HRFI18

HINCKLEY NATIONAL RAIL FREIGHT INTERCHANGE, LEICESTERSHIRE

GEOPHYSICAL SURVEY

commissioned by EDP
on behalf of db symmetry

May 2018

HEADLAND ARCHAEOLOGY

REGISTERED CIfA ORGANISATION

HINCKLEY NATIONAL RAIL FREIGHT INTERCHANGE, LEICESTERSHIRE

GEOPHYSICAL SURVEY

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

PROJECT INFO:

HA Project Code **HRFI18** / NGR **SP 4624 9494** / Parish **Elmesthorpe, Sapcote, Aston Flamville** / Local Authority **Leicestershire** / OASIS Ref. **headland5-317763**

PROJECT TEAM:

Project Manager **Sam Harrison** / Author **David Harrison** / Fieldwork **Kevin Heaton, Krasimir Dyulgerski, Mark Evans, Richard McGregor Edwards, Ross Bishop** / Graphics **Caroline Norrman, David Harrison, Rafael Maya Torcelly**

Approved by **Sam Harrison** ....

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PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey, covering a 190 hectare site at Hinckley, Leicestershire, where a new strategic rail freight interchange (SRFI) is proposed. Evaluation of the proposed development area has been notably affected by the extensive application of green waste as soil conditioner over 75% of the site. This has resulted in a widespread elevated magnetic background against which any low magnitude anomalies of archaeological potential, if present, may be masked. For this reason, the archaeological potential over the affected fields remains uncertain although it is thought that any extensive areas of enclosed settlement, if present, would have been detected, at least in part, over the majority of the geophysical survey area. A single localised ring-ditch has been identified at Hobbs Hayes Farm in an area unaffected by green waste. This anomaly is ascribed high archaeological potential and probably locates a round barrow. No further anomalies of archaeological potential have been identified over the 25% of fields where green waste has not been applied and, in these fields, the archaeological potential is assessed as low.

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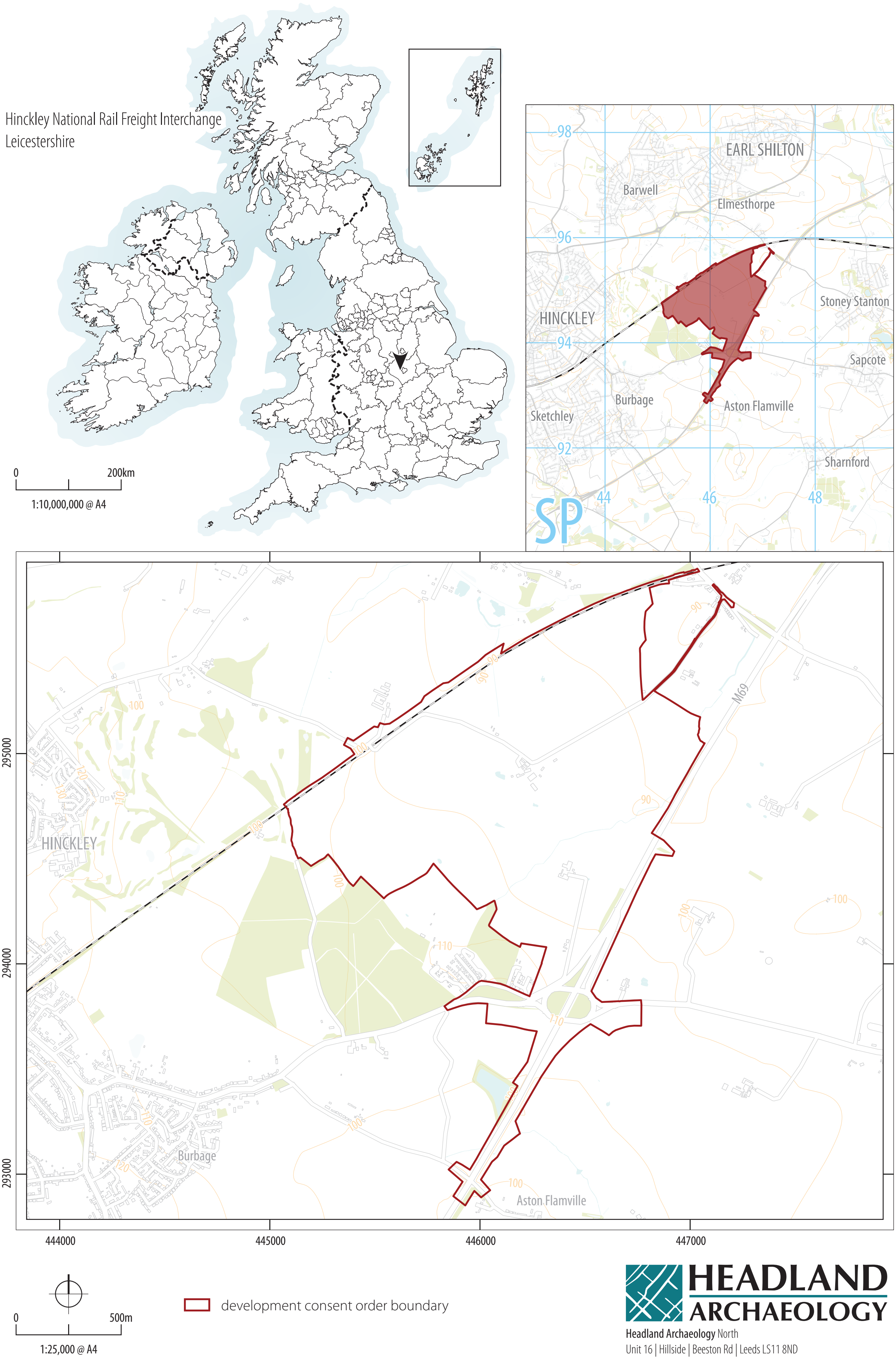
LIST OF ILLUSTRATIONS



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ILLUS 1 Site location

HINCKLEY NATIONAL RAIL FREIGHT INTERCHANGE, LEICESTERSHIRE

GEOPHYSICAL SURVEY

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by EDP (the Consultant), on behalf of db symmetry (the Client) to undertake a geophysical (magnetometer) survey at Hinckley, Leicestershire, where a new strategic rail freight interchange (SRFI) is proposed. The survey will inform an Environmental Statement which will be submitted with a Development Consent Order (DCO) to the Planning Inspectorate to be examined on behalf of the Secretary of State for Transport.

The work was undertaken in accordance with the requirements of the National Policy Statement for National Networks (DfT 2014) a Written Scheme of Investigation for Geophysical Survey (Harrison 2018) and in line with current best practice (Chartered Institute for Archaeologists 2014, English Heritage 2008).

The survey was carried out between the 5th of March and 6th of April 2018.

1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

The site lies 3km north-east of Hinkley in an area of mixed farmland to the north-west of M69 Junction 2 (see Illus 1). The Development Consent Order Boundary (DCOB) encompasses 48 fields (F1-F48) and three farms which are bounded to the north-west by the Nuneaton to Felixstowe railway, with the M69 motorway defining the south-eastern boundary. The the south-western boundary is defined by field boundaries beyond which are blocks of deciduous woodland, including Burbage Wood, Aston Firs and Freeholt Wood. The north-eastern boundary is also bounded by field boundaries beyond which lies the village of Elmesthorpe, a linear settlement on the B581 Station Road (see Illus 6). An unnamed stream flows north-eastwards through the southern portion of the site.

Generally, the topography slopes from north to south at a height of between 85m Above Ordnance Datum (AOD) in the north to 110m AOD in the south, although there are a number of more localised undulations within this range.

At the time of the survey the majority of the fields to the north of the unnamed stream were under short wheat and rape crops with the exception of F13, F14, F17 and F18 which were under pasture. To the south of the unnamed stream the fields were mostly under pasture, although F45 contained rape (see Illus 2 – Illus 5). Access was not granted to F46 or F48.

1.2 GEOLOGY AND SOILS

The bedrock geology within the DCOB comprises mudstone of the Mercia Mudstone Group. The superficial deposits vary mostly between Bosworth Clay and Thrussington Member – diamicton (see Illus 7). Pockets of Wolston sand and gravel are recorded in the west, whilst alluvial deposits are recorded along the course of the unnamed stream in the southern portion of the site. No superficial deposits are recorded around Hobbs Hayes Farm (NERC 2018).

The soils are mainly classified in the Soilscape 18 association, characterised as slowly permeable, seasonally wet loams with the soils in the north-east of the DCOB being classified in the Soilscape 8 association, characterised as freely draining, slightly acid but base-rich soils (Cranfield University 2018).

ILLUS 2 F1, looking south-west

2 ARCHAEOLOGICAL BACKGROUND

Little is known with regards the archaeological potential of the DCOB. A single undated ditch cropmark is recorded on the Leicestershire Historic Environment Record (HER) within the north of the site (see Illus 7). Other than an upstanding barn at Hobbs Hayes Farm, no further heritage assets are known within the DCOB.

Analysis of historical Ordnance Survey (OS) mapping indicates that the pattern and division of land within the DCOB has remained largely unchanged since the publication of the first edition OS map in 1888 (see Illus 7) albeit with the occasional removal of boundaries to create larger fields.

3 AIMS, METHODOLOGY AND PRESENTATION

The general aim of the geophysical survey was to provide sufficient information to establish the presence/absence, character and extent of any archaeological remains within the survey area. This will therefore enable an assessment to be made of the impact of the proposed development on any sub-surface archaeological remains, if present.

The specific archaeological objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore model the presence/absence and extent of any buried archaeological features; and
- to prepare a report summarising the results of the survey.

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)

3

4

5

ILLUS 3 F25, looking north-west **ILLUS 4** F38, looking south-east **ILLUS 5** F45, looking south-east

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 V3.0.32.4 (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 1:25,000. Illus 2–5 are site condition photographs. Illus 6 is a 1:10,000 survey location plan showing the direction of survey as GPS swaths. Illus 7 shows the cropmark and geology data (NERC 2018) overlying the 1888-1913 six inch OS map, also at 1:10,000. Detailed data plots of the fully processed data, with accompanying interpretative plots are produced, also at 1:10,000, as Illus 8 and Illus 9. Large-scale, fully processed (greyscale) data, minimally processed data (XY traceplot) and accompanying interpretative plots are presented at a scale of 1:2,000 in Illus 10–36 inclusive with more detailed plots (1:1,000) of the area of archaeological activity (AAA) shown in Illus 37 to Illus 39 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 (Harrison 2018), guidelines outlined by Historic England (English Heritage 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All illustrations from Ordnance Survey 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

Generally, the ground conditions were good although soft conditions impeded progress in places. However, this has not impacted adversely on the quality of data collected which is of a high standard throughout.

The magnetic background differs clearly throughout the DCOB, from a relatively uniform background within F13, F14, F15 (south), F17, F18, F29–F31, F34, F36, F37–F44 and F47 to a highly elevated and speckled magnetic background elsewhere. This elevated background is characteristic of the recent application of green waste as soil conditioner. Against these backgrounds numerous, linear and discrete anomalies have been identified and these are discussed below and cross-referenced to specific examples on the interpretive figures, where appropriate.

4.1 FERROUS 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 consequence of manuring or tipping/infilling. There is no obvious clustering to these ferrous anomalies which might indicate an archaeological origin. Across those fields unaffected by green waste it is probable that the 'spike' responses are likely caused by the random distribution of ferrous debris in the upper soil horizons.

Extensive areas of high magnitude magnetic responses are recorded over 75% of the DCOB. These responses are characteristic of green waste which has been spread and mixed into the topsoil as soil conditioner. The response is not fully understood but is thought to be caused by the presence of magnetic compounds in the soil created during decomposition processes, and also by frequent ferrous contaminants within the waste material. Against this background it may not be possible to clearly distinguish any low magnitude anomalies of archaeological potential, if present, within the affected area. Whilst high magnitude anomalies have been identified against the elevated background such as the ploughing trends within F19 (see Illus 10–12) and the broad, amorphous geological anomalies within F22/F24/F26 (see Illus 13-15) it is possible that low magnitude archaeological anomalies, if present, may be masked against this background.

Localised areas of magnetic disturbance within F1 (FP1; see Illus 16–18), F25 (FP2 and FP3; see Illus 19–21) and F26 (FP4; see Illus 13–15) locate former ponds. The disturbance is due to magnetic material within the material used to infill the former ponds.

The magnetic disturbance dominating F29 (see Illus 22–24) is less uniform than that caused by green waste and is thought to be caused by modern dumping/tipping, perhaps being associated with the construction of the adjacent M69 and/or overpass.

A single high magnitude dipolar linear anomaly (SP1; Illus 31–33) has been identified aligned north-east/south-west in the north-west of F45. The anomaly locates a buried service pipe.

Areas of disturbance around the perimeter of the survey areas and along the field edges is due to ferrous material within the adjacent boundaries.

4.2 AGRICULTURAL ANOMALIES

Analysis of historical Ordnance Survey (OS) mapping indicates that the pattern and division of land within the DCOB has remained largely unchanged since the publication of the first edition OS map in 1888 albeit with the occasional removal of boundaries to create larger fields. Seven of these former boundaries have been detected by the survey as high magnitude linear anomalies (FB1–FB7). The anomalies are caused by the contrast between the soil-fill of a ditch and the surrounding soils. A curvilinear anomaly (FT; see Illus 16-18) within F1 corresponds to a former farm track which is depicted on modern OS maps.

Broadly-spaced linear anomalies are recorded within F1 and F17-F19 (Illus 10–12). These anomalies are due to the medieval and post-medieval practice of ridge and furrow cultivation with the striped appearance being due to the magnetic contrast between former ridges and the soil-filled furrows.

More closely-spaced linear trend anomalies across F17, F18 and in the fields surrounding Hobbs Hayes Farm are typical of recent ploughing. Other linear anomalies, often specked in appearance, and oblique to the surrounding field boundaries are likely to locate field drains.

It is notable that former field boundaries, ridge and furrow, modern ploughing and field drains have been identified within most of the fields affected by the green waste, demonstrating that some soil-filled features can be detected against this background. On this basis, it is thought likely that any extensive areas of enclosed settlement, if present, would have been detected, at least in part, by the geophysical survey. However, no agricultural anomalies have been detected within the extremely variable backgrounds in F12, F16, F24 and F26. In these fields it is considered unlikely that any anomalies of archaeological potential, if present, would manifest in the data.

4.3 GEOLOGICAL ANOMALIES

Broad and amorphous high magnitude anomalies are clearly discernible against the elevated magnetic backgrounds in F22, F24 and F26. These anomalies are thought to be geological in origin, perhaps locating isolated deposits of sand and/or gravel.

Across those fields unaffected by green waste, numerous discrete areas of magnetic enhancement are thought to be due to localised variations in the depth and composition of the soils.

4.4 ARCHAEOLOGICAL AND POSSIBLE ARCHAEOLOGICAL ANOMALIES

An isolated ring-ditch is identified in F38, immediately west of Hobbs Hayes Farm, centred at SP 4635 9446 (RD1; see Illus 37–39). The ring-ditch measures 20m in diameter and probably locates a round barrow. Discrete areas of magnetic enhancement in the interior of the ring-ditch and to the immediate north-west, may be due to pits.

No anomalies of archaeological potential have been identified to confirm the undated ditch cropmark (MLE68) which is recorded on the Leicestershire HER in F23/25. The cropmark is recorded in a field affected by the application of green waste and, if it is caused by a soil-filled feature, it is unclear whether it would manifest as a magnetic anomaly under these conditions.

5 CONCLUSION

Evaluation of the proposed development area has been notably affected by the extensive application of green waste as soil conditioner over 75% of the site. This has resulted in a widespread elevated magnetic background against which any low magnitude anomalies of archaeological potential, if present, may be masked. For this reason, the archaeological potential over the affected fields remains uncertain although it is thought that any extensive areas of enclosed settlement, if present, would have been detected, at least in part, over the majority of the geophysical survey area. A single localised ring-ditch has been identified at Hobbs Hayes Farm in an area unaffected by green waste. This anomaly is ascribed high archaeological potential and probably locates a round barrow. No further anomalies of archaeological potential have been identified over the 25% of fields where green waste has not been applied and, in these fields, the archaeological potential is assessed as low.

