ARCHAEOLOGICAL SERVICES WYAS

Keresley Sustainable Urban Expansion Coventry

Geophysical Survey

Report no. 2610

February 2014

Client: Cotswold Archaeology

REGISTERED ORGANISATION IfA

Keresley Sustainable Urban Expansion
Coventry

Geophysical Survey

Summary

A geophysical (magnetometer) survey, covering approximately 42 hectares, was carried out on agricultural land on the north-western edge of Coventry in advance of the determination of a planning application for a proposed urban expansion scheme. There is a clear correlation between the levels of magnetic contamination and current land-use with a high degree of ferrous contamination on the fields under arable cultivation and a very 'quiet' magnetic background on the pasture fields. Against these varying backgrounds anomalies caused by sub-surface pipes and other modern activity are identified. Anomalies due to ridge and furrow and later ploughing and geological boundaries are also noted. The only features of possible archaeological potential are a line of pit type anomalies towards the east of the site. Overall the archaeological potential of the site is considered to be low.

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Report Information

Client:	Cotswold Archaeology Ltd
Address:	Building 11, Kemble Enterprise Park, Cirencester, Gloucestershire, GL7 6BQ
Report Type:	Geophysical Survey
Location:	Keresley, Coventry
County:	Warwickshire
Grid Reference:	SP 3153 8337
Period(s) of activity:	post-medieval/modern
Report Number:	2610
Project Number:	4190
Site Code:	KJE14
OASIS ID:	archaeol11-178506
Planning Application No.:	n/a
Museum Accession No.:	n/a
Date of fieldwork:	February 2014
Date of report:	February 2014
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Photography:	Site Staff
Research:	n/a

Authorisation for distribution: --

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1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by Hannah Armstrong of Cotswold Archaeology Ltd (the Client), on behalf of Pegasus Planning Group Ltd, to undertake a geophysical (magnetometer) survey of agricultural land on the north-western outskirts of Coventry at Keresley (see Fig. 1), prior to the determination of a planning application for a proposed urban expansion. The work was undertaken in accordance with a Project Design (Harrison, 2014) supplied to and approved by the Client, 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 February 3rd and February 10th 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) comprises an irregular shaped block of agricultural land at Keresley, north-west of Coventry, centred at SP 3153 8337. It is bounded to the west by Tamworth Road, by the Royal Court Hotel, a golf driving range and Sandpits Lane to the south, to the east by Bennetts Road South and by farmland to the north. The PDA comprises fifteen fields that are predominantly arable to the west and pasture to the east (see plates) and covers an area of 42 hectares. Although very wet throughout only a small area was unsuitable for survey; Field 15 was completely overgrown (see Plate 12) and a strip of maize in Field 7 and mounds of manure in Field 1 and Field 3 (see Plate 3) also precluded survey.

The PDA is situated at the southern end of a north-west/south-east escarpment, covering part of the scarp top to the north-west, the north-east facing slope of the escarpment and the south-east facing slope at the end of the escarpment. The highest point of the site is on the north-western edge at approximately 145m above Ordnance Datum (aOD) falling to approximately 120m aOD to the north-east and south-east.

Soils and geology

The underlying bedrock geology comprises Keresley Member Carboniferous sandstone with three south-east/north-west aligned strata of Keresley Member Carboniferous Interbedded Argillaceous Rocks, Sandstone and Conglomerate. There are no recorded superficial deposits. (British Geological Survey 2014).

The soils in this area are classified in the Bromsgrove association, characterised as well-drained reddish coarse loams over soft sandstone (Soil survey of England and Wales 1983).

2 Archaeological Background

A Heritage Desk-Based Assessment (Cotswold Archaeology, 2013), undertaken of the site and the immediate area, reported that prehistoric flints have been recovered during fieldwalking from the northern part of the PDA in Field 3 and Field 7 (see Fig. 2) and that there was therefore '*potential for below-ground prehistoric remains in this area*'. Fieldwalking also recovered fragments of medieval pottery and floor tile in Field 6 and Field 7 (see Fig. 2) which indicates that '*there is also some potential for below-ground remains of a medieval building within the site*'. To the east of the PDA cropmarks and degraded earthworks indicate the former agricultural practice of ridge and furrow cultivation.

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 available parts of the PDA was carried out, an area of 42 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 (1:4000) location plan displaying the processed magnetic data. Figure 3 is an overall data interpretation plot also at a scale of 1:4000. Detailed data plots ('raw' and processed) and full interpretative figures are presented at a scale of 1:1000 in Figures 4 to 21 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 21 inclusive)

Numerous anomalies have been identified by the survey. The anomalies 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, where appropriate.

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, as ferrous debris or material is common on rural sites, often being present as a consequence of manuring or tipping/infilling.

On this site there is a clear distinction between the data recorded on those fields that are currently under arable cultivation and those which are under permanent pasture. To the north and west of the PDA the fields are primarily arable and there are a huge number of individual iron 'spike' anomalies, probably due to ferrous material introduced into the topsoil during manuring over a prolonged period or possibly due to the recent use of organic mulch. The density of these anomalies gives the data a 'speckled' appearance in contrast to the eastern half of the site where, although there are still numerous 'spike' anomalies, the density of anomalies is much lower giving the data a much 'smoother' grey tone (see Fig. 2).

Larger areas of magnetic disturbance are identified at several locations around the periphery of the site. As noted above these anomalies are either due to the proximity of magnetic material in field boundaries, buildings or other above ground features or to tipping from adjacent properties. None is considered to have any archaeological significance.

Three high magnitude linear dipolar anomalies, **A**, **B** and **C**, caused by sub-surface pipes are identified crossing the site. Anomalies **A** and **B** are located to the east of the PDA, aligned north-east/south-west and anomaly **C** is aligned north/south to the west of the site.

Three circular areas of magnetic disturbance, **D**, **E** and **F**, are due to the proximity of three electricity pylons.

Agricultural Anomalies

Analysis of historical Ordnance Survey mapping has established that the division and layout of fields within the PDA has altered only slightly over the past 130 years, with a couple of boundaries in the central part of the PDA having been removed. These 19th century former boundaries are not, however, identified as magnetic anomalies.

Numerous linear anomalies indicative of agricultural activity have been identified. To the east of the site in Field 11, parallel curvilinear anomalies are clearly visible on two alignments, north-west/south-east at the northern edge of the field and broadly west/east in the southern half of the field. These anomalies are due to the former practice of ridge and furrow cultivation and are caused by the magnetic contrast between the soil forming the ridge and the partially filled furrow.

Similar anomalies, also attributable to ridge and furrow cultivation, are identified in all the fields currently under permanent pasture, fields 8 to 14 inclusive. In the fields under arable cultivation the variable magnetic background precludes the identification of very weak anomalies but linear trends in the data in Field 1, Field 4 and Field 5 are due to more recent agricultural (ploughing) activity.

Field 10 was subdivided into a series of smaller paddocks by electric fences (see Plate 9). The proximity of the magnetometer to these fences has resulted in a series of linear anomalies, the most obvious of which are the two parallel anomalies aligned north/south, **G** and **H** that broadly divide the field in half.

A possible field drain, **I**, has been identified to the west of Field 8.

A curvilinear, **J**, in Field 13 corresponds with a cropmark clearly visible on an air photograph taken in the 1940s. It is probably a trackway or possible headland between areas of ridge and furrow cultivation.

Geological anomalies

Clusters of anomalies, characterised as areas of enhanced magnetic response, are identified at two locations. Both clusters are interpreted as of geological origin. The cluster of anomalies, **K**, along the northern edge of Field 8 borders Hall Brook and the anomalies are almost certainly caused by the deposition of alluvium from the stream.

Further to the south a linear cluster of anomalies, **L**, correlates with a geological boundary between the Keresley Member strata.

Other vague trends in the data, particularly to the south of Field 8 are also interpreted as of likely geological origin.

Extraction? anomalies

A cluster of anomalies, **M**, at the south-eastern corner of the PDA in Field 14 may be caused by material backfilling locate a former pond or extraction pit. Circumstantial evidence to support this interpretation comes from the name of the road immediately to the south, Sandpits Lane. Alternatively it might locate the demolished remains of a structure or an area of tipping.

Archaeological? anomalies

A row of discrete anomalies, **N**, aligned north/south in Field 13, is indicative of a line of infilled pits. There are no obvious features or landmarks extant or on the historic mapping to suggest a cause and therefore an archaeological cause cannot be dismissed. A modern origin could, however, be equally likely.

6 Conclusions

Although the magnetometer survey has identified a plethora of anomalies none are of clear archaeological potential. For the most part the anomalies reflect, predominantly agricultural, activity including ploughing and manuring but also possible localised mineral extraction. Anomalies due to geology and soils are also present. The only anomalies considered of some archaeological potential are a line of pit like responses to the east of the site. Flint scatters to the west of the PDA attest to prehistoric activity within the site boundary and so an archaeological origin cannot be dismissed. However, a post-medieval or modern cause is equally plausible. No definite evidence for a medieval building has been identified although a cluster of anomalies to the south-eastern corner of the PDA, interpreted as a possible backfilled quarry pit, could be indicative of a spread of rubble.

Overall the archaeological potential of the PDA is assessed as being 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.

