Archaeological Services
University of Durham

Eccup to East Rigton Water Main, West Yorkshire

geophysical surveys

for

Northern Archaeological Associates

on behalf of

Costain

Report 1425
April 2006

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Marwood House, Harmire Enterprise Park, Barnard Castle, Co Durham DL12 8BN

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Contents

1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted in advance of a proposed pipeline development between Eccup and East Rigton, West Yorkshire. The works comprised of seven geophysical surveys in six fields.

1.2 The works were commissioned by Northern Archaeological Associates (NAA) on behalf of Costain and conducted by Archaeological Services in accordance with instructions provided by NAA.

Results

1.3 Anomalies indicating the presence of probable soil-filled features have been identified in six of the survey areas. The majority of these appear to reflect former field boundaries, though some may have earlier origins. In particular, the curvilinear form of possible ditches in Area 3 may indicate an enclosure ditch and associated features, and one anomaly in Area 7 may reflect a small ring-ditch.

1.4 Ferrous pipes were detected in two of the survey areas, one of which appears to be associated with Rigton reservoir.

2. Project background

Location (Figure 1)

2.1 The study area comprises a corridor of land between Eccup and East Rigton in West Yorkshire (NGR: SE 3450 4320 to SE 3700 4420). Seven areas along the corridor were surveyed, totalling approximately 5ha.

Development proposal

2.2 The surveys have been carried out in advance of the installation of a water main between Eccup and Rigton reservoirs.

Objective

2.3 The principal aim of the surveys was to determine the nature and extent of any sub-surface features of potential archaeological significance 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 advance of development.

Methods statement

2.4 The surveys have been undertaken in accordance with instructions provided by Northern Archaeological Associates (NAA).

Dates

2.5 Fieldwork was undertaken between 15th March and 13th April 2006. This report was prepared between 20th March and 19th April 2006.

Personnel

2.6 Fieldwork was conducted by Janice Adams, Graeme Attwood (Supervisor), Edward Davies, Sam Roberts (Supervisor) and Louise Robinson. This report was prepared by Graeme Attwood and Duncan Hale, with illustrations by David Graham, Martin Railton and Janine Fisher. The Project Manager was Duncan Hale.

Archive/OASIS

2.7 The site code is **EER06**, for **E**ccup to **E**ast **R**igton water main 20**06**. The survey archive will be transferred to the NAA. 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 **archaeol3-13765**.

3. Landuse, topography and geology

3.1 The seven survey areas were within six fields, of which two were in a ploughed state and four were under pasture.

3.2 Survey Areas 1 and 2 occupied a gentle north-west-facing slope at 100-108m OD. Area 3 sharply rose from an elevation of 65m OD at its northern end to 90m OD at its southern limit. Areas 4, 5 and 6 were predominantly level at a mean elevation of 110m OD. Area 7 occupied a north-west-facing slope between 80-100m OD.

3.3 The underlying solid geology of the area comprises Carboniferous Namurian millstone grit, which is overlain by boulder clay and morainic drift.

4. Geophysical survey

Standards

4.1 The surveys and reporting were conducted in accordance with English Heritage Research and Professional Services Guideline No.1, *Geophysical survey in archaeological field evaluation* (David 1995); the Institute of Field Archaeologists Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Geophysical Data in Archaeology: A Guide to Good Practice* (Schmidt 2001).

Technique selection

4.2 Geophysical surveying enables the relatively rapid and non-invasive identification of potential archaeological features within landscapes and can involve a variety of complementary techniques such as magnetometry, electrical resistivity, ground-penetrating radar and electromagnetic survey. Some techniques are more suitable than others in particular situations, depending on a variety of 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.

4.3 In this instance, it was considered likely that cut features, such as ditches and pits, would 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.

4.4 Given the anticipated shallowness of the targets and the non-igneous geological environment of the study area a geomagnetic technique, fluxgate gradiometry, was considered appropriate for detecting each of the types of feature mentioned above. This technique involves the use of hand-held magnetometers to detect and record minute 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

4.5 A 20m grid was established across each survey area and tied-in to known, mapped Ordnance Survey points using a Leica TR307 total survey station instrument equipped with a datalogger and *Penmap* software.

4.6 The westernmost survey area, Area 6, was moved several metres to the north as the original highlighted area crossed a bridle way with trees on either side.

Immediately east of Area 6 the land to be surveyed spanned a field boundary and so was surveyed in two parts, Areas 4 and 5.

4.7 Measurements of vertical geomagnetic field gradient were determined using Geoscan FM256 gradiometers with automatic datalogging facilities. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was set to 0.1nT, the sample interval to 0.25m and the traverse interval to 1.0m, thus providing 1600 sample measurements per 20m grid unit.

4.8 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

4.9 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 data. The greyscale images and interpretations are presented in Figures 2-16; the trace plots are provided in Appendix I. In the greyscale images, positive magnetic anomalies are displayed as dark grey and negative magnetic anomalies as light grey. A palette bar relates the greyscale intensities to anomaly values in nanoTesla.

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

Clip – clips, or limits 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.

Despike – locates and suppresses random iron spikes in gradiometer data.

Destagger – corrects for displacement of anomalies caused by alternate zig-zag traverses.

Low pass filter – is useful for smoothing data or for enhancing larger weak features.

Interpolate – increases the number of data points in a survey, to match sample and traverse intervals. In this instance the gradiometer data have been interpolated to 0.25m by 0.25m intervals.

Interpretation: anomaly types

4.11 Colour-coded geophysical interpretation plans are provided for each survey area. 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

4.12 Colour-coded archaeological interpretation plans are provided for each survey area.

4.13 Discrete dipolar magnetic anomalies have been detected across all survey areas; these almost certainly reflect small items of near-surface ferrous and/or fired debris. A representative sample of these anomalies is indicated on the interpretation plans.

Area 1 (Figs 2-4)

4.14 A chain of dipolar magnetic anomalies traverses the area, almost certainly reflecting a ferrous pipe. This is probably related to the present reservoir complex; indeed part of its course corresponds to the proposed route for the new pipe.

4.15 Several linear positive magnetic anomalies were also detected here. These are indicative of soil-filled features and may represent former field systems.

Area 2 (Figs 2-4)

4.16 A linear positive magnetic anomaly detected in Area 1 continues into this area. It is associated with another, perpendicular, positive magnetic linear anomaly and both may reflect former field boundaries.

Area 3 (Figs 5-7)

4.17 A chain of dipolar magnetic anomalies detected here almost certainly reflects a ferrous pipe traversing the area; this appears likely to be associated with the existing reservoirs to the south, next to Whin Hill House.

4.18 A number of linear positive magnetic anomalies were detected across this survey area. The majority of these appear to reflect former field boundaries, while others may represent other soil-filled ditches.

4.19 A magnetic ‘texture’ was detected across the western part of the survey area; this almost certainly reflects the current plough direction.

Areas 4 and 5 (Figs 8-10)

4.20 One feature of potential archaeological interest was detected in these two areas, which were located either side of a wire fence. A weak and diffuse positive magnetic anomaly parallel to and south of the fence may reflect a soil-filled ditch feature. The only other anomalies detected reflect the existing fence, a gate and near-surface ferrous litter.

Area 6 (Figs 8-10)

4.21 A linear positive magnetic anomaly was detected towards the eastern end of the survey area. This may reflect a soil-filled feature such as a former field boundary or ditch.

4.22 An extremely weak curvilinear positive magnetic anomaly detected in the central part of the area is likely to reflect the remains of a soil-filled feature, possibly an enclosure ditch. Additional weak curvilinear anomalies could reflect the remains of other ditch features.

4.23 Parallel, positive magnetic linear anomalies traverse the survey area in an east-west direction, spaced at approximately 6-8m intervals. These are likely to reflect the presence of land drains in this boggy pasture area.

Area 7 (Figs 11-13)

4.24 A linear positive magnetic anomaly was detected towards the eastern end of the survey area. This is likely to reflect a soil-filled feature such as a ditch or former field boundary. A cluster of possible pit features was detected to the east of this feature.

4.25 A small sub-circular positive magnetic anomaly detected in the southernmost corner of the survey may also reflect a soil-filled feature such as a small ring-ditch, measuring *c*.4m in diameter.

4.26 A magnetic 'texture' was detected aligned north-east/south-west across much of the survey area, following the contours of the slope; these anomalies almost certainly correspond to soil-creep terracettes evident on the hillside.

5. Conclusions

5.1 Seven geophysical surveys were undertaken along three sections of the proposed pipeline corridor.

5.2 Anomalies indicating the presence of possible soil-filled features have been identified in six of the survey areas. The majority of these appear to reflect former field boundaries though some may have earlier origins. In particular, the curvilinear form of possible ditch features in Area 6 may indicate the presence of an enclosure ditch and associated features, while a small circular anomaly in Area 7 could reflect a ring-ditch.

5.3 Ferrous pipes were detected in two of the survey areas (1 and 3); both appear to be associated with existing reservoirs.

