RIPC/01

ROSSINGTON INLAND PORT 33KV CABLE ROUTE, ROSSINGTON, SOUTH YORKSHIRE

GEOPHYSICAL SURVEY

commissioned by CgMs Consulting

December 2016

HEADLAND ARCHAEOLOGY

REGISTERED ORGANISATION CIfA

ROSSINGTON INLAND PORT 33KV CABLE ROUTE, ROSSINGTON, SOUTH YORKSHIRE

GEOPHYSICAL SURVEY

commissioned by CgMs Consulting

December 2016

project info

HA JOB NO.	RIPC/01
NGR	SK 5920 9970
PARISH	Rossington
LOCAL AUTHORITY	Doncaster
OASIS REF.	headland5-271224

project team

PROJECT MANAGER	Sam Harrison
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APPROVED BY	Sam Harrison – Project Manager

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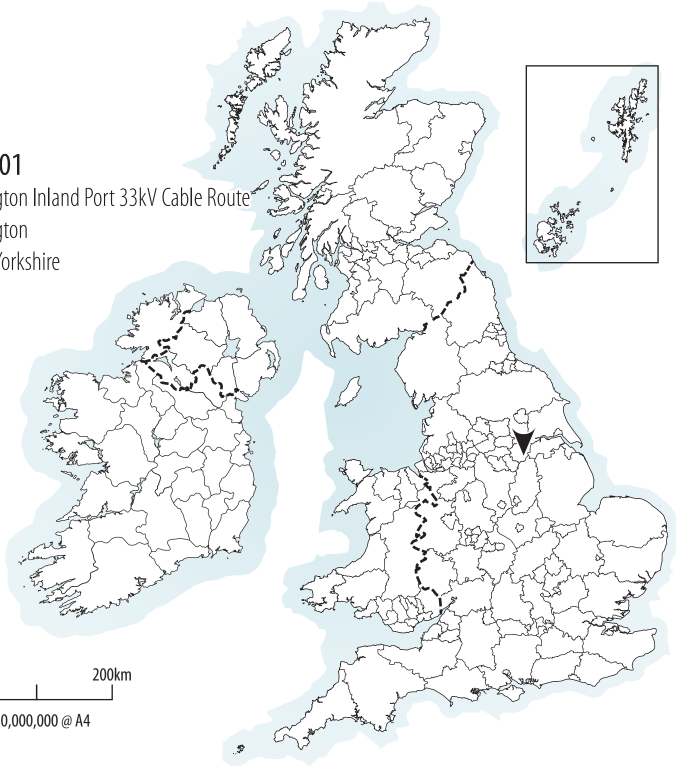
PROJECT SUMMARY

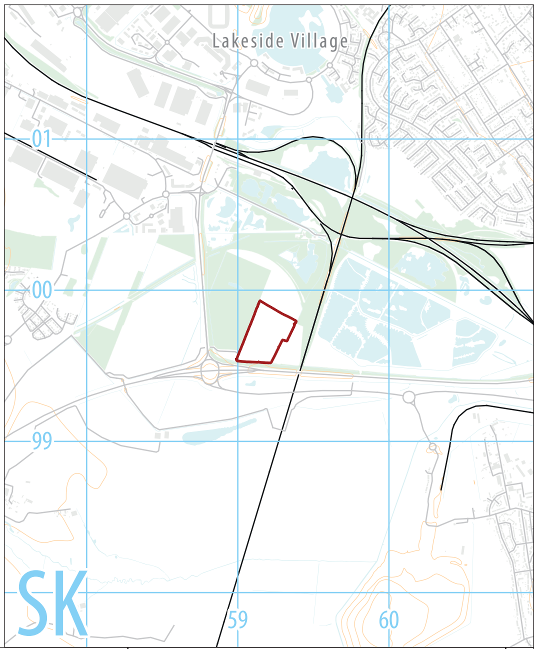
Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey, covering approximately 8 hectares, at Loversall Carr, near Rossington, in order to provide further information on the archaeological potential of the geophysical survey area prior to finalising the route of a 33KV cable which will connect Rossington Inland Port with the National Grid. The survey has corroborated and enhanced the cropmark data confirming the location and extent of a large sub-rectangular double-ditched enclosure with smaller attached enclosures to the south-eastern side. Circular anomalies within the enclosure are interpreted as ring ditches indicative of roundhouses. Discrete anomalies are also suggestive of settlement activity. A previous geophysical survey of land immediately north of the current area (across which the cable route is also proposed to pass) did not identify any anomalies of archaeological potential. The proposed cable route only impacts on the known archaeological resource (as indicated by the cropmark and survey data) at a single location on the eastern site boundary where it crosses an outlying ditch feature. Therefore, on the available evidence, the impact of the proposed cable route on the archaeological resource is assessed as very low.

CONTENTS

LIST OF ILLUSTRATIONS

RIPC/01
Rossington Inland Port 33kV Cable Route
Rossington
South Yorkshire





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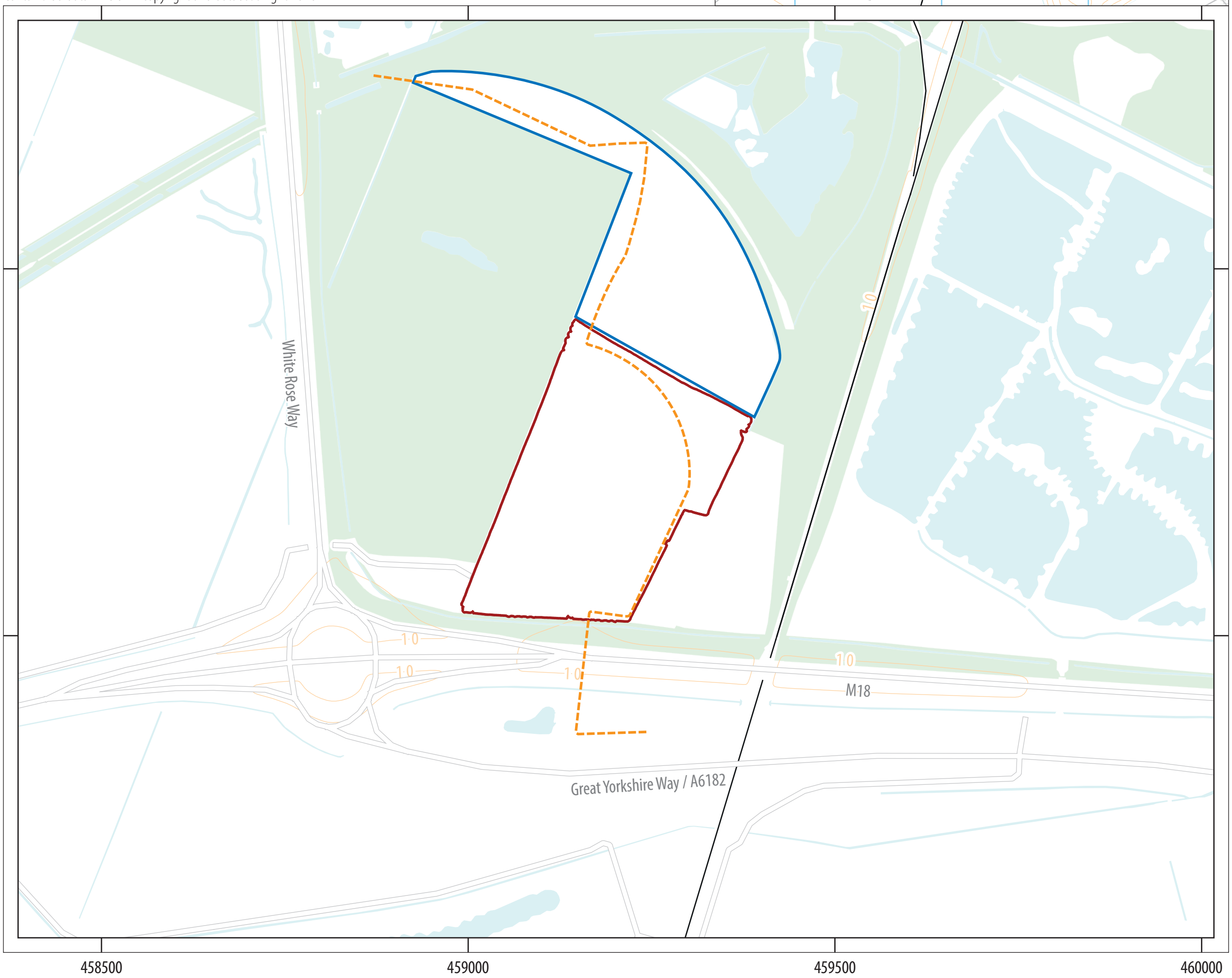

