SGL

Technical Report

Fixed-Wing High-Resolution Aeromagnetic, Gamma-ray Spectrometric and Frequency-Domain Electromagnetic Survey

Tellus Waterford Block, Republic of Ireland, 2016

for

Geological Survey of Ireland

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1. EXECUTIVE SUMMARY

Sander Geophysics Limited (SGL) conducted a fixed-wing high-resolution aeromagnetic, gamma-ray spectrometry and frequency-domain electromagnetic survey around Waterford in the Republic of Ireland for the Geological Survey of Ireland (GSI) in partnership with Unicorn Mineral Resources Ltd. The survey block “Waterford” is part of the ongoing Tellus Programme that commenced with the Tellus Airborne Geophysical survey of Northern Ireland in 2005/2006, conducted by the British Geological Survey (BGS), and the subsequent Tellus Border Survey in 2012 jointly administered by the GSI and the Geological Survey of Northern Ireland (GSNI).

The survey was conducted using SGL's De Havilland DHC-6 Twin Otter, registration C-GSGF. Production flights commenced on May 8, 2016 and were completed on May 30, 2016. A total of 18 flights were flown during the survey to complete the planned 6,560 line kilometres. The survey operations were conducted from Waterford Airport (EIWF).

The traverse lines were oriented N15°W and spaced at 200 m. The control lines were oriented E15°N and spaced at 2,000 m. The target clearance was 60 m above ground level, based on the Irish Aviation Authority (IAA) permit. The target average ground speed was 60 m/s, or 115 knots.

2. INTRODUCTION

This report describes the survey of the Waterford Block flown by Sander Geophysics Limited (SGL) for the Geological Survey of Ireland (GSI) and Unicorn Mineral Resources Ltd. in the spring of 2016 in Republic of Ireland in the vicinity of Waterford. See *Appendix I* for a company profile of SGL.

Fixed-wing high-resolution aeromagnetic, gamma-ray spectrometric, and frequency-domain electromagnetic data was gathered during this survey. The instruments used to collect the data, the tests performed to ensure optimal data quality and the data processing methods are described in this report.

Picture 1: SGL's Twin Otter flying over the survey area

The Field Operations section contains all information relating to operations at the survey location including reference station coordinates and any problems encountered during the survey. Re-flights are listed as well as field crew members. The Digital Data Compilation section details all processing performed from data acquisition to final product creation.

The following Project Brief gives a quick reference of the details of the survey.

Project Brief

Survey Title	Fixed-wing high-resolution aeromagnetic, gamma-ray spectrometric, and frequency-domain electromagnetic Survey, Republic of Ireland
Client:	Geological Survey of Ireland (GSI)
Survey Location:	Republic of Ireland
Survey Start Date:	May 8, 2016
Survey End Date:	May 30, 2016
Contact:	Jim Hodgson (jim.hodgson@gsi.ie / tellus@gsi.ie)
Field Office Location:	Waterford, Ireland
Airport Used:	Waterford Airport (EIWF)
Aircraft Type:	De Havilland DHC-6 Twin Otter
Total line kilometres:	6,560
Survey Flying Particulars	
Traverse Lines	
Line numbers:	1001 to 1251
Line direction:	N15°W
Line spacing:	200 m
Control Lines	
Line numbers:	101 to 118
Line direction:	E15°N
Line spacing:	2000 m
Survey Altitude:	Target height of 60 m above ground. This number increased to 240m over built up areas and high fly zones outlined by the GSI.
Digital Terrain Source:	SRTM
Number of Flights (numbers):	18 (0001 to 0018)
Aircraft Target Ground Speed	60 m/s
Data	
Survey Base Parking Location (WGS-84):	N52°11'23.21" W7°4'49.32" 36.2 m
Base Station Locations (WGS-84)	GND1: N52°08'25.8027" W07°01'05.1237" 96.6615 m GND2: N52°08'25.8027" W07°01'05.1237" 96.6615 m
Datum:	IRENET95
Projection:	Irish Transverse Mercator (ITM)

3. SURVEY AREA

The weather in the region is mild and wet, with temperatures that averaged 13°C over the survey period. Morning fog and overcast days with occasional rain showers were common during the survey.

Figure 1 shows the geographical location of the survey area. The area is mostly rural in character but contains a significant amount of infrastructure including many towns, villages, roads, railway lines and power lines. The topography in the area is fairly flat, but includes part of the Comeragh Mountains to the west and cliffs along the coast line to the south. The Suir and Barrow rivers flow in the northeast part of the survey area. The planned survey lines are illustrated in *Figure 2* and listed in *Appendix II*. The flown lines are listed in *Appendix III*.

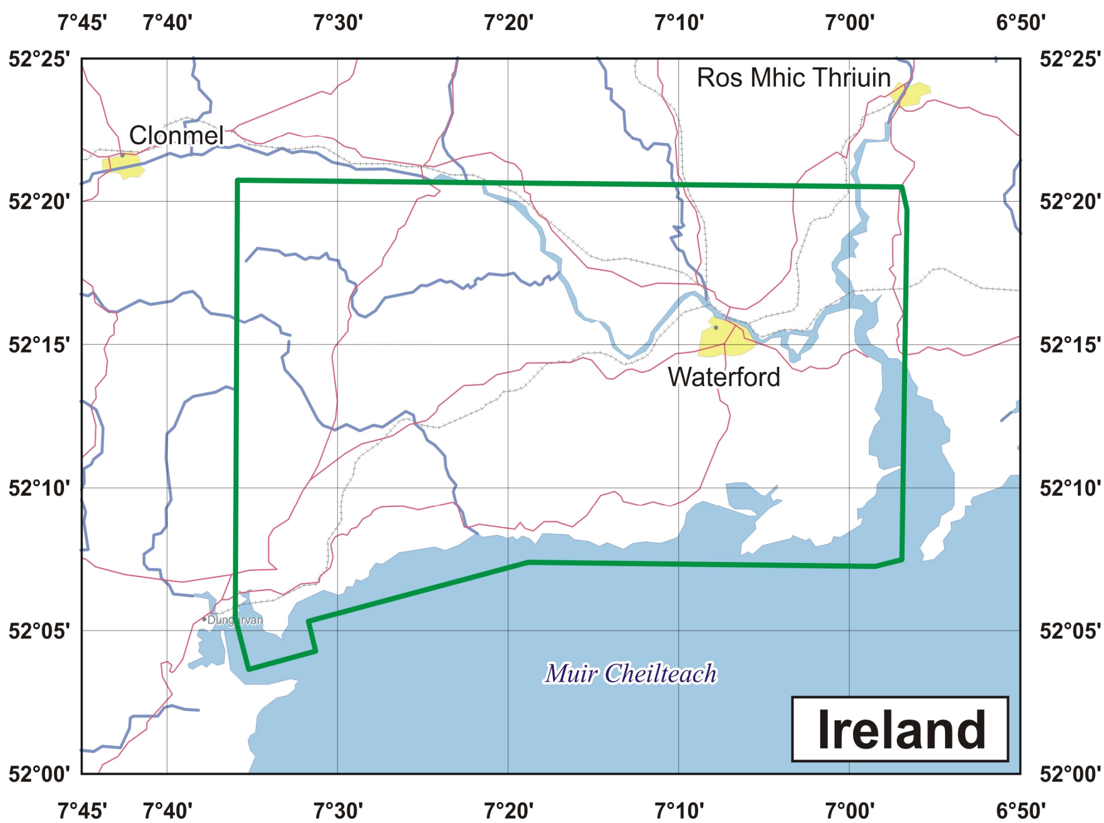


Figure 1: Survey Location Map of the A1 Block

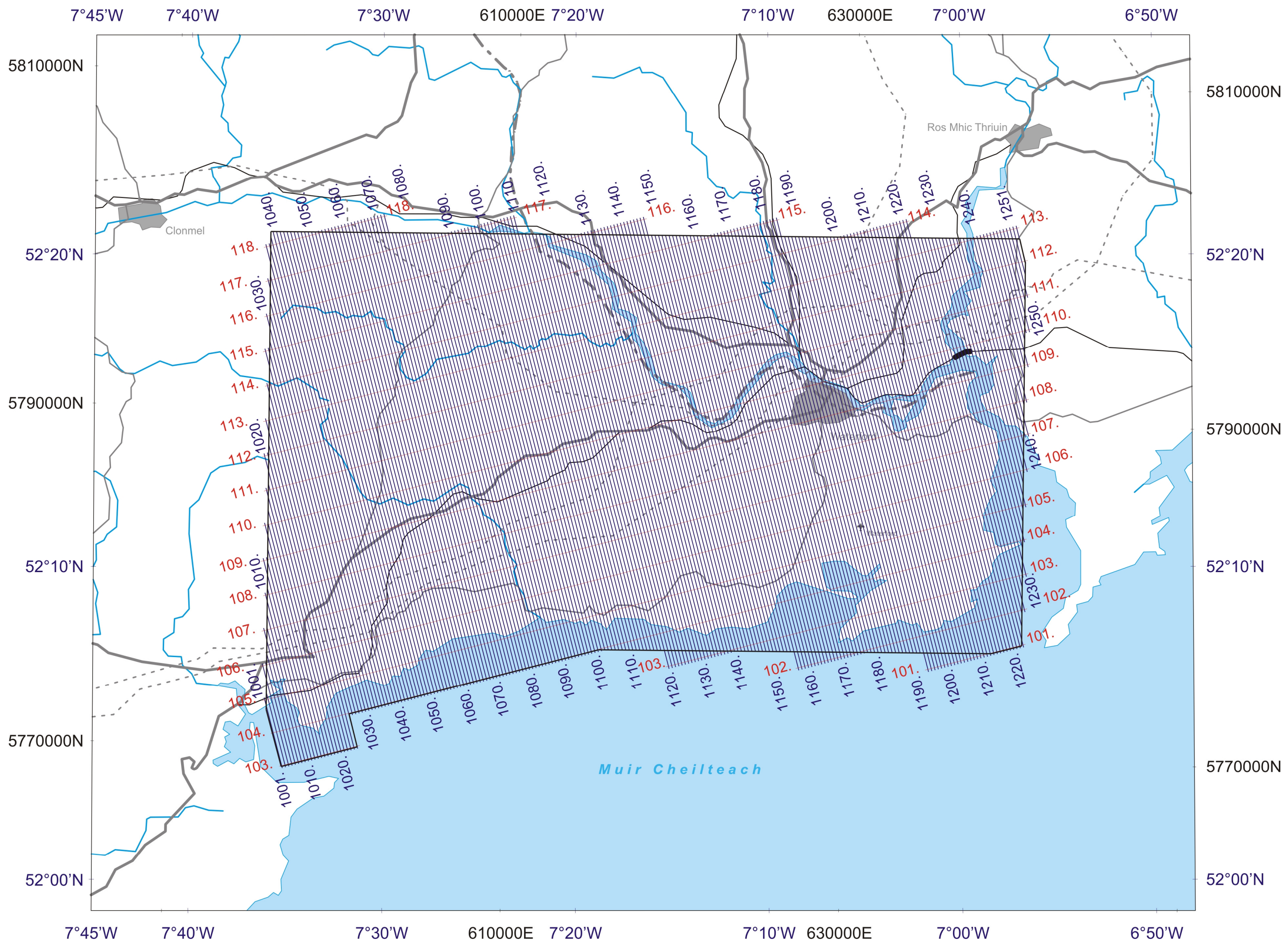


Figure 2: Planned survey lines

Survey Boundary

The Waterford Block is bounded by the coordinates provided in *Table 1* in the IRENET95 datum, Irish Transverse Mercator (ITM) projection:

Table 1: Survey Boundaries (IRENET95, ITM)

Easting (m)	Northing (m)
627400.0000000000	621650.0000000037
671650.0000000019	621650.0000000037
672000.0000000019	620200.0000000037
672000.0000000019	597520.0000000037
670200.0000000019	597050.0000000019
647000.0000000009	597050.0000000019
632299.9999999991	593100.0000000037
632800.0000000019	591149.9999999981
628320.0000000000	589950.0000000000
627400.0000000000	593299.9999999981
627400.0000000000	621650.0000000037

4. SURVEY EQUIPMENT

SGL provided the following instrumentation for this survey; see *Appendix V* for further details:

Frequency Domain Electromagnetic (FEM) System

JAC AEM05 four frequency (1) EM System (0.9, 3, 12, 24.5 kHz)

SGL's DHC-6 Twin Otter is configured with a four-frequency, wingtip mounted Frequency Electromagnetic (FEM) system that operates at four frequencies, 912, 3005, 11962 and 24510 Hz. This configuration results in a large transmitter-receiver coil separation which improves the signal to noise ratio. The transmitter-receiver coil pairs are mounted in a vertical-coplanar orientation which reduces noise by minimizing coupling with the wingtip surface. Additionally, the coils in any one set (transmitter or receiver) are axially offset and are kept adequately separated from each other. The system also comes equipped with a 50/60 Hz power line monitor which becomes particularly useful in identifying cultural interference when surveying in urban settings. The system has a 40 Hz sampling rate which is later decimated to 10 Hz in the processing.

Aerial and Ground Magnetometers

Geometrics G-822A

Both the ground and airborne systems used a non-oriented (strap-down) optically-pumped cesium split-beam sensor. One airborne sensor was mounted in a fibreglass stinger extending from the tail of the aircraft and a second sensor was housed in the left FEM pod attached to the left wingtip. These magnetometers have a sensitivity of 0.005 nT and a range of 20,000 to 100,000 nT with a sensor noise of less than 0.02 nT. Total magnetic field measurements were recorded at 160 Hz in the aircraft then later decimated to 10 Hz in the processing. The ground systems recorded magnetic data at 11 Hz. For the primary purpose of the survey, the wingtip sensor is considered to be redundant.

Magnetic Compensation System

Sander Geophysics AIRComp

SGL's own hardware and software system, AIRComp, was used to remove the effects of the aircraft and its maneuvers from the recorded magnetic data. This system records the magnetic field measured by up to 4 cesium magnetometers, as well as the three axis output of a fluxgate magnetometer. These data are recorded for post-processing. Calibration of the magnetic effects of the aircraft is carried out as described in section 6, System Tests. Coefficients to be used for compensation are derived by processing the calibration flight data. The compensation coefficients are applied to data recorded during normal survey operations to produce compensated magnetic data.

Gamma Ray Spectrometer System

Radiation Solutions RS-501 with Crystal Detector Packs RS5558, RS5557, RS5444, RS5632

The Radiation Solutions spectrometer system includes an on-board ADS computer for each crystal, providing real-time signal processing and analysis, and allowing automatic gain control for individual crystals using the natural thorium peak, and multi-channel recording and analysis. The system utilizes 16 downward-looking and 3 upward-looking parallelepiped

NaI(Tl) crystals of 4.2 L each for a total downward volume of 67.2 litres and upward volume of 12.6 litres. The crystal are housed in four detector packs, four downward crystals in each pack and one upward crystal in three of the packs. Data were recorded in 1024 channel spectral mode and windowed data mode at an interval of 1 s.

Airborne Navigation and Data Acquisition System

Sander NavDAS

The NavDAS is the latest version of airborne navigation and data acquisition computers developed by SGL. It displays all incoming data on a flat panel screen for real-time monitoring. The data are recorded in database format on a solid-state internal hard drive and a removable hard drive simultaneously for transfer of data to the field office. The computer incorporates a magnetometer coupler, an altimeter analogue to digital converter and a GPS multi-frequency receiver NovAtel OEMV-V3 tracking 14 GPS Satellites, 12 GLONASS Satellites, 2 SBAS and 1 L-Band which automatically provides the UTC time base for the recorded data. In addition to providing essential post-mission positional data, the NavDAS computer processes user-received GPS or real-time differentially corrected GPS (RDGPS) data and compares the data to the coordinates of a theoretical flight plan in order to guide pilots along the desired survey line in three dimensions.

Septentrio PolaRx2, 48 channel dual-frequency GNSS GPS receiver

The PolaRx2 system is a 3-antenna, 48-channel L1/L2 GPS receiver, designed to record attitude data of the airplane.

Reference Station Acquisition System

SGRef

The reference station system SGRef, consists of a ground data acquisition computer with a Sander magnetometer frequency counter to process the signal from the magnetometer sensor and from the GPS receiver. The noise level of the station magnetometer is less than 0.1 nT. The time base (UTC) of both the ground and airborne systems is automatically provided by the GPS receiver, ensuring proper merging of both data sets. All data are displayed on an LCD flat panel monitor. The magnetic data, sampled at 11 Hz and GPS data, sampled at 10 Hz, are recorded on the internal hard drive of the computer and the removable hard drive simultaneously for transfer to the processing computers in the field office. The entire reference data acquisition system is fully automatic and was set for unattended recording.

Reference Station GPS Receiver

NovAtel Millennium, 12-channel, dual-frequency

The NovAtel Millennium, 12-channel, dual-frequency receiver forms an integral part of the SGRef system. It provides averaged position and raw range information of all satellites in view, sampled every 0.1 s. The comparative navigation data supplied during all production flights allows for post-processed differential GPS (DGPS) corrections for every survey flight.

Digital Video System

SGDIS - Sander Geophysics Digital Imaging System

The video camera is mounted in the floor of the aircraft and oriented to look vertically below while in flight. Real time text annotation of position, flight information and fiducial marking are incorporated for flight path verification. The data are stored, by flight line, in avi format, viewable by any commercial media player.

Altimeters

SGLas-P - Riegl LD90-3300VHS-FLP Laser Rangefinder

The Riegl laser altimeter is an eye safe laser, has a range of 338 m, a resolution of 0.01 m with an accuracy of 5 cm and a 20 Hz data rate.

Collins AL-101 Radar Altimeter

The Collins radar altimeter has a resolution of 0.5 m, an accuracy of 5%, a range of 0 to 408 m., and a 10 Hz data rate. This system is actively employed for survey guidance and data acquisition.

Honeywell Barometric Pressure Sensor

The barometric pressure sensor measures static pressure to an accuracy of ± 4 m and resolution of 2 m over a range up to 30,000 ft. above sea level. The barometric altimeter data is sampled at 10 Hz.

Omega RTD-805 Outside Air Temperature Probe

The outside air temperature is measured at 10 Hz with a resolution of 0.1º C. The temperature sensor has a range of +/-100º C and an accuracy of +/-0.2º C. The temperature sensor is mounted in an air inlet duct at the point where the wing strut attaches to the right hand wing.

Survey Aircraft

De Havilland DHC-6 Twin Otter (C-GSGF)

Picture 2: SGL's Twin Otter, Registration C-GSGF

The De Havilland DHC-6 Twin Otter (C-GSGF) is an all metal, high-wing, twin-engine, short takeoff and landing (STOL) aircraft. It is powered by two Pratt & Whitney Canada PT6A-27 engines that run a constant speed, fully feathering, reversible propeller. The PT6 turbine engines provide ample power for climbing over steep terrain, working at altitudes up to 7,000 m and can withstand frequent rapid power changes. The aircraft is highly manoeuvrable, rugged in design and can be flown at speeds from 80 to 160 knots. The low stall speeds and abundant available power make the Twin Otter a safe and effective aircraft for surveys requiring flying over rough topography, low air speeds or flights at high altitude. The aircraft has fixed gear, extendable flaps and manually adjustable trim tabs on the primary controls for the roll and pitch axes and full rudder trim for the yaw axis. The aircraft is equipped with full de-icing equipment and sufficient avionics for instrument flying, including a flight control system. Supplementary fuel can be added for transoceanic flight. The Twin Otter is certified for IFR flights in known icing conditions.

The SGL Twin Otter is fully equipped for airborne magnetic, radiometric and frequency-domain Electromagnetic (FEM) surveys. EM fields are measured with the SGL frequency-domain EM system (SGFEM). The four-frequency FEM transmitter is located in the right wingtip FEM pod, and the receiver is located in the left wingtip FEM pod. The magnetic field is measured by up to two sensors allowing for horizontal gradient with one sensor in the composite tail stinger and one in the left wingtip FEM pod. The Twin Otter can carry up to 79.8 litres of detector crystals for gamma-ray spectrometer surveys. The aircraft conforms to Canadian aeronautical regulations in survey configuration. See *Appendix XI*.

Data Processing Hardware and Software

Processing was performed on high performance desktop computers optimized for processing tasks. SGL's proprietary geophysical software was used for data processing.

5. SURVEY SPECIFICATIONS

Data Recording

In the aircraft:

- GPS positional data (time, latitude, longitude, altitude and raw range from each satellite being tracked) 10 readings per second (10 Hz);
- Altitude as measured by the barometric altimeter at 10 readings per second (10 Hz);
- Terrain clearance as measured by the radar altimeter at 10 readings per second (10 Hz);
- Terrain clearance as measured by the laser rangefinder at 20 readings per second (20 Hz);
- Total magnetic field recorded at 160 readings per second (160 Hz);
- Airborne spectrometer data recorded in windowed and 1024 channel spectral format at 1 reading per second (1 Hz);
- Outside air temperature at 10 readings per second (10 Hz);
- Digital video at 30 frames per second (30 Hz).
- Electromagnetic in-phase and quadrature components for four frequencies (912, 3005, 11962 and 24510 Hz designated as P09, Q09, P3, Q3, P12, Q12, P25 and Q25 respectively) recorded at 40 Hz.

At the base and remote magnetic/GPS reference stations:

- Total magnetic field at 11 readings per second (11 Hz);
- GPS positional data (time, latitude, longitude, and raw range from each satellite being tracked) at 10 readings per second (10 Hz).

Technical Specifications

The following technical specifications were adhered to:

- The horizontal accuracy of the final flight path after correction shall typically be +/- 0.5 m.
- Traverse lines with deviation greater than 45 m from the planned line over a distance of 2.5 km or more, or greater than 90 m from the planned line over any distance, will be reflown (except where ground conditions dictate otherwise).
- Tie lines with deviation greater than 100 m from the planned line over a distance of 2.5 km or more, or greater than 200 m from the planned line over any distance, will be reflown (except where ground conditions dictate otherwise).
- Lines where terrain clearance exceeds +/- 20 m from the nominal survey height for more than 2.5 km or 40 m form the nominal survey height at any time on any line will be reflown (unless local topography makes it unavoidable).
- The average flying speed for the survey aircraft is 116 knots or 60 m/s and should not be exceeded by more than 30% for more than 2.5 km.
- The aircraft shall be equipped with a survey magnetometer fitted according to the manufacturer's specification, with a resolution of 0.001 nT and a noise envelope of <0.1 nT.

- The aircraft magnetic heading error after compensation shall be less than +/- 1.0 nT on reciprocal survey headings.
- The envelope sum of the compensation maneuvers shall not exceed 3 nT.
- During data acquisition magnetic variations recorded at the local base magnetometer should not exceed 12 nT over any 3 minute chord or exceed 2 nT over any 30 second chord, on flight lines or tie lines.
- Relative count rates above background during the pre/post flight source tests will be within two standard deviations of the average sample checks for the survey.
- The average line gamma spectra for any line should not appear anomalous by comparison with previously acquired data.
- The calculated PDOP should be <6 and more than 4 satellites should be available.
- If both primary and secondary GPS base stations fail to record for 30 minutes or more simultaneously the affected lines will be reflown.
- If both primary and secondary magnetic base stations fail to record for 30 minutes or more simultaneously the affected lines will be reflown.
- The calibration of the EM system should not deviate significantly from the norm.
- A reflown line must overlap a good line for two tie lines.

Flight Line Specifications

The survey area flight line specifications were as follows (line direction is with respect to the UTM zone reference frame):

Table 2: Flight Lines Specification

	Line Direction	Line Spacing (m)
Traverse Lines	N15°W	200
Control Lines	E15°N	2,000

Terrain Clearance

Flying guidance was provided primarily by SGNav, a flexible and simple navigation system specifically designed by SGL for the airborne geophysical environment. Following the pre-planned survey lines, SGL's SGNav system guides the pilots from their point of departure to the start of a specific line, directs them along the survey line, and then to the next line or any other line of their choosing. While flying along a line, the SGNav system shows the pilots the correct x and y location and their altitude on a small LCD screen mounted in the pilot's line of vision.

Additional navigation parameters are displayed, such as DTS (distance to start of line), DTE (distance to end of line), TMG (track made good), SPD (aircraft ground speed), XHT (up/down error), DTK (desired heading), TTS (time to start of line), TTE (time to end of line), TKE (track error).

For the Waterford survey, the target height was set to 60 meters above ground level in accordance with the IAA permit. The altitude measurements were provided by an aviation radar altimeter. The system is equipped with a safety pull up mode that warns the pilots if the clearance is below a pre-determined height, set at 50 meters above ground level in this case. Each survey line is flown as close to the target height as possible so as to maximize the quality and coverage of the frequency domain EM data which drops off rapidly in signal strength with distance from the source. FEM data quality is very good up to altitudes of about 75 m above ground whilst data collected above 150 m is usually unreliable due to reduced coupling. For this reason, the altitude in adjacent lines and at intersections of lines is not consistent, as would normally be preferred for aeromagnetic data acquisition.

A Garmin GNS430/530 was employed as a second guidance system for this survey with dual receiver navigation system that uses a Jeppesen NavData database. A Garmin was installed on each pilot's yoke that displayed the survey lines and also let the pilots know which lines have already been flown. Another important use for this GPS system was to mark pre-determined areas that pilots had to avoid flying low over. This included towns, farms, equestrian centres etc. Each pre-determined high-fly area had a buffer around it to allow the plane to climb to a higher altitude before reaching the area. The method for dealing with areas to be avoided is discussed in more detail in the *Public Relations and Flying* section below.

Public Relations and Flying

A public relations (PR) campaign was set up by GSI to inform the public about the Tellus survey. A website was set up showing the survey area and the layout of the flight lines, along with some information about the survey. Each week the website was updated with lines that SGL planned to fly that week. This information was submitted to the PR representatives each week by the crew. There was also a phone hotline set up where the public could call with concerns, usually issues related to low flying. People also had the option to become a 'notify' or an 'hig-fly'. The people on the 'notify' list were notified before each day that SGL planned to fly over their property. The people on the 'high-fly' list were generally not notified but the plane flew at 240 m over their property to avoid disruption of people and animals. In such a case the person gave the GPS coordinates of their property to the PR group, who in turn passed it along to the crew. This polygon was then input into the Garmin GPS along with a buffer area. This allowed the pilots to see the areas they needed to avoid during the flight and plan accordingly. Avoid polygons were also made for large towns and cities (with a population of 2000 people or greater) without previous request from any specific person. In some cases the pilots climbed over a built up area that was not marked in their GPS to avoid complaints from the public.

6. OTTAWA SYSTEM TESTS

Magnetometer System Tests

Magnetometer Heading Test

A test was performed to measure the heading error of the magnetic system in the survey aircraft. The test was performed by flying a "cloverleaf" pattern over a known point at high altitude (roughly 10,000 ft) to limit the contribution of ground magnetic signal as much as possible. The cloverleaf consists of a pass over the known point orientated in the north-south and east-west directions.

A heading test was performed prior to the aircraft leaving Ottawa. A test was flown on April 4, 2016 for the tail magnetometer in the same flight in which the compensation test was performed.

The results of the heading test are presented in *Table 3.* The test determined an average north-south (N-S) heading error for the tail magnetometer of 0.54 nT and an average east-west (E-W) heading error of -0.11 nT.

Table 3: Tail magnetometer heading test

Aircraft type:	DHC6 Twin Otter
Registration:	C-GSGF
Field Location:	Ottawa, Canada
Organization:	Sander Geophysics
Pilot:	Charles Dicks
Date:	4 April 2016
Height flown:	~10,000 ft AGL
Magnetometer type:	Geometrics G-822A
Compensator:	SGL AIRComp
Sampling rate:	10/s
Data acquisition system:	Sander SGDAS-3

Dir	Line #	Diurnally Corrected Mag	Variation from Average
N	1	6.7	0.03
S	2	6.3	-0.43
E	3	6.4	-0.33
W	4	6.6	-0.10
N	5	7.2	0.50
S	6	6.6	-0.11
E	7	6.9	0.22
W	8	6.9	0.21
Average N-S Heading Error: 0.54nT			
Average E-W Heading Error: -0.11 nT			

Compensation Calibration

Compensation calibrations determine the magnetic influence of aircraft and its maneuvers. During the compensation calibration flight, the aircraft performs sets of three pitches (+/-5°), rolls (+/-10°), and yaws (+/-5°), while flying in the four flight line directions at high altitude over a magnetically quiet area. The coefficients calculated from the calibration are applied to the acquired magnetometer data to measure the effectiveness of the compensation system in mitigating the magnetic interference.

The total compensated signal noise resulting from the twelve maneuvers, referred to as the Figure of Merit (FOM), is calculated from the maximum peak-to-peak value resulting from each maneuver. A compensation calibration was performed on April 4, 2016 for the tail magnetometer before the aircraft left Ottawa. See *Figure 3* for an illustration of the compensated and uncompensated data acquired during the compensation calibration.

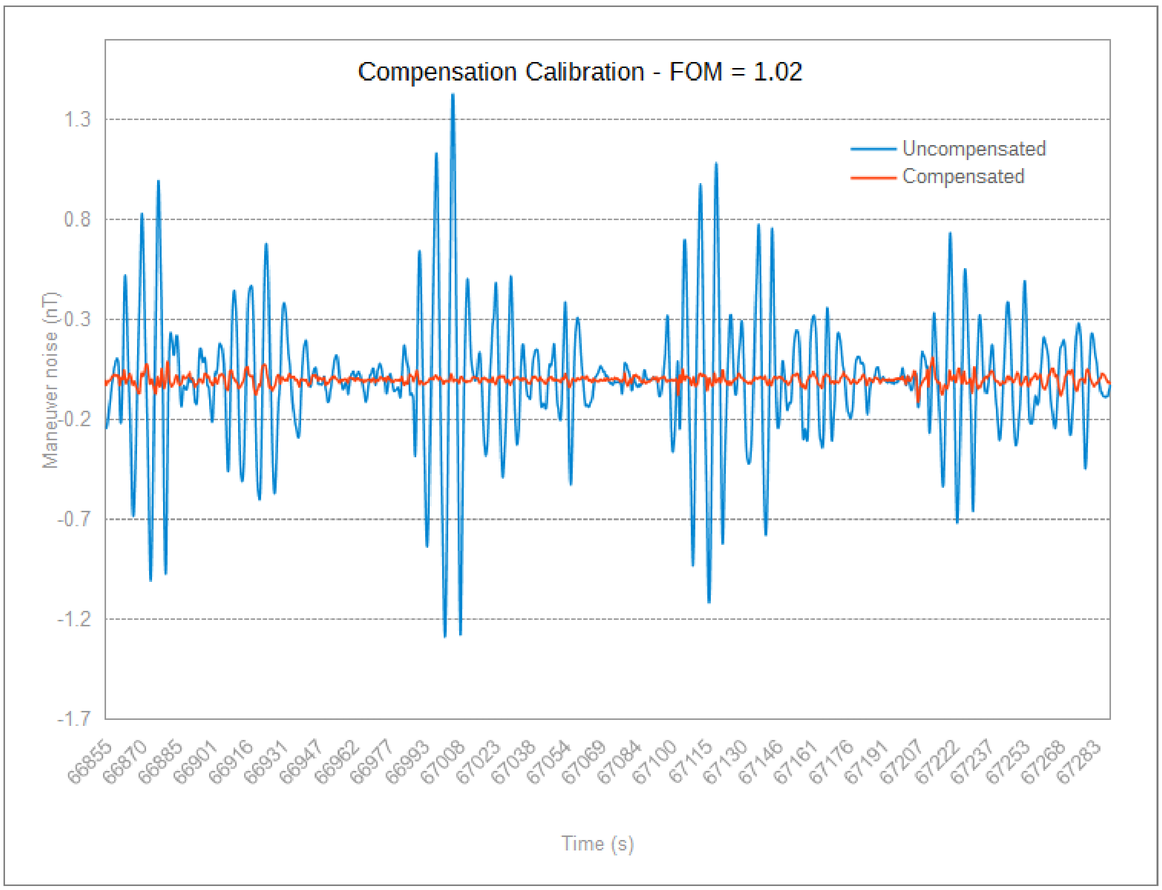


Figure 3: Tail magnetometer compensation calibration test, April 4, 2016

Instrumentation Lag

The lag in the magnetic data is a function of two components, a static lag due to signal processing and a speed-dependent dynamic lag due to the physical offset of the magnetometer and the GPS antenna. Both elements of the lag are well-known. The static lag is known to be 0.244 s from the filters applied during signal processing. The dynamic lag is equal to the offset of the sensors along the long axis of the aircraft, known to be 15.55 m for the tail magnetometer divided by the flying speed. For this test the dynamic tail magnetometer lag averaged 0.287 s, for a total lag of 0.53 s.

The lag test was flown on April 4, 2016 for the tail magnetometer before the aircraft left Ottawa. The test was performed by flying in opposite directions over a railway bridge west of Ottawa that generates a sharp magnetic anomaly. The results are shown in *Figure 4.* The lag correction is applied in the first step of magnetic data compilation.

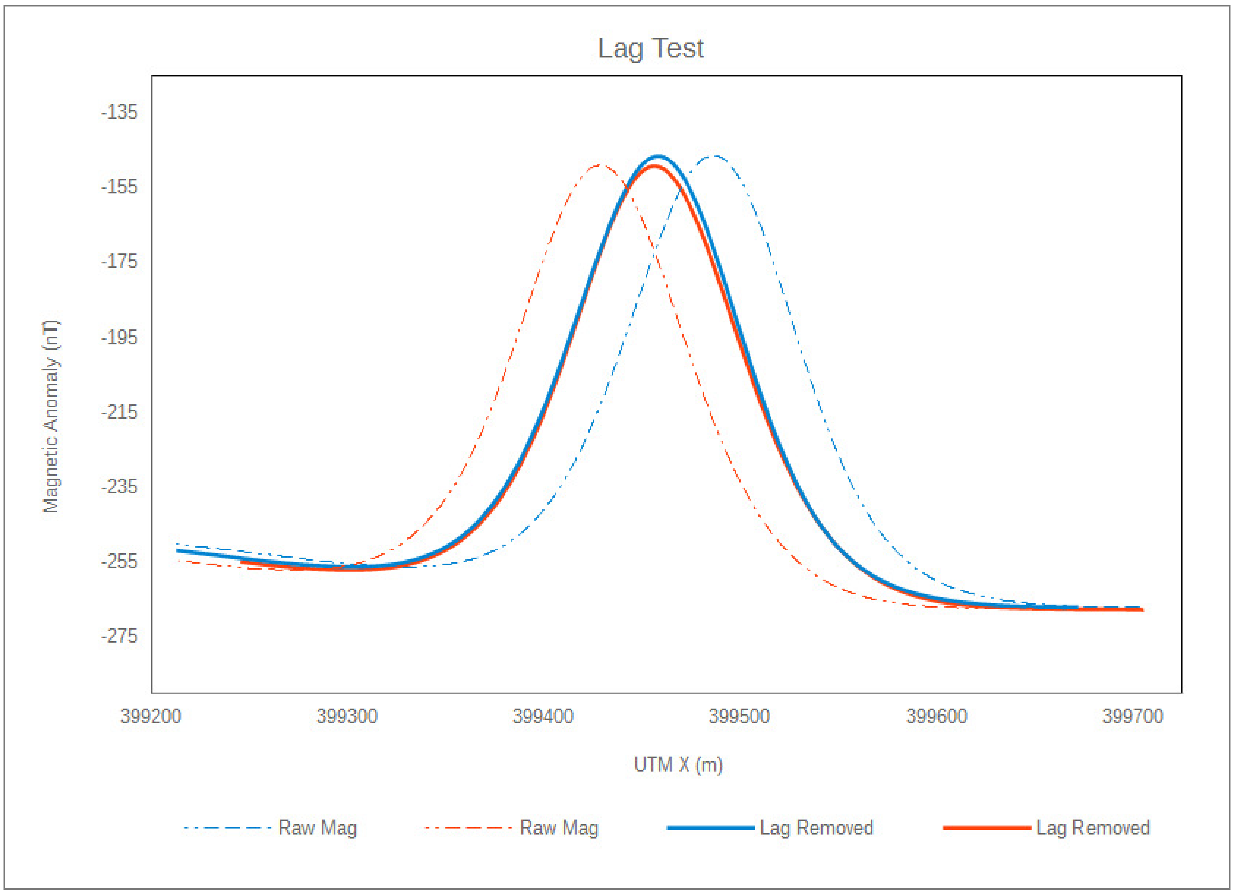


Figure 4: Tail magnetometer lag test; blue traces and red traces are magnetic profiles from data flown in opposite directions.

Spectrometer System Tests

Ground Calibration Pads Test

The stripping ratios for the gamma-ray spectrometer were determined on March 30, 2016 before the aircraft departed Ottawa. The GSC calibration pads, which are stored at the SGL hangar in Ottawa, were used. The tests were performed with the detectors installed in survey configuration on board the aircraft. Each detector was tested separately and the test results were averaged to create stripping ratios for this system. See *Table 4* for a complete list of stripping ratios.

The following procedure was carried out:

- Pre-pads source test, one thorium source below pack
- Pads test carried out in order: background, potassium, uranium, thorium, and background (six minutes recording each)
- Post-pads source test, one thorium source below pack

Table 4: Spectrometer stripping ratios

	Crystal Pack A	Crystal Pack B	Crystal Pack C	Crystal Pack D	Crystal Pack E	Overall System
Thorium into Uranium (α)	0.2737	0.2800	0.2718	0.2786	0.2783	0.2760
Thorium into Potassium (β)	0.4349	0.4334	0.3948	0.4431	0.4202	0.4208
Uranium into Potassium (γ)	0.7808	0.7730	0.7645	0.7728	0.7623	0.7702
Uranium into Thorium (a)	0.0480	0.0435	0.0497	0.0374	0.0357	0.0442
Potassium into Thorium (b)	0.0000	0.0000	0.0000	0.0016	0.0000	0.0000
Potassium into Uranium (g)	0.0000	0.0007	0.0000	0.0000	0.0028	0.0009

Attenuation Test

The exponential height attenuation coefficients for the spectrometer were calculated using the data acquired during a pre-survey test flight over the GSC test range at Breckenridge, Quebec near Ottawa on April 5, 2016. The calibration flights were carried out from approximately 150 m to 290 m mean terrain clearance at 15 m and 30 m intervals. A series of background measurements were made by flying the same altitudes over the Ottawa River to determine the background due to cosmic radiation, radon decay products in the air and the radioactivity of the aircraft and equipment. Results of this test are given in *Table 5*.

After correction for background and stripping, the variation in count rate with effective height was used to determine the attenuation coefficients shown in *Table 6*. Results of the attenuation test are shown in *Figure 5*.

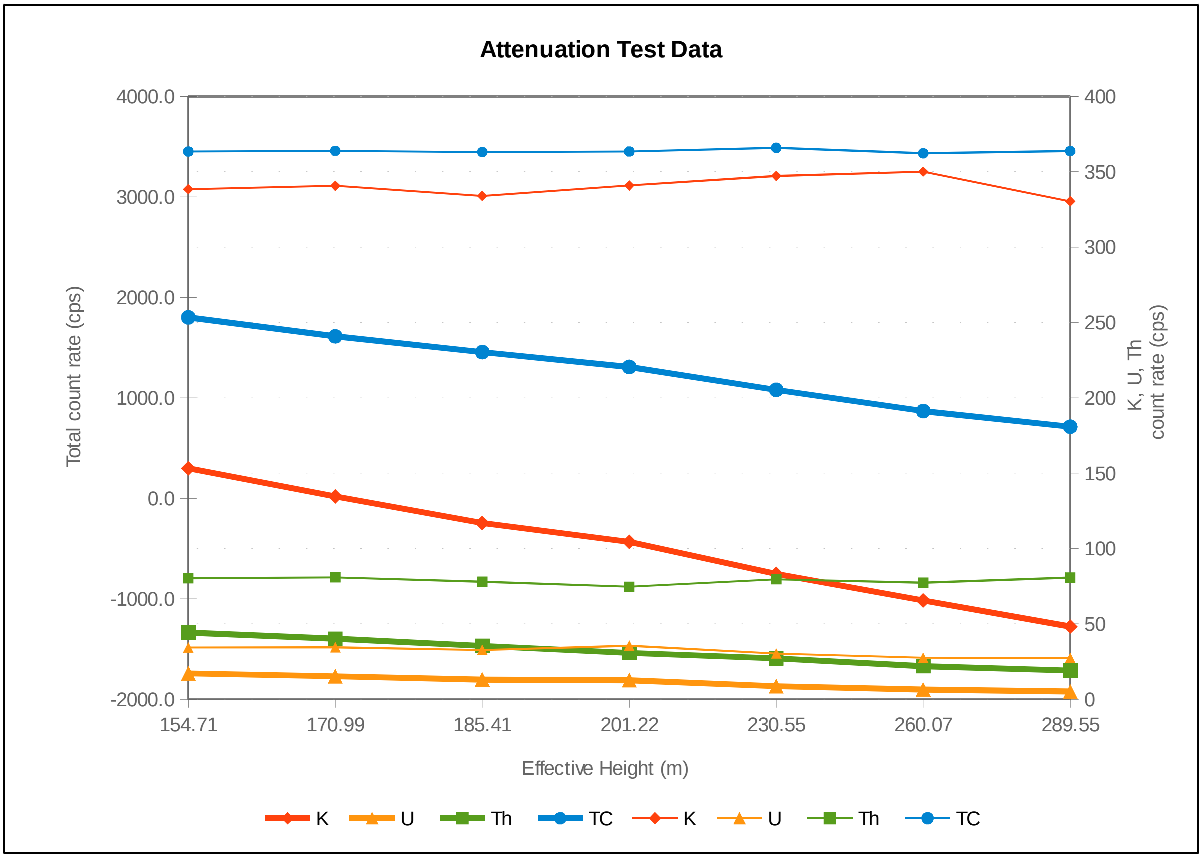


Figure 5: Spectrometer attenuation test

Table 5: Spectrometer calibration test data – height corrected values

Altitude at STP (m)	**Total Counts (cps)**	**Potassium (cps)**	**Uranium (cps)**	**Thorium (cps)**
289.55	3456.8	330.4	27.3	80.7
260.07	3434.6	350.1	27.5	77.3
230.55	3488.6	347.2	30.3	79.6
201.22	3452.2	341.0	35.4	74.7
185.41	3446.6	334.0	32.7	78.0
170.99	3458.2	340.7	34.4	80.9
154.71	3451.9	338.5	34.2	80.3

Table 6: Spectrometer attenuation coefficients

	Coefficients (m^{-1})
Total	-0.006882
Potassium	-0.008383
Uranium	-0.009370
Thorium	-0.006312

System Sensitivity

A pre-survey test flight to determine the gamma ray spectrometer sensitivity was carried out over the GSC test range at Breckenridge, Quebec on April 5, 2016 (the same test flight as performed to determine attenuation). The test flight served to determine system sensitivities through comparison of airborne data with data acquired on the ground.

The ground measurements were made using an Exploranium portable gamma-ray spectrometer, acquired at 25 different sites along the 10 km length of the calibration range. Measurements were also made using the portable spectrometer on a boat on the Ottawa River to determine background radiation due to cosmic radiation, radon decay products in the air and any radioactivity of the equipment. The background was subtracted from the ground measurements and the ground concentrations of potassium, uranium and thorium were determined by calibration of the portable spectrometer using the GSC calibration pads located at Ottawa Airport.

The sensitivities of the airborne system for potassium, equivalent uranium, and equivalent thorium were calculated by dividing the average count rates corrected to an effective height of 60 m above ground by the measured ground concentrations. The results are presented in *Table 7*.

Table 7: Spectrometer system sensitivities, Breckenridge, QC

	Average counts at 60 m (cps)	Ground Concentrations	Sensitivities
Potassium	340.3	1.81%	187.9987 cps/%
Equivalent Uranium	31.7	1.27 ppm	24.9462 cps/ppm
Equivalent Thorium	78.8	7.60 ppm	10.3658 cps/ppm

Altimeter System, Position And Digital Terrain Model Tests

Radar And Laser Altimeter Calibration

A test flight to calibrate the radar and laser altimeters was flown on April 5, 2016 over the runway at Gatineau Airport, near Ottawa. Seven passes were conducted over the runway at heights from 0 to 300 m above ground at various levels. The altimeter values were compared to the post-flight differentially corrected GPS altitude information for calibration. An ideal altimeter would yield a slope of 1 and an intercept of 0. The Collins radar altimeter slope was 0.9953 and the intercept 1.5333 m. The laser altimeter slope was 0.9999 and the intercept was -0.5598 m. These results are within the expected accuracy of the altimeters. Please refer to *Figure 6* which illustrates the results of the altimeter test.

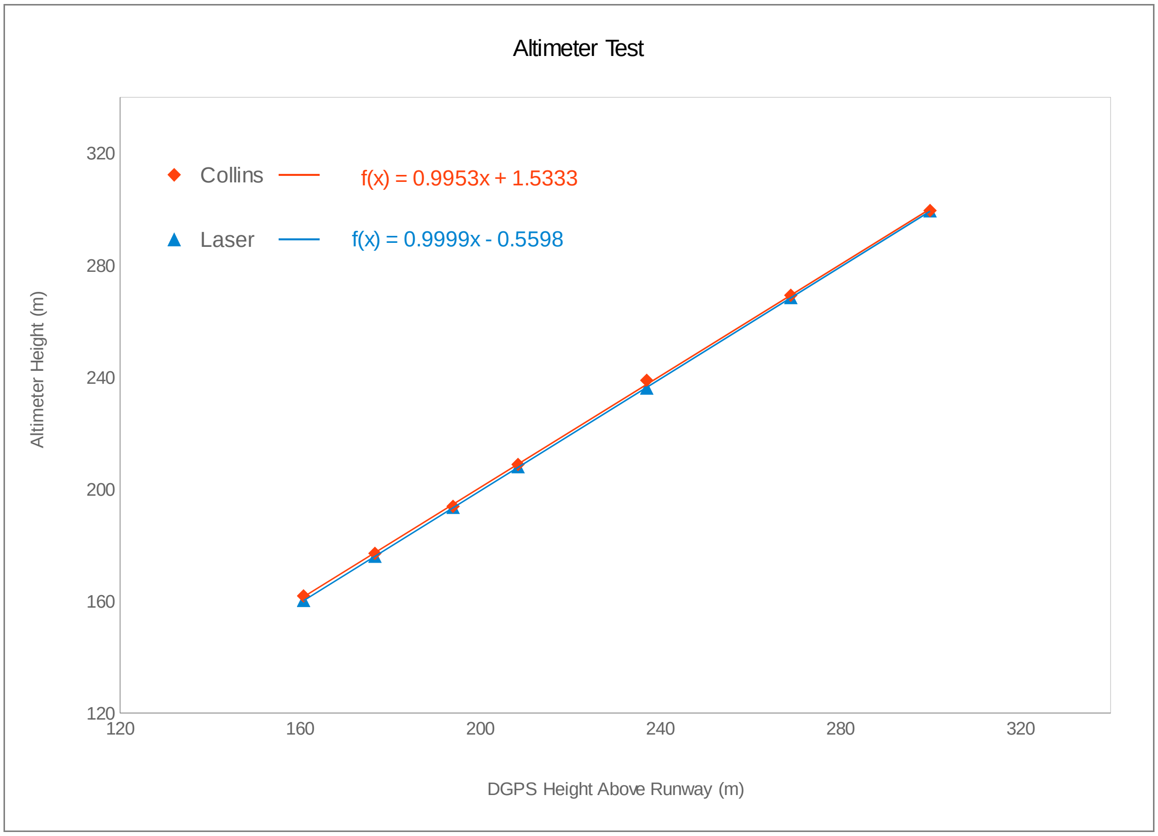


Figure 6: Altimeter test

7. WATERFORD SYSTEM TESTS

Magnetometer System Tests

Magnetometer Heading Test

A heading test was performed over the sea southwest of Waterford prior to the start of the survey on May 16, 2016. The heading test flight lines were pre-planned, and reference ground magnetic data were obtained through the use of the survey SGL reference station.

The results of the heading test are presented in *Table 8*. The test determined an average north-south heading error of 0.01 nT and an average east-west heading error of -0.08 nT for the tail magnetometer. The heading error remains consistent through the duration of the survey, and is fully corrected in the normal airborne magnetic data during processing.

Table 8: Tail magnetometer heading test

Aircraft type: DHC6 Twin Otter
Registration: C-GSGF
Field Location: Republic of Ireland
Organization: Sander Geophysics
Pilot: Steve Gebhardt

Dir	Line #	Diurnally Corrected Mag	Variation From Average
1	N	-563.7	-0.10
2	S	-563.8	-0.18
3	E	-563.7	-0.06
4	W	-563.7	-0.07
5	N	-563.6	0.05
6	S	-563.5	0.10
7	E	-563.6	0.06
8	W	-563.4	0.22
	Avg	-563.6	
Average N-S Heading Error			0.01 nT
Average E-W Heading Error			-0.08 nT

Compensation Calibration

Compensation calibrations determine the magnetic influence of aircraft and its manoeuvres. During the compensation calibration flight, the aircraft performs sets of three pitches (+/-5°), rolls (+/-10°), and yaws (+/-5°), while flying in the four flight line directions at high altitude over a magnetically quiet area. The coefficients calculated from the calibration are applied to the acquired magnetometer data to measure the effectiveness of the compensation system in mitigating the magnetic interference.

The total compensated signal noise resulting from the twelve manoeuvres, referred to as the Figure of Merit (FOM), is calculated from the maximum peak-to-peak value resulting from each manoeuvre. A new compensation calibration must be performed after any aircraft or system modifications that may affect the aircraft's magnetic field interference. A Compensation flight was performed on May 16, 2016 at high altitude over the sea to the southwest of Waterford. *Table 9* shows the compensation calibration tests performed for the tail magnetometer and the results. See *Figure 7* for an illustration of the compensated and uncompensated data acquired during the compensation calibration.

Table 9: Magnetic compensation calibration tests and results

Date	Flight	FOM (nT)	Used for Flights
May 16, 2016	9007	0.89	all

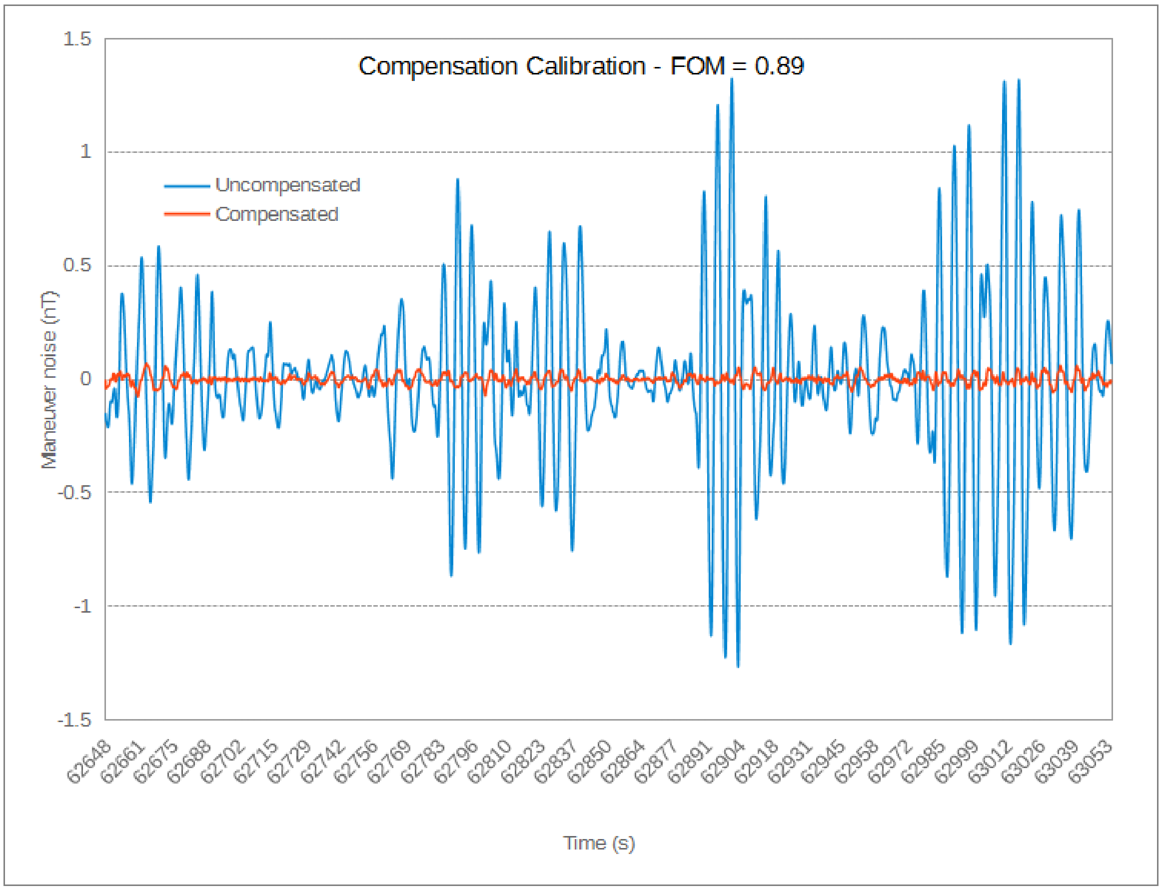


Figure 7: Compensation Calibration Test Results, May 16, 2016

Spectrometer System Tests

Cosmic and Aircraft Background

A cosmic and aircraft background test was performed for the spectrometer on May 16, 2016, over the sea southwest of Waterford. The test flight consisted of flying at heights of approximately 1500 m to 3500 m above sea level at 300 m and 150 m intervals, recording between 3 and 6.5 minutes of data at each altitude. Coefficients are determined by linear regression of cosmic counts versus each spectral window as described in the IAEA Report 323 (1991). *Table 10* lists the computed cosmic and aircraft background coefficients. *Figure 8* shows the cosmic test results.

