ARCHAEOLOGICAL SERVICES WYAS

Land to the rear of Millham House
Bishop's Cleeve
Gloucestershire

Geophysical Survey

Report no. DRAFT

February 2015

Client: Headland Archaeology Ltd

REGISTERED CIfA ORGANISATION

Land to the rear of Millham House
Bishop's Cleeve
Gloucestershire

Geophysical Survey

Summary

A geophysical (magnetometer) survey covering approximately 1.6 hectares, was carried out on land on the northern periphery of Bishop's Cleeve in advance of the proposed development of the site for housing. Although numerous anomalies indicative of probable prehistoric activity have been identified immediately east of the site there is no evidence from the survey that this activity extends into the current site. Anomalies due to the former agricultural practice of ridge and furrow cultivation have, however, been recorded throughout. On the basis of the geophysical survey, the archaeological potential of the site is considered to be low.

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Report Information

Client:	Headland Archaeology Ltd.
Address:	Unit 1, Premier Business Park, Faraday Road, Hereford, HR4 9NZ
Report Type:	Geophysical Survey
Location:	Bishop's Cleeve
County:	Gloucestershire
Grid Reference:	SO 956 285
Period(s) of activity:	post-medieval
Report Number:	DRAFT
Project Number:	4367
Site Code:	BCL15
OASIS ID:	archaeol11-
Planning Application No.:	14/01223/APP
Museum Accession No.:	n/a
Date of fieldwork:	February 2015
Date of report:	February 2015
Project Management:	Sam Harrison BSc MSc MCIfA
Fieldwork:	Alex Schmidt BA
	Becky Goulding BA MSc (Dip)
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Photography:	Alex Schmidt
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Authorisation for distribution: --

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1 Introduction

Archaeological Services WYAS (ASWYAS) was commissioned by Headland Archaeology Ltd., (the Client), to undertake a geophysical (magnetometer) survey of land to the rear Millham House, to the north of Bishop’s Cleeve, approximately 5km north-east of Cheltenham, in Gloucestershire (see Fig. 1). The survey was undertaken to inform a planning application for the proposed development of the site for housing and was undertaken in accordance with guidance contained within the National Planning Policy Framework (DCLG 2012), in line with current best practice (CIfA 2014; David *et al.* 2008) and to a Project Design (Harrison 2015) approved by the Client and Charles Parry at Gloucestershire County Council. The survey was carried out on February 11th 2015 to provide information on the archaeological resource of the site.

Site location, topography and land-use

The Proposed Development Area (PDA), centred at SO 956 285, comprises a single rectangular field under permanent pasture surrounded by mature hedges immediately north of Millham House, Bishop’s Cleeve. The site borders a motor vehicle dismantlers to the west with Millham House to the south. Agricultural land extends to the north and east. Agricultural debris in the north-east and south-east corners (see plates and Fig. 2) precluded survey over a small area. The PDA slopes very gently from approximately 51m above Ordnance Datum (aOD) in the south to 49m aOD in the north.

Soils and geology

The underlying bedrock comprises mudstone of the Charmouth Mudstone Formation with no superficial deposits recorded (British Geological Survey 2015). The soils are classified in the Badsey 2 association and are characterised as well-drained, calcareous fine loams over limestone gravel (Soil Survey of England and Wales 1983).

2 Archaeological Background

There are no known heritage assets recorded within the PDA. However, the site is located within an area of high archaeological potential and a number of probable prehistoric enclosures were identified following a magnetometer survey of the land bordering the PDA to the east at Homelands Farm, later confirmed by an extensive programme of evaluation trenching (Cotswold Archaeology 2008). One of these square enclosures may extend into the south-eastern corner of the PDA (see Fig. 2). Evidence of ridge and furrow cultivation is evident in the survey area and is also recorded in all the fields north and east of the PDA.

3 Aims, Methodology and Presentation

The general objective of the geophysical survey was to provide information about the presence/absence, character, and extent of any archaeological remains within the PDA and to help inform further strategies, should they be required.

