ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Wessex Solar Energy

Beaford Brook
Upcott Barton
Devon

geophysical survey

report 3017
October 2012

Durham University

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South Road · Durham · DH1 3LE · tel 0191 334 1121 · fax 0191 334 1126
archaeological.services@durham.ac.uk · www.dur.ac.uk/archaeological.services

1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted in advance of proposed development at Beaford Brook, Upcott Barton, Devon. The works comprised the geomagnetic survey of 14.2ha of farmland.

1.2 The works were commissioned by Wessex Solar Energy and conducted by Archaeological Services Durham University.

Results

1.3 A complex series of ditches forming a multi-phase enclosure system was detected in Area 3. These enclosures probably reflect a relatively long-lived, defended occupation site, perhaps of late prehistoric/Romano-British date.

1.4 A former track was also detected in Area 3.

1.5 Possible soil-filled ditches were detected in Areas 1 and 2.

1.6 Intense anomalies resulting from the modern plough regime were detected in Areas 1 and 2, which could obscure other small or weak anomalies of possible archaeological origin.

1.7 Land drains were detected in all the areas surveyed.

2. Project background

Location (Figure 1)

2.1 The proposed development area was located at Upcott Barton, approximately 500m north of Beaford Brook, in Beaford parish, Devon (NGR centre: SS 5713 1564). Three surveys totalling 14.2ha were conducted in three land parcels. The study area was surrounded by open farmland.

Development proposal

2.2 The development proposal is for a solar farm.

Objective

2.3 The principal aim of the surveys was to assess the nature and extent of any sub-surface features of potential archaeological significance within the proposed development area, so that an informed decision may be made regarding the nature and scope of any further scheme of archaeological works that may be required in relation to the development.

Methods statement

2.4 The surveys have been undertaken in accordance with instructions from the client and in line with national standards and guidance (see para. 5.1 below).

Dates

2.5 Fieldwork was undertaken between 8th and 12th October 2012. This report was prepared for 31th October 2012.

Personnel

2.6 Fieldwork was conducted by Natalie Swann (Supervisor) and Nathan Thomas. The geophysical data were processed by Natalie Swann. This report was prepared by Natalie Swann, with illustrations by David Graham, and edited by Duncan Hale, the Project Manager.

Archive/OASIS

2.7 The site code is **DBB12**, for **D**evon **B**eaford **B**rook 20**12**. The survey archive will be supplied on CD to the client for deposition with the project archive in due course. Archaeological Services Durham University is registered with the **O**nline **A**cces**S** to the **I**ndex of archaeological investigation**S** project (**OASIS**). The OASIS ID number for this project is **archaeol3-136348**.

3. Historical and archaeological background

Previous archaeological works

3.1 An archaeological desk-based assessment has previously been undertaken for the proposed development area (Archaeological Services 2010a). The results of that report are summarised here.

3.2 There is no direct evidence for prehistoric or Roman activity within the proposed development area but a number of sites are recorded in the wider area, including a multi-vallate enclosure at Cowflop Cross 1km south-east of the present site (Archaeological Services 2010b & 2011), indicating that an as yet unidentified resource has the potential to exist within the proposed development area.

3.3 The proposed development area is situated in an area of medieval manors and farmsteads, the nearest being 300m to the west at Upcott Barton. While there is no direct evidence that the site was exploited during this period it is likely that it was used for farming practices at this time.

3.4 During the post-medieval period the site was used for farming, and this has remained the case through to the present day. Field boundaries removed during these periods of activity have the potential to survive as buried features.

4. Landuse, topography and geology

4.1 At the time of survey the proposed development area comprised two fields of arable land and one of pasture. Both arable fields had unploughed borders where it was not possible to collect data due to overgrown vegetation. It was also not possible to collect data at the north end of the pasture field (Area 3) due to boggy ground conditions and tall reeds.

4.2 The proposed development area was situated on top of and along the north-west-facing slope of the western spur of a small hill, with a minimum elevation of approximately 140m OD and a maximum elevation of approximately 166m OD.

