Archaeological Services WYAS

Land south of the River Bow
Pershore
Worcestershire

Geophysical Survey

Report no. 2547

December 2013

Client: CgMs Consulting

Land south of the River Bow
Pershore
Worcestershire

Geophysical Survey

Summary

A geophysical (magnetometer) survey, covering 17.5 hectares, was carried out on land south of the River Bow, Pershore, as part of an initial assessment for the proposed development of the site. The survey has identified anomalies indicative of ridge and furrow cultivation throughout the site, probably originating in the medieval and/or post medieval periods. A former field boundary and field drains have also been identified. On the basis of the geophysical survey, the site is assessed as having a low archaeological potential.

ARCHAEOLOGICAL
SERVICES
WYAS

Report Information

Client:	CgMs Consulting
Address:	43 Temple Row, Birmingham, B2 5LS
Report Type:	Geophysical Survey
Location:	North Pershore
County:	Worcestershire
Grid Reference:	SO 94715 47795
Period(s) of activity:	post-medieval
Report Number:	2547
Project Number:	4159
Site Code:	NPS13
OASIS ID:	archaeol11-166348
Planning Application No.:	-
HER Event Number:	WSM16324
Date of fieldwork:	November 2013
Date of report:	December 2013
Project Management:	Sam Harrison BSc MSc MIfA
Fieldwork:	Christopher Sykes BA MSc
	David Harrison BA MSc MIfA
Report:	David Harrison
Illustrations:	David Harrison
Photography:	David Harrison

Authorisation for distribution: ---

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

ISOQAR QUALITY ASSURED ISO 9001 Cert. No. 125

REGISTERED ORGANISATION IfA

Contents

List of Figures

List of Plates

1 Introduction

Archaeological Services WYAS (ASWYAS) was commissioned by James Gidman of CgMs Consulting, on behalf of Persimmon Homes South Midlands, to undertake a geophysical (magnetometer) survey on land to the north-west of Pershore, a market town on the banks of the River Avon, approximately six miles north-west of Evesham, Worcestershire (see Fig. 1). The results of the survey will be used to determine the need for further archaeological work, if required, as a condition of a planning application for the proposed development of the site. The scheme of work is in accordance with a Project Design (Harrison 2013a) submitted to and approved by the local authority archaeologist, and with government guidance contained in the National Planning Policy Framework (NPPF). The survey was carried out between November 25th and November 29th 2013.

Site location, topography and land-use

The proposed development area (PDA) is situated on the north-western periphery of the town on land to the south of the River Bow and west of the A4104, Station Road (see Fig. 2). The site comprises of two parcels of arable land (Field 1 and Field 2) centred at NGR 394715 247795 which are bounded to the north by the River Bow, by Station Road to the east and by open arable land to the south and east. The site is relatively flat at approximately 25m above Ordnance Datum (aOD) with the north of Field 1 sloping down towards the River Bow at 21m aOD. At the time of the survey, the land was under a short cereal crop (see plates). Narrow strips of land adjacent to the River Bow were waterlogged and unsuitable for survey (see Plate 1). Overgrown vegetation in the south-east of Field 2 also slightly reduced the area available for survey (see Fig. 2).

Geology and soils

The underlying bedrock comprises mudstone of the Charmouth Formation overlain by superficial deposits of Wasperton and Bretford sand and gravel. Alluvial deposits are recorded within the north of the survey area, adjacent to the River Bow (British Geological Survey 2013). The soils in this area are classified in the Bishampton 2 and Evesham 2 associations, being characterised as deep, fine loams and clays with slowly permeable subsoils and prone to slight seasonal waterlogging (Soil Survey of England and Wales 1983).

2 Archaeological background

A Heritage Assessment (CgMs 2012), undertaken as part of the wider Strategic Land Assessment, identified no designated heritage assets within the PDA or its immediate environment. The site lies within a largely medieval landscape with little evidence for prehistoric or Roman activity. The assessment concluded that, notwithstanding the evidence of ridge and furrow cultivation, which survives as cropmarks throughout the PDA, the archaeological potential of the site is thought to be low.

No anomalies of obvious archaeological potential were identified during the first phase of geophysical survey (Harrison 2013b) of adjoining land to the south and west (see Fig. 2).

3 Aims, Methodology and Presentation

The general aim of the geophysical survey was to establish and clarify the nature of the archaeological resource within the PDA.

Specifically the survey sought to provide information about the nature and possible interpretation of any anomalies identified during the survey and thereby determine the presence or absence and likely extent of any buried archaeological remains.

The information from the geophysical survey will enable further evaluation and/or mitigation measures, if required, to be designed in advance of the determination of the planning application.

In order to achieve these aims, a detailed (recorded) magnetometer survey was carried out covering the full extent of the PDA, an area of 17.5 hectares.

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 map is shown in Figure 1. A large scale (1:4000) plan showing the greyscale magnetometer data and the previous survey data is shown in Figure 2. Figure 3 is an overall interpretation drawing at a scale of 1:2000. The data is presented in greyscale, XY trace plot and interpretation formats in Figures 4 to 15 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 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

Numerous anomalies have been identified throughout the PDA within a variable magnetic background. For clarity, the interpretation of the results will be described according to the causes of the identified anomalies with those interpreted as having a non-archaeological origin first and possible archaeological anomalies last.

Ferrous anomalies

Isolated dipolar ('iron spike') anomalies have been identified throughout the survey area. These anomalies are typically caused by ferrous (magnetic) debris, either on the ground surface or in the topsoil horizon, which causes rapid variations in the magnetic readings giving a characteristic 'spiky' XY trace. Unless there is supporting evidence for an archaeological interpretation, little importance is normally attributed to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring or tipping/infilling.

A high magnitude linear anomaly, **A**, at the eastern edge of Field 1 is caused by a service pipe located within or close to the adjacent field boundary. To the west of this anomaly, a large ferrous 'spike', **B**, is due to a manhole cover (see Fig. 3). The east/west aligned linear anomaly, **C**, to the immediate east of the 'spike' is thought to be indicate a non-ferrous, or deeply buried service pipe, probably a sewer. Broad areas of magnetic disturbance, **D** and **E**, within the north of Field 1 correspond to spreads of rubble, including brick, which were noted during the fieldwork.

Magnetic disturbance identified around the edges of the PDA is due to the close proximity of ferrous material within the adjacent field boundaries.

Geological anomalies

Numerous small discrete anomalies, characterised as localised areas of magnetic enhancement, have been identified across the survey area. The lack of any apparent pattern suggests these anomalies have a geological origin, being due to localised variations in the underlying superficial deposits of sands and gravels.

Agricultural anomalies

Analysis of historical Ordnance Survey mapping has shown that, with the exception of the removal of three field boundaries, the division of land within the PDA has changed little since the publication of the first edition Ordnance Survey map in 1884, with all but the eastern strip of land within Field 1 being depicted as formal orchards into the latter part of the 20th century. One of these former boundaries, which is also depicted as a trackway within Field 2, manifests in the data as an east-west aligned high magnitude linear anomaly, **F**. Two further former boundaries which are depicted within the north-east of Field 1 have not been detected by the magnetometer survey. It is unclear whether this lack of detection is a result of the unresponsive superficial deposits or whether all trace of the former boundaries have been subsequently removed by the plough.

Series of parallel linear trends can be seen respecting and running parallel to the field boundaries. These trends are indicative of the medieval and post-medieval practice of ridge and furrow cultivation. The characteristic striped appearance to the data is a result of the magnetic contrast between the now soil-filled furrows and the former ridges. Elsewhere, speckled linear trend anomalies have been identified within the north of Field 1 and the south of Field 2. These are characteristic of field drains.