Table 10: Cosmic coefficients

	Cosmic Stripping Factor	Aircraft Background (cps)
Total	1.2501	13.9282
Potassium	0.0685	20.3222
Uranium	0.0557	-4.9112
Thorium	0.0680	-5.0069
Upward	0.0107	-1.1109

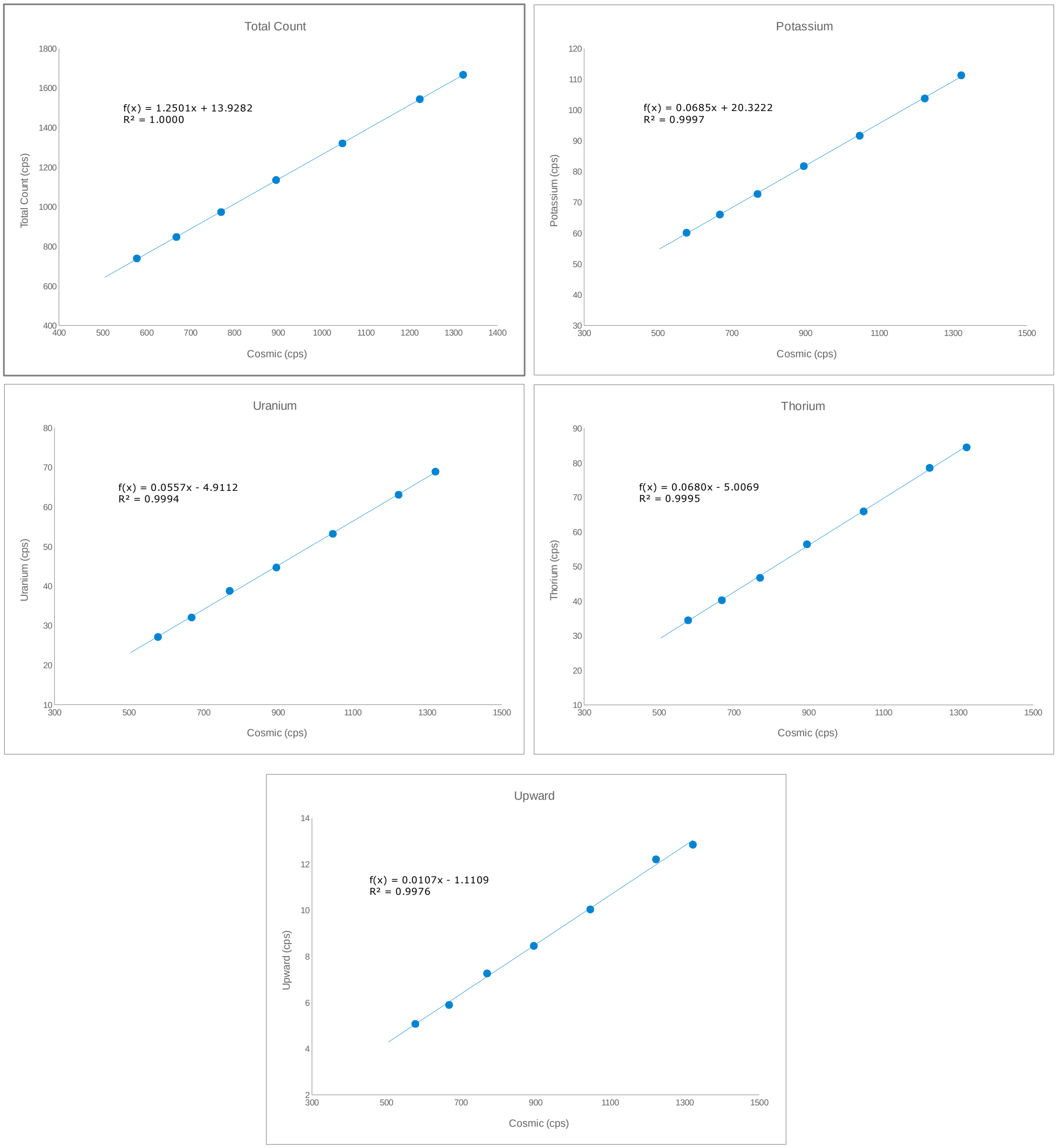


Figure 8: Cosmic test results

Radon Background Calibration

Radon background was monitored through the use of three upward looking detectors. Coefficients relating the count rate in the uranium window from the upward detectors to the count rate in the potassium, uranium, thorium and total count windows from the downward facing detectors were determined using several over water test lines flown over the sea, south of the town of Tramore.

The cosmic and background corrected data from each of the up (ur), thorium (Tr), potassium (Kr) and total (Ir) windows are plotted against the counts in the uranium (Ur) window for each over water line flown. The coefficients determined for this survey are presented in *Table 11*. Linear regressions of these plots provide the radon coefficients to be used in the radiometric data processing are shown in *Figure 9.*

Table 11: Radon correction coefficients

	a	b
$I_r = a_I U_r + b_I$	16.8212	40.4862
$K_r = a_K U_r + b_K$	0.8313	6.2788
$T_r = a_T U_r + b_T$	0.0681	0.8433
$u_r = a_u U_r + b_u$	0.2536	0.0602

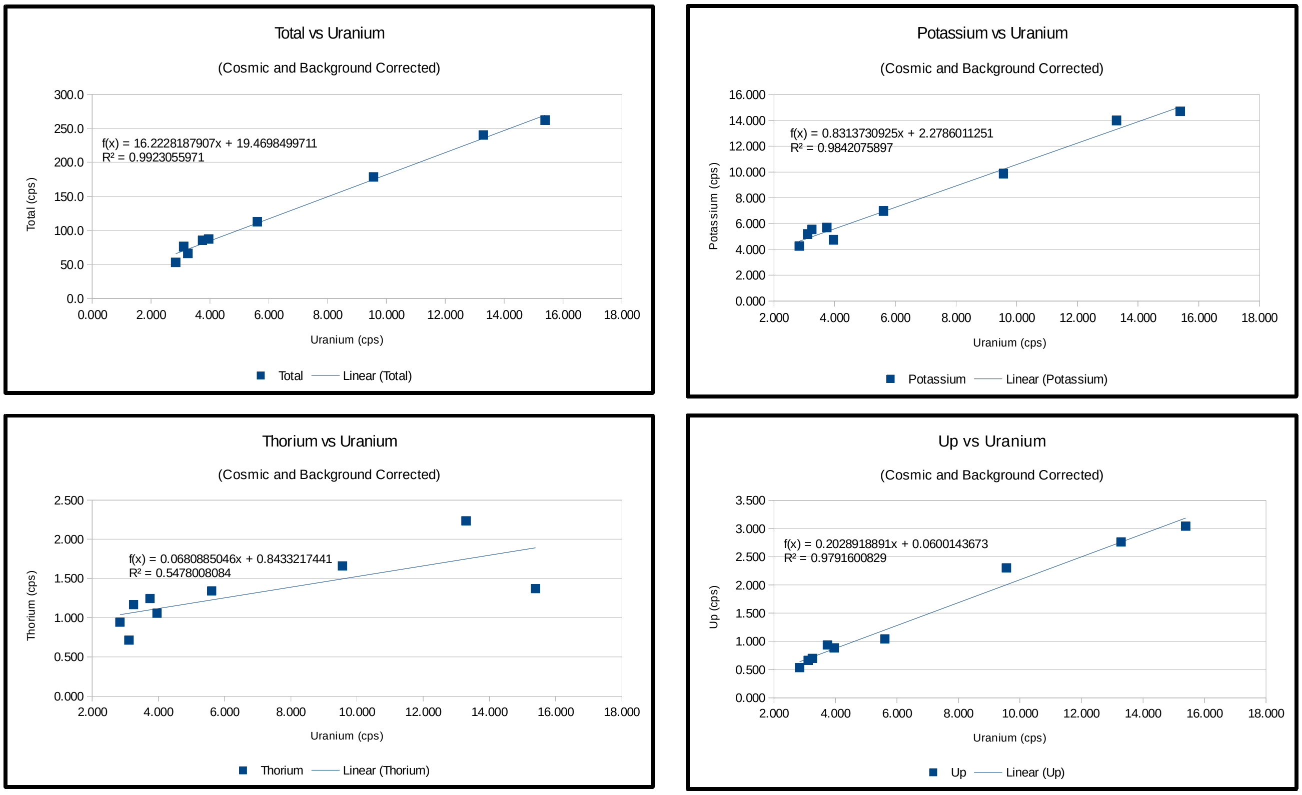


Figure 9: Radon test results

Ground Component

The ground component coefficients are used to quantify the response of the upward looking detector to radiation from the ground using the technique described in IAEA Report 323. This involves computing two coefficients based on the counts in the uranium and thorium windows as follows:

$$u_g = a_1 U_g + a_2 T_g$$

where: u_g is the upward window count from the ground

U_g is the downward uranium window count

T_g is the downward thorium window count

a_1 and a_2 are the ground coefficients

The ground component coefficients are determined from the full survey data set and those used for this project are listed in *Table 12*.

Table 12: Spectrometer ground component coefficients

a_1 (uranium)	a_2 (thorium)
0.034225	0.019581

Daily Source Tests

Thorium and uranium source tests were performed at the start and end of each production day. A source was positioned beneath each crystal pack. Data from the thorium, uranium, and background windows were recorded for 300 seconds during each test. Recorded data were dead-time and background corrected and statistics were compiled. Thorium source test results were within +/-2σ of the mean value, see *Figure 10* and *Figure 11*. The coherence of the data indicates that the system is operating correctly.

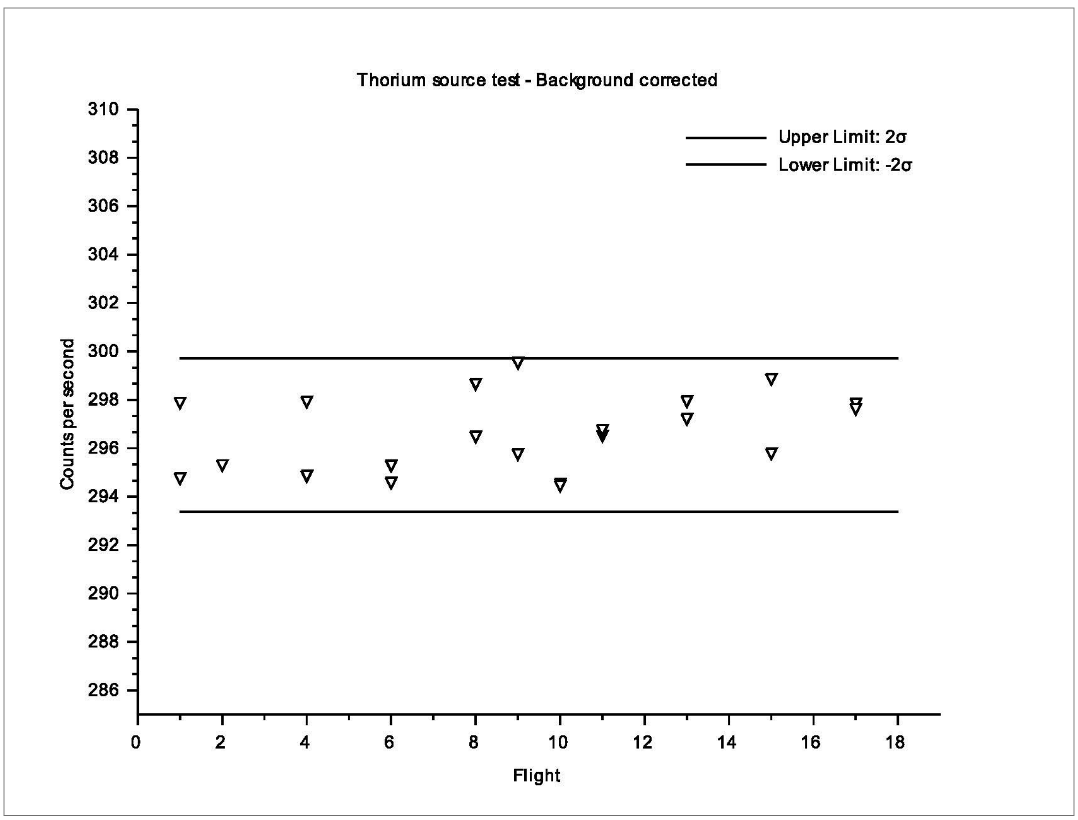


Figure 10: Thorium source test

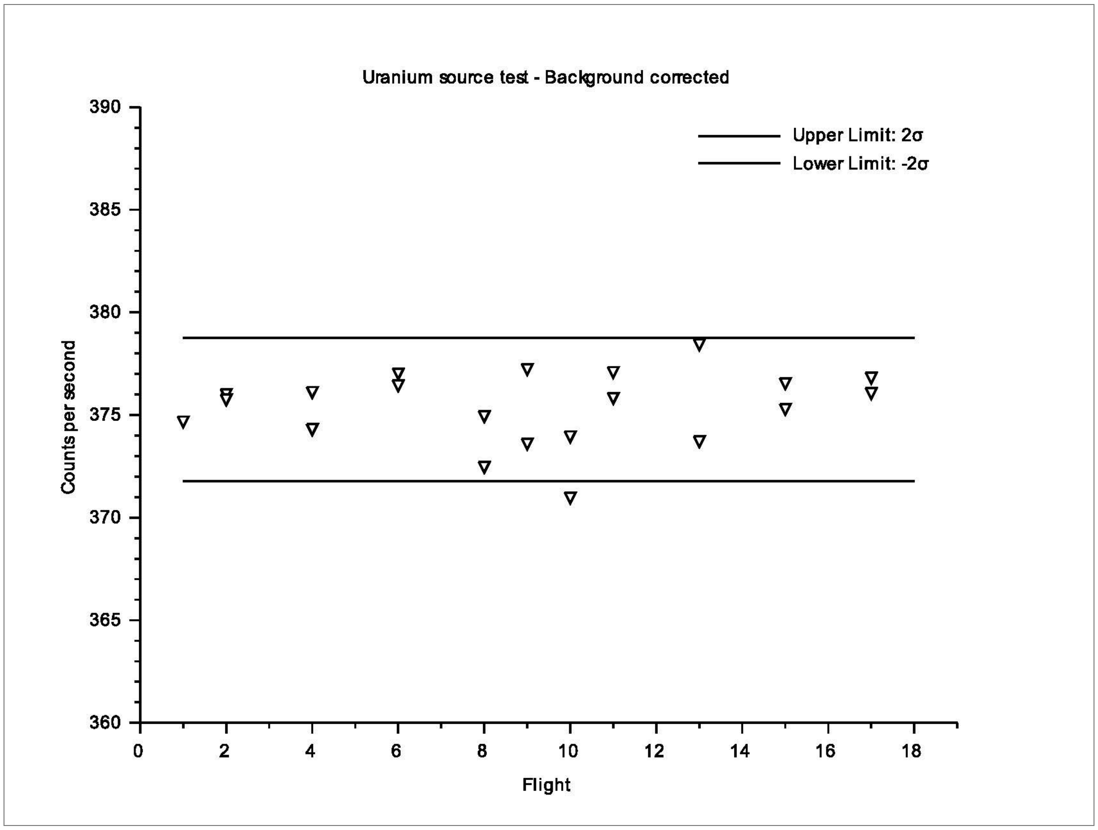


Figure 11: Uranium source test

Frequency-Domain Electromagnetic System Tests

EM System Orthogonality

Prior to each flight, the phase shift between the in-phase and quadrature parts of the EM response is verified and adjusted if required. For each frequency, two pulses of constant amplitude are artificially generated, the first being perfectly in-phase with the primary field, and the second being phase shifted by 90 degrees. Therefore, when the phase orthogonality is properly adjusted, no quadrature response should be observed during the first pulse, and no in-phrase response should be observed during the second. This test is usually performed at 300 m or more above the ground to avoid any EM response from the ground and to minimize cultural interference. The compensation of the primary field that enables EM data to be recorded with reference to an arbitrary zero-level low enough to ensure that the full range of the receiving device can be utilized, is also verified to ensure the system is functioning properly. The orthogonality check is also performed following the flight, while ferrying back to the base. An example of the orthogonality check is shown in *Figure 12*.

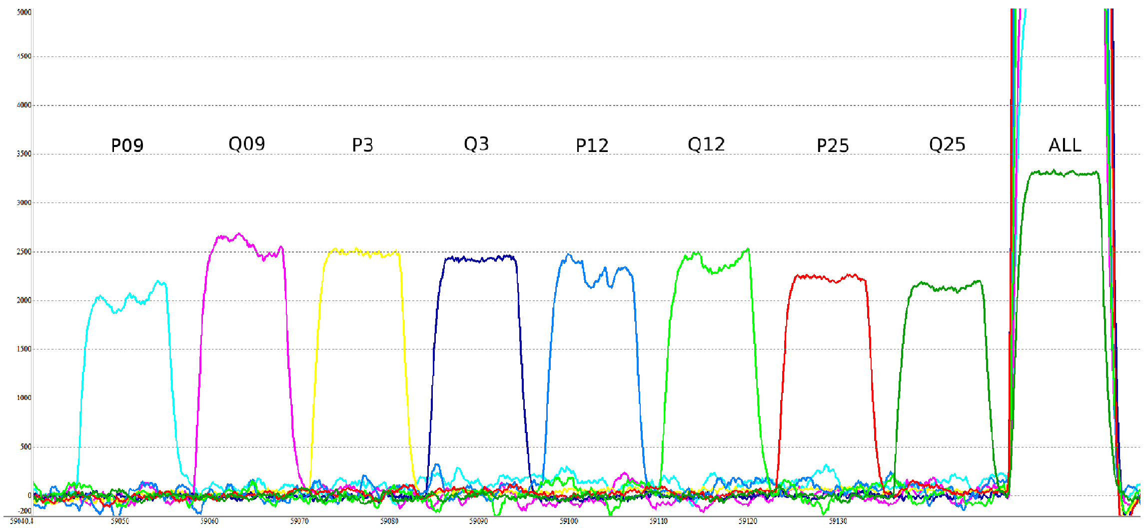


Figure 12: Orthogonality check

Each pulse represents the in-phase and quadrature response for each of the four frequencies in turn, followed by a single large pulse for all frequencies. For the first eight pulses, a well adjusted system will only show a response in the single channel expected, as illustrated here.

EM Over-Seawater Calibration

The frequency domain electromagnetic system was calibrated following procedures described by Hautaniemi et al. (2005) using the results from the previous survey flown in 2015. The test site at the time was chosen over Donegal Bay, in an area where water conductivity and temperature have been measured several times over the years, at every meter from surface to sea floor, by the Irish Marine Institute. The water depth reaches over 60 m, ensuring that the bottom sediments do not contribute to the EM response. Conductivity data from two different stations taken at three different years were analyzed, and proved conductivity profiles to be essentially consistent at the two stations and therefore can be assumed to be constant between them. The calibration line location (in red) and the two sampling stations (CE10003_056 and CE10003_057) are shown in *Figure 13*. The conductivity data was analyzed to estimate the conductivity variation with depth, see *Figure 14*. The conductivity change with respect to temperature was analyzed as well over three different years, see *Figure 15*.

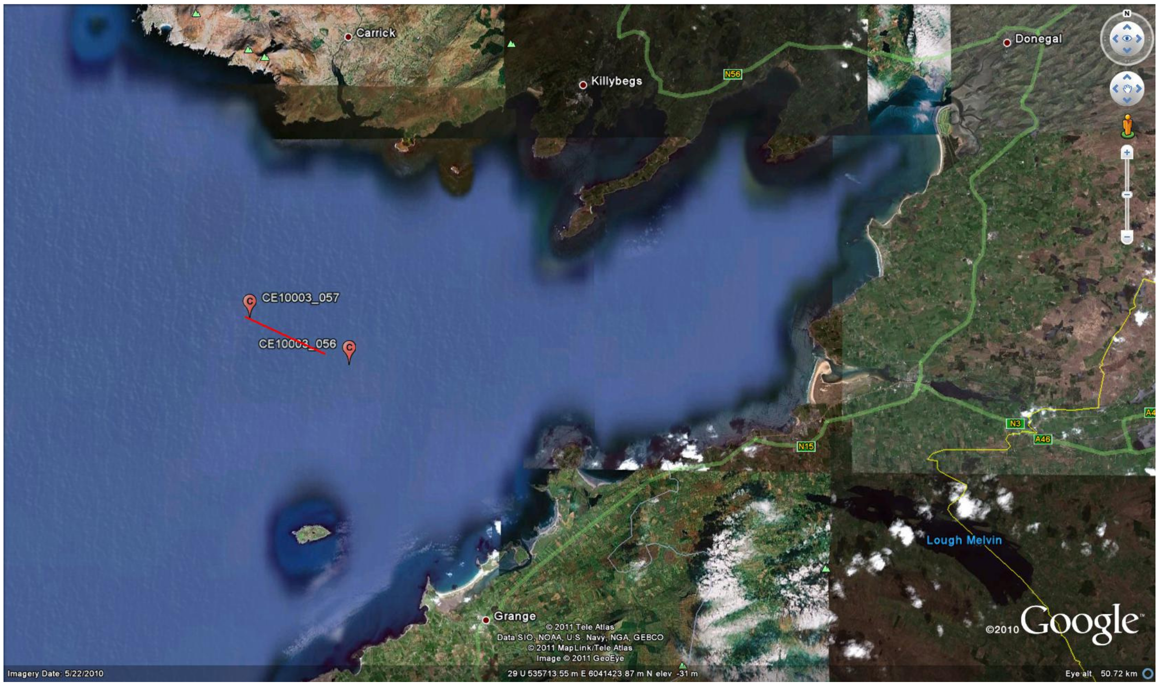


Figure 13: Seawater test line location

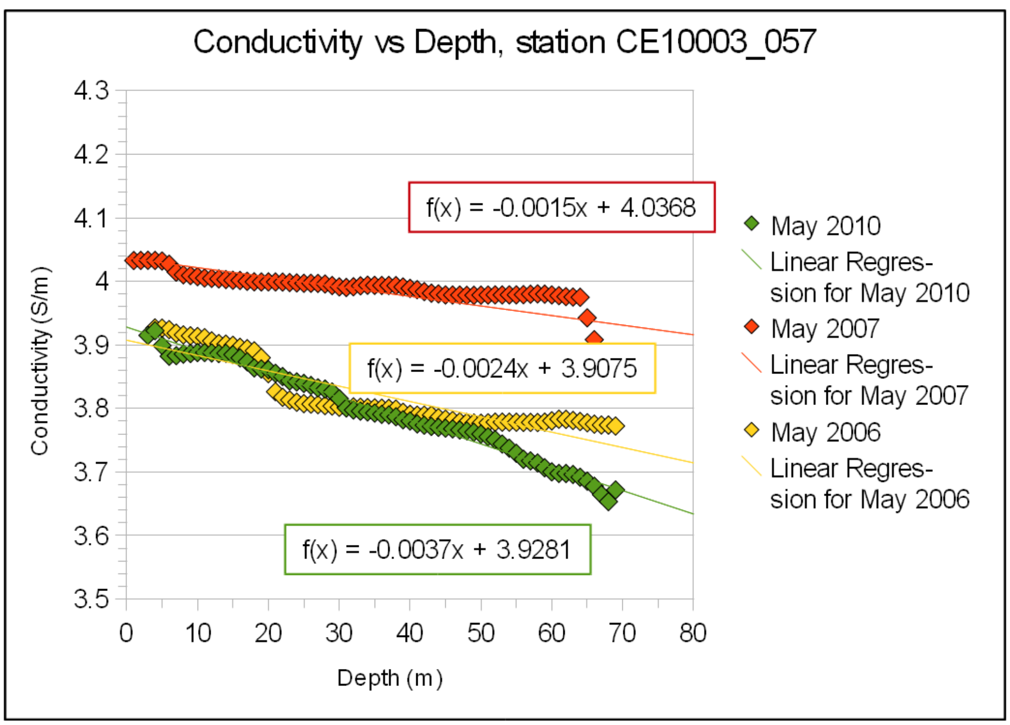


Figure 14: Conductivity variation with depth

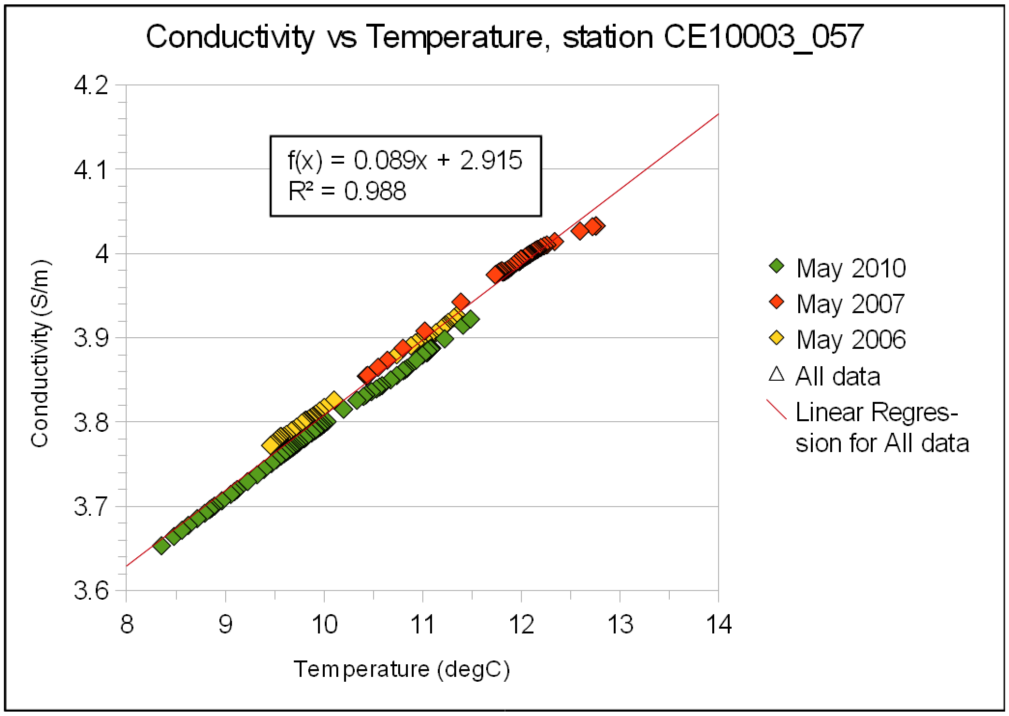


Figure 15: Conductivity variation with temperature

The 4.5 km long calibration line was flown on August 6, 2015 at several heights from 25 to 100 m. Surface water temperature measured on the same day the calibration flight took place (13.36 °C, published by the Irish Marine Institute) enabled the estimation of the water conductivity close to surface ([0.089 S/m℃* 13.36 ℃] + 2.915 S/m = 4.10 S/m). Based on the average conductivity decrease with depth observed over the three years, it was possible to estimate the water conductivity at a depth of 30 m ([-0.0025 S/m^2 * 30 m] + 4.10 S/m = 4.03 S/m), and the average conductivity between the surface and a depth of 30 m at the calibration site (4.07 S/m). The skin depth of the induced current is inversely proportional to conductivity and signal frequency, and it is calculated that slight changes in conductivity below 30 m are negligible. This conductivity was used to create a single layer model (half-space), which was employed to calculate the EM response for each component of each frequency, for the range of altitudes covered during the calibration flight. The calculation was performed with the software Airbeo, developed by AMIRA. The results are shown in *Figure 16*.

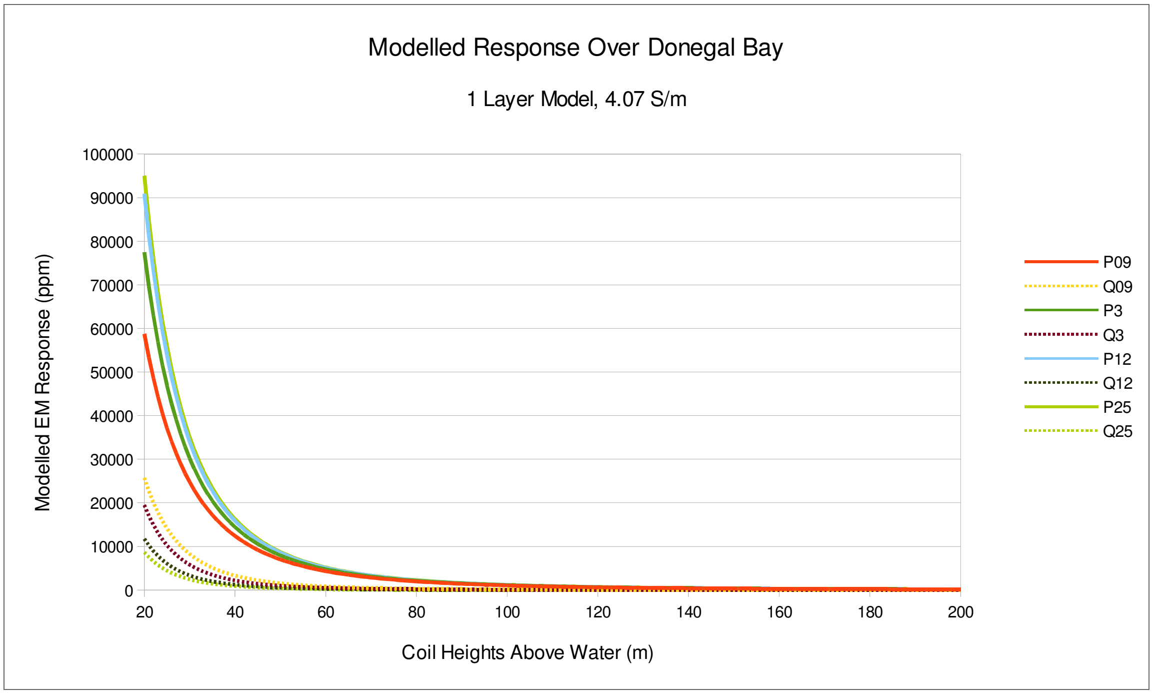


Figure 16: Modelled EM response vs. Coil height above water over Donegal Bay

This model shows how sensitive the EM response is with respect to separation distance between the system and the water. It is therefore important to use accurate clearance information to perform the calibration. The radar altimeter was properly calibrated over the Gatineau airport runway in Canada. Moreover, the altimeter data was corrected for the distance between the radar system and the EM coils. Given the wide footprint of the radar, the use of the strongest return when recording altitude, and the relatively low flying altitude, attitude corrections were deemed negligible. The EM data was also corrected for lag effects.

The receiver measured voltage (V units) recorded along the calibration line were plotted against the theoretical secondary to primary field coupling ratio (ppm units), and the calibration coefficients (ppm/V units) were obtained through a linear regression. In order to ensure that the measured in-phase data used for the calibration is indeed entirely in-phase, the in-phase/quadrature orthogonality was verified before and after the calibration flight and confirmed to be good.

The coefficients obtained for each frequency are summarized in *Table 13*. These coefficients were used for all flights to convert from Volts to ppm. The plots showing the fit obtained for the in-phase response at each frequency are presented in *Figures 17 to 20*. The quadrature coefficients are assumed to be the same at each frequency.

Table 13: Calculated conductivity coefficients for each frequency (ppm/volt)

Frequency	912 Hz	3005 Hz	11962 Hz	24510 Hz
Coefficient	5372	5784	7496	6122

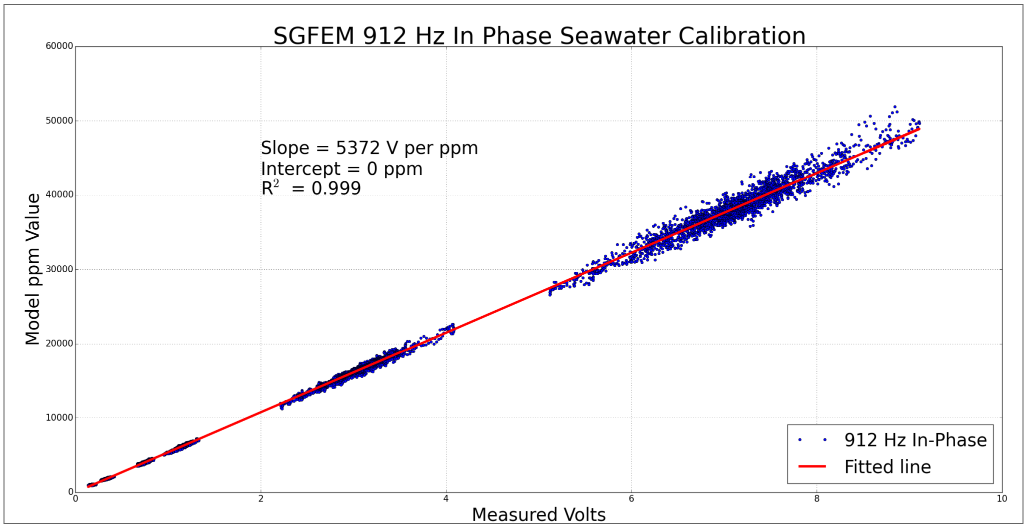


Figure 17: SGFEM 912 Hz In Phase Seawater Calibration

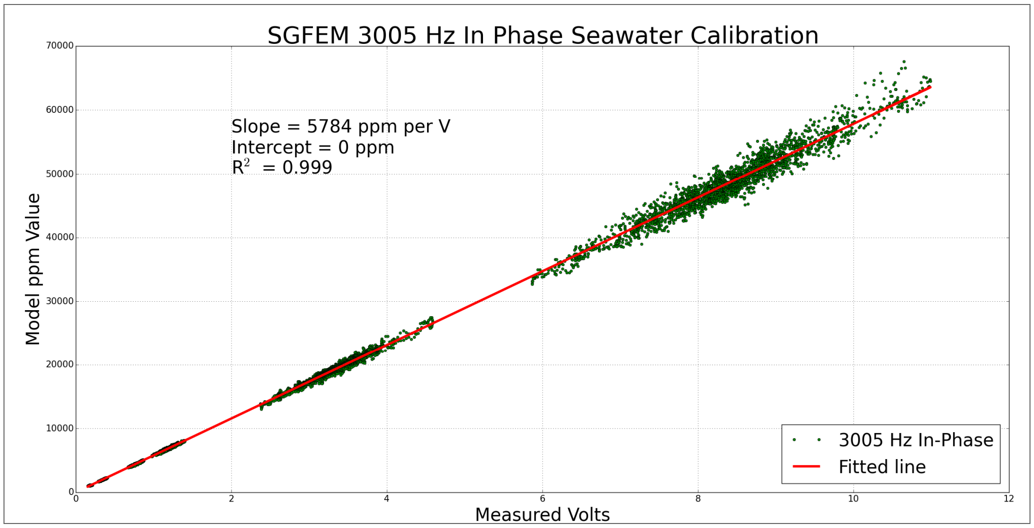


Figure 18: SGFEM 3005 Hz In Phase Seawater Calibration

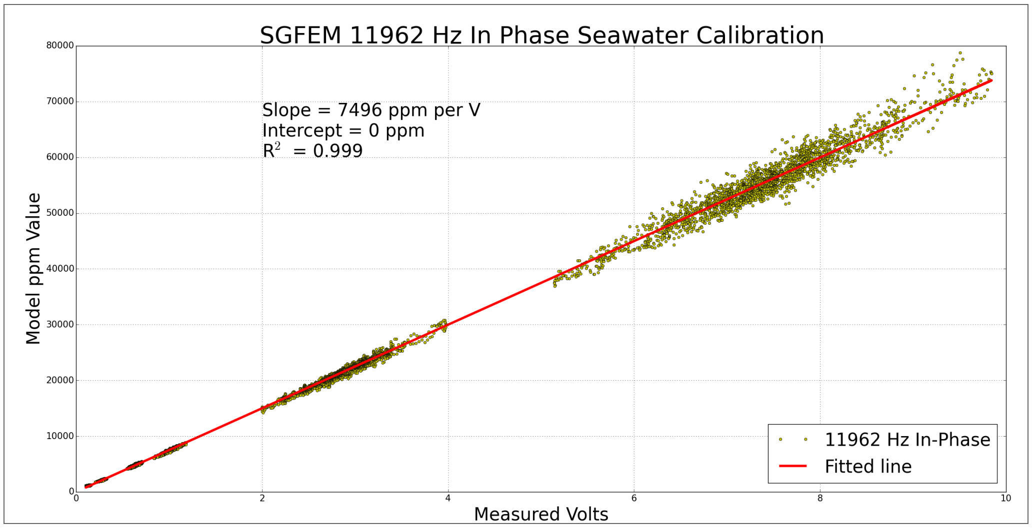


Figure 19: SGFEM 11962 Hz In Phase Seawater Calibration

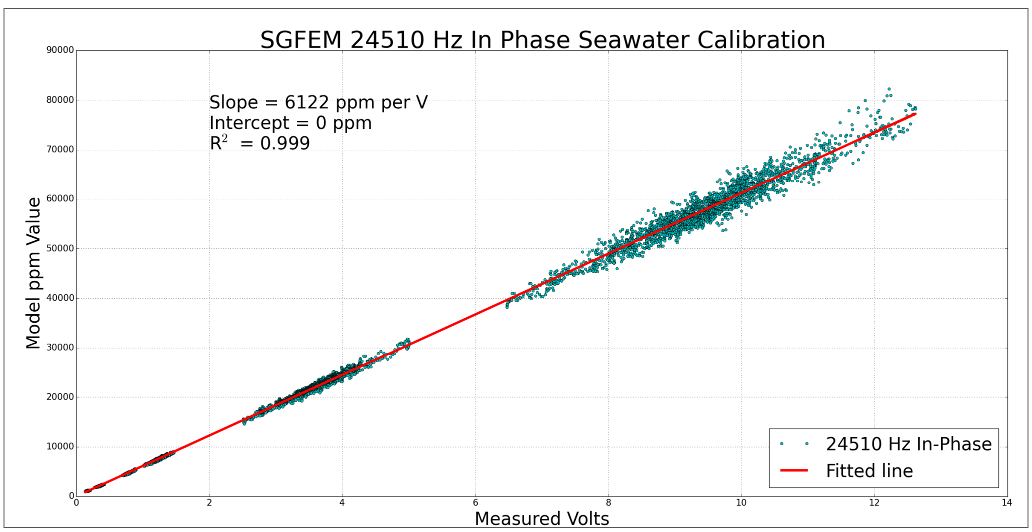


Figure 20: SGFEM 24510 Hz In Phase Seawater Calibration

EM Instrumentation Lag

The lag in the EM data is a function of two components, a static lag due to signal processing and a speed-dependent dynamic lag due to the physical offset of the EM coils and the GPS antenna. The static lag is known to be 0.70 s from the filters applied during signal processing. The dynamic lag is equal to the offset of the coils and GPS antenna along the long axis of the aircraft, known to be 2.888 m, divided by the flying speed. For this test the dynamic lag averaged 0.048 s, for a total lag of 0.748 s. The lag test was flown for the previous survey, on October 29th, 2015 in Ireland, over a farm compound near the town of Derrinturn Co. Kildare. The results are shown in *Figure 21*.

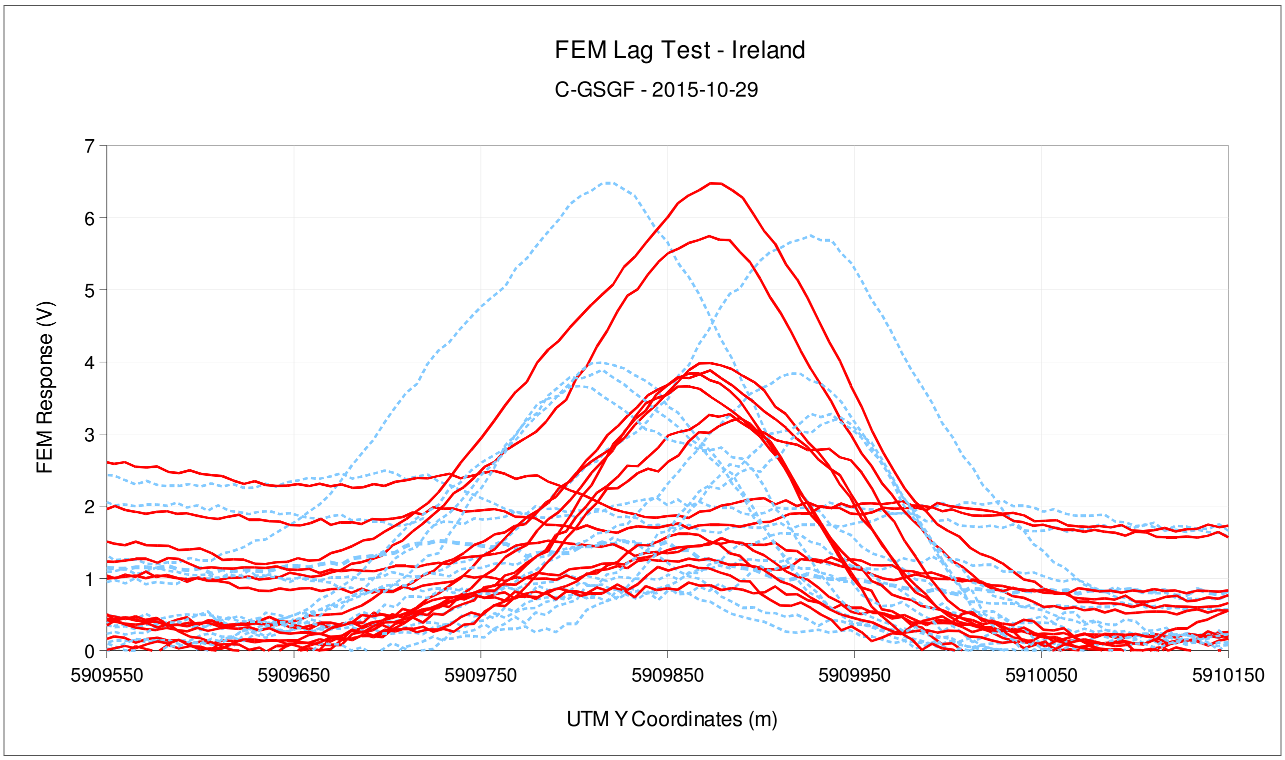


Figure 21: EM instrumentation lag test. The blue traces are the raw EM traces and the red traces are the lag corrected EM traces

EM Transmitter Noise

The effect of the FEM transmitter on the magnetic response was verified for the tail and wing sensors, while flying at high altitude (about 10,000 ft.). This was done by turning the EM transmitter OFF, then back ON. *Figure 22* and *Figure 23* show that the EM transmitter induces no effect on the magnetic signal from either sensor.

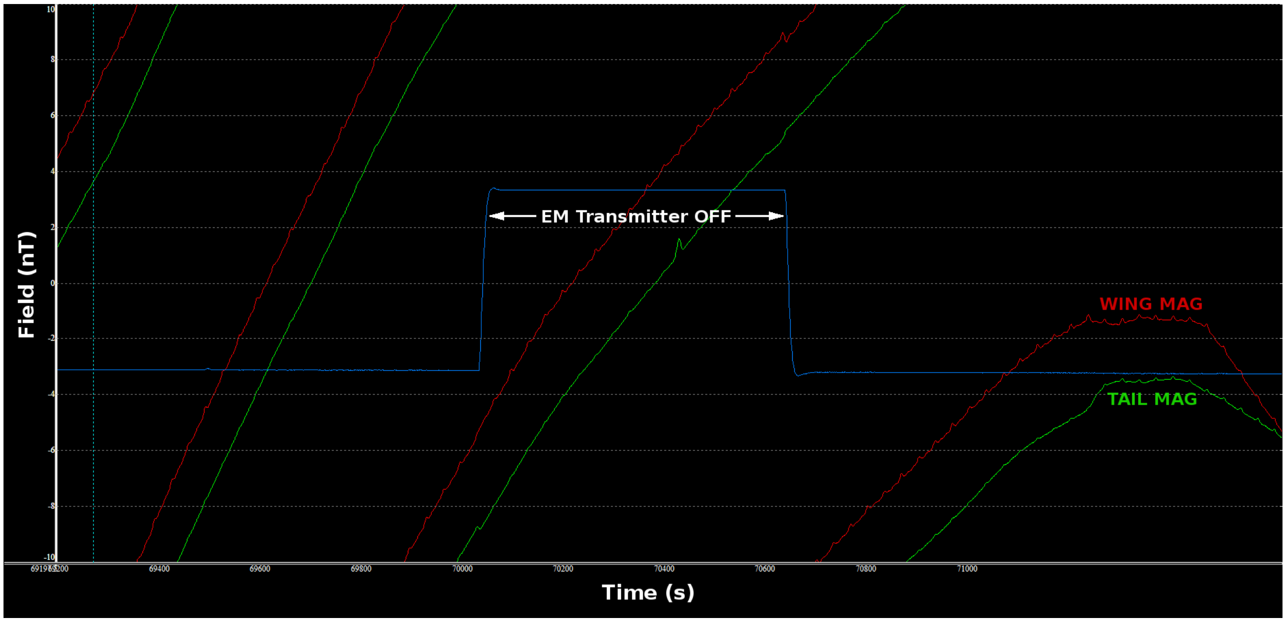


Figure 22: EM transmitter noise test, showing tail and wing magnetic sensor traces.

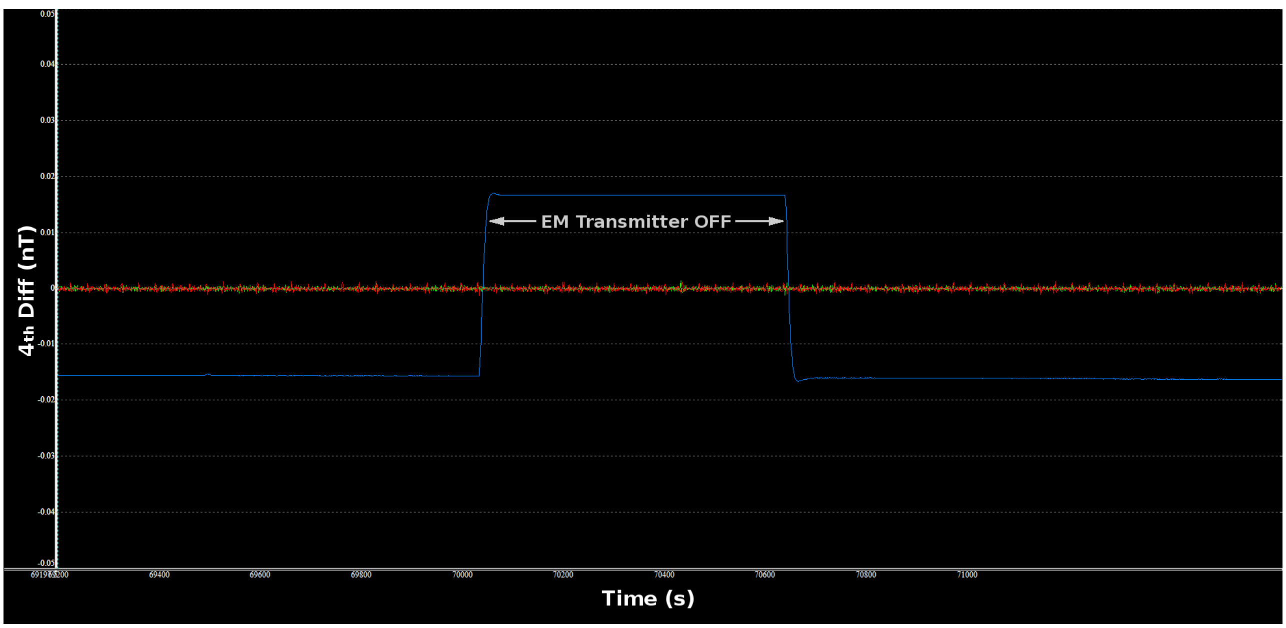


Figure 23: EM transmitter noise test, showing the 4th difference of the tail and wing magnetic sensor traces.

8. FIELD OPERATIONS

Flight operations for this project were performed from Waterford Airport. The survey required 18 production flights, from May 8, 2016 to May 30, 2016. Weekly reports are provided in *Appendix VI*.

Mobilization of the SGL crew and equipment to Waterford began with the arrival of the field crew chief and lead pilot in Ireland. The magnetic ground stations were installed on May 2, 2016. The survey aircraft arrived in Waterford on May 3, 2016. Magnetic compensation, magnetic heading and cosmic tests were flown on May 16, 2016 over the sea south of the town of Tramore.

The aircraft was parked northeast of the airport tower beside the fuel station, and all survey flights departed from and return to this location. Power was available at the parking spot via an outlet in a nearby hanger. The position of the aircraft is given in *Table 14.*

Table 14: Aircraft parking location in the WGS-84 datum

Latitude	Longitude	Elevation
N52°11'23.21"	W07°4'49.32"	36.27 m

Reference Stations

The two reference stations used for this project were installed at the crew house yard in Portally Cove, Dunmore East. During flights, the gate to the house was closed to avoid the circulation of vehicles in the area. Picture 3 illustrates the setup that was used on site.

Picture 3: GPS reference station antennas (left at rear) and magnetometer sensors (right at front)

Triangulation using three reference stations from the International GPS Service (IGS) was used to differentially correct the GPS receiver locations. Data from IGS stations HERT (Hailsham, United Kingdom), HERS (Hailsham, United Kingdom) and HOFN (Hoefn, Iceland) recorded on days 125, 126 and 127 were used.

Due to a power supply malfunction, both ground stations were connected to the same power supply. The result was a redundant configuration for one reference station. The position of the GPS antenna of the local reference station after differential correction is shown in *Table 15.*

Table 15: GPS Reference Station Location in the WGS-84 datum

Station	Latitude	Longitude	Elevation
GND1 and GND2	N52º08'25.803"	W07º01'05.124"	96.6615 m

Operational Issues

The weather provided the main challenge for airborne operations in the Waterford block. Rain, poor visibility and windy days caused various delays and flight cancelations. A possible bird strike occurred on May 15, 2016 but no evidence or damage was found, and an incident report was filed. Scheduled maintenance was also performed on the aircraft during the survey. Reflights and partialed lines are listed in *Appendix IV*.

Field Personnel

The technical personnel of SGL that participated in field operations are given in *Table 16*.

Table 16: Field Personnel

Field Personnel	Name	Dates in Field
Operations Manager	Alex Pritchard	n/a
Field Crew Chief	Alison McCleary	April 27, 2016 – May 30, 2016
Data Processor	Diana Kuiper	May 1, 2016 – May 30, 2016
Technician	Craig McMahon	April 28, 2016 – May 30, 2016
Lead Pilot	Steve Gebhardt	April 27, 2016 – May 30, 2016
Pilot	Charles Dicks	April 30, 2016 – May 30, 2016
Pilot	Jason Thomas	April 30, 2016 – May 30, 2016
AME	Ian Boychuck	April 28, 2016 – May 30, 2016

9. DIGITAL DATA COMPILATION

Preliminary processing for on-site quality control was performed in the field as each flight was completed. This included verifying the data on the computer screen, generating traces of all of the data channels, and creating preliminary data grids.

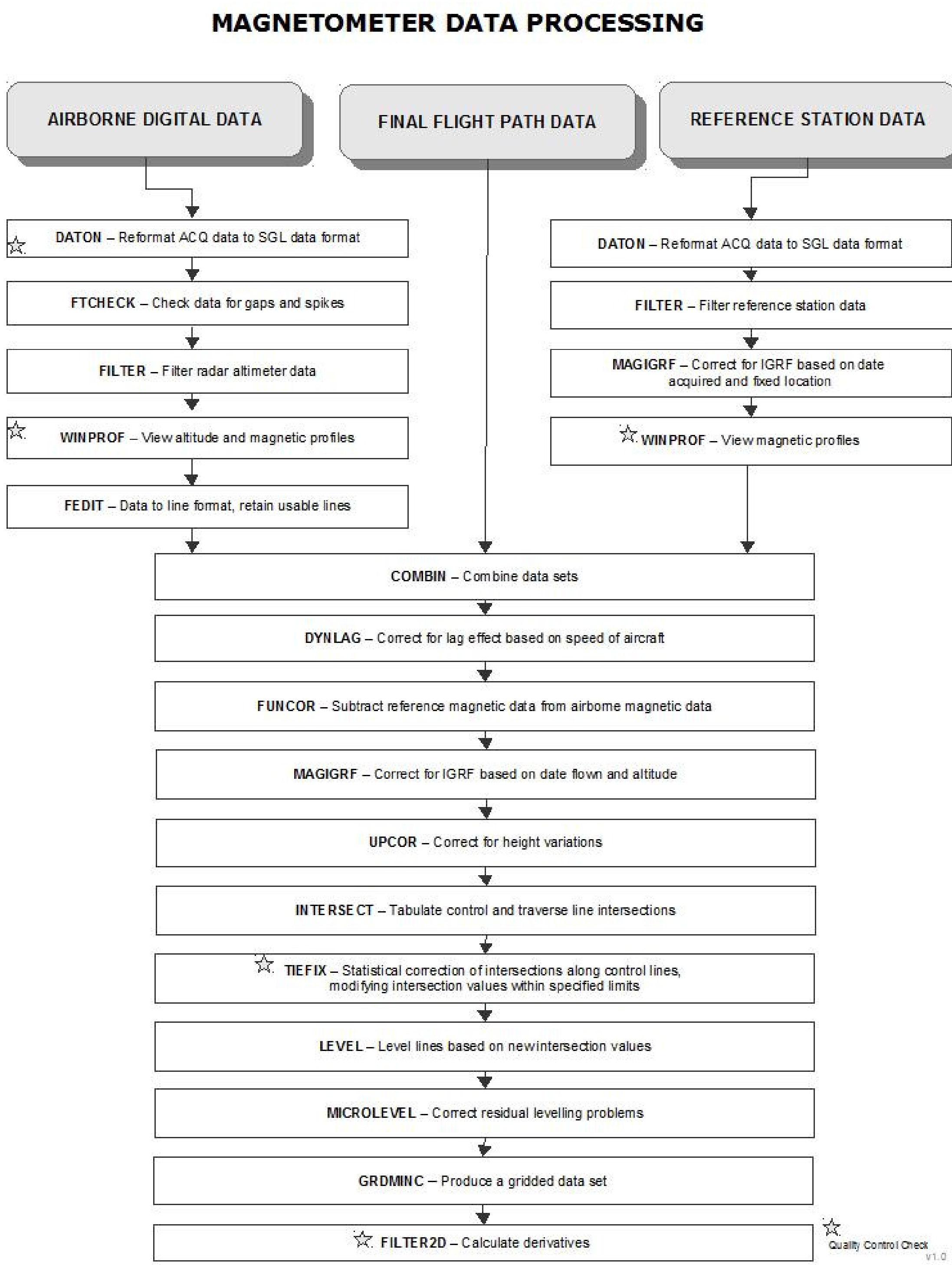


Figure 24: Magnetometer data processing flowchart

Magnetometer Data

A magnetic data flowchart is presented in Figure 24. The airborne magnetometer data were recorded at 160 Hz, and down sampled to 10 Hz for processing. All magnetic data were plotted and checked for any spikes or noise. Although the data is not edited to remove the large number of cultured effects, one large spike due to infrastructure was removed at the north end of line 1125. A dynamic lag correction averaging 0.287 s depending on the instantaneous velocity of the aircraft was applied to each data point. The aircraft speed dependent dynamic lag was calculated using SGL's Dynlag software.

