

RBFP/01



LAND AT RED BRICK FARM, PETERBOROUGH

GEOPHYSICAL SURVEY

commissioned by The Environmental Dimension Partnership
on behalf of The Church Commissioners for England

January 2017

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project info

HA JOB NO. RBFP/01
NGR TF 2200 0000
LOCAL AUTHORITY Peterborough
OASIS REF. Headland5-274264

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PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey, covering 21 hectares of predominantly former peat fen, at Red Brick Farm, Peterborough to provide further information on the archaeological potential of the site prior to the submission of a planning application to develop the site. The proposed development area (PDA) covers 48 hectares the remainder being currently unsuitable for survey. The results are dominated by geological responses caused by the underlying peat and alluvium which covers most of the PDA. It is considered that the type of archaeological features likely to be present in this former wetland landscape combined with the masking effect of the peat preclude the detection of archaeological anomalies on the former peat fen. For this reason it would seem debatable to complete the survey once the remainder of the site is cleared. No anomalies of archaeological potential have been identified on the slightly higher ground on the sand and gravel deposits on the northern edge of the PDA.

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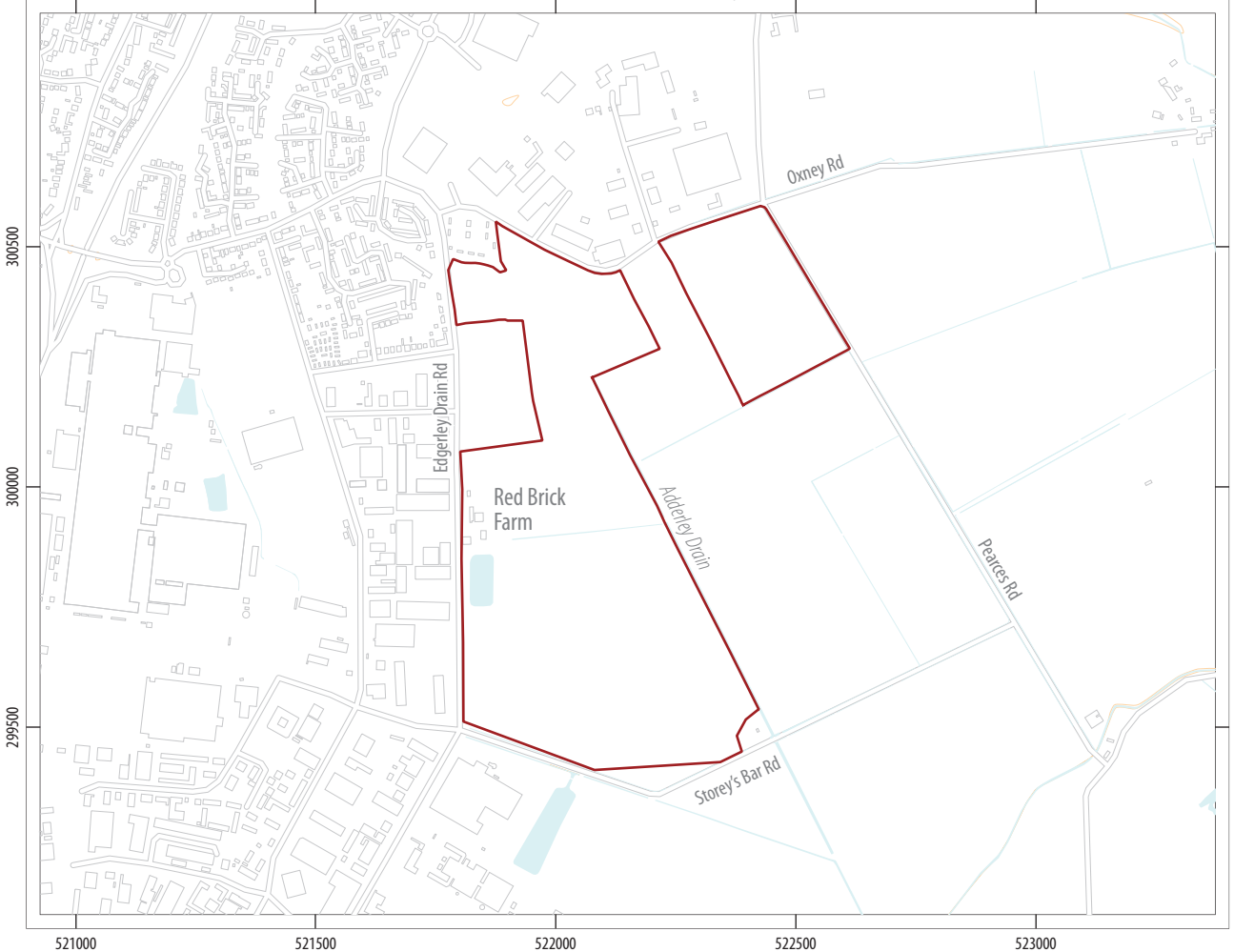
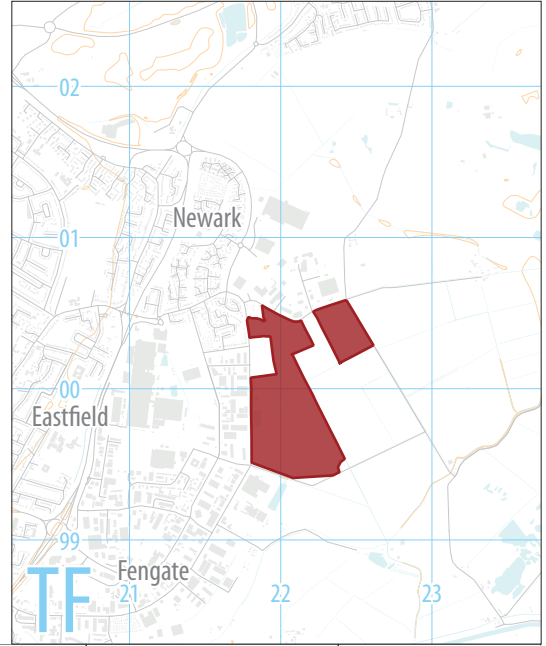
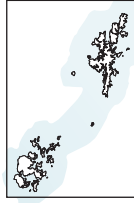
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land at Red Brick Farm
east of Edgerley Drain Rd
Peterborough

0 200km
1:10,000,000 @ A4

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N
0 200m
1:15,000 @ A4

KEY
[Red outline] proposed development area



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GEOPHYSICAL SURVEY

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Rob Johns of the Environmental Dimension Partnership (the Consultant) on behalf of The Church Commissioners for England (the Client) to undertake a geophysical (magnetometer) survey of land at Red Brick Farm, Peterborough (Illus 1). The results of the survey will inform forthcoming archaeological strategy in advance of the determination of an application to develop the site.

