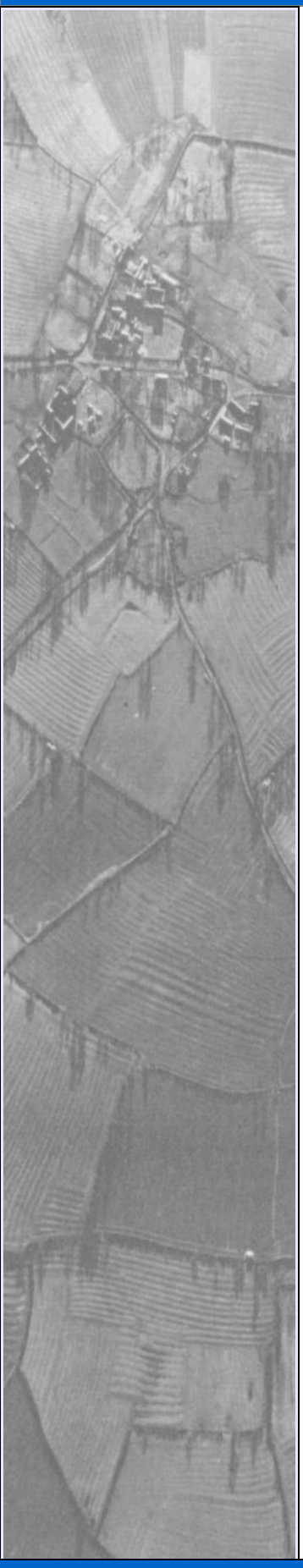


South Petherwin Wind Turbine
Cornwall

MAGNETOMETER SURVEY REPORT

for

Richard Jasper

Kerry Donaldson & David Sabin

April 2015

Ref. no. 603

ARCHAEOLOGICAL SURVEYS LTD

South Petherwin Wind Turbine
Cornwall

Magnetometer Survey Report

for

Richard Jasper

Fieldwork by David Sabin (Hons) MCIfA
Report by Kerry Donaldson BSc (Hons)
Report checked by David Sabin
Primary archive location - Archaeological Surveys Ltd, Yatesbury, Wiltshire

Survey date – 2nd April 2015
Ordnance Survey Grid Reference – **SX 31828 82271**

Archaeological Surveys Ltd
1 West Nolands, Nolands Road, Yatesbury, Calne, Wiltshire, SN11 8YD
Tel: 01249 814231 Fax: 0871 661 8804
Email: info@archaeological-surveys.co.uk
Web: www.archaeological-surveys.co.uk

CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY

A detailed magnetometer survey was carried out by Archaeological Surveys Ltd, on behalf of Richard Jasper, over a single wind turbine and access/cable route at South Petherwin near Launceston in Cornwall. The results demonstrate the presence of a positive curvilinear anomaly with an entrance on the western edge within the cable/access route immediately west of the turbine area. This appears to relate to a penannular enclosure ditch, possibly containing associated anomalies within. To the east of this, within the turbine area, are a number of rectilinear anomalies. The responses are far less well defined than the circular enclosure ditch; however, their morphology indicates that they may relate to a number of rectangular enclosures. Other positive linear anomalies can be seen within this part of the site, and it is possible that they too have archaeological potential. A number of clusters of positive and negative anomalies have also been located, and it is not certain if some relate to buried stones and pits or have an association with thermoremanent magnetism. The cable/access route also crosses at least three former field boundaries.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Richard Jasper to undertake a magnetometer survey of an area of land at South Petherwin, near Launceston, Cornwall. The site has been outlined for a proposed development of single wind turbine with access and cable routes, and the survey forms part of an archaeological assessment of the site.

1.2 Survey objectives and techniques

1.2.1 The objective of the survey was to use magnetometry to locate geophysical anomalies that may be archaeological in origin so that they may be assessed prior to development of the site. The methodology is considered an efficient and effective approach to archaeological prospection.

1.2.2 The survey and report generally follow the recommendations set out by: English Heritage (2008) *Geophysical survey in archaeological field evaluation;* and Institute for Archaeologists (2002) *The use of Geophysical Techniques in Archaeological Evaluations*. The work has been carried out to the Chartered Institute for Archaeologists (2014) *Standard and Guidance for Archaeological Geophysical Survey.*

1.3 Site location, description and survey conditions

1.3.1 The site is located at East Petherwin, within the parish of South Petherwin,

1.5km south west of the southern edge of Launceston in Cornwall. The turbine is centred on Ordnance Survey National Grid Reference (OS NGR) SX 31828 82271 with the cable route extending westwards to SX 31298 82259 see Figures 01 and 02.

1.3.2 The geophysical survey covers approximately 2.5ha of pasture within 3 separate fields. Area 1 covers approximately 1ha centred on the turbine location and a 30m wide corridor that extends 230m to the west. The turbine area lies in an elevated position just off the crest of a hill with land sloping down to the north. Area 2 is a 30m wide corridor approximately 230m long that traverses land sloping down steeply to the north. Area 3 is a 30m wide corridor approximately 110m long and running below overhead electricity cables. Steel feeding troughs and rough ground prevented survey at the northern end of Area 2. Two electricity poles were located within Area 3.

Plate 1: Area 1 looking east

1.3.3 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data. Some localised zones of rough ground were present at the northern ends of Areas 2 and 3. Weather conditions during the survey were mainly fine.

1.4 Site history and archaeological potential

1.4.1 The Cornwall Council Interactive Map shows that a possible round barrow or enclosure is situated within the turbine field, to the west of the turbine location. A second possible barrow or enclosure is located 125m to the north, but this is outside of the survey area. Two further round enclosures are have also been mapped from aerial photographs 375m to the south east and 375m to the

south south west. (Cornwall Council, 2015).

1.4.2 The location of the possible barrow or enclosure directly within the survey area indicates that there is a high potential to locate this and possibly other archaeological remains.

1.5 Geology and soils

1.5.1 The underlying geology is quite complex within the site. The central zone is underlain with the Lezant Slate Formation from the Devonian period with an unnamed igneous intrusion in the most eastern part of the survey area and Teign Chert Formation from the Carboniferous period at the most western end. (BGS, 2015).

1.5.2 The overlying soil across the site is from the Denbigh 1 association and is a typical brown earth. It consists of a well drained, fine loamy and fine silty soils over rock (Soil Survey of England and Wales, 1983).

1.5.3 Magnetometry carried out over similar geology and soil has produced good results. The site is, therefore, considered suitable for magnetic survey.

2 METHODOLOGY

2.1 Technical synopsis

2.1.1 Magnetometry survey records localised magnetic fields that can be associated with features formed by human activity. Magnetic susceptibility and magnetic thermoremnance are factors associated with the formation of localised fields. Additional details are set out below and within Appendix A.

2.1.2 Iron minerals within the soil may become altered by burning and the break down of biological material; effectively the magnetic susceptibility of the soil is increased, and the iron minerals become magnetic in the presence of the Earth's magnetic field. Accumulations of magnetically enhanced soils within features, such as pits and ditches, may produce magnetic anomalies that can be mapped by magnetic prospection.

2.1.3 Magnetic thermoremnance can occur when ferrous minerals have been heated to high temperatures such as in a kiln, hearth, oven etc. On cooling, a permanent magnetisation may be acquired due to the presence of the Earth's magnetic field. Certain natural processes associated with the formation of some igneous and metamorphic rock may also result in magnetic thermoremnance.

2.1.4 The localised variations in magnetism are measured as sub-units of the Tesla, which is a SI unit of magnetic flux density. These sub-units are nano Teslas (nT), which are equivalent to 10^{-9} Tesla (T).

