Archaeological Services WYAS

Land at Winneycroft Farm Gloucester

Geophysical Survey

Report no. 2605

February 2014

Client: Barwood Strategic Land II LLP

Registered IA Organisation

Land at Winneycroft Farm
Gloucester

Geophysical Survey

Summary

A geophysical (magnetometer) survey covering approximately 20 hectares was carried out on the southern outskirts of Gloucester, to inform the determination of an outline planning application for the proposed development of the site. Anomalies due to ridge and furrow ploughing predominate throughout the site confirming the cropmark evidence. However, at the southern apex of the site, and partially masked by the effects of the later cultivation, anomalies indicative of archaeological activity have been identified. Two distinct clusters of anomalies, both within 200m of a scheduled moated site, are clearly visible although the weak and fragmentary nature of the anomalies makes it difficult to interpret the precise nature of the activity. On the basis of the magnetic survey, the archaeological potential of the site is assessed as generally low, except to the south where it is assessed as moderate to high.

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Report Information

Client:	Barwood Strategic Land II LLP
Address:	Grange Park Court, Roman Way, Northampton, NN4 5EA
Report Type:	Geophysical Survey
Location:	Winneycroft Farm, Gloucester
County:	Gloucestershire
Grid Reference:	SO 853 145
Period(s) of activity:	Medieval?/post-medieval
Report Number:	2605
Project Number:	4193
Site Code:	WFG14
OASIS ID:	archaeol11-178021
Planning Application No.:	
Museum Accession No.:	n/a
Date of fieldwork:	January 2014
Date of report:	February 2014
Project Management:	Alistair Webb BA MIfA
Fieldwork:	Tom Fildes BA
	Alex Schmidt BA
	Chris Sykes BA MSc
	Dan Waterfall BA
Report:	Alistair Webb
Illustrations:	Sam Harrison BSc MSc MIfA
Photography:	Chris Sykes
Research:	n/a

Authorisation for distribution: --

PO Box 30, Nepshaw Lane South, Morley, Leeds
LS27 0UG
Telephone: 0113 383 7500.
Email: admin@aswyas.com

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1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by Jo Vallender of The Environmental Dimension Partnership (the Consultant), on behalf of Barwood Strategic Land II LLP (the Client), to undertake a geophysical (magnetometer) survey of land on the southern outskirts of Gloucester (see Fig. 1), prior to the determination of a planning application for the proposed development of the site. The work was undertaken in accordance with a Project Design (Harrison 2014) supplied to and approved by Gloucester City Council and 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 January 27th and January 31st 2014 in order 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 southern periphery of Gloucester at Sneedham's Green, south-west of Winneycroft Farm and centred at SO 8530 1450. The PDA comprises an irregular shaped parcel of land comprised of ten pasture fields (see plates) bounded to the north-west by Winneycroft Lane and to the south-east by the M5 motorway (see Fig. 2). Farm land extends to the south-west and north-east.

The site is flat (see plates) and situated at approximately 50m above Ordnance Datum (aOD).

Soils and geology

The underlying bedrock geology comprises Blue Lias Formation and Charmouth Mudstone Formation. There are no recorded superficial deposits (British Geological Survey 2014).

The soils are classified in the Martock association, characterised as slowly permeable, seasonally waterlogged stoneless silts over clay (Soil Survey of England and Wales 1983).

2 Archaeological Background

The PDA lies 100m north-east of a moated site at Sneedham's Green (see Fig. 2), thought to date from between 1250 and 1350, that is protected as a scheduled monument (Ref. No. 1019399). Cropmarks suggest that ditches and structures survive as buried features to the south of the earthworks.

To the north of the monument ridge and furrow earthworks are clearly visible, extending throughout the PDA. Therefore, a moderate potential for the presence of unrecorded features, within the PDA, from the medieval period was assumed.

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 development on 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 of the PDA was carried out, an area of approximately 20 hectares.

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 (1:2500) location plan displaying the processed magnetometer data in greyscale format and Figure 3 presents an overall interpretation of the data across the whole site. Large scale data plots, of both the minimally processed (X–Y trace plot) and processed (greyscale) data, together with interpretative figures are presented at a scale of 1:1000 in Figures 4 to 15 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 15 inclusive)

The anomalies identified by the survey fall into several different types and categories according to their origin. These are discussed below and cross-referenced to specific examples and locations within the site, where appropriate.

Ferrous 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, as 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.

Two linear dipolar anomalies, **A** and **B**, are identified in the south-eastern half of the site. Anomaly **A** crosses Field 7 and Field 8 aligned south-west/north-east and Anomaly **B** runs north/south, also through Field 7. Both anomalies are caused by sub-surface pipes. A third linear anomaly, **C**, crosses Field 4, also aligned south-west/north-east, and is also caused by a pipe.

Agricultural Anomalies

Throughout the site the data is dominated by series of parallel linear trend anomalies on several alignments, the orientation depending on the shape of the field and the lie of the land. These anomalies are caused by the medieval or post-medieval agricultural practice of ridge and furrow cultivation and are due to the magnetic contrast between the now (mostly) soil-filled furrows and the former ridges. Ridge and furrow anomalies are identified in all the fields except in Field 3 and Field 4, which are nearest to the stream which runs through the site. Here any evidence of the former agricultural activity may have been masked by alluvium. In Field 10, linear anomalies, **D** and **E**, perpendicular to two separate areas of ploughing, probably represent headlands between two areas of ploughing.

Across the site several other, mostly short, individual linear anomalies have also been identified. Without any information to support an archaeological interpretation these anomalies are also interpreted as agricultural in origin, possibly drains such as in Field 3, or more recent ploughing such as in Field 5. A faint linear anomaly crossing Field 8 and Field 9, corresponds with a cattle path visible on satellite images of the site.

Geological anomalies

Broad, low magnitude anomalies are identified, primarily in Field 3. These areas of enhanced magnetic response are adjacent to the stream and are due to accumulations of alluvium

Archaeological anomalies

In Field 10, at the southern apex of the site, two distinct clusters of discontinuous linear and curvilinear anomalies can be identified against the much stronger and differently aligned anomalies that are caused by ridge and furrow cultivation. These clusters of anomalies are interpreted as being caused by sub-surface archaeological features. Of the two clusters the northernmost is more coherent and the discontinuous linear anomaly, **F**, (caused by an infilled ditch feature) looks to describe a reverse D-shaped enclosure, measuring approximately 50m on its longest side. Although the anomalies caused by the later ridge and furrow cultivation make differentiation between the two phases of activity difficult a sub-circular anomaly, **G**, is identified within the enclosure. Several other discrete anomalies are also highlighted within the enclosure which are also considered likely to have an archaeological origin.

Fifty metres to the south-east a second, less coherent, cluster of anomalies, **H**, is identified. Here the anomalies are much more fragmented and much weaker in magnitude and it is difficult to gain a confident understanding of the underlying features. However, the anomalies are clearly on a different alignment to the ploughing anomalies.

5 Conclusions

The survey has confirmed that ridge and furrow cultivation has been carried out across most, if not all, of the site. Against this background of agricultural activity, which may be of local interest, two clusters of anomalies of archaeological potential have been identified at the southern end of the site. Whether these features are associated with the medieval moated site located about 200m to the south-west, or are associated with much earlier activity is not clear at present. Consequently the archaeological potential of the site is assessed as low, except to the south, where it is assessed as moderate to high.

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.

