98/12

BRAUNCEWELL LIMESTONE QUARRY, LINCOLNSHIRE

Topsoil Magnetic Susceptibility and Gradiometer Survey

(Survey Ref : 0940996/BRL/LAS)

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Produced by

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under the direction of

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Commissioned by

Lindsey Archaeological Services

on behalf of

Brauncewell Quarries Limited

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SUMMARY

A geophysical evaluation programme comprising topsoil magnetic susceptibility mapping and gradiometer survey was carried out on land immediately adjacent to the north and east of Brauncewell Limestone Quarry (centred on 503200 352150) in advance of a proposed quarry extension.

A triple ditch system (of probable later prehistoric date) visible as a cropmark from the air crosses the existing quarry and part of the survey area to the north, whilst archaeological excavation in advance of the existing quarry has revealed further evidence for a multi-phase complex of Roman activity and quarry pits continuing into the late 3rd. century AD.

The survey was based upon the principle that past human activity and its associated debris usually creates slight but persistent changes in the local magnetic environment which can be sensed from the surface.

In the present case, magnetic survey north of the quarry located the triple ditch system. A number of other areas of anthropogenic modification of the soils identified by topsoil magnetic susceptibility mapping, were demonstrated by magnetometry (gradiometer survey) to represent the location of underlying 'cut' features, representing ditches, enclosures, pits and a possible structure. There is little magnetic evidence, however, that the complex of previously excavated archaeological features extends significantly east of the present quarry.

1. INTRODUCTION

1.1 Geophysical survey was commissioned by Lindsey Archaeological Services on land adjacent (on the north and east) to Brauncewell Limestone Quarry (centred on 503200 352150) in advance of a proposed quarry extension.. The survey area lies c. 0.5 km west of the A15 Lincoln to Sleaford road (7 km. north of Sleaford and 20 km south of Lincoln), and just over 1 km east of the small village of Brauncewell, Lincolnshire. The location is shown on Fig. 1. The fieldwork was carried out in September 1996.

1.2 A shallow (c. 0.30 m) depth of topsoil overlies (Middle Jurassic) limestone brash and bedrock. The ground lies between 30 and 40 m OD, sloping northwards towards a dry valley running on a southwest-northeast trend close to the northern boundary (just south of Church Row Plantation). The land was under corn stubble at the time of survey.

1.3 The cropmark of a sinuous 'triple linear ditch system' has been observed from aerial photographs crossing the existing quarry and extending northwards within the survey area. Archaeological evaluation and excavation work in advance of the existing quarry in 1994 (Field 1994, Tipper 1994) located not only the triple ditch complex, (probably later prehistoric in date), but also detected a number of Roman quarry pits together with a variety of enclosures, burials, pits, postholes and agricultural features, with activity continuing into the late 3rd. century AD (Fig. 11). The survey area lies 4 km east of a major Roman road (Ermine Street).

1.4 Fieldwalking within the current survey area in 1994 by Lindsey Archaeological Services recorded a scatter of Romano-British pottery sherds,

eighteen worked flints and a few pieces of Medieval and post Medieval pottery(Field 1994). Previous geophysical work had located some components of the triple ditch system within the present quarry and, identified a possible double linear feature further east, running almost east - west parallel and approximately 10 m north of the field boundary alongside the minor road to Brauncewell (Lyall 1994) (now beneath the bund which forms the southern extent of the present survey area).

1.5 The present geophysical survey, comprising a combination of topsoil magnetic susceptibility field sensing and magnetometry, aimed to identify activity areas and characterise 'cut' features and structural remains of later prehistoric or subsequent periods. An explanation of the techniques used, and the rationale behind their selection, is included in an Appendix to the present report.

2. MAGNETIC SURVEY DESIGN

2.1 Survey control was established to a local (100m) grid using a baseline offset 20 m south of the stone wall (i.e. between the corn field and Church Row Plantation) which forms the northern boundary of the site. The positions of two temporary wooden baseline pegs, and two further pegs which represent a perpendicular line, have been left at the boundaries of the survey area, and are shown on Fig. 2.

2.2 The equipment used for the 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. The 10 m grid configuration also favours the detection of ploughed-out earthworks, 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 the latter may eventually prove to relate to the positions of underlying archaeological features.

2.5 Four areas showing significant enhanced topsoil magnetic susceptibility and which also produced gradiometer scanning anomalies were targeted for detailed gridded survey with a Geoscan Research FM 36 Fluxgate Gradiometer (sampling 4 readings per metre at 1 metre traverse intervals in the 0.1 nT range). 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 also undertaken along parallel traverses, 25 m apart in order to check for any major concentrations of underlying archaeological features whose presence may not have been indicated 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 software.

2.7 The topsoil magnetic susceptibility grey shade and colour shade plots (Figs. 3 & 4) show soil magnetic contours at 20 SI intervals. Magnetometer data have been presented as grey scale and raw data stacked trace plots (Figs. 5 - 7), the results are summarised on Fig. 10, and interpretation of results is shown on Figs. 8 & 9.

3. SURVEY RESULTS

TOPSOIL MAGNETIC SUSCEPTIBILITY SURVEY (Figs. 3 & 4)

3.1 A total of 829 *in situ* magnetic susceptibility readings were taken. 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.

3.2 *In situ* topsoil susceptibility measurements generally ranged between 16 and 167 (x 10^{-5}) SI units; the mean for the survey was 93.2 SI units and the standard deviation calculated against the mean was 21.3 SI units.

3.3 Soils within the survey area displayed a good range of magnetic contrasts. The topsoil magnetic susceptibility map shows three principal zones of patterning.

3.4 The dry valley bottom within the northern half of the survey area is dominated by a spread of strongly enhanced topsoils, running on a general westsouthwest - eastnortheast trend across the whole area. The pattern partly represents colluvial accumulations of magnetically susceptible soils, although within this broad zone there are indications of patterning which suggest the presence of anthropogenic intervention. Interfaces between zones of magnetically contrasting soils were recorded which subsequently proved to relate to the locations of significant 'cut' features known from both aerial photographs and subsequent gradiometer survey (see gradiometer survey Areas 3 & 4 below); most notable is the southwest-northeast patterning of soils exceeding 120 SI visible in the western extremity of the survey area (light yellow shade on Fig. 3), which reflects the trend of a series of underlying ditches and other lineations.

3.5 A roughly triangular spread of magnetically enhanced topsoils (exceeding 100 SI over an area roughly 80 x 60 m) situated adjacent to the existing (northeastern) quarry edge, marks the location of underlying 'cut' features', subsequently identified by gradiometer survey as a pattern of enclosure ditches together with features which may represent elements of a possible rectilinear structure/s (see 3.17 below).

3.6 A second focