WORK DECLARATION REPORT

BONTERRA RESOURCES’

Symphony Silver Property

Houston Area, British Columbia

Omineca Mining Division, British Columbia

N.T.S. SHEET 093L

October 4, 2011

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EXECUTIVE SUMMARY

This report was written to summarize work the company has completed on the Symphony property which is situated approximately 30 kilometres to the southwest of the town of Houston, BC. Houston is situated on the Yellowhead highway, the primary transportation corridor serving northern British Columbia, including a large modern port at the western terminus of both the Canadian National Railway and the Yellowhead highway, Prince Rupert. Access to the property from Houston is by the Morice River – Owen Lake Road. The city of Prince George is situated 305 kilometres to the east. Prince George is the largest city in Northern British Columbia.

The Symphony property is composed of 7 unpatented unsurveyed mining claims totaling approximately 2975 hectares in one contiguous block. The Symphony property is situated in the Owen Lake area. This area is the centre of one of the largest Eocene volcanic complexes of the central interior region of British Columbia. The Eocene complex is part of the Challis-Kamloops belt (Leitch, 1991) composed of isolated volcanic fields which extend from the northern United States through British Columbia and into the Yukon Territory.

BonTerra Resources contracted Fugro to complete an airborne survey over the entire property in September of 2011, spending a total of $94,000 on the claim block ($13,428.57 per claim). A total of 308 line kilometres was flown along lines spaced one hundred metres apart. The helicopter-borne survey used a DIGHEM five frequency electromagnetic system, airborne high sensitivity magnetometer and a 256 channel gamma ray spectrometer. The field data includes resistivity data, total magnetic intensity and radiometric total counts. The final report will include DIGHEM EM anomaly maps, resistivity maps, residual magnetic intensity maps, calculated vertical magnetic gradient maps as well as U, Th, K, and TC maps.

The Symphony property is a target for high sulphidation silver mineralization. The principal high sulphidation mineral deposits in the area are the Equity and Silver Queen mines. These deposits are situated several kilometres northeast of Goosly Lake and a few kilometres east of Owen Lake respectably. The Silver Queen mine is contiguous with BonTerra Resources' Symphony property (Mitchell, 2009).

The primary targets in the area are high sulphidation epithermal mineralization, also known as acid sulphate Nansatsu-types (White, 1991). This mineralization is present in some of the siliceous, advanced argillic alteration zones studied. The most notable are those at Mount Macintosh and in the Pemberton Hills area. Mineralization consists of pyrite as veins, disseminations, breccia matrix, and crystalline open-space filling and massive to semi-massive rock replacements. Marcasite is present locally, generally as banded veinlets and fine-grained overgrowths on pyrite grains and rims of rock fragments in breccias. Pyrite commonly forms 5 to 10 volume percent of the rock and up to 30% locally. Typical high-sulphidation assemblages, those derived from strongly oxidized hydrothermal fluids with high sulphur to metal ratios (Mitchell, 2009).

1.0 INTRODUCTION

This report is required to both summarize the recently completed airborne survey on the property. The report is based on:

1: Public data and assessment reports for the area;
2: In-house reference material available in the author's office;
3: Public data reported from mining companies in the immediate vicinity of the property;
4: Airborne field data from Fugro Airborne Geophysics.
5: Field data for the survey will be complimented with final maps and a report.

The Symphony property is composed of 7 unpatented unsurveyed mining claims totaling approximately 2975 hectares located 29km south of Houston, British Columbia. This area is the centre of one of the largest Eocene volcanic complexes of the central interior region of British Columbia, part of the Challis-Kamloops belt which is composed of isolated volcanic fields which extend from the northern United States through British Columbia and into the Yukon Territory.

BonTerra Resources contracted Fugro to complete an airborne survey over the entire property in September of 2011. The targets of this survey are to identify areas prospective for high sulphidation silver mineralization, a total of 308 line kilometres was flown along lines spaced one hundred metres apart. The helicopter-borne survey used a DIGHEM five frequency electromagnetic system, airborne high sensitivity magnetometer and a 256 channel gamma ray spectrometer. The field data includes resistivity data, total magnetic intensity and radiometric total counts. The final report will include DIGHEM EM anomaly maps, resistivity maps, residual magnetic intensity maps, calculated vertical magnetic gradient maps as well as U, Th, K, and TC maps.

1.1 BONTERRA RESOURCES

BonTerra Resources is a Vancouver-based, TSX Venture-listed, public company trading under the symbol "BTR". BonTerra's contact information is as follows:

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2.0 PROPERTY DESCRIPTION AND TENURE

The Symphony property consists of 7 unpatented unsurveyed mining claims totaling approximately 2975 hectares. The full list of claims is present in table 1 with a map of the claims shown by figure 1.

The mineral tenures are numbered: 649483, 649484, 649503, 649563, 879189, 879209 and 879229. All of the claims are held in good standing by BonTerra Resources (100%).

The claims are located approximately 29 kilometres southwest of the town of Houston, BC in the Omineca Mining Division as shown by figure 1. The property is road accessible. From the town of Houston, drive on the all-weather Owen Lake Road.

Table 1: Property summary; see Appendix 1 for a claim list

Property Name	Number of Claims	Area Ha[1]	Interest	Current Good to Dates
Symphony	7	2975	100%	October 9, 2011 & August 2, 2012
Totals	**7**	**2975**		

1: Nominal areas based on polygons depicted on MTO claim maps.

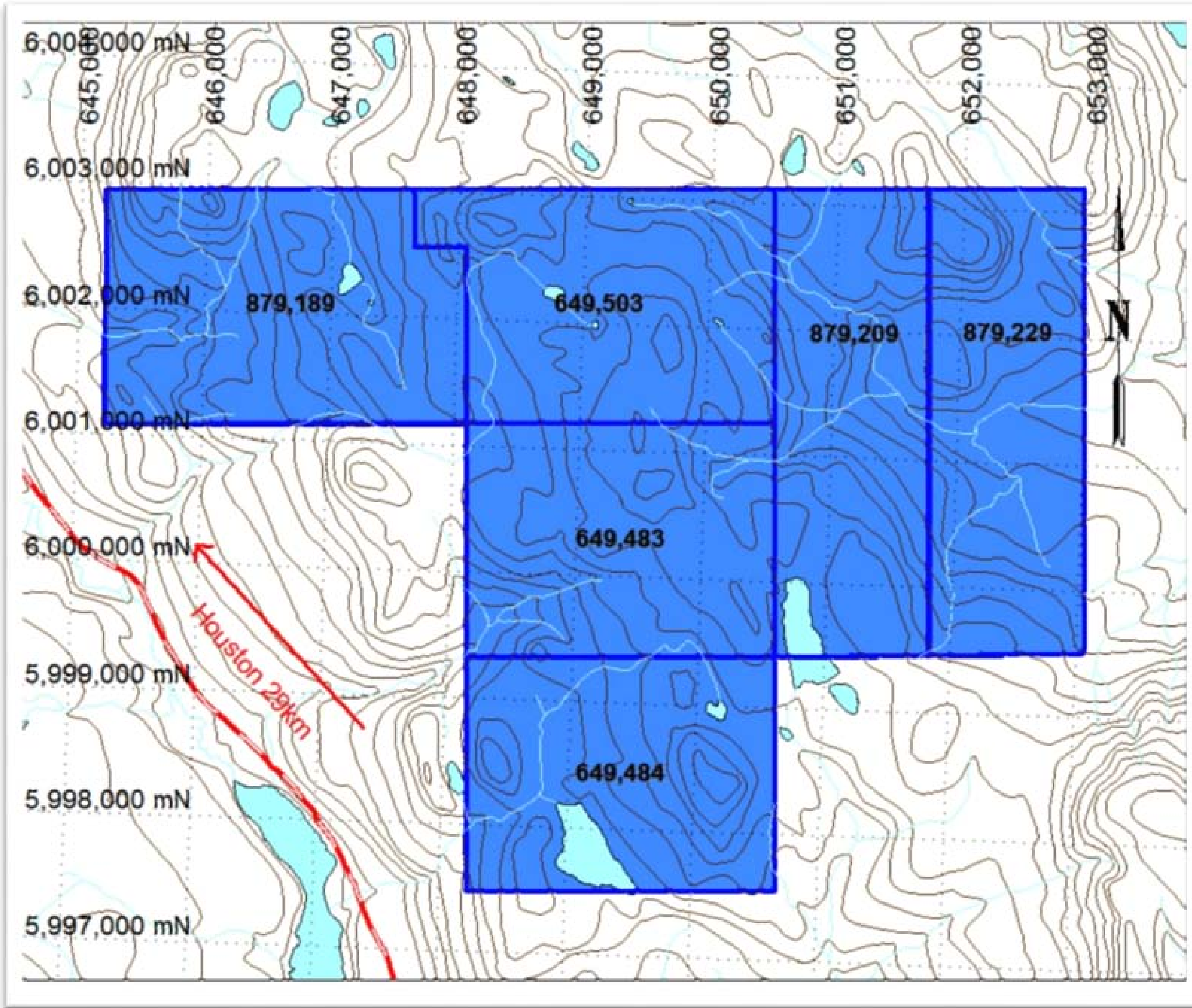

Figure 1: Claim map for the Symphony property (UTM NAD83 Zone 9)

3.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE & PHYSIOGRAPHY

3.1 LOCATION AND ACCESS

Access to the property is provided by road. The property is located 29km southwest of Houston, British Columbia (N.T.S. 93L) as shown in figure 2. Houston is 305 kilometres northwest of the city of Prince George. The property is an approximate 4 hour drive from Prince George. Prince George is the largest city in Northern British Columbia with a population of approximately 80,000. Road access to Prince George is via the Yellowhead Highway #16.

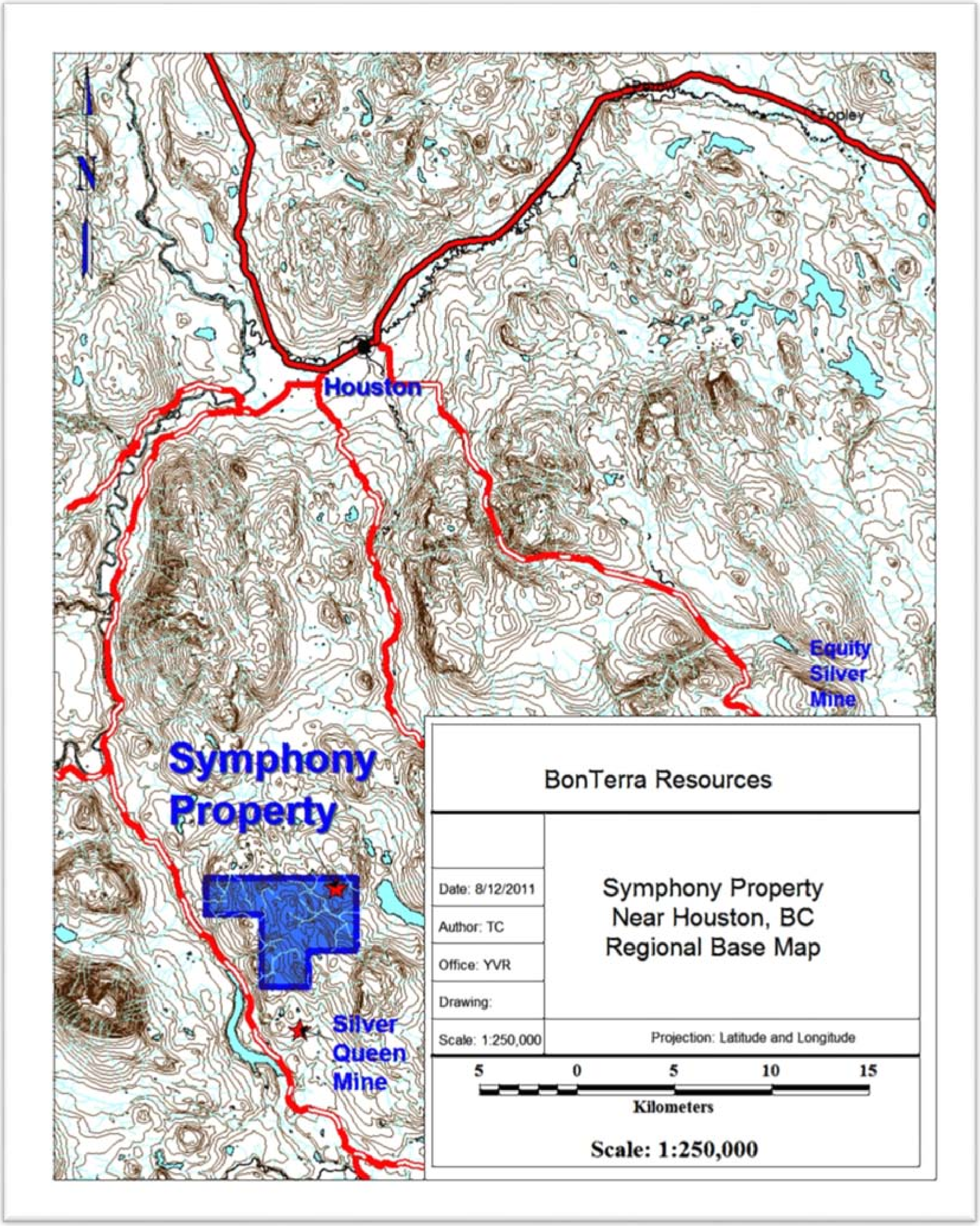

Figure 2: Regional base map and location of the Symphony property

3.2 CLIMATE AND PHYSIOGRAPHY

The climate of the area is temperate with warm summers and cold winters, with the average annual precipitation totaling approximately 500 mm (rain and snow). Summer mean temperatures average 15°C range with moderate precipitation. Winters are cold, with mean temperatures averaging –12°C, but it can get as low as –20°C for periods of time.

The vegetation is heavy and dominated by poplar, willow, spruce and fir. In addition there is a thick ground cover.

The Symphony property is composed of moderate slopes and rolling hills to the north of the Silver Queen Mine. The southwestern portion of the property has low relief. The elevations range from 2,500 feet at the access road to over 4,000 feet at the summit of Tip Top Hill. Outcrop is quite scarce due to an overburden which can exceed 100 feet thick locally.

3.3 INFRASTRUCTURE

The region has a skilled workforce. This workforce works on the regions numerous exploration and development projects as well as forestry. Houston is the town closest to the property. There limited supplies as well as groceries can be purchased. The property can be accessed by well-maintained forestry roads and the Yellowhead Highway. The town of Smithers, to the west of Houston offers commercial flights and has a sample prep lab.

4.0 PROPERTY HISTORY AND PREVIOUS EXPLORATION

HISTORY OF SILVER EXPLORATION IN THE HOUSTON AREA

There has been no previously documented exploration on the Symphony property after examining assessment reports. This said mining assessment work is abundant for the area, especially the Silver Queen Mine which is contiguous to the Symphony property (Mitchell, 2009). BonTerra spent a total of $94,000 (CAD) on the airborne survey.

SUMMARY OF EXPLORATION FOR THE NEIGHBOURING SILVER QUEEN MINE

1910's

1912: Mineralization discovered, three adits driven on the Wrinch vein system.

1915: 38 tons of ore (31% Pb and 6 Oz Ag) shipped from two shallow shafts.

1920's

1923: optioned to Federal Mining and Smelting Co., more than 500 feet of drifting done from the three adits.

1928: Silver Queen and Cole Lake properties acquired by Owen Lake Mining and Development Company, Cole Shaft sunk, a 3,000 feet cross-cut driven.

1940's

1941: Canadian Exploration (now Placer Development) purchased Silver Queen claims, and optioned Cole Lake property; surface and underground mapping and sampling completed.

1943: The option on the Cole Lake ground dropped, work continued on Silver Queen veins until 1947.

1960's

1963: Nadina Explorations Ltd optioned Silver Queen claims; diamond drilling, trenching, and underground development on the No. 3 vein – traced Wrinch vein system south to the "Ruby Extension zone"

1966: Nadina continued underground and surface work on the property.

1967: Property optioned to Kennco Explorations; geological mapping, soil sampling and IP survey done; several deep holes drilled to test for porphyry copper mineralization.

1968: Nadina continued work on Silver Queen veins; soil sampling, trenching, diamond drilling and underground mapping done 1969 - BC Ministry of Energy, Mines and Petroleum Resources mapped entire property in detail, as well as the area surrounding Owen Lake. Nadina completed 4,000 feet of drifting, 51 drill holes (both underground and surface) plus airborne geophysical surveys.

1970's

1970: Northgate Explorations optioned the property from Nadina; did extensive underground check sampling, 13,500 feet of surface drilling, 1,500 feet of underground drilling and 4,200 feet of drifting and raising.

1971: Bralorne Can Fer Resources Limited and Pacific Petroleum Ltd. optioned the property, and formed the Bradina Joint Venture; feasibility study prepared by Dolmage Cambell and Associates, surface EM and IP surveys, 6,000 feet of surface drilling and 800 feet of drifting and raising done.

1972: Property put into production in March, 1972, using equipment from Bralorne's recently closed gold mine in southern B.C.

1973: Operations ceased September, 1973 due to an over design of the mill and complex metallurgy. 200,000 tons of ore milled. Drill indicated reserves (Historical; not 43-101 compliant) on the Wrinch vein system at mine closure were 577,600 tonnes averaging 3.7 g/t Au, 257 g/t Ag, 6.53% Zn, 1.49% Pb, and 0.49% Cu. During 1972-73, 47 surface holes and 68 underground holes, totaling over 20,000 feet drilled.

1974: 5,900 feet of drilling done, JV agreement terminated.

1977: Nadina purchased Silver Queen property outright in 1977; Placer retained back in right,

this hampered the involvement of larger companies in the property. Property optioned by New Frontier Petroleum Ltd, the successor company to Frontier Explorations Ltd. which held the Cole Lake property. Limited deep surface drilling done
and the option dropped in 1978.

1980's

1980: Nadina reorganized as New Nadina Explorations Limited; a major program of backhoe trenching done, as well as surface drilling and rehabilitation of underground workings.

1981: rehabilitation completed, additional drifting done, and 28 underground and 4 surface drill holes drilled (a total of over 8,000 feet).

1982: Campbell Resources did detailed re-evaluation of the Silver Queen property in 1982, completed limited metallurgical testing.

1983–84: New Nadina completed 7,500 feet of surface diamond drilling in 15 holes.

1985: Bulkley Silver optioned the New Nadina ground to put the entire camp under one management; a max-min EM survey and 6 diamond drill holes were completed.

1987: JV formed between Houston Metals Corp, the successor to Bulkley Silver (later reorganized as Pacific Houston Resources Inc.), and New Nadina. In excess of $7,500,000 was spent on exploration on the property during 1987 and 1988, including 35,000 feet of diamond drilling and 8,100 feet of tunneling, cross-cutting, and declining; minor metallurgical work done.

1988: A pre- NI43-101 resource estimate of indicated reserves was published. Although total proven, probable and possible reserves for the veins have been published at 1.7 million tons (Houston Metals Corp, Annual Report 1988); this does not take these mineralogical and metallurgical variations into consideration. (Note – this figure is not 43-101 compliant).

1989: University of British Columbia became involved under NSERC grant; Numerous studies done including geological mapping, structural studies, 2 M.Sc. theses (mineralogy, ore reserves), 1 Ph.D. thesis (alteration) Non 43-101 compliant "in situ mining resource" determined for central and south areas.

1990's

1990: Pacific Houston bankrupt, New Nadina assumed the debts and purchased the claims outright from Pacific Houston. Also in 1990, an agreement was reached with Placer, whereby Placer signed over all remaining rights to the property.

1991: New Nadina addressed site remediation through a study by consultant Tom Higgs, to develop a system of treating zinc rich mine drainage prior to release into the environment.

1992: A tailings pond/wetland passive treatment system was implemented to treat mine drainage.

1993: Present Ongoing water sampling by New Nadina to test mine drainage, as required by the Ministry of Environment.

1995-1996
New Nadina Explorations abandoned the old Silver 4 claim and re-staked the property as the current Owen 1 - 5 claims. An Explore BC Grant was obtained to assist in a thorough compilation project of previous data on the property, interpretation of this data and target generation based on the results. The metallurgy of the known ore was also to be addressed and further metallurgical testing to be done if warranted. This proved to be unnecessary. Sampling of water treated by the wetland option indicates that this treatment is working well, however contamination is occurring in the old mill site/waste dump areas. A significant reclamation program was undertaken to rectify this problem. This reclamation program has been filed for assessment. It is not part of the Explore BC Grant program described in this report. A combined program of satellite imagery analysis, Digital Elevation Modeling and regional aeromagnetics was done to identify regional controls for bulk tonnage mineralization. A re-evaluation of property scale geophysics was initiated to provide further control.

1996: Spring Drill program, L. Caron (report #832) - Five NQ diamond drill holes were drilled in May, 1996, for a total of 3,041 feet and Fall Drill program, L. Caron (report #865). Five NQ diamond drill holes, a total of 3,027 feet, were drilled from November 16 to 27, 1996.

1997: Drill core storage lists by Jim Hutter (report #910)

1998: PIMA short wave spectroscopy (#926), ERA Maptec structural report (#929), compiled by G. Stewart into report #1064.

1999: Reclamation, Trenching and Water Sample report #1211. During the period Nov 3 – 10/ 99, a 690 John Deere excavator was used to deepen the existing 75 metre long trench. The rocky knoll was drilled and blasted for a length of 10 metres, 3-4 metres wide and approximately 1.5 metres deep. The rock was removed.

<u>2000's</u>

2000: Lab Physical Property Tests on Samples from Silver Queen, Quantec Geoscience, Apr 17, 2000 (report #1011).

2005: GPS of claims by J. Hutter (report #1117), a 3-D, and IP survey on 2 selected areas by SJ
Geophysics (report #1126) and one hole drilled by Beaupre Drilling (report #1120). Sampling by J.Hutter.

2008: Trench Reclamation conducted by local rancher.

2009: Reclamation of trenches east of mine hill, raise covers installed, Cole Shaft covered, fences repaired around raises, cleaned site.

<u>2010's</u>

2010: Re-sampled core for verification purposes, 10 person container camp installed complete with septic and water system, geophysics (EM16), soil sampling and diamond drilling.

2010-2011: Diamond drilling continues on the property.

4.1 AIRBORNE GEOPHYSICAL SURVEY (2011)

BonTerra Resources decided to conduct an airborne survey of the Symphony property to identify structures to target for further exploration and to identify areas prospective for high sulphidation silver mineralization. The total cost of the survey was $94,000 and was completed by Fugro over the entire property in September of 2011. A total of 308 line kilometres was flown along lines spaced one hundred metres apart. The helicopter-borne survey used a DIGHEM five frequency electromagnetic system, airborne high sensitivity magnetometer and a 256 channel gamma ray spectrometer. The field data includes resistivity data, total magnetic intensity and radiometric total counts. The final report will include DIGHEM EM anomaly maps, resistivity maps, residual magnetic intensity maps, calculated vertical magnetic gradient maps as well as U, Th, K, and TC maps. The Flight lines and overall survey are shown in appendix 2. The total magnetic field is attached as appendix 3. At the time of writing, resistivity was available in two frequencies. The 56,000 Hz resistivity map is seen in appendix 4. Appendix 5 contains the resistivity map for the 7200 Hz frequency. Lastly, appendix 6 shows the map of total radiometrics.

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5.0 GEOLOGICAL SETTING

The following description is excerpted from a paper by Dostal, J., Robichaud, D.A., Church, B.N., and Reynolds, P.H. entitled Eocene Challis-Kamloops volcanism in central BC, an example from the Buck Creek basin (Mitchell, 2009).

"During the early Tertiary, prominent magmatic activity related to interaction between the North American and Farallon plates produced numerous intrusive and volcanic complexes along the length of the Canadian Cordillera (Armstrong and Ward 1991). Widespread magmatism began 60 Ma, culminated at 50 Ma, and by 40 Ma was sporadic and localized. The magmatic culmination coincided with major plate reorganization in the Pacific basin. By mid-Eocene, there was an abrupt change in movement of the North American and Farallon plates (Engebretson et. al.1985) from orthogonal to oblique along the continental margin of western Canada (Hyndman and Hamilton 1993). Tectonic regimes along the plate' margin, including contrasting local environments, may be reflected in the composition of the volcanic rocks, although subsequent tectonic activity can complicate the interpretation of the original setting (e.g. Monger et al-1982). Some volcanic suites are inferred to have had a subduction-related origin while others may have been generated in a trans-tensional setting (Souther 1991). However, few geochemical data for suites of this age in the Canadian Cordillera are available to constrain the various tectonic models and hypotheses. Consequently, the origin and primary tectonic setting of these volcanic suites remains enigmatic (Mitchell, 2009).

The Buck Creek area is the centre of one of the largest Eocene volcanic complexes of the central interior region of British Columbia. The Eocene complex is part of the Challis-Kamloops belt (Souther 1991) composed of isolated volcanic fields which extends from the northern United States through British Columbia to the Yukon). This paper describes the field relations and petrography of the Buck Creek complex (based upon geological mapping of the area on a scale of 1: 100 000; Church 1984), presents major and trace element and Nd-Sr isotope data, as well as $^{39}Ar/^{40}Ar$ ages for the volcanic rocks, and constrains their pedogenesis, Understanding the origin of these volcanics in turn will help to better constrain the Eocene tectonic setting and geological evolution of central British Columbia (Mitchell, 2009).

5.1 PROPERTY GEOLOGY

The geology of the property is dominated by Andesitic volcanic rocks. There are two high level quartz phyric intrusions as well, the west and east with the western intrusive being situated on the southwestern of the property. The eastern such intrusive is primarily outside the property boundaries although it does underlay the far southeastern area of the Symphony. Minor coarse clastic sedimentary rocks are also seen on the property and are situated immediately north of the western quartz phyric intrusion. A geological map follows in figure 3.

The claims are mainly underlain by the Upper Cretaceous Tip Top Hill Formation. Near the southern portion of the claims upper cretaceous rhyolitic volcanic rocks and lower Cretaceous sandstone, chert, shale and massive rhyolite lava tentatively identified as Skeena Group are found in a window through the Tip Top Formation (Mitchell, 2009).

The following is excerpted from Church, B.N. and Barakso, J.J. in their 1990 paper on the area.

"The Tip Top Hill formation consisting of andesitic lavas and pyroclastic rocks (Church, 1971a), overlies rhyolites in the Owen Lake area. Radiometric analysis of a typical sample of the andesite gives a date of 77.1 @ 2.7 Ma. The relative age and stratigraphic position of this unit resemble "Andesitic Flows (Unit 9)" of the Whitesail-Troitsa Lake map area (Diakow and Mihalynuk, 1987).

The Tip Top Hill volcanics cover a large area in the west part of the Buck Creek map area extending in a belt from the Owen Lake area to the north end of upper Parrott Lake and easterly to Goosly Lake. The best-developed section, which is about 500 metres thick, is found on the divide north of Tip Top Hill (Mitchell, 2009).

The principal eruptive centre for the Tip Top Hill volcanics appears to be the Mine Hill microdiorite intrusion at the Silver Queen mine just east of Owen Lake. The age and composition of these rocks is similar, and volcaniclastics near the microdiorite are locally coarse, containing markedly angular fragments, suggesting proximity to a volcanic vent (Church, 1970a). The long axis of the volcanic field, containing the thickest sections, trends north-east through the intervening area between the Silver Queen and Equity mines (Mitchell, 2009).

Figure 3: Geological map of the Symphony property

5.2 STRUCTURE

No structural mapping has yet been completed on the property. The airborne survey is the first step in identifying such structures. Once the final interpretive report is completed it is hoped to identify shears and structures.

5.3 MINERALIZATION

There are no known mineral deposits on the Symphony property.

6.0 SAMPLING METHOD AND APPROACH

There have been no samples submitted for assay at this time.

7.0 SAMPLING PREPARATION, ANALYSIS AND SECURITY

There have been no samples submitted for assay at this time.

8.0 ADJACENT PROPERTIES

Silver Queen Mine (MINFILE 093L1 002)

The property is situated in the Houston area in northwestern British Columbia. The Symphony property is contiguous with the Silver Queen Mine (New Nadina Exploration). The area is primarily underlain by a series of volcanic rocks and intrusions. The volcanic rocks consist mainly of dacites and dacitic andesites which are likely part of the Upper Cretaceous-Eocene Endako Group (Tip Top Hill Formation). A sill-like body of microdiorite intrudes these volcanic rocks and is referred to as the Mine Hill microdiorite which is part of the Middle-Late Bulkley Intrusions. This intrusive sill is dated as 74.0 Ma +/- 1.0 Ma (Mitchell, 2009). The volcanics and microdiorite have been intruded by dikes and sills of porphyritic felsite and by basalt dikes (Minfile 093L1 002).

Approximately 20 mineralized veins have been discovered. The four main quartz vein systems are the Wrinch, Portal, Chisholm and Cole systems. The average width of the veins is 0.9 to 1.2 metres with local increases up to about 4.6 metres. In general the veins occupy northwest striking fractures that cut the volcanics, the microdiorite and the felsite porphyry and the basalt dikes. Chalcopyrite-sphalerite and sphalerite-galena are the two general types of sulphide mineralization occurring in the veins but there are gradations between the two types. Good gold and silver values are generally associated with the chalcopyrite-sphalerite veins (Mitchell, 2009). The age of mineralization is thought to be Early Tertiary and probably Eocene. (Minfile 093L1 002).

