ARCHAEOLOGICAL SERVICES WYAS

Land at Sketchley House
Burbage
Leicestershire

Geophysical Survey

Report no. 2509

September 2013

Client: Rainier Properties Ltd

REGISTERED ORGANISATION IA

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Burbage
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Summary

A geophysical (magnetometer) survey was completed in the grounds of Sketchley House, Burbage to inform the determination of an outline planning application for residential and associated development. The survey has identified anomalies indicative of medieval ridge and furrow. Areas of magnetic disturbance correlate with features on recent and historic mapping. Although the site borders Watling Street no anomalies of obvious archaeological potential have been identified. Numerous discrete anomalies are interpreted as of probable geological origin although given the proximity of the Roman road an archaeological cause cannot be completely dismissed. Therefore, on the basis of the geophysical survey the archaeological potential of the majority of the site is considered to be very low with a very slight chance of encountering isolated features adjacent to Watling Street.

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Report Information

Client:	Rainier Properties Ltd
Address:	Rutland House, 148 Edmund Street, Birmingham, West Midlands, B3 2FD
Report Type:	Geophysical Survey
County:	Leicestershire
Grid Reference:	SK 428 916
Period(s) of activity:	Medieval/Post-medieval
Report Number:	2509
Project Number:	4121
Site Code:	SKL13
OASIS ID:	archaeol11- 158428
Planning Application No.:	13/005029/OUT
Museum Accession No.:	n/a
Date of fieldwork:	August 2013
Date of report:	September 2013
Project Management:	Sam Harrison BSc MSc AIfA
Fieldwork:	Christopher Sykes BA MSc Alexander Schmidt BA
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Photography:	Christopher Sykes
Research:	n/a

Authorisation for distribution: ---

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1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by Ben Stephenson of BSA Heritage Ltd (the Consultant), on behalf of Rainier Properties Ltd (the Client), to undertake a geophysical (magnetometer) survey of land at Sketchley House, Burbage, Leicestershire, to provide further information prior to the determination of a planning application for a proposed housing development (Planning Application No: 13/00529/OUT). The survey was requested by the Senior Planning Archaeologist at Leicestershire County Council. The work was undertaken in accordance with a Project Design (Harrison, 2013) supplied to and approved by the Consultant, with guidance contained within the National Planning Policy Framework (2012) and in line with current best practice (David *et al* 2008). The survey was carried out between August 26th and August 28th 2013 to provide additional information on the archaeological potential of the site.

Site location, topography and land-use

The Proposed Development Area (PDA) is situated on the south-western periphery of the village of Burbage, Leicestershire, centred at SK 428 916 (see Fig. 1). The survey area is bounded to the south and west by the A5 Watling Street, by residential properties fronting onto Welbeck Avenue to the east and by open pasture fields to the north (sees Fig. 2). The survey area comprised one field of pasture planted with numerous mature trees (see plates). It is situated on a gentle west-facing gradient at between 125m above Ordnance Datum (aOD) at the eastern site perimeter and around 114m aOD in the west. Survey was restricted slightly to the east of Sketchley House by overgrown vegetation (see Fig 2).

Soils and geology

The underlying bedrock comprises Mercia Mudstone, overlain by superficial deposits of Diamicton and Wolston sand and gravel (British Geological Survey 2013). The soils in this area are unclassified, but are thought to be in the Beccles 3 association, characterised as seasonally waterlogged fine loams over clays (Soil Survey of England and Wales 1983).

2 Archaeological Background

An Archaeological Desk Based Assessment of the site (CgMs 2013) has established that the site lies adjacent to Watling Street Roman Road (HER records MWA420 and MLA1388) although the assessment concluded that there is limited potential for the presence of unrecorded archaeological features from this period.

The medieval core of Sketchley (MLE2847) lies approximately 400m to the south-east of the PDA and the deserted medieval village of Stretton Baskerville (MWA2762) is located 500m to the south-west. Therefore, whilst there is low archaeological potential for the presence of hitherto unrecorded domestic medieval remains, there is considered moderate potential for the presence of agricultural medieval remains, such as ploughed-out ridge and furrow earthworks. On this basis, the PDA was assessed by CgMs as having a low to moderate potential for the presence of unrecorded archaeological remains.