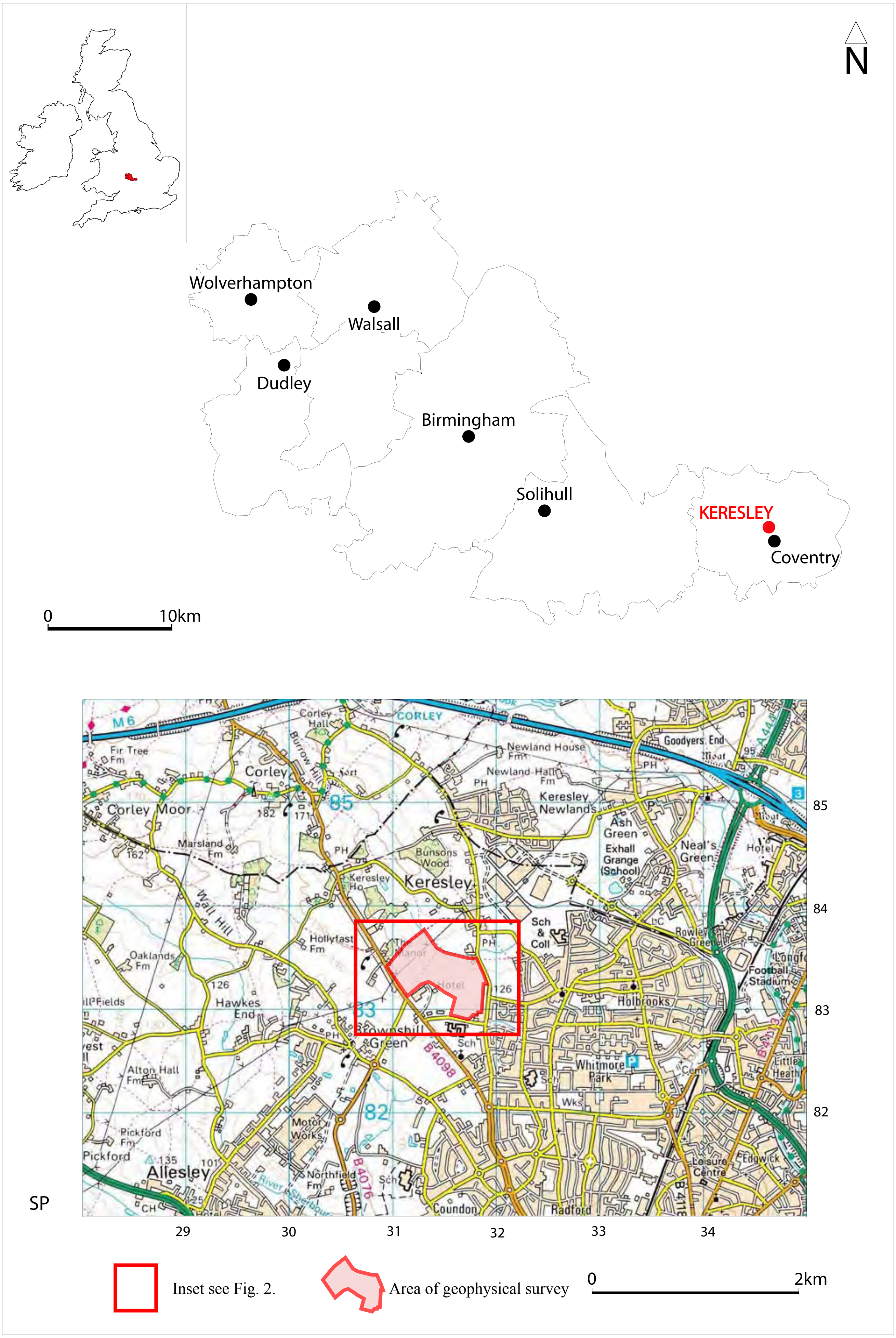

Fig. 1. Site location

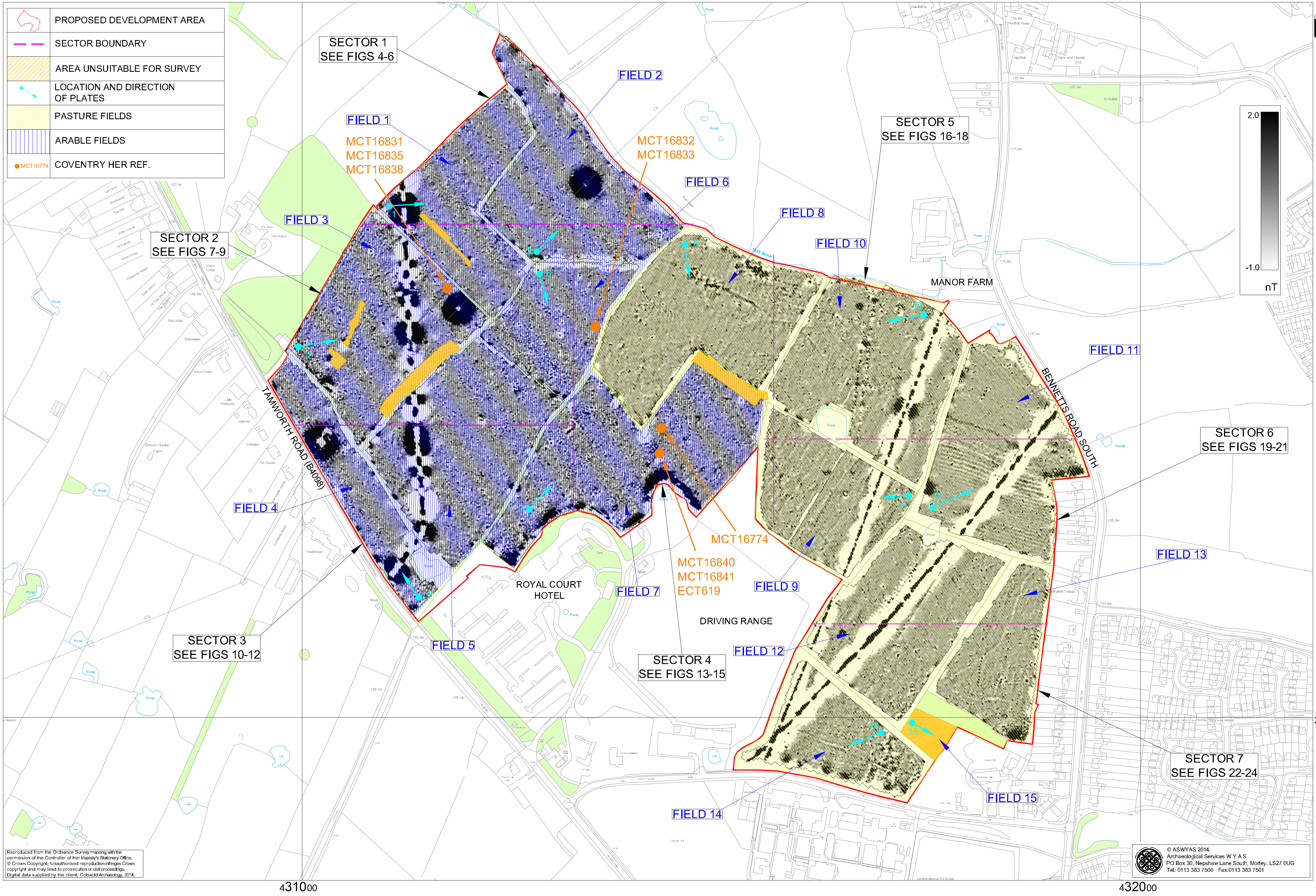

Fig. 2. Survey location showing magnetometer data (1:4000 @ A3)

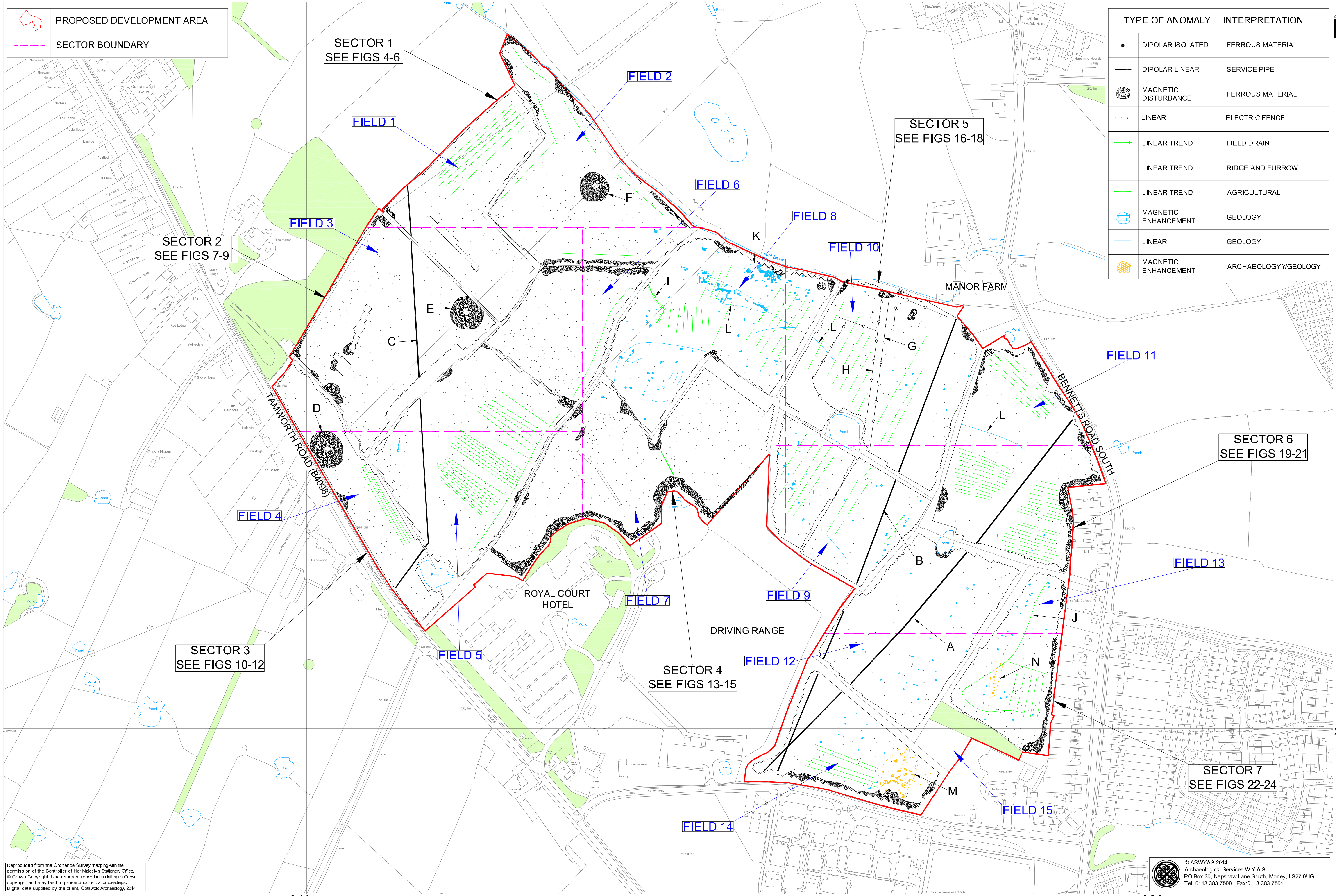

Fig. 3. Overall interpretation of magnetometer data (1:4000 @ A3)

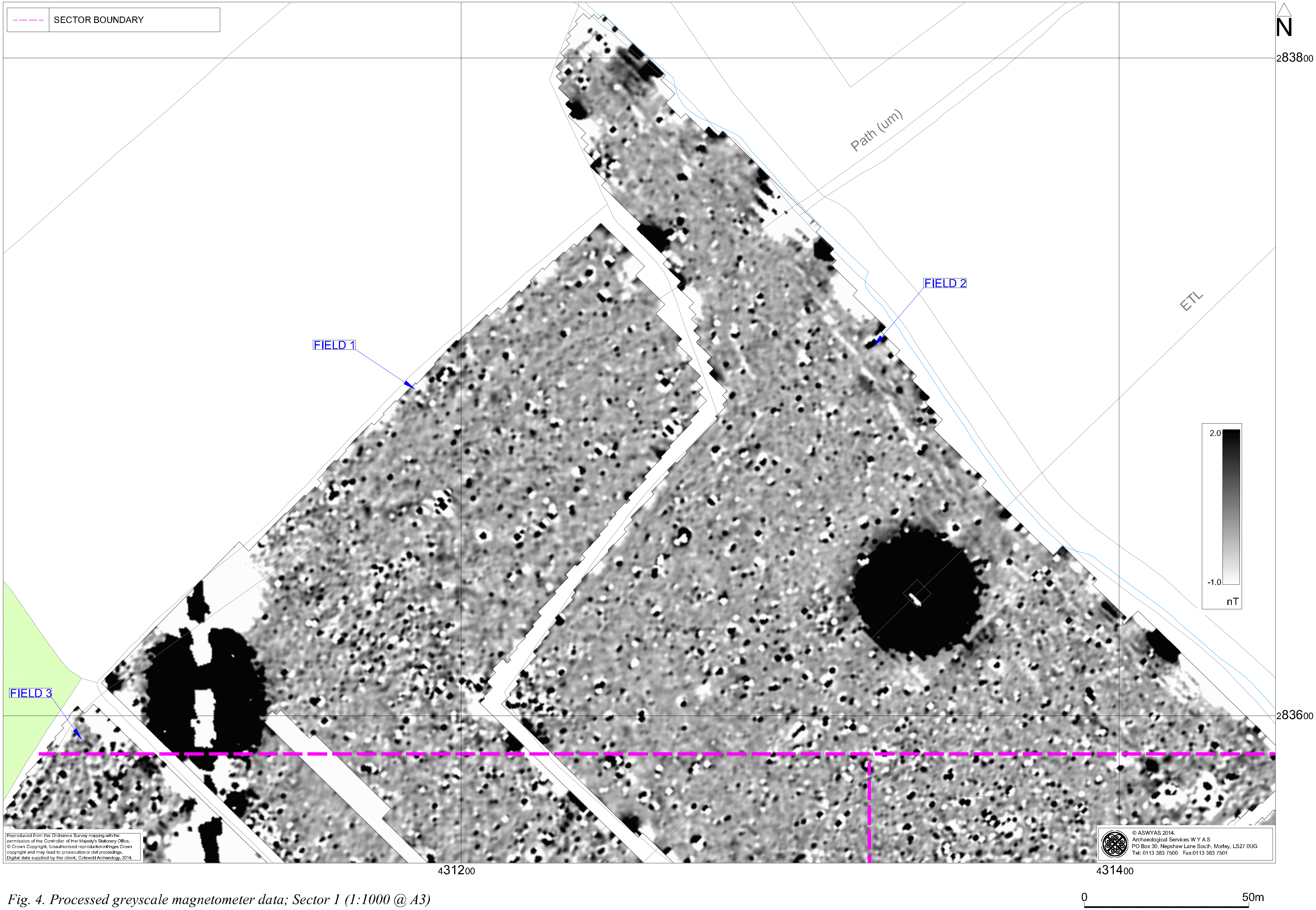

Fig. 4. Processed greyscale magnetometer data; Sector 1 (1:1000 @ A3)

