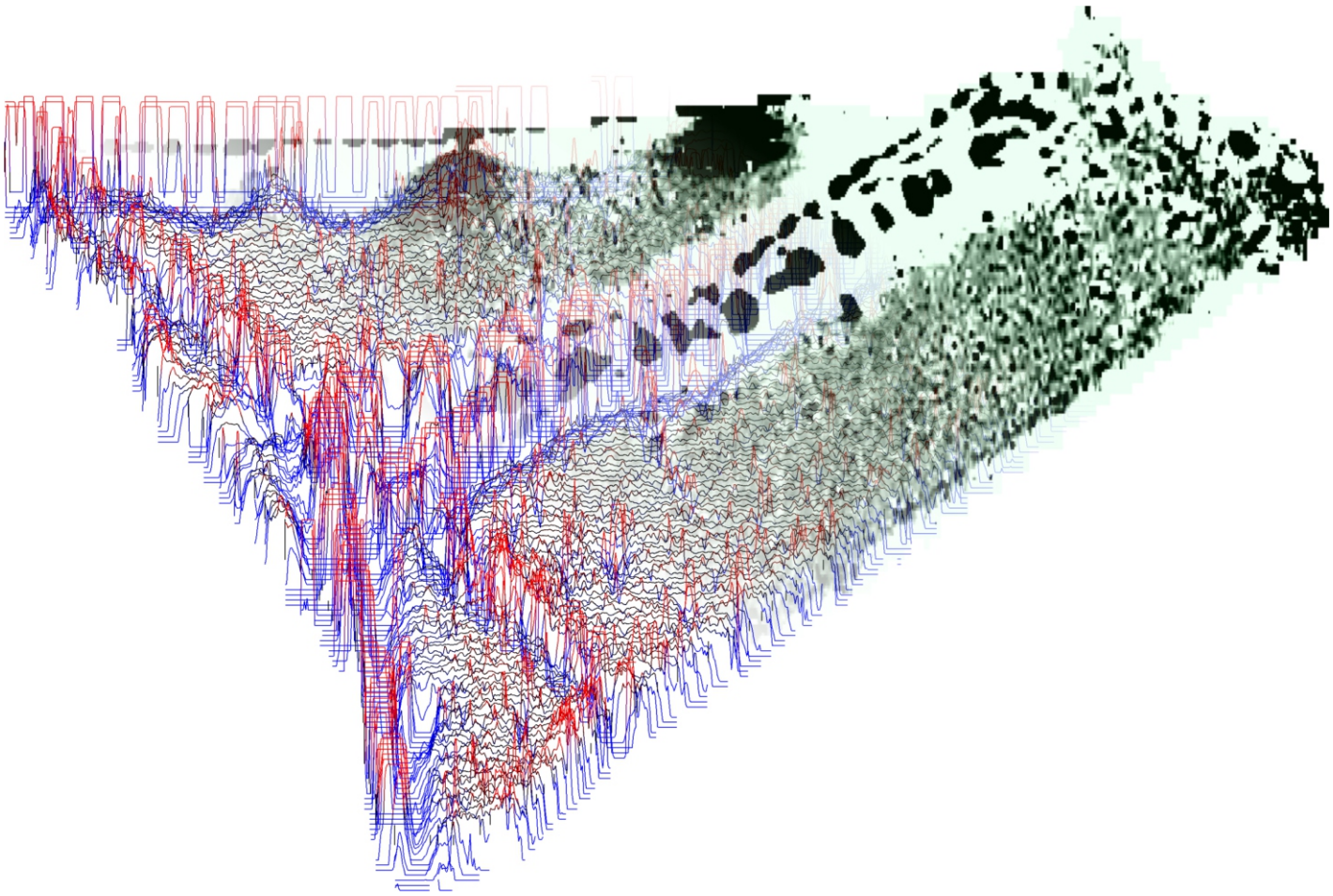
Wessex Archaeology

Land off Old Rydon Lane
Exeter, Devon

Detailed Gradiometer Survey Report



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June 2012

LAND OFF OLD RYDON LANE
EXETER
DEVON

Detailed Gradiometer Survey Report

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Detailed Gradiometer Survey Report

Summary

A detailed gradiometer survey was conducted over land off Old Rydon Lane, near Exeter, Devon. The project was commissioned by Heritage Developments South West Ltd. 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 an arable field to the south of Old Rydon Lane, approximately 4km southeast of Exeter and some 700m west of the M5 motorway. The site occupies the base of a low valley, sloping up towards the northwestern and southeastern extents, and had been recently drilled and rolled at the time of survey. The gradiometer survey covered 2ha and has demonstrated the presence of anomalies of possible archaeological interest within the survey area, along with a region of increased magnetic response and several modern services.

