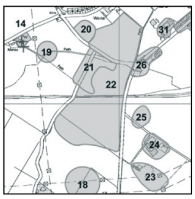
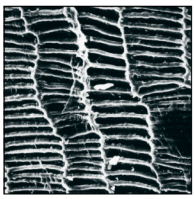
ELQL19








ELLEL QUARRY, LANCASHIRE

GEOPHYSICAL SURVEY REPORT

commissioned by Stephenson Halliday
on behalf of J A Jackson (Preston) Ltd

December 2019

HEADLAND ARCHAEOLOGY

REGISTERED ORGANISATION CIfA

ELLEL QUARRY, LANCASHIRE

GEOPHYSICAL SURVEY REPORT

commissioned by Stephenson Halliday
on behalf of J A Jackson (Preston) Ltd

December 2019

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

PROJECT INFO:

HA Project Code **ELQL19** / NGR **SD 5067 5490** / Parish **Ellel** / Local Authority **Lancashire County Council** / OASIS Ref. **headland5-378378**

PROJECT TEAM:

Project Manager **Sam Harrison** / Author **David Harrison** / Fieldwork **Glyn Sheldrick, Richard McGregor Edwards** / Graphics **Eleanor Winter, Rafa Maya Torcelly, Sam Harrison**

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

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HEADLAND ARCHAEOLOGY

part of the RSK Group

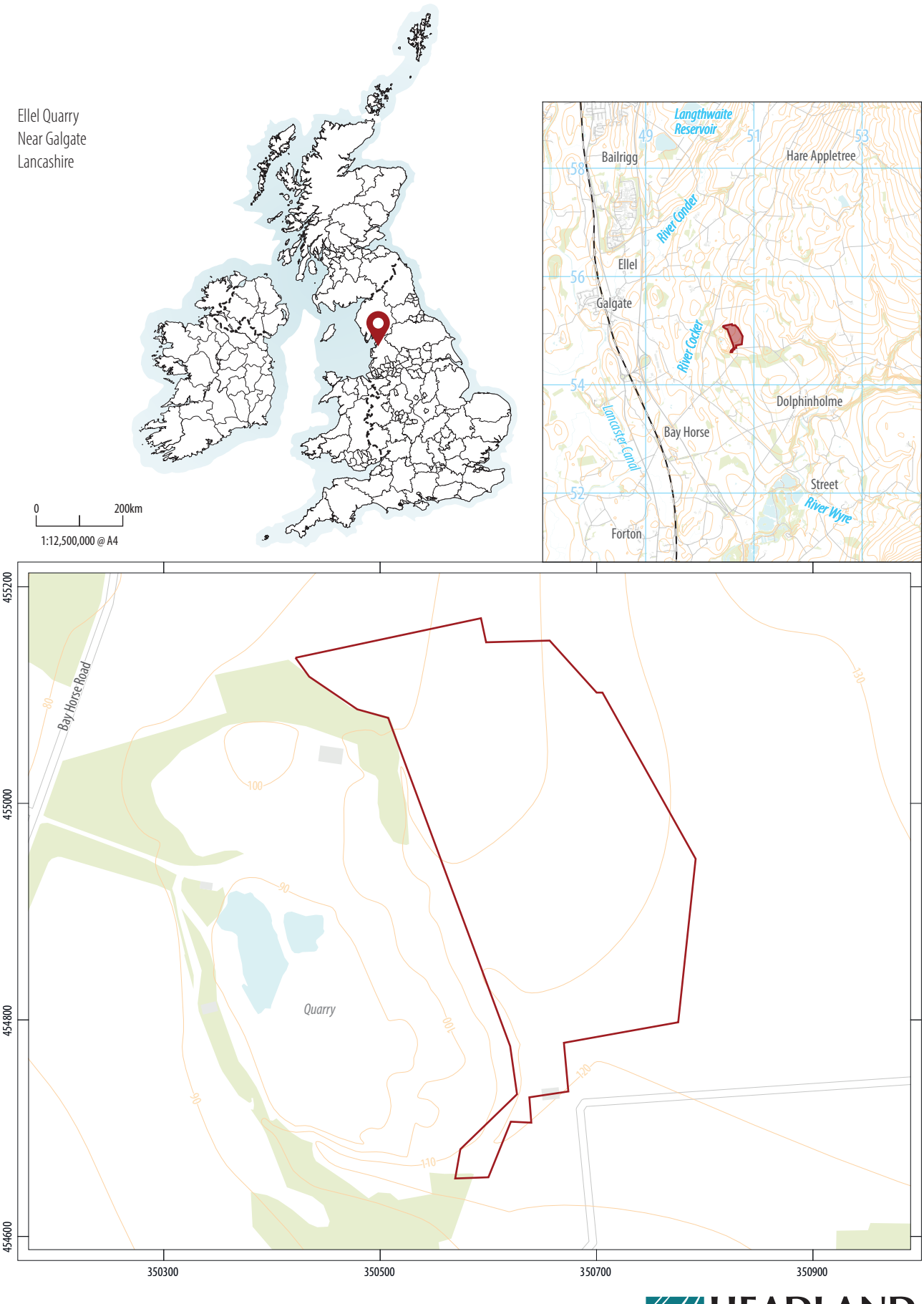
REGISTERED ORGANISATION CIfA

PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey covering 5.5 hectares on land at Ellel Quarry, near Galgate, Lancashire, to inform a planning application for the extension of the quarry. No anomalies of any archaeological potential have been identified by the survey and none to suggest the presence of medieval remains which are recorded on the Lancashire Historic Environment Record (HER) immediately east of the application area. The survey has identified anomalies which are consistent with land drainage. Therefore, on the basis of the geophysical survey, the application area is assessed as being of low archaeological potential, corroborating the results of the Desk-Based Assessment.

CONTENTS

LIST OF ILLUSTRATIONS



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ILLUS 1 Site location

ELLEL QUARRY, LANCASHIRE

GEOPHYSICAL SURVEY REPORT

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Stephenson Halliday (the Agent), on behalf of JA Jackson (Preston) Ltd (the Client) to undertake a geophysical survey on land at Ellel Quarry, near Galgate, Lancashire, to inform a planning application for the proposed extension of the quarry. The results of the survey will inform future archaeological strategy at the site.

