ARCHAEOLOGICAL SERVICES WYAS

Land at Field House Farm
Ladwell
City of Winchester

Geophysical Survey

Report no. 2597

April 2014

Client: Cotswold Archaeology

REGISTERED ORGANISATION IfA

Land at Field House Farm
Ladwell
City of Winchester

Geophysical Survey

Summary

A geophysical (magnetometer) survey covering approximately 15 hectares was carried out on agricultural land at Ladwell, Winchester, to inform the determination of an outline planning application for a proposed solar park. Anomalies suggestive of an irregularly-shaped enclosure are visible in the north of the site towards the summit of a low hill. No anomalies have been identified in the vicinity of the possible late prehistoric or Roman enclosure which is recorded through cropmark data on the Hampshire Historic Environment Record. A high pressure gas main has been located traversing the site as well as sub-surface pipes relating to a reservoir and wind pump. On the basis of the magnetic survey the archaeological potential of the site is considered to be low, with the exception of north of the PDA where a moderate to high potential is ascribed.

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Report Information

Client:	Cotswold Archaeology
Address:	Stanley House, Walworth Road, Andover, Hampshire, SP10 5LH
Report Type:	Geophysical Survey
Location:	Ladwell
District:	City of Winchester
County:	Hampshire
Grid Reference:	SU 42770 23412
Period(s) of activity:	prehistoric?/Roman?/Modern
Report Number:	2597
Project Number:	4222
Site Code:	FHF14
OASIS ID:	archaeol11-176644
Planning Application No.:	n/a
Museum Accession No.:	n/a
Date of fieldwork:	March 2014
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Project Management:	David Harrison BA MSc MIfA
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Research:	n/a

Authorisation for distribution: --

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1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by Cotswold Archaeology (the Client), on behalf of Orta Field House Solar Limited, to undertake a geophysical (magnetometer) survey of land at Field House Farm, Ladwell, Winchester, Hampshire (see Fig. 1), in order to support a planning application for a proposed solar park development to be submitted to Winchester City Council. The work was undertaken in accordance with a Project Design (Webb 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 March 24th and March 28th 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) covers approximately 15 hectares, centred at SU 42770 23412, and is situated south of the hamlet of Ladwell, 1.2km south of the village of Hursley and 240m north of Chandler’s Ford. It comprises an irregular parcel of land, occupying two large pasture fields, Field 1 and Field 2 (see plates), which are bound to the west by the B3043 Hursley Road. The southern and eastern boundaries are demarcated by Hocombe Plantation and by Barn Copse and Ryder’s Row respectively and the northern boundary is delineated by an east-west aligned power line. An area within the north-west of Field 2 contained a small plantation/copse (see Plate 4) and was unsuitable for survey. Within the east of Field 2 survey was restricted by a narrow strip of land which was set-aside as bird cover (see Plate 8).

The PDA is located on the gentle east and south-east facing slope of a low hill. The land rises from approximately 62m above Ordnance datum (aOD) in the south-east corner of Field 2 to approximately 78m aOD in the north-west corner of Field 1, towards the summit of the hill (see Plate 5).

Soils and geology

The underlying bedrock geology comprises north-south orientated bands of sand which is classified in the Whitecliff Sand Member with clay, silt and sand of the Nursling Sand Member within the east of the site (see Fig. 3). There are no recorded superficial deposits (British Geological Survey 2014). The soils are classified in the Shirrell Heath 2 association, being characterised as well-drained sandy soils (Soil Survey of England and Wales 1983).

2 Archaeological Background

A Heritage Desk-Based Assessment (Cotswold Archaeeology 2014) highlights the presence of a potential late prehistoric or Roman settlement enclosure which is shown within the south-east of Field 2 as rectilinear cropmarks on aerial photographs (see Fig. 2). The site is recorded in the Hampshire Historic Environment Record (HER) (Ref. 58231). The wider landscape contains Bronze Age activity associated with funerary remains and therefore, prior to survey, the site was assumed to have a moderate potential for the presence of unrecorded archaeological remains from this period onwards.

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 the proposed development on potential sub-surface archaeological remains and for further evaluation or mitigation proposals, if appropriate, to be recommended. To achieve this aim a magnetometer survey covering all available parts of the PDA was carried out.

The general objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore determine the presence/absence and extent of any buried archaeological features; and
- to prepare a report summarising the results of the survey.

Magnetometer survey

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble 5800 model). Bartington Grad601 magnetic gradiometers were used during the survey, taking readings at 0.25m intervals on zig-zag traverses 1m apart within 30m by 30m grids, so that 3600 readings were recorded in each grid. These readings were stored in the memory of the instrument and later downloaded to computer for processing and interpretation. Geoplot 3 (Geoscan Research) software was used to process and present the data. Further details are given in Appendix 1.

Reporting

A general site location plan, incorporating the 1:50000 Ordnance Survey (OS) mapping, is shown in Figure 1. Figure 2 is a large scale survey location plan displaying the processed greyscale magnetometer data at a scale of 1:2000. Figures 3 and 4 show the geology detail and an overall data interpretation plot at the same scale. Detailed data plots (‘raw’ and processed) and full interpretative figures are presented at a scale of 1:1000 in Figures 5 to 13 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 (Webb 2013) and guidelines outlined by English Heritage (David *et al.* 2008) and by the Institute for Archaeologists (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 and Discussion (see Figs 5 to 13 inclusive)

Generally, a low level of background variation has been recorded across the PDA as is often the case on sandstone geologies. The minimal variation results from the homogenous properties of the sandstone. Nevertheless, a number of linear and curvilinear anomalies can be seen traversing the site on a variety of different alignments. The anomalies identified by the survey 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 responses, either as individual 'spike' anomalies or more extensive areas of magnetic disturbance, are typically caused by modern ferrous (magnetic) debris, either on the ground surface or in the plough-soil, or are due to the proximity of magnetic material in field boundaries, buildings or other above ground features. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as ferrous debris or material is common on rural sites, often being present as a consequence of manuring or tipping/infilling. Throughout the PDA individual iron 'spike' anomalies are common but there is no obvious pattern or clustering to their distribution to suggest anything other than a random background scatter of ferrous debris in the soil.

A clear high-magnitude dipolar linear anomaly, **A**, crossing the PDA on a broadly north/south orientation is caused by a sub-surface, high pressure, gas pipe. Narrower dipolar linear anomalies **B** and **C** are also thought to locate buried service pipes and can be seen radiating north and north-east from a reservoir (see Plate 6) which is first depicted on the 1910 OS map. The reservoir manifests in the data as a broad area of magnetic disturbance, **D**. A wind pump is depicted on the same edition OS map and corresponds to a small concrete platform

30m to the south-east of the reservoir (see Plate 6). The wind pump also manifests in the data as a broad circular area of magnetic disturbance, **E**, and appears to be connected to the reservoir by another pipe, **F**. The route of two overhead power-lines supported by telegraph poles traverse the PDA on separate north/south and east/west alignements. The telegraph poles can be seen in the data as large ferrous ‘spikes’, **G**, **H**, **I** and **J**. Larger pylons at the northern extent of the survey area have produced a higher magnitude magnetic signature and can be seen as broad areas of magnetic disturbance, **K** and **L**. Within the west of Field 2 a broad area of magnetic disturbance, **M**, corresponds to the site of a barn which is shown on the 1839 Hursely Tithe map and later OS maps. The disturbance is thought to be due to buried rubble, demolition material and possibly *in situ* remains. Within the south of Field 1, a broad area of magnetic disturbance, **N**, corresponds to the site of a spring which is depicted on the 1898 second edition OS map. Subsequent OS maps depict a spring 40m to the south of **N** and the magnetic disturbance is likley to result from the construction of a culvert or to an area of magnetically enhanced infill.