6 REFERENCES

Chartered Institute for Archaeologists (CIfA) 2014 ***Standard and guidance for archaeological geophysical survey*** (Reading) http://www.archaeologists.net/sites/default/files/CIfAS%26GGeophysics_2.pdf accessed 11 May 2018

Cranfield University 2018 ***Cranfield Soil and Agrifood Institute Soilscapes*** http://www.landis.org.uk/soilscapes/ accessed 11 May 2018

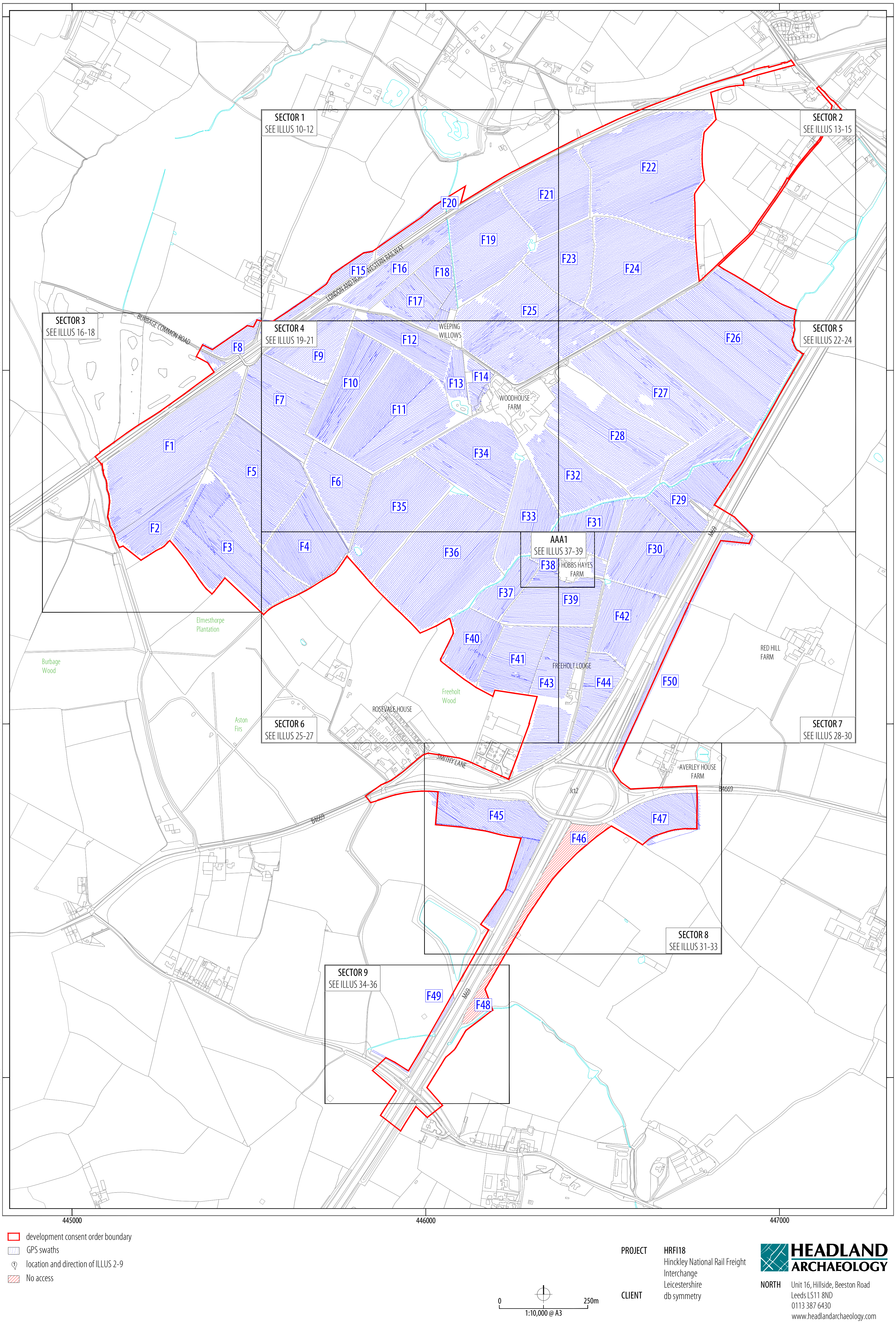
Department for Transport (DfT) 2014 ***National Policy Statement for National Networks*** https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf accessed 11 May 2018

English Heritage 2008 ***Geophysical Survey in Archaeological Field Evaluation: Research and Professional Services Guidelines*** (2nd edn) http://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf accessed 11 May 2018

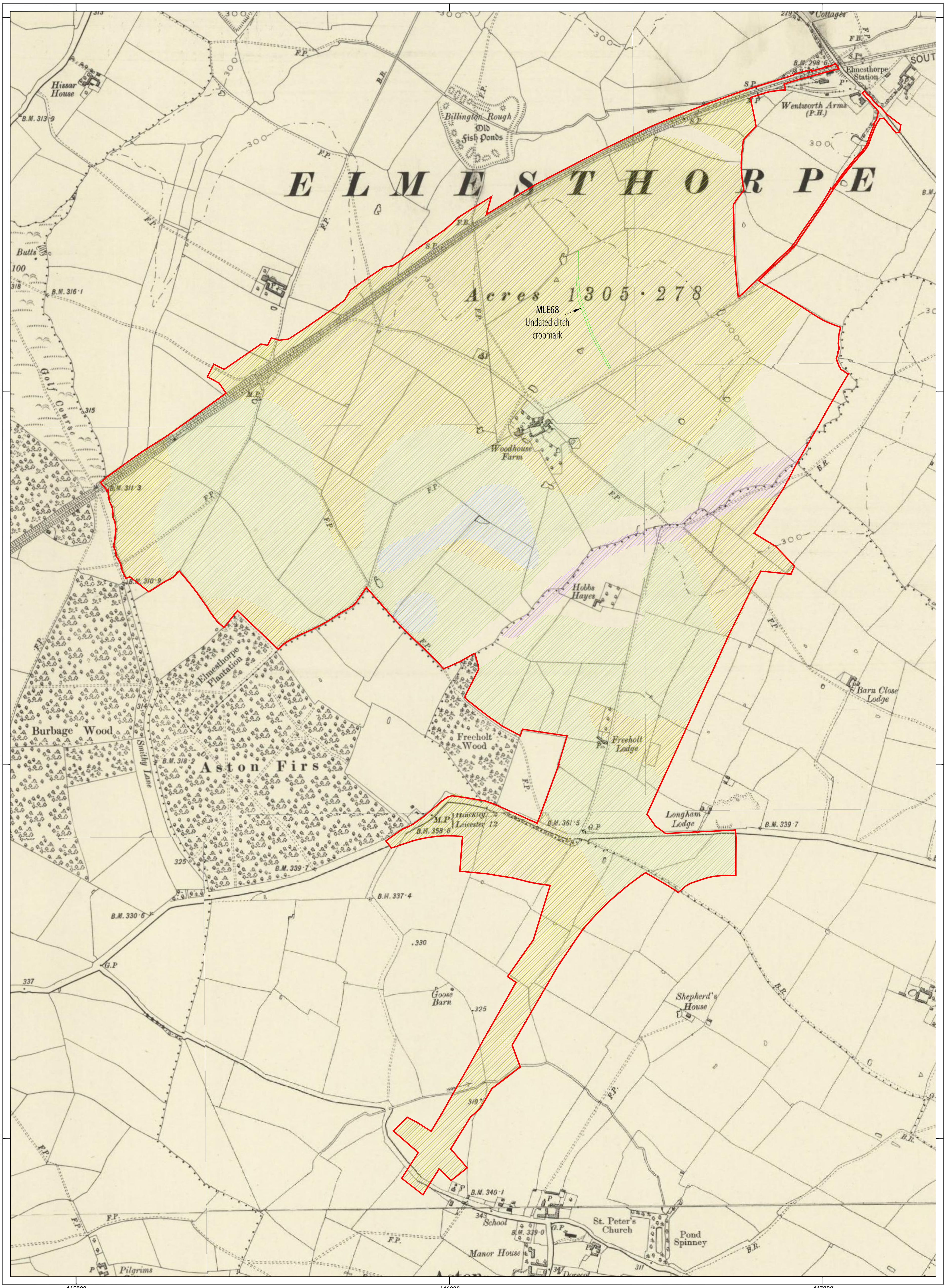
Gaffney C & Gater J (2003) ***Revealing the Buried Past: Geophysics for Archaeologists*** Stroud

Harrison S 2018 ***Hinckley National Rail Freight Interchange, Leicestershire; Written Scheme of Investigation for Geophysical Survey*** [unpublished client report] Ref HRFI18

Natural Environment Research Council (NERC) 2018 ***British Geological Survey*** http://www.bgs.ac.uk/ accessed 11 May 2018



ILLUS 6 Survey location showing GPS swaths



development consent order boundary

Leicestershire HER data

SUPERFICIAL DEPOSITS

Bosworth Clay Member - clay and silt

Thrussington Member - diamicton

Wolston Sand and Gravel - sand and gravel

Alluvium - clay, silt, sand and gravel

0 250m

1:10,000 @ A3

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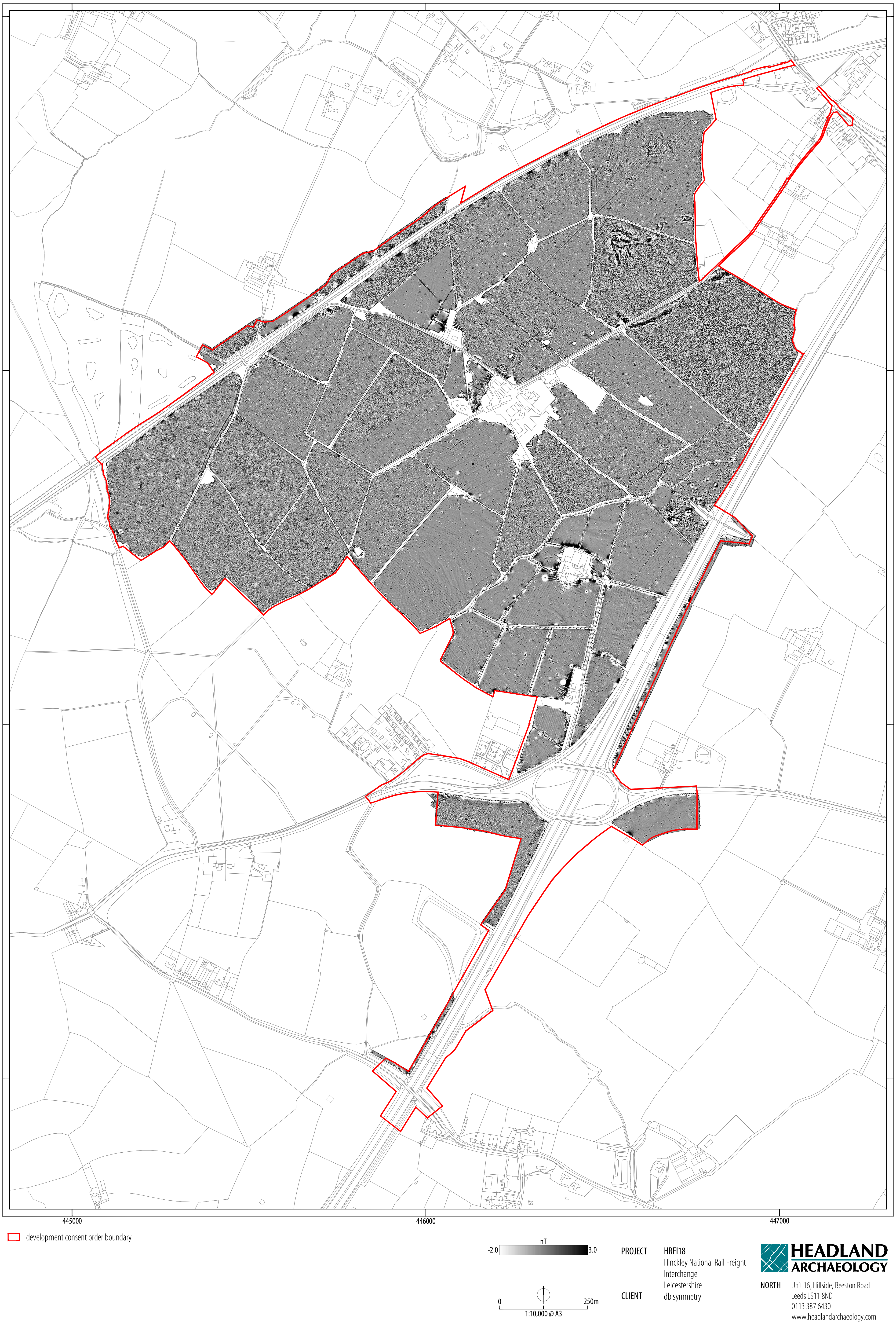
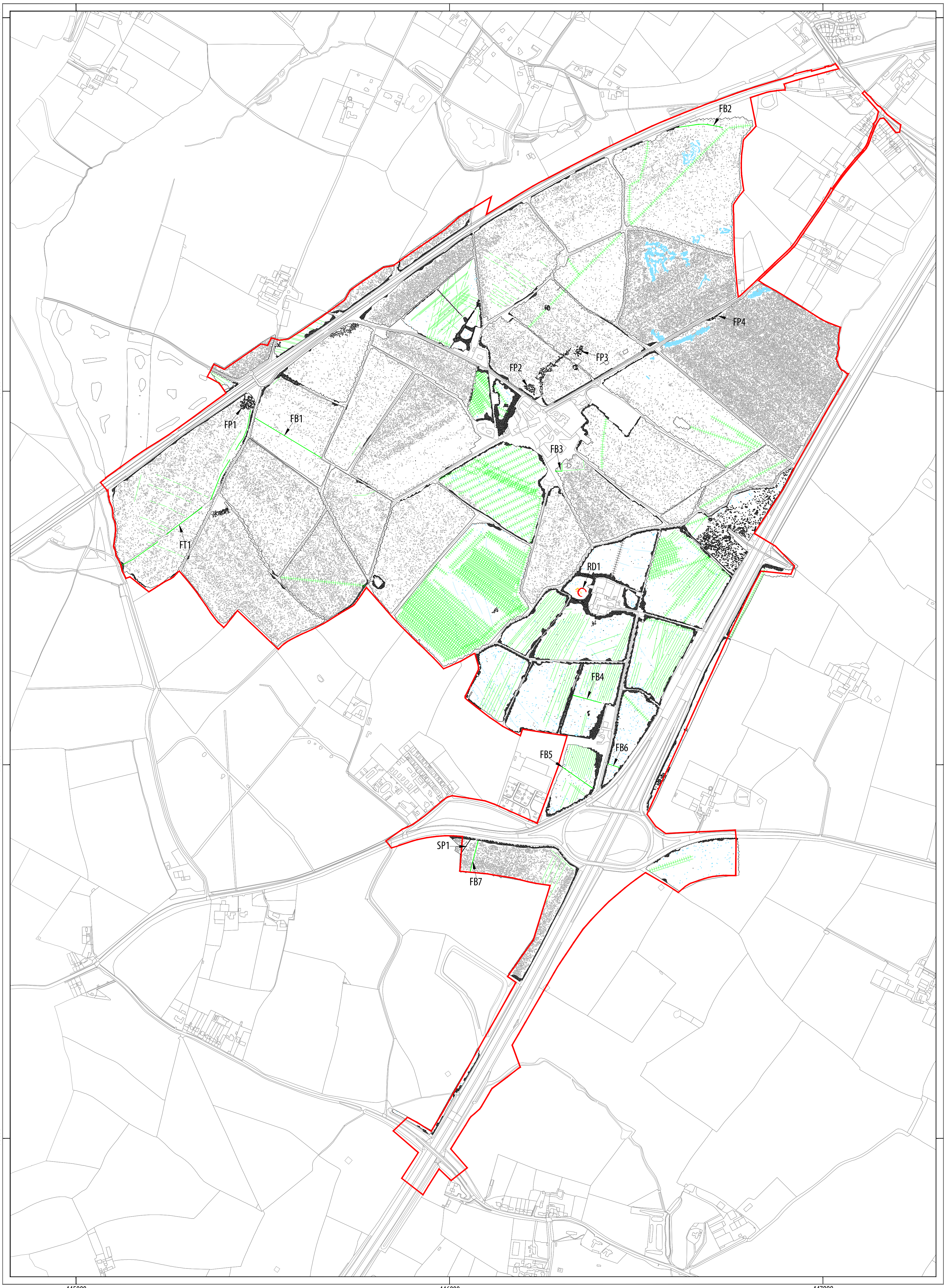
ILLUS 7 Survey location showing cropmark and superficial deposits overlying the 1888–1913 six inch OS map



ILLUS 8 Processed greyscale magnetometer data



TYPE OF ANOMALY	INTERPRETATION	TYPE OF ANOMALY	INTERPRETATION	TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material	linear trend	ridge and furrow	magnetic enhancement	archaeology?
magnetic disturbance	ferrous material	linear trend	field drain	magnetic enhancement	archaeology
dipolar linear	service pipe	linear	former field boundary		
dipolar linear	fence	linear	farm track		
magnetic disturbance	green waste	linear trend	geological variation		
linear trend	agricultural	magnetic enhancement	geology		

ABBREVIATIONS

FT	farm track	RD	ring-ditch
FB	former boundary	SP	service pipe
FP	former pond		

NORTH

0 250m
1:10,000 @ A3

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ILLUS 9 Interpretation of magnetometer data