The Wrinch vein system is the most important and has been the focus of most of the mining and development work. The overall strike of the veins is about 130 degrees. These veins are traceable over a length of more than 1300 metres. These veins are generally banded with sphalerite as the predominant sulphide with pyrite, chalcopyrite and galena. By 1973, a total of 1050 metres of adits and crosscuts plus 810 metres of drifting and raises and 1500 metres of diamond drilling had been completed on the Wrinch vein system (Minfile 093L1 002) (Mitchell, 2009).

The Portal vein system contains some of the most spectacular metal grades found on the property. The ore reserve in this system appears small due to the position of the veins which are generally less than 30 vertical metres from surface. A quartz-chalcopyrite sample from Vein No. 5 assayed 9.6 grams per tonne gold, 829.7 grams per tonne silver, 7.2 per cent copper, 0.17 per cent lead, 0.17 per cent zinc, 0.11 per cent bismuth, and 0.01 per cent barium (Minfile 093L1 002) (Mitchell, 2009).

The Chisholm vein system (Minfile 093L 216) consists of three sub parallel veins located about 1200 metres south of Mine Hill. The veins strike about 125 degrees and dip northeast. The minerals are mainly argentiferous sphalerite, galena, pyrite and minor chalcopyrite. The veins are mainly the result of fissure-filling as indicated by their vuggy structure and the colloform banding of the ore minerals and gangue (Minfile 093L1 002) (Mitchell, 2009).

The Cole system lies to the northeast of the Diamond Belle occurrence (Minfile 093L 162). These veins uniformly carry low-temperature assemblages of sphalerite-pyrite-galena (Mitchell, 2009).

Inferred reserves **(non NI-43101 Compliant)** for the No. 3 vein are 632,300 tonnes grading 6.52 per cent zinc, 235.9 grams per tonne silver and 3.49 grams per tonne gold. Inferred reserves for the Footwall vein **(non NI-43101 Compliant)** are 163,200 tonnes grading 6.1 per cent zinc, 310.28 grams per tonne silver and 2.05 grams per tonne gold (Open File 1992-1) (Mitchell, 2009).

Proven/probable/possible reserves **(non NI-43101 Compliant)** at the Silver Queen property are 1,726,211 tonnes grading 6.19 per cent zinc, 327.71 grams per tonne silver and 2.74 grams per tonne gold (Houston Metals Corp. Annual Report 1988) (Mitchell, 2009).

The south end of the No. 3 vein has defined reserves **(non NI-43101 Compliant)** of 399,124 tonnes grading 8.29 grams per tonne gold, 401 grams per tonne silver and 7.6 per cent zinc. The central/north end of the No. 3 vein has defined reserves **(non NI-43101 Compliant)** of 644,041 tonnes grading 2.94 grams per tonne gold, 163.8 grams per tonne silver and 5.43 per cent zinc. The Camp vein has inferred reserves **(non NI-43101 Compliant)** of 204,097 tonnes grading 0.99 grams per tonne gold, 829.5 grams per tonne silver and 4 per cent zinc (George Cross News Letter No.61 (March 26), 1996) (Mitchell, 2009).

The George Lake Lineament, located parallel and 600 metres northeast of No. 3 vein, has a strike length of 1.5 kilometres. A 1.4-metre intersection graded 11.6 grams per tonne gold (Kettle River Resources Ltd. website). As part of an effort to assess the feasibility that the Silver Queen veins may represent the top or distal portion of a larger system which may have bulk tonnage potential, New Nadina Explorations Ltd. with support from the Explore B.C. Program launched on a project of compilation and digitizing of previous work, including all plans and sections of mine workings. This work together with modeling of the deposit and analysis of satellite imagery defined targets with bulk tonnage potential which warrant testing (Assessment Report 25370). Kettle River Resources Ltd. Owns 15.8 per cent of New Nadina (Mitchell, 2009).

Equity Silver Mine (MINFILE 093L1 001)

The Equity Silver Mine is situated further to the east. The Equity Silver Mine ceased operation in 1994. The mining operation consisted of open pits, underground workings, and a 9,000 tonne per day mill. The Southern Tail deposit has been mined out to the economic limit of an open pit. Formerly an open pit, Equity is mined from underground at a scaled-down rate of 1180 tonnes-per-day. Proven and probable ore reserves at the end of 1992 were about 286,643 tonnes grading 147.7 grams per tonne silver, 4.2 grams per tonne gold and 0.46 per cent copper, based on a 300 grams per tonne silver-equivalent grade. Equity Silver Mines Ltd. ceased milling in January 1994, after thirteen years of open pit and underground production. Production totaled 2,219,480 kilograms of silver, 15,802 kilograms of gold and 84,086 kilograms of copper, from over 33.8 Million tonnes mined at an average grade of 0.4 per cent copper, 64.9 grams per tonne silver and 0.46 gram per tonne gold (Minfile 093L1 001).

10.0 INTERPRETATION AND CONCLUSIONS

BonTerra Resources' Symphony property offers the potential to develop an economic silver deposit. The locations most amiable for silver mineralization on the property are the NW-SE trending magnetic anomalies, faults and related quartz veins. It is hoped to trace the mineralized veins on the Silver Queen property to the south onto BonTerra's Symphony property.

Silver occurrences are commonly associated with quartz veining as well as fault systems and shear zones in the region. The two examples are the Silver Queen Mine and the Equity Silver Mine (Mitchell, 2009). Silver occurrences have been noted in a northwest trending vein on the Silver Queen property. It is yet unknown if this vein system continues onto BonTerra's Symphony property.

The interpretation of the geophysical data is preliminary and based only on the field data. At the time of writing the final data was yet to be available. The various products accompanying this report display the magnetic, conductive and radiometric properties of the survey area. It is recommended that a complete assessment and detailed evaluation of the survey results be carried out, in conjunction with all available geophysical, geological and geochemical information.

The magnetic results have provided valuable structural information that can be used to help locate the more favourable areas for mineral deposition on the properties. In addition to locating numerous linear faults and shears, the magnetic data have outlined the contacts of both magnetic and non-magnetic units. The latter could reflect felsic intrusions or siliceous breccias that might host auriferous mineralization. In addition, the combined magnetic and resistivity parameters have outlined a few very interesting magnetic lows and resistivity highs that could reflect alteration zones or siliceous caps.

There are several low resistivity zones where values of less than 50 ohm-m are evident. Some of these broader zones are likely due to conductive clays or graphitic shales, while some of the more discrete responses might be attributed to increases in conductive sulphide content or clay-altered shears. Although the former "formational" zones may be of little economic interest, those in the latter category might warrant additional work.

Other anomalous responses coincide with magnetic linears that could reflect contacts, faults, or shears. These inferred contacts and structural breaks are also considered to be of particular interest as they may have influenced or controlled mineral deposition within the survey areas.

The anomalous (resistive) targets and some of the bedrock conductors defined by the survey should be subjected to further investigation, using appropriate surface exploration techniques. Anomalies that are currently considered to be of moderately low priority may require upgrading if follow-up results are favourable.

It is also suggested that additional processing of existing geophysical data be considered, in order to extract the maximum amount of information from the survey results. Current software and imaging techniques can often provide valuable information on structure and lithology, which may not be clearly evident on the images provided with this report. These techniques can yield images that define subtle, but significant, structural details.

Data density is thin at this stage. This is due to the fact that BonTerra Resources is the first company to conduct a significant work program on the Symphony property. As work programs intensity and data becomes more plentiful on the Symphony property, the relative thin density of data will obviously change.

In closing the Symphony property of BonTerra Resources' offers potential to discover silver mineralization. At this early juncture the data set is still relatively small. That said the data received from the airborne survey has been received has met the expectations to date.

11.0 RECOMMENDATIONS

A first phase exploration program is recommended. This will focus on mapping as well as stream and soil sampling with a budget of $115,500 is proposed to evaluate the potential economic silver mineralization on the Symphony property as identified by the airborne survey.

All rock, soil and stream sediment samples should be sampled and sent for assay using ICP and fire assay. Areas of most interest should be trenched and stripped to build the geological data base and understanding of the property. Work should be concentrated on structures that have been identified to date from the airborne survey. At the time of writing only the field data has been received. Once the final data is received this will aid in target selection. The proposed work program is outlined in table 2.

If this first phase work program outlines and defines significant silver mineralization a second phase of exploration is warranted. This second phase of work will be guided by the first phase and should include diamond drilling, geological mapping, an IP survey and trenching on the property.

Table 2: Proposed Work Program on the Urban-Barry property

Item	Unit Cost	Units	Total
Soil Sampling and Assays	$25,000	1	$25,000
Geological mapping and sampling	$25,000	1	$25,000
Stream sediment sampling	$25,000	1	$25,000
Camp Costs (per person per day)	$100	300	$30,000
Subtotal			$105,000
15% Contingency			$10,500
TOTAL			**$115,500**

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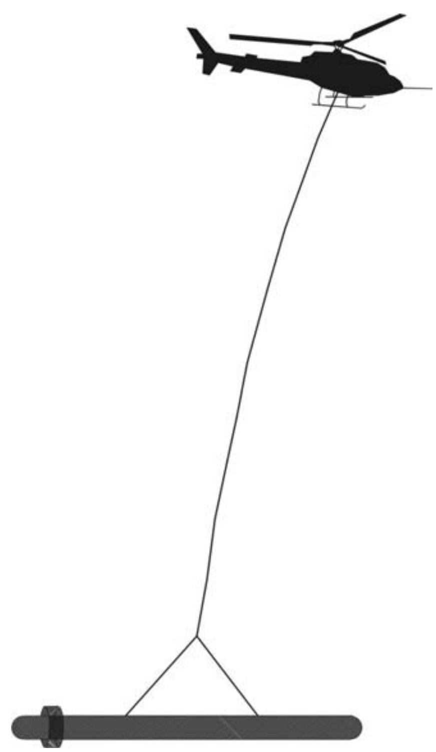
Dated at Vancouver, this 4th day of October, 2011

Thomas Clarke Pr.Sci.Nat., Director
BonTerra Resources Inc.

Report # 11068

DIGHEM ^{V} SURVEY
FOR
BONTERRA RESOURCES INC
SYMPHONY PROPERTY, B.C.

NTS: 93L/2



Fugro Airborne Surveys Corp.
Mississauga, Ontario

September 28, 2011

Fugro Airborne Surveys, 2505 Meadowvale Boulevard, Mississauga, Ontario, Canada, L5N 5S2
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SUMMARY

This report describes the logistics, data acquisition, processing, and presentation of results pertaining to a DIGHEM^V airborne geophysical survey carried out for BonTerra Resources Inc., over the Symphony Property located 30 Km south of Houston, B.C. Total coverage of the survey blocks amounted to 308 line-km. The survey was flown from September 18 to 21 2011.

The purpose of the survey was to map any intrusions or shears in the area that might be favourable for gold deposition, to detect any zones of conductive mineralization or alteration, and to provide information that could be used to map the geology and structure of the project area. This was accomplished by using a DIGHEM ^{V} multi-coil, multi-frequency electromagnetic system, supplemented by a high sensitivity magnetometer and a 256-channel spectrometer. The information from these sensors was processed to produce maps that display the magnetic, conductive and radiometric properties of the survey area. A GPS electronic navigation system ensured accurate positioning of the geophysical data with respect to the base maps.

The survey property hosts several anomalous features, some of which are considered to be of moderate priority as exploration targets. Although auriferous targets in this area are likely to be associated with resistive units, rather than conductive units, there are a few inferred bedrock conductors that may also warrant further investigation using appropriate surface exploration techniques. Areas of interest may be assigned priorities on the basis of supporting geophysical, geochemical and/or geological information. After initial investigations have been carried out, it may be necessary to re-evaluate the remaining anomalous responses based on information acquired from the follow-up program.

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APPENDICES

A. List of Personnel
B. Data Processing Flowcharts
C. Background Information
D. Glossary

1. INTRODUCTION

A DIGHEM V electromagnetic/resistivity/magnetic/radiometric survey was flown for BonTerra Resources Inc., over the Symphony property located south of Houston, B.C. The survey was flown from September 18 to 21, 2011. The survey area can be located on NTS map sheet 93L/2. (Figure 2).

Survey coverage consisted of approximately 308 line-km including tie lines. Flight lines were flown north-south (0°/180°) with a line separation of 100 metres. Tie lines were flown orthogonal to the traverse lines (E-W) with a line separation of 1000 metres.

The survey employed the DIGHEM ^{V} electromagnetic system. Ancillary equipment consisted of an optically pumped, high-sensitivity cesium magnetometer, radar, laser and barometric altimeters, a video camera, digital recorders, and an electronic navigation system and a 256-channel spectrometer. The instrumentation was installed in an AS350-B2 turbine helicopter (Registration C-GJIX) that was provided by Questral Helicopters Ltd. The helicopter flew at an average airspeed of 100 km/h with an EM sensor height of approximately 35 metres.

Figure 1: Fugro Airborne Surveys DIGHEM ^{V} EM bird with AS350-B2

2. SURVEY OPERATIONS

The base of operations for the survey was established at the Houston Airport. Table 2-1 lists the corner coordinates of the survey area in NAD83, UTM Zone 9N, central meridian 129°W.

Table 2-1

NAD83 UTM Zone 9N

Block	Corners	X-UTM (E)	Y-UTM (N)
11068	1	645189.0	6002945.0
Symphony	2	652946.0	6003196.0
	3	653055.0	5999513.0
	4	650614.0	5999408.0
	5	650674.0	5997554.0
	6	648223.0	5997475.0
	7	648104.0	6001183.0
	8	645232.0	6001081.0

The survey specifications were as follows:

Parameter	Specifications
Traverse line direction	N-S (0°)
Traverse line spacing	100 m
Tie line direction	E-W (180°)
Tie line spacing	000 m
Sample interval	10 Hz, 2.75 m @ 100 km/h
Aircraft mean terrain clearance	65 m
EM sensor mean terrain clearance	35m
Mag sensor mean terrain clearance	35 m
Average speed	100 km/h
Navigation (guidance)	±5 m, Real-time GPS
Post-survey flight path	±2 m, Differential GPS

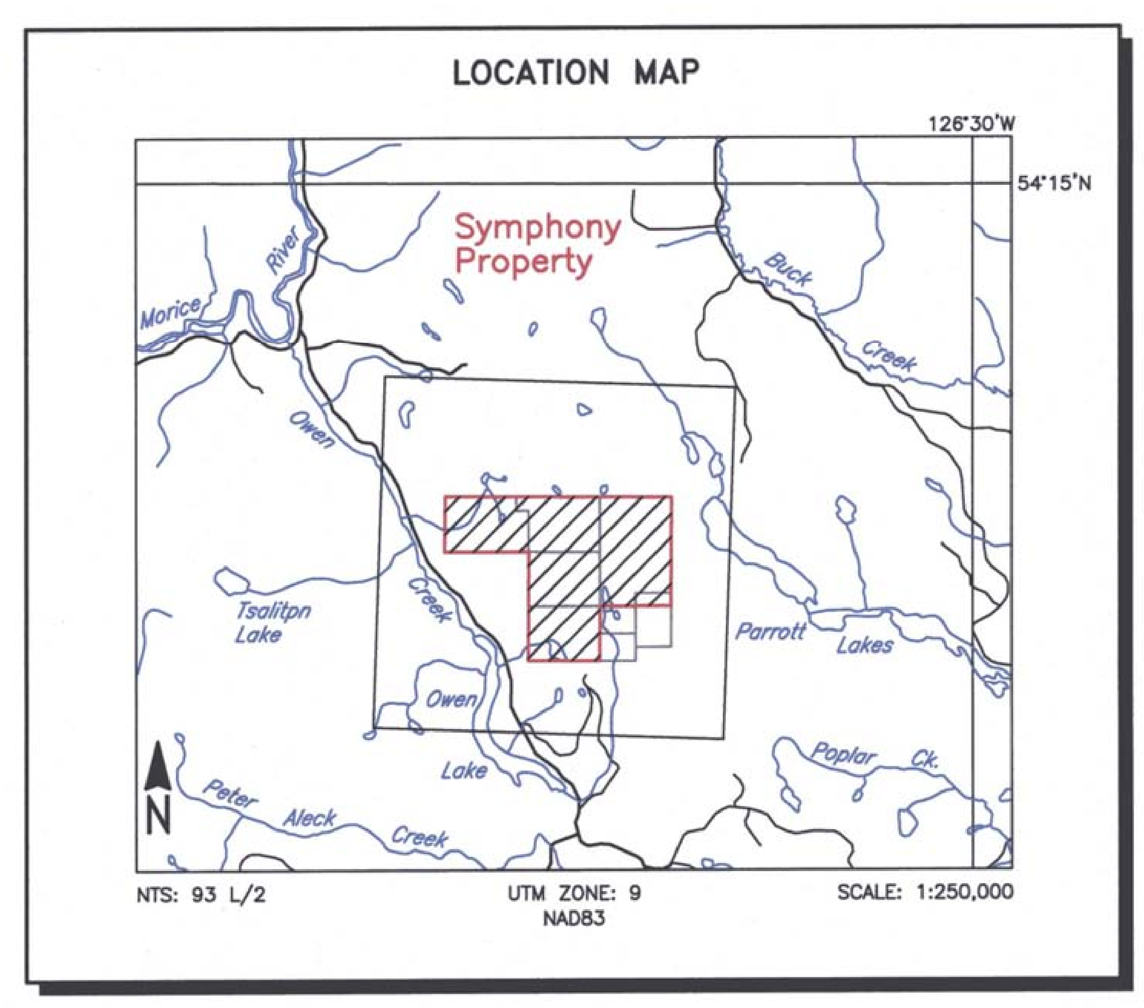


Figure 2
Location Map and Sheet Layout
Symphony Area
Job # 11068

3. SURVEY EQUIPMENT

This section provides a brief description of the geophysical instruments used to acquire the survey data and the calibration procedures employed. The geophysical equipment was installed in an AS350-B2 helicopter. This aircraft provides a safe and efficient platform for surveys of this type.

Electromagnetic System

Model: DIGHEM ^{V}-BKS 54

Type: Towed bird, symmetric dipole configuration operated at a nominal survey altitude of 50 metres. Coil separation is 8 metres for 900 Hz, 1000 Hz, 5500 Hz and 7200 Hz, and 6.3 metres for the 56,000 Hz coil-pair.

Coil orientations, frequencies and dipole moments

Atm^2	orientation		nominal	actual
211	coaxial	/	1000 Hz	1114 Hz
211	coplanar	/	900 Hz	924 Hz
67	coaxial	/	5500 Hz	5495 Hz
56	coplanar	/	7200 Hz	7095 Hz
15	coplanar	/	56,000 Hz	55630 Hz

Channels recorded:
5 in-phase channels
5 quadrature channels
2 monitor channels

Sensitivity:
0.06 ppm at 1000 Hz Cx
0.12 ppm at 900 Hz Cp
0.12 ppm at 5,500 Hz Cx
0.24 ppm at 7,200 Hz Cp
0.60 ppm at 56,000 Hz Cp

Sample rate: 10 per second, equivalent to 1 sample every 2.75 m, at a survey speed of 100 km/h.

The electromagnetic system utilizes a multi-coil coaxial/coplanar technique to energize conductors in different directions. The coaxial coils are vertical with their axes in the flight direction. The coplanar coils are horizontal. The secondary fields are sensed simultaneously by means of receiver coils that are maximum-coupled to their respective transmitter coils. The system yields an in-phase and a quadrature channel from each transmitter-receiver coil-pair.

In-Flight EM System Calibration

Calibration of the system during the survey uses the Fugro AutoCal automatic, internal calibration process. At the beginning and end of each flight, and at intervals during the flight, the system is flown up to high altitude to remove it from any "ground effect" (response from the earth). Any remaining signal from the receiver coils (base level) is measured as the zero level, and is removed from the data collected until the time of the next calibration. Following the zero level setting, internal calibration coils, for which the response phase and amplitude have been determined at the factory, are automatically triggered – one for each frequency. The on-time of the coils is sufficient to determine an accurate response through any ambient noise. The receiver response to each calibration coil "event" is compared to the expected response (from the factory calibration) for both phase angle and amplitude, and any phase and gain corrections are automatically applied to bring the data to the correct value.

In addition, the outputs of the transmitter coils are continuously monitored during the survey, and the gains are adjusted to correct for any change in transmitter output.

Because the internal calibration coils are calibrated at the factory (on a resistive half-space) ground calibrations using external calibration coils on-site are not necessary for system calibration. A check calibration may be carried out on-site to ensure all systems

are working correctly. All system calibrations will be carried out in the air, at sufficient altitude that there will be no measurable response from the ground.
The internal calibration coils are rigidly positioned and mounted in the system relative to the transmitter and receiver coils. In addition, when the internal calibration coils are calibrated at the factory, a rigid jig is employed to ensure accurate response from the external coils.

Using real time Fast Fourier Transforms and the calibration procedures outlined above, the data are processed in real time, from measured total field at a high sampling rate, to in-phase and quadrature values at 10 samples per second.

Magnetometer

Model:	Scintrex CS-3 sensor with a Fugro D1344 counter.
Type:	Optically pumped cesium vapour
Sensitivity:	0.01 nT
Sample rate:	10 per second

The magnetometer sensor is housed in the HEM bird, which is flown 28 m below the helicopter.

Magnetic Base Station

Primary

Model:	Fugro CF1 base station with timing provided by integrated GPS	
Sensor type:	Scintrex CS-3	
Counter specifications:	Accuracy:	±0.1 nT
	Resolution:	0.01 nT
	Sample rate	1 Hz

GPS specifications:	Model:	Marconi Allstar
	Type:	Code and carrier tracking of L1 band, 12-channel, C/A code at 1575.42 MHz
	Sensitivity:	-90 dBm, 1.0 second update
	Accuracy:	Manufacturer's stated accuracy for differential corrected GPS is 2 metres

Environmental
Monitor specifications: Temperature:

- Accuracy: ±1.5ºC max
- Resolution: 0.0305ºC
- Sample rate: 1 Hz
- Range: -40ºC to +75ºC

Barometric pressure:

- Model: Motorola MPXA4115AP
- Accuracy: ±3.0º kPa max (-20ºC to 105ºC temp. ranges)
- Resolution: 0.013 kPa
- Sample rate: 1 Hz
- Range: 55 kPa to 108 kPa

Backup

Model:	GEM Systems GSM-19T
Type:	Digital recording proton precession
Sensitivity:	0.10 nT
Sample rate:	3 second intervals

A digital recorder is operated in conjunction with the base station magnetometer to record the diurnal variations of the earth's magnetic field. The clock of the base station is synchronized with that of the airborne system, using GPS time, to permit subsequent removal of diurnal drift. The Fugro CF1 was the primary magnetic base station. It was located at the Houston Airport, at WGS 84 Latitude 54° 26′ 07.93845″ N; Longitude 126° 46′ 27.65370″ W at an orthometric elevation of 640 m (a.m.s.l.).

Navigation (Global Positioning System)

Airborne Receiver for Real-time Navigation & Guidance

Model:	NovAtel OEM4/V with PNAV 2100 interface
Type:	Code and carrier tracking of L1-C/A code at 1575.42 MHz and L2-P code at 1227.0 MHz. Dual frequency, 24-channel. WAAS enabled.
Sensitivity:	-132 dBm, 10 Hz update
Accuracy:	Manufacturer's stated accuracy is better than 2 metres real-time
Antenna:	Aero AT1675; Mounted on tail of aircraft

Primary Base Station for Post-Survey Differential Correction

Model:	NovAtel OEM4/V
Type:	Code and carrier tracking of L1-C/A code at 1575.42 MHz and L2-P code at 1227.0 MHz. Dual frequency, 24-channel.
Sample rate:	10 Hz update.
Accuracy:	Better than 1 metre in differential mode.

Secondary GPS Base Station

Model:	Marconi Allstar, CMT-1200
Type:	Code and carrier tracking of L1 band, 12-channel, C/A code at 1575.42 MHz
Sensitivity:	-90 dBm, 1.0 second update
Accuracy:	Manufacturer's stated accuracy for differential corrected GPS is 2 metres.

The Wide Area Augmentation System (WAAS enabled) NovAtel OEM/V is a line of sight, satellite navigation system that utilizes time-coded signals from at least four of forty-eight available satellites. Both GLONASS and NAVSTAR satellite constellations are used to calculate the position and to provide real time guidance to the helicopter. For flight path processing, a similar NovAtel system was used as the primary base station receiver. The mobile and base station raw XYZ data were recorded, thereby permitting post-survey differential corrections for theoretical accuracies of better than 2 metres. A Marconi Allstar GPS unit, part of the CF-1, was used as a secondary (back-up) base station.

Each base station receiver is able to calculate its own latitude and longitude. For this survey, the primary GPS station was located at Houston Airport at the same coordinates as the Magnetic base station.

The GPS records data relative to the WGS84 ellipsoid, which is the basis of the revised North American Datum (NAD83). Conversion software is used to transform the WGS84 Lat/Lon coordinates to the UTM Zone 9N system displayed on the maps.

Radar Altimeter

Manufacturer:	Honeywell/Sperry
Model:	RT300
Type:	Short pulse modulation, 4.3 GHz
Sensitivity:	0.3 m

Sample rate:	2 per second

The radar altimeter measures the vertical distance between the helicopter and the ground except in areas of dense tree cover. This information is used in the processing algorithm that determines conductor depth.

Barometric Pressure and Temperature Sensors

Model:	DIGHEM D 1300	
Type:	Motorola MPX4115AP analog pressure sensor	
	AD592AN high-impedance remote temperature sensors	
Sensitivity:	Pressure:	150 mV/kPa
	Temperature:	100 mV/°C or 10 mV/°C (selectable)
Sample rate:	10 per second	

The D1300 circuit is used in conjunction with one barometric sensor and up to three temperature sensors. Two sensors (baro and temp) are installed in the EM console in the aircraft, to monitor pressure (KPA) and internal operating temperatures (TEMP_INT).

Digital Data Acquisition System

Manufacturer:	Fugro
Model:	HeliDAS – Integrated Data Acquisition System
Recorder:	SanDisk compact flash card (PCMCIA)

The stored data are downloaded to the field workstation PC at the survey base, for verification, backup and preparation of in-field products.

Video Flight Path Recording System

Type:	Axis 2420 Digital Network Camera
Recorder:	Axis 241S Video Server and Tablet Computer
Format:	BIN/BDX

Fiducial numbers are recorded continuously and are displayed on the margin of each image. This procedure ensures accurate correlation of data with respect to visible features on the ground.

Spectrometer

Manufacturer:	Exploranium
Model:	GR-820
Type:	256 Multichannel, Potassium stabilized
Accuracy:	1 count/sec.
Update:	1 integrated sample/sec.

The GR-820 Airborne Spectrometer employs four downward looking crystals (1024 cu.in..= 16.8 L) and one upward looking crystal (256 cu.in. = 4.2L). The downward crystal records the radiometric spectrum from 410 KeV to 3 MeV over 256 discrete energy windows, as well as a cosmic ray channel which detects photons with energy levels above 3.0 MeV. From these 256 channels, the standard Total Count, Potassium, Uranium and Thorium channels are extracted. The upward crystal is used to measure and correct for Radon.

The shock-protected Sodium Iodide (Thallium) crystal package is unheated, and is automatically stabilized with respect to the Potassium peak. The GR-820 provides raw or Compton stripped data which has been automatically corrected for gain, base level, ADC offset and dead time.

The system is calibrated before and after each flight using three accurately positioned hand-held sources. Additionally, fixed-site hover tests or repeat test lines are flown to determine if there are any differences in background. This procedure allows corrections to be applied to each survey flight, to eliminate any differences that might result from changes in temperature or humidity.

4. QUALITY CONTROL AND IN-FIELD PROCESSING

Digital data for each flight were transferred to the field workstation, in order to verify data quality and completeness. A database was created and updated using Geosoft Oasis Montaj and proprietary Fugro Atlas software. This allowed the field personnel to calculate, display and verify both the positional (flight path) and geophysical data on a screen or printer. Records were examined as a preliminary assessment of the data acquired for each flight.

In-field processing of Fugro survey data consists of differential corrections to the airborne GPS data, verification of the flight path, verification of EM calibrations, drift correction of the raw airborne EM data, spike rejection and filtering of all geophysical and ancillary data, verification of the flight videos, calculation of preliminary resistivity data, diurnal correction, and preliminary leveling of magnetic data.

All data, including base station records, were checked on a daily basis, to ensure compliance with the survey contract specifications. Reflights were required if any of the following specifications were not met.

Navigation - Positional (x,y) accuracy of better than 10 m, with a CEP (circular error of probability) of 95%.

Flight Path - No lines to exceed ±25 m departure from nominal line spacing over a continuous distance of more than 1 km, except for reasons of safety.

Clearance - Mean terrain sensor clearance of 35 m, ±10 m, except where precluded by safety considerations, e.g., restricted or populated areas, severe topography, obstructions, tree canopy, aerodynamic limitations, etc.

Airborne Mag - Aerodynamic magnetometer noise envelope not to exceed 0.5 nT over a distance of more than 1 km. The non-normalized 4th difference not to exceed 1.6 nT over a continuous distance of 1 kilometre excluding areas where this specification is exceeded due to natural anomalies.

Base Mag - Diurnal variations not to exceed 10 nT over a straight-line time chord of 1 minute.

EM - Spheric pulses may occur having strong peaks but narrow widths. The EM data area considered acceptable when their occurrence is less than 10 spheric events exceeding the stated noise specification for a given frequency per 100 samples continuously over a distance of 2,000 metres.