The ground based reference magnetometer data were inspected for cultural interference and edited where necessary. All reference station magnetometer data were filtered using a 121-point low pass filter (see *Appendix VII*) to remove any high frequency signal, but retain the low frequency diurnal variations.

A correction for the International Geomagnetic Reference Field (IGRF) year 2015 model, was extrapolated for all ground magnetometer data using the fixed ground station location and the recorded date for each flight. The mean residual value of the reference station calculated to be 2.720 nT for GND1 was subtracted from the ground station data to remove any bias from the local anomalous field. Diurnal variations in the airborne magnetometer data were removed by subtracting the corrected reference station data.

The airborne magnetometer data were corrected for the IGRF using the location, altitude, and date of each point. IGRF values were calculated using the year 2015 IGRF model. The altitude data used for the IGRF corrections are DGPS heights above the GRS-80 ellipsoid.

Height Correction

The survey was flown in radar guidance mode in order to stay as close to the target survey altitude of 60 m as much as possible. This approach was adopted in order to optimize the acquisition of frequency domain electromagnetic (FEM) data which is known to drop off in signal strength rapidly. Little reliable FEM data is acquired a heights of 200 to 250 m above ground depending on the signal frequency and the conductivity of the ground, and the lower the survey is flown, the higher the signal to noise ratio for all frequencies.

By adopting a flying strategy optimized for FEM data, drape flying was not possible, resulting in survey lines flown at different altitudes in adjacent lines and at intersections between traverse and control lines. Inevitably this results in differences in the spectral content of airborne magnetic data where the survey height above ground was inconsistent. At low altitudes, even relatively small differences in altitude may result in significant changes in spectral content of the magnetic data. Amplitude of magnetic signal drops off with height at an exponential rate proportional to the frequency of the signal, so that high frequency signal in particular changes rapidly with small changes in altitude close to the ground. Correcting for such changes using traditional levelling methods can be challenging since there is no way to properly extrapolate corrections from miss-ties at intersections due to altitude differences.

Therefore, there is an advantage to correcting the airborne data for height variation before attempting levelling.

In order to correct magnetic data for altitude variation, we first need to define a consistent surface that will be used as a reference height. This can be a surface of constant height with respect to the ellipsoid or a “virtual” drape surface. The drape surface approach has the advantage of retaining as much of the recorded signal content as possible whilst achieving consistency of height at intersections and smoothly varying heights between adjacent lines. The reference drape surface was a made based on a grid of the height of the survey lines as actually flown. At intersections where traverse and control lines cross, the higher of the two is used. The resultant surface is then converted to a smooth drape using a climb rate of 500 feet/nMile. This ensures that the reference surface is always at or slightly higher than the altitude as flown so that all corrections for height can be achieved using a stable upward continuation operation.

To determine the height corrections, a preliminary version of the levelled data is created that uses heavy micro-levelling to temporarily account for the height differences. A grid of the preliminary levelled magnetic data is then upwardly continued by a range of distances up to the maximum separation between the survey altitude as flown and the reference surface. The mean separation is 46 m, up to a maximum of 426 m in the hills in the northwest corner of the survey block, although most of the height corrections are the result of flying over towns. A profile based method was used to perform the latter because high frequency cultural effects in this survey block were not well sampled in the cross line direction. The height correction is then applied to the unlevelled data, and final levelling is then performed.

Levelling

Intersections between control and traverse lines were determined by a program which extracts the magnetic, altitude, and x and y values of the traverse and control lines at each intersection point. Each control line was adjusted by a constant value to minimize the intersection differences, calculated as follows:

$\Sigma\ |i - a|$ summed over all traverse lines
where, i = (individual intersection difference)
a = (average intersection difference for that traverse line)

Adjusted control lines were further corrected locally to minimize any residual differences. Traverse line levelling was carried out by a program that interpolates and extrapolates levelling values for each point based on the two closest levelling values. After traverse lines have been levelled, the control lines are matched to them. This ensures that all intersections tie perfectly and permits the use of all data in the final products.

CLEVEL provides a curved correction using a function similar to spline interpolation. A third degree polynomial is used to interpolate between two intersections and the two values and two derivatives are chosen to determine the polynomial. CLEVEL is an improved method as it allows intersection points to be preserved with no mismatch and interpolation is smooth with the first derivative continuously approaching the same value from both sides of the intersection points.

The levelling procedure was verified through inspection of magnetic anomaly and vertical derivative grids, plotting profiles of corrections along lines, and examining levelling statistics to check for steep correction gradients.

Micro-Levelling

Micro-levelling was applied to remove any residual diurnal and/or height related artifacts from the data. This was achieved by using directional filters to identify and remove artifacts that are long wavelength parallel to survey lines and short wavelength perpendicular to survey lines. A limit of +/-2 nT was set for all micro-levelling corrections.

Gridding

The grid of the magnetic anomaly was made using a minimum curvature algorithm to create a two-dimensional grid equally sampled in the x and y directions. The algorithm produces a smooth grid by iteratively solving a set of difference equations minimizing the total second horizontal derivative while attempting to honour the input data (Briggs, I.C, 1974, Geophysics, v 39, no. 1). The final grids of the magnetic data were created with 50 m grid cell size appropriate for survey lines spaced at 200 m. Images of fully processed data are provided in *Appendix XII*.

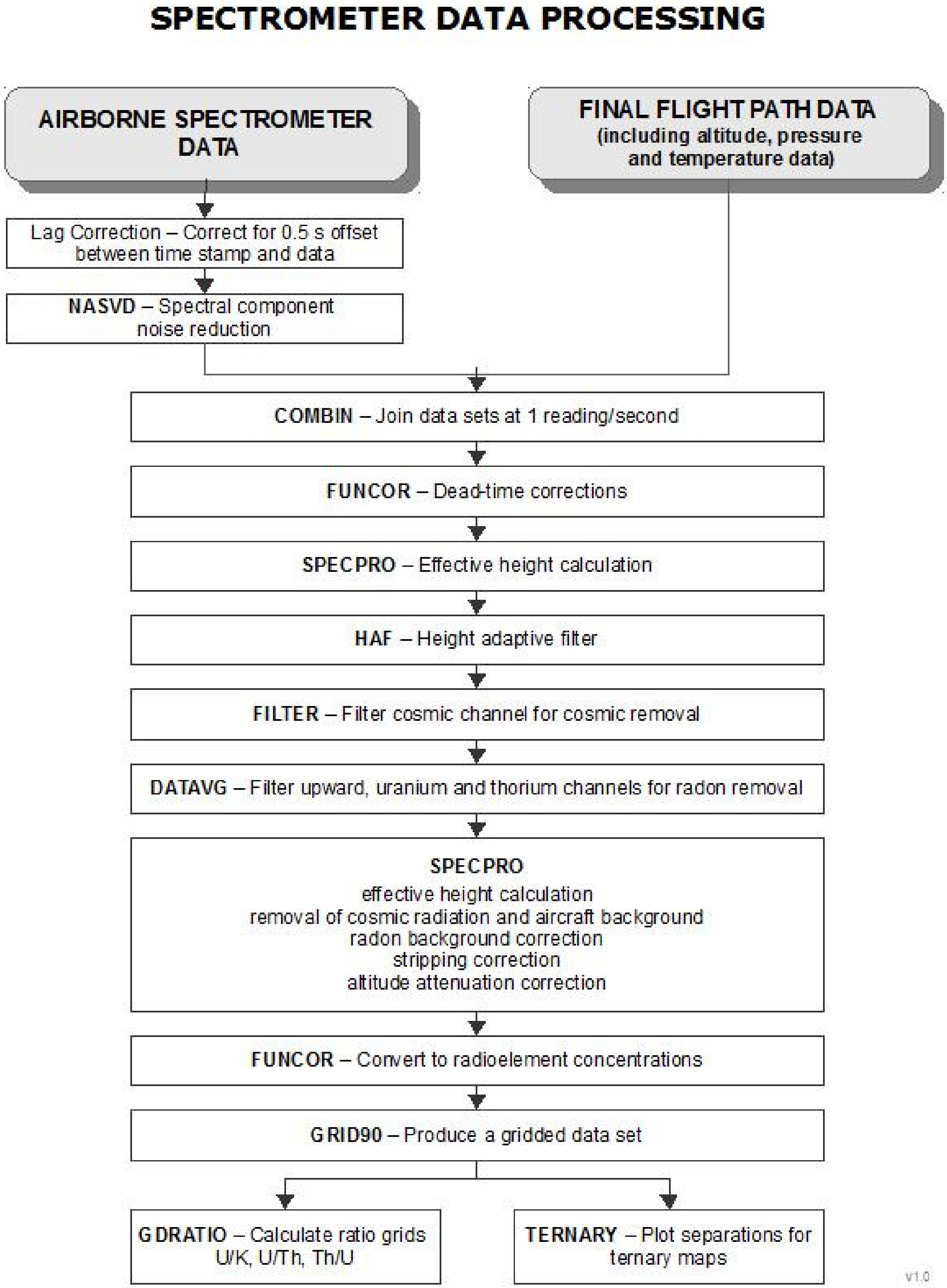


Figure 25: Spectrometer data processing flowchart

Spectrometer Data

A spectrometer data compilation flowchart is presented in *Figure 25*.

A 0.5 second lag correction was applied to all data to correct for the time delay between detection and recording of the airborne data. The data were recorded at 1 Hz in asynchronous mode, and subsequently interpolated to 1 Hz synchronous data on the exact second.

Spectral Component Analysis

Raw 1024 channel spectrometer data were analyzed using noise adjusted singular value decomposition (NASVD; J. Hovgaard and R L. Grasty paper 98; Geophysics and Geochemistry at the Millennium, Proceedings of the 4th Decennial International Conference on Mineral Exploration, 1997). Normalization with respect to the count rate is achieved by dividing each measured spectrum by the standard deviation of the best fit of the mean spectra, i.e. component zero. The NASVD method determines the components in order of significance with respect to the amount of variance in the data they describe. Each component is a spectrum with 1024 channels. In theory, there are as many components as there are channels. Variation in the signal is accounted for by the low order components, and variation due to noise is accounted for by the higher order components. Spectra are reconstructed from the low order signal only components, and the count rates in the standard windows are recalculated.

Components 0 to 5 plus component 26, 27 and 28 were retained for the lower flown data (See *Appendix VIII*).

Standard Corrections

Spectrometer data were corrected as documented in the Geological Survey of Canada Open File No. 109 and the IAEA report "Airborne gamma-ray spectrometer surveying; Technical Report Series No. 323 (International Atomic Energy Agency, Vienna). The gamma-ray spectroscopy processing parameters are shown in *Table 17*. Parameters are adjusted during processing through analysis of the corrections applied, and therefore may differ from those determined from calibration test flight data

Table 17: Spectrometer processing parameters

Spectrometer Processing Parameters		
Window	Cosmic Stripping Ratio (b)	Aircraft Background (a)
Total	1.2501	13.9282
Potassium	0.0685	20.3222
Uranium	0.0407	0.0000
Thorium	0.0508	0.0000
Upward	0.0071	0.0000
Radon Component	a	b
Total (I_r)	16.8212	40.4862
Potassium (K_r)	0.8313	6.2788
Thorium (T_r)	0.0681	0.8433
Up (u_r)	0.2536	0.0602
Ground Component	a_1	a_2
Up (u_g)	0.034225	0.019581
Stripping Ratios	Contribution on the Ground	Effective Height Adjustment (m^{-1})
α	0.2760	0.00049
β	0.4208	0.00065
γ	0.7702	0.00069
a	0.0442	
b	0.0004	
g	0.0009	
Attenuation Coefficients (m^{-1})		
Total	-0.006882	
Potassium	-0.008386	
Uranium	-0.006062	
Thorium	-0.006309	
Sensitivities		
Potassium	187.9987 cps/%	
Uranium	24.9462 cps/eU ppm	
Thorium	10.3658 cps/eTh ppm	

Before gridding, the following corrections were applied to the spectrometer data in the order shown:

Calculation of effective height above ground level (AGL)

Clearances obtained by the subtracting the SRTM measurements from the aircraft DGPS altitude in conjunction with barometric altitudes were used to calculate the effective height. A frequency domain filter was used to filter the 10 Hz barometric altimeter data. The latter was then converted to equivalent pressure and used with the digitally recorded temperature to convert the clearance data to effective height at standard pressure and temperature (STP) as follows:

$$h_e = h \times \frac{273.15}{T + 273.15} \times \frac{P}{101.325}$$

where, h_e = the effective height
h = the clearance above ground in metres
T = the air temperature in degrees Celsius and
P = the barometric pressure in millibars.

Height adaptive filter

Adaptive filters were applied between 300 m and 400 m effective height to improve the signal-to-noise ratio for Potassium, Thorium, Uranium and Total Count. A moving average filter is applied to data and the degree of filtering applied increases gradually up to 400 m up to a maximum of a 9 point running average. Data collected at a terrain clearance greater than 500 m are often considered unreliable due to the low count rates and consequent low signal to noise ratio, but the maximum effective height for this survey was 484 m so the issue does not arise.

Removal of cosmic radiation and aircraft background radiation

A 67-point low pass filter (see *Appendix VII*) is applied to 1 Hz cosmic data to reduce statistical noise. Cosmic radiation and aircraft background radiation are removed from each spectral window using the cosmic coefficients and aircraft background values determined from test flight data using the following equation:

$$N = a + bC$$

where, N = the combined cosmic and aircraft background in each spectral window,
a = the aircraft background in the window,
b = the cosmic stripping factor for the window, and
C = the cosmic channel count.

Radon background corrections

A 199-point running average filter is applied to 1 Hz downward uranium, downward thorium and upward uranium count data for the purposes of the radon correction only. The radon component in the uranium window is calculated using the radon coefficients determined from the survey data using the following equation:

$$U_r = \frac{u - a_1 U - a_2 T + a_2 b_T - b_u}{a_u - a_1 - a_2 a_T}$$

where, U_r	=	the radon background measured in the downward uranium window,
u	=	the filtered observed count in the upward uranium window,
U	=	the filtered observed count in the downward uranium window,
T	=	the filtered observed count in the downward thorium window,
a_1 and a_2	=	the ground component coefficients,
a_u and b_u	=	the radon coefficients for uranium,
a_T and b_T	=	the radon coefficients for thorium.

The radon counts in the uranium upward window and the potassium, thorium and total count downward windows are calculated from U_r using the following equations:

$$u_r = a_u U_r + b_u$$
$$K_r = a_K U_r + b_K$$
$$T_r = a_T U_r + b_T$$
$$I_r = a_I U_r + b_I$$

Where u_r is the radon component in the upward uranium window, K_r, U_r, T_r and I_r are the radon components in the various windows of the downward detectors, and a and b are the radon calibration coefficients.

Stripping

The stripping ratios for the spectrometer system are determined experimentally. The stripped count rates for the potassium, uranium and thorium downward windows are calculated using the following equations:

$$N_K = \frac{n_{Th}(\alpha\gamma - \beta) + n_U(\alpha\beta - \gamma) + n_K(1 - a\alpha)}{A}$$

$$N_U = \frac{n_{Th}(g\beta - \alpha) + n_U(1 - b\beta) + n_K(b\alpha - g)}{A}$$

$$N_{Th} = \frac{n_{Th}(1 - g\gamma) + n_U(b\gamma - a) + n_K(ag - b)}{A}$$

where A has the value*:*

$$A = 1 - g\gamma - a(\alpha - g\beta) - b(\beta - \alpha\gamma)$$

and where,

n_K, n_U and n_{Th} = the unstripped potassium, uranium and thorium downward windows counts,
N_K, N_U and N_{Th} = the stripped potassium, uranium and thorium downward windows counts,
α, β, and γ = the forward stripping ratios, and
a, b and g = the reverse stripping ratios.

α, β, and γ are adjusted for effective height (as calculated above) by standard factors given in *Table 17 Spectrometer Processing Parameters.*

Altitude attenuation correction

This correction normalizes the data to a constant terrain clearance of 60 m above ground level (AGL) at standard temperature and pressure (STP). Attenuation coefficients for each of the downward windows were determined from test flights. The measured count rate is related to the actual count rate at the nominal survey altitude by the equation:

$$N_s = N_m\left(e^{\mu(h_o - h)}\right)$$

where, N_S = the count rate normalized to the nominal survey altitude, h_o,
N_m = the background corrected, stripped count rate at effective height h,
μ = the attenuation coefficient for that window,
h_o = the nominal survey altitude, and
h = the effective height.

The effective height was determined in step 2).

Correction for the effects of residual radon and terrain

Scaling corrections were applied to portions of line in the hilly area in to the northwest of the survey block. A DC shift was also applied to the uranium concentration in one of those lines due to the effect of residual radon in the area. See *Appendix IX* for a list of factors applied.

Micro-Levelling

Micro-levelling was applied to remove any residual artifacts probably due to radon from the total counts and uranium concentration. This was achieved by using directional filters to identify and remove artifacts that are long wavelength parallel to survey lines and short wavelength perpendicular to survey lines. A limit of +/-40 counts/s and +/-0.05 ppm were set for micro-levelling corrections of total counts and uranium concentration, respectively.

Conversion to radio element concentration

Sensitivities are determined experimentally from the test flight data. The units of the count rates in each spectral window are converted to “apparent radio element concentrations” using the following equation:

$$C = \frac{N}{S}$$

where, C = the concentration of the element(s)

N = the count rate for the window after correction for dead-time, background, stripping and attenuation

S = the broad source sensitivity for the window

Potassium concentration is expressed as a percentage and equivalent uranium and thorium as parts per million of the accepted standards. Uranium and thorium are described as "equivalent" since their presence is inferred from gamma-ray radiation from daughter elements (^{214}Bi for uranium, ^{208}Tl for thorium).

Data gridding

A cosine weighted moving average gridding algorithm is considered appropriate for gridding gamma-ray data. The method generates a 2-dimensional grid, equally incremented in x and y, from randomly placed data points. Radiometric data for each cell are derived from a circular average within a radius of 305 m with a cosine weighting function that gives greatest weight to data located closest to the cell centre. The radiometric data were interpolated to a 50 m grid cell size appropriate for survey lines spaced at 200 m. Control and test lines were not included in the grids. Images of fully processed data are provided in *Appendix XII*.

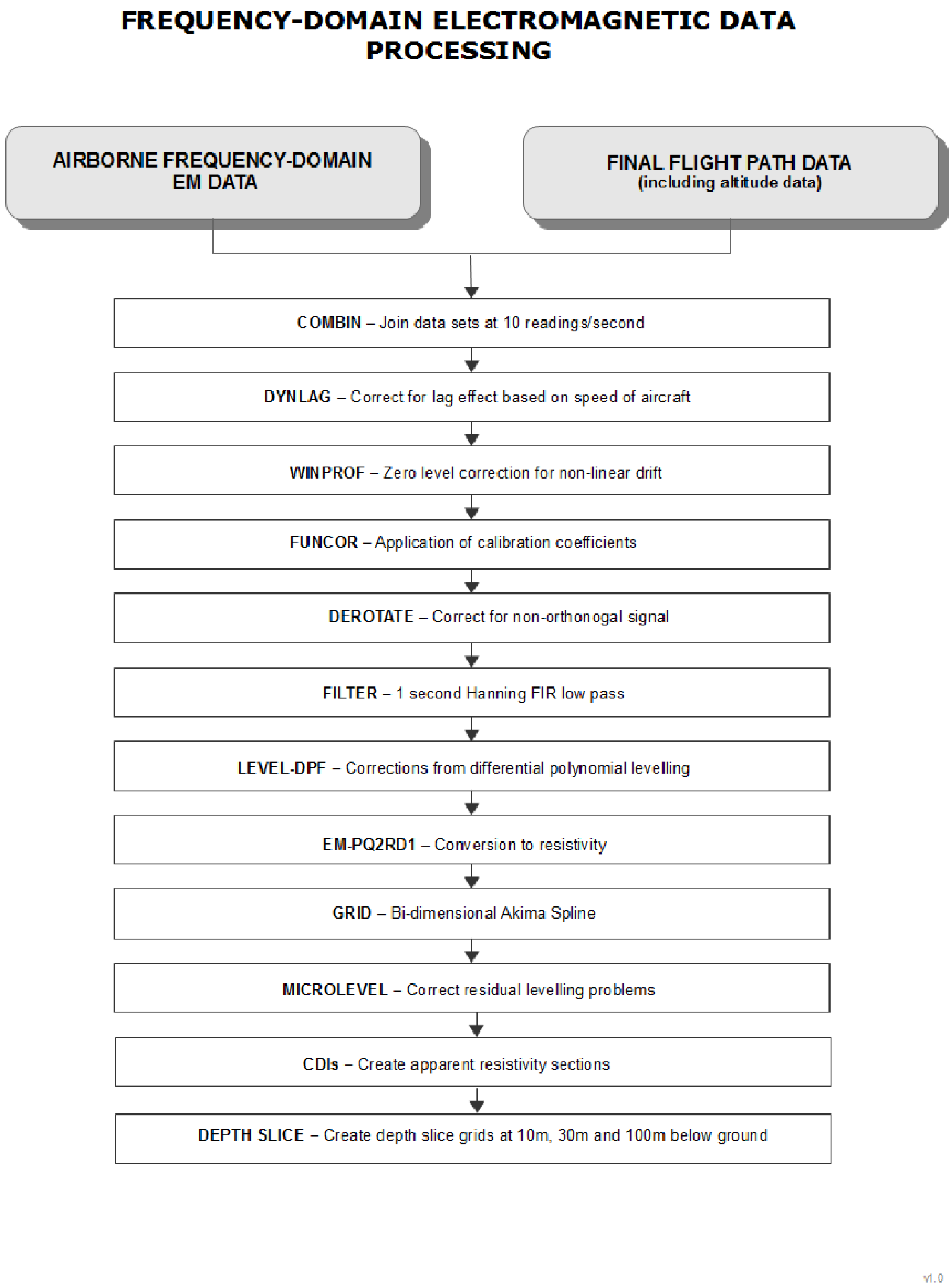


Figure 26: Frequency-domain electromagnetic data processing flowchart

Frequency-Domain Electromagnetic Data

A flowchart showing all the data processing steps can be found in *Figure 26.*

The airborne electromagnetic data were recorded in volts at 40 Hz, and down sampled to 10 Hz for processing. The data were recorded at four frequencies (912 Hz, 3005 Hz, 11962 Hz and 24510 Hz) each with two components, in-phase with the source pulse and out of phase "quadrature" each expressed as volts. The data were visually inspected for spikes and noise. Identification of cultural interference is assisted by the Power Line Monitor, and radio calls are detected and recorded in a flag channel that is 1 when a call is made, and 0 otherwise.

Lag

A +0.70 s static lag correction due to signal processing was applied to each data point. In addition a variable lag correction is applied that is a function of speed and the physical offset between the GPS antenna on the aircraft cabin and the electromagnetic pods as measured along the long axis of the aircraft, known to be 2.888 m. Therefore, the total lag applied is equal to (0.70 + (2.888/v)) s where v is the instantaneous velocity of the aircraft in m/s. The aircraft speed dependent lag is calculated using SGL's Dynlag software.

Interactive Single Flight, Zero Level Correction For Non-Linear Drift

The zero level of the system can drift, possibly due to variations in the temperature of the air outside and inside the aircraft, and of the instrument components. To correct for drift, SGL uses a method similar to that described by Leväniemi et. al (2009, Journal of Applied Geophysics, 67, 219-233). The data is often zero when the survey aircraft is more than 250 m above resistive ground, and we can use these regions to define a curve of corrections which brings the data to the correct level on a flight by flight basis. The start and end of the correction curve for each flight are set to coincide with the zero level calibration pulse procedure which is performed at approximately 350 m above ground before and after flying the survey lines. Intermediate points during production were determined when the aircraft ascended to flying heights of over 120m to 250 m above resistive ground, particularly when flying over obstacles or ferrying between sections of the survey block. The EM response data at the start, end and intermediate points are shifted until they are zero. Shifts between the known zero points are interpolated using an akima spline to define the full correction curve in between. A separate correction curve is required for the in-phase and quadrature data of each frequency and is subtracted from the observed data. The drift curve is centred on the noise envelope of the data, which varies between frequencies (see below), therefore when the base level is near zero some negative data will occur.

Conversion to PPM

Drift corrected data in volts are converted to parts per million (ppm) of the source signal using the calibration coefficients described in the section "EM Over Seawater Calibration" earlier in this report (see *Table 13*). The sea water calibration assumes a homogeneous half space which allows modelling in ppm, which when compared to the measured voltages allows calibration coefficients to be determined.

Derotation

The pre and post flight phase orthogonality test is used to verify that the in-phase and quadrature data are at 90° to each other (see "EM Source Orthogonality" earlier in this report). If an in-phase response is detected in the quadrature signal for any frequency, or vice versa, for a given flight, a derotation correction is applied on a flight by flight basis, linearly interpolated between the pre- and post-flight calibration. The following formulae are applied to each component and frequency as necessary:

$$I' = I \cos \theta_i + Q \sin \theta_i$$

$$Q' = Q \cos \theta_q - I \sin \theta_q$$

where:

I = Observed in-phase signal,
I' = R=Derotated in-phase signal,
Q = Observed quadrature signal,
Q' = R=Derotated quadrature signal,
and
θ_i,θ_q = angle of rotation from orthogonality.

θ_i, and θ_q are determined experimentally until the rotation effect is removed from the orthogonality test data. The average of the rotations applied was approximately -1.8° with a standard deviation of 1.8°, the larger rotations were applied to the 25 kHz data.

Filtering

A 1 second (10 sample) Hanning FIR low pass filter is applied to each component and frequency of EM signal to reduce the high-frequency (out of the earth signal range) noise envelope.

Levelling

Data from each flight is split into lines for the purpose of levelling. Averages are calculated, first by flight and then by line (two pass approach) in order to determine zero order ("DC shift") corrections to each survey flight/line to bring them to a level with neighbouring flights/lines. Following the zero order corrections, differential polynomial levelling following the method of Beiki et. al (2010, Geophysics, Vol. 75, No. 1, L13-L23) is used as a third and last set of corrections. The algorithm is based on polynomial fitting of data points in 1D and 2D sliding windows. The levelling error is taken as the difference between 1D and 2D polynomial fitted data at the centre of the windows. Polynomials of order 1 were used along with a search radius of 600 meters for all components, and the long wavelength (>200s) correction for the line is applied to bring each line to the same zero base level. Manual adjustments to the line-by-line levelling are applied to render correctly levelled apparent resistivity.

Conversion to Resistivity

A look-up procedure employing the in-phase and quadrature data components at each frequency was used to calculate resistivity and an associated apparent height of the sensor over an assumed conductive homogeneous half-space. For a properly calibrated system over a conductive, uniform earth the apparent height will be exactly the altitude above the surface; for example, over sea water the apparent height will be the same as the height from the radar altimeter. Using the Airbeo program (http://www.electromag.com.au/csiro.php) the ground was modelled as a homogeneous halfspace with constant rock properties. Heights of the look-up table are modelled from 16 m to 240 m below the surface at 2 m intervals, while the resistivity sampling was from 0.001 ohm.m to 79,432 ohm.m using a uniform logarithmic sampling interval of 20 points per decade. Nomograms that display the relationship between the phase, quadrature, resistivity and apparent height for the survey parameters as flown are shown in *Figure 27* to *Figure 30.*

When deriving resistivity, lower limits are placed on the in-phase and quadrature data so that spurious values are not derived from data that falls below the noise threshold. The minimum limits employed are as follows:

Frequency (Hz)	912		3005		11962		24510	
Component	In_Phase	Quadrature	In_Phase	Quadrature	In_Phase	Quadrature	In_Phase	Quadrature
Minimum (ppm)	20	50	30	30	30	30	30	30

In each case if the minimum limit is reached, the value is capped and the limited value employed in the calculation. Therefore if the limit is reached for both in-phase and quadrature for any given frequency, the resistivity is capped at a known minimum value. In addition, a maximum resistivity value set at half the frequency value is also set to avoid spuriously high values being derived. The resultant minimum and maximum values for each frequency are as follows:

Frequency (Hz)	912	3005	11962	24510
Minimum (ohm.m)	0.1	0.1	0.1	0.1
Maximum (ohm.m)	456	1503	5981	12255

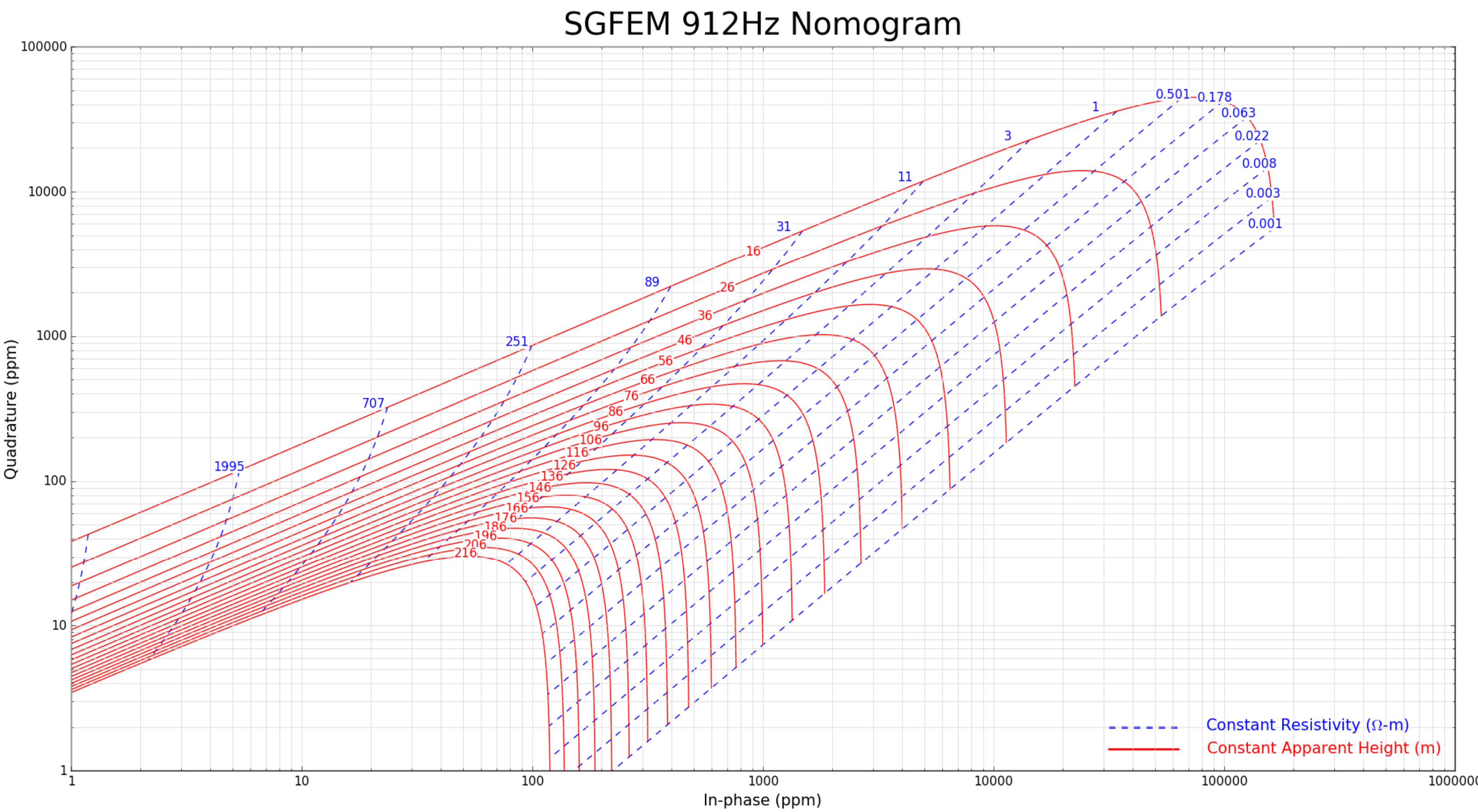


Figure 27: SGFEM 912Hz Nomogram

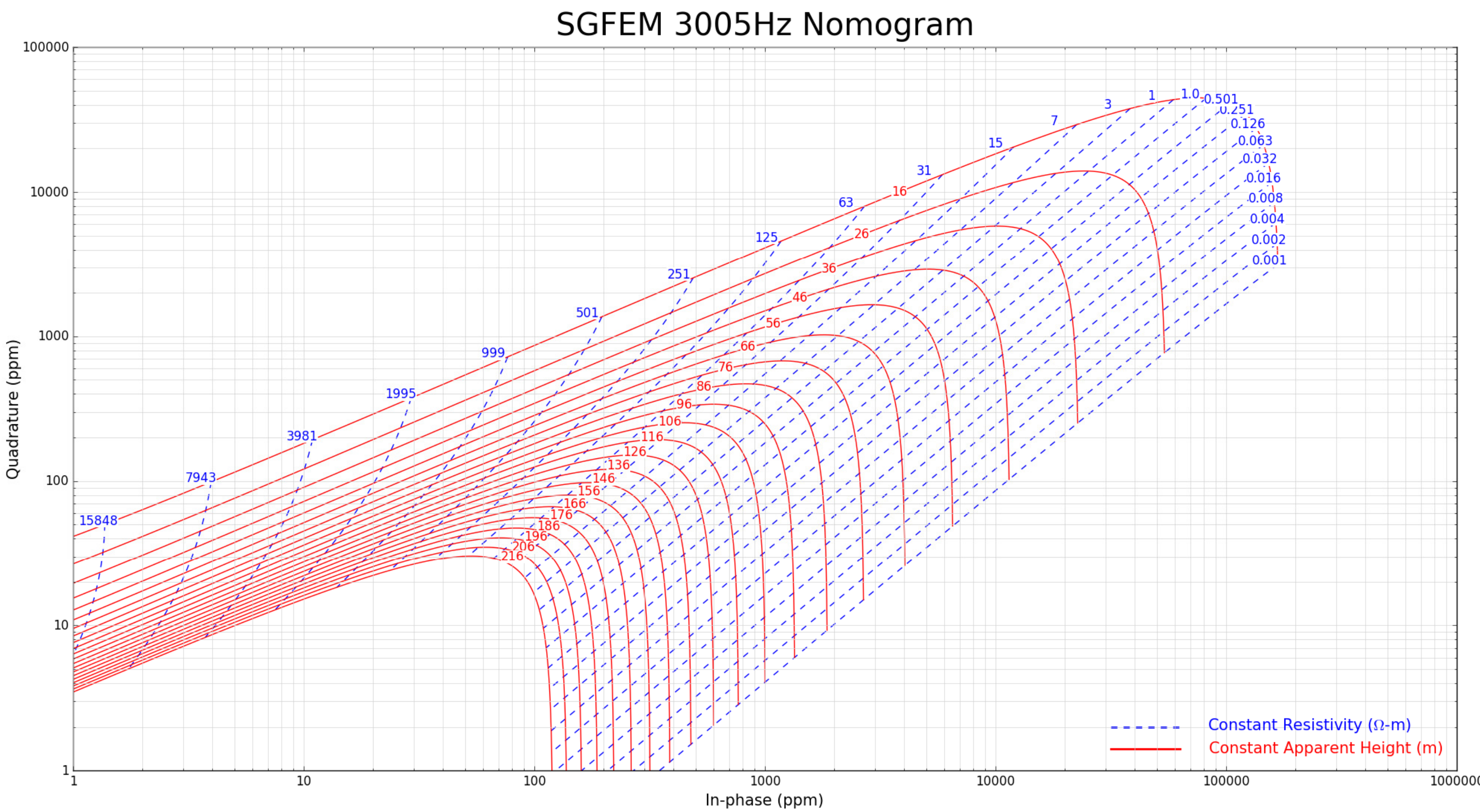


Figure 28: SGFEM 3005Hz Nomogram

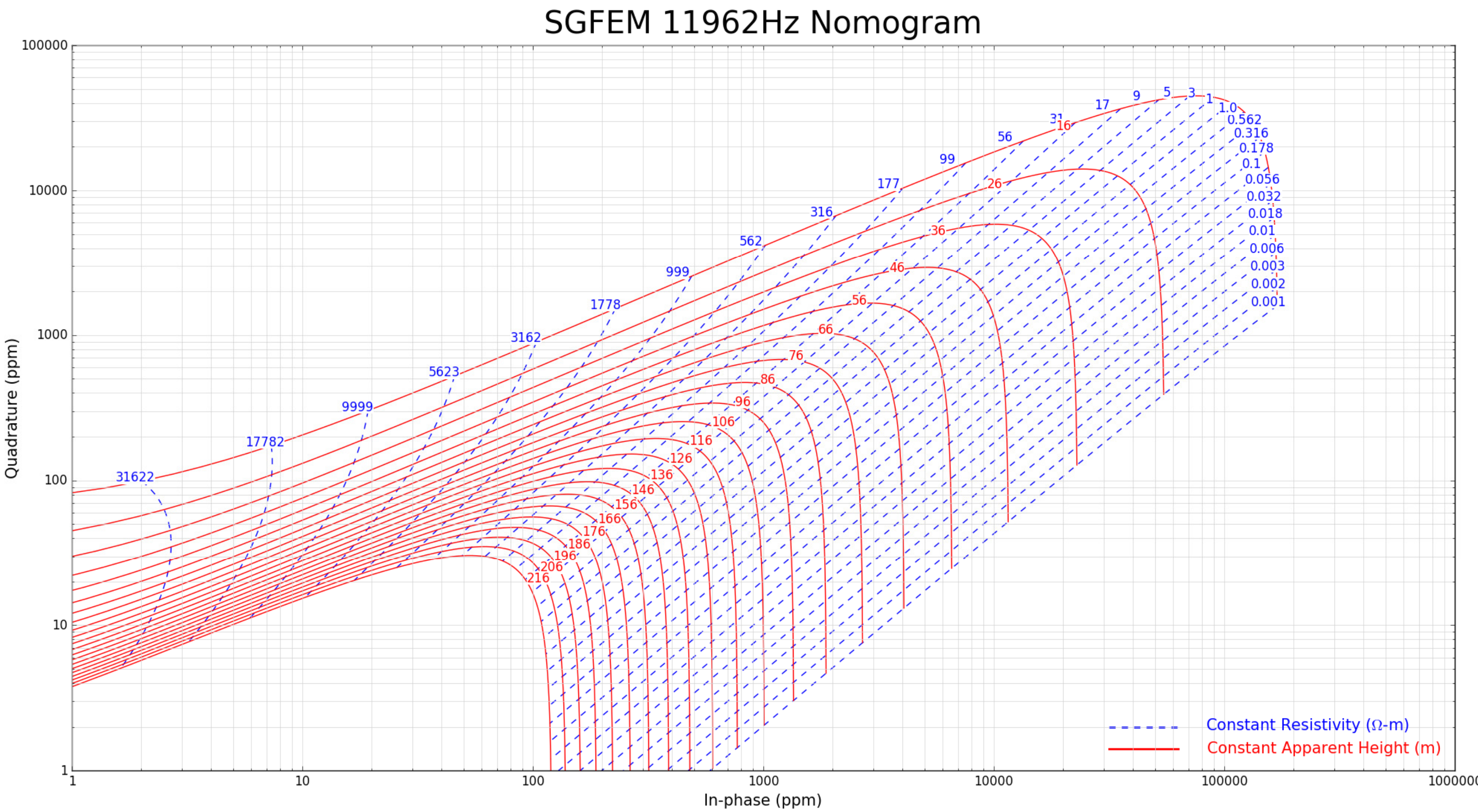


Figure 29: SGFEM 11962Hz Nomogram

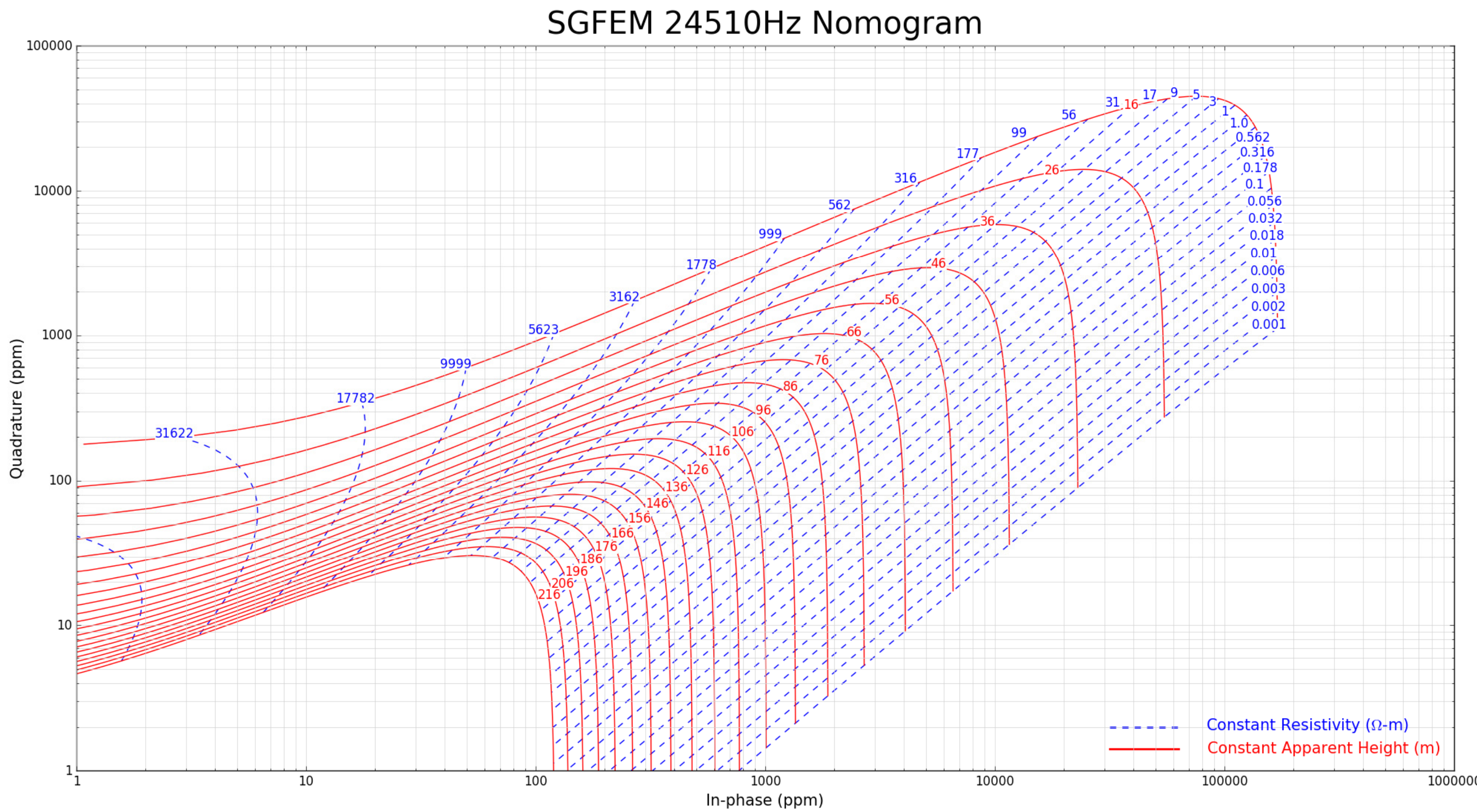


Figure 30: *SGFEM 24510Hz Nomogram*

Microlevelling

For the purpose of micro-levelling, the log value of each resistivity is calculated. This approach is preferred because small changes in low resistivity values are as measurable and significant as large changes in large resistivity values. Micro-levelling was applied using the log grids to remove residual levelling errors from the gridded log of resistivity data. This was achieved by using a combined directional cosine filter and high pass Butterworth filter to identify and remove artifacts that are long wavelength parallel to survey lines and short wavelengths perpendicular to survey lines. A limit of +/-0.2 log (ohm.m) was set for all microlevelling corrections. The cut-off wavelength of the directional Butterworth filter was chosen to be 800 meters for each frequency and component. The microlevelling corrections are converted back to ohm.m and applied to the resistivity data.

Gridding

All grids were made using a bi-directional Akima spline gridding routine which is appropriate for the high range of EM data. The final grids of the electromagnetic data were created with 50 m grid cell size appropriate for survey lines spaced at 200 m. The EM grid based products were interpolated locally in one place due to a flight path deviation at the intersection of traverse line 1070.00 and control line 106.00 that resulted in a gap of about 400 m between adjacent lines for a distance of about 2 km. This should be noted in case a detailed interpretation is done in this area. Images of fully processed data are provided in *Appendix XII*.

Conductivity Depth Images

The Conductivity Depth Image (CDI) used here is a type of apparent resistivity section first defined by Sengpiel (1988, Geophysical Prospecting v.36 p.446-459) then refined in Sengpiel and Siemon (1998, Exploration Geophysics v.9 p.133-141). The conductivity depth section is created by assigning "a centroid depth z* to the half-space resistivity ρ_a" (Sengpiel and Siemon, 1998).

The centroid depth $z^*_p = D_a - h_0 + p_a/2$

where:

D_a is the apparent height above ground in m (see above),
h_0 is the measured height above ground in m (eg. from laser or radar altimeter),
and
p_a is the skin depth = 503 $\sqrt{\text{(resistivity (ohm.m)/frequency (Hz))}}$.

At SGL we do not use the apparent depth term ($D_a - h_0$) in calculation of the centroid depth because in conditions where the measured altitude is affected by tree cover this will add an artificial error to the centroid depth. Also in conditions of near-surface conductivity the negative apparent depth ($D_a - h_0$) is not directly equivalent to the depth to the top of the layer. Therefore in our calculations, the centroid depth is simply equal to the skin depth divided by two as defined above.

A series of profiles are created for each resistivity and centroid depth along each survey line. In cases where the profiles cross, preference is given to the shallower profile derived from the higher frequency which is considered to be more reliable. The resistivity is then linearly interpolated in the vertical direction between the profiles and the lowest resistivity profile value is projected for an additional depth equal to 25% of the depth of the lowest profile to create the full CDI.

Depth Slices

The final step is to extract resistivity at specific depths from the CDIs of each survey line and grid them using a bi-directional Akima spline gridding algorithm to provide maps of resistivity at specific depths, or so called "depth slices". Depth slices at 10m, 30m, 60m and 100m below the surface have been generated. The gridded data is micro-levelled to produce an even grid without line related artifacts.

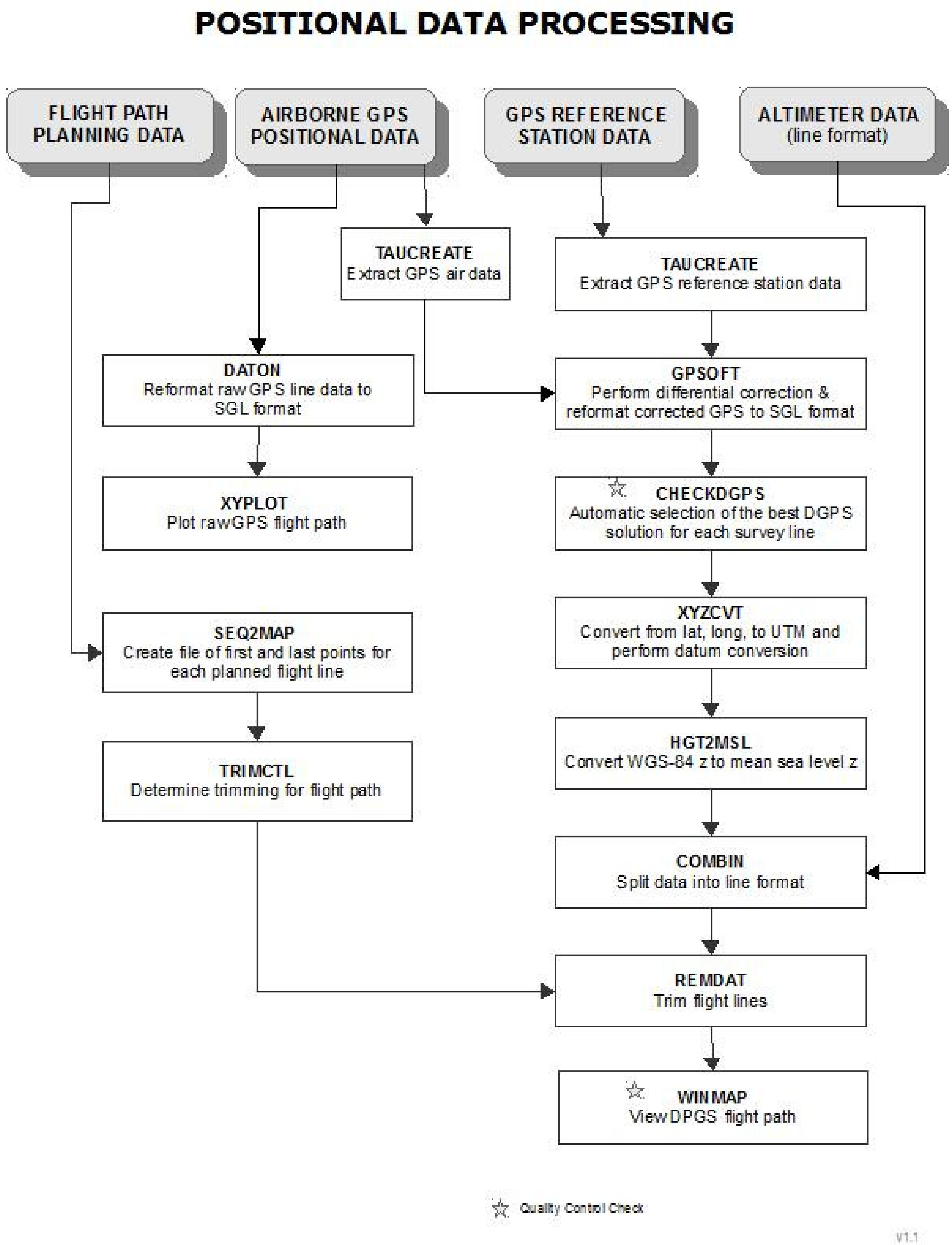


Figure 31: Positional data processing flowchart

Positional Data

A positional data flowchart is presented in *Figure 31.* A number of programs were executed for the compilation of navigation data in order to reformat and recalculate positions in differential mode. SGL's GPS data processing package, GPSoft, was used to calculate DGPS positions from raw 10 Hz range data obtained from the moving (airborne) and stationary (ground) receivers using combinations of L1 and L2 phase signal.

Accurate locations of the GPS antenna were determined through Precise Point Positioning (PPP) differential corrections using the algorithm developed by the National Research Council of Canada (NRCAN) (http://webapp.geod.nrcan.gc.ca/geod/tools-outils/ppp.php) adapted to run under SGL's suite of software. This technique provides a final receiver location with an accuracy of better than 5 cm.

Positional data (x, y, z) were recorded and all data processing was performed in the WGS-84 datum. Please see *Table A* for ellipsoid parameters. Positions were calculated and delivered in the WGS-84 datum, UTM projection zone UTM29N. The delivered data are provided with x, y locations converted to the Irish National Grid (IRENET95 Datum, Irish Transverse Mercator projection). See *Tables B* and *C* for the ellipsoid parameters and the datum conversion parameters, and *Table D* for the projection parameters.

Table A: Ellipsoid parameters for WGS-84

Ellipsoid	WGS-84
Semi-major axis	6378137.0
1/flattening	298.257223563

Table B: Ellipsoid parameters for IRENET95

Ellipsoid	GRS-80
Semi-major axis	6378137.0
1/flattening	298.257222101

Table C: Datum conversion parameters from IRENET95 to WGS-84

x shift (m)	0
y shift (m)	0
z shift (m)	0
x rotation (rad)	0
y rotation (rad)	0
z rotation (rad)	0

Table D: Irish Transverse Mercator Projection Parameters

Central meridian	8° West
Latitude of origin	53.5° North
False northing (m)	250,000
False easting (m)	200,000
Scale factor	1.000035

Elevation data were recorded relative to the GRS-80 ellipsoid and transformed to mean sea level (MSL) using the Earth Gravitational Model 2008 (EGM2008).

