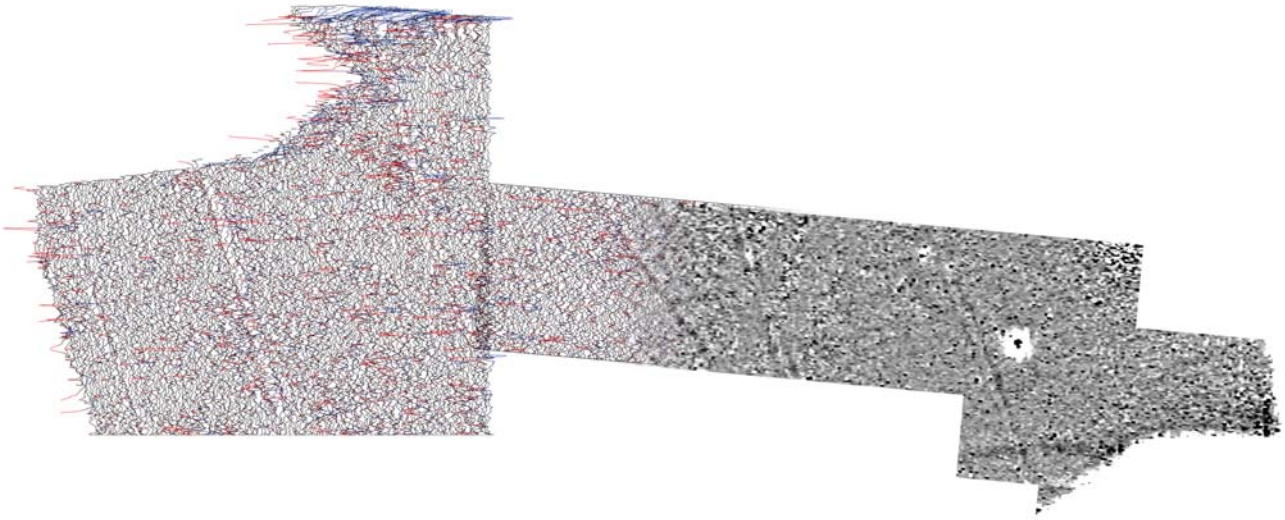
Wessex Archaeology

Exeter Science Park Drive, Exeter, Devon

Detailed Gradiometer Survey Report



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December 2010

Exeter Science Park Drive
Exeter, Devon

Detailed Gradiometer Survey Report

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Exeter Science Park Drive
Exeter, Devon

DETAILED GRADIOMETER SURVEY REPORT

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FIGURES

Exeter Science Park Drive (North and South) Exeter, Devon

DETAILED GRADIOMETER SURVEY REPORT

SUMMARY

Wessex Archaeology (WA) has been commissioned by Parsons Brinckerhoff, on behalf of Devon County Council, to undertake a programme of geophysical and metal detector survey of land within the proposed development site of Exeter Science Park. The Site was centred upon OS NGR 297340 93570 and comprised two survey areas. This phase of work is a continuation of previous surveys undertaken by WA at the Site.

The results of this survey indicate the presence of a range of anomalies of possible to definite archaeological origin. An extensive series of former field systems dominates the dataset, and are particularly clear in the area to the south of Blackhorse Lane.

Numerous amorphous anomalies appear throughout the survey areas, the majority of which exhibit relatively weak contrast with the magnetic background. Several clusters of more closely distributed anomalies are of somewhat greater potential and may indicate further field systems, although it is possible that they relate to settlement activity.

A number of regions of increased magnetic response can be observed, notably towards the outer extents of the survey areas. It is possible that these reflect changes in near-surface geology or former land use practices.

Numerous linear trends can be seen which are on similar orientations to the more obvious field systems and probably represent further phases of fields or are associated with ploughing. Other linear and curvilinear trends may be of archaeological provenance although they are only weakly magnetic.

The texture of the magnetic background varies across the site, reflecting changes in superficial geology or former land use.

Exeter Science Park Drive
Exeter, Devon

DETAILED GRADIOMETER SURVEY REPORT

ACKNOWLEDGEMENTS

The geophysical survey was commissioned by Parsons Brinckerhoff, on behalf of Devon County Council, prior to the construction of the Exeter Science Park. Wessex Archaeology would like to acknowledge the assistance of Roger North in this regard.

The fieldwork was directed by Lucy Parker and assisted by Ross Lefort. Lucy Parker processed and interpreted the geophysical data and Ben Urmston compiled this report. The geophysical survey was quality-controlled by Paul Baggaley. Illustrations were prepared by Rob Goller. The project was managed on behalf of Wessex archaeology by Abigail Rolland and Ben Urmston.

Exeter Science Park Drive
Exeter, Devon

DETAILED GRADIOMETER SURVEY REPORT

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology (WA) was commissioned by Roger North of Parsons Brinckerhoff, on behalf of Devon County Council (the Client), to undertake a programme of geophysical survey of land within the proposed Exeter Science Park; (**Figure 1**), hereafter 'the Site'. This phase of work is the second such programme of survey undertaken by WA at the Site, which is centred upon OS NGR 297340 93570 and comprises two survey areas some 200m apart.