4.3 The underlying solid geology of the area comprises Carboniferous Crackington Formation Sandstone, which is overlain in the northern part of the site by river terrace deposits.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage guidelines, *Geophysical survey in archaeological field evaluation* (David, Linford & Linford 2008); the Institute for Archaeologists (IfA) *Standard and Guidance for archaeological geophysical survey* (2011); the IfA Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Guide to Good Practice: Geophysical Data in Archaeology* (Schmidt & Ernenwein 2011).

Technique selection

5.2 Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a suite of complementary techniques such as magnetometry, earth electrical resistance, ground-penetrating radar, electromagnetic survey and topsoil magnetic susceptibility survey. Some techniques are more suitable than others in particular situations, depending on site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.

5.3 In this instance, based on the desk-based assessment, it was considered likely that cut features such as ditches and pits might be present on the site, and that other types of feature such as trackways, wall foundations and fired structures (for example kilns and hearths) might also be present.

5.4 Given the anticipated shallowness of targets and the non-igneous geological environment of the study area a geomagnetic technique, fluxgate gradiometry, was considered appropriate for detecting the types of feature mentioned above. This technique involves the use of hand-held magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect archaeological features.

Field methods

5.5 A 30m grid was established across each survey area and related to known, mapped Ordnance Survey points and the National Grid using a Leica GS15 global navigation satellite system (GNSS) with real-time kinematic (RTK) corrections typically providing 10mm accuracy.

5.6 Measurements of vertical geomagnetic field gradient were determined using Bartington Grad601-2 dual fluxgate gradiometers. A zig-zag traverse scheme was employed and data were logged in 30m grid units. The instrument sensitivity was nominally 0.03nT, the sample interval was 0.25m and the traverse interval was 1m, thus providing 3,600 sample measurements per 30m grid unit.

Data processing

5.7 Geoplot v.3 software was used to process the geophysical data and to produce both continuous tone greyscale images and trace plots of the raw (minimally processed) data. The greyscale images and interpretations are presented in Figures 2-5; the trace plots are provided in Figure 6. In the greyscale images, positive magnetic anomalies are displayed as dark grey and negative magnetic anomalies as light grey. Palette bars relate the greyscale intensities to anomaly values in nanoTesla.

5.8 The following basic processing functions have been applied to the data:

clip	clips data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic
zero mean traverse	sets the background mean of each traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities
destagger	corrects for displacement of geomagnetic anomalies caused by alternate zig-zag traverses
interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

Interpretation: anomaly types

5.9 Colour-coded geophysical interpretations are provided. Three types of geomagnetic anomaly have been distinguished in the data:

positive magnetic	regions of anomalously high or positive magnetic field gradient, which may be associated with high magnetic susceptibility soil-filled structures such as pits and ditches
negative magnetic	regions of anomalously low or negative magnetic field gradient, which may correspond to features of low magnetic susceptibility such as wall footings and other concentrations of sedimentary rock or voids
dipolar magnetic	paired positive-negative magnetic anomalies, which typically reflect ferrous or fired materials (including fences and service pipes) and/or fired structures such as kilns or hearths

Interpretation: features

General comments

5.10 Colour-coded archaeological interpretation plans are provided.

5.11 Small, discrete dipolar magnetic anomalies have been detected in all of the survey areas. These almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes and brick fragments, and in most cases have little or no archaeological significance. A sample of these is shown on the geophysical interpretation plan, however, they have been omitted from the archaeological interpretation plans and the following discussion.

Area 1

5.12 A weak linear positive magnetic anomaly was detected aligned approximately north-west/south-east, which could reflect a soil-filled feature such as a former ditch.

5.13 A linear positive magnetic anomaly was also detected along the southern edge of the survey area, which is likely to reflect a former boundary ditch, now backfilled. Traces of a second boundary ditch along the western edge of the survey were also detected.

5.14 Four linear dipolar magnetic anomalies were detected aligned approximately north-west/south-east; these are likely to reflect land drains.

