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Land at Steeton Hall
South Milford
Near Selby
North Yorkshire

Geophysical Survey

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Land at Steeton Hall,

South Milford,

Near Selby,

North Yorkshire.

Geophysical Survey

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Summary

A magnetometer survey earned out to the south of Steeton Hall has identified magnetic anomalies across all parts of the site Evidence of ridge and furrow ploughing is suggested both by an upstanding earthwork and magnetic anomalies The origin or function of a second more prominent linear earthwork is unclear although it may be associated with the manorial complex Parallel linear anomalies in the centre of the site are thought to be caused by infilled ditches that may also be associated with early occupation of the site Other areas of magnetic enhancement could also have an archaeological origin although modern activity could also explain the anomalous responses The proposed location of the stable block is centred on an area of magnetic disturbance and is therefore likely to have a minimal archaeological impact However there could be archaeological features surviving beneath the magnetic material that remain undetected due to the masking effect of the ferrous material

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1 Introduction and Archaeological Background

1 1 Archaeological Services WYAS was commissioned by Mr Gary Walshaw to carry out a geophysical (fluxgate gradiometer) survey over part of a field to the south of Steeton Hall, South Milford (see Fig 1) where the client is proposing to construct a stable block

1 2 Steeton Hall, the site of a Magnate's residence and manorial centre, would have been at the centre of a complex of domestic and agricultural structures lying within a large precinct (enclosure) that was defined by a wall The origins of the complex are thought to date to the mid-14th century although it is not known whether the site was adapted from an earlier development, whether there are any other ancillary buildings still to be discovered, or how the current complex has expanded and contracted English Heritage has designated the site as a Scheduled Ancient Monument (National Monument No 28240) with the scheduled area covering standing buildings, earthworks and the adjacent agricultural land where the client is proposing to erect a stable block

1 3 The survey area, centred at NGR SE 4836 3142, comprised a single irregular shaped field covering approximately 1 5 hectares that at the time of survey was under permanent pasture Field boundaries defined the survey area to the south and west, a new wooden fence to the east and a stone boundary (precinct?) wall to the north (see Fig 2) The survey was carried out on February 13th 2004 No problems were encountered during the survey

1 4 Topographically the site undulates between approximately 30m and 40m Above Ordnance Datum sloping towards Steeton Hall from west to east The solid geology comprises Permian, Jurassic and Eocene limestone The overlying soils are classified in the Aberford Soil Association that are described as shallow, locally brashy, well-drained, calcareous fine loamy soils

2 Methodology and Presentation

2 1 The regional Inspector of Ancient Monuments for English Heritage, Mr Keith Emerick, advised the client that a geophysical survey should be undertaken prior to the construction of the stable block It was recommended that the whole of the field, not just that part to be directly impacted by the proposed structure, should be evaluated by detailed magnetic survey as it was recognised that the use of the area for grazing of horses may lead to other intrusive groundworks in the future In line with the status of the site a Section 42 Licence was sought from, and approved by, the English Heritage Inspector prior to the commencement of the survey

2 2 The objectives of the geophysical survey were -

- to establish the presence or absence of any archaeological anomalies within and immediately surroundmg the area of the proposed development
- to characterise, if possible, any such anomalies

2 3 The survey methodology and report comply with the recommendations outlined in the English Heritage Guidelines (David 1995) as a minimum standard All figures reproduced from Ordnance Survey mapping are done so

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2 4 A general site location plan, incorporating the 1 50000 Ordnance Survey mapping, is shown in Figure 1 Figure 2 is a site location plan, showing the processed greyscale gradiometer data, superimposed onto a scanned image of a base map supplied by the client, at a scale of 1 2000 The processed data is displayed in greyscale format, at a scale of 1 500 in Figure 3 with the accompanying interpretation shown at the same scale in Figure 5 The unprocessed ('raw') data is presented in XY trace plot format in Figure 4