1.1.2 The primary objective of the geophysical survey is to survey the remaining development areas still accessible and not assessed in the previous geophysical survey (WA 2010) prior to the development of the Exeter Science Park.

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 Survey areas

1.2.1 The Site falls within arable fields immediately northeast of the intersection between the A30 and the M5 at Junction 29, and was divided into two areas for the purposes of the detailed gradiometer survey.

1.2.2 Area A totals 1.6ha and lies to the north of Blackhorse Lane and west of the M5 (centre NGR 297045 93645). Area B, totalling 3.7ha, lies to the south of Blackhorse Lane and east of Honiton Road (centre 297500 93485).

1.2.3 The underlying geology is Permian sandstone (BRS 2001). The overlying soils across the site are from the Bridgnorth association which are typical brown sands. These consist of well drained sandy soils (SSEW 1983). Soils in similar geological settings have been shown to produce magnetic contrasts suitable for the detection of archaeological remains through survey with the Bartington Grad 601-2 gradiometer.

2 METHODOLOGY

2.1 Introduction

2.1.1 A geophysical specification was prepared by Wessex Archaeology to investigate the Site. The methodology consisted of detailed gradiometer survey conducted using Bartington Grad 601-2 dual gradiometer systems.

The survey was conducted in accordance with English Heritage guidelines Geophysical Survey in Archaeological Field Evaluation (2008) and the Exeter Science Park Written Scheme of Investigation (Wessex Archaeology 2010).

2.1.2 The geophysical survey was conducted by Wessex Archaeology's in-house geophysics team from 22nd to 26th November 2010. Ground conditions for survey were generally acceptable, with the majority of the Site being under arable cultivation. The majority of the survey took place in fields with maize stubble standing up to 0.4m high. The fields were separated by a combination of hedgerows and wire fencing. Parts of the proposed development area were not surveyable through the presence of a newly constructed compound and haul road.

2.1.3 Individual survey grid nodes were established at 30m x 30m intervals using a Leica Viva RTK GNSS system, which is precise to within 0.05m and therefore exceeds English Heritage recommendations.

2.1.4 The detailed gradiometer survey was conducted using Bartington Grad 601-2 gradiometer systems over 30m x 30m grids with a sample interval of 0.25m along transects spaced 1m apart. This results in 3600 logged values per complete grid. Data were collected in the zigzag manner.

2.1.5 Data from the survey was subject to minimal data correction processes. These comprise a thresholded zero-mean traverse function 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 further data filtering or interpolation.

2.1.6 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

3 RESULTS AND INTERPRETATION

3.1 Introduction

3.1.1 The geophysical survey identified a number of anomalies of definite and possible archaeological origins. Results are presented as a series of greyscale, XY trace plots and interpretation diagrams over the Site at a scale of 1:1250 (**Figures 2** to **6**).

3.1.2 The interpretation of the datasets (**Figure 5**) highlights the presence of potential archaeological anomalies, ploughing trends, ferrous/burnt or fired objects, areas of general increased magnetic response and modern services. Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.

3.1.3 The magnetic background of the Site exhibits marked granularity, resulting from the local geology and former land use. Whilst this may have masked some weaker archaeological responses, the interpreted anomalies exhibit

clear contrast with the magnetic background, thereby validating the methodology.

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. It is possible that any weaker archaeological anomalies will have been masked by these ferrous responses.

3.2 Detailed gradiometer survey results and interpretation

3.2.1 In Area A, numerous amorphous anomalies appear throughout. Anomaly **4000** abuts the field boundary and is of possible archaeological interest, although there is some magnetic disturbance caused by the boundary.

3.2.2 Complex of anomalies **4001** exhibits a greater density of responses, although the individual anomalies do not contrast strongly with the magnetic background. It is possible to discern linear trends within the distribution of these anomalies, suggesting that they may form part of a system of fields or enclosures.

3.2.3 At the southern extent of Area A, linear anomaly **4002** is possibly part of a former field boundary, although it is only weakly magnetised. At the northwestern extent, a region of increased magnetic response **4003** lies adjacent to the western boundary. It is possible that this is the result of former land use and therefore indicates the extents of a former field.

3.2.4 Elsewhere in Area A, a profusion of linear and curvilinear trends are apparent. Some of these are relatively weak magnetically and are simply chance alignments within the data. The majority that have been identified form longer and more coherent trends, however, and their alignments suggest that they relate to either former field systems or historic ploughing.

3.2.5 A former field boundary extends WSW-ENE across Area A to the south of **4003** and appears as a band of ferrous responses. It is almost certainly associated with the extant boundary forming part of the eastern border of the survey area.

3.2.6 A series of linear anomalies **4004** to **4009**, aligned NNW-SSE, dominates Area B and is likely to represent former field systems. Further curvilinear anomalies **4010** to **4012** are somewhat less well defined but are probably associated with these field systems, given that their alignments are approximately perpendicular to **4004** - **4009**.