Elsewhere, areas of disturbance around the periphery of the PDA are due to ferrous material forming part of, or incorporated into, the adjacent field boundaries.

Agricultural Anomalies

Analysis of historical mapping indicates that the division and layout of land within the PDA has undergone little change since the publication of the Hursley Tithe in 1839, albeit with the removal of the barn, discussed above, and two former field boundaries, **O** and **P**. The former boundaries manifest in the data as linear alignments of ferrous ‘spikes’. No anomalies indicative of ditched field boundaries have been identified. If present, it is possible that there is insufficient contrast between the ditch fill and the surrounding soils for the feature to manifest as a magnetic anomaly. In this instance, the only identifiable signature of the former boundary may be the ferrous ‘spikes’ caused by ferrous debris within the backfilled ditch. Alternatively, the former boundaries may have been hedgerows, in which case the ferrous spikes may result from debris gathered or cleared to the edges of the fields. Within the north-west of Field 1 an east/west aligned linear anomaly, **Q**, has been identified. The anomaly corresponds closely to a former field boundary depicted on the first edition OS map (1874). Within the east of Field 1 a clear negative linear anomaly, **R**, can be seen on a north/south alignment. The anomaly doesn’t correspond to any former field boundaries, but is broadly aligned on the same orientation as the extant boundaries to the north and south. Therefore, this anomaly has been assigned an agricultural interpretation, perhaps being caused by a former boundary or field drain. Faint linear trends, **S** and **T**, within the east of the PDA are very low in magnitude and are unlikely to be of any archaeological interest.

Geological Anomalies

Throughout the survey area discrete anomalies, characterised as localised areas of enhanced magnetic response, have been identified. These anomalies are interpreted as geological in origin, being caused by variation in the composition of the soils from which they derive. Generally, the anomalies increase in size and frequency within Field 1 towards the highest part of the site. It is possible that these anomalies are due to localised near-surface variations in the sandstone bedrock, which is detected as a result of reduced topsoil depth.

Archaeological? Anomalies

No anomalies of definite archaeological potential have been identified by the survey and none have been identified at the location of rectilinear cropmark enclosure recorded within the Hampshire HER (see Fig. 2). If present, it is possible that the contrast between the soil-fill of the cut features and the prevailing sandy soils is insufficient for the enclosure to be detected with clarity by the magnetometer. However, this seems unlikely since anomalies suggestive of ditches have been detected within the site further north. A sinuous anomaly, **U**, can be seen on a north/south alignment within Field 1. The anomaly runs from the north of the PDA for 145m before appearing to return north-westwards. Interpretation of the data is hampered by magnetic interference from two sub-surface pipes, **A** and **B**, and from a general increase in magnetic background response, but it is possible that the anomaly locates an ditch forming an irregularly-shaped enclosure. On the interior of the possible enclosure three linear anomalies, **V**, **W** and **X** may also locate ditches, perhaps forming internal divisions. Interpretation is tentative however and it is possible that the anomalies locate localised variations in the sandstone bedrock, perhaps soil-filled cracks or channels.

Isolated linear and rectilinear anomalies, **Y** and **Z**, have been identified within Field 2. An archaeological origin cannot be dismissed for either of these anomalies although no clear archaeological pattern is visible. A geological cause is equally plausible.

5 Conclusions

The geophysical survey has identified anomalies in the main suggestive of an agricultural landscape as depicted on historical mapping. Demolition material from a former barn and anomalies locating three former field boundaries have been mapped. No anomalies of archaeological potential have been identified in the vicinity of the potential late prehistoric or Roman settlement enclosure within the south-east of the site. However, anomalies suggestive of ditches, possibly forming an irregularly-shaped enclosure have been identified towards the top of the hill at the north of the PDA.

Therefore, on the basis of the geophysical survey, the PDA is assessed as having a low archaeological potential with a moderate to high potential in the north of the PDA.

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.