The work was undertaken in accordance with a Written Scheme of Investigation (Headland Archaeology 2016), submitted to the Consultant and approved by Peterborough Archaeological Services, and was undertaken in accordance with guidance contained within the National Planning Policy Framework (DCLG 2012). All work was also undertaken in line with current best practice (English Heritage 2008).

Before commencing on site it was already known that approximately 50% of the site was not suitable for survey (see below) and it was therefore agreed that the remainder of the site, that was suitable for survey, would be used to assess the effectiveness of gradiometer survey on the prevailing geology. The survey was carried out between September 27th and September 30th 2016 in order to provide information on the archaeological potential of the site.

1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

The proposed development area (PDA) comprises an irregular shaped parcel of land, on the eastern periphery of Peterborough surrounding Red Brick Farm. The PDA, centred at TF 2200 0000, covers approximately 48 hectares and is bound to the west by the farm and Edgerley Drain Road, to the south by Storey's Bar Road, by open farmland to the east and Oxney Road to the north. The site is in two parts divided by a small field which does not form part of the PDA. The eastern part of the PDA is bound by Oxney Road to the north and Pearces Road to the east.

The PDA is basically flat at between 2m and 3m above Ordnance Datum (AOD). The highest point on the site is on the northern site boundary on Oxney Road which is at 5m AOD, where superficial sand and gravel deposits (see below) overlie the bedrock geology.

The PDA comprises six fields (F1–F6). Field 1 and Field 2 were overgrown and unsuitable for survey see (Illus 2). Field 6 was under a potato crop and also currently unsuitable for survey. The remainder of the fields were fallow following harvest (see Illus 3 and Illus 4).

1.2 GEOLOGY AND SOILS

The PDA lies within the Flag Fen basin and is mostly underlain by a succession of late Holocene alluvial sediments, the uppermost of which is mapped as Nordelph peat (see Illus 6) with the peat thinning out onto the flank of a gravel island on the northern edge of the site south of Oxney Road (see above). The underlying bedrock mainly comprises Oxford Clay Formation mudstones to the east and Kellaways Sand Member (interbedded sandstones and siltstones) to the west (NERC 2016).

The soils are classified in the Soilscape 22 association, characterised as loams with naturally high groundwater (Cranfield University 2016).

2 ARCHAEOLOGICAL BACKGROUND

A Baseline Scoping Report (Environmental Dimension Partnership 2106) concluded that 'the PDA is located within an area of high archaeological potential with a Bronze Age post alignment and timber platform at Flag Fen and associated Bronze Age and later field systems and settlement to either side of the Northley Road 300m to the site of the PDA'.

There are also two entries on the Peterborough Historic Environment Record. The first is the site of a former Bronze Age barrow (HER 03111) which was excavated in the early 20th century. However, this feature is just outside the PDA (see Illus 6) on slightly higher ground where there are no recorded superficial deposits. The second is a cropmark interpreted as a ditch forming part of a large enclosure (HER 08377) although analysis of this photograph and the geological data suggests the cropmark could mark the boundary at the edge of the superficial peat deposits. Unfortunately this cropmark is located in Field 2 which was unsuitable for survey.



ILLUS 2 Field 4, looking south-west **ILLUS 3** Field 5, looking north-west
ILLUS 4 Field 2, looking west

A geophysical survey of an adjoining site at America Farm, also on former peat fen (Northamptonshire Archaeology 2013), recorded a series of convoluted anomalies interpreted as a network of creeks within the fen. Later trenching (Wessex Archaeology 2013) confirmed the natural origin of the features.

There are also a number of records in the surrounding area relating to prehistoric and Roman activity although it is likely that the site has been in agricultural use from the medieval period onwards.

3 AIMS, METHODOLOGY AND PRESENTATION

The main aim of the geophysical survey was to provide sufficient information to enable an assessment to be made of the impact of any proposed development on any sub-surface archaeological remains, if present.

The general 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 sub-surface 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. Features 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 and 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 is programmed to take readings at a frequency of 10Hz (allowing for a 10–15cm sample interval) on roaming traverses 4m apart. These readings are stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system is 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 has been used to collect and export the data. Terrasurveyor V3.0.28.4 (DWConsulting) software has been used to process and present the data.

3.2 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:14,000. Illus 2–Illus 4 are site condition photographs. Illus 5 is a 1:4,000 scale

location plan showing the GPS track data, the location and direction of the site condition photographs. Illus 6 shows the superficial geology and HER data. Illus 7 and Illus 8 show the fully processed greyscale data for the whole site and accompanying interpretative drawings respectively, both at a scale of 1:4,000.

Detailed data plots (greyscale and XY trace) and interpretative illustrations, of the two sectors into which the site is broken down, are presented at a scale of 1:2,000 in Illus 9 to Illus 14 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 Brief for Geophysical Survey (Headland 2016) and guidelines outlined by Historic England (English Heritage 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All illustrations reproduced from Ordnance Survey mapping are 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

The survey data is dominated by magnetic responses caused by the underlying peat and alluvium and which are due to localised pockets of iron minerals deposited or modified by fluctuating groundwater levels. The absence of these anomalies is taken to indicate the boundary along which the peat deposits thin out towards the sands and gravel river terrace deposits along the northern edge of the PDA and the sandstones and siltstones to the west. This 'boundary', as interpreted from the magnetic data, is shown on Illus 6.

In those parts of the site where survey was possible the ground conditions were good and data quality is correspondingly good throughout. It is known however that superficial deposits of peat cover most of the PDA and that previous surveys in the vicinity have had limited success in identifying archaeological features under similar circumstances.

Against this background a few linear anomalies have been identified and these are discussed below by category type.

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 or material is common on most sites, often being present as a consequence of manuring or tipping/infilling. An area of magnetic disturbance immediately east of Red Brick Farm is due to a combination of modern tipping and the proximity of farm buildings and machinery.

Magnetic disturbance around the field edges is due to the accumulation of ferrous material in the boundary, the proximity of structures/buildings and/or barbed wire or wire mesh forming the boundary.

4.2 AGRICULTURAL ANOMALIES

One former field boundary (FB), recorded on the first edition Ordnance Survey mapping (1887), has been identified, aligned south-west/north-east in F3. Four other former boundaries, in F4 and F5, have not been identified.

Closely spaced linear anomalies aligned east/west in F5 and north-west/south-east in F3, are due to recent cultivation. These ploughing trends are clearly visible where the peat becomes shallower, to the north and west of the PDA, but are not identified where the geological anomalies become more extensive, to the east and south.

A single linear anomaly, aligned south-west/north-east in F5, is interpreted as a drain.

4.3 GEOLOGICAL ANOMALIES

Numerous discrete anomalies are visible throughout the magnetic datasets. These broadly correspond to the mapped extent of the superficial peat deposits and are due to localised pockets of iron minerals.

