

95/4

ARCHAEOLOGICAL ASSESSMENT AND PHASE I FIELD EVALUATION
REPORT

PROPOSED GOLF COURSE DEVELOPMENT
AT WOODHALL SPA, LINCOLNSHIRE

PRE-CONSTRUCT ARCHAEOLOGY (Lincoln)

Site Code: WGC95
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AN ARCHAEOLOGICAL ASSESSMENT AND EVALUATION REPORT

CONTENTS

FOR

DONALD STEEL & COMPANY LIMITED
(ON BEHALF OF THE ENGLISH GOLF UNION)

BY

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1.0 Non-technical summary

The English Golf Union proposes to create a new golf course on the north side of Woodhall Spa, Lincolnshire. In two areas within the proposed development site, below, you may be concerned which, inevitably, could contain archaeological resources.

On the basis of an archaeological survey of the site, the following is a summary of the results of the survey. Both below and above the proposed development site, there are a number of archaeological resources which are of interest to the site, and it is necessary to take account of these resources in the design and construction of the proposed development.

The report illustrates the results of archaeological field walking and geophysical survey.

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1.0 Non-technical summary

The English Golf Union propose to create a second golf course on the north side of Woodhall Spa, Lincolnshire. In two areas within the proposed development site, borrow pits may be excavated which, potentially, could threaten archaeological resources.

On the basis of data compiled during the production of this report, the archaeological potential of both borrow pit sites is considered to be low. Despite the close proximity of cropmarks and other remains to one site, no information has been obtained which would suggesting that significant archaeological remains lie within either area.

This report incorporates the results of archaeological field walking and a geophysical (magnetometer) survey.

The central National Grid Reference is TF 1935/6415 for area BA3 and TF 1970/6470 for area BA5.

2.0. Introduction

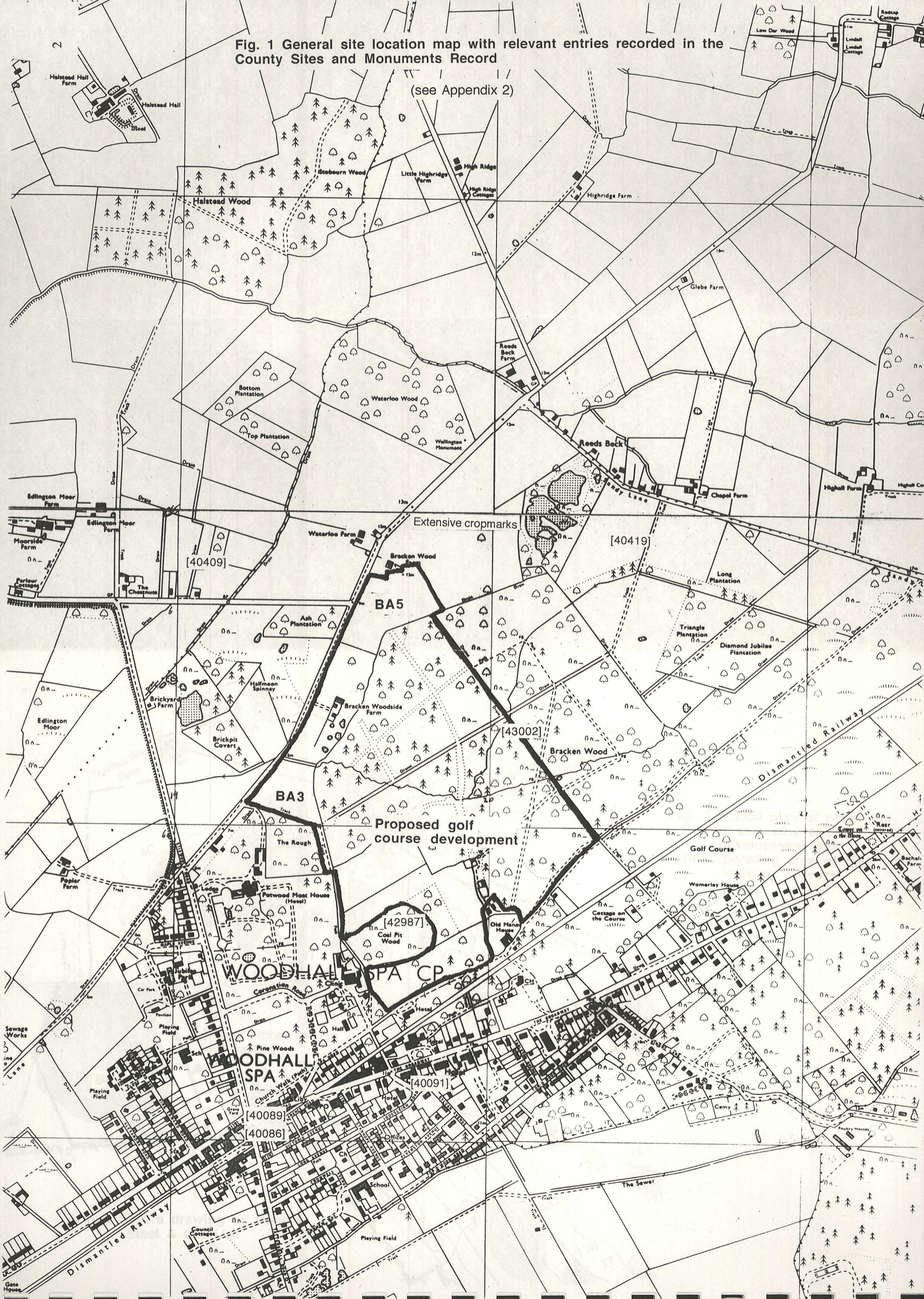
This desk top/evaluation study was commissioned by Donald Steel & Co. Ltd. on behalf of the English Golf Union in advance of possible golf course development on land on the north side of Woodhall Spa, Lincolnshire (Fig. 1). The commission was requested in advance of a formal planning application.

The report was researched and written between April 13th and April 27th, 1995, by Colin Palmer-Brown of Pre-Construct Archaeology (Lincoln). Research included a visual inspection of the site; inspection of the Sites and Monuments Record (SMR) held at the City & County Museum, Lincoln; the Local Studies Library, Lincoln and the Lincolnshire Archives Office. Aerial photographic cover-searches were requested from Cambridge University Dept. of Aerial Photography, the Sites and Monuments Record, Lincoln and the National Monuments Record at Swindon. Relevant published and unpublished records held by Pre-Construct Archaeology were also consulted as part of the assessment/evaluation.

In addition to the normal range of data consulted, one site (BA3) was field walked in 20m grids. On both sites (BA3 and BA5), a geophysical survey was undertaken by GeoQuest Associates (Appendix 1). Neither methods of non-intrusive evaluation has produced significant results.

Fig. 1 General site location map with relevant entries recorded in the County Sites and Monuments Record

(see Appendix 2)



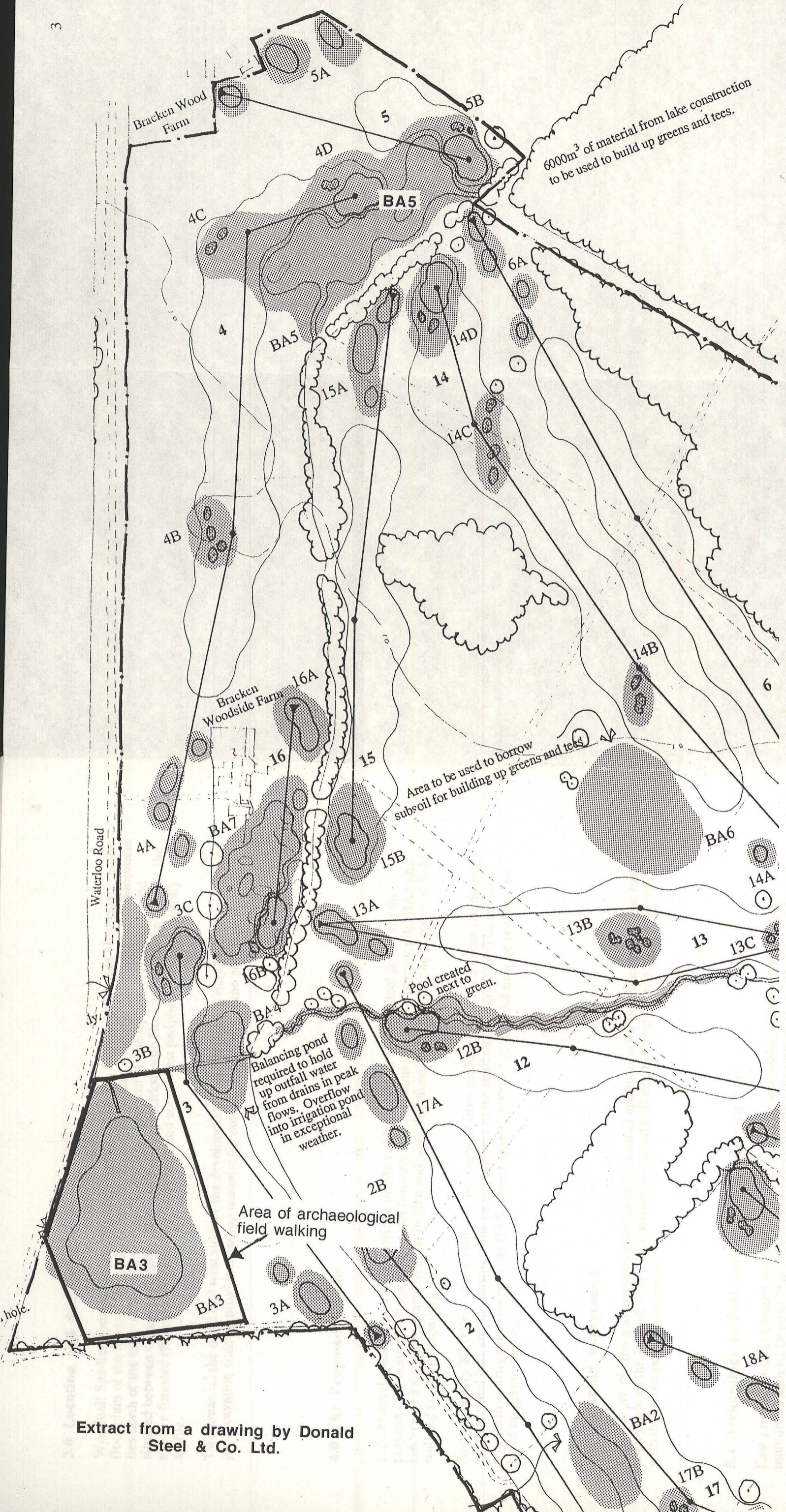


Fig. 2 1:2500 plan of north and east side of proposed development site (incorporating area of field walking survey)

Extract from a drawing by Donald Steel & Co. Ltd.

3.0 Location and description

Woodhall Spa lies approximately 25km south-east of Lincoln, 5km south-west of Horncastle on the floodplain of the Rivers Bain and Witham in the district of East Lindsey. The proposed development lies north of the main settlement focus and encompasses most of one square kilometre on land situated between Green Lane and a dismantled railway (Kirksteadto Horncastle). Large areas of the site are forested (Bracken Wood), though the west and south-west periphery is predominantly arable.

Two areas on the north and west sides of the development (BA3 and BA5) may be used as borrow pit excavation sites: to provide make-up material for landscape features on the golf course.

4.0 The Proposed Scheme

1:2500 development plans were provided by Mr T. Mackenzie of Donald Steel & Co. for the purpose of this study, which marked-out (broadly) the positions of the two borrow pits, BA3 and BA5 (Fig. 2). The areas are irregular in plan and were therefore formalised for the purpose of field walking and magnetometry.

Approximately 20,000m³ of material may be removed from pit BA3; to be used in the building-up of greens and tees and to construct low banks adjacent to the road on the third hole. The pit void will form an irrigation reservoir. At BA5, approximately 6000m³ of material may be removed to build up greens and tees.

5.0. Planning background

This is a pre-planning assessment/evaluation. No formal application for planning permission has been made as the English Golf Union wishes to quantify all environmental constraints associated with the development in advance.

5.1 Archaeology in East Lindsey and the Deposit Plan

East Lindsey District Council recognises the importance of archaeological resources and has included within its Deposit Plan (1993) conditions regarding the protection or otherwise of buried deposits in association with the granting of planning permission.

Policy C8 (extract)

4.26 Archaeological remains are a finite and non-renewable resource, highly fragile and often vulnerable to damage and destruction. They can contain irreplaceable information about our past and the potential for an increase in future knowledge. They are part of our national identity and are vulnerable both for their own sake and for their role in education, leisure and tourism.

4.27 The District Council will support the County Council in its aim to protect Scheduled Ancient Monuments at all times and will try to make sure that offenders causing damage to them are prosecuted. There will be a strong presumption against all development which harm the site, character or setting of Scheduled Ancient Monuments as stressed in the Governments PPG16 - *Archaeology and Planning*. In the case of other sites of archaeological importance, the Council will also try to make sure that the archaeological effects of

development proposals are fully assessed before planning applications are determined. Planning permission will not be granted without such an assessment. To this end, the Council will liaise closely with the Archaeological Service provided by the County Council.

4.28 Policy C8 seeks to protect sites yet undiscovered or unrecorded as well as those which are fully documented. The Sites and Monuments Register is constantly evolving with information on new and existing sites. Under the National Monuments Protection Programme, English Heritage is reviewing and updating sites to be protected. This will clearly increase the number of sites to fall within the terms of this Policy.

4.29 There will normally be a presumption against development which would harm other sites of archaeological significance. However, permission may be granted if the Applicant has shown that the site will be preserved, either in situ or by record and that the proposed development is totally sympathetic to the site's character. Site investigation and recording should be seen as part of normal development costs to be borne by the Developer.

The Local Plan mirrors advice contained in a Department of the Environment document, *Planning Policy Guidance: Archaeology And Planning (PPG16)*. This identifies the need for early consultation in the planning process to determine the impact of construction schemes upon buried archaeological deposits".

The current report forms two phases within a process of elimination. Using the results of the assessment and, where necessary, evaluation procedures, an informed decision on the requirement (or otherwise) for further archaeological intervention may be taken. Where archaeology remains a requirement, beyond desk-top stage, further management strategies for safeguarding the archaeological resource may be developed, including; preservation *in situ* (usually the preferred option by all interested parties); excavation (preservation by record), or a recording brief.

5.2 Report Objectives

The report aims to identify and assess (without the use of intrusive techniques) archaeological deposits which may be threatened by excavations at the two borrow pit sites - in essence, to gather sufficient information to provide interested parties with a set of data from which a reasoned judgement may be made regarding future archaeological resource management. Desk-top assessment is the first stage in a common process of archaeological investigation and may be procedurally followed by further assessments, exploratory trial work or a watching brief within a defined development area. In the case of this study, it was agreed that all non-intrusive forms of evaluation would be integrated within a wider desk top/evaluation report.

5.3 Method

The assessment is based largely on data contained within the Sites and Monuments Record (SMR) held at the City & County Museum, Lincoln. Other data has been derived from records held by the Lincolnshire Archives Office and the Local Studies Library, Lincoln, as well as published and unpublished accounts held by Pre-Construct Archaeology.

Requests were made to the University of Cambridge Aerial Photographic Library and to the National Monuments Record for vertical and oblique cover searches, and all relevant aerial photographs held at the County Sites and Monuments Record, Lincoln, were also consulted. Where appropriate, features revealed as cropmarks have been plotted at scale 1:5000 (Fig. 3). Other sources relating to the geological, historical, and archaeological heritage of Woodhall Spa have also been consulted.

The site of the southern borrow pit (BA3) was systematically field walked within 20.0m grids. Surface remains were collected during the survey and are considered in section 8.0 below. The soil surface of proposal area BA5 is largely obscured beneath grass vegetation and would not be responsive, therefore, to this type of survey.

Both borrow pit sites were surveyed by magnetometry. The work was undertaken by GeoQuest Associates and a copy of their report is included (Appendix 1).

6.0 Geology and topography

The geology is complex and varied. Brown acidic soils dominate and these overlie beds of sand and gravel. Much of central Lincolnshire, from Brigg to Woodhall, is occupied by a heavy-textured glacial boulder clay/till (Straw 1969). Calcareous gley soils dominate but colluvial and alluvial gravel-based materials in the valley floors give lighter sandier soils. In the valley of the Bain, alluvial areas are extensive.

Podsolised soils are common on the free-draining sands, especially on the Kirkby Moor Sands east of Woodhall Spa (*ibid*). These podsolis may have originated under primitive oak woodland or may be consequent to the increased use of coniferous forestation. Generally, soils in the Bain valley are acidic with marked iron-panning in places - a situation perpetuated or extended by coniferous and/or heath vegetation.

Gravels in the Bain valley around Woodhall Spa are almost exclusively of flint or quartzite pebbles.

7.0 Archaeological and historical background

Although Woodhall Spa is a settlement of relatively recent origin, finds dating from the later Stone Age (Neolithic) have been recorded within the modern parish. These include two stone axes and a pebble mace from fields west of the village. Bronze Age artefacts have been found adjacent to the modern course of the Witham, c. 2km south-west of the proposed development. There are extensive cropmark sites around the periphery of the town, some of which lie close to one of the proposed borrow pit sites (below).

The parent village is Old Woodhall; now a tiny hamlet occupied by a couple of farm houses and modern barns, approximately 3.5km north of Woodhall Spa. Its church, St Margaret, was demolished in 1973 and the oldest surviving structure, Darwood House, probably dates within the C16th (Pevsner and Harris, 1989, 810).

The modern settlement developed after 1811 following John Parkinson's abandoned attempts at sinking a mine shaft on Kirkby Moor Allotment to extract coal - the void which was left filled with water which, soon, was found to have health-giving properties (White 1882). When White was writing in 1882, Woodhall Spa was included in the parish of Langton St Andrew (*ibid*). In 1889, Woodhall and Woodhall Spa were constituted a civil parish (Green, c. 1910, 49-52).

Inevitably, the commercial potential of the spa discovered in 1811 was put to good use and in 1849 the Lord of Woodhall Manor spent some £30,000 on sinking a well and erecting a hotel and bath house. This succeeded a more modest bath house, built by Thomas Hotchkin in 1835.

The railway arrived in 1855 with the construction of the Kirkstead to Horncastle line (disused since 1971). The south-east boundary of the proposed development lies a short distance from the line. The existing golf course was first laid down by H. Vardon and J. H. Taylor in 1905: today the site is maintained to championship standards (Lincs. WI, 1990, 181).

There has been little systematic archaeological research in the parish, despite the known presence of prehistoric, Romano-British, Saxon and medieval remains (often recorded as 'chance discoveries' during ditch digging and river management). Although not generally noted as an area of population

in the Roman period, for example, it is clear that some form of settlement was taking place as four Romano-British pots (Ollae) were found in the heart of the village.

Archaeologically, Woodhall is perhaps best known for the nearby Cistercian abbey at Kirkstead. It was founded in 1139, though was apparently moved to its final site in 1187. Although extant remains are sparse today, much of the fabric has only disappeared since the early C18th when William Stukely, the antiquarian, visited the site.

In the medieval period, much of the Witham Fen was probably flooded, though the river was used increasingly at this time for the transfer of wool to Boston for export. Kirkstead was but one of many religious houses which maintained the navigable state of the River Witham and probably initiated small-scale land reclamation projects. Following the dissolution of the monasteries (1536-39) the state of the river deteriorated (Owen, 1971).

8.0 Archaeological field walking

Agreement was reached between Pre-Construct Archaeology, the Client and the County Archaeological Officer that it was appropriate the results of gridded field walking be incorporated within the wider desk-based study.

8.1 Methodology

The area of the proposed borrow pit BA3 was systematically field walked (working in 20.0m grids, divided into 5.0m transects) on April 13th, 1995 by two experienced field archaeologists. Their brief was to establish a base line, divide and number the site into 20.0m grid squares (with close gridding if appropriate), and to collect and bag surface finds.

A north-south base line was established on the east side of the proposed pit and a plan of the site drawn at scale 1:500 (the plan has not been reduced for the purpose of this report due to the extremely low density of surface material present, though the data is retained as part of the site archive).

8.2 Results

A total of only five finds were collected from the entire pit area during the survey (from the west and central areas of the site). These finds constitute flakes of tile and/or relatively modern drainage pipe. It is concluded, therefore, that the site of BA3 is totally devoid of significant surface remains.

9.0 Geophysical survey (summary)

GeoQuest Associates were commissioned by Pre-Construct Archaeology (Lincoln) to undertake a magnetometer survey on both of the proposed borrow pit areas, BA3 and BA5. The purpose of the survey was to assess whether archaeological features capable of responding to this mode of non-intrusive evaluation (eg pits, ditches) lay within the proposed extraction sites.

The full results of the survey can be examined in Appendix 1, though a summary may be presented thus:

a) BA3

Close to the south limit of the site are some diffuse positive anomalies, possibly pits. It is suggested in the interpretation that these may be quarry pits as extant remains of such features can be seen c. 100m north-east of BA3. GeoQuest Associates have suggested that the anomalies may reflect the presence of similar buried features.

There is a strong sub-circular anomaly near the northern limit of the surveyed area - possibly an area of burning or a large ferrous buried object. Other dipolar anomalies were thought to reflect the presence of surface or sub-surface ferrous objects such as chain link, horseshoes etc.

b) BA5

In this larger area, except for the frequent occurrence of small dipolar anomalies (?ferrous litter), no potential archaeological features were recorded.

10.0 Aerial photographs

There exists a substantial archive of aerial photographs for the area, incorporating cropmark sites about the periphery of Woodhall Spa. These include a dense cluster of such features to the north-east of BA5.

A stated requirement of the archaeological brief (section 7.1) was for the plotting of aerial photographic evidence at desk top level, with a view to aiding the design of the evaluation phase. As, for this report, non-intrusive evaluation techniques have been applied from the outset, the evidence from aerial photography may be viewed in a wider context.