5 Conclusions

No anomalies of obvious archaeological potential have been identified by the geophysical survey. Anomalies have been identified which are due to ridge and furrow cultivation, land drainage and modern services. Therefore, on the basis of the geophysical survey, the archaeological potential of the PDA is considered to be low, corroborating the conclusions of the Heritage Assessment.

Disclaimer

The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits.

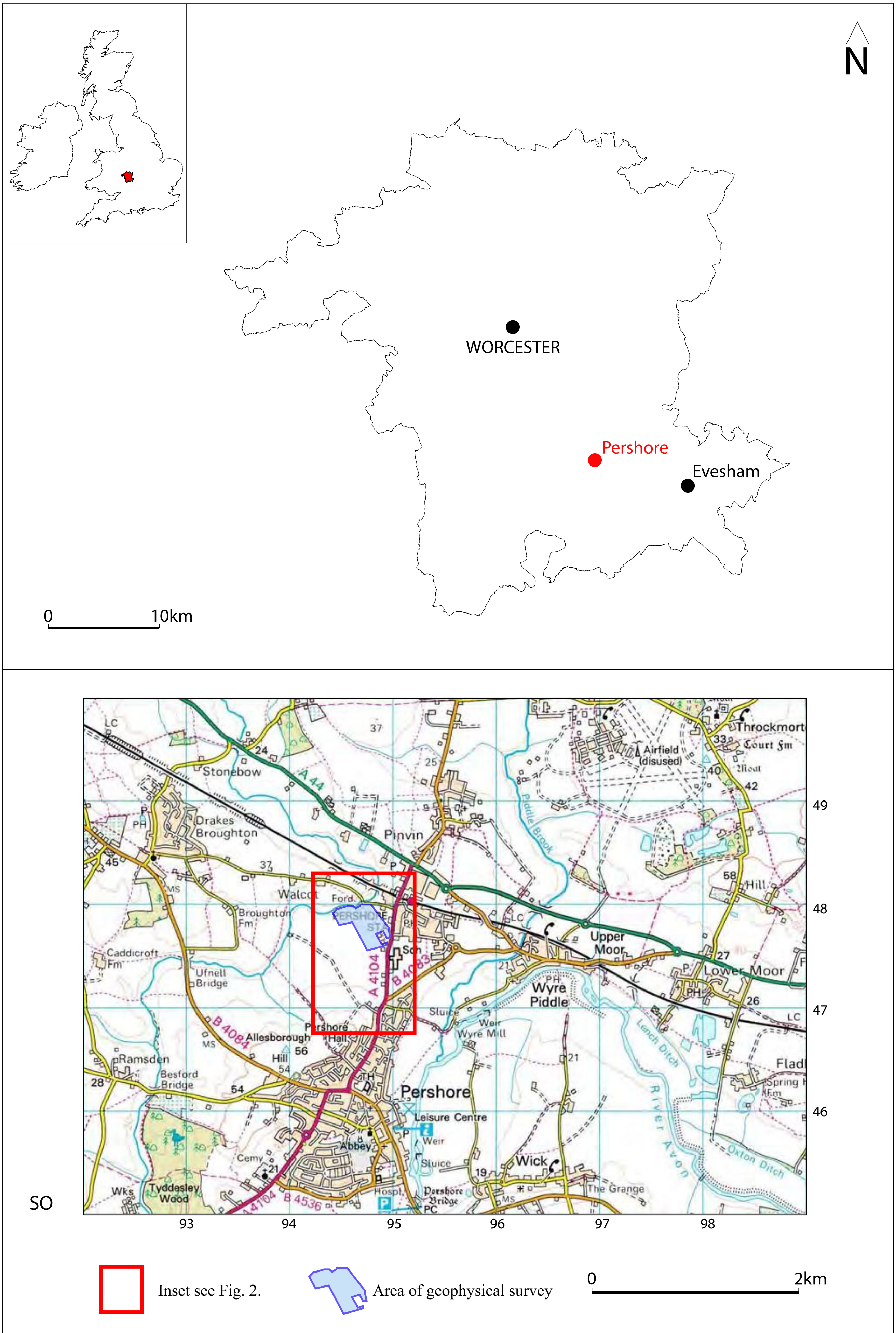


Fig. 1. Site location

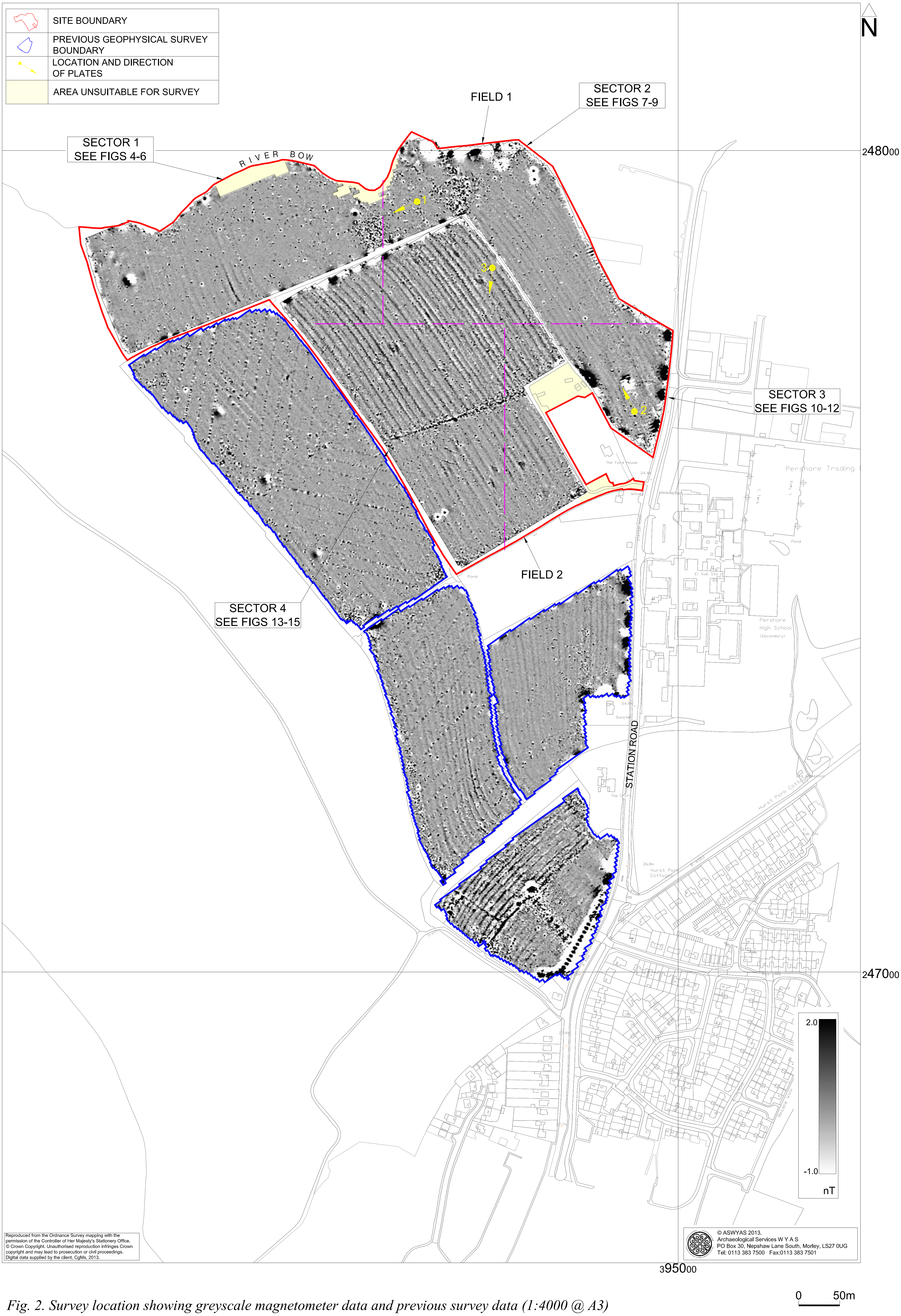


Fig. 2. Survey location showing greyscale magnetometer data and previous survey data (1:4000 @ A3)

