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WYAS

Land at East Common Lane
Selby
North Yorkshire

Geophysical Survey

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Summary

A geophysical (fluxgate gradiometer) survey covering 6 hectares was carried out at a site south of East Common Lane Selby The survey comprised rapid magnetic scanning of the whole site followed by a sample detailed survey totalling 3 hectares Several linear anomalies indicative of infilled cut features have been identified although it is considered likely that most of these anomalies are caused by modern field boundaries Linear anomalies probably caused by ridge and furrow ploughing or by more recent agricultural practice have also been identified No anomalies of a probable archaeological origin have been identified

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1 Introduction and Archaeological Background

1 1 Archaeological Services WYAS was commissioned by Mr Barry Collins, Project Engineer, for Rigid Group Ltd, to carry out a geophysical (fluxgate gradiometer) survey at the site of a proposed development south of East Common Lane on the eastern periphery of Selby (see Figs 1 and 2)

1 2 The proposed development area, centred at SE 6300 3150, covers approximately 6 hectares and comprised two fields East Common Lane defined the northern edge of the site and an open drain and a steel fence the southern and western limits respectively The eastern edge was not defined by a physical boundary

1 3 The (larger) western field had been cleared of scrub vegetation to allow unrestricted access to all parts of the site during the survey, which was carried out between April 7th and April 10th 2003 The eastern field had been ploughed and recently harrowed No problems were encountered during the fieldwork

1 4 Topographically the site is flat at about 5m Above Ordnance Datum (AOD) The solid geology comprises Bunter Sandstone overlain by an unknown depth of wind blown (Aeolian) sands The resultant soils, classified in the Everingham Soil Association, are characterised as deep, stoneless, and permeable (Soil Map of England and Wales, 1983)

1 5 Prior to the submission of a planning application the client contacted the Heritage Unit of the North Yorkshire County Council who advised that there was '*no information to indicate that remains of significant archaeological or historical interest are present within the (development) area*' on the County Sites and Monuments Record Consequently, following consultation with, and advice from, Mr Neil Campling, Senior Archaeologist at the NYCC Heritage Unit, a programme of rapid magnetic scanning followed by targeted sample detailed magnetic survey was proposed by Archaeological Services and agreed by Mr Campling

2 Methodology and Presentation

2 1 Rapid magnetic scanning was proposed as a means of identifying potential areas of archaeological interest within the proposed development area Detailed magnetic survey was then carried out covering 50% of the proposal area (3 hectares) To aid interpretation no blocks smaller than $40m^2$ were surveyed Known services and areas likely to be characterised by magnetic disturbance were avoided except where it was necessary to determine the extent of previously identified anomaly

2 2 Specific objectives were

- to identify areas of possible archaeological activity within the proposed development area by magnetic scanning for further investigation by detailed magnetic survey
- to use detailed magnetic survey to establish the presence, extent and character of any magnetic anomalies within the proposed development area

2 3 A general site location plan incorporating the 1 50000 Ordnance Survey mapping is shown in Figure 1 Figure 2 is a site location plan, at a scale of

1 10000, showing the greyscale gradiometer data superimposed onto a scanned base map supplied by the client The detailed survey comprised six discrete areas (Fig 3 - Blocks 1 to 6) and the processed data is displayed in greyscale format at a scale of 1 1000, in Figure 3 The accompanying interpretation is shown at the same scale in Figure 4

2 4 Large scale, 1 500, greyscale and X-Y trace plots are shown in Appendix 4 Details on data processmg and display are given in Appendix 1 and the survey location information is presented in Appendix 2 The composition of the archive comprises Appendix 3

2 5 The survey methodology and report presentation conform to the recommendations outlined in the English Heritage Guidelines (David 1995) as a minimum standard All figures reproduced from Ordnance Survey mapping are done so with the permission of the controller of Her Majesty's Stationery Office, © Crown copyright

The interpretative figures should not be looked at in isolation but in conjunction with the relevant discussion section and with the information contained in the Appendices

3 Results and Discussion

3 1 Rapid Magnetic Scanning

3 1 1 Variation in the magnetic background across the site in general fluctuated between +/-1 nT from the mean background in any given area

3 1 2 'Iron spike' responses (see Appendix 1) were noted across the whole of the site, but were more prevalent across the northem and north-westem parts The locations of these responses were not recorded

3 1 3 Two linear anomalies were identified during the scanning and these were deemed to warrant further detailed investigation Consequently survey blocks were positioned centred on these responses to further investigate the nature of the anomalies These blocks were subsequently expanded to define the extent of the identified anomalies The remainder of the survey blocks were located to give an even sample distribution across the site subject to the constraints of the sample