Sources of material consulted for the purpose of this project (details in Appendix 3) were as follows:

The National Monuments Record Aerial Photographic Library

University of Cambridge Committee for Aerial Photography

Sites and Monuments Record (Lincoln) aerial photographic collection

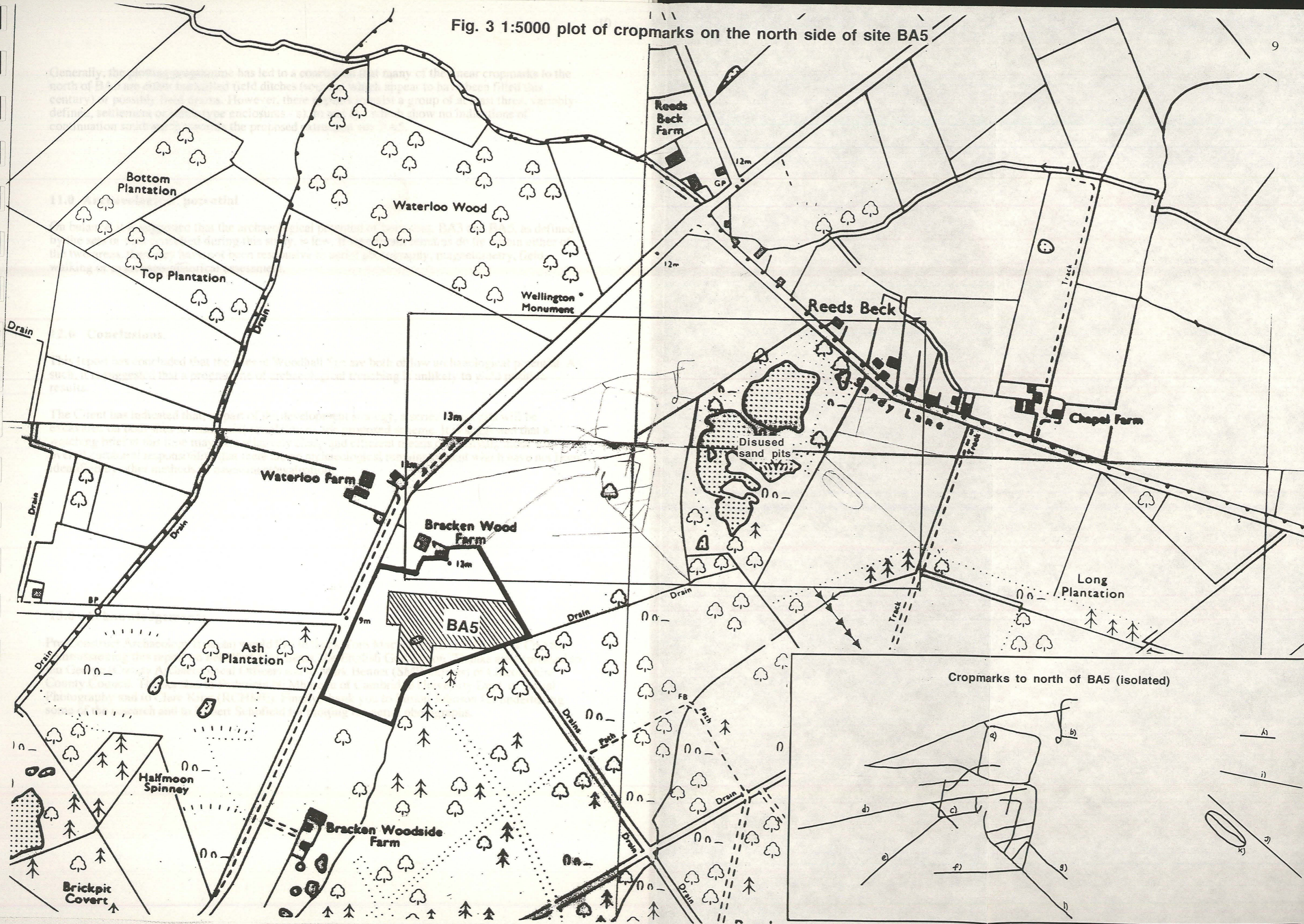
An assessment of the above sources (involving rapid cover-searches at Cambridge and the National Monuments Record) confirmed that there exists a cluster of features revealed as cropmarks approximately 150m north-east of BA5. These cropmarks are dense and, in some cases, suggest the possible continuation of features which may not have been exposed to conditions capable of revealing them as cropmarks during high summer.

Following the collection of data derived from the above named sources, Mr R. Schofield, working on behalf of Pre-Construct Archaeology (Lincoln), undertook a measured assessment of the data and plotted the results at scale 1:5000 (Fig. 3). The data has subsequently been reviewed and incorporated with cartographic material which has been examined as part of the assessment.

Some of the features expressed as cropmarks can be interpreted as field boundaries of relatively recent origin (or decline). For example, the linear feature coded e) can be seen on 1st and 2nd edition Ordnance Survey maps of the area (Appendix 4), as can feature coded l). Other features (eg d), f), g), h), i) and j) may be also have disappeared in relatively recent times, though these were not identified on the maps consulted - it is possible that some of the cropmarks reflect the presence of buried land drains.

Cropmarks coded a), b), and c) may be enclosures or moated sites (extant earthwork remains can be seen at Old Woodhall and Poolham Hall, north of Woodhall Spa), though quantification of such remains would require a far more detailed assessment than is possible at the present time.

Fig. 3 1:5000 plot of cropmarks on the north side of site BA5



Generally, the plotting programme has led to a conclusion that many of the linear cropmarks to the north of BA5 are either backfilled field ditches (some of which appear to have been filled this century) or possibly field drains. However, there appears to exist a group of at least three, variably-defined, settlement or stock-type enclosures - a), b) and c) - which show no indications of continuation southwards towards the proposed extraction site BA5.

11.0 Archaeological potential

On balance, it is suggested that the archaeological potential of both sites, BA3 and BA5, as defined by the sets of data consulted during this study, is low. If significant remains do lie within either of the two areas, then they have not been responsive to aerial photography, magnetometry, field walking or to archaeo-historical assessment.

12.0 Conclusions

This report has concluded that the sites at Woodhall Spa are both of low archaeological potential. As such, it is suggested that a programme of archaeological trenching is unlikely to yield positive results.

The Client has indicated that, as part of the development strategy, a series of test pits will be excavated on both sites to assess soil suitability re. the proposed scheme. It is suggested that a watching brief at this time may be a relatively cheap and efficient means of satisfying those with overall curatorial responsibility that there are no archaeological remains present which have not been identified by other methods of assessment/evaluation.

13.0 Acknowledgements

Pre-Construct Archaeology (Lincoln) would like to thank Tom Mackenzie (Donald Steel & Co.) for commissioning this report on behalf of his Clients, the English Golf Union. Thanks are expressed to Ian George (County Archaeological Officer) and to Mark Bennet (SMR Officer) of Lincolnshire County Council. Thanks also to Padraicin Ni Mhurchu of Cambridge University Dept. of Aerial Photography and to Clare King (RCHME). Finally, thank you to Simon Johnson for undertaking some of the research and to Robert Schofield for plotting the aerial photographs.

14.0 References

- Department of the Environment. 1990: *Planning Policy Guidance: Archaeology and Planning (PPG16)*
- Green, H c. 1910 *Lincolnshire Town and Village Life*, Vol. 5,
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- Owen, D 1971 *Church and Society in Medieval Lincolnshire*, *Hist. of Lincolnshire V*
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GEOPHYSICAL SURVEYS OF
WOODHALL SPA
LINCOLNSHIRE

A PROGRAMME OF RESEARCH CARRIED OUT
ON BEHALF OF

PRE-CONSTRUCTION ARCHAEOLOGY GROUP AND
DONALD STEEL & CO. LTD

INTRODUCTION

This report presents the results of geophysical surveys of two areas of land north of Woodhall Spa village in Lincolnshire. The surveyed areas are shown yellow in Figure 1. The research was carried out on behalf of Colin Palmer Brown, (Pre-Construct Archaeology (Lincoln)) and Tom McKerrell, (Donald Steel & Co. Ltd.) in accordance with instructions supplied by Palmer Brown.

The aim of the study was to test for the presence of archaeological features in two areas, BA5 and BA3, proposed to be developed as extensions to an existing golf course.

GEOLOGY, TOPOGRAPHY

**GEOPHYSICAL SURVEYS AT
WOODHALL SPA,
LINCOLNSHIRE**

Area BA5, covering approximately 2.5 hectares, is situated to the north of the existing golf course and is bounded to the east by the railway line. The area is a mixture of open fields and woodland. Area BA3, approximately 1.5 hectares, is situated to the south of Area BA5 and is bounded to the east by the railway line.

The local geology of Upper Jurassic Anglian Clay and Lincolnshire Limestone is predominant in the landscape.

**A PROGRAMME OF RESEARCH CARRIED OUT
ON BEHALF OF**

THE GEOPHYSICAL SURVEY

**PRE-CONSTRUCT ARCHAEOLOGY (Lincoln) and
DONALD STEEL & CO. LTD.**

By

GeoQuest Associates

INTRODUCTION

This report presents the results of geophysical surveys on two areas of land north of Woodhall Spa village in Lincolnshire. The surveyed areas are shown yellow in Figure 1. The research was carried out on behalf of Colin Palmer-Brown (Pre-Construct Archaeology [Lincoln]) and Tom MacKenzie (Donald Steel & Co. Ltd.) in accordance with instructions supplied by Palmer-Brown.

The aim of the study was to test for the presence of archaeological features in two areas, BA5 and BA3, proposed to be developed as extensions to an existing golf course.

GEOLOGY, TOPOGRAPHY AND LANDUSE

Area BA5, covering approximately 2ha, lies between Bracken Wood Farm (disused) and the north-west corner of Bracken Wood. Although most of this area is pasture the northern part is under arable cultivation. Area BA3, approximately 1ha, lies south of Bracken Woodside Farm and west of Bracken Wood and is currently arable land.

The local geology of Upper Jurassic Ampthill Clay and Kimmeridge Clay underlies a predominantly flat landscape.

THE GEOPHYSICAL SURVEY

Geophysical surveying provides a rapid method for the detection of subsoil features within archaeological landscapes. Two methods are most frequently used. *Geomagnetic* surveying employs a portable magnetometer to detect small perturbations in the Earth's magnetic field caused by changes in soil magnetic susceptibility or permanent magnetisation. The *resistivity* method, on the other hand, maps differences in soil electrical resistance which mainly reflect variations in water content.

Although there is no documentary or aerial photographic evidence to suggest the presence of any archaeological features in either Area BA5 or BA3, the types of features that might be encountered, such as stone and timber buildings, rubbish pits and ditches, should be characterised by significant contrasts in magnetic susceptibility and so geomagnetic surveying was chosen as an appropriate technique for this investigation.

Measurements of vertical geomagnetic field gradient were made over a regular grid using an enhanced Geoscan FM36 fluxgate gradiometer with ST1 sample trigger. A zig-zag traverse scheme was employed and data were logged in units of 20 x 20m at

1.0 x 0.5m intervals. Appendix A provides further information about the techniques employed.

The GeoQuest *InSite* Windows program was used to process the geophysical data and produce grey-scale images at a scale of 1:1000 showing the residual geomagnetic anomalies on a base-map (Figure 2) digitised from an architectural plan supplied by C. Palmer-Brown. A 3x3 low pass filter has been applied to this image to reduce the 'speckle' due to soil susceptibility noise. A convention is used that shows positive magnetic anomalies as dark grey and negative magnetic anomalies as light grey. (Note that the slight banding visible in the geophysical images is a data artefact.)

RESULTS AND DISCUSSION

The first stage in the interpretation has been to extract significant anomalies in the geomagnetic data and present them on a plan using coded colours and patterns (Figure 3). An archaeological interpretation is shown in Figure 4. The three classes of anomalies which have been distinguished are as follows:

- 1 **Green:** Significant regions of anomalously high magnetic field gradient which might be associated with high susceptibility soil-filled structures such as pits or ditches.
- 2 **Blue:** Areas of anomalously low magnetic field gradient, corresponding to material with low magnetic susceptibility, such as sedimentary rock rubble.
- 3 **Red:** Strong dipolar anomalies (paired positive-negative) which, in this context, mostly reflect ferrous surface litter such as horse-shoes, chain links and ploughshares.

