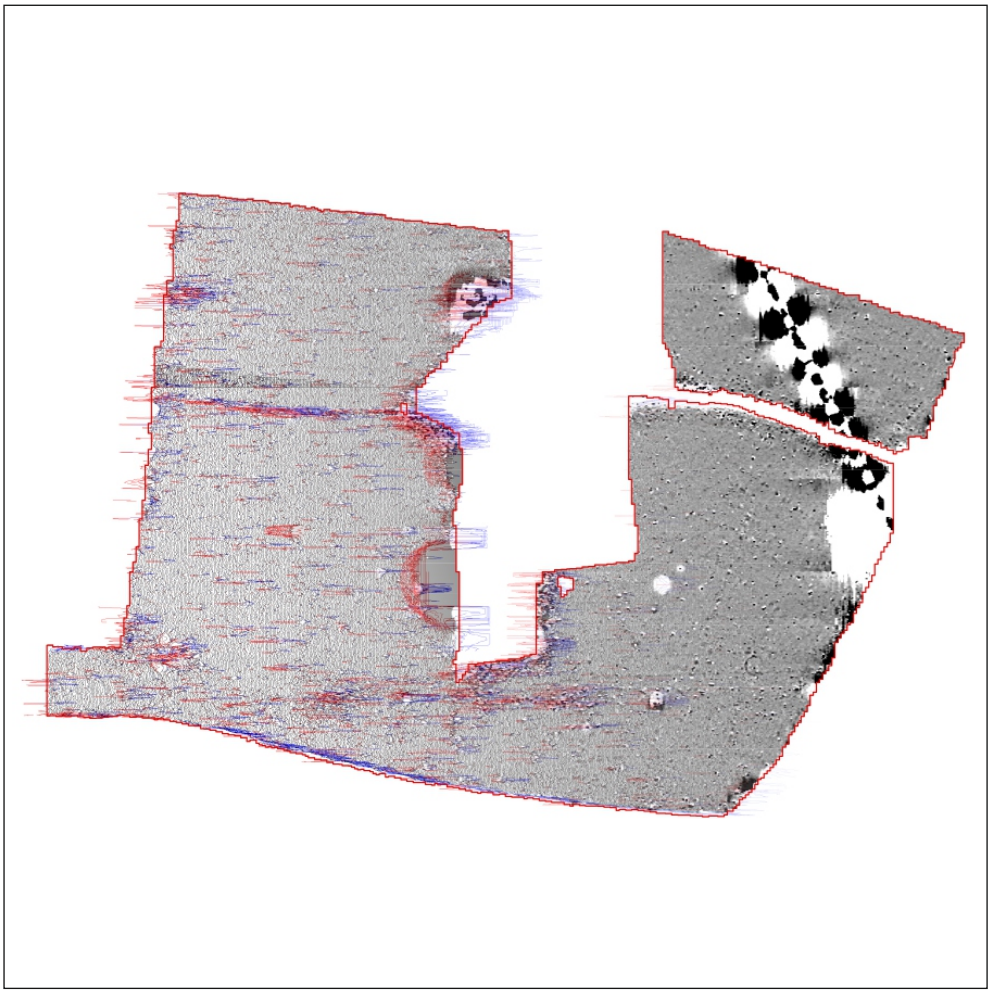
making sense of heritage

New Motorway Service Area
Rugby, Warwickshire

Detailed Gradiometer Survey Report



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geoservices

New Motorway Service Area
Rugby, Warwickshire

Detailed Gradiometer Survey Report

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

New Motorway Service Area, Rugby, Warwickshire

Detailed Gradiometer Survey Report

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Summary

A detailed gradiometer survey was conducted over land around New Ash Tree Farm, Warwickshire (centred on NGR 451310, 279180). The project was commissioned by The Millbridge Group Plc with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features ahead of the development of a new motorway service area.

The site comprises arable fields covering an area of 15.5 ha, bounded to the south by the M6 motorway and to the east by the A426. Significant medieval archaeology has been discovered previously in the vicinity of the site, notably the excavation of Coton Deserted Medieval Village to the immediate south on the other side of the M6 motorway. The majority of the geophysical survey was undertaken between the 14th and 18th March 2016 with a further area surveyed on 7th April 2016.