3 2 Detailed Survey

3 2 1 Numerous 'iron spike' responses (see Appendix 1) have been identified across all parts of the site particularly, as noted in Section 3 1 2 above, in the northem parts of the site These are indicative of ferrous material in the topsoil or subsoil and, although archaeological artefacts may cause them, they are more often caused by modem material Unless there is strong supporting evidence to the contrary, for example if they are located close to obvious areas of archaeological activity, they are assumed not to be of archaeological importance The first edition Ordnance Survey map shows that the southem and south-eastem parts of the site were wooded in the 1850's while the northem and north-westem parts were open fields This would explain the distribution of the iron spike anomalies as most ferrous material is introduced into the soil as a consequence of manuring

3 2 2 The two linear anomalies identified during the scanning have been confirmed and located by the detailed survey in Blocks 3 and 4, which were subsequently expanded to map the extent of the anomalies within the bounds of the proposed development area The magnetic anomalies are variable in strength and intermittent in nature but are clearly visible mnning from south-west to north-east in Block 3 and from north-west to south-east in Blocks 3 and 4 The location of these anomalies correlates with field boundaries, no longer extant, that are shown on the first edition Ordnance Survey map

3 2 3 A third short linear anomaly can be seen in the northem comer of the site in Block 1, also aligned from south-west to north-east This does not correlate with any mapped field boundaries However it is considered likely to have a modem origin although an archaeological origin cannot be completely dismissed

3 2 4 Another very short, weak, linear anomaly has been identified in the south-westem comer of Block 5 Without supporting information a definitive interpretation cannot be given although a modem origin is considered probable

3 2 5 Five parallel linear anomalies on a broadly north/south alignment can be seen on the northem edge of Block 3 It is thought that these are caused by ridge and furrow ploughing or more recent agricultural activity

3 2 6 A linear negative anomaly parallel with, and 10m south of, East Common Lane is probably caused by a modem service pipe

4 Conclusions

4 1 Several linear anomalies have been identified during the detailed magnetic survey However, most of these are caused by infilled field boundaries shown on the first edition Ordnance Survey map Other anomalies on similar alignments could be caused by archaeological ditches but without further supporting information a modem and/or agricultural origin for these remaining anomalies is considered probable

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

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Fieldwork

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Report

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Figures

Figure 1	Site location (1 50000)
Figure 2	Site location showing greyscale gradiometer data (1 10000)
Figure 3	Greyscale plot of gradiometer data (1 1000)
Figure 4	Interpretation of gradiometer data (1 1000)

Appendices

Appendix 1	Magnetic Survey Technical Information
Appendix 2	Survey Location Information
Appendix 3	Geophysical Archive
Appendix 4	Gradiometer Data (1 500)

