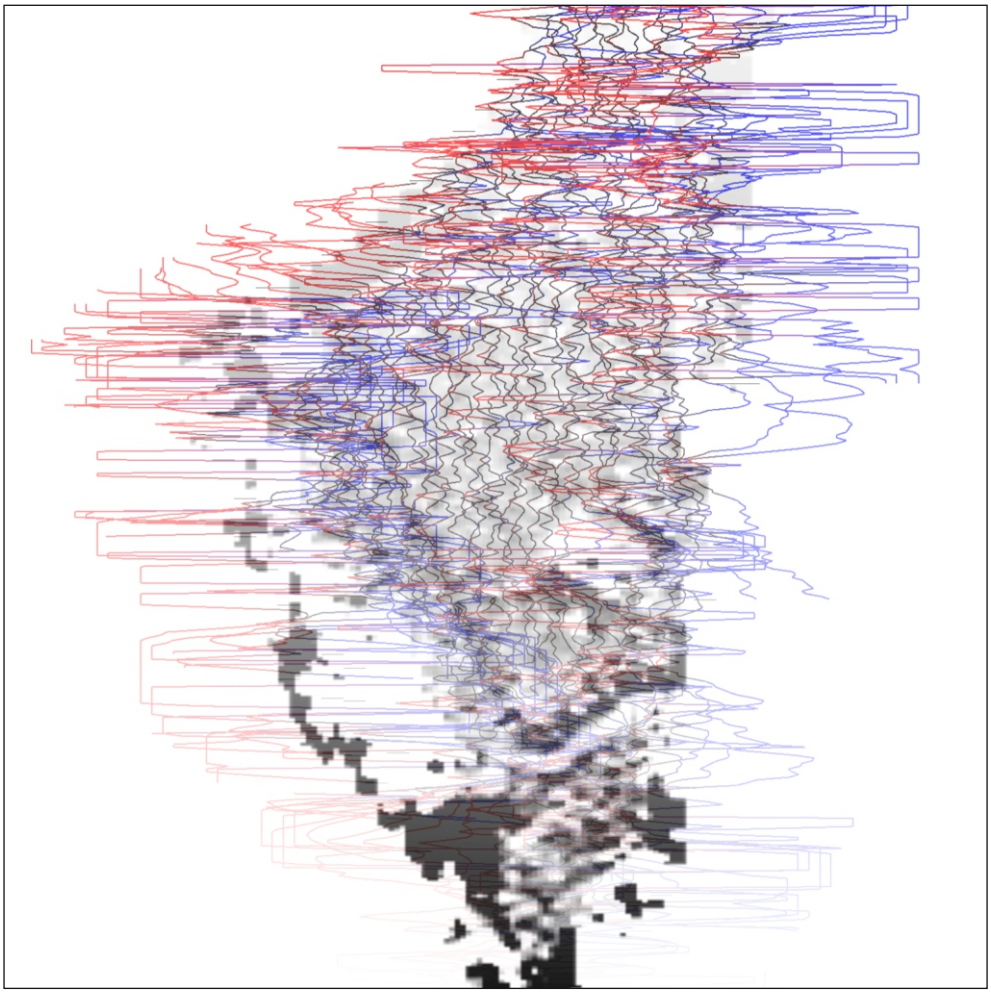
making sense of heritage

Land at Newcourt Drive, Exeter, Devon

Detailed Gradiometer Survey Report



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geoservices

Land at Newcourt Drive, Exeter, Devon

Detailed Gradiometer Survey Report

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Land at Newcourt Drive, Exeter, Devon

Detailed Gradiometer Survey Report

Contents

Figures

Land at Newcourt Drive, Exeter, Devon

Detailed Gradiometer Survey Report

Summary

A detailed gradiometer survey was conducted over land off Newcourt Drive, Exeter, Devon. The project was commissioned by Heritage Developments South West Limited with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features on the site ahead of proposed development.

The site comprises two parcels of landoff Newcourt Drive, some 500m west from the M5, 2.2km northwest of Topsham and 4.0km southeast from the centre of Exeter. The site occupies a relatively flat area of landwith a gentle slope towards the southern extents. Heras fencing and other highly magnetic objects covered extensive areas of the site at the time of surveying. The gradiometer survey covered 1ha and has demonstrated the presence of anomalies of probable and possible archaeological interest within the survey area, along with regions of increased magnetic response and at least one modern service.