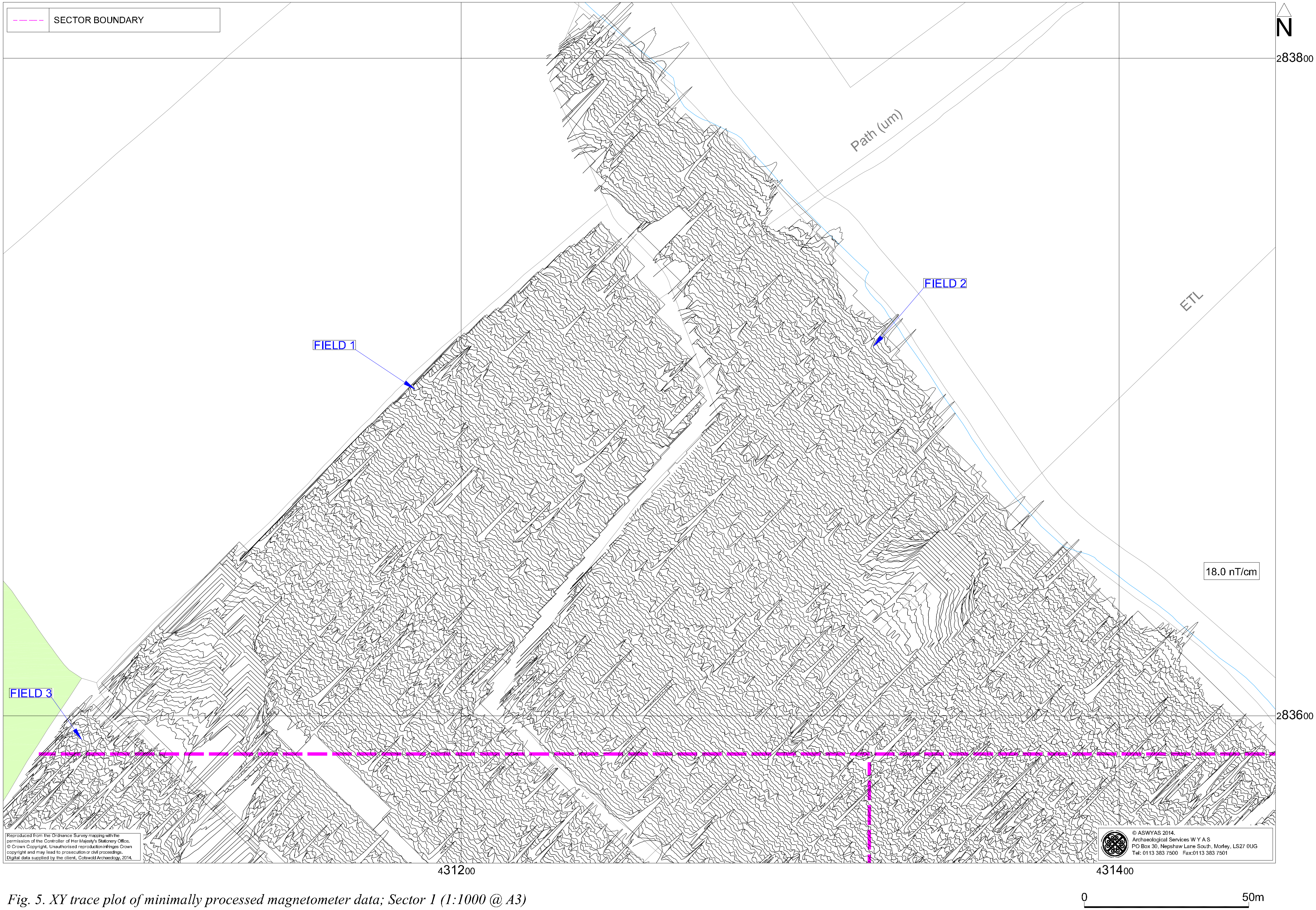

Fig. 5. XY trace plot of minimally processed magnetometer data; Sector 1 (1:1000 @ A3)

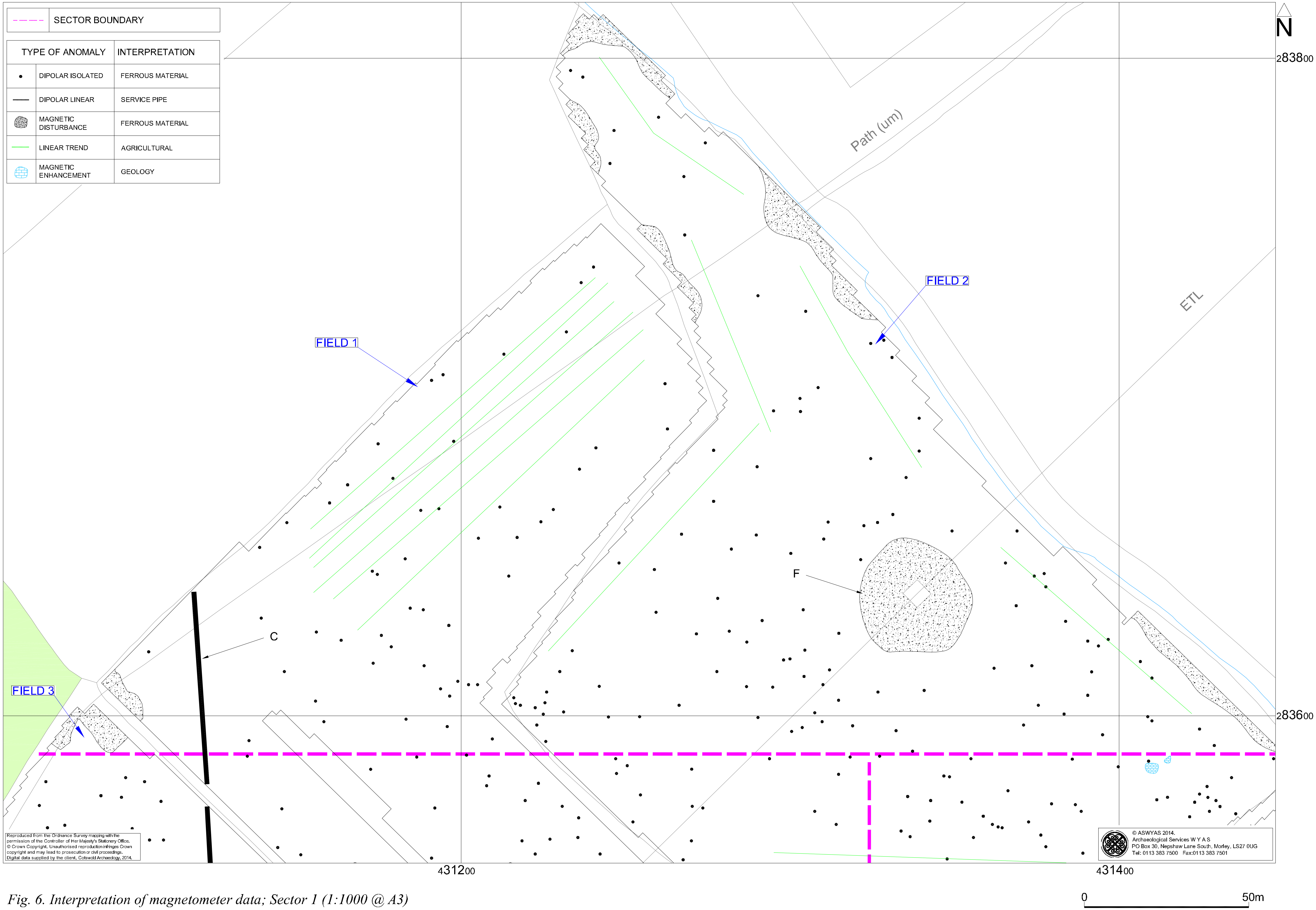

Fig. 6. Interpretation of magnetometer data; Sector 1 (1:1000 @ A3)

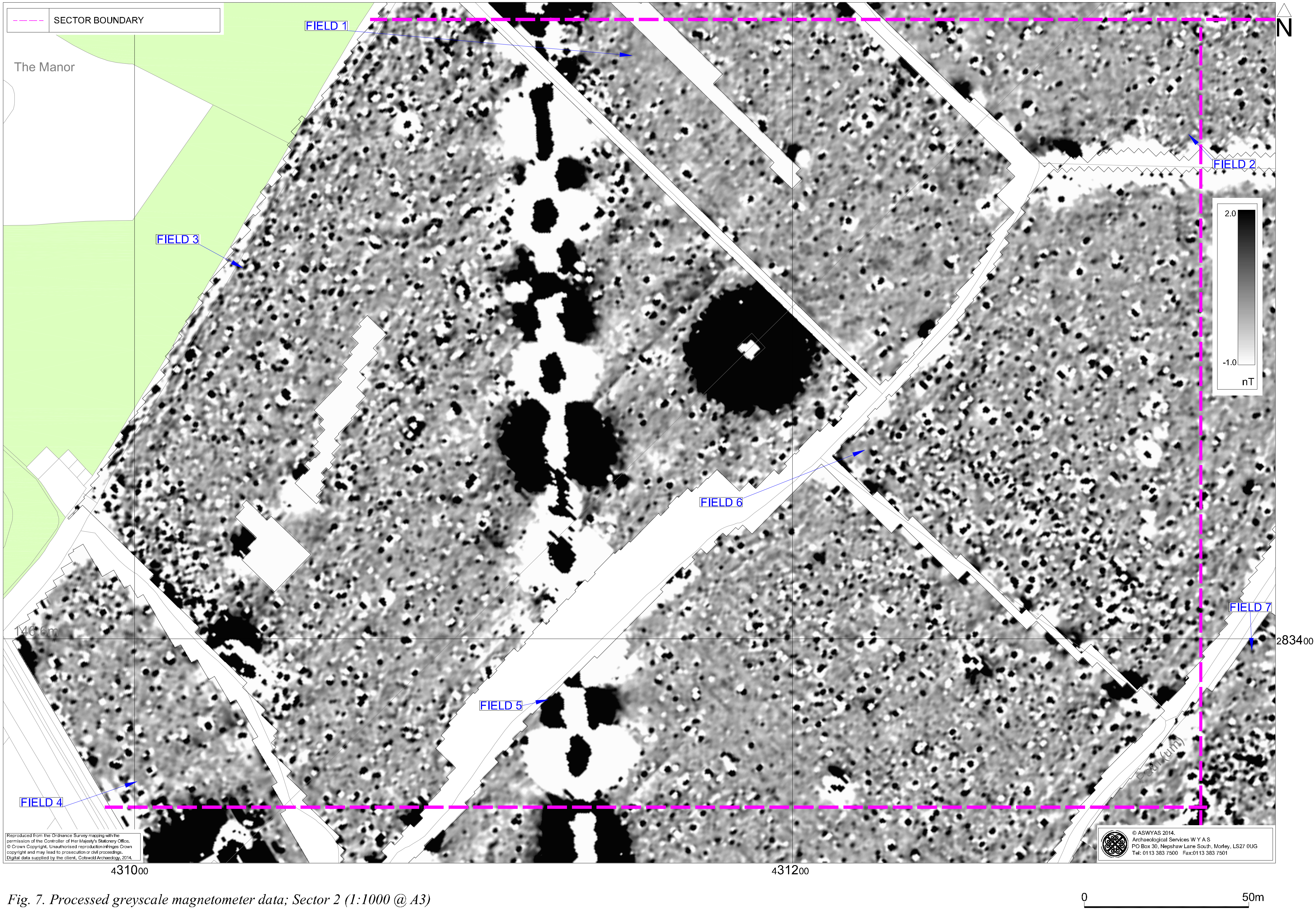

Fig. 7. Processed greyscale magnetometer data; Sector 2 (1:1000 @ A3)

