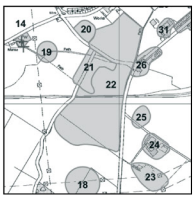
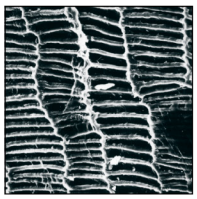
FQFO19










FINMERE QUARRY, FINMERE, OXFORDSHIRE

GEOPHYSICAL SURVEY REPORT

commissioned by AECOM

November 2019

HEADLAND ARCHAEOLOGY

REGISTERED CIfA ORGANISATION

FINMERE QUARRY, FINMERE, OXFORDSHIRE

GEOPHYSICAL SURVEY REPORT

commissioned by AECOM

November 2019

This report adheres to the quality standard of ISO 9001:2015

PROJECT INFO:

HA Project Code **FQFO19** / NGR **SP 6257 3278** (Area 1), **SP 6320 3221** (Area4) / Parish **Finmere** / Local Authority **Oxfordshire County Council** / OASIS Ref. **headland5-374838**

PROJECT TEAM:

Project Manager **David Harrison** / Author **David Harrison** / Fieldwork **Olivier Vansassenbrouck, Phoebe Utting** / Graphics **Eleanor Winter, Nick Hannon, Rafa Maya Torcelly**

Approved by **David Harrison** D Harrison .....

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HEADLAND ARCHAEOLOGY

part of the RSK Group

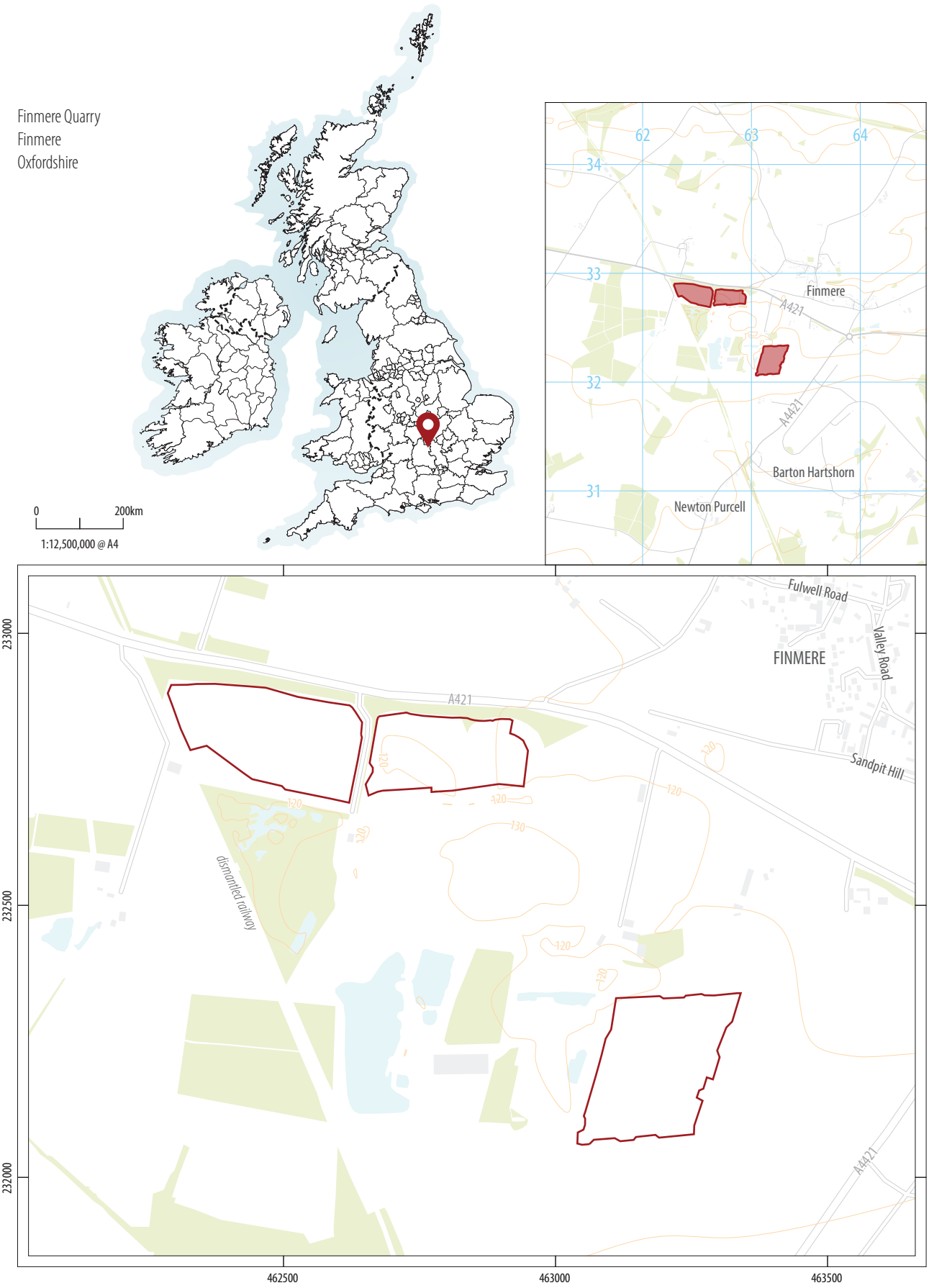
REGISTERED ORGANISATION CIfA

PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of two discrete blocks (Area 1 and Area 4) covering 14.5 hectares at Finmere, Oxfordshire, where the expansion of the operational Finmere Quarry is proposed. A circular anomaly indicative of a ring-ditch in Area 1 corresponds with a cropmark. Two other possible circular features have been identified but an archaeological cause for these anomalies is not certain. Other linear and discrete anomalies in the vicinity of the possible barrow are interpreted as of possible archaeological origin although there is no clear pattern of activity. Immediately south of the possible barrow is a rectangular anomaly possibly indicative of a kiln. The archaeological potential of this central part of Area 1 is assessed as moderate to high. Other anomalies are due to modern agricultural activity and variation in the soils and superficial deposits. No anomalies of archaeological potential have been identified in Area 4. Here the archaeological potential is assessed as very low.

CONTENTS

LIST OF ILLUSTRATIONS



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ILLUS 1 Site location

FINMERE QUARRY, FINMERE, OXFORDSHIRE

GEOPHYSICAL SURVEY REPORT

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by AECOM (the Client), to undertake a geophysical (magnetometer) survey south-west of Finmere, Oxfordshire, where two separate areas of aggregate extraction (sand, gravel and clay) are proposed as extensions to the operational Finmere Quarry.

The survey was undertaken in order to assess the impact of the proposed development on the historic environment and was undertaken in accordance with an Written Scheme of Investigation for Geophysical Survey (WSI) (Wilson 2019), with guidance within the National Planning Policy Framework (MHCLG 2019) and in line with current best practice (Chartered Institute for Archaeologists 2014, Europae Archaeologia Consilium 2016). The results of the survey will inform future archaeological strategy at the site.

1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

The Site (centred on SP 6271 3252) is located approximately 6km west of Buckingham, south-west of the village of Finmere and lies on the edge of the county boundary between Oxfordshire and Buckinghamshire, being situated in the former. The site comprises two Geophysical Survey Areas (GSA): Area 1 which contains two blocks covering 8.8ha and Area 4, a single block measuring 5.55ha.

Both GSA's are flat at between 119m–122m Above Ordnance Datum (AOD). At the time of survey, both were fallow (Illus 2–4). Soil bunds and existing quarry infrastructure in the east of GSA1 and around the perimeter of GSA4 were unsuitable for survey (Illus 5).

The survey was carried out on the 28th and 29th October 2019.

1.2 GEOLOGY AND SOILS

The bedrock in GSA1 comprises White Limestone Formation which is mostly overlain by glaciofluvial deposits (sand and gravel). In GSA4 the bedrock mainly comprises Forest Marble Formation (limestone and mudstone interbedded), with the south-east corner forming part of the Cornbrash Formation (limestone). This is overlain by Till – (diamicton) (NERC 2019).

The soils in GSA1 and the north of GSA4 are classified in the Soilscape 17 association, characterised as slowly permeable, wet acidic loams and clays. The soils in GSA4 are classified in the Soilscape 8 association characterised as slightly acidic loams and clays with impeded drainage (Cranfield University 2019).