3 Aims, Methodology and Presentation

The main aim of the geophysical survey was to provide sufficient information to enable an assessment to be made of the impact of potential sub-surface archaeological remains and for further evaluation or mitigation proposals, if appropriate, to be recommended. To achieve this aim a magnetometer survey covering all accessible parts of the PDA was carried out.

The general 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 1m 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. Figure 2 is a large scale (1:1500) location plan displaying the processed magnetic data. Figure 3 is an overall data interpretation plot at the same scale. Detailed data plots (‘raw’ and processed) and full interpretative figures are presented at a scale of 1:1000 in Figures 4 to 9 inclusive.

Further technical information on the equipment used, data processing and survey methodologies is 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 Project Design (Harrison 2013) and guidelines outlined by English Heritage (David *et al* 2008) and by the Institute for Archaeologists (IfA 2010). 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 Figs 4 to 9 inclusive)

Generally, a low level of background magnetic variation has been identified throughout the PDA. This is attributed to the low magnetic susceptibility properties of the mudstone bedrock and clay soils. The anomalies identified by the survey fall into a number of different types and categories according to their origin and these are discussed below and cross-referenced to specific examples and locations within the site.

Ferrous and Modern Anomalies

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. Ferrous debris or material is common on rural sites, often being present as a consequence of manuring or tipping/infilling. Throughout the PDA individual iron 'spike' anomalies are common but there is no obvious pattern or clustering to their distribution to suggest anything other than a random background scatter of ferrous debris in the soil.

Larger areas of magnetic disturbance are recorded throughout the site and correlate with the position of the many mature trees present. The high magnitude responses are due to the use of cast iron 'collars' to protect the trees. Similar magnetic disturbance around the edge of the site is due to ferrous material in the perimeter fencing.

Three other areas of magnetic disturbance that cannot be attributed to either of the above causes are also noted. Fifty metres south of Sketchley House a large area of magnetic disturbance, **A**, surrounding a clump of trees, is the location of a former pond and tank. These features are first mapped in 1903 and were still present on the 1983 OS mapping.

Also mapped on the 1983 OS mapping are tennis courts immediately south-east of the house. The former (probable ash/cinder) surface of the courts probably explains the broadly rectangular area of disturbance, **B**, at this location.

The third area of disturbance, **C**, is approximately 75m west of the house, oval in shape and about 25m along its long axis. This anomaly does not correspond with any feature recorded on the historic mapping. However, it is considered likely that this anomaly probably locates another pond or small quarry pit, possibly dug to extract sand and gravel, and later backfilled with strongly magnetic material.

Agricultural Anomalies

Ordnance Survey mapping shows that a single field boundary has been removed since the publication of the 1888 edition Ordnance Survey map; this boundary was also shown on the 1841 Burbage Tithe map. This boundary manifests in the magnetic data as a linear dipolar anomaly, **D**, which is caused by a pipe laid along, or in the bottom of, the ditch formerly defining the boundary.

In the northern half of the site a series of parallel linear trend anomalies on three differing alignments have been identified. These broad, slightly sinuous, trends are due to the medieval and post-medieval agricultural practice of ridge and furrow cultivation. The characteristic striped appearance to the data is a result of the magnetic contrast between the now soil-filled furrows and the former ridges.

Four parallel linear trends aligned west/east, immediately north of the former quarry pit, **C**, are identified as a series of intermittent ‘spiky’ responses. These anomalies are interpreted as probable field drains. Three short linear trends, **E**, immediately east of the former pond, **A**, are probably also caused by drains.

Geological Anomalies

Small discrete anomalies, characterised as localised areas of enhanced magnetic response, have been identified across the site. There is no coherent pattern to the distribution of these anomalies and they are interpreted as geological in origin due to variations in the composition of the soils and superficial deposits of sand and gravel.

