



**TERRAMIN AUSTRALIA LIMITED** ABN 67 062 576 238

# **SURRENDER REPORT**

## **ADELAIDE HILLS PROJECT**

EL 5356 (Currency Creek)

EL 5784 (Langhorne Creek)

DECEMBER 2016



Type of report	Surrender Report
Tenement numbers	EL5356 (Currency Creek), EL 5784 (Langhorne Creek),
Name of combined reporting project	Adelaide Hills Project
Tenement holder	Terramin Australia Ltd
Operator	Terramin Australia Ltd
Managed by	Terramin Australia Ltd ABN 67 062 576 238
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- Appendix A Drilling Data
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## SUMMARY OF ACTIVITIES

This report summarizes work undertaken on tenements EL 5356 and EL 5784 and their preceding licences. These tenements were part of Terramin's Adelaide Hills Project from 2014 and prior to that Terramin's Fleurieu Project.

In 2016 Terramin was requested to relinquish 10% of the Adelaide Hills Project on the Anniversary of the Amalgamated Expenditure Agreement. The decision to relinquish EL 5356 and EL 5784 was based upon their high annual expenditure commitments, respectively \$160,000 and \$220,000. With Terramin's current primary exploration objective for the Adelaide Hills Project to discover gold mineralisation to compliment the developing Bird-in-Hand Project. Although there is potential for gold mineralisation in the area, tenements EL 5356 and EL 5784 were seen largely as being most prospective for base metal mineralisation.

## Key words

Adelaide Hills Project; Aerial Electro-Magnetic survey (AEM); Aeromagnetic survey; Angas Zinc Mine; Anomaly 19; Brinkley; Cambrian; drilling; Eckert/Anomaly 4; Fenceline; Fleurieu Project; Heavy Mineral Sands; HHXRF analysis; soil sampling; Tapanappa Formation; Tunkalilla Formation; VTEM survey

## 1. INTRODUCTION AND HISTORY

### 1.1. Introduction and tenement details

The following report summarises exploration activities conducted in Exploration Licences 5356 (EL 5356/Currency Creek) and 5784 (EL 5784/Langhorne Creek) held by Terramin Australia Limited (Terramin). Located on the Fleurieu Peninsula, tenements EL 5356 and EL 5784 (Figure 1) were included in Terramin’s Adelaide Hills Amalgamated Expenditure Agreement.

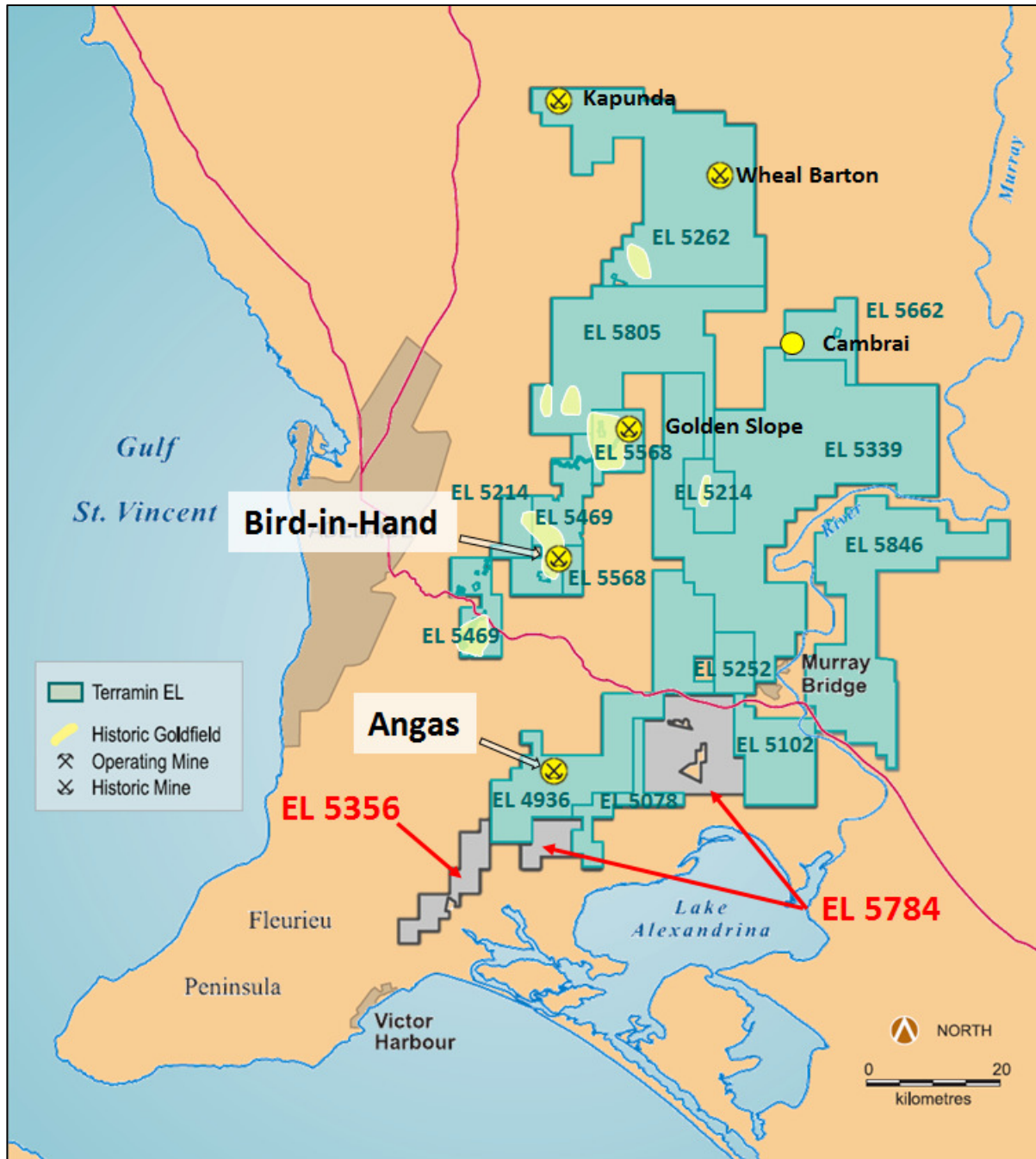


Figure 1: Location of Terramin’s Adelaide Hills Project Exploration Licences.

During the period Terramin was requested to relinquish 10% of the Adelaide Hills Project on the Anniversary of the Amalgamated Expenditure Agreement, the area relinquished is shown as the shaded area on Figure 1.

The land is hilly to gently undulating. Most land use is agricultural (mainly grazing and cropping) and ownership freehold, with a small proportion being Crown Land (generally as national or conservation parks) and the area as a whole is well serviced with power and water. Access is generally good with a dense network of roads and tracks link the numerous properties and small towns throughout the area. Terramin's field activities operated from a head office located in Adelaide and an exploration office and sample processing facility adjacent to the company's Angas Zinc Mine on ML6229, located 2km north-east of Strathalbyn.

This report covers exploration activities on the tenements up until relinquishment.

The details of the tenements the history are shown in Table 1 for EL 5356 and Table 2 for EL 5784.

Tenement	Licencees	Start Date	Expiry Date	Prior Tenement
EL 1778	Western Metals Copper Ltd	4/06/1992	3/06/1997	-
EL 2424	Western Metals Copper Ltd	9/09/1997	8/09/2002	EL1778;
EL 3128	Terramin Australia Limited	17/09/2003	16/09/2008	EL2424; EL1778;
EL 4210	Terramin Australia Limited	24/11/2008	23/11/2013	EL3128; EL2424; EL1778;
EL 5356	Terramin Australia Limited	24/11/2013	18/10/2016	EL4210; EL3128; EL2424; EL1778;

Table 1: Tenement summary history EL 5356.

Tenement	Licencees	Start Date	Expiry Date	Prior Tenement
EL 1981	Western Metals Copper Ltd	12/08/1994	11/08/1999	-
EL 2677	Western Metals Copper Ltd	3/12/1999	2/12/2004	EL1981;
EL 3310	Terramin Australia Limited	24/02/2005	23/02/2010	EL2677; EL1981;
EL 4466	Terramin Australia Limited	19/04/2010	18/04/2015	EL3310; EL2677; EL1981;
EL 5784	Terramin Australia Limited	19/04/2015	18/04/2017	EL4466; EL3310; EL2677; EL1981;

Table 2: Tenement summary history EL 5784.

Tenement	Ref	Title	Document URL
EL 5356	Env 08631	Data release [made at SA Director of Mines' discretion] : Currency Creek.	<a href="https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/ENV08631.pdf">https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/ENV08631.pdf</a>
EL 5356 /EL 5784	Env 09093	Data release [made at SA Director of Mines' discretion] : Bremer, Currency Creek, Langhorne Creek, Crozier Hill and Tunkalilla (the Fleurieu Project). Joint annual reports for the period 9/3/1995 to 23/4/2001.	<a href="https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/ENV09093.pdf">https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/ENV09093.pdf</a>
EL 5356	Env 12563	Currency Creek (part of the Fleurieu Project). First partial surrender report, for the period 4/6/1992 to 20/9/2013.	<a href="https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/ENV12563.pdf">https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/ENV12563.pdf</a>
EL 5784	Env 12566	Langhorne Creek (part of the Fleurieu Project). First partial surrender report, for the period 12/8/1994 to 20/9/2013.	<a href="https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/ENV12566.pdf">https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/ENV12566.pdf</a>
EL 5784	Env 12650	Langhorne Creek (part of the Fleurieu Project). Second partial surrender report, for the period 12/8/1994 to 14/8/2014.	<a href="https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/ENV12650.pdf">https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/ENV12650.pdf</a>

## 1.2. History

### 1.2.1. Early mining and exploration history

The Strathalbyn Mine, located about 1km north of Terramin's operating Angas Mine (was one of the earliest metal mines worked in Australia. It commenced operations in 1848 and was worked sporadically until 1908. Other historic workings of lead and silver include the Aclare, Wheal Ellen, and Talisker mines, all of which produced small tonnages of ore that were difficult to treat using the smelting technology available. The Bremer copper mine, discovered near Callington in 1848, was the largest of the pre-World War I copper mines in the Kanmantoo-Strathalbyn area, with recorded ore production of 34,869 tonnes averaging 8-10% copper. Water was a major problem and attempts to mine below the water table in the 1850's, 1870's and in 1907 were all unsuccessful.

Numerous Cu-Au-As deposits were discovered in the Monarto District in the 1850's. Mines were developed at Preamimma, Lady Jane and Frahns prospects on the western limb of the Monarto Syncline. These are described in Chilman and Jeffery, 1975 and are discussed in more detail in the drilling and geochemistry sections below. Copper diggings were also developed on the eastern limb of the syncline. The early mines were only worked to shallow depths and mostly abandoned when much of the workforce moved to Victoria during the mid-19th Century gold rush.

In 1952–1953 the SA Department of Mines & Energy drilled two diamond holes as part of an appraisal of the Strathalbyn Mine – Strathburn area.

The exploration history between the early 1970's and mid 1990's is summarised in Table 3. By 1993 enough work had been done at Angas for Aberfoyle Resources Ltd to report a so-called 'pre-resource potential' of 2.1Mt @ 10.7% Zn, 4.9% Pb, 60g/t Ag and 1.0g/t Au.

Details of Aberfoyle's work has previously been made public in Env 09093. in a data release that covers joint annual reports for the period 9/3/1995 to 23/4/2001.

<b>Date</b>	<b>Company</b>	<b>Work done</b>
<b>1970–1971</b>	<b>Northern Mining Co.</b>	IP geophysics Soil sampling and post hole drilling
<b>1974</b>	<b>RMC Minerals Pty Ltd</b>	<b><i>Strathalbyn mine</i></b> IP geophysics Five percussion holes 668 auger holes Two diamond drillholes
<b>Early 1980's</b>	<b>CRA Exploration</b>	<b><i>Fleurieu regional</i></b> Stream silt sampling Soil sampling Airborne magnetics and EM surveys Minor drilling in an area east of Angas
<b>1991–1993</b>	<b>BHP Minerals Ltd</b>	Regional prospects assessed – Murray Bridge area 110 air core holes (3,647m) Gravity and ground magnetics surveys 16 RC percussion holes (2,549m) DHEM on six holes
<b>1991–1994</b>	<b>Aberfoyle Resources</b>	<b><i>Angas prospect</i></b> Ground magnetics and surface EM surveys Soil sampling 222 RAB holes (1,550m) 17 diamond drillholes (8,234m) Seven percussion holes (1,532m) Down-hole EM survey of 19 holes <b><i>Fleurieu regional – various prospects</i></b> Glenalbyn, Rushmore, Allandale and Strathburn 176 RAB holes (368m) Surface EM survey Airborne EM survey
<b>1994–1996</b>	<b>Aberfoyle–North Ltd joint venture</b>	35 regional prospects assessed Ground magnetics surveys 225 RAB holes (2273m) 317 air core holes (3647m) One percussion hole (70m)

Table 3: Exploration history 1970–1996

### **1.2.2. Exploration post 1996**

In 1997, Playford Resources NL farmed into the Fleurieu Project and changed its name to Terramin Australia Ltd. Terramin became Project Manager and, in late 1997, began a major assessment program on the Angas deposit to define a mineable resource.

Details of exploration work up until Sept 2010 can be found in previously released annual reports held in Env 09093 (9/3/1995 to 23/4/2001) and Env 10525 (24/4/2001 to 30/9/2010).

## 2. GEOLOGY

The Fleurieu Project tenements cover a belt of prospective Cambrian siliciclastic marine sediments within the Kanmantoo Trough (Figure 2 and Figure 3). The Trough covers an area of ~11,000km<sup>2</sup> from the north eastern Adelaide Plains, south through the Fleurieu Peninsula and west to Kangaroo Island. It forms the eastern part of the Stansbury Basin (Figure 3), is the youngest succession in the southern part of the Adelaide Geosyncline, and has a stratigraphic thickness of ~7–8km. The stratigraphy of the Kanmantoo Trough is summarised in Figure 4.

Many of the major stratigraphic units in the Kanmantoo Trough contain iron-rich sulphidic horizons, but most of the significant known base metal mineralisation occurrences on the Fleurieu Peninsula are restricted to the Tapanappa Formation and the underlying Talisker Formation. Within these two formations Pb and Zn are preferentially associated with pyrrhotite-rich sandstone rather than pyrite-rich siltstone, and this is a factor considered in broad scale regional targeting of base metal deposits. Terramin's exploration focus is on the Tapanappa formation which hosts all of the larger base metal deposits known within the Kanmantoo Trough. The Tapanappa Formation is overlain conformably by the Tunkalilla Formation, a dominantly phyllitic unit characterised by the presence of pyritic, blue-black, laminated, carbonaceous mudstone at its base and top. Younger Kanmantoo units are not well represented in the Project area. In much of the southern central part of the Project area the Tapanappa Formation is overlain unconformably by up to 40m of Tertiary limestone, unconsolidated sand, gravel and minor clay. Elsewhere there is a thin cover (up to about 5m thick) of Quaternary alluvium and soil, with calcrete developed locally. Saline groundwater is widespread within these younger cover rocks in the southern parts of the Project area.

Rocks in the Kanmantoo Trough were deformed and regionally metamorphosed during the Cambro-Ordovician Delamerian Orogeny (Foden et al., 1999). Metamorphism locally reached upper amphibolite facies with migmatite development associated with synorogenic granites in the east (Sandiford et. al., 1995). Folds are relatively open, upright, symmetrical, and south-plunging, with amplitudes in the order of 10km. Folds on all scales have been disrupted by faults and shear zones sub parallel to the major fold axes, and locally have been truncated by comparatively later cross-cutting faults. The north-trending Bremer Fault in the northeast of the Adelaide Hills Project area is one of a number of faults thought to have been active during sedimentation and it shows evidence of comparatively recent reactivation probably associated with Tertiary and younger uplift of the Mt Lofty Ranges (Tokarev et. al., 1999). Gold mineralisation in and near the Project area is commonly associated with base metals, locally with arsenic (eg. Preamimma Mine and Frahns Mine). Gold commonly occurs in quartz vein systems spatially associated with synorogenic granitic orthogneisses and some post orogenic granites.

Zn-Pb-Ag(-Cu-Au) mineralisation across the southern Adelaide Hills Project area is associated with a garnetiferous, and locally gahnite-bearing, meta-sandstone/quartzite unit (known informally as the 'Host Unit') within the Tapanappa Formation. At the Angas deposit, the 'Host Unit' alteration varies from about 50 to 200m in thickness, is discordant to bedding and currently has a dip extent of more than 500m. To the north of Angas, the Host Unit appears to continue through the Strathalbyn mine, and northwards for a further 10km to Wheal Ellen. Approximately 10km north of Wheal Ellen is the Kanmantoo copper deposit hosting a Mineral Resource of 32.2 million tonnes (2.3Mt Measured, 22.5Mt Indicated and 7.4Mt Inferred) grading 0.9% Cu and 0.2g/t Au, and including 3,313,600oz Ag (Hillgrove Resources, 2010). Mineralisation in the vicinity of this deposit occurs as discordant Cu-Au veinlets, stockworks and podiform lenses of chalcopyrite, pyrrhotite, pyrite, magnetite, chalcocite and covellite within a host rock consisting of quartz–biotite–andalusite±garnet±chlorite schist.

The Talisker Calc-siltstone hosts low-grade stratabound Pb-Zn-Ag at Mount Torrens in the north but, with the exception of (late) discordant As-Ag-Pb at the Talisker mine near Cape Jervis, is generally deficient in base metals in the south. The Talisker Calc-siltstone also incorporates a local sulphidic marker unit, the Nairne Pyrite Member that was mined for sulphur at Brukunga prior to 1972.

The Angas massive sulphide horizons consist of predominantly coarse-grained sphalerite-galena-pyrite-pyrrhotite with minor chalcopyrite. The sphalerite is dark brown to black and contains about 9% iron. The Zn-Pb ore zones display morphologies and textures suggesting remobilisation, possibly into dilational areas associated with shear movements along northerly-trending structures, but with its original stratigraphic position not significantly altered. The mineralised zones plunge steeply to moderately in a southerly direction.

A range of syngenetic and epigenetic models has been proposed for the origin(s) of base metal mineralisation in the Kanmantoo Trough. While accepting that the Tapanappa Formation appears to be the most favourable host for base metal deposits, Terramin has adopted an empirical approach to exploration in the Project area, utilising geochemical and geophysical techniques to generate drilling targets and investigating post-peak metamorphic structural features as possible locii for mechanical or hydrothermal remobilisation of early mineralisation, and as potential fluid pathways for epigenetic hydrothermal overprints.

The Trough as a whole forms a regional magnetic and gravity low. The NNW-trending, continental-scale G2 gravity lineament (Figure 3) associated with major IOCG deposits in the Olympic Domain of the Gawler Craton to the northwest (O'Driscoll, 1985, Skirrow et al., 2005) crosses the eastern half of the tenements. Sulphidic (and graphitic) units form extensive regional basement EM conductors. Conductive sulphidic, saline, clayey and graphitic stratigraphic horizons in the cover and basement present challenges for the use of electrical techniques to locate massive base metal sulphide deposits. Lead-zinc deposits generally lack magnetite but widespread occurrences of pyrrhotite also complicate detailed interpretation of magnetic and electrical responses.