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KEY

- geophysical survey area
- previous geophysical survey (ASWYAS 2015)
- proposed route of 33kV cable

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ILLUS 1 Site location

ROSSINGTON INLAND PORT 33KV CABLE ROUTE, ROSSINGTON, SOUTH YORKSHIRE

GEOPHYSICAL SURVEY

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Chris Harrison of CgMs Consulting (the Client) to undertake a geophysical (magnetometer) survey of land at Loversall Carr, near Doncaster (Illus 1). The results of the survey will help determine the route of a new 33KV cable that will connect Rossington Inland Port with the National Grid and will inform forthcoming archaeological strategy in advance of the excavation of the cable trench.

The work was undertaken in accordance with a Written Scheme of Investigation (Headland Archaeology 2016), submitted to the Client and approved by Andrew Lines of the South Yorkshire Archaeology Service, and was undertaken in accordance with guidance contained within the National Planning Policy Framework (DCLG 2012). All work was also undertaken in line with current best practice (CIfA 2014, English Heritage 2008).

The survey was carried out on October 20th and October 21st 2016 in order to provide information on the archaeological potential of the site.

1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

The geophysical survey area (GSA) covers approximately 8 hectares and comprises a trapezoidal shaped parcel of land, centred at NGR SK 5920 9970 located to the north of the M18 motorway and east of White Rose Way (the A6182). It comprises part of a single field (F1) subdivided by a recently fenced off section (F2) to the north and is bound by the M18 to the south, Beeston Plantation to the west and agricultural land to the north and east.

The GSA lies between 6m and 10m above Ordnance Datum (aOD). The higher ground is along the western boundary of the GSA sloping down towards the central and eastern parts of the GSA.

1.2 GEOLOGY AND SOILS

The underlying bedrock comprises Nottingham Castle Sandstone Formation overlain by superficial deposits of alluvium (NERC 2016).

The soils are classified in the Soilscape 20 association, characterised as loams and clays from floodplain soils, with naturally high groundwater (Cranfield University 2016).

2 ARCHAEOLOGICAL BACKGROUND

The GSA is located in an intensively cropmarked landscape of enclosure, trackways and field systems. Many of these cropmarks have been investigated by geophysical survey and excavation and have been revealed to form a system of land division and enclosure which dates to the later Iron Age or early post-Roman periods.

Within the GSA a large sub-rectangular cropmark indicative of double/triple ditched enclosure has been recorded during the Magnesian Limestone National Mapping Programme. Internal features are also clearly visible within the enclosure.

An earlier geophysical survey (ASWYAS 2015) covered the northern half of the field currently under survey as well as land to the north-west (see Illus 1) as part of evaluation works for a previous planning application. The cable route is currently proposed to cross this area. This survey did not identify any anomalies of archaeological potential.

3 AIMS, METHODOLOGY AND PRESENTATION

The main aim of the geophysical survey was to provide sufficient information to enable an assessment to be made of the impact of the preferred 33KV cable route on any sub-surface archaeological remains, if present, and therefore to help in finalising the cable route and thereby to minimise any damage to the archaeological resource.

The general archaeological objectives of the geophysical survey were:

› to provide information about the nature and possible interpretation of any magnetic anomalies identified;

ILLUS 2 Field 1, looking north-east

- › to therefore model the presence/absence and extent of any buried archaeological features; and
- › to prepare a report summarising the results of the survey.

3.1 MAGNETOMETER SURVEY

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

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

MLGrad601 and MultiGrad601 (Geomar Software Inc.) software was used to collect and export the data. Terrasurveyor V3.0.28.4 (DWConsulting) software was used to process and present the data.

3.2 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:10,000. Illus 2 and Illus 3 are site condition photographs. Illus 4 is a 1:2,500 scale location plan showing the GPS tracks and cropmark data. Illus 5 shows the fully processed greyscale data for the whole site and Illus 6 is the accompanying interpretative drawing, both at a scale of 1:2,500.

Detailed data plots of the fully processed data (greyscale) and minimally processed data (XY traceplot), of the two sectors into which the site is broken down, are presented at a scale of 1:1250 in Illus 7 to Illus 12 inclusive.

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

The survey methodology, report and any recommendations comply with the WSI (Headland Archaeology 2016) and guidelines outlined

ILLUS 3 Field 2, looking west

by Historic England (English Heritage 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All illustrations from Ordnance Survey mapping are reproduced with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The illustrations in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All illustrations are presented to most suitably display and interpret the data from this site based on the experience and knowledge of management and reporting staff.

4 RESULTS AND DISCUSSION

The ground conditions were very good across the GSA and the data quality was correspondingly good throughout. The magnetic background was homogeneous as would be expected on alluvial soils except in the south-west quarter of the GSA where the data appears speckled, probably due to a pocket of peat or recently deposited alluvial material.

4.1 FERROUS AND MODERN ANOMALIES

Ferrous anomalies, characterised as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris or material is common on most sites, often being present as a consequence of manuring or tipping/infilling. Three large spikes in the south of F1 are caused by capped bore-holes (BH1 – BH3 see Illus 10–12).

A high magnitude linear anomaly aligned north-west/south-east at the northern end of the GSA is caused by a recently erected post and wire fence (FE1 see Illus 3).

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

4.2 AGRICULTURAL ANOMALIES

The data set is characterised by numerous, regularly spaced, linear trend anomalies the majority of which are aligned north-west/south-east. These anomalies are caused by a system of field drains.

Two linear anomalies (FB1 and FB2), on the same alignment as the drains, are due to former boundaries recorded on the first edition Ordnance Survey (OS) map.

