Archaeological Services WYAS

Land at Cottam Hall
Cottam
Preston

Geophysical Survey

Report no. 2591

March 2014

Client: URS on behalf of the Homes and Communities Agency

Registered Organisation IA

Land at Cottam Hall
Cottam
Preston

Geophysical Survey

Summary

A geophysical (magnetometer) survey, covering 6.75 hectares, was carried as part of pre-determination work for a proposed housing development at Cottam, on the north-western periphery of Preston, Lancashire. The route of a Roman Road is thought to pass immediately to the south of the site although no anomalies have been identified to indicate either the presence of the road nor any associated roadside activity. Ridge and furrow cultivation has been identified within the east of the site, whilst the majority of the anomalies identified relate to the 19th century agricultural landscape as depicted on historical Ordnance Survey mapping. Based on the results of the geophysical survey, the archaeological potential of this site is thought to be low.

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Report Information

Client:	URS on behalf of the Homes and Communities Agency
Address:	West One, Wellington Street, Leeds, LS1 1BA
Report Type:	Geophysical Survey
Location:	Cottam, Preston
County:	Lancashire
Grid Reference:	SD 49822 31674
Period(s) of activity:	Post-medieval
Report Number:	2591
Project Number:	4207
Site Code:	CHP14
OASIS ID:	archaeol11 - 175733
Planning Application No.:	Pre-determination (Outline)
Museum Accession No.:	n/a
Date of fieldwork:	February 2014
Date of report:	March 2014
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Fieldwork:	Christopher Sykes BA MSc
	Daniel Waterfall BA
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Photography:	Site Staff
Research:	n/a

Authorisation for distribution: --

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1 Introduction

Archaeological Services WYAS (ASWYAS) was commissioned by Andrew Copp of URS (the Client) on behalf of the Homes and Communities Agency, to carry out a geophysical (magnetometer) survey as part of pre-determination work for a proposed housing development to the north-west of Preston city centre (see Fig. 1). The survey was undertaken in order to comply with Planning Condition 36 which requires that prior to works taking place the developer must '*secure the implementation of a programme of archaeological work. This must be in accordance with a written scheme of investigation*'. The survey was carried out in accordance with a Project Design (Harrison 2014) supplied to and approved by the Client, and with a Specification (URS 2014) approved by Doug Moir, Planning Archaeologist with Lancashire County Archaeological Service, and confirmed by Lancashire County Council via e-mail to the Client. The survey adhered with guidance contained in the National Planning Policy Framework (2012) and was undertaken in line with current best practice (David *et al.* 2008). The survey was carried out on February 27th and February 28th 2014 in order to assess, in more detail, the archaeological potential of the site. The results of the survey will inform a programme of targeted archaeological trial trenching, if appropriate.

Site location, topography and land-use

The proposed development area (PDA) is situated on the north-west periphery of Preston and covers approximately 36ha of land which is broadly contained by Lea Road to the west, Hoyles Lane to the north, Valentines Lane to the east and by the Lancaster Canal to the south (see Fig. 2). The geophysical survey focused on land within the southern half of the PDA, south of Cottam Way, an area of 24ha, of which 6.75ha was subject to detailed magnetometer survey. The survey area is situated on flat or gently undulating topography with grazed grassland being the dominant landcover type (see plates).

Geology and soils

The underlying bedrock comprises Sherwood Sandstone Group - sandstone overlain by superficial deposits of till (British Geological Survey 2014). The soils in this area are classified in the Salop association, characterised as slowly permeable, seasonally waterlogged, reddish fine loams over clay (Soil Survey of England and Wales 1983).

2 Archaeological background

There are no known heritage assets within the PDA although it is thought to have potential to contain unknown archaeological remains, particularly from the Roman period. The course of a Roman Road (HER Ref. MLA15487/8), which runs between Ribchester and the coast, is postulated to pass immediately to the south of the survey area (see Fig. 2). It is thought that any associated roadside settlement, if present, may extend into the south of the PDA.

The site is thought to have remained largely in use as arable and/or pastoral farmland since at least the medieval period although, at the end of the 19th century, the formal layout of Lea Road Gardens are shown on historic maps within the south-west of the site. The gardens are renamed Lea Nursuries by 1962/1963 but are returned to farmland by 1993/1994.

3 Aims, Methodology and Presentation

The main aim of the geophysical survey is to provide sufficient information to enable an assessment to be made of the impact of the proposed development on any potential archaeological remains and for mitigation proposals, if appropriate, to be recommended.

To achieve this aim a magnetometer survey was carried out within 75 grids in thirteen separate areas, over eleven fields (Field 1 – 11) in order to provide a representative sample across the site. This approach adhered to the specification for archaeological geophysical survey (URS 2014).

The objectives of the geophysical survey were:

- to identify the alignment and course of the possible Roman Road that ran from Ribchester, through Kirkham, and across the Fylde to the coast;
- identify any evidence for Roman activity that could be associated with the Roman Road, including evidence of roadside settlement;
- identify the extent of medieval and later cultivation, including ridge and furrow, that may extend across the site;
- investigate the general archaeological potential in the area south of Cottam Way;
- 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;
- to prepare a report summarising the results of the survey; and
- to inform the design of archaeological trial trench evaluation (where this is necessary) and, if appropriate, archaeological mitigation at the scheme design stage.

Magnetometer survey

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 Ordnance Survey map, is shown in Figure 1. Figure 2 is a survey location drawing showing the PDA and the greyscale magnetometer data, at a scale of 1:5000. Figure 3 and Figure 4 are large scale (1:3000) plans showing the magnetometer data and overall interpretation plan respectively. The processed and minimally processed data, together with interpretation graphics of the survey results are presented in Figures 5 to 16 inclusive, at a scale of 1:1000.

Further technical information on the equipment used, data processing and survey methodologies are given in Appendix 1 and Appendix 2. Appendix 3 describes the composition and location of the site archive.

The geophysical survey methodology, report and any recommendations comply with guidelines outlined by English Heritage (David *et al.* 2008) and by the Institute for Archaeology (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 Figs 5 to 16 inclusive)

Generally, the survey has recorded a moderate level of background variation across the PDA with an area of increased background response concentrated at the former site of Lea Nurseries in the south-west of the survey area. Numerous anomalies have been identified which 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 Anomalies

Ferrous anomalies, either as individual ‘spikes’ or more extensive areas of magnetic disturbance, 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. Throughout the site iron spike anomalies are common and 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.

Generally, the broad areas of magnetic disturbance identified by the survey are thought to result from above-ground objects, such as perimeter fencing, and to localised areas of dumping. However, two former ponds, **A** and **B**, also manifest in the data as areas of magnetic disturbance. The ponds are depicted on the first edition Ordnance Survey map (1848) and the responses result from the contrast between the back-filled ponds and the prevailing soils. A band of magnetic disturbance has also been identified either side of a high-magnitude dipolar linear anomaly, **C**, which can be seen running north-south through Field 8 before taking a north-west/south-east trajectory through Field 7. This anomaly, **C**, demarcates the route of a buried water sewer with the surrounding magnetic disturbance likely to be due to ground disturbance associated with its installation.