Specifically, the objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore determine the presence/absence and extent of any buried archaeological features; and
- to prepare a report summarising the results of the survey.

Magnetometer survey

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble 5800 model). Bartington Grad601 magnetic gradiometers were used during the survey, taking readings at 0.25m intervals on zig-zag traverses 1.0m apart within 30m by 30m grids, so that 3600 readings were recorded in each grid. These readings were stored in the memory of the instrument and later downloaded to computer for processing and interpretation. Geoplot 3 (Geoscan Research) software was used to process and present the data. Further details are given in Appendix 1.

Reporting

A general site location plan, incorporating the 1:50000 Ordnance Survey (OS) mapping, is shown in Figure 1. A large scale (1:3000) survey location plan is provided as Figure 2. The processed and minimally processed data, together with an interpretation of the survey results are presented in Figures 3, 4 and 5, at a scale of 1:1000.

Technical information on the equipment used, data processing and survey methodologies are given in Appendix 1 and Appendix 2. Appendix 3 describes the composition and location of the archive.

The survey methodology, report and any recommendations comply with guidelines outlined by English Heritage (David *et al.* 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All figures reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The figures in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All figures are presented to most suitably display and interpret the data from this site based on the experience and knowledge of Archaeological Services staff.

4 Results and Discussion (see Figures 3, 4 and 5)

Generally, a low level of magnetic background variation has been recorded but with specific areas of ferrous contamination. However, several anomalies have been identified by the survey. These are discussed below and cross-referenced to specific examples and locations within the site, where appropriate.

Ferrous Anomalies and Areas of Magnetic Disturbance

Ferrous responses, either as individual 'spike' anomalies or more extensive areas of magnetic disturbance, are typically caused by modern ferrous (magnetic) debris, either on the ground surface or in the plough-soil, or are due to the proximity of magnetic material in field boundaries, buildings or other above ground features. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as ferrous debris or material is common on rural sites, often being present as a consequence of manuring or tipping/infilling. There is no obvious pattern or clustering to their distribution to suggest anything other than a random background scatter of ferrous debris in the plough-soil.

Two large areas of ferrous contamination, **A** and **B**, are recorded in the north-eastern and south-eastern corners of the site respectively. Anomaly **A** is due to a large dump of fencing material (see Plate 1) whilst anomaly **B** is caused by an old animal feeder (see Plate 2). A zone of ferrous contamination along the western site perimeter is caused by a large steel fence (see Plate 1).

Agricultural Anomalies

Broad linear trend anomalies are identified on a north-north-east/south-south-west, parallel with the extant field boundary. These anomalies are due to ridge and furrow cultivation which is extant and has also been recorded in all the surrounding fields (see Fig. 2).

Geological Anomalies

Throughout the site several small discrete anomalies are recorded. These anomalies are likely to be due to minor variation in the upper soil horizons or to recent localised ground disturbance.

5 Conclusions

Significant archaeological activity has been identified in the fields immediately east of the PDA. However, the current survey has not identified any anomalies that suggest that this likely prehistoric activity extends into the proposed development site. Evidence of post-medieval ridge and furrow cultivation has been recorded throughout as it has been in all the surrounding fields. Consequently, on the basis of the magnetometer survey, the archaeological potential of the site is considered to be low.

The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits.