Radar, Barometric, and Laser Altimeter Data

The terrain clearance measured by the Collins radar altimeter and the barometric altitude were recorded at 10 Hz. The barometric altimeter was recorded but was not used for altitude because of the availability of more accurate GPS altitudes. Barometric data is employed in the calculation of effective height when processing gamma ray data (see "Calculation of Effective height above ground level").

The Collins radar data records the first return within the footprint of its signal. The radar altimeter data were filtered to remove high-frequency noise using a 67-point low pass filter (see *Appendix VII*). The final data was plotted and inspected for quality. Taking into account clearance limits for spectrometric and EM data, hardware modifications were made to the Collins radar to improve clearance measurements. As a result an upper limit of 408 m was introduced to radar clearances.

The laser altimeter was modified to record terrain clearances at 20 Hz, with a maximum recorded clearance of 338 m. Laser data was corrected for attitude using pitch, roll and azimuth data recorded by the Septentrio PolaRx2 GPS unit.

A clearance value was derived based on a combination of laser data as the primary altimeter, replaced by radar data when more than 338 m above the ground, and by a height above ground value determined by subtracting Shuttle Radar Terrain Model (SRTM) data from the GPS height when more than 408 m above ground. A Terrain Model was derived from a combination of the clearance and the GPS altitude (effectively the SRTM at clearances greater than 408 m). Some artifacts associated with steep climbs on the north side of the Comeragh Mountains in the west of the block were corrected in the DEM and equivalent clearance data by applying microlevelling locally with a limit of ±5 m. A second Terrain Model based only on radar (no laser data) was also created in the same way, incorporating SRTM for clearances above 408 m. The radar based DEM required microlevel corrections in small areas of steep climbs both north and south of the Comeragh Mountains.

Temperature Data

Outside air temperature was recorded at 10 Hz and smoothed using a 199 point low pass filter.

10. FINAL PRODUCTS

Magnetic Line Data Format

A listing of the data channels delivered in ASCII format with a sampling rate of 10 Hz can be found in *Table 18*.

File Name: GSI___16.IRL_DLV1653_MAG.xyz

Table 18: Magnetic line data channels and format

Title	Size	Units	Null	Description
LINE	08	-	-	Line number - LLLL.SR (L=line, S=segment, R=reflight)
FLIGHT	06	-	-	Flight number
DATE	10	-	-	Date YYYYMMDD
DAY	05	-	-	Day of year
TIME	10	s	-	Fiducial Seconds
ITM-X	11	m	*	X coordinate, IRENET95 ITM
ITM-Y	11	m	*	Y coordinate, IRENET95 ITM
UTM-X	12	m	*	X coordinate, WGS-84 UTM29N
UTM-Y	12	m	*	Y coordinate, WGS-84 UTM29N
UTM-Z	10	m	*	GPS Elevation above WGS-84 Ellipsoid
MSLHGT	10	m	*	GPS Elevation above Mean Sea Level
LAT	13	degree	*	Latitude, WGS-84
LONG	13	degree	*	Longitude, WGS-84
CLEAR	11	m	*	Clearance above Terrain
RADAR	11	m	*	Radar Altimeter altitude above Terrain
LASER	11	m	*	Laser Altimeter altitude above Terrain
DEM	11	m	*	Digital Elevation Model from SRTM (above WGS-84 Ellipsoid)
DEMRAD	11	m	*	Digital Elevation Model from Radar(above WGS-84 Ellipsoid)
DEMLAS	11	m	*	Digital Elevation Model from Laser(above WGS-84 Ellipsoid)
DICOR	11	nT	*	Diurnal Magnetic Field from reference station
IGRF	11	nT	*	IGRF Correction
MAG-uncomp	11	nT	*	Uncompensated Airborne Magnetic Field
MAG-comp	11	nT	*	Compensated Airborne Magnetic Field
MAG-DC	11	nT	*	Diurnally Corrected Airborne Magnetic Field
MAG-IGRF	11	nT	*	IGRF Corrected Airborne Magnetic Field
MAG-HC	11	nT	*	Height Corrected Airborne Magnetic Field
MAG-LEV	11	nT	*	Levelled Airborne Magnetic Field
MAG-MIC	11	nT	*	Microlevelled Airborne Magnetic Field

Radiometric Line Data Format

A listing of the data channels delivered in ASCII format with a sampling rate of 1 Hz can be found in Table 19.

File Name: GSI___16.IRL_DLV1654_Spec.xyz

Table 19: Radiometric line data channels and format

Title	Size	Units	Null	Description
LINE	08	-	-	Line number - LLLL.SR (L=line, S=segment, R=reflight)
FLIGHT	06	-	-	Flight Number
DATE	10	-	-	Date YYYYMMDD
DAY	05	-	-	Day of year
TIME	10	s	-	Fiducial Seconds
ITM-X	11	m	*	X coordinate, IRENET95 ITM
ITM-Y	11	m	*	Y coordinate, IRENET95 ITM
UTM-X	12	m	*	X coordinate, WGS-84 UTM29N
UTM-Y	12	m	*	Y coordinate, WGS-84 UTM29N
UTM-Z	10	m	*	GPS Elevation above WGS-84 Ellipsoid
MSLHGT	10	m	*	GPS Elevation above Mean Sea Level
LAT	13	degree	*	Latitude, WGS-84
LONG	13	degree	*	Longitude, WGS-84
RADAR	11	m	*	Radar Altimeter altitude above Terrain
CLEAR	11	m	*	Clearance above Terrain
BARO	11	m	*	Barometric Pressure Altitude
TEMP	11	msec	*	Temperature
E_HGT	11	m	*	Effective Height at Standard Temperature and Pressure
R_LIVE	08	counts/s	*	Gamma-ray spectrometer live time
R_COS	10	counts/s	*	Recorded Cosmic Count
R_UPU	10	counts/s	*	Recorded Up-Looking Uranium Count
R_TOT	10	counts/s	*	Recorded Total Count,de-lagged
R_POT	10	counts/s	*	Recorded Potassium Count,de-lagged
R_URA	10	counts/s	*	Recorded Uranium Count,de-lagged
R_THO	10	counts/s	*	Recorded Thorium Count,de-lagged
C_TOT_M	10	counts/s	*	Corrected Total Count, de-lagged, micro-levelled
C_POT	10	%	*	Corrected Potassium Concentration,de-lagged
C_URA_M	10	ppm	*	Corrected Uranium Concentration,de-lagged, micro-levelled
C_THO	10	ppm	*	Corrected Thorium Concentration,de-lagged
C_TOT_ML	10	counts/s	*	Corrected Total Count, de-lagged, micro-levelled and minimum limited to 0

Title	Size	Units	Null	Description
C_POTL	10	%	*	Corrected Potassium Concentration, de-lagged and minimum limited to 0
C_URA_ML	10	ppm	*	Corrected Uranium Concentration, de-lagged, micro-levelled and minimum limited to 0
C_THOL	10	ppm	*	Corrected Thorium Concentration, de-lagged and minimum limited to 0
E_DOSE	10	nGy/hr	*	Air absorbed dose rate
RUT	10	-	*	Uranium / Thorium Ratio
RUK	10	-	*	Uranium / Potassium Ratio
RKT	10	%/ppm	*	Thorium / Potassium Ratio

Frequency-Domain Electromagnetic Line Data Format

A listing of the data channels delivered in ASCII format with a sampling rate of 10 Hz can be found in *Table 20*.

File Name: GSI___16.IRL_DVL1655_FEM.xyz

Table 20: Frequency-domain electromagentic line data channels and format

Title	Size	Units	Null	Description
LINE	08	-	-	Line number - LLLL.SR (L=line, S=segment, R=reflight)
FLIGHT	06	-	-	Flight number
DATE	10	-	-	Date YYYYMMDD
DAY	05	-	-	Day of year
TIME	11	s	-	UTC seconds
ITM-X	13	m	*	X coordinate, IRENET95 ITM
ITM-Y	13	m	*	Y coordinate, IRENET95 ITM
UTM-X	13	m	*	X coordinate, WGS-84 UTM 29N
UTM-Y	13	m	*	Y coordinate, WGS-84 UTM 29N
WGSHGT	13	m	*	GPS Elevation (above WGS-84 Ellipsoid)
RADAR	11	m	*	Radar Altimeter altitude above Terrain
P09ppm	08	ppm	*	In-phase 912 Hz
Q09ppm	08	ppm	*	Quadrature 912 Hz
P3ppm	08	ppm	*	In-phase 3005 Hz
Q3ppm	08	ppm	*	Quadrature 3005 Hz
P12ppm	08	ppm	*	In-phase 11962 Hz
Q12ppm	08	ppm	*	Quadrature 11962 Hz
P25ppm	08	ppm	*	In-phase 24510 Hz
Q25ppm	08	ppm	*	Quadrature 24510 Hz

Title	Size	Units	Null	Description
P09filt	08	ppm	*	Filtered in-phase 912 Hz
Q09filt	08	ppm	*	Filtered quadrature 912 Hz
P3filt	08	ppm	*	Filtered in-phase 3005 Hz
Q3filt	08	ppm	*	Filtered quadrature 3005 Hz
P12filt	08	ppm	*	Filtered in-phase 11962 Hz
Q12filt	08	ppm	*	Filtered quadrature 11962 Hz
P25filt	08	ppm	*	Filtered in-phase 24510 Hz
Q25filt	08	ppm	*	Filtered quadrature 24510 Hz
P09lev	08	ppm	*	Levelled and filtered in-phase 912 Hz
Q09lev	08	ppm	*	Levelled and filtered quadrature 912 Hz
P3lev	08	ppm	*	Levelled and filtered in-phase 3005 Hz
Q3lev	08	ppm	*	Levelled and filtered quadrature 3005 Hz
P12lev	08	ppm	*	Levelled and filtered in-phase 11962 Hz
Q12lev	08	ppm	*	Levelled and filtered quadrature 11962 Hz
P25lev	08	ppm	*	Levelled and filtered in-phase 24510 Hz
Q25lev	08	ppm	*	Levelled and filtered quadrature 24510 Hz
Radio_Flag	09	ppm	*	Radio call flag
PLM_mV	10	mV	*	Power line monitor
Res09	10	ohm-m	*	Apparent resistivity, half-space model, 912 Hz
Res3	10	ohm-m	*	Apparent resistivity, half-space model, 3005 Hz
Res12	10	ohm-m	*	Apparent resistivity, half-space model, 11962 Hz
Res25	10	ohm-m	*	Apparent resistivity, half-space model, 24510 Hz
Res3_MLEV	10	ohm-m	*	Microlevelled apparent resistivity, half-space model, 3005 Hz
Res12_MLEV	10	ohm-m	*	Microlevelled apparent resistivity, half-space model, 11962 Hz
Res25_MLEV	10	ohm-m	*	Microlevelled apparent resistivity, half-space model, 24510 Hz
Depth09	10	m	*	Centroid depth 912Hz
Depth3	10	m	*	Centroid depth 3005Hz
Depth12	10	m	*	Centroid depth 11962Hz
Depth25	10	m	*	Centroid depth 24510Hz
ResSlice10	11	ohm-m	*	Resistivity depth slice at 10m
ResSlice30	11	ohm-m	*	Resistivity depth slice at 30m
ResSlice60	11	ohm-m	*	Resistivity depth slice at 60m
ResSlice100	11	ohm-m	*	Resistivity depth slice at 100m
ResSlice10_ML	11	ohm-m	*	Microlevelled resistivity depth slice at 10m
ResSlice30_ML	11	ohm-m	*	Microlevelled resistivity depth slice at 30m

Title	Size	Units	Null	Description
ResSlice60_ML	11	Ohm-m		Microlevelled resistivity depth slice at 60m
ResSlice100_ML	11	ohm-m	*	Microlevelled resistivity depth slice at 100m

Full Spectrum Spectrometer Line Data Format

A listing of the data channels delivered in ASCII format with a sampling rate of 10 Hz can be found in *Table 21*.

File Names: 1024DOWN.xyz, 1024UP.xyz

Table 21: Frequency-domain electromagentic line data channels and format

Column	Title	Size	Units	Null	Description
01	TIME	9	s	-	Fiducial Seconds
02	LIVE	6	ms	-	Live time
03	S:0	6	counts	-	Spectrometer channel 1
04	S:1	6	counts	-	Spectrometer channel 2
.	.	.		.	.
.	.	.	.	.	.
.	.	.	.	.	.
1026	S:1024	6	counts	-	Spectrometer channel 1024

Digital Grids

The following are provided as digital grids:

Formats:	ASCII (.XYZ), Geosoft Binary (.GRD), Grid Exchange (.GXF)
Grid Cell Size:	50 m
Datum:	IRENET95
Projection:	Irish Transverse Mercator (ITM)

Table 22: Delivered digital grids

Grid File Name	Units	Description
MAG	nT	Magnetic Anomaly
FVM	nT/km	First Vertical Derivative of Magnetic Anomaly
Tot	counts/sec	Total counts
Pot	%	Potassium
Tho	ppm	Equivalent Thorium
Ura	ppm	Equivalent Uranium
P09	ppm	In-phase coupling ratio, 912 Hz, levelled
Q09	ppm	Quadrature coupling ratio, 912 Hz, levelled
P3	ppm	In-phase coupling ratio, 3005 Hz, levelled
Q3	ppm	Quadrature coupling ratio, 3005 Hz, levelled
P12	ppm	In-phase coupling ratio, 11962 Hz, levelled
Q12	ppm	Quadrature coupling ratio, 11962 Hz, levelled
P25	ppm	In-phase coupling ratio, 24510 Hz, levelled
Q25	ppm	Quadrature coupling ratio, 24510 Hz, levelled
Res09	ohm-m	Apparent resistivity, half-space model, 912 Hz
Res3	ohm-m	Microlevelled apparent resistivity, half-space model, 3005 Hz
Res12	ohm-m	Microlevelled apparent resistivity, half-space model, 11962 Hz
Res25	ohm-m	Microlevelled apparent resistivity, half-space model, 24510 Hz
ResSlice10	ohm-m	Microlevelled resistivity depth slice at 10m
ResSlice30	ohm-m	Microlevelled resistivity depth slice at 30m
ResSlice60	ohm-m	Microlevelled resistivity depth slice at 60m

Digital Video

Please see *Appendix X* for Digital Video Inventory. Note that no video is available for the 10 survey lines acquired on flight 4.

Appendix I

Company Profile

About Us

Sander Geophysics Limited (SGL) provides worldwide airborne geophysical surveys for petroleum and mineral exploration, and geological and environmental mapping. Services offered include high resolution airborne gravity, magnetic, electromagnetic, and radiometric surveys, using fixed-wing aircraft and helicopters.

SGL head office in Ottawa, Canada

Dr. George W. Sander (1924-2008) founded SGL in 1956 to provide ground geophysical surveys. The first airborne surveys were performed as early as 1958, and by 1967 airborne geophysical surveys were the company's main focus. Operations have expanded steadily since SGL was founded more than 50 years ago. The company is led by co-Presidents Luise Sander and Stephan Sander.

Worldwide Operations

SGL's head office and aircraft maintenance hangar are located at the International Airport in Ottawa, Canada. Sander Geophysics has operated on every continent including Antarctica, over diverse conditions ranging from the tropics to deserts, mountains and offshore.

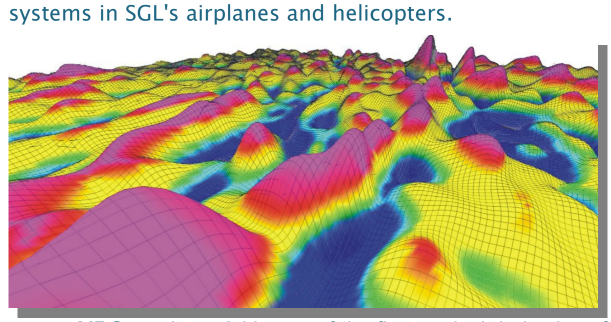
Facilities at the head office include a state of the art data processing department with an integrated digital cartographic department and a fully equipped electronics workshop for research, development and production of geophysical instruments. A Transport Canada Approved Maintenance Organization (AMO) for fixed-wing aircraft and helicopters allows most aircraft maintenance and modifications to be performed in-house.

Services

Airborne Surveys

- **Gravity (AIRGrav)**
- **Magnetic Total Field**
- **Magnetic Gradient**
- **Electromagnetic**
- **Gamma-ray Spectrometer**
- **Scanning LiDAR**

SGL offers gravity surveys with **AIRGrav** (Airborne Inertially Referenced Gravimeter), which was designed specifically for the unique characteristics of the airborne environment and is the highest resolution airborne gravimeter available. **AIRGrav** can be flown in an efficient survey aircraft during normal daytime conditions and is routinely flown in combination with magnetometer systems in SGL's airplanes and helicopters.



***AIRGrav** data: 3d image of the first vertical derivative of terrain corrected Bouguer gravity*

Data Processing

Immediate data processing is part of SGL's standard quality control procedure, and provides clients with rapid results for evaluation while a survey is in progress. Sander Geophysics offers a full range of data enhancement programs and integrated interpretation services by experienced geoscientists. Available products in digital and/or hard copy include:

- **Contour, colour or shaded relief maps of any parameter or combination of parameters**
- **NASVD processed gamma-ray spectrometer data**
- **Filtered line or grid products such as vertical or horizontal gradients, frequency slices,**

high/low-pass or band-pass filtered, amplitude of the analytic signal, reduction to the pole, upward or downward continuation

- **Computed depth to basement**
- **Calculated digital terrain models**
- **Two- or three-dimensional modelling**
- **Cultural editing**
- **Complete geophysical interpretative reports**

ENVIRONMENTAL MONITORING

The company also provides environmental monitoring services using gamma-ray spectrometers and specialized processing to detect and quantify natural and anthropogenic radiation.

HEALTH & SAFETY

Sander Geophysics is a founding and active executive member of the International Airborne Geophysics Safety Association (IAGSA), which promotes the safe operation of helicopters and fixed-wing aircraft on airborne geophysical surveys.

SGL has developed and implemented a Safety Management System (SMS) and comprehensive Health, Safety and Environment (HSE) policies that govern all aspects of company operations. Safety initiatives include:

- **Project-specific Aviation Risk Analysis (ARA) and Personnel Risk Analysis (PRA) for all surveys**
- **Real-time satellite tracking of SGL aircraft**
- **HSE and first aid training for all field personnel**
- **Low-level flight and aircraft simulator training for pilots**
- **Advanced safety training appropriate to the survey location, such as water-egress, wilderness survival, etc.**

SGL's excellent safety record reflects the quality and experience of its survey crews. This, combined with management's ongoing commitment to safety, helps to ensure that Sander Geophysics is a safe and reliable choice for airborne geophysical surveys.

PERSONNEL

Sander Geophysics has over 160 experienced permanent employees, including geophysicists, software and hardware engineers, aircraft maintenance engineers and pilots.

AIRCRAFT

SGL owns and operates seventeen aircraft, including eight Cessna Grand Caravans and a Twin Otter all equipped for geophysical surveys.

The Grand Caravans have been modified to allow the installation of a tri-axial magnetic gradiometer system. The company's fleet also includes three all composite Diamond DA42 Twin Stars, modified for gravity and horizontal magnetic gradient surveys, and two AS350 B3 helicopters equipped for gravity, magnetic and radiometric surveys. Extensive modifications have been made to all of the survey aircraft to accommodate geophysical instruments and to reduce the aircraft's magnetic field. Typical Figures of Merit (FOM) for Sander Geophysics' fixed-wing aircraft are less than 1 nT. The company's aircraft are flown and maintained by licensed and experienced permanent employees of Sander Geophysics.

SGL aircraft

RESEARCH & DEVELOPMENT

Nearly one-third of the company's resources are devoted to developing new and more efficient instrumentation for airborne geophysical surveying, and to further refine its full suite of software for geophysical data processing.

Appendix II

Tellus Waterford Block - PLANNED SURVEY LINES
WGS-84

SEGMENT	START		END		LENGTH	
NO	LAT	LONG	LAT	LONG	NM	KM
C0101.0	N52:06.74	W007:01.89	N52:07.55	W006:56.71	3.29	6.10
C0102.0	N52:06.80	W007:08.61	N52:08.67	W006:56.63	7.61	14.10
C0103.0	N52:03.66	W007:35.32	N52:04.32	W007:31.17	2.65	4.90
C0103.1	N52:06.85	W007:15.32	N52:09.80	W006:56.55	11.93	22.10
C0104.0	N52:04.70	W007:35.77	N52:10.90	W006:56.64	24.89	46.10
C0105.0	N52:05.74	W007:36.21	N52:12.02	W006:56.56	25.22	46.70
C0106.0	N52:06.84	W007:36.32	N52:13.15	W006:56.48	25.32	46.90
C0107.0	N52:07.97	W007:36.25	N52:14.27	W006:56.40	25.32	46.90
C0108.0	N52:09.09	W007:36.19	N52:15.37	W006:56.49	25.22	46.70
C0109.0	N52:10.19	W007:36.29	N52:16.50	W006:56.41	25.32	46.90
C0110.0	N52:11.32	W007:36.23	N52:17.62	W006:56.33	25.32	46.90
C0111.0	N52:12.44	W007:36.17	N52:18.72	W006:56.41	25.22	46.70
C0112.0	N52:13.54	W007:36.27	N52:19.82	W006:56.50	25.22	46.70
C0113.0	N52:14.66	W007:36.21	N52:20.86	W006:56.94	24.89	46.10
C0114.0	N52:15.79	W007:36.14	N52:21.09	W007:02.66	21.22	39.30
C0115.0	N52:16.89	W007:36.25	N52:21.15	W007:09.41	17.01	31.50
C0116.0	N52:18.01	W007:36.18	N52:21.17	W007:16.33	12.58	23.30
C0117.0	N52:19.14	W007:36.12	N52:21.22	W007:23.08	8.26	15.30
C0118.0	N52:20.24	W007:36.23	N52:21.26	W007:29.84	4.05	7.50
T1001.0	N52:03.60	W007:35.16	N52:05.84	W007:36.12	2.32	4.30
T1002.0	N52:03.62	W007:34.99	N52:06.00	W007:36.00	2.46	4.56
T1003.0	N52:03.65	W007:34.82	N52:06.94	W007:36.22	3.40	6.30
T1004.0	N52:03.68	W007:34.65	N52:06.97	W007:36.05	3.40	6.30
T1005.0	N52:03.71	W007:34.48	N52:07.25	W007:35.99	3.67	6.80
T1006.0	N52:03.73	W007:34.31	N52:08.06	W007:36.16	4.48	8.30
T1007.0	N52:03.76	W007:34.15	N52:08.09	W007:35.99	4.48	8.30
T1008.0	N52:03.79	W007:33.98	N52:08.50	W007:35.98	4.88	9.03
T1009.0	N52:03.82	W007:33.81	N52:09.19	W007:36.09	5.56	10.30
T1010.0	N52:03.84	W007:33.64	N52:09.34	W007:35.97	5.68	10.53
T1011.0	N52:03.87	W007:33.47	N52:10.29	W007:36.20	6.64	12.30
T1012.0	N52:03.90	W007:33.30	N52:10.32	W007:36.03	6.64	12.30
T1013.0	N52:03.93	W007:33.13	N52:10.59	W007:35.96	6.89	12.76
T1014.0	N52:03.95	W007:32.96	N52:11.41	W007:36.14	7.72	14.30
T1015.0	N52:03.98	W007:32.79	N52:11.44	W007:35.97	7.72	14.30
T1016.0	N52:04.01	W007:32.62	N52:11.83	W007:35.95	8.10	15.00
T1017.0	N52:04.03	W007:32.45	N52:12.54	W007:36.07	8.80	16.30
T1018.0	N52:04.06	W007:32.28	N52:12.67	W007:35.94	8.91	16.49
T1019.0	N52:04.09	W007:32.11	N52:13.64	W007:36.18	9.88	18.30
T1020.0	N52:04.12	W007:31.94	N52:13.67	W007:36.01	9.88	18.30
T1021.0	N52:04.14	W007:31.77	N52:13.92	W007:35.93	10.11	18.73
T1022.0	N52:04.17	W007:31.61	N52:14.76	W007:36.11	10.96	20.30
T1023.0	N52:04.20	W007:31.44	N52:14.79	W007:35.94	10.96	20.30
T1024.0	N52:04.23	W007:31.27	N52:15.17	W007:35.92	11.32	20.97
T1025.0	N52:05.30	W007:31.54	N52:15.89	W007:36.05	10.96	20.30
T1026.0	N52:05.32	W007:31.37	N52:16.00	W007:35.91	11.05	20.46
T1027.0	N52:05.35	W007:31.20	N52:16.99	W007:36.15	12.04	22.30
T1028.0	N52:05.38	W007:31.03	N52:17.01	W007:35.98	12.04	22.30
T1029.0	N52:05.41	W007:30.86	N52:17.25	W007:35.90	12.26	22.70
T1030.0	N52:05.43	W007:30.69	N52:18.11	W007:36.09	13.12	24.30
T1031.0	N52:05.46	W007:30.52	N52:18.14	W007:35.92	13.12	24.30
T1032.0	N52:05.49	W007:30.35	N52:18.50	W007:35.89	13.46	24.94
T1033.0	N52:05.51	W007:30.18	N52:19.24	W007:36.03	14.20	26.30
T1034.0	N52:05.54	W007:30.01	N52:19.33	W007:35.88	14.27	26.43
T1035.0	N52:05.57	W007:29.85	N52:20.34	W007:36.13	15.28	28.30
T1036.0	N52:05.60	W007:29.68	N52:20.36	W007:35.96	15.28	28.30
T1037.0	N52:05.62	W007:29.51	N52:20.58	W007:35.87	15.48	28.66
T1038.0	N52:05.65	W007:29.34	N52:20.75	W007:35.76	15.62	28.93

Tellus Waterford Block - PLANNED SURVEY LINES
WGS-84

SEGMENT	START		END		LENGTH	
NO	LAT	LONG	LAT	LONG	NM	KM
T1039.0	N52:05.68	W007:29.17	N52:20.74	W007:35.58	15.59	28.87
T1040.0	N52:05.70	W007:29.00	N52:20.74	W007:35.40	15.56	28.82
T1041.0	N52:05.73	W007:28.83	N52:20.74	W007:35.21	15.53	28.77
T1042.0	N52:05.76	W007:28.66	N52:20.74	W007:35.03	15.50	28.71
T1043.0	N52:05.79	W007:28.49	N52:20.74	W007:34.85	15.47	28.66
T1044.0	N52:05.81	W007:28.32	N52:20.74	W007:34.67	15.45	28.60
T1045.0	N52:05.84	W007:28.15	N52:20.74	W007:34.48	15.42	28.55
T1046.0	N52:05.87	W007:27.98	N52:20.74	W007:34.30	15.39	28.50
T1047.0	N52:05.90	W007:27.81	N52:20.74	W007:34.12	15.36	28.44
T1048.0	N52:05.92	W007:27.64	N52:20.74	W007:33.94	15.33	28.39
T1049.0	N52:05.95	W007:27.47	N52:20.74	W007:33.76	15.30	28.34
T1050.0	N52:05.98	W007:27.30	N52:20.75	W007:33.58	15.28	28.30
T1051.0	N52:06.00	W007:27.13	N52:20.77	W007:33.41	15.28	28.30
T1052.0	N52:06.03	W007:26.96	N52:20.80	W007:33.24	15.28	28.30
T1053.0	N52:06.06	W007:26.79	N52:20.83	W007:33.07	15.28	28.30
T1054.0	N52:06.09	W007:26.62	N52:20.86	W007:32.90	15.28	28.30
T1055.0	N52:06.11	W007:26.46	N52:20.88	W007:32.72	15.28	28.30
T1056.0	N52:06.14	W007:26.29	N52:20.91	W007:32.55	15.28	28.30
T1057.0	N52:06.17	W007:26.12	N52:20.94	W007:32.38	15.28	28.30
T1058.0	N52:06.19	W007:25.95	N52:20.96	W007:32.21	15.28	28.30
T1059.0	N52:06.22	W007:25.78	N52:20.99	W007:32.04	15.28	28.30
T1060.0	N52:06.25	W007:25.61	N52:21.02	W007:31.87	15.28	28.30
T1061.0	N52:06.28	W007:25.44	N52:21.05	W007:31.70	15.28	28.30
T1062.0	N52:06.30	W007:25.27	N52:21.07	W007:31.53	15.28	28.30
T1063.0	N52:06.33	W007:25.10	N52:21.10	W007:31.36	15.28	28.30
T1064.0	N52:06.36	W007:24.93	N52:21.13	W007:31.19	15.28	28.30
T1065.0	N52:06.38	W007:24.76	N52:21.16	W007:31.02	15.28	28.30
T1066.0	N52:06.41	W007:24.59	N52:21.18	W007:30.85	15.28	28.30
T1067.0	N52:06.44	W007:24.42	N52:21.21	W007:30.68	15.28	28.30
T1068.0	N52:06.46	W007:24.25	N52:21.24	W007:30.51	15.28	28.30
T1069.0	N52:06.49	W007:24.08	N52:21.26	W007:30.34	15.28	28.30
T1070.0	N52:06.52	W007:23.91	N52:21.29	W007:30.17	15.28	28.30
T1071.0	N52:06.55	W007:23.74	N52:21.32	W007:30.00	15.28	28.30
T1072.0	N52:06.57	W007:23.57	N52:20.72	W007:29.56	14.63	27.10
T1073.0	N52:06.60	W007:23.40	N52:20.72	W007:29.38	14.61	27.05
T1074.0	N52:06.63	W007:23.23	N52:20.72	W007:29.20	14.58	27.00
T1075.0	N52:06.65	W007:23.06	N52:20.72	W007:29.01	14.55	26.94
T1076.0	N52:06.68	W007:22.89	N52:20.72	W007:28.83	14.52	26.89
T1077.0	N52:06.71	W007:22.72	N52:20.72	W007:28.65	14.49	26.83
T1078.0	N52:06.74	W007:22.55	N52:20.72	W007:28.47	14.46	26.78
T1079.0	N52:06.76	W007:22.39	N52:20.72	W007:28.28	14.43	26.73
T1080.0	N52:06.79	W007:22.22	N52:20.71	W007:28.10	14.40	26.67
T1081.0	N52:06.82	W007:22.05	N52:20.71	W007:27.92	14.37	26.62
T1082.0	N52:06.84	W007:21.88	N52:20.71	W007:27.74	14.34	26.57
T1083.0	N52:06.87	W007:21.71	N52:20.71	W007:27.56	14.32	26.51
T1084.0	N52:06.90	W007:21.54	N52:20.71	W007:27.37	14.29	26.46
T1085.0	N52:06.92	W007:21.37	N52:20.71	W007:27.19	14.26	26.41
T1086.0	N52:06.95	W007:21.20	N52:20.71	W007:27.01	14.23	26.35
T1087.0	N52:06.98	W007:21.03	N52:20.71	W007:26.83	14.20	26.30
T1088.0	N52:07.01	W007:20.86	N52:20.74	W007:26.66	14.20	26.30
T1089.0	N52:07.03	W007:20.69	N52:20.76	W007:26.49	14.20	26.30
T1090.0	N52:07.06	W007:20.52	N52:20.79	W007:26.31	14.20	26.30
T1091.0	N52:07.09	W007:20.35	N52:20.82	W007:26.14	14.20	26.30
T1092.0	N52:07.11	W007:20.18	N52:20.85	W007:25.97	14.20	26.30
T1093.0	N52:07.14	W007:20.01	N52:20.87	W007:25.80	14.20	26.30
T1094.0	N52:07.17	W007:19.84	N52:20.90	W007:25.63	14.20	26.30
T1095.0	N52:07.19	W007:19.67	N52:20.93	W007:25.46	14.20	26.30

Tellus Waterford Block - PLANNED SURVEY LINES
WGS-84

SEGMENT	START		END		LENGTH	
NO	LAT	LONG	LAT	LONG	NM	KM
T1096.0	N52:07.22	W007:19.50	N52:20.95	W007:25.29	14.20	26.30
T1097.0	N52:07.25	W007:19.33	N52:20.98	W007:25.12	14.20	26.30
T1098.0	N52:07.28	W007:19.16	N52:21.01	W007:24.95	14.20	26.30
T1099.0	N52:07.30	W007:18.99	N52:21.04	W007:24.78	14.20	26.30
T1100.0	N52:07.33	W007:18.82	N52:21.06	W007:24.61	14.20	26.30
T1101.0	N52:07.36	W007:18.65	N52:21.09	W007:24.44	14.20	26.30
T1102.0	N52:07.38	W007:18.48	N52:21.12	W007:24.27	14.20	26.30
T1103.0	N52:07.40	W007:18.31	N52:21.14	W007:24.10	14.22	26.33
T1104.0	N52:07.40	W007:18.13	N52:21.17	W007:23.93	14.24	26.38
T1105.0	N52:07.39	W007:17.94	N52:21.20	W007:23.76	14.27	26.43
T1106.0	N52:07.39	W007:17.76	N52:21.22	W007:23.59	14.30	26.49
T1107.0	N52:07.39	W007:17.58	N52:21.25	W007:23.42	14.33	26.54
T1108.0	N52:07.39	W007:17.40	N52:21.28	W007:23.25	14.36	26.59
T1109.0	N52:07.39	W007:17.22	N52:20.69	W007:22.81	13.75	25.47
T1110.0	N52:07.39	W007:17.04	N52:20.69	W007:22.63	13.75	25.47
T1111.0	N52:07.39	W007:16.86	N52:20.69	W007:22.45	13.75	25.47
T1112.0	N52:07.39	W007:16.67	N52:20.69	W007:22.27	13.75	25.47
T1113.0	N52:07.39	W007:16.49	N52:20.69	W007:22.08	13.75	25.47
T1114.0	N52:07.38	W007:16.31	N52:20.68	W007:21.90	13.75	25.47
T1115.0	N52:07.38	W007:16.13	N52:20.68	W007:21.72	13.75	25.47
T1116.0	N52:07.38	W007:15.95	N52:20.68	W007:21.54	13.75	25.47
T1117.0	N52:07.38	W007:15.77	N52:20.68	W007:21.36	13.75	25.47
T1118.0	N52:07.38	W007:15.59	N52:20.68	W007:21.17	13.75	25.47
T1119.0	N52:06.80	W007:15.16	N52:20.68	W007:20.99	14.35	26.58
T1120.0	N52:06.82	W007:14.99	N52:20.68	W007:20.81	14.32	26.53
T1121.0	N52:06.85	W007:14.82	N52:20.68	W007:20.63	14.30	26.48
T1122.0	N52:06.88	W007:14.65	N52:20.68	W007:20.44	14.27	26.42
T1123.0	N52:06.90	W007:14.48	N52:20.68	W007:20.26	14.24	26.37
T1124.0	N52:06.93	W007:14.31	N52:20.67	W007:20.08	14.21	26.31
T1125.0	N52:06.96	W007:14.14	N52:20.69	W007:19.91	14.20	26.30
T1126.0	N52:06.98	W007:13.97	N52:20.72	W007:19.73	14.20	26.30
T1127.0	N52:07.01	W007:13.80	N52:20.75	W007:19.56	14.20	26.30
T1128.0	N52:07.04	W007:13.63	N52:20.77	W007:19.39	14.20	26.30
T1129.0	N52:07.06	W007:13.46	N52:20.80	W007:19.22	14.20	26.30
T1130.0	N52:07.09	W007:13.29	N52:20.83	W007:19.05	14.20	26.30
T1131.0	N52:07.12	W007:13.12	N52:20.86	W007:18.88	14.20	26.30
T1132.0	N52:07.15	W007:12.96	N52:20.88	W007:18.71	14.20	26.30
T1133.0	N52:07.17	W007:12.79	N52:20.91	W007:18.54	14.20	26.30
T1134.0	N52:07.20	W007:12.62	N52:20.94	W007:18.37	14.20	26.30
T1135.0	N52:07.23	W007:12.45	N52:20.96	W007:18.20	14.20	26.30
T1136.0	N52:07.25	W007:12.28	N52:20.99	W007:18.03	14.20	26.30
T1137.0	N52:07.28	W007:12.11	N52:21.02	W007:17.86	14.20	26.30
T1138.0	N52:07.31	W007:11.94	N52:21.04	W007:17.69	14.20	26.30
T1139.0	N52:07.33	W007:11.77	N52:21.07	W007:17.52	14.20	26.30
T1140.0	N52:07.35	W007:11.59	N52:21.10	W007:17.35	14.21	26.31
T1141.0	N52:07.35	W007:11.41	N52:21.12	W007:17.18	14.24	26.36
T1142.0	N52:07.35	W007:11.23	N52:21.15	W007:17.01	14.26	26.42
T1143.0	N52:07.35	W007:11.05	N52:21.18	W007:16.84	14.29	26.47
T1144.0	N52:07.35	W007:10.87	N52:21.21	W007:16.66	14.32	26.53
T1145.0	N52:07.35	W007:10.69	N52:21.23	W007:16.49	14.35	26.58
T1146.0	N52:07.35	W007:10.51	N52:20.65	W007:16.07	13.75	25.47
T1147.0	N52:07.35	W007:10.32	N52:20.65	W007:15.89	13.75	25.47
T1148.0	N52:07.34	W007:10.14	N52:20.65	W007:15.70	13.75	25.47
T1149.0	N52:07.34	W007:09.96	N52:20.65	W007:15.52	13.75	25.47
T1150.0	N52:07.34	W007:09.78	N52:20.65	W007:15.34	13.75	25.47
T1151.0	N52:07.34	W007:09.60	N52:20.64	W007:15.16	13.75	25.47
T1152.0	N52:07.34	W007:09.42	N52:20.64	W007:14.97	13.75	25.47

Tellus Waterford Block - PLANNED SURVEY LINES
WGS-84

SEGMENT	START		END		LENGTH	
NO	LAT	LONG	LAT	LONG	NM	KM
T1153.0	N52:07.34	W007:09.24	N52:20.64	W007:14.79	13.75	25.47
T1154.0	N52:07.34	W007:09.05	N52:20.64	W007:14.61	13.75	25.47
T1155.0	N52:07.33	W007:08.87	N52:20.64	W007:14.43	13.75	25.47
T1156.0	N52:06.74	W007:08.45	N52:20.64	W007:14.24	14.36	26.60
T1157.0	N52:06.77	W007:08.28	N52:20.64	W007:14.06	14.33	26.54
T1158.0	N52:06.80	W007:08.11	N52:20.64	W007:13.88	14.30	26.49
T1159.0	N52:06.82	W007:07.94	N52:20.64	W007:13.70	14.28	26.44
T1160.0	N52:06.85	W007:07.77	N52:20.63	W007:13.52	14.25	26.38
T1161.0	N52:06.88	W007:07.60	N52:20.63	W007:13.33	14.22	26.33
T1162.0	N52:06.90	W007:07.43	N52:20.64	W007:13.16	14.20	26.30
T1163.0	N52:06.93	W007:07.26	N52:20.67	W007:12.98	14.20	26.30
T1164.0	N52:06.96	W007:07.09	N52:20.70	W007:12.81	14.20	26.30
T1165.0	N52:06.98	W007:06.92	N52:20.72	W007:12.64	14.20	26.30
T1166.0	N52:07.01	W007:06.75	N52:20.75	W007:12.47	14.20	26.30
T1167.0	N52:07.04	W007:06.58	N52:20.78	W007:12.30	14.20	26.30
T1168.0	N52:07.06	W007:06.41	N52:20.80	W007:12.13	14.20	26.30
T1169.0	N52:07.09	W007:06.24	N52:20.83	W007:11.96	14.20	26.30
T1170.0	N52:07.12	W007:06.07	N52:20.86	W007:11.79	14.20	26.30
T1171.0	N52:07.14	W007:05.90	N52:20.89	W007:11.62	14.20	26.30
T1172.0	N52:07.17	W007:05.73	N52:20.91	W007:11.45	14.20	26.30
T1173.0	N52:07.20	W007:05.56	N52:20.94	W007:11.28	14.20	26.30
T1174.0	N52:07.22	W007:05.39	N52:20.97	W007:11.11	14.20	26.30
T1175.0	N52:07.25	W007:05.22	N52:20.99	W007:10.94	14.20	26.30
T1176.0	N52:07.28	W007:05.05	N52:21.02	W007:10.77	14.20	26.30
T1177.0	N52:07.30	W007:04.88	N52:21.05	W007:10.60	14.20	26.30
T1178.0	N52:07.30	W007:04.70	N52:21.07	W007:10.43	14.23	26.35
T1179.0	N52:07.30	W007:04.52	N52:21.10	W007:10.25	14.26	26.40
T1180.0	N52:07.30	W007:04.34	N52:21.13	W007:10.08	14.29	26.46
T1181.0	N52:07.30	W007:04.16	N52:21.15	W007:09.91	14.31	26.51
T1182.0	N52:07.30	W007:03.98	N52:21.18	W007:09.74	14.34	26.56
T1183.0	N52:07.30	W007:03.79	N52:21.21	W007:09.57	14.37	26.62
T1184.0	N52:07.29	W007:03.61	N52:20.60	W007:09.14	13.75	25.47
T1185.0	N52:07.29	W007:03.43	N52:20.60	W007:08.96	13.75	25.47
T1186.0	N52:07.29	W007:03.25	N52:20.60	W007:08.77	13.75	25.47
T1187.0	N52:07.29	W007:03.07	N52:20.60	W007:08.59	13.75	25.47
T1188.0	N52:07.29	W007:02.89	N52:20.60	W007:08.41	13.75	25.47
T1189.0	N52:07.29	W007:02.71	N52:20.60	W007:08.23	13.75	25.47
T1190.0	N52:07.29	W007:02.52	N52:20.60	W007:08.05	13.75	25.47
T1191.0	N52:07.28	W007:02.34	N52:20.60	W007:07.86	13.75	25.47
T1192.0	N52:07.28	W007:02.16	N52:20.59	W007:07.68	13.75	25.47
T1193.0	N52:06.68	W007:01.73	N52:20.59	W007:07.50	14.37	26.61
T1194.0	N52:06.71	W007:01.56	N52:20.59	W007:07.32	14.34	26.56
T1195.0	N52:06.74	W007:01.39	N52:20.59	W007:07.13	14.31	26.51
T1196.0	N52:06.76	W007:01.22	N52:20.59	W007:06.95	14.28	26.45
T1197.0	N52:06.79	W007:01.05	N52:20.59	W007:06.77	14.25	26.40
T1198.0	N52:06.81	W007:00.88	N52:20.59	W007:06.59	14.23	26.35
T1199.0	N52:06.84	W007:00.71	N52:20.59	W007:06.41	14.20	26.30
T1200.0	N52:06.87	W007:00.54	N52:20.61	W007:06.24	14.20	26.30
T1201.0	N52:06.89	W007:00.37	N52:20.64	W007:06.06	14.20	26.30
T1202.0	N52:06.92	W007:00.20	N52:20.67	W007:05.89	14.20	26.30
T1203.0	N52:06.95	W007:00.03	N52:20.69	W007:05.72	14.20	26.30
T1204.0	N52:06.97	W006:59.86	N52:20.72	W007:05.55	14.20	26.30
T1205.0	N52:07.00	W006:59.69	N52:20.75	W007:05.38	14.20	26.30
T1206.0	N52:07.03	W006:59.52	N52:20.77	W007:05.21	14.20	26.30
T1207.0	N52:07.05	W006:59.35	N52:20.80	W007:05.04	14.20	26.30
T1208.0	N52:07.08	W006:59.19	N52:20.83	W007:04.87	14.20	26.30
T1209.0	N52:07.11	W006:59.02	N52:20.85	W007:04.70	14.20	26.30

Tellus Waterford Block - PLANNED SURVEY LINES
WGS-84

SEGMENT	START		END		LENGTH	
NO	LAT	LONG	LAT	LONG	NM	KM
T1210.0	N52:07.13	W006:58.85	N52:20.88	W007:04.53	14.20	26.30
T1211.0	N52:07.16	W006:58.68	N52:20.91	W007:04.36	14.20	26.30
T1212.0	N52:07.19	W006:58.51	N52:20.93	W007:04.19	14.20	26.30
T1213.0	N52:07.21	W006:58.34	N52:20.96	W007:04.02	14.20	26.30
T1214.0	N52:07.24	W006:58.17	N52:20.99	W007:03.85	14.20	26.30
T1215.0	N52:07.27	W006:58.00	N52:21.01	W007:03.68	14.20	26.30
T1216.0	N52:07.29	W006:57.83	N52:21.04	W007:03.50	14.20	26.30
T1217.0	N52:07.32	W006:57.66	N52:21.07	W007:03.33	14.20	26.30
T1218.0	N52:07.34	W006:57.49	N52:21.09	W007:03.16	14.20	26.30
T1219.0	N52:07.37	W006:57.32	N52:21.12	W007:02.99	14.20	26.30
T1220.0	N52:07.40	W006:57.15	N52:21.15	W007:02.82	14.20	26.30
T1221.0	N52:07.42	W006:56.98	N52:20.55	W007:02.39	13.56	25.11
T1222.0	N52:07.45	W006:56.81	N52:20.55	W007:02.21	13.53	25.06
T1223.0	N52:08.11	W006:56.90	N52:20.55	W007:02.03	12.85	23.80
T1224.0	N52:08.52	W006:56.89	N52:20.55	W007:01.85	12.42	23.00
T1225.0	N52:08.58	W006:56.73	N52:20.55	W007:01.66	12.36	22.90
T1226.0	N52:09.36	W006:56.87	N52:20.55	W007:01.48	11.56	21.40
T1227.0	N52:09.67	W006:56.82	N52:20.54	W007:01.30	11.23	20.79
T1228.0	N52:09.70	W006:56.65	N52:20.54	W007:01.12	11.20	20.74
T1229.0	N52:10.61	W006:56.84	N52:20.54	W007:00.93	10.26	19.00
T1230.0	N52:10.80	W006:56.74	N52:20.54	W007:00.75	10.06	18.63
T1231.0	N52:11.44	W006:56.82	N52:20.54	W007:00.57	9.40	17.40
T1232.0	N52:11.85	W006:56.81	N52:20.54	W007:00.39	8.97	16.61
T1233.0	N52:11.92	W006:56.65	N52:20.53	W007:00.21	8.89	16.47
T1234.0	N52:12.69	W006:56.79	N52:20.53	W007:00.02	8.10	15.01
T1235.0	N52:13.02	W006:56.74	N52:20.53	W006:59.84	7.75	14.36
T1236.0	N52:13.05	W006:56.57	N52:20.53	W006:59.66	7.73	14.31
T1237.0	N52:13.94	W006:56.76	N52:20.55	W006:59.49	6.83	12.65
T1238.0	N52:14.15	W006:56.66	N52:20.58	W006:59.32	6.64	12.30
T1239.0	N52:14.17	W006:56.49	N52:20.60	W006:59.14	6.64	12.30
T1240.0	N52:15.19	W006:56.73	N52:20.63	W006:58.97	5.62	10.42
T1241.0	N52:15.27	W006:56.58	N52:20.66	W006:58.80	5.56	10.30
T1242.0	N52:16.02	W006:56.71	N52:20.68	W006:58.63	4.82	8.92
T1243.0	N52:16.37	W006:56.67	N52:20.71	W006:58.46	4.48	8.30
T1244.0	N52:16.40	W006:56.50	N52:20.74	W006:58.29	4.48	8.30
T1245.0	N52:17.27	W006:56.68	N52:20.76	W006:58.12	3.61	6.69
T1246.0	N52:17.50	W006:56.59	N52:20.79	W006:57.95	3.40	6.30
T1247.0	N52:17.52	W006:56.42	N52:20.82	W006:57.78	3.40	6.30
T1248.0	N52:18.52	W006:56.65	N52:20.84	W006:57.61	2.40	4.45
T1249.0	N52:18.62	W006:56.51	N52:20.87	W006:57.44	2.32	4.30
T1250.0	N52:19.35	W006:56.63	N52:20.90	W006:57.27	1.60	2.96
T1251.0	N52:19.72	W006:56.60	N52:20.92	W006:57.10	1.24	2.30

Appendix III

Tellus Waterford Block – FLOWN LINES (FEM)
IRENET95, Irish Transverse Mercator

LINE	TIME	TIME	MIN X	MAX X	MIN Y	MAX Y	FLIGHT	DAY	YEAR
101.00	57291.10	57405.00	666328.97	672223.35	596053.76	597632.30	11	142	2016
102.00	33847.60	34075.60	658665.23	672279.47	596062.05	599713.86	11	142	2016
103.00	40381.80	40460.30	628199.46	632933.27	589997.66	591246.78	11	142	2016
103.10	52735.90	53086.80	651004.02	672349.03	596076.53	601801.83	11	142	2016
104.00	39402.70	40277.40	627686.14	672215.83	591888.55	603834.65	11	142	2016
105.00	53278.20	54208.90	627168.56	672278.62	593824.31	605926.89	11	142	2016
106.00	55166.80	56014.80	627036.91	672337.73	595864.87	608019.99	11	142	2016
107.00	54317.10	55071.50	627101.16	672403.42	597935.88	610098.45	11	142	2016
108.00	50718.60	51470.50	627160.07	672274.22	600029.80	612127.24	13	143	2016
109.00	56180.20	56258.30	627031.19	632251.35	602056.14	603473.60	11	142	2016
109.01	31277.90	32048.00	632156.75	672333.78	603449.28	614214.02	17	146	2016
110.00	51646.80	52396.40	633375.08	672396.20	605835.01	616297.77	13	143	2016
110.01	52604.40	52703.80	627092.12	633461.75	604151.76	605859.06	13	143	2016
111.00	48816.10	49541.80	627148.95	672262.23	606262.53	618344.58	13	143	2016
112.00	33560.80	33763.70	627028.56	639766.34	608274.77	611694.38	13	143	2016
112.01	49641.30	50254.00	639681.48	672127.39	611673.92	620388.83	13	143	2016
113.00	34188.10	34326.40	627084.35	635775.60	610374.25	612691.90	13	143	2016
113.02	32273.10	32837.50	635687.90	671610.75	612659.11	622308.09	17	146	2016
114.00	38821.80	39439.30	627139.89	665104.83	612474.26	622636.37	13	143	2016
115.00	46495.30	46988.80	627012.57	657436.71	614494.27	622652.23	13	143	2016
116.00	47173.90	47476.10	633951.83	649583.31	618421.75	622609.39	13	143	2016
116.01	47735.20	47844.00	627072.60	634016.40	616584.82	618441.12	13	143	2016
117.01	30302.00	30538.20	627130.59	641914.27	618670.11	622635.54	17	146	2016
118.00	35241.30	35366.40	627003.90	634243.18	620703.23	622647.27	13	143	2016
1001.00	33130.40	33207.80	627264.26	628385.77	589855.80	594012.38	4	135	2016
1002.00	33335.00	33408.80	627403.99	628582.23	589910.78	594312.88	4	135	2016
1003.00	33532.80	33647.00	627140.28	628775.73	589961.38	596045.34	4	135	2016
1004.00	33781.90	33889.60	627330.91	628964.84	590019.93	596094.65	4	135	2016
1005.00	34030.80	34154.50	627396.74	629158.58	590066.83	596632.68	4	135	2016
1006.00	34311.10	34455.50	627198.14	629351.41	590123.72	598128.74	4	135	2016
1007.00	34600.10	34743.90	627387.52	629537.09	590169.61	598184.46	4	135	2016
1008.00	34894.40	35050.50	627401.22	629744.90	590223.82	598950.80	4	135	2016
1009.00	35201.50	35386.50	627256.35	629924.60	590272.18	600216.33	4	135	2016
1010.00	35536.20	35712.60	627390.86	630137.23	590329.78	600489.72	4	135	2016
1011.00	35862.40	36074.60	627123.53	630306.02	590374.75	602252.98	4	135	2016
1012.00	36205.60	36415.30	627331.58	630512.79	590429.55	602306.88	4	135	2016
1013.00	36558.60	36784.00	627390.99	630700.96	590480.38	602803.87	4	135	2016
1014.00	36926.30	37172.50	627171.41	630896.81	590536.88	604335.84	4	135	2016
1015.00	37321.10	37557.00	627387.77	631085.59	590581.18	604390.14	4	135	2016
1016.00	37687.30	37940.60	627336.06	631287.36	590640.08	605104.66	4	135	2016
1017.01	50134.70	50397.40	627252.05	631490.25	590692.94	606429.08	18	151	2016
1018.01	50533.00	50823.00	627403.49	631674.70	590742.17	606673.54	18	151	2016
1019.01	50954.00	51222.60	627123.59	631860.94	590793.20	608468.88	18	151	2016
1020.00	42934.00	43258.50	627176.08	632060.39	590842.76	608505.39	11	142	2016
1021.01	51375.40	51689.80	627396.25	632239.89	590894.34	608991.36	18	151	2016
1022.01	51824.10	52135.10	627182.42	632443.98	590950.31	610551.06	18	151	2016
1023.01	52254.80	52584.60	627378.93	632632.32	591002.13	610604.58	18	151	2016
1024.01	52705.20	53012.60	627399.29	632833.48	591056.41	611304.50	18	151	2016
1025.00	35514.00	35824.10	627276.35	632514.13	593039.38	612651.85	13	143	2016
1026.00	37196.20	37518.40	627400.69	632690.74	593081.48	612845.17	13	143	2016
1027.01	53124.70	53513.50	627106.53	632887.34	593138.15	614676.82	18	151	2016
1028.00	45540.60	45897.50	627308.64	633089.34	593189.28	614728.93	13	143	2016
1029.00	48100.90	48464.30	627412.82	633286.25	593245.83	615168.69	13	143	2016
1030.00	53119.10	53489.30	627166.18	633480.93	593294.06	616760.19	13	143	2016
1031.00	29091.50	29467.00	627369.92	633662.23	593346.64	616817.87	15	144	2016
1032.00	30059.50	30445.00	627404.51	633856.29	593395.13	617485.42	15	144	2016
1033.00	31024.50	31428.20	627237.79	634046.12	593448.66	618855.01	15	144	2016
1034.00	32036.00	32443.20	627400.56	634241.24	593494.55	619028.87	15	144	2016
1035.00	32997.50	33439.00	627098.86	634437.01	593554.36	620887.67	15	144	2016
1036.00	34037.30	34473.80	627302.44	634633.58	593602.63	620941.22	15	144	2016
1037.00	35028.60	35478.80	627394.73	634823.82	593656.98	621341.64	15	144	2016
1038.00	36068.70	36530.50	627526.62	635013.53	593707.52	621646.06	15	144	2016
1039.00	36628.80	37152.50	627716.29	635208.03	593761.29	621647.25	15	144	2016
1040.00	37272.10	37739.40	627950.61	635404.33	593812.14	621649.34	15	144	2016
1041.00	37874.30	38367.50	628152.58	635581.06	593859.96	621651.27	15	144	2016
1042.00	38493.50	38955.30	628361.05	635793.97	593910.15	621647.68	15	144	2016