Modern Anomalies

An area of notable increase in background magnetic response has been identified throughout the south of Field 6 and the entirety of Field 7. Whilst some of this 'noise' can be attributed to the buried water sewer, **C**, discussed above, the majority is likely to be due to variations in the composition and depth of the topsoil as a result of modern ground disturbance associated with the removal and levelling of the former Lea Nurseries site.

Agricultural Anomalies

Analysis of historical Ordnance Survey (OS) mapping indicates that the layout and division of fields across the survey area has undergone considerable alterations since the publication of the first edition OS map in 1848. The most obvious changes include the construction of a housing estate within the east of the site and the removal of Lea Nurseries in the west. In addition, several field boundaries have been removed to form a larger field system. These former boundaries appear in the data as fragmented linear anomalies, **D** – **L**. The anomalies are caused by the contrast between the soil-filled ditch and the surrounding soils. The fragmented linear anomaly, **F**, within the south of Field 1, is not depicted on the first edition OS map, but it is assumed to be due to a former field boundary based upon its north-east/south-west orientation, parallel with former boundaries **E** and **D** to its north.

A series of parallel linear trends have been identified throughout the survey area, generally orientated parallel with the existing field boundaries. These are all thought to be agricultural in origin, being due to drainage and modern ploughing activity. More widely-spaced parallel anomalies within Field 2 and Field 3 are characteristic of the medieval and post-medieval agricultural practice of ridge and furrow cultivation, evidence of which survives as low earthworks throughout Field 3 (see Plate 3). The characteristic striped appearance to the data in these fields is a result of the magnetic contrast between the now soil-filled furrows and the former ridges.

Geological Anomalies

Across all parts of the survey areas discrete, low magnitude, anomalies (areas of magnetic enhancement) have been identified. Whilst any of these anomalies could be caused by an archaeological feature, such as a pit, the sheer number precludes an archaeological origin and they are therefore interpreted as being geological in nature, probably relating to natural pedological variations.

5 Discussion and Conclusions

Despite the presence of the postulated Roman Road a short distance to the south of the PDA no anomalies of archaeological potential have been identified by the survey to indicate the presence of the road or any associated roadside settlement within the site. Anomalies have been identified which are consistent with the 19th century agricultural landscape as depicted on historical OS mapping, whilst ridge and furrow cultivation within the east of the site may indicate earlier, medieval agriculture. Within the south-west of the site, a broad area of increased background response demarcates the extent of the ground disturbance caused by the removal of the Lea Nurseries site.

Therefore, on the basis of the geophysical survey, the archaeological potential of the site 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.

