ARCHAEOLOGICAL SERVICES WYAS

Ashfield Road
Workington
Cumbria

Geophysical Survey

Report no. 2713

February 2015

Client: WYG Environment Planning Transport Ltd

REGISTERED ORGANISATION CIfA

Ashfield Road
Workington
Cumbria

Geophysical Survey

Summary

A geophysical (magnetometer) survey covering approximately 10 hectares, was carried out on land south of Ashfield Road South on the southern outskirts of Workington, to support a planning application for the proposed development of the site for housing. The survey has recorded anomalies indicative of extensive field drainage throughout the site and evidence of alluvial flood deposits to the south of Eller Beck. No anomalies of archaeological significance have been identified. Consequently, on the basis of the survey, the archaeological potential of the site is considered to be low.

ARCHAEOLOGICAL
SERVICES
WYAS

Report Information

Client:	WYG Environment Planning Transport Ltd
Address:	Arndale Court, Headingley, Leeds, LS6 2UJ
Report Type:	Geophysical Survey
Location:	Workington
County:	Cumbria
Grid Reference:	NY 0050 2700
Period(s) of activity:	modern
Report Number:	2713
Project Number:	4358
Site Code:	ARW15
OASIS ID:	archaeol11-203601
Planning Application No.:	2/2014/0857
Museum Accession No.:	n/a
Date of fieldwork:	February 2015
Date of report:	February 2015
Project Management:	Sam Harrison BSc MSc MCIfA
Fieldwork:	Ross Bishop BA
	Mark Evans BSc
	Becky Goulding BSc MSc
Report:	Alistair Webb BA MCIfA
Illustrations:	Chris Sykes BA MSc
Photography:	Mark Evans
Research:	n/a

Authorisation for distribution: ----------

PO Box 30, Nepshaw Lane South, Morley, Leeds
LS27 0UG
Telephone: 0113 383 7500.
Email: admin@aswyas.com

Contents

List of Figures

List of Plates

1 Introduction

Archaeological Services WYAS (ASWYAS) was commissioned by Kirsten Holland of WYG Environment Planning Transport Ltd (the Client), to undertake a geophysical (magnetometer) survey of land to the south of Ashfield Road South, Workington (see Fig. 1). The work has been undertaken to inform a planning application for the proposed development of the site for housing. The work was undertaken in accordance with policy contained within the National Planning Policy Framework (DCLG 2012), in line with current best practice (CIfA 2014; David *et al.* 2008) and to a Project Design (Harrison 2014) approved by the Client. The survey was carried out between February 2nd and February 4th 2015 to provide additional information on the archaeological resource of the site.

Site location, topography and land-use

The Proposed Development Area (PDA), centred at NY 0050 2700, is located on the southern edge of Workington and is bound by Ashfield Road South to the north-west and Workington Sports Centre to the south-west (see Fig. 2) with farmland to the south and east. The survey area comprises two fields under permanent pasture divided by Eller Beck with stands of trees around and between the two fields. The site slopes gradually up to the north and west from Eller Beck. An area to the north-east of Field 3 was unsuitable for survey due to the presence of soft rush (see Fig. 2 and Plate 3).

Soils and geology

The underlying bedrock comprises Lower Pennine Coal Measures formation comprising sandstone, siltstone and mudstone. The bedrock geology is overlain by superficial Devensian Till (British Geological Survey 2015). The soils are classified in the Brickfield 3 association, characterised as fine loams over clays and prone to seasonal waterlogging (Soil Survey of England and Wales 1983).

2 Archaeological Background

An Archaeological Desk-Based Assessment compiled by Wardell Armstrong Archaeology (Newman 2014) stated that there are no heritage assets within the application boundary and that there were currently no non-designated assets. It did, however, note that although there are no recorded archaeological remains recorded on the Cumbria Historic Environment Record '*prehistoric remains have been found within the 0.5km study area*' and that therefore '*the potential for remains to be present within the site boundary cannot be discounted*'.

3 Aims, Methodology and Presentation

The general objective of the geophysical survey was to provide information about the presence/absence, character, and extent of any archaeological remains identified within the PDA and to help inform further strategies, should they be required.

Specifically, the objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore determine the presence/absence and extent of any buried archaeological features; and
- to prepare a report summarising the results of the survey.