2 ARCHAEOLOGICAL BACKGROUND

A Historic Environment Desk-Based Assessment (AECOM 2017) is revised and outlined in detail in the WSI. It identifies 45 heritage assets within a wider study area and three heritage assets within the site boundary including a circular enclosure (HER 13468) which was recorded by the National Mapping Programme in the north-west corner of GSA1.

3 AIMS, METHODOLOGY AND PRESENTATION

The general objectives of the geophysical survey were:

› to investigate the archaeological potential of the Site;

ILLUS 2 GSA1 (west), looking north-west **ILLUS 3** GSA1 (east), looking north-east **ILLUS 4** GSA4, looking south-east

- to assess the presence/absence of potential archaeological anomalies that might be present;
- to determine the level of risk that the archaeological resource would present to the proposed development; and
- to inform the layout of further reconnaissance or evaluation fieldwork, or to aid the determination of a suitable mitigation works specification and programme.

3.1 MAGNETOMETER SURVEY

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. A feature such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the earth's magnetic field. In mapping these slight variations, detailed plans of sites can be obtained as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney & Gater 2003). Further information on soil magnetism and the interpretation of magnetic anomalies is provided in Appendix 1.

The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid carrying frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10–15cm sample interval) on roaming traverses (swaths) 4m apart. These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point.

MLGrad601 and MultiGrad601 (Geomar Software Inc) software was used to collect and export the data. Terrasurveyor V3.0.35.1 (DWConsulting) software was used to process and present the data.

3.2 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:10,000. Illus 2–4 are site condition photographs. Illus 5 is a 1:5,000 survey location plan showing the direction of survey as GPS swaths. Illus 6 and Illus 7 present the overall greyscale and interpretation plots at the same scale. Fully processed (greyscale), minimally processed (XY trace plot) data and interpretation plots are presented in Illus 8 to Illus 13 at a scale of 1:2,500 with larger scale (1:1,000) plots of the Area of Archaeological Activity (AAA) presented in Illus 14 to Illus 16 inclusive.

Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes the composition and location of the site archive. Data processing details are presented in Appendix 4. A copy of the OASIS entry (Online Access to the Index of Archaeological Investigations) is reproduced in Appendix 5.

The survey methodology, report and any recommendations comply with the Written Scheme of Investigation (AECOM 2019), guidelines outlined by Europae Archaeologia Consilium (EAC 2016) and by the Chartered Institute for Archaeologists (CIfA 2014). All illustrations

from Ordnance Survey (OS) mapping are reproduced with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The illustrations 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 illustrations are presented to most suitably display and interpret the data from this site based on the experience and knowledge of management and reporting staff.

4 RESULTS AND DISCUSSION

With the exception of those areas where no survey could be undertaken, ground conditions were generally good and have contributed to a high standard of data throughout. A variable magnetic background has been identified throughout the GSA characterised by numerous discrete areas of magnetic enhancement.

Against this background several anomalies have been identified and cross-referenced to specific examples on the interpretation figures.

4.1 FERROUS AND MODERN ANOMALIES

Ferrous anomalies, characterised as individual 'spikes', 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 is common on most sites, often being present as a result of manuring or tipping/ infilling. There is no obvious clustering to these ferrous anomalies which might indicate an archaeological origin. Far more probable is that the 'spike' responses are likely caused by the random distribution of ferrous debris in the upper soil horizons.

The broad band of magnetic disturbance aligned north-east/south-west within the east of GSA1 corresponds to a farm/quarry track and is caused by magnetically enhanced material within the metalled track surface.

Magnetic disturbance around the field edges is due to ferrous material within, or adjacent to the boundaries and is of no archaeological interest.

4.2 AGRICULTURAL ANOMALIES

Analysis of historical Ordnance Survey mapping indicates that the division of land within the GSA's has remained largely unchanged since the publication of the first edition OS map in 1881, albeit with the removal of one north-west/south-east boundary from within GSA4. This former boundary has been detected by the survey as a low magnitude, fragmented linear trend. Series of parallel linear trends both north and south of the former boundary locate land drains.

A clear north/south linear anomaly in the east of GSA1does not correspond to any features on historic OS maps. However, the anomaly is aligned parallel to a series of modern cultivation trends and, on this basis, is ascribed an agricultural origin, probably being due to an unmapped former boundary.

Closely-spaced east/west linear trends throughout the west of GSA1 are typical of modern ploughing.

no Low magnitude parallel linear trend anomalies, recorded in the north and the south of the GSA, are typical of modern ploughing.

4.3 GEOLOGICAL ANOMALIES

The magnetic background is generally homogenous throughout – being characterised by numerous discrete anomalies which are probably due to localised variation in the depth and composition of the soils and the glacial superficial deposits from which they derive. Broader areas of magnetic enhancement in the centre and east of GSA1 are thought to be due to broader geological variations, perhaps localised concentrations of glacial sand or gravel.

4.4 ARCHAEOLOGICAL AND POSSIBLE ARCHAEOLOGICAL ANOMALIES

A clear circular anomaly has been identified in the north of GSA1, corresponding with the cropmark data (HER 13468). The anomaly measures 10.5m in diameter and a clear break in the north of the anomaly may locate an entrance. 16m due south of the enclosure, a clear high magnitude sub rectangular anomaly has been identified. The anomaly is suggestive of burning and may locate industrial activity, perhaps a kiln. These anomalies are assessed ass of high archaeological potential.

Several anomalies of possible archaeological potential are visible both north and south of the enclosure including faint and fragmented linear and rectilinear anomalies and at least two further possible circular enclosures although a confident interpretation of these is tentative due to their low magnitude. These anomalies may locate soil-filled ditches and are assessed as of moderate archaeological potential.

5 CONCLUSION

The survey has successfully evaluated the geophysical survey area and has identified a ring-ditch in Area 1 corresponding with a cropmark. Two other possible circular features have been identified but an archaeological cause for these anomalies is not certain. Other linear and discrete anomalies in the vicinity of the possible barrow are interpreted as of possible archaeological origin although there is no clear pattern of activity. Immediately south of the possible barrow is a rectangular anomaly possibly indicative of a kiln. The archaeological potential of this central part of Area 1 is assessed as moderate to high. Other anomalies are due to modern agricultural activity and variation in the soils and superficial deposits. No anomalies of archaeological potential have been identified in Area 4. Here the archaeological potential is assessed as very low.

6 REFERENCES

Chartered Institute for Archaeologists (ClfA) 2014 ***Standard and guidance for archaeological geophysical survey*** (Reading) http://www.archaeologists.net/sites/default/files/ClfAS%26GGeophysics_2.pdf accessed 20 November 2019