5 Conclusions

Although the PDA borders Watling Street, no anomalies with obvious archaeological potential have been identified by the survey. It should be noted, however, that it is impossible to definitively distinguish between discrete anomalies caused by geological variation and those with an archaeological origin, such as may be caused by pits or small areas of burning. In this context there is no other information to support an archaeological interpretation, other than proximity to the Roman road, and on balance it is considered highly likely that all discrete anomalies have an underlying geological cause. On the basis of the geophysical survey, the archaeological potential of the site is assessed as being very low throughout with the possible exception of immediately adjacent to Watling Street where there is a very slight chance of encountering isolated features.

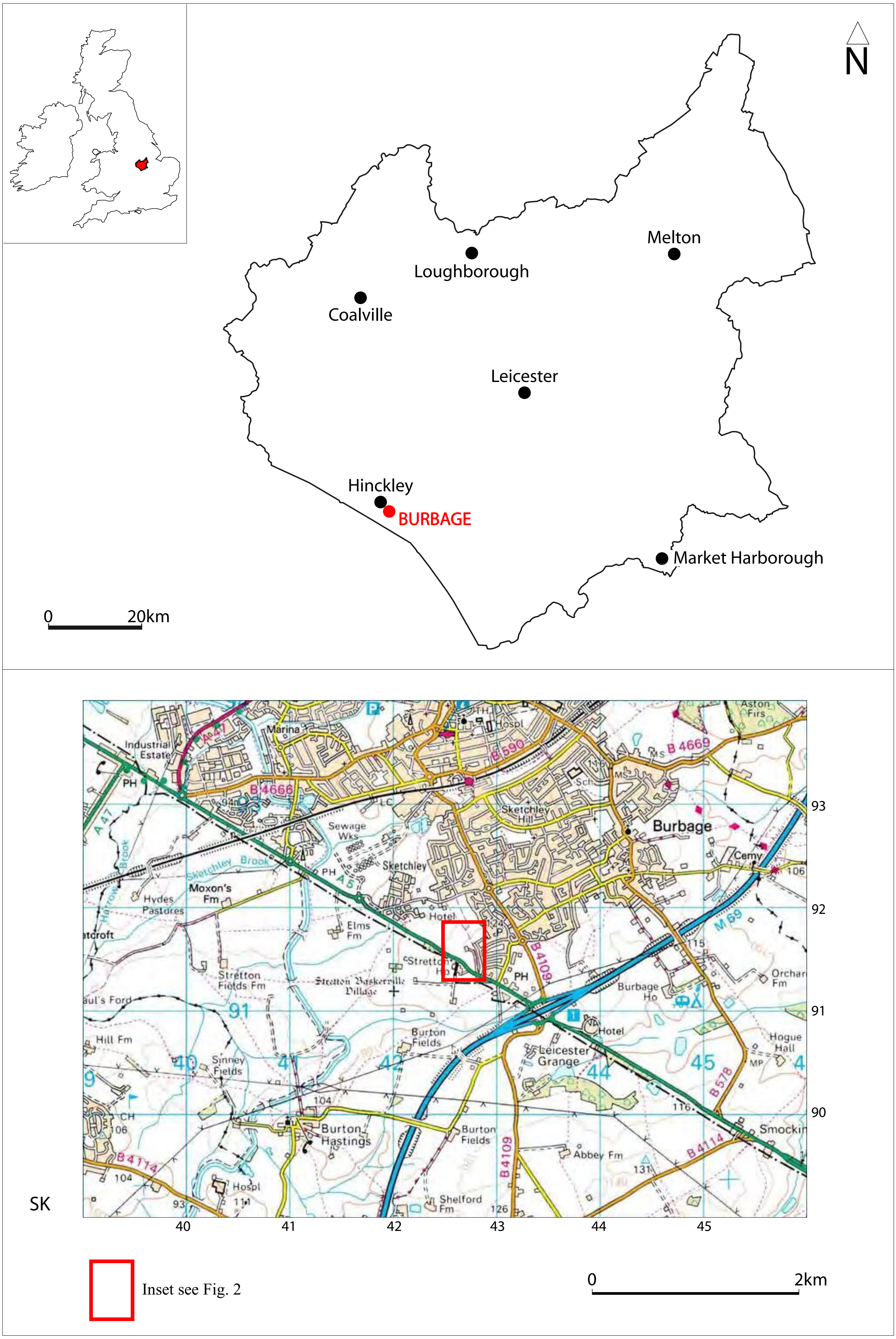

Fig. 1. Site location

Fig. 2. Site location showing greyscale magnetometer data (1:1500 @ A3)

