

BECC22



# BECCLES SOLAR FARM, SUFFOLK

## GEOPHYSICAL SURVEY REPORT

commissioned by Neo Environmental

April 2023





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#### PROJECT INFO:

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## PROJECT SUMMARY

Headland Archaeology (UK) Ltd was commissioned by Neo Environmental Ltd (the Client), to undertake a geophysical (magnetometer) survey of a site covering approximately 111 hectares, west of Beccles, Suffolk where a solar farm is being proposed. This geophysical survey report will be submitted as part of a planning application for the proposed Beccles Solar Photovoltaic (PV) array and associated infrastructure development. The results will also inform future archaeological strategy, if required.

The survey has identified a range of anomalies consistent with modern activity and agricultural usage of the proposed development area (PDA) but also of uncertain and of possible archaeological origin against a largely homogenous magnetic background. Five small clusters of magnetically enhanced ditch and pit-like anomalies, possibly indicative of enclosures, are identified on the lower ground at the eastern peripheries of the two separate land parcels that comprise the PDA. Two of these clusters lie adjacent to a ditch and former trackway (Gull Lane) and a further two groupings lie close to areas of medieval common land. Very high magnitude anomalies indicative of localised burning, anomalies of uncertain origin and a possible area of localised extraction are also recorded. A group of linear trend anomalies and two areas of magnetic enhancement of uncertain origin identified at the northernmost part of the PDA may locate a former area of extraction.

The survey has also recorded the location of several former boundaries and regular patterns of field drains. The sites of the demolished post-medieval Gull Farm and a former pond adjacent to Furze Common have also been identified; both these features are recorded on historic mapping.

Based on the results of the survey the archaeological potential of the areas in and around the five locations where anomalies of possible archaeological origin are identified is assessed as moderate. The archaeological potential of most of the PDA is however regarded as low.

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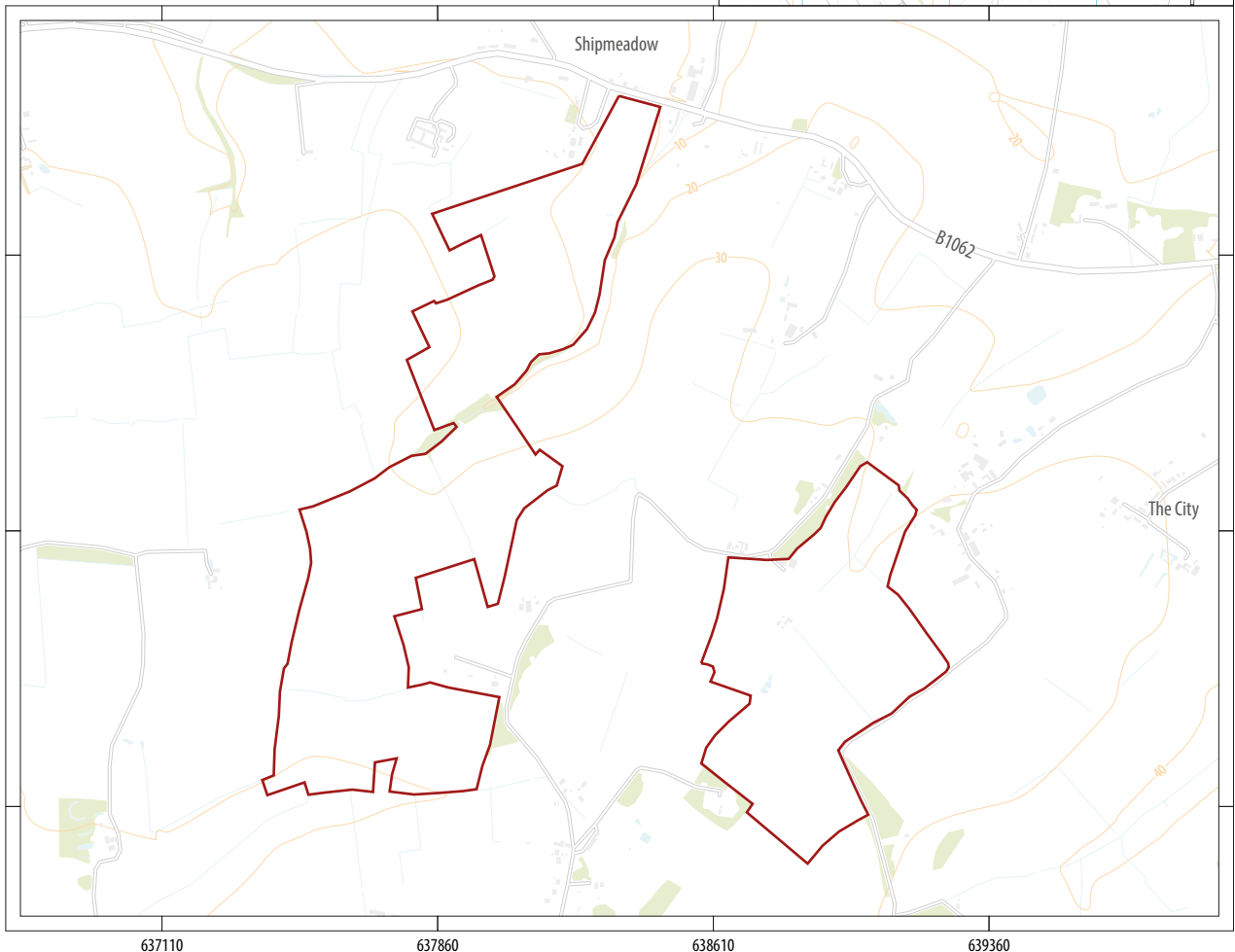
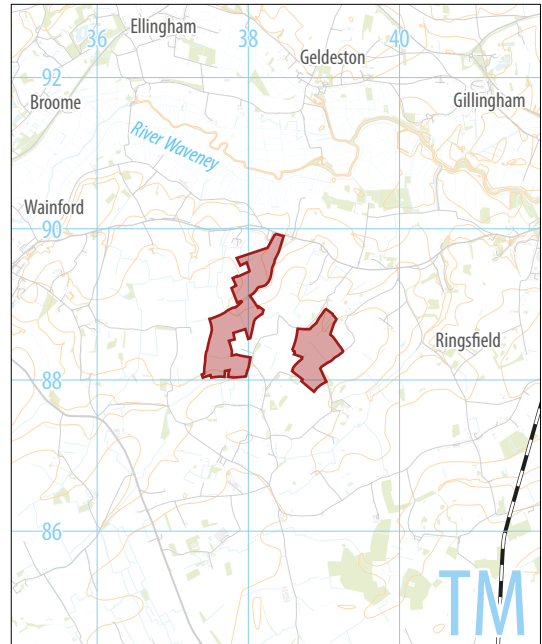
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Beccles Solar Farm  
Suffolk



0 200km  
1:12,500,000 @ A4



0 400m  
1:20,000 @ A4

proposed development area



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# BECCELES SOLAR FARM, SUFFOLK

## GEOPHYSICAL SURVEY REPORT

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### 1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Neo Environmental Ltd (the Client), to undertake a geophysical (magnetometer) survey at Beccles Solar Farm, Suffolk, (Illus 1) where a solar farm is being proposed.

This geophysical survey report will be submitted in support of a planning application for the proposed Solar Photovoltaic (PV) array and associated infrastructure development. The results will also inform future archaeological strategy, if required.

The scheme of work was undertaken in accordance with the requirements of the National Planning Policy Framework (MHCLG 2021) and with the Written Scheme of Investigation for Geophysical Survey (WSI) (Headland Archaeology 2022).

The WSI was produced to the standards laid down in the European Archaeological Council's guideline publication EAC Guidelines for the Use of Geophysics in Archaeology (Europae Archaeologia Consilium 2016), the Chartered Institute for Archaeologists (CIfA) Standard and Guidance for Archaeological Geophysical Survey (CIfA 2014) and the Suffolk County Council's Requirements for a Geophysical Survey (SCC 2021). The survey was also carried out in line with the same best practice guidelines. The WSI was approved by Rachael Abraham, Senior Archaeological Officer at Suffolk County Council Archaeological Service on November 1st, 2022.

The survey was carried out between November 7th and November 24th, 2022.

### 1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

The Proposed Development Area (PDA) consists of two irregularly shaped parcels of land south of Shipmeadow and the B1062 in Suffolk. The two parcels are separated by Clarke's Lane and agricultural fields and are bound by agricultural land in all directions apart from the B1062 to the north and Hall Road to the east. The PDA is centred at TM 380558 88993 (west) and TM 38882 88410 (east) and covers an area of approximately 111 hectares, consisting of eleven arable fields (Illus F1 to F11 inclusive).

The western parcel of the PDA is located on a gentle slope which gradually increases in height from the north at 14m Above Ordnance Datum (AOD) to 37m AOD in the south. The topography of the easternmost parcel also gradually increases to the east and south from approximately 31m AOD at the northern boundary of the parcel to 37m AOD at the eastern and southern boundaries.

### 1.2 GEOLOGY AND SOILS

The bedrock geology underlying the PDA is recorded as sedimentary sand of the Crag Group formed between 5.333 million and 11.8 thousand years ago during the Neogene and Quaternary periods. Sedimentary diamicton superficial deposits of the Lowestoft Formation overlay most of the PDA except for a sinuous spread of sand of the Happisburgh Glacigenic Formation covering the north-eastern part of the western parcel of the site corresponding to F1 (UKRI 2021).

Most of the soils overlying the PDA are classified in the Soilscape 18 Association and described as slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils. The soils overlying F1 are recorded as lime-rich loamy and clayey soils with impeded drainage and classified in the Soilscape 9 Association (Cranfield University 2021).



ILLUS 2 F1, looking south-southwest

## 2 ARCHAEOLOGICAL BACKGROUND

The following is a summary of the baseline assessment for Cultural Heritage and Archaeology within an Environmental Impact Assessment Screening document produced and provided by Neo Environmental (n.d.).

The PDA lies within a known medieval landscape, evidenced by the presence of three scheduled monuments within its close vicinity. These are Mettingham Castle (1006055) 1.45km to the west, a motte and bailey castle known as ‘The Mount’ (1018329) 450m to the west, and a moated site (1018968) located 1.15km to the north-east. Further medieval activity in the landscape is attested by several parcels of common land (Shipmeadow Common, High Common, Little Common, Blacksmith Common and Furze Common) surrounding the PDA.

Three non-designated assets are recorded within the PDA in the Suffolk Heritage Explorer website; findspots of a bronze post-medieval coin and Neolithic flakes and scrapers and the location of a since demolished 19th century farmstead ‘Gull Farm’. These three heritage assets are all located close to the northern boundary of F2.

Analysis of historic mapping highlights the presence of several post-medieval farmsteads surrounding the PDA and a former trackway (Gull Lane) along the eastern boundary of the western parcel of the

PDA linking Gull Farm to the B1062. Historic mapping also indicates the land within the PDA was previously divided into much smaller land parcels and has been in agricultural use for at least the last 150 years.

## 3 AIMS, METHODOLOGY & PRESENTATION

### 3.1 AIMS & OBJECTIVES

The principal aim of the geophysical survey was to gather information to establish the presence/absence, character, and extent of any archaeological remains within the PDA. This will enable an assessment to be made of the impact of the proposed development on any sub-surface archaeological remains, if present, and thereby inform any further investigation strategies, as appropriate.

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 determine the likely presence/absence and extent of any buried archaeological features, and
- › to prepare a report summarising the results of the survey.





ILLUS 3 F8, looking south-east

## 3.2 METHODOLOGY

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.

Magnetometry is the most widely used geophysical survey technique in archaeology as it can quickly evaluate large areas and, under favourable conditions, identify a wide range of archaeological features including infilled cut features such as large pits, gullies and ditches, hearths, and areas of burning and kilns and brick structures. It is therefore good at locating settlements of all periods, prehistoric field systems and enclosures and areas of industrial or modern activity, amongst others. It is less successful in identifying smaller features such as post-holes and small pits (except when using a non-standard sampling interval), unenclosed (prehistoric) settlement sites and graves/burial grounds. However, magnetometry is by far the single most useful technique and was assessed as the best non-intrusive evaluation tool for this site.

The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid 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 (Illus 6). These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R12 Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point.

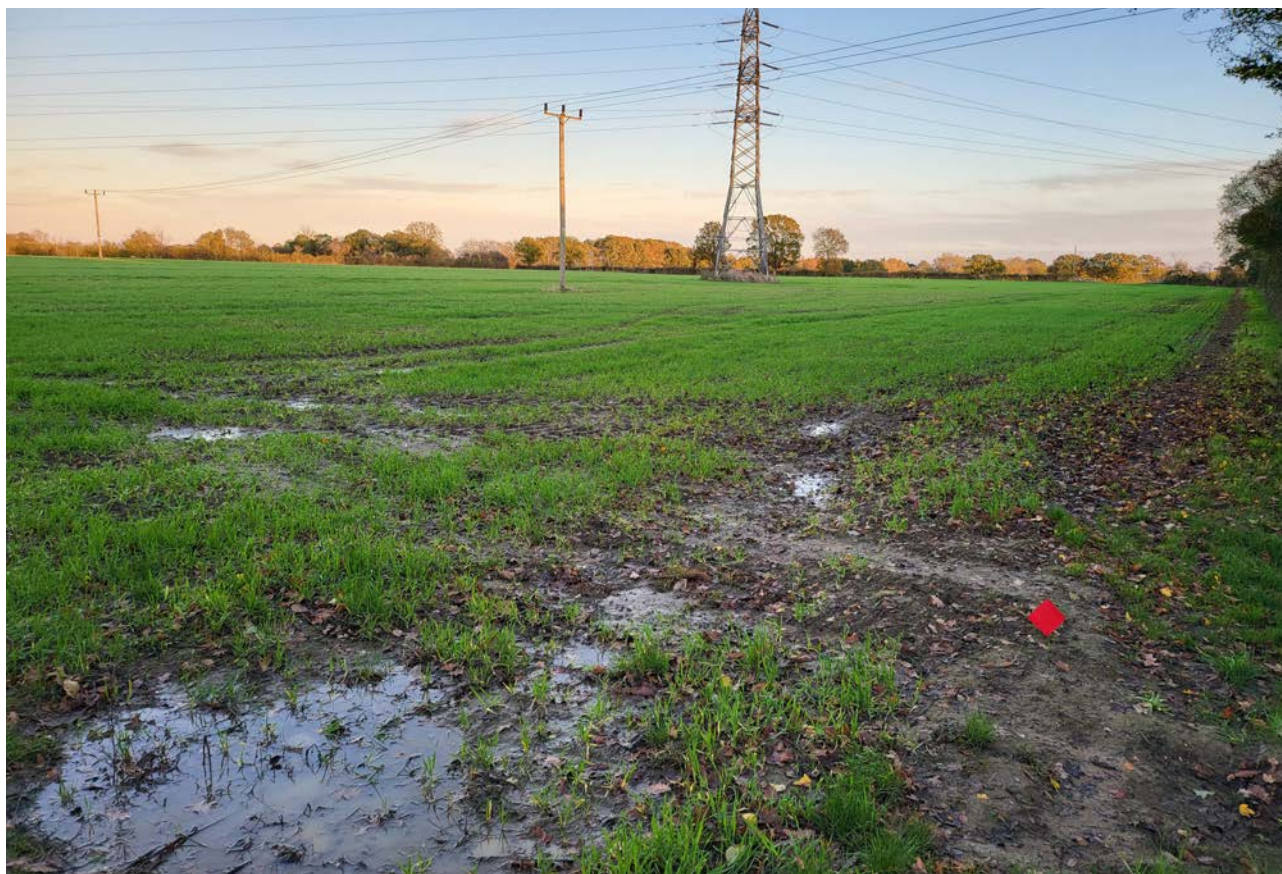
MLGrad601 and MultiGrad601 (Geomar Software Inc.) software was used to collect and export the data. Terrasurveyor V3.0.37.0 (DWConsulting) software was used to process and present the data.