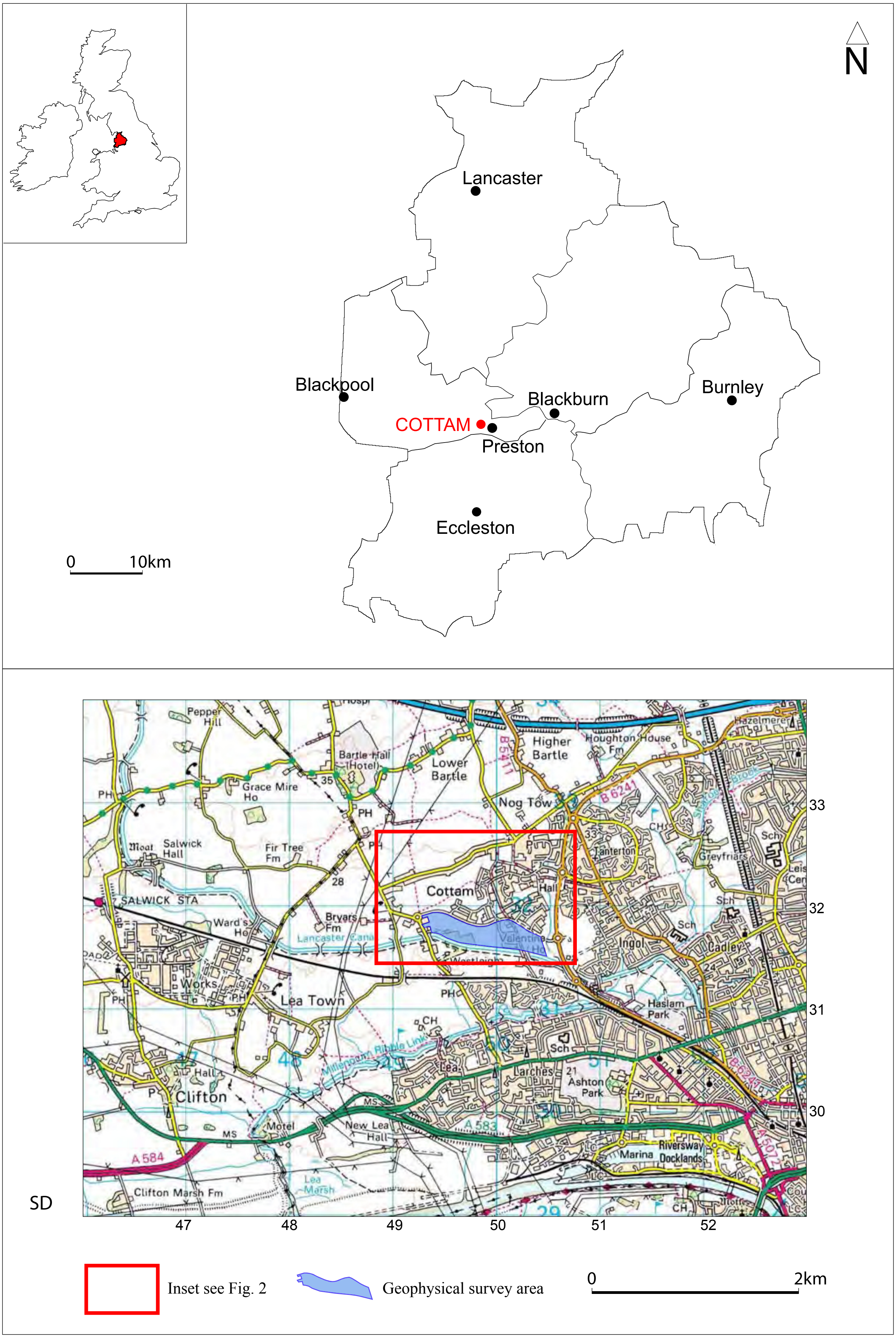

Fig. 1. Site location

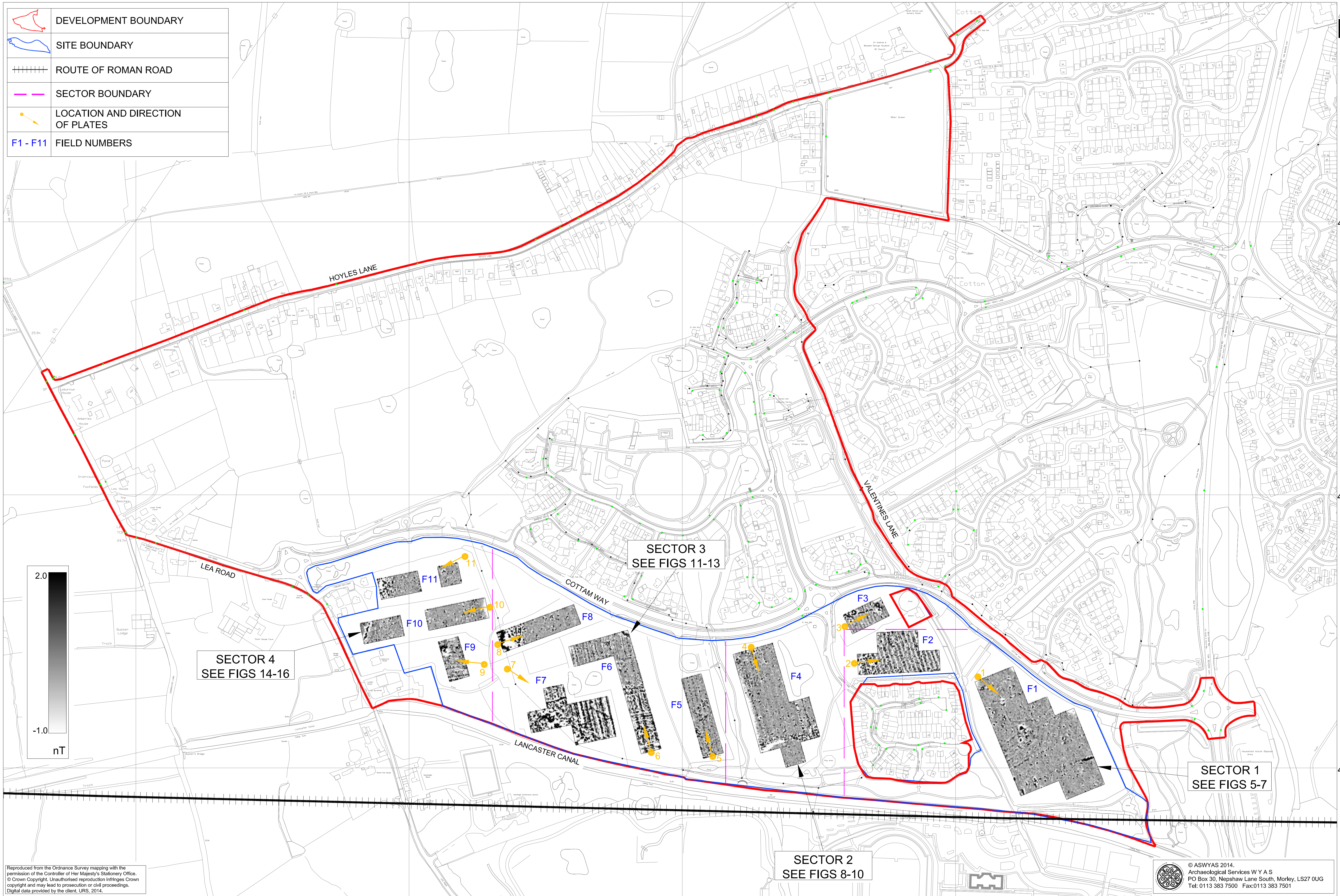

Fig. 2. Site location showing greyscale magnetometer data (1:5000 @ A3)

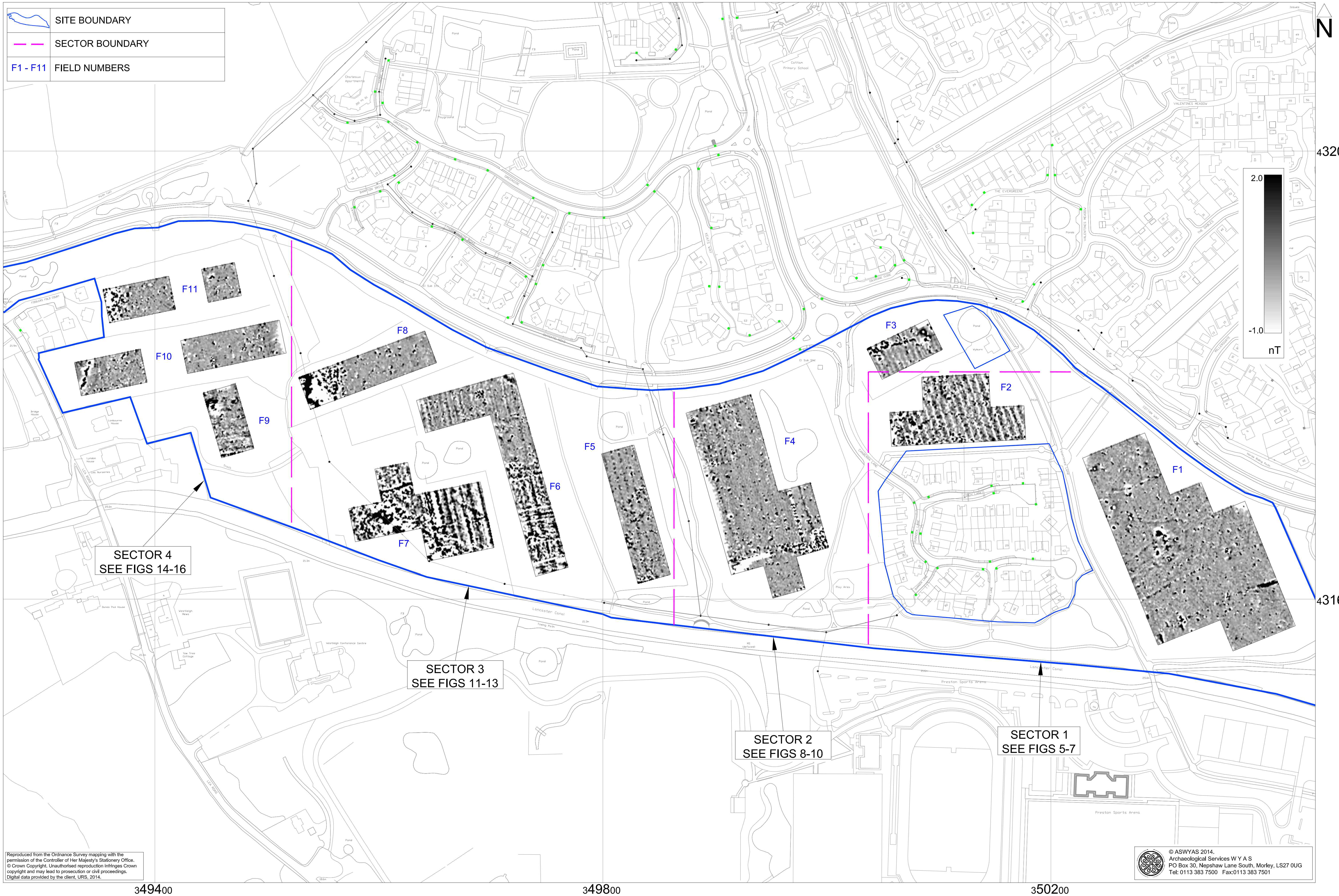

Fig. 3. Overall processed greyscale magnetometer data (1:3000 @ A3)

