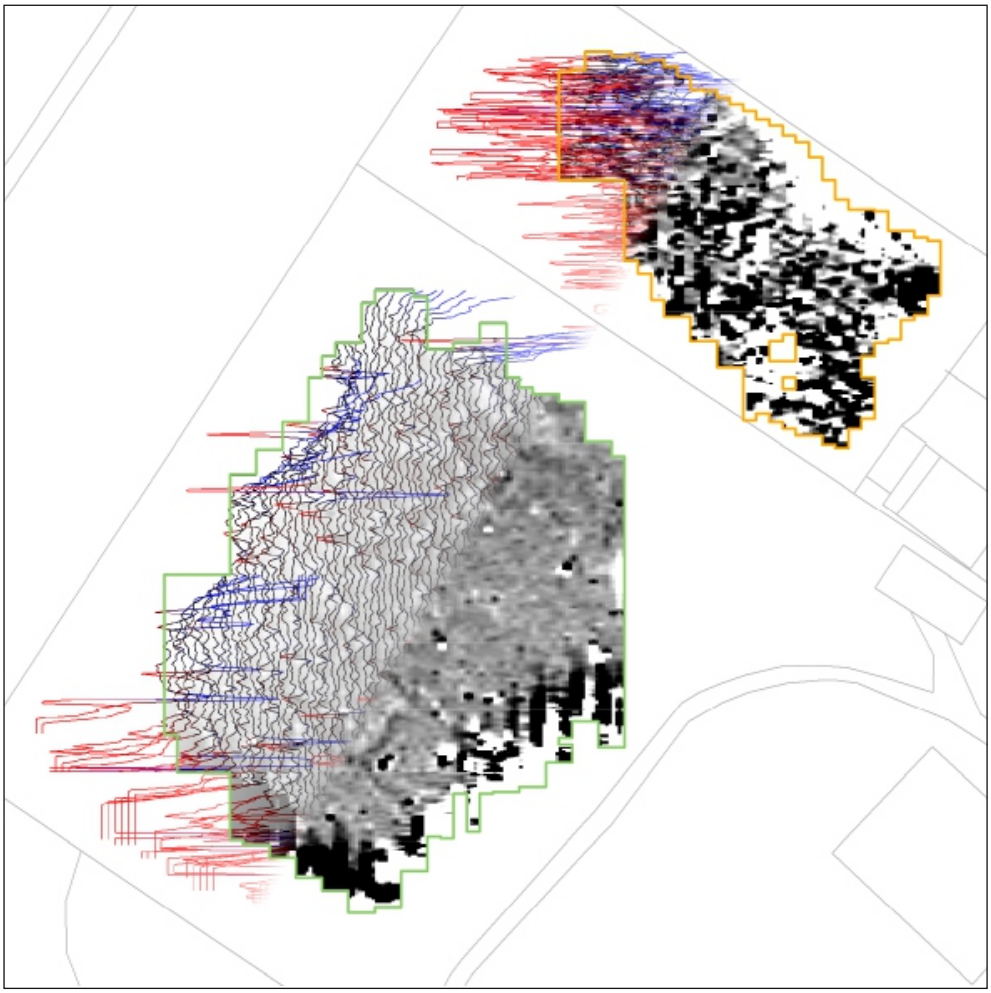
making sense of heritage

NFH Scheme
Bristol

Detailed Gradiometer Survey Report



Ref: 108670.02
August 2015

geoservices

NFH Scheme, Bristol

Detailed Gradiometer Survey Report

Prepared for:
ATKINS
The Hub
500 Aztec West
Almondsbury
Bristol
BS32 4AZ

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

www.wessexarch.co.uk

August 2015

Report Ref. 108670.02

Quality Assurance

Project Code	108670	**Accession Code**		**Client Ref.**	
Planning Application Ref.		**Ordnance Survey (OS) national grid reference (NGR)**	362740, 177175		