Two ditch-like anomalies were identified oriented parallel with the southeastern boundary, and it is possible that they represent a former field boundary. Towards the northwestern extent of the survey area, ploughing trends aligned with the current agricultural regime are apparent. Weak linear and curvilinear trends were observed throughout the dataset, although their origins are unclear.

A number of modern services were detected within the Site, predominantly oriented NE-SW across the centre of the survey area, with further services noted along the northern and western boundaries.

Extensive magnetic disturbance associated with the services and numerous small-scale ferrous responses were seen throughout the dataset.

The geophysical survey has demonstrated a low archaeological potential across the Site and it is considered that no further archaeological evaluation is required to inform the planning application. If any archaeological mitigation is deemed necessary, e.g. watching brief, it could be secured as a condition of any planning permission granted for the proposed development.

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Acknowledgements

The detailed gradiometer survey was commissioned by Heritage Developments South West Ltd. The assistance of David Lovell is gratefully acknowledged in this regard.

The fieldwork was directed by Ben Urmston and assisted by Laura Andrews and Hannah Brown. Ben Urmston processed and interpreted the geophysical data in addition to writing this report. The geophysical work was quality controlled by Dr. Paul Baggaley. Illustrations were prepared by Karen Nichols. The project was managed on behalf of Wessex Archaeology by Ben Urmston.

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Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by Heritage Developments South West Ltd. to carry out a geophysical survey of land off Old Rydon Lane, Exeter, Devon (**Figure 1**), hereafter "the Site" (centred on NGR 295580 90280). 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 The Site

1.2.1 The survey area comprises an arable field off Old Rydon Lane, some 4km southeast of the centre of Exeter (**Figure 1**). Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of 2ha.

1.2.2 The Site occupies the base of a shallow valley, extending NE-SW, sloping from 25m above Ordnance Datum (aOD) at the northwestern corner to c. 16m aOD at centre to 20m aOD along the southeastern boundary. The survey area lies 700m west of the M5 motorway, with the other extents of the survey area defined by Old Rydon Lane to the north, field boundaries to the southeast, and the Exeter Golf and Country Club to the southwest.

1.2.3 The soils underlying the Site are likely to be typical brown sands of the 551a (Bridgnorth) association and the typical brown earths of the 541e (Crediton) (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.

2 METHODOLOGY

2.1 Introduction

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

2.1.2 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team on 29th May 2012. Field conditions at the time of the survey were good, with the survey area having been drilled and rolled immediately prior to the survey.

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 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 anomalies of possible archaeological interest across the Site, along with a number of modern services. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:2000 (**Figures 2** and **3**). 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.

3.1.2 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 Linear ditch-like anomalies **4000** and **4001** are seen towards the southeastern extent of the survey area, oriented approximately NE-SW. Although the anomalies are separated, it is possible that they represent a continuous feature, given their similar alignments.

3.2.2 Towards the eastern extent of the survey, region of increased magnetic response **4002** is characterised by numerous small-scale anomalies; whilst some of these are ferrous in origin, the nature of the wider region is unclear. It is possible that it relates to agricultural activity or other modern intrusion.

3.2.3 Towards the northwestern survey extent, a cluster of ploughing trends **4003** is visible. These are on a similar orientation to the current ploughing regime, suggesting that deposits somewhat more magnetically enhanced than the surrounding subsoil have been disturbed.

3.2.4 Elsewhere, weak linear and curvilinear trends can be seen throughout the dataset. The origin of these trends is not clear, although it is likely that some are the result of ploughing; others may simply be chance alignments within the data.

3.2.5 Strong magnetic disturbance has affected large regions of the dataset in the vicinity of the numerous modern services apparent within the survey area, and by probable dumping along the northeastern boundary. Weaker archaeological anomalies would have been masked by this disturbance, should any have been present.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 A number of modern services were identified. Probable service **4004** is oriented parallel with Old Rydon Lane and extends along much of the northern boundary. Another service, marked **4005** and **4006**, is aligned parallel with the western boundary, extending NW-SE across the western

portion of the dataset, although its response is partly masked by other services near its centre.

3.3.2 A large service **4008** and **4009** extends northward from the southwestern corner of the survey area, before turning to the northeast to exit at the northeastern corner near the current gate.