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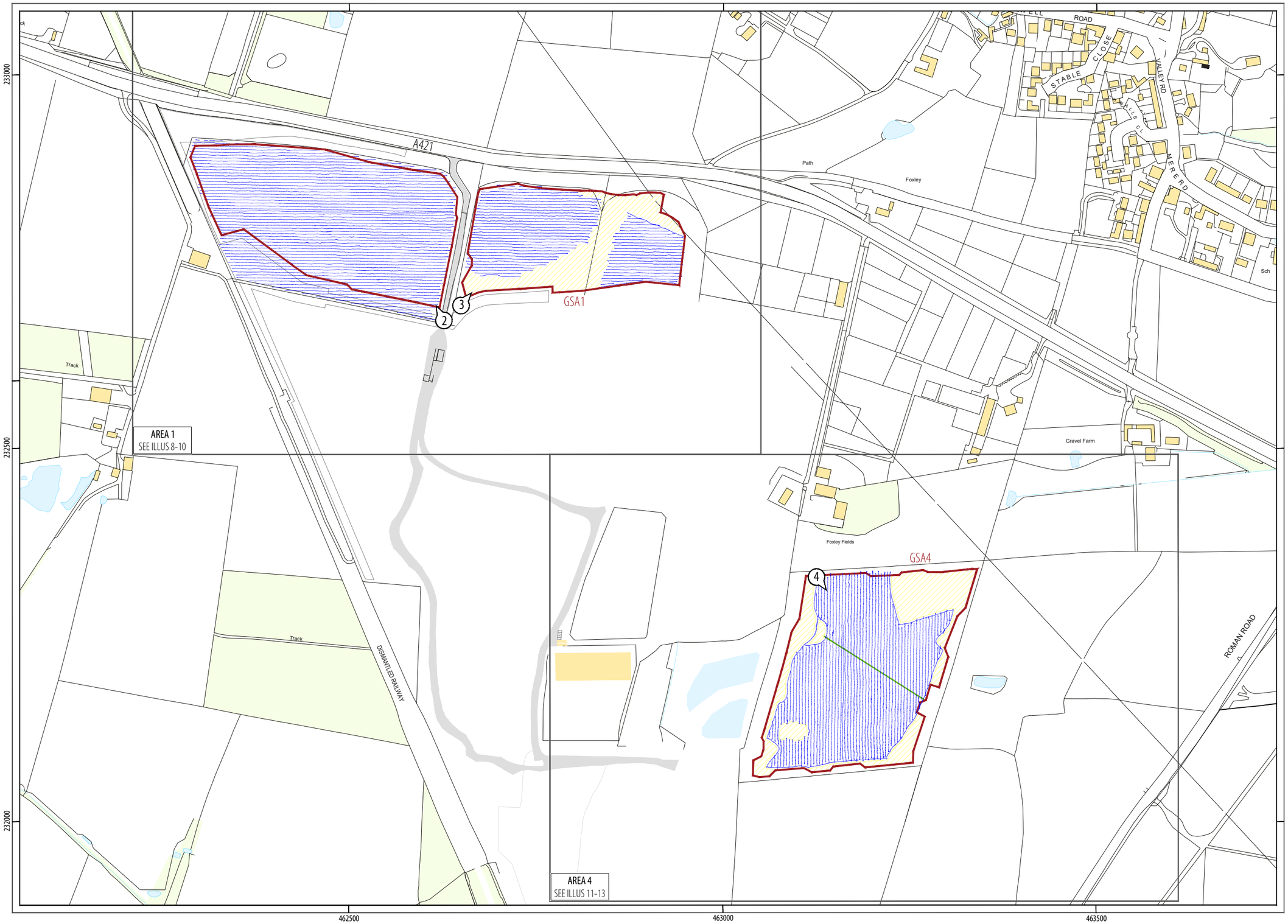

- geophysical survey area
- GPS swaths
- area unsuitable for survey
- location and direction of ILLUS 2-4

0 100m
1:5,000 @ A3

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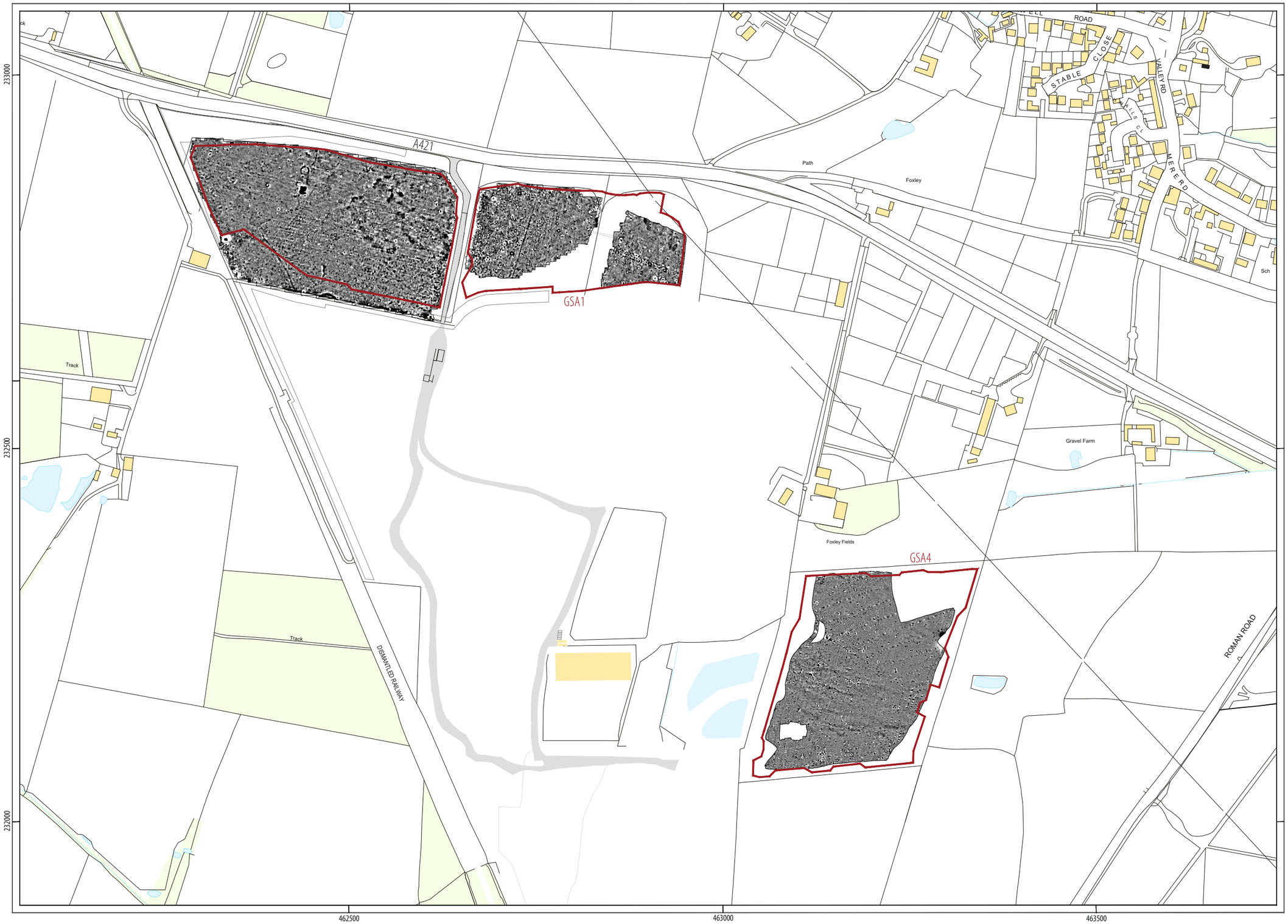
ILLUS 5 Survey location showing GPS swaths (1:5,000)



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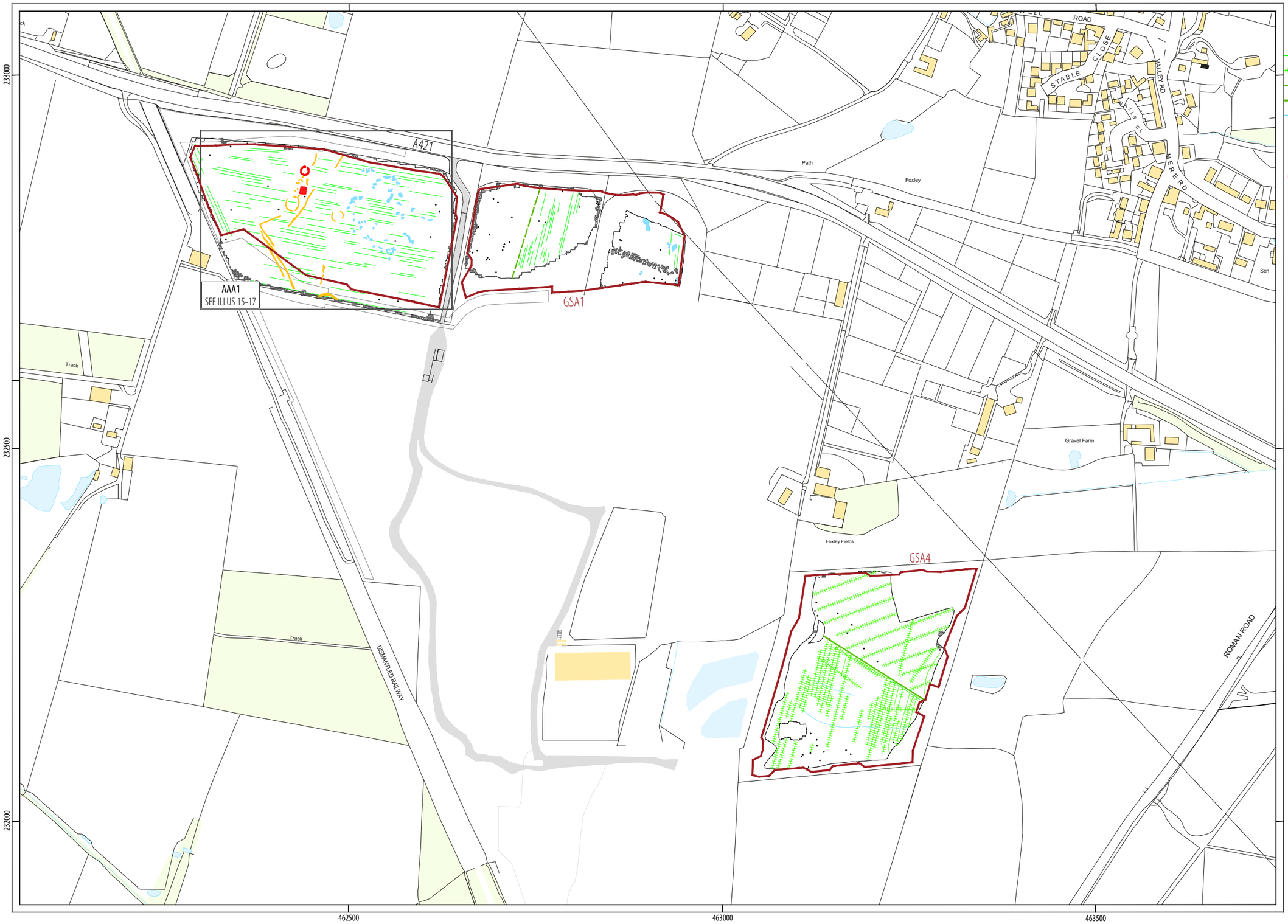
ILLUS 6 Processed greyscale magnetometer data (1:5,000)