6. Sources

David, A 1995 *Geophysical survey in archaeological field evaluation,* Research and Professional Services Guideline **1**, English Heritage

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

Schmidt, A 2001 *Geophysical Data in Archaeology: A Guide to Good Practice,* Archaeology Data Service

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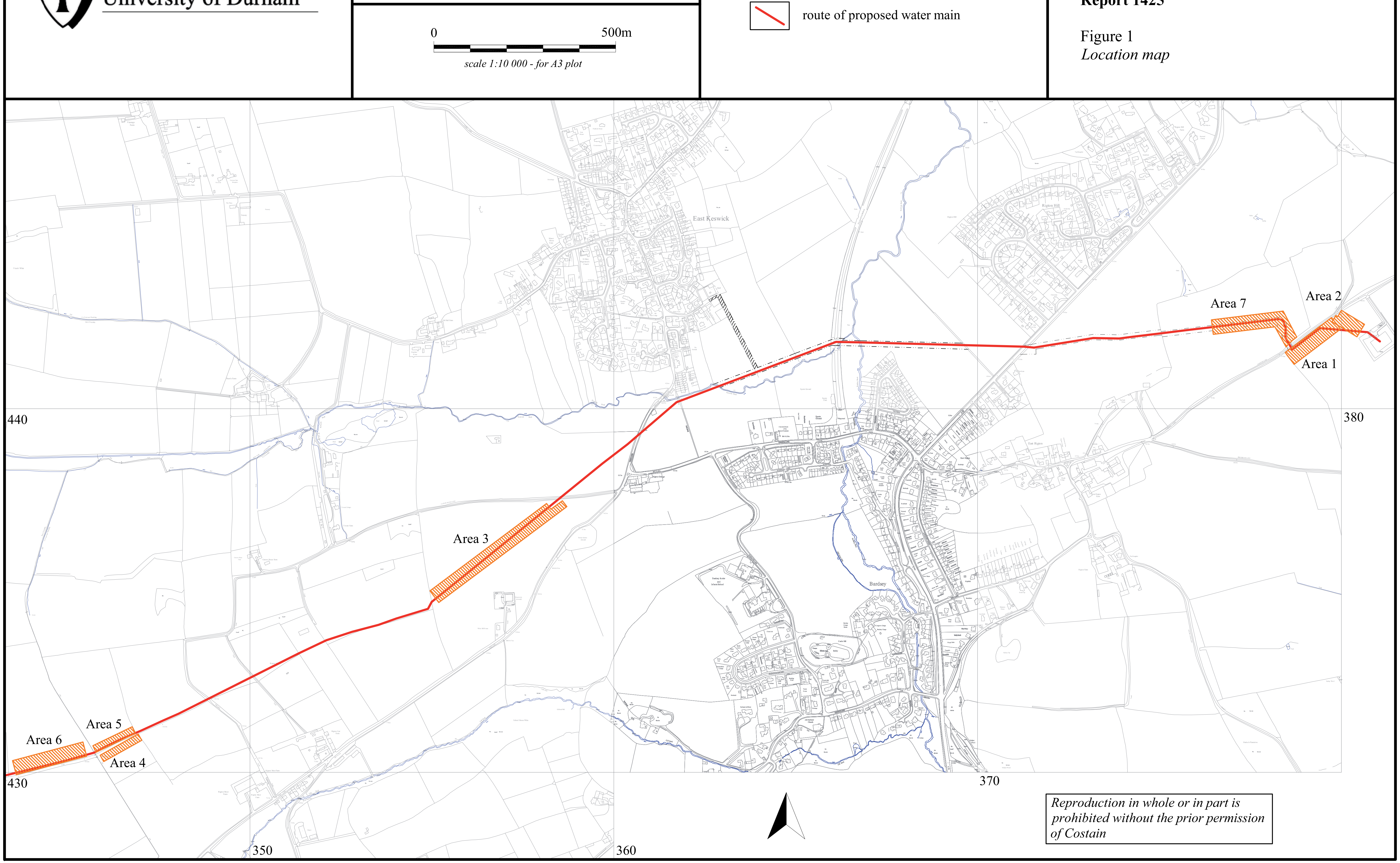
Figure 1
Location map



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0 50m
scale 1:1000 - for A3 plot

outline of survey area

5.00
4.17
3.33
2.50
1.67
0.83
0
-0.83
-1.67
-2.50
-3.33
-4.17
-5.00 nT

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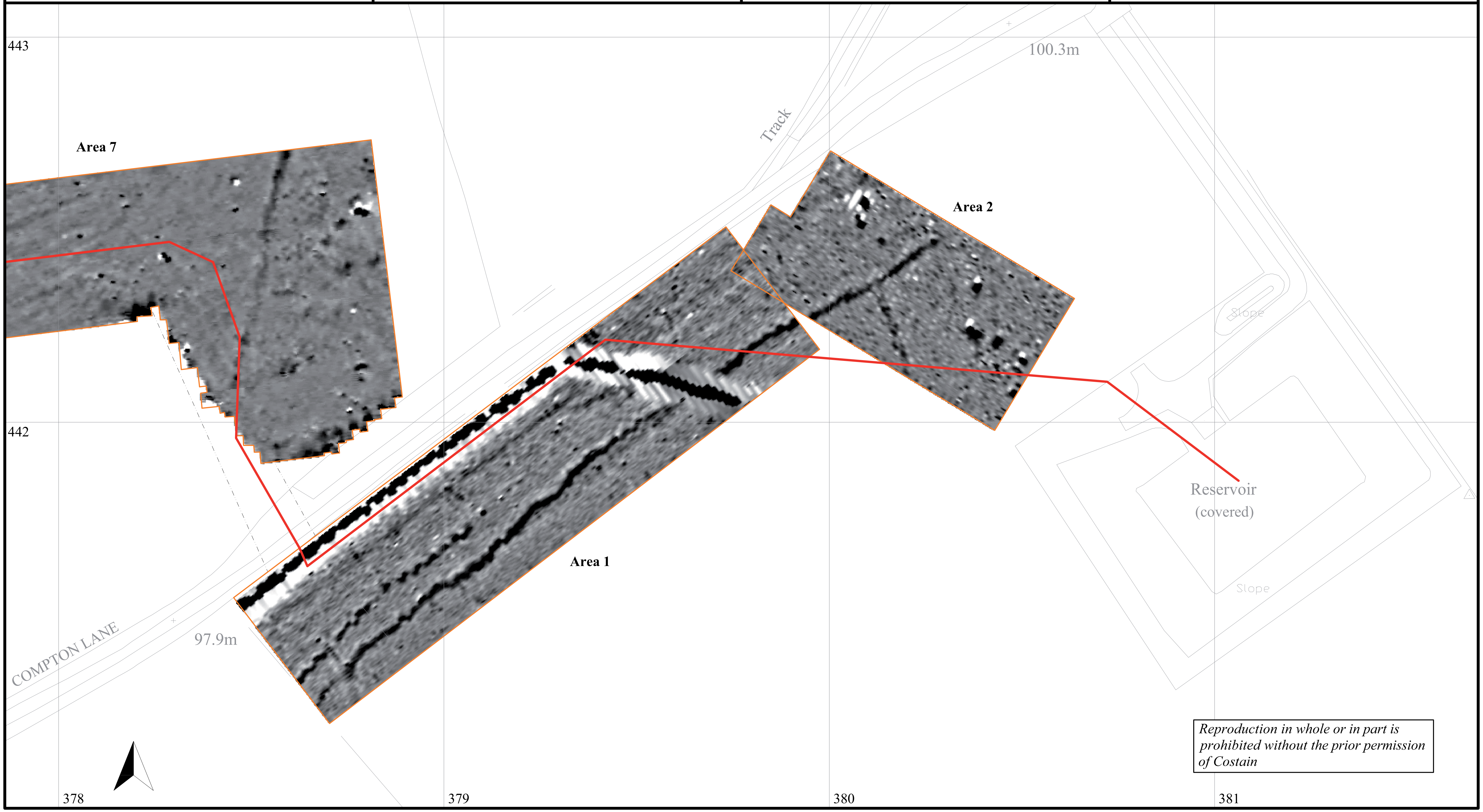
Figure 2

Areas 1 and 2, geophysical surveys



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0 50m
scale 1:1000 - for A3 plot

- outline of survey area
- positive magnetic anomalies
- negative magnetic anomalies
- dipolar magnetic anomalies

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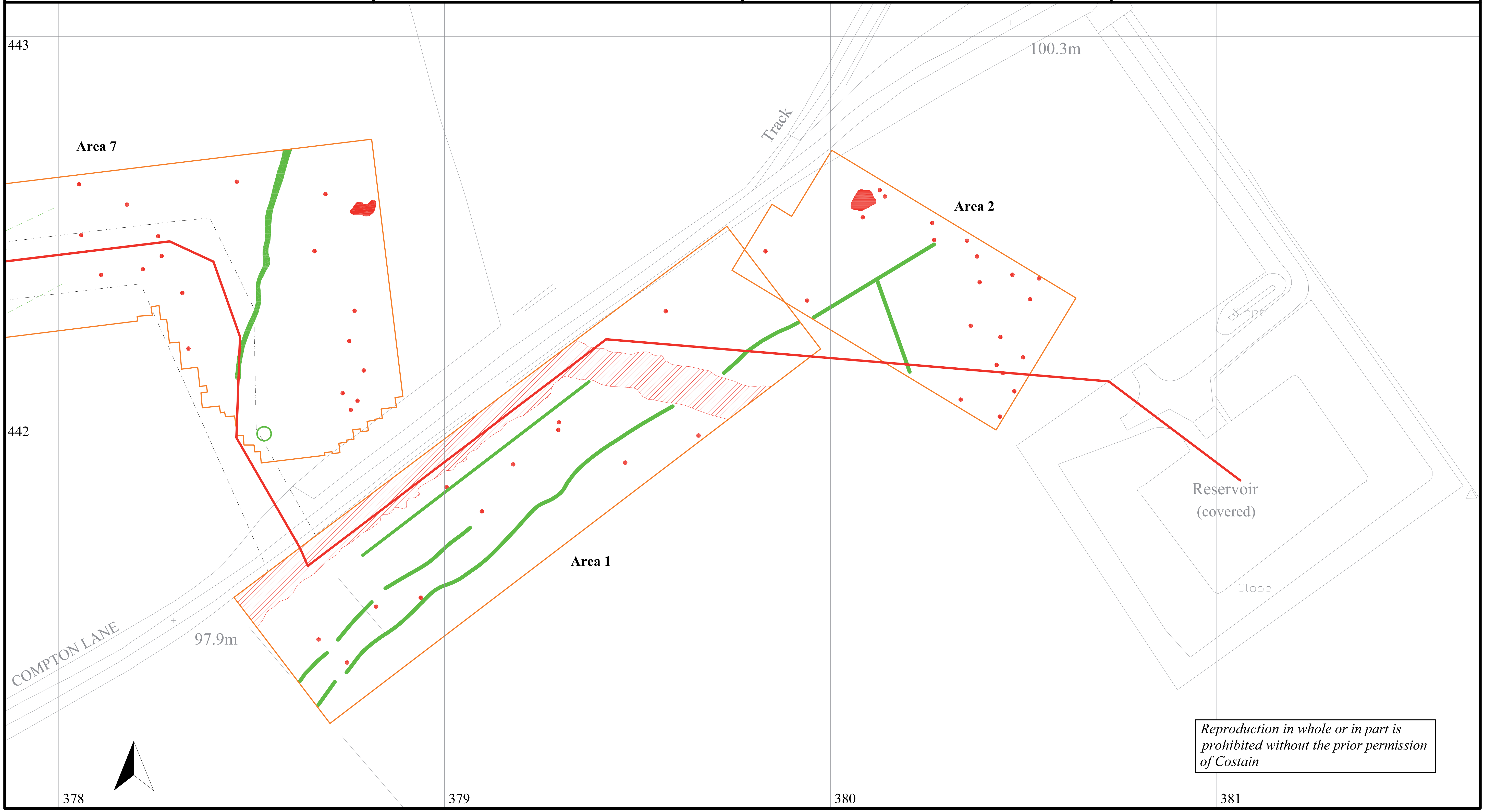
Figure 3