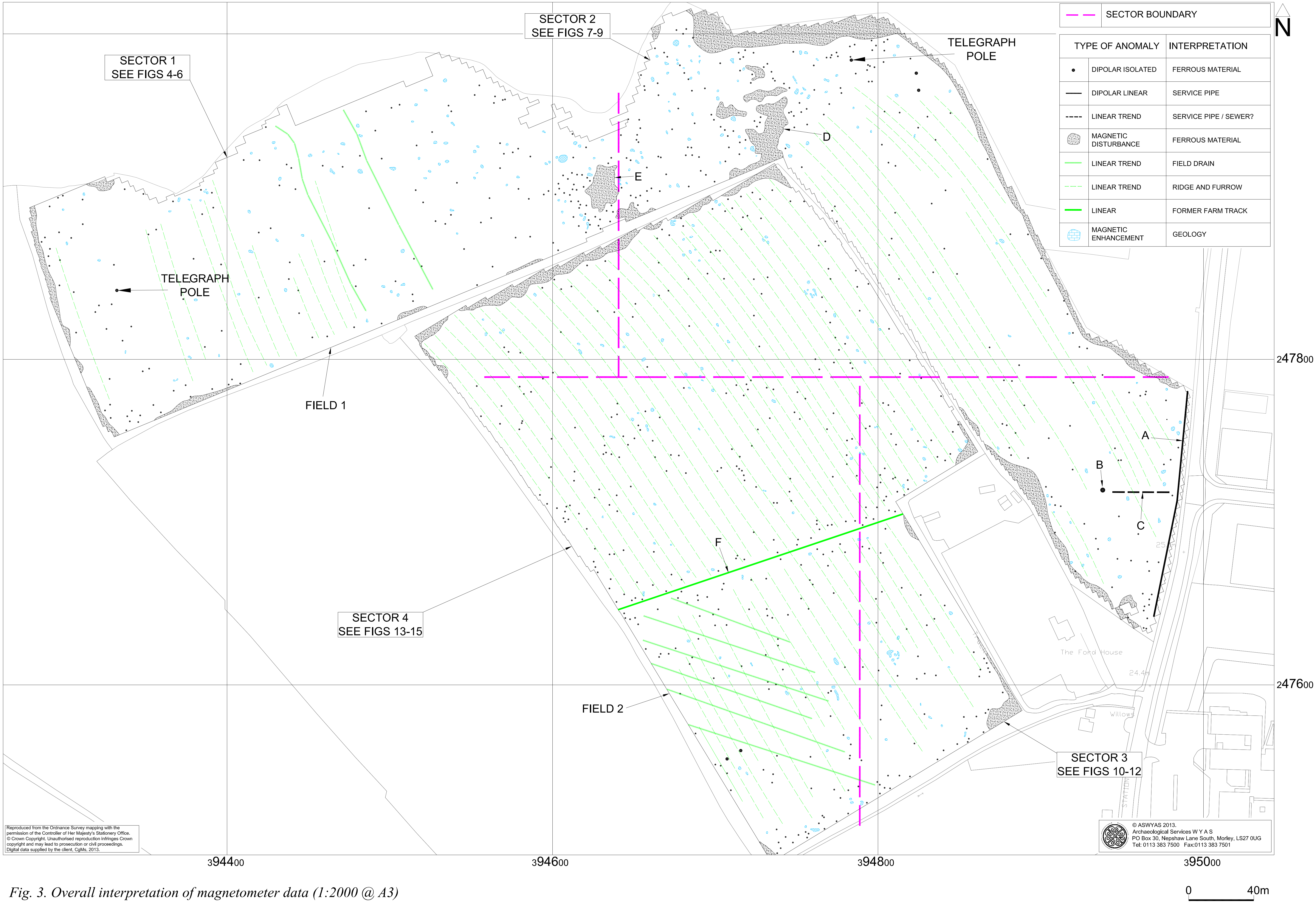


Fig. 3. Overall interpretation of magnetometer data (1:2000 @ A3)

