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LAND SOUTH EAST OF NORTON BIG WOOD, NORTON DISNEY, LINCOLNSHIRE

Topsoil Magnetic Susceptibility and Gradiometer Survey

(Survey Ref : 0341193/NOL/BUT)

Produced by

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under the direction of

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Commissioned by

Butterley Aggregates Limited

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Oxford Archaeotechnics

Specialist Field Evaluation

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SUMMARY

A global geophysical evaluation programme was carried out on land (centred at SK 883600) southeast of Norton Big Wood, Norton Disney, Lincolnshire.

The survey was based upon the principle that debris from past human activity usually creates slight but persistent anomalies in the local magnetic field, anomalies which can be sensed from the surface (using magnetic susceptibility measurement and magnetometry). Any suggestive anomalies are then tested by hand augering to verify the nature of the buried material responsible.

In the present case, the following features were identified: (a) recent pollution (from trackways and other consolidated ground); (b) post-Medieval field boundaries (now removed but mostly already known from historical maps); and (c) magnetically augmented geological features of Pleistocene origin. No material of archaeological significance was encountered, and it is concluded that magnetically enhanced sites (such as settlement sites) are absent. Any older (prehistoric) sites, representing only brief episodes of 'clean' activity, might not have been located by magnetic survey. No ancient topsoil debris or artefact scatters were noted at any point within the survey area.

CONTENTS

LIST OF FIGURES

1. INTRODUCTION

1.1 A geophysical evaluation programme was commissioned by Ready Mixed Concrete (UK) Limited, on behalf of Butterley Aggregates Limited, on land southeast of Norton Big Wood, Norton Disney, Lincolnshire. The survey forms part of an archaeological assessment in advance of mineral extraction.

1.2 The work comprised a combination of topsoil magnetic susceptibility field sensing, magnetometry, and the extraction by hand auger of topsoil, subsoil and archaeological fill samples. An explanation of the techniques used, and the rationale behind their selection, is included in an Appendix to the present report.

1.3 The fieldwork was carried out in December 1993.

1.4 The survey area (centred at SK 883600) covers an area of just over 30 ha, situated immediately southeast of Norton Big Wood, and c.700 m northwest of the village of Norton Disney (Fig. 1). It is a roughly triangular in shape, bounded on the north and west by Norton Big Wood, and on the east by a minor road known as Butt Lane. The existing Butterley Aggregates Thurlby Quarry lies c.400 m to the northeast.

1.5 The survey area was arable farmland, with the exception of a strip of young conifer plantation, alongside the southern boundary. The field surface was corn stubble at the time of survey. Ground conditions were moist to wet (locally surface-saturated), with a small area of deeper mud in the vicinity of the access track on the southeastern side of the survey area, which had been utilised as a beet store, and was unsuitable for survey. Weather conditions during the survey were very poor (wind, rain and sleet) but, in this case, would not have affected the reliability of results.

1.6 The land is generally flat (c.16 m OD), with a slight overall slope trend from northwest to southeast.

1.7 The drift deposits are mapped by the IGS as Older River Gravel (probably the fossiliferous Balderton Sand & Gravel formation, which has been reasonably well correlated with Oxygen Isotope Stage 6). The fluvial deposits overlie Jurassic grey clays and mudstone (mostly Lower Lias Clay).

1.8 No archaeological sites or finds are recorded in the County Sites and Monuments Record, either within or in close proximity to the survey area. A Roman villa (partially excavated in the 1930s) lies 2 km west of the survey area (centred at SK 859603; SMR: SK86SE/E); two Neolithic stone artefacts were revealed in the course of the excavations (Oswald 1937). Roman pottery sherds were found in Norton Disney village during extensions to the Fox and Hounds Public House (centred at SK 887591) in 1964 (SMR: SK85NE/E).

1.9 A recent desk-top archaeological assessment of the site by OAA (Johnson 1993) noted a number of indeterminate crop/soil marks visible on high altitude vertical photographs within the southwestern and western parts of the survey area, although it was extremely difficult to distinguish marks of possible archaeological origin from geological patterning. A wide and sinuous linear mark, consisting of alternating dark and light bands, was also observed, running east and northeastwards from the southwestern corner towards the centre of the survey area (Fig. 5).

2. MAGNETIC SURVEY DESIGN

2.1 Survey control was established to the National Grid by EDM Total Station.

2.2 The equipment used for the direct topsoil magnetic susceptibility survey was a Bartington Instruments MS2 meter with an 18.5 cm loop.

2.3 *In situ* magnetic susceptibility readings were taken on a 10 metre grid, an interval proven to give a high probability of intersection with the magnetic signal from a wide range of archaeological sites, particularly occupation sites of the later prehistoric, Roman or Medieval periods. However, under favourable conditions the survey technique is equally capable of locating earlier prehistoric features, such as soils dispersed by agriculture from ring ditches or spreads of less clearly defined occupation material. The 10 m grid configuration also favours the detection of ploughed-out earthwork banks, which can occasionally be located as areas of more weakly magnetic soils.

2.4 A 10 m resolution, although perfectly satisfactory for defining general areas of activity, will inevitably intersect locally with soils showing marked magnetic contrasts. It is more important to pay attention to the general trend/pattern than to concentrate upon specific magnetically enhanced 'hotspots', even though some of the latter may eventually prove to relate to the positions of underlying archaeological features.

2.5 Areas showing significant magnetic enhancement and those identified by OAA as marks of possible archaeological interest were examined with a Geoscan Research FM 36 Fluxgate Gradiometer, both by detailed grids (sampling 4 readings per metre at 1 metre traverse intervals in the 1 nT range) and by scanning. The nanotesla (nT) is the standard unit of magnetic flux (expressed as the current density), here used to indicate positive and negative deviations from the Earth's normal magnetic field. Routine scanning by gradiometer was undertaken to check for any major concentrations of underlying archaeological features whose presence may not have been detected by the topsoil susceptibility survey.

2.6 Field data were stored to 3.5-inch disks, and processed using Geoscan Research Geoplot and Oxford Archaeotechnics Geomath software.

2.7 Colour contour and scale (shade) plots have been used to present the topsoil magnetic susceptibility data. Gradiometer data have been presented as grey scale and stacked trace plots.

2.8 The topsoil magnetic susceptibility colour contour plot (Fig. 3) shows contours at 5 SI intervals. The colour shade plot (Fig. 4) is interpolated to 5 m, but is otherwise unprocessed.

Auger Sampling & Laboratory Results

2.9 Auger logs were recorded in series along traverses cutting certain magnetic susceptibility and/or cropmark features and, in a few cases, across precise magnetometer anomalies. In one instance, a 2.0 x 0.25 m slot was dug from the surface with spade and trowel.

2.10 The auger logs were constructed using a 20 cm long dutch auger head, with a 4 cm internal diameter, producing a twin helix of relatively undisturbed sample with a capability of retrieving objects up to c.2 cm in diameter. This technique is very much more rapid than the use of cylinder coring, although the finest detail of sedimentary geometry will not often survive. On the other hand, the dutch head (unlike screw augers) will still recover much sedimentary detail (e.g. laminae of over c.0.5 mm thickness in coherent materials), together with relatively fragile objects (e.g. bone, charred remains, shell, plant remains, friable ceramic, etc.). The dutch head is also capable of penetration of stonier deposits than cylinder coring (the latter would have been impossible at Norton Big Wood), and of penetration to much greater depths than screw augering (without risk of physical strain to the operator).

2.11 The recorded logs are set out in Appendix 2 to the present text. The main emphasis is upon visual examination of the samples, enhanced by magnification of up to 20 times. Field magnetic susceptibility measurements could not be taken in the poor weather conditions.

2.12 In some cases, laboratory measurements of magnetic susceptibility parameters were taken using a Bartington bench meter and 10 ml subsamples of damp auger samples, with results indicated in (x 10^{-5}) SI volume susceptibility units: LF low frequency, HF high frequency, and X_{fd} frequency dependence (see 3.36 below). The two frequencies differ by a factor of 10 and X_{fd} is given as a percentage. Subsamples are identified in the Appendix with lower case letters in brackets. The overall sample in a subsampled case was deliberately not homogenised before measurement in order to assess the degree of small scale spatial variation (relative homogeneity or heterogeneity) in magnetic values.

3. SURVEY RESULTS

Topsoil Magnetic Susceptibility Survey

3.1 Topsoils within the survey area proved generally responsive to topsoil magnetic susceptibility mapping.

3.2 A total of 3034 *in situ* magnetic susceptibility readings was recorded. Susceptibility is reported in SI:volume susceptibility units (x 10^{-5}), a dimensionless measure of the relative ease with which a sample can be magnetized in a given magnetic field; the lack of dimensions (a common situation in physical science) is an algebraic artefact (the actual units of measurement cancelling each other out in the formula for volume susceptibility) and in no way indicates subjectivity or lack of precision in the result.

3.3 *In situ* topsoil susceptibility measurements ranged between 5 and 548 (x 10^{-5}) SI units; the latter measurement from an area of modern (trackway) disturbance. The mean for the survey area was 11 (x 10^{-5}) SI units; the standard deviation calculated against the mean was 4 (x 10^{-5}) SI units. The brown contour on Fig. 3 (20 SI units) approximates to 2 standard deviations above the mean for the survey area as a whole.

3.4 Subsoil measurements from augering ranged between 9 and 43 SI units.

3.5 Figs. 2-4 show the pattern of topsoil magnetic susceptibility as shade, colour contour and colour shade plots respectively.

3.6 The topsoil magnetic susceptibility map is generally relatively uniform and unremarkable, with the exception of concentrations of imported modern debris dispersed from the modern farm trackway, and a swathe of soils which runs diagonally northeast-southwest across the centre of the survey area.

3.7 This broad diagonal band of enhancement (up to 50-60 m wide) corresponds with a feature visible on aerial photographs (Fig. 5) and tentatively identified in an OAA desk-top assessment as probably having a geological origin (Johnson 1993). The spread of more magnetic soils has been dispersed by ploughing and is contained within a former arable field in the centre of the survey area, both north and south of the present track.

3.8 A smaller focus derived from the same (geological) source is visible close to the southwestern corner of the survey area.

3.9 There are further indications of slightly enhanced soil blocks which relate to the positions of former small fields (cf. Fig. 6). Their locations can be seen particularly clearly on the colour shade plot (Fig. 4); an obvious example is the c.1 ha field close to the road on the eastern boundary of the survey area (centred at SK 8845 6015). This field also contains a small focus of enhanced soils adjacent to the road, which probably marks the site of a former access point.

3.10 The outlines of other former small fields can also be seen, frequently following the 10 SI unit (blue) contour, on Fig. 3. The slight magnetic variations visible between these former enclosures represent varying levels of past agricultural activity within them, with the more intensively cultivated displaying slightly higher levels of magnetic susceptibility.

3.11 The fact that these field blocks are visible is relevant to the interpretation of the survey data. As the differing zones of enhancement reflect varying landuse, it is likely that, had any significant archaeological material been present, patterns of enhancement should have been transferred into the topsoil and spread within the confines of the former field boundaries by ploughing. No such archaeological indications were observed.

3.12 No correspondence was noted between the magnetic susceptibility map and the location of any of the possible archaeological marks noted by OAA (Johnson 1993).

