Archaeological Services WYAS

Land at Llysonen Road
Johnstown
Carmarthenshire

Geophysical Survey

Report no. 2628

July 2014

Client: The Environmental Dimension Partnership

Registered Organisation IfA

Land at Llysonen Road
Johnstown
Carmarthen

Geophysical Survey

Summary

A geophysical (magnetometer) survey covering 3 hectares was carried out to the north of Llysonen Road, Johnstown, in order to provide information on the archaeological resource of the site and therefore inform planning proposals for a residential development. Numerous discrete anomalies are interpreted as geological caused by the variations in the depth and composition of the soils and superficial deposits. Two clusters of higher magnitude anomalies have been highlighted but on balance are also considered likely to have a geological origin. Other anomalies are caused by two former field boundaries, ploughing and a water pipe. No anomalies consistent with the presence of a Roman road postulated to cross the PDA have been identified corroborating the results of an evaluation undertaken on an adjacent site. Evidence from this site also confirmed that a geophysical survey is likely to give an accurate assessment of the extent of any significant archaeological activity. Therefore it is assessed that the apparent lack of archaeological anomalies on the current site reflects an absence of such features. Consequently the archaeological potential of the site is assessed as being low.

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Report Information

Client:	The Environmental Dimension Partnership
Address:	Tithe Barn, Barnsley Park Estate, Barnsley, Cirencester, Gloucestershire, GL7 5EG
Report Type:	Geophysical Survey
Location:	Johnstown
County:	Carmarthenshire
Grid Reference:	SN 3857 1943
Period(s) of activity:	-
Report Number:	2628
Project Number:	4262
Site Code:	CAR14
Planning Application No.:	Pre-application
Museum Accession No.:	n/a
Date of fieldwork:	June 2014
Date of report:	July 2014
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REGISTERED ORGANISATION IfA

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1 Introduction

Archaeological Services WYAS (ASWYAS) was commissioned by Dr Ed Oakley of the Environmental Dimension Partnership, on behalf of Persimmon Homes West Wales, to undertake a geophysical (magnetometer) survey on land proposed for possible future development at Johnstown, Carmarthen (see Fig. 1). The work was undertaken in accordance with guidance contained within the National Planning Policy Framework (2012) and in line with current best practice (Institute for Archaeologists 2013; David *et al.* 2008). The survey was carried out on June 30th 2014 to provide additional information on the archaeological resource of the site and inform proposals for a residential development.

Site location, topography and land-use

The Proposed Development Area (PDA) is situated to the west of Johnstown and Carmarthen, and immediately north of Llysonen Road and the A40 (see Fig. 1) which border the site to the south. The PDA covers approximately 3 hectares and is centred at SN 3857 1943 being bound by agricultural land to the north, west and east and by a former cattle breeding centre to the south (see Fig. 2).

The PDA lies on a south facing gradual slope, being 34m above Ordnance Datum (aOD) in the north and 29m aOD in the south and was under grass at the time of the survey (see plates). An area to the south of the PDA was overgrown and unsuitable for survey (see Plate 1).

Soils and geology

The underlying bedrock comprises Tetragraptus Beds (mudstone), overlain with superficial deposits of Devensian Glaciofluvial sands and gravels (British Geological Survey 2014). The soils are classified in the Rheidol association, being characterised as well-drained, fine loams over gravels (Soil Survey of England and Wales 1983).

2 Archaeological Background

An archaeological evaluation (Dyfed Archaeological Trust 2012), comprising geophysical survey followed by trial trenching, was undertaken in the field to the immediate east of the PDA. The magnetometer survey identified linear anomalies that were interpreted as former field boundaries one of which was depicted on historic Ordnance Survey mapping and the other which was not. Three circular anomalies, were identified in the east of the site and subsequently confirmed by trial trenching to be the remains of Bronze Age round barrows. Ephemeral features containing Neolithic pottery were present beneath the round barrows. No evidence (either in the survey data or the trial trenches) was found for a Roman Road postulated to cross the site in an east/west direction (see Fig. 2). Other anomalies identified throughout the survey were subsequently proved to be due to geological variation. Overall the trenching demonstrated that the magnetic survey provided a reliable indicator of the extent of archaeological activity on the prevailing soils and geology. It is also worthy of note that the archaeological activity was confined to an area of (relatively) high ground.

