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Cat Babbleton Farm, Ganton, Scarborough, North Yorkshire

Geophysical Survey

August 2009

Report No. 1980

CLIENT

Ian Pick Associates

Cat Babbleton Farm
Ganton
North Yorkshire

Geophysical Survey

Summary

A geophysical (magnetometer) survey covering the footprint of a proposed free range egg laying unit was carried out just to the north-west of Cat Babbleton Farm, Ganton. Although the site lies in an area of high archaeological potential the survey has not identified any anomalies of probable archaeological origin. Anomalies due to modern services and agricultural practice have been recorded. On the basis of the survey results and on the situation of the proposed development the site is considered to have a low archaeological potential.

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Report Information

Client:	Ian Pick Associates
Address:	Unit 9, Brook Street, Driffield, East Yorkshire, YO25 6QP
Report Type:	Geophysical survey
Location:	Ganton
County:	North Yorkshire
Grid Reference:	TA 0002 7452
Period(s) of activity represented:	n/a
Report Number:	1980
Project Number:	3467
Site Code:	CBF09
Planning Application No.:	09/00595/MFULE
Museum Accession No.:	-
Date of fieldwork:	August 2009
Date of report:	August 2009
Project Management:	Alistair Webb BA MIfA
Fieldwork:	Sam Harrison BSc MSc AIfA Ian Wilkins BSc MSc
Report:	Alistair Webb
Illustrations:	Sam Harrison
Photography:	n/a
Research:	n/a
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Authorisation for distribution: ---

ISOQAR ISO 9001:2000
Certificate No. 125/93

Contents

List of Figures

List of Plates

1 Introduction

Archaeological Services WYAS was commissioned by Ian Pick Associates on behalf of his clients to undertake a geophysical (magnetometer) survey at the proposed location of a free range egg laying unit and associated feed bins at Cat Babbleton Farm (see Fig. 1). The geophysical survey was recommended by North Yorkshire County Council, Heritage and Environment Services, in advance of a decision being taken on the planning application (09/00595/MFULE).

The aim of the evaluation is to determine the nature, extent and significance of the archaeological resource and provide sufficient detail to allow the scope of any mitigation to be designed with confidence.

Site location, topography and land use

Cat Babbleton Farm is located approximately 3.5km to the south of the village of Ganton, in the Yorkshire Wolds (Fig. 1), to the west of Ganton Hill which runs north-south between Ganton and Foxholes. The proposed development site, centered at TA 0002 7452, is located approximately 130m to the north-west of the farm (see Fig. 2) in a depression between two ridges (see Plates 1 and 2) at a height of approximately 135m above Ordnance Datum. The footprint of the proposed free range egg unit is rectangular in shape and comprises an area some 2720m^2 in size. The survey area is situated within a field under arable cultivation which was harvested immediately prior to survey.

Geology and soils

The geology consists predominately of chalk with flint and thin marl beds, though a narrow band of mudstone (Lias Group) runs north-east of Cat Babbleton Farm in a south-westerly direction, where it meets a second narrow band which runs north-west/south-west through Ganton Dale (British Geological Survey 1998). The overlying soils are classified in the Panholes association being described as well-drained, calcareous, fine silts over chalk (Soil Survey of England and Wales 1980).

2 Archaeological background

A review of the known archaeological resource of the site and the surrounding area undertaken on behalf of the client (Grassam 2009) noted that the site lies within the Yorkshire Wolds, an area rich in archaeological remains. Cropmarks indicative of such activity identified from air photographs can be seen approximately 400m to the north-east of the site. However, no cropmarks have been identified within the site itself.

In addition the farm is thought to date to the early 17th century suggesting that there is also potential for the survival of archaeological remains associated with the establishment and use of this farmstead.

3 Aims, Methodology and Presentation

The general aim of the geophysical survey was to obtain information that would evaluate the archaeological potential of the site. This information would then enable further evaluation and/or mitigation measures to be designed as appropriate.

Specifically the aims were:

- To interpret any geophysical anomalies identified by the survey and thereby
- To determine (so far as is possible) the presence and extent or absence of buried archaeological remains in the proposed development area

These aims were to be achieved by undertaking a detailed magnetometer survey to cover the footprint of the proposed new structures and a small buffer zone.

