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LIGHTSOURCE RENEWABLE ENERGY LTD

REDHILL SOLAR FARM,

HOLCOMBE ROGUS, DEVON

GEOPHYSICAL SURVEY REPORT

November 2014

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DATE ISSUED: **November 2014**
JOB NUMBER: **CP11087**
GRID REFERENCE: **ST 0860 1808**
OASIS REFERENCE: **Wardella2-194779**

LIGHTSOURCE RENEWABLE LTD

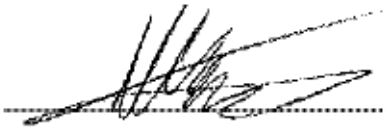
REDHILL SOLAR FARM, HOLCOMBE ROGUS, DEVON

GEOPHYISCAL REPORT

NOVEMBER 2014

PREPARED BY:

Martin Railton Senior Project Manager



APPROVED BY:

Frank Giecco Technical Director

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SUMMARY

In November 2014 Wardell Armstrong Archaeology undertook a geophysical survey of land at Redhill Solar Farm, Holcombe Rogus, Devon. The survey was undertaken for Lightsource Renewable Energy Ltd, to provide information in relation to a proposed solar development at the site.

The site is located to the northeast of Burlescombe and west of Holcombe Rogus in Devon. The proposed solar development lies within three fields to the north of Redhill Farm, immediately west of the A38. The site is centered on Ordnance Survey grid reference ST 0860 1808, and covers approximately 8.8ha of agricultural land in total.

An Archaeology and Cultural Heritage Assessment had been undertaken of the site by Wardell Armstrong LLP. Although there are no recorded heritage assets within the proposed development area, it is recognised that there is the potential for as-yet unidentified archaeological remains to survive at the site. A Roman road is believed to run to the east of the site. The Devon Historic Environment Record also records evidence for Bronze Age, Iron Age and early medieval activity in the vicinity. Of particular significance is evidence for a late 1st millennium iron-working site to the south of the proposed development area.

The objective of the geophysical surveys was to determine the presence/absence, nature and extent of potential archaeological features within the study area, and the presence/absence of any known modern features within the survey area, which may affect the results.

The geophysical surveys confirmed the presence of historic quarrying over parts of the proposed development area. Any potential archaeological features will therefore have been removed in these areas.

A number of possible soil-filled features were detected to the north of Redhill Farm, including a possible road or track way of unknown date. The geophysical surveys therefore indicated there is some potential for archaeological remains to survive at the site, in the area not previously subjected to quarrying.

1 INTRODUCTION

1.1 Circumstances of the Project (Figure 1)

1.1.1 Between 3rd and 7th November 2014 Wardell Armstrong Archaeology (WAA) undertook a geophysical survey of land at Redhill Solar Farm, Holcombe Rogus, Devon. The survey was undertaken for Lightsource Renewable Energy Ltd, to provide information in relation to a proposed solar development at the site. This is in line with government advice as set out in Section 12 of the National Planning Policy Framework (NPPF 2012).

1.1.2 The site is located to the northeast of Burlescombe and west of Holcombe Rogus in Devon. The proposed solar development lies within three fields to the north of Redhill Farm, immediately west of the A38. The site is centered on Ordnance Survey grid reference ST 0860 1808 (Figure 1), and covers approximately 8.8ha of agricultural land in total (Figure 2).

1.1.3 An Archaeology and Cultural Heritage Assessment has been undertaken of the site by Wardell Armstrong LLP. Although there are no recorded heritage assets within the proposed development area, it is recognised that there is the potential for as-yet unidentified archaeological remains to survive at the site. A Roman road is believed to run to the east of the site. The Devon Historic Environment Record also records evidence for Bronze Age, Iron Age and early medieval activity in the vicinity. Of particular significance is evidence for a late 1st millennium iron-working site to the south of the proposed development area (*pers. com*. Stephen Reed, Devon County Council).

1.1.4 The objective of the geophysical survey was therefore to determine the presence/absence, nature and extent of potential archaeological features within the survey area, and the presence/absence of any known modern features within the survey area, which may affect the results. This report outlines the results of the geophysical survey undertaken, and includes an interpretation of the geophysical survey results, in light of the historical and archaeological background of the site.

2 METHODOLOGY

2.1 Standards

2.1.1 A Written Scheme of Investigation (WSI) for the geophysical survey was submitted to Stephen Reed, Devon County Council, for approval prior to the start of the project. The WSI was adhered to in full, the work being consistent with English Heritage guidelines (English Heritage 2008), and in accordance with the standard and guidance of the Institute for Archaeologists (IfA 2011).

2.2 Geophysical Surveys

2.2.1 Technique Selection: geomagnetic survey was selected as the most appropriate technique, given the non-igneous environment, and the expected presence of cut archaeological features at depths of no more than 1.5m. This technique involves the use of hand-held gradiometers, which measure variations in the vertical component of the earth's magnetic field. These variations can be due to the presence of sub-surface archaeological features. Data were recorded by the instruments and downloaded into a laptop computer for initial data processing in the field using specialist software.

2.2.2 Field Methods: the geophysical study area measured c.8.8ha in total, and within a three fields of pasture (Figure 2). A 30m grid was established across each area (Areas 1-3), and tied-in to known Ordnance Survey points Total Station Theodolite.

2.2.3 Geomagnetic measurements were determined using a Bartington Grad601-2 dual gradiometer system, with twin sensors set 1m apart. It was expected that significant archaeological features at a depth of up to 1.5m would be detected using this arrangement. The survey was undertaken using a zig-zag traverse scheme, with data being logged in 30m grid units. A sample interval of 0.25m was used, with a traverse interval of 1m, providing 3600 sample measurements per grid unit, with measurements being recorded at the centre of each grid cell. The data were downloaded on site into a laptop computer for processing and storage.

2.2.4 ***Data Processing:*** geophysical survey data were processed using Terra Surveyor software, which was used to produce 'grey-scale' images of the raw data. Positive magnetic anomalies are displayed as dark grey, and negative magnetic anomalies are displayed as light grey. A palette bar shows the relationship between the grey shades and geomagnetic values in nT.

2.2.5 Raw data were processed in order to further define and highlight the archaeological features detected. The following basic data processing functions were used:

- *Despike:* to locate and suppress random iron spikes in the gradiometer data (despike was performed on all survey grids using a window of 11x3 and threshold of 2.0).
- *Destripe:* to reduce the effect of striping in the gradiometer data, sometimes caused by misalignment of the twin sensors (zero mean traverse was performed on all survey grids using a threshold of 2 standard deviations).
- *Destagger:* to reduce location inaccuracies in the gradiometer data, sometimes caused by operator error (destagger applied in both x directions by -2 readings).
- *Clip*: to clip data to specified maximum and minimum values, in order to limit large noise spikes in the geophysical data (clipped from -4nT to 4nT).
- *Interpolate*: to match the resolution of the sample intervals in the x and y directions (doubled in the y direction).

2.2.6 ***Interpretation:*** four types of geophysical anomaly were detected in the gradiometer data:

- *positive magnetic*:regions of anomalously high or positive magnetic data, which may be associated with the presence of high magnetic susceptibility soil-filled features, such as pits or ditches.
- *dipolar magnetic*: regions of paired positive and negative magnetic anomalies, which typically reflect ferrous or fired materials, including fired/ferrous debris in the topsoil, or fired structures, such as kilns or hearths.
- *negative magnetic*: regions of anomalously low or negative magnetic data, which may be associated with features of low magnetic susceptibility, such as stone-built features, geological features, land-drains or sub-surface voids.
- *magnetic disturbance*: areas of high amplitude magnetic disturbance or interference, which may be associated with the presence of modern structures, such as services, fences or buildings.

2.2.7 ***Presentation:*** the grey-scale images were combined with site survey data and Ordnance Survey data to produce the geophysical survey figures. Colour-coded geophysical interpretation diagrams are provided, showing the locations and extent of positive, negative, dipolar and bipolar geomagnetic anomalies and areas of magnetic disturbance. Archaeological interpretation diagrams are also provided,

which are based on the interpretation of the geophysical survey results in light of the archaeological and historical context of the site.

2.2.8 Plots of the raw unprocessed data are included in Appendix 1, which are clipped for display purposes only from -5nT to 5nT.

2.3 Archive

2.3.1 The data archive for the geophysical survey has been created in accordance with the recommendations of the Archaeology Data Service (ADS 2013). This archive is held at the company offices at Carlisle, Cumbria. The archive comprises a compressed (zipped) file folder, containing the geophysics data, documentation (metadata), and other project material (report and field notes).

2.3.2 One copy of the final report will be deposited with the County Historic Environment Record, where viewing will be available on request. The project is registered with the Online AccesS to the Index of archaeological investigationS (OASIS). The OASIS reference for the project is: wardella2-194779.

3 BACKGROUND

3.1 Location and Geological Context

3.1.1 The site is located to the northeast of Burlescombe and west of Holcombe Rogus in Devon. The proposed solar development lies within three fields to the north of Redhill Farm, immediately west of the A38, which is near the Somerset border. The site is centered on Ordnance Survey grid reference ST 0860 1808 (Figure 1), and covers approximately 8.8ha of agricultural land in total.

3.1.2 The underlying geology at the site comprises conglomerate known as Budleigh Salterton Pebble Beds Formation. This sedimentary bedrock was formed approximately 246 to 251 million years ago in the Triassic Period (BGS 2001). The proposed development area is located on a southeast-facing slope, with elevations falling from a high point of 162m AOD to a low point of 145m AOD.

3.1.3 The site has been subject to some historic quarrying. A quarry is depicted on the on an aerial photograph dating to the 1940s on the east side of the site. In addition the Devon Historic Landscape Characterisation (HLC) Project has characterised the northwest side of the site as former quarried land, although the exact extent is uncertain as this quarry did not appear on any historic mapping or air photographs consulted during the assessment. The rest of the site is recorded by the HLC as medieval enclosure.

3.2 Historical Background

3.2.1 ***Introduction:*** an archaeology and cultural heritage assessment has been prepared by Wardell Armstrong LLP (Wardell Armstrong 2014), a summary of which is provided below. This historical background is compiled mostly from secondary sources and from records consulted during the desk-based assessment, including the Devon Historic Environment Record (DHER) and Somerset Historic Environment Record (SHER). It is intended only as a summary of historical developments around the study area.

3.2.2 ***Prehistoric (up to c.AD 43):*** there is no evidence for prehistoric activity in the immediate vicinity of the proposed development area, although a possible prehistoric routeway is recorded 1km southwest of the site, which may have been aligned along a ridgeway.

3.2.3 Situated 1.2km south of the site, in the immediate vicinity of the ridgeway, two Middle Bronze Age burnt mounds were identified and excavated prior to quarrying activity attesting to settlement activity in the area (Gent 2007).

3.2.4 ***Roman (c.AD 43-c.410):*** the A38, which bounds the site to the east, is thought to broadly match the line of the Roman road to Exeter. No other Roman sites are recorded in the vicinity of the site.

3.2.5 ***Early Medieval (c. 410 - 1066):*** there are no known early medieval remains at the site. However, there is evidence for a late 1st millennium iron-working site to the south of the proposed development area (see Section 3.3 below).

3.2.6 ***Medieval (1066 - 1485):*** the HER does not record any evidence for medieval activity within the proposed development area, and it is likely that during this time the site was located away from the main foci of settlement, such as those located at Burlescombe 1.3km to the southwest, and Holcombe Rogus located 2.8km to the west. Settlement at these locations by the end of the eleventh century is verified by their inclusion in Domesday Book (1086).

3.2.7 It is likely that the site would have been located within the open field system in the medieval period. The Historic Landscape Characterisation states that the sinous nature of the field boundaries at the site, reflects the former presence of strip fields.

3.2.8 ***Post-medieval to Modern (1485-present):*** the earliest cartographic evidence studied as part of the assessment was the 1840 Holcombe Rogus Tithe Map, which showed the majority of the site was within four parcels of land to the north of Redhill Road, and one parcel of land to the south of Redhill Road. The land within the site was recorded as being owned and occupied by William Hill of Redhill farm which was shown to the south of the site boundary (Wardell Armstrong 2014).