The survey was undertaken in order to assess the impact of the proposed development on the historic environment and was undertaken in accordance with an Archaeological Written Scheme of Investigation (WSI) (Harrison 2019) which was submitted to Archaeological Officer at Lancashire County Council, with guidance within the National Planning Policy Framework (MHCLG 2019) and in line with current best practice (Chartered Institute for Archaeologists 2014, Europae Archaeologia Consilium 2016).

1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

The Application Area (AA) is located immediately east and north-east of the existing quarry workings, centred on SD 5067 5490 (Illus 1). It comprises five fields (F1–F5) of largely improved pasture (Illus 2–3), although F5 is unimproved, marshy and overgrown and was mostly unsuitable for geophysical survey (Illus 4).

Generally, the topography slopes towards the north-west being at 117m Above Ordnance Datum (AOD) in F3 and at 97m AOD in the north-west of F1.

The survey was carried out on the 9th and 10th December 2019.

1.2 GEOLOGY AND SOILS

The bedrock geology comprises Millstone Grit (mudstone, siltstone and sandstone) and is overlain by glacial till (NERC 2019).

The soils are classified in the Soilscape 6 Association, characterised as freely draining loams (Cranfield University 2019).

2 ARCHAEOLOGICAL BACKGROUND

An Archaeological Desk-Based Assessment (Glancy 2019) identified no previously known heritage assets within the AA. However, to the immediate east of the AA an area of medieval clamp kilns and pottery were identified during work on the route of the Carnforth to Treales 1050mm gas pipeline (MLA25956) and therefore the AA is ascribed a medium potential for archaeological remains of medieval origin.

3 AIMS, METHODOLOGY AND PRESENTATION

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

The specific archaeological objectives of the geophysical survey were:

ILLUS 2 F1, looking north-west

- 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.

3.1 MAGNETOMETER SURVEY

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

The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid carrying frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10–15cm sample interval) on roaming traverses (swaths) 4m apart. These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) 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 V3.0.35.1 (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 1:5,000. Illus 2–4 are site condition photographs. Illus 5 is a 1:4,000 survey location plan showing the direction of survey as GPS swaths. The data is presented in greyscale and XY trace formats, at a scale of 1:2,000, in Illus 6 and Illus 7. Illus 8 is an interpretation plot of the data also at a scale of 1:2,000.

