ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Wessex Solar Energy

Land at Cowflop Cross
Beaford
Devon

geophysical survey

report 2588
February 2011

Durham University

Contents

Figures

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1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted on land at Cowflop Cross, near Beaford, in Devon. The works comprised geomagnetic surveys of four fields totalling approximately 23.5ha.

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

Results

1.3 The surveys in Areas 1 and 2 have confirmed the survival of a significant archaeological resource in parts of those areas, in the form of enclosures previously noted on an aerial photograph. An oval ditched enclosure with possible internal features, perhaps a late prehistoric farmstead, has been recorded in the lower ground of Area 1. A multi-vallate enclosure complex has been detected on the high ground in Area 2, with probable internal and external features; this could be considered to be a small hillfort.

1.4 Several less substantial anomalies in Areas 1-3 could also reflect the remains of former ditched features, of unknown date but possibly contemporary with the enclosures.

1.5 Former field boundaries and tracks have been detected across the proposed development area. Most of these are likely to be post-medieval or recent.

1.6 Existing or former plough regimes have resulted in a geomagnetic 'texture' of striations being recorded across each survey area. These striations are relatively strong and could have obscured other weaker anomalies of possible archaeological interest, both within the enclosures and elsewhere.

2. Project background

Location (Figures 1 and 2)

2.1 The proposed development area is located at Cowflop Cross, in the parish of Beaford, Devon (NGR centre: SS 5843 1505). It comprises four fields in a rural landscape, between Beaford village and the B3217 road, approximately 20km due south of Barnstaple.

Development proposal

2.2 The development proposal is for a solar farm. The details of the proposed construction techniques, including any associated works that will have a below-ground impact, are detailed in an environmental statement.

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 were undertaken in accordance with instructions from the client and in accordance with current national standards and guidance (see paragraph 5.1 below).

Planning guidance

2.5 This report and its recommendations are a considered response to the proposed development in relation to Government policy, as it is set out in *Planning Policy Statement 5: Planning for the Historic Environment*, and the *Historic Environment Planning Practice Guide*.

Dates

2.6 The surveys were undertaken between 10th and 14th January 2011. This report was prepared for 4th February 2011.

Personnel

2.7 Fieldwork was conducted by Jamie Armstrong, Edward Davies, Duncan Hale and Natalie Swann (Supervisor). Data processing and report preparation was by Duncan Hale, the Project Manager, with illustrations by Janine Watson.

Archive/OASIS

2.8 The site code is **FDF11** for **F**irsdon **D**own **F**arm 20**11**. 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 **archaeol3-92574**.

3. Historical and archaeological background

3.1 An archaeological desk-based assessment of the proposed development was conducted by Archaeological Services (2010). The results of the assessment are summarised below:

3.2 There is no evidence of activity in the proposed development area or in the study area prior to the Neolithic period. However, there is the potential that an as yet unidentified resource relating to this period may survive within the proposed development area.

3.3 Several prehistoric barrows have been identified 300m to the south of the proposed development area; some of the monuments are Scheduled. There is the potential for similar monuments to exist in the surrounding area, and evidence for as yet unidentified barrows or associated activity may exist within the proposed development area.

3.4 Two soilmarks recorded on aerial photographs have been interpreted as later prehistoric enclosures within the northern and south-western parts of the proposed development area. These may be settlement sites comprising a significant archaeological resource.

3.5 The north-west corner of the site has been identified by the Historic Landscape Characterisation project as being potentially part of a medieval field system. Archaeological and palaeoenvironmental evidence may survive within or beneath the existing boundaries.

3.6 Evidence of post-medieval and modern activity is likely to be limited to agricultural practices, mainly ploughing. This is likely to have caused some damage to any surviving archaeological remains, but is unlikely to have completely truncated all deposits.

4. Landuse, topography and geology

4.1 At the time of survey, the proposed development area comprised three arable fields carrying a young cereal crop (Areas 1-3) and one pasture field to the west used for horses (Area 4). The ground in the arable fields was very soft, clayey and waterlogged in places.

4.2 The proposed development area occupied the broad flat top and gentle western slopes of a slight hill. The highest point of the site was at the boundary between Areas 1 and 2, at approximately 193m OD; the lowest parts of the site were in the west at approximately 175m OD.

4.3 The underlying solid geology of the area comprises Carboniferous sandstone of the Crackington Formation.

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) *Draft Standard and Guidance for archaeological geophysical survey* (2010); 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* (draft 2nd edition, Schmidt & Ernenwein 2010).

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 research and cropmarks, it was considered likely that cut features such as ditches and pits would 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 tied-in to known, mapped Ordnance Survey points using a Trimble Pathfinder Pro XRS global positioning system with real-time correction.

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.

5.7 Data were downloaded on site into a laptop computer for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Data processing

5.8 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.

5.9 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

5.10 A colour-coded geophysical interpretation plan is 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

5.11 A colour-coded archaeological interpretation plan is provided.

5.12 Except where stated otherwise in the text below, positive magnetic anomalies are taken to reflect relatively high magnetic susceptibility materials, typically sediments in cut archaeological features (such as ditches or pits) whose magnetic susceptibility has been enhanced by decomposed organic matter or by burning.

