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ARCHAEOLOGICAL
SERVICES
WYAS

Caistor Hospital
Caistor
Lincolnshire

Geophysical Survey

August 2001

Report No. 922

CLIENT
Site Master

EVENT L12428
SOURCE L17070

Caistor Hospital,

Caistor,

Lincolnshire.

Geophysical Survey

Contents

Summary

A geophysical (fluxgate gradiometer) survey, covering approximately 1.5 hectares, was carried out at the site of a proposed residential development in the grounds of the former Caistor Hospital, Caistor. No anomalies of a probable archaeological origin were detected.

Archaeological Services WYAS
PO Box 30, Nepshaw Lane South, Morley, Leeds LS27 0UG

0113 383 7500

1. *Introduction and Archaeological Background*

1.1 Archaeological Services WYAS was commissioned by Mr R.G. Bolton of Development Land and Planning Consultants Ltd, on behalf of Site Master, to carry out a geophysical (fluxgate gradiometer) survey over an area of approximately 1.5ha at the site of a proposed residential development in the grounds of the former Caistor Hospital, Caistor (see Figs 1 and 2).

1.2 The proposed development, centred at TA 1025 0140,* is approximately 1.5km west of Caistor town centre and lies on approximately 5.5ha of land located to the south of North Kelsey Road. The northern part of the site consists of grassed landscape gardens, the central area contains building remains, (both demolished and standing) relating to the Caistor House of Industry, the Caistor Union Workhouse and Caistor Hospital, and the southern part of the site consists of a grass field. There is a chapel and graveyard in the western part of the proposed development area and an Anglian Water pumping station is located in the northern part of the grass field.

* geophysical survey centred on TA1015 0123

1.3 The proposed development area has been subject to an archaeological desk-based assessment by Lindsey Archaeological Services (1998) wherein it was recommended that a geophysical survey be carried out in the southern part of the site.

1.4 The ground cover at the time of survey (August 9th 2001) was pasture. The site was bounded to the east by a hedge and wire fence, the south by a ditch, the west by an intermittent hedgerow, the north-west by a wire fence and the north-east was limited by demolished buildings, rubble and tarmac areas. An Anglian Water pumping station, that lies on the site of earlier filter beds, was located in the north of the survey area and was bounded on all sides by ferrous paling fencing. A small field, immediately south of the building complex, lay within the proposed survey area but the presence of ferrous fencing, waist high grass cover and significant amounts of modern tipping and building rubble, particularly along the northern and western edges of the field, meant that this area was not amenable for gradiometer survey (see Figure 2). No other problems were encountered during the survey.

1.5 The site lies just below the 40m Ordnance Datum contour and slopes down gently towards the south. The geology comprises sandy and coarse loamy soils of the Blackwood glaciofluvial drift. The drift overlies Upper Cretaceous chalk beds and is in turn overlain by an unknown depth of soil cover.

1.6 The archaeological interest in the application area relates to the fact that Caistor was an important settlement during the Roman and Anglo-Saxon periods. There is also significant evidence for prehistoric activity in the vicinity of Caistor and, although the town declined in importance, there has been continuous settlement through the medieval and post-medieval periods to the present day. The desk-based assessment undertaken by Lindsey Archaeological Services (1998) sought to directly assess the archaeological potential of the site and is summarised below.

1.7 The site contains buildings and features associated with the Caistor House of Industry, the Caistor Union Workhouse and Caistor Hospital. These buildings will either be demolished or incorporated into the proposed development. The presence of these buildings and associated services means that the potential for surviving archaeological remains, pre-dating the buildings, in the northern part of the site is low.

1.8 Although there is no direct evidence for sub-surface archaeological remains within the proposed development area the air photograph cover for the surrounding area suggests that the site may lie within a late prehistoric or Romano-British field system. Given the close proximity of a Roman settlement (Caistor), a possible Roman road (hypothesised as North Kelsey Road to the north) and crop marks and flint finds in the fields immediately west of the proposed development area it is considered that 'the potential for archaeological remains on this [southern] part of the site is considered to be high' (Lindsey Archaeological Services 1998).