Frequency	**Coil Orientation**	**Peak to Peak Noise Envelope (ppm)**
1000Hz	vertical coaxial	5.0
900 Hz	horizontal coplanar	10.0
5500 Hz	vertical coaxial	10.0
7200 Hz	horizontal coplanar	20.0
56,000 Hz	horizontal coplanar	40.0

5. DATA PROCESSING

Flight Path Recovery

The raw range data from at least four satellites are simultaneously recorded by both the base and mobile GPS units. The geographic positions of both units, relative to the model ellipsoid, are calculated from this information. Differential corrections, which are obtained from the base station, are applied to the mobile unit data to provide a post-flight track of the aircraft, accurate to within 2 m. Speed checks of the flight path are also carried out to determine if there are any spikes or gaps in the data.

The corrected WGS84 latitude/longitude coordinates are transformed to the UTM coordinate system used on the final maps. Images or plots are then created to provide a visual check of the flight path.

Electromagnetic Data

EM data are processed at the recorded sample rate of 10 samples/second. Spheric rejection median and Hanning filters are then applied to reduce noise to acceptable levels. EM test profiles are then created to allow the interpreter to select the most appropriate EM anomaly picking controls for a given survey area. The EM picking parameters depend on several factors but are primarily based on the dynamic range of the resistivities within the survey area, and the types and expected geophysical responses of the targets being sought.

The interpretation geophysicist determines initial anomaly picking parameters and thresholds. Anomalous electromagnetic responses that meet the specific criteria are then automatically selected and analysed by computer to provide a preliminary electromagnetic anomaly map. The automatic selection algorithm is intentionally oversensitive to assure that no meaningful responses are missed. Using the preliminary maps in conjunction with the multi-parameter stacked profiles, the interpreter then classifies the anomalies according to their source and eliminates those that are not substantiated by the data. The final interpreted EM anomaly map will include bedrock, surficial and cultural conductors. A map containing only bedrock conductors can be generated, if desired.

Apparent Resistivity

The apparent resistivities in ohm-m are generated from the in-phase and quadrature EM components for all of the coplanar frequencies, using a pseudo-layer half-space model. The inputs to the resistivity algorithm are the in-phase and quadrature amplitudes of the secondary field. The algorithm calculates the apparent resistivity in ohm-m, and the apparent height of the bird above the conductive source. Any difference between the apparent height and the true height, as measured by the radar altimeter, is called the pseudo-layer and reflects the difference between the real geology and a homogeneous half-space. This difference is often attributed to the presence of a highly resistive upper layer. Any errors in the altimeter reading, caused by heavy tree cover, are included in the pseudo-layer and do not affect the resistivity calculation. The apparent depth estimates, however, will reflect the altimeter errors. Apparent resistivities calculated in this manner may differ from those calculated using other models.

In any areas where the effects of magnetic permeability or dielectric permittivity have suppressed the in-phase responses, the calculated resistivities will be erroneously high. Various algorithms and inversion techniques can be used to partially correct for the effects of permeability and permittivity.

Apparent resistivity maps portray all of the information for a given frequency over the entire survey area. This full coverage contrasts with the electromagnetic anomaly map, which provides information only over interpreted conductors. The large dynamic range afforded by the multiple frequencies makes the apparent resistivity parameter an excellent mapping tool.

The preliminary apparent resistivity maps and images are carefully inspected to identify any lines or line segments that might require base level adjustments. Subtle changes between in-flight calibrations of the system can result in line-to-line differences that are more recognizable in resistive (low signal amplitude) areas. If required, manual level adjustments are carried out to eliminate or minimize resistivity differences that can be attributed, in part, to changes in operating temperatures. These leveling adjustments are usually very subtle, and do not result in the degradation of discrete anomalies.

After the manual leveling process is complete, revised resistivity grids are created. The resulting grids can be subjected to a microleveling technique in order to smooth the data for contouring. The coplanar resistivity parameter has a broad 'footprint' that requires very little filtering.

The calculated resistivities for the 900 Hz 7200 Hz and 56kHz coplanar frequencies will be included in the XYZ and grid archives. Values are in ohm-metres.

Residual Magnetic Intensity

The residual magnetic intensity (RMI) is derived from the total magnetic field (TMF) channels, the diurnal, and the regional magnetic field. The total magnetic intensity is measured in the aircraft, the diurnal is measured from the ground station, and the regional magnetic field is calculated from the IGRF (International Geomagnetic Reference Field).

A fourth difference editing routine is applied to the magnetic data to remove any spikes. The result is then corrected for diurnal variation using the magnetic base station data. The results are then leveled using tie and traverse line intercepts. Manual adjustments are applied to any lines that require leveling, as indicated by shadowed images of the gridded magnetic data.

The low frequency component of the diurnal is extracted from the filtered ground station data and removed from the averaged total magnetic field. The average of the diurnal is then added back in to obtain the resultant total magnetic intensity. The IGRF calculated for the specific survey location and the time of the survey, is then removed from the resultant total magnetic intensity to yield the residual magnetic intensity (RMI). The leveled data are then subjected to a microleveling filter.

Calculated Vertical Magnetic Gradient

The diurnally-corrected residual magnetic field data are subjected to a processing algorithm that enhances the response of magnetic bodies in the upper 500 m and attenuates the response of deeper bodies. The resulting vertical gradient map provides better definition and resolution of near-surface magnetic units. It also identifies weak magnetic features that may not be evident on the total field or residual magnetic maps. However, regional magnetic variations and changes in lithology may be better defined on the total magnetic field or residual magnetic intensity maps.

Magnetic Derivatives (optional)

The total magnetic field data can be subjected to a variety of filtering techniques to yield maps or images of the following:

enhanced magnetics
second vertical derivative
reduction to the pole/equator
magnetic susceptibility with reduction to the pole
upward/downward continuations
analytic signal

All of these filtering techniques improve the recognition of near-surface magnetic bodies, with the exception of upward continuation. Any of these parameters can be produced on request.

Contour, Colour and Shadow Map Displays

The geophysical data are interpolated onto a regular grid using a modified Akima spline technique. The resulting grid is suitable for image processing and generation of contour maps. The grid cell size is 20% of the line interval.

Colour maps or images are produced by interpolating the grid down to the pixel size. The parameter is then incremented with respect to specific amplitude ranges to provide colour "contour" maps.

Monochromatic shadow maps or images can be generated by employing an artificial sun to cast shadows on a surface defined by the geophysical grid. There are many variations in the shadowing technique. These techniques can be applied to total field or enhanced magnetic data, magnetic derivatives, resistivity, etc. The shadowing technique is also used as a quality control method to detect subtle changes between lines.

6. PRODUCTS

At the time this report was prepared, not all of the acquired survey data had been processed. Therefore, some final products, such as the EM anomaly maps, cannot be supplied. These will be provided later under separate cover, when they have been completed. All EM data, however, are included on the digital database accompanying this report.

This section lists the final maps and products that will be provided under the terms of the survey agreement. Other products can be prepared from the existing dataset, if requested. These include stacked multi-parameter profiles, resistivity-depth sections, inversions, magnetic enhancements or derivatives, percent magnetite, resistivities corrected for magnetic permeability and/or dielectric permittivity, and digital elevation. Most parameters can be displayed as contours, profiles, or in colour; or as digital images in PDF or other file formats.

Base Maps

Base maps of the survey area are produced by scanning published topographic maps to a bitmap (.bmp) format. This process provides a relatively accurate, distortion-free base that facilitates correlation of the navigation data to the map coordinate system. It should be noted that the (older) scanned topographic map shows UTM coordinate lines in the NAD 27 datum, whereas the graticules (crosses) are in the newer NAD 83 system. The difference between the two coordinate systems is seen as a shift of about 200 m to the south and 90 m to the east for the NAD 83 relative to NAD 27. This is not a location error, as the NAD 83 geophysical data are properly positioned relative to the NAD 27 topography. The NAD 27 topographic files were combined with NAD 83 geophysical data for plotting the final maps. All maps were created using the following parameters:

Projection Description:

Datum: NAD 83

Ellipsoid:	WGS 84; GRS 1980
Projection:	UTM (Zone: 9N)
Central Meridian:	129° W
False Northing:	0
False Easting:	500000
Scale Factor:	0.9996
WGS84 to Local Conversion:	Molodensky
Datum Shifts:	DX: 0 DY: 0 DZ: 0

Digital Products

For assessment purposes, the survey data have been presented in digital format only, as Geosoft (GDB) databases and Geosoft (GRD) files. Digital grids are included for the following products.

- Total Magnetic Intensity
- Apparent Resistivity 7200 Hz
- Apparent Resistivity 56 kHz
- Radiometric total count

Additional Products

Digital Archive
Survey Report PDF version

To Follow

The following paper products will be presented on a single map sheet at a scale of 1:10,000. All final maps will include flight lines and topography, unless otherwise indicated.

- EM Anomaly Map
- Residual Magnetic Intensity
- Calculated Vertical Magnetic Gradient
- Apparent Resistivity 7200 Hz
- Apparent Resistivity 56 kHz
- Radiometrics total count, K, U, Th

Final Digital versions of all maps above	PDF files on Archive

7. SURVEY RESULTS

The data contained on the digital archive show the magnetic, conductive and radiometric properties of the rock units underlying the survey area.

The magnetic images show that the survey area have been subjected to deformation and/or alteration. These structural complexities are evident on the colour maps as variations in magnetic intensity, irregular patterns, and as offsets or changes in strike direction.

If a specific magnetic intensity can be assigned to the rock type that is believed to host the target mineralization, it may be possible to select areas of higher priority on the basis of the magnetic data. This is based on the assumption that the magnetite content of the host rocks will give rise to a limited range of contour values that will permit differentiation of the various lithological units.

The magnetic results have provided valuable information that can be used in conjunction with the other geophysical parameters, to help map the geology and structure in the survey area.

Apparent resistivity grids, which display the conductive properties of the survey area, were produced from the 7200 Hz, and 56000 Hz coplanar data. The maximum resistivity values, which are calculated for each frequency, are 8,000 and 30,000 ohm-m respectively. These cut-offs eliminate the erratic higher resistivities that could result from unstable ratios of very small EM amplitudes. All coplanar resistivity data will be included on the final data archive.

Both resistive and weakly conductive trends are evident on the near-surface 56 kHz maps. There is no consistent resistivity/magnetic correlation. This suggests that in some cases, the magnetic and resistivity parameters are responding to different causative sources; i.e., the EM-derived resistivity is responding to changes in the overburden and near-surface layers, while the magnetic data are reflecting changes in the underlying deeper basement units.

If the target shears are highly silicified and non-porous, these should show as narrow resistive units. These non-magnetic, non-conductive linear trends may prove to be the more attractive targets in the search for quartz-vein mineralization. Conversely, increased porosity, alteration, or an increase in sulphide content associated with some shears or faults, could show as more conductive trends. Any weak responses that are associated with the margins of inferred intrusive features will also be of exploration interest.

There are other resistivity lows and highs in the areas that might also be of interest. Some of these are quite extensive and might reflect "formational" conductors or layers that could be of minor interest as direct exploration targets. However, attention may be focused on areas where these zones appear to be faulted or folded or where anomaly characteristics differ along strike

Some of the resistive zones could reflect intrusive plugs, flows or caps. These are more evident on the 56 kHz resistivity parameter. Although some of these are due to resistive rock units, others might be attributed to magnetite suppression. Some anomalous magnetite-associated responses exhibit positive quadrature responses, denoting weak conductivity, but still show as resistive units because of the magnetite suppression.

Other resistive zones are quite subtle, and could be due to changes in overburden thickness, rather than changes in rock type. However, those that are associated with linear magnetic breaks, contacts, or decreases in magnetite, are considered to be of slightly higher priority.

In the search for auriferous mineralization, the value of EM conductors may be of little importance, unless the gold is known to be associated with conductive material such as sulphides, conductive shears or faults, alteration products, or magnetite-rich zones. As mentioned previously, resistive zones can often be of greater exploration interest, particularly if the host rocks are siliceous. On the Symphony survey block, the magnetic parameter appears to have been more effective than the resistivity, in delineating rock units and areas of structural deformation that may have influenced local mineral deposition.

Radiometrics

All radiometric data reductions performed by Fugro rigorously follow the procedures described in the IAEA Technical Report[1].

All processing of radiometric data was undertaken at the natural sampling rate of the spectrometer, i.e., one second. The data were not interpolated to match the fundamental 0.1 second interval of the EM and magnetic data.

The following sections describe each step in the process.

Pre-filtering

The radar altimeter data were processed with a 49-point median filter to remove spikes.

Reduction to Standard Temperature and Pressure

The radar altimeter data were converted to effective height (h_e) in feet using the acquired temperature and pressure data, according to the following formula:

$$h_e = h * \frac{273.15}{T + 273.15} * \frac{P}{1013.25}$$

where: *h* is the observed crystal to ground distance in feet
T is the measured air temperature in degrees Celsius
P is the barometric pressure in millibars

Live Time Correction

The spectrometer, an Exploranium GR-820, uses the notion of "live time" to express the relative period of time the instrument was able to register new pulses per sample interval. This is the opposite of the traditional "dead time", which is an expression of the relative period of time the system was unable to register new pulses per sample interval.

The GR-820 measures the live time electronically, and outputs the value in milliseconds. The live time correction is applied to the total count, potassium, uranium, thorium, upward uranium and cosmic channels. The formula used to apply the correction is as follows:

$$C_{lt} = C_{raw} * \frac{1000.0}{L}$$

where: C_{lt} is the live time corrected channel in counts per second
C_{raw} is the raw channel data in counts per second
L is the live time in milliseconds

Intermediate Filtering

Two parameters were filtered, but not returned to the database:

[1] Exploranium, I.A.E.A. Report, Airborne Gamma-Ray Spectrometer Surveying, Technical Report No. 323, 1991.

- Radar altimeter was smoothed with a 5-point Hanning filter (h_{ef}).
- The Cosmic window was smoothed with a 29-point Hanning filter (Cos_f).

Aircraft and Cosmic Background

Aircraft background and cosmic stripping corrections were applied to the total count, potassium, uranium, thorium and upward uranium channels using the following formula:

$$C_{ac} = C_{lt} - (a_c + b_c * \mathrm{Cos}_f)$$

where: C_{ac} is the background and cosmic corrected channel
C_{lt} is the live time corrected channel
a_c is the aircraft background for this channel
b_c is the cosmic stripping coefficient for this channel
Cos_f is the filtered Cosmic channel

Radon Background

The determination of calibration constants that enable the stripping of the effects of atmospheric radon from the downward-looking detectors through the use of an upward-looking detector is divided into two parts:

1) Determine the relationship between the upward- and downward-looking detector count rates for radiation originating from the ground.

2) Determine the relationship between the upward- and downward-looking detector count rates for radiation due to atmospheric radon.

The procedures to determine these calibration factors are documented in IAEA Report #323 on airborne gamma-ray surveying. The calibrations for the first part were determined as outlined in the report.

The latter case normally requires many over-water measurements where there is no contribution from the ground. Where this is not possible, it is standard procedure to establish a test line over which a series of repeat measurements are acquired. From these repeat flights, any change in the downward uranium window due to variations in radon background would be directly related to variations in the upward window and the other downward windows.

The validity of this technique rests on the assumption that the radiation from the ground is essentially constant from flight to flight. Inhomogeneities in the ground, coupled with deviations in the flight path between test runs, add to the inaccuracy of the accumulated results. Variations in flying heights and other environmental factors also contribute to the uncertainty.

The use of test lines is a common solution for a fixed-wing acquisition platform. The ability of rotary wing platforms to hover at a constant height over a fixed position eliminates a number of the variations which degrade the accuracy of the results required for this calibration.

Hover test sites were established in or near the survey area. The tests were carried out at the start and end of each day, and at the end of each flight. Data were acquired over a four minute period at the nominal survey altitude (60 m). The data were then corrected for livetime, aircraft background and cosmic activity.

Once the survey was completed, the relationships between the counts in the downward uranium window and in the other four windows due to atmospheric radon were determined using linear regression for each of the hover sites. The following equations were used:

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

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
the various "a" and "b" coefficients are the required calibration constants

In practice, only the "a" constants were used in the final processing. The "b" constants, which are normally near zero for over-water calibrations, were of no value as they reflected the local distribution of the ground concentrations measured in the five windows.

The thorium, uranium and upward uranium data for each line were copied into temporary arrays, then smoothed with 21, 21 and 51 point Hanning filters to product Th_f, U_f, and u_f respectively. The radon component in the downward uranium window was then determined using the following formula:

$$U_r = \frac{u_f - a_1 * U_f - a_2 * Th_f + a_2 * b_{Th} - b_u}{a_u - a_1 - a_2 * a_{Th}}$$

where: U_r is the radon component in the downward uranium window
u_f is the filtered upward uranium
U_f is the filtered uranium

Th_f is the filtered thorium

a_1, a_2, a_u and a_{Th} are proportionality factors and

b_u and b_{Th} are constants determined experimentally

The effects of radon in the downward uranium are removed by simply subtracting U_r from U_{ac}. The effects of radon in the total count, potassium, thorium and upward uranium are then removed based upon previously established relationships with U_r. The corrections are applied using the following formula:

$$C_{rc} = C_{ac} - (a_c * U_r + b_c)$$

where: C_{rc} is the radon corrected channel

C_{ac} is the background and cosmic corrected channel

U_r is the radon component in the downward uranium window

a_c is the proportionality factor and

b_c is the constant determined experimentally for this channel

Compton Stripping

Following the radon correction, the potassium, uranium and thorium are corrected for spectral overlap. First, α,β and γ the stripping ratios, are modified according to altitude. Then an adjustment factor based on a, the reversed stripping ratio, uranium into thorium, is calculated. (Note: the stripping ratio altitude correction constants are expressed in change per metre. A constant of 0.3048 is required to conform to the internal usage of height in feet):

$$\alpha_h = \alpha + h_{ef} * 0.00049$$

$$\alpha_r = \frac{1.0}{1.0 - a * \alpha_h}$$

$$\beta_h = \beta + h_{ef} * 0.00065$$

$$\gamma_h = \gamma + h_{ef} * 0.00069$$

where: α, β, γ are the Compton stripping coefficients

α_h, β_h, γ_h are the height corrected Compton stripping coefficients

h_{ef} is the height above ground in metres

α_r is the scaling factor correcting for back scatter

a is the reverse stripping ratio

The stripping corrections are then carried out using the following formulas:

$$Th_c = (Th_{rc} - a * U_{rc}) * \alpha_r$$

$$K_c = K_{rc} - \gamma_h * U_c - \beta_h * Th_c$$

$$U_c = (U_{rc} - \alpha_h * Th_{rc}) * \alpha_r$$

where: U_c, Th_c and K_c are corrected uranium, thorium and potassium

α_h,β_h,γ_h are the height corrected Compton stripping coefficients

U_{rc}, Th_{rc} and K_{rc} are radon-corrected uranium, thorium and potassium

α_r is the backscatter correction

Attenuation Corrections

The total count, potassium, uranium and thorium data are then corrected to a nominal survey altitude, in this case 200 feet. This is done according to the equation:

$$C_a = C * e^{\mu(h_{ef} - ho)}$$

where: C_a is the output altitude corrected channel

C is the input channel

e^{μ} is the attenuation correction for that channel

h_{ef} is the effective altitude

h_0 is the nominal survey altitude to correct to

8. CONCLUSIONS AND RECOMMENDATIONS

This report provides a very brief description of the survey results and describes the equipment, data processing procedures and logistics of the airborne survey over the Symphony block, near Houston, B.C.

The various products accompanying this report display the magnetic, conductive and radiometric properties of the survey area. It is recommended that a complete assessment and detailed evaluation of the survey results be carried out, in conjunction with all available geophysical, geological and geochemical information.

The magnetic results have provided valuable structural information that can be used to help locate the more favourable areas for mineral deposition on the properties. In addition to locating numerous linear faults and shears, the magnetic data have outlined the contacts of both magnetic and non-magnetic units. The latter could reflect felsic intrusions or siliceous breccias that might host auriferous mineralization. In addition, the combined magnetic and resistivity parameters have outlined a few very interesting magnetic lows and resistivity highs that could reflect alteration zones or siliceous caps.

There are several low resistivity zones where values of less than 50 ohm-m are evident. Some of these broader zones are likely due to conductive clays or graphitic shales, while some of the more discrete responses might be attributed to increases in conductive sulphide content or clay-altered shears. Although the former “formational” zones may be of little economic interest, those in the latter category might warrant additional work.

Other anomalous responses coincide with magnetic linears that could reflect contacts, faults, or shears. These inferred contacts and structural breaks are also considered to be of particular interest as they may have influenced or controlled mineral deposition within the survey areas.

The anomalous (resistive) targets and some of the bedrock conductors defined by the survey should be subjected to further investigation, using appropriate surface exploration techniques. Anomalies that are currently considered to be of moderately low priority may require upgrading if follow-up results are favourable.

It is also suggested that additional processing of existing geophysical data be considered, in order to extract the maximum amount of information from the survey results. Current software and imaging techniques can often provide valuable information on structure and lithology, which may not be clearly evident on the images provided with this report. These techniques can yield images that define subtle, but significant, structural details.

Respectfully submitted,

FUGRO AIRBORNE SURVEYS CORP.

R11068

APPENDIX A

LIST OF PERSONNEL

The following personnel were involved in the acquisition, processing, interpretation and presentation of data, relating to a DIGHEM airborne geophysical survey carried out over the Symphony project area, for BonTerra Resources Inc., near Houston, B.C.

Brett Robinson	Project Manager
Sunny Bhatia	Equipment Operator
Terry Lacey	Equipment Operator
Michael Wu	Data Processor
Amanda Heydorn	Data Processor/ Crew leader
Lyn Vanderstarren	Drafting Supervisor
Ed Ashie	Pilot (Questral Helicopters Ltd.)

The survey consisted of 308 km of coverage, flown from September 18 to 21, 2011.

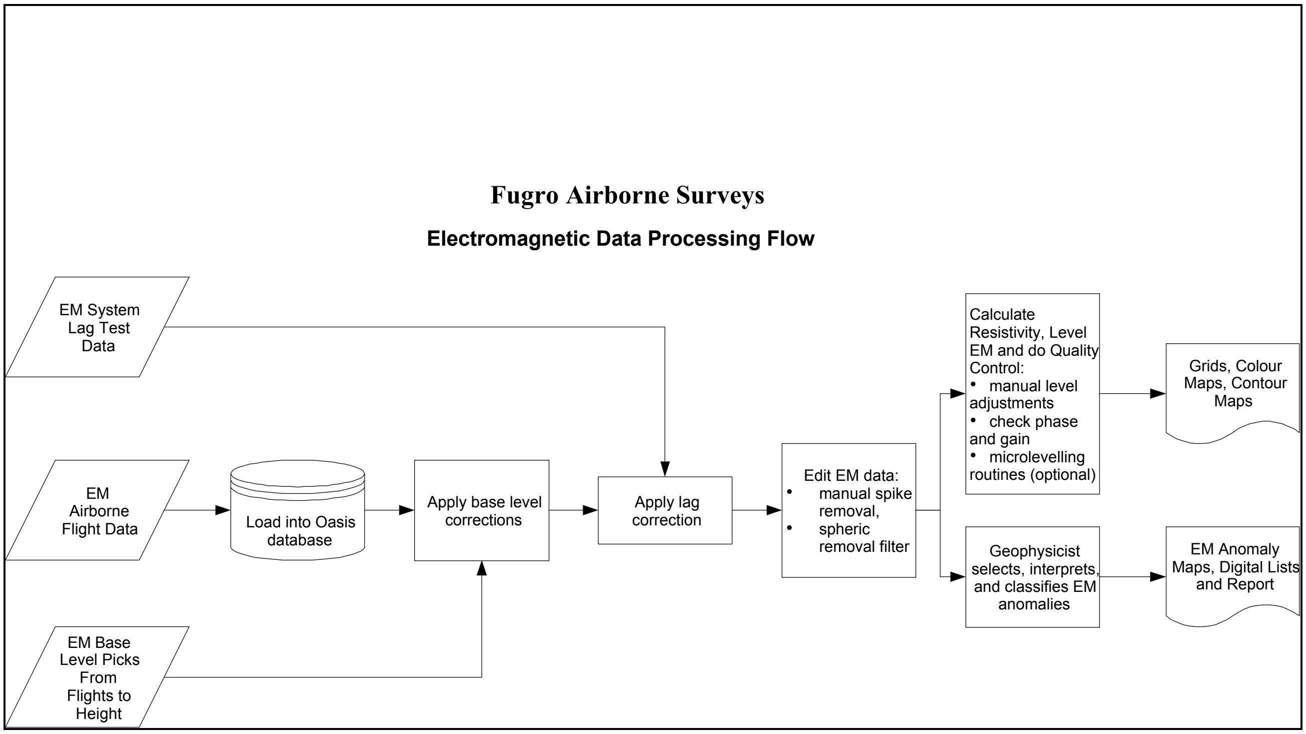
All personnel are employees of Fugro Airborne Surveys, except for the pilot who is an employee of Questral Helicopters Ltd.

APPENDIX B

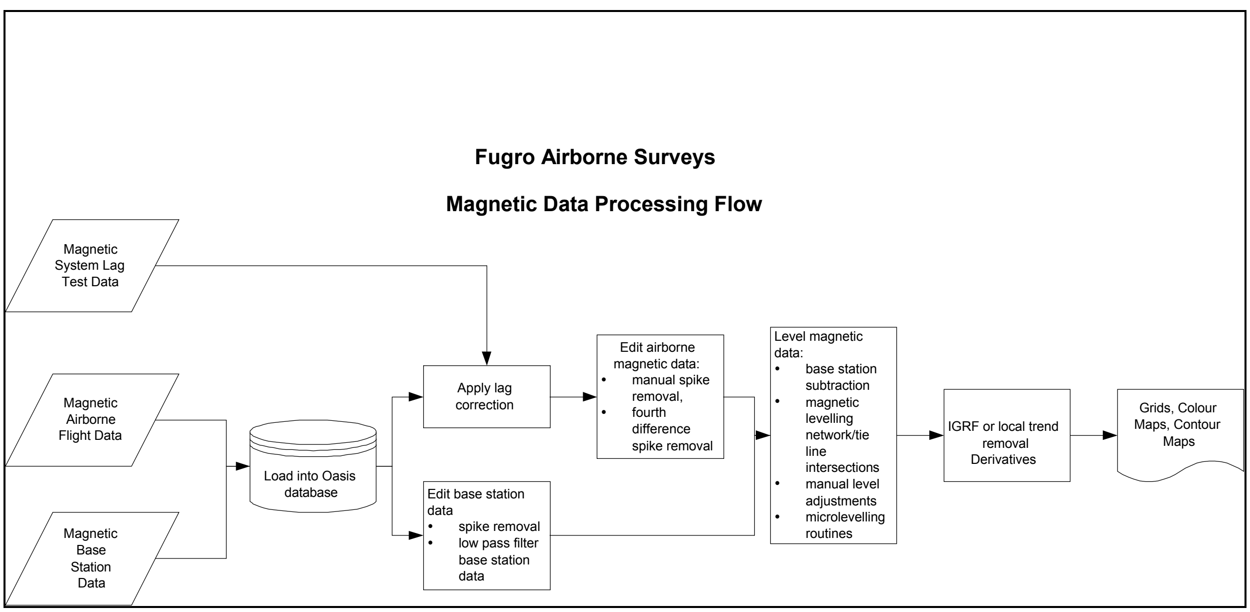
DATA PROCESSING FLOWCHARTS

APPENDIX B

Processing Flow Chart - Electromagnetic Data



Processing Flow Chart - Magnetic Data



APPENDIX C

BACKGROUND INFORMATION

BACKGROUND INFORMATION

Electromagnetics

An Electromagnetic anomaly interpretation had not been carried out at the time of this report. This will be included in the final products.

Fugro electromagnetic responses fall into two general classes, discrete and broad. The discrete class consists of sharp, well-defined anomalies from discrete conductors such as sulphide lenses and steeply dipping sheets of graphite and sulphides. The broad class consists of wide anomalies from conductors having a large horizontal surface such as flatly dipping graphite or sulphide sheets, saline water-saturated sedimentary formations, conductive overburden and rock, kimberlite pipes and geothermal zones. A vertical conductive slab with a width of 200 m would straddle these two classes.

The vertical sheet (half plane) is the most common model used for the analysis of discrete conductors. The B, D and T type are analyzed according to this model, with the conductance being calculated from the local amplitudes of the coaxial data.. The following section entitled **Discrete Conductor Analysis** describes this model in detail.