The following features have been identified:

Area BA5

- 1 Many small dipolar anomalies are present this area and reflect the presence of small items of ferrous litter such as horseshoes and chain links, several of which were observed on the ground. The large dipolar anomaly detected along the central fenceline corresponds to a metal gate.
- 2 No anomalies were detected that might represent archaeological features.

Area BA3

- 1 Near the southern limit of the survey area some diffuse positive magnetic anomalies were detected. Anomalies of this type often represent high-susceptibility soil-filled structures such as pits. Since there are remains of brickpits

approximately 100m northeast of the survey area (C. Palmer-Brown *pers. comm.*) it seems likely that these features may also represent the remains of such features.

- 2 A strong sub-circular anomaly 3-4m in diameter near the northern limit of BA3 may indicate an area of burning, such as a hearth, although as there appear to be no associated features the anomaly may rather reflect a large, ferrous buried object.
- 3 Along the southern edge of this area there is a linear grouping of small dipolar anomalies likely to represent a length of chain or wire.
- 4 A scatter of small dipolar anomalies were detected throughout this area, again reflecting the presence of ferrous surface litter.

CONCLUSIONS

Two geomagnetic surveys were carried out on proposed development areas north of Woodhall Spa in Lincolnshire. The following features have been located:

- 1 Three diffuse positive magnetic anomalies were detected near the southern limit of BA3 which may represent the sites of former brickpits.
- 2 A strong sub-circular positive anomaly 3-4m in diameter was detected near the northern limit of BA3. This anomaly may represent an area of burning, such as a hearth, although as no other features were detected in association with this the anomaly may rather reflect the presence of a buried ferrous object.
- 3 Both areas are characterised by a low scatter of ferrous litter.
- 4 No geotechnical hazards, such as service pipes, were located in either area.

CONFIDENCE RATINGS

The percentage levels of confidence which we assign to the features interpreted from the geophysical survey are as follows:

Area BA3

Brickpits: 60%

Area of burning: 50%

Hearth: 20%

Large ferrous object: 50%

CREDITS

Field survey: D.N. Hale, A. Favell

Graphics: R. Grove

Report: D.N. Hale

Date: 25nd April 1995

Note: Whilst every effort has been taken in the preparation and submission of this report in order to provide as complete an assessment as possible within the terms of the brief, GeoQuest Associates cannot accept any responsibility for consequences arising as a result of unknown and undiscovered sites or artifacts.