5.15 The majority of anomalies detected in this survey area were narrow, alternate parallel positive and negative magnetic anomalies, which created a striated ‘texture’ across the survey. This reflects the modern plough regime. Linear negative magnetic anomalies near the edges of fields are also associated with current farming practices. The anomalies creating this texture are relatively strong and could obscure other small or weak anomalies of possible archaeological origin, for example the possible remains of ring-ditches. The plough-derived anomalies are not present in the eastern part of the area, which at the time of the survey was much boggier than the rest of the field. This may indicate that this part of the field does not have the same history of ploughing.

Area 2

5.16 The alternate parallel positive and negative magnetic anomalies reflecting the modern plough regime are also present in this area; again the intensity of these anomalies could obscure other small or weak anomalies of possible archaeological origin. Some possible features have been identified.

5.17 A series of linear dipolar magnetic anomalies reflecting a system of land drains was also detected in this area.

5.18 Two small areas were not surveyed in the south-west corner: the larger area was flooded and the smaller area contained hay bales.

Area 3

5.19 A concentration of strong positive magnetic anomalies was detected in the northern half of the survey area. These anomalies almost certainly reflect soil-filled ditches and appear to form a complex, multi-phase, enclosure system. The strength of the anomalies may indicate that a lot of organic and/or burnt material was incorporated in the ditchfills, perhaps indicating relatively long-lived occupation here. Given the site's location within a landscape containing a number of later prehistoric sites, such as the nearby multi-vallate enclosure at Cowflop Cross (Archaeological Services 2010a & 2011), it is possible that the enclosures found here may also be prehistoric in date.

5.20 Two parallel positive magnetic anomalies detected in the southern half of this survey area reflect a former double-ditched track shown on historic maps.

5.21 Five linear negative magnetic anomalies were also detected in this area, which are likely to reflect land drains.

6. Conclusions

6.1 14.2ha of geomagnetic survey was undertaken at Upcott Barton, Devon, prior to proposed development of Beaford Brook Solar Farm.

6.2 A complex series of ditches forming a multi-phase enclosure system was detected in Area 3. These enclosures probably reflect a relatively long-lived, defended occupation site, perhaps of late prehistoric/Romano-British date.

6.3 A former track was also detected in Area 3.

6.4 Possible soil-filled ditches were detected in Areas 1 and 2.

6.5 Intense anomalies resulting from the modern plough regime were detected in Areas 1 and 2, which could obscure other small or weak anomalies of possible archaeological origin.

6.6 Land drains were detected in all the areas surveyed.

7. Sources

Archaeological Services 2010a *Land at Upcott Barton, Devon: archaeological desk-based assessment.* Unpublished report **2520.** Archaeologicla Services Durham University

Archaeological Services 2010b *Land at Cowflop Cross, Devon: archaeological desk-based assessment.* Unpublished report **2521**. Archaeological Services Durham University

Archaeological Services 2011 *Land at Cowflop Cross: geophysical surveys.* Unpublished report **2588.** Archaeological Services Durham University

David, A, Linford, N, & Linford, P, 2008 *Geophysical Survey in Archaeological Field Evaluation*. English Heritage

Gaffney, C, Gater, J, & Ovenden, S, 2002 *The use of geophysical techniques in archaeological evaluations*. Technical Paper **6**, Institute of Field Archaeologists

IfA 2011 *Standard and Guidance for archaeological geophysical survey*. Institute for Archaeologists

Schmidt, A, & Ernenwein, E, 2011 *Guide to Good Practice: Geophysical Data in Archaeology*. Archaeology Data Service