## 3.3 DATA PRESENTATION & TECHNICAL DETAIL

A general site location plan is shown in Illus 1 at a scale of 1:20,000. Illus 2 to Illus 5 inclusive are site condition photographs. Illus 6 shows the GPS swaths and the location and direction of the site condition photographs at 1:10,000. The fully processed (greyscale) data and interpretative plot overviews of the whole of the PDA are presented, also at 1:10,000, in Illus 7 and Illus 8. Fully processed (greyscale) data, minimally processed data (XY trace plot) data and interpretative plots are presented, by Sector, at a scale of 1:2,500, in Illus 9 to Illus 26 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





ILLUS 4 F10, looking east

composition and location of the site archive. Data processing details are presented in Appendix 4. The OASIS Ref. is included as Appendix 5.

The survey methodology, report and any recommendations comply with the Written Scheme of Investigation (Headland Archaeology 2022), 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' (minimally processed) and processed formats and over a range of different display levels. All illustrations are presented to display and interpret the data to best effect. The interpretations are based on the experience and knowledge of Headland management and reporting staff.

## 4 RESULTS AND DISCUSSION

### 4.1 SITE CONDITIONS

Magnetometer survey is generally recommended over any sedimentary bedrock (English Heritage 2008; Table 4) although the presence of overlying superficial deposits (as is the case here) can lead to variability of results. Nevertheless, magnetometry was still the most appropriate non-intrusive geophysical technique

for evaluating the PDA, taking account of the limitations noted in Section 3.2 above.

Surface conditions were generally good across the PDA with a majority of the site being under young arable cereal crops (Illus 2 to Illus 4). Field F4 located at the southern end of the westernmost survey parcel and measuring approximately 15 hectares, had recently been heavily ploughed and was unsuitable for survey (Illus 5). Data quality was also good with only minimal post-processing required. No problems were encountered during the fieldwork.

Generally, the magnetic background to the data across the PDA is relatively homogenous (resulting in a 'smoother' appearance to the data) containing occasional, sporadic low magnitude discrete anomalies likely derived from the overlying diamicton superficial deposits. A noticeable increase in the number of discrete, low magnitude anomalies is recorded across F1, creating a more variable magnetic background. This increase corresponds to the spread of superficial sand deposits and change of soil type in this location.

Against this magnetic background numerous anomalies of geological, agricultural, modern, and possible archaeological origin have been recorded (Illus 8). This confirms that the soils and geology were suitable for magnetometry and that the results likely provide a reasonably good indication of the extent of sub-surface archaeological features within the PDA notwithstanding



**ILLUS 5** F4, unsuitable area looking south-east

the limitations of magnetometer survey to identify the types, sizes, and period of archaeological feature described in Section 3.2.

The anomalies are discussed below according to their interpreted origin.

## 4.2 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 introduced into the topsoil during manuring or tipping/infilling. There is no obvious clustering to the ferrous anomalies across the PDA more generally 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.

A cluster of strong magnetic anomalies on the northern boundary of F2 (FB1; Illus 8 and Illus 14) are identified in the location of a since demolished post-medieval farmstead (Gull Farm - SMW 021) recorded on the Ordnance Survey (OS) Six Inch map 1888–1913. The vaguely rectilinear dispersion of anomalies and alignment of adjacent former boundaries identified as linear anomalies associated with the farm, corresponds to the arrangement of structures depicted on historic mapping. The mixed high magnitude anomaly

response is consistent with the demolished remains of a former structure. Historic mapping indicates Gull Farm was demolished during the early-mid 20th century. No other anomalies of possible archaeological potential are identified immediately surrounding the former farm.

Another localised concentration of very high magnitude responses (FP1; Illus 8 and Illus 26) is recorded at the north-eastern boundary of F11 adjacent to Hall Road along the line of a former boundary. Historic mapping records the location of a pond here. The anomaly response is a result of the magnetic material used to infill the feature.

Bands or small areas of magnetic disturbance are also recorded along or adjacent to some of the current and former field boundaries and entrances. This magnetic disturbance is typically due to the accumulation of ferrous debris at field margins, or to barbed wire or mesh in the boundary itself and to the tipping of material in gateways to improve access to/from fields.

Localised magnetic disturbance is also recorded around large pylon bases in F7 and F10 despite surveying with a buffer around these features.

No buried services are recorded in the data set.

## 4.3 AGRICULTURAL ANOMALIES

Analysis of historic mapping shows that many field boundaries have been removed since the late 19th century across the whole of the PDA. These former boundaries are clearly recorded in the data as a



series of often interconnected linear and curvilinear anomalies (Illus 8) confirming that several of the current fields have been rationalised from the amalgamation of several smaller fields, most notably F1 and F3 which result from the removal of at least seven and nine former boundaries respectively.

Parallel arrangements of low magnitude linear anomalies particularly in the eastern parcel of the PDA (F7 – F9) identify regular systems of field drains.

A few faint linear trend anomalies generally aligned with the extant field boundaries are a result of modern ploughing.

Within F11 a linear anomaly marked on historic mapping (B1; Illus 8 and Illus 25) defines the edge of Furze Common. Linear anomalies within proximity of this could represent activity related to the common.

#### 4.4 ANOMALIES OF NATURAL/ GEOLOGICAL ORIGIN

There are few anomalies interpreted as of natural or geological origin above the general magnetic background recorded across the PDA and the higher density of discrete magnetically enhanced anomalies creating a more variable magnetic background across F1, caused by subtle variations in the overlying superficial sand deposits in this location.

#### 4.5 ANOMALIES OF PROBABLE OR POSSIBLE ARCHAEOLOGICAL ORIGIN

Five small clusters of magnetically enhanced ditch and pit-like anomalies, possibly indicative of enclosures, are identified on the lower ground at the eastern peripheries of the two parcels which comprise the PDA (E?1 – E?5; Illus 8).

Firstly, a series of faint, low magnitude perpendicular ditch-like anomalies (E?1; Illus 8 and Illus 11) are identified east of centre at the eastern boundary of F1. At least three very high magnitude, discrete anomalies located just inside the boundary have a magnetic signature indicative of localised burning (B?1; Illus 8 and Illus 11). This cluster of anomalies are located adjacent to a ditch and former trackway recorded on historic maps as Gull Lane which linked the now demolished Gull Farm (FB1; Illus 8 and Illus 14) with the B1062 to the north.

Along the same boundary, but approximately 430m to the south-west, is a second cluster of low magnitude pit-like anomalies around a partial right-angled ditch-like anomaly measuring approximately 80m x 20m (E?2; Illus 8 and Illus 14).

Roughly 200m south-southeast of E?2 in F2, is a small group of faint, low magnitude, perpendicular linear anomalies (E?3; Illus 8 and Illus 17) again located on the eastern boundary of western parcel of the PDA. The arrangement of anomalies suggests the presence of at least one possible rectilinear enclosure aligned north-west/south-east measuring 30m x 35m. These anomalies lie approximately 150m

south-east of the former site of Gull Farm and are not located along Gull Lane unlike the groups of anomalies at E?1 and E?2.

In the eastern parcel of the PDA two further groups of ditch and pit-like anomalies suggestive of rectilinear enclosures are identified at the eastern boundary of the parcel in the north-east corners of F6 (E?4; Illus 8 and Illus 23) and F8 (E?5; Illus 8, 23 and Illus 26). Two discrete high magnitude anomalies within E?4 indicate possible localised burning (B?3; Illus 8 and Illus 23). The anomalies at E?4 are located between two areas of medieval common land, High Common (BRS 070) 190m to the west and Little Common (BRS 072) 40m to the east. Anomalies at E?5 are also located adjacent to a parcel of medieval common land (Furze Common - BRS 071) recorded in the Suffolk HER and which are also recorded on historic mapping. It remains unclear from the survey data whether the magnetic anomalies have any association with these heritage assets located immediately outside the PDA. Consequently, similar to E?1 – E?3 these anomalies remain difficult to interpret with confidence located so close to the edge of the survey and with an absence of any other previously recorded heritage assets nearby.

Close to E?2 is a possible area of extraction (Q?1; Illus 8 and Illus 14) identified as a weakly magnetically enhanced patch, with a unique magnetic signature indicative of a non-ferrous backfill of a former extraction pit. Located between Q?1 and E?2 is a group of high magnitude discrete anomalies (ME3; Illus 8 and Illus 14) of uncertain origin whose magnetic signatures differ from the general magnetic background. These anomalies are interpreted as uncertain based on their magnetic form and proximity to anomalies interpreted as of possible archaeological potential.

Two sets of low magnitude parallel ditch like anomalies of possible archaeological potential (D?4 and D?5; Illus 8, 11 and Illus 14) aligned roughly north/south and oblique to mapped former boundaries, are identified approximately 140m west of the possible archaeological activity at E?1 and a similar distance from the group of anomalies of uncertain origin at the northernmost part of the site (ME1, ME2 and D?1 – D?3).

Isolated linear ditch-like anomalies (D?6 and D?7; Illus 8 and Illus 14) located within 75m of Q?3 may also be of archaeological origin associated with possible archaeological activity at E?2, ME3 and Q?3 but could equally relate to neighbouring former boundaries and have an agricultural origin.

The survey has also recorded a group of magnetically enhanced anomalies with different magnetic signatures (ME1 and ME2; Illus 8 and Illus 11) and linear trend anomalies (D?1 – D?3; Illus 8 and Illus 11) at the northern end of F1. A roughly circular spread of high magnitude anomalies approximately 45m in diameter towards the centre of the field (ME1), may record the location of a former extraction site or former pond not recorded on historic mapping, with the anomaly response a result of the material used to infill the feature. This area at the northern end of F1 corresponds to amorphous, patchy cropmarks seen on Google Earth satellite imagery and lies approximately 60m east of a 19th century farmstead (Church Farm - SMW 020).

Immediately adjacent to ME1 are a series of very faint linear trends or linear arrangements of discrete low magnitude anomalies suggestive



of a linear feature (D?1 – D?3; Illus 8 and Illus 11) primarily aligned at right angles north-northeast/south-southwest and west-northwest/east-southeast. These anomalies remain difficult to interpret with confidence due to the more variable magnetic background present across F1 but may represent ditch-like features.

A parallel linear arrangement of very high magnitude 'spike' anomalies (ME2; Illus 8 and Illus 11) at the eastern boundary of this part of the field corresponds to the line of a former boundary recorded on historic mapping. However, there is no evidence in the data for any anomaly extending across the field as indicated by the mapping. These anomalies share an alignment with ditch-like trend anomalies at D?1 and D?2 though no relationship is established.

A cluster of isolated high magnitude anomalies of uncertain origin (ME4; Illus 8 and Illus 23) are identified approximately 100m west of 19th century farmstead Low Farm (BRS 062) in F7. These anomalies are identified based on the increased strength of their magnetic response which does not suggest a ferrous component. The anomalies are located at the end of a field drain and close to a former boundary and may therefore be of agricultural or modern origin.

North of centre in F3 a single discrete high magnitude anomaly with magnetic signature possibly indicative of localised burning is recorded (B?2; Illus 8 and Illus 17). The anomaly exists in isolation but central within a former field and a natural or modern cause remains plausible.

## 5 CONCLUSION

The survey has identified a range of anomalies consistent with modern activity and agricultural usage of the proposed development area (PDA) but also of uncertain and of possible archaeological origin against a largely homogenous magnetic background.

Five small clusters of magnetically enhanced ditch and pit-like anomalies possibly indicative of enclosures are identified on the lower ground at the eastern peripheries of the two parcels that comprise the PDA. Two of these clusters in the western parcel lay adjacent to a ditch and former trackway recorded on historic maps (Gull Lane) which linked the since demolished Gull Farm with the B1062. The two groupings of anomalies in the eastern parcel lie close or adjacent to areas of medieval common land.

Very high magnitude anomalies within two of these possible enclosure sites are indicative of localised burning and other discrete high magnitude anomalies of uncertain origin and a possible area of localised extraction near others, supports a possible archaeological interpretation for these anomalies. A more confident interpretation of all these areas however remains difficult as they all lie on or immediately adjacent to the PDA boundaries.

A group of linear trend anomalies and two areas of magnetic enhancement of uncertain origin area identified at the northernmost part of the PDA in F1. Collectively these anomalies may identify an area of extraction and possible archaeological activity although this interpretation is considered tentative.

Other than the anomalies identified as of uncertain or possible archaeological potential, the survey has recorded numerous former boundaries and regular patterns of field drainage, the former site of Gull Farm and the location of a former pond adjacent to Furze Common, these latter features detailed on historic mapping.

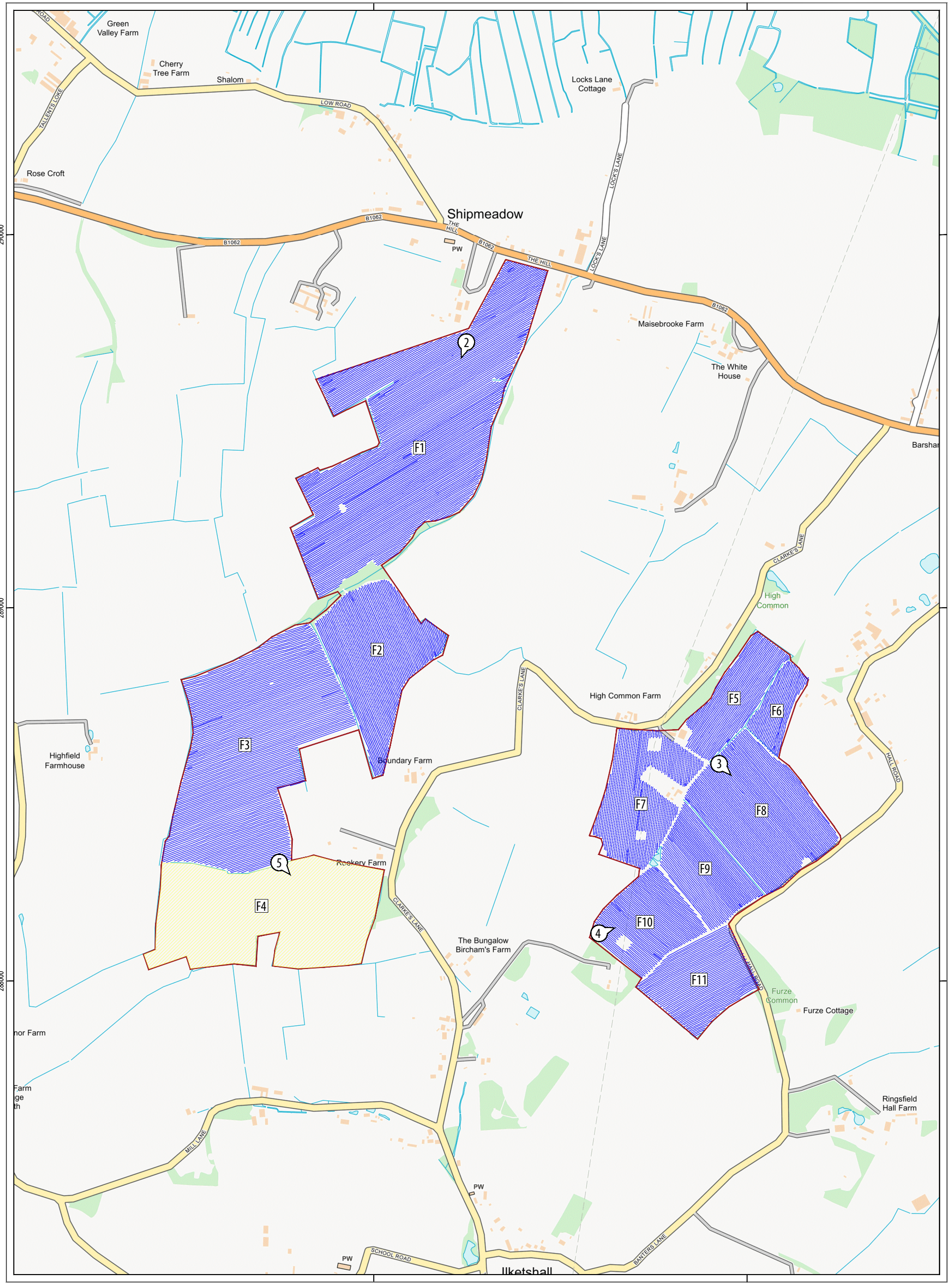
Based on the results of the survey the archaeological potential of those areas in and around the five clusters of magnetic anomalies of possible archaeological origin are assessed as of moderate potential. The archaeological potential of the remainder of the PDA is however assessed as low.