3.13 No archaeological artefacts or debris spreads were noted on the field surface during the course of the survey (field visibility was moderate, i.e. 50% or better).

Magnetometer (Gradiometer) Survey

3.14 Scanning by gradiometer was carried out on 25 m traverses across the whole site, enabling not only an appreciation of susceptibility anomalies but also providing a rapid check on apparently 'blank' (low magnetic susceptibility) areas.

3.15 Areas showing magnetically enhanced topsoils (above 2 standard deviations) and areas of possible cropmarks noted in the OAA report were investigated by detailed gridded gradiometer survey: a total of eleven 30 x 30 m gradiometer survey boxes (c. 1 ha in area).

3.16 The location of the gradiometer survey areas is shown on Fig. 6.

Area 1 (60 x 30 m)

3.17 This gradiometer survey box was located to examine the focus of high topsoil magnetic susceptibility close to the centre of the survey area, north of the farm track. Gradiometer scanning suggested magnetic anomalies in the range of 2-3 nT at this location.

3.18 The resultant gradiometer plot (Fig. 7) indicates a weak linear feature running northeast-southwest, parallel with the former field boundaries shown on the 1887 25-inch OS sheet (1st. Edition). It most probably represents a weak agricultural feature of post-Medieval date, associated with the first enclosure of this land, whose magnetic signal has perhaps been amplified locally by soils of higher natural magnetic susceptibility (see 3.7 above).

Area 2 (60 x 30 m)

3.19 This location includes a focus of high topsoil magnetic susceptibility close to the southwestern corner of the survey area, where weak anomalies were also encountered during gradiometer scanning.

3.20 The plot shows slight lineations on a northeast-southwest trend, again presumed to be of agricultural origin and probably post-Medieval in date.

3.21 No trace was found of the former field boundary which ran almost east-west across this zone (clearly revealed in the gradiometer survey 100 m further west; Fig. 8, Area 5).

Area 3 (60 x 30 m)

3.22 This location was selected to test possible aerial photograph features (Johnson 1993: fig.2), at the intersection of a 'broken' curvilinear with a linear feature.

3.23 No precisely defined 'cut' features were recorded. There is a suggestion of a slightly deeper pocket of soil visible on Fig. 7 as a broad zone, some 10 m wide running northeast-southwest, which probably represents an area of slightly deeper soils infilling a natural irregularity.

3.24 There are no clear indications of any underlying 'cut' features of possible archaeological origin.

Area 4 (60 x 30 m)

3.25 This gradiometer survey area was positioned to examine a number of weak scanning anomalies which, although lying in the general area of a former field boundary (Fig. 6), had nevertheless to be checked and eliminated in case further underlying archaeological features were also present.

3.26 The magnetic anomalies visible on the resultant plot are consistent with a grubbed-out boundary in the correct position and alignment to be equated with the mapped boundary. There are no indications of any other significant 'cut' features in the vicinity.

Area 5 (three 30 x 30 m boxes)

3.27 This area was sited to investigate an area of patterned ground and linear marks visible on aerial photographs, together with the position of a mapped former field boundary.

3.28 The dominant feature on the gradiometer plot (Fig. 8) appears to relate to the position of a former field boundary (Fig. 6). The signal is sufficiently strong to suggest the inclusion of material with higher magnetic susceptibility than the local soils, and may indicate the line of a buried pipe. Striations on a northeast-southwest trend again probably represent agricultural marks.

Augering and Laboratory Analyses (see Appendix 2 and Fig. 9)

3.29 A broad set of curving 'colour' bands, swinging from the southwest corner of the survey area to the northeast and north, was identified from aerial photographs as probably having a geological origin during the OAA desk-top assessment (Johnson 1993). The same trend can be seen in the field as a zone of raised magnetic susceptibility (see 3.7 above), slightly 'outside' (south and east of) a wide curving surface rise, resembling a very broad 'embankment'.

3.30 Auger traverses A, B and C were positioned so as the transect this broad feature, with the result that a purely geological origin can now be confirmed.

3.31 There is a significant lateral facies shift in the near-surface sedimentary outcrops as one passes from the south or east towards the north and northwest. Initially, the deposits are clean sands and gravels, set in rather thick massive beds; the bedding units thin and a few clay partings then appear; just before the topographic rise, magnetic susceptibility values become significantly raised, in conjunction with obvious enrichment in iron; the topographic rise itself is made up of alternating sets of sand/gravel and clay/silt, the boundaries between these two facies often showing strong Mn or Fe-Mn enrichment; the northwestern facies in the lateral sequence is composed of interstratified beds of strongly laminated sand, clay and silt, with low magnetic susceptibility.

3.32 These sediments represent a Pleistocene fluvial association. Torrential/strong flow regime deposits (massive sands and gravels) to the south and west give way to weaker/interrupted flow regimes (laminated sands, clays and silts) within a 'basinal' morphology created by the gentle bedding dip to the northwest (and exaggerated by the slight modern surface slope to the southeast). The Pleistocene age of these sediments is shown (a) by the calibre of gravels which could not possibly be transported within the modern topography under the present climate, and (b) by the total lack of bioturbation within the finer laminated sediments which would be most unlikely in Holocene deposits.

3.33 Since the Pleistocene, near-surface lateral water movement has been interrupted at the shift to impermeable silts/clays, so that iron oxides have been deposited (with a modest rise in magnetic susceptibility) in the coarser deposits around the periphery. Such diagenetic magnetic susceptibility enhancement is often observed in proximity to 'spring-like' features; both simple chemical and biochemical (bacterial) mechanisms may be involved.

3.34 The interstratified fine and coarse sediments actually at the main facies shift are more resistant to surface erosion than either of the dominantly coarse or dominantly fine flanking series. Even the modern plough will ride up over this transition, leaving the low topographic rise as a residual feature; it is the surface moisture contrast between coarse and fine outcrops which produced the banding seen on aerial photographs.

3.35 Within the 'basin' of fine sediments to the northwest, drainage is sluggish and, after a single winter, there is a significant moss cover at the surface in some slightly depressed zones (seasonal standing water). However, the surface gradients are too low to have produced sufficient Holocene sedimentation to have survived arable use of the land (i.e. the Holocene is represented by the tilth alone).

3.36 Augering was also used to examine zones with 'sharper' linear features, seen on aerial photographs and/or by magnetometry. The fill of certain 19th. century ploughed-out ditches (smaller field boundaries) was located (cf. Logs C14 and E). These showed nothing but the normal range of agricultural activities within their catchment. The magnetic phenomenon of 'frequency dependence' (often an indicator of significant human activity) need not be further explained here; suffice it to say that it is barely measurable in the 19th. century ditch fills and absent from all other tested sediments. The magnetometer signal (see 3.28 above) from one ditch would seem to be too strong to be accounted for by the sediment fill and the suggestion that there may be a pipe in this feature is therefore attractive. Even the slight trace of parallel sets of agricultural (plough) features were sometimes visible during augering (cf. Log D3). In one case (Log F5), a slot was opened by spade and the action of a subsoiler was recognised.

3.37 At one point in the power auger logs provided by the client, a deposit of "fibrous peat" had been recorded. Augering of this area (Series G) recovered no significant organic remains but did locate significant enrichment in iron and manganese at the depth noted in the power auger logs. This 'wad' (a term coined by early miners working thick and pure diagenetic deposits of Fe-Mn oxides found at the contact between siliceous sediments and limestone) has a dark brown colour and a 'felted' texture that could easily be mistaken for rotted wood or peat (see Appendix 2: G5, p. 42 below for a listing of the distinguishing characteristics between wad and organic matter). Alternatively, the power augering might indeed have passed through an organic deposit (a buried tree stump or the fill of a very small depression) at the one recorded point. Whatever the source of the original observation, there is no significant peat deposit in this area and thus no archaeological or palaeoenvironmental interest.

3.38 The hand augering in general across the survey area showed a weak and patchy tendency towards the development of podzolic soil sequences, although true eluvial (clay destruction) and organic illuvial horizons do not occur at any observed point. Despite the interruption of near-surface drainage (noted above), there are very few signs of gleying, suggesting that waterlogging is only temporary.

4. CONCLUSIONS

4.1 There are no indications from topsoil magnetic susceptibility mapping of the presence of any significant archaeological accumulations.

4.2 Two primary areas of magnetic enhancement have been detected. One relates to materials (bricks, rubble, clinker, etc.) imported onto the site to consolidate a modern farm trackway. The other source of enhanced soils has been shown by hand augering to relate to a geological feature, the boundary zone between coarser and finer Pleistocene fluvial deposits. Minor enhancement may also be associated with the line of a few of the ploughed-out 19th. century field boundary ditches (as confirmed by magnetometry).

4.3 As the generally sandy soils within the survey area show traces of incipient podzolisation, it is possible that some weak and subtle magnetic features, from older (prehistoric) periods, may not be visible to magnetic survey.

4.4 However, it is significant that topsoil magnetic susceptibility mapping has registered the location of former field systems, and it would be fair to conclude that, had any underlying archaeological material with a reasonable magnetic identity been present (e.g. habitation sites or other marked activity areas associated with heating/burning and debris disposal), it would have been detected by the survey methods employed. Surface visibility was moderately good on this set-aside land but no artefacts or construction debris were noted during the systematic coverage for the magnetic survey.

4.5 The lack of correlation between the magnetic susceptibility map and the location of possible cropmarks, suggests that these marks are unlikely to be associated with human occupation sites. The obviously complex nature of the bedding and texture of the underlying Pleistocene fluvial deposits, the zones of periglacial patterned ground (seen on aerial photographs) and the traces of agricultural (ploughing) features are together sufficient to explain all the "marks of unknown origin" noted with caution in the OAA desk-top assessment.

4.6 There is no trace of a peat bed in the location indicated by the original power auger log at NGR 88273 60060. No significant Holocene sedimentation was noted at any point within the survey area.

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MAPS

1778 *Map of Lincolnshire comprehending Lindsey, Kesteven and Holland, surveyed in the Years 1776, 7 and 8* by A. Armstrong. Scale 1 inch to 1 mile (LRO FL Maps 5: Sheet 5)

1840 Tithe Award Map: Parish of Norton Disney.

1887 OS 25-inch map, Ist Edition. Lincolnshire Sheet LXXXV.3.

1906 OS 1-inch map (1906 Revision). Sheet 47, 19.

1984 OS 1:10,000 sheets (SK86SE and SK85NE).

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Geoarchaeological and microarchaeological (field and laboratory) observations by S.N. Collcutt *MA(Hons)*, *DEA*, *DPhil*, *FSA*, *MIFA*, *CGeol*, *FGS*.

APPENDIX 1 - MAGNETIC TECHNIQUES: GENERAL PRINCIPLES

A.1 It is possible to define areas of human activity (particularly soils spread from occupation sites and the fills of cut features such as pits or ditches) by means of *magnetic survey* (Clark 1990; Scollar et al. 1990). The results will vary, according to the local geology and soils (Thompson & Oldfield 1986; Gale & Hoare 1991), as modified by past and present agricultural practices. Under favourable conditions, areas of suspected archaeological activity can be accurately located and targeted for further investigative work (if required) without the necessity for extensive random exploratory trenching. Magnetic survey has the added advantages of enabling large areas to be assessed relatively quickly, and is non-destructive.