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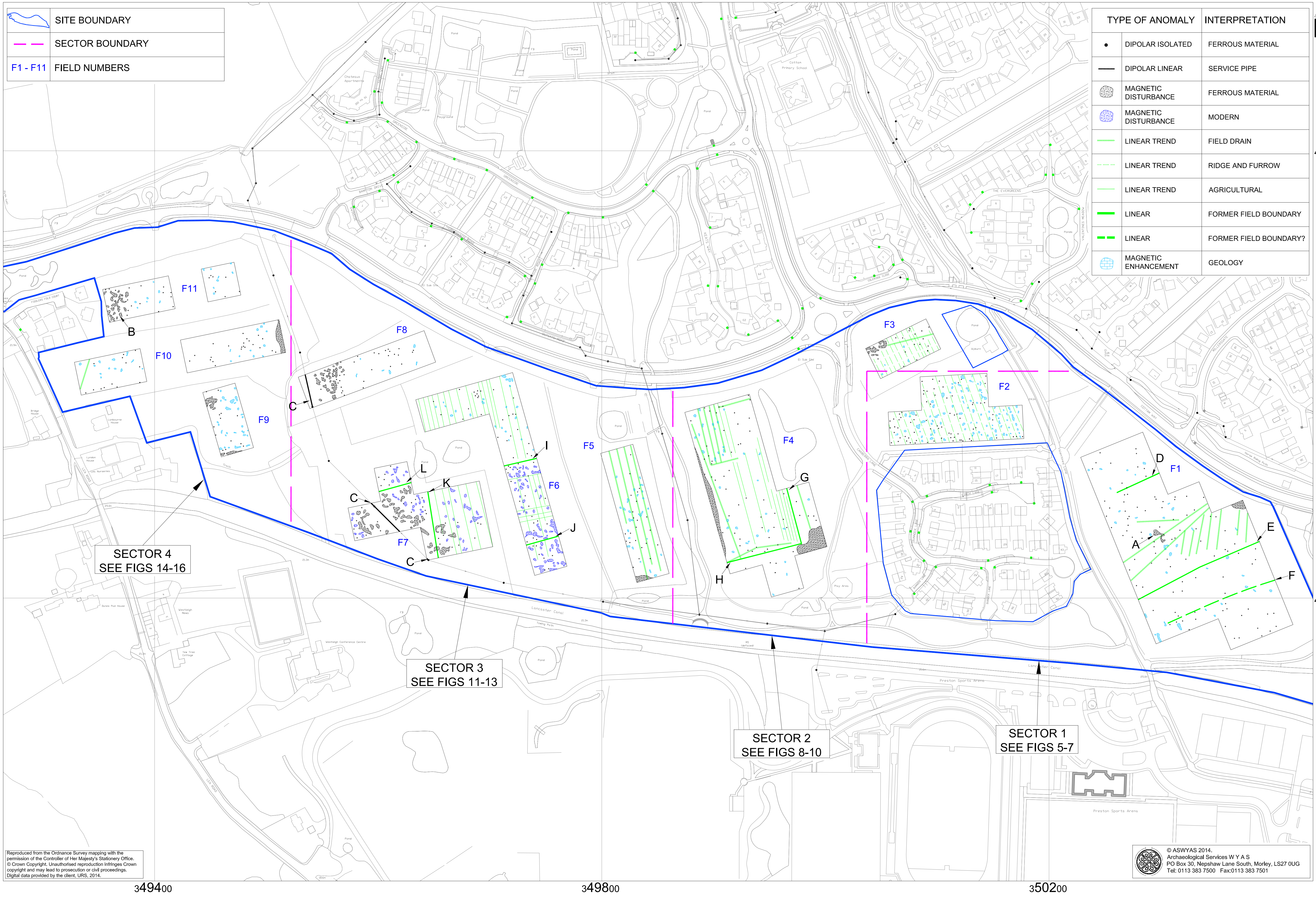

Fig. 4. Overall interpretation of magnetometer data (1:3000 @ A3)

