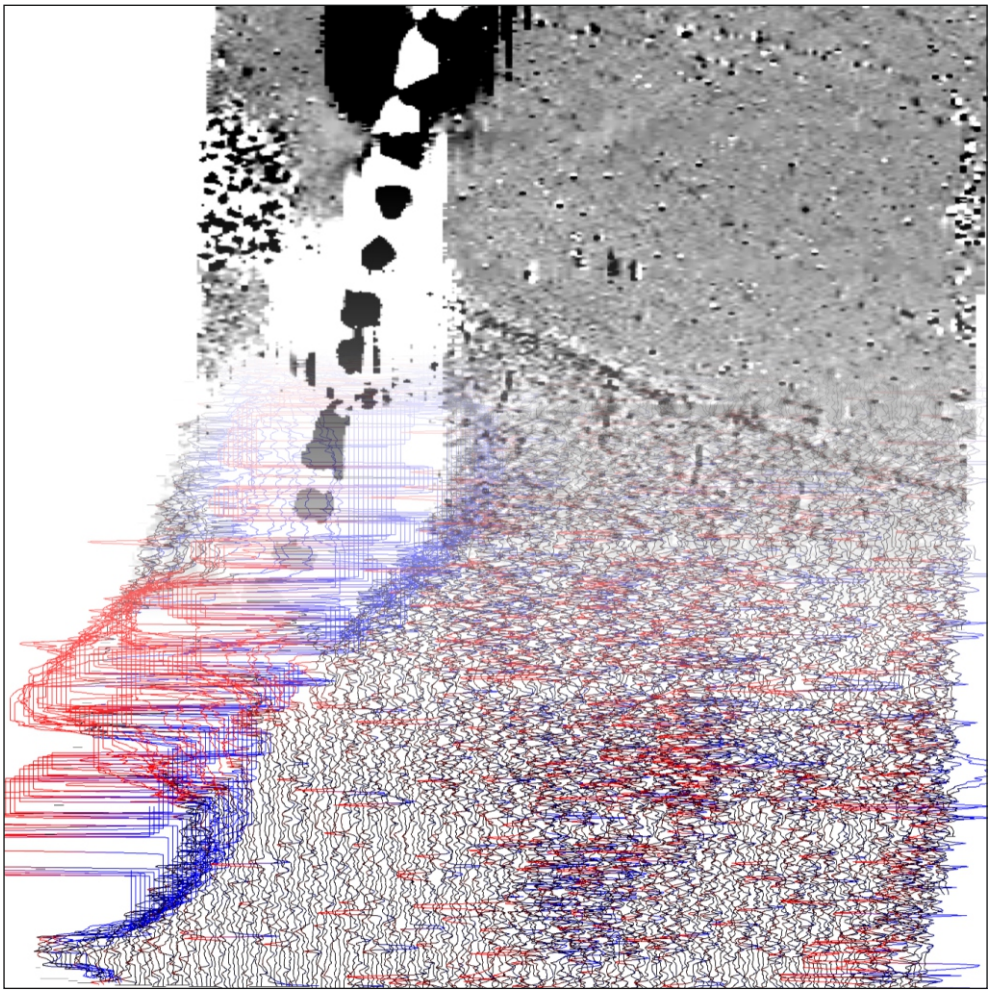
making sense of heritage

Heskin Old Hall Solar Farm, Chorley, Lancashire

Detailed Gradiometer Survey Report



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geoservices

Heskin Old Hall Solar Farm
Chorley, Lancashire

Detailed Gradiometer Survey Report

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Chorley, Lancashire

Detailed Gradiometer Survey Report

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Detailed Gradiometer Survey Report

Summary

A detailed gradiometer survey was conducted over land off Hall Green Lane, near Chorley, Lancashire, centred on NGR 351275, 415000. The project was commissioned by MSP Heskin Limited with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features on the site ahead of the proposed development of a solar farm.