All the survey areas were set out using a Trimble VRS dGPS system and superimposed onto a digital Ordnance Survey map base supplied by the client.

Magnetometer survey

For the survey Bartington Grad601 instruments were used to take readings at 0.25m intervals on zig-zag traverses 1m apart within 20m by 20m grids so that 1600 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. Detailed survey allows the visualisation of weaker anomalies that may not have been readily identifiable by magnetometer (magnetic) scanning.

Reporting

A general site location plan, incorporating the 1:50000 Ordnance Survey mapping is shown in Figure 1. Figure 2 is a more detailed site location showing the footprint of the proposed new unit together with the magnetometer data. The processed greyscale data, the 'raw' XY trace plot data and interpretation figure are presented at a scale of 1:1000 in Figures 3, 4 and 5.

Further 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 site archive.

The survey methodology, report and any recommendations comply with the Methodology (Archaeological Services 2009) and guidelines outlined by English Heritage (David *et al* 2008) and by the IfA (Gaffney, Gater and Ovenden 2002). All figures reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright – OS Licence No. 100023320).

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

Magnetometer Survey

The types of anomaly identified on this site can be divided into four categories.

Discrete ferrous, dipolar anomalies

These anomalies are typically caused by ferrous (magnetic) material, either on the ground surface or in the topsoil, which causes rapid variations in the magnetic readings giving a characteristic, 'spiky', XY trace. Unless there is supporting evidence for an archaeological interpretation, little importance is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring or tipping/infilling. Iron spike anomalies are present across the whole of the survey area and there is no obvious pattern or clustering to their distribution to suggest anything other than random ferrous debris in the ploughsoil.

Linear anomalies and trends

A strong, linear, dipolar anomaly runs north/south through the middle of the survey area. This is caused by a modern service pipe.

A vague linear trend on the same alignment to the east of the pipe locates the trench for a recently installed water pipe.

Vague linear trends aligned north-west/south-east, parallel with the field boundary immediately to the south-west of the survey reflect the alignment of recent agricultural regimes.

Areas of magnetic variation

Two discrete areas of magnetic variation, one to the south-west and one to the north-east, have been identified. It is thought probable that these anomalies are due either to modern activity or perhaps to geological variation in the soils. They are not considered to have any archaeological potential.

Areas of magnetic enhancement

Three discrete anomalies have been identified. Whilst these responses could be due to archaeological features it is considered much more likely that they are due to modern activity or to geological variation.

5 Discussion and Conclusions

No anomalies interpreted as probably archaeological have been identified by the survey. Whilst three discrete anomalies have been noted that could have some archaeological potential the lack of any other supporting evidence combined with the location of the survey area in a depression make it difficult to support an archaeological interpretation. Overall the site is considered to have a low archaeological potential based on the results of the geophysical survey.

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.

