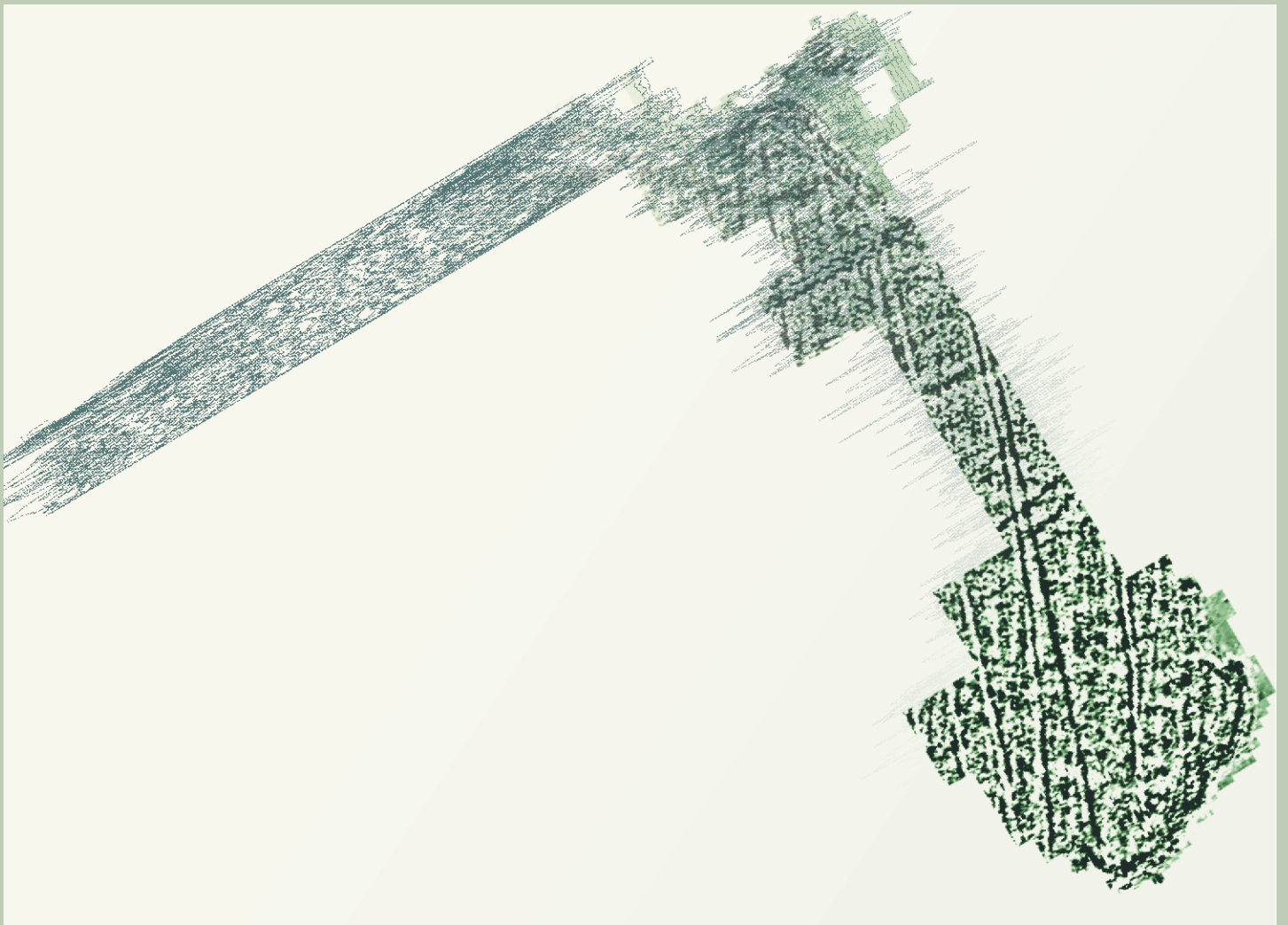




Land at Bickham Moor
Devonshire

Detailed Gradiometer Survey Report



BICKHAM MOOR

DEVONSHIRE

Detailed Gradiometer Survey Report

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Summary

Wessex Archaeology was commissioned by CgMs Consulting, on behalf of their client PMSS, to conduct geophysical survey on land at Bickham Moor, Devonshire, ahead of a proposed development centred on NGR 286600 121500. An area of 7.5ha survey was required for the proposed development, however to simplify fieldwork operations WA defined a total area of 11ha for surveying. Of this proposed total 9ha were suitable for detailed gradiometer survey, the remainder of the land being under dense vegetation.

