

**Treloggan Road,
Newquay, Cornwall
Geophysical Survey
Report**

Client: COTSWOLD ARCHAEOLOGY

AB Heritage Project No:1085

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CONTENTS

1.	NON TECHNICAL SUMMARY	4
2.	INTRODUCTION	5
2.1	Project Background	5
2.2	Site Location & Description.....	5
2.3	Geology & Topography.....	5
2.4	Archaeological Background.....	5
3.	AIMS & METHODOLOGY	7
3.1	Aims of Survey Works	7
3.2	Methodology of Survey Works Summary.....	7
3.3	Known Constraints	7
4.	RESULTS	10
4.2	Geophysical Survey Results.....	10
5.	INTERPRETATIONS AND DISCUSSION	12
6.	CONCLUSION	14
7.	ARCHIVE	15
8.	REFERENCES	16

FIGURES

Figure 1:	Site Location
Figure 2:	Raw Geophysical Data
Figure 3:	Processed Geophysical Data
Figure 4:	Interpretation of Geophysical Data

PLATES

Plate 1	South western corner of the site, view of a gravel Car Park.....	8
Plate 2	View western side of Area D, which was un-surveyed	8
Plate 3	View of the western side of Area E, which was un-surveyed	9

1. NON TECHNICAL SUMMARY

- 1.1.1 AB Heritage Limited (herein AB Heritage) were commissioned by Cotswold Archaeology to undertake a programme of geophysical survey covering c.3.6ha of land at Treloggan Road, Newquay, Cornwall, ahead of a proposed development.
- 1.1.2 The survey identified potential for archaeological features to exist within the proposed development site. These potential features include field boundaries, which likely pre-date the 1840 Tithe Map [GP1, 1 & 5] a linear feature [GP1, 3], and a corner of potential rectangular feature [GP1, 4].
- 1.1.3 Therefore it is concluded that the proposed development site has potential for the recovery of archaeological remains.

2. INTRODUCTION

2.1 Project Background

- 2.1.1 AB Heritage has been asked to undertake a geophysical survey covering a proposed development site consisting of housing and industrial units at Treloggan road, Newquay, Cornwall.
- 2.1.2 The purpose of the survey is to identify any potential surviving archaeological remains along the proposed route.

2.2 Site Location & Description

- 2.2.1 The proposed development at Treloggan Road in Newquay covers approximately 3.6 hectares (ha) and is centred at National Grid Reference (NGR) SW 82765 60300. On the south eastern outskirts of Newquay, the proposed development sits c.1.6km from the town centre (Figure 1).
- 2.2.2 The proposed development lies within an area of strip fields of medieval origin and irregular fields of post-medieval origin. The proposed development site is bounded by fields to the north. A section of Tren creek Road and a housing development surrounding Gannel View Road, bound the site to the east and the A392, forms the boundary to the south. To the south west of the proposed development site is a Wesleyan chapel, a roundabout and the King's Head public house. To the west a superstore and industrial estate bound the site along Treloggan Road.
- 2.2.3 Also the site had until recently, become over grown and was cleared of refuse and vegetation before on site works took place. Whilst the majority of the proposed development site was open grassland the south western corner of the site was occupied by a car parking area covered by gravel. The site has been split into five separate surveyable areas based upon the field divisions present.

2.3 Geology & Topography

- 2.3.1 The underlying geology of the proposed development site is Meadfoot Group - Mudstone, Siltstone and Sandstone. A sedimentary bedrock formed approximately 398 to 411 million years ago in the Devonian Period in an area previously dominated by shallow seas. No superficial geologies are recorded on the site (BGS 2016). The geophysical response is expected to be average on this geology although results can be variable (Historic England 2008).
- 2.3.2 Topographically the area gradually drops from approximately 50m OD in the south-east to 45m OD in the north-west. In the south-west of the area is a natural spring and a watercourse, until recently, led from it to the north.

