Archaeological Services WYAS

Land north of the A140 Norwich Road
Aylsham
Norfolk

Geophysical Survey

Report no. 2405

November 2012

Client: NPS Archaeology

Registered Organisation IfA

Land north of the A140 Norwich Road
Aylsham
Norfolk

Geophysical Survey

Summary

A geophysical (magnetometer) survey, covering approximately 12 hectares, was carried out on the southern edge of Aylsham in advance of the proposed development of the site for housing. Several linear anomalies, interpreted as boundary ditches possibly indicative of three phases of land division, have been identified in the northern half of the site. The most recent boundaries, which are shown on first edition Ordnance Survey mapping, were extant in the 1880s and have only been removed in the last 50 years. A second phase of boundaries (not shown on any historic mapping), which respect the later boundaries and are on the same alignment, are also thought to be post-medieval, and were probably created when nearby Diggens Farm was established in the late 17th century. Weak, discontinuous, linear anomalies on a completely different alignment hint at a much earlier system of land division. These anomalies have been interpreted as of possible archaeological potential. Elsewhere, a square 'enclosure' to the south-west corner of the site is thought to locate a compound used during the construction of the Aylsham Bypass. On the basis of the survey the archaeological potential of the site is considered to be low to moderate.

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Report Information

Client:	NPS Archaeology
Address:	Scandic House, 85 Mountergate, Norwich, NR1 1PY
Report Type:	Geophysical survey
Location:	Land north of the A140 Norwich Road, Aylsham
County:	Norfolk
Grid Reference:	TG 198 260
Period(s) of activity: represented	post-medieval?
Report Number:	2405
Project Number:	3987
Site Code:	AYL12
OASIS ID:	archaeol11- 137128
Planning Application No.:	Pre-application
Museum Accession No.:	n/a
Date of fieldwork:	October 2012
Date of report:	November 2012
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Fieldwork:	Louise Felding BA Mag. Art David Harrison BA MA MIfA Orland Prestidge BA MA PIfA
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Authorisation for distribution: --

ISOQAR QUALITY ASSURED ISO 9001 Cert. No. 125

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REGISTERED IfA ORGANISATION

Contents

List of Figures

List of Plates

1 Introduction

Archaeological Services WYAS was commissioned by David Whitmore of NPS Archaeology, on behalf of their clients Norfolk Homes Limited, to undertake a geophysical (magnetometer) survey on the south-eastern edge of Aylsham (see Fig. 1), in advance of the submission of a planning application for the proposed development of the site for housing. The scheme of work was undertaken in accordance with the guidance contained in the National Planning Policy Framework (NPPF) and was carried out between October 22nd and October 24th 2012.

Site location, topography and land-use

The proposed development area (PDA) is centred at TG 198 260 to the south of the historic centre of Aylsham and is currently agricultural land (see Plate 1). The site is bounded by the A140 bypass to the south, the B1145 to the west, housing fronting onto Copemen Road to the north and Buxton Road and Diggens Farm to the east (see Fig. 2) and covered an area of approximately 12 hectares. The site is flat and is situated at approximately 35m above Ordnance Datum.

Geology and soils

The underlying bedrock geology comprises Wroxham Crag Formation overlain by superficial geology varying between Glaciofluvial deposits, comprising sand and gravels, to the west of the site and Brickearth (clay, silt and sands) to the east. (British Geological Survey 2012). The soils are classified in the Wick 2 association being described as deep, well-drained coarse loams, often stoneless (Soil Survey of England and Wales 1980).

2 Archaeological background

An archaeological desk-based assessment of the site (Sillwood 2012) reported that only a single entry in the Norfolk Historic Environment Record was recorded within the PDA. This pertained to a multi-period assemblage of finds recovered during fieldwalking along the southern edge of the site prior to the construction of the road bypass (A140). It was also noted that Aylsham is a historic town although the medieval centre of the town lies to the north of the PDA. It was concluded that '*the overall impact of the scheme on buried archaeological remains (should they be present) would be slight*'.

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 proposed development.

In order to achieve these aims a detailed (recorded) magnetometer survey was carried out over the whole of the PDA, an area of approximately 12 hectares.

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 1:50000 Ordnance Survey map is shown in Figure 1. A large scale (1:5000) site location plan showing the greyscale magnetometer data is shown in Figure 2 with an overall interpretation of the data presented in Figure 3 at a scale of 1:2000 in Figure 3. The site has been split into three sectors (see Fig. 2) and the data presented in greyscale, XY trace plot and interpretation formats in Figures 4 to 12 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. Trace plots of the ‘raw’ data and data repeatability plots are included in Appendix 3 and Appendix 4. Appendix 5 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

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/modern activity

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.

On this site there is an increase in density of these 'spike' anomalies towards the southern edge of the site (see Fig. 3). This is almost certainly due to residual ferrous debris, left over from the construction of the bypass, being incorporated into the topsoil after the completion of the road building programme. A cluster of particularly strongly magnetic responses, **A**, is noted in the south-eastern corner of the site. These anomalies are also interpreted as due to residual material left over from the road building.

In the south-western corner of the site numerous discrete anomalies, characterised as distinct areas of magnetic enhancement, contained within an area defined by rectilinear anomalies, **B**, is clearly visible. In another context an archaeological origin for these anomalies might be put forward. However, this is supposedly the location of a site compound used during the construction of the bypass. Therefore, a modern cause is considered probable.

Larger areas of magnetic disturbance are identified around the periphery of the site. Along the northern and eastern site boundaries this disturbance is due to the proximity of buildings.

A number of very large, high magnitude, 'spikes' located along the 19th century field boundaries (removed post-1960) are due to a series of drain covers along the line of a deeply buried water or sewerage pipe - the pipe has not been identified by the survey.

Geological anomalies

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

Agricultural anomalies

Numerous parallel linear trend anomalies, aligned broadly east/west at right angles to the western boundary of the site, have been identified across the whole of the site. These trends in the data are caused by modern ploughing.

Three linear anomalies clearly correspond with former field boundaries that are recorded on the first edition Ordnance Survey mapping of the 1880s. Anomaly **C** extends east/west from the western edge of the site for 175m before it terminates at the intersection with a second former boundary, **D**. This former boundary is much less clearly defined and is visible as a vague, discontinuous, curvilinear line of enhanced responses aligned broadly north/south through the centre of the site. The third former boundary, **E**, extends east from **D** to the eastern site boundary.

