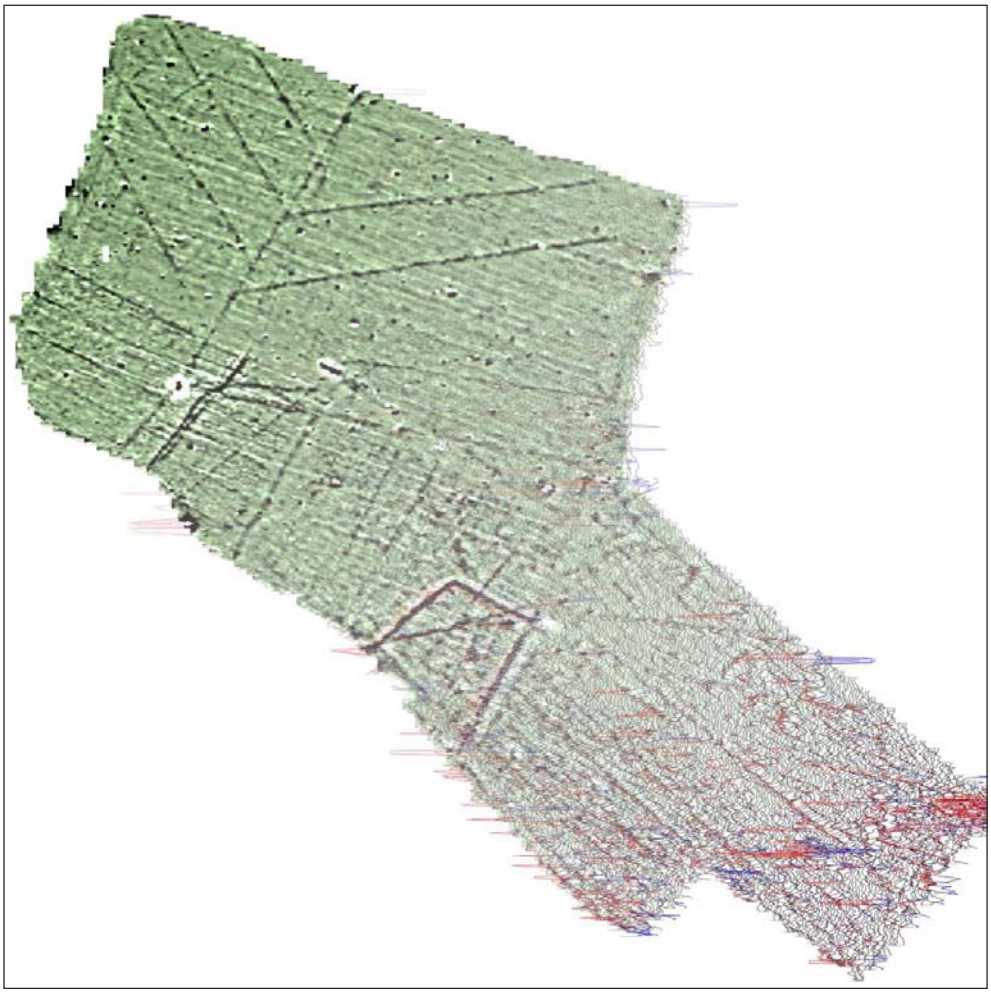
making sense of heritage

Grange Farm, Winterbourne South Gloucestershire

Detailed Gradiometer Survey Report



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November 2013

geoservices

Grange Farm, Winterbourne
South Gloucestershire

Detailed Gradiometer Survey Report

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* I = Internal Draft; E = External Draft; F = Final

Grange Farm, Winterbourne
South Gloucestershire

Detailed Gradiometer Survey Report

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Detailed Gradiometer Survey Report

Summary

A detailed gradiometer survey was conducted over land near Grange Farm, Winterbourne, South Gloucestershire. The project was commissioned by Smiths Gore on behalf of their client Solar Power South Ltd with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features on the site ahead of a proposed development of a solar array.

The site comprises eight fields to the north of Trench Lane, approximately 10km north of the centre of Bristol. The site occupies an area of relatively flat land. The gradiometer survey covered 34.6ha and has demonstrated the presence of anomalies of likely, probable and possible archaeological interest within the survey area, along with a region of increased magnetic response and at least one modern service.

Some anomalies were identified that may relate to a nearby lime kiln in the north and at least two enclosures have been identified at the southwest corner of the site. The majority of the anomalies detected appear to relate to this areas use for agriculture.

The geophysical survey was undertaken between the 7th and 31st October 2013.

Grange Farm, Winterbourne
South Gloucestershire

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by Smiths Gore on behalf of their client Solar Power South Ltd. The assistance of Peter Grubb is gratefully acknowledged in this regard.

The fieldwork was directed by Jennifer Smith and assisted by Clara Dickinson, Rachel Chester, Angus Forshaw and Rachel Williams. Jennifer Smith and Ross Lefort processed the geophysical data which was interpreted by Ross Lefort who also wrote this report. The geophysical work was quality controlled by Ben Urmston. Illustrations were prepared by Ken Lymer. The project was managed on behalf of Wessex Archaeology by Caroline Budd.

Grange Farm, Winterbourne South Gloucestershire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by Smiths Gore on behalf of their client Solar Power South Ltd to carry out a geophysical survey of land at Grange Farm, Winterbourne, South Gloucestershire (**Figure 1**), hereafter "the Site" (centred on NGR 363400, 182800). The survey forms part of an ongoing programme of archaeological works being undertaken ahead of proposed development at the Site.