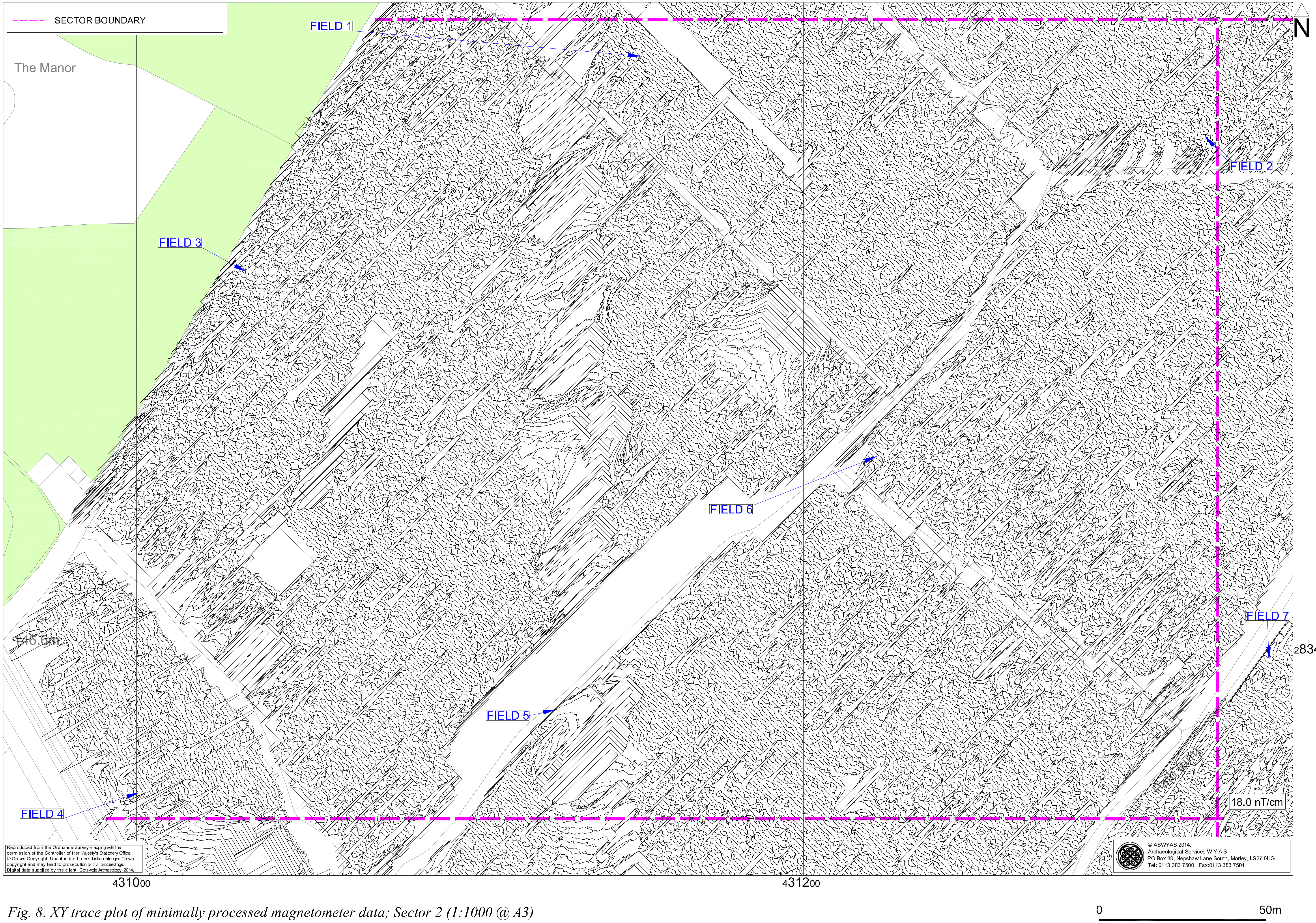

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Fig. 8. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1000 @ A3)

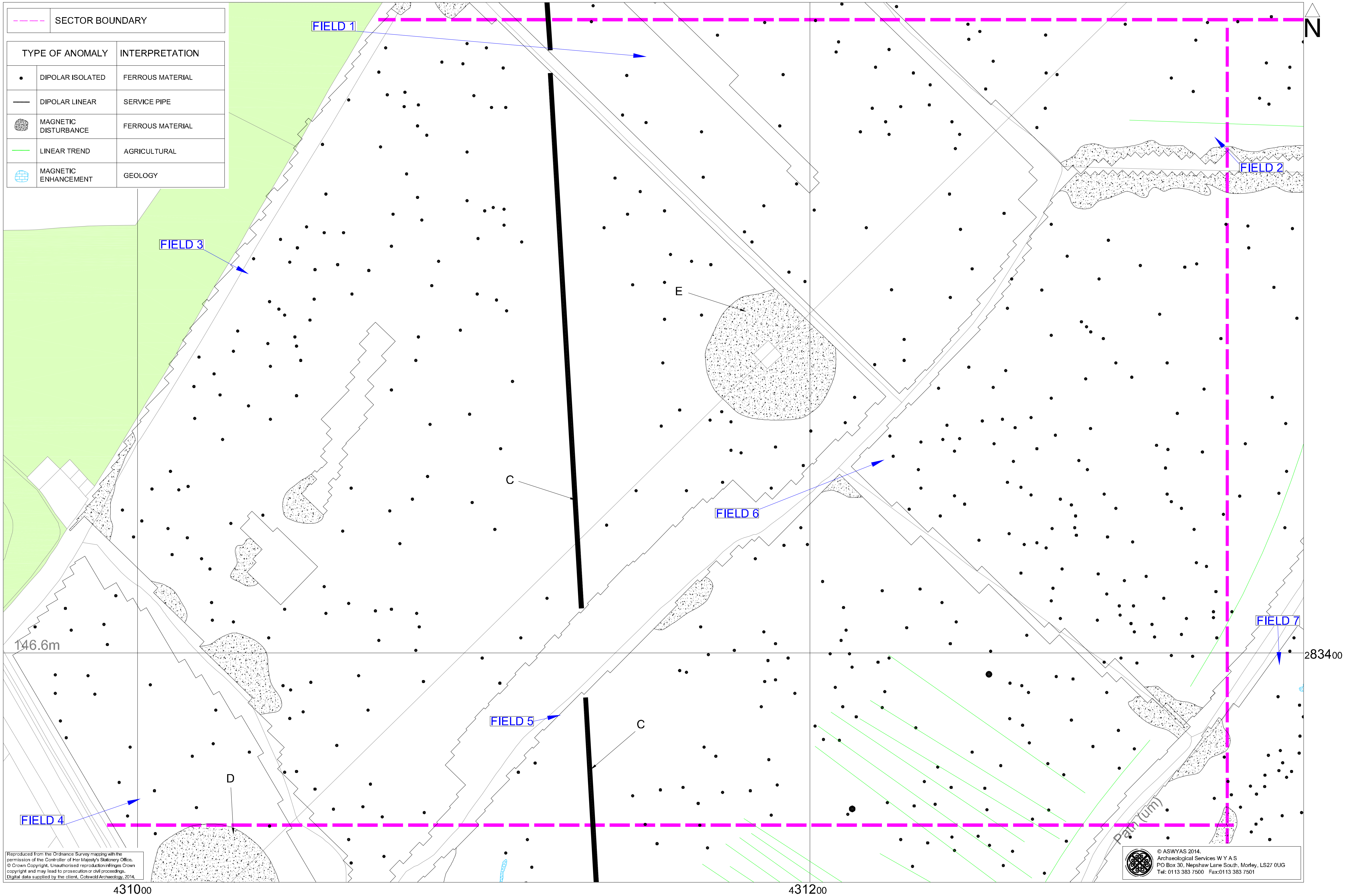

Fig. 9. Interpretation of magnetometer data; Sector 2 (1:1000 @ A3)

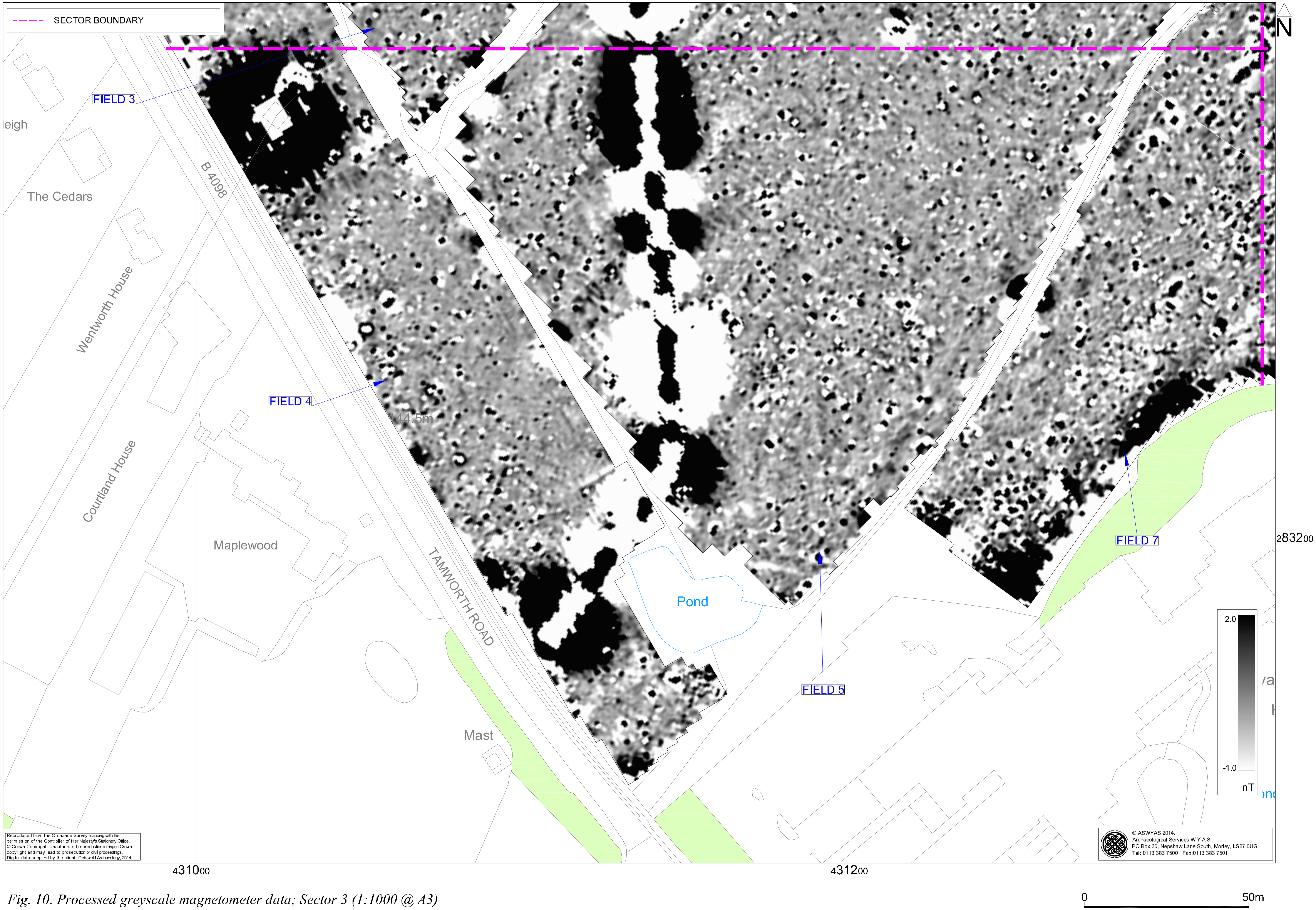

Fig. 10. Processed greyscale magnetometer data; Sector 3 (1:1000 @ A3)