Version	Status*	Prepared by	Checked and Approved By	Approver's Signature	Date
v01	I	*DCC*	*GJS/PAB*		17/08/2015
File:	X:\PROJECTS\108670_Reports\108670_NFHSchemeGE_20150806_GJS.docx				
v02	E	*GJS*	*PAB*		17/08/2015
File	X:\PROJECTS\108670_Reports\108670_NFHSchemeGE.docx				
v03	F				
File					

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

NFH Scheme, Bristol

Detailed Gradiometer Survey Report

Contents

Figures

NFH Scheme, Bristol

Detailed Gradiometer Survey Report

Summary

A detailed gradiometer survey was conducted over land at Stapleton Allotments, Bristol. The project was commissioned by Atkins on behalf of Bristol City Council with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features on site ahead of the proposed Metrobus route development connecting North Fringe to Hengrove.

The survey area comprises several small parcels of mixed-use land currently occupied by allotments and smallholding with intermittent areas of grassland. All areas accessible at the time of survey were covered with a total of 1.1ha of data collected out of a proposed survey area of 4.3ha. The width of the field boundaries, artificial obstructions (heras fencing, skips, and rubble) and unsafe conditions underfoot reduced the size of the area that could be surveyed. The gradiometer survey has demonstrated the presence of some anomalies of possible archaeological interest along with trends of uncertain origin possibly associated with the modern agricultural use of the site as allotments and smallholdings.

The anomalies identified of possible archaeological potential are a rectilinear ditch-type feature and two further pit-type features. The site as a whole is dominated by weak trends likely to be as a result of modern agricultural activity as well as large scale ferrous responses. Few anomalies apart from trends of uncertain origin have been identified in the areas of ferrous response.

The survey was undertaken in two phases on the 23rd March and the 3rd August 2015 by the in-house geophysics team at Wessex Archaeology.

NFH Scheme, Bristol

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by Atkins, and Wessex Archaeology is grateful to Andrew Holmes in this regard.

The fieldwork in March 2015 was carried out by Patrick Dresch and Stewart Wareing. The fieldwork in August 2015 was carried out by Diana Chard and Rebecca Hall. The geophysical data was processed and interpreted by Lizzie Richley, Jen Smith and Diana Chard. This report was written by Jen Smith and Diana Chard. The geophysical work was quality controlled by Genevieve Shaw and Paul Baggaley and illustrations were prepared by Richard Milwain. The project was managed on behalf of Wessex Archaeology by Lucy Learmonth.

NFH Scheme, Bristol

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by Atkins, on behalf of Bristol City Council, to carry out a geophysical survey on land at Stapleton Allotments, Bristol (**Figure 1**), hereafter "the Site" (centred on NGR 362640, 177175). The survey forms part of an ongoing programme of archaeological works being undertaken in advance of the proposed development of the North Fringe to Hengrove (NFH) Metrobus Scheme.

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 Site is located in Stapleton between Broomhill and Frenchay and approximately 5.5km northeast of the centre of Bristol (**Figure 1**).

1.2.2 The Site encompasses a multi-use area of allotments, grassland and a number of sheds or outhouses located to the south. The Site is bounded by the M32 motorway to the north, Stoke Lane to the west and Frenchay Park Road to the south. The east of the site is bordered by further allotments and residential dwellings.

1.2.3 The Site occupies an area of relatively flat land with a gentle incline to the north of the Site to approximately 45m above Ordnance Datum (aOD).

1.2.4 Detailed gradiometer survey was undertaken over all accessible parts of the Site some of which was unsurveyable due to unsafe conditions at the time of the surveys. A total of 1.07ha was surveyed out of a proposed survey area of 4.3ha. The width of field boundaries, artificial obstructions (heras fencing, skips, and rubble) and unsafe conditions underfoot reduced the size of the area that could be surveyed.

1.3 Soils and geology

1.3.1 The underlying geology of the Site is recorded as Mercia Mudstone Group to the northwest of the Site and of the Redcliffe Sandstone Member to the southeast. Both of these deposits date to the Triassic Period. There are no superficial deposits recorded at the Site (British Geological Survey).