The geophysical survey identified linear anomalies of possible archaeology along with numerous, weaker, linear trends. It is difficult to provide a definite interpretation of these features although they are likely to be former field boundaries or ditches. These features are thought likely to continue beyond the extents of the geophysical survey.

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Acknowledgements

The detailed gradiometer survey was commissioned by CgMs Consulting, on behalf of their client PMSS. The assistance of Rob Bourn and Sally Dicks is gratefully acknowledged.

The fieldwork was directed by Ben Urmston, and assisted by Daniel Tarrant, Jonathan Pettitt and Robert Fry. Ben Urmston processed and interpreted the geophysical data and wrote this report. The geophysical work was managed and quality controlled by Paul Baggaley. Illustrations were prepared by Karen Nichols. The project was managed on behalf of Wessex Archaeology by Paul Baggaley.

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Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

- 1.1.1 Wessex Archaeology was commissioned by CgMs Consulting, on behalf of their client PMSS, to undertake a geophysical survey on land at Bickham Moor, Devonshire (**Figure 1**), centred on NGR 286600 121500 (hereafter 'the Site'). The proposed development is a windfarm comprising four turbines, an anemometry mast, sub station and a construction compound all connected via access tracks.
- 1.1.2 The aim of the project was to conduct a geophysical survey to establish the presence/absence, extent, character and date of archaeological remains at the Site.
- 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 A total area of 7.5ha was required to be surveyed for the development, however due to the changing orientations of the access tracks a total area of 11ha was selected for surveying by WA to simplify field operations (**Figure 1**).
- 1.2.2 Of the approximate 11ha proposed for surveying, 9ha was suitable for assessment using geophysics equipment and this area was subjected to detailed gradiometer survey. The remainder of the Site was precluded from the survey by dense vegetation or waterlogged ground conditions, typically near field boundaries.
- 1.2.3 The three northern most turbine locations for the Site lie along one ridge with a valley to the south. The fourth turbine location is further to the south on a second ridge. The land was used for pasture although some areas, particularly near field boundaries, were covered by dense vegetation and could not be surveyed.
- 1.2.4 The superficial drift geology underlying the Site largely comprises the typical pelo-stagnogleyic soils of the 712e Hallsworth 2 association (SSEW 1983). These soils are likely to have a moderate to high iron content, but the exact mineral form will depend on the local conditions; the iron ions tend to form layers of non-magnetic panning, especially in water-logged and mire

conditions These soils are likely to produce a magnetic contrast suitable for identification of archaeological remains through survey with the Bartington Grad 601-2 gradiometer.

2 METHODOLOGY

2.1 Introduction

2.1.1 The methodology employed for the Site comprised detailed gradiometer survey using a Bartington Grad 601-2 dual gradiometer system in accordance with English Heritage *Guidelines for Geophysical Surveys* (1995).

2.2 Detailed survey

2.2.1 The detailed survey was conducted by Wessex Archaeology's in-house geophysics team in accordance with English Heritage Guidelines and was undertaken between the 29th April and 1st May 2008. Survey grids were established at 30m x 30m using a Leica 1200 RTK GPS system, which is able to provide locations in real-time, accurate to within 2cm, and therefore exceeds English Heritage recommendations (*ibid.*).

2.2.2 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 anthropogenic origin and the results are presented as greyscale and XY trace plots (**Figure 2**). The results are discussed numerically.

3.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, trends, ferrous/burnt or fired objects, areas of general increased magnetic response, and anomalies of probable geological origin (**Figure 3**). Full definitions of these terms are provided in **Appendix 2**.

3.1.3 A few small-scale ferrous anomalies are visible throughout the detailed survey dataset. These are presumed to be modern in provenance and are not referred to in the interpretation, unless considered relevant to the archaeological interpretation.

3.1.4 In addition to this a few areas of ferrous responses were delimited, particularly in the western and central areas of the Site. These features are of modern origin and are related to modern gates, field boundaries and areas of hardcore.

3.1.5 The site generally gave very strong magnetic responses, however in some areas the responses were markedly quieter. This is particularly noticeable in the area of the turbine at the north of the Site. Due to the limited areas

surveyed it is not possible to state whether these areas are showing an absence of features or reflecting a localised change in geological conditions.

