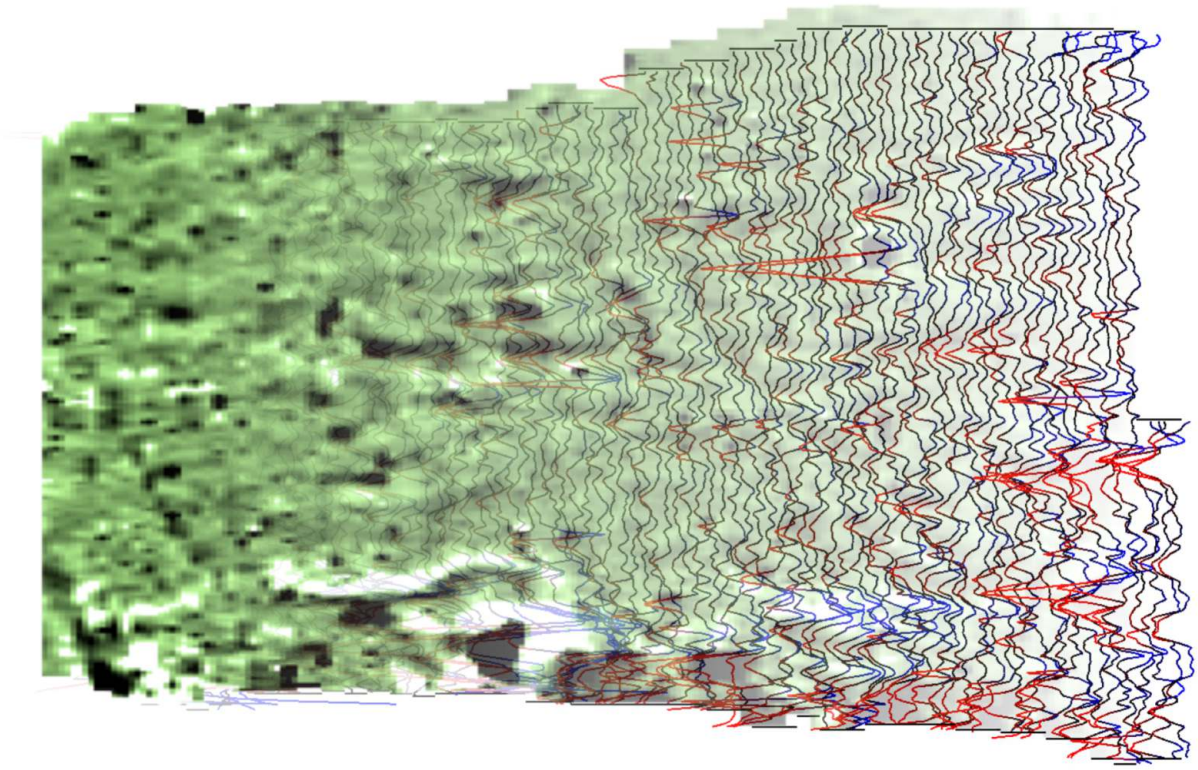
making sense of heritage

Land at Heywood Road Bideford, North Devon

Detailed Gradiometer Survey Report



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February 2014

geoservices

Land at Heywood Road
Bideford, Devon

Detailed Gradiometer Survey Report

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

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Summary

A detailed gradiometer survey was conducted over land at Heywood Road in Bideford, Devon. 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 several pasture fields approximately 1.5km northwest of Bideford town centre and some 50m south of the A39. The site occupies the fields to the north and south of a steep valley and the garden of a care home. The gradiometer survey covered 3.1ha and has demonstrated the presence of anomalies of possible archaeological interest within the survey area, along with areas of increased magnetic response and a modern service.

A number of sinuous anomalies are apparent within the data towards the western and southern extents of the survey. Whilst these anomalies are broadly consistent with natural features, such as channels, the clarity of their responses suggests that they may be of some archaeological interest. However, this is tempered by the presence of other anomalies more typical of near-surface geological changes.

The northern parts of the Site show strong magnetic disturbance, which is consistent with the presence of spreads of modern debris. The A39 forms the northern boundary of the Site and it is possible that the disturbance relates to the construction of the road. A possible service has been identified near the northeastern extent of the survey, although it is not clear whether this was ever functioning or whether it is part of the debris.

Land at Heywood Road, Bideford, Devon

Detailed Gradiometer Survey

Acknowledgements

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

The fieldwork was directed by Laura Andrews, Jen Smith and Rachel Williams. Jen Smith and Ben Urmston processed and interpreted the geophysical data in addition to writing this report. The geophysical work was quality controlled by Ben Urmston. Illustrations were prepared by Karen Nichols. The project was managed on behalf of Wessex Archaeology by Ben Urmston.

