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Home Farm
Kirkby Fleetham
North Yorkshire

Geophysical Survey

June 2010

Report No. 2090

CLIENT

Field Archaeology Specialists Ltd.

Home Farm
Kirkby Fleetham
North Yorkshire

Additional Geophysical Survey

Summary

A geophysical (magnetometer) survey covering approximately 21 hectares was carried out at the proposed site of a gravel quarry near Kirkby Fleetham, North Yorkshire. Detailed survey was undertaken at seven locations based on the results of a magnetic transect survey. Linear anomalies locating former field boundaries (both mapped and previously unrecorded) and ploughing regimes have been identified across all parts of the site. Additionally at least three small enclosures have been identified to the west of the site. It is not clear whether these features are post-medieval in date or whether they could reflect a much earlier period of land division. Elsewhere anomalies locating the former course of a stream used to demarcate a parish boundary and the edge of the floodplain have been noted.

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Report Information

Client:	Field Archaeology Specialists Ltd
Address:	Unit 8, Fulford Business Centre, 35 Hospital Fields Road, York YO10 4DZ
Report Type:	Geophysical survey
Location:	Kirkby Fleetham
County:	North Yorkshire
Grid Reference:	SE 2815 9605
Period(s) of activity represented:	Medieval/post-medieval
Report Number:	2090
Project Number:	3555
Site Code:	KIR10
Planning Application No.:	pre-determination
Museum Accession No.:	-
Date of fieldwork:	March 2010
Date of report:	June 2010
Project Management:	Sam Harrison BSc MSc AIfA
Fieldwork:	Sam Harrison Alex Harrison BSc Marina Rose BSc Ian Wilkins BSc MSc
Report:	Sam Harrison Alistair Webb BA MIfA
Illustrations:	Sam Harrison
Photography:	n/a
Research:	n/a
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Contents

List of Figures

1 Introduction

Archaeological Services WYAS was commissioned by Justin Garner-Lahire of Field Archaeology Specialists Ltd (FAS) to undertake additional geophysical (magnetometer) survey at Home Farm, Kirkby Fleetham in North Yorkshire (see Fig. 1). The survey expanded an initial geophysical evaluation undertaken in November 2009 (Wilkins 2010).

Site location, topography and land use

The site covers an area of approximately 140 hectares with Home Farm (SE 280 960) lying to the centre of the site, just north of Kirkby Fleetham Hall (see Fig. 2). At the time of survey most of the site consisted of large fields with a maturing arable crop. A few small pasture fields lie to the south and east of Home Farm and two plantations (Park and Low Birch) are located to the east of the farm. The site is generally flat forming part of the river Swale flood plain, with Fiddale Beck cutting through the north-west corner of the site and feeding into the river. The topography varies from 34m above Ordnance Datum in the south-east to 40m aOD in the west. The river defences run along the northern edge of the site forming a significant embankment with a scarp slope marking the southern extent of the flood plain.

Geology and soils

The geology comprises Upper Permian Marl (Roxby Formation) to the west and Triassic Sherwood Sandstones to the east. This is overlain by alluvial gravel deposits from the river Swale. The soils are classified in the Alun association being described as deep, stoneless, permeable coarse loams over gravel.

2 Archaeological background

A review of the known archaeological resource of the site and the surrounding area has been undertaken by the client. This information suggests little evidence of Palaeolithic to Neolithic activity within the survey area although locally a number of ritual monuments including cursus monuments, henges and burial enclosures have been identified. Again, although Bronze and Iron Age sites are known within the region, no monuments or finds have been recorded in the survey area. The Roman town of Catterick (*Caractonium*) lies 7km to the north-west of the site and Roman finds have been numerous in the area with spot finds of coins from Low Kiplin and Great Langton just to the north of the site, on the opposite bank of the river Swale.

The village of Kirkby is documented in the Domesday Book suggesting a pre-existing settlement with associated agricultural system. Ridge and furrow has been identified to the east of Kirkby Fleetham Hall within the survey area. The 1857 Ordnance Survey map depicts a number of tracks, field boundaries and river defences which have subsequently been removed with the introduction of large scale and intensive farming techniques (see Fig. 2).

An initial geophysical evaluation (Wilkins 2010) covering 15 hectares comprising seven 30m wide transects across the site (see Fig. 2) identified anomalies caused by former field boundaries, trackways, a plantation and river defence features, all of which were shown on the first edition Ordnance Survey mapping of 1857. In addition other anomalies caused by ploughing or land drainage were also identified.

A programme of fieldwaking was carried out at the same time as the geophysical survey. However, the results of this are unknown at the time of writing.

3 Aims, Methodology and Presentation

The general aim of the geophysical survey was to provide additional information that would further evaluate the archaeological potential of the site. This information would be included as part of an Environmental Impact Assessment which may be submitted in support of any future planning application. This information will then enable further evaluation, and/or mitigation measures to be designed as appropriate.

Specifically the aims were:

- To interpret any magnetic anomalies identified by the survey and;
- to determine (so far as is possible) the presence or absence of buried archaeological remains in the selected survey areas and thereby assess the archaeological potential of the site.

The original survey covered approximately 15 hectares in seven 30m wide transects. The second phase survey sought to further define and characterise anomalies or areas of archaeological potential by expanding the survey around anomalies identified during the first phase survey and around any find spot clusters noted during the fieldwalking. Detailed survey was carried out at seven locations totalling approximately 21 hectares (see Table 1 below).

Table 1: Detailed magnetometer survey target blocks

Area Number (see Fig 2)	Size (ha)
Area 1	3.5
Area 2	4.72
Area 3	0.54
Area 4	2.82
Area 5	1.26
Area 6	3.75
Area 7	4.03

The survey areas were set out by the client using a dGPS system. Survey station positions (wooden stakes) had been set out in the initial survey (Wilkins 2010).

Magnetometer survey

Bartington Grad601 instruments were used to take 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 mapping is shown in Figure 1. Figure 2 is a more detailed site location showing the magnetometer data and boundaries and features from the 1857, first edition, Ordnance Survey map. The processed greyscale data, the 'raw' XY trace plot data and interpretation figures are presented at a scale of 1:1000 in Figures 3 to 20 inclusive.

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 survey methodology, report and any recommendations comply with the methodology and guidelines outlined by English Heritage (David *et al.* 2008) and by the IfA (Gaffney, Gater and Ovenden 2002). 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

Several types of anomalies are present in most of the survey areas. Where a definite interpretation can be attributed it is stated in the text for the individual area otherwise the range of possible causes is outlined below.

Ferrous responses/Magnetic disturbance

These anomalies are typically caused by ferrous (magnetic) material, either on the ground surface or in the topsoil, 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 given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring or tipping/infilling.

Discrete areas of magnetic enhancement

Numerous discrete anomalies/small areas of magnetic enhancements have been identified in the survey areas. It is impossible to give a confident interpretation for many of these anomalies – given the nature of the superficial geology, it is considered likely that many of these discrete anomalies will be due to natural variations in the composition of the soils and the effects of the underlying superficial deposits, although an archaeological cause cannot be discounted.

Linear anomalies and trends

Linear anomalies are commonly caused by agricultural activity such as ridge and furrow or later ploughing regimes, former (ploughed out) field boundaries or field drains.

All the blocks show phases of ploughing. Most are weak narrow spaced linear anomalies aligned with existing or, in some cases suspected, former field boundaries and are therefore interpreted as indicative of modern ploughing regimes. Many of the field boundaries mapped on the 1857 Ordnance Survey map (see Fig. 2) which are no longer extant also either manifest as magnetic anomalies or can be inferred either by the extent or change in direction of ploughing anomalies.

Area 1 (see Figs 3, 4 and 5)

Area 1 appears to be the most complex of the seven survey areas with several linear, curvilinear and rectilinear anomalies being identified as well as evidence of ridge and furrow ploughing. Broadly speaking the anomalies reflect the irregular pattern of field division shown on the first edition mapping although there are some clear distinctions which suggest a system of division changing over time.

In the north-west corner of the survey area two parallel linear anomalies are identified. The southernmost anomaly, **D1**, corresponds well with a boundary shown on the first edition mapping. Perpendicular to and intersecting with **D1** is another linear ditch type anomaly, **D2**, which appears to form an enclosure, **E1**, approximately 50m by 20m. Two more linear anomalies, **D3** and **D4,** possibly define two other enclosures, **E2** and **E3**, to the north-east and south-west of **E1**. Within these enclosures numerous discrete anomalies have been identified which may be indicative of archaeological features such as pits or areas of burning. Of particular note is anomaly **P1**, to the south-west and a cluster of anomalies in the centre of **E1**. Other discrete anomalies are visible in **E3** although these are less confidently interpreted as archaeological.

In the centre of the survey block is an irregular shaped area which has been subject to ridge and furrow ploughing and which is delimited by a curvilinear anomaly, **D5** and a vague, loosely defined, linear trend, **D6**. Anomaly **D5** partially reflects the alignment of a curving boundary visible on the first edition mapping but there is no mapped boundary feature corresponding with **D6**. Towards the northern end of this area another small enclosure, **E4**, approximately 25m by 25m, is clearly visible appended to the eastern side of **D5**.

Towards the eastern edge of the survey area several linear trend anomalies aligned north/south are identified. The most prominent, **D7**, again correlates with a field boundary on the first edition mapping.

Area 2 (see Figs 6, 7 and 8)

Several linear trend anomalies have been identified in this area which are interpreted as being due to former field boundaries or to ploughing.

A line of ‘spikes’ running north-north-west/south-south-east locates a former field boundary, **D8**, shown on the first edition mapping although the boundary itself does not manifest as a magnetic anomaly. Intersecting with this boundary from the south is a pipe and, slightly oblique to the line of the pipe, another probable field boundary, **D9**. To the north of, and perpendicular to **D8** is a very weak anomaly, **D10**, that also correlates with a former boundary.

Several, broader, more sinuous trends are interpreted as being geological in nature reflecting changes in the nature of the superficial deposits.

An oval shaped area of magnetic variation is noted in the southern half of the survey area. There are no mapped features to explain this anomaly but a modern origin is considered likely although an archaeological cause cannot be dismissed.

Area 3 and Area 4 (Figs 9, 10 and 11)

Two linear anomalies of possible archaeological potential were identified at the southern end of Transect 3 in the initial geophysical survey. The additional survey comprising Area 3 and Area 4 and analysis of the first edition mapping clearly show that the northernmost of these two anomalies correlates with the current parish boundary which itself was based on the course of a stream which has either since been diverted and its course filled in or it has been enpiped. Either possibility would account for the curvilinear anomaly.

The additional survey has also clearly shown that the southernmost anomaly identified in T3, **D11**, terminates at/intersects with the former stream and is presumably either a tributary stream, since diverted, or possibly another former boundary division. Parallel linear trend ploughing anomalies perpendicular to and east of this anomaly would suggest that whatever its origin that it was a physical feature in the landscape. To the north of the parish boundary weak linear trend anomalies are interpreted as probable field drains.