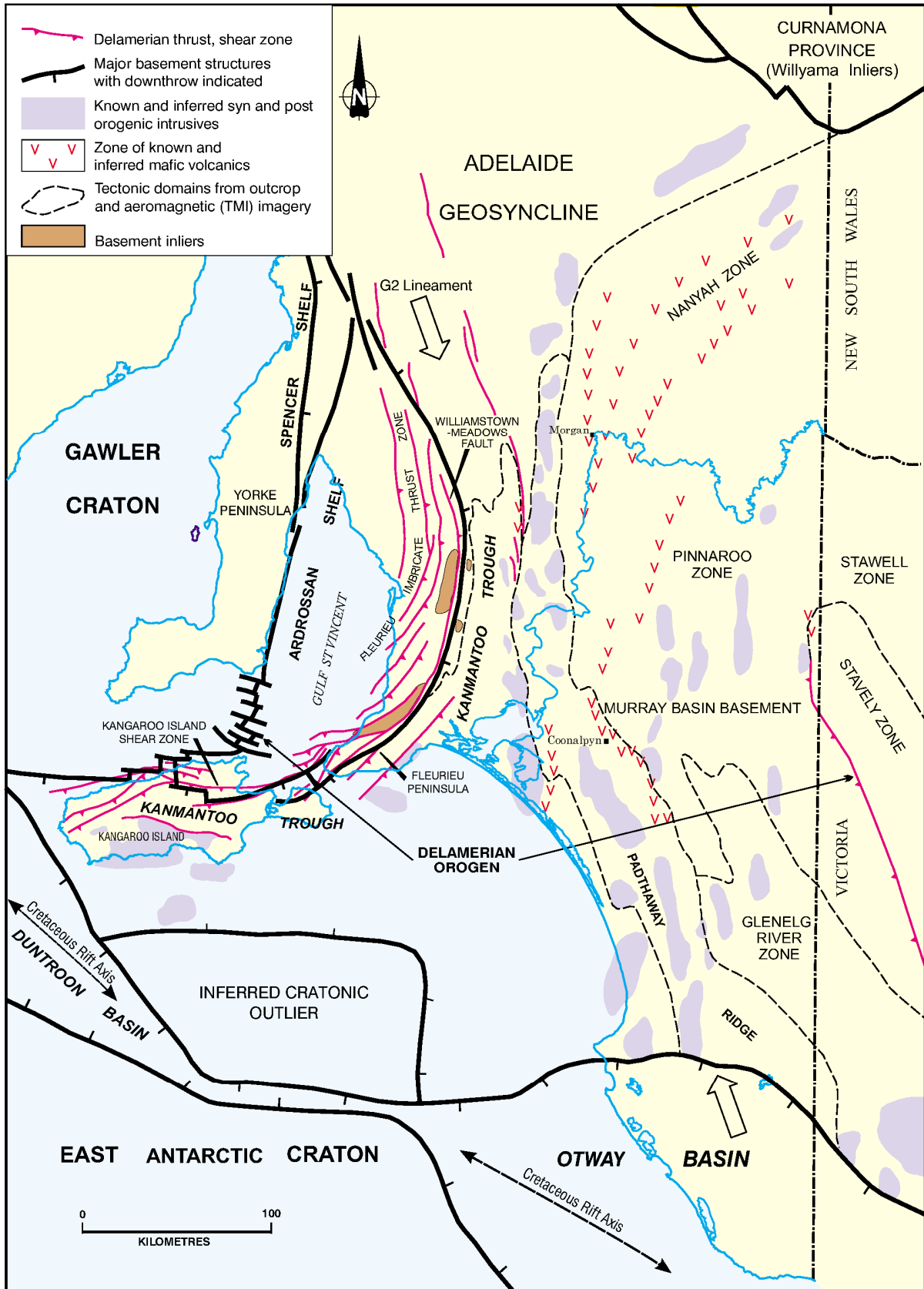


Figure 2: Tectonic setting of the Stansbury Basin and Kanmantoo Trough (from Burtt, 2007)

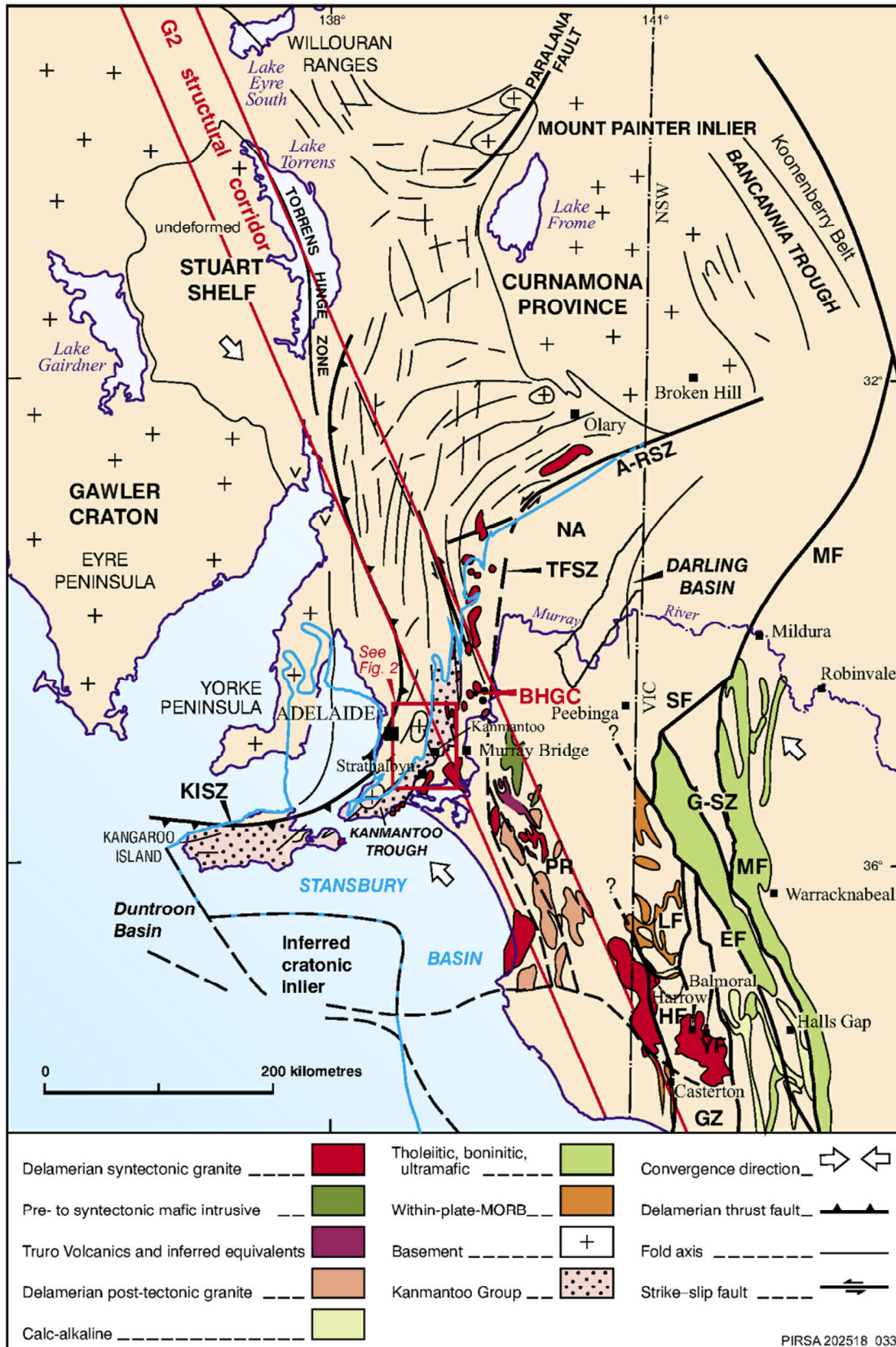


Figure 3: Extent of the Kanmantoo Trough and Kanmantoo Group equivalents (from Abott et al., 2006)

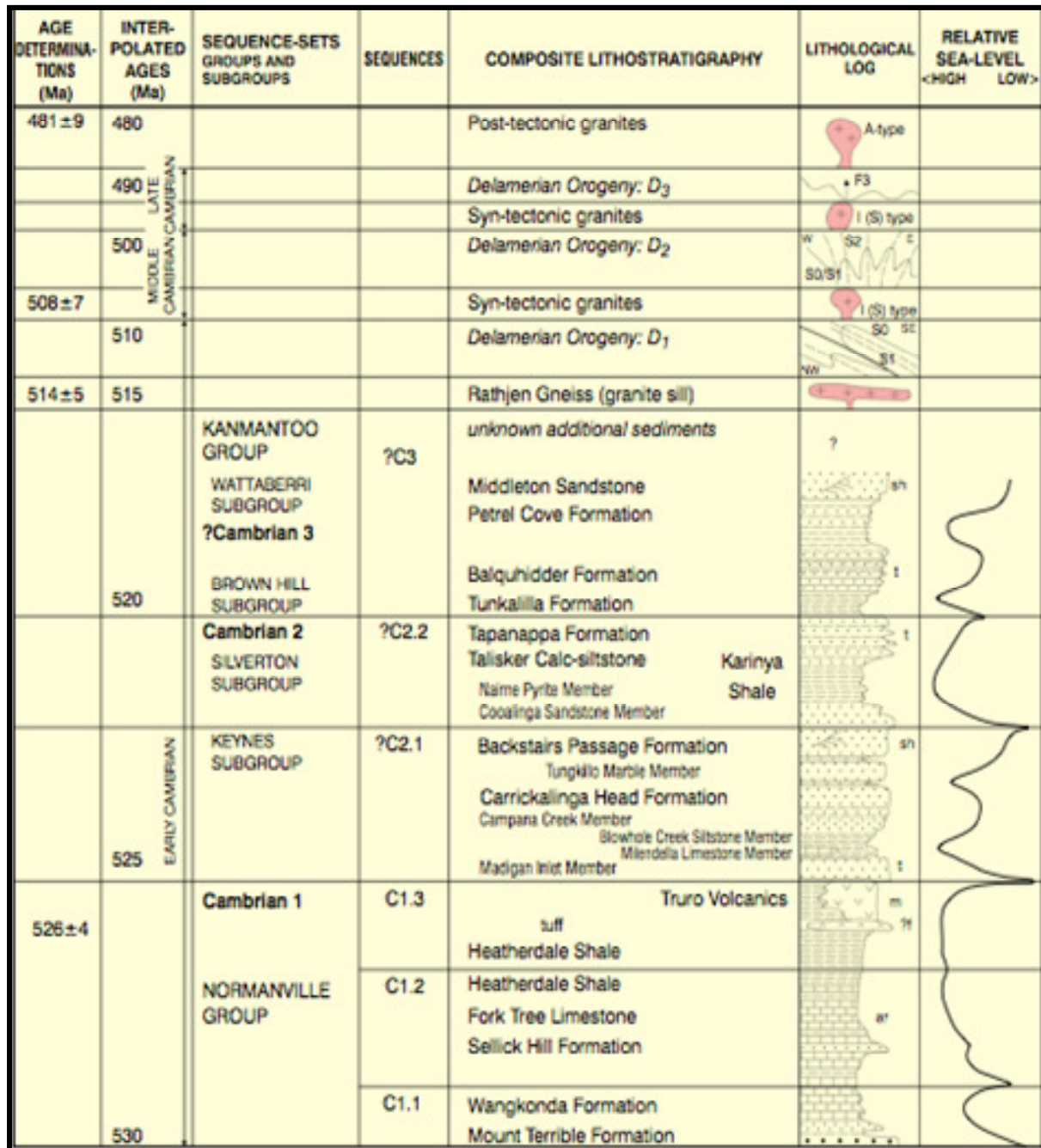


Figure 4: Stratigraphy of the Kanmantoo Trough (from Burt, 2007)

## 4. DRILLING

Exploration drilling was undertaken in several phases. Holes CUR001 to CUR017 (268m) and LANG001 to LANG039 (524m) were RAB holes drilled by North Ltd. (North) in 1995. Holes LANG040 to LANG061 were drilled by air core for North in 1996 (946m). Details of this work has previously been made public, Env 09093 in a data release that covers joint annual reports for the period 9/3/1995 to 23/4/2001.

Terramin drilled three diamond holes (888.7) and two open hole percussion water bores (360m) at Harriot Hill (previously misspelt Harriett Hill) in 2007 and three diamond holes in 2008 at Brinkley, BYDD001 to BYDD003 (748.9m). Details of this work has previously been made public, Env 10525 in a data release that covers joint annual reports for the period 24/4/2001 to 30/9/2010. Harriot Hill drilling was awarded Theme 2, Plan for Accelerating Exploration (PACE) funding with the full documentation in Env 11558.

In these campaigns a combined total of 86 drill holes (2,935.6m) drilled.

Drilling data is located in Appendix A

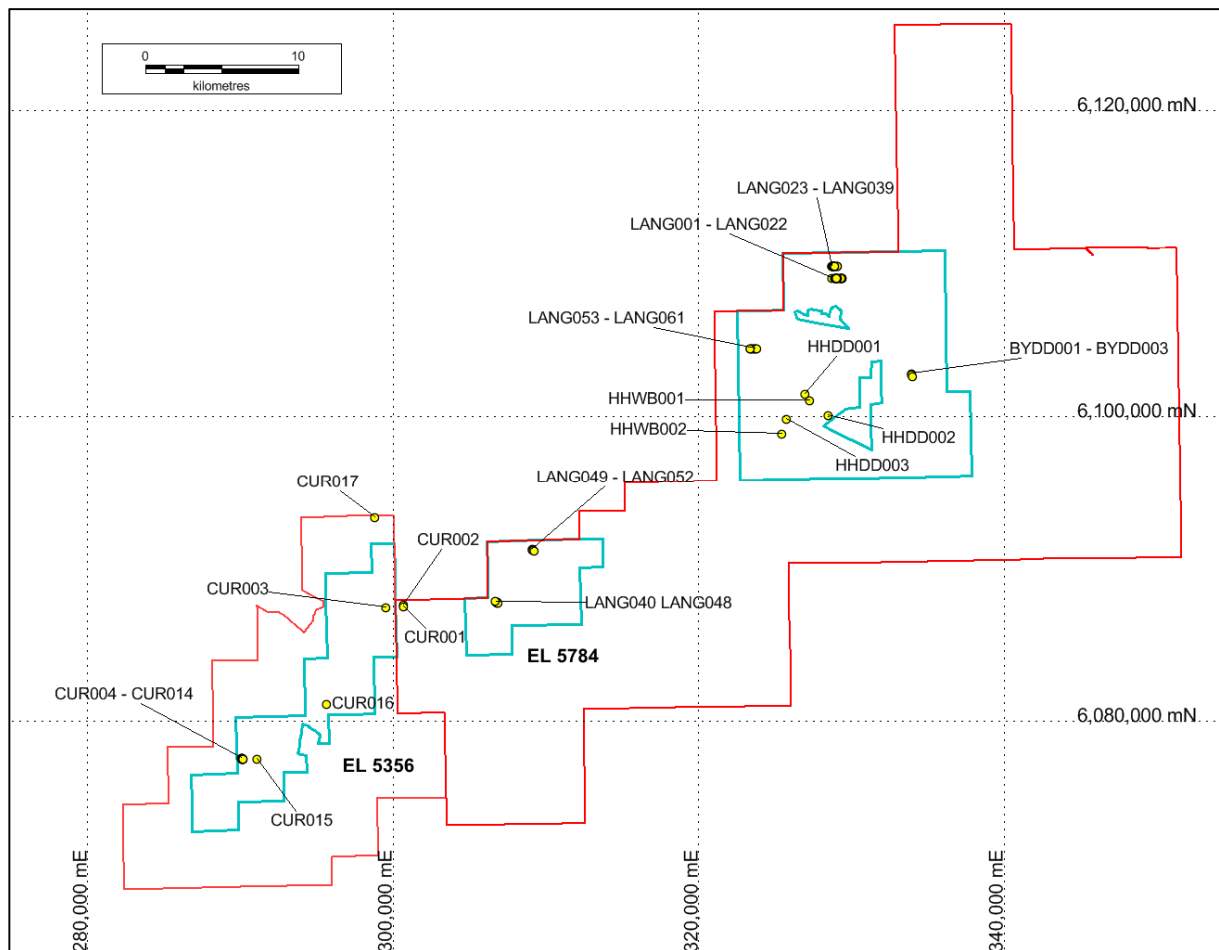


Figure 5: Drillhole locations

## 5. SURFACE GEOCHEMISTRY

### 5.1. Sample collection and preparation

The four main surface sample data sets collected were: rock chips (outcrop only), float (typically transported rocks) soil samples sieved and soil samples. When available the XRF is used to analyse soil samples, often in the field to assist in sample selection

HHXRF – sampling often undertaken along road sides and can be affected to contamination from discarded rubbish particularly zinc from fence wire and agricultural practices.

Surface geochemistry data is located in Appendix B

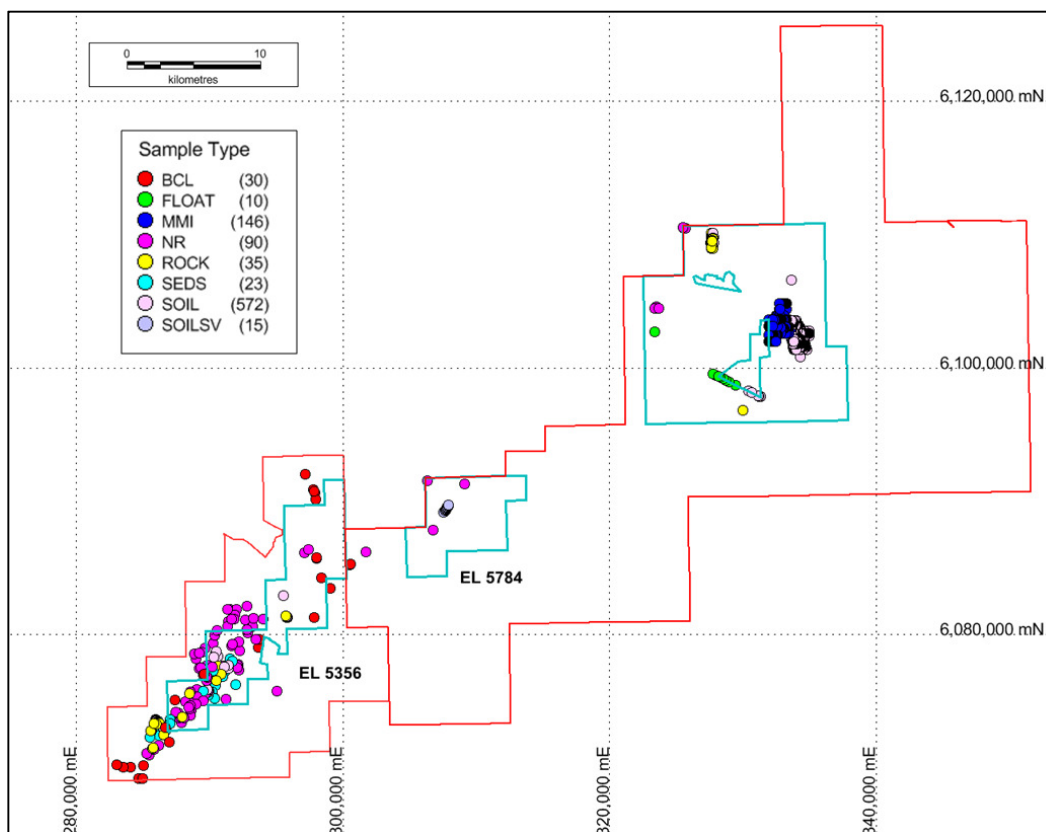


Figure 6: Traditional surface sample locations by sample type.