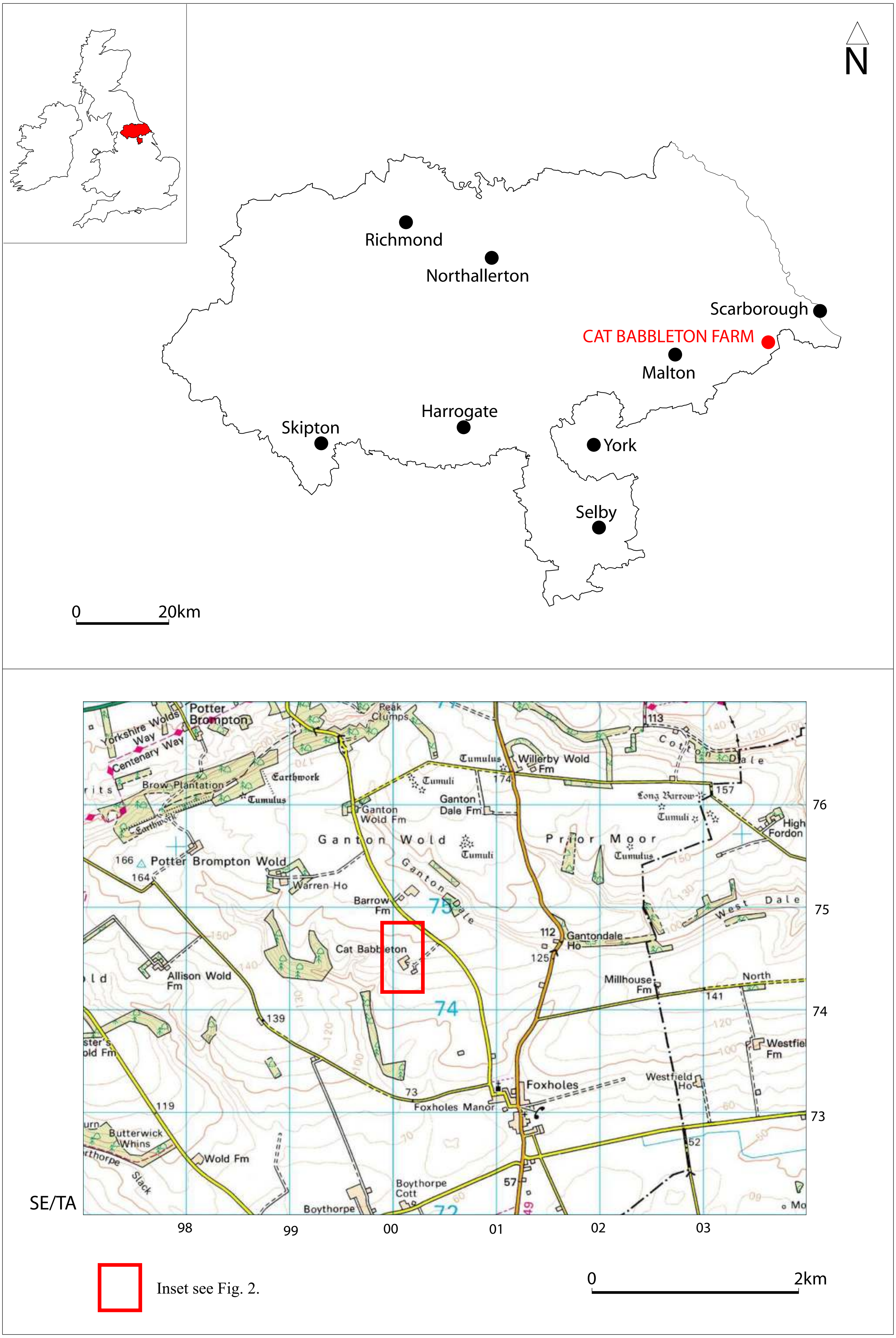

Fig. 1. Site location

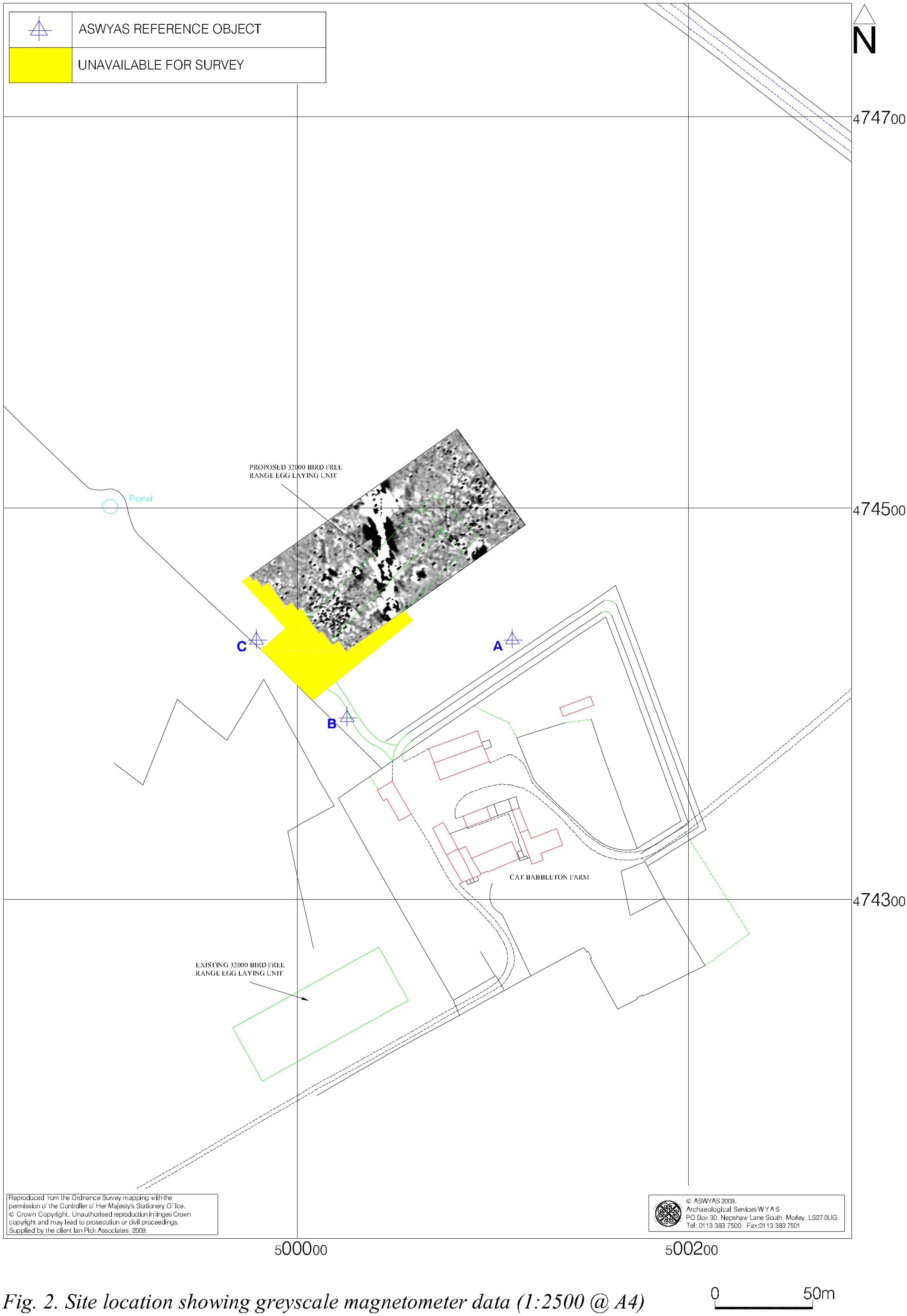

Fig. 2. Site location showing greyscale magnetometer data (1:2500 @ A4)

