HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

# Wylfa Newydd Project

## 6.6.33 ES Volume F - Park and Ride App F11-2 - Land at Dalar Hir, Near Junction 4 of the A55, Geophysical Survey

PINS Reference Number: EN010007

Application Reference Number: 6.6.33

June 2018

Revision 1.0

Regulation Number: 5(2)(a)

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-JAC-PAC-APP-00189

[This page is intentionally blank]

WNAD/01
FINAL

# WYLFA NEWYDD ASSOCIATED DEVELOPMENT AND OFF-SITE POWER STATION FACILITIES, ANGLESEY

# LAND AT DALAR HIR, NEAR JUNCTION 4 OF THE A55

*Geophysical Survey*

*for JACOBS (UK) LTD ON BEHALF OF HORIZON NUCLEAR POWER LTD (HORIZON)*

*July 2016*

HEADLAND ARCHAEOLOGY

HORIZON NUCLEAR POWER

FINAL REPORT

# LAND AT DALAR HIR, NEAR JUNCTION 4 OF THE A55

*Geophysical Survey*

*for HORIZON NUCLEAR POWER LTD (HORIZON)*

*July 2016*

| | |
|---|---|
| HA Job no.: | WNAD/01 |
| NGR: | 232750, 378400 |
| Parish: | |
| Council: | Isle of Anglesey |

| | |
|---|---|
| Project Manager: | Sam Harrison BSc MSc MCIfA |
| Author: | Alistair Webb BA MCIfA |
| | David Harrison BSc, MA, MCIfA |
| Fieldwork: | Alex Schmidt BA |
| | Joe Turner BA MA |
| Graphics: | Sam Harrison |
| | Caroline Norrman |
| Approved by: | Alistair Webb BA MCIfA |

FINAL REPORT
CONTENTS

LIST OF ILLUSTRATIONS

# LAND AT DALAR HIR, NEAR JUNCTION 4 OF THE A55

# GEOPHYSICAL SURVEY

*The work was undertaken at the request of Jacobs (UK) Ltd on behalf of Horizon Nuclear Power Ltd (Horizon) in order to assess the impact of the proposed development on any potential sub-surface archaeological remains. This report presents the results and interpretation of the magnetic survey data. The overwhelming majority of anomalies are due to variation in the soils and the near surface outcropping of solid geology. Linear trend anomalies are indicative of ploughing. Other linear anomalies may be caused by earlier field boundaries. Several anomalies which cannot be confidently interpreted as of either geological, agricultural or modern origin have been interpreted as being of possible archaeological origin. These include discrete anomalies adjacent to a water course which may indicate burnt mounds. There is no indication from any other source to suggest that the magnetic data provides anything other than an accurate representation of the sub-surface conditions.*

## 1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Jacobs (UK) Ltd on behalf of Horizon Nuclear Power Ltd (Horizon) to undertake a geophysical survey of ten fields at Land at Dalar Hir where it is proposed to construct a park and ride facility for use by construction workers during the construction of the Wylfa Newydd Generating Station.

The survey was undertaken in accordance with a Written Scheme of Investigation (WSI) (Horizon 2016) submitted to and approved by Gwynedd Archaeological Planning Services (GAPS). Guidance contained within Planning Policy Wales (Edition 8, January 2016), Ch.6 Conserving the Historic Environment and within Welsh Office Circular 60/96 Planning and the Historic Environment: Archaeology was also followed. Current best practice was adhered to throughout (David et al. 2008). The survey was carried out between April 27th and April 28th and on May 17th 2016.

This report presents the results of the survey together with interpretations of the anomalies that have been identified.

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

The geophysical survey area comprises ten fields with a combined area of approximately 14 hectares, to the east and west of the former farmstead at Dalar Hir, near Junction 4 of the A55. The site is centred on NGR 232750, 378400 (Illus 1) and is bound to the south by the A55/A5 interchange and to the west by a minor road to Bodedern.

All fields were under permanent/rough pasture at the time of survey (Illus 2 to Illus 6 inclusive). An area of hard standing and dumping immediately east of the farmstead was unsuitable for survey (Illus 7 and Illus 8). A tree screen around the southern perimeter of the site also prohibited survey (Illus 8).

Topographically, the site is relatively flat varying between 17m and 19m above Ordnance Datum (aOD); the farmstead is at the highest point of the site.

### 1.2 GEOLOGY AND SOILS

The underlying bedrock across the whole of the survey area comprises metamorphic rocks (mica schist and psammite) of the New Harbour Group. The solid geology is overlain by Devensian till (diamicton - undifferentiated glacial outwash sands and gravels) across the whole site with the exception of a small part of Filed B5 where there are no recorded superficial deposits (British Geological Survey 2016).

The soils are classified in the Soilscape 17 association, characterised as slowly permeable, seasonally wet loams and clays (LandIS 2016).

## 2 ARCHAEOLOGICAL BACKGROUND

An Archaeological Baseline Assessment (Gwynedd Archaeological Trust, 2013) concluded that the site comprises semi-improved fields and relict field boundaries around the 19th century farmstead of Dalar Hir. Seven archaeological assets identified within the site, the locations of which are shown in Illus 1, include a boundary wall associated with Telford's A5 (Asset 1), a post-medieval boundary (Asset 2), the site of Dalar Hir Farmstead (Asset 6) and the findspot of a Bronze Age axe head (Asset 7). The remaining three assets (Assets 3, 4 and 5) of unknown origin identified during a walkover survey may be indicative of natural outcropping, post-medieval field clearance or possibly earlier activity.

## 3 AIMS, METHODOLOGY AND PRESENTATION

The main aim of the geophysical survey was to provide sufficient information on any potential sub-surface archaeological remains to inform the requirement for, and design of, any potential further archaeological investigations.

The general aims of the archaeological geophysical survey were:

- to identify (as far as possible) the presence or absence of buried archaeological remains in the survey areas;
- to clarify the extent and layout of known sites of archaeological interest within or adjacent to the survey areas;
- to clarify the extent and layout of previously unknown remains within the survey area; and
- to interpret any geophysical anomalies identified by the surveys.

### 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).

Bartington Grad601 magnetic gradiometers were used during the geophysical survey. As specified in the WSI (Horizon 2016) these were set to take readings at 0.25m intervals on zig-zag traverses 1m apart within a series of 30m by 30m grids. This resulted in 3600 readings per 30m grid square. When in operation, data was stored in the memory of the instrument before being downloaded to a separate computer every day in preparation for data processing and interpretation. Data processing was later undertaken using Geoplot 3 (Geoscan Research) software.

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble GeoXR model) with accuracy greater than 0.01m.

### 3.2 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:6,000. Illus 2 to Illus 7 are time stamped photographs showing ground conditions at the time of the survey. Illus 8 is a 1:3000 survey location plan displaying the processed greyscale magnetometer data and Illus 9 shows an overall interpretation at the same scale. Detailed data plots ('raw' and processed) and interpretative illustrations are presented at a scale of 1:1000 in Illus 10 to Illus 18 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.

The survey methodology, report and any recommendations comply with the WSI (Horizon 2016) and guidelines outlined by English Heritage (David et al. 2008) and by the Chartered Institute for Archaeologists (ClfA 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

Generally, the magnetic background is fairly homogenous resulting in a generally uniform grey tone to the data plots. However, there are frequent low and medium magnitude discrete and broader anomalies that are due to the presence of near-surface geology and variation within the superficial deposits and upper soil horizons. Against this background other non-geological anomalies have been identified and cross-referenced to specific examples depicted on the interpretative illustrations, where appropriate.

### 4.1 FERROUS/MODERN ANOMALIES

Ferrous anomalies, characterised as individual 'spikes', have been identified across the survey area. These 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.

A linear dipolar anomaly, (Illus 9 and Illus 12 - A) in Field B1 and Field B3 is caused by a sub-surface pipe.