3.3.3 A smaller service, marked **4010** and **4011**, extends NE-SW across the Site, parallel with **4009** and appearing to exit the survey area near the same point to the northeast. A probable section of service between **4009** and **4011** may indicate a continuation of **4007**.

3.3.4 A section of possible service **4012** can be seen towards the northwestern extent of the Site, oriented NE-SW; its negative response is consistent with a plastic pipe or trench backfilled with imported material.

4 CONCLUSION

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

4.1.2 The nature of ditch-like anomalies **4000** and **4001** is unclear, although it is possible that it represents a former field boundary.

4.1.3 The relative dimensions of the modern services 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.

4.1.4 The extent of magnetic disturbance associated with the services and the frequency of small-scale ferrous anomalies have reduced the area in which it is possible to detect archaeological features. The possible ditches identified along the southeastern boundary exhibit only weak contrast with the general magnetic background and it is difficult to assess whether more substantial archaeological features would produce more readily detectable anomalies.

4.1.5 It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be encountered than have been identified through geophysical survey.

4.1.6 The geophysical survey has demonstrated a low archaeological potential across the Site and it is considered that no further archaeological evaluation is required to inform the planning application. If any archaeological mitigation is deemed necessary, e.g. watching brief, it could be secured as a condition of any planning permission granted for the proposed development. The required approach would be agreed in consultation with the County Archaeologist for Devon County Council.

5 REFERENCES

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

Soil Survey of England and Wales, 1983. *Sheet 5, South West England*. Ordnance Survey, Southampton.

6 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.

7 APPENDIX 2: GEOPHYSICAL INTERPRETATION

The interpretation methodology used by Wessex Archaeology separates the anomalies into two main categories: archaeological and unidentified responses.

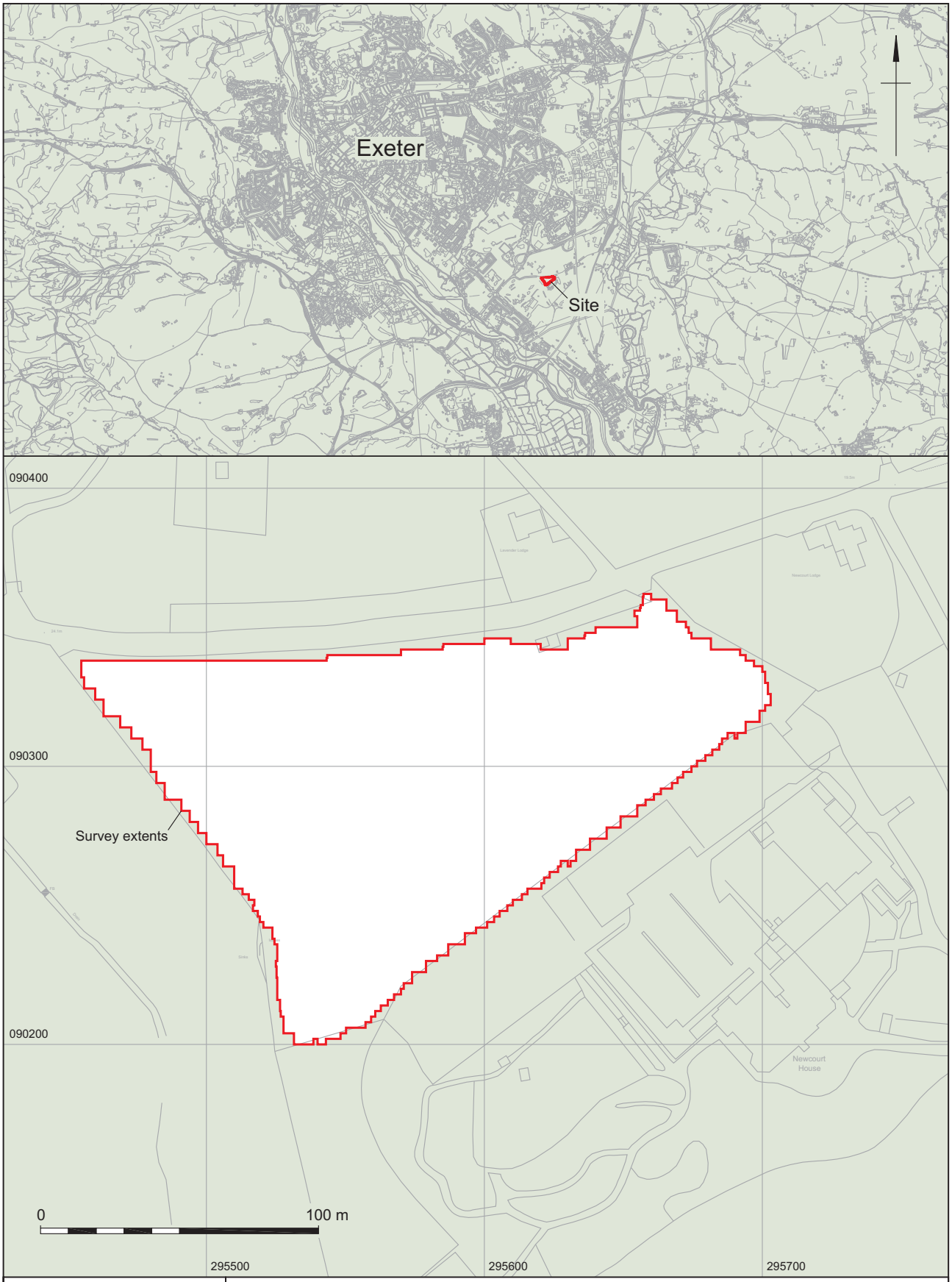
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided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