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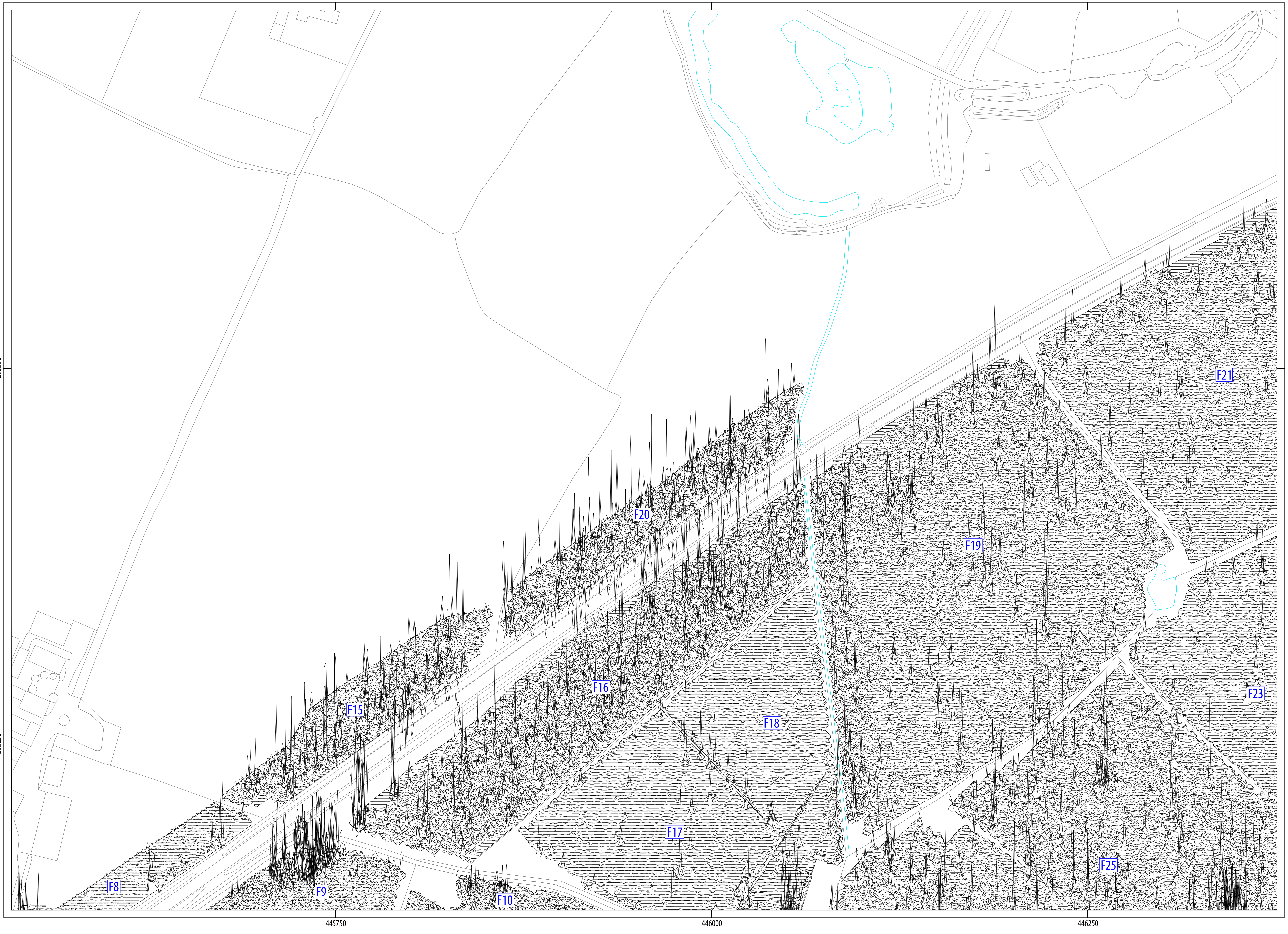
ILLUS 10 Processed greyscale magnetometer data; Sector 1



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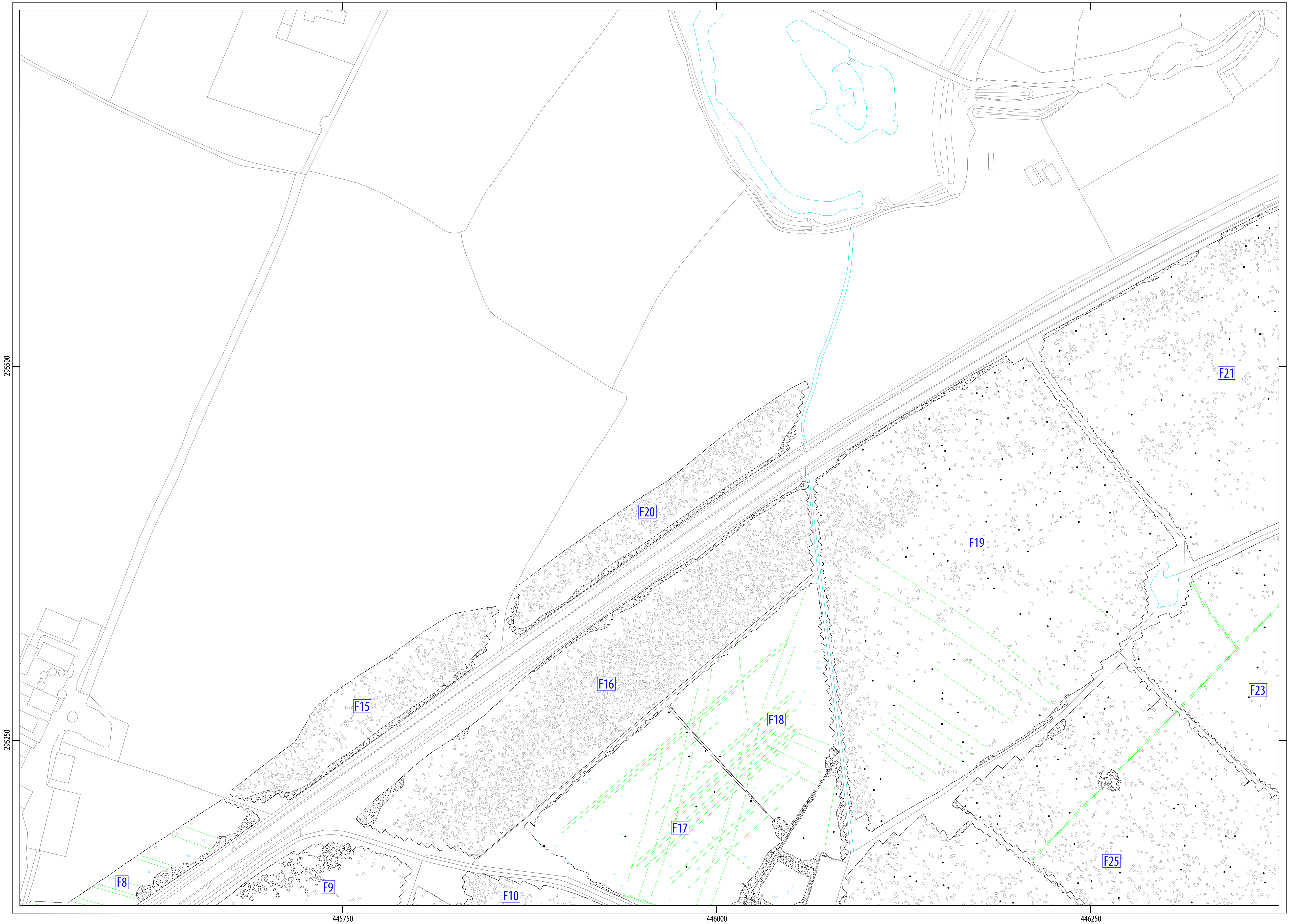
ILLUS 11 XY trace plot of minimally processed magnetometer data; Sector 1



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
magnetic disturbance	green waste
linear trend	ridge and furrow
linear trend	agricultural
linear trend	field drain
magnetic enhancement	geology

0 50m
1:2,500 @ A3

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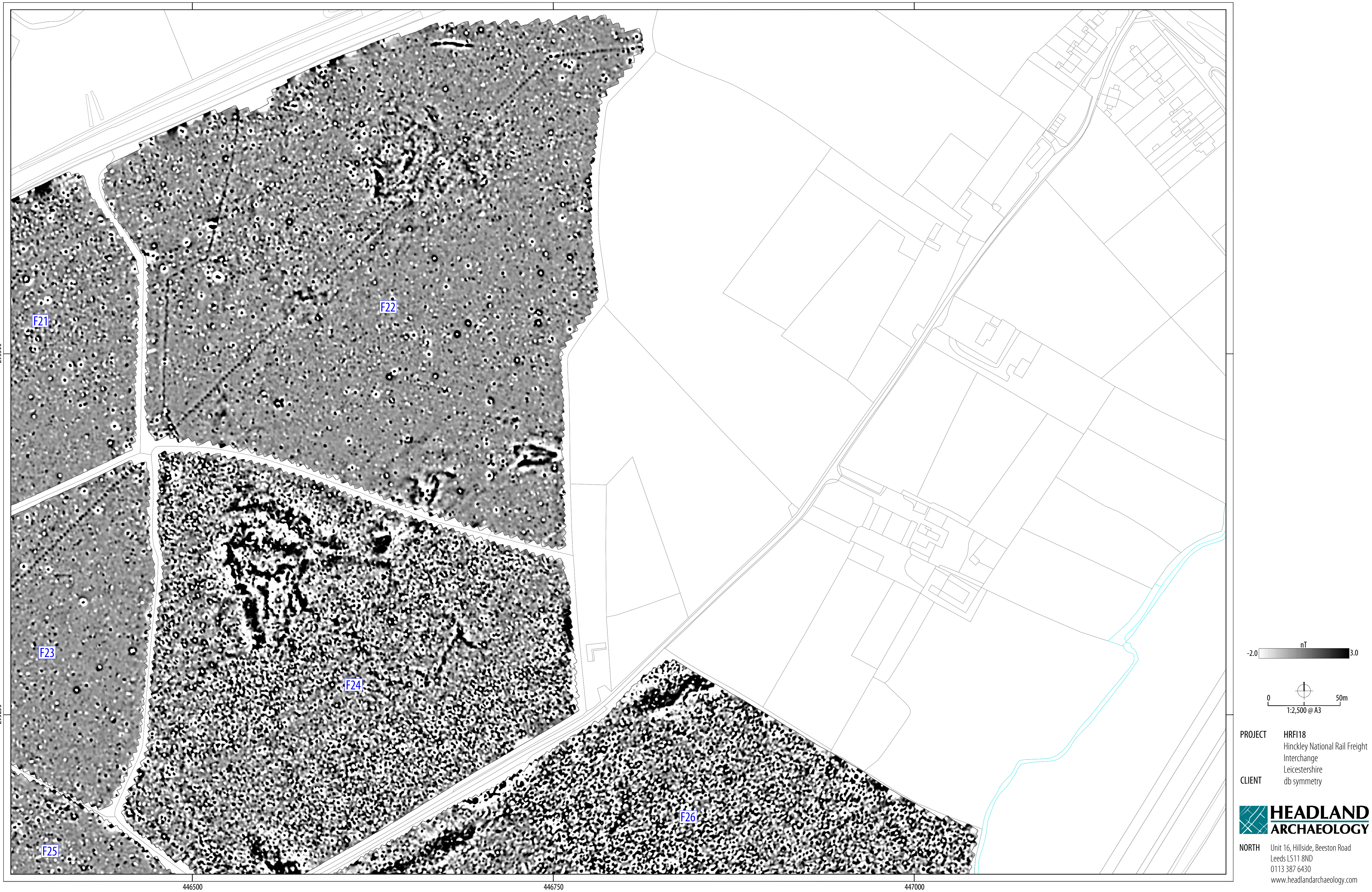
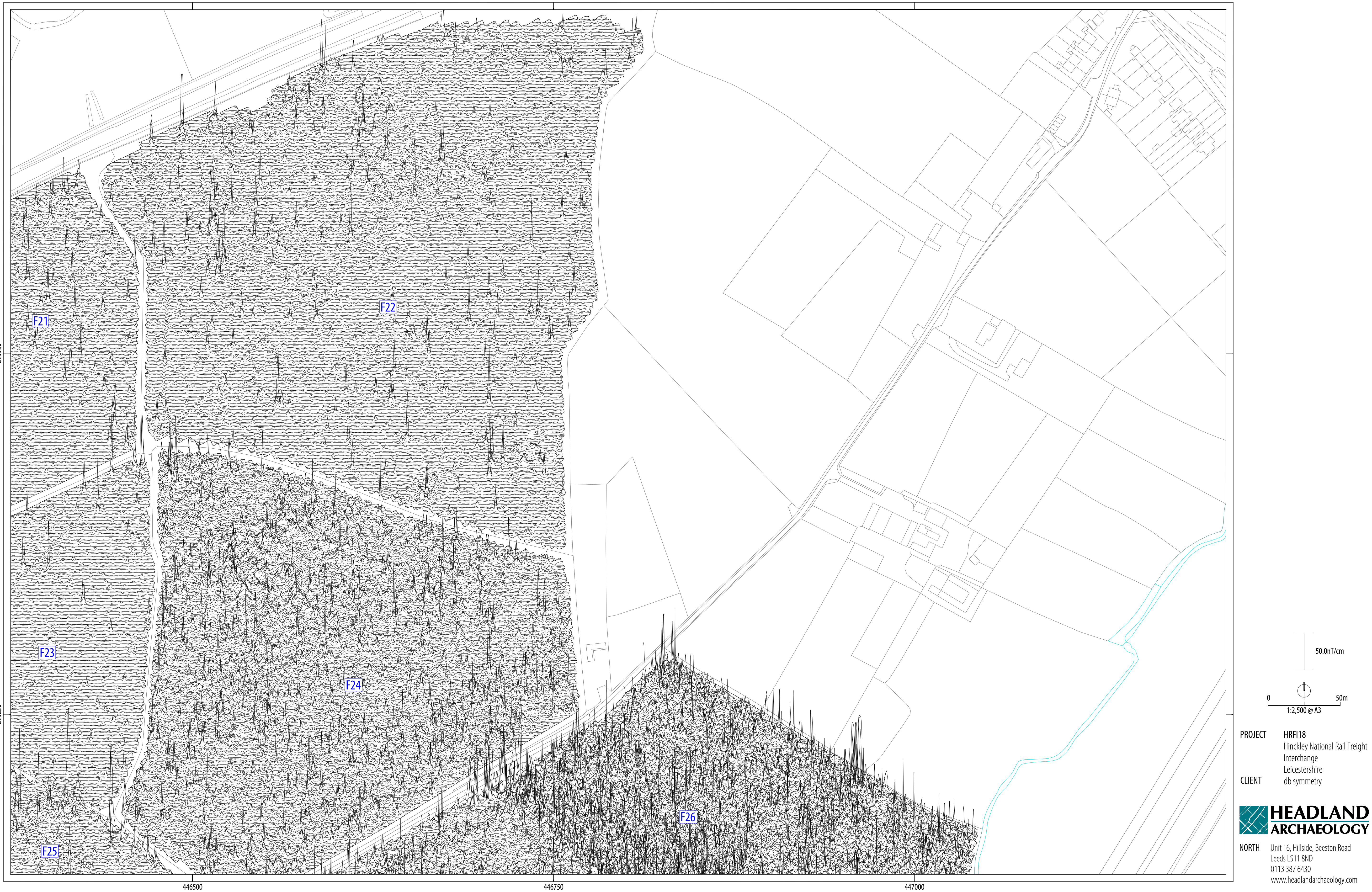
ILLUS 11 XY trace plot of minimally processed magnetometer data; Sector 1



ILLUS 13 Processed greyscale magnetometer data; Sector 2



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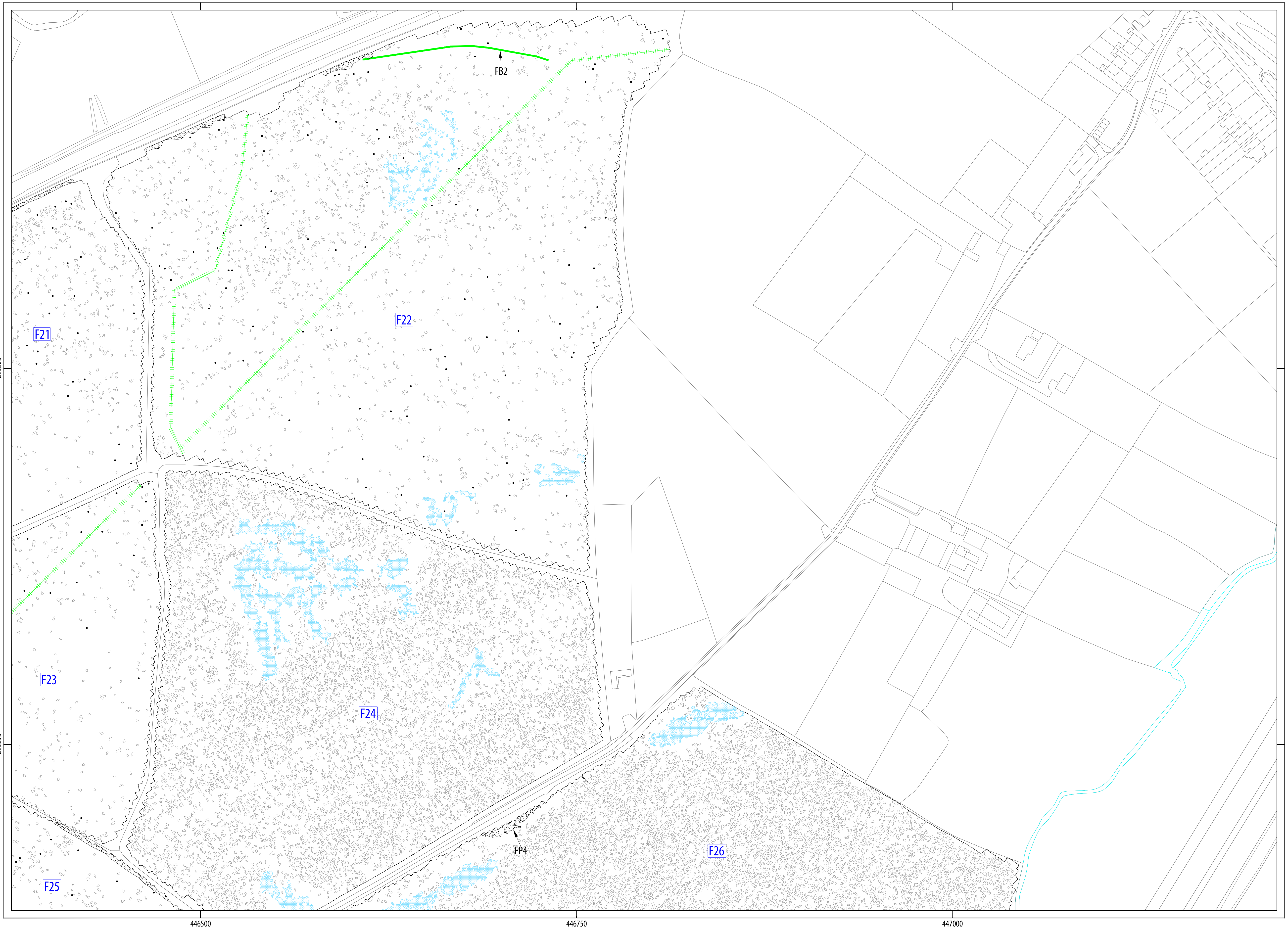
ILLUS 14 XY trace plot of minimally processed magnetometer data; Sector 2