A Heritage Statement (Environmental Dimension Partnership 2014) submitted in support of the application reported that there are no designated or non-designated heritage assets within the PDA, whilst acknowledging the '*limited potential (of the site) to contain archaeological remains by virtue of the presence of Neolithic and Bronze Age remains …. in the field to the east*'.

Since the publication of Ordnance Survey mapping in the late 18th century a single field boundary on a north/south orientation has been removed from within 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 identified within the defined areas 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 (1:2000) survey location plan is provided as Figure 2. The processed and minimally processed data, together with interpretation graphics 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 Institute for Archaeologists (IfA 2013). 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 (see Figures 3, 4 and 5)

Numerous anomalies have been identified which fall into three different types and categories according to their origin and these are discussed below and cross-referenced to specific examples and locations within the site, where appropriate.

Ferrous Anomalies

Ferrous anomalies, as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern 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.

Extensive areas of magnetic disturbance are identified around the edge of the site are caused by the proximity of buildings, livestock troughs and perimeter fencing as well as by areas of dumping/clearance around the edges of the field.. It should be noted that any low magnitude anomalies of archaeological potential, if present, may be masked or obscured within areas affected by magnetic disturbance.

A single, dipolar linear anomaly, **A**, on a north/south alignment, is caused by a service pipe.

Agricultural Anomalies

A high magnitude linear, anomaly **B**, has been identified aligned north-west/south-east parallel with the field boundary marking the eastern edge of the PDA. This anomaly correlates with a boundary depicted on historic Ordnance Survey mapping (1890). A second linear anomaly, **C**, has been recorded to the north of the survey area, aligned east/west parallel with the northernmost boundary of the site, and may also locate a former boundary although this is not shown on the historic mapping.

Linear trend anomalies have been identified in the northern half of the site orientated parallel with the existing and historical field boundaries. The anomalies are thought to be caused by ploughing.

Geological? Anomalies

Across all parts of the survey area discrete, low magnitude, anomalies (areas of magnetic enhancement) have been identified. These anomalies are interpreted as geological in origin, being caused by changes in the depth and composition of the soils and superficial deposits of sands and gravels, variations that have been recorded in the trial trenches to the east.

Against this variable background two clusters of slightly higher magnitude anomalies, **D** and **E**, have been highlighted. Whilst an archaeological origin for these anomalies cannot be completely dismissed a geological origin is considered most likely.

5 Discussion and Conclusions

An archaeological evaluation (geophysical survey and trial trenching) on an adjacent site (The Limes, Carmarthen) revealed three Bronze Age round barrows overlying Neolithic activity located on the highest ground within that site. Other than post-medieval boundaries no other features of archaeological significance were identified on the lower lying parts of that site. No evidence was found for a Roman road whose route is postulated to cross the site. Here, the trial trenching clearly demonstrated that the magnetic survey had provided an accurate assessment of the extent of archaeological activity.

On the basis that the soils and geology on the site currently being evaluated are the same as on the site to the east it would seem reasonable to assume that the survey here has the potential to identify any significant archaeological features, if present. No anomalies of obvious archaeological potential have been identified. Again, using the negative evidence from the adjacent site (i.e no archaeological features were present in areas of low or uncertain potential as determined by the magnetic survey) it can be concluded that the absence of any anomalies on this site is likely to indicate an absence of such features. No anomalies consistent with the presence of a Roman road have been identified; presumably either the postulated route is inaccurate or all traces of it have been removed by later (agricultural) activity.

On the basis of the geophysical survey, and taking account of the results of a previous evaluation on an adjacent site, the archaeological potential of the site is assessed as 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.