Areas 1 and 2 , geophysical interpretation



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0 50m
scale 1:1000 - for A3 plot

outline of survey area
soil-filled features
service pipes

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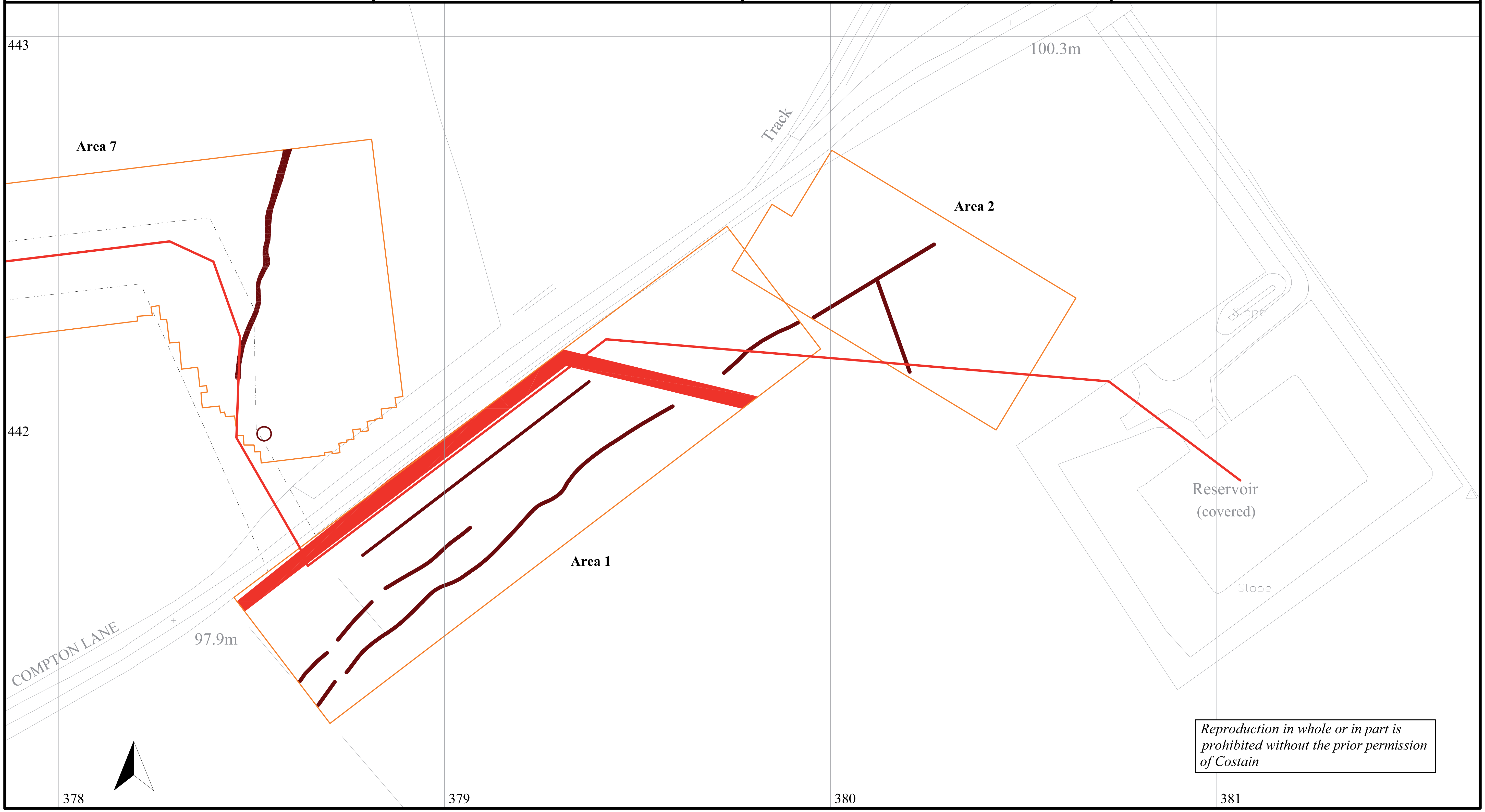
Figure 4

Areas 1 and 2, archaeological interpretation



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0 50m
scale 1:1500 - for A3 plot

outline of survey area

5.00
4.17
3.33
2.50
1.67
0.83
0
-0.83
-1.67
-2.50
-3.33
-4.17
-5.00 nT

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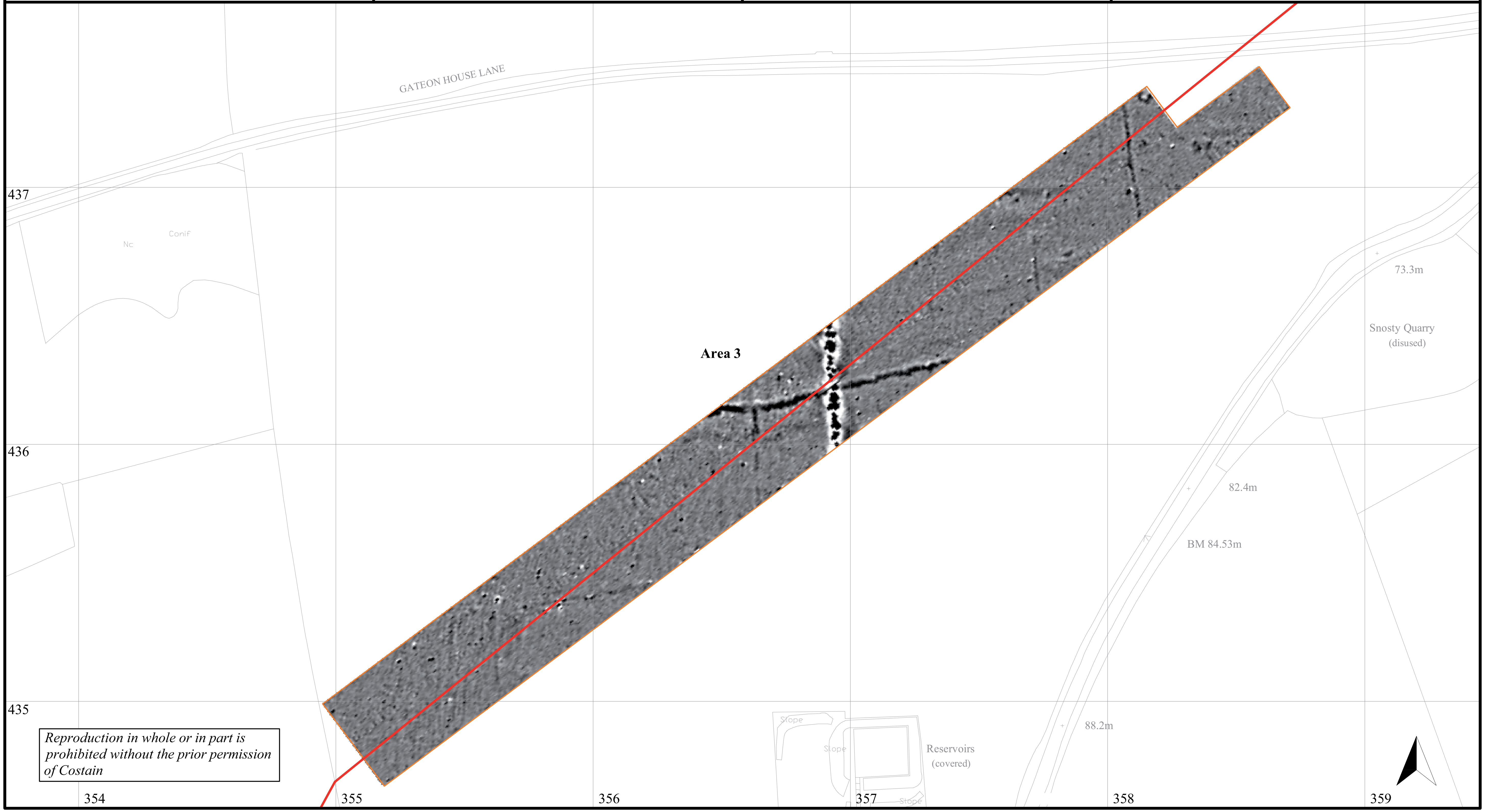
Figure 5

Area 3, geophysical survey



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0 50m
scale 1:1500 - for A3 plot

- outline of survey area
- positive magnetic anomalies
- negative magnetic anomalies
- dipolar magnetic anomalies

