WYAS Archaeological Services

Lansdowne Court,
Carlisle,
Cumbria

Geophysical Survey

Report no. 3626
September 2021

Client: Partner Construction

Lansdowne Court,
Carlisle,
Cumbria

Geophysical Survey

Summary

The geophysical survey has detected a number of magnetic anomalies associated with the former cultivation of the site, consisting of former field boundaries, modern ploughing and field drains. Magnetic disturbance, along the southern part of Field 2 relates to a modern service whilst other areas of disturbance around the periphery of the fields are due to metal fencing within the boundaries. Geological anomalies have been recorded throughout due to variations within the soils. Uncertain anomalies within the dataset may have an archaeological origin although a geological cause is also possible. Based on the results of the geophysical survey the site is considered to have a low potential for the presence of archaeological remains.

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Report Information

Client:	Partner Construction
Address:	Ribble House, Mandale Business Park, Belmont, Durham DH1 1TH
Report Type:	Geophysical Survey
Location:	Lansdowne Court, Carlisle
County:	Cumbria
Grid Reference:	NY 40395 58147
Period(s) of activity:	Modern
Report Number:	3626
Project Number:	XC65
Site Code:	LDC21
OASIS ID:	archaeol11-502266
Date of fieldwork:	August 2021
Date of report:	September 2021
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Document Issue Record

Ver	Author(s)	Reviewer	Approver	Date
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1 Introduction

Archaeological Services ASWYAS has been commissioned by Lanpro Services on behalf of Partner Construction to undertake a geophysical survey of land at Lansdowne Court, Carlisle, Cumbria. This was undertaken in line with current best practice (CIfA 2014; Schmidt *et al.* 2015). The survey was carried out between 9th and 10th August 2021 to provide additional information on the archaeological resource of the Site.

Site location, topography and land-use

The Site is located at NY 40395 58147 (approximate centre), comprising *c*. 7ha over two fields situated to the north-east of Carlisle (see Fig. 1).

The Site is situated to the east of Lansdowne Court with land consisting of pasture, arable and rough ground (see Plates 1-2). It is bounded to the south by woodland, to the north by residential dwellings, and to the east by pasture fields. A mature hedge runs between the two fields. A watercourse runs along the southern boundary. The site lies at 29m (above Ordnance Datum) aOD in the north, falling to approximately 23m aOD in the south.

Soils and geology

The recorded bedrock geology comprises Mercia Mudstone Group– mudstone, a sedimentary bedrock that formed approximately 201 to 252 million years ago in the Triassic Period. Superficial deposits have been recorded as Till, Devensian across the majority of the Site. A band of alluvium (clay, silt, sand and gravel) is recorded bisecting the western areas on a northeast to southwest alignment (BGS 2021). Soils are described as slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils (Landis 2021).

2 Archaeological Background

The following archaeological background is taken from an online version of the Cumbria Historic Environment Record, using a search radius of 500m. It is designed to give a broad indication of the archaeological potential within the Site boundary and also the wider area.

Previous work in the vicinity of the Site includes a detailed resistivity survey of the presumed site of the milecastle, which located a structure 480m to the south-east of the Site. A small test-trench across one of the walls showed that the milecastle survived to a minimum of two courses of foundation stones. The geophysical survey also suggested that a considerable part of the internal cobble flooring remains *in situ*. A sword and altar were supposedly found here in the 19th century.

The early history of Carlisle is marked by its status as a Roman settlement, established to serve the forts on Hadrian's Wall (McCarthy 2017). Within the Site boundary stray finds of

Roman metal studs and coins have been found. To the immediate south of the Site at Beech Grove Farmstead both Iron Age and Romano-British earthworks have been identified.

Hadrian's Wall has been traced as slight broad depression in pasture 500m to the east of the Site and has been excavated to the immediate south of the Site, revealing a 6.5m wide ditch with a berm between the wall and ditch. The wall is marked on OS maps as running to the south of the Site on a north-east to south-west alignment. An altar to Mars Cocidius was found in 1804 in cutting a drain across the line of the Wall west of Tarraby, 500m to the south-east of the Site.

During the medieval period, because of its proximity to the Kingdom of Scotland, Carlisle became an important military stronghold; Carlisle Castle, which is still relatively intact, was built in 1092 by William Rufus, and once served as a prison for Mary, Queen of Scots in 1568. The castle now houses the Duke of Lancaster's Regiment and the Border Regiment Museum. In the early 12th century, Henry I allowed the foundation of a priory in Carlisle. The town gained the status of a city, when its diocese was formed in 1133 and the priory became Carlisle Cathedral.