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear trend	field drain
linear	former field boundary?
linear	former field boundary
linear trend	geological variation
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	kiln/burning
magnetic enhancement	archaeology

0 100m
1:5,000 @ A3

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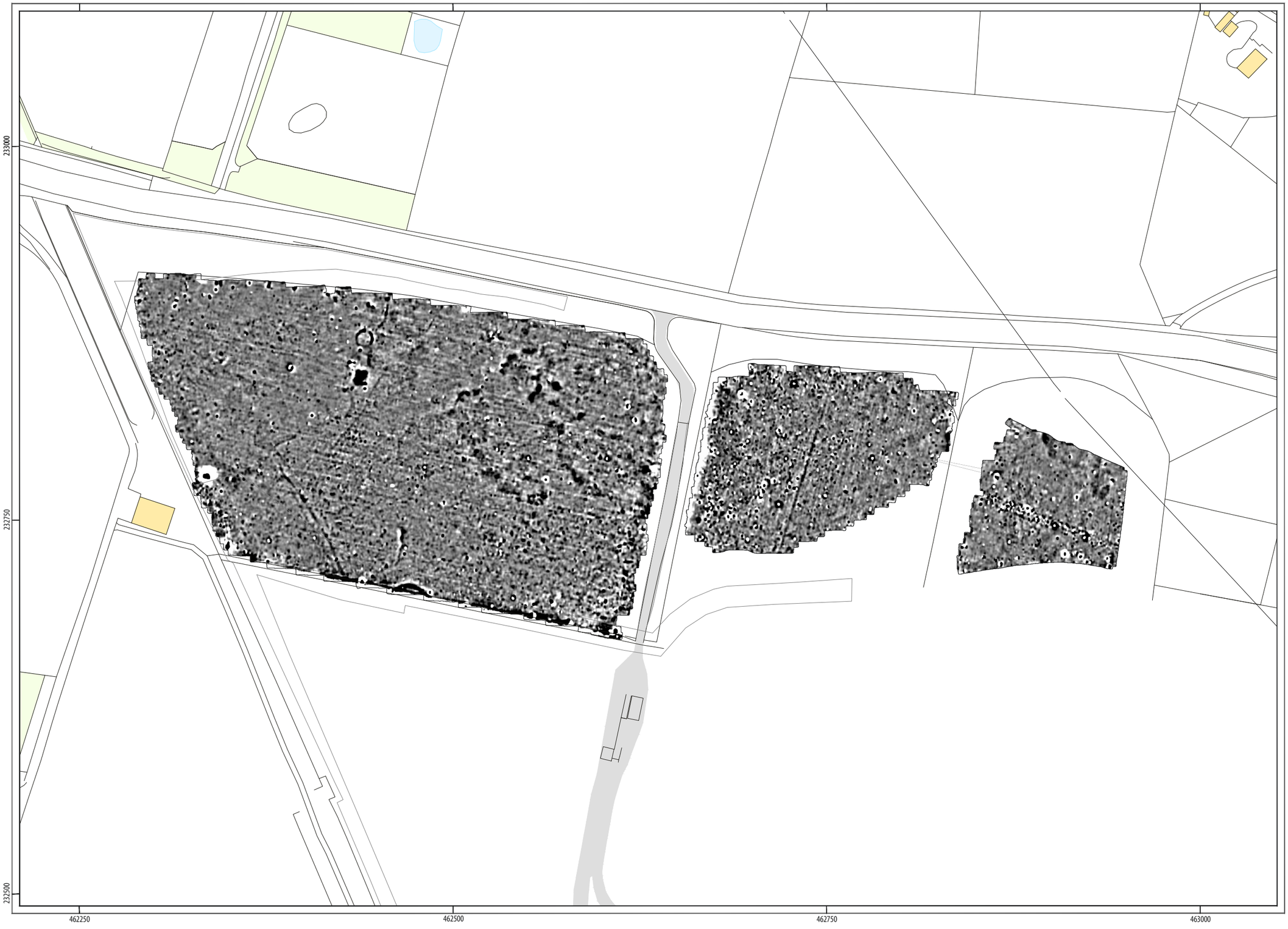
ILLUS 7 Interpretation of magnetometer data (1:5,000)



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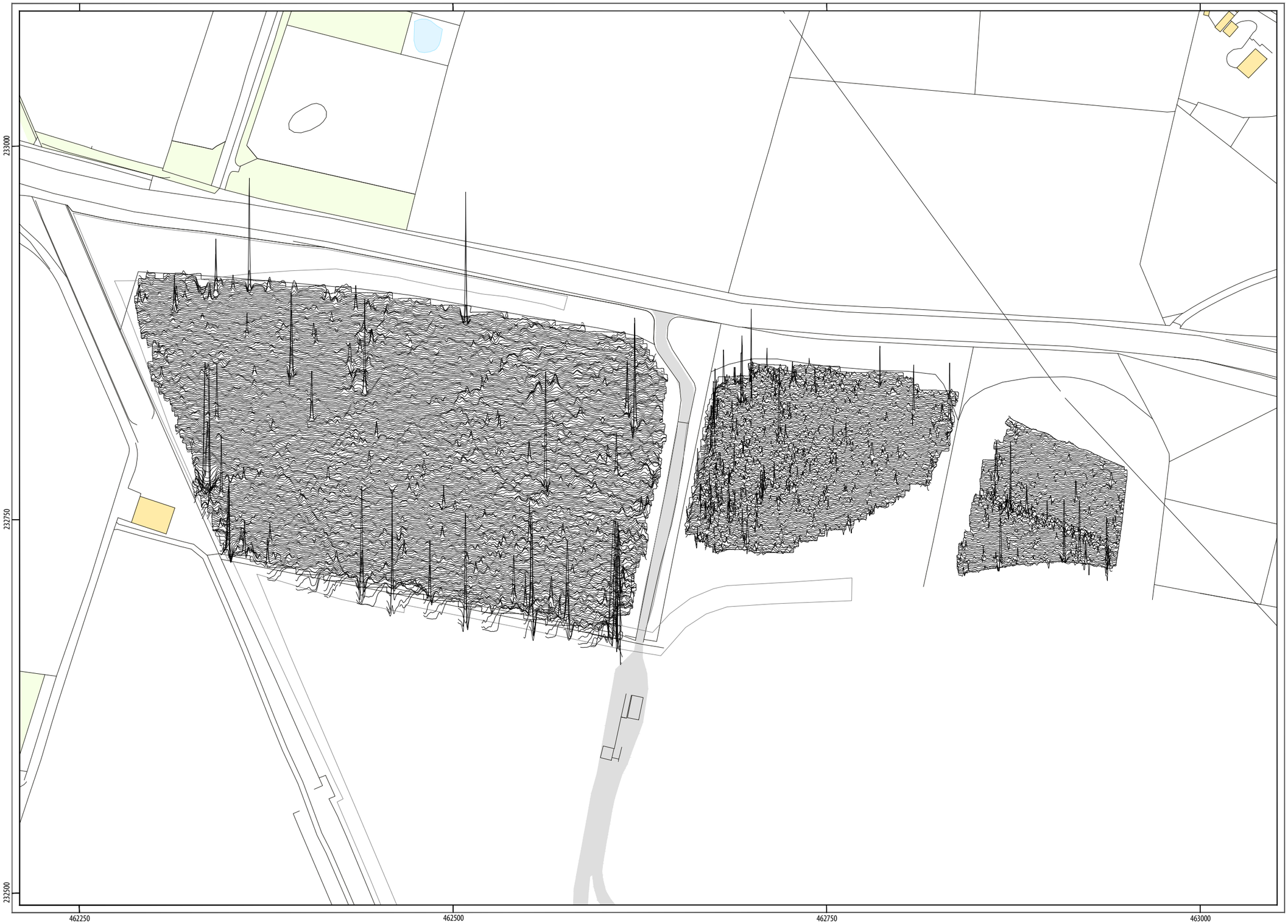
ILLUS 8 Processed magnetometer data; Area 1 (1:2,500)