A rectangular block of high magnitude responses, (Illus 9 and Illus 12 – B) immediately east of the farmstead and adjacent to the area which was unsuitable for survey (Illus 8 and Illus 9) is indicative of modern ferrous contamination.

High magnitude discrete anomalies C and D (Illus 9 and Illus 18) in Field B10 are caused by the proximity of cattle feeders.

Magnetic disturbance around the perimeter of several of the fields (particularly Field B3 and Field B5 – Illus 9 and Illus 12) is caused by the magnetic response from the post and wire fencing and/or other ferrous material within, or forming part of, the field boundaries.

### 4.2 AGRICULTURAL ANOMALIES

Parallel linear trends in the data, such as in Field B5 (Illus 9 and Illus 15), Field B9 (Illus 9, Illus 15 and Illus 18) and Field B10 (Illus 9 and Illus 18) are interpreted as being of agricultural origin. The linearity and regularity of these anomalies is indicative of modern ploughing rather than by ridge and furrow cultivation and suggests a period of arable cultivation. Alternatively some may be caused by field drains. It is not considered likely that these anomalies caused by ploughing could 'mask' the response from an archaeological feature, if present, due to the low magnitude of the ploughing responses.

In Field B10 anomaly E (Illus 9 and Illus 18) appears to continue the alignment of the semi-relict boundary which partially splits Field B10 into two parts (Illus 18). For this reason this E is considered likely to locate a former boundary.

Other low magnitude and ephemeral linear trend anomalies identified throughout the site are considered likely to be also of agricultural origin.

### 4.3 GEOLOGICAL ANOMALIES

As noted above although the magnetic background is generally uniform, resulting in a generally grey tone to the data plots, there are numerous discrete and broader low magnitude anomalies throughout the site. These anomalies are due to variations in the composition of the soils and superficial till deposits from which they derive. The most extensive of these anomalies, F (Illus 9 and Illus 15) in the south-eastern corner of Field B5, corresponds with a small area where no superficial deposits are recorded. This clearly demonstrates the effects of the solid geology on the data when there is no layer of superficial deposits to mask the response from the parent bedrock.

### 4.4 POSSIBLE ARCHAEOLOGICAL ANOMALIES

No anomalies of obvious archaeological potential have been identified by the geophysical survey. However, several anomalies cannot be confidently ascribed a modern, agricultural or geological origin and have therefore been identified as possible archaeological anomalies.

The first of these, linear anomaly G, which extends 25m south-westwards from the northern boundary of Field B4 (Illus 9 and Illus 15), is of a higher magnitude than most of the ploughing anomalies and also aligned at an oblique angle to the current field boundaries. This anomaly may be indicative of an infilled ditch of archaeological potential. However, there are no other identified anomalies of archaeological potential in the vicinity.

Three discrete clusters of anomalies, H (Illus 9 and Illus 18), have been identified along the eastern edge of Field B8. The location of these anomalies adjacent to a watercourse suggest they may be caused by burnt mounds.

A discrete anomaly, I (Illus 9 and 15), in Field B7 has also been interpreted as of possible archaeological potential. The anomaly describes a regular rectangular shape, unlike the possible burnt mound anomalies, and is also aligned parallel with the current field boundaries. For these reasons the anomaly may be caused by a small in situ burned structure.

Anomaly J and K are located close to the southern boundary of Field B10 (Illus 9 and Illus 18) and both describe broadly sub-circular shapes. They do not have the same profile or characteristics of any of the geological anomalies and therefore have been identified as possible archaeological anomalies.

A small cluster of anomalies, L, located close to the western edge of Field B10 and adjacent to the stream (Illus 9 and Illus 18), comprise two parallel linear anomalies aligned north/south with a sub-circular component at the northern end. No obvious non-archaeological source has been identified and therefore these anomalies may be of archaeological origin.

Similarly a small cluster of anomalous responses, M, (Illus 9 and Illus 18) located in Field B5 cannot be

ascribed to a modern, agricultural or geological origin and have been identified as possible archaeological anomalies.

## 5 CONCLUSION

Although no anomalies of definite archaeological origin have been identified by the geophysical survey several anomalies that cannot be readily interpreted as being of modern, agricultural or geological origin have been identified. These anomalies have therefore been interpreted to be possible archaeological anomalies.

There is no indication from any other source to suggest the magnetic data provides anything other than an accurate representation of the sub-surface conditions.

## 6 REFERENCES

British Geological Survey, 2016. www.bgs.ac.uk/discoveringGeology/geology OfBritain/viewer.html. (Viewed May 23rd 2016)

Chartered Institute for Archaeologists 2014 *Standard and Guidance for archaeological geophysical survey.* CIfA

David, A, Linford, N, Linford. P and Martin, L, 2008. Geophysical *Survey in Archaeological Field Evaluation: Research and Professional Services Guidelines (2nd edition)* English Heritage

Department of Communities and Local Government, 2012. *National Planning Policy Framework*. Department of Communities and Local Government

Horizon, 2016. *Wylfa Newydd Associated Development and Off-Site Power Station Facilities: Written Scheme of Investigation for Archaeological Geophysical Survey of Land at Madyn Farm, Amlwch* Horizon unpublished document DCRM Ref. No. WN034-JAC-PAC-REP-00035

Gaffney, C and Gater, J 2003. *Revealing the Buried Past* Tempus Publishing

LandIS, 2016. www.landis.org.uk/soilscapes/ (Viewed May 23rd 2016)

# 7 APPENDIX 1

## 7.1 MAGNETIC SUSCEPTIBILITY AND SOIL MAGNETISM

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms 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.

## 7.2 TYPES OF MAGNETIC ANOMALY

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

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

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

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

*Isolated dipolar anomalies (iron spikes)*

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

*Areas of magnetic disturbance*

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

*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.

# 8 APPENDIX 2

## 8.1 SURVEY LOCATION INFORMATION

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble GeoXR model). The accuracy of this equipment is better than 0.01m. The survey grids were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if 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.*

