Land at Snow Hill, Wrenthorpe, West Yorkshire

Geophysical Survey

Summary

A cart-based geophysical (magnetometer) survey, covering approximately 8 hectares, was carried out on agricultural land at Snow Hill, Wrenthorpe, West Yorkshire. An additional 3 hectares was surveyed using conventional hand held survey equipment as it was unsuitable for cart-based magnetometery. The survey was undertaken prior to the proposed development of the site. A geological anomaly across the south of the site relates to the undulatory nature of the field. A service has been identified orientated across the site parallel with the geological trend. Former field boundaries have been identified, and two enclosures have been potentially recognised in the dataset. A high magnetic response, close to an area of former quarrying, might be a thermos-remnant signature indicative of a former kiln which occur within the area. Therefore the archaeological potential of this site is deemed to be medium to high.

WYAS
Archaeological Services

Report Information

Client:	Prospect Archaeology Ltd.
Address:	Prospect House, Garden Lane, Sherburn-in-Elmet, Leeds, LS25 6AT
Report Type:	Geophysical Survey
Location:	Wrenthorpe
County:	West Yorkshire
Grid Reference:	SE 32429 22257
Period(s) of activity:	Prehistoric to modern
Report Number:	2853
Project Number:	6326
Site Code:	SNO16
OASIS ID:	archaeol11-245517
Date of fieldwork:	February 2016
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Project Management:	Emma Brunning BA MCIfA
Fieldwork:	Becky Goulding BSc MSc
	Marina Rose BSc
Report:	Christopher Sykes BA MSc
Illustrations:	Emma Brunning
Photography:	Becky Goulding
Research:	Becky Goulding

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

Nepshaw Lane South, Morley, Leeds LS27 7JQ
Telephone: 0113 383 7500.
Email: admin@aswyas.com

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1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by Prospect Archaeology Ltd. (the Client) on behalf of their client Persimmon Homes, to undertake a cart-based geophysical (magnetometer) survey of land to the east of London Road, Wrenthorpe, West Yorkshire, to inform a proposed planning application. Guidance contained within the National Planning Policy Framework (DCLG 2012) was followed, in line with current best practice (CIfA 2014; David *et al*. 2008) as detailed in the project design (Goulding 2016). The survey was carried out between the 24th to 26th February 2016 to provide additional information on the archaeological resource of the Proposed Development Area (PDA).

Site location, topography and land-use

The PDA consists entirely of an arable field of approximately 11 hectares, bound by Red Hall Lane to the north, housing to the west and south and agricultural land to the east. The site is located approximately 800m to the southeast of the village of Wrenthorpe and approximately 1.5km north of Wakefield (see Fig. 1). The survey area is centred at SE 32429 22257 at a height above Ordnance Datum (aOD) of approximately 59m in the southwestern corner and rising to 66m in the northeastern corner. At the time of survey the field was under cover of stubble with approximately 3ha that had been ploughed (see plates).

Soils and geology

The underlying geology of the site is sandstone, specifically that of the Pennine Middle Coal Measures formation. This is a sedimentary bedrock formed during the Carboniferous period. The rocks were formed in a local environment previously dominated by lakes and swamps (BGS 2016). The geology is overlain by soil association Dale (712a), a slowly permeable and seasonally waterlogged fine loam of silty and clayey soils (SSEW 1983).

2 Archaeological Background

In the 16th and 17th centuries Wrenthorpe, or 'Potovens' as the place was known was the centre of a very large pottery making industry, taking place within the confines of the extensive woodland known as The Outwood. Excavations in the 1980's prior to the development of a road improvement scheme revealed numerous kilns and pottery making tenements (Moorhouse 1992). Recent excavations and geophysical surveys near to this current survey have also identified further kiln structures.

3 Aims and Methodology

The main aim of the geophysical survey was to provide sufficient information to enable an assessment to be made of the impact of the development on potential sub-surface archaeological remains and for further evaluation or mitigation proposals, if appropriate, to be recommended. To achieve this aim, a magnetometer survey covering all amenable parts of the PDA was undertaken (see Fig. 2).

The general 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 magnetometer survey, for the majority of the site was undertaken using a Sensys Magneto MXPDA cart-based instrument. The instrument has 5 fluxgate gradiometers spaced 0.5m apart with readings recorded at 20Hz. The gradiometers have a range of recording between 0.1nT and 10,000nT. They are linked to a Trimble R6 RTK dGPS system with data recorded by Sensys Magneto MXPDA software on a rugged PDA device. The data was stored on an SD memory card within the PDA and later downloaded to a computer for processing and interpretation. MAGNETO (Sensys Gmbh) and TerraSurveyor V3.0.25.0 software was used to process and present the data.

Where ground was not suitable for the cart-based instrument the survey was undertaken using Bartington Grad601 magnetic gradiometers. These were employed 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. The grid was laid out using a Trimble VRS differential Global Positioning System (Trimble 5800 model). Further details are given in Appendix 1.

Data processing

The gradiometer data have been presented in this report in greyscale formats. The data in the greyscale images have 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. TerraSurveyor V3.0.25.0 software was used to process and present the data recorded by the cart-mounted system. Geoplot 3 (Geoscan Research) software was used to process and present the Bartington data.

Reporting

A general site location plan, incorporating the 1:50000 Ordnance Survey (OS) mapping, is shown in Figure 1. Figure 2 displays processed magnetometer data at a scale of 1:2500 and Figure 3 shows the interpretation at the same scale. The processed data, together with an interpretation of the survey results are presented in Figures 4 and 7 inclusive at a scale of 1:1000.