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1043.00	39055.70	39563.80	628545.12	635982.99	593970.44	621647.27	15	144	2016
1044.00	39699.40	40157.50	628773.39	636193.47	594022.31	621646.37	15	144	2016
1045.01	53702.70	54144.00	628976.57	636369.15	594070.21	621647.14	18	151	2016
1046.00	40922.50	41398.00	629179.97	636565.75	594119.37	621647.34	15	144	2016
1047.01	54259.00	54764.00	629375.91	636756.84	594172.46	621639.32	18	151	2016
1048.00	46100.90	46577.50	629584.70	636939.24	594222.97	621649.17	15	144	2016
1049.00	46705.40	47163.00	629814.83	637149.24	594280.14	621652.03	15	144	2016
1050.00	47296.50	47767.50	630007.30	637343.18	594334.53	621664.33	15	144	2016
1051.00	47908.10	48354.40	630205.00	637521.88	594379.74	621719.36	15	144	2016
1052.01	30851.70	30953.60	630401.52	632020.83	615780.52	621771.57	17	146	2016
1052.02	54962.50	55308.40	631988.67	637730.42	594430.17	615872.50	18	151	2016
1053.00	56890.40	57387.90	630599.90	637923.78	594489.22	621825.24	4	135	2016
1054.00	55364.30	55859.50	630802.84	638106.73	594537.62	621880.81	4	135	2016
1055.00	41194.10	41679.30	630989.57	638311.15	594590.96	621928.96	4	135	2016
1056.00	40585.00	41065.30	631159.07	638495.95	594637.19	621977.30	4	135	2016
1057.00	39984.80	40489.50	631363.43	638691.50	594690.07	622031.73	4	135	2016
1058.00	39382.10	39850.50	631549.00	638881.04	594743.85	622070.96	4	135	2016
1059.00	38752.80	39246.80	631746.52	639080.39	594797.86	622131.44	4	135	2016
1060.00	38158.60	38637.80	631932.77	639253.31	594845.25	622182.46	4	135	2016
1061.00	41834.80	42317.90	632126.22	639465.90	594899.63	622236.49	4	135	2016
1062.00	42467.50	42974.60	632318.47	639652.60	594953.57	622283.17	4	135	2016
1063.00	43096.20	43578.40	632519.70	639841.21	595003.46	622344.76	4	135	2016
1064.00	43710.70	44216.80	632716.96	640042.79	595052.45	622392.48	4	135	2016
1065.00	49556.30	50033.80	632902.83	640229.49	595103.88	622444.78	4	135	2016
1066.00	50161.80	50690.80	633103.58	640428.22	595159.43	622493.37	4	135	2016
1067.00	50806.70	51285.90	633282.46	640602.04	595208.64	622546.31	4	135	2016
1068.00	51419.60	51939.30	633483.12	640819.69	595261.28	622597.52	4	135	2016
1069.00	52087.20	52552.50	633673.66	640996.97	595311.75	622650.83	4	135	2016
1070.00	52689.10	53207.80	633874.62	641202.38	595366.40	622703.26	4	135	2016
1071.00	53324.80	53792.00	634056.71	641386.39	595415.99	622751.24	4	135	2016
1072.00	53952.60	54440.40	634577.41	641601.30	595471.21	621652.02	4	135	2016
1073.00	44993.10	45425.10	634769.12	641781.80	595527.56	621647.80	1	129	2016
1074.00	45572.00	46071.00	634980.66	641974.76	595580.68	621647.87	1	129	2016
1075.00	46220.40	46674.00	635174.33	642159.58	595621.57	621639.89	1	129	2016
1076.00	46809.60	47274.50	635383.52	642351.84	595674.02	621646.04	1	129	2016
1077.00	47430.10	47861.50	635597.57	642545.63	595726.50	621646.08	1	129	2016
1078.00	48003.60	48489.60	635820.60	642748.39	595782.07	621652.03	1	129	2016
1079.00	48639.80	49084.00	636015.33	642927.67	595826.77	621651.70	1	129	2016
1080.00	49239.20	49702.00	636218.77	643124.76	595877.44	621648.68	1	129	2016
1081.00	49854.30	50294.00	636428.41	643318.91	595934.01	621643.12	1	129	2016
1082.00	50459.40	50940.60	636647.09	643523.92	595992.80	621653.28	1	129	2016
1083.00	51613.90	52041.50	636839.84	643720.28	596043.80	621651.33	1	129	2016
1084.00	41820.60	42306.60	637060.64	643895.68	596089.53	621644.19	2	133	2016
1085.00	42457.70	42893.40	637257.04	644088.99	596142.12	621646.19	2	133	2016
1086.00	43063.50	43566.50	637470.07	644290.65	596198.06	621650.78	2	133	2016
1087.00	43679.80	44098.50	637648.83	644489.27	596249.31	621646.35	2	133	2016
1088.00	44253.00	44725.90	637873.98	644679.51	596300.67	621707.41	2	133	2016
1089.00	44871.80	45302.40	638056.80	644865.68	596345.86	621758.79	2	133	2016
1090.00	45474.20	45970.80	638256.51	645066.06	596401.09	621809.39	2	133	2016
1091.00	46114.70	46529.10	638414.70	645250.13	596458.65	621850.86	2	133	2016
1092.00	46711.70	47189.00	638649.13	645445.99	596506.05	621912.80	2	133	2016
1093.00	47320.40	47766.00	638831.89	645637.96	596560.36	621961.37	2	133	2016
1094.00	47933.70	48426.50	639038.77	645843.51	596611.24	622015.71	2	133	2016
1095.00	48547.20	48969.10	639193.36	646016.41	596666.03	622055.30	2	133	2016
1096.00	49115.80	49588.30	639402.61	646219.01	596711.17	622116.40	2	133	2016
1097.00	49709.30	50156.90	639602.90	646414.61	596763.20	622168.28	2	133	2016
1098.00	50327.80	50796.40	639797.17	646615.07	596819.70	622218.93	2	133	2016
1099.00	50945.80	51363.30	639979.77	646797.77	596862.96	622265.05	2	133	2016
1100.00	51533.20	52019.60	640183.29	646996.16	596922.00	622320.11	2	133	2016
1101.00	52137.80	52581.10	640368.84	647180.52	596977.94	622370.72	2	133	2016
1102.00	52759.90	53237.00	640579.33	647387.10	597025.31	622426.79	2	133	2016
1103.00	53369.90	53786.60	640740.47	647578.47	597058.14	622476.37	2	133	2016
1104.00	53937.40	54409.10	640966.14	647788.79	597051.29	622527.20	2	133	2016
1105.00	54530.40	54973.00	641143.25	648003.05	597051.99	622585.79	2	133	2016
1106.00	60676.60	61157.30	641348.90	648201.71	597051.36	622636.81	2	133	2016
1107.00	61294.30	61719.90	641522.69	648406.48	597048.35	622684.04	2	133	2016

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1108.00	61863.60	62344.40	641724.33	648608.39	597049.76	622739.50	2	133	2016
1109.00	62484.70	62913.80	642215.34	648825.67	597051.95	621646.27	2	133	2016
1110.00	63089.10	63552.40	642450.79	649028.01	597047.30	621654.49	2	133	2016
1111.00	63866.70	64097.90	645414.52	649238.49	597046.12	611196.58	2	133	2016
1111.01	65369.90	65564.30	642636.46	645467.54	611117.28	621646.97	11	142	2016
1112.00	64257.80	64709.00	642842.81	649448.50	597050.93	621649.35	2	133	2016
1113.00	64843.40	65276.30	643057.02	649654.51	597052.75	621648.31	2	133	2016
1114.00	65448.70	65902.60	643265.15	649858.00	597053.56	621652.32	2	133	2016
1115.00	66047.20	66461.30	643474.87	650066.77	597055.79	621647.50	2	133	2016
1116.00	66633.30	67089.00	643668.72	650270.76	597055.29	621651.38	2	133	2016
1117.00	67219.50	67637.30	643883.68	650480.96	597053.93	621648.88	2	133	2016
1118.00	67808.90	68264.60	644092.31	650689.86	597057.03	621653.10	2	133	2016
1119.00	68419.70	68847.60	644300.29	651179.44	595977.49	621652.38	2	133	2016
1120.00	68999.40	69469.80	644500.79	651371.80	596023.68	621653.81	2	133	2016
1121.00	69599.00	70039.80	644721.75	651571.54	596085.16	621651.77	2	133	2016
1122.00	54666.40	55086.40	644918.93	651735.68	596122.28	621648.52	4	135	2016
1123.00	56154.30	56587.50	645114.25	651950.47	596177.15	621648.52	4	135	2016
1124.00	58752.90	59167.00	645319.24	652154.78	596240.56	621642.01	9	139	2016
1125.00	59325.70	59813.30	645523.84	652354.19	596289.08	621686.94	9	139	2016
1126.00	57691.90	58115.00	645723.33	652526.53	596331.11	621734.22	4	135	2016
1127.00	58858.90	59295.80	645920.18	652732.91	596384.26	621794.74	4	135	2016
1128.00	58259.00	58744.90	646105.76	652926.98	596437.27	621839.93	4	135	2016
1129.00	59431.30	59900.90	646298.60	653123.63	596489.59	621892.97	4	135	2016
1130.00	43608.20	44039.60	646499.35	653304.69	596545.54	621942.17	11	142	2016
1131.00	44182.20	44661.40	646696.52	653501.66	596596.33	621996.31	11	142	2016
1132.00	44772.80	45187.00	646874.88	653673.76	596643.63	622053.31	11	142	2016
1133.00	45348.90	45873.80	647080.26	653888.02	596700.16	622101.25	11	142	2016
1134.00	57675.60	58108.00	647269.28	654098.18	596754.22	622155.35	11	142	2016
1135.00	58270.30	58767.60	647466.43	654275.69	596807.61	622208.47	11	142	2016
1136.00	59957.90	60393.10	647664.38	654468.29	596855.00	622250.99	4	135	2016
1137.00	60542.30	61013.60	647843.36	654657.09	596906.56	622306.95	4	135	2016
1138.00	61129.20	61573.60	648036.54	654852.20	596957.84	622353.56	4	135	2016
1139.00	61710.30	62182.90	648250.54	655061.43	597013.05	622413.14	4	135	2016
1140.00	62344.50	62782.10	648421.10	655236.69	597048.14	622460.80	4	135	2016
1141.00	54114.80	54531.10	648635.96	655457.53	597053.43	622521.25	9	139	2016
1142.00	54677.90	55156.60	648802.96	655653.97	597051.28	622558.23	9	139	2016
1143.00	55265.10	55665.60	649012.64	655875.90	597055.50	622615.19	9	139	2016
1144.00	55843.70	56337.30	649192.44	656078.33	597052.42	622666.71	9	139	2016
1145.00	56467.00	56881.50	649388.95	656269.90	597048.48	622716.16	9	139	2016
1146.00	57039.10	57504.80	649886.13	656482.44	597045.36	621651.10	9	139	2016
1147.00	57619.60	58021.90	650093.46	656707.42	597048.50	621644.38	9	139	2016
1148.00	58170.30	58629.10	650293.71	656895.29	597048.89	621642.82	9	139	2016
1149.00	58899.80	59302.00	650509.93	657110.05	597050.39	621651.38	11	142	2016
1150.00	59444.20	59916.50	650720.35	657306.87	597055.93	621650.18	11	142	2016
1151.00	60035.10	60443.50	650924.75	657525.80	597048.97	621647.40	11	142	2016
1152.00	60602.30	61069.40	651136.44	657722.59	597047.03	621651.57	11	142	2016
1153.00	61195.00	61606.80	651345.46	657956.29	597053.28	621649.73	11	142	2016
1154.00	61760.70	62268.90	651548.74	658128.95	597046.54	621647.35	11	142	2016
1155.00	62381.90	62794.30	651756.50	658356.73	597051.75	621651.45	11	142	2016
1156.00	62930.20	63415.40	651963.13	658842.12	595951.17	621647.58	11	142	2016
1157.00	63536.20	63956.50	652182.42	659051.71	596011.46	621647.63	11	142	2016
1158.00	64092.30	64597.80	652371.84	659233.72	596062.25	621652.46	11	142	2016
1159.00	64699.80	65140.50	652585.82	659440.14	596115.86	621649.76	11	142	2016
1160.00	33207.30	33688.00	652781.25	659618.88	596164.39	621642.90	6	136	2016
1161.00	33814.60	34258.40	652986.04	659813.98	596212.82	621645.07	6	136	2016
1162.00	34410.60	34896.50	653204.06	659997.21	596268.15	621666.56	6	136	2016
1163.00	35017.30	35463.10	653392.33	660204.35	596321.00	621722.60	6	136	2016
1164.00	35589.00	36074.00	653579.42	660385.77	596371.28	621778.28	6	136	2016
1165.00	36203.00	36626.30	653780.35	660586.91	596422.39	621824.84	6	136	2016
1166.00	36763.70	37246.60	653971.27	660783.85	596479.48	621875.93	6	136	2016
1167.00	37364.70	37803.50	654159.05	660965.94	596529.94	621925.37	6	136	2016
1168.00	37911.40	38393.50	654355.94	661154.20	596579.15	621979.41	6	136	2016
1169.00	38518.90	38956.90	654560.90	661365.89	596631.68	622035.43	6	136	2016
1170.00	39104.70	39587.00	654754.00	661560.46	596684.74	622089.12	6	136	2016
1171.00	39729.60	40096.10	654934.88	660688.97	600701.37	622135.73	6	136	2016
1171.01	46951.60	47023.80	660651.26	661755.20	596735.98	600790.01	6	136	2016

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LINE	TIME	TIME	MIN X	MAX X	MIN Y	MAX Y	FLIGHT	DAY	YEAR
1172.00	47254.00	47717.90	655127.91	661948.42	596786.69	622192.28	6	136	2016
1173.00	47843.80	48296.80	655321.82	662141.56	596836.62	622237.88	6	136	2016
1174.00	48459.30	48923.50	655522.44	662331.24	596889.24	622293.54	6	136	2016
1175.00	49058.80	49510.60	655708.79	662528.66	596948.12	622346.29	6	136	2016
1176.00	49619.70	50059.50	655900.29	662696.40	596989.60	622395.04	6	136	2016
1177.00	50182.30	50642.90	656110.12	662914.15	597042.91	622450.88	6	136	2016
1178.00	50785.90	51259.50	656288.30	663124.94	597052.75	622495.85	6	136	2016
1179.00	51409.50	51882.80	656469.06	663324.72	597053.00	622548.56	6	136	2016
1180.00	52001.10	52452.30	656673.34	663516.51	597050.82	622606.75	6	136	2016
1181.00	52573.50	53035.30	656871.29	663741.57	597052.16	622659.21	6	136	2016
1182.00	53178.30	53623.10	657060.71	663931.55	597051.70	622706.51	6	136	2016
1183.00	53747.40	54229.50	657242.30	664142.44	597051.04	622756.96	6	136	2016
1184.00	54347.00	54779.40	657760.90	664343.92	597047.38	621647.41	6	136	2016
1185.00	54912.70	55380.10	657968.83	664573.24	597057.93	621648.14	6	136	2016
1186.00	55524.30	55960.90	658164.84	664764.95	597048.60	621645.52	6	136	2016
1187.00	56116.80	56575.10	658374.51	664984.22	597053.10	621647.48	6	136	2016
1188.00	56694.30	57136.10	658601.27	665182.00	597050.04	621645.93	6	136	2016
1189.00	57268.00	57731.50	658794.97	665398.02	597056.87	621649.92	6	136	2016
1190.00	57873.80	58305.60	658994.71	665599.19	597048.80	621643.19	6	136	2016
1191.00	58443.90	58909.10	659204.95	665803.56	597053.11	621646.77	6	136	2016
1192.00	59010.30	59451.90	659405.45	666011.82	597049.74	621649.17	6	136	2016
1193.00	31556.80	32062.40	659629.30	666531.31	595945.84	621653.60	8	139	2016
1194.00	32213.70	32656.20	659833.85	666716.59	596001.03	621650.39	8	139	2016
1195.00	32791.50	33268.80	660028.87	666899.29	596044.46	621651.01	8	139	2016
1196.00	33403.50	33819.50	660237.91	667090.86	596103.81	621647.36	8	139	2016
1197.00	33986.80	34478.50	660449.04	667284.59	596149.18	621648.15	8	139	2016
1198.00	35785.10	36204.40	660651.08	667478.43	596201.88	621643.96	8	139	2016
1199.00	34613.60	35023.90	660881.23	667681.19	596251.84	621656.33	8	139	2016
1200.00	35164.30	35641.30	661052.66	667867.50	596302.98	621710.99	8	139	2016
1201.00	36358.00	36847.80	661248.66	668060.20	596357.07	621762.72	8	139	2016
1202.00	36965.70	37387.60	661438.52	668258.28	596414.33	621810.42	8	139	2016
1203.00	37536.00	38028.60	661635.59	668445.38	596458.04	621858.47	8	139	2016
1204.00	38173.40	38605.50	661824.70	668636.89	596506.89	621912.25	8	139	2016
1205.00	38757.00	39245.50	662025.58	668837.35	596564.57	621963.34	8	139	2016
1206.00	39362.60	39803.60	662210.53	669033.85	596618.34	622017.70	8	139	2016
1207.00	39952.80	40439.30	662405.41	669208.18	596664.39	622073.64	8	139	2016
1208.00	40555.60	40994.10	662601.18	669407.67	596724.04	622122.53	8	139	2016
1209.00	41129.20	41629.10	662796.52	669608.39	596770.64	622173.50	8	139	2016
1210.00	41737.30	42173.30	662992.12	669793.01	596821.28	622223.85	8	139	2016
1211.00	42306.70	42801.50	663183.02	669984.92	596872.69	622279.07	8	139	2016
1212.00	42915.90	43353.80	663373.60	670186.31	596925.41	622330.34	8	139	2016
1213.00	43471.80	43972.10	663570.28	670373.31	596980.93	622381.36	8	139	2016
1214.00	50360.40	50775.40	663777.74	670582.18	597033.01	622439.64	9	139	2016
1215.00	50928.70	51428.30	663944.60	670765.49	597083.44	622483.56	9	139	2016
1216.00	51546.40	51958.40	664119.21	670955.32	597133.72	622530.38	9	139	2016
1217.00	52121.20	52607.40	664341.09	671139.52	597181.92	622590.81	9	139	2016
1218.00	52708.60	53123.10	664525.56	671346.03	597243.48	622641.58	9	139	2016
1219.00	53262.70	53761.40	664732.31	671535.17	597291.70	622696.72	9	139	2016
1220.00	60140.80	60562.00	664925.78	671728.32	597338.06	622744.61	9	139	2016
1221.00	60699.30	61143.00	665416.41	671918.00	597392.50	621650.06	9	139	2016
1222.00	61265.20	61667.50	665651.04	672116.72	597443.31	621653.13	9	139	2016
1223.00	61832.40	62270.90	665831.14	672004.19	598660.44	621649.34	9	139	2016
1224.00	62373.80	62732.80	666049.44	672001.40	599430.76	621651.09	9	139	2016
1225.00	62867.20	63282.50	666243.34	672172.20	599528.82	621643.93	9	139	2016
1226.00	28042.40	28411.00	666464.11	672004.64	600981.18	621646.59	10	141	2016
1227.00	28555.10	28911.50	666664.87	672047.09	601572.79	621648.52	10	141	2016
1228.00	29038.30	29381.20	666870.65	672230.50	601614.89	621652.09	10	141	2016
1229.00	29528.10	29864.40	667071.42	671986.60	603287.73	621646.88	10	141	2016
1230.00	30037.20	30341.70	667284.74	672104.46	603658.59	621652.43	10	141	2016
1231.00	30468.70	30792.00	667514.38	672007.62	604836.34	621654.15	10	141	2016
1232.00	30941.70	31223.70	667706.90	672003.72	605610.87	621648.26	10	141	2016
1233.00	31391.90	31702.90	667906.47	672174.10	605737.26	621647.77	10	141	2016
1234.00	31831.70	32087.70	668117.79	671993.87	607156.00	621643.88	10	141	2016
1235.00	34234.70	34466.00	668323.92	672042.69	607776.01	621646.91	11	142	2016
1236.00	34620.10	34895.30	668530.40	672239.28	607828.46	621649.77	11	142	2016
1237.00	35044.90	35254.80	668725.97	672006.37	609473.92	621693.06	11	142	2016

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1238.00	35405.50	35625.00	668913.66	672100.24	609864.94	621742.29	11	142	2016
1239.00	35743.30	35940.40	669111.42	672298.54	609914.50	621796.84	11	142	2016
1240.00	36070.80	36253.30	669306.41	671998.70	611789.93	621848.09	11	142	2016
1241.00	36385.50	36549.60	669486.00	672149.48	611949.67	621890.62	11	142	2016
1242.00	37051.80	37218.00	669686.79	671998.10	613337.27	621950.32	11	142	2016
1243.00	37326.60	37460.80	669875.55	672033.35	613986.25	622003.90	11	142	2016
1244.00	37611.50	37767.60	670077.16	672225.07	614040.53	622054.83	11	142	2016
1245.00	37907.40	38019.10	670272.01	672000.84	615652.82	622101.72	11	142	2016
1246.01	29751.60	29862.90	670461.21	672094.64	616074.23	622161.17	17	146	2016
1247.00	38380.40	38485.10	670660.22	672286.56	616124.79	622207.52	11	142	2016
1248.00	38609.90	38688.60	670847.68	672004.93	617972.16	622262.91	11	142	2016
1249.00	38805.10	38872.80	671038.23	672154.28	618161.59	622315.98	11	142	2016
1250.00	39007.30	39061.80	671234.16	672003.06	619509.15	622365.64	11	142	2016
1251.00	36773.50	36815.00	671435.30	672033.70	620202.18	622416.90	11	142	2016

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LINE	TIME	TIME	MIN X	MAX X	MIN Y	MAX Y	FLIGHT	DAY	YEAR
101.00	57289.20	57406.80	666236.85	672322.22	596029.29	597658.52	11	142	2016
102.00	33846.10	34077.40	658569.98	672385.53	596036.84	599742.70	11	142	2016
103.00	40380.40	40462.00	628110.24	633034.48	589973.54	591272.51	11	142	2016
103.10	52734.20	53088.30	650900.38	672442.26	596049.45	601825.42	11	142	2016
104.00	39400.80	40279.40	627585.26	672315.05	591859.74	603862.69	11	142	2016
105.00	53276.20	54211.30	627069.10	672374.36	593795.37	605952.35	11	142	2016
106.00	55164.70	56016.70	626936.77	672438.53	595837.52	608048.96	11	142	2016
107.00	54315.60	55073.20	626997.74	672500.83	597907.50	610123.95	11	142	2016
108.00	50717.10	51472.20	627062.79	672367.88	600006.74	612152.70	13	143	2016
109.00	56178.70	56915.80	626930.76	672427.57	602027.75	614244.84	11	142	2016
110.00	51645.00	52388.70	633762.05	672489.55	605942.28	616320.18	13	143	2016
110.01	52602.90	52709.90	626993.79	633854.80	604127.34	605967.66	13	143	2016
111.00	48814.70	49543.40	627056.08	672358.78	606234.57	618372.08	13	143	2016
112.00	33559.10	33754.80	626919.40	639189.92	608244.72	611540.36	13	143	2016
112.01	49639.60	50266.30	639096.70	672225.35	611524.59	620417.56	13	143	2016
113.00	34186.60	34373.30	626984.45	638670.43	610347.75	613472.46	13	143	2016
113.01	39686.70	40288.50	638578.90	671706.71	613459.70	622341.50	13	143	2016
114.00	38820.40	39440.90	627047.40	665199.18	612441.93	622662.29	13	143	2016
115.00	46493.60	46990.30	626909.76	657534.68	614467.16	622680.36	13	143	2016
116.00	47172.10	47493.90	632966.16	649679.94	618157.59	622635.94	13	143	2016
116.01	47733.60	47828.80	626974.46	633057.85	616562.38	618186.15	13	143	2016
117.00	34829.10	35076.70	627035.41	642008.51	618648.62	622654.08	13	143	2016
118.00	35239.60	35368.10	626906.50	634345.41	620679.79	622674.17	13	143	2016
1001.00	33128.80	33209.60	627238.14	628410.48	589759.10	594108.45	4	135	2016
1002.00	33333.30	33410.50	627378.52	628606.51	589811.67	594411.64	4	135	2016
1003.00	33531.20	33648.90	627115.31	628801.37	589867.51	596144.27	4	135	2016
1004.00	33780.20	33891.40	627306.02	628992.97	589917.35	596195.45	4	135	2016
1005.00	34029.10	34156.30	627366.41	629185.36	589967.94	596730.33	4	135	2016
1006.00	34309.40	34457.40	627170.62	629381.74	590019.87	598232.58	4	135	2016
1007.00	34598.30	34745.80	627360.83	629564.30	590070.38	598283.99	4	135	2016
1008.00	34892.80	35052.40	627374.27	629773.42	590123.39	599046.91	4	135	2016
1009.00	35199.70	35388.50	627226.14	629950.32	590177.63	600322.54	4	135	2016
1010.00	35534.50	35714.60	627361.21	630165.99	590226.10	600592.10	4	135	2016
1011.00	35860.80	36076.40	627092.99	630330.69	590280.58	602355.18	4	135	2016
1012.00	36204.10	36417.20	627315.98	630540.17	590328.99	602407.05	4	135	2016
1013.00	36556.90	36785.80	627362.10	630726.21	590383.81	602906.08	4	135	2016
1014.00	36924.60	37174.40	627133.66	630925.50	590435.20	604446.07	4	135	2016
1015.00	37319.50	37558.90	627358.89	631110.31	590487.53	604497.53	4	135	2016
1016.00	37685.30	37942.50	627268.92	631314.84	590537.54	605225.55	4	135	2016
1017.00	40825.60	41111.00	627246.22	631521.09	590591.98	606533.42	11	142	2016
1018.00	41530.10	41813.30	627372.15	631696.27	590641.81	606767.72	11	142	2016
1019.00	42247.80	42580.80	627118.72	631880.16	590693.34	608566.61	11	142	2016
1020.00	42931.80	43260.60	627097.27	632089.99	590744.29	608623.54	11	142	2016
1021.00	30304.70	30608.00	627367.09	632277.35	590800.33	609083.14	13	143	2016
1022.00	31131.10	31455.10	627189.36	632482.30	590850.26	610652.12	13	143	2016
1023.00	31952.40	32272.10	627345.86	632655.31	590904.31	610706.10	13	143	2016
1024.00	32816.60	33133.10	627376.63	632848.51	590954.81	611401.47	13	143	2016
1025.01	36329.50	36652.40	627213.56	632536.63	592934.98	612741.15	13	143	2016
1026.00	37194.70	37520.10	627376.74	632714.32	592988.91	612944.30	13	143	2016
1027.00	38058.30	38413.00	627073.10	632920.92	593040.23	614775.73	13	143	2016
1028.00	45539.10	45899.20	627283.62	633111.34	593094.57	614829.22	13	143	2016
1029.00	48099.50	48466.10	627387.27	633314.02	593144.46	615261.04	13	143	2016
1030.00	53117.40	53491.00	627132.94	633508.63	593196.22	616867.15	13	143	2016
1031.00	29089.90	29468.70	627344.90	633687.44	593250.36	616916.16	15	144	2016
1032.00	30057.90	30446.60	627381.52	633881.85	593300.38	617582.83	15	144	2016
1033.00	31023.00	31429.90	627212.61	634072.73	593350.46	618952.21	15	144	2016
1034.00	32034.50	32444.80	627373.43	634264.31	593400.81	619126.87	15	144	2016
1035.00	32996.00	33440.80	627071.85	634465.00	593452.98	620988.68	15	144	2016
1036.00	34035.90	34475.50	627276.26	634659.89	593507.87	621042.15	15	144	2016
1037.00	35026.90	35480.40	627362.42	634850.54	593556.47	621445.15	15	144	2016
1038.00	36067.10	36532.20	627500.26	635039.61	593609.53	621745.85	15	144	2016
1039.00	36627.00	37154.40	627688.67	635234.70	593660.58	621748.86	15	144	2016
1040.00	37270.50	37741.40	627924.58	635432.12	593711.82	621746.94	15	144	2016
1041.00	37872.80	38369.30	628128.07	635605.03	593763.10	621747.31	15	144	2016
1042.00	38491.80	38956.90	628334.09	635817.58	593820.43	621744.43	15	144	2016
1043.00	39054.00	39565.70	628521.63	636009.87	593872.01	621745.52	15	144	2016

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1044.00	39697.80	40159.50	628745.28	636219.11	593920.44	621745.19	15	144	2016
1045.00	40295.30	40772.80	628950.64	636398.33	593970.24	621747.19	15	144	2016
1046.00	40920.60	41399.80	629151.85	636592.17	594026.15	621750.55	15	144	2016
1047.00	45540.40	46010.00	629361.06	636778.31	594075.33	621750.60	15	144	2016
1048.00	46099.40	46579.40	629560.54	636965.35	594127.20	621746.52	15	144	2016
1049.00	46703.80	47164.90	629786.75	637176.74	594178.50	621749.40	15	144	2016
1050.00	47294.80	47769.20	629979.28	637369.70	594231.82	621765.51	15	144	2016
1051.00	47906.40	48356.20	630181.00	637547.36	594285.48	621817.02	15	144	2016
1052.00	48465.10	48932.90	630356.85	637744.34	594337.07	621868.15	15	144	2016
1053.00	56888.50	57389.90	630577.69	637951.46	594387.39	621917.46	4	135	2016
1054.00	55362.70	55861.20	630783.93	638131.14	594439.58	621973.10	4	135	2016
1055.00	41192.30	41681.20	630962.18	638338.02	594493.17	622024.72	4	135	2016
1056.00	40583.50	41067.10	631134.55	638523.56	594545.38	622077.11	4	135	2016
1057.00	39983.00	40491.40	631336.14	638717.67	594595.50	622125.82	4	135	2016
1058.00	39380.50	39852.20	631520.66	638905.81	594648.58	622175.76	4	135	2016
1059.00	38750.80	39248.70	631721.55	639107.28	594700.16	622232.89	4	135	2016
1060.00	38156.90	38639.50	631906.74	639278.58	594749.34	622284.11	4	135	2016
1061.00	41833.20	42319.60	632100.57	639495.85	594803.81	622332.68	4	135	2016
1062.00	42465.70	42976.60	632289.23	639679.76	594851.07	622385.07	4	135	2016
1063.00	43094.60	43579.90	632495.07	639866.37	594907.49	622437.52	4	135	2016
1064.00	43709.00	44218.70	632690.64	640069.21	594955.89	622486.68	4	135	2016
1065.00	49554.50	50035.40	632878.02	640255.74	595008.07	622543.29	4	135	2016
1066.00	50159.90	50692.70	633070.20	640452.52	595058.50	622590.66	4	135	2016
1067.00	50804.90	51287.50	633255.03	640626.60	595113.32	622644.88	4	135	2016
1068.00	51417.70	51941.20	633456.49	640844.26	595164.73	622696.35	4	135	2016
1069.00	52085.60	52554.10	633642.84	641024.40	595215.28	622746.60	4	135	2016
1070.00	52687.30	53209.60	633849.69	641223.69	595270.77	622798.80	4	135	2016
1071.00	53323.10	53793.70	634027.60	641413.38	595320.61	622855.33	4	135	2016
1072.00	53950.80	54442.40	634552.14	641628.33	595369.80	621745.56	4	135	2016
1073.00	44991.60	45426.80	634741.92	641804.69	595427.12	621749.07	1	129	2016
1074.00	45570.00	46073.00	634955.03	642003.10	595476.53	621747.64	1	129	2016
1075.00	46218.70	46675.70	635147.52	642184.78	595525.64	621746.24	1	129	2016
1076.00	46807.50	47276.10	635355.96	642376.17	595581.55	621749.67	1	129	2016
1077.00	47428.40	47863.10	635571.08	642572.04	595631.88	621747.83	1	129	2016
1078.00	48001.70	48491.50	635795.63	642775.50	595681.97	621747.14	1	129	2016
1079.00	48638.10	49085.50	635990.37	642951.84	595734.00	621746.10	1	129	2016
1080.00	49237.30	49703.70	636188.96	643149.66	595786.85	621748.87	1	129	2016
1081.00	49852.60	50295.70	636398.27	643345.51	595836.98	621746.67	1	129	2016
1082.00	50457.50	50942.50	636621.65	643554.94	595888.93	621749.62	1	129	2016
1083.00	51612.20	52043.00	636817.61	643749.21	595941.89	621747.04	1	129	2016
1084.00	41818.80	42308.20	637033.60	643923.09	595995.62	621744.61	2	133	2016
1085.00	42456.10	42895.10	637231.00	644112.50	596043.21	621744.94	2	133	2016
1086.00	43061.60	43568.10	637449.37	644317.14	596094.84	621746.37	2	133	2016
1087.00	43678.10	44100.20	637619.12	644516.57	596150.24	621751.08	2	133	2016
1088.00	44251.10	44727.40	637848.78	644707.79	596198.60	621799.68	2	133	2016
1089.00	44870.30	45304.10	638029.92	644890.98	596251.34	621855.39	2	133	2016
1090.00	45472.50	45972.50	638227.04	645093.02	596306.80	621905.70	2	133	2016
1091.00	46113.10	46530.80	638385.12	645275.13	596357.67	621953.32	2	133	2016
1092.00	46709.90	47190.90	638623.83	645472.80	596408.58	622008.79	2	133	2016
1093.00	47318.90	47767.70	638804.76	645660.48	596462.19	622060.13	2	133	2016
1094.00	47931.80	48428.40	639011.66	645869.06	596511.81	622110.83	2	133	2016
1095.00	48545.50	48970.70	639161.18	646044.75	596566.25	622162.95	2	133	2016
1096.00	49114.00	49590.30	639369.69	646247.79	596613.01	622216.04	2	133	2016
1097.00	49707.80	50158.60	639576.62	646440.82	596666.73	622268.39	2	133	2016
1098.00	50325.90	50798.40	639775.44	646641.89	596717.13	622320.57	2	133	2016
1099.00	50944.20	51364.80	639955.49	646822.53	596773.50	622368.33	2	133	2016
1100.00	51531.30	52021.60	640154.21	647020.84	596822.89	622424.26	2	133	2016
1101.00	52136.20	52582.90	640331.93	647209.31	596876.70	622474.16	2	133	2016
1102.00	52758.10	53239.00	640550.74	647412.46	596925.88	622528.20	2	133	2016
1103.00	53368.20	53788.30	640713.87	647604.61	596953.72	622579.35	2	133	2016
1104.00	53935.70	54410.90	640935.89	647812.55	596954.16	622628.03	2	133	2016
1105.00	54528.90	54974.80	641116.56	648032.45	596951.30	622681.50	2	133	2016
1106.00	60674.80	61159.20	641323.96	648228.53	596954.53	622730.75	2	133	2016
1107.00	61292.60	61721.50	641494.10	648430.53	596955.52	622786.54	2	133	2016
1108.00	61861.90	62346.30	641697.62	648633.08	596955.03	622835.59	2	133	2016
1109.00	62483.20	62915.60	642186.98	648850.39	596951.52	621746.57	2	133	2016

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1110.00	63087.30	63554.00	642425.28	649053.51	596954.23	621745.35	2	133	2016
1111.00	63897.70	64099.40	645962.27	649263.36	596955.03	609274.15	2	133	2016
1111.01	65368.30	65596.80	642610.99	645988.77	609181.41	621750.34	11	142	2016
1112.00	64256.00	64710.80	642816.32	649474.36	596952.85	621746.94	2	133	2016
1113.00	64841.80	65278.10	643032.55	649681.45	596949.78	621747.95	2	133	2016
1114.00	65446.90	65904.40	643245.63	649883.37	596955.09	621746.71	2	133	2016
1115.00	66045.60	66463.00	643449.79	650090.60	596955.79	621748.26	2	133	2016
1116.00	66631.40	67090.70	643647.16	650299.17	596951.95	621745.27	2	133	2016
1117.00	67217.90	67639.10	643858.43	650508.20	596953.38	621748.24	2	133	2016
1118.00	67806.90	68266.30	644065.53	650716.03	596950.79	621745.86	2	133	2016
1119.00	68418.40	68849.30	644274.12	651208.04	595875.78	621744.37	2	133	2016
1120.00	68997.60	69471.60	644478.01	651397.07	595925.17	621750.14	2	133	2016
1121.00	69597.40	70041.70	644692.61	651600.96	595976.01	621744.83	2	133	2016
1122.00	54665.10	55087.90	644892.47	651755.93	596029.44	621743.81	4	135	2016
1123.00	56152.70	56589.20	645087.32	651974.91	596081.87	621750.32	4	135	2016
1124.00	58751.20	59168.70	645308.46	652180.20	596131.81	621746.37	9	139	2016
1125.00	59323.60	59815.20	645492.17	652379.79	596183.24	621787.76	9	139	2016
1126.00	57690.40	58116.90	645694.13	652557.66	596238.76	621839.69	4	135	2016
1127.00	58857.30	59297.50	645895.71	652760.57	596291.46	621888.51	4	135	2016
1128.00	58257.10	58746.80	646076.07	652952.58	596340.15	621943.71	4	135	2016
1129.00	59429.30	59902.70	646269.41	653152.72	596391.33	621991.23	4	135	2016
1130.00	43606.50	44041.40	646469.52	653332.85	596446.72	622046.07	11	142	2016
1131.00	44180.40	44663.50	646672.95	653527.47	596495.35	622096.30	11	142	2016
1132.00	44771.30	45188.60	646850.08	653692.30	596549.03	622148.91	11	142	2016
1133.00	45346.80	45875.70	647049.57	653914.35	596601.05	622199.84	11	142	2016
1134.00	57674.00	58109.70	647241.93	654125.86	596653.31	622253.40	11	142	2016
1135.00	58268.50	58769.50	647440.91	654301.91	596701.51	622302.83	11	142	2016
1136.00	59956.40	60395.00	647639.36	654484.70	596755.58	622357.83	4	135	2016
1137.00	60540.40	61015.40	647813.55	654682.05	596808.76	622408.56	4	135	2016
1138.00	61127.40	61575.20	648008.06	654879.65	596856.95	622455.83	4	135	2016
1139.00	61708.50	62184.80	648225.90	655090.21	596910.12	622509.73	4	135	2016
1140.00	62342.90	62783.70	648391.17	655262.30	596951.89	622559.04	4	135	2016
1141.00	54113.40	54532.70	648612.79	655486.49	596955.16	622614.16	9	139	2016
1142.00	54676.10	55158.70	648769.90	655679.07	596951.90	622668.48	9	139	2016
1143.00	55263.60	55667.30	648986.37	655903.73	596953.48	622716.57	9	139	2016
1144.00	55841.70	56339.20	649162.43	656104.44	596950.39	622771.44	9	139	2016
1145.00	56465.40	56882.90	649363.57	656292.73	596953.66	622822.10	9	139	2016
1146.00	57037.20	57506.70	649859.84	656509.62	596950.81	621749.25	9	139	2016
1147.00	57618.10	58023.50	650067.59	656733.45	596951.70	621745.48	9	139	2016
1148.00	58168.40	58631.30	650260.30	656919.55	596952.72	621749.13	9	139	2016
1149.00	58898.30	59303.60	650483.47	657136.14	596955.93	621747.87	11	142	2016
1150.00	59442.40	59918.30	650693.30	657332.86	596950.23	621748.90	11	142	2016
1151.00	60033.50	60445.10	650897.91	657551.41	596953.77	621748.35	11	142	2016
1152.00	60600.40	61071.50	651111.49	657748.41	596950.61	621748.25	11	142	2016
1153.00	61193.30	61608.50	651314.03	657982.14	596950.45	621749.15	11	142	2016
1154.00	61758.70	62270.90	651522.94	658156.08	596952.25	621749.07	11	142	2016
1155.00	62380.50	62795.80	651728.93	658380.28	596956.48	621750.44	11	142	2016
1156.00	62928.50	63417.10	651934.42	658865.76	595857.17	621745.94	11	142	2016
1157.00	63534.60	63958.00	652158.26	659079.05	595910.88	621749.58	11	142	2016
1158.00	64090.50	64599.80	652343.54	659259.15	595964.90	621749.77	11	142	2016
1159.00	64698.10	65142.20	652559.91	659469.61	596013.00	621745.49	11	142	2016
1160.00	33205.80	33690.10	652757.72	659645.99	596068.68	621746.15	6	136	2016
1161.00	33813.00	34260.10	652962.08	659837.75	596117.38	621744.81	6	136	2016
1162.00	34408.90	34898.60	653181.42	660023.86	596171.97	621771.45	6	136	2016
1163.00	35015.60	35465.00	653363.85	660230.38	596222.80	621820.18	6	136	2016
1164.00	35587.20	36075.80	653554.67	660412.03	596272.13	621871.70	6	136	2016
1165.00	36201.40	36628.00	653755.90	660612.82	596327.44	621927.98	6	136	2016
1166.00	36761.90	37248.40	653943.31	660811.52	596378.41	621976.76	6	136	2016
1167.00	37363.00	37805.40	654131.89	660993.76	596426.76	622028.74	6	136	2016
1168.00	37909.70	38395.50	654329.85	661181.65	596482.39	622083.59	6	136	2016
1169.00	38517.40	38958.70	654532.18	661390.26	596534.25	622129.01	6	136	2016
1170.00	39102.90	39588.80	654727.54	661589.39	596586.09	622182.59	6	136	2016
1171.00	39727.90	40096.10	654907.07	660688.97	600701.37	622233.39	6	136	2016
1171.01	46949.80	47023.80	660651.26	661783.04	596634.63	600790.01	6	136	2016
1172.00	47252.40	47719.70	655104.61	661974.93	596688.51	622286.26	6	136	2016
1173.00	47842.10	48298.60	655292.53	662168.23	596740.60	622337.47	6	136	2016

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1174.00	48457.60	48925.50	655491.44	662353.70	596791.71	622394.41	6	136	2016
1175.00	49057.30	49512.50	655684.42	662556.47	596841.20	622440.66	6	136	2016
1176.00	49618.10	50061.30	655872.87	662722.72	596894.40	622496.35	6	136	2016
1177.00	50180.60	50644.70	656083.32	662941.72	596948.92	622549.39	6	136	2016
1178.00	50784.10	51261.40	656260.39	663154.07	596953.67	622596.91	6	136	2016
1179.00	51407.70	51884.60	656437.45	663348.94	596950.58	622652.08	6	136	2016
1180.00	51999.50	52454.10	656645.68	663543.03	596953.54	622703.93	6	136	2016
1181.00	52571.90	53037.20	656845.59	663768.63	596952.83	622752.31	6	136	2016
1182.00	53176.60	53624.90	657035.33	663957.31	596950.31	622807.98	6	136	2016
1183.00	53745.70	54231.30	657211.74	664165.90	596953.81	622860.07	6	136	2016
1184.00	54345.10	54781.00	657735.02	664369.58	596954.57	621744.62	6	136	2016
1185.00	54910.50	55382.20	657943.74	664603.13	596950.99	621750.66	6	136	2016
1186.00	55522.60	55962.60	658137.81	664788.61	596952.01	621746.11	6	136	2016
1187.00	56115.00	56576.90	658348.89	665008.13	596952.22	621747.75	6	136	2016
1188.00	56692.60	57137.90	658574.15	665207.72	596953.67	621747.98	6	136	2016
1189.00	57266.30	57733.60	658769.03	665425.42	596952.92	621746.02	6	136	2016
1190.00	57872.10	58307.50	658965.64	665620.45	596953.23	621747.60	6	136	2016
1191.00	58442.00	58910.90	659179.58	665832.05	596951.84	621746.33	6	136	2016
1192.00	59008.50	59453.60	659377.08	666041.28	596950.55	621745.53	6	136	2016
1193.00	31554.70	32064.40	659606.97	666548.45	595842.35	621748.11	8	139	2016
1194.00	32212.10	32658.10	659807.26	666744.41	595895.45	621748.84	8	139	2016
1195.00	32789.70	33270.80	660004.26	666923.71	595950.93	621750.12	8	139	2016
1196.00	33402.00	33821.20	660212.67	667118.68	595999.87	621745.53	8	139	2016
1197.00	33985.00	34480.50	660424.51	667311.27	596054.43	621746.97	8	139	2016
1198.00	35783.40	36206.00	660622.39	667504.30	596105.86	621748.83	8	139	2016
1199.00	34612.00	35025.50	660851.20	667705.14	596156.36	621753.28	8	139	2016
1200.00	35162.60	35643.00	661025.89	667893.53	596206.15	621806.80	8	139	2016
1201.00	36356.10	36849.50	661220.97	668085.50	596258.96	621858.39	8	139	2016
1202.00	36964.20	37389.40	661411.51	668285.20	596310.88	621908.43	8	139	2016
1203.00	37534.20	38030.70	661606.51	668469.63	596364.62	621963.20	8	139	2016
1204.00	38171.70	38607.00	661795.85	668662.02	596417.29	622015.98	8	139	2016
1205.00	38755.10	39247.30	661995.74	668861.25	596465.59	622062.61	8	139	2016
1206.00	39361.00	39805.40	662184.17	669061.36	596515.77	622114.37	8	139	2016
1207.00	39951.00	40441.10	662380.52	669232.59	596571.31	622171.37	8	139	2016
1208.00	40553.90	40995.70	662575.29	669435.87	596624.12	622222.91	8	139	2016
1209.00	41127.40	41631.10	662762.06	669636.02	596673.77	622272.57	8	139	2016
1210.00	41735.60	42174.80	662964.99	669818.23	596728.27	622322.03	8	139	2016
1211.00	42304.90	42803.30	663156.11	670011.75	596775.68	622374.49	8	139	2016
1212.00	42914.40	43355.50	663352.75	670208.24	596828.15	622428.97	8	139	2016
1213.00	43470.10	43973.90	663541.57	670397.00	596882.96	622478.81	8	139	2016
1214.00	50358.90	50777.00	663750.36	670609.37	596932.36	622534.14	9	139	2016
1215.00	50926.80	51430.20	663915.91	670791.26	596984.48	622582.23	9	139	2016
1216.00	51544.80	51960.00	664099.32	670981.59	597036.00	622635.61	9	139	2016
1217.00	52119.30	52609.30	664316.37	671165.87	597086.30	622685.96	9	139	2016
1218.00	52707.10	53124.70	664499.19	671374.51	597142.04	622739.33	9	139	2016
1219.00	53260.80	53763.30	664709.51	671562.76	597192.41	622788.92	9	139	2016
1220.00	60139.40	60563.60	664901.15	671751.84	597244.99	622841.29	9	139	2016
1221.00	60697.40	61144.70	665390.55	671945.44	597294.60	621749.71	9	139	2016
1222.00	61263.70	61669.20	665628.23	672142.20	597345.17	621748.00	9	139	2016
1223.00	61830.20	62272.80	665803.87	672059.57	598561.55	621745.11	9	139	2016
1224.00	62372.20	62734.40	666023.63	672027.09	599334.27	621747.85	9	139	2016
1225.00	62865.30	63284.40	666216.90	672199.83	599432.15	621747.32	9	139	2016
1226.00	28040.60	28412.90	666435.93	672033.38	600877.02	621749.12	10	141	2016
1227.00	28553.30	28913.40	666637.22	672074.80	601467.76	621746.78	10	141	2016
1228.00	29036.70	29382.90	666845.59	672255.63	601520.64	621746.10	10	141	2016
1229.00	29526.20	29866.00	667046.59	672012.95	603199.14	621746.49	10	141	2016
1230.00	30035.50	30343.50	667259.37	672130.56	603554.41	621748.34	10	141	2016
1231.00	30467.00	30793.90	667490.08	672031.21	604740.44	621749.62	10	141	2016
1232.00	30940.00	31225.50	667679.21	672030.29	605510.14	621749.15	10	141	2016
1233.00	31389.80	31704.50	667879.23	672197.51	605642.44	621749.62	10	141	2016
1234.00	31830.10	32089.50	668089.17	672019.08	607059.38	621746.90	10	141	2016
1235.00	34233.00	34467.70	668300.94	672070.59	607677.68	621746.34	11	142	2016
1236.00	34618.10	34897.30	668503.87	672265.99	607730.57	621750.42	11	142	2016
1237.00	35043.20	35256.40	668700.91	672031.85	609371.93	621788.93	11	142	2016
1238.00	35403.50	35626.80	668885.83	672124.34	609768.44	621844.87	11	142	2016
1239.00	35741.70	35942.00	669084.83	672322.17	609816.36	621893.61	11	142	2016

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1240.00	36069.20	36255.00	669280.92	672026.38	611689.70	621943.95	11	142	2016
1241.00	36384.00	36551.30	669455.06	672173.32	611854.16	622000.75	11	142	2016
1242.00	37049.70	37220.00	669658.69	672025.97	613235.28	622052.70	11	142	2016
1243.00	37325.00	37462.40	669851.06	672059.45	613889.26	622101.43	11	142	2016
1244.00	37609.50	37769.50	670048.45	672251.92	613943.80	622155.88	11	142	2016
1245.00	37905.70	38020.80	670243.76	672026.25	615552.62	622203.76	11	142	2016
1246.01	29749.70	29864.70	670433.75	672122.62	615974.65	622258.37	17	146	2016
1247.00	38378.70	38486.80	670632.98	672313.94	616025.52	622309.98	11	142	2016
1248.00	38608.10	38690.40	670821.38	672033.48	617870.39	622361.81	11	142	2016
1249.00	38803.60	38874.50	671008.66	672180.89	618066.59	622414.14	11	142	2016
1250.00	39005.40	39063.50	671207.03	672028.25	619416.11	622464.22	11	142	2016
1251.00	36771.60	36816.90	671405.04	672070.57	620096.41	622518.00	11	142	2016