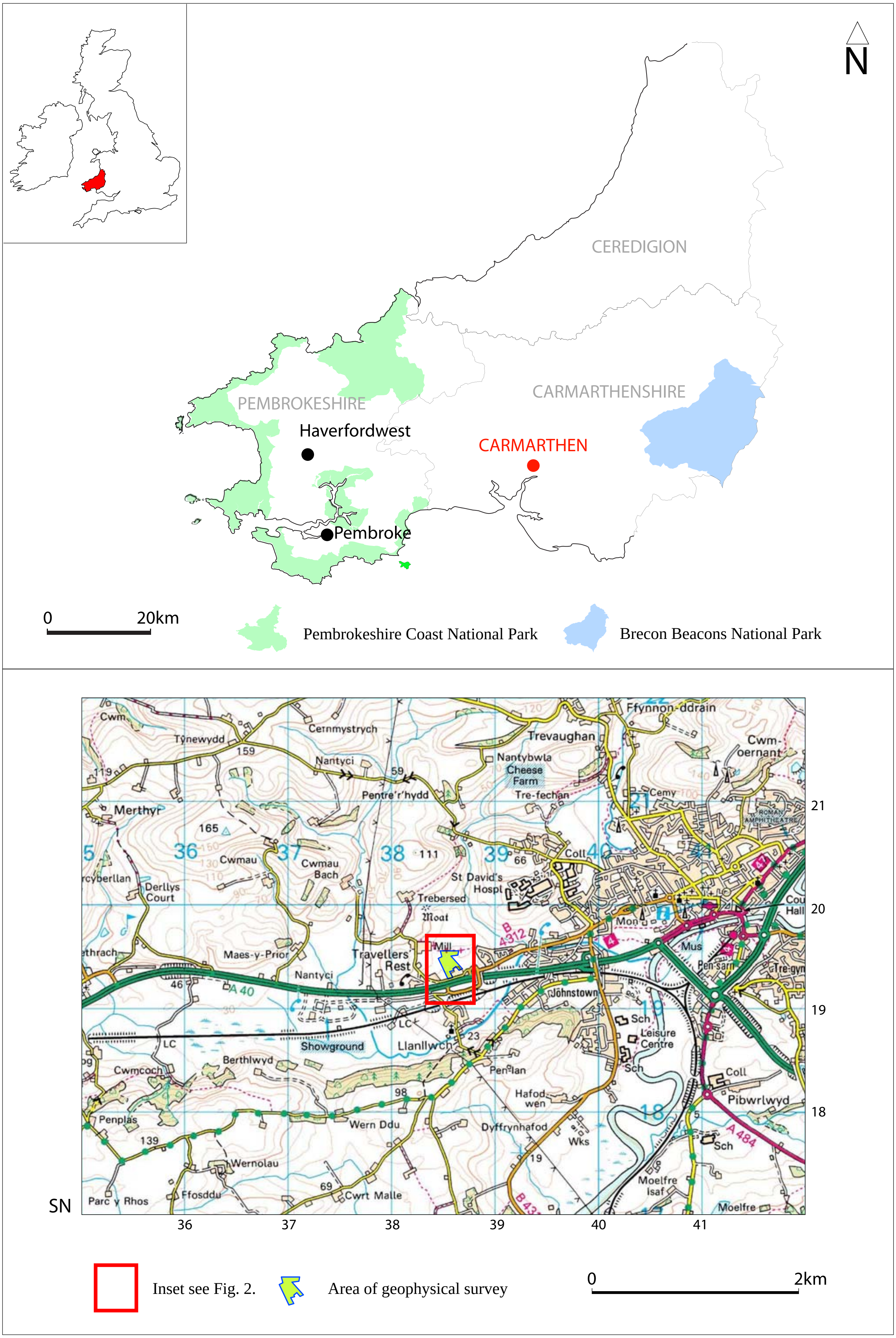

Fig. 1. Site location

Fig. 2. Survey location showing greyscale magnetometer data and previous geophysical survey data (1:2000 @ A4)