2.2 Equipment configuration, data collection and survey detail

2.2.1 The detailed magnetic survey was carried out using a SENSYS MAGNETO®MXPDA 5 channel cart-based system. The instrument has 5 fluxgate gradiometers spaced 0.5m apart with readings recorded at 20 Hz. The gradiometers have a range of recording data between 0.1nT and 10,000nT. The system is linked to a Leica GS10 RTK GPS with data recorded by SENSYS MAGNETO®MXPDA software on a rugged PDA computer system.

2.2.2 Data are collected along a series of parallel survey transects wherever possible. The length of each transect is variable and relates to the size of the survey area and other factors including ground conditions. A visual display allows accurate placing of transects and helps maintain the correct separation between adjacent traverses.

2.2.3 Data are not collected within fixed grids and data points are considered to be random even though the data are collected in a systematic manner covering all accessible areas (Aspinall, Gaffney and Schmidt, 2009).

2.3 Data processing and presentation

2.3.1 Magnetic data collected by the MAGNETO®MXPDA cart-based system are initially prepared using SENSYS MAGNETO®DLMGPS software. Survey tracks are analysed and georeferenced raw data (UTM Z30N) are then exported in ASCII format for further analysis and display using TerraSurveyor.

2.3.2 The data are collected between limits of ±10000nT and clipped for display. Data are interpolated to a resolution of effectively 0.5m between tracks and 0.12m along each survey track. A zero median traverse function is required in order to remove fixed offset values present within the sensors which do not undergo a zeroing procedure in the field. The approach ensures that the gradiometer sensors are very accurately aligned and fixed to the vertical magnetic field and are not influenced by localised magnetic fields or disturbed by vibration. Although a zero median traverse algorithm can remove anomalies aligned with the survey tracks, in practice this rarely occurs due to the use of long traverses, high resolution measurement and variability within the magnetic susceptibility of long linear features.

2.3.3 Appendix C contains metadata concerning the survey and data attributes and is derived directly from TerraSurveyor. Reference should be made to Appendix B for further information on any processes, such as clipping, carried out on the data.

2.3.4 A TIF file is produced by TerraSurveyor software along with an associated world file (.TFW) that allows automatic georeferencing (OSGB36 datum) when using GIS or CAD software. The main form of data display used in the report

is the minimally processed greyscale plot.

2.3.5 The raster images are combined with base mapping using ProgeCAD Professional 2014, creating DWG file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical quality. The CAD plots are effectively georeferenced facilitating relocation of features using GPS, resection method, etc.

2.3.6 An abstraction and interpretation is offered for all geophysical anomalies located by the survey. Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing. A brief summary of each anomaly, with an appropriate reference number, is set out in list form within the results (Section 3) to allow a rapid and objective assessment of features within each survey area.

2.3.7 A digital archive is produced with this report, see Appendix D below. The main archive is held at the offices of Archaeological Surveys Ltd.

3 RESULTS

3.1 General assessment of survey results

3.1.1 The detailed magnetic survey was carried out over a total of three survey areas covering approximately 2.5ha.

3.1.2 Magnetic anomalies located can be generally classified as positive responses of archaeological potential, positive and negative anomalies of an uncertain origin, anomalies associated with land management, linear anomalies of an agricultural origin, anomalies with a natural origin, strong discrete dipolar anomalies relating to ferrous objects, areas of magnetic disturbance and strong multiple dipolar linear anomalies relating to buried services or pipelines.

3.2 Statement of data quality

3.2.1 Data are considered representative of the magnetic anomalies present within the site. There are no significant defects within the dataset.

3.3 Data interpretation

3.3.1 The list of sub-headings below attempts to define a number of separate categories that reflect the range and type of features located during the survey. A basic explanation of the characteristics of the magnetic anomalies is set out for each category in order to justify interpretation, a basic key is indicated to allow cross referencing to the abstraction and interpretation plot. CAD layer names are included to aid reference to associated digital files (.dwg/.dxf). Sub-headings are then used to group anomalies with similar

characteristics for each survey area.

Report sub-heading CAD layer names and plot colour	Description and origin of anomalies
Anomalies with archaeological potential AS-ABST MAG POS LINEAR ARCHAEOLOGY AS-ABST MAG POS DISCRETE ARCHAEOLOGY AS-ABST MAG POS ARCHAEOLOGY AS-ABST MAG POS CURVILINEAR RING DITCH	Anomalies have the characteristics (mainly morphological) of a range of archaeological features such as pits, ring ditches, enclosures, etc..
Anomalies with an uncertain origin AS-ABST MAG POS LINEAR UNCERTAIN AS-ABST MAG NEG LINEAR UNCERTAIN AS-ABST MAG POS DISCRETE UNCERTAIN AS-ABST MAG NEG DISCRETE UNCERTAIN AS-ABST MAG POS UNCERTAIN AS-ABST MAG NEG UNCERTAIN	The category applies to a range of anomalies where there is not enough evidence to confidently suggest an origin. Anomalies in this category may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered. Positive anomalies are indicative of magnetically enhanced soils that may form the fill of 'cut' features or may be produced by accumulation within layers or 'earthwork' features; soils subject to burning may also produce positive anomalies. Negative anomalies are produced by material of comparatively low magnetic susceptibility such as stone and subsoil.
Anomalies relating to land management AS-ABST MAG BOUNDARY	Anomalies are mainly linear and may be indicative of the magnetically enhanced fill of cut features (i.e. ditches). The anomalies may be long and/or form rectilinear elements and they may relate to topographic features or be visible on early mapping. Associated agricultural anomalies (e.g. headlands, plough marks and former ridge and furrow) may support the interpretation.
Anomalies with an agricultural origin AS-ABST MAG AGRICULTURAL	The anomalies are often linear and form a series of parallel responses or are parallel to extant land boundaries. Where the response is broad, former ridge and furrow is likely; narrow response is often related to modern ploughing.
Anomalies with a natural origin AS-ABST MAG NATURAL FEATURES	Naturally formed magnetic anomalies are are caused by localised variability in the magnetic susceptibility of soils, subsoils and other drift or solid geologies. Anomalies may be amorphous, linear or curvilinear and may appear 'fluvial' or discrete; the latter are almost impossible to distinguished from pit-like anomalies with an anthropogenic origin. Igneous and metamorphic activity can lead to anomalies within more solid geology and shallow geology can also result in anomalies.
Anomalies associated with magnetic debris AS-ABST MAG STRONG DIPOLAR	Strong discrete dipolar anomalies are responses to ferrous objects within the topsoil.
Anomalies with a modern origin AS-ABST MAG DISTURBANCE AS-ABST MAG SERVICE	The magnetic response is often strong and dipolar indicative of ferrous material and may be associated with extant above surface features such as wire fencing, cables, pylons etc.. Often a significant area around such features has a strong magnetic flux which may create magnetic disturbance; such disturbance can effectively obscure low magnitude anomalies if they are present. Fluxgate sensors may respond erratically and with hysteresis adjacent to strong magnetic sources. Buried services may produce characteristic multiple dipolar anomalies dependant upon their construction.

Table 1: List and description of interpretation categories

3.4 List of anomalies - Area 1

Turbine centred on OS NGR 231828 82271, Area centred on 231710 82270, see Figure 04.

Anomalies of archaeological potential

(1) - A positive curvilinear anomaly is located in the central part of the survey area within the line of the access/cable route. It has an internal diameter of at least 34m but the northern side is just beyond the limit of the survey corridor. It also has a deliberate 4.5m wide gap on the western side which appears to form an entrance. The response is very strong, at around 35nT, but peaking at over 45nT. It appears to contain other positive anomalies (2) and relates to a penannular ring ditch or enclosure.

(2) - A number of positive linear and discrete anomalies appear within the centre of anomaly (1). Although they do not have a clear or coherent morphology and the shallow geology can create similar features, given the location within the confines of the ring ditch/enclosure they are considered to have archaeological potential.