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

The survey methodology, report and any recommendations comply with the Written Scheme of Investigation (Harrison 2019), 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' 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.

ILLUS 3 F4, looking north-east

4 RESULTS AND DISCUSSION

With the exception of the overgrown conditions in F5, ground conditions were good throughout the AA and have contributed to a high standard of data throughout. A low level of background magnetic variation has been detected throughout the AA, probably due to the homogenous properties of the superficial geology. Against this background several anomalies have been identified and cross-referenced to specific examples on the interpretation figure (Illus 8).

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 is common on most sites, often being present as a result of manuring or tipping/ infilling. There is no obvious clustering to these ferrous anomalies 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. Large 'spikes' (TP; Illus 8) in F1 and F2 are due to telegraph poles carrying overhead wires.

Magnetic disturbance along the field edges is due to the presence of ferrous material within and adjacent to the field boundaries and is of no archaeological interest.

4.2 AGRICULTURAL ANOMALIES

Analysis of historic Ordnance Survey maps indicates that a single east/west field boundary has been removed from within the AA since the publication of the first edition OS map in 1888. The former east/west boundary in F2 has not been detected by the geophysical survey, perhaps suggesting a low level of magnetic susceptibility in the surrounding soils.

Faint linear anomalies on differing alignments across F2, F4 and F5 are typical of field drains.

4.3 GEOLOGICAL ANOMALIES

Isolated discrete areas of magnetic enhancement across the AA are probably due to localised variation in the depth and composition of the soils and are unlikely to be of any archaeological interest.

5 CONCLUSION

The survey has successfully evaluated the geophysical survey area and has not identified any anomalies of clear archaeological potential and none to suggest the presence of medieval remains which are recorded on the Lancashire Historic Environment Record (HER) immediately east of the application area. The survey has identified anomalies which are consistent with land drainage. Therefore, on the basis of the geophysical survey, the application area is assessed as being of low archaeological potential, corroborating the results of the Desk-Based Assessment.

ILLUS 4 F5, looking north

6 REFERENCES

Chartered Institute for Archaeologists (CIfA) 2014 ***Standard and guidance for archaeological geophysical survey*** (Reading) http://www.archaeologists.net/sites/default/files/CIfAS%26GGeophysics_2.pdf accessed 16 December 2019

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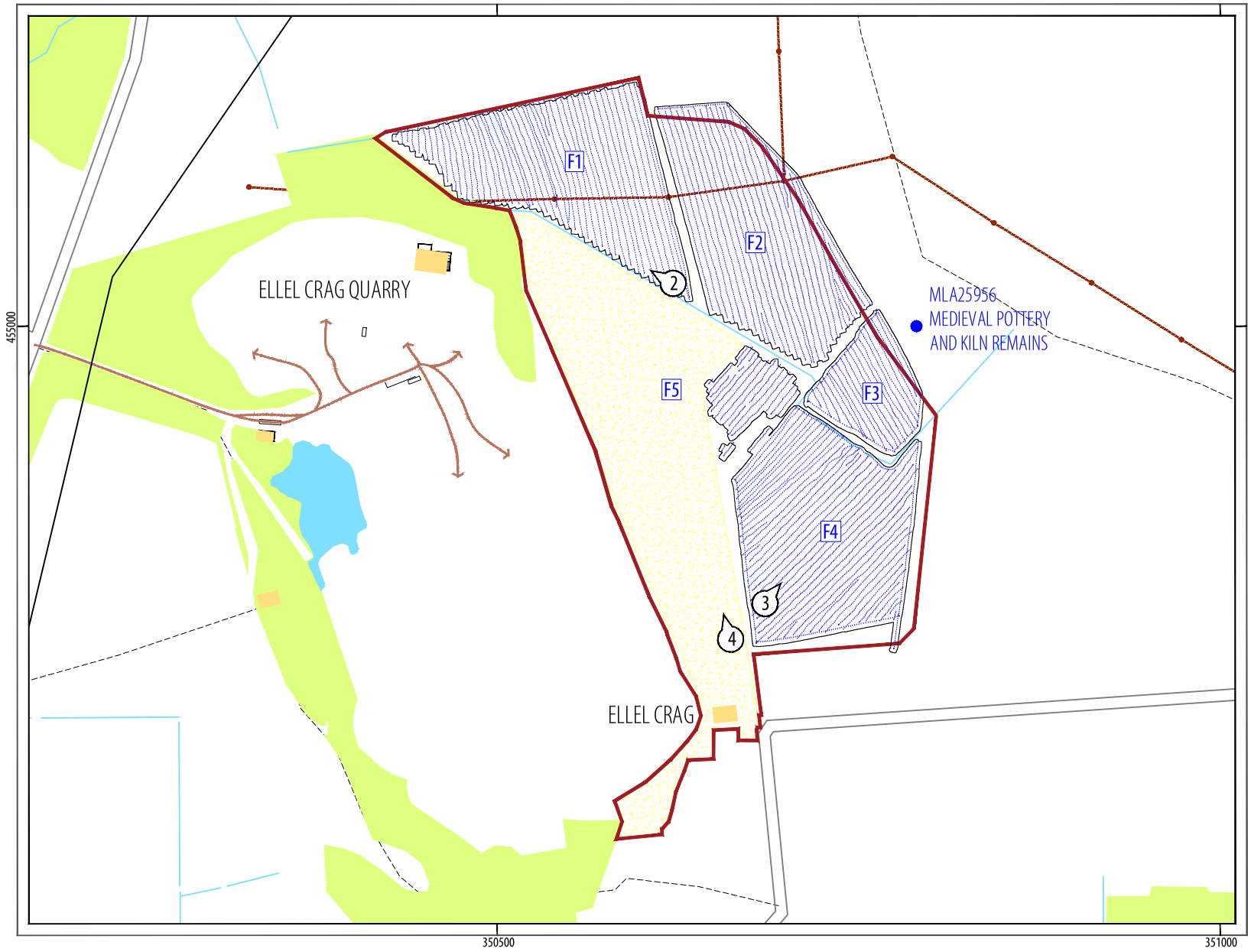