The Site comprises three arable fields located to the east of Salt Pit Farm, 2km SSW of Eccleston and 7.5km WSW of Chorley. The site occupies a relatively flat area of land with a gentle slope towards the northwest. The gradiometer survey covered 15.2ha and has demonstrated the presence of a few anomalies of probable and possible archaeological interest within the survey area, along with agricultural features, regions of increased magnetic response and at least one modern service (an underground high pressure gas pipeline).

The most interesting features detected include two pit-like anomalies, an isolated linear ditch and two ring shaped features that have all been classed as probable archaeology. The remaining features detected relate to agricultural activity with ceramic field drains, former field boundaries and numerous ploughing trends detected.

The survey was undertaken between 27 and 30 October 2014 by Wessex Archaeology's in-house geophysics team.

Heskin Old Hall Solar Farm
Chorley, Lancashire

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by MSP Heskin Limited. The assistance of Chris Brake is gratefully acknowledged in this regard.

The fieldwork was undertaken by Philip Roberts, Natasha Brett and Matthew Tooke. Ross Lefort processed the geophysical data which was interpreted by Ross Lefort and Alistair Salisbury. This report was written by Ross Lefort. The geophysical work was quality controlled by Dr. Paul Baggaley. Illustrations were prepared by Ross Lefort and Linda Coleman. The project was managed on behalf of Wessex Archaeology by Caroline Budd.

Heskin Old Hall Solar Farm
Chorley, Lancashire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project Background

1.1.1 Wessex Archaeology was commissioned by MSP Heskin Limited (the Applicant) to carry out a geophysical survey on land off Hall Green Lane, near Chorley, Lancashire (**Figure 1**), hereafter "the Site" (centred on NGR 351275, 415000). The aim of the geophysical survey was to establish the presence/absence, extent and character of detectable archaeological remains within the survey area in advance of a proposed solar farm development.

1.1.2 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 three arable fields to the east of Salt Pit Farm less than 2km SSW of Eccleston and approximately 7.5km WSW of the centre of Chorley (**Figure 1**). Detailed gradiometer survey was undertaken over all accessible parts of the Site with a total of 15.2ha surveyed.

1.2.2 The Site occupies a relatively flat area of land with a gentle slope towards the northwest. The area lies at a height between 45m and 40m above Ordnance Datum (aOD). The survey extents are defined by field boundaries to the south, east and west and by the limit of the proposed development to the north. The nearest watercourse is an unnamed stream flowing east past the south of the Site toward the River Douglas.

1.3 Soils and Geology

1.3.1 The bedrock geology under most of the the Site is recorded as Sherwood sandstone group and dates to the Triassic and Permian periods. There is a possibility of some Brooksbottoms grit sandstone lying under the eastern edge of the Site and this rock formation dates to the Carboniferous period. Superficial deposits of till (diamicton) are recorded under the Site (BGS).

1.3.2 The soils underlying the Site are likely to be typical stagnogley soils of the 711m (Salop) 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 A Desk-Based Assessment (DBA) was prepared by Wessex Archaeology (2014). This revealed few designated heritage assets within or close to the Site boundary with the closest record relating to a 19th century salt works. The assessment concluded that there

is an archaeological interest within the Site. The results of this DBA will be referred to, where relevant, in the interpretation of the geophysical data.

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 under the direction of Wessex Archaeology in two phases between 27 and 30 October 2014. Field conditions at the time of the survey were good with firm conditions under foot. A total of 15.2ha of a possible 15.1ha was surveyed; some of the data runs beyond the northern limit of the proposed development which explains the higher value for data collected.

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, a deslope function to remove minor grid edge discontinuities and a de-step function to account for variations in traverse position due to varying ground cover and topography. 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 a few anomalies of probable and possible archaeological interest although the majority of the detected features appear to relate to agricultural and modern activity. 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 1:2000 (**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.

3.1.3 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**.

3.1.4 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 There are numerous small positive sub-oval shaped anomalies scattered throughout the dataset; most are classed as possible archaeology due to the likelihood of them relating to modern or geological activity. There are two exceptions at **4000** and **4001** that look very pit-like in the XY trace plots (**Figure 3**) and have been classed as probable archaeology. Both measure around 3m in length and have positive magnetic values over +3nT and are considered to represent pits.

