Proposed Hulands Quarry Extension
near Bowes
County Durham

Geophysical Survey

January 2007

Report No. 1643

Headland Archaeology Ltd

Proposed Hulands Quarry Extension

County Durham

Geophysical Survey

Contents

Summary

A geophysical (magnetometer) survey was carried out on land east of Hulands Quarry, in advance of the proposed eastward expansion of limestone extraction operations. The survey covered 18 hectares and was constrained by the A66 to the south and the A67 to the north, both former Roman roads. However, besides extensive evidence of ridge and furrow ploughing no archaeological anomalies have been identified. On the basis of the geophysical survey the site is considered to have a low archaeological potential.

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Archaeological Services WYAS

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1. Introduction and Archaeological Background

1.1 Archaeological Services WYAS was commissioned by Mark Roberts of Headland Archaeology Ltd to carry out a geophysical (magnetic) survey on land immediately east of Hulands Quarry in advance of the proposed eastward extension of the limestone quarrying operation.

1.2 The site is located approximately 2km east of Bowes (see Fig. 1) and 4km to the west of Barnard Castle, centred at NY 0190 1400. The survey area covered approximately 18 hectares and comprised fourteen fields situated between the A66 to the south and the A67 to the north. To the north the site is bounded by Thorsgill Beck, to the west by the existing quarry workings, to the south by a redundant section of the A66 and to the east by field boundaries (see Fig. 2).

1.3 At the time of the fieldwork (between November 27th and November 30th 2006) all the fields were under permanent pasture. Tree screens had been planted around the southern and eastern boundaries (see Fig. 2). Detailed survey was not undertaken in these areas although scanning was carried out. No problems were encountered during the survey.

1.4 Topographically, the site is located on the dip slope of Kilmond Scars, an eastward trending limestone escarpment that undulates between approximately 290m Above Ordnance Datum (AOD) and 260m AOD. The underlying solid geology comprises Great Limestone overlain by soils of the Dunkeswick association. These soils are described as slowly permeable, seasonally waterlogged, fine loams.

1.5 A Cultural Heritage Assessment of the site (Headland Archaeology Ltd 2006) identified four reported sites along the southern limit of the proposed extension (survey) area. These comprised three small limestone quarries and a reference to a medieval or post-medieval cross, no longer present. In the wider study area the main potential relates to the two Roman roads which are fossilised in the landscape by the current routes of the A66 and A67, immediately north and south of the application area. Ridge and furrow earthworks are still visible in some of the fields and the current field boundaries also exhibit the characteristic S-shape indicative of this medieval/post-medieval farming technique.

2. Methodology and Presentation

2.1 The general aim of the survey was to obtain information that would contribute further to an evaluation of the archaeological potential of the site by determining the presence or absence of buried archaeological remains in the defined survey area.

2.2 More specific objectives were to:-

- provide information about the nature and possible interpretation of any magnetic anomalies identified by the survey.
- clarify the extent of any possible archaeological remains.

2.3 In order to achieve this aim it was proposed that magnetic scanning would be undertaken across the whole of the site, an area of approximately 18 hectares.

2.4 Scanning is a good method for quickly identifying areas of archaeological potential and is usually employed as a means of selecting areas for detailed magnetic survey, particularly on large green field sites or along road corridors. 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 identify. However, there is generally a very good magnetic contrast between infilled cut features, such as ditches or pits, and the surrounding soils on limestone geology.

2.5 The technique may also be of limited use on sites where there is a large variation in the magnetic background, either as a consequence of the prevailing soils and geology or due to modern ferrous contamination. The relatively coarse sampling interval also means that discrete features such as kilns or features associated with unenclosed settlement may not be identified. Linear features that are parallel or broadly oblique to the direction of traverse may also not be detected. The direction of the scanning traverses is shown on Figure 2. These drawbacks mean that ‘negative’ results from magnetic scanning should be checked with an agreed amount of detailed magnetic survey in order to minimise the chance of the scanning giving an inaccurate impression of the archaeological potential of any given site.

2.6 The second objective was to be achieved by undertaking selected detailed survey of any areas of potential revealed by the scanning. Apparently ‘blank’ areas, as well as those identified as of potential following the scanning, were to be targeted in order to validate a ‘negative’ scanning result. No detailed sample block was smaller than 0.24ha (an area equivalent to 40m by 60m) in order to aid interpretation of the results. In this case detailed survey was undertaken in eleven blocks covering 3.7 hectares in total, 20% of the total site area.

