WYAS Archaeological Services

Holme Wood Lane

Armthorpe

South Yorkshire

Geophysical Survey

Report no. 3469
September 2020

Client: Archaeology Collective

West Yorkshire Joint Services

Land at Holme Wood Lane
Armthorpe
South Yorkshire

Geophysical Survey

Summary

A geophysical (magnetometer) survey was undertaken on approximately 23 hectares of land located to the east of Armthorpe at Holme Wood Lane, South Yorkshire. Anomalies of a possible archaeological origin have been detected along with field drains, former field boundaries and modern ploughing. Geological responses within the dataset are likely to be from the sand pits used for extraction. Magnetic disturbance within the survey area relate to overhead power lines, an old track and modern debris. Based on the results of the magnetic survey, the archaeological potential of the site is moderate in the east and low elsewhere.

WYAS
Archaeological Services

Report Information

Client:	Archaeology Collective
Address:	The Office Leeds, 1 Aire Street, Leeds, LS1 4PR
Report Type:	Geophysical Survey
Location:	Armthorpe
County:	South Yorkshire
Grid Reference:	SE 6547 0559
Period(s) of activity:	?Prehistoric / modern
Report Number:	3469
Project Number:	X633
Site Code:	HDL20
OASIS ID:	archaeol1-404371
Date of fieldwork:	August 2020
Date of report:	September 2020
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Document Issue Record

Ver	Status	Author(s)	Reviewer	Approver	Date
1.0	Issue	EB	DW	DW	Sept 2020

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1 Introduction

Archaeological Services ASWYAS has been commissioned by Archaeology Collective to undertake a geophysical survey at land at Holme Wood Lane, Armthorpe, South Yorkshire. This was undertaken in line with current best practice (CIfA 2014; Schmidt *et al.* 2015). The survey was carried out between 24th and 26th August 2020 to provide additional information on the archaeological resource of the Site.

Site location, topography and land-use

The survey areas are located to the east of Armthorpe, centred at SE 6547 0559 and totals approximately 23ha (see Fig. 1). The survey area is bound to the east by the M18 motorway, to the south and east by Holme Wood Lane and to the north by a motocross circuit. The site lies between 2m aOD (above Ordnance Datum) and 7m aOD with the highest point of the Site located towards the south-west corner. The lowest part of the site was situated next to the motorway.

Soils and geology

The underlying bedrock of the site belongs to the Chester Formation comprising sandstone and gravels. Sedimentary bedrock formed approximately 247 to 250 million years ago in the Triassic period. Superficial deposits comprise the Hemingbrough Glaciolacustrine Formation of clay and silts and of the Breighton Sand Formation (BGS 2020). The soils of this area comprise slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils (soilscape 18) (CSAI 2020).

2 Archaeological Background

The archaeological background below is taken from a HER search conducted by Archaeology Collective and covers a 1km radius from the site.

Approximately 700m to the north-west of the survey area an Iron Age or Romano-British complex of small conjoined enclosures (SMR number 033358/01) which probably represent a farm have been recorded on aerial photographs.

A geophysical survey conducted by GSB Prospection in 2005 (SMR number 04924 also event ID ESY643) along a corridor to the west of the M18 recorded a series of anomalies that may correspond to a prehistoric field system, they have yet to be proved to be of an archaeological origin.

To the south-east of the survey area a prehistoric field system and possible stock enclosures have been recorded though gradiometer survey and evaluation trenching (SMR number 04923 also event IDs ESY641 and ESY1386)

Immediately to the east of the survey area a heavy anti-aircraft gun battery is recorded at Holme Wood (SMR number 04707). The exact location of the battery is unknown.

Previous works surrounding the survey areas include a geophysical survey (ESY641) of several fields at Huggin Lakes. A concentration of linear responses interpreted as ditches were detected, appearing to comprise an old field system or possible settlement area.

A geophysical survey of Low Grounds Farm (ESY253) indicated the presence of former field systems and linear and pit type anomalies of unknown date.

An archaeological evaluation at West Moor Park to the south-west of the survey area (ESY120) was undertaken by ASWYAS in January 2005, no evidence of any archaeological activity was identified.

3 Aims, Methodology and Presentation

The aims and objectives of the programme of geophysical survey were to gather sufficient information to establish the presence/absence, character and extent, of any archaeological remains within the specific area and to inform an assessment of the archaeological potential of the site. To achieve this aim, a magnetometer survey covering all amenable parts of the Site 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 survey was undertaken using an eight channel SenSYS MX V3 system containing eight FGM650 sensors was undertaken. Readings are taken every 20MHz (between 0.05 and 0.1m). Data will be recorded onto a device, using a Carlson GNSS Smart antenna, for centimetre accuracy. These readings were stored in the memory of the instrument and downloaded for processing and interpretation. DLMGPS and MAGNETO software, alongside bespoke in-house 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 the survey location at a scale of 1:5000. Figure 3 shows an overview of the processed data at a scale of 1:2500 whilst Figure 4 shows an overview of the interpretation at the same scale. Minimally processed data, together with interpretation of the survey results are presented in Figures 5 to 10 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 the European Archaeological Council (Schmidt *et al*. 2015) 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 2 to 10)

Ferrous anomalies and magnetic disturbance

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 disturbance (**F1**) bisects the northern half of the data on an east to west alignment, this corresponds with an overhead power line that have caused electromagnetic interference within the data. The area of disturbance is, however, much higher that would be expected so it is also possible that a service pipe follows the same alignment, or the area have been highly disturbed during the installation of the overhead powerlines.

