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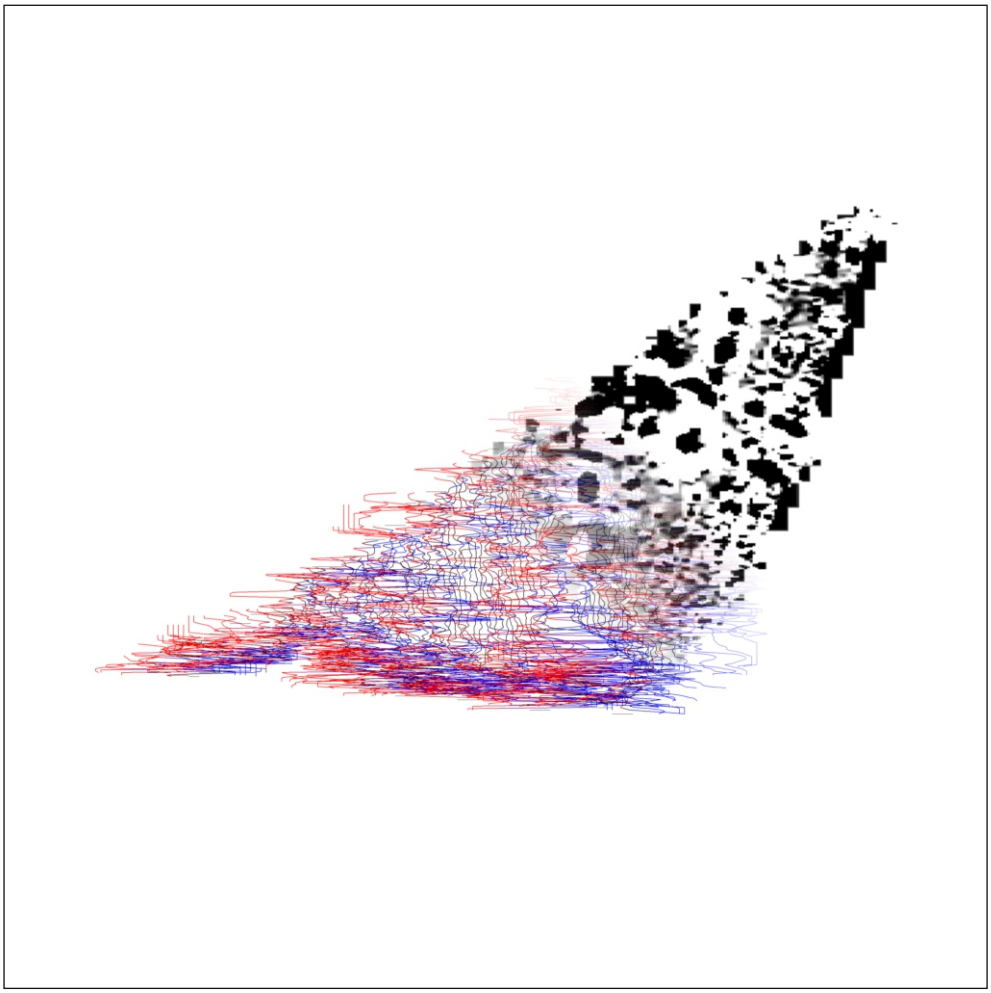
Army Rebasing: Bulford SFA North Site Salisbury, Wiltshire

Detailed Gradiometer Survey Report



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August 2014

geoservices

Army Rebasing: Bulford SFA North Site, Salisbury, Wiltshire

Detailed Gradiometer Survey Report

Prepared for:
URS Infrastructure & Environment UK Limited
Scott House
Alencon Link
Basingstoke
Hampshire
RG21 7PP

Prepared by:
Wessex Archaeology
Portway House
Old Sarum Park
Salisbury
SP4 6EB

www.wessexarch.co.uk

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

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Summary

A detailed gradiometer survey was conducted over land at Bulford Camp, Wiltshire. The project was commissioned by URS Infrastructure & Environment UK Limited with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features on the site ahead of a proposed development.

The survey area comprises of a triangular parcel of land within a residential area of Bulford Camp directly southeast off Tidworth Road, some 2.4 km to the northeast of the centre of Bulford, and 6.3 km southwest of Tidworth. The Site occupies an area of flat land. The gradiometer survey covered 0.52 ha and has demonstrated the presence of only two small anomalies of possible archaeological interest within the survey area, along with regions of magnetic disturbance, ferrous response and several modern services.