On the same basic alignment as these former mapped boundaries are a series of linear and curvilinear anomalies in the north-eastern corner of the site which do not appear on the historic mapping. These anomalies are caused by infilled ditches and appear to form a series of smaller fields/enclosures.

Seemingly appended to the northern side of boundary **E** is a small field, **F1**, 80m by 60m, defined by double ditches, **F**, to the western and northern sides. A second field, **F2**, also defined by double ditches, **G**, to the western and northern sides is located to the immediate north of **F1**. To the north of **F2** the south-western corner of **F3** is just located within the corner of the survey area, again defined by a double ditch, **H**. At the northern apex of the site a much larger field, **F4**, is defined by the northern side of **F2** and the western side of **F3**. Extending west for 180m from the western side of **F2** is a single linear ditch, **J**, which turns through 90º before reaching the northern site boundary, forming a large field, **F5**. None of these fields/boundaries are shown on the historic mapping. However, it is considered likely, given the orientation of the fields, that they are associated with Diggens Farm, a 17th century farmhouse, which is located immediately to the east of the two small fields, **F1** and **F2**, and which were probably removed prior to the publication of the first edition mapping. However, a much earlier, archaeological, origin cannot be discounted.

Possible archaeological anomalies

A series of much weaker, discontinuous, linear anomalies on a completely different alignment to the post-medieval boundaries described above are also identified in the northern half of the site. Aligned south-west/north-east is discontinuous linear anomaly, **K**. At right angles to, and at either end of, **K** are two other linear anomalies **M** and **N** which together with linear anomaly **L** possibly describe another earlier field, **F6**. These anomalies are also thought to be caused by infilled ditches and have been interpreted as potentially archaeological.

A vague, discontinuous, sub-circular anomaly, **O**, has been noted in the south-western part of the site. This may also have an archaeological origin but this interpretation should be considered as speculative.

Two discrete anomalies, **P** and **Q**, are also interpreted as possibly archaeological. These anomalies may be large pit features. A modern cause id also considered plausible.

5 Conclusions

In the northern half of the site numerous linear anomalies interpreted as being due to infilled ditched field boundaries have been identified. Only three of these boundaries are shown on the first edition Ordnance Survey mapping remaining in the landscape until the late 20th century. A more extensive series of boundaries are also considered to be post-medieval in date due to the fact that they are on the same basic alignment as, and appear to respect, the boundaries mapped in the late 19th century, and are immediately adjacent to a late 17th century farmhouse. However, a third, possibly earlier, phase of boundary features, aligned at 45º to the later boundaries, hints at a much earlier sub-division of the landscape. These features are considered to have some archaeological potential. A sub-circular anomaly to the south-west of the site has also been tentatively interpreted as archaeological. However, this interpretation should be considered to be speculative.

Elsewhere in the data anomalies due to variation in the soils and superficial deposits and to modern activity associated with the construction of the bypass have been noted. On the basis of the survey the site is assessed as having a low to moderate archaeological potential.

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.