Land at Heywood Road, Bideford, Devon

Detailed Gradiometer Survey

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by CgMs Consulting to carry out a geophysical survey of land at Heywood Road, Bideford, (**Figure 1**), hereafter "the Site" (centred on NGR 244652 127793). The survey forms part of an ongoing programme of archaeological works being undertaken ahead of proposed development at the Site.

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 The Site

1.2.1 The survey area comprises pasture fields off Heywood Road, some 1.5km northwest of the centre of Bideford (**Figure 1**). Detailed gradiometer survey was undertaken over all accessible parts of the Site, a total of 3.1ha.

1.2.2 The Site occupies the crest of a valley, extending NW-SE. The site is divided by a stream c. 10m above Ordnance Datum (aOD). The survey was carried out in areas that were between c.15m aOD and c. 30m aOD. The overall survey area is bounded by the A39 on the northern extent. The eastern extent is demarcated by Heywood Road. To the south and the west of the site lies a housing estate.

1.2.3 Four areas were surveyed in total. The northern part of the site was divided into two parts by a garden belonging to a care home that is located within the boundary of the site. The northeastern survey area lay immediately south of the A39 and the southern extent of this area was marked by a steep bank running down towards the stream. The northwestern area was a small well-maintained area of grassland that formed part of the garden of a care home, and the southern extent of this area was demarked by the care home's car park. The south western area surveyed comprised two fields, the western field was surveyed within its entirety apart from one area of this brambles, the eastern field was surveyed to a break of slope at approximately 15m aOD.

1.2.4 The soils underlying the Site are likely to be typical brown earths of the 541k (Denbigh a) association (SSEW 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts suitable 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 on 14th and 15th of January 2014. Field conditions at the time of the survey were acceptable.

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 possible archaeological interest across the Site, large areas of increased magnetic responses, several linear trends along with a modern service. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:1500 (**Figures 2** and **3**). The data are displayed at -2nT (white) to +3nT (black) for the greyscale image and ±25nT at 50nT 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 western fields contain a number of anomalies (**4000**, **4001**, **4002**, **4003**, **4004**, **4005** and **4006**) that are labelled as possible archaeology. They are sinuous in form and are

consistent with geological features, such as former channels; however, the strength and clarity of their responses is unusual and suggests that they may have been deliberately backfilled. It is therefore considered possible that archaeological deposits may be encountered within these features. Regions of increased magnetic response and other anomalies more clearly consistent with geological sources are visible in close proximity.

3.2.2 The southernmost survey area contains several anomalies of possible archaeological interest, notably around **4007**, which forms a linear high response running E-W with a break in the centre of the feature and banded by linear trends. These anomalies lie within a band of probable geological responses although an archaeological origin cannot be excluded entirely. Curvilinear anomaly **4008** lies at the southeastern extent of the survey area and is considered to be of possible archaeological interest.

3.2.3 The northern part of the site exhibits strong magnetic disturbance. This type of response is typical of construction or demolition debris and the most likely source is construction debris or upcast from the A39, which forms the northern boundary of the area. The trends identified by area **4009** are consistent with the dumping of piles of rubble or demolition debris and may indicate the physical extents of different types of debris. A small window of data **4010** is less affected but still contains probable dumped material.

3.2.4 The small survey area at the northeastern extent of the Site shows further strong magnetic disturbance, within which curvilinear anomaly **4011** can be seen. The coherency of its response suggests that it might be associated with a service.

4 CONCLUSION

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

4.1.2 The anomalies of possible archaeological interest within the western and southern portions of the Site have been interpreted tentatively, as their form is suggestive of natural origins and their location on the slope would support this interpretation. However, an archaeological interpretation cannot be entirely ruled out due to the character of their responses.

4.1.3 Regions of strong magnetic disturbance across the northern portion of the Site have effectively masked any weaker anomalies within these areas. The responses are similar to those seen over landfill sites and other extensive spreads of modern debris. It is interesting to note the relatively straight edge near **4010**, oriented NNW-SSE, and the presence of linear trends within the variability; it is possible therefore that these indicate some form of organisation within the deposits.

5 REFERENCES

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 5, South West England*. 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 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.