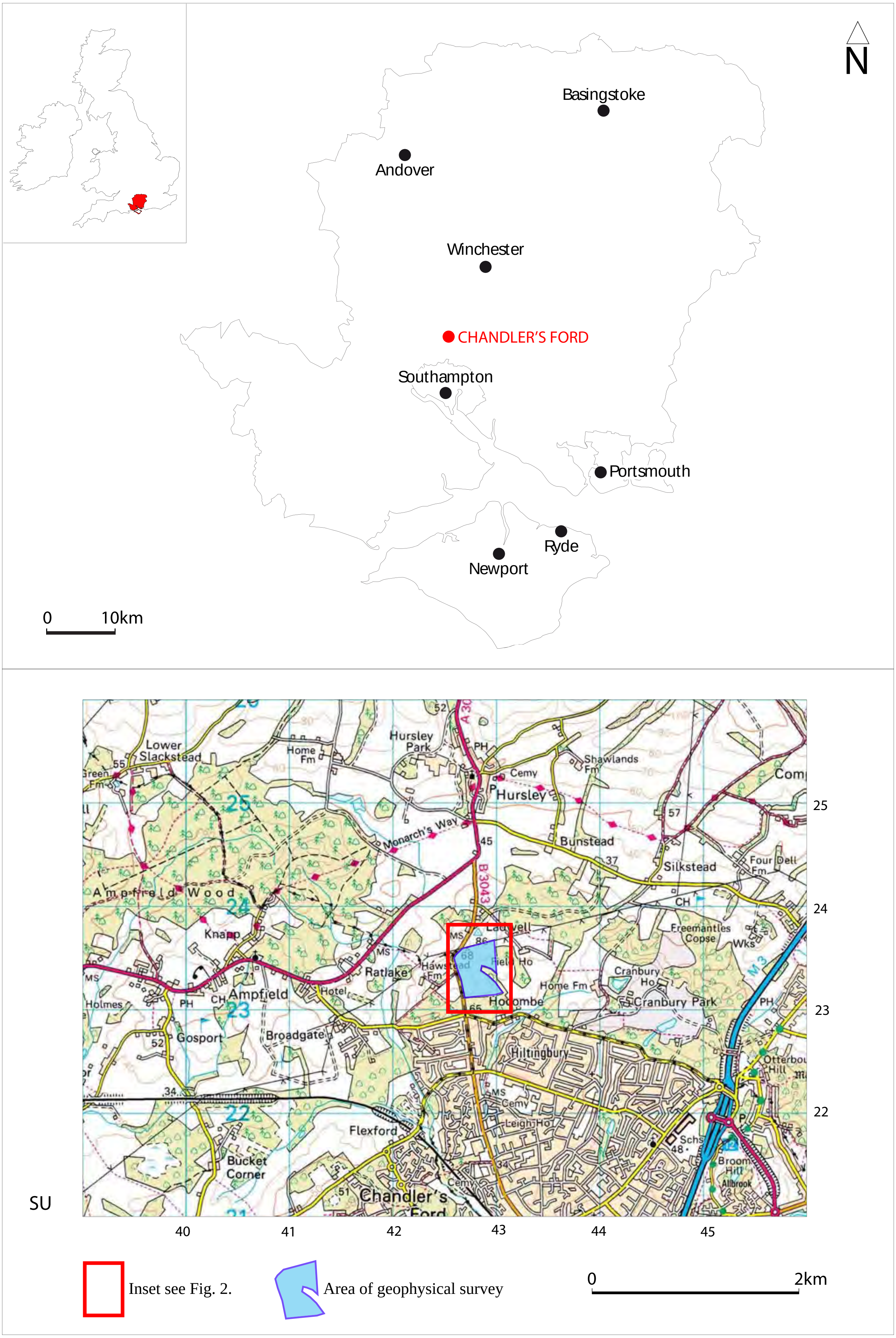

Fig. 1. Site location

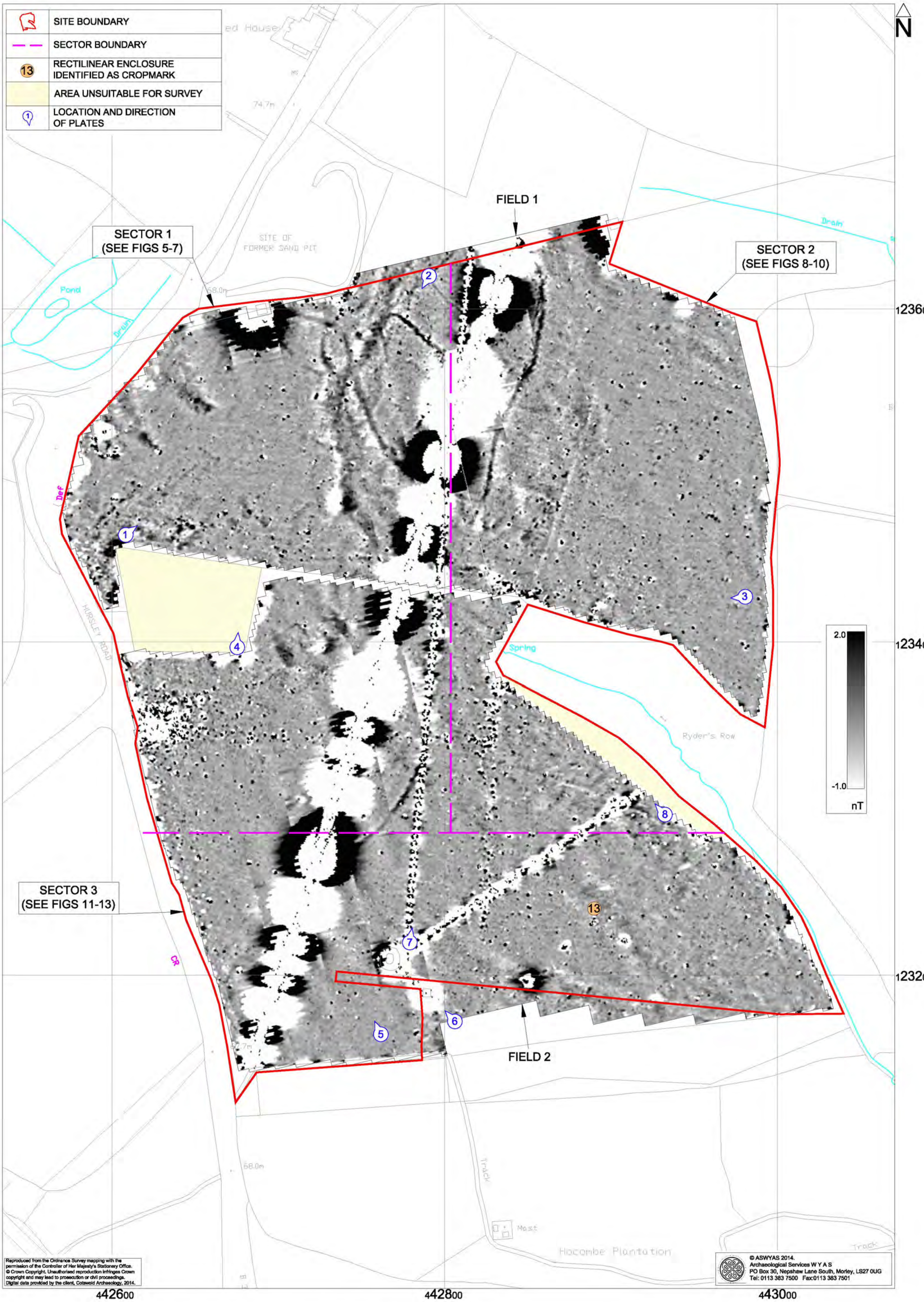

Fig. 2. Survey location showing greyscale magnetometer data (1:2000 @ A3)

0 100m

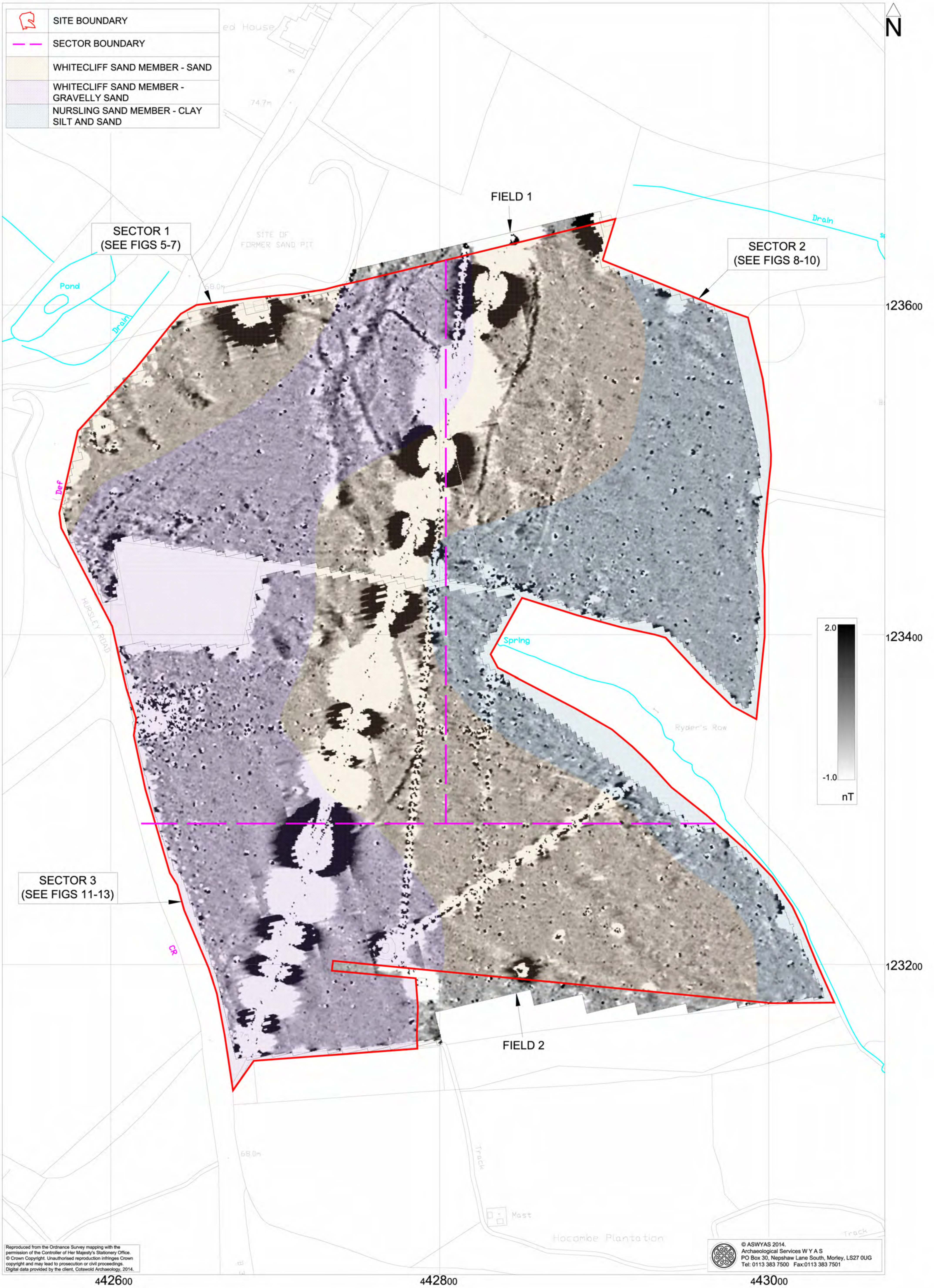

Fig. 3. Processed greyscale magnetometer data showing geology detail (1:2000 @ A3)