The modern services and associated ferrous responses dominate the survey results and it is possible that they may obscure other archaeological features that may lie within this area.

Throughout the entire survey area magnetic trends aligned northeast-southwest and WNW-ESE are clearly visible and may be associated with agricultural activity.

The geophysical survey was undertaken on 31st June 2014.

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Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by URS Infrastructure & Environment UK Limited and Wessex Archaeology is grateful to Robert Beaumont and Colin Bush in this regard.

The fieldwork was directed by Jen Smith and Alistair Black. Jen Smith processed the geophysical data which was interpreted by Ross Lefort. This report was written by Jen Smith. The geophysical work was quality controlled by Ross Lefort and Ben Urmston. Illustrations were prepared by Ross Lefort and Karen Nichols. The project was managed on behalf of Wessex Archaeology by Paul Baggaley.

Army Rebasing: Bulford SFA North Site, Salisbury, Wiltshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by URS Infrastructure & Environment UK Limited, on behalf of the Defence Infrastructure Organisation (DIO), to carry out a geophysical survey on land within the Salisbury Plain Training Area (SPTA), Wiltshire (**Figure 1**), hereafter "the Site" (centred on NGR 419150, 144225). The survey forms part of an ongoing programme of archaeological works being undertaken ahead of the proposed development of Service Family Accommodation (SFA).

1.1.2 The aim of the geophysical survey was to establish the presence/absence, extent and character of detectable archaeological remains within the survey area.

1.1.3 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 and Topography

1.2.1 The survey area comprises of a triangular parcel of land within a residential area of Bulford Camp directly southeast off Tidworth Road, some 2.4 km to the northeast of the centre of Bulford, 4.2 km northeast of Amesbury and 6.3 km southwest of Tidworth (**Figure 1**). Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of 0.52 ha.

1.2.2 The Site occupies an area of gently sloping land that lies at a height of approximately 100m above the Ordnance datum (aOD) at the northeast corner of the Site and slopes down to 95m aOD at the southwest corner. The survey extents are defined by a housing estate to the east, a sub-station with car park and a small forest area to the south and Tidworth Road to the west and north.

1.3 Soils and geology

1.3.1 The soils underlying the Site are unrecorded due to the urbanisation of the area, but the area surrounding the Site is likely to be the brown rendzinas of the 343h (Andover 1) 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.

1.3.2 The Sire bedrock geology is composed of chalk belonging to the Seaford Chalk Formation, forming in the Cretaceous period. No superficial deposits are recorded at this Site (BGS).

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 on 31st June 2014. Field conditions at the time of the survey were good.

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 (±5nT 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. These two 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 several anomalies of possible archaeological interest within the Site, along with areas of magnetic disturbance and ferrous responses. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:1250 (**Figure 2**). The data is displayed at -2nT (white) to +3nT (black) for the greyscale image and ±50nT at 50nT per cm for the XY trace plots.

3.1.2 The interpretation of the datasets highlights the presence of possible archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figure 2**). 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 The survey area is dominated by ferrous responses with several modern services running through the area at **4000** to **4003**; these services will be discussed in more detail in the next section of the report. This spread of ferrous covers the majority of the survey area and is easily strong enough to mask any weaker archaeological features that may be present at this Site.

3.2.2 There are a few small areas where the ferrous coverage is not total and within these regions are two small sub-circular positive anomalies that do not look to be ferrous such as the example north of **4004**. These features are extremely small (less than 1m in diameter) and it is unclear whether they represent small archaeological cut features such as postholes or are simply natural variations in the soil. These two small anomalies have been classed as possible archaeology due to the greater likelihood that they could relate to geological variations.

3.2.3 Numerous linear and curvilinear trends can be seen throughout the Site such as at **4005** and **4006**. These are predominately orientated northeast-southwest and WNW-ESE respectively, but these are most likely to be the result of agricultural activity at the Site.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 There are at least four modern services within the dataset at **4000** to **4003**. Two of the services **4001** and **4002** run parallel to each other along a WNW-ESE orientation across the Site, whilst **4000** and **4003** are set on differing northerly alignments. All four services appear to connect or cross one another and are considered to be ferrous pipes with each extending out beyond the limits of the geophysical survey.

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 two anomalies of possible archaeological interest within the Site but the wide spread of the ferrous responses associated with the modern services obscures the majority of the surveyed area.

4.1.2 The two possible archaeological anomalies identified are extremely small and it should be stressed that it is equally likely that they may turn out to be geological features.

