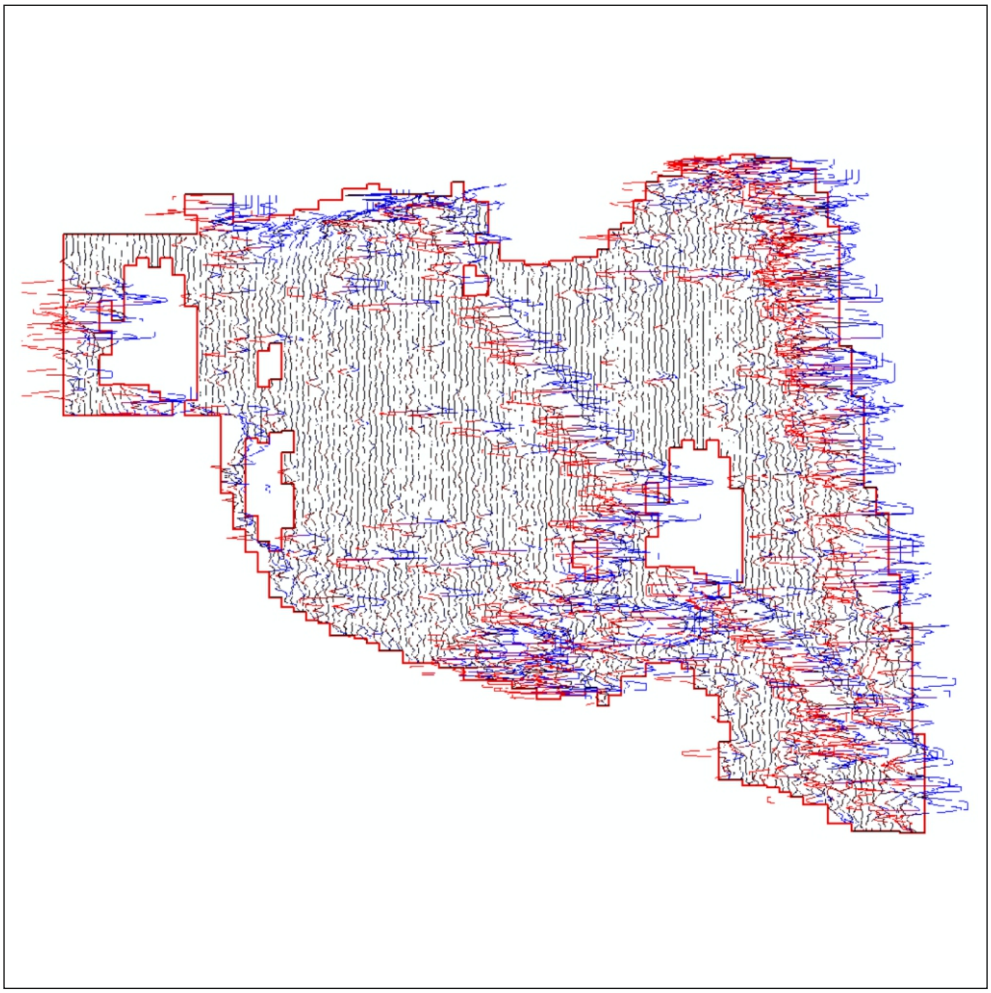
making sense of heritage

Land at Golden Mede and West of Warmstone Lane Waddesdon, Buckinghamshire

Detailed Gradiometer Survey Report



Ref: 106820.04
November 2014

geoservices

Land at Golden Mede and West of Warmstone Lane, Waddesdon, Buckinghamshire

Detailed Gradiometer Survey Report

Prepared for:
The Rothschild Foundation
Waddesdon Estate Office
Queens Street
Waddesdon
Aylesbury
Buckinghamshire
HP18 0JW

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

www.wessexarch.co.uk

November 2014

Report Ref. 106820.04

Quality Assurance

Project Code	106820	**Accession Code**		**Client Ref.**	106820.04
Planning Application Ref.		**Ordnance Survey (OS) national grid reference (NGR)**	Area 1: NGR 474550, 216725 Area 2: NGR 474875, 216625		

Version	Status*	Prepared by	Checked and Approved By	Approver's Signature	Date
v01	I	*RDL*	*C Budd*		19/11/2014
File:	X:\PROJECTS\106820_Reports\Geophysics report\106820_Geophysics_Report_RDL_20141119.docx				
v02	F	*RDL*	*C Budd*		24/11/2014
File:	\\projectserver\wessex\PROJECTS\106820_Reports\Geophysics report\106820_Geophysics_Report_V02_GC_CB_241114.docx				

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

Land at Golden Mede and West of Warmstone Lane, Waddesdon, Buckinghamshire

Detailed Gradiometer Survey Report

Contents

Figures

Land at Golden Mede and West of Warmstone Lane, Waddesdon, Buckinghamshire

Detailed Gradiometer Survey Report

Summary

A detailed gradiometer survey was conducted over land at Golden Mede and to the west of Warmstone Lane, Waddesdon, Buckinghamshire, centred on NGR 474550, 216725 and NGR 474875, 216625. The project was commissioned by The Rothschild Foundation with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features on the Site ahead of proposed development.