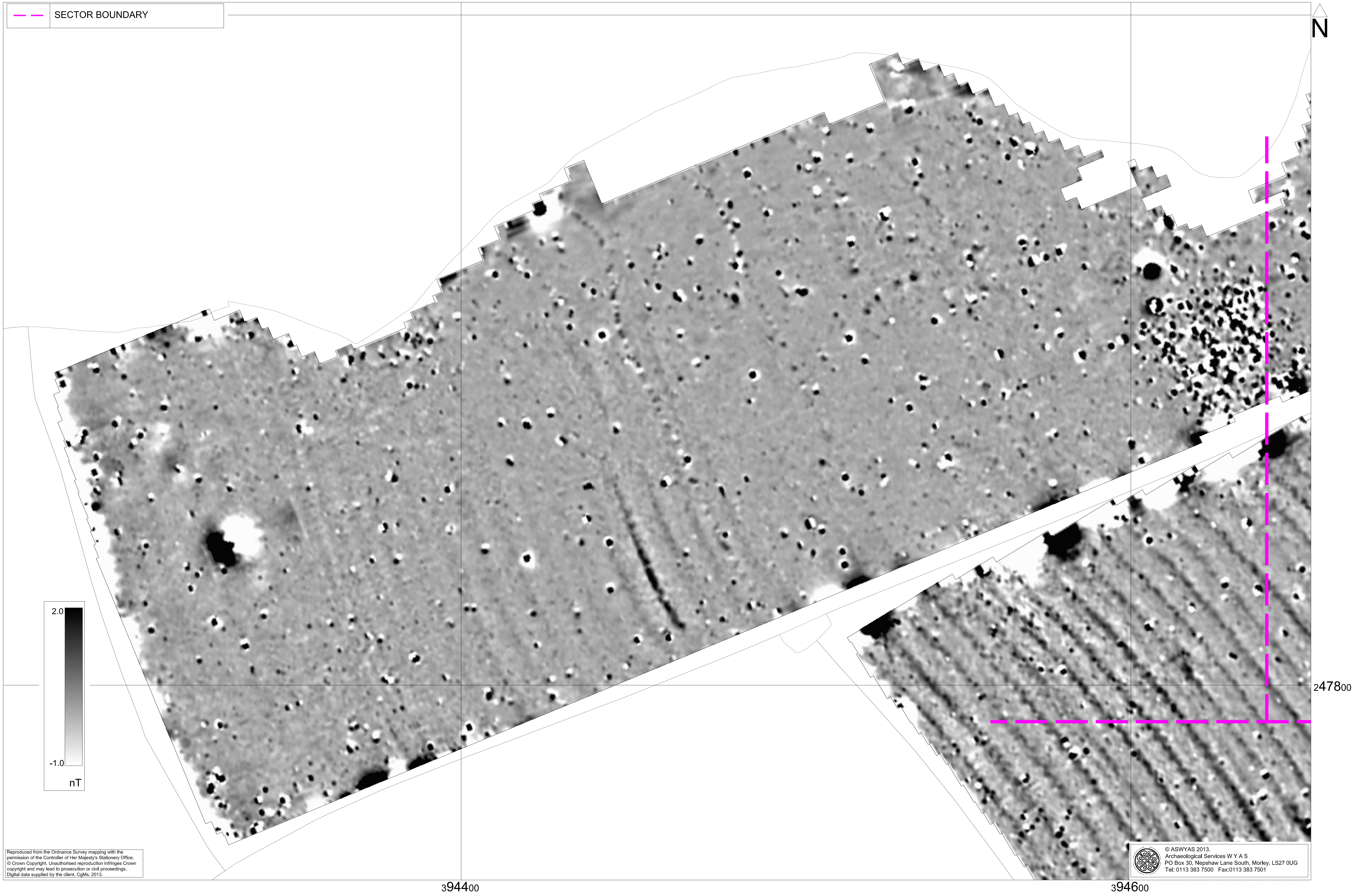


Fig. 4. Processed greyscale magnetometer data; Sector 1 (1:1000 @ A3)

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

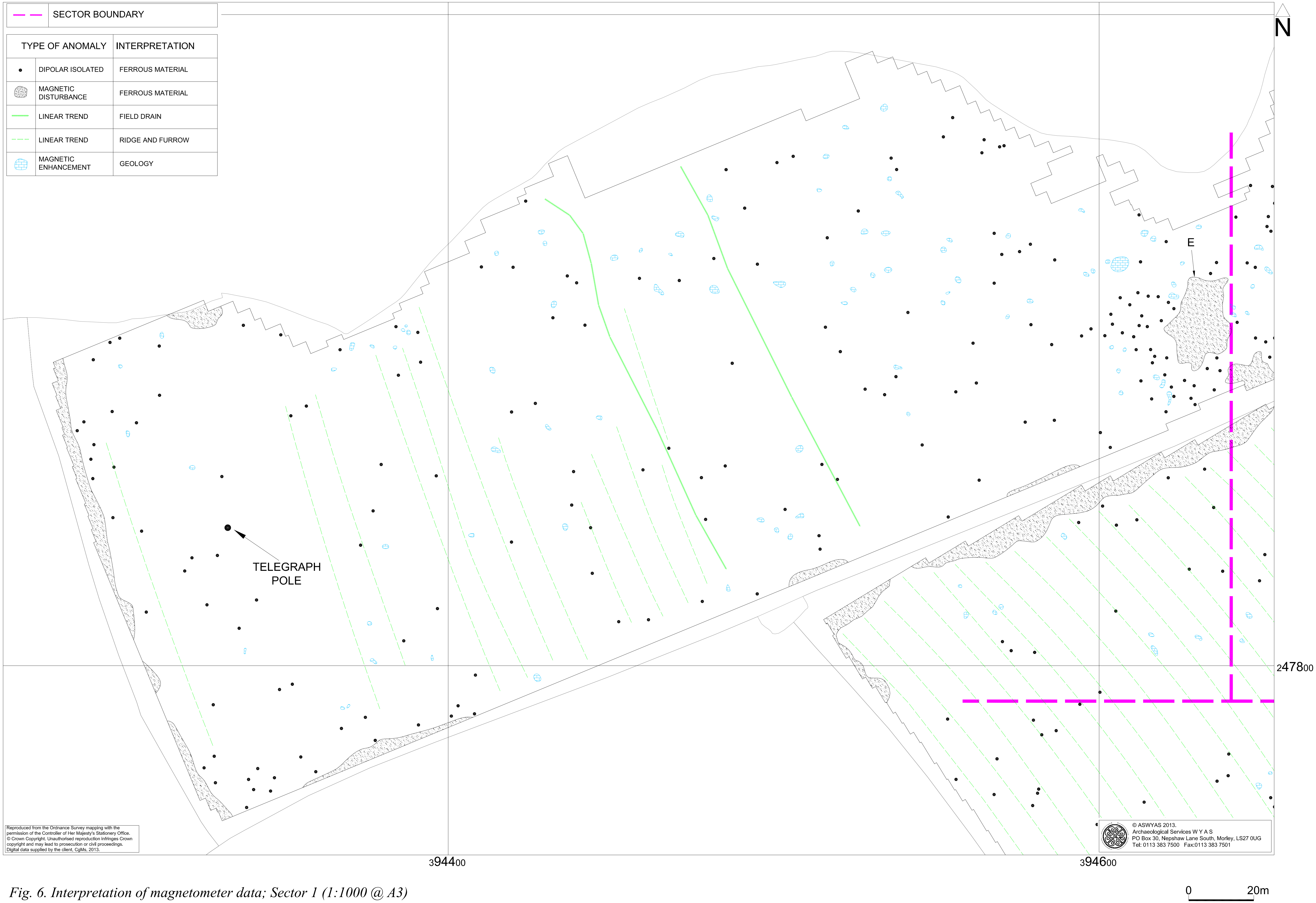


Fig. 6. Interpretation of magnetometer data; Sector 1 (1:1000 @ A3)

