WYAS Archaeological Services

Axis 50

Willington

Derbyshire

Geophysical Survey

Report no. 3166
May 2018

Client: Cotswold Archaeology

REGISTERED ORGANISATION CIfA

West Yorkshire Joint Services

Axis 50,
Willington,
Derbyshire

Geophysical Survey

Summary

A geophysical (magnetometer) survey, covering approximately 13 hectares was undertaken on land at Burnaston Cross, Willington, Derbyshire on the site known as Axis 50. This was ahead of proposed development. Anomalies of an agricultural origin have been identified in the form of, ridge and furrows, former field boundaries and field drains. An area of magnetic disturbance has been detected throughout the central core of the survey area. A collection of possible archaeological anomalies have been identified in the northeast corner. Overall the survey area is deemed to have low archaeological potential.

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Services

Report Information

Client:	Cotswold Archaeology
Address:	Building 11, Kemble Enterprise Park, Cirencester, Derbyshire, GL7 6BQ
Report Type:	Geophysical Survey
Location:	Axis 50, Willington
County:	Derbyshire
Grid Reference:	SK 29265 29082
Period(s) of activity:	?Prehistoric / medieval / modern
Report Number:	3166
Project Number:	8317
Site Code:	BCW18
OASIS ID:	archaeol11-317902
Date of fieldwork:	May 2018
Date of report:	May 2018
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Authorisation for distribution: ----------

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1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by Cotswold Archaeology, on behalf of their client, Brackley Property Developments to undertake a geophysical (magnetometer) survey on land to the west of the B5008 in Burnaston Cross, Willington ahead of a proposed industrial development, in line with current best practice (CIfA 2014; David *et al*. 2008) and also to the project design (ASWYAS 2018). The survey was carried out between the 8th and 10th May 2018 to provide additional information on the archaeological resource of the survey area.

Site location, topography and land-use

The survey area is approximately centred on National Grid Reference SK 29265 29082. It is located to the east of the A38. It is bound to the immediate south by a railway line and to the west by the B5008, with agricultural fields to the north. The site covers an area of c.13 hectares across two fields (Fig. 1). The topography is generally flat. The height above Ordnance Datum (aOD) is between 49m and 55m.

Soils and geology

The underlying bedrock deposits are shown to comprise the Gunthorpe Member Mudstone, with superficial deposits of Egginton Common Sand and Gravel (BGS 2018). The soils are recorded as belonging to the Arrow association and are listed as deep permeable coarse loams, affected by groundwater (SSEW 1983).

2 Archaeological Background

The following background has been taken from a Desk-based Assessment provided by Cotswold Archaeology (Cotswold Archaeology 2018) and is summarised below.

Palaeolithic hand axes and flakes were recovered during quarry extraction to the immediate north of the survey area during the 1930's – 1960's. Within a 1km radius of the survey area, there is evidence of Neolithic and Bronze Age cropmarks, predominantly to the east, with ring ditches and funerary monuments approximately 25m to the south.

Whilst there are no Roman features within the survey area the western boundary lies next to the A38, under which a former routeway known as Ryknield Street is thought to exist. In addition there is cropmark evidence to suggest that there were enclosures and boundaries which may have an association with this feature.

Excavations of the 1970's, within the extraction area to the north, were able to locate evidence of intermittent occupation, with the Saxon period represented by a settlement of three grubenhaus, with a scatter of pits and post holes.

Evidence from the Domesday book records a settlement of Willington, of which the historic core of this settlement is likely to have been focused around the church, c.800m to the southeast of the site.

Extensive ridge and furrow has been recorded, via historic aerial photographs, in the area surrounding Willington.

Whilst there has been no archaeological investigation within the survey area, within a 1km radius of the site there has been a number of geophysical surveys, excavations and evaluations. A geophysical survey and subsequent excavation, approximately 40m from the survey boundary, identified ridge and furrow, with cut features of possible archaeological origin (Cotswold Archaeology 2018). The subsequent excavation revealed archaeological features, however, there was a lack of dateable material, to allow for phasing of the features.

3 Aims and Methodology

The main aim of the geophysical survey was to provide sufficient information to enable an assessment to be made of the impact of the 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 amenable parts of the PDA was undertaken (see Fig. 2).

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 R6 model). The survey was undertaken using Bartington Grad601 magnetic gradiometers. These were employed taking readings at 0.25m intervals on zig-zag traverses 1.0m 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 displays an overview of the processed magnetometer data at a scale of 1:2500, with the overall interpretation, at the same scale in Figure 3. The minimally processed data, together with an interpretation of the survey results are presented in Figures 4 to 9 inclusive at a scale of 1:1250.

Technical information on the equipment used, data processing and survey methodologies are given in Appendix 1. Technical information on locating the survey area is provided in Appendix 2. Appendix 3 describes the composition and location of the archive. A copy of the completed OASIS form is included in Appendix 4.

The survey methodology, report and any recommendations comply with guidelines outlined by English Heritage (David *et al.* 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). 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 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 Figures 4 to 9)

Ferrous anomalies

Ferrous anomalies, as individual 'spikes', or as large discrete areas are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris or material is common on rural sites, often being present as a consequence of manuring or tipping/infilling. There is no obvious pattern or clustering to their distribution in this survey to suggest anything other than a random background scatter of ferrous debris in the plough-soil.