2.4 Archaeological Background

- 2.4.1 An Archaeological Assessment was undertaken over the site in 2007 by the Historic Environment Service at Cornwall County Council (HES CCC). The Assessment reviewed and

assessed the known cultural heritage features within and surrounding the proposed development site, in order to gain an understanding of the potential for the presence of archaeological features within the site boundary, and the potential impact of the proposed development upon these. The outcome of known heritage resource has been detailed below.

- 2.4.2 The proposed development site does not contain any statutory historic designations. However, the site does lie within the non-statutory Landscape Character type of 'medieval farmland'.
- 2.4.3 Within the wider area, the survival of prehistoric and medieval features suggests there is potential for medieval and prehistoric sites to survive below ground on the proposed development site.
- 2.4.4 A total of 20 archaeological sites were identified within the vicinity of the proposed development area. Five features were assessed to be directly affected by the proposals. These features include: a medieval field system, the site of a spring, possible well and water course, one standing building and two sites of former buildings. The impact on these sites was determined to be negative and representative of both moderate and major significance.
- 2.4.5 The Archaeological Assessment recommends a geophysical survey (Which this report encompasses) to help clarify the archaeological potential.
- 2.4.6 The Archaeological Assessment goes on to recommend further works outside the scope of this survey (HES CCC 2007).

3. AIMS & METHODOLOGY

3.1 Aims of Survey Works

3.1.1 Geophysical survey is a programme of non-intrusive archaeological work. The aims of this geophysical survey were to:

- Identify any geophysical anomalies of possible archaeological origin within the specified survey area;
- Accurately locate these anomalies and present the findings in map form

3.2 Methodology of Survey Works Summary

Site Specific Information

3.2.1 A geophysical survey was undertaken covering c.3.6 ha of ground at Treloggan Road, Newquay on the 24th of February 2016.

3.2.2 The AB Heritage staff members who undertook the works were Glenn Rose (Project Officer), and Peter Bonvoisin (Archaeological Technician) and Laura Simpson (Site Technician).

3.2.3 The weather conditions were dry throughout the survey; these conditions had no material impact upon the survey.

Equipment

3.2.4 The magnetic survey equipment used was two Bartington Grad-601 (fluxgate magnetometers). Please see Appendix A, which contains a detailed methodology for the works undertaken; however, briefly, Table 1, below, shows site specific information on how the magnetometer was set up:

Table 1: Setting Parameters of Magnetometer

Grid Size	30x30 metres
Data Capture Distances	1m x 0.25m
Sensors	2
Sensitivity	0.1nT

3.2.5 A Trimble Geo XR GPS was used to setup the geophysical survey. This has sub-centimetre accuracy suitable for this survey.

3.3 Known Constraints

3.3.1 The proposed development site had been recently cleared of refuse and vegetation, though the proposed development site was largely cleared it should be noted that disturbance from the clearance activities is evident within the data.

- 3.3.2 Some areas of the proposed development site remained un-surveyed (Plate 1-3) due to onsite constraints these included a car park area (Plate 1), disturbed and overgrown ground (Plate 2), and trees (Plate 3).



Plate 1 South western corner of the site, view of a gravel Car Park



Plate 2 View western side of Area D, which was un-surveyed



Plate 3 View of the western side of Area E, which was un-surveyed

4. RESULTS

- 4.1.1 For the purposes of this detailed magnetic survey, results for the geophysics data have been shown within Figures 2-3, with interpretations shown in Figure 4.
- 4.1.2 The site has been split into six separate Areas, labelled A-E (shown on Figure 1), and detailed below is a factual account of the results.

4.2 Geophysical Survey Results

Area A

- 4.2.1 A negative linear feature [GP 3], with an average reading of -20nt extends in a north east to south west direction; c.20m in length, with a width of c. 7m.

Area B

- 4.2.2 A group of positive linears [GP 1, 5] with an average reading of 2.5nt runs in a north west to south east direction. The most eastern linear stretches to a length of c.100m though is broken up into 3 sections along its line. The western linear is broken up into two linears, with varying lengths of c.20m and 15m. Both features run parallel with each other and have a separation of c.10m.
- 4.2.3 A few dipolar anomalies [GP 5] are also noted within the field mainly situated around the centre of the field.