Tellus Waterford Block - FLOWN LINES (Spectrometer)
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LINE	TIME	TIME	MIN X	MAX X	MIN Y	MAX Y	FLIGHT	DAY	YEAR
101.00	57290.00	57406.00	666277.75	672280.59	596040.18	597647.57	11	142	2016
102.00	33847.00	34077.00	658627.17	672361.93	596052.00	599736.35	11	142	2016
103.00	40381.00	40462.00	628148.54	633034.48	589984.21	591272.51	11	142	2016
103.10	52735.00	53088.00	650949.16	672423.61	596062.12	601820.75	11	142	2016
104.00	39401.00	40279.00	627605.60	672304.59	591865.08	603859.73	11	142	2016
105.00	53277.00	54211.00	627081.64	672336.21	593798.95	605942.08	11	142	2016
106.00	55165.00	56016.00	626973.47	672424.20	595847.77	608044.84	11	142	2016
107.00	54316.00	55073.00	627025.49	672489.33	597914.80	610120.89	11	142	2016
108.00	50718.00	51472.00	627121.30	672356.91	600020.46	612149.72	13	143	2016
109.00	56179.00	56915.00	626950.86	672379.89	602033.39	614231.54	11	142	2016
109.01	31279.00	32049.00	632211.99	672383.82	603462.79	614226.35	17	146	2016
110.00	51645.00	52388.00	633798.82	672489.55	605952.45	616320.18	13	143	2016
110.01	52603.00	52709.00	627000.38	633797.14	604128.91	605950.28	13	143	2016
111.00	48815.00	49543.00	627075.86	672334.74	606241.03	618365.27	13	143	2016
112.00	33560.00	33754.00	626977.40	639136.39	608260.80	611526.12	13	143	2016
112.01	49640.00	50266.00	639110.69	672202.24	611528.05	620410.91	13	143	2016
113.00	34187.00	34373.00	627011.15	638651.39	610354.86	613467.58	13	143	2016
113.01	39687.00	40288.00	638607.04	671690.87	613467.13	622337.37	13	143	2016
113.02	32272.00	32839.00	635585.81	671682.45	612637.35	622328.57	17	146	2016
114.00	38821.00	39440.00	627086.66	665146.08	612456.65	622647.61	13	143	2016
115.00	46494.00	46990.00	626933.83	657515.09	614473.88	622674.61	13	143	2016
116.00	47173.00	47493.00	633017.32	649631.75	618170.10	622622.74	13	143	2016
116.01	47734.00	47828.00	626999.15	633007.49	616567.77	618171.77	13	143	2016
117.00	34830.00	35076.00	627092.46	641968.94	618664.76	622642.35	13	143	2016
117.01	30301.00	30539.00	627081.08	641973.57	618655.87	622652.39	17	146	2016
118.00	35240.00	35368.00	626912.26	634321.28	620681.16	622667.82	13	143	2016
1001.00	33129.00	33209.00	627246.81	628407.37	589771.19	594076.18	4	135	2016
1002.00	33334.00	33410.00	627389.19	628599.49	589840.90	594370.96	4	135	2016
1003.00	33532.00	33648.00	627127.40	628788.66	589914.51	596097.46	4	135	2016
1004.00	33781.00	33891.00	627317.88	628986.93	589940.14	596147.77	4	135	2016
1005.00	34030.00	34156.00	627371.54	629171.19	590020.36	596714.08	4	135	2016
1006.00	34310.00	34457.00	627180.25	629375.48	590041.82	598195.92	4	135	2016
1007.00	34599.00	34745.00	627372.23	629553.74	590109.01	598242.18	4	135	2016
1008.00	34893.00	35052.00	627377.63	629767.47	590144.51	599034.94	4	135	2016
1009.00	35200.00	35388.00	627233.88	629946.00	590193.44	600295.90	4	135	2016
1010.00	35535.00	35714.00	627370.09	630157.29	590257.17	600562.10	4	135	2016
1011.00	35861.00	36076.00	627099.93	630327.58	590292.44	602332.45	4	135	2016
1012.00	36205.00	36417.00	627325.38	630537.32	590339.62	602346.86	4	135	2016
1013.00	36557.00	36785.00	627374.57	630724.67	590389.49	602860.79	4	135	2016
1014.00	36925.00	37174.00	627142.47	630919.57	590456.56	604420.17	4	135	2016
1015.00	37320.00	37558.00	627372.62	631102.44	590516.79	604446.71	4	135	2016
1016.00	37686.00	37942.00	627291.96	631307.50	590564.46	605183.04	4	135	2016
1017.00	40826.00	41111.00	627252.27	631521.09	590591.98	606510.17	11	142	2016
1017.01	50133.00	50399.00	627224.77	631518.01	590603.52	606529.34	18	151	2016
1018.00	41531.00	41813.00	627383.71	631692.57	590658.82	606719.37	11	142	2016
1019.00	42248.00	42580.00	627121.68	631870.91	590735.10	608556.25	11	142	2016
1020.00	42932.00	43260.00	627105.01	632081.49	590772.36	608613.17	11	142	2016
1021.00	30305.00	30608.00	627372.57	632277.35	590800.33	609063.97	13	143	2016
1022.00	31132.00	31455.00	627204.33	632480.97	590855.66	610593.66	13	143	2016
1022.01	51823.00	52136.00	627161.24	632457.82	590897.79	610628.00	18	151	2016
1023.00	31953.00	32272.00	627356.14	632653.84	590909.99	610665.92	13	143	2016
1024.01	52704.00	53014.00	627376.35	632853.20	590977.71	611387.58	18	151	2016
1025.00	35513.00	35825.00	627252.21	632527.60	592986.38	612715.74	13	143	2016
1025.01	36330.00	36652.00	627223.00	632530.40	592958.46	612709.62	13	143	2016
1026.00	37195.00	37520.00	627381.51	632712.92	592994.35	612924.46	13	143	2016
1027.00	38059.00	38413.00	627086.97	632920.92	593040.23	614725.86	13	143	2016
1027.01	53124.00	53515.00	627082.20	632899.49	593091.84	614772.11	18	151	2016
1028.00	45540.00	45899.00	627298.34	633108.79	593105.67	614769.01	13	143	2016
1029.00	48100.00	48466.00	627396.50	633312.49	593150.09	615228.09	13	143	2016
1030.00	53118.00	53491.00	627143.50	633508.63	593196.22	616829.06	13	143	2016
1031.00	29090.00	29468.00	627346.50	633677.03	593289.97	616910.05	15	144	2016
1032.00	30058.00	30446.00	627383.00	633872.24	593335.95	617576.70	15	144	2016
1033.00	31023.00	31429.00	627212.61	634058.63	593402.40	618952.21	15	144	2016
1034.00	32035.00	32444.00	627382.45	634252.87	593447.73	619094.17	15	144	2016
1035.00	32996.00	33440.00	627071.85	634452.59	593498.00	620988.68	15	144	2016

Tellus Waterford Block – FLOWN LINES (Spectrometer)
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LINE	TIME	TIME	MIN X	MAX X	MIN Y	MAX Y	FLIGHT	DAY	YEAR
1036.00	34036.00	34475.00	627278.16	634652.23	593535.79	621034.94	15	144	2016
1037.00	35027.00	35480.00	627364.35	634843.85	593581.62	621439.10	15	144	2016
1038.00	36068.00	36532.00	627515.05	635036.58	593621.06	621689.80	15	144	2016
1039.00	36627.00	37154.00	627694.43	635234.70	593660.58	621727.28	15	144	2016
1040.00	37271.00	37741.00	627932.80	635426.60	593731.74	621716.24	15	144	2016
1041.00	37873.00	38369.00	628132.20	635601.82	593776.02	621731.23	15	144	2016
1042.00	38492.00	38956.00	628337.22	635804.21	593870.87	621733.06	15	144	2016
1043.00	39054.00	39565.00	628530.35	636009.87	593872.01	621708.93	15	144	2016
1044.00	39698.00	40159.00	628748.84	636212.79	593945.91	621732.83	15	144	2016
1045.00	40296.00	40772.00	628963.30	636387.58	594012.37	621700.88	15	144	2016
1046.00	40921.00	41399.00	629157.82	636580.33	594067.63	621728.83	15	144	2016
1047.00	45541.00	46010.00	629369.68	636778.31	594075.33	621719.33	15	144	2016
1048.00	46100.00	46579.00	629565.61	636954.81	594165.68	621726.11	15	144	2016
1049.00	46704.00	47164.00	629790.33	637163.76	594226.54	621737.21	15	144	2016
1050.00	47295.00	47769.00	629982.76	637366.61	594243.93	621753.68	15	144	2016
1051.00	47907.00	48356.00	630189.30	637544.60	594295.97	621782.43	15	144	2016
1052.00	48466.00	48932.00	630370.79	637729.16	594391.58	621815.52	15	144	2016
1052.01	30850.00	30920.00	630375.83	631474.97	617743.74	621868.18	17	146	2016
1053.00	56889.00	57389.00	630583.52	637938.96	594433.09	621893.05	4	135	2016
1054.00	55363.00	55861.00	630787.53	638128.26	594451.06	621955.80	4	135	2016
1055.00	41193.00	41681.00	630973.08	638335.12	594503.37	621987.36	4	135	2016
1056.00	40584.00	41067.00	631135.93	638514.40	594576.07	622071.47	4	135	2016
1057.00	39983.00	40491.00	631336.14	638712.01	594615.33	622125.82	4	135	2016
1058.00	39381.00	39852.00	631523.97	638898.12	594678.38	622163.27	4	135	2016
1059.00	38751.00	39248.00	631724.08	639097.28	594736.08	622222.71	4	135	2016
1060.00	38157.00	38639.00	631914.54	639277.12	594754.98	622254.03	4	135	2016
1061.00	41834.00	42319.00	632109.67	639480.79	594851.74	622298.55	4	135	2016
1062.00	42466.00	42976.00	632294.12	639671.73	594881.79	622368.03	4	135	2016
1063.00	43095.00	43579.00	632509.79	639860.01	594931.55	622381.86	4	135	2016
1064.00	43709.00	44218.00	632690.64	640059.40	594991.46	622486.68	4	135	2016
1065.00	49555.00	50035.00	632884.23	640248.32	595034.63	622518.79	4	135	2016
1066.00	50160.00	50692.00	633071.97	640443.64	595095.77	622585.53	4	135	2016
1067.00	50805.00	51287.00	633263.62	640625.21	595118.62	622614.18	4	135	2016
1068.00	51418.00	51941.00	633460.60	640841.75	595174.89	622680.82	4	135	2016
1069.00	52086.00	52554.00	633644.78	641017.50	595239.40	622740.61	4	135	2016
1070.00	52688.00	53209.00	633859.57	641217.13	595302.72	622761.69	4	135	2016
1071.00	53324.00	53793.00	634039.59	641399.11	595371.12	622812.56	4	135	2016
1072.00	53951.00	54442.00	634555.00	641622.78	595390.02	621735.18	4	135	2016
1073.00	44992.00	45426.00	634754.75	641798.63	595454.00	621701.27	1	129	2016
1074.00	45570.00	46073.00	634955.03	642003.10	595476.53	621747.64	1	129	2016
1075.00	46219.00	46675.00	635158.61	642180.36	595542.54	621702.21	1	129	2016
1076.00	46808.00	47276.00	635362.29	642374.72	595587.36	621724.76	1	129	2016
1077.00	47429.00	47863.00	635572.75	642562.61	595665.23	621741.43	1	129	2016
1078.00	48002.00	48491.00	635799.56	642768.35	595708.41	621732.10	1	129	2016
1079.00	48639.00	49085.00	635998.69	642939.02	595783.13	621714.50	1	129	2016
1080.00	49238.00	49703.00	636199.77	643139.53	595824.11	621711.93	1	129	2016
1081.00	49853.00	50295.00	636410.62	643339.25	595859.83	621704.02	1	129	2016
1082.00	50458.00	50942.00	636628.51	643546.77	595916.15	621724.33	1	129	2016
1083.00	51613.00	52043.00	636817.61	643735.60	595989.87	621747.04	1	129	2016
1084.00	41819.00	42308.00	637037.08	643919.89	596006.05	621732.03	2	133	2016
1085.00	42457.00	42895.00	637245.52	644111.15	596049.04	621689.30	2	133	2016
1086.00	43062.00	43568.00	637450.67	644311.38	596116.60	621740.42	2	133	2016
1087.00	43679.00	44100.00	637634.53	644513.46	596161.96	621695.29	2	133	2016
1088.00	44252.00	44727.00	637855.77	644694.14	596246.88	621775.27	2	133	2016
1089.00	44871.00	45304.00	638042.55	644889.52	596256.92	621810.14	2	133	2016
1090.00	45473.00	45972.00	638235.66	645085.06	596334.55	621877.39	2	133	2016
1091.00	46114.00	46530.00	638401.61	645263.52	596405.18	621895.48	2	133	2016
1092.00	46710.00	47190.00	638636.53	645471.30	596413.98	621963.38	2	133	2016
1093.00	47319.00	47767.00	638806.60	645651.46	596502.65	622053.51	2	133	2016
1094.00	47932.00	48428.00	639017.64	645866.39	596522.32	622090.89	2	133	2016
1095.00	48546.00	48970.00	639170.10	646032.42	596609.88	622131.30	2	133	2016
1096.00	49114.00	49590.00	639375.07	646247.79	596613.01	622201.29	2	133	2016
1097.00	49708.00	50158.00	639580.14	646431.53	596700.72	622255.01	2	133	2016
1098.00	50326.00	50798.00	639779.98	646640.51	596722.54	622300.21	2	133	2016
1099.00	50945.00	51364.00	639967.56	646809.30	596821.26	622316.57	2	133	2016
1100.00	51532.00	52021.00	640163.32	647011.62	596859.36	622393.13	2	133	2016

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LINE	TIME	TIME	MIN X	MAX X	MIN Y	MAX Y	FLIGHT	DAY	YEAR
1101.00	52137.00	52582.00	640350.68	647195.02	596927.34	622422.54	2	133	2016
1102.00	52759.00	53239.00	640550.74	647399.71	596975.51	622528.20	2	133	2016
1103.00	53369.00	53788.00	640726.16	647599.97	596972.09	622530.79	2	133	2016
1104.00	53936.00	54410.00	640951.69	647808.30	596971.27	622577.78	2	133	2016
1105.00	54529.00	54974.00	641118.32	648019.63	596996.07	622675.10	2	133	2016
1106.00	60675.00	61159.00	641326.64	648225.49	596965.30	622720.83	2	133	2016
1107.00	61293.00	61721.00	641500.81	648423.12	596984.58	622762.42	2	133	2016
1108.00	61862.00	62346.00	641701.89	648631.61	596960.57	622820.40	2	133	2016
1109.00	62484.00	62915.00	642201.68	648842.13	596985.00	621692.94	2	133	2016
1110.00	63088.00	63554.00	642425.28	649043.40	596990.41	621745.35	2	133	2016
1111.00	63898.00	64099.00	645967.28	649256.85	596979.34	609256.03	2	133	2016
1111.01	65369.00	65596.00	642621.77	645976.61	609230.18	621705.14	11	142	2016
1112.00	64256.00	64710.00	642827.74	649474.36	596952.85	621703.48	2	133	2016
1113.00	64842.00	65278.00	643035.66	649679.97	596955.49	621735.45	2	133	2016
1114.00	65447.00	65904.00	643249.91	649881.94	596960.56	621725.49	2	133	2016
1115.00	66046.00	66463.00	643456.15	650090.60	596955.79	621723.03	2	133	2016
1116.00	66632.00	67090.00	643655.76	650290.01	596984.52	621706.55	2	133	2016
1117.00	67218.00	67639.00	643859.99	650506.73	596958.97	621742.01	2	133	2016
1118.00	67807.00	68266.00	644070.24	650714.69	596956.09	621729.59	2	133	2016
1119.00	68419.00	68849.00	644286.58	651203.02	595893.75	621701.99	2	133	2016
1120.00	68998.00	69471.00	644485.31	651391.37	595947.09	621718.15	2	133	2016
1121.00	69598.00	70041.00	644703.80	651590.31	596016.21	621709.88	2	133	2016
1122.00	54666.00	55087.00	644908.70	651741.78	596093.73	621686.71	4	135	2016
1123.00	56153.00	56589.00	645090.47	651970.24	596099.74	621738.34	4	135	2016
1124.00	58752.00	59168.00	645311.44	652169.87	596176.57	621697.23	9	139	2016
1125.00	59324.00	59815.00	645495.54	652375.10	596203.42	621777.14	9	139	2016
1126.00	57691.00	58116.00	645708.38	652544.85	596275.63	621789.93	4	135	2016
1127.00	58858.00	59297.00	645903.08	652748.43	596332.06	621860.82	4	135	2016
1128.00	58258.00	58746.00	646090.13	652941.80	596381.03	621894.77	4	135	2016
1129.00	59430.00	59902.00	646279.41	653141.37	596429.52	621956.99	4	135	2016
1130.00	43607.00	44041.00	646476.48	653324.62	596475.75	622022.99	11	142	2016
1131.00	44181.00	44663.00	646680.87	653521.37	596519.29	622062.90	11	142	2016
1132.00	44772.00	45188.00	646859.27	653683.58	596593.09	622113.05	11	142	2016
1133.00	45347.00	45875.00	647052.49	653904.62	596637.58	622190.37	11	142	2016
1134.00	57674.00	58109.00	647253.35	654125.86	596653.31	622213.01	11	142	2016
1135.00	58269.00	58769.00	647448.02	654294.94	596729.41	622276.59	11	142	2016
1136.00	59957.00	60395.00	647639.36	654479.01	596795.46	622357.83	4	135	2016
1137.00	60541.00	61015.00	647822.75	654676.71	596830.49	622376.50	4	135	2016
1138.00	61128.00	61575.00	648011.70	654870.43	596890.46	622443.00	4	135	2016
1139.00	61709.00	62184.00	648232.76	655078.07	596953.31	622482.98	4	135	2016
1140.00	62343.00	62783.00	648404.23	655260.69	596957.90	622516.11	4	135	2016
1141.00	54114.00	54532.00	648622.74	655474.01	596998.08	622574.31	9	139	2016
1142.00	54677.00	55158.00	648781.52	655666.41	597001.51	622631.95	9	139	2016
1143.00	55264.00	55667.00	648993.37	655898.80	596971.51	622689.55	9	139	2016
1144.00	55842.00	56339.00	649165.63	656100.57	596965.71	622760.45	9	139	2016
1145.00	56466.00	56882.00	649372.95	656278.10	597014.61	622782.32	9	139	2016
1146.00	57038.00	57506.00	649869.77	656498.07	596990.52	621713.26	9	139	2016
1147.00	57619.00	58023.00	650083.02	656725.32	596981.83	621684.72	9	139	2016
1148.00	58169.00	58631.00	650265.11	656911.87	596983.07	621734.86	9	139	2016
1149.00	58899.00	59303.00	650493.70	657123.87	597000.07	621711.78	11	142	2016
1150.00	59443.00	59918.00	650702.28	657328.63	596967.87	621716.02	11	142	2016
1151.00	60034.00	60445.00	650899.55	657543.37	596983.48	621742.02	11	142	2016
1152.00	60601.00	61071.00	651119.59	657742.34	596973.61	621717.67	11	142	2016
1153.00	61194.00	61608.00	651323.34	657971.65	596992.85	621719.97	11	142	2016
1154.00	61759.00	62270.00	651526.95	658143.85	596994.90	621733.89	11	142	2016
1155.00	62381.00	62795.00	651743.63	658372.11	596990.68	621697.73	11	142	2016
1156.00	62929.00	63417.00	651942.97	658864.41	595862.70	621717.03	11	142	2016
1157.00	63535.00	63958.00	652158.26	659072.28	595936.03	621749.58	11	142	2016
1158.00	64091.00	64599.00	652351.22	659249.08	596003.78	621722.94	11	142	2016
1159.00	64699.00	65142.00	652562.86	659454.15	596067.59	621734.29	11	142	2016
1160.00	33206.00	33690.00	652758.84	659642.35	596081.45	621741.24	6	136	2016
1161.00	33813.00	34260.00	652962.08	659836.41	596123.00	621744.81	6	136	2016
1162.00	34409.00	34898.00	653187.68	660022.29	596177.63	621741.50	6	136	2016
1163.00	35016.00	35465.00	653370.48	660230.38	596222.80	621797.37	6	136	2016
1164.00	35588.00	36075.00	653565.66	660400.40	596316.35	621830.31	6	136	2016
1165.00	36202.00	36628.00	653764.95	660612.82	596327.44	621889.27	6	136	2016

Tellus Waterford Block – FLOWN LINES (Spectrometer)
IRENET95, Irish Transverse Mercator

LINE	TIME	TIME	MIN X	MAX X	MIN Y	MAX Y	FLIGHT	DAY	YEAR
1166.00	36762.00	37248.00	653949.57	660809.98	596384.03	621954.30	6	136	2016
1167.00	37363.00	37805.00	654131.89	660987.89	596448.46	622028.74	6	136	2016
1168.00	37910.00	38395.00	654336.42	661176.70	596499.48	622057.45	6	136	2016
1169.00	38518.00	38958.00	654543.64	661380.95	596572.12	622091.52	6	136	2016
1170.00	39103.00	39588.00	654739.38	661587.74	596591.56	622140.96	6	136	2016
1171.00	39728.00	40096.00	654908.72	660687.45	600706.77	622227.65	6	136	2016
1171.01	46950.00	47023.00	660663.29	661779.94	596645.89	600744.32	6	136	2016
1172.00	47253.00	47719.00	655113.84	661964.98	596725.39	622249.82	6	136	2016
1173.00	47843.00	48298.00	655308.09	662159.37	596772.59	622284.73	6	136	2016
1174.00	48458.00	48925.00	655499.09	662348.36	596814.69	622369.18	6	136	2016
1175.00	49058.00	49512.00	655695.78	662549.36	596869.35	622396.69	6	136	2016
1176.00	49619.00	50061.00	655877.41	662707.77	596948.01	622479.55	6	136	2016
1177.00	50181.00	50644.00	656089.70	662931.10	596985.35	622526.17	6	136	2016
1178.00	50785.00	51261.00	656266.35	663139.58	597003.26	622575.55	6	136	2016
1179.00	51408.00	51884.00	656442.70	663340.89	596984.74	622634.76	6	136	2016
1180.00	52000.00	52454.00	656647.25	663534.65	596983.95	622698.55	6	136	2016
1181.00	52572.00	53037.00	656847.21	663765.87	596963.26	622746.48	6	136	2016
1182.00	53177.00	53624.00	657047.90	663951.20	596974.14	622757.19	6	136	2016
1183.00	53746.00	54231.00	657217.13	664162.24	596970.03	622841.77	6	136	2016
1184.00	54346.00	54781.00	657735.02	664357.20	596998.57	621744.62	6	136	2016
1185.00	54911.00	55382.00	657949.45	664600.33	596961.20	621727.51	6	136	2016
1186.00	55523.00	55962.00	658147.28	664782.98	596974.79	621710.63	6	136	2016
1187.00	56115.00	56576.00	658348.89	664996.43	597002.67	621747.75	6	136	2016
1188.00	56693.00	57137.00	658587.79	665201.64	596976.48	621697.07	6	136	2016
1189.00	57267.00	57733.00	658779.69	665417.73	596982.63	621706.59	6	136	2016
1190.00	57873.00	58307.00	658973.50	665609.45	597003.92	621720.31	6	136	2016
1191.00	58442.00	58910.00	659179.58	665818.10	597002.37	621746.33	6	136	2016
1192.00	59009.00	59453.00	659387.10	666033.00	596978.28	621711.54	6	136	2016
1193.00	31555.00	32064.00	659611.23	666546.01	595857.13	621729.29	8	139	2016
1194.00	32213.00	32658.00	659822.20	666742.95	595901.03	621693.46	8	139	2016
1195.00	32790.00	33270.00	660014.13	666919.63	595966.47	621710.44	8	139	2016
1196.00	33402.00	33821.00	660212.67	667115.46	596012.09	621745.53	8	139	2016
1197.00	33985.00	34480.00	660430.52	667311.27	596054.43	621722.16	8	139	2016
1198.00	35784.00	36206.00	660632.57	667504.30	596105.86	621711.70	8	139	2016
1199.00	34612.00	35025.00	660851.20	667697.89	596186.21	621753.28	8	139	2016
1200.00	35163.00	35643.00	661025.89	667887.40	596228.91	621806.80	8	139	2016
1201.00	36357.00	36849.00	661229.28	668073.45	596305.47	621830.26	8	139	2016
1202.00	36965.00	37389.00	661425.80	668279.24	596333.92	621856.10	8	139	2016
1203.00	37535.00	38030.00	661616.26	668458.76	596406.12	621928.49	8	139	2016
1204.00	38172.00	38607.00	661800.95	668662.02	596417.29	621997.63	8	139	2016
1205.00	38756.00	39247.00	662000.76	668849.93	596512.43	622046.13	8	139	2016
1206.00	39361.00	39805.00	662184.17	669055.26	596538.65	622114.37	8	139	2016
1207.00	39951.00	40441.00	662381.84	669232.59	596571.31	622165.91	8	139	2016
1208.00	40554.00	40995.00	662576.83	669423.53	596667.94	622216.99	8	139	2016
1209.00	41128.00	41631.00	662763.88	669626.96	596706.09	622267.66	8	139	2016
1210.00	41736.00	42174.00	662971.38	669805.06	596777.80	622298.97	8	139	2016
1211.00	42305.00	42803.00	663160.76	670010.27	596781.07	622358.77	8	139	2016
1212.00	42915.00	43355.00	663361.02	670201.99	596856.80	622389.46	8	139	2016
1213.00	43471.00	43973.00	663556.00	670384.41	596934.96	622430.38	8	139	2016
1214.00	50359.00	50777.00	663752.22	670609.37	596932.36	622527.81	9	139	2016
1215.00	50927.00	51430.00	663919.06	670788.55	596994.92	622571.78	9	139	2016
1216.00	51545.00	51960.00	664101.44	670981.59	597036.00	622622.38	9	139	2016
1217.00	52120.00	52609.00	664320.33	671156.18	597121.39	622670.94	9	139	2016
1218.00	52708.00	53124.00	664515.05	671361.97	597186.42	622680.72	9	139	2016
1219.00	53261.00	53763.00	664713.29	671559.86	597202.87	622774.46	9	139	2016
1220.00	60140.00	60563.00	664911.67	671743.12	597279.84	622799.82	9	139	2016
1221.00	60698.00	61144.00	665401.02	671936.73	597325.53	621708.46	9	139	2016
1222.00	61264.00	61669.00	665633.10	672139.22	597356.72	621729.07	9	139	2016
1223.00	61831.00	62272.00	665815.66	672036.68	598595.85	621704.82	9	139	2016
1224.00	62373.00	62734.00	666036.73	672020.62	599358.37	621699.35	9	139	2016
1225.00	62866.00	63284.00	666222.67	672189.74	599467.66	621725.41	9	139	2016
1226.00	28041.00	28412.00	666449.36	672027.03	600900.21	621700.40	10	141	2016
1227.00	28554.00	28913.00	666648.01	672069.07	601489.95	621708.57	10	141	2016
1228.00	29037.00	29382.00	666859.04	672250.96	601538.34	621696.44	10	141	2016
1229.00	29527.00	29866.00	667056.98	672012.95	603199.14	621704.59	10	141	2016
1230.00	30036.00	30343.00	667266.31	672122.97	603585.07	621721.61	10	141	2016

Tellus Waterford Block – FLOWN LINES (Spectrometer)
IRENET95, Irish Transverse Mercator

LINE	TIME	TIME	MIN X	MAX X	MIN Y	MAX Y	FLIGHT	DAY	YEAR
1231.00	30467.00	30793.00	667490.08	672020.02	604785.96	621749.62	10	141	2016
1232.00	30940.00	31225.00	667687.05	672030.29	605510.14	621721.00	10	141	2016
1233.00	31390.00	31704.00	667881.83	672190.68	605672.10	621739.84	10	141	2016
1234.00	31831.00	32089.00	668097.18	672004.81	607113.65	621718.24	10	141	2016
1235.00	34233.00	34467.00	668310.39	672070.59	607677.68	621705.46	11	142	2016
1236.00	34619.00	34897.00	668515.98	672262.08	607745.24	621705.26	11	142	2016
1237.00	35044.00	35256.00	668707.16	672019.87	609419.92	621764.94	11	142	2016
1238.00	35404.00	35626.00	668892.72	672114.08	609811.30	621819.21	11	142	2016
1239.00	35742.00	35942.00	669084.83	672317.75	609834.75	621893.61	11	142	2016
1240.00	36070.00	36255.00	669293.68	672026.38	611689.70	621895.96	11	142	2016
1241.00	36384.00	36551.00	669460.41	672173.32	611854.16	621981.17	11	142	2016
1242.00	37050.00	37220.00	669662.48	672025.97	613235.28	622038.14	11	142	2016
1243.00	37325.00	37462.00	669857.19	672059.45	613889.26	622076.97	11	142	2016
1244.00	37610.00	37769.00	670055.63	672244.76	613969.29	622130.64	11	142	2016
1245.00	37906.00	38020.00	670257.06	672021.67	615570.28	622155.65	11	142	2016
1246.00	38161.00	38277.00	670434.15	672108.90	616007.33	622259.58	11	142	2016
1246.01	29750.00	29864.00	670444.43	672118.19	615990.41	622220.66	17	146	2016
1247.00	38379.00	38486.00	670645.70	672309.13	616043.06	622261.83	11	142	2016
1248.00	38609.00	38690.00	670834.62	672027.48	617893.03	622312.36	11	142	2016
1249.00	38804.00	38874.00	671017.63	672173.76	618092.02	622385.41	11	142	2016
1250.00	39006.00	39063.00	671215.48	672020.77	619443.45	622433.33	11	142	2016
1251.00	36772.00	36816.00	671411.47	672051.85	620146.20	622496.80	11	142	2016

Appendix IV

ORIGINAL FLIGHT		RE-FLIGHTS		
Line No.	Flight	Reflight Line No.	Reflight Flight No.	Reason for Reflight
109.00	11	109.01	17	FEM issues
110.00	13	110.01	13	partial for logistics, mountain flying. Completed same day
112.00	13	112.01	13	partial for logistics, mountain flying. Completed same day
113.00	13	113.01	13	partial for logistics, mountain flying. Completed same day
113.00/01	13	113.02	17	FEM issues
116.00	13	116.01	13	partial for logistics, mountain flying. Completed same day
117.00	13	117.01	17	FEM issues
1017.00	11	1017.01	18	FEM issues
1018.00	11	1018.01	18	FEM issues
1019.00	11	1019.01	18	FEM issues
1021.00	13	1021.01	18	FEM issues
1022.00	13	1022.01	18	FEM issues
1023.00	13	1023.01	18	FEM issues
1024.00	13	1024.01	18	FEM issues
1025.00	13	1025.01	13	Accidental reflight
1027.00	13	1027.01	18	FEM issues
1045.00	15	1045.01	18	FEM issues
1047.00	15	1047.01	18	FEM issues
1052.00	15	1052.01	17	FEM issues
1052.01	17	1052.02	18	FEM issues
1111.00	2	1111.01	11	Partial due to large deviation for wind turbine
1171.00	6	1171.01	7	Aborted due to possible bird strike. Completed same day on next flight.
1246.00	11	1246.01	17	FEM issues

SGL

Appendix V

Equipment List

Part	Serial No.	Description	Manufacturer
Aircraft C-GSGF	DHC-6-642	Twin Otter Series 300, DE HAVILLAND (SGF)	DE HAVILLAND
Barometric Sensor	1347373	HONEYWELL MODEL TJE ABSOLUTE PRESSURE SENSOR	HONEYWELL
Collins Rad Alt	7497	860F-1 Radio Altimeter	Collins
Data acquisition computer	CDAC-20	CPCI Data Acquisition computer	SGL
EM Computer	SGFEM-CI-01	Frequency EM Control Interface	SGL
Fluxgate Magnetometer	487	model TFM100G2-1E	Billingsley Magnetics
GPS Antenna	NZT07260011	Model 702L, w OMNISTAR, L1/L2 Kinematic GPS Antenna	Novatel
GPS Antenna	NAE10170022	Model 702-GG, L1/L2 Kinematic GPS Antenna	Novatel
GPS Receiver	4101	Septentrio Dual frequency multi ant. GPS/SBAS receiver	Novatel
Laser Profilometer	9996756	LD90-31K-HiP, 11-28VDC laser rangefinder.	Septentrio
Magnetometer Sensor	75543-C2461	model G-822A	Riegl
Magnetometer Sensor	75129-C057	model G-822A	Geometrics
Magnetometer Sensor	75231-C020	model G-822A	Geometrics
Magnetometer Sensor	75230-C365	model G-822A	Geometrics
Magnetometer Sensor	75368-C1576	model G-822A	Geometrics
SGRef Station	M-SGREF-59	CPCI ground station – 28Vdc input	SGL
SGRef Station	M-SGREF-62	CPCI ground station – 28Vdc input	SGL
Spectrometer detector	5557	RSX-5	Radiation Solutions
Spectrometer detector	5444	RSX-5	Radiation Solutions
Spectrometer detector	5632	RSX-5	Radiation Solutions
Spectrometer detector	5558	RSX-5	Radiation Solutions

Appendix VI

SANDER GEOPHYSICS AIRBORNE GEOPHYSICAL SURVEY

260 Hunt Club Road, Ottawa, ON K1V 1C1 Canada Tel: +1 613-521-9626 Fax: +1 613-521-0215 www.sgl.com

SURVEY DETAILS			
Survey Name	Tellus	**Client Name**	Geological Survey of Ireland
Survey Location	Waterford, Ireland	**Contact Name**	Jim Hodgson
Project Code	GSI___16.IRL	**Contact Phone**	+353 1678 2742
Total km	6560	**Client Address**	Beggar's Bush, Haddington Road, Dublin 4, Ireland
Line Spacing	200 m by 2000 m		
Survey Type	MAG/SPEC/FEM	**Email**	jim.hodgson@gsi.ie / tellus@gsi.ie

SURVEY PRODUCTION SUMMARY			
Production This Week (km)	0.0	**Total km Flown to Date**	0.0
Total Remaining (km)	6560.0	**km Reflown This Week**	0.0
Percent Complete (%)	0.0	**Flight Time This Week (h)**	0.0
Prod km/Day This Week	0.0	**Prod km/Flt Hour This Week**	

WEEKLY PRODUCTION

Week 1		Flight No.	Flight Time	No. of Lines Flown	No. Reflight Lines Flown	Production (km)	Reflown (km)
TOTALS			**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
25-Apr	**Monday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Partly sunny, high of 13C.		**Remarks**	Steve Gebhardt, captain, and Alison McCleary, crew chief, arrive in Ireland on April 22. C-GSGF departs Ottawa on April 17. C-GSGF departs Newfoundland today, arrives in Greenland. Mobilization of crew from Canada to Ireland is underway. Meeting with GSI in Dublin.			
Geomag	N/A						
26-Apr	**Tuesday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Partly sunny, high of 10C.		**Remarks**	Mobilization continues. C-GSGF departs Greenland and arrives in Iceland. Steve and Alison logistics in Dublin.			
Geomag	N/A						
27-Apr	**Wednesday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Partly sunny, high of 10C.		**Remarks**	Mobilization continues. Steve and Alison arrive in Waterford.			
Geomag	N/A						
28-Apr	**Thursday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Partly sunny, high of 12C.		**Remarks**	Mobilization continues. Meetings with Waterford Airport including ATC. C-GSGF departs Iceland and arrives Faroe Islands. Craig McMahon, technician, and Ian Boychuck, AME, arrive in Dublin.			
Geomag	N/A						
29-Apr	**Friday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Partly sunny, high of 10C.		**Remarks**	Mobilization continues.			
Geomag	N/A						
30-Apr	**Saturday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Partly sunny, high of 12C.		**Remarks**	Mobilization continues. C-GSGF departs Faroe Island and arrives Weston Airport, Ireland. Charles Dicks and Jason Thomas, pilots, arrive with C-GSGF.			
Geomag	N/A						
1-May	**Sunday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Heavy fog on coast, partly sunny inland, high of 14C.		**Remarks**	Mobilization continues. Reconfiguration of aircraft from ferry mode to survey mode commences. Diana Kuiper, geophysicist, arrives in Waterford.			
Geomag	N/A						
Comments	Mobilization from Canada to Ireland. Aircraft is at Weston Airport for reconfiguration of aircraft to survey mode by end of week. Entire crew arrive in Ireland.						
Signed	Alison McCleary						

PERSONNEL ON SITE THIS WEEK						
Name	**Position**	**Arrival This Week**	**Departure This Week**	**On Site?**	**No. of Days On Site This Week**	**No. of Days on Site To Date**
Alison McCleary	Crew Chief			ON SITE	7	10
Steve Gebhardt	Lead Pilot			ON SITE	7	10
Ian Boychuck	AME	28-Apr-16		ON SITE	4	4
Craig McMahon	Technician	28-Apr-16		ON SITE	4	4
Charles Dicks	Pilot	30-Apr-16		ON SITE	2	2
Jason Thomas	Pilot	30-Apr-16		ON SITE	2	2
Diana Kuiper	Geophysicist	1-May-16		ON SITE	1	1

HSE Statistics	This Week	Project Totals
SGL Person Hours	202.5	202.5
Inductions	7	7
Near Miss		0
First Aid Case (FAC)		0
Medical Treatment Case (MTC)		0
Restricted Work Case (RWC)		0
Lost Time Injuries (LTI)		0
Safety Meeting		0
Tellus Complaints		0

SANDER GEOPHYSICS AIRBORNE GEOPHYSICAL SURVEY

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SURVEY DETAILS

Survey Name	Tellus	**Client Name**	Geological Survey of Ireland
Survey Location	Waterford, Ireland	**Contact Name**	Jim Hodgson
Project Code	GSI___16.IRL	**Contact Phone**	+353 1678 2742
Total km	6560	**Client Address**	Beggar's Bush, Haddington Road, Dublin 4, Ireland
Line Spacing	200 m by 2000 m		
Survey Type	MAG/SPEC/FEM	**Email**	jim.hodgson@gsi.ie / tellus@gsi.ie

SURVEY PRODUCTION SUMMARY

Production This Week (km)	294.6	**Total km Flown to Date**	294.6
Total Remaining (km)	6265.4	**km Reflown This Week**	0.0
Percent Complete (%)	4.5	**Flight Time This Week (h)**	8.1
Prod km/Day This Week	42.1	**Prod km/Flt Hour This Week**	36.4

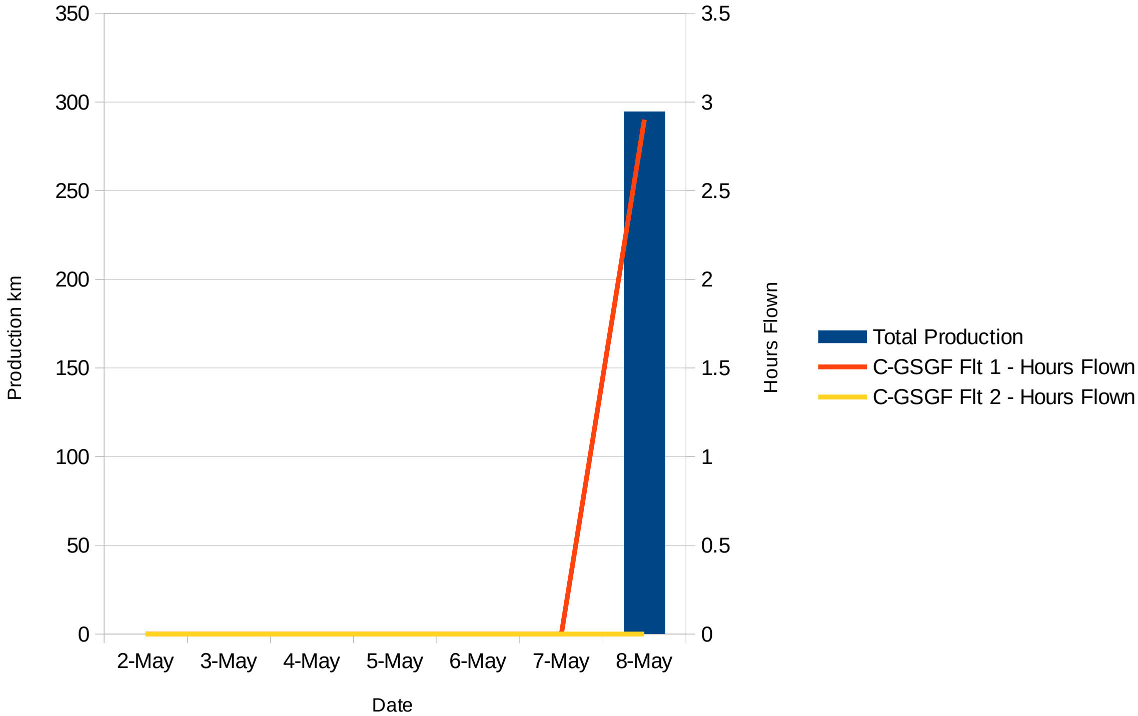
WEEKLY PRODUCTION

Week 2		**Flight No.**	**Flight Time**	**No. of Lines Flown**	**No. Reflight Lines Flown**	**Production (km)**	**Reflown (km)**
TOTALS			**8.1**	**11.0**	**0.0**	**294.6**	**0.0**
2-May	**Monday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Partly sunny with heavy rain showers, high of 11C.		**Remarks**	Mobilization continues. Reconfiguration of aircraft continues. Two ground stations erected in Portally Cove.			
Geomag	quiet						
3-May	**Tuesday**		**1.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1	ferry	1.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Partly sunny, high of 11C.		**Remarks**	Mobilization continues. Reconfiguration of aircraft completed. Aircraft moved from Weston to Waterford. Aircraft plugged into ground power.			
Geomag	quiet						
4-May	**Wednesday**		**2.3**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1	training	2.3	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Overcast with light rain, partly sunny in pm, high of 12C.		**Remarks**	Mobilization continues. Pilot training flight completed. Discovered missing power cable crucial for FEM system. Shipped from Ottawa, also ordered online from 2 sources. Safety meeting complete, all crew present.			
Geomag	quiet						
5-May	**Thursday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Overcast with light rain, high of 14C.		**Remarks**	Mobilization continues. Data from training flight confirms survey systems all good, waiting for FEM sytem power cable. Visit with GSI, Jim and Emma.			
Geomag	quiet						
6-May	**Friday**		**1.9**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1	training	1.9	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Sunny, high of 16C.		**Remarks**	Mobilization continues. Pilot training flight completed. Power cable arrives and installed. All survey systems ready for test flight. Visit with GSI, Mairead, including RTE radio interview.			
Geomag	quiet						
7-May	**Saturday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Heavy rain all day, high of 10C.		**Remarks**	Mobilization continues. No flight due to weather.			
Geomag	quiet						
8-May	**Sunday**		**2.9**	**11.0**	**0.0**	**294.6**	**0.0**
	C-GSGF Flt 1	1	2.9	11.0	0.0	294.6	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Fog in am, partly sunny pm, high of 15C.		**Remarks**	Mobilization complete. Test flight for survey systems. Data is good, becomes production data.			
Geomag	quiet						
Comments	Mobilization complete. First flight of data is good.						
Signed	Alison McCleary						

PERSONNEL ON SITE THIS WEEK						
Name	**Position**	**Arrival This Week**	**Departure This Week**	**On Site?**	**No. of Days On Site This Week**	**No. of Days on Site To Date**
Alison McCleary	Crew Chief			ON SITE	7	17
Steve Gebhardt	Lead Pilot			ON SITE	7	17
Ian Boychuck	AME			ON SITE	7	11
Craig McMahon	Technician			ON SITE	7	11
Charles Dicks	Pilot			ON SITE	7	9
Jason Thomas	Pilot			ON SITE	7	9
Diana Kuiper	Geophysicist			ON SITE	7	8

HSE Statistics	This Week	Project Totals
SGL Person Hours	367.5	570
Inductions	0	7
Near Miss		0
First Aid Case (FAC)		0
Medical Treatment Case (MTC)		0
Restricted Work Case (RWC)		0
Lost Time Injuries (LTI)		0
Safety Meeting	1	1
Tellus Complaints		0

WEEKLY PRODUCTION KILOMETRES AND HOURS FLOWN



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SURVEY DETAILS			
Survey Name	Tellus	**Client Name**	Geological Survey of Ireland
Survey Location	Waterford, Ireland	**Contact Name**	Jim Hodgson
Project Code	GSI___16.IRL	**Contact Phone**	+353 1678 2742
Total km	6560	**Client Address**	Beggar's Bush, Haddington Road, Dublin 4, Ireland
Line Spacing	200 m by 2000 m		
Survey Type	MAG/SPEC/FEM	**Email**	jim.hodgson@gsi.ie / tellus@gsi.ie

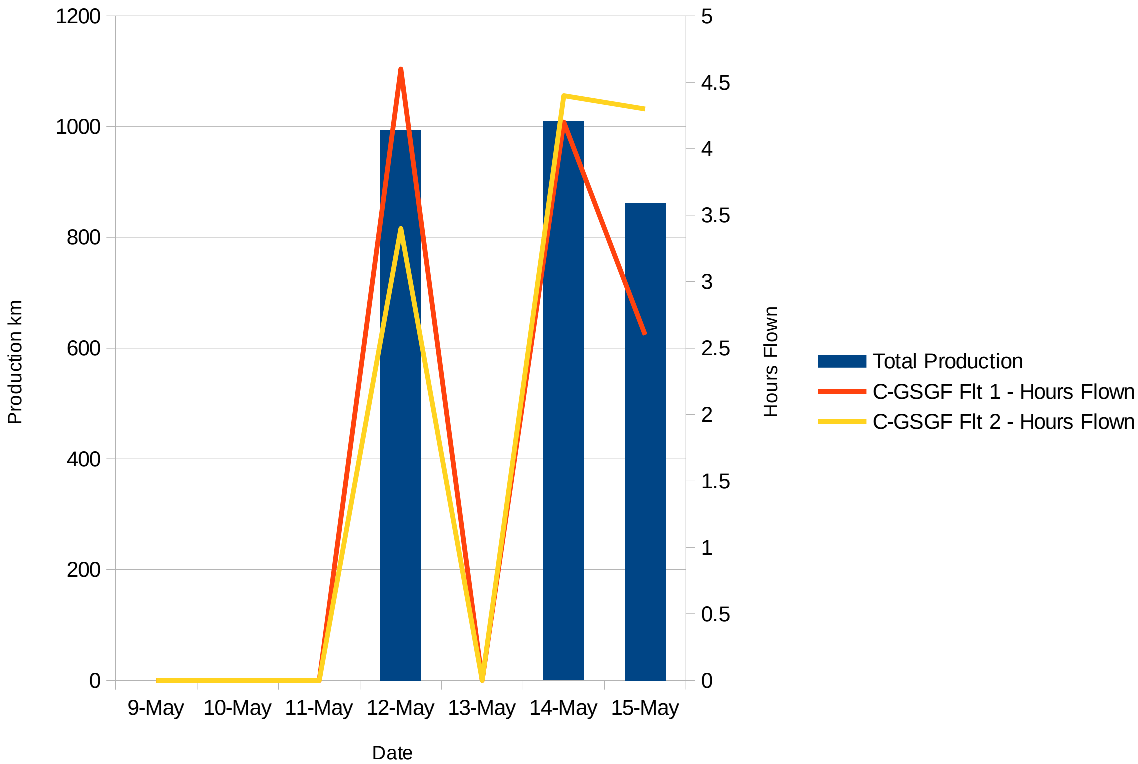
SURVEY PRODUCTION SUMMARY			
Production This Week (km)	2864.7	**Total km Flown to Date**	3159.3
Total Remaining (km)	3400.7	**km Reflown This Week**	0.0
Percent Complete (%)	48.2	**Flight Time This Week (h)**	23.5
Prod km/Day This Week	409.2	**Prod km/Flt Hour This Week**	121.9

WEEKLY PRODUCTION

Week 3		**Flight No.**	**Flight Time**	**No. of Lines Flown**	**No. Reflight Lines Flown**	**Production (km)**	**Reflown (km)**
TOTALS			**23.5**	**118.0**	**0.0**	**2864.7**	**0.0**
9-May	**Monday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Light rain becomes heavy in pm, high of 14C.		**Remarks**	No flight due to rain.			
Geomag	quiet						
10-May	**Tuesday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Heavy fog in am, rain in pm, high of 18C.		**Remarks**	No flight due to poor visibility and rain.			
Geomag	quiet						
11-May	**Wednesday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Heavy fog all day, rain in pm, high of 19C.		**Remarks**	No flight due to poor visibility and rain.			
Geomag	quiet						
12-May	**Thursday**		**8.0**	**38.0**	**0.0**	**993.1**	**0.0**
	C-GSGF Flt 1	2	4.6	22.0	0.0	579.2	0.0
	C-GSGF Flt 2	3	3.4	16.0	0.0	413.9	0.0
Weather	Fog in am, sunny and hazy in pm, high of 20C.		**Remarks**	Two flights completed.			
Geomag	micro pulsations						
13-May	**Friday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Sunny all day, high of 21C.		**Remarks**	No flight due to maintenance.			
Geomag	quiet						
14-May	**Saturday**		**8.6**	**47.0**	**0.0**	**1010.0**	**0.0**
	C-GSGF Flt 1	4	4.2	26.0	0.0	438.7	0.0
	C-GSGF Flt 2	5	4.4	21.0	0.0	571.3	0.0
Weather	Fog in am, sunny in pm, mountains remain in fog, high of 13C.		**Remarks**	Two flights completed.			
Geomag	quiet						
15-May	**Sunday**		**6.9**	**33.0**	**0.0**	**861.6**	**0.0**
	C-GSGF Flt 1	6	2.6	12.0	0.0	315.7	0.0
	C-GSGF Flt 2	7	4.3	21.0	0.0	545.9	0.0
Weather	Fog in am, very hazy over coast, mountains remain in fog, high of 16C.		**Remarks**	Two flights completed. First flight aborted due to possible bird strike. No evidence of strike upon inspection.			
Geomag	quiet						
Comments	Very poor weather made for a slow start this week. Once rain stopped production was steady.						
Signed	Alison McCleary						

PERSONNEL ON SITE THIS WEEK						
Name	Position	Arrival This Week	Departure This Week	On Site?	No. of Days On Site This Week	No. of Days on Site To Date
Alison McCleary	Crew Chief			ON SITE	7	24
Steve Gebhardt	Lead Pilot			ON SITE	7	24
Ian Boychuck	AME			ON SITE	7	18
Craig McMahon	Technician			ON SITE	7	18
Charles Dicks	Pilot			ON SITE	7	16
Jason Thomas	Pilot			ON SITE	7	16
Diana Kuiper	Geophysicist			ON SITE	7	15

HSE Statistics	This Week	Project Totals
SGL Person Hours	367.5	937.5
Inductions		7
Near Miss		0
First Aid Case (FAC)		0
Medical Treatment Case (MTC)		0
Restricted Work Case (RWC)		0
Lost Time Injuries (LTI)		0
Safety Meeting		1
Tellus Complaints	1	1



1200
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3
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Production km
Hours Flown
9-May
10-May
11-May
12-May
13-May
14-May
15-May
Date
Total Production
C-GSGF Flt 1 - Hours Flown
C-GSGF Flt 2 - Hours Flown

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SURVEY DETAILS

Survey Name	Tellus	**Client Name**	Geological Survey of Ireland
Survey Location	Waterford, Ireland	**Contact Name**	Jim Hodgson
Project Code	GSI___16.IRL	**Contact Phone**	+353 1678 2742
Total km	6560	**Client Address**	Beggar's Bush, Haddington Road, Dublin 4, Ireland
Line Spacing	200 m by 2000 m		
Survey Type	MAG/SPEC/FEM	**Email**	jim.hodgson@gsi.ie / tellus@gsi.ie

SURVEY PRODUCTION SUMMARY

Production This Week (km)	2785.4	**Total km Flown to Date**	5944.7
Total Remaining (km)	615.3	**km Reflown This Week**	33.2
Percent Complete (%)	90.6	**Flight Time This Week (h)**	33.8
Prod km/Day This Week	397.9	**Prod km/Flt Hour This Week**	82.4

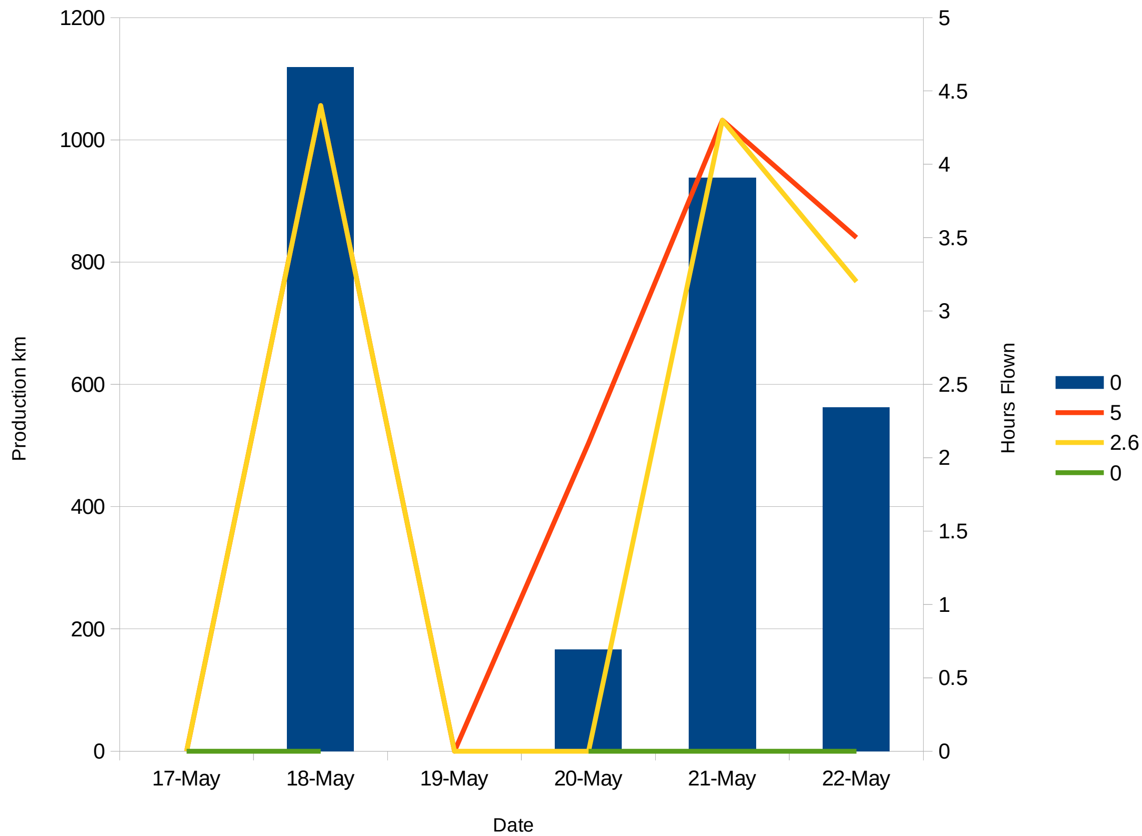
WEEKLY PRODUCTION

Week 4		**Flight No.**	**Flight Time**	**No. of Lines Flown**	**No. Reflight Lines Flown**	**Production (km)**	**Reflown (km)**
TOTALS			**33.8**	**119.0**	**1.5**	**2785.4**	**33.2**
16-May	**Monday**		**7.6**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1	9006	5.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2	9007	2.6	0.0	0.0	0.0	0.0
Weather	Sunny, high of 15C.		**Remarks**	Two test flights completed. Bundoran test line, FEM calibration, magenetic compensation and heading, and cosmic tests flown.			
Geomag	quiet						
17-May	**Tuesday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Heavy fog with rain, high of 15C.		**Remarks**	No flight due to poor visibility.			
Geomag	quiet						
18-May	**Wednesday**		**8.8**	**43.0**	**0.0**	**1118.8**	**0.0**
	C-GSGF Flt 1	8	4.4	21.0	0.0	553.4	0.0
	C-GSGF Flt 2	9	4.4	22.0	0.0	565.4	0.0
Weather	Partly sunny with heavy showers, high of 15C.		**Remarks**	Two flights completed. Pilots worked around rain showers.			
Geomag	unsettled						
19-May	**Thursday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Heavy fog and rain, high winds, high of 17C.		**Remarks**	No flight due to poor visibility, rain and strong winds.			
Geomag	unsettled						
20-May	**Friday**		**2.1**	**9.0**	**0.0**	**166.1**	**0.0**
	C-GSGF Flt 1	10	2.1	9.0	0.0	166.1	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Overcast with rain in am, heavy rain and poor visibility in pm, high of 12C.		**Remarks**	Early morning flight, aborted due to rain.			
Geomag	micro pulsations						
21-May	**Saturday**		**8.6**	**47.0**	**0.5**	**937.8**	**12.9**
	C-GSGF Flt 1	11	4.3	28.0	0.0	385.2	0.0
	C-GSGF Flt 2	12	4.3	19.0	0.5	552.6	12.9
Weather	Partly sunny and windy, high of 15C.		**Remarks**	Two flights completed, turbulent.			
Geomag	quiet						
22-May	**Sunday**		**6.7**	**20.0**	**1.0**	**562.7**	**20.3**
	C-GSGF Flt 1	13	3.5	11.0	1.0	251.6	20.3
	C-GSGF Flt 2	14	3.2	9.0	0.0	311.1	0.0
Weather	Partly sunny with heavy showers, high of 15C.		**Remarks**	Two flights, shorter due to storms in the area.			
Geomag	unsettled						
Comments	Flights most days this week. Weather in the mountains makes it difficult to complete the western edge of block. 2 flights remain with good weather in the forecast.						
Signed	Alison McCleary						

