ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
AMEC

Benningholme Lane
Skirlaugh
East Yorkshire

geophysical survey

report 2996
October 2012

Durham University

Contents

Figures

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1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted on land north of Benningholme Lane, Skirlaugh, East Yorkshire, prior to proposed development. The works comprised the geomagnetic survey of 6ha.

1.2 The works were commissioned by AMEC and conducted by Archaeological Services Durham University.

Results

1.3 Possible soil-filled ditch features were identified in all three surveyed areas, including possible small rectangular enclosures in Areas 1 and 3.

1.4 Probable traces of former ridge and furrow cultivation were detected in Area 1.

1.5 Variations in the underlying geology were detected in Areas 1 and 2.

1.6 Existing services and sports furniture were detected in Areas 1 and 3.

2. Project background

Location (Figure 1)

2.1 The proposed development area was located north of Benningholme Lane, Skirlaugh, East Yorkshire (NGR centre: TA 13763 39485). Three surveys totalling 6ha were conducted in three land parcels. To the east and south was housing and to the west open farmland and a sewage treatment works. The northern boundary of the site was formed by the Lambwath Stream.

Development proposal

2.2 The development proposal is for housing.

Objective

2.3 The principal aim of the surveys was to assess the nature and extent of any sub-surface features of potential archaeological significance within the proposed development area, so that an informed decision may be made regarding the nature and scope of any further scheme of archaeological works that may be required in relation to the development.

Methods statement

2.4 The surveys have been undertaken in accordance with instructions from the client and in line with national standards and guidance (see 5.1 below).

Dates

2.5 Fieldwork was undertaken between 13th and 14th September 2012. This report was prepared for 4th October 2012.

Personnel

2.6 Fieldwork was conducted by Andy Platell and Natalie Swann (Supervisor). The geophysical data were processed by Natalie Swann. This report was prepared by Natalie Swann, with illustrations by David Graham, and edited by Duncan Hale, the Project Manager.

Archive/OASIS

2.7 The site code is **SBL12**, for **S**kirlaugh **B**enningholme **L**ane 20**12**. The survey archive will be supplied on CD to the client for deposition with the project archive in due course. Archaeological Services Durham University is registered with the **O**nline **A**cces**S** to the **I**ndex of archaeological investigation**S** project (**OASIS**). The OASIS ID number for this project is **archaeol3-134214**.

3. Historical and archaeological background

3.1 A number of archaeological investigations have previously been conducted near the proposed development area. In 2007 a desk-based assessment and geophysical survey were conducted immediately west of the proposed development area for the sewage pumping station. The survey identified a number of anomalies thought to be archaeological in origin, but which may have been geological (Cooper 2007). A watching brief was recommended which identified a number of ditches and gullies, trackways and enclosures. Undiagnostic prehistoric flints and Late Iron Age pottery were recovered (Cooper & Fraser 2008).

3.2 In 2010 a geophysical survey was undertaken at Hillfield Drive, immediately north-east of the proposed development area. The survey indicated occasional, possibly archaeological, linear anomalies that may have represented ditches. A substantial service trench crossed the site and areas of modern magnetic disturbance were also present (Gourley 2010).

4. Landuse, topography and geology

4.1 At the time of survey the proposed development area comprised three fields. Area 1 in the north was overgrown pasture bounded on the north by the Lambwath Stream; a number of footpaths cross the field. Area 2 in the south comprised a ploughed field and Area 3 to the east was a playing field with goal posts, a cricket square and a children's play area.

4.2 Areas 2 and 3 were predominantly level with a mean elevation of approximately 10m OD. Area 1 sloped gently down from approximately 10m OD in the south to 5m OD along the banks of the Lambwath Stream.

4.3 The underlying solid geology of the area comprises Flamborough Chalk Formation. Along the Lambwath Stream the chalk is overlain by alluvium deposits of clay, silt sand and gravel, elsewhere it is overlain by Devensian till.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage guidelines, *Geophysical survey in archaeological field evaluation* (David, Linford & Linford 2008); the Institute for Archaeologists (IfA) *Standard and Guidance for archaeological geophysical survey* (2011); the IfA Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Guide to Good Practice: Geophysical Data in Archaeology* (Schmidt & Ernenwein 2011).

Technique selection

5.2 Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a suite of complementary techniques such as magnetometry, earth electrical resistance, ground-penetrating radar, electromagnetic survey and topsoil magnetic susceptibility survey. Some techniques are more suitable than others in particular situations, depending on site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.

5.3 In this instance, based previous work in the area, it was considered likely that cut features such as ditches and pits might be present on the site, and that other types of feature such as trackways, wall foundations and fired structures (for example kilns and hearths) might also be present.

5.4 Given the anticipated shallowness of targets and the non-igneous geological environment of the study area a geomagnetic technique, fluxgate gradiometry, was considered appropriate for detecting the types of feature mentioned above. This technique involves the use of hand-held magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect archaeological features.

Field methods

5.5 A 30m grid was established across each survey area and tied-in to known, mapped Ordnance Survey points using a Leica GS15 global navigation satellite system (GNSS) with real-time kinematic (RTK) corrections typically providing 10mm accuracy.

5.6 Measurements of vertical geomagnetic field gradient were determined using Bartington Grad601-2 dual fluxgate gradiometers. A zig-zag traverse scheme was employed and data were logged in 30m grid units. The instrument sensitivity was nominally 0.03nT, the sample interval was 0.25m and the traverse interval was 1m, thus providing 3,600 sample measurements per 30m grid unit.