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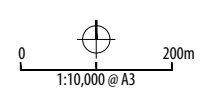
- proposed development area
- GPS swaths
- area unsuitable for survey
- location and direction of ILLUS 2-5

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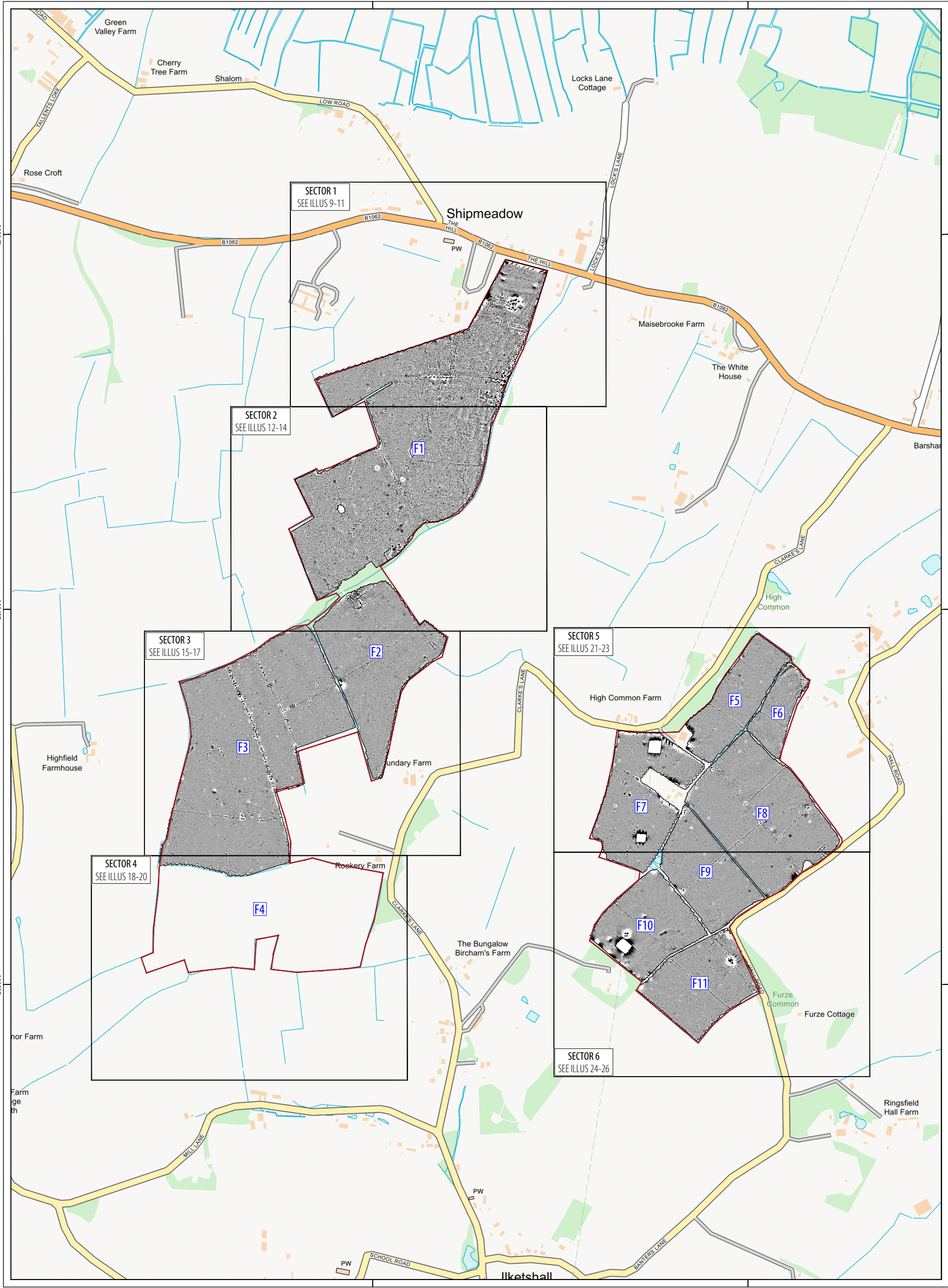


ILLUS 6 Survey location showing GPS swaths and photograph locations

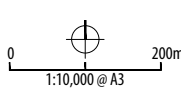
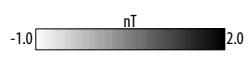








□ proposed development area



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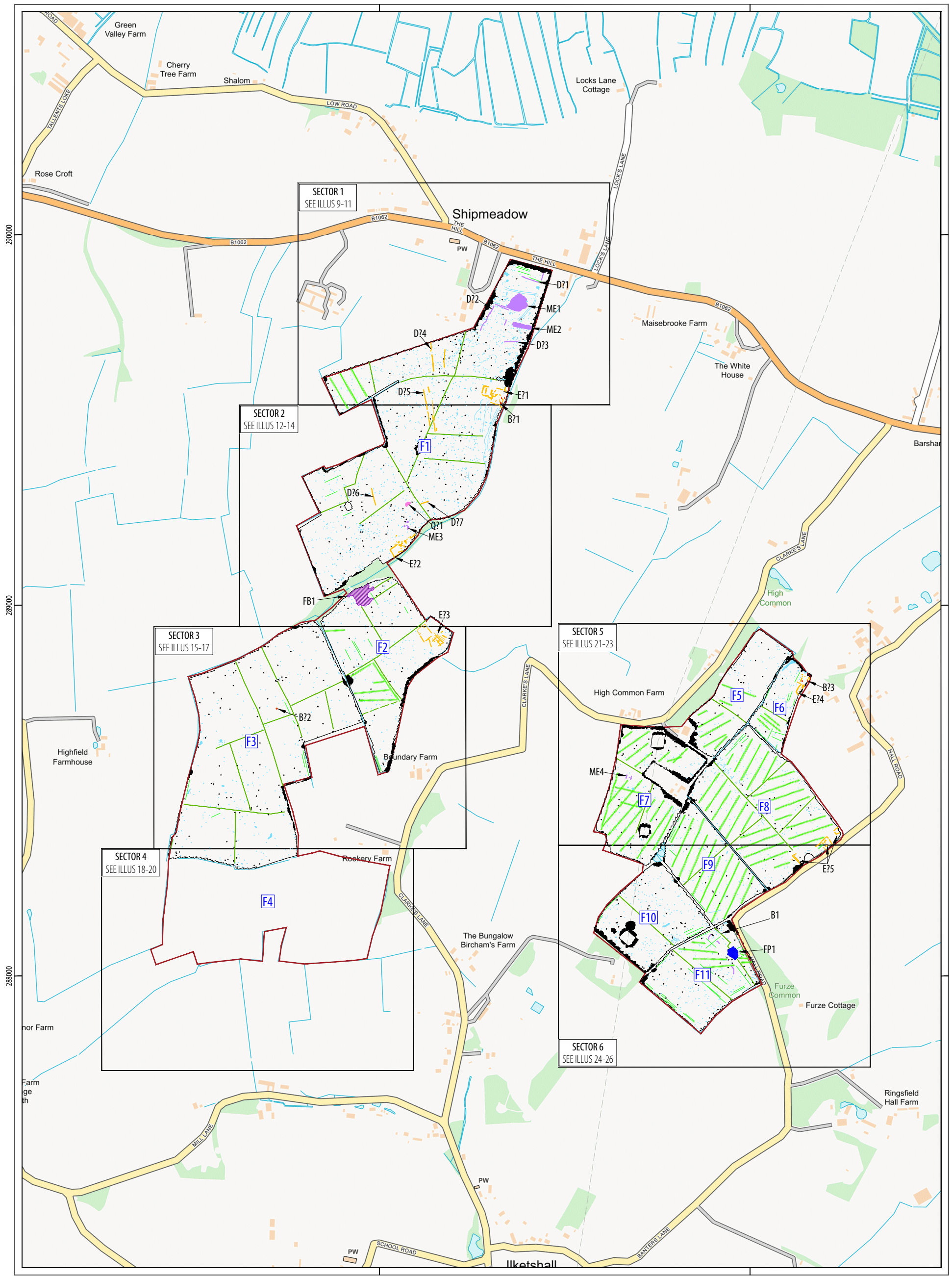
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ILLUS 7 Overall greyscale plot of processed magnetometer data









TYPE OF ANOMALY	INTERPRETATION
● dipolar isolated	ferrous material
⦿ magnetic disturbance	ferrous material
⊕ magnetic enhancement	uncertain
⊖ magnetic enhancement	quarrying
⊗ magnetic disturbance	former building

TYPE OF ANOMALY	INTERPRETATION
⊕ magnetic enhancement	former pond
— linear trend	agricultural
— linear trend	field drain
— linear	former field boundary
— linear	former field boundary?
— linear trend	geological variation

TYPE OF ANOMALY	INTERPRETATION
⊕ magnetic enhancement	geology
— linear trend	archaeology?
⊕ magnetic enhancement	archaeology?
⊗ magnetic enhancement	burning?

ABBREVIATIONS

D? - ditch?	E? - enclosure?
FB - former building	FP - former pond

ME - magnetic enhancement  
 Q? - quarrying?  
 B? - burning?

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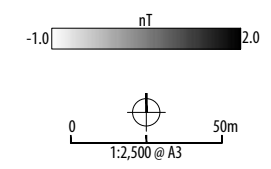
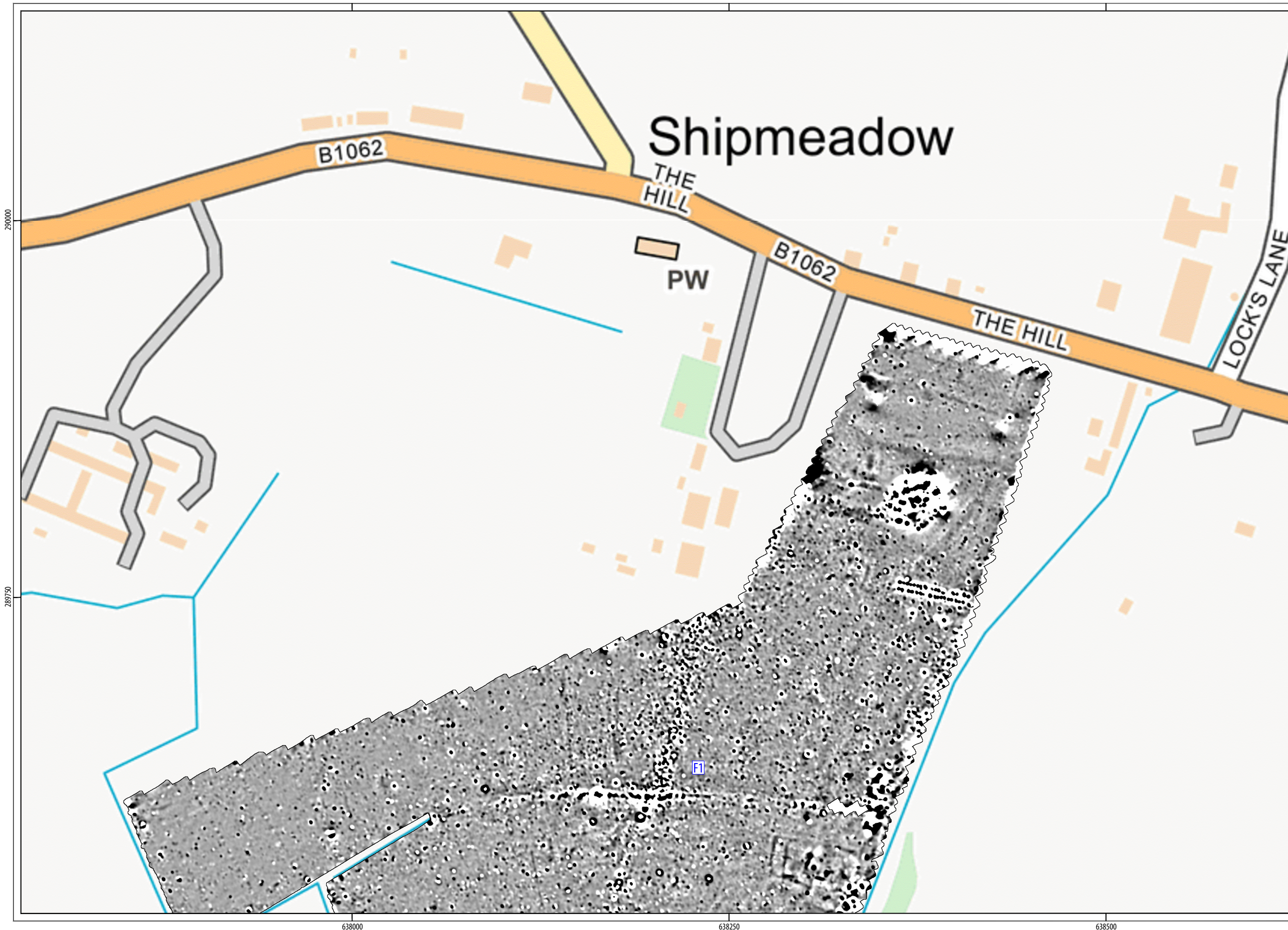
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ILLUS 8 Overall interpretation of processed magnetometer data