Magnetic disturbance (**F2**) leading from Holme Wood Grange (marked West Moor Farm on the 1st edition OS mapping), in the north of the site, towards the north-west corner corresponds to a track marked on the Ordnance Survey mapping dating from 1854. Given the magnetic signature, the material used for the track could be rich in ferrous material. This track also leads to a feature noted as the Wood House Sewer as such it is also likely that there are former services or drains running from Holme Wood Grange to this open sewer.

A further band of disturbance (**F3**) in the western section of the data follows a north-west to south-east alignment and corresponds to a drain or large field boundary marked on the 1854 map.

Magnetic disturbance in the south-eastern area is likely to be caused by the former quarrying and the dumping of ferrous material within an areas of extraction. This area of the Site is also in close proximity to the access roads and it is likely that some of the ferrous responses are generated by dumped material.

Geological anomalies

The survey has detected a handful of anomalies that have been interpreted as geological in origin. It is thought that the responses have been detected because of the variation in the composition and depth of the deposits of superficial material in which they derive. These are particularly evident in the south-east of the survey area and are likely to also have a connection with the former sand pits.

Agricultural anomalies

In the south-west of the survey area, field drains are particularly evident. They have been recorded on differing alignments, leading into a central drain which is on a north-east to south-west orientation.

Former field boundaries have been recorded throughout the survey area (**A1 – A6**). The majority of these apart from **A1** are recorded on mapping dating from 1854 (OM 2020). The boundary at **A6** has been removed by 1891, whilst **A5** removed by 1982. Boundaries **A2** to **A4** are all still recorded on the published OS map of 1986. Boundary **A4** appears to show a double-ditched feature, it is possible that this feature is of slightly more interest than a field boundary such as a trackway. Parch marks can be seen in aerial imagery dated 2002 (Google Earth) of the latter boundaries, so have therefore been removed sometime between 1986 and 2002.

Parallel linear trends can be seen within all areas and are associated with modern ploughing cultivation.

Possible archaeological anomalies

Anomalies of a possible archaeological origin have been recorded within the eastern half of the dataset. The majority of these are linear trends and may possibly represent former field systems. Field boundaries such as these tend to form a series of rectilinear fields locally described as 'brickwork' type fields (Riley 1980, Chapter 3) and these types may indicate later divisions as land became integrated into more organised field systems later in the Roman period (Roberts *et al.* 2010, 58).

Given the poor contrast likely between the archaeological fill material and the sandy natural caution is suggested as the responses are parallel and an agricultural origin is also just as likely.

5 Conclusions

The geophysical survey has detected a number of magnetic anomalies including linear trends of a possible archaeological origin, along with former field boundaries, field drains and modern ploughing. The agricultural anomalies dominate the data set making it problematic to distinguish archaeological anomalies. This is further compounded by the archaeological fill material which is likely to be very similar to the natural deposits and therefore not provide a good contrast.

Magnetic disturbance within the survey area relate to overhead power lines, an old track and modern debris. Based on the results of the magnetic survey, the archaeological potential of the site is moderate in the east and low elsewhere.