3.2.7 Numerous amorphous anomalies of possible archaeological interest are distributed randomly throughout Area B. Two clusters of more densely packed responses, **4013** and **4014**, are somewhat more likely to be archaeological in provenance, given their more coherent distribution.

3.2.8 Two region of increased magnetic response, **4015** and **4016**, appear at the eastern extent of Area B. These responses are consistent with the effects of former land use or the presence of modern dumped material.

3.2.9 Numerous linear and curvilinear trends are apparent within the dataset from Area B and many are likely to indicate former ploughing, especially those oriented WNW-ESE. Several are much longer and consistent, however, such as those oriented approximately E-W through the centre of Area B. These are perhaps associated with a different phase field systems from the

more obvious anomalies described above, although the chronological relationship is not clear should this be the case.

4 CONCLUSION

4.1 Introduction

4.1.1 The geophysical survey has been successful in identifying anomalies of definite, probable and possible archaeological interest, and can therefore be considered to have successfully fulfilled the aims as set out in the geophysical specification. Numerous isolated anomalies, weak trends and regions of increased magnetic response have also been identified.

4.1.2 There appear to be several extensive field systems across the Site, the most obvious of which lie in Area B. The relationship and chronology of these enclosures is uncertain from the geophysical data alone.

4.1.3 Several clusters of anomalies of possible archaeological interest can be observed in Areas A and B. Given the relative density of responses in these areas, it is thought that these are more likely to be archaeological than isolated pit-like anomalies.

4.1.4 Numerous linear and curvilinear trends appear throughout the datasets, of which many are thought to relate to former field systems. The longest and most continuous of these trends are perhaps indicative of former boundaries. Other curvilinear trends may be of some archaeological interest, although they exhibit only weak contrast with the magnetic background.

4.1.5 Several regions of increased magnetic response have been identified in the survey areas, which are probably the result of either superficial geological changes or former land use. These effects are likely to be the cause of the variability seen within the magnetic background of the Site and the resulting granularity of the magnetic 'texture'.

5 REFERENCES

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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 GNSS instrument and then extended using tapes. The Leica Viva GNSS receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined to an accuracy of c. 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 detail 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 complete 20m or 30m grid respectively, and are the recommended methodologies for archaeological surveys of this type (English Heritage, 2008).

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 forward or backward 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 image can include a hidden line algorithm to remove certain lines and enhance the image. This type of image is useful as it shows the full range and shape 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.