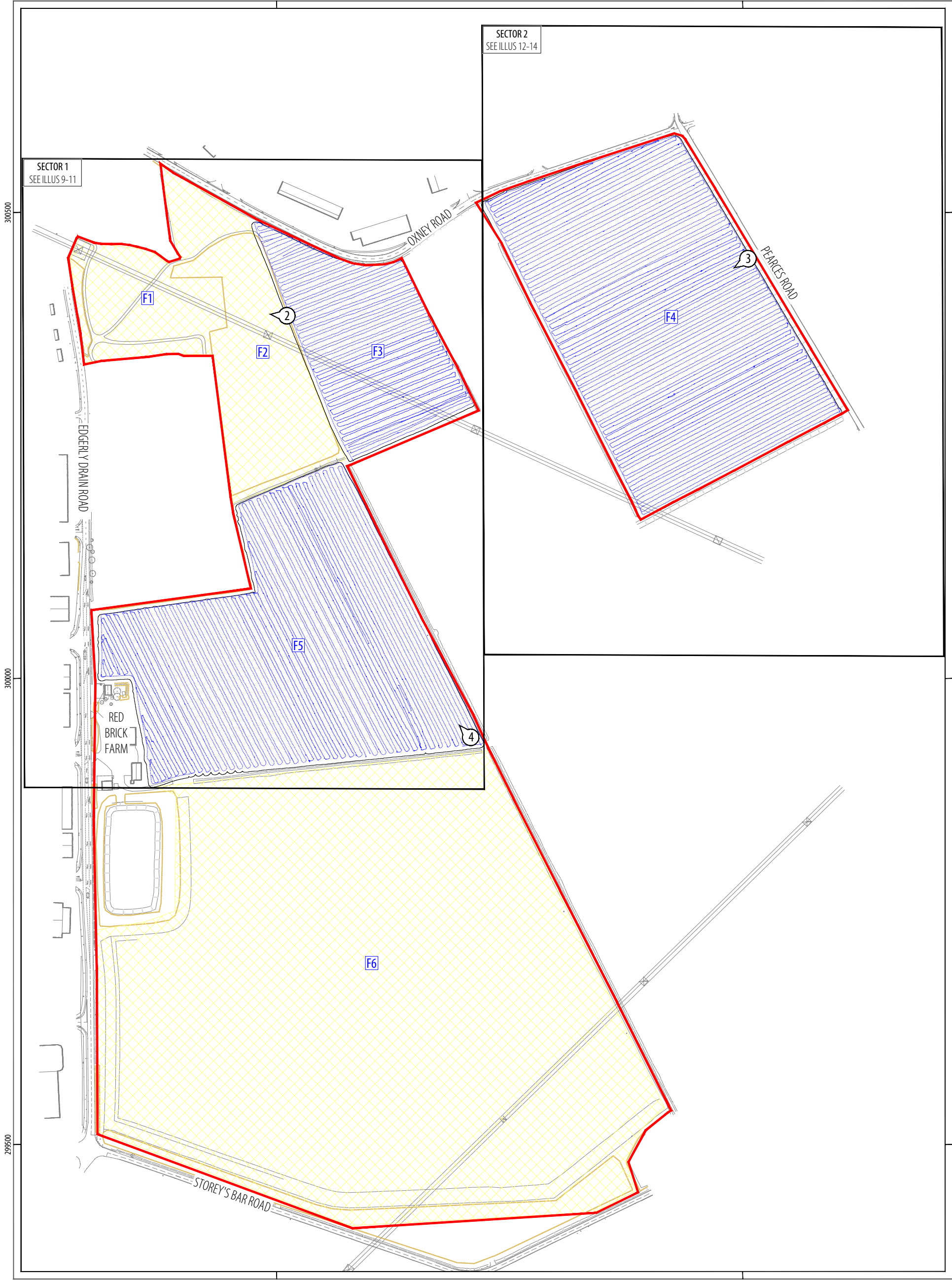
The edge of the peat deposits is identified as a boundary at which the number of geological responses decreases in density (see Illus 6).

5 CONCLUSION

The geophysical survey has not identified any anomalies of obvious archaeological potential in the areas where it has been possible to carry out the survey. It has confirmed the extent of the superficial peat deposits and it is considered likely that any early prehistoric remains are unlikely to be detected below the peat due to the depth and type of features which might be expected. For this reason it is assessed that it is not worth completing the survey on the other parts of the PDA where peat is present. Based on these reasons it is possible that peat deposits may also mask the results in those areas which have been surveyed.

6 REFERENCES

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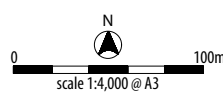
- ▭ proposed development area
- ▨ GPS track data
- area unsuitable for survey
- location and direction of ILLUS 2-4

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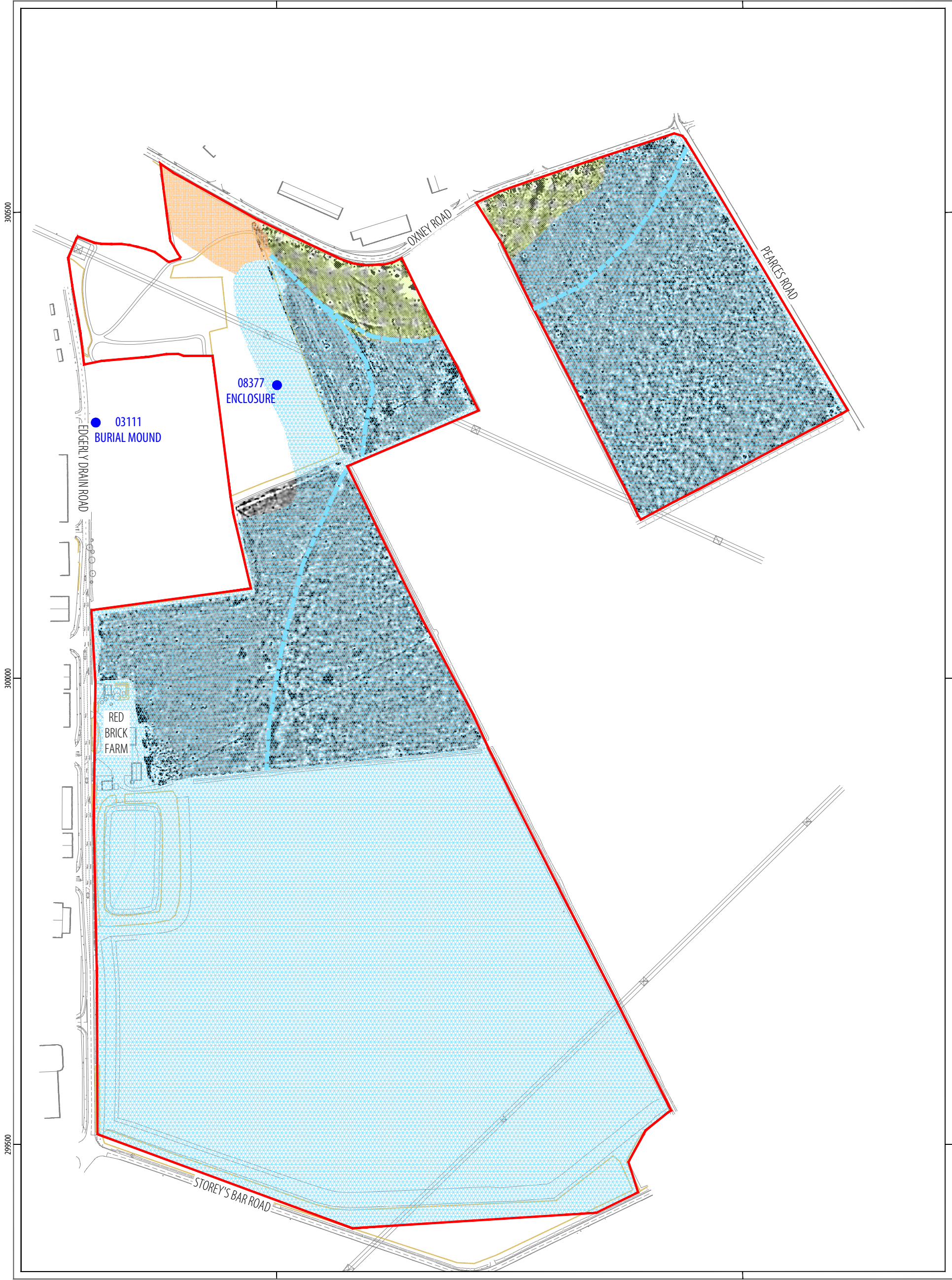
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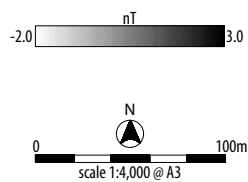
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ILLUS 5 Survey location showing GPS track data and location of ILLUS 2 - 4