A band of anomalies through the middle of the survey area have been identified as disturbed material. Mapping of the area has detailed that a former pond was located within the area and as such this may have something to do with it. This feature can be seen on early satellite imagery (Google Earth 2018).

Agricultural anomalies

The remnants of two former field boundaries have been detected which correspond to Ordnance Survey (OS) mapping (Figs 4-9). The longer of the two, runs west to east along the

northern extent of the survey area. It was removed in 1970. The second and shorter of the two occurs to the east and formed two paddocks in the southeast corner. It was a field boundary which was recorded on 1892 mapping (NLS 2018) and subsequently removed after 1970.

Faint magnetic signatures of a possible ridge and furrow nature have been detected in the survey area, occurring more fully in the west.

Prominent magnetic features in the southeast corner of the survey area have been identified and interpreted as field drains, based upon their magnetic signature and regular spacing.

Possible archaeological anomalies

A cluster of anomalies in the northeast corner of the survey area have been identified as having a possible archaeological origin. The magnetic signature is comparable to that of the magnetic disturbance, yet the clustering of material may represent two circular features. However it is likely that these could also be remnant features from a metallic agricultural feeder, or disturbed material. Therefore a possible archaeological interpretation has been reached.

5 Conclusions

The geophysical survey has detected a number of magnetic anomalies. Agricultural anomalies, synonymous with former field boundaries, field drains and faint ridge and furrow. Centrally located within the survey area, an elliptical feature can be determined which may be an area which has been filled for agricultural purposes. A collection of anomalies within the northeast corner of the survey area have been identified as having a possible archaeological origin, but may also be an indication of former freestanding feeders. Therefore based on these results, the archaeological potential of the site is deemed to be low.