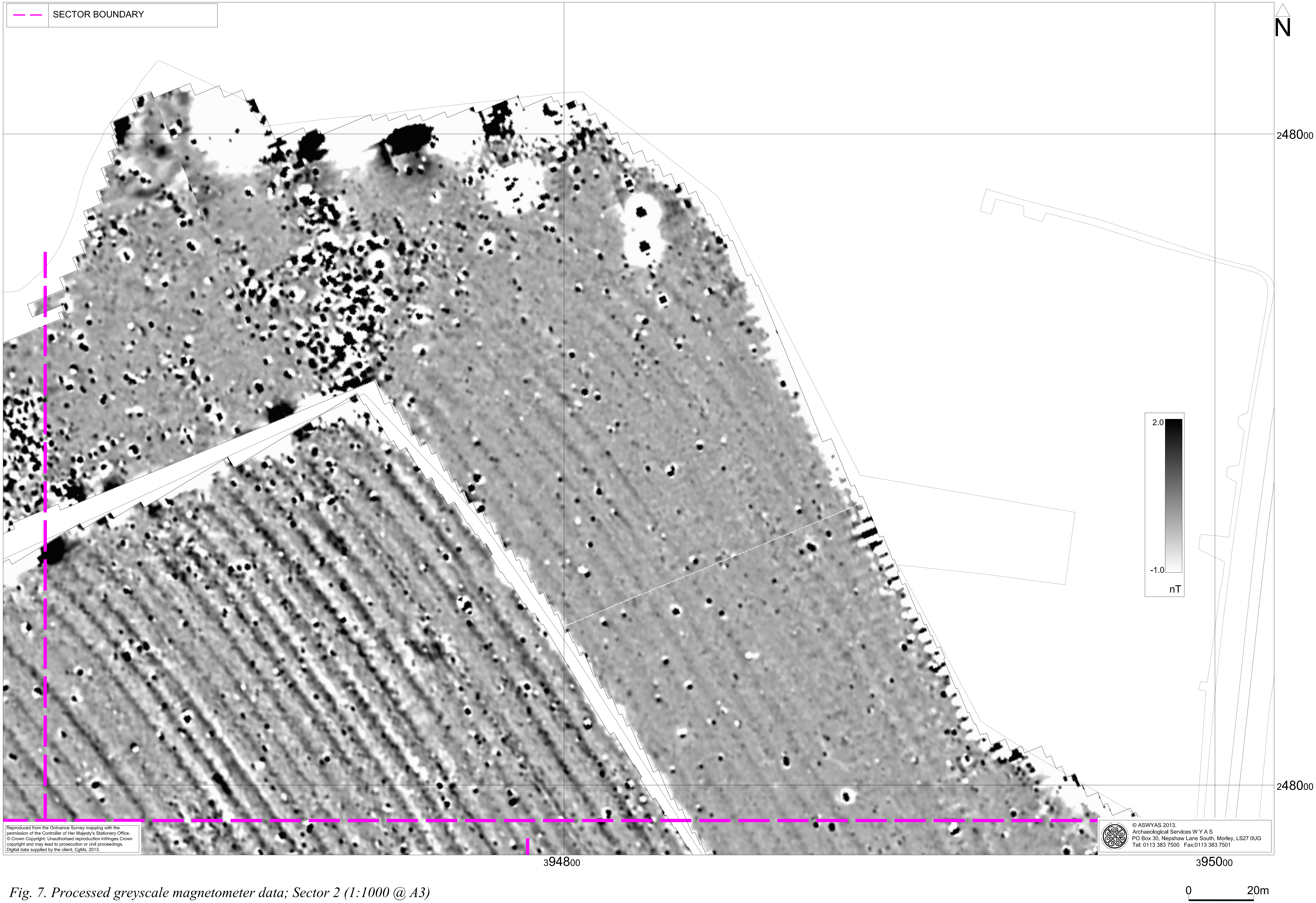


Fig. 7. Processed greyscale magnetometer data; Sector 2 (1:1000 @ A3)

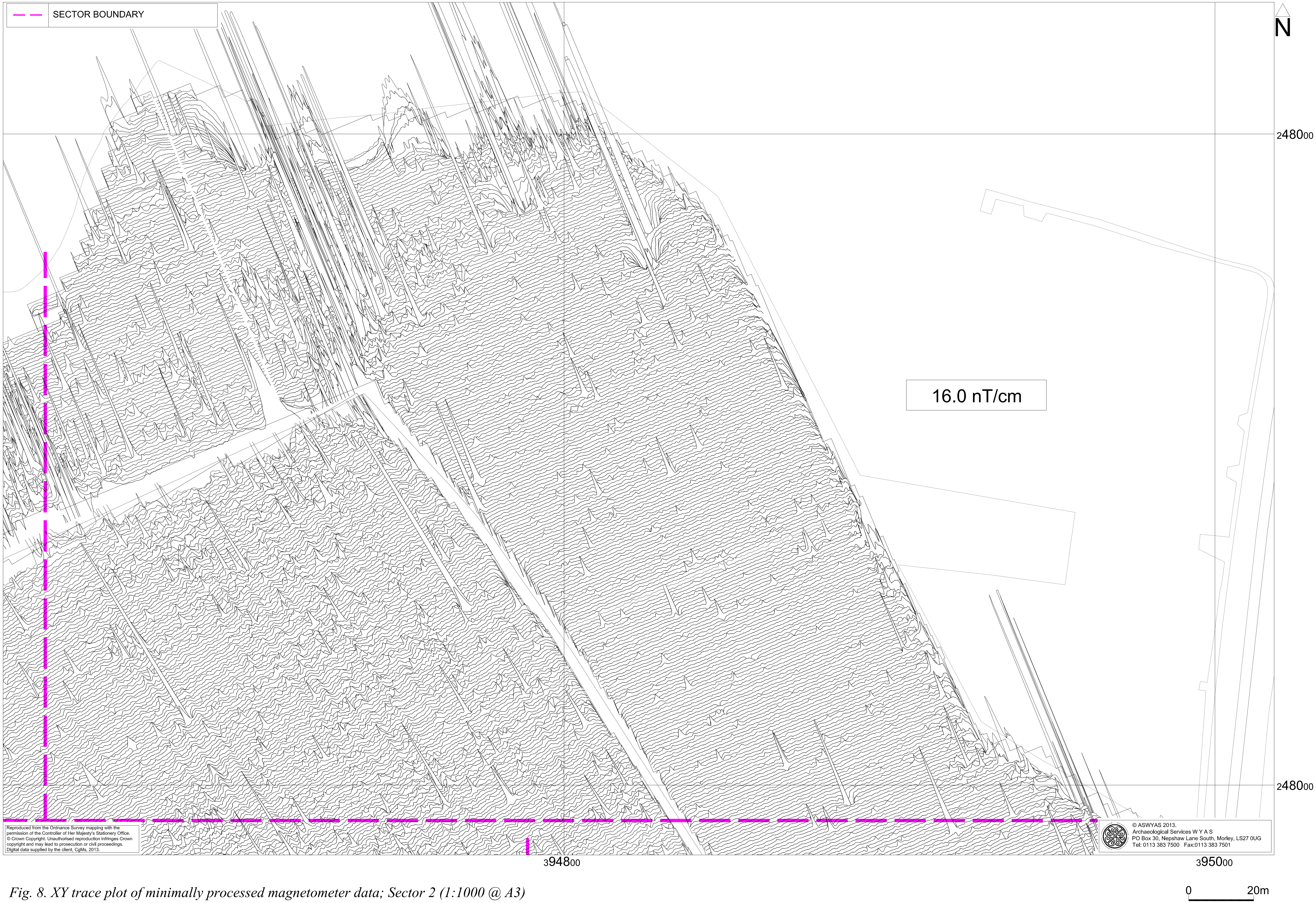


Fig. 8. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1000 @ A3)