geophysical survey area
GPS swaths
area unsuitable for survey
Lancashire HER data
location and direction of ILLUS 2-4

0 100m
1:4,000 @ A4

PROJECT ELQL19
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Galgate
Lancaster
CLIENT JA Jackson Contractors (Preston)

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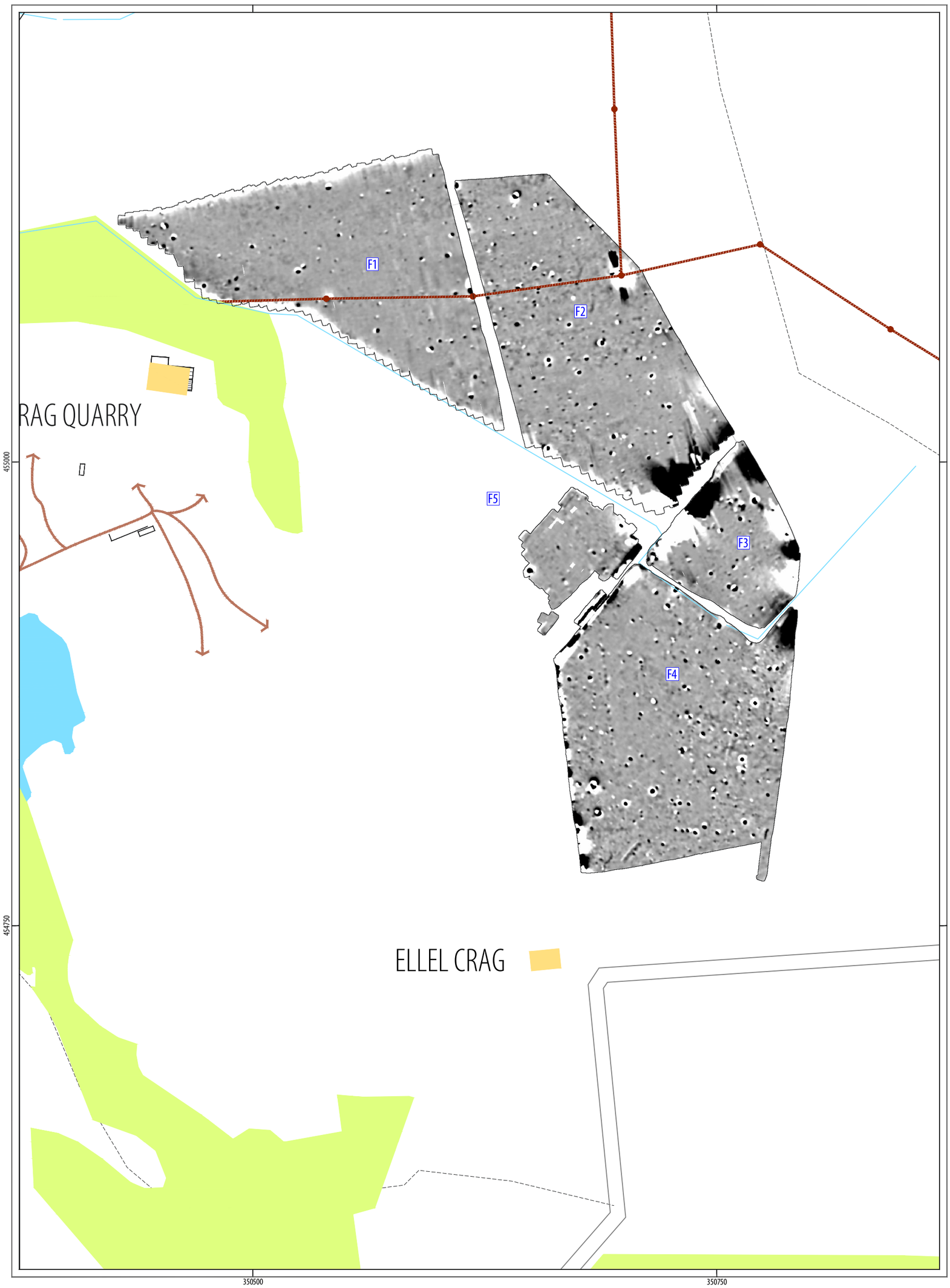
ILLUS 5 Survey location showing GPS swaths (1:4,000)



