commences at the start of the Tx cycle and the width of each channel is 27.778 µs.

The ancillary data (i.e. the positional and secondary geophysical) including magnetics, radar altimeter, GPS position, processed 6 channel EM, and time is also recorded by the AeroDAS data acquisition system. The ancillary data can be viewed on the color monitor and is used for onboard quality control. Data are recorded at 10Hz.

Navigation System:
The navigation system consists of an Ag-Nav AG-NAV GPS navigation system comprising a PC-based acquisition system, navigation software, a deviation indicator in front of the aircraft pilot to direct the flight, a full screen display with controls in front of the operator, a Mid-Tech RX400p

WAAS-enabled GPS receiver mounted on the instrument rack (Figure 4) and an antenna mounted on the magnetometer bird. WAAS (Wide Area Augmentation System) consists of approximately 25 ground reference stations positioned across the United States that monitor GPS satellite data. Two master stations located on the east and west coasts collect data from the reference stations and create a GPS correction message. This correction accounts for GPS satellite orbit and clock drift plus signal delays caused by the atmosphere and ionosphere. The corrected differential signal is then broadcast through one of two geostationary satellites. The corrected position has a published accuracy of less than 3 metres. Survey co-ordinates are set up prior to the survey and the information is fed into the airborne navigation system. The real-time differentially corrected GPS positional data was recorded by the AeroDAS acquisition system in geodetic coordinates (latitude and longitude using WGS84) at 0.2 s intervals.

Figure 4: AeroTEM™ Instrument Rack

Radar Altimeter:
A Terra TRA 3500/TRI-30 radar altimeter was used to record terrain clearance. The antenna was mounted on the outside of the helicopter beneath the cockpit. Therefore, the recorded data reflect the height of the helicopter above the ground. The Terra altimeter has an altitude accuracy of ±1.5 m.

Video System:
A high resolution digital colour 8 mm video camera was used to record the helicopter ground flight path along the survey lines. The video was digitally annotated with GPS position and time and recorded on a DVD Express DX2. The video can be used to verify ground positioning information and cultural causes of anomalous geophysical responses. The camera itself was

mounted beneath the helicopter to provide a clear, bird's eye image of the EM system in flight and the terrain below.

4.2.3 BASE STATION EQUIPMENT

Two proprietary Aeroquest Surveys base station systems were used to record the diurnal variation of the magnetic field. Each system incorporates a Scintrex EnviMag high sensitivity proton-precession magnetometer sensor, a digital data acquisition console (i.e., Scintrex Envi. System). The data are recorded at 0.5 Hz.

4.3 PERSONNEL

The following Aeroquest Surveys personnel were involved in the project:

- Field Processing: Thomas Wade
- Field Operations: Viktor Shevchenko
- Project Management: Jonathan Rudd
- Operations Management: Lee Harper
- Processing Management: Doug Garrie
- Data Processing, Interpretation and Reporting: Chris Kahue, Kyle Orlowski

Survey pilot Joel Breton and helicopter engineer Chris Snell were employed directly by the helicopter operator, Kelner Helicopters.

5.0 CALIBRATION AND TEST DATA

The following tests and calibrations were performed and approved prior to the commencement of the survey flying and at the end of survey. The details of these calibrations are provided in the Appendices as indicated below:

APPENDIX B – GPS ACCURACY TEST
APPENDIX C – RADAR ALTIMETER TEST
APPENDIX D – MAGNETOMETER LAG TEST
APPENDIX E – MAGNETOMETER CLOVERLEAF
APPENDIX F – DAILY CALIBRATION

6.0 LOGISTICS

The survey was flown using a privately owned airstrip near Tottenham as a base for the field crew and helipad for the helicopter AeroTEM™ system. The airstrip was selected as a base of operations due to its close proximity to the survey area, and local emergency services to support the field crew.

A fuel truck was brought to the site to supply fuel.

7.0 DATA ACQUISITION AND ARCHIVING

The general data acquisition process is described below.

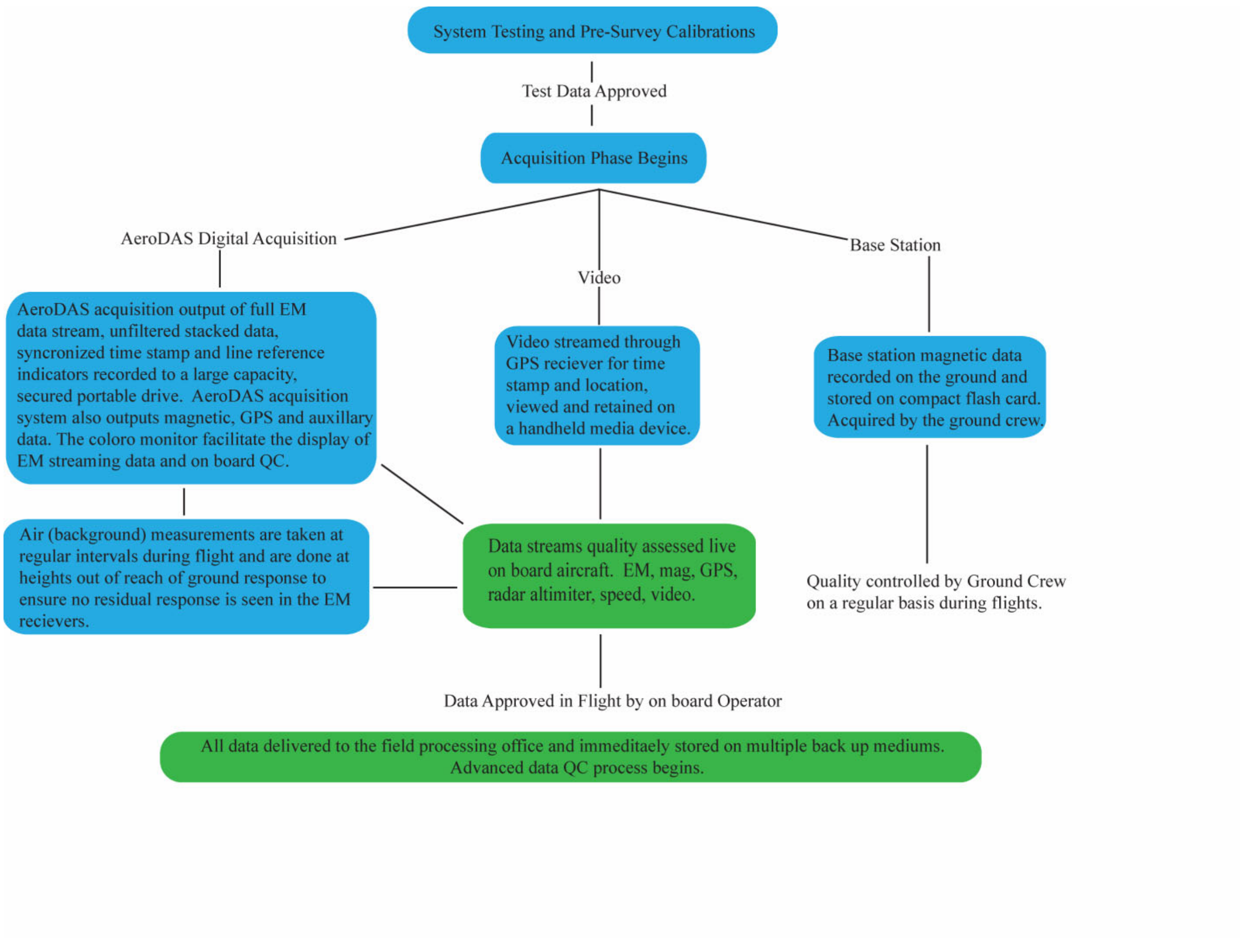

Figure 5: Flow chart describing the AeroTEM™ IV Acquisition Process.

7.1 DATA ACQUISITION:

The following describes the procedures performed during acquisition.

PRE-FLIGHT

At the start of each day extensive checks were made to ensure the correct operations of the geophysical and ancillary sensors, the data acquisition system as well as the physical integrity of the towed bird.

SURVEY

Every production flight start and finish with a background and internal calibration. Other backgrounds could be done every 60 min. If the system is too drifty in the beginning of flight, three backgrounds should be done in first hour. Flight time between backgrounds and survey lines should be minimized (maximum of two minutes) to save production time.

7.2 VIDEO

Video acquisition on a DVD Express DX2 is completed by streaming portions of the live GPS feed through to the video recording system. The UTC time stamp information and GPS locations are recorded to the video file to enable correlation with the survey data. The video is verified and backed up for each flight to a DVD for archiving.

7.3 MAGNETIC BASE STATION

Two Aeroquest Surveys proprietary base station systems were utilized throughout the survey. The primary unit along with the second backup unit, located in close proximity, were positioned in a relatively culturally quiet location. The magnetometer sensors were correctly positioned for the local magnetic field. The units were powered by two 12 V batteries. Data was acquired at a sampling rate of 0.5 Hz. The magnetic readings were synchronized with an internal GPS receiver to allow correlation with the airborne data. The magnetic base stations were monitored by the field processor throughout each survey day to ensure data quality.

8.0 DATA PROCESSING PROCEDURES

All in-field and post-field data processing was carried out using Aeroquest Surveys proprietary data processing software (ATPpro) and Geosoft Oasis Montaj software. Figure 6 describes the standard processing procedure in a simplified flow diagram.