3.2.9 Subsequent editions of Ordnance Survey mapping show no change within the site until the production of the 1972/80 Ordnance Survey map. This shows the re-alignment of the east end of Redhill Road so that it was no longer present within the boundary of the site. This was as a consequence of the duelling of the A38 which by this time bounded the site to the immediate east. Between 1972/80 and 1980/93 the hedgerow between the two eastern-most fields within the site was removed and since the production of the 1980/93 Ordnance Survey the remaining internal hedgerows/boundaries were removed (ibid).

3.3 Previous Archaeological Work

3.3.1 There have been no prvious archaeological interventions within the proposed development site, but work has been undertaken within the wider area.

3.3.2 ***Old Town Farm Quarry***: A proposed quarry extension located 500m-1.3km south of the site at Town Farm Quarry, was subject to geophysical survey and trial trenching in 2008. This was due to the presence of three late Saxon iron-smelting furnaces which had been recorded 140m west of the proposed quarry extension, 1.03km south-west of the site (Reed et al 2006). Geophysical anomalies indicative of the former presence of medieval field boundaries and ridge and furrow were detected, along with evidence for further smelting furnaces. The subsequent trial trenching did not record any buried remains associated with iron smelting.

3.3.3 A ditch, thought to be a prehistoric boundary ditch (DHER Ref. MDV80034), was recorded 600m south of the site and was the earliest evidence of activity recorded by the trial trenching. The remainder of archaeological features comprised nine ditches, a trackway and two hedgebanks all of which were believed to be post-medieval in date (Exeter Archaeology 2008).

3.3.4 ***Barton Farm Quarry:*** A geophysical survey was undertaken at Barton Farm, located 860m south of the site, ahead of the construction of a solar farm. This was primarily due to the site's proximity to the Saxon furnaces discussed above. Geological conditions at Barton Farm included Budleigh Salterton Pebble Beds, the same geology as that recorded within the site. Whilst the report stated that geophysical survey on this geology often provides poor results, it was hoped that any industrial activity such as iron working, would have increased the magnetic susceptibility of the topsoil, and thus enhance the results. Furthermore, it was noted that the Budleigh Salterton Pebble Beds Formation often conglomerates with a very iron rich cement which may have proved an easily obtainable source of iron ore for smelting (Archaeological Survey Ltd 2012).

3.3.5 The survey did record evidence for widespread magnetic debris in the area of the site which corresponded with the Budleigh Salterton Pebble Beds. Whilst this may have been attributable to Iron smelting, no features could be confidently identified as being associated with Saxon Iron Smelting.

4 THE GEOPHYSICAL SURVEYS

4.1 Introduction (Figure 2)

4.1.1 The geophysical surveys were undertaken between 3rd and 7th November 2014. Geomagnetic survey was undertaken over the majority of the study area, which comprised three fields of pasture at the time of the survey.

4.1.2 The survey area was bounded by field boundaries consisting of mature hedges, and wire fences. These fences produced strong magnetic disturbance around the periphery some of the survey areas.

4.1.3 Small discrete dipolar magnetic anomalies were detected across the whole of the study area. These are almost certainly caused by fired/ferrous litter in the topsoil, which is typical for modern agricultural land. It is also the possibility that some of these relate to the Budleigh Salterton Pebble Beds geology. These anomalies are indicated on the geophysical interpretation drawings, but not referred to again in the subsequent interpretations.

4.2 Area 1 (Figures 3 -5)

4.2.1 Area 1 comprised rectangular area of land on the northwest side of the survey area. This area had been identified in the Historic Landscape Characterisation project as an area of former quarrying, although the extent of this activity was unknown. The whole of Area 1 appeared very disturbed indicating that the majority of this area may have been subjected to quarrying operations.

4.2.2 Very strong dipolar magnetic anomalies were detected on the northeast side of Area 1, which were almost certainly due to the presence of landfill containing fired/ferrous material. Similar magnetic anomalies were detected to the southeast.

4.2.3 Very strong positive linear magnetic anomalies were detected along the south side of Area 1, aligned northeast to southwest, which are probably due to landfill deposits associated with the former quarry, or may possibly reflect the quarry edge. A similar feature was detected on the east side of Area 1, aligned northwest to southeast.

4.2.4 An alignment of very weak dipolar magnetic anomalies was detected on the east side of Area 1, aligned northwest to southeast, which is probably a land drain.

4.3 Area 2 (Figures 6-8)

4.3.1 Area 2 comprised a smaller field to the east of Area 1, to the north of Redhill Farm. Strong magnetic disturbance was experienced along the southwest and southeast sides of this field due to the presence of wire fences.

4.3.2 Two broad parallel positive magnetic anomalies were detected crossing the north side of Area 1, aligned northeast to southwest, which may represent soil-filled features. These were spaced between 8m and 14m apart, with an area of low or negative magnetic data between them. It is possible that these features represent a former road or track way, but this is uncertain. These features continued into Area 3 to the east.

4.3.3 Another linear positive magnetic anomaly was detected on the north side of Area 2, aligned approximately east to west, which may represent soil-filled ditch or boundary feature. This feature was also detected in Area 3 to the east.

4.3.4 Several other linear and curvilinear positive magnetic anomalies were detected on the north side of Area 2, which may reflect the presence of soil-filled ditches.

4.3.5 A very weak linear negative magnetic anomaly was detected crossing Area 3, aligned north to south, which may reflect the presence of a land drain. Two parallel curvilinear negative magnetic anomalies were detected to the south, the nature of which is uncertain.

4.4 Area 3 (Figures 6-8)

4.4.1 Area 3 comprised a separate field to the east of Area 2, immediately to the west of the A38. Area 3 is known to have been subjected to historic quarrying, which is shown on a 1940s aerial photograph on the east side of the site.

4.4.2 Very strong dipolar magnetic anomalies were detected on the southeast side of Area 3, which were almost certainly due to the presence of the former quarry, which has been backfilled with fired/ferrous material.

4.4.3 Strong positive curvilinear magnetic anomalies were detected along in Area 3, which almost certainly reflect the former quarry edge/landfill boundaries.

4.4.4 A weak linear positive magnetic anomaly was detected on the north side of Area 3, aligned approximately east to west, which may represent soil-filled ditch or boundary feature. This feature was also detected in Area 2 to the west.

4.4.5 Another very weak linear positive magnetic anomaly was detected on the north side of Area 3, aligned approximately northwest to southeast, which may represent another soil-filled ditch.

4.5 Discussion (Figure 5)

4.5.1 The presence of historic quarrying was confirmed in Area 1 and Area 3. Very strong positive and dipolar magnetic anomalies were detected in each area, due to the presence of the former quarries and landfill. Any potential archaeological features will therefore have been previously removed in these areas.

4.5.2 A number of positive anomalies were detected crossing Area 2 and in the northern portion of Area 3, which may represent soil-filled ditches. The most notable anomalies were two broad parallel features, which may represent a former road or track way of unknown date.

5 CONCLUSIONS

5.1 Conclusions

5.1.1 Geomagnetic survey covering c.8.8ha of land has been conducted at Redhill Solar Farm in Devon, to provide information in relation to a proposed solar development at the site. A previous assessment of the site has established that a Roman road, runs adjacent to the proposed development area, and that there is the potential for Saxon iron-smelting in the wider area.

5.1.2 The geophysical surveys have confirmed the presence of historic quarrying over parts of the proposed development area. Any potential archaeological features will therefore have been removed in these areas.

5.1.3 A number of possible soil-filled features were detected to the north of Redhill Farm, including a possible road or track way of unknown date. The geophysical surveys therefore indicate there is some potential for archaeological remains to survive at the site, in the area not previously subjected to quarrying.