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Site location and survey extents

Figure 1

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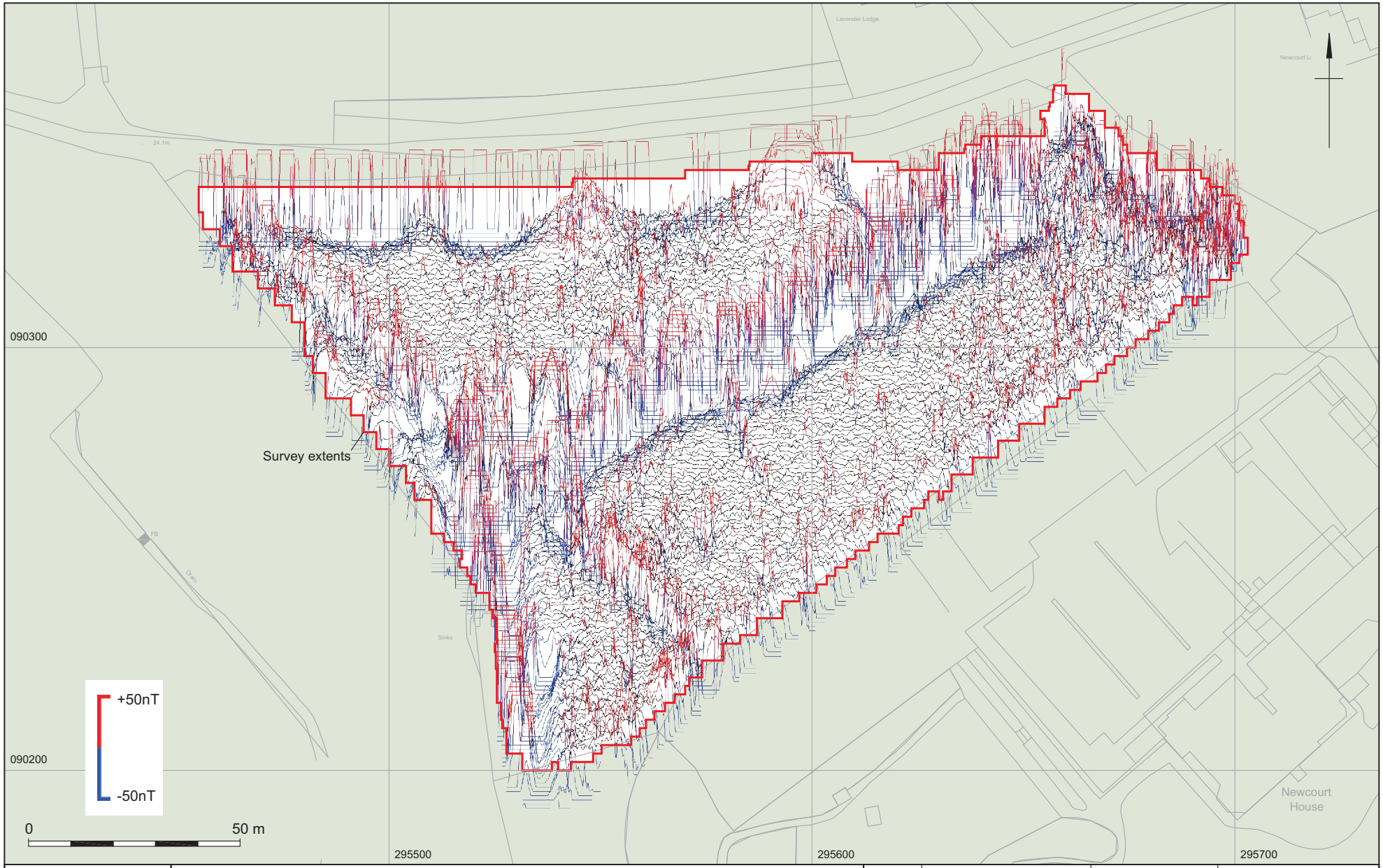
Greyscale

