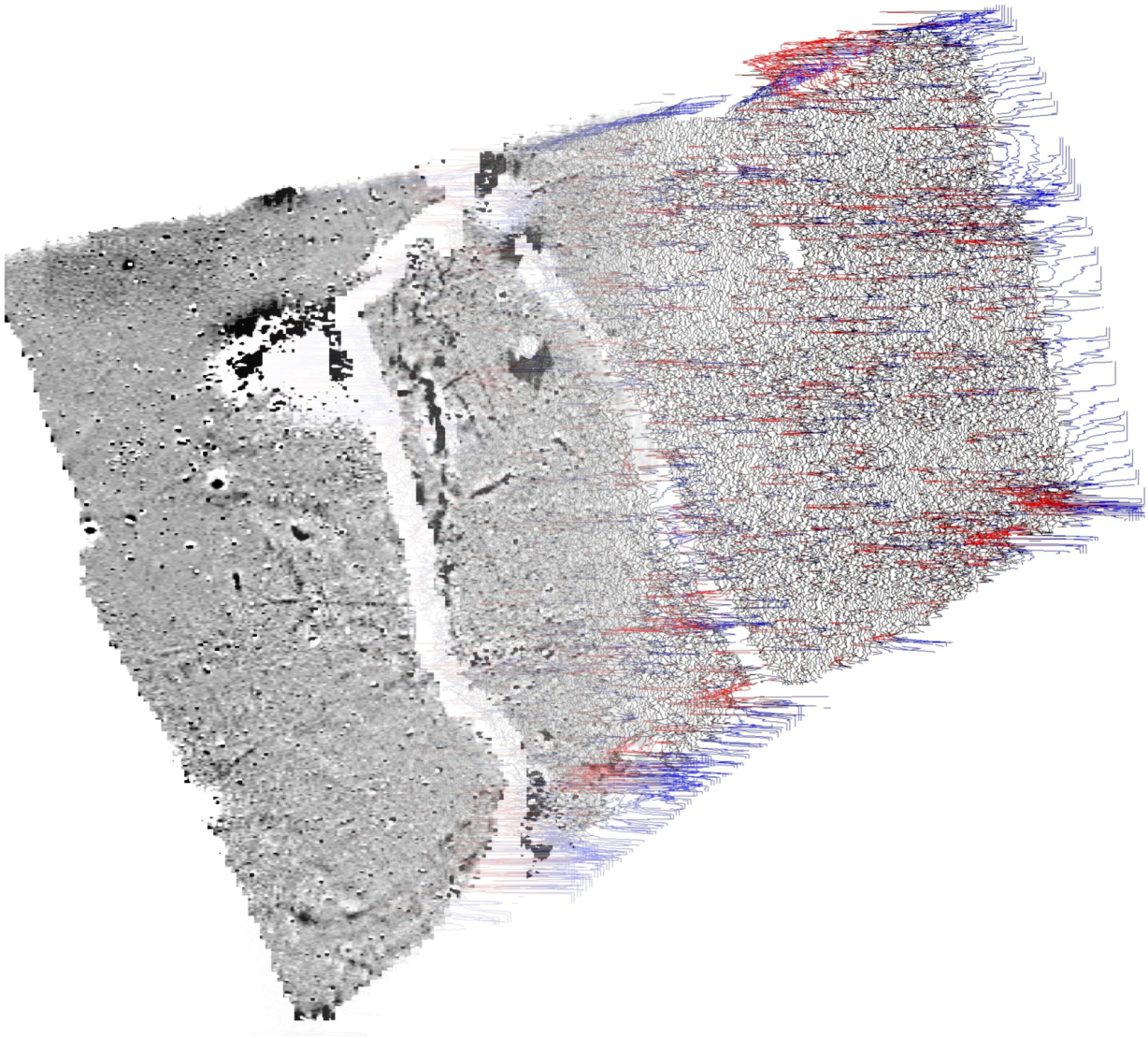
making sense of heritage

Land at Hayne Lane
Honiton, Devon

Detailed Gradiometer Survey Report



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geoservices

Land to the West of Hayne Lane, Honiton
Devon

Detailed Gradiometer Survey Report

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

Land to the West of Hayne Lane, Honiton Devon

Detailed Gradiometer Survey Report

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Detailed Gradiometer Survey Report

Summary

A detailed gradiometer survey was conducted over land off Hayne Lane, near Honiton, Devon. The project was commissioned by Archaeology & Planning Solutions on behalf of their client Welbeck Strategic Land LLP with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features on the site ahead of a proposed development.