Magnetometer survey

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble 5800 model). Bartington Grad601 magnetic gradiometers were used during the survey, taking readings at 0.25m intervals on zig-zag traverses 1.0m apart within 30m by 30m grids, so that 3600 readings were recorded in each grid. These readings were stored in the memory of the instrument and later downloaded to computer for processing and interpretation. Geoplot 3 (Geoscan Research) software was used to process and present the data. Further details are given in Appendix 1.

Reporting

A general site location plan, incorporating the 1:50000 Ordnance Survey (OS) mapping, is shown in Figure 1. A large scale (1:2500) survey location plan, showing the processed data, is provided as Figure 2 with an overall interpretation of the data at the same scale included as Figure 3. The processed and minimally processed data, together with an interpretation of the survey results are presented in Figures 4 to 9 inclusive, at a scale of 1:1250.

Technical information on the equipment used, data processing and survey methodologies are given in Appendix 1 and Appendix 2. Appendix 3 describes the composition and location of the archive.

The survey methodology, report and any recommendations comply with guidelines outlined by English Heritage (David *et al.* 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All figures reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The figures in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All figures are presented to most suitably display and interpret the data from this site based on the experience and knowledge of Archaeological Services staff.

4 Results and Discussion (see Figures 4, 5 and 6)

Ferrous Anomalies

Ferrous anomalies, as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris or material is common on rural sites, often being present as a consequence of manuring or tipping/infilling. There is no obvious pattern or clustering to their distribution to suggest anything other than a random background scatter of ferrous debris in the plough-soil, except where stated below.

A series of high magnitude 'spikes' recorded across the northern part of the site locate boreholes.

Disturbance around the periphery of the survey areas is due to the proximity of ferrous material either in or forming part of the boundary.

Geological Anomalies

Throughout the site the magnetic background is fairly variable, hence the number of discrete anomalies of enhanced magnetic response. These anomalies are geological in origin being indicative of the variation in the composition of the superficial deposits and soils.

In the smaller survey area south of Eller Beck a cluster of much more extensive and broader anomalies are indicative of alluvium deposited following flooding of the beck.

Agricultural Anomalies

Throughout the site numerous linear trend anomalies on varying alignments are identified. All are indicative of agricultural activity. These anomalies are particularly prominent to the north-east of the site where an extensive and interconnecting series of anomalies clearly locates a system of field drains. To the west of the site a further pattern of drains is located. Other linear trend anomalies that do not obviously form a coherent pattern are considered more likely to reflect the alignment of ploughing although some of these may also be drains.

5 Conclusions

The magnetometer survey has identified anomalies indicative of recent agricultural practice, predominantly extensive field drainage and ploughing. Variation in the soils and superficial deposits and deposition of alluvium adjacent to Eller Beck also account for a large number of discrete anomalies. A series of boreholes is also recorded. No anomalies of archaeological potential have been recorded. Consequently, on the basis of the survey, the archaeological potential of the site is considered to be low.