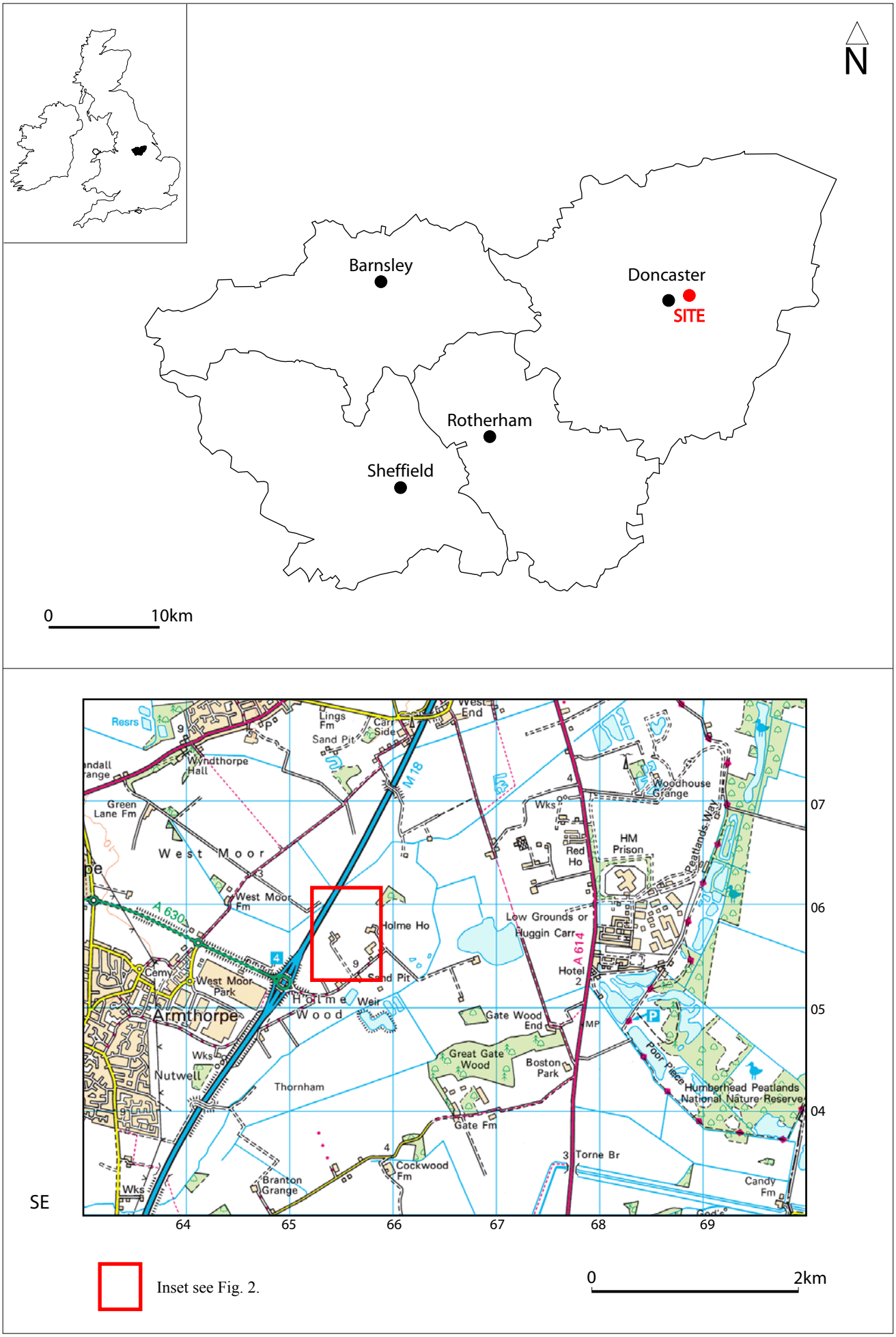

Fig. 1. Site location

PROJECT ID: X633_HDL20	
	UNSURVEYABLE
	SURVEY AREA
	PREVIOUS AREA OF INVESTIGATION
	ENTIRE AREA
	CROPMARKS

Area 1

Area 2

Area 3

Area 4

N

406000

2.0

-1.0

nT

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465000

466000

0 200m

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

PROJECT ID: X633_HDL20

UNSURVEYABLE

SECTOR BOUNDARY

SECTOR 1
SEE FIGS 5-6

SECTOR 2
SEE FIGS 7-8

SECTOR 3
SEE FIGS 9-10

West Moor

Holme Wood

Holme House Farm

Holmewood Piggeries

Waterton Drain

N

405800

405600

405400

2.0

-1.0

nT

4650 00

4652 00

4654 00

4656 00

4658 00

0

100m

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Fig. 3. Overview greyscale of magnetometer data (1:2500 @ A3)

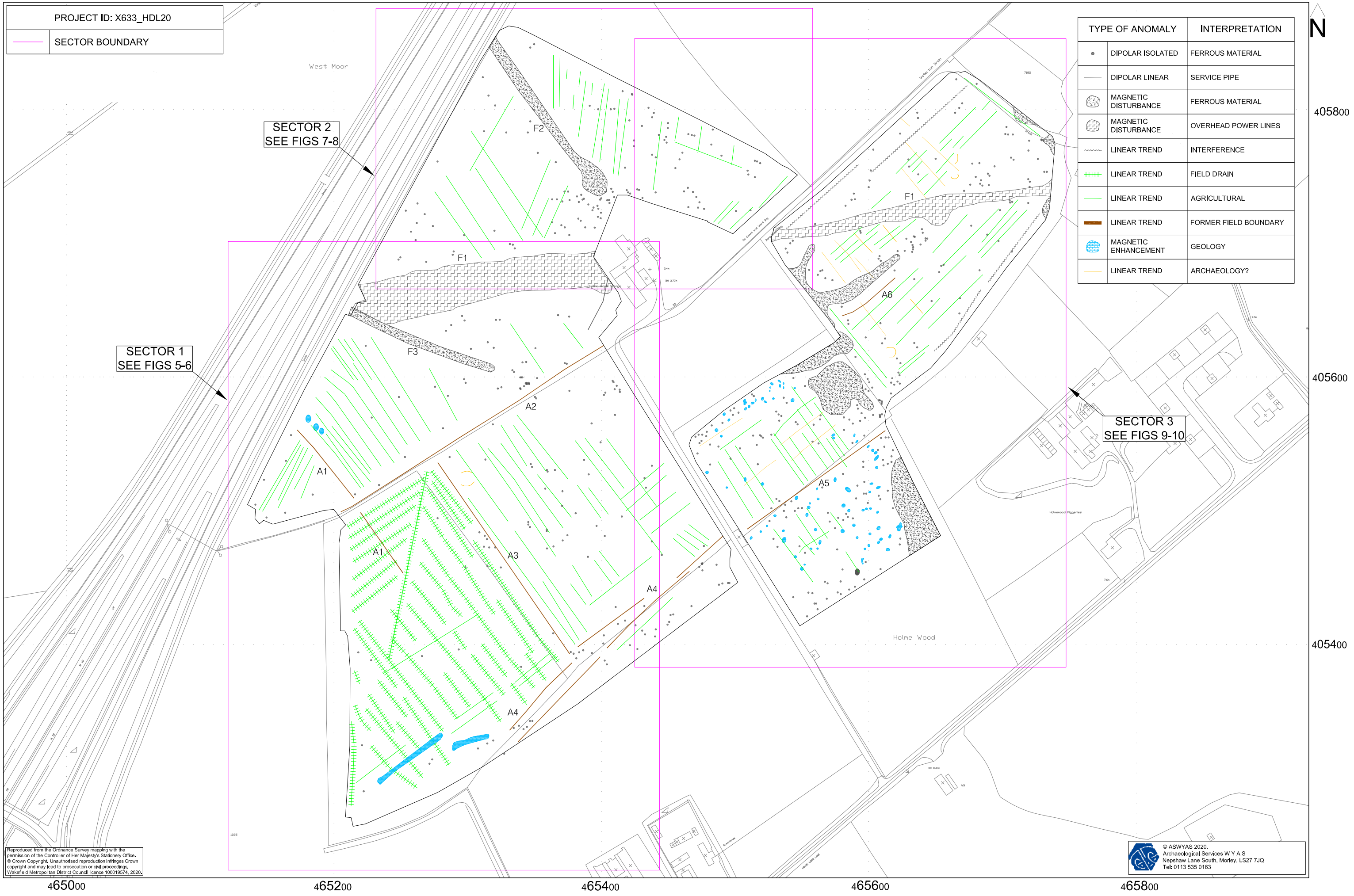

Fig. 4. Overview interpretation of magnetometer data (1:2500 @ A3)