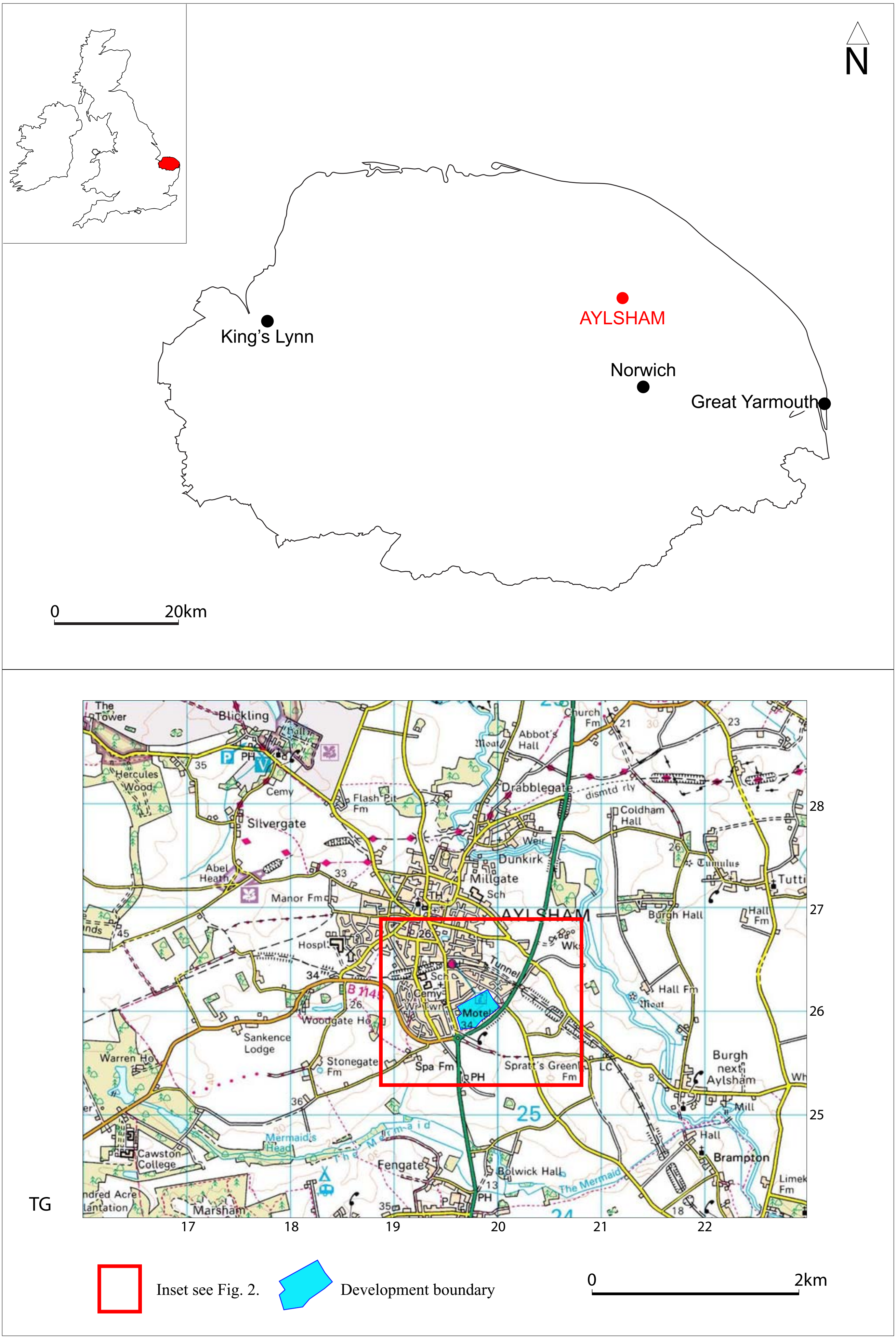


Fig. 1. Site location

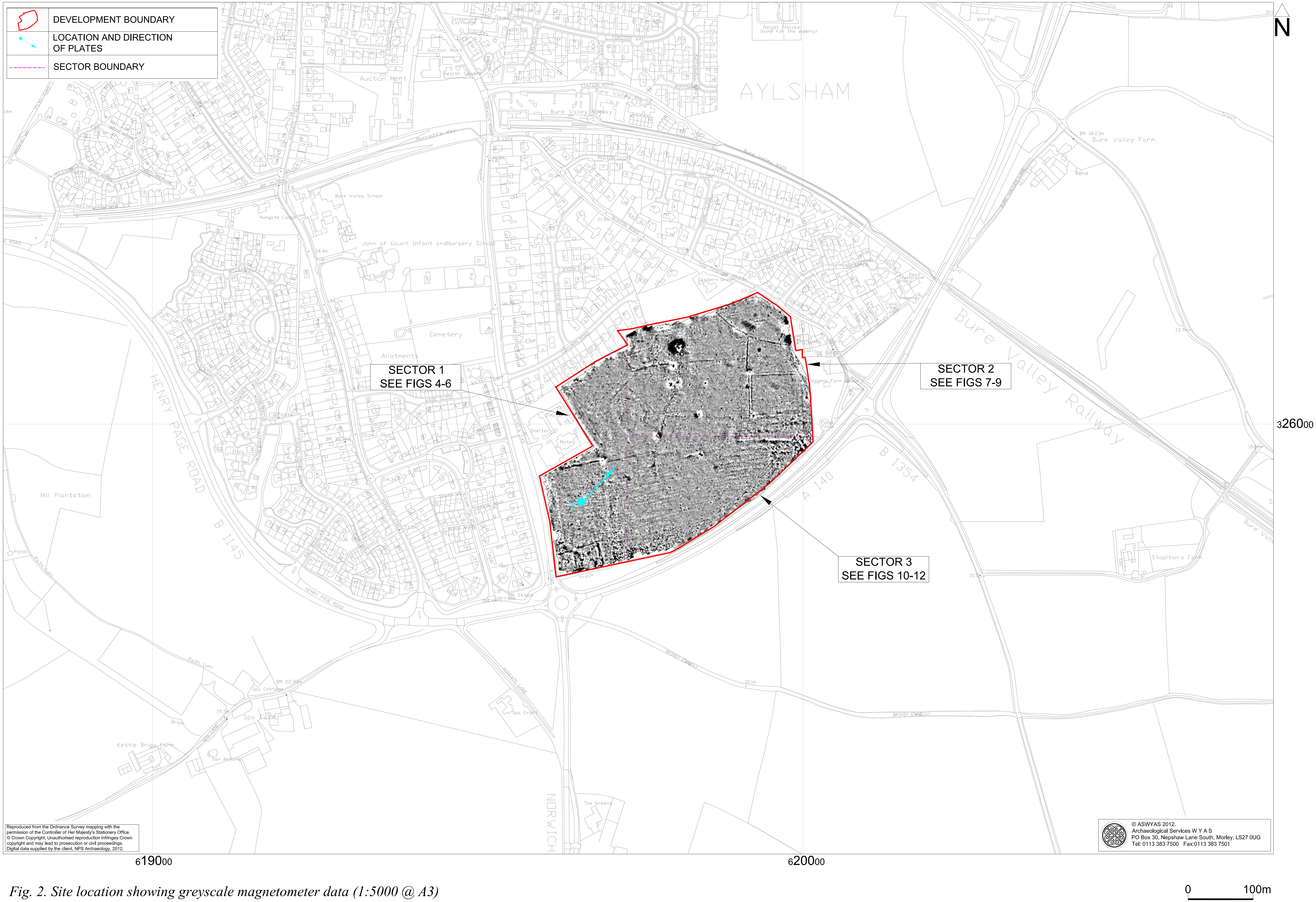


Fig. 2. Site location showing greyscale magnetometer data (1:5000 @ A3)