The Site comprises two survey areas located on the southern edge of Waddesdon, some 7.5km west north west of the centre of Aylesbury. The Site occupies a gently sloping area that is used for allotments and pasture. The gradiometer survey covered 2.2ha and has demonstrated the presence of a few anomalies of possible archaeological interest within the survey area, along with agricultural features, regions of increased magnetic response and at least one modern service.

The most interesting feature detected was a pit-like anomaly that lies to the far east of the Site. The remaining features detected relate to agricultural activity with ceramic field drains, former field boundaries and numerous ploughing trends detected. The western of the two survey areas is dominated by ferrous responses and these are considered dense and strong enough to obscure any archaeological features that may be present here.

The survey was undertaken between the 5th and 6th November 2014 by Wessex Archaeology's in-house geophysics team.

Land at Golden Mede and West of Warmstone Lane, Waddesdon, Buckinghamshire

Detailed Gradiometer Survey Report

Acknowledgements

This project was commissioned by The Rothschild Foundation and Wessex Archaeology is grateful to Edward and Sue Parsons and Rolf Nielsen (C F Møller) for all the help and assistance they have provided in this regard.

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

Land at Golden Mede and West of Warmstone Lane, Waddesdon, Buckinghamshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project Background

1.1.1 Wessex Archaeology was commissioned by The Rothschild Foundation to carry out a geophysical survey over two parcels of land near Waddesdon, Buckinghamshire (**Figure 1**), hereafter "the Site" (centred on NGR 474550, 216725 and NGR 474875, 216625). The aim of the geophysical survey was to establish the presence/absence, extent and character of detectable archaeological remains within the survey area in advance of proposed development at the Site.

1.1.2 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 western survey area is termed **Area 1** and comprises an area previously used as allotments in an area known as Golden Mede. The eastern survey area is termed **Area 2** and comprises one pasture field to the west of Warmstone Lane. The two survey areas are located on the southern edge of Waddesdon, some 7.5km WNW of the centre of Aylesbury (**Figure 1**). Detailed gradiometer survey was undertaken over all accessible parts of the Site with a total of 2.2ha surveyed.

1.2.2 **Area 1** occupies a relatively flat area of land with a gentle slope towards the north; the area lies at a height around 100m above Ordnance Datum (aOD). The survey extents of **Area 1** are defined by a school to the south and by housing to the north, west and east. **Area 2** lies on a gentle east facing slope with the land at a height of over 95m at the west and slopes down to just under 95m aOD at the east. The survey extents of **Area 2** are defined by housing to the north and west, Warmstone Lane to the east and a field boundary to the south. The highest point in the local area lies to the west at Lodge Hill at a height of 159m aOD. The nearest watercourse is an unnamed stream flowing past the north of **Area 1** and along the eastern edge of **Area 2**; the stream flows southwest before it joins the River Thame.

1.3 Soils and Geology

1.3.1 The bedrock geology under the Site is recorded as Ampthill clay formation mudstone and dates to the Jurassic period. Kimmeridge clay formation mudstone is recorded close by. Superficial deposits of head are recorded along the east edge of **Area 1** and alluvium is recorded under the western edge of **Area 2** near the stream (BGS).

1.3.2 The soils underlying the Site are likely to be pelo-stagnogley soils 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.

1.4 Archaeological Background

1.4.1 A Desk-Based Assessment (DBA) was prepared by Wessex Archaeology (2014). This revealed the potential for buried archaeological remains from the Iron Age, Romano-British, Saxon and medieval periods. The only heritage asset recorded within the Site is the line of a Roman road named Akeman Street that linked London and Cirencester. The results of this DBA will be referred to, where relevant, in the interpretation of the geophysical data.

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 under the direction of Wessex Archaeology in two phases between 5th and 6th November 2014. Field conditions at the time of the survey were variable with good conditions at **Area 2** but poorer conditions at the allotment area at **Area 1** due to the presence of numerous surface obstructions. A total of 2.2ha of a possible 3.3ha was surveyed; areas were lost to surface obstructions in **Area 1** and by the width of the enclosing field boundary in **Area 2**.

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 a few anomalies of possible archaeological interest although the majority of the detected features appear to relate to agricultural and modern activity. Regions of increased magnetic response and at least one modern service have also been detected.

3.1.2 Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:1500 (**Figures 2** to **4**). The data are displayed at -2nT (white) to +3nT (black) for the greyscale image and ±25nT at 50nT per cm for the XY trace plots.