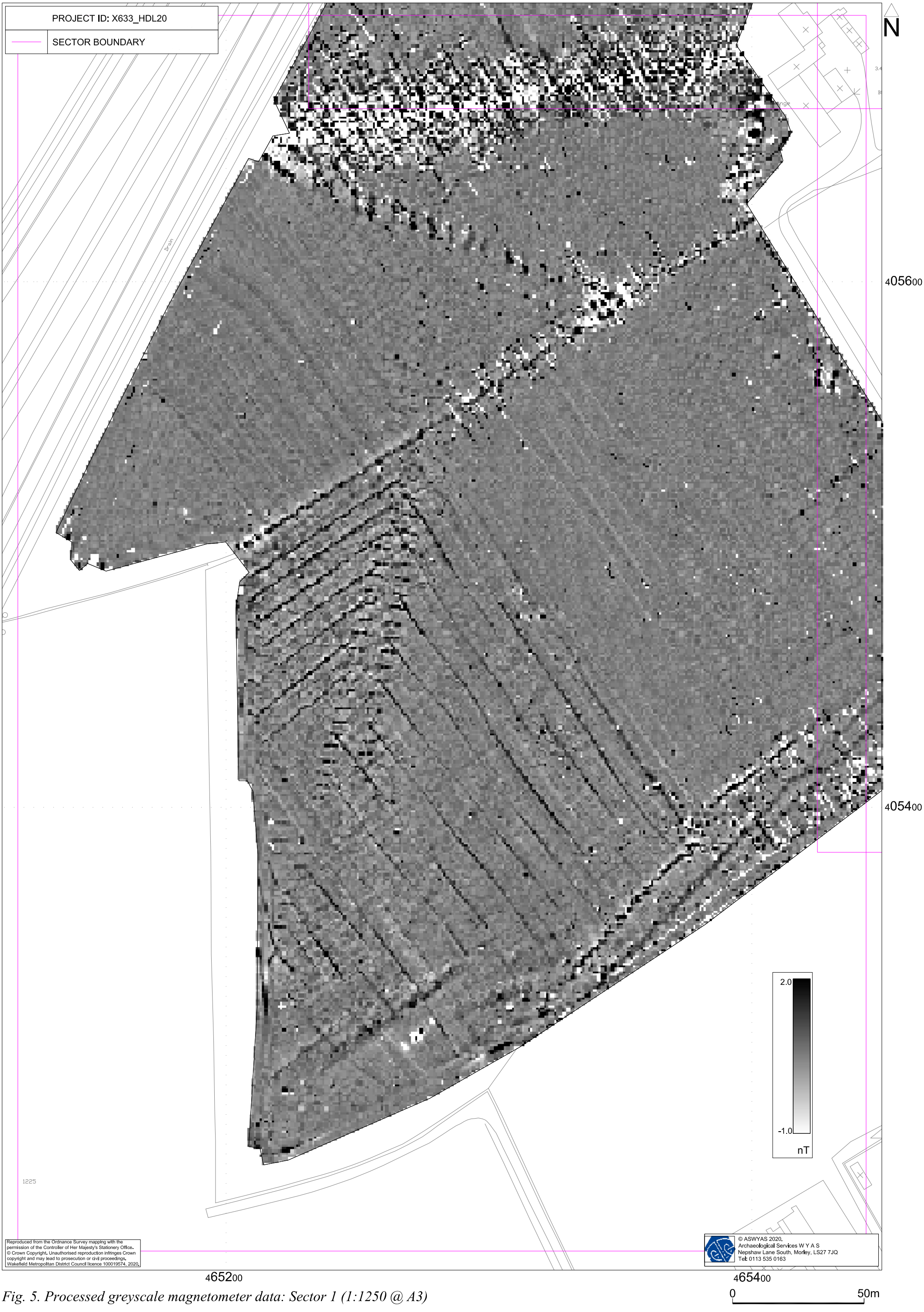

Fig. 5. Processed greyscale magnetometer data: Sector 1 (1:1250 @ A3)

PROJECT ID: X633_HDL20

SECTOR BOUNDARY

N

F1

F3

A1

A1

A2

A3

A4

A4

Holme Wood Grange

Drain

4056 00

4054 00

TYPE OF ANOMALY		INTERPRETATION
•	DIPOLAR ISOLATED	FERROUS MATERIAL
	DIPOLAR LINEAR	SERVICE PIPE
	MAGNETIC DISTURBANCE	OVERHEAD POWER LINES
	LINEAR TREND	FIELD DRAIN
	LINEAR TREND	AGRICULTURAL
	LINEAR TREND	FORMER FIELD BOUNDARY
	MAGNETIC ENHANCEMENT	GEOLOGY
	LINEAR TREND	ARCHAEOLOGY?