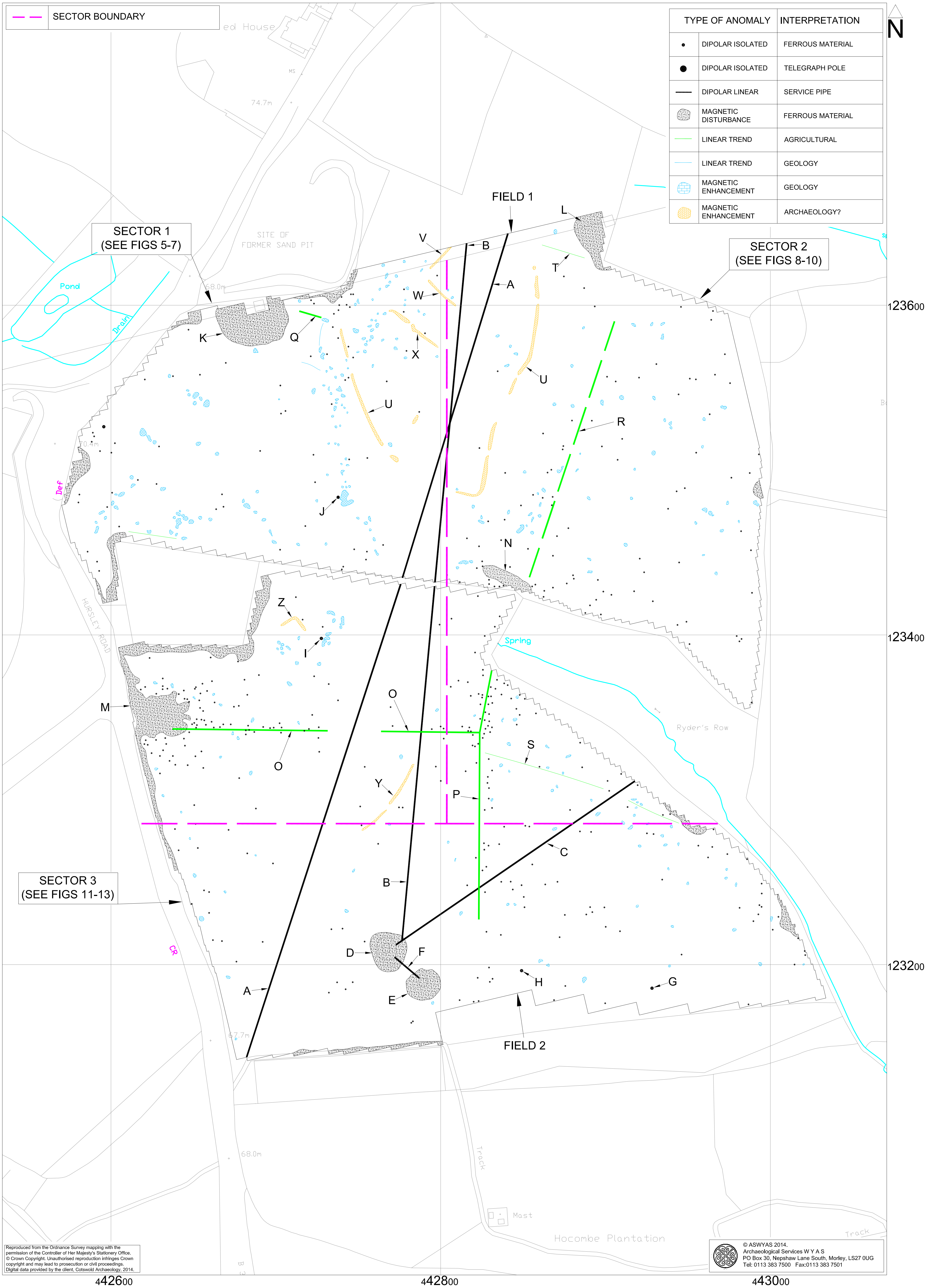

Fig. 4. Overall interpretation of magnetometer data (1:2000 @ A3)