# 9 APPENDIX 3

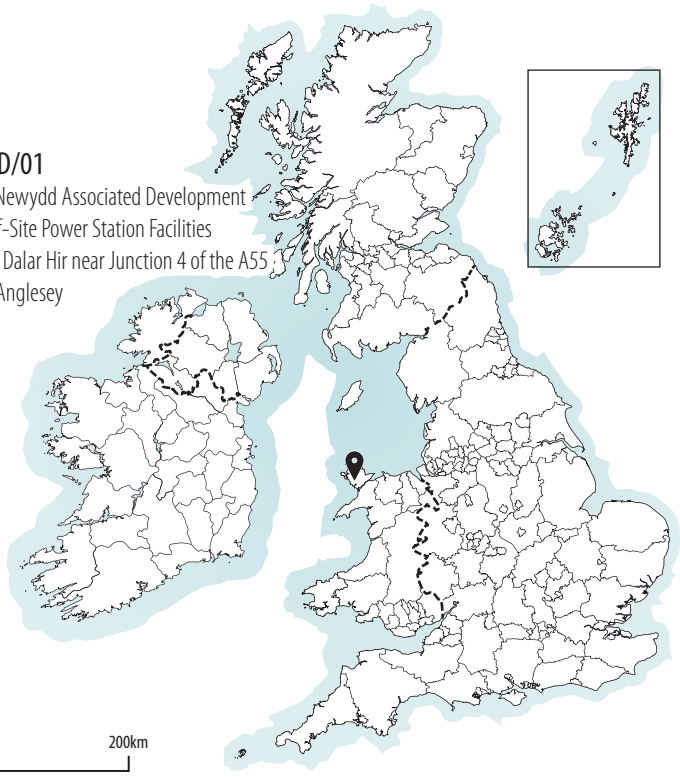
## 9.1 GEOPHYSICAL SURVEY ARCHIVE

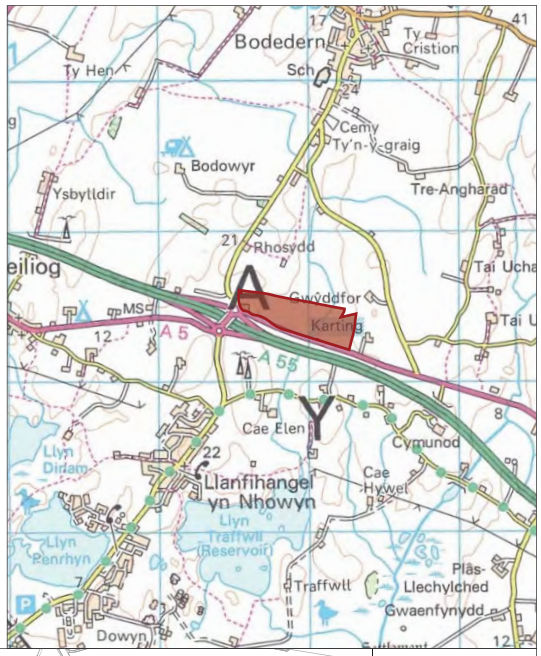
The geophysical archive comprises:-

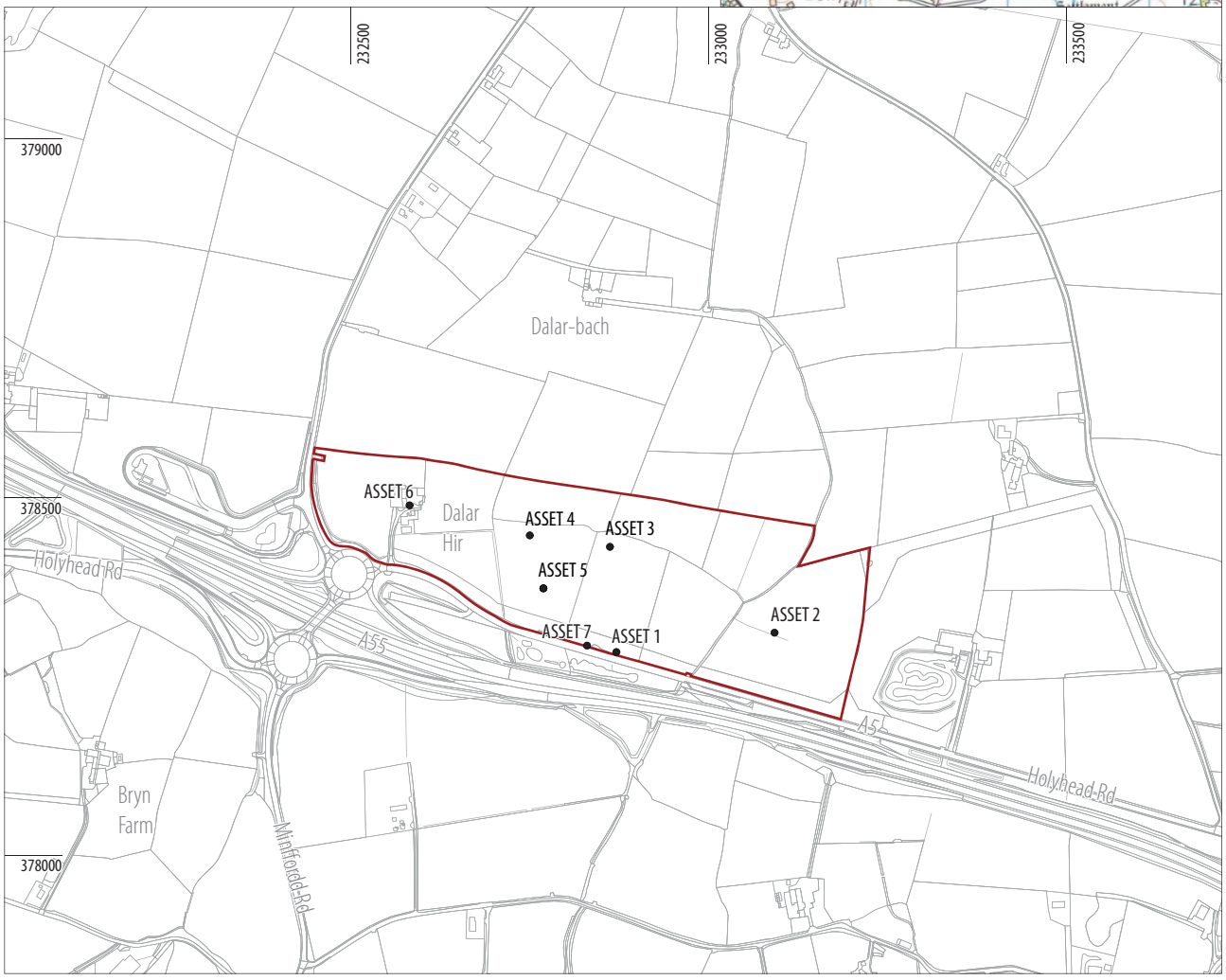
- an archive disk containing the raw data in XYZ format, a raster image of each greyscale plot with associate world file, and a PDF of the report

The digital archive will be submitted to The National Monuments Record of Wales (NMRW) in accordance with the RCAHMS Guidelines for Archiving of Archaeological Projects (V13, 2013). The project will also 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.

**WNAD/01**
Wylfa Newydd Associated Development
and Off-Site Power Station Facilities
land at Dalar Hir near Junction 4 of the A55
Isle of Anglesey




KEY
- proposed development area
- Cultural Heritage Asset

N
0 500m
1:10,000 @ A4



HEADLAND ARCHAEOLOGY
NORTH
Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

**ILLUS 1** Site location

Illus 2. General view of Field B1, looking south-west

Illus 3. General view of Field B5, looking south-east

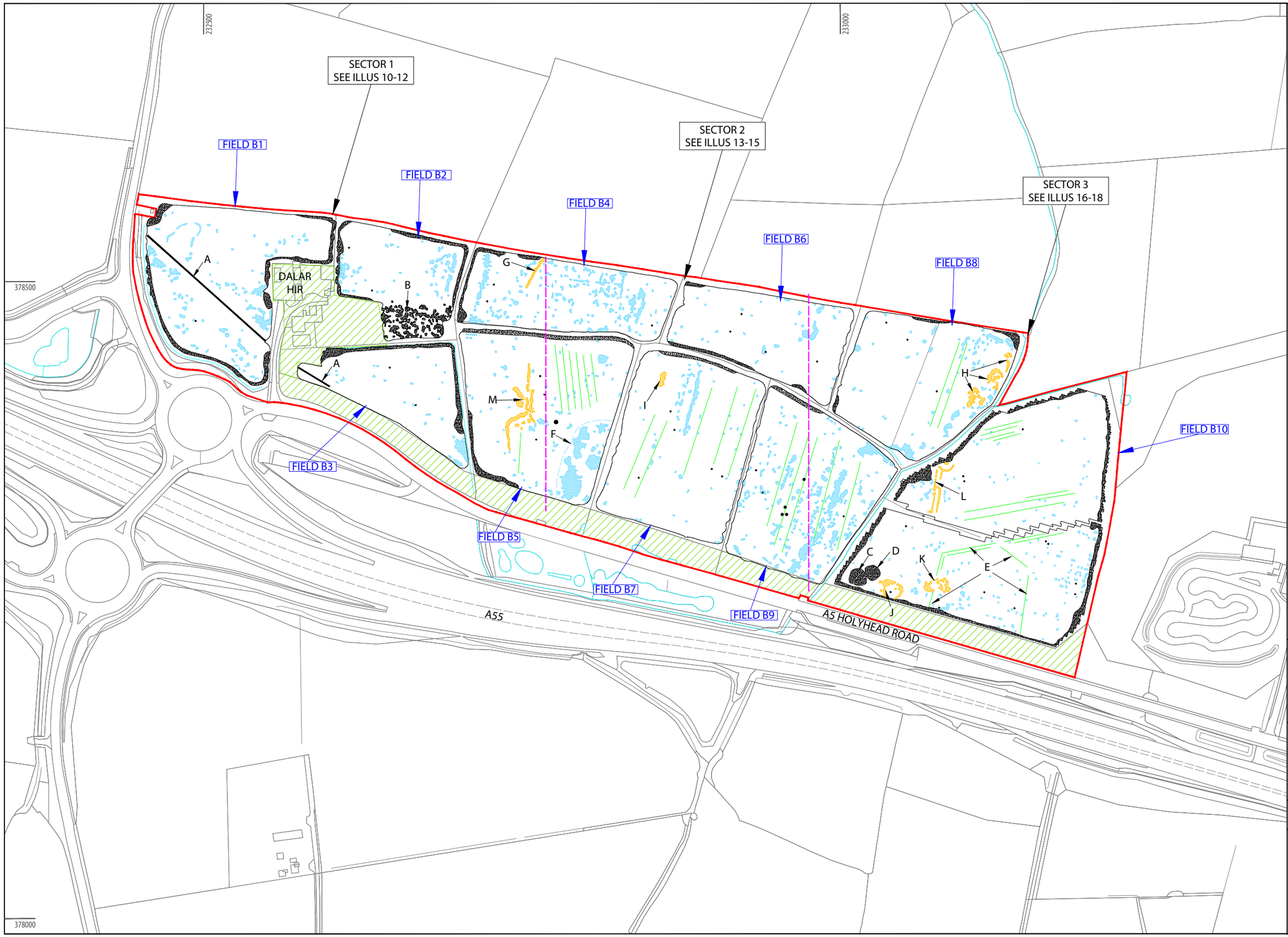
Illus 4. General view of Field B6, looking east