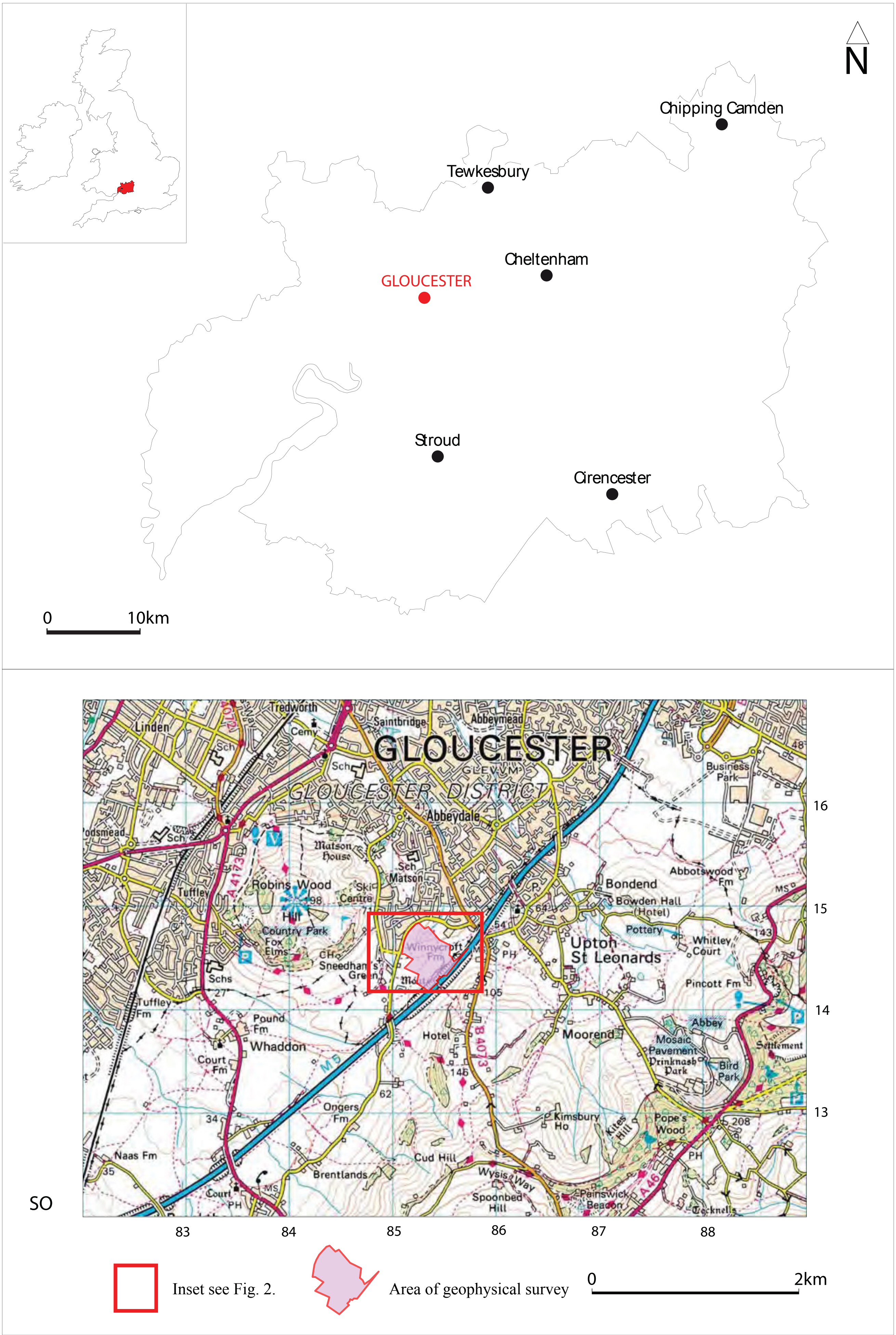


Fig. 1. Site location

Fig. 2. Site location showing greyscale magnetometer data (1:2500 @ A3)

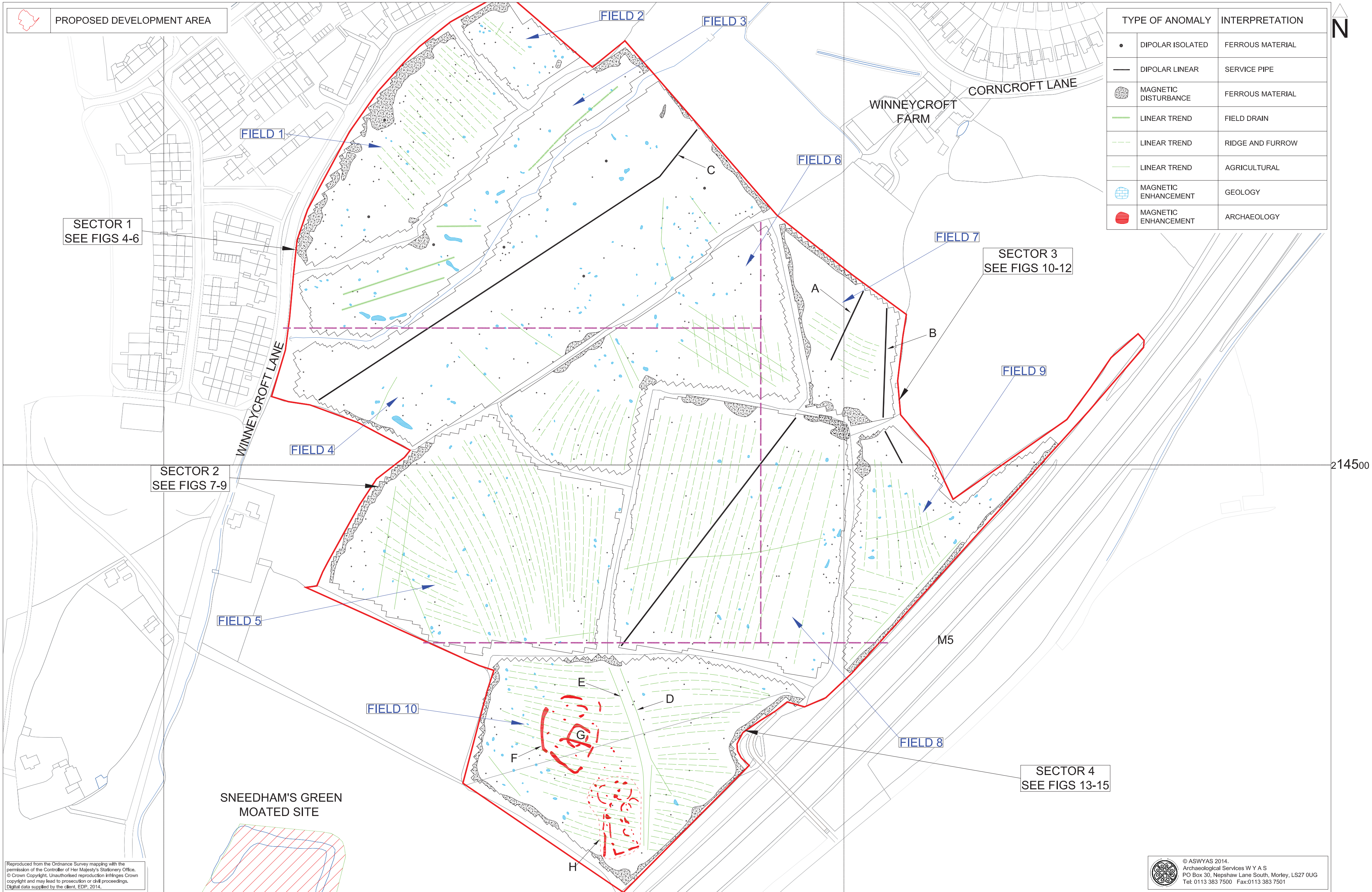


Fig. 3. Overall interpretation of magnetometer data (1:2500 @ A3)