nT
-1.0 2.0

0 50m
1:2,000 @ A3

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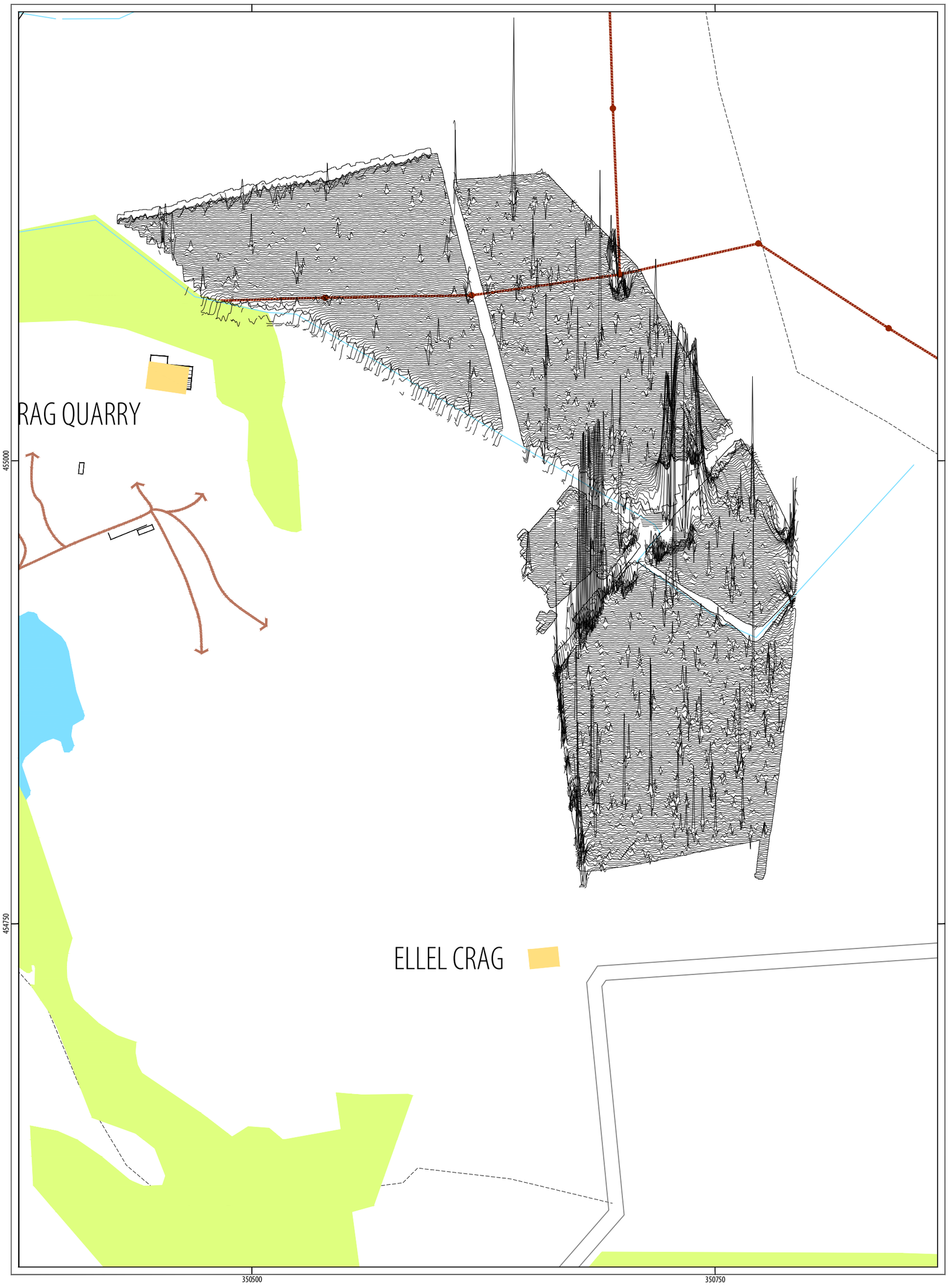
ILLUS 6 Processed greyscale magnetometer data (1:2,000)