1.1.2 The aims of the geophysical survey are set out in a Written Scheme of Investigation (WSI) prepared by Wessex Archaeology (WA 2013a) and are as follows; to:

- Conduct a detailed gradiometer survey which covers as much of the specified area as possible, allowing for artificial obstructions;
- Clarify the presence/absence and extent of any detectable buried archaeological remains within the Site;
- Characterise any sites identified during the detailed survey;
- Produce a report which will present the results of the geophysical survey in sufficient detail to allow an informed decision to be made concerning the Site's archaeological potential.

1.1.3 A Desk-Based Assessment (DBA) was carried out by Wessex Archaeology that revealed there are only a couple of recorded heritage assets within the survey area. This lack of evidence may be related to a lack of archaeological investigation in this area (WA 2013b) rather than to a true absence of archaeological potential.

1.1.4 This report presents a brief description of the methodology followed, the detailed survey results and the archaeological interpretation of the geophysical data.

1.2 Site Location, Topography, Soils and Geology

1.2.1 The Site is located between the settlements of Bradley Stoke to the west and Winterbourne to the east, approximately 10km north of Bristol city centre (**Figure 1**). Geophysical survey was carried out over all accessible areas of the Site, a total of 34.6ha.

1.2.2 The Site comprises an irregular parcel of land of approximately 37 hectares occupies eight large agricultural fields, the majority of which is currently under arable cultivation. It is bounded to the west a reservoir associated with West Country Water Park and Woodlands Golf Club, to the north by farmland, to the east by a number of fields and Rugby Football Ground and to the south by Trench Lane. A valley of a minor watercourse,

feeding into the Bradley Brook, a tributary to the River Frome, is situated to the north and west of the Site.

1.2.3 The Site occupies a relatively level plateau within a gently undulating landscape at an elevation of approximately 60m above Ordnance Datum (aOD). The underlying geology is mapped as Jurassic and Triassic limestone and mudstone of the Blue Lias Formation across the majority of the Site and of the Penarth Group around the north-eastern and western edges (WA 2013b).

1.2.4 The soils underlying the Site are likely to be pelo-stagnogleys of the 712b (Denchworth) association (SSEW 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

2 METHODOLOGY

2.1 Introduction

2.1.1 The detailed magnetometer survey was conducted using a Bartington Grad601-2 dual fluxgate gradiometer system. The survey was conducted in accordance with English Heritage guidelines (2008).

2.1.2 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team between the 7th and 31st October 2013. Field conditions at the time of the survey were good, with firm ground under foot and little vegetation present on site.

2.2 Method

2.2.1 Individual survey grid nodes were established at 30m x 30m intervals using a Leica Viva RTK GNSS instrument, which is precise to approximately 0.02m and therefore exceeds English Heritage recommendations (2008).

2.2.2 The magnetometer survey was conducted using a Bartington Grad601-2 fluxgate gradiometer instrument, which has a vertical separation of 1m between sensors. Data were collected at 0.25m intervals along transects spaced 1m apart with an effective sensitivity of 0.03nT, in accordance with EH guidelines (2008). Data were collected in the zigzag method.

2.2.3 Data from the survey was subject to minimal data correction processes. These comprise a zero mean traverse function (±8nT thresholds) applied to correct for any variation between the two Bartington sensors used, and a de-step function to account for variations in traverse position due to varying ground cover and topography. The multiply and deslope functions were used to correct minor inconsistencies in the data. These four steps were applied to all survey areas, with no interpolation applied.

2.2.4 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

3 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

3.1 Introduction

3.1.1 The gradiometer survey has been successful in identifying anomalies of likely, probable and possible archaeological interest across the Site, along with at least one modern service. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:2000 (**Figures 2** to **10**). The data are displayed at -2nT

(white) to +3nT (black) for the greyscale image and ±25nT at 25nT per cm for the XY trace plots.

3.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figure 4**, **7** and **10**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.

3.1.3 Numerous ferrous anomalies are visible throughout the detailed survey dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.

3.2 Gradiometer Survey Results and Interpretation

3.2.1 **Field 1** contains a probable enclosure around **4000** that is defined by a ditch with magnetic values over +3nT; there are some pit-like responses within that may be related and a number of positive linear ditches cross this enclosure that are not likely to be contemporary. The enclosure ditch is classed as archaeology and the other crossing ditches and pit-like anomalies have been classed as probable or possible archaeology depending on their strength and orientation.

3.2.2 This enclosure is surrounded by a larger enclosure with weaker positive magnetic values around +1.5nT. The northern side of this enclosure is peculiar in that two ditches cross around **4001** and **4002** to form a bow tie shape. This larger enclosure contains a much lower concentration of pit-like anomalies than the smaller enclosure around **4000**. It is unclear whether these two enclosures are contemporary and related in any way but the weaker enclosure ditches around **4001** and **4002** have been classed as probable archaeology.

3.2.3 There are more ditches to the west of **4002** at **4003**; clearly more than one phase is represented given the close arrangement. The ditch with the highest magnetic values is curved and has been classed as archaeology. The slightly weaker ditches have been classed as probable archaeology as they are on a similar alignment to the enclosure at **4001** and **4002**.

3.2.4 There are some isolated pit-like anomalies and ditch sections at **4004**, **4005**, **4006** and **4007**. All of these anomalies have magnetic values over +3nT and are variously classed as probable or possible archaeology depending on alignment with the current field boundaries.