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 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. 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 magnetometer data at a scale of 1:2000 whilst Figure 3 shows an overview of the interpretation at the same scale. Processed and minimally processed data, together with interpretation of the survey results are presented in Figures 4 to 9 inclusive at a scale of 1:1000.

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 4 to 9)

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.

Along the southern edge of Field 2, two linear dipolar trends (**F1**) has been recorded which are likely to be buried services.

Magnetic disturbance along the limits of the survey areas are due to metal fencing within the field boundaries and interference from the adjacent roads.

Further isolated areas of magnetic disturbance with the survey area such as **F2**, are most likely the product of former telegraph poles that have been removed.

Geological anomalies

The survey has detected a number 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.

To some degree, ploughing has also spread magnetic material across the site making it difficult to determine any coherent patterns. Fragmented, negative linear responses have also been interpreted as geological in origin. They likely represent desiccation cracks in the subsurface due to evaporated water that was once deposited in the soil.

Agricultural anomalies

Former field boundaries (**FB1**, **FB2** and **FB3**) have been detected in both fields which are recorded on first edition OS mapping dating from 1866-1869 (NLS 2021), but by the middle of the 20th century they have been removed.

Parallel linear trends can be seen within all areas and are associated with modern ploughing. The majority of these follow the current layout of the fields. Within the northern part of Field 2 there are several parallel anomalies oriented in a northeast to southwest direction. These are slightly enhanced above the regular ploughing anomalies and are likely to be a scheme of drainage that runs across the Site.

5 Conclusions

The geophysical survey has detected a number of magnetic anomalies associated with the former cultivation of the Site and consists of former field boundaries, modern ploughing and field drains. Magnetic disturbance, along the southern part of Field 2 relates to a modern service whilst other areas of disturbance around the periphery of the fields are due to metal fencing within the boundaries. Geological anomalies have been recorded throughout due to variations within the soils.

Based on the results of the geophysical survey the site is considered to have a low potential for the presence of archaeological remain.