4.1.3 The linear and curvilinear trends that are seen in several places across the dataset are considered to be related to some form of agricultural activity given that many are aligned parallel to one another.

4.1.4 The relative dimensions of the modern services identified by the gradiometer survey are indicative of the strength of its magnetic response, which is dependent upon the materials used in their construction and the backfill of the service trenches. The physical dimensions of the service indicated may therefore differ from their magnetic extent in plan; it is assumed that the centreline of service is coincident with the centreline of the anomaly, 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.

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, Soils of South West England*. Ordnance Survey, Southampton.

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.

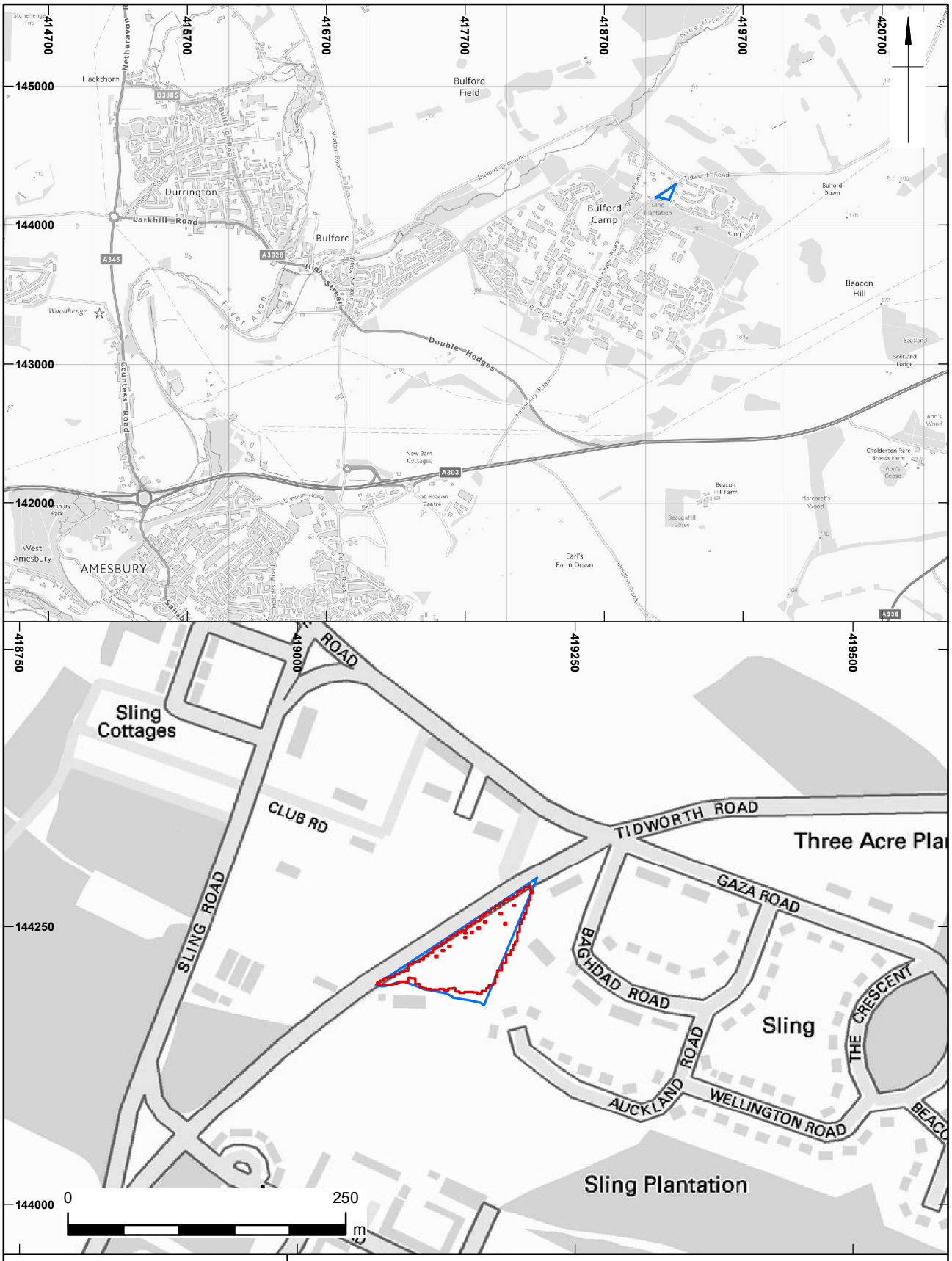
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided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