Area C

- 4.2.4 A 'right angle' feature with adjoining linears [GP1, 4] has been identified within the south western corner of the field, the complete feature has a length in total of c.30m with an average reading of 2nt.
- 4.2.5 A set of parallel positive linears [GP 2] run in a north west to south east direction with equidistant spacing of c.10m and an average of 1nt.
- 4.2.6 In the north eastern corner of the field there is an area of high magnetic disturbance [GP 4] covering c. 100m².
- 4.2.7 Some Di-polar anomalies [GP 5] are also noted sporadically around the area

Area D

- 4.2.8 A small linear [GP 1, 3] c. 10m in length extending in a north west to south east direction with a reading of 6nt.
- 4.2.9 Two positive features [GP 1, 2] have been identified within the western side of Area D with an average reading of 4nt.
- 4.2.10 A few Di-polar anomalies [GP 5] have been identified within the centre of the site in a amorphous pattern

Area E

- 4.2.11 A linear [GP1, 1] measuring c.40m runs in a north to south direction with an average reading of -1nt in the eastern side of Area E.

- 4.2.12 A strong positive linear [**GP 3**] of between 5-13m runs in a east to west direction through the centre of Area E.
- 4.2.13 In the southern half of Area E there is a large amount of magnetic disturbance [**GP 4**], covering up to half of the total Area surveyed.

5. INTERPRETATIONS AND DISCUSSION

- 5.1.1 Interpretation of the results of geophysical survey is based on professional judgement as to the likely/probable cause of an anomaly or reading. For example, strong dipolar discrete anomalies of small size are often associated with ferrous debris or similarly magnetic debris. In addition, where a positive linear anomaly is recorded, which has a negative anomaly associated alongside either side of it, is often likely to relate to the line of a modern utility.
- 5.1.2 GP numbers have been used to place interpretations into categories. Below is a discussion of the results, there has also been applied a confidence rating to the features identified (See Appendix 1). As with English Heritage 2008 guidelines for geophysical survey for archaeological field evaluation, this is an acceptable additional option only on the clear understanding that such ratings are subjective and potentially fallible assessments which can only really be tested through excavation.

Table 2: Interpretation of Geophysical Anomalies

AB No	Appearance	Potential Cause
GP 1 (1-5)	Positive/negative features	Possible Archaeology
GP 2	Positive parallel linears	Agricultural activity
GP 3	Strong Positive and negative linears	Known field boundaries
GP 4	Negative and positive readings	Modern ground disturbance
GP 5	Di-polar Anomalies	Amorphous Magnetic debris

- 5.1.3 Possible archaeological features [**GP1, 1-5**] have been identified within the site, with the majority of features located within Areas B-D.
- 5.1.4 Features located across the south western corner of Area C [**GP1, 4**] and south eastern corner of Area D [**GP1, 3**] have a medium confidence to be representative of archaeological potential based on their form, though a low positive reading of 2nt could be suggestive of an agricultural cause, for feature [**GP1, 4**] identified within Area C.
- 5.1.5 Other features [**GP1, 2**] identified within Area D in the form of positive areas have a low confidence to contain archaeological potential, though they have readings of 4nt their form and origin are unclear.
- 5.1.6 There is a medium confidence that linear features [**GP1, 1&5**] identified within Area B and E are most likely related to previous field boundaries, based on their shape and orientation to surrounding boundaries. Other known field boundaries [**GP3**] identified within Areas A and E have been noted on the Tithe mapping (1840 Tithe Map, St Columb Minor) and OS mapping (2nd ed.1907 OS map) this in turn gives a high confidence these features are previous field

boundaries, with the field boundary noted in Area A having been recorded as being removed recently (HES,2015).