At right angles to the drains are more closely spaced linear trends. These anomalies reflect the direction of recent cultivation.

4.3 GEOLOGICAL ANOMALIES

Numerous discrete anomalies are visible throughout the magnetic datasets. These are interpreted as geological in origin and are due to minor variations in the depth and composition of the upper soil horizons.

A sub-oval area of variable and enhanced magnetic response (GV1) is identified in the south-western quarter of the GSA. This is interpreted as being caused by geological variation, either to a pocket of peat, of which there are several recorded in the vicinity although not at this location, or alluvium deposited during recent episodes of flooding.

4.4 ARCHAEOLOGICAL AND POSSIBLY ARCHAEOLOGICAL ANOMALIES

The survey has clearly identified anomalies indicative of archaeological activity. The anomalies are caused by soil-filled features (ditches and pits) although some of the discrete anomalies may be due to heat affected features such as hearths or areas of burning.

The most prominent feature is a rectangular enclosure previously identified as a cropmark. The enclosure, E1, is aligned north-west/south-east along the long axis and is defined by double ditches to the north-western and south-western western sides with a third possible ditch on the north-eastern side. A second enclosure, E2, is appended to the south-eastern side of E1.

Within the main enclosure, E1, three curvilinear anomalies, RD1–RD3, are identified. These are interpreted as ring ditches indicative of the presence of roundhouses. These features were also previously identified as cropmarks. In addition several discrete anomalies have been interpreted as of possible archaeological origin and may be indicative of gulleys, pits or areas of burning. The smallest anomalies could also be interpreted as geological in origin but have been ascribed a possible archaeological origin based on their position within the main enclosure.

Outside the main enclosure three ditch type anomalies are identified. Ditch D1 extends in a south-easterly direction from the southern corner of E2 and continues beyond the boundary of the GSA. This is the only feature identified by the survey that will be impacted by the proposed cable route and was also previously recorded as a cropmark. Ditch D2 extends for a short distance in a westerly direction also from the southern corner of but becomes indistinct and weakening in magnitude close to the geological boundary, GB1. Finally ditch D3 runs parallel with the south-western edge of E2 and possibly forms a trackway leading towards entrances into both E1 and E2.

5 CONCLUSION

The geophysical survey has confirmed and enhanced the cropmark data and has successfully defined the extent of archaeological activity within the GSA. An earlier survey confirmed the absence of any anomalies of likely archaeological origin on land to the north of the GSA across which the cable route is also proposed to cross.

With the exception of a single ditch on the eastern edge of the GSA the proposed cable route will not have any impact on the archaeological resource as identified by cropmark data and geophysical survey.

6 REFERENCES

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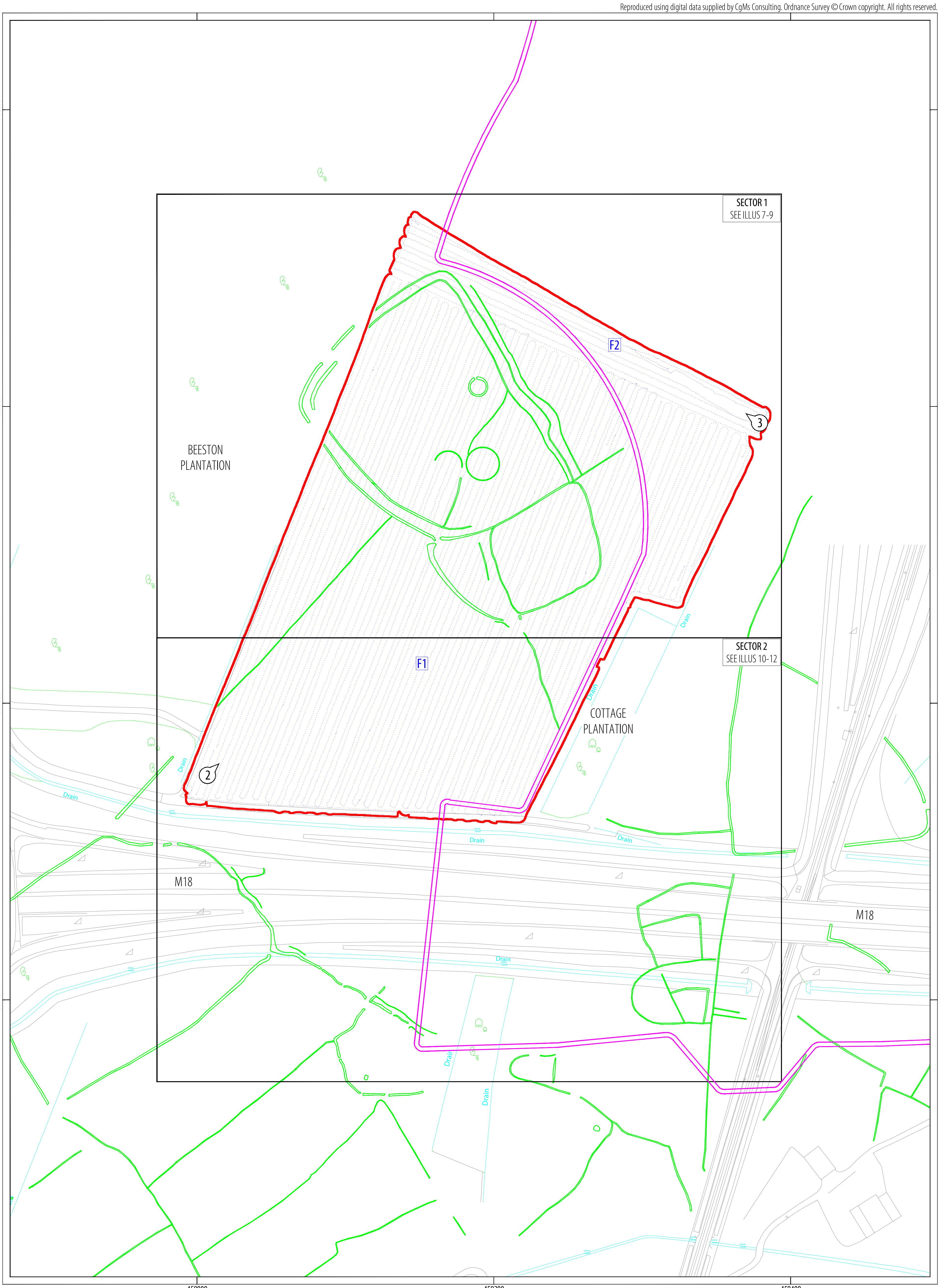

geophysical survey area
proposed route of 33kV cable
cropmark data
GPS track data
location and direction of ILLUS 2–3