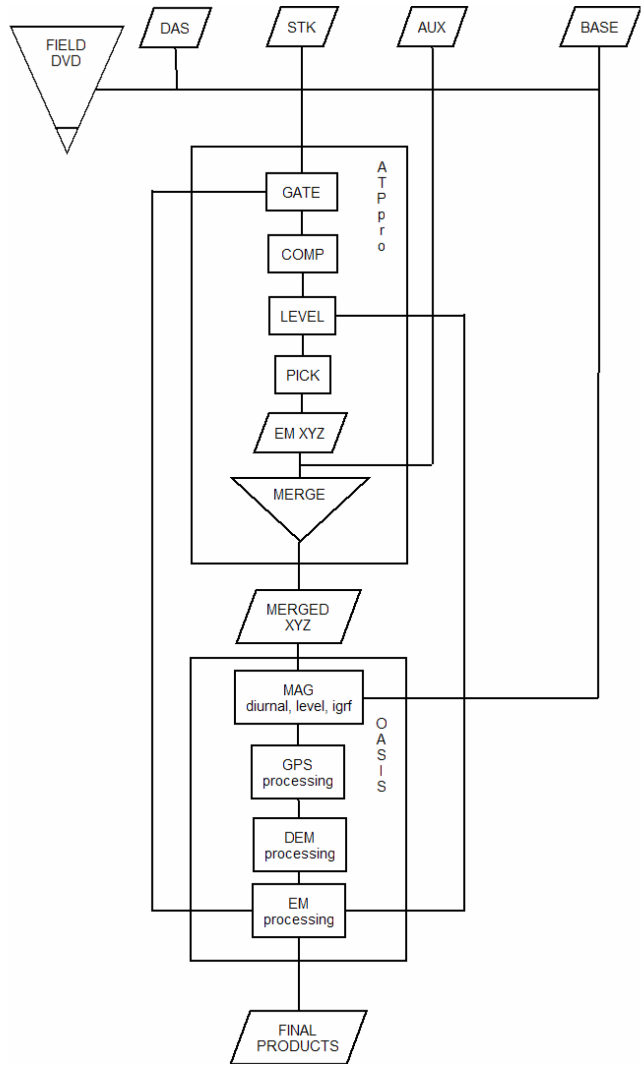

Figure 6: Aeroquest Surveys processing procedure flow diagram.

8.1 FLIGHT AND TERRAIN DATA

The position of the survey helicopter was directed by use of the GPS system. Positions were updated five times per second (5 Hz) and expressed as WGS84 latitude and longitude calculated from the raw pseudo range derived from the C/A code signal. The instantaneous GPS flight path, after conversion to UTM co-ordinates, is drawn using linear interpolation between the x/y positions. The terrain clearance was maintained with reference to the radar altimeter. The Digital Elevation Model (DEM) was derived by subtracting the radar altimeter terrain clearance values from the GPS altitude. To account for the different locations of the altimeters, 17 m were added to the DEM data.

8.2 TDEM DATA

The raw streaming data, sampled at a rate of 36 000 Hz (200 channels, 180 times per second) was reprocessed using a proprietary software algorithm developed by Aeroquest Surveys. Processing involves the compensation of the X and Z component data for the primary field waveform. Compensation coefficients for the system transient were determined and applied to the stream data. The stream data were then pre-filtered, stacked, binned to the 33 on and off-time channels and checked for the effectiveness of the compensation and stacking processes. The stacked data were then filtered, levelled and split up into the individual line segments. The filtering of the stacked data is designed to remove or minimize high frequency noise that cannot be sourced from the geology. The survey gate time definitions for both the on and off time can be found in Appendix I.

The EM data were then merged with the other ancillary data sets and loaded in a Geosoft GDB file. The processed EM channels were merged into array formatted channels in the Geosoft database as Zon, Zoff, Xon, and Xoff. Each of the EM channels was gridded and inspected for line to line levelling discrepancies. If required, additional levelling procedures were performed.

8.3 MAGNETIC DATA

Prior to any levelling the magnetic data was subjected to a lag correction of -0.2 seconds and a spike removal filter. The magnetic data were corrected for diurnal variations, levelled to the control lines. An International Geomagnetic Reference Field (IGRF) correction (Finlay et al. 2010) was applied to the total magnetic field data at survey altitude using the 2010 model year extrapolated to 2012.03. The residual magnetic data were interpolated onto a 40 m regular grid, using Bi-directional gridding algorithm. The data were then contoured at an interval of 5 nT.

Magnetic declination on March 14, 2012 for the centre of the survey area was 10.4° W and magnetic inclination was 70.6° N. Magnetic field strength was 54 867 nT (calculated using IGRF).

9.0 QA/QC PROCEDURES

Quality Assurance / Quality Control (QA/QC) was performed by Desmond Rainsford (MNDM) by implementing a range of procedures and inspections to ensure that the goals of the project were met.

It was the responsibility of the QA/QC Geophysicist to inspect, and the responsibility of Aeroquest Surveys to execute, with respect to QA/QC of the airborne geophysical data.

The Quality Assurance and Control process took place throughout all stages of data acquisition and processing to ensure that all considerations for meeting contract specifications were met.

9.1 REAL TIME QC

The hierarchy of quality control starts with the operator, who has live visual feed of all acquired data. If data are unacceptable for any reason or there are problems in determining its acceptability, the survey flight will stop and issues are immediately addressed. If this situation occurs, data is brought to the field processing office where a more specific analysis of its quality is done by the field geophysicist / data processor.

9.2 FLIGHT TO FLIGHT & DAILY QC

Quality control was done by the field geophysicist / data processor who reviewed and checked the data for any quality issues. The QC process involved following strict guidelines for examining all data streams to ensure that the recorded data were present, complete and within contract specifications. A spreadsheet of the data noise levels and other quality indicators was completed along with a daily report. Appendix H contains a copy of the daily processing report specifications. The data were uploaded to the Aeroquest Surveys office to be reviewed by the senior processing QC personnel on a daily basis.

Navigation data:

- The differentially corrected GPS flight path was checked against the theoretical flight path for any deviations that may be out of the contract specifications.
- The radar altimeter data and GPS altitude was checked and was closely monitored to identify any contouring errors (flying too high, too low or erratically) or system drop-outs.
- Speed was calculated and checked to confirm correct survey speeds were maintained to ensure safety, system noise minimization and sampling rate optimization.

Magnetometer data:

- The base stations magnetic data were checked to ensure that they met specifications.
- The airborne magnetic data were checked to ensure that there are no drop-outs and that they met the noise specifications.

- Data were displayed in both profile and gridded format to ensure that both the raw and processed data were complete and accurate.

Electromagnetic data:

- The raw and stacked EM data were checked to ensure that the quality was within contract specifications for both on and off time x and z components.
- The "background checks" were reviewed for each flight to ensure consistency.
- The EM flight data were checked for sferics.
- EM noise were reviewed against contract specifications and noted within the daily report.
- The EM data were reviewed after gating and compensation in order to ensure flight to flight consistency.
- EM channels were examined pre and post filtering to ensure geologic responses remain intact.
- EM data were then levelled for system drift using the background calibrations.

9.3 OFFICE QC

In office quality control was done daily by Aeroquest Surveys senior processing employees. This additional data check helped to ensure that the processing steps were executed correctly and that all required data were being acquired. An example of this daily assessment can be found in Appendix H.

9.4 STATUS UPDATES

Aeroquest Surveys personnel provided status updates throughout the duration of the survey. The updates were sent to the QA/QC Geophysicist.

9.5 QA/QC GEOPHYSICIST RESPONSIBILITIES

The QA/QC Geophysicist conducted inspections during data acquisition, focusing initially on the data acquisition procedures, base station monitoring and instrument calibration. As data was collected, it was reviewed for adherence to the survey specifications and completeness. Any problems encountered during data acquisition were discussed and resolved.

The QA/QC checks included the following:

Navigation Data

- appropriate location of the GPS base station
- flight line and control line separations were maintained, and deviations along lines were minimized
- verified synchronicity of GPS navigation and flight video
- all boundary control lines were properly located
- terrain clearance specifications were maintained
- aircraft speed remained within the satisfactory range
- area flown covered the entire specified survey area

- differentially corrected GPS data did not suffer from satellite-induced shifts or dropouts
- GPS height and radar/laser altimeter data were able to produce an image-quality DEM
- GPS and geophysical data acquisition systems were properly synchronized
- GPS data were adequately sampled

Magnetic Data

- appropriate location of the magnetic base station, and adequate sampling of the diurnal variations
- heading error and lag tests were satisfactory
- magnetometer noise levels were within specifications
- magnetic diurnal variations remained within specifications
- magnetometer drift was minimal once diurnal and IGRF corrections had been applied
- spikes and/or drop-outs were minimal to non-existent in the raw data
- filtering of the profile data was minimal to non-existent
- in-field levelling produced image-quality grids of total magnetic field and higher–order products (e.g. second vertical derivative)

Time-domain Electromagnetic Data

- selected receiver coil orientations, base frequency, primary field waveform and secondary field sampling were appropriate for the local geology
- raw "stream" data were recorded and archived
- data behaved consistently between channels (i.e. consistent signal decay)
- noise levels were within specifications, and system noise was minimized
- bird swing and orientation noise was not evident
- sferics and other spikes were minimal (after editing)
- cultural (60 Hz) noise was not excessive
- regular tests were conducted to monitor the reference waveform and system drift, and ensure proper zero levels
- filtering of the profile data was minimal
- In-field processing produces image-quality images of apparent conductivity and decay constant (tau).

The Geophysicist reviewed interim and final digital and map products throughout the data compilation phase, to ensure that noise was minimized and that the products adhered to specifications. This typically resulted in several iterations before all digital products were considered satisfactory. Considerable effort was devoted to specifying the data formats, and verifying that the data adhered to these formats.

10.0 PROJECT ISSUES

No issues to report.

11.0 PREPARATION OF FINAL PRODUCTS

11.1 MAGNETIC PRODUCTS

Residual Magnetic Field Map:

The contours of residual magnetic intensity were generated from digitally recorded data. The magnetic data were corrected for diurnal variations, leveled to the control lines and interpolated onto a 40 m regular grid, using the bi-directional algorithm. An International Geomagnetic Reference Field (IGRF) correction (Finlay et al. 2010) was applied to the total magnetic field data at survey altitude using the 2010 model year extrapolated to 2012.21 (March 14, 2012). A regional correction was applied to level the magnetic field to the Ontario Master Aeromagnetic Grid (Ontario Geological Survey 1999).

Magnetic declination on March 14, 2012 for the centre of the survey area was 10.4° W and magnetic inclination was 70.6° N. Magnetic field strength was 54 867 nT (calculated using IGRF).

First Vertical Derivative of the Magnetic Field:

The values for the first vertical derivative of the magnetic field were computed directly from the gridded residual magnetic intensity data using a fast Fourier transform, combining the transfer functions of the first vertical derivative and an eighth-order Butterworth low-pass filter (100 m cut-off wave-length). The low-pass filter was aimed at attenuating unwanted high frequencies enhanced by the derivative operator.