0 100m

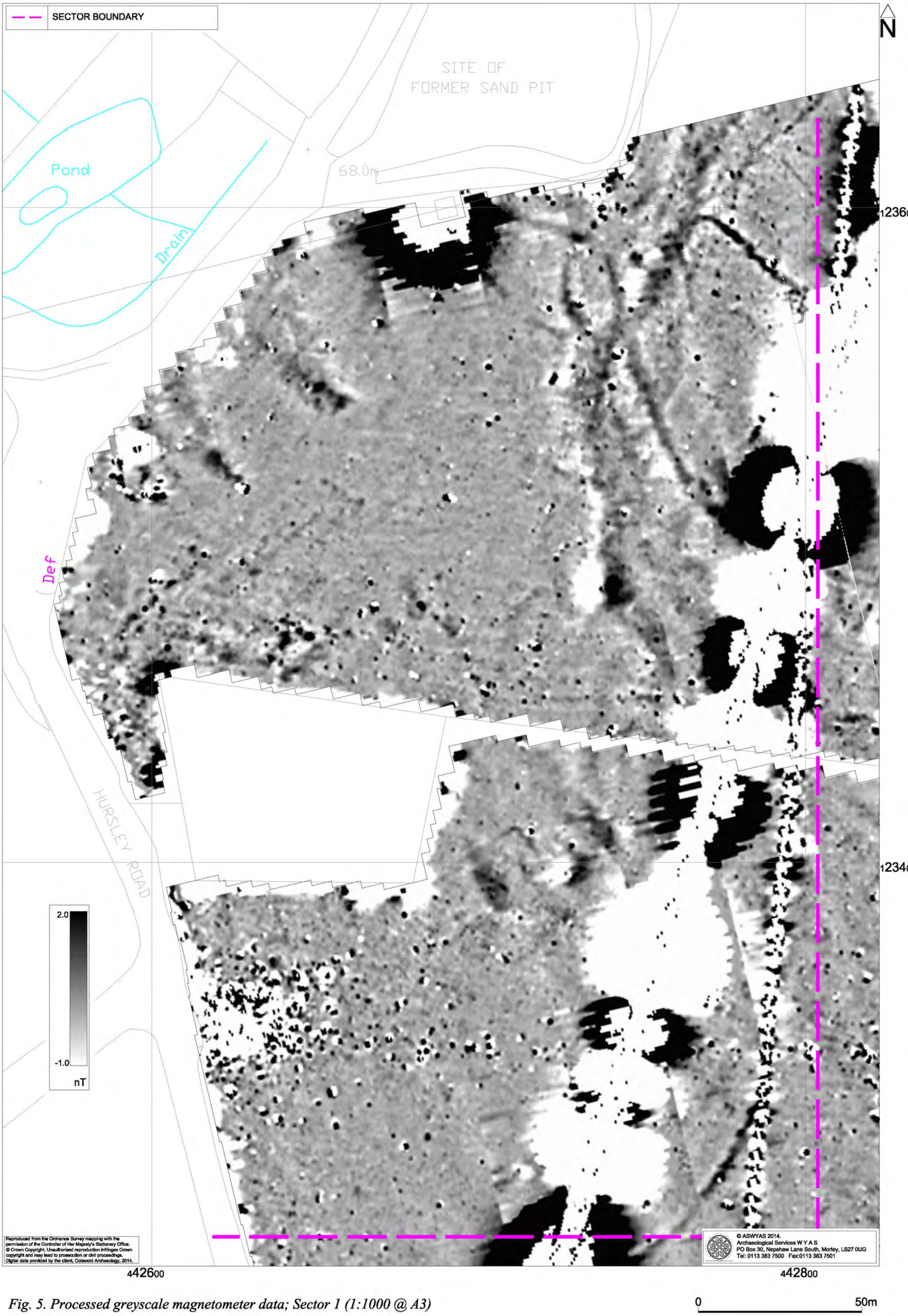

Fig. 5. Processed greyscale magnetometer data; Sector 1 (1:1000 @ A3)

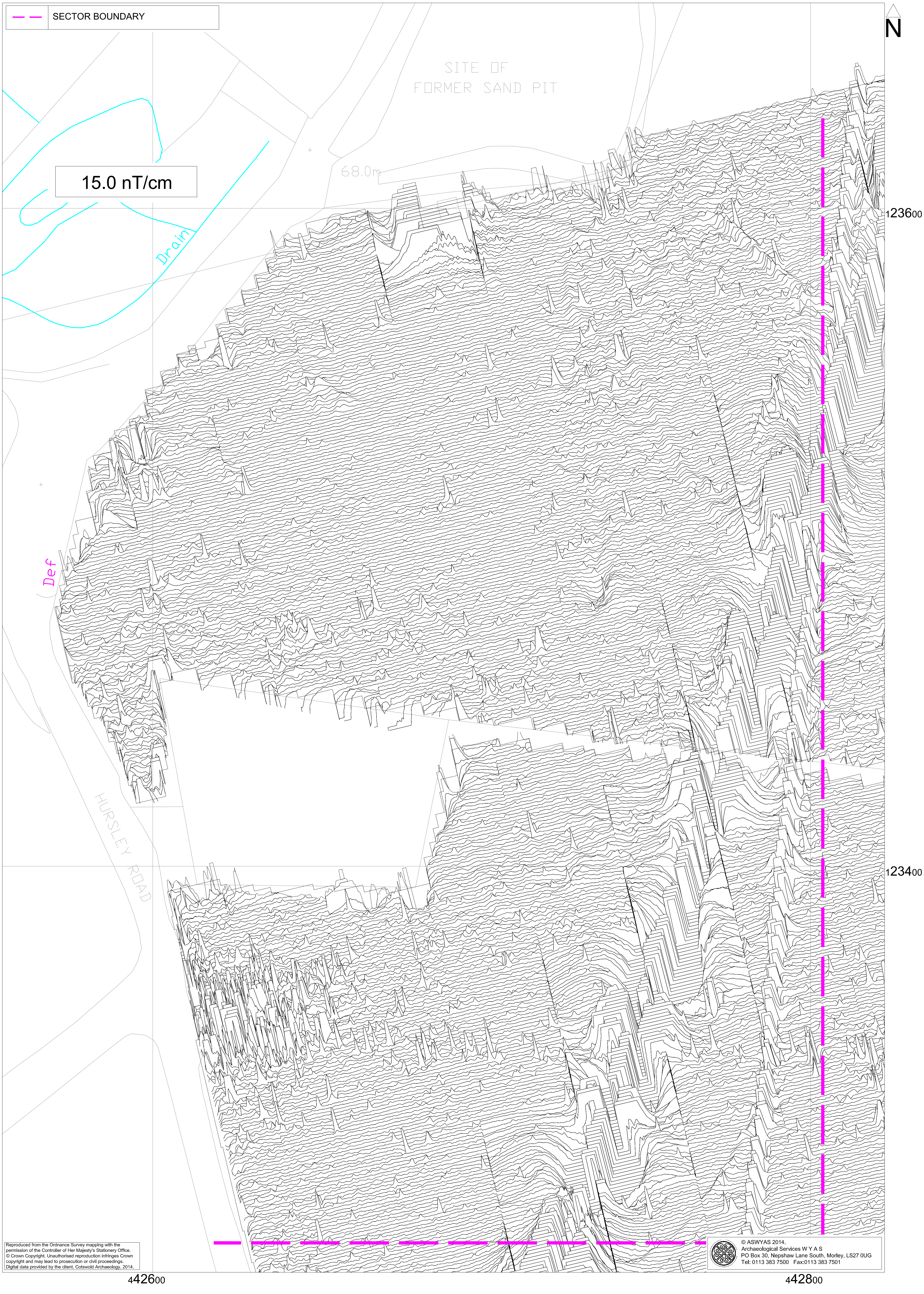

Fig. 6. XY trace plot of minimally processed magnetometer data; Sector 1 (1:1000 @ A3)