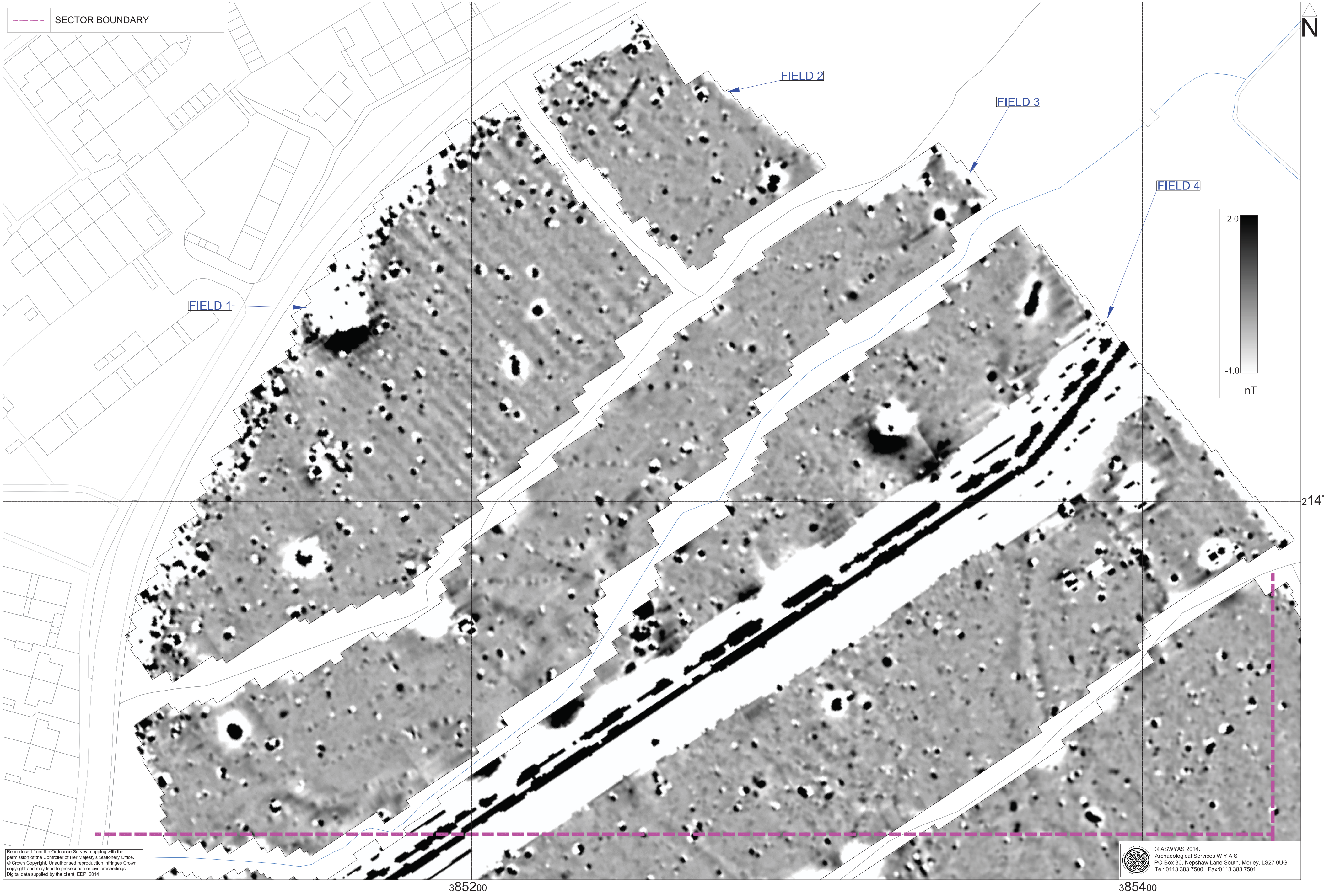


Fig. 4. Processed greyscale magnetometer data; Sector 1 (1:1000 @ A3)

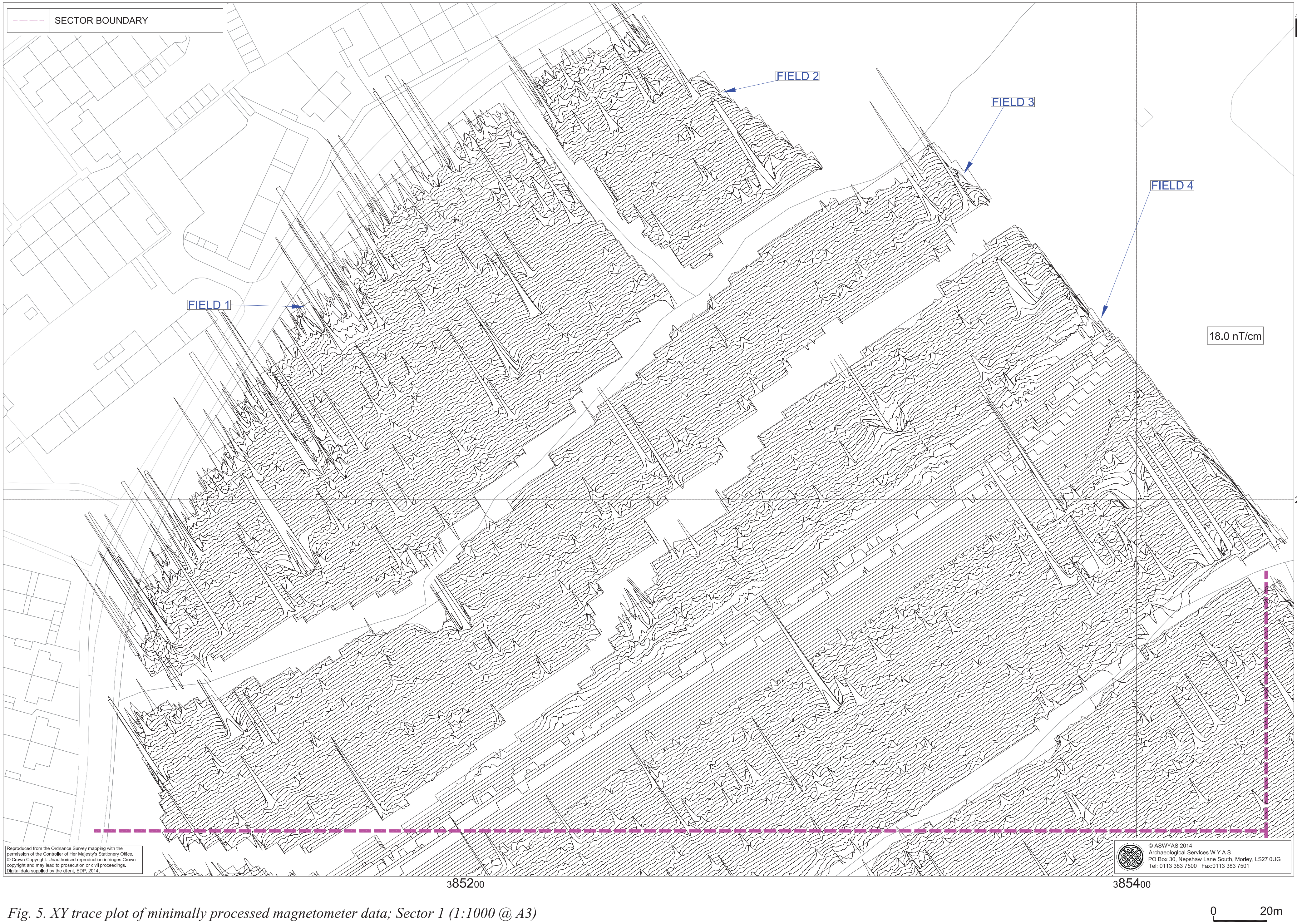


Fig. 5. XY trace plot of minimally processed magnetometer data; Sector 1 (1:1000 @ A3)