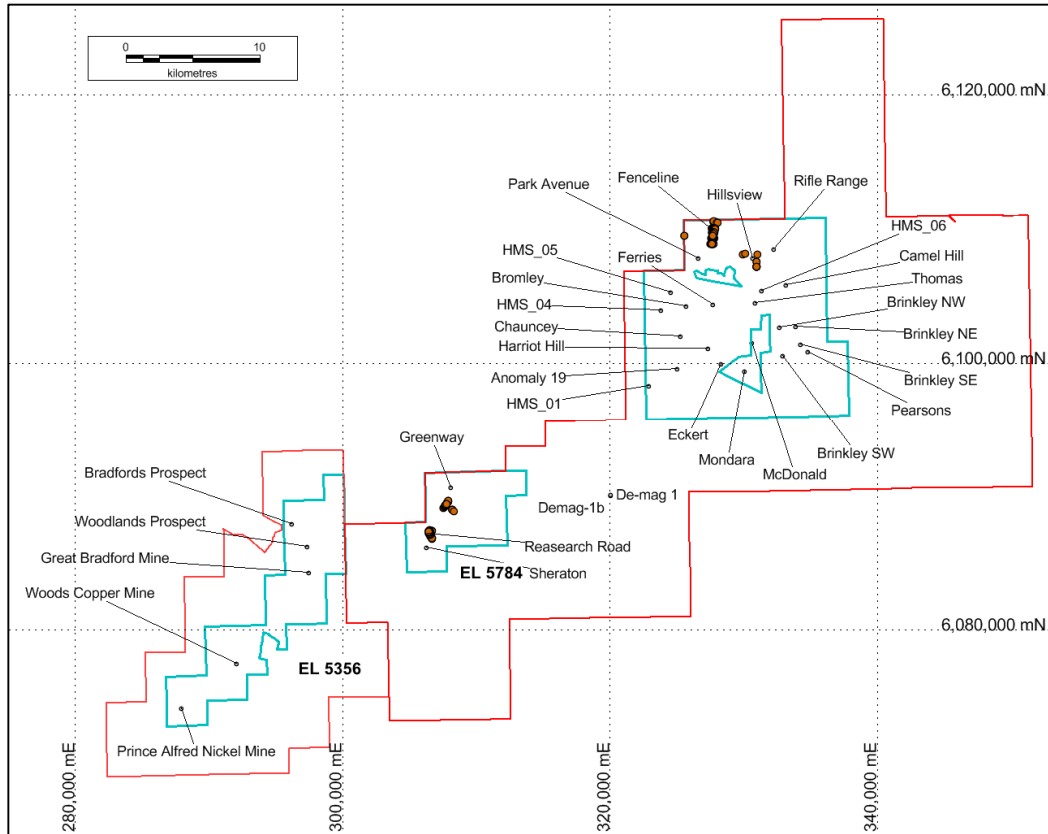


Figure 7: HXRf sample locations

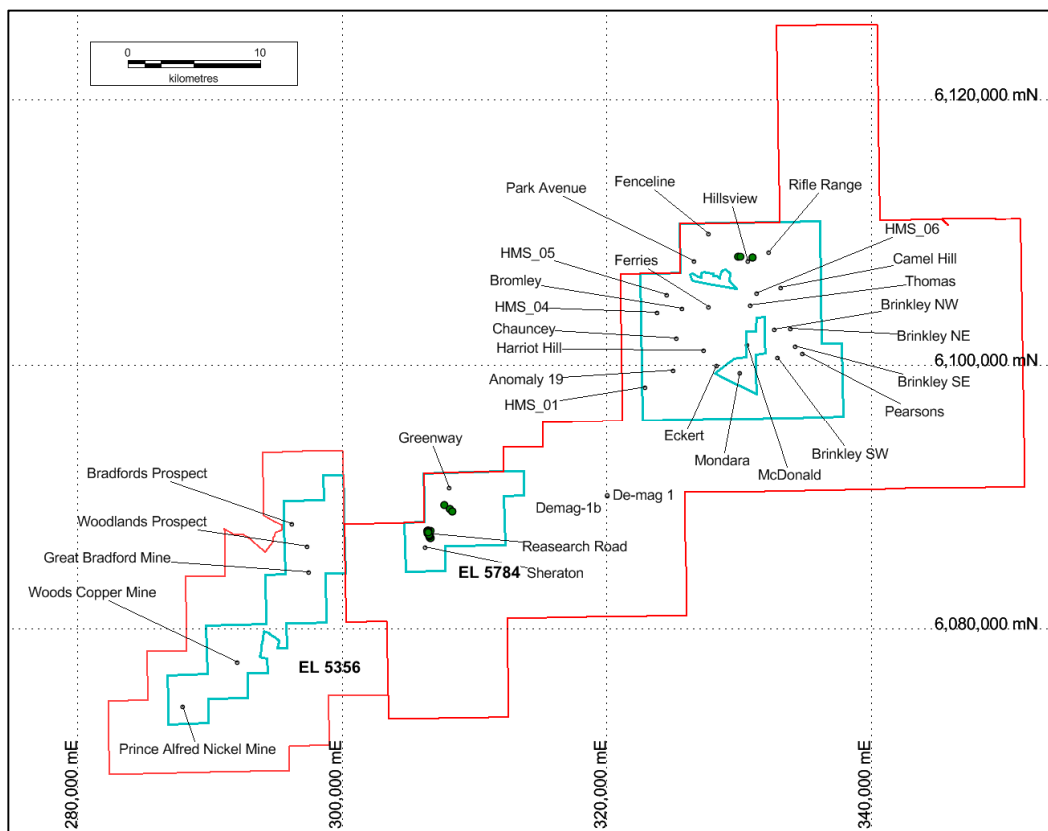


Figure 8: HXRf bio sample locations

## 6. GEOPHYSICS

### 6.1. Aerial EM surveys, processing of data VTEM data and

In 2010, Terramin had contracted Geotech Airborne Pty Ltd to fly Versatile Time-Domain Electromagnetic (VTEM) geophysical system to locate conductive anomalies which could indicate the presence of massive base metal sulphide mineralisation within Kanmantoo Group rocks beneath the cover. VTEM was reputedly the best airborne EM system at the time, capable of detecting conductive features in basement rocks beneath conductive cover sequences. The survey combined acquisition of EM and magnetic data for a total of 3,684.3 line km covering most of the Fleurieu Project tenements including EL 5356 and EL 5784. A significant portion of EL 5784 was covered at 200 m flight line spacing, with areas of interest infilled to 100 m spaced flight lines, Figure 9. Over EL 5356 only a few flight lines over the Bradfords and Woodlands Prospects.

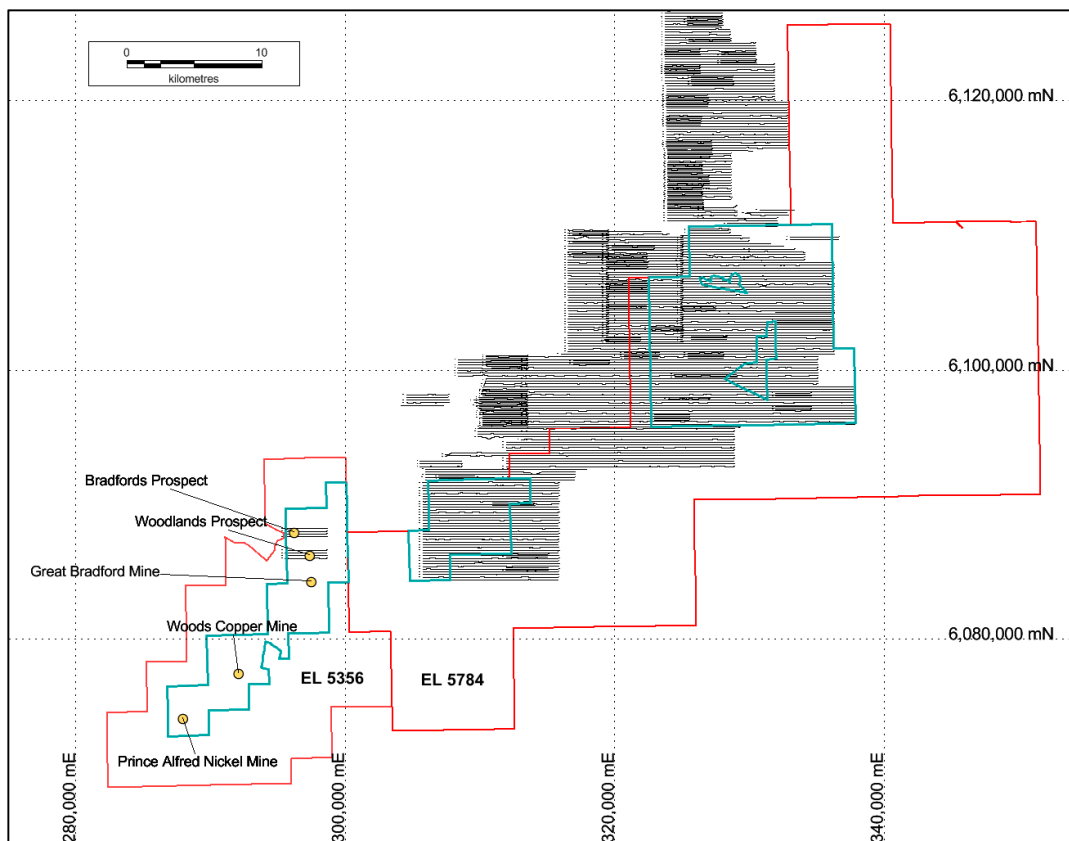


Figure 9: Location of VTEM flight lines

Geophysical data is located in Appendix C

## 6.2. Ground EM surveys

### 6.2.1. Harriot Hill

Surface EM was undertaken in the Harriot Hill area where a cluster of coincident airborne EM and magnetic anomalies was identified. shows the location of Harriot Hill, about 20 km east of the Angas mine. Airborne anomalies 3, 4, 6, 8 and 19 ( Figure 10) were chosen for the initial moving and fixed loop EM surveys.

Details of this work has previously been made public, Env 10525 in a data release that covers joint annual reports for the period 24/4/2001to 30/9/2010.

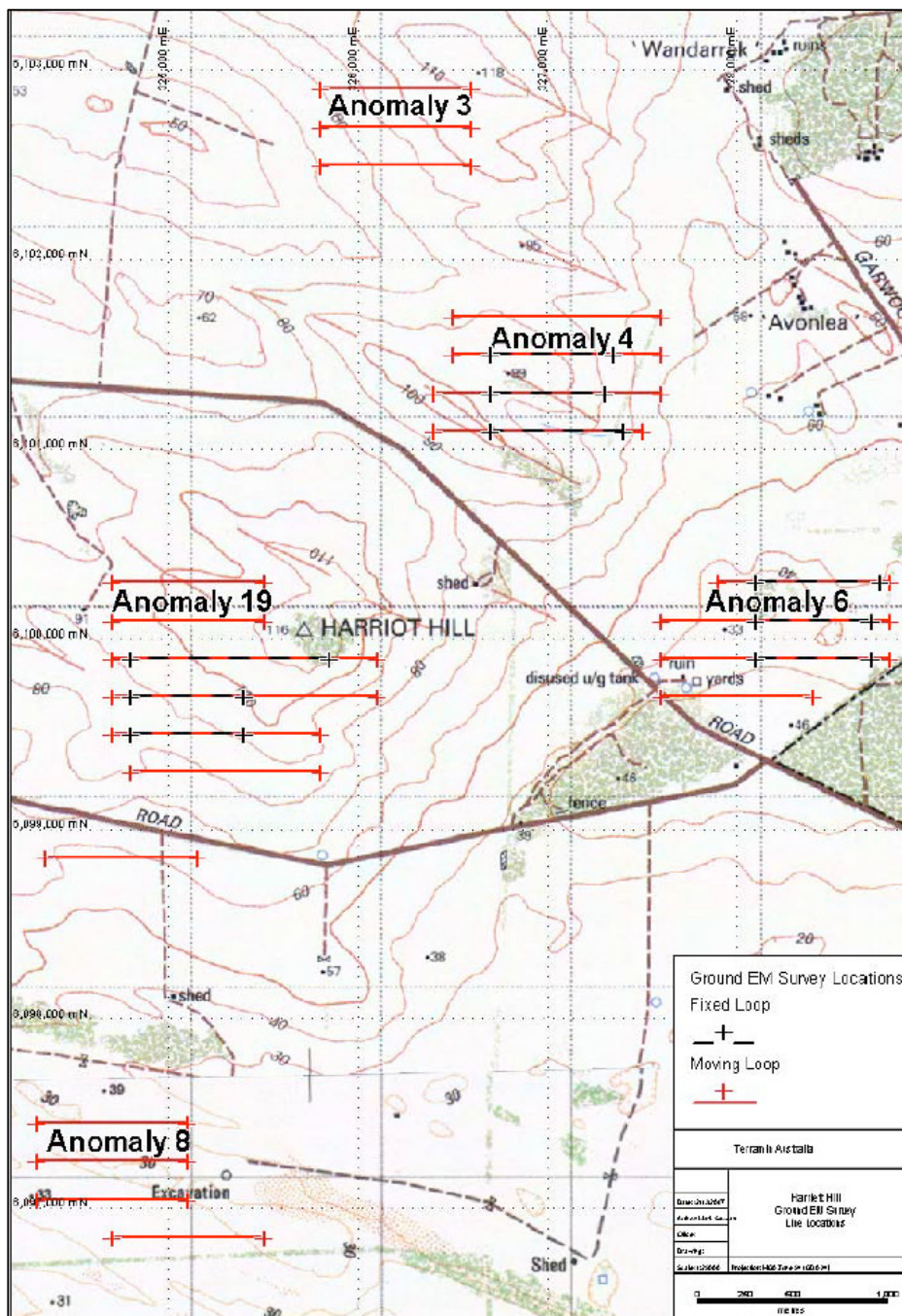


Figure 10: Location of Harriot Hill ground EM surveys

## 6.2.2. Brinkley

MLEM surveys were undertaken at Brinkley in December 2007 January 2008. Contractor McSkimming Geophysics utilised a Sirotem II system with 200m loops were used to energise the ground. Measurements were recorded from the centre of the loop in 100m and 50m intervals.

A FLEM survey was carried out over Anomaly 39A with the objective was to run the fixed loop lines as nearly as possible at right angles to the conductor, Figure 11.

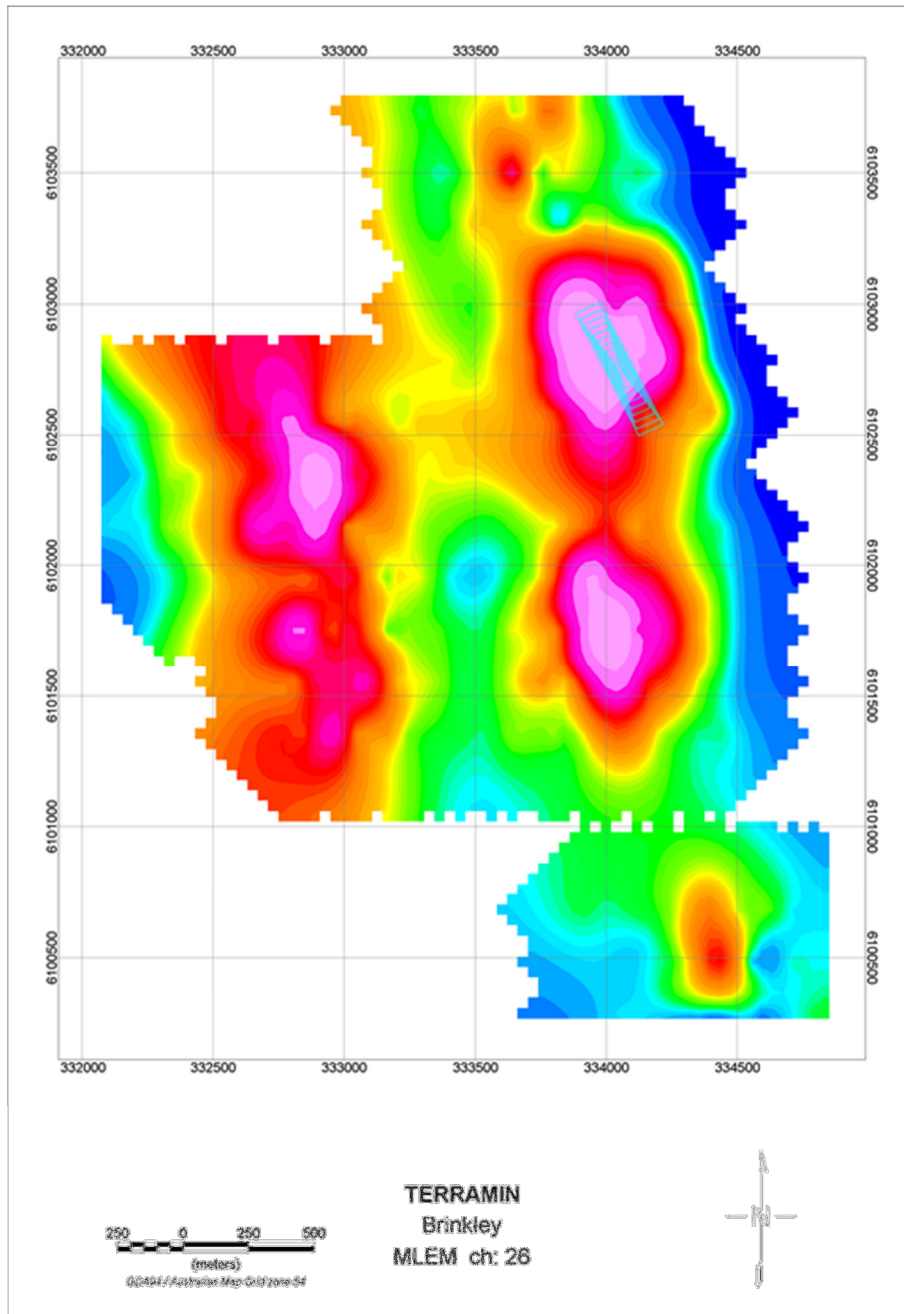


Figure 11: Brinkley – MLEM contours with Anomaly 39A's FLEM conductor shown in pale blue

## 7. PROSPECT SUMMARIES

### 7.1. Prospect Ranking

Terramin identified 33 areas of interest (Figure 12), with the higher priority areas described below. Areas of interest on EL 5356 are solely historic workings, details of which can be found in the Department of State Development’s “Resource and Energy Georeference Databases” whereas areas of interest on EL 5784 are either aeromagnetic or VTEM anomalies.