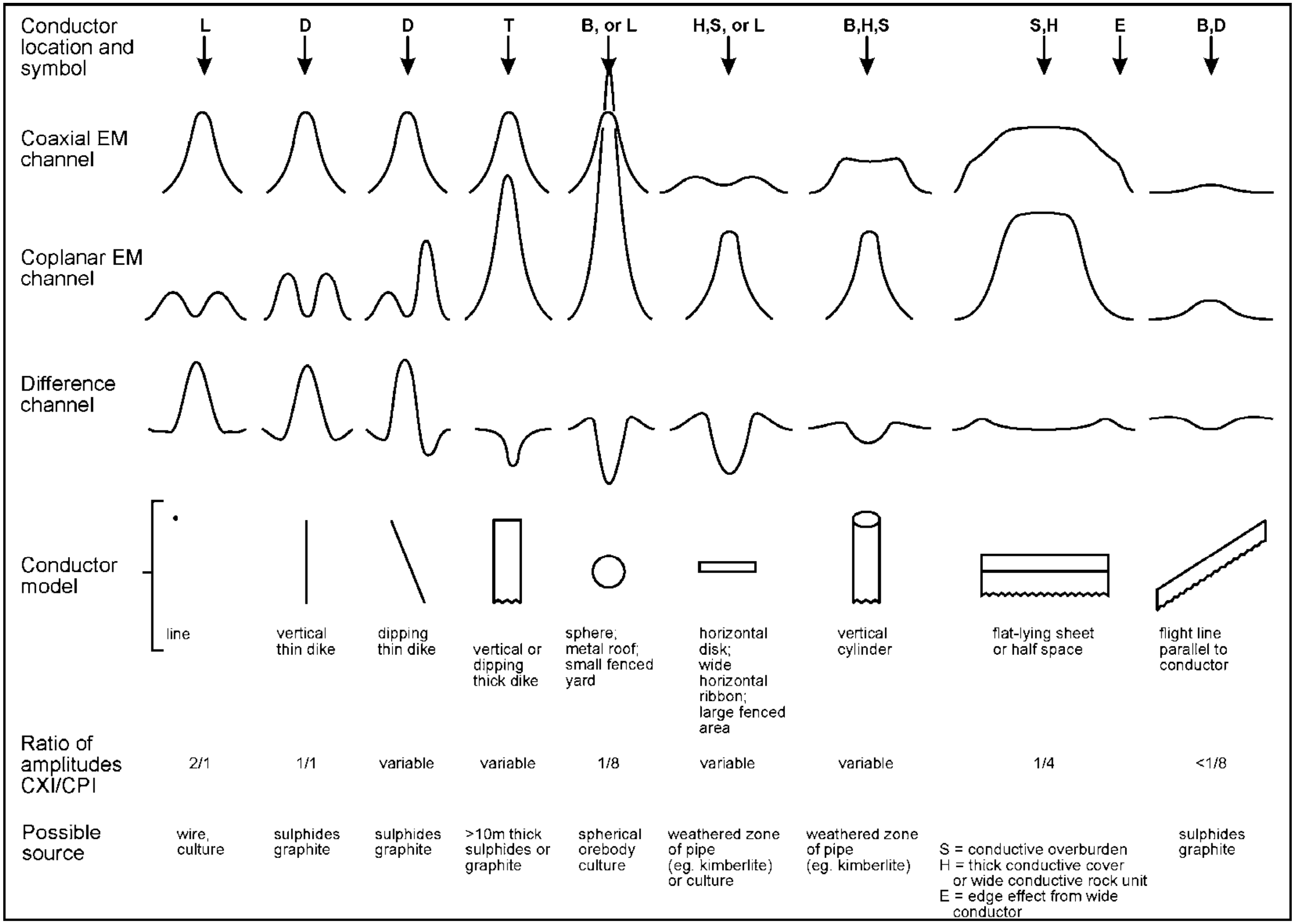
The conductive earth (half-space) model is more suitable for broad conductors that carry an S, H, or E type interpretation symbol. Conductance values for these anomalous responses are based on the absolute amplitudes of the selected coplanar channels. Resistivity maps result from the use of this model. A later section entitled **Resistivity Mapping** describes the method further.

Geometric Interpretation

The geophysical interpreter attempts to determine the geometric shape and dip of the conductor. Figure C-1 shows typical HEM anomaly shapes that are used to guide the geometric interpretation.

Discrete Conductor Analysis

The EM anomalies appearing on the electromagnetic map are analyzed by computer to give the conductance (i.e., conductivity-thickness product) in siemens (mhos). The B, D, and T type calculations are based on a vertical sheet model. This is not an unreasonable procedure, because the computed conductance increases as the electrical quality of the conductor increases, regardless of its true shape. HEM anomalies are divided into seven grades of conductance, as shown in Table C-1. The conductance in siemens (mhos) is the reciprocal of resistance in ohms.



Typical HEM anomaly shapes

Figure C-1

The conductance value is a geological parameter because it is a characteristic of the conductor alone. It generally is independent of frequency, flying height or depth of burial, apart from the averaging over a greater portion of the conductor as height increases. Small anomalies from deeply buried strong conductors are not confused with small anomalies from shallow weak conductors because the former will have larger conductance values.

Table C-1. EM Anomaly Grades

Anomaly Grade	Siemens
7	> 100
6	50 - 100
5	20 - 50
4	10 - 20
3	5 - 10
2	1 - 5
1	< 1

Conductive overburden generally produces broad EM responses which may not be shown as anomalies on the geophysical maps. However, patchy conductive overburden in otherwise resistive areas can yield discrete anomalies with a conductance grade (cf. Table C-1) of 1, 2 or even 3 for conducting clays that have resistivities as low as 50 ohm-m. In areas where ground resistivities are less than 10 ohm-m, anomalies caused by weathering variations and similar causes can have any conductance grade. The anomaly shapes from the multiple coils often allow such conductors to be recognized, and these are indicated by the letters S, H, and sometimes E on the geophysical maps (see EM legend on maps).

For bedrock conductors, the higher anomaly grades indicate increasingly higher conductances. Examples: the New Insco copper discovery (Noranda, Canada) yielded a grade 5 anomaly, as did the neighbouring copper-zinc Magusi River ore body; Mattabi (copper-zinc, Sturgeon Lake, Canada) and Whistle (nickel, Sudbury, Canada) gave grade 6; and the Montcalm nickel-copper discovery (Timmins, Canada) yielded a grade 7 anomaly. Graphite and sulphides can span all grades but, in any particular survey area, field work may show that the different grades indicate different types of conductors.

Strong conductors (i.e., grades 6 and 7) are characteristic of massive sulphides or graphite. Moderate conductors (grades 4 and 5) typically reflect graphite or sulphides of a less massive character, while weak bedrock conductors (grades 1 to 3) can signify poorly connected graphite or heavily disseminated sulphides. Grades 1 and 2 conductors may not respond to ground EM equipment using frequencies less than 2000 Hz.

The presence of sphalerite or gangue can result in ore deposits having weak to moderate conductances. As an example, the three million ton lead-zinc deposit of Restigouche Mining Corporation near Bathurst, Canada, yielded a well-defined grade 2 conductor. The 10 percent by volume of sphalerite occurs as a coating around the fine-grained massive pyrite, thereby inhibiting electrical conduction. Faults, fractures and shear zones may produce anomalies that typically have low conductances (e.g., grades 1 to 3). Conductive rock formations can yield anomalies of any conductance grade. The conductive materials in such rock formations can be salt water, weathered products such as clays, original depositional clays, and carbonaceous material.

For each interpreted electromagnetic anomaly on the geophysical maps, a letter identifier and an interpretive symbol are plotted beside the EM grade symbol. In areas where anomalies are crowded, the letter identifiers and interpretive symbols may be obliterated. The EM grade symbols, however, will always be discernible, and any obliterated information can be obtained from the anomaly listing appended to this report.

The conductance measurement is considered more reliable than the depth estimate. There are a number of factors that can produce an error in the depth estimate, including the averaging of topographic variations by the altimeter, overlying conductive overburden, and the location and attitude of the conductor relative to the flight line. Conductor location and attitude can provide an erroneous depth estimate because the stronger part of the conductor may be deeper or to one side of the flight line, or because it has a shallow dip. A heavy tree cover can also produce errors in depth estimates. This is because the depth estimate is computed as the distance of the bird from the conductor, minus the altimeter reading. The altimeter can lock onto the top of a dense forest canopy. This situation yields an erroneously large depth estimate but does not affect the conductance estimate.

Dip symbols are used to indicate the direction of dip of conductors. These symbols are used only when the anomaly shapes are unambiguous, which usually requires a fairly resistive environment.

A further interpretation is often presented on the EM map by means of the line-to-line correlation of bedrock anomalies, which is based on a comparison of anomaly shapes on adjacent lines. This provides conductor axes that may define the geological structure over portions of the survey area. The absence of conductor axes in an area implies that anomalies could not be correlated from line to line with reasonable confidence.

The electromagnetic anomalies are designed to provide a correct impression of conductor quality by means of the conductance grade symbols. The symbols can stand alone with geology when planning a follow-up program. The actual conductance values are printed in the attached anomaly list for those who wish quantitative data. The map provides an interpretation of conductors in terms of length, strike and dip, geometric shape, conductance, and thickness. The accuracy is comparable to an interpretation from a high quality ground EM survey having the same line spacing.

The appended EM anomaly list provides a tabulation of anomalies in ppm, conductance, and depth for the vertical sheet or horizontal sheet models. The vertical sheet model (B, D, and T types) uses the local coaxial amplitudes for the calculation. Values for the horizontal sheet model (S, H, and E types) are calculated from the absolute amplitudes of the selected coplanar channels. No conductance or depth estimates are shown for weak anomalous responses that are not of sufficient amplitude to yield reliable calculations, or where magnetite effects have caused negative in-phase responses.

Questionable Anomalies

The EM maps may contain anomalous responses that are displayed as asterisks (*). These responses denote weak anomalies of indeterminate conductance, which may reflect one of the following: a weak conductor near the surface, a strong conductor at depth (e.g., 100 to 120 m below surface) or to one side of the flight line, or aerodynamic noise. Those responses that have the appearance of valid bedrock anomalies on the flight profiles are indicated by appropriate interpretive symbols (see EM legend on maps). The others probably do not warrant further investigation unless their locations are of considerable geological interest.

The Thickness Parameter

A comparison of coaxial and coplanar shapes can provide an indication of the thickness of a steeply dipping conductor. The amplitude of the coplanar anomaly (e.g., CPI channel) increases relative to the coaxial anomaly (e.g., CXI) as the apparent thickness increases, i.e., the thickness in the horizontal plane. (The thickness is equal to the conductor width if the conductor dips at 90 degrees and strikes at right angles to the flight line.) This report refers to a conductor as thin when the thickness is likely to be less than 5 m, and thick when in excess of 10 m. Thick conductors are indicated on the EM map by parentheses "( )". For base metal exploration in steeply dipping geology, thick conductors can be high priority targets because many massive sulphide ore bodies are thick. The system cannot sense the thickness when the strike of the conductor is subparallel to the flight line, when the conductor has a shallow dip, when the anomaly amplitudes are small, or when the resistivity of the environment is less than 100 ohm-m.

Resistivity Mapping

Resistivity mapping is useful in areas where broad or flat lying conductive units are of interest. One example of this is the clay alteration that is associated with Carlin-type deposits in the south west United States. The resistivity parameter was able to identify the clay alteration zone over the Cove deposit. The alteration zone appeared as a strong resistivity low on the 900 Hz resistivity parameter. The 7,200 Hz and 56,000 Hz resistivities showed more detail in the covering sediments, and delineated a range front fault. This is typical in many areas of the southwest United States, where conductive near surface sediments, which may sometimes be alkalic, attenuate the higher frequencies.

Resistivity mapping has proven successful for locating diatremes in diamond exploration. Weathering products from relatively soft kimberlite pipes produce a resistivity contrast with the unaltered host rock. In many cases weathered kimberlite pipes were associated with thick conductive layers that contrasted with overlying or adjacent relatively thin layers of lake bottom sediments or overburden.

Areas of widespread conductivity are commonly encountered during surveys. These conductive zones may reflect alteration zones, shallow-dipping sulphide or graphite-rich units, saline ground water, or conductive overburden. In such areas, EM amplitude changes can be generated by decreases of only 5 m in survey altitude, as well as by increases in conductivity. The typical flight record in conductive areas is characterized by in-phase and quadrature channels that are continuously active. Local EM peaks reflect either increases in conductivity of the earth or decreases in survey altitude. For such conductive areas, apparent resistivity profiles and contour maps are necessary for the correct interpretation of the airborne data. The advantage of the resistivity parameter is that anomalies caused by altitude changes are virtually eliminated, so the resistivity data reflect only those anomalies caused by conductivity changes. The resistivity analysis also helps the interpreter to differentiate between conductive bedrock and conductive overburden. For example, discrete conductors will generally appear as narrow lows on the contour map and broad conductors (e.g., overburden) will appear as wide lows.

The apparent resistivity is calculated using the pseudo-layer (or buried) half-space model defined by Fraser (1978)[2]. This model consists of a resistive layer overlying a conductive half-space. The depth channels give the apparent depth below surface of the conductive material. The apparent depth is simply the apparent thickness of the overlying resistive layer. The apparent depth (or thickness) parameter will be positive when the upper layer is more resistive than the underlying material, in which case the apparent depth may be quite close to the true depth.

The apparent depth will be negative when the upper layer is more conductive than the underlying material, and will be zero when a homogeneous half-space exists. The apparent depth parameter must be interpreted cautiously because it will contain any errors that might exist in the measured altitude of the EM bird (e.g., as caused by a dense tree cover). The inputs to the resistivity algorithm are the in-phase and quadrature components of the coplanar coil-pair. The outputs are the apparent resistivity of the conductive half-space (the source) and the sensor-source distance. The flying height is not an input variable, and the output resistivity and sensor-source distance are independent of the flying height when the conductivity of the measured material is sufficient to yield significant in-phase as well as quadrature responses. The apparent depth, discussed above, is simply the sensor-source distance minus the measured altitude or flying height. Consequently, errors in the measured altitude will affect the apparent depth parameter but not the apparent resistivity parameter.

The apparent depth parameter is a useful indicator of simple layering in areas lacking a heavy tree cover. Depth information has been used for permafrost mapping, where positive apparent depths were used as a measure of permafrost thickness. However, little quantitative use has been made of negative apparent depths because the absolute value of the negative depth is not a measure of the thickness of the conductive upper layer and, therefore, is not meaningful physically. Qualitatively, a negative apparent depth estimate usually shows that the EM anomaly is caused by conductive overburden. Consequently,

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[2] Resistivity mapping with an airborne multicoil electromagnetic system: Geophysics, v. 43, p.144-172

the apparent depth channel can be of significant help in distinguishing between overburden and bedrock conductors.

Interpretation in Conductive Environments

Environments having low background resistivities (e.g., below 30 ohm-m for a 900 Hz system) yield very large responses from the conductive ground. This usually prohibits the recognition of discrete bedrock conductors. However, Fugro data processing techniques produce three parameters that contribute significantly to the recognition of bedrock conductors in conductive environments. These are the in-phase and quadrature difference channels (DIFI and DIFQ, which are available only on systems with "common" frequencies on orthogonal coil pairs), and the resistivity and depth channels (RES and DEP) for each coplanar frequency.

The EM difference channels (DIFI and DIFQ) eliminate most of the responses from conductive ground, leaving responses from bedrock conductors, cultural features (e.g., telephone lines, fences, etc.) and edge effects. Edge effects often occur near the perimeter of broad conductive zones. This can be a source of geologic noise. While edge effects yield anomalies on the EM difference channels, they do not produce resistivity anomalies. Consequently, the resistivity channel aids in eliminating anomalies due to edge effects. On the other hand, resistivity anomalies will coincide with the most highly conductive sections of conductive ground, and this is another source of geologic noise. The recognition of a bedrock conductor in a conductive environment therefore is based on the anomalous responses of the two difference channels (DIFI and DIFQ) and the resistivity channels (RES). The most favourable situation is where anomalies coincide on all channels.

The DEP channels, which give the apparent depth to the conductive material, also help to determine whether a conductive response arises from surficial material or from a conductive zone in the bedrock. When these channels ride above the zero level on the depth profiles (i.e., depth is negative), it implies that the EM and resistivity profiles are responding primarily to a conductive upper layer, i.e., conductive overburden. If the DEP channels are below the zero level, it indicates that a resistive upper layer exists, and this usually implies the existence of a bedrock conductor. If the low frequency DEP channel is below the zero level and the high frequency DEP is above, this suggests that a bedrock conductor occurs beneath conductive cover.

Reduction of Geologic Noise

Geologic noise refers to unwanted geophysical responses. For purposes of airborne EM surveying, geologic noise refers to EM responses caused by conductive overburden and magnetic permeability. It was mentioned previously that the EM difference channels (i.e., channel DIFI for in-phase and DIFQ for quadrature) tend to eliminate the response of conductive overburden.

Magnetite produces a form of geological noise on the in-phase channels. Rocks containing less than 1% magnetite can yield negative in-phase anomalies caused by magnetic permeability. When magnetite is widely distributed throughout a survey area, the in-phase

EM channels may continuously rise and fall, reflecting variations in the magnetite percentage, flying height, and overburden thickness. This can lead to difficulties in recognizing deeply buried bedrock conductors, particularly if conductive overburden also exists. However, the response of broadly distributed magnetite generally vanishes on the in-phase difference channel DIFI. This feature can be a significant aid in the recognition of conductors that occur in rocks containing accessory magnetite.

EM Magnetite Mapping

The information content of HEM data consists of a combination of conductive eddy current responses and magnetic permeability responses. The secondary field resulting from conductive eddy current flow is frequency-dependent and consists of both in-phase and quadrature components, which are positive in sign. On the other hand, the secondary field resulting from magnetic permeability is independent of frequency and consists of only an in-phase component which is negative in sign. When magnetic permeability manifests itself by decreasing the measured amount of positive in-phase, its presence may be difficult to recognize. However, when it manifests itself by yielding a negative in-phase anomaly (e.g., in the absence of eddy current flow), its presence is assured. In this latter case, the negative component can be used to estimate the percent magnetite content.

A magnetite mapping technique, based on the low frequency coplanar data, can be complementary to magnetometer mapping in certain cases. Compared to magnetometry, it is far less sensitive but is more able to resolve closely spaced magnetite zones, as well as providing an estimate of the amount of magnetite in the rock. The method is sensitive to 1/4% magnetite by weight when the EM sensor is at a height of 30 m above a magnetitic half-space. It can individually resolve steep dipping narrow magnetite-rich bands that are separated by 60 m. Unlike magnetometry, the EM magnetite method is unaffected by remanent magnetism or magnetic latitude.

The EM magnetite mapping technique provides estimates of magnetite content that are usually correct within a factor of 2 when the magnetite is fairly uniformly distributed. EM magnetite maps can be generated when magnetic permeability is evident as negative in-phase responses on the data profiles.

Like magnetometry, the EM magnetite method maps only bedrock features, provided that the overburden is characterized by a general lack of magnetite. This contrasts with resistivity mapping which portrays the combined effect of bedrock and overburden.

The Susceptibility Effect

When the host rock is conductive, the positive conductivity response will usually dominate the secondary field, and the susceptibility effect[3] will appear as a reduction in

[3] Magnetic susceptibility and permeability are two measures of the same physical property. Permeability is generally given as relative permeability, μ_r, which is the permeability of the substance divided by the permeability of free space ($4 \pi \times 10^{-7}$). Magnetic susceptibility *k* is related to permeability by $k=\mu^r-1$. Susceptibility is a unitless measurement, and is usually

the in-phase, rather than as a negative value. The in-phase response will be lower than would be predicted by a model using zero susceptibility. At higher frequencies the in-phase conductivity response also gets larger, so a negative magnetite effect observed on the low frequency might not be observable on the higher frequencies, over the same body. The susceptibility effect is most obvious over discrete magnetite-rich zones, but also occurs over uniform geology such as a homogeneous half-space.

High magnetic susceptibility will affect the calculated apparent resistivity, if only conductivity is considered. Standard apparent resistivity algorithms use a homogeneous half-space model, with zero susceptibility. For these algorithms, the reduced in-phase response will, in most cases, make the apparent resistivity higher than it should be. It is important to note that there is nothing wrong with the data, nor is there anything wrong with the processing algorithms. The apparent difference results from the fact that the simple geological model used in processing does not match the complex geology.

Measuring and Correcting the Magnetite Effect

Theoretically, it is possible to calculate (forward model) the combined effect of electrical conductivity and magnetic susceptibility on an EM response in all environments. The difficulty lies, however, in separating out the susceptibility effect from other geological effects when deriving resistivity and susceptibility from EM data.

Over a homogeneous half-space, there is a precise relationship between in-phase, quadrature, and altitude. These are often resolved as phase angle, amplitude, and altitude. Within a reasonable range, any two of these three parameters can be used to calculate the half space resistivity. If the rock has a positive magnetic susceptibility, the in-phase component will be reduced and this departure can be recognized by comparison to the other parameters.

The algorithm used to calculate apparent susceptibility and apparent resistivity from HEM data, uses a homogeneous half-space geological model. Non half-space geology, such as horizontal layers or dipping sources, can also distort the perfect half-space relationship of the three data parameters. While it may be possible to use more complex models to calculate both rock parameters, this procedure becomes very complex and time-consuming. For basic HEM data processing, it is most practical to stick to the simplest geological model.

Magnetite reversals (reversed in-phase anomalies) have been used for many years to calculate an "FeO" or magnetite response from HEM data (Fraser, 1981). However, this technique could only be applied to data where the in-phase was observed to be negative, which happens when susceptibility is high and conductivity is low.

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reported in units of 10^{-6}. The typical range of susceptibilities is –1 for quartz, 130 for pyrite, and up to 5×10^5 for magnetite, in 10^{-6} units (Telford et al, 1986).

Applying Susceptibility Corrections

Resistivity calculations done with susceptibility correction may change the apparent resistivity. High-susceptibility conductors, which were previously masked by the susceptibility effect in standard resistivity algorithms, may become evident. In this case the susceptibility corrected apparent resistivity is a better measure of the actual resistivity of the earth. However, other geological variations, such as a deep resistive layer, can also reduce the in-phase by the same amount. In this case, susceptibility correction would not be the best method. Different geological models can apply in different areas of the same data set. The effects of susceptibility, and other effects that can create a similar response, must be considered when selecting the resistivity algorithm.

Susceptibility from EM vs Magnetic Field Data

The response of the EM system to magnetite may not match that from a magnetometer survey. First, HEM-derived susceptibility is a rock property measurement, like resistivity. Magnetic data show the total magnetic field, a measure of the potential field, not the rock property. Secondly, the shape of an anomaly depends on the shape and direction of the source magnetic field. The electromagnetic field of HEM is much different in shape from the earth's magnetic field. Total field magnetic anomalies are different at different magnetic latitudes; HEM susceptibility anomalies have the same shape regardless of their location on the earth.

In far northern latitudes, where the magnetic field is nearly vertical, the total magnetic field measurement over a thin vertical dike is very similar in shape to the anomaly from the HEM-derived susceptibility (a sharp peak over the body). The same vertical dike at the magnetic equator would yield a negative magnetic anomaly, but the HEM susceptibility anomaly would show a positive susceptibility peak.

Effects of Permeability and Dielectric Permittivity

Resistivity algorithms that assume free-space magnetic permeability and dielectric permittivity, do not yield reliable values in highly magnetic or highly resistive areas. Both magnetic polarization and displacement currents cause a decrease in the in-phase component, often resulting in negative values that yield erroneously high apparent resistivities. The effects of magnetite occur at all frequencies, but are most evident at the lowest frequency. Conversely, the negative effects of dielectric permittivity are most evident at the higher frequencies, in resistive areas.

The table below shows the effects of varying permittivity over a resistive (10,000 ohm-m) half space, at frequencies of 56,000 Hz (DIGHEM^{V}) and 140,000 Hz (RESOLVE).

Apparent Resistivity Calculations
Effects of Permittivity on In-phase/Quadrature/Resistivity

Freq (Hz)	Coil	Sep (m)	Thres (ppm)	Alt (m)	In Phase	Quad Phase	App Res	App Depth (m)	Permittivity
56,000	CP	6.3	0.1	30	7.3	35.3	10118	-1.0	1 Air
56,000	CP	6.3	0.1	30	3.6	36.6	19838	-13.2	5 Quartz
56,000	CP	6.3	0.1	30	-1.1	38.3	81832	-25.7	10 Epidote
56,000	CP	6.3	0.1	30	-10.4	42.3	76620	-25.8	20 Granite
56,000	CP	6.3	0.1	30	-19.7	46.9	71550	-26.0	30 Diabase
56,000	CP	6.3	0.1	30	-28.7	52.0	66787	-26.1	40 Gabbro
140,000	CP	7.94	0.1	30	52.1	159.1	8710	0.2	1 Air
140,000	CP	7.94	0.1	30	16.1	180.4	29215	-18.5	5 Quartz
140,000	CP	7.94	0.1	30	-27.0	211.9	102876	-26.9	10 Epidote
140,000	CP	7.94	0.1	30	-103.6	287.0	84044	-27.2	20 Granite
140,000	CP	7.94	0.1	30	-166.0	371.5	70766	-27.5	30 Diabase
140,000	CP	7.94	0.1	30	-215	459.3	61433	-27.6	40 Gabbro

Methods have been developed (Huang and Fraser, 2000, 2001) to correct apparent resistivities for the effects of permittivity and permeability. The corrected resistivities yield more credible values than if the effects of permittivity and permeability are disregarded.

Recognition of Culture

Cultural responses include all EM anomalies caused by man-made metallic objects. Such anomalies may be caused by inductive coupling or current gathering. The concern of the interpreter is to recognize when an EM response is due to culture. Points of consideration used by the interpreter, when coaxial and coplanar coil-pairs are operated at a common frequency, are as follows:

1. The CPPL channel monitors 60 Hz radiation. An anomaly on this channel shows that the conductor is radiating power. Such an indication is normally a guarantee that the conductor is cultural. However, care must be taken to ensure that the conductor is not a geologic body that strikes across a power line, carrying leakage currents.

2. A flight that crosses a "line" (e.g., fence, telephone line, etc.) yields a centre-peaked coaxial anomaly and an m-shaped coplanar anomaly.[4] When the flight crosses the cultural line at a high angle of intersection, the amplitude ratio of coaxial/coplanar response is 2. Such an EM anomaly can only be caused by a line. The geologic

[4] See Figure C-1 presented earlier.

body that yields anomalies most closely resembling a line is the vertically dipping thin dike. Such a body, however, yields an amplitude ratio of 1 rather than 2. Consequently, an m-shaped coplanar anomaly with a CXI/CPI amplitude ratio of 2 is virtually a guarantee that the source is a cultural line.

3. A flight that crosses a sphere or horizontal disk yields centre-peaked coaxial and coplanar anomalies with a CXI/CPI amplitude ratio (i.e., coaxial/coplanar) of 1/8. In the absence of geologic bodies of this geometry, the most likely conductor is a metal roof or small fenced yard.[5] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

4. A flight that crosses a horizontal rectangular body or wide ribbon yields an m-shaped coaxial anomaly and a centre-peaked coplanar anomaly. In the absence of geologic bodies of this geometry, the most likely conductor is a large fenced area.[5] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

5. EM anomalies that coincide with culture, as seen on the video display, are usually caused by culture. However, care is taken with such coincidences because a geologic conductor could occur beneath a fence, for example. In this example, the fence would be expected to yield an m-shaped coplanar anomaly as in case #2 above. If, instead, a centre-peaked coplanar anomaly occurred, there would be concern that a thick geologic conductor coincided with the cultural line.

6. Thee above description of anomaly shapes is valid when the culture is not conductively coupled to the environment. In this case, the anomalies arise from inductive coupling to the EM transmitter. However, when the environment is quite conductive (e.g., less than 100 ohm-m at 900 Hz), the cultural conductor may be conductively coupled to the environment. In this latter case, the anomaly shapes tend to be governed by current gathering. Current gathering can completely distort the anomaly shapes, thereby complicating the identification of cultural anomalies. In such circumstances, the interpreter can only rely on the radiation channel and the video records

Magnetic Responses

The measured total magnetic field provides information on the magnetic properties of the earth materials in the survey area. This information can be used to locate magnetic bodies of direct interest for exploration, and for structural and lithological mapping.

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[5] It is a characteristic of EM that geometrically similar anomalies are obtained from: (1) a planar conductor, and (2) a wire that forms a loop having dimensions identical to the perimeter of the equivalent planar conductor.

The total magnetic field response reflects the abundance of magnetic material in the source. Magnetite is the most common magnetic mineral. Other minerals such as ilmenite, pyrrhotite, franklinite, chromite, hematite, arsenopyrite, limonite and pyrite are also magnetic, but to a lesser extent than magnetite on average.

In some geological environments, an EM anomaly with magnetic correlation has a greater likelihood of being produced by sulphides than one that is non-magnetic. However, sulphide ore bodies may be non-magnetic (e.g., the Kidd Creek deposit near Timmins, Canada) as well as magnetic (e.g., the Mattabi deposit near Sturgeon Lake, Canada).

Iron ore deposits will be anomalously magnetic in comparison to surrounding rock due to the concentration of iron minerals such as magnetite, ilmenite and hematite.

Changes in magnetic susceptibility often allow rock units to be differentiated based on the total magnetic field. Geophysical classifications may differ from geological classifications if various magnetite levels exist within one general geological classification. Geometric considerations of the source such as shape, dip and depth, inclination of the earth's field and remanent magnetization will complicate such an analysis.

In general, mafic lithologies contain more magnetite and are therefore more magnetic than many sediments which tend to be weakly magnetic. Metamorphism and alteration can also increase or decrease the magnetization of a rock unit.

Textural differences on a total field magnetic contour, colour or shadow map due to the frequency of activity of the magnetic parameter resulting from inhomogeneities in the distribution of magnetite within the rock, may define certain lithologies. For example, near surface volcanics may display highly complex contour patterns with little line-to-line correlation.

Rock units may be differentiated based on the plan shapes of their total or residual magnetic field responses. Mafic intrusive plugs can appear as isolated "bulls-eye" anomalies. Granitic intrusives appear as sub-circular zones, and may have contrasting rings due to contact metamorphism. Generally, granitic terrain will lack a pronounced strike direction, although granite gneiss may display strike.