A.2 Topsoil is normally more magnetic than the subsoil or bedrock from which it is derived. Human activity further locally enhances the magnetic properties of soils, and amplifies the contrast with the geological background. The main enhancement effect is the increase of *magnetic susceptibility*, by fire and, to a lesser extent, by the bacterial activity associated with rubbish decomposition; the introduction of materials such as fired clay and ceramics - and, of course, iron and many industrial residues - may also be important in some cases. Other agencies include the addition and redistribution of naturally magnetic rock such as basalt or ironstone, either locally derived or imported.

A.3 The tendency of most human activity is to increase soil magnetic susceptibility. In some cases, however, features such as traces of former mounds or banks, or imported soil/subsoil or non-magnetic bedrock (such as most limestones), will show as zones of lower susceptibility in comparison with the surrounding topsoil.

A.4 Archaeologically magnetically enhanced soils are therefore a response of the parent geological material to a series of events which make up the total domestic, agricultural and industrial history of a site, usually over a prolonged period. Climatic factors may subsequently modify the susceptibility of soils yet again but, in the absence of strong chemical alteration (e.g. during the process of podzolisation or extreme reduction), magnetic characteristics may persist over millions of years.

A.5 Both the magnetic contrast between archaeological features and the subsoil into which they are dug, and the magnetic susceptibility of topsoil spreads associated with occupation horizons, can be measured in the field.

A.6 There are several highly sensitive instruments available which can be used to measure these magnetic variations. Some are capable, under favourable conditions, of producing extraordinarily detailed plots of subsurface features. The detection of these features is usually by means of a *magnetometer* (normally a fluxgate gradiometer). These are defined as passive instruments which respond to the magnetic anomalies produced by buried features in the presence of the Earth's magnetic field. The gradiometer uses two sensors mounted vertically, often 50 cm apart. The bottom sensor is carried some 30 cm above the ground, and registers local magnetic anomalies with respect to the top sensor. As both sensors are affected equally by gross magnetic effects, such as diurnal variation, these are cancelled out. In order to produce good results, the magnetic susceptibility contrast between features and their surroundings must be reasonably high and thereby creating good local anomalies; a generally raised background, even if due to human occupation within a settlement context, will sometimes preclude meaningful magnetometer results. The sensitive nature of magnetometers makes them suitable for detailed work, logging measurements at a closely spaced (less than 1 metre) sample interval, particularly in areas where an archaeological site is already suspected. Magnetometers may also be used for rapid 'prospecting' within larger areas (where the operator directly monitors the changing magnetic field and pinpoints specific anomalies).

A.7 *Magnetic susceptibility measuring systems*, whilst responding to basically the same magnetic component in the soil, are 'active' instruments which subject the sample area being measured (according to the size of the sensor used) to a low intensity alternating magnetic field. Magnetically susceptible material within the influence of this field can be measured by means of changes which are induced in oscillator frequency. For general work, measuring topsoil susceptibility *in situ*, a sensor loop of around 20 cm diameter is convenient, and responds to the concentration of magnetic (especially ferrimagnetic) minerals mostly in the top 10 cm of the soil. Magnetically enhanced horizons which have been reached by the plough, and even those from which material has been transported by soil biological activity, can thus be recognised.

A.8 Whilst only rarely encountering anomalies as graphically defined as those detected by magnetometers, magnetic susceptibility systems are ideal for detecting magnetic spreads and thin archaeological horizons not seen by magnetometers. Using a 10 m interval grid, large areas of landscape can be covered relatively quickly. The resulting plot can frequently determine the general pattern of activity and define the nuclei of any occupation or industrial areas. As the intervals between susceptibility readings generally exceed the parameters of most individual archaeological features (but not of the general spread of enhancement around features), the resulting plots should be used as a guide to areas of archaeological potential and to suggest the general form of major activity areas; further refinement is possible using a finer mesh grid or, more usually, by detailing underlying features using a gradiometer.

A.9 Magnetic survey is not successful on all geological and pedological substrates. As a rule of thumb, in the lowland zone of Britain, the more sandy/stony a deposit, the less magnetic material is likely to be present, so that a greater magnetic contrast in soil materials will be needed to locate archaeological features; in practice, this means that only stronger magnetic anomalies (e.g. larger accumulations of burnt material) will be visible, with weaker signals (e.g. from the fillings of simple ditches) disappearing into the background. Similar problems can arise when the natural background itself is very high or very variable (e.g. in the presence of sediments partially derived from magnetic volcanic rocks).

A.10 The precise physical and chemical processes of changing soil magnetism are extremely complex and subject to innumerable variations. In general terms, however, there is no doubt that magnetic enhancement of soils by human activity provides valuable archaeological information.

A.11 As well as locating specific sites, topsoil magnetic susceptibility survey frequently provides information regarding former landuse. Variations in the soils and subsoils, both natural and those enhanced by anthropogenic agencies, when modified by agriculture, give rise to distinctive patterns of topsoil susceptibility. The containment of these spreads by either natural or man-made features (streams, hedgerows, etc.) gives rise to a characteristic chequerboard pattern of varying enhancement, often showing the location of former field systems, which persist even after the physical barriers have been removed. These patterns are often further amplified in fields containing underlying archaeological features within reach of the plough. More subtle landuse boundaries and indications of former cultivation regimes are often suggested by topsoil magnetic susceptibility plots.

A.12 Where a general spread of magnetically enhanced soils contained within a long-established boundary becomes admixed over a long period by constant ploughing, it can be diffused to such a point that the original source is masked altogether. Magnetically enhanced material may also be moved or masked by natural agencies such as colluviation or alluviation. Generally, it appears that the longer a parcel of land has been under arable cultivation, the greater is the tendency for topsoil susceptibility to increase; at the same time there is increasing homogeneity of the magnetic signal within the soils owing to continuous agricultural mixing of the material. Some patterns of soil enhancement derived from underlying archaeological features are, however, apparently capable of resisting agricultural dispersal for thousands of years (Clark 1990).

APPENDIX 2 - AUGER LOGS & ANALYSES

These brief descriptions record observations down-log in intervals measured in centimetres. The number of samples (stratified if more than one), retrieved for laboratory observation, is shown (e.g. (S) or (2S)) following the log of the interval depth range. The analytical procedures used are defined in the main text. The locations of borehole series are indicated in Fig. 9.

A AUGER TRAVERSE

South-north series from NGR 87900 59850 to NGR 87900 59980 (intersecting with major composite linear cropmark and associated band of raised magnetic susceptibility; cf. Fig.7 Area 2).

A1 (At northing 59850)

0 - 35

Topsoil; mid-brown slightly stony sand to sandy loam.

35 - 60

Compact yellow/grey medium sand, with some finest (<4 mm) granules and rare larger gravel (pebbles); no clay content and very low plasticity; no obvious substratification; becoming stonier downwards and developing a slight ginger colouring; wet at very base.

60+

Impenetrable (dense gravel).

A2 (At northing 59860)

0 - 37

Topsoil; mid-brown slightly stony sand to sandy loam.

37 - 50

Compact pink/grey gravelly medium sand, with ginger-coloured stonier patches; no clay content and very low plasticity; no obvious substratification.

50+

Impenetrable (dense gravel).

A3 (At northing 59870)

0 - 37

Topsoil; mid-brown slightly stony sand to sandy loam.

37 - 60

Compact variegated gravelly and very slightly clayey sand, becoming ginger-coloured with depth; no obvious substratification; moderately sharp lower boundary.

60 - 80

Compact ginger very gravelly sand; no obvious substratification; moderately sharp lower boundary.

80 - 90

Compact brown/ginger slightly clayey gravelly sand; no obvious substratification.

90+

Impenetrable (dense gravel).

A4 (At northing 59880; just southeast of slight topographic rise)

0 - 35

Topsoil; mid-brown slightly stony sand to sandy loam.

35 - 50

Compact ginger gravelly medium sand; no obvious substratification; moderately sharp lower boundary.

50 - 70

Compact buff gravelly medium sand; no obvious substratification; sharp lower boundary.

70 - 80

Compact buff/grey very clayey sand; no obvious substratification; moderately sharp lower boundary.

80 - 85

Very compact buff sandy clay, strongly laminated; moderately sharp lower boundary.

85 - 95

Compact buff medium sand, possibly weakly bedded.

95+

Impenetrable (dense gravel).

A5 (At northing 59890; on slight topographic rise)

0 - 35

Topsoil; mid-brown slightly stony sand to sandy loam.

35 - 55

Compact mid-brown gravelly medium sand; no obvious substratification; moderately sharp lower boundary.

55 - 60

Compact buff well sorted medium sand; no obvious substratification; sharp lower boundary.

60 - 70

Compact brown gravelly sand; no obvious substratification.

70+

Impenetrable (dense gravel).

A6 (At northing 59900; on slight topographic rise)

0 - 35

Topsoil; mid-brown slightly stony sand to sandy loam.

35 - 60 (S)

Compact ginger-brown medium sand with fine gravel; no obvious substratification; colours becoming variegated downwards; moderately sharp lower boundary.

40 - 50 MS bench meter (damp subsamples):

LF 24.5 HF 24.5

60 - 70

Compact brown gravelly sand; no obvious substratification.

70+

Impenetrable (dense gravel).

A7 (At northing 59910; on slight topographic rise)

0 - 35

Topsoil; mid-brown slightly stony sand to sandy loam.

35 - 40

Compact light brown clayey sand; no obvious substratification; moderately sharp lower boundary.

40 - 70

Compact sandy/silty clay, strongly laminated; ginger (coarser) and grey (finer) laminations, with rare dark Mn flecks; laminations very complete, with no bioturbation traces; interstratified lower boundary.

70 - 100+ (S)

Compact grey clay with minor silty clay units; very strongly laminated (slight colour variation between laminae); laminations very complete, with absolutely no bioturbation traces.

90 - 100 MS bench meter (damp subsamples):

LF 23.2 HF 23.2

A8 (At northing 59920; on slight topographic rise)

0 - 35

Topsoil; mid-brown slightly stony sand to sandy loam.

35 - 75

Compact brown gravelly sand, becoming variegated (Fe/Mn colouring and slight cementation) at depth with slightly more fine gravel; no obvious substratification; diffuse lower boundary.

75 - 100+

Compact ginger clean sand with some fine gravel; possible coarse substratification; wet at base.

A9 (At northing 59930; on northwestern flank of slight topographic rise)

0 - 38

Topsoil; mid-brown slightly stony sand to sandy loam.

38 - 100+

Compact grey/ginger alternations of sandy and very sandy clay; slight interruption of laminations by bioturbation near top, no such traces at depth.

A10 (At northing 59940; northwest of slight topographic rise)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 43

Compact grey/ginger clayey sand; no obvious substratification; moderately sharp lower boundary.

43 - 60

Compact grey/brown plastic slightly silty/sandy clay; strongly laminated, without bioturbation; interstratified lower boundary.

60 - 80

Compact grey/buff silty/sandy clay; strongly laminated, without bioturbation; interstratified lower boundary.

80 - 90

Compact grey/buff clayey sand; laminated without bioturbation; moderately sharp lower boundary.