N
0 50m
scale 1:2,500 @ A3

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Cable Route
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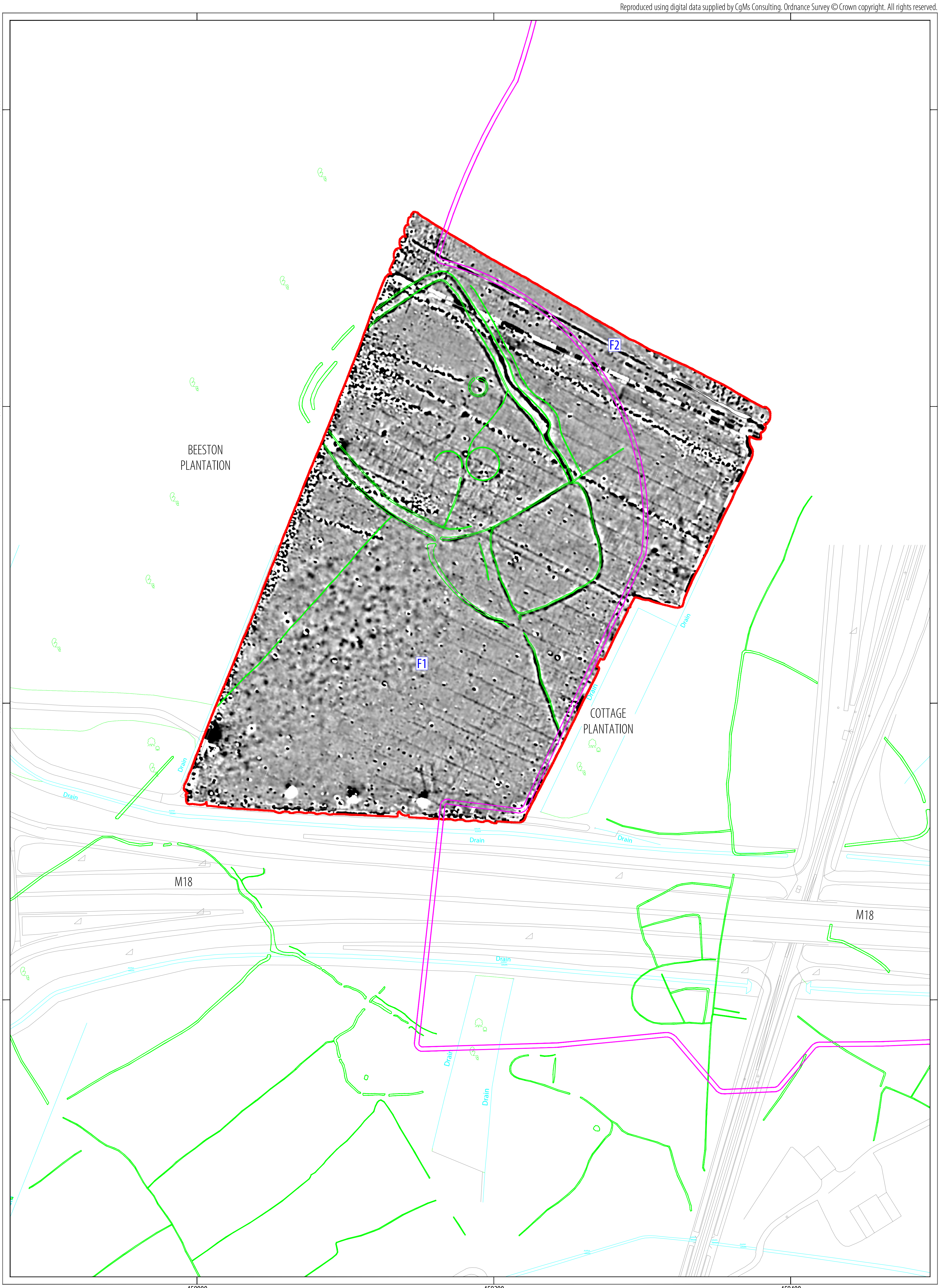
ILLUS 4 Survey location showing GPS tracks and cropmark data



geophysical survey area
proposed route of 33kV cable
cropmark data

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-1.0 2.0

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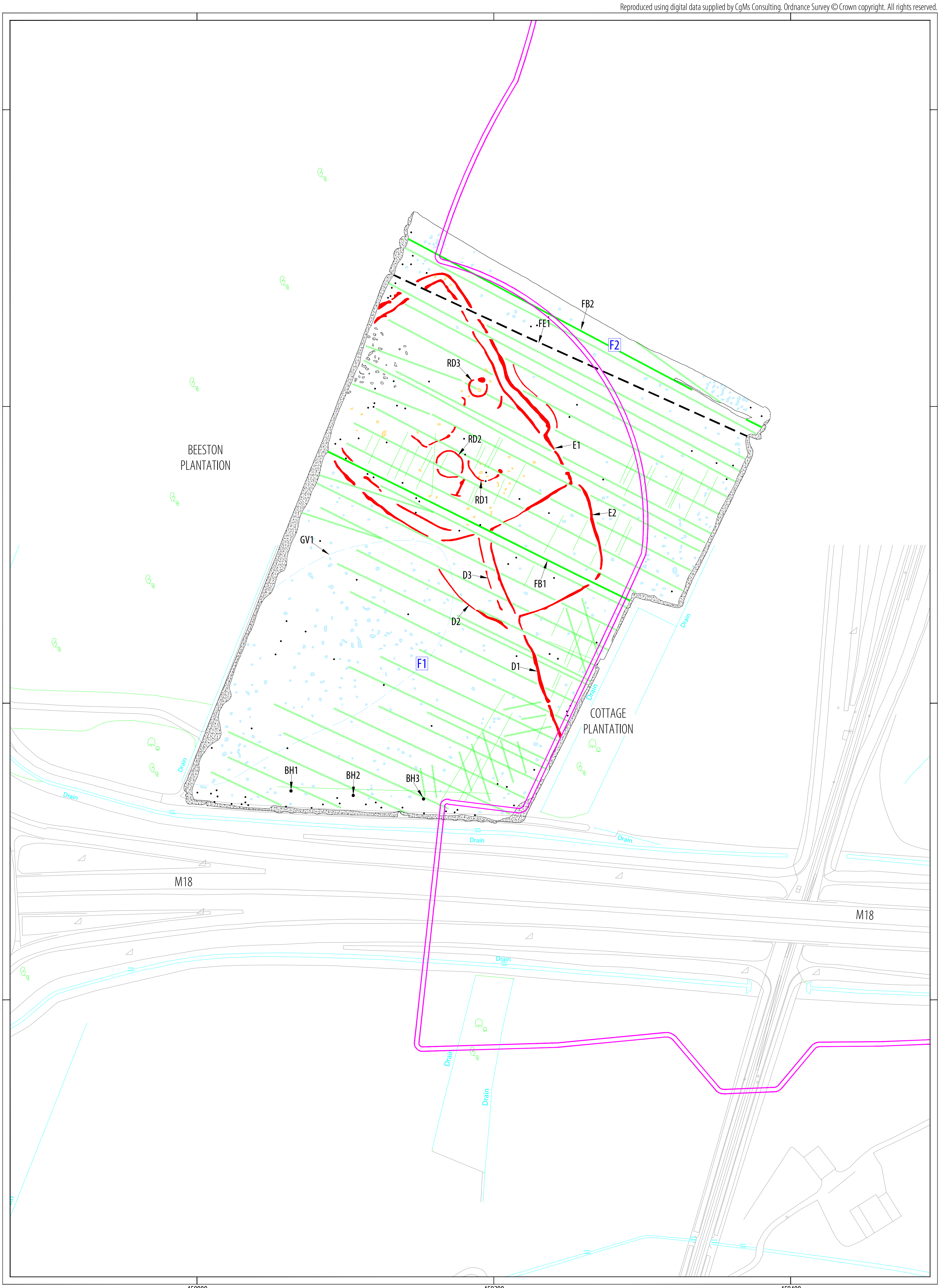
ILLUS 5 Processed greyscale magnetometer data showing cropmark data



proposed route of 33kV cable

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
dipolar linear	fence
linear trend	agricultural