N b – as Ordnance Survey digital data was not available all the figures with the exception of Figure 1 display the data on a local grid that is aligned closely with that of the Ordnance Survey

2 5 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 archive

The interpretations of the observed anomalies are based on information contained in all parts of the report including the appendices

3 Results and Discussion

3 1 Numerous isolated dipolar anomalies ('iron spikes' - see Appendix 1) have been identified across all parts of the survey area These 'iron spike' 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 modem cultural debris that has been introduced into the topsoil There is no apparent clustering to these anomalies and consequently they are not considered to be archaeologically significant Only the strongest of these responses have been shown on the interpretation figure

3 2 Two areas of magnetic disturbance have been identified in the north-eastem and south-westem comers of the survey area In the north-eastem comer the extensive disturbance is indicative of a spread of magnetic material such as slag waste In the south-westem comer the observed magnetic disturbance is caused by the magnetic effect of the close proximity of a metal gate combined with several isolated ferrous 'iron spike' anomalies caused by infill material tipped in the gateway

3 3 The location and alignment (from north-west to south-east) of a linear dipolar anomaly corresponds with that of a linear earthwork up to 1m in height which peters out at the point the anomaly terminates The anomaly is thought to be caused by magnetic material either beneath the bank or in a now infilled ditch parallel with the upstanding feature The origin of the earthwork is unknown

3 4 A second linear earthwork, aligned from west to east, was visible at the southem end of the site and this too is identifiable as a broad, positive, curvilinear magnetic anomaly This feature may be a remnant of ridge and furrow ploughing Other linear anomalies on the same alignment are also visible to the north although none are visible as earthworks

3 5 In the centre of the site, also aligned from north to south, are two parallel, discontinuous, ditch type linear anomalies that extend for approximately 100m The anomalies appear to terminate 20m from the stone boundary wall at the northern edge of the site However, it may be that the high readings from the area of magnetic disturbance in the north-east corner are masking the much weaker response from the ditch/es These anomalies are indicative of infilled ditches that may relate to the early occupation of the site The discontinuous nature of these anomalies may indicate that later ridge and furrow ploughing has truncated the underlying feature

3 6 An irregular shaped area of magnetic enhancement in the centre of the block corresponds with a shallow depression This may denote that quarrying has taken place There are a several other discrete areas of magnetic enhancement that could possibly be archaeological in origin, although the fact that they are not clustered may indicate a modern intrusive origin

4 Conclusions

4 1 The detailed magnetometer survey has located magnetic anomalies across all parts of the survey area Evidence of ridge and furrow ploughing is suggested both by an upstanding earthwork and magnetic anomalies The origin or function of a second more prominent linear earthwork is unclear although it may be part of the manorial complex

4 2 Parallel linear anomalies in the centre of the site are thought to be caused by infilled ditches that may also be associated with early occupation of the site Certainly the ridge and furrow ploughing appears to have truncated the feature/s Other areas of magnetic enhancement could also have an archaeological origin although modern activity could also explain the anomalous responses

4 3 The proposed location of the stable block is centred on a magnetically disturbed area and is therefore likely to have a minimal archaeological impact However, there could be archaeological features surviving beneath the magnetic material that remain undetected due to the strong magnetic response from the ferrous material

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

Acknowledgements

Project Management

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Fieldwork

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Report

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Graphics

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Figures

Figure 1	Site location (1 50000)
Figure 2	Site location showing greyscale gradiometer data (1 2000)
Figure 3	Greyscale plot of gradiometer data (1 500)
Figure 4	Interpretation of gradiometer data (1 500)
Figure 5	XY trace plot of gradiometer data (1 500)

Appendices

Appendix 1	Magnetic Survey Technical Information
Appendix 2	Survey Location Information
Appendix 3	Geophysical Archive