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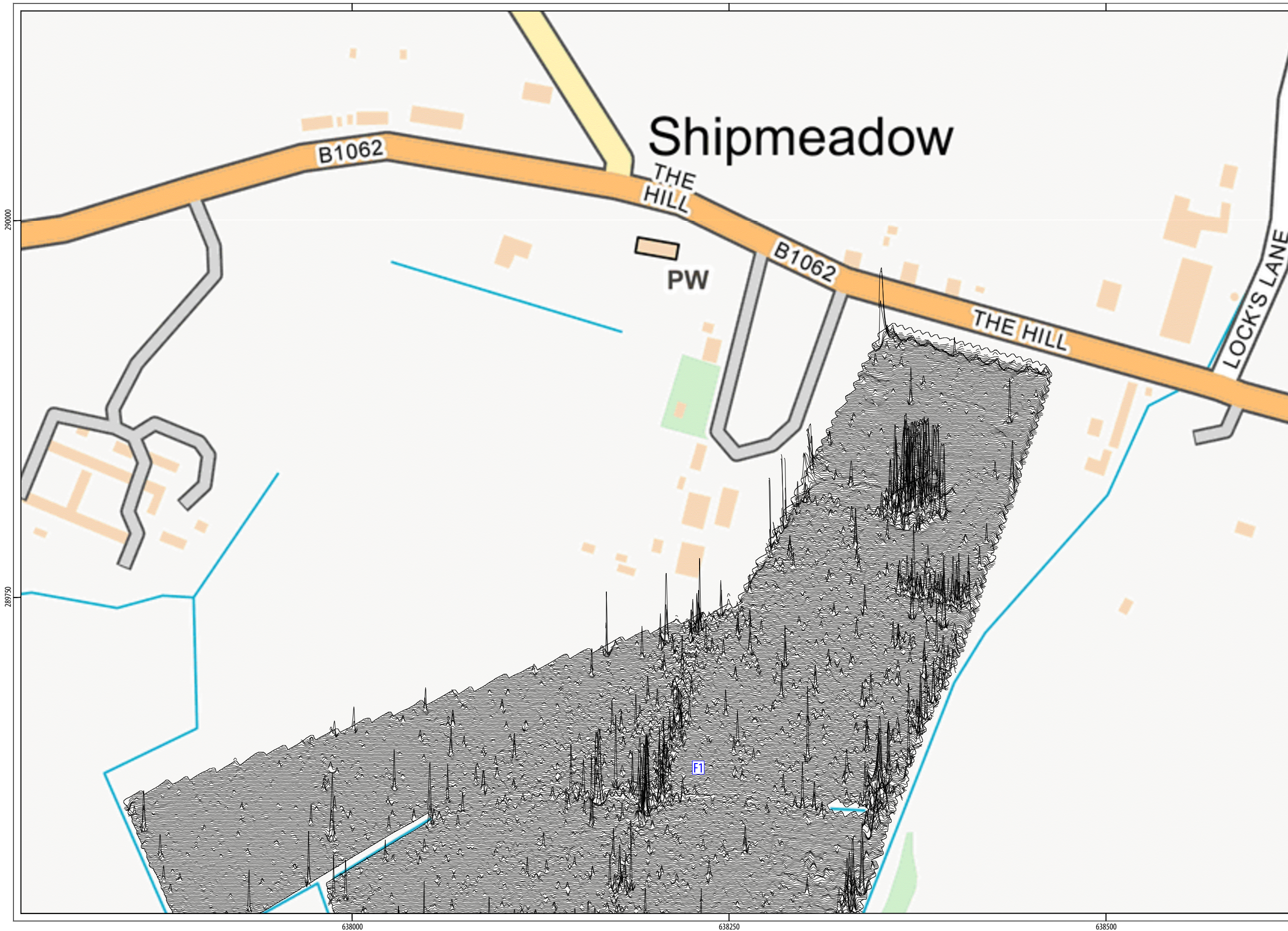
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ILLUS 9 Processed greyscale magnetometer data; Sector 1









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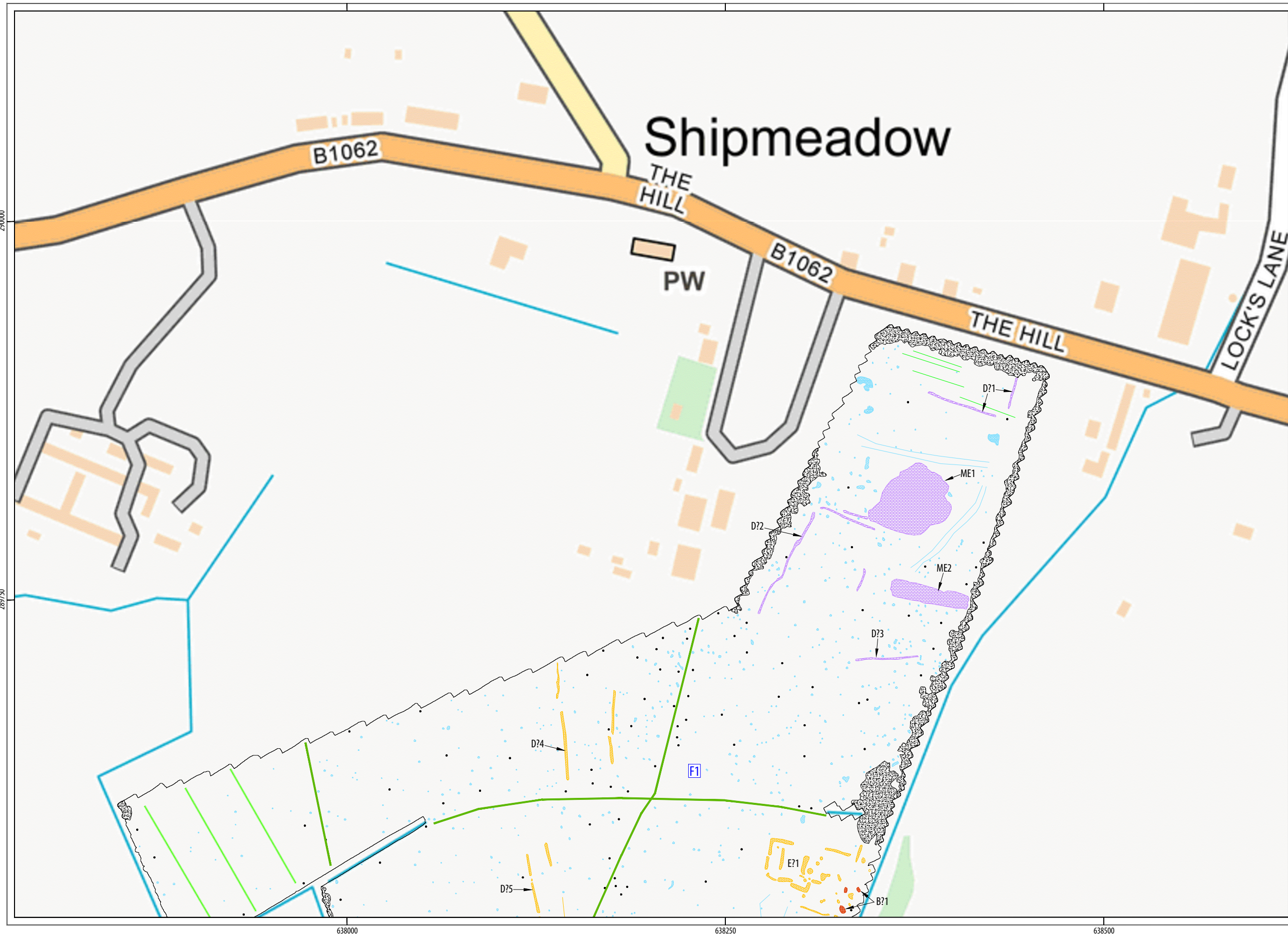
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ILLUS 10 XY trace plot of minimally processed magnetometer data; Sector 1



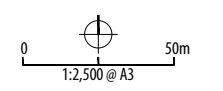






TYPE OF ANOMALY	INTERPRETATION
• dipolar isolated	ferrous material
● magnetic disturbance	ferrous material
⊕ magnetic enhancement	uncertain
— linear trend	ridge and furrow
— linear trend	agricultural
— linear trend	field drain
— linear	former field boundary
— linear trend	geological variation
⊕ magnetic enhancement	geology
— linear trend	archaeology?
⊕ magnetic enhancement	archaeology?
⊕ magnetic enhancement	burning?

ABBREVIATIONS  
 D? - ditch?  
 E? - enclosure?  
 ME - magnetic enhancement  
 B? - burning?



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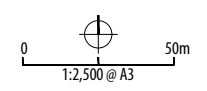
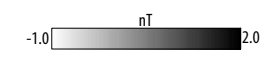
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ILLUS 11 Interpretation of magnetometer data; Sector 1









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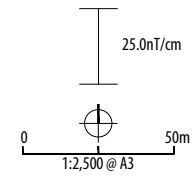
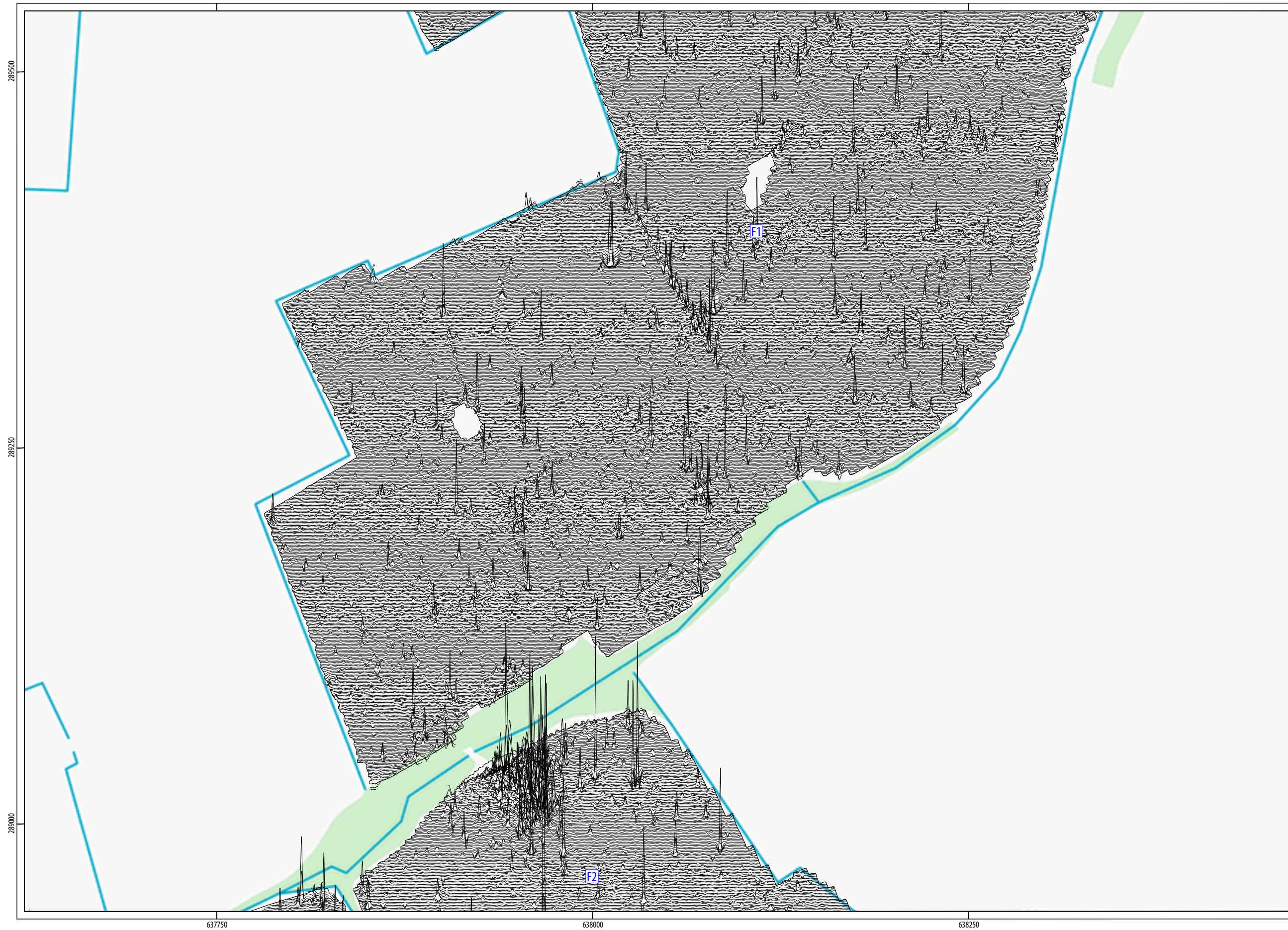
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ILLUS 12 Processed greyscale magnetometer data; Sector 2









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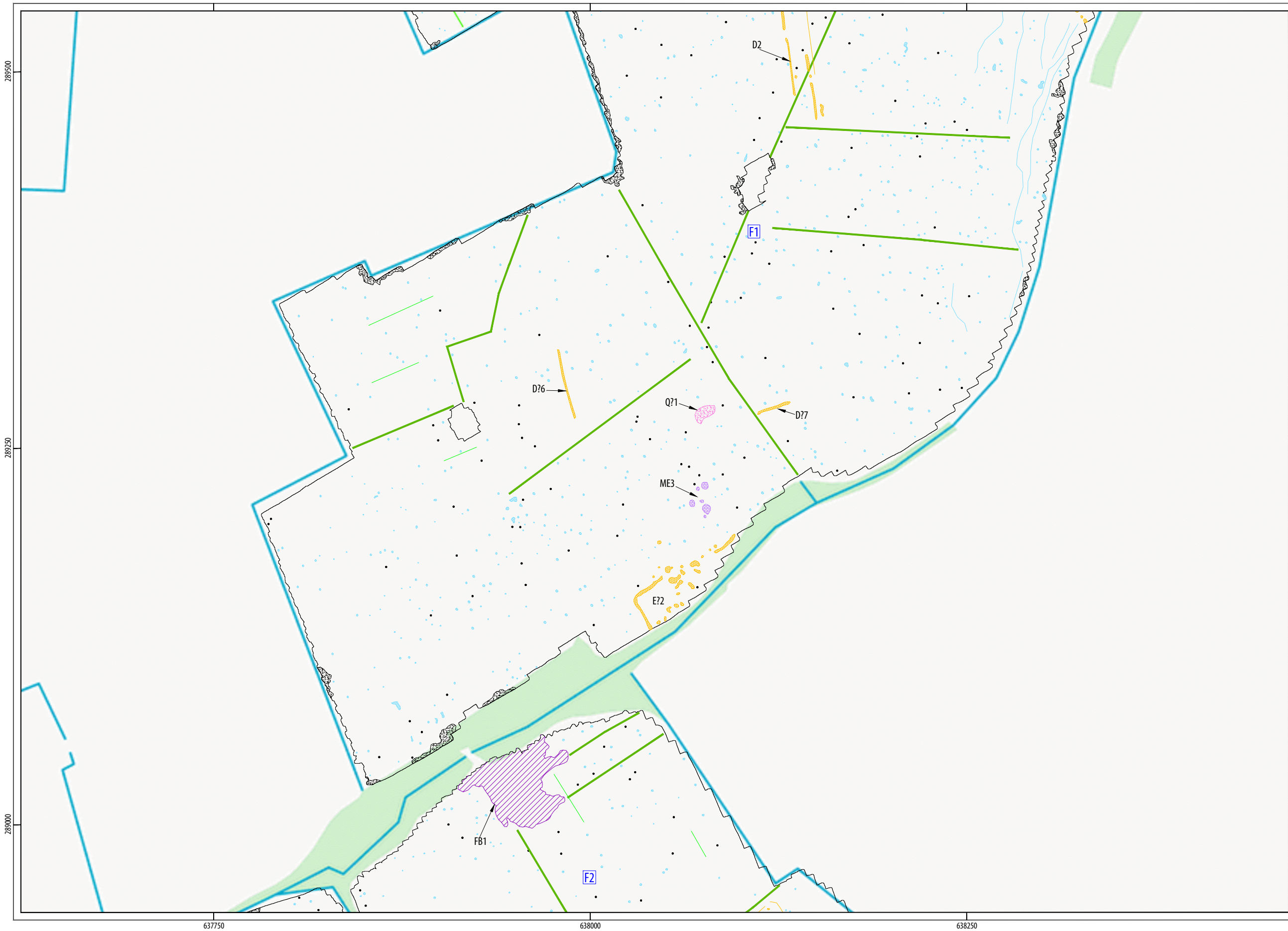
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ILLUS 13 XY trace plot of minimally processed magnetometer data; Sector 2





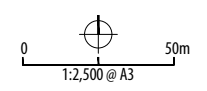




TYPE OF ANOMALY	INTERPRETATION
● dipolar isolated	ferrous material
● magnetic disturbance	ferrous material
● magnetic enhancement	quarrying
● magnetic disturbance	former building
● magnetic enhancement	uncertain
— linear trend	agricultural
— linear trend	field drain
— linear	former field boundary
— linear trend	geological variation
● magnetic enhancement	geology
— linear trend	archaeology?
● magnetic enhancement	archaeology?