Illus 5. General view of Field B7, looking north

Illus 6. General view of Field B10, looking north-east

Illus 7. General view of area unsuitable for survey in Field B2, looking south-east


Illus 8
Survey location showing greyscale magnetometer data




Proposed development area
Sector boundary
Not suitable for geophysical survey
Watercourse

| TYPE OF ANOMALY | INTERPRETATION |
|---|---|
| Dipolar Isolated | Ferrous Material |
| Magnetic Disturbance | Ferrous Material |
| Dipolar Linear | Service Pipe |
| Linear Trend | Agricultural |
| Magnetic Enhancement | Geology |
| Magnetic Enhancement | Archaeology? |

N
0 50m
scale 1:3,000 @ A3

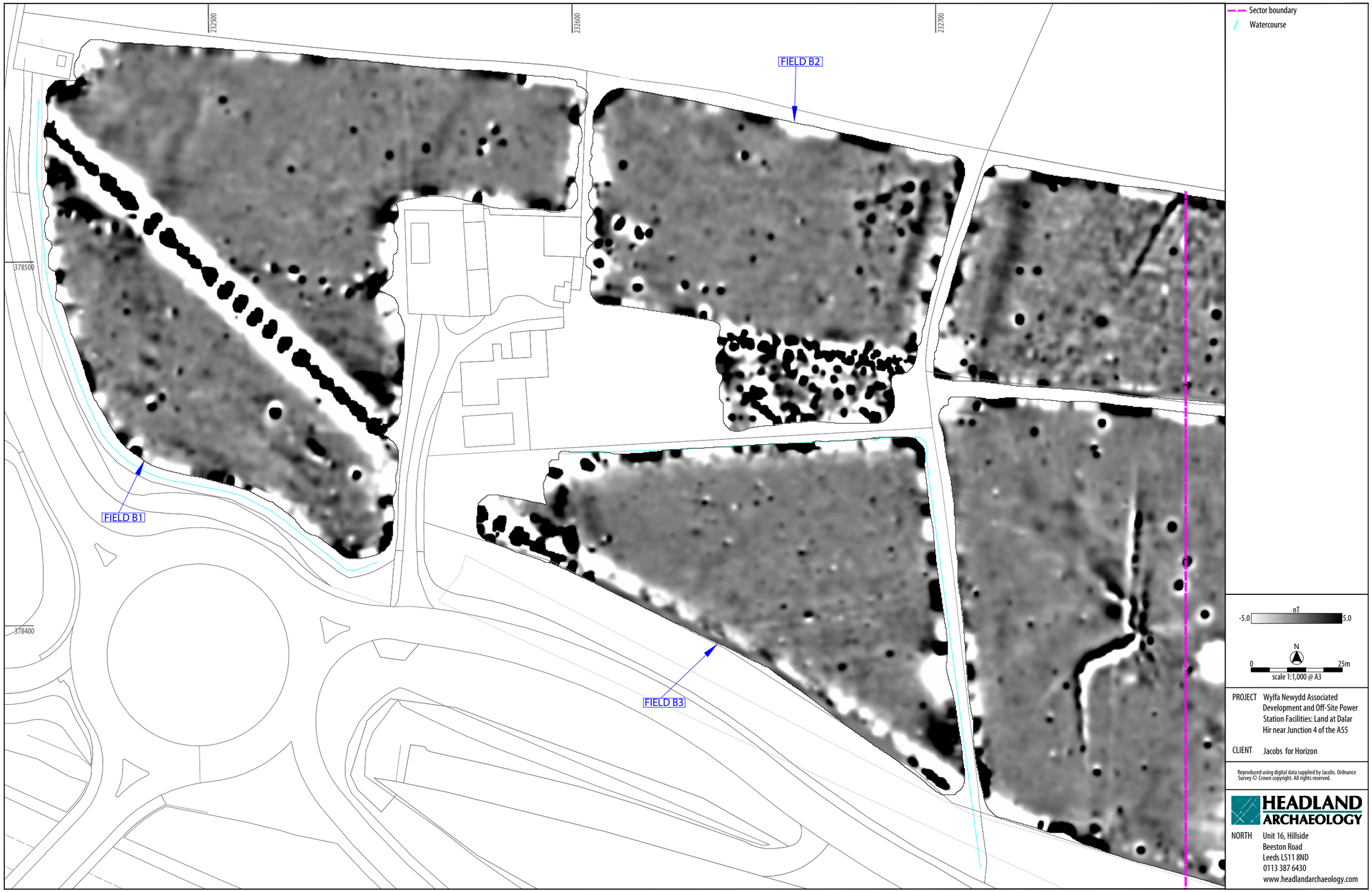
PROJECT Wylfa Newydd Associated Development and Off-Site Power Station Facilities: Land at Dalar Hir near Junction 4 of the A55

CLIENT Jacobs for Horizon



HEADLAND ARCHAEOLOGY
NORTH Unit 16, Hillside
Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