90 - 100+

Compact grey slightly sandy clay; poor lamination but no bioturbation.

A11 (At northing 59950)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 45

Compact grey/ginger clayey sand; no obvious substratification; moderately sharp lower boundary.

45 - 60

Compact grey/brown slightly sandy clay; laminated, without bioturbation; interstratified lower boundary.

60 - 100 (S)

Compact grey/buff/ginger slightly silty clay; strongly laminated, without bioturbation; interstratified lower boundary.

90 - 100 MS bench meter (damp subsamples):
LF 9.1 HF 9.1

100 - 120

Compact slightly sandy clay (light grey) and clayey sand (ginger); strongly laminated without bioturbation; gradational lower boundary.

120 - 140

Compact sandy clay (grey) and clayey sand (ginger), the latter becoming dominant; strongly laminated without bioturbation; gradational lower boundary.

140 - 160+

Compact clayey sand with very minor sandy clay; mostly ginger colours; strongly laminated without bioturbation.

A12 (At northing 59960)

0 - 38

Topsoil; mid-brown slightly stony sand to sandy loam.

38 - 50

Compact grey/ginger clayey sand; poorly laminated; moderately sharp lower boundary.

50 - 60

Compact grey/brown slightly silty clay; strongly laminated, without bioturbation; interstratified lower boundary.

60 - 100+

Compact grey/buff slightly silty clay; slightly to moderately well laminated, without bioturbation.

A13 (At northing 59965)

0 - 35

Topsoil; mid-brown slightly stony sand to sandy loam.

35 - 40

Relatively compact light brown/pink sand; no obvious substratification; moderately sharp lower boundary.

40 - 50

Compact grey/brown clayey sand; laminated, without bioturbation; interstratified lower boundary.

50 - 60

Compact grey/brown slightly clayey sand; laminated, without bioturbation; interstratified lower boundary.

60 - 73

Compact grey/brown clayey sand; laminated, without bioturbation; interstratified lower boundary.

73 - 81

Very compact grey/ginger slightly sandy clay; strongly laminated, without bioturbation; interstratified lower boundary.

81 - 90

Very compact grey clayey sand; laminated, without bioturbation.

90+

Apparently plastic sediment (clay dominating) but too stiff to penetrate.

A14 (At northing 59970)

0 - 39

Topsoil; mid-brown slightly stony sand to sandy loam.

39 - 50

Relatively compact brown to light brown slightly clayey sand with fine gravel; no obvious substratification; sharp lower boundary.

50 - 70

Compact sand, very slightly clayey partings in places; strongly laminated, without bioturbation, possible low-angle cross-sets; Mn-stained giving various very light, medium and dark browns; interstratified lower boundary.

70 - 80

Compact sand; laminated, without bioturbation; colours becoming homogeneous pink/brown; interstratified lower boundary.

80 - 90

Compact grey/brown sand with rare clay (light grey) units; laminated, without bioturbation; relatively sharp lower boundary.

90 - 100

Compact grey/brown sand with light grey clay units; laminated but with some break-up of clay units and some rolled clayey lithorelics.

100+

Apparently plastic sediment (clay dominating) but too stiff to penetrate.

A15 (At northing 59980)

0 - 39

Topsoil; mid-brown slightly stony sand to sandy loam.

39 - 60

Relatively compact brown to light brown (Mn) clayey sand; laminated but no clay differentiation; relatively sharp lower boundary.

60 - 90 (S)

Compact clayey sand with rare clay units; strongly laminated, without bioturbation; Mn-stained giving various very light, medium and dark (almost black) browns; also some deep red Fe-concretions; interstratified lower boundary.

80 - 90 MS bench meter (damp subsamples):

LF 11.1 HF 11.1

90 - 100+

Compact sandy clay and clay; strongly laminated, without bioturbation; Mn-stained giving various very light, medium and dark (almost black) browns; also some deep red Fe-concretions.

B AUGER TRAVERSE

West-east series from NGR 88130 60000 to NGR 88200 60000 (intersecting with major composite linear cropmark and associated band of raised magnetic susceptibility; cf. Fig.7 Area 1).

B1 (At easting 88130)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60

Compact reddish brown laminated clean sand with some finest gravel; bioturbation diminishing rapidly downwards; sharp but slightly convoluted lower boundary.

60-80+

Laminated sandy clay.

B2 (At easting 88140)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Compact reddish brown clayey sand with some finest gravel; rare traces of substratification only.

B3 (At easting 88150)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Compact reddish brown slightly clayey laminated sand with some finest gravel.

B4 (At easting 88160)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+ (S)

Compact ginger slightly clayey laminated sand with some finest gravel.

50 - 60 MS bench meter (damp subsamples):

(a)	LF 39.2	HF 39.2
(b)	LF 38.4	HF 38.5
(c)	LF 42.0	HF 42.0
(d)	LF 40.9	HF 40.9

B5 (At easting 88170)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Compact dark brown stony sand, grossly laminated, with Mn concentrations along partings.

B6 (At easting 88180)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Compact reddish laminated sand and fine gravel.

B7 (At easting 88190)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Compact reddish laminated sand and fine gravel.

B8 (At easting 88200)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 80+

Compact reddish brown laminated clean sand with some fine gravel; bioturbation diminishing rapidly downwards.

C AUGER SERIES

Series intersecting with the extrapolated line of the major composite linear cropmark and associated band of raised magnetic susceptibility (cf. Series A and B above) but northeast of the last visible traces of the cropmark.

C1 (At NGR 88269 60160)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60

Compact dark variegated sandy gravel with Mn concentrations; diffuse lower boundary.

60 - 70+

Compact variegated sandy gravel.

C2 (At NGR 88270 60160)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 80

Compact dark variegated gravelly sand with Mn concentrations; diffuse lower boundary.

80+

Compact ginger gravelly sand.

C3 (At NGR 88271 60160)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 105

Compact dark variegated gravelly sand with Mn concentrations; weak amorphous organic component; diffuse lower boundary.

105-110+

Compact light orange-pink sand.

C4 (At NGR 88272 60160)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Compact orange-brown clayey sand.

C5 (At NGR 88273 60160)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Compact orange-brown slightly clayey sand.

C6 (At NGR 88274 60160)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Compact orange-brown slightly clayey sand.

C7 (At NGR 88275 60160)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Compact orange-brown slightly clayey sand.

C8 (At NGR 88276 60160)

0 - 45

Topsoil; mid-brown slightly stony sand to sandy loam.

45 - 47

Compact orange-brown variegated sand.

47 - 48

Dark sand with both Mn and a little amorphous organic matter.

48 - 60

Slightly Fe-cemented deep red sand.

[Comment: the observed sequence is dominantly pedogenic (weak podzolisation) rather than sedimentary in origin.]

C9 (At NGR 88277 60160)

0 - 45

Topsoil; mid-brown slightly stony sand to sandy loam.

45 - 47

Compact deep red sand.

47 - 70

Dark sand becoming increasingly gravelly downwards; strong Mn content.

70+

Impenetrable.

[Comment: apparently showing deep pedogenic effects (base of podzolic sequence).]

C10 (At NGR 88278 60160)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60

Compact deep ginger sand.

60 - 70+

Dark sand and gravel.

C11 (At NGR 88279 60160)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Compact deep ginger sand.

C12 (At NGR 88280 60160)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Compact ginger variegated sand.

C13 (At NGR 88273 60159)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Compact orange-brown slightly clayey sand.

C14 (At NGR 88275 60171 over magnetometer anomaly)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 55

Almost indistinguishable from topsoil but more compact.

40 - 50 MS bench meter (damp subsamples):

LF 24.4 HF 24.4

55 - 70+

Compact ginger sand.

60 - 70 MS bench meter (damp subsamples):

LF 11.2 HF 11.2

[Comment: probably fill of 19th. century ploughed-out ditch (cf. Fig.7 Area 4).]

D AUGER SERIES

Series intersecting with a weak northeast-southwest linear feature (one of a parallel set) seen by magnetometer (cf. Fig.8 Area 5).

D1 (At NGR 88069 59900)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Buff/light ginger slightly stony slightly clayey fine sand.

D2 (At NGR 88069.5 59900)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Buff/light ginger slightly stony slightly clayey fine sand.

D3 (At NGR 88070 59900)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 50

Mottled ('dirty') fine gravel and sand.

50 - 55

Stony and lighter colours.

55+

Impenetrable.

[Comment: this weak feature, probably an agricultural trace, was confirmed at a second augering point at NGR 88069.5 59899.5.]

D4 (At NGR 88070.5 59900)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Buff/light ginger slightly stony slightly clayey fine sand.

E AUGER POINT

Intersecting with a strong west-east linear feature seen by magnetometer (cf. Fig.8 Area 5).

E (At NGR 88070 59873)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60 (2S)

Compact topsoil-like material; charcoal flecks; diffuse lower boundary.

40 - 50 MS bench meter (damp subsamples):

LF 44.3 HF 42.1 X_{fd} 5.0%

50 - 60 MS bench meter (damp subsamples):

LF 40.9 HF 40.8

60 - 75 (S)

Dirty mix of topsoil-like material and sandy gravel; relatively sharp lower boundary.

60 - 70 MS bench meter (damp subsamples):

LF 22.1 HF 22.1

75 - 90+ (S)

Clean ginger sand with some fine gravel.

80 - 90 MS bench meter (damp subsamples):

LF 8.3 HF 8.3

[Comment: probably the fill of a 19th. century plough-out ditch.]

F AUGER SERIES

Series intersecting with a weak northnortheast-southsouthwest linear feature (one of a parallel set) seen by magnetometer (cf. Fig.7 Area 3).

F1 (At NGR 87995 60125)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Clean compact clayey sand.

F2 (At NGR 87997 60125)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Clean compact clayey sand.

F3 (At NGR 88000 60125)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 55

Topsoil-like material; disturbed lower boundary.

55 -70+

Clayey sand.

[Comment: see Slot F5 below.]

F4 (At NGR 88002 60125)

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 60+

Clean compact clayey sand.

F5 OPEN SLOT dug by spade and trowel (from NGR 87999 60125 to 88001 60125)*

0 - 40

Topsoil; mid-brown slightly stony sand to sandy loam.

40 - 55

Material indistinguishable from topsoil, filling a broad and shallow 'furrow'.

55 - 65

Clayey sand subsoil in a disturbed (undercompacted) 'root' below 'furrow' but flanked by compact subsoil.

65+

Clean compact clayey sand.

[Comment: a relatively recent agricultural trace, probably made by a subsoiler.]

G AUGER SERIES

Series centred upon a report of "fibrous peat" at NGR 88273 60060 in the original power auger logs.

G1 (At NGR 88273 60060.5)

0 - 35

Topsoil; mid-brown slightly stony sand to sandy loam.

35 - 45

Laminated sand with clay partings; bioturbation disappearing before base; gradual interstratified lower boundary.

45 - 60

Sand and clay laminae; gradual interstratified lower boundary.

60 - 80

Clay with sand stringers and thin laminae; 'felted' Fe-Mn wad in patches; diffuse lower boundary.

80 - 100+

Clayey sand and sandy clay with some fine gravel stringers; quite strong Mn concentrations.

G2 (At NGR 88278 60061)

0 - 35

Topsoil; mid-brown slightly stony sand to sandy loam.