(3) - A number of positive broad rectilinear anomalies appear to form a rectangular enclosure. Although far less well defined than anomaly (1), the location of the feature close to the ring ditch/enclosure and the morphology indicates that this has archaeological potential.

(4) - A number of small rectilinear and irregularly shaped broad positive linear responses appear to relate to a group of enclosures, parallel with and east of anomaly (3).

(5) - A broad positive rectilinear anomaly appears to cross or have been crossed by anomaly (3). It may relate to an enclosure, and it is possible that is has some association with anomalies (6).

Anomalies with an uncertain origin

(6) - A broad, positive possible curvilinear anomaly is located between the junction of the turbine area and the cable route. A similar anomaly located to the north may also be associated. It is possible that they relate to cut features.

(7) - A broad, positive linear response extends southwards for 47m from the northern edge of the survey boundary. It has a similar response to anomaly (5), and although it may be an associated cut feature, its weak response (1-4nT) and indistinct form prevent confident interpretation.

(8) - A circular positive response may relate to a pit-like feature, but this is uncertain.

(9) - A broad, negative linear anomaly extends across the turbine survey area. It appears that it may have truncated part of anomaly (3). It is not certain if this

relates to a former unmapped boundary feature; however, the general orientation is roughly parallel with the cultivation trend within the field.

(10) - A group of positive and negative responses are located towards the north eastern corner of the turbine area. It is possible that they could be associated with thermoremanent magnetism caused by a lightning strike, or the underlying igneous intrusion, but this is not certain.

(11 & 12) - Two clusters of discrete positive and negative anomalies are located within a line to the south west of anomalies (10). They are similar to, although more discrete than, anomalies (10); however, they are located within the corner of anomaly (3) as anomalies (11) and close to other uncertain positive responses (6) as anomalies (12).

(13) - A small group of discrete positive responses are located to the west of the ring ditch/enclosure (1). It is not possible to determine if they relate to pit-like features with a natural or anthropogenic origin but given the proximity to anomaly (1), an archaeological origin should be considered.

(14) - A small number of positive linear responses can be seen in the western part of the survey area. They lack a coherent morphology or pattern and their origin is uncertain.

Anomalies associated with land management

(15) - A negative linear anomaly, flanked by two positive linear responses, relates to a former field boundary, mapped since 1841 until the late 20th century.

(16) - A negative linear anomaly, flanked by two positive linear responses and located towards the western end of the survey area, relates to an unmapped field boundary. It appears as a direct continuation of anomaly (20) to the north.

Anomalies with an agricultural origin

(17) - A series of parallel linear anomalies are located throughout the survey area and are parallel with the northern field boundary. These relate to former cultivation marks. In the western part of the survey area, a number of linear anomalies can also be seen, parallel with the western field boundary.

Anomalies associated with magnetic debris

(18) - The survey area contains a very small number of strong, discrete, dipolar anomalies which are a response to ferrous and other magnetically thermoremanent objects within the topsoil.

3.5 List of anomalies - Area 2

Area centred on OS NGR 231479 82313, see Figure 05.

Anomalies with an uncertain origin

(19) - A positive linear anomaly extends across the central part of the survey area. It is parallel with the southern field boundary, and although it may relate to a cut, ditch-like feature, its date and function are uncertain.

Anomalies associated with land management

(20) - A broad negative response is flanked by two positive linear anomalies and relates to a recently removed field boundary.

Anomalies with an agricultural origin

(21) - A number of parallel linear anomalies appear to relate to agricultural activity.

Anomalies with a natural origin

(22) - A large zone of magnetically variable responses appears to have been caused by the underlying geology.

Anomalies with a modern origin

(23) - A strong, multiple dipolar, linear anomaly relates to a buried service or cable in the western part of the survey area.

3.6 List of anomalies - Area 3

Area centred on OS NGR 231327 82305, see Figure 04.

Anomalies with an uncertain origin

(24) - A broad, positive linear response extends south westwards for 57m from the north eastern edge of the survey area. It appears that it may have been truncated by agricultural anomalies (27) and although it may relate to a cut feature, its origin is uncertain.

(25) - Located at the southern edge of the survey area is a fragmented positive linear anomaly. Although it is possible that it relates to a cut, ditch-like feature, it is also possible that it has some association with the buried services/cables immediately to the north of it.

Anomalies associated with land management

(26) - Two parallel positive linear anomalies flank a negative response and relate to a former field boundary, removed during the first half of the 20th century.

Anomalies with an agricultural origin

(27) - A series of parallel linear anomalies relate to agricultural activity. Their response may suggest ridge and furrow.

Anomalies with a modern origin

(28) - Magnetic disturbance is associated with an electricity pole in the northern part of the survey area.

(29) - Strong, multiple dipolar linear anomalies are associated with buried services/cables that merge towards the south western edge of the survey area.

4 CONCLUSION

4.1.1 The results of the geophysical survey clearly show a ring ditch or circular enclosure immediately west of the turbine area, and directly within the line of the access/cable route. The northern part of the ring ditch/enclosure is to the north of the survey area; however, the internal diameter of the feature is at least 34m and there is a deliberate gap or entrance on the western side. It is possible that the confines of the enclosure ditch contain cut features, but they lack definition and a coherent morphology. It is possible that this feature relates to an enclosure associated with occupation, rather than with a round barrow funerary monument, but this is unresolved without further evaluation.

4.1.2 To the east of the round enclosure ditch are what appear to be a series of rectilinear features, with some evidence of possible phasing. However, the responses lack clarity and are poorly defined compared to the circular enclosure ditch. Despite this, it should be considered that they relate to enclosure ditches with archaeological potential.

4.1.3 Also within the turbine survey area are a number of clusters of positive and negative responses. Some are discrete, others more diffuse and it is possible that there is some association, at least with the northernmost group with thermoremanent magnetism.

4.1.4 Within the remaining cable/access route the data reveal a number of former field boundaries, together with agricultural anomalies. A zone of magnetically variable responses in the central part of the site may be a response to the underlying geology. Towards the western end of the cable route a broad negative linear response may have been partly truncated by agricultural anomalies indicative of ridge and furrow.

5 REFERENCES

Aspinall, A., Gaffney, C. and Schmidt, A., *Magnetometry for Archaeologists*. Lanham (US), AltaMira Press.

British Geological Survey, 2015. *Geology of Britain viewer, 1:50 000 scale [online]* available from http://mapapps.bgs.ac.uk/geologyofbritain/home.html [accessed 17/4/2015].

Chartered Institute for Archaeologists, 2014. *Standard and Guidance for archaeological geophysical survey*. IfA, University of Reading.

Cornwall Council, 2015. *Cornwall Council Interactive Map [online]* available from http://map.cornwall.gov.uk/website/ccmap/ [accessed 17/04/2015]

English Heritage, 2008. *Geophysical survey in archaeological field evaluation. Research and Professional Service Guideline No.1.* 2nd ed. Swindon: English Heritage.

Institute for Archaeologists, 2002. *The use of Geophysical Techniques in Archaeological Evaluations*. IfA Paper No. 6. IfA, University of Reading.

Chartered Institute for Archaeologists, 2014. *Standard and Guidance for archaeological geophysical survey*. IfA, University of Reading.

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 5 South West England.*

Appendix A – basic principles of magnetic survey

Iron minerals are always present to some degree within the topsoil and enhancement associated with human activity is related to increases in the level of magnetic susceptibility and thermoremnant material.

Magnetic susceptibility is an induced magnetism within a material when it is in the presence of a magnetic field. This can be thought of as effectively permanent due to the presence of the Earth's magnetic field.

Thermoremnant magnetism occurs when ferrous material is heated beyond a specific temperature known as the Curie Point. Demagnetisation occurs at this temperature with re-magnetisation by the Earth's magnetic field upon cooling.