2. Methodology and Presentation

2.1 The objectives of the survey were:

- to establish the presence, extent and character of any magnetic anomalies within the proposal area.

2.2 Details on the equipment used and general survey methodology are given in Appendix 1 and Appendix 2.

2.3 The survey and report adhere to the recommendations outlined in the English Heritage Guidelines (David 1995). All figures reproduced from Ordnance Survey mapping are done so with the permission of the controller of Her Majesty's Stationary Office, © Crown copyright.

2.4 A general site location plan incorporating the 1:50000 Ordnance Survey mapping is shown in Figure 1. A more detailed site location plan showing the greyscale gradiometer data superimposed on a copy of an Ordnance Survey base map is presented, at a scale of 1:2500, in Figure 2. A greyscale plot and an interpretation of the gradiometer data are shown in Figures 3 and 4 respectively, both at a scale of 1:1000. Large scale, 1:500, greyscale and X-Y trace plots are shown in Figures 5 and 6. Details on data processing and display are given in Appendix 1 and the survey location information is presented in Appendix 2.

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 Ubiquitous across the site are 'iron spike' responses (see Appendix 1) which are indicative of ferrous material in the topsoil or subsoil. These responses can be caused by archaeological artefacts but are more often caused by modern material. Unless there is strong supporting evidence to the contrary they are assumed not to be of archaeological significance. The majority of the responses occur close to the field boundaries or the water pumping station which strongly suggests a modern origin. Only the larger responses have been indicated on the interpretation figure.

3.2 There was strong magnetic disturbance around all of the field boundaries and so a gap of between 2m and 5m was left between the field boundaries and the edge of the survey area. The magnetic background was also severely disturbed around the water pumping station reflecting the presence of ferrous material and ground disturbance associated with the building, fencing and possibly the earlier filter beds. A gap of up to 12m was left around the pumping station to avoid this very strong disturbance.

3.3 An area of magnetic disturbance and a possible dipolar, linear anomaly are also present in the survey data to the north-east of the pumping station. These anomalies may be caused by a ferrous service pipe, and associated ground disturbance, attached to the pumping station. It is also possible that they are caused by modern ground disturbance or tipping not associated with the pumping station, although there were no obvious surface features to account for the anomalies.

3.4 To the north-west of the pumping station there is a dipolar, linear anomaly and an adjacent area of magnetic disturbance. Again these anomalies are thought to have a modern origin and could be caused by features associated with the pumping station or by drainage features.

3.5 The remaining anomalies are positive, linear anomalies of varying strengths and orientations. The linearity and regularity of these anomalies is strongly suggestive of field drains. An archaeological origin for some of these anomalies cannot be completely ruled out but a modern origin is considered most probable.

4. Conclusions

4.1 No anomalies of a probable archaeological origin have been detected.

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.

Lindsey Archaeological Services, 1998, 'Caistor, Former Hospital Site, North Kelsey Road: Archaeological Desk-Based Assessment', Lindsey Archaeological Services, unpubl., (LAS Report No. 305). → Box 98/14