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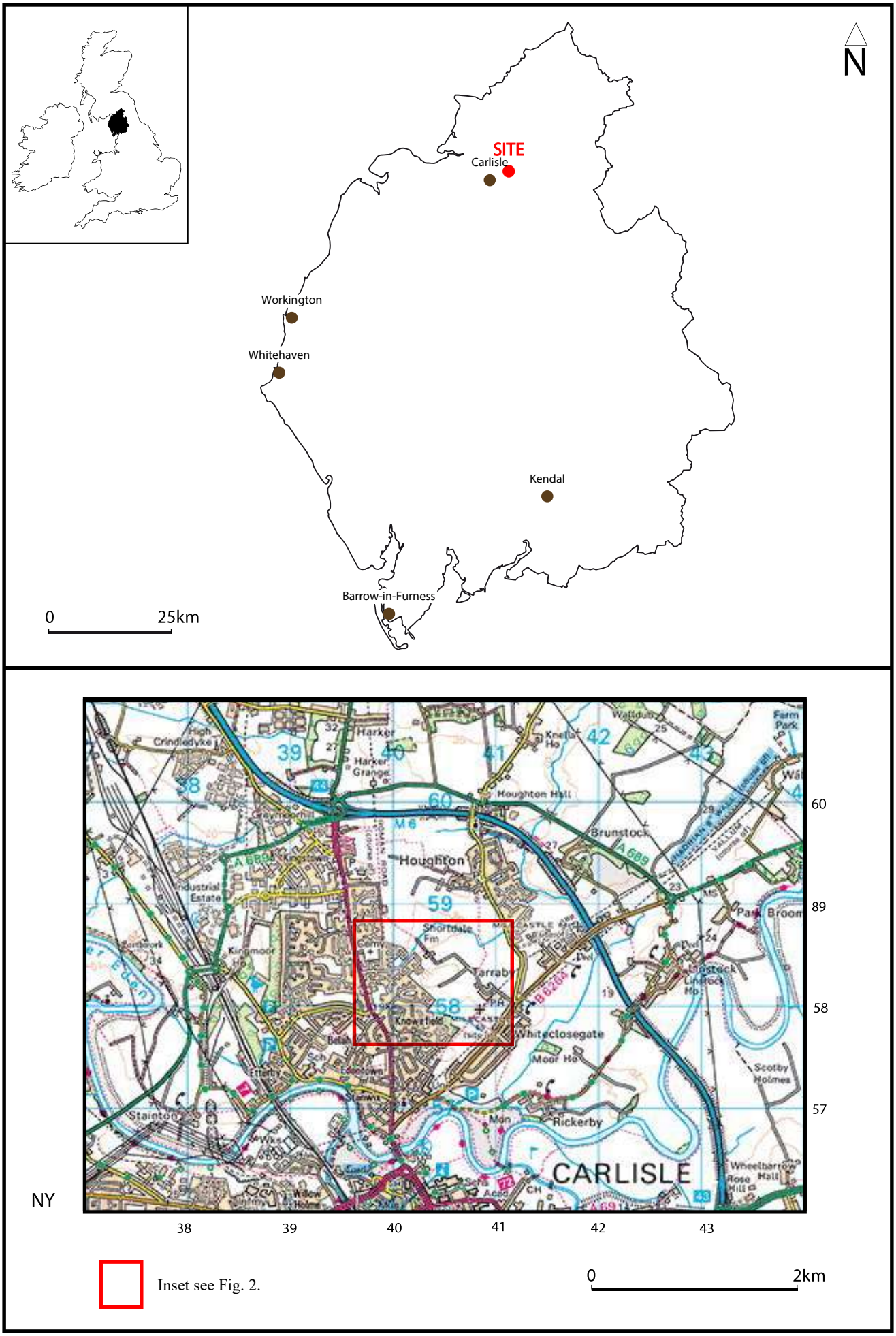
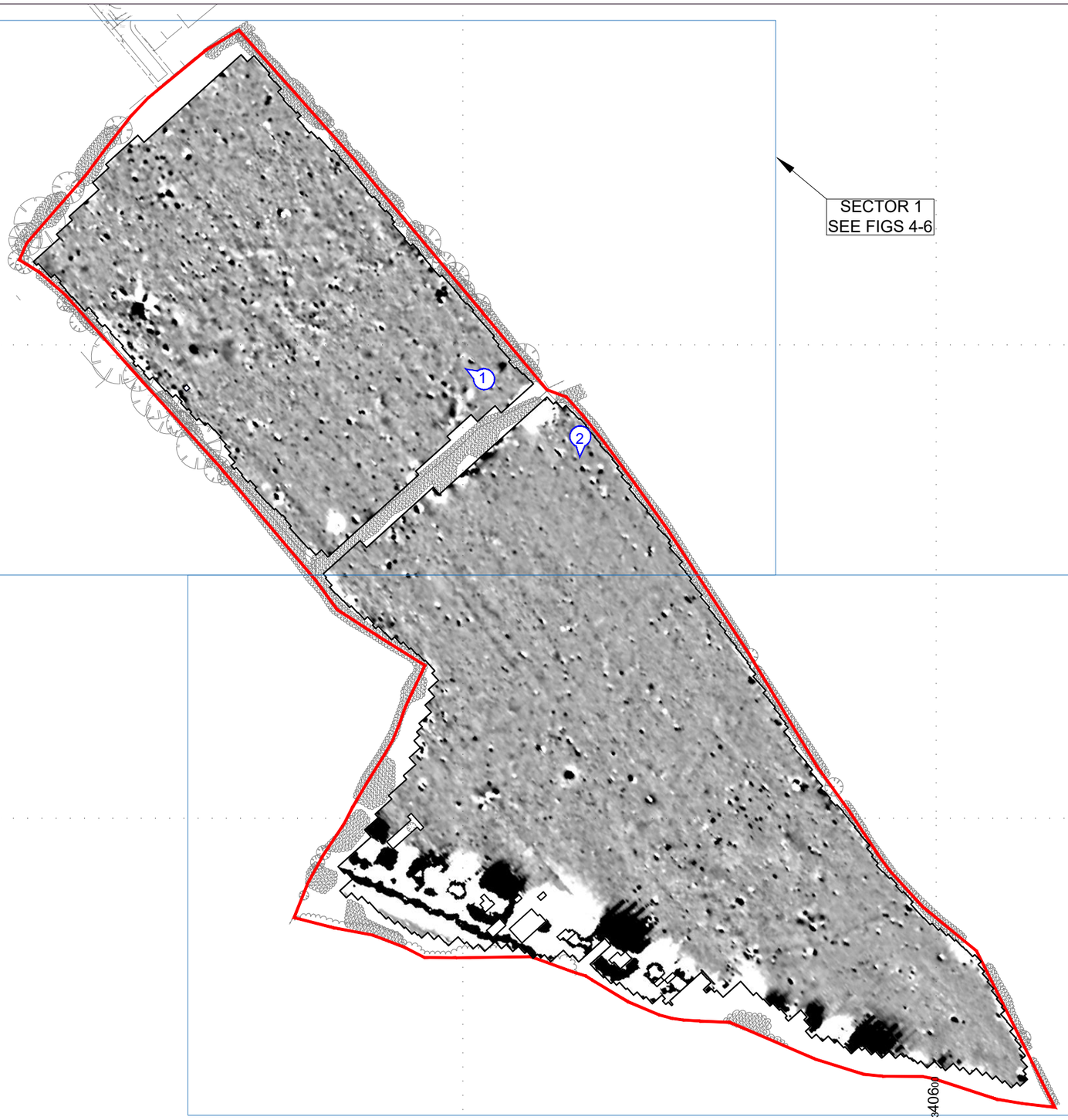