ABBREVIATIONS

D? - ditch?
E? - enclosure?
FB - former building
ME - magnetic enhancement
Q? - quarrying?



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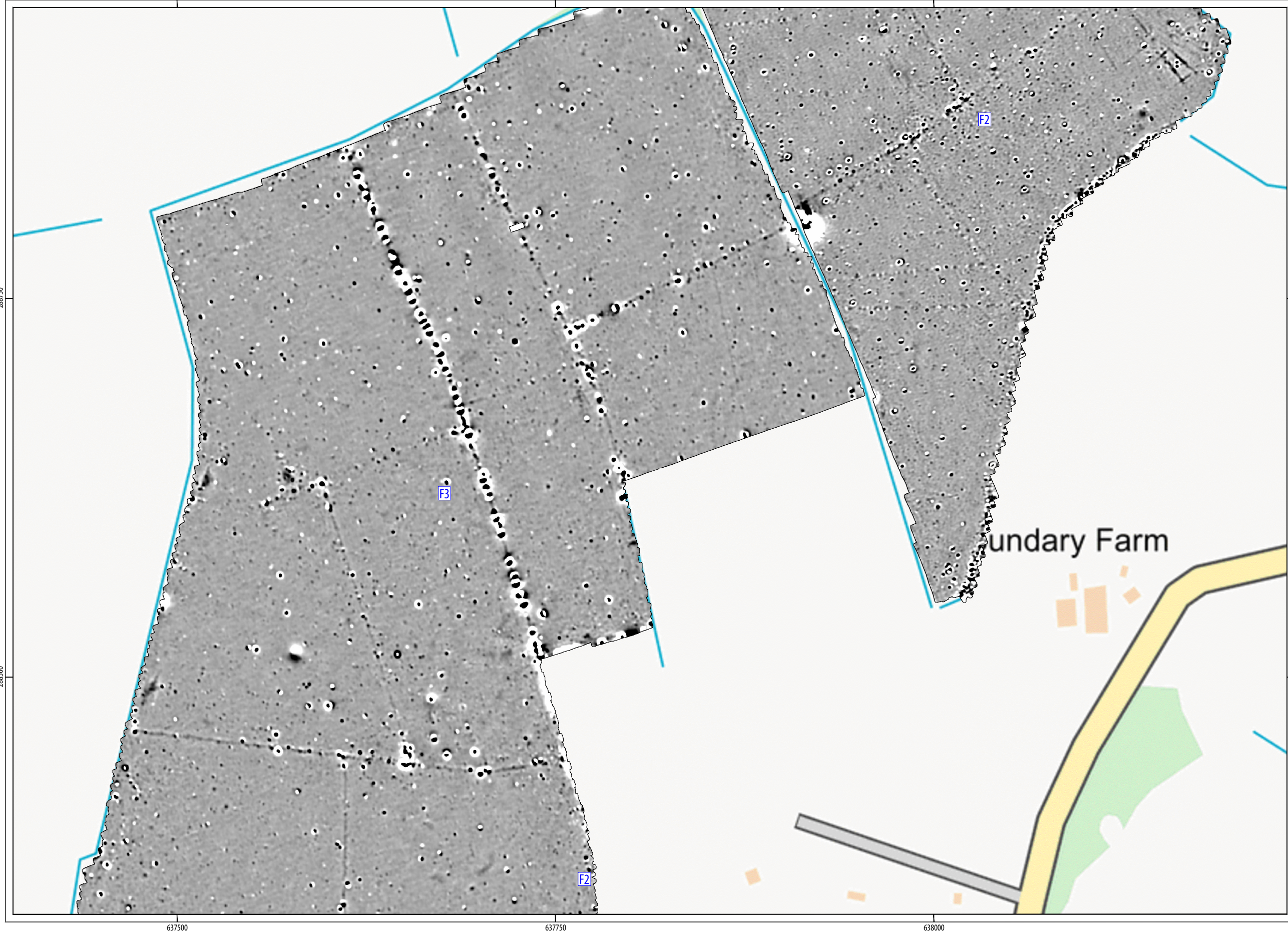
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ILLUS 14 Interpretation of magnetometer data; Sector 2









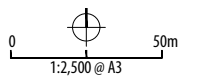
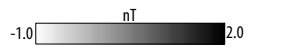
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288500

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638000



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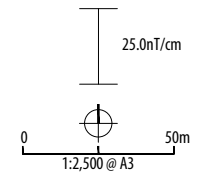
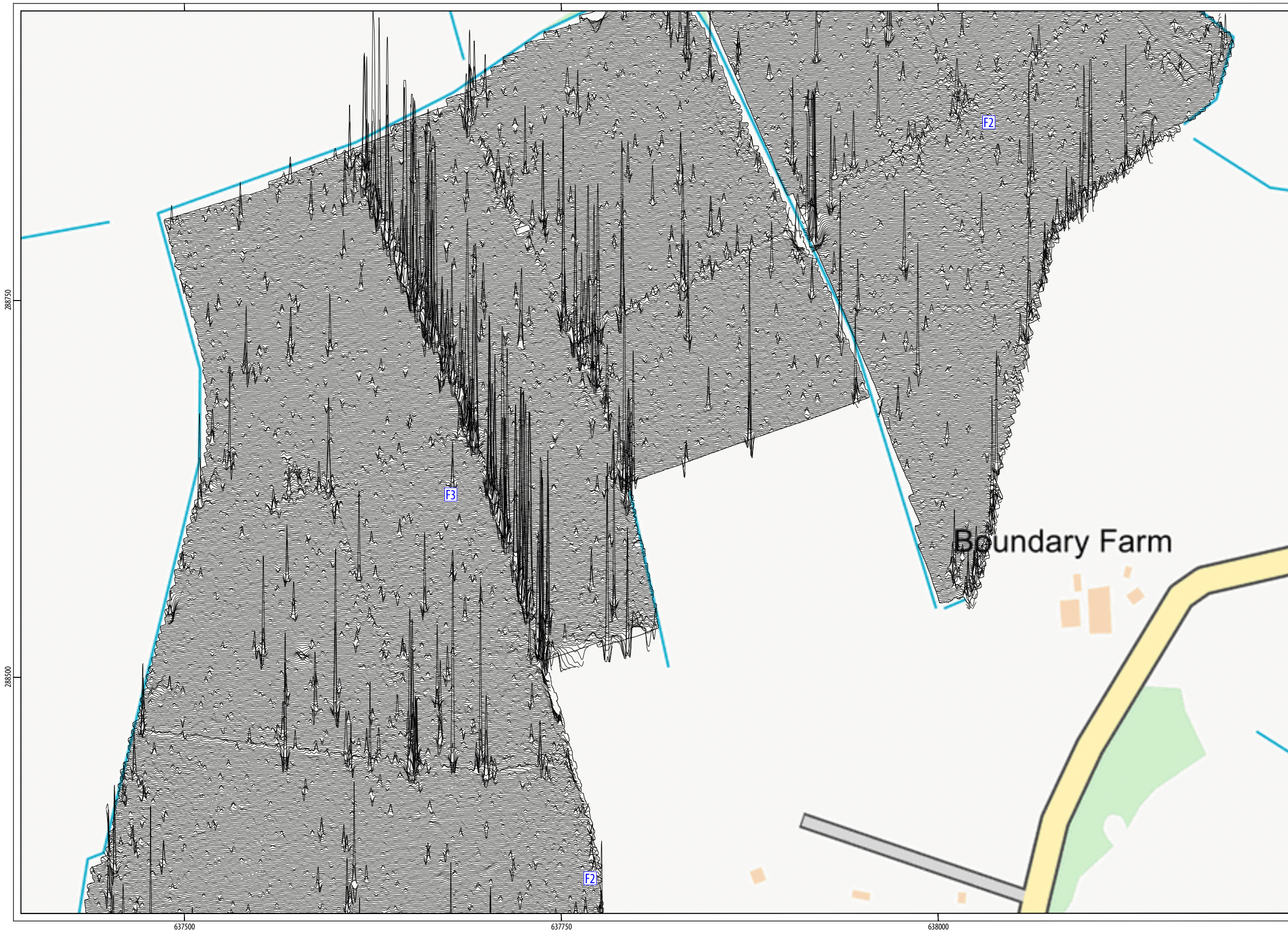
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ILLUS 15 Processed greyscale magnetometer data; Sector 3









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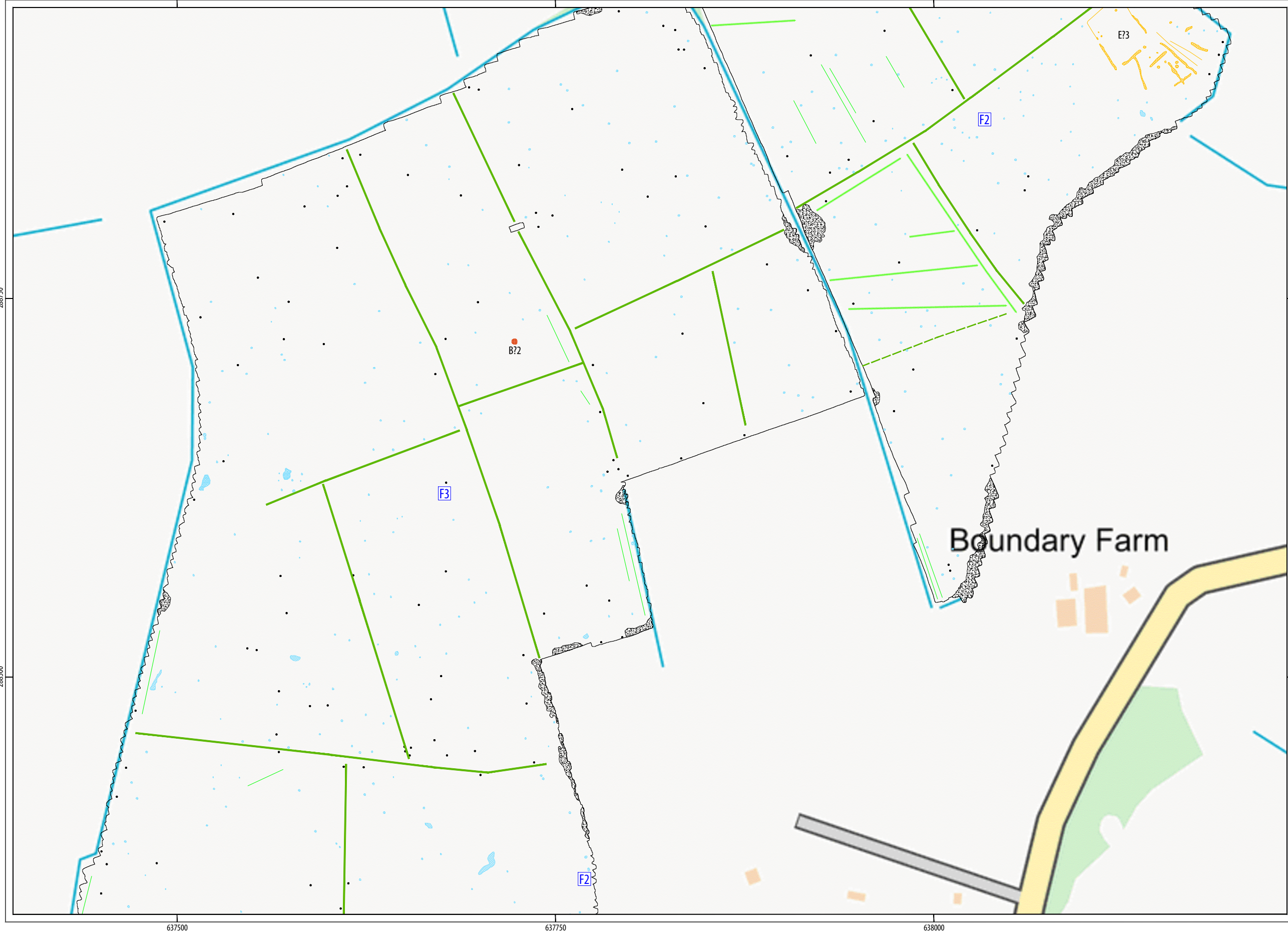
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ILLUS 16 XY trace plot of minimally processed magnetometer data; Sector 3



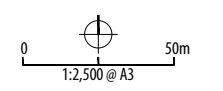






TYPE OF ANOMALY	INTERPRETATION
● dipolar isolated	ferrous material
● magnetic disturbance	ferrous material
— linear trend	agricultural
- - - linear trend	field drain
— linear	former field boundary
— linear	former field boundary?
— linear trend	geological variation
⊕ magnetic enhancement	geology
— linear trend	archaeology?
⊗ magnetic enhancement	archaeology?
⊗ magnetic enhancement	burning?

ABBREVIATIONS  
 E? - enclosure?  
 B? - burning?