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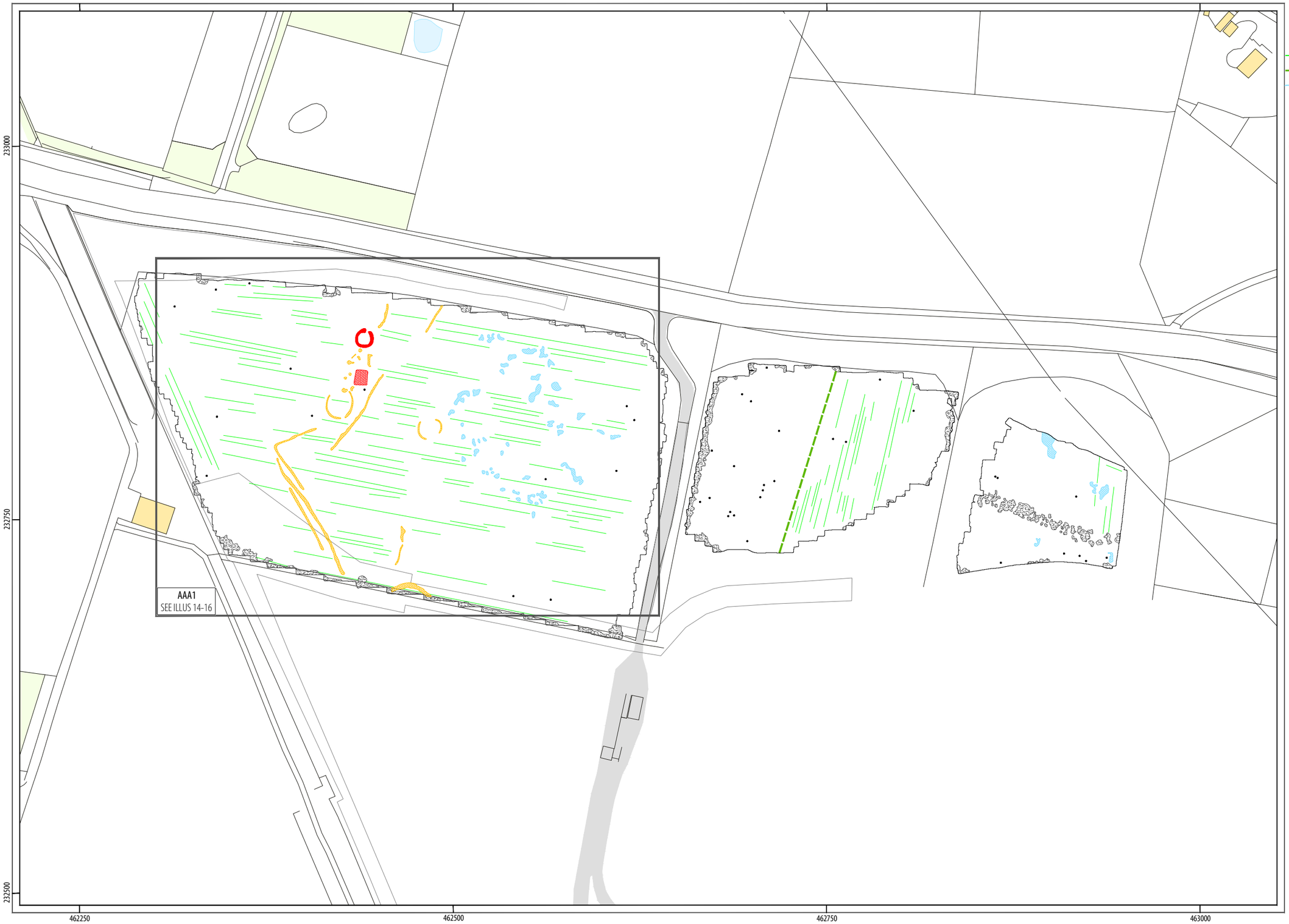
ILLUS 9 XY plot of minimally processed magnetometer data; Area 1 (1:2,500)



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
linear	former field boundary?
linear trend	geological variation
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	kiln/burning
magnetic enhancement	archaeology

0 50m
1:2,500 @ A3

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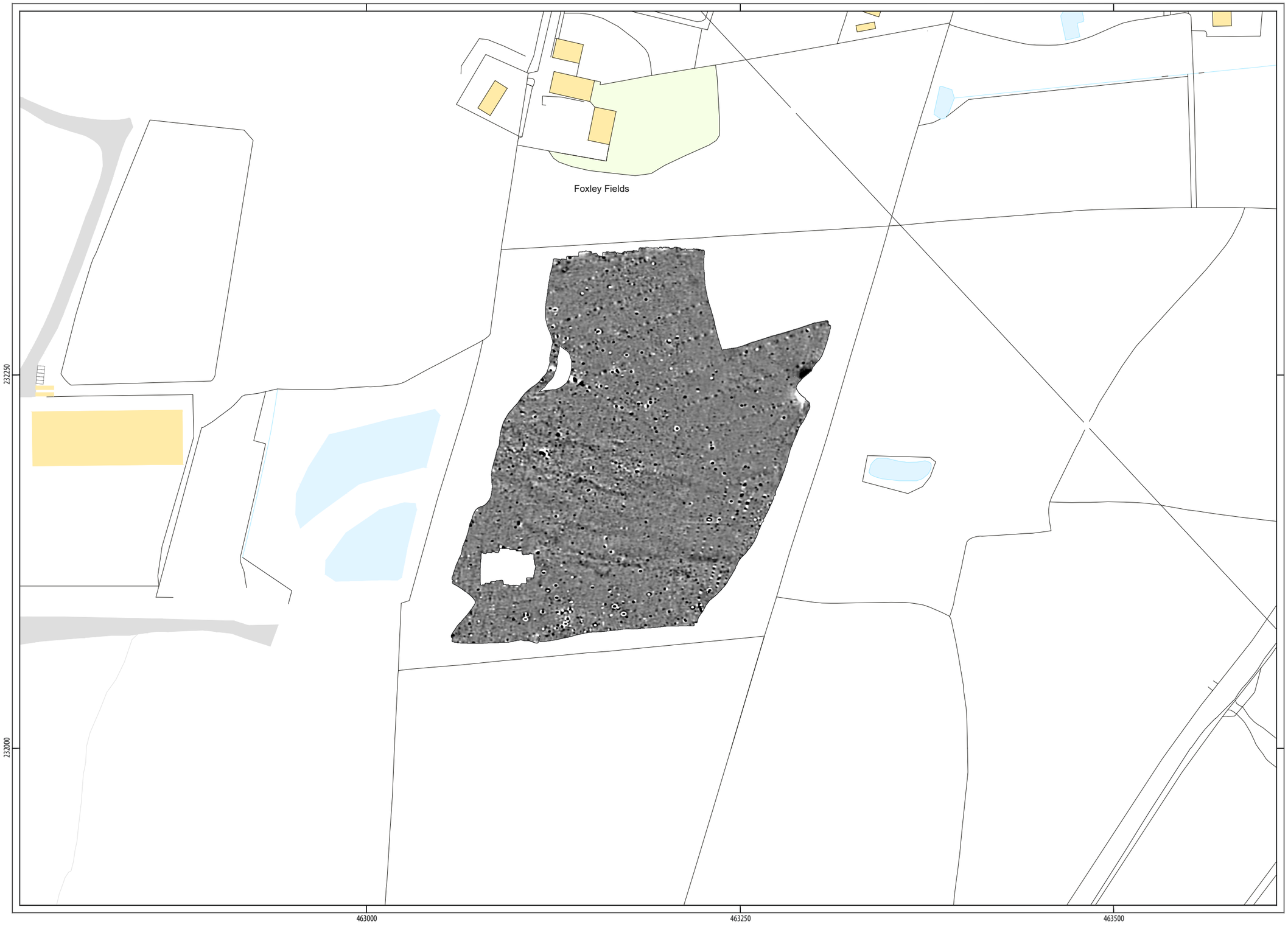
ILLUS 10 Interpretation of magnetometer data; Area 1 (1;2,500)