35 - 50

Laminated sand with clay partings; bioturbation disappearing before base; gradual interstratified lower boundary.

50 - 60

Sand and clay laminae; gradual interstratified lower boundary.

60 - 80

Clay with sand stringers and thin laminae; almost continuous zones of 'felted' Fe-Mn wad; diffuse lower boundary.

80 - 100+

Clayey sand and sandy clay with some fine gravel stringers; strong Fe-Mn wad.

G3 (At NGR 88268 60060.5)

0 - 35

Topsoil; mid-brown slightly stony sand to sandy loam.

35 - 80

Laminated sand with clay partings; bioturbation disappearing within first 10 cm; gradual interstratified lower boundary.

80 - 100+

Sand and clay laminae with some Mn staining.

G4 (At NGR 88273 60065)

0 - 35

Topsoil; mid-brown slightly stony sand to sandy loam.

35 - 45

Laminated sand with clay partings; bioturbation disappearing before base; gradual interstratified lower boundary.

45 - 65

Sand and clay laminae; gradual interstratified lower boundary.

65 - 80

Clay with sand stringers and thin laminae; Mn staining in patches; diffuse lower boundary.

80 - 100+

Clayey sand and sandy clay with some fine gravel stringers; quite strong Mn concentrations.

G5 (At NGR 88273 60055)

0 - 35

Topsoil; mid-brown slightly stony sand to sandy loam.

35 - 55

Weakly laminated sand with rare clay partings and a little dispersed gravel; point cementation by Fe (rigid structure collapsing to individual particles under applied compression); gradual interstratified lower boundary.

55 - 100+

Laminated sand with some gravel stringers.

[Comment on Series G: There is no trace of "fibrous peat" in this area (samples observed at x20 magnification). The Fe-Mn wad may be very dark brown and has a 'felted' structure; it does not weep under compression and there is no ignition in a flame. Individual thin sand laminae, although warped, may be traced across patches of wad; there is no seatearth rooting pattern at the base of patches of wad (or any bioturbation at all beyond the reach of the modern cultivars). Red iron (sesqui)oxides are present in some laminae. There is no departure from the normal background magnetic susceptibility levels of 5-15 units (organic concentrations should give lower to diamagnetic readings). It seems probable that the wad (a common diagenetic phenomenon) may have been mistaken for highly decomposed organic matter (a primary biosediment) in the original power auger log.]

FIGURE CAPTIONS

1. Location maps. Scale 1:50,000 and 1:10,000. Based upon OS Map 121 and 1:10,000 Sheets SK86SE & SK85NE.

2. Topsoil magnetic susceptibility survey: shade plot (Geoscan Research Geoplot Licence No. GPB 885-6). Scale 1:5000, based on OS 1:2500 Sheets SK 8760, 8860, 8759 & 8859.

3. Topsoil magnetic susceptibility survey: colour contour plot. Scale 1:2500, based on OS 1:2500 Sheets SK 8760, 8860, 8759 & 8859.

4. Topsoil magnetic susceptibility survey: colour shade plot (Geoscan Research Geoplot Licence No. GPB 885-6). Scale 1:2500, based on OS 1:2500 Sheets SK 8760, 8860, 8759 & 8859.

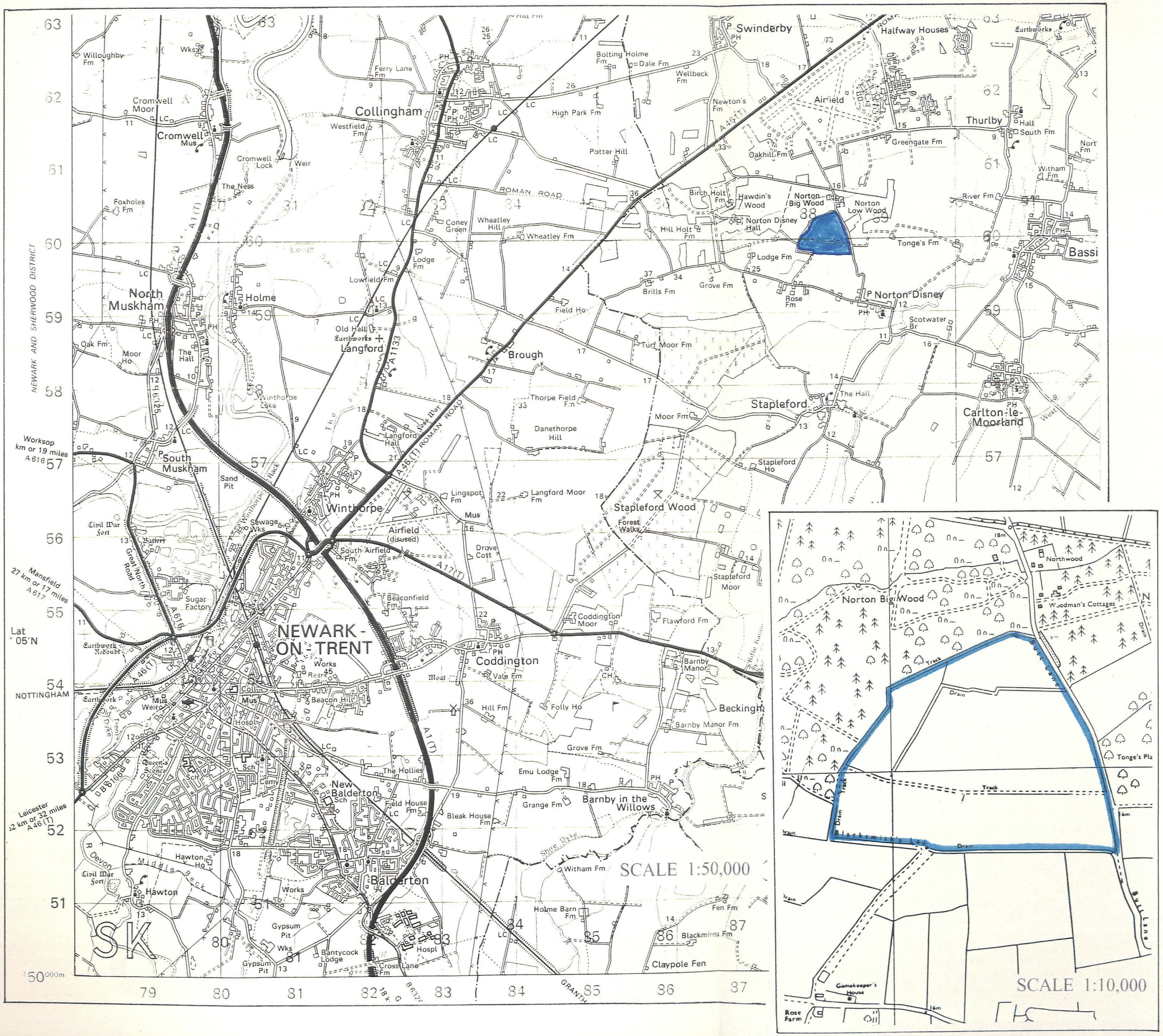
5. Vertical aerial photograph (RAF 543/673 F42 57, 24-8-59). Crown Copyright.

6. Location of gradiometer survey areas, and boundaries shown on the OS 1st. Edition 25-inch map, 1887. Scale 1:2500, based on OS 1:2500 Sheets SK 8760, 8860, 8759 & 8859.

7. Magnetometer (gradiometer) survey. Areas 1 - 4: stacked trace (raw & smoothed) and shade plots Geoscan Research Geoplot Licence No. GPB 885-6). Scale 1:1000.

8. Magnetometer (gradiometer) survey. Area 5: stacked trace (raw & smoothed) and shade plots. (Geoscan Research Geoplot Licence No. GPB 885-6). Scale 1:1000.

9. Location of Auger Series. Scale 1:2500, based on OS 1:2500 Sheets SK 8760, 8860, 8759 & 8859.



NORTON BIG WOOD NORTON DISNEY, LINCOLNSHIRE.

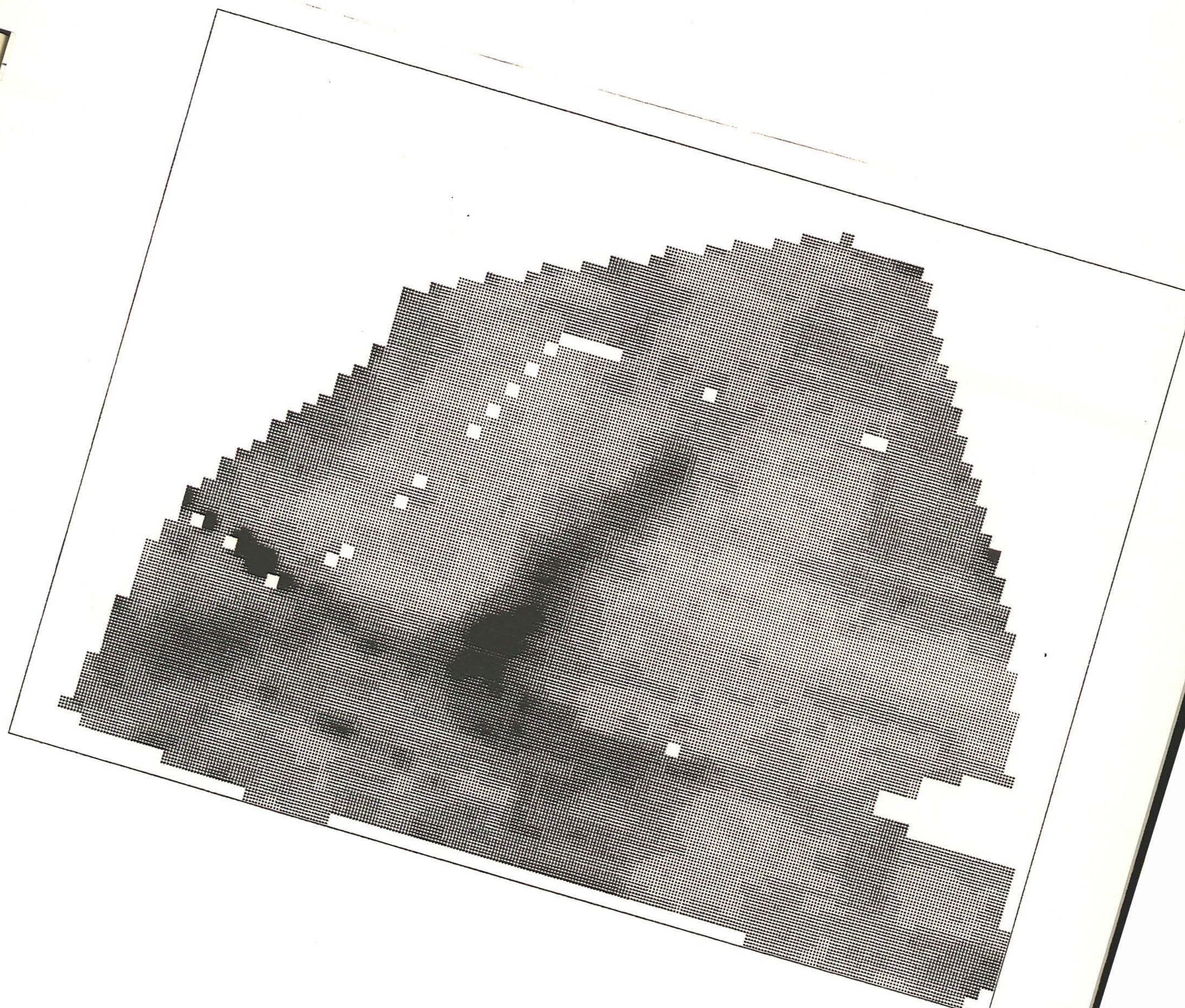
MAGNETIC SUSCEPTIBILITY AND MAGNETOMETER SURVEY