Enhancement of magnetic susceptibility can occur in areas subject to burning and complex fermentation processes on biological material; these are frequently associated with human settlement. Thermoremnant features include ovens, hearths, and kilns. In addition thermoremnant material such as tile and brick may also be associated with human activity and settlement.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil can create an area of enhancement compared with surrounding soils and subsoils into which the feature is cut. Mapping enhanced areas will produce linear and discrete anomalies allowing an assessment and characterisation of hidden subsurface features.

It should be noted that areas of negative enhancement can be produced from material having lower magnetic properties compared to the topsoil. This is common for many sedimentary bedrocks and subsoils which were often used in the construction of banks and walls etc. Mapping these 'negative' anomalies may also reveal archaeological features.

Magnetic survey or magnetometry can be carried out using a fluxgate gradiometer and may be referred to as gradiometry. The SENSYS gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 65cm apart. The instrument is carried about 10-20cm above the ground surface and the upper sensor measures the Earth's magnetic field as does the lower sensor but this is influenced to a greater degree by any localised buried field. The difference between the two sensors will relate to the strength the magnetic field created by the buried feature.

There are a number of factors that may affect the magnetic survey and these include soil type, local geology and previous human activity. Situations arise where magnetic disturbance associated with modern services, metal fencing, dumped waste material etc., obscures low magnitude fields associated with archaeological features.

Appendix B – data processing notes

Clipping

Minimum and maximum values are set and replace data outside of the range with those values. Extreme values are removed improving colour or greyscale contrast associated with data values that may be archaeologically significant. It has been found that clipping data to ranges between ±20nT and ±10nT often improves the appearance of features associated with archaeology. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

Zero (destripe) Median/Mean Traverse

The median (or mean) of each traverse is calculated ignoring data outside a threshold value, the median (or mean) is then subtracted from the traverse. The process is used to equalise differences between the baseline value of gradiometer sensors.

High Pass Filtering

A mathematical process used to remove low frequency anomalies relating to survey tracks and modern agricultural features.

Appendix C – survey and data information

Area 1

COMPOSITE
Path: C:\Business\Jobs\J603 South Petherwin\Data\Area 1\comps\
Filename: J603-mag-Area1.xcp
Description: Imported as Composite from: J603-mag-Area1-proc.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y): OGB36
Northwest corner: 231553.529098434, 82322.9726157698 m
Southeast corner: 231865.409098434, 82217.8526157698 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 449100

Dimensions
Composite Size (readings): 2599 x 876
Survey Size (meters): 312 m x 105 m
Grid Size: 312 m x 105 m
X Interval: 0.12 m
Y Interval: 0.12 m

Stats
Max: 22.10
Min: -22.00
Std Dev: 6.88
Mean: 0.17
Median: -0.05
Composite Area: 3.2785 ha
Surveyed Area: 1.5153 ha

PROGRAM
Name: TerraSurveyor
Version: 3.0.23.0

Processes: 1
1 Base Layer

GPS based Proce3
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 Clip from -20.00 to 20.00 nT

Area 2

COMPOSITE

Filename: J603-mag-Area2-proc.xcp
Description: Imported as Composite from: J603-mag-Area2.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y): OSGB36
Northwest corner: 231366.915757785, 82366.4851815484 m
Southeast corner: 231591.675757785, 82264.8451815484 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 284600

Dimensions
Composite Size (readings): 1873 x 847
Survey Size (meters): 225 m x 102 m
Grid Size: 225 m x 102 m
X Interval: 0.12 m
Y Interval: 0.12 m

Stats
Max: 22.10
Min: -22.00
Std Dev: 8.50
Mean: 0.03
Median: -0.04
Composite Area: 2.2845 ha
Surveyed Area: 0.7134 ha

Processes: 1
1 Base Layer

GPS based Proce3
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 Clip from -20.00 to 20.00 nT

Area 3

COMPOSITE
Filename: J603-mag-Area3.xcp
Description: Imported as Composite from: J603-mag-Area3-proc.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y): OSGB36
Northwest corner: 231297.092399177, 82358.2406385884 m
Southeast corner: 231372.572399177, 82249.6406385884 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 134900

Dimensions
Composite Size (readings): 629 x 905
Survey Size (meters): 75.5 m x 109 m
Grid Size: 75.5 m x 109 m
X Interval: 0.12 m
Y Interval: 0.12 m

Stats
Max: 22.10
Min: -22.00
Std Dev: 9.64
Mean: -0.12
Median: 0.00
Composite Area: 0.81971 ha
Surveyed Area: 0.3525 ha

Processes: 1
1 Base Layer

GPS based Proce3
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 Clip from -20.00 to 20.00 nT

Appendix D – digital archive

Archaeological Surveys Ltd hold the primary digital archive at their offices in Wiltshire. Data are backed-up onto an on-site data storage drive and at the earliest opportunity data are copied to CD ROM for storage on-site and off-site. A submission of the report will be made to Online AccesS to the Index of archaeological investigationS (OASIS).

Archive contents:

Geophysical data Area 1 - path: J603 South Petherwin\Data				
Path and Filename	**Software**	**Description**	**Date**	**Creator**
petherwin1\MX\ .prm., dgb., disp	Sensys MXPDA	Proprietary data formats representing magnetometer survey traverses logged to a PDA.	02/04/05	D.J.Sabin
petherwin1\MX\J603-mag-Area1.asc	Sensys DLMGPS	ASCII CSV (tab) file representing survey Area 1 in eastings, northings (UTM Z30N), magnetic measurement, traverse file and sensor number.	10/04/15	D.J.Sabin
Area1\comps\J603-mag-Area1.xcp	TerraSurveyor 3.0.23.0	Composite data file derived from ASCII CSV.	10/04/15	D.J.Sabin
Area1\comps\J603-mag-Area1-proc.xcp	TerraSurveyor 3.0.23.0	Processed composite data file (zmt and clipping to ±20nT).	10/04/15	D.J.Sabin
Geophysical data Area 2 - path: J603 South Petherwin\Data				
petherwin2\MX\ .prm., dgb., disp	Sensys MXPDA	Proprietary data formats representing magnetometer survey traverses logged to a PDA at.	02/04/05	D.J.Sabin
petherwin2\MX\J603-mag-Area2.asc	Sensys DLMGPS	ASCII CSV (tab) file representing survey Area 2 in eastings, northings (UTM Z30N), magnetic measurement, traverse file and sensor number.	10/04/15	D.J.Sabin
Area2\comps\J603-mag-Area2.xcp	TerraSurveyor 3.0.23.0	Composite data file derived from ASCII CSV.	10/04/15	D.J.Sabin
Area2\comps\J603-mag-Area2-proc.xcp	TerraSurveyor 3.0.23.0	Processed composite data file (zmt and clipping to ±20nT).	10/04/15	D.J.Sabin
Geophysical data Area 3 - path: J603 South Petherwin\Data				
petherwin3\MX\ .prm., dgb., disp	Sensys MXPDA	Proprietary data formats representing magnetometer survey traverses logged to a PDA at.	02/04/05	D.J.Sabin
petherwin3\MX\J603-mag-Area3.asc	Sensys DLMGPS	ASCII CSV (tab) file representing survey Area 2 in eastings, northings (UTM Z30N), magnetic measurement, traverse file and sensor number.	10/04/15	D.J.Sabin
Area3\comps\J603-mag-Area3.xcp	TerraSurveyor 3.0.23.0	Composite data file derived from ASCII CSV.	10/04/15	D.J.Sabin
Area3\comps\J603-mag-Area3-proc.xcp	TerraSurveyor 3.0.23.0	Processed composite data file (zmt and clipping to ±20nT).	10/04/15	D.J.Sabin
Graphic data - path: J603 South Petherwin\Data				
Area1\graphics\ J603-mag-Area1-proc.tif	TerraSurveyor 3.0.23.0	TIF file showing a minimally processed greyscale plot clipped to ±3nT.	10/04/15	D.J.Sabin
Area1\graphics\ J603-mag-Area1-proc.tfw	TerraSurveyor 3.0.23.0	World file for georeferencing TIF to OSGB36.	10/04/15	D.J.Sabin
Area2\graphics\ J603-mag-Area2-proc.tif	TerraSurveyor 3.0.23.0	TIF file showing a minimally processed greyscale plot clipped to ±3nT.	10/04/15	D.J.Sabin
Area2\graphics\ J603-mag-Area2-proc.tfw	TerraSurveyor 3.0.23.0	World file for georeferencing TIF to OSGB36.	10/04/15	D.J.Sabin
Area3\graphics\ J603-mag-Area3-proc.tif	TerraSurveyor 3.0.23.0	TIF file showing a minimally processed greyscale plot clipped to ±3nT.	10/04/15	D.J.Sabin
Area3\graphics\ J603-mag-Area3-proc.tfw	TerraSurveyor 3.0.23.0	World file for georeferencing TIF to OSGB36.	10/04/15	D.J.Sabin