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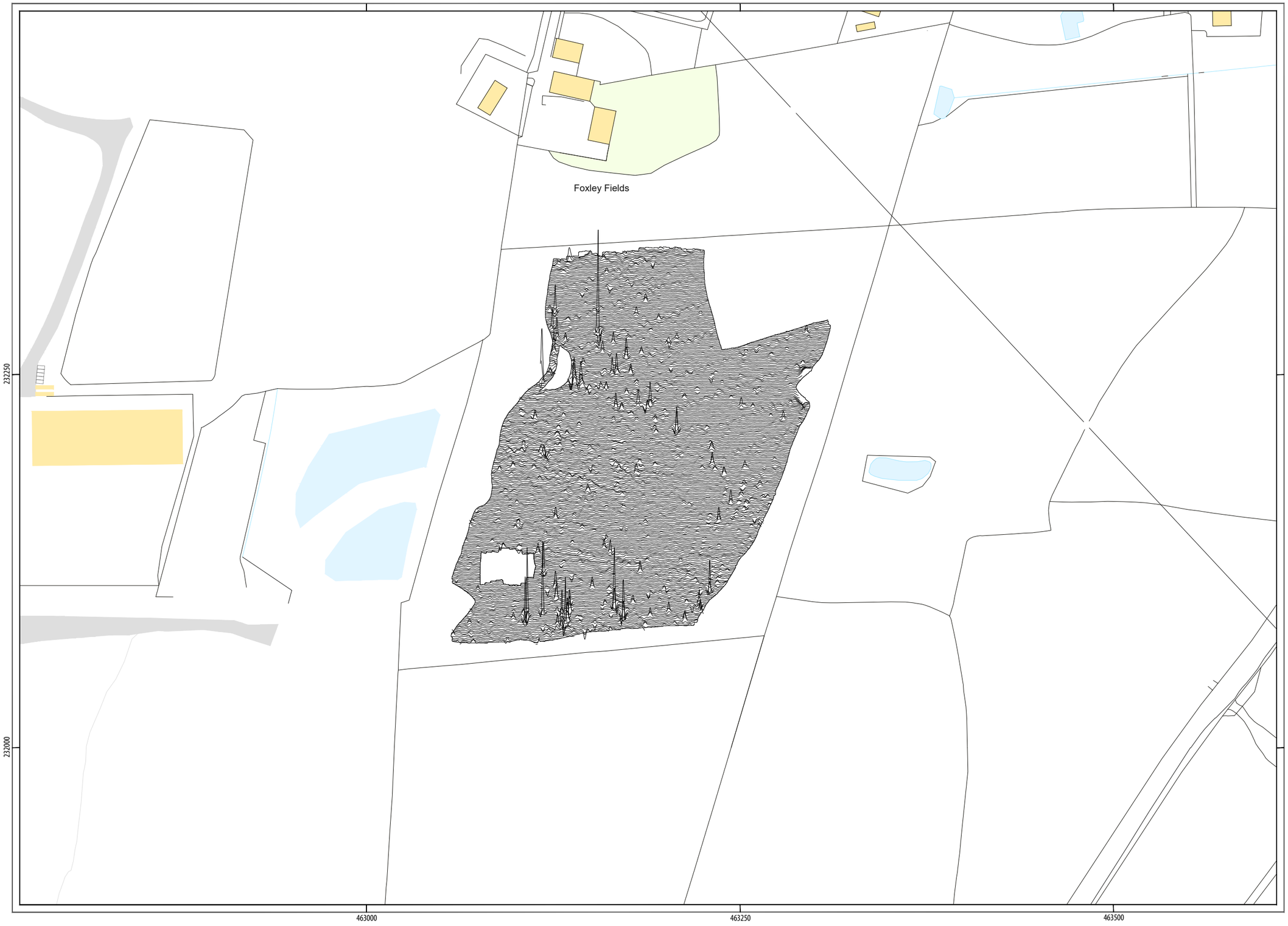
ILLUS 11 Processed magnetometer data; Area 4 (1:2,500)



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1:2,500 @ A3

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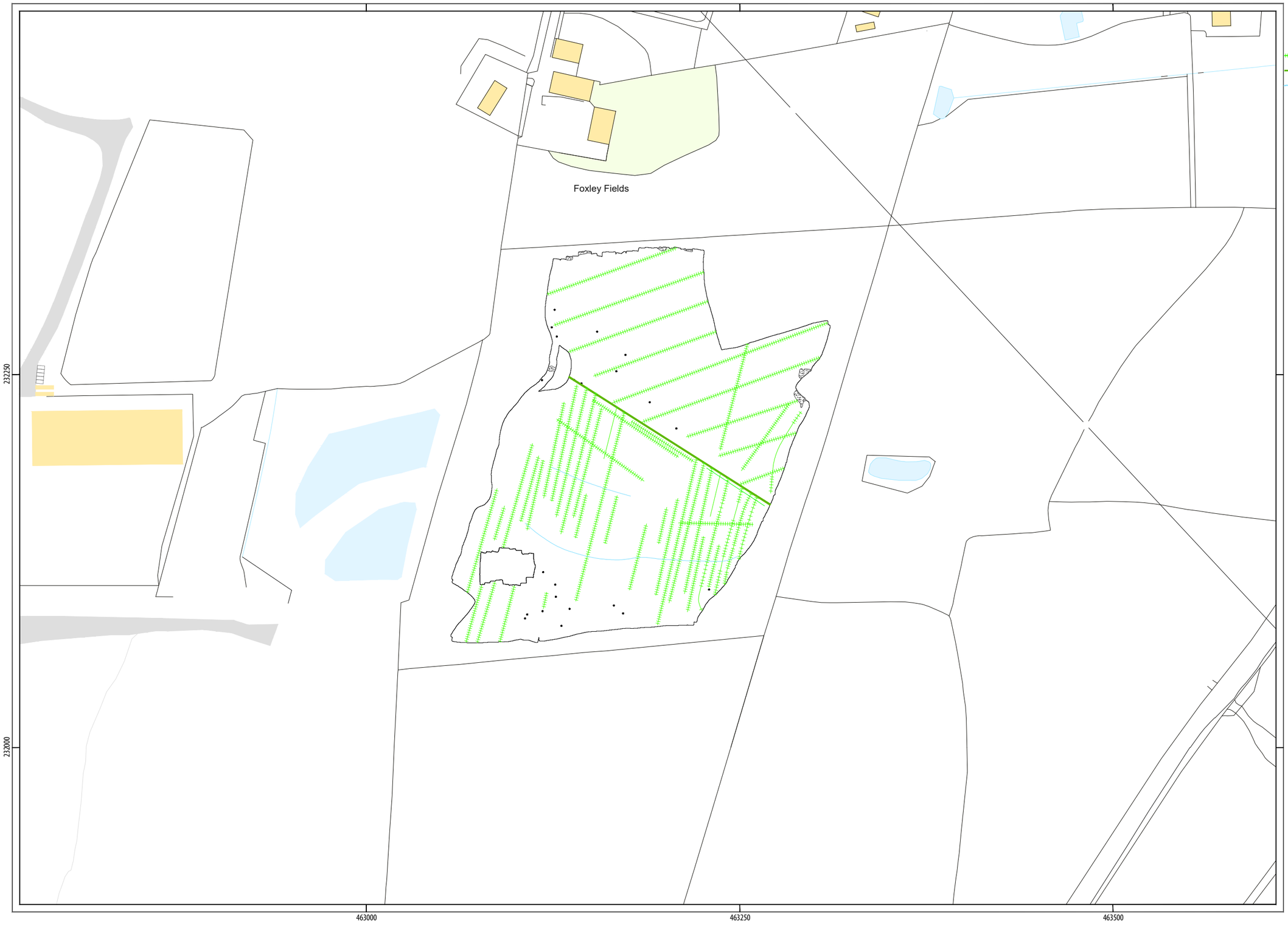
ILLUS 12 XY plot of minimally processed magnetometer data; Area 4 (1:2,500)