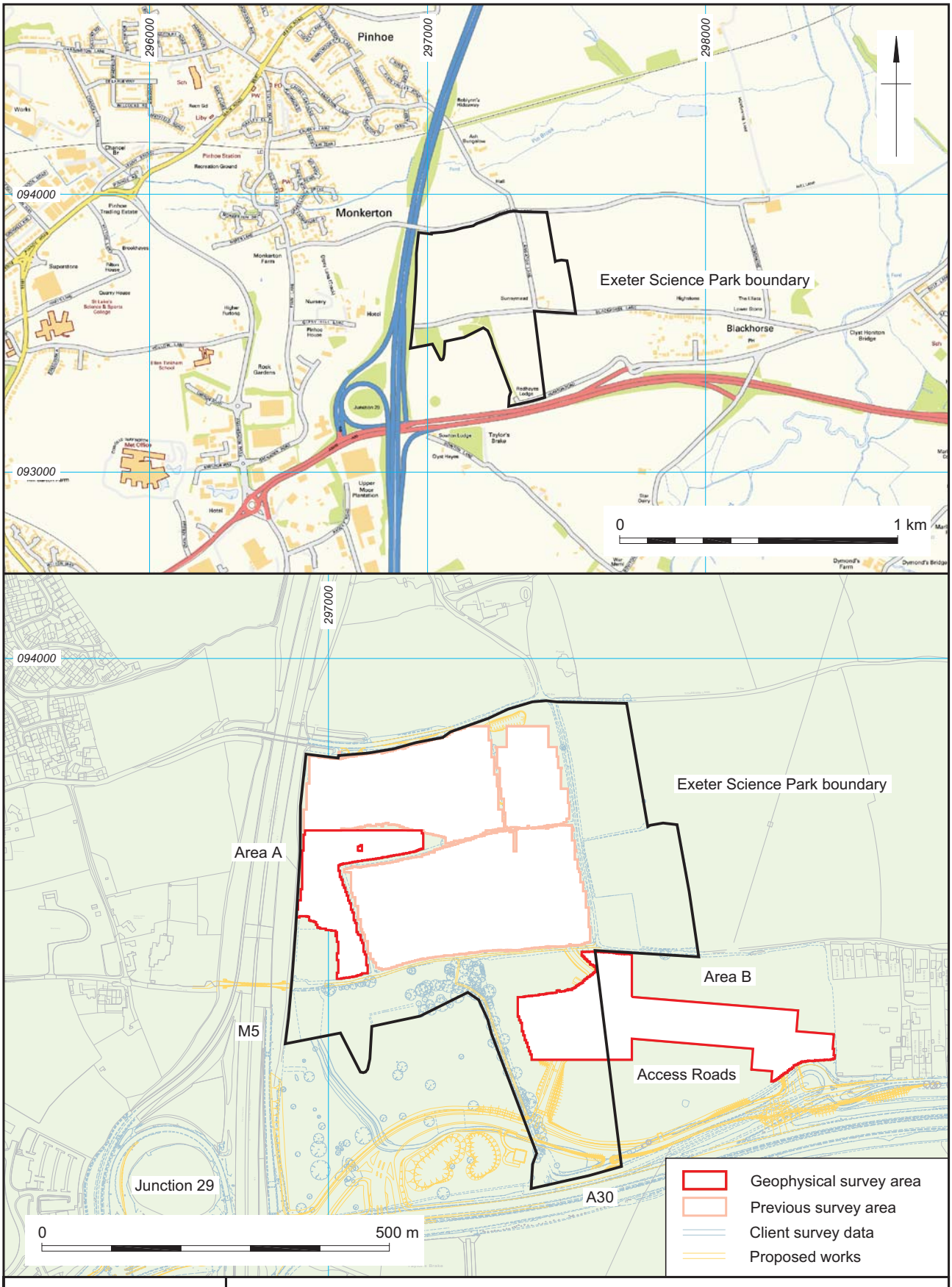
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided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