To the south-west corner of Area 4 a vague linear trend, **D12**, correlates with another boundary shown on the first edition mapping. An area of magnetic disturbance can be seen immediately adjacent to this former boundary.

Throughout the two areas small areas of magnetic enhancement have been identified. These are interpreted as geological being due to variation in the drift deposits.

Area 5 (see Figs 12, 13 and 14)

The anomalies in Area 5 are all due to ploughing regimes identified in the original transect or to possible boundaries not shown on the first edition mapping.

Area 6 (see Figs 15, 16 and 17)

At least two distinct ploughing regimes can be identified in the data in this area. In the western half of Area 6 strong linear trend anomalies aligned north-north-west/south-south-east, parallel with the current field boundary abutting Park Plantation, are identified. To the east the most prominent anomalies are aligned west-south-west/east-north-east although there are still ploughing anomalies perpendicular to these. In the southern third of the survey area ploughing anomalies are much fewer to the south of a linear anomaly, **D13**, that corresponds with a boundary shown on the 1857 mapping.

Towards the eastern edge of the area a change in the background magnetic response is visible immediately east of a sinuous curvilinear anomaly which correlates with a drop in ground level to the east. This anomaly marks the topographic boundary between the river floodplain to the east, which is littered with river cobbles, and the first terrace to the west.

Other vague linear and curvilinear trends and small discrete areas of magnetic enhancement are interpreted as being due to variation in the soils and superficial deposits.

Area 7 (see Figs 18, 19 and 20)

In the western third of the survey area ploughing anomalies on two distinct alignments are clearly visible. Both phases of ploughing terminate along an edge, **D14**, not visible as a magnetic anomaly, that correlates with a boundary shown on the first edition mapping. To the south-east of this former boundary ploughing anomalies are still present but in much reduced numbers. A few geological anomalies are also noted in this area.

5 Discussion and Conclusions

The expansion of the original survey transects to full open area surveys at the seven locations has lead to a much greater degree of confidence being able to be placed on the interpretation of many of the anomalies identified during the initial evaluation and hence to a better understanding of the evolution of the agricultural landscape on and around the floodplain and first terrace of the river Swale. Similarly reference to the first edition Ordnance Survey mapping has further confirmed the nature of many anomalies whose origin was previously only suspected.

Overall the survey has demonstrated that the overwhelming majority of anomalies are due to agricultural activity, either locating former field boundaries or reflecting the alignment of ridge and furrow or later ploughing regimes. Other linear anomalies are also probably due to field boundaries removed prior to 1857 when the first Ordnance Survey map of the area was produced. The pattern of land division (as shown on the first edition mapping) is far from regular with field shape being determined by the extent of pockets of woodland, water courses and the edge of the floodplain. In fact one of the anomalies has now been identified as being due to a stream whose former course marked the boundary between two parishes.

Perhaps the most archaeologically interesting area is to the west of the site, north-east of Hookcar (formerly Hooker) Hill, in Area 1. Here the field boundaries appear particularly irregular with only partial correlation with the pattern of division shown on the 1857 map. At least three distinct small enclosures have been identified which may hint at a much earlier period of land division. Several discrete anomalies perhaps indicative of features such as pits or areas of burning have been noted in the vicinity of these enclosures. However, it should be noted that these anomalies could also be due to variations in the soils and superficial deposits.

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.

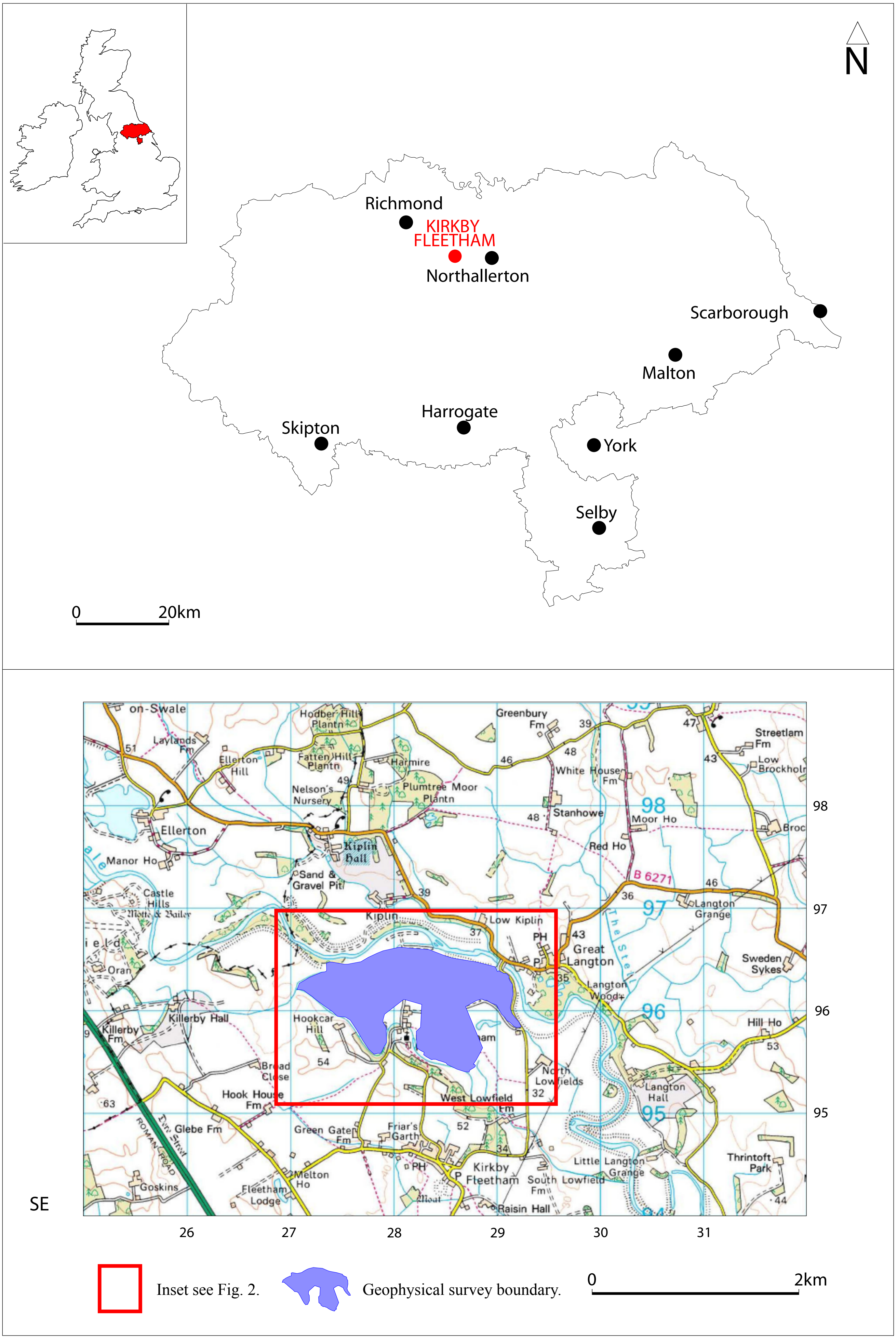

Fig. 1. Site location

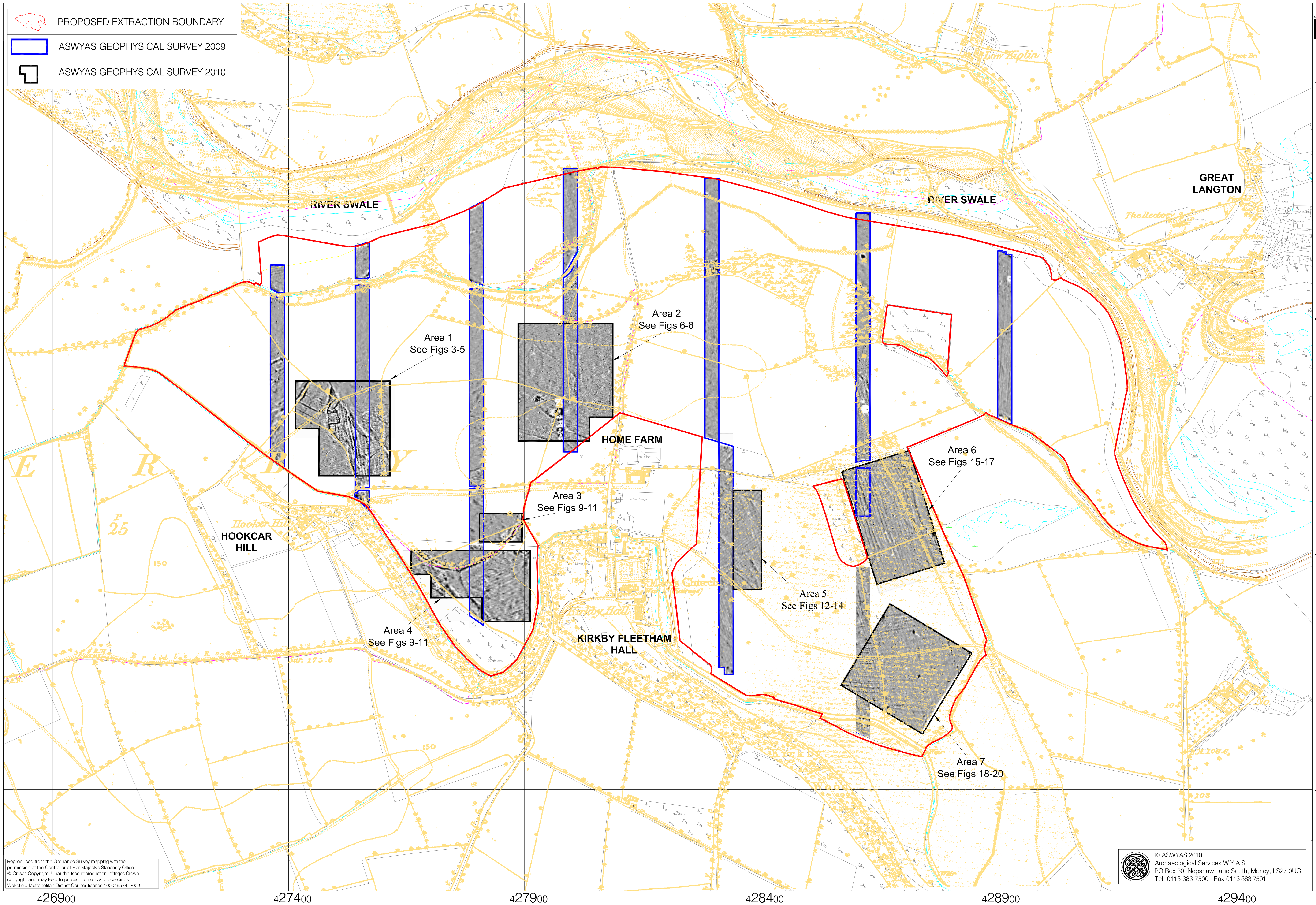

Fig. 2. Site location showing greyscale magnetometer data, previous geophysical survey and first edition Ordnance Survey mapping of 1857 (1:7500 @ A3)