Fig. 3. Overall interpretation of magnetometer data (1:1500 @ A3)

0 25m

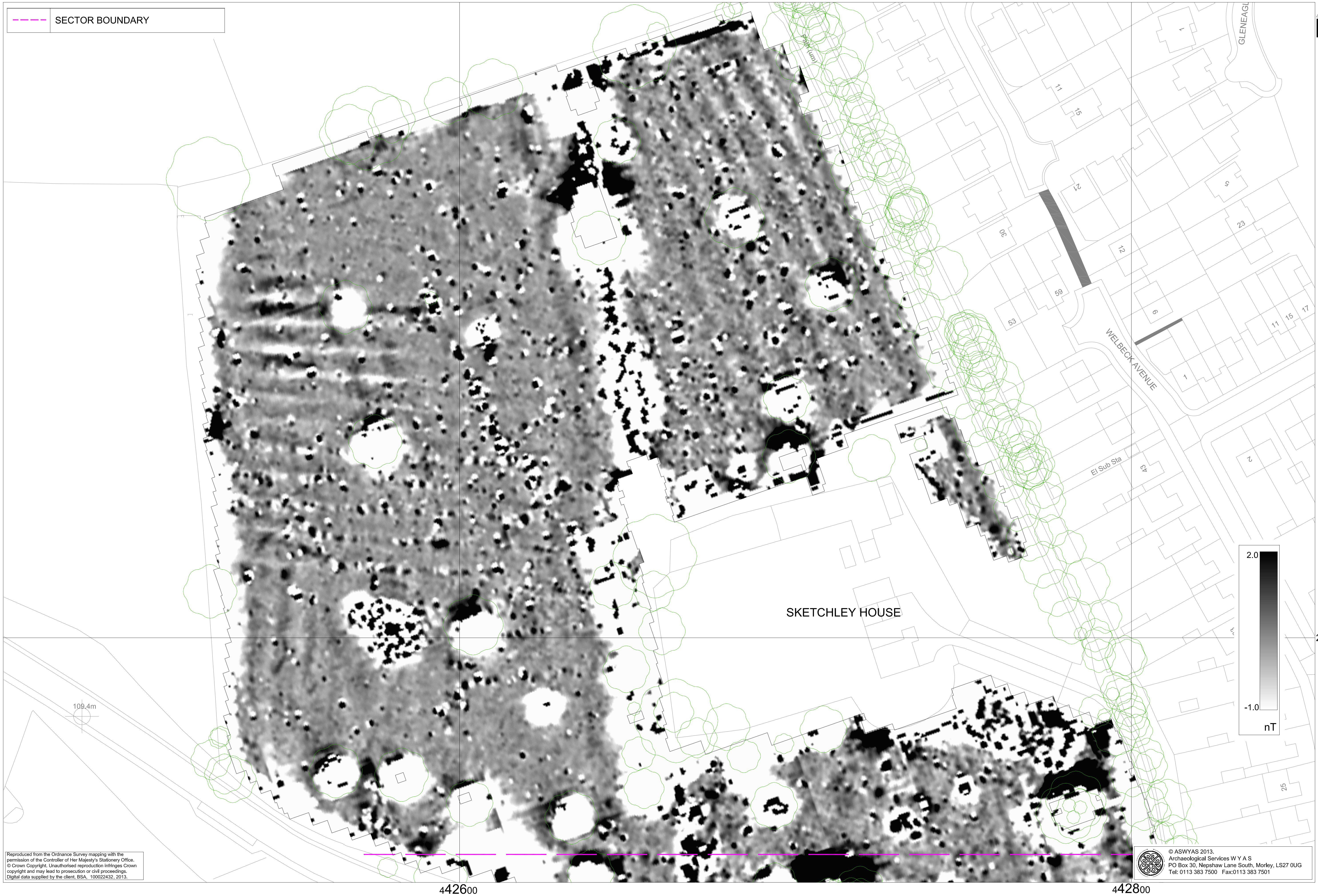

Fig. 4. Processed greyscale magnetometer data; Sector 1 (1:1000 @ A3)