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Acknowledgements

Fieldwork

A. Webb BA

M. Whittingham BSc MA

Report

M. Whittingham

Graphics

M. Whittingham

Figures

Appendices

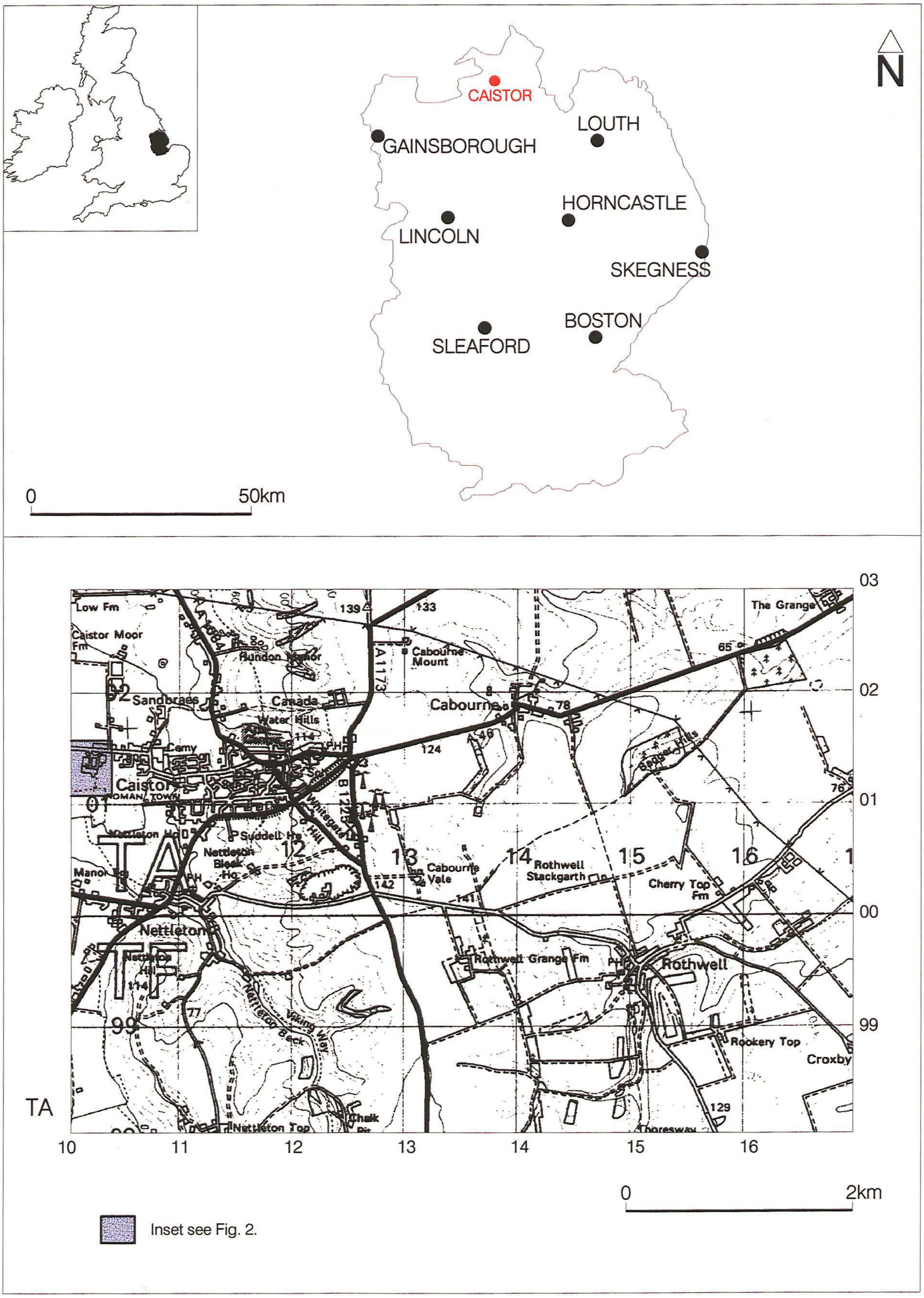