3.2 Detailed survey results and interpretation

3.2.1 The anomalies across the Site can be discussed in two distinct groups: possible archaeology and trends.

3.2.2 Relatively strong linear responses have been classified a possible archaeology due to their magnitude and extent. These features are particularly dense towards the northeast of the Site and were also detected in southern and central areas of the site. These features are mainly orientated north-south or northeast-southwest and are thought to represent either former field boundaries or ditches and as such their archaeological significance at this Site is unclear. However, these features are clearly extensive and continue beyond the survey extents.

3.2.3 In addition to the possible archaeology there were numerous, weaker, linear trends with similar orientations and possibly have similar origins.

3.2.4 An alternative interpretation of some of these linear trends is that they may be due to the presence of ceramic drainages pipes in the field, however WA has not been able to confirm this possible interpretation with the landowner.

4 CONCLUSION

4.1 Introduction

4.1.1 A detailed survey was carried out over approximately 9ha at the Site. The rest of the land was not suitable for geophysical survey, as it was under dense vegetation.

4.2 Conclusions

4.2.1 Numerous linear anomalies were identified as possible archaeology or trends although their significance at this site can not be determined. However, these features are extensive and are thought to continue beyond the survey extents.

4.2.2 It is not possible to provide a definite interpretation for these features are likely to be former field boundaries or ditches although it is possible that some of them may be related to modern ceramic drainage systems.

5 REFERENCES

English Heritage, 1995. *Geophysical survey in archaeological field evaluation*. Research and Professional Service Guideline No 1.

Soil Survey of England and Wales, 1983. *Soils of South East England: Sheet 6*. Ordnance Survey, Southampton.

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 a resolution of 0.1nT over a ± 3000 nT 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 1200 RTK GPS system and then extended using tapes. The Leica 1200 RTK GPS system 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 1-2cm in real-time and therefore exceed the level of accuracy recommended by English Heritage (1995) 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 30m x 30m grids, and data are collected at 0.25m intervals along traverses spaced 1m apart. This gives 3600 measurements per grid and is the recommended methodology for archaeological surveys of this type (English Heritage, 1995).

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;
- Clipping – Limiting the displayed range of the processed data to either $\pm 3nT$ or $\pm 3s.d.$ in order to enhance the appearance of smaller anomalies.
- Despike – Filtering any data points that exceed the mean by a specified amount to reduce the appearance of dominant anomalous readings caused by modern, small ferrous objects at the surface

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:

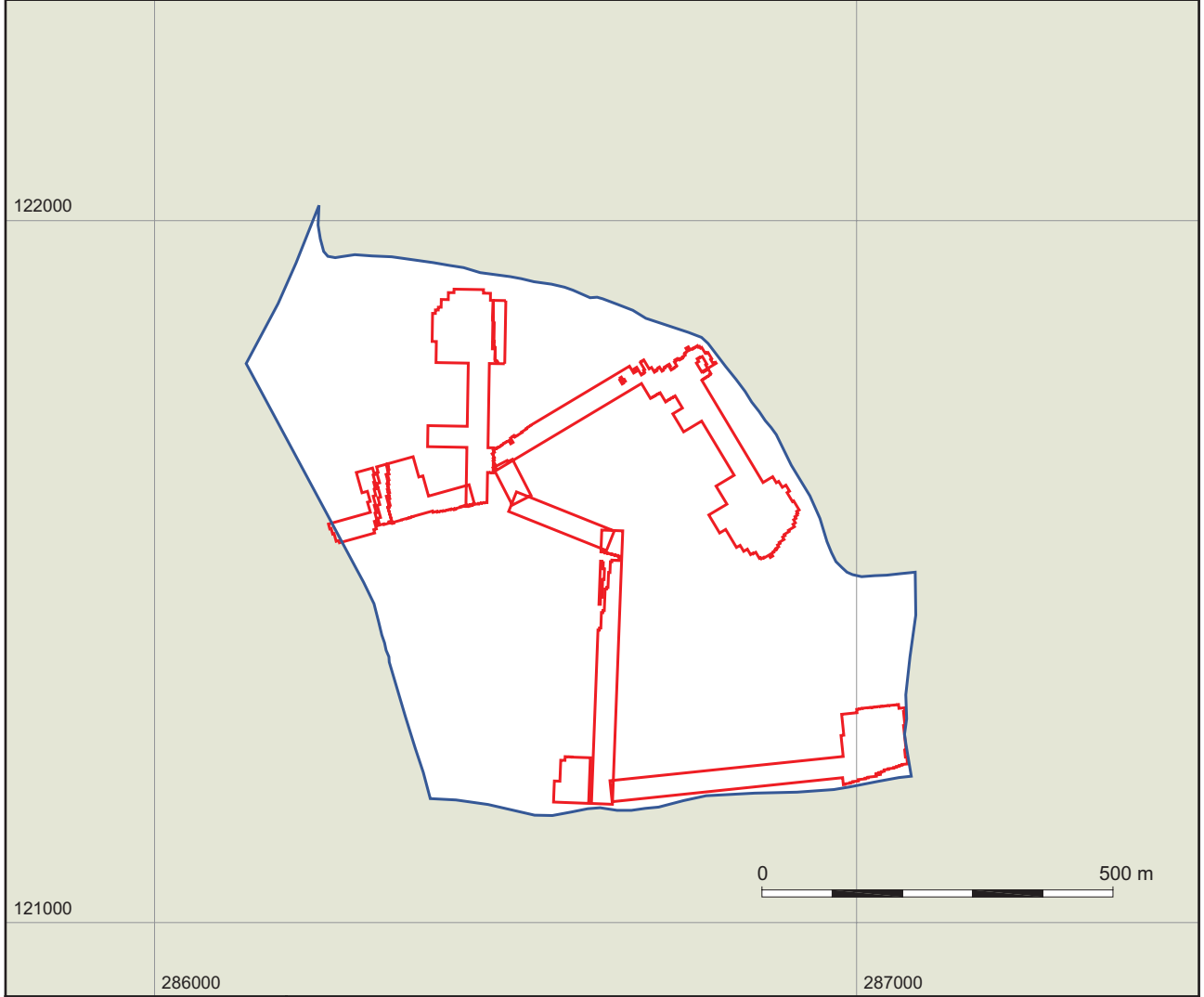
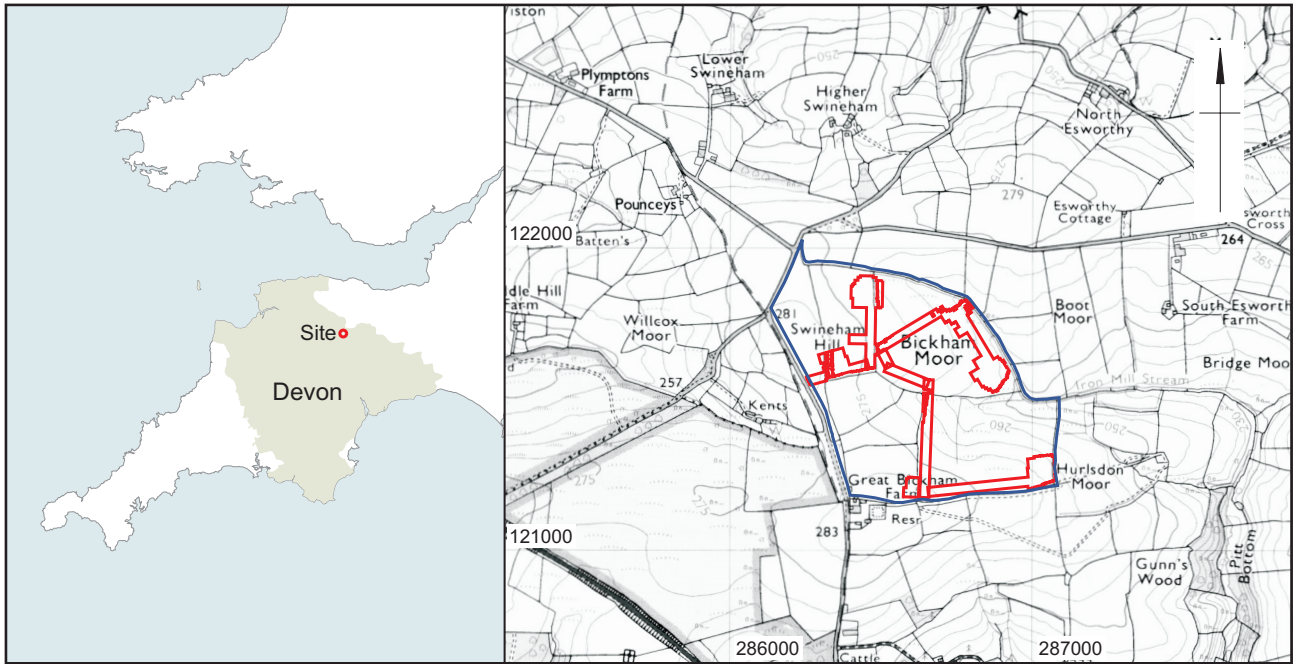
- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Probable archaeology – used for features which give a clear response but which form incomplete patterns.