- proposed development area
 - Peterborough HER data
 - apparent geological boundary
- SUPERFICIAL GEOLOGY
- Peat - peat
 - Alluvium - clay, silt, sand and gravel
 - River Terrace Deposits 2 - sand and gravel



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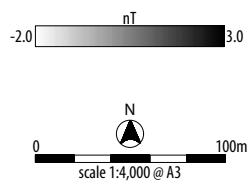
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ILLUS 6 Survey location showing geology and HER data



proposed development area



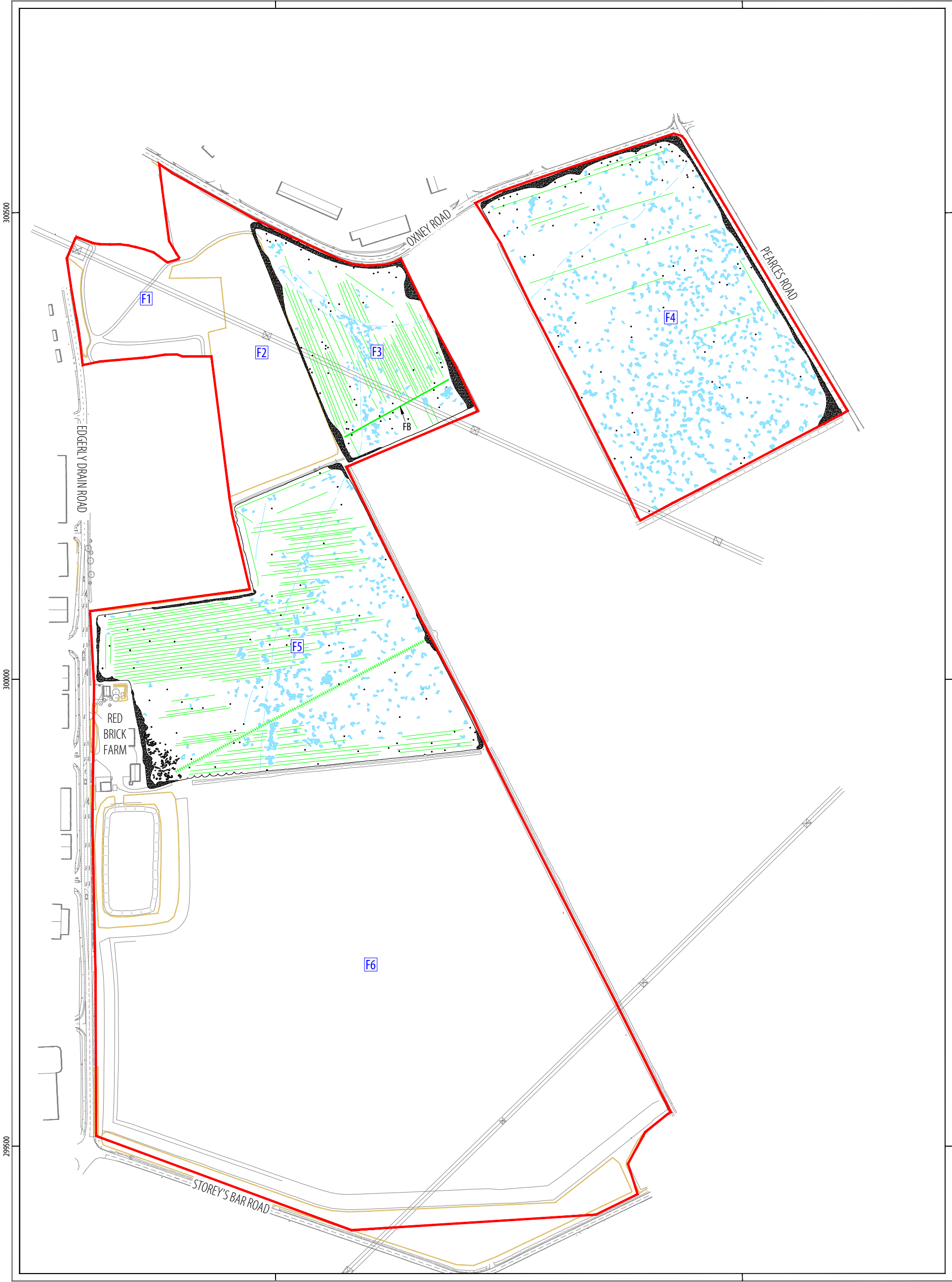
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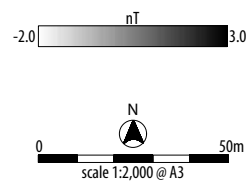
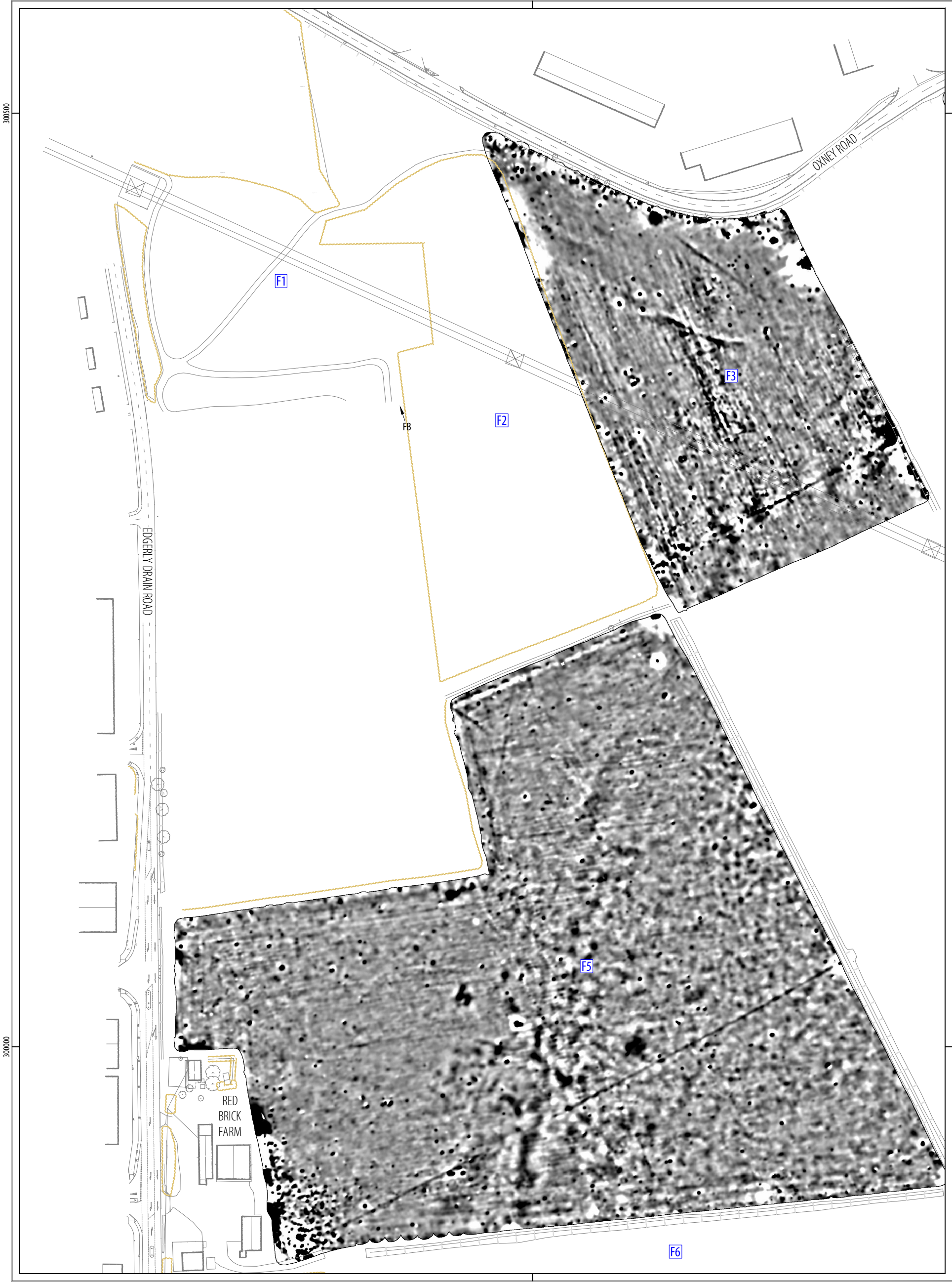
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ILLUS 7 Overall greyscale magnetometer data



