Land west of Monkhill Lane
Pontefract
West Yorkshire

Geophysical Survey

Report no. 2638

August 2014

Client: Harron Homes Ltd

Land west of Monkhill Lane
Pontefract
West Yorkshire

Geophysical Survey

Summary

A geophysical (magnetometer) survey covering approximately 1 hectare was carried out on land to the west of Monkhill Lane, Pontefract, prior to the determination of a planning application for the proposed development of the site for housing. The survey has identified anomalies which are consistent with the agricultural use of the land, with ridge and furrow cultivation indicating post-medieval and possibly earlier land-use. No anomalies of archaeological potential have been identified. Therefore, on the basis of the survey, the archaeological potential of the site is thought to be low.

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Report Information

Client:	Harron Homes Ltd
Address:	Colton House, Temple Point, Bullerthorpe Lane, Leeds, LS15 9JL
Report Type:	Geophysical Survey
Location:	Pontefract
County:	WestYorkshire
Grid Reference:	SE 456 235
Period(s) of activity:	-
Report Number:	2638
Project Number:	4273
Site Code:	MHP14
OASIS ID:	archaeol11-188284
Planning Application No.:	14/00458/FUL
Museum Accession No.:	n/a
Date of fieldwork:	August 2014
Date of report:	August 2014
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Photography:	Mark Evans
Research:	n/a

Authorisation for distribution: --

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1 Introduction

Archaeological Services WYAS (ASWYAS) was commissioned by Daniel Starkey of Harron Homes Ltd (the Client), to undertake a geophysical (magnetometer) survey of land to the west of Monkhill Lane, Pontefract. The work is being undertaken prior to the determination of a planning application (Planning Ref. 14/00458/FUL) for a proposed housing development. The work was undertaken in accordance with guidance contained within the National Planning Policy Framework (2012), in line with current best practice (IfA 2013; David *et al.* 2008). The survey was carried out on August 1st 2014 to provide additional information on the archaeological resource of the site.

Site location, topography and land-use

The Proposed Development Area (PDA) is situated to the west of Monkhill Lane, north of Pontefract, centred at SE 456 235 (see Fig. 1). The site comprises of the rear garden of a property called Castlebar to the north of a track and a paddock to the south and covers approximately 2.1 hectares. However, at the time of the survey, only the paddock was suitable for geophysical survey reducing the survey area to 1 hectare. The survey area was under grass (see Plate 1 and Plate 2), and was flat at between 35m above Ordnance Datum (aOD) and 36m aOD.

Soils and geology

The underlying bedrock comprises Pennine Middle Coal Measures Formation – mudstone, siltstone and sandstone. No superficial deposits are recorded (British Geological Survey 2014). The soils in this area are unclassified (Soil Survey of England and Wales 1983).

2 Archaeological Background

A Heritage Assessment (Prospect Archaeology 2014) has identified an extensive network of Iron Age and/or Roman field systems and settlements in the vicinity of the site (see Fig. 2; HER 966, HER 976 – 9, HER1287 – 8), although none are recorded within the proposed development area. The site is thought to have been in agricultural use throughout the medieval and post-medieval periods until the 19th century, when sand extraction commenced within the north of the PDA. No extraction is recorded within the south of the PDA, although the presence of quarrying in the north (HER 10261) and a brickworks to the south of the site (HER 7368 and HER 7515) increases the potential of impact from these industries.

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 specific area to be impacted by the proposed development 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 (1:4000) survey location plan is provided as Figure 2 and shows cropmark data from the National Mapping Programme. The processed and minimally processed data, together with interpretation graphics of the survey results are presented in Figures 3, 4 and 5, at a scale of 1:1000.

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 a Project Design (Harrison, 2014), with guidelines outlined by English Heritage (David *et al.* 2008) and by the Institute for Archaeologists (IfA 2013). 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 3, 4 and 5)

Generally an elevated level of background response has been identified throughout the survey area with numerous anomalies being identified. The anomalies fall into a number of different types and categories according to their origin and these are discussed below and cross-referenced to specific examples and locations within the site, where appropriate.