Illus 9
Overall interpretation of magnetometer data



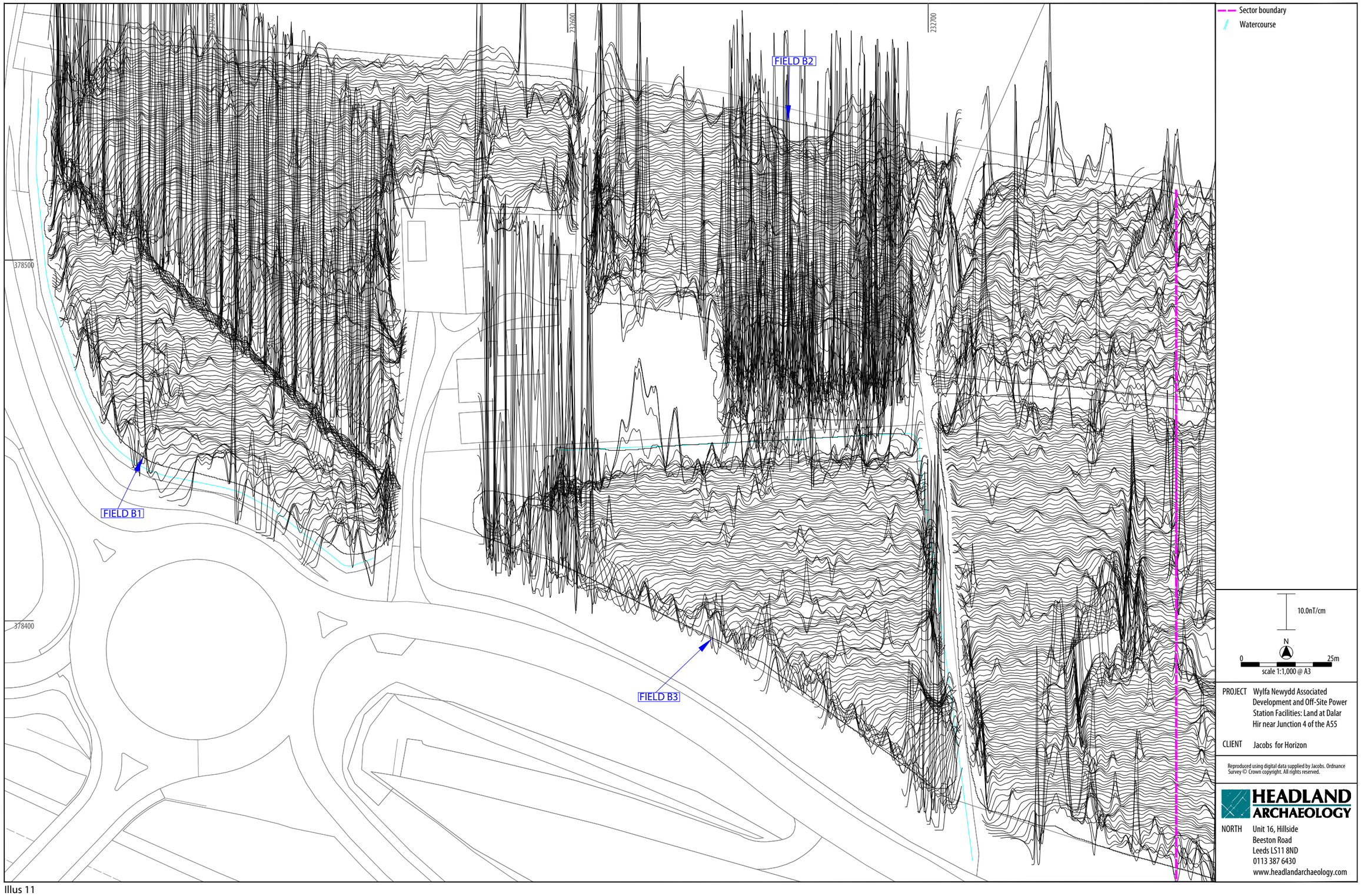

PROJECT Wylfa Newydd Associated Development and Off-Site Power Station Facilities: Land at Dalar Hir near Junction 4 of the A55

CLIENT Jacobs for Horizon

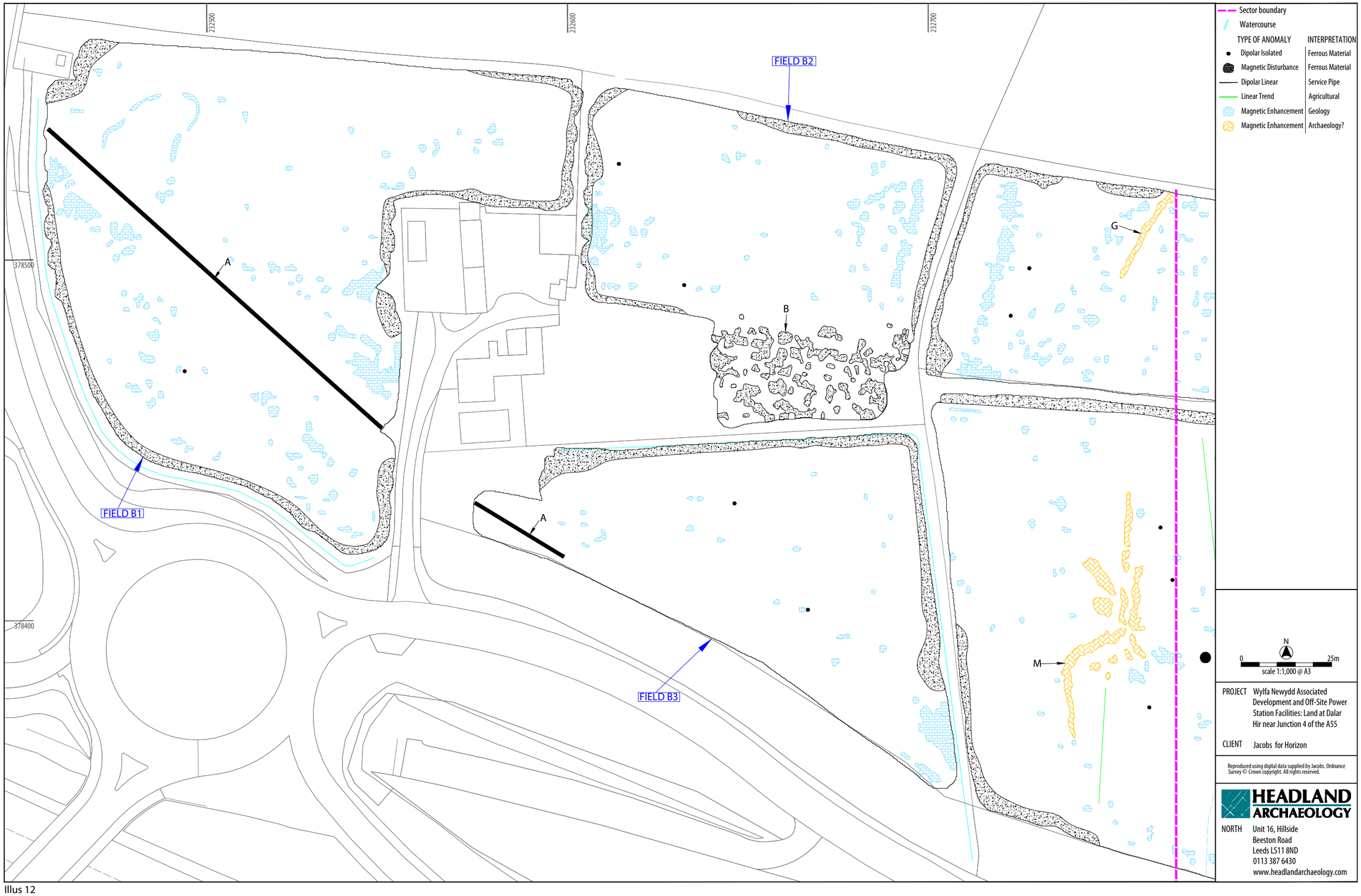


HEADLAND ARCHAEOLOGY
NORTH Unit 16, Hillside
Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