1.3.2 The soils underlying the Site are likely to be Pelo-Stagnogley soils of the 712b (Denchworth) association. 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 & historical background

1.4.1 The following information is summarised from information available online at Heritage Gateway.

1.4.2 There are no World Heritage Sites, Scheduled Monuments, designated historical assets, Registered Parks and Gardens, Conservation Areas or Historic Battlefields identified within the Site.

1.4.3 There are no recorded findspots within the boundaries of the Site with the majority of the recorded sites in the vicinity of the survey area related to post-medieval parks and listed buildings.

1.4.4 Two possibly early Medieval or later parallel banks have been identified from aerial photography approximately 500m to the north of the Site; they are crossed by a current field boundary (Pastscape ID.231311).

1.4.5 To the west of the Site is Stoke Deer Park (PastscapeID 201326), a medieval deer park which was emparked during the mid-14th century. Stoke Park Hospital resides directly to the north of the deer park and is a 16th century medieval manor house. It was badly damaged during the Civil War and was rebuilt as a country house circa 1760, and subsequently altered in 1800. In 1939 it opened as a 'mental deficiency colony' hospital and is an H-plan building of Bath stone ashlar and Pennant rubble. Within the grounds of Stoke Park Hospital there is a record of a medieval/post medieval cockpit which is shown on OS 6" 1934-8 map.

1.4.6 Frenchay Hospital is located approximately 0.9km to the northeast of the Site and was a post-medieval manor house built *c.*1540 before being converted into a hospital *c.*1901.

1.4.7 To the east of the Site is Oldbury Court Estate which has Pleasure grounds and a landscape park as part of Oldbury Court which is Grade II Listed. The grounds were laid out in 1800 and it has been used as a public park since 1937.

1.4.8 Approximately 750m south of the Site is the River Frome which was an important source of power during the post-medieval period with a number of water mills along its course such as Whitwood Mill grist mill and Snuffy Jack's snuff mill (PastScapeID 1305385)

2 METHODOLOGY

2.1 Introduction

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

2.1.2 The initial Phase 1 geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team on the 23rd March 2015, with a further Phase 2 survey taking place on the 3rd of August 2015. In total the geophysical survey covered 1.07ha.

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 were subject to minimal data correction processes. These comprise a Zero Mean Traverse (ZMT) 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. The deslope and add functions were used to account for errors in the ZMT function and to remove grid edge discontinuities. 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 possible archaeological interest across the Site along with numerous linear and curvilinear trends and a large amount of ferrous. Many of the features identified are related to the modern activity on the Site and ferrous responses.

3.1.2 Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:1000 (**Figures 2** to **4**). The data are displayed at -2nT (white) to +3nT (black) for the greyscales and ±25nT at 25nT per cm for the XY traces.

3.1.3 The interpretation of the datasets highlights the presence of potential archaeological anomalies, areas of increased magnetic response and linear trends (**Figures 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 features of potential archaeological interest are two small oval-shaped or short linear positive features at **4000** and a rectilinear ditch-type feature at **4001** measuring between +2 and +6nT. The rectilinear enclosure is aligned with current plot or allotment boundaries and is possibly associated with the current use of the Site. They have been interpreted as Possible Archaeology as they could be modern and agricultural in origin due to this currently being an area under small scale cultivation.

3.2.2 There are several areas of increased magnetic response identified such as at **4002** whereby an enhanced magnetic background is visible. These areas also contain a high concentration of ferrous material, such as at **4004** and they likely to refer to modern disturbances related to the current use of the Site as allotments.

3.2.3 Both the north western and eastern areas are dominated by strong dipolar ferrous responses which could be masking any potentially weaker anomalies of archaeological interest in these fields. However, a few linear trends are visible in these areas between **4004** and **4006** but they have been characterised as of uncertain origin. The linear trends at **4004** to **4006** are oriented in a similar orientation or perpendicular to the current field boundaries possibly suggesting an agricultural origin. Available satellite mapping demonstrates ploughing in this area before 2009. The ploughing direction visible from the aerial photography is predominantly north-west, south-east and may account for some of the linear trends that are visible in the dataset.