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

3.1.4 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 allotment at **Area 1** is dominated by strong ferrous responses and these were most likely introduced during the use of the allotments and during the construction of nearby housing. This ferrous material is considered dense and strong enough to mask any archaeological features that may lie in these areas.

3.2.2 A few positive anomalies of possible archaeological interest have been detected within this area but many of these may prove to either be modern in date or could represent deeply buried ferrous objects that present a smooth pit-like shape in the XY trace plot (**Figure 3**).

3.2.3 Linear responses can be seen running through the area such as at **4000** but these correspond to known allotment divisions and have been classed as agricultural.

3.2.4 **Area 2** by contrast has a much lower density of ferrous responses and it is possible to identify potential archaeological remains in this area. A sub-oval positive anomaly can be seen at **4001** with magnetic values over +3nT and a length of 4m. This feature could prove to be a cut archaeological feature such as a pit but it could equally prove to be a geological feature such as a tree throw. As a result of this uncertainty this feature has been classed as possible archaeology.

3.2.5 A linear ditch runs parallel to Warmstone Lane at **4002**; this feature closely corresponds to a mapped feature identified in the DBA on the 1899 edition Ordnance Survey (OS) map. It is unclear whether this represents a field boundary but is considered to be agricultural in origin.

3.2.6 There are numerous weak linear trends running through the entire dataset; the function and identity of these anomalies is unclear and they are regarded as being of uncertain origin.

3.2.7 A modern service can be seen in the data at **4003**; this feature will be discussed in more detail in the next section of the report.

3.2.8 There are a number of small sub-oval shaped positive anomalies of possible archaeological interest scattered across the dataset. These anomalies could represent cut archaeological features such as postholes but could equally relate to natural features or deeply buried ferrous objects; as there is no significant patterning in their spatial distribution these features are considered to be of low archaeological potential.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 One modern service has been identified in the geophysical data at **4003** which continues beyond the limits of the survey area. This service appears to represent a pipe although its exact function cannot be ascertained from the geophysical data.

3.3.2 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 gradiometer survey has been successful in identifying a few anomalies of possible archaeological interest although the majority of the detected features appear to relate to agricultural and modern activity. Regions of increased magnetic response and at least one modern service have also been detected.

4.1.2 The most interesting feature detected is the possible pit at **4001**, the remaining features detected relate to modern or agricultural use of this area with a possible former field boundary, a modern service and numerous ploughing trends detected.

4.1.3 Dense spreads of ferrous responses have been observed over **Area 1**. These ferrous anomalies are easily strong enough to mask weaker archaeological features that may lie underneath. The frequency of such responses within **Area 1** is considered great enough to prevent a full assessment of the majority this area.

4.1.4 The most notable absence from the geophysical interpretation is the Roman road that is recorded as running through this area. It is possible that the dense spread of ferrous responses within **Area 1** and along the southern edge of **Area 2** has obscured this feature but it is also possible this road was surfaced with local stone and is therefore undetectable to a gradiometer.

4.1.5 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 trench. 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.

4.1.6 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

British Geological Survey
http://www.bgs.ac.uk/discoveringgeology/geologyofbritain/viewer.html

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 6, Soils of South East England*. Ordnance Survey, Southampton.

Wessex Archaeology, 2014. Land at Golden Mede and west of Warmstone Lane*, Waddesdon, Buckinghamshire: Archaeological Desk-Based Assessment.* Unpublished client report. Report ref. 106820.01.

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 four main categories: archaeological, modern, agricultural and uncertain origin/geological.

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 modern category is used for anomalies that are presumed to be relatively modern in date:

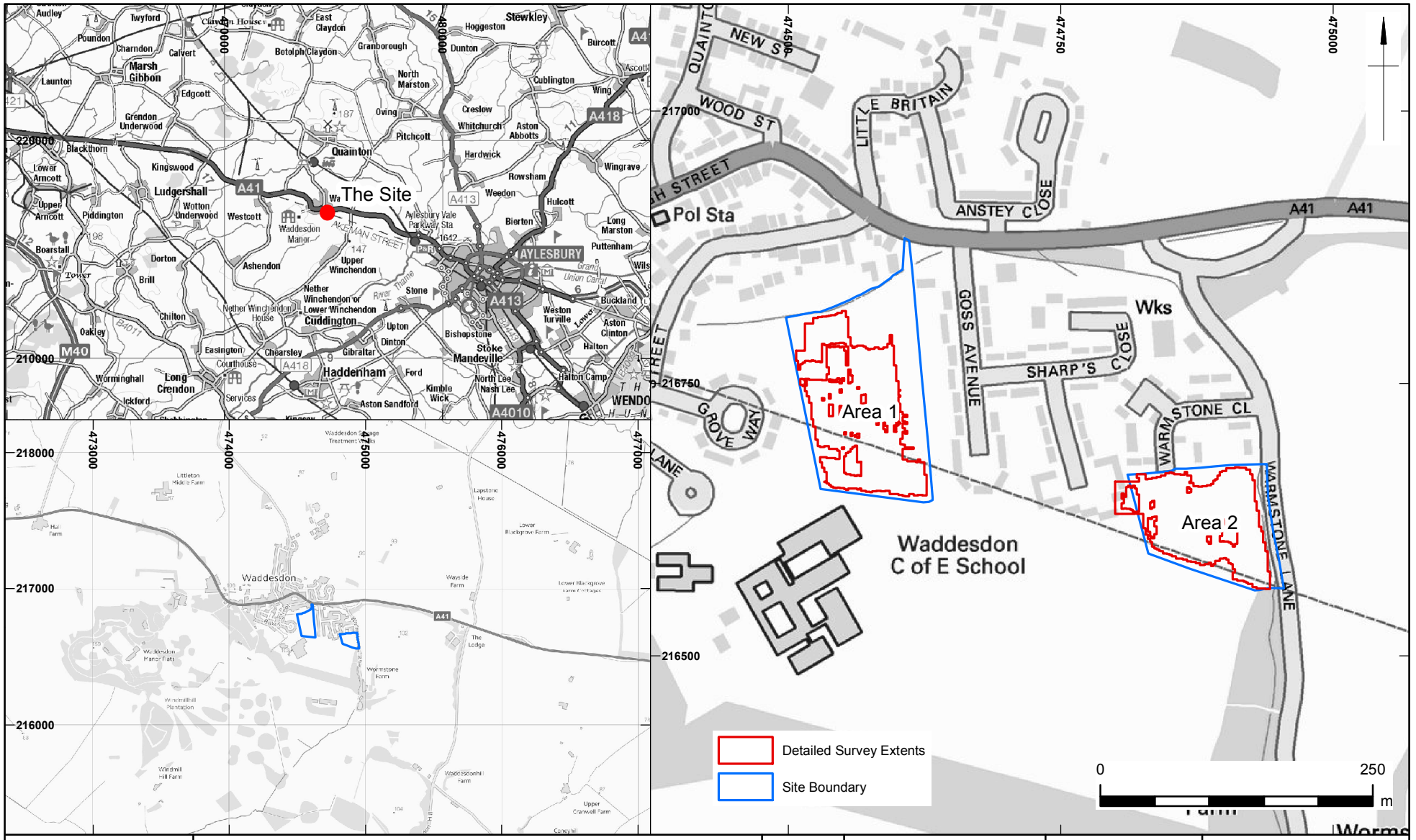
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be observed.

The agricultural category is used for the following:

- Former field boundaries – used for ditch sections that correspond to the position of boundaries marked on earlier mapping.
- Agricultural ditches – used for ditch sections that are aligned parallel to existing boundaries and former field boundaries that are not considered to be of archaeological significance.
- Ridge and furrow – used for broad and diffuse linear anomalies that are considered to indicate areas of former ridge and furrow.
- Ploughing – used for well-defined narrow linear responses, usually aligned parallel to existing field boundaries.
- Drainage – used to define the course of ceramic field drains that are visible in the data as a series of repeating bipolar (black and white) responses.

The uncertain origin/geological 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.
- Superficial geology – used for diffuse edged spreads considered to relate to shallow geological deposits. They can be distinguished as areas of positive, negative or broad bipolar (positive and negative) anomalies.



Date:	18/11/2014	Revision Number:	1
Scale:	1:250000, 1:40000 and 1:5000 at A4	Illustrator:	RDL
Path:	X:\PROJECTS\106820_Reports\Geophysics report\PDFs\Geophysics_2014_11_17		

Site location and detailed survey extents

Figure 1

474500
474600
474700
474800
474900
216800
216700
216600
+3nT
-2nT
Detailed Survey Extents
0
100
m

Date:	18/11/2014	Revision Number:	0
Scale:	1:1500 at A3	Illustrator:	RDL
Path:	X:\PROJECTS\106820_Reports\Geophysics report\PDFs\Geophysics_2014_11_17		

Greyscale plot

Figure 2

474500
474600
474700
474800
474900
216800
216700
216600
+50nT
-50nT
Detailed Survey Extents
0
100
m

Date:	18/11/2014	Revision Number:	0
Scale:	1:1500 at A3	Illustrator:	RDL
Path:	X:\PROJECTS\106820_Reports\Geophysics report\PDFs\Geophysics_2014_11_17		

XY trace plot

Figure 3

Date:	18/11/2014	Revision Number:	0
Scale:	1:1500 at A3	Illustrator:	RDL
Path:	X:\PROJECTS\106820_Reports\Geophysics report\PDFs\Geophysics_2014_11_17		

Interpretation

Figure 4

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