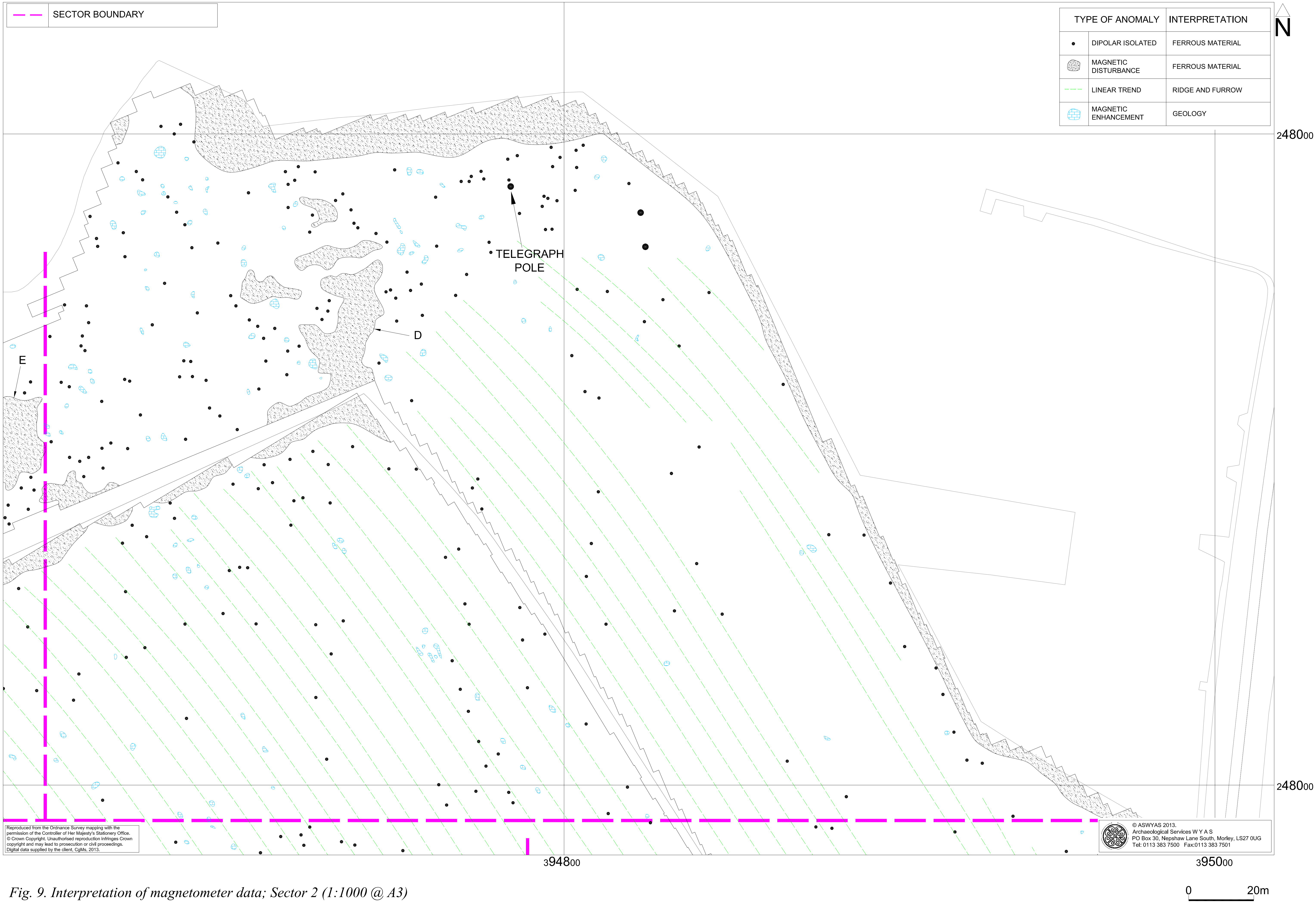


Fig. 9. Interpretation of magnetometer data; Sector 2 (1:1000 @ A3)

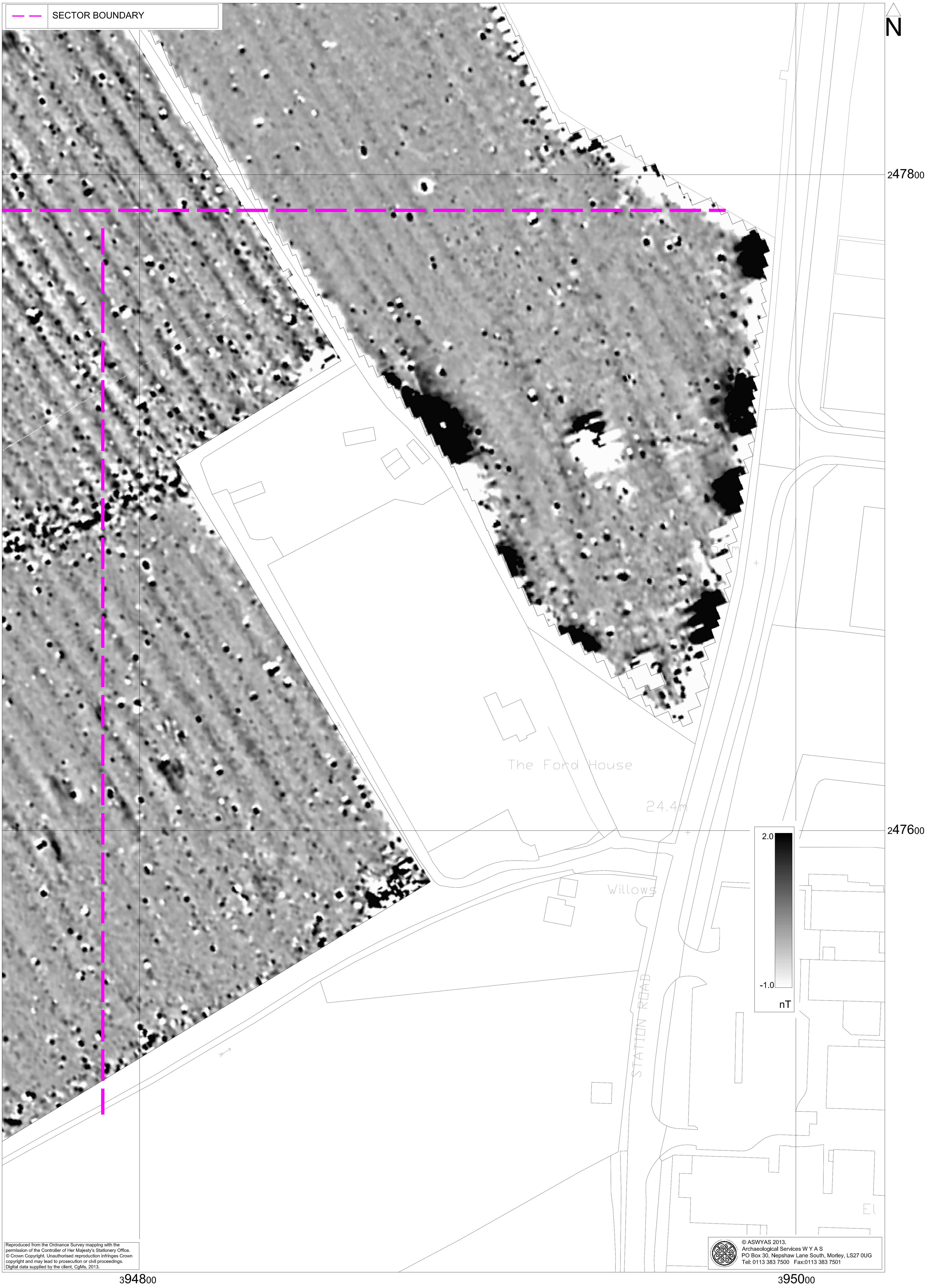


Fig. 10. Processed greyscale magnetometer data; Sector 3 (1:1000 @ A3)

© ASWYAS 2013.
Archaeological Services W Y A S
PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