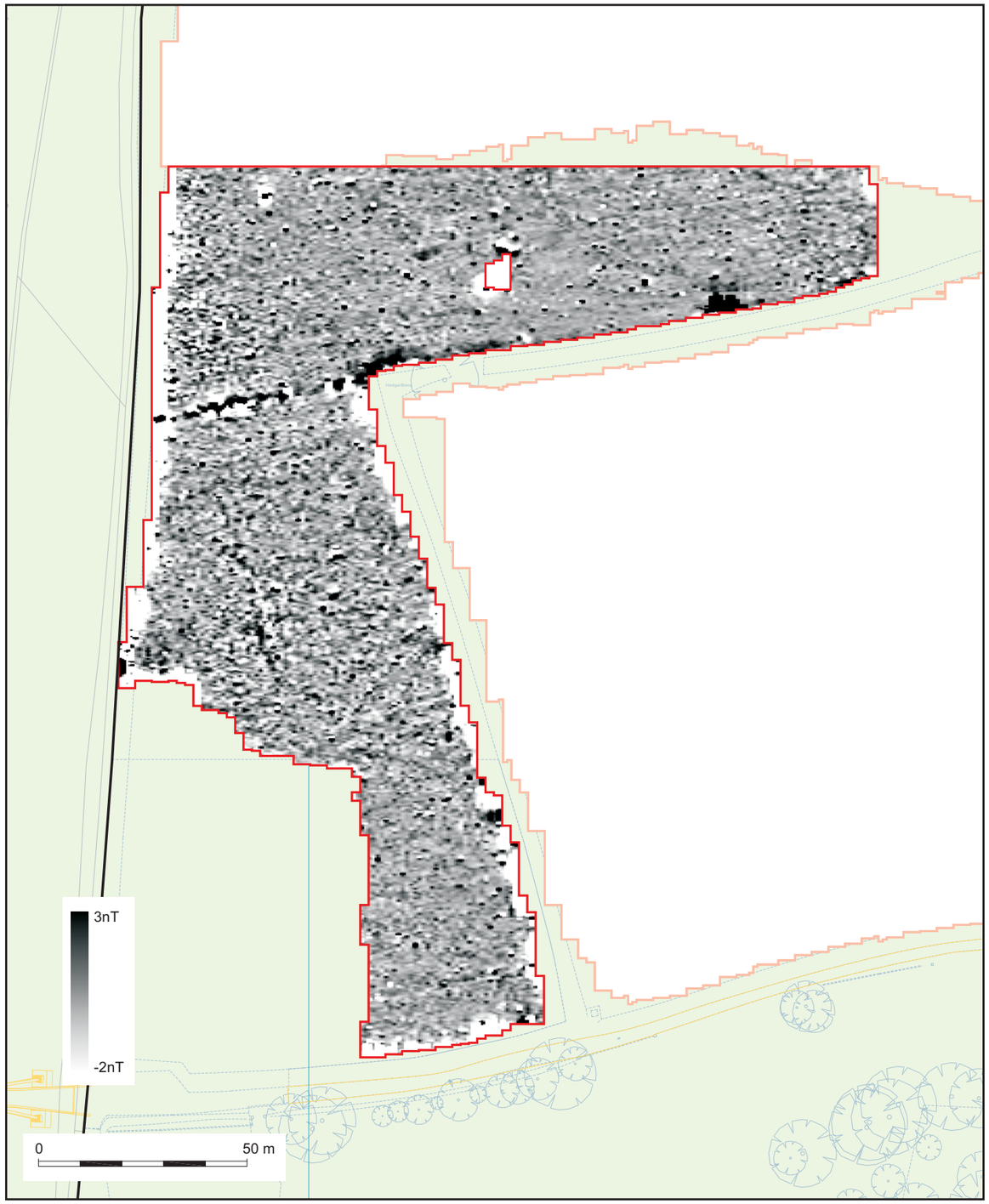
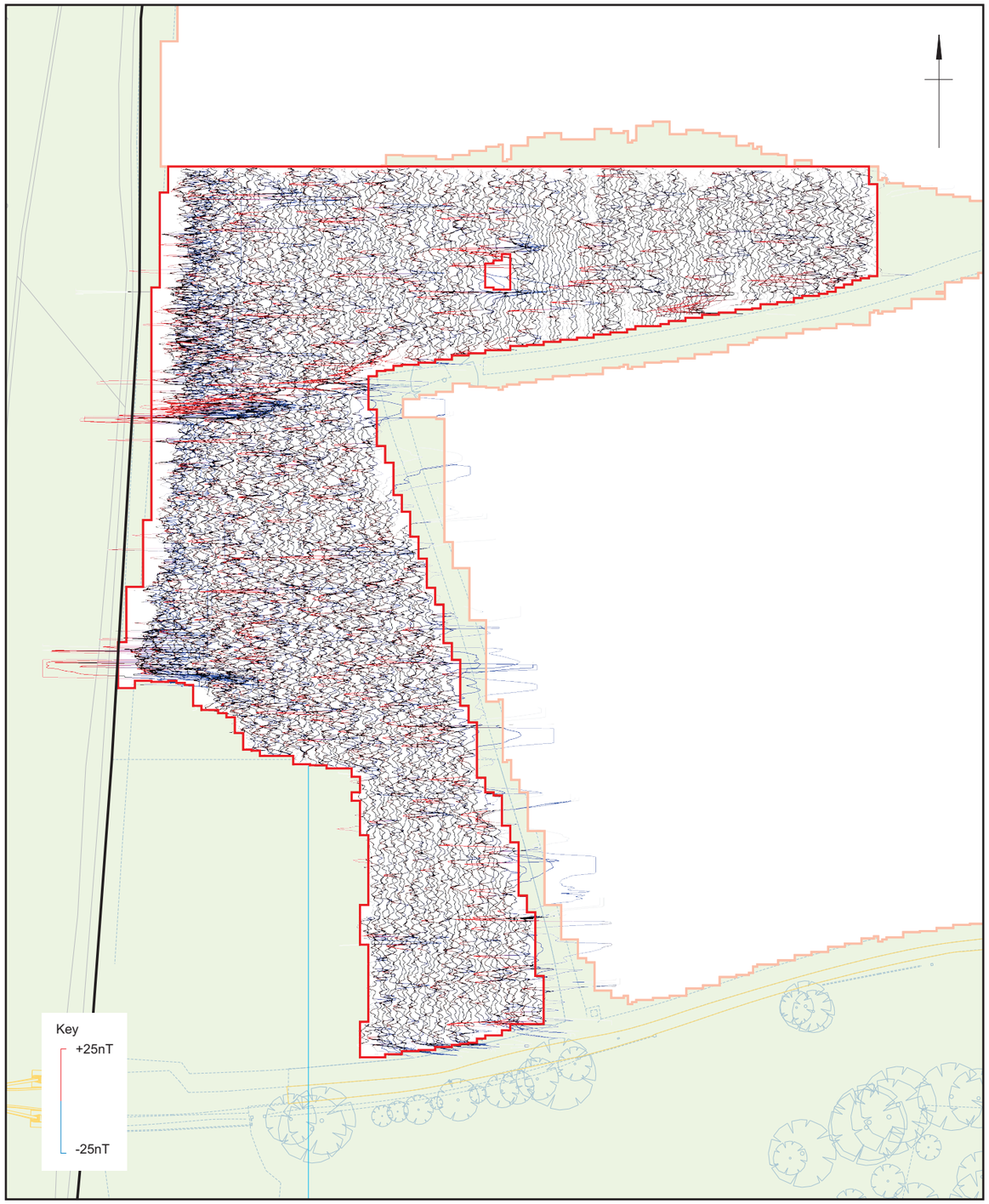
Wessex Archaeology