<p>300500</p> <p>300000</p> <p>299500</p>	<p>522000</p> <p>522500</p>	<p>proposed development area</p> <p>TYPE OF ANOMALY</p> <ul style="list-style-type: none"> ● dipolar isolated ● magnetic disturbance — linear trend — linear trend — linear <p>INTERPRETATION</p> <ul style="list-style-type: none"> ferrous material ferrous material agricultural field drain former field boundary <p>TYPE OF ANOMALY</p> <ul style="list-style-type: none"> — linear — magnetic enhancement <p>INTERPRETATION</p> <ul style="list-style-type: none"> geological variation geology <p>ABBREVIATIONS</p> <ul style="list-style-type: none"> FB former boundary 	<p>PROJECT RBFP/01 Land at Red Brick Farm Peterborough</p> <p>CLIENT The Church Commissioners for England</p> <p>HEADLAND ARCHAEOLOGY</p> <p>NORTH Unit 16, Hillside, Beeston Road Leeds LS11 8ND 0113 387 6430 www.headlandarchaeology.com</p> <p style="text-align: center;">N 0 100m scale 1:4,000 @ A3</p>
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ILLUS 8 Overall interpretation of magnetometer data

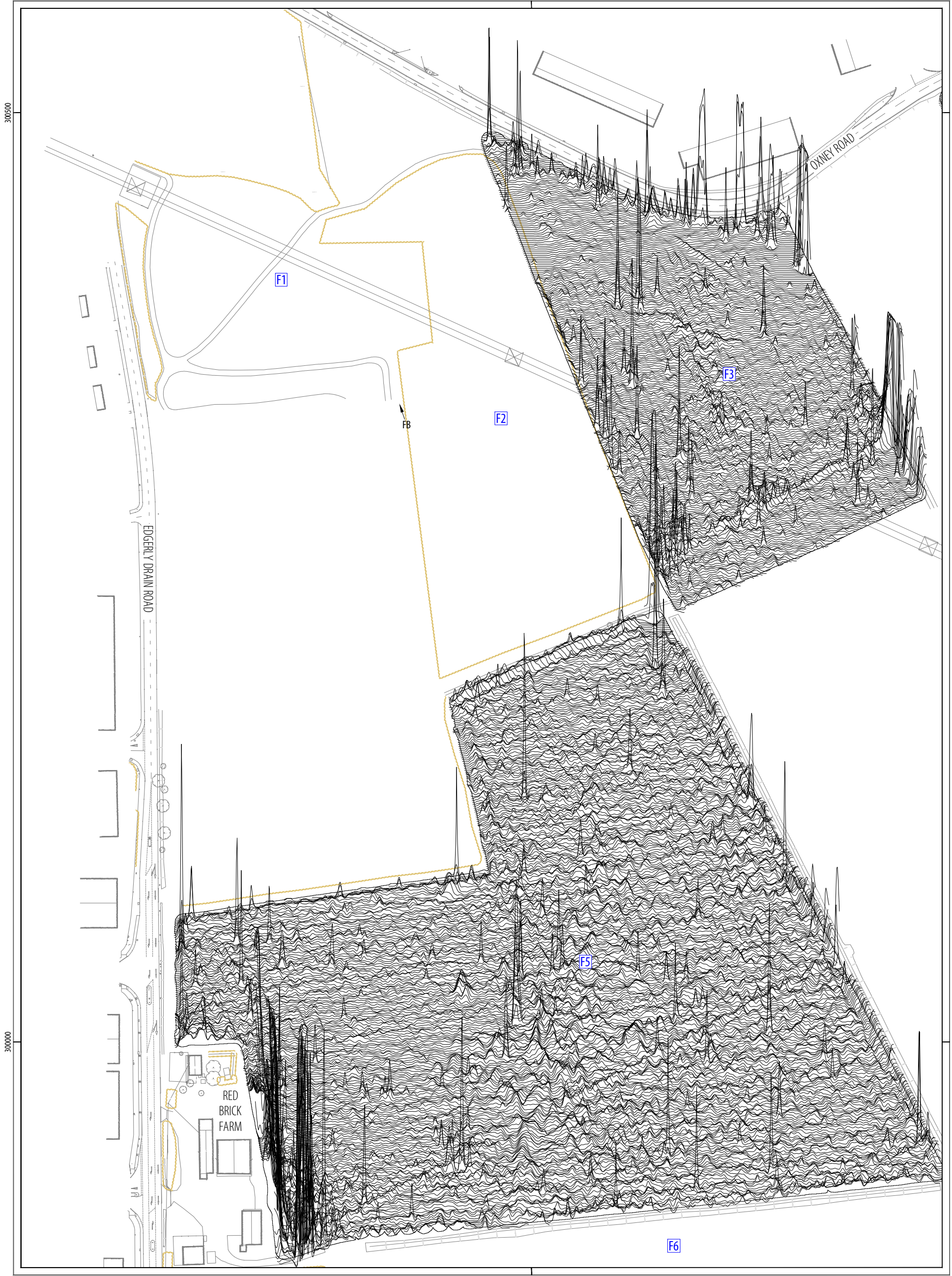


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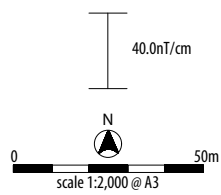
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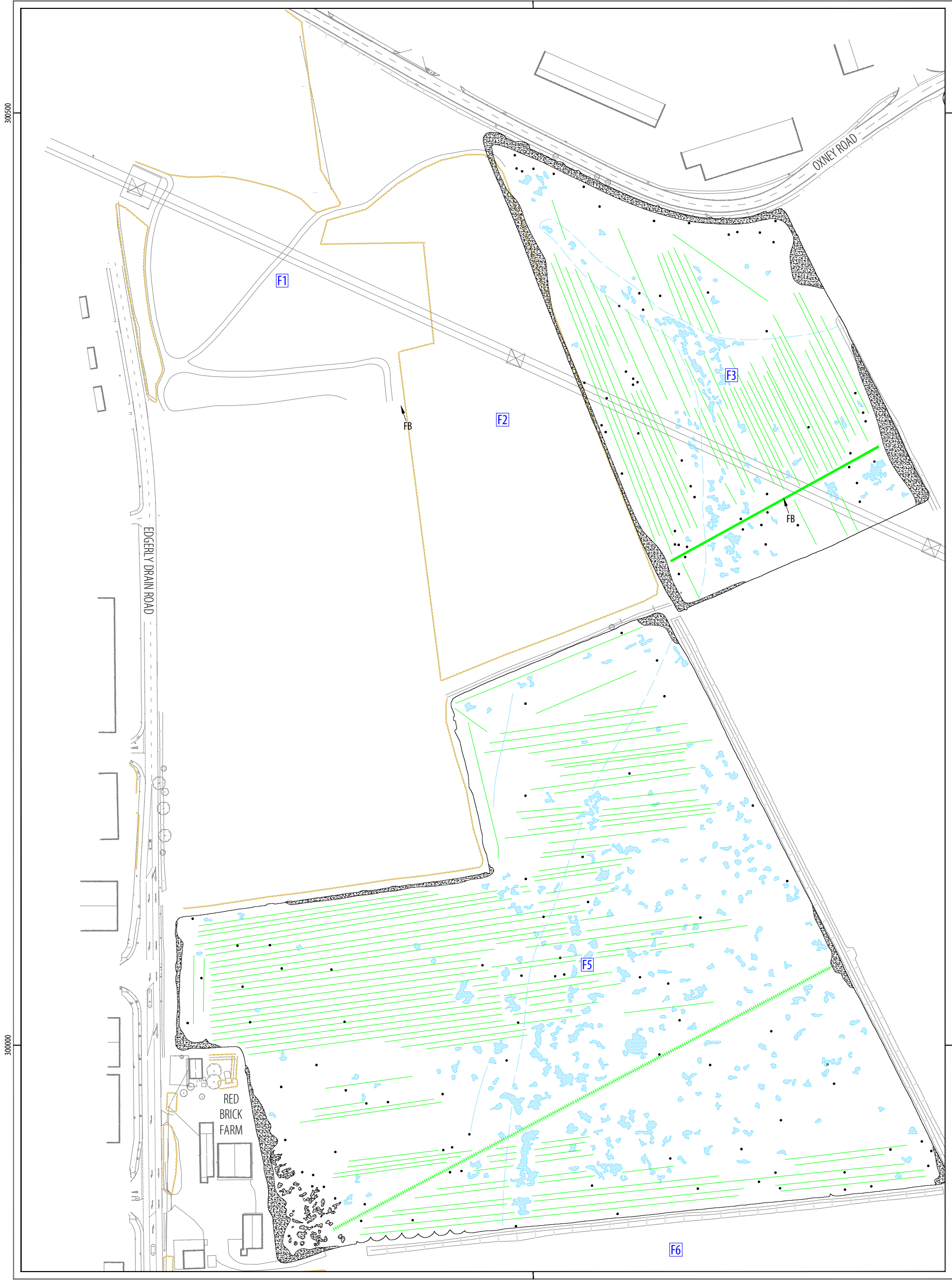


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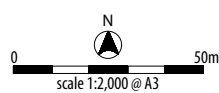
TYPE OF ANOMALY	INTERPRETATION	TYPE OF ANOMALY	INTERPRETATION	ABBREVIATIONS
● dipolar isolated	ferrous material	— linear	geological variation	FB former boundary
● magnetic disturbance	ferrous material	● magnetic enhancement	geology	
— linear trend	agricultural			
— linear trend	field drain			
— linear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