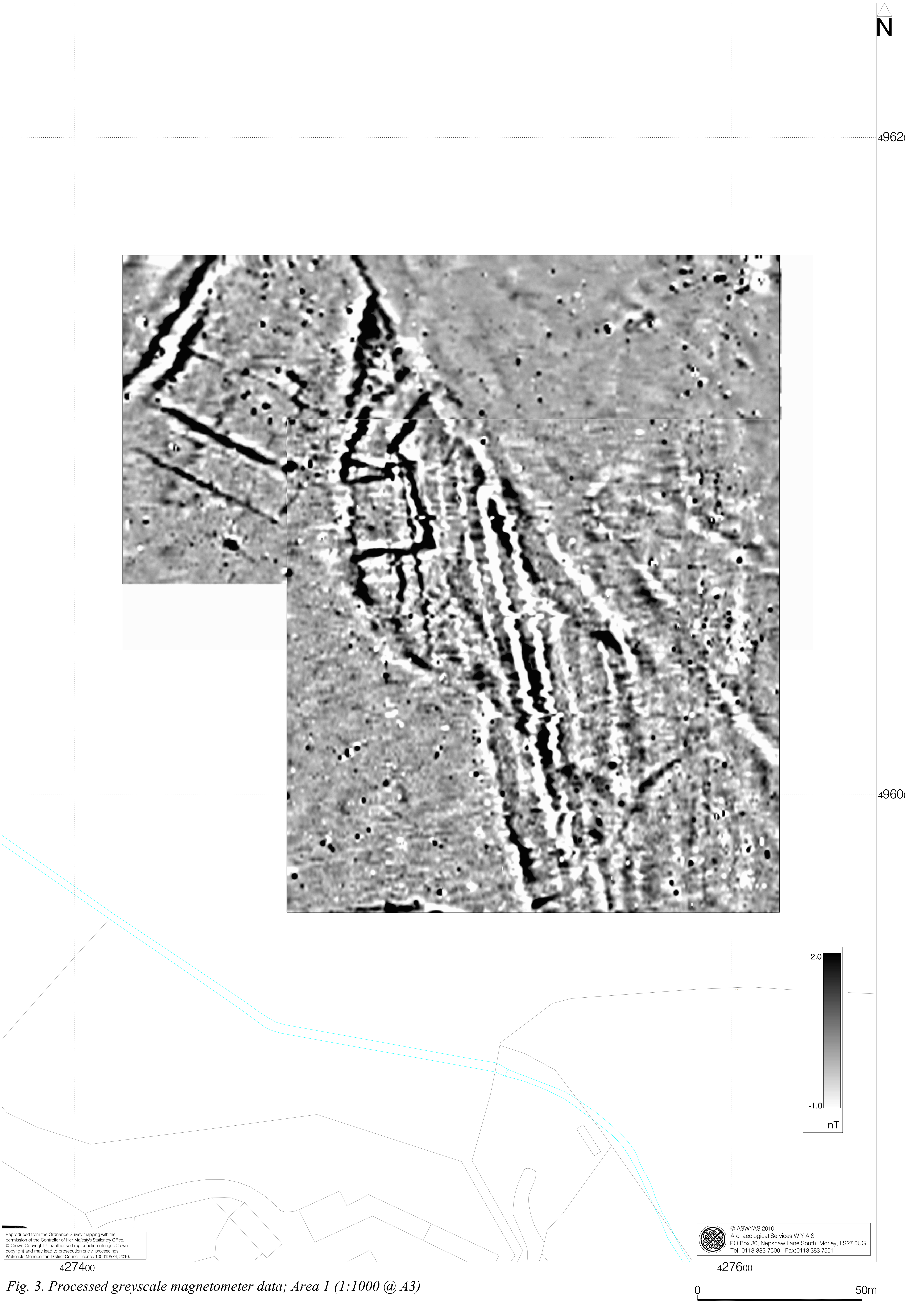

Fig. 3. Processed greyscale magnetometer data; Area 1 (1:1000 @ A3)

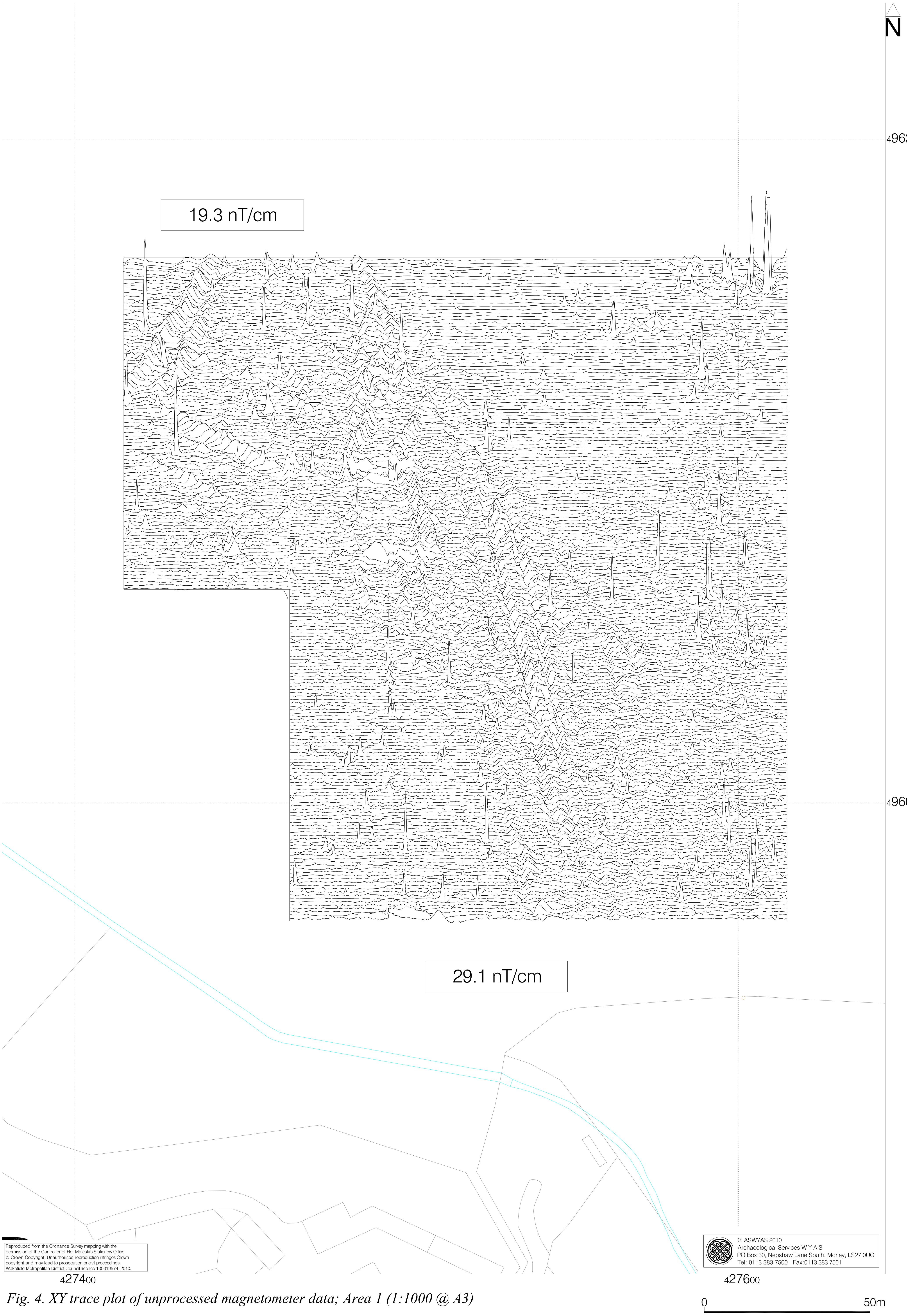

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Fig. 4. XY trace plot of unprocessed magnetometer data; Area 1 (1:1000 @ A3)

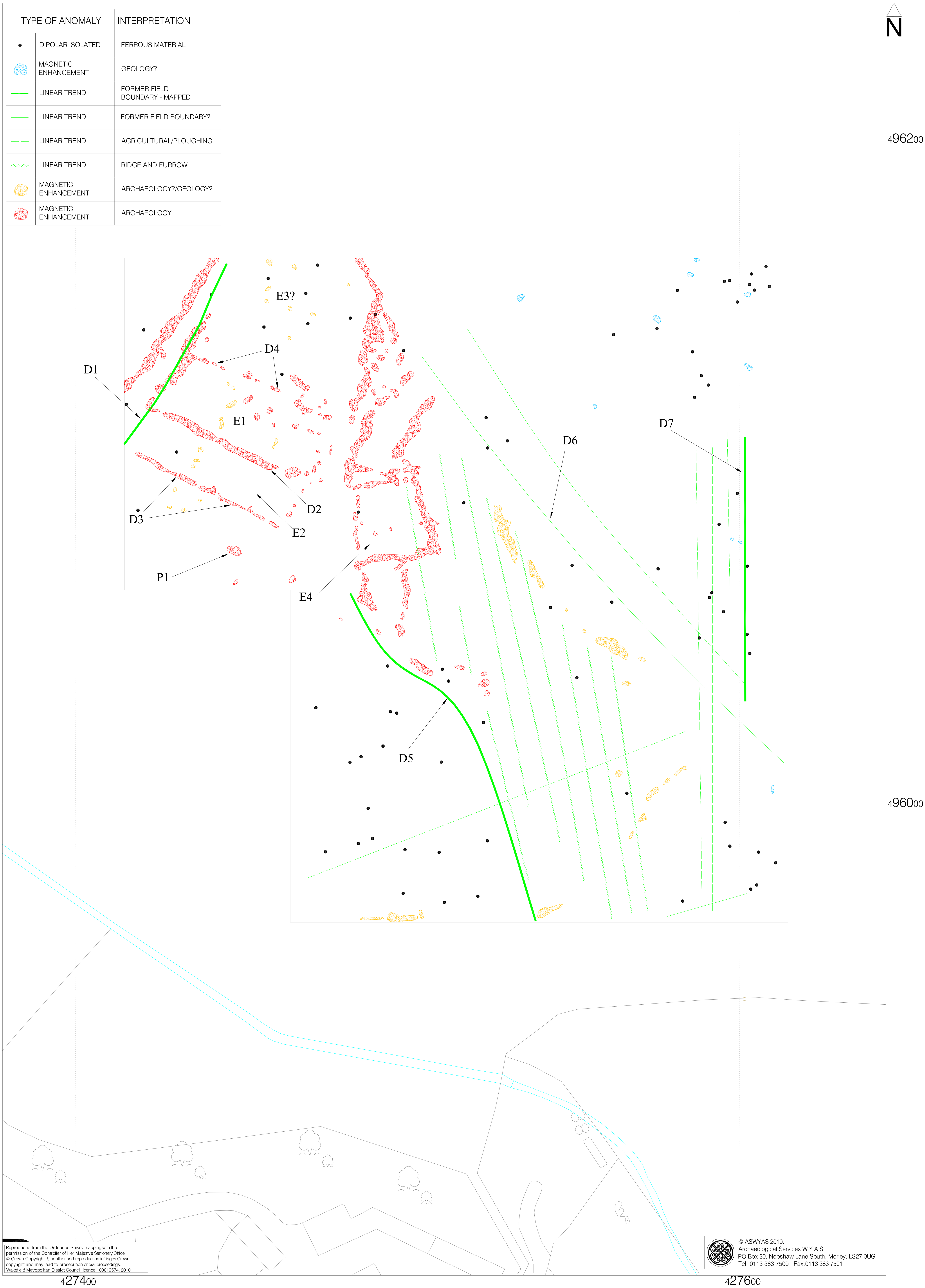

Fig. 5. Interpretation of magnetometer data; Area 1 (1:1000 @ A3)