5.7 Data were downloaded on site into a laptop computer for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Data processing

5.8 Geoplot v.3 software was used to process the geophysical data and to produce both continuous tone greyscale images and trace plots of the raw (minimally processed) data. The greyscale images and interpretations are presented in Figures 2-5; the trace plots are provided in Figure 6. In the greyscale images, positive magnetic anomalies are displayed as dark grey and negative magnetic anomalies as light grey. Palette bars relate the greyscale intensities to anomaly values in nanoTesla.

5.9 The following basic processing functions have been applied to each dataset:

clip — clips data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic

zero mean traverse — sets the background mean of each traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities

destagger — corrects for displacement of geomagnetic anomalies caused by alternate zig-zag traverses

interpolate — increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

Interpretation: anomaly types

5.10 A colour-coded geophysical interpretation plan is provided. Three types of geomagnetic anomaly have been distinguished in the data:

positive magnetic — regions of anomalously high or positive magnetic field gradient, which may be associated with high magnetic susceptibility soil-filled structures such as pits and ditches

negative magnetic	regions of anomalously low or negative magnetic field gradient, which may correspond to features of low magnetic susceptibility such as wall footings and other concentrations of sedimentary rock or voids
dipolar magnetic	paired positive-negative magnetic anomalies, which typically reflect ferrous or fired materials (including fences and service pipes) and/or fired structures such as kilns or hearths

Interpretation: features

General comments

5.11 A colour-coded archaeological interpretation plan is provided.

5.12 Small, discrete dipolar magnetic anomalies have been detected in each of the survey areas. These almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes and brick fragments, and in most cases have little or no archaeological significance. A sample of these is shown on the geophysical interpretation plans, however, they have been omitted from the archaeological interpretation plans and the following discussion.

Area 1

5.13 A series of parallel, alternate positive and negative magnetic anomalies has been detected aligned approximately north-east/south-west across this survey area; these are likely to reflect former ridge and furrow cultivation of the area.

5.14 Several linear positive magnetic anomalies were detected in the south-western corner of this field, which probably reflect soil-filled features such as ditches or foundation trenches.

5.15 A sinuous, broad positive magnetic anomaly was detected across this survey area. This broadly corresponds to a break in slope in the field and is probably geomorphological. More diffuse, weak and broad anomalies across both this area and Area 2 are likely to reflect variations in the rockhead topography.

5.16 A linear negative anomaly was detected aligned approximately north-east/south-west across the northern part of the survey area. This almost certainly reflects a service pipe or drain. Weaker negative magnetic anomalies aligned north-west/south-east probably reflect land drains.

5.17 The intense dipolar magnetic anomalies detected along the western edge of this area reflect security fencing around the sewage works.

5.18 Two inspection covers were noted on the ground and detected as large dipolar magnetic anomalies. Any pipe that might lie between them has not been clearly distinguished in the data but may correspond to an anomaly along a former plough furrow.

Area 2

5.19 Two faint linear positive magnetic anomalies were detected in the east-part of this survey area which could reflect soil-filled ditches.

5.20 A large number of broad and diffuse positive and negative magnetic anomalies were detected across this area, which are likely to reflect variation in the underlying solid geology. Some of these anomalies could mask smaller and weaker anomalies of possible archaeological origin.

5.21 The modern plough regime was detected as a weak magnetic texture across the field, aligned north-east/south-west.

Area 3

5.22 A narrow curvilinear positive magnetic anomaly was detected in the southern corner of this area. Further rectilinear and linear positive magnetic anomalies were also detected in this part of the survey area. These anomalies could reflect former ditches.

5.23 Further positive magnetic anomalies were detected in the north-western part of this area, which could also reflect soil-filled features such as ditches.

5.24 Most other anomalies in this area are due to the sports furniture of the playing field. The six intense dipolar magnetic anomalies in the centre of the survey area reflect metal fence posts around a cricket square; those in the north-west corner reflect cricket nets; those along the eastern edge of the area reflect a fenced-off children's play area and a building. The pairs of dipolar magnetic anomalies on the east and west edges of the area reflect goal posts.

5.25 The dipolar magnetic anomaly on the southern edge of this survey area may reflect an adjacent service pipe.

6. Conclusions

6.1 6ha of geomagnetic survey was undertaken on land north of Benningholme Lane, Skirlaugh, East Yorkshire, prior to proposed development.

6.2 Possible soil-filled ditch features were identified in all three surveyed areas, including possible small rectangular enclosures in Areas 1 and 3.

6.3 Probable traces of former ridge and furrow cultivation were detected in Area 1.

6.4 Variations in the underlying geology were detected in Areas 1 and 2.

6.5 Existing services and sports furniture were detected in Areas 1 and 3.

7. Sources

Cooper, O, 2007 *Skirlaugh Sewage Pumping Station and Rising Main, Skirlaugh, near Beverley. Desk-based Cultural Heritage Assessment and Geophysical Survey*. Northern Archaeological Associates

Cooper, O, & Fraser, M 2008 *Skirlaugh SPS and Rising Main, near Beverley, East Riding of Yorkshire: archaeological observation, investigation and recording.* Report No **08/23**. Northern Archaeological Associates

David, A, Linford, N, & Linford, P, 2008 *Geophysical Survey in Archaeological Field Evaluation*. English Heritage

Gaffney, C, Gater, J, & Ovenden, S, 2002 *The use of geophysical techniques in archaeological evaluations*. Technical Paper **6**, Institute of Field Archaeologists

Gourley, B, 2010 *Land at Hillfield Drive, Skirlaugh, East Riding of Yorkshire. Report on Geophysical Survey*. On Site Archaeology.