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Figure 6

Area 3, geophysical interpretation

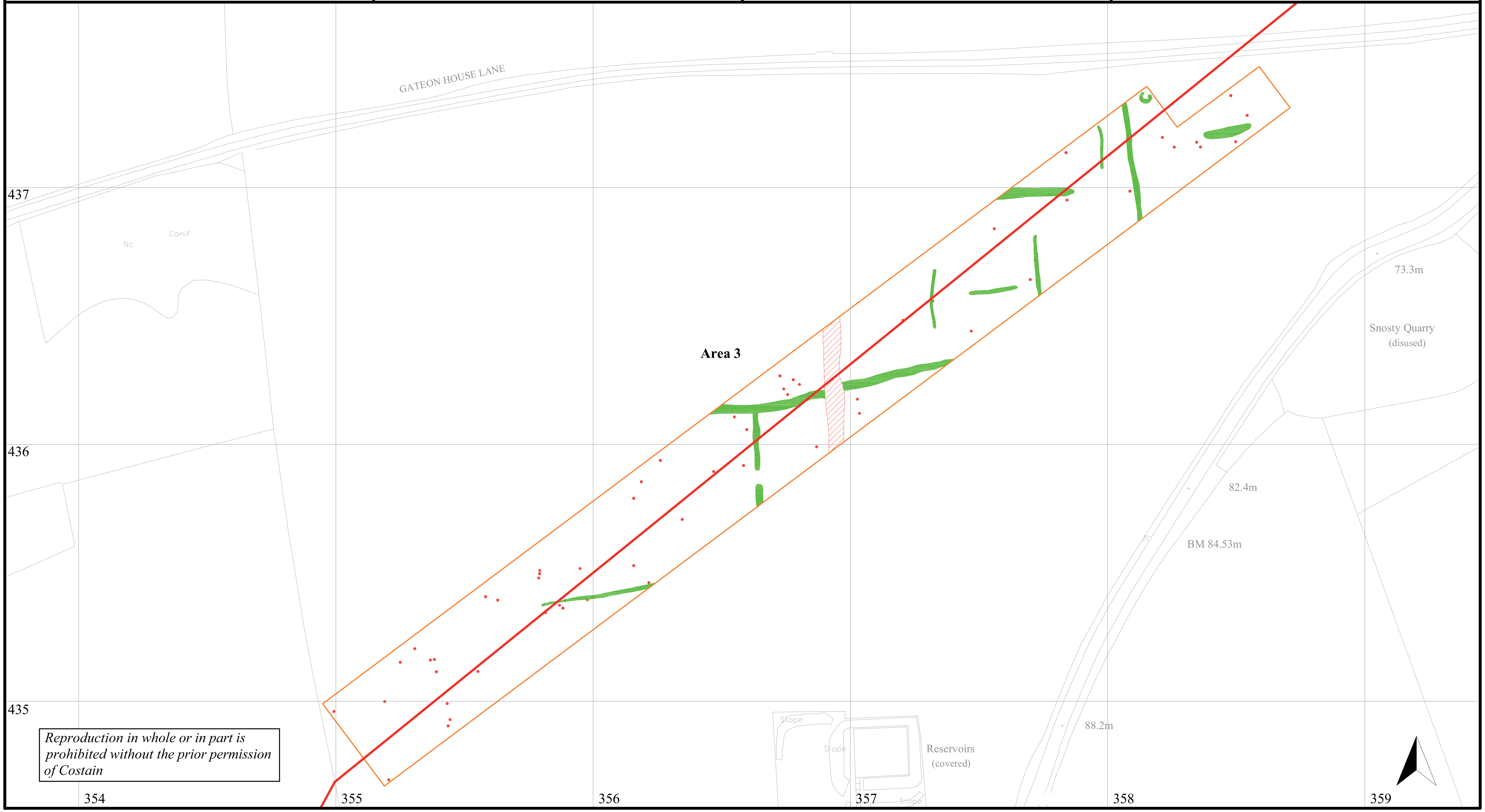

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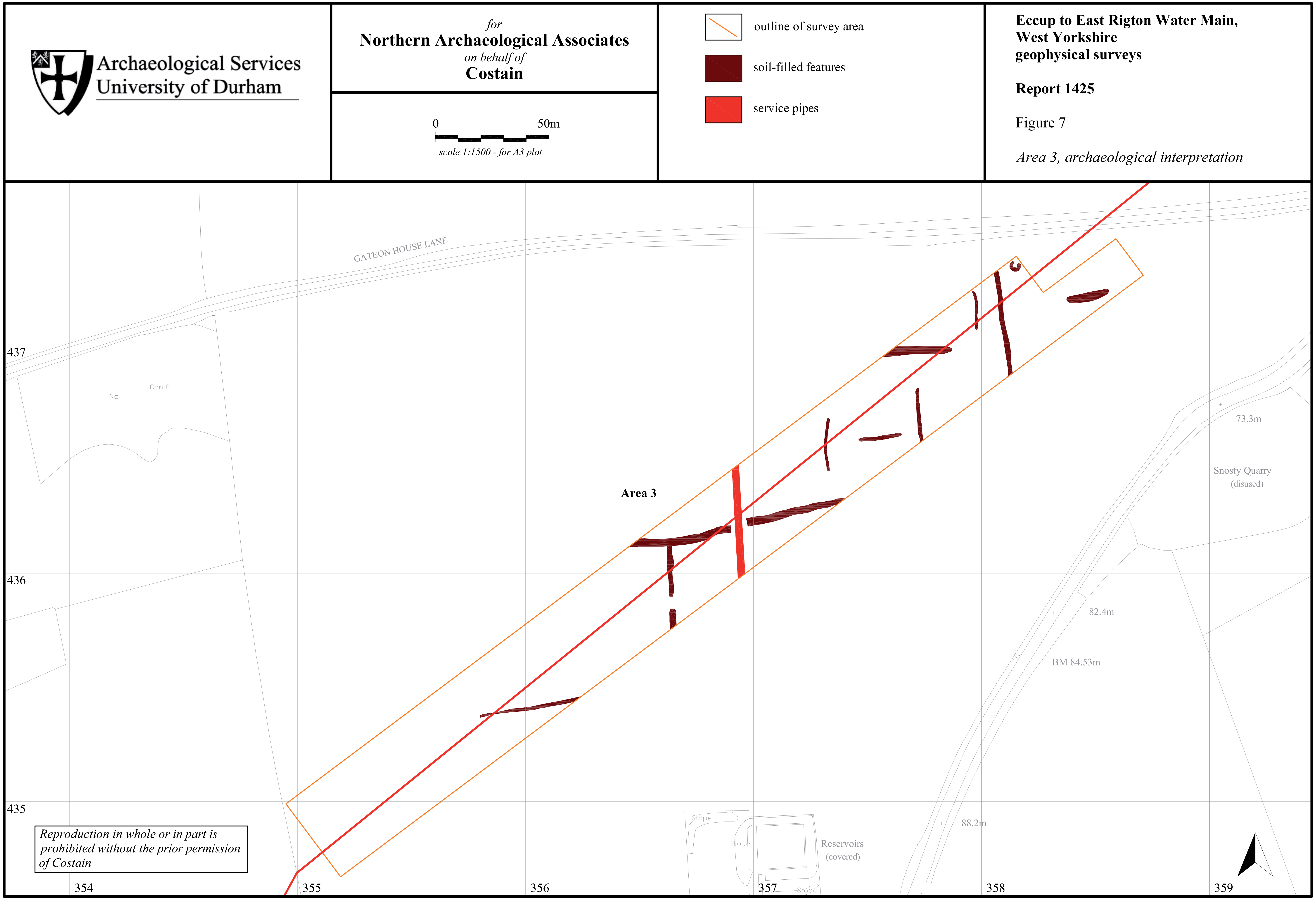
Figure 7

Area 3, archaeological interpretation



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0 50m
scale 1:1000 - for A3 plot

outline of survey area

5.00
4.17
3.33
2.50
1.67
0.83
0
-0.83
-1.67
-2.50
-3.33
-4.17
-5.00 nT

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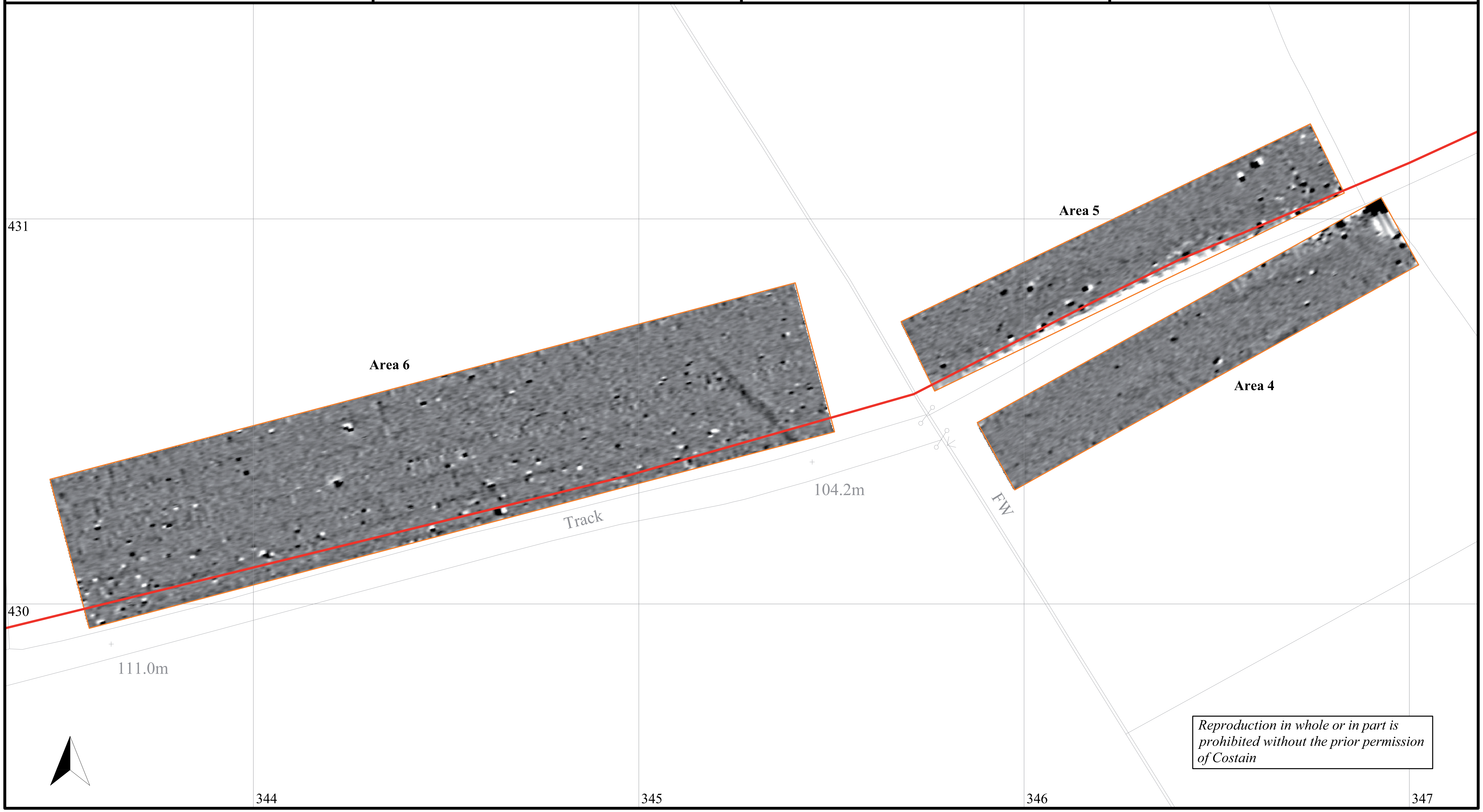
Figure 8