2.0

-1.0

nT

1225

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4652 00

4654 00

0 50m

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

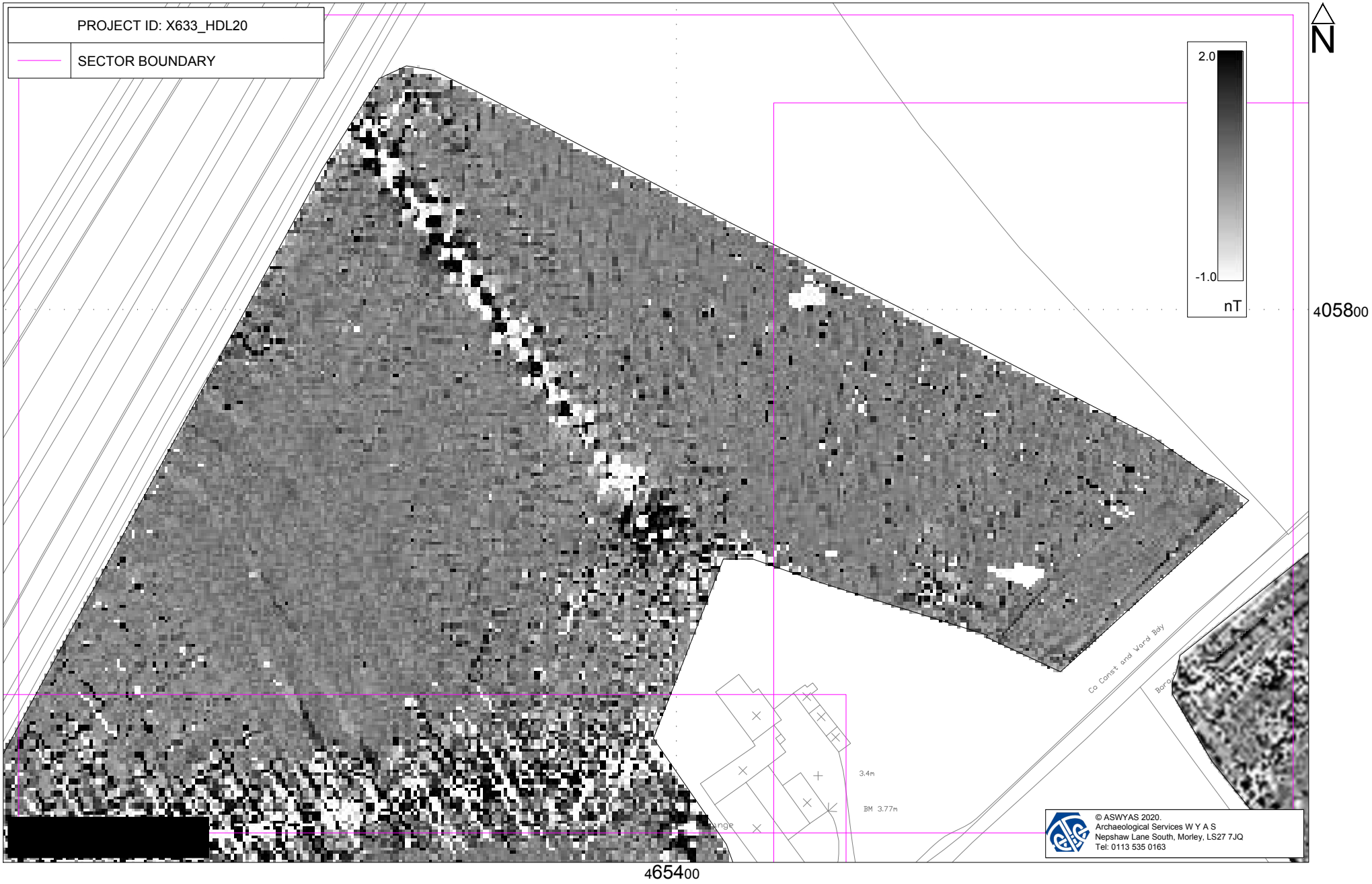

Fig. 7. Processed greyscale magnetometer data: Sector 2 (1:1250 @ A4)

