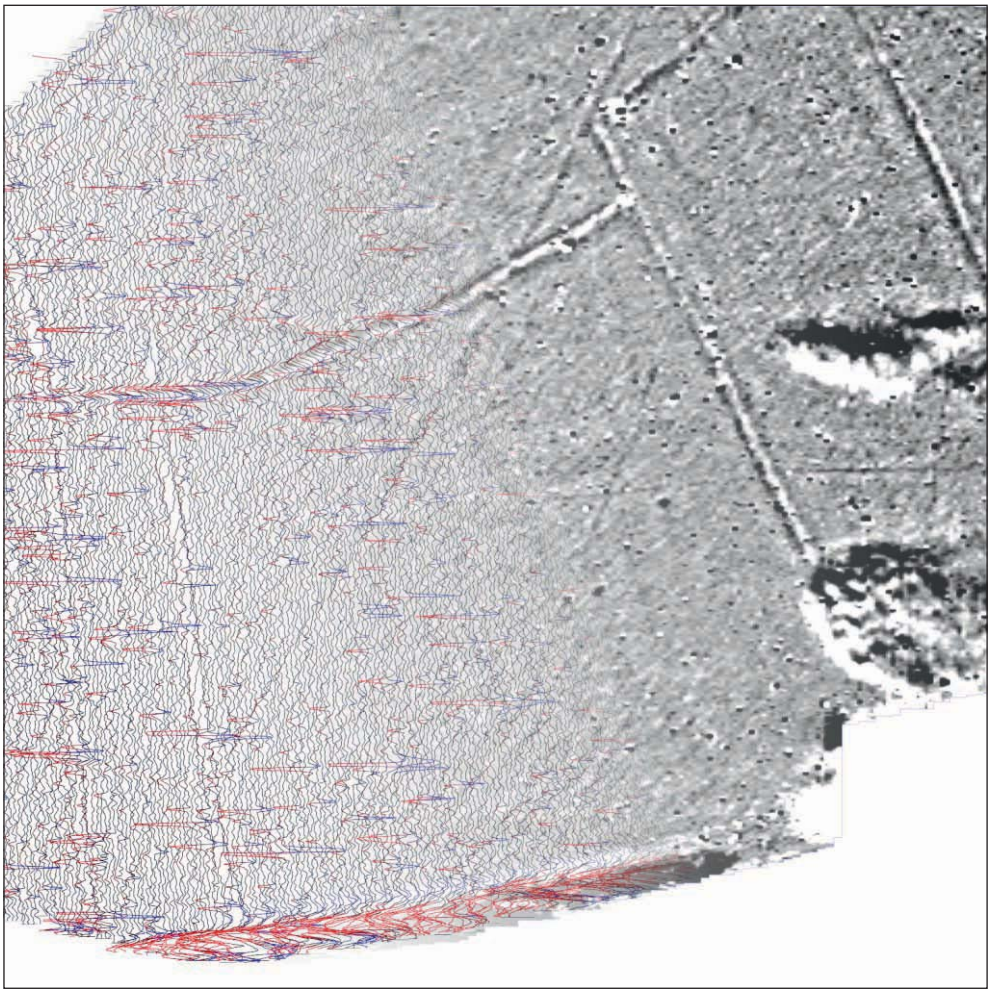
making sense of heritage

Land Adjacent to Babylon Lane Silverton, Devon

Detailed Gradiometer Survey Report



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geoservices

Land Adjacent to Babylon Lane
Silverton, Devon

Detailed Gradiometer Survey Report

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

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Summary

A detailed gradiometer survey was conducted over land adjacent to Babylon Lane, near Silverton, Devon. The project was commissioned by AMEC Environment & Infrastructure UK 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 of a single pasture field directly north of Babylon Lane, some 1.2km to the southwest of Silverton, and 10.3km NNE of the centre of Exeter. The Site occupies an area of undulating land with a gentle slope to the south of the Site and an increasingly steep slope towards the north of the Site, with the slope predominately facing south. The gradiometer survey covered 8.0ha and has demonstrated the presence of anomalies of probable and possible archaeological interest within the survey area, along with agricultural features and regions of magnetic disturbance.

The geophysical survey has revealed one former field system with complimentary ploughing which are congruous with 19th century mapping. The linear anomalies of probable and possible archaeological interest may be related to at least one further phase of field system. Some pit-like anomalies were observed across the dataset and are interpreted as possible archaeology.

Magnetic disturbance thought to be associated with the construction of the neighbouring road and numerous small-scale ferrous responses were seen throughout the dataset.