The geophysical data has revealed a probable enclosure in the southern extent of the site as well as a spread of pit-like anomalies and/or post holes in the same area. This enclosure along with a sub-rectangular feature at the north of the site may represent landscaping features that formed part of the design of the grounds of Newcourt House.

The survey was undertaken on the 8th October 2014 by Wessex Archaeology's in-house geophysics team.

Land at Newcourt Drive, Exeter, Devon

Detailed Gradiometer Survey Report

Acknowledgements

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

The fieldwork was undertaken by Laura Andrews and Alistair Black. Jen Smith processed and interpreted the geophysical data, in addition to writing this report. The geophysical work was quality controlled by Ross Lefort and Dr. Paul Baggaley. Illustrations were prepared by Ross Lefort and Linda Coleman. The project was managed on behalf of Wessex Archaeology by Sue Farr.

Land at Newcourt Drive, Exeter, 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 geophysical survey on land off Newcourt Drive, Exeter, Devon (**Figure 1**), hereafter "the Site" (centred on NGR 295825 90276). 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 survey area comprises a parcel of grassed land off Newcourt Drive, some 500m west from the M5, 2.2km northwest of Topsham and 4.0km southeast of the centre of Exeter (**Figure 1**). The survey area lies close to the Grade II Listed Newcourt House that dates from the 18th century. Detailed gradiometer survey was undertaken over all accessible parts of the Site. Isolated areas were not surveyed due to the presence of geotechnical trenches. A total of 1ha was surveyed.

1.2.2 The Site occupies a relatively flat area of land with a gentle slope towards the south; sloping from *c.* 20m above Ordnance Datum (aOD) at the northern extent to *c.* 15m aOD at the southern boundary. The survey extents are defined by Old Rydon Lane to the north, new housing estates to the east and west and private land to the south. The nearest watercourse is an unnamed stream located less than 0.5km to the southwest that flows further southwest into the River Exe. The River Clyst is located 1km to the east; this river flows south to join the River Exe.

1.3 Soils and Geology

1.3.1 The bedrock geology under the Site is recorded as Dawlish sandstone formation with Heavitree breccia formation close by to the west; both formations date to the Permian period. Superficial deposits are recorded as river terrace deposits of sand and gravel that date to the Quaternary period (BGS).

1.3.2 The soils underlying the Site are likely to be typical brown sands of the 551a (Bridgnorth) 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.

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 the 8th October 2014. Field conditions at the time of the survey were poor, with the survey area having been stripped of all vegetation and turf and occupied by open trenches and equipment, i.e. Heras fencing.

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 (±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 probable and possible archaeological interest across the Site. Regions of increased magnetic response and at least one modern service 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 1:1500 (**Figure 2**). 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.

3.1.3 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figure 2**). 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 westernmost survey area has a number of anomalies of interest present. A single ditch-like feature at **4000**, aligned northwest to southeast, can be seen at the southern end of the survey area. Both ends of this anomaly have 90° turns which run in a northeast direction. It is unclear how far this feature may extend as there are widespread strong ferrous anomalies which may be masking some of this feature. The anomaly has magnetic values that vary in strength from around +1.5nT to over +5nT in places. The function of this anomaly is unclear and no matching features can be identified from historic Ordnance Survey (OS) maps. This feature has been classed as probable archaeology due to its regularity in plan.

3.2.2 Small anomalies of possible archaeological interest can be seen in a small localised spread around **4001**. They have a smooth profile in the XY trace plot that stands out from the other nearby ferrous anomalies. For this reason they may be interpreted as possibly representing small pits or post holes.

3.2.3 A negative linear anomaly can be seen running on an approximate northeast to southwest alignment at **4002**. This feature has magnetic values around -2nT and may relate in some way to agricultural activity given its common alignment with nearby ploughing scars. This feature has been classed as possible archaeology as it may prove to be agricultural in origin.

3.2.4 A sub-rectangular positive anomaly lies within an area of ferrous responses at **4003**; this feature appears far too regular in form to represent a ferrous anomaly and may instead be a cut feature filled with magnetic debris or is a ceramic footing. This feature lies in a former wooded area within the park around Newcourt House according to the 1889 OS map. It is possible this feature relates to a former garden feature. This anomaly has been classed as possible archaeology.

3.2.5 A modern service is visible in the data at **4004**; this will be discussed in more detail in the next section of the report.

3.2.6 There are numerous weak linear trends running through the data as at **4005**; the function and identity of these anomalies is unclear and they are regarded as being of uncertain origin.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 One modern service has been identified in the geophysical data near the centre of the Site at **4004**. It appears to represent a pipe that continues beyond the limits of the geophysical survey area although its function cannot be ascertained from the geophysical data.