11.2 ADVANCED PRODUCTS

EM Decay Constant:

The decay constant values were obtained by fitting the amplitude data from the Z-coil channels 1 to 16 (approximately 50 to 4600 μsec after turn-off) to an exponential function using least-squares linear regression. For each data sample, only those channel values exceeding a noise threshold of 10 nT/s were used. In semi-log space, the slope of this function will reflect the decay rate of the transient and therefore the conductivity. A slow rate of decay, reflecting a high conductivity, will be represented by a high decay constant value.

The computed decay constant values were then microleveled and interpolated onto a 40 m regular grid, using the bi-directional algorithm.

Apparent Conductance

Apparent conductance was computed from the off-time z-component data at each measurement location. The algorithm uses the pseudo-layer half-space model (Huang and Rudd 2008). The primary advantages of this method are immunity to altimeter errors, and better resolution of conductive layers than other methods. A table lookup procedure is established based on the analytic solution of a half-space model to speed up the processing. This method can be expanded to generate depth sections (CDIs). The effective depths for the sections are derived empirically from the computed diffusion depth and apparent thickness of the pseudo-layer.

11.3 MAPPING

The survey geodetic GPS positions have been projected using the Universal Transverse Mercator projection in Zone 17 North. A summary of the map datum and projection specifications is given following:

Projection: Universal Transverse Mercator

Datum: NAD83

Central Meridian: 81°00'W (UTM zone 17)

Central scale factor: 0.9996

False easting: 500 000 m

False northing: 0 m

The Ministry of Northern Development and Mines (MNDM) was responsible for the following files and materials for mapping use:

- Layout design of the 1:20 000 scale map tiles
- Completed base maps and map surrounds for each tile, in OASIS Montaj map formats, to use to construct the 1:20 000-scale maps
- Seamless base map of the entire survey area (for inclusion in the GeoTIFF files);
- Comprehensive instructions for preparing the digital maps (i.e. incorporating the grid and vector data, and colour table, in the map tiles prepared by MNDM)

Resultant Digital Maps:

- 1:20 000-scale contours of residual magnetic field with flight path and Ministry-supplied planimetric base and map surrounds
- 1:20 000 scale shaded colour of the first vertical derivative of the residual magnetic field with flight path and Ministry-supplied planimetric base and map surrounds
- 1:20 000 scale colour-filled contours of Z-component decay constant (de-herringboned if applicable) and planimetric base and map surrounds supplied by the MNDM
- 1:20 000 scale colour-filled contours of apparent conductance (de-herringboned if applicable) with flight path and planimetric base and map surrounds supplied by the MNDM.

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APPENDIX A – AEROTEM™ IV SYSTEM CHARACTERISTICS

- AeroTEM is tried and tested to be a reliable system having acquired over 500 000 line-km of survey data worldwide to date.
- AeroTEM is a broadband system offering very early off-time data for high sensitivity to weakly conductive geology and for resistivity mapping applications
- The AeroTEM on-time data is unique in the industry, and is the only commercially-available system that provides true on-time measurement of geologic features in a time-domain technology. Traditional 'B-field' systems do not measure the b-field, but use off-time data to approximate the B-field response.
- The AeroTEM™ IV system is a suitably-powered system at over 226 236 NIA at 90 Hz for a higher signal to noise ratio and resultant excellent depth penetration.
- AeroTEM systems require a rigid airframe technology in order to recover useful on-time measurements. This rigid airframe provides for very low noise levels due to the stability in the location of the receiver coils within the transmitted electromagnetic field.
- The AeroTEM receivers are positioned at the same ground clearance as the transmitter, nominally 30 m. This low receiver sensor height maximizes spatial resolution. Systems that have the receiver(s) positioned higher than the transmitter have significantly lower spatial resolution.
- AeroTEM systems record both X-component and Z-component data sets with the receivers positioned semi-coincident with the transmitter. The X-component data set is sensitive to vertically-oriented geology and will be an invaluable parameter in the interpretation of the data sets for the geometry of the geologic units and more discrete sources.
- In mountainous terrain and remote environments, the dual receivers facilitate a more confident interpretation of the results and in the planning for ground follow-up and drilling programs directly from the airborne survey results.
- Stream data is recorded as a standard practice for all AeroTEM surveys. This standard has been in place for 4 years and benefits our client in the flexibility in the processing and archiving of the survey results.
- The high volume of data (stream data, on-time, off-time, X-component and Z-component) provides for very diagnostic data for subsequent interpretation of the geology in the survey area.
- AeroTEM systems provide data redundancy with two separate decay series – one from the on-time data and another from the off-time data for both the Z-component and X-component receivers.
- The data quality, high volume and breadth of data parameters that AeroTEM surveys provide reduces risk in the use of the data for all end users and stakeholders.
- The bandwidth and breadth of data parameters the AeroTEM system provides strengthens and broadens the applicability of the survey results to a wide variety of geological, environmental, engineering and environmental problems.

APPENDIX B – GPS ACCURACY TEST

The accuracy of the GPS system was determined using a scatter test. The GPS data were collected on March 12th, 2012. The results of this test are given below.

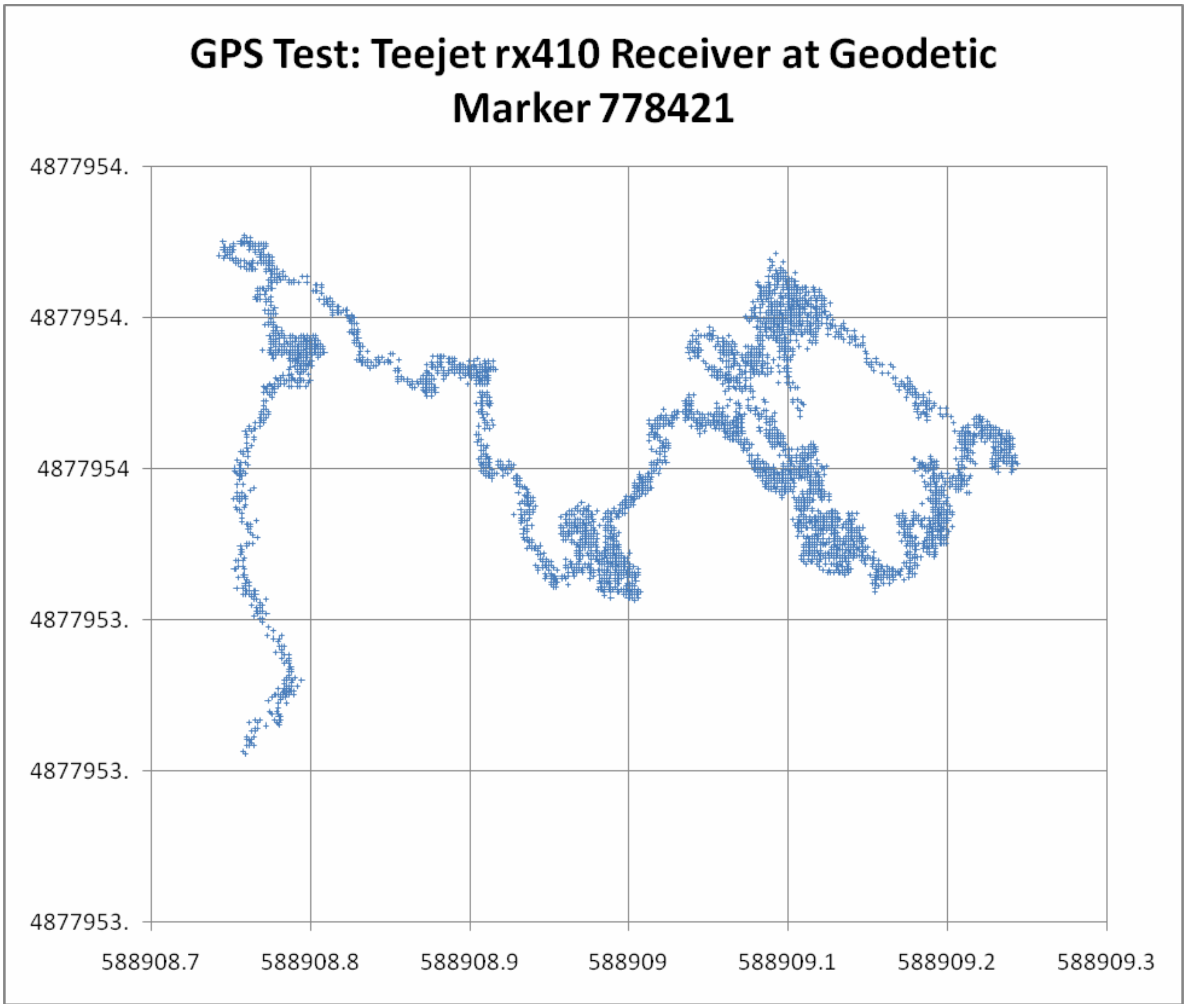


Figure 7. Scatter test results of the GPS accuracy test.

APPENDIX C – RADAR ALTIMETER CALIBRATION TEST

Pre-Survey:

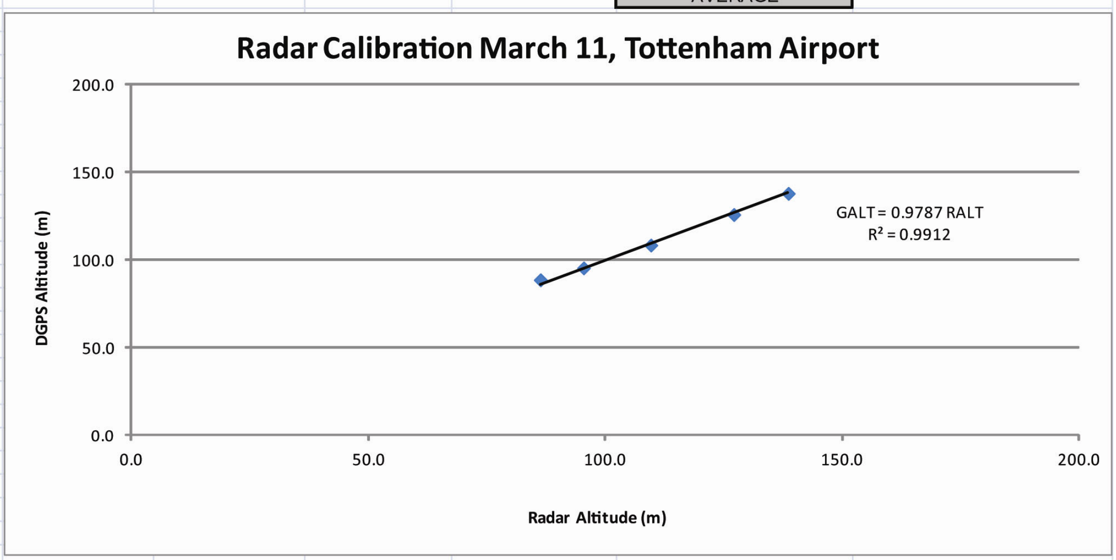
Pre-survey calibration of radar altimeter was conducted near Tottenham, Ontario. The test was completed on March 11th, 2012. A total of five survey lines were flown at different altitudes. A correlation coefficient R^2=0.9912 was used to correct radar and differential GPS measurements. Graphical and tabulated results are presented below.

