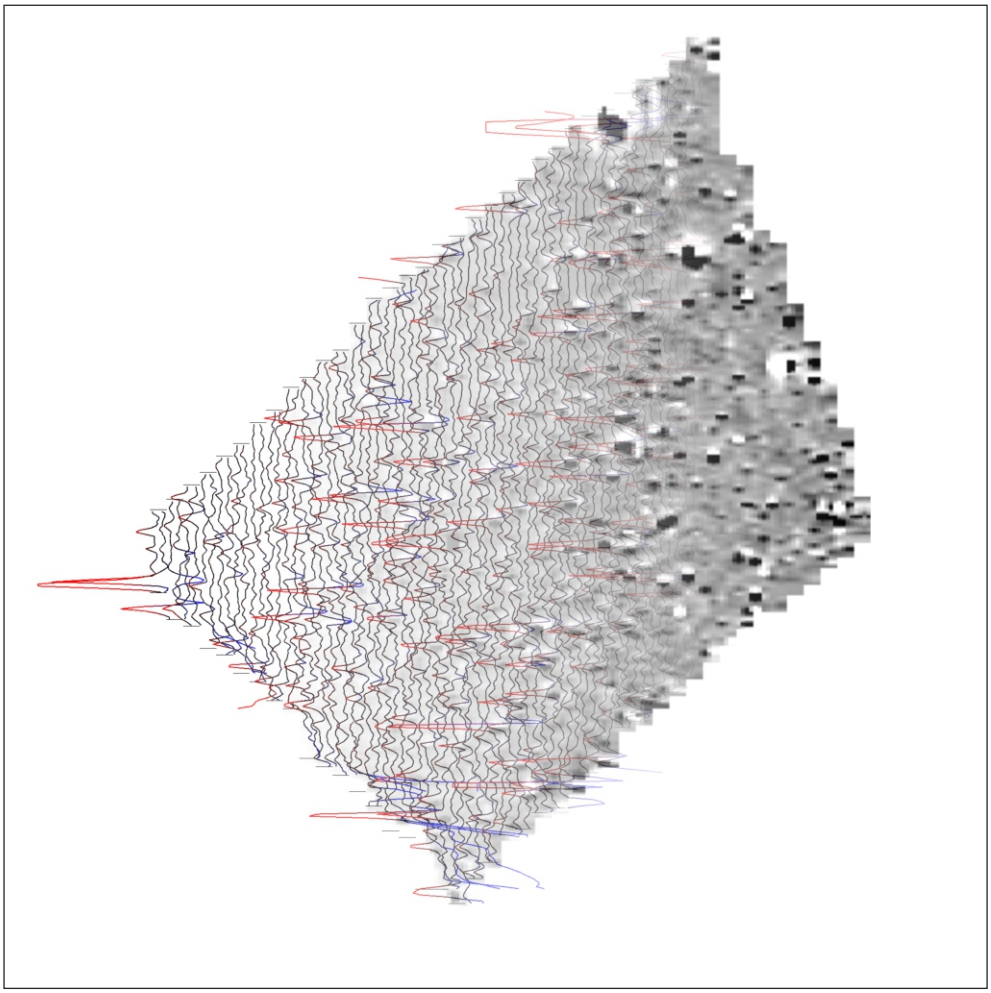
making sense of heritage

Land off Stillington Road Easingwold, North Yorkshire

Detailed Gradiometer Survey Report



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geoservices

Land off Stillington Road
Easingwold, North Yorkshire

Detailed Gradiometer Survey Report

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

Land off Stillington Road
Easingwold, North Yorkshire

Detailed Gradiometer Survey Report

Contents

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Summary

A detailed gradiometer survey was conducted over land off Stillington Road, Easingwold, North Yorkshire. The project was commissioned by CgMs Consulting 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 four arable fields to the southeast of Easingwold, North Yorkshire. The site occupies an area of gently sloping land. The gradiometer survey covered 6.1ha and has demonstrated the presence of a very limited anomalies of possible archaeological interest within the survey area, along with regions of increased magnetic response.

A number of anomalies appear to relate to features visible on the 1841 Tithe Map of Easingwold and later Ordnance Survey mapping (1856-1958). There are a few probable pits and agricultural features of relatively modern date. Nothing conclusively of archaeological origin was identified.

The geophysical survey was undertaken between the 4th and the 8th October 2013.

Land off Stillington Road
Easingwold, North Yorkshire

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by CgMs Consulting. The assistance of Rob Smith is gratefully acknowledged in this regard.

The fieldwork was directed by Jonathan Buttery and assisted by Andrew Reid, Michael O'Connell, Matthew Weightman and David Loeb. Clara Dickinson processed the geophysical data and Ross Lefort interpreted the geophysical data in addition to writing this report. The geophysical work was quality controlled by Ben Urmston. Illustrations were prepared by Linda Coleman. The project was managed on behalf of Wessex Archaeology by Richard O'Neill.

Land off Stillington Road
Easingwold, North Yorkshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by CgMs Consulting to carry out a geophysical survey of land off Stillington Road, Easingwold, North Yorkshire (**Figure 1**), hereafter "the Site" (centred on NGR 453575, 469425).