TYPE OF ANOMALY | INTERPRETATION
dipolar isolated | ferrous material
magnetic disturbance | ferrous material
magnetic disturbance | green waste
linear trend | field drain
linear | former field boundary
magnetic enhancement | geology

ABBREVIATIONS

FB former boundary

FP former pond

0 50m

1:2,500 @ A3

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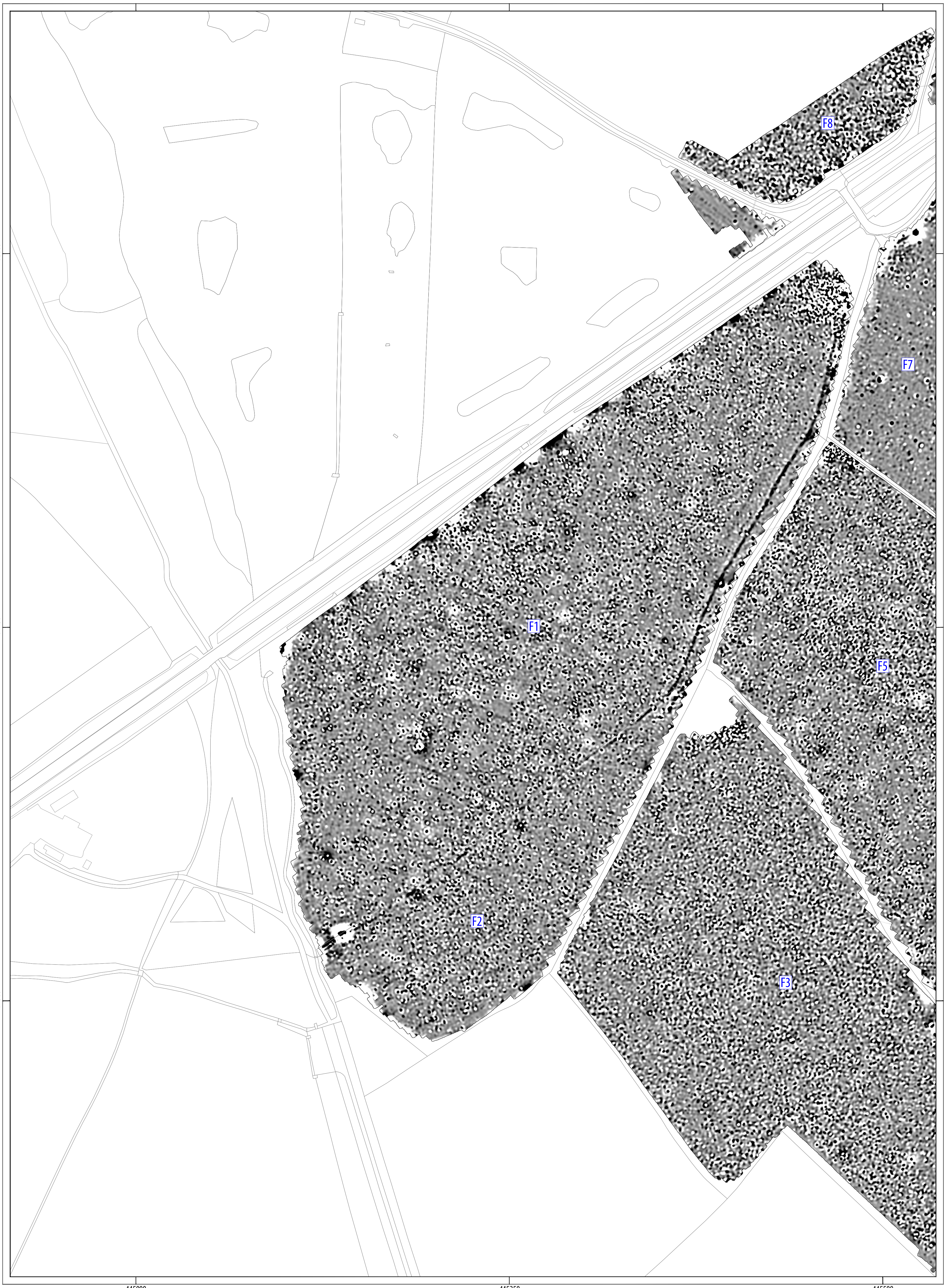
ILLUS 15 Interpretation of magnetometer data; Sector 2



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Land off Welsh Road West
Southam
Warwickshire

CLIENT Barwood Development
Securities Ltd

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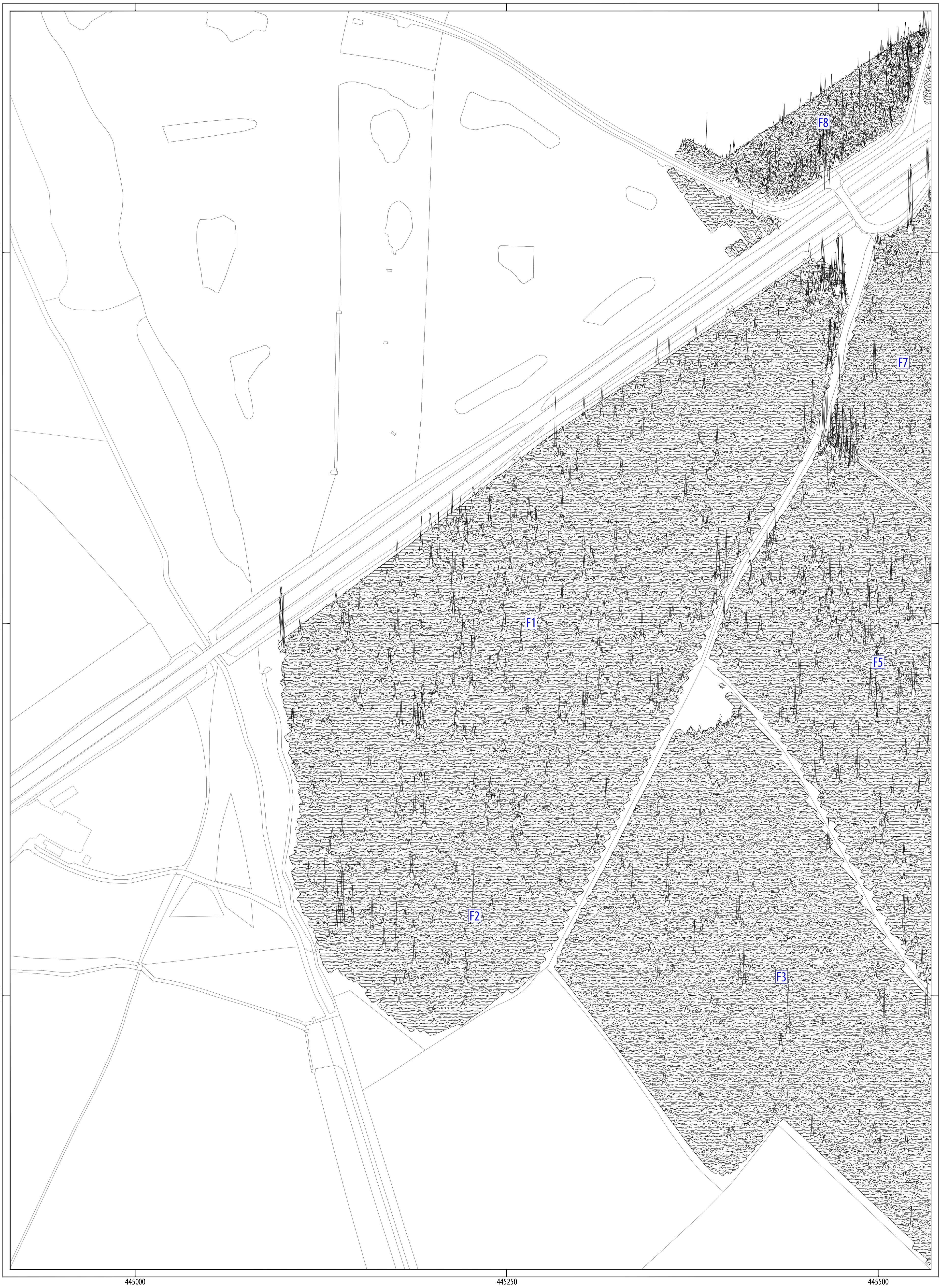
ILLUS 16 Processed greyscale magnetometer data; Sector 3



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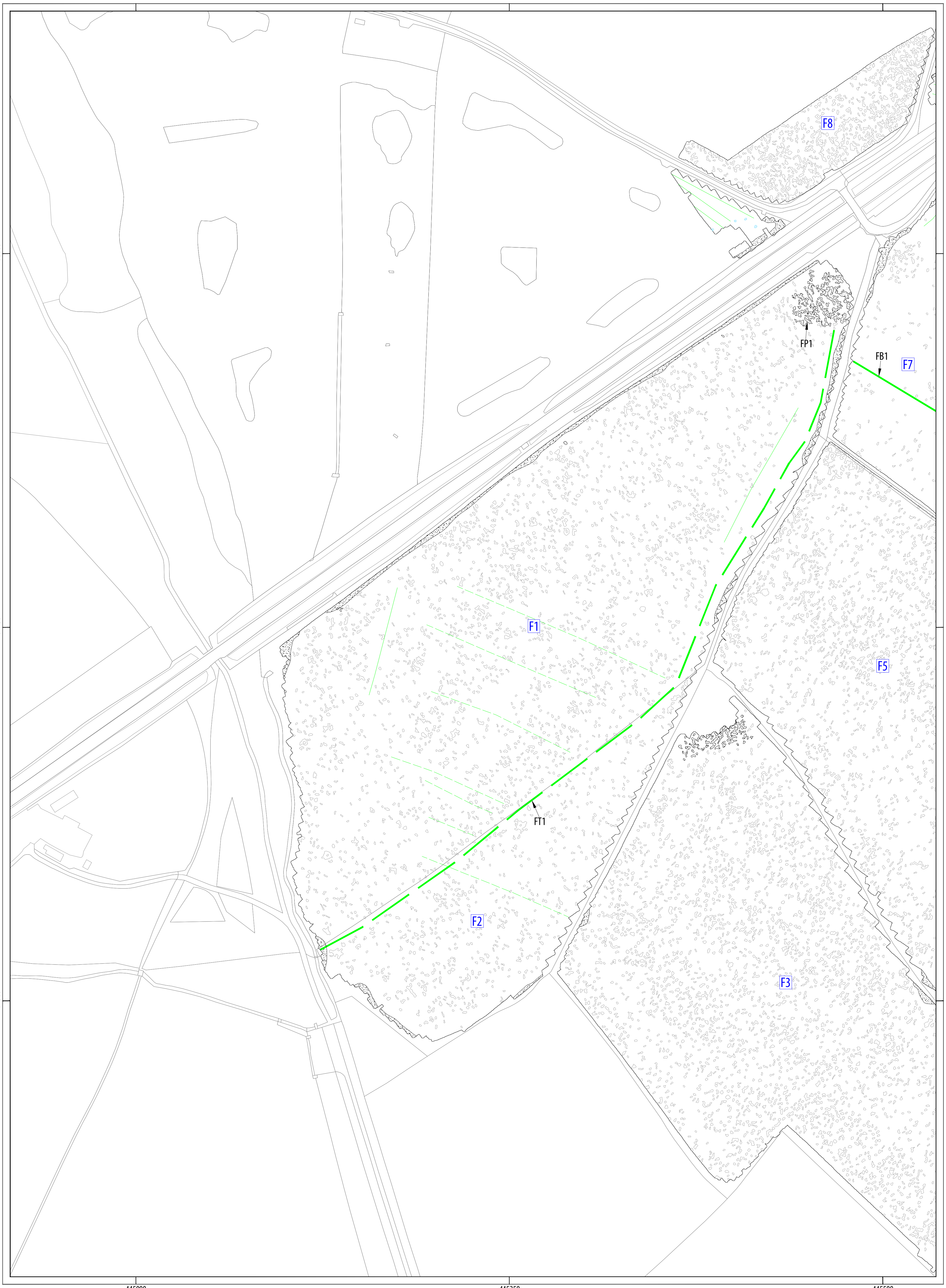
ILLUS 17 XY trace plot of minimally processed magnetometer data; Sector 3



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear trend	ridge and furrow
linear trend	agricultural
linear	former field boundary
magnetic enhancement	geology

ABBREVIATIONS

FT farm track
FB former boundary
FP former pond

0 100m
1:4,000 @ A3

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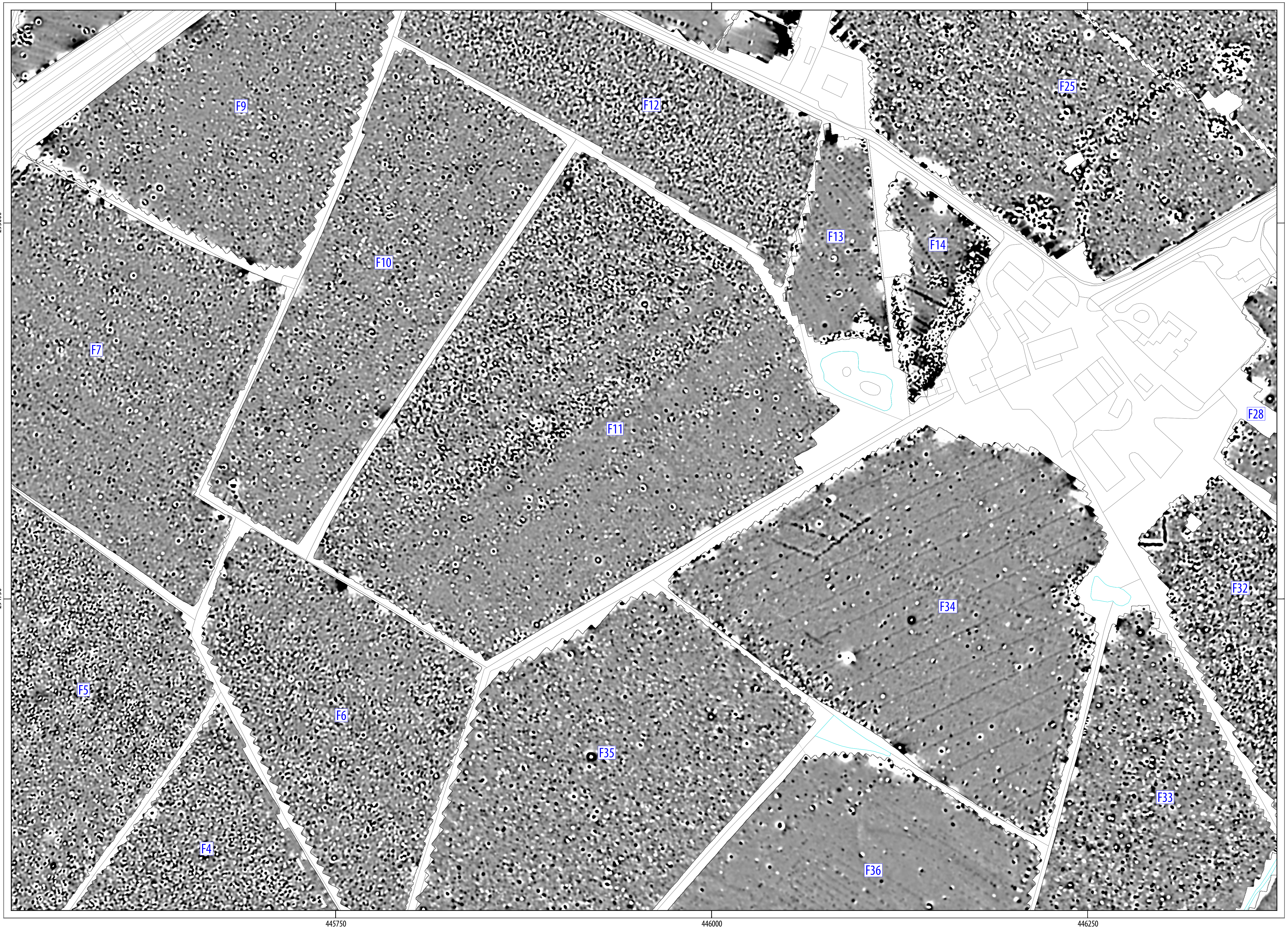
ILLUS 18 Interpretation of magnetometer data; Sector 3



