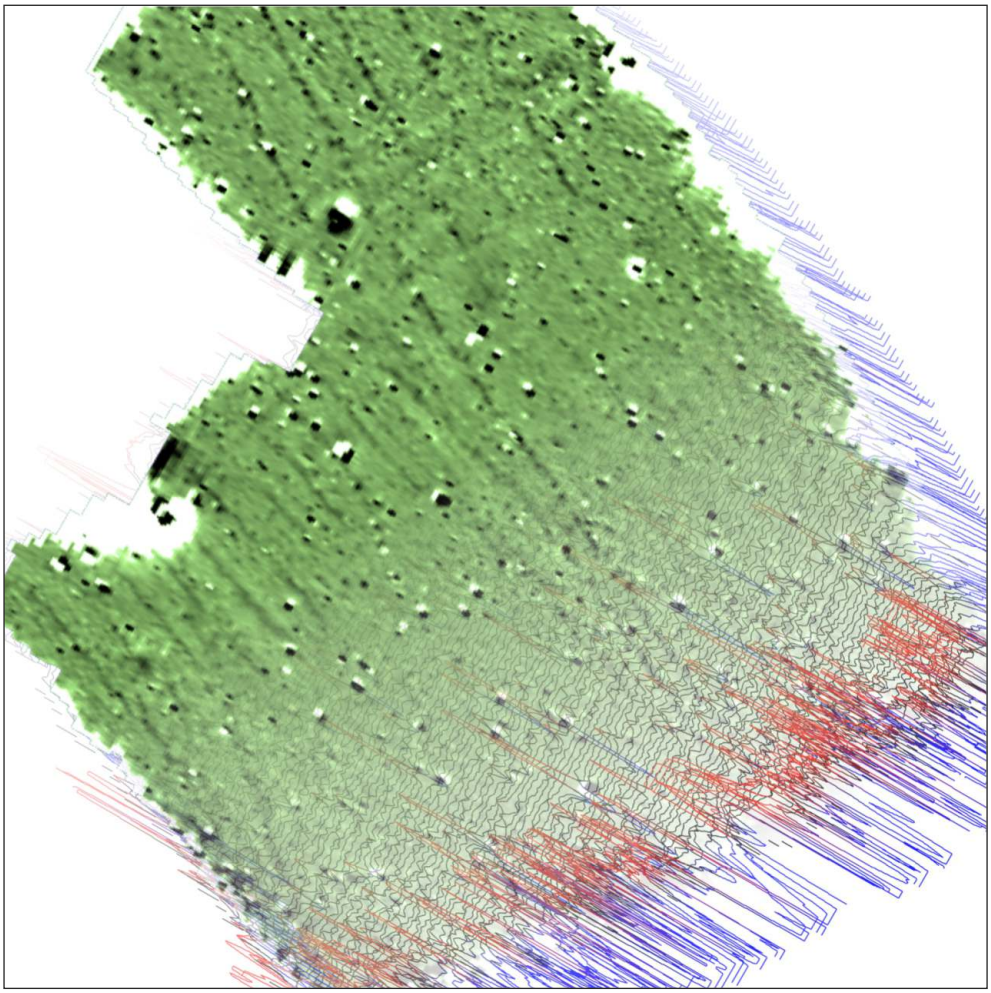
making sense of heritage

Land at Yelland Farm
Yelland, North Devon

Detailed Gradiometer Survey Report



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geoservices

Land at Yelland Farm
Yelland, Devon

Detailed Gradiometer Survey Report

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Summary

A detailed gradiometer survey was conducted over land at Yelland Farm, in Yelland, Devon. The project was commissioned by 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 housing development project.

The site comprises of pastures directly to the north of B3233 Yelland Road, 1.5km to the south of the river Taw, and 2km to the west of Fremington, Devon. The proposed scheme covers 6.3ha and gradiometer survey was undertaken over all accessible parts of the site, a total of 5.7ha. The site occupies largely flat land, which lies at around 10m above Ordnance Datum (aOD). The gradiometer survey has demonstrated the presence of anomalies of possible archaeological interest within the survey area, along with regions of increased magnetic response, ploughing and other trends.