3.2.5 There are numerous trends spread throughout the field, most are related to agricultural activity such as those around **4009** but others such as the examples around **4008** may prove to be of archaeological significance.

3.2.6 **Field 2** contains few anomalies of archaeological interest. There are two larger pit-like anomalies at **4010** and **4011** that may prove to be of interest; they are both classed as possible archaeology as a non-archaeological explanation is possible for them. There is a small spread of bipolar and dipolar responses around **4012**; this spread is likely to be a concentration of ceramic/metallic debris and may prove to be archaeological.

3.2.7 **Field 3** also contains few anomalies of archaeological interest aside from a few along the western side of the field. A curving ditch is present around **4013** with magnetic values around +2nT; it does not appear to define an enclosure but has been classed as probable archaeology due to its slightly unusual form. There are two smaller anomalies further north at **4014** and **4015**; **4014** is U-shaped and **4015** is sub-oval shaped and both have

magnetic values over +3nT. Anomaly **4014** measures 6m in length and has a very regular anthropogenic form with the pit-like anomaly at **4015** measuring 3.5m in length. Both anomalies have been classed as probable archaeology.

3.2.8 A former field boundary is visible as a line of ferrous at **4016** and a modern service is visible at **4017** although this will be discussed in more detail below. There is a large spread of bipolar responses covering much of this field; it is unclear whether this is a geological change or a concentration of anthropogenic debris.

3.2.9 **Field 4** contains few anomalies of archaeological interest aside from one clear pit-like anomaly at **4018**; this feature sub-oval shaped and measures 3.5m in length with magnetic values over +3nT. This feature is considered to represent a pit and is classed as probable archaeology. There is a concentration of bipolar and dipolar responses towards the south of this field around **4019**; this spread is considered to represent modern debris including metallic and ceramic material.

3.2.10 **Field 5** contains few anomalies of archaeological interest but has a uniformly enhanced magnetic background. This enhancement is defined by the field boundaries which strongly suggest this enhancement is anthropogenic and not geological. The only anomalies of interest are two linear features either side of **4020** that may prove to be isolated ditch sections; both have been classed as probable archaeology.

3.2.11 **Field 6** contains few anomalies of archaeological interest but also has an enhanced magnetic background like **Field 5**. There is an irregular shaped positive anomaly at 4021 with magnetic values over +3nT and a length of at least 8m. This feature is considered to possibly represent a large cut feature and has been classed as probable archaeology due to its large size. There are two concentrations of positive anomalies at **4022** and **4023** that have been classed as possible archaeology. It is unclear what these concentrations could represent but the sub-rectangular form suggests that an archaeological interpretation is justified.

3.2.12 **Field 7** contains two ditch-like anomalies that may define former field boundaries along with a number of other ditches running parallel to the current boundaries. This field also has an enhanced magnetic background like **Fields 5** and **6**. The two ditches at **4024** and **4025** have an interrupted form which may be a reflection of their state of preservation and both have magnetic values around +2nT. These features may either be former field boundaries or may be more substantial drainage features. Neither of these ditches coincides with any feature visible on old maps consulted in the DBA (WA 2013b) and have therefore been classed as probable archaeology due to the uncertainty in their interpretation. There are two smaller cut features around **4026**; one is sub-rectangular and the other is L-shaped and both have magnetic values in excess of +3nT. These features are clearly anthropogenic given their regular form and shape and are classed as probable archaeology.

3.2.13 There are more ditches visible in the data at **4027**, **4028**, **4029**, **4030** and **4031**; all have positive values over +3nT but have been classed as possible archaeology as they are aligned parallel to the current field boundaries.

3.2.14 **Field 8** contains several possible field boundaries at **4032**, **4033**, **4034**, **4035** and **4036**; they have an interrupted form which may be a combination of poor preservation in places and an effect of the processing applied to the data. The ditches range in strength from over +3nT at the strongest points to around +1nT at the weakest places. Like the ditches encountered in the previous field they cannot be linked to any feature visible on the maps consulted in the DBA (WA 2013b). These ditches have been variously classed as

archaeology or probable archaeology depending on the strength of the response. A curving section of ditch near **4036** may prove to be of greater significance.

3.2.15 A group of peculiar anomalies is present at **4037**, **4038**, **4039** and **4040**; they are made up of rectilinear shapes that do not appear to be geological given their shape. The magnetic values vary across these broad anomalies giving them a textured appearance; the magnetic values within these regions varies from over +3nT to -1.5nT. These anomalies are located very close to a record of a post-medieval lime kiln identified in the DBA (WA 2013b) so may be related in some way to this activity. These anomalies have been classed as archaeology as they are unique in the available data set and are clearly anthropogenic given their shape in plan.

3.2.16 There is a concentration of slightly irregular shaped positive responses around **4041**; these anomalies have been classed as possible archaeology as a geological explanation may also be possible for them. There are broad spreads of bipolar responses in this field, similar to **Field 3**; again it is unclear whether these concentrations are anthropogenic or geological.

3.2.17 There is a number of small sub-circular and sub-oval shaped positive anomalies scattered throughout all of the fields. These anomalies could represent archaeological features such as pits or postholes but could also represent data spikes, unusual ferrous responses or geological features. These anomalies have been classed as possible archaeology as there is no significant patterning in their spatial distribution to allow further interpretation.