0 50m

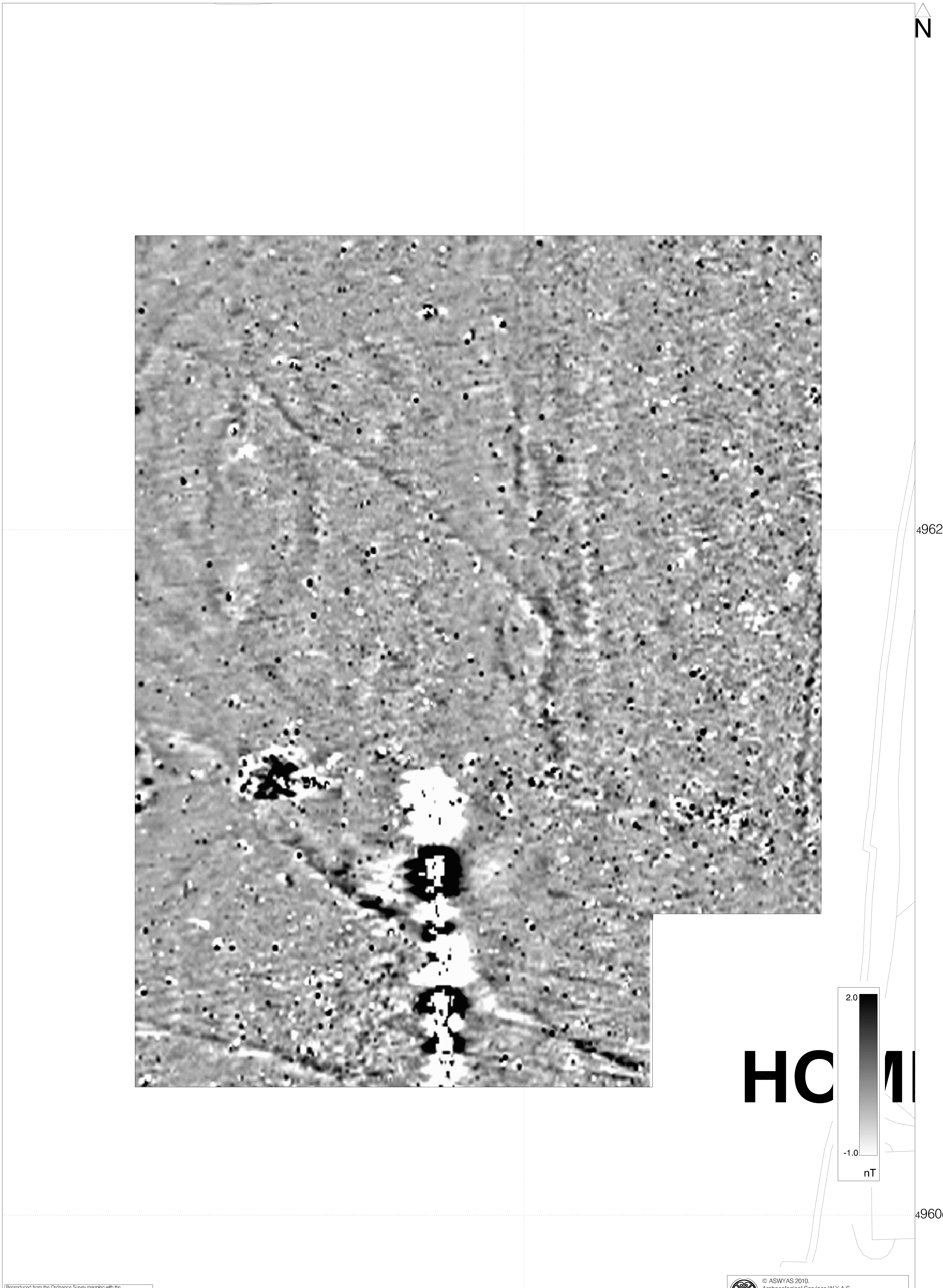

Fig. 6. Processed greyscale magnetometer data; Area 2 (1:1000 @ A3)

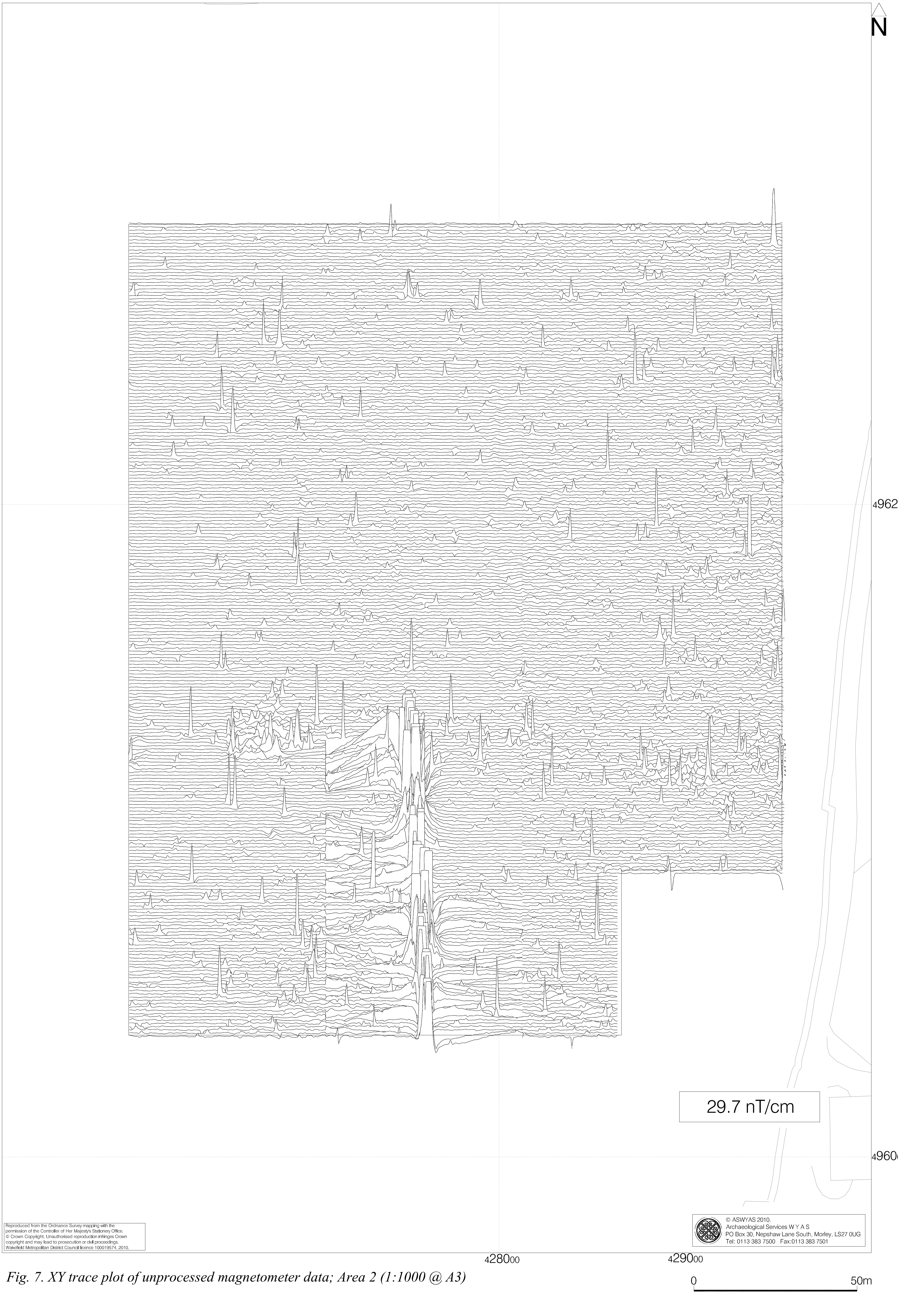

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Fig. 7. XY trace plot of unprocessed magnetometer data; Area 2 (1:1000 @ A3)

Fig. 8. Interpretation of magnetometer data; Area 2 (1:1000 @ A3)