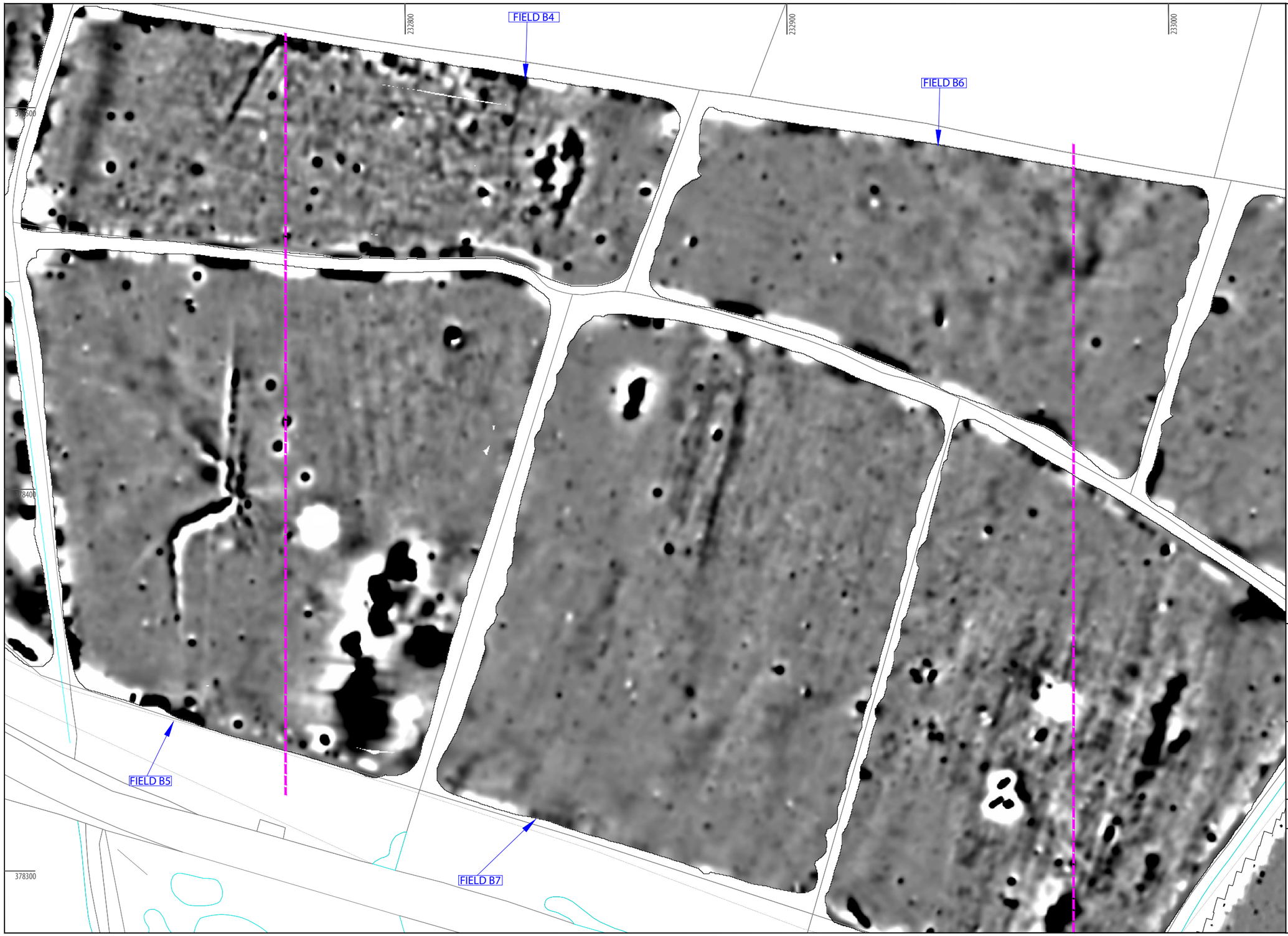
Illus 10
Processed greyscale magnetometer data; Sector 1




Illus 11
XY trace plot of magnetometer data; Sector 1




Illus 12
Interpretation of magnetometer data; Sector 1



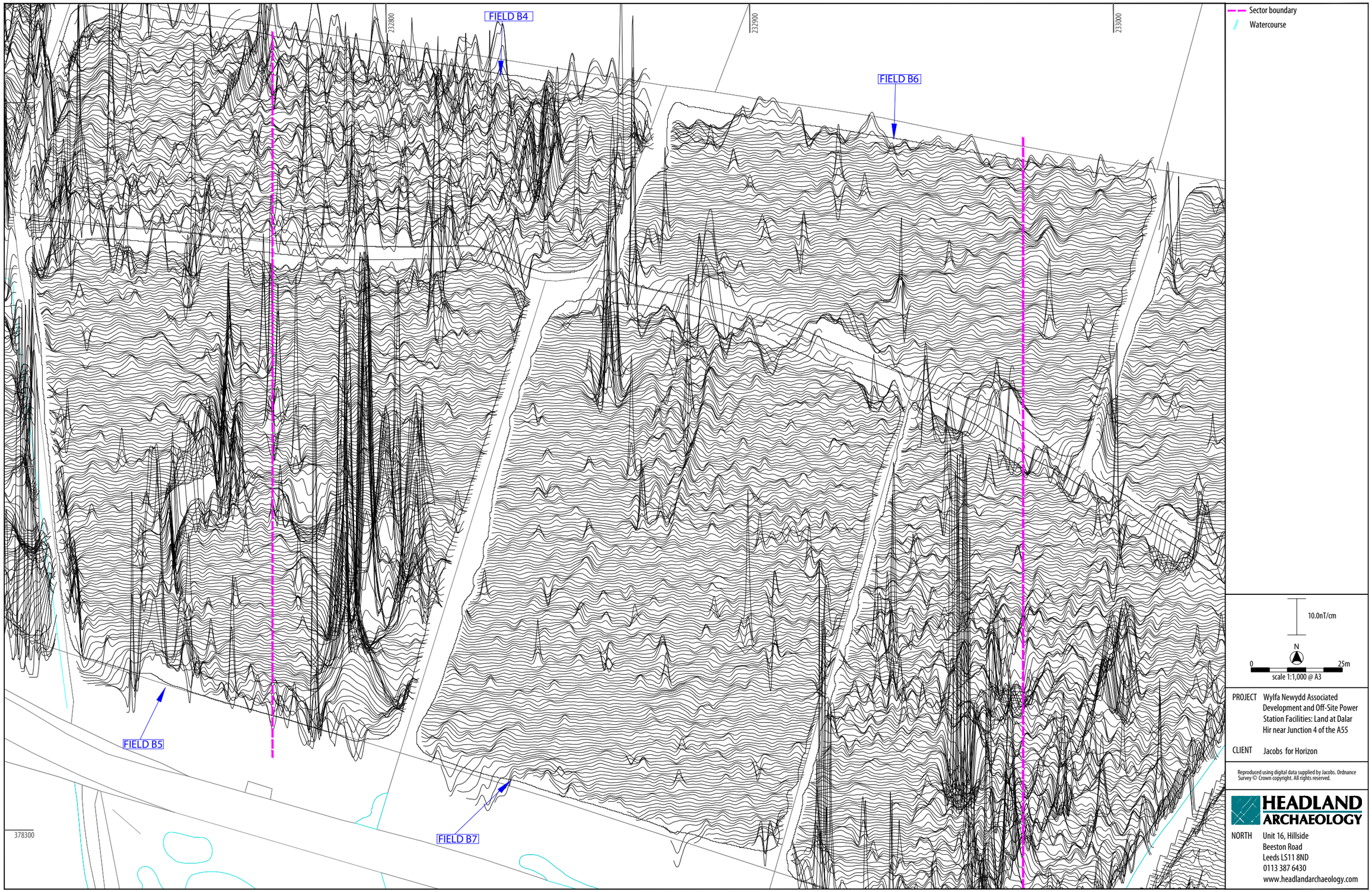

PROJECT Wylfa Newydd Associated Development and Off-Site Power Station Facilities: Land at Dalar Hir near Junction 4 of the A55