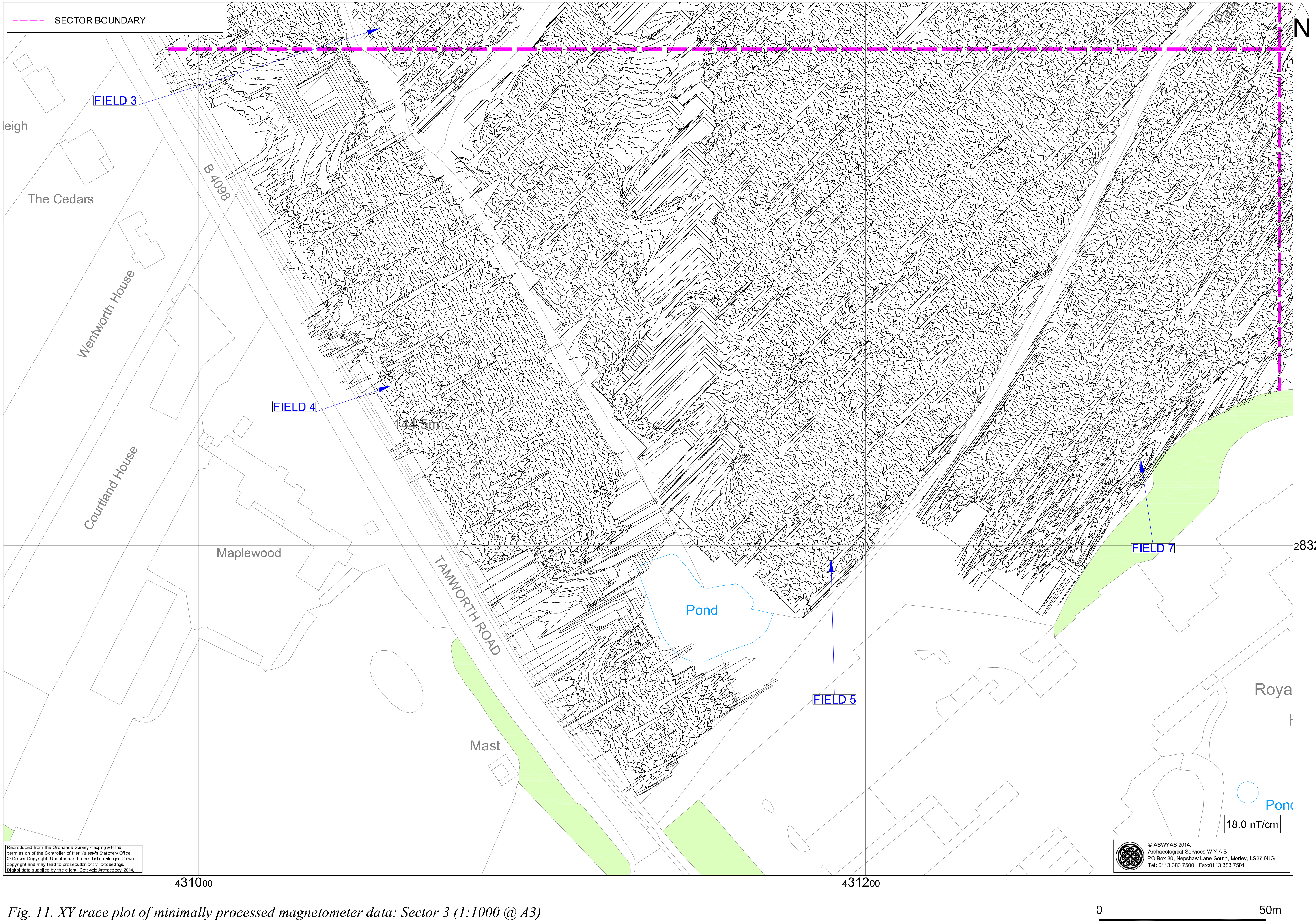

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Fig. 11. XY trace plot of minimally processed magnetometer data; Sector 3 (1:1000 @ A3)

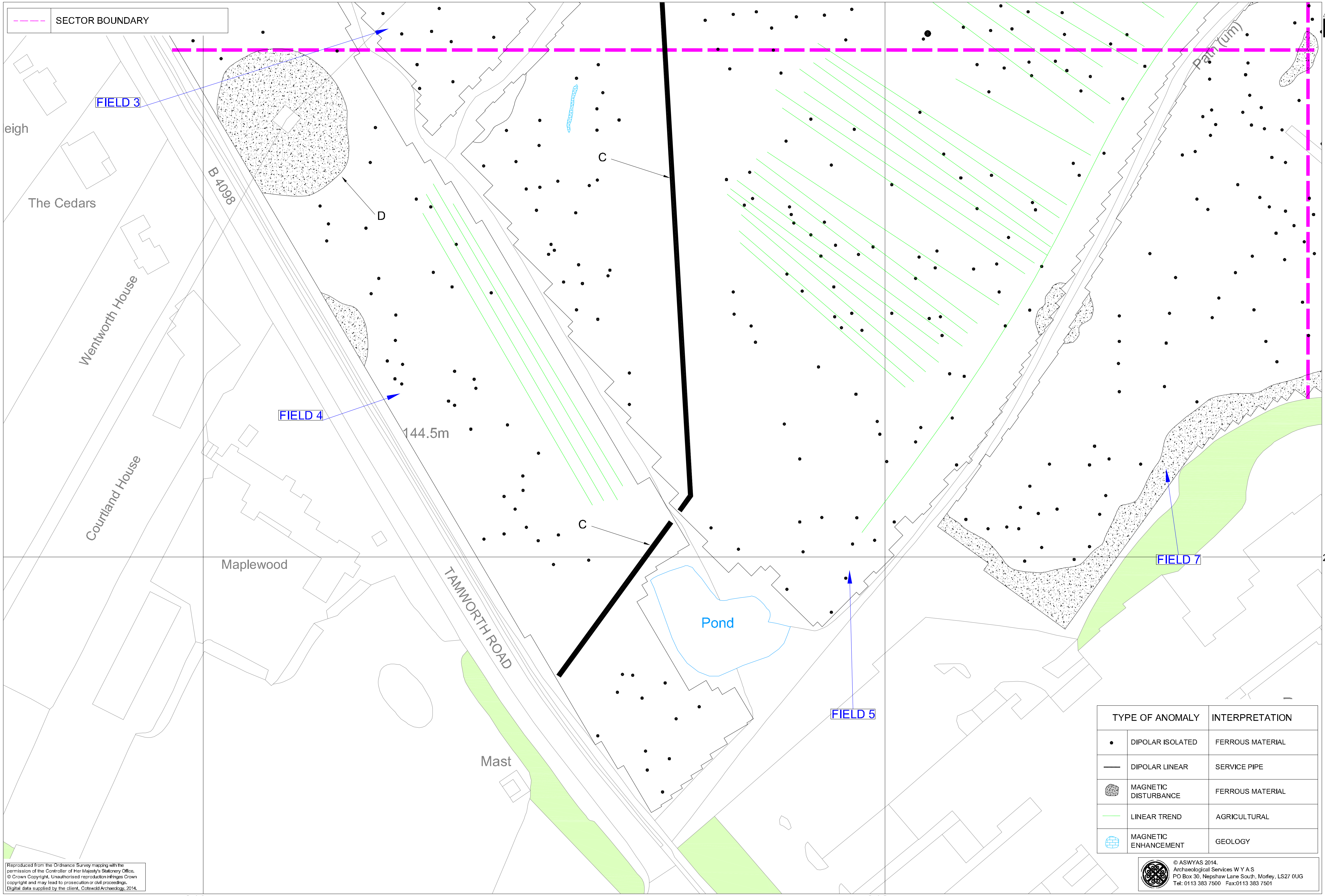

Fig. 12. Interpretation of magnetometer data; Sector 3 (1:1000 @ A3)

0 50m

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

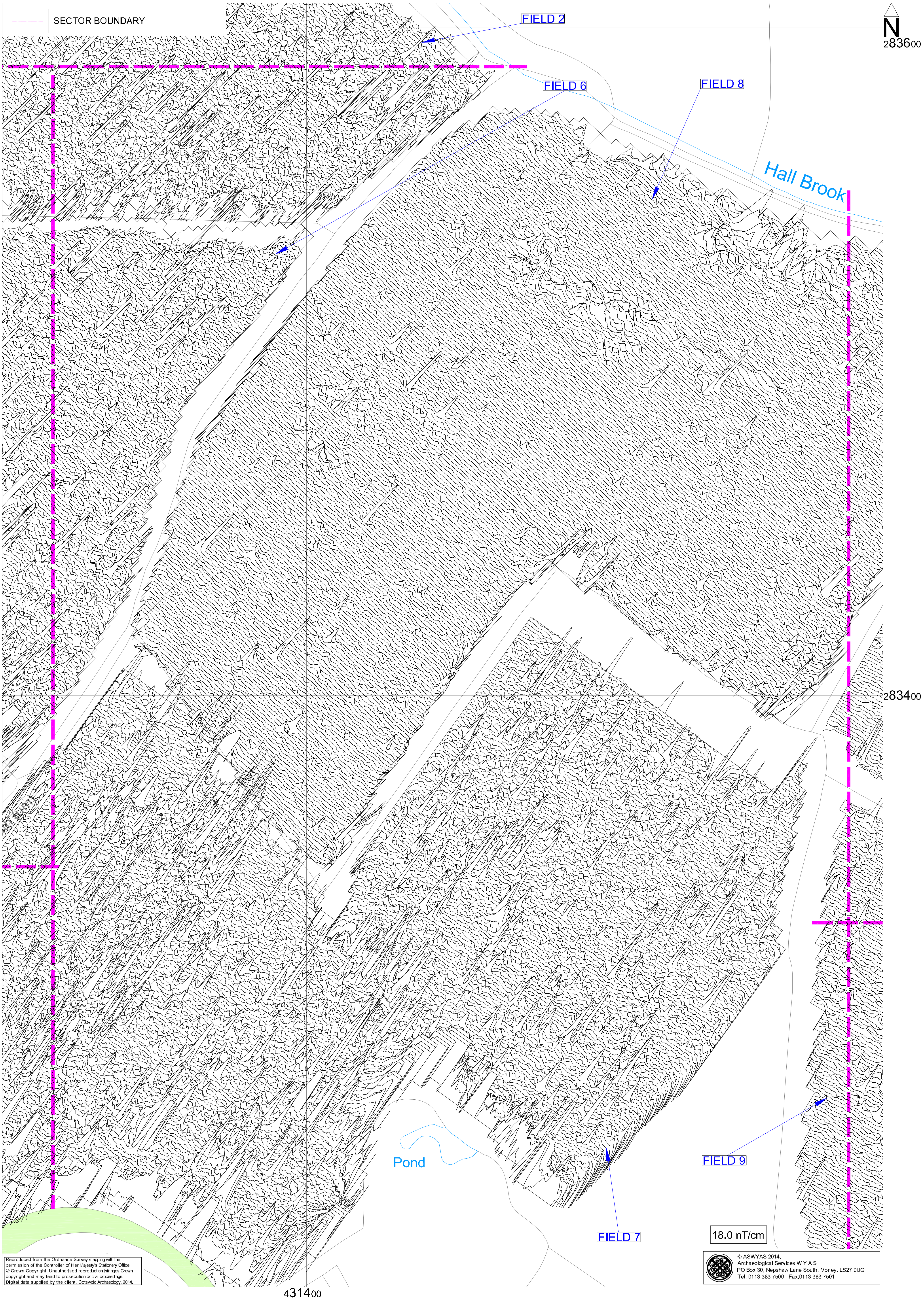

Fig. 14. XY trace plot of minimally processed magnetometer data; Sector 4 (1:1000 @ A3)

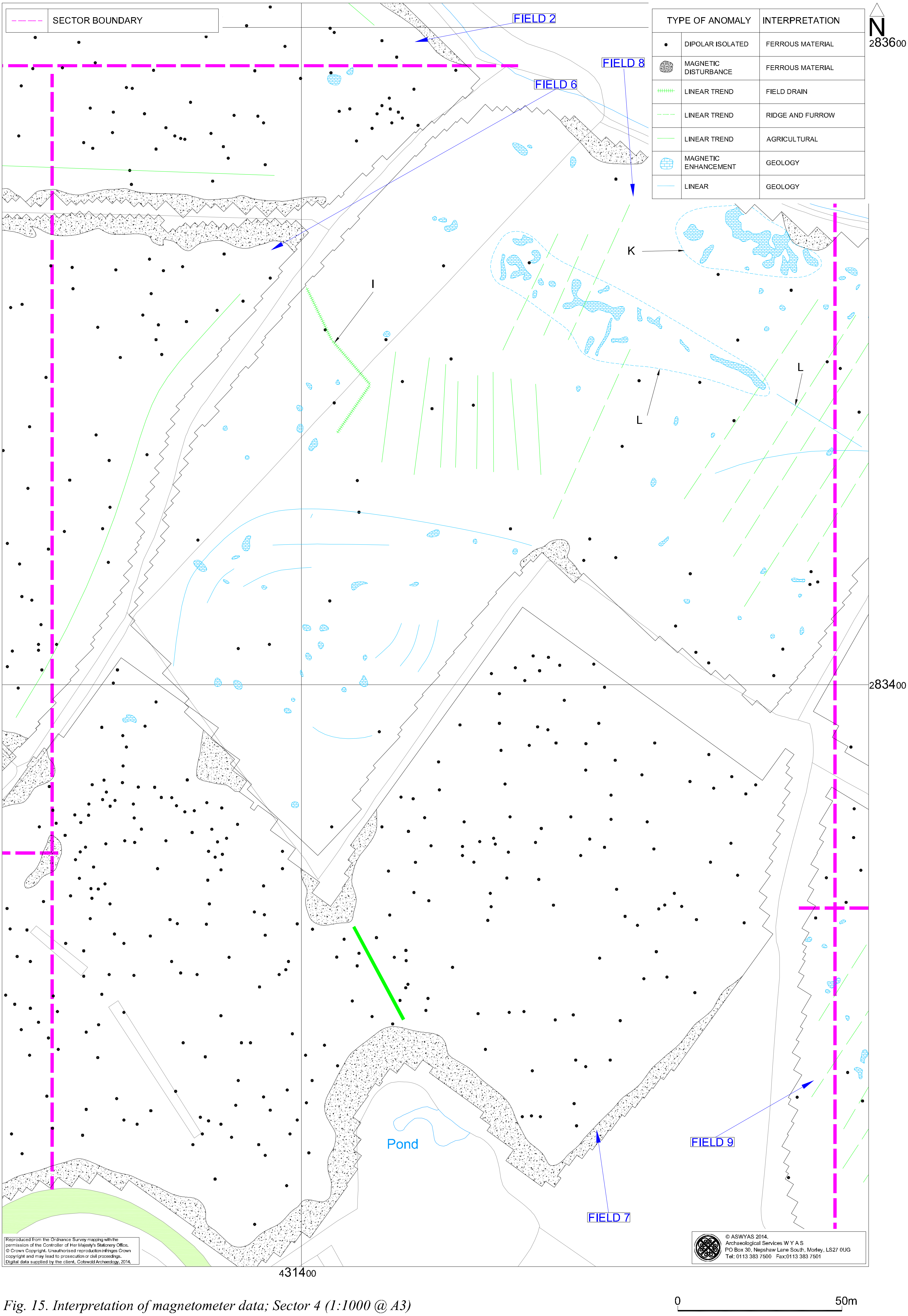

Fig. 15. Interpretation of magnetometer data; Sector 4 (1:1000 @ A3)