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

0 40m

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

0 40m

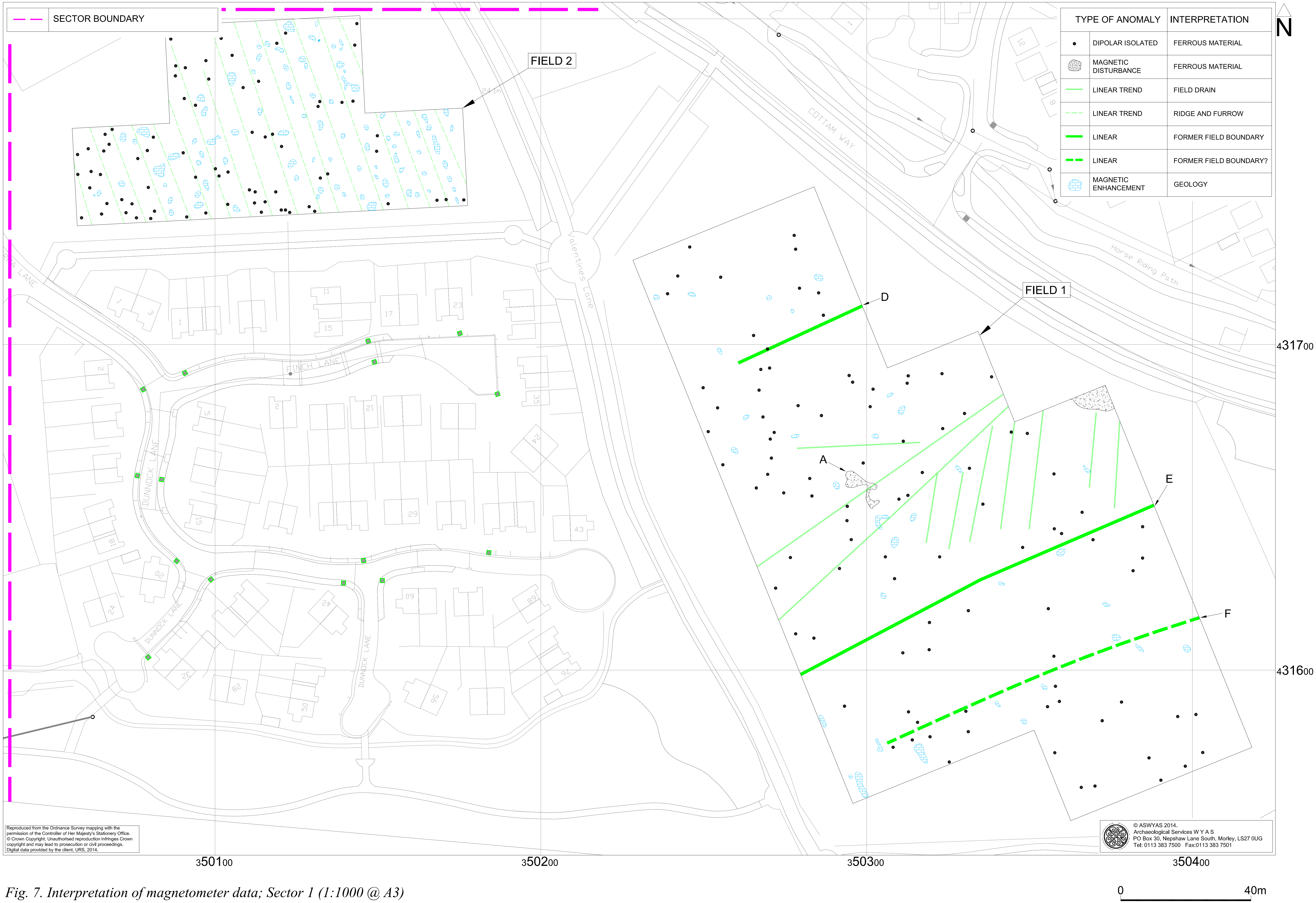

Fig. 7. Interpretation of magnetometer data; Sector 1 (1:1000 @ A3)

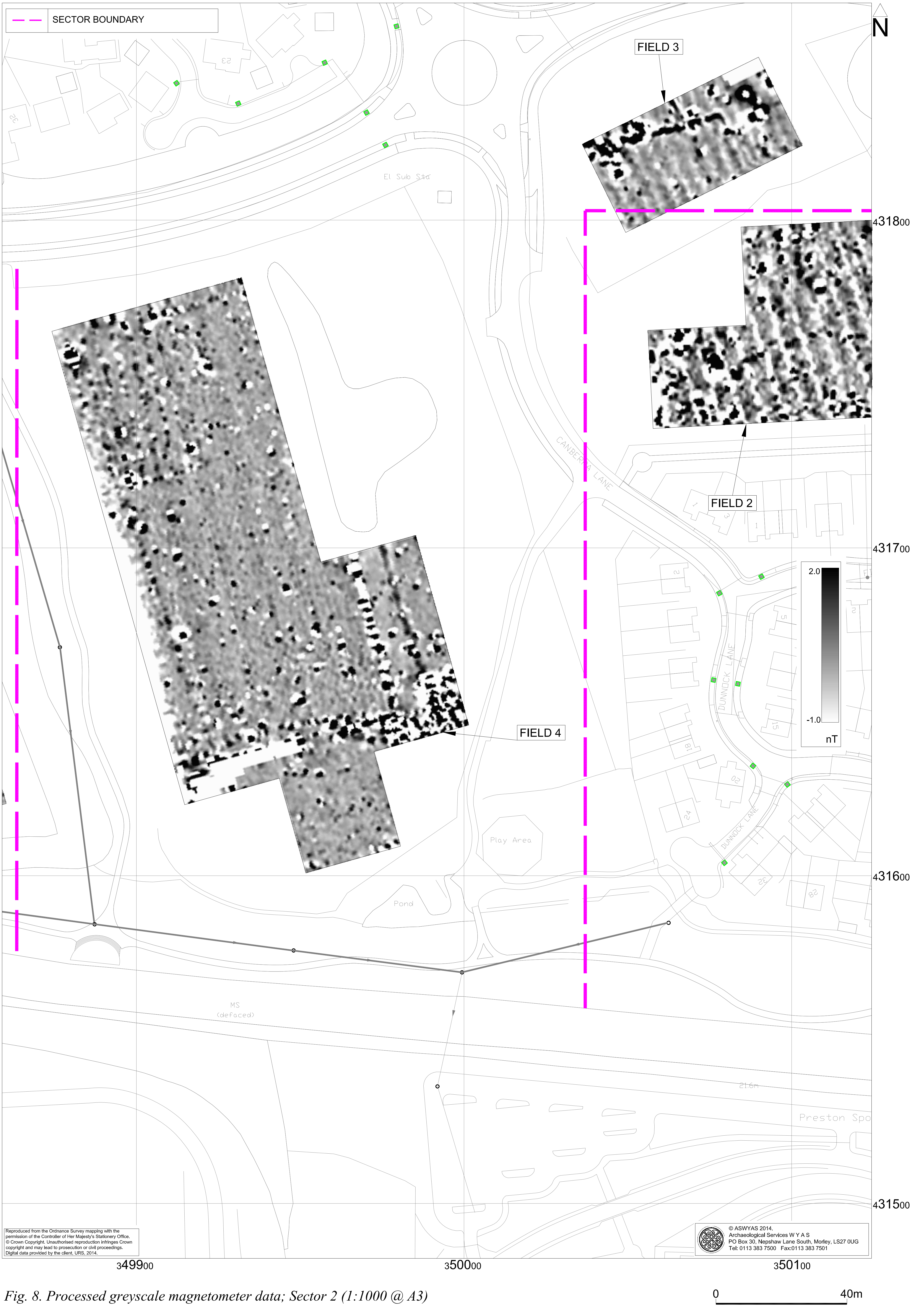

Fig. 8. Processed greyscale magnetometer data; Sector 2 (1:1000 @ A3)