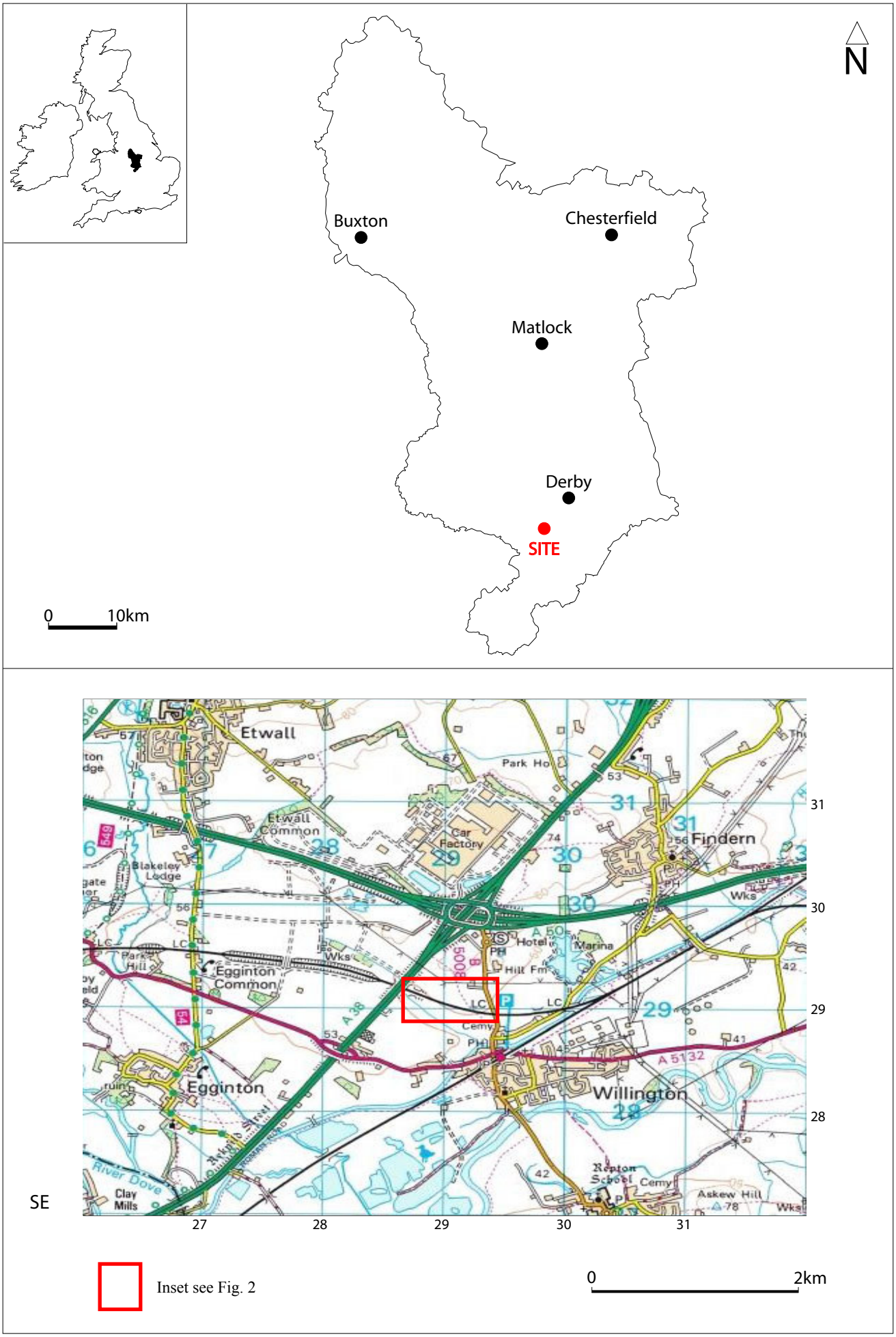

Fig. 1. Site location

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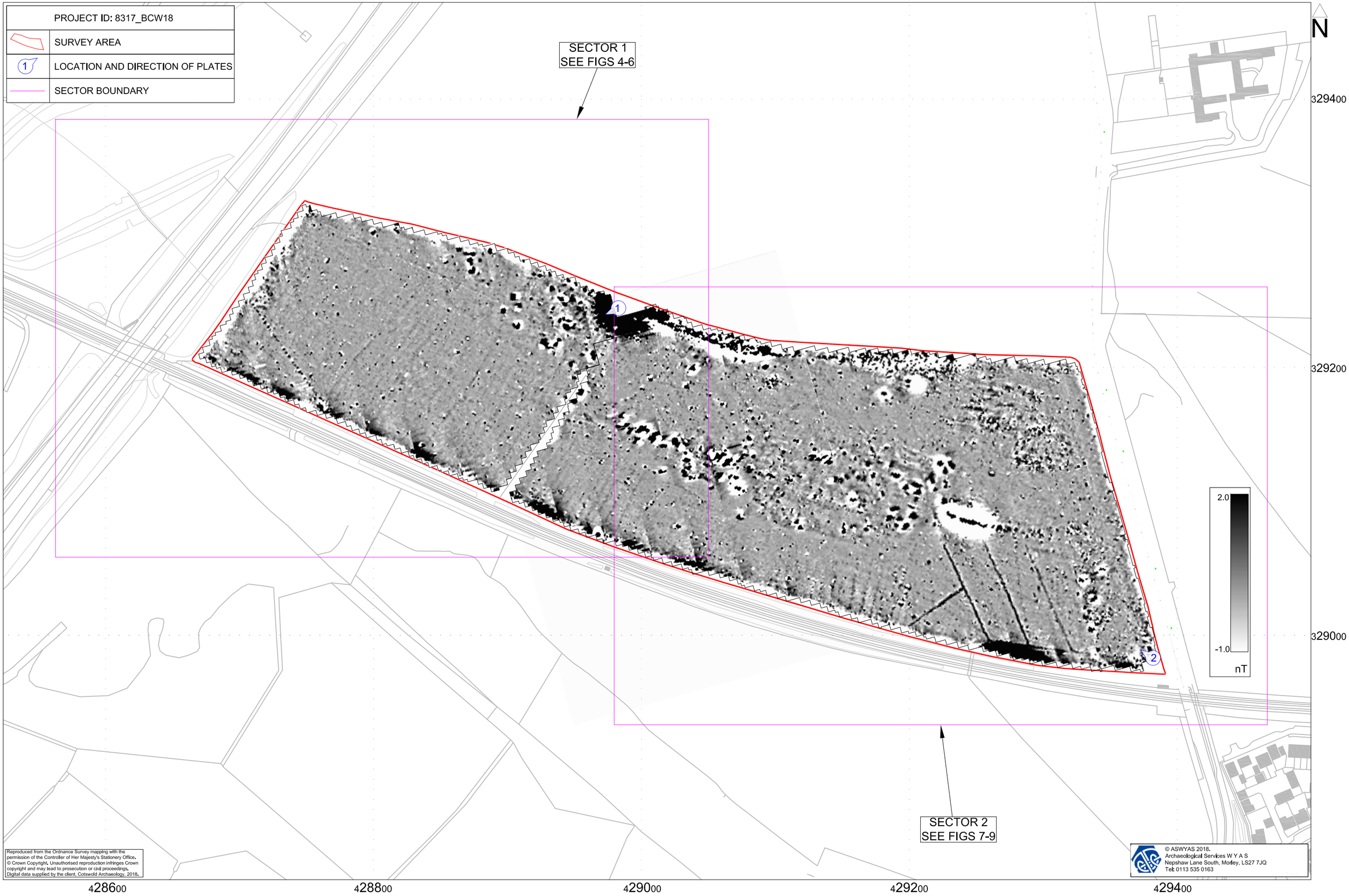

Fig. 2. Survey location showing greyscale magnetometer data (1:2500 @ A3)