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 method used, the survey results and archaeological interpretation of the geophysical data.

1.2 Site Location, Topography and Geology

1.2.1 The survey area comprises four arable fields to the north of Stillington Road, Easingwold (**Figure 1**). Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of 6.1ha.

1.2.2 The Site occupies an area of gently sloping land that slopes down towards the south; the land slopes from just over 30m above Ordnance Datum (aOD) at the northern corner of the Site to just over 25m aOD at the southwest edge of the Site. The survey extents are defined by the surrounding field boundaries.

1.2.3 The majority of the site comprises Sand of Blown Sand 1, with pockets of Clay, Silt, Sand and Gravel of Head in the north-east and south-west. These deposits are underlain by Mudstone of Mercia Mudstone Group (CgMs 2013).

1.2.4 The soils underlying most of the Site are likely to be typical brown sands of the 551d (Newport 1) association with typical sandy gley soils of the 821b (Blackwood) association to the south (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.

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 the 4th and the 8th October 2013. Field conditions at the time of the survey were good.

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 several spreads of increased magnetic response. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:1500 (**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 anomalies of greatest interest are concentrated more towards the south of the survey area. A pair of parallel linear positive anomalies is present at **4000**; they have varying magnetic values across their length typically ranging from +1nT to over +3nT. There is a negative running through the middle of these two positive anomalies but it is the positive responses that are considered to be representative of the archaeological features. These positive anomalies are considered to represent cut features such as ditches. The feature corresponds with the location of a boundary or track shown on the 1841 Tithe Map, but not the 1856 edition Ordnance Survey (OS) map or later mapping.

3.2.2 A large area of ferrous response **4001** corresponds with the location of a pond/ large pit shown on the 1841 Tithe Map and later OS mapping, apparently filled in by the time of the 1911 edition OS map. In addition to these ditches are a number of regular positive responses of sub-circular and sub-oval shape either side of **4002**. These anomalies have positive magnetic values in excess of +3nT and have clearly defined edges. The form of these anomalies in the XY trace plots (**Figure 3**) suggests they may be pits and have therefore been classed as possible archaeology.

3.2.3 There are a number of short linear and small sub-circular positive anomalies scattered throughout the data such as at **4003**, **4007**, and **4008**. These anomalies have magnetic values over +3nT and are considered to represent cut features such as short ditch sections and small pits and postholes. A line of short linear anomalies **4008** and a further short linear anomaly **4003** correspond to the position of former field boundaries shown on the 1841 Tithe Map and later edition OS mapping. An area of increased magnetic and ferrous response adjacent to **4003** corresponds to the location of a small structure on the 1911 edition OS and later mapping.

3.2.4 A weak linear anomaly runs parallel to an existing field boundary from **4005** through **4006** and past **4004**; Its magnetic values range from +0.5nT to +3nT. This feature is considered to represent a cut feature such as a ditch and its alignment corresponds with a path or track shown on the 1856 edition OS map, but not later mapping.

3.2.5 Another more irregular shaped positive anomaly is present further north at **4004**; in addition to its irregular shape its values vary across the anomaly to form a closely spaced cluster of positive peaks measuring over 7m in length. This anomaly looks less like a pit than the other examples described above but has been interpreted as possible archaeology as it is unique in the data.

3.2.6 There are numerous trends in the data; most are agricultural trends relating to ploughing such as the examples around **4009**.

3.2.7 There are spreads of concentrated dipolar and bipolar responses (black and white) at various locations in the data such as the wide spread around **4010**. These anomalies are considered to represent spreads of relatively modern ceramic and metallic debris.

3.2.8 There are wide spreads of weak bipolar responses across much of the data. These spreads are considered to be geological with most responses in these areas having very diffuse edges. The better defined of the positive anomalies in these areas have been interpreted as possible archaeology but there is a good chance these anomalies correspond to geological features such as tree throws. There is a possibility that some of these suspected tree throws may partially define a former field boundary in the area between **4002** and **4010**. The boundary is shown on the 1841 Tithe Map and later edition OS mapping (1856-1958).

4 CONCLUSION

4.1.1 The detailed gradiometer survey has been successful in detecting a few anomalies of possible archaeological interest within the Site, in addition to regions of increased magnetic response.

4.1.2 The data has revealed only a few anomalies of possible interest which include pit-like anomalies and probable ditch sections. The ditch sections appear to resemble former field divisions with most corresponding to features on the 1841 Tithe Map and later OS mapping (1856-1958). The double ditch at **4000** appears to correspond to a boundary or track shown on the 1841 Tithe Map, but removed by the time of the 1856 Ordnance Survey map. A large ferrous anomaly **4001** to the northwest corresponds to a pond/ pit also shown on the 1841 Tithe Map and later OS mapping (1856-1911).

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. It is also the case that strongly magnetised regions, such as certain geological formations, can mask weaker archaeological features.

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 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.