3.2.18 There are many weak linear anomalies scattered throughout the data; the vast majority relate to agricultural activity representing either ploughing trends or field drains but a few classed as trends may prove to be of archaeological significance.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 There is at least one modern service located in the data at **4017**; this service appears to be a ferrous pipe. This service runs roughly northwest to southeast through **Field 3** and north to south through **Fields 7** and **8** and continues beyond the limits of the geophysical survey. Another short section of pipe is visible south of **4026** but it is unclear whether this joins up with the service discussed above. There is a line of ferrous at **4016**, this looks to be a former field boundary rather than a service but the possibility that it relates to a service cannot be ruled out entirely.

3.3.2 It is not clear from the geophysical data whether any of the services identified are in active use or not. Also gradiometer data will not be able to locate and identify all services present on site. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on site.

4 CONCLUSION

4.1.1 The detailed gradiometer survey has been successful in detecting anomalies of likely, probable and possible archaeological interest within the Site, in addition to regions of increased magnetic response and at least one modern service.

4.1.2 The data has revealed a number of features including some peculiar cut features possibly related to activity at a nearby lime kiln in **Field 8** and two enclosures in **Field 1**. In addition to these features a number of former field boundaries have been identified along with other agricultural features such as ploughing scars and field drains. Apart from **Fields 1**

and **8** the majority of the fields are largely clear of extensive archaeological features with **Fields 2**, **4**, **5** and **6** largely empty besides a few small pit-like anomalies.

4.1.3 **Fields 5**, **6** and **7** have background magnetic values that are much higher than the other fields. As this enhancement is defined by field boundaries a geological explanation for this is unlikely. It is probable that some magnetically enhanced material has been added to the field as manure or some other method of soil improvement such as liming. The higher background strength in these fields may obscure weaker archaeological features.

4.1.4 The relative dimensions of the modern services identified by the gradiometer survey are indicative of the strength of their magnetic response, which is dependent upon the materials used in their construction and the backfill of the service trenches. The physical dimensions of the services indicated may therefore differ from their magnetic extents in plan; it is assumed that the centreline of services is coincident with the centreline of their anomalies, however. Similarly, it is difficult to estimate the depth of burial of the services through gradiometer survey.

4.1.5 It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be encountered than have been identified through geophysical survey. This is particularly true in **Fields 5**, **6** and **7** where the stronger background values may obscure weak archaeological features.

5 REFERENCES

English Heritage, 2008. *Geophysical Survey in Archaeological Field Evaluation*. Research and Professional Service Guideline No 1, 2nd edition.

Soil Survey of England and Wales, 1983. *Sheet 5, South West England*. Ordnance Survey, Southampton.

Wessex Archaeology, 2013a. *Grange Farm, Winterbourne, South Gloucestershire: Written Scheme of Investigation*. Unpublished Report. Report reference: 101061.02

Wessex Archaeology, 2013b. *Grange Farm, Winterbourne, South Gloucestershire: Archaeological Desk-Based Assessment.* Unpublished Report. Report reference: 101060.01

APPENDIX 1: SURVEY EQUIPMENT AND DATA PROCESSING

Survey Methods and Equipment

The magnetic data for this project was acquired using a Bartington 601-2 dual magnetic gradiometer system. This instrument has two sensor assemblies fixed horizontally 1m apart allowing two traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 1m separation, and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.

The gradiometers have an effective resolution of 0.03nT over a ±100nT range, and measurements from each sensor are logged at intervals of 0.25m. All of the data are stored on an integrated data logger for subsequent post-processing and analysis.

Wessex Archaeology undertakes two types of magnetic surveys: scanning and detail. Both types depend upon the establishment of an accurate 20m or 30m site grid, which is achieved using a Leica Viva RTK GNSS instrument and then extended using tapes. The Leica Viva system receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02m in real-time and therefore exceed the level of accuracy recommended by English Heritage (2008) for geophysical surveys.

Scanning surveys consist of recording data at 0.25m intervals along transects spaced 10m apart, acquiring a minimum of 80 data points per transect. Due to the relatively coarse transect interval, scanning surveys should only be expected to detect extended regions of archaeological anomalies, when there is a greater likelihood of distinguishing such responses from the background magnetic field.

The detailed surveys consist of 20m x 20m or 30m x 30m grids, and data are collected at 0.25m intervals along traverses spaced 1m apart. These strategies give 1600 or 3600 measurements per 20m or 30m grid respectively, and are the recommended methodologies for archaeological surveys of this type (EH, 2008).

Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. Data may be collected at up to 0.125m intervals along traverses spaced up to 0.25m apart, resulting in a maximum of 28800 readings per 30m grid, exceeding that recommended by English Heritage (2008) for characterisation surveys.

Post-Processing

The magnetic data collected during the detail survey are downloaded from the Bartington system for processing and analysis using both commercial and in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

As the scanning data are not as closely distributed as with detailed survey, they are georeferenced using the GPS information and interpolated to highlight similar anomalies in adjacent transects. Directional trends may be removed before interpolation to produce more easily understood images.

Typical data and image processing steps may include:

- Destripe – Applying a zero mean traverse in order to remove differences caused by directional effects inherent in the magnetometer;
- Destagger – Shifting each traverse longitudinally by a number of readings. This corrects for operator errors and is used to enhance linear features;
- Despike – Filtering isolated data points that exceed the mean by a specified amount to reduce the appearance of dominant anomalous readings (generally only used for earth resistance data)

Typical displays of the data used during processing and analysis:

- XY Plot – Presents the data as a trace or graph line for each traverse. Each traverse is displaced down the image to produce a stacked profile effect. This type of image is useful as it shows the full range of individual anomalies.
- Greyscale – Presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.