0 100m

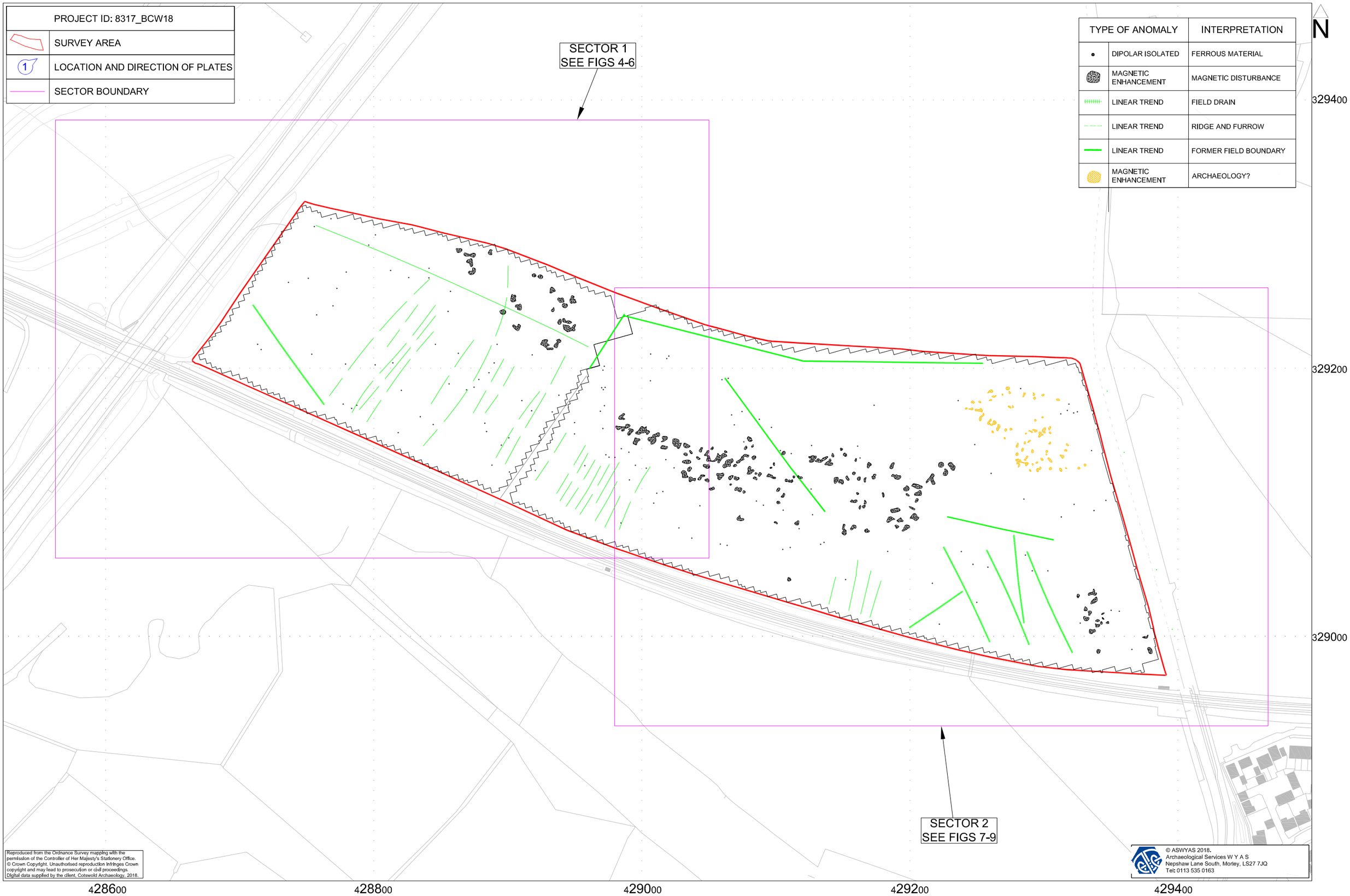

Fig. 3. Overall interpretation of magnetometer data (1:2500 @ A3)