LOCATION

OXFORD ARCHAEOTECHNICS

Fig 1

NORTON BIG WOOD, NORTON DISNEY, LINCOLNSHIRE
MAGNETIC SUSCEPTIBILITY AND GRADIOMETER SURVEY



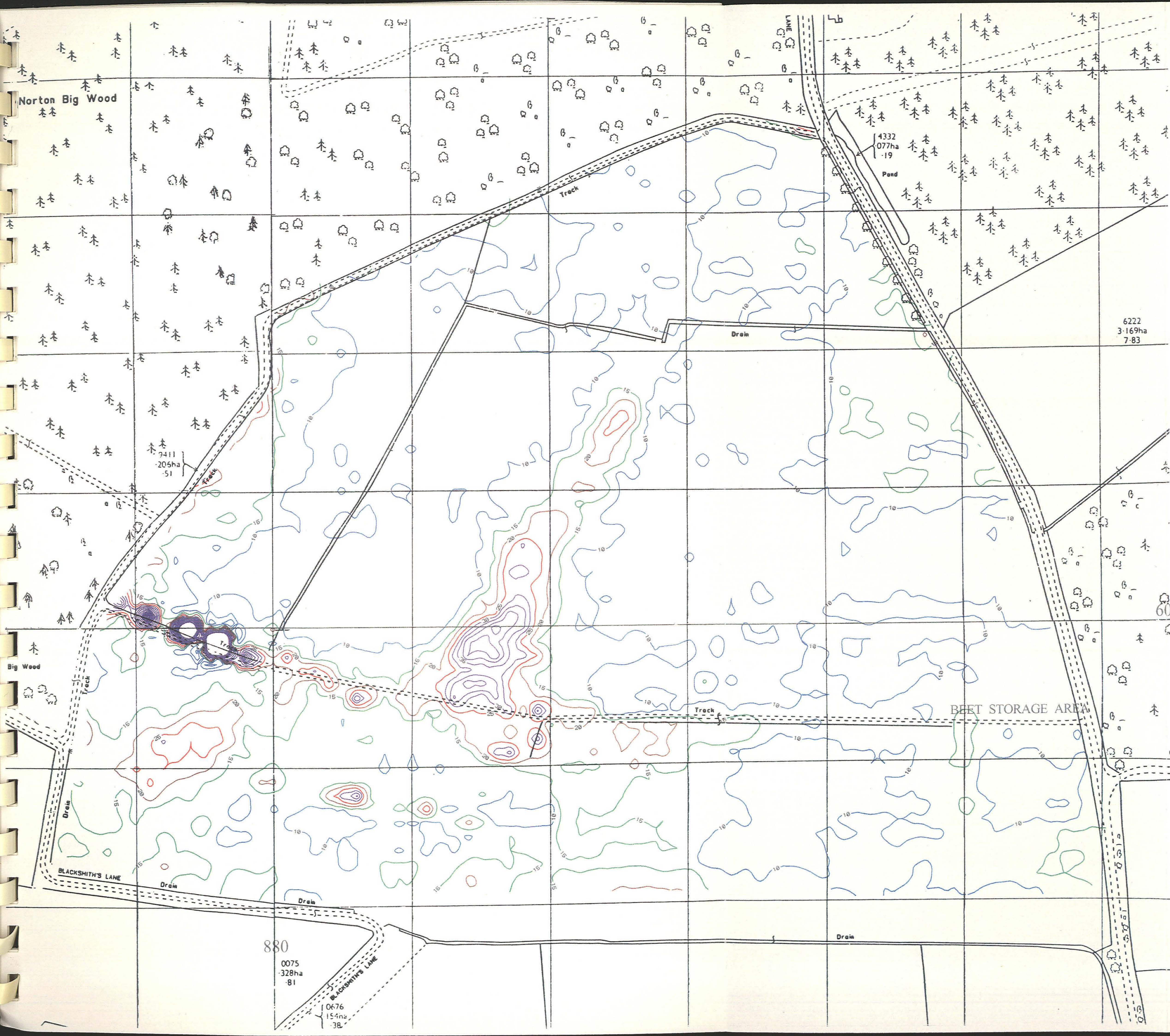
TOPSOIL MAGNETIC SUSCEPTIBILITY: SHADE PLOT, 17 LEVELS, 0-35 SI (x10⁻⁸)

N

scale 1:5000

OXFORD ARCHAEOTECHNICS

Fig. 2



NORTON BIG WOOD, NORTON DISNEY, LINCOLNSHIRE.

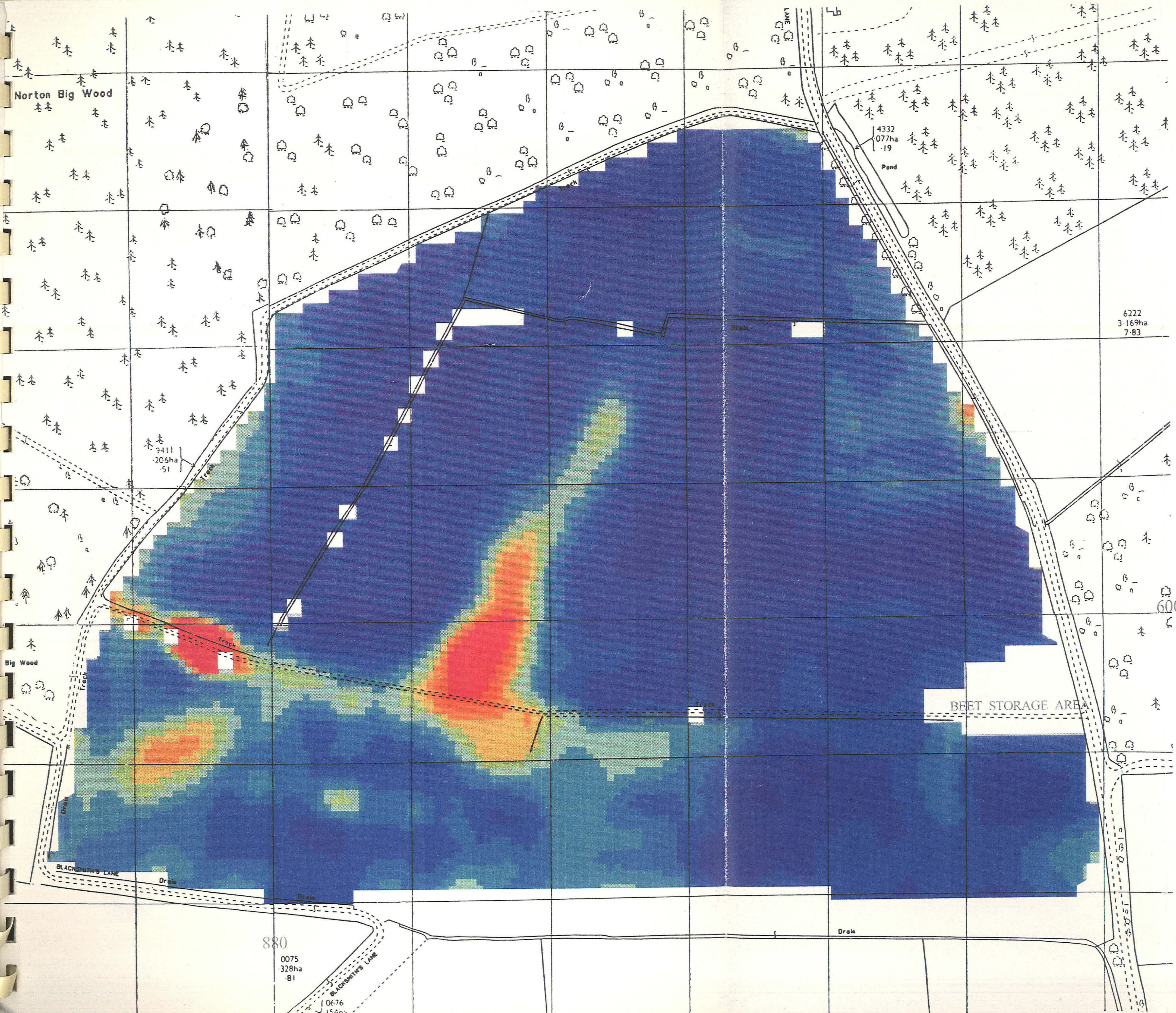
MAGNETIC SUSCEPTIBILITY AND MAGNETOMETER SURVEY

TOPSOIL MAGNETIC SUSCEPTIBILITY: COLOUR CONTOUR PLOT. INTERVAL 5 ($x10^{-5}$) SI

SCALE 1:2500

OXFORD ARCHAEOTECHNICS

Fig 3



NORTON BIG WOOD, NORTON DISNEY, LINCOLNSHIRE.

MAGNETIC SUSCEPTIBILITY AND MAGNETOMETER SURVEY

TOPSOIL MAGNETIC SUSCEPTIBILITY: COLOUR SHADE PLOT.

33.0
30.6
28.2
25.8
23.3
20.9
18.5
16.1
13.7
11.3
8.8
6.4
4.0

SI (x10^{-5})