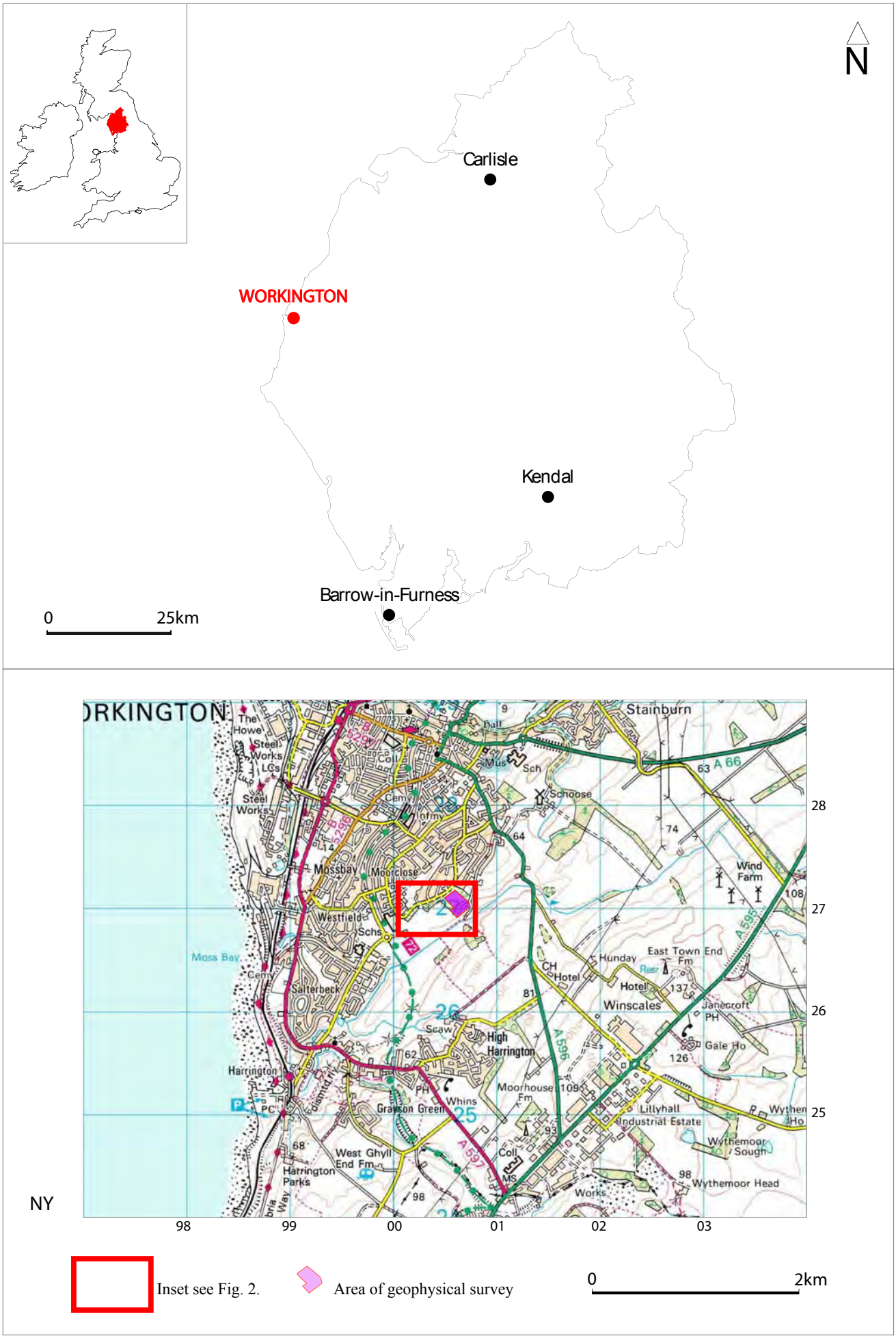

Fig. 1. Site location

PROPOSED DEVELOPMENT AREA

LOCATION AND DIRECTION OF PLATES

SECTOR BOUNDARY

UNSUITABLE FOR SURVEY

N

SECTOR 1:
SEE FIGS 4-6

FIELD 1

FIELD 2

FIELD 3

SECTOR 2:
SEE FIGS 7-9

1

2

3

4

2.0

-2.0

nT

5270 00

3000 00

3005 00

Archaeological Services W Y A S
PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

0 100m

Fig. 2. Survey location showing greyscale magnetometer data (1:2500 @ A3)

	PROPOSED DEVELOPMENT AREA
	SECTOR BOUNDARY

TYPE OF ANOMALY		INTERPRETATION
•	DIPOLAR ISOLATED	FERROUS MATERIAL
●	DIPOLAR ISOLATED	BOREHOLES/ PYLONS
	MAGNETIC DISTURBANCE	FERROUS MATERIAL
	MAGNETIC DISTURBANCE	OVERHEAD CABLES
	LINEAR TREND	FIELD DRAIN
	LINEAR TREND	AGRICULTURAL
	MAGNETIC ENHANCEMENT	GEOLOGY

N

SECTOR 1:
SEE FIGS 4-6

SECTOR 2:
SEE FIGS 7-9

5270 00

3000 00

3005 00

Archaeological Services W Y A S
PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

0 100m

Fig. 3. Overall interpretation of magnetometer data (1:2500 @ A3)

SECTOR BOUNDARY

N

5272 00

5270 00

3004 00

3006 00

2.0

-2.0

nT

Archaeological Services W Y A S
PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

0 40m

Fig. 4. Processed greyscale magnetometer data; Sector 1 (1:1250 @ A3)

SECTOR BOUNDARY

N

5272 00

5270 00

3004 00

3006 00

20.0 nT/cm

Archaeological Services W Y A S
PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

0 40m

Fig. 5. XY trace plot of minimally processed magnetometer data; Sector 1 (1:1250 @ A3)