The site comprises five pasture fields to the southwest of Hayne Lane, approximately 1.1 miles southwest of Honiton. The site occupies an area of sloping land that forms part of the valley of the River Otter. The gradiometer survey covered 10.6 hectares and was undertaken between 16th and 19th September 2013. It has demonstrated the presence of anomalies of likely, probable and possible archaeological interest within the survey area, along with regions of increased magnetic response and at least one modern service.

Several ditch-like anomalies and one possible enclosure were identified in the southwestern portion of the Site, although these anomalies are confined to a relatively small area in the westernmost two fields. They appear as a series of fragmentary linear and rectilinear anomalies, some of which are parallel with the existing field boundaries, although it is not possible to determine their date.

A number of irregular regions of diffuse background responses can be seen within the southwestern part of the Site that are typical of geological features and may indicate alluvial deposits. Elsewhere, regions of increased magnetic response can be seen; whilst the origins of these areas of variability are uncertain, it is possible that they are associated with geological deposits being ploughed to the surface.

Many of the observed anomalies appear to relate to relatively recent use of this land for agriculture, with frequent ploughing trends visible throughout. Weak linear and curvilinear trends were observed within the dataset, although their origins are unclear and it is possible that they are agricultural or geological in origin.

Land to the West of Hayne Lane, Honiton Devon

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by Archaeology & Planning Solutions (APS) on behalf of their client Welbeck Strategic Land LLP. The assistance of Alan Thomas at APS and Charlotte Robinson at Welbeck is gratefully acknowledged in this regard. WA would also like to recognise the assistance of Stephen Reed at Devon County Council.

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

Land to the West of Hayne Lane, Honiton Devon

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by Archaeology & Planning Solutions on behalf of their client Welbeck Strategic Land LLP to carry out a geophysical survey of land off Hayne Lane, Honiton, Devon (**Figure 1**), hereafter "the Site" (centred on NGR 314300 99450). The survey forms part of an ongoing programme of archaeological works being undertaken ahead of proposed development at the Site.

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, Topography, Geology and Archaeological Background

1.2.1 The survey area comprises five pasture fields off Hayne Lane, Honiton, approximately 1.1 miles southwest of the centre of Honiton (**Figure 1**). The Honiton to Exeter railway runs through the middle of the survey area. Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of 10.6 ha.

1.2.2 The Site occupies the northwest facing slope of a river valley; the land lies at a height of over 110m above Ordnance Datum (aOD) at the southeast edge of the survey area and slopes downhill toward the northwest edge to a little over 80m aOD. Two small streams flow through the survey area that both form tributaries of the River Otter to the northwest of the Site. The survey extents are defined by the surrounding field boundaries.

1.2.3 The solid geology on Site is recorded as marl (Triassic) with deposits of upper greensand and gault (Cretaceous) close by to the south (Ordnance Survey 1957). The Quaternary deposits nearby are recorded as alluvium and river deposits close to the River Otter on lower ground; clay with flints is recorded on higher ground (Ordnance Survey 1977).

1.2.4 The soils underlying the Site are likely to be typical brown earths of the 541w (Newnham) association. There are typical humic gley soils of the 871b (Hense) association close to the River Otter and there are also stagnogleyic argillic brown earths of the 572f (Whimple 3) association close to the Site (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.

1.2.5 There are archaeological remains located in close proximity to the site including several prehistoric enclosures and associated field systems, a Roman road and numerous finds of various dates. Flint finds make up the only records within the Site including a handaxe and a flint scatter in the northeast of the survey area (MDV60474 and MDV51909).

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 16th and 19th September 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 deslope function was also used in places to correct minor errors introduced by the zero mean traverse function. These three 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 1:2,000 (**Figures 2** and **3**). The data are displayed at -2nT (white) to +3nT (black) for the greyscale image and 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**). 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 first field in the southwest corner of the Site contains a number of anomalies of likely archaeological interest including two weakly positive linear anomalies at **4000** and **4001** at its centre. These anomalies are weakly positive and are considered to represent cut features such as ditches. It is unclear whether these features represent former field boundaries or enclosures but they have been classed as archaeology.