2.7 Detailed survey employs the use of a sample trigger to automatically take 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 downloaded to computer for processing and interpretation. Further details are given in Appendix 1. Detailed survey allows the visualisation of weaker anomalies that may not have been readily identifiable by magnetic scanning.

2.8 A Bartington Grad601 magnetic gradiometer was used during the survey with readings being taken at 0.25m intervals on zig-zag traverses 1m apart within 20m by 20m grids. The readings were stored in the memory of the instrument and later downloaded to computer for processing and interpretation using Geoplot 3 software.

2.9 The survey methodology, report and any recommendations comply with guidelines outlined by English Heritage (David 1995) and by the IFA (Gaffney, Gater and Ovenden 2002) and were agreed with the Assistant Archaeology Officer for Durham County Council, advisor to the local planning authority, prior to the start of the survey. All figures reproduced from Ordnance Survey mapping are done so with the permission of the controller of Her Majesty’s Stationery Office (© Crown copyright).

2.10 A general site location plan, incorporating the 1:50000 Ordnance Survey mapping, is shown in Figure 1. Figure 2 shows the processed magnetometer data superimposed onto a digital map base at a scale of 1:4000. The processed (greyscale) and unprocessed (XY trace plot) data, together with accompanying interpretation diagrams, are presented in Figures 3 to 8 inclusive at a scale of 1:1000.

2.11 Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes the composition and location of the site archive.

3. Results

3.1 Magnetic Scanning (Unrecorded Survey)

Summary

3.1.1 A brief walkover showed ridge and furrow to be extant across much of the site aligned north to south parallel with the long axis of the current field system. In order to minimise the possibility that the relatively strong magnetic anomalies caused by the ridge and furrow did not mask the presence of any other magnetic anomalies the scanning traverses were also aligned north to south along the bottom of the furrows where possible. In general the ridge and furrow was better preserved to the south of the site and this was reflected in the strength of the resultant anomalies (see Fig. 2). The magnetic background also varied between the northern and southern halves of the site broadly correlating with the degree of slope.

Field 1

3.1.2 There was no ridge and furrow visible in this field. The background was fairly low, with readings fluctuating between –1nT and +1nT. No anomalous responses or linear anomalies were noted. However, there were numerous ‘iron spike’ anomalies indicative of buried ferrous objects. Quarry staff stated that this field had been used in the recent past as a topsoil dump. Due to this and the lack of any significant anomalies, the use of recorded magnetic survey was considered inappropriate for this field.

Field 2

3.1.3 Slight remnants of ridge and furrow were still visible to the east of the field. The magnetic background fluctuated between 0nT and +2nT with no significant anomalies detected.

Field 3

3.1.4 The magnetic background varied here between 0nT and +3nt with no significant anomalies detected.

Field 4

3.1.5 The southern part of this field had been recently planted with young trees. Scanning was undertaken here but there was extensive magnetic disturbance as there was within the planted zone at the southern end of Fields 7 and 8. Across the remainder of the field the magnetic background varied between -1nT and +1.5nT with extant ridge and furrow across most of the field. Several discrete anomalies were detected to the north and east of a shallow depression.

Field 5

3.1.6 The general background was fairly low with readings between -0.5nT to +1nT but varying between -2nT in the furrows and +4nT on the ridges across the extant earthworks.

Field 6

3.1.7 In Field 6 the background varied between -1nT and +0.5nT in the northern half of the field. To the south the land was elevated forming a mound. There was significant magnetic disturbance over this raised area with most readings several nT above the magnetic background noted to the north of the field. Linear anomalies aligned broadly north-west to south-east were also noted, however most were difficult to trace, with the magnetic scanning providing no clear indication as to the exact nature of these anomalies.

Field 7

3.1.8 The general background varied between -0.5nT and +0.5nT but where the ground rose at the northern end of the field the readings varied within a range of -6nT to +6nT.

Field 8

3.1.9 The magnetic background in this field fluctuated between -1nT and +2nT. A metalled track runs through the field from north to south and there was a tree screen to the southern and eastern boundaries. Magnetic interference from a power line, track and the new tree screens limited scanning. No anomalies were identified other than those caused by ridge and furrow ploughing.