nT
-2.0 3.0

0 50m
1:2,500 @ A3

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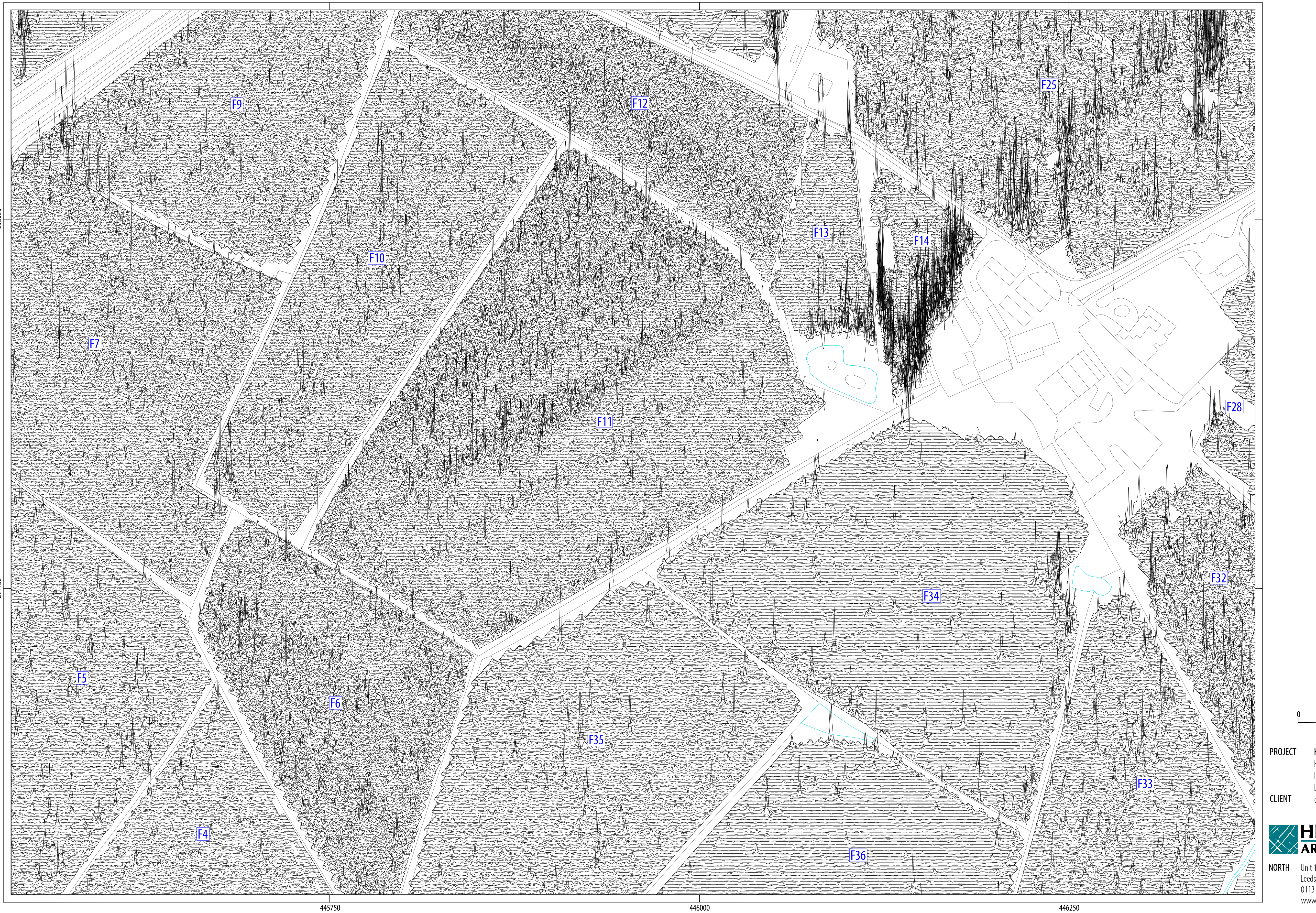
ILLUS 19 Processed greyscale magnetometer data; Sector 4



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ILLUS 20 XY trace plot of minimally processed magnetometer data; Sector 4

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

ABBREVIATIONS

FB former boundary

FP former pond

0 50m

1:2,500 @ A3

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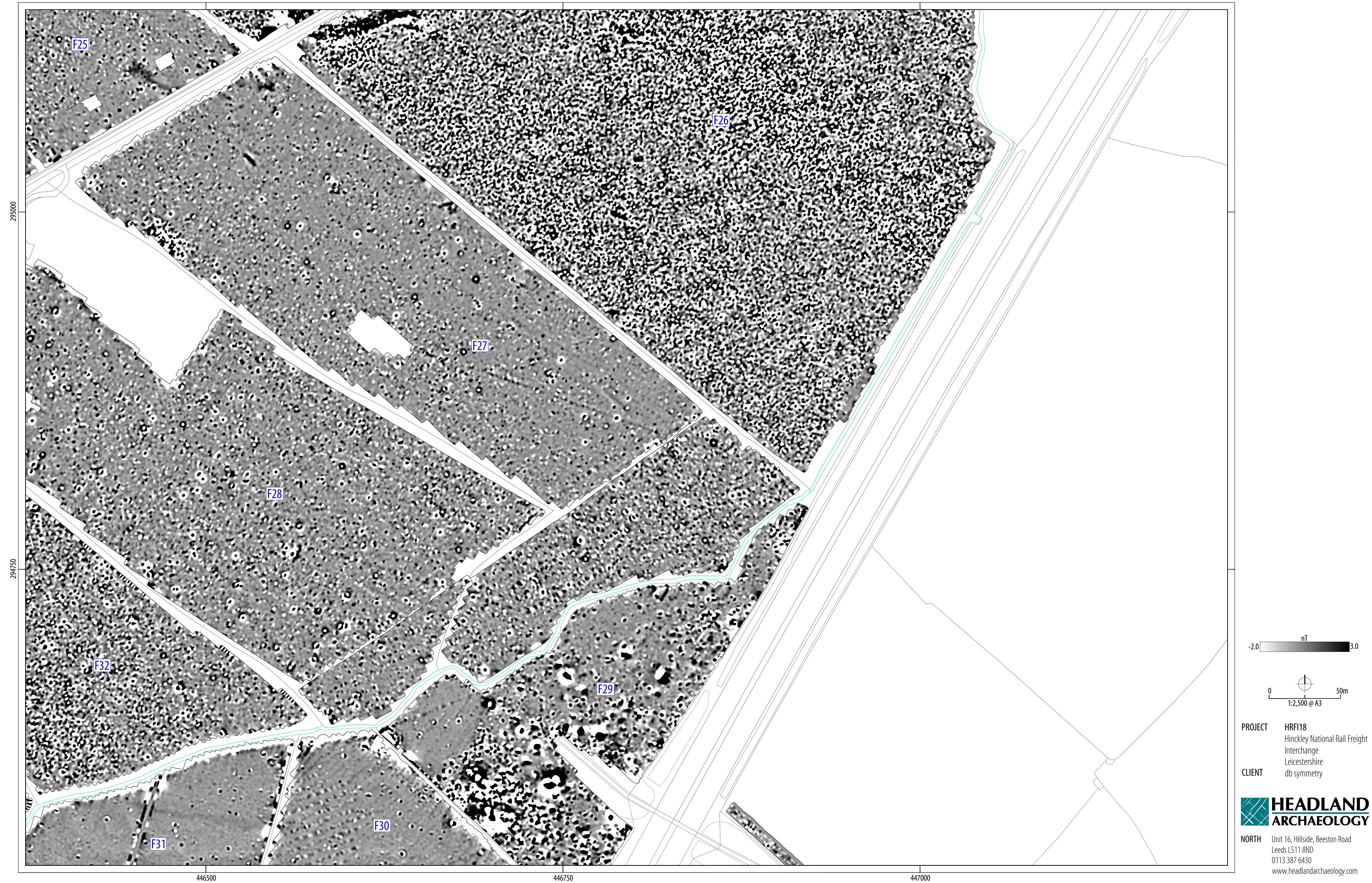
ILLUS 21 Interpretation of magnetometer data; Sector 4



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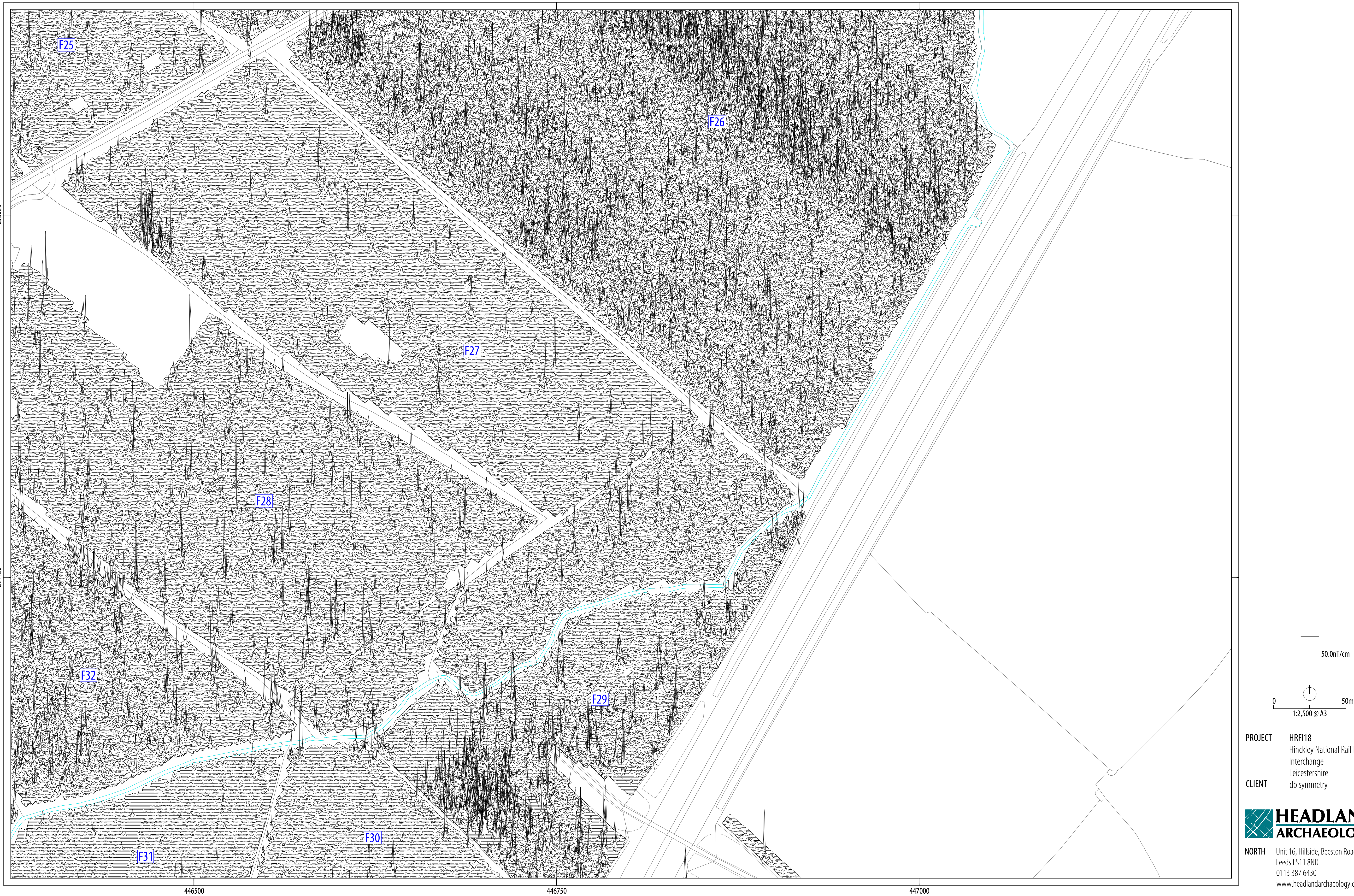
ILLUS 22 Processed greyscale magnetometer data; Sector 5



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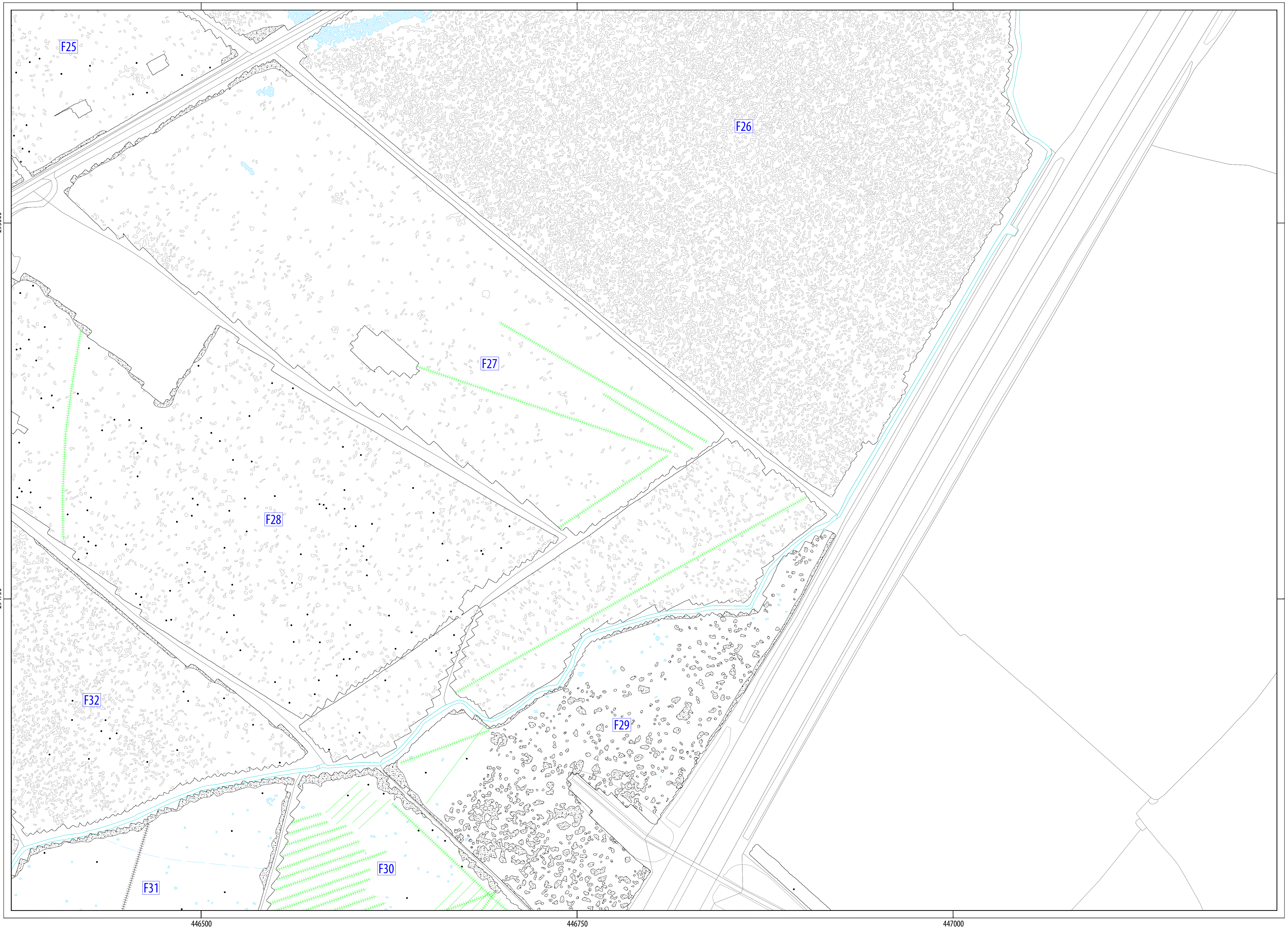
ILLUS 23 XY trace plot of minimally processed magnetometer data; Sector 5



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
magnetic disturbance	green waste
dipolar linear	fence
linear trend	agricultural
linear trend	field drain
magnetic enhancement	geology

0 50m
1:2,500 @ A3

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ILLUS 24 Interpretation of magnetometer data; Sector 5