TYPE OF ANOMALY	INTERPRETATION
linear trend	field drain
linear	former field boundary
linear	geological variation
magnetic enhancement	geology?
magnetic enhancement	archaeology?
magnetic enhancement	archaeology

ABBREVIATIONS

BH bore-hole
D ditch
E enclosure
FB former boundary
FE fence
GV geological variation
RD ring-ditch

N

0 50m
scale 1:2,500 @ A3

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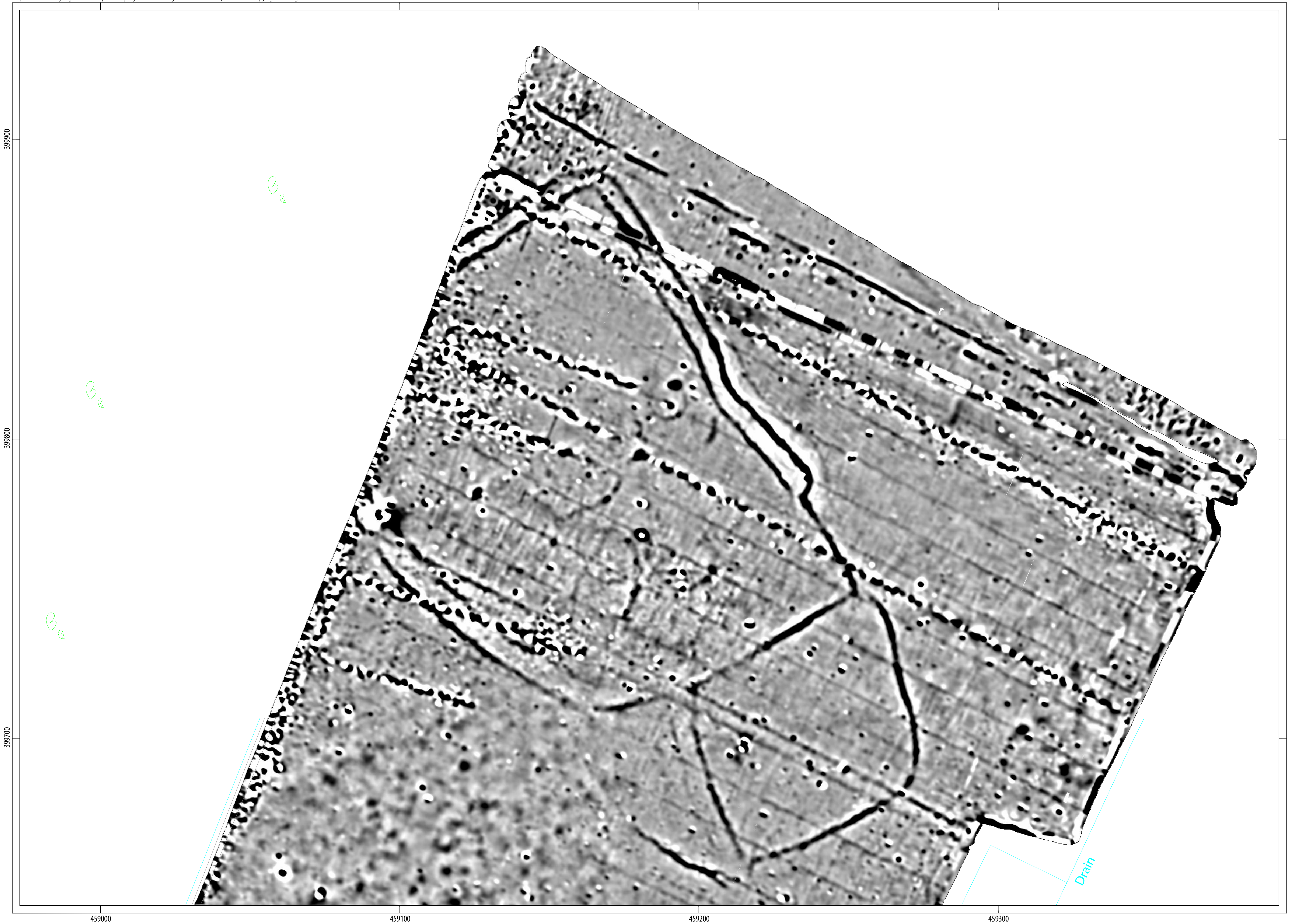
ILLUS 6 Overall interpretation of magnetometer data



nT
-1.0 2.0

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0 25m
scale 1:1,250 @ A3

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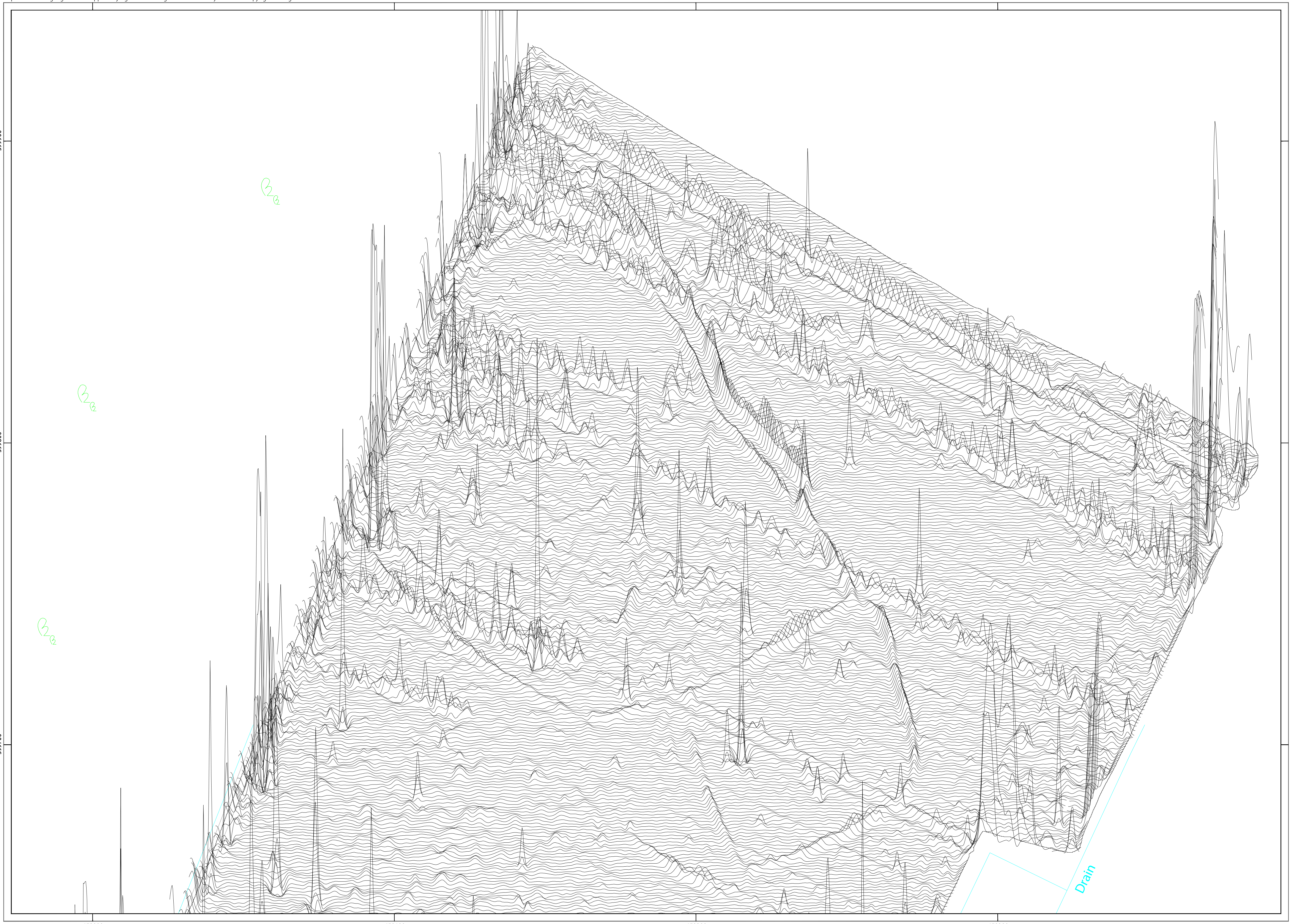
ILLUS 7 Processed greyscale magnetometer data; Sector 1