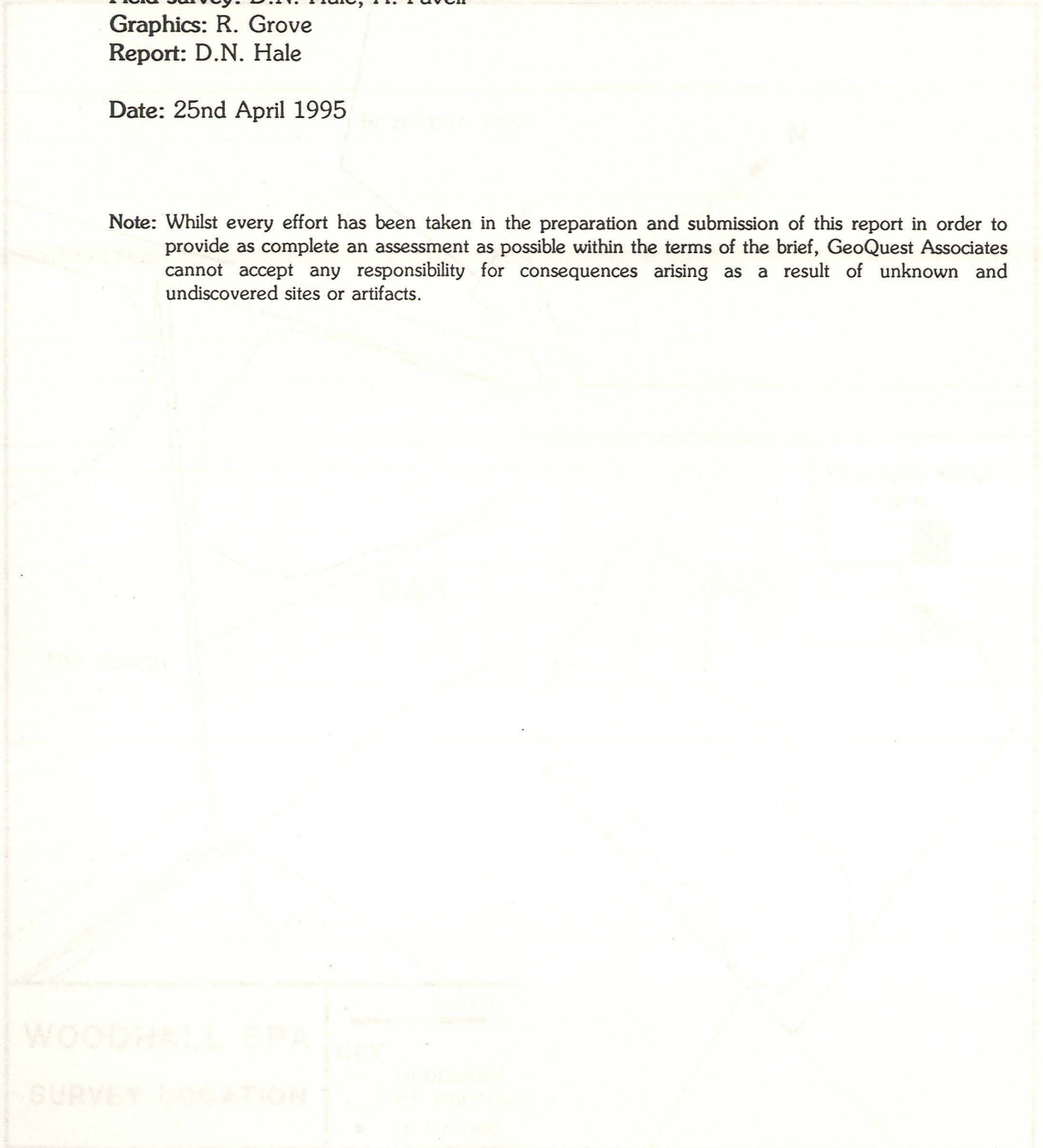


FIGURE 1

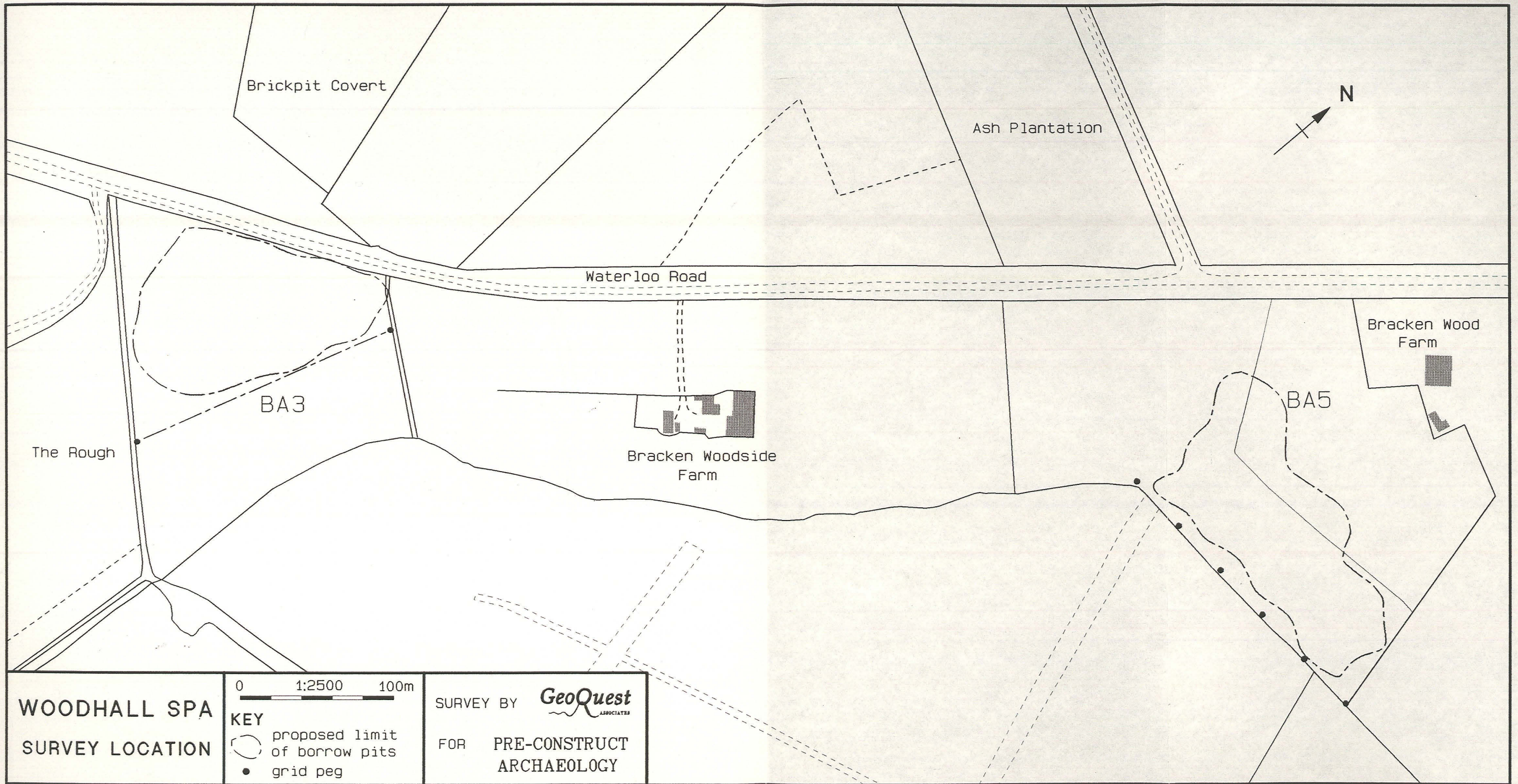


FIGURE 1

FIGURE 2

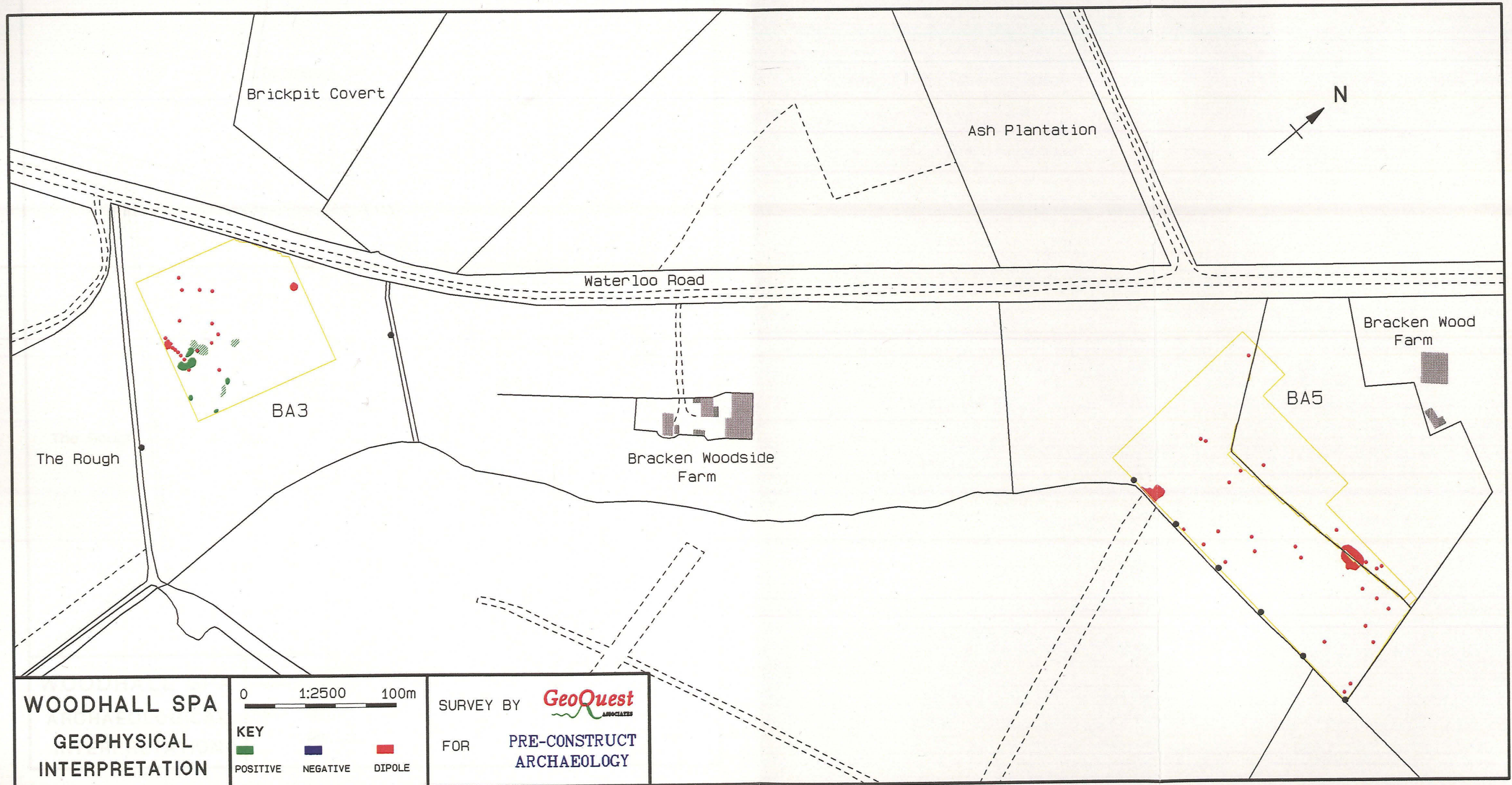


FIGURE 3

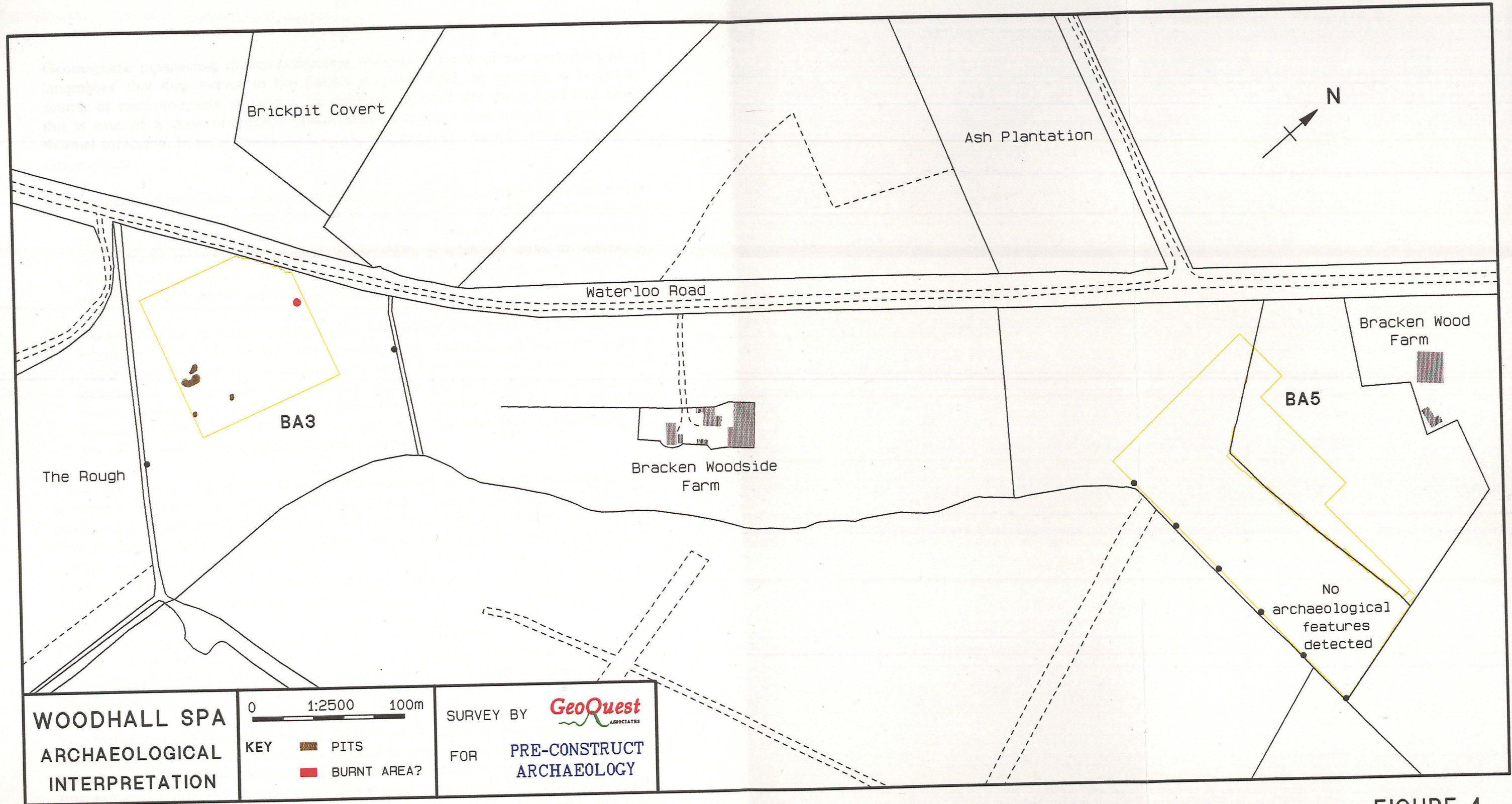


FIGURE 4

APPENDIX A

Principles of Geomagnetic Surveying

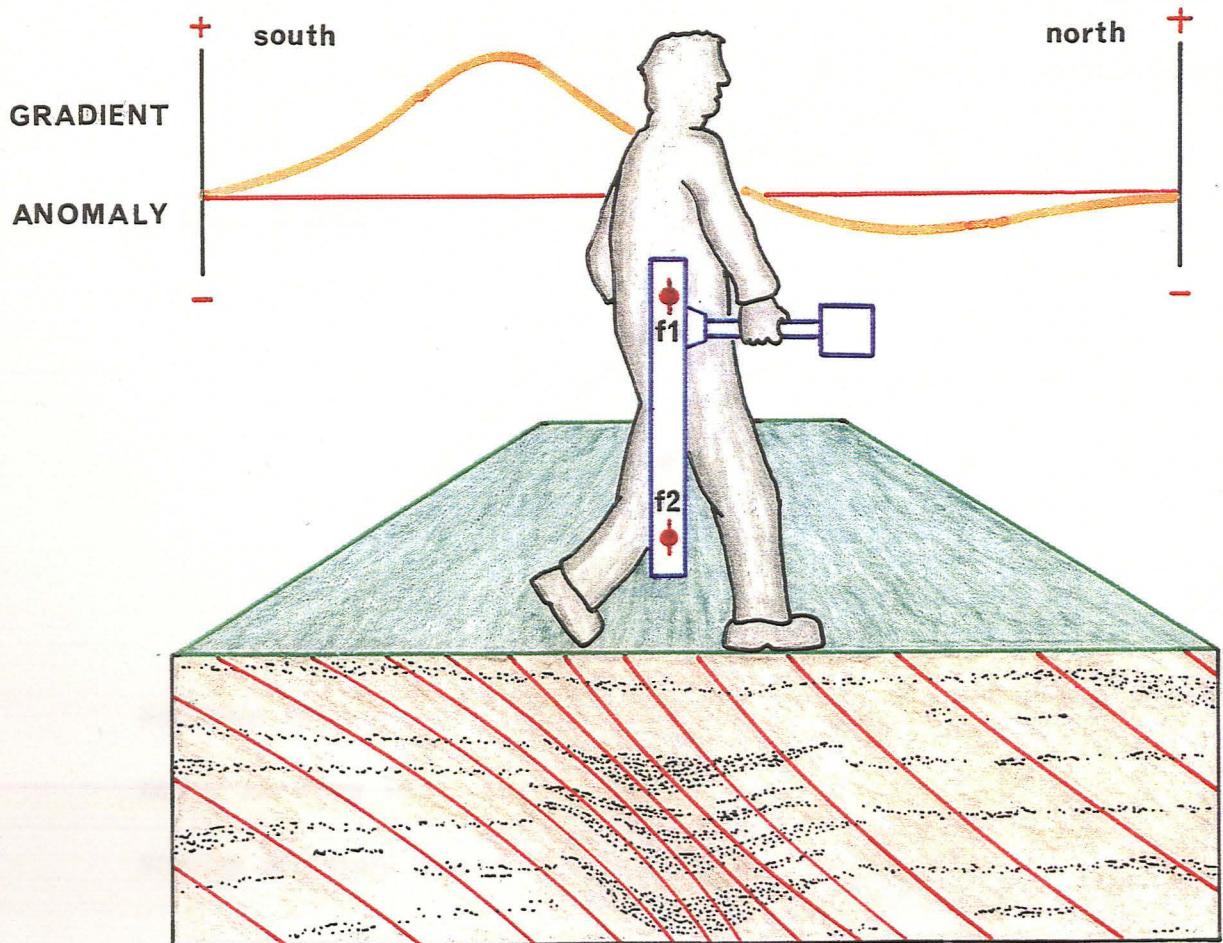
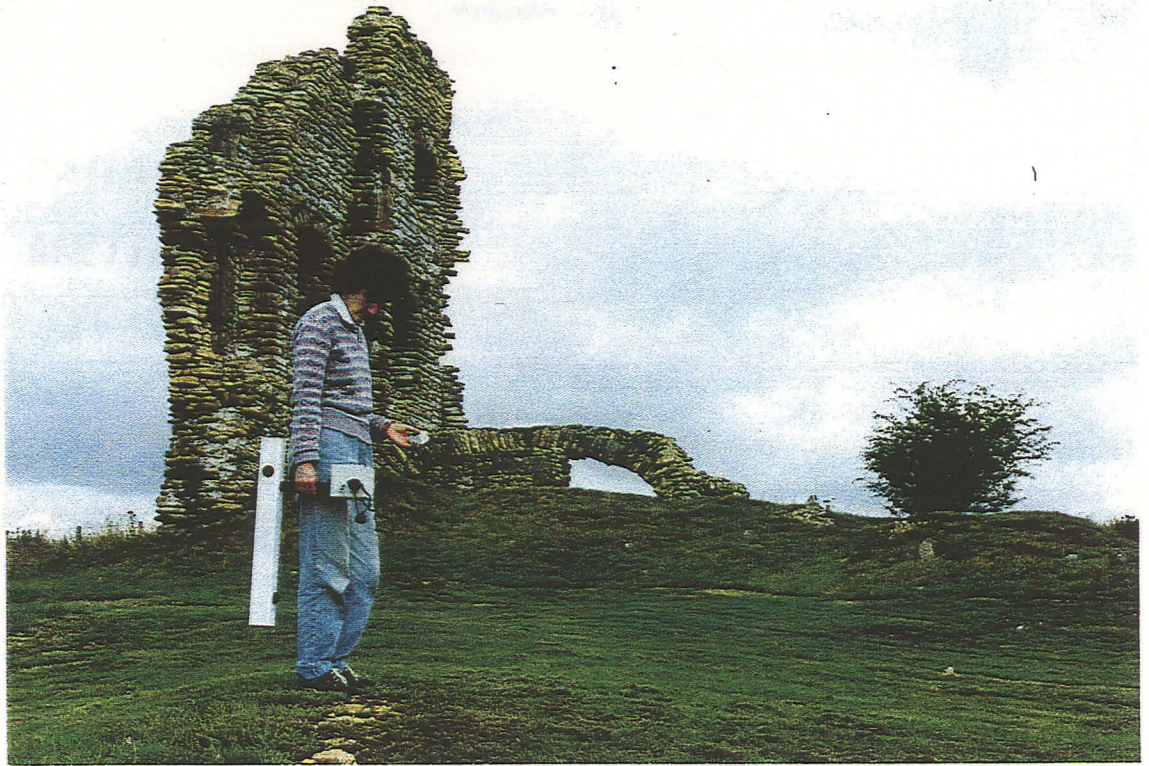
Geomagnetic prospecting detects subsurface features in terms of the perturbations or 'anomalies' that they induce in the Earth's magnetic field. In contrast to resistivity, seismic or electromagnetic surveying, no energy is injected into the subsoil and hence this is one of a class of *passive* geophysical techniques that includes gravity and thermal surveying. In an archaeological setting two types of magnetic anomalies can be distinguished:

- 1 Anomalies arising from variations in *magnetic susceptibility* which will modulate the component of magnetisation *induced* in the subsurface by the Earth's magnetic field. For most archaeological sites, this is the dominant factor giving rise to geomagnetic anomalies. In general, susceptibility is relatively weak in sediments, such as sandstones and enhanced in igneous rocks and soils, especially those which have been burnt or stratified with organic material.
- 2 Anomalies due to large, *permanently magnetised* structures. Such permanent magnetisation or 'remanence' arises when earth materials are heated to above $\sim 600^{\circ}\text{C}$ and cooled in the geomagnetic field. Thus kilns and hearths are often detected as strong permanent magnets causing highly localised anomalies that dominate effects due to background susceptibility variations. Remanence can result from other physical and chemical processes but these give rise to anomalies that are usually unimportant for geophysical prospecting.

There are several approaches towards the practical measurement of geomagnetic anomalies. In this study measurements were made using a Geoscan FM36 fluxgate gradiometer which records the change with height in the vertical component of the Earth's magnetic field, as shown overleaf. This method has the advantage of being insensitive to diurnal variations while the Geoscan instrument also benefits from an integrated data logger. Note that in mid northern latitudes the magnetic anomaly will be asymmetric with the main peak displaced to the south of the archaeological feature. Thus, a ditch filled with a soil of enhanced susceptibility, for example, will generate a positive anomaly to the south, mirrored by a weak negative anomaly north of the feature. When portrayed as an area map of grey tones this gives rise to a 'shadowing' or pseudo relief effect which must be borne in mind when making an archaeological interpretation.

Two techniques can be used to survey gridded areas using the fluxgate magnetometer. In the parallel method the instrument is used to scan the area along traverses which are always in the same direction. This method minimises 'heading errors' due to operator and instrument magnetisation but is time consuming. The alternative zig-zag method is significantly faster and suitable for areas where anomalies are large compared to these and other sources of error.

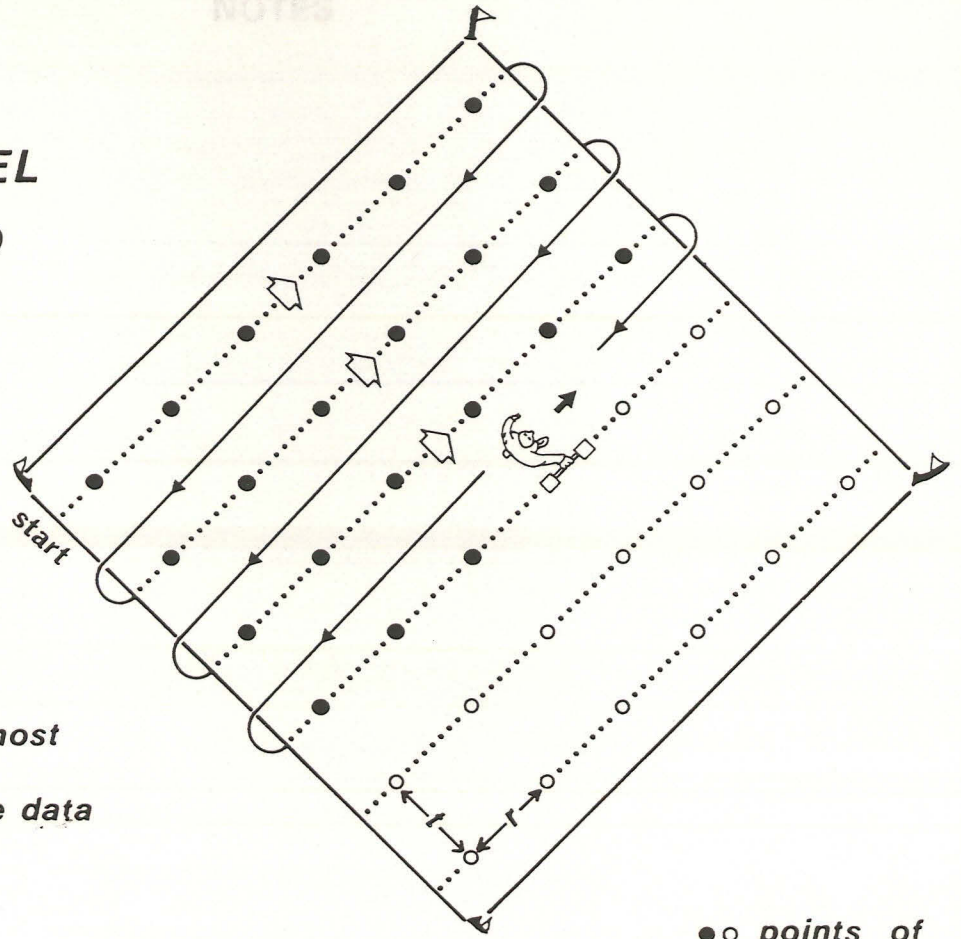
MAGNETIC SURVEYING



SURVEY SCHEMES

NOTES

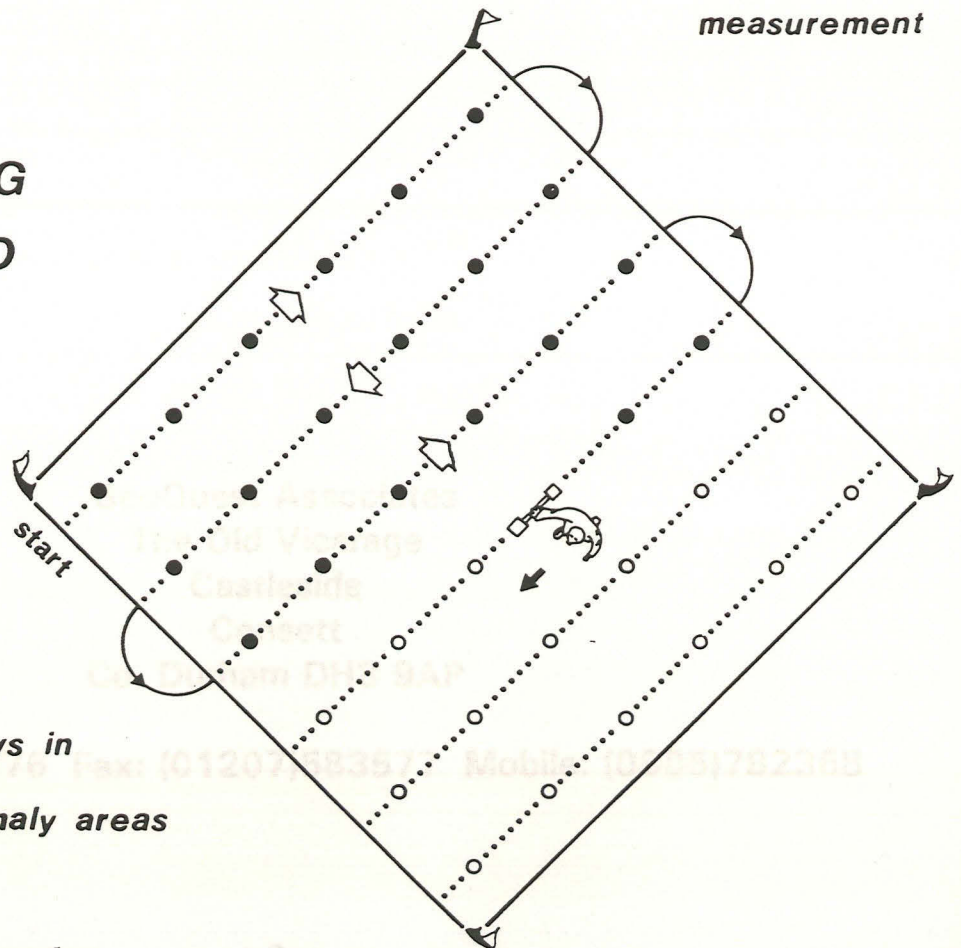
PARALLEL METHOD



*slower but
minimises most
errors in the data*

●○ points of
measurement

ZIG-ZAG METHOD



*suitable for
rapid surveys in
strong anomaly areas*

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Appendix 3 Information derived from the Sites and Monuments Record, Lincoln

NOTES

NMR code	NGR	Description
40391	TF 18746320	Carved stonework and tiles from Kirkstall Abbey, now in St Peter's Church, Eastgate, York YO1 1AA
40409	TF 1790643	Extensive undated settlement remains, including a stone wall, includes great wall, ditched enclosure and track ways
40419	TF 20426492	Delimited prehistoric field system, also the site of a stone wall on eastern and lower ditched field system
40487	TF 18706370	Area of low-walled stone wall, part of a larger enclosure, included in the Historic Cultural Landscape Survey of a 100m x 200m area
40488	TF 20416490	Remains of a Roman villa, including a large rectangular building, a bathhouse and a central courtyard
40489	TF 18716392	The walls of a Roman villa, the site of a large rectangular building, bathhouse and a central courtyard
40490	TF 18706470	Large stone wall, part of a larger enclosure, including a ditched enclosure
40491	TF 18706294	Remains of a Roman villa, including a large rectangular building, bathhouse and a central courtyard
40492	TF 18706216	Remains of a Roman villa, including a large rectangular building, bathhouse and a central courtyard
40493	TF 18706210	Large Roman villa, including a large rectangular building, bathhouse and a central courtyard
40494	TF 18706210	Large Roman villa, including a large rectangular building, bathhouse and a central courtyard
40495	TF 18706210	Large Roman villa, including a large rectangular building, bathhouse and a central courtyard
40496	TF 18706210	Large Roman villa, including a large rectangular building, bathhouse and a central courtyard
40497	TF 18706210	Large Roman villa, including a large rectangular building, bathhouse and a central courtyard
40498	TF 18706210	Large Roman villa, including a large rectangular building, bathhouse and a central courtyard
40499	TF 18706210	Large Roman villa, including a large rectangular building, bathhouse and a central courtyard
40500	TF 18706210	Large Roman villa, including a large rectangular building, bathhouse and a central courtyard