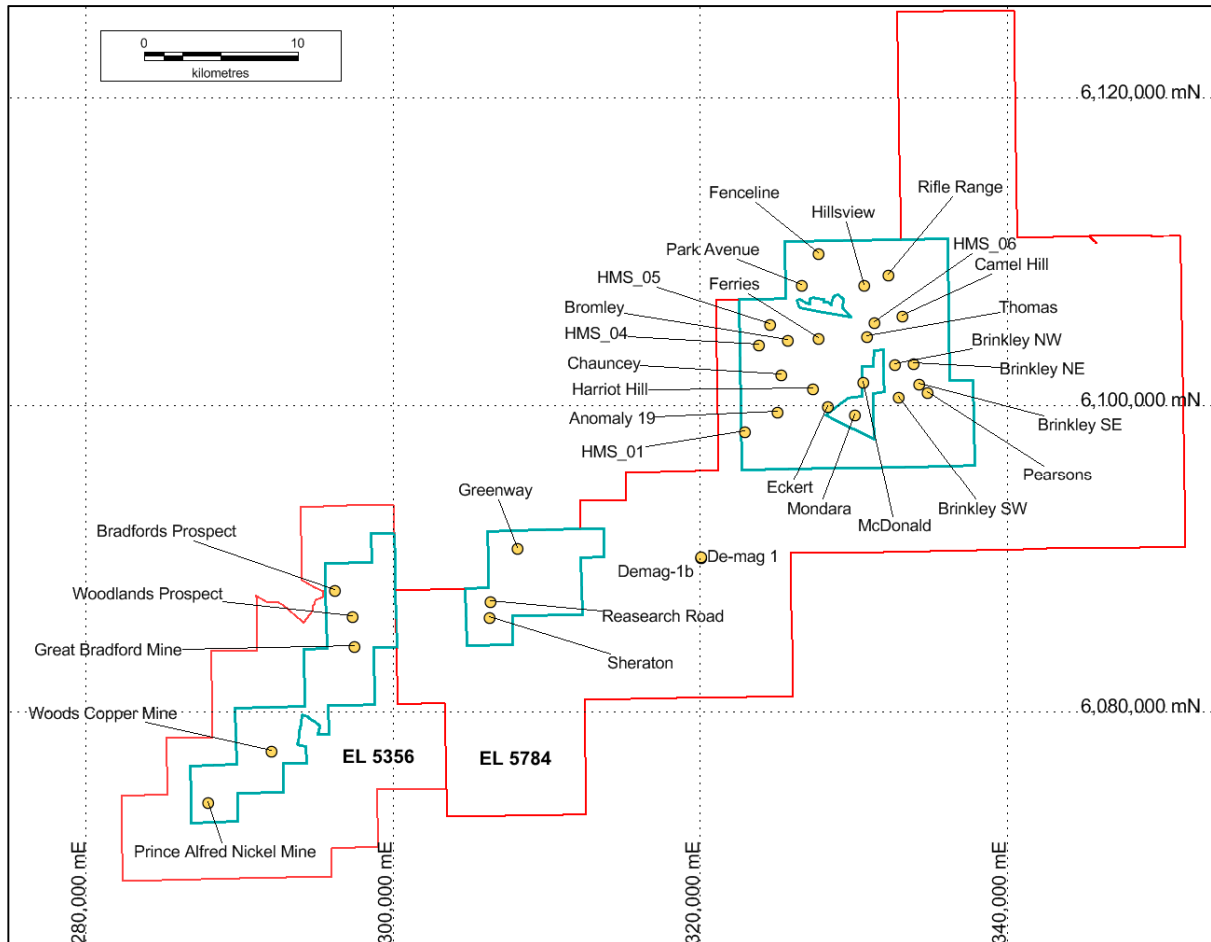


Figure 12: Fleurieu prospect locality map on aerial magnetic image

Name	East	North	EL	Alternate Name(s)
Prince Alfred Nickel Mine	287922	6074228	5356	
Woods Copper Mine	292098	6077514	5356	
Great Bradford Mine	297494	6084328	5356	
Woodlands Prospect	297372	6086278	5356	
Bradfords Prospect	296222	6087978	5356	
Brinkley NW	332700	6102738	5784	InMB38
Brinkley SW	334247	6101462	5784	InMB39
Brinkley SW	332932	6100573	5784	
Bromley	325728	6104309	5784	
Chauncey	325294	6102042	5784	
De-mag 1	320053	6090099	5784	
Demag-1b	320053	6090132	5784	
Fenceline	327735	6109945	5784	
Ferries	327731	6104401	5784	Mag 4, Mag5
Greenway	308114	6090734	5784	
Hillsview	330670	6107862	5784	
McDonald	330592	6101578	5784	
Park Avenue	326591	6107878	5784	
Thomas	330856	6104539	5784	
Harriot Hill	327338	6101159	5784	Anomaly H2
Eckert	328337	6100024	5784	Mag 3
Reasearch Road	306363	6087266	5784	T 14 sth
Sheraton	306273	6086222	5784	
Rifle Range	332257	6108556	5784	
Brinkley NE	333921	6102793	5784	
Camel Hill	333180	6105879	5784	Anomaly K1
Pearsons	334778	6100897	5784	PD84MI6, INMB39a
Mondara	330064	6099425	5784	
HMS_01	322885	6098374	5784	
HMS_04	323840	6104006	5784	
HMS_05	324572	6105311	5784	
HMS_06	331351	6105472	5784	
Anomaly 19	325059	6099626	5784	

Table 4: Prospect locations, coordinates in MGA 94 Zone 54

## 7.2. Brinkley (Lead Zinc) Pearson (Copper)

The Brinkley and Pearson prospects are located 12km to the south of Murray Bridge.

Both CRA and BHPB explored the Brinkley area for lead and zinc mineralization.

PD84MI3 (CRA) located to the north of the northern conductor intersected from 110m, 5m @ 0.10% Pb+Zn and 158m, 6m @ 0.42% Pb+Zn. PD84MI5 (CRA) located to the north of the southern conductor intersected from 42m, 16m @ 0.16% Pb+Zn.

The high quality of the new aeromagnetic survey allows a greater understanding of the faulting in the area and modern software allows for better modelling and interrogation of the data.

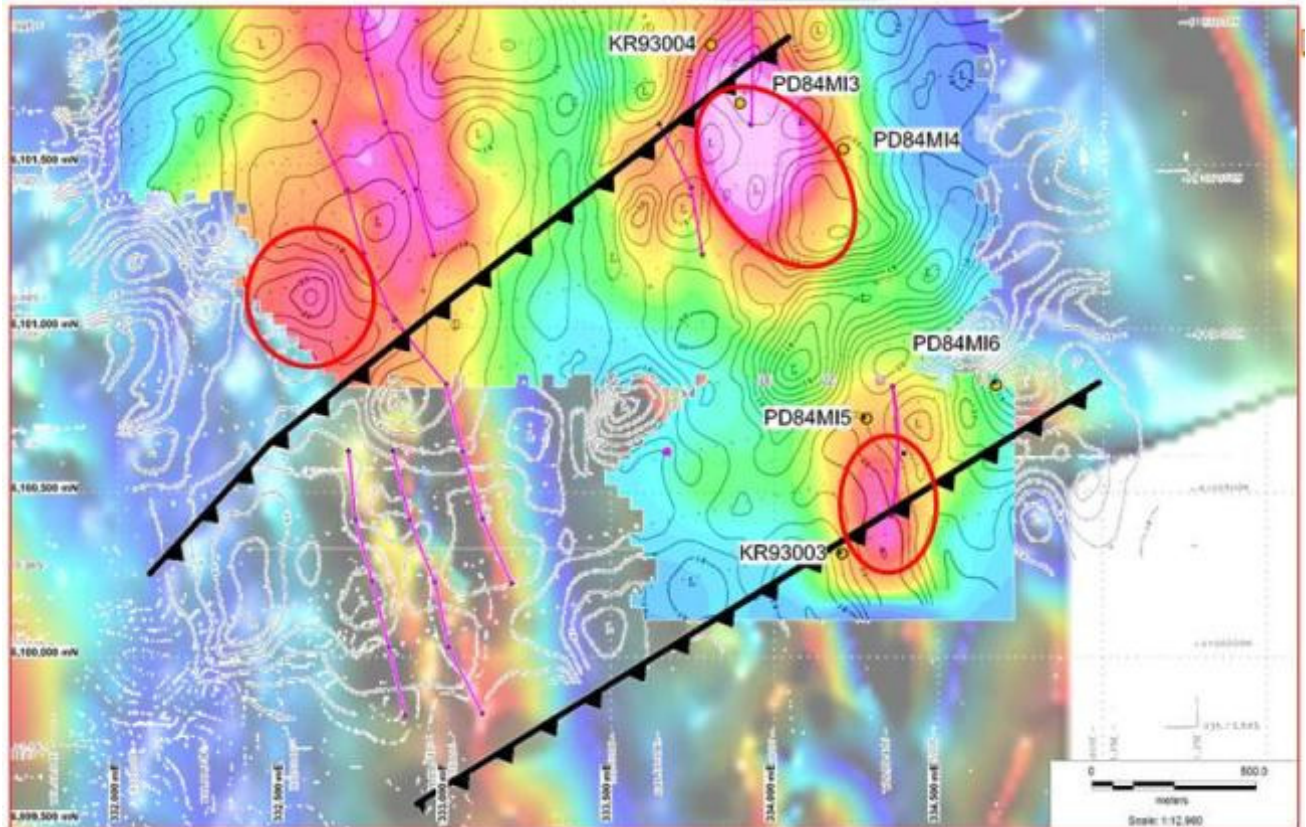


Figure 13: Brinkley area conductors circled in red on ground EM overlain with gravity contours, VTEM conductors (pink lines)

### 7.3. Eckert – Harriot Hill– Anomaly 4 (Lead Zinc)

The Eckert prospect is located 18km to the east of the Angas Zinc Mine and is part of the Harriot Hill area. Drillhole HHDD001 located to the north of the VTEM anomaly is the most anomalous hole from the Harriot Hill area with the hole intersecting from 104m, 7m @0.30% Pb+Zn, from 148.7m, 10m @ 0.26% Pb+Zn and from 173.3m, 3m @ 0.31% Pb+Zn. Hole KR9204 drilled by BHP is considered to have been drilled too far to the east and water bore HHWB001 was not assayed.

The massive sulphides at Angas are hosted by a garnet bearing quartz-rich siltstone/quartzite rock that carries significant iron sulphides as pyrrhotite and pyrite. In 2007 modelling and interpretation of the 2002 TEMPEST airborne geophysics data set collected by the National Action Plan for Salinity, the Bureau of Rural Sciences (BRS) identified a number of areas with Angas-like signatures within Terramin’s ELs. One of these areas was at Eckert near Harriot Hill, where the prospective Kanmantoo Group rocks are obscured by Tertiary and Quaternary cover.

#### 7.3.1. Geophysics

Ground geophysical surveys (moving and fixed loop EM) in 2007 were undertaken over several prospect areas to better-defined the airborne geophysics signatures. Three targets; Anomaly 4 (Eckerts), Anomaly 6 and Anomaly 19, were chosen for drill-testing.

MLEM - A Sirotem Mark II instrument was used to acquire the data. The moving loops were 200 x 200 m. Moving loop stations were at 100 m intervals on east-west lines 200 m apart. 21.5 line km of moving loop were acquired.

FLEM - from the five MLEM areas surveyed, three (Anomalies 4 (Eckerts), 6 and 19) were deemed worthy of fixed loop follow-up, which totaled approximately 6.1 line km. Each of the three fixed loops was 600 x 300 m with stations at 50 m intervals, also on east-west lines 200m apart.

The 2007 MLEM/FLEM surveys over Eckerts were not centered over the conductive body identified in the 2002 TEMPEST survey which was the stated intention of the surveys but over the apparent fold closure as defined in the aeromagnetics. The magnetic intensity of the apparent limbs is asymmetric, with the eastern “limb” having a higher magnetic intensity. The MLEM/FLEM survey coverage over the eastern “limb” was only partial.

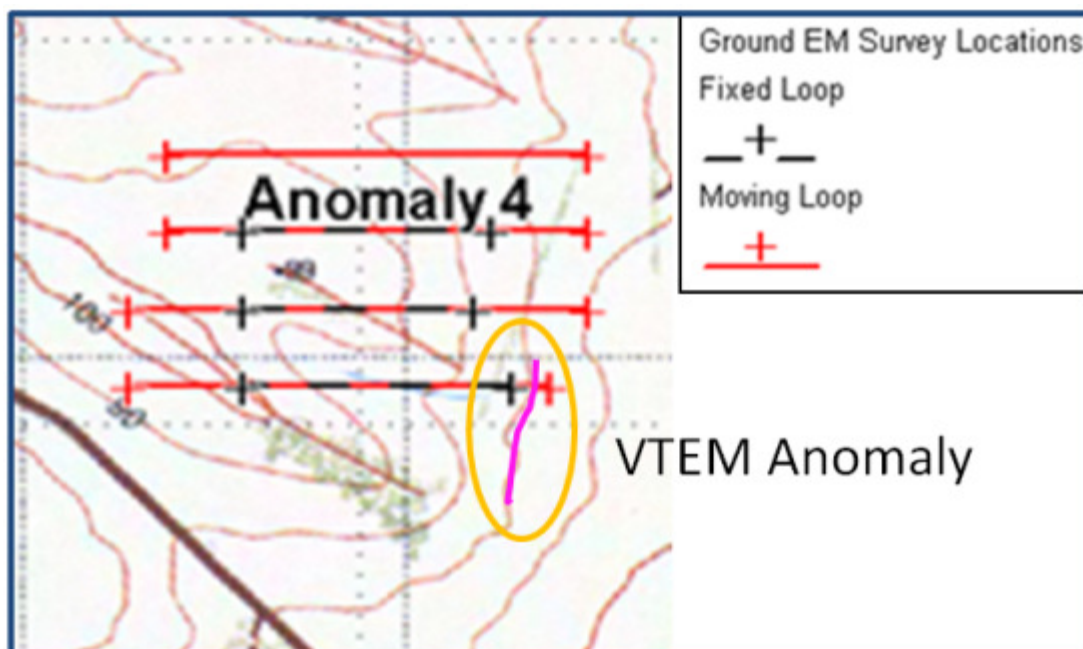


Figure 14: Location of the MLEM and FLEM surveys in relation to the defined VTEM anomaly

The 2010 VTEM survey also covered the Eckert area and a “priority 1” VTEM conductor was identified in the modelling undertaken by David McInnes in 2012, shown in Figure 15 with Figure 16 showing the profile data for line 70115, (6,101,100N).

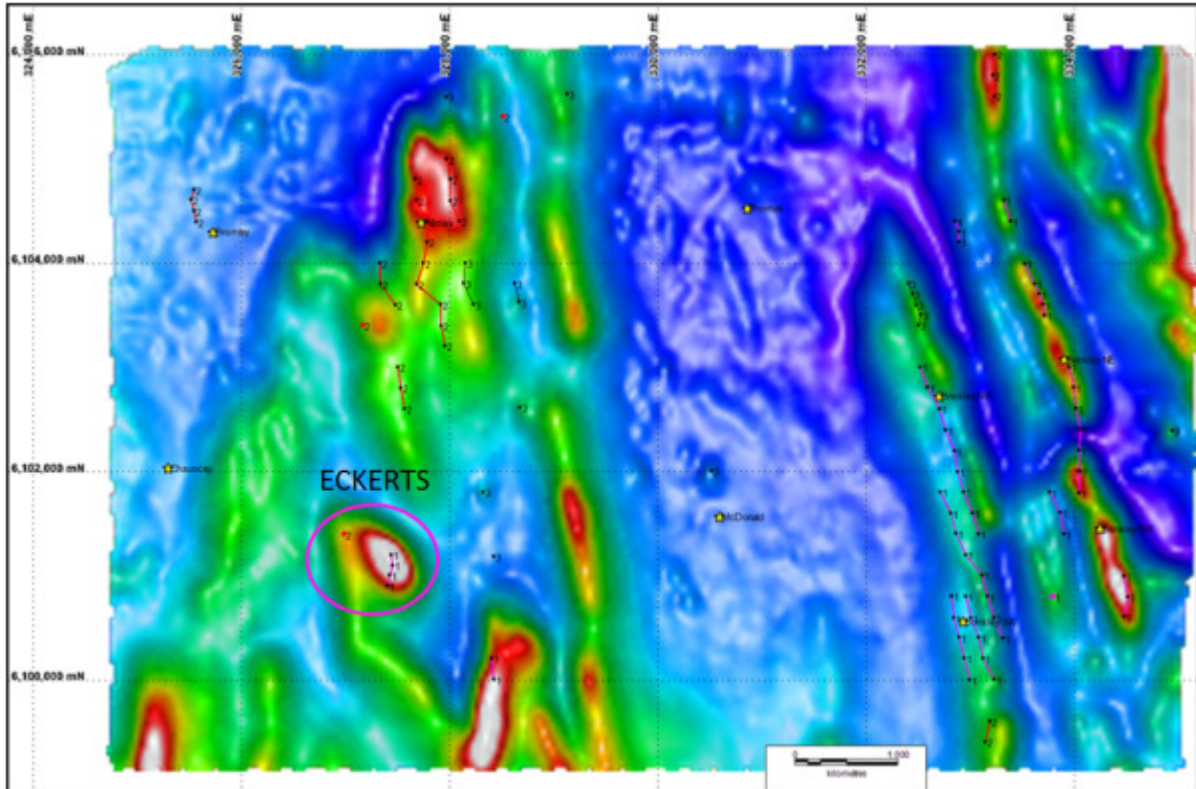


Figure 15: Trends of conductor anomalies in the Bromley-Brinkley area labeled with their priority (1-3) and overlain on the magnetic image (RTP) derived from the VTEM survey.

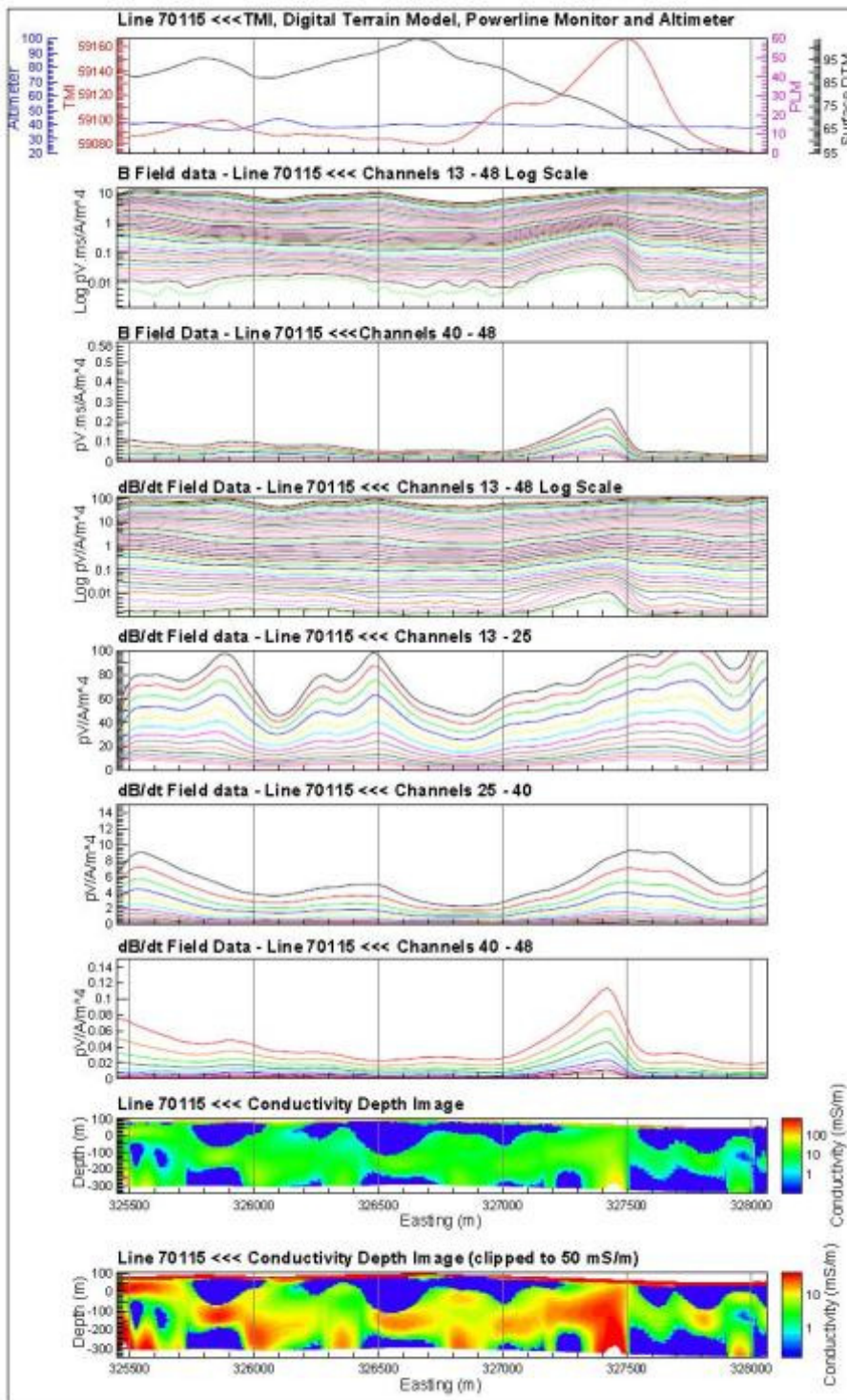


Figure 16: VTEM profile 70115

### 7.3.2. Previous Drilling

Hole KR9204 drilled by BHP in 1992 was targeted at was interpreted to be a “folded linear magnetic units on the western limb of a major syncline east of the Kanmantoo Fault” (EL1733 – Quarterly Report – to 15 July 1992, page 7). The drillhole was to be sighted based on two ground-magnetic traverses that formed an essentially north-south (023), east-west cross (113) shown on Figure 17 but the east-west line was considered to have been collected along strike and not modelled. The hole intersected multiple broad zones of lead + zinc mineralization detailed in Table 5.