Linear north-south units are theoretically not well defined on total magnetic field maps in equatorial regions, due to the low inclination of the earth's magnetic field. However, most stratigraphic units will have variations in composition along strike that will cause the units to appear as a series of alternating magnetic highs and lows.

Faults and shear zones may be characterized by alteration that causes destruction of magnetite (e.g., weathering) that produces a contrast with surrounding rock. Structural breaks may be filled by magnetite-rich, fracture filling material, as is the case with diabase dikes, or by non-magnetic felsic material.

Faulting can also be identified by patterns in the magnetic contours or colours. Faults and dikes tend to appear as lineaments and often have strike lengths of several kilometres.

Offsets in narrow, magnetic, stratigraphic trends also delineate structure. Sharp contrasts in magnetic lithologies may arise due to large displacements along strike-slip or dip-slip faults.

Gamma Ray Spectrometry

Radioelement concentrations are measures of the abundance of radioactive elements in the rock. The original abundance of the radioelements in any rock can be altered by the subsequent processes of metamorphism and weathering.

Gamma radiation in the range that is measured in the thorium, potassium, uranium and total count windows is strongly attenuated by rock, overburden and water. Almost all of the total radiation measured from rock and overburden originates in the upper .5 metres. Moisture in soil and bodies of water will mask the radioactivity from underlying rock. Weathered rock materials that have been displaced by glacial, water or wind action will not reflect the general composition of the underlying bedrock. Where residual soils exist, they may reflect the composition of underlying rock except where equilibrium does not exist between the original radioelement and the products in its decay series.

Radioelement counts (expressed as counts per second) are the rates of detection of the gamma radiation from specific decaying particles corresponding to products in each radioelements decay series. The radiation source for uranium is bismuth (Bi-214), for thorium it is thallium (Tl-208) and for potassium it is potassium (K-40).

The uranium and thorium radioelement concentrations are dependent on a state of equilibrium between the parent and daughter products in the decay series. Some daughter products in the uranium decay are long lived and could be removed by processes such as leaching. One product in the series, radon (Rn-222), is a gas which can easily escape. Both of these factors can affect the degree to which the calculated uranium concentrations reflect the actual composition of the source rock. Because the daughter products of thorium are relatively short lived, there is more likelihood that the thorium decay series is in equilibrium.

Lithological discrimination can be based on the measured relative concentrations and total, combined, radioactivity of the radioelements. Feldspar and mica contain potassium. Zircon, sphene and apatite are accessory minerals in igneous rocks that are sources of uranium and thorium. Monazite, thorianite, thorite, uraninite and uranothorite are also sources of uranium and thorium which are found in granites and pegmatites.

In general, the abundance of uranium, thorium and potassium in igneous rock increases with acidity. Pegmatites commonly have elevated concentrations of uranium relative to thorium. Sedimentary rocks derived from igneous rocks may have characteristic signatures that are influenced by their parent rocks, but these will have been altered by subsequent weathering and alteration.

Metamorphism and alteration will cause variations in the abundance of certain radioelements relative to each other. For example, alterative processes may cause uranium enrichment to the extent that a rock will be of economic interest. Uranium anomalies are more likely to be economically significant if they consist of an increase in the uranium relative to thorium and potassium, rather than a sympathetic increase in all three radioelements.

Faults can exhibit radioactive highs due to increased permeability which allows radon migration, or as lows due to structural control of drainage and fluvial sediments which attenuate gamma radiation from the underlying rocks. Faults can also be recognized by sharp contrasts in radiometric lithologies due to large strike-slip or dip-slip displacements. Changes in relative radioelement concentrations due to alteration will also define faults.

Similar to magnetics, certain rock types can be identified by their plan shapes if they also produce a radiometric contrast with surrounding rock. For example, granite intrusions will appear as sub-circular bodies, and may display concentric zonations. They will tend to lack a prominent strike direction. Offsets of narrow, continuous, stratigraphic units with contrasting radiometric signatures can identify faulting, and folding of stratigraphic trends will also be apparent.

APPENDIX D

GLOSSARY

GLOSSARY OF AIRBORNE GEOPHYSICAL TERMS

Note: The definitions given in this glossary refer to the common terminology as used in airborne geophysics.

altitude attenuation: the absorption of gamma rays by the atmosphere between the earth and the detector. The number of gamma rays detected by a system decreases as the altitude increases.

apparent- : the ***physical parameters*** of the earth measured by a geophysical system are normally expressed as apparent, as in "apparent ***resistivity*"**. This means that the measurement is limited by assumptions made about the geology in calculating the response measured by the geophysical system. Apparent resistivity calculated with ***HEM***, for example, generally assumes that the earth is a ***homogeneous half-space*** – not layered.

amplitude: The strength of the total electromagnetic field. In ***frequency domain*** it is most often the sum of the squares of ***in-phase*** and ***quadrature*** components. In multi-component electromagnetic surveys it is generally the sum of the squares of all three directional components.

analytic signal: The total amplitude of all the directions of magnetic ***gradient***. Calculated as the sum of the squares.

anisotropy: Having different ***physical parameters*** in different directions. This can be caused by layering or fabric in the geology. Note that a unit can be anisotropic, but still **homogeneous**.

anomaly: A localized change in the geophysical data characteristic of a discrete source, such as a conductive or magnetic body. Something locally different from the **background**.

B-field: In time-domain **electromagnetic** surveys, the magnetic field component of the (electromagnetic) **field**. This can be measured directly, although more commonly it is calculated by integrating the time rate of change of the magnetic field **dB/dt**, as measured with a receiver coil.

background: The "normal" response in the geophysical data – that response observed over most of the survey area. **Anomalies** are usually measured relative to the background. In airborne gamma-ray spectrometric surveys the term defines the **cosmic**, radon, and aircraft responses in the absence of a signal from the ground.

base-level: The measured values in a geophysical system in the absence of any outside signal. All geophysical data are measured relative to the system base level.

base frequency: The frequency of the pulse repetition for a ***time-domain electromagnetic*** system. Measured between subsequent positive pulses.

bird: A common name for the pod towed beneath or behind an aircraft, carrying the geophysical sensor array.

calibration coil: A wire coil of known size and dipole moment, which is used to generate a field of known ***amplitude*** and ***phase*** in the receiver, for system calibration. Calibration coils can be external, or internal to the system. Internal coils may be called Q-coils.

coaxial coils: **[CX]** Coaxial coils are in the vertical plane, with their axes horizontal and collinear in the flight direction. These are most sensitive to vertical conductive objects in the ground, such as thin, steeply dipping conductors perpendicular to the flight direction. Coaxial coils generally give the sharpest anomalies over localized conductors. (See also ***coplanar coils***)

coil: A multi-turn wire loop used to transmit or detect electromagnetic fields. Time varying ***electromagnetic*** fields through a coil induce a voltage proportional to the strength of the field and the rate of change over time.

compensation: Correction of airborne geophysical data for the changing effect of the aircraft. This process is generally used to correct data in ***fixed-wing time-domain electromagnetic*** surveys (where the transmitter is on the aircraft and the receiver is moving), and magnetic surveys (where the sensor is on the aircraft, turning in the earth's magnetic field.

component: In ***frequency domain electromagnetic*** surveys this is one of the two **phase** measurements – ***in-phase or quadrature***. In "multi-component" electromagnetic surveys it is also used to define the measurement in one geometric direction (vertical, horizontal in-line and horizontal transverse – the Z, X and Y components).

Compton scattering: gamma ray photons will bounce off the nuclei of atoms they pass through (earth and atmosphere), reducing their energy and then being detected by ***radiometric*** sensors at lower energy levels. See also ***stripping***.

conductance: See ***conductivity thickness***

conductivity: [σ] The facility with which the earth or a geological formation conducts electricity. Conductivity is usually measured in milli-Siemens per metre (mS/m). It is the reciprocal of ***resistivity***.

conductivity-depth imaging: see ***conductivity-depth transform***.

conductivity-depth transform: A process for converting electromagnetic measurements to an approximation of the conductivity distribution vertically in the earth, assuming a ***layered earth***. (Macnae and Lamontagne, 1987; Wolfgram and Karlik, 1995)

conductivity thickness: [**σt**] The product of the ***conductivity***, and thickness of a large, tabular body. (It is also called the "conductivity-thickness product") In electromagnetic geophysics, the response of a thin plate-like conductor is proportional to the conductivity multiplied by thickness. For example a 10 metre thickness of 20 Siemens/m mineralization will be equivalent to 5 metres of 40 S/m; both have 200 S conductivity thickness. Sometimes referred to as conductance.

conductor: Used to describe anything in the ground more conductive than the surrounding geology. Conductors are most often clays or graphite, or hopefully some type of mineralization, but may also be man-made objects, such as fences or pipelines.

coplanar coils: **[CP]** The coplanar coils lie in the horizontal plane with their axes vertical, and parallel. These coils are most sensitive to massive conductive bodies, horizontal layers, and the ***halfspace***.

cosmic ray: High energy sub-atomic particles from outer space that collide with the earth's atmosphere to produce a shower of gamma rays (and other particles) at high energies.

counts (per second): The number of ***gamma-rays*** detected by a gamma-ray ***spectrometer*****.** The rate depends on the geology, but also on the size and sensitivity of the detector.

culture: A term commonly used to denote any man-made object that creates a geophysical anomaly. Includes, but not limited to, power lines, pipelines, fences, and buildings.

current gathering: The tendency of electrical currents in the ground to channel into a conductive formation. This is particularly noticeable at higher frequencies or early time channels when the formation is long and parallel to the direction of current flow. This tends to enhance anomalies relative to inductive currents (see also ***induction***). Also known as current channelling.

current channelling: See current gathering.

daughter products: The radioactive natural sources of gamma-rays decay from the original element (commonly potassium, uranium, and thorium) to one or more lower-energy elements. Some of these lower energy elements are also radioactive and decay further. ***Gamma-ray spectrometry*** surveys may measure the gamma rays given off by the original element or by the decay of the daughter products.

dB/dt: As the ***secondary electromagnetic field*** changes with time, the magnetic field [**B**] component induces a voltage in the receiving ***coil***, which is proportional to the rate of change of the magnetic field over time.

decay: In ***time-domain electromagnetic*** theory, the weakening over time of the ***eddy currents*** in the ground, and hence the ***secondary field*** after the ***primary field***

electromagnetic pulse is turned off. In ***gamma-ray spectrometry***, the radioactive breakdown of an element, generally potassium, uranium, thorium, or one of their ***daughter*** products.

decay series: In ***gamma-ray spectrometry***, a series of progressively lower energy ***daughter products*** produced by the radioactive breakdown of uranium or thorium.

decay constant: see time constant.

depth of exploration: The maximum depth at which the geophysical system can detect the target. The depth of exploration depends very strongly on the type and size of the target, the contrast of the target with the surrounding geology, the homogeneity of the surrounding geology, and the type of geophysical system. One measure of the maximum depth of exploration for an electromagnetic system is the depth at which it can detect the strongest conductive target – generally a highly conductive horizontal layer.

differential resistivity: A process of transforming ***apparent resistivity*** to an approximation of layer resistivity at each depth. The method uses multi-frequency HEM data and approximates the effect of shallow layer ***conductance*** determined from higher frequencies to estimate the deeper conductivities (Huang and Fraser, 1996)

dipole moment: [NIA] For a transmitter, the product of the area of a ***coil***, the number of turns of wire, and the current flowing in the coil. At a distance significantly larger than the size of the coil, the magnetic field from a coil will be the same if the dipole moment product is the same. For a receiver coil, this is the product of the area and the number of turns. The sensitivity to a magnetic field (assuming the source is far away) will be the same if the dipole moment is the same.

diurnal: The daily variation in a natural field, normally used to describe the natural fluctuations (over hours and days) of the earth's magnetic field.

dielectric permittivity: **[ε]** The capacity of a material to store electrical charge, this is most often measured as the relative permittivity [ε_r], or ratio of the material dielectric to that of free space. The effect of high permittivity may be seen in HEM data at high frequencies over highly resistive geology as a reduced or negative ***in-phase***, and higher ***quadrature*** data.

drift: Long-time variations in the base-level or calibration of an instrument.

eddy currents: The electrical currents induced in the ground, or other conductors, by a time-varying ***electromagnetic field*** (usually the ***primary field***). Eddy currents are also induced in the aircraft's metal frame and skin; a source of ***noise*** in EM surveys.

electromagnetic: **[EM]** Comprised of a time-varying electrical and magnetic field. Radio waves are common electromagnetic fields. In geophysics, an electromagnetic system is one which transmits a time-varying ***primary field*** to induce ***eddy currents*** in the ground, and then measures the ***secondary field*** emitted by those eddy currents.

energy window: A broad spectrum of ***gamma-ray*** energies measured by a spectrometric survey. The energy of each gamma-ray is measured and divided up into numerous discrete energy levels, called windows.

equivalent (thorium or uranium): The amount of radioelement calculated to be present, based on the gamma-rays measured from a **daughter** element. This assumes that the ***decay series*** is in equilibrium – progressing normally.

fiducial, or fid: Timing mark on a survey record. Originally these were timing marks on a profile or film; now the term is generally used to describe 1-second interval timing records in digital data, and on maps or profiles.

fixed-wing: Aircraft with wings, as opposed to “rotary wing” helicopters.

footprint: This is a measure of the area of sensitivity under the aircraft of an airborne geophysical system. The footprint of an ***electromagnetic*** system is dependent on the altitude of the system, the orientation of the transmitter and receiver and the separation between the receiver and transmitter, and the conductivity of the ground. The footprint of a ***gamma-ray spectrometer*** depends mostly on the altitude. For all geophysical systems, the footprint also depends on the strength of the contrasting ***anomaly***.

frequency domain: An ***electromagnetic*** system which transmits a ***primary field*** that oscillates smoothly over time (sinusoidal), inducing a similarly varying electrical current in the ground. These systems generally measure the changes in the ***amplitude*** and ***phase*** of the ***secondary field*** from the ground at different frequencies by measuring the **in-phase** and **quadrature** phase components. See also ***time-domain***.

full-stream data: Data collected and recorded continuously at the highest possible sampling rate. Normal data are stacked (see ***stacking***) over some time interval before recording.

gamma-ray: A very high-energy photon, emitted from the nucleus of an atom as it undergoes a change in energy levels.

gamma-ray spectrometry: Measurement of the number and energy of natural (and sometimes man-made) gamma-rays across a range of photon energies.

gradient: In magnetic surveys, the gradient is the change of the magnetic field over a distance, either vertically or horizontally in either of two directions. Gradient data is often measured, or calculated from the total magnetic field data because it changes more quickly over distance than the ***total magnetic field***, and so may provide a more precise measure of the location of a source. See also ***analytic signal***.

ground effect: The response from the earth. A common calibration procedure in many geophysical surveys is to fly to altitude high enough to be beyond any measurable response from the ground, and there establish ***base levels*** or ***backgrounds***.

half-space: A mathematical model used to describe the earth – as infinite in width, length, and depth below the surface. The most common halfspace models are ***homogeneous*** and ***layered earth***.

heading error: A slight change in the magnetic field measured when flying in opposite directions.

HEM: Helicopter ElectroMagnetic, This designation is most commonly used to helicopter-borne, ***frequency-domain*** electromagnetic systems. At present, the transmitter and receivers are normally mounted in a ***bird*** carried on a sling line beneath the helicopter.

herringbone pattern: a pattern created in geophysical data by an asymmetric system, where the **anomaly** may be extended to either side of the source, in the direction of flight. Appears like fish bones, or like the teeth of a comb, extending either side of centre, each tooth an alternate flight line.

homogeneous: This is a geological unit that has the same ***physical parameters*** throughout its volume. This unit will create the same response to an HEM system anywhere, and the HEM system will measure the same apparent ***resistivity*** anywhere. The response may change with system direction (see ***anisotropy***).

in-phase: the component of the measured ***secondary field*** that has the same phase as the transmitter and the ***primary field***. The in-phase component is stronger than the ***quadrature*** phase over relatively higher ***conductivity***.

induction: Any time-varying electromagnetic field will induce (cause) electrical currents to flow in any object with non-zero ***conductivity***. (see ***eddy currents***)

infinite: In geophysical terms, an "infinite' dimension is one much greater than the ***footprint*** of the system, so that the system does not detect changes at the edges of the object.

International Geomagnetic Reference Field: **[IGRF]** An approximation of the smooth magnetic field of the earth, in the absence of variations due to local geology. Once the IGRF is subtracted from the measured magnetic total field data, any remaining variations are assumed to be due to local geology. The IGRF also predicts the slow changes of the field up to five years in the future.

inversion, or **inverse modeling**: A process of converting geophysical data to an earth model, which compares theoretical models of the response of the earth to the data measured, and refines the model until the response closely fits the measured data (Huang and Palacky, 1991)

layered earth: A common geophysical model which assumes that the earth is horizontally layered – the ***physical parameters*** are constant to ***infinite*** distance horizontally, but change vertically.

magnetic permeability: **[μ]** This is defined as the ratio of magnetic induction to the inducing magnetic field. The relative magnetic permeability [μ_r] is often quoted, which is the ratio of the rock permeability to the permeability of free space. In geology and geophysics, the ***magnetic susceptibility*** is more commonly used to describe rocks.

magnetic susceptibility: **[k]** A measure of the degree to which a body is magnetized. In SI units this is related to relative ***magnetic permeability*** by $k=\mu_r-1$, and is a dimensionless unit. For most geological material, susceptibility is influenced primarily by the percentage of magnetite. It is most often quoted in units of 10^{-6}. In HEM data this is most often apparent as a negative ***in-phase*** component over high susceptibility, high ***resistivity*** geology such as diabase dikes.

noise: That part of a geophysical measurement that the user does not want. Typically this includes electronic interference from the system, the atmosphere (***sferics***), and man-made sources. This can be a subjective judgment, as it may include the response from geology other than the target of interest. Commonly the term is used to refer to high frequency (short period) interference. See also ***drift***.

Occam's inversion: an ***inversion*** process that matches the measured ***electromagnetic*** data to a theoretical model of many, thin layers with constant thickness and varying resistivity (Constable et al, 1987).

off-time: In a ***time-domain electromagnetic*** survey, the time after the end of the ***primary field pulse***, and before the start of the next pulse.

on-time: In a ***time-domain electromagnetic*** survey, the time during the ***primary field pulse***.

phase: The angular difference in time between a measured sinusoidal electromagnetic field and a reference – normally the primary field. The phase is calculated from $\tan^{-1}$(***in-phase / quadrature***).

physical parameters: These are the characteristics of a geological unit. For electromagnetic surveys, the important parameters for electromagnetic surveys are ***conductivity***, ***magnetic permeability*** (or ***susceptibility***) and ***dielectric permittivity***; for magnetic surveys the parameter is magnetic susceptibility, and for gamma ray spectrometric surveys it is the concentration of the major radioactive elements: potassium, uranium, and thorium.

permittivity: see ***dielectric permittivity***.

permeability: see ***magnetic permeability***.

primary field: the EM field emitted by a transmitter. This field induces ***eddy currents*** in (energizes) the conductors in the ground, which then create their own ***secondary* fields**.

pulse: In time-domain EM surveys, the short period of intense ***primary*** field transmission. Most measurements (the ***off-time***) are measured after the pulse.

quadrature: that component of the measured ***secondary field*** that is phase-shifted 90° from the ***primary field***. The quadrature component tends to be stronger than the ***in-phase*** over relatively weaker ***conductivity***.

Q-coils: see ***calibration coil***.

radiometric: Commonly used to refer to ***gamma ray*** spectrometry.

radon: A radioactive daughter product of uranium and thorium, radon is a gas which can leak into the atmosphere, adding to the non-geological background of a gamma-ray spectrometric survey.

resistivity: **[ρ]** The strength with which the earth or a geological formation resists the flow of electricity, typically the flow induced by the ***primary field*** of the electromagnetic transmitter. Normally expressed in ohm-metres, it is the reciprocal of ***conductivity***.

resistivity-depth transforms: similar to ***conductivity depth transforms***, but the calculated ***conductivity*** has been converted to ***resistivity***.

resistivity section: an approximate vertical section of the resistivity of the layers in the earth. The resistivities can be derived from the ***apparent resistivity***, the ***differential resistivities***, ***resistivity-depth transforms***, or ***inversions***.

secondary field: The field created by conductors in the ground, as a result of electrical currents induced by the ***primary field*** from the ***electromagnetic*** transmitter. Airborne ***electromagnetic*** systems are designed to create, and measure a secondary field.

Sengpiel section: a ***resistivity section*** derived using the ***apparent resistivity*** and an approximation of the depth of maximum sensitivity for each frequency.

sferic: Lightning, or the ***electromagnetic*** signal from lightning, it is an abbreviation of “atmospheric discharge”. These appear to magnetic and electromagnetic sensors as sharp “spikes” in the data. Under some conditions lightning storms can be detected from hundreds of kilometres away. (see ***noise***)

signal: That component of a measurement that the user wants to see – the response from the targets, from the earth, etc. (See also ***noise***)

skin depth: A measure of the depth of penetration of an electromagnetic field into a material. It is defined as the depth at which the primary field decreases to 1/e of the field at the surface. It is calculated by approximately 503 x √(resistivity/frequency). Note that depth of penetration is greater at higher ***resistivity*** and/or lower ***frequency***.

spectrometry: Measurement across a range of energies, where ***amplitude*** and energy are defined for each measurement. In gamma-ray spectrometry, the number of gamma rays are measured for each energy ***window***, to define the ***spectrum***.

spectrum: In ***gamma ray spectrometry***, the continuous range of energy over which gamma rays are measured. In ***time-domain electromagnetic*** surveys, the spectrum is the energy of the **pulse** distributed across an equivalent, continuous range of frequencies.

spheric: see ***sferic***.

stacking: Summing repeat measurements over time to enhance the repeating ***signal***, and minimize the random ***noise***.

stripping: Estimation and correction for the gamma ray photons of higher and lower energy that are observed in a particular ***energy window***. See also ***Compton scattering***.

susceptibility: See ***magnetic susceptibility***.

tau: [τ] Often used as a name for the ***time constant***.

TDEM: ***time domain electromagnetic***.

thin sheet: A standard model for electromagnetic geophysical theory. It is usually defined as thin, flat-lying, and ***infinite*** in both horizontal directions. (see also ***vertical plate***)

tie-line: A survey line flown across most of the ***traverse lines***, generally perpendicular to them, to assist in measuring ***drift*** and ***diurnal*** variation. In the short time required to fly a tie-line it is assumed that the drift and/or diurnal will be minimal, or at least changing at a constant rate.

time constant: The time required for an ***electromagnetic*** field to decay to a value of 1/e of the original value. In ***time-domain*** electromagnetic data, the time constant is proportional to the size and ***conductance*** of a tabular conductive body. Also called the decay constant.

Time channel: In ***time-domain electromagnetic*** surveys the decaying ***secondary field*** is measured over a period of time, and the divided up into a series of consecutive discrete measurements over that time.

time-domain: ***Electromagnetic*** system which transmits a pulsed, or stepped ***electromagnetic*** field. These systems induce an electrical current (***eddy current***) in the ground that persists after the ***primary field*** is turned off, and measure the change over time of the ***secondary field*** created as the currents ***decay***. See also ***frequency-domain***.

total energy envelope: The sum of the squares of the three ***components*** of the ***time-domain electromagnetic secondary field***. Equivalent to the ***amplitude*** of the secondary field.

transient: Time-varying. Usually used to describe a very short period pulse of ***electromagnetic*** field.

traverse line: A normal geophysical survey line. Normally parallel traverse lines are flown across the property in spacing of 50 m to 500 m, and generally perpendicular to the target geology.

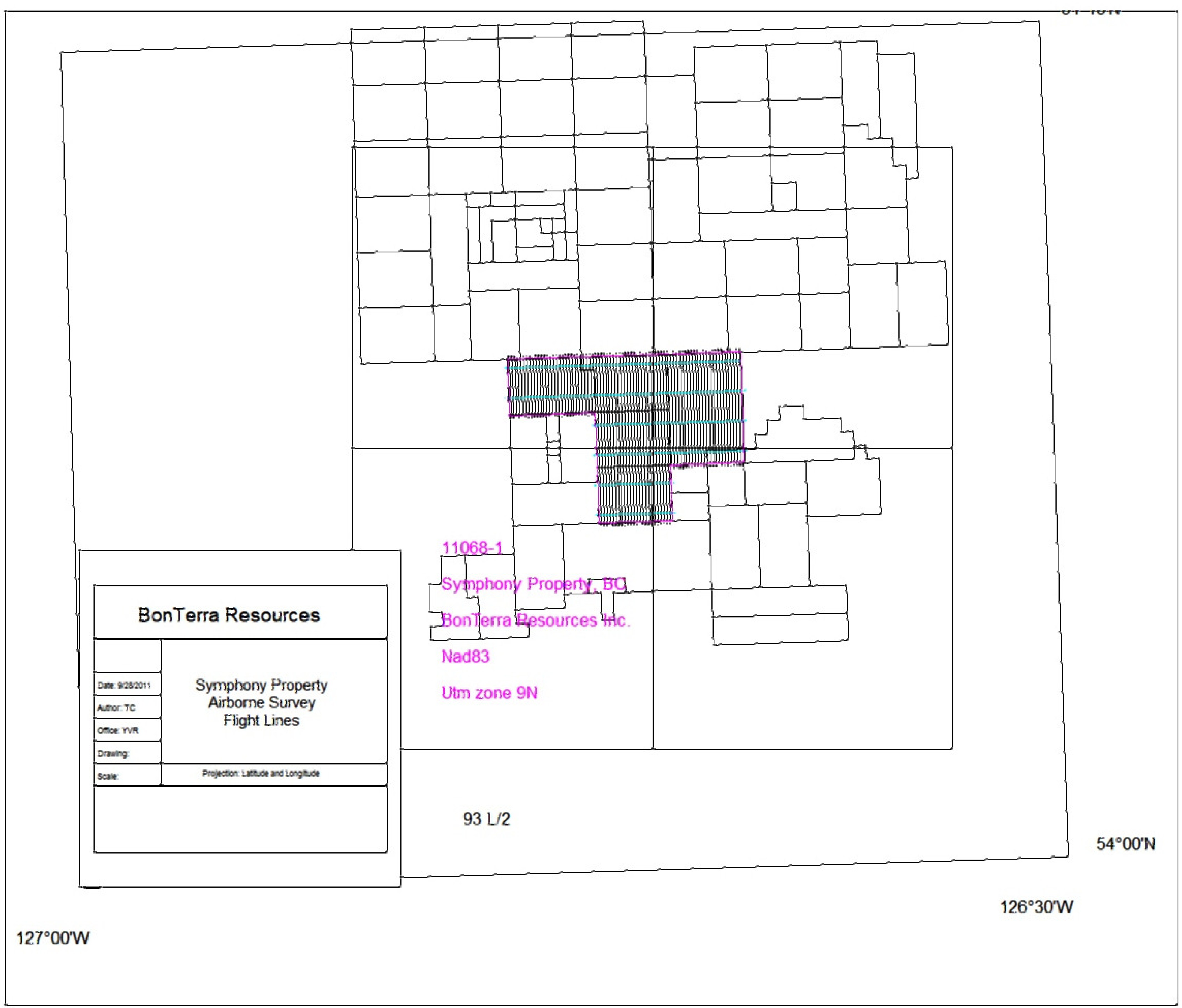
vertical plate: A standard model for electromagnetic geophysical theory. It is usually defined as thin, and ***infinite*** in horizontal dimension and depth extent. (see also ***thin shee***t)

waveform: The shape of the ***electromagnetic pulse*** from a ***time-domain*** electromagnetic transmitter.