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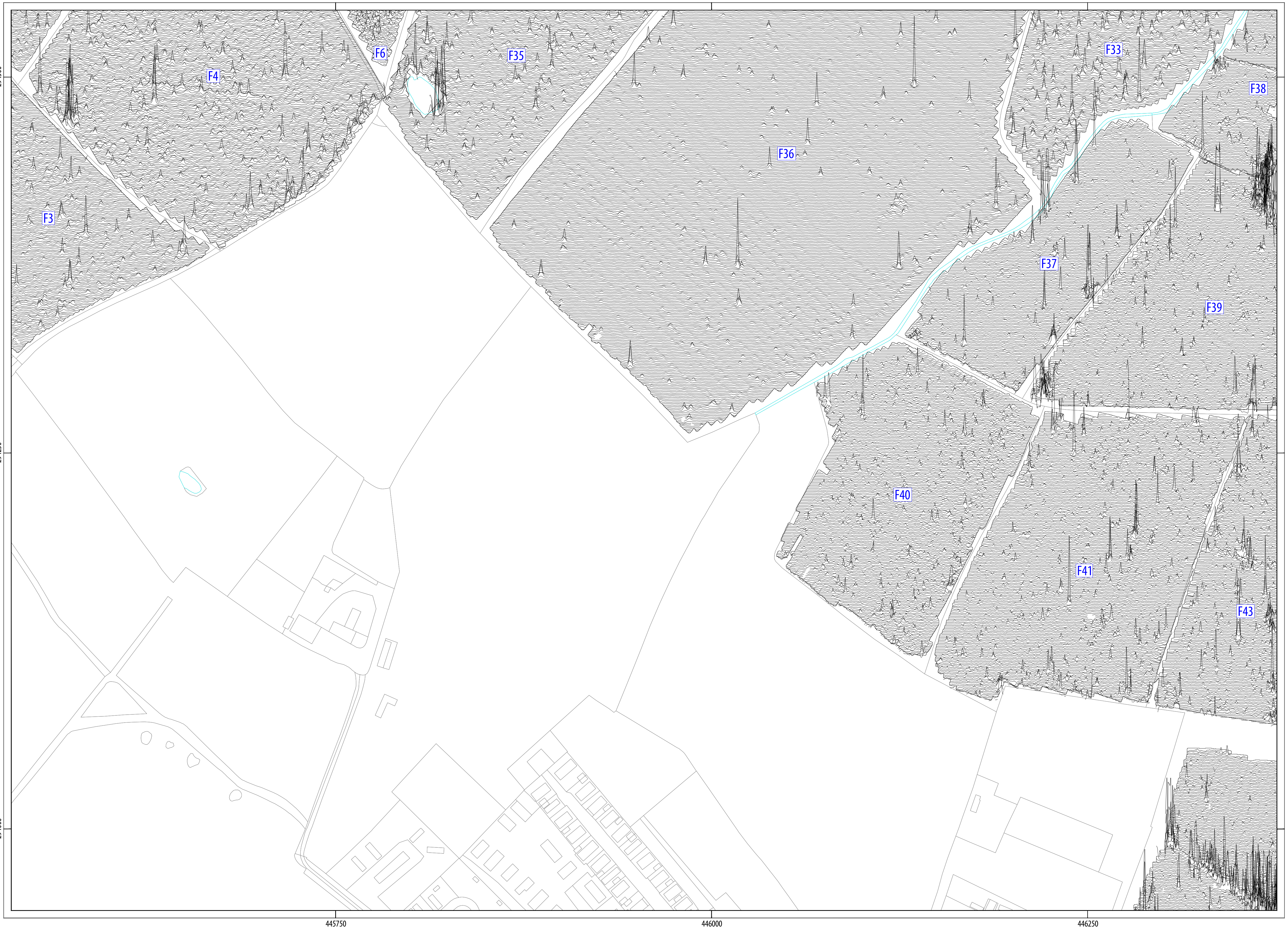
ILLUS 25 Processed greyscale magnetometer data; Sector 6



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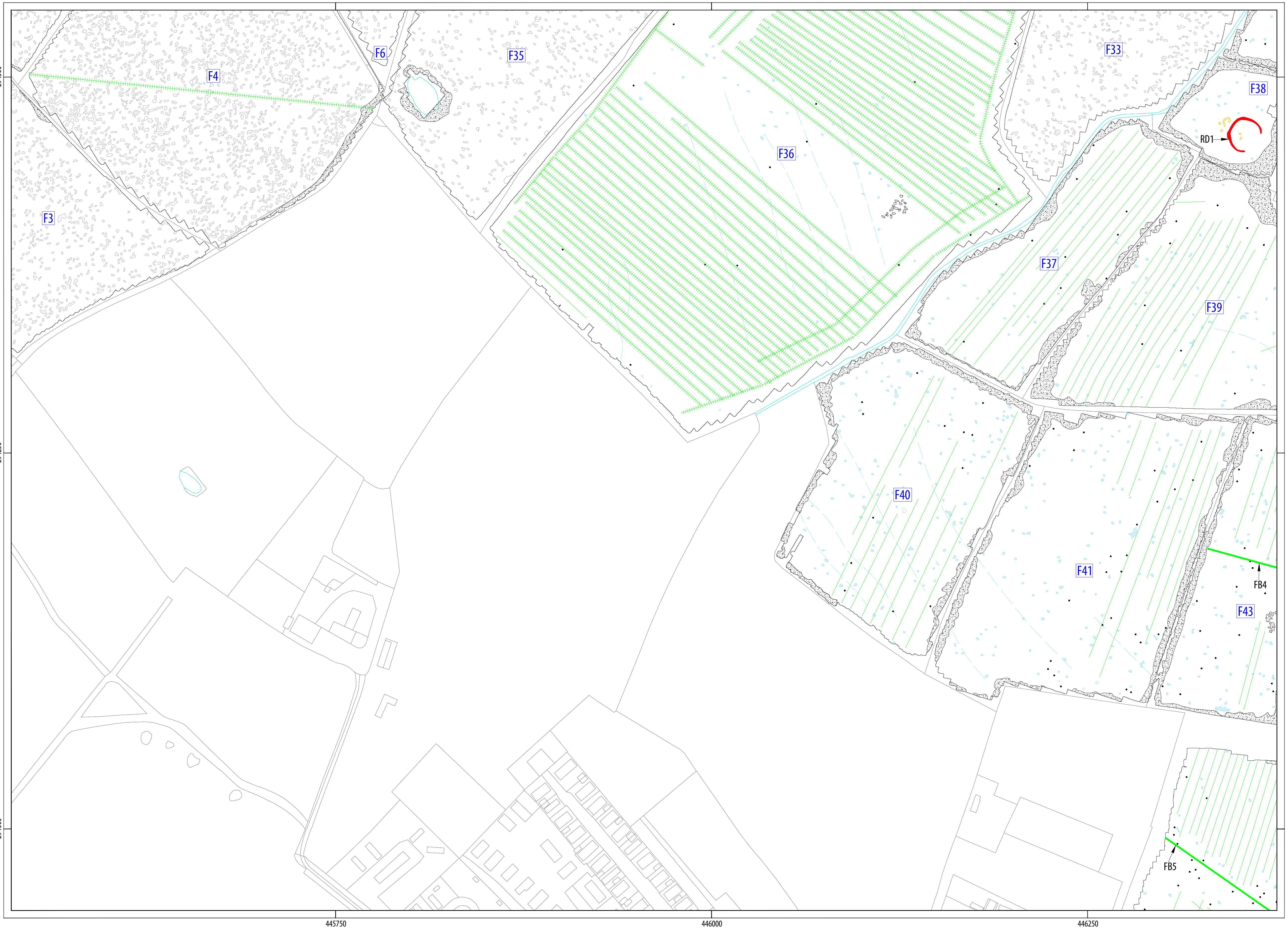
ILLUS 26 XY trace plot of minimally processed magnetometer data; Sector 6



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

ABBREVIATIONS

FB former boundary

RD ring-ditch

0 50m
1:2,500 @ A3

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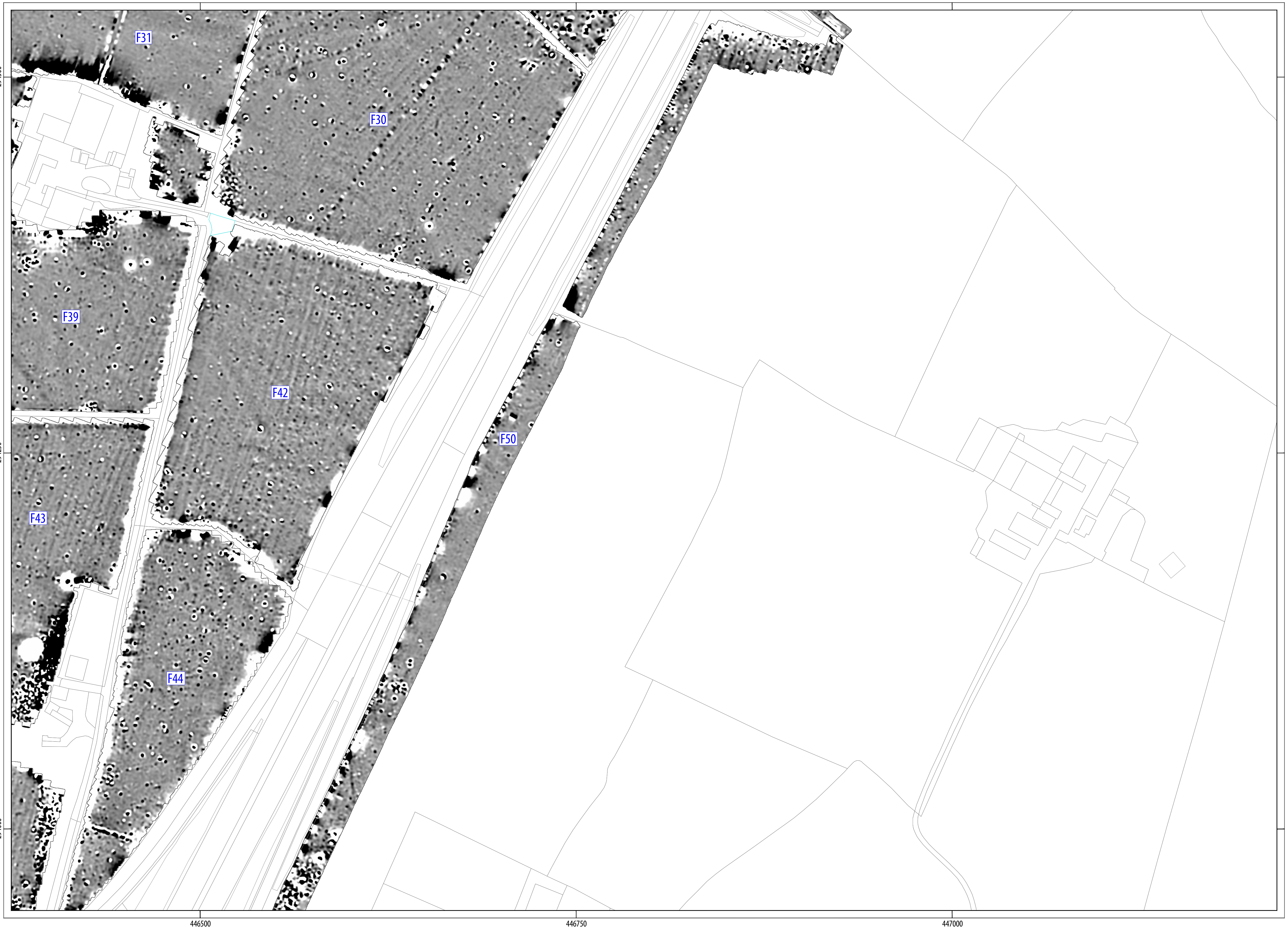
ILLUS 27 Interpretation of magnetometer data; Sector 6



nT
-2.0 3.0

0 50m
1:2,500 @ A3

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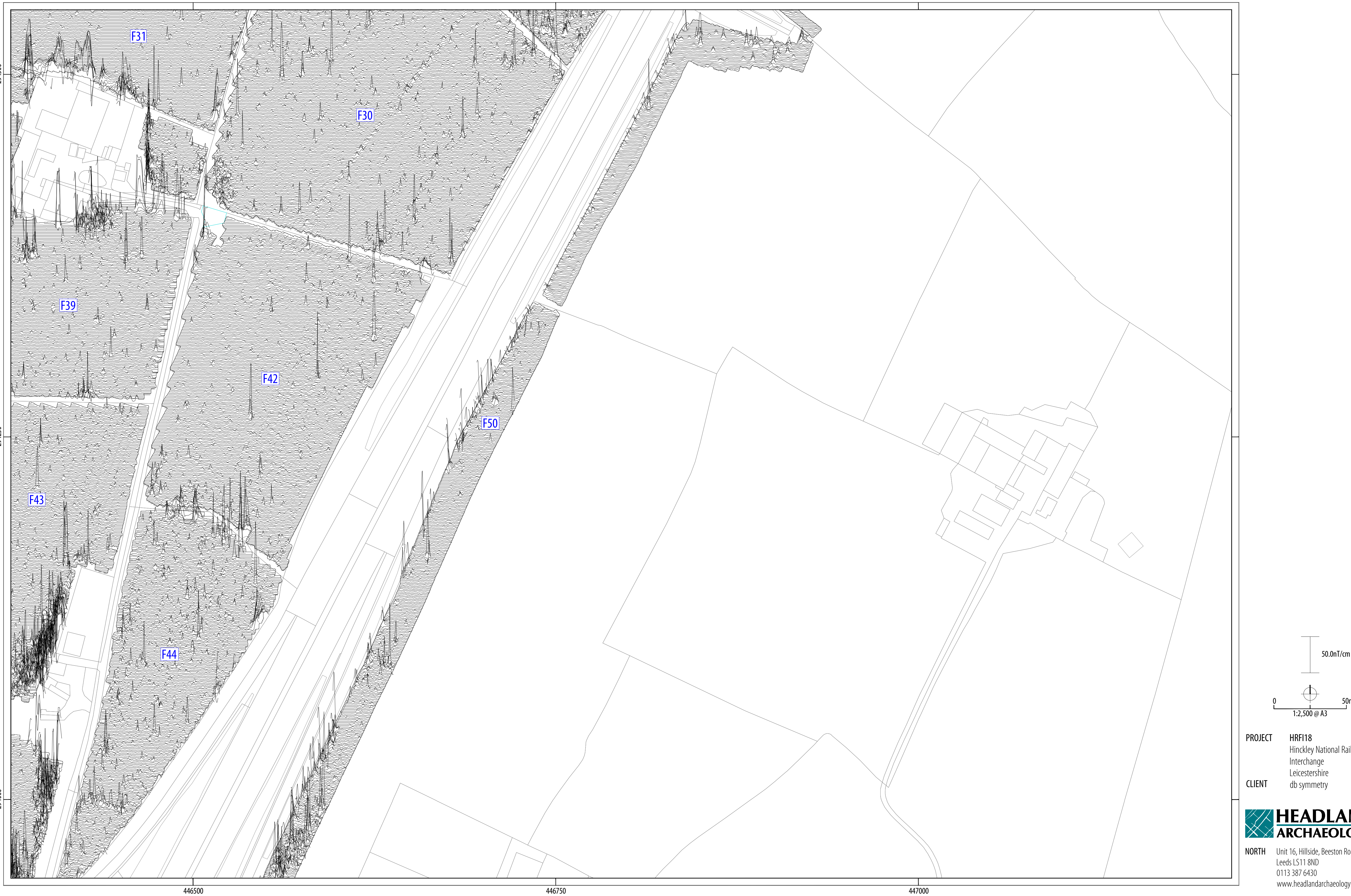
ILLUS 28 Processed greyscale magnetometer data; Sector 7



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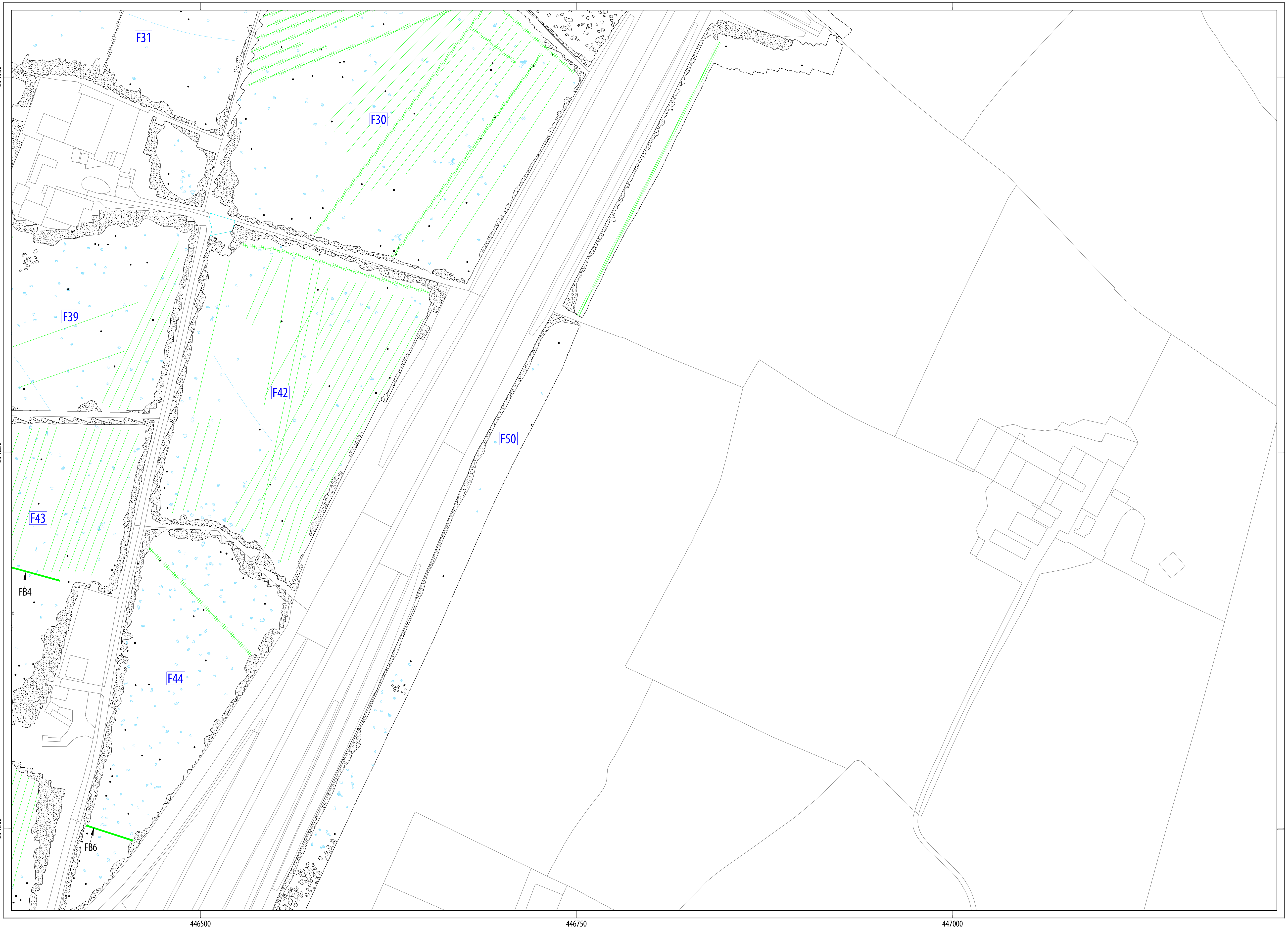
ILLUS 29 XY trace plot of minimally processed magnetometer data; Sector 7