Site location and survey extents

Figure 1





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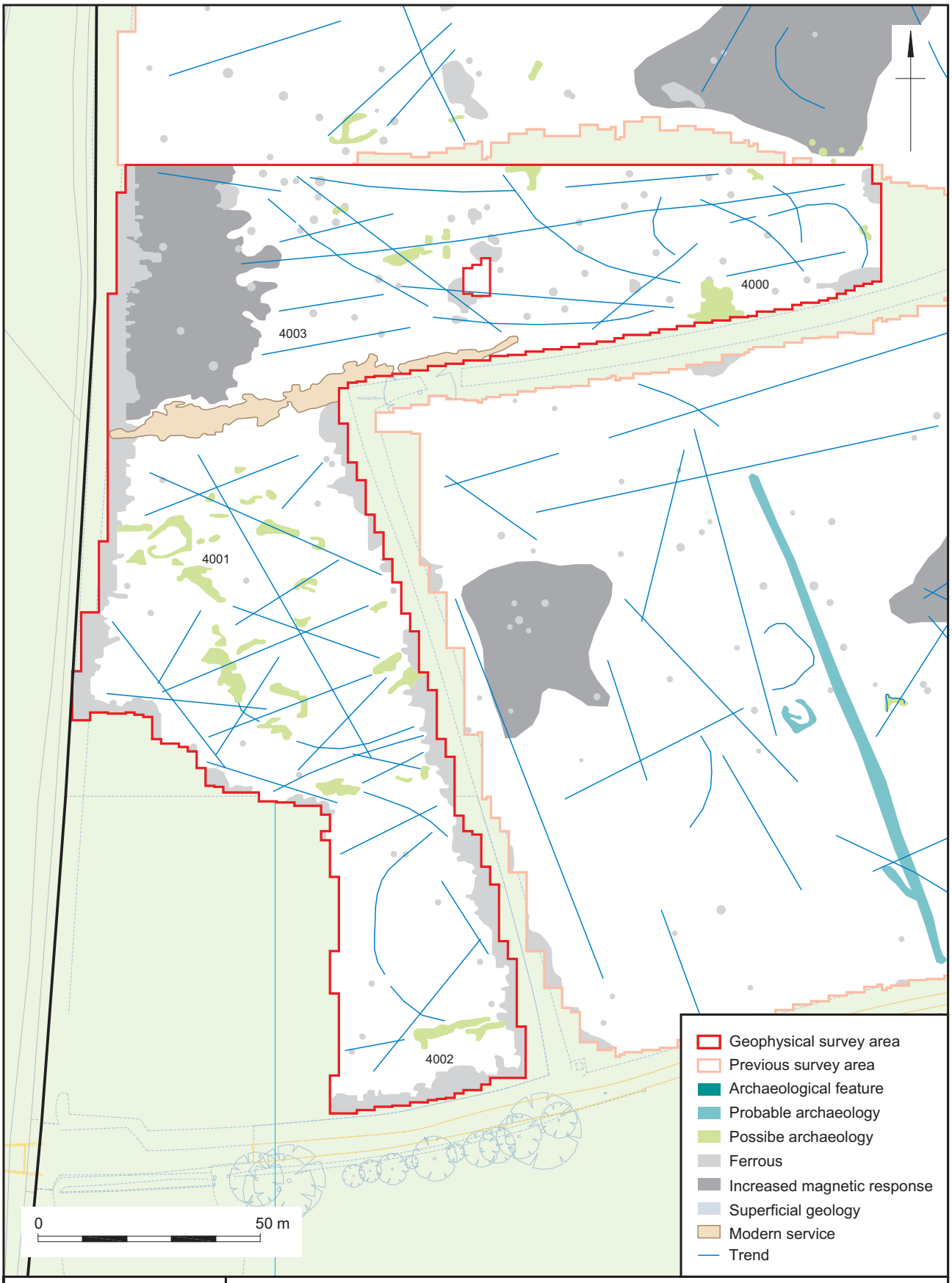
Greyscale and XY trace plots Area A