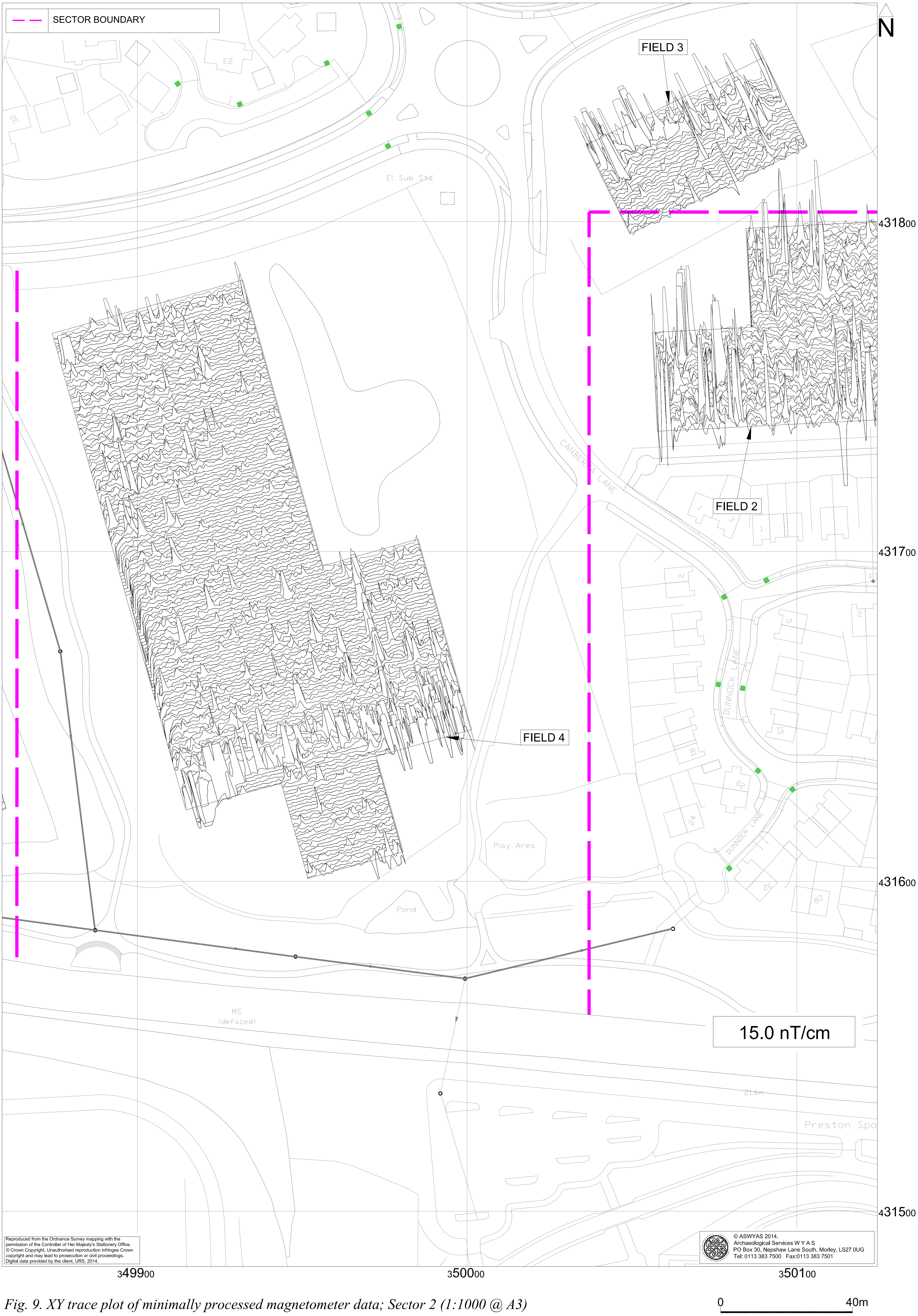

Fig. 9. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1000 @ A3)

Fig. 10. Interpretation of magnetometer data; Sector 2 (1:1000 @ A3)

Fig. 11. Processed greyscale magnetometer data; Sector 3 (1:1000 @ A3)

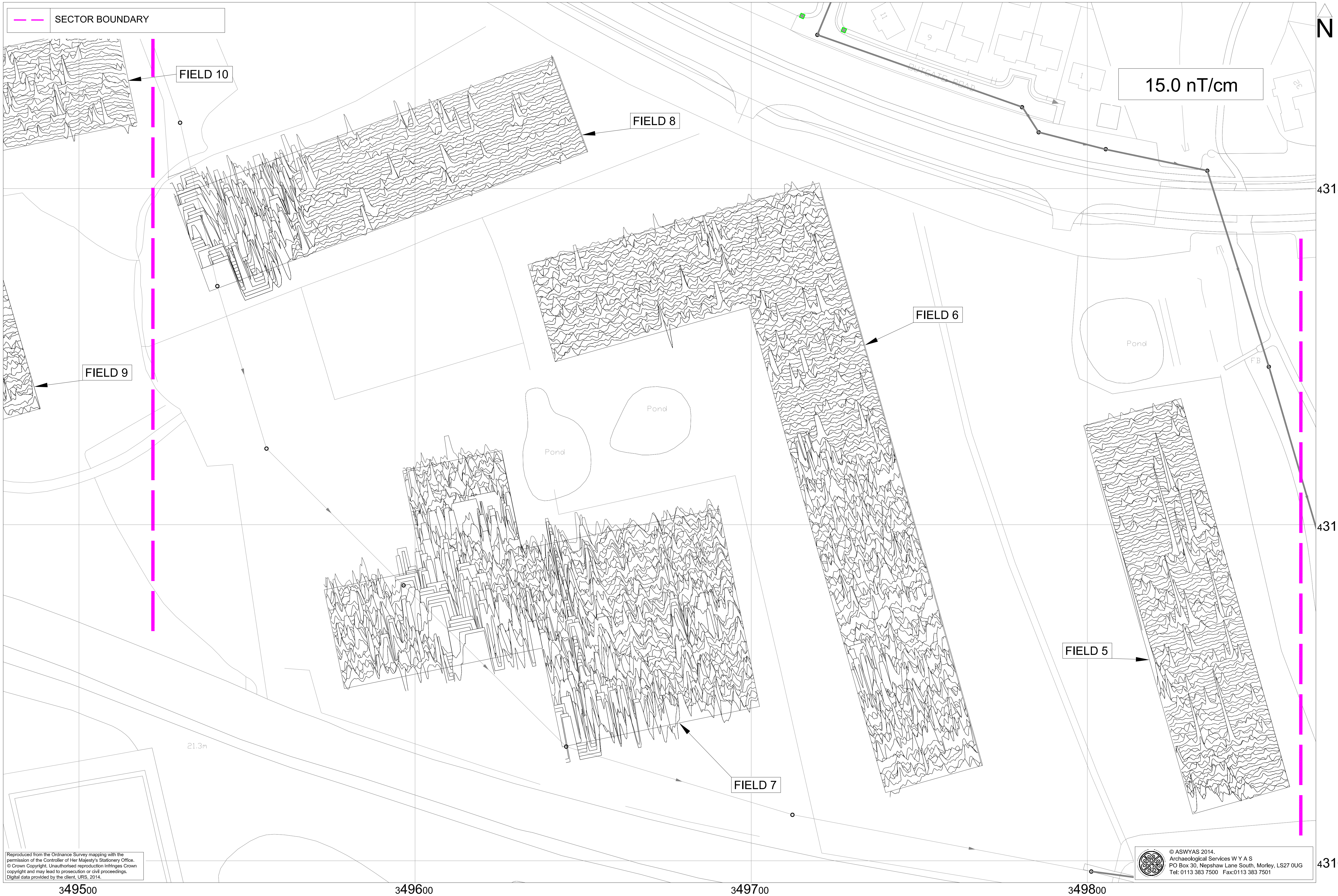

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Fig. 12. XY trace plot of minimally processed magnetometer data; Sector 3 (1:1000 @ A3)