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Appendix 2 Information derived from the Sites and Monuments Record, Lincoln

SMR code	NGR	Description
40091	TF 19746320	Carved stonework and tiles from Kirkstead Abbey; now in St Peters Church. One tile inlaid, two green glazed
40409	TF 19806485	Extensive undated settlement remains showing as cropmark: includes linear features, ditched enclosures and trackways
40419	TF 20426492	Undated prehistoric field system: double ditches, rectangular enclosure and linear ditched field system
42987	TF 19706370	Area of semi-natural woodland, probably of ancient status. Included in the Nature Conservancy Council's inventory of ancient woodland
43002	TF 20106430	As above; 36 hectares classified as semi-natural, 44 hectares as plantation
40085	TF18216297	Two axes; one of stone, the other of partly polished flint. Both discovered during ditch digging
40408	TF18306020	Undated linear cropmarks, discovered 1979 (Everson)
40063	TF17366294	Neolithic pebble mace
42787	TF17246286	Medieval pottery sherd; fish smoker
40083	TF17526237	Late Bronze Age spearhead; discovered 1964, 300 yds north-west of the bridge
40084	TF17466242	Anglo-Saxon/Danish sword, dagger and spearhead; discovered in Witham at Kirkstead Wath, 1788
40089	TF193631	Four Roman pots (Ollae)
40086	TF193631	Polished stone axe (in Canon Hunt Collection)

Appendix 3. Sources of aerial photographic data consulted

1. University of Cambridge Committee for Aerial Photography

Code	NGR	Description
CDK29	TF199650	Black and white oblique of cropmarks to north of BA5
CDK30	TF199650	As above, different angle
CDK31	TF199650	As above, different angle
CDK32	TF199650	As above, different angle

2. National Monuments collection, Swindon (cropmarks to north of BA5)

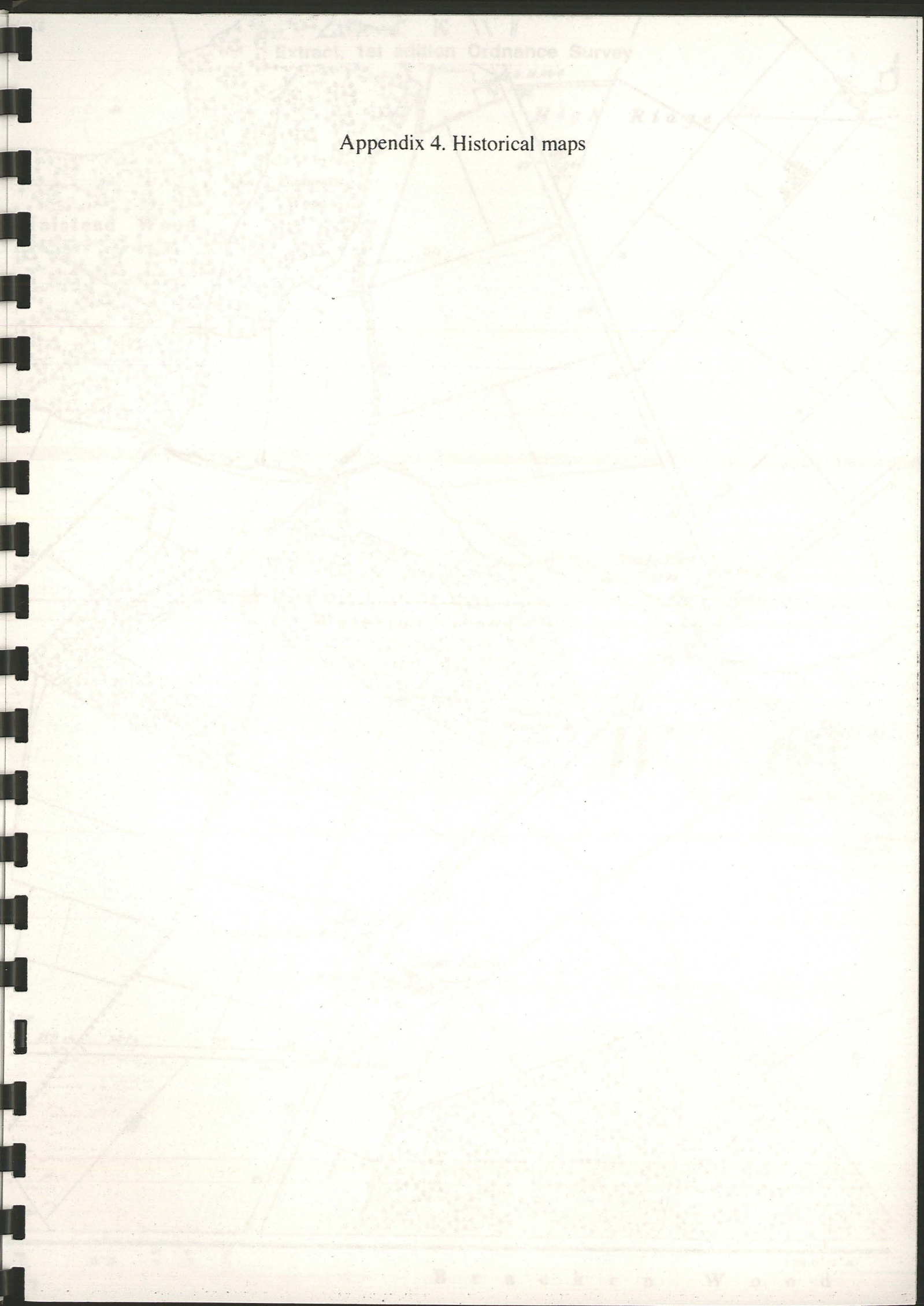
Library number	NGR
851	TF 199650
913	TF 199650
9788	TF 199650
10008	TF 199650
10114	TF 199650

3. County Sites and Monuments Record (SMR)

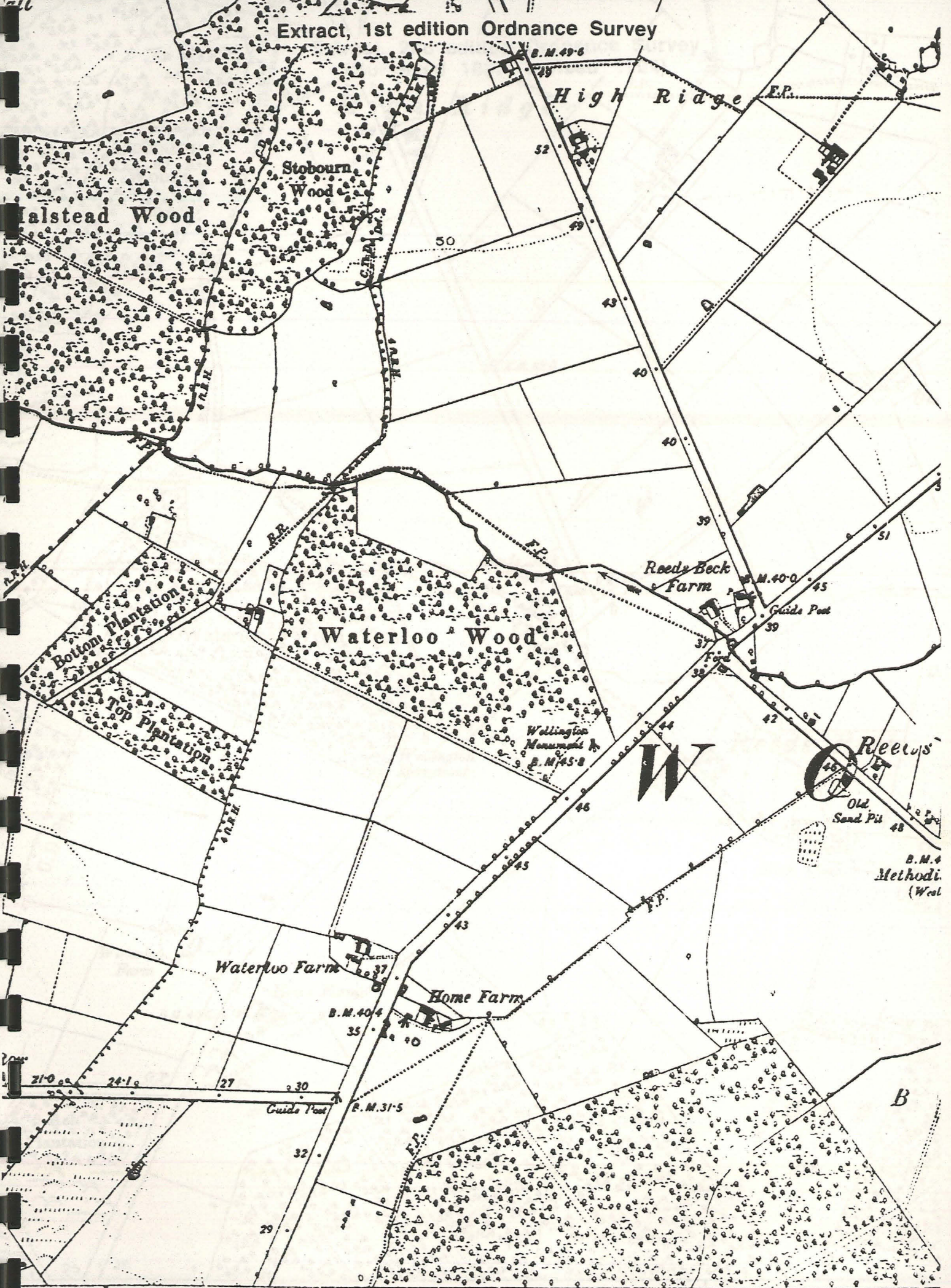
RCHM	5165-5	Neg. TF 1964/6	NGR TF 201 648
RCHM	5165-1	Neg. TF 1964/2	NGR TF201648
RCHM	2960/31PLE	Neg. TF 1965/2	NGR TF199651
CDK 30/32			NGR TF 199650
RCHM	5165-3		NGR TF201648
RCHM	5165-7		NGR TF201648
RCHM	2960/32PLE		NGR TF203649

Extract, 1st edition Ordnance Survey

Appendix 4. Historical maps



Extract, 1st edition Ordnance Survey



B.M. 4
Methodi
(Wel)