Field 9

3.1.10 The track, power lines and tree screen were also present in Field 9 again limiting the extent of the scanning in the eastern half of the field. No anomalies were identified.

Field 10

3.1.11 In Field 10 the magnetic background varied between -2nT and 0nT with no anomalies noted during the scanning. An old boundary was still visible aligned east/west with ridge and furrow earthworks also present aligned north/south.

Fields 11 and 12

3.1.12 The magnetic background in Fields 11 and 12 varied between -1.5nT and +1nT. There was no ridge and furrow visible within either of these fields nor were any significant anomalies identified.

Field 13

3.1.13 The magnetic background in Field 13 varied between -0.5nT and +1.5nT. Ridge and furrow was still extant aligned north/south. No significant anomalies were noted during scanning.

Field 14

3.1.14 The magnetic background was the same as noted in Field 13. There was a lot of magnetic disturbance in the north-east corner of the field due to a pile of concrete, sheet metal and old stone. A possible linear was detected running broadly north/south across the field for about 20m to 30m with readings between –4nT and +3nT. No additional anomalies other than those attributable to ridge and furrow ploughing were identified.

3.2 Detailed (Recorded) Magnetic Survey

The Southern Half of the site - Fields 4, 6, 7, 8 and 14 (Figs 3, 4 and 5)

3.2.1 The magnetic scanning showed the areas within the new tree plantation to be unsuitable for detailed magnetic survey. In order to minimise the risk of missing any features associated with the Roman road immediately to the south of the site, three survey blocks were positioned as close as possible to the southern boundary whilst maintaining a buffer to avoid the magnetic disturbance caused by the wire mesh fencing surrounding the tree screen.

Field 4

3.2.2 An area of variable magnetic background has been noted in the southern block in Field 4. Vague linear trends aligned north-west to south-east in this area of changeable readings can also just be discerned. The cause of these anomalies is uncertain but is considered likely to be due to the local geology.

3.2.3 The northern block in Field 4 was placed in order to gather further information on the cluster of discrete anomalies located during the magnetic scanning (see para 3.1.5 above), in addition to covering the break of slope at the base of a mound that rises to the east of the field. The discrete anomalies located during the scanning were confirmed located around the eastern edge of a shallow depression (indicated on the Ordnance Survey mapping). This feature is considered to be modern in origin. The anomalies due to the ridge and furrow earthworks are particularly prominent to the east of the survey block.

Field 6

3.2.4 Detailed magnetic survey was undertaken over the southern half of Field 6 in order to determine the nature of the linear anomalies and magnetic disturbance identified during the scanning and a number of linear trend anomalies aligned broadly from north-west to south-east have been confirmed. The cause of these anomalies is unclear, however a geological explanation is again considered to be the most likely. Some ‘iron spike’ responses have also been identified within the survey area.

Fields 7 and 8

3.2.5 Other than ferrous ‘iron spike’ anomalies, only linear trends caused by ridge and furrow ploughing have been identified in these two fields.

Field 14

3.2.6 A survey block was located in this field to further evaluate the possible north/south linear anomaly identified during the magnetic scanning. The detailed survey has revealed the ‘linear’ to comprise a number of discrete anomalies along the same alignment. Examination of the First Edition Ordnance Survey mapping has revealed this to correlate with the position and alignment of a former field boundary. Vague linear trends west of this old boundary are probably due to ridge and furrow ploughing.

The Northern Half of the site - Fields 2, 5, 10, 12 and 13 (Figs 6, 7 and 8)

3.2.7 As no definite 'targets' were identified in this part of the site following the scanning the survey blocks in these five fields were all positioned to confirm the 'negative' scanning results and to provide a relatively even distribution within the constraints of the overall sample (20%).

3.2.8 Other than the, albeit much weaker, linear trend anomalies caused by ridge and furrow ploughing only a north/south aligned linear anomaly caused by a former field boundary, and shown on the First Edition Ordnance Survey mapping, has been identified in this part of the site.

4. Discussion and Conclusions

4.1 Isolated dipolar anomalies ('iron spikes' - see Appendix 1) have been identified across all the surveyed areas. These anomalies are indicative of ferrous objects or other magnetic material in the topsoil/subsoil and, although archaeological artefacts may cause them, they are more often caused by modern cultural debris that has been introduced into the topsoil often as a consequence of manuring. There is no obvious clustering to these responses to suggest that they are caused by anything other than random ferrous debris.