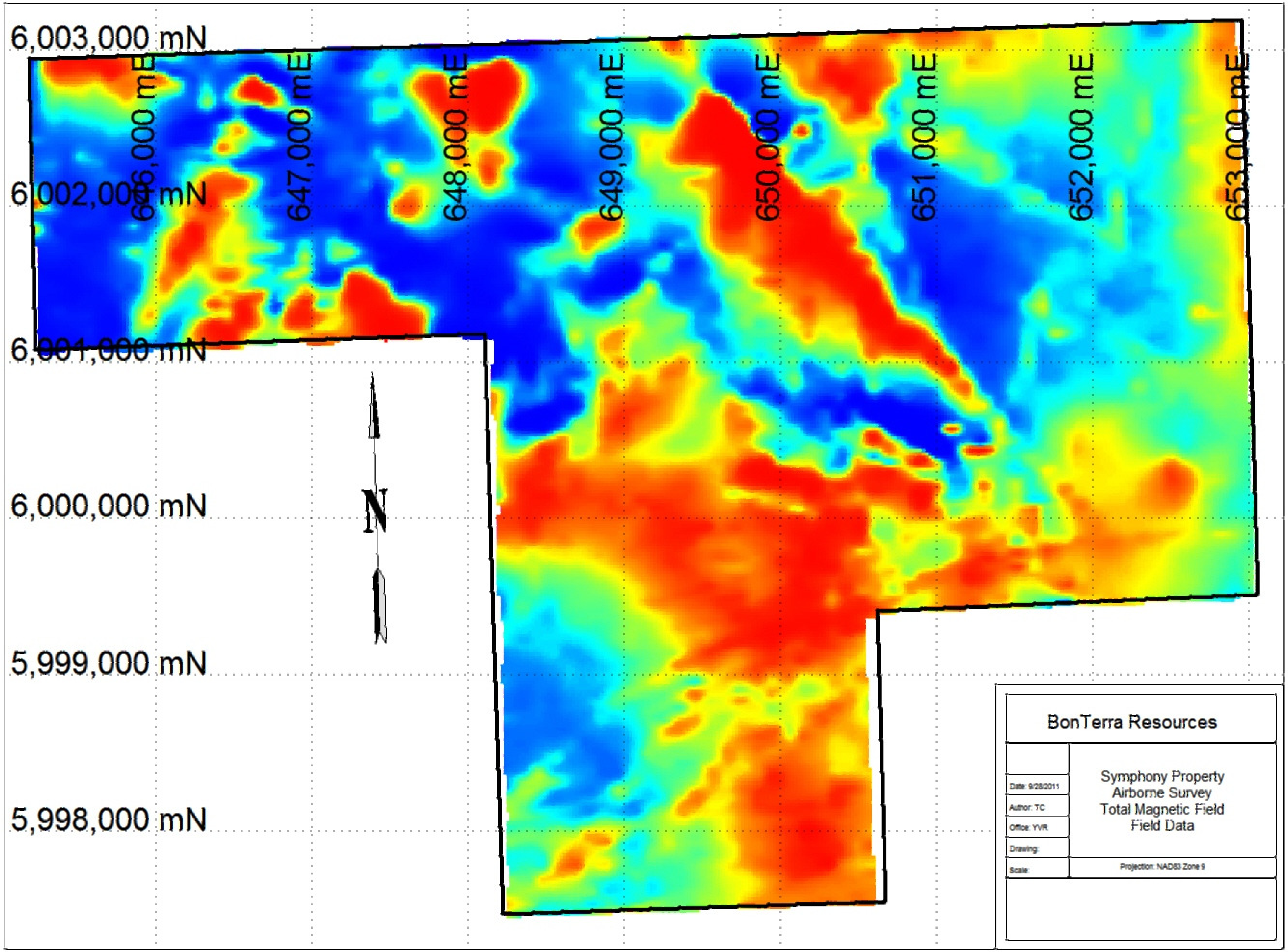
window: A discrete portion of a ***gamma-ray spectrum*** or ***time-domain electromagnetic decay***. The continuous energy spectrum or ***full-stream*** data are grouped into windows to reduce the number of samples, and reduce ***noise***.

Version 1.1, March 10, 2003
Greg Hodges,
Chief Geophysicist
Fugro Airborne Surveys, Toronto

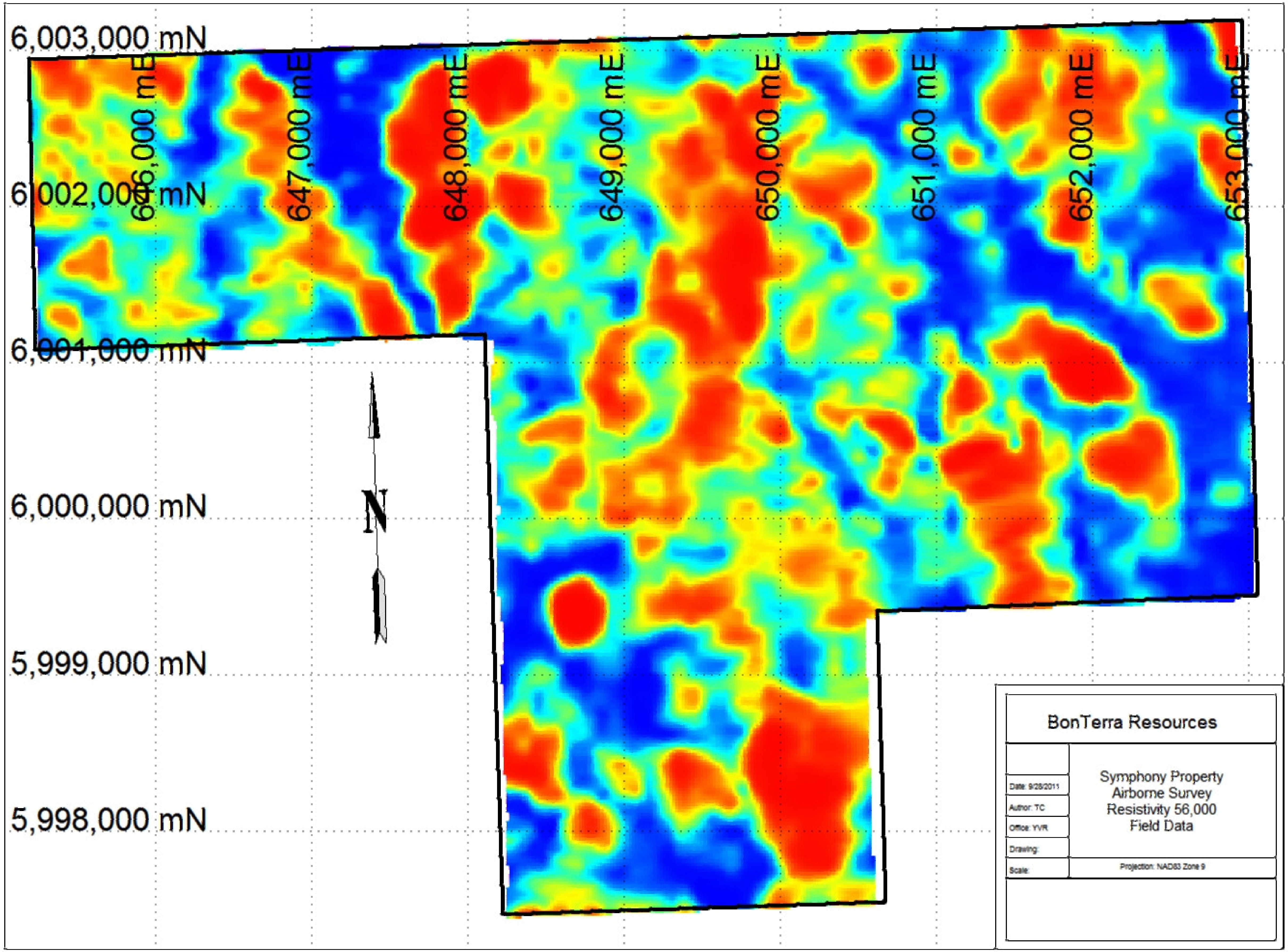
APPENDIX 2: Map of Flight Lines for Airborne Geophysical Survey



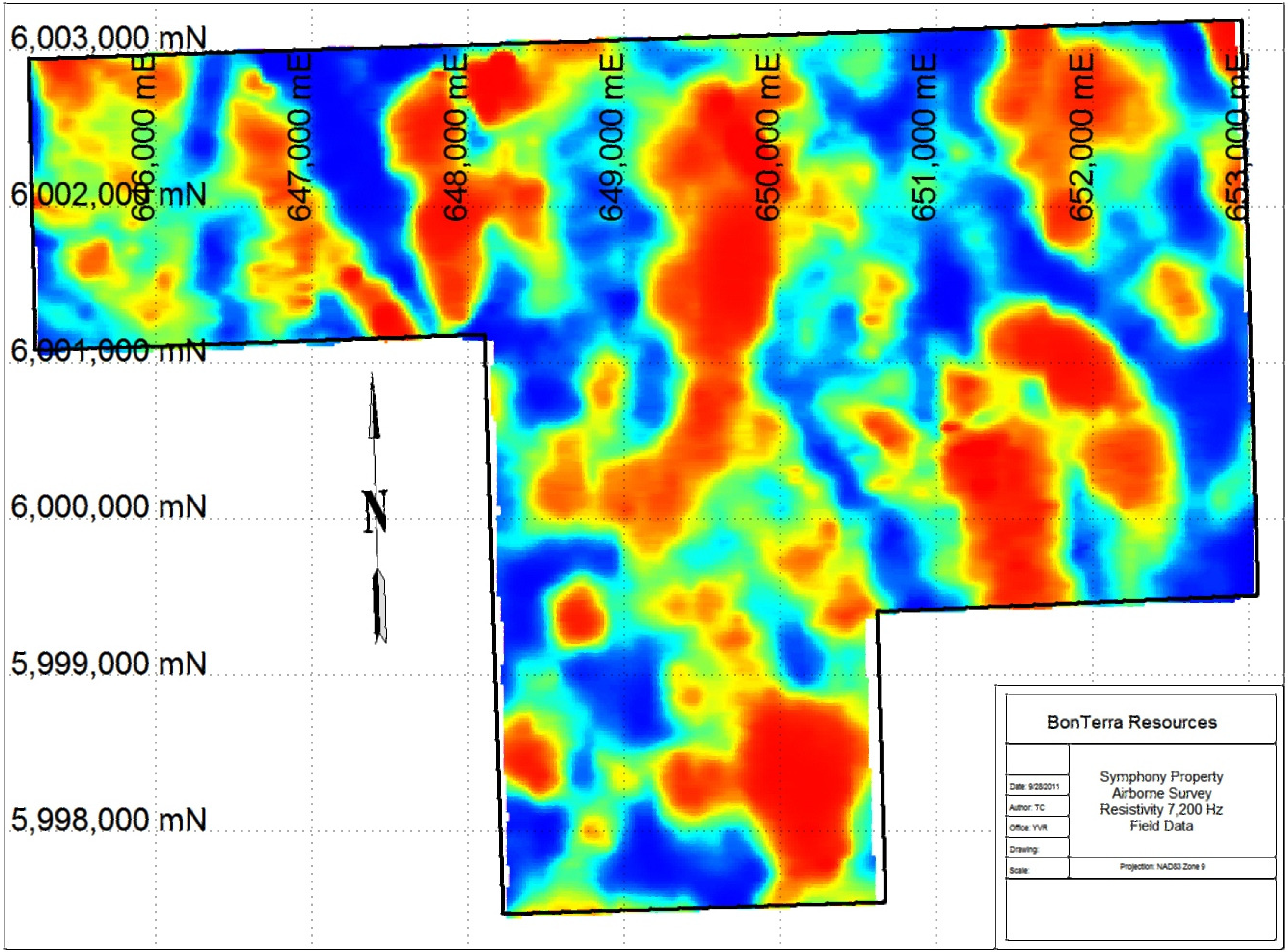
APPENDIX 3- TOTAL MAGNETICS



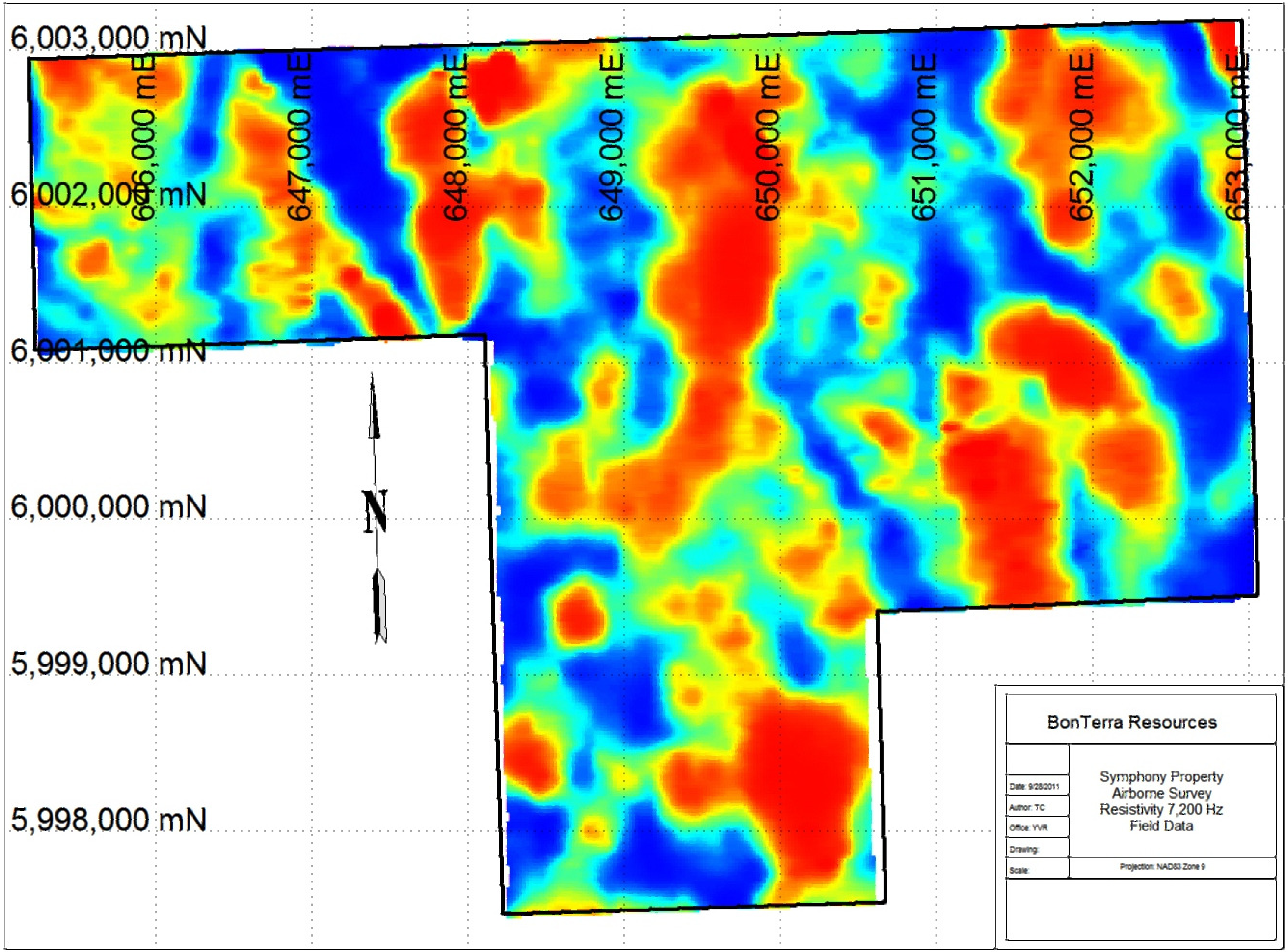
APPENDIX 4- RESISTIVITY MAP at 56,00 Hz FREQUENCY



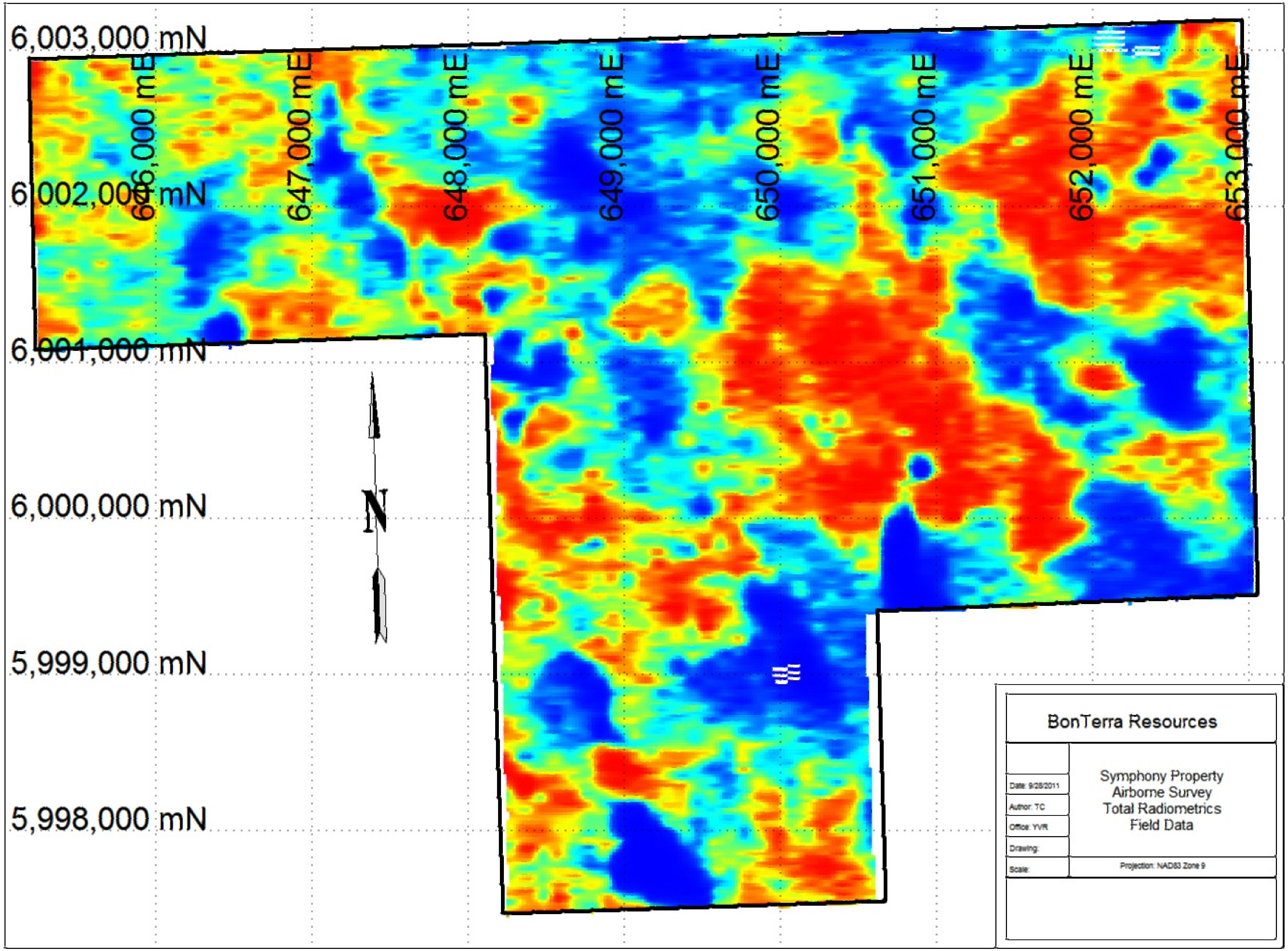
APPENDIX 5- RESISTIVITY at 7,200 Hz FREQUENCY

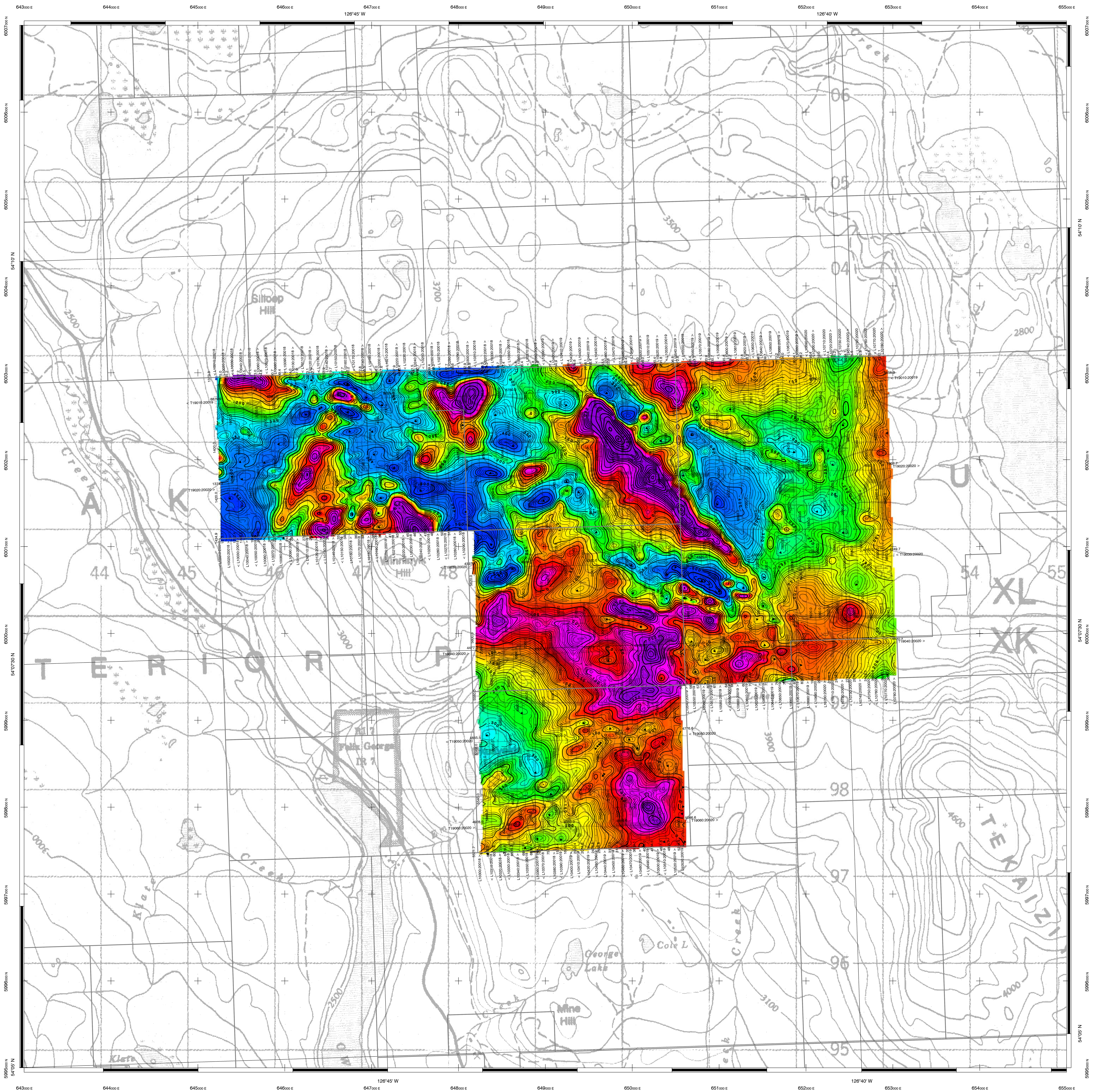


APPENDIX 5- RESISTIVITY at 7,200 Hz FREQUENCY



APPENDIX 6: TOTAL RADIOMETRICS





TECHNICAL SUMMARY

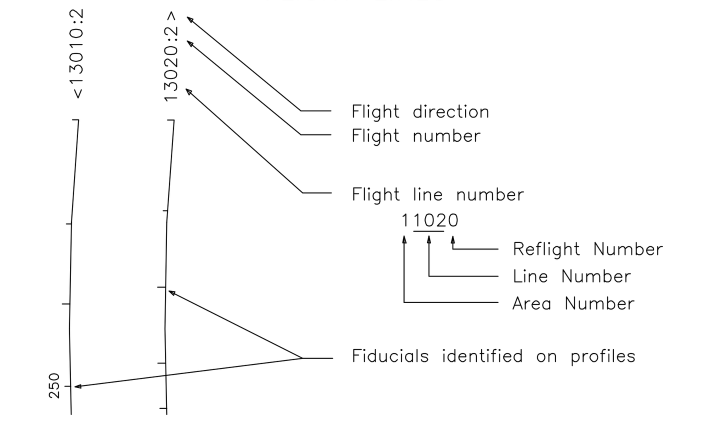
Navigation	Differentially-corrected GPS
Data reduction grid interval	20 metres
Terrain clearance	Helicopter, Spectrometer 60 m Electromagnetic sensor 35 m Magnetometer 35 m
Data sampling interval	0.1 second
Magnetometer / sensitivity	Cesium / 0.01 nT
Electromagnetic system	DIGHEM[V]
Spectrometer	GR820

Frequency	Sensitivity	Coil Orientation
1000 Hz	.06 ppm	Vertical coaxial
5500 Hz	.12 ppm	Vertical coaxial
900 Hz	.12 ppm	Horizontal coplanar
7200 Hz	.24 ppm	Horizontal coplanar
56000 Hz	.60 ppm	Horizontal coplanar

nT

274.0, 206.8, 159.8, 126.9, 102.3, 81.2, 61.9, 42.5, 25.4, 10.7, -1.9, -15.4, -27.6, -38.3, -48.9, -57.5, -65.1, -73.1, -81.9, -90.2, -99.0, -107.6, -116.7, -125.2, -133.4, -141.7, -149.7, -157.0, -165.1, -172.8, -180.2, -186.9, -193.4, -199.8, -205.7, -211.7, -217.7, -223.5, -229.6, -235.4, -241.6, -247.9, -253.9, -259.7, -265.6, -270.2, -275.2, -280.7, -286.2, -293.0, -300.2, -306.2, -313.8, -323.6, -335.0, -347.2, -359.5, -372.3, -385.0, -398.6, -412.9, -430.9, -454.7

FLIGHT LINES

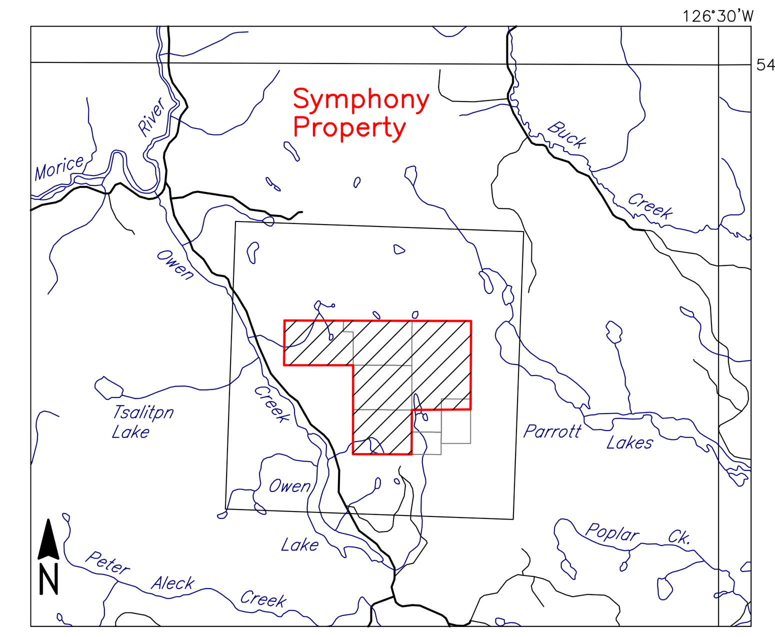


RESIDUAL MAGNETIC FIELD CONTOURS

(thick solid line)	250 nT
(solid line)	50 nT
(thin solid line)	10 nT
(dashed line)	5 nT
(closed contour with ticks)	magnetic low

Magnetic inclination within the survey area: 73 degrees N
Magnetic declination within the survey area: 19 degrees E

LOCATION MAP



NTS: 93 L/2 | UTM ZONE: 9 NAD83 | SCALE: 1:250,000

BONTERRA RESOURCES INC.
SYMPHONY PROPERTY, BC

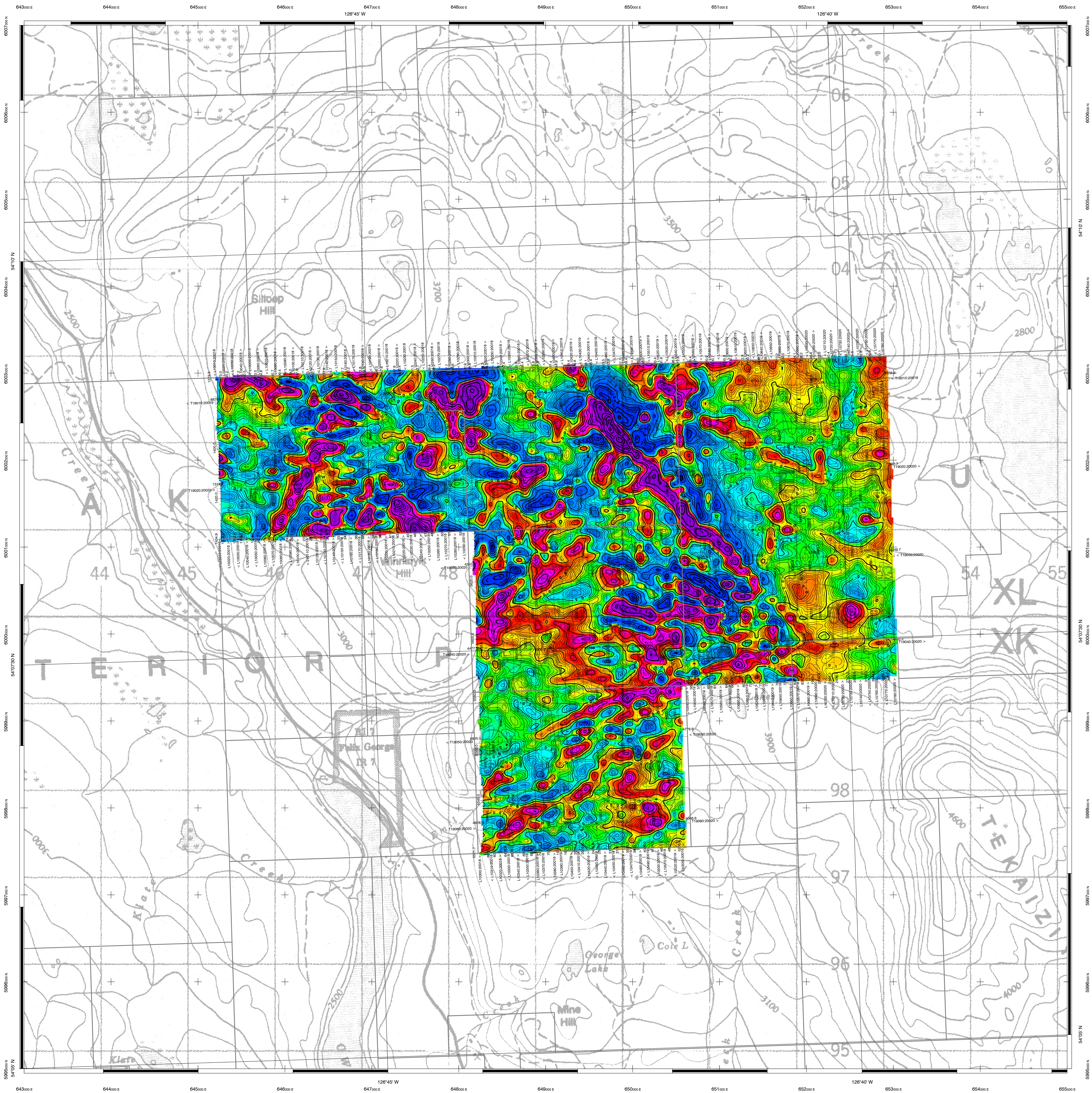
RESIDUAL MAGNETIC FIELD
IGRF Removed

FUGRO DIGHEM[V]/RAD SURVEY	NTS: 93 L/2	GEOPHYSICIST:
DATE: NOVEMBER, 2011	JOB: 11068	SHEET: 1

Fugro Airborne Surveys

0 1 2 Km
0 1 Mi
Scale 1:20 000

FUGRO AIRBORNE SURVEYS



TECHNICAL SUMMARY

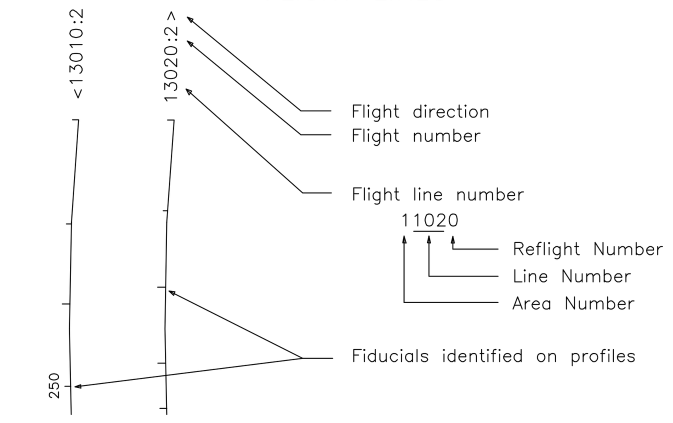
Navigation	Differentially-corrected GPS
Data reduction grid interval	20 metres
Terrain clearance	Helicopter, Spectrometer 60 m Electromagnetic sensor 35 m Magnetometer 35 m
Data sampling interval	0.1 second
Magnetometer / sensitivity	Cesium / 0.01 nT
Electromagnetic system	DIGHEM[V]
Spectrometer	GR820