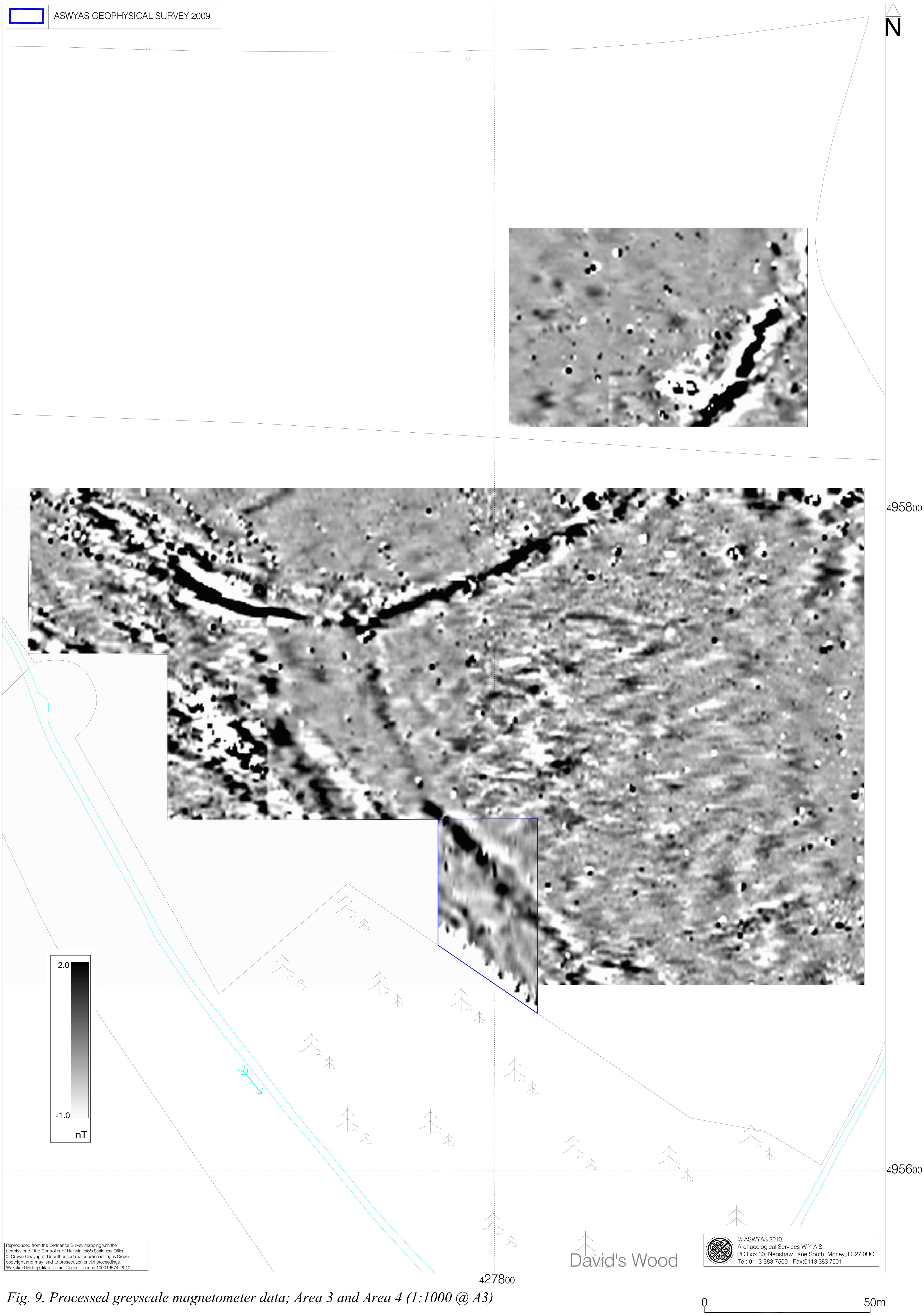

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Fig. 9. Processed greyscale magnetometer data; Area 3 and Area 4 (1:1000 @ A3)

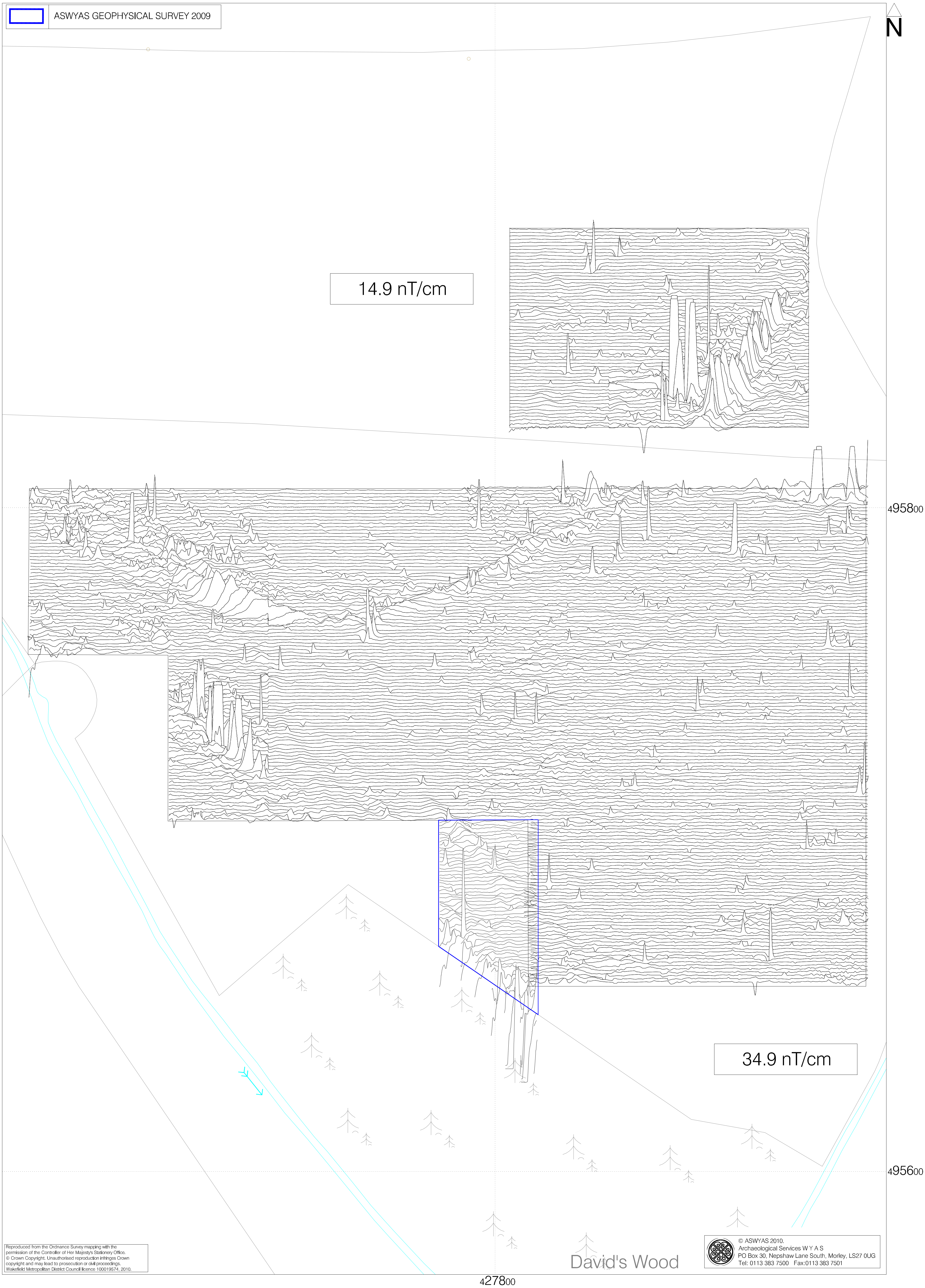
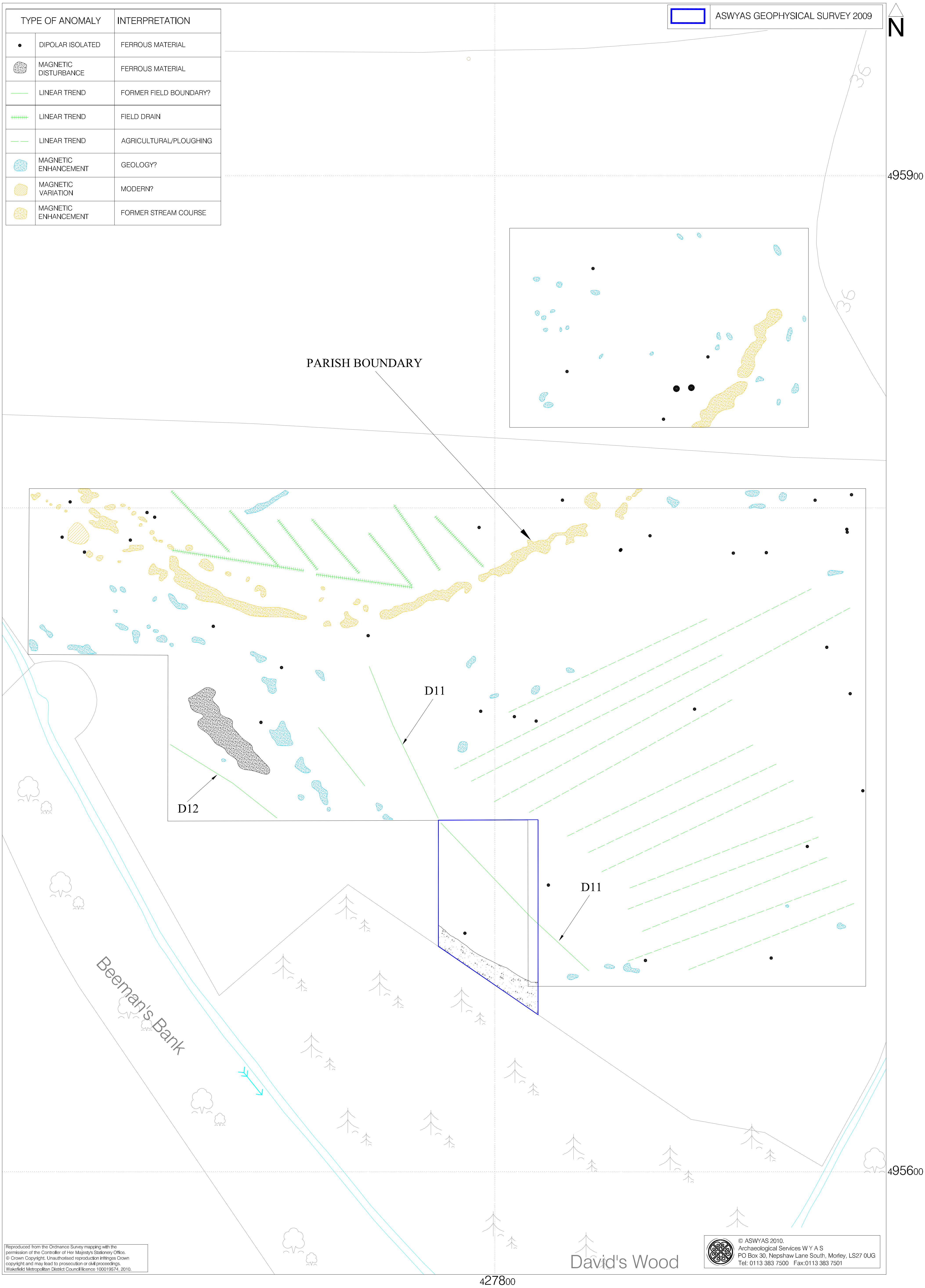


Fig. 10. XY trace plot of unprocessed magnetometer data; Area 3 and Area 4 (1:1000 @ A3)

0 50m



TYPE OF ANOMALY	INTERPRETATION
DIPOLAR ISOLATED	FERROUS MATERIAL
MAGNETIC DISTURBANCE	FERROUS MATERIAL
LINEAR TREND	FORMER FIELD BOUNDARY?
LINEAR TREND	FIELD DRAIN
LINEAR TREND	AGRICULTURAL/PLOUGHING
MAGNETIC ENHANCEMENT	GEOLOGY?
MAGNETIC VARIATION	MODERN?
MAGNETIC ENHANCEMENT	FORMER STREAM COURSE