The geophysical survey was undertaken on 9th and 10th June 2014.

Land Adjacent to Babylon Lane
Silverton, Devon

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by AMEC Environment & Infrastructure UK Ltd. The assistance of Robert Johns is gratefully acknowledged in this regard.

The fieldwork was directed by Ross Lefort and was assisted by Jen Smith and Alistair Salisbury. Jen Smith processed the geophysical data which was interpreted by Ross Lefort and Jen Smith. This report was written by Ross Lefort and Jen Smith. The geophysical work was quality controlled by Ben Urmston. Illustrations were prepared by Ross Lefort and Linda Coleman. The project was managed on behalf of Wessex Archaeology by Paul Baggaley.

Land Adjacent to Babylon Lane Silverton, Devon

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by AMEC Environment & Infrastructure UK Ltd. to carry out a geophysical survey on land adjacent to Babylon Lane, near Silverton, Devon (**Figure 1**), hereafter "the Site" (centred on NGR 295100 101850). 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 comprised of a single pasture field directly north of Babylon Lane, some 1.2km to the southwest Silverton and 10.3km NNE of the centre of Exeter (**Figure 1**). The survey extents are defined by Quarry Lane, Babylon Lane and Kenson Hill to the west, south and east. The northern edge of the survey extent was defined by the client as only the southern half of the field is to be impacted on by future development.

1.2.2 The Site occupies an area of undulating land with a gentle slope to the south of the Site and an increasingly steep slope towards the north of the Site. The slopes faces predominately to the south with the land to the north lying at a height of over 75m above Ordnance Datum (aOD) and the south lying at approximately 45m aOD. A small unnamed stream flows past the Site to the east that flows south into the River Culm. The River Exe flows north to south roughly 1.5km to the west of the Site.

1.3 Geology and Soils

1.3.1 The solid geology recorded under the north and west of the Site is Cadbury breccia formation breccia that dates to the Permian. The geology under the rest of the Site belongs to the Thorverton sandstone formation and is a mix of sandstone and igneous basalt. No superficial deposits are recorded under the Site but head deposits are recorded a short distance to the west and east in lower lying stream valleys (BGS).

1.3.2 The soils underlying the Site are likely to be typical brown earths of the 541b (Bromsgrove) 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 summarized from information available online at Heritage Gateway (http://www.heritagegateway.org.uk/gateway/). The only record that falls within the Site is a large undated mound visible on 1947 aerial photographs; this feature falls just outside of the area covered by the geophysical survey although the record does mention visible field boundaries further to the south (MDV19091).

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 9th and 10th June 2014. Field conditions at the time of the survey were good with firm conditions under foot. Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of 8.0ha.

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, along with former field boundaries. Results are presented as a series of greyscale and XY plots at a scale of 1:1,500 (**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 archaeological features visible in the data are a series of weak linear positive anomalies at **4000** to **4006**; these features have magnetic values around +1nT and are considered to represent ditches marking a former field system. These ditches have been interpreted as probable archaeology. There are other weaker ditch sections at **4007** to **4011** that may relate to this field system but as they have weaker magnetic values (around +0.5nT) have been interpreted as possible archaeology. Some of these weaker linear features such as **4010** and **4011** could represent lynchets rather than ditches. The date of this field system is unclear and none of the ditches can be linked to field boundaries featured on any of the maps consulted. For this reason they have been interpreted as archaeology rather than agricultural features.

3.2.2 There is a small sub-circular shaped anomaly at **4012**; this feature has magnetic values around +1.5nT with slightly weaker values along the western half. At first sight this feature appears to resemble a ring ditch but on closer inspection it looks too irregular in shape. It is possible that this anomaly is made up of two unrelated features. The stronger region has been interpreted as probable archaeology and the weaker region as possible archaeology.

3.2.3 The most noticeable features are a series of linear anomalies defined by a negative central region flanked on either side by positive responses at **4013** to **4017**. These anomalies are typical for post-medieval field boundaries found across many parts of Devon and Cornwall and study of historic maps shows that their positions relate to former field boundaries (Budgen 1801 and Ordnance Survey 1889). The anomalies at **4013** and **4015** are not recorded on the maps consulted but are considered to relate to field boundaries due to their alignment and distinctive form.

3.2.4 There are small positive anomalies scattered across the dataset such as at **4018** and **4019**; it is unclear whether these anomalies represent cut archaeological features or are natural features. These anomalies have been interpreted as possible archaeology to reflect this uncertainty.