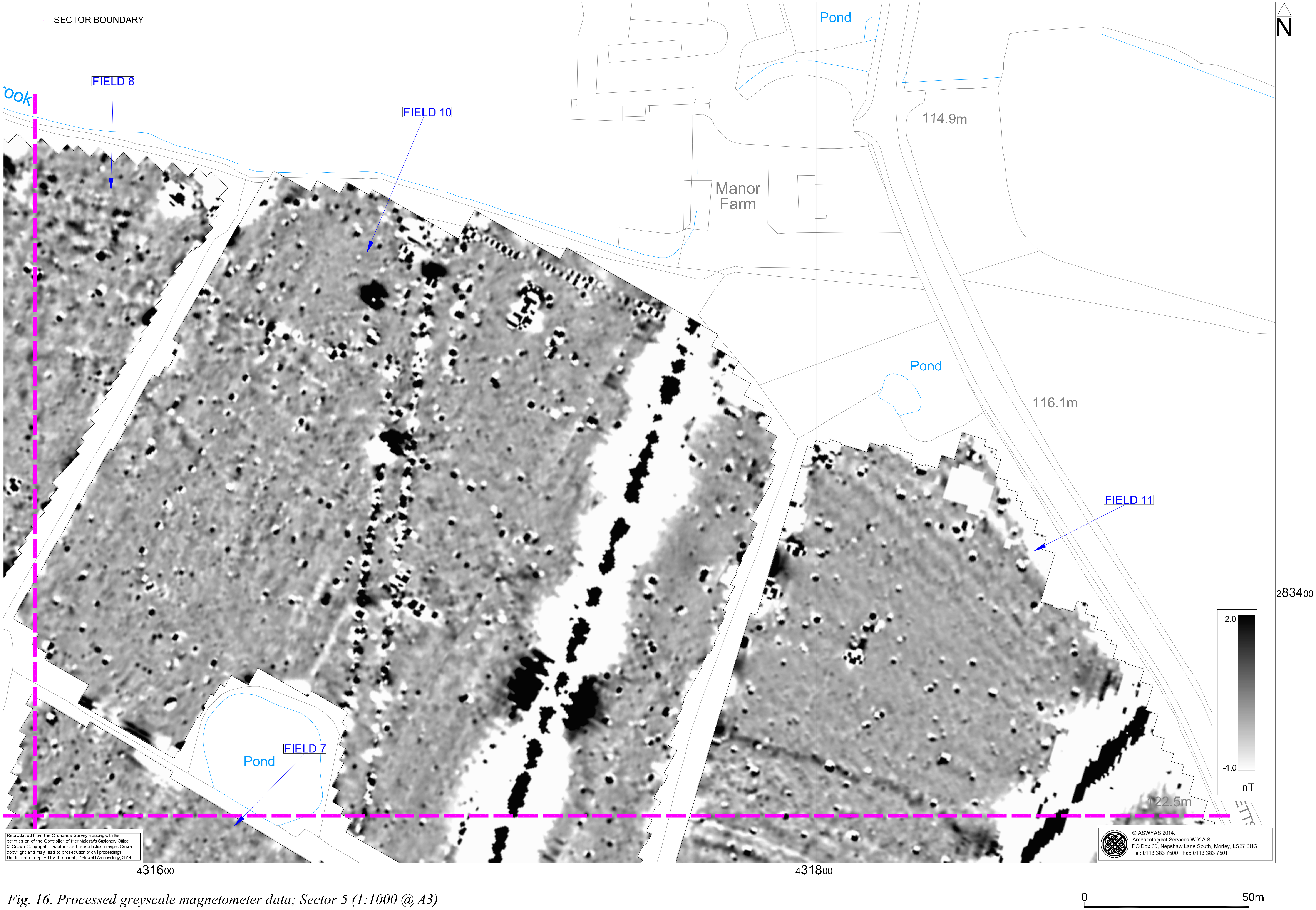

Fig. 16. Processed greyscale magnetometer data; Sector 5 (1:1000 @ A3)

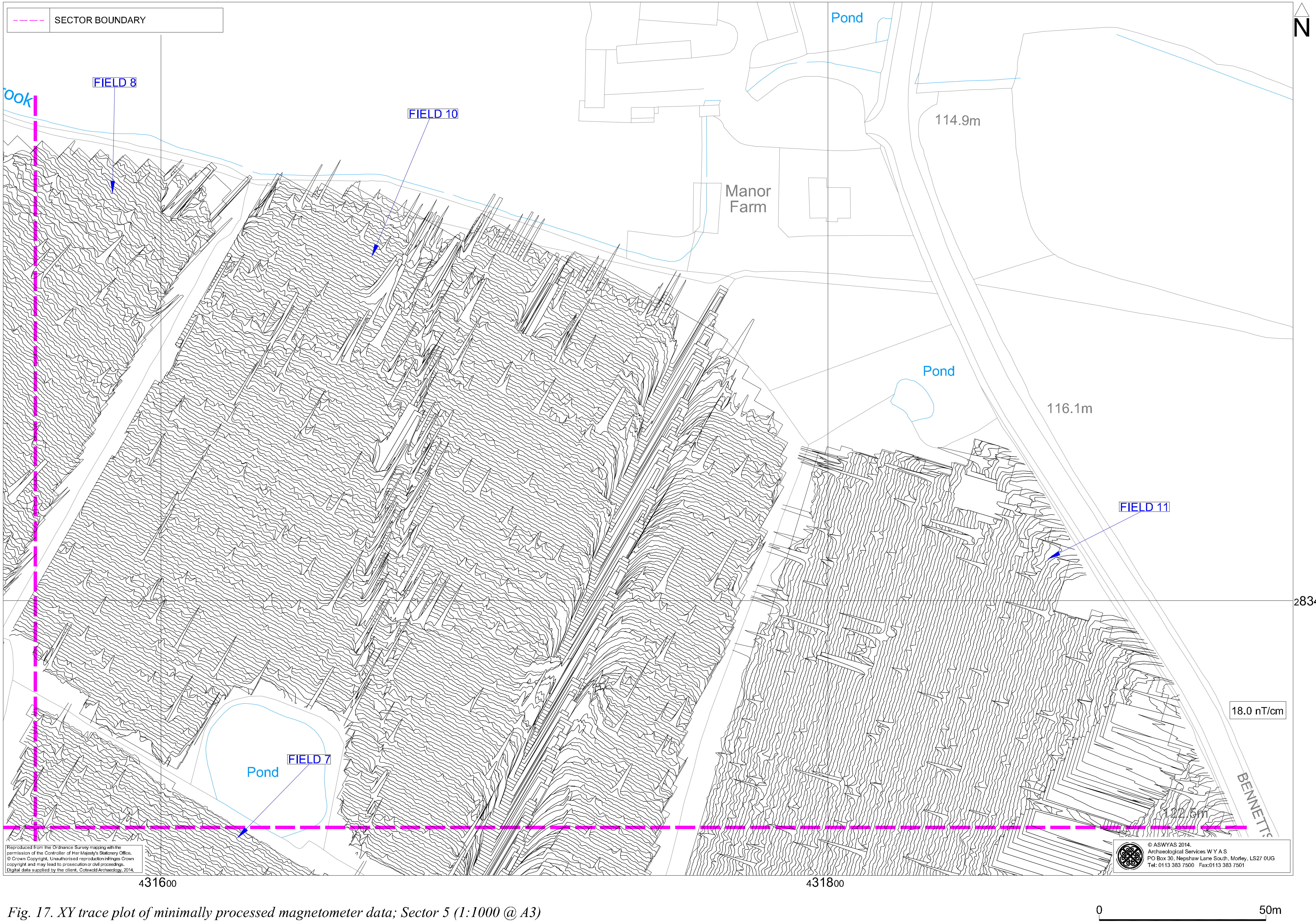

Fig. 17. XY trace plot of minimally processed magnetometer data; Sector 5 (1:1000 @ A3)

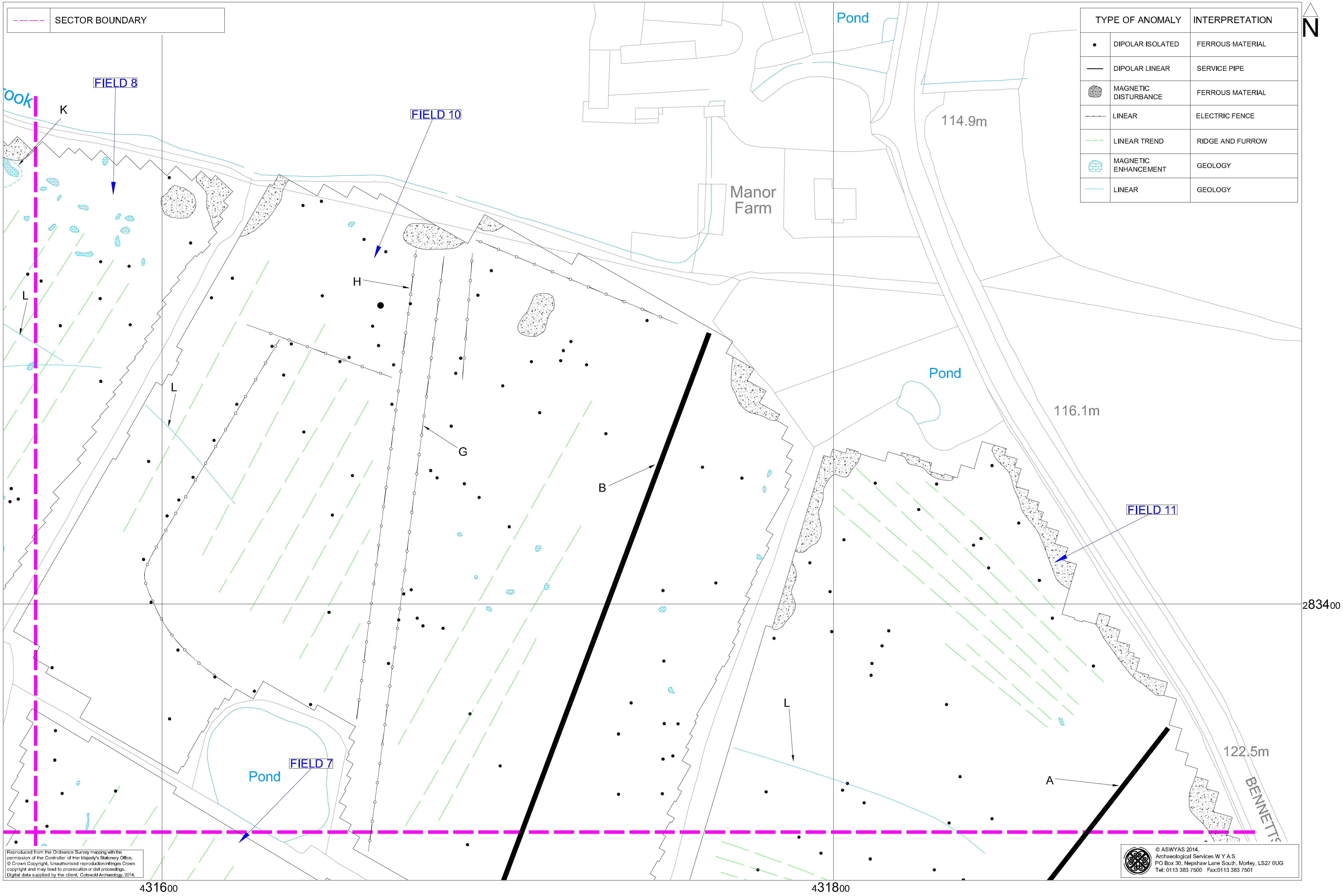

Fig. 18. Interpretation of magnetometer data; Sector 5 (1:1000 @ A3)