5.13 Small, discrete dipolar magnetic anomalies have been detected in each survey area. 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 plans,

however, they have been omitted from the archaeological interpretation plans and the following discussion.

5.14 The modern plough regime is evident in the magnetic data for Areas 1, 2 and 3, as narrow, parallel positive and negative magnetic anomalies forming a striated 'texture' across each ploughed area. Similarly, a former plough texture is evident in the magnetic data for Area 4. The anomalies creating this texture in each area are relatively strong and could obscure other small or weak anomalies of possible archaeological origin. Linear negative magnetic anomalies near the edges of fields are also associated with current farming practices.

Area 1

5.15 The most prominent anomaly recorded in this area comprises an oval positive magnetic anomaly, measuring up to 65m in length and up to 48m in width, in the lower-lying ground to the west. The anomaly almost certainly reflects a soil-filled ditch forming an enclosure, and corresponds to a soilmark noted on a 1948 RAF aerial photograph. Further weak anomalies detected within the enclosure probably reflect the remains of either a less substantial internal ditch circuit or a palisade trench. No entrance causeway has been identified in the survey. This enclosure could be a late prehistoric settlement site and is included in the county Historic Environment Record (HER 309).

5.16 Several smaller and weaker positive magnetic anomalies in this area are likely to reflect the remains of other soil-filled ditches, of unknown date but possibly contemporary with the oval enclosure.

5.17 Other more prominent anomalies in this field are aligned broadly north-south and correspond to a former field boundary and adjacent ditched trackway, as shown on early Ordnance Survey (OS) maps and the aerial photograph above.

Area 2

5.18 The survey of this area is dominated by curvilinear positive magnetic anomalies which almost certainly reflect soil-filled ditches. The most prominent features are three concentric, oval ditch circuits on the higher ground in the southern half of the field. The outermost circuit measures up to 130m in length and 105m in width; the south-western part of this ditch appears to underlie the existing field boundary. The innermost curvilinear anomaly is slightly narrower and weaker than the outer two, and this could reflect either a less substantial internal ditch circuit or a palisade trench. Other weak anomalies here almost certainly indicate the survival of some of internal features. One possible causewayed entrance has been identified to the north in the outermost ditch circuit. This complex also corresponds to a soilmark noted on a 1948 RAF aerial photograph and appears to be a defended, multi-vallate settlement site, possibly a small hillfort, which again may be late prehistoric in origin. This site is also included in the county Historic Environment Record (HER 293).

5.19 A further curvilinear anomaly to the immediate north of the outermost ditch almost certainly reflects another ditched enclosure. It is not clear if this smaller oval enclosure is contemporary with and part of the larger complex, forming an annex for example, or if the enclosure pre-or post-dates the small hillfort.

5.20 Several other positive magnetic anomalies were also detected in this field. These are also likely to reflect soil-filled ditches. The linear nature of these could indicate that

they reflect former field boundaries, or possibly a double-ditched trackway in the north, however, the date of these features is unknown and they could be contemporary with the enclosure. Only one of the features, which crosses the enclosure circuits, is shown as a former field boundary on early OS maps.

Area 3

5.21 Aside from the plough texture, most of the anomalies in this field correspond to post-medieval field boundaries and a track, again as shown on former OS maps. Some less substantial ditch features here might reflect earlier field boundaries.

5.22 Two relatively large, intense dipolar magnetic anomalies in the southern part of this field are likely to reflect buried ferrous or fired debris.

Area 4

5.23 Two strong positive magnetic anomalies across this area represent a continuation of the post-medieval track and boundary detected in Area 3.

5.24 Aside from a former ploughing regime, no other significant anomalies have been detected in this field.

6. Conclusions

6.1 Detailed geomagnetic survey was undertaken on land near Cowflop Cross, Beaford parish, Devon, prior to proposed development.

6.2 The surveys in Areas 1 and 2 have confirmed the survival of a significant archaeological resource in parts of those areas, in the form of enclosures previously noted on an aerial photograph. An oval ditched enclosure with possible internal features, perhaps a late prehistoric farmstead, has been recorded in the lower ground of Area 1. A multi-vallate enclosure complex has been detected on the high ground in Area 2, with probable internal and external features; this could be considered to be a small hillfort.

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6.5 Existing or former plough regimes have resulted in a geomagnetic ‘texture’ of striations being recorded across each survey area. These striations are relatively strong and could have obscured other weaker anomalies of possible archaeological interest, both within the enclosures and elsewhere.