4.2 Linear trend anomalies caused by medieval/post-medieval ploughing have been identified in the majority of the survey blocks aligned north/south. In many of the fields the ridge and furrow earthworks are still visible but even where later ploughing has reduced or removed entirely (mostly on the flatter land to the north of the site) the undulating landscape this former agricultural technique can still be surmised by the characteristic striping in the magnetic data. This is due to the magnetic contrasts between infilled furrows and former ridges.

4.3 The only other anomalies attributed to human activity are the two linear anomalies caused by old field boundaries, now removed, in Field 14 and Field 10.

4.4 The three blocks placed along the southern boundary of the site in Fields 4, 7 and 8, show no evidence for any activity associated with the nearby Roman road. However, it should be noted that the area nearest the road (also containing the three small quarries) at the southern edge of the site could not be surveyed due to the recent tree screen planting.

4.5 A variable magnetic background was noted in two fields at the southern end of the site. This variability is not considered to be archaeologically significant but due to localised changes in the soil/geology, perhaps as a consequence of the sloping nature of the site.

4.6 The detailed survey has verified the essentially 'negative' results from the magnetic scanning, despite the slight difficulty caused by the extensive survival of ridge and furrow. It is therefore considered that the small number of anomalies identified during scanning was a result of the low level of activity as opposed to masking caused by the later agricultural activity.

4.7 Overall, the results of the geophysical survey support the conclusions of the archaeological assessment in that the site would appear to have a low archaeological potential.

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.

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.

Bibliography

David, A., 1995. *Geophysical Survey in Archaeological Field Evaluation: Research and Professional Services Guidelines* No. 1. English Heritage

Gaffney, C., Gater, J. and Ovenden, S. 2002. *The Use of Geophysical Techniques in Archaeological Evaluations*. IFA Technical Paper No. 6

Headland Archaeology Ltd, 2006. Hulands Quarry, County Durham: Cultural Heritage Assessment. Unpubl. Client Report