0 50m

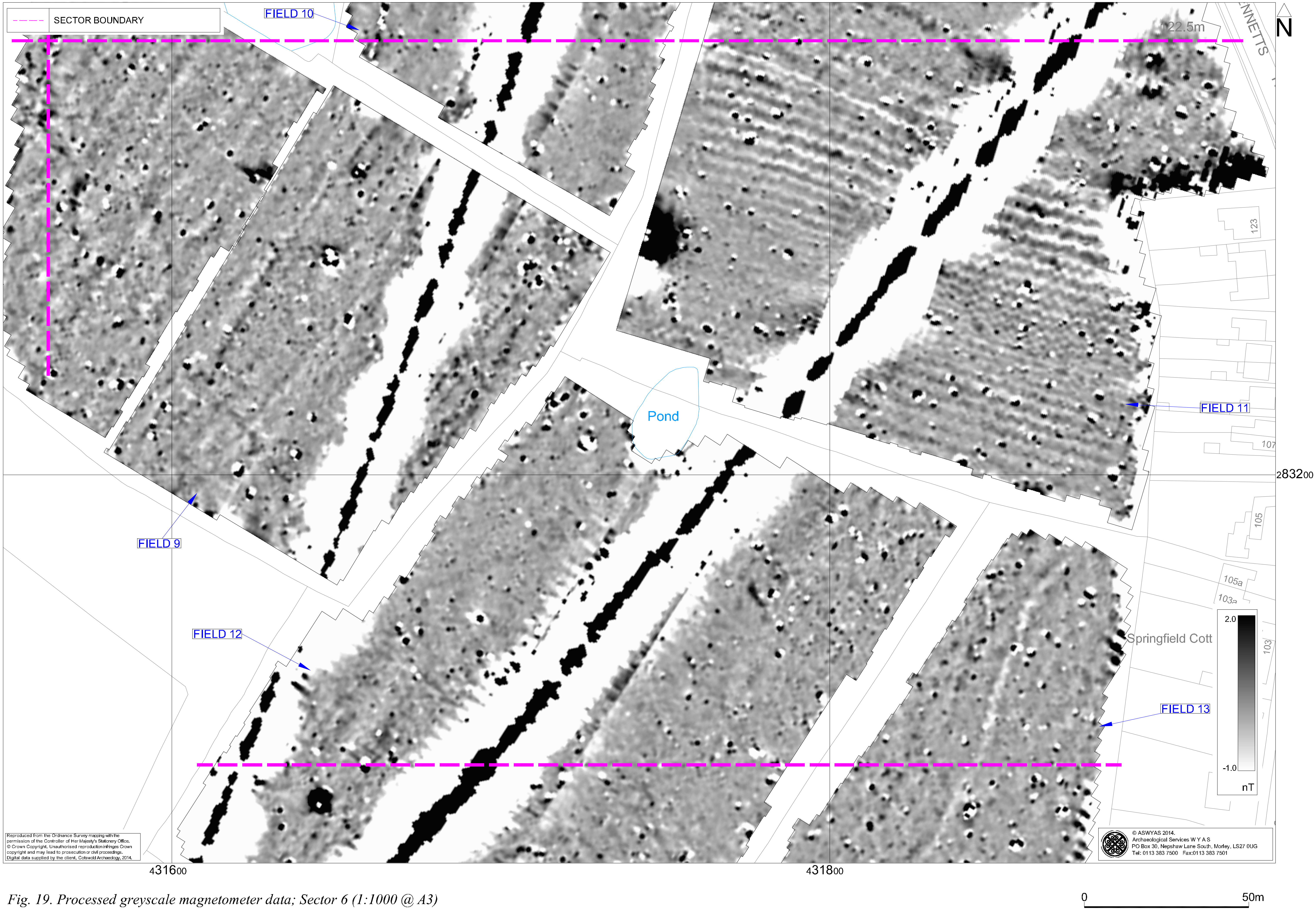

Fig. 19. Processed greyscale magnetometer data; Sector 6 (1:1000 @ A3)

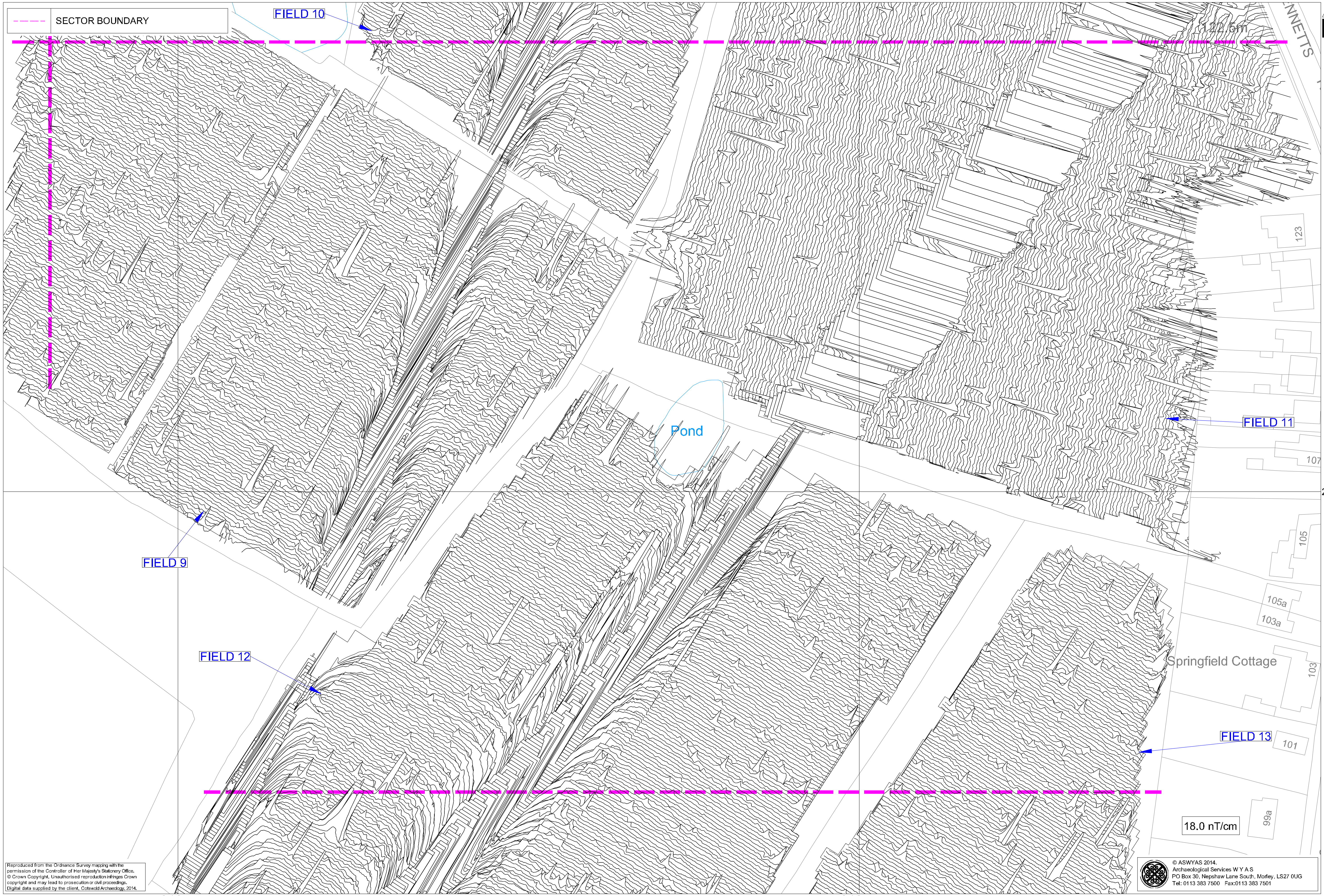

Fig. 20. XY trace plot of minimally processed magnetometer data; Sector 6 (1:1000 @ A3)

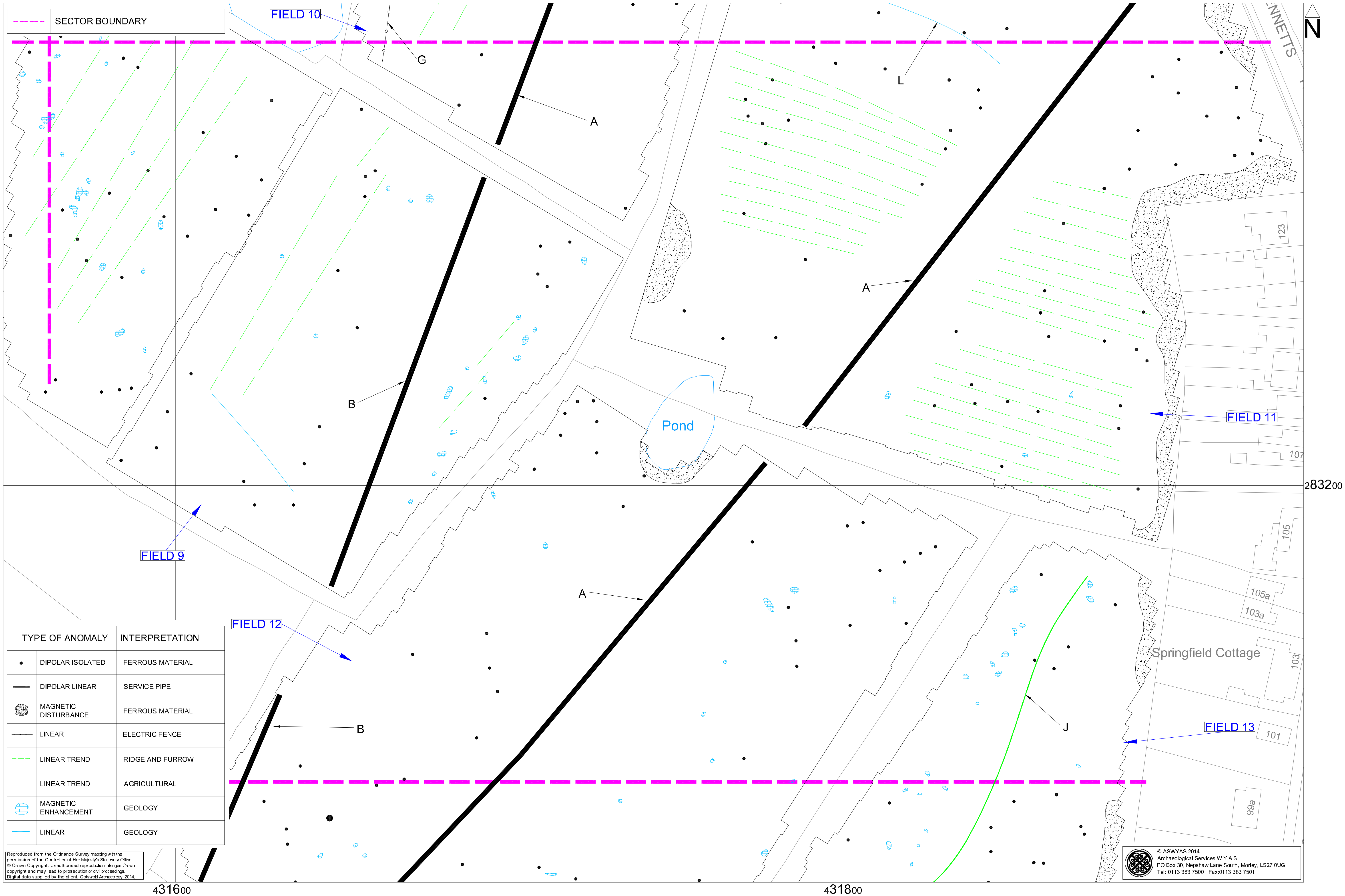

Fig. 21. Interpretation of magnetometer data; Sector 6 (1:1000 @ A3)