B

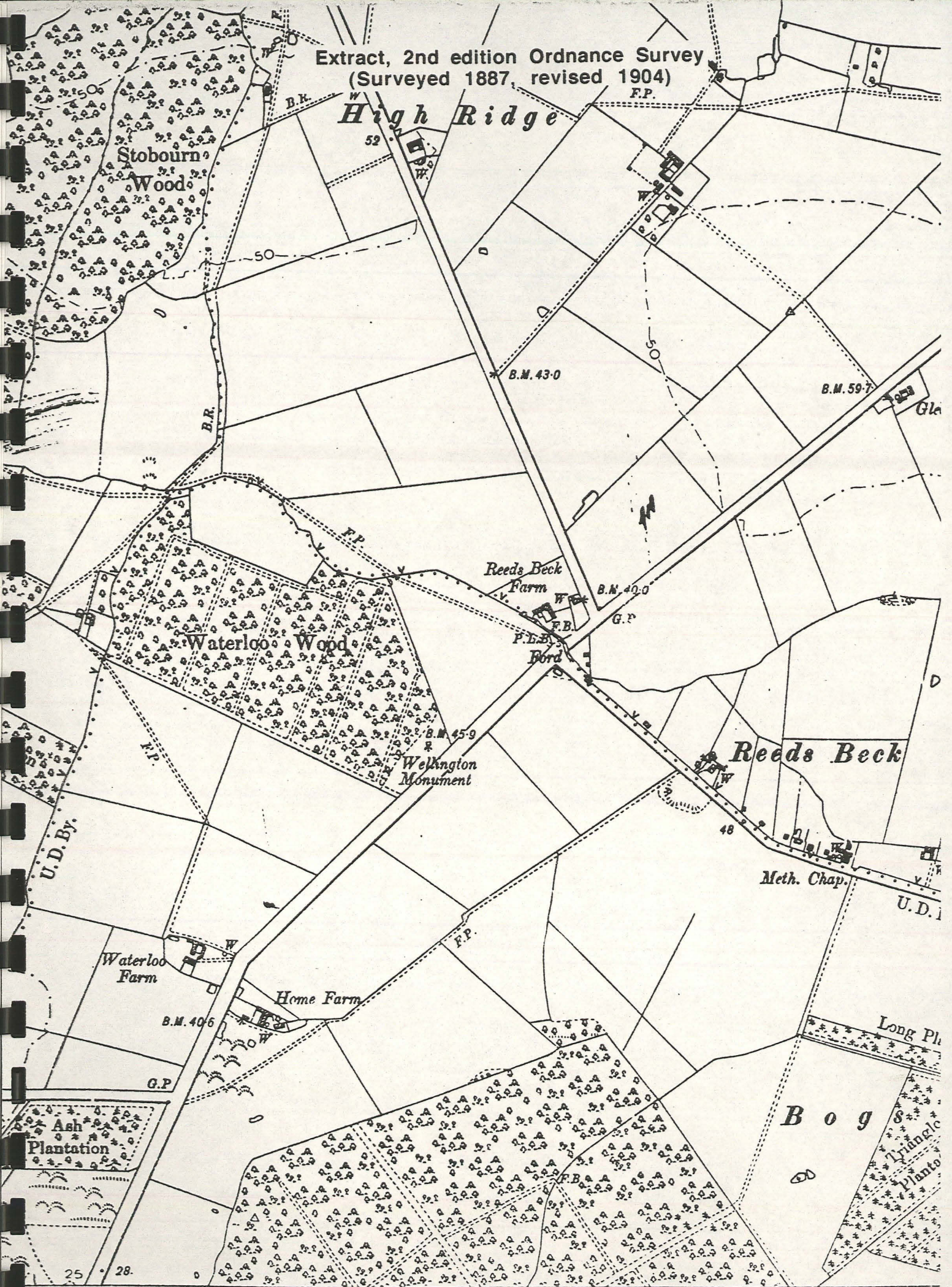
0° 13' 25' 30'

Bracken Wood

Lon. 0° 12' W.

Extract, 2nd edition Ordnance Survey
(Surveyed 1887, revised 1904)

High Ridge

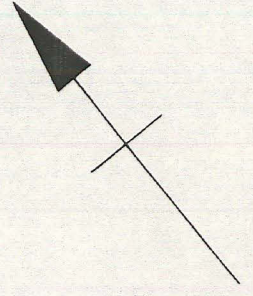


WOODHALL SPA U.D.

Bracken Wood

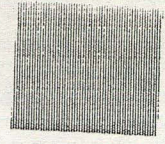
W. 12' 0" LONG. WOODHALL SPA PH.

N



Ash Plantation

Bracken Wood Farm



BA5

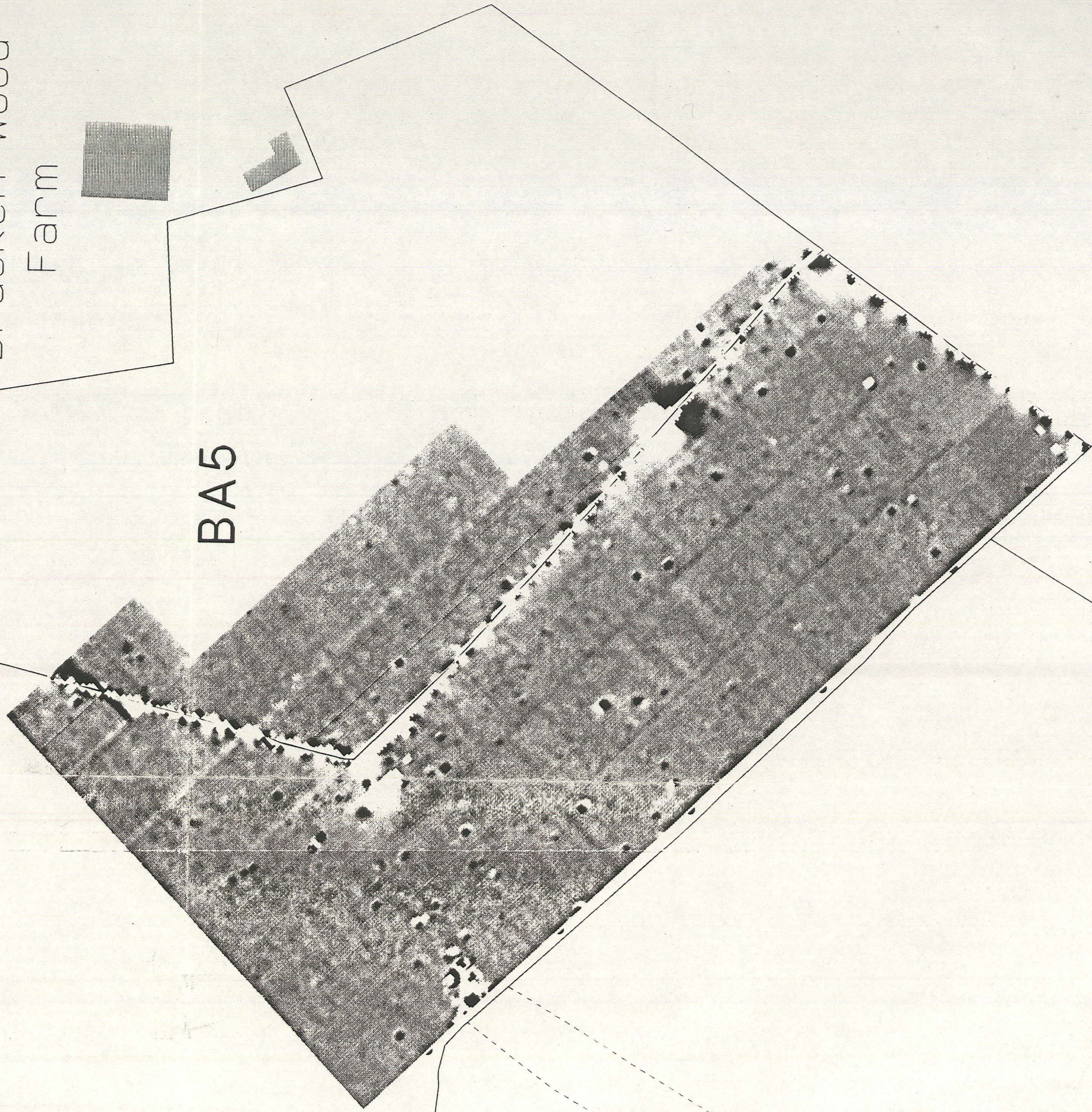
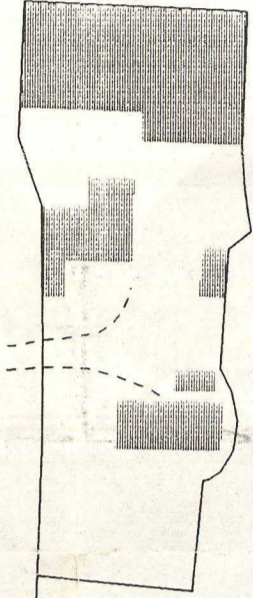


FIGURE 2

Covert

Waterloo Road

Bracken Woodside
Farm



100m



GeoQuest
ASSOCIATES

SURVEY BY

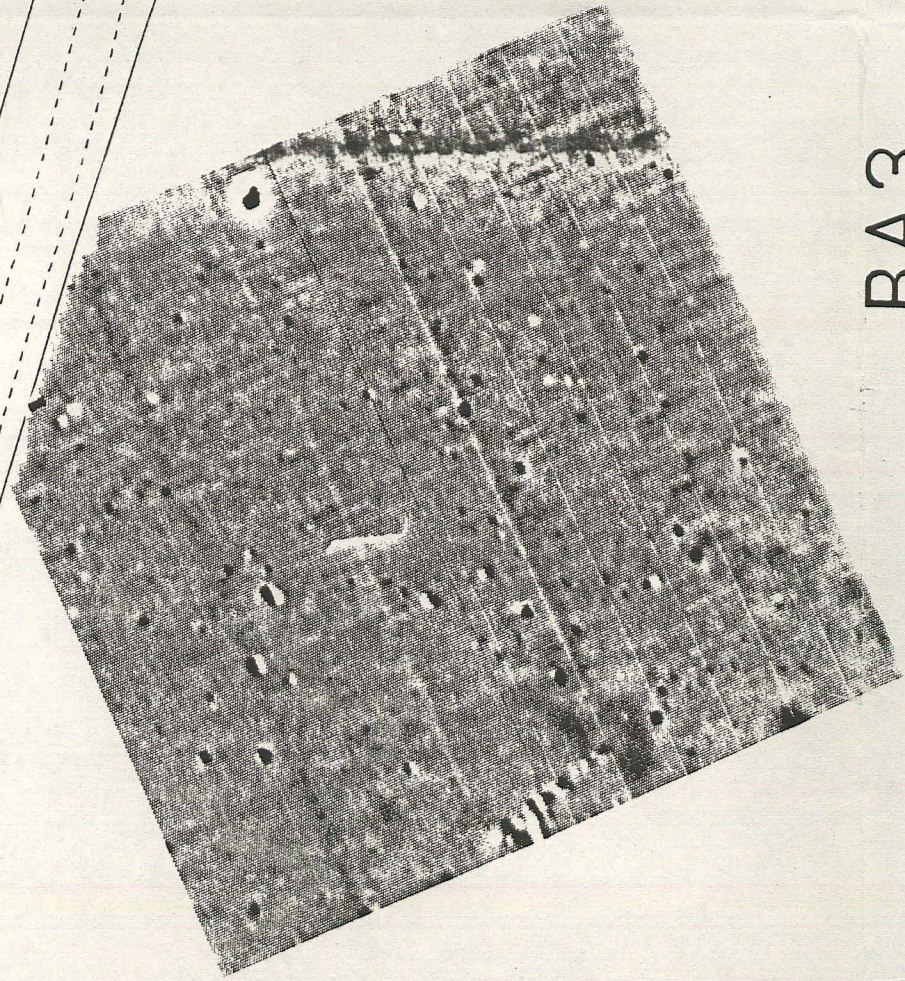
FOR PRE-CONSTRUCT
ARCHAEOLOGY

FIGURE 2

Brickpit Covert

Plantation

Waterl



BA3

The Rough

WOODHALL SPA

SURVEY RESULTS

SURVEY BY

GeoQuest
ASSOCIATES

FOR

PRE-CONSTRUCT
ARCHAEOLOGY

0 1:1000 100m