25.0nT/cm

0 50m

1:2,000 @ A3

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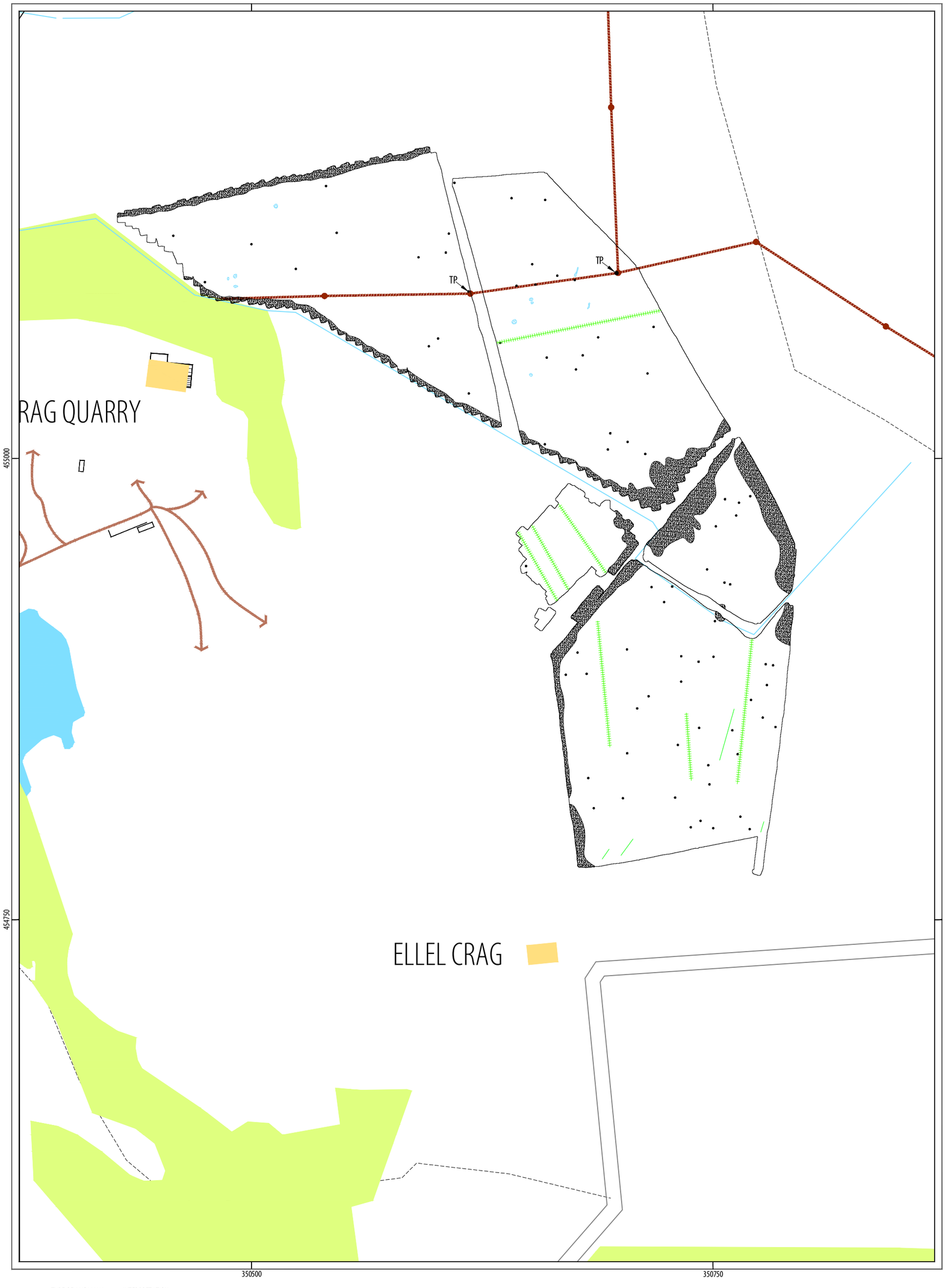
ILLUS 7 XY trace plot of minimally processed magnetometer data (1:2,000)