3.2.5 There is a broad linear positive anomaly at **4020** with magnetic values over +5nT. This feature is too regular to represent a geological feature and is either related to construction of the nearby road or is a former agricultural track. Due to it possibly being relatively recent in date this anomaly has been classed as possible archaeology.

3.2.6 There are some strong geological features at **4021** and **4022**; these anomalies most likely indicate the presence of igneous geology such as the basalts recorded by BGS in the area. These geological anomalies are strong enough to mask archaeological features but only cover a small area of the Site.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 There are no modern services visible in the data although 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 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 strong geological features. The geophysical survey has revealed mainly features related to agriculture with at least two phases of landscape division detected.

4.1.2 There are at least two phases of field system present; one is relatively modern and is recorded on historic maps but the other is clearly different in both construction and alignment. This second field system is undated but is considered to be earlier than the mapped field system. The only other feature of potential interest is a sub-circular feature although it should be noted that it is possible this apparent feature is formed from more than one unrelated feature.

4.1.3 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. The geological features detected in the southeast corner of the site are considered strong enough to mask archaeological features although it should be noted that these strong geological features are restricted to a small area.

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

Budgen, T. 1801. *Bickleigh*. From the British Library Online Collection. Available at: http://www.bl.uk/onlinegallery/onlineex/ordsurvdraw/other/002osd000000005u00326000.html [Accessed: 4th July 2014].

Ordnance Survey, 1889. *Devonshire*, 1:2500.

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

5.3 Devonshire Historic Environment Records

MDV19091 – Large Mound

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.