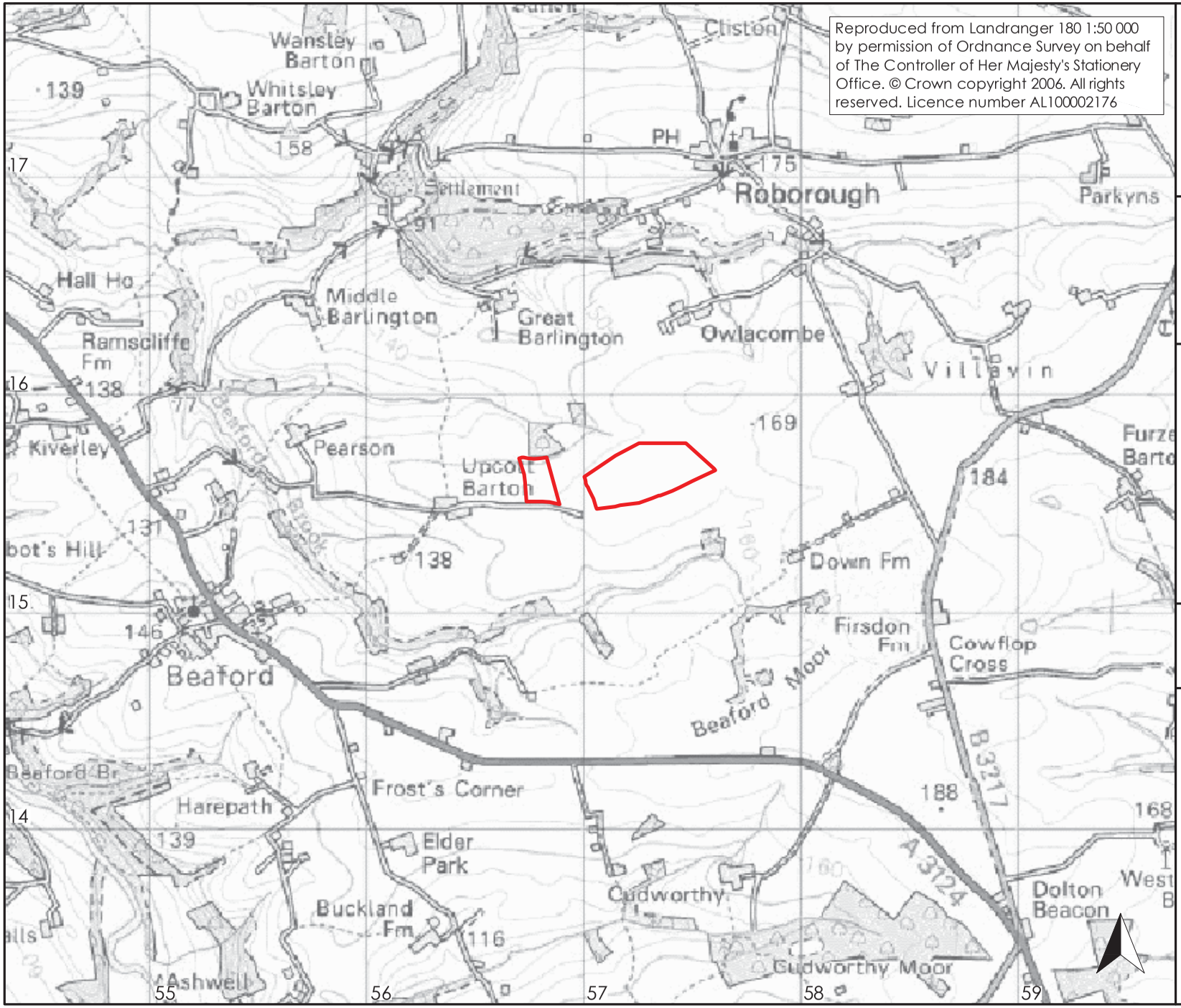

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Figure 1: Site location

0 1km
scale 1:25 000 for A4 plot

survey areas

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magnetic survey
-20 Areas 1-2 nT 20
-5 Area 3 nT 5