Fig. 1. Site location



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Processed greyscale magnetometer data

Fig. 2

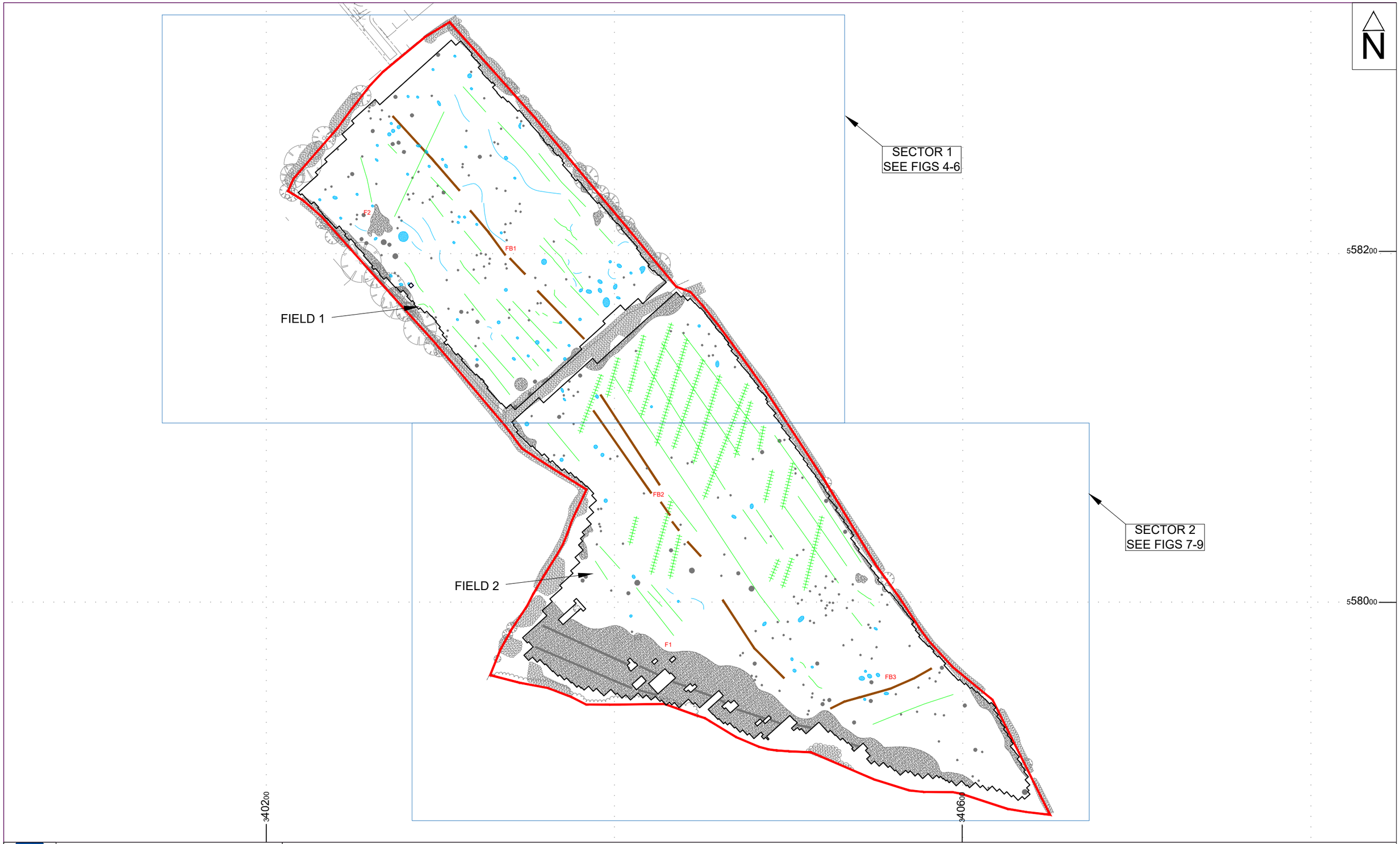
Key

	SURVEY AREA
	SECTOR BOUNDARY
1	PHOTO LOCATIONS

nT -1.0 2.0

0 100m

1:2000 @ A3



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Overall interpretation of magnetometer data