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

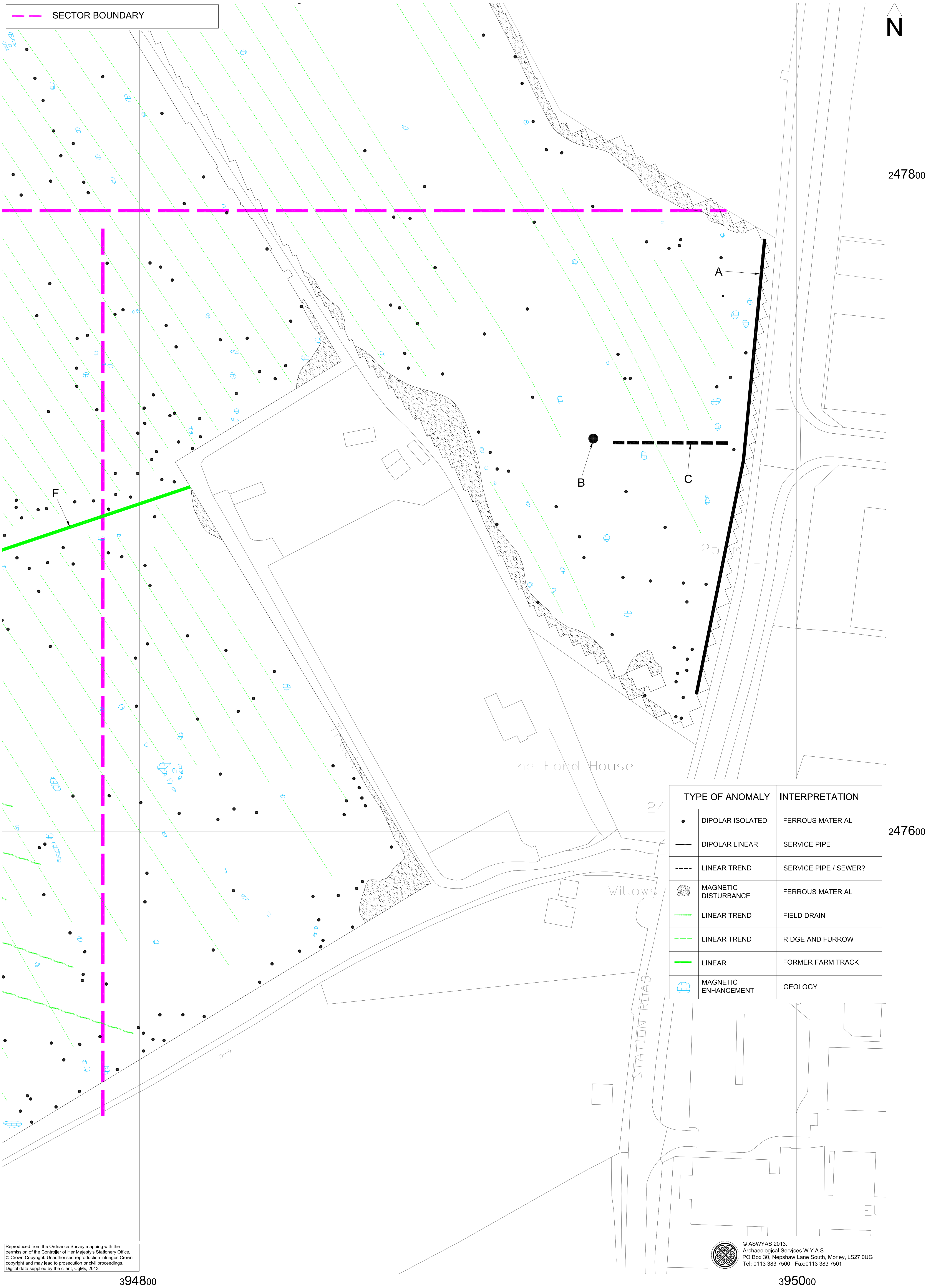
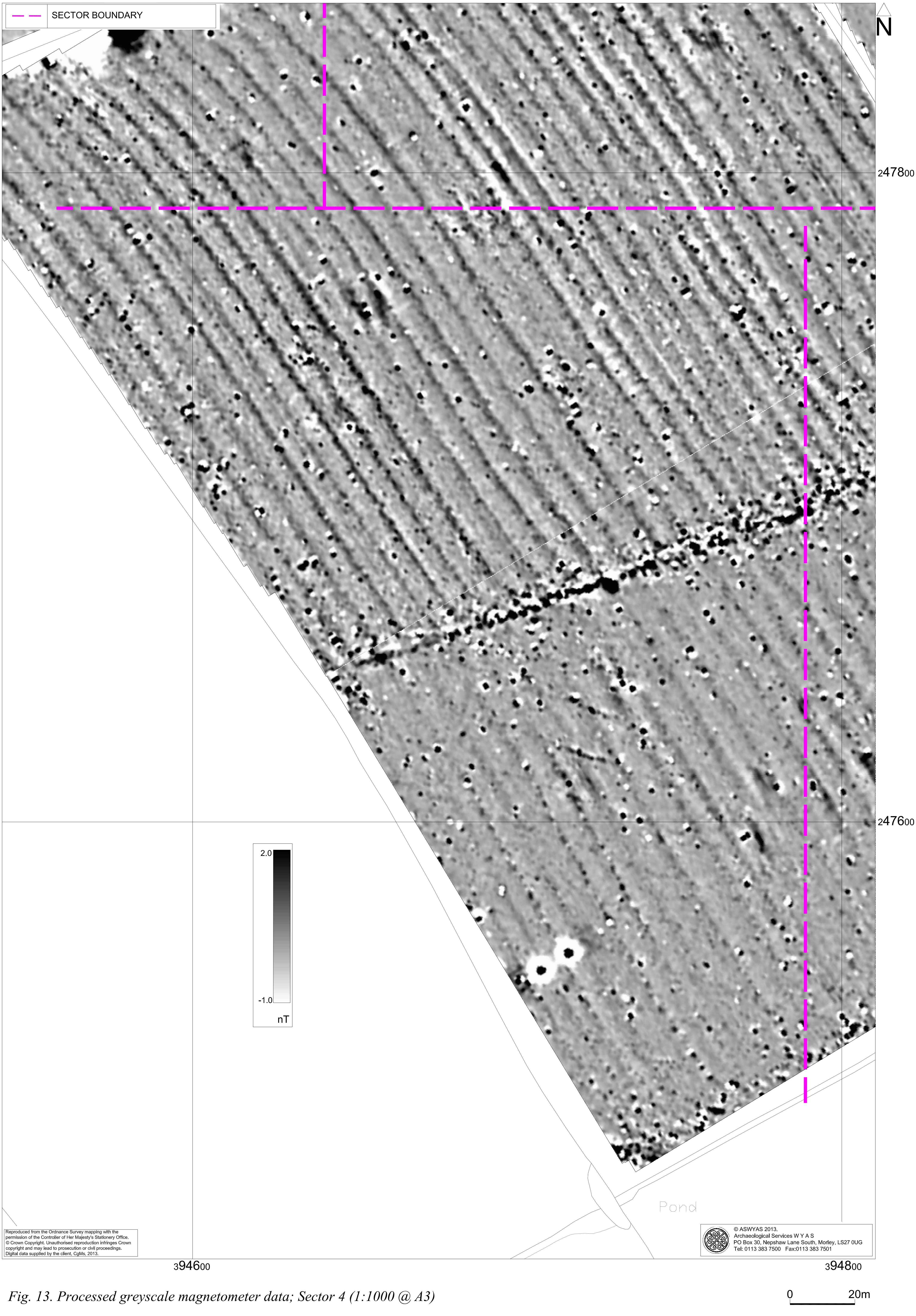
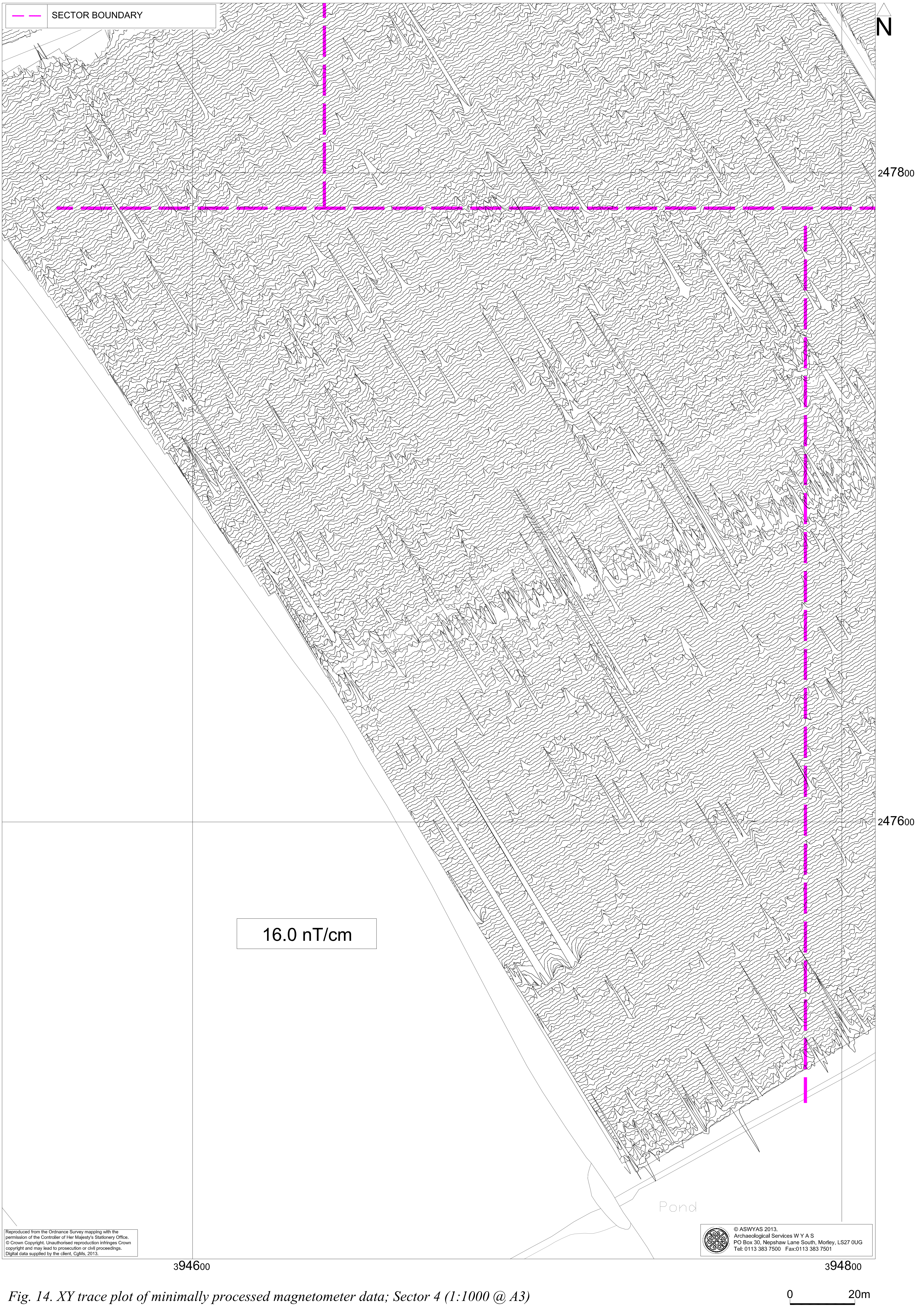