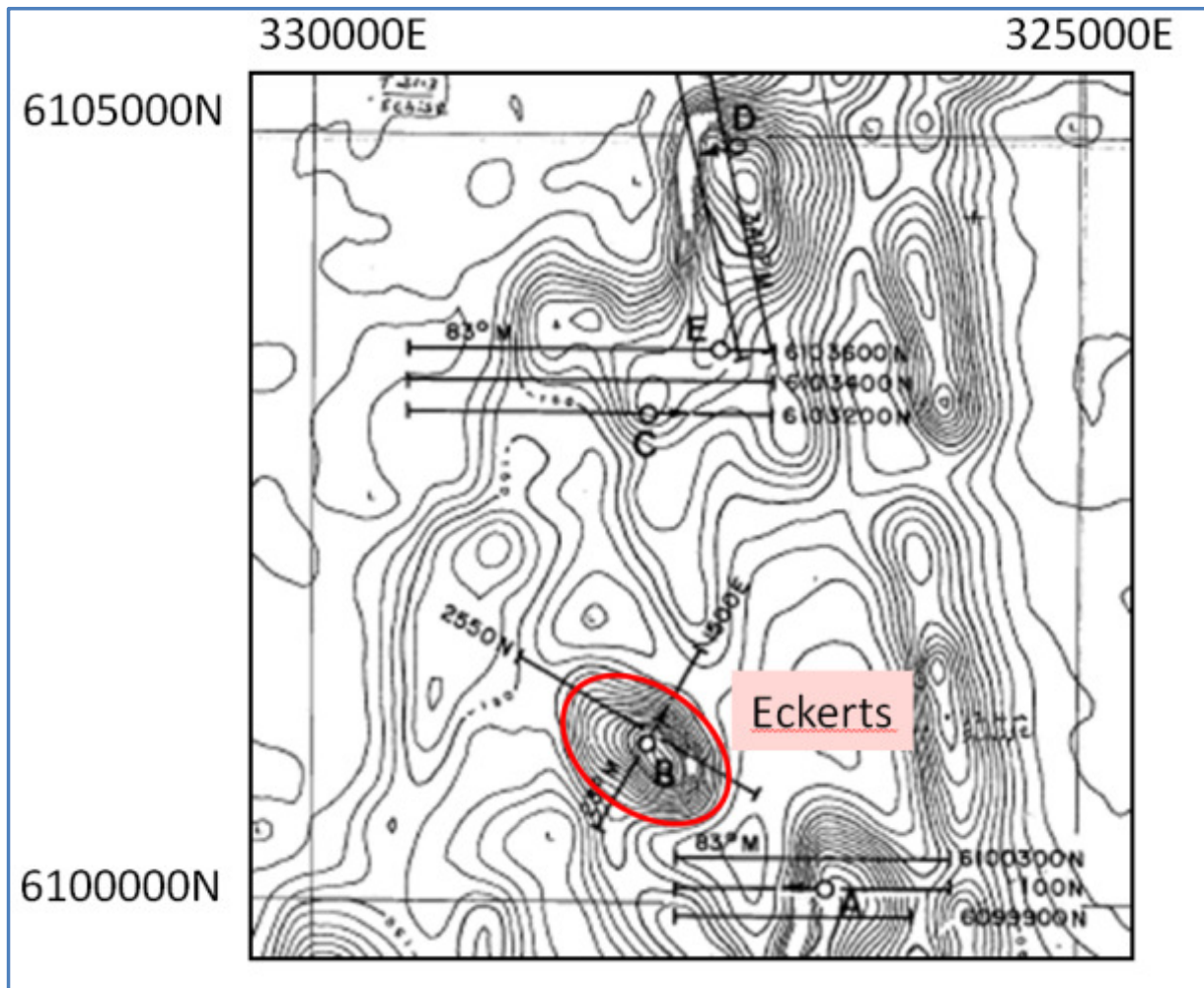


Figure 17: Ground magnetic survey with proposed holes (BHP EL1733-Quarterly Report – to 15 January 1992) with magnetic contours from CRA’s 1982 survey.

KR9204	100-104	4m @	480(590)	1680(2000)	1(2)
	128-136	8m @	310(370)	1080(1280)	2(2)
	162-168	6m @	335(430)	1880(2000)	2(2)
	174-178	4m @	270(280)	1055(1150)	2(2)

Table 5: Summary intersections for KR9204.

From the 1982, 2002 and 2010 magnetic data sets it can be seen that the ground magnetic data was collected to the north of the magnetic anomaly’s peak.

As part of the compensation to the landowners for the work undertaken on their land in 2007 a hole was drilled in the attempt to establish a waterbore. The RC drillhole HHWB001 was completed to a

depth of 180m. Sample return was poor with the return of drill cuttings inconsistent. From 138m the hole returned 12m @ 0.132% Zn 0.027% Pb and 0.015% Cu. There was no sample from 150 to 156m.

### 7.3.3. Data Review

Terramin's 2007 drillhole HHDD001 was drilled to the north of the magnetic in Figure 18 which shows 3D magnetic shell is coloured by RL. Figure 18 also highlights that the magnetic body plugs to the north beneath KR9204. BHP's drillhole KR9204 is also located to the north of the main VTEM conductor shown as a pink line.

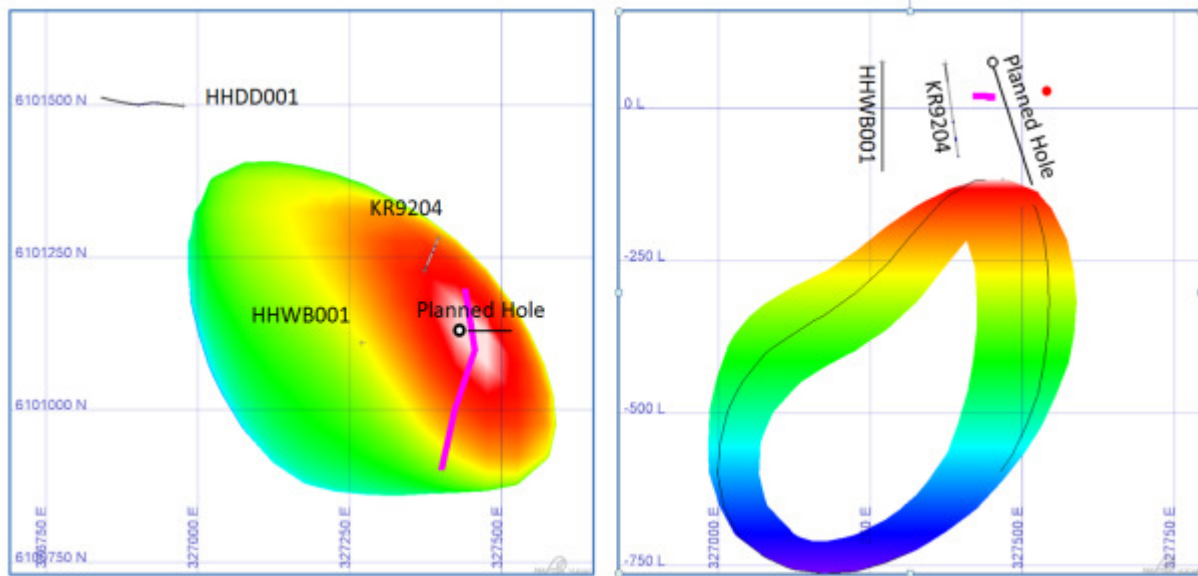


Figure 18: Location of drilling in relation to magnetic body.

Drillholes in the Eckert area are shown on Figure 19 with the MLEM survey's data collection points shown as black dots, of Channel 12 from the MLEM colour stretch, grey scale aeromagnetics from the 2002 TEMPEST survey with the magnetic ridges highlighted in red. Also shown are the VTEM profiles (dBdt channels 45-48) and the interpreted VTEM conductor.

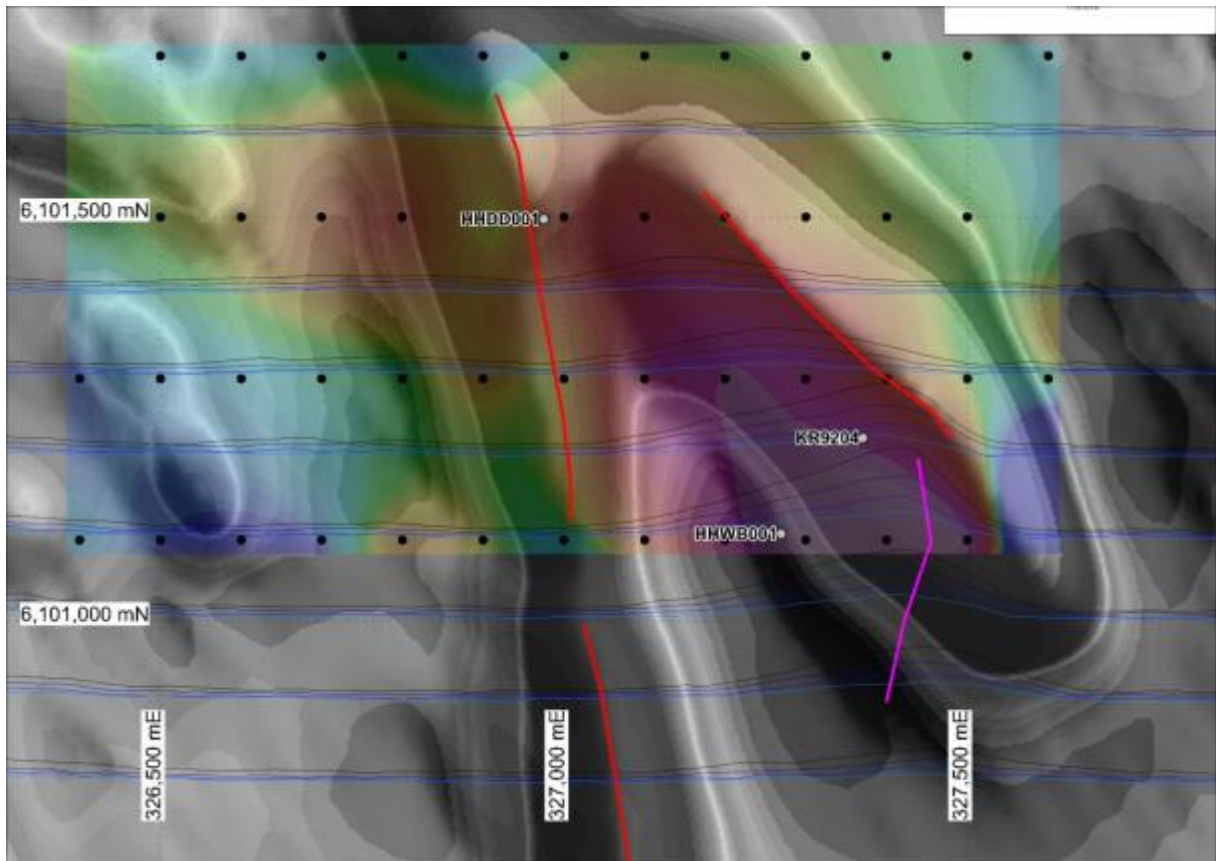


Figure 19: Location of drillholes on composited geophysical datasets

## **7.4. Anomaly 19 (Lead Zinc)**

The massive sulphides at Angas are hosted by a garnet bearing quartz-rich siltstone/quartzite rock that carries significant iron sulphides as pyrrhotite and pyrite. In 2007 modelling and interpretation of the 2002 TEMPEST airborne geophysics data set collected by the National Action Plan for Salinity, the Bureau of Rural Sciences (BRS) identified a number of areas with Angas-like signatures within Terramin's ELs. One of these areas was at Harriot Hill, where the prospective Kanmantoo Group rocks are obscured by Tertiary and Quaternary cover (Figure 20: Harriot Hill area—Airborne EM, X-component, 150 m depth slice; anomalies 3, 4, 6, 8 and 19 shown).

Ground geophysical surveys (moving and fixed loop EM) in 2007 were undertaken over several prospect areas to better-defined the airborne geophysics signatures. Three targets; Anomaly 4, Anomaly 6 and Anomaly 19, were chosen for drill-testing.

Three diamond holes (888.7 m) were drilled to test geophysical targets. These holes were supported by a PACE grant. Two water bores (180 m each) were also drilled in an attempt to find water for the diamond drilling. Down-hole electro-magnetic (DHEM) geophysics surveys were undertaken on each of the three diamond holes at Harriot Hill, and the two water bores.

### **7.4.1. Geophysics – Pre 2010 VTEM**

In 2007 a MLEM survey was undertaken using a Sirotem Mark II instrument. The moving loops were 200 x 200 m. with the moving loop stations at 100 m intervals on east-west lines 200 m apart. A total of 21.5 line kilometres of moving loop were acquired.

From the five MLEM areas surveyed, three (Anomalies 4, 6 and 19) were deemed worthy of fixed loop follow-up, which totalled approximately 6.1 line km. Each of the three fixed loops was 600 x 300 m with stations at 50 m intervals, also on east-west lines 200 m apart.

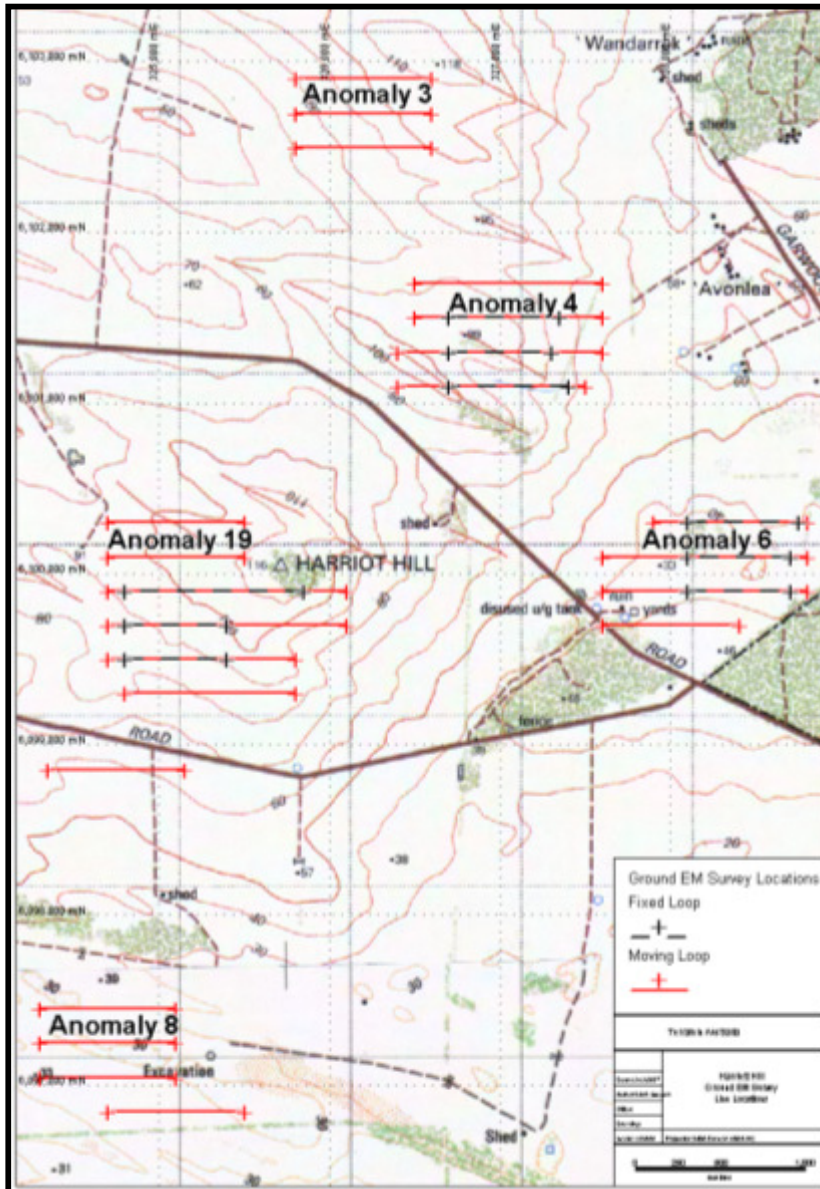


Figure 20: Harriot Hill area—Airborne EM, X-component, 150 m depth slice; anomalies 3, 4, 6, 8 and 19 shown

Anomaly 19--the MLEM/FLEM survey outlined two conductive responses within the broader airborne anomaly. Both responses were initially modelled as reflecting east-dipping conductors. The geophysicist rated highly the eastern response (on the eastern end of line 6099900N), which was interpreted to be relatively shallow. (Subsequently, oriented core from HHDD-003 indicated that the units dip  $\sim 50^\circ$  westwards.) Following the drilling the geophysicist re-modelled the data with a low-angle, westerly dip (Figure 21). Note that FLEM line modelled in Figure 21 was located at 6099900N, well north of the western conductive body identified from the MLEM survey.

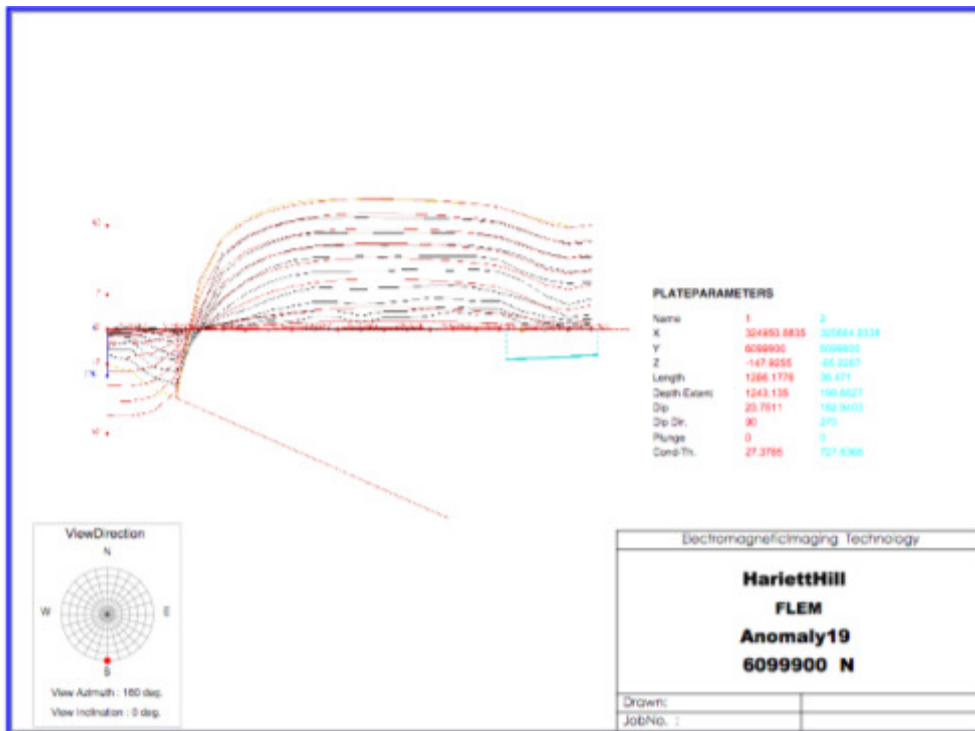


Figure 21: Harriet Hill Anomaly 19 — geophysical modelling FLEM showing an easterly dipping conductor (above) and a westerly dipping conductor (below)

DHEM confirmed the presence of a gently west-dipping conductor. A weak in-hole response was detected by the DHEM at about 130 m. No strong off-hole component is evident, indicating that the hole intersected near the centre of the anomaly.