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 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.

Broad magnetic disturbance are noted around the perimeter of the site. This disturbance is caused by the proximity of ferrous material within or forming part of the adjacent field boundaries. Magnetic disturbance along the north-eastern field boundary corresponds to the former site of farm buildings which are visible on recent satellite imagery. It is possible that any low magnitude anomalies of archaeological potential, if present, may be masked or obscured within areas affected by magnetic disturbance, although there is no reason to assume that this is the case on this site.

Agricultural Anomalies

A series of fragmentary north/south aligned linear anomalies are typical of former ploughing activity. The anomalies are caused by the contrast between the soil-fill of the former furrows and the surrounding soils. The spacing between the former furrows, between 7m and 8m, and is consistent with the medieval and post-medieval practice of ridge and furrow cultivation, although this is likely of historical interest rather than archaeological significance

Geological Anomalies

The magnetic background is variable across the site with numerous discrete anomalies of enhanced magnetic response giving a 'speckled' appearance to the data. In theory, any of these anomalies could be archaeological in origin although the sheer number of anomalies and lack of any coherent pattern precludes against an archaeological interpretation. It is likely that the anomalies are due to the fracturing and redistribution of the bedrock materials – mudstone, siltstone and sandstone, throughout the topsoil.

5 Conclusions

Despite the presence of known heritage assets in the surrounding landscape, no anomalies of archaeological potential have been identified within the proposed development area. The anomalies identified are consistent with the agricultural use of the land in the post-medieval and perhaps medieval periods.

On the basis of the geophysical survey, the archaeological potential of the site is thought to be low.