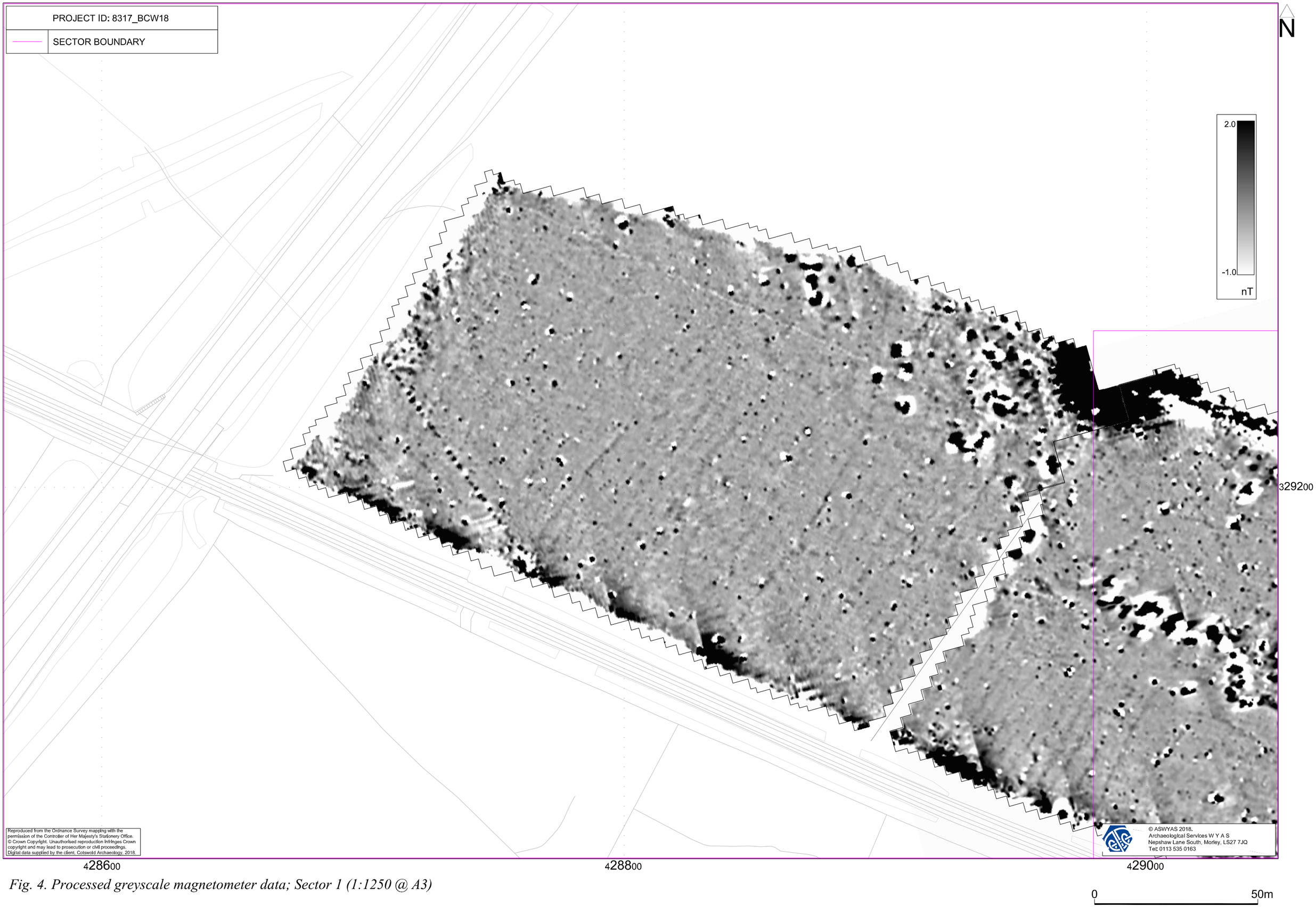

Fig. 4. Processed greyscale magnetometer data; Sector 1 (1:1250 @ A3)

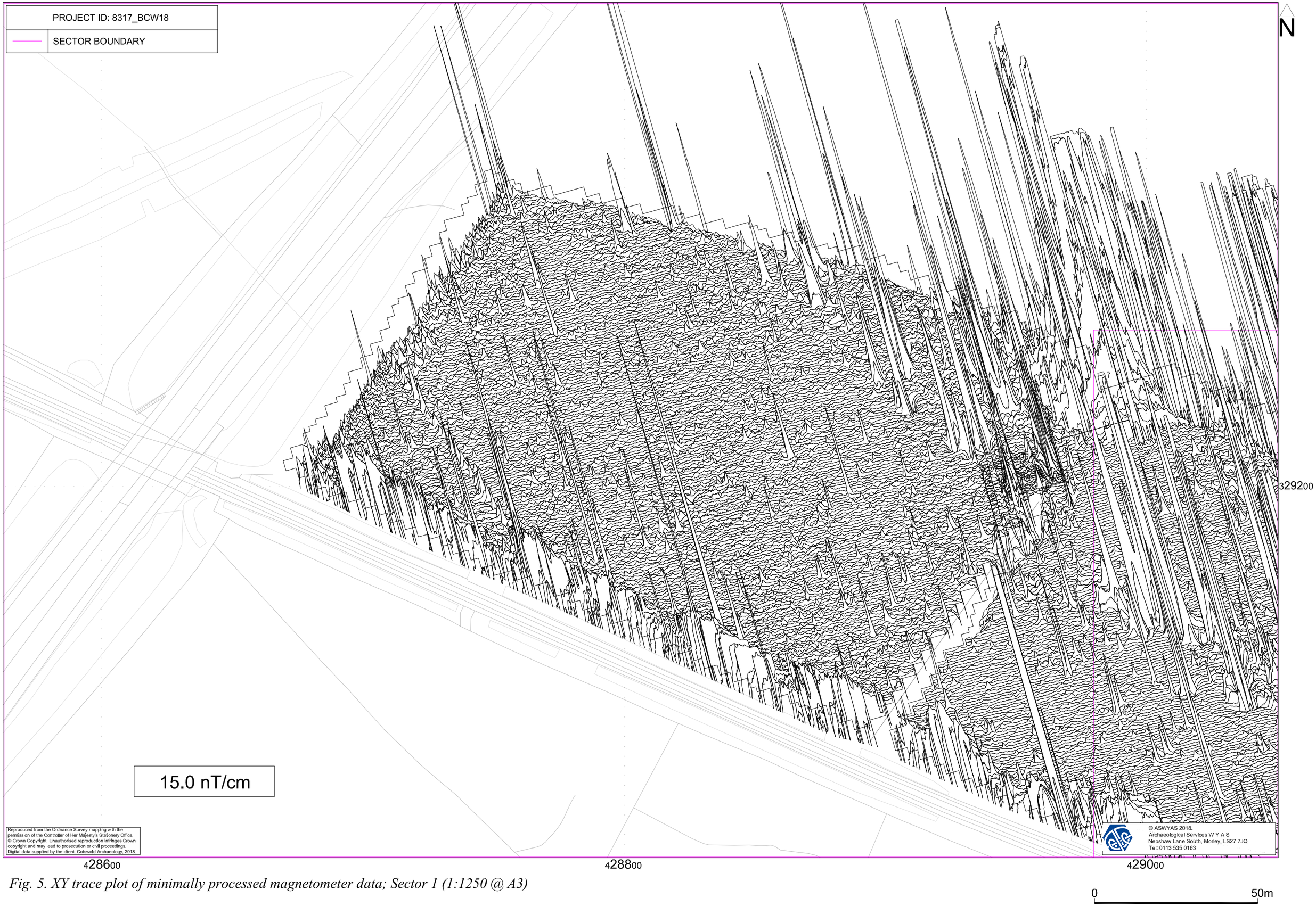

Fig. 5. XY trace plot of minimally processed magnetometer data; Sector 1 (1:1250 @ A3)