The detailed gradiometer survey has demonstrated the presence of a number of anomalies of potential archaeological interest across the site. A number of possible linear and curvilinear ditches and possible pits or postholes have been identified. Alongside these responses, areas of agricultural activity such as ploughing trends and former field boundaries and areas of increased magnetic response have also been recorded. There are also several weak trends of an uncertain origin which are considered to have low archaeological potential.

Numerous ferrous responses have been recorded across the site, some of which are of considerable size. These cannot be accurately interpreted without further information but are thought to represent historic agricultural activity or be modern in provenance. A large ferrous response has been identified in the south-west corner of the site, this may represent an area of burning or a spread of modern debris however an archaeological origin cannot be ruled out. A modern service has also been detected in the north-east corner of the site.

New Motorway Service Area
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Detailed Gradiometer Survey Report

Acknowledgements

Wessex Archaeology would like to thank The Millbridge Group Plc for commissioning the geophysical survey. The assistance of Graham Clarke and Antonella Noto is gratefully acknowledged in this regard.

The fieldwork was undertaken by Alistair Salisbury and Becky Hall. Becky Hall processed and interpreted the geophysical data and wrote this report. The geophysical work was quality controlled by Lizzie Richley. Illustrations were prepared by Jen Smith. The project was managed on behalf of Wessex Archaeology by Lucy Learmonth.

New Motorway Service Area
Rugby, Warwickshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by The Millbridge Group Plc on behalf of Moto Hospitality Ltd to carry out a geophysical survey over land at New Ash Tree Farm (hereafter "the Site"), centred on NGR 451156, 279396 (**Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken in advance of the development of a new motorway service area.

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 Site is located approximately 4.5 km north of the town of Rugby and approximately 18.5 km east of Coventry, within the county of Warwickshire and occupies an area of 15.3 ha of arable land.

1.2.2 The Site is bounded by the M6 motorway to the immediate south and the A426 to the east with further arable land to the north and west. New Ash Tree Farm is located in the centre of the Site with an access route from the A426 through the eastern part of the Site.

1.2.3 The Site sits on hilly ground between approximately 115 m and 130 m aOD.

1.3 Soils and geology

1.3.1 The solid geology of the Site is mapped as Charmouth Mudstone Formation. This type of sedimentary bedrock was formed approximately 183 to 197 million years ago in the Jurassic Period, when the local environment was dominated by shallow seas (BGS 2016).

1.3.2 The superficial deposits are mapped as Oadby Member – Diamicton, formed up to 2 million years ago in the Quaternary period when the local environment was dominated by ice age conditions (BGS 2016)

1.3.3 The soils underlying the Site are likely to consist of slowly permeable, seasonally waterlogged fine loamy over clayey soils of the 0711t (Beccles 3) association (SSEW SE Sheet 4_1 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 potential for the discovery of archaeological features on the Site has been briefly assessed and details of relevant sits and past investigations within a 1 km radius of the Site are summarised below. This information has been compiled from data provided by the Warwickshire Historic Environment Record and the National Heritage List for England (NHLE). This will be referred to during the interpretation of the geophysical results.

1.4.2 Recorded within 1km of the Site are one Scheduled Monument, one Grade II listed building, and one Grade II* listed building. There are no World Heritage Sites, Registered Parks and Gardens or Historic Battlefields identified within the Study Area.

1.4.3 The Scheduled Monument is an undated mound located immediately to the east of the survey area on the eastern side of the A426 (Monument No. 340108, NHLE No. 1016883). Its record on the Heritage Gateway website (accessed online, March 2016) suggests that the monument may be a Bronze Age bowl barrow, or a medieval mill mound.

1.4.4 Warwickshire HER (accessed online at Heritage Gateway, March 2016) identifies a series of archaeological investigations that took place between 1996 and 1998 at Coton Park to the south of the. These included geophysical survey, field walking, trench evaluations, a Desk Based Assessment and an excavation on Coton Deserted Medieval Village (DMV).