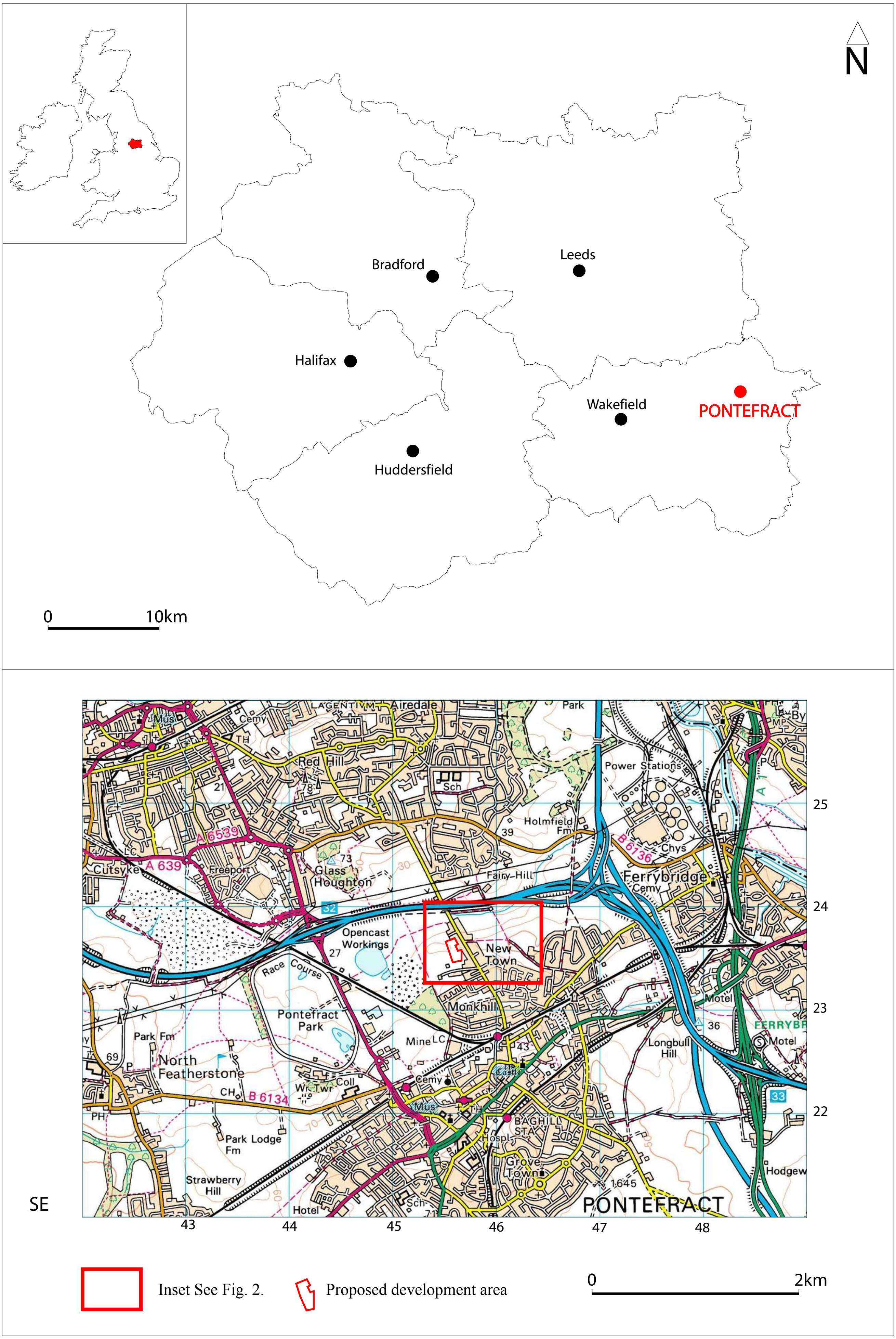

Fig. 1. Site location

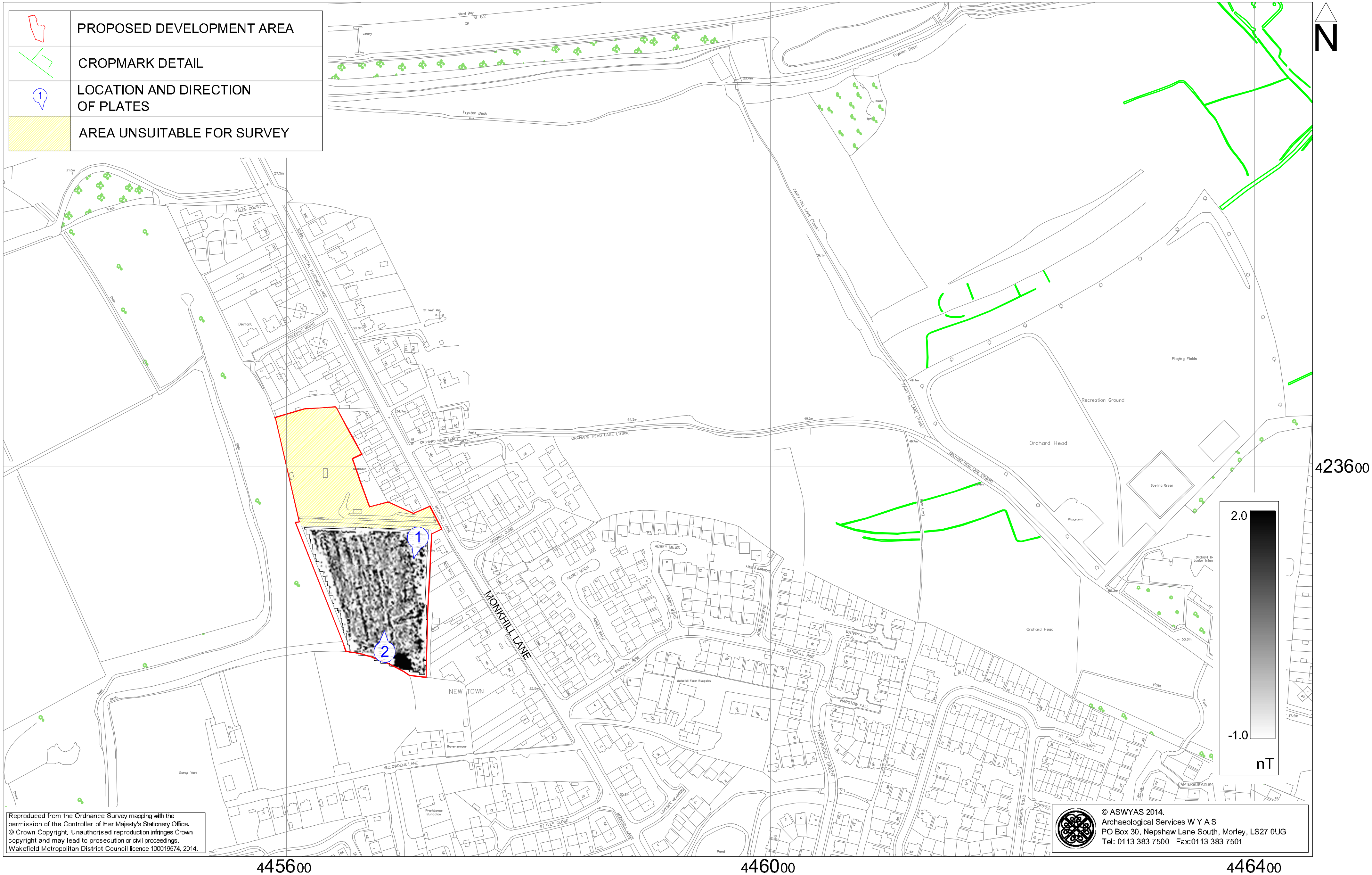

Fig. 2. Survey location showing greyscale magnetometer data and cropmark data (1:4000 @ A4)

0 100m

Fig. 3. Processed greyscale magnetometer data (1:1000 @ A4)

Fig. 4. XY trace plot of minimally processed magnetometer data (1:1000 @ A4)

Fig. 5. Interpretation o magnetometer data (1:1000 @ A4)

Plate 1. General view of survey area, looking south-west

Plate 2. General view of survey area, looking north

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 so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue 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: Magnetic Susceptibility Survey

There are two methods of measuring the magnetic susceptibility of a soil sample. The first involves the measurement of a given volume of soil, which will include any air and moisture that lies within the sample, and is termed volume specific susceptibility. This method results in a bulk value that it not necessarily fully representative of the constituent components of the sample. For field surveys a Bartington MS2 meter with MS2D field loop is used due to its speed and simplicity. The second technique overcomes this potential problem by taking into account both the volume and mass of a sample and is termed mass specific susceptibility. However, mass specific readings cannot be taken in the field where the bulk properties of a soil are usually unknown and so volume specific readings must be taken. Whilst these values are not fully representative they do allow general comparisons across a site and give a broad indication of susceptibility changes. This is usually enough to assess the susceptibility of a site and evaluate whether enhancement has occurred.

Methodology: Gradiometer Survey