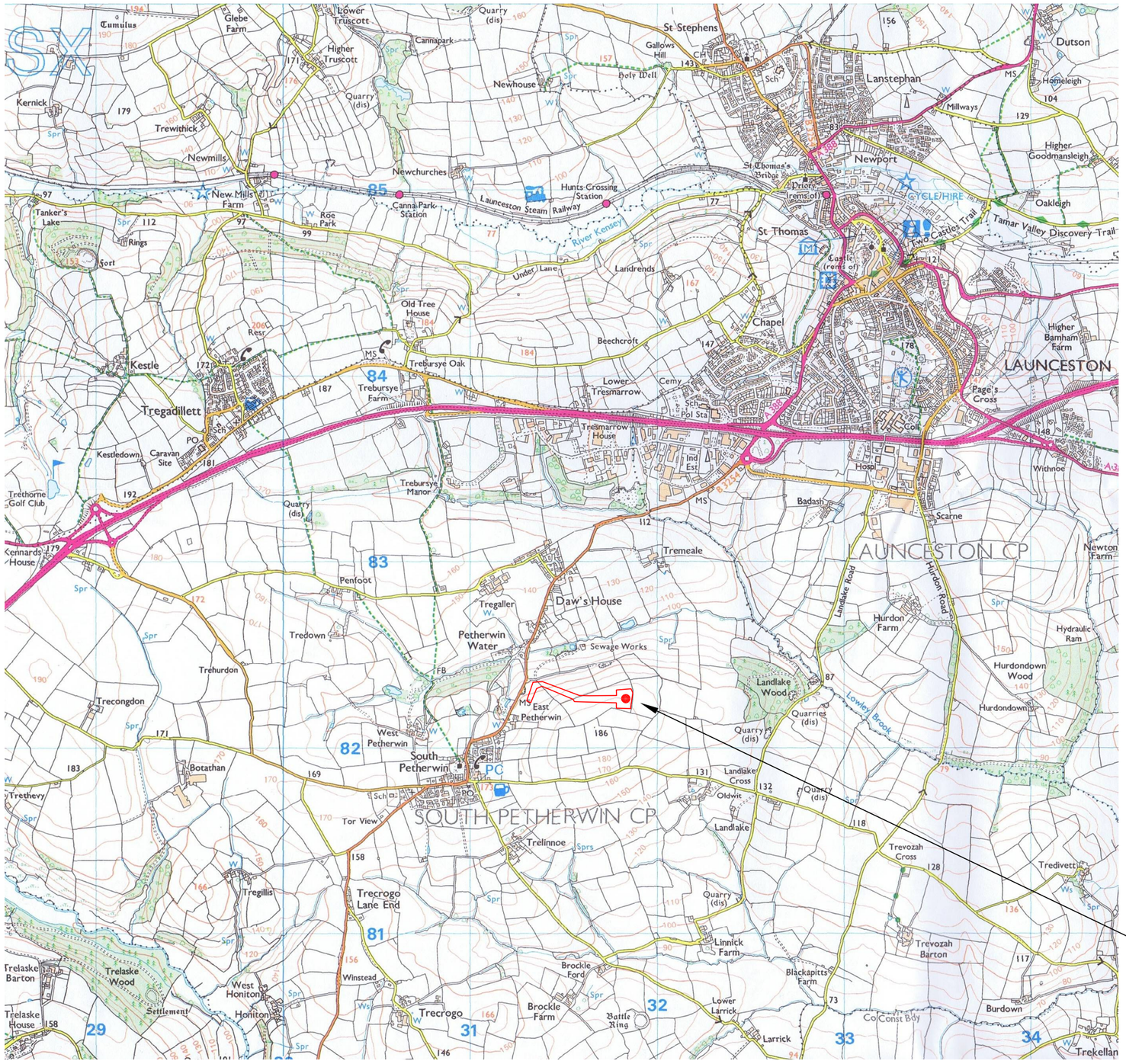
CAD data - path: J603 South Petherwin\CAD				
J603 version 1.dwg	ProgeCAD 2014	CAD file for creating plots of greyscales, abstraction, interpretation and mapping. Grid coordinates as OSGB. AutoCAD 2010 format.		K.T.Donaldson
Text data - path: J603 South Petherwin\Documentation				
J603 report.odt	OpenOffice.org 3.0.1 Writer	Report text as an Open Office document.		K.T.Donaldson

Appendix E – copyright and intellectual property

This report may contain material that is non-Archaeological Surveys Ltd copyright (eg Ordnance Survey, Crown Copyright) or the intellectual property of third parties, which we are able to provide for limited reproduction under the terms of our own copyright licences, but for which copyright itself is non-transferable by Archaeological Surveys Ltd. Users remain bound by the conditions of the Copyright, Design and Patents Act 1988 with regard to multiple copying and electronic dissemination of this report.

Archaeological Surveys Ltd shall retain intellectual property rights for the materials and records created as part of this project. A non-exclusive, transferable, sub-licensable, perpetual, irrevocable and royalty-free licence shall be granted to the client in order for them to use, reproduce and enhance the reports, documentation, graphics and illustrations produced as part of this project for the purpose for which they were commissioned. Copyright licence will also be granted to the local authority for planning use and within in the Historic Environment Record for public dissemination upon payment by the client. Any document produced to meet planning requirements may be freely copied for planning, development control, research and outreach purposes without recourse to the originator, subject to all due and appropriate acknowledgements being provided and to the terms of the original contract with the client. Archaeological Surveys Ltd shall retain the right to be identified as the author and originator of the material.

The report, data and any associated material produced by Archaeological surveys Ltd cannot be freely used for any commercial activity other than those set out above. Any unauthorised use will be considered to be in breach of copyright.