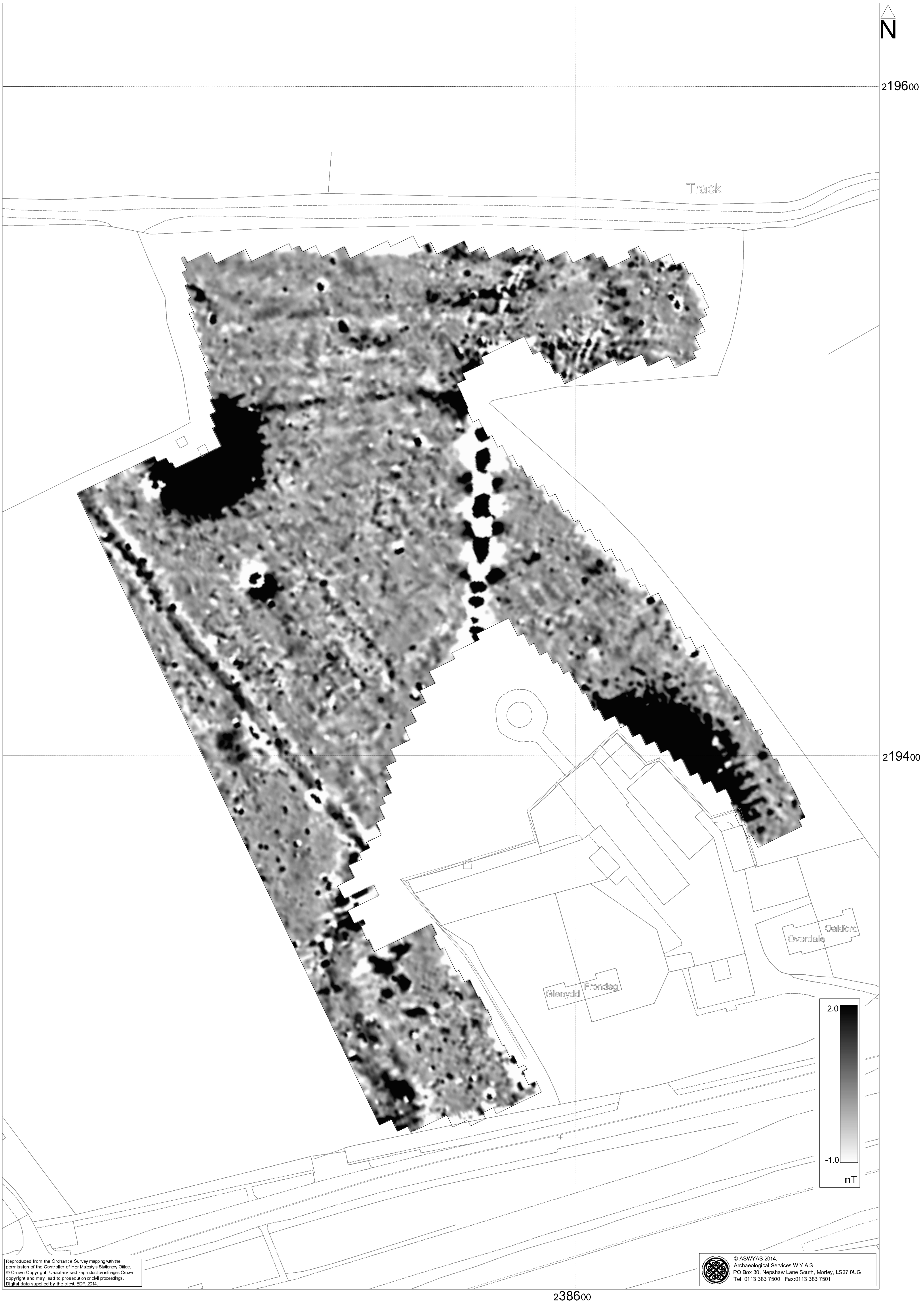

Fig. 3. Processed greyscale magnetometer data (1:1000 @ A3)

Fig. 4. XY trace plot of minimally processed magnetometer data (1:1000 @ A3)