CLIENT Jacobs for Horizon

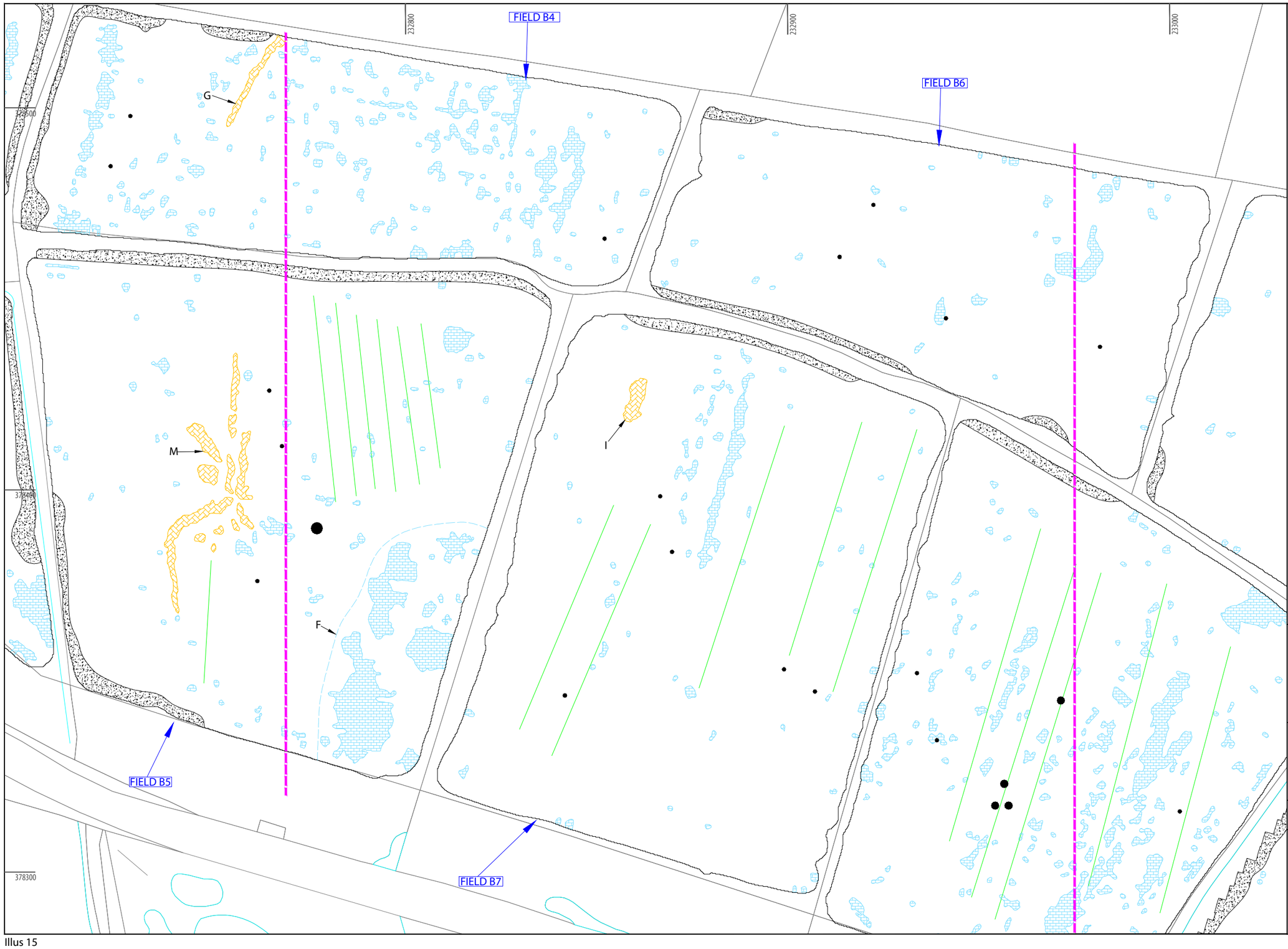


HEADLAND ARCHAEOLOGY
NORTH Unit 16, Hillside
Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

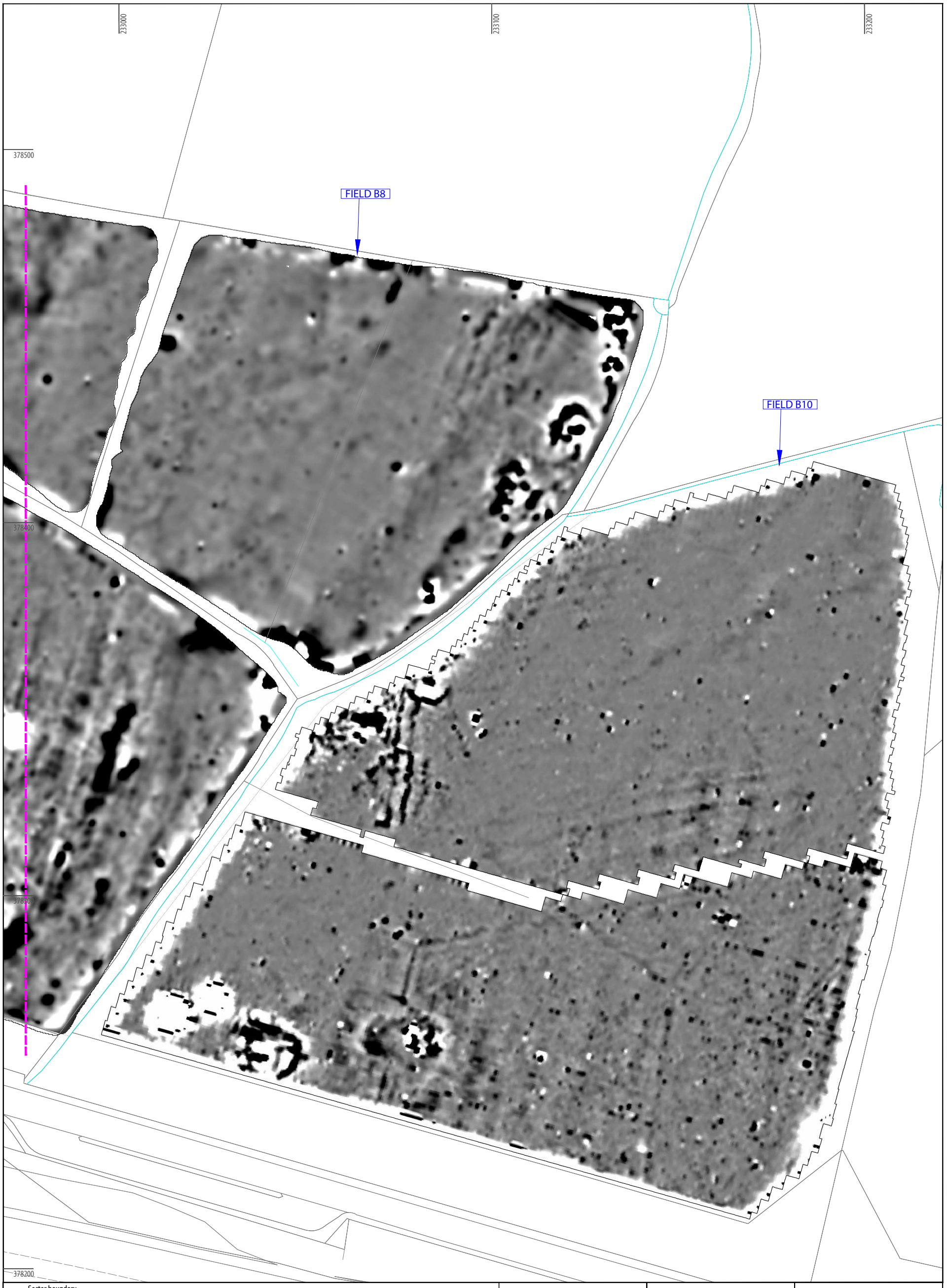
Illus 13
Processed greyscale magnetometer data; Sector 2