0 100m
scale 1:2500 for A3 plot

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Figure 2: Geophysical survey overview

magnetic survey

scale 1:1000 for A0 plot

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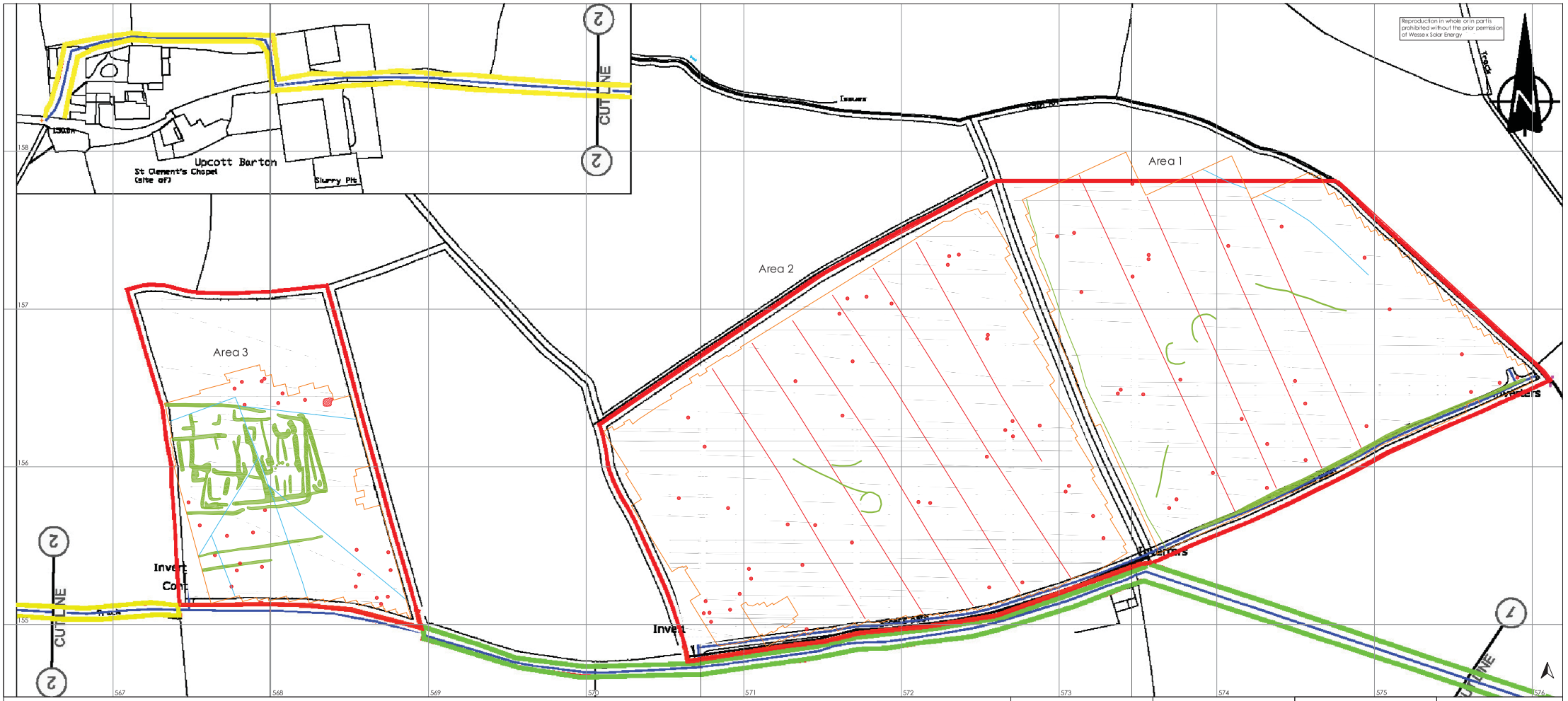
Figure 3: Geophysical survey



magnetic survey
dipolar magnetic anomaly
positive magnetic anomaly
negative magnetic anomaly