0 50m

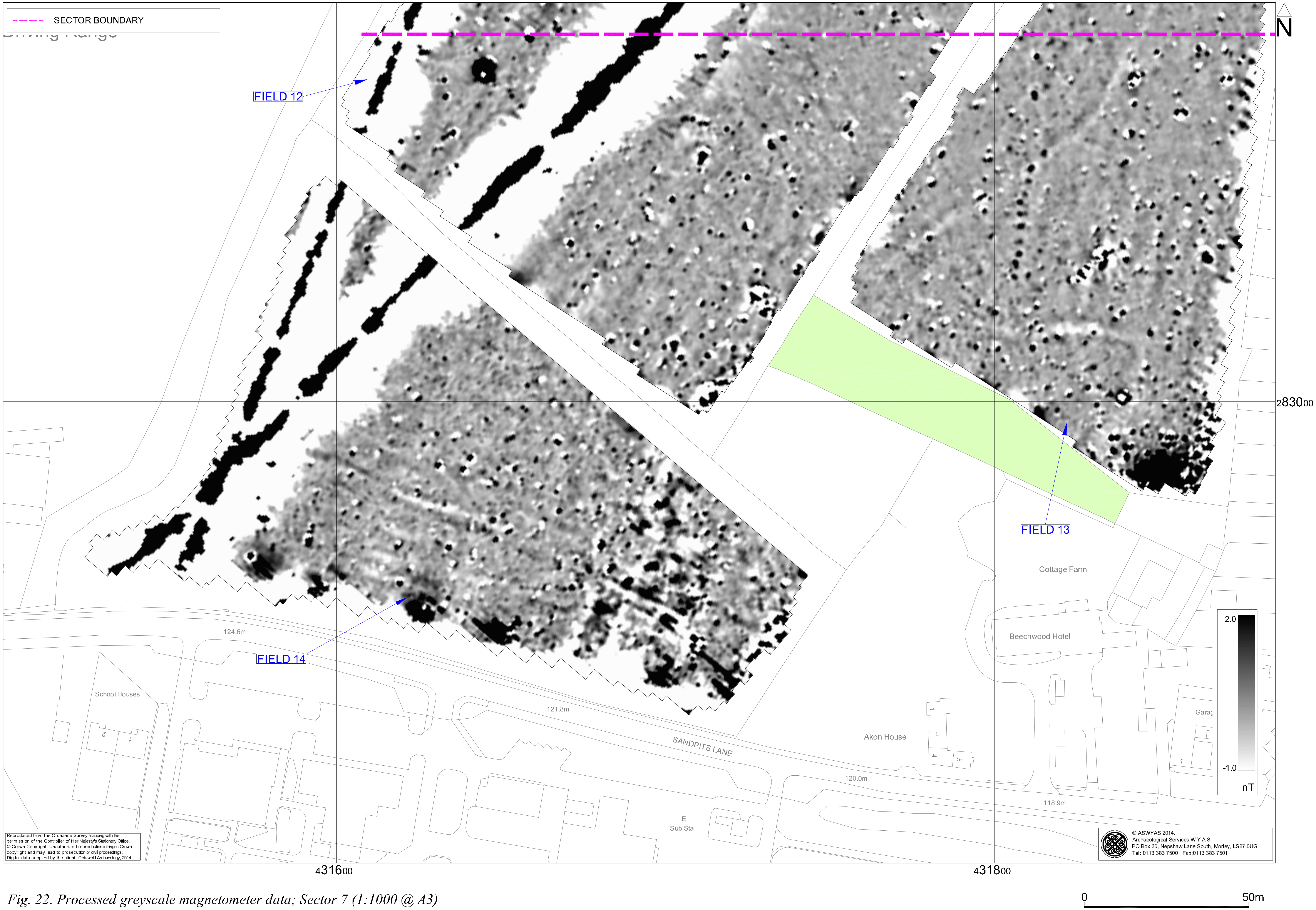

Fig. 22. Processed greyscale magnetometer data; Sector 7 (1:1000 @ A3)

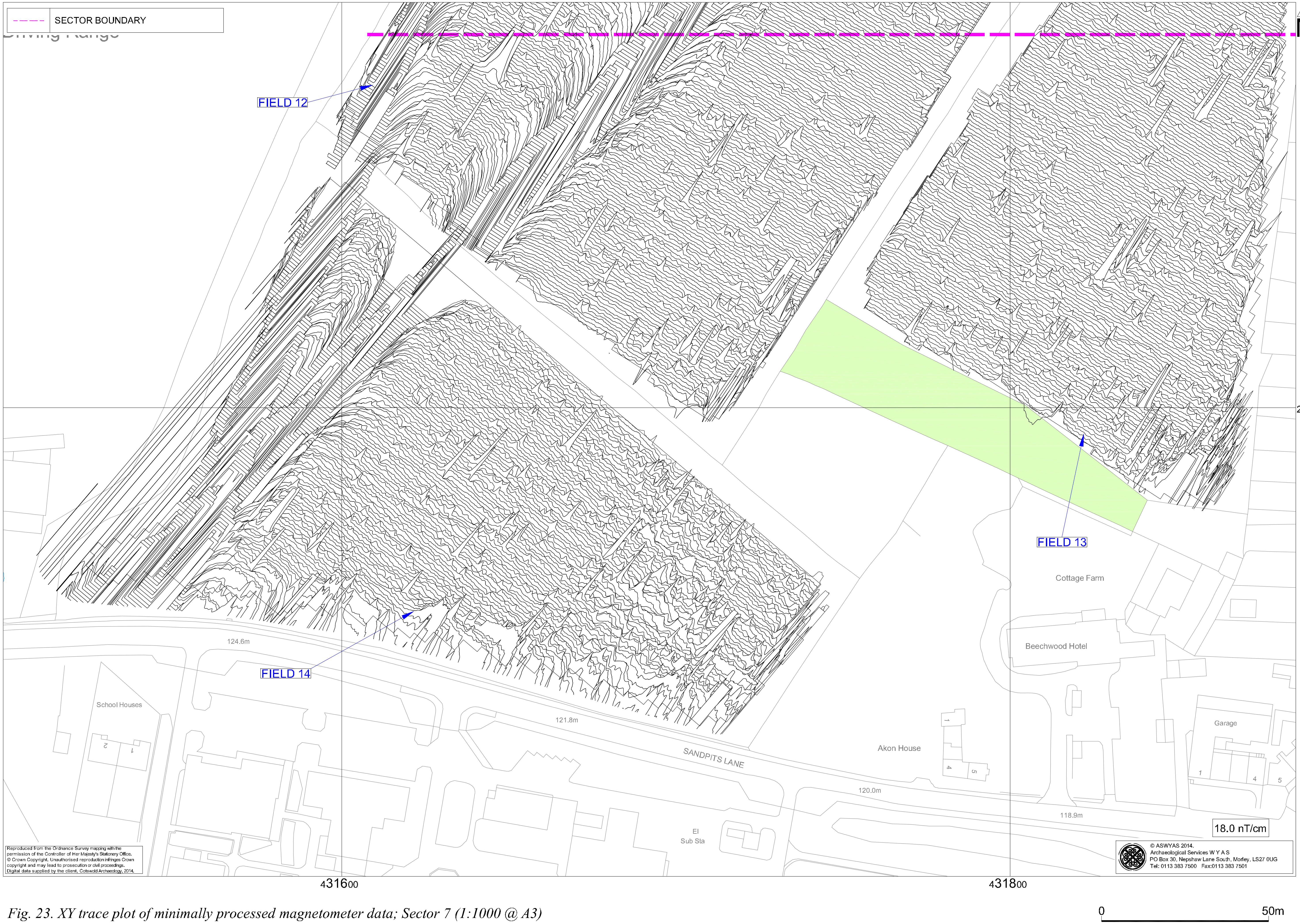

Fig. 23. XY trace plot of minimally processed magnetometer data; Sector 7 (1:1000 @ A3)

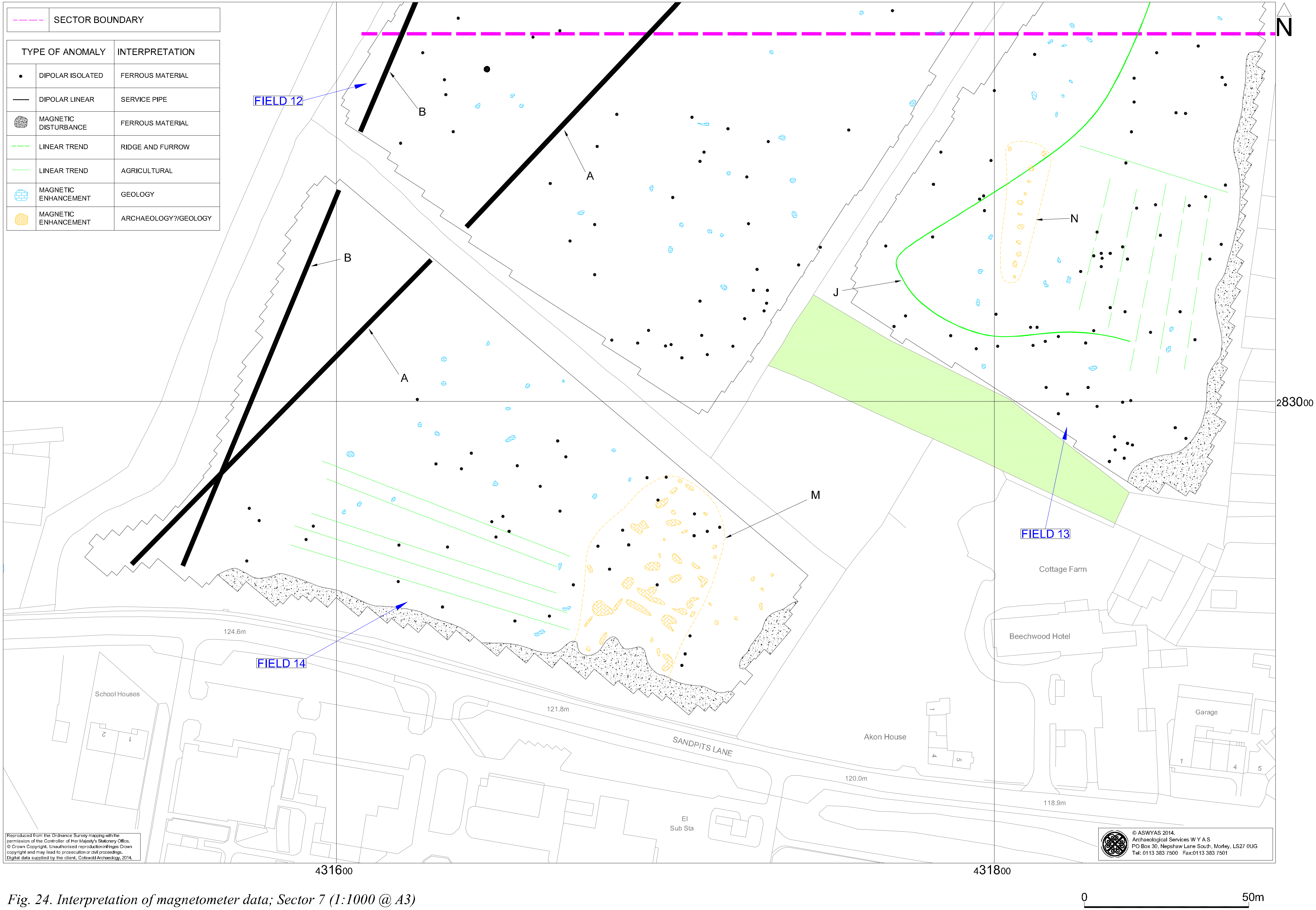

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Fig. 24. Interpretation of magnetometer data; Sector 7 (1:1000 @ A3)

Plate 1. General view of Field 1, looking east

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

Plate 3. General view of Field 3 showing agricultural dumping, looking north-east

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

Plate 5. General view of Field 6, looking south

Plate 6. General view of Field 7, looking north-east

Plate 7. General view of Field 8, looking south

Plate 8. General view of Field 9, looking west

Plate 9. General view of Field 10, looking south-west

Plate 10. General view of Field 11, looking north-east

Plate 11. General view of Field 14, looking west

Plate 12. General view of Field 15 showing area unsuitable for survey, 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 Warwickshire Historic Environment Record).

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