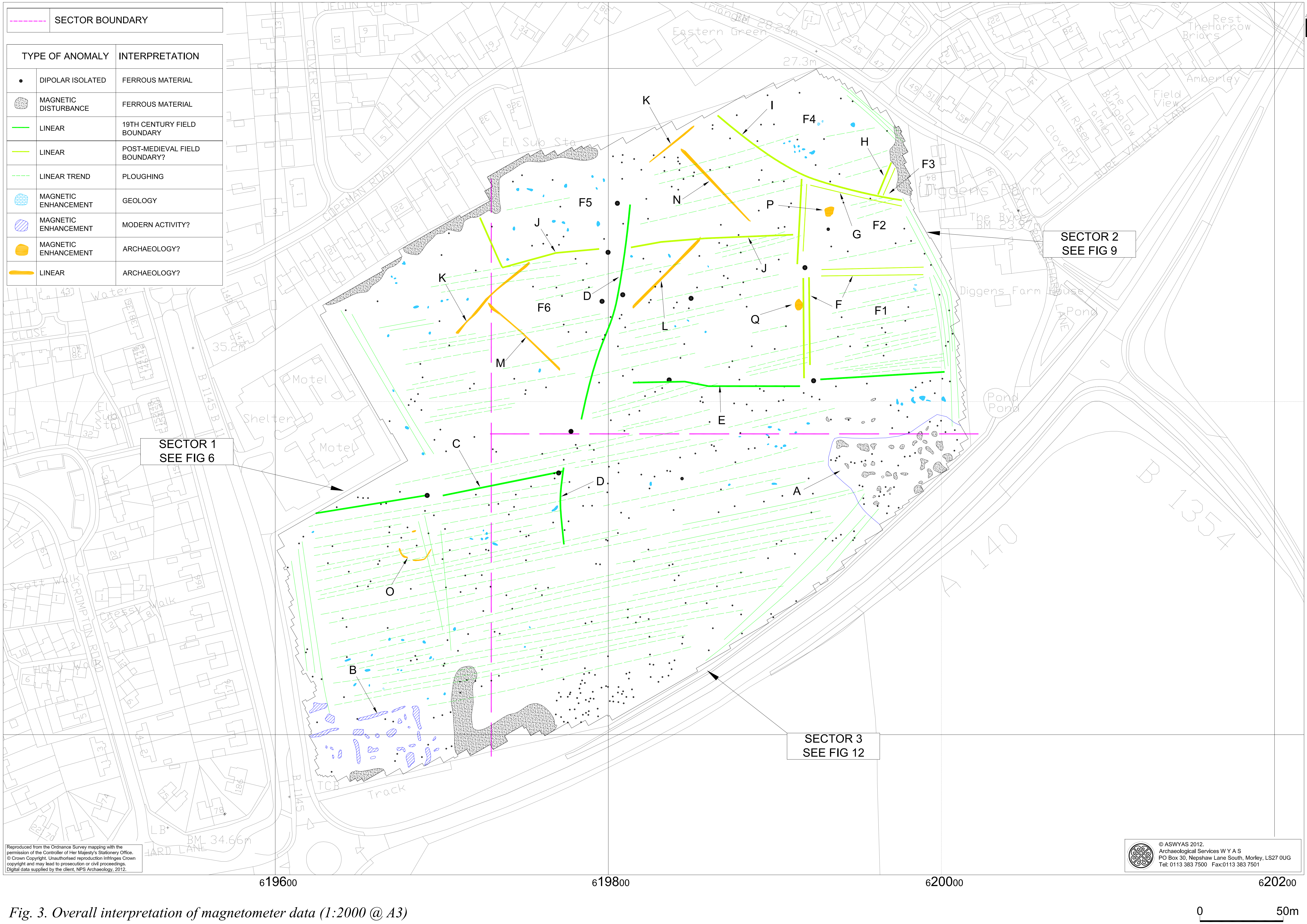


Fig. 3. Overall interpretation of magnetometer data (1:2000 @ A3)

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

0 20m

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

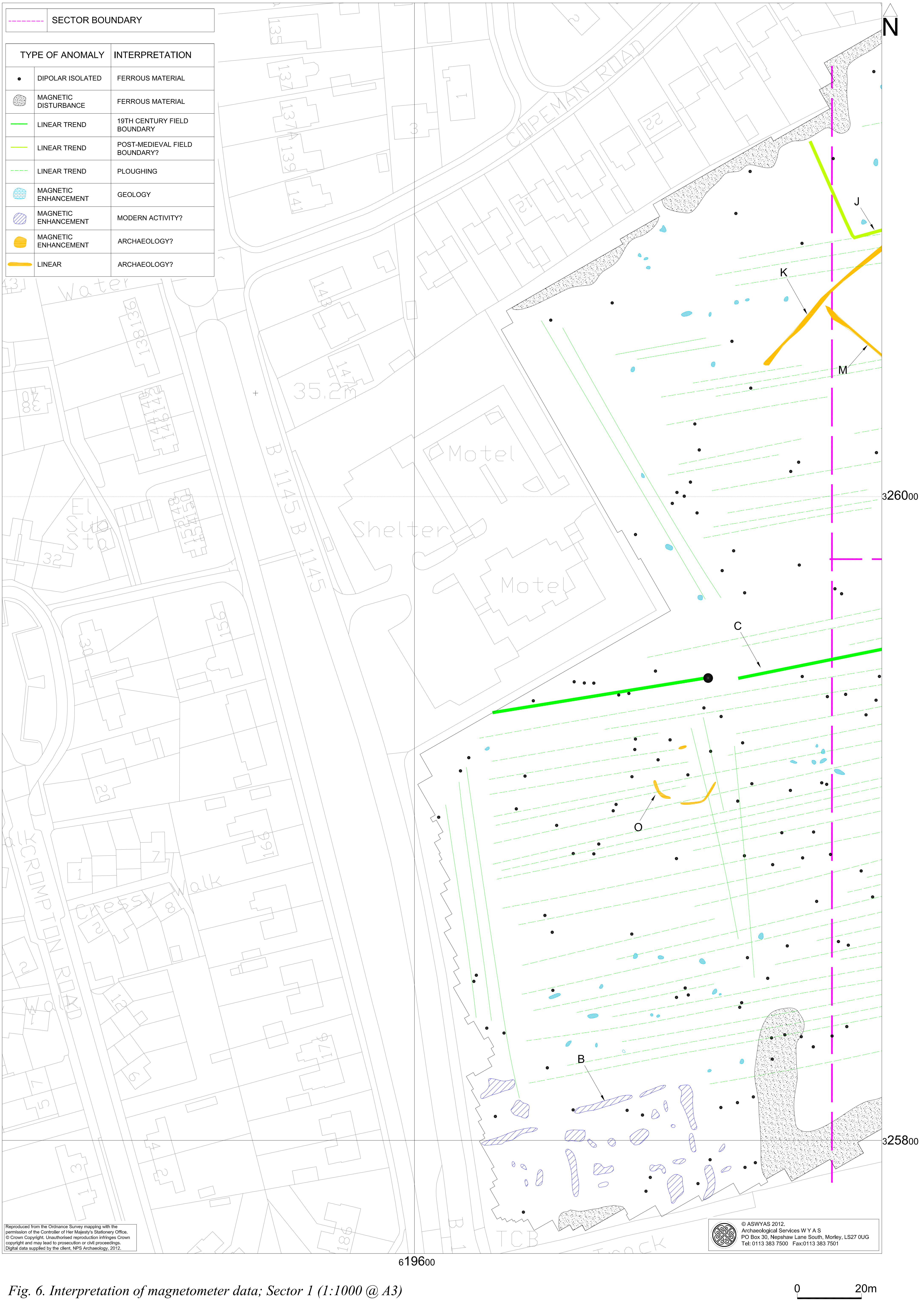


Fig. 6. Interpretation of magnetometer data; Sector 1 (1:1000 @ A3)