3.2.2 An isolated section of ditch can be seen at **4002** that does not appear to relate to an agricultural feature based on its position and alignment. The function of this feature is unclear and has been classed as probable archaeology.

3.2.3 Two annular anomalies can be seen at **4003** and **4004** and both have varying magnetic values around their circuits. The strongest regions (defined as probable archaeology) measure around +1.5nT with the weakest regions (defined as trends) measuring around +0.5nT. The function of these features is unknown but their regular shapes suggest they are anthropogenic rather than geological.

3.2.4 A number of concentrated areas of ferrous responses have been interpreted as quarry pits at **4005** to **4008**. These features appear on the 1837 tithe map consulted in the DBA with **4005** to **4007** appearing as ponds with **4008** shown as an infilled feature. The pit at **4008** is marked on the 1849 first edition Ordnance Survey (OS) map as a salt pit. It is possible that **4005** to **4007** did not ever relate to quarrying and were dug for agricultural needs. All of these features appear to have been filled with highly magnetic material after they had gone out of use.

3.2.5 Several former field boundaries have been detected that can be correlated with historic maps consulted in the DBA at **4009** to **4012**. Most of these responses appear as ditches although **4011** is defined by a dense concentration of ferrous responses. A ditch runs parallel to the west of **4011** and several short ditches run perpendicular to the south side of **4012**; these do not feature on any of the historic maps consulted. These features may represent some other agricultural features such as drainage ditches.

3.2.6 There are some wide spreads of increased magnetic response in the data such as at **4013**. These spreads are confined to particular fields and are likely to be the result of material added as part of agricultural/industrial use of these areas.

3.2.7 There are numerous weak linear trends running through the entire dataset such as at **4014** and **4015**; the function and identity of these anomalies is unclear and they are regarded as being of uncertain origin.

3.2.8 Ceramic field drains can be seen in many areas of the dataset at **4016** to **4018** and are likely to be of a fairly recent date.

3.2.9 A modern service can be seen in the data at **4019**; this feature will be discussed in more detail in the next section of the report. A pair of parallel trends at **4020** is created by the effect from overhead power lines and is not an effect of a buried feature.

3.2.10 There are a number of small sub-oval shaped positive anomalies of possible archaeological interest scattered across the dataset. These anomalies could represent cut archaeological features such as postholes but could equally relate to natural features or deeply buried ferrous objects; as there is no significant patterning in their spatial distribution these features are considered to be of low archaeological potential.

3.3 Gradiometer Survey Results and Interpretation: Modern Services

3.3.1 One modern service has been identified in the geophysical data at **4019** which continues beyond the limits of the survey area. This service appears to represent an underground pipeline, although its exact 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 gradiometer survey has been successful in identifying a few anomalies of probable and possible archaeological interest although the majority of the detected features appear to relate to agricultural and modern activity. Regions of increased magnetic response and at least one modern service have also been detected.

4.1.2 The most interesting features detected are the pits at **4000** and **4001**, the isolated ditch at **4002** and the ring features at **4003** and **4004**. All of these features are classed as probable archaeology and may prove to be of greater archaeological significance.

4.1.3 The remaining anomalies relate to modern and agricultural activity with ceramic field drains, former field boundaries, a modern service and numerous ploughing trends detected.

4.1.4 Dense spreads of ferrous responses have been observed over various parts of the three survey areas. These ferrous anomalies are easily strong enough to mask weaker archaeological features that may lie underneath. The frequency of such responses is not considered great enough to prevent an assessment of the majority this area however.

4.1.5 The relative dimensions of the modern services identified by the gradiometer survey are 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.

4.1.6 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

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

English Heritage, 2008, *Geophysical Survey in Archaeological Field Evaluation*. Research and Professional Service Guideline No 1, 2nd edition.

Soil Survey of England and Wales, 1983, *Sheet 1, Soils of Northern England*. Ordnance Survey, Southampton.

Wessex Archaeology, 2014. *Heskin Old Hall Solar Farm, Chorley, Lancashire: Archaeological Desk-Based Assessment.* Unpublished client report. Report ref. 106510.01.