Acknowledgements

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Figures

Plates

Appendices

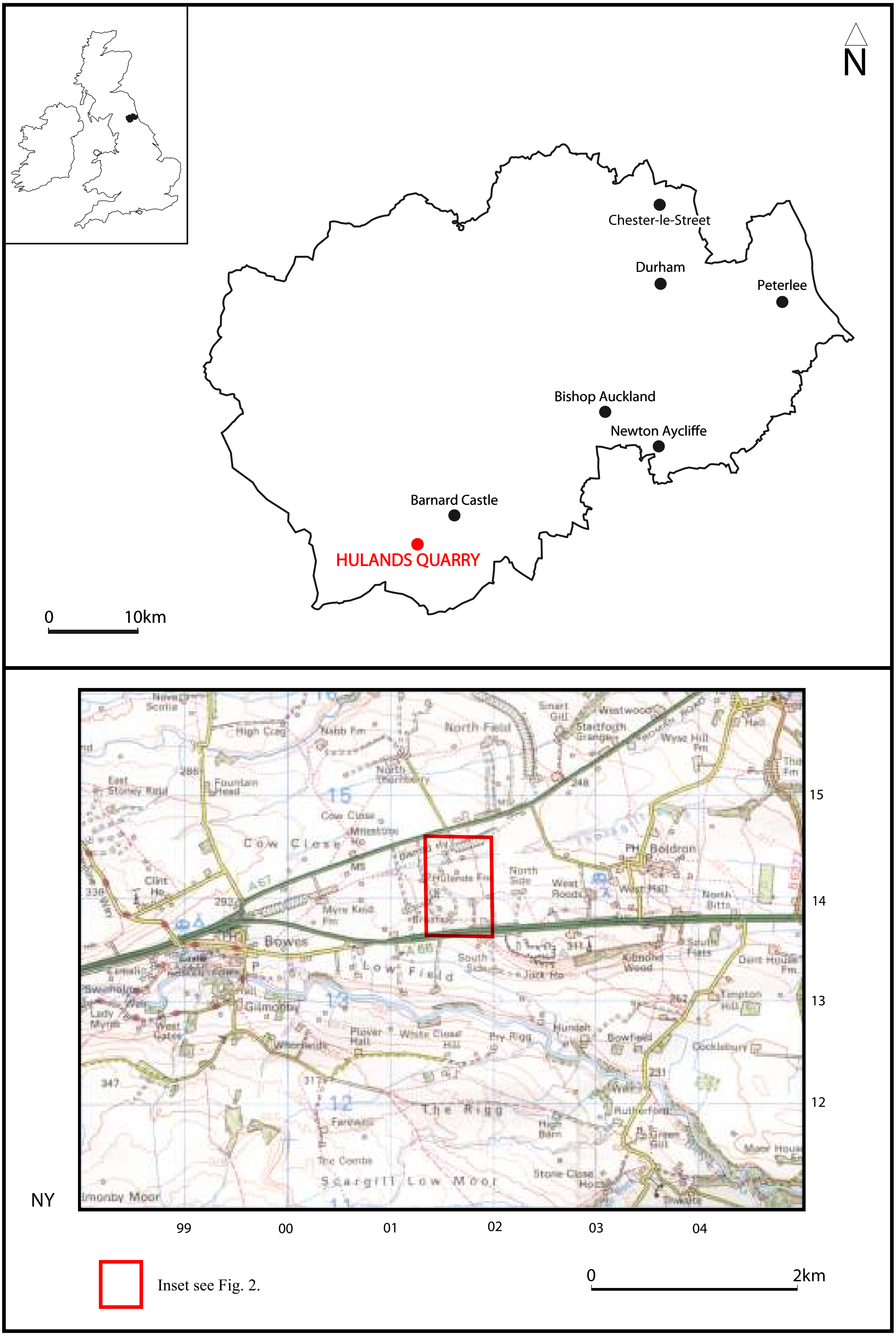

Fig. 1. Site location

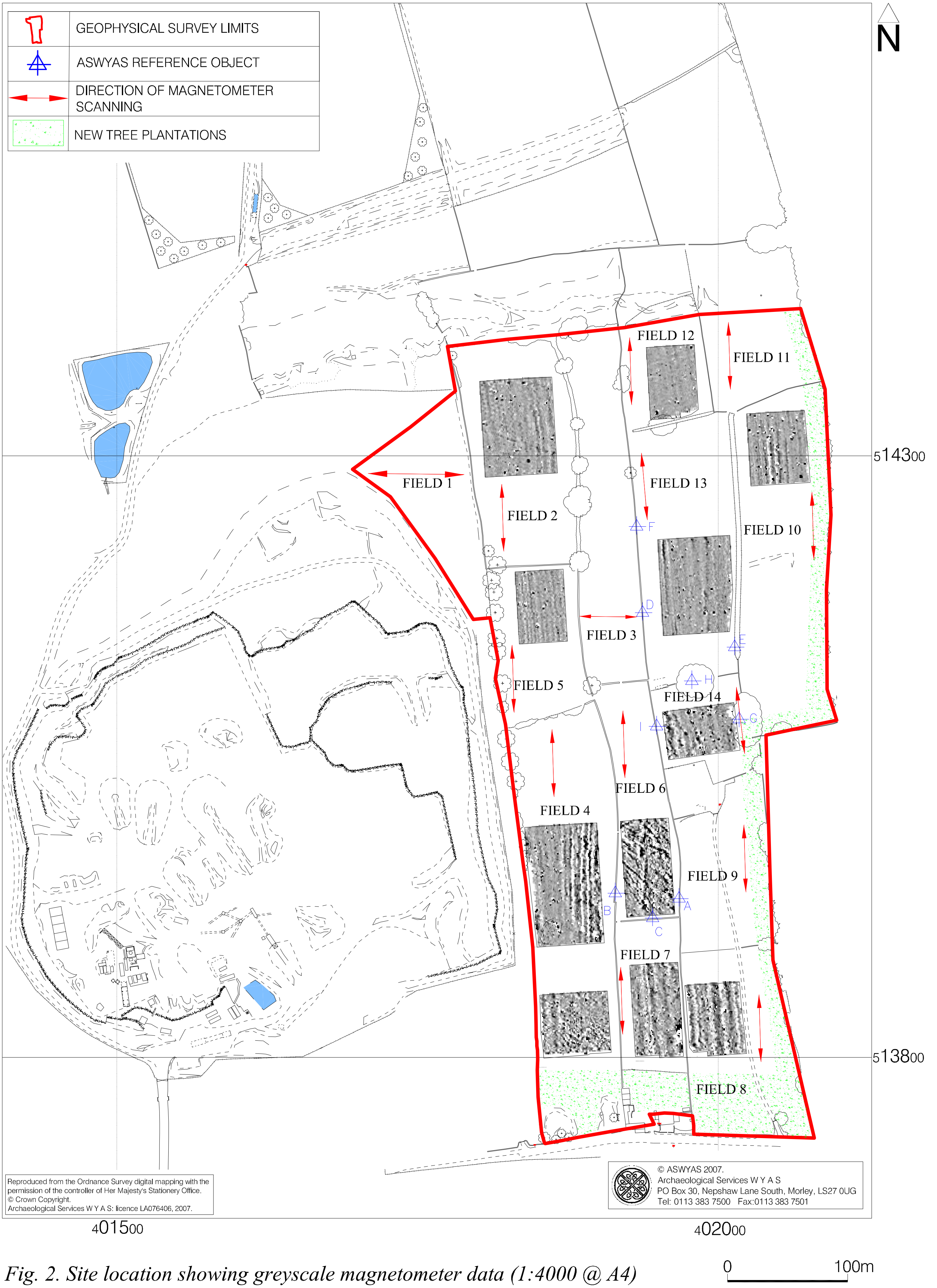

Fig. 2. Site location showing greyscale magnetometer data (1:4000 @ A4)

Fig. 3. Processed greyscale magnetometer data: Fields 4, 6, 7, 8, and 14 (1:1000 @ A3)

0 50m

Fig. 4. XY trace plot showing unprocessed magnetometer data: Fields 4, 6, 7, 8 and 14 (1:1000 @ A3)

Fig. 5. Interpretation of magnetometer data: Fields 4, 6, 7, 8 and 14 (1:1000 @ A3)