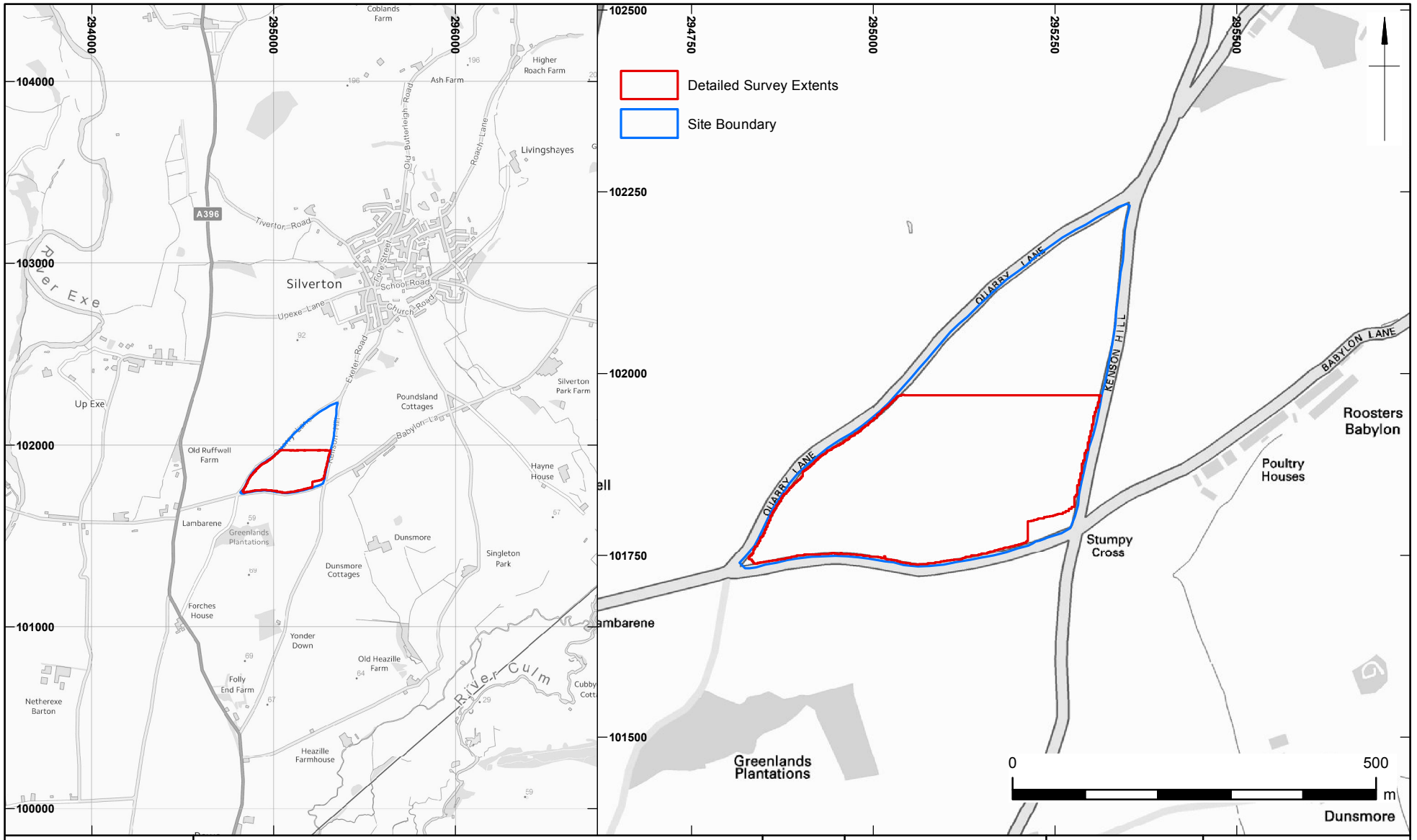
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided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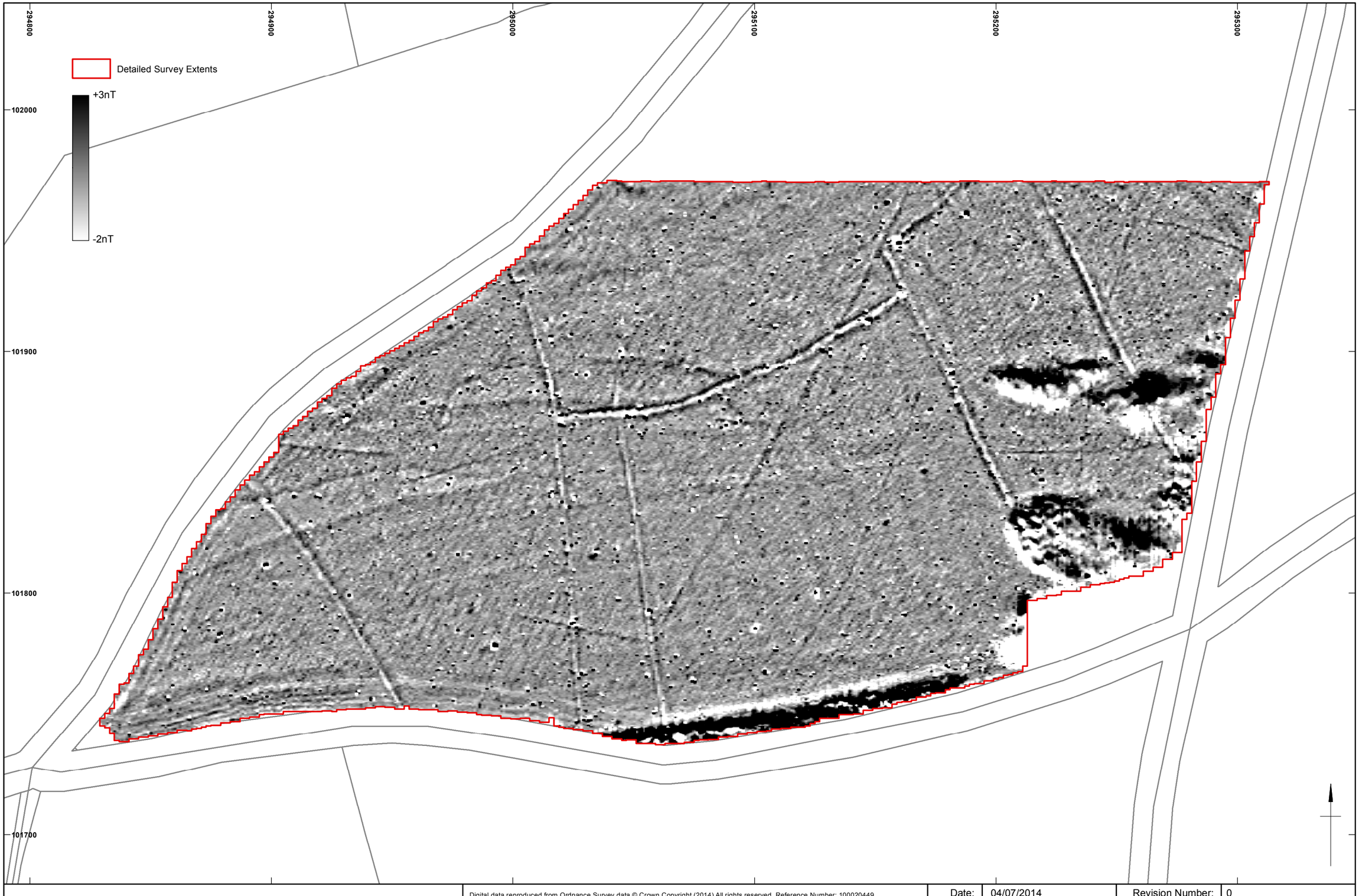
Site location and detailed survey extents