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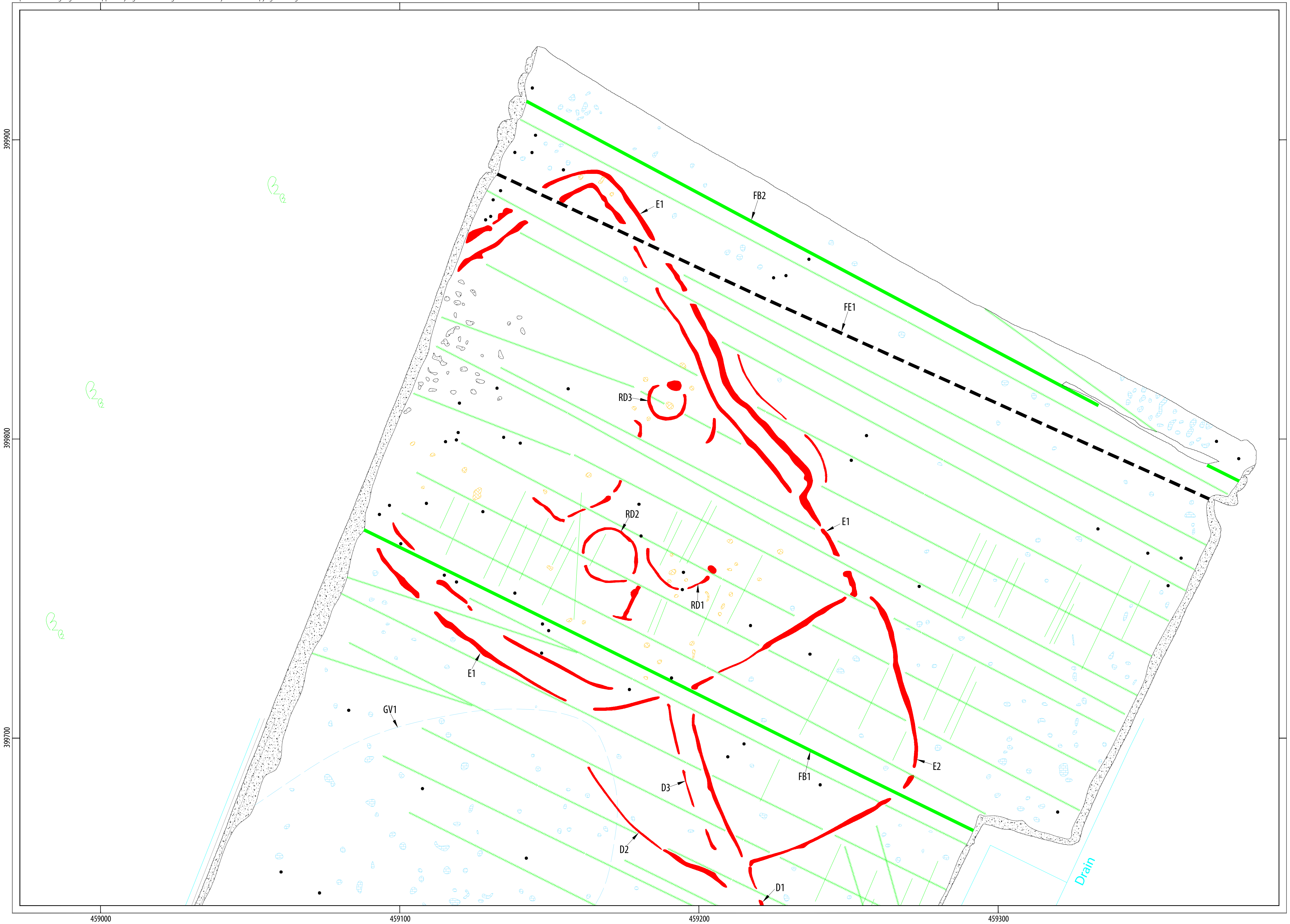
ILLUS 8 XY trace plot of minimally processed magnetometer data; Sector 1



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

ABBREVIATIONS

D	ditch	FE	fence
E	enclosure	GV	geological variation
FB	former boundary	RD	ring-ditch