1.4.5 Results from these investigations revealed some prehistoric evidence, including Bronze Age pottery, dispersed pits and cremation deposits, and an Iron Age roundhouse ring gully. There were also several rectangular enclosures and linear boundaries dated to the Iron Age and Roman periods. (Northamptonshire Archaeology, 1998).

1.4.6 The DMV is a multi-phase settlement, dating from approximately the 10th century to the late 13th century when evidence suggests the village was abandoned. Features and structures include probable stock enclosures with contemporary structures, an “exceptionally broad road or “green”” with flanking ditches, and a series of ridge and furrow earthworks which overlay the outer parts of some village plots.

1.4.7 The Grade II* and Grade II listed buildings consist of Coton House (NHLE No. 1276617), a two storey 18th century house located 0.7 km from the Site, and its contemporary stable block (NHLE No. 1233436) located 200m to the west of the house (records accessed online at the Historic England website, March 2016).

1.4.8 The proximity of a DMV to the Site and the small amount of prehistoric evidence in the vicinity indicates that there is a medium potential for the presence of prehistoric and medieval evidence on the Site.

2 METHODOLOGY

2.1 Introduction

2.1.1 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team between the 14th March and 7th April 2016. Field conditions at the time of the survey were favourable, with dry conditions throughout the period of survey.

2.1.2 An overall coverage of 14.1 ha of the 15.5 ha was achieved, with reduction due to the presence of field boundaries, farm tracks and other on-site obstructions.

2.2 Method

2.2.1 Individual survey grid nodes were established at 30 m x 30 m intervals using a Leica Viva RTK GNSS instrument, which is precise to approximately 0.02 m and therefore exceeds Historic England recommendations (English Heritage 2008).

2.2.2 The detailed gradiometer survey was conducted using a Bartington Grad601-2 fluxgate gradiometer instrument, which has a vertical separation of 1 m between sensors. Data were collected at 0.25 m intervals along transects spaced 1 m apart with an effective sensitivity of 0.03 nT, in accordance with Historic England guidelines (English Heritage 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 (±5 nT 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 throughout the survey area, 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 detailed gradiometer survey has identified magnetic anomalies across the Site, along with areas of increased magnetic response and a large amount of ferrous. Results are presented as a series of greyscale plot s, XY plots and archaeological interpretations at a scale of 1:2000 (**Figures 2** to **4**). The data are displayed at -2 nT (white) to +3 nT (black) for the greyscale image and ±25 nT at 25 nT 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 dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation. The size of the reading is unlikely to represent the size of the object accurately, as a strong dipolar reading can create a virtual halo around an anomaly.

3.1.4 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 present than have been identified through geophysical survey.

3.1.5 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.

3.2 Gradiometer survey results and interpretation

3.2.1 The clearest potential archaeological feature is at **4000**. A weakly positive curvi-linear ditch-like feature measuring approximately 12 m in diameter that displays readings ranging between 0 nT and +3 nT. The feature is semi-circular in shape, and may constitute part of an enclosure. However, it is difficult to conclusively interpret this anomaly without further investigation.

3.2.2 A positive linear feature at **4001** has been interpreted as possible archaeology. It is distinct from the magnetic background showing low positive readings ranging between 0 nT and +1.5 nT. Evidence from historical (early 20th century (Ordnance Survey 1905, 1926)) mapping indicates that the feature was a bridleway which ran on an east to west alignment south of the contemporary field boundaries that can be seen at **4003**.

3.2.3 Two weakly positive ditches can be seen at **4002**. These are sinuous in form and are not thought to be related to anything of archaeological significance. However, they may represent former trackways or be related to past agricultural practices.

3.2.4 At **4003** an elongated linear anomaly represents a former field boundary that can be seen in aerial photography from 1945 and in historical mapping from the late 19th and early 20th centuries (Ordnance Survey 1886, 1905). This feature can also be identified in satellite imagery (Google Earth, 2016).

3.2.5 A number of linear trends across the Site can be attributed to ploughing activity. These are particularly prevalent in the north-west of the Site at **4004**, but are of limited archaeological importance.