IfA 2011 *Standard and Guidance for archaeological geophysical survey*. Institute for Archaeologists

Schmidt, A, & Ernenwein, E, 2011 *Guide to Good Practice: Geophysical Data in Archaeology*. Archaeology Data Service

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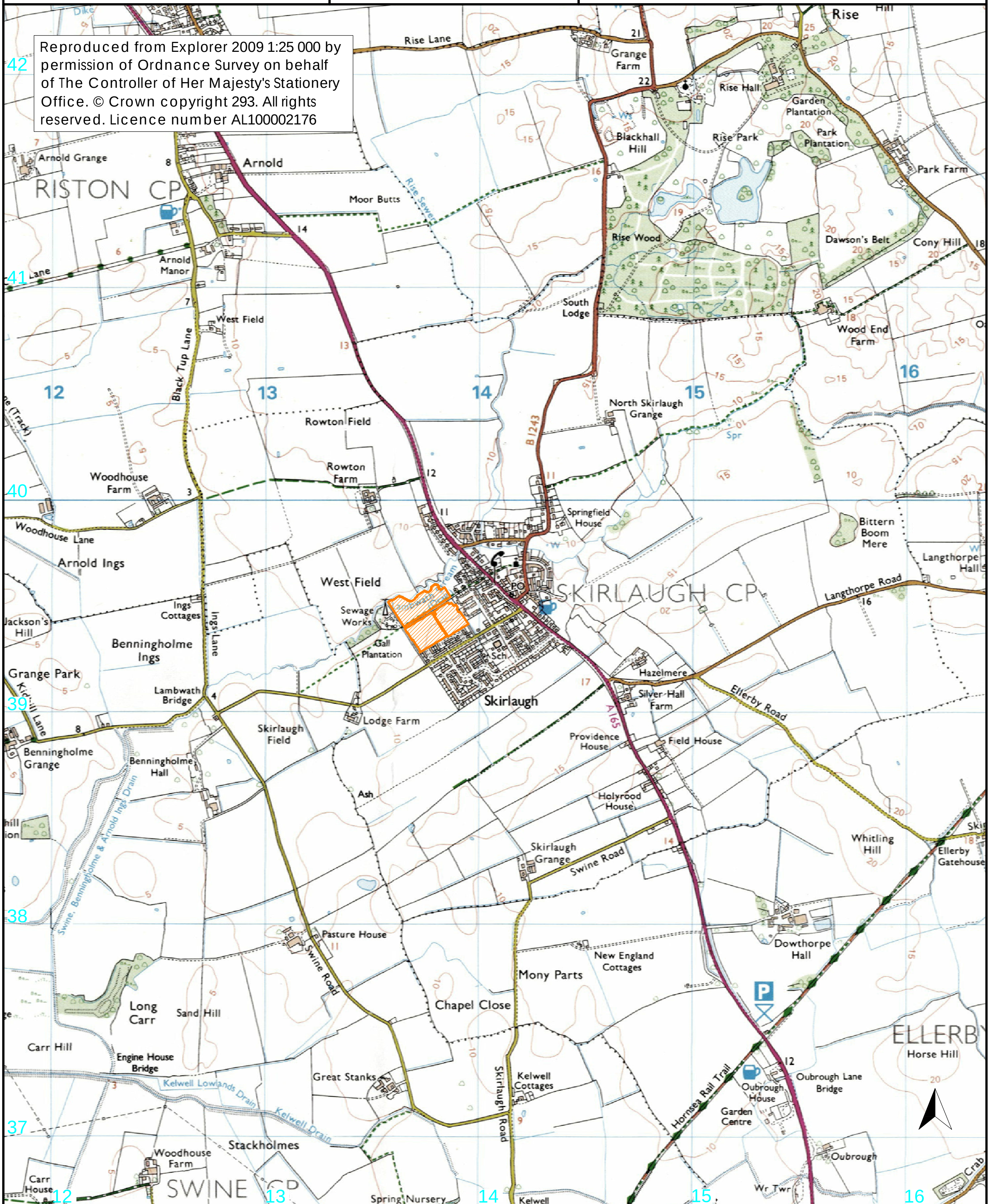
Figure 1: Site location