SCALE 1:2500

N

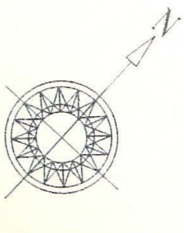
OXFORD ARCHAEOTECHNICS

Fig 4

NORTON BIG WOOD, NORTON DISNEY, LINCOLNSHIRE

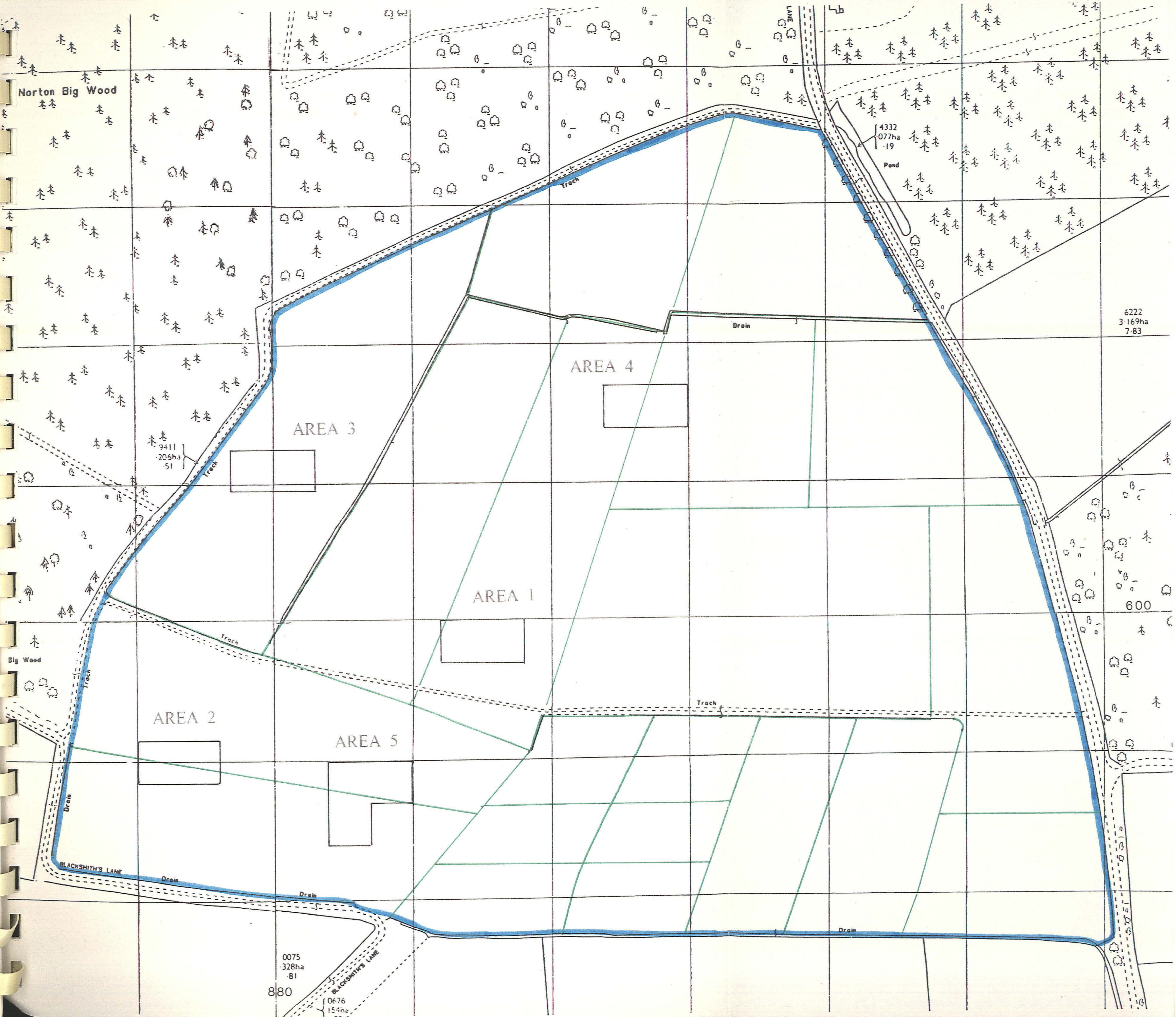
MAGNETIC SUSCEPTIBILITY AND GRADIOMETER SURVEY

VERTICAL AERIAL PHOTOGRAPH,
RAF 543/673 F42 57, 24-8-59
(Crown Copyright)



OXFORD ARCHAEOTECHNICS

Fig. 5



NORTON BIG WOOD
NORTON DISNEY,
LINCOLNSHIRE.

MAGNETIC SUSCEPTIBILITY
AND MAGNETOMETER SURVEY

BOUNDARIES SHOWN ON THE
OS 1st. EDITION 25-inch MAP, 1887.

LOCATION OF GRADIOMETER
SURVEY AREAS

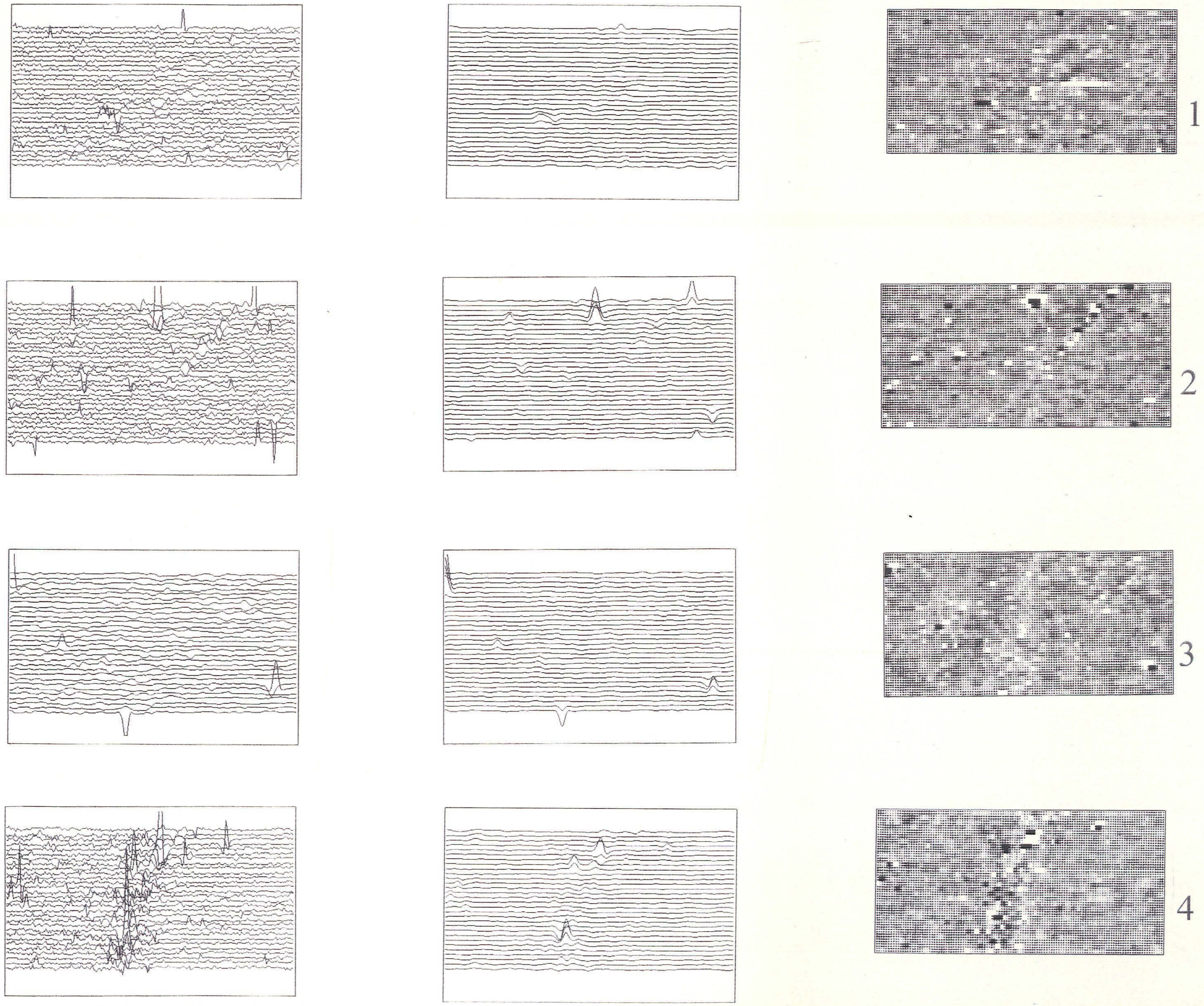
SCALE 1:2500

N

OXFORD ARCHAEOTECHNICS

Fig 6

STACKED TRACE RAW DATA | STACKED TRACE SMOOTHED | SHADE PLOTS



22 nT/cm | 22 nT/cm | -1 to + 3 nT

NORTON BIG WOOD
NORTON DISNEY,
LINCOLNSHIRE.

MAGNETIC SUSCEPTIBILITY
AND MAGNETOMETER SURVEY

GRADIOMETER PLOTS

AREAS 1 - 4

SCALE 1:1000

N

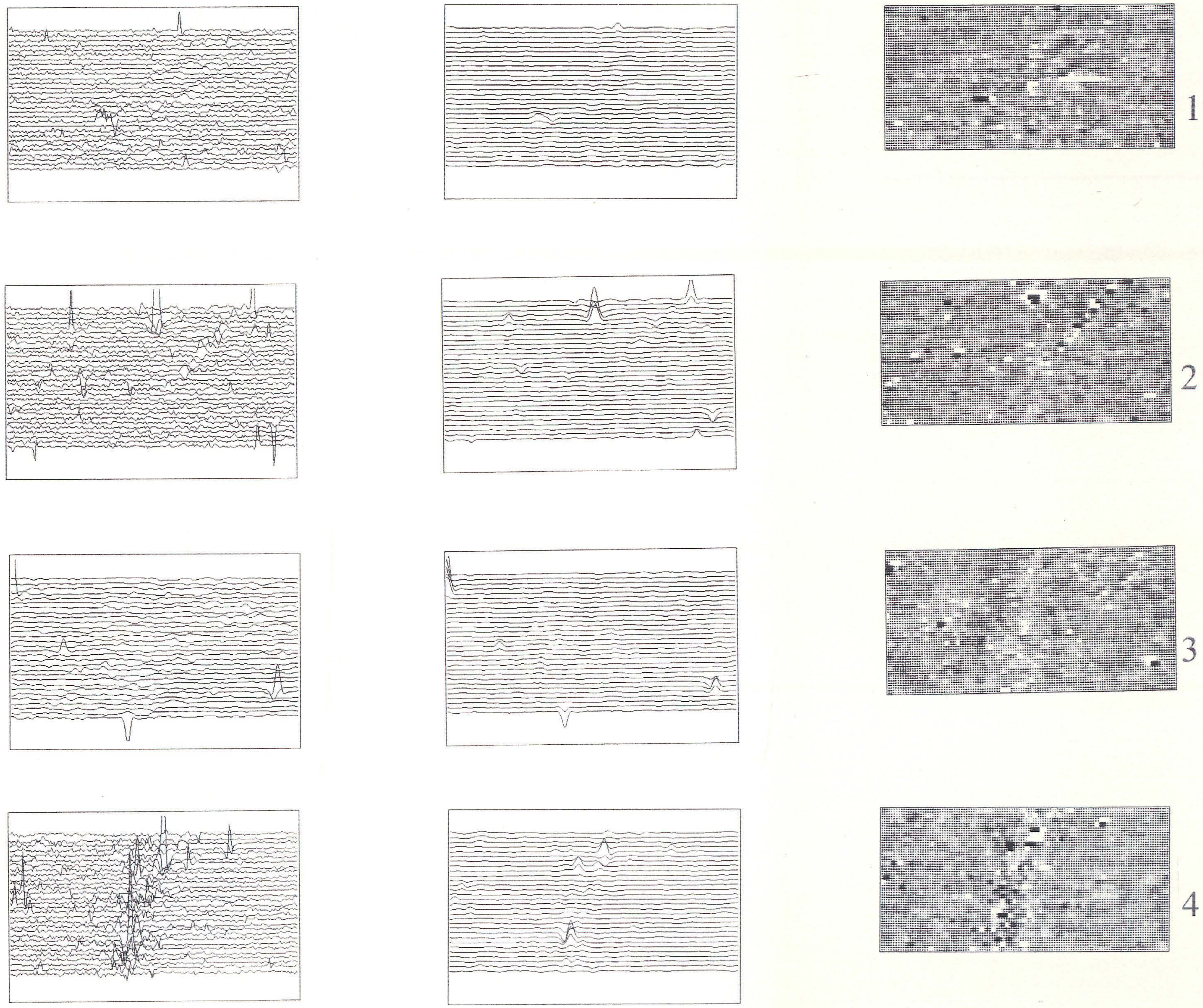
OXFORD ARCHAEOTECHNICS

Fig 7

STACKED TRACE RAW DATA

STACKED TRACE SMOOTHED

SHADE PLOTS



22 nT/cm

22 nT/cm

-1 to + 3 nT

NORTON BIG WOOD
NORTON DISNEY,
LINCOLNSHIRE.