APPENDIX 2: GEOPHYSICAL INTERPRETATION

The interpretation methodology used by Wessex Archaeology separates the anomalies into two main categories: archaeological and unidentified responses.

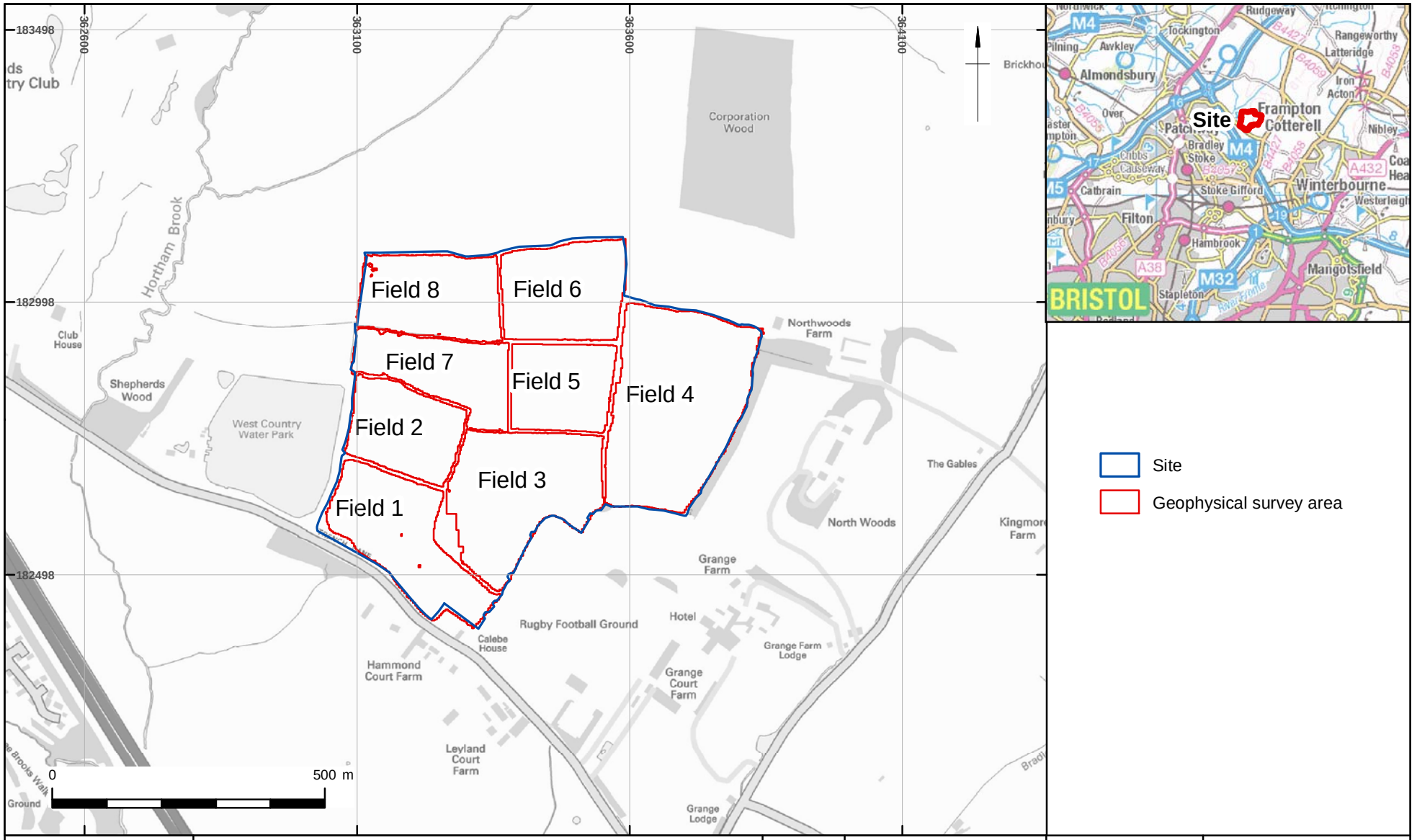
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:

- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Probable archaeology – used for features which give a clear response but which form incomplete patterns.
- Possible archaeology – used for features which give a response but which form no discernible pattern or trend.

The unidentified category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend – used for low amplitude or indistinct linear anomalies.
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.

Finally, services such as water pipes are marked where they have been identified.