Altimeter Calibration Test

Project:	**12-014**
Location:	Tottenham Airport
Date:	11-Mar-12
Flight:	1
Test No.	1
Aircraft:	C-FVFK

mV Ratio 2.5 mV/feet

Line	Nominal Altitude above ground (m)	Nominal Altitude above ground (ft)	Radar Altitude Raw Data (m)	DGPS Altitude Ellipsoidal Height (m)	DTM = DGPS - Radar Alt Ellipsoidal Height WGS84 (m)	DGPS Altitude (ALT) ALT=DGPS - AVERAGE(DTM) (m)
270	82.32	270	86.3	308.6	222.3	88.8
300	91.46	300	95.4	315.4	220.0	95.6
350	106.71	350	109.6	328.4	218.8	108.6
400	121.95	400	127.1	345.8	218.7	126.0
450	137.20	450	138.6	357.9	219.3	138.1
					219.8	
					AVERAGE	



Pilot:	Joel Breton	Kelner Heli.	Approved: Yes	Date: 11-Mar-12
Operator:	Viktor Shevchenko	AQL		Name: Geoffrey Plastow
QC:	Thomas Wade	AQL		
PM:	Lee Harper	AQL		

Figure 8. Results of radar altimeter calibration.

APPENDIX D – MAGNETOMETER LAG TEST

The lag time in our system can be verified by performing a test whereby the system is flown over a known magnetic target in two opposing directions. The lag correction is applied to minimize any geographic offset in the response.

The data were collected on March 11th, 2012 and were approved by Project Management to conduct further processing for final publication.

The magnetometer lag test was performed at survey altitude (~30 metres bird altitude, ~40 knots ground speed) in the survey block along the survey line (L10921) in two directions (South West-North East and then North East-South West) over the same line path. This survey was performed over two known anomalies which can be seen in the profile window below.

The first image is of the un-lagged Magnetic data from lines of opposing directions. The Upper profile is of the Line PASS1 (SW-NE), the Second is the profile of the Line PASS2 (NE-SW) and the map to the right.

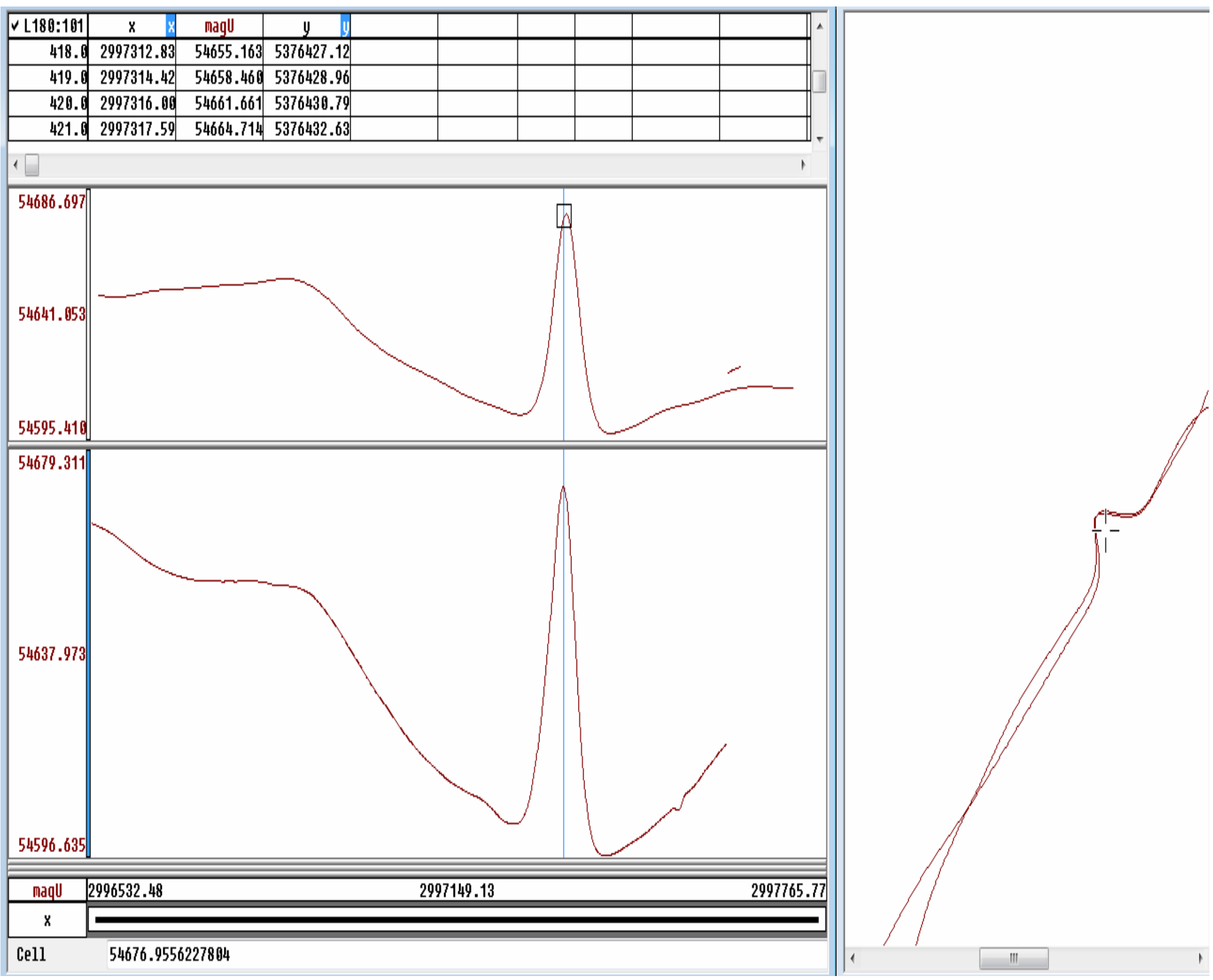


Figure 9a. AeroTEM magnetic data showing system lag.

This second image is of the un-lagged data from these lines, zoomed in to show the difference in scans between the two passes. It is shown that the lag in the data is shown as two scans, or two samples (at ten samples per second). This puts the lag of our system to two EM fiducial marker to be used for correction. A map is shown in this image to illustrate the exact location of the anomalies over it.

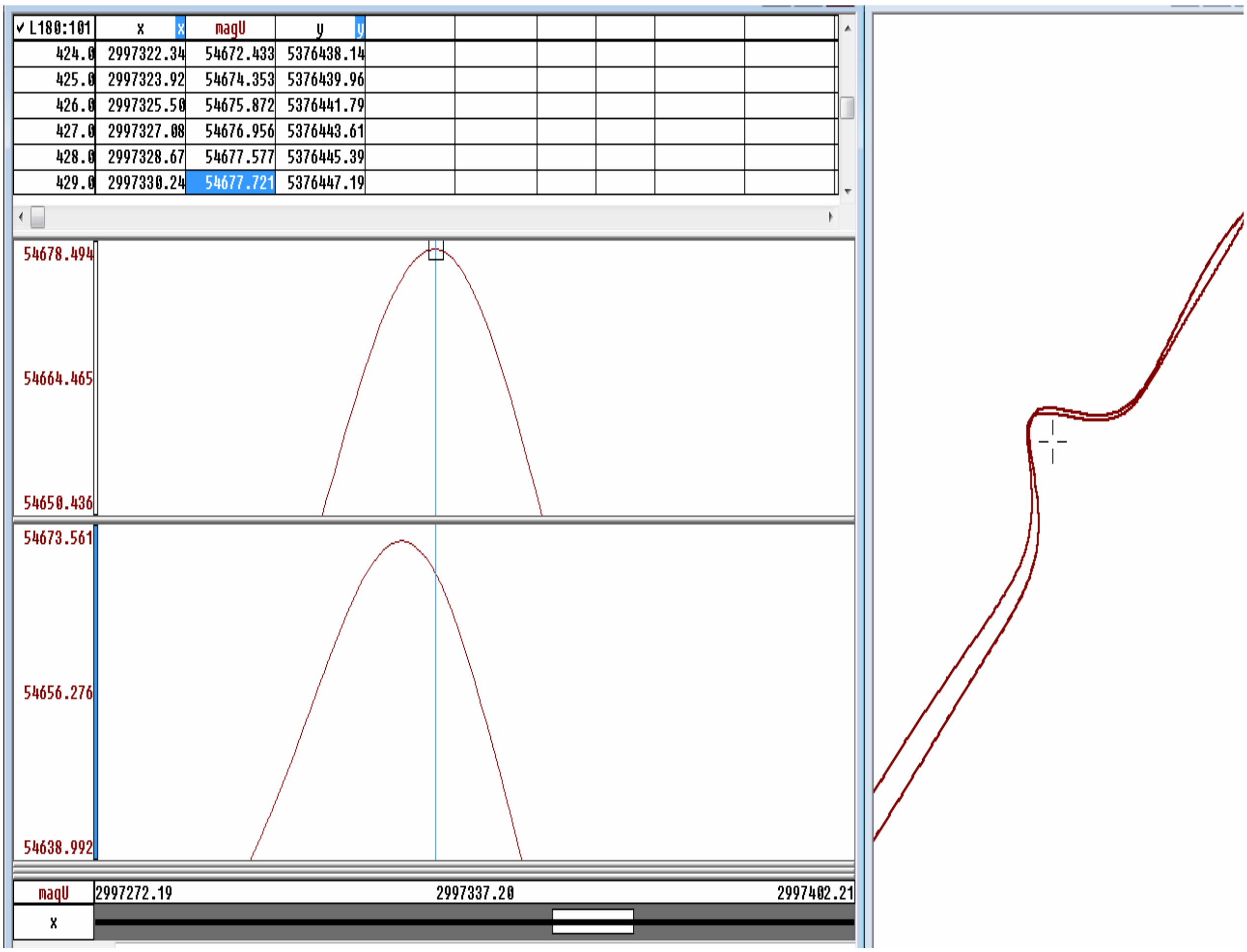


Figure 9b. Zoomed image of system lag.