Fig. 12. Interpretation of magnetometer data; Sector 3 (1:1000 @ A3)



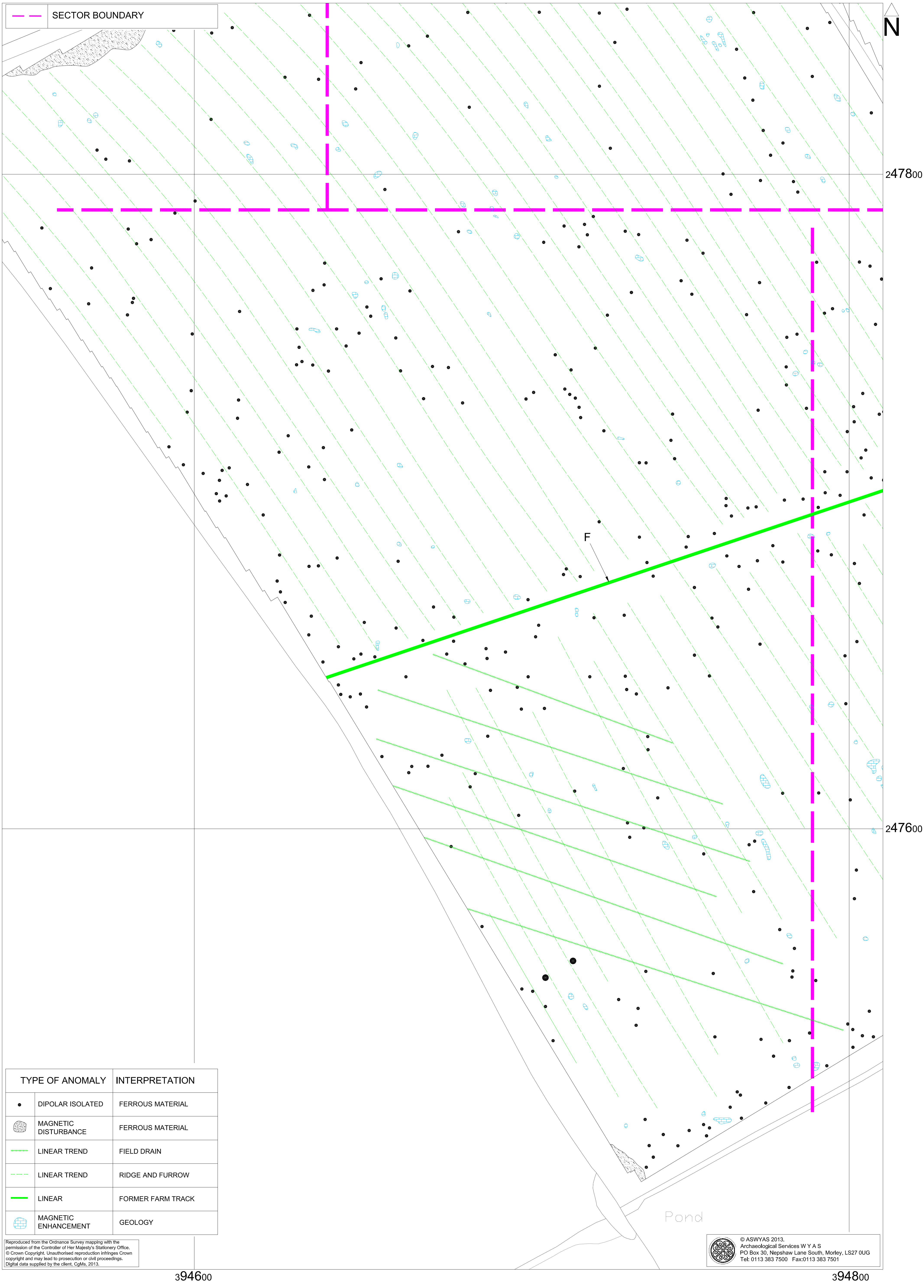
Archaeological Services W Y A S
PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

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)



0 20m

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

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

Plate 2. General view of Field 1, looking north-west

Plate 3. General view of Field 2, looking south

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 or for the removal of any of the survey reference points.

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 Worcestershire Historic Environment Record).

Bibliography

Harrison, D., 2013a. *Land west of Station Road, North Pershore, Worcestershire; Geophysical Survey Project Design* Unpublished ASWYAS document

Harrison, D., 2013b. *Land west of Station Road, North Pershore, Worcestershire: Geophysical Survey* Unpublished ASWYAS report

British Geological Survey, 2013. http://mapapps.bgs.ac.uk/geologyofbritain/home.html (Accessed: December 4th 2013)

CgMs Consulting, 2012. *Heritage Assessment; North Pershore Strategic Land* Unpublished Client Report Ref. GP/13225

David, A., N. Linford, P. Linford and L. Martin, 2008. *Geophysical Survey in Archaeological Field Evaluation: Research and Professional Services Guidelines (2nd edition)* English Heritage

Institute for Archaeologists, 2011. *Standard and Guidance for archaeological geophysical survey*. Institute for Archaeologists

Soil Survey of England and Wales, 1983, Soils of Midland and Western England Sheet 3