Frequency	Sensitivity	Coil Orientation
1000 Hz	.06 ppm	Vertical coaxial
5500 Hz	.12 ppm	Vertical coaxial
900 Hz	.12 ppm	Horizontal coplanar
7200 Hz	.24 ppm	Horizontal coplanar
56000 Hz	.60 ppm	Horizontal coplanar

nT/m

4.03, 2.97, 2.38, 2.03, 1.75, 1.53, 1.36, 1.22, 1.09, 0.98, 0.88, 0.79, 0.72, 0.65, 0.59, 0.54, 0.49, 0.44, 0.39, 0.35, 0.31, 0.28, 0.24, 0.22, 0.19, 0.16, 0.13, 0.11, 0.08, 0.05, 0.03, 0.00, -0.03, -0.05, -0.07, -0.10, -0.12, -0.15, -0.17, -0.19, -0.21, -0.24, -0.26, -0.29, -0.31, -0.34, -0.37, -0.41, -0.44, -0.47, -0.51, -0.56, -0.60, -0.66, -0.72, -0.80, -0.88, -0.98, -1.10, -1.25, -1.47, -1.80, -2.31

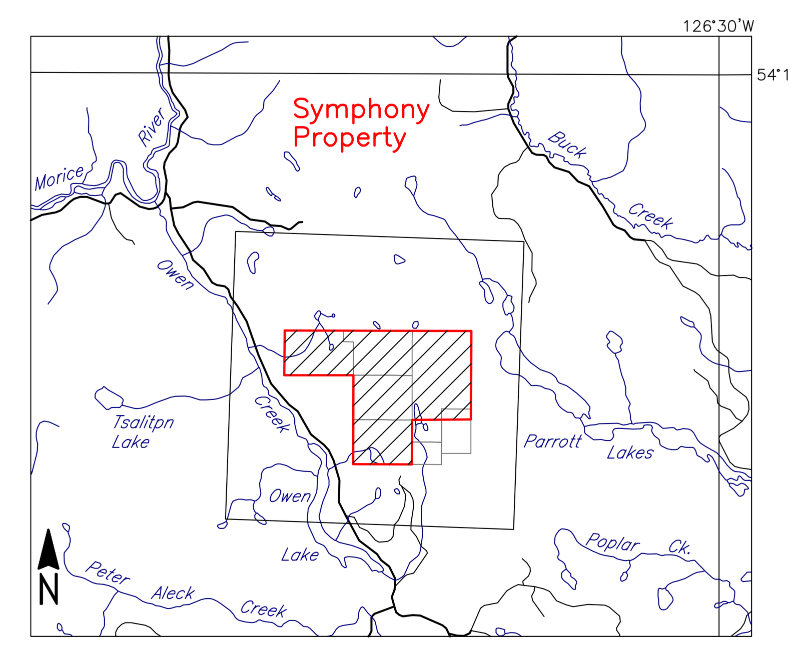
FLIGHT LINES



CALCULATED VERTICAL GRADIENT CONTOURS

————	2.5 nT/metre
————	0.5 nT/metre
————	0.1 nT/metre
— — — —	0.05 nT/metre

LOCATION MAP



NTS: 93 L/2 UTM ZONE: 9 NAD83 SCALE: 1:250,000

BONTERRA RESOURCES INC.
SYMPHONY PROPERTY, BC

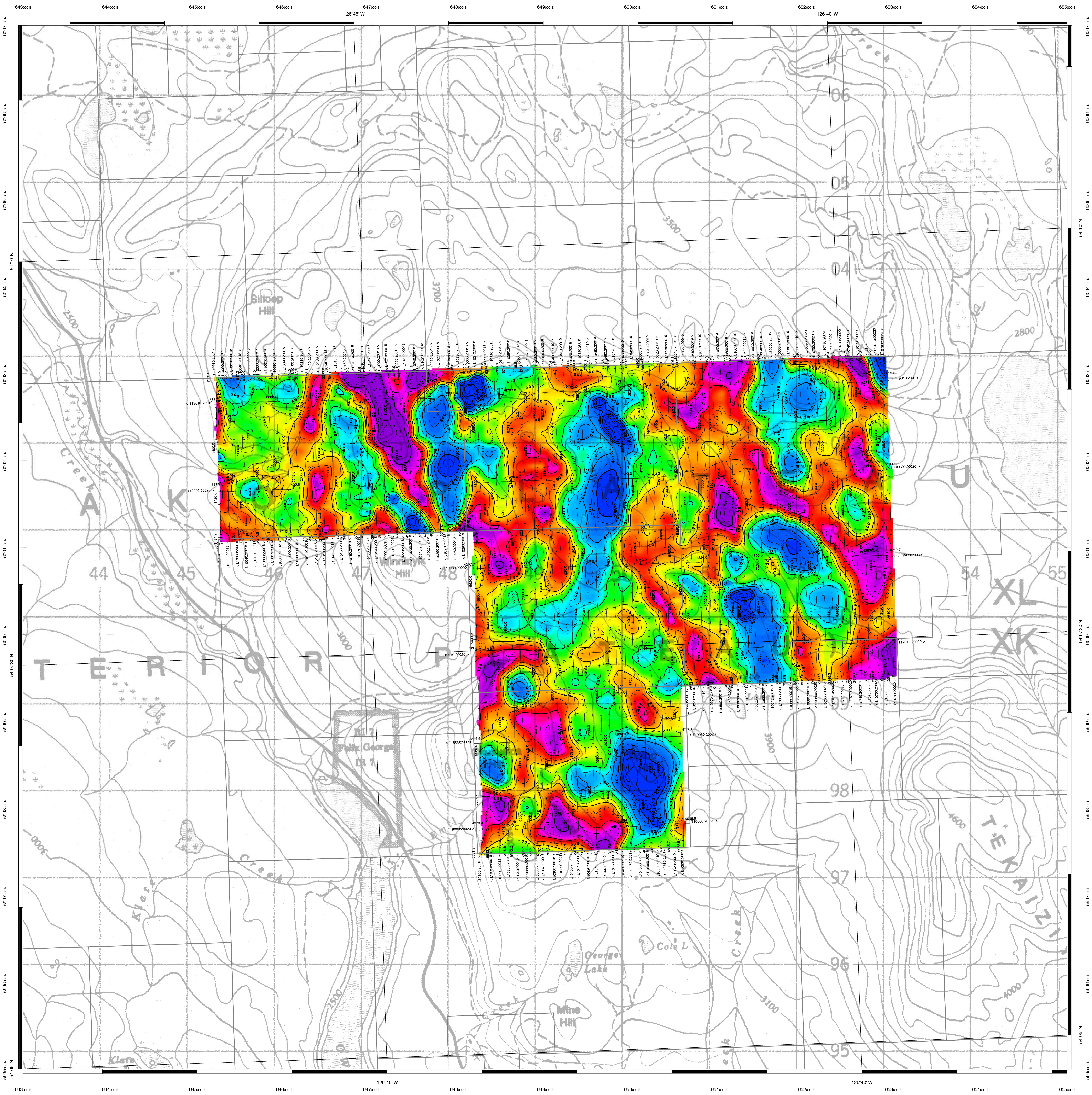
CALCULATED VERTICAL MAGNETIC GRADIENT

FUGRO DIGHEM[V]/RAD SURVEY	NTS: 93 L/2	GEOPHYSICIST:
DATE: NOVEMBER, 2011	JOB: 11068	SHEET: 1

Fugro Airborne Surveys

0 1 2 Km
0 1 Mi
Scale 1:20 000

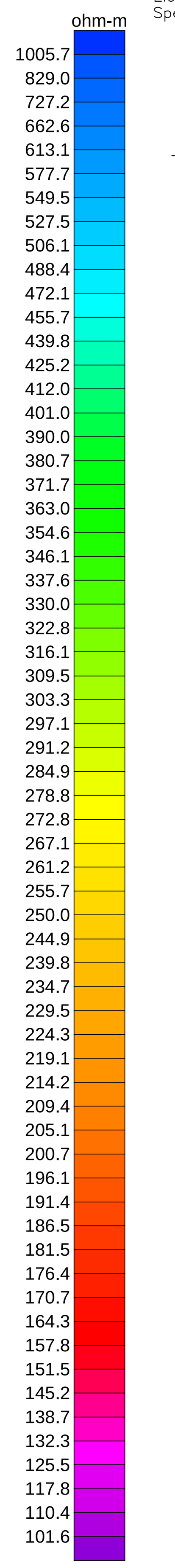
FUGRO AIRBORNE SURVEYS



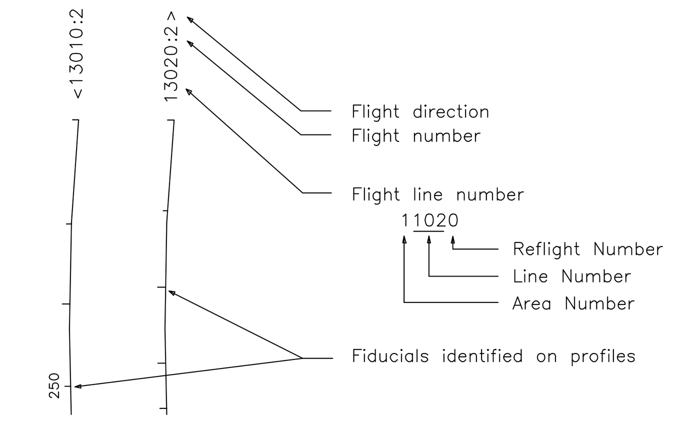
TECHNICAL SUMMARY

Navigation	Differentially–corrected GPS
Data reduction grid interval	20 metres
Terrain clearance	Helicopter, Spectrometer 60 m Electromagnetic sensor 35 m Magnetometer 35 m
Data sampling interval	0.1 second
Magnetometer / sensitivity	Cesium / 0.01 nT
Electromagnetic system	DIGHEM V
Spectrometer	GR820

Frequency	Sensitivity	Coil Orientation
1000 Hz	.06 ppm	Vertical coaxial
5500 Hz	.12 ppm	Vertical coaxial
900 Hz	.12 ppm	Horizontal coplanar
7200 Hz	.24 ppm	Horizontal coplanar
56000 Hz	.60 ppm	Horizontal coplanar



FLIGHT LINES

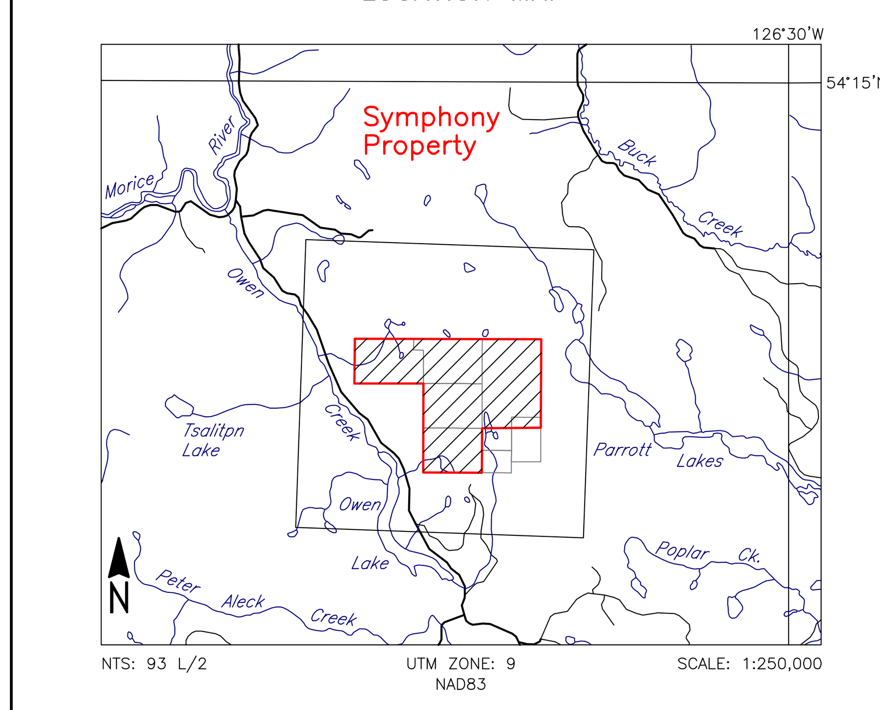


RESISTIVITY CONTOURS

1000
800
600
500
400
300
250
200
150
125
100

Contours in ohm–m at 10 intervals per decade. Apparent resistivity calculated using a pseudo-layer half-space model (Fraser 1978).

LOCATION MAP



NTS: 93 L/2 UTM ZONE: 9 NAD83 SCALE: 1:250,000

BONTERRA RESOURCES INC.
SYMPHONY PROPERTY, BC

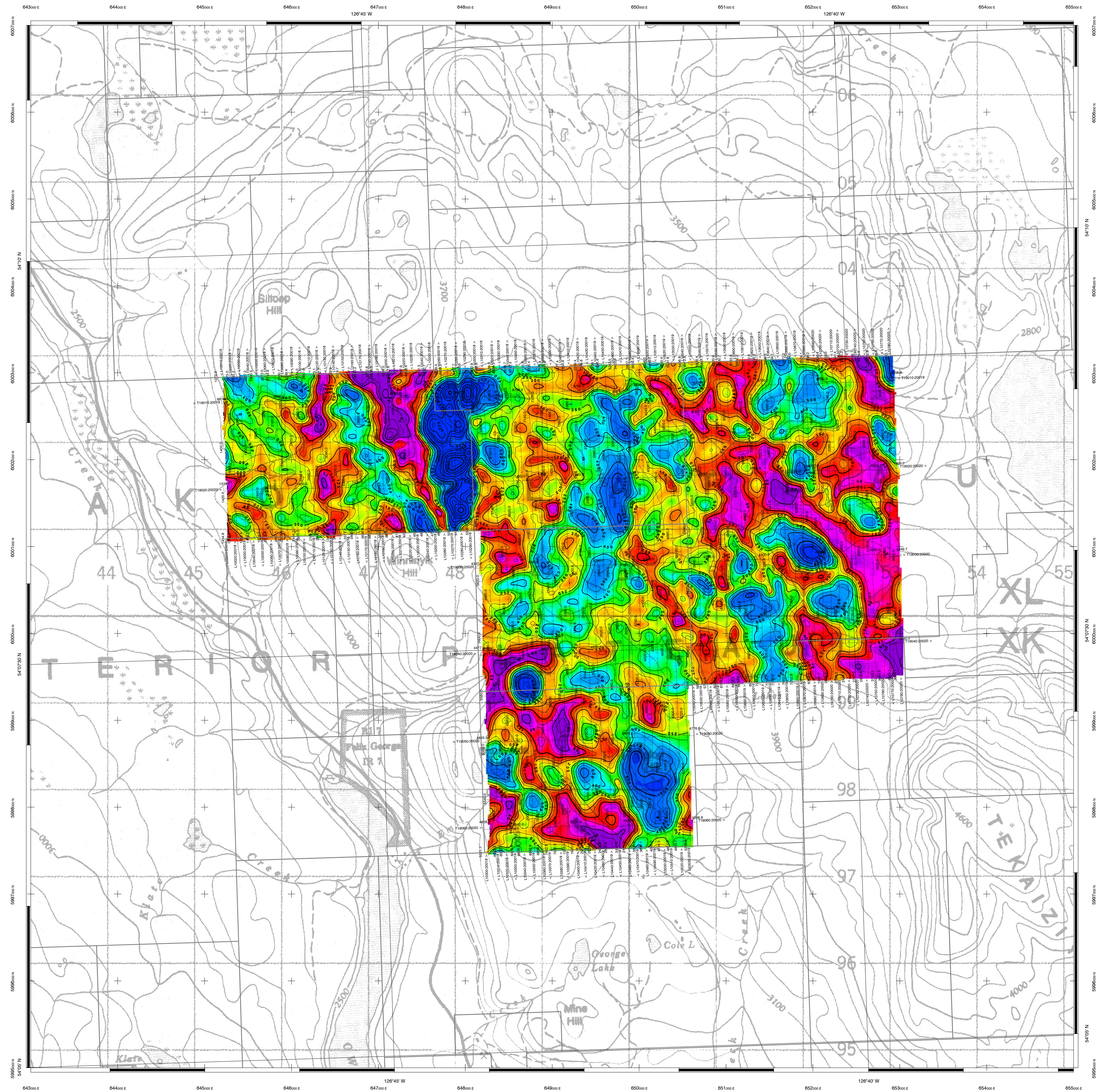
APPARENT RESISTIVITY
7200 Hz COPLANAR

FUGRO DIGHEM V/RAD SURVEY	NTS: 93 L/2	GEOPHYSICIST:
DATE: NOVEMBER, 2011	JOB: 11068	SHEET: 1

Fugro Airborne Surveys

0 1 2 Km
0 1 Mi
Scale 1:20 000

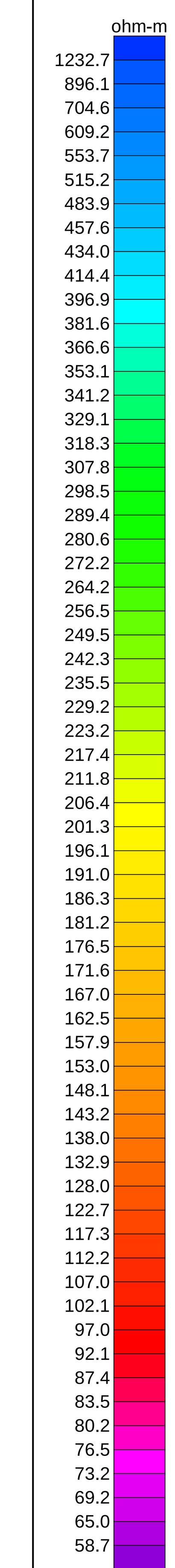
FUGRO AIRBORNE SURVEYS



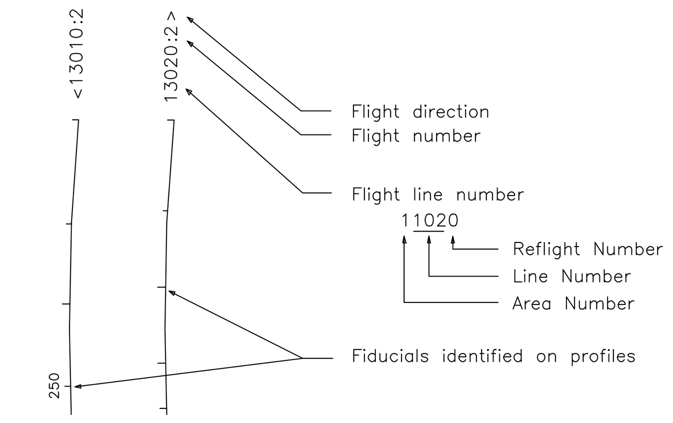
TECHNICAL SUMMARY

Navigation . . . . Differentially–corrected GPS
Data reduction grid interval . . . . 20 metres
Terrain clearance . . . . Helicopter, Spectrometer 60 m
Electromagnetic sensor 35 m
Magnetometer 35 m
Data sampling interval . . . . 0.1 second
Magnetometer / sensitivity . . . . . Cesium / 0.01 nT
Electromagnetic system . . . . . . DIGHEM[V]
Spectrometer GR820

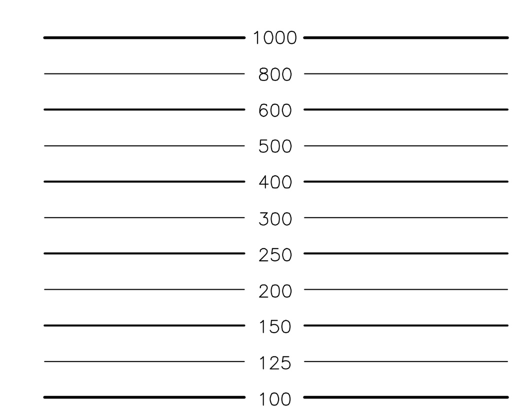
Frequency	Sensitivity	Coil Orientation
1000 Hz	.06 ppm	Vertical coaxial
5500 Hz	.12 ppm	Vertical coaxial
900 Hz	.12 ppm	Horizontal coplanar
7200 Hz	.24 ppm	Horizontal coplanar
56000 Hz	.60 ppm	Horizontal coplanar



FLIGHT LINES

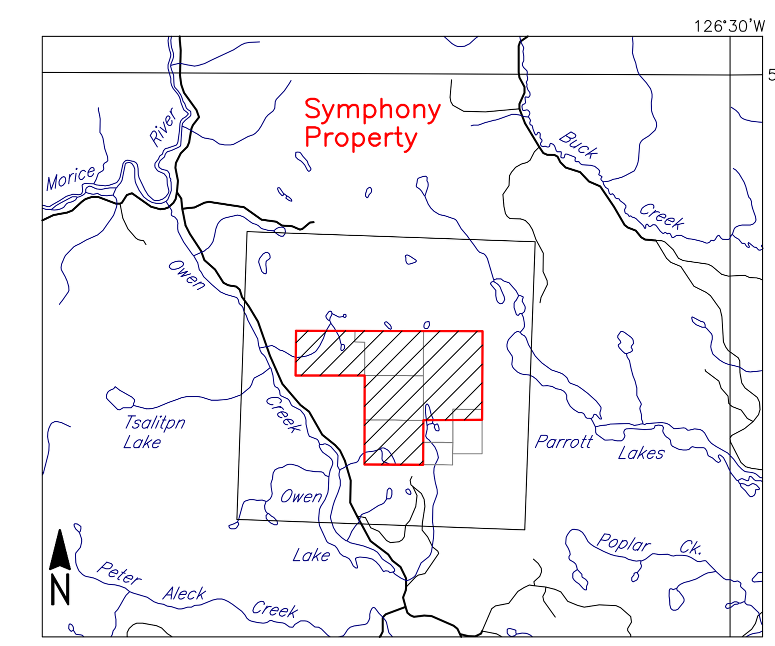


RESISTIVITY CONTOURS



Contours in ohm–m at 10 intervals per decade.
Apparent resistivity calculated using a pseudo-layer half-space model (Fraser 1978).

LOCATION MAP



NTS: 93 L/2 | UTM ZONE: 9 NAD83 | SCALE: 1:250,000

BONTERRA RESOURCES INC.
SYMPHONY PROPERTY, BC

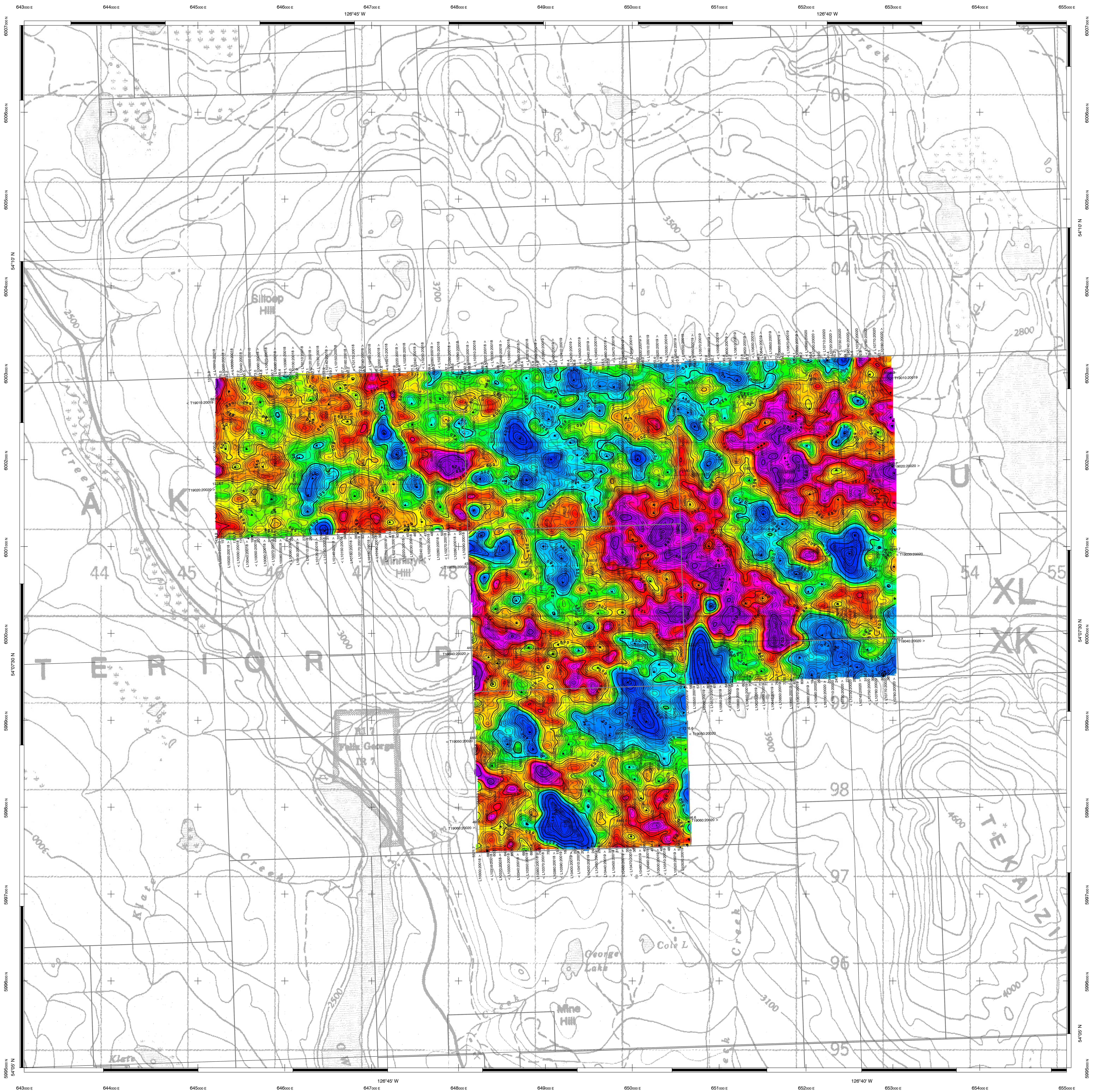
APPARENT RESISTIVITY
56,000 Hz COPLANAR

FUGRO DIGHEM[V]/RAD SURVEY	NTS: 93 L/2	GEOPHYSICIST:
DATE: NOVEMBER, 2011	JOB: 11068	SHEET: 1

Fugro Airborne Surveys

0 1 2 Km
0 1 Mi
Scale 1:20 000

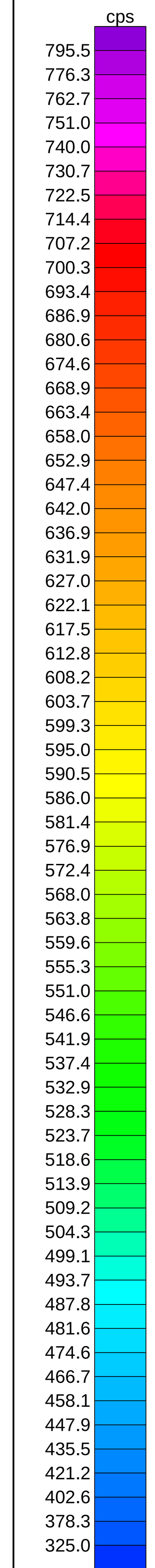
FUGRO AIRBORNE SURVEYS



TECHNICAL SUMMARY

Navigation	Differentially-corrected GPS
Data reduction grid interval	25 metres
Terrain clearance	Helicopter, Spectrometer 60 m Electromagnetic sensor 35 m Magnetometer 35 m
Data sampling interval	0.1 second
Magnetometer / sensitivity	Cesium / 0.01 nT
Electromagnetic system	DIGHEM^{V}
Spectrometer	GR820