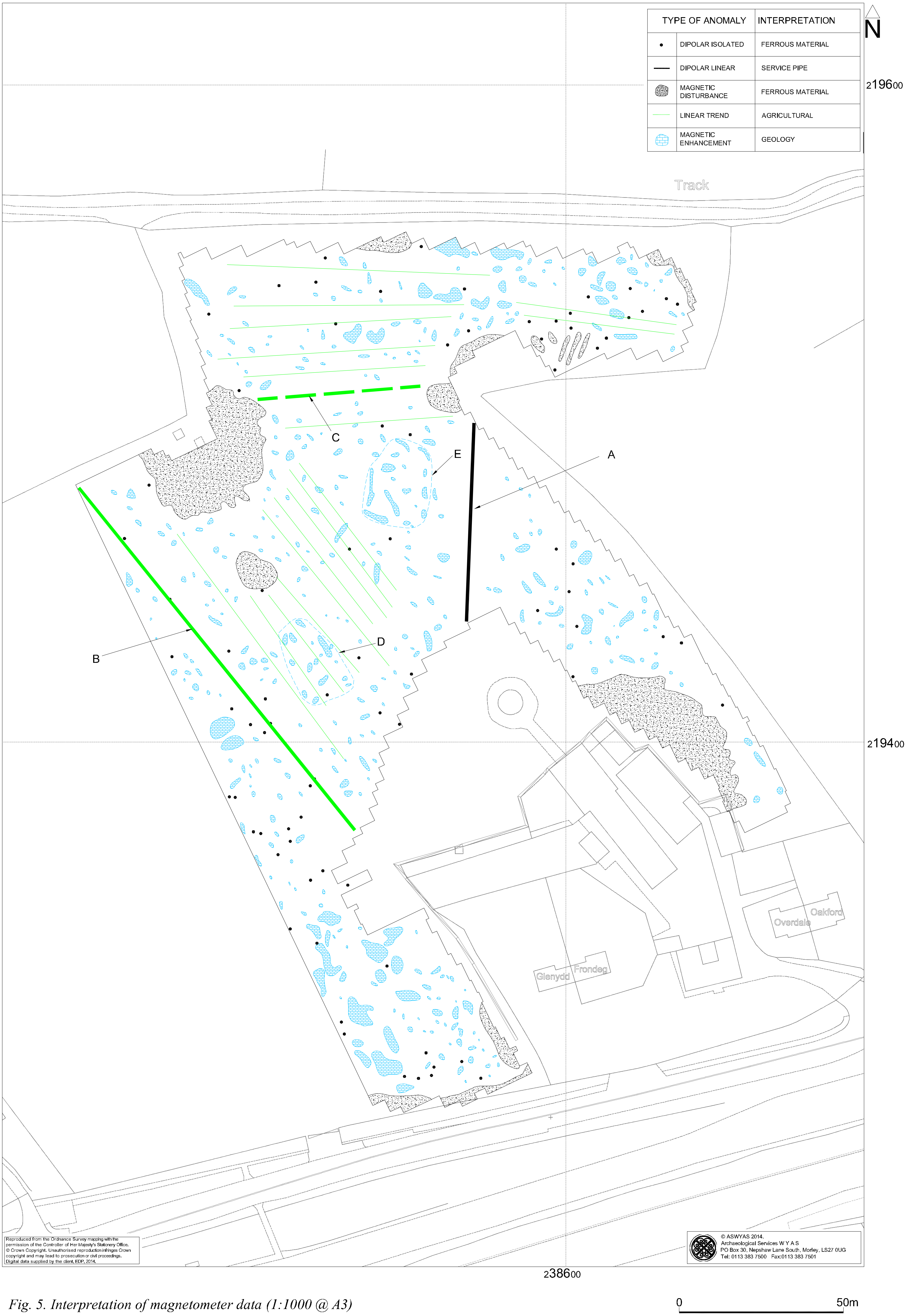

Fig. 5. Interpretation of magnetometer data (1:1000 @ A3)

Plate 1. General view of area unsuitable for survey, looking east

Plate 2. General view of survey area, looking north-west

Plate 3. General view of survey area, looking south-west

Plate 4. General view of survey area, looking north-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 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 approximately 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 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). The report will be submitted to the public domain (i.e. available for consultation in the Dyfed Historic Environment Record).

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