PERSONNEL ON SITE THIS WEEK						
Name	Position	Arrival This Week	Departure This Week	On Site?	No. of Days On Site This Week	No. of Days on Site To Date
Alison McCleary	Crew Chief			ON SITE	7	31
Steve Gebhardt	Lead Pilot			ON SITE	7	31
Ian Boychuck	AME			ON SITE	7	25
Craig McMahon	Technician			ON SITE	7	25
Charles Dicks	Pilot			ON SITE	7	23
Jason Thomas	Pilot			ON SITE	7	23
Diana Kuiper	Geophysicist			ON SITE	7	22

HSE Statistics	This Week	Project Totals
SGL Person Hours	367.5	1305
Inductions		7
Near Miss		0
First Aid Case (FAC)		0
Medical Treatment Case (MTC)		0
Restricted Work Case (RWC)		0
Lost Time Injuries (LTI)		0
Safety Meeting		1
Tellus Complaints		0

WEEKLY PRODUCTION KILOMETRES AND HOURS FLOWN



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SURVEY DETAILS

Survey Name	Tellus	**Client Name**	Geological Survey of Ireland
Survey Location	Waterford, Ireland	**Contact Name**	Jim Hodgson
Project Code	GSI___16.IRL	**Contact Phone**	+353 1678 2742
Total km	6560	**Client Address**	Beggar's Bush, Haddington Road, Dublin 4, Ireland
Line Spacing	200 m by 2000 m		
Survey Type	MAG/SPEC/FEM	**Email**	jim.hodgson@gsi.ie / tellus@gsi.ie

SURVEY PRODUCTION SUMMARY

Production This Week (km)	615.3	**Total km Flown to Date**	6560.0
Total Remaining (km)	0.0	**km Reflown This Week**	104.8
Percent Complete (%)	100.0	**Flight Time This Week (h)**	7.6
Prod km/Day This Week	87.9	**Prod km/Flt Hour This Week**	81.0

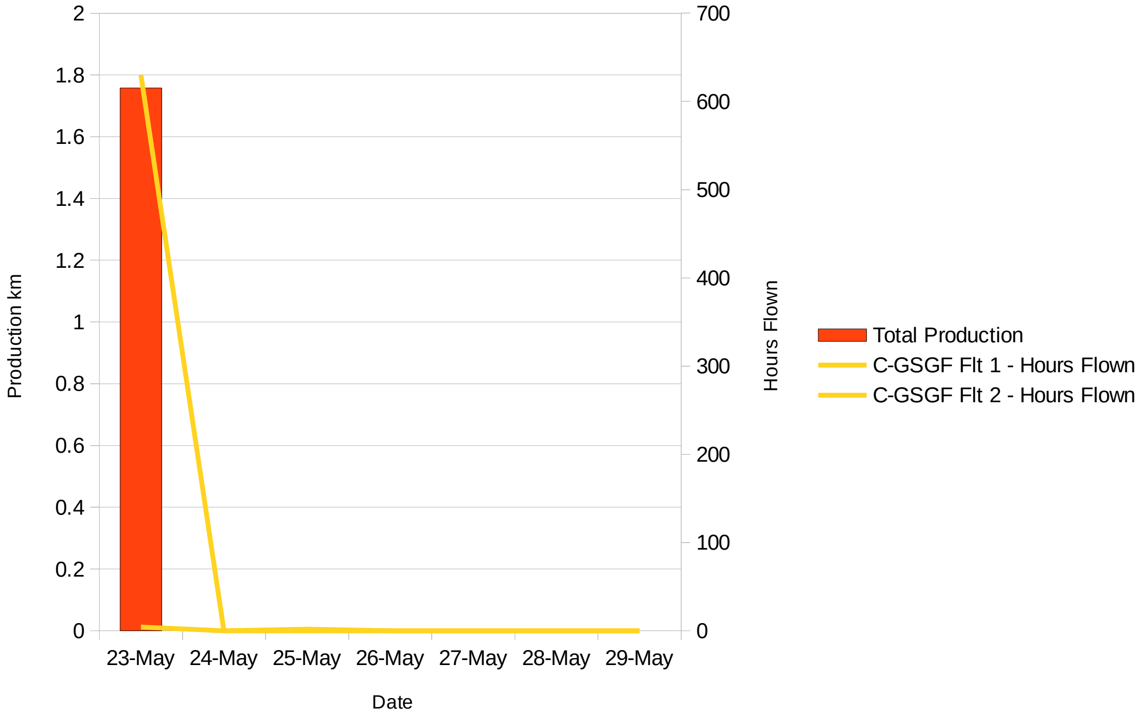
WEEKLY PRODUCTION

Week 5		**Flight No.**	**Flight Time**	**No. of Lines Flown**	**No. Reflight Lines Flown**	**Production (km)**	**Reflown (km)**
TOTALS			**7.6**	**22.0**	**3.9**	**615.3**	**104.8**
23-May	**Monday**		**5.9**	**22.0**	**0.0**	**615.3**	**0.0**
	C-GSGF Flt 1	15	4.1	16.0	0.0	445.2	0.0
	C-GSGF Flt 2	16	1.8	6.0	0.0	170.1	0.0
Weather	Sunny, high of 14C.		**Remarks**	Waterford block completed.			
Geomag	unsettled						
24-May	**Tuesday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Sunny, high of 14C.		**Remarks**	Reflights for FEM identified.			
Geomag	quiet						
25-May	**Wednesday**		**1.7**	**0.0**	**3.9**	**0.0**	**104.8**
	C-GSGF Flt 1	17	1.7	0.0	3.9	0.0	104.8
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Partly cloudy, very windy, high of 13C.		**Remarks**	Reflights for FEM. Incomplete due to strong winds in the mountains. Ground station dismantled and crew begins mobilization to Galway.			
Geomag	quiet						
26-May	**Thursday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Partly cloudy, high of 13C.		**Remarks**	Aircraft moved to Weston for maintenance. Crew moves to Galway.			
Geomag	n/a						
27-May	**Friday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Fog in am, partly cloudy, high of 18C.		**Remarks**	Maintenance on aircraft commences. Meetings with Galway Council. Galway airport opened and shipment received from Waterford.			
Geomag	n/a						
28-May	**Saturday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Fog in am, partly cloudy, rain in late pm, high of 19C.		**Remarks**	Maintenance on aircraft continues.			
Geomag	n/a						
29-May	**Sunday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather	Heavy fog in am, sunny in pm, high of 20C.		**Remarks**	Maintenance on aircraft continues.			
Geomag	n/a						
Comments	Waterford block completed. FEM reflights remain, will fly from either Weston or Galway. Maintenance on aircraft commences in Weston, it is almost complete. Mobilization to Galway going smoothly.						
Signed	Alison McCleary						

PERSONNEL ON SITE THIS WEEK						
Name	Position	Arrival This Week	Departure This Week	On Site?	No. of Days On Site This Week	No. of Days on Site To Date
Alison McCleary	Crew Chief			ON SITE	7	38
Steve Gebhardt	Lead Pilot			ON SITE	7	38
Ian Boychuck	AME			ON SITE	7	32
Craig McMahon	Technician			ON SITE	7	32
Charles Dicks	Pilot			ON SITE	7	30
Jason Thomas	Pilot			ON SITE	7	30
Diana Kuiper	Geophysicist			ON SITE	7	29

HSE Statistics	This Week	Project Totals
SGL Person Hours	367.5	1672.5
Inductions		7
Near Miss		0
First Aid Case (FAC)		0
Medical Treatment Case (MTC)		0
Restricted Work Case (RWC)		0
Lost Time Injuries (LTI)		0
Safety Meeting		1
Tellus Complaints		0

WEEKLY PRODUCTION KILOMETRES AND HOURS FLOWN



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SURVEY DETAILS

Survey Name	Tellus	**Client Name**	Geological Survey of Ireland
Survey Location	Waterford, Ireland	**Contact Name**	Jim Hodgson
Project Code	GSI___16.IRL	**Contact Phone**	+353 1678 2742
Total km	6560	**Client Address**	Beggar's Bush, Haddington Road, Dublin 4, Ireland
Line Spacing	200 m by 2000 m		
Survey Type	MAG/SPEC/FEM	**Email**	jim.hodgson@gsi.ie / tellus@gsi.ie

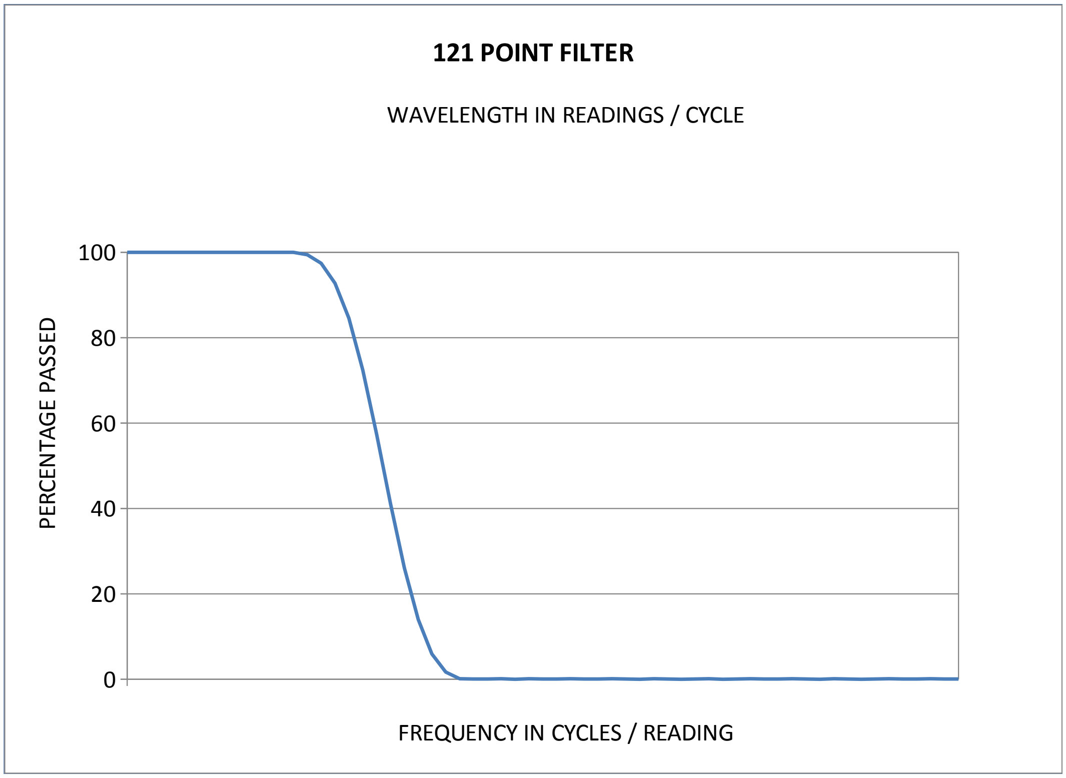
SURVEY PRODUCTION SUMMARY

Production This Week (km)	0.0	**Total km Flown to Date**	6560.0
Total Remaining (km)	0.0	**km Reflown This Week**	239.0
Percent Complete (%)	100.0	**Flight Time This Week (h)**	3.4
Prod km/Day This Week	0.0	**Prod km/Flt Hour This Week**	0.0

WEEKLY PRODUCTION

Week 6		**Flight No.**	**Flight Time**	**No. of Lines Flown**	**No. Reflight Lines Flown**	**Production (km)**	**Reflown (km)**
TOTALS			**3.4**	**0.0**	**11.0**	**0.0**	**239.0**
30-May	**Monday**		**3.4**	**0.0**	**11.0**	**0.0**	**239.0**
	C-GSGF Flt 1	18	3.4	0.0	11.0	0.0	239.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather			**Remarks**	Russborough test line completed. Reflights completed. Waterford block complete.			
Geomag	quiet						
31-May	**Tuesday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather			**Remarks**				
Geomag	quiet						
1-Jun	**Wednesday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather			**Remarks**				
Geomag	quiet						
2-Jun	**Thursday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather			**Remarks**				
Geomag	unsettled						
3-Jun	**Friday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather			**Remarks**				
Geomag	quiet						
4-Jun	**Saturday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather			**Remarks**				
Geomag	quiet						
5-Jun	**Sunday**		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	C-GSGF Flt 1		0.0	0.0	0.0	0.0	0.0
	C-GSGF Flt 2		0.0	0.0	0.0	0.0	0.0
Weather			**Remarks**				
Geomag	quiet						
Comments	Waterford Block production completed May 30th. Final delivery made on June 3rd.						
Signed	Alison McCleary						

Appendix VII


121 POINT FILTER
WAVELENGTH IN READINGS / CYCLE
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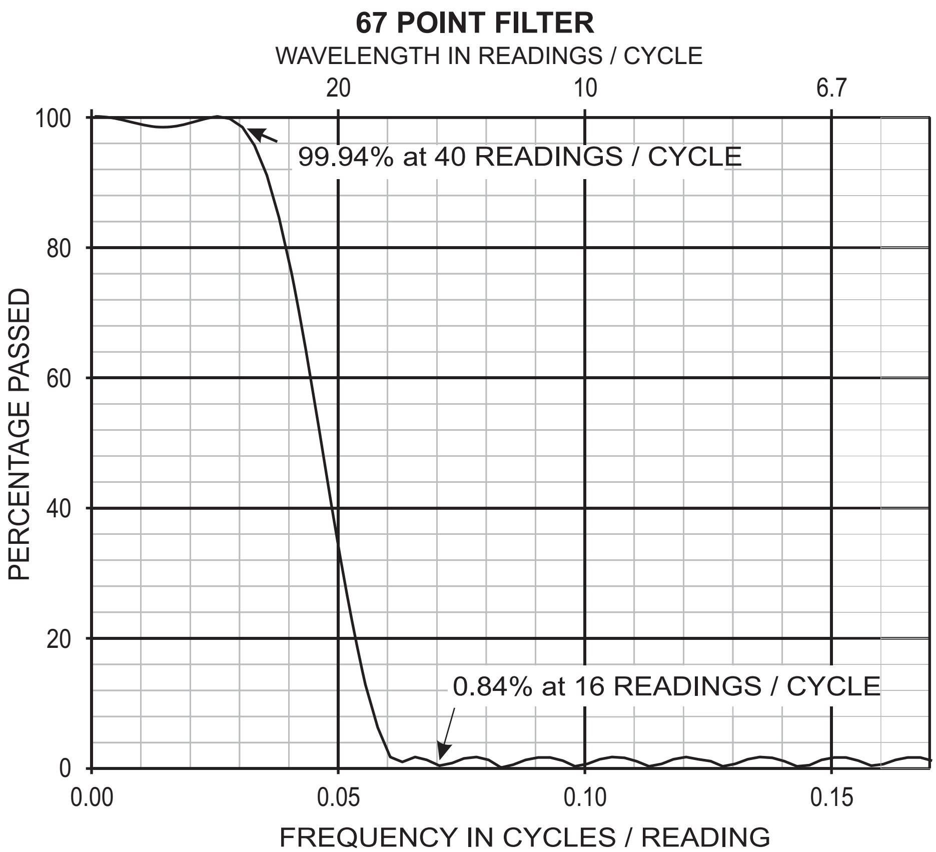
80
60
40
20
0
PERCENTAGE PASSED
FREQUENCY IN CYCLES / READING



FILTER 67 COEFFICIENTS

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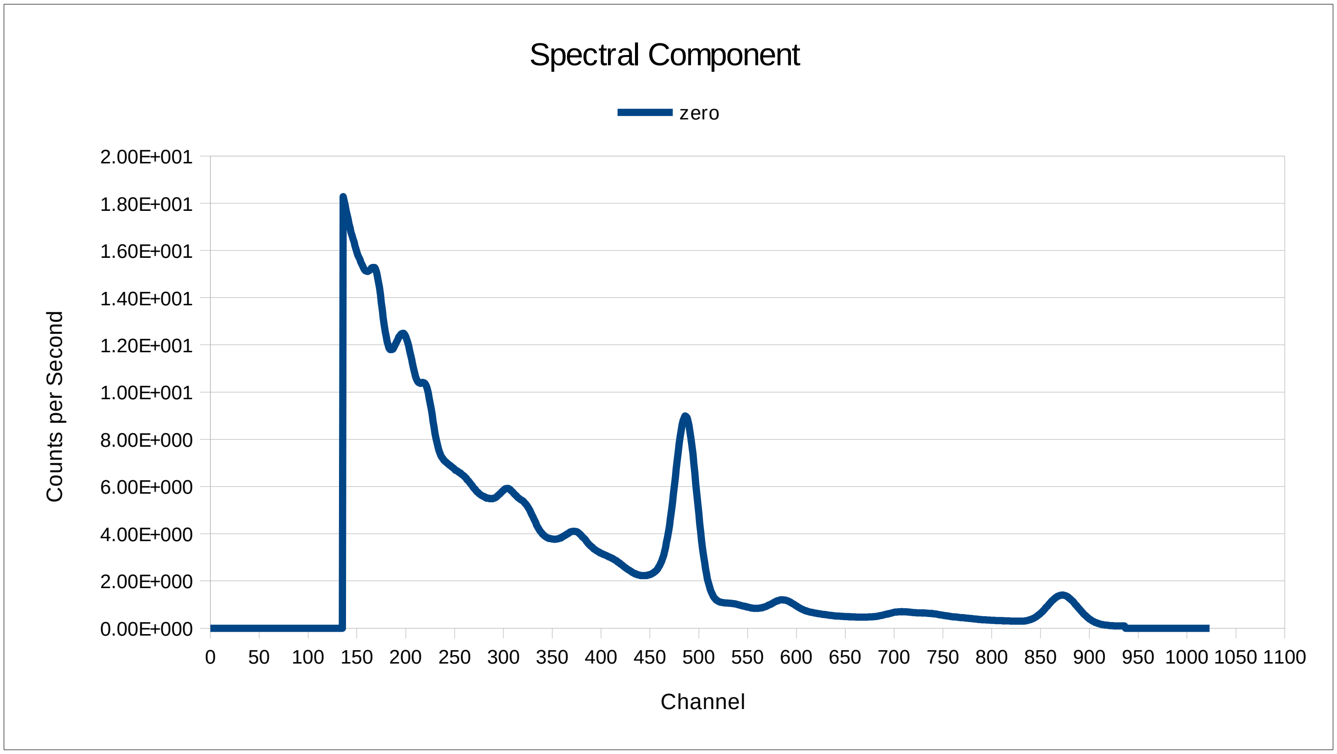
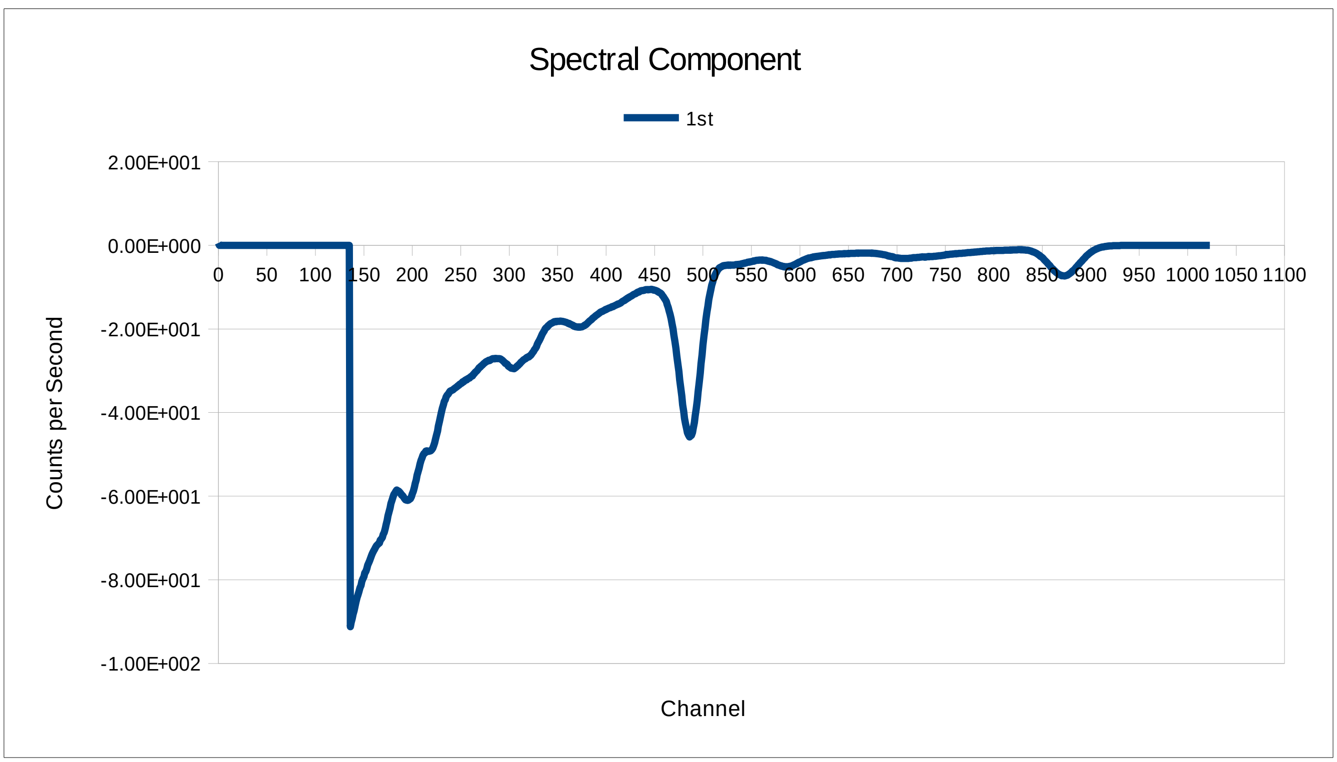
SGL

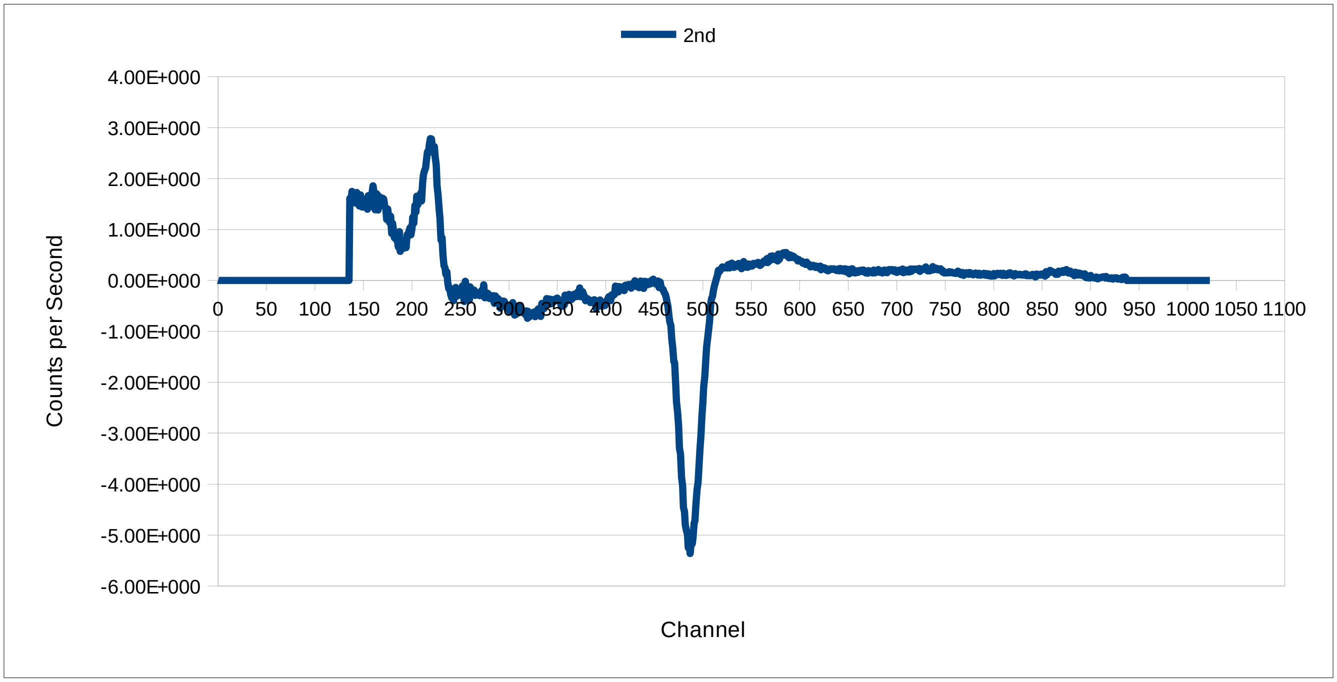
Appendix VIII

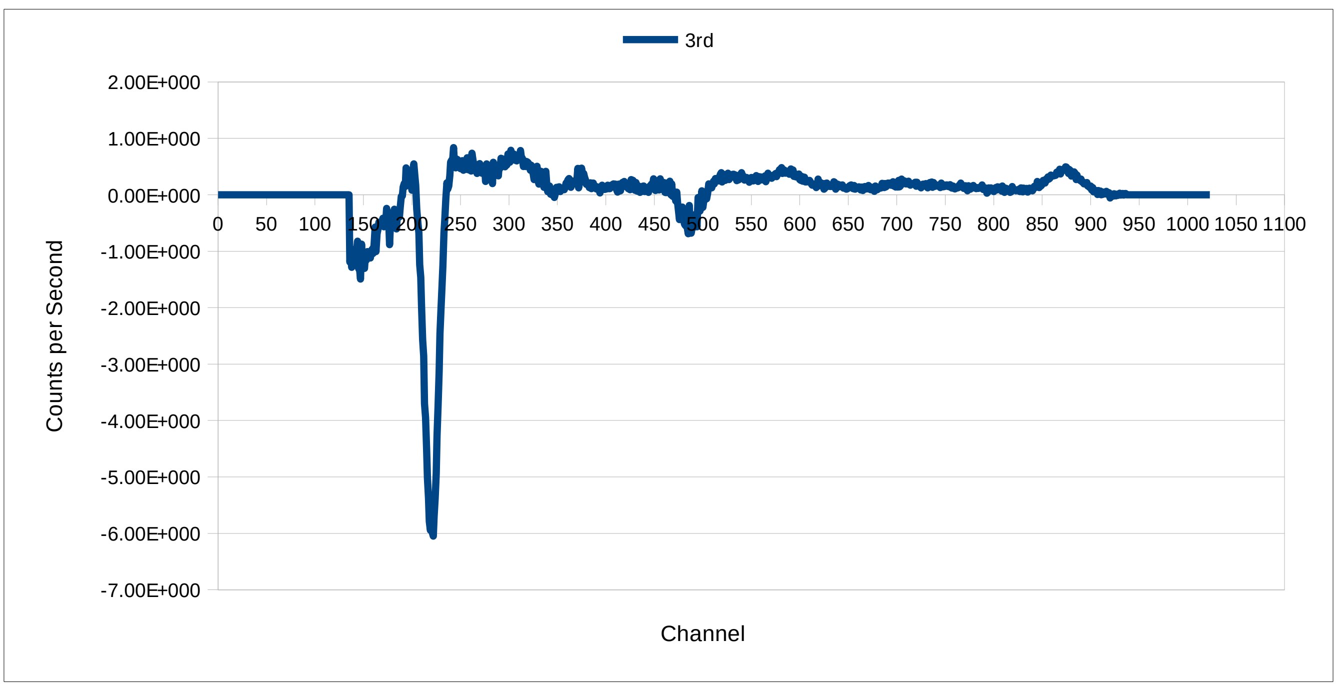
Spectral Components



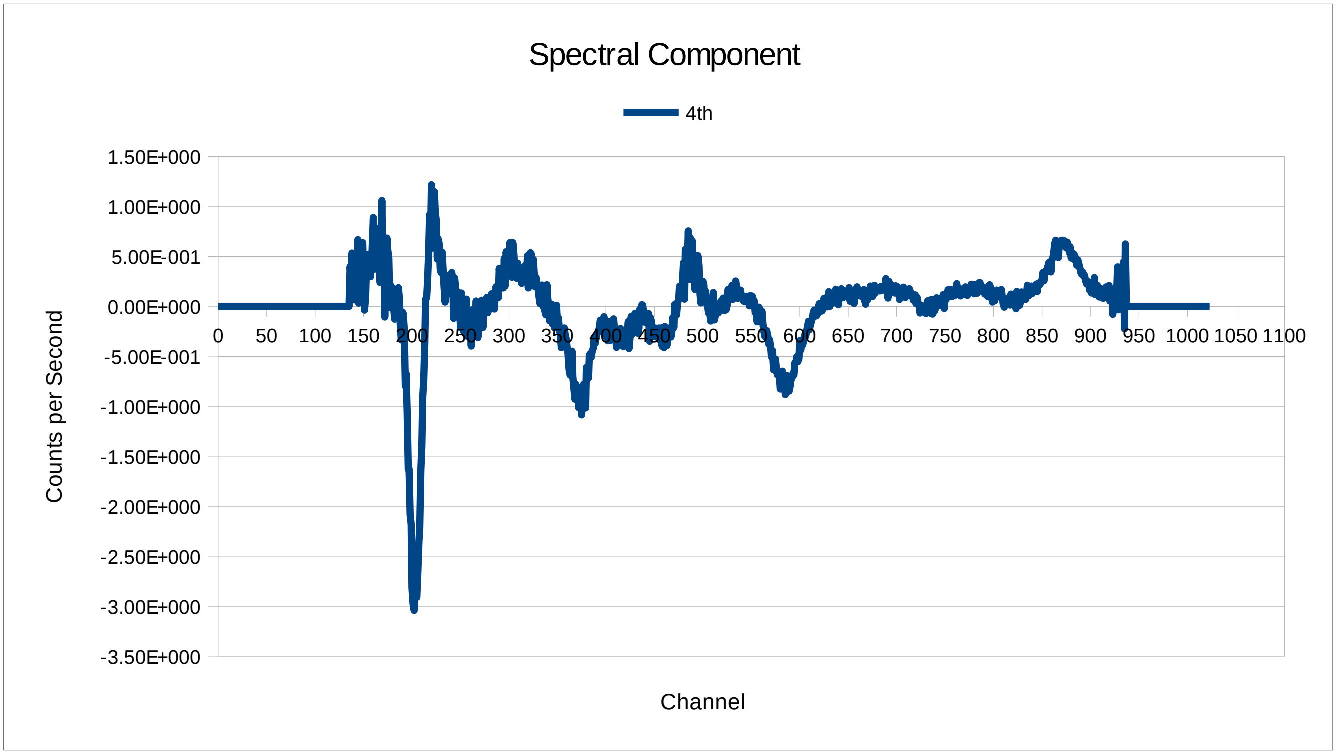


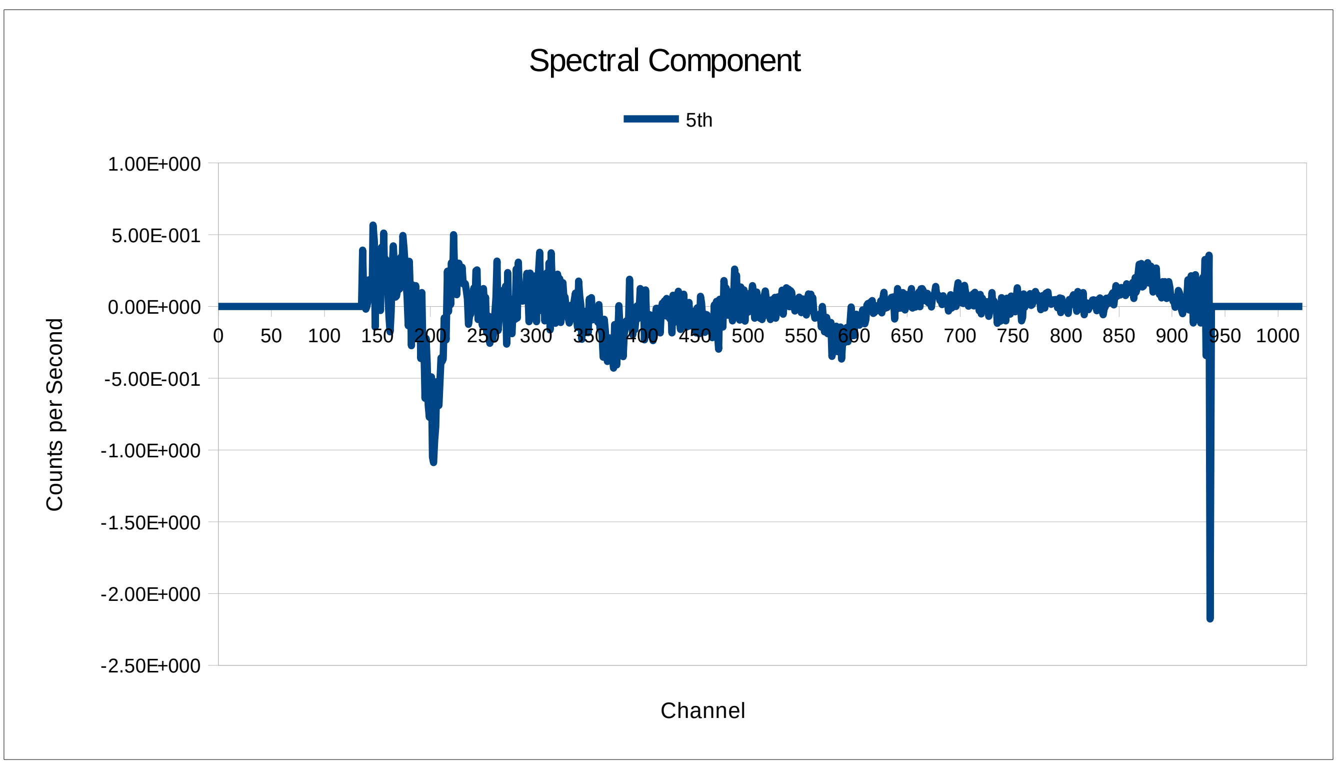
Spectral Components



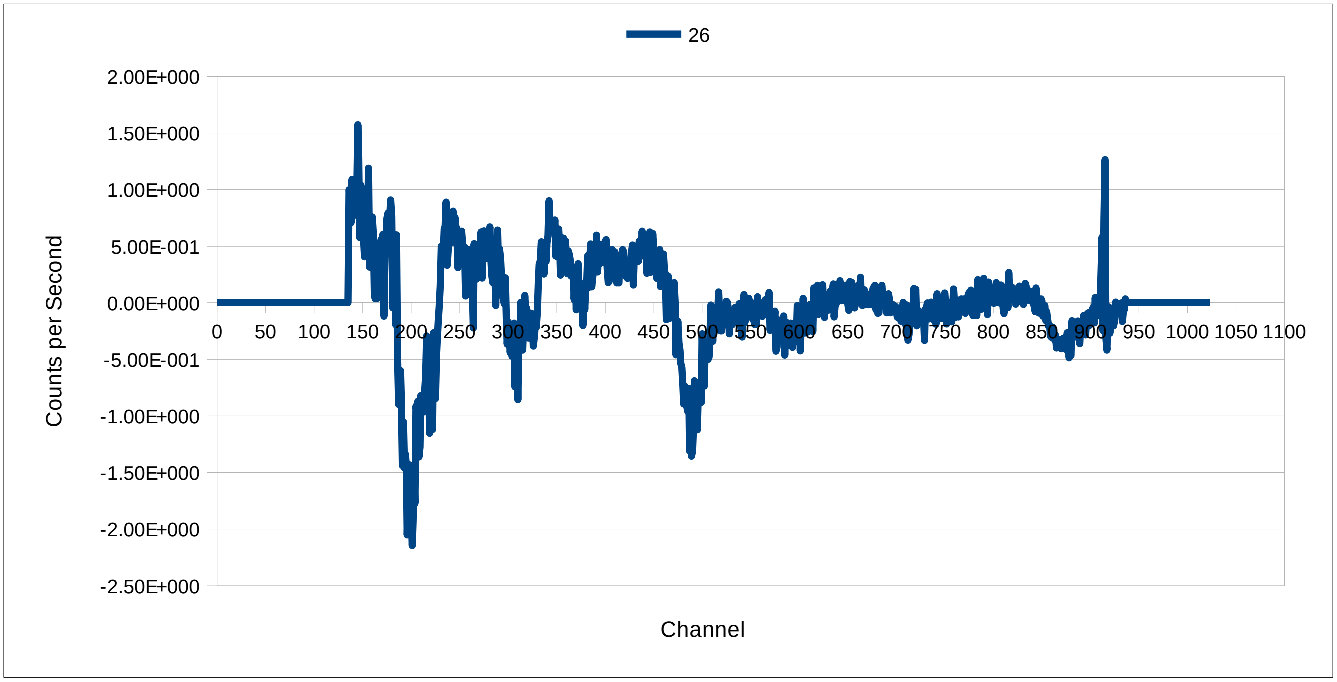


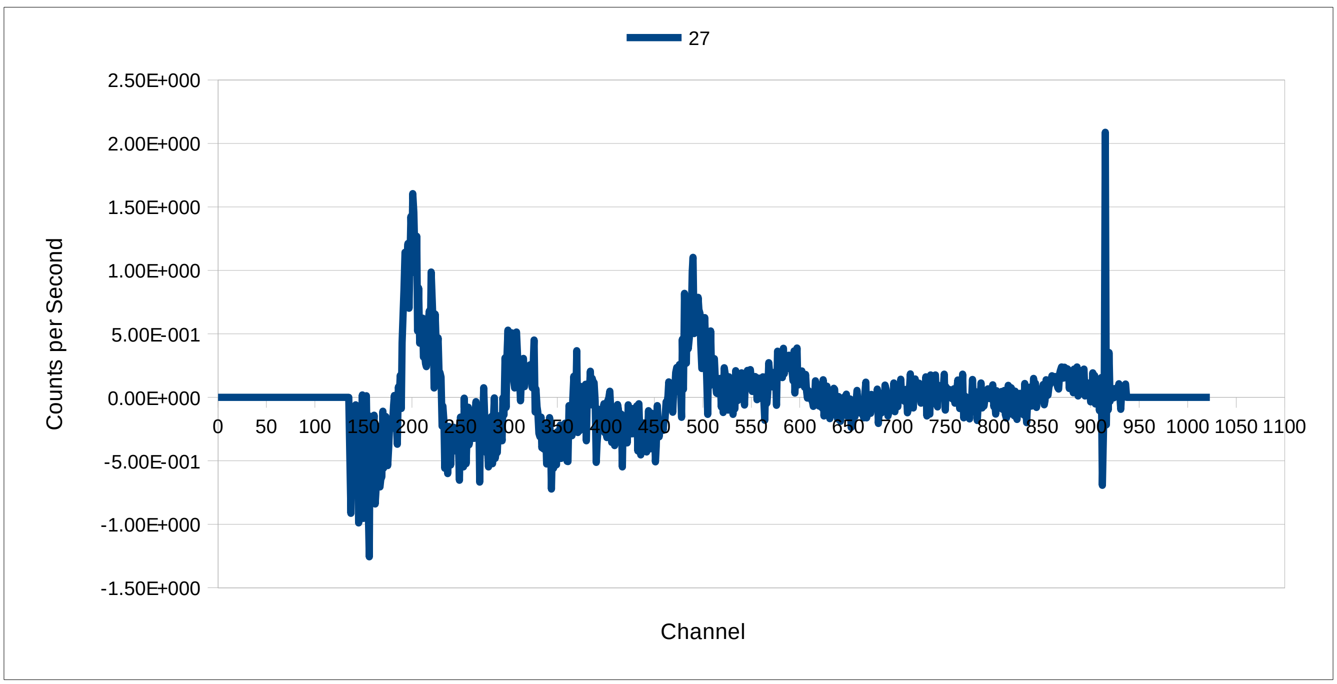
Spectral Components



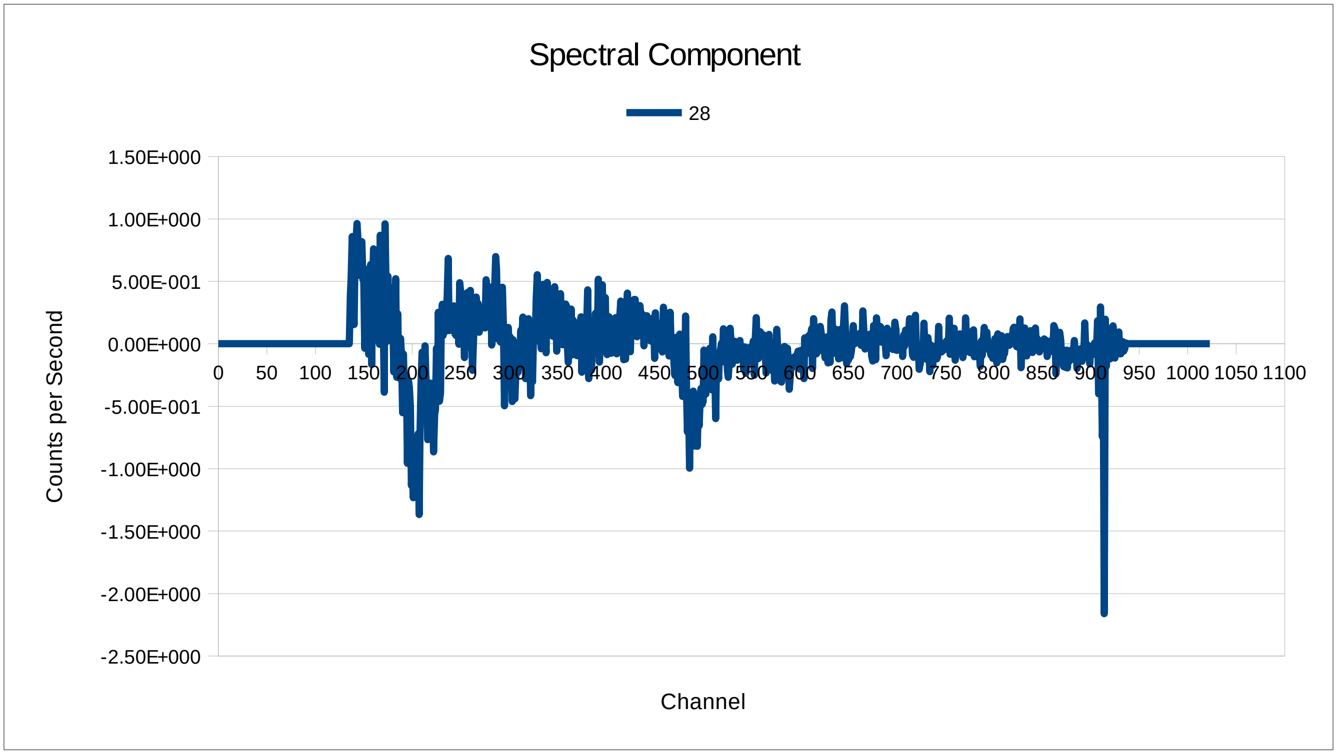


Spectral Components





Spectral Components



SGL

Appendix IX

Scale factors

Line Number	Total Count	Potassium	Uranium	Thorium	Time Start (sec)	Time End (sec)
1039.00	0.90	0.90	0.90	0.90	37014	37051
1042.00	1.00	1.15	1.15	1.00	38588	38638
1043.00	1.00	0.85	0.85	1.00	39421	39466
1044.00	1.00	1.20	1.20	1.00	39805	39834
1045.00	1.00	0.70	0.70	1.00	40640	40687
1046.00	1.00	1.30	1.00	1.00	41018	41062
1047.00	1.00	1.10	0.80	1.00	45630	45683
1048.00	1.00	0.90	0.90	1.00	46443	46489
1049.00	1.00	1.10	1.30	1.00	46789	46834
1050.00	1.00	0.90	0.90	1.00	47628	47669
1051.00	1.00	1.10	1.10	1.00	48002	48046
1052.00	1.00	0.90	0.90	1.00	48792	48836

DC Shift

Line Number	DC Shift Uranium Concentration (ppm)	Time start (sec)	Time End (sec)
1046.00	0.8	41018	41062

SGL

Appendix X

Digital Video Inventory

Flight Line	Flight	Data Time Start	Data Time End	Video Filename (.avi)
101.00	11	57289.2	57406.8	C0101.0B_0011
102.00	11	33846.1	34077.4	C0102.0F_0011
103.00	11	40380.4	40462	C0103.0F_0011
103.10	11	52734.2	53088.3	C0103.1F_0011
104.00	11	39400.8	40279.4	C0104.0B_0011
105.00	11	53276.2	54211.3	C0105.0B_0011
106.00	11	55164.7	56016.7	C0106.0B_0011
107.00	11	54315.6	55073.2	C0107.0F_0011
108.00	13	50717.1	51472.2	C0108.0F_0013
109.00	11	56178.7	56261.1	C0109.0F_0011
109.01	17	31281.6	32049.9	C0109.0F_0017
110.00	13	51645	52388.7	C0110.0B_0013
110.01	13	52602.9	52709.9	C0110.0F_0013
111.00	13	48814.7	49543.4	C0111.0F_0013
112.00	13	33559.1	33754.8	C0112.0F_0013
112.01	13	49639.6	50266.3	C0112.0B_0013
113.00	13	34186.6	34373.3	C0113.0F_0013_1
113.02	17	32271.6	32792.8	C0113.0B_0017
114.00	13	38820.4	39440.9	C0114.0F_0013_1
115.00	13	46493.6	46990.3	C0115.0F_0013_2
116.00	13	47172.1	47493.9	C0116.0B_0013
116.01	13	47733.6	47828.8	C0116.0F_0013_1
117.01	17	30300.4	30539.7	C0117.0B_0017
118.00	13	35239.6	35368.1	C0118.0B_0013
1001.00	4	33128.8	33209.6	T1001.0F_0004
1002.00	4	33333.3	33410.5	T1002.0B_0004
1003.00	4	33531.2	33648.9	T1003.0F_0004
1004.00	4	33780.2	33891.4	T1004.0B_0004
1005.00	4	34029.1	34156.3	T1005.0F_0004
1006.00	4	34309.4	34457.4	T1006.0B_0004
1007.00	4	34598.3	34745.8	T1007.0F_0004
1008.00	4	34892.8	35052.4	T1008.0B_0004
1009.00	4	35199.7	35388.5	T1009.0F_0004
1010.00	4	35534.5	35714.6	T1010.0B_0004
1011.00	4	35860.8	36076.4	T1011.0F_0004
1012.00	4	36204.1	36417.2	T1012.0B_0004
1013.00	4	36556.9	36785.8	T1013.0F_0004
1014.00	4	36924.6	37174.4	T1014.0B_0004
1015.00	4	37319.5	37558.9	T1015.0F_0004
1016.00	4	37685.3	37942.5	T1016.0B_0004
1017.00	11	40825.6	41111	T1017.0B_0011
1018.00	11	41530.1	41813.3	T1018.0B_0011_1
1019.00	11	42247.8	42580.8	T1019.0B_0011_1
1020.00	11	42931.8	43260.6	T1020.0B_0011
1021.00	13	30304.7	30608	T1021.0B_0013
1022.00	13	31131.1	31455.1	T1022.0B_0013

Digital Video Inventory

Flight Line	Flight	Data Time Start	Data Time End	Video Filename (.avi)
1023.00	13	31952.4	32272.1	T1023.0B_0013
1024.00	13	32816.6	33133.1	T1024.0B_0013
1025.01	13	36329.5	36652.4	T1025.0B_0013_1
1026.00	13	37194.7	37520.1	T1026.0B_0013
1027.00	13	38058.3	38413	T1027.0B_0013
1028.00	13	45539.1	45899.2	T1028.0B_0013_1
1029.00	13	48099.5	48466.1	T1029.0B_0013_2
1030.00	13	53117.4	53491	T1030.0B_0013_1
1031.00	15	29089.9	29468.7	T1031.0B_0015
1032.00	15	30057.9	30446.6	T1032.0B_0015_1
1033.00	15	31023	31429.9	T1033.0B_0015
1034.00	15	32034.5	32444.8	T1034.0B_0015
1035.00	15	32996	33440.8	T1035.0B_0015
1036.00	15	34035.9	34475.5	T1036.0B_0015
1037.00	15	35026.9	35480.4	T1037.0B_0015
1038.00	15	36067.1	36532.2	T1038.0B_0015
1039.00	15	36627	37154.4	T1039.0F_0015
1040.00	15	37270.5	37741.4	T1040.0B_0015
1041.00	15	37872.8	38369.3	T1041.0F_0015
1042.00	15	38491.8	38956.9	T1042.0B_0015
1043.00	15	39054	39565.7	T1043.0F_0015
1044.00	15	39697.8	40159.5	T1044.0B_0015
1045.00	15	40295.3	40772.8	T1045.0F_0015
1046.00	15	40920.6	41399.8	T1046.0B_0015
1047.00	15	45540.4	46010	T1047.0B_0015
1048.00	15	46099.4	46579.4	T1048.0F_0015
1049.00	15	46703.8	47164.9	T1049.0B_0015
1050.00	15	47294.8	47769.2	T1050.0F_0015
1051.00	15	47906.4	48356.2	T1051.0B_0015
1052.00	15	48465.1	48861.8	T1052.0F_0015
1052.01	17	30850	30920.6	T1052.0B_0017
1053.00	4	56888.5	57389.9	Not Available
1054.00	4	55362.7	55861.2	Not Available
1055.00	4	41192.3	41681.2	T1055.0B_0004
1056.00	4	40583.5	41067.1	T1056.0F_0004
1057.00	4	39983	40491.4	T1057.0B_0004
1058.00	4	39380.5	39852.2	T1058.0F_0004
1059.00	4	38750.8	39248.7	T1059.0B_0004
1060.00	4	38156.9	38639.5	T1060.0F_0004
1061.00	4	41833.2	42319.6	T1061.0F_0004
1062.00	4	42465.7	42976.6	T1062.0B_0004
1063.00	4	43094.6	43579.9	T1063.0F_0004
1064.00	4	43709	44218.7	T1064.0B_0004
1065.00	4	49554.5	50035.4	Not Available
1066.00	4	50159.9	50692.7	Not Available
1067.00	4	50804.9	51287.5	Not Available
1068.00	4	51417.7	51941.2	Not Available

Digital Video Inventory

Flight Line	Flight	Data Time Start	Data Time End	Video Filename (.avi)
1069.00	4	52085.6	52554.1	Not Available
1070.00	4	52687.3	53209.6	Not Available
1071.00	4	53323.1	53793.7	Not Available
1072.00	4	53950.8	54442.4	Not Available
1073.00	1	449.916	454.268	T1073.0F_0001
1074.00	1	455.7	460.73	T1074.0B_0001
1075.00	1	462.187	466.757	T1075.0F_0001
1076.00	1	468.075	472.761	T1076.0B_0001
1077.00	1	474.284	478.631	T1077.0F_0001_1
1078.00	1	480.017	484.915	T1078.0B_0001
1079.00	1	486.381	490.855	T1079.0F_0001
1080.00	1	492.373	497.037	T1080.0B_0001
1081.00	1	498.526	502.957	T1081.0F_0001
1082.00	1	504.575	509.425	T1082.0B_0001
1083.00	1	516.122	520.43	T1083.0F_0001
1084.00	2	41818.8	42308.2	T1084.0F_0002
1085.00	2	42456.1	42895.1	T1085.0B_0002
1086.00	2	43061.6	43568.1	T1086.0F_0002
1087.00	2	43678.1	44100.2	T1087.0B_0002
1088.00	2	44251.1	44727.4	T1088.0F_0002
1089.00	2	44870.3	45304.1	T1089.0B_0002
1090.00	2	45472.5	45972.5	T1090.0F_0002
1091.00	2	46113.1	46530.8	T1091.0B_0002
1092.00	2	46709.9	47190.9	T1092.0F_0002
1093.00	2	47318.9	47767.7	T1093.0B_0002
1094.00	2	47931.8	48428.4	T1094.0F_0002
1095.00	2	48545.5	48970.7	T1095.0B_0002
1096.00	2	49114	49590.3	T1096.0F_0002
1097.00	2	49707.8	50158.6	T1097.0B_0002
1098.00	2	50325.9	50798.4	T1098.0F_0002
1099.00	2	50944.2	51364.8	T1099.0B_0002
1100.00	2	51531.3	52021.6	T1100.0F_0002
1101.00	2	52136.2	52582.9	T1101.0B_0002
1102.00	2	52758.1	53239	T1102.0F_0002
1103.00	2	53368.2	53788.3	T1103.0B_0002
1104.00	2	53935.7	54410.9	T1104.0F_0002
1105.00	2	54528.9	54974.8	T1105.0B_0002
1106.00	2	60674.8	61159.2	T1106.0F_0002
1107.00	2	61292.6	61721.5	T1107.0B_0002
1108.00	2	61861.9	62346.3	T1108.0F_0002
1109.00	2	62483.2	62915.6	T1109.0B_0002
1110.00	2	63087.3	63554	T1110.0F_0002
1111.00	2	63897.7	64099.4	T1111.0B_0002
1111.01	11	65368.3	65596.8	T1111.0B_0011
1112.00	2	64256	64710.8	T1112.0F_0002
1113.00	2	64841.8	65278.1	T1113.0B_0002
1114.00	2	65446.9	65904.4	T1114.0F_0002