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	field drain
linear	former field boundary
linear trend	geological variation

0 50m
1:2,500 @ A3

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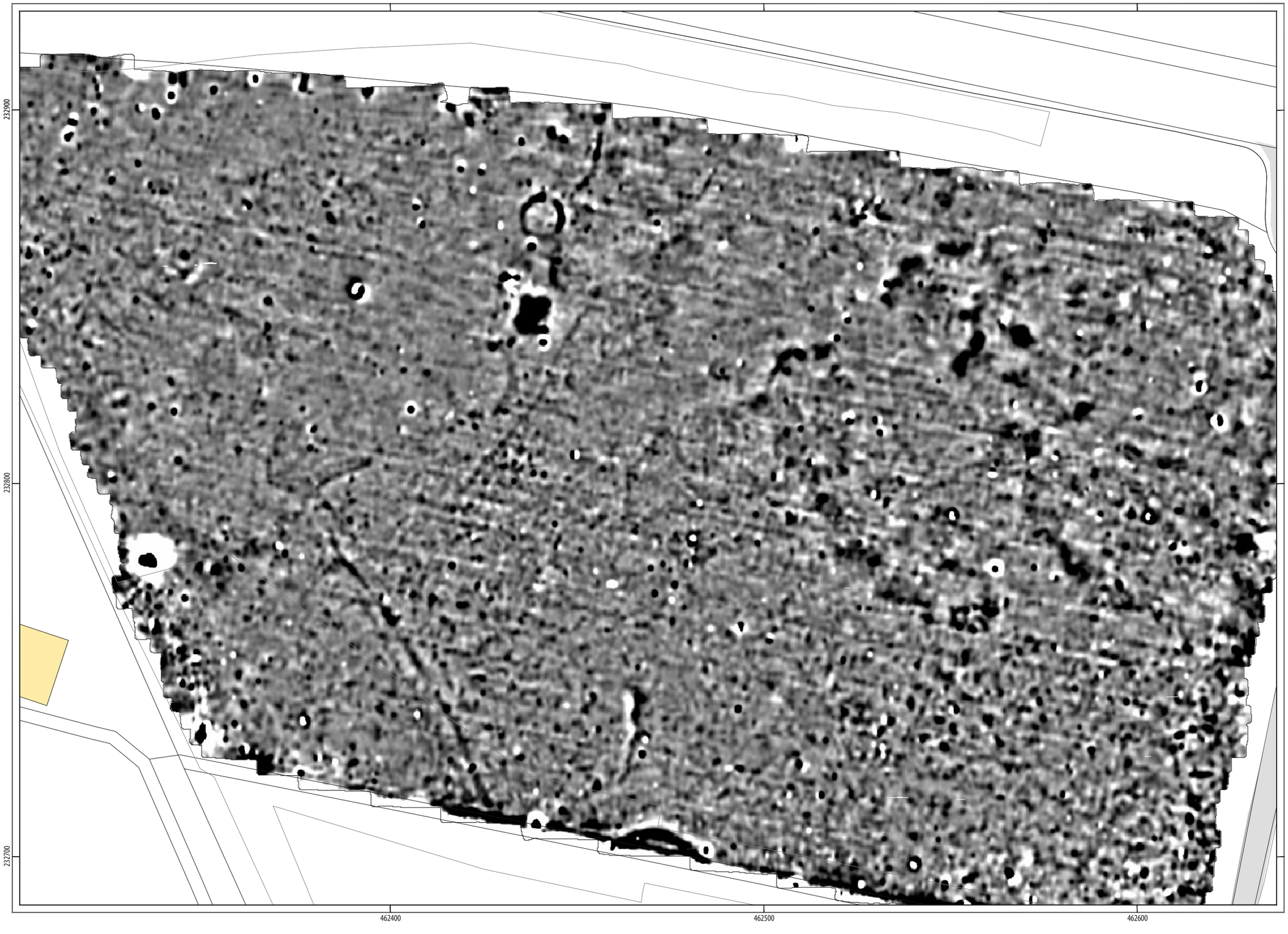
ILLUS 13 Interpretation of magnetometer data; Area 4 (1;2,500)



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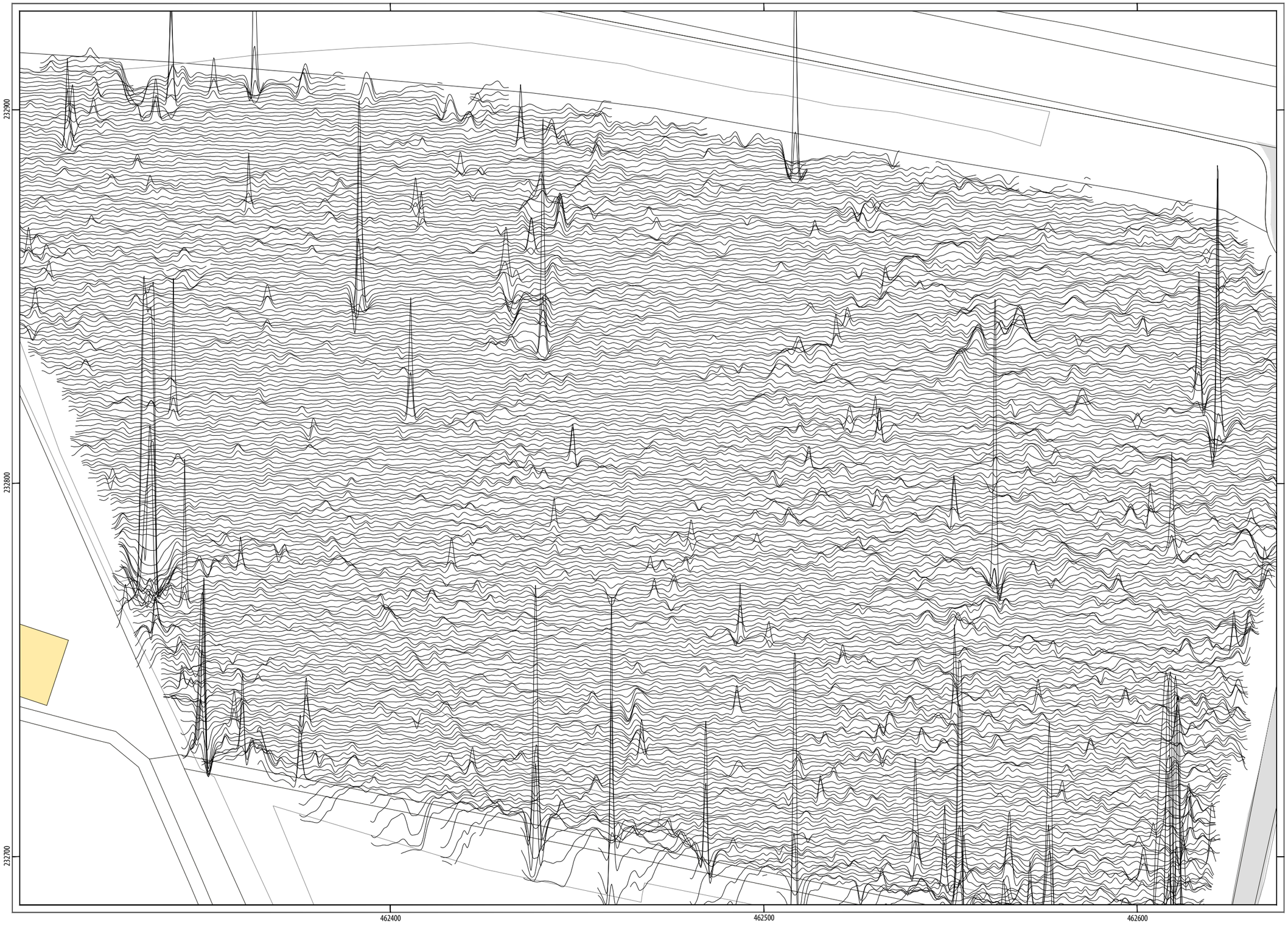
ILLUS 14 Processed greyscale magnetometer data; AAA1 (1:1,000)