N

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scale 1:1,250 @ A3

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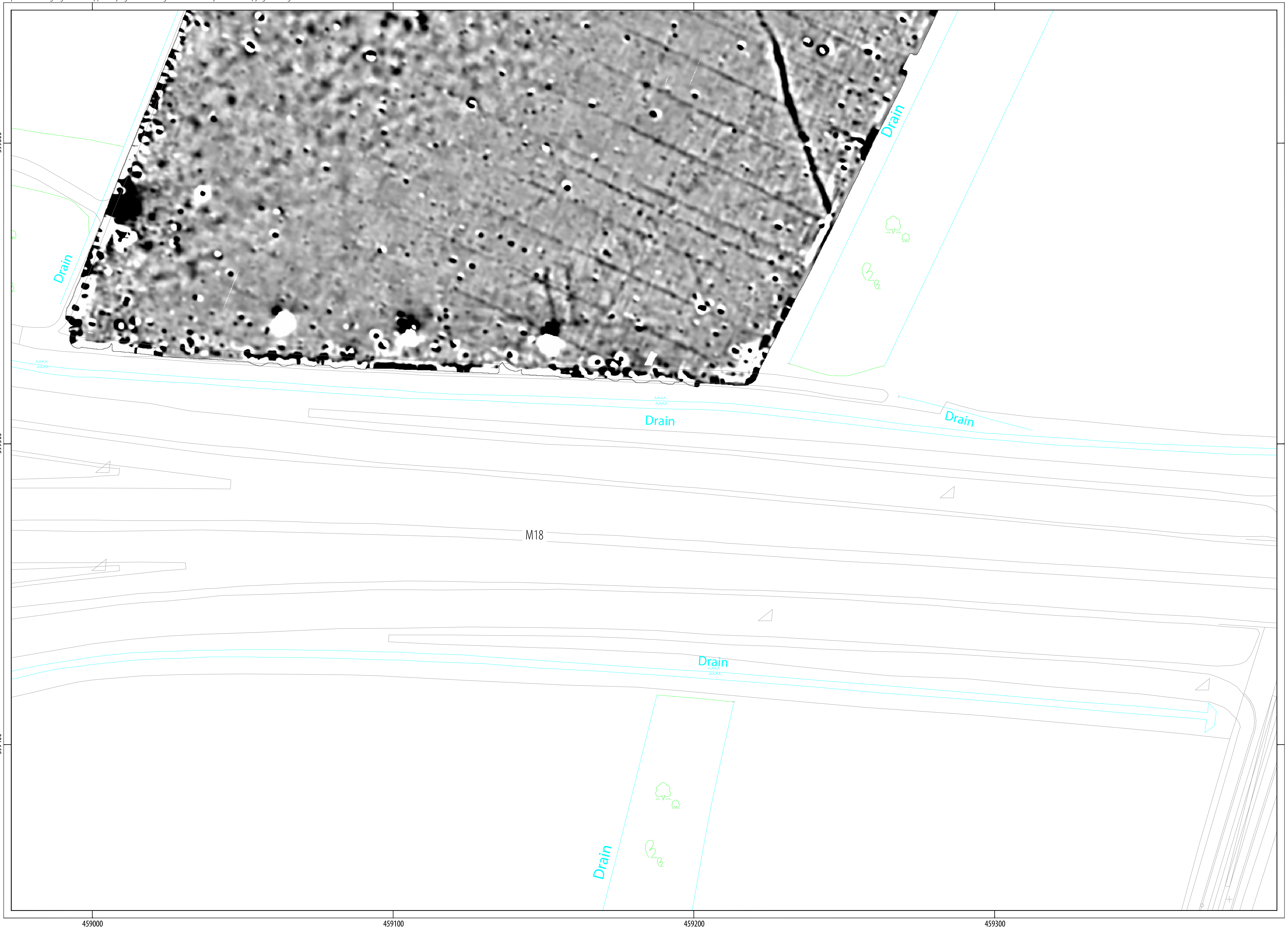
ILLUS 9 Interpretation of magnetometer data; Sector 1



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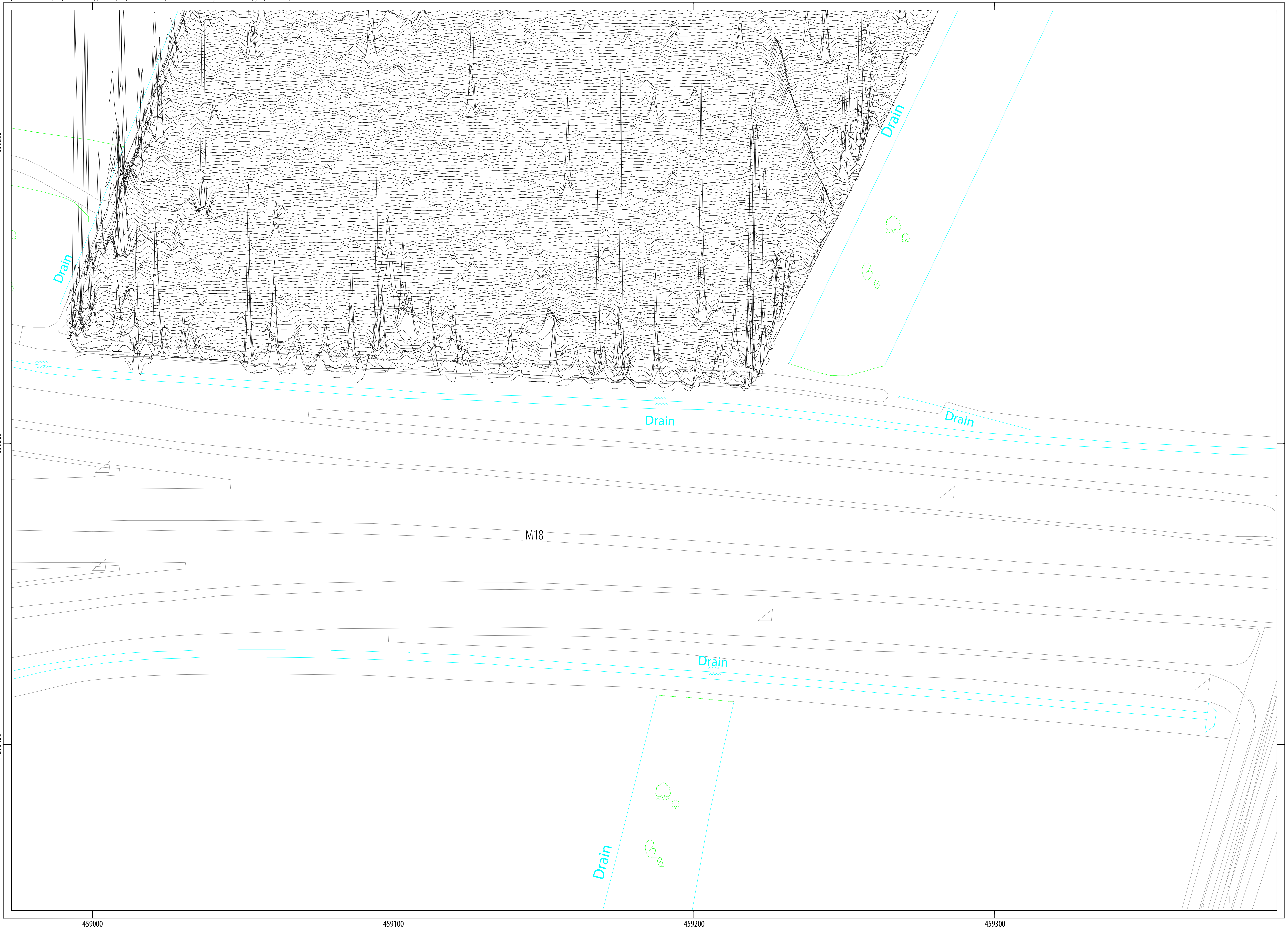
ILLUS 10 Processed greyscale magnetometer data; Sector 2



