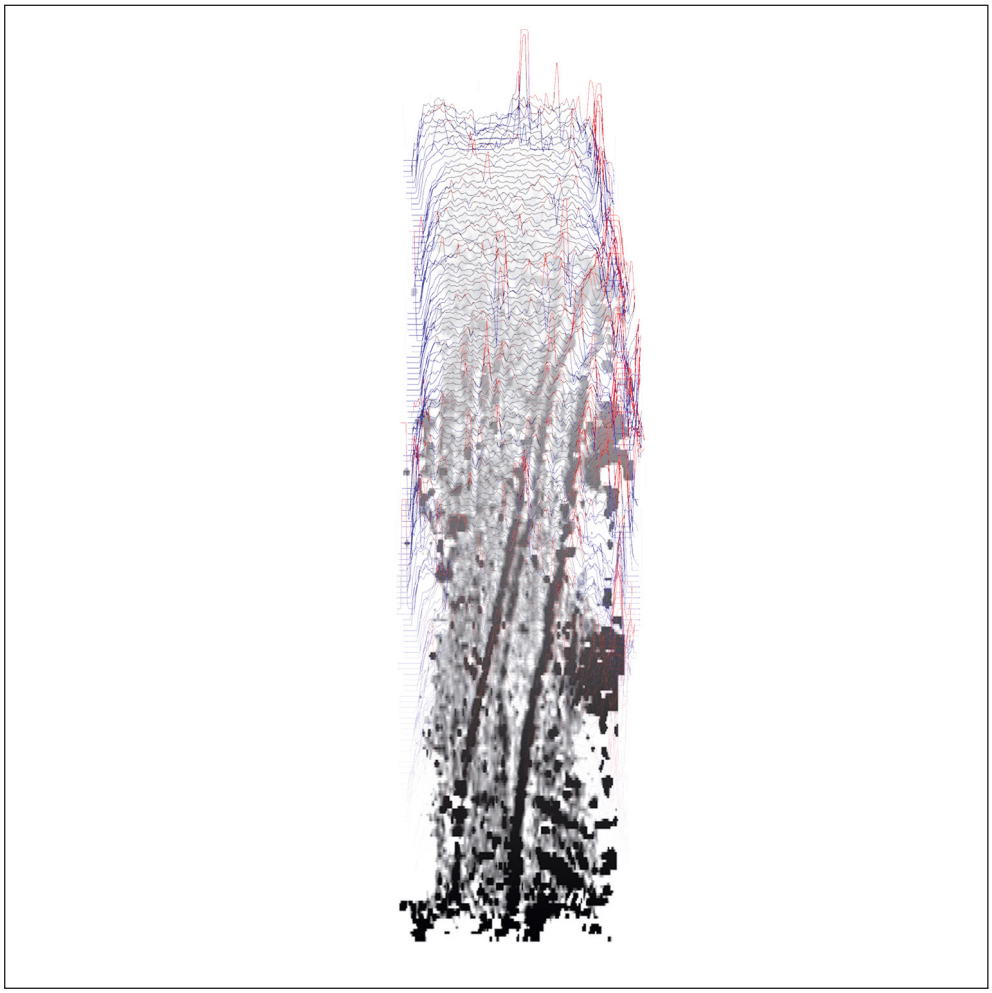
making sense of heritage

Land off Exeter Road Topsham, Devon

Detailed Gradiometer Survey Report



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April 2014

geoservices

Land off Exeter Road
Topsham, Devon

Detailed Gradiometer Survey Report

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Summary

Wessex Archaeology was commissioned by Heritage Developments South West Limited to undertake a detailed gradiometer survey of land adjacent to Exeter Road, near Topsham, Exeter (centred on NGR 295850, 088940). The aim of the work was to establish the presence, or otherwise, and nature of detectable archaeological features on the site as part of a programme of archaeological works ahead of a proposed development.