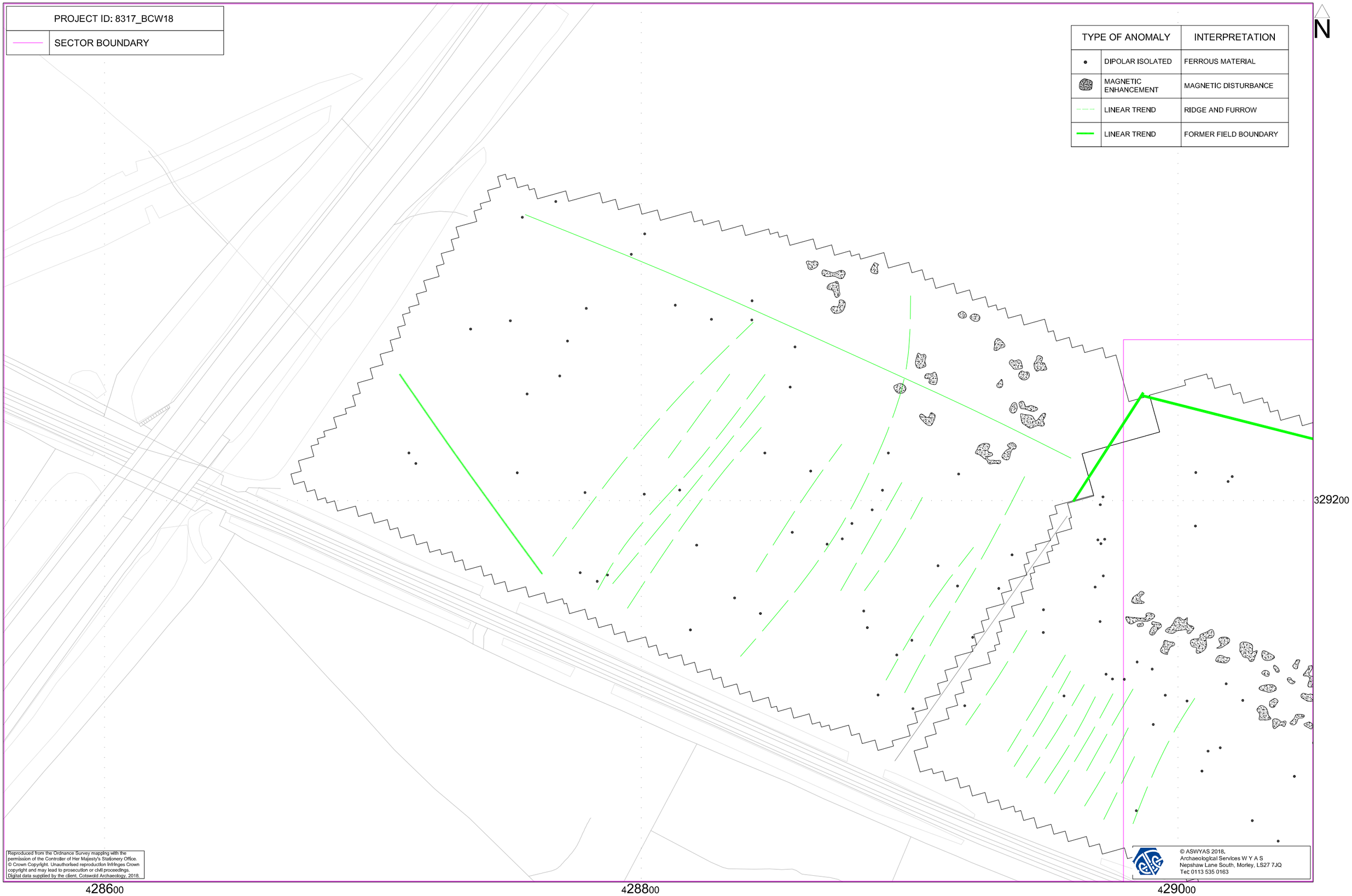

Fig. 6. Interpretation of minimally processed magnetometer data; Sector 1 (1:1250 @ A3)