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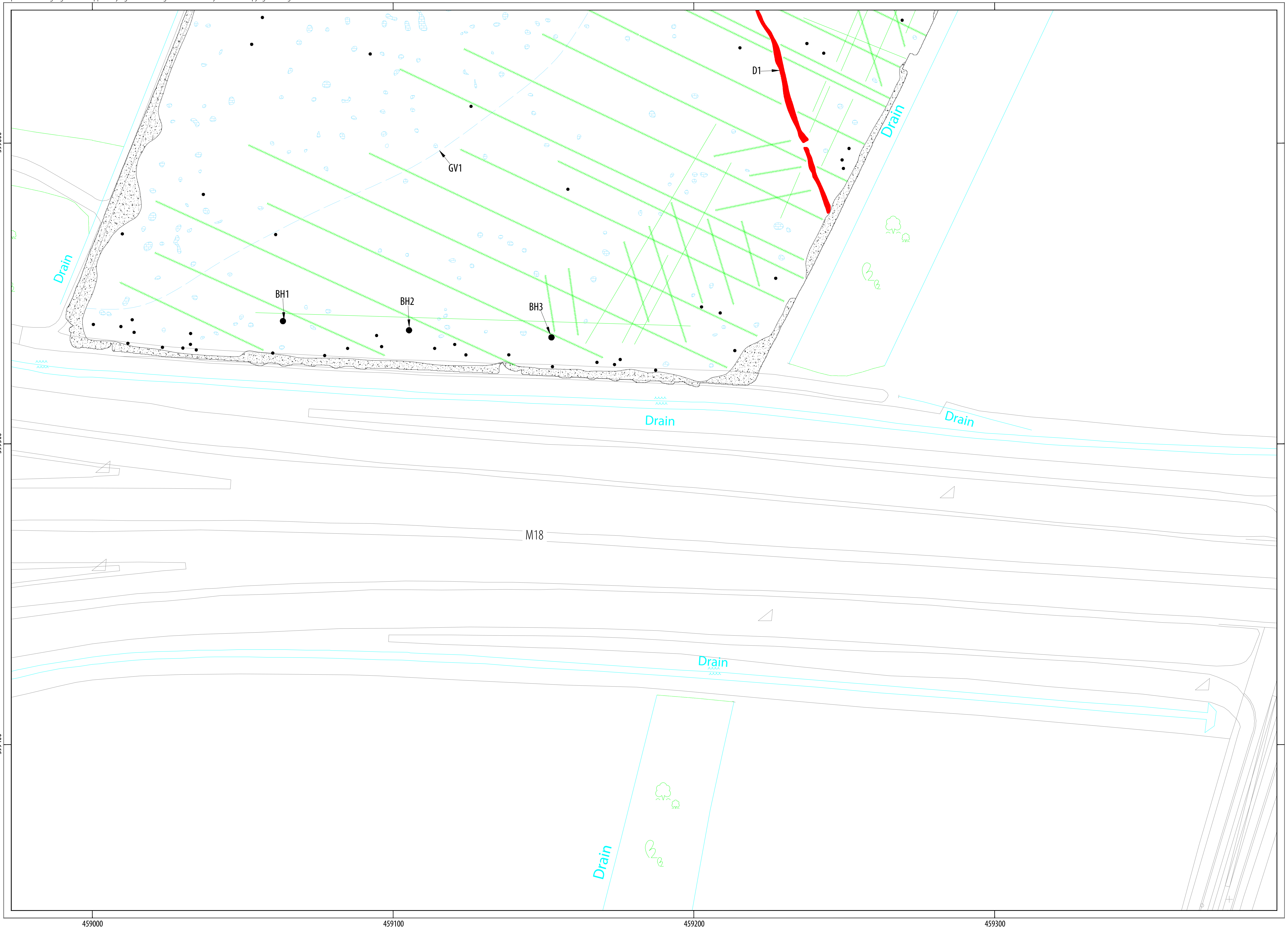
ILLUS 11 Processed greyscale magnetometer data; Sector 2



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

ABBREVIATIONS

- **BH** bore-hole
- **D** ditch
- **GV** geological variation

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scale 1:1,250 @ A3

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ILLUS 12 Interpretation of magnetometer data; Sector 2

7 APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

Magnetic susceptibility and soil magnetism

Iron makes up about 6% of the earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haematite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected.

The magnetic susceptibility of a soil can also be enhanced by the application of heat. This effect can lead to the detection of features such as hearths, kilns or areas of burning.

Types of magnetic anomaly

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

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

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

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

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

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

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

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

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

APPENDIX 2 SURVEY LOCATION INFORMATION

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

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

The survey data were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if coordinates are measured off hard copies of the mapping rather than using the digital coordinates.

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

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

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

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

APPENDIX 4 DATA PROCESSING

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

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

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

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

APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: headland5-271224

PROJECT DETAILS	
Project name	ROSSINGTON INLAND PORT 33KV CABLE ROUTE, ROSSINGTON, SOUTH YORKSHIRE
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey, covering approximately 8 hectares, at Loversall Carr, near Rossington, in order to provide further information on the archaeological potential of the geophysical survey area prior to finalising the route of a 33KV cable which will connect Rossington Inland Port with the National Grid. The survey has corroborated and enhanced the cropmark data confirming the location and extent of a large sub-rectangular double-ditched enclosure with smaller attached enclosures to the south-eastern side. Circular anomalies within the enclosure are interpreted as ring ditches indicative of round-houses. Discrete anomalies are also suggestive of settlement activity. A previous geophysical survey of land immediately north of the current area (across which the cable route is also proposed to pass) did not identify any anomalies of archaeological potential. The proposed cable route only impacts on the known archaeological resource (as indicated by the cropmark and survey data) at a single location on the eastern site boundary where it crosses an outlying ditch feature. Therefore, on the available evidence, the impact of the proposed cable route on the archaeological resource is assessed as very low.
Project dates	Start: 20-10-2016 End: 21-10-2016
Previous/future work	Yes / Yes
Any associated project reference codes	RIPC/01 - Sitecode
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 2 - Operations to a depth less than 0.25m
Monument type	CROPMARK Late Prehistoric
Monument type	CROPMARK Roman
Significant Finds	NONE None
Significant Finds	NONE None
Methods & techniques	"Geophysical Survey"
Development type	Underground cable
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Pre-application
Solid geology (other)	Nottingham Castle Sandstone
Drift geology	ALLUVIUM
Techniques	Magnetometry

PROJECT LOCATION	
Country	England
Site location	SOUTH YORKSHIRE DONCASTER ROSSINGTON Rossington Inland Port
Postcode	DN11 9DX
Study area	8 Hectares
Site coordinates	SK 5920 9970 53.49042324984 -1.107631074063 53 29 25 N 001 06 27 W Point
Height OD / Depth	Min: 6m Max: 10m

PROJECT CREATORS	
Name of Organisation	Headland Archaeology
Project brief originator	CgMs (Newark)
Project design originator	Headland Archaeology
Project director/manager	Alistair Webb
Project supervisor	Bishop, R
Type of sponsor/funding body	Developer
Name of sponsor/funding body	CgMs Consulting

PROJECT ARCHIVES	
Physical Archive Exists?	No
Digital Archive recipient	In house
Digital Contents	"Survey"
Digital Media available	"Geophysics"
Paper Archive Exists?	No
Entered by	Alistair Webb (alistair.webb@headlandarchaeology.com)
Entered on	14 December 2016

REGISTERED · CIfA · ORGANISATION

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