- 5.1.7 Signs of potential agricultural activity [**GP 2**] have been shown within Area C, there is a low confidence this could relate to possible ridge and furrow, as the separation between features is over 10m.
- 5.1.8 The majority of the proposed development site is covered by disturbed ground likely caused by recent ground clearance. The disturbance is greatest in the southern part of Area E [**GP4**], which corresponds to recent movement of earth. Within Area C there is an area of high magnetic disturbance [**GP 4**] likely due to the presence of a more modern feature, though its origin is unclear.

6. CONCLUSION

- 6.1.1 A geophysical survey was undertaken by AB Heritage at the proposed development site of Treloggan Road, Newquay.
- 6.1.2 The purpose of this work was to understand the potential for any archaeological remains to survive within the site, and, where possible, identify the form, function and extent of any potential remains.
- 6.1.3 Overall the geophysical survey has identified potential archaeological remains. Features identified likely relate to previous known and unknown field boundaries [GP1, 1 & 5] that are likely to pre-date the 1840 Tithe Map. Additional features [GP1, 3-4] have been identified and are categorised with higher archaeological potential based on form.

7. ARCHIVE

7.1.1 The Site Archive will contain the following, as a minimum:

Table 3: Site Archive Data

Archive	Format
Raw Geophysical Data files	XYZ and Text
Processed geophysical data files	JPEG, BMAP
Archaeological Interpretation	Shape Files ARC GIS
Final Report	PDF
Final Images	PDF

7.1.2 A physical and digital archive will be stored in a suitable format at AB Heritage Limited offices in Taunton, Somerset.

8. REFERENCES

- BGS (British Geological Society) 2015. *Geology of Britain viewer*.
<http://mapapps.bgs.ac.uk/geologyofbritain/home.html>.
- CIFA, 2014. Standard and Guidance for archaeological geophysical survey.
- Cranfield Soil and Agrifood Industry, 2015. *Soilscapes viewer*,
<http://www.landis.org.uk/soilscapes/>
- Historic Environment Service, Cornwall County Council. 2015. Land at Treloggan Road, Newquay, Environmental Statement: Archaeological Assessment.
- Jones, D.M. (ED) 2008. Geophysical Survey in Archaeological Field Evaluation. English Heritage.
- Ordnance Survey, c1880. 25 Inch Map First Edition (licensed digital copy at HES)
- Ordnance Survey, c1907. 25 Inch Map Second Edition (licensed digital copy at HES)
- Ordnance Survey, c1930s. 25 Inch Map (licensed digital copy at HES)
- Ordnance Survey, 2003. LandLine Digital Mapping at 1:2500
- Schmidt, A. 2002. *Geophysical Data in Archaeology: a Guide to Good Practice*. Oxford. Oxbow.
- Tithe Map and Apportionment, c1840. Parish of St Columb Minor (microfiche copy at HES)

Appendix 1 Technical Information on Geophysical Survey

FLUXAGTE MAGNETOMETRY SURVEY

The magnetic survey is carried out using a fluxgate gradiometer, which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field, whilst the lower sensor measures the same field but is also more affected by any localised buried field. The difference between the two sensors will relate to the strength of a magnetic field created by a buried feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity, disturbance from modern services etc.

Survey equipment

The Bartington Grad 601-2 dual magnetic gradiometer is capable of surveying to an accuracy of 0.1 nanotesla (nT).

Sample interval and depth of scan

The magnetometer data is collected in 30mx30m grids at a resolution of 1m x 0.25m. This sample density is recommended for site evaluation (English Heritage, 2008). This equates to 3600 points per 30mx30m grid. The magnetometer has a typical depth of penetration of 0.5m to 1.0m. This would be increased if strongly magnetic objects are buried within the site.

Data capture

The readings are logged continually by the data logger during the survey, which is then downloaded on site to a site laptop. At the end of each job, data is transferred to the office PC's for processing and presentation.

This 'regular xy' data is then downloaded into specialist data processing software, at user defined sample intervals (in this case 1 m by 0.25 m). This is processed as standard magnetometer data.