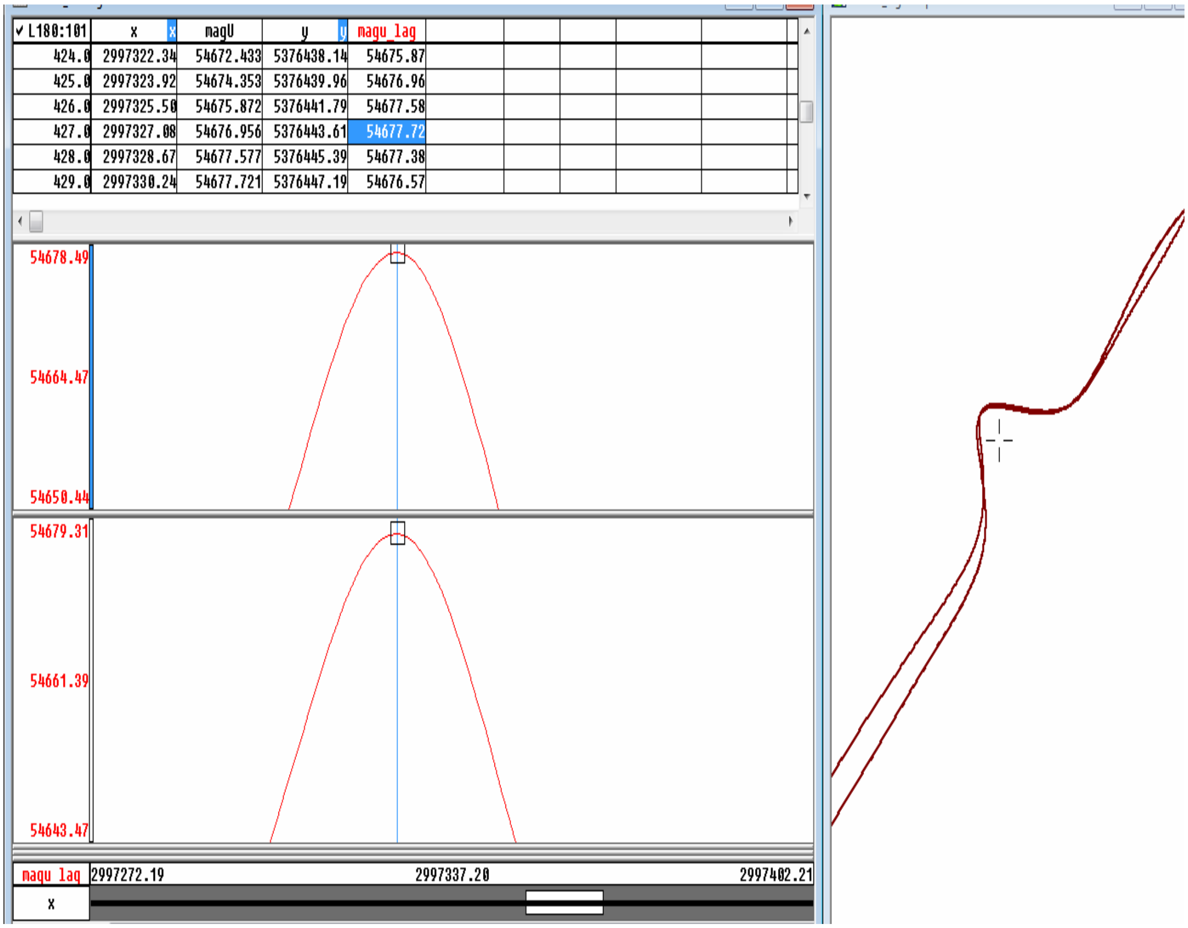


Figure 9c. Correction applied to correct for the lag in the magnetic sensor. The final image is of the lag-corrected Magnetic data using two EM fiducial for correction.

APPENDIX E – MAGNETOMETER CLOVERLEAF

A pre-survey calibration flight was done to verify the heading errors of the magnetometer in the four cardinal directions. The TDEM data is analyzed during this process as well to confirm data quality in terms of response to turns and varying wind conditions.

Pre-Survey

Pre-survey magnetometer cloverleaf test was flown near Tottenham, Ontario near the south Simcoe survey site on March 12th, 2012 and was approved by Project Management in advance of survey commencement.

Project:	**12-014**
Location:	Tottenham, ON
Altitude:	5000ft AGL
Date:	12-Mar
Flight:	2
Test No.	1
Aircraft:	C-FVFK

RAW DATA - Sensor 1 (Mag Bird)

(note: MAG1 is FOM compensated and for diurnal corrected value of Total Magnetic Intensity)

	Direction	Line #	Fiducial	Mag1
pass 1	72	72	338.0	54555.8
	252	252	1388.0	54557.2
	169	169	1727.0	54557.1
	349	349	432.0	54557.7
pass 2	72	72.1	496.0	54556.4
	252	252.1	1571.0	54557.1
	169	169.1	1659.0	54556.2
	349	349.1	705.0	54557.0

HEADING EFFECT CALCULATION

Direction:	pass 1 MAG1	pass 2 MAG1	AVG MAG1	offset 1	corrected MAG1	offset 2	corrected MAG1	offset 1+2 = offset 3
72	54555.8	54556.4	54556.1	0.30	54556.37	0.43	54556.80	0.73
252	54557.2	54557.1	54557.1	0.13	54557.23	-0.43	54556.80	-0.30
169	54557.1	54556.2	54556.7	-0.30	54556.37	0.43	54556.80	0.12
349	54557.7	54557.0	54557.4	-0.13	54557.23	-0.43	54556.80	-0.55

HEADING EFFECT COEFFICIENTS

Direction	Heading Correction
72	0.73
252	-0.30
169	0.12
349	-0.55

HEADING CORRECTED DATA

Direction	Line #	Fiducial	Mag1 Corr
72	72	338.0	54556.5
252	252	1388.0	54556.8
169	169	1727.0	54557.2
349	349	432.0	54557.1
72	72.1	496.0	54557.1
252	252.1	1571.0	54556.8
169	169.1	1659.0	54556.4
349	349.1	705.0	54556.5

Pilot:	Joel Breton		Approved:	Date: 12-Mar-12	
Operator:	Viktor Shevchenko			Name: Geoffrey Plastow	
QC:	Thomas Wade				
PM:	Lee Harper				
Clients Rep.:	Desmond Rainsford				

APPENDIX F – DAILY CALIBRATION

Pre- and post-flight TDEM calibration:

TDEM systems must be compensated to remove all effects of the primary field on the received secondary signal. This primarily affects the on-time channels and the early off-time channels, close to the turn-off of the pulse. This compensation is done at altitude, sufficiently high to avoid contaminating the signal with ground conductive response. The background test is performed at the start of every flight and repeated at least once during the flight and once at the end of the flight. The image below is an example of a background internal calibration pulse.

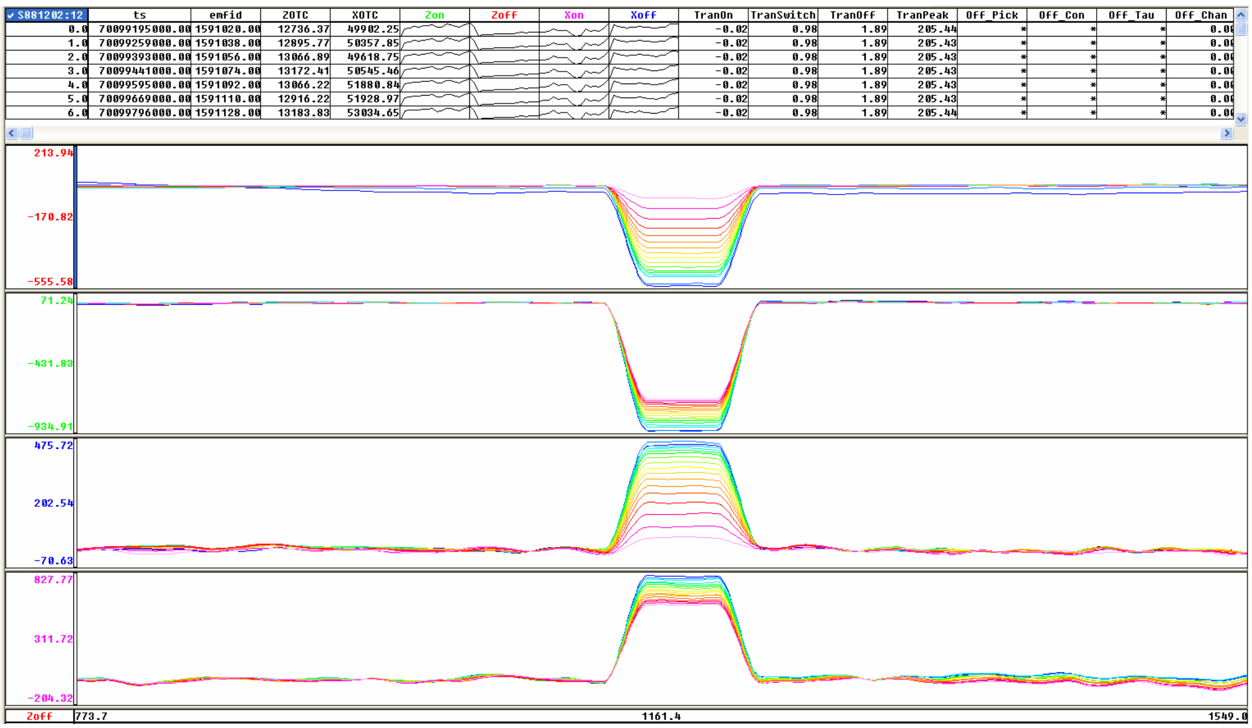


Figure 10. Internal calibration background shown in the Z and X data, in on- and off-time.