Figure 2



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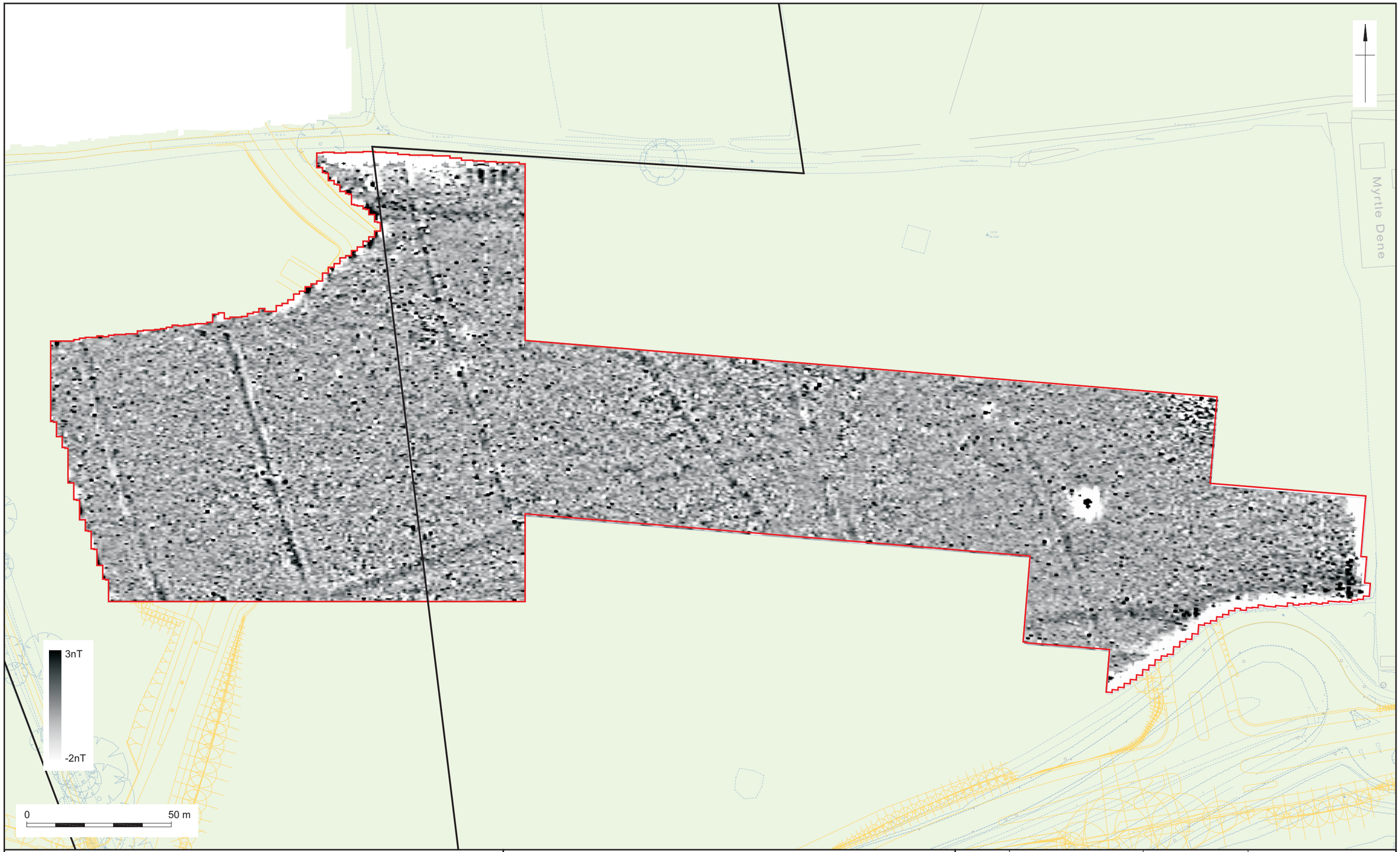
Area A interpretation

Figure 3



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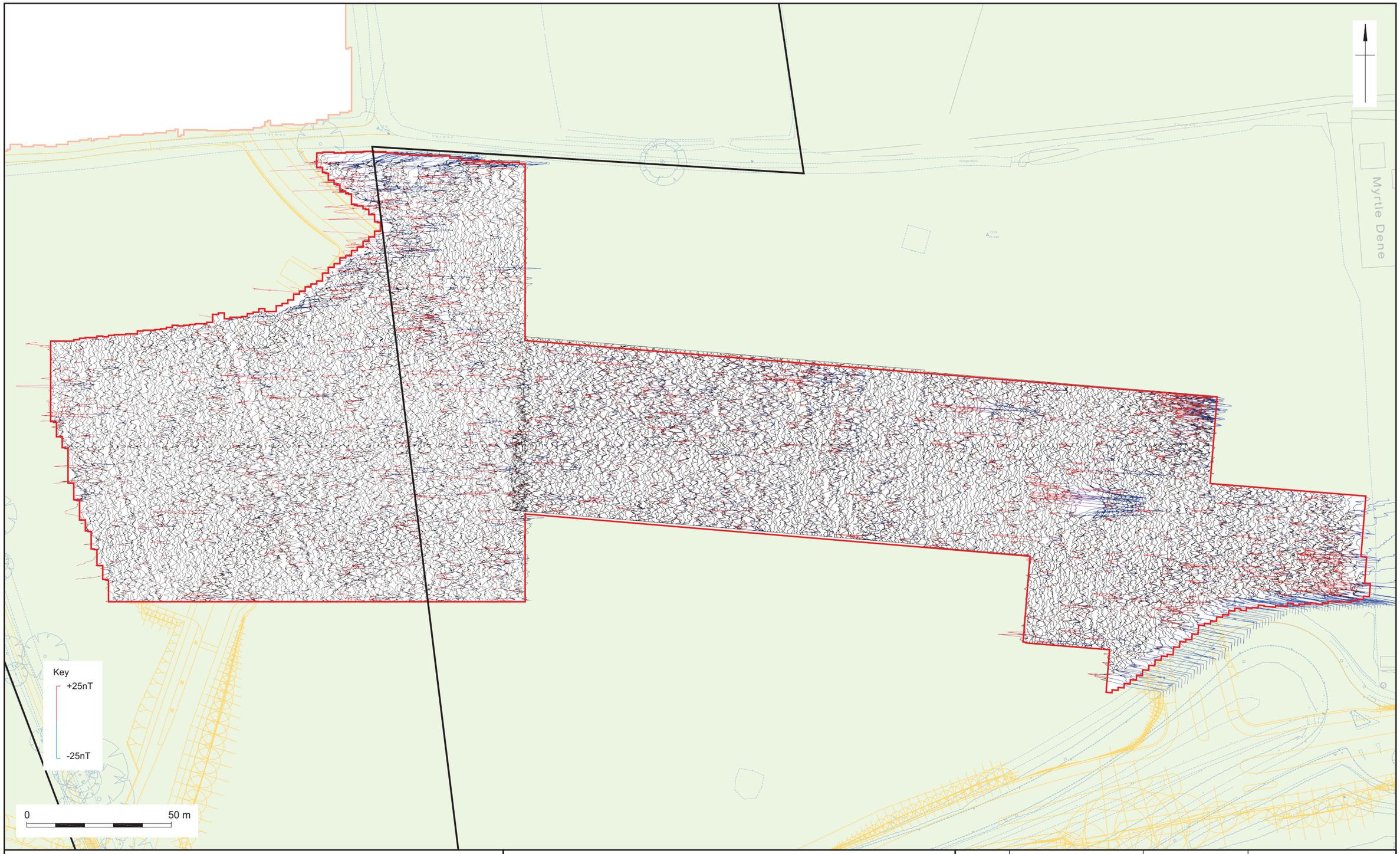
Greyscale trace plot Area B