Areas 4, 5 and 6, geophysical surveys



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0 50m
scale 1:1000 - for A3 plot

outline of survey area
positive magnetic anomalies
negative magnetic anomalies
dipolar magnetic anomalies

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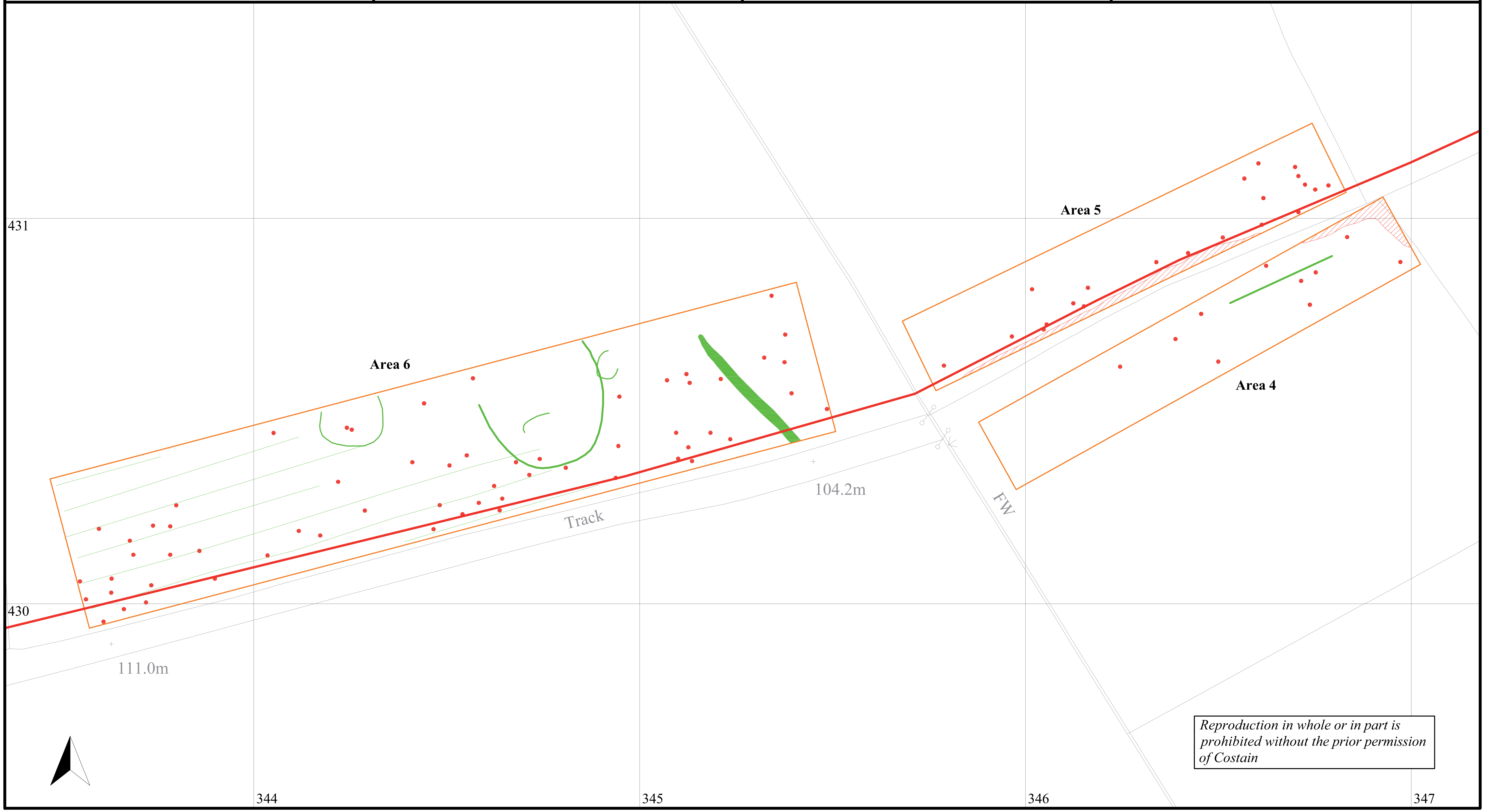
Figure 9

Areas 4, 5 and 6, geophysical interpretation



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0 50m
scale 1:1000 - for A3 plot

outline of survey area
soil-filled features
land drain

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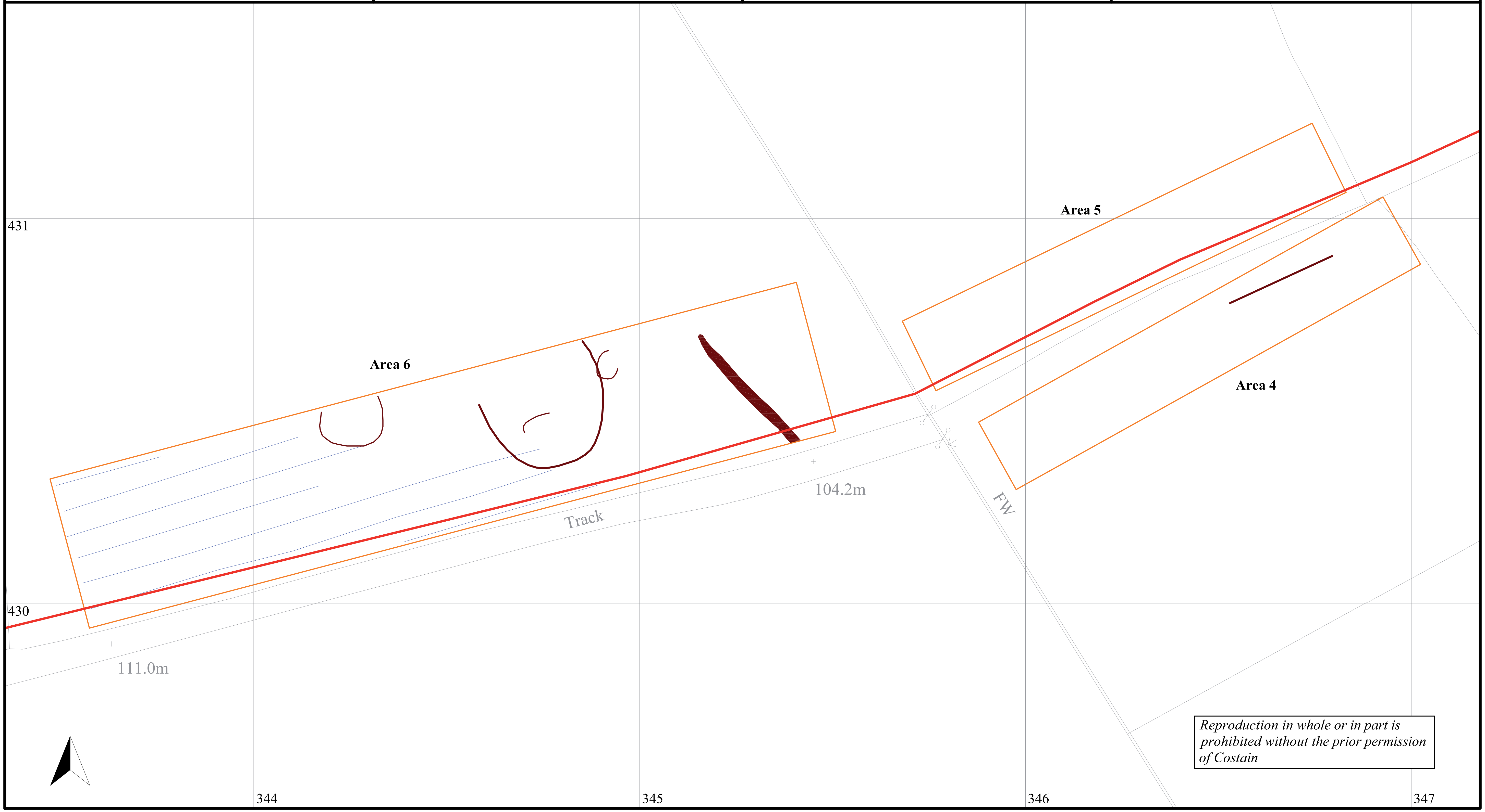
Figure 10