3.3.2 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 anomalies of 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 three-sided rectangular anomaly at **4000** is highly suggestive of a former enclosure even though the majority of the feature is being masked by the widespread high magnetic responses in the dataset. Its shared alignment with the layout of the nearby Newcourt House may suggest it relates in some way to this estate. The sub-rectangular feature at **4003** may also relate to a landscape or gardening feature associated with the house.

4.1.3 A modern service was identified in the central region of the Site along with a wide dense spread of ferrous responses. A broad spread of ferrous responses was also observed across the northern edge of the Site. These ferrous anomalies are easily strong enough to mask weaker archaeological features that may lie underneath.

4.1.4 The relative dimensions of the modern service identified by the gradiometer survey is indicative of the strength of its magnetic response, which is dependent upon the materials used in their construction and the backfill of the service trench. 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.

4.1.5 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.

5 REFERENCES

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

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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.

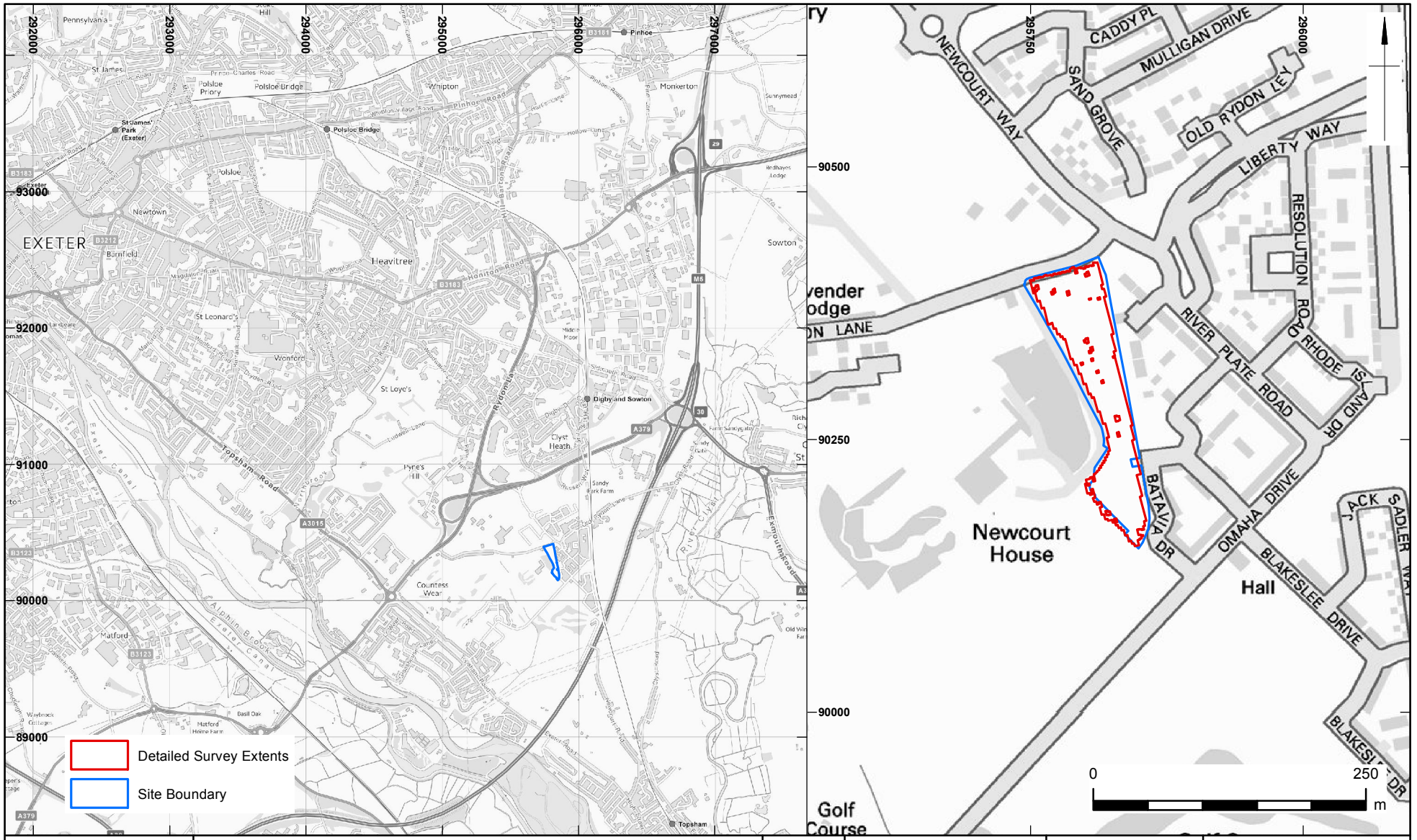
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided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