A stronger DHEM response was intersected at 250 m. This coincides with the lower pyrite-pyrrhotite matrix breccia. An off-hole component is associated with this intersection, indicating conductive sulphides extend away from the drill hole.

Modelling for shallow-dipping conductors gave a poor correlation between the profiles modelled for shallow-dipping conductors and the observed profiles.

Figure 22 and Figure 23 are models created for two conductors, one moderately dipping to the east, the other dipping steeply northwards. The correlation between observed and modelled profiles is shown in Figure 24.

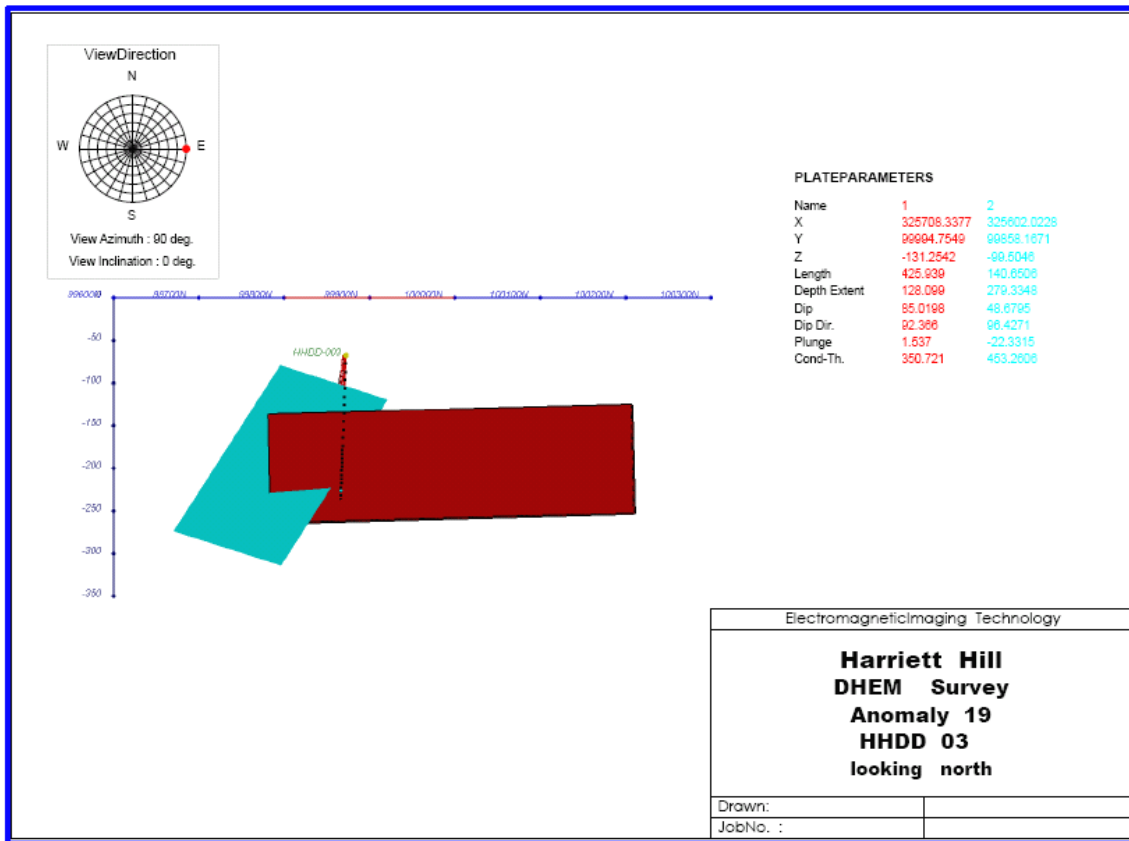


Figure 22: HHDD-003 – modelled conductors, looking west

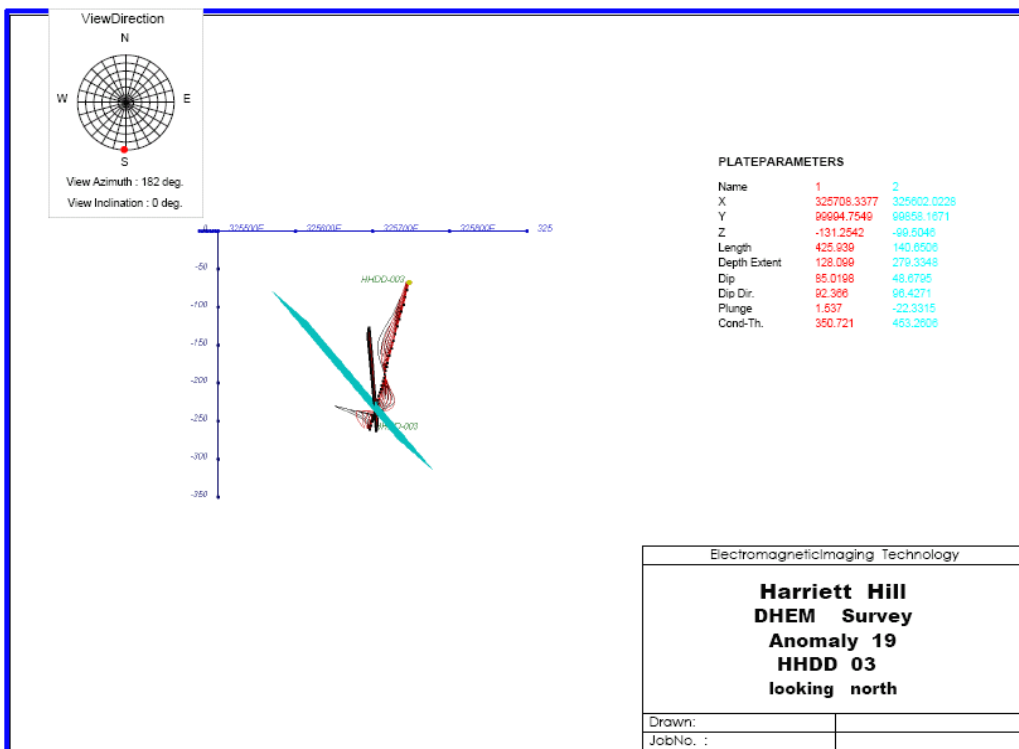


Figure 23: HHDD-003 – modelled conductors, looking north

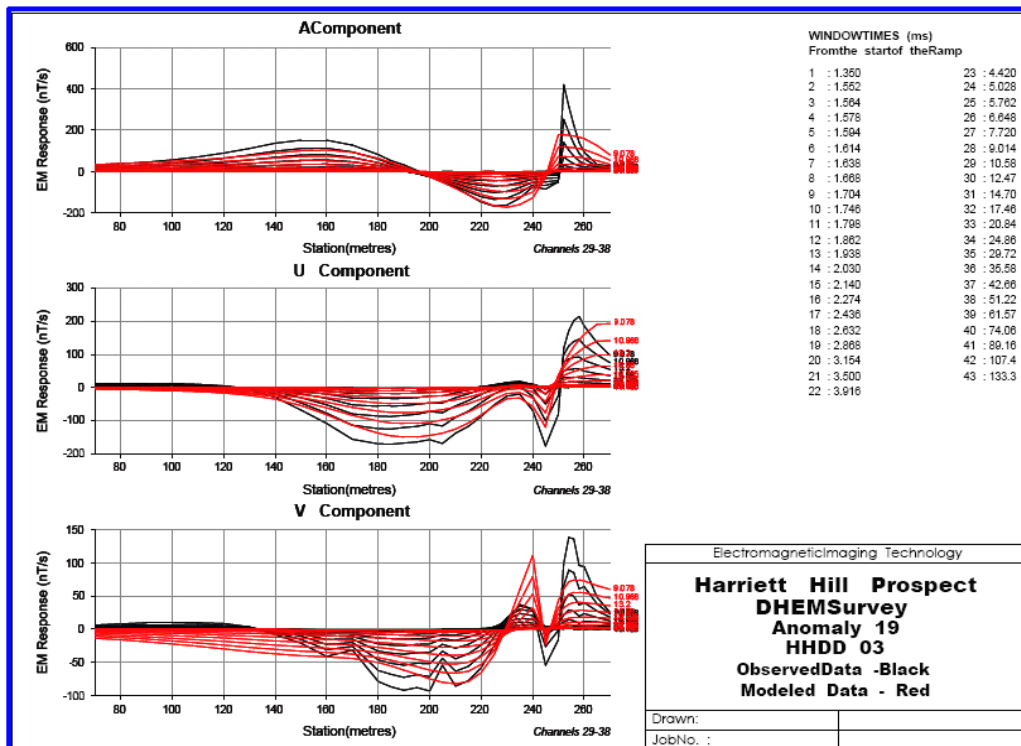


Figure 24: HHDD-003 – comparison between the observed data and a model suggesting relatively steep-dipping conductors

#### 7.4.2. Terramin Drilling

On the advice of the geophysicist the shallow-dipping MLEM/FLEM conductor on the east side of Anomaly 19 was tested by HHDD-003.

The hole intersected a pyritic fine-grained metasediment with 10-15% pyrite at 84–94 m down hole. The hole also intersected half metre breccia intercepts with up to 15% sulphidic matrices including pyrite, pyrrhotite and perhaps 2% sphalerite and galena at 144–144.5 m and 247.5–248 m. The lower breccia is underlain by muscovite-pyrite-pyrrhotite schist.

Hole ID	from (m)	to (m)	intercept (m)	Zn (%)	Pb (%)	Cu (%)
HHDD-003	88.3	89.1	0.8	0.1262	0.0312	0.0046

Table 6: Anomaly 19 – best drilling results

#### 7.4.3. Drilling pre-Terramin

In 1992 BHP targeted drillhole KR9207 on “a linear magnetic feature within a fault controlled block SW of the Kanmantoo Fault” (EL1733 – Quarterly Report – to 15 July 1992, page 9). The hole intersected multiple broad zones of lead + zinc mineralization (from 116m, 4m @ 0.30% Pb + Zn and from 164m, 12m 0.21% Pb + Zn).

#### 7.4.4. Data Review

The FLEM survey identified two conductive bodies 500m apart with the eastern body tested by drillhole HHDD003 which only intersecting weak base metal mineralisation.

Hole KR9207 drilled by BHP was drilled 500m south of the western MLEM anomaly but still on the same magnetic linear associated with the MLEM anomaly, shown on Figure 25. Despite the MLEM response being much weaker in the vicinity of KR9207 the mineralized widths and grades intersected by the hole were significantly higher than those seen in HHDD003. This suggests that the western conductive body is more enriched with base metals than the eastern conductive body.

From the RTP Tilt aeromagnetic image (2010 VTEM dataset) shown in Figure 25 it can be seen that the MLEM anomaly also coincides with a Y structure or splay off of the main magnetic linear. Throughout the Fleurieu the convergence of structures is seen as an important feature for fluid pathways and dilatational openings for mineral precipitation.

The modelled location of the conductive body is around 80m west of the magnetic body as seen in Figure 25. This could be that the magnetic minerals are located in the hanging-wall of the conductive body and/or that magnetic signature is sourced deeper and/or one of the geophysical datasets is incorrectly geo-spatially located.

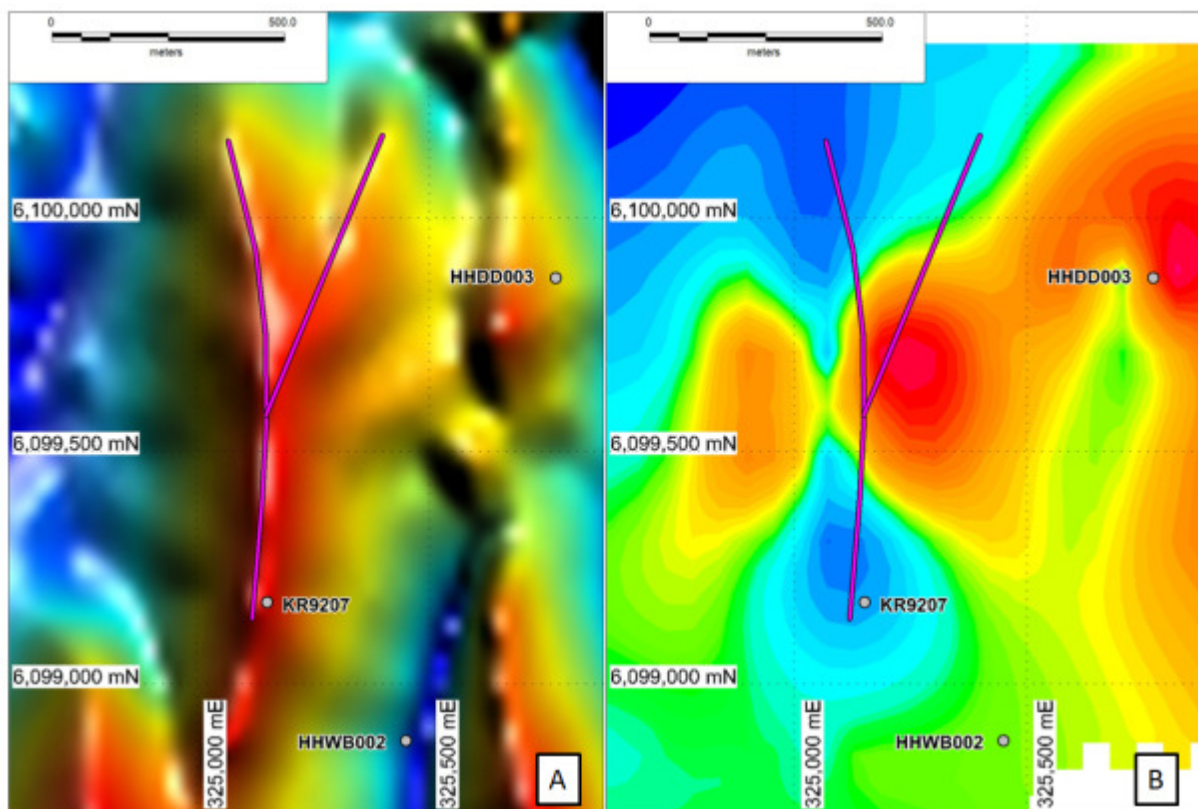


Figure 25: A – RTP Tilt aeromagnetic image from the 2010 VTEM survey and B – channel 12 from the 2007 MLEM survey. Both geophysical images show drillholes and Y structure.

## 7.5. Pearson (Copper)

The Pearson Prospect is slightly different in style of mineralization from that at Brinkley. PD84MI6 drilled by CRA in 1984 targeted a poorly modelled ground magnetic anomaly intersected from 52m, 4m @ 0.23% Cu. Modelling of the aeromagnetics data from the 2010 VTEM survey shows a discrete magnetic body to the south, discordant to bedding and coincident with a gravity high identified from the 1993 BHP gravity survey.

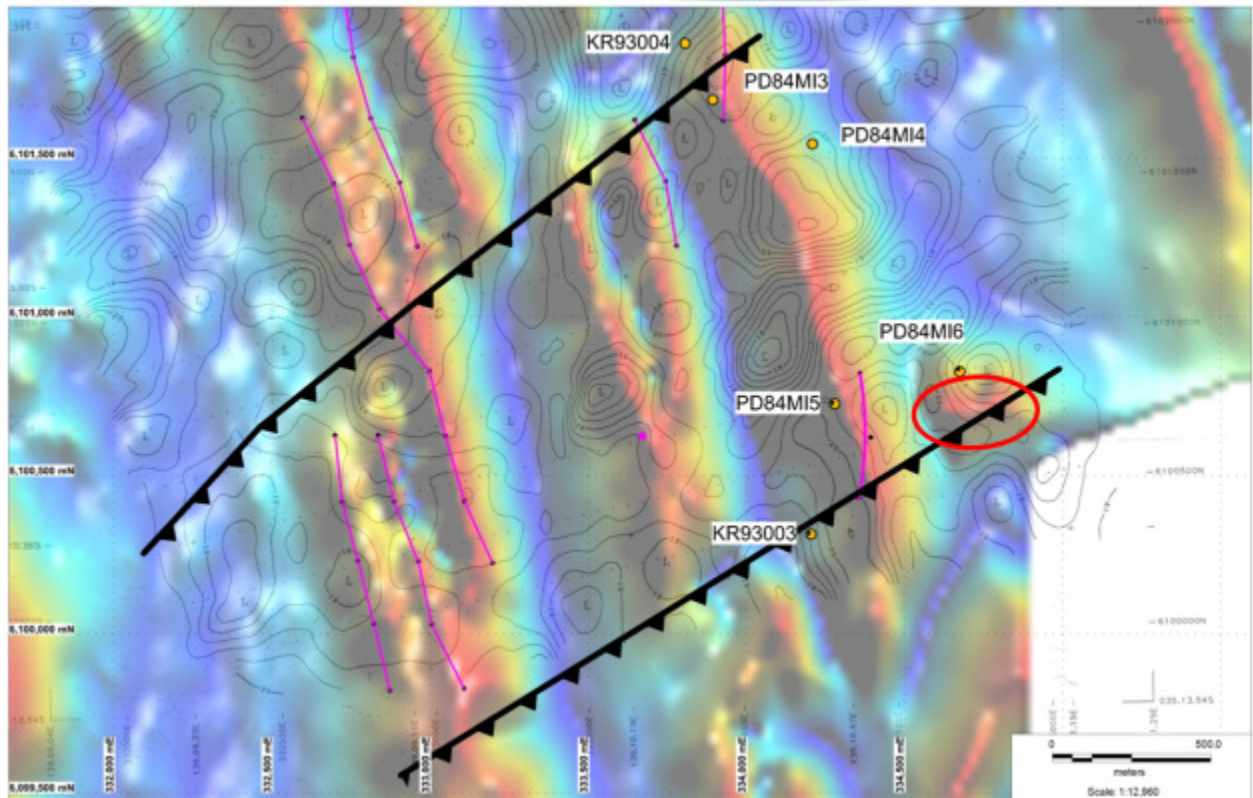


Figure 26: Pearson Copper Prospect circled in red on RTP TILT aeromagnetic image overlain with gravity contours, VTEM conductors (pink lines)

The Brinkley and Pearson prospects are likely to be worked contemporaneously as a single project.

### 7.5.1. Proposed Exploration

Proposed fieldwork includes an IP line over the Pearson prospect to assist targeting drilling. The Brinkley anomalies require no further geophysics to assist drill targeting.

A single drillhole is proposed for Pearson and four additional holes are proposed to test the Brinkley EM/gravity anomalies.

## 7.6. Mondara (Copper, lead zinc)

Mondara is an aerial magnetic anomaly located within the Ferries-McDonald Conservation Park. Mondara has a similar appearance in aerial magnetics to Anomaly 19 and Pearsons. A NE orientated magnetic body, discordant to bedding coming off a NNW orientated (bedding) magnetic body is similar to Terramin’s Angas and Sunter lead zinc deposits.

Ferries McDonald Conservation Park which was excluded from EL 5784 covers an area of 845 hectares and provides a habitat for a range of native and endangered species including the malleefowl.