Responses consistent with a former field boundary have been identified extending NE-SW across the centre of the survey area, largely characterised by weak linear trends. Historic mapping indicates the presence of such a boundary in a similar location at the southwestern extent of the Site.

Two parallel anomalies of possible archaeological interest are visible extending NNW-SSE near the centre of the Site and are consistent with a former track or closely spaced field boundaries. Two further linear anomalies near the eastern extent of the dataset are typical of ditches and are likely to relate to agricultural activity. Several pit-like anomalies can be seen near the southwestern extent of the survey, although it is possible that these are natural or agricultural in origin.

The geophysical survey was undertaken between 16th and 17th January 2014.

Land at Yelland Farm
Yelland, Devon

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by Welbeck Strategic Land LLP and the assistance of Charlotte Robinson and Alan Thomas of Archaeology & Planning Solutions is gratefully acknowledged in this regard. Wessex Archaeology would also like to thank the landowner for granting access to the survey areas.

The fieldwork was undertaken by Rachel Williams, Laura Andrews, and Jennifer Smith. Alistair Salisbury processed and interpreted the geophysical data in addition to writing this report. The geophysical work was quality controlled by Ben Urmston. Illustrations were prepared by Ken Lymer. The project was managed on behalf of Wessex Archaeology by Ben Urmston.

Land at Yelland Farm
Yelland, Devon

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology (WA) was commissioned by Welbeck Strategic Land LLP to carry out a geophysical survey of land at Yelland Farm, to the north of B3233 West Yelland Road in Yelland, Devon (**Figure 1**), and hereafter "the Site" (centred on NGR 48913, 32038). The survey forms part of a programme of archaeological works undertaken ahead of a proposed housing development and follows a Desk-Based Assessment of the Site (APS 2013).

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 The Site

1.2.1 The survey area comprises 6.3ha of land currently under pasture directly to the north of Yelland Road, 1.5km to the south of the river Taw, and 2km to the west of Fremington, Devon (**Figure 1**). Detailed gradiometer survey was undertaken over all accessible parts of the Site, which totalled 5.7 ha.

1.2.2 The Site occupies a roughly rectangular parcel of mostly flat agricultural land, lying at around 10m above Ordnance Datum (aOD). The site is bordered by Lower Yelland Farm to the east, West Yelland Road to the south, and sewage works to the west.

1.2.3 The soils underlying the Site are likely to comprise elements of the typical brown earths of the 541h (Neath) association and pelo-stagnogleys of the 712e (Hallsworth 2) association (SSEW 1983) overlying Crackington Formations (APS 2013). However, previous geotechnical investigations (APS 2013) have demonstrated the presence of estuarine alluvium to depths of up to 2.5m below the surface. Soils derived from such geological parent material have been shown to produce magnetic contrasts suitable for the detection of archaeological remains through gradiometer survey. However, significant thicknesses of alluvial deposits will have the effect of masking magnetic anomalies produced by deeply buried archaeological features.

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 between 16th and 17th January 2014. Field conditions at the time of the survey were largely suitable, with the survey area consisting of five pasture fields. The surveyable area was somewhat reduced through the existing field boundaries.

2.2 Method

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

2.2.2 The gradiometer 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. In places, further data processing was undertaken to reduce the effect of periodic errors within the data resulting largely from ground conditions.

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. Regions of increased magnetic response, drainage, ferrous anomalies and a number of trends 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 1:1,500 (**Figures 2** and **3**). The data are displayed at -2nT (white) to +3nT (black) for the greyscale images. The XY trace plots are presented at ±25nT at 25nT per cm.

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 Towards the western extent of the site, linear band of increased response **4000** is flanked by a series of parallel trends oriented NE-SW. Whilst these responses are not clearly defined from the magnetic background, they are consistent with the remnants of a former field boundary. It is possible to trace similar anomalies extending to the northeast, e.g. **4004** and south of **4006**.