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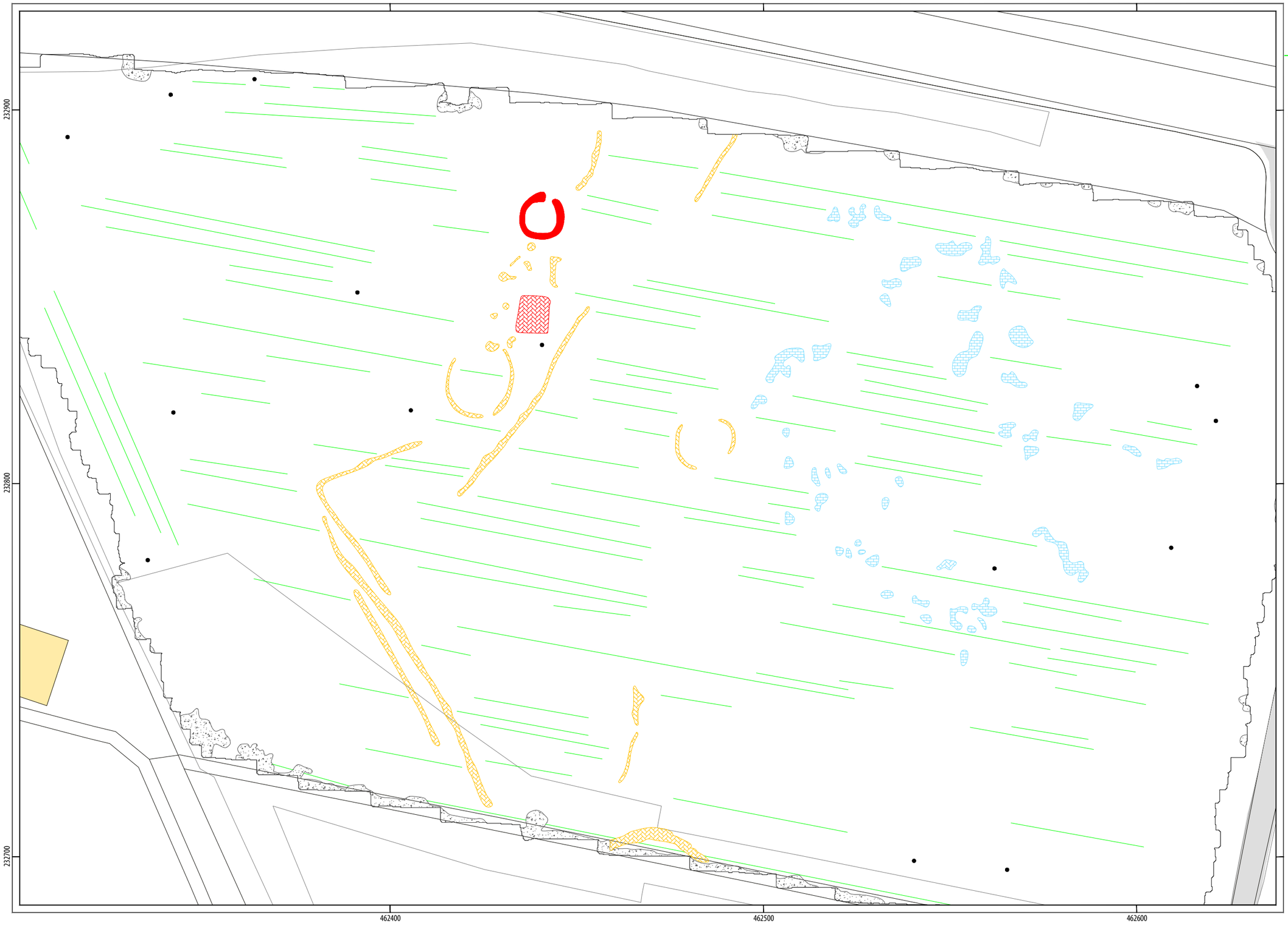
ILLUS 15 XY plot of minimally processed magnetometer data; AAA1 (1:1,000)



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	agricultural
magnetic enhancement	geology
magnetic enhancement	archaeology?
magnetic enhancement	kiln/burning
magnetic enhancement	archaeology

0 25m
1:1,000 @ A3

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ILLUS 16 Interpretation of magnetometer data AAA1; (1;1,000)

7 APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

Appendix 1.1 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 haematite. 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. This effect can lead to the detection of features such as hearths, kilns or areas of burning.

Appendix 1.2 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.

Lightning-induced remnant magnetisation (LIRM) LIRM anomalies are thought to be caused in the near surface soil horizons by the flow of an electrical currents associated with lightning strikes. These observed anomalies have a strong bipolar signal which decreases with distance from the spike point and often appear as linear or radial in shape.

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.

APPENDIX 2 SURVEY LOCATION INFORMATION

An initial survey base station was established using a Trimble VRS differential Global Positioning System (dGPS). The magnetometer data was georeferenced using a Trimble RTK differential Global Positioning System (Trimble R8s model).

Temporary sight markers were laid out using a Trimble VRS differential Global Positioning System (Trimble R8s model) to guide the operator and ensure full coverage. The accuracy of this dGPS equipment is better than 0.01m.

The survey data 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 coordinates are measured off hard copies of the mapping rather than using the digital coordinates.

Headland Archaeology cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

The geophysical archive comprises an archive disk containing the raw data in XYZ format, a raster image of each greyscale plot with associate world file, and a PDF of the report.

The project will be archived in-house in accordance with recent good practice guidelines (http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3). The data will be stored in an indexed archive and migrated to new formats when necessary.

APPENDIX 4 DATA PROCESSING

The gradiometer data has been presented in this report in processed greyscale and minimally processed XY trace plot format.

Data collected using RTK GPS-based methods cannot be produced without minimal processing of the data. The minimally processed data has been interpolated to project the data onto a regular grid and de-striped to correct for slight variations in instrument calibration drift and any other artificial data.

A high pass filter has been applied to the greyscale plots to remove low frequency anomalies (relating to survey tracks and modern agricultural features) in order to maximise the clarity and interpretability of the archaeological anomalies.

The data has also been clipped to remove extreme values and to improve data contrast.

OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: headland5-374838

PROJECT DETAILS	
Project name	Finmere Quarry, Finmere, Oxfordshire
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey of two discrete blocks (Area 1 and Area 4) covering 14.5 hectares at Finmere, Oxfordshire, where the expansion of the operational Finmere Quarry is proposed. A circular anomaly indicative of a ring-ditch in Area 1 corresponds with a cropmark. Two other possible circular features have been identified but an archaeological cause for these anomalies is not certain. Other linear and discrete anomalies in the vicinity of the possible barrow are interpreted as of possible archaeological origin although there is no clear pattern of activity. Immediately south of the possible barrow is a rectangular anomaly possibly indicative of a kiln. The archaeological potential of this central part of Area 1 is assessed as moderate to high. Other anomalies are due to modern agricultural activity and variation in the soils and superficial deposits. No anomalies of archaeological potential have been identified in Area 4. Here the archaeological potential is assessed as very low.
Project dates	Start: 28-10-2019 End: 29-10-2019
Previous/future work	Yes / Not known
Any associated project reference codes	FQFO19 – Contracting Unit No.
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 4 – Character Undetermined
Monument type	N/A
Monument type	N/A
Significant Finds	N/A
Significant Finds	N/A
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	Pre-application
Solid geology (other)	White Limestone Formation, Forest Marble Formation
Drift geology	GLACIAL SAND AND GRAVEL
Techniques	Magnetometry

PROJECT LOCATION	
Country	England
Site location	OXFORDSHIRE CHERWELL FINMERE Finmere Quarry, Finmere
Study area	14.5 Hectares
Site coordinates	SP 6271 3252 51.987163193672 -1.086697149557 51 59 13 N 001 05 12 W Point

PROJECT CREATORS	
Name of Organisation	Headland Archaeology
Project brief originator	AECOM
Project design originator	Headland Archaeology
Project director/manager	Harrison, D

Project supervisor	Olivier Vansassenbrouck
Type of sponsor/funding body	Developer

PROJECT ARCHIVES	
Physical Archive Exists?	No
Digital Archive recipient	In house
Digital Contents	"other"
Digital Media available	"Geophysics"
Paper Archive Exists?	No

PROJECT BIBLIOGRAPHY 1	
Publication type	Grey literature (unpublished document/manuscript)
Title	Finmere Quarry, Finmere, Oxfordshire; Geophsical Survey Report
Author(s)/Editor(s)	David Harrison
Date	2019
Issuer or publisher	Headland Archaeology
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