APPENDIX G – EM ANOMALY CLASSIFICATION

For the purposes of this survey, the picking and classification of EM anomalies were not carried out. The AeroTEM™ IV system will respond to conductive overburden, near-surface horizontal conducting layers, man-made sources and bedrock conductors. Identification of natural conductors is based on the rate of transient decay, magnetic correlation and response shape, together with the response pattern and topography. Man-made responses are identifiable by examining the power line monitor and the flight track video.

A thin, vertically orientated source produces a double peak anomaly in the z-component response and a positive to negative crossover in the x-component response (Figure 11). For a vertically orientated thick source (say, greater than 10 metres), the response is a single peak in the z-component response and a negative to positive crossover in the x-component response (Figure 12). The AeroTEM system provides discrimination of thin and thick sources and this distinction is indicated on the EM anomaly symbols (N = thin and K = thick). Where multiple, closely spaced conductive sources occur, or where the source has a shallow dip, it can be difficult to uniquely determine the type (thick vs. thin) of the source (Figure 13). In these cases both possible source types may be indicated by picking both thick and thin response styles. For shallow dipping conductors the 'thin' pick will be located over the edge of the source, whereas the 'thick' pick will fall over the down dip 'heart' of the anomaly.

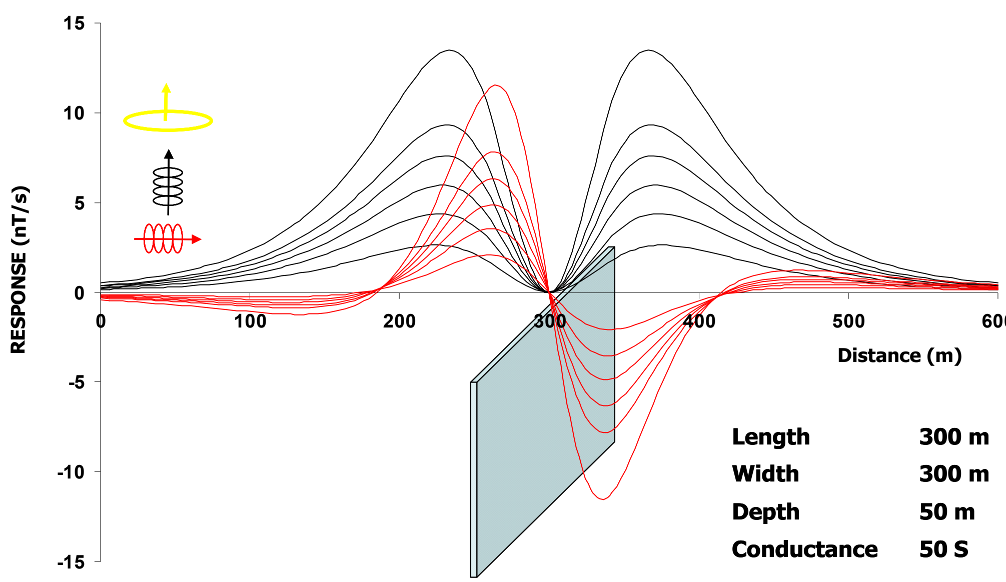


Figure 11. AeroTEM response to a 'thin' vertical conductor.

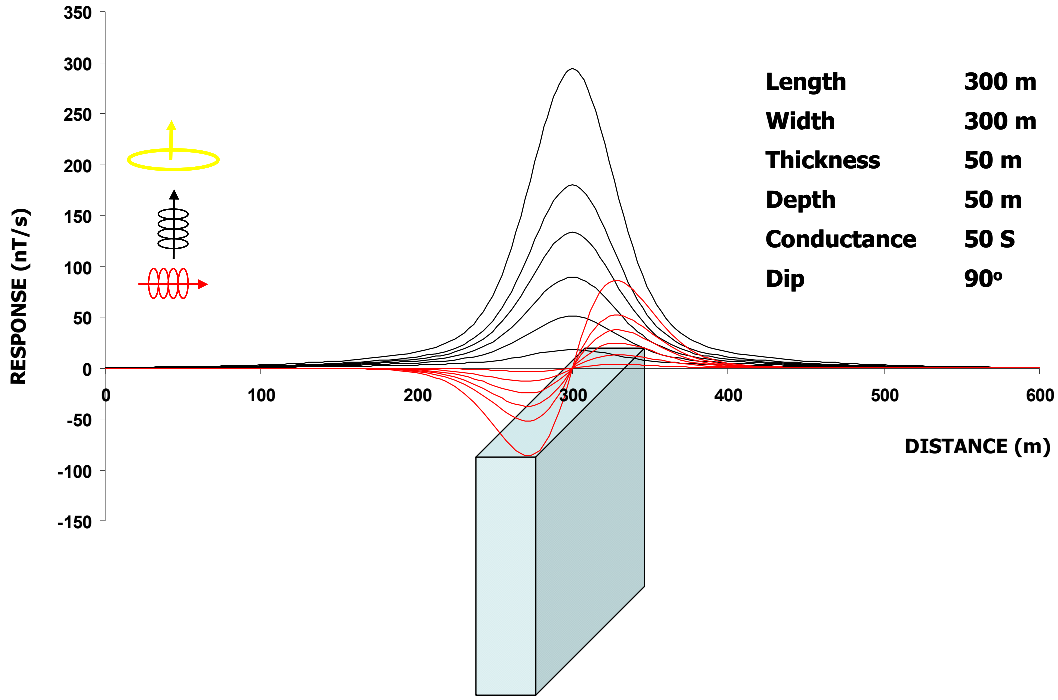


Figure 12. AeroTEM response for a 'thick' vertical conductor.

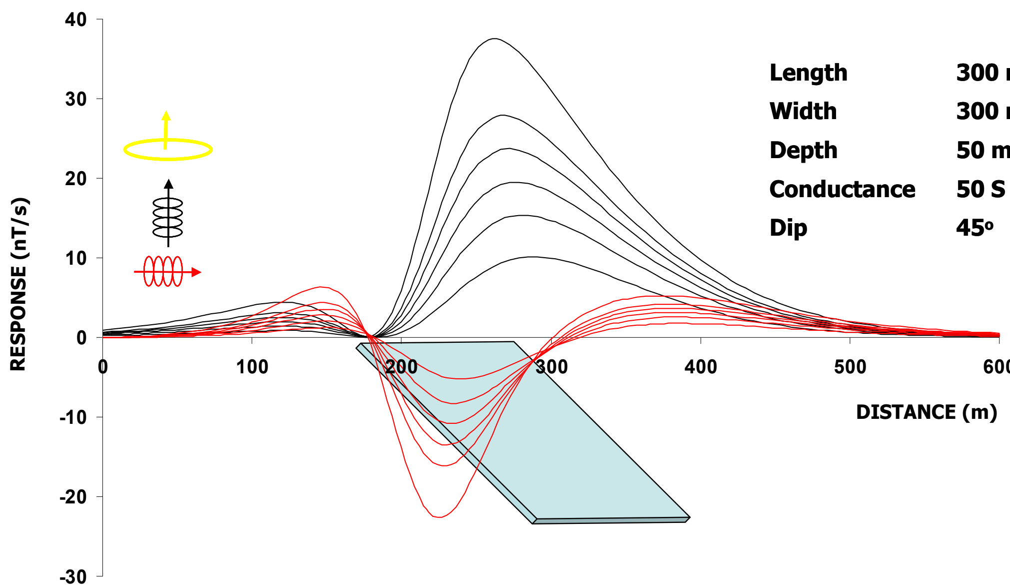


Figure 13: AeroTEM response over a 'thin' dipping conductor.

All cases should be considered when analyzing the interpreted picks and prioritizing for follow-up. Specific anomalous responses which remain as high priority should be subjected to numerical modeling prior to drill testing to determine the dip, depth and probable geometry of the source.

APPENDIX H – DATA QUALITY QA/QC PROVISIONS

Quality control practices:

Daily Data Quality Report

JOB #: **Client:**
System: **Operator:**
Field data processor: **Office Reviewer:**

	Flight #																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Data Stream	y	y	y	y	y	y	y	y	y	y	y	y	y																	
Video	y	y	y	y	y	y	y	y	y	y	y	y	y																	
Flight Path	y	y	y	y	y	y	y	y	y	y	y	y	y																	
Radar Altimeter	y	y	y	y	y	y	y	y	y	y	y	y	y																	
GPS elevation	y	y	y	y	y	y	y	y	y	y	y	y	y																	
bheight verification	40	40	40	40	40	40	40	40	40	40	40	40	40																	
basemag verification	y	y	y	y	y	y	y	y	y	y	y	y	y																	
mag, MOB verification	y	y	y	y	y	y	y	y	y	y	y	y	y																	
mag gradiometer																														
Start off-time gate	72	72	72	72	72	72	72	72	72	72	72	72	72																	
EM noise - Z off-time	10	10	10	12	12	12	12	12	12	12	12	12	12																	
EM noise - X off-time	30	30	30	30	30	30	30	30	30	30	30	30	30																	
EM noise - Z on-time	16	16	16	16	16	16	16	16	16	16	16	16	16																	
EM noise - X on-time	40	40	40	40	40	40	40	40	40	40	40	40	40																	
EM compensation	y	y	y	y	y	y	y	y	y	y	y	y	y																	
EM leveling																														
HFEM - low frequency coax																														
HFEM - mid frequency coax																														
HFEM - high frequency coax																														
HFEM - low frequency copl																														
HFEM - mid frequency copl																														
HFEM - high frequency copl																														
QC packed map																														
Spectrometer																														

Note: All data issue comments are to be reported both in the comments section of the OPS report and in the e-mail text

Figure 14. Data QA/QC checklist and drop down menu as part of the daily in-field quality control report.

APPENDIX I – TDEM VERSION DEFINITION FILE

A version file exists for each survey flight. This file describes the processed post-survey of the steaming data to yield to yield 33 stacked and binned on-time and off-time channels at a 10 Hz sample rate.

Each file is stored as "job#flightxx.ver", where # and xx identifies the corresponding number.

The files are archived as standard ASCII text files and contain the following information.