Processing

Standard Raw Magnetometer data processing consists of:

Zero mean Traverse- This process sets the background mean of each traverse within each grid to zero, the operation allows for the removal of striping effects.

Destagger- The collection of geophysical data can lead to errors with time due to a slight variation in speed of traverses or time lag within the collection of data. The process corrects the errors of stagger within the data.

Non-Standard Magnetometer processing:

Interpolation- The results of greyscale geophysical data can sometimes appear blocky in nature. Interpolation is a process which calculates and inserts values between existing data to give a smoother grey scale image.

Clipping – The clipping process will clip extreme values from the data set and increase the contrast in the data values closer to the mean. As most data within a data set is concentrated around the mean clipping can produce a better visualisation of standard data sets, particularly very weak signals that tend to be lost in a myriad of grey shades.

Some degree of heading error is inevitable when using a fluxgate gradiometer with such an acute sensitivity to the direction of travel in bi directional manner i.e. zigzag traverses. The error displays as a series of alternating lighter and darker stripes in the traverse direction and the function assesses and corrects the mean for each line of data to bring them in to the same mean range and remove any visible artefacts.

Display of data

Greyscale-This is display takes a range of reading and divides into a set number of classes. Each class is represented by a specific shade of grey and the higher the positive reading the darker the grey.

Colour- Colour can be applied to Greyscale plots to show high and low data collection points in a more direct way.

XY Trace Plot- Data is represented by a line, which is incremented along the Y axis. This produces a stepped effect, thus the data can be viewed to show a possible shaping of a feature. Typically features are clipped to limit odd readings.

Assigned ranges can be adjusted to give the best display of the data.

Some degree of heading error is inevitable when using a fluxgate gradiometer with such an acute sensitivity to the direction of travel in bi directional manner i.e. zigzag traverses. The error displays as a series of alternating lighter and darker stripes in the traverse direction and the function assesses and corrects the mean for each line of data to bring them in to the same mean range and remove any visible artefacts.

GPS METHODOLOGY

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to sub-cm accuracy, a far greater accuracy than a standard GPS unit. An RTK system uses a base station receiver and a number of mobile units (rovers). The base station takes measurements from satellites in view and then broadcasts them along with its known position to the rover receivers. The rover receiver also collects measurements from the satellites in view and processes them with the base station data. The rover then computes its location relative to the base.

During such a survey a Trimble GeoXR Differential Global Positioning System (dGPS), capable of Real Time Kinematic (RTK) is used to set out a nominal grid prior to the survey. This increases the accuracy and efficiency of the survey. The data is then downloaded from the unit on the day, using a USB stick.