The survey was undertaken on 26th March 2014 and the site is located approximately 5.1km southeast of the centre of Exeter and 1km northwest of the centre of Topsham. The site comprises one pasture field located on the southwest side of Exeter Road close to the M5.

Detailed gradiometer survey was undertaken over all accessible parts of the site, a total of 0.67ha, and has demonstrated the presence of anomalies of likely, probable and possible archaeological significance along with regions of increased magnetic response and at least one modern service.

As the survey are is fairly narrow it is unclear whether the archaeological features detected are indicative of concentrated settlement activity or are agricultural in function. Given the volume of known prehistoric, Roman and medieval activity in close proximity to the site it is likely that the anomalies detected relate to at least one of these phases.

Land off Exeter Road
Topsham, Devon

Detailed Gradiometer Survey Report

Acknowledgements

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

The fieldwork was carried out by Jennifer Smith, Laura Andrews and Alistair Salisbury. The geophysical data was processed and interpreted by Ross Lefort who also wrote this report. The geophysical work was quality controlled by Dr. Paul Baggaley and Ben Urmston. Illustrations were prepared by Ross Lefort and Rob Goller. The project was managed on behalf of Wessex Archaeology by Sue Farr.

Land off Exeter Road
Topsham, Devon

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project Background

1.1.1 Wessex Archaeology was commissioned by Heritage Developments South West Limited to carry out a programme of geophysical survey over land adjacent to Exeter Road on the northwest side of Topsham, Devon (centred on NGR 295850, 088940; **Figure 1**), hereafter "the Site". 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 and Topography

1.2.1 The Site is located approximately 1km northwest of the centre of Topsham and 5.1km southeast of the centre of Exeter. The Site comprises one arable field on the southwest side of Exeter Road (**Figure 1**). The Site lies on the northwest edge of Topsham close to the M5.

1.2.2 The Site lies at an elevation between 5m and 10m above Ordnance Datum (aOD); the relief in the wider area gently undulates. The Site occupies a low ridge flanked by rivers with the River Exe to the southwest and the River Clyst to the northeast. The Site is defined by field boundaries, with Exeter Road to the northeast.

1.3 Soils and Geology

1.3.1 The bedrock geology under the Site is recorded as Dawlish sandstone formation (Permian) with Heavitree Breccia formation further to the west (BGS). The superficial deposits are recorded as river terrace deposits of sand and gravel (Quaternary) with tidal flat deposits of clay, silt, sand and gravel recorded around the Rivers Exe and Clyst (BGS).

1.3.2 The soils recorded across most the Site are typical brown earths of the 541w (Newnham) association with pelo-alluvial gley soils of the 813f (Wallasea 1) association (SSEW 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

1.4 Archaeological Background

1.4.1 The following information is summarised from the Heritage Gateway website (www.heritagegateway.org.uk). A search was performed for all heritage assets within 1km of the Site.

1.4.2 Prehistoric sites recorded include flint scatters with one relating to a late Neolithic or early Bronze Age settlement with some earlier Mesolithic microliths recorded. This site is located a short distance to the southwest of the survey area (MDV14344).

1.4.3 A large proportion of records relate to Roman period activity with numerous findspots and monuments recorded. Several Roman coins have been found in this field including coins of Augustus (MDV71560) with an early Roman farmstead discovered a short distance to the southwest during construction of the M5 (MDV14394). A cropmark enclosure of possible Roman date is visible as a cropmark to the northeast of the Site with sherds of Roman pottery recovered from the same area (MDV56062 and MDV65434).

1.4.4 The most significant Roman remains lie further to the southeast and include a first century Roman military base (MDV67998) and a possibly contemporary inhumation cemetery (MDV71475). Other Roman buildings have been recorded within Topsham including a bakehouse and a corn drier (MDV65498 and MDV9946).