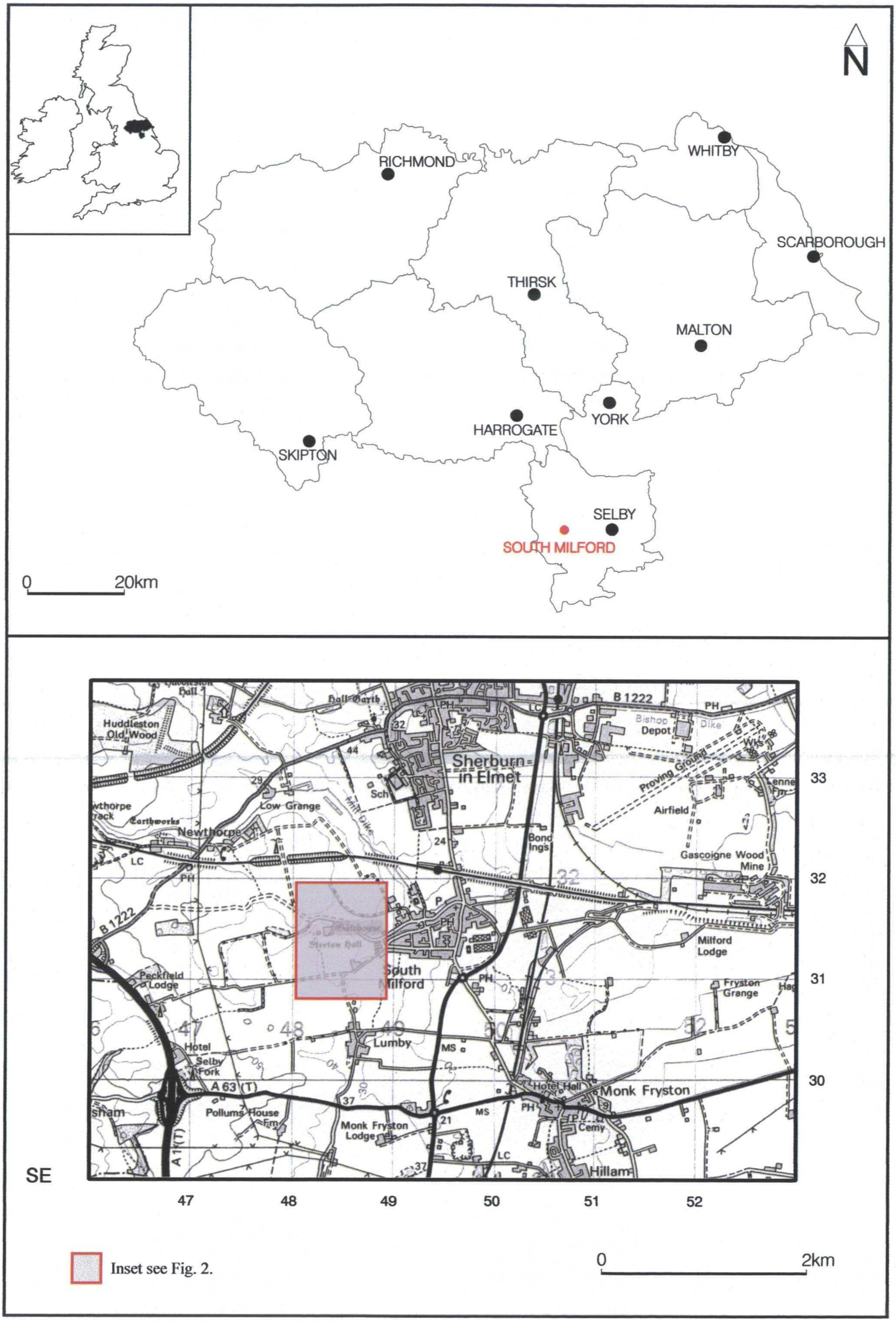

Fig. 1. Site location

Fig. 2. Site location showing greyscale