CONFIDENCE RATING OF INTERPRETATION

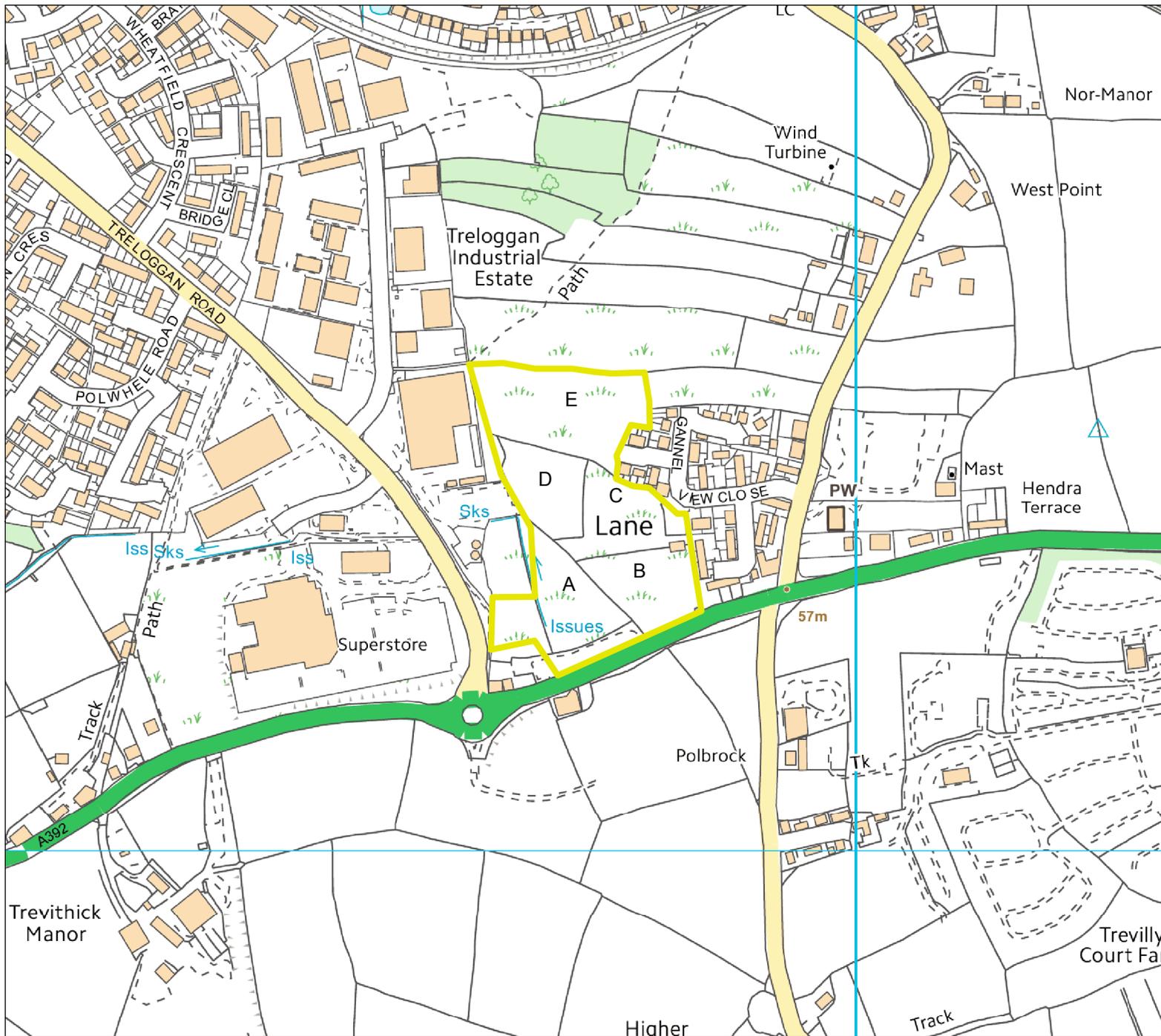
Categories for interpretations when there is corroborative evidence from mapping/desk based or excavation data can be assigned to magnetic anomalies (for example, Utility, Road, Wall, etc.) and where appropriate, such interpretations will be applied.

Table 2: Table of Confidence with interpretation

Interpretation Confidence	Evidence
High	Backed by mapping/desk based work/ excavation. A clear feature with a clear form.
Medium	A feature which has an unclear structure though has grouped potential or associated potential.
Low	Unknown provenance entirely based on form.