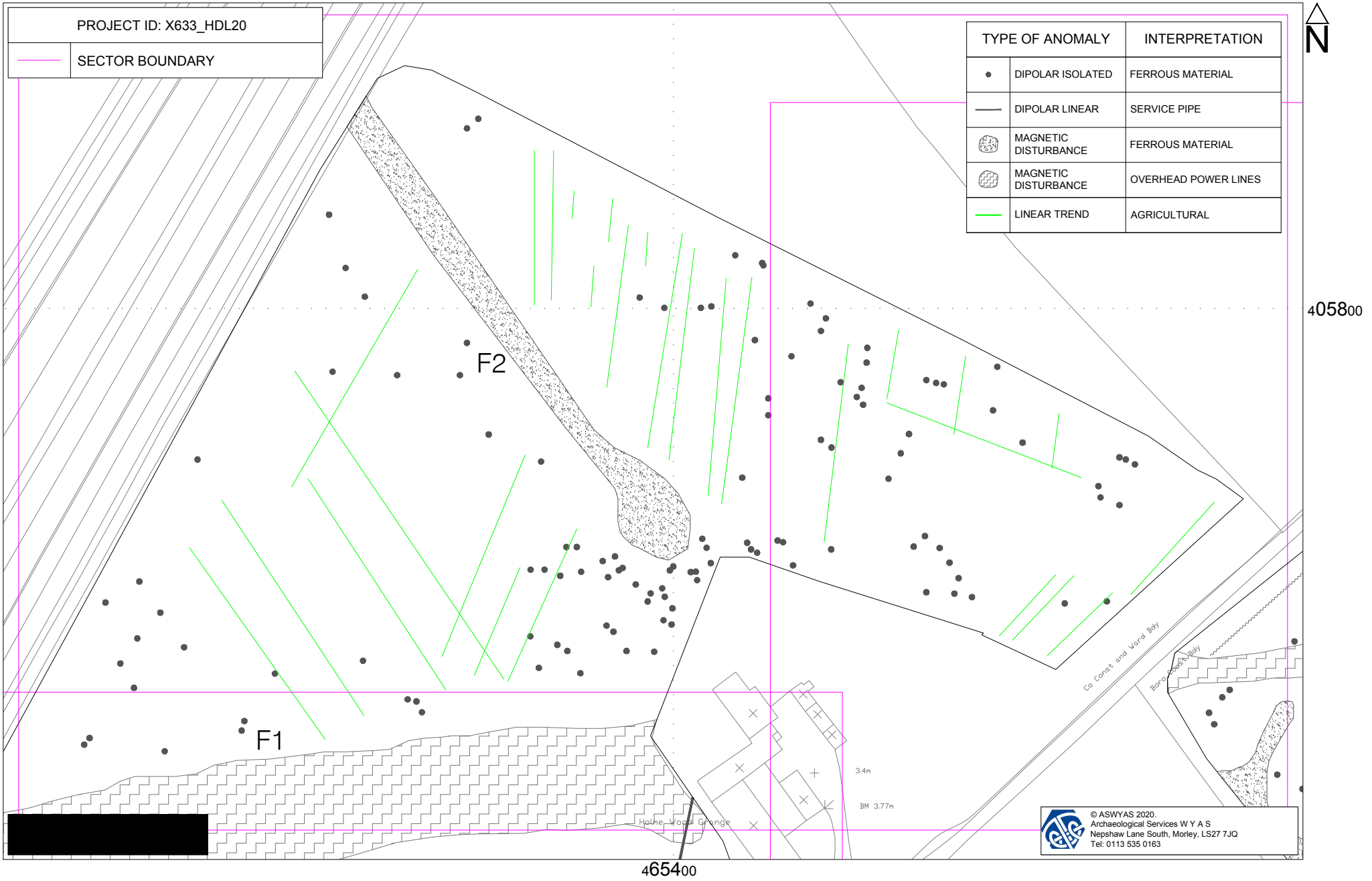

Fig. 8. Interpretation of magnetometer data: Sector 2 (1:1250 @ A4)

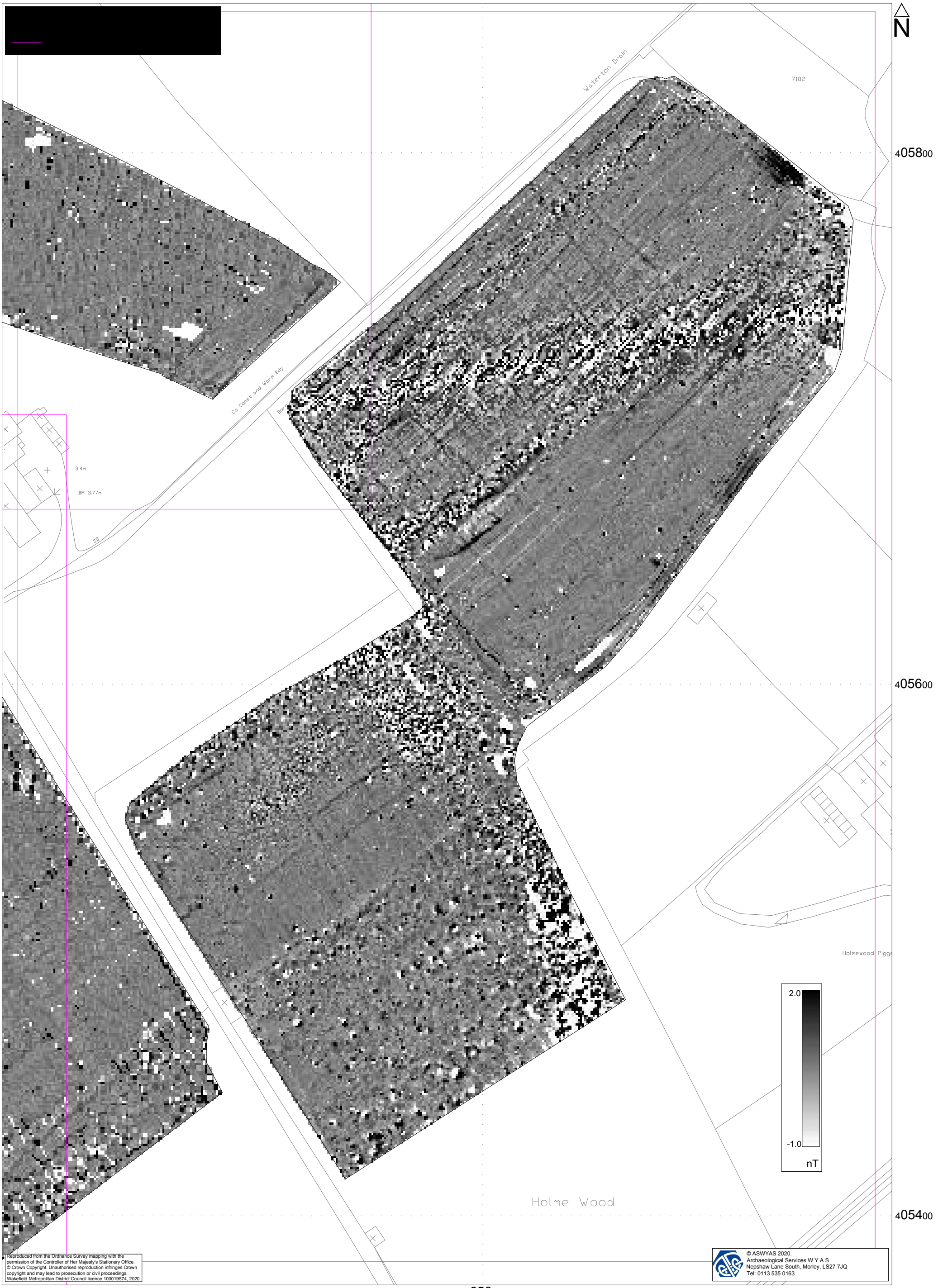

Fig. 9. Processed greyscale magnetometer data: Sector 3 (1:1250 @ A3)