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Site location plan

Figure 1

Site

Geophysical survey area

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Greyscale: southwest

Figure 2

182750

182500

363250

363500

363750

+25nT

-25nT

0 100 m

Site

Geophysical survey area

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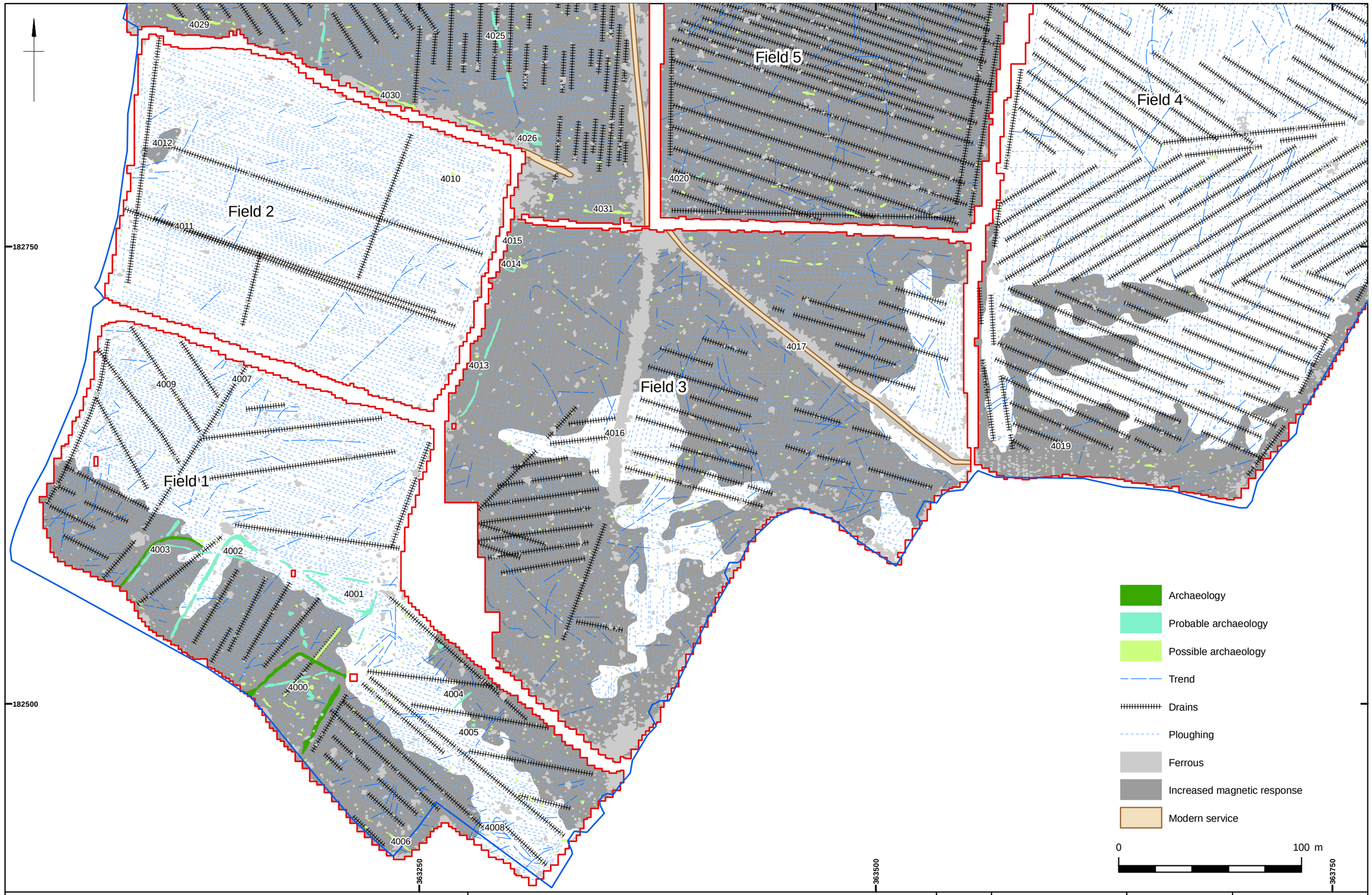
XY trace: southwest

Figure 3



Site

Geophysical survey area

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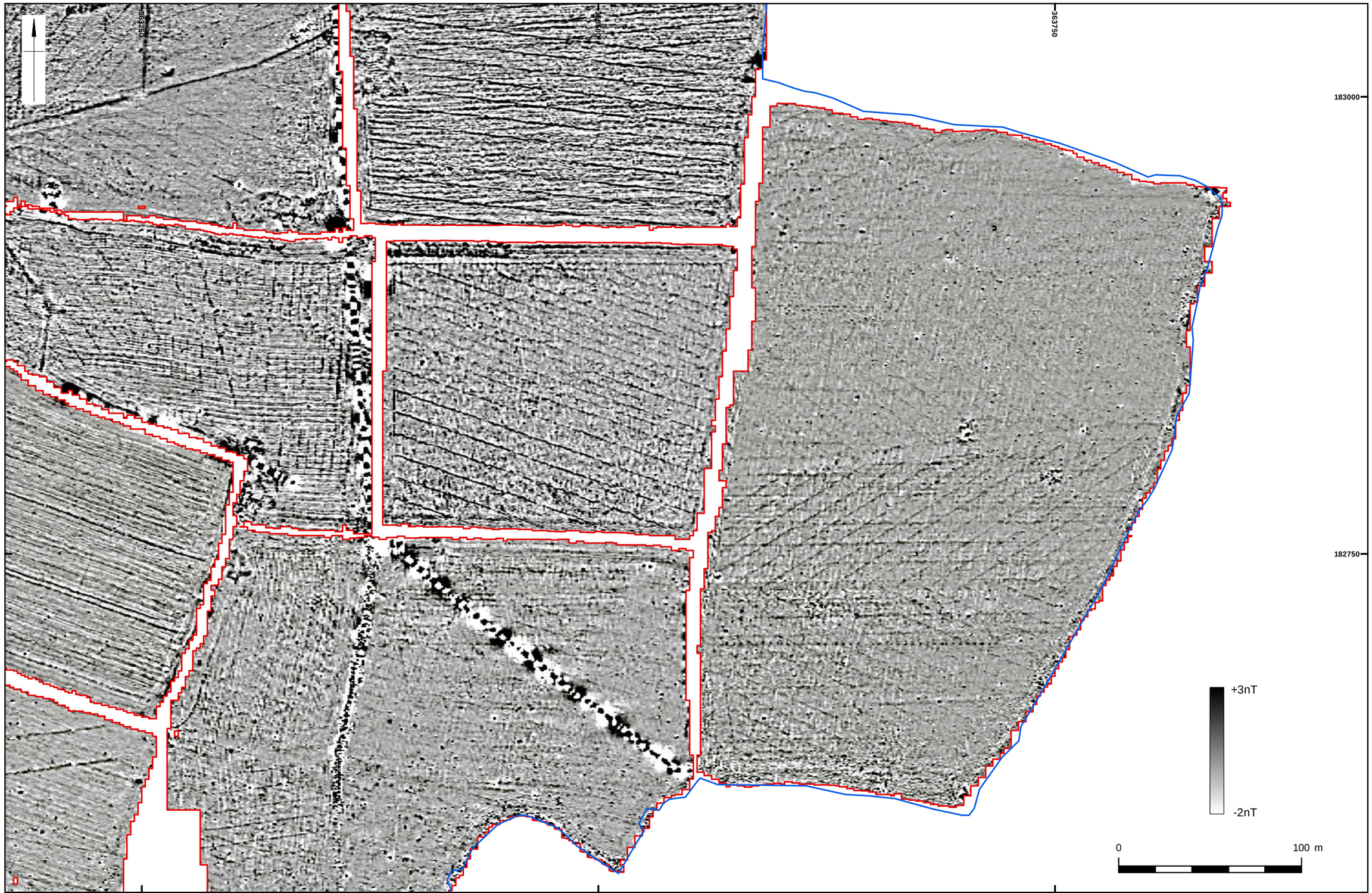
Interpretation: southwest