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:

- Possible archaeology – used for features which give a response but which form no discernable pattern or trend.
- 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

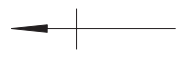
Figure 1



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Greyscale plot and XY trace

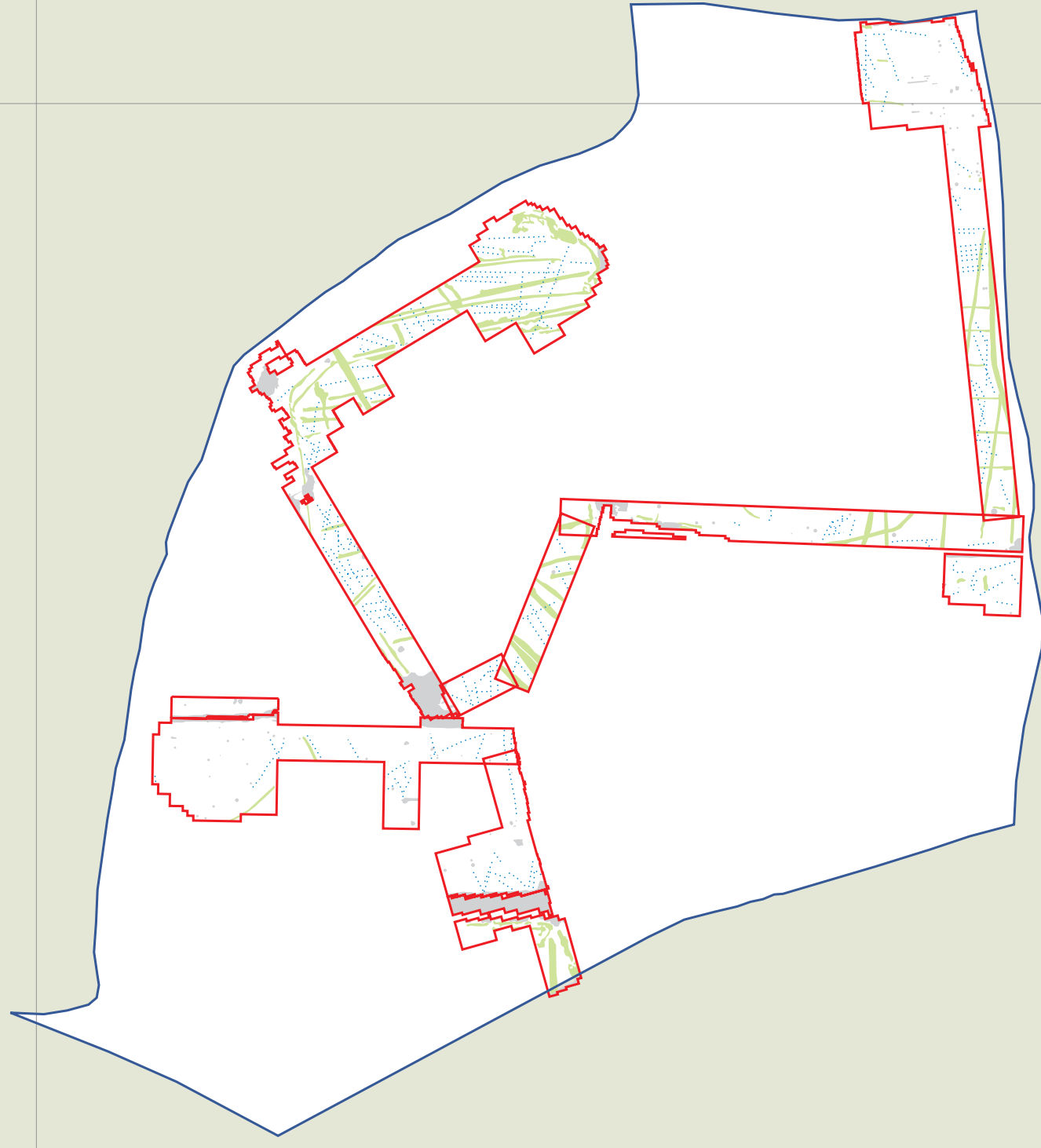
Figure 2



- Site boundary
- Survey extents
- Possible archaeology
- Trend
- Ferrous

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