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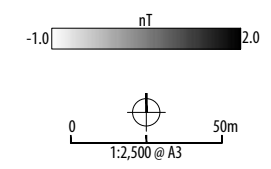
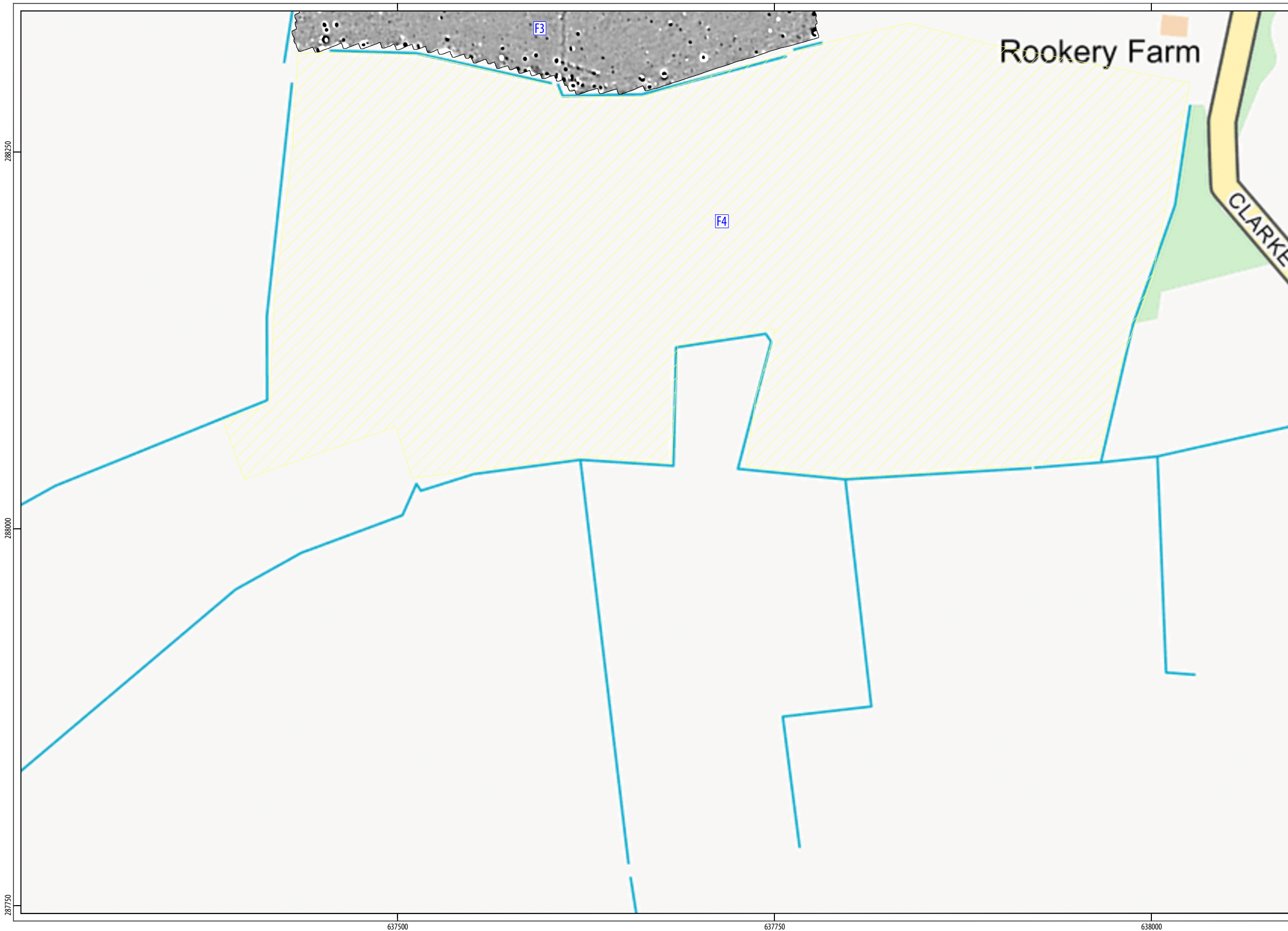
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ILLUS 17 Interpretation of magnetometer data; Sector 3









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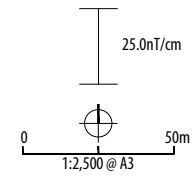
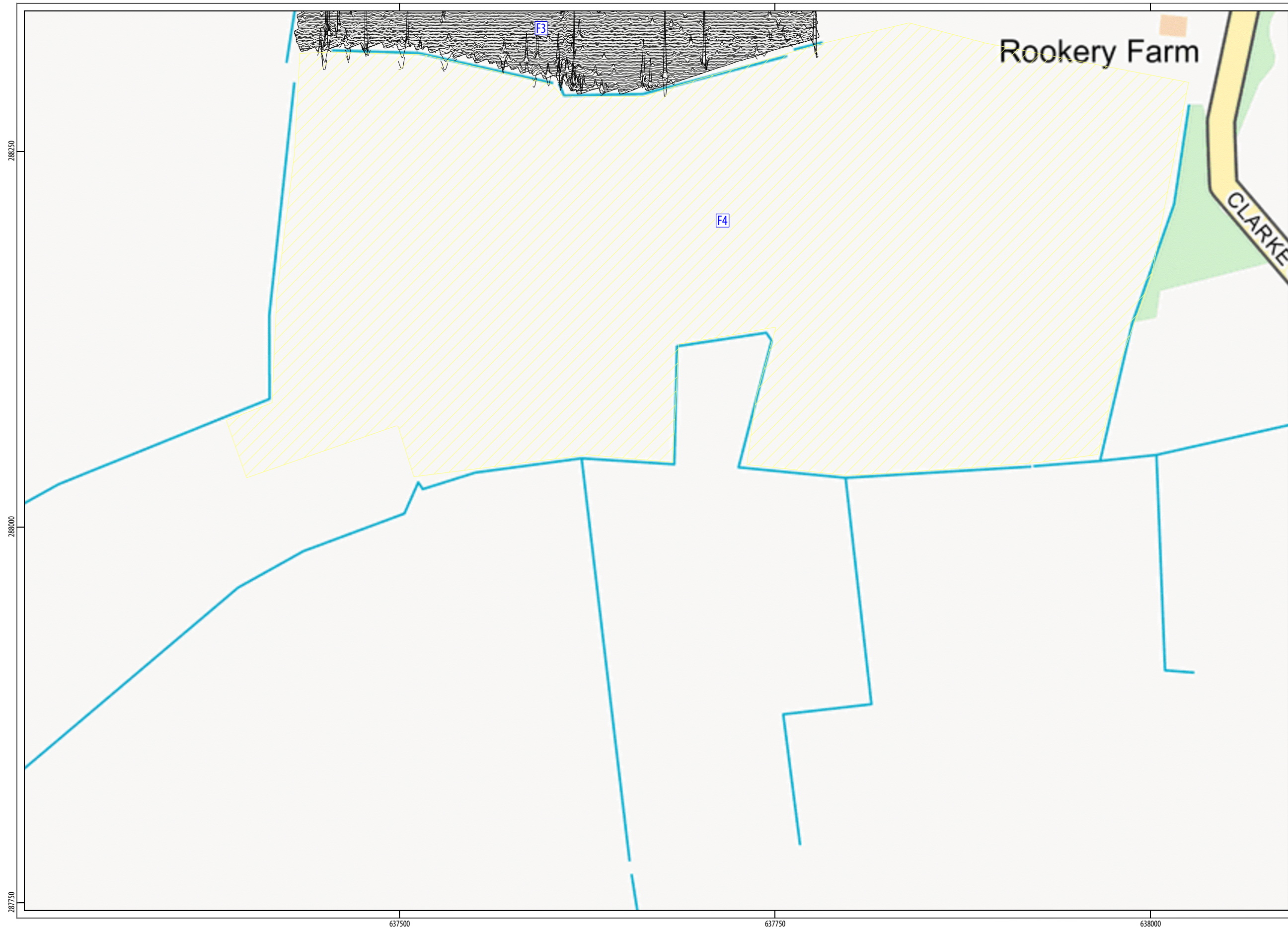
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ILLUS 18 Processed greyscale magnetometer data; Sector 4









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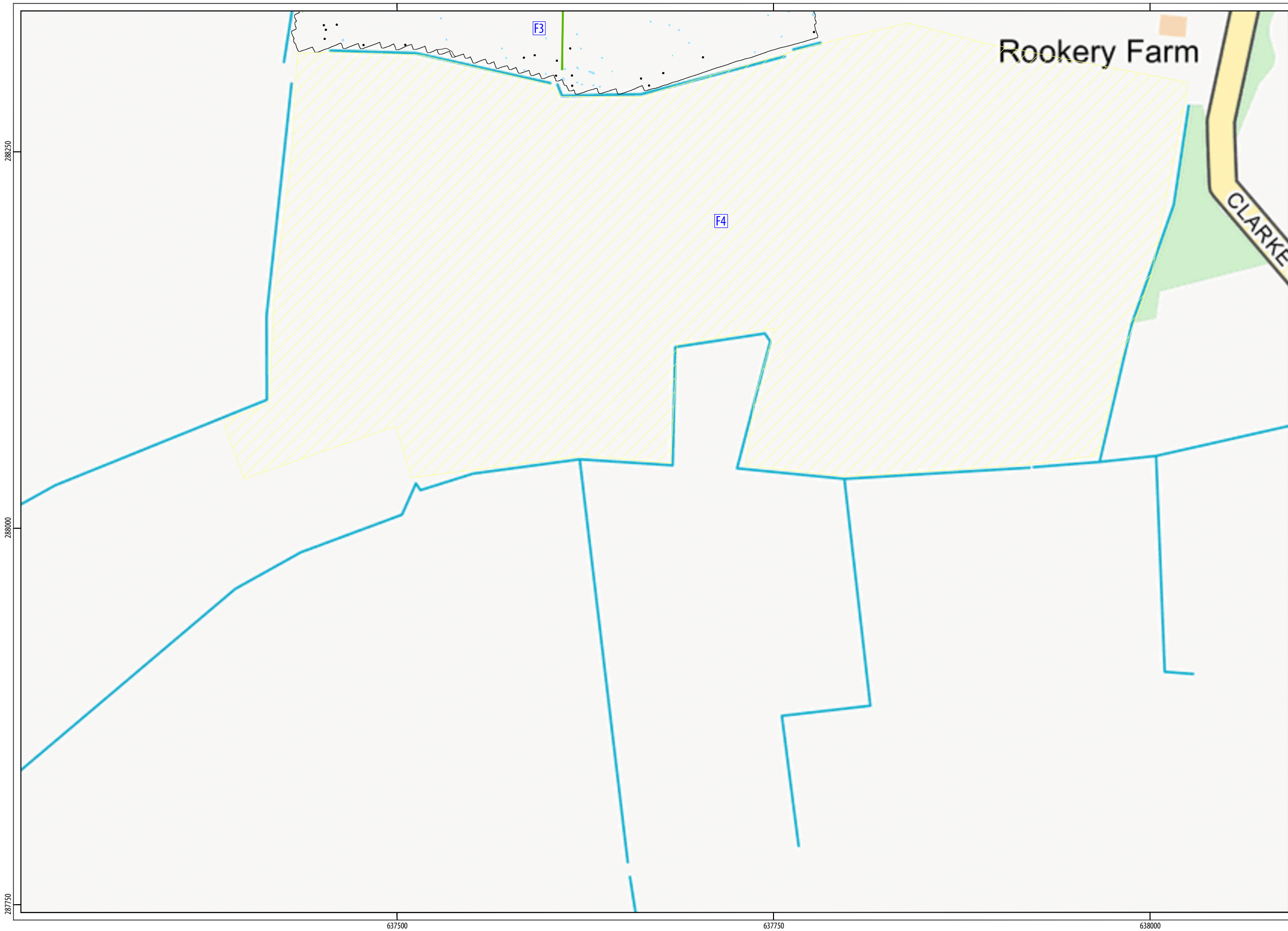
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ILLUS 19 XY trace plot of minimally processed magnetometer data; Sector 4

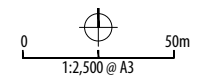








TYPE OF ANOMALY	INTERPRETATION
● dipolar isolated	ferrous material
— linear	former field boundary
⊕ magnetic enhancement	geology



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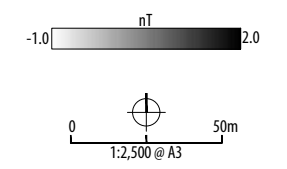
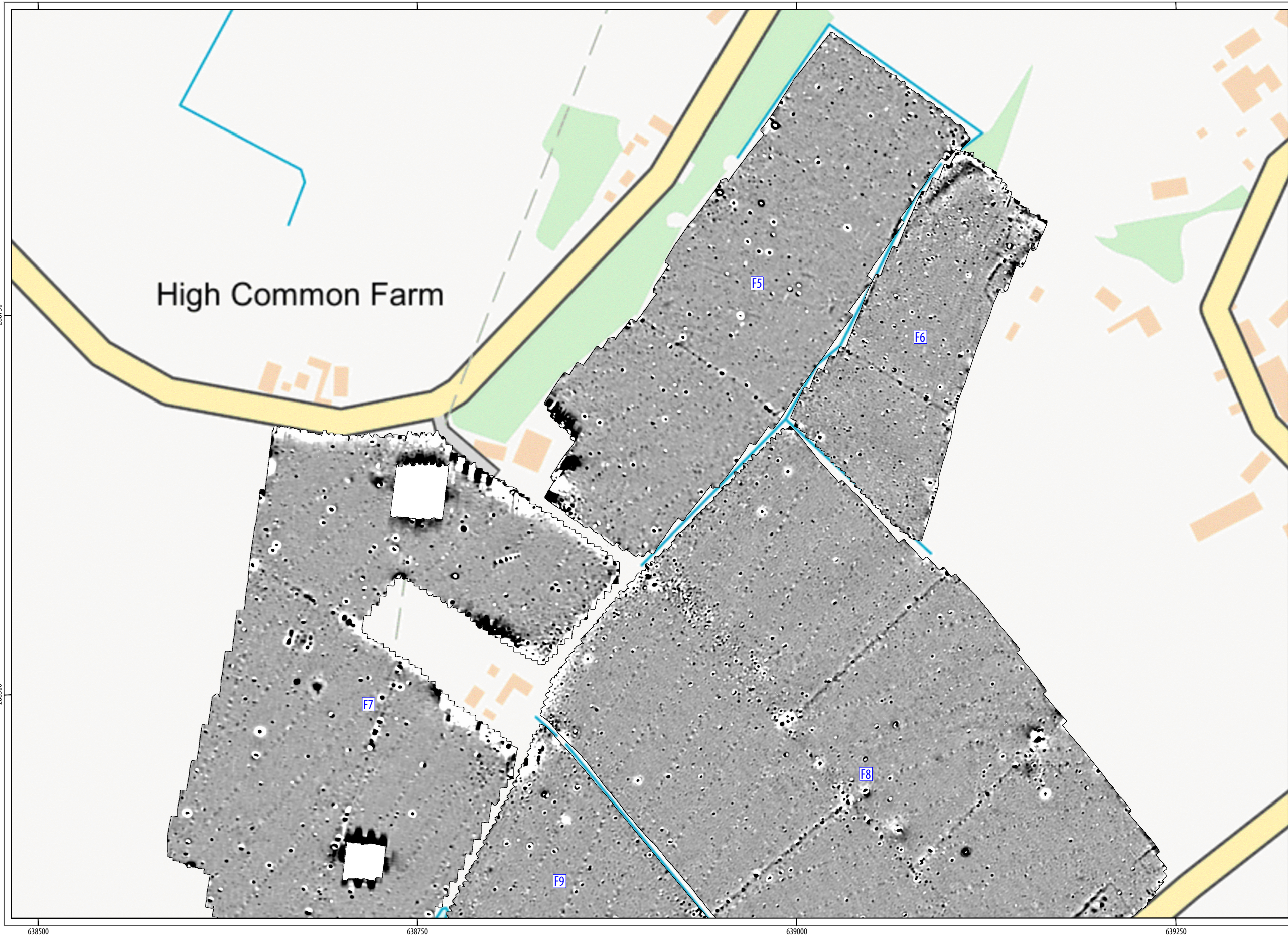