Areas 4, 5 and 6, archaeological interpretation



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outline of survey area

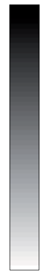

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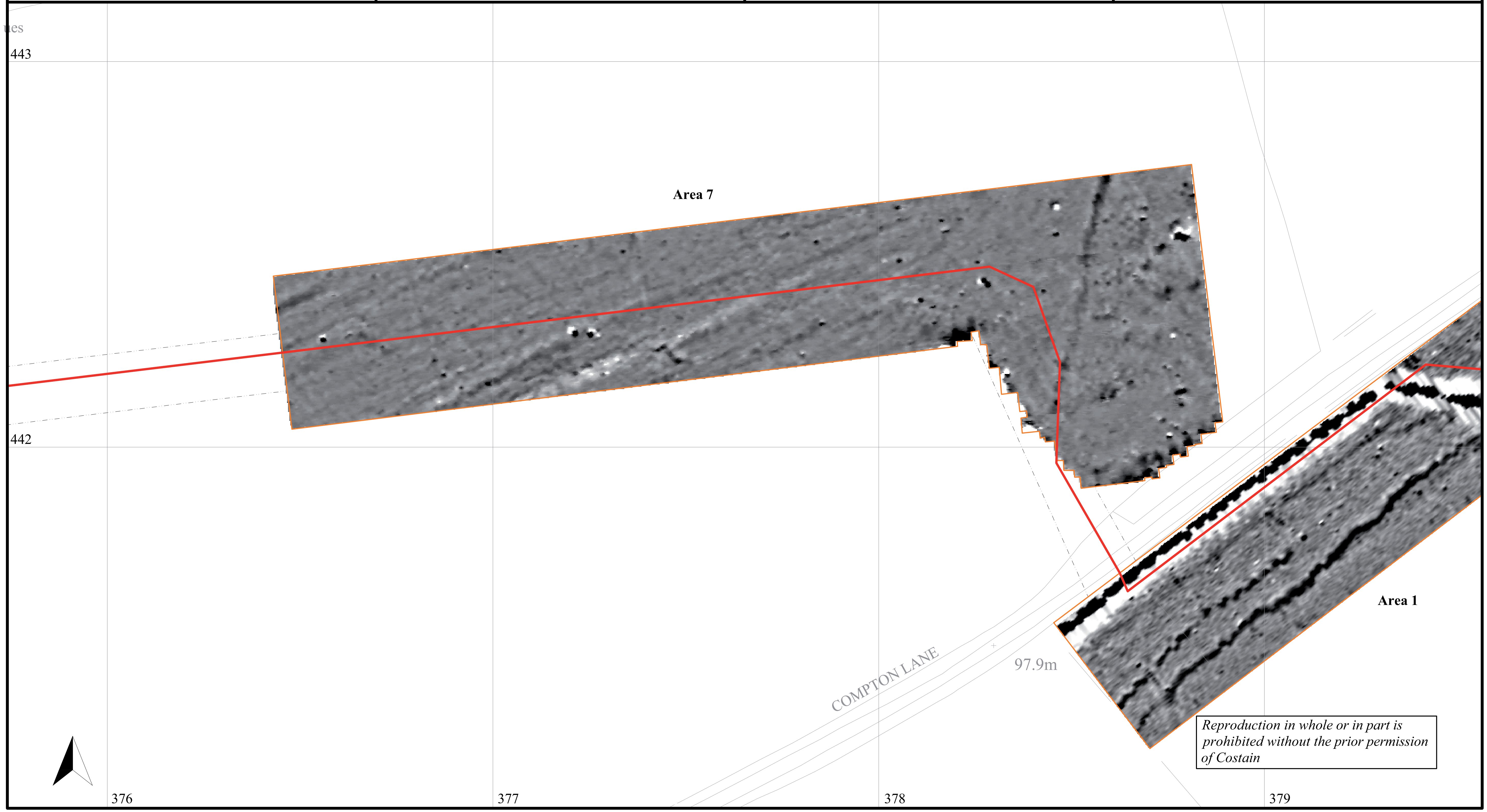
Figure 11

Area 7, geophysical survey



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0 50m
scale 1:1000 - for A3 plot

outline of survey area
positive magnetic anomalies
negative magnetic anomalies
dipolar magnetic anomalies

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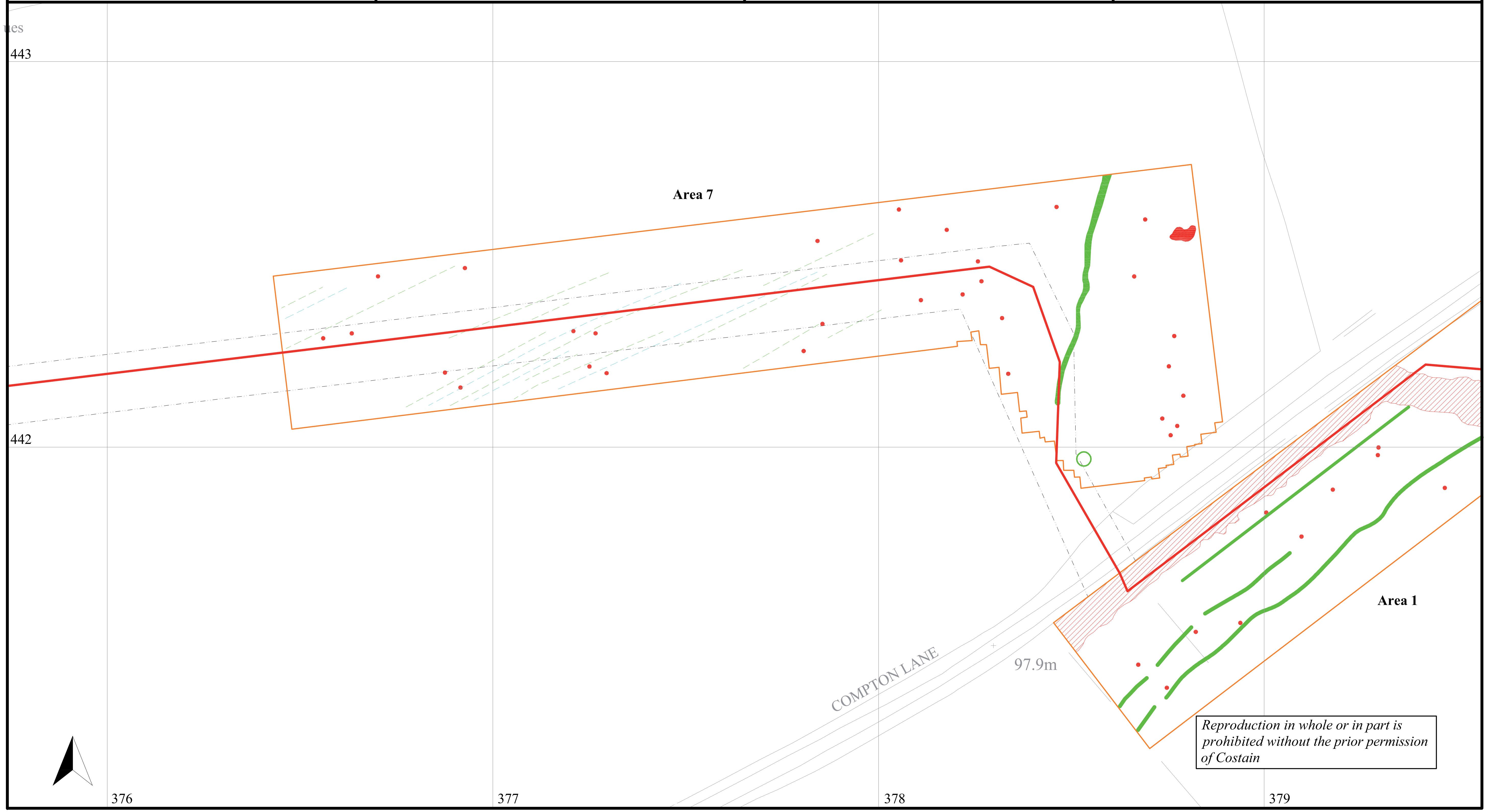
Figure 12

Area 7, geophysical interpretation



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0 50m
scale 1:1000 - for A3 plot