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:

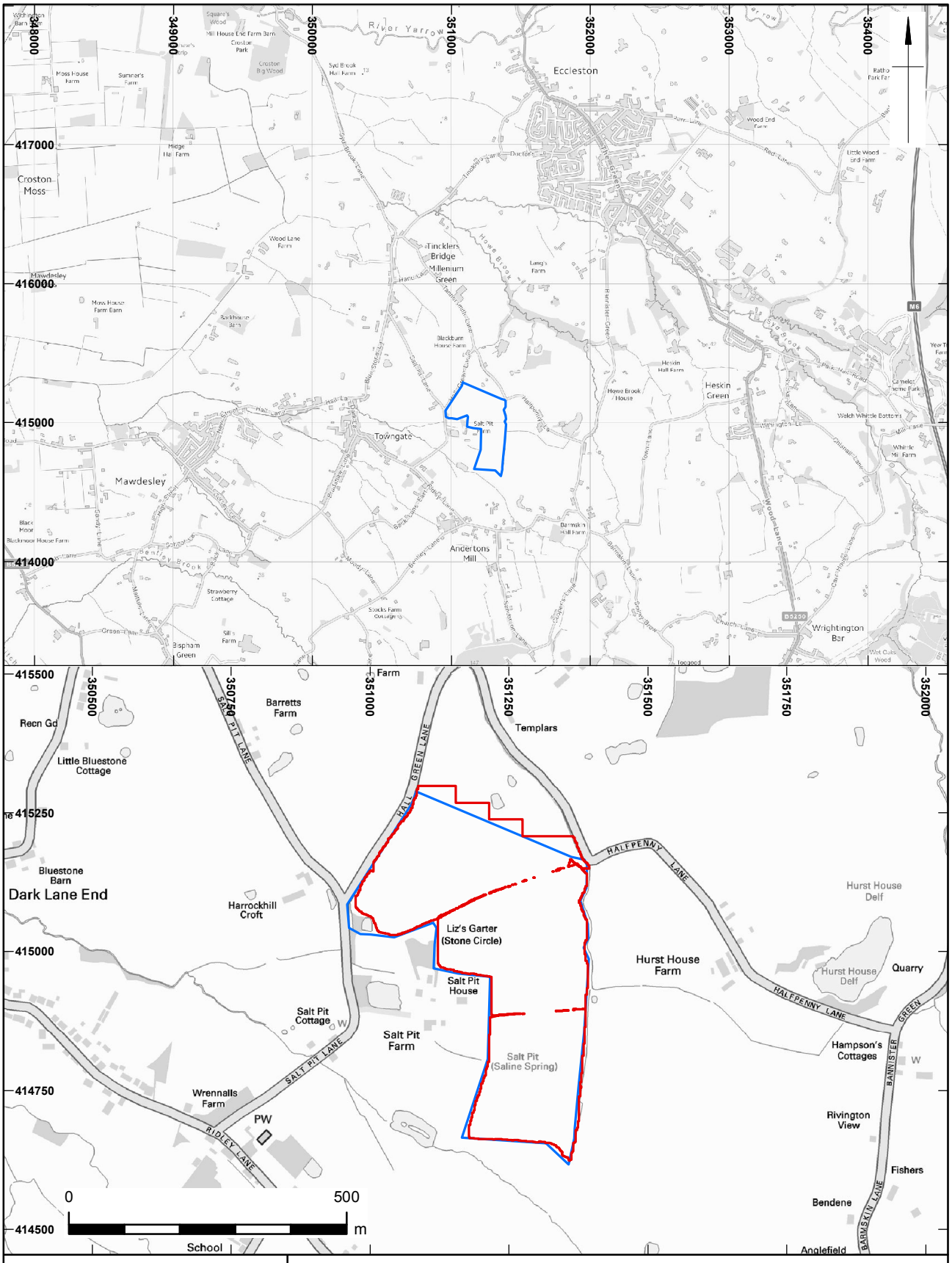
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be 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