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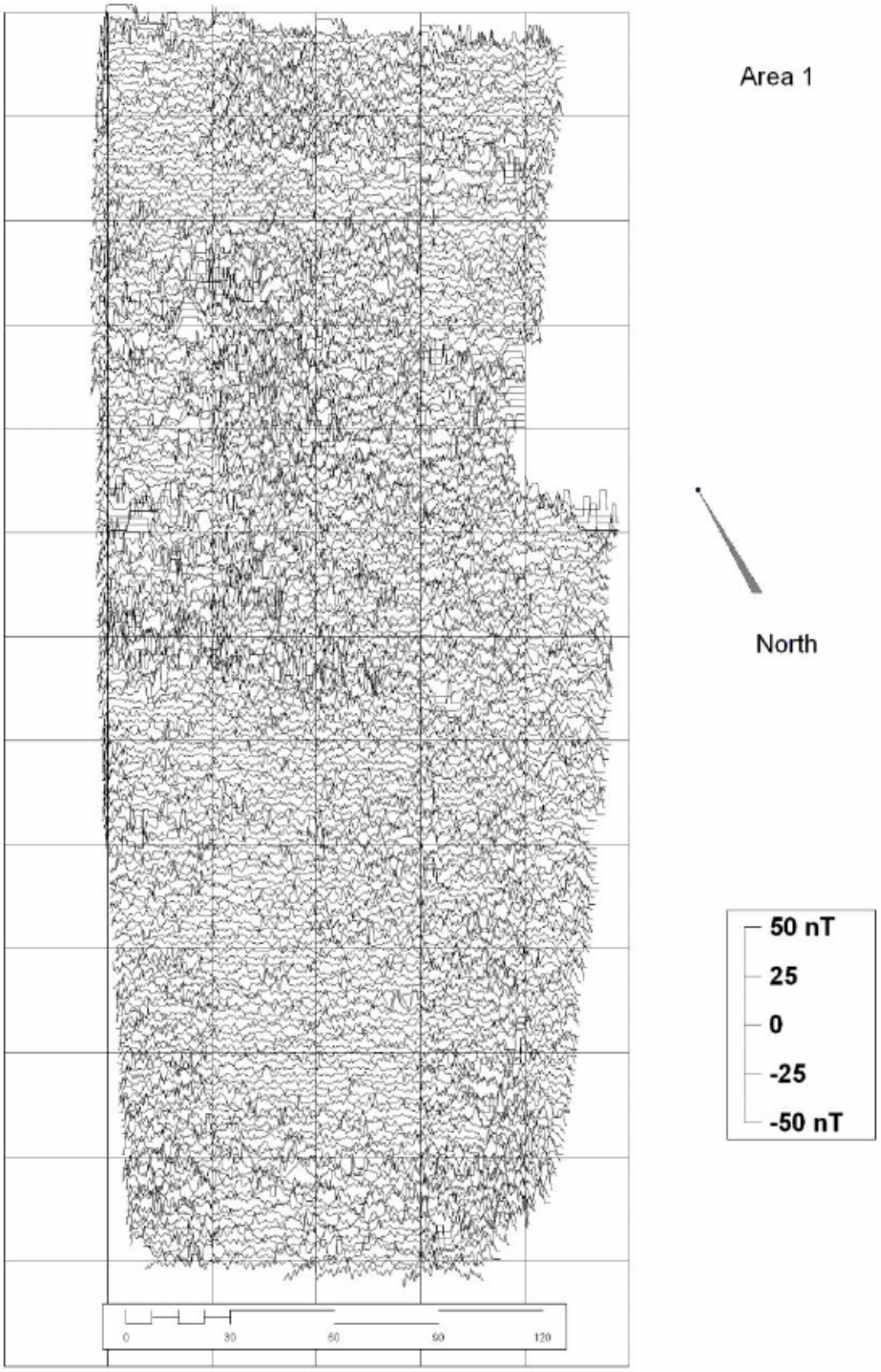
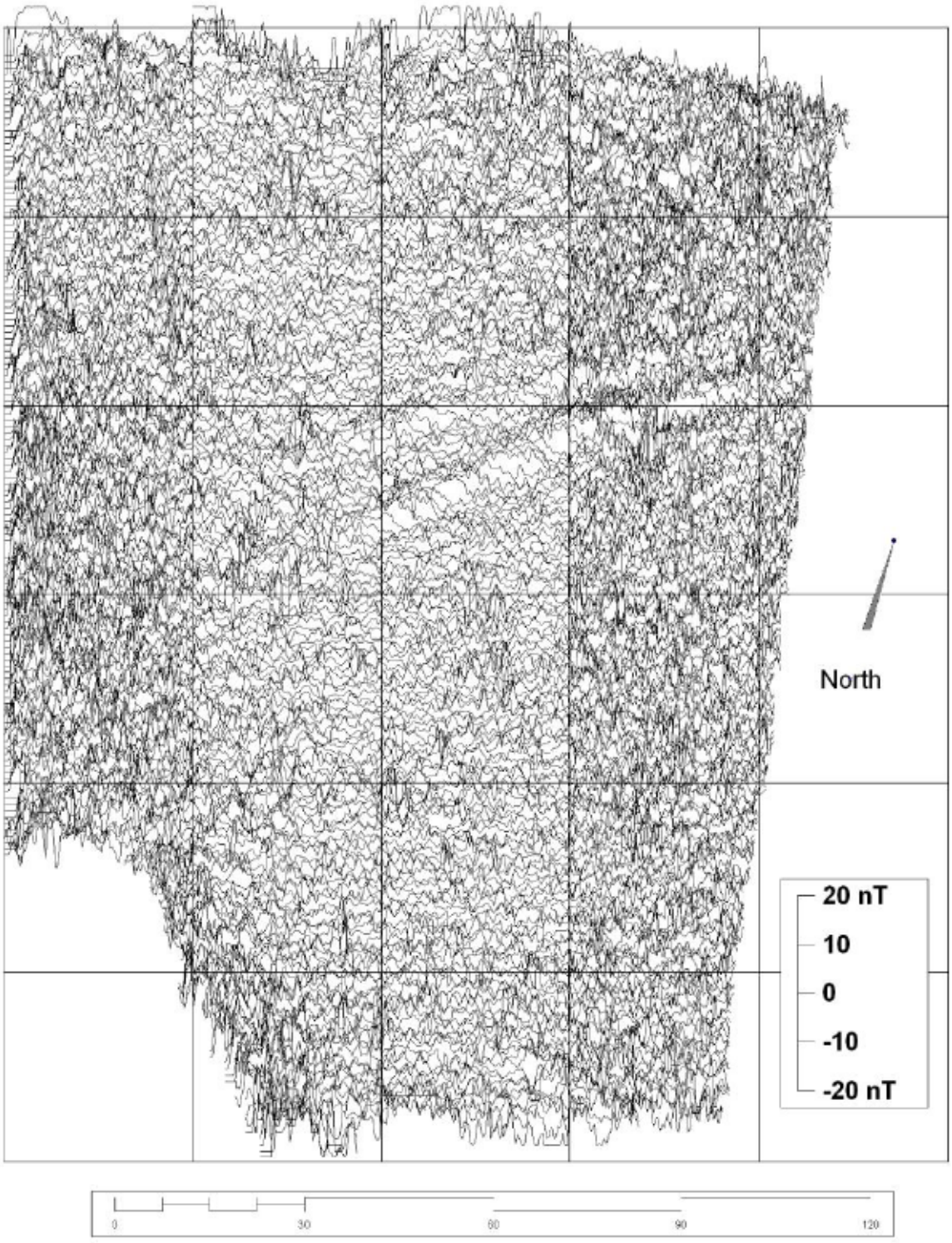
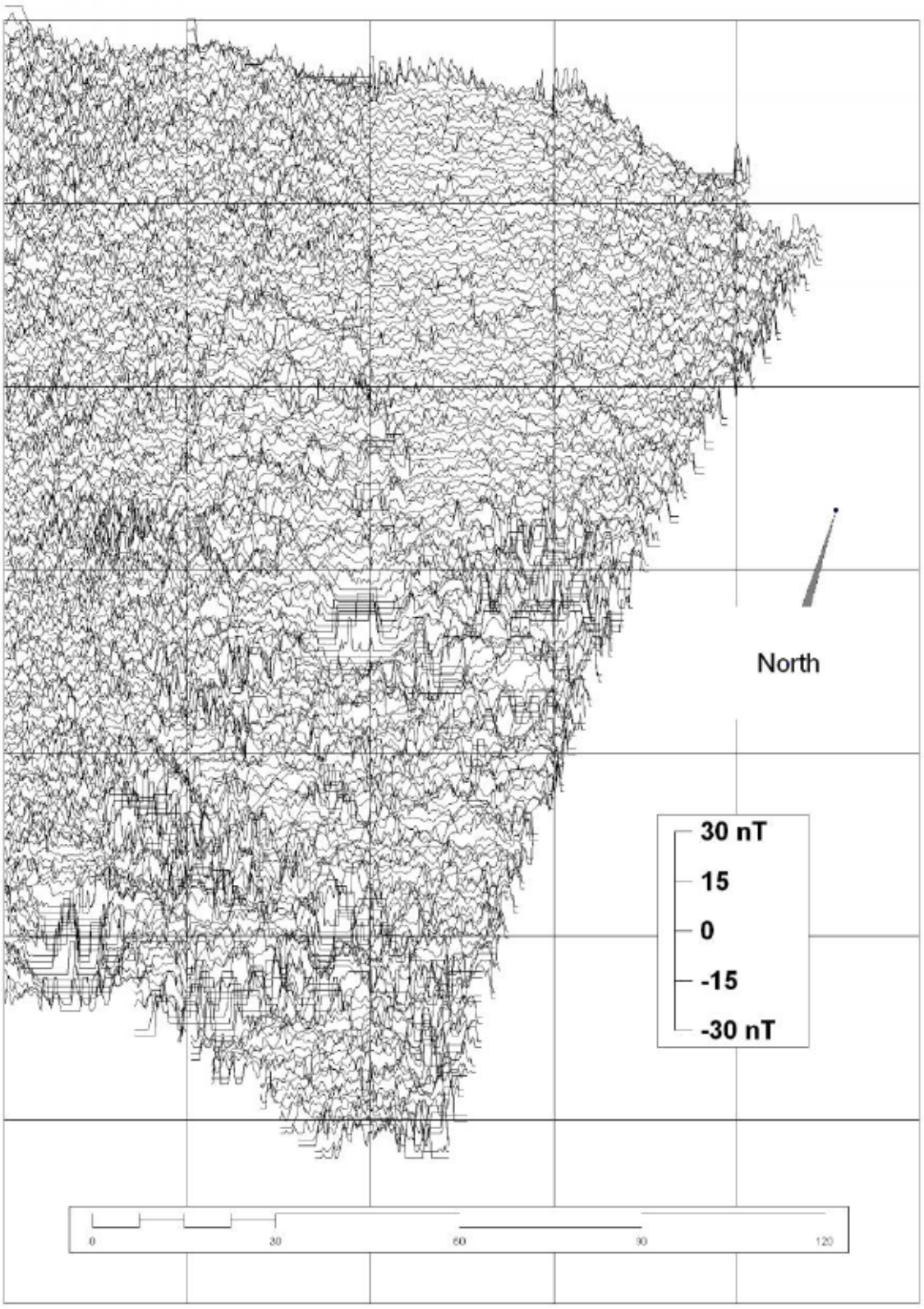
APPENDIX 1 – TRACE PLOTS


Area 1
North
50 nT
25
0
-25
-50 nT
0
30
60
90
120

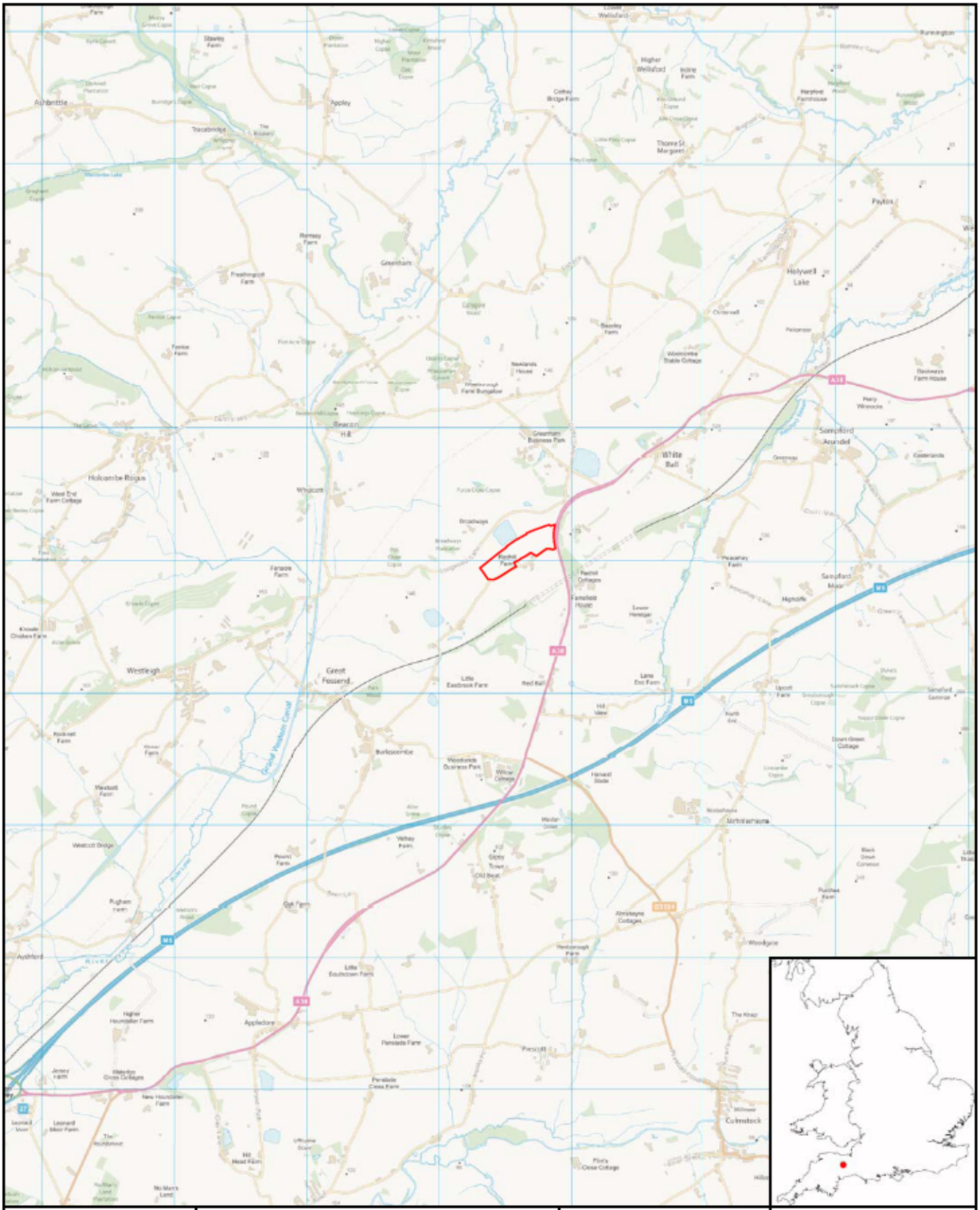
Area 2



Area 3



APPENDIX 2 – FIGURES



wardell armstrong archaeology Wardell Armstrong Archaeology 2014	PROJECT: Redhill Solar Farm, Holcombe Rogus, Devon SCALE: 1:40,000 at A4 REPORT No: CP11087 CLIENT: Lightsource Renewable Energy Ltd DRAWN BY: AB DATE: November 2014 FIGURE: 1	KEY: Site location	

Figure 1: Site location.