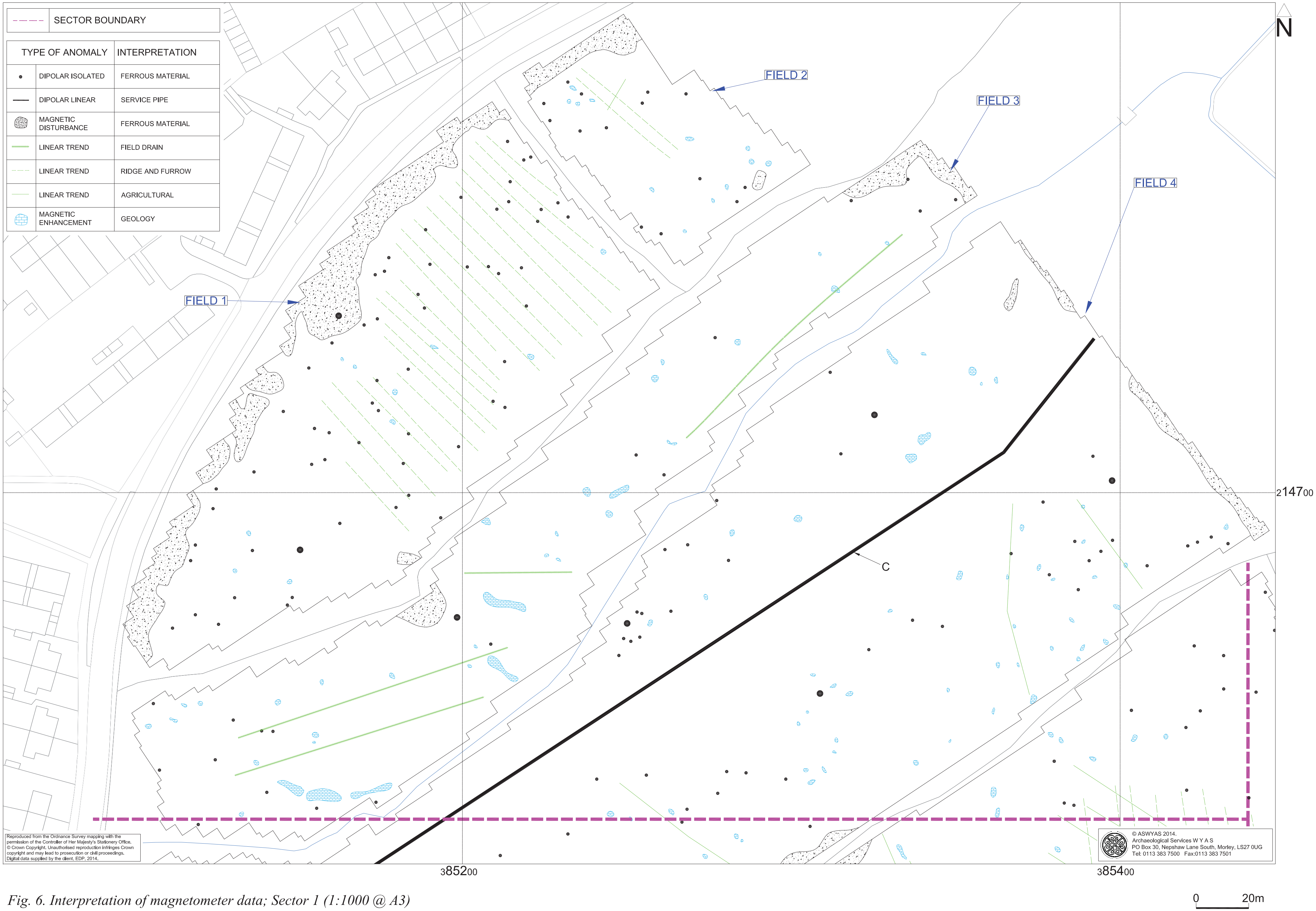


Fig. 6. Interpretation of magnetometer data; Sector 1 (1:1000 @ A3)

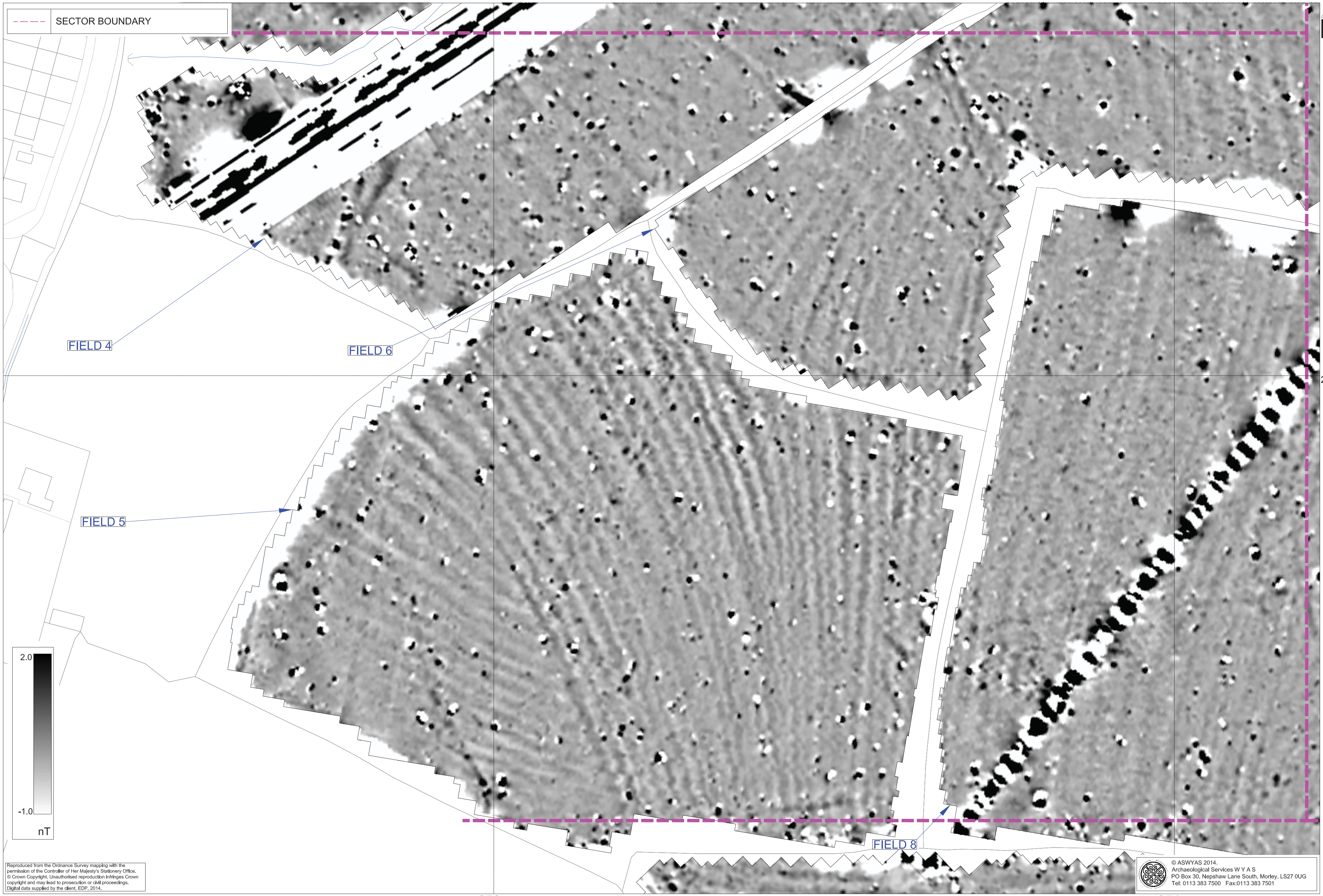


Fig. 7. Processed greyscale magnetometer data; Sector 2 (1:1000 @ A3)