gradiometer data

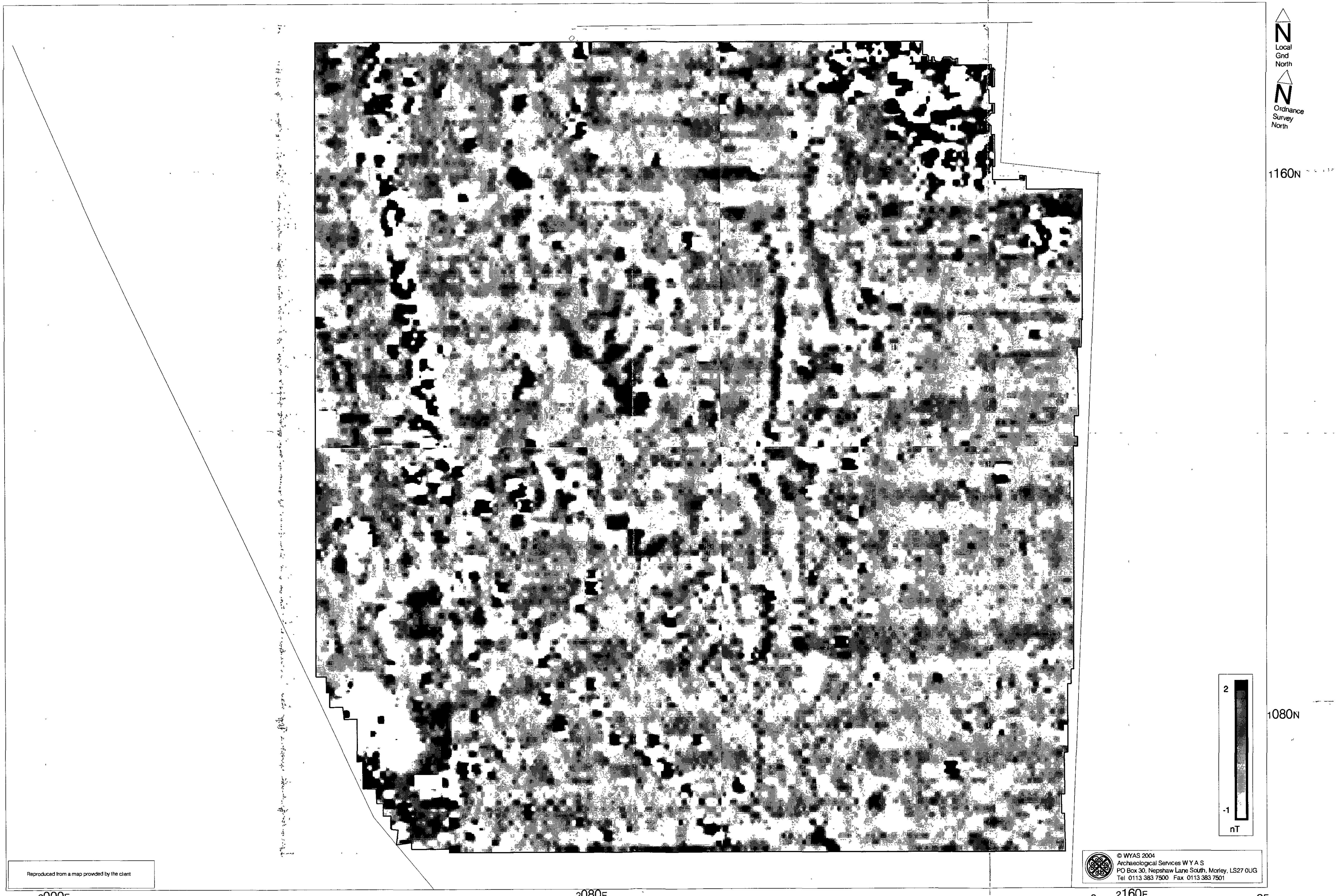

Fig. 3. Greyscale plot of gradiometer data.