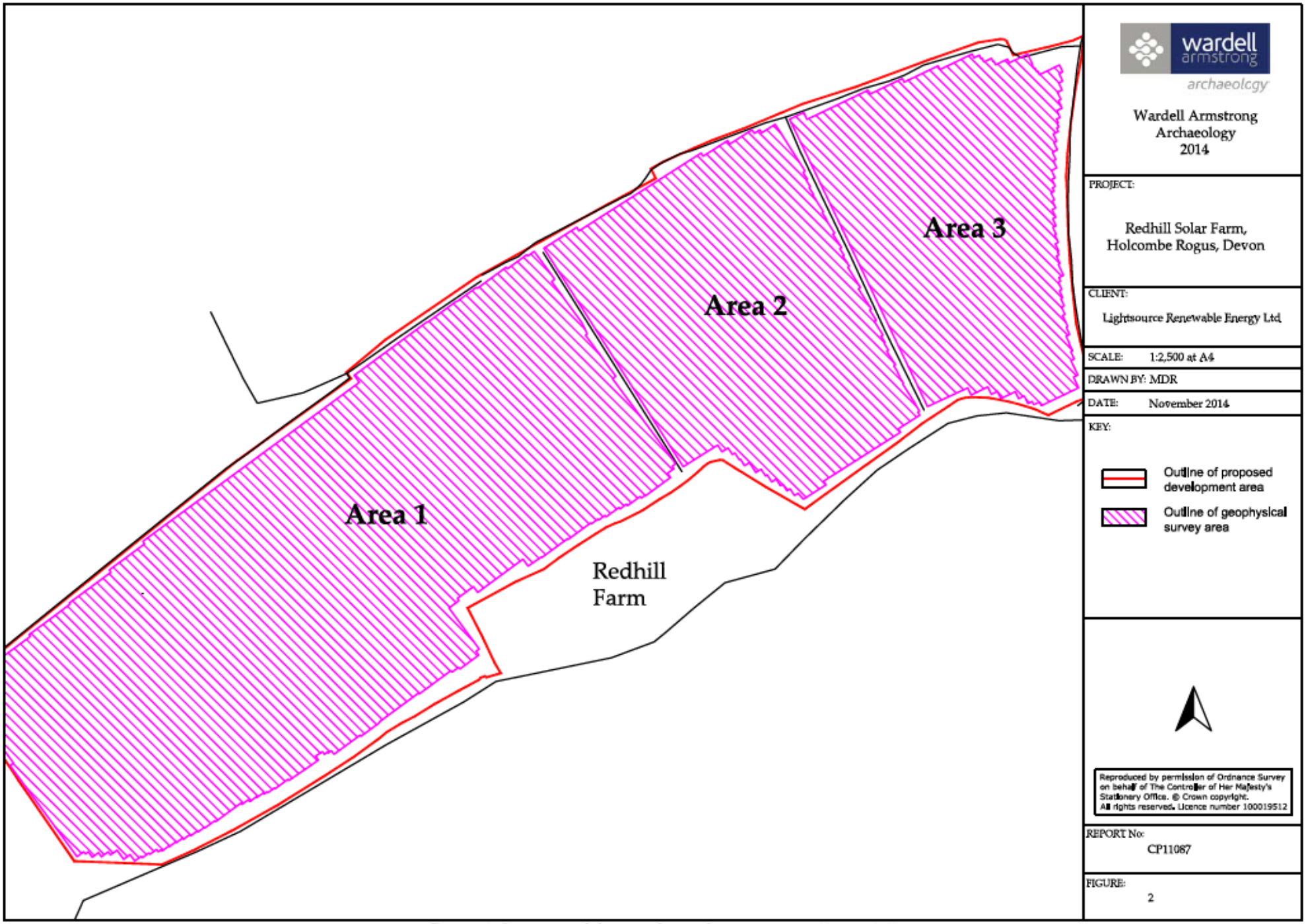
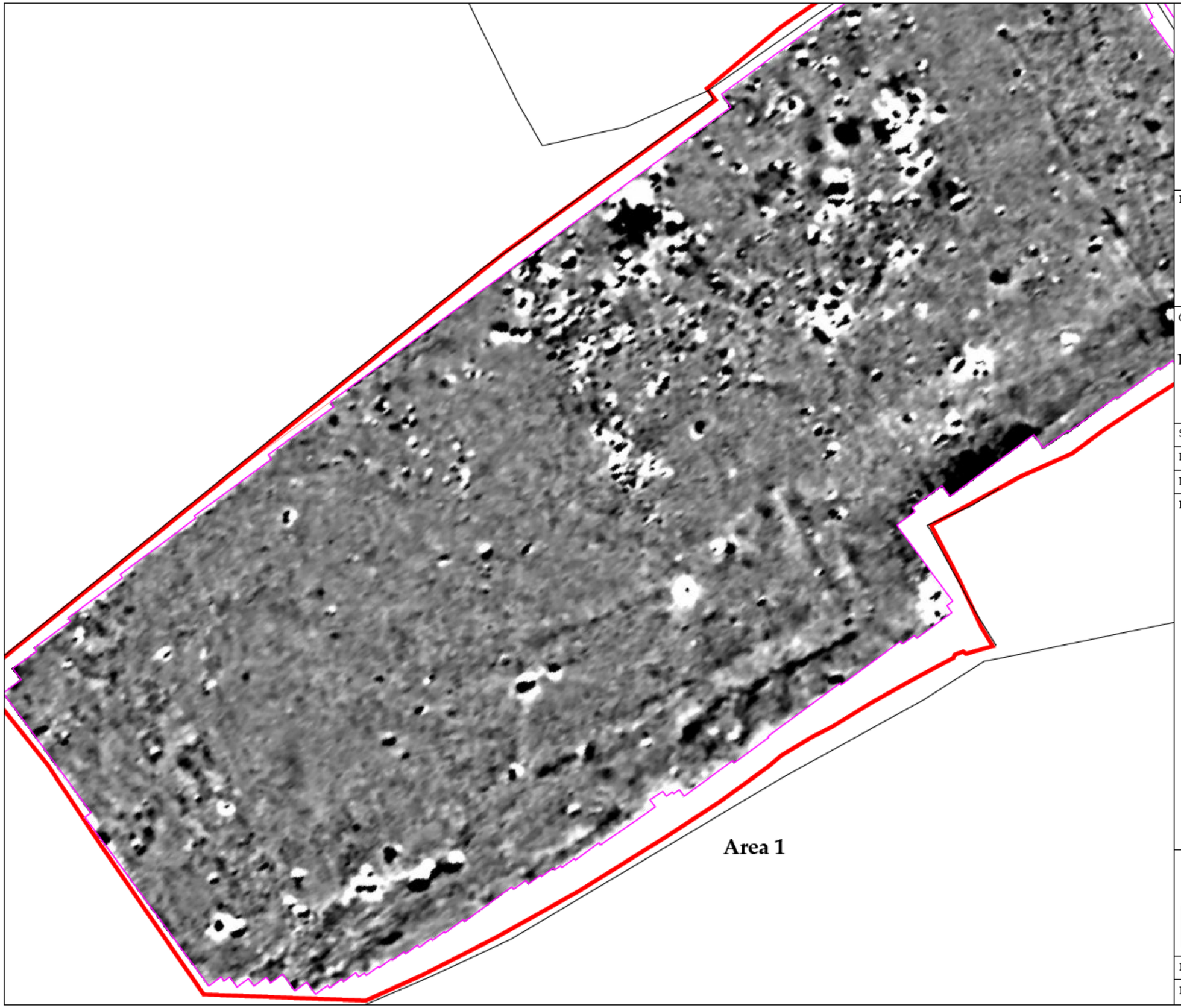


Figure 2: Location of the geophysical survey areas (Areas 1-3).



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PROJECT:

Redhill Solar Farm,
Holcombe Rogus, Devon

CLIENT:

Lightsource Renewable Energy Ltd

SCALE: 1:1000 at A3

DRAWN BY: MDR

DATE: November 2014

KEY:

Outline of proposed development area

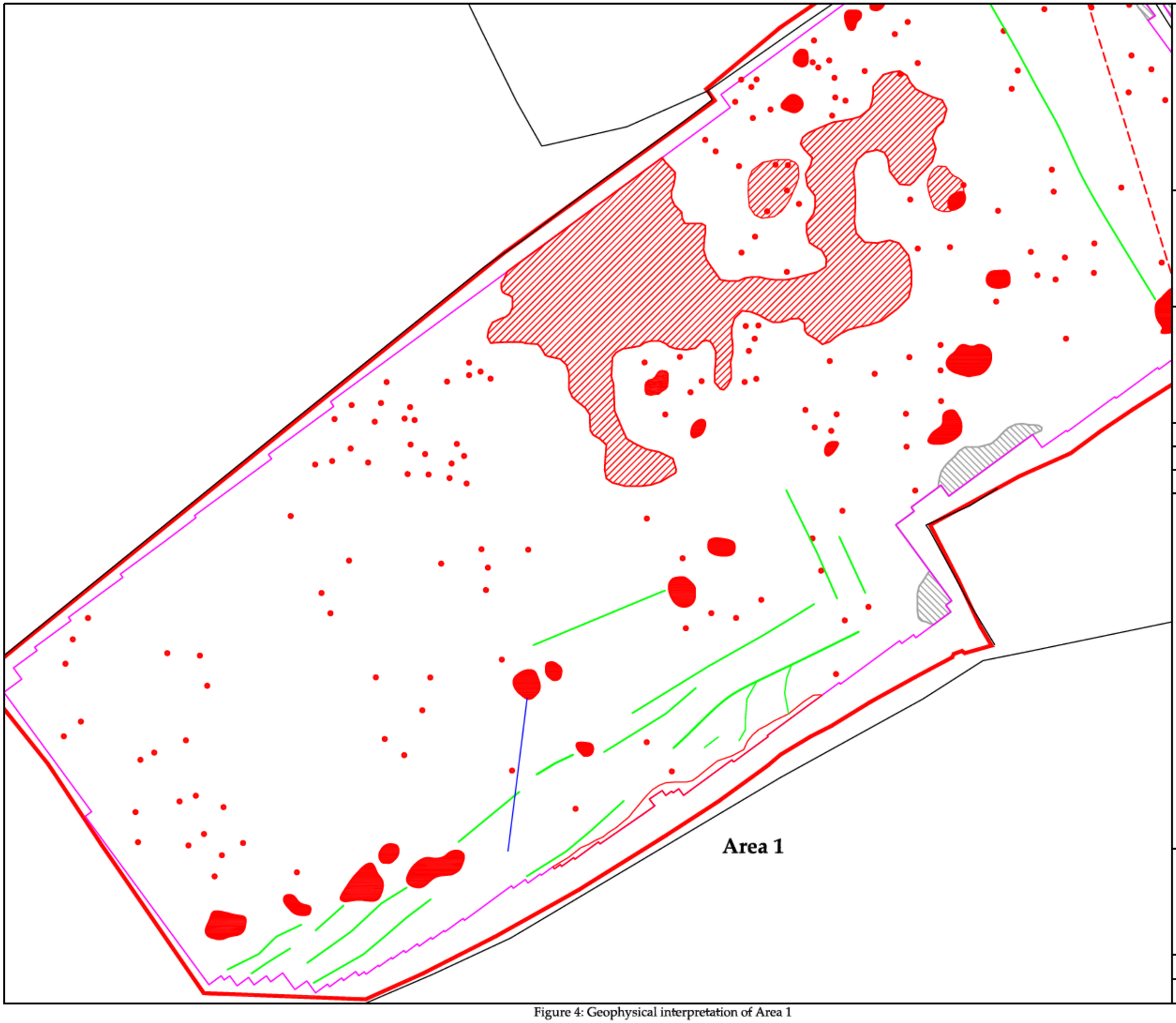
Outline of geophysical survey area

4 nT
3.2
2.4
1.6
0.8
0
-0.8
-1.6
-2.4
-3.2
-4 nT

REPORT No: CP11087

FIGURE: 3

Figure 3: Geophysical survey of Area 1



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SCALE: 1:1000 at A3

DRAWN BY: MDR

DATE: November 2014

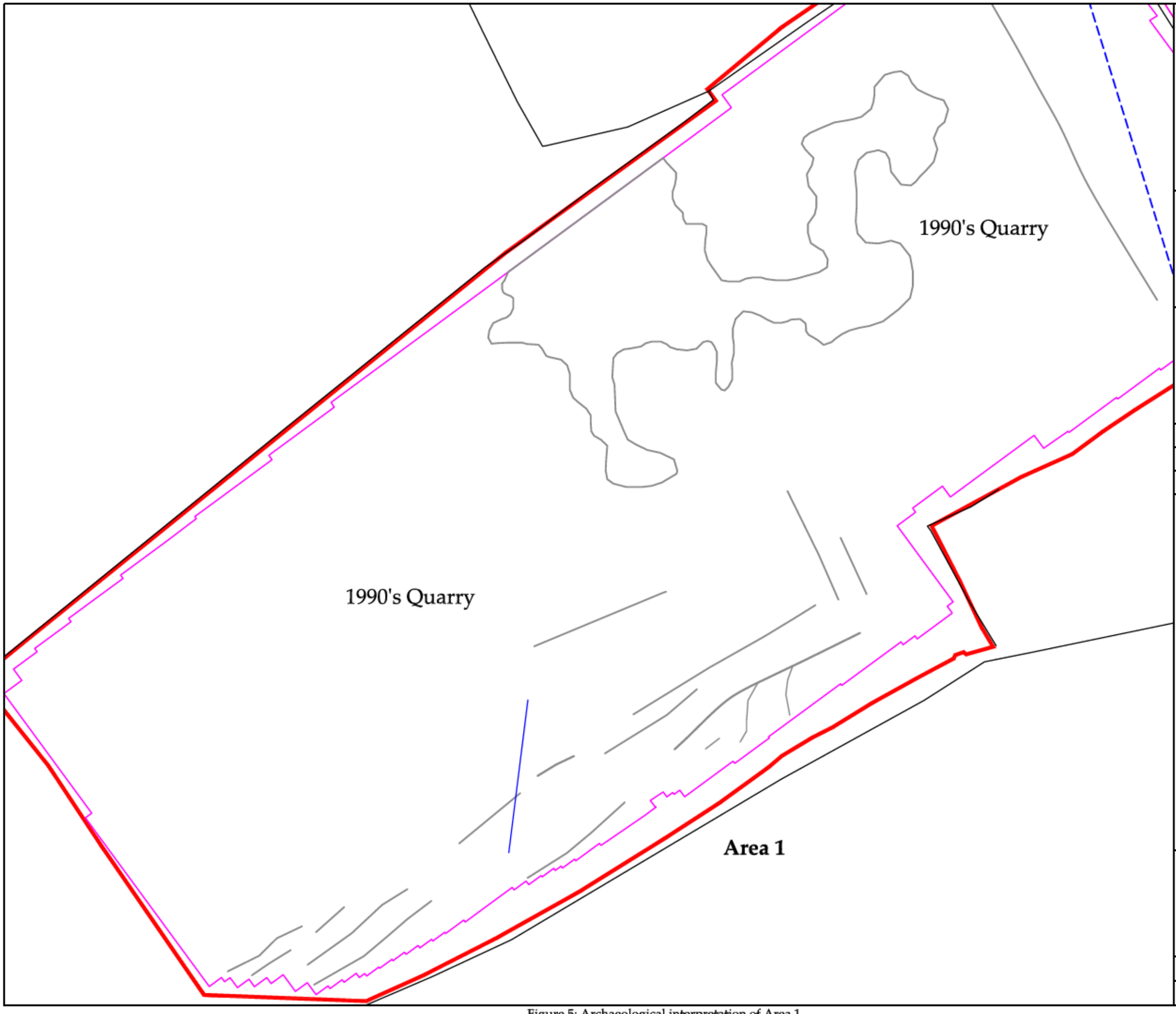
KEY:

- Outline of proposed development area
- Outline of geophysical survey area
- Dipolar magnetic anomaly
- Dipolar magnetic anomaly
- Dipolar magnetic anomaly
- Magnetic disturbance

REPORT No: CP11087

FIGURE: 4

Figure 4: Geophysical interpretation of Area 1



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SCALE: 1:1000 at A3

DRAWN BY: MDR

DATE: November 2014

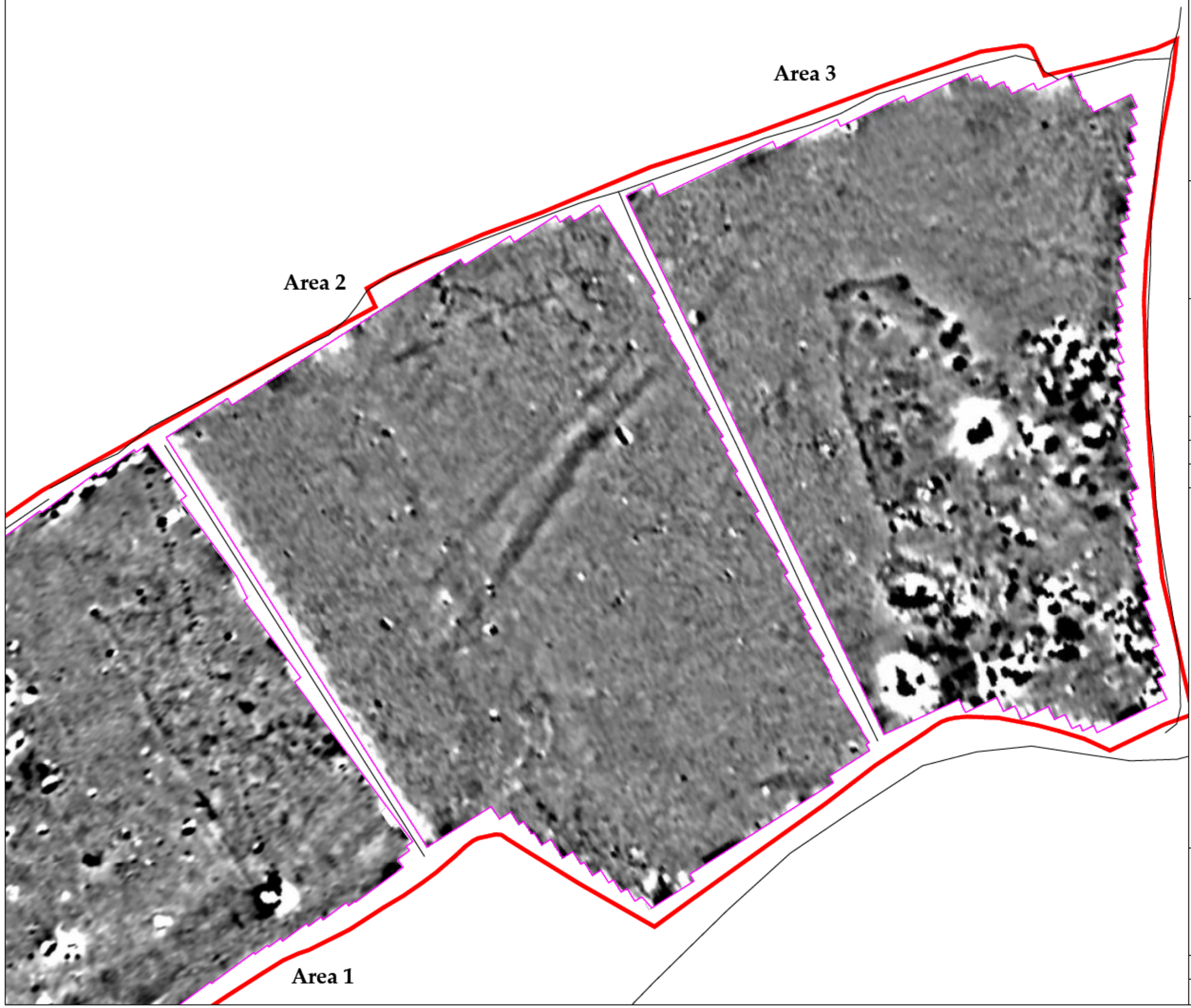
KEY:

- Outline of proposed development area
- Outline of geophysical survey area
- Possible land drain
- Possible soil-filled ditches
- Landfill boundaries

REPORT No: CP11087

FIGURE: 5

Figure 5: Archaeological interpretation of Area 1



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KEY:

Outline of proposed development area

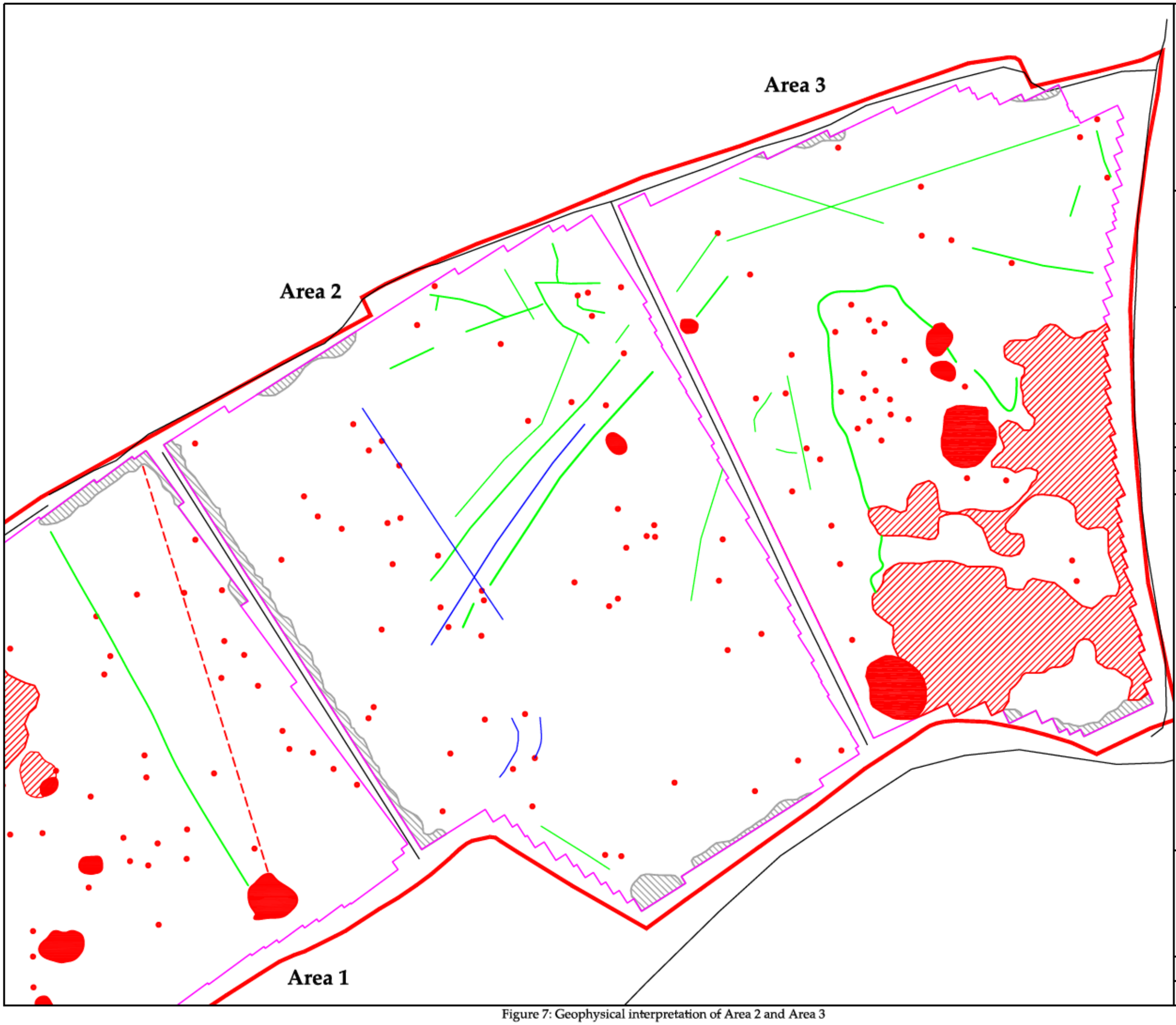
Outline of geophysical survey area

4 nT
3.2
2.4
1.6
0.8
0
-0.8
-1.6
-2.4
-3.2
-4 nT

REPORT No: CP11087

FIGURE: 6

Figure 6: Geophysical survey of Area 2 and Area 3



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SCALE: 1:1000 at A3

DRAWN BY: MDR

DATE: November 2014

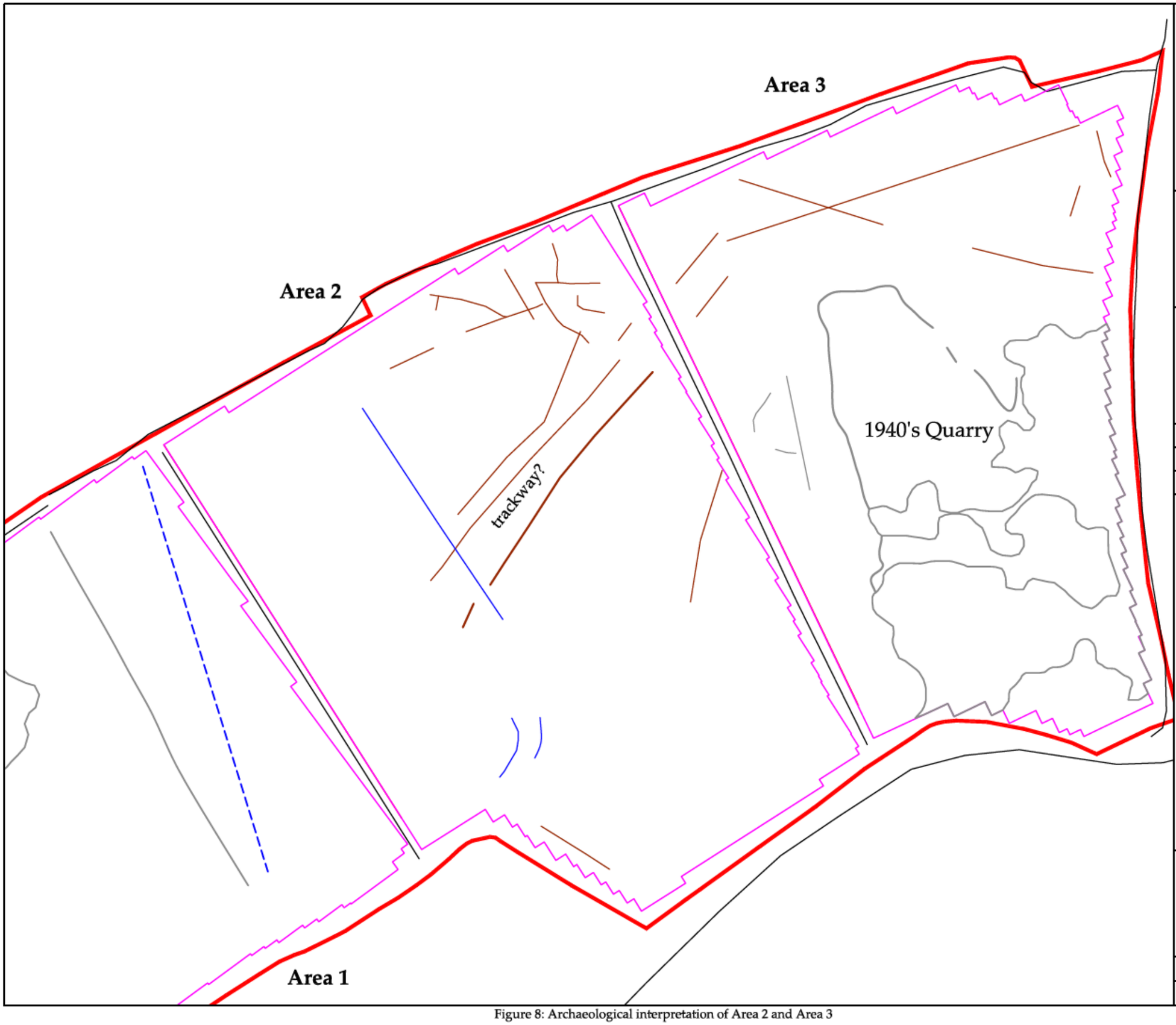
KEY:

- Outline of proposed development area
- Outline of geophysical survey area
- Dipolar magnetic anomaly
- Dipolar magnetic anomaly
- Dipolar magnetic anomaly
- Magnetic disturbance

REPORT No: CP11087

FIGURE: 7

Figure 7: Geophysical interpretation of Area 2 and Area 3



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PROJECT:

Redhill Solar Farm,
Holcombe Rogus, Devon

CLIENT:

Lightsource Renewable Energy Ltd

SCALE: 1:1000 at A3

DRAWN BY: MDR

DATE: November 2014

KEY:

- Outline of proposed development area
- Outline of geophysical survey area
- Possible land drain
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- Landfill boundaries

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FIGURE: 8

Figure 8: Archaeological interpretation of Area 2 and Area 3

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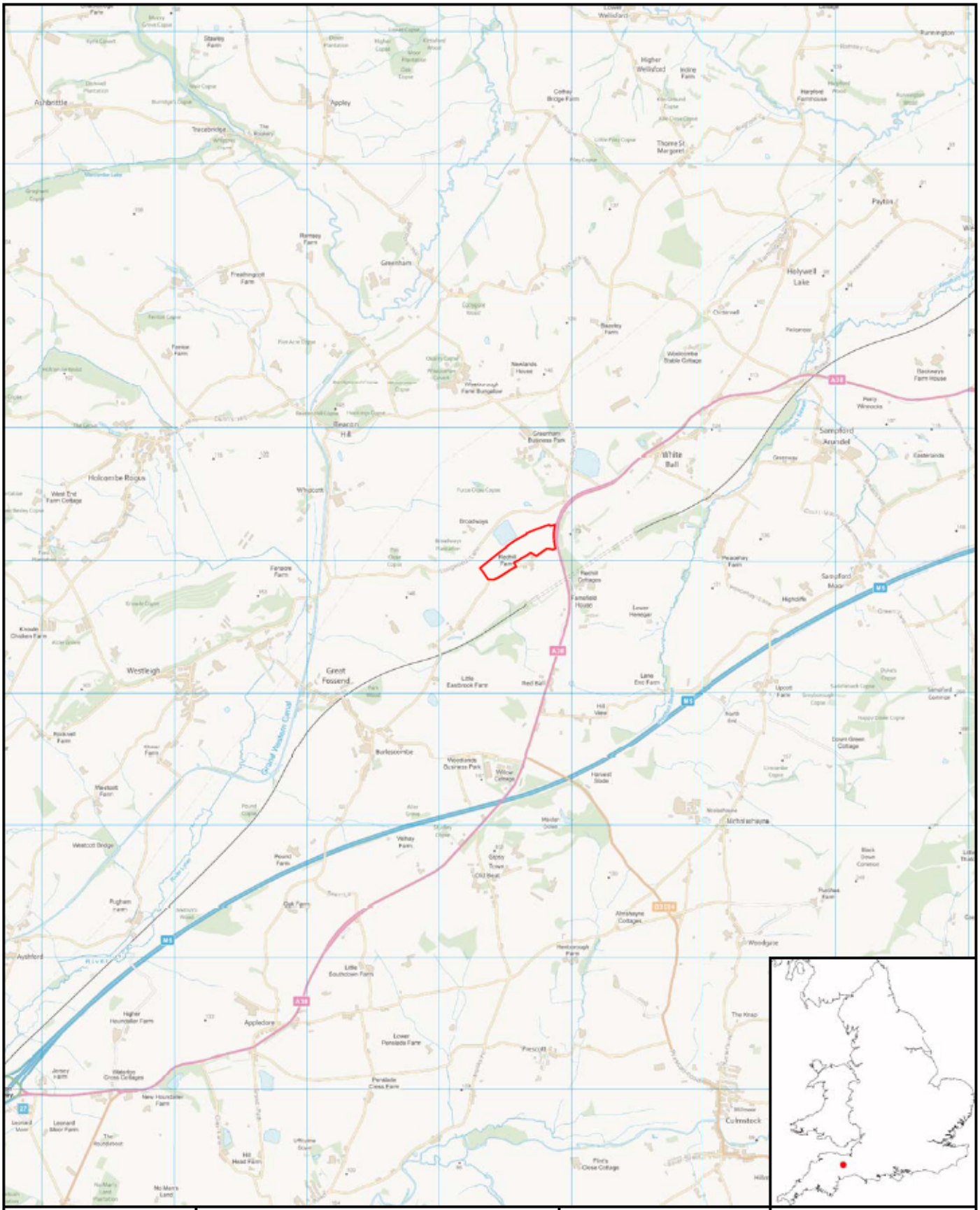

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Figure 1: Site location.