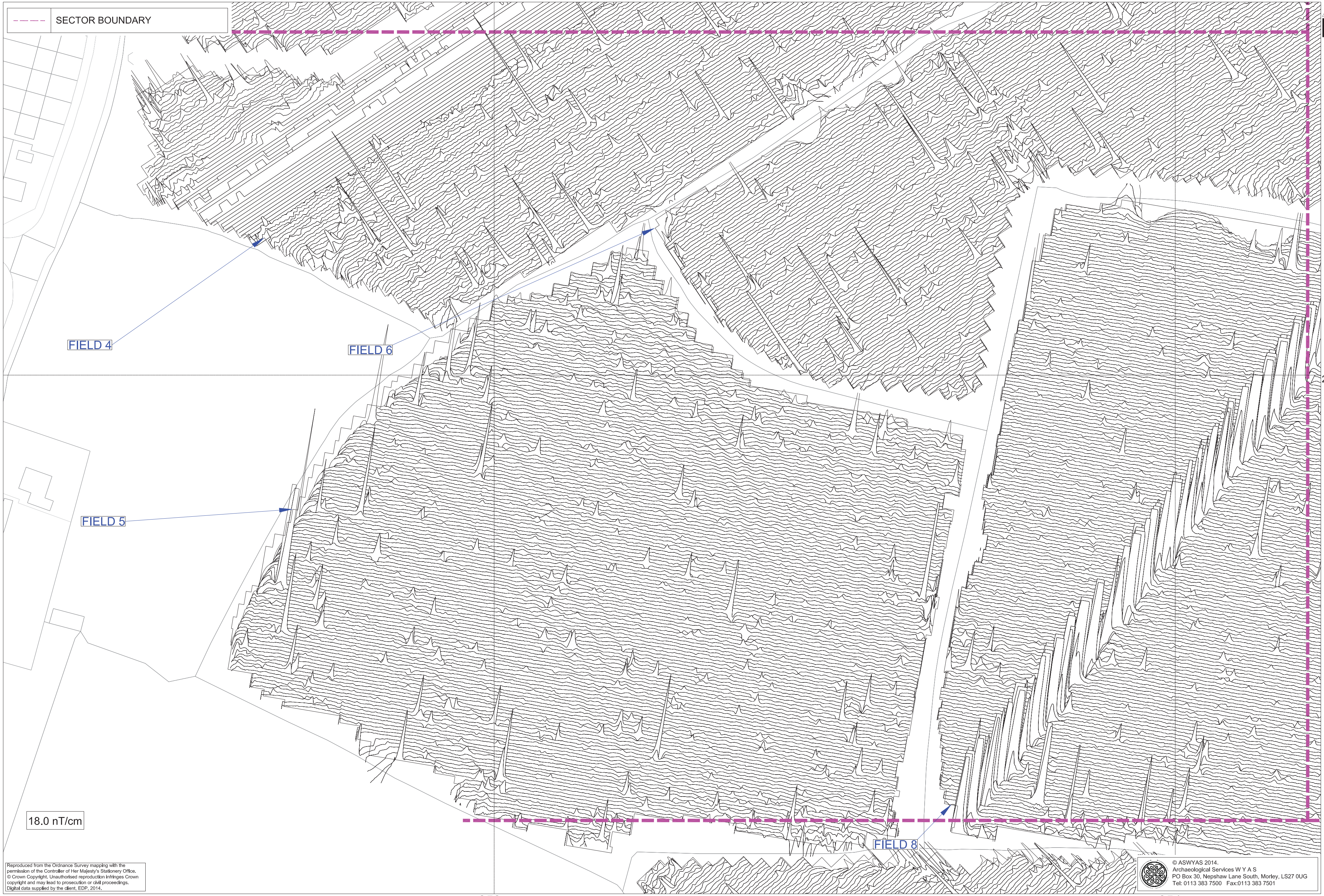


Fig. 8. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1000 @ A3)

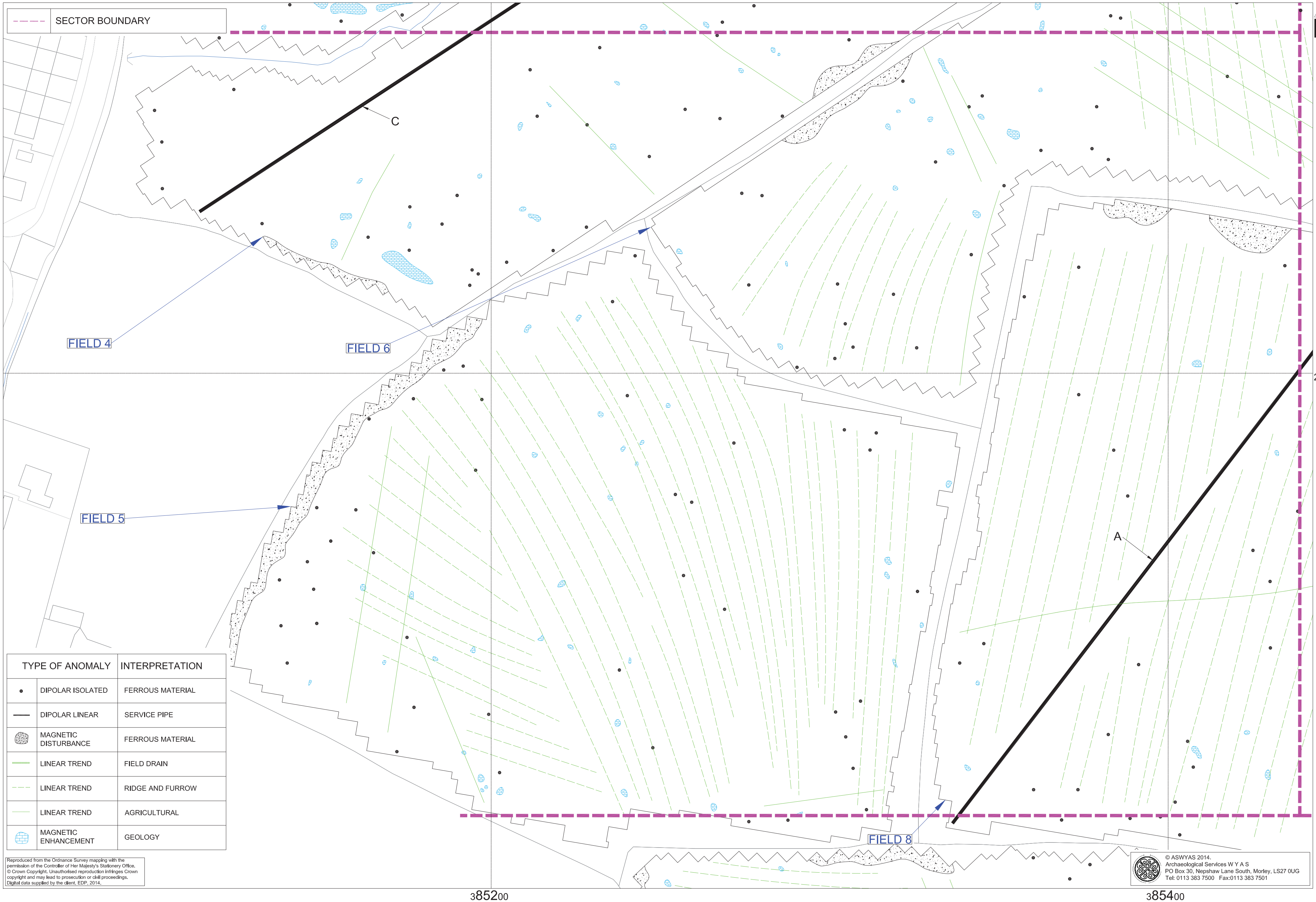


Fig. 9. Interpretation of magnetometer data; Sector 2 (1:1000 @ A3)