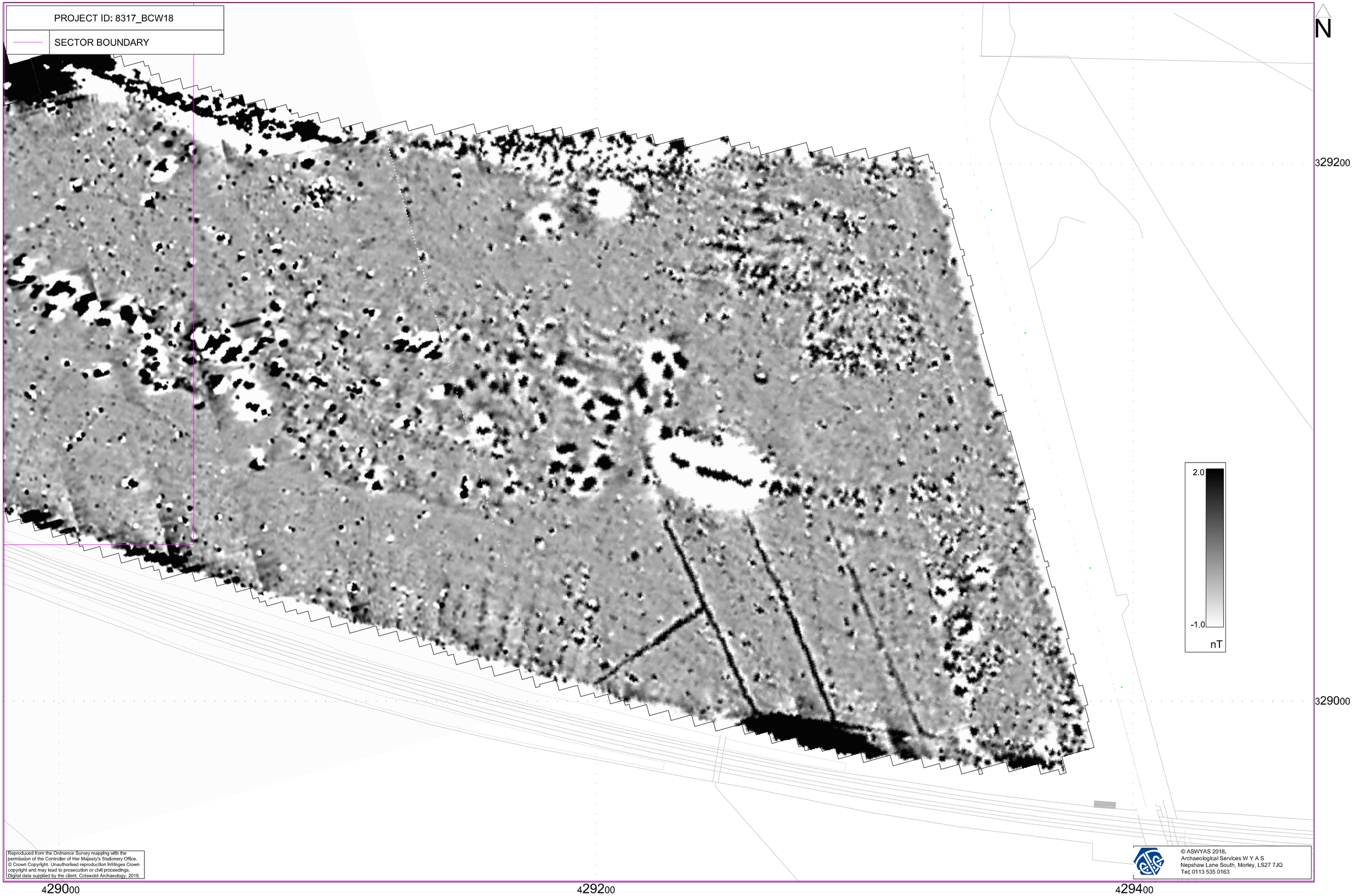

Fig. 7. Processed greyscale magnetometer data; Sector 2 (1:1250 @ A3)