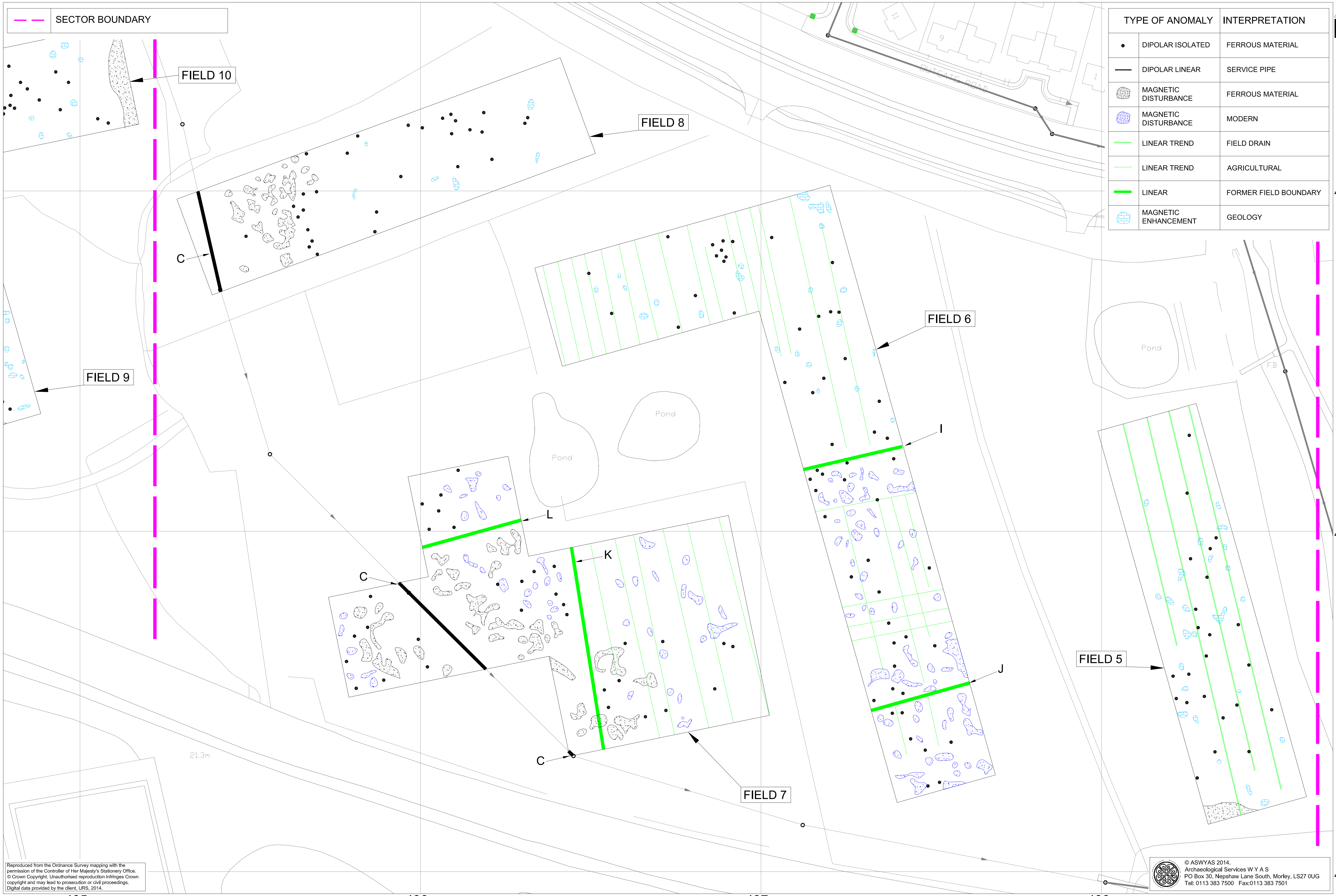

Fig. 13. Interpretation of magnetometer data; Sector 3 (1:1000 @ A3)

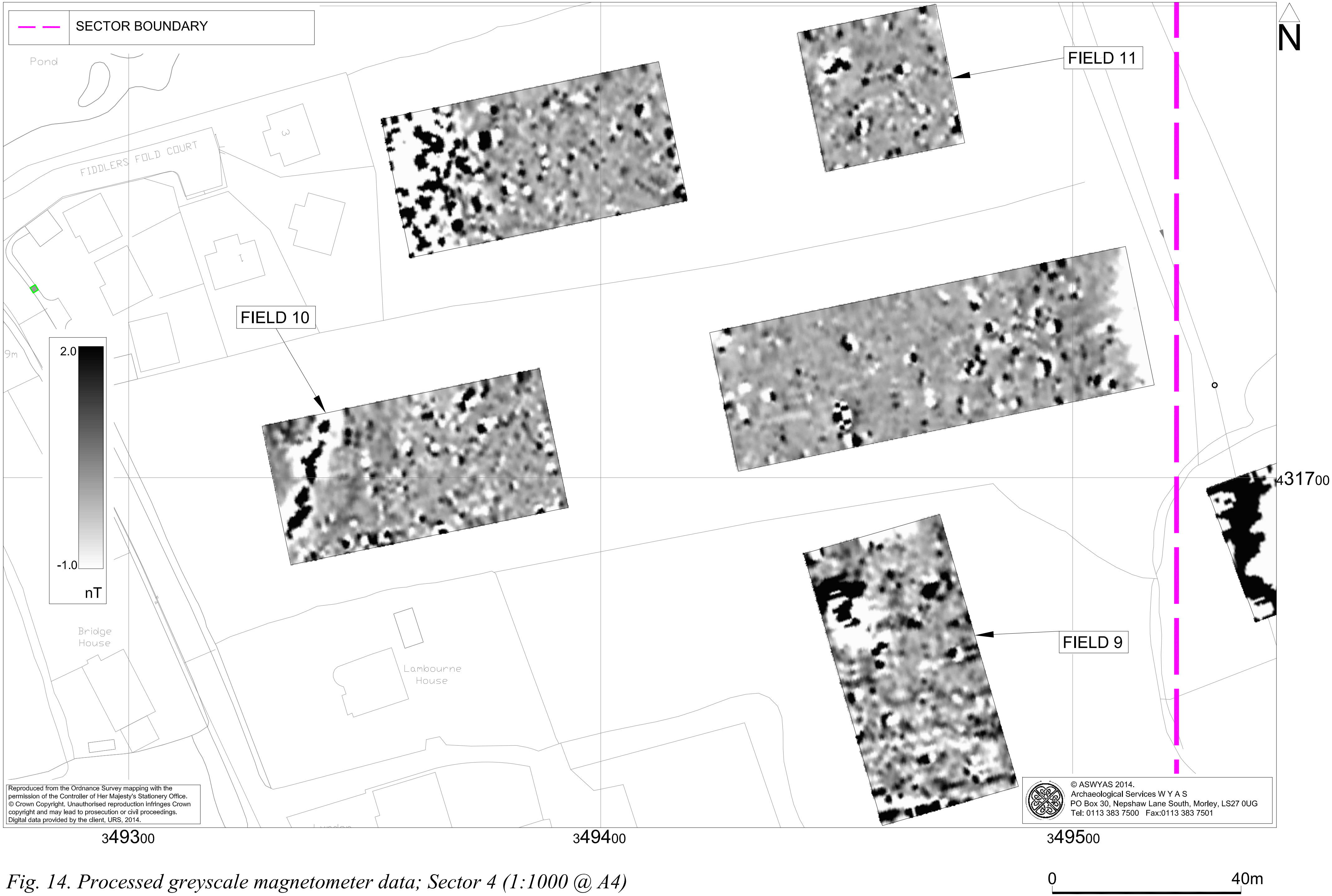

Fig. 14. Processed greyscale magnetometer data; Sector 4 (1:1000 @ A4)