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

ABBREVIATIONS

FB former boundary

RD ring-ditch

0 50m
1:2,500 @ A3

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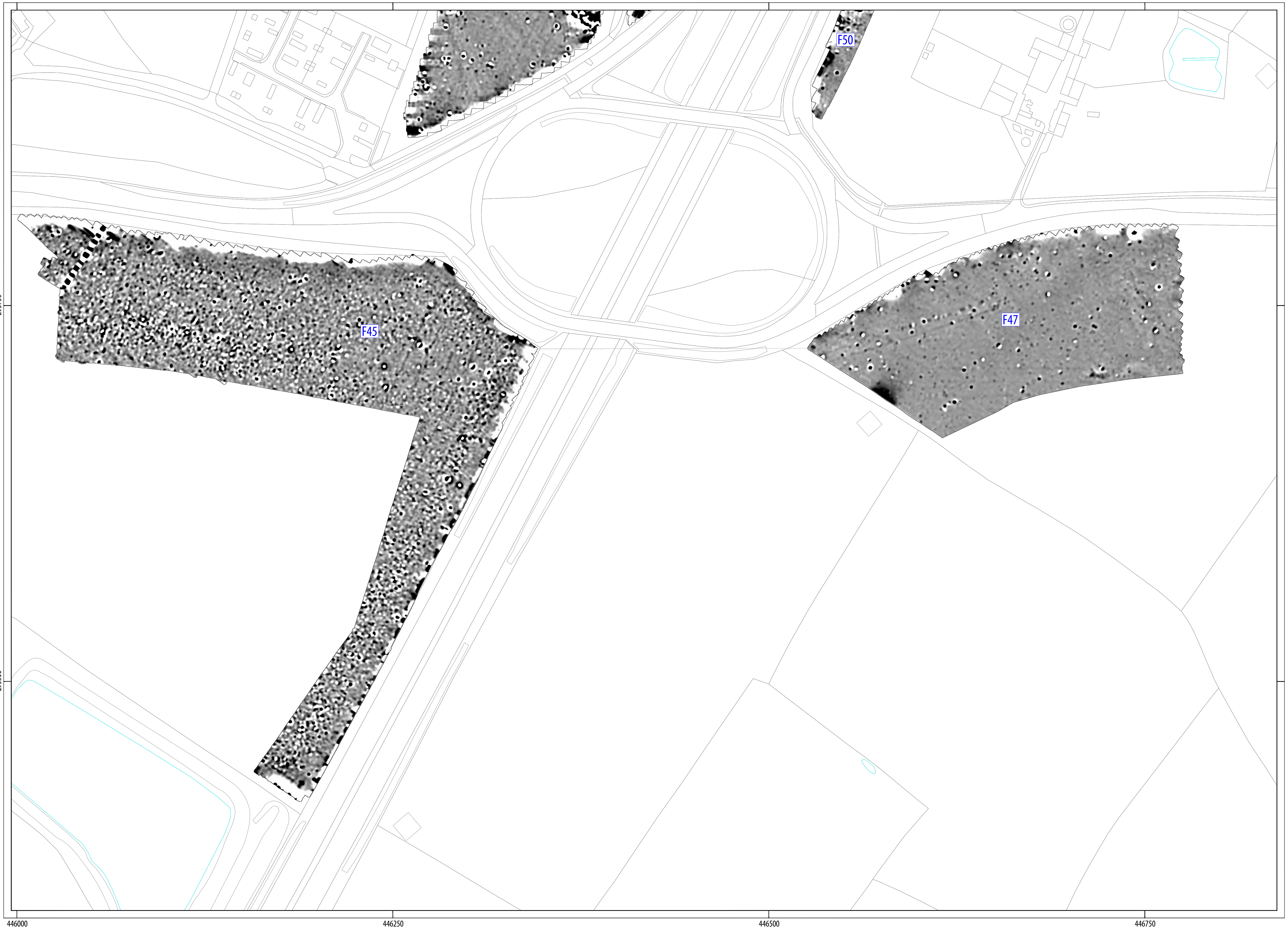
ILLUS 30 Interpretation of magnetometer data; Sector 7



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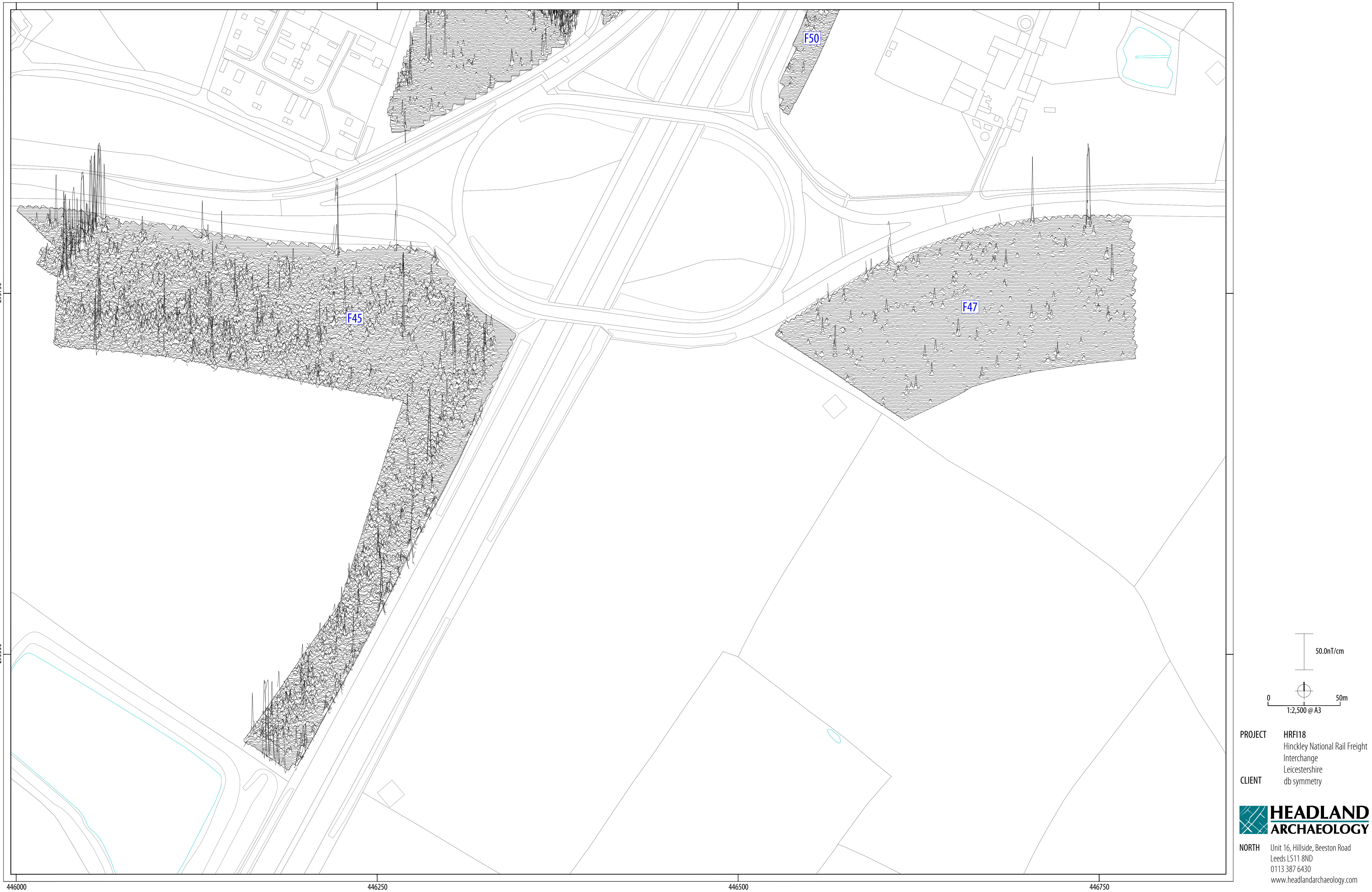
ILLUS 31 Processed greyscale magnetometer data; Sector 8



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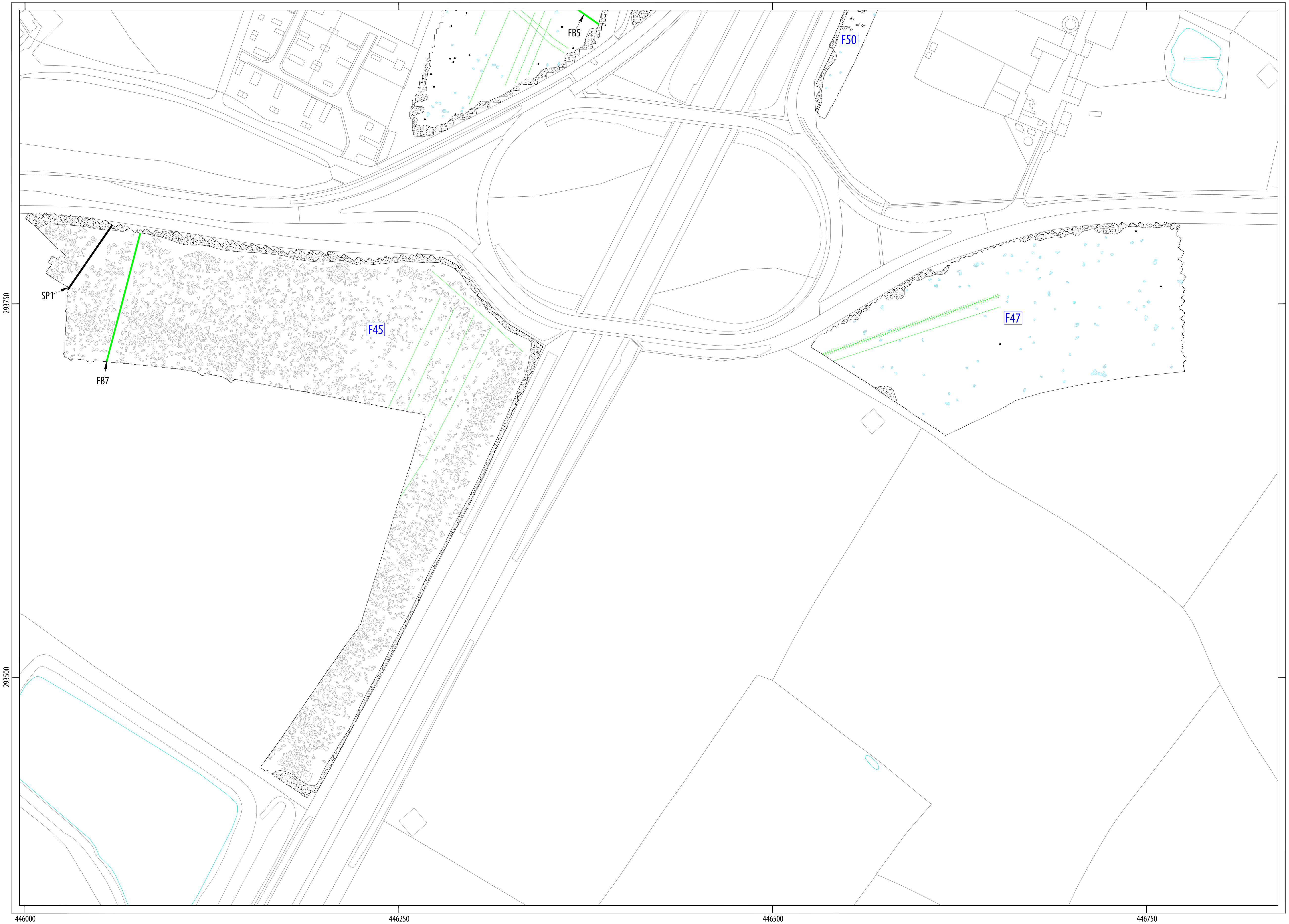
ILLUS 32 XY trace plot of minimally processed magnetometer data; Sector 8



TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	service pipe
linear trend	agricultural
linear trend	field drain
linear	former field boundary
magnetic enhancement	geology

ABBREVIATIONS

FB former boundary

SP service pipe

0 50m

1:2,500 @ A3

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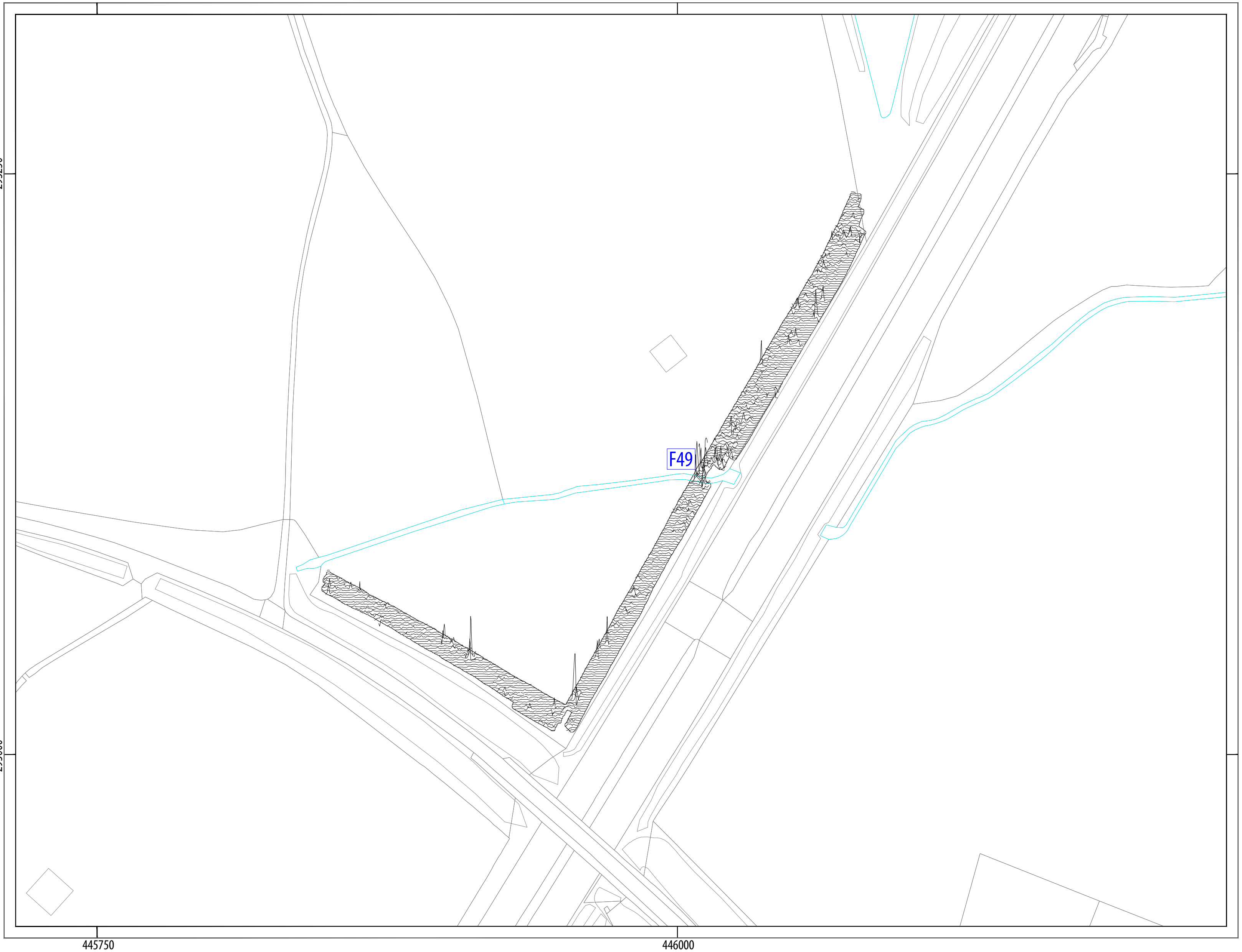
ILLUS 33 XY trace plot of minimally processed magnetometer data; Sector 8