0 50m

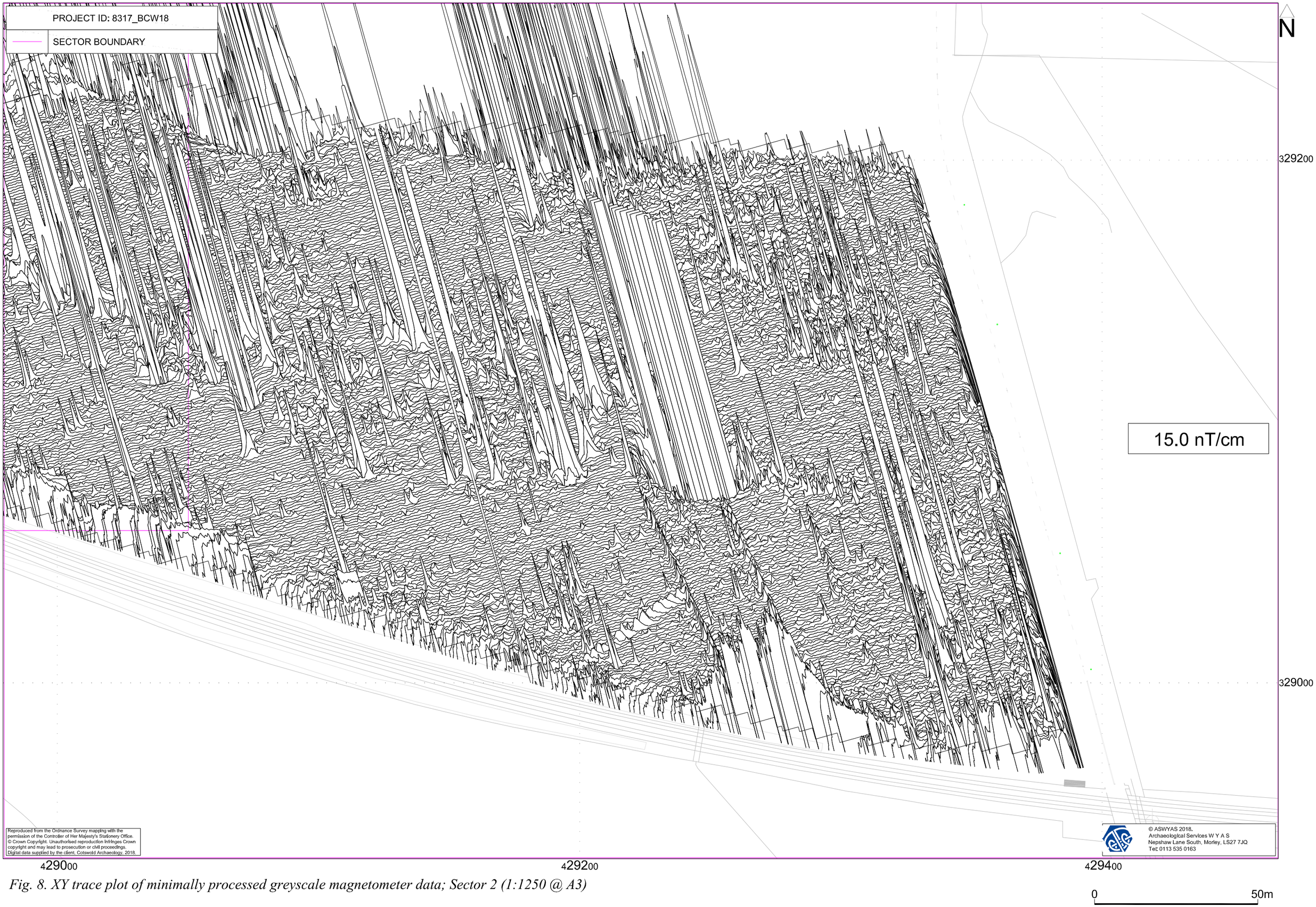

Fig. 8. XY trace plot of minimally processed greyscale magnetometer data; Sector 2 (1:1250 @ A3)

Fig. 9. Interpretation of greyscale magnetometer data; Sector 2 (1:1250 @ A3)

Plate 1. General overview of survey area, facing southwest

Plate 2. General overview of survey area, facing northwest

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. Areas of human occupation or settlement can then be identified by measuring the magnetic susceptibility of the topsoil because 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.

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 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: Gradiometer Survey

The main method of using the fluxgate gradiometer for commercial evaluations is referred to as ***detailed survey*** and requires the surveyor to walk at an even pace carrying the instrument within a grid system. A sample trigger automatically takes readings at predetermined points, typically at 0.25m intervals, on traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation.

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 0.5m 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.

The gradiometer data have been presented in this report in processed greyscale format. The data in the greyscale images have 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.

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.

Appendix 2: Survey location information

An initial survey station was established using a Trimble VRS differential Global Positioning System (Trimble R6 model). The data was geo-referenced using the geo-referenced survey station with a Trimble RTK differential Global Positioning System (Trimble R6 model). The accuracy of this equipment is better than 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 CS6 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 Derbyshire Historic Environment Record).

Appendix 4: Oasis form

OASIS DATA COLLECTION FORM: England

Printable version

OASIS ID: archaeol11-317902

Project details

Project name	Axis 50
Short description of the project	A geophysical (magnetometer) survey, covering approximately 13 hectares was undertaken on land at Burnaston Cross, Willington, Derbyshire. This was ahead of proposed development. Anomalies of an agricultural origin have been identified in the form of, ridge and furrows, former field boundaries and field drains. An area of magnetic disturbance has been detected throughout the central core of the survey area. A collection of possible archaeological anomalies have been identified in the northeast corner. Overall the survey area is deemed to have low archaeological potential.
Project dates	Start: 08-05-2018 End: 10-05-2018
Previous/future work	No / Not known
Any associated project reference codes	8317 - Sitecode
Type of project	Field evaluation
Monument type	NONE None
Significant Finds	NONE None
Methods & techniques	'''Geophysical Survey'''
Development type	Not recorded
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Not known / Not recorded
Solid geology (other)	Mudstone
Drift geology	SAND AND GRAVEL OF UNCERTAIN AGE OR ORIGIN
Techniques	Magnetometry

Project location

Country	England
Site location	DERBYSHIRE SOUTH DERBYSHIRE WILLINGTON Burnaston Cross, Willington

Study area	13 Hectares
Site coordinates	SK 2926 2908 52.858089433397 -1.565382395306 52 51 29 N 001 33 55 W Point
Height OD / Depth	Min: 49m Max: 55m

Project creators

Name of Organisation	Archaeological Services WYAS
Project brief originator	Cotswold Archaeology
Project design originator	Cotswold Archaeology
Project director/manager	E Brunning
Project supervisor	A. Trace

Project archives

Physical Archive Exists?	No
Digital Archive recipient	Cotswold Archaeology
Digital Contents	"Survey"
Digital Media available	"Geophysics","Images raster / digital photography","Survey","Text"
Paper Archive Exists?	No

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Axis 50, Willington, Derbyshire
Author(s)/Editor(s)	Sykes, C
Date	2018
Issuer or publisher	ASWYAS
Place of issue or publication	Leeds
Description	A4 report with A3 figures

Entered by	Emma Brunning (emma.brunning@aswyas.com)
Entered on	3 August 2018

Cookies Privacy Policy

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