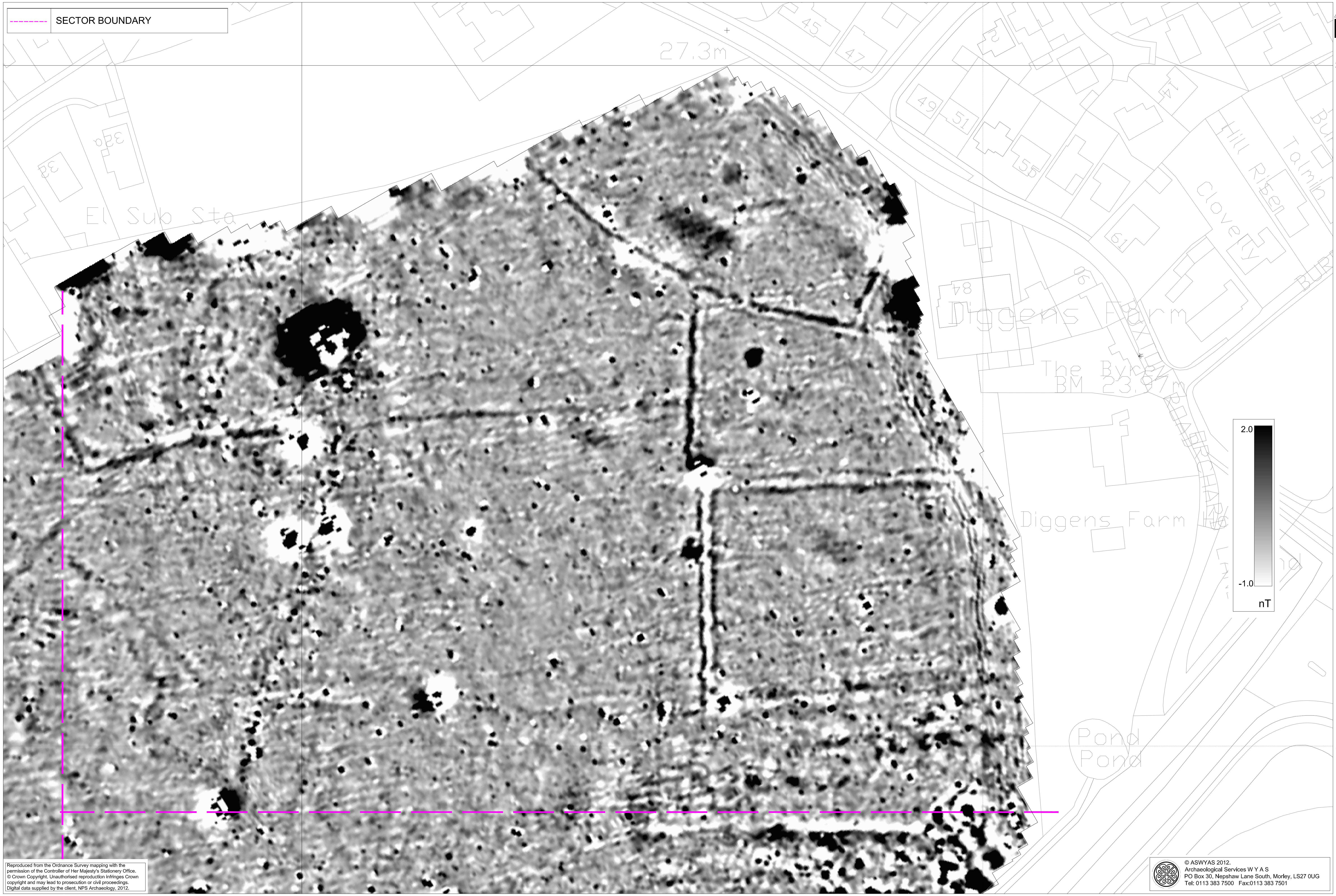


Fig. 7. Processed greyscale magnetometer data; Sector 2 (1:1000 @ A3)