3.2.6 Across the Site there are a number of linear anomalies characterised by their weak dipolar responses. These readings are similar with those associated with clay field drains and can be seen particularly in the north-west and the north-east at **4005** and **4006** respectively.

3.2.7 There are several large anomalous dipolar readings which have been interpreted as being of modern origin. On the ground, these readings occurred where large steel pipes protruded from the ground with associated small man-hole covers labelled “monitoring well” e.g. **4007**, **4008**, **4009** and **4010**.

3.2.8 Two large areas of increased magnetic response have been identified due to the high density of ferrous readings. Both areas are located close to modern agricultural hard standing and former field boundaries; as a result these readings are likely to represent modern and historical agricultural debris. These are considered unlikely to be of archaeological importance.

3.2.9 There are also a small number of small, weakly positive features which are not strong enough to indicate ferrous readings. These may represent possible archaeology and are likely to be pits or post-holes.

3.2.10 Several linear trends have been identified as across the Site, though their origins remain unknown.

3.2.11 At **4011** there is a modern service orientated north-west to south-east.

4 CONCLUSION

4.1.1 The detailed gradiometer survey has been successful in detecting several anomalies of possible archaeological interest across the Site. In addition to these, anomalies interpreted as ploughing trends, areas of increased magnetic response, and former field boundaries have also been identified.

4.1.2 Although no clear archaeological features have been identified, there are a number of features of possible archaeological interest, notably a semi-circular ditch-like feature located approximately 50 m from the eastern field boundary which may represent a segment of an enclosure ditch.

4.1.3 Further features of possible archaeological significance have been identified across the Site, some in the form of pit or post-hole shaped feature, and others as linear trends. The origin of these features remains unclear.

4.1.4 Various weak linear trends present themselves across the Site. These are unlikely to relate to any significant archaeology, but may indicate historical agricultural activity in the form of ploughing.

4.1.5 There are extensive ferrous readings from across the Site, which are expected to relate to modern agricultural debris which is commonly deposited in rural locations.

5 REFERENCES

5.1 Bibliography

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

Northamptonshire County Council, Northamptonshire Archaeology, May 2000, *Excavation of a Deserted Medieval Village at Coton Park, Rugby, Warwickshire 1998,* Assessment Report and Updated Research Design.

5.2 Cartographic and documentary sources

Soil Survey of England and Wales, 1983, *Sheet 4, Soils of Eastern England*, Ordnance Survey: Southampton.

1886 Ordnance Survey 6 inch map / 1:10,560 (Warwickshire Sheet XXIII.SE)

1905 Ordnance Survey 6 inch map / 1:10,560 (Leicestershire Sheet LII.SE)

1926 Ordnance Survey 6 inch map / 1:10,560 (Leicestershire Sheet LII.SE)

5.3 Online resources

British Geological Survey, http://www.bgs.ac.uk [accessed March 2016]

Google Earth Pro 7.1.5. http://www.google.com/earth/index.html [accessed April 2016].

LandIS Soil Observatory, http://www.landis.org.uk [accessed March 2016]

National Heritage List for England, https://historicengland.org.uk/listing/ [accessed March 2016]

Warwickshire Historic Environment Record, http://heritage.warwickshire.gov.uk/archaeology/historic-environment-record/ [accessed March 2016]

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 Historic England (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 Historic England (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.
- 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:

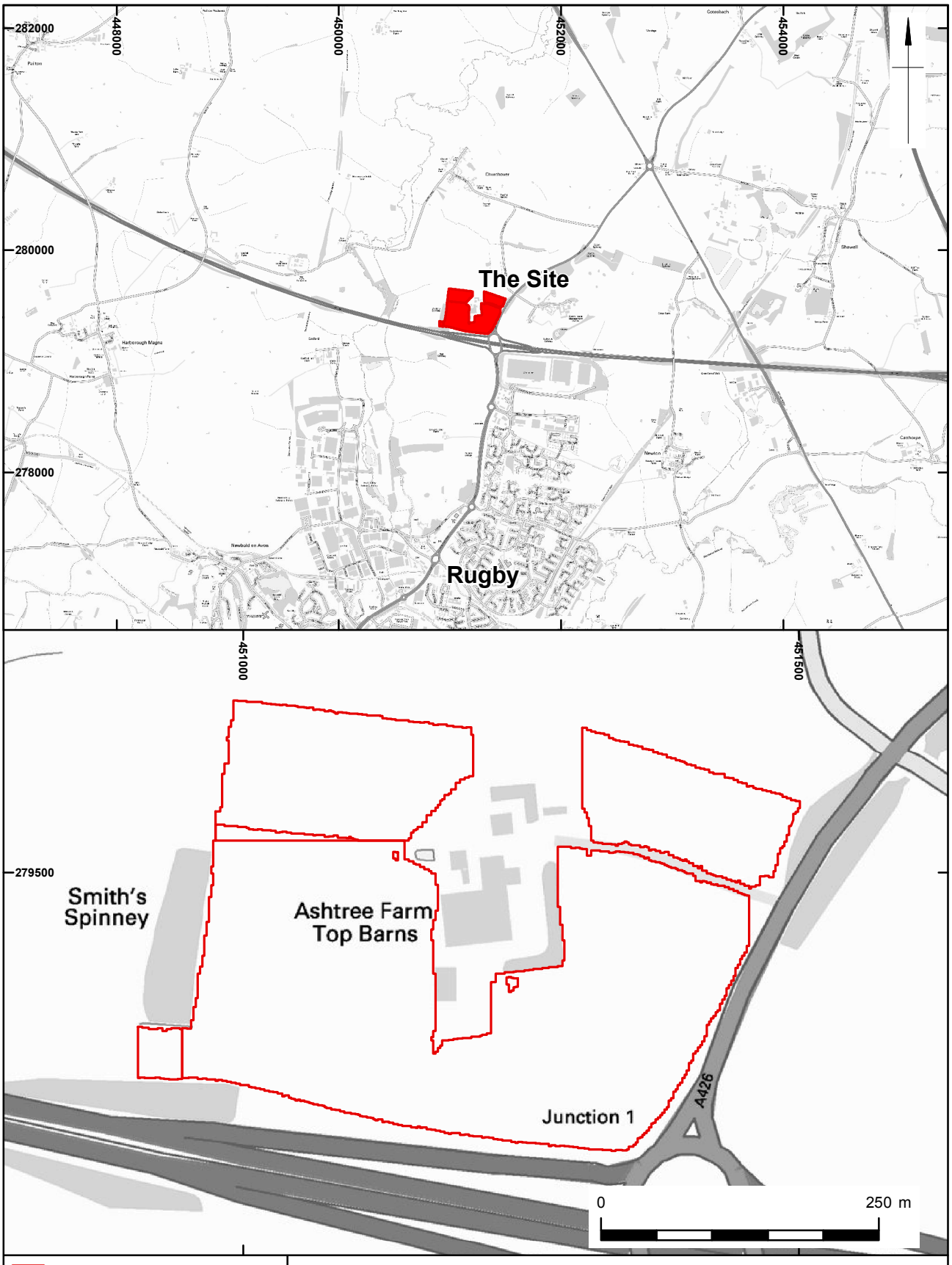
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be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