Profile Generation LOG

[General Information]
Software..ATP Pro Ver3.64 (Build 0025)
Filename..12-014 Flt 7_001.stk
Date..3/15/2012
Time..12:41:52 PM
System..AeroTEM™ IVr
Stack Size..36 Half-Cycles
Stack Type ....Box-Car Stacking
# of Samples..200
Frequency..90Hz
Gate Width 27.778us
Options...Remove Ringing, Lag EM
On-time Comp ....Slope Matching
TranPeak Threshold..25Amp

[Data Invert]

[Multi Compensation]
The vertical Offset in Multi Compensation is enabled

[Filter]
9-Point Spike Removal (1.8x SD) time(s): 1
21-Point Hanning Filter time(s): 1

[Data Scale]
The EM data are amplified automatically by 3.0 time(s).

[Gate Information]
Average TxOn -9.7705 us
Average TxSwitch 1001.1770 us
Average TxOff 1934.7013 us
Average TxPeak 192.8342 A

OTC Gate 66
Gate Shift 36

Channel	Sample Range	Time Width (us)	Time Center (us)	Time After TxOn (us)
On1	4 - 4	27.8	97.2	107
On2	5 - 5	27.8	125	134.8
On3	6 - 6	27.8	152.8	162.5
On4	7 - 7	27.8	180.6	190.3
On5	8 - 8	27.8	208.3	218.1
On6	9 - 9	27.8	236.1	245.9
On7	10 - 10	27.8	263.9	273.7
On8	11 - 11	27.8	291.7	301.4
On9	12 - 12	27.8	319.4	329.2
On10	13 - 13	27.8	347.2	357
On11	14 - 14	27.8	375	384.8
On12	15 - 15	27.8	402.8	412.5
On13	16 - 16	27.8	430.6	440.3
On14	17 - 17	27.8	458.3	468.1
On15	18 - 18	27.8	486.1	495.9
On16	19 - 19	27.8	513.9	523.7

Channel	Sample Range	Time Width (us)	Time Center (us)	Time After TxOff (us)
Off0	72 - 72	27.8	1986.1	51.4
Off1	73 - 73	27.8	2013.9	79.2
Off2	74 - 74	27.8	2041.7	107
Off3	75 - 75	27.8	2069.4	134.7
Off4	76 - 76	27.8	2097.2	162.5
Off5	77 - 77	27.8	2125	190.3
Off6	78 - 80	83.3	2180.6	245.9
Off7	81 - 83	83.3	2263.9	329.2
Off8	84 - 86	83.3	2347.2	412.5
Off9	87 - 89	83.3	2430.6	495.9
Off10	90 - 94	138.9	2541.7	607
Off11	95 - 99	138.9	2680.6	745.9
Off12	100 - 105	166.7	2833.3	898.6
Off13	106 - 115	277.8	3055.6	1120.9
Off14	116 - 129	388.9	3388.9	1454.2
Off15	130 - 151	611.1	3888.9	1954.2
Off16	152 - 186	972.2	4680.6	2745.9

APPENDIX J – STACK DATA ARCHIVE DEFINITION

The stack data is stored in binary files labelled Job#Flightxx.stk, where xx = flight number. Each file represents the EM data acquisition for one complete flight. A Windows utility called "ATP Pro Viewer" is provided to convert these binary files to a flat ASCII files. This utility is run in windows environment.

The output ASCII file will contain the emfid (EM fiducial) and the 200 waveform points for the three components, Z, X, and I, stored in that order. These components are:

Z - the amplitude of the secondary field as seen by the Z coil;
X - the amplitude of the secondary field as seen by the X coil; and
I - the amplitude of the current transmitted;

For each of the three components, the following data is stored: power line monitor and the 200 samples of the waveform. Each fiducial represents a 27.778 µs sample.

A sample of stack file is shown below showing the sampled current half waveform.

Sample	Time (µs)	Itx (A)
1	0	3.17096
2	27.778	11.4529
3	55.556	22.2305
4	83.334	34.0568
5	111.112	45.8471
6	138.89	57.6363
7	166.668	69.3939
8	194.446	81.1351
9	222.224	92.8478
10	250.002	104.537
11	277.78	116.199
12	305.558	127.838
13	333.336	139.449
14	361.114	151.033
15	388.892	162.586
16	416.67	174.108
17	444.448	185.6
18	472.226	197.063
19	500.004	208.495
20	527.782	219.895
21	555.56	231.262
22	583.338	242.597
23	611.116	253.897
24	638.894	265.162
25	666.672	276.392
26	694.45	287.59
27	722.228	298.755
28	750.006	309.882
29	777.784	320.966
30	805.562	332.015
31	833.34	343.025
32	861.118	353.989
33	888.896	364.905
34	916.674	375.767
35	944.452	386.596
36	972.23	397.026
37	1000.01	402.647
38	1027.79	398.109
39	1055.56	386.445
40	1083.34	373.519
41	1111.12	360.668
42	1138.9	347.804
43	1166.68	334.963
44	1194.45	322.131
45	1222.23	309.318

46	1250.01	296.521
47	1277.79	283.744
48	1305.57	270.988
49	1333.34	258.255
50	1361.12	245.546
51	1388.9	232.862
52	1416.68	220.207
53	1444.46	207.58
54	1472.23	194.984
55	1500.01	182.419
56	1527.79	169.888
57	1555.57	157.399
58	1583.35	144.949
59	1611.12	132.528
60	1638.9	120.138
61	1666.68	107.78
62	1694.46	95.4561
63	1722.24	83.1648
64	1750.01	70.9079
65	1777.79	58.6864
66	1805.57	46.5355
67	1833.35	34.4294
68	1861.13	22.3403
69	1888.9	10.3245
70	1916.68	3.63893
71	1944.46	-1.5728
72	1972.24	-2.1137
73	2000.02	-1.6507
74	2027.79	-1.4983
75	2055.57	-1.4155
76	2083.35	-1.3652
77	2111.13	-1.3183
78	2138.91	-1.2768
79	2166.68	-1.2296
80	2194.46	-1.1521
81	2222.24	-1.0634
82	2250.02	-0.9933
83	2277.8	-0.9168
84	2305.57	-0.8315
85	2333.35	-0.7462
86	2361.13	-0.6606
87	2388.91	-0.5756

88	2416.69	-0.4927
89	2444.46	-0.4125
90	2472.24	-0.3359
91	2500.02	-0.2635
92	2527.8	-0.196
93	2555.58	-0.134
94	2583.35	-0.0774
95	2611.13	-0.0271
96	2638.91	0.01634
97	2666.69	0.05363
98	2694.47	0.08467
99	2722.24	0.10923
100	2750.02	0.12777
101	2777.8	0.14093
102	2805.58	0.14806
103	2833.36	0.14937
104	2861.13	0.14586
105	2888.91	0.13819
106	2916.69	0.12568
107	2944.47	0.1089
108	2972.25	0.08883
109	3000.02	0.06569
110	3027.8	0.03992
111	3055.58	0.01119
112	3083.36	-0.0194
113	3111.14	-0.0503
114	3138.91	-0.0816
115	3166.69	-0.1131
116	3194.47	-0.1432
117	3222.25	-0.1721
118	3250.03	-0.1995
119	3277.8	-0.2245
120	3305.58	-0.2474
121	3333.36	-0.2678
122	3361.14	-0.2847
123	3388.92	-0.2987
124	3416.69	-0.311
125	3444.47	-0.3207
126	3472.25	-0.3269
127	3500.03	-0.3297
128	3527.81	-0.3298
129	3555.58	-0.3275

130	3583.36	-0.3229
131	3611.14	-0.3167
132	3638.92	-0.3087
133	3666.7	-0.2989
134	3694.47	-0.287
135	3722.25	-0.2735
136	3750.03	-0.2585
137	3777.81	-0.2424
138	3805.59	-0.2253
139	3833.36	-0.2075
140	3861.14	-0.1893
141	3888.92	-0.1703
142	3916.7	-0.1521
143	3944.48	-0.1352
144	3972.25	-0.1179
145	4000.03	-0.1006
146	4027.81	-0.0851
147	4055.59	-0.0715
148	4083.37	-0.0588
149	4111.14	-0.0471
150	4138.92	-0.0373
151	4166.7	-0.0285
152	4194.48	-0.0208
153	4222.26	-0.0146
154	4250.03	-0.0097
155	4277.81	-0.0058
156	4305.59	-0.0035
157	4333.37	-0.0022
158	4361.15	-0.0016
159	4388.92	-0.0021
160	4416.7	-0.0034
161	4444.48	-0.0053
162	4472.26	-0.0077
163	4500.04	-0.0106
164	4527.81	-0.0147
165	4555.59	-0.0188
166	4583.37	-0.0229

167	4611.15	-0.0273
168	4638.93	-0.0314
169	4666.7	-0.0352
170	4694.48	-0.0389
171	4722.26	-0.0416
172	4750.04	-0.0428
173	4777.82	-0.0435
174	4805.59	-0.044
175	4833.37	-0.043
176	4861.15	-0.0413
177	4888.93	-0.04
178	4916.71	-0.0382
179	4944.48	-0.0358
180	4972.26	-0.0322
181	5000.04	-0.0283
182	5027.82	-0.0242
183	5055.6	-0.0202
184	5083.37	-0.0159
185	5111.15	-0.0105
186	5138.93	-0.0042
187	5166.71	0.0011
188	5194.49	0.00702
189	5222.26	0.01283
190	5250.04	0.01941
191	5277.82	0.02544
192	5305.6	0.03246
193	5333.38	0.03849
194	5361.15	0.04551
195	5388.93	0.05078
196	5416.71	0.05922
197	5444.49	0.06163
198	5472.27	0.07315
199	5500.04	0.06547
200	5527.82	1.67689

APPENDIX K – GEOPHYSICAL DATA FILE LAYOUT

The Geophysical Data Survey (1070) files are archived as a 2 DVD set with the file content divided as follows:

Type of data	Magnetic and Electromagnetic
Format	Grid and Profile data (DVD+Rdl)
ASCII and Geosoft® Binary	1070a

Type of data	Half wave Electromagnetic
Format	Stacked EM data (DVD+Rdl)
Binary	1070b

DVD - 1070a

- ASCII (GXF) and Geosoft® Binary (GRD) grids
  - Digital elevation model.
  - Residual magnetic field.
  - First vertical derivative of the residual magnetic field.
  - Z-coil EM decay constant (tau).
  - Apparent conductance.
- Profile databases (10 Hz sampling) in ASCII (XYZ) Geosoft® Binary (GDB) formats
- DXF files of entire survey block for:
  - Flight path
  - Residual magnetic field contours
  - Z-coil decay constant (tau) contours
  - Apparent conductance contours
- GEOTIFF images (200 dpi) of the entire survey block for:
  - Residual magnetic field
  - Shaded color image of the first vertical derivative of residual magnetic field
  - Colour Z-coil EM decay constant
  - Colour apparent conductance
- Project report (portable document file (*.pdf*) format)
- TDEM Inversion database in ASCII (CSV) and Geosoft® Binary (GDB) formats
- TDEM Inversion section maps in TIFF format
- TDEM Inversion report by Aarhus Geophysics (portable document file (*.pdf*) format)

DVD – 1070b

- Half wave EM data (10Hz sampling) in binary format.
- Readme file with half wave data description (portable document file (*.pdf*) format)
- TDEM version definition files (ASCII format)
- Profile viewing and format conversion software
- Project report (portable document file (*.pdf*) format)

APPENDIX L – PROFILE ARCHIVE DEFINITION

Co-ordinate Systems

The profile and magnetic data are provided in two co-ordinate systems:

- Universal Transverse Mercator (UTM) projection, Zone 17N, NAD83 datum, North American local datum; and

- Latitude/longitude co-ordinates, NAD83 datum, North American local datum.