MAGNETIC SUSCEPTIBILITY
AND MAGNETOMETER SURVEY

GRADIOMETER PLOTS

AREAS 1 - 4

SCALE 1:1000

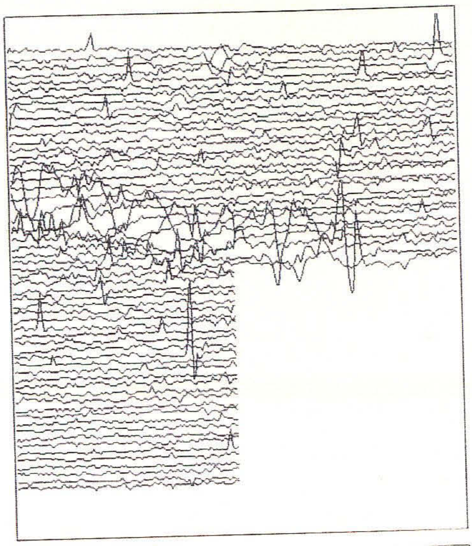
N

OXFORD ARCHAEOTECHNICS

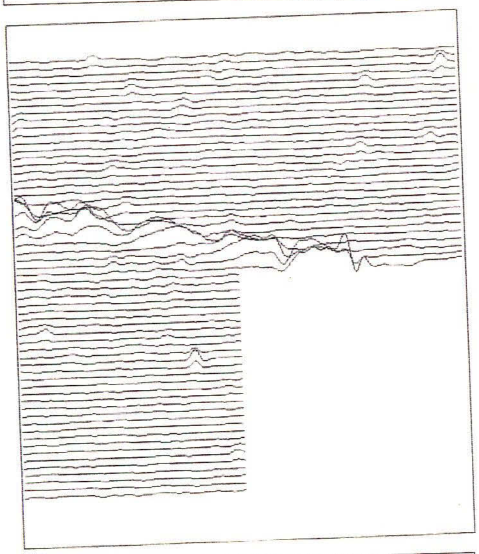
Fig 7

NORTON BIG WOOD, NORTON DISNEY, LINCOLNSHIRE

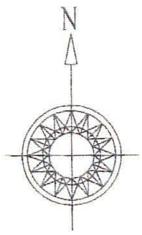
MAGNETIC SUSCEPTIBILITY AND GRADIOMETER SURVEY



STACKED TRACE;
RAW DATA, 22 nT/cm



STACKED TRACE,
SMOOTHED, 22 nT/cm



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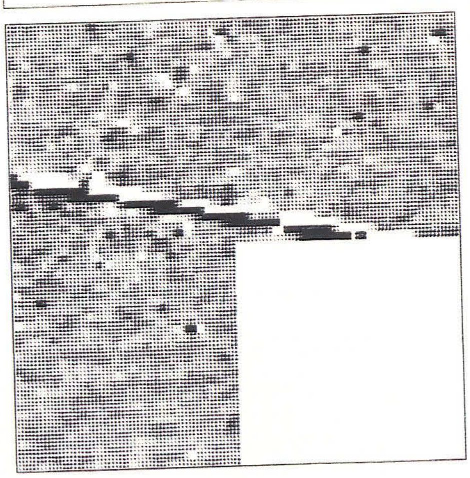


SHADE PLOT,
-1 to + 3 nT

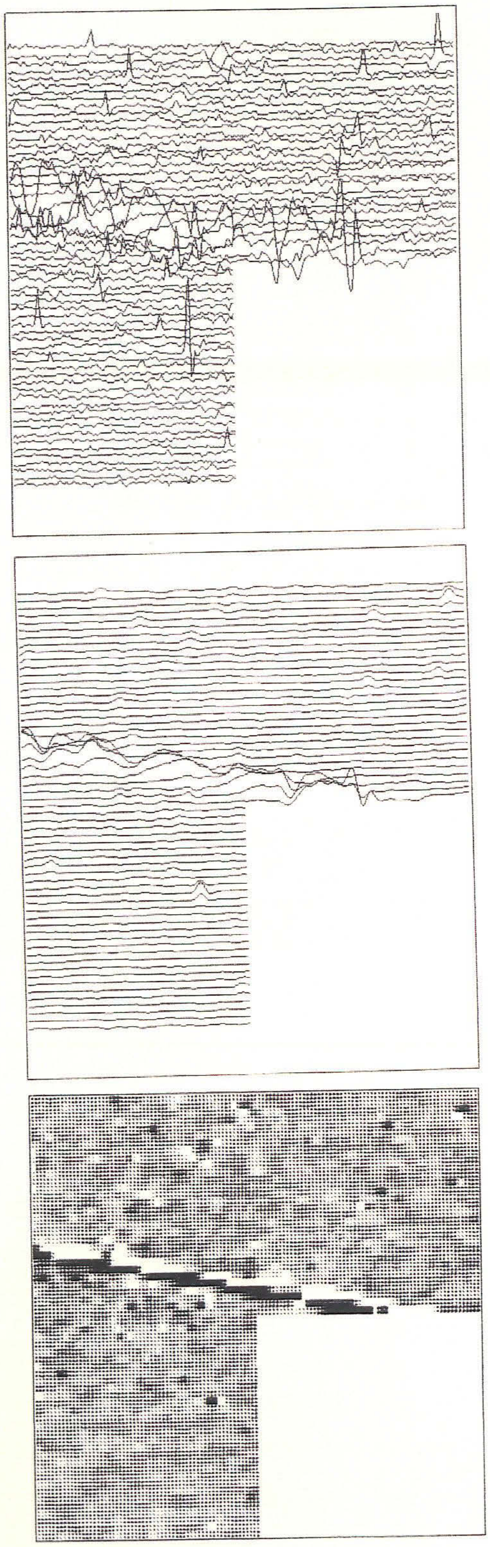
GRADIOMETER PLOT: AREA 5

OXFORD ARCHAEOTECHNICS

Fig. 8

NORTON BIG WOOD, NORTON DISNEY, LINCOLNSHIRE

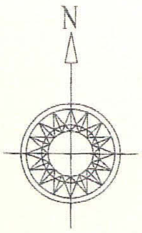
MAGNETIC SUSCEPTIBILITY AND GRADIOMETER SURVEY



STACKED TRACE;
RAW DATA, 22 nT/cm

STACKED TRACE,
SMOOTHED, 22 nT/cm

SHADE PLOT,
-1 to + 3 nT

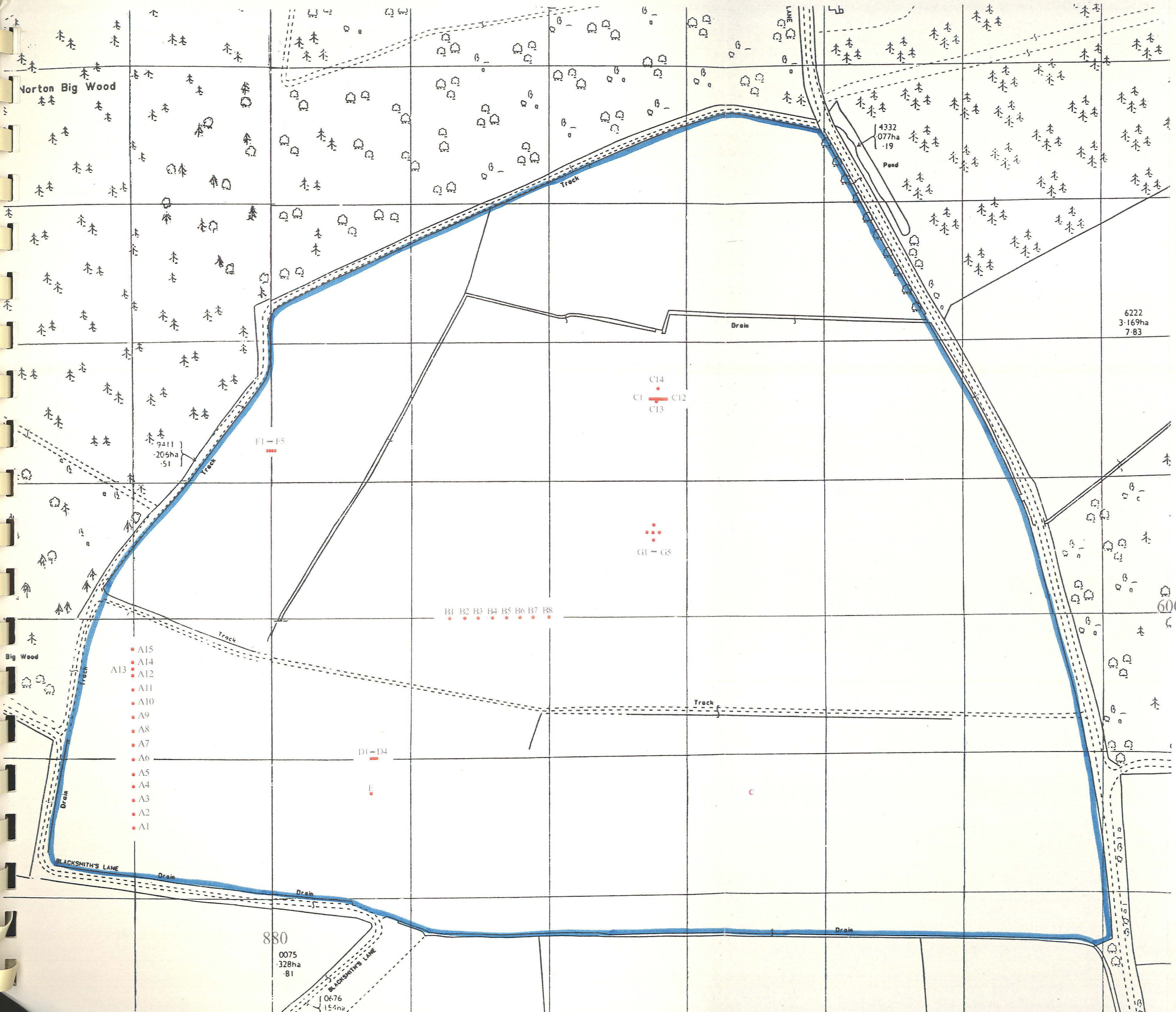


scale 1:1000

GRADIOMETER PLOT: AREA 5

OXFORD ARCHAEOTECHNICS

Fig. 8



NORTON BIG WOOD
NORTON DISNEY,
LINCOLNSHIRE.

MAGNETIC SUSCEPTIBILITY
AND MAGNETOMETER SURVEY

LOCATION OF AUGER SERIES

SCALE 1:2500

N

OXFORD ARCHAEOTECHNICS

Fig 9

INTERNAL QUALITY CHECK

Survey Reference:	0341193/NOL/BUT		
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