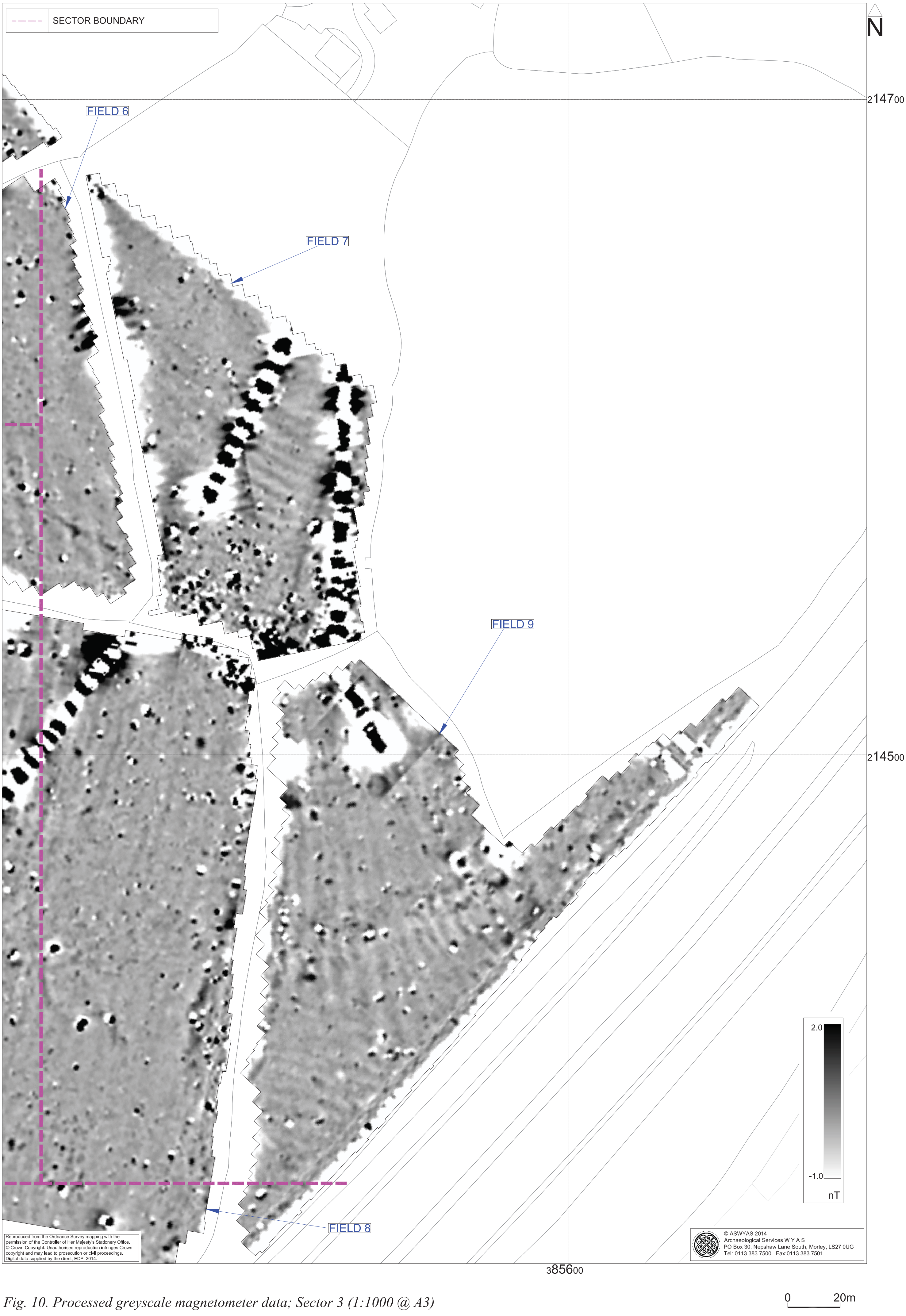


Fig. 10. Processed greyscale magnetometer data; Sector 3 (1:1000 @ A3)

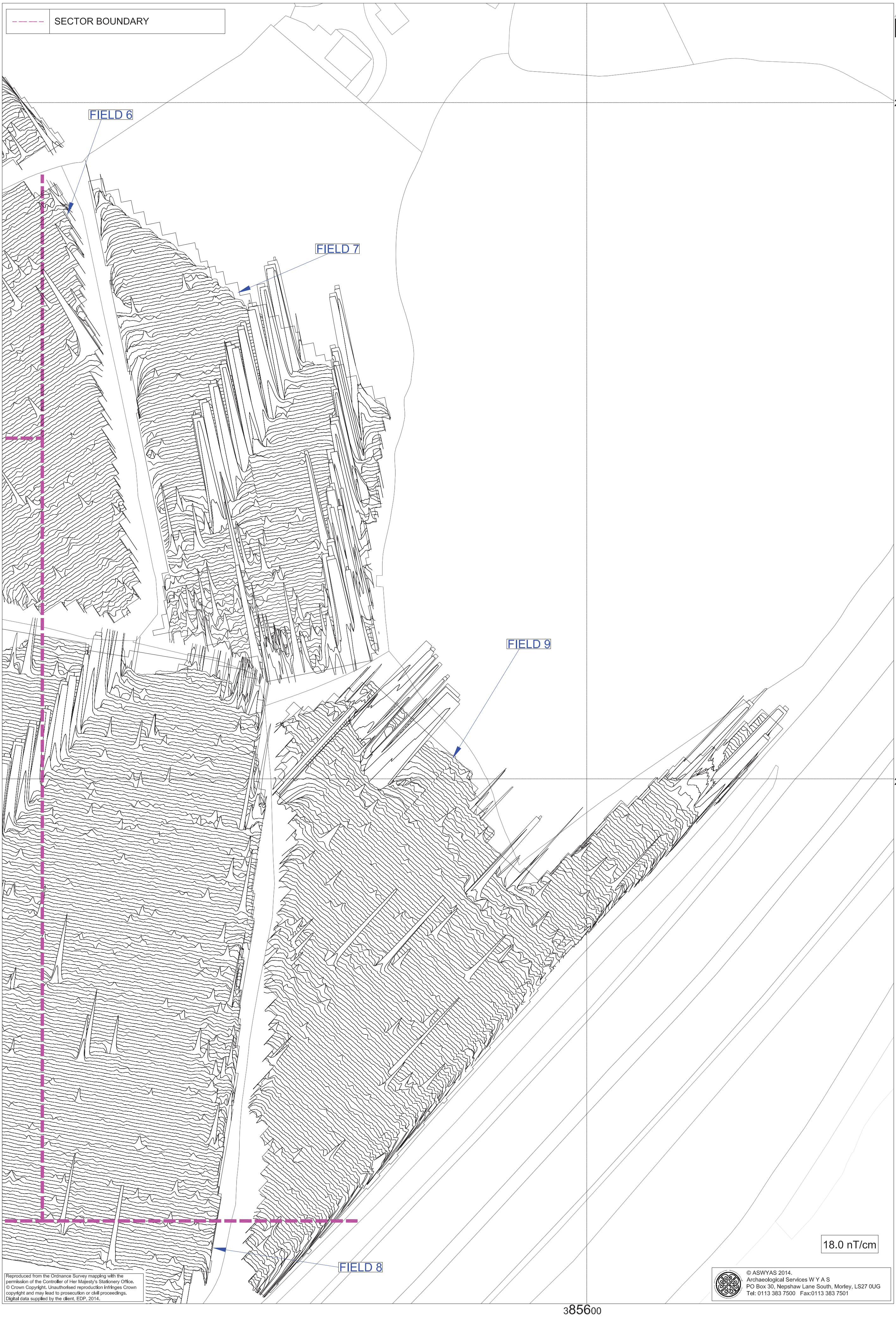


Fig. 11. XY trace plot of minimally processed magnetometer data; Sector 3 (1:1000 @ A3)