Figure 1



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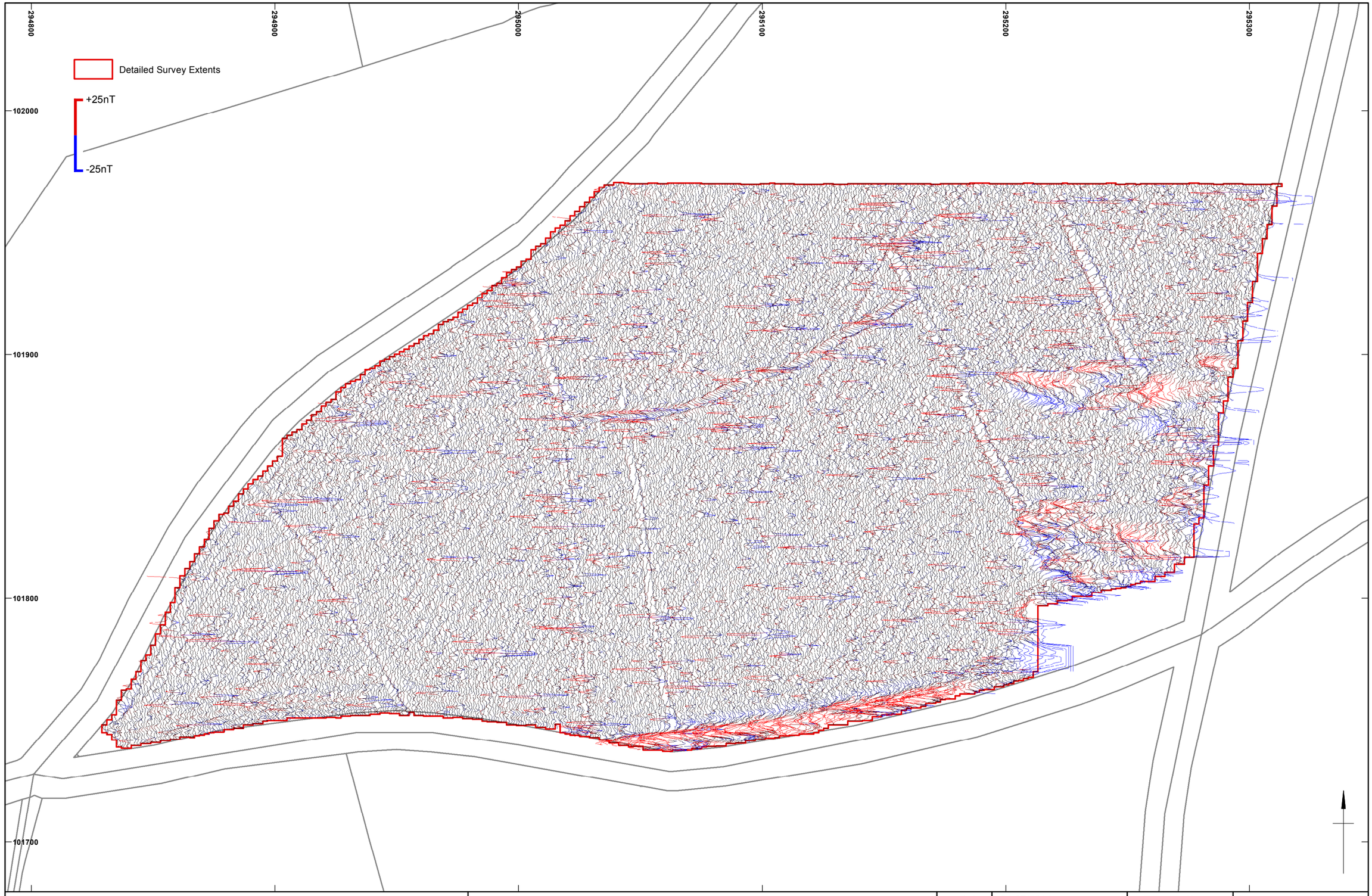
Greyscale plot

Figure 2



0 100 m

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XY trace plot

Figure 3

0 100 m

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Interpretation

Figure 4

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