0 25m

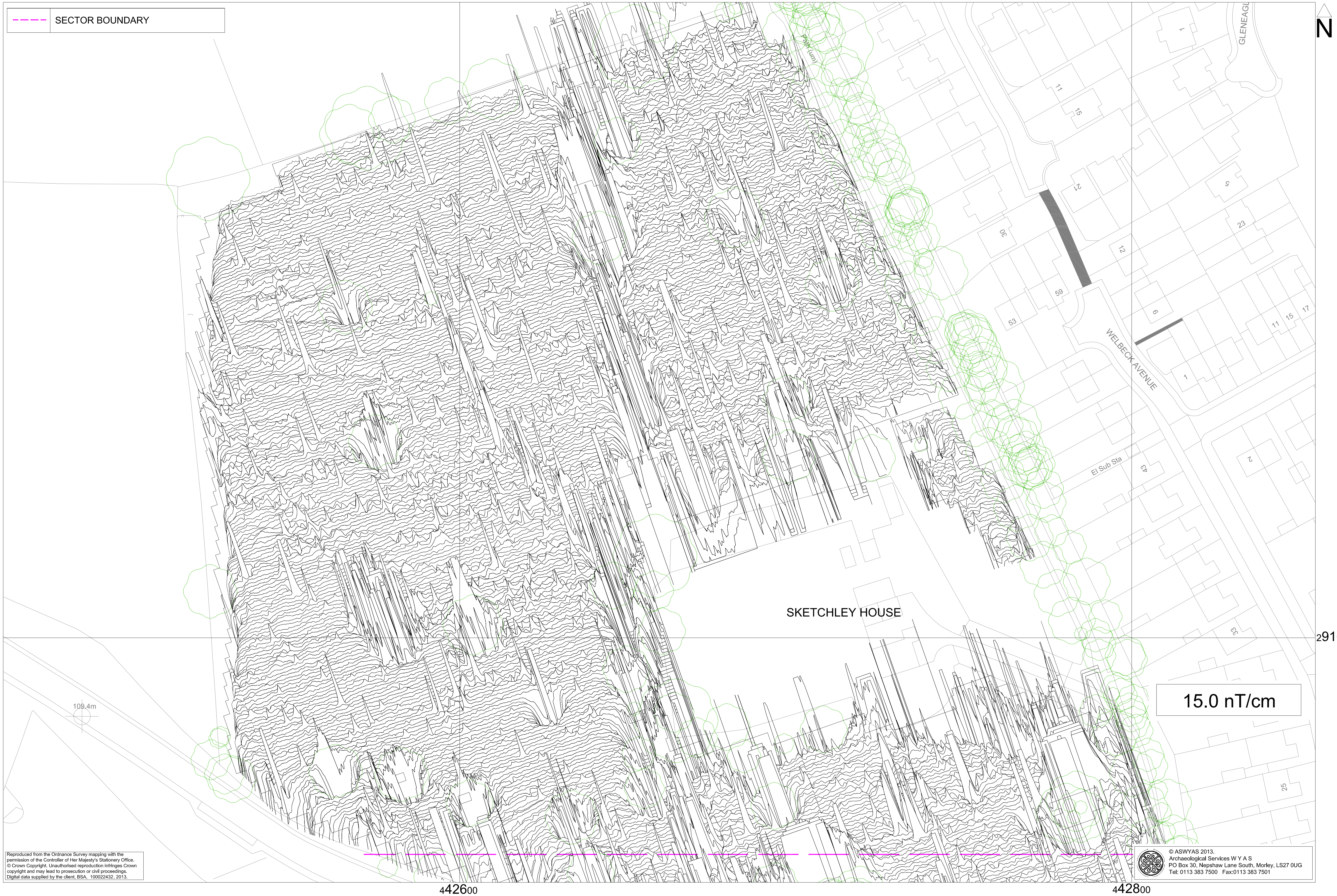

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Fig. 5. XY trace plot of minimally processed magnetometer data; Sector 1 (1:1000 @ A3)