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Legend
 Site Boundary

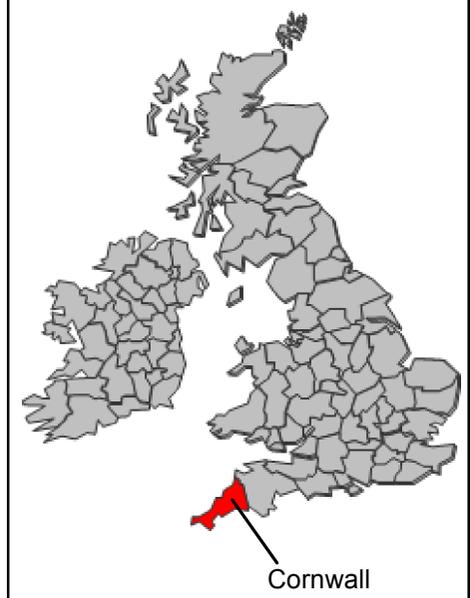


Figure 1: Site Location

Project: Land North of Treloggan Road

Date: 19/02/16 Job Number: 10785

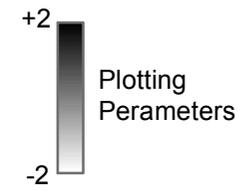
Drawn by: ZE Approved by: HR





Legend

-  Unsurveyed
-  Site Boundary



Field Identification

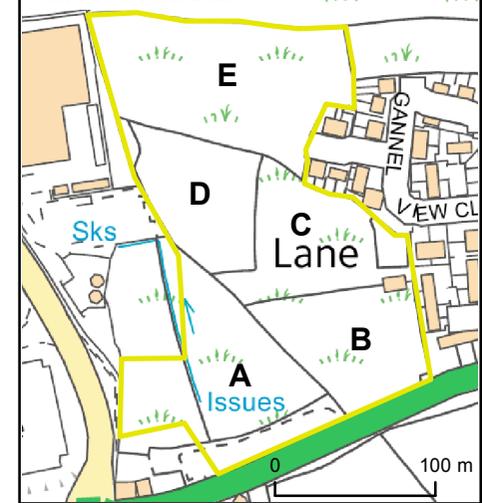


Figure 2: Raw Geophysical Data

Project: Land North of Trelogan Road

Date: 15/03/16 Job Number: 10785

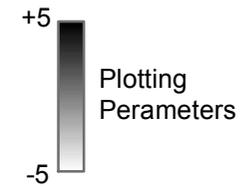
Drawn by: ZE Approved by: GR





Legend

-  Unsurveyed Area
-  Site Boundary