ILLUS 34 Processed greyscale magnetometer data; Sector 9



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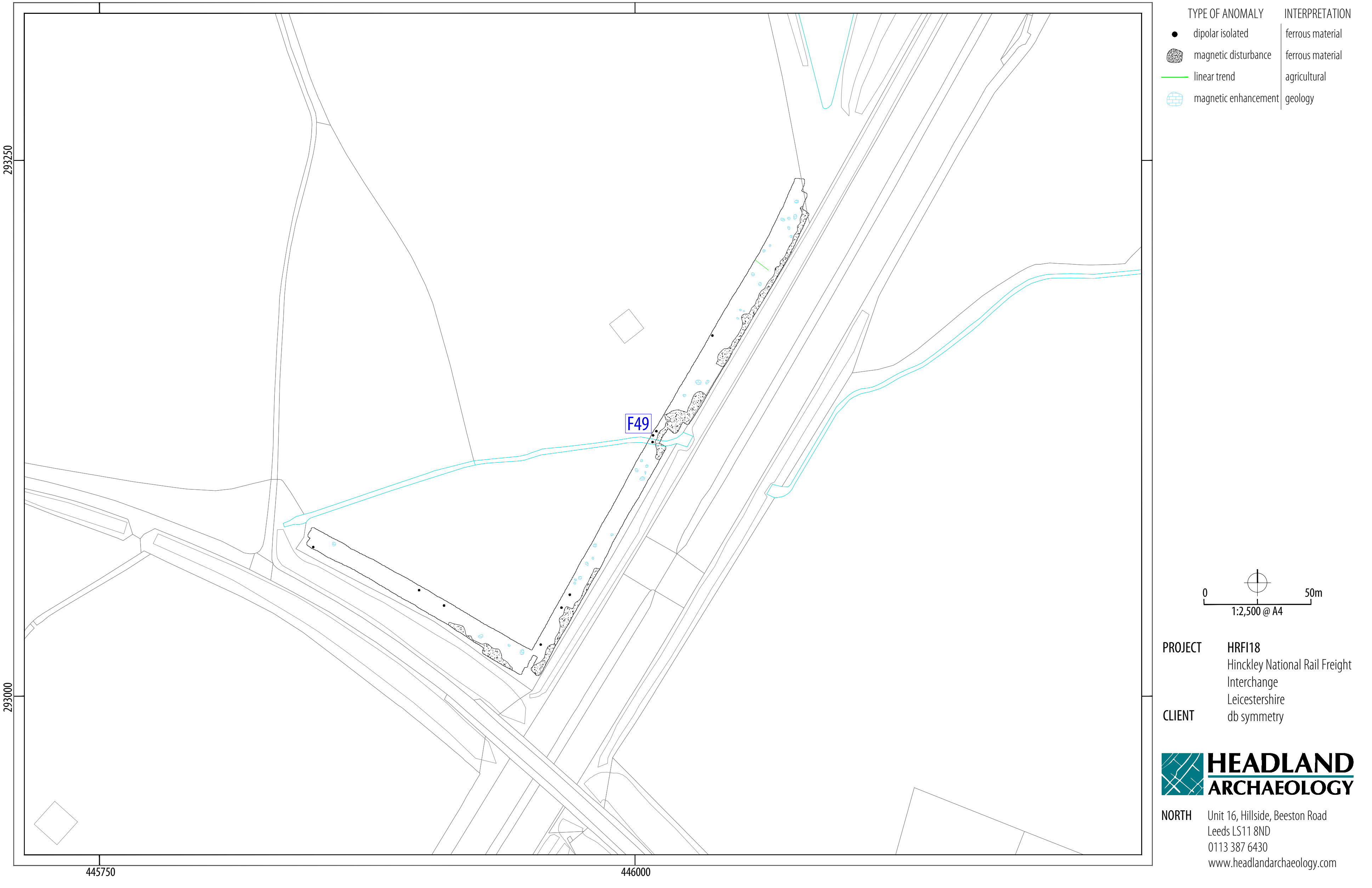
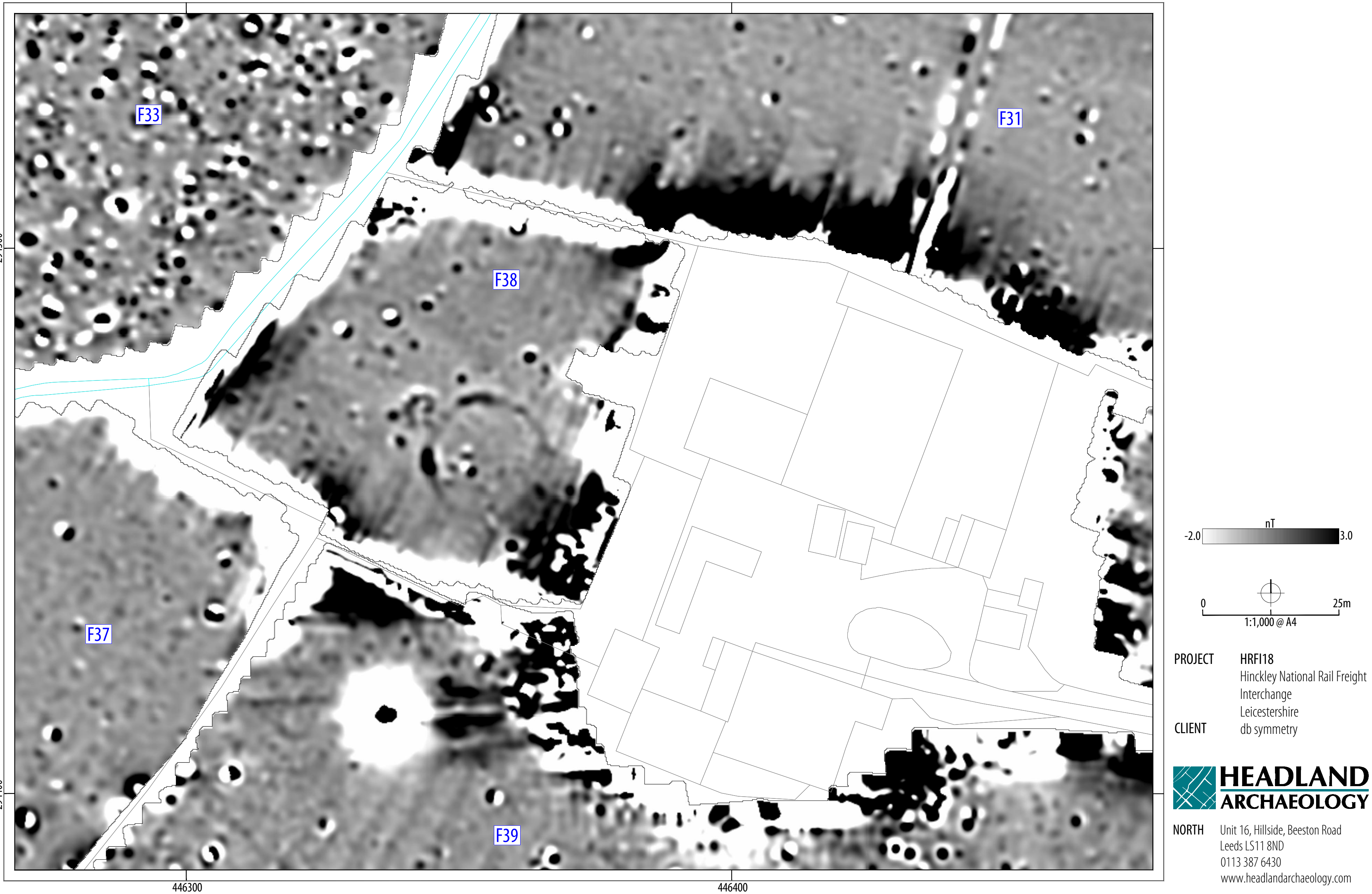
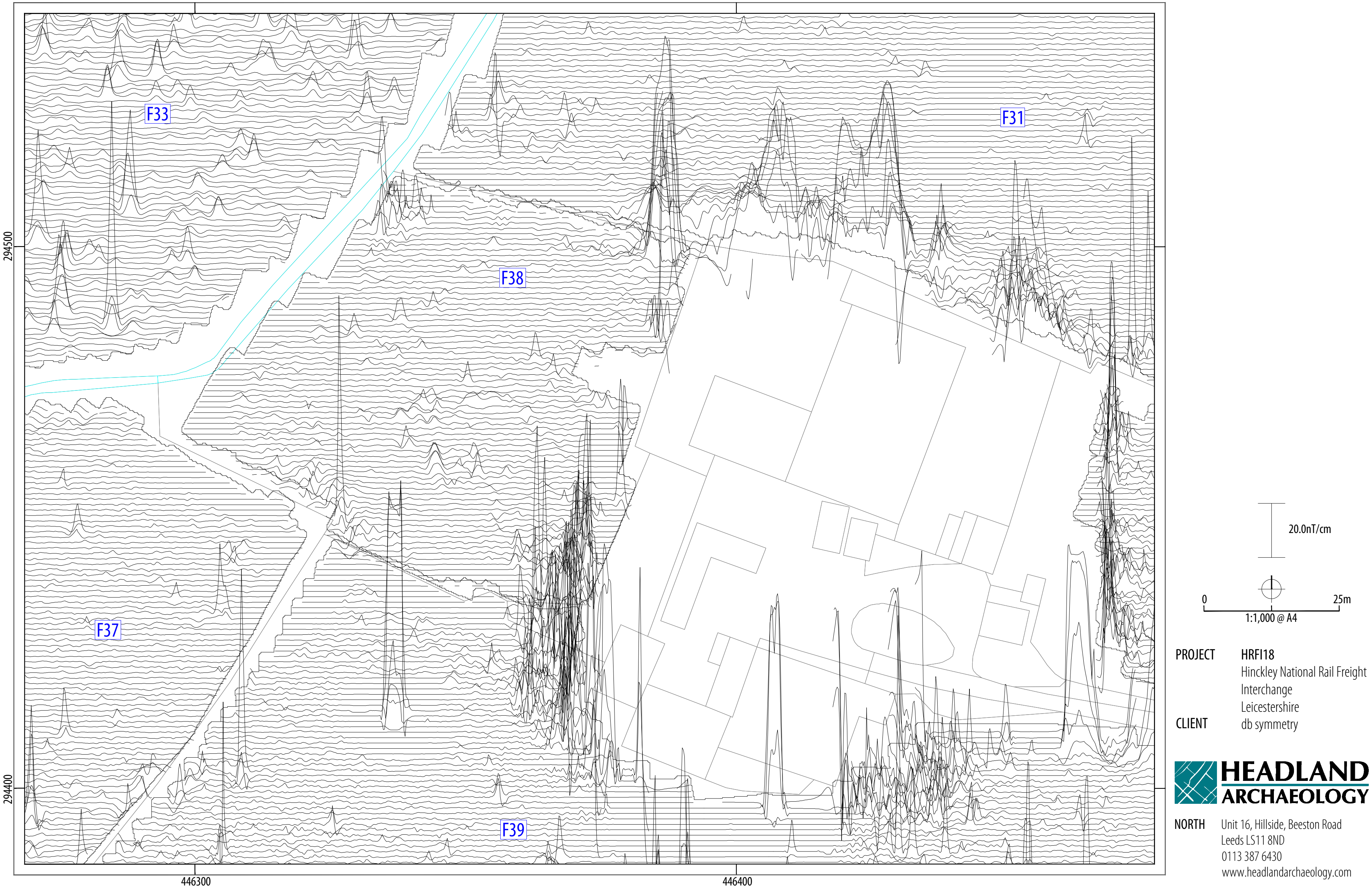
ILLUS 35 XY trace plot of minimally processed magnetometer data; Sector 9



ILLUS 36 Interpretation of magnetometer data; Sector 9



ILLUS 37 Processed greyscale magnetometer data; AAA1



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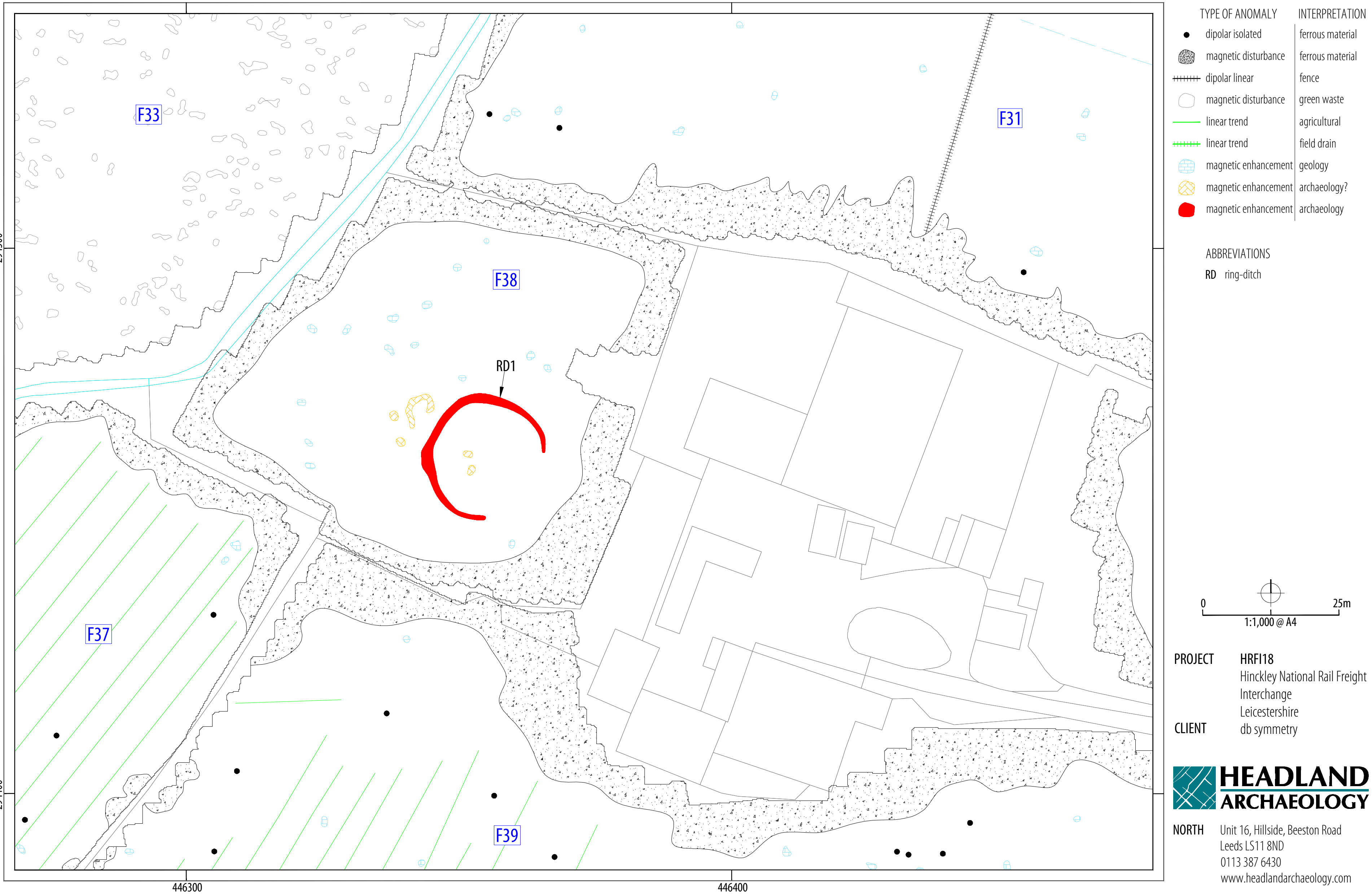
ILLUS 38 XY trace plot of minimally processed magnetometer data; AAA1



ILLUS 39 Interpretation of magnetometer data; AAA1

7 APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

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.

Types of magnetic anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes) These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

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.

APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: headland5-317763

Project details	
Project name	Hinckley National Rail Freight Interchange
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey, covering a 190 hectare site at Hinckley, Leicestershire, where a new strategic rail freight interchange (SRFI) is proposed. Evaluation of the proposed development area has been notably affected by the extensive application of green waste as soil conditioner over 75% of the site. This has resulted in a widespread elevated magnetic background against which any low magnitude anomalies of archaeological potential, if present, may be masked. For this reason, the archaeological potential over the affected fields remains uncertain although it is thought that any extensive areas of enclosed settlement, if present, would have been detected, at least in part, over the majority of the geophysical survey area. A single localised ring-ditch has been identified at Hobbs Hayes Farm in an area unaffected by green waste. This anomaly is ascribed high archaeological potential and probably locates a round barrow. No further anomalies of archaeological potential have been identified over the 25% of fields where green waste has not been applied and, in these fields, the archaeological potential is assessed as low.
Project dates	Start: 05-03-2018 End: 06-04-2018
Previous/future work	Not known / Not known
Any associated project reference codes	HRFI18 - Contracting Unit No.
Type of project	Field evaluation
Site status	None
Current Land use	Grassland Heathland 5 - Character undetermined
Current Land use	Cultivated Land 4 - Character Undetermined
Monument type	N/A None
Monument type	N/A None
Significant Finds	N/A None
Significant Finds	N/A None
Methods & techniques	"Geophysical Survey"
Development type	Rail links/railway-related infrastructure (including Channel Tunnel)
Prompt	National Policy Statement for National Networks
Position in the planning process	Not known / Not recorded
Solid geology (other)	Mercia Mudstone Group
Drift geology	GLACIAL SAND AND GRAVEL
Drift geology	ALLUVIUM
Drift geology (other)	Diamicton
Techniques	Magnetometry
Project location	
Country	England
Site location	LEICESTERSHIRE BLABY ELMESTHORPE Hinckley National Rail Freight Interchange
Study area	190 Hectares
Site coordinates	SP 4624 9494 52.54997886317 -1.317985292236 52 32 59 N 001 19 04 W Point
Project creators	
Name of Organisation	Headland Archaeology
Project brief originator	The Environmental Dimension Partnership
Project design originator	Headland Archaeology
Project director/manager	Harrison, S

Project supervisor	Bishop, R
Type of sponsor/funding body	Developer
Project archives	
Physical Archive Exists?	No
Digital Archive recipient	In house
Digital Contents	"Survey"
Digital Media available	"Geophysics"
Paper Archive Exists?	No
Project bibliography 1	
Publication type	Grey literature (unpublished document/manuscript)
Title	HINCKLEY NATIONAL RAIL FREIGHT INTERCHANGE, LEICESTERSHIRE; GEOPHYSICAL SURVEY
Author(s)/Editor(s)	Harrison, D.
Date	2018
Issuer or publisher	Headland Archaeology
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Entered by	David Harrison (david.harrison@headlandarchaeology.com)
Entered on	22 May 2018

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