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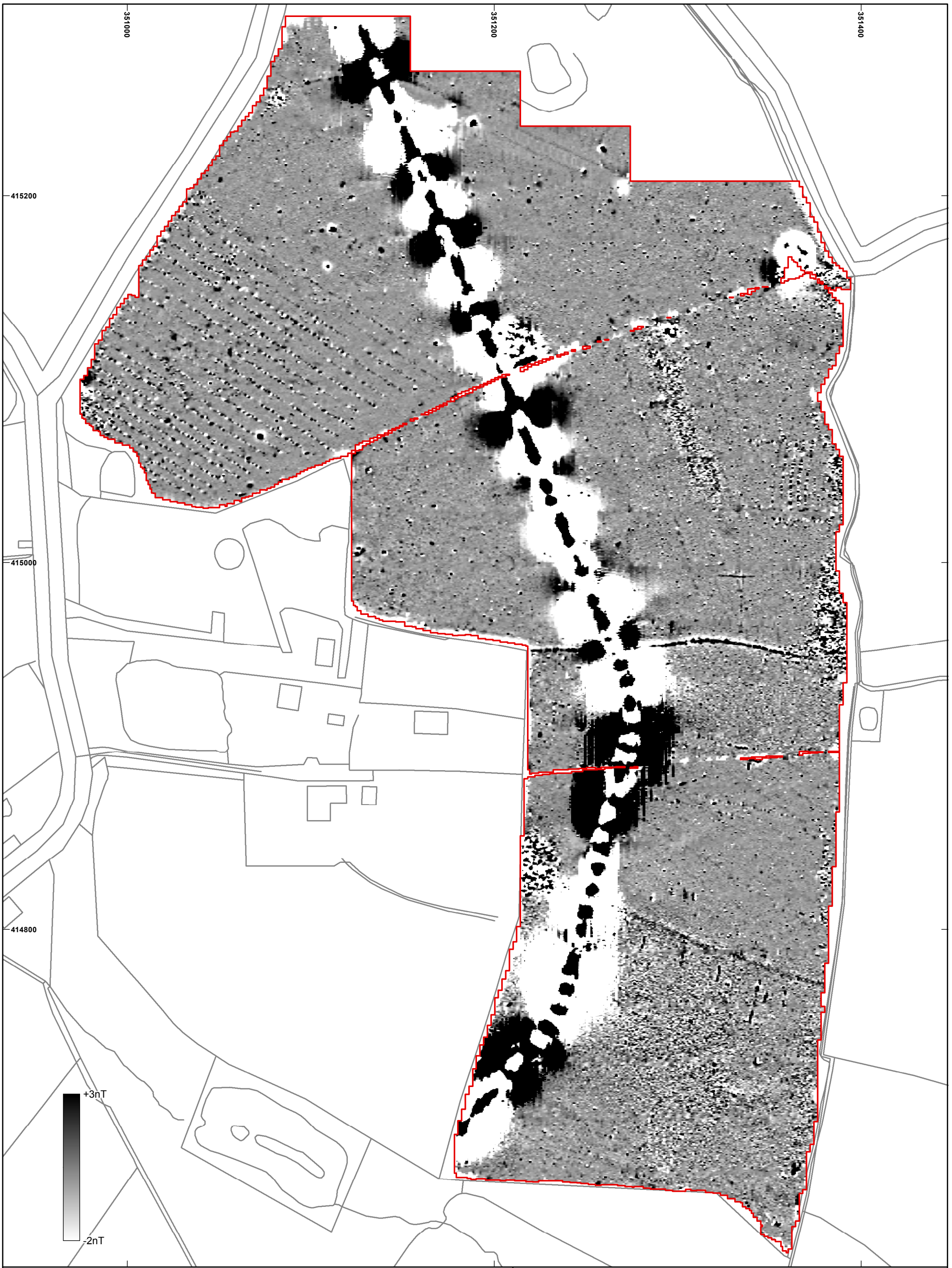
Path:	X:\PROJECTS\106510\GIS\FigsPDF\Geophysics_2014_11_05		