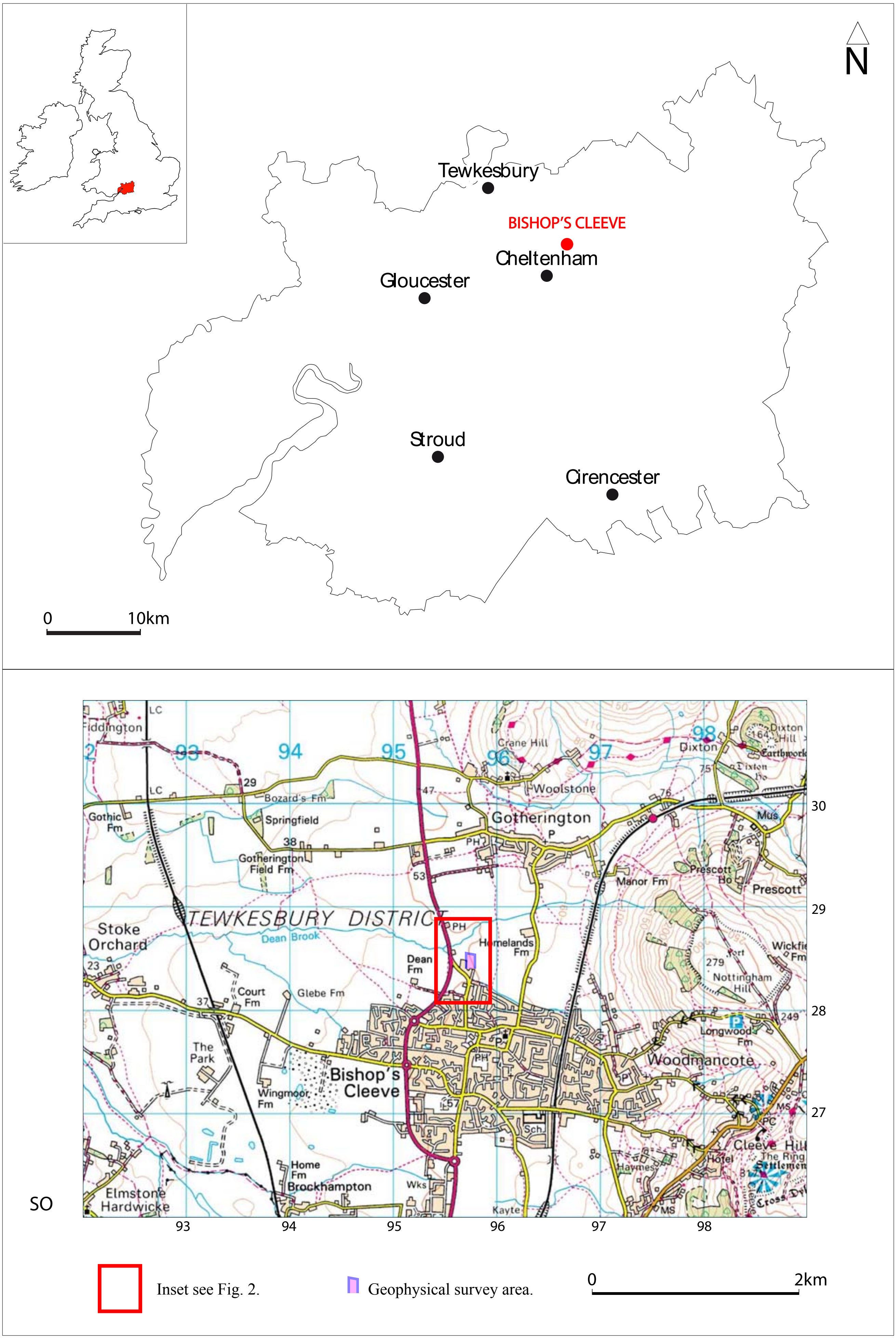

Fig. 1. Site location

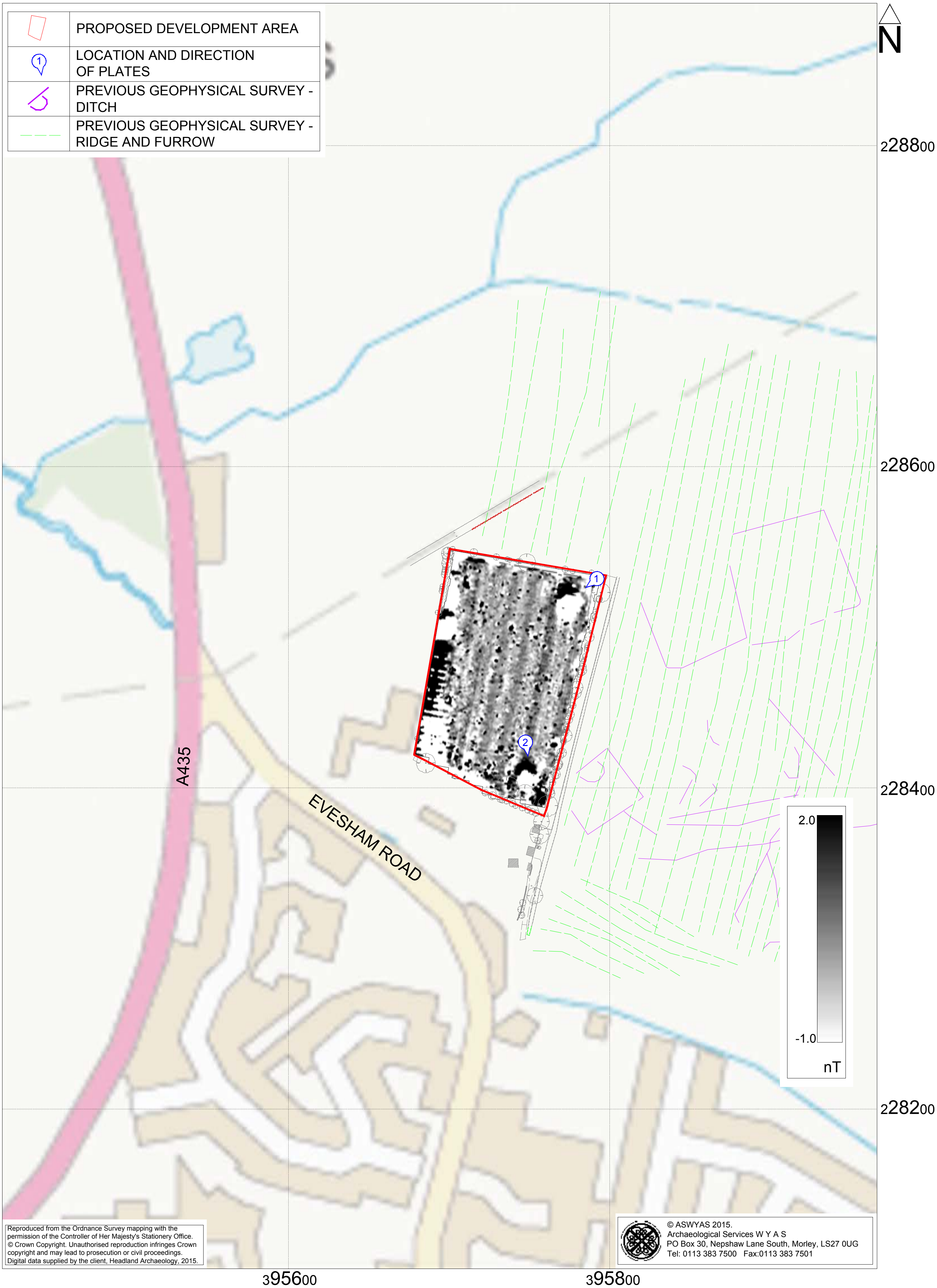

Fig. 2. Survey location showing greyscale magnetometer data (1:3000 @ A4)