site location

0 1km
scale 1:25 000 for A4 plot

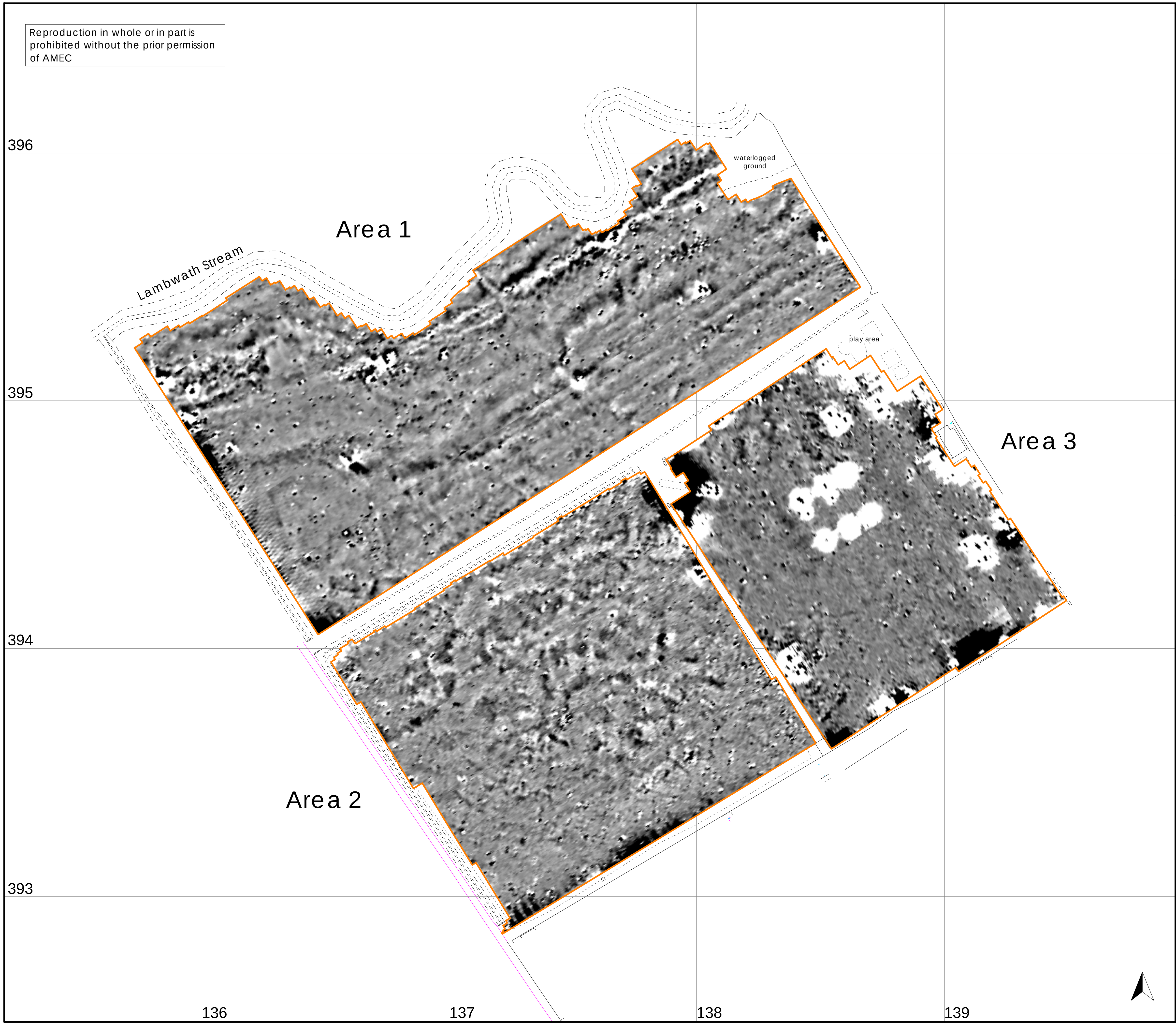


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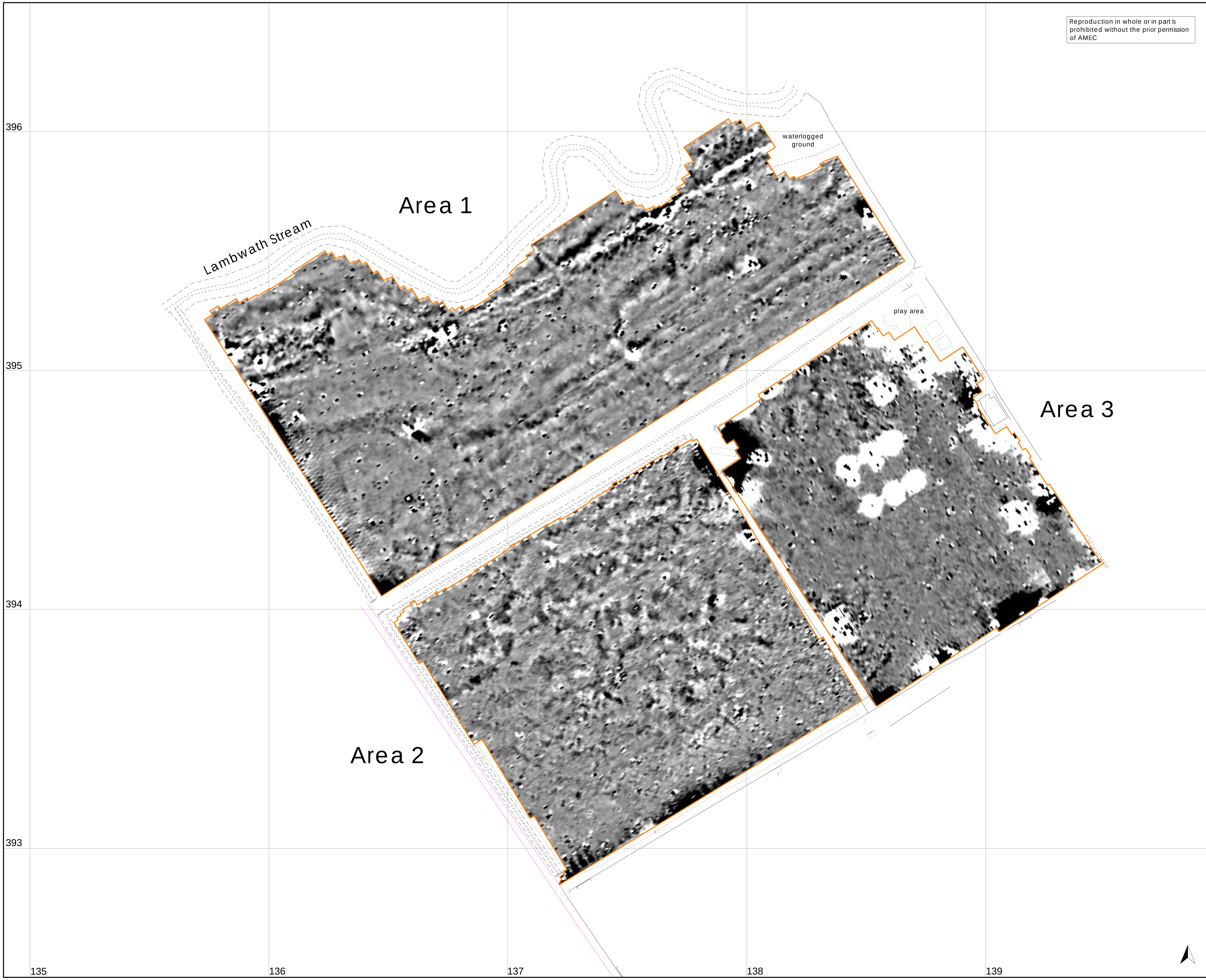
Figure 2: Survey area 1:1500