Fig. 3

Key

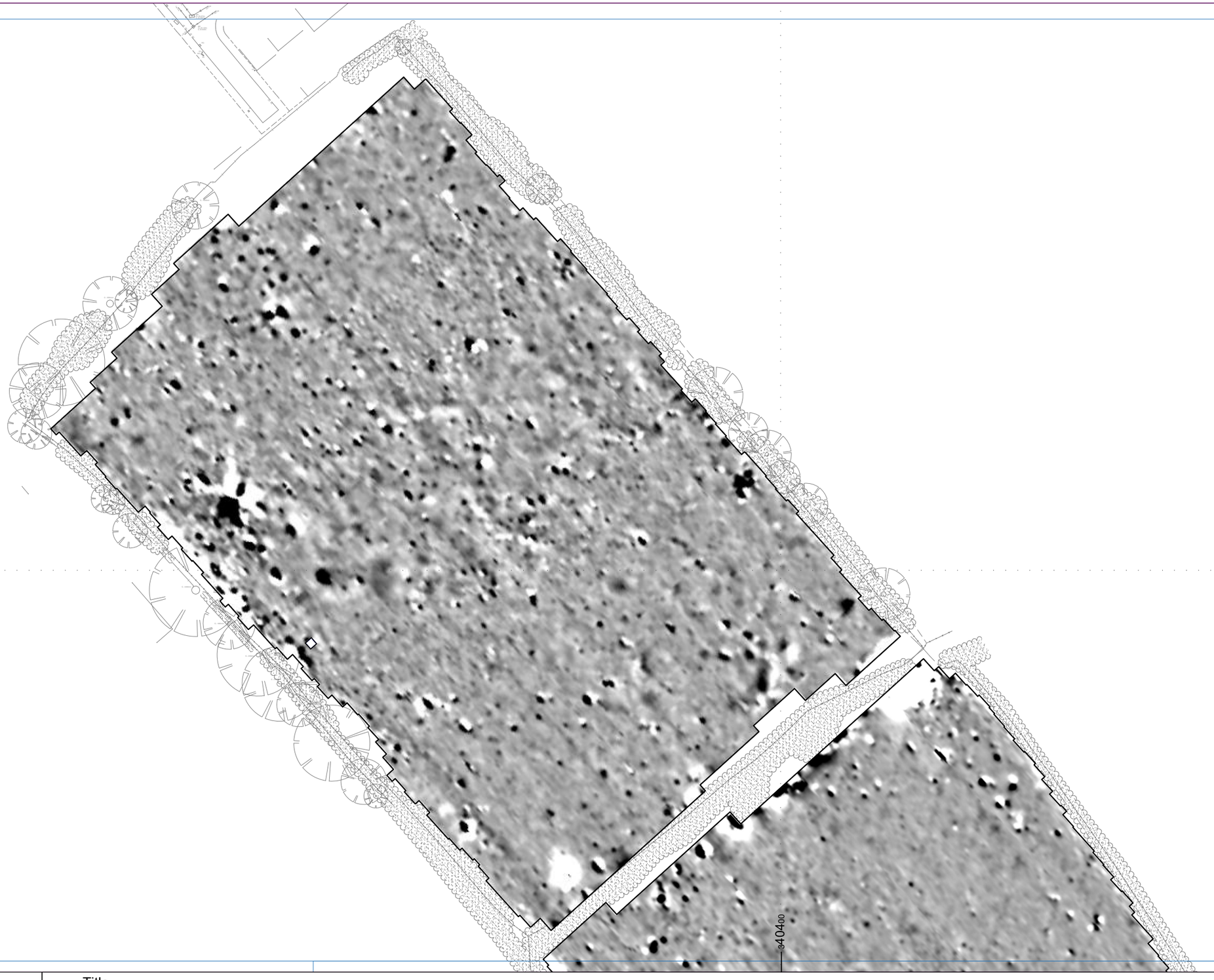
- SURVEY AREA
- SECTOR BOUNDARY

Interpretation

- FERROUS
- SERVICE PIPE
- MAGNETIC DISTURBANCE
- AGRICULTURAL
- FORMER FIELD BOUNDARY
- GEOLOGY
- FIELD DRAIN

0 100m

1:2000 @ A3



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Processed greyscale magnetometer data; Sector 1