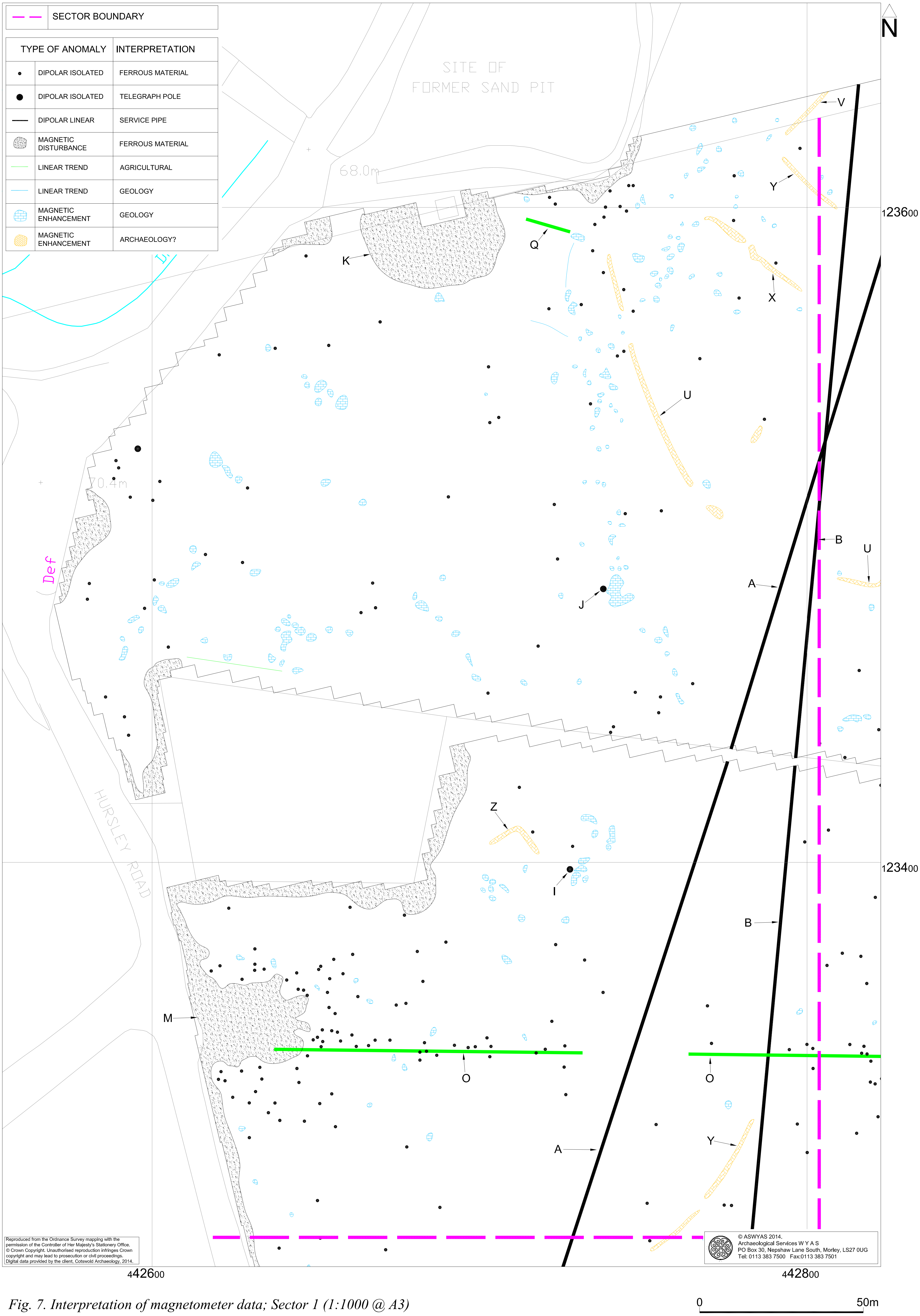

Fig. 7. Interpretation of magnetometer data; Sector 1 (1:1000 @ A3)

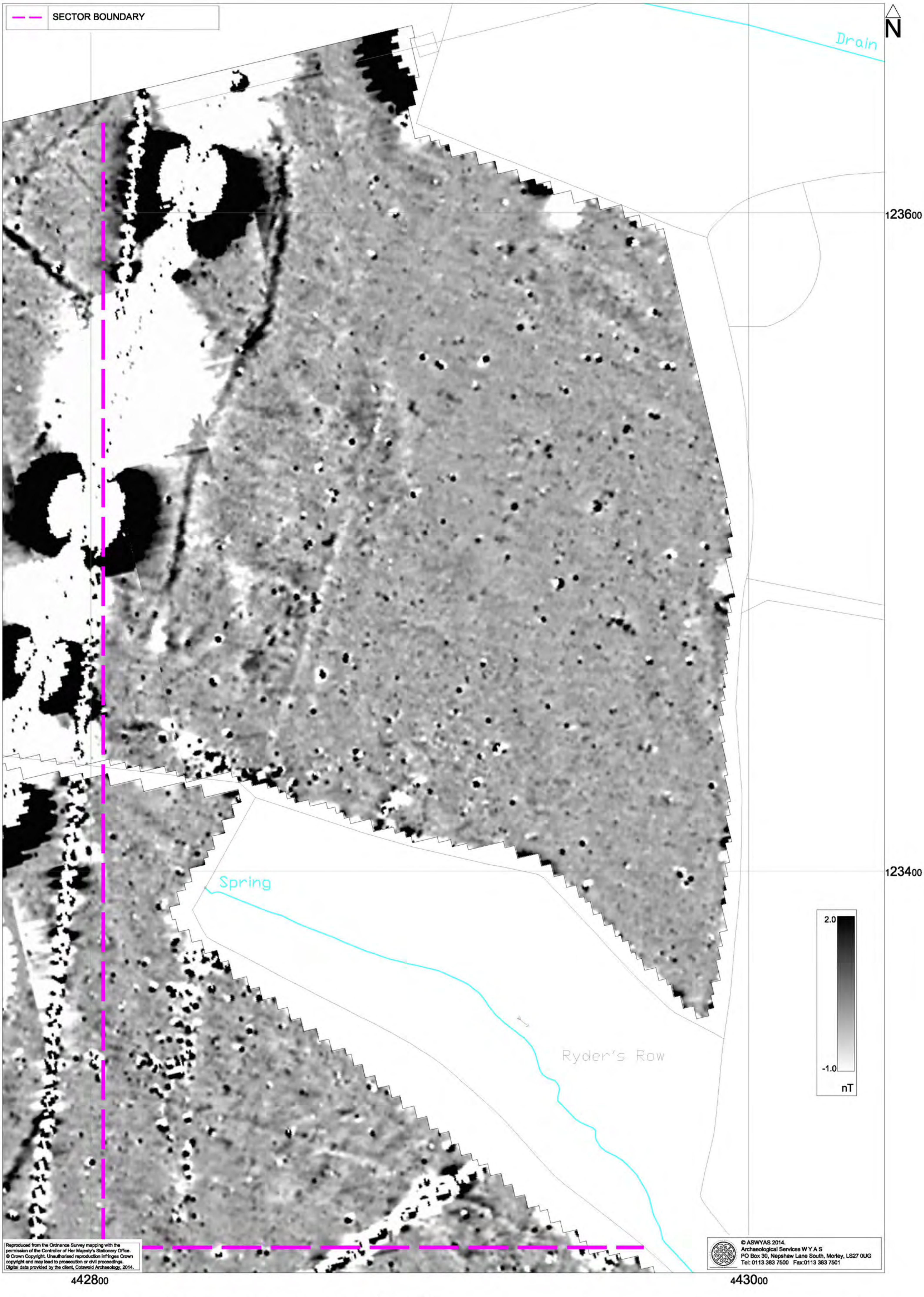

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Fig. 8. Processed greyscale magnetometer data; Sector 2 (1:1000 @ A3)