1.4.5 A medieval road named the Portway is recorded within the Site and served as a route for the transport of goods to and from Exeter, especially when ships could no longer reach the city (MDV15325). To the northeast of the survey area a probable medieval field system has been recorded (MDV63890).

1.4.6 There are a number of records relating to the post-medieval with many relating ti listed buildings within Topsham. The Retreat is a notable example that is documented as a sugar refinery from at least the late 17th century. This was converted to a private house in the 18th century and served to house prisoners of war during the Napoleonic wars (MDV9936).

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 geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team on 26th March 2014. Field conditions at the time of the survey were good, with firm conditions under foot.

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 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 add function was used in certain instances to correct errors in 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, along with a modern service. 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 greyscale image and ±25nT at 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 clearest features visible in the data are three near-parallel ditches around **4000**; they have magnetic values typically over +3nT although there are weaker regions with values less than +1.5nT. There are possible offshoots from these ditches at **4001** and **4002**. The survey area is not large enough to establish whether these ditches mark out a road, enclosures or a field system. These features have been classed as either archaeology or probable archaeology depending on their magnetic values.

3.2.2 There are possible pit like anomalies in this field with a large example located at **4003** and a cluster of smaller ones around **4004**. These features have magnetic values around +3nT and have been classed as either probable archaeology or possible archaeology depending on their size and arrangement.

3.2.3 Some weak parallel linear trends are visible at the western end of the field around **4005**; these anomalies may prove to be of archaeological significance but are considered to be of uncertain origin.

3.2.4 A modern service is visible at **4006**, which is discussed in more detail in the next section of the report.

3.2.5 There are two spreads of increased magnetic response at the northwestern end of the Site. These areas are characterised by concentrations of small dipolar and bipolar (black and white) anomalies. Several explanations are possible for these spreads including that they are geological, are concentrations of archaeological debris or that they represent modern debris. As it is not possible to determine which is the case from the geophysical data alone, these spreads are considered to be of uncertain origin.

3.2.6 The remaining anomalies include ploughing trends, weak linear trends of uncertain origin and small positive anomalies of possible archaeological significance. These small positive anomalies may prove to be archaeological features such as small pits or postholes but as their spatial distribution forms no significant patterns are classed as possible archaeology as a geological explanation is also possible for them.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 One service is visible running through the data at **4006** that is thought to represent a pipe running alongside Exeter Road.

3.3.2 It is not clear from the geophysical data whether any of the services identified are in active use. It should also be noted that gradiometer survey may not detect 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 Summary

4.1.1 The detailed gradiometer survey has been successful in detecting 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 ditches detected are considered as the most significant features and could represent anything from a former alignment of The Portway to field or enclosure boundaries. It is not possible to establish their origins conclusively due to the limited extents of the survey area. Given the concentrations of prehistoric, Roman and medieval activity in the area it is considered likely that at least some of the features detected may relate to these periods.

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; however, it is assumed that the centreline of services is coincident with the centreline of their anomalies. Similarly, it is difficult to estimate the depth of burial of the services through gradiometer survey.

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 HER Records Consulted

MDV9936 – The Retreat, Topsham

MDV9946 – Roman Bakehouse

MDV14344 – Neolithic settlement at Topsham

MDV14394 – Roman farmstead on Exeter Road

MDV15325 – The Portway, Retreat Field

MDV56062 – Cropmark enclosure, northeast of Exeter Road

MDV63890 – Medieval field system northwest of Topsham

MDV65434 – Roman pottery, near Exeter Road

MDV65498 – Roman corn drier at Orchard Way, Topsham

MDV67998 – Roman military site in Topsham

MDV71475 – Roman cemetery in Topsham

MDV71560 – Five Roman coins, Retreat Field

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:

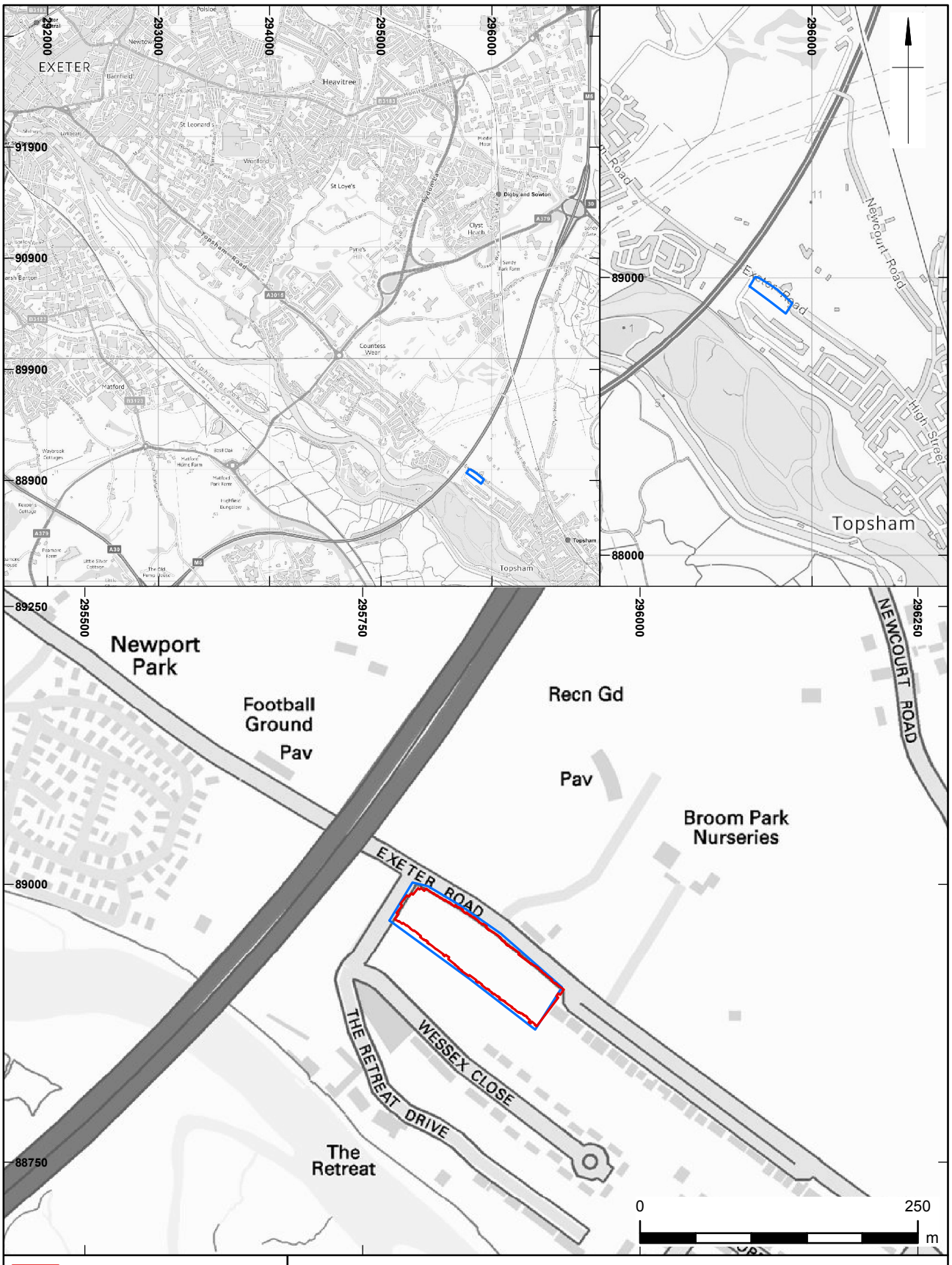
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be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