• 101061_MagInterp_TextAnomaly

Figure 4



Site

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Greyscale: east

Figure 6

363250

363500

363750

183000

182750

+25nT

-25nT

0 100 m

Site

Geophysical survey area

Date:	18/11/13	Revision Number:	0
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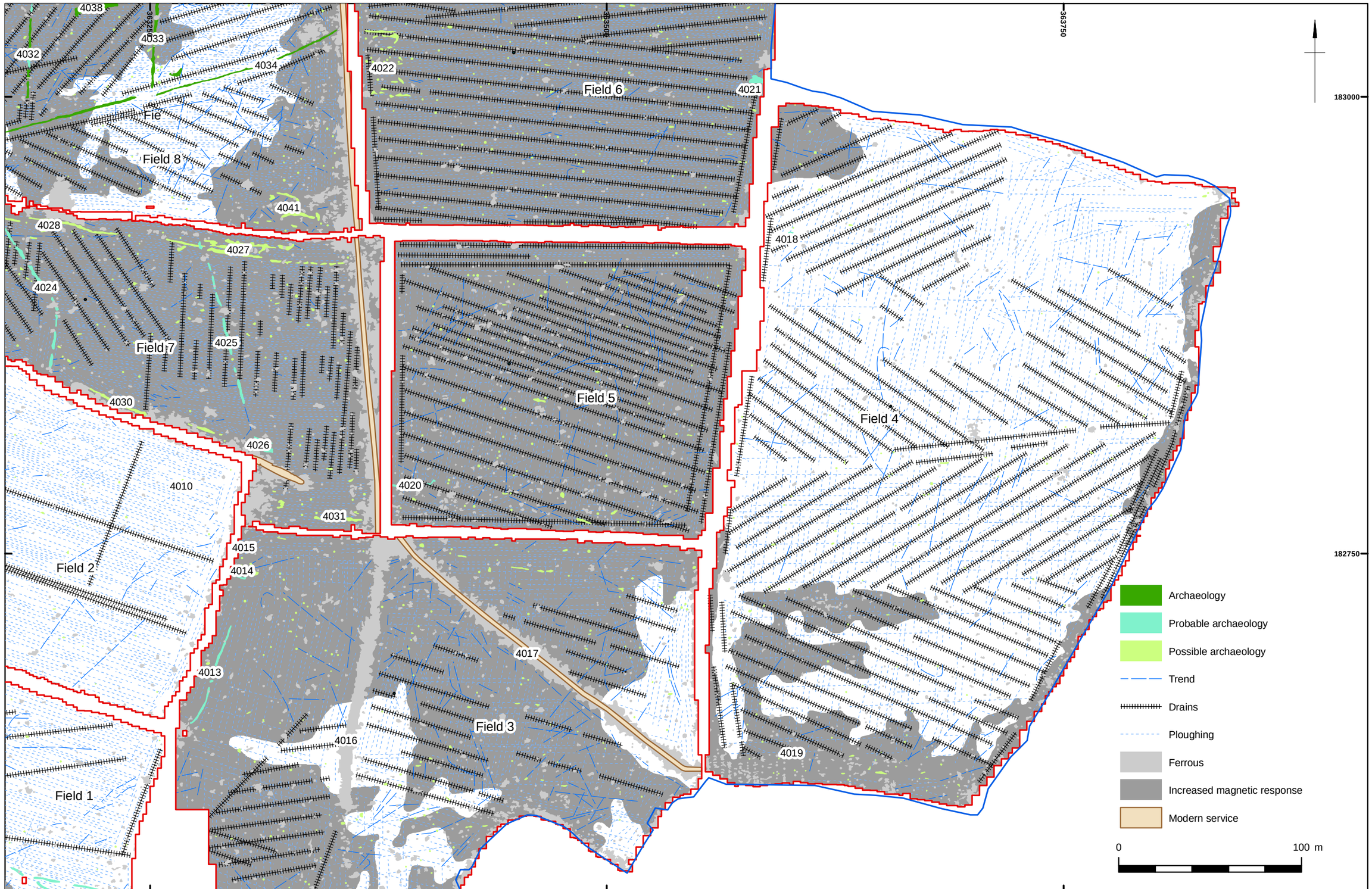
XY trace: east