3.2.2 There are a number of smaller but regularly shaped anomalies close to **4000** at **4002** and **4003**. The anomalies around **4002** are L-shaped and are relatively weak, whereas the values of the more irregular shaped anomalies like **4003** are somewhat higher. These responses are considered to represent cut features such as pits and ditch sections, and have been classed as probable archaeology either due to their weak magnetic values or their slightly irregular shapes in plan.

3.2.3 There are other positive anomalies present in this field such as at **4004** and around **4005** that are not considered to be of likely or probable archaeological interest. Weak linear anomaly **4004** is aligned with the current field boundaries and is considered to possibly be an agricultural feature; the stronger sub-oval anomalies around **4005** lie close to a region of geological responses and therefore may prove to be geological. These anomalies are classed as possible archaeology to reflect the uncertainty in their interpretation. There are other small sub-circular and sub-oval positive anomalies scattered throughout the data; as there is no significant patterning in their spatial distribution they have been classed as possible archaeology.

3.2.4 There are spreads of concentrated dipolar and bipolar responses (black and white) in various places in this field. Most, such as **4006**, are considered to be modern spreads of ferrous and ceramic debris whereas others such as the spread around **4000** may prove to relate to concentrations of ceramic debris.

3.2.5 There are a number of trends of possible archaeological interest in this field such as those around **4007**. It is unclear what features that these anomalies could correspond to and many may prove to be modern. The remaining trends visible in the data such as those around **4008** are considered to represent ploughing scars.

3.2.6 There are more anomalies of likely archaeological potential in the field to the east including a rectangular enclosure at **4009** and a linear ditch section at **4010**. Both of these anomalies are well defined and are considered to represent ditches. The enclosure at **4009** is open-ended to the south, measures 24m x 8m and is aligned roughly northwest to southeast. Both anomalies are classed as archaeology.

3.2.7 There is a very strong positive curving anomaly at **4011** but has a slightly irregular and intermittent form in plan; it lies close to the archaeological anomalies discussed above and part of **4009** appears to be obscured by its strong negative shadow. This response is classed as possible archaeology as its form suggests a geological explanation is also possible for given its close proximity to a small stream.

3.2.8 There are other anomalies of probable archaeological interest at **4012** and **4013** including linear ditch-like anomalies and smaller sub-oval pit-like anomalies. The possible ditch at **4012** has positive values and a very regular shape in plan but may prove to be fairly modern as it is aligned parallel with the nearby existing field boundary. The other anomalies around **4013** are slightly irregular in form and have been interpreted as probable archaeology rather than archaeology due to their close proximity to **4011**.

3.2.9 There are other positive anomalies present in this field such as those at **4014** and **4015**; the curvilinear positive responses around **4014** are considered to possibly be geological whereas the linear at **4015** is considered to be related to agricultural activity. These two anomalies have both been classed as possible archaeology due to the uncertainty in their interpretation.

3.2.10 The remaining anomalies of possible archaeological interest are linear and curvilinear trends such as those around **4016** and numerous small positive anomalies classed as possible archaeology due to their lack of any significant patterning.

3.2.11 The magnetic background within the large central field is relatively quiet and contains only one anomaly of probable archaeological interest at **4017**. This response is weakly positive and is oriented parallel to a nearby field boundary. This feature is classed as probable archaeology as there is a possibility it may prove to be a former field boundary or other agricultural feature. The remaining anomalies of possible interest are linear and curvilinear trends and small positive anomalies classed as possible archaeology.

3.2.12 The remaining anomalies in this field are concentrations of magnetic debris that may be relatively modern (**4018**) and geological anomalies (**4019**).

3.2.13 The next field further east contains one large linear anomaly of possible archaeological interest at **4020**. This anomaly is very weakly defined from the magnetic background and may prove to be a cut feature such as a ditch section; it has been classed as possible archaeology due to its weak magnetic values. The remaining anomalies of possible archaeological interest are linear and curvilinear trends and small positive anomalies classed as possible archaeology.

3.2.14 Another weak linear positive anomaly of possible archaeological interest is located in the next field at **4021**; it is not aligned parallel to any nearby field boundaries so may prove to be an archaeological feature such as a ditch. This feature has been classed as possible archaeology given its weakly positive magnetic values. There are some curvilinear trends in this field that may be archaeological in origin, such as those around **4022** although it is not clear what sort of features these anomalies could represent. The remaining anomalies of possible interest are numerous small sub-circular and sub-oval positive responses, which may represent small cut features such as postholes but, as there is no significant patterning in their spatial distribution, they have been termed possible archaeology.