3.2.2 The magnetic background at **4001** is typical of this majority of the dataset. There are linear ploughing trends oriented NW-SE and similar trends can be seen within each of the fields. Occasional magnetic disturbance can be seen in close association with the field boundaries.

3.2.3 The small areas to the north and northwest of the Site are largely unremarkable, with regular ploughing trends oriented NW-SE and occasional trends on other orientations, e.g. **4002** and **4003**. It is possible that the linear trends oriented NE-SW near the southern boundaries of these fields are associated with the probable former boundary seen to the southwest.

3.2.4 Near the centre of the Site, linear trends **4004** are likely to indicate the course of the probable former boundary seen at **4000**. They are not well-defined from the general magnetic background.

3.2.5 Parallel linear anomalies **4005** are oriented NNW-SSE and extend part way across the central field from its southern boundary. Although they are oriented parallel with the ploughing trends seen elsewhere, the character of their responses is sufficiently different to suggest that they relate to more substantial features, which are consistent with a former track or closely spaced boundaries. This interpretation is supported to a degree by the presence of Lagoon View to the southeast, which shares the same alignment; historic mapping (APS 2013) demonstrates a former field boundary to the south of West Yelland Road that appears on the 1840 Fremington tithe map.

3.2.6 Within the easternmost field, linear anomaly **4006** is oriented NW-SE and is more clearly defined that the ploughing trends on the same alignment. It is therefore likely to be agricultural in origin and may relate to a former boundary or ploughing headland.

3.2.7 Linear anomaly **4007** lies near the easternmost extent of the survey area and is oriented WNW-ESE. It is well-defined and on a different alignment from the majority of other anomalies within the dataset. It appears as though this anomaly overlies the ploughing trends, although it is possible that this is a result of the marked difference in strength of response.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 There are no modern services located 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 CONCLUSION

4.1.1 The detailed gradiometer survey has been successful in detecting some anomalies of possible archaeological interest within the Site, in addition to regions of increased magnetic response, extensive agricultural anomalies and several other trends.

4.1.2 The probable former boundary that apparently extends across the Site from southwest to northeast is likely to be associated with a boundary in a similar location on the 1840 tithe map (APS 2013). The northeastern extents of the boundary do not appear on the historic mapping, perhaps suggesting that it was removed prior to the tithe.

4.1.3 Four linear anomalies of possible archaeological interest have been identified, although it is considered likely that these are associated with agricultural activity and they probably relate to former field systems or ploughing.

4.1.4 A number of isolated pit-like anomalies have been detected, for which an archaeological interpretation cannot be entirely excluded. However, it is possible that such anomalies are the result of natural features, such as tree throws, or geological processes.

4.1.5 The detection of ephemeral features such as ploughing trends suggests that even weakly magnetised anomalies are identifiable in this geological setting. It is considered likely that more substantial archaeological features would have produced magnetic anomalies detectable at the surface, should any have been present.

5 REFERENCES

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Geological Map of Great Britain, 1987. *Sheet 2, England and Wales*, 2nd Edition, Geological Survey

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)
- Periodic Filter – This function is used to reduce or remove the amplitude of regular, periodic features present in the data. This is most commonly used to correct for operator error during the collection of data;
- Low Pass Filter – The low pass filter can be used to remove small scale, high frequency spatial detail. It is used to supress noise in the data to enhance larger and weaker anomalies;
- Add – The add function simply involves adding or subtracting data values to a selected area of the 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.