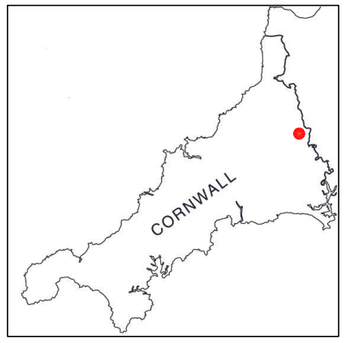


Survey location

Archaeological Surveys Ltd

Geophysical Survey
South Petherwin Wind Turbine
Cornwall

Map of survey area



Survey location

Turbine centred on OS NGR
SX 31828 82271

SCALE 1:25 000

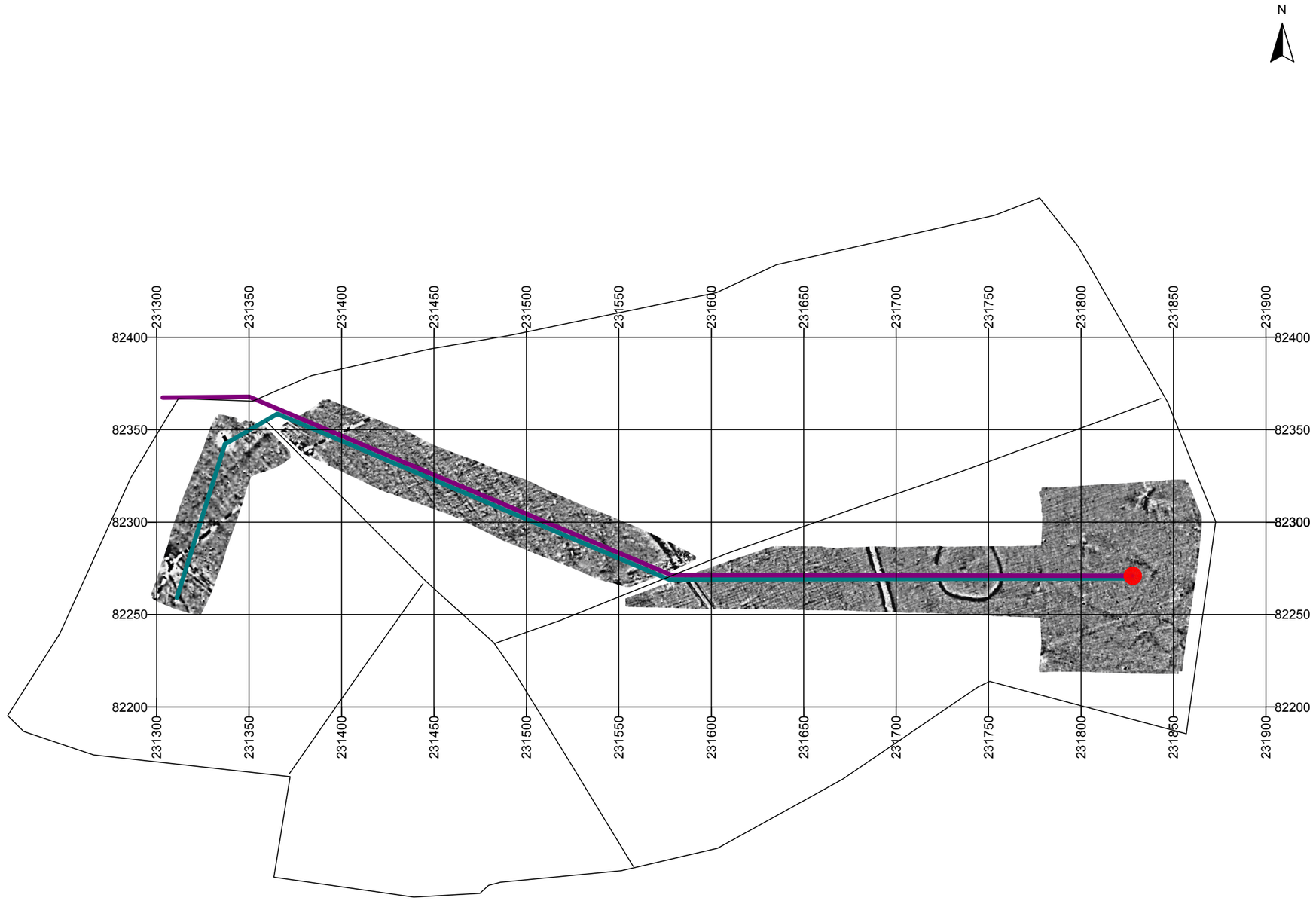
0m 500m 1000m

SCALE TRUE AT A3

FIG 01

Archaeological Surveys Ltd

Geophysical Survey
South Petherwin Wind Turbine
Cornwall



Referencing information

Referencing grid to OSGB36 datum at 50m intervals

Data collected at 20Hz and georeferenced to ETRS89 zone 30 with conversion to OSGB36 using OSTN02

231828 82271

Access route

Cable route

SCALE 1:2500

0m 50 100m

SCALE TRUE AT A3

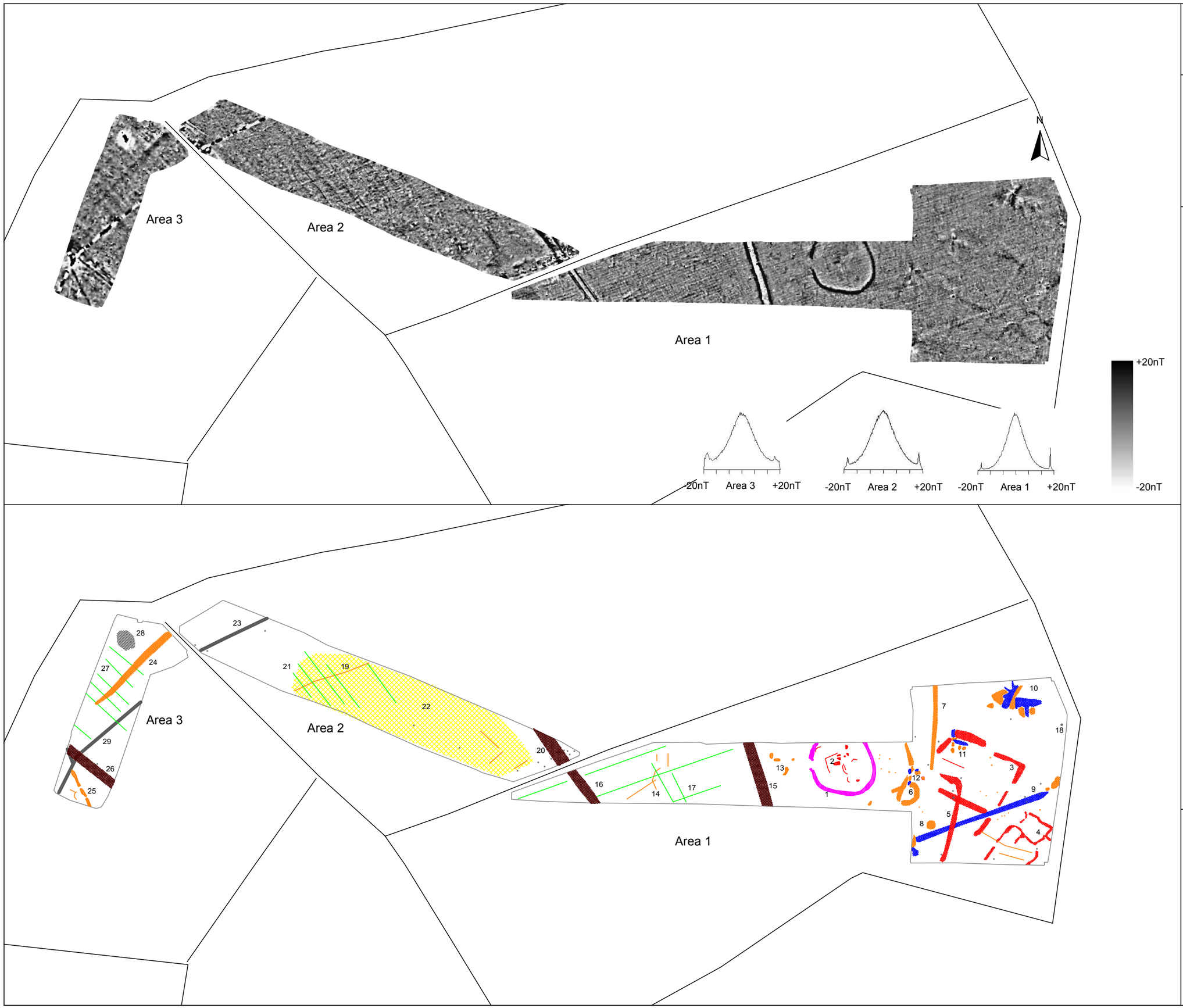
FIG 02

Archaeological Surveys Ltd

Geophysical Survey
South Petherwin Wind Turbine
Cornwall

Greyscale plot of processed magnetometer data and abstraction and interpretation of magnetic anomalies