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Fig. 11. Interpretation of magnetometer data; Area 3 and Area 4 (1:1000 @ A3)

0 50m

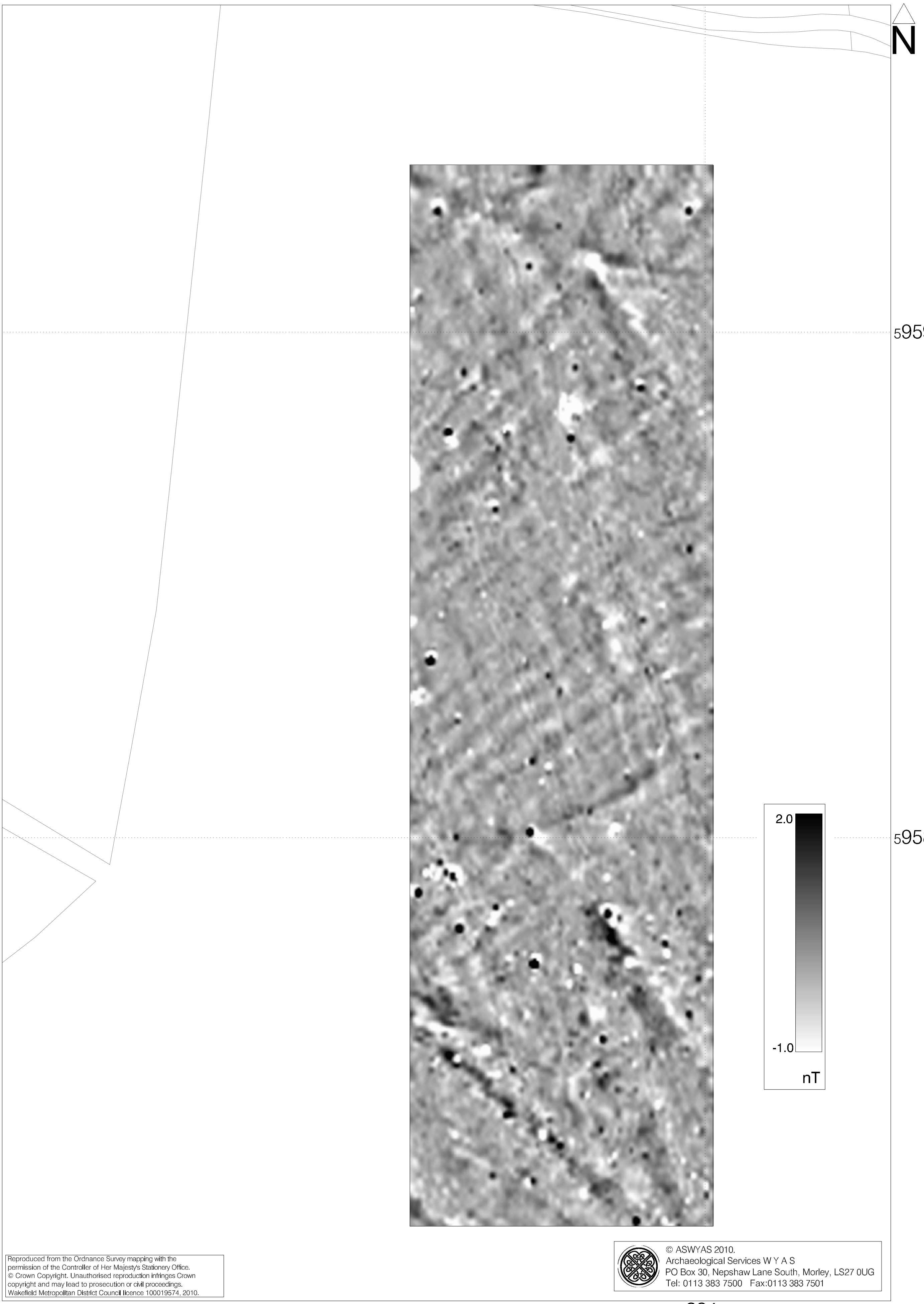


Fig. 12. Processed greyscale magnetometer data; Area 5 (1:1000 @ A4)

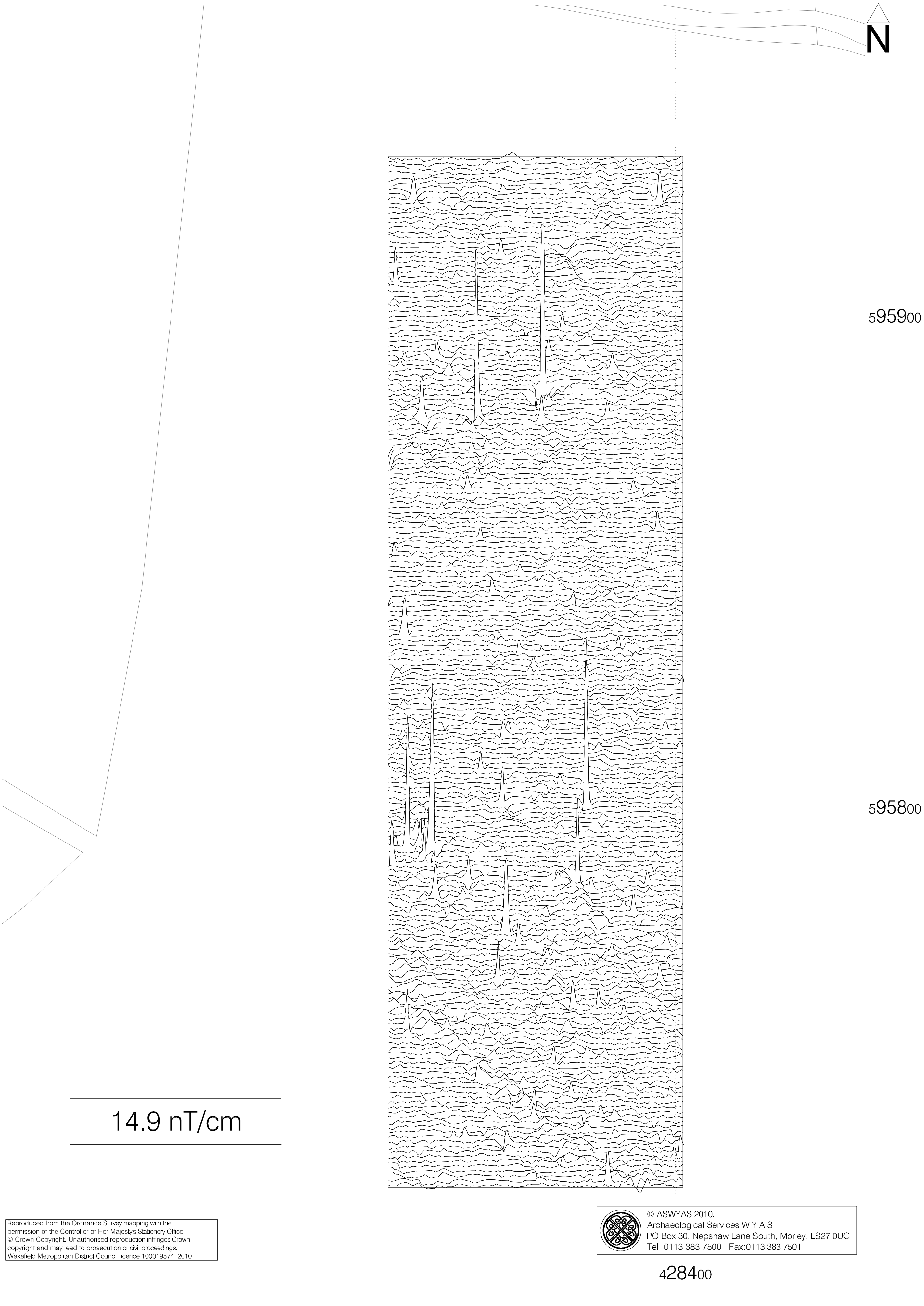
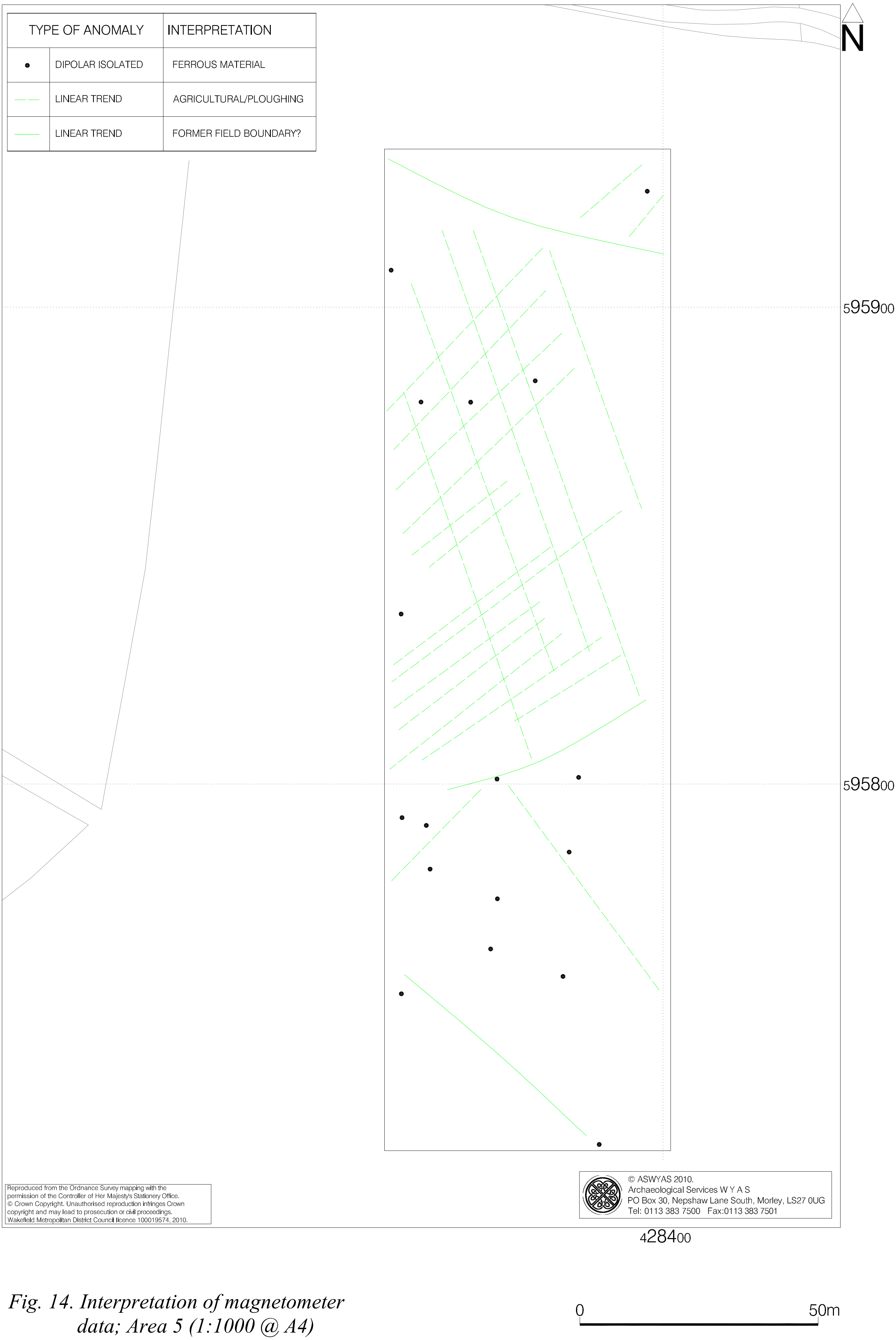


Fig. 13. XY trace plot of unprocessed magnetometer data; Area 5 (1:1000 @ A4)



TYPE OF ANOMALY		INTERPRETATION
•	DIPOLAR ISOLATED	FERROUS MATERIAL
— —	LINEAR TREND	AGRICULTURAL/PLOUGHING
——	LINEAR TREND	FORMER FIELD BOUNDARY?