Frequency	Sensitivity	Coil Orientation
1000 Hz	.06 ppm	Vertical coaxial
5500 Hz	.12 ppm	Vertical coaxial
900 Hz	.12 ppm	Horizontal coplanar
7200 Hz	.24 ppm	Horizontal coplanar
56000 Hz	.60 ppm	Horizontal coplanar



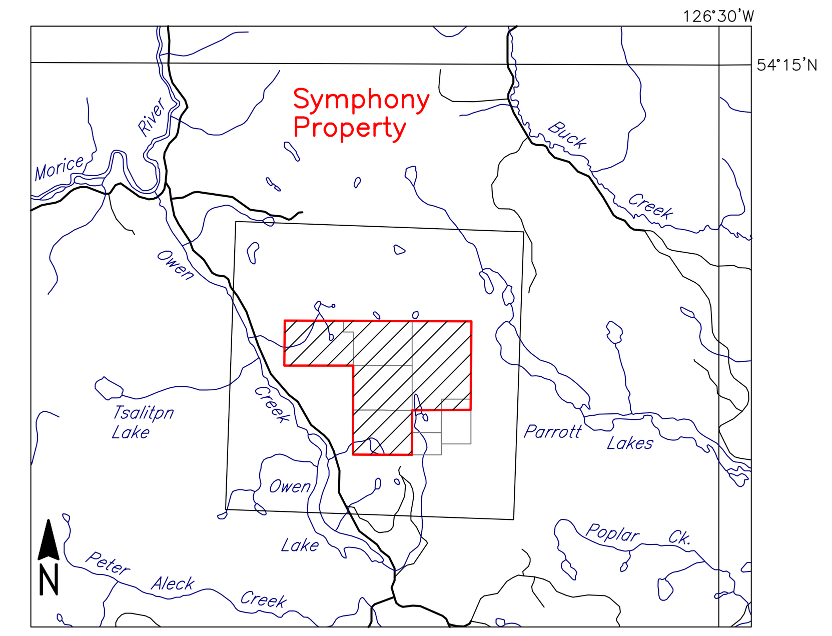
FLIGHT LINES

< 13010:2
13020:2 >
Flight direction
Flight number
Flight line number
11020
Reflight Number
Line Number
Area Number
250
Fiducials identified on profiles

CONTOUR INTERVALS

500 cps
100 cps
20 cps
10 cps
low

LOCATION MAP



NTS: 93 L/2 UTM ZONE: 9 NAD83 SCALE: 1:250,000

BONTERRA RESOURCES INC.
SYMPHONY PROPERTY, BC

RADIOMETRIC TOTAL COUNT

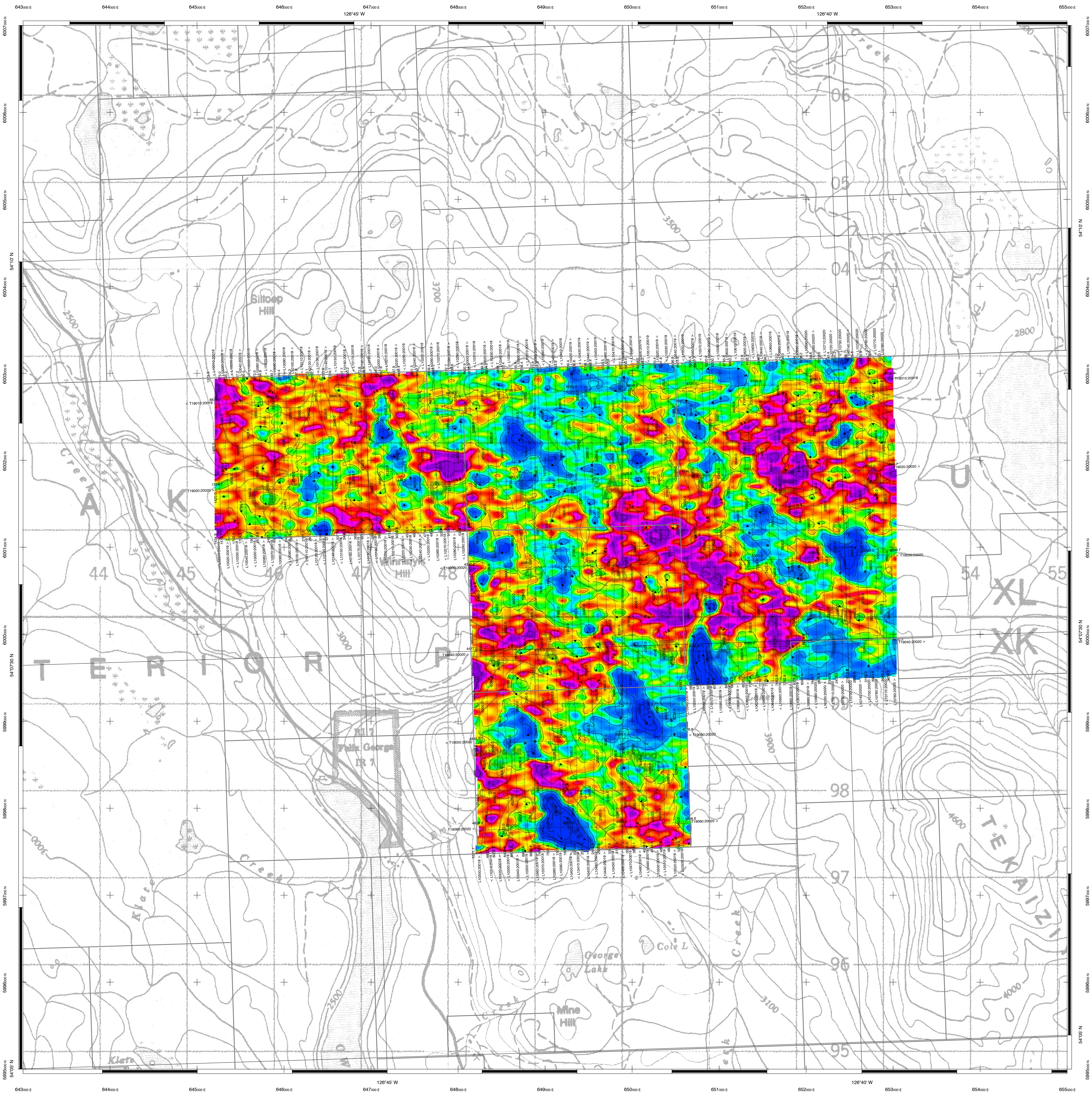
FUGRO DIGHEM^{V}/RAD SURVEY	NTS: 93 L/2	GEOPHYSICIST:
DATE: NOVEMBER, 2011	JOB: 11068	SHEET: 1

Fugro Airborne Surveys

0 1 2 Km
0 1 Mi
Scale 1:20 000

FUGRO

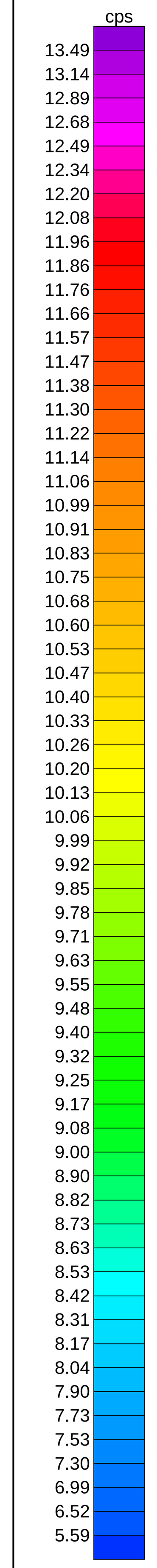
FUGRO AIRBORNE SURVEYS



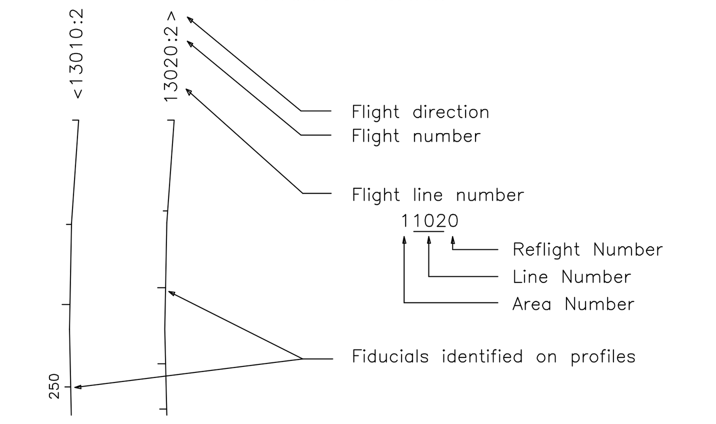
TECHNICAL SUMMARY

Navigation . . . . Differentially-corrected GPS
Data reduction grid interval . . . . 25 metres
Terrain clearance . . . . Helicopter, Spectrometer 60 m
Electromagnetic sensor 35 m
Magnetometer 35 m
Data sampling interval . . . . 0.1 second
Magnetometer / sensitivity . . . . . Cesium / 0.01 nT
Electromagnetic system . . . . DIGHEM^V
Spectrometer GR820

Frequency	Sensitivity	Coil Orientation
1000 Hz	.06 ppm	Vertical coaxial
5500 Hz	.12 ppm	Vertical coaxial
900 Hz	.12 ppm	Horizontal coplanar
7200 Hz	.24 ppm	Horizontal coplanar
56000 Hz	.60 ppm	Horizontal coplanar



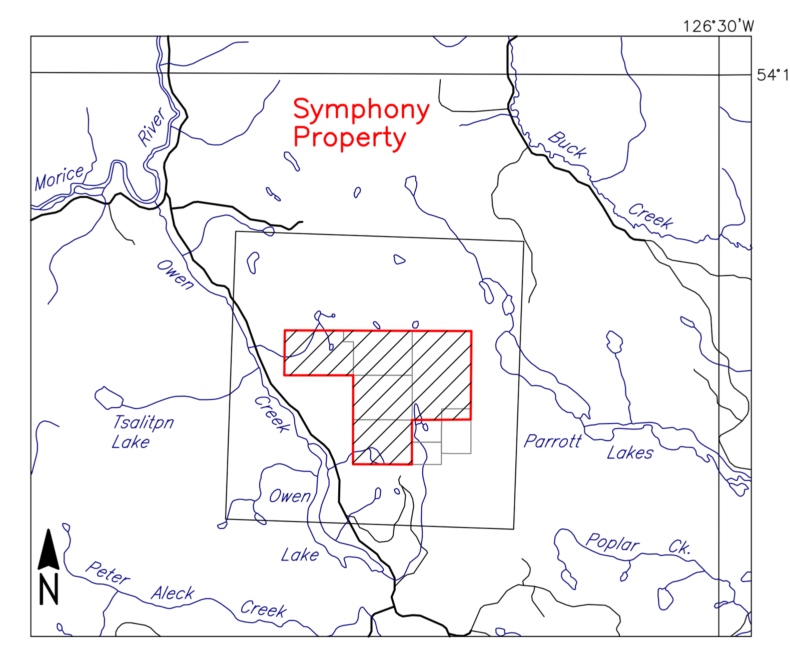
FLIGHT LINES



CONTOUR INTERVALS

. . . . 100 cps
. . . . 20 cps
. . . . 4 cps
. . . . 2 cps
. . . . low

LOCATION MAP



NTS: 93 L/2 | UTM ZONE: 9 NAD83 | SCALE: 1:250,000

BONTERRA RESOURCES INC.
SYMPHONY PROPERTY, BC

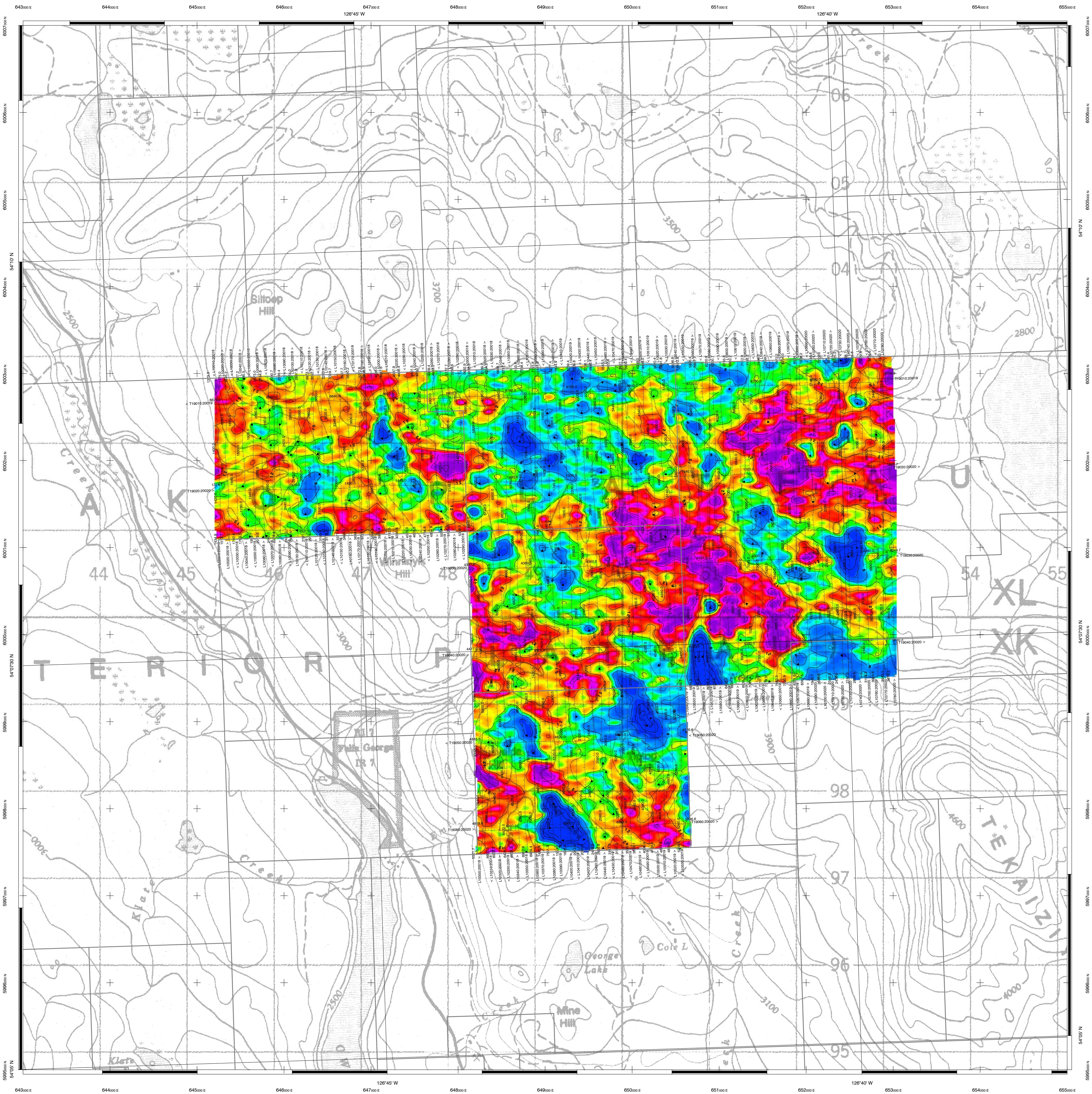
RADIOMETRIC URANIUM COUNTS

FUGRO DIGHEM^V/RAD SURVEY	NTS: 93 L/2	GEOPHYSICIST:
DATE: NOVEMBER, 2011	JOB: 11068	SHEET: 1

Fugro Airborne Surveys

0 1 2 Km
0 1 Mi
Scale 1:20 000

FUGRO AIRBORNE SURVEYS



cps

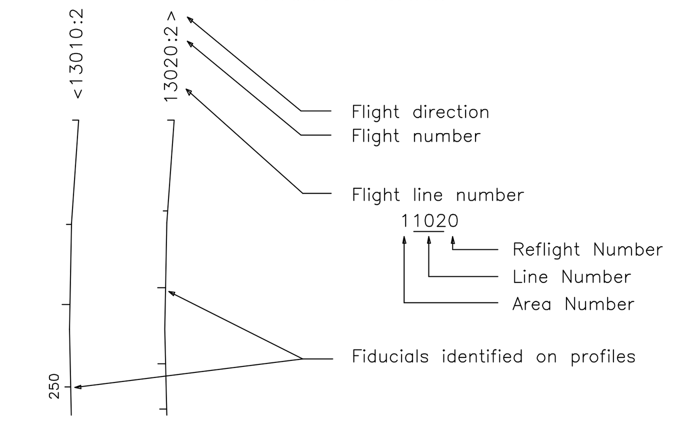
14.8
14.4
14.1
13.8
13.6
13.5
13.3
13.2
13.0
12.9
12.8
12.6
12.5
12.4
12.3
12.2
12.1
12.0
11.9
11.8
11.7
11.6
11.5
11.4
11.3
11.2
11.1
11.0
10.9
10.8
10.8
10.7
10.6
10.5
10.4
10.3
10.3
10.2
10.1
10.0
9.9
9.8
9.7
9.6
9.5
9.4
9.3
9.2
9.1
9.0
8.9
8.8
8.7
8.6
8.5
8.3
8.1
8.0
7.7
7.4
7.1
6.5
5.5

TECHNICAL SUMMARY

Navigation . . . . Differentially-corrected GPS
Data reduction grid interval . . . . 25 metres
Terrain clearance . . . . Helicopter, Spectrometer 60 m
Electromagnetic sensor 35 m
Magnetometer 35 m
Data sampling interval . . . . 0.1 second
Magnetometer / sensitivity . . . . . Cesium / 0.01 nT
Electromagnetic system . . . . . . DIGHEM^V
Spectrometer GR820

Frequency	Sensitivity	Coil Orientation
1000 Hz	.06 ppm	Vertical coaxial
5500 Hz	.12 ppm	Vertical coaxial
900 Hz	.12 ppm	Horizontal coplanar
7200 Hz	.24 ppm	Horizontal coplanar
56000 Hz	.60 ppm	Horizontal coplanar

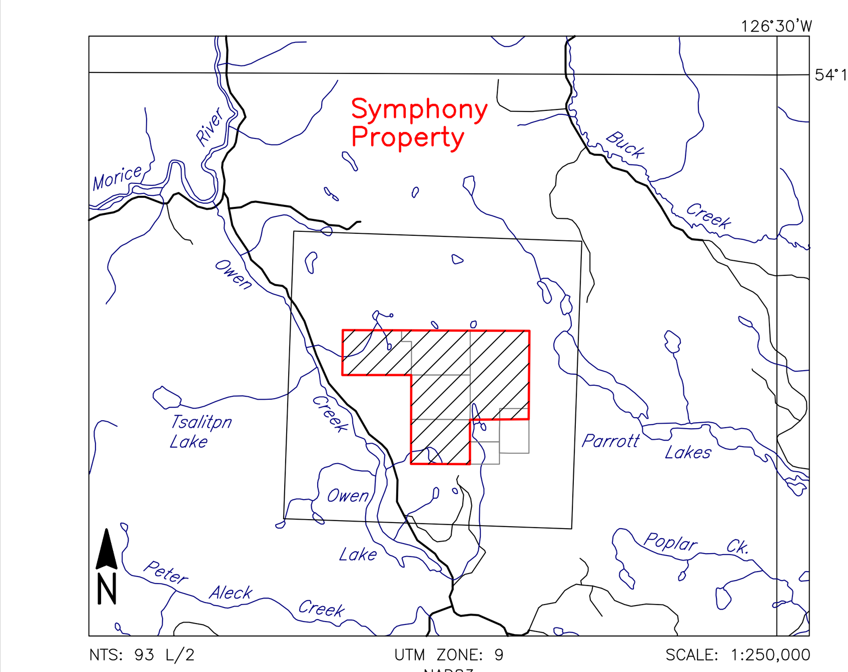
FLIGHT LINES



CONTOUR INTERVALS

. . . . 100 cps
. . . . 20 cps
. . . . 4 cps
. . . . 2 cps
. . . . low

LOCATION MAP



NTS: 93 L/2 UTM ZONE: 9 NAD83 SCALE: 1:250,000

BONTERRA RESOURCES INC.
SYMPHONY PROPERTY, BC

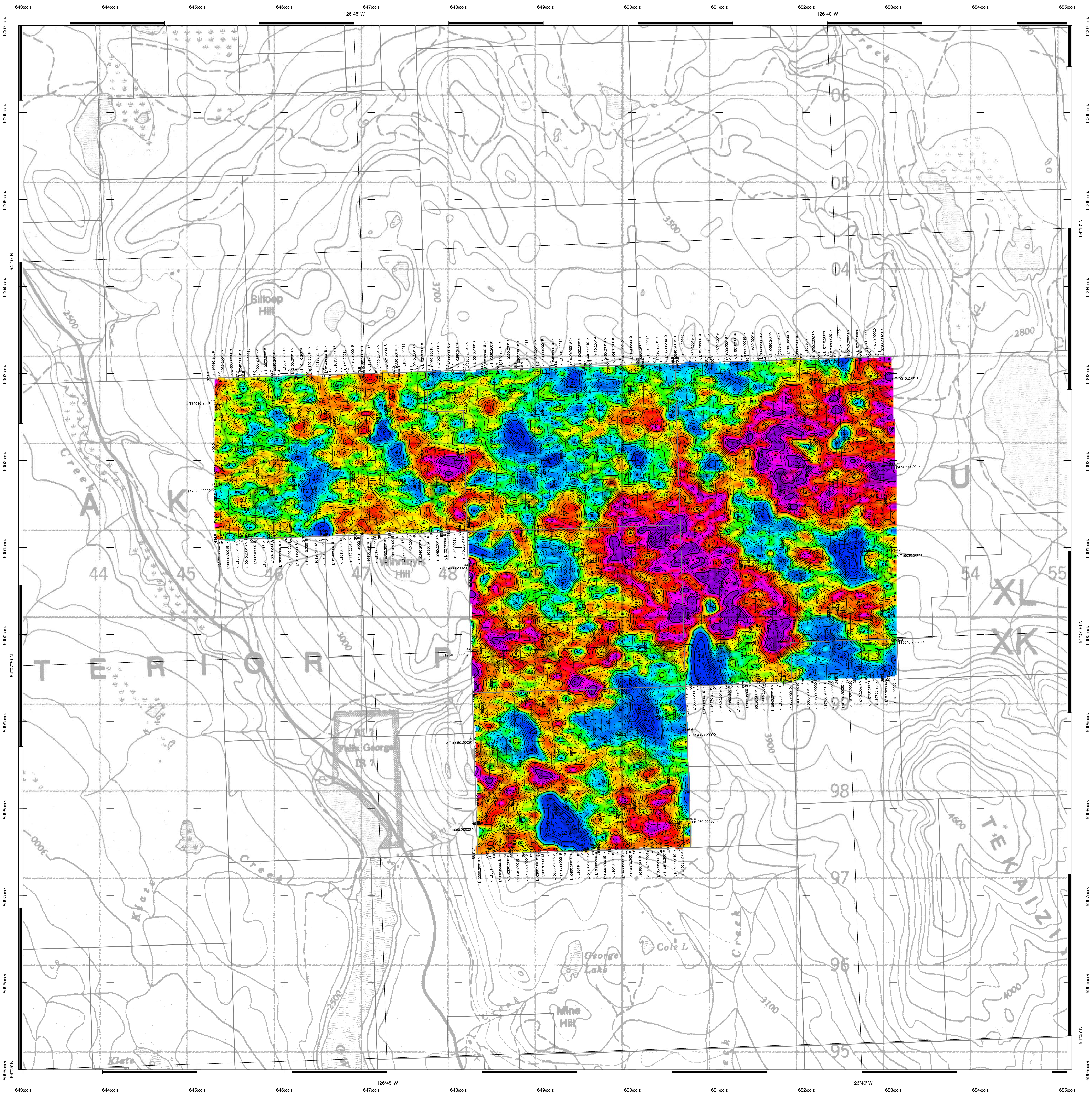
RADIOMETRIC THORIUM COUNTS

FUGRO DIGHEM^V/RAD SURVEY	NTS: 93 L/2	GEOPHYSICIST:
DATE: NOVEMBER, 2011	JOB: 11068	SHEET: 1

Fugro Airborne Surveys

0 1 2 Km
0 1 Mi
Scale 1:20 000

FUGRO AIRBORNE SURVEYS



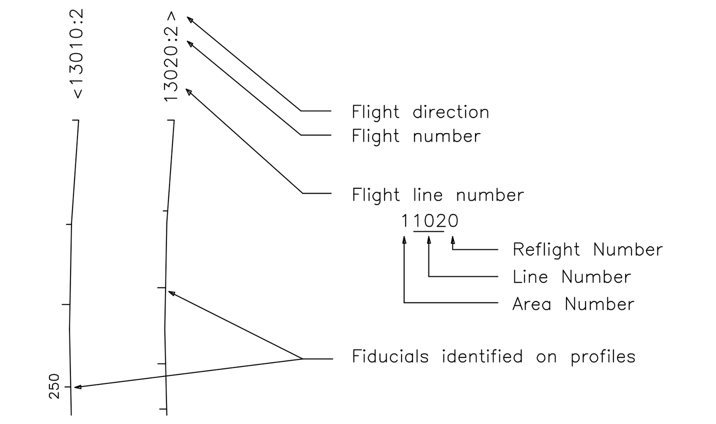
TECHNICAL SUMMARY

Navigation . . . . Differentially–corrected GPS
Data reduction grid interval . . . . 25 metres
Terrain clearance . . . . Helicopter, Spectrometer 60 m
Electromagnetic sensor 35 m
Magnetometer 35 m
Data sampling interval . . . . 0.1 second
Magnetometer / sensitivity . . . . . Cesium / 0.01 nT
Electromagnetic system . . . . DIGHEM V
Spectrometer GR820

Frequency	Sensitivity	Coil Orientation
1000 Hz	.06 ppm	Vertical coaxial
5500 Hz	.12 ppm	Vertical coaxial
900 Hz	.12 ppm	Horizontal coplanar
7200 Hz	.24 ppm	Horizontal coplanar
56000 Hz	.60 ppm	Horizontal coplanar

cps
102.2
99.5
97.3
95.5
93.8
92.2
90.8
89.4
88.1
86.9
85.8
84.6
83.4
82.4
81.3
80.3
79.2
78.3
77.4
76.5
75.6
74.7
73.8
73.0
72.3
71.5
70.8
70.0
69.3
68.6
67.9
67.2
66.5
65.9
65.2
64.6
64.0
63.4
62.7
62.1
61.5
60.8
60.2
59.6
59.0
58.4
57.7
57.1
56.4
55.7
55.0
54.2
53.3
52.4
51.4
50.4
49.2
47.9
46.3
44.5
42.2
38.9
32.7

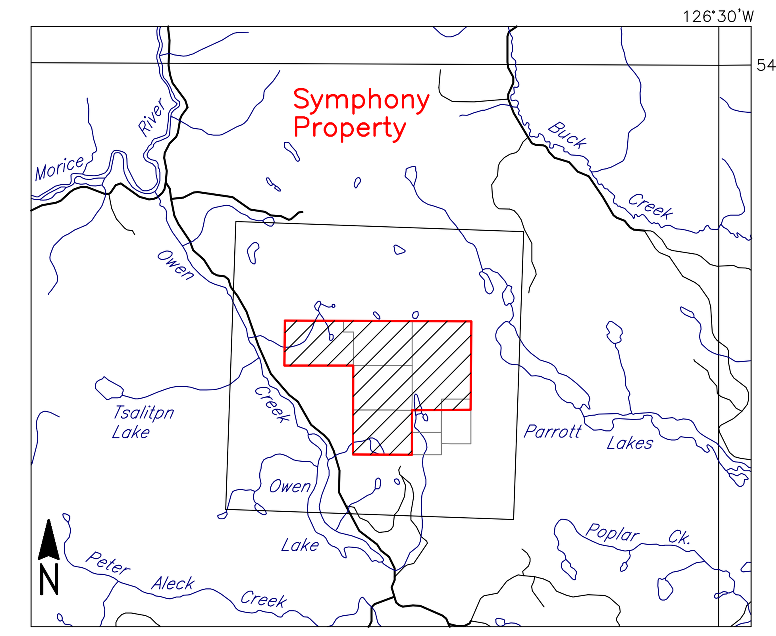
FLIGHT LINES



CONTOUR INTERVALS

. . . . 100 cps
. . . . 20 cps
. . . . 4 cps
. . . . 2 cps
. . . . low

LOCATION MAP



NTS: 93 L/2 UTM ZONE: 9 NAD83 SCALE: 1:250,000

BONTERRA RESOURCES INC.
SYMPHONY PROPERTY, BC

RADIOMETRIC POTASSIUM COUNTS

FUGRO DIGHEM V/RAD SURVEY	NTS: 93 L/2	GEOPHYSICIST:
DATE: NOVEMBER, 2011	JOB: 11068	SHEET: 1

Fugro Airborne Surveys

0 1 2 Km
0 1 Mi
Scale 1:20 000

FUGRO AIRBORNE SURVEYS