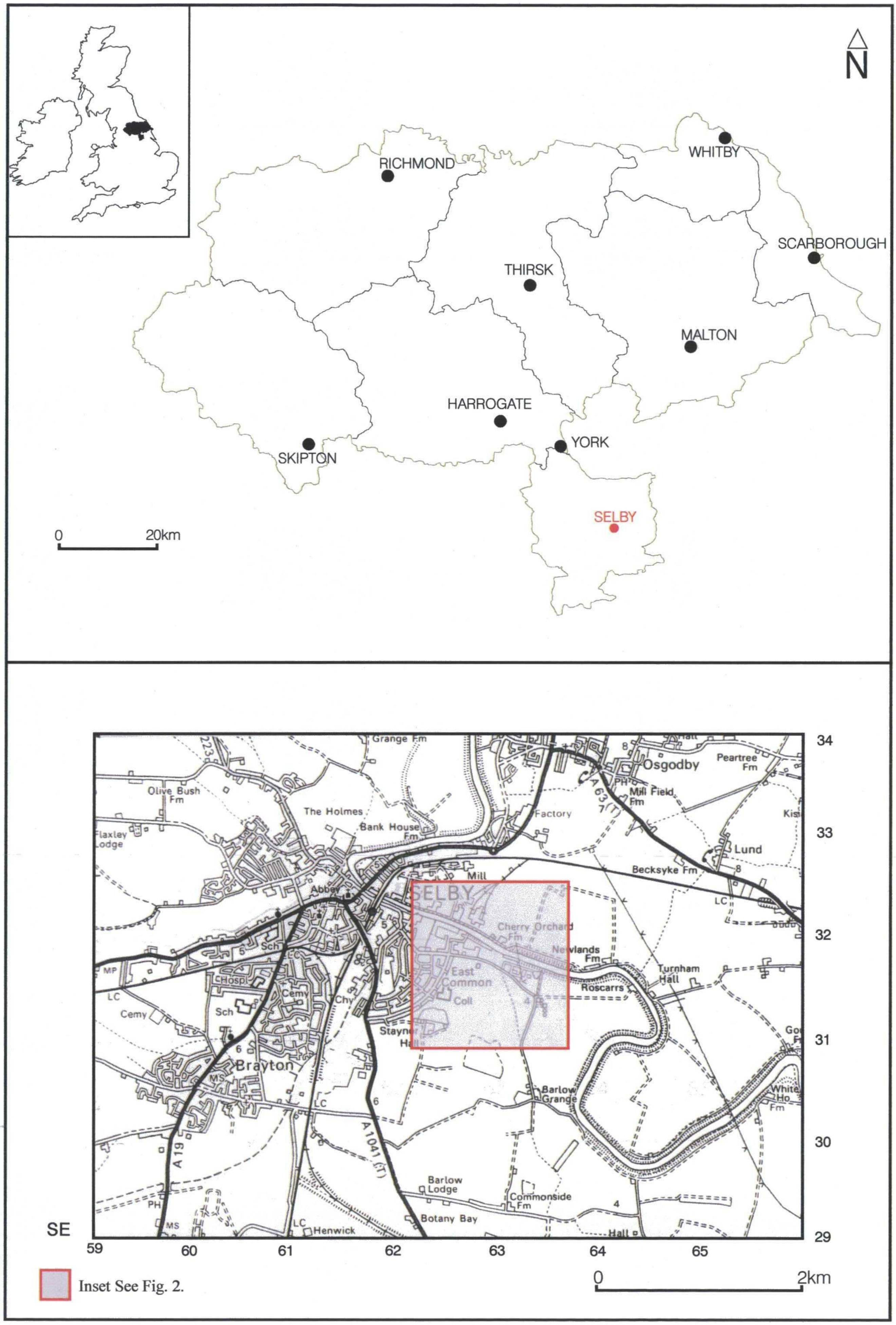

Fig. 1. Site Location

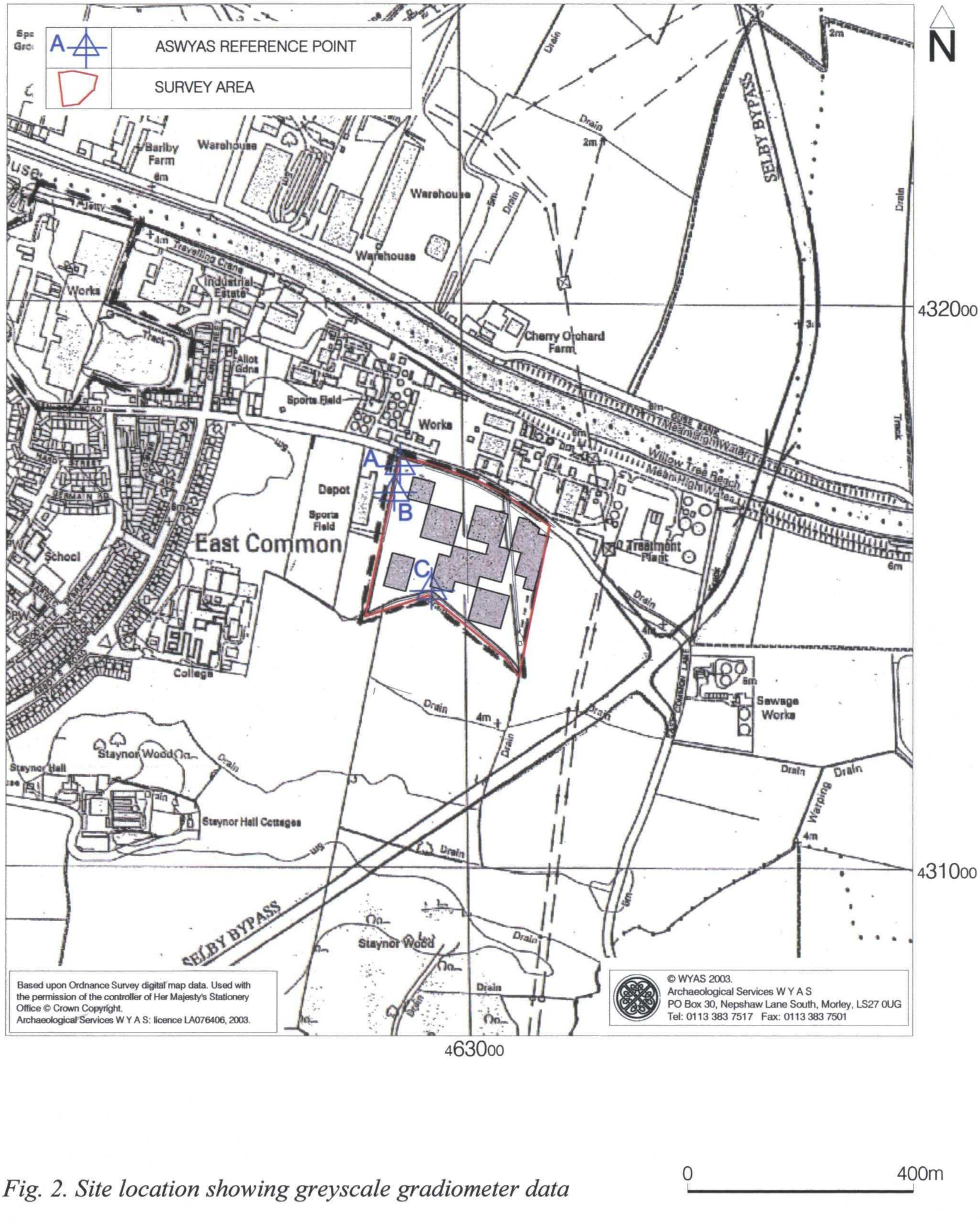

Fig. 2. Site location showing greyscale gradiometer data

Fig. 3. Greyscale plot of gradiometer data

Fig. 4. Interpretation of gradiometer data

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

1 3 The magnetic susceptibility of the soil can also be enhanced significantly by heating This can lead to the detection of features such as hearths kilns or bumt areas

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 which 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 geologies

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 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 modem ferrous objects are common on mral sites often being present as a consequence of manuring

Areas of magnetic disturbance

These responses can have several causes often being associated with bumt material such as slag waste or brick mbble or other strongly magnetised/fired material Ferrous stmctures such as pylons mesh or barbed wire fencing and buried pipes can also cause the same disturbed response This type of anomaly is characterised by very strong, 'spiky' variations in the magnetic background A modem 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 X–Y trace plot) on two or three successive traverses In neither instance is there the intense dipolar response characteristic of an area of magnetic disturbance or of an iron spike' (see above) These anomalies can be caused by infilled discrete archaeological features such as pits or post holes or by kilns with the latter often being characterised by a strong, positive double peak response 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 intmsive 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

3 *Methodology*

3 1 Magnetic Susceptibility Survey

3 1 1 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

3 2 **Gradiometer Survey**

3 2 1 There are two main methods of using the fluxgate gradiometer for commercial evaluations The first of these is referred to as ***scanning*** and requires the operator to visually identify anomalous responses on the instmment display panel whilst covering the site in widely spaced traverses typically 10 15m apart The instmment 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 In favourable circumstances scanning may be used to map out the full extent of features located during a detailed survey

3 2 2 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 5m intervals on zig-zag traverses 1m apart These readings are stored in the memory of the instmment and are later dumped to computer for processing and mterpretation