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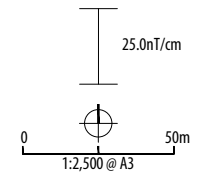
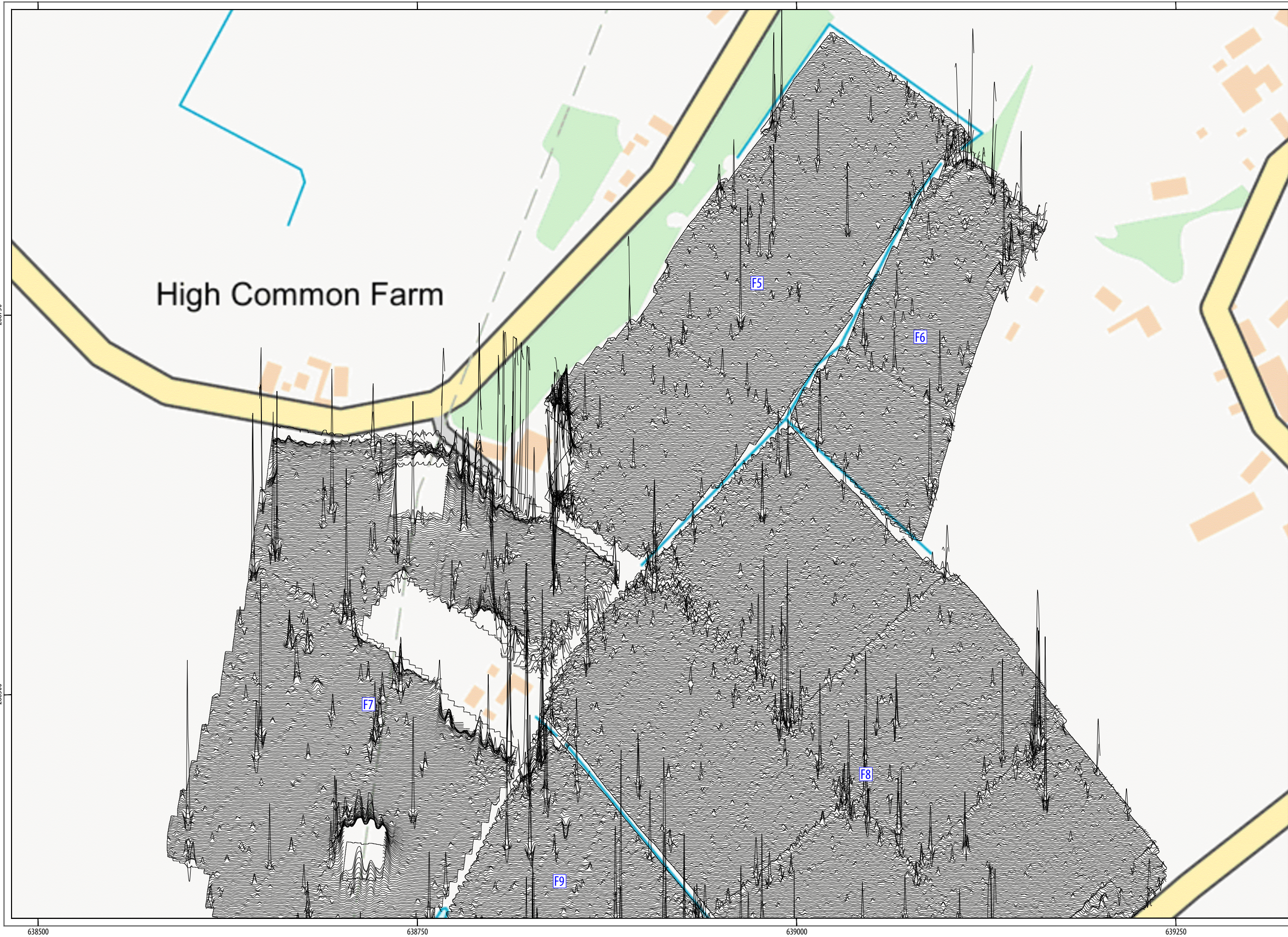
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ILLUS 21 Processed greyscale magnetometer data; Sector 5









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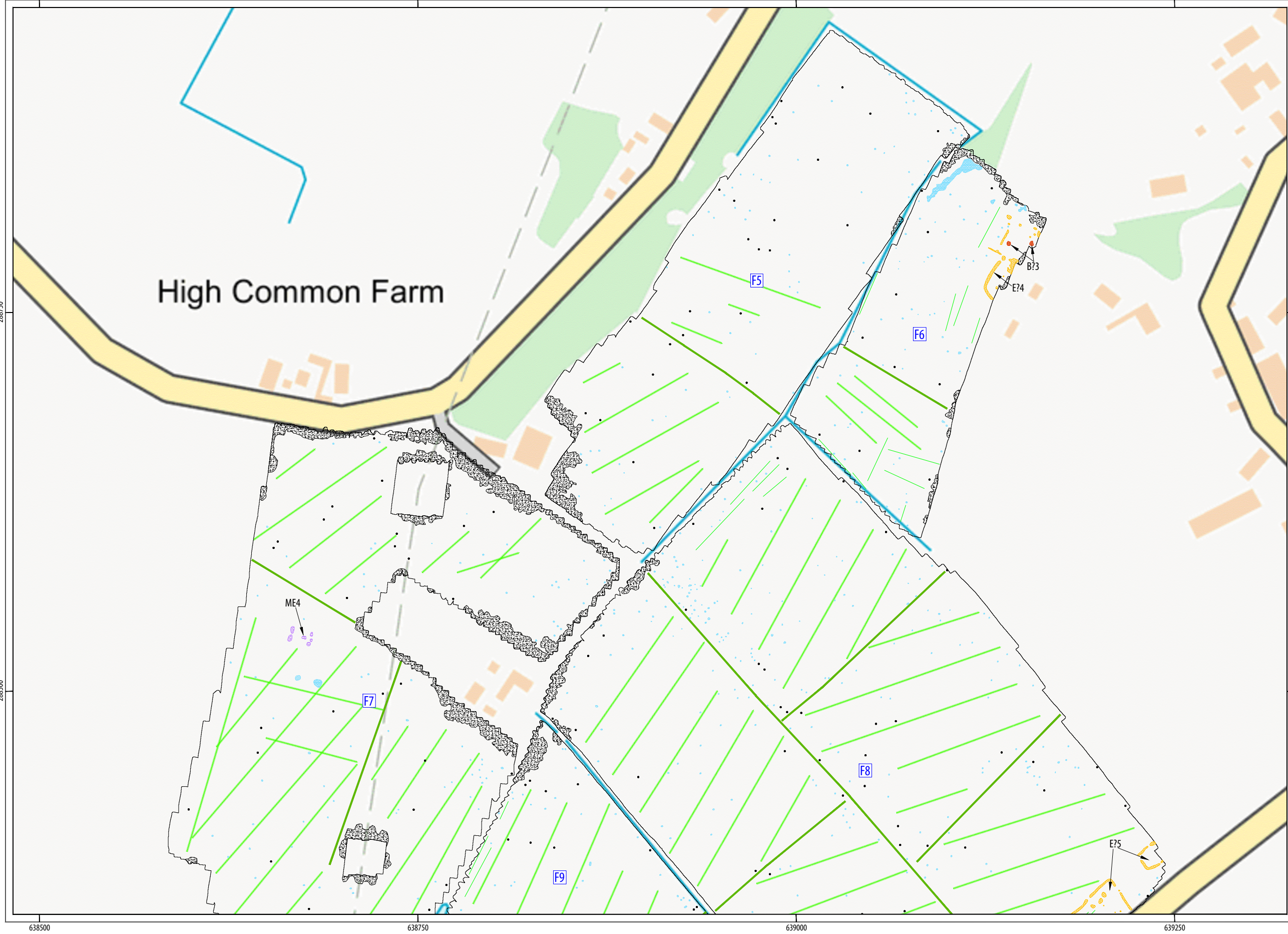
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ILLUS 22 XY trace plot of minimally processed magnetometer data; Sector 5



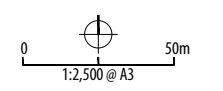






TYPE OF ANOMALY	INTERPRETATION
● dipolar isolated	ferrous material
● magnetic disturbance	ferrous material
● magnetic enhancement	uncertain
— linear trend	agricultural
— linear trend	field drain
— linear	former field boundary
— linear trend	geological variation
● magnetic enhancement	geology
● magnetic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

ABBREVIATIONS  
 E? - enclosure?  
 B? - burning?  
 ME - magnetic enhancement



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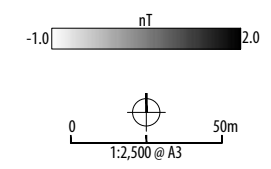
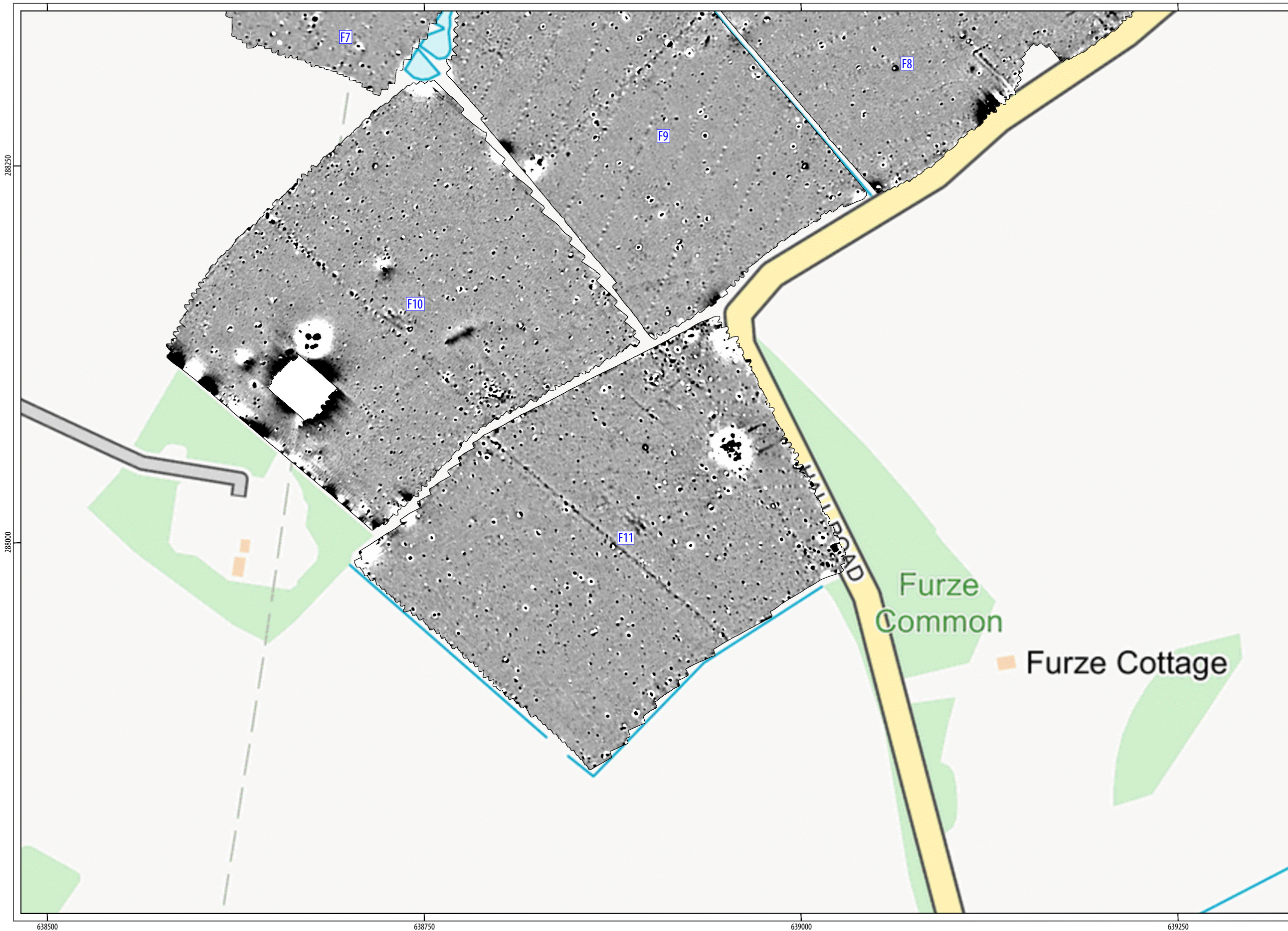
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ILLUS 23 Interpretation of magnetometer data; Sector 5









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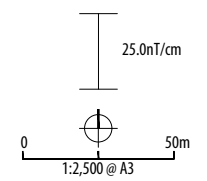
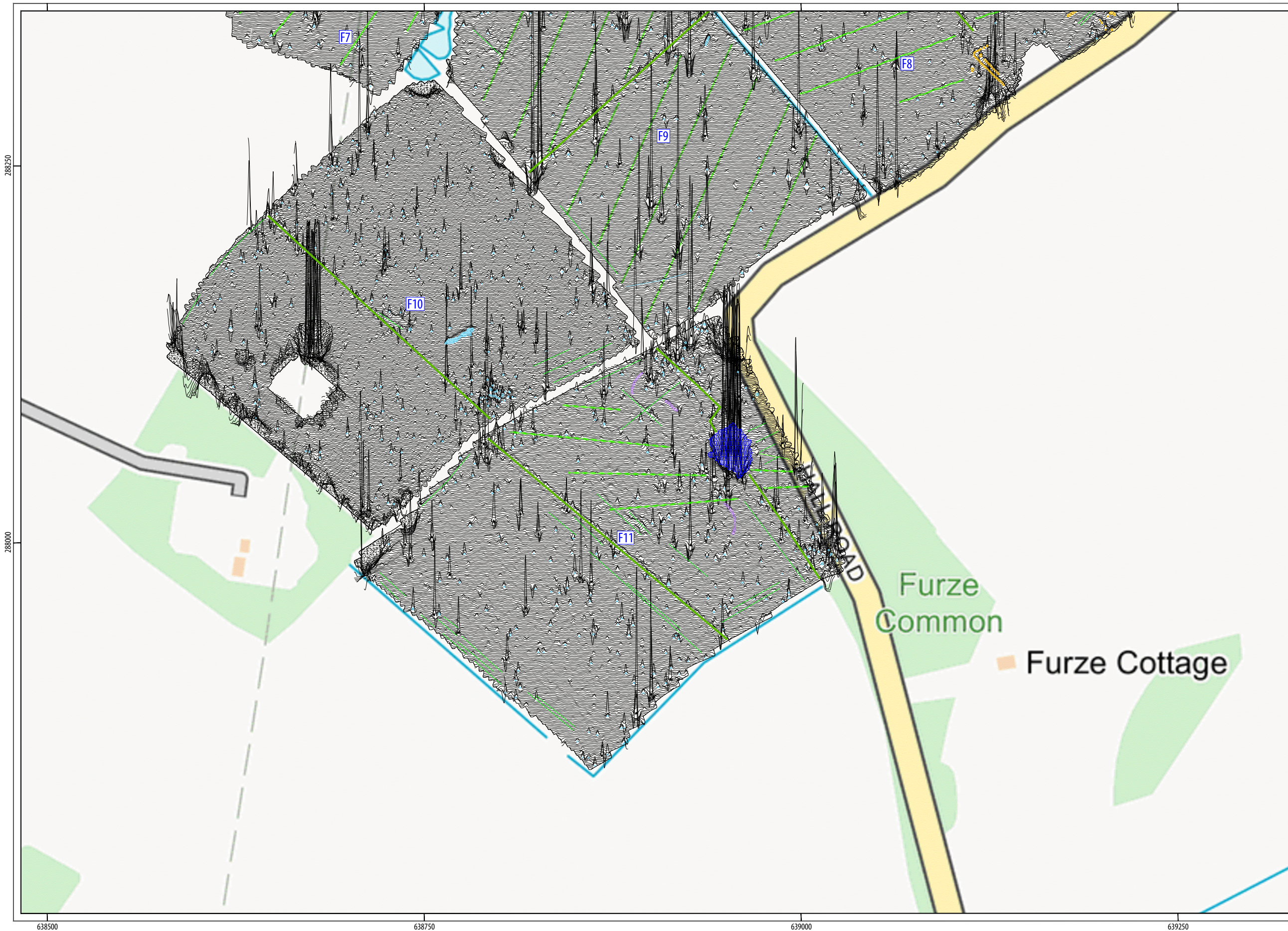
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ILLUS 24 Processed greyscale magnetometer data; Sector 6