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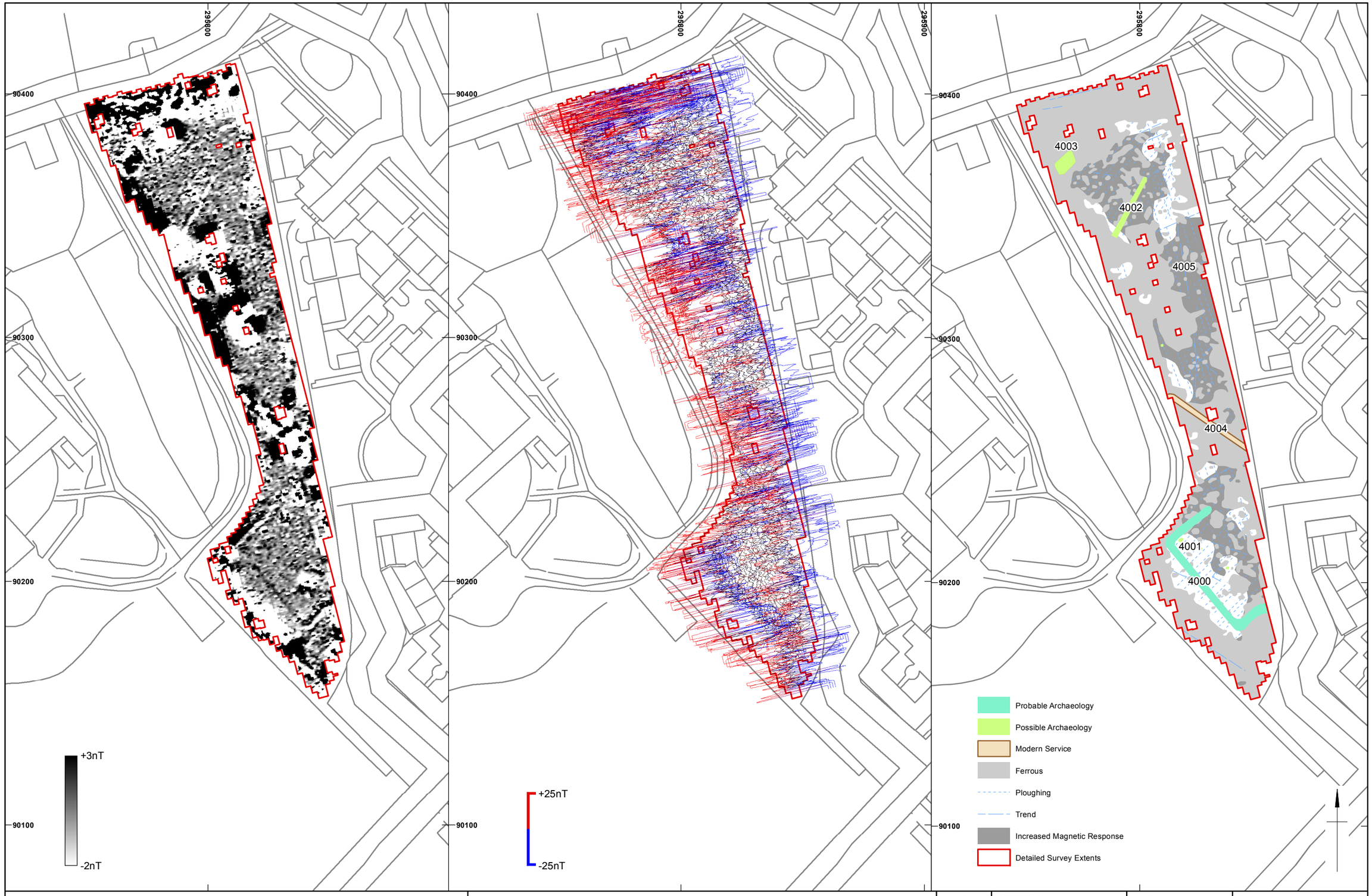
Site location and detailed survey extents

Figure 1



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Greyscale plot, XY trace plot and interpretation

Figure 2

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