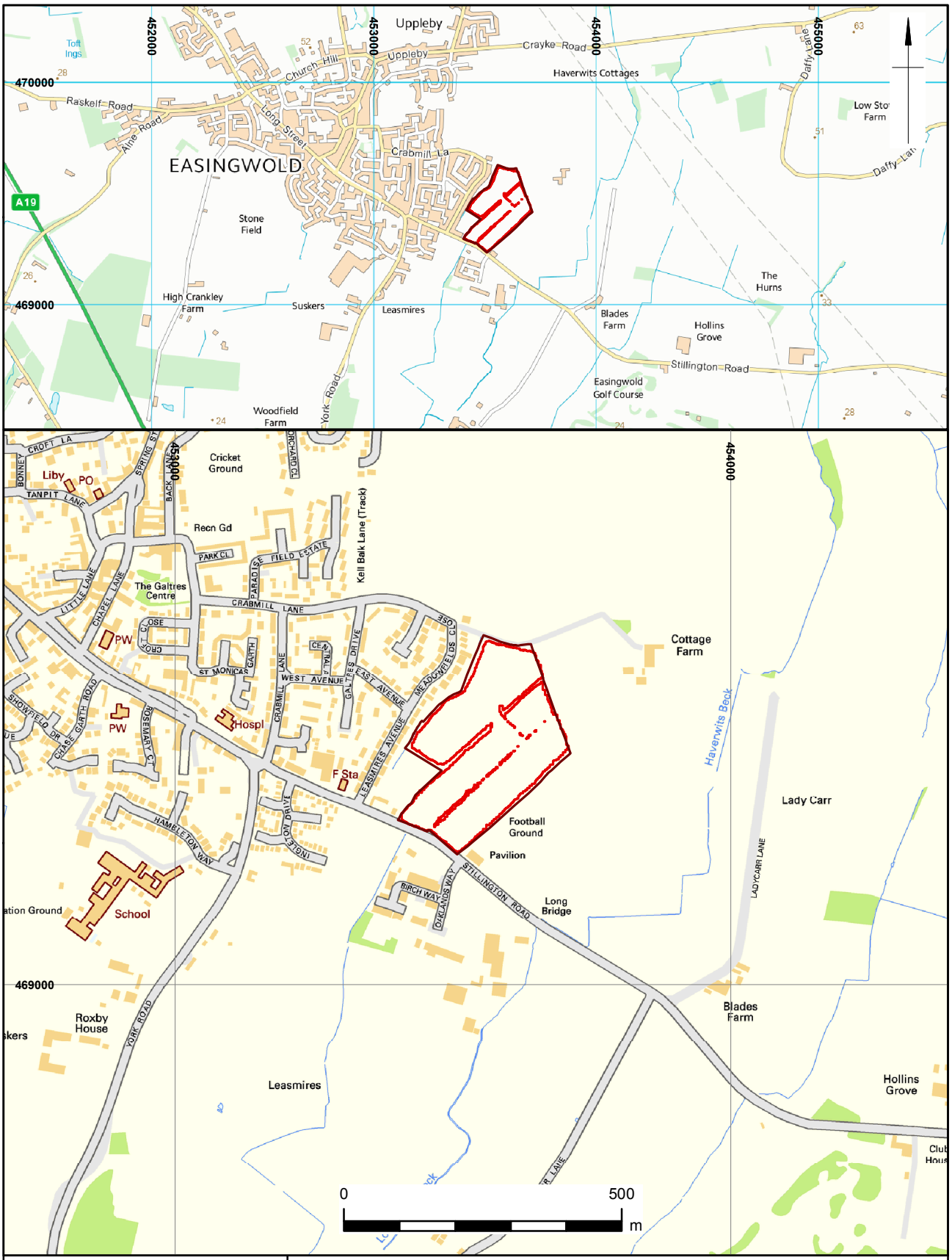
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided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



The Site

Survey Extents

Date:	25/10/13	Revision Number:	0
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Path:	X:\PROJECTS\101550\GIS\FigsMXD		

Site location and survey extents

Figure 1

453400
453500
453600
453700
469600
469500
469400
469300
469200

+3nT
-2nT

0
100
m

Survey Extents

Date:	25/10/13	Revision Number:	0
Scale:	1:1500 at A3	Illustrator:	LJC
Path:	X:\PROJECTS\101550\GIS\FigsMXD		

Greyscale

Figure 2

453400
453500
453600
453700
469600
469500
469400
469300
469200
+25nT
-25nT
0
100
m

Survey Extents

Date:	25/10/13	Revision Number:	0
Scale:	1:1500 at A3	Illustrator:	LJC
Path:	X:\PROJECTS\101550\GIS\FigsMXD		

XY trace plot

Figure 3

453400
453500
453600
453700
469600
469500
469400
469300
469200
4009
4010
4007
4004
4001
4006
4002
4003
4005
4000
4008
Survey Extents
Probable Archaeology
Possible Archaeology
Ferrous
Increased Magnetic Response
Superficial Geology
Trend
Ploughing
0
100
m

Date:	25/10/13	Revision Number:	0
Scale:	1:1500 at A3	Illustrator:	LJC
Path:	X:\PROJECTS\101550\GIS\FigsMXD		

Interpretation

Figure 4

wessex archaeology

salisbury rochester sheffield edinburgh

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