outline of survey area
soil-filled features
service pipes

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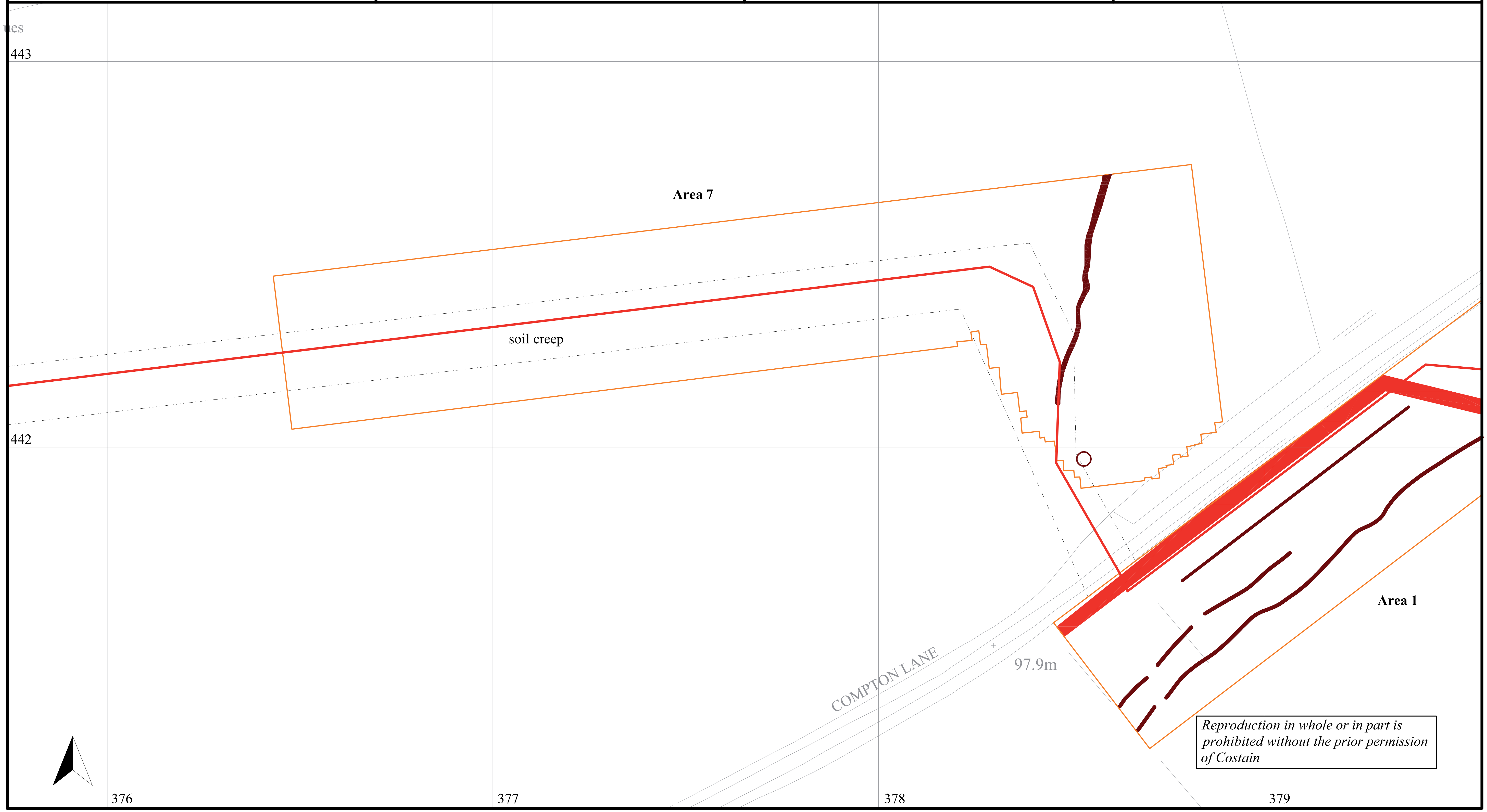
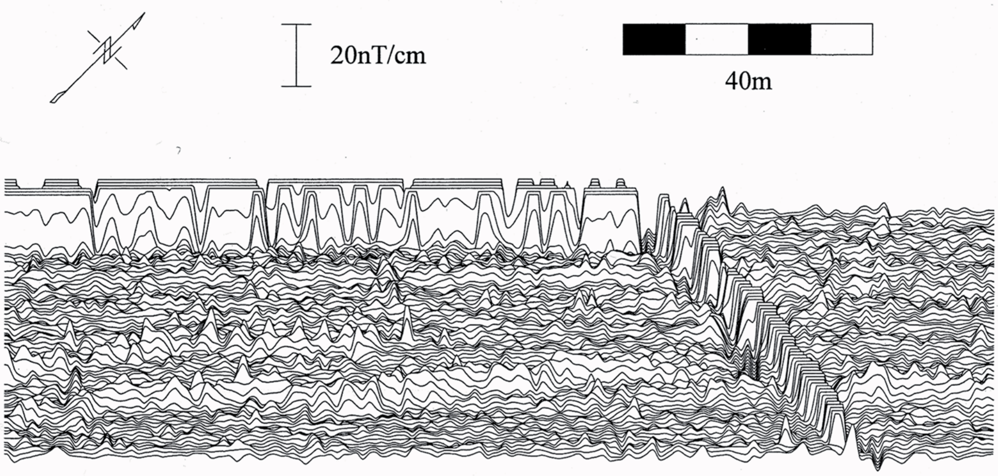
Figure 13

Area 7, archaeological interpretation

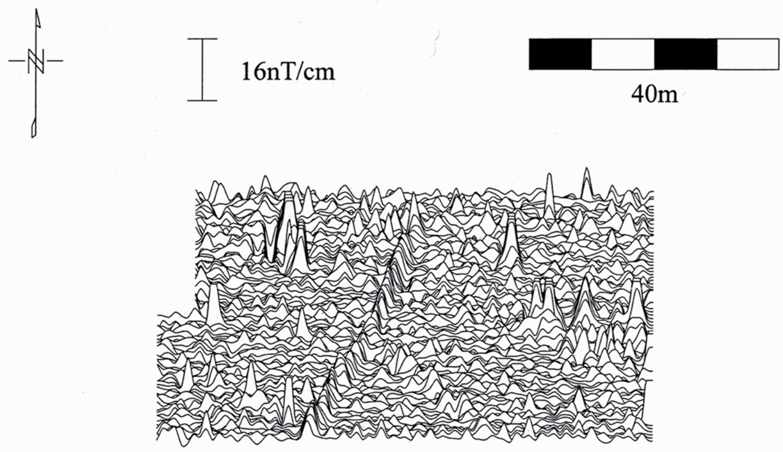


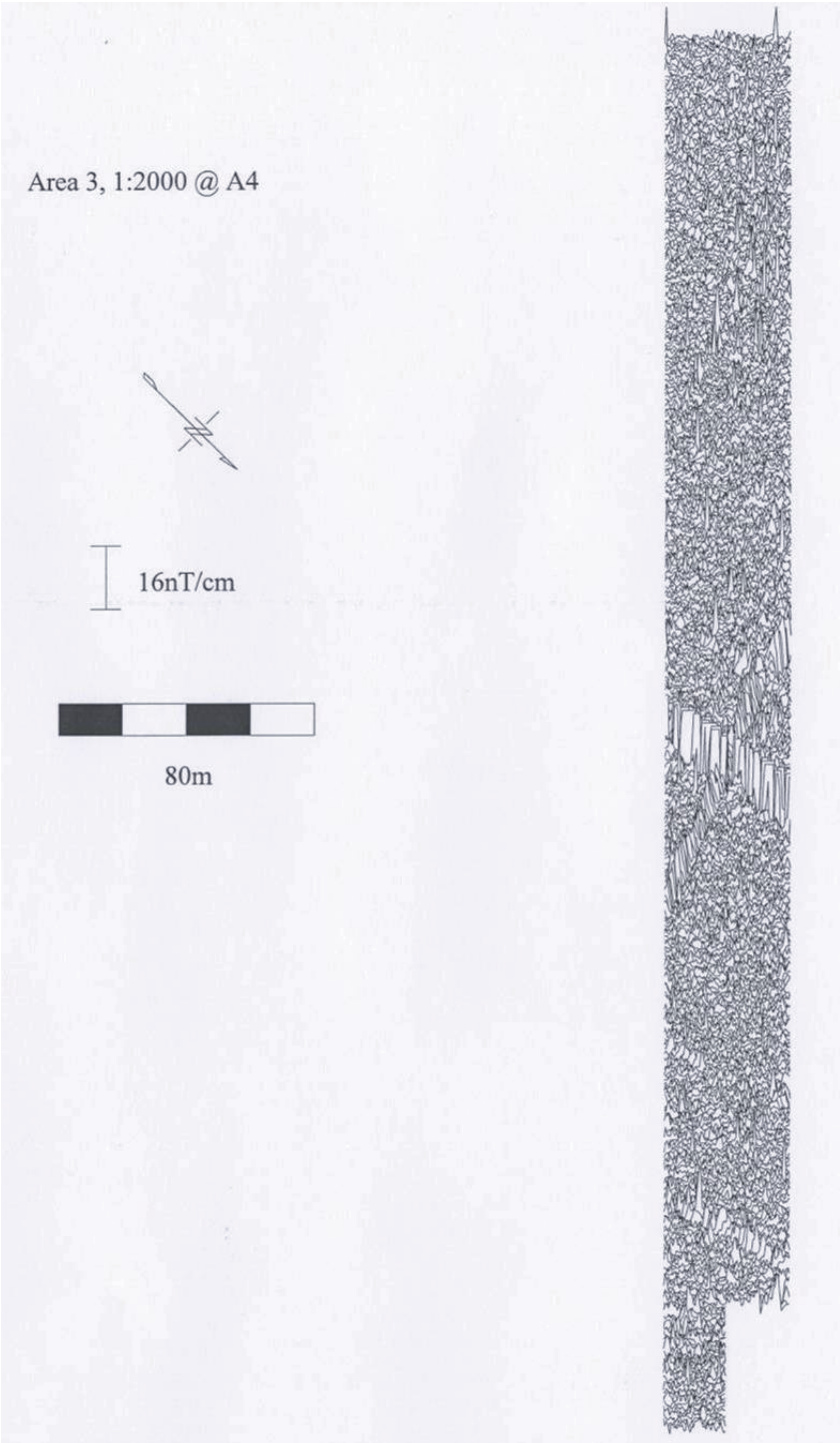
Appendix I: Trace plots of geophysical data