0 75m
scale 1:1500 for A3 plot

magnetic survey



magnetic survey

-6 nT 8

0 50m
scale 1:1000 for A2 plot

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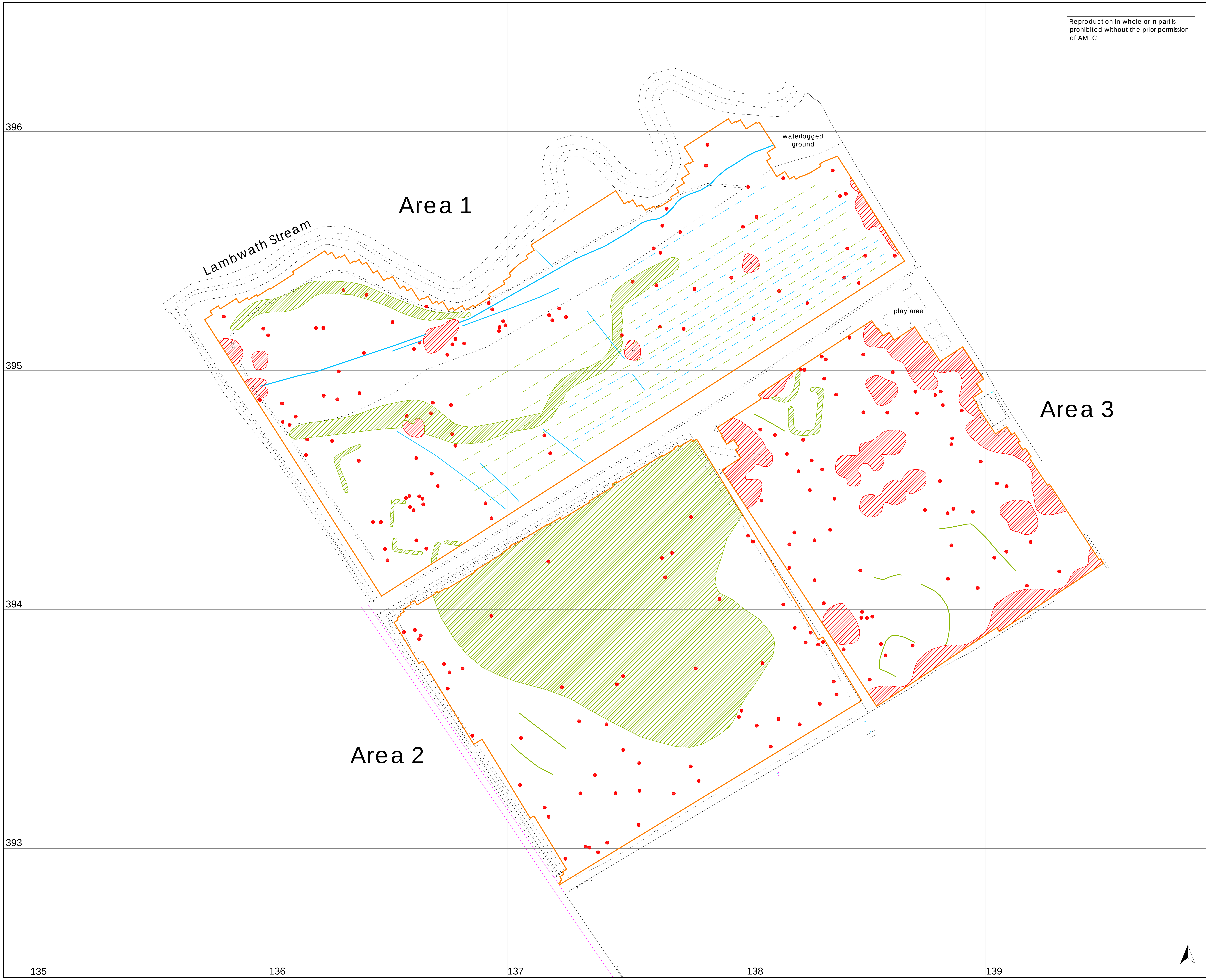
Figure 3: Geophysical survey 1:1000



magnetic survey
dipolar magnetic anomaly
positive magnetic anomaly
negative magnetic anomaly