Fig. 1. Site location

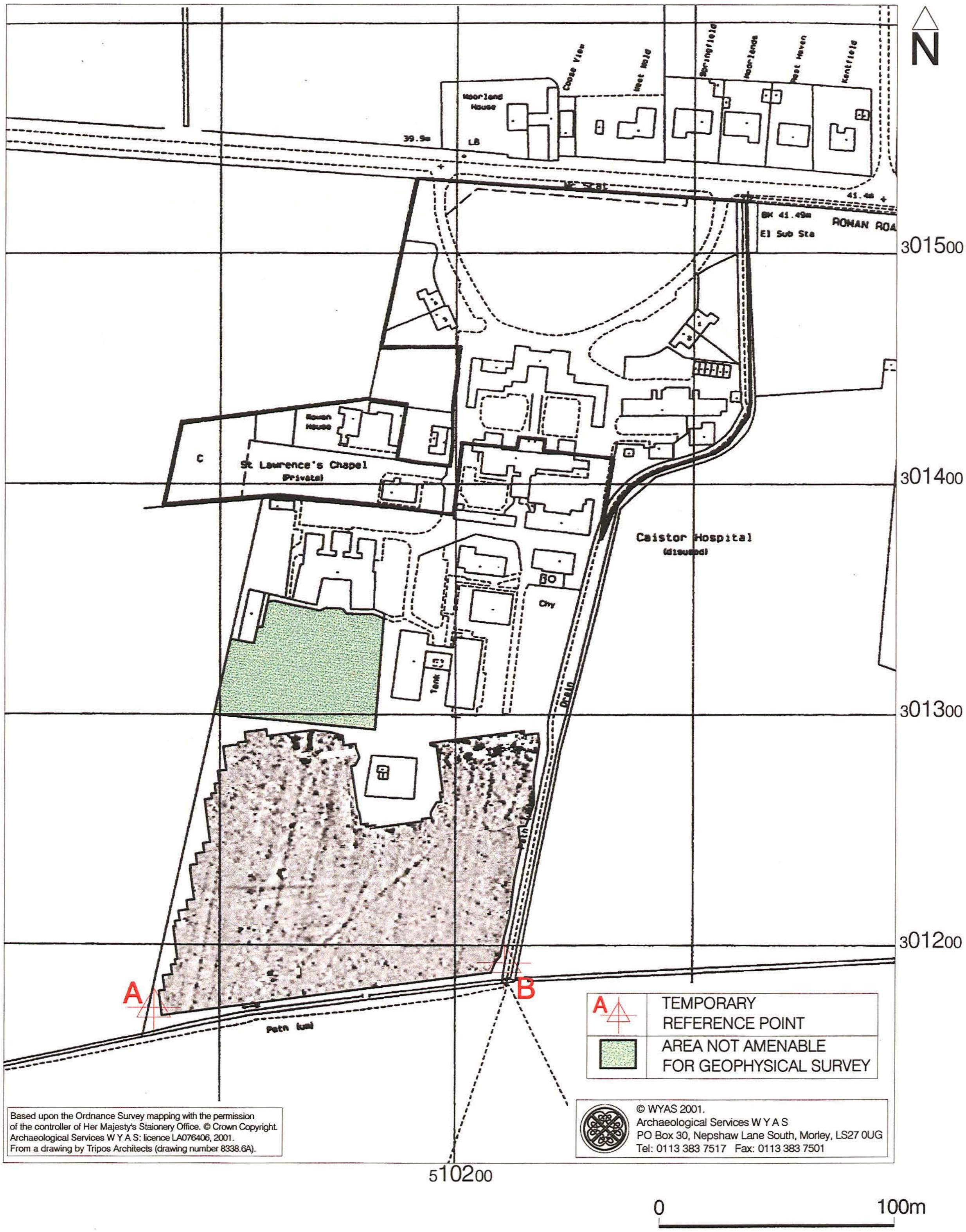

Fig. 2. Site location showing greyscale gradiometer data

Fig. 3. Greyscale gradiometer data

Fig. 4. Interpretation of gradiometer data

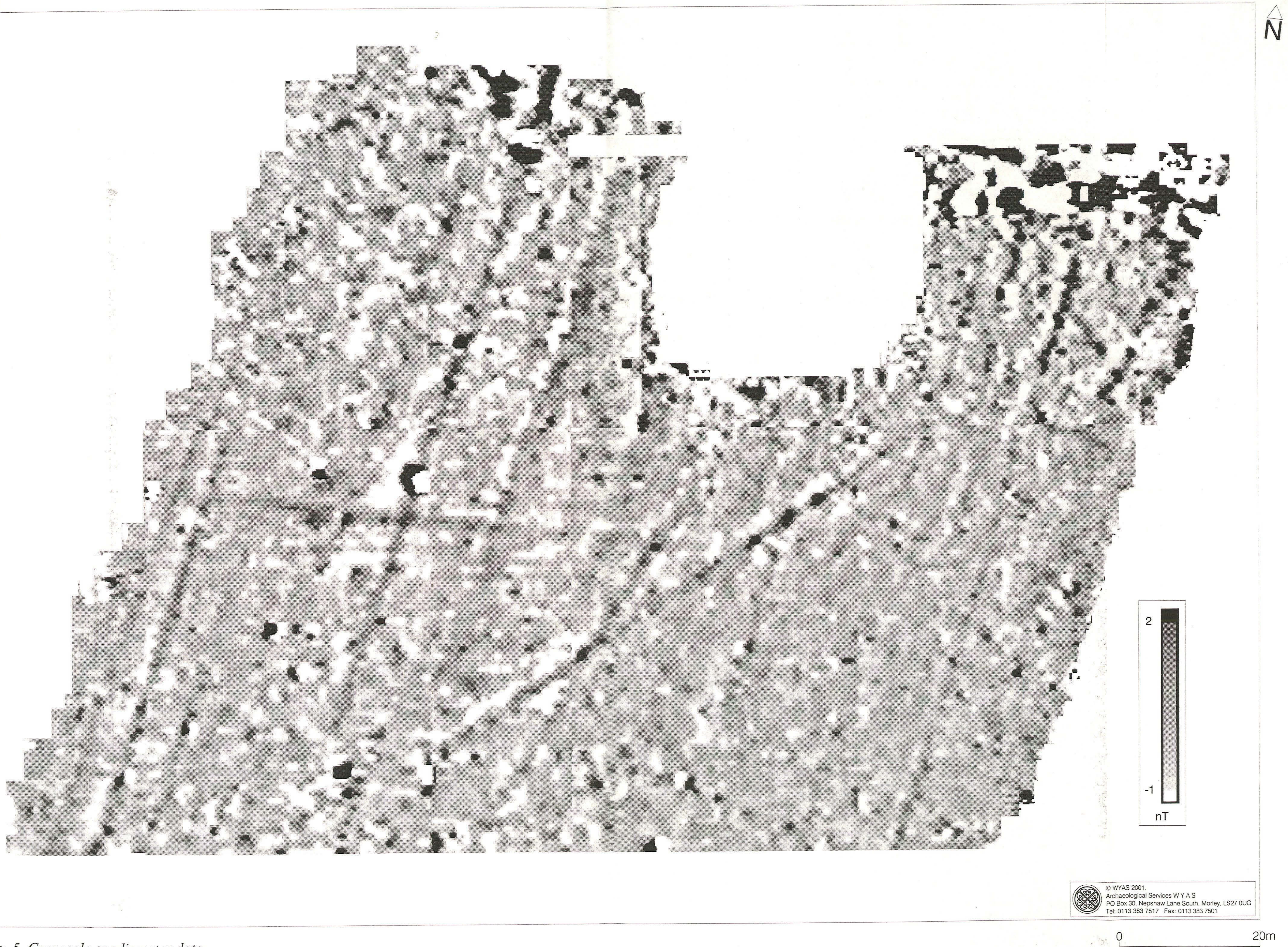

Fig. 5. Greyscale gradiometer data

Fig. 6. X-Y trace plot of gradiometer data

0 20m

Appendix 1

Magnetic Survey: Technical Information

1. Magnetic Susceptibility and Soil Magnetism

1.1 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).