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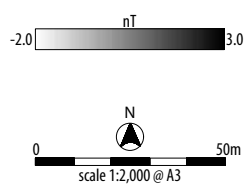
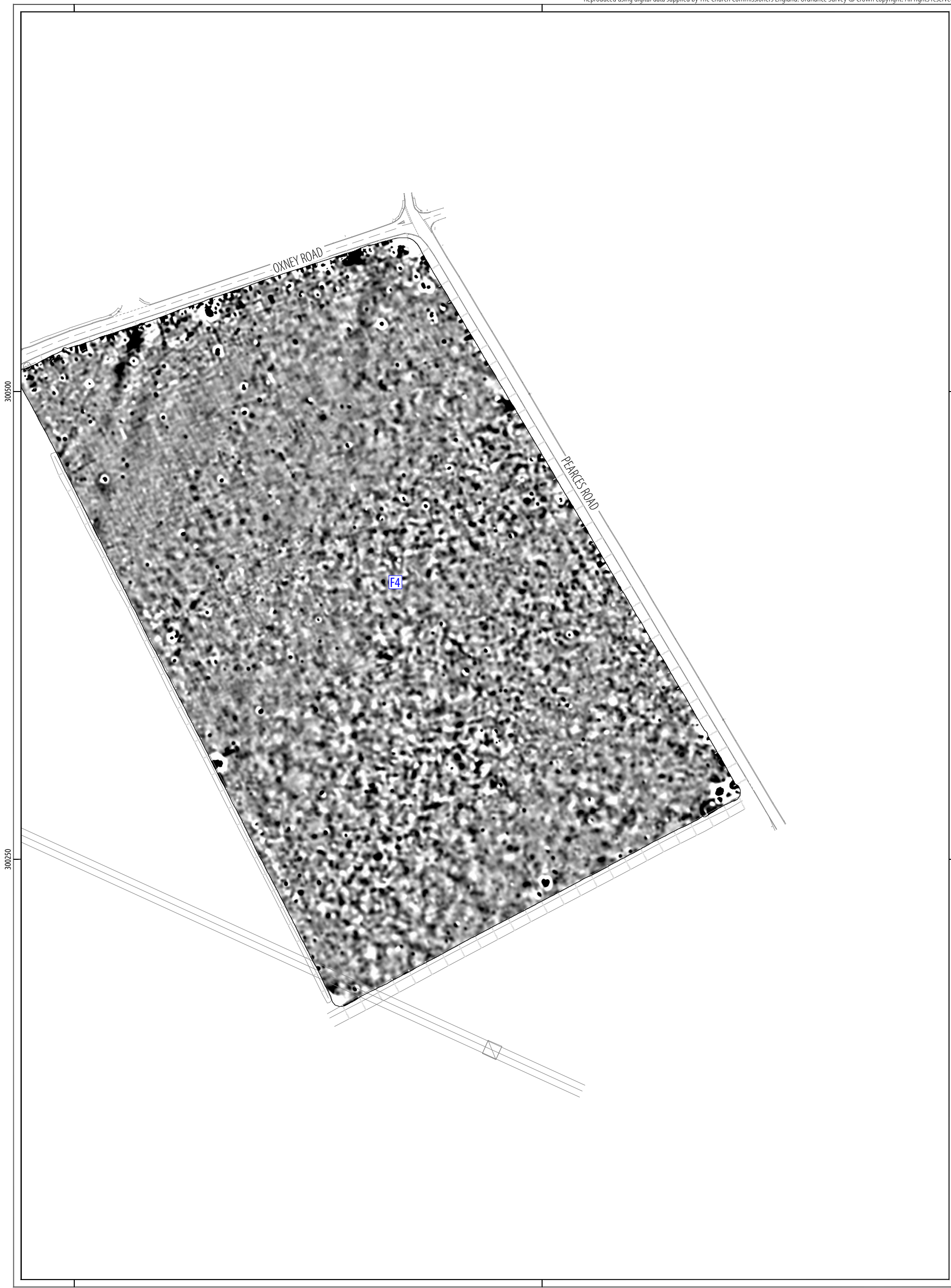
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ILLUS 11 Interpretation of magnetometer data; Sector 1

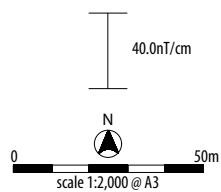
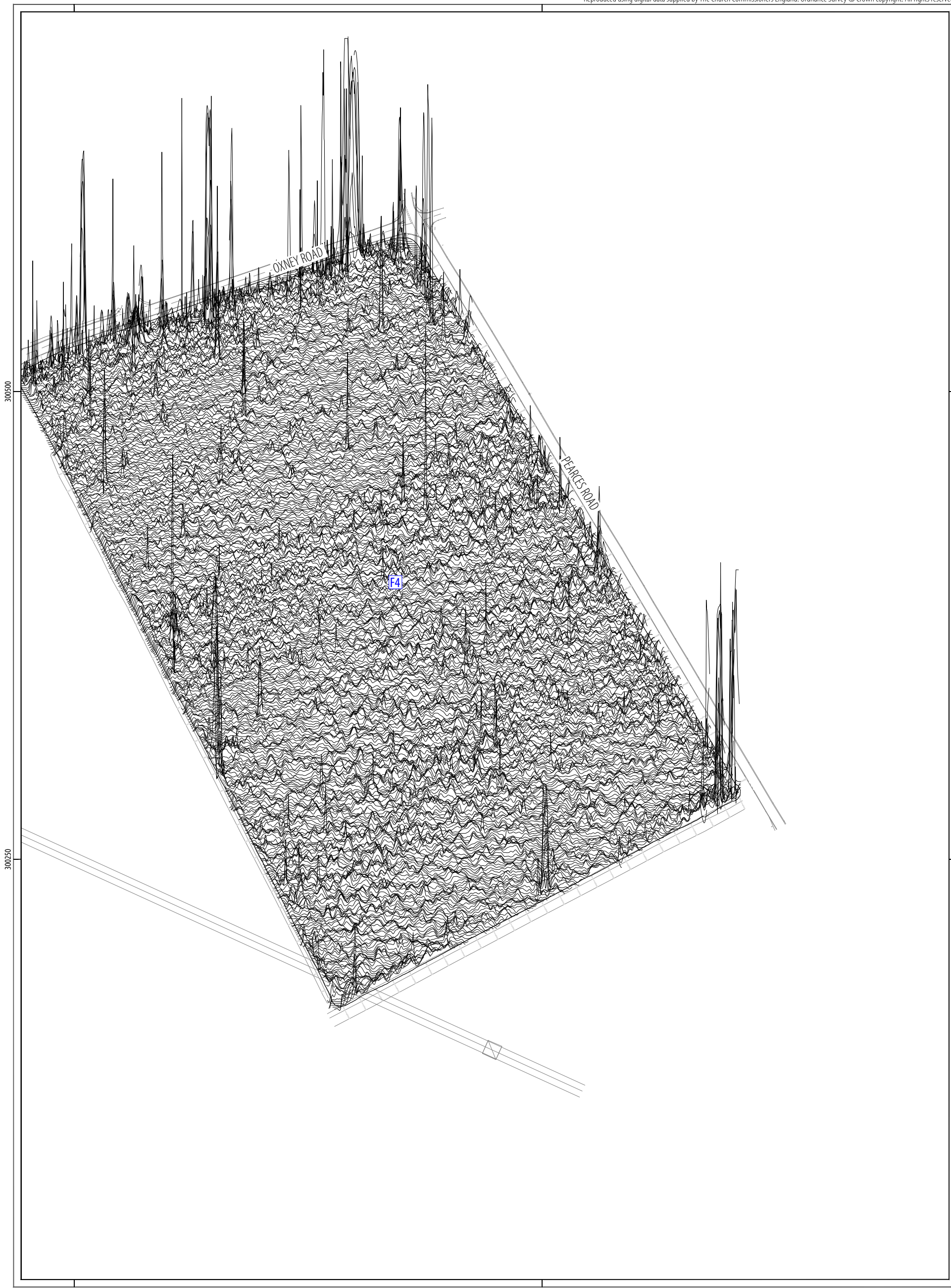