0 50m
scale 1:1000 for A2 plot

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Figure 4: Geophysical interpretation

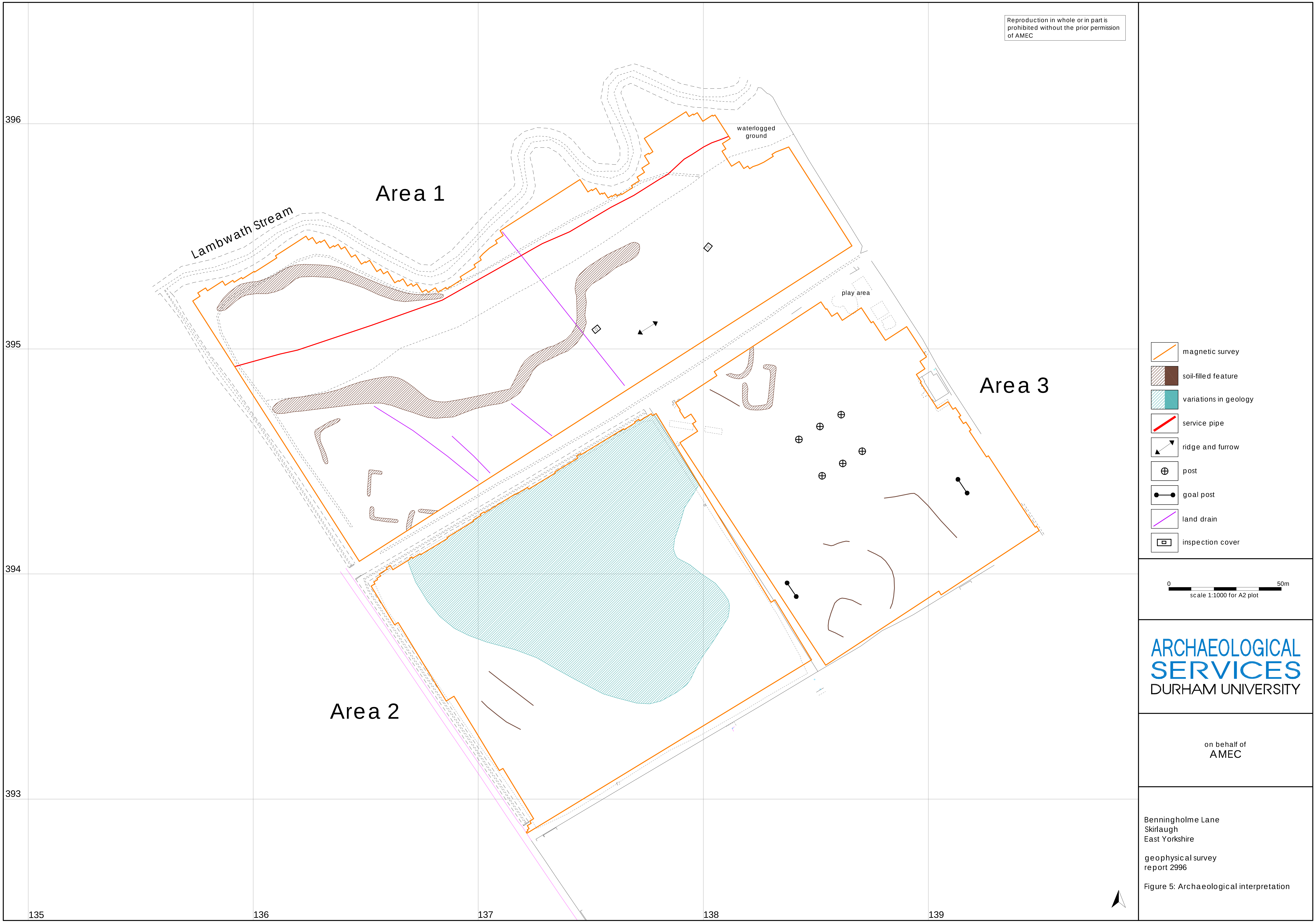