Fig. 4

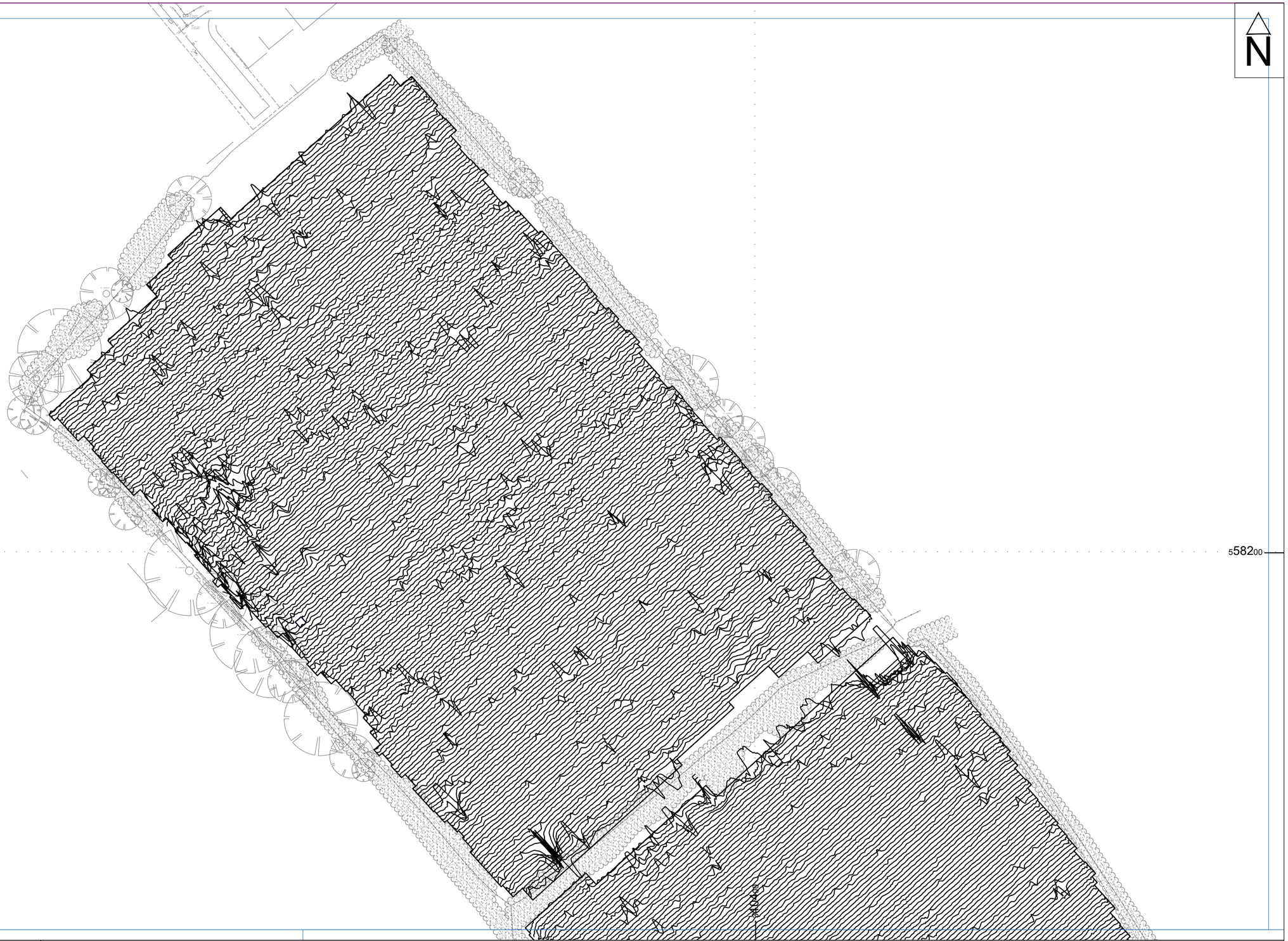
Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1000 @ A3



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XY trace plot of minimally processed magnetometer data; Sector 1