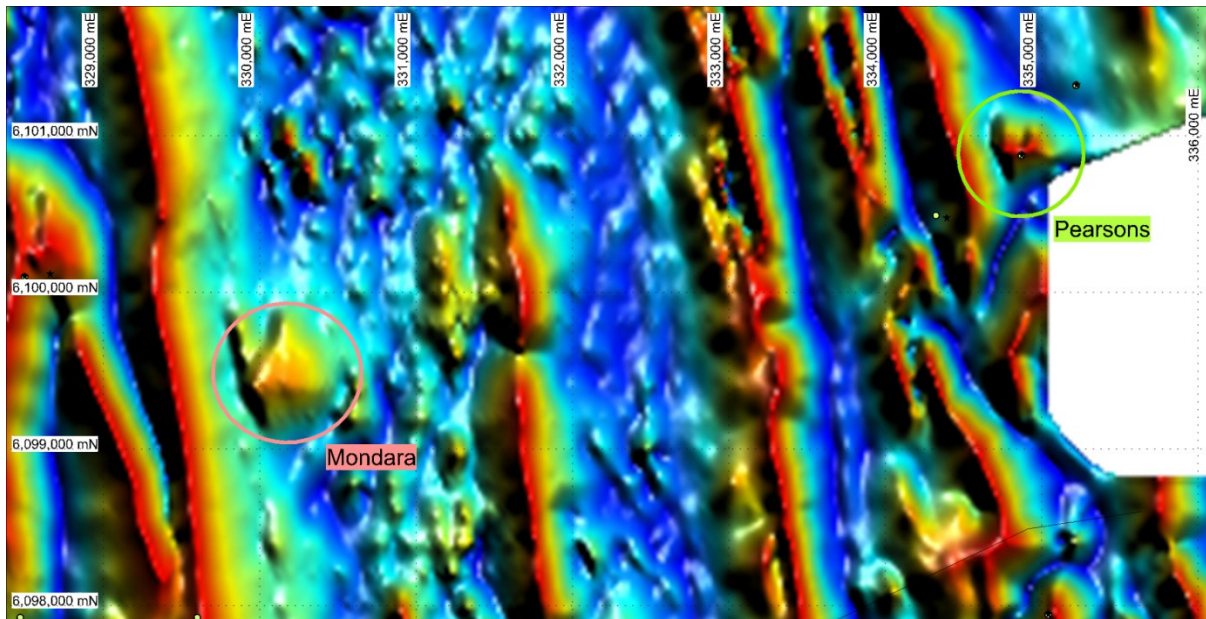


Figure 27: Mondara geophysical anomaly and Pearsons prospect shown on RTP TILT aeromagnetic image.

## 7.7. Icon (Copper)

Icon is defined from aerial magnetics as a broad magnetic high to the west and adjacent to the Bremer Fault as seen in **Error! Reference source not found.** Conductivity contours from the VTEM show a good correlation with a linear magnetic high apparent in RTP TILT aeromagnetic image, figure. The strike of the distinct 1.5km linear feature is discordant to bedding.

Copper analysis of the Tertiary sediments from CRA hole 80HRM12 returned 22m of +100ppm Cu with a maximum value of 300ppm Cu. Typical copper values in the limestone are in the range of 2 to 20ppm which suggests the copper enrichment seen in 80HRM12 is the result of hydromorphic remobilization of copper from a bedrock source.

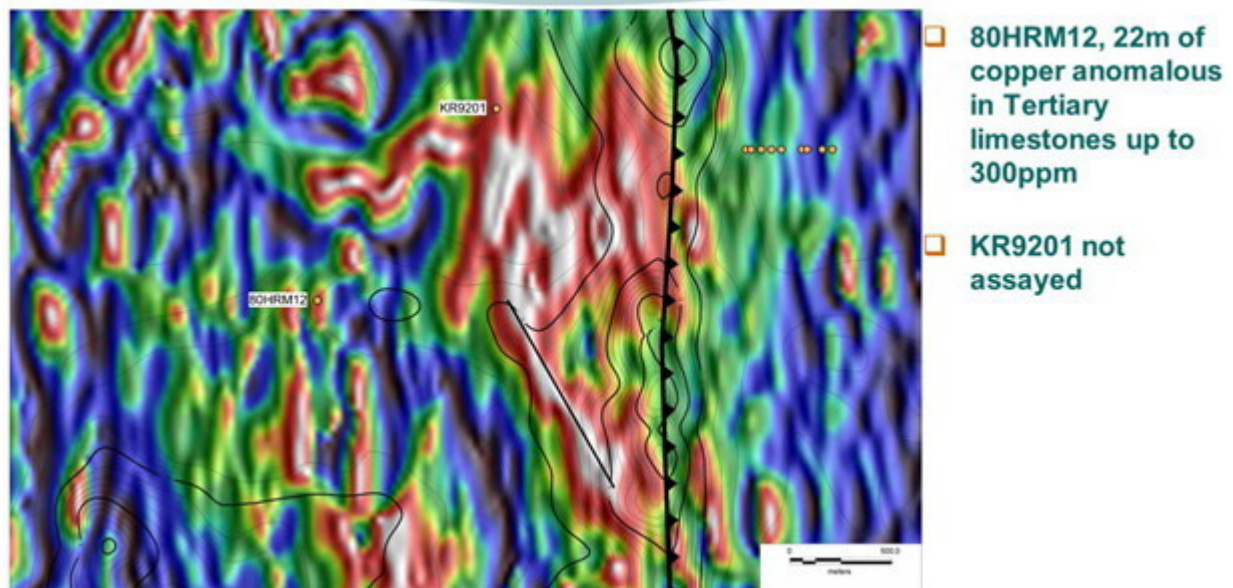


Figure 28: Conductivity contours from the VTEM show a good correlation with a linear magnetic high within the broader magnetic feature (RTP TILT)

### 7.7.1. Proposed Exploration

Single line of IP over linear magnetic and conductive feature to assist in targeting drillhole.

Single diamond drillhole to test magnetic/IP feature with possible downhole EM survey of at least one hole.



## 7.8. Copper No.84 (DMITRE Site No 239817, Deposit Number 1671)

DMITRE added a new mineral occurrence to “SA Geodata Database - Mineral Deposit Details “Copper No.84” also recorded as “Site number” 239817 and “Deposit Number” 1671.

Copper No.84 was located by DMITRE from an archived, hard copy mineral occurrences (MEIS) 250K map sheet, where it was marked as copper show in the Carrickalinga Head Formation. Ore mineral is recorded as malachite and gangue as quartz. No other geological details supplied.

The occurrence is located 200m east of the Monarto Rifle Range and 200m south of the South Eastern Freeway.

Historical drilling in the area is concentrated along the road is made up of a combination of drilling for mineral sands (Sandhurst Mining NL – 70753 and BHP Minerals Exploration 147275 and 147276), SADME stratigraphic holes (70697- 70699 and 70702), engineering drilling for the freeway and a water bore (70760).

The majority of the drill holes in the area have not penetrated the Tertiary sands that cover the Cambrian basement. The deeper holes in the area have intersected basement in the range of 15 to 20 metres.

A regional soil survey was undertaken by the then Department of Mines, South Australia in the mid 1970’s. Copper values from the survey are reported on the maps as 8ppm, the apparent detection limit for the assay technique used.



Figure 29 : Location of historic drill collars proximal to Copper No. 84 on aerial photograph.

Hole Number	Hole Name	Easting	Northing	Max Depth	Cover Depth (m)
70497		333081	6109281	6.2	
70498		333606	6109471	6.2	
70554		332087	6109488	6.2	
70555		332663	6109271	6.25	
70570		333588	6109743	6	
70571		332853	6109747	7	
70697	MS14	333687	6109520	12	
70698	MS15	332858	6109127	20	+20
70699	MS16	332613	6109836	20.1	
70702	MS19	331942	6109492	19.8	17.7
70742		331546	6109551	1.04	
70743		331974	6109441	1.33	
70744		332340	6109407	1.19	
70745		332814	6109302	1.37	
70746		333254	6109154	1.14	
70753	H5	331906	6109449	10.43	
70760	MCH 1	331652	6109578	40	28
147275	MB 22	332901	6109328	15	
147276	MB 23	331941	6109568	18	16

Table 7: Summary of existing drillholes proximal to Copper No. 84.



Figure 30 : Location of historic surface samples collected proximal to Copper No. 84 on aerial photograph.

### 7.9. Fenceline

The exception were soil samples from the two middle east-west traverses collected from the Fence Line Prospect which were sent to Genalysis for analysis by mini BLEG to determine if low level gold and copper anomalies could be detected that correlated with the low level arsenic anomalism indicated by the HHXRF (Figure 31).

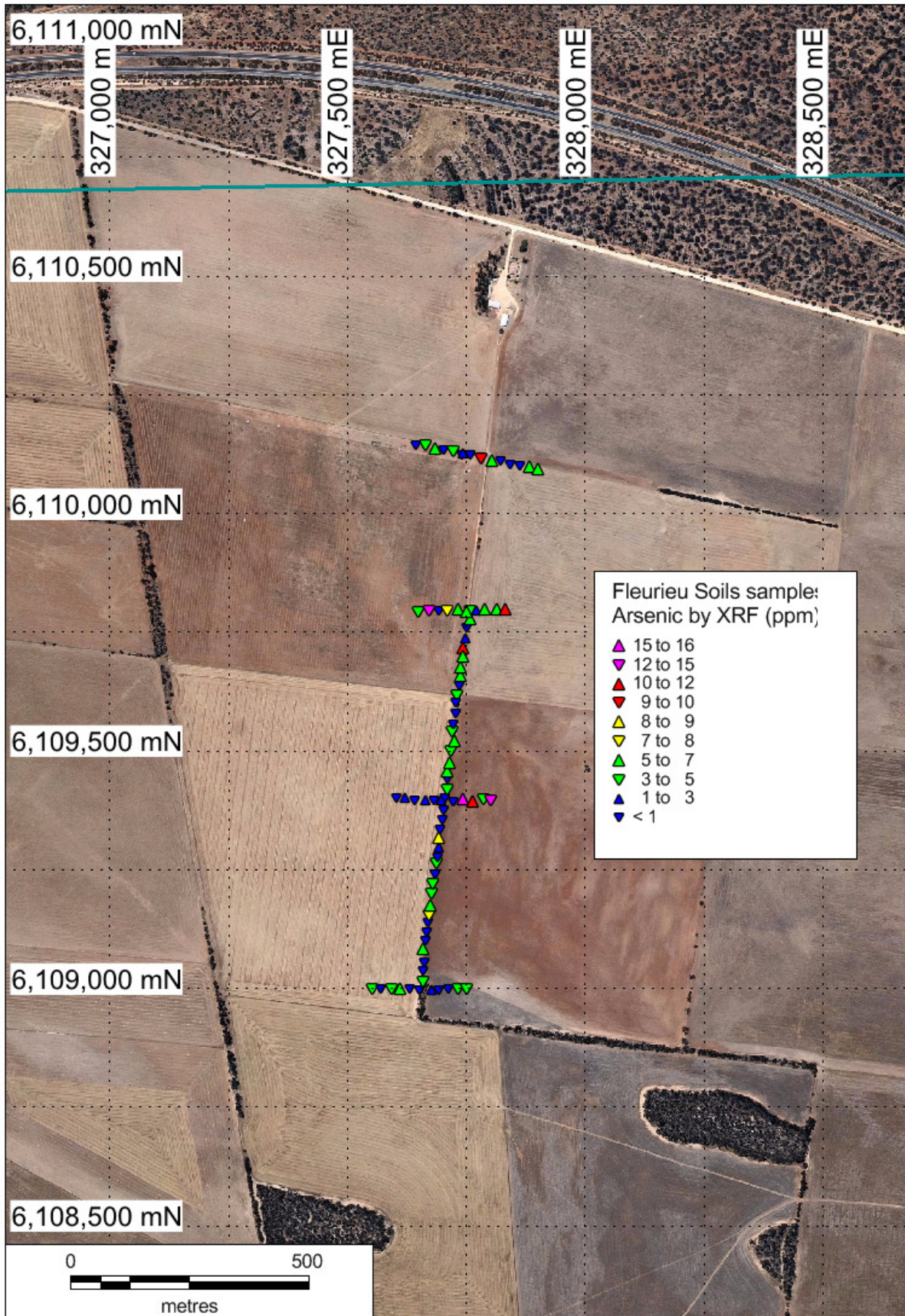


Figure 31: Fenceline, arsenic in soil assays by HHXRF

## 7.10. Fleurieu Heavy Mineral Sand Potential

BHP Minerals Limited (BHP) was granted EL1733 in 1991 which in part covers Terramin's current tenements. BHP considered the area prospective for rutile and other economic minerals shed from metamorphosed Kanmantoo Group of the Mt Lofty Ranges and deposited in Loxton – Parilla Sand at the western margin of the Murray Basin.

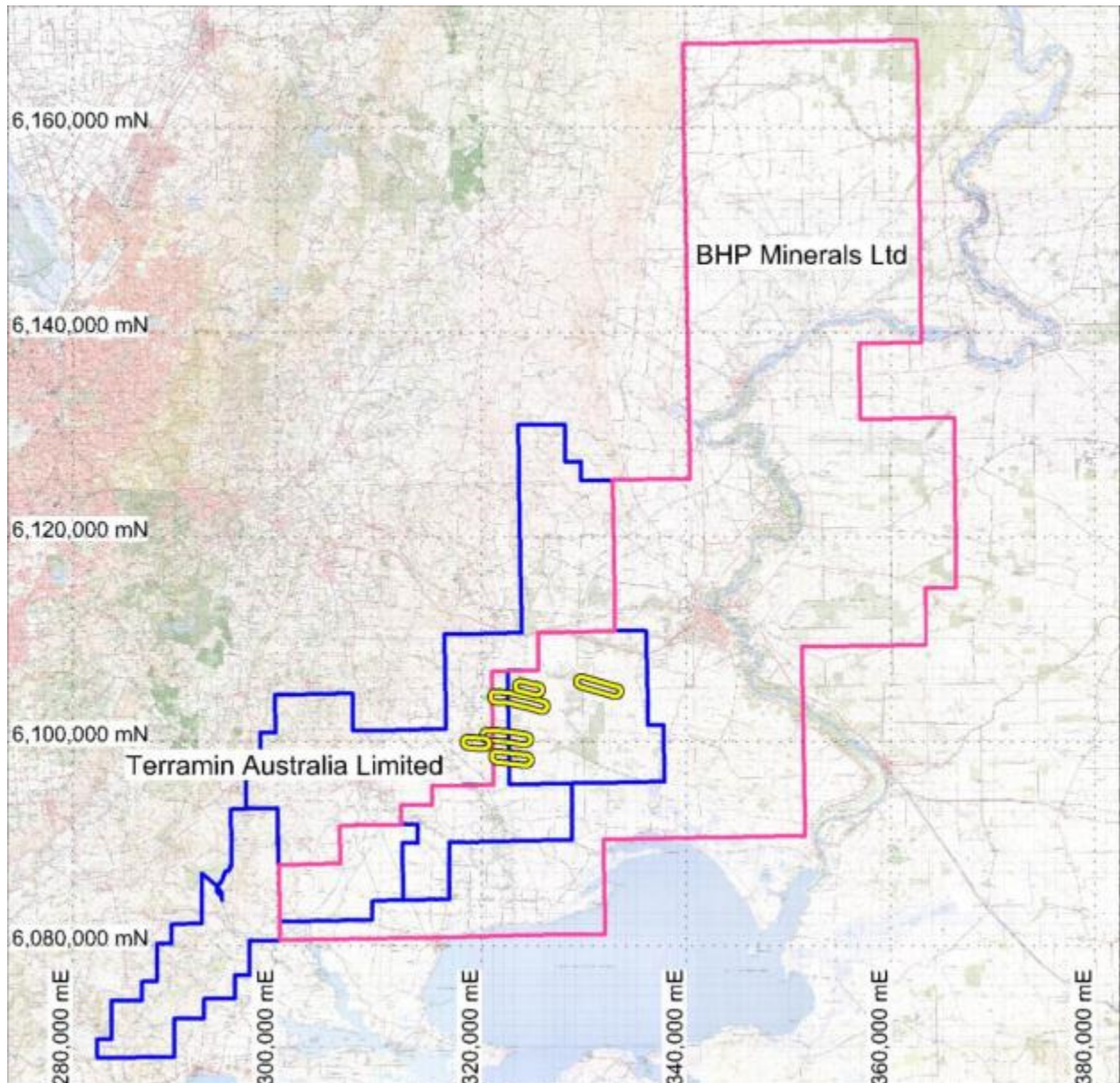


Figure 32: Terramin's tenement (blue) in relation to BHP's EL1733 (pink)

Initial work undertaken by BHP involved heavy mineral analysis and mineralogy of material held by DMITRE which including CRA's 1980's drilling of the Bremer Basin. Total heavy mineral values were relatively low, but rutile values of up to 19% and leucoxene values up to 47% of heavy minerals gave encouragement for BHP to proceed.

Mineral sand exploration by BHP continued until 1993 during which time they completed 110 RC drillholes specifically for mineral sands from which 795 samples were analysed. Additional samples came from BHP's base metal exploration drilling and from DMITRES core library. Mineralogy was carried out on a total of 31 composites with best results from an area of 6x6 km<sup>2</sup> with up to 13%

rutile and 14% zircon in the heavy mineral fraction. However, the best total heavy mineral values were only in the range of 0.3-0.5%.

Heavy mineral exploration is currently being undertaken in the Murray Basin by Iluka Resources, the world's largest producer of zircon and Murray Zircon. Murray Zircon is also the holder of several mining leases previously operated by Australian Zircon and is currently in the process of

Iluka and Murray Zircon's tenements are shown in Figure 33 in relation to Terramin's tenements.

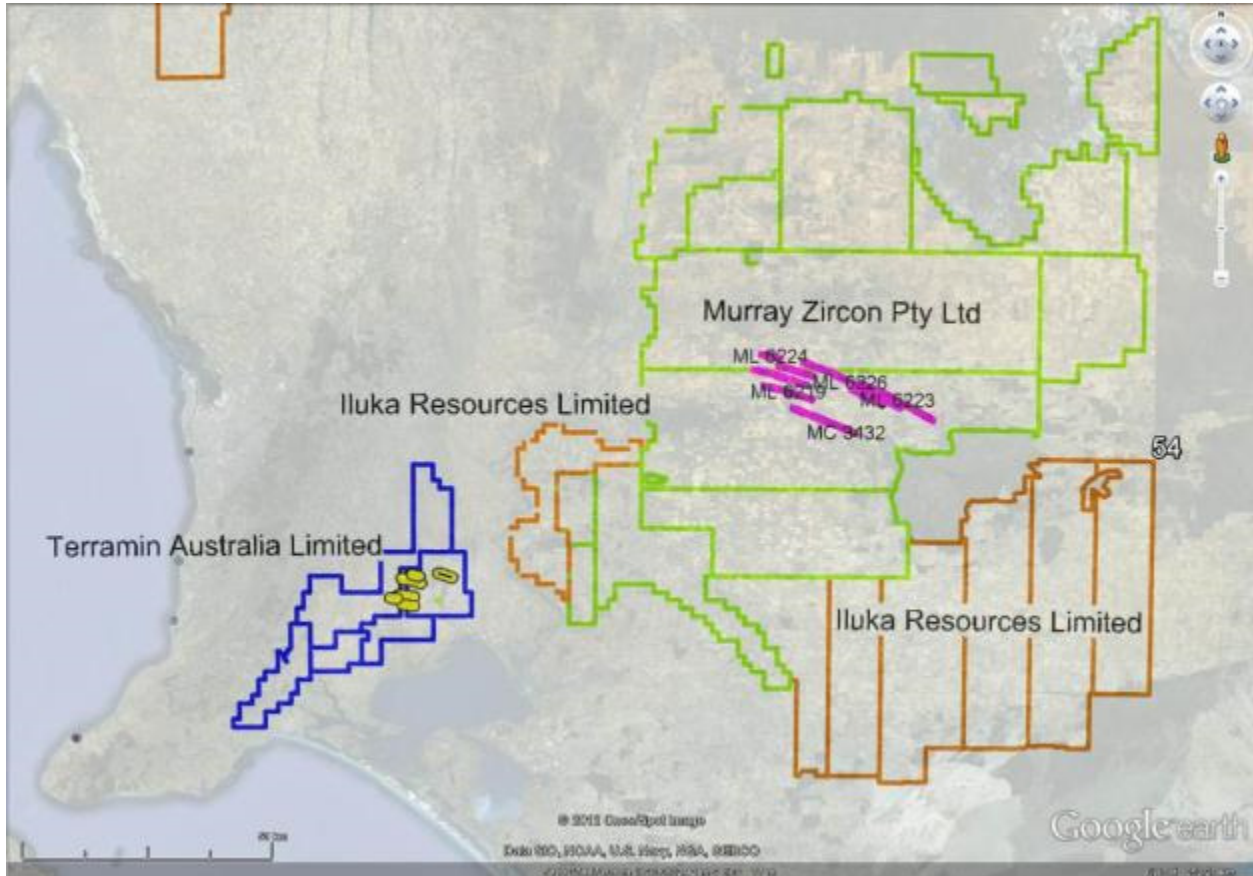


Figure 33: Terramin tenements (in blue) in relation to Iluka (orange) and Murray Zircon's (green) tenements.