There are two main methods of using the fluxgate gradiometer for commercial evaluations. The first of these is referred to as ***magnetic scanning*** and requires the operator to visually identify anomalous responses on the instrument display panel whilst covering the site in widely spaced traverses, typically 10m apart. The instrument logger is not used and there is therefore no data collection. Once anomalous responses are identified they are marked in the field with bamboo canes and approximately located on a base plan. This method is usually employed as a means of selecting areas for detailed survey when only a percentage sample of the whole site is to be subject to detailed survey.

The disadvantages of magnetic scanning are that features that produce weak anomalies (less than 2nT) are unlikely to stand out from the magnetic background and so will be difficult to detect. The coarse sampling interval means that discrete features or linear features that are parallel or broadly oblique to the direction of traverse may not be detected. If linear features are suspected in a site then the traverse direction should be perpendicular (or as close as is possible within the physical constraints of the site) to the orientation of the suspected features. The possible drawbacks mentioned above mean that a 'negative' scanning result should be validated by sample detailed magnetic survey (see below).

The second method is referred to as ***detailed survey*** and employs the use of a sample trigger to automatically take readings at predetermined points, typically at 0.25m intervals, on zig-zag traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation. Detailed survey allows the visualisation of weaker anomalies that may not have been detected by magnetic scanning.

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 West Yorkshire Historic Environment Record).

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