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 intrude 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 burnt 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 modern, 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 modern 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 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. This type of anomaly is characterised by very strong, 'spiky' variations in the magnetic background. 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 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 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.

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 instrument display panel whilst covering the site in widely spaced traverses, typically 10-15m 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. 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 instrument and are later dumped to computer for processing and interpretation.

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.

3.3 Data Processing and Presentation

3.3.1. 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 instrument drift and inconsistencies in survey technique caused by poor field conditions.

3.3.2. 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 discerned 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 obtained for each 20m by 20m grid. Contors software (University of Bradford) 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 baseline was established broadly parallel with the southern field boundary and the geophysical survey grid was laid out and tied-in to 'permanent' landscape features, such as field boundaries, and temporary reference points, using a Geotronics Geodimeter 600s total station theodolite.

2. The survey grid was then superimposed onto an a copy of an Ordnance Survey map base using common field boundaries and Ordnance Survey grid co-ordinates were obtained for the reference points (see Fig. 2. and below). There was a reasonable correlation between the local survey and the map base but it should be noted that the copy of the map base was skewed in the vertical axis. It is estimated that the 'best fit' error is no better than ±1.0m. It should also be noted that Ordnance Survey co-ordinates for 1:2500 map data have an error of ±1.08m at 95% confidence. This error must be considered if co-ordinates are measured off for relocation purposes.

Station	Easting	Northing
A (wooden stake)	510072.05	301173.25
B (wooden stake)	510221.05	301192.43

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 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).

DEVELOPMENT LAND & PLANNING
CONSULTANTS LTD
THE COOPER BUILDINGS, SHEFFIELD SCIENCE PARK, ARUNDEL STREET, SHEFFIELD, S1 2NS
TELEPHONE: (0114) 2211811/00 FACSIMILE: (0114) 2211801
E-MAIL: dlpsheff@fdgroup.co.uk
Offices also at Bedford and Wokingham

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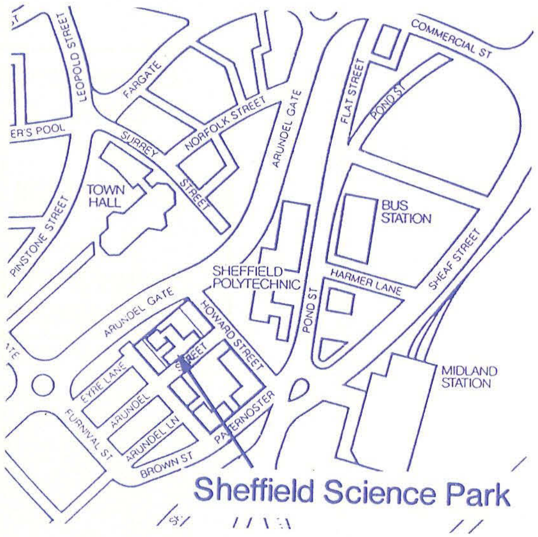
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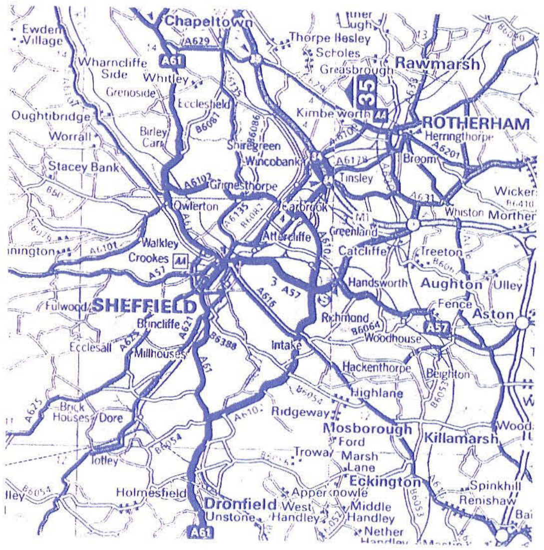
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