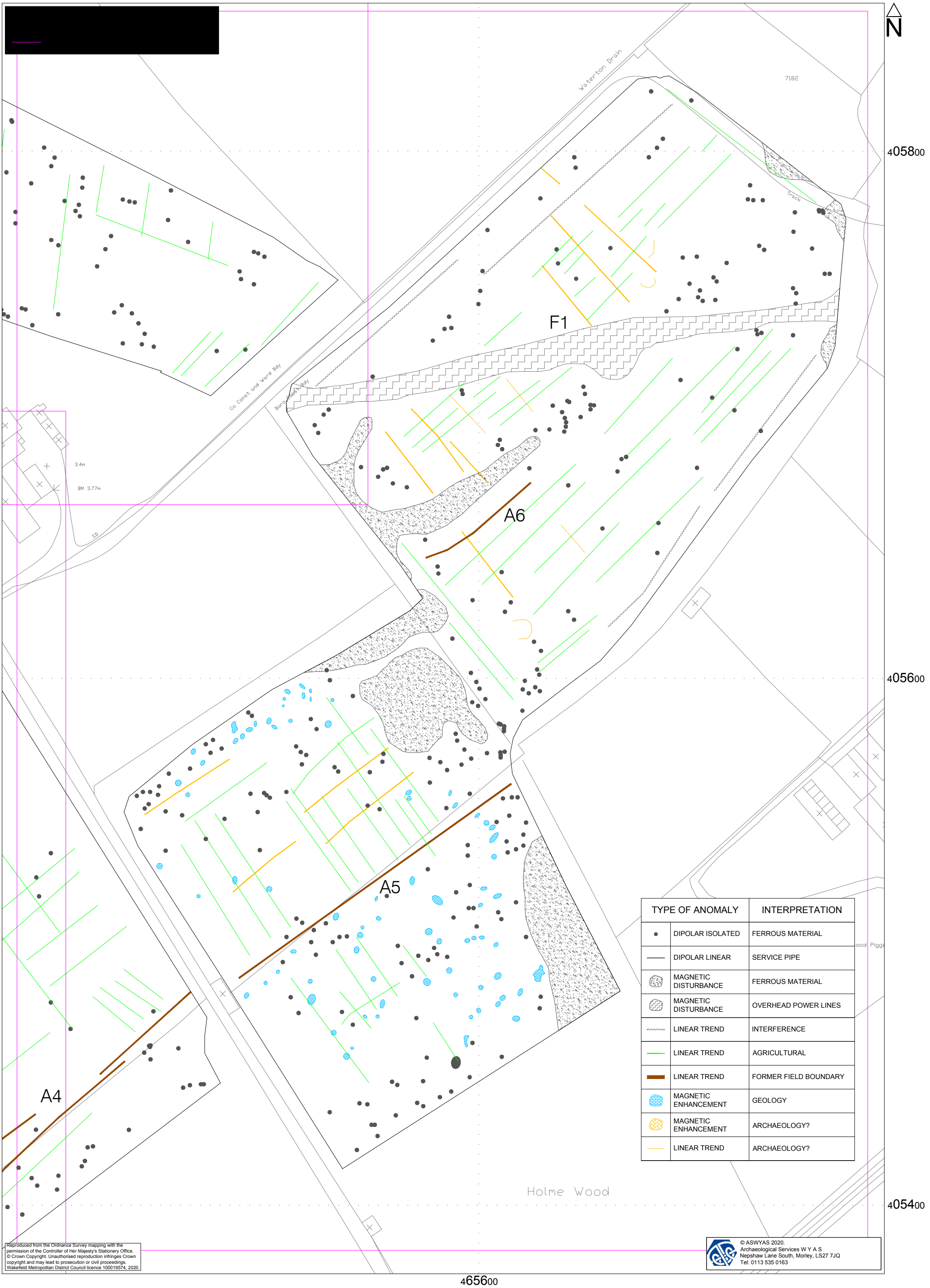

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Fig. 10. Interpretation of magnetometer data: Sector 3 (1:1250 @ A3)