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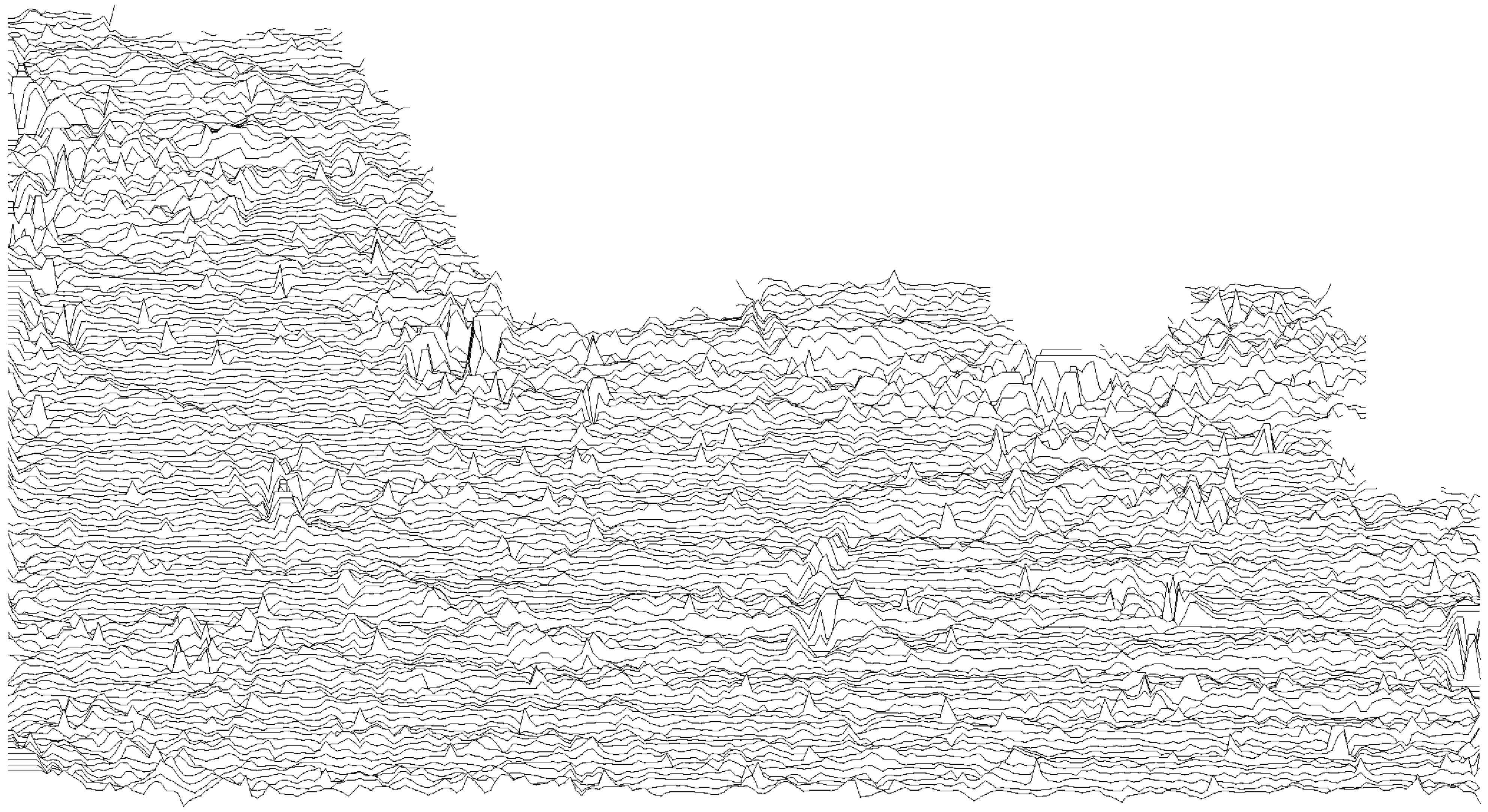
Figure 5: Archaeological interpretation