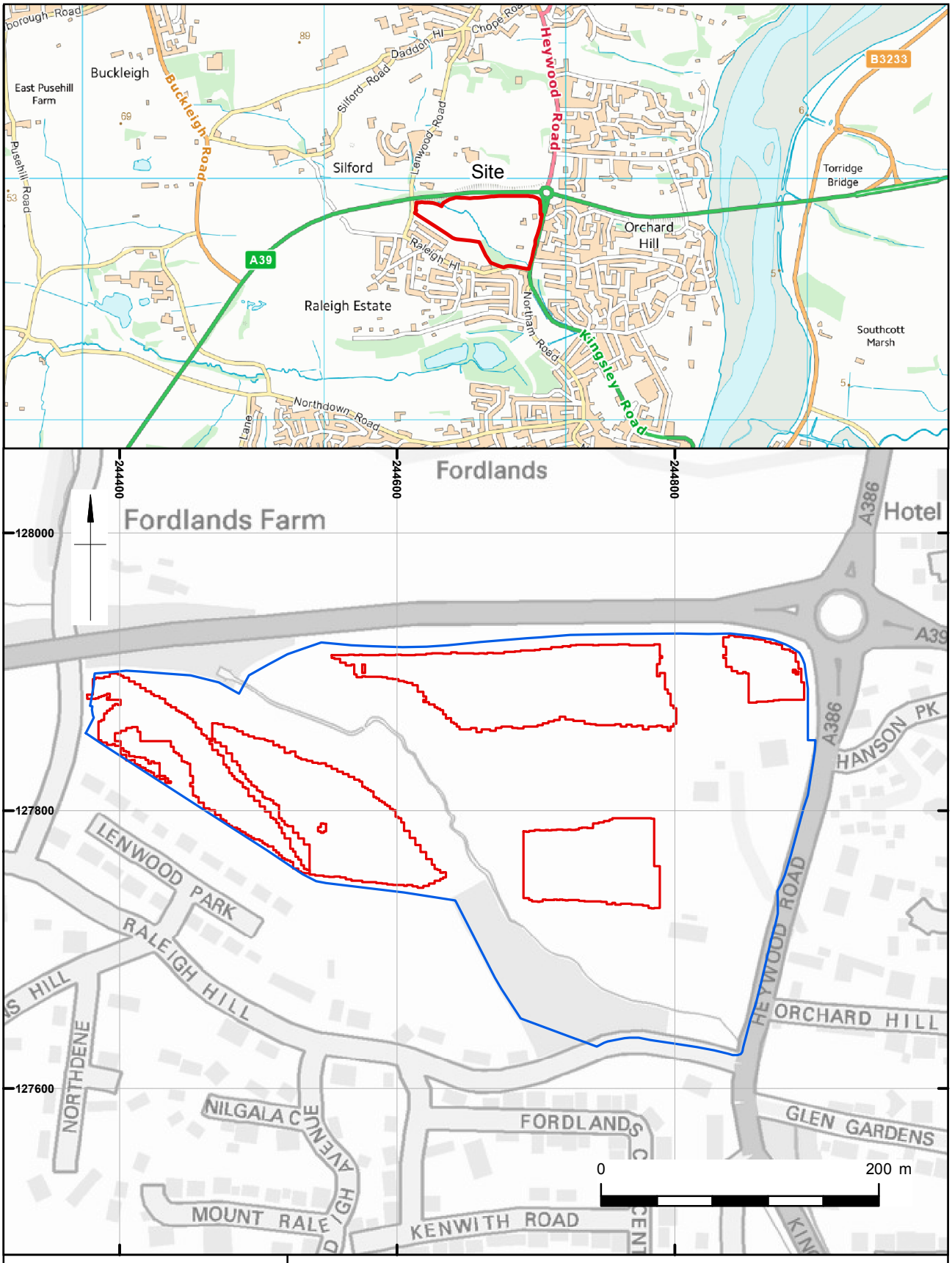
The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided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



Site boundary

Geophysical survey extents

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Site location and survey extents

Figure 1

244400

244600

244800

127900

127800

127700

+3nT

-2nT

0

100 m

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Site boundary

Geophysical survey extents

Date:	05/02/14	Revision Number:	0
Scale:	1:1500 at A3	Illustrator:	KL
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Greyscale

Figure 2

244400

244600

244800

127900

127800

127700

+50nT

-50nT

0

100 m

Site boundary

Geophysical survey extents

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XY plot

Figure 3

244400

244600

244800

127900

127800

127700

4000

4001

4002

4003

4004

4005

4006

4007

4008

4009

4010

4011

Possible archaeology

Modern service

Trend

Ferrous

Increased magnetic response

Superficial Geology

0

100 m

Site boundary

Geophysical survey extents

Date:	05/02/14	Revision Number:	0
Scale:	1:1500 at A3	Illustrator:	KL
Path:	X:\PROJECTS\102720\GIS\FigsMXD\geophys\Fig04.mxd		

Interpretation

Figure 4

wessex archaeology

salisbury rochester sheffield edinburgh

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