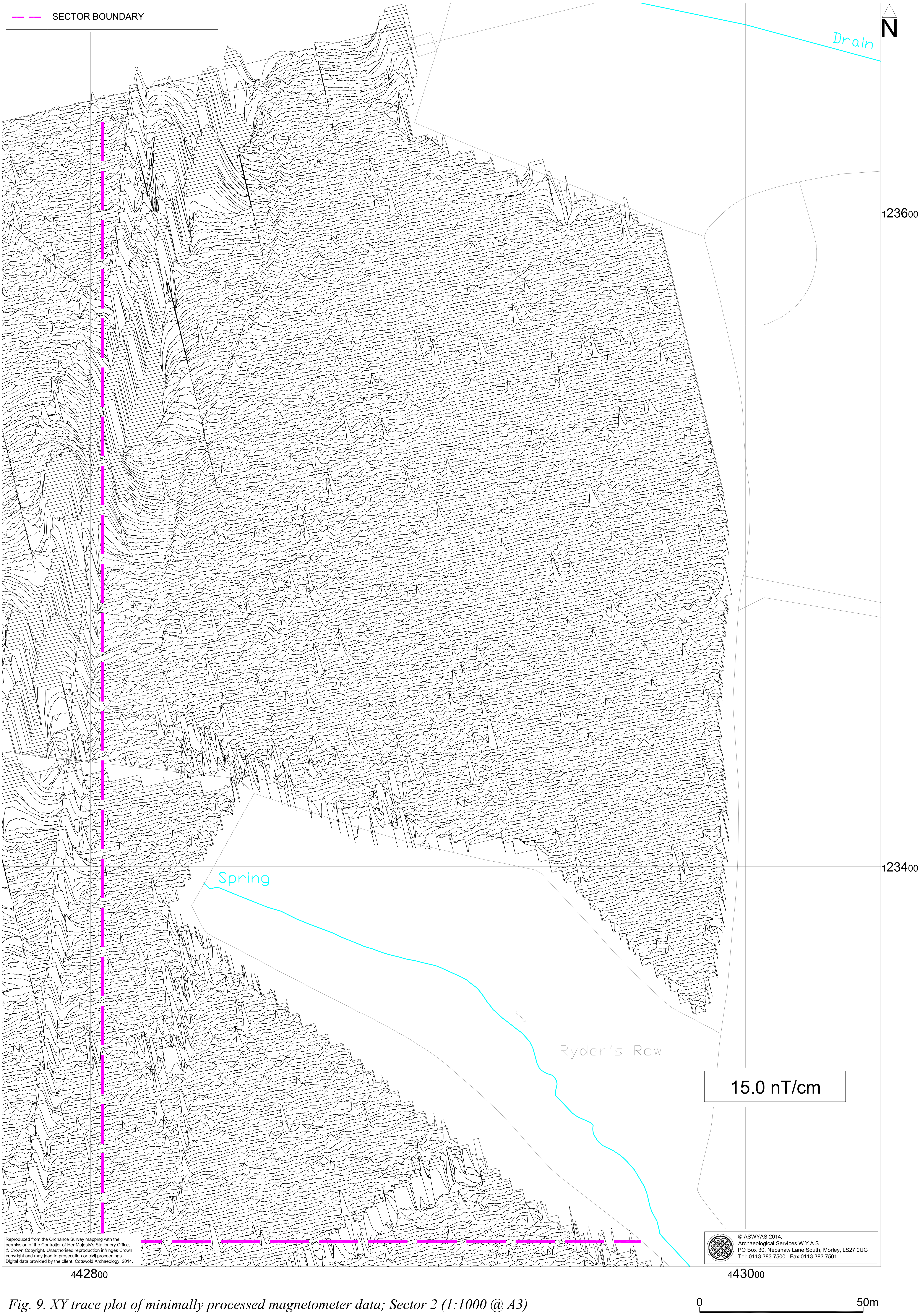

Fig. 9. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1000 @ A3)

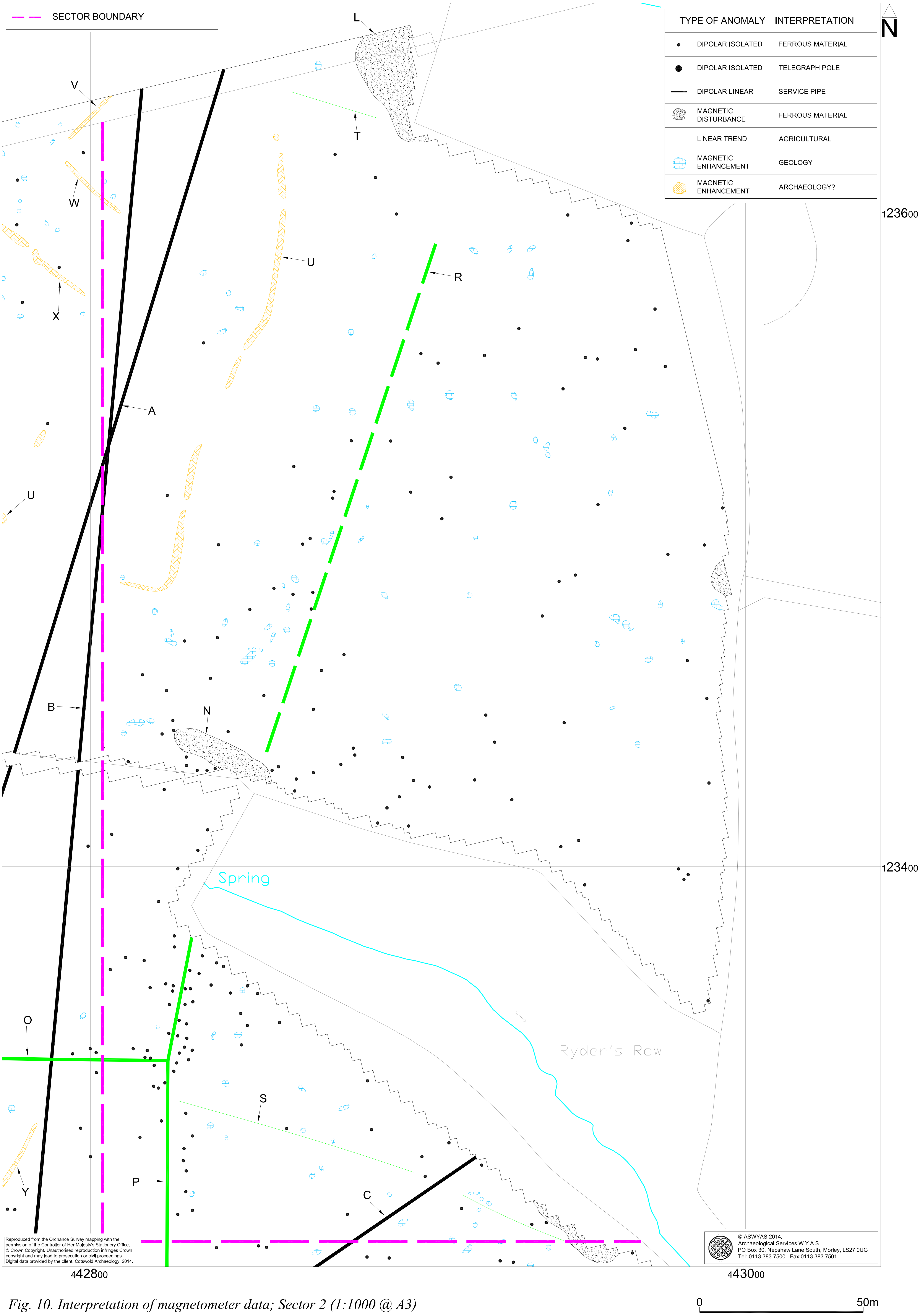

Fig. 10. Interpretation of magnetometer data; Sector 2 (1:1000 @ A3)