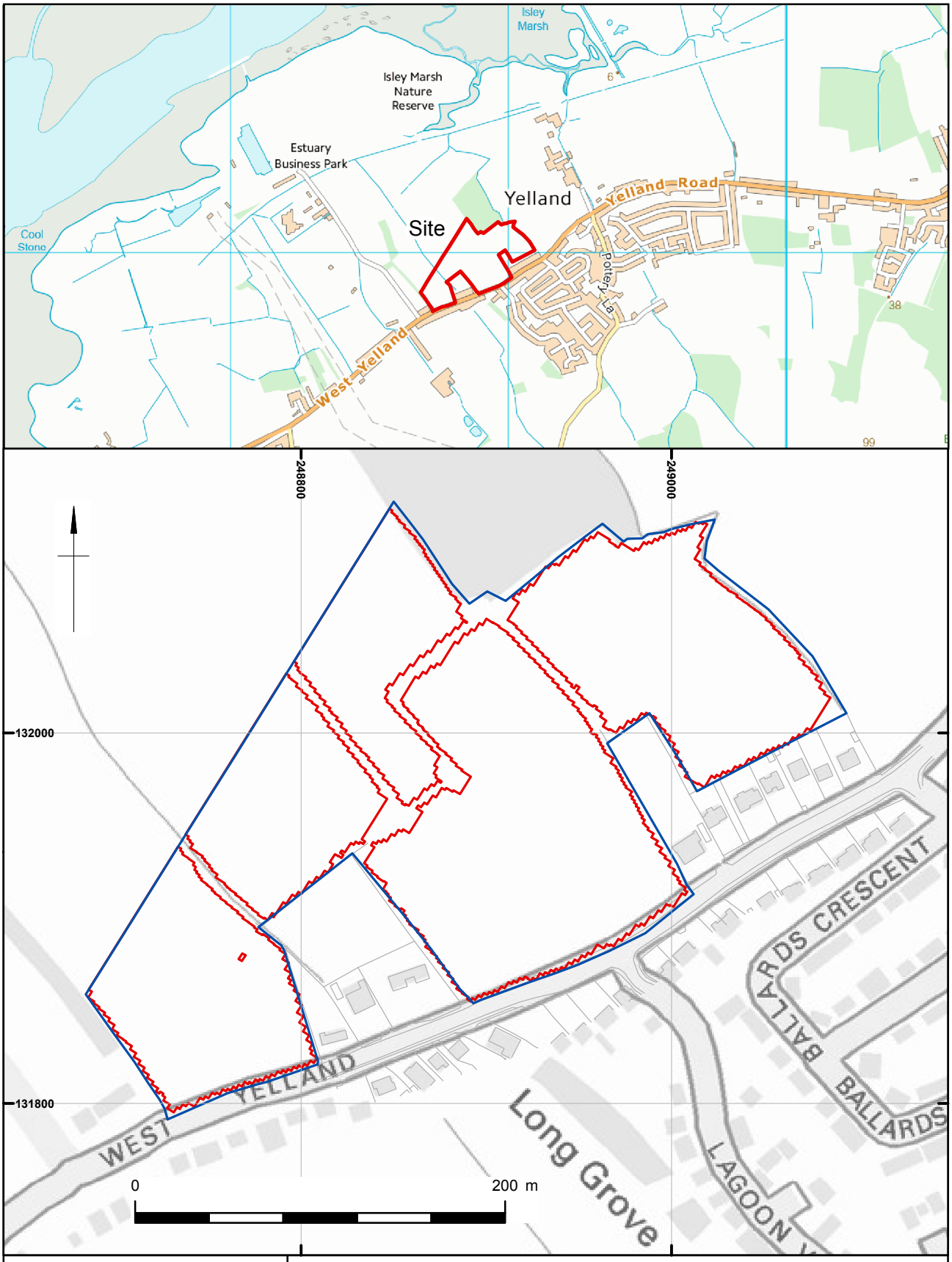
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided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



Site area

Geophysical survey extents

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Scale:	1:3000 at A4	Illustrator:	KL
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Site location and survey extents

Figure 1

248600

248800

249000

132000

131800

+3nT

-2nT

0

100 m

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Site area

Geophysical survey extents

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Greyscale

Figure 2

248600

248800

249000

132000

131800

+25nT

-25nT

0

100 m

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Site area

Geophysical survey extents

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XY plot

Figure 3

248600
248800
249000
132000
131800
4000
4001
4002
4003
4004
4005
4006
4007
Possible archaeology
Ferrous
Trend
Increased Magnetic Response
Agricultural
0
100 m
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Site area
Geophysical survey extents

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Interpretation

Figure 4

wessex archaeology

salisbury rochester sheffield edinburgh

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