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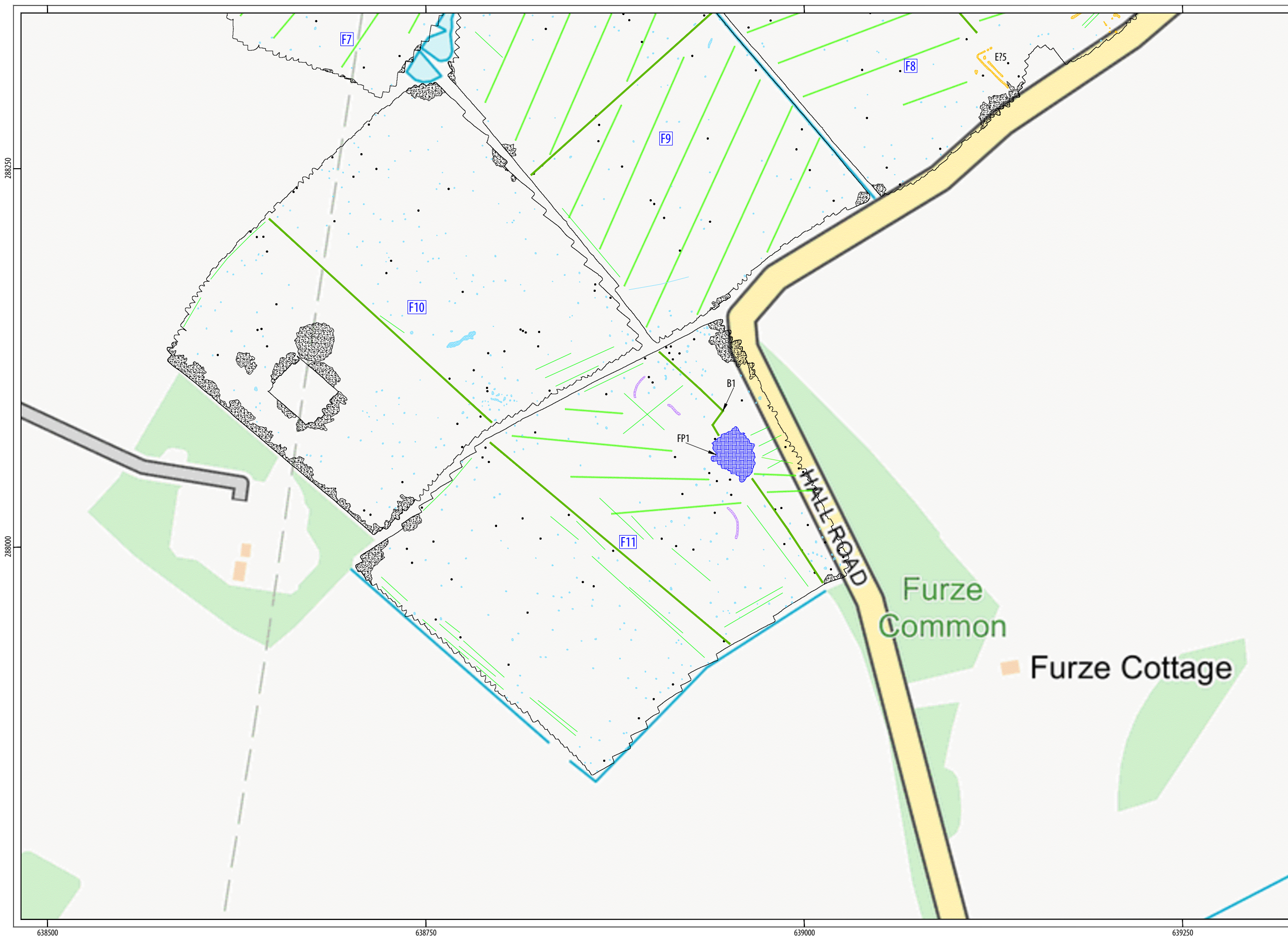
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ILLUS 25 XY trace plot of minimally processed magnetometer data; Sector 6



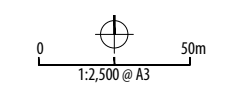






TYPE OF ANOMALY	INTERPRETATION
● dipolar isolated	ferrous material
● magnetic disturbance	ferrous material
■ magnetic enhancement	former pond
— linear trend	agricultural
— linear trend	field drain
— linear	former field boundary
— linear trend	geological variation
■ magnetic enhancement	geology
■ magnetic enhancement	archaeology?

ABBREVIATIONS  
 E? - enclosure?  
 FP - former pond  
 B - boundary



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ILLUS 26 Interpretation of magnetometer data; Sector 6







## 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 the topsoil, subsoil, and rock, 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 most 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 introduced into the topsoil during 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 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 current 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.

**Lineartrend** 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](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) 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 (UID): headland1-510044*

<b>Project Name:</b>	Geophysical Survey at Beccles Solar Farm
<b>Activity type:</b>	Geophysical Survey, Magnetometry Survey
<b>Project Identifier(s):</b>	BECC22
<b>Planning Id:</b>	[no data]
<b>Reason for Investigation:</b>	Planning requirement
<b>Organisation Responsible for work:</b>	Headland Archaeology (UK) Ltd
<b>Project Dates:</b>	7-Nov-2022 – 24-Nov-2022
<b>HER:</b>	Suffolk HER
<b>HER Identifiers:</b>	HER Event No – SMW 024
<b>Project Methodology:</b>	The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid 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 (Illus 6). These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R12 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 V3.0.37.0 (DWConsulting) software was used to process and present the data
<b>Project Results:</b>	Headland Archaeology (UK) Ltd was commissioned by Neo Environmental Ltd (the Client), to undertake a geophysical (magnetometer) survey of a site covering approximately 111 hectares, west of Beccles, Suffolk where a solar farm is being proposed. This geophysical survey report will be submitted as part of a planning application for the proposed Beccles Solar Photovoltaic (PV) array and associated infrastructure development. The results will also inform future archaeological strategy, if required. The survey has identified a range of anomalies consistent with modern activity and agricultural usage of the proposed development area (PDA) but also of uncertain and of possible archaeological origin against a largely homogenous magnetic background. Five small clusters of magnetically enhanced ditch and pit-like anomalies, possibly indicative of enclosures, are identified on the lower ground at the eastern peripheries of the two separate land parcels that comprise the PDA. Two of these clusters lie adjacent to a ditch and former trackway (Gull Lane) and a further two groupings lie close to areas of medieval common land. Very high magnitude anomalies indicative of localised burning, anomalies of uncertain origin and a possible area of localised extraction are also recorded. A group of linear trend anomalies and two areas of magnetic enhancement of uncertain origin identified at the northernmost part of the PDA may locate a former area of extraction. The survey has also recorded the location of several former boundaries and regular patterns of field drains. The sites of the demolished post-medieval Gull Farm and a former pond adjacent to Furze Common have also been identified; both these features are recorded on historic mapping. Based on the results of the survey the archaeological potential of the areas in and around the five locations where anomalies of possible archaeological origin are identified is assessed as moderate. The archaeological potential of most of the PDA is however regarded as low.
<b>Keywords:</b>	–
<b>Archive:</b>	–
<b>Reports in OASIS:</b>	Bishop, R. and Berry, M., (2022). Beccles Solar Farm, Suffolk – Geophysical Survey Report. Cleckheaton: Headland Archaeology (UK) Ltd.



## APPENDIX 6 WRITTEN SCHEME OF INVESTIGATION



**BECC22**



**Beccles Solar Farm, Suffolk  
(Suffolk Parish Codes xxx XXX)**

**Written Scheme of Investigation for Geophysical Survey**

**Client: Neo Environmental Ltd.**

**v.01**

**Headland Archaeology (UK) Ltd  
Units 23-25  
Acorn Business Centre  
Balme Road  
Cleckheaton  
BD19 4EZ**



## **1 INTRODUCTION**

- 1.1 This Written Scheme of Investigation (WSI) has been prepared by Headland Archaeology in advance of a geophysical (magnetometer) survey of a proposed Solar Photovoltaic (PV) array and associated infrastructure on land at Eccles, Suffolk.
- 1.2 The scheme of work will be undertaken in accordance with the requirements of the National Planning Policy Framework (MHCLG 2021).
- 1.3 The WSI is produced to the standards laid down in the European Archaeological Council's guideline publication EAC Guidelines for the Use of Geophysics in Archaeology (*Europae Archaeologia Consilium* 2016), the Chartered Institute for Archaeologists (CIfA) Standard and Guidance for Archaeological Geophysical Survey (CIfA 2014) and the Suffolk County Council's Requirements for a Geophysical Survey (SCC 2021).

## **2 DESCRIPTION OF THE SITE**

- 2.1 The Proposed Development Area (PDA) comprises of 2 irregularly shaped parcels of land, both being situated south of Shipmeadow, Suffolk and the B1062. The two parcels are separated by Clarks Lane and agricultural fields. The PDA, centred at TM 38058 88993 (West) and TM 38882 88410 (East), is bounded by agricultural land in all directions apart from the B1062 to the north and Hall Road to the east.
- 2.2 The PDA is located gentle slope which increases in height from the north at 14m Above Ordnance Datum (AOD) to 37m AOD in the south.
- 2.3 The bedrock geology is recorded as Crag Group – Sand, which is a sedimentary bedrock formed between 5.333 million and 11.8 thousand years ago during the Neogene and Quaternary periods. Superficial deposits across the PDA are recorded predominately as diamicton of the Lowestoft Formation, with bands of sand of the Happisburgh Glacigenic Formation in the north (UKRI 2021).
- 2.4 The soils are classified in the Soilscape 10 Association, these are classified Slowly permeable seasonally wet acid loamy and clayey soils in the south and Shallow lime-rich soils over chalk or limestone in the north (Cranfield University 2021).

## **3 ARCHAEOLOGICAL BACKGROUND**

- 3.1 The following is a summary of the baseline assessment for Cultural Heritage and Archaeology within an Environmental Impact Assessment Screening produced and provided by Neo Environmental (n.d.).
- 3.2 The survey area lies within a known medieval landscape, evidenced by the presence of three scheduled monuments within its vicinity. These are Mettingham Castle, c. 1.45km to the west, a motte and bailey castle known as 'The Mount' c. 450m to the west and a moated site located c. 1.15km to the north east. Other evidence of medieval activity is recorded in the form of Shipmeadow, Blacksmith and Furze Commons all within a 1km radius of the survey area. Other features recorded within the same 1km radius include findspots of post-medieval coins in addition to flakes and scrapers with a Neolithic origin.

## **4 OBJECTIVES**

- 4.1 The principal objectives of the programme of geophysical survey are to gather information to establish the presence/absence, character and extent of any archaeological remains within the PDA, and to inform any further investigation strategies.



4.2 The aims of the survey are:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore determine the likely presence/absence and extent of any buried archaeological features; and
- to produce a comprehensive site archive and report.

## **5 PROJECT TEAM**

5.1 The project will be managed for Headland Archaeology by Christian Adams (Project Manager). The field team will comprise of at least one Supervisor.

5.2 The project team will familiarise themselves with the background to the site and will be aware of the project's aims and methodologies.

5.3 Headland Archaeology (UK) Ltd is a Registered Archaeological Organisation and abides by the Codes of Conduct and Approved Practice and Standards of the Chartered Institute for Archaeologists. The company has all the necessary technical and personnel resources for the satisfactory completion of the survey.

## **6 INSURANCE & COPYRIGHT**

6.1 Headland Archaeology (UK) Ltd is fully indemnified and all necessary insurances can be presented on request.

6.2 Copyright will be retained by Headland Archaeology (UK) Ltd. Headland will licence the client and other bodies as necessary for use in matters relating to the project and for use of the project archive by the relevant museum. This licence will also extend to non-commercial use.

## **7 HEALTH & SAFETY**

7.1 All of Headland's work is undertaken in accordance with current H&S legislation. A risk assessment and method statement will be prepared prior to the commencement of fieldwork. All staff will wear appropriate PPE.

## **8 FIELDWORK METHODOLOGY**

8.1 A geophysical (magnetometer - gradiometer) survey will be carried out across all parts of the PDA which are amenable to magnetometer survey, an area of up to approximately 111ha

8.2 The actual areas of survey, and any features of possible archaeological, palaeoenvironmental and/or geoarchaeological interest, will be accurately located on a site plan and recorded in a written description sufficient to permit the preparation of a report on the site. During fieldwork a record will be made of surface and weather conditions and sources of modern geophysical interference that may have a bearing on subsequent interpretation of field data.

8.3 The survey will be undertaken using four Bartington Grad601 sensors mounted at 1m intervals (allowing for a 1m traverse interval) onto a rigid carrying frame. The system will be programmed to take readings at a frequency of 10Hz (allowing for a 10-15cm sample interval) on roaming traverses spaced 4m apart. These readings will be stored on an external weatherproof laptop and later downloaded for



processing and interpretation. MLGrad601 and MultiGrad601 (Geomar Software Inc.) software will be used to collect and export the data. Terrasurveyor V3.0.37.0 (DWConsulting) software will be used to process and present the data.

- 8.4 The magnetometer system will be linked to a Trimble R8s and R2 Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy of each data point.
- 8.5 At the start of each day the magnetometer will be left idle whilst switched on for approximately 30 minutes to allow the instrument to acclimatise to the site conditions. The instrument will thereafter be balanced when necessary and at least twice during the day.
- 8.6 The survey is expected to commence on October 31<sup>st</sup> 2022, and take three weeks to complete.

## **9 REPORTING AND ARCHIVE**

- 9.1 On completion of the survey, a report will be produced containing all relevant information including:
  - site code/project number; dates for fieldwork visits; grid references; location plan, and a plan showing the limits of the survey area;
  - The Suffolk Parish codes (xxx XXX)
  - OASIS Reference Number: headland1- 510044
  - a non-technical summary of the reason for, aims and main results of the survey;
  - an introduction to outline the circumstances leading to the commission of the project and any restrictions encountered;
  - the aims and objectives of the survey;
  - the methodology used;
  - a summary and synthesis of the archaeological results in relation to the methods used. This shall be supported by a survey location plans and plots of minimally processed (X-Y traceplot) and fully processed (greyscale) data at a minimum scale of 1:2500 with larger scale (1:1000) plots of all areas of clear archaeological potential. Each plan/plot will have a bar scale and accurately orientated north arrow; and
  - references to all primary and secondary sources consulted.
- 9.2 The interpretation of survey data will be undertaken by a competent archaeological geophysicist who is knowledgeable of the archaeological and geomorphological conditions prevailing on site. A clear distinction will be made between interpretation that is scientifically demonstrable, and interpretation based on informed speculation.
- 9.3 Results will be compared to all available sources (APs/cropmarks, historic mapping and the DBA), which will be discussed in the report.
- 9.4 All raster images will be supplied in greyscale GeoTIFF format with the interpretation data to be supplied in either georeferenced SHP or DXF format.



- 9.5 All figures will be reproduced from Ordnance Survey mapping with the permission of the controller of His Majesty's Stationery Office (© Crown copyright).
- 9.6 The project will be archived in-house in accordance with recent good practice guidelines ([http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics\\_3](http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3)). The data will be stored in an indexed archive and migrated to new formats when necessary.
- 9.7 A draft copy of report will be submitted to the Suffolk County Council Historic Environment Record for comment/review before final copies are issued. In addition to this one bound copy of the final report will be supplied to Suffolk County Council Historic Environment Record. Digital georeferenced Tiff and DXF files of the data will be supplied to the HER.
- 9.8 The effectiveness of the technique will be considered in relation to the local geology and soils.
- 9.9 Headland Archaeology will make their work accessible to the wider research community by submitting digital data and copies of the report online to OASIS (headland1-510044).
- 9.10 A copy of the OASIS summary sheet and WSI will be included as an appendix to the report.

## 10 MONITORING

- 10.1 A standard working day will involve driving to site, condition surveys of the survey area, survey area setting out and detailed geophysical survey. Data will be sent back to the office on a regular basis and progress reports provided to the client.

### Key Contacts

Christian Adams, Project Manager	07392 870524
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## 11 BIBLIOGRAPHY

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