Detailed Survey Extents

Site Boundary

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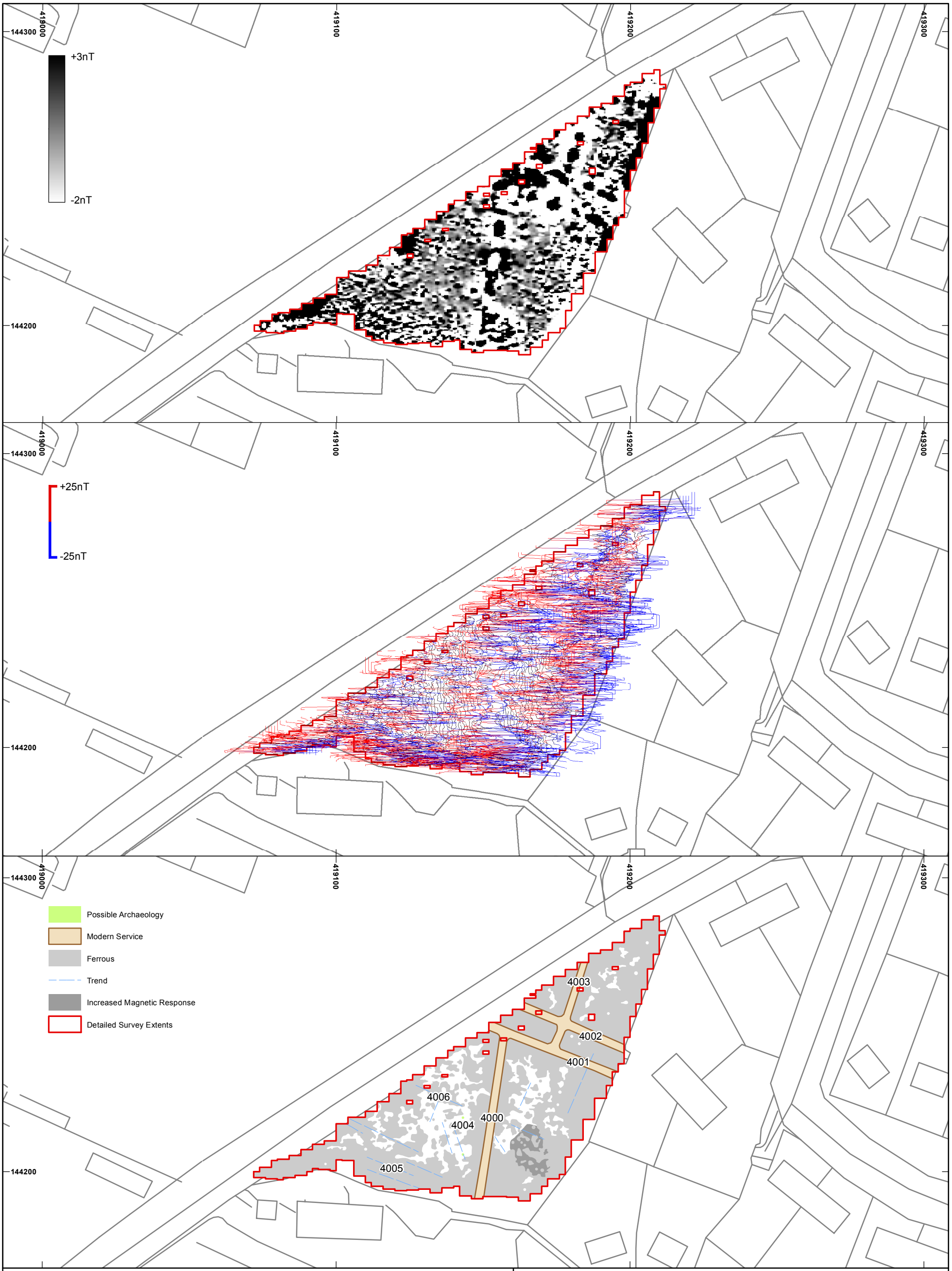
Site location and detailed survey extents

Figure 1



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Greyscale plot, XY trace plot and interpretation

Figure 2

Wessex Archaeology Ltd registered office Portway House, Old Sarum Park, Salisbury, Wiltshire SP4 6EB
Tel: 01722 326867 Fax: 01722 337562 info@wessexarch.co.uk www.wessexarch.co.uk