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Fig. 14. Interpretation of magnetometer data; Area 5 (1:1000 @ A4)

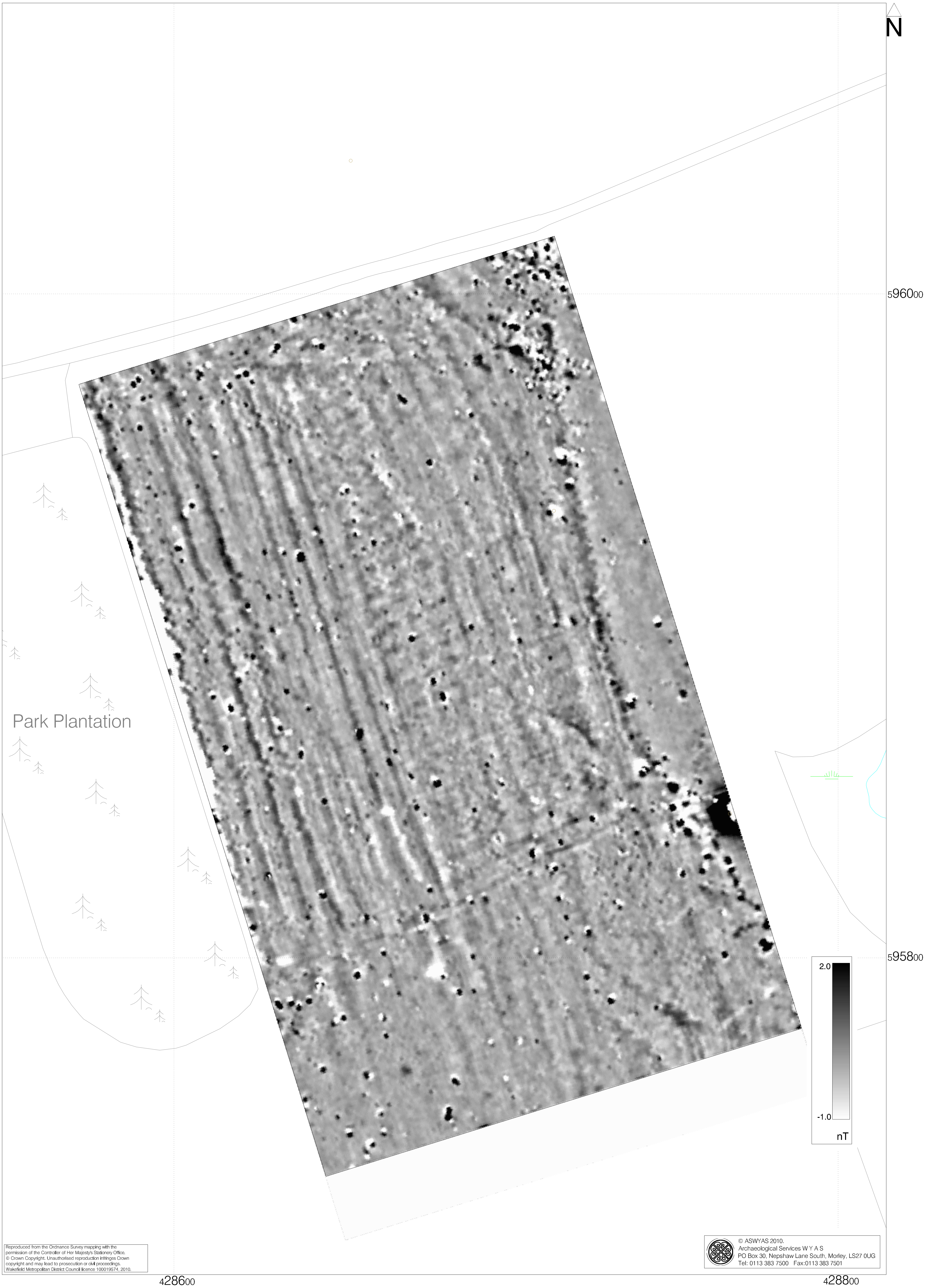

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Fig. 15. Processed greyscale magnetometer data; Area 6 (1:1000 @ A3)

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Fig. 16. XY trace plot of unprocessed magnetometer data; Area 6 (1:1000 @ A3)

TYPE OF ANOMALY		INTERPRETATION
•	DIPOLAR ISOLATED	FERROUS MATERIAL
	MAGNETIC DISTURBANCE	FERROUS MATERIAL
	LINEAR TREND	AGRICULTURAL/PLOUGHING
	LINEAR TREND	FORMER FIELD BOUNDARY?
	MAGNETIC ENHANCEMENT	GEOLOGY?
	LINEAR TREND	TOPOGRAPHIC BOUNDARY

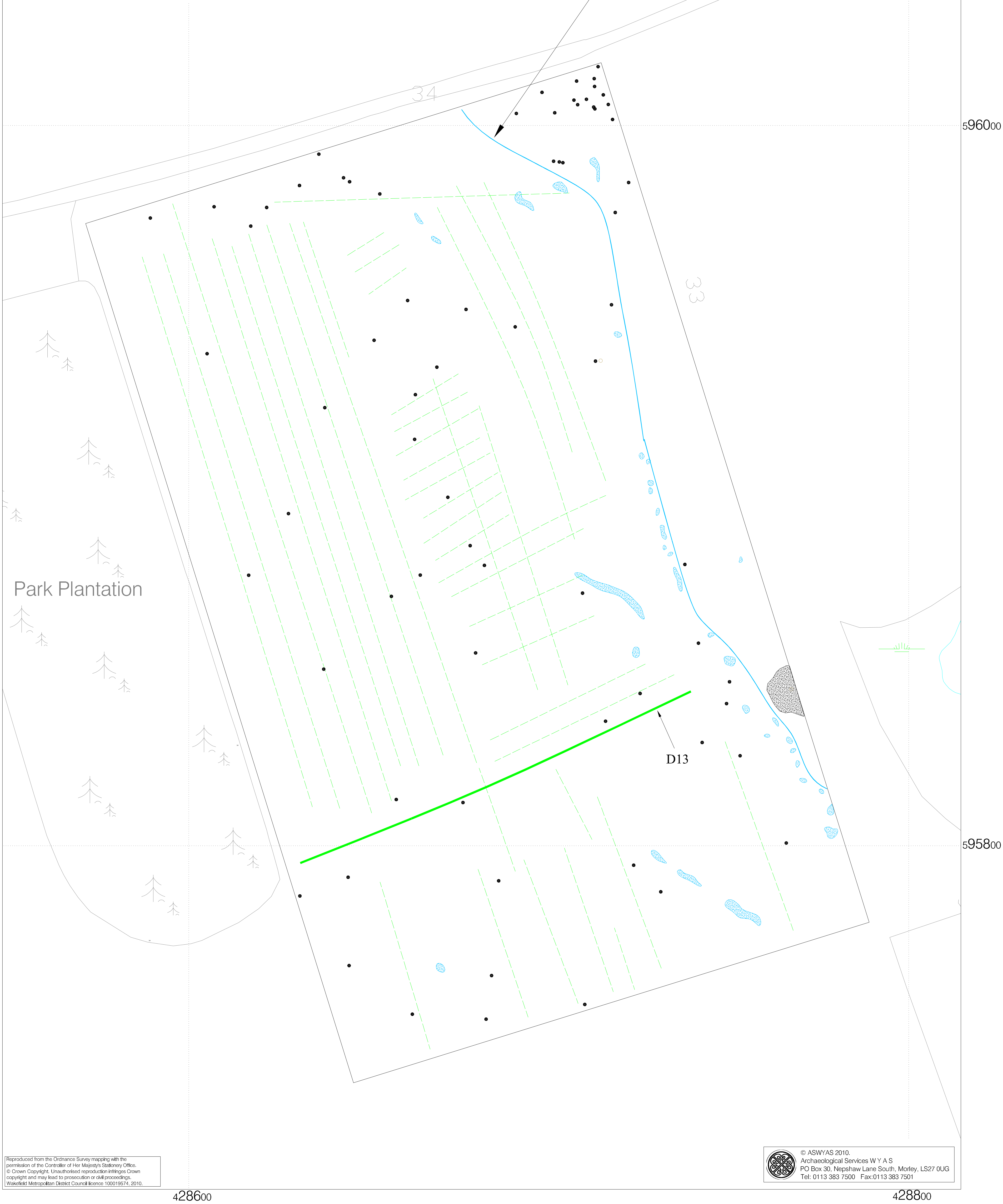

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Fig. 17. Interpretation of magnetometer data; Area 6 (1:1000 @ A3)