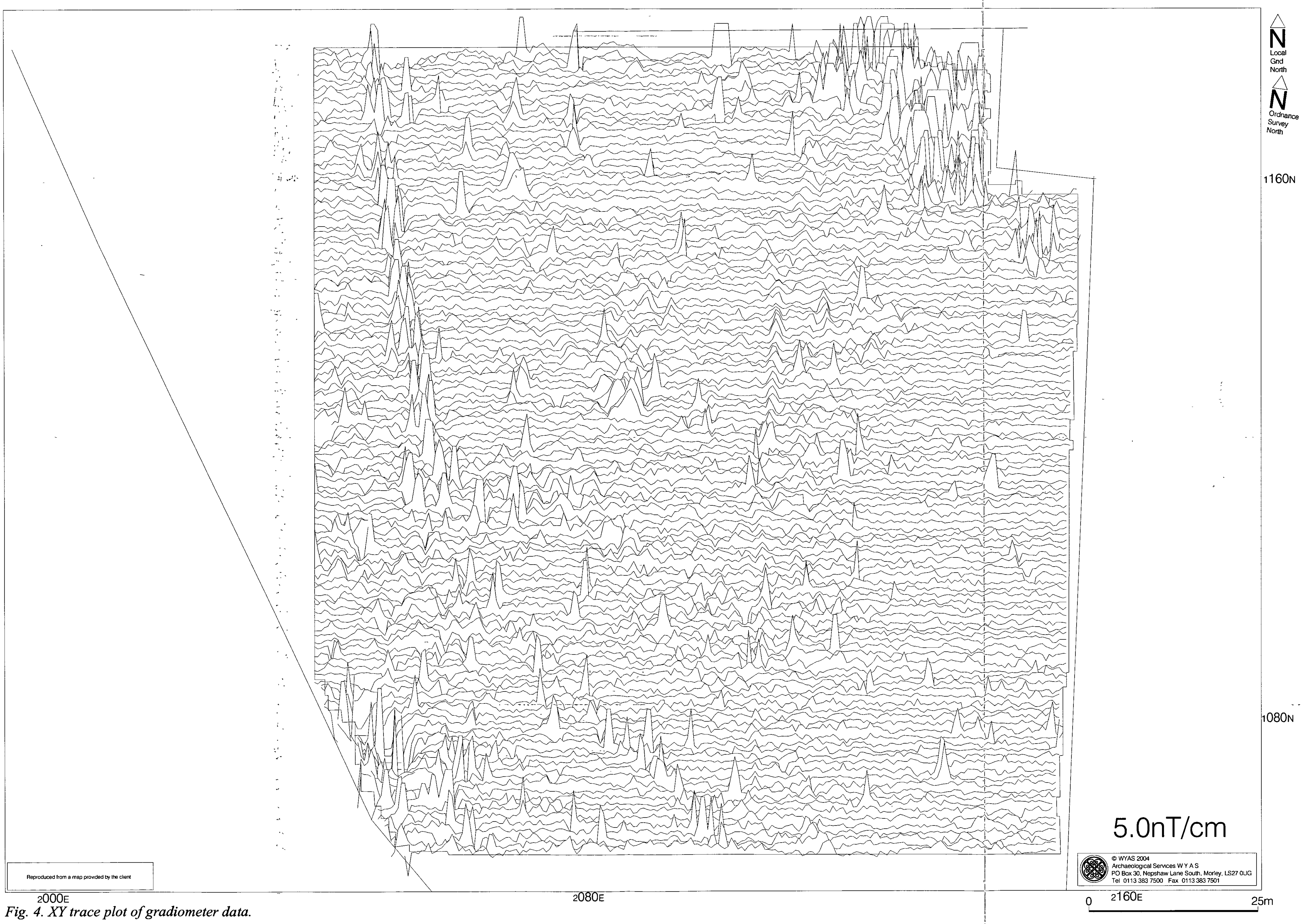

Fig. 4. XY trace plot of gradiometer data.

Fig. 5. Interpretation of gradiometer data.