3.2.4 The western part of the site comprises one field which was surveyed in two phases (see **Figure 1**). For Phase 1 the field comprised an area of contaminated land, part of which could not be surveyed due to various obstacles in the southern corner. By the time the team had returned to complete the unsurveyed corner for Phase 2, the entire field had been dug, turned over and the top metre of earth replaced with fresh soils. This disturbance to the ground will have greatly altered the potential of the results, because much of what can be detected with a magnetic gradiometer survey will have resided in the top one to two metres of earth. As such the two phases of this field show differing results in the collected data which can be seen around **4006**. Much of what can be seen in the southern part of this field is dominated by ferrous responses.

3.3 Gradiometer survey results and interpretation: modern services

3.3.1 No modern services have been identified in the data however 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 DISCUSSION

4.1 Conclusions

4.1.1 The detailed gradiometer survey has been successful in detecting anomalies of possible archaeological interest in addition to spreads of increased magnetic response and numerous linear and curvilinear trends of uncertain origin.

4.1.2 The anomalies of possible archaeological interest around **4000** to **4003** are located in the area which has the lowest concentration of dipolar ferrous responses. These anomalies have been interpreted as Possible Archaeology with a rectilinear arrangement of ditches and a further two potentially shorter sections of ditch or pits. However it should be noted that an agricultural or natural origin may also be possible for them (e.g. tree throws). Due to the type of feature, the orientation of the possible ditches parallel to the current allotment boundaries and the current use of the Site they should be regarded as having a low archaeological potential.

4.1.3 The majority of the detected features across the site appear to relate to more recent agricultural use and current activity at the Site which is in use as allotments. Weak trends are visible across the entire dataset around **4004** to **4006** and are possibly associated with past and present agricultural activity.

4.1.4 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

5.1 Bibliography

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

5.2 Cartographic sources

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

Soil Survey of England and Wales (SSEW), 1983: *Sheet 5, Soils of South West England*. Ordnance Survey: Southampton.

5.3 Online sources

Heritage Gateway, accessed 04.08.2015
http://www.heritagegateway.org.uk/Gateway/Results.aspx

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:

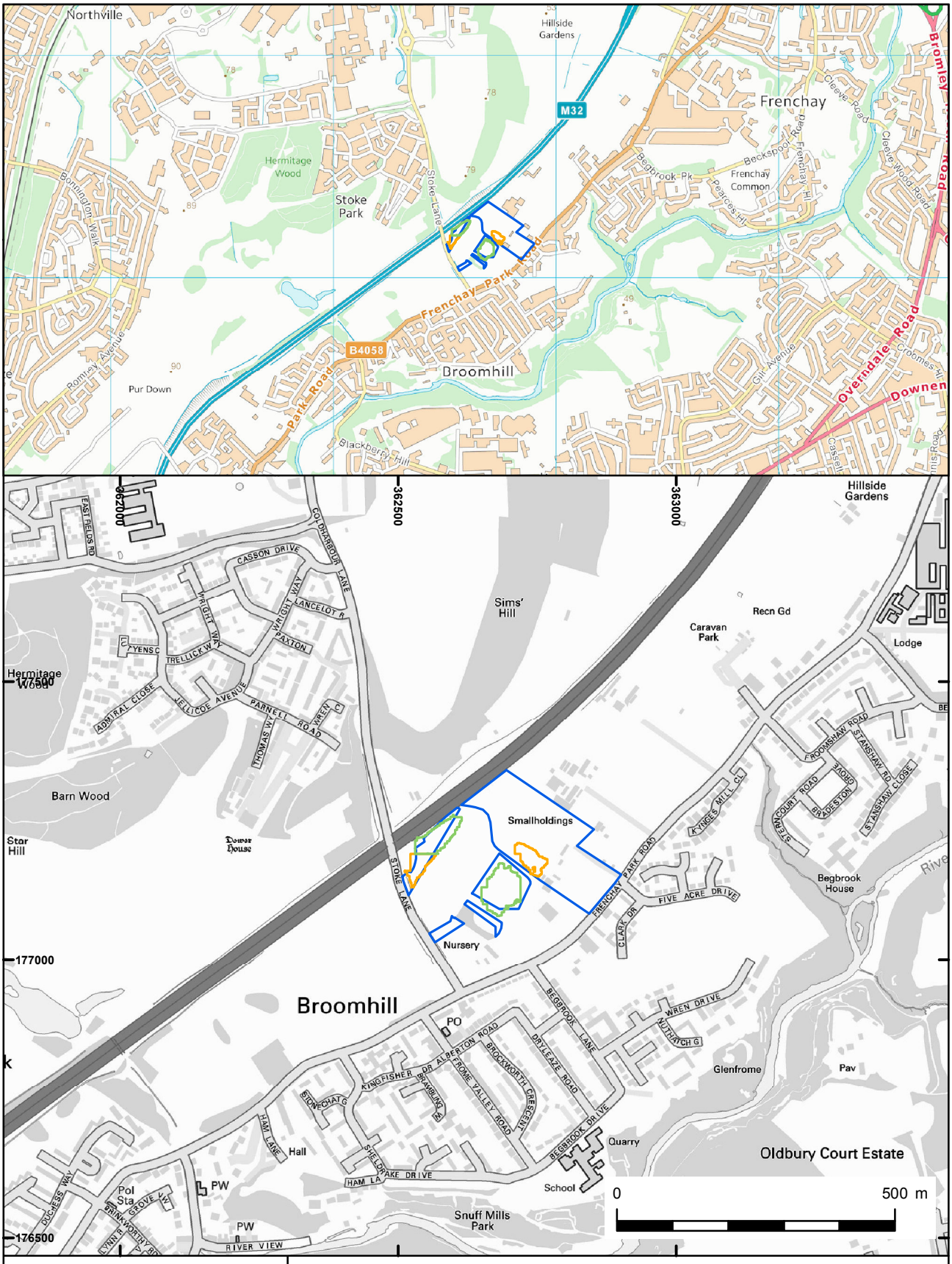
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be 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:	07/08/15	Revision Number:	0
Scale:	1:25000 and 1:10000 at A4	Illustrator:	RAM
Path:	X:\PROJECTS\108670\GIS\FigsMXD\2015_08_07\108670_Fig01.mxd		