Figure 2



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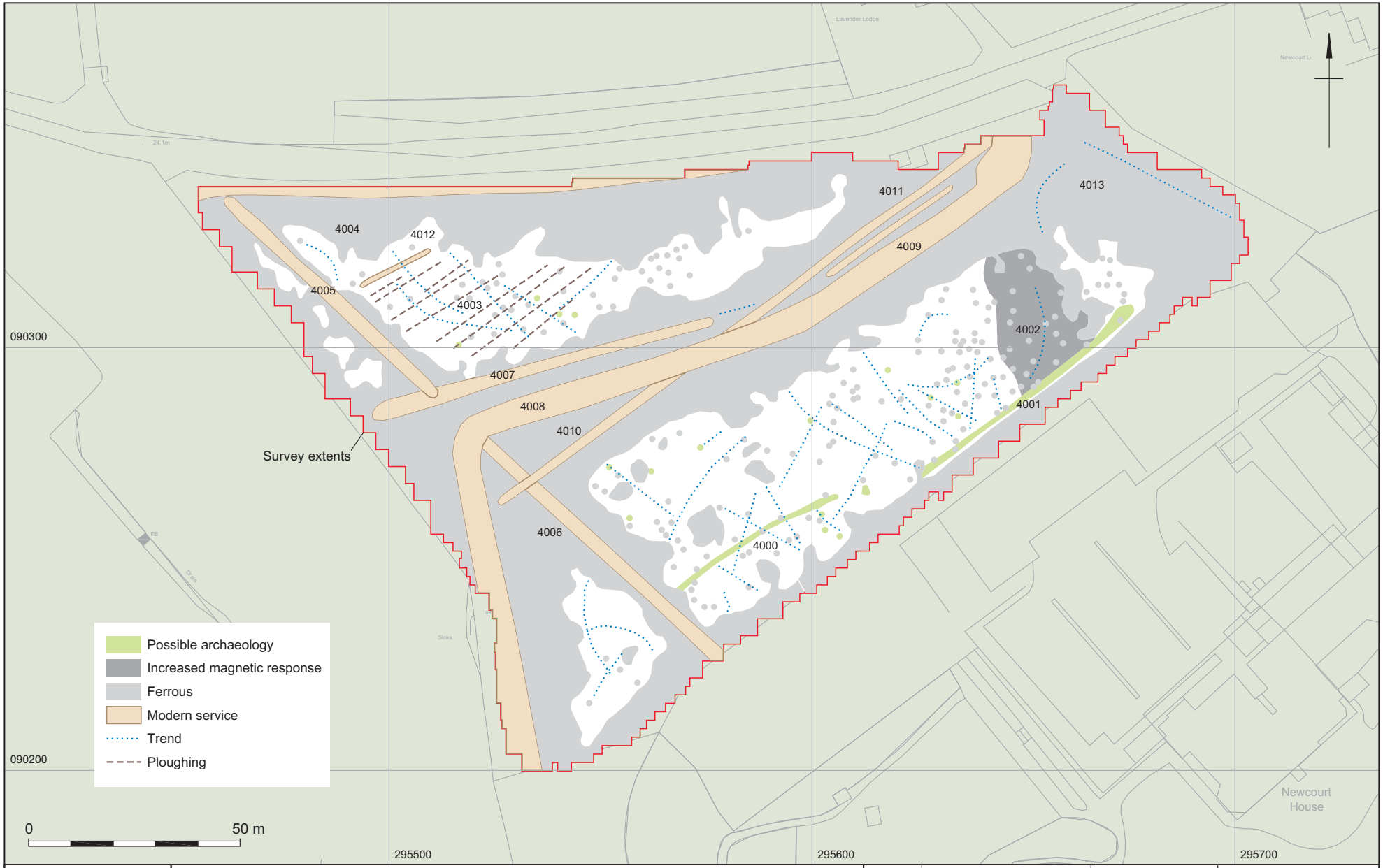
XY trace

Figure 3



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Interpretation

Figure 4

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