SECTOR BOUNDARY

TYPE OF ANOMALY		INTERPRETATION
•	DIPOLAR ISOLATED	FERROUS MATERIAL
●	DIPOLAR ISOLATED	BOREHOLES/ PYLONS
	MAGNETIC DISTURBANCE	FERROUS MATERIAL
	MAGNETIC DISTURBANCE	OVERHEAD CABLES
	LINEAR TREND	FIELD DRAIN
	LINEAR TREND	AGRICULTURAL
	MAGNETIC ENHANCEMENT	GEOLOGY

N

5272**00**

5270**00**

3004**00**

3006**00**

Archaeological Services W Y A S
PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

0 40m

Fig. 6. Interpretation of magnetometer data; Sector 1 (1:1250 @ A3)

SECTOR BOUNDARY

N

5268 00

2.0

-2.0

nT

Archaeological Services W Y A S
PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

3004 00

3006 00

Fig. 7. Processed greyscale magnetometer data; Sector 2 (1:1250 @ A3)

0 40m

SECTOR BOUNDARY

N

5268 00

3004 00

3006 00

20.0 nT/cm

Archaeological Services W Y A S
PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

0 40m

Fig. 8. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1250 @ A3)

SECTOR BOUNDARY

N

5268 00

TYPE OF ANOMALY		INTERPRETATION
•	DIPOLAR ISOLATED	FERROUS MATERIAL
●	DIPOLAR ISOLATED	BOREHOLES/ PYLON
	MAGNETIC DISTURBANCE	FERROUS MATERIAL
	MAGNETIC DISTURBANCE	OVERHEAD CABLES
	LINEAR TREND	FIELD DRAIN
	LINEAR TREND	AGRICULTURAL
	MAGNETIC ENHANCEMENT	GEOLOGY

Archaeological Services W Y A S
PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

3004 00

3006 00

0 40m

Fig. 9. Interpretation of magnetometer data; Sector 2 (1:1250 @ A3)

Plate 1. General view of Field 1, looking north

Plate 2. General view of Field 2, looking west

Plate 3. Unsurveyable area of Field 3, looking north-east

Plate 4. General view of Field 3, looking north-east

Appendix 1: Magnetic survey - technical information

Magnetic Susceptibility and Soil Magnetism

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms. Areas of human occupation or settlement can then be identified by measuring the magnetic susceptibility of the topsoil because of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. The magnetic susceptibility of a soil can also be enhanced by the application of heat and the fermentation and bacterial effects associated with rubbish decomposition. The area of enhancement is usually quite large, mainly due to the tendency of discard areas to extend beyond the limit of the occupation site itself, and spreading by the plough. An advantage of magnetic susceptibility over magnetometry is that a certain amount of occupational activity will cause the same proportional change in susceptibility, however weakly magnetic is the soil, and so does not depend on the magnetic contrast between the topsoil and deeper layers. Susceptibility survey is therefore able to detect areas of occupation even in the absence of cut features. On the other hand susceptibility survey is more vulnerable to the masking effects of layers of colluvium and alluvium as the technique, using the Bartington system, can generally only measure variation in the first 0.15m of ploughsoil.

Types of Magnetic Anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

Methodology: Gradiometer Survey

The main method of using the fluxgate gradiometer for commercial evaluations is referred to as ***detailed survey*** and requires the surveyor to walk at an even pace carrying the instrument within a grid system. A sample trigger automatically takes readings at predetermined points, typically at 0.25m intervals, on traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation.

During this survey a Bartington Grad601 magnetic gradiometer was used taking readings on the 0.1nT range, at 0.25m intervals on zig-zag traverses 0.5m apart within 30m by 30m square grids. The instrument was checked for electronic and mechanical drift at a common point and calibrated as necessary. The drift from zero was not logged.

Data Processing and Presentation

The detailed gradiometer data has been presented in this report in XY trace and greyscale formats. In the former format the data shown is 'raw' with no processing other than grid biasing having been done. The data in the greyscale images has been interpolated and selectively filtered to remove the effects of drift in instrument calibration and other artificial data constructs and to maximise the clarity and interpretability of the archaeological anomalies.

An XY plot presents the data logged on each traverse as a single line with each successive traverse incremented on the Y-axis to produce a 'stacked' plot. A hidden line algorithm has been employed to block out lines behind major 'spikes' and the data has been clipped. The main advantage of this display option is that the full range of data can be viewed, dependent on the clip, so that the 'shape' of individual anomalies can be discerned and potentially archaeological anomalies differentiated from 'iron spikes'. Geoplot 3 software was used to create the XY trace plots.