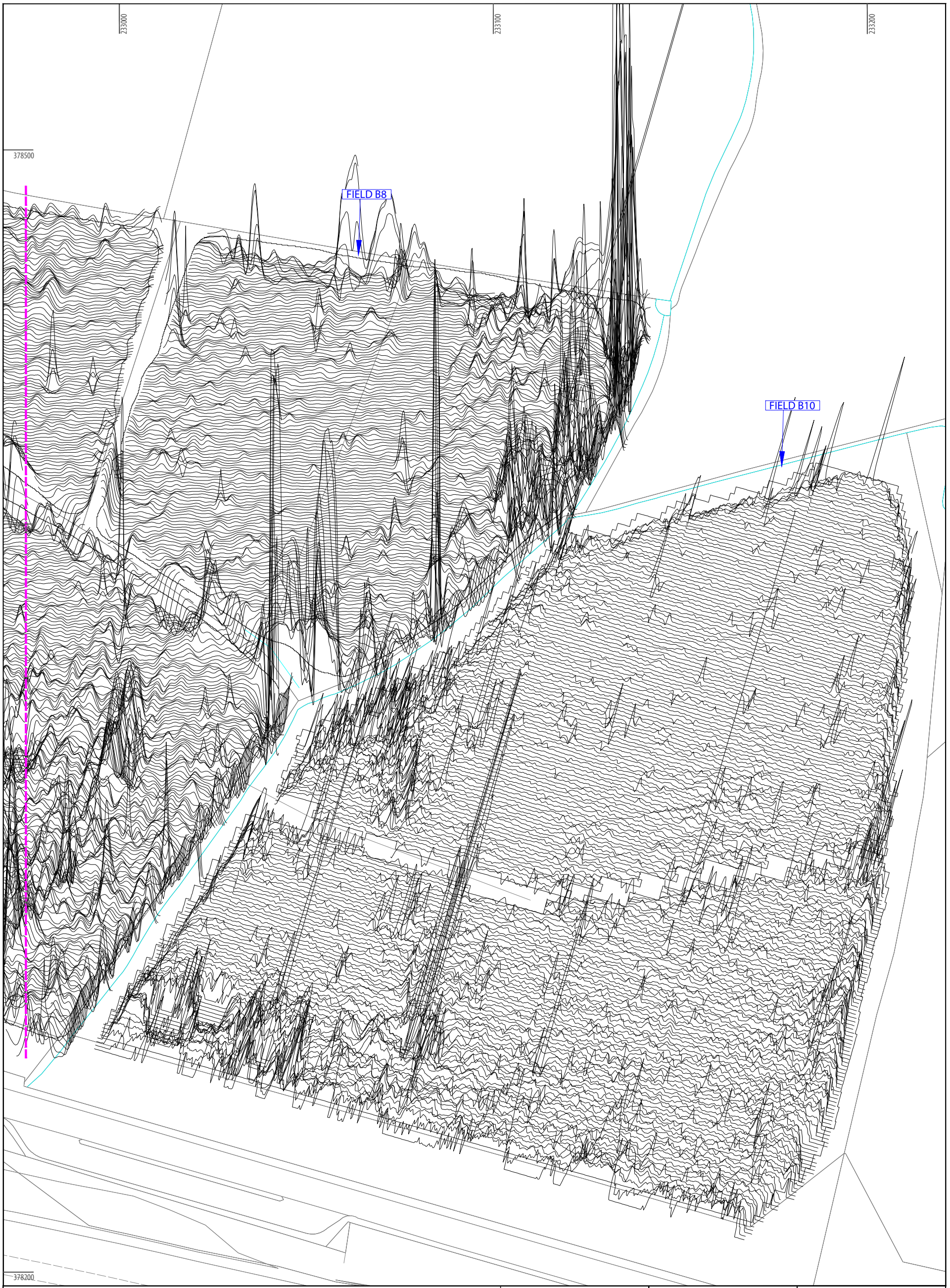

Illus 14
XY trace plot of magnetometer data; Sector 2



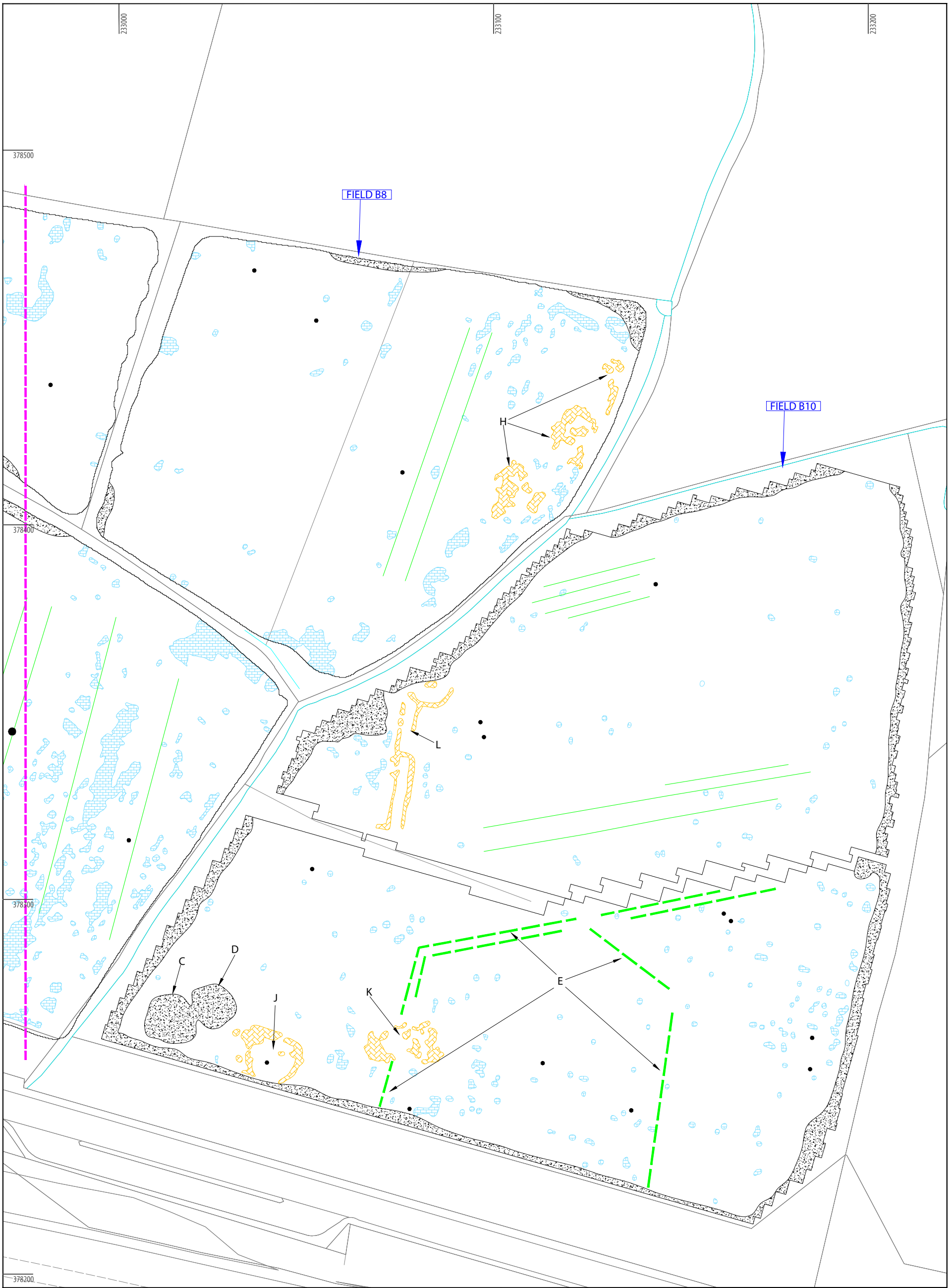

Illus 15
Interpretation of magnetometer data; Sector 2




Illus 16
Processed greyscale magnetometer data; Sector 3




Illus 17
XY trace plot of magnetometer data; Sector 3




Illus 18
Interpretation of magnetometer data; Sector 3