Detailed Survey Extents

Site Boundary

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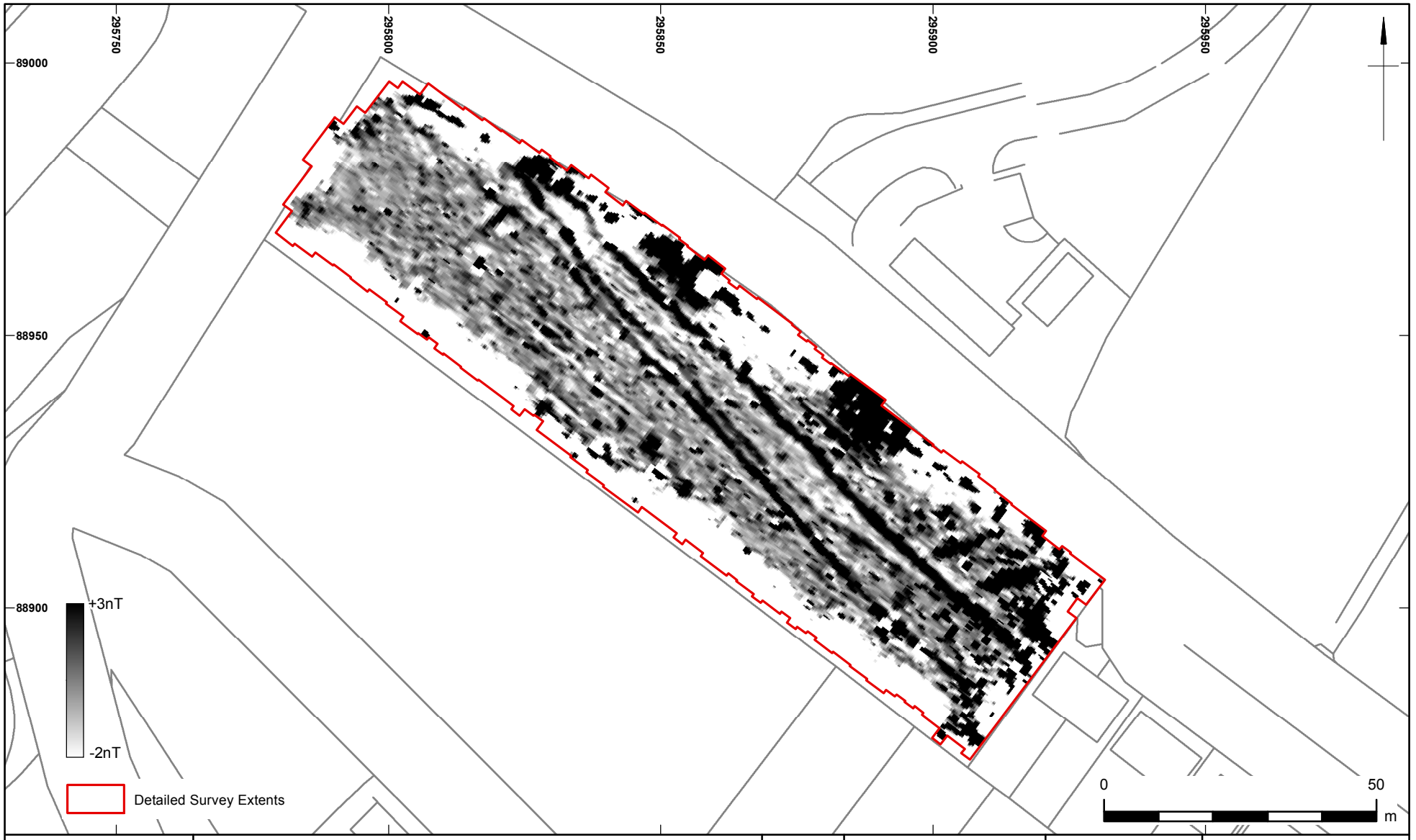
Site location map and detailed survey extents