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

0 50m
1:2,000 @ A3

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ILLUS 8 Interpretation of magnetometer data (1:2,000)

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.

Lightning-induced remnant magnetisation (LIRM) LIRM anomalies are thought to be caused in the near surface soil horizons by the flow of an electrical currents 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.

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: headland5-378378

PROJECT DETAILS	
Project name	Ellel Quarry, Lancashire: Geophysical Survey
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey covering 5.5 hectares on land at Ellel Quarry, near Galgate, Lancashire, to inform a planning application for the extension of the quarry. No anomalies of any archaeological potential have been identified by the survey and none to suggest the presence of medieval remains which are recorded on the Lancashire Historic Environment Record (HER) immediately east of the application area. The survey has identified anomalies which are consistent with land drainage. Therefore, on the basis of the geophysical survey, the application area is assessed as being of low archaeological potential, corroborating the results of the Desk-Based Assessment.
Project dates	Start: 09-12-2019 End: 10-12-2019
Previous/future work	Yes / Not known
Any associated project reference codes	ELQL19 – Sitecode
Type of project	Field evaluation
Site status	N/A
Current Land use	Grassland Heathland 5 – Character undetermined
Monument type	N/A
Monument type	N/A
Significant Finds	N/A
Significant Finds	N/A
Methods & techniques	"Geophysical Survey"
Development type	Mineral extraction (e.g. sand, gravel, stone, coal, ore, etc.)
Prompt	Planning condition
Position in the planning process	Not known / Not recorded
Solid geology (other)	Millstone Grit
Drift geology	Glacial sand and gravel
Techniques	Magnetometry

PROJECT LOCATION	
Country	England
Site location	Ellel Quarry, Lancaster, Lancashire
Study area	5.5 Hectares
Site coordinates	SD 5067 5490 53.987597793577 -2.75241623675 53 59 15 N 002 45 08 W Polygon

PROJECT CREATORS	
Name of Organisation	Headland Archaeology
Project brief originator	Headland Archaeology
Project design originator	Headland Archaeology
Project director/manager	Sam Harrison
Project supervisor	Richard McGregor Edwards
Type of sponsor/funding body	Landowner

PROJECT ARCHIVES	
Physical Archive Exists?	No
Digital Archive recipient	In house
Digital Contents	"other"
Digital Media available	"Geophysics","Images raster / digital photography","Images vector"
Paper Archive Exists?	No

PROJECT BIBLIOGRAPHY 1	
Publication type	Grey literature (unpublished document/manuscript)
Title	Ellel Quarry, Lancashire: Geophysical Survey
Author(s)/Editor(s)	David Harrison
Other bibliographic details	ELQL19
Date	2019
Issuer or publisher	Headland Archaeology
Place of issue or publication	Edinburgh
Description	A4 Glue bound report and PDF/A
Entered by	Sam Harrison (sam.harrison@headlandarchaeology.com)
Entered on	18 December 2019

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