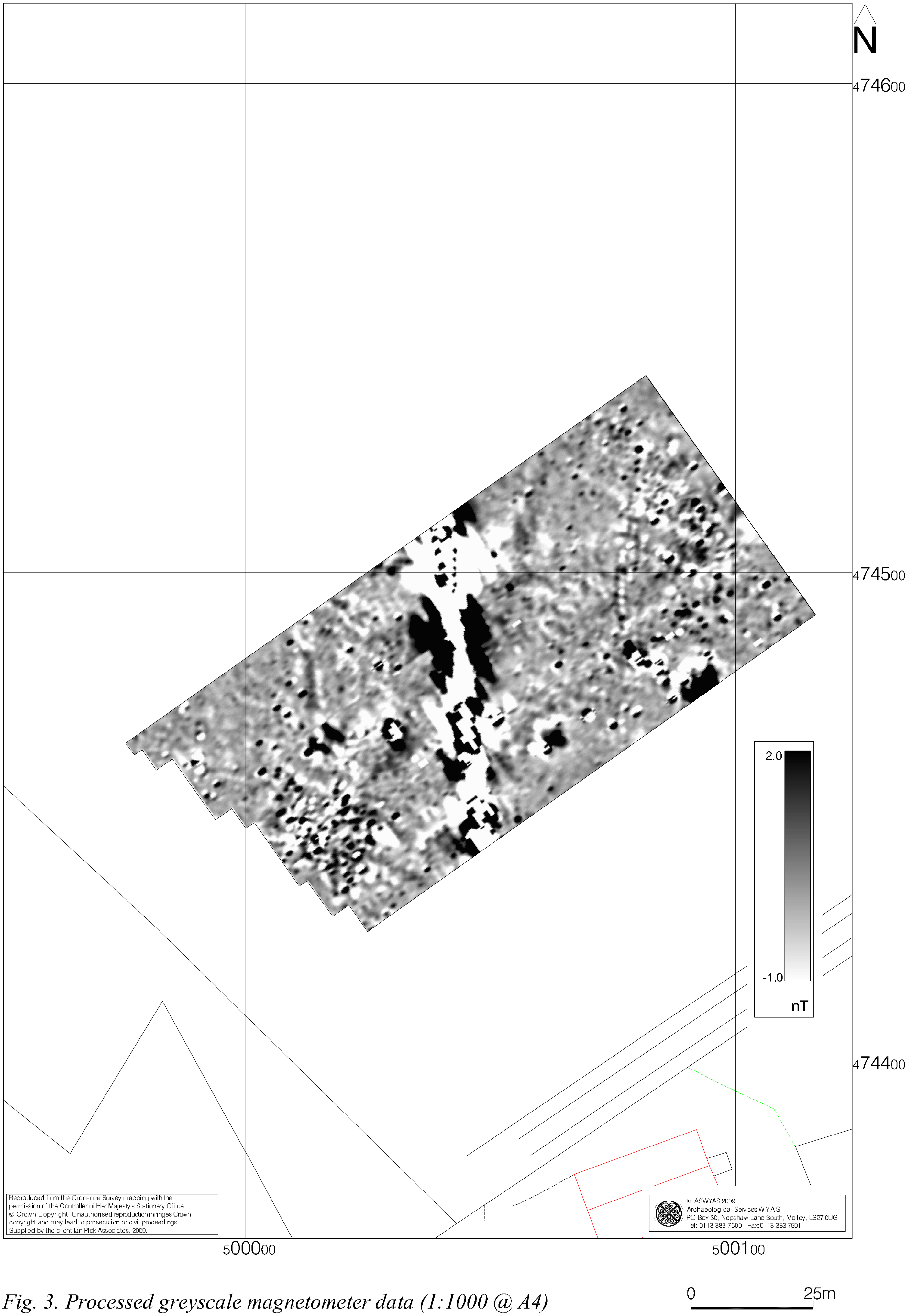

Fig. 3. Processed greyscale magnetometer data (1:1000 @ A4)