3 2 3 The Geoscan FM36 fluxgate gradiometer and ST1 sample trigger were used for the detailed gradiometer survey Readings were taken on the 0 1nT range, at 0 5m intervals on zig-zag traverses 1m apart within 20m by 20m square grids The instmment was facing north for improved data collection and was checked for electronic and mechanical drift at a common point after every three grids and calibrated as necessary The drift from zero was not logged

3 2 4 The detailed gradiometer data has been presented in this report in X Y trace and greyscale formats The former option shows the raw data with no processing other than grid biasing whilst in the latter the data has been selectively filtered to remove spurious errors such as striping effects and edge discontinuities caused by instmment drift and inconsistencies in survey technique caused by poor field conditions

3 2 5 An X Y 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 at 10nT 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 discemed and potentially archaeological anomalies differentiated from ‘iron spikes In-house software (XY3) was used to create the X-Y trace plots

3 2 6 In house software (Geocon 9) was used to interpolate the gradiometer data so that 1600 readings were obtained for each 20m by 20m grid Contors software (University of Bradford) was used to produce the greyscale images All gradiometer greyscale plots are displayed in the range –1nT to 2nT, unless otherwise stated, using a linear incremental scale

Appendix 2

Survey Location Information

1 The survey grid was set out with a Trimble Geodimeter 600s total station theodolite Points at 60m intervals were set out with the total station theodolite and points at 20m intervals were set out as required using 100m tapes The grid was then tied in to permanent landscape features such as field boundaries and temporary reference points (Fig 2 – A B and C) using the theodolite

2 The survey grids were then superimposed onto a scanned Ordnance Survey map base supplied 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 ±1m 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

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 6) files of the raw data report text (Word 97) 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 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 relevant Sites and Monument Record Office)

Appendix 4

Gradiometer Data (1 500)

SNY8422
Gradiometer data plots x2 not scanned
Please see Parish File for originals