Figure 1



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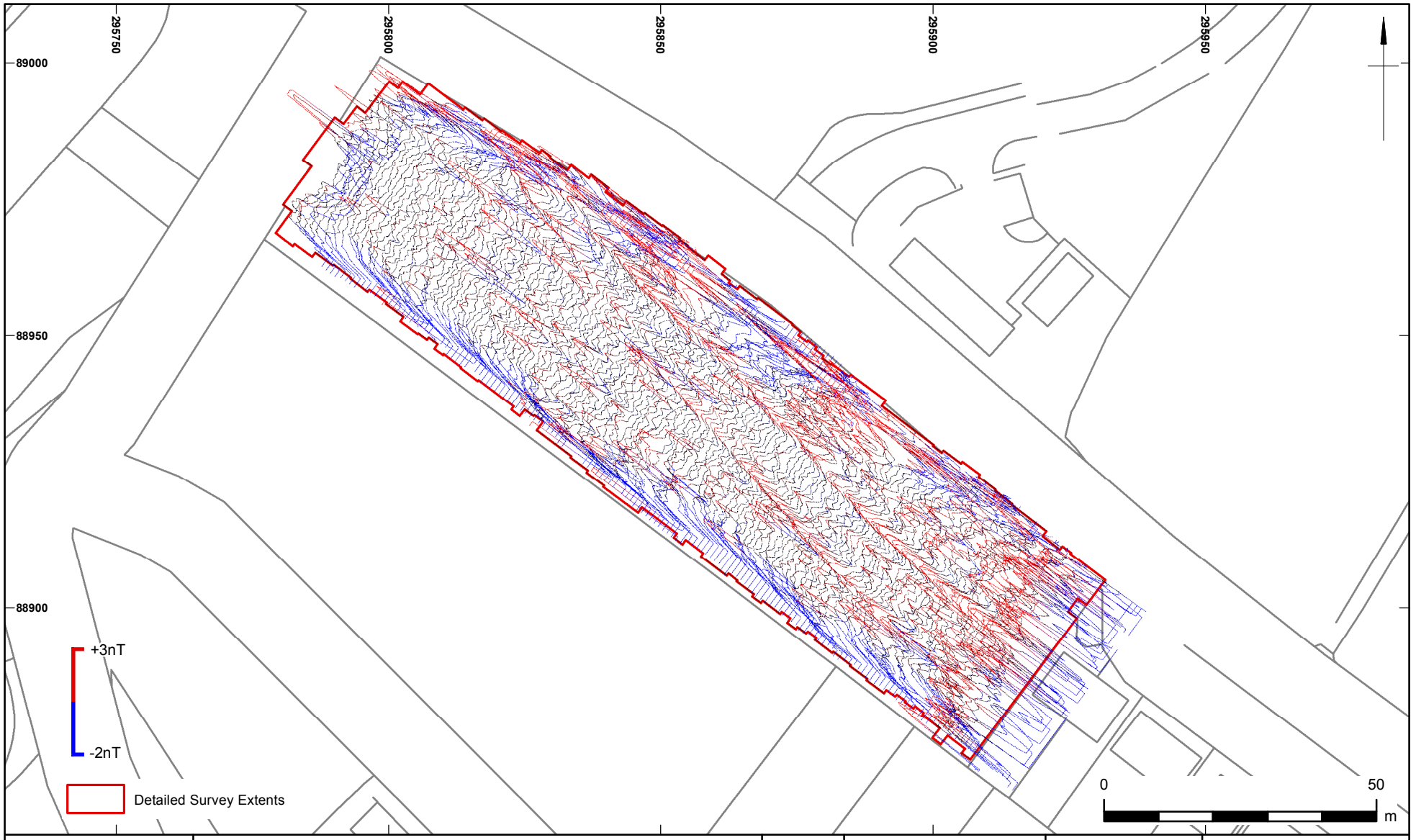
Greyscale plot

Figure 2



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XY trace plot

Figure 3

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Interpretation

Figure 4

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