Geoplot 3 software was used to interpolate the data so that 3600 readings were obtained for each 30m by 30m grid. The same program was used to produce the greyscale images. All greyscale plots are displayed using a linear incremental scale.

The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits.

Appendix 2: Survey location information

The site grid was laid out using a Trimble dual frequency Global Positioning System (GPS) with two Rovers (Trimble 5800 models) working in real-time kinetic mode. The accuracy of such equipment was better than 0.02m. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if co-ordinates are measured off for relocation purposes.

Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

Appendix 3: Geophysical archive

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Microsoft Word 2000), and graphics files (Adobe Illustrator CS2 and AutoCAD 2008) files; and
- a full copy of the report.

At present the archive is held by Archaeological Services WYAS although it is anticipated that it may eventually be lodged with the Archaeology Data Service (ADS). Brief details may also be forwarded for inclusion on the English Heritage Geophysical Survey Database after the contents of the report are deemed to be in the public domain (i.e. available for consultation in the Cumbria Historic Environment Record).

Appendix 4: OASIS Form

OASIS DATA COLLECTION FORM: England

OASIS ID: archaeol11-203601

Project details

Project name	Ashfield Road, Workington
Short description of the project	A geophysical (magnetometer) survey covering approximately 10 hectares, was carried out on land south of Ashfield Road South on the southern outskirts of Workington, to support a planning application for the proposed development of the site for housing. The survey has recorded anomalies indicative of extensive field drainage throughout the site and evidence of alluvial flood deposits to the south of Eller Beck. No anomalies of archaeological significance have been identified. Consequently, on the basis of the survey, the archaeological potential of the site is considered to be low.
Project dates	Start: 02-02-2015 End: 04-02-2015
Previous/future work	Not known / Not known
Any associated project reference codes	ARW15 - Sitecode
Any associated project reference codes	4358 - Contracting Unit No.
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 4 - Character Undetermined
Monument type	N\A None
Monument type	N\A None
Significant Finds	N\A None
Significant Finds	N\A None
Methods & techniques	"Geophysical Survey"
Development type	Housing estate
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Not known / Not recorded
Solid geology (other)	Lower Pennine Coal Measures

Drift geology (other)	Till
Techniques	Magnetometry

Project location

Country	England
Site location	CUMBRIA ALLERDALE WORKINGTON Ashfield Road, Workington
Study area	10.00 Hectares
Site coordinates	NY 0050 2700 54.6281883154 -3.54144376123 54 37 41 N 003 32 29 W Point

Project creators

Name of Organisation	Archaeological Services WYAS
Project brief originator	WYG
Project design originator	Archaeological Services WYAS
Project director/manager	Harrison, S.
Project supervisor	Evans, M.
Type of sponsor/funding body	Consultant

Project archives

Physical Archive Exists?	No
Digital Archive recipient	N/A
Digital Contents	"other"
Digital Media available	"Geophysics"
Paper Archive Exists?	No

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Ashfield Road, Workington, Cumbria: Geophysical Survey
Author(s)/Editor(s)	Webb, A.
Other bibliographic details	Report Number 2713
Date	2015
Issuer or publisher	ASWYAS
Place of issue or	Morley

publication	
Description	A4 Blue comb bound report
Entered by	Sam Harrison (sharrison@aswyas.com)
Entered on	12 February 2015

OASIS:

Bibliography

British Geological Survey, 2015. www.bgs.ac.uk/discoveringGeology/geology OfBritain/viewer.html. (Viewed January 16th 2015)

Chartered Institute for Archaeologists, 2014. *Standard and Guidance for archaeological geophysical survey.* CIfA

David, A., N. Linford, P. Linford and L. Martin, 2008. *Geophysical Survey in Archaeological Field Evaluation: Research and Professional Services Guidelines (2nd edition)* English Heritage

DCLG, 2012. *National Planning Policy Framework*. Department of Communities and Local Government

Harrison, S. 2014. *Ashfield Road, Workington, Cumbria: Geophysical Survey Project Design.* Unpublished ASWYAS document

Newman, R., 2014. *Ashfield Road, Workington, Cumbria: Archaeological Desk-based Assessment*. Unpublished Report No. CS00028. Wardell Armstrong Archaeology

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