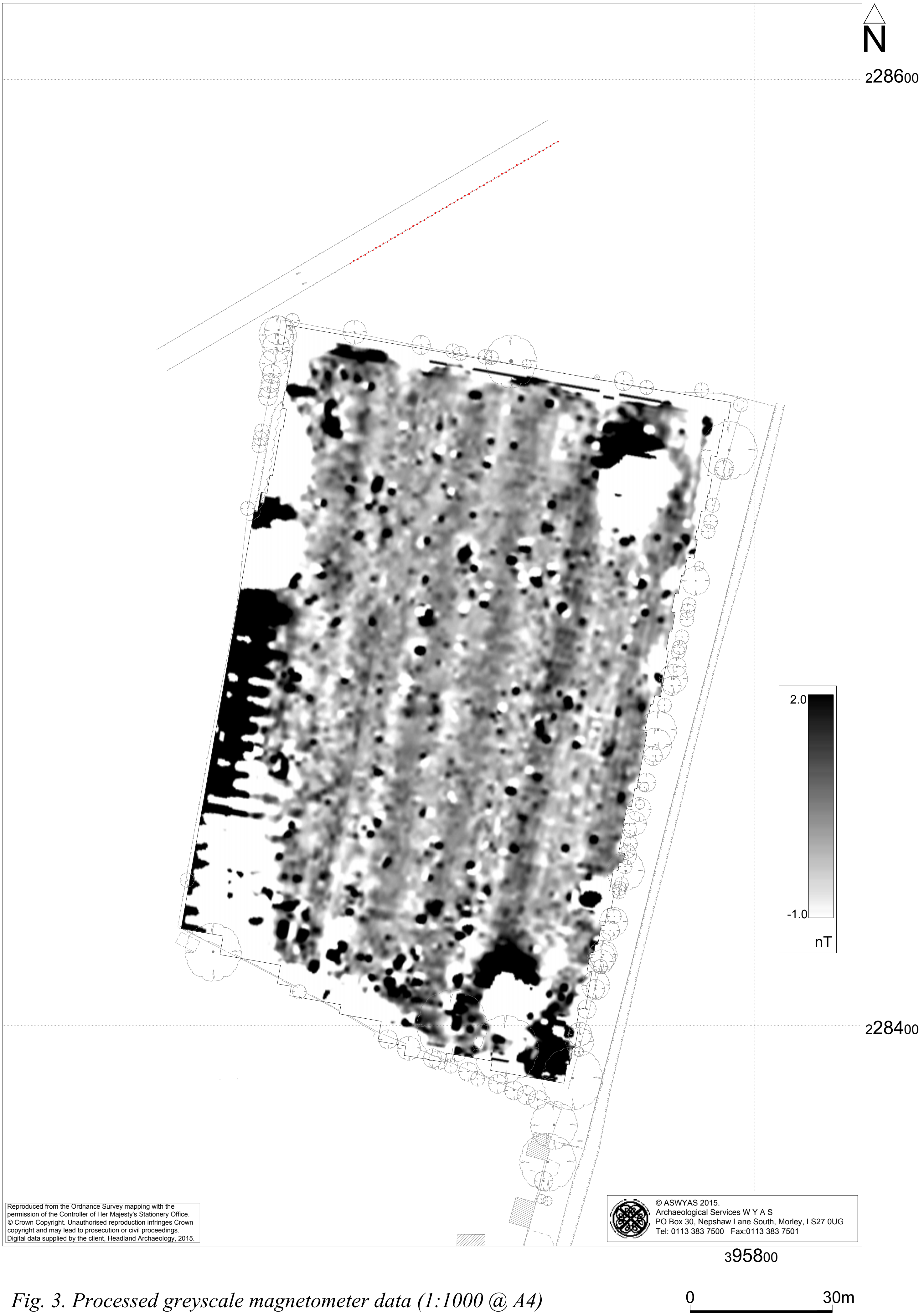

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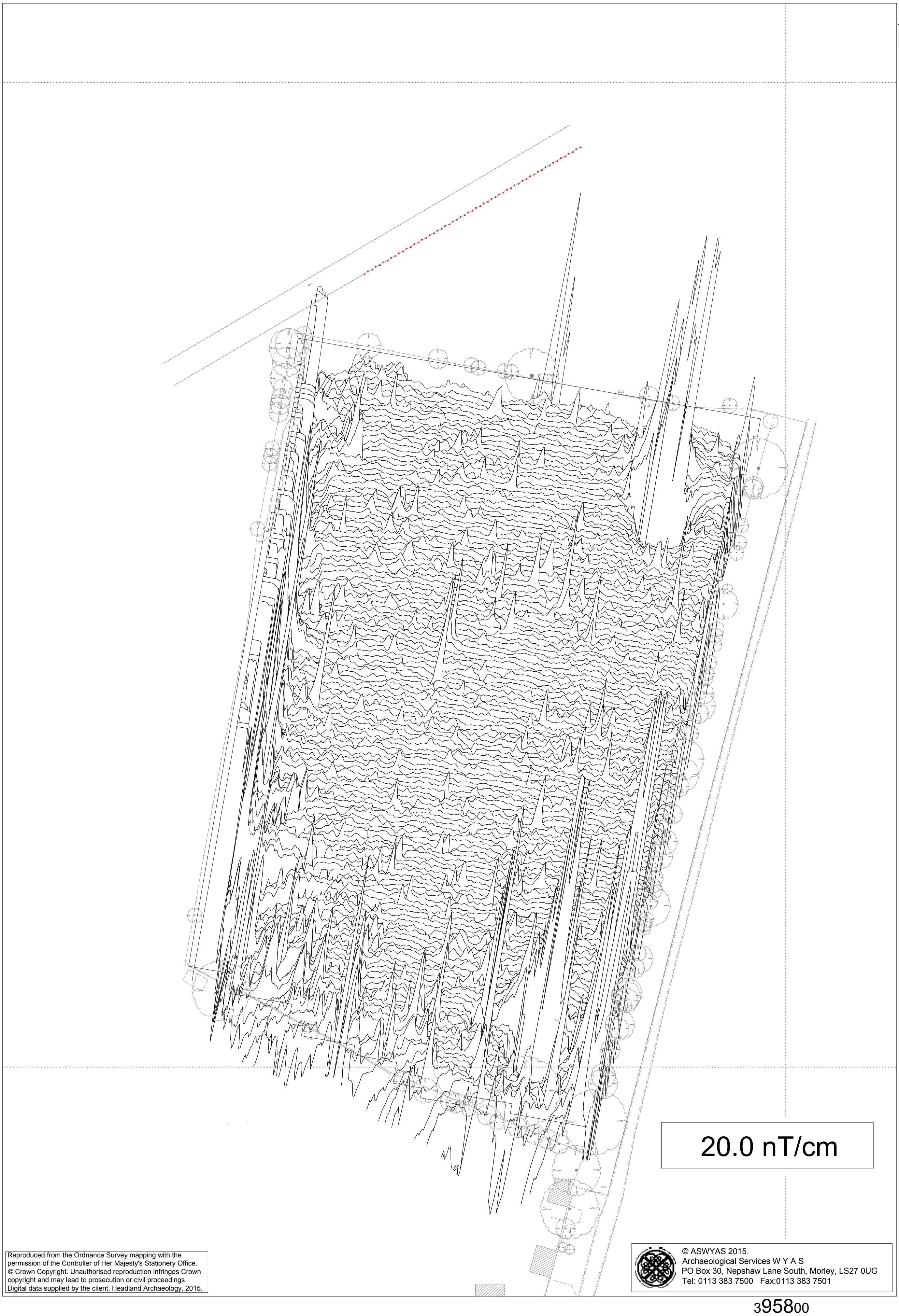
Fig. 3. Processed greyscale magnetometer data (1:1000 @ A4)



Digital data supplied by the client, Headland Archaeology, 2015.

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Fig. 4. XY trace plot of minimally processed magnetometer data (1:1000 @ A4)

Fig. 5. Interpretation of magnetometer data (1:1000 @ A4)

Plate 1. View of survey area showing dumped fencing material, looking south-west

Plate 2. View of southern corner of the survey area showing animal feeder, looking south-east