- Positive linear anomaly - cut feature of archaeological potential
- Positive curvilinear anomaly - ring ditch
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Discrete positive response - cut feature of archaeological potential
- Discrete positive response - possible pit-like feature
- Discrete positive response - material with low magnetic susceptibility
- Negative linear anomaly flanked by positive linear responses - former field boundary
- Negative anomaly - material of low magnetic susceptibility
- Positive anomaly - magnetically enhanced material
- Magnetically variable response - of natural origin
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object



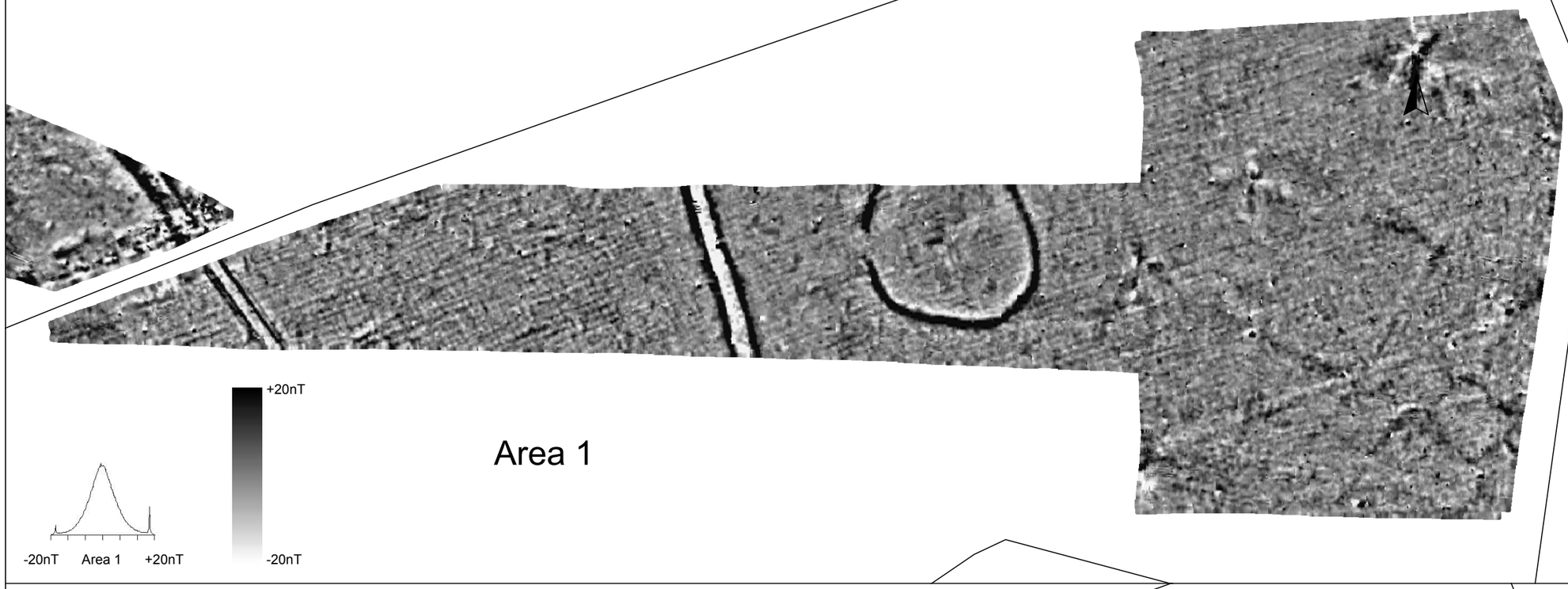
SCALE 1:2000

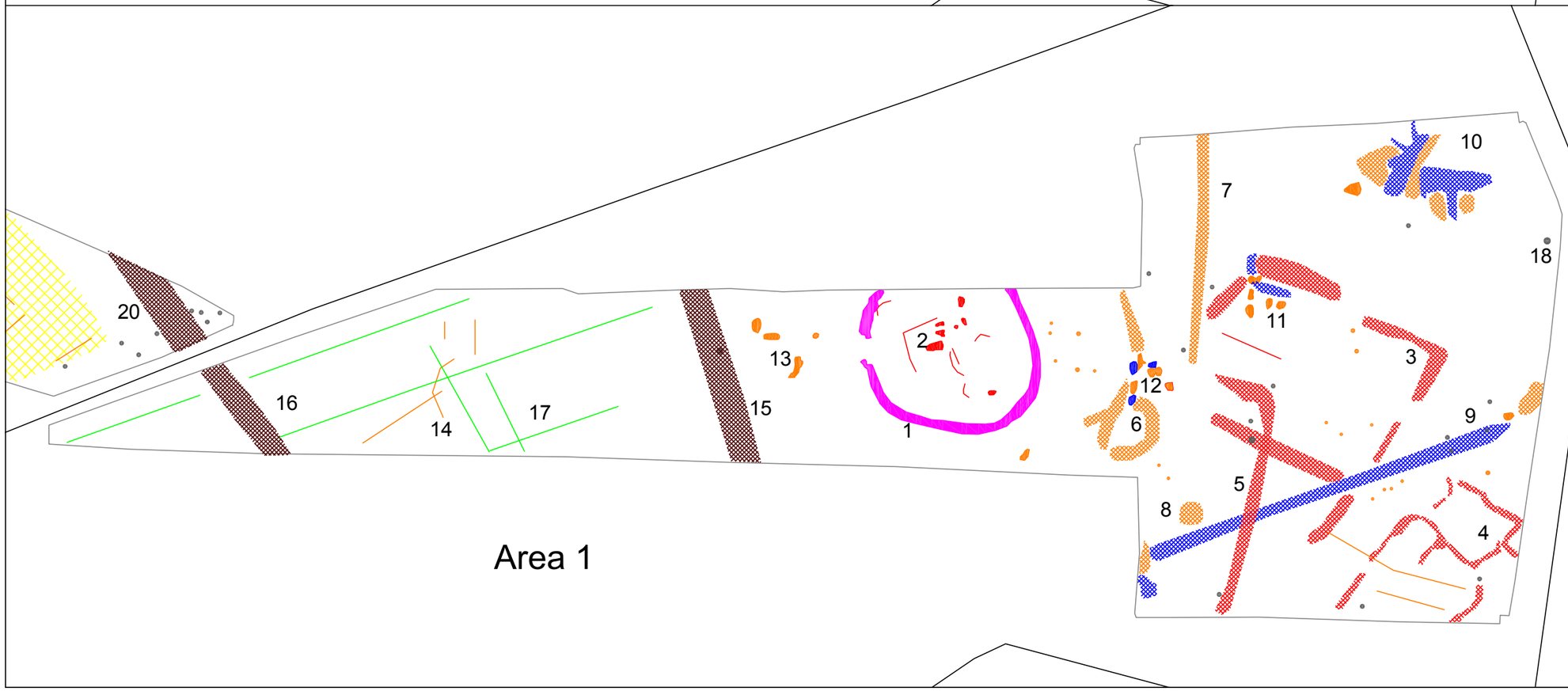
0m 20 40 60 80 100m

SCALE TRUE AT A3

FIG 03

Greyscale plot of minimally processed magnetometer data - Area 1





Archaeological Surveys Ltd

Geophysical Survey
South Petherwin Wind Turbine
Cornwall

Abstraction and interpretation of magnetometer anomalies - Area 1

- Positive linear anomaly - cut feature of archaeological potential
- Positive curvilinear anomaly - ring ditch
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Discrete positive response - cut feature of archaeological potential
- Discrete positive response - possible pit-like feature
- Discrete positive response - material with low magnetic susceptibility
- Negative linear anomaly flanked by positive linear responses - former field boundary
- Negative anomaly - material of low magnetic susceptibility
- Positive anomaly - magnetically enhanced material
- Strong dipolar anomaly - ferrous object