### 7.10.1. Geophysics

Examination of the 2004 aerial magnetic survey from Bureau of Agriculture's TEMPEST survey several linear structures can be seen in Figure 34, where there is a low magnetic signature of the Cambrian basement. These linear features are aligned to the Tertiary sand dunes and are thought to potentially relate to ilmenite rich strandlines. Ilmenite is a weakly magnetic mineral, commonly associated with zircon deposits. Ilmenite is a titanium mineral but of little economic significance in comparison to zircon. Heavy mineral strandlines are not normally visible from aeromagnetic surveys except when the basement is magnetically very quiet.

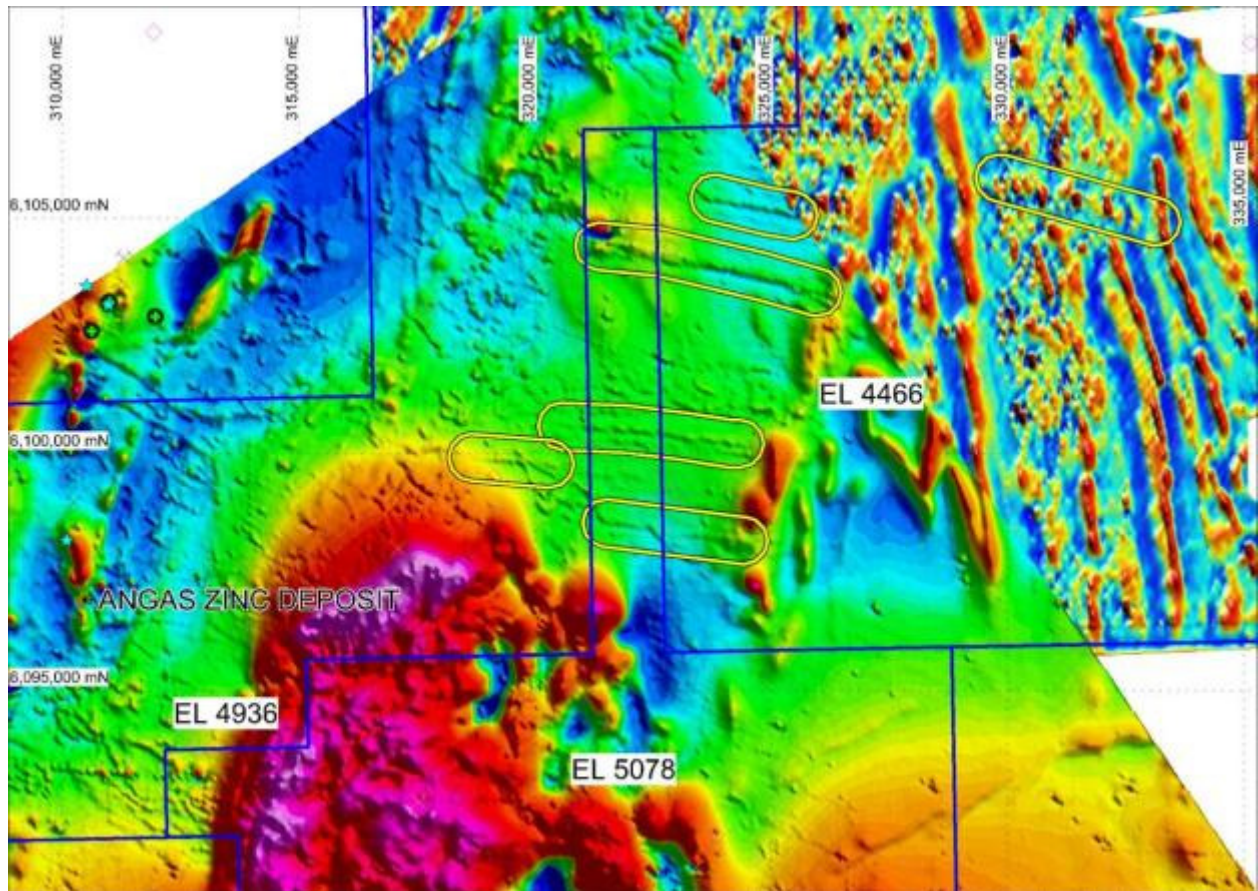


Figure 34: Magnetic linear features on RTP TMI aeromagnetic image

### 7.10.2. Topography Mineral Sand Strandlines-

From the publicly available aeromagnetic data magnetic linears are not apparent on Murray Zircons mining leases but that is largely due to the strong magnetic signature of the basement and the poor quality of the aeromagnetic survey. A correlation does exist between their mining leases and topography. Figure 35 shows how Murray Zircon's mining leases are aligned with sand dunes indicating that these were foredunes, coastal dunes that ran parallel to the Late Pleistocene - Holocene shoreline. The linear magnetic features on Terramin's tenements are also aligned to the dunes but located on the seaward (southern) side, Figure 36.

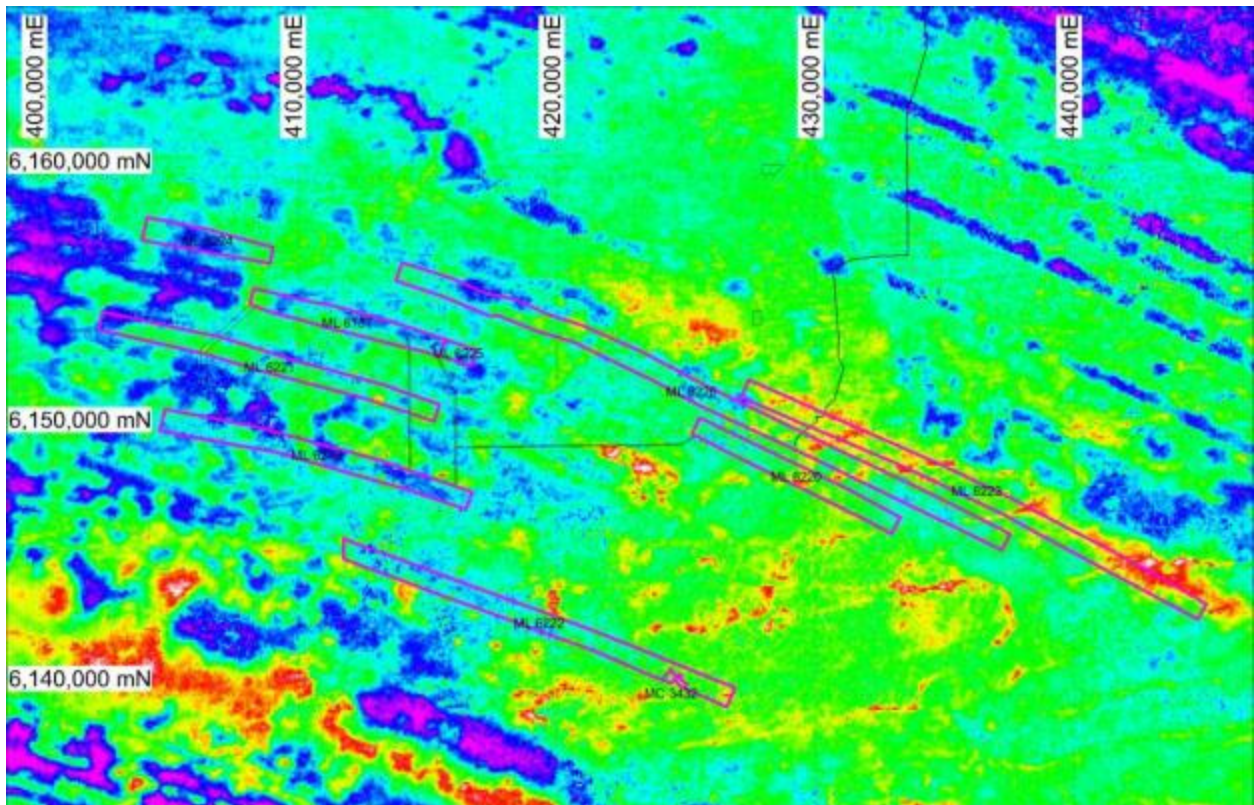


Figure 35: Murray Zircon's mining leases in relation to topography

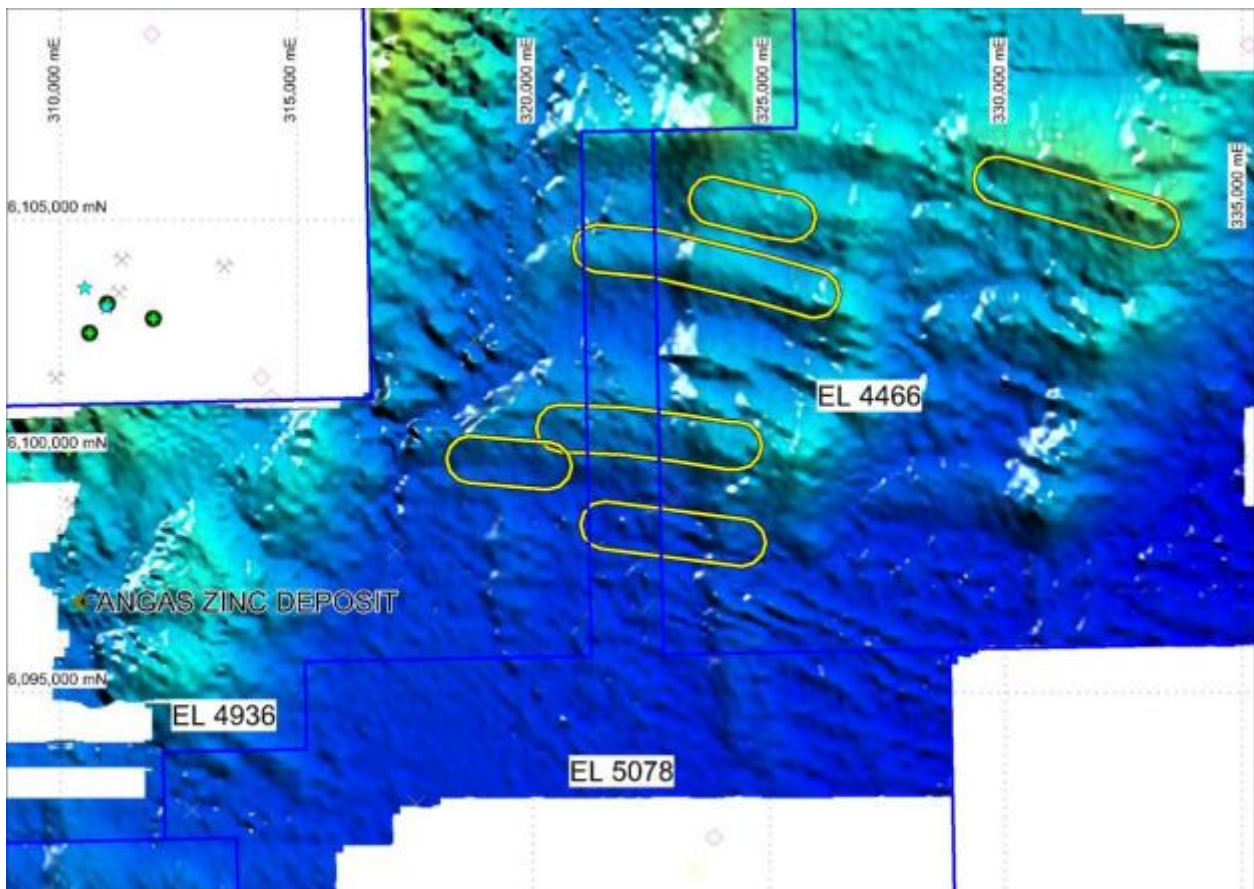


Figure 36: Location of magnetic anomalies shown on topography

The BHP mineral sand RC drilling program was undertaken along roads and typically at 1km spacing, Figure 37. No geophysics was used to aid in the targeting of the drilling. Typical width of Murray Zircon's mining leases is only 700 to 800m whereas lengths are typically in the order of 5 to 25km. From press releases by Murray Zircon the best strand lines have a maximum width of 200m, Figure 38, meaning that the at BHP had at best a 1 in 5 chance of intersecting a strandline. Figure 37 shows the position of BHP's drilling in relation to the linear magnetic features.

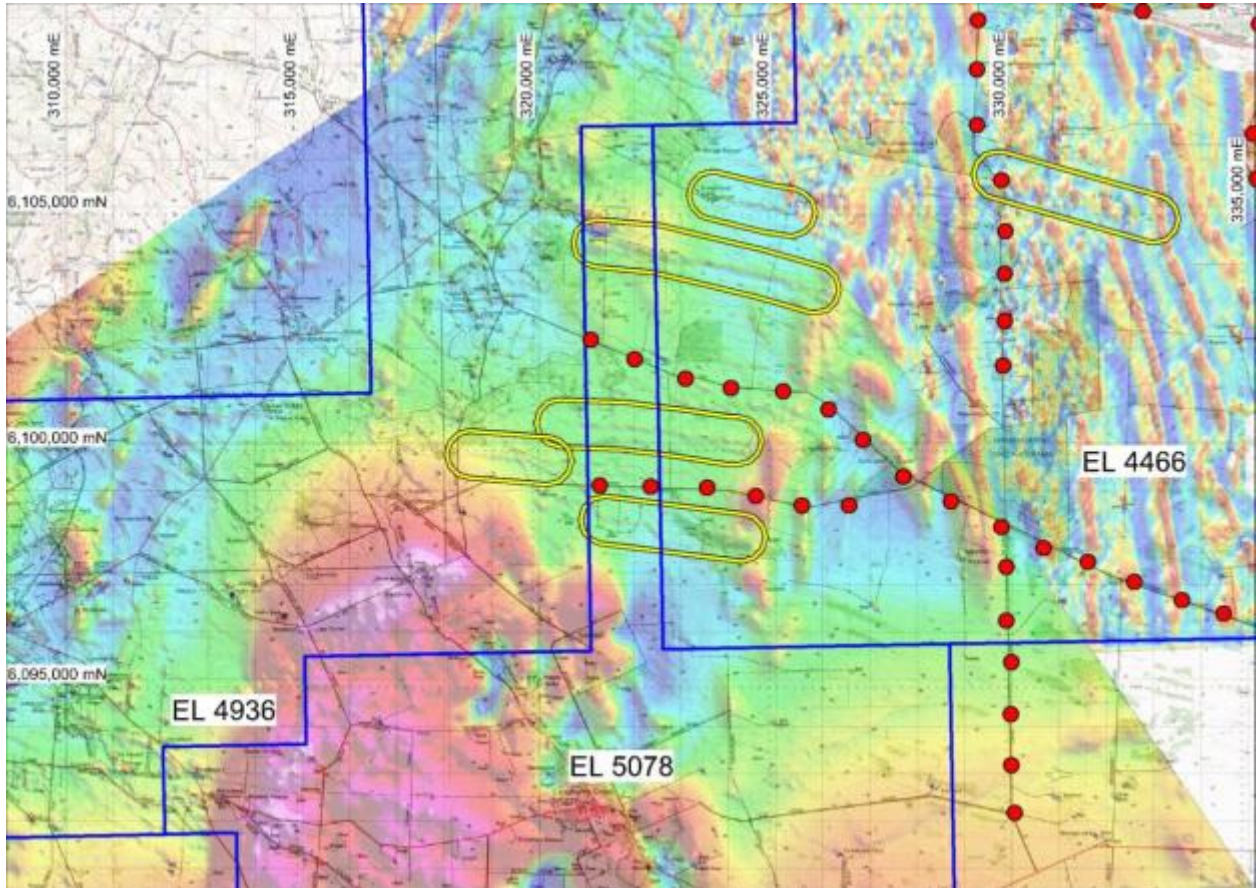


Figure 37: BHP heavy mineral sand exploration holes shown as red dots on RTP TMI aeromagnetic image

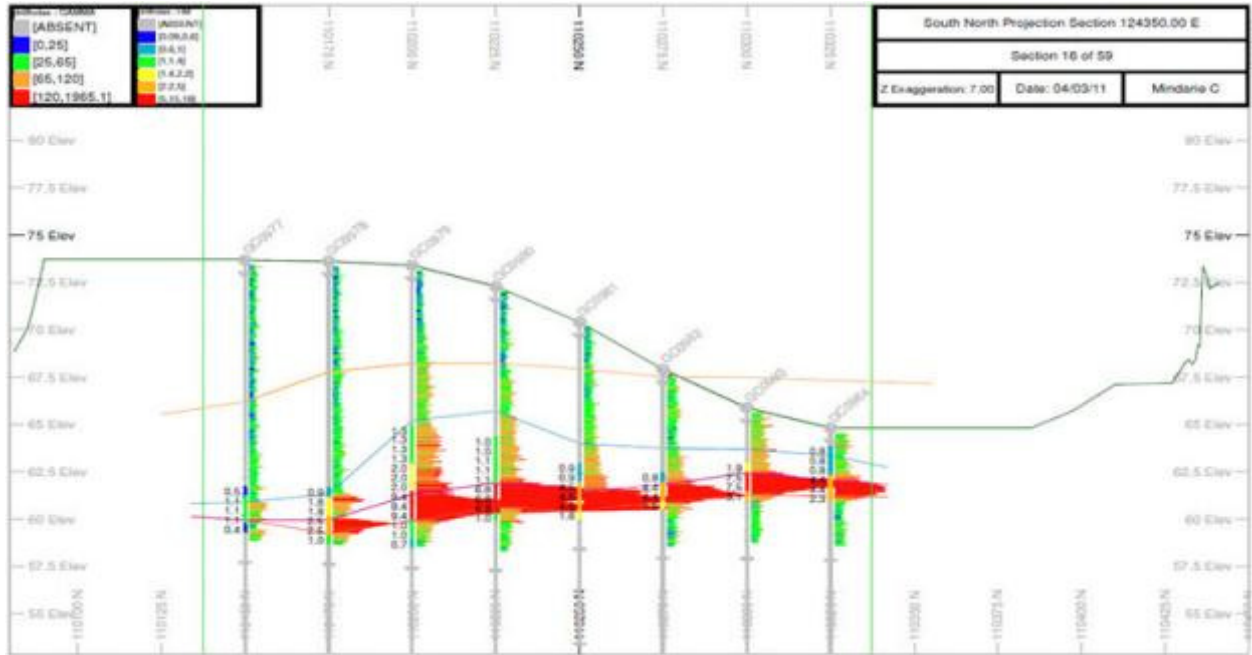


Figure 38: Typical cross-section of the Mindarie C strandline

## 8. CONCLUSIONS

Exploration on the EL 5356 (Currency Creek) and 5784 (Langhorne Creek) could be assisted by by more modern aerial EM surveys. The VTEM survey flown in 2010 only recorded the z component while more modern aerial EM systems can now also record the x component which is much better at mapping out basement conductors.

Land owner negotiations are typically more fraught on EL 5356 while the Murray Basin cover over EL 5784 with its saline waters adds its own level of complexity.

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