Site location and detailed survey extents

Figure 1



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Greyscale plot

Figure 2

351000

351200

351400

415200

415000

414800

+25nT

-25nT

Detailed Survey Extents

0

100

m

Date:	14/11/2014	Revision Number:	0
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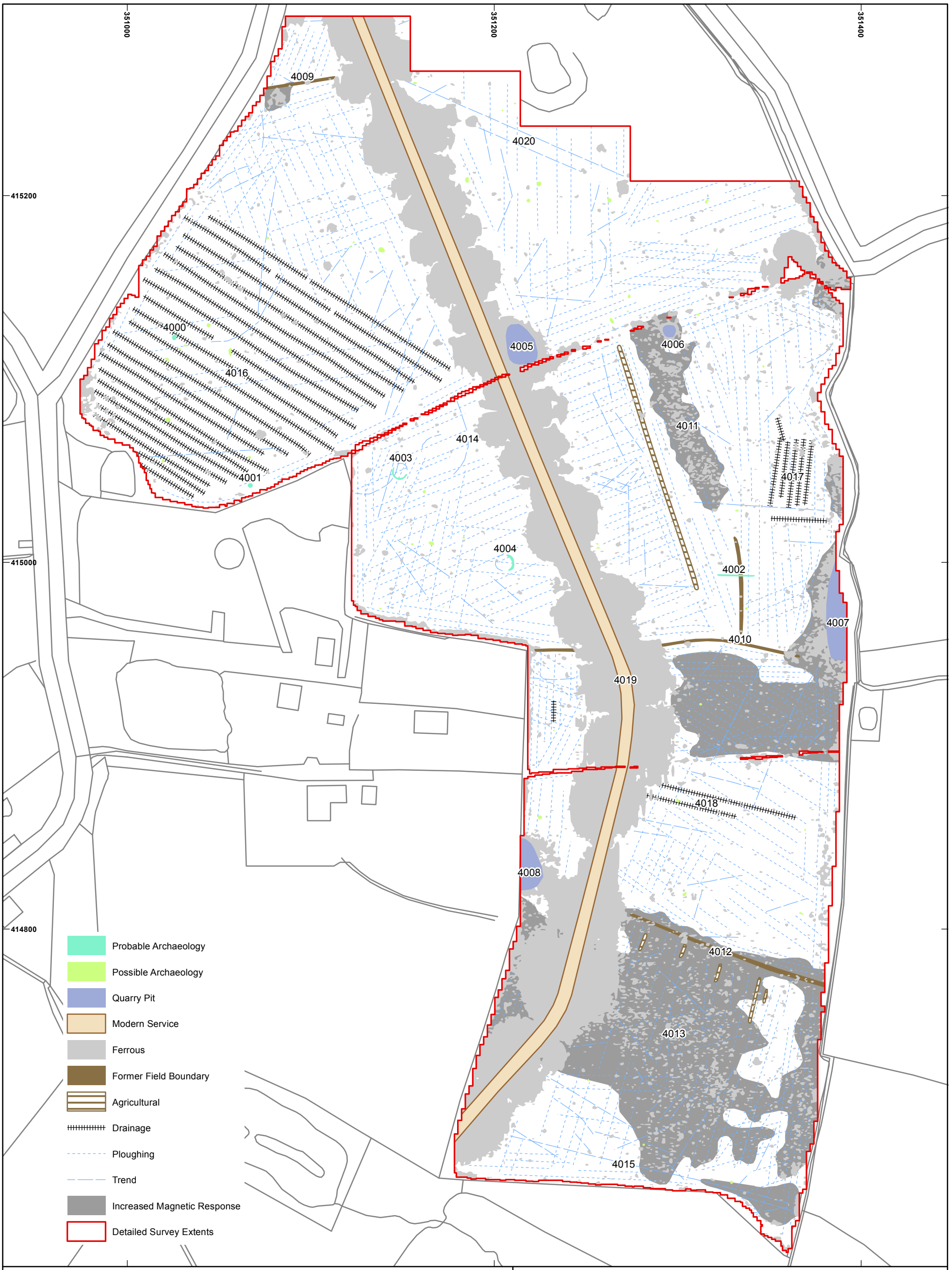
XY trace plot

Figure 3



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Interpretation

Figure 4

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