scale 1:1000 for A0 plot

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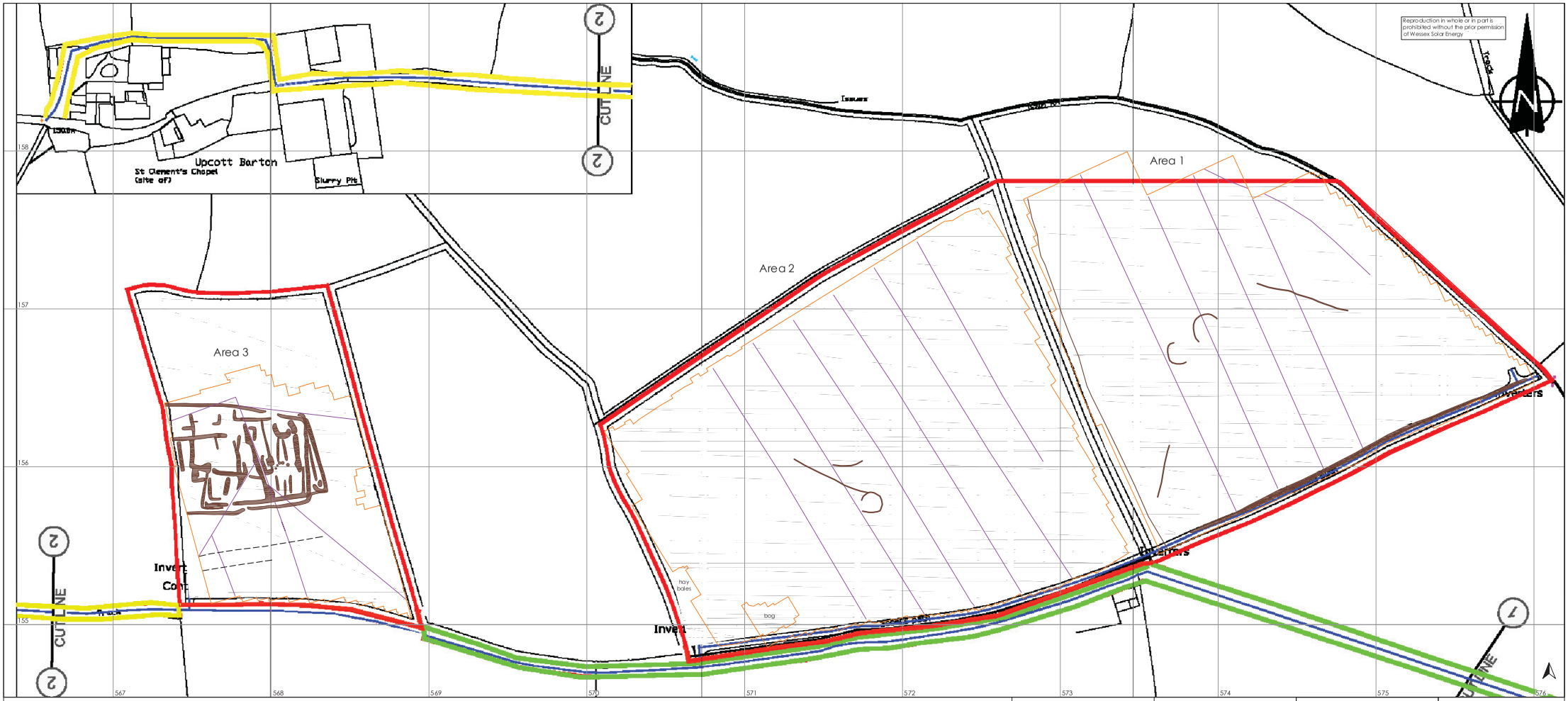
Figure 4: Geophysical interpretation