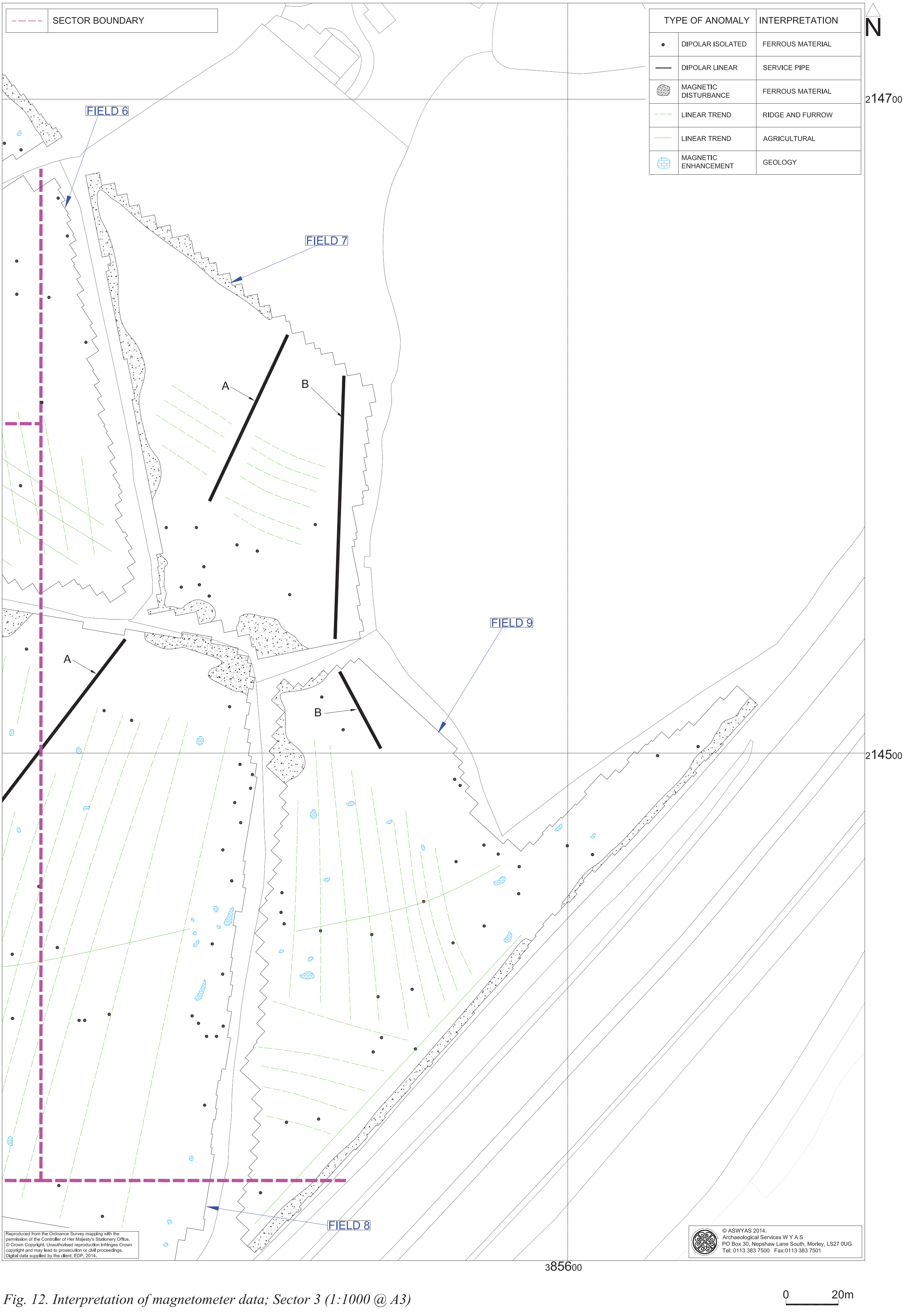


Fig. 12. Interpretation of magnetometer data; Sector 3 (1:1000 @ A3)

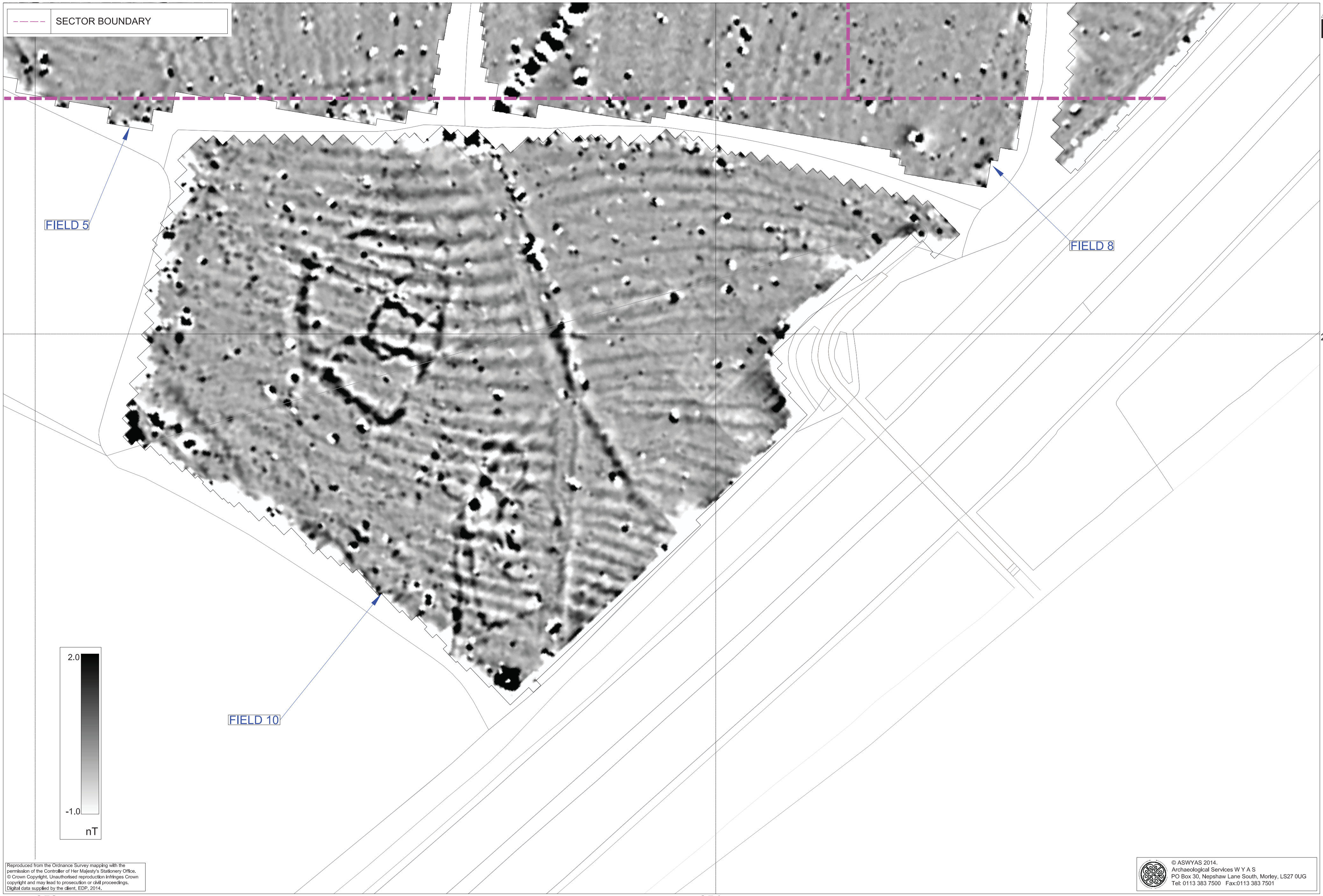
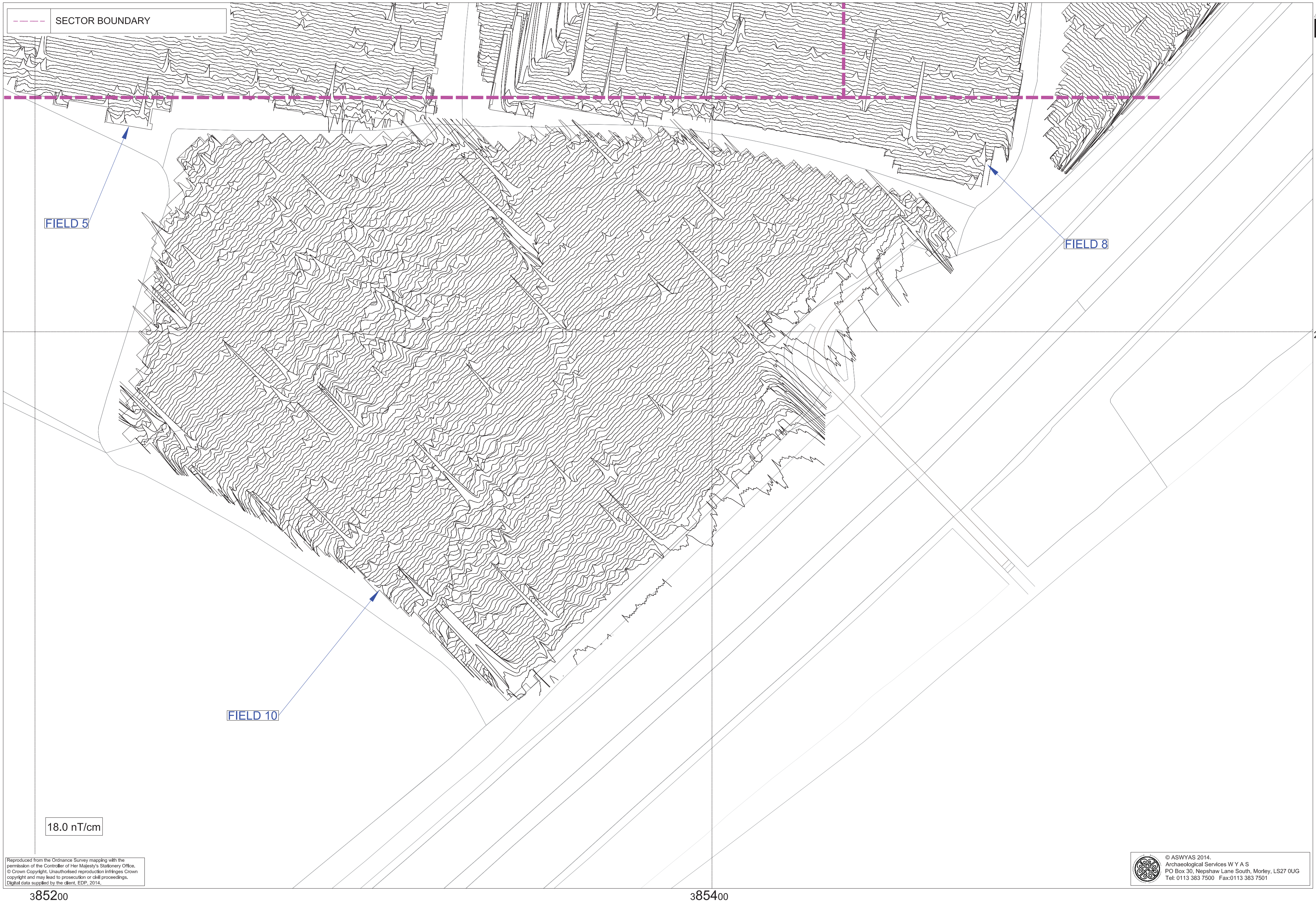