Figure 4



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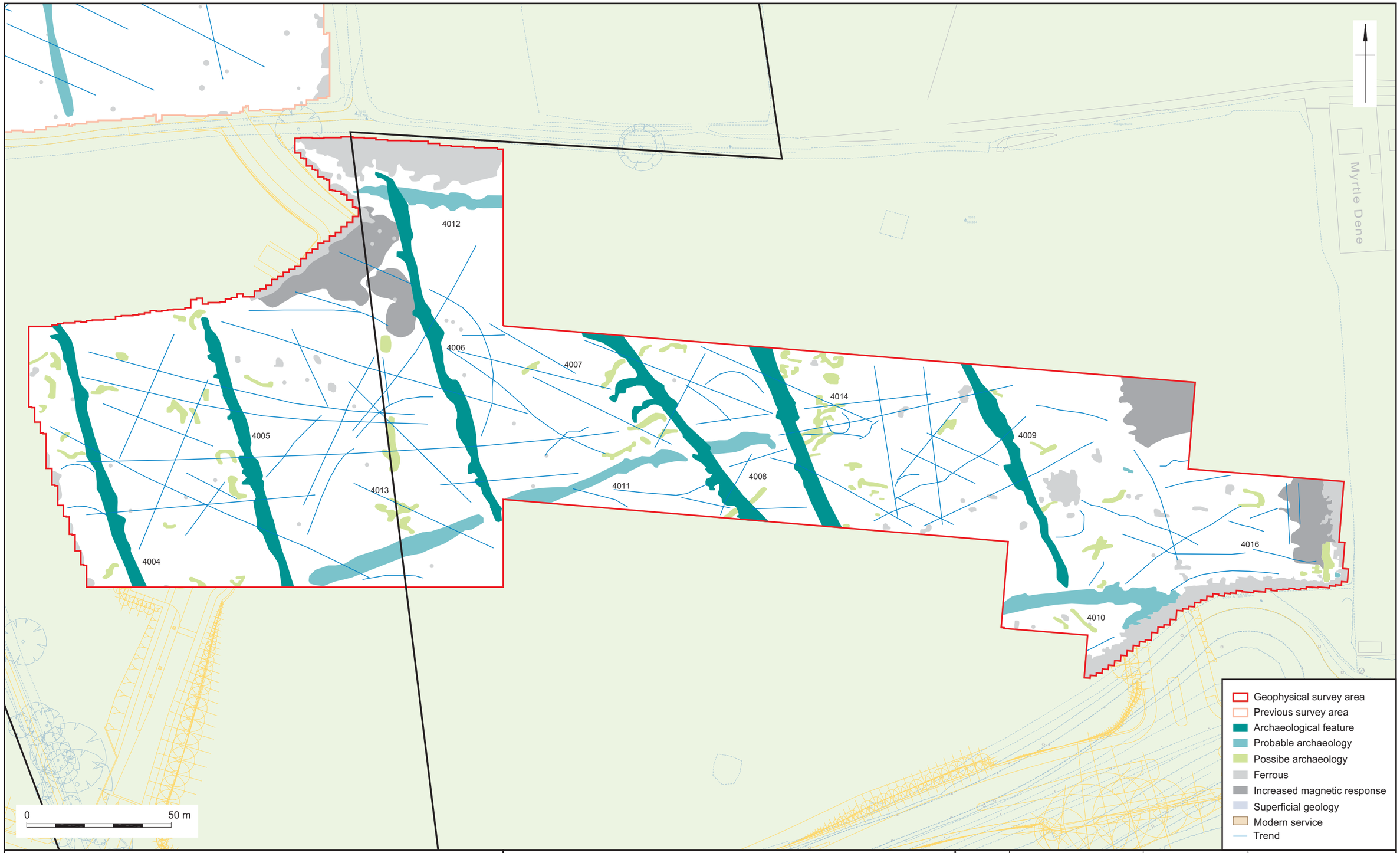
XY trace plot Area B

Figure 5



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Area B interpretation

Figure 6

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