Fig. 5

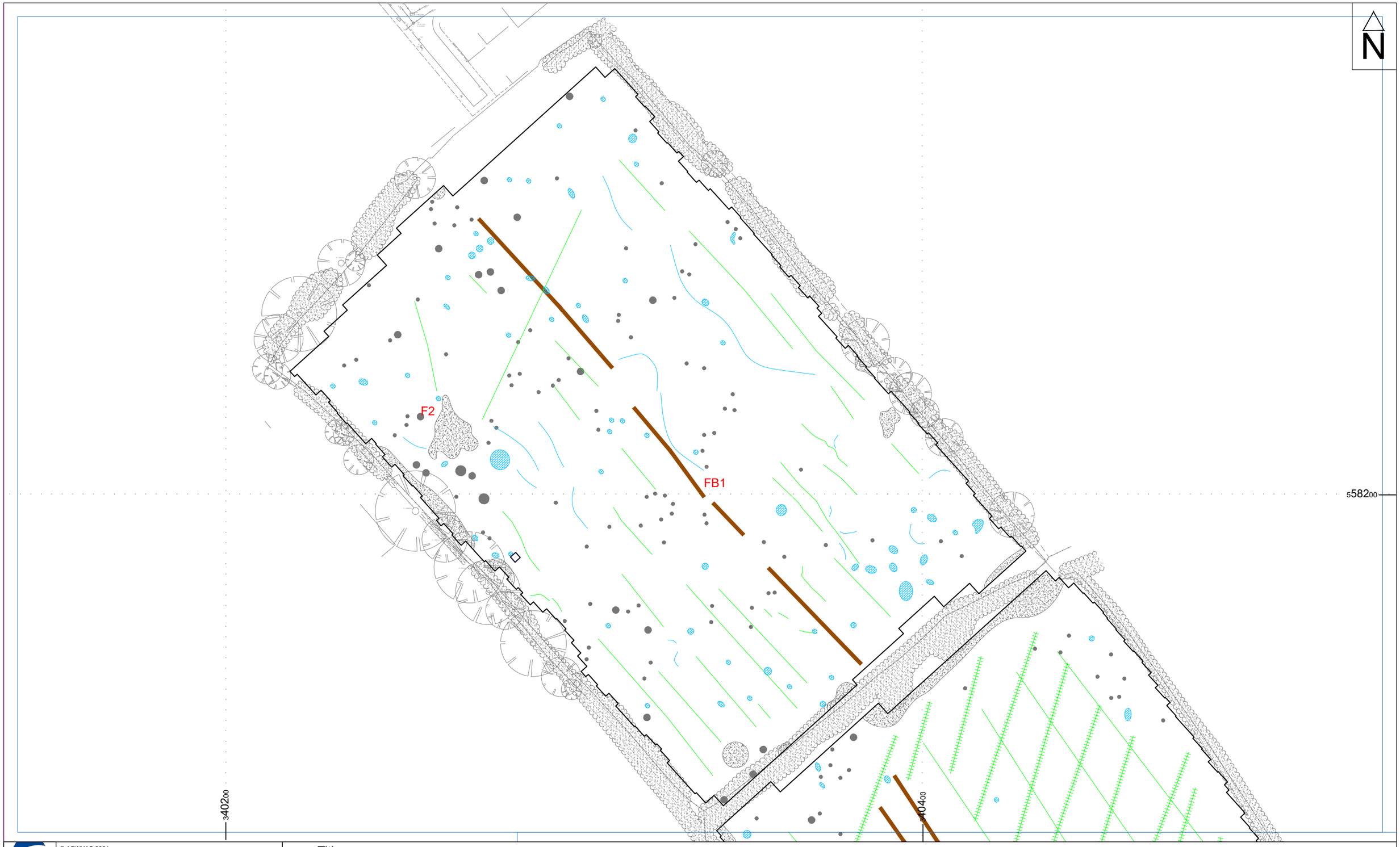
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1000 @ A3



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Interpretation of magnetometer data; Sector 1

Fig. 6

Title

- SECTOR BOUNDARY

Interpretation

- FERROUS
- SERVICE PIPE
- MAGNETIC DISTURBANCE
- AGRICULTURAL
- FORMER FIELD BOUNDARY
- GEOLOGY
- FIELD DRAIN

0 50m

1:1000 @ A3

N

5580$_{00}$

3404$_{00}$

3406$_{00}$

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Processed greyscale magnetometer data; Sector 2

Fig. 7

Title

SECTOR BOUNDARY

nT -1.0 2.0

0 50m

1:1000 @ A3

N

5580$_{00}$

3404$_{00}$

3406$_{00}$

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XY trace plot of minimally processed magnetometer data; Sector 2