The gridded data, GeoTIFF images, vector files and digital maps are provided in UTM co-ordinate systems.

Line Numbering

The line numbering convention for the south Simcoe Area survey 12-014 is as follows:

(Block # x 100) + (Line number x 10) :

(i.e.) Block 1 Line 1 is identified as 10010:6

The same convention is used for the labelling of the control lines; however the convention of using a second digit of 9 is standard practice when describing a control line.

[(Block # + 9) x 10] + (Control line # x 10) :

(i.e.) Block 1 Control line 1 is identifiable as T19010:4

Profile Data

The profile data are provided in two formats, one binary and one ASCII.

ASCII and Binary

- ASCII XYZ and Geosoft® OASIS Montaj binary database file (no compression) of electromagnetic, magnetic and ancillary data, sampled at 10 Hz as for south Simcoe Area
    - SSMAGEM.XYZ (ASCII)
    - SSMAGEM.GDB (Binary)

The contents of *.GDB/*.XYZ (both file types contain the same set of data channels) are summarized as follows:

Magnetic/Electromagnetic/ Ancillary Line Data

In SSMAGEM.XYZ, the electromagnetic channel data are provided in individual channels with numerical indices (e.g. em_x_final_on[1] to em_x_final_on[16], and em_x_final_off[1] to em_x_final_off[17] and same for z-component) along with magnetic and ancillary channels. In SSMAGEM.GDB, the electromagnetic channel data are provided in array channels with 16 elements (on-time) or 17 elements (off-time).

Channel Name	Description	Units
x_nad83	easting in UTM co-ordinates using NAD83 datum	metres
y_nad83	northing in UTM co-ordinates using NAD83 datum	metres
lon_nad83	longitude using NAD83 datum	decimal-degrees
lat_nad83	latitude using NAD83 datum	decimal-degrees
gps_z_final	differentially corrected GPS Z (NAD83 datum)	metres above sea level
x_raw	raw GPS X	metres
y_raw	raw GPS Y	metres
line	flightline number	
flight	flight number	
fiducial	fiducial	
date	local date	YYYYMMDD
utctime	UTC time	seconds
radar_raw	raw radar altimeter	metres above terrain
radar_final	corrected radar altimeter	metres above terrain
dem	digital elevation model	metres above sea level
height_em	electromagnetic receiver height	metres above terrain
height_mag	magnetometer height	metres above terrain
basemag	raw magnetic base station data	nanoteslas
mag_base_final	corrected magnetic base station data	nanoteslas
mag_raw	raw magnetic field	nanoteslas
mag_diurn	diurnally-corrected magnetic field	nanoteslas
mag_final	micro-levelled magnetic field	nanoteslas
igrf	local IGRF field	nanoteslas
mag_igrf	IGRF-corrected magnetic field	nanoteslas
em_x_raw_on	raw (stacked) dB/dT, X-component, on-time(1-16 channels)	nanoteslas per second
em_x_raw_off	raw (stacked) dB/dT, X-component, off-time(1-17 channels)	nanoteslas per second
em_z_raw_on	raw (stacked) dB/dT, Z-component, on-time(1-16 channels)	nanoteslas per second
em_z_raw_off	raw (stacked) dB/dT, Z-component, off-time(1-17 channels)	nanoteslas per second
em_x_drift_on	drift-corrected dB/dT, X-component, on-time(1-16 channels)	nanoteslas per second
em_x_drift_off	drift-corrected dB/dT, X-component, off-time(1-17 channels)	nanoteslas per second
em_z_drift_on	drift-corrected dB/dT, Z-component, on-time(1-16 channels)	nanoteslas per second
em_z_drift_off	drift-corrected dB/dT, Z-component, off-time(1-17 channels)	nanoteslas per second
em_x_final_on	filtered dB/dT, X-component, on-time(1-16 channels)	nanoteslas per second
em_x_final_off	filtered dB/dT, X-component, off-time (1-17 channels)	nanoteslas per second
em_z_final_on	filtered dB/dT, Z-component, on-time(1-16 channels)	nanoteslas per second
em_z_final_off	filtered dB/dT, Z-component, off-time(1-17 channels)	nanoteslas per second
tau_z	decay constant (tau) for Z-component(1-16 channels)	microseconds
off_alltau	Off time decay constant for Z-component	microseconds
off_allcon	Off time apparent conductivity for Z-component	milliSiemens per metre
power	60 Hz power line monitor	microvolts
TranOn	Transmitter turn-on time	seconds
TranPeak	Transmitter peak current	amperes
TranSwitch	Transmitter peak current time	seconds
TranOff	Transmitter turn-off time	seconds

APPENDIX M – GRID ARCHIVE DEFINITION

Gridded Data

The gridded data are provided in two formats, one ASCII and one binary:
*.gxf - Geosoft® ASCII Grid eXchange Format (no compression)
*.grd - Geosoft® OASIS montaj binary grid file (no compression)

The grids are summarized as follows:

- All grids are NAD83 UTM Zone 17 North, with a grid cell size of 40 m x 40 m.

south Simcoe (SS) Block:

SS1VD83.grd/.gxf – First Vertical Derivative of GSC Levelled Residual Magnetic Field
SSDCZ83.grd/.gxf – Z-coil EM Decay Constant
SSDEM83.grd/.gxf – Digital Elevation Model
SSMAG83.grd/.gxf – Grid of GSC Residual Magnetic Field
SSCON83.grd/.gxf – Apparent Conductance

APPENDIX N – GEOTIFF AND VECTOR ARCHIVE DEFINITION

GeoTIFF Images

Geographically referenced colour images, incorporating a planimetric base, are provided in GeoTIFF format for use in GIS applications:

- SSMAG83.TIF – SI Residual Magnetic Field
- SS1VD83.TIF – First Vertical Derivative of SI Leveled Residual Magnetic Field
- SSDCZ83.TIF –Z coil EM decay constant
- SSCON83.TIF – Apparent Conductance

Vector Archives

Vector line work from the map is provided in DXF (v12) ASCII format using the following naming convention:

- SSPATH83.DXF – flight path of the survey area
- SSMAG83.DXF – contours of the residual magnetic field in nano-teslas
- SSDCZ83.DXF – contours of the Z coil decay constant
- SSCON83.DXF – contours of the TDEM apparent conductance

- The layers within the DXF files correspond to the various object types found therein and have intuitive names.

APPENDIX O – TDEM INVERSION ARCHIVE DEFINITION

Co-ordinate Systems

The TDEM inversion data are provided in two co-ordinate systems:

- Universal Transverse Mercator (UTM) projection, Zone 17N, NAD83 datum, North American local datum; and
- Latitude/longitude co-ordinates, NAD83 datum, North American local datum.

The gridded data, GeoTIFF images are provided in UTM co-ordinate systems.

Line Numbering

The line numbering convention for the south Simcoe Area survey 12-014 is as follows:
(Block # x 100) + (Line number x 10) :
(i.e.) Block 1 Line 1 is identified as 10010:6

The same convention is used for the labelling of the control lines; however the convention of using a second digit of 9 is standard practice when describing a control line.
[(Block # + 9) x 10] + (Control line # x 10) :
(i.e.) Block 1 Control line 1 is identifiable as T19010:4

TDEM Inversion Data

The profile data are provided in two formats, one binary and two ASCII:

ASCII and Binary

- ASCII and Geosoft® OASIS montaj binary database files (no compression) of electromagnetic, magnetic and ancillary data, sampled at 10 Hz as for south Simcoe Area
  - SSESECTION.CSV(ASCII)
  - SSESECTION.GDB (Binary)

The contents of *.GDB/*.XYZ (both file types contain the same set of data channels) are summarized as follows:

Channel Name	Description	Units
line	flight line number	
flight	flight number	
x_nad83	easting in UTM co-ordinates using NAD83 datum	metres
y_nad83	northing in UTM co-ordinates using NAD83 datum	metres
lon_nad83	longitude using NAD83 datum	decimal-degrees
lat_nad83	latitude using NAD83 datum	decimal-degrees
dem	digital elevation model	metres

height_em	bird height	metres
emfid	fiducial	
em_resistivity	resistivity for N layers from surface	Ohm metres
em_conductivity	conductivity for N layers to surface	S/metres
em_depth_upper_layer	depth to top of N layers from surface	metres
em_depth_bottom_layer	depth to bottom of N layers from surface	metres
em_layer_thickness	thickness of N layers from surface	metres
doi_upper	depth of investigation (more conservative)	metres
doi_lower	depth of investigation (less conservative)	metres

TDEM Inversion Methods and Results

Please refer to "AeroTEM Simcoe_2012_05.pdf" for inversion methods and results.

Aarhus Geophysics 2012. Processing and inversion of AeroTEM data; prepared for Aeroquest Surveys (Mississauga, Ontario), Report Number 2012_05, 107p.