magnetic survey
soil-filled feature
land drain
track / former field boundary

scale 1:1000 for A0 plot

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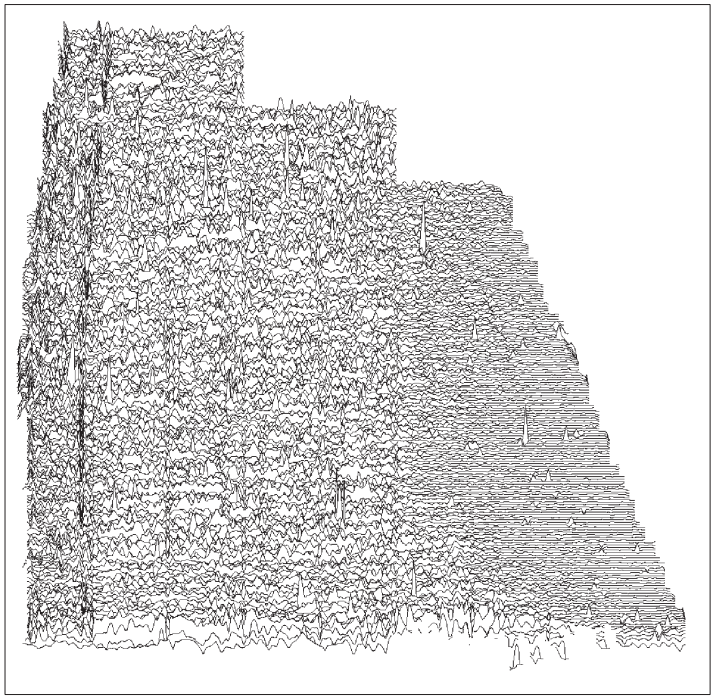
Figure 5: Archaeological interpretation

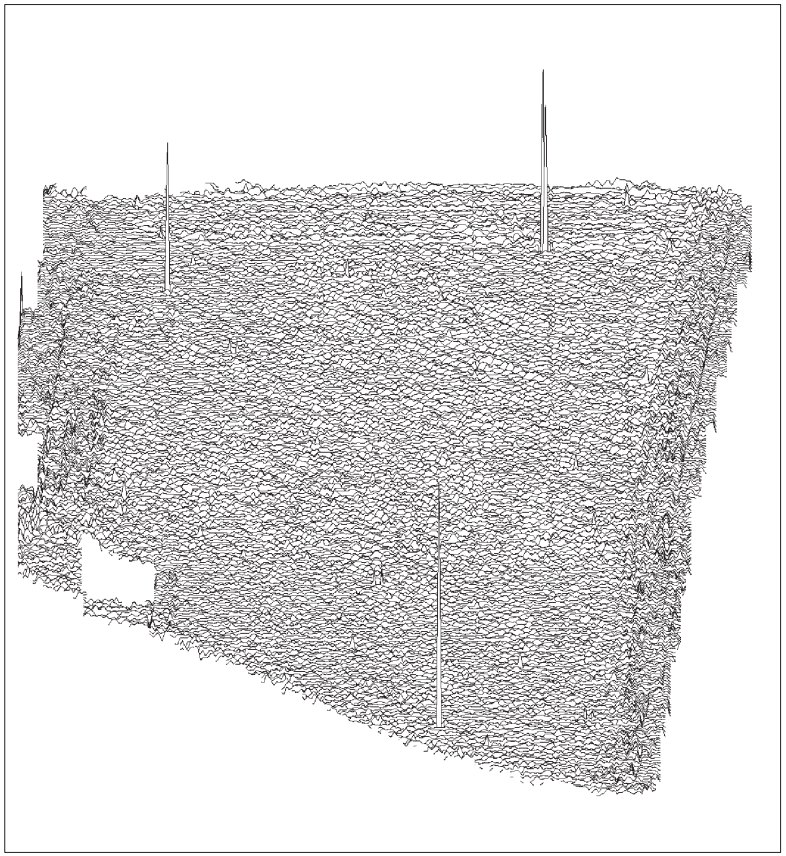
Area 1

78.90nT/cm



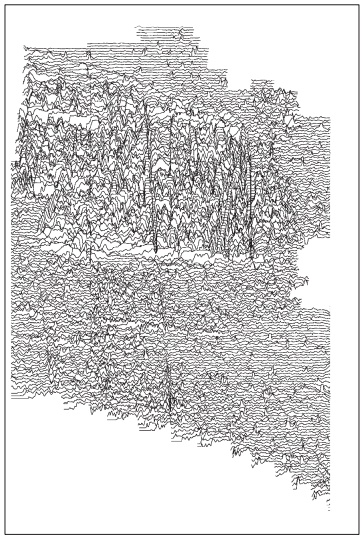
Area 2

250.70nT/cm



Area 3

39.60nT/cm



0 50m

scale 1:1000 for A1 plot

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Figure 6: Trace plots of geomagnetic data