Fig. 13. Processed greyscale magnetometer data; Sector 4 (1:1000 @ A3)



Archaeological Services W Y A S
PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

Fig. 14. XY trace plot of minimally processed magnetometer data; Sector 4 (1:1000 @ A3)

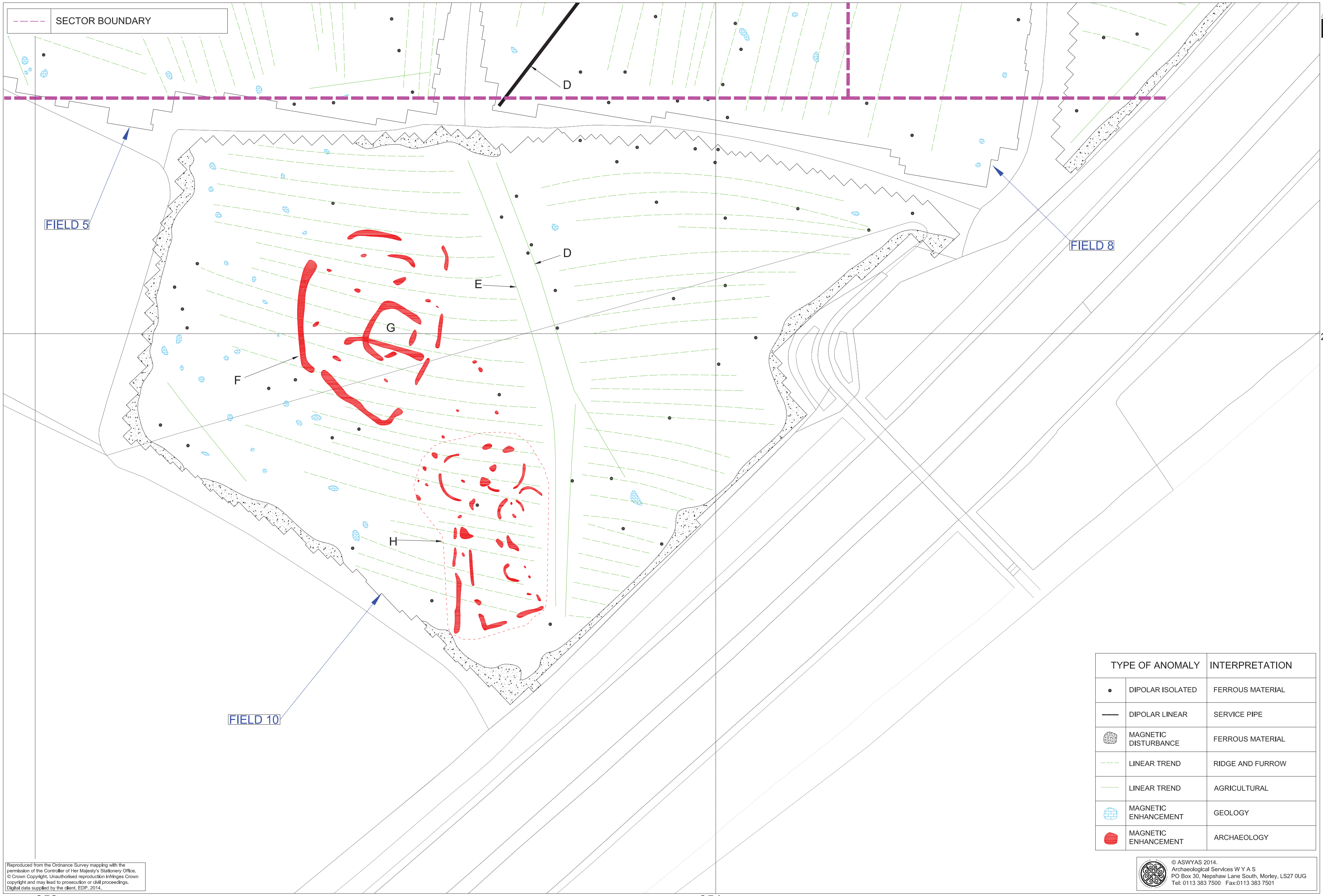


Fig. 15. Interpretation of magnetometer data; Sector 4 (1:1000 @ A3)

Plate 1. General view of Field 3, looking south-west

Plate 2. General view of Field 4, looking north-east

Plate 3. General view of Field 5, looking north

Plate 4. General view of Field 6, looking north-west

Plate 5. General view of Field 8, looking north-west

Plate 6. General view of Field 10, 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 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.

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 City of Gloucester Historic Environment Record).

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