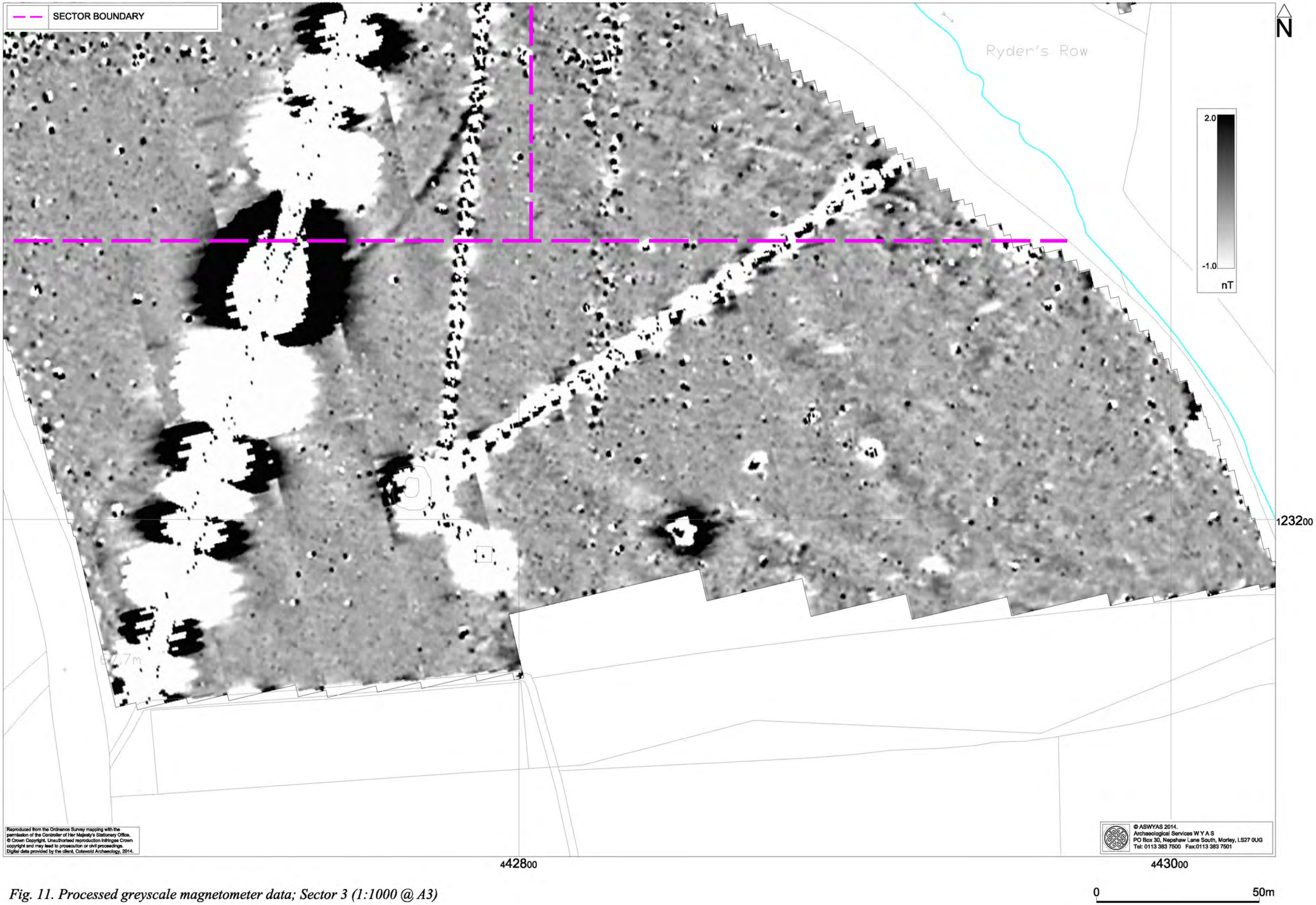

Fig. 11. Processed greyscale magnetometer data; Sector 3 (1:1000 @ A3)

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

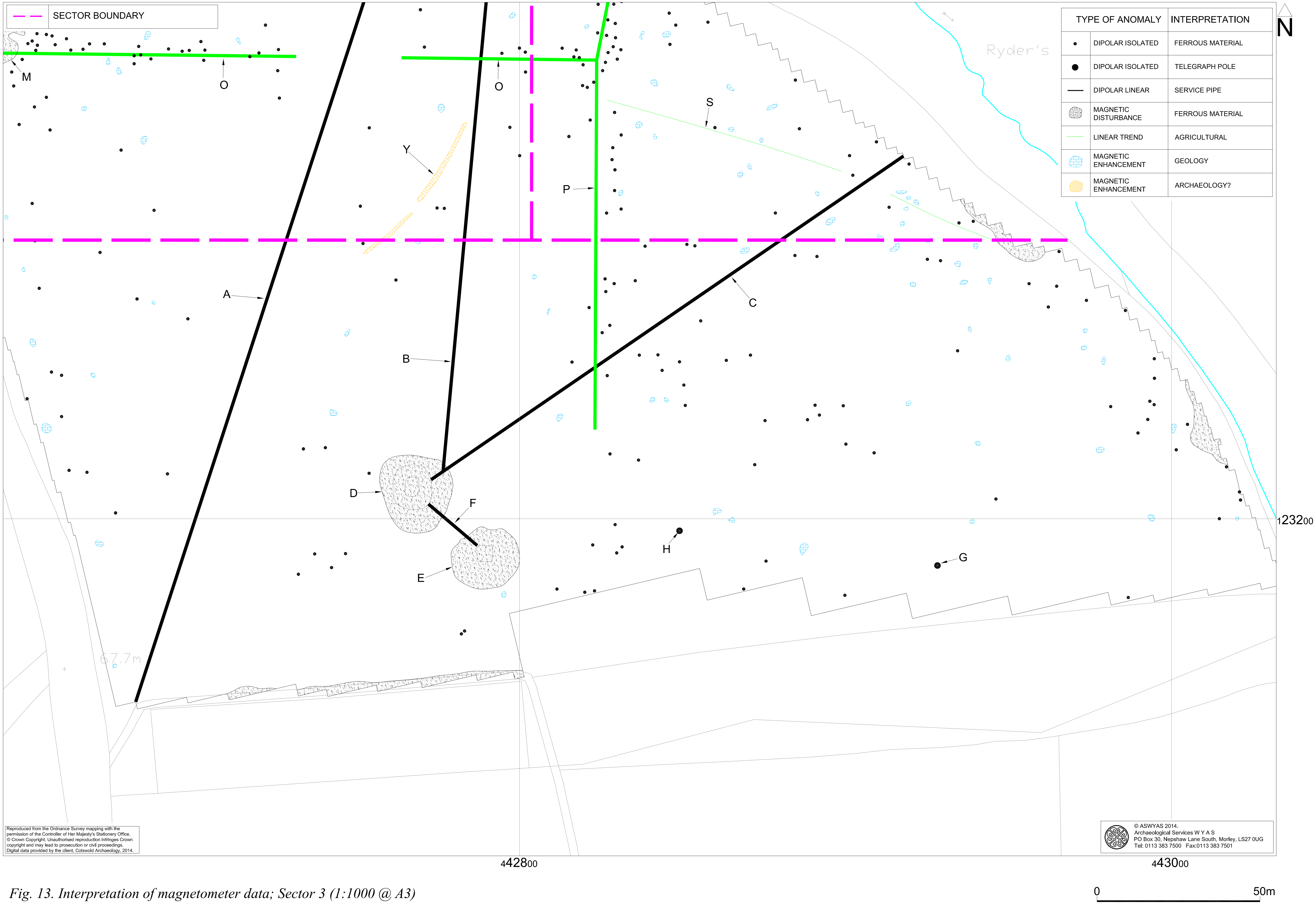

Fig. 13. Interpretation of magnetometer data; Sector 3 (1:1000 @ A3)


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


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


Plate 3. General view of Field 1, looking west


Plate 4. View of area unsuitable for survey in the north-west corner of Field 2, looking north

Plate 5. General view of Field 2, looking north

Plate 6. View of reservoir and wind pump within Field 2, looking north-west

Plate 7. General view of Field 2, looking north-east

Plate 8. View of area unsuitable for survey in the west of Field 2, looking north-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; 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 Winchester Historic Environment Record).

Bibliography

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