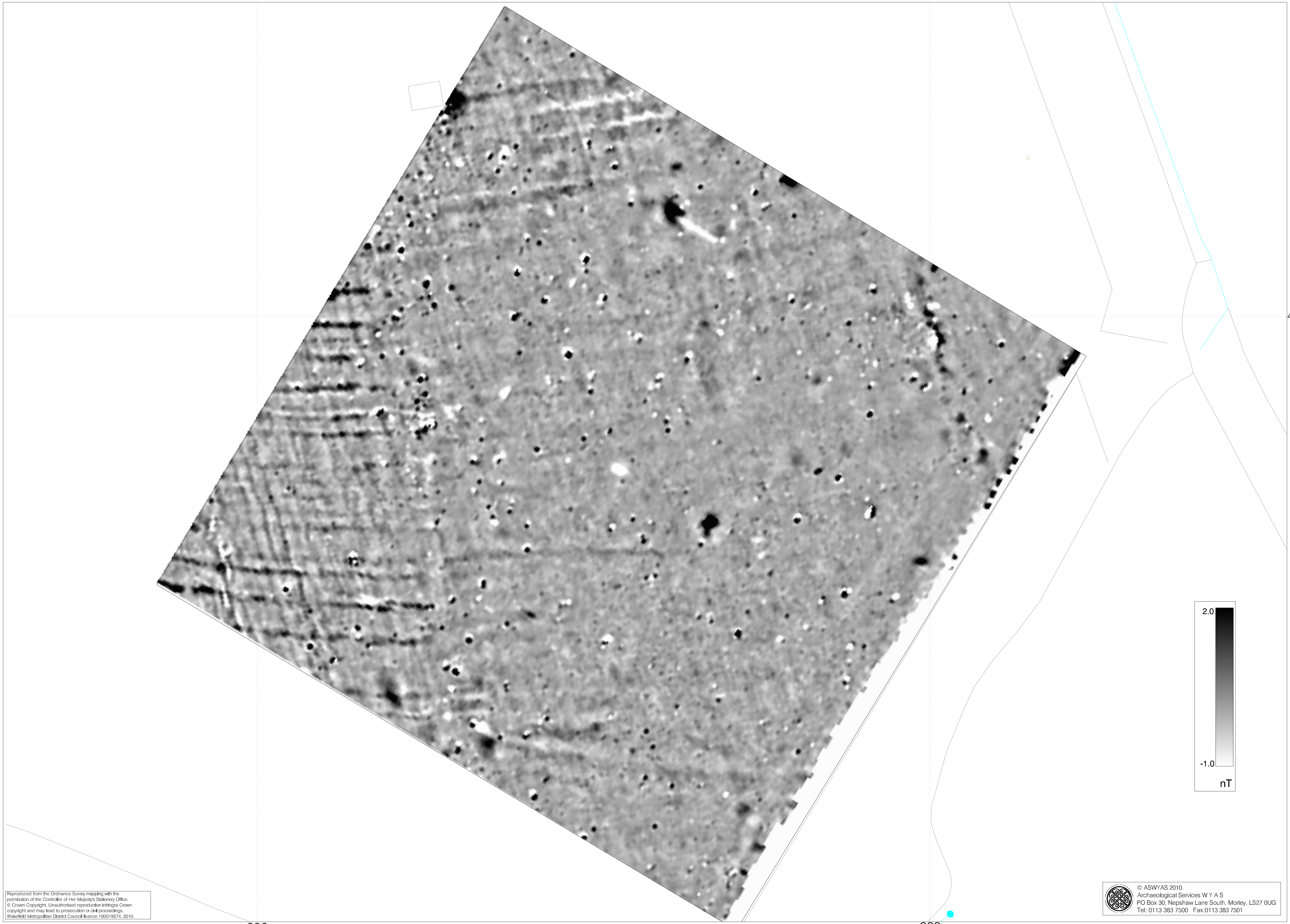

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Fig. 18. Processed greyscale magnetometer data; Area 7 (1:1000 @ A3)

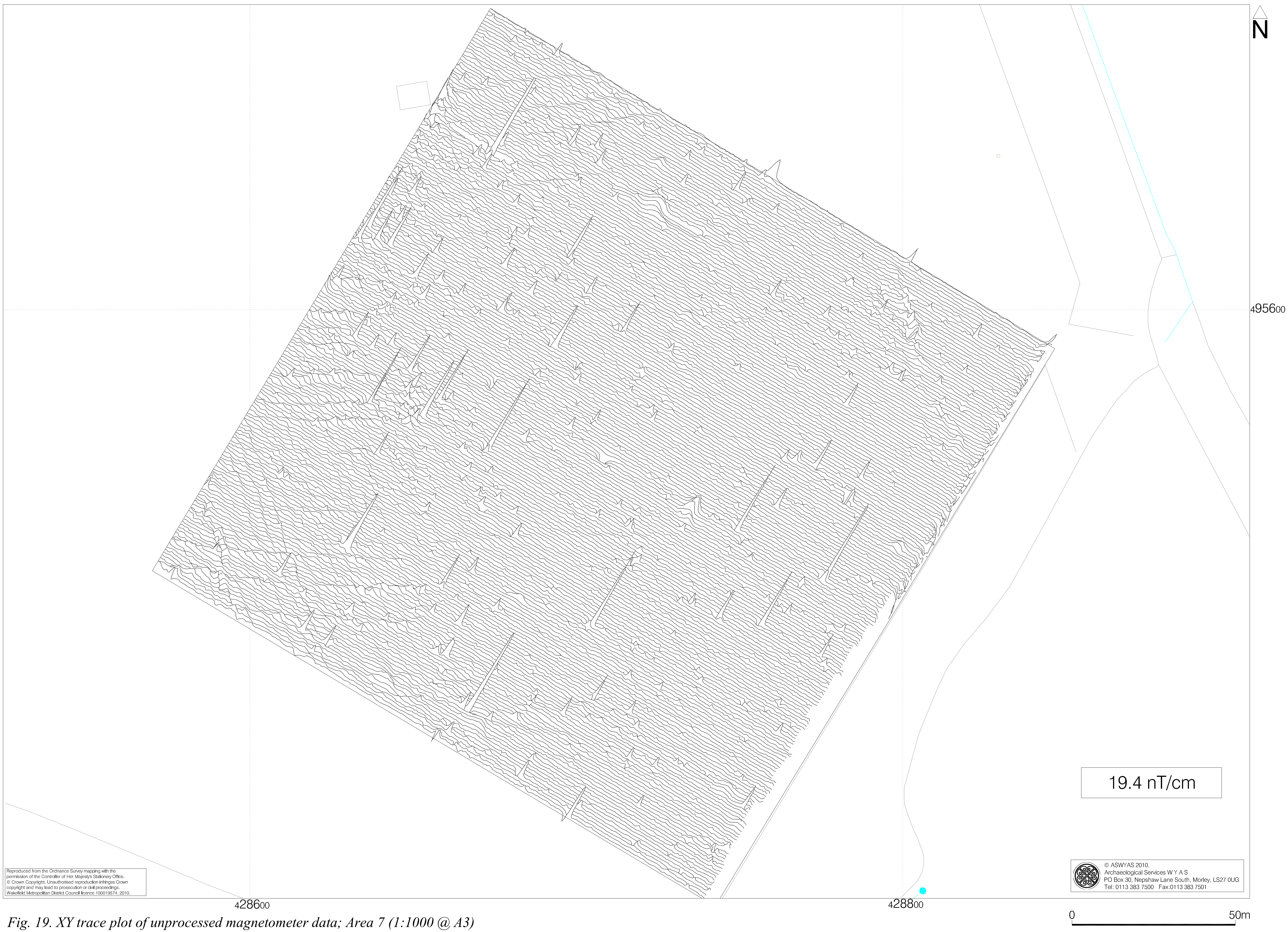

Fig. 19. XY trace plot of unprocessed magnetometer data; Area 7 (1:1000 @ A3)

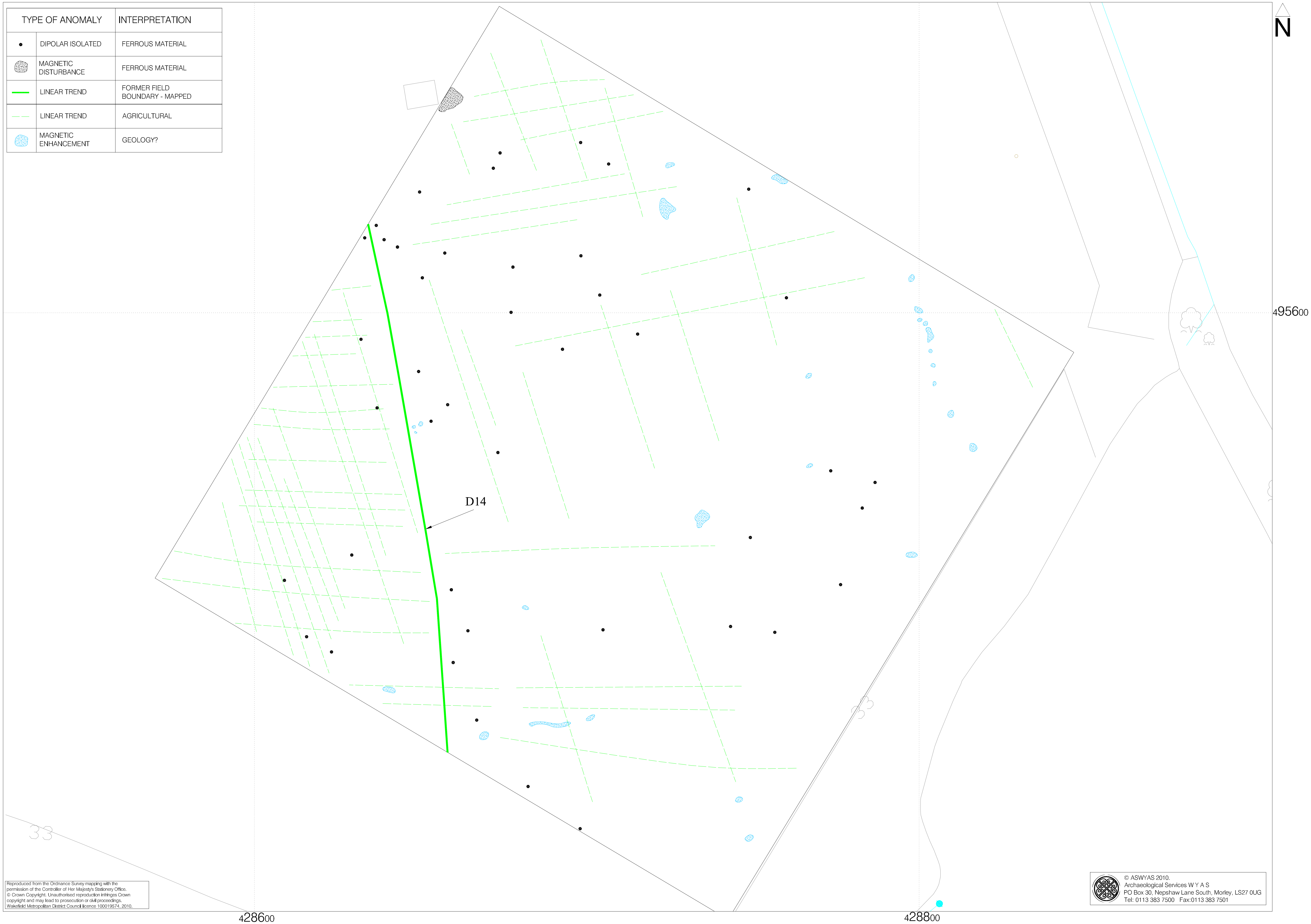

Fig. 20. Interpretation of magnetometer data; Area 7 (1:1000 @ A3)

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 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. The same program was used to produce the greyscale images. All greyscale plots are displayed using a linear incremental scale.

Appendix 2: 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 2007) 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 relevant Sites and Monument Record Office).

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