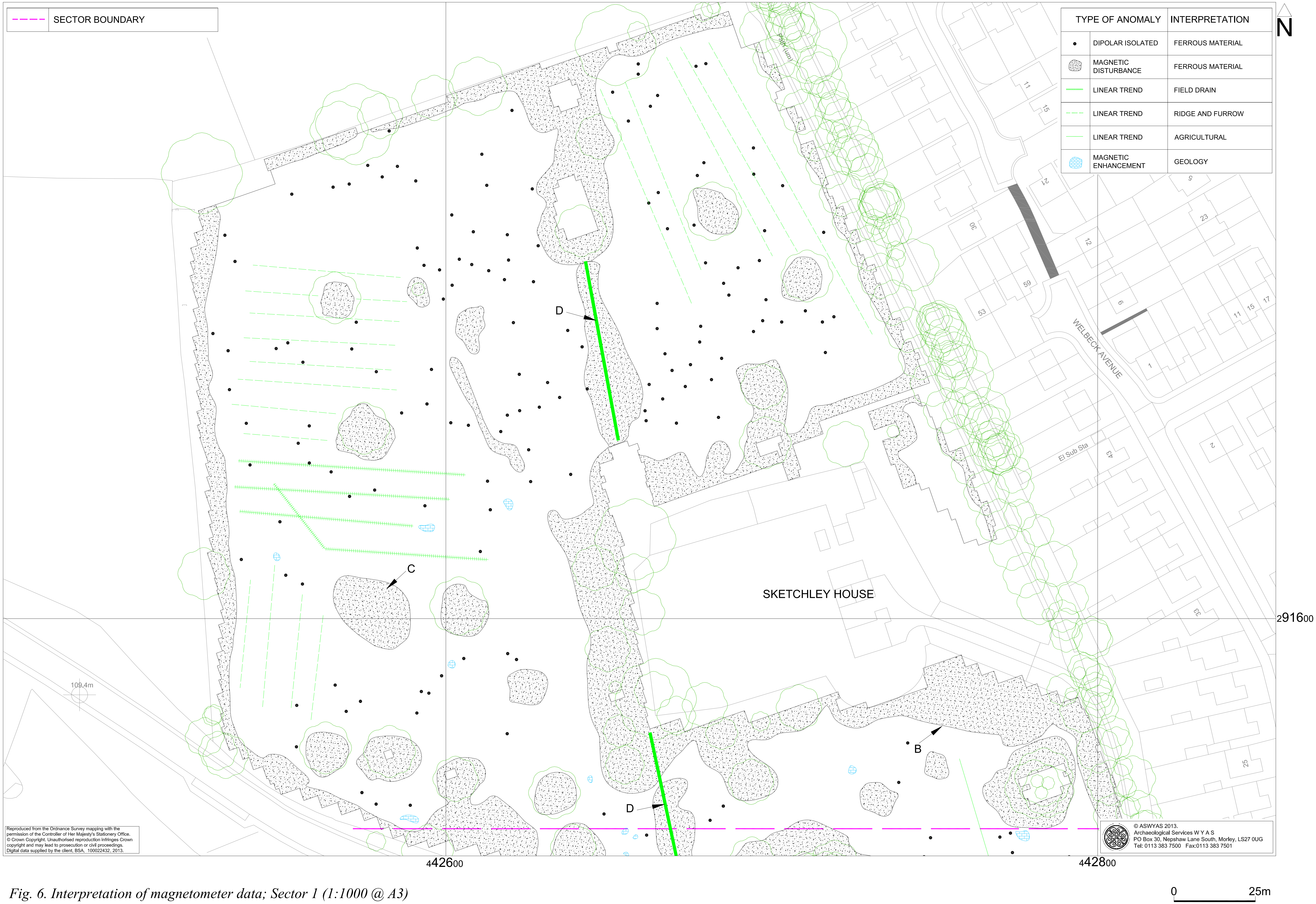

Fig. 6. Interpretation of magnetometer data; Sector 1 (1:1000 @ A3)