1:500

Appendix 1

Magnetic Survey Technical Information

1 Magnetic Susceptibility and Soil Magnetism

1 1 Iron makes up about 6% of the Earth s cmst 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)

1 2 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 intmde into the topsoil may give a negative magnetic response relative to the background level

1 3 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 buming

2 Types of Magnetic Anomaly

2 1 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 modem, non ferrous features such as plastic water pipes Infilled natural features may also appear as negative anomalies on some geological substrates

2 2 Where it is not possible to give a probable cause of an observed anomaly a ? is appended

2 3 It should be noted that anomalies that are interpreted as modem in origin may 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

2 4 The types of response mentioned above can be divided into five main categories which are used in the graphical interpretation of the magnetic data

Isolated dıpolar anomahes (ıron spıkes)

These responses are typıcally caused by ferrous materıal eıther on the surface or ın the topsoıl They cause a rapıd varıatıon ın the magnetıc response gıvıng a characterıstıc spıky' trace Although ferrous archaeologıcal artefacts could produce thıs type of response unless there ıs supportıng evıdence for an archaeologıcal ınterpretatıon lıttle emphasıs ıs normally gıven to such anomalıes as modem ferrous objects are common on mral sıtes often beıng present as a consequence of manurıng

Areas of magnetıc dısturbance

These responses can have several causes often beıng assocıated wıth bumt materıal, such as slag waste or brıck mbble or other strongly magnetısed/fired materıal Ferrous stmctures such as pylons mesh or barbed wıre fencıng and burıed pıpes can also cause the same dısturbed response A modem orıgın ıs usually assumed unless there ıs other supportıng ınformatıon

Lınear trend

Thıs ıs usually a weak or broad lınear anomaly of unknown cause or date An agrıcultural orıgın eıther ploughıng or land draıns ıs a common cause

Areas of magnetıc enhancement/posıtıve ısolated anomalıes

Areas of enhanced response are characterısed by a general ıncrease ın the magnetıc background over a localısed area whılst dıscrete anomalıes are manıfest by an ıncreased response (sometımes only vısıble on an X–Y trace plot) on two or three successıve traverses In neıther ınstance ıs there the ıntense dıpolar response characterıstıc exhıbıted by an area of magnetıc dısturbance or of an ıron spıke anomaly (see above) These anomalıes can be caused by ınfilled dıscrete archaeologıcal features such as pıts or post holes or by kılns They can also be caused by pedologıcal varıatıons or by natural ınfilled features on certaın geologıes Ferrous materıal ın the subsoıl can also gıve a sımılar response It can often therefore be very dıfficult to establısh an anthropogenıc orıgın wıthout ıntmsıve ınvestıgatıon or other supportıng ınformatıon

Lınear and curvılınear anomahes

Such anomalıes have a varıety of orıgıns They may be caused by agrıcultural practıce (recent ploughıng trends earlıer rıdge and ftırrow regımes or land draıns) natural geomorphologıcal features such as palaeochannels or by ınfilled archaeologıcal dıtches

3 Methodology

3 1 Magnetıc Susceptıbılıty Survey

3 1 1 There are two methods of measurıng the magnetıc susceptıbılıty of a soıl sample The first ınvolves the measurement of a gıven volume of soıl whıch wıll ınclude any aır and moısture that lıes wıthın the sample and ıs termed volume specıfic susceptıbılıty Thıs method results ın a bulk value that ıt not necessarıly fully representatıve of the constıtuent components of the sample The second technıque overcomes thıs potentıal problem by takıng ınto account both the volume and mass of a sample and ıs termed mass specıfic susceptıbılıty However, mass specıfic readmgs cannot be taken ın the field where the bulk propertıes of a soıl are usually unknown and so volume specıfic readıngs must be taken Whılst these values are not fully

representatıve they do allow general comparısons across a sıte and gıve a broad ındıcatıon of susceptıbılıty changes Thıs ıs usually enough to assess the susceptıbılıty of a sıte and evaluate whether enhancement has occurred