3.2.15 The small field just north of the railway contains a few trends and small positive anomalies of possible interest but is dominated by a modern service at **4023**. The shadow of this service obscures a large section of this small field and may obscure weaker archaeological features.

3.2.16 The next field to the west contains a couple of positive anomalies of possible archaeological interest at **4024** and **4025**, which may correspond with cut features such as ditches but are classed as possible because they are either located close to large ferrous responses or geological features.

3.2.17 A line of ferrous and increased magnetic response at **4026** corresponds to a map feature named “Hodge Lane” and is a former field boundary and access route. Another small area of increased magnetic response is present to the east of **4024**; it is not clearly related to the nearby ferrous response and may prove to be of archaeological interest as an area of burning.

3.2.18 The remaining anomalies are linear and curvilinear trends like those around **4027** and numerous small sub-circular and sub-oval positive responses. These small positive anomalies could represent small archaeological features but as there is no significant patterning in their spatial distribution have been termed possible archaeology.

3.2.19 There are geological responses to the southwest of **4025** and around **4028** and the modern service observed in the previous field continues into this field at **4029**.

3.2.20 The last field to the northwest contains no anomalies of likely or probable archaeological interest; only trends and small anomalies of possible interest are present. The most noticeable anomalies are two lines of ferrous responses at **4030** and **4031** which are considered to be modern agricultural features. There is also a spread of increased magnetic response at **4032** that is considered to represent relatively modern debris.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 There is at least one modern service located in the data to the east of **4022**, although the function of the service and its depth of burial are beyond the scope of this 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 a number of 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 probable ditch segments at **4000**, **4001**, **4002**, **4009** and **4010** represent the clearest anomalies within the survey area but these are located with a small region towards the southwestern extent of the Site. These anomalies have been interpreted based upon their form in plan and it is not possible to determine from what period they date through geophysical survey alone.

4.1.3 However, the desk-based assessment (APS 2013) identifies a barn or farming settlement, known as Hodges, from historic mapping. Given the proximity of the anomalies to this map feature, it is possible that these fragmentary enclosures or field systems are associated with Hodges barn. The earliest map evidence for the barn are tithe maps from 1838 and 1841, perhaps suggesting a post-medieval date for the enclosures or field system.

4.1.4 Other anomalies such as **4003**, **4011**, **4013** and **4014** are less certain to be archaeological and some may prove to be geological or agricultural. The remaining ditch-like anomalies all appear to be former field divisions or agricultural features of varying date.

4.1.5 Elsewhere, numerous weak trends and changes in magnetic texture can be seen within the general magnetic background across the Site. Few other anomalies of possible archaeological interest can be seen, and it is conceivable that these may be geological or agricultural in origin.

4.1.6 The relative dimensions of the modern service 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.

4.1.7 It should be noted that small, weakly magnetised anomalies 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

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Ordnance Survey, 1977. *Quaternary Map of the United Kingdom*: South. Ordnance Survey: Southampton.

Ordnance Survey, 1957. *Sheet 2, Geological Map of Great Britain: England and Wales*. Ordnance Survey: Chessington.

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5.2 HER Records Consulted

MDV51909 – Flint scatter

MDV60474 – Prehistoric handaxe from the northwest of Hayne Farm

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.