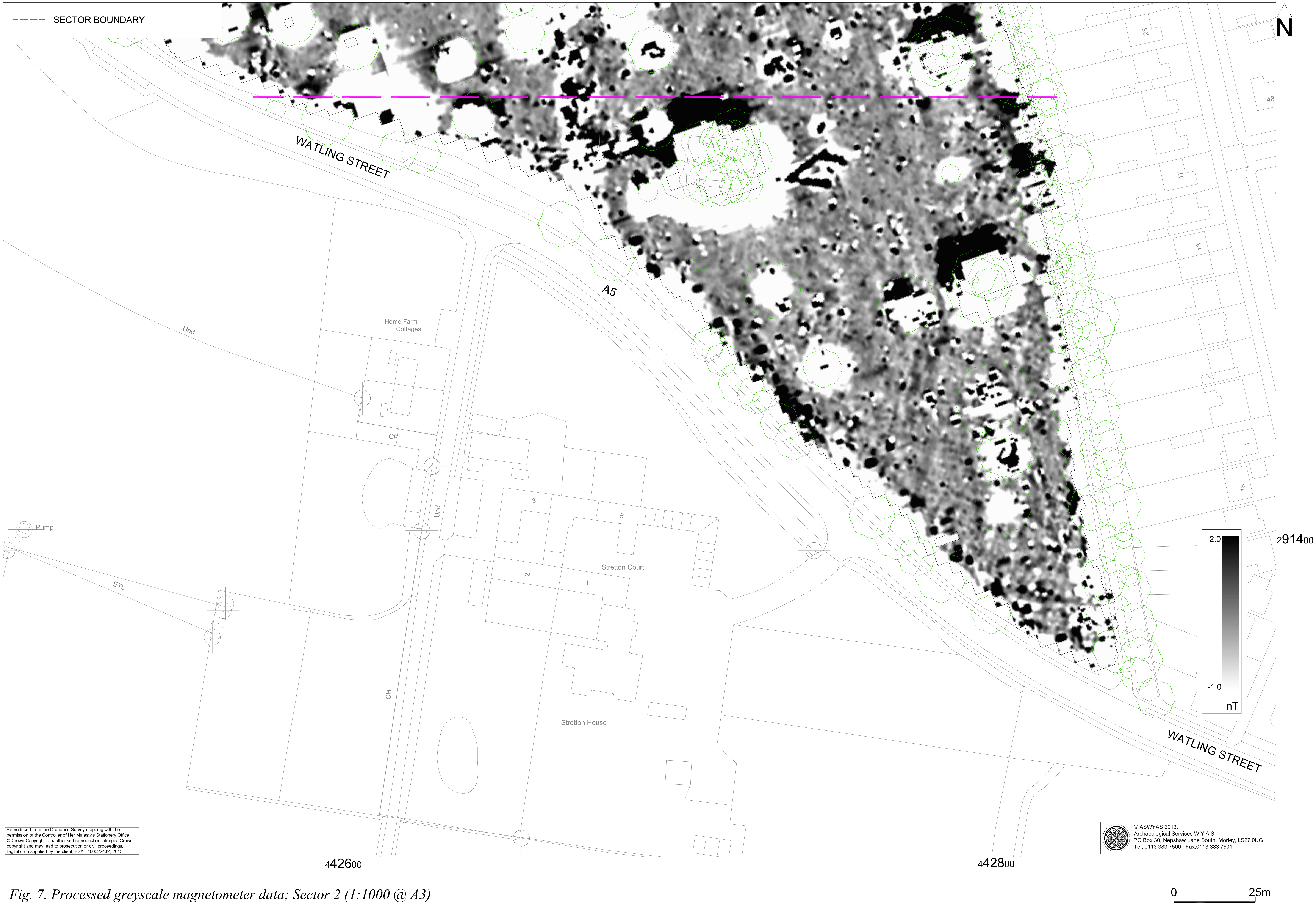

Fig. 7. Processed greyscale magnetometer data; Sector 2 (1:1000 @ A3)

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Fig. 8. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1000 @ A3)