Area 1, 1:1000 @ A4

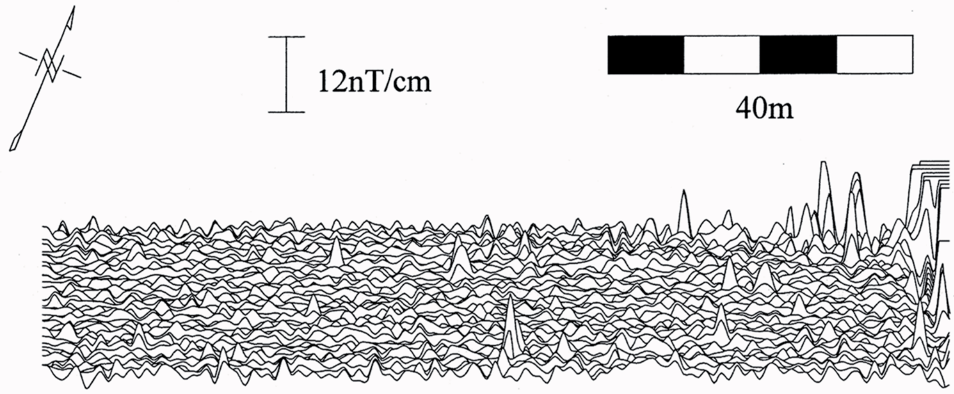


Area 2, 1:1000 @ A4

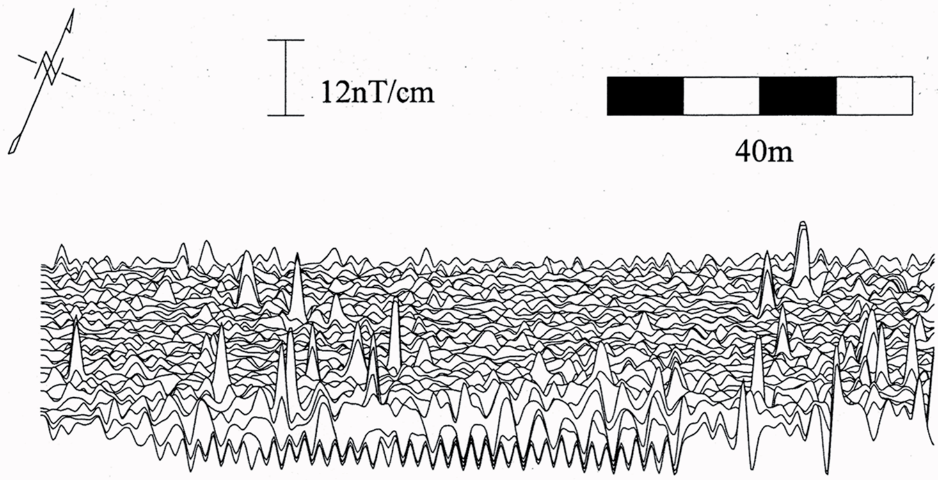


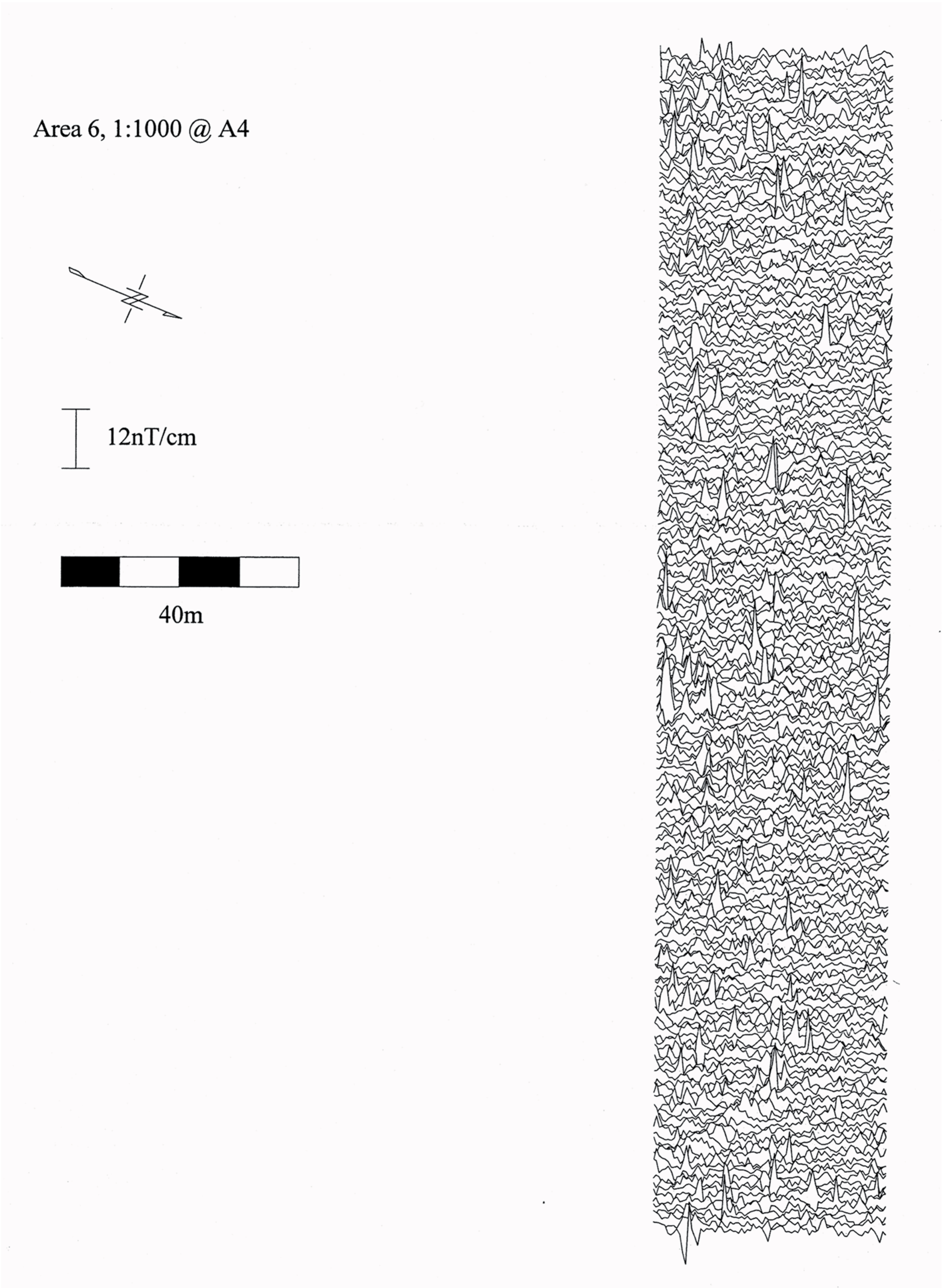

Area 3, 1:2000 @ A4
16nT/cm
80m

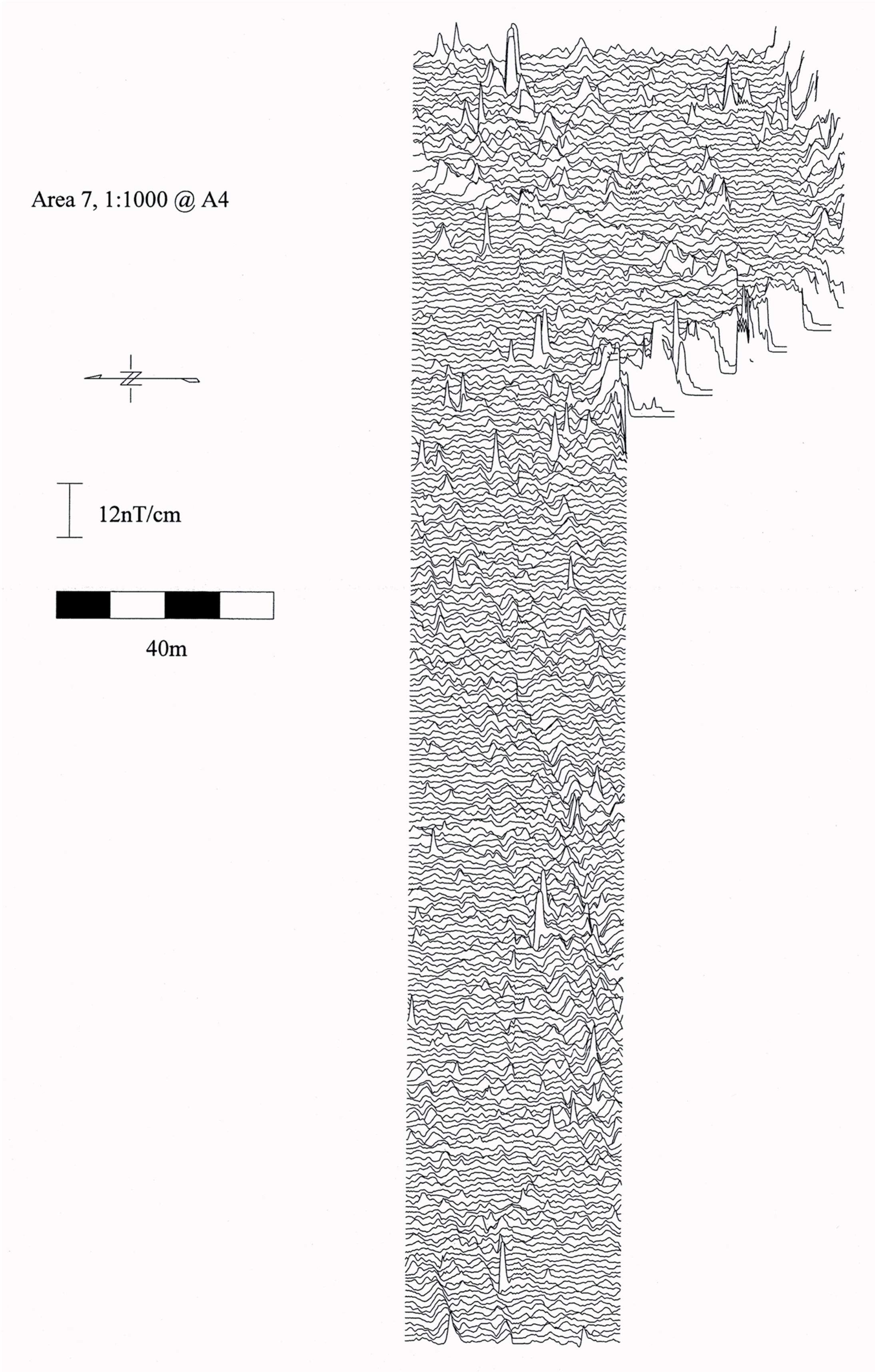
Area 4, 1:1000 @ A4



Area 5, 1:1000 @ A4




Area 6, 1:1000 @ A4
12nT/cm
40m


Area 7, 1:1000 @ A4
12nT/cm
40m