Fig. 8

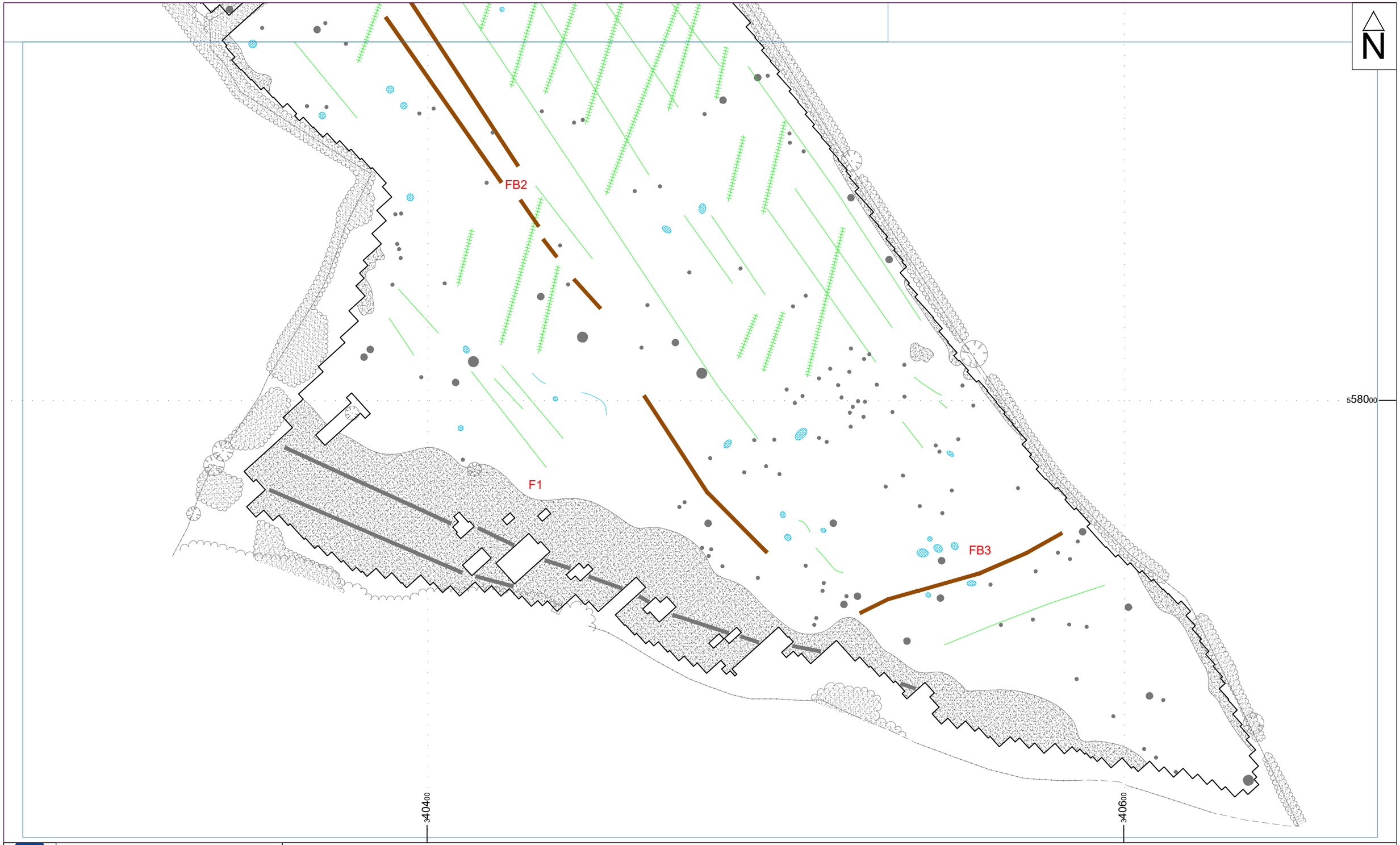
Title

SECTOR BOUNDARY

15.0 nT/cm

0 50m

1:1000 @ A3



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Interpretation of magnetometer data; Sector 2

Fig. 9

Title

- SECTOR BOUNDARY

Interpretation

- FERROUS
- SERVICE PIPE
- MAGNETIC DISTURBANCE
- AGRICULTURAL
- FORMER FIELD BOUNDARY
- GEOLOGY
- FIELD DRAIN

0 50m

1:1000 @ A3

Plate 1. General view of survey area, facing northwest

Plate 2. General view of survey area, facing south

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.

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 2022) 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 Cumbria Historic Environment Record).

Appendix 4: Oasis form

Summary for archaeol11-502266

OASIS ID (UID)	archaeol11-502266
Project Name	Geophysical Survey at Lansdowne Court, Carlisle
Activity type	Geophysical Survey, MAGNETOMETRY SURVEY
Project Identifier(s)	
Planning Id	
Reason For Investigation	Planning: Pre application
Organisation Responsible for work	Archaeological Services WYAS
Project Dates	09-Aug-2021 - 10-Aug-2021
Location	Lansdowne Court, Carlisle NGR : NY 40395 58147 LL : 54.9144524375335, -2.93132443759051 12 Fig : 340395,558147
Administrative Areas	Country : England County : Cumbria District : Carlisle Parish : Stanwix Rural
Project Methodology	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.

Project Results	The geophysical survey has detected a number of magnetic anomalies associated with the former cultivation of the site and consists of former field boundaries, modern ploughing and field drains. Magnetic disturbance, along the southern part of Field 2 related to a modern service whilst other areas of disturbance around the periphery of the fields are due to metal fencing within the boundaries. Geological anomalies have been recorded throughout due to variations within the soils. Uncertain anomalies within the dataset may have an archaeological origin although a geological cause is also likely. Based on the results of the geophysical survey the site is considered to have a low potential for the presence of archaeological remains
Keywords	
HER	Cumbria HER - noRev - LITE
HER Identfiers	
Archives	

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