Field Identification

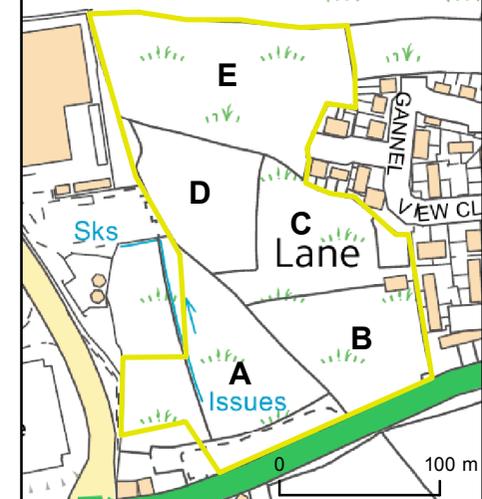


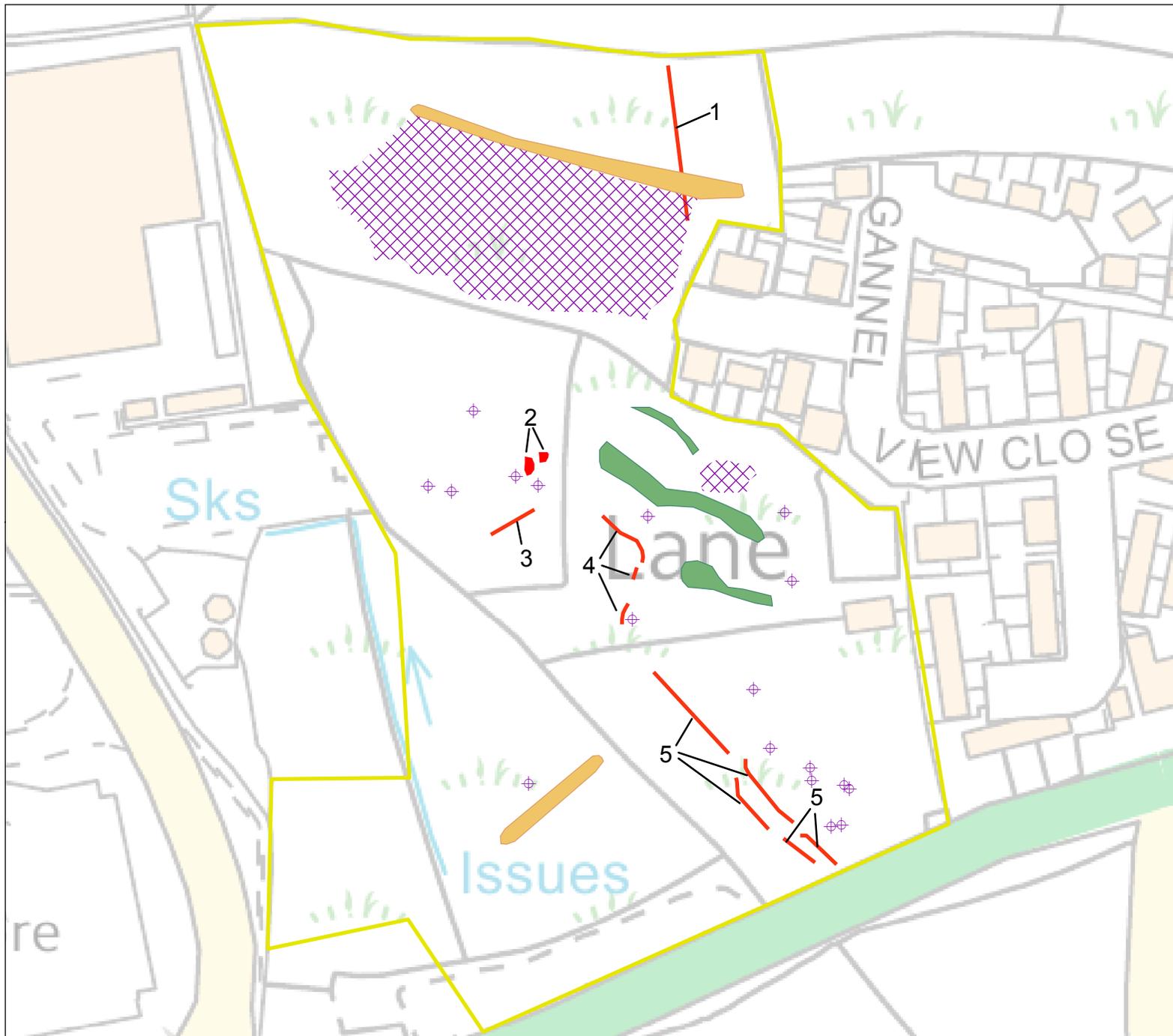
Figure 3: Processed Geophysical Data

Project: Land North of Treloggan Road

Date: 15/03/16 Job Number: 10785

Drawn by: ZE Approved by: GR





Legend

- Possible Archaeology [GP1]
- Possible Agricultural Features [GP2]
- Known Boundaries [GP3]
- Magnetic Disturbance [GP4]
- Di-Polar Anomalies [GP5]
- Site Boundary

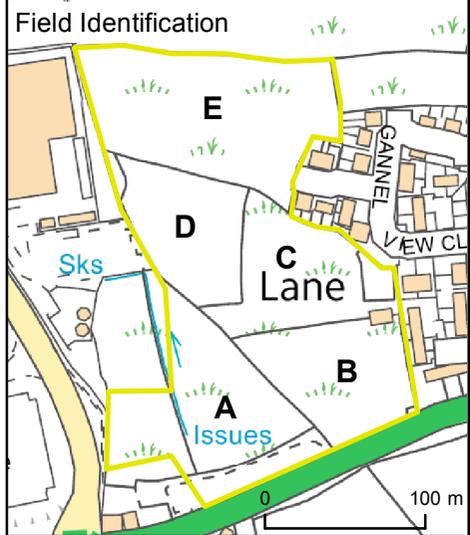


Figure 4: Interpretation of Geophysical Data

Project: Land North of Treloggan Road

Date: 07/03/16 Job Number: 10785

Drawn by: ZE Approved by: GR