3 2 Gradıometer Survey

3 2 1 There are two maın methods of usıng the fluxgate gradıometer for commercıal evaluatıons The first of these ıs referred to as ***magnetıc scannıng*** and requıres the operator to vısually ıdentıfy anomalous responses on the ınstmment dısplay panel whılst coverıng the sıte ın wıdely spaced traverses typıcally 10m apart The ınstmment logger ıs not used and there ıs therefore no data collectıon Once anomalous responses are ıdentıfied they are marked ın the field wıth bamboo canes and approxımately located on a base plan Thıs method ıs usually employed as a means of selectıng areas for detaıled survey when only a percentage sample of the whole sıte ıs to be subject to detaıled survey

3 2 2 The dısadvantages of magnetıc scannıng are that features that produce weak anomalıes (less than 2nT) are unlıkely to stand out from the magnetıc background and so wıll be dıfficult to detect The coarse samplıng ınterval means that dıscrete features or lınear features that are parallel or broadly oblıque to the dırectıon of traverse may not be detected If lınear features are suspected m a sıte then the traverse dırectıon should be perpendıcular (or as close as ıs possıble wıthın the physıcal constraınts of the sıte) to the orıentatıon of the suspected features The possıble drawbacks mentıoned above mean that negatıve results from magnetıc scannıng should always be checked wıth at least a sample detaıled magnetıc survey (see below)

3 2 3 The second method ıs referred to as ***detaıled survey*** and employs the use of a sample trıgger to automatıcally take readıngs at predetermıned poınts typıcally at 0 5m ıntervals on zıg zag traverses 1m apart These readıngs are stored ın the memory of the ınstmment and are later dumped to computer for processıng and ınterpretatıon Detaıled survey allows the vısualısatıon of weaker anomalıes that may not have been detected by magnetıc scannıng

3 2 4 The Geoscan FM36 fluxgate gradıometer and ST1 sample trıgger were used for the detaıled gradıometer survey Readıngs were taken on the 0 1nT range at 0 5m ıntervals on zıg zag traverses 1m apart wıthın 20m by 20m square grıds The ınstmment was checked for electronıc and mechanıcal drıft at a common poınt after every three grıds and calıbrated as necessary The drıft from zero was not logged

3 3 Data Processıng and Presentatıon

3 3 1 The detaıled gradıometer data has been presented m thıs report ın X-Y trace and greyscale formats In the former format the data shown ıs 'raw' wıth no processıng other than grıd bıasıng havıng been done The data ın the greyscale ımages has been selectıvely filtered

3 3 2 An X Y plot presents the data logged on each traverse as a sıngle lıne wıth each successıve traverse ıncremented on the Y axıs to produce a stacked plot A hıdden lıne algorıthm has been employed to block out lınes behınd major spıkes and the data has been clıpped at 10nT The maın advantage of thıs dısplay optıon ıs that the full range of data can be vıewed dependent on the clıp so that the shape' of ındıvıdual anomalıes can be dıscemed and

potentially archaeological anomalies differentiated from iron spikes In-house software (XY3) was used to create the X Y trace plots

3 3 3 In house software (Geocon 9) was used to interpolate the data so that 1600 readings were obtamed for each 20m by 20m grid Contors software was used to produce the greyscale images All greyscale plots are displayed in the range −1nT to 2nT unless otherwise stated, using a linear incremental scale

Appendix 2

Survey Location Information

1 A Trimble Geodimeter 600s total station theodolite was used to set out the survey grid which was then tied in to 'permanent' landscape features such as field boundaries and to temporary reference objects (wooden stakes) using the theodolite The locations of the three temporary reference objects are shown on Figure 2 and the local grid co ordinates tabulated below

2 The survey grid was then superimposed onto a scanned image of a map base provided by the client using common field boundaries and other fixed points Overall there was a good correlation between the local survey and the map base and it is estimated that the average best fit error is better than ±1 5m 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 from points other than those listed below

Station	Easting	Northing
A	2007 94	1151 12
B	2153 88	1117 72
C	2142 46	1182 60

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 (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)