Fig. 15. XY trace plot of minimally processed magnetometer data; Sector 4 (1:1000 @ A4)

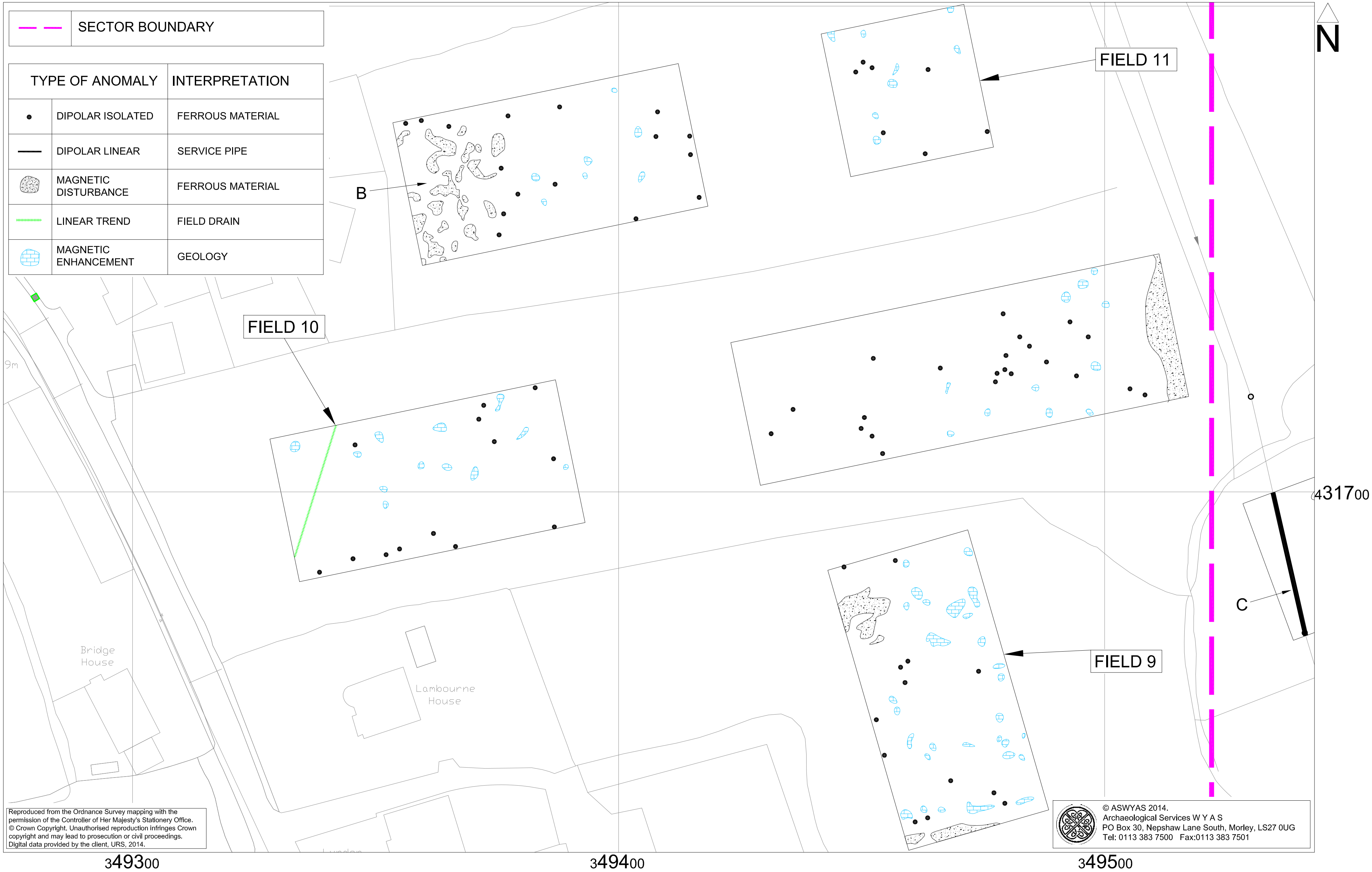

Fig. 16. Interpretation of magnetometer data; Sector 4 (1:1000 @ A4)

0 40m


Plate 1. General view of Field 1, looking south-east


Plate 2. General view of Field 2, looking east


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


Plate 4. General view of Field 4, looking south


Plate 5. General view of Field 5, looking north


Plate 6. General view of Field 6, looking north


Plate 7. General view of Field 7, looking south-east


Plate 8. General view of Field 8, looking north-east


Plate 9. General view of Field 9, looking west


Plate 10. General view of Field 10, looking west


Plate 11. General view of Field 11, looking south-west

Appendix 1: Magnetic survey - technical information

Magnetic Susceptibility and Soil Magnetism

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. The magnetic susceptibility of a soil can also be enhanced by the application of heat and the fermentation and bacterial effects associated with rubbish decomposition. The area of enhancement is usually quite large, mainly due to the tendency of discard areas to extend beyond the limit of the occupation site itself, and spreading by the plough. An advantage of magnetic susceptibility over magnetometry is that a certain amount of occupational activity will cause the same proportional change in susceptibility, however weakly magnetic is the soil, and so does not depend on the magnetic contrast between the topsoil and deeper layers. Susceptibility survey is therefore able to detect areas of occupation even in the absence of cut features. On the other hand susceptibility survey is more vulnerable to the masking effects of layers of colluvium and alluvium as the technique, using the Bartington system, can generally only measure variation in the first 0.15m of ploughsoil.

Types of Magnetic Anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

Methodology: Magnetic Susceptibility Survey

There are two methods of measuring the magnetic susceptibility of a soil sample. The first involves the measurement of a given volume of soil, which will include any air and moisture that lies within the sample, and is termed volume specific susceptibility. This method results in a bulk value that it not necessarily fully representative of the constituent components of the sample. For field surveys a Bartington MS2 meter with MS2D field loop is used due to its speed and simplicity. The second technique overcomes this potential problem by taking into account both the volume and mass of a sample and is termed mass specific susceptibility. However, mass specific readings cannot be taken in the field where the bulk properties of a soil are usually unknown and so volume specific readings must be taken. Whilst these values are not fully representative they do allow general comparisons across a site and give a broad indication of susceptibility changes. This is usually enough to assess the susceptibility of a site and evaluate whether enhancement has occurred.

Methodology: Gradiometer Survey

There are two main methods of using the fluxgate gradiometer for commercial evaluations. The first of these is referred to as ***magnetic scanning*** and requires the operator to visually identify anomalous responses on the instrument display panel whilst covering the site in widely spaced traverses, typically 10m apart. The instrument logger is not used and there is therefore no data collection. Once anomalous responses are identified they are marked in the field with bamboo canes and 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.
- 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 Lancashire Historic Environment Record).

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