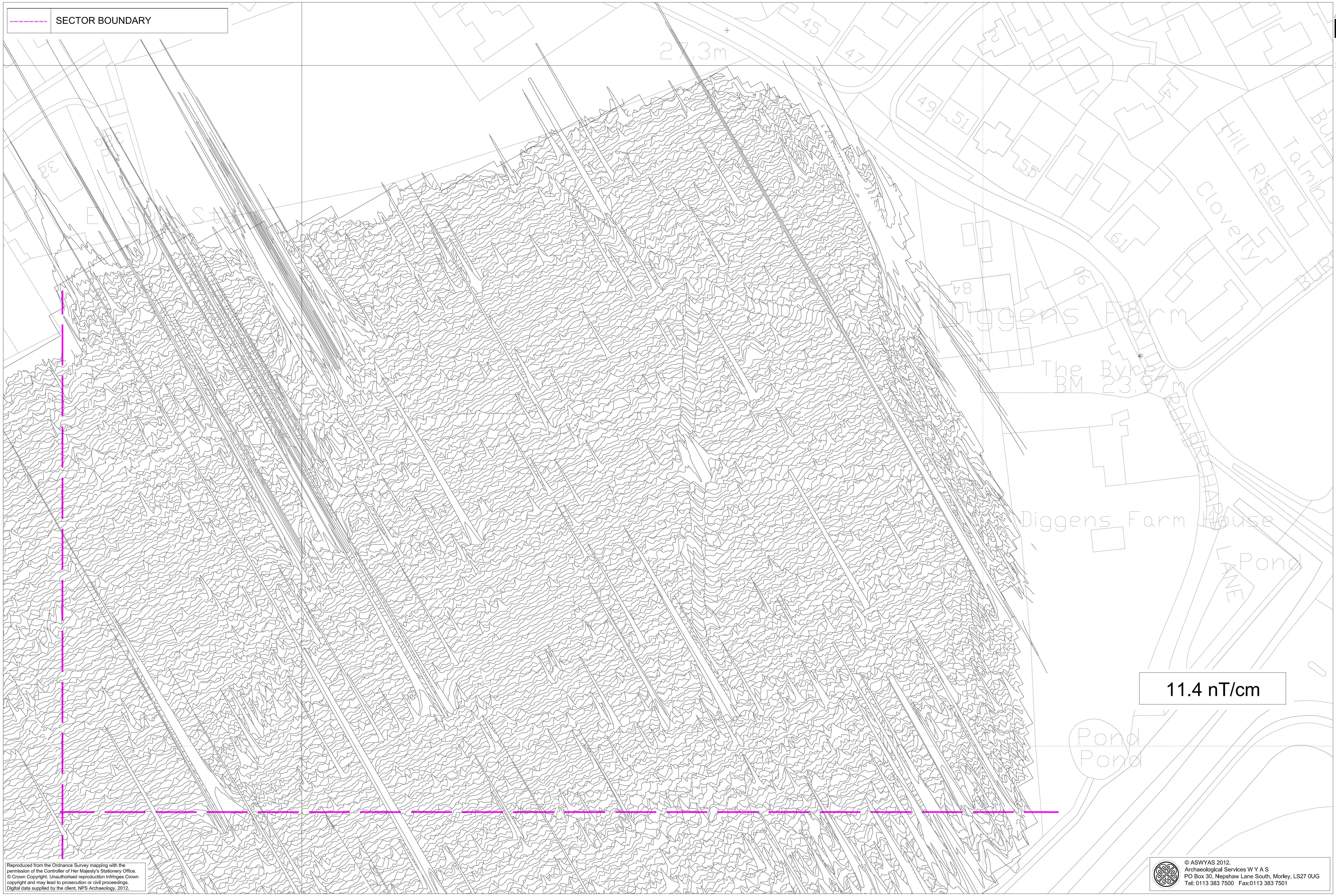


Fig. 8. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1000 @ A3)

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

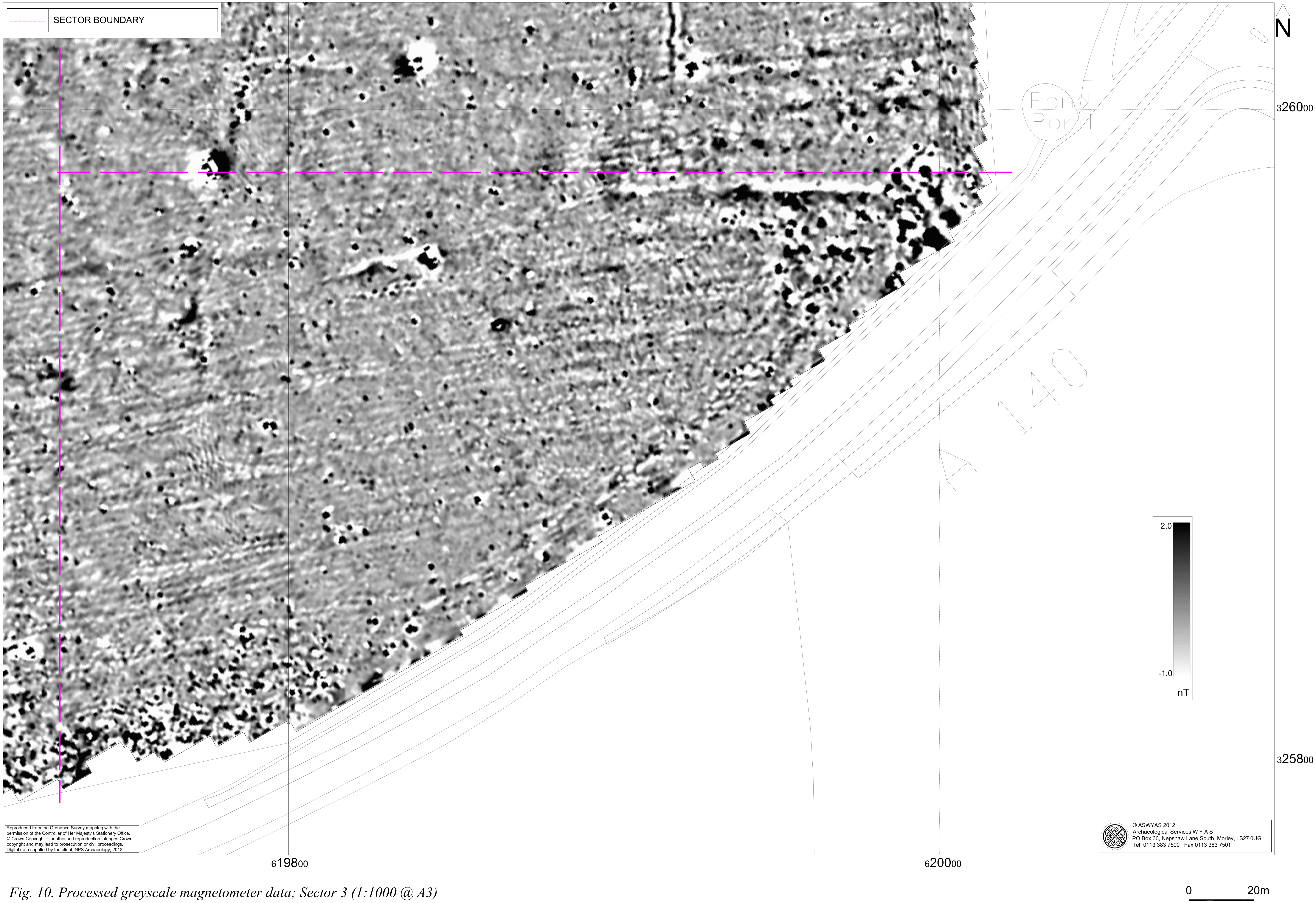


Fig. 10. Processed greyscale magnetometer data; Sector 3 (1:1000 @ A3)