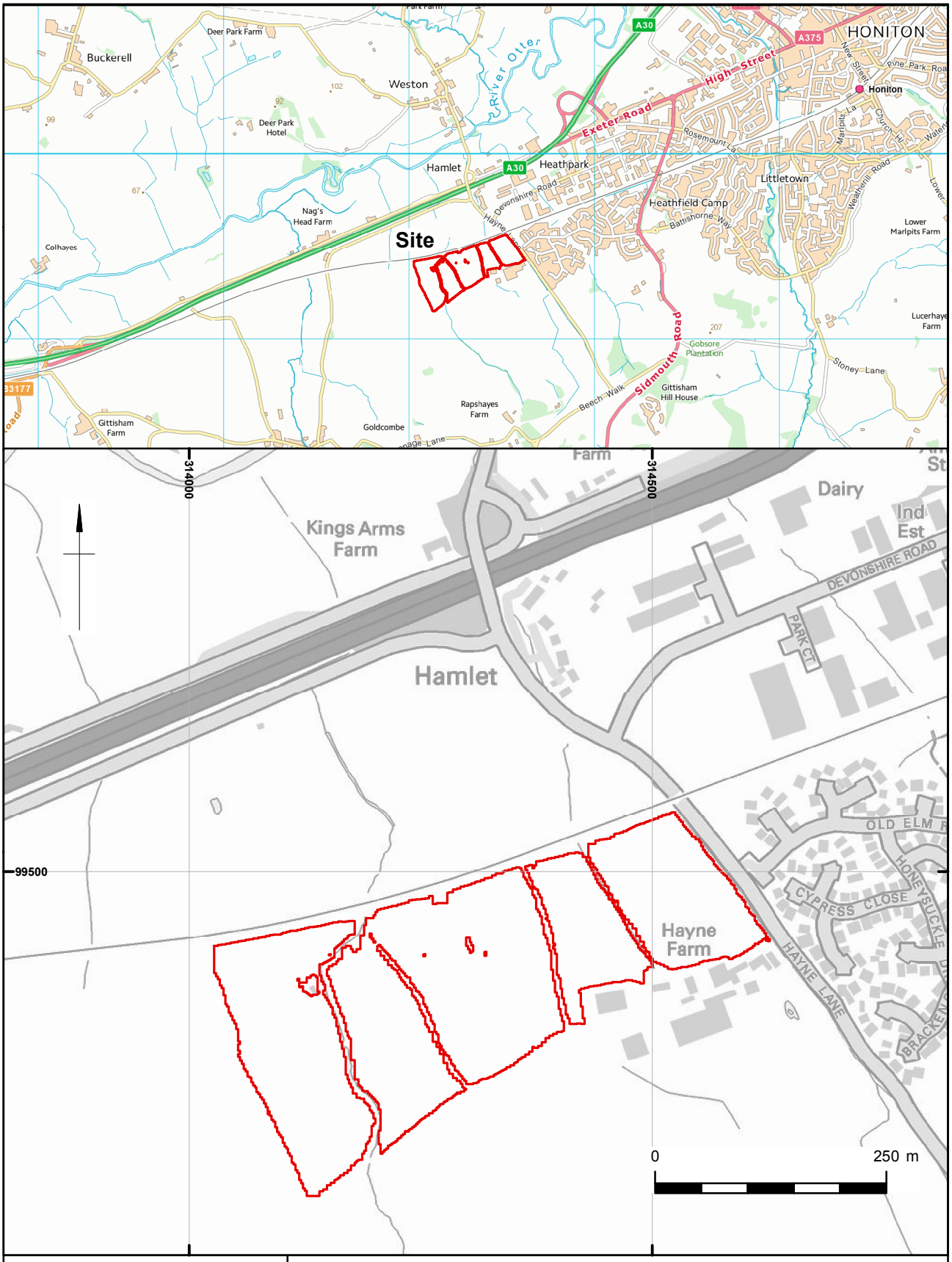
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided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

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Site location and survey extents

Figure 1

314000
314200
314400
314600
99400
99200
+3nT
-2nT
0
100 m
Detailed Survey Extents

Date:	20/11/13	Revision Number:	0
Scale:	1:2000 at A3	Illustrator:	KL/LJC
Path:	X:\PROJECTS\101310\GIS\FigsMXD\fig02.mxd		

Greyscale

Figure 2

314000

314200

314400

314600

99400

99200

+25nT

-25nT

0 100 m

Detailed Survey Extents

Date:	20/11/13	Revision Number:	0
Scale:	1:2000 at A3	Illustrator:	KL/LJC
Path:	X:\PROJECTS\101310\GIS\FigsMXD\fig02.mxd		

XY trace

Figure 3

314000
314200
314400
314600
99400
99200
4000
4001
4002
4003
4004
4005
4006
4007
4008
4009
4010
4011
4012
4013
4014
4015
4016
4017
4018
4019
4020
4021
4022
Detailed Survey Extents
Modern Service
Archaeology
Probable Archaeology
Possible Archaeology
Ferrous
Increased Magnetic Response
Superficial Geology
Ploughing
Trend
0
100 m

Date:	20/11/13	Revision Number:	0
Scale:	1:2000 at A3	Illustrator:	KL/LJC
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Interpretation

Figure 4

wessex archaeology

salisbury rochester sheffield edinburgh

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