Digital Video Inventory

Flight Line	Flight	Data Time Start	Data Time End	Video Filename (.avi)
1115.00	2	66045.6	66463	T1115.0B_0002
1116.00	2	66631.4	67090.7	T1116.0F_0002
1117.00	2	67217.9	67639.1	T1117.0B_0002
1118.00	2	67806.9	68266.3	T1118.0F_0002
1119.00	2	68418.4	68849.3	T1119.0B_0002
1120.00	2	68997.6	69471.6	T1120.0F_0002
1121.00	2	69597.4	70041.7	T1121.0B_0002
1122.00	4	54665.1	55087.9	Not Available
1123.00	4	56152.7	56589.2	Not Available
1124.00	9	58751.2	59168.7	T1124.0B_0009
1125.00	9	59323.6	59815.2	T1125.0F_0009
1126.00	4	57690.4	58116.9	Not Available
1127.00	4	58857.3	59297.5	Not Available
1128.00	4	58257.1	58746.8	Not Available
1129.00	4	59429.3	59902.7	Not Available
1130.00	11	43606.5	44041.4	T1130.0F_0011
1131.00	11	44180.4	44663.5	T1131.0B_0011
1132.00	11	44771.3	45188.6	T1132.0F_0011
1133.00	11	45346.8	45875.7	T1133.0B_0011
1134.00	11	57674	58109.7	T1134.0F_0011_2
1135.00	11	58268.5	58769.5	T1135.0B_0011
1136.00	4	59956.4	60395	Not Available
1137.00	4	60540.4	61015.4	Not Available
1138.00	4	61127.4	61575.2	Not Available
1139.00	4	61708.5	62184.8	Not Available
1140.00	4	62342.9	62783.7	Not Available
1141.00	9	54113.4	54532.7	T1141.0B_0009
1142.00	9	54676.1	55158.7	T1142.0F_0009
1143.00	9	55263.6	55667.3	T1143.0B_0009
1144.00	9	55841.7	56339.2	T1144.0F_0009
1145.00	9	56465.4	56882.9	T1145.0B_0009
1146.00	9	57037.2	57506.7	T1146.0F_0009
1147.00	9	57618.1	58023.5	T1147.0B_0009
1148.00	9	58168.4	58631.3	T1148.0F_0009
1149.00	11	58898.3	59303.6	T1149.0F_0011
1150.00	11	59442.4	59918.3	T1150.0B_0011
1151.00	11	60033.5	60445.1	T1151.0F_0011
1152.00	11	60600.4	61071.5	T1152.0B_0011
1153.00	11	61193.3	61608.5	T1153.0F_0011
1154.00	11	61758.7	62270.9	T1154.0B_0011
1155.00	11	62380.5	62795.8	T1155.0F_0011
1156.00	11	62928.5	63417.1	T1156.0B_0011
1157.00	11	63534.6	63958	T1157.0F_0011
1158.00	11	64090.5	64599.8	T1158.0B_0011
1159.00	11	64698.1	65142.2	T1159.0F_0011
1160.00	6	33205.8	33690.1	T1160.0F_0006
1161.00	6	33813	34260.1	T1161.0B_0006

Digital Video Inventory

Flight Line	Flight	Data Time Start	Data Time End	Video Filename (.avi)
1162.00	6	34408.9	34898.6	T1162.0F_0006
1163.00	6	35015.6	35465	T1163.0B_0006
1164.00	6	35587.2	36075.8	T1164.0F_0006
1165.00	6	36201.4	36628	T1165.0B_0006
1166.00	6	36761.9	37248.4	T1166.0F_0006
1167.00	6	37363	37805.4	T1167.0B_0006
1168.00	6	37909.7	38395.5	T1168.0F_0006
1169.00	6	38517.4	38958.7	T1169.0B_0006
1170.00	6	39102.9	39588.8	T1170.0F_0006
1171.00	6	39727.9	40096.1	T1171.0B_0006
1171.01	6	46949.8	47023.8	T1171.0F_0006_1
1172.00	6	47252.4	47719.7	T1172.0F_0006
1173.00	6	47842.1	48298.6	T1173.0B_0006
1174.00	6	48457.6	48925.5	T1174.0F_0006
1175.00	6	49057.3	49512.5	T1175.0B_0006
1176.00	6	49618.1	50061.3	T1176.0F_0006
1177.00	6	50180.6	50644.7	T1177.0B_0006
1178.00	6	50784.1	51261.4	T1178.0F_0006
1179.00	6	51407.7	51884.6	T1179.0B_0006
1180.00	6	51999.5	52454.1	T1180.0F_0006
1181.00	6	52571.9	53037.2	T1181.0B_0006
1182.00	6	53176.6	53624.9	T1182.0F_0006
1183.00	6	53745.7	54231.3	T1183.0B_0006
1184.00	6	54345.1	54781	T1184.0F_0006
1185.00	6	54910.5	55382.2	T1185.0B_0006_1
1186.00	6	55522.6	55962.6	T1186.0F_0006
1187.00	6	56115	56576.9	T1187.0B_0006
1188.00	6	56692.6	57137.9	T1188.0F_0006
1189.00	6	57266.3	57733.6	T1189.0B_0006
1190.00	6	57872.1	58307.5	T1190.0F_0006
1191.00	6	58442	58910.9	T1191.0B_0006
1192.00	6	59008.5	59453.6	T1192.0F_0006
1193.00	8	31554.7	32064.4	T1193.0F_0008
1194.00	8	32212.1	32658.1	T1194.0B_0008
1195.00	8	32789.7	33270.8	T1195.0F_0008
1196.00	8	33402	33821.2	T1196.0B_0008
1197.00	8	33985	34480.5	T1197.0F_0008
1198.00	8	35783.4	36206	T1198.0B_0008
1199.00	8	34612	35025.5	T1199.0B_0008
1200.00	8	35162.6	35643	T1200.0F_0008
1201.00	8	36356.1	36849.5	T1201.0F_0008
1202.00	8	36964.2	37389.4	T1202.0B_0008
1203.00	8	37534.2	38030.7	T1203.0F_0008
1204.00	8	38171.7	38607	T1204.0B_0008
1205.00	8	38755.1	39247.3	T1205.0F_0008
1206.00	8	39361	39805.4	T1206.0B_0008
1207.00	8	39951	40441.1	T1207.0F_0008

Digital Video Inventory

Flight Line	Flight	Data Time Start	Data Time End	Video Filename (.avi)
1208.00	8	40553.9	40995.7	T1208.0B_0008
1209.00	8	41127.4	41631.1	T1209.0F_0008
1210.00	8	41735.6	42174.8	T1210.0B_0008
1211.00	8	42304.9	42803.3	T1211.0F_0008
1212.00	8	42914.4	43355.5	T1212.0B_0008
1213.00	8	43470.1	43973.9	T1213.0F_0008
1214.00	9	50358.9	50777	T1214.0B_0009
1215.00	9	50926.8	51430.2	T1215.0F_0009
1216.00	9	51544.8	51960	T1216.0B_0009
1217.00	9	52119.3	52609.3	T1217.0F_0009
1218.00	9	52707.1	53124.7	T1218.0B_0009
1219.00	9	53260.8	53763.3	T1219.0F_0009
1220.00	9	60139.4	60563.6	T1220.0B_0009_1
1221.00	9	60697.4	61144.7	T1221.0F_0009
1222.00	9	61263.7	61669.2	T1222.0B_0009_1
1223.00	9	61830.2	62272.8	T1223.0F_0009
1224.00	9	62372.2	62734.4	T1224.0B_0009_2
1225.00	9	62865.3	63284.4	T1225.0F_0009
1226.00	10	28040.6	28412.9	T1226.0F_0010
1227.00	10	28553.3	28913.4	T1227.0B_0010
1228.00	10	29036.7	29382.9	T1228.0F_0010
1229.00	10	29526.2	29866	T1229.0B_0010
1230.00	10	30035.5	30343.5	T1230.0F_0010
1231.00	10	30467	30793.9	T1231.0B_0010
1232.00	10	30940	31225.5	T1232.0F_0010
1233.00	10	31389.8	31704.5	T1233.0B_0010
1234.00	10	31830.1	32089.5	T1234.0F_0010
1235.00	11	34233	34467.7	T1235.0F_0011
1236.00	11	34618.1	34897.3	T1236.0B_0011
1237.00	11	35043.2	35256.4	T1237.0F_0011
1238.00	11	35403.5	35626.8	T1238.0B_0011
1239.00	11	35741.7	35942	T1239.0F_0011
1240.00	11	36069.2	36255	T1240.0B_0011
1241.00	11	36384	36551.3	T1241.0F_0011
1242.00	11	37049.7	37220	T1242.0B_0011_1
1243.00	11	37325	37462.4	T1243.0F_0011
1244.00	11	37609.5	37769.5	T1244.0B_0011
1245.00	11	37905.7	38020.8	T1245.0F_0011
1246.01	17	29749.7	29864.7	T1246.0F_0017
1247.00	11	38378.7	38486.8	T1247.0F_0011
1248.00	11	38608.1	38690.4	T1248.0B_0011
1249.00	11	38803.6	38874.5	T1249.0F_0011_1
1250.00	11	39005.4	39063.5	T1250.0B_0011
1251.00	11	36771.6	36816.9	T1251.0B_0011

SGL

Appendix XI

GEOPHYSICAL SURVEY AIRCRAFT

de Havilland DHC-6 Twin Otter

Registration	C-GSGF
Serial #	642

The de Havilland DHC-6 Twin Otter is an all metal, high wing, twin-engine, short takeoff and landing (STOL) aircraft. The Twin Otter is powered by two Pratt & Whitney Canada PT6A-27 engines. These engines drive a constant speed, fully feathering, reversible propeller. The PT6 turbine engines provide ample power for climbing over steep terrain, working at altitudes up to 7,000 m and can withstand frequent rapid power changes. The aircraft is highly maneuverable, rugged in design and can be flown at speeds from 80 to 160 knots. The low stall speeds and abundant available power make the Twin Otter a safe and effective aircraft for surveys requiring drape flying over rough topography, low air speeds or flights at high altitude. The aircraft has fixed gear, extendable flaps and manually adjustable trim tabs on the primary controls for the roll and pitch axes and full rudder trim for the yaw axis. The aircraft is equipped with full de-icing equipment and sufficient avionics for instrument flying including a flight control system. Supplementary fuel can be added for transoceanic flight. The Twin Otter is certified for IFR flights in known icing conditions.

GEOPHYSICAL SURVEYING

The SGL Twin Otter is fully equipped for airborne magnetic, gravity, radiometric and frequency-domain EM surveys. EM fields are measured with the SGL frequency-domain EM system (**SGFEM**). The four-frequency EM transmitter is located in the right wingtip EM pod, and the receiver is located in the left wingtip EM pod. The magnetic field is measured by up to two sensors allowing for horizontal gradient with one sensor in the composite nose stinger and one in the left wingtip EM pod. Gravity surveys are performed using SGL's state-of-the-art **AIRGrav** system. The Twin Otter can carry up to 63 litres of detector crystals for gamma-ray spectrometer surveys.

DE HAVILLAND DHC-6 TWIN OTTER SPECIFICATIONS

Crew Capacity:
- 2 pilots, 1 operator (optional)

Fuselage:
- semi-monocoque

Wings:
- strut braced, high wing
- outboard ailerons and trim tab, full span flaps

Tail:
- conventional stabilizers
- elevator and rudder with trim tabs

Power Plant:
- Pratt & Whitney Canada PT6A-27, 680 shp, free-turbine gas engine, overhaul 3,600 hours
- three-blade, fully-feathering, constant-speed, reversible propeller, overhaul 3,000 hours or 5 years

Systems:
- dual flight controls with IFR instruments and avionics
- 2-axis autopilot
- full airframe and propeller de-icing

Dimensions:

Wing span	65 ft	19.8 m
Exterior length	51 ft 9 in	15.8 m
Exterior height	19 ft 6 in	5.94 m
Interior usable length	18 ft 5 in	5.61 m
Interior usable width	4 ft 4 in	1.32 m
Interior height	4 ft 11 in	1.5 m
Usable fuel capacity	385 US gal	1,455 l

Weights:

Empty	8,100 lb	3,674 kg
Maximum take-off	12,500 lb	5,670 kg

Performance (2,000 ft ASL, standard day, maximum take-off weight, 1,900 rpm, 1,375 ft-lb tq):

Range, maximum range power (plus reserve)	920 nm	1,704 km
Cruise speed at maximum range power	170 kt	315 km/h
Fuel flow at maximum range power	50 US gal/h	189 l/h
Stall airspeed, landing configuration	58 kt	107 km/h
Service ceiling	25,000 ft	7,620 m
Minimum required runway length	2,500 ft	762 m
Rate of climb	1,600 ft/min	488 m/min
Maximum sustained climb gradient	650 ft/nm	107 m/km

Type of Aviation Fuel: Jet A, A-1, B, JP-1, 4, 5, 8
Maximum Endurance: 8 hours plus 1 hour reserve at maximum range power

GEOPHYSICAL CAPABILITIES

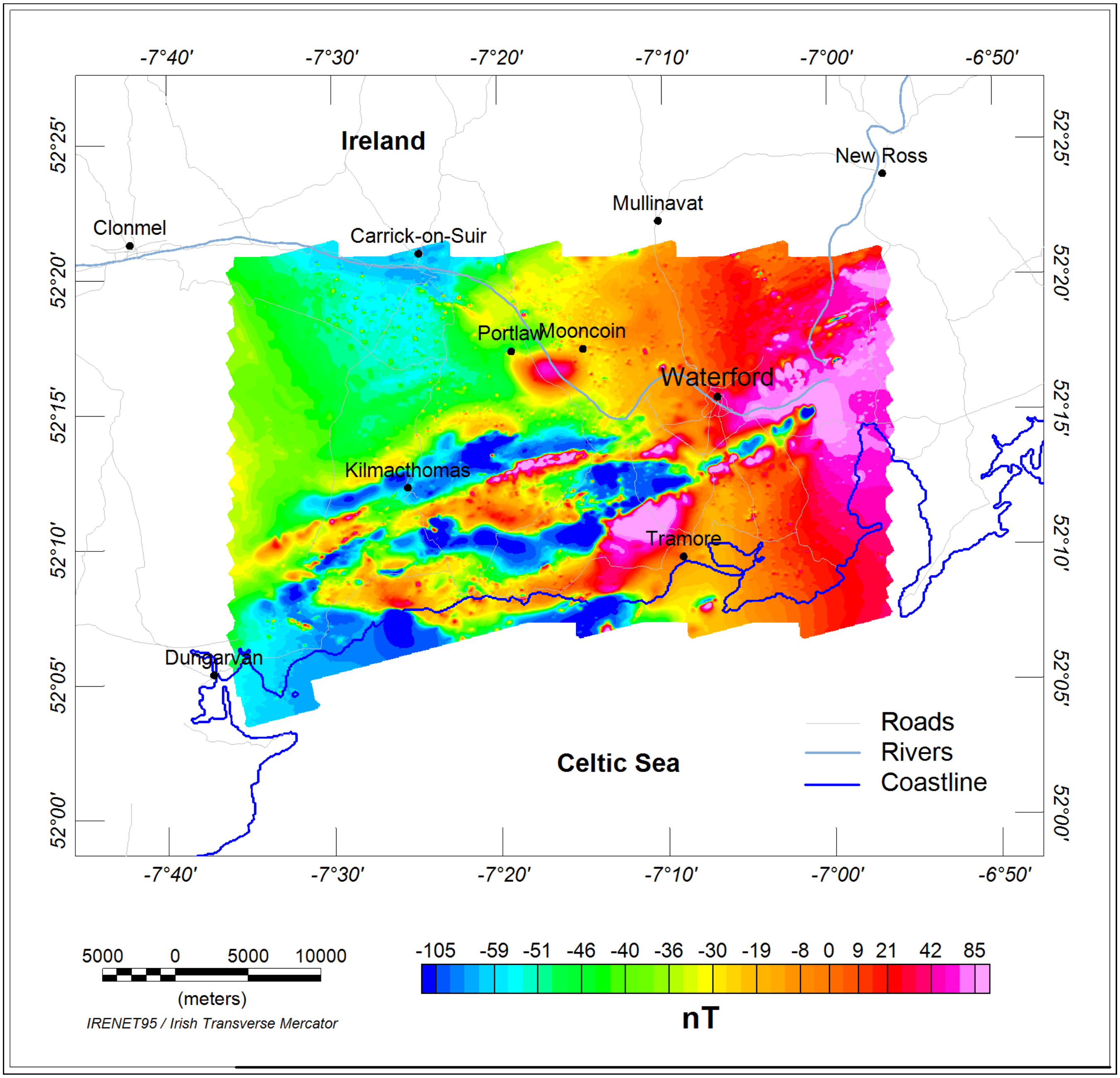
SGFEM, frequency-domain EM
AIRGrav, SGL airborne gravimeter
Magnetic total field
Horizontal magnetic gradient
Gamma-ray spectrometer, up to 63 litres (3,840 in^3) of detector crystals
SGMethane, methane gas sensing

Additional Features:
- Nose stinger, 1.8 m long, 23 cm in diameter, capable of housing a 5.5 kg sensor
- HF radio
- Video camera mount with 23 cm diameter glass covered opening in the belly of the aircraft
- Two instrument racks, standard 48 cm (19 in) width
- Radar altimeter, 0-750 m
- Electrical power capacity, 28 VDC at 200 amp
- Static inverters, 115 VAC - 400 Hz, 110 VAC - 60 Hz
- GPS receiver and antenna

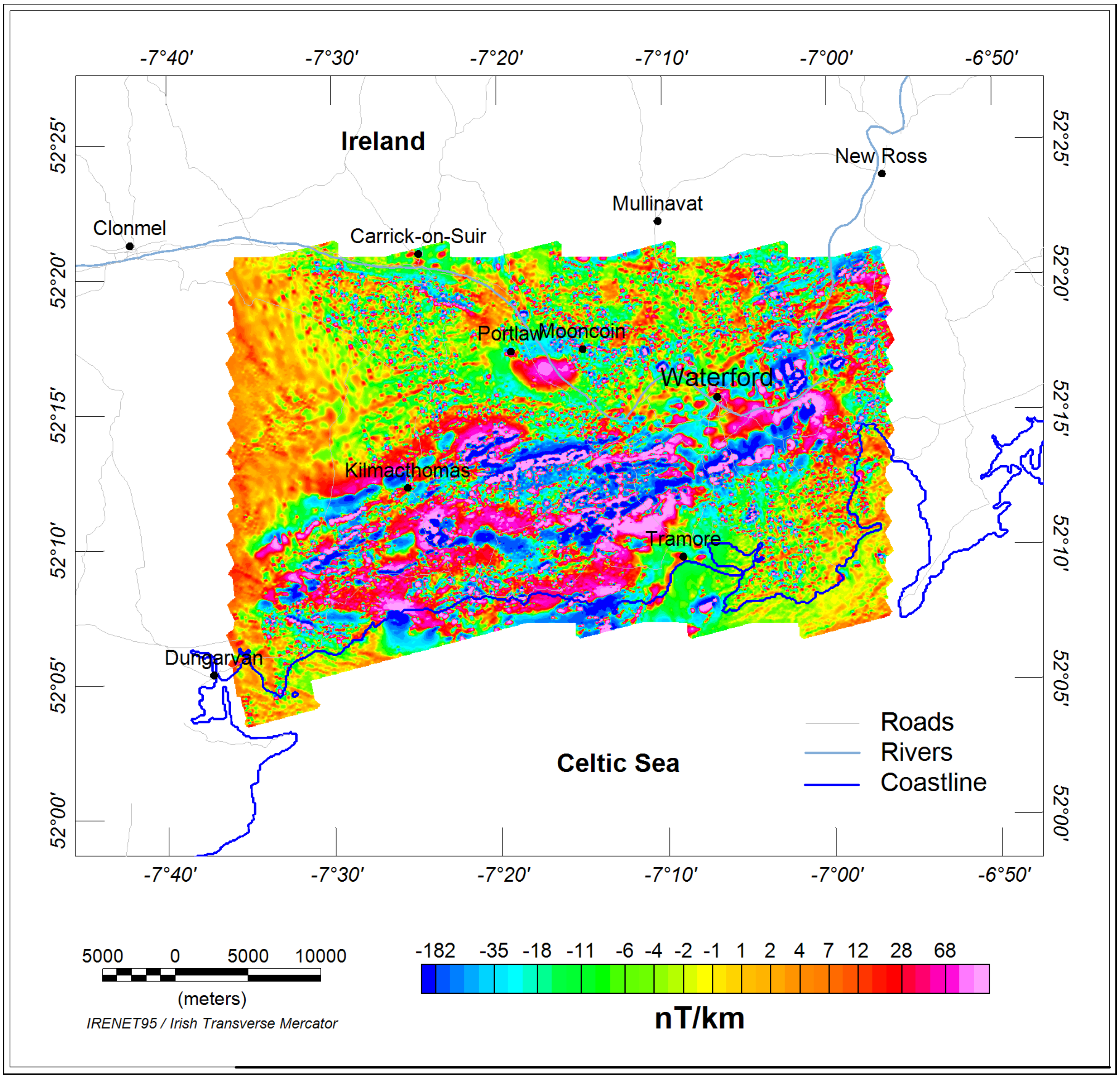
v2.1

Appendix XII

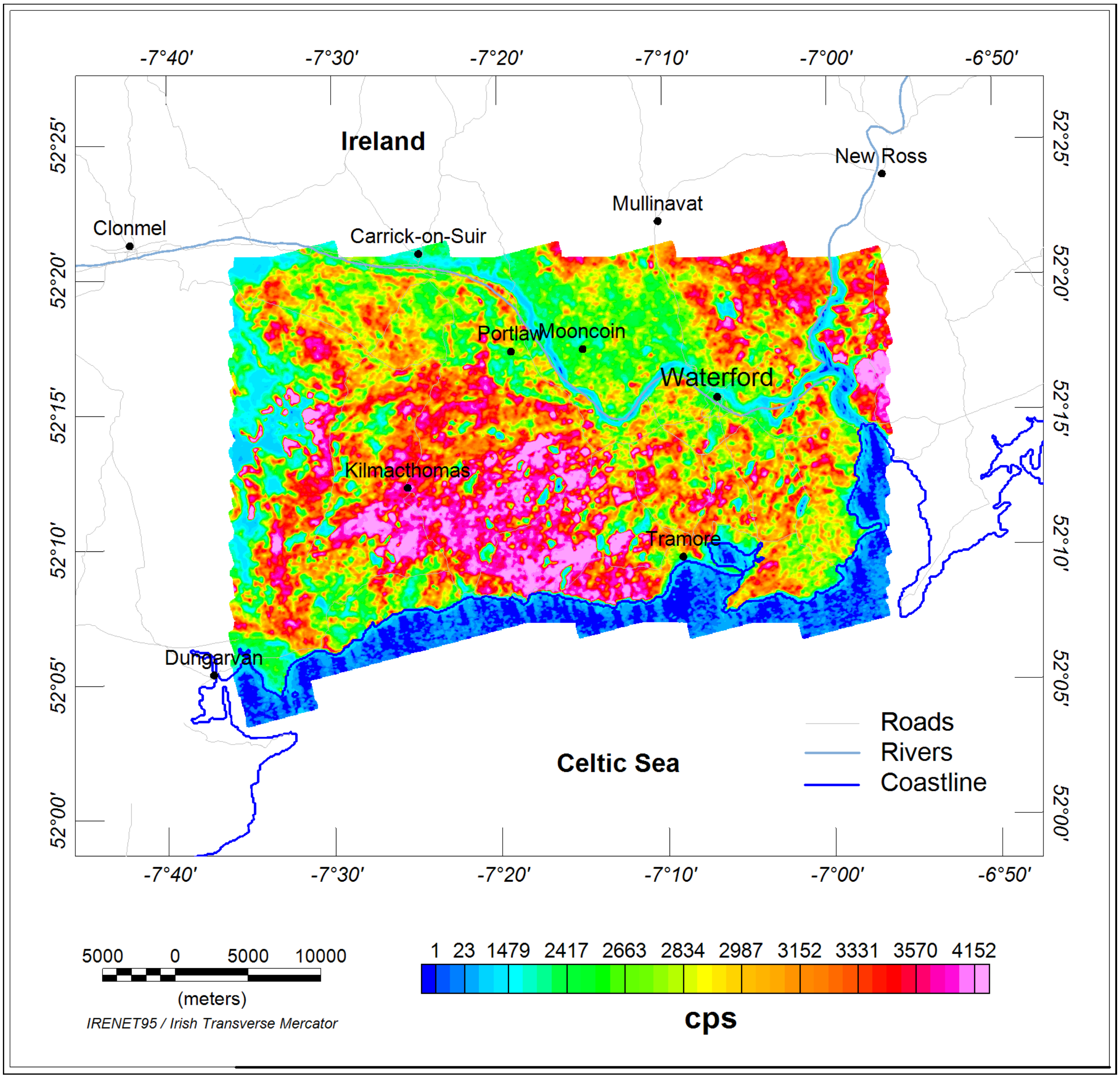
Magnetic Anomaly



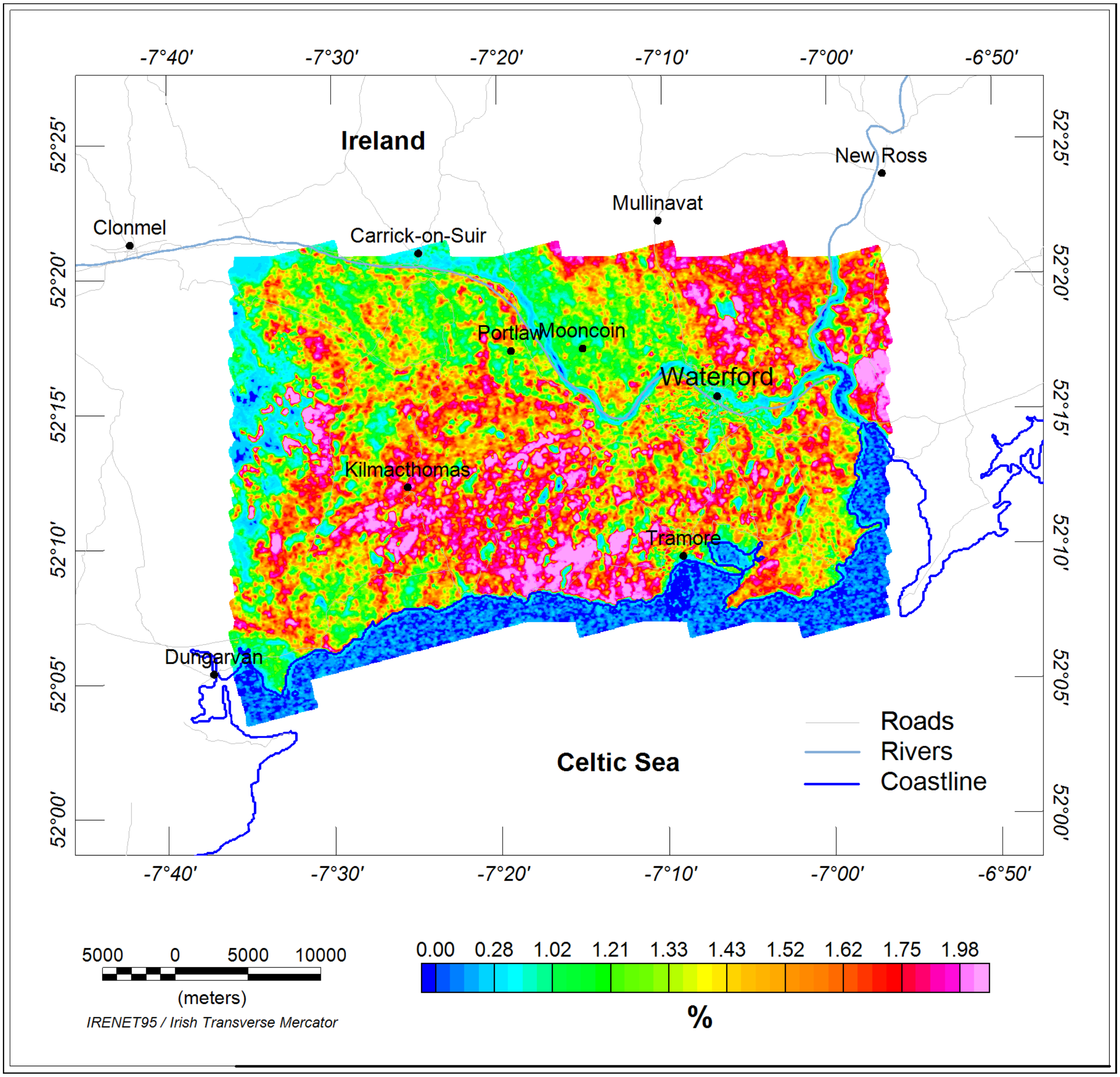
First Vertical Derivative of Magnetic Anomaly



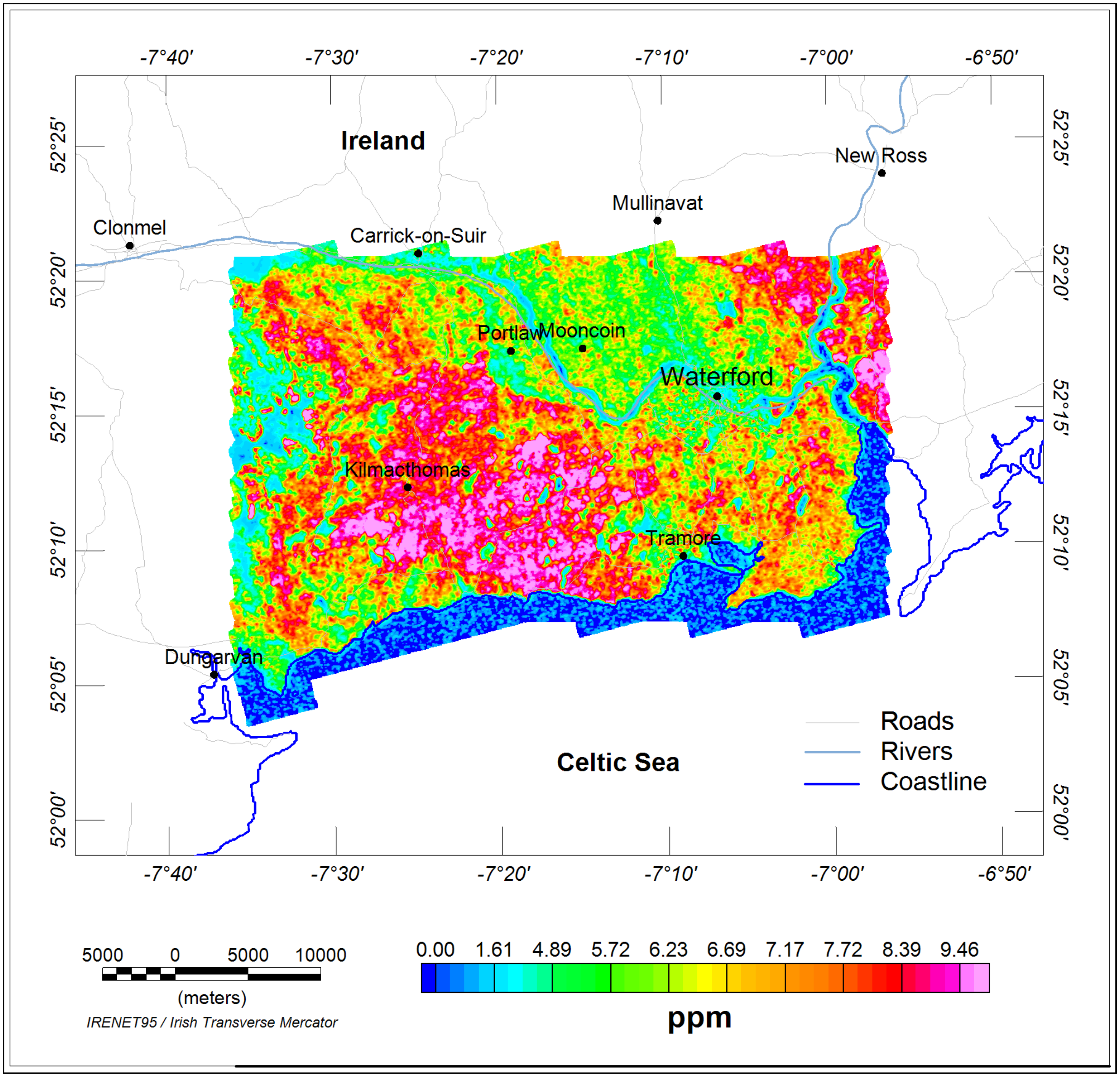
Total Counts



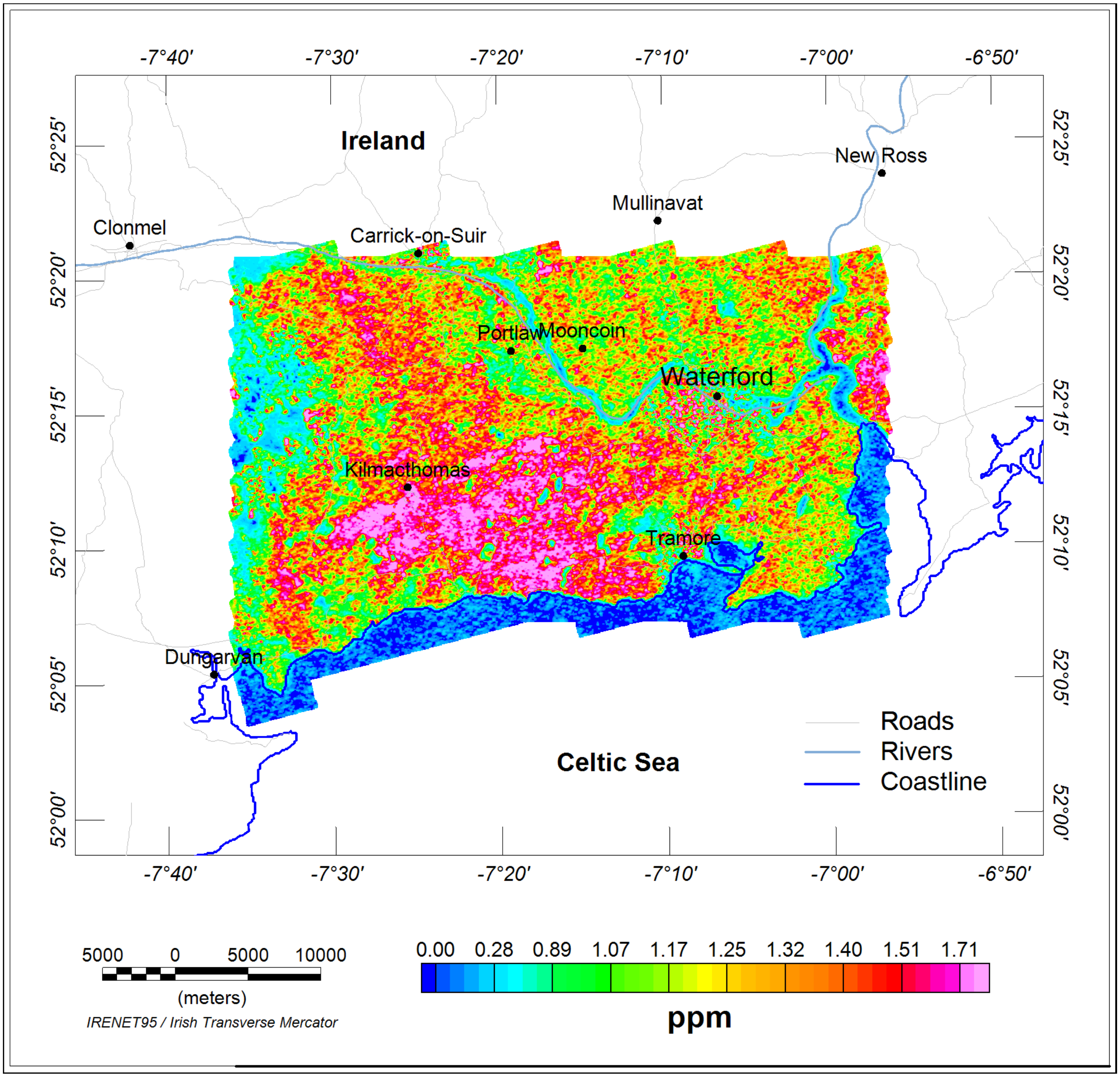
Potassium


-7°40'
-7°30'
-7°20'
-7°10'
-7°00'
-6°50'
52°25'
52°20'
52°15'
52°10'
52°05'
52°00'
Ireland
New Ross
Mullinavat
Clonmel
Carrick-on-Suir
Portlaw
Mooncoin
Waterford
Kilmacthomas
Tramore
Dungarvan
Celtic Sea
Roads
Rivers
Coastline
5000 0 5000 10000
(meters)
IRENET95 / Irish Transverse Mercator
0.00 0.28 1.02 1.21 1.33 1.43 1.52 1.62 1.75 1.98
%

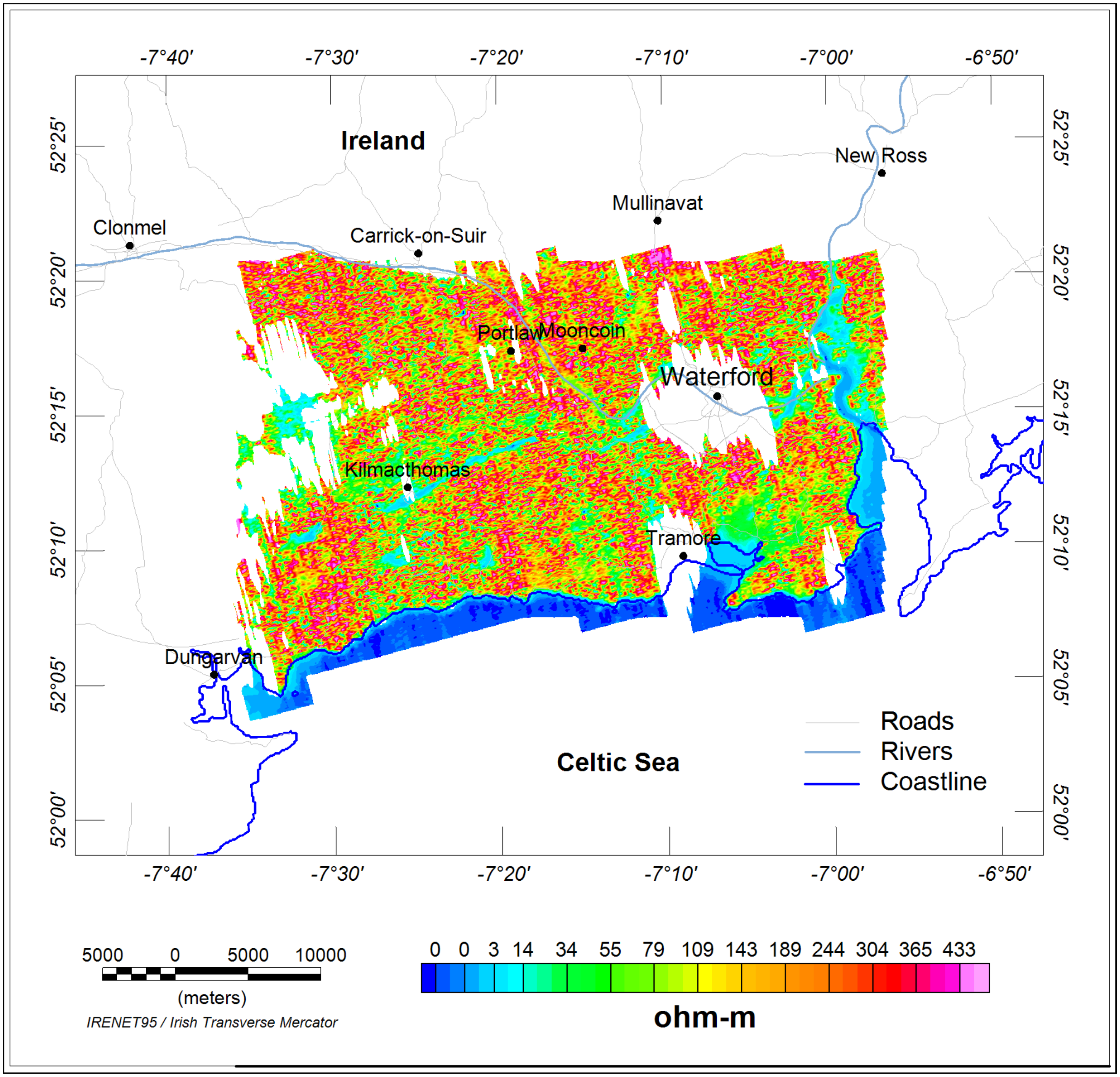
Equivalent Thorium



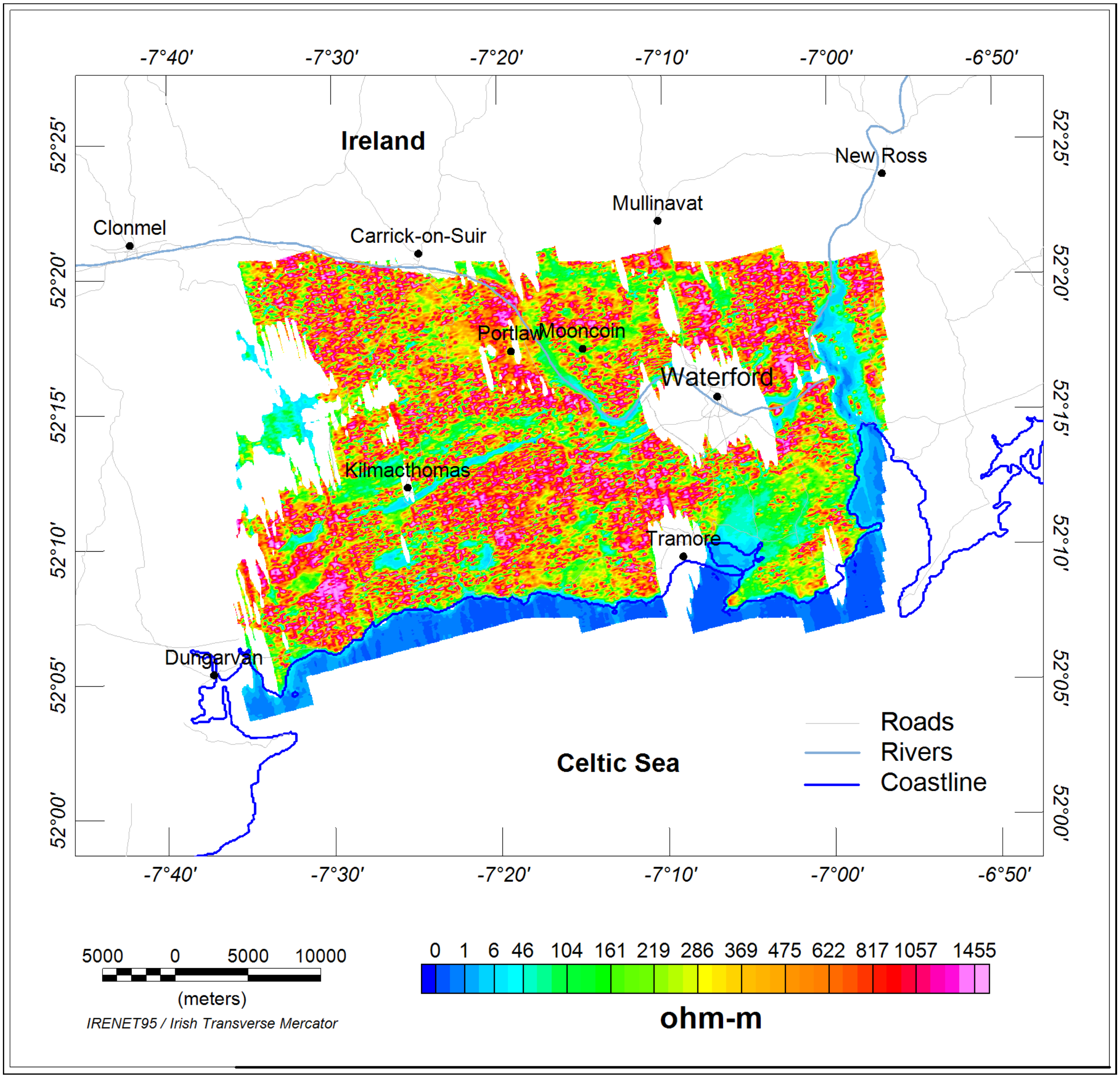
Equivalent Uranium



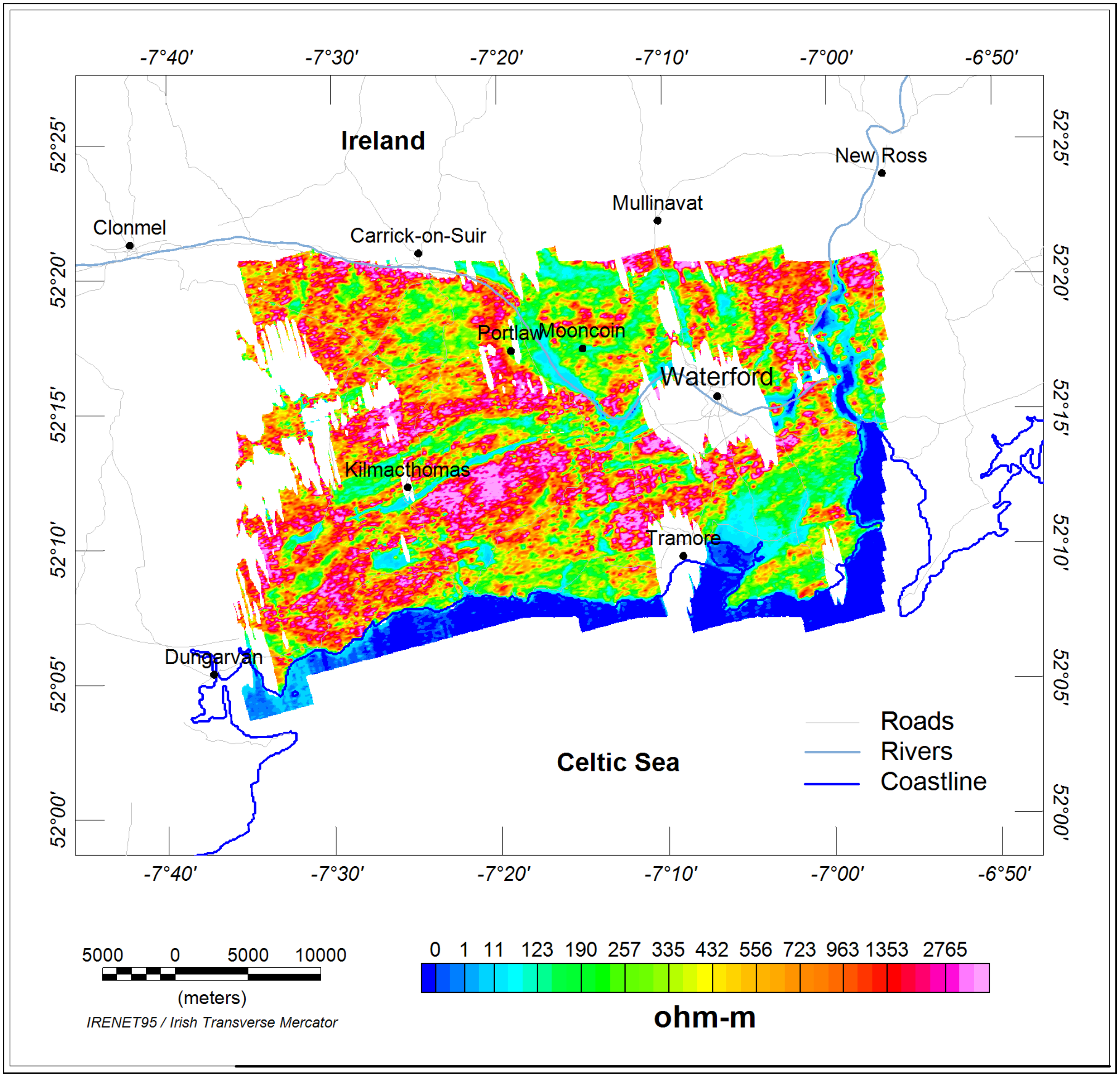
Apparent resistivity, half-space model, 912 Hz
(data limited to <120 m above the ground)



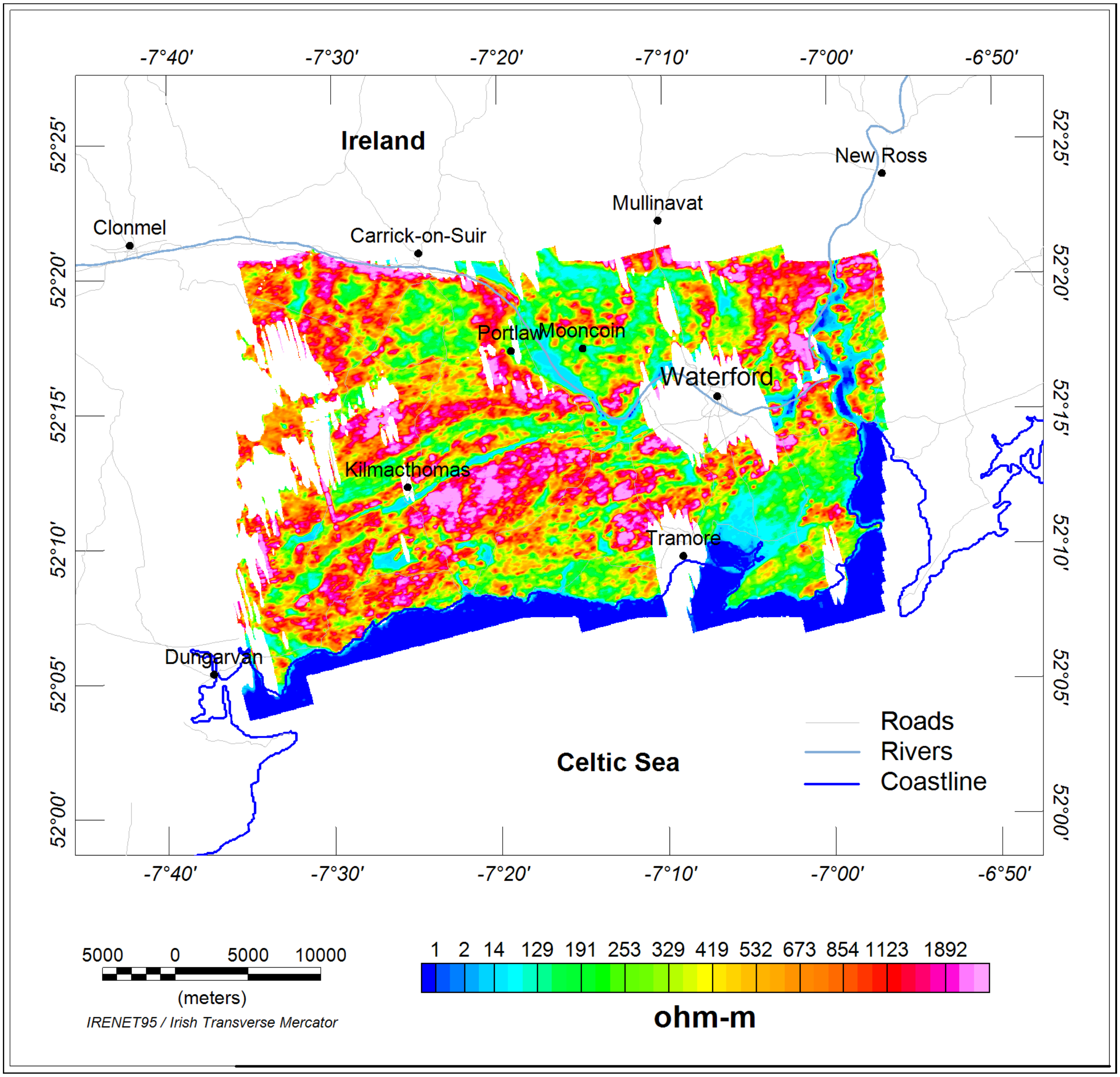
Microlevelled apparent resistivity, half-space model, 3005 Hz
(data limited to <120 m above the ground)



Microlevelled apparent resistivity, half-space model, 11962 Hz
(data limited to <120 m above the ground)



Microlevelled apparent resistivity, half-space model, 24510 Hz
(data limited to <120 m above the ground)



Digital Terrain Model