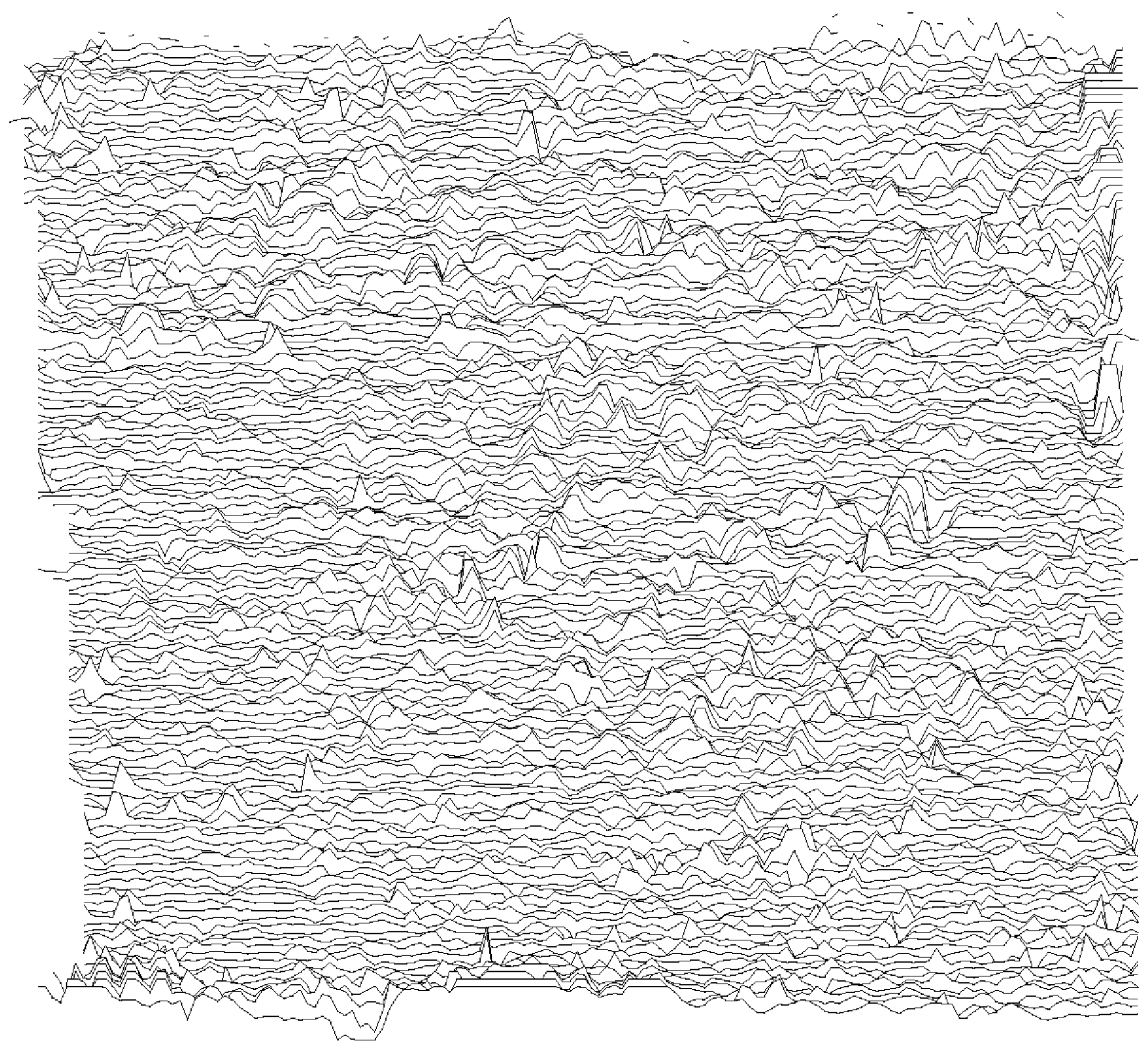
Area 1

28.00nT/cm



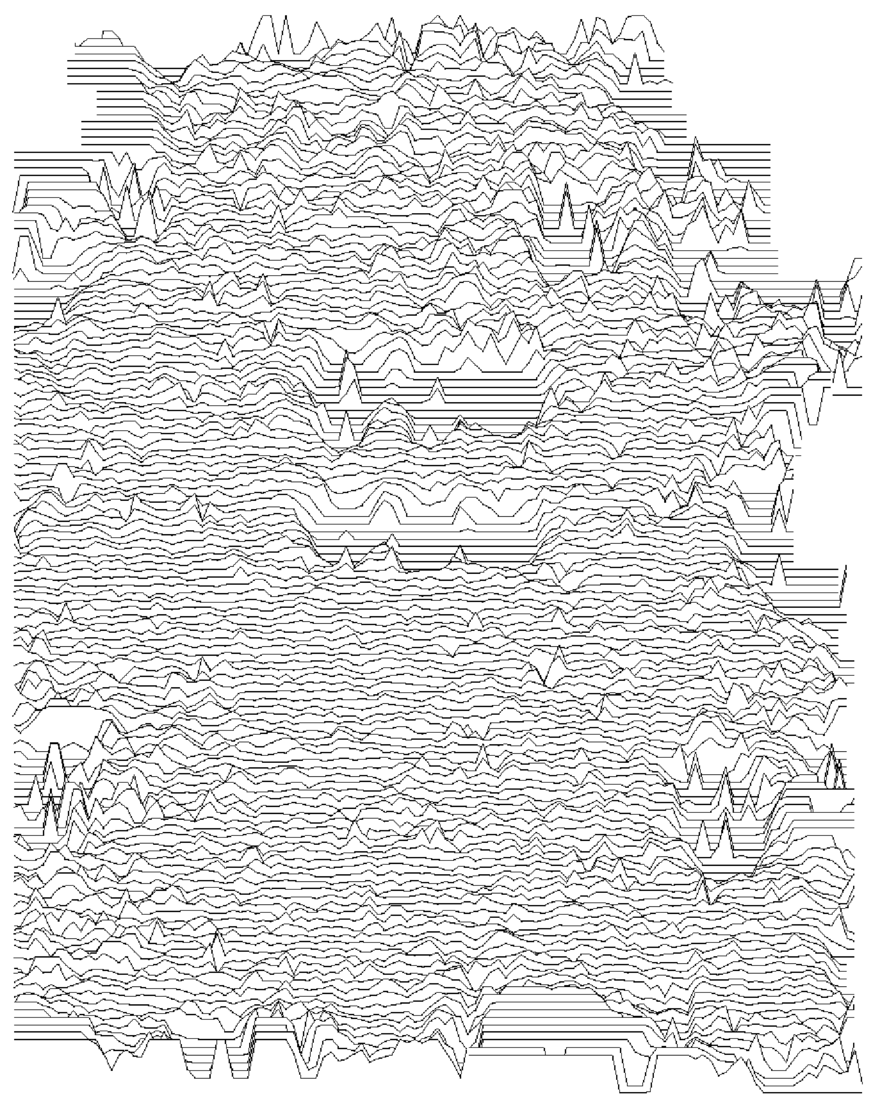
Area 2

28.00nT/cm



Area 3

20.00nT/cm



0 50m

scale 1:1000 for A2 plot

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Figure 6: Trace plots of geomagnetic data