Appendix 1: Magnetic survey - technical information

Magnetic Susceptibility and Soil Magnetism

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms. Areas of human occupation or settlement can then be identified by measuring the magnetic susceptibility of the topsoil because of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. The magnetic susceptibility of a soil can also be enhanced by the application of heat and the fermentation and bacterial effects associated with rubbish decomposition. The area of enhancement is usually quite large, mainly due to the tendency of discard areas to extend beyond the limit of the occupation site itself, and spreading by the plough. An advantage of magnetic susceptibility over magnetometry is that a certain amount of occupational activity will cause the same proportional change in susceptibility, however weakly magnetic is the soil, and so does not depend on the magnetic contrast between the topsoil and deeper layers. Susceptibility survey is therefore able to detect areas of occupation even in the absence of cut features. On the other hand susceptibility survey is more vulnerable to the masking effects of layers of colluvium and alluvium as the technique, using the Bartington system, can generally only measure variation in the first 0.15m of ploughsoil.

Types of Magnetic Anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

Methodology: Magnetic Susceptibility Survey

There are two methods of measuring the magnetic susceptibility of a soil sample. The first involves the measurement of a given volume of soil, which will include any air and moisture that lies within the sample, and is termed volume specific susceptibility. This method results in a bulk value that it not necessarily fully representative of the constituent components of the sample. For field surveys a Bartington MS2 meter with MS2D field loop is used due to its speed and simplicity. The second technique overcomes this potential problem by taking into account both the volume and mass of a sample and is termed mass specific susceptibility. However, mass specific readings cannot be taken in the field where the bulk properties of a soil are usually unknown and so volume specific readings must be taken. Whilst these values are not fully representative they do allow general comparisons across a site and give a broad indication of susceptibility changes. This is usually enough to assess the susceptibility of a site and evaluate whether enhancement has occurred.

Methodology: Gradiometer Survey

The main method of using the fluxgate gradiometer for commercial evaluations is referred to as ***detailed survey*** and requires the surveyor to walk at an even pace carrying the instrument within a grid system. A sample trigger automatically takes readings at predetermined points, typically at 0.25m intervals, on traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation.

During this survey a Bartington Grad601 magnetic gradiometer was used taking readings on the 0.1nT range, at 0.25m intervals on zig-zag traverses 0.5m apart within 30m by 30m square grids. The instrument was checked for electronic and mechanical drift at a common point and calibrated as necessary. The drift from zero was not logged.

Data Processing and Presentation

The detailed gradiometer data has been presented in this report in XY trace and greyscale formats. In the former format the data shown is ‘raw’ with no processing other than grid biasing having been done. The data in the greyscale images has been interpolated and selectively filtered to remove the effects of drift in instrument calibration and other artificial data constructs and to maximise the clarity and interpretability of the archaeological anomalies.

An XY plot presents the data logged on each traverse as a single line with each successive traverse incremented on the Y-axis to produce a ‘stacked’ plot. A hidden line algorithm has been employed to block out lines behind major ‘spikes’ and the data has been clipped. The main advantage of this display option is that the full range of data can be viewed, dependent on the clip, so that the ‘shape’ of individual anomalies can be discerned and potentially archaeological anomalies differentiated from ‘iron spikes’. Geoplot 3 software was used to create the XY trace plots.

Geoplot 3 software was used to interpolate the data so that 3600 readings were obtained for each 30m by 30m grid. The same program was used to produce the greyscale images. All greyscale plots are displayed using a linear incremental scale.

The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits.

Appendix 2: Survey location information

The site grid was laid out using a Trimble dual frequency Global Positioning System (GPS) with two Rovers (Trimble 5800 models) working in real-time kinetic mode. The accuracy of such equipment was better than 0.02m. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if co-ordinates are measured off for relocation purposes.

Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

Appendix 3: Geophysical archive

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Microsoft Word 2000), and graphics files (Adobe Illustrator CS2 and AutoCAD 2008) files; and
- a full copy of the report.

At present the archive is held by Archaeological Services WYAS although it is anticipated that it may eventually be lodged with the Archaeology Data Service (ADS). Brief details may also be forwarded for inclusion on the English Heritage Geophysical Survey Database after the contents of the report are deemed to be in the public domain (i.e. available for consultation in the Gloucestershire Historic Environment Record).

Appendix 4: OASIS form

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