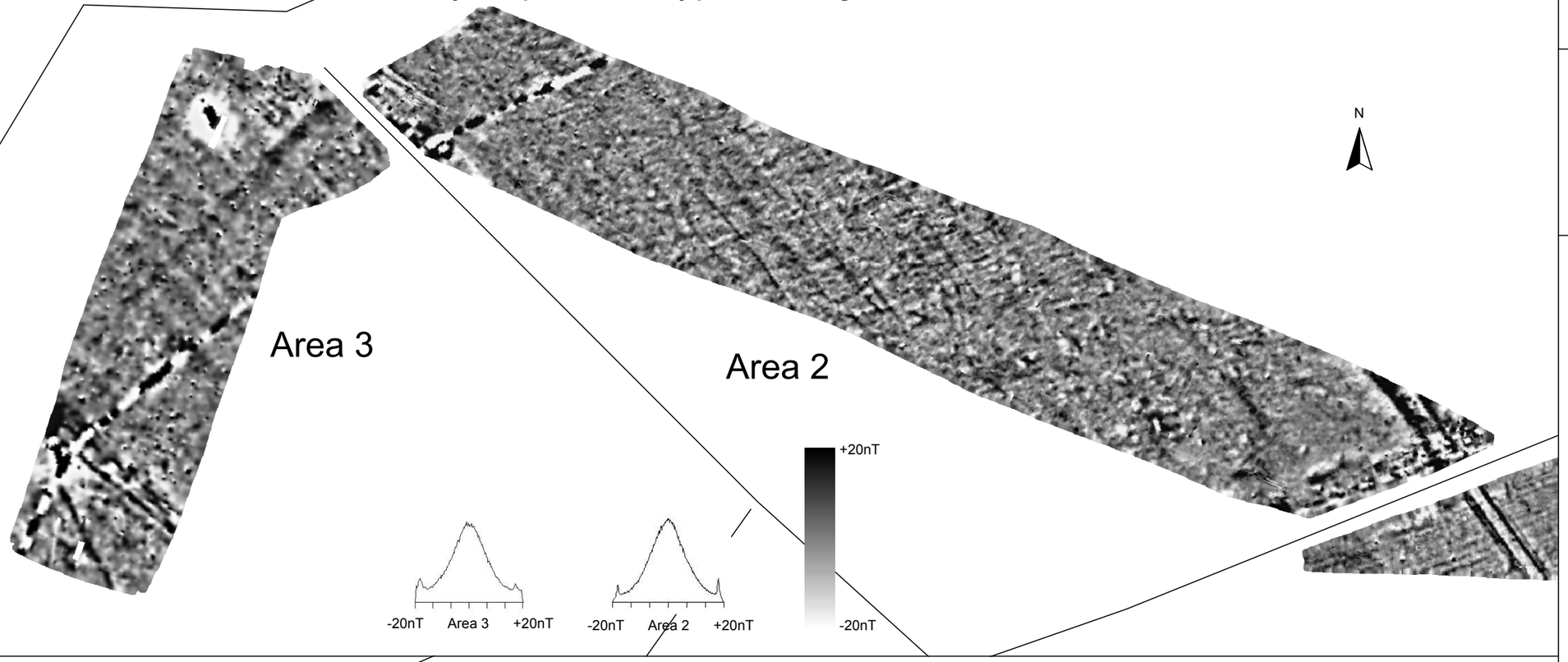
SCALE 1:1000

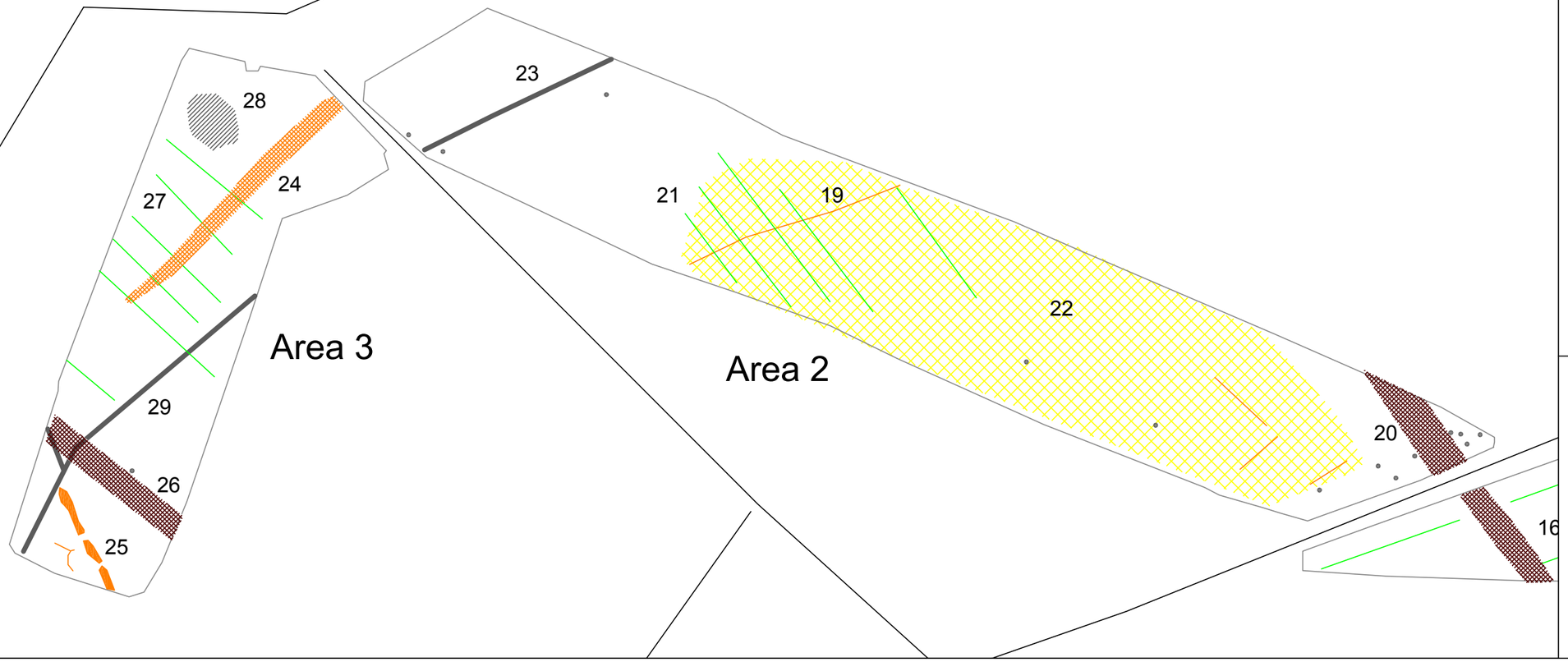
0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 04

Greyscale plot of minimally processed magnetometer data - Areas 2 & 3





Archaeological Surveys Ltd

Geophysical Survey
South Petherwin Wind Turbine
Cornwall

Abstraction and interpretation of magnetometer anomalies - Areas 2 & 3

- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Discrete positive response - possible pit-like feature
- Negative linear anomaly flanked by positive linear responses - former field boundary
- Positive anomaly - magnetically enhanced material
- Magnetically variable response - of natural origin
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 05