Figure 6



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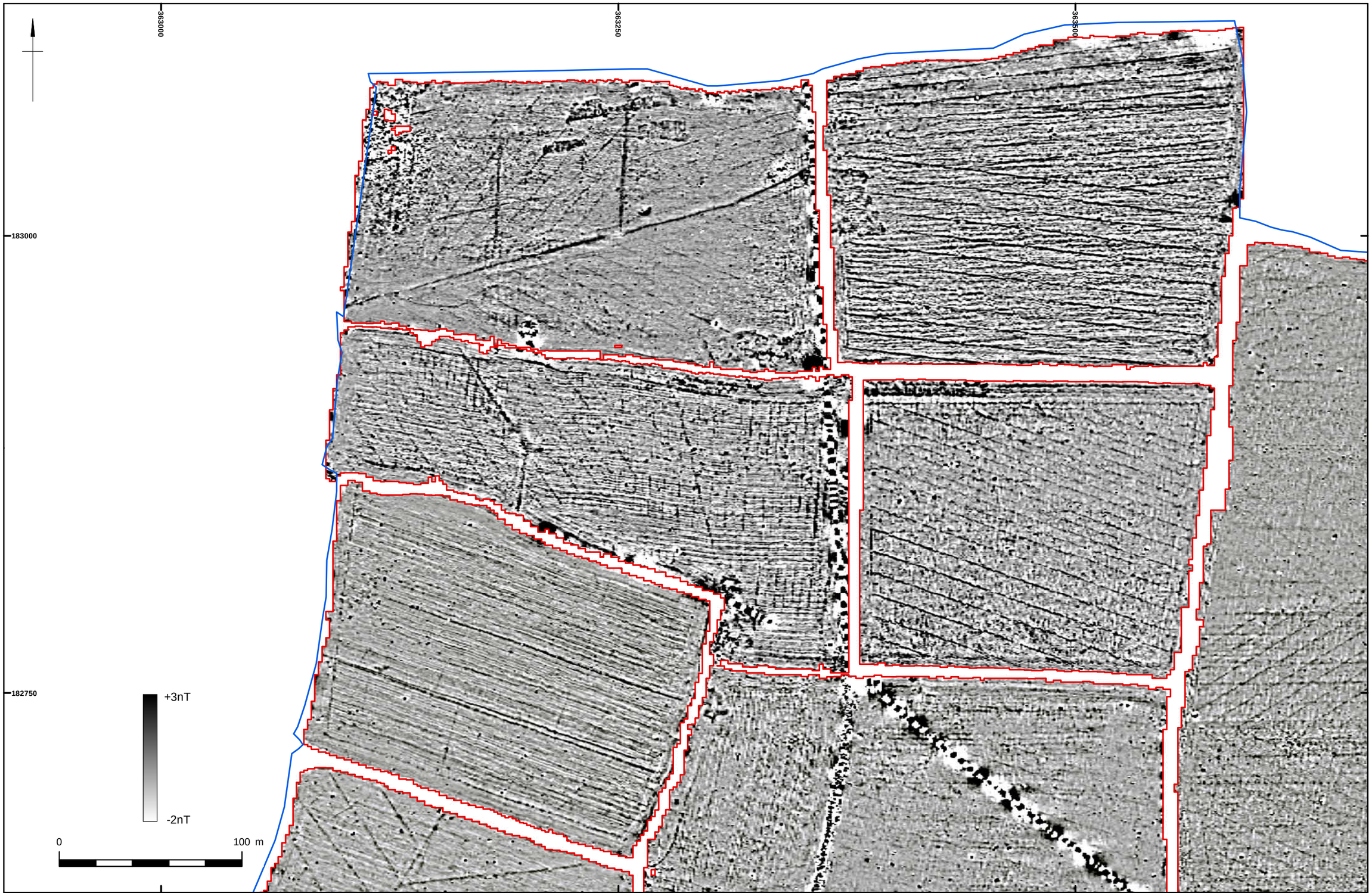
Interpretation: east

Figure 7



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Greyscale: northwest

Figure 8

363000

363250

363500

183000

182750

+25nT

-25nT

0

100 m

Site

Geophysical survey area

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Scale:	1:2000 at A3	Illustrator:	KL
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XY trace: northwest

Figure 9

363000

363250

363500

183000

182750

Field 1

Field 2

Field 3

Field 4

Field 5

Field 6

Field 7

Field 8

4007 4009 4011 4012 4013 4014 4015 4016 4017 4018 4019 4020 4021 4022 4023 4024 4025 4026 4027 4028 4029 4030 4031 4032 4033 4034 4035 4036 4037 4038 4039 4040 4041

Modern service

Ferrous

Archaeology

Probable archaeology

Possible archaeology

Trend

Drains

Ploughing

Increased magnetic response

0 100 m

Site

Geophysical survey area

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Interpretation: northwest

Figure 10

wessex archaeology

salisbury rochester sheffield edinburgh

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