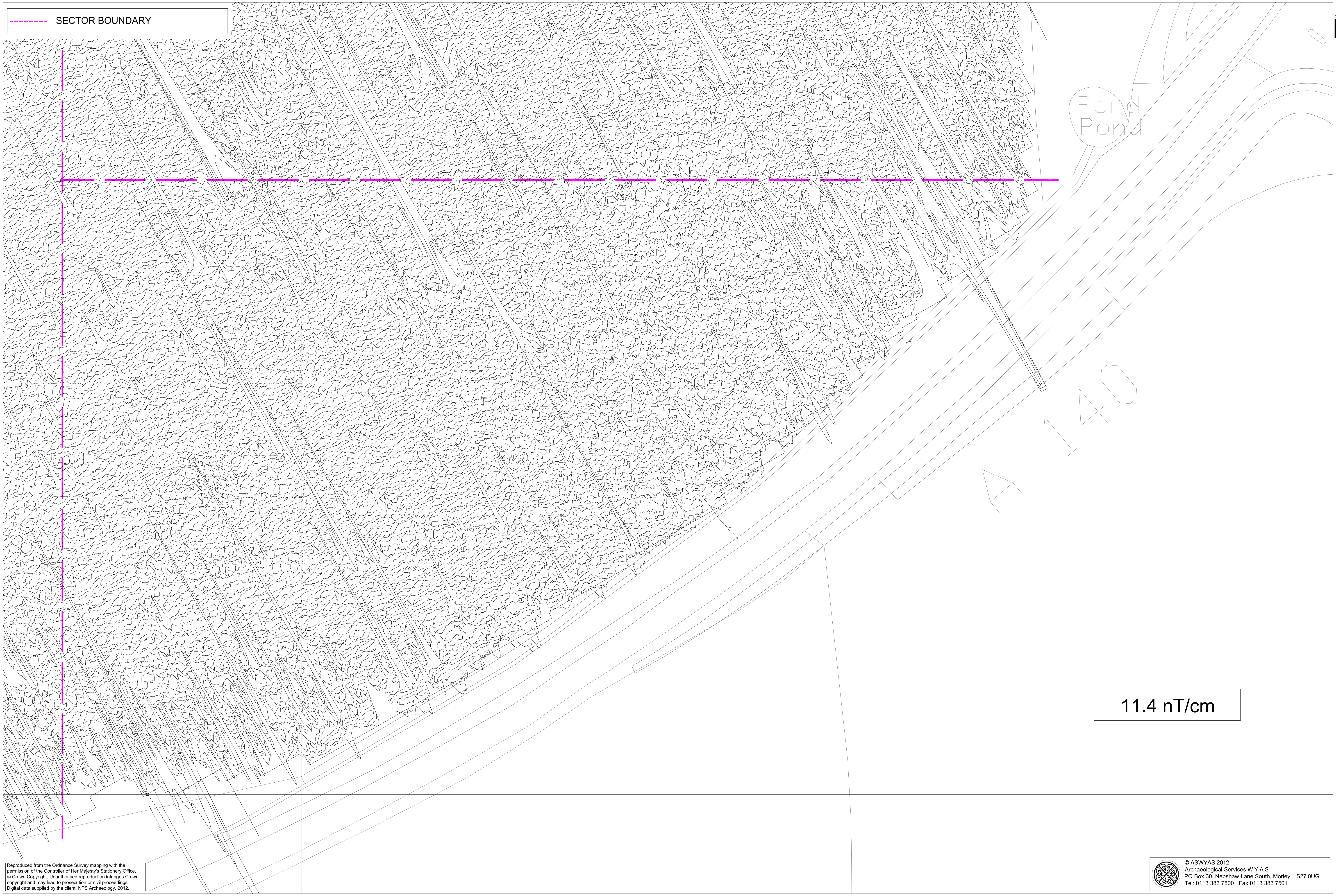


Fig. 11. XY trace plot of minimally processed magnetometer data; Sector 3 (1:1000 @ A3)

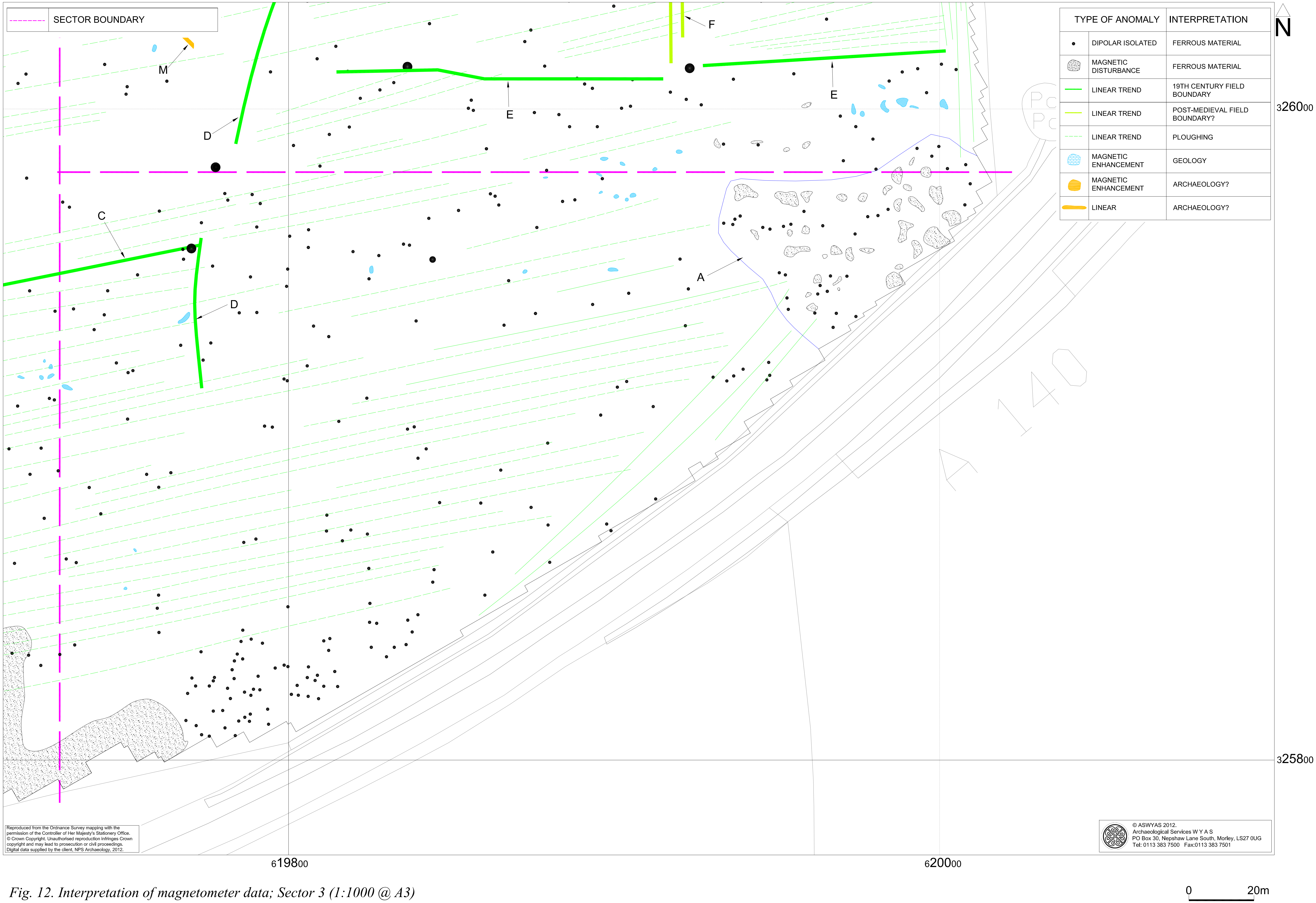


Fig. 12. Interpretation of magnetometer data; Sector 3 (1:1000 @ A3)

Plate 1. General view of survey area; looking north-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.