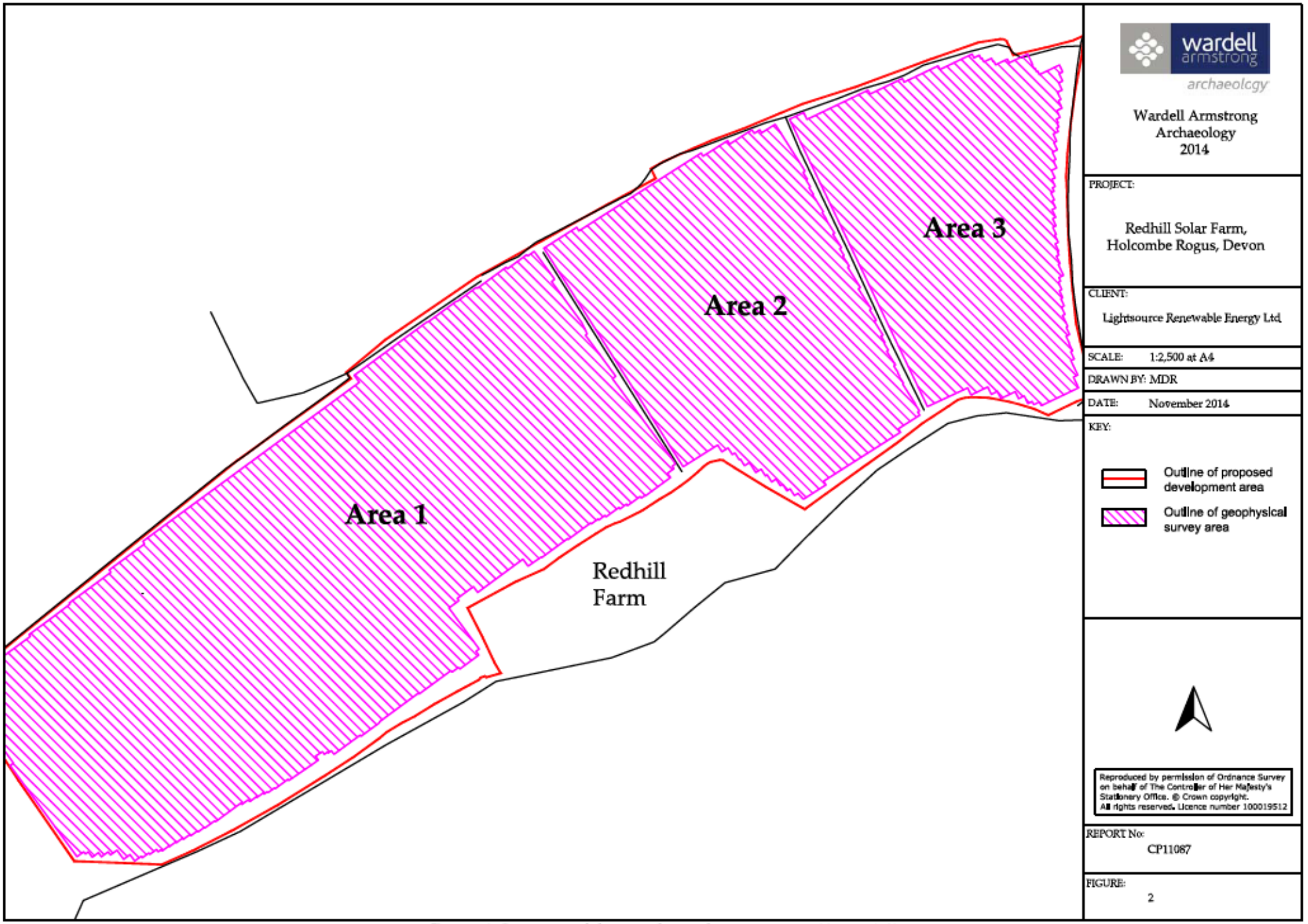
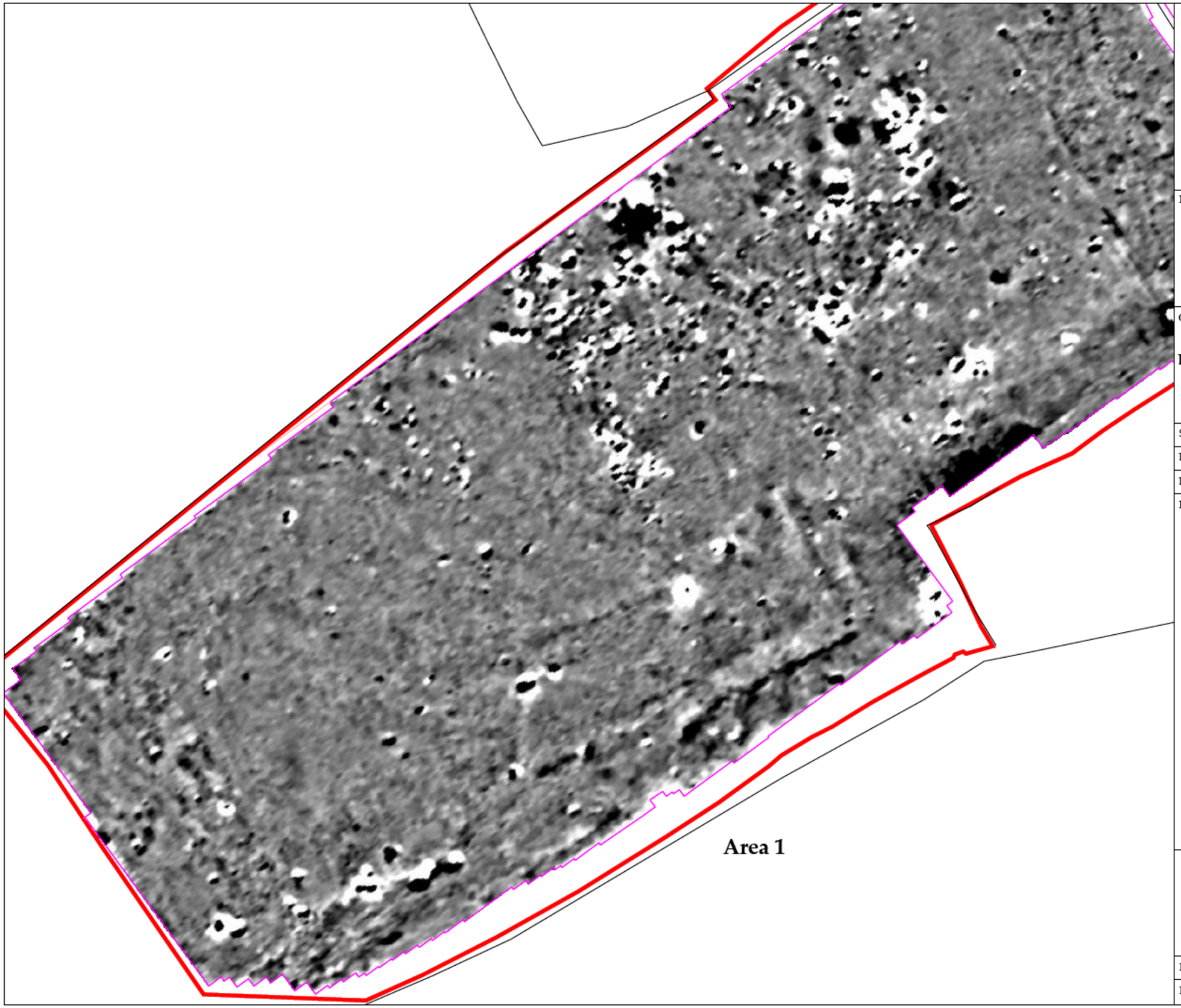


Figure 2: Location of the geophysical survey areas (Areas 1-3).



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CLIENT:

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DATE: November 2014

KEY:

Outline of proposed development area

Outline of geophysical survey area

4 nT
3.2
2.4
1.6
0.8
0
-0.8
-1.6
-2.4
-3.2
-4 nT

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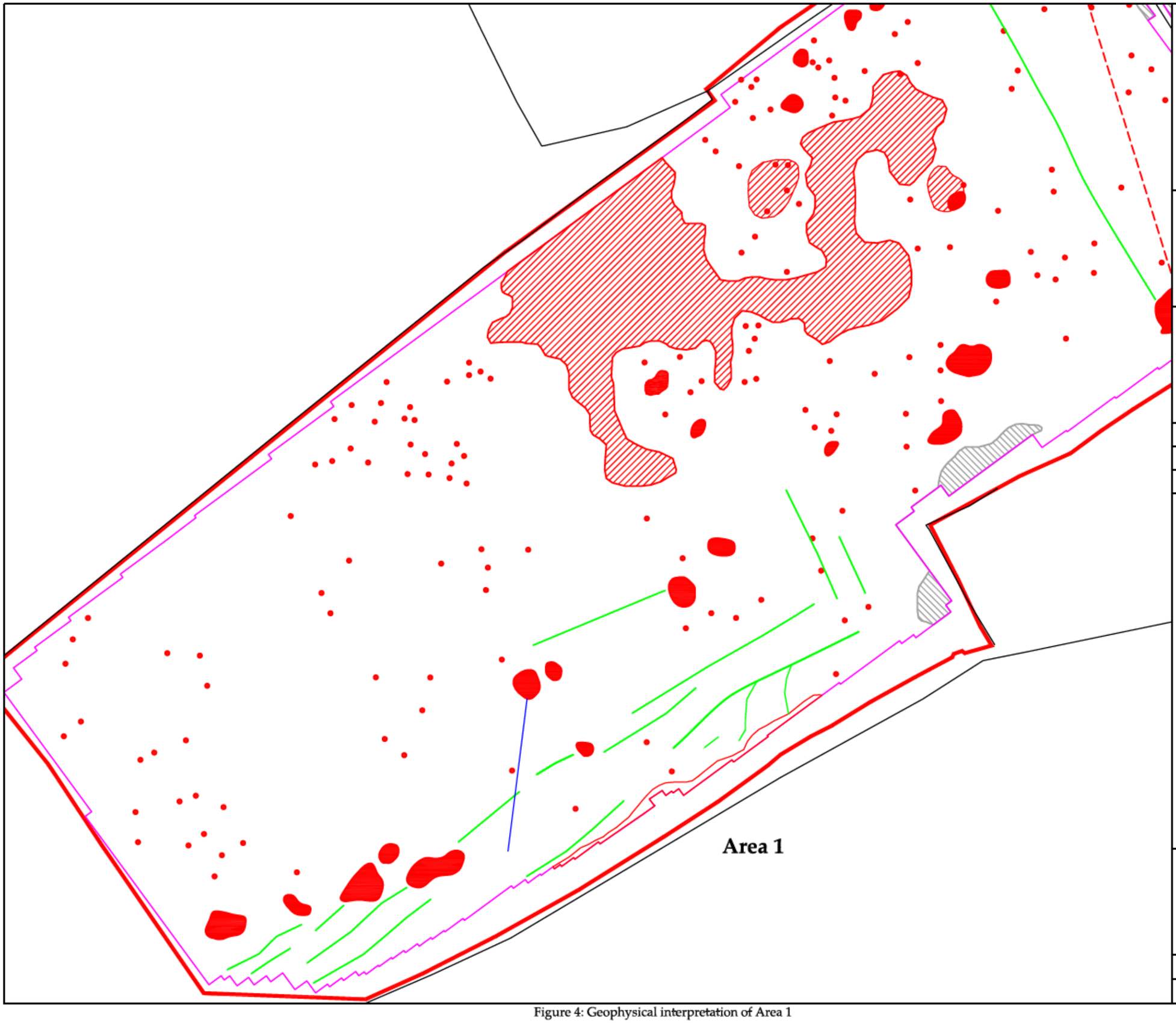
FIGURE: 3

Figure 3: Geophysical survey of Area 1



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SCALE: 1:1000 at A3

DRAWN BY: MDR

DATE: November 2014

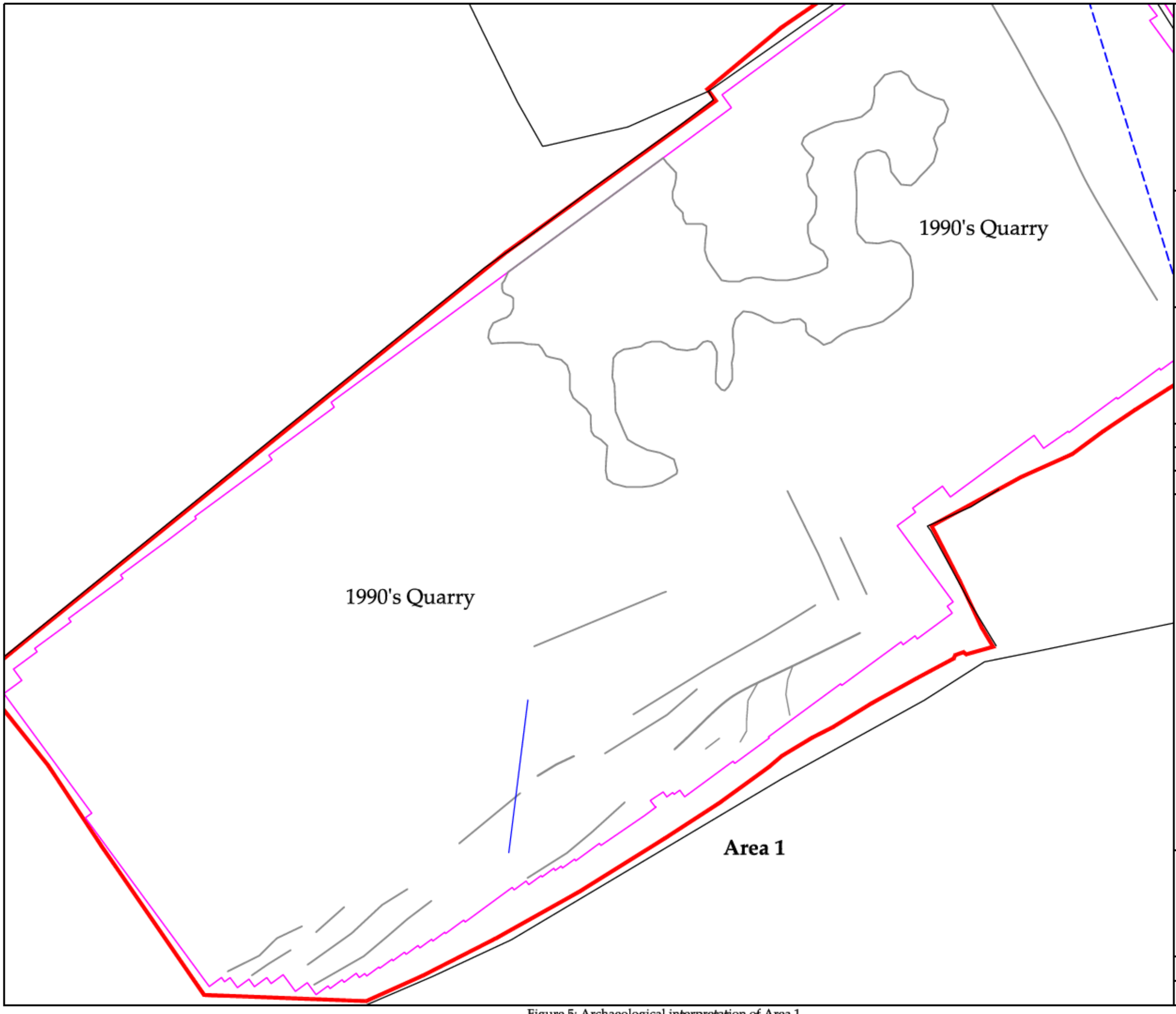
KEY:

- Outline of proposed development area
- Outline of geophysical survey area
- Dipolar magnetic anomaly
- Dipolar magnetic anomaly
- Dipolar magnetic anomaly
- Magnetic disturbance

REPORT No: CP11087

FIGURE: 4

Figure 4: Geophysical interpretation of Area 1



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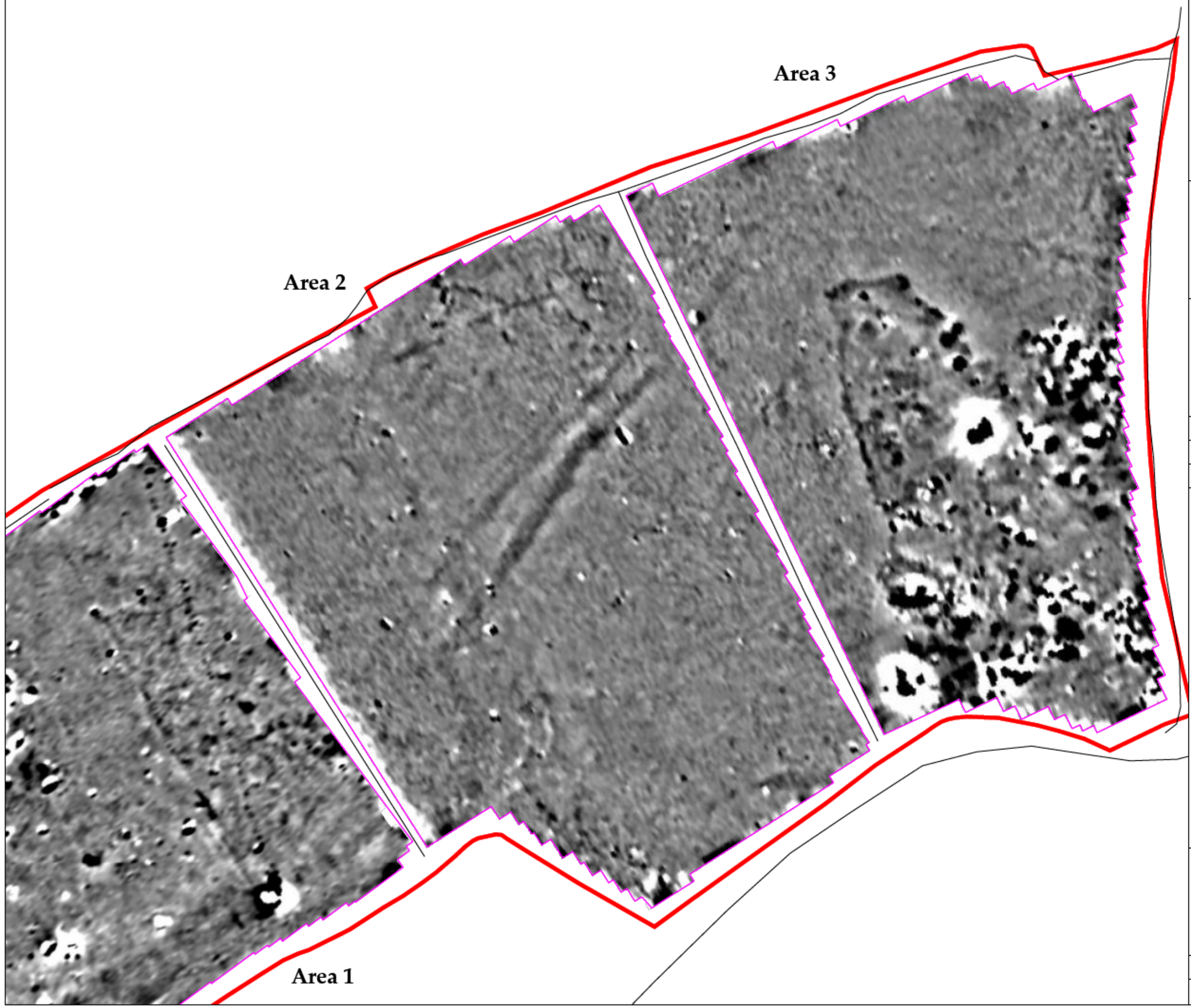
REPORT No: CP11087

FIGURE: 5

Figure 5: Archaeological interpretation of Area 1



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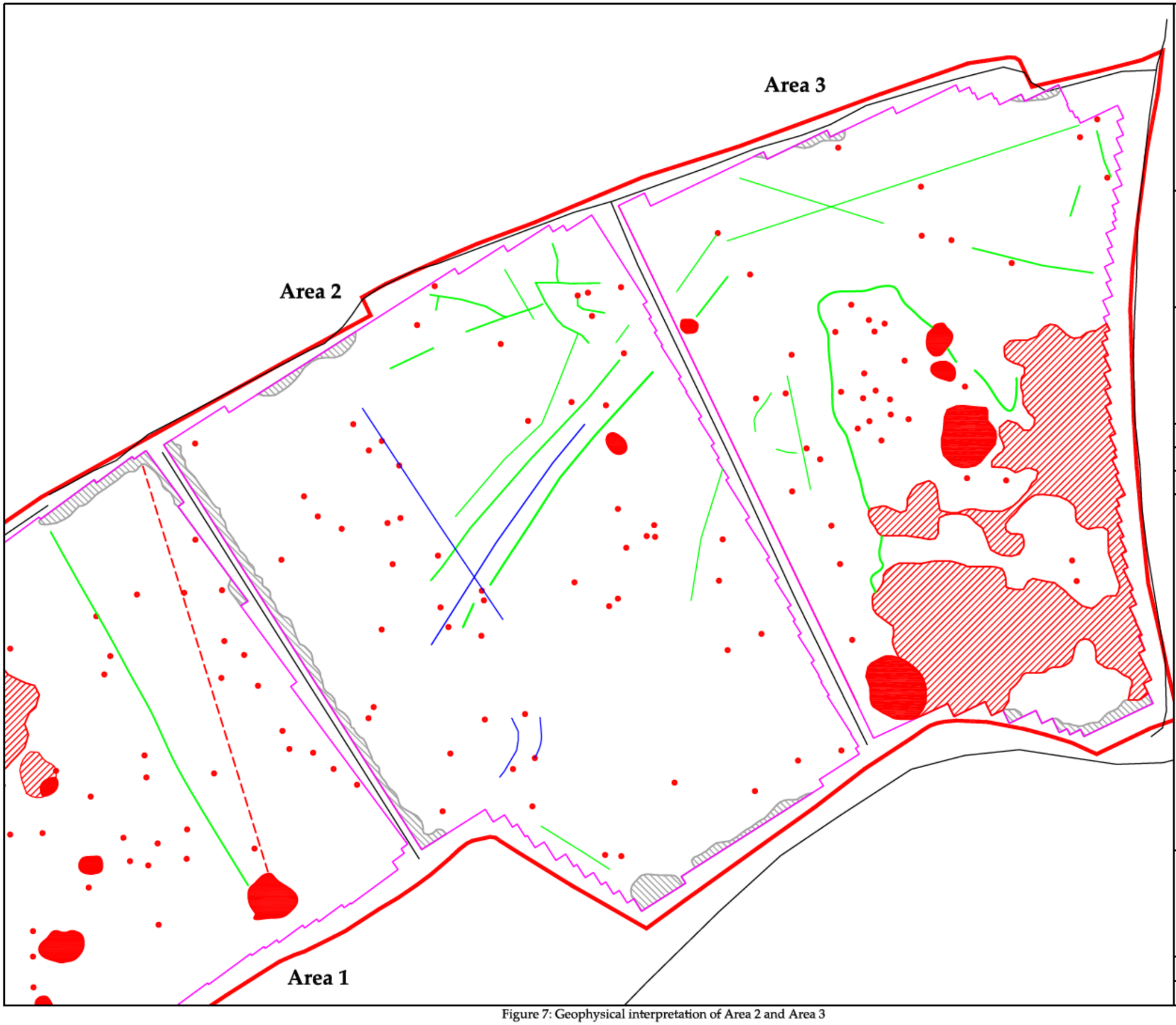
3.2
2.4
1.6
0.8
0
-0.8
-1.6
-2.4
-3.2
-4 nT

REPORT No: CP11087

FIGURE: 6

Figure 6: Geophysical survey of Area 2 and Area 3



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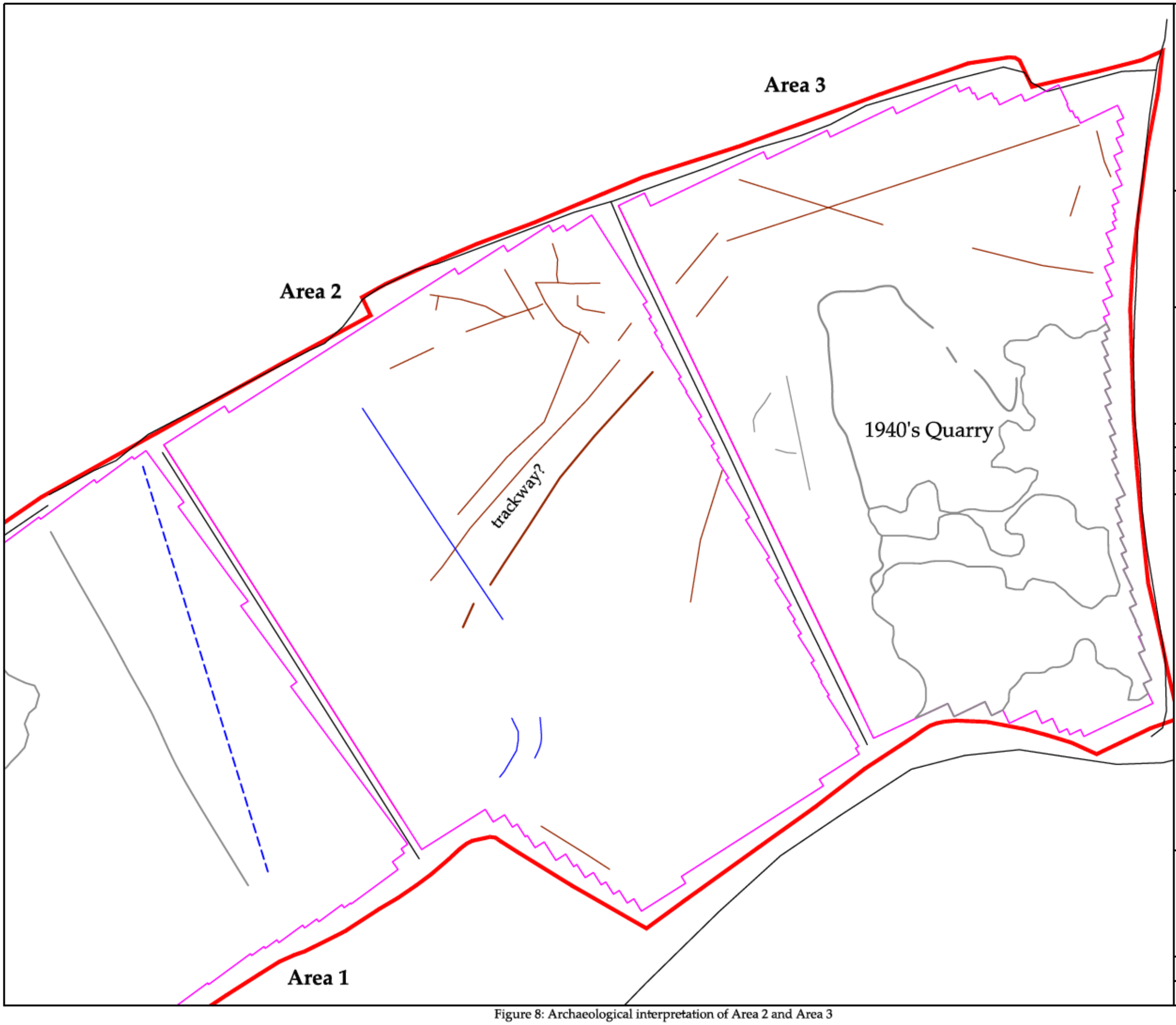

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