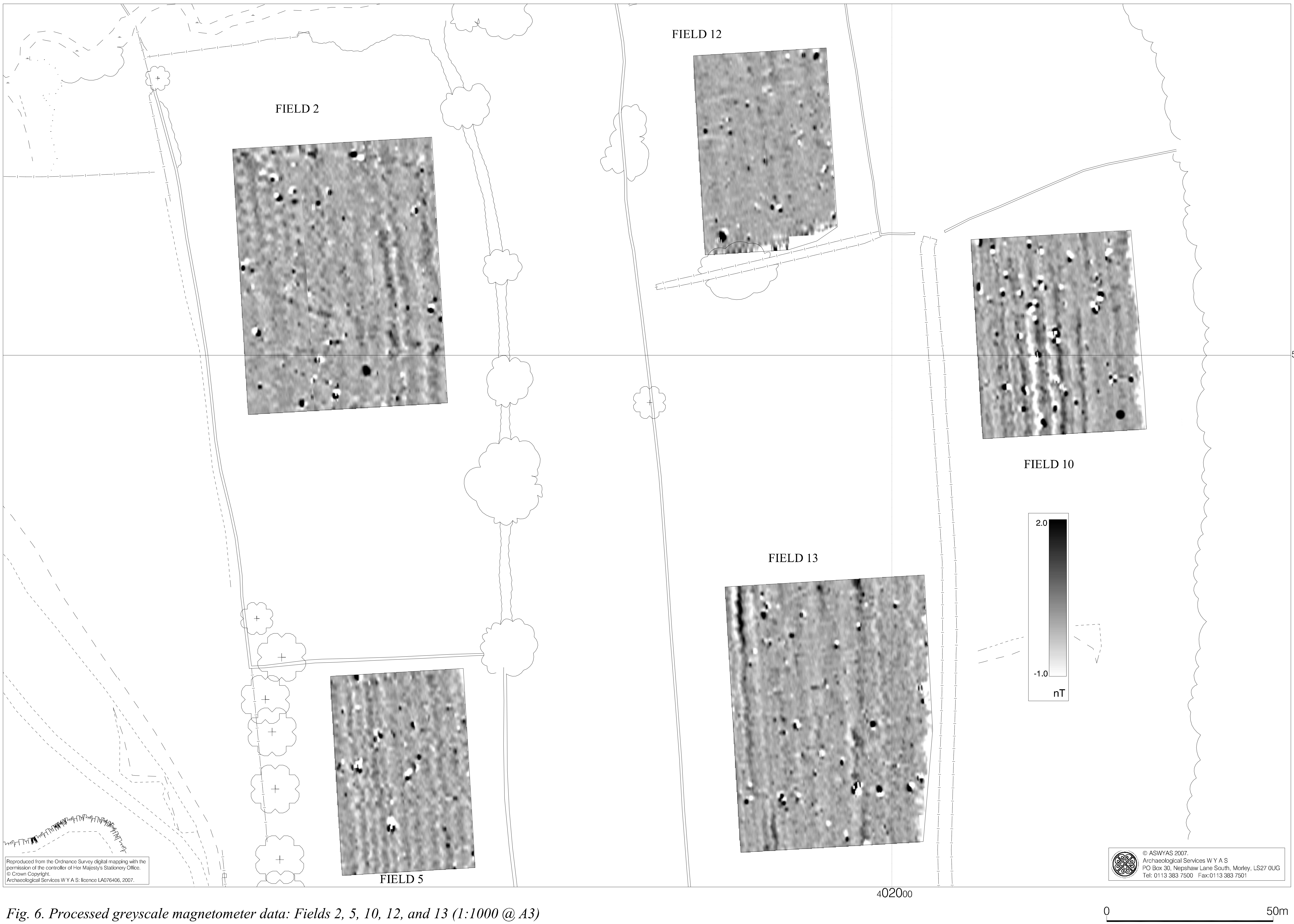

Fig. 6. Processed greyscale magnetometer data: Fields 2, 5, 10, 12, and 13 (1:1000 @ A3)

Fig. 7. XY trace plot showing unprocessed magnetometer data: Fields 2, 5, 10, 12 and 13 (1:1000 @ A3)

Fig. 8. Interpretation of magnetometer data: Fields 2, 5, 10, 12 and 13 (1:1000 @ A3)

Plate 1. Tree plantation in the south of the site facing north

Plate 2. Tree plantation in the north-east of the site facing 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. Less magnetic material such as masonry or plastic service pipes that intrude into the topsoil may give a negative magnetic response relative to the background level.

The magnetic susceptibility of a soil can also be enhanced by the application of heat. This effect can lead to the detection of features such as hearths, kilns or areas of burning.

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. Such negative anomalies are often very faint and are commonly caused by modern, non-ferrous, features such as plastic water pipes. Infilled natural features may also appear as negative anomalies on some geological substrates.

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. An agricultural origin, either ploughing or land drains is 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. 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 1m apart within 20m by 20m 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 1600 readings were obtained for each 20m by 20m grid. The same program was used to produce the greyscale images. All greyscale plots are displayed using a linear incremental scale.

Appendix 2

Survey Location Information

The site grid was laid out using a Geodimeter 600s total station theodolite and tied in to the corners of buildings and other permanent landscape features and to temporary reference points (survey marker stakes) that were established and left in place following completion of the fieldwork for accurate geo-referencing. The locations of the temporary reference points are shown on Figure 2 and the Ordnance Survey grid co-ordinates tabulated below. The internal accuracy of the survey grid relative to these markers is better than 0.05m. The survey grids were then superimposed onto a map base provided by the client as a 'best fit' to produce the displayed block locations. Overall there was a good correlation between the local survey and the digital map base and it is estimated that the average 'best fit' error is better than ±1.5m. However, it should be noted that Ordnance Survey co-ordinates for 1:2500 map data have an error of ±1.9m at 95% confidence. This potential error must be considered if co-ordinates are measured off for relocation purposes.

Station	Easting	Northing
A	401967.458	513932.080
B	401914.622	513936.458
C	401945.666	513915.904
D	401937.390	514169.439
E	402013.621	514141.118
F	401932.139	514241.208
G	402017.645	514081.131
H	401978.165	514112.850
I	401948.991	514075.122

Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party or for the removal of any of the survey reference points.

Appendix 3

Geophysical Archive

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Word 2000), and graphics files (Adobe Illustrator, CorelDraw6 and AutoCAD 2000) files.
- 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 will 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 relevant Sites and Monument Record Office).