Technical information on the equipment used, data processing and survey methodologies are given in Appendix 1. Technical information on locating the survey area is provided in Appendix 2. Appendix 3 describes the composition and location of the archive. A copy of the completed OASIS form is included in Appendix 4.

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 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 3 to 7)

The background levels of the site are magnetically 'noisey' which can be seen in the greyscale plots. The plotting levels of the data have been widened more than normal for display purposes.

Ferrous anomalies

Ferrous anomalies, as individual 'spikes', or as large discrete areas 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 in this survey to suggest anything other than a random background scatter of ferrous debris in the plough-soil. There are small areas of increased magnetic disturbance along three of the survey edges, likely to be caused by the accumulation of ferrous material against the field boundaries. A modern service pipe crosses the survey area from the north-west corner to the eastern side of the PDA, with a second service located along the northern boundary. A number of borehole pipes can be seen within the data, these have been marked on the interpretation diagram as (**BH**).

Geological anomalies

A band of anomalies in the southern section of the data are typical of responses associated with geology and are thought to be caused by variations in the depth and composition of the soils and the superficial deposits from which they derive. It is likely that they are associated with the topography of the site.

In addition anomalies considered to be part of former quarrying within the PDA, and closely associated with a high magnitude anomaly (**P2**) indicative of a thermos-remnant response, has been identified.

Agricultural anomalies

The survey is dominated by the presence of modern ploughing of the area, which is aligned on an approximately north-south axis, with the addition of areas of ploughing perpendicular to this at the southern boundaries of the survey area. These anomalies are distinguishable as modern agricultural activity by their regular appearance and tight parallel spacing. As a cultivation practice, ploughing disturbs the subsoil causing variations in the magnetic susceptibility of the soil. As the furrows are backfilled, the magnetic signal of the infill differs from that of the surrounding area. These types of anomalies are not considered to be of archaeological interest.

A number of linear anomalies with stronger responses have been interpreted as old field boundaries, which represent former field systems. Some of these boundaries compare to those shown on old mapping dating from 1893 (Old-Maps 2016)

Possible Archaeology

A number of isolated linear trends of possible archaeological origin have been highlighted across the site. They may be the remnants of former enclosures, but the low magnitude, and broadly comparable orientation to the modern ploughing regime mean that positive identification cannot be made.

Two linear anomalies (**P1**) have been identified within the rectilinear enclosure (**A1**). Because of their circular nature and the relationship to the enclosure they have been identified as possible archaeology. The faint magnetic signature, in comparison to the enclosure means that a definitive interpretation cannot be made at this stage.

A high magnetic response (**P2**) has been identified to the east of the enclosure, and is tentatively interpreted as being a thermos-remnant response indicative of a kiln. A number of previous archaeological investigations with a 1km radius of the site have also identified responses of similar magnitude and shape. However this anomaly cannot be positively identified as a kiln, orientated as it is along a former field boundary and may be a collection of material accumulated as a result of the boundary removal.

A fragmentary linear (**P3**), orientated north/south has been identified and may be a former field boundary. However, it may also be related to an unofficial tree line for a former copse which was removed in the early 20th century (Old-Maps 2016).

Further possible archaeological responses can be seen to the east of (**P3**). These consist of a rectilinear enclosure (**P4**) in which (**P3**) may form the western extent, a pit-like response (**P5**) and a ditch length (**P6**).

Archaeology

An enclosure (**A1**) and (**A2**) has been positively identified to the west of the survey area. It is a clearly defined former structure, measuring 55m by 40m and may have been slightly truncated by the service pipe which cuts across the site. It may be related to the industrial activity that has been illustrated across the site, namely the possible kiln (**P2**), and secondary enclosure to the east (**P4**).

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.

5 Conclusions

An enclosure has been identified which is located in a prominent position on the plateau above the geological band which runs diagonally across the southwest corner of the survey area. Its relation to the possible archaeological anomalies across and the putative kiln suggests that the anomalies recorded relate to pottery production either directly or in a supporting function. A likely second enclosure has also been identified in the data, which again maybe associated with industrial activity. An earlier date for the enclosures perhaps either Iron Age or Romano-British at this stage cannot be ruled out.

In addition to the possible post-medieval kiln activity, there may be evidence of other activities, such as quarrying and the exploitation of a former copse, which may have been used in the pottery production process.

Based upon the geophysical survey the archaeological potential of the site is medium to high, as it has the potential to represent a microcosm of pottery manufacture in the area, and the interactivity of various industries during the late medieval and post-medieval periods.

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.

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 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 magnetometer survey was undertaken using a Sensys Magneto MXPDA cart-based instrument. The instrument has 5 fluxgate gradiometers spaced 0.5m apart with readings recorded at 20Hz. The gradiometers have a range of recording between 0.1nT and 10,000nT. They are linked to a Trimble R6 RTK dGPS system with data recorded by Sensys Magneto MXPDA software on a rugged PDA device. The data was stored on an SD memory card

within the PDA and later downloaded to a computer for processing and interpretation. MAGNETO (Sensys Gmbh) and TerraSurveyor V3.0.25.0 software was used to process and present the dataData Processing and Presentation

The detailed gradiometer data has been presented in this report in processed greyscale format. 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.

TerraSurveyor V3.0.25.0 was used to compensate (destripe) interpolate and clip the data. 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

An initial survey station was established using a Trimble VRS differential Global Positioning System (Trimble R6 model). The cart data was geo-referenced using the geo-referenced survey station with a Trimble RTK differential Global Positioning System (Trimble R6 model). The accuracy of this equipment is better than 0.01m. The survey grids were then super-imposed onto a base map provided by the client to produce the displayed block locations. 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 hard copies of the mapping rather than using the digital co-ordinates.

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 West Yorkshire Environment Record).

Appendix 4: Oasis form

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