7. Sources

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

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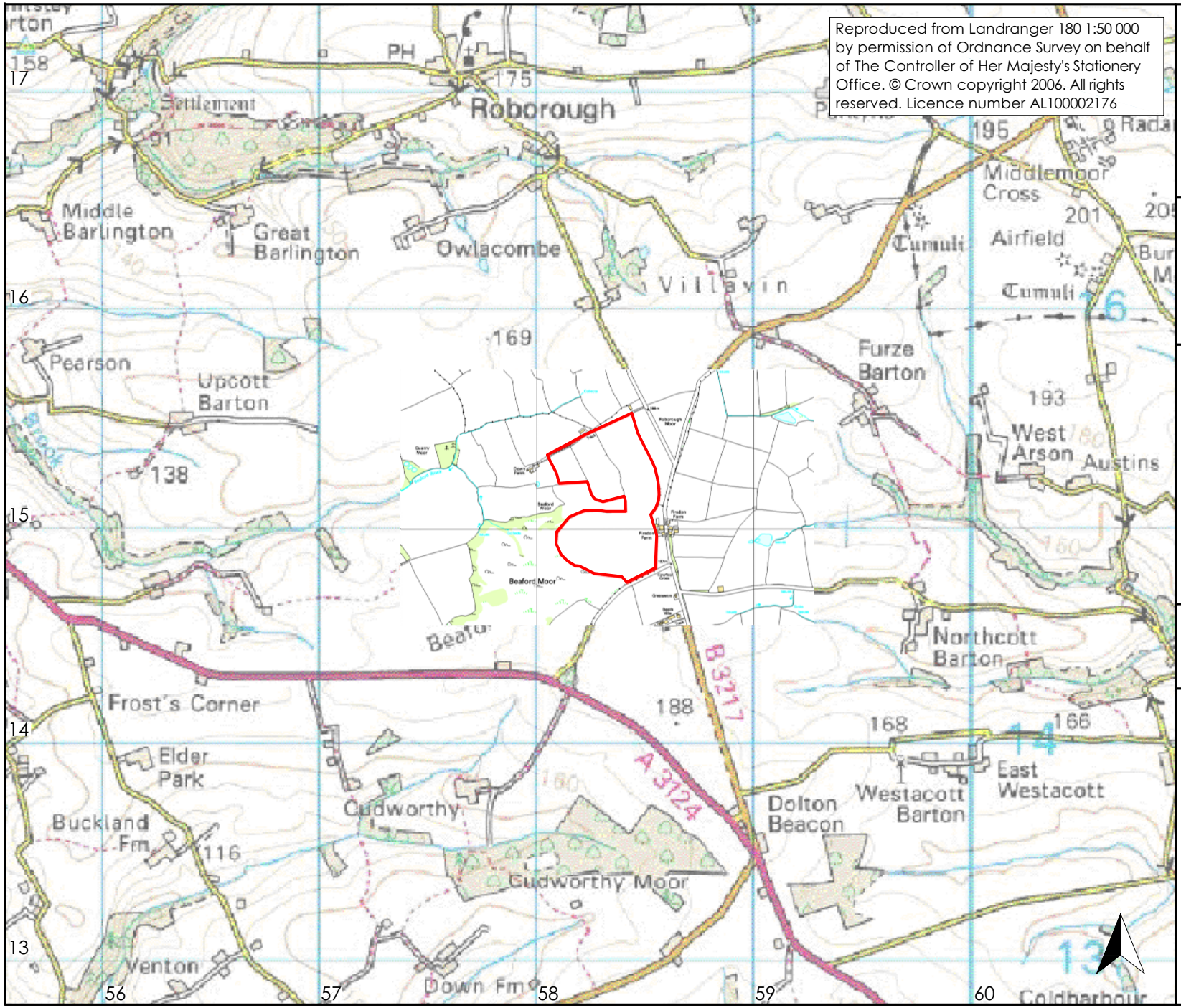

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Figure 1: Site location

0 1km
scale 1:25 000 for A4 plot

site location

site boundary

magnetic survey

-12 nT 15

0.91m RH

Track

Area 2

Area 4

Area 3

Def

Firsdon Farm

150

Area 1

580

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0 100m

scale 1:2500 for A3 plot

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Figure 2: Geophysical survey overview

Area 1

Area 2

Area 3

Area 4

0.91m RH

Track

CB

Def

Firsdon Farm

155
154
153
152
151
150
149
148
581
582
583
584
585
586

site boundary

magnetic survey

-12 nT 15

0 50m

scale 1:1000 for A1 plot

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Figure 3: Geophysical surveys

Area 1

Area 2

Area 3

Area 4

0.91m RH

Track

CB

Def

Firsdon Farm

155
154
153
152
151
150
149
148
581
582
583
584
585
586

magnetic survey
dipolar magnetic anomaly
positive magnetic anomaly
negative magnetic anomaly

0 50m
scale 1:1000 for A1 plot

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Figure 4: Geophysical interpretation

0.91m RH

Track

Area 2

CB

Area 4

Area 3

Def

0.91m RH

Firsdon Farm

0.91m RH

CB

Area 1

155
154
153
152
151
150
149
148
581
582
583
584
585
586

magnetic survey
soil-filled feature
?recent ferrous debris
track / former field boundary

0 50m
scale 1:1000 for A1 plot

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Figure 5: Archaeological interpretation

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Figure 6:
Trace plots of geomagnetic data