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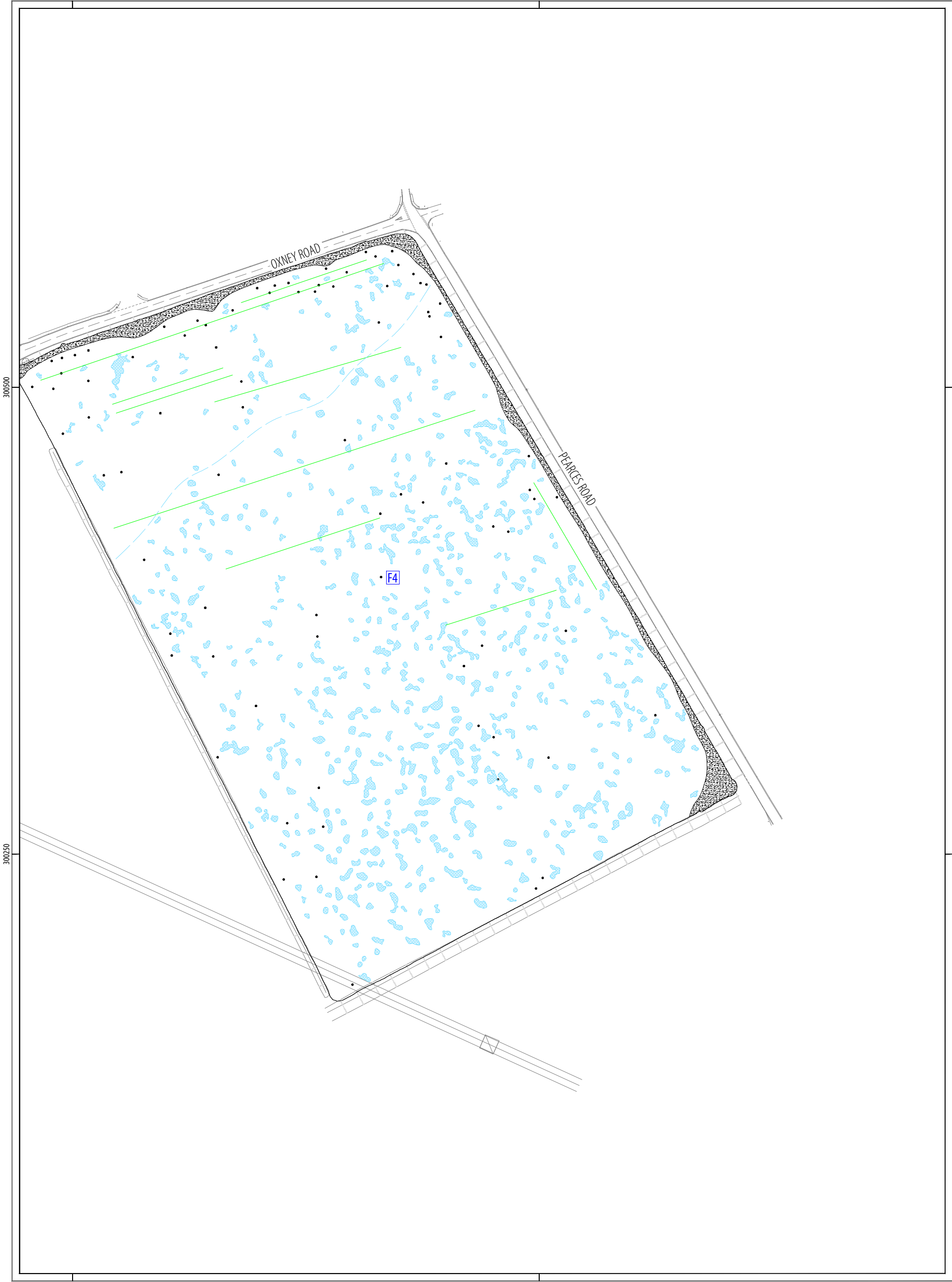


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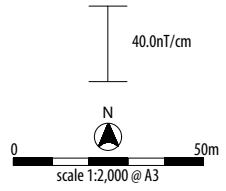
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TYPE OF ANOMALY	INTERPRETATION
● dipolar isolated	ferrous material
● magnetic disturbance	ferrous material
— linear trend	agricultural
— magnetic enhancement	geological variation
	geology



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ILLUS 14 Interpretation of magnetometer data; Sector 2

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 associated 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.

Data is also clipped to remove extreme values and to improve data contrast.

APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: headland5-274264

PROJECT DETAILS

Project name	Land at Redbrick Farm: Geophysical Survey
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey, covering 21 hectares of predominantly former peat fen, at Red Brick Farm, Peterborough to provide further information on the archaeological potential of the site prior to the submission of a planning application to develop the site. The proposed development area (PDA) covers 48 hectares the remainder being currently unsuitable for survey. The results are dominated by geological responses caused by the underlying peat and alluvium which covers most of the PDA. It is considered that the type of archaeological features likely to be present in this former wetland landscape combined with the masking effect of the peat preclude the detection of archaeological anomalies on the former peat fen. For this reason it would seem debatable to complete the survey once the remainder of the site is cleared. No anomalies of archaeological potential have been identified on the slightly higher ground on the sand and gravel deposits on the northern edge of the PDA.
Project dates	Start: 27-09-2016 End: 30-09-2016
Previous/future work	Not known / Not known
Any associated project reference codes	RBFP-01 - Contracting Unit No.
Type of project	Field evaluation
Site status	None
Current Land use	Grassland Heathland 5 - Character undetermined
Current Land use	Grassland Heathland 3 - Disturbed
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	Not recorded
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Not known / Not recorded
Solid geology (other)	Oxford Clay Formation mudstones to the east and Kellaways Sand Member (interbedded sandstones and siltstones) to the west
Drift geology (other)	Nordelph peat
Techniques	Magnetometry

PROJECT LOCATION

Country	England
Site location	CAMBRIDGESHIRE PETERBOROUGH PETERBOROUGH Land at Red Brick Farm
Study area	21 Hectares
Site coordinates	TF 2200 0000 52.583731198002 -0.199117604882 52.35 01 N 000 11 56 W Polygon

PROJECT CREATORS

Name of Organisation	Headland Archaeology
Project brief originator	Headland Archaeology
Project design originator	Headland Archaeology

Project director/manager	Harrison, S
Project supervisor	Schmidt, A
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	Land at Red Brick Farm, Peterborough: Geophysical Survey
Author(s)/Editor(s)	Webb, A.
Other bibliographic details	RBFP-01
Date	2017
Issuer or publisher	Headland Archaeology
Place of issue or publication	Edinburgh
Description	A4 Glue bound report
Entered by	Sam Harrison (sam.harrison@headlandarchaeology.com)
Entered on	24 January 2017z



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