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

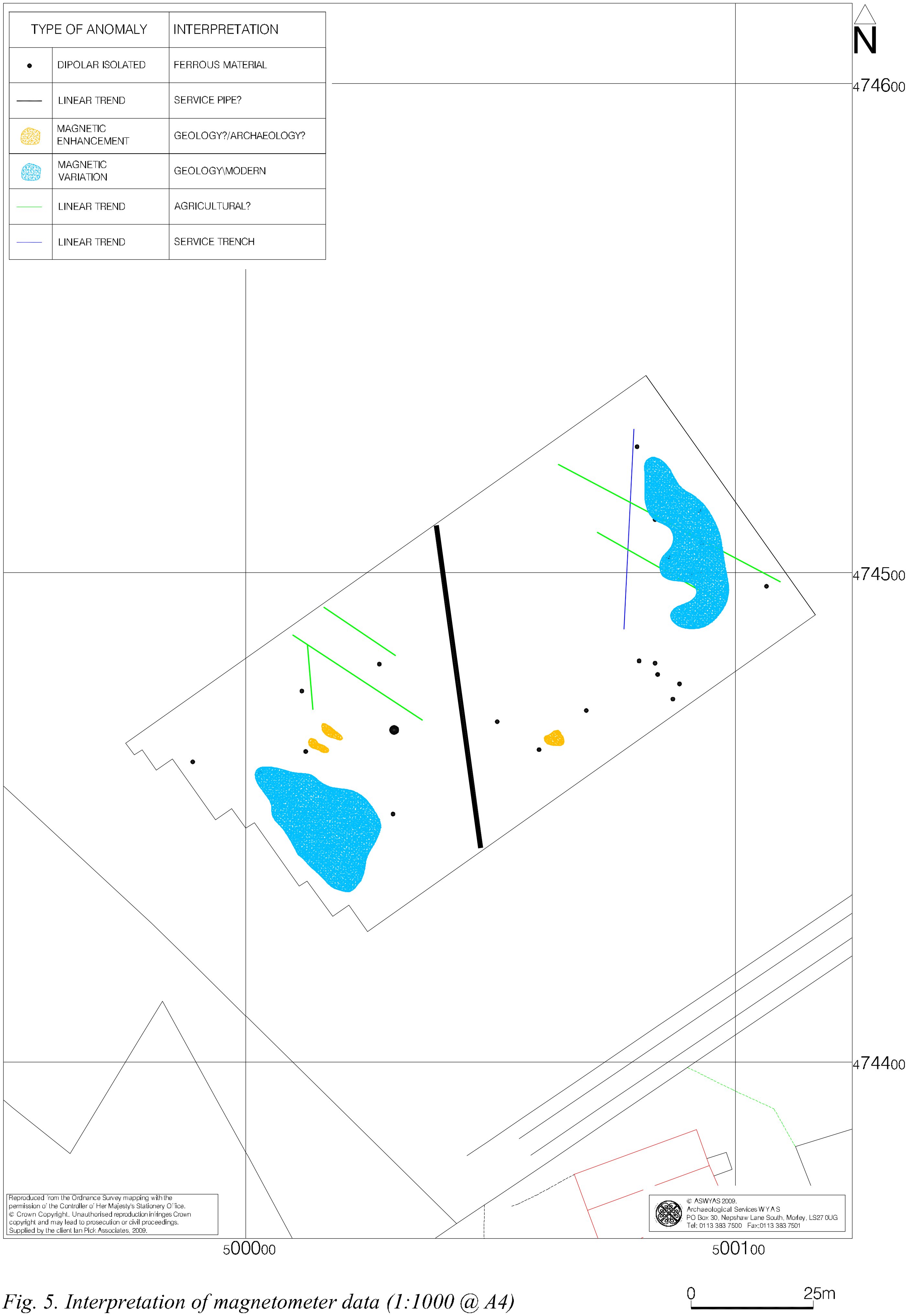

Fig. 5. Interpretation of magnetometer data (1:1000 @ A4)

Plate 1. Survey area showing topography, looking south-west.

Plate 2. Magnetometer survey in progress showing topography, looking west.

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 so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue 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

There are two main methods of using the fluxgate gradiometer for commercial evaluations. The first of these is referred to as ***magnetic scanning*** and requires the operator to visually identify anomalous responses on the instrument display panel whilst covering the site in widely spaced traverses, typically 10m apart. The instrument logger is not used and there is therefore no data collection. Once anomalous responses are identified they are marked in the field with bamboo canes and located on a base plan. This method is usually employed as a means of selecting areas for detailed survey when only a percentage sample of the whole site is to be subject to detailed survey.

The disadvantages of magnetic scanning are that features that produce weak anomalies (less than 2nT) are unlikely to stand out from the magnetic background and so will be difficult to detect. The coarse sampling interval means that discrete features or linear features that are parallel or broadly oblique to the direction of traverse may not be detected. If linear features are suspected in a site then the traverse direction should be perpendicular (or as close as is possible within the physical constraints of the site) to the orientation of the suspected features. The possible drawbacks mentioned above mean that a ‘negative’ scanning result should be validated by sample detailed magnetic survey (see below).

The second method is referred to as ***detailed survey*** and employs the use of a sample trigger to automatically take readings at predetermined points, typically at 0.25m intervals, on zig-zag traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation. Detailed survey allows the visualisation of weaker anomalies that may not have been detected by magnetic scanning.

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 1m apart within 20m by 20m 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. The same program was used to produce the greyscale images. All greyscale plots are displayed using a linear incremental scale.

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 then 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.

Temporary reference objects were left on site (see Fig. 2). The Ordnance Survey reference points are listed below.

Station	**Easting**	**Northing**
A	50010	47443
B	50002	47439
C	49997	47443

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.
- 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 relevant Sites and Monument Record Office).

Bibliography

David, A., N. Linford, P. Linford and L. Martin, 2008. *Geophysical Survey in Archaeological Field Evaluation: Research and Professional Services Guidelines (2nd edition)* English Heritage

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