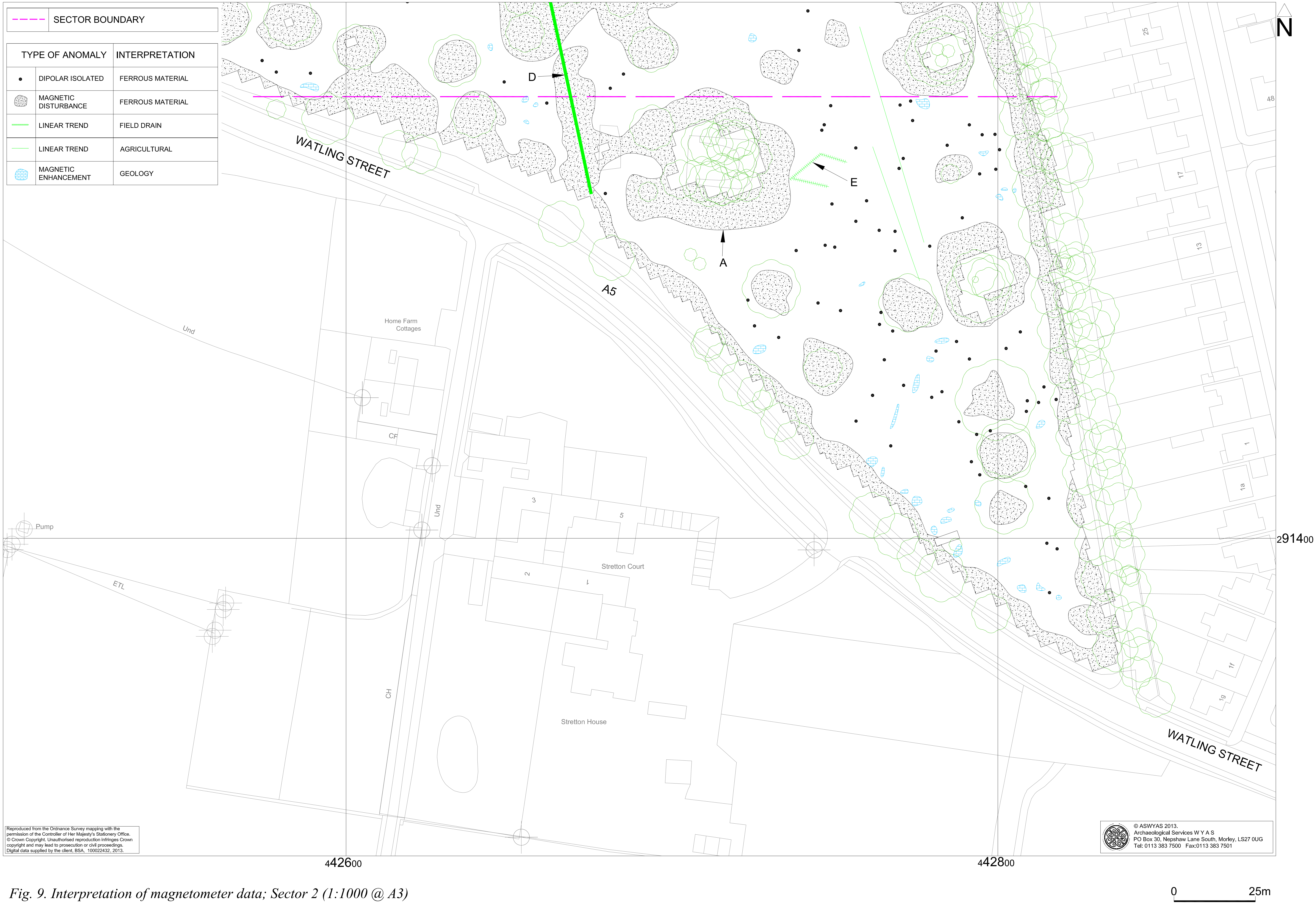

Fig. 9. Interpretation of magnetometer data; Sector 2 (1:1000 @ A3)


Plate 1. General view of survey area, looking south-east


Plate 2. 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 1m 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 VRS differential Global Positioning System (Trimble 5800 model). The accuracy of this equipment is better then 0.01m. The survey grids were then super-imposed onto a base map provided by the client to produce the displayed block locations. 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 hard copies of the mapping rather than using the digital co-ordinates.

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 Leicestershire Historic Environment Record).

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