Site location and survey extents

Figure 1

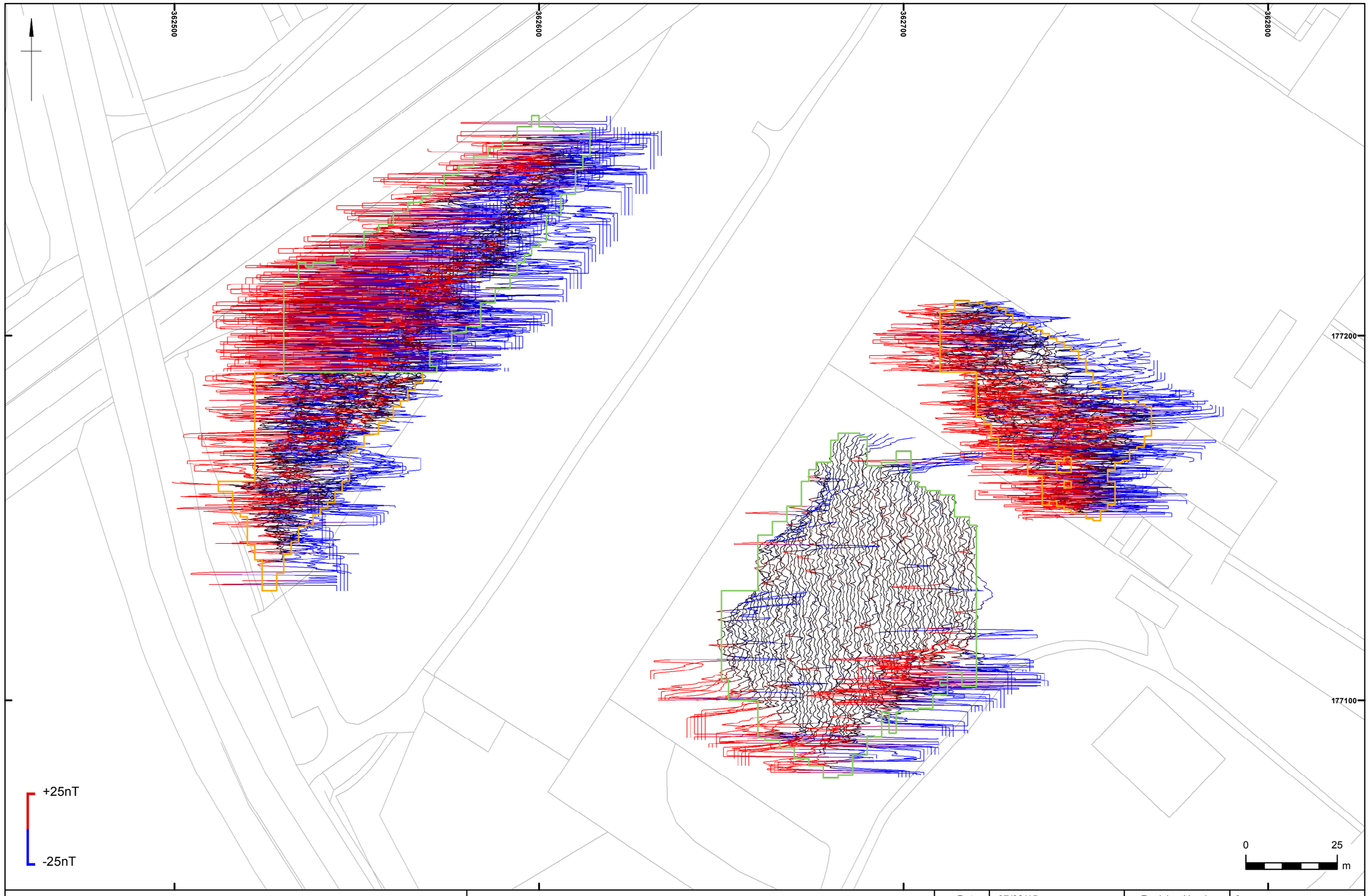
362500
362600
362700
362800
177200
177100
+3nT
-2nT
0
25
m

Detailed Survey Extents: First Phase
Detailed Survey Extents: Second Phase

Date:	07/08/15	Revision Number:	0
Scale:	1:1000 at A3	Illustrator:	RAM
Path:	X:\PROJECTS\108670\GIS\FigsMXD\2015_08_07\108670_Fig02.mxd		

Greyscale

Figure 2



Detailed Survey Extents: First Phase

Detailed Survey Extents: Second Phase

Date:	07/08/15	Revision Number:	0
Scale:	1:1000 at A3	Illustrator:	RAM
Path:	X:\PROJECTS\108670\GIS\FigsMXD\2015_08_07\108670_Fig03.mxd		

XY trace

Figure 3

362500
362600
362700
362800
177200
177100
4005
4006
4004
4000
4003
4002
4001
Detailed Survey Extents: First Phase
Detailed Survey Extents: Second Phase
Possible Archaeology
Trend
Increased Magnetic Response
Ferrous
0
25
m

Date:	07/08/15	Revision Number:	0
Scale:	1:1000 at A3	Illustrator:	RAM
Path:	X:\PROJECTS\108670\GIS\FigsMXD\2015_08_07\108670_Fig04.mxd		

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