Survey Extents

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Scale:	1:50,000 & 1:5,000 at A4	Illustrator:	JS
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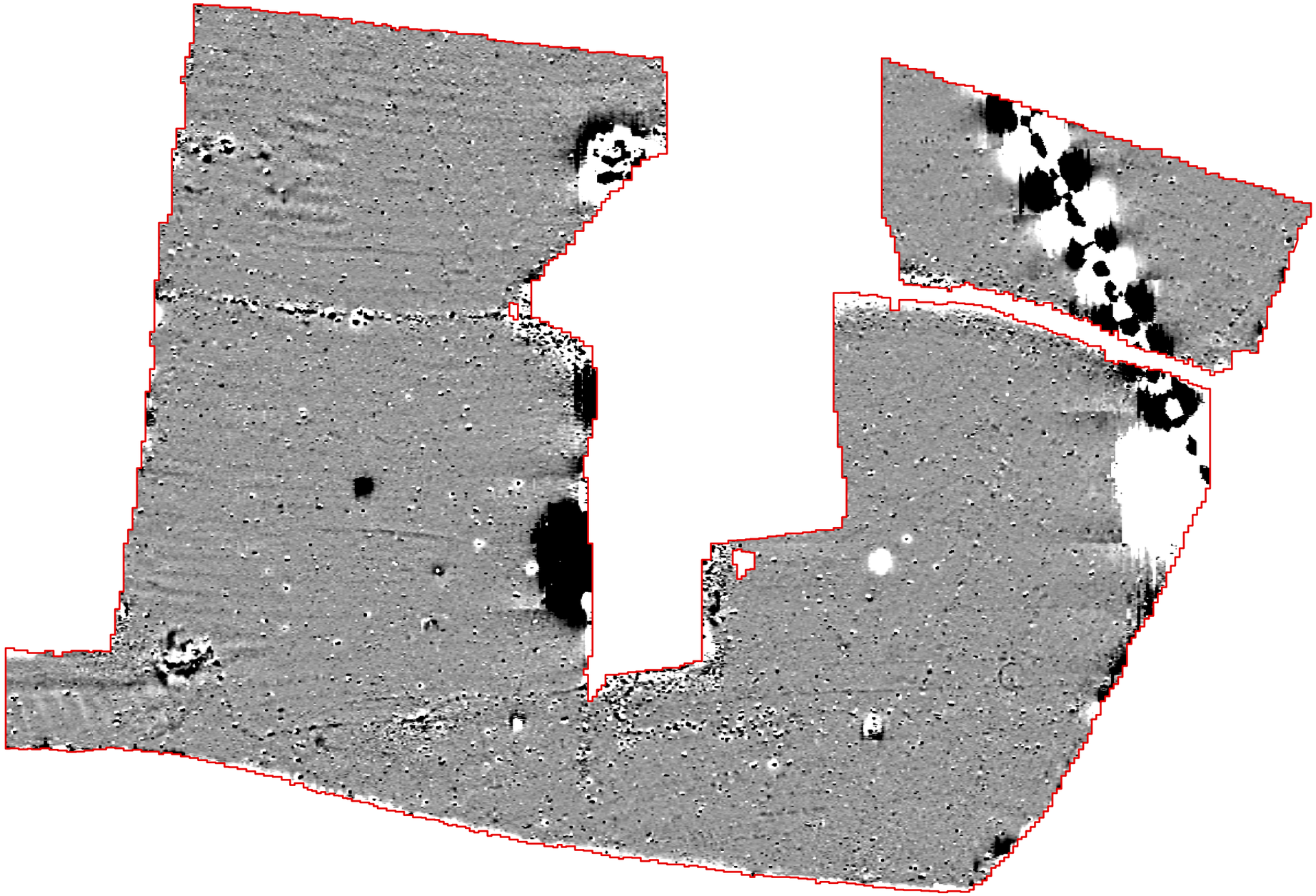
Site Location and Survey Extents

Figure 1

451000

451500

279500



+3 nT

-2 nT

0 100 m

Survey_Extents

Date:	08/04/2016	Revision Number:	0
Scale:	1:2000 at A3	Illustrator:	JS
Path:	X:\PROJECTS\112940\GIS\FigsMXD\2016_04_08		

Greyscale Plot

Figure 2

451000

451500

279500

+25 nT

-25 nT

0 50 m

Survey_Extents

Date:	08/04/2016	Revision Number:	0
Scale:	1:2000 at A3	Illustrator:	JS
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XY Trace Plot

Figure 3

451000

451500

279500

4004

4005

4002

4007

4011

4006

4010

4001

4003

4008

4009

4000

Survey Extents

Drainage

Ploughing

Trend

Arch Possible

Former field boundary

Modern Service

Ferrous

Increased Magnetic Response

Superficial Geology

0 100 m

Date:	14/04/2016	Revision Number:	0
Scale:	1:2000 at A3	Illustrator:	JS
Path:	X:\PROJECTS\112940\GIS\FigsMXD\2016_04_08		

Archaeological Interpretations

Figure 4

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