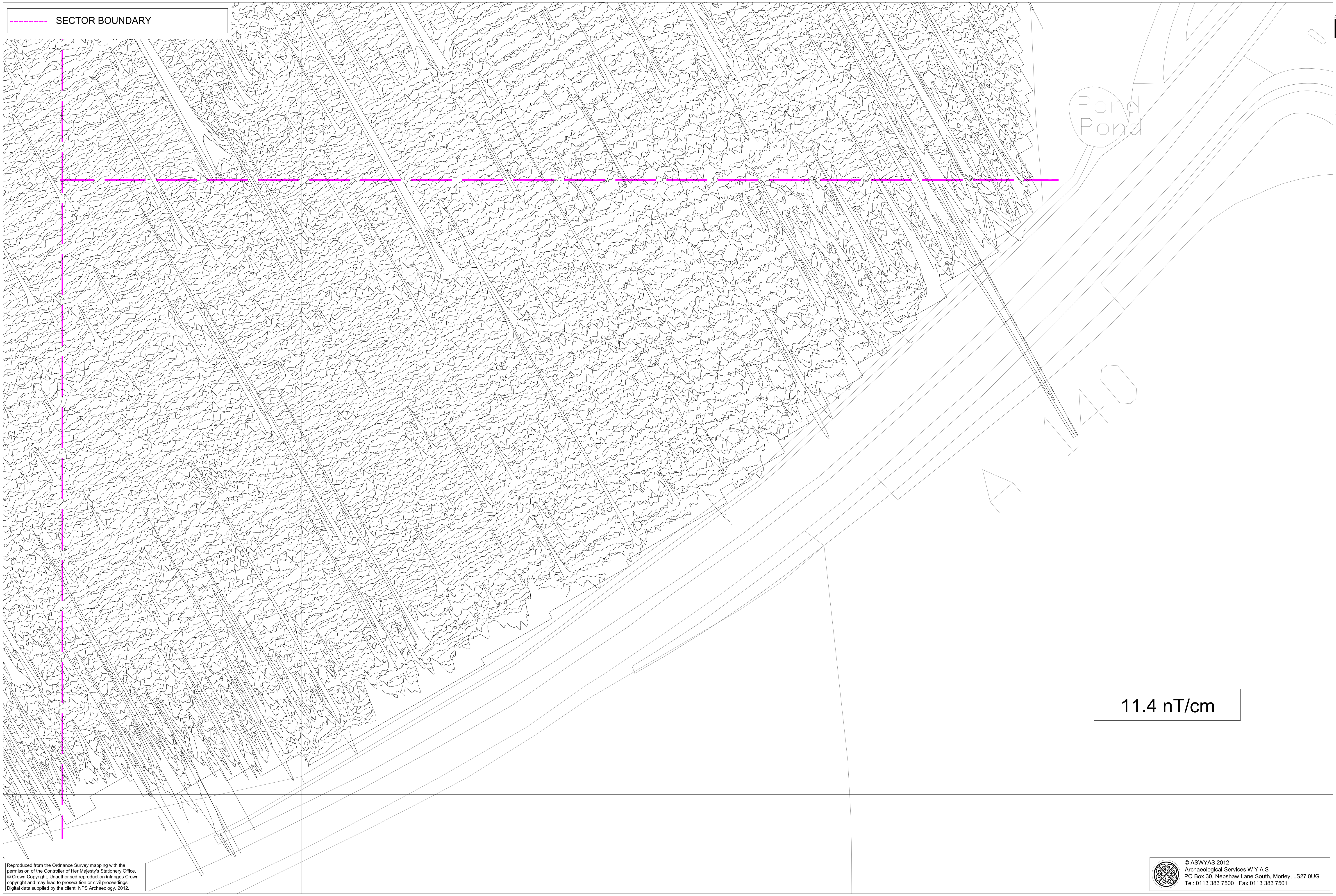
Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party or for the removal of any of the survey reference points.

Appendix 3: Raw XY trace plot data

XY trace plot of raw magnetometer data; Sector 1 (1:1000 @ A3)

0 20m

XY trace plot ofraw magnetometer data; Sector 2 (1:1000 @ A3)

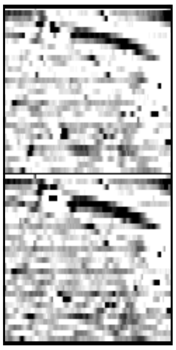


XY trace plot of raw magnetometer data; Sector 3 (1:1000 @ A3)

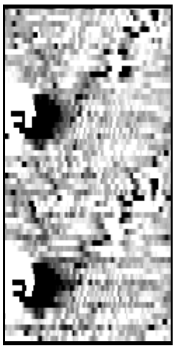
Appendix 4: Data repeatability

Data Repeatability

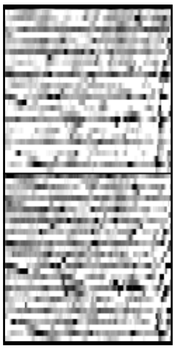
JOB NUMBER	3987	SITE CODE	AYL12	JOB NAME	Land off the A140 Norwich Road, Aylsham, Norfolk



22/10/2012 Grid surveyed at 12:30 and 16:00



23/10/2012 Grid surveyed at 09:00 and 14:15



24/10/2012 Grid surveyed at 09:00 and 11:15

Appendix 5: 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 Norfolk Historic Environment Record).

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Soil Survey of England and Wales, 1980, Soils of Eastern England Sheet 3