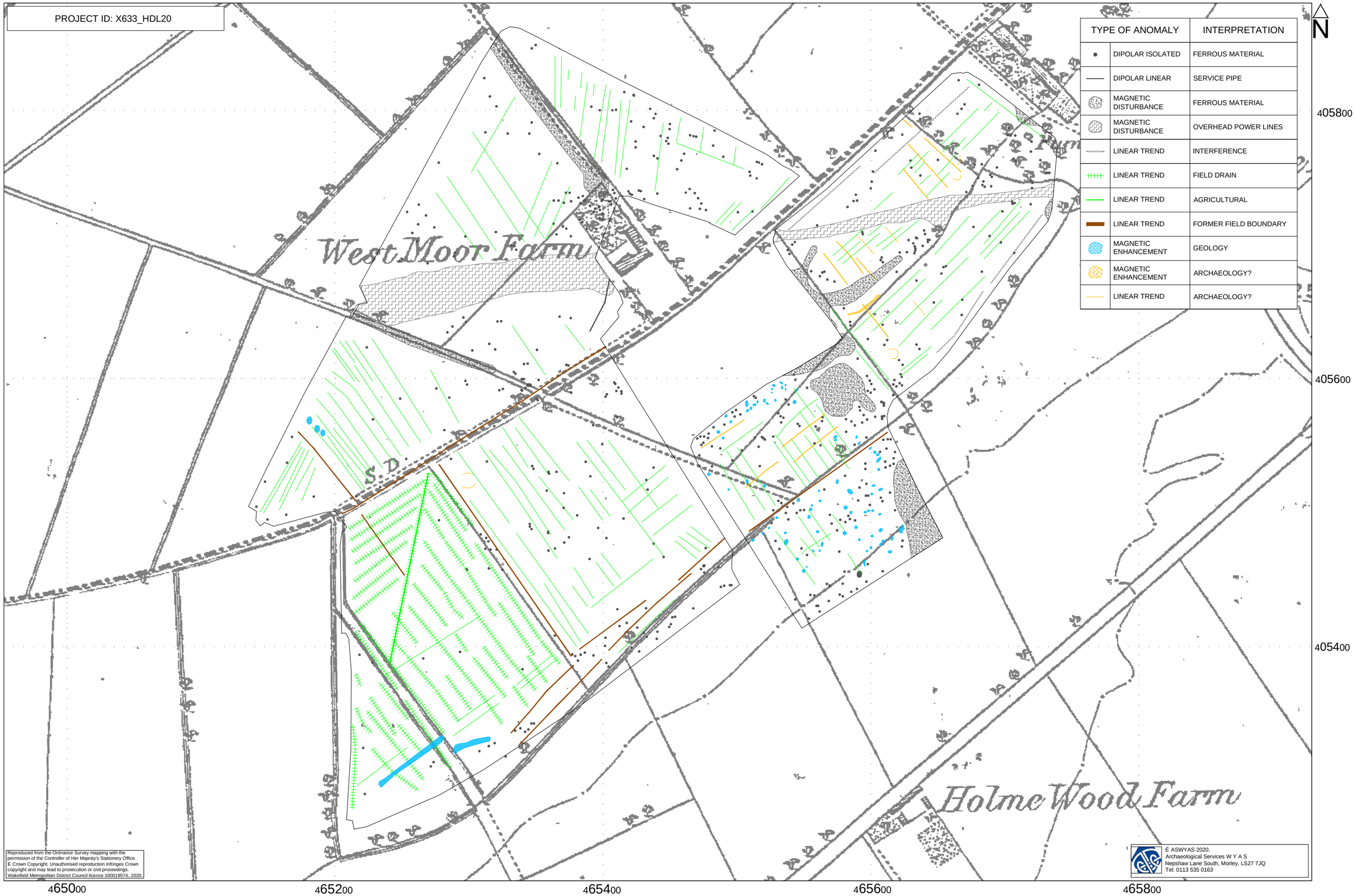

Fig. 11. Overview interpretation of magnetometer data with 1st Edition OS mapping (1:2500 @ A3)

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. 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 an eight channel Sensys MX V3 system containing eight FGM650 sensors was used which was towed across the area using an ATV. Readings were taken every 20MHz (between 0.05 and 0.1m). Data was be recorded onto a device, using a Carlson GNSS Smart antenna, for centimetre accuracy. These readings were stored in the memory of the instrument and downloaded for processing and interpretation

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.

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 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 South Yorkshire Historic Environment Record).

Appendix 4: Oasis form

OASIS DATA COLLECTION FORM: England

OASIS ID: archaeol11-404371

Project details

Project name	Land at Holme Wood Lane, Armthorpe
Short description of the project	A geophysical (magnetometer) survey was undertaken on approximately 23 hectares of land located to the east of Armthorpe at Holme Wood Lane, South Yorkshire. Anomalies of a possible archaeological origin have been detected along with field drains, former field boundaries and modern ploughing. Geological responses within the dataset are likely to be from the sand pits used for extraction. Magnetic disturbance within the survey area relate to overhead power lines, an old track and modern debris. Based on the results of the magnetic survey, the archaeological potential of the site is moderate in the east and low elsewhere.
Project dates	Start: 24-08-2020 End: 26-08-2020
Previous/future work	No / Not known
Any associated project reference codes	X633 - Sitecode
Type of project	Field evaluation
Monument type	NONE None
Significant Finds	NONE None
Methods & techniques	"Geophysical Survey"
Development type	Mineral extraction (e.g. sand, gravel, stone, coal, ore, etc.)
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Not known / Not recorded
Solid geology (other)	Sandstone and Gravels
Drift geology	LACUSTRINE CLAYS, SILTS AND SANDS
Techniques	Magnetometry

Project location

Country	England
Site location	SOUTH YORKSHIRE DONCASTER ARMTHORPE Land at Holme Wood Lane
Study area	23 Hectares
Site coordinates	SE 6547 0559 53.542619864302 -1.01190201432 53 32 33 N 001 00 42 W Point
Height OD / Depth	Min: 2m Max: 5m

Project creators

Name of Organisation	Archaeological Services WYAS
Project brief originator	Archaeological Collective
Project design originator	Archaeology Collective
Project director/manager	E Brunning
Project supervisor	C. Sykes

Project archives

Physical Archive Exists?	No
Digital Archive recipient	Archaeology Collective
Digital Contents	"Survey"
Digital Media available	"Geophysics","Survey","Text"
Paper Archive Exists?	No

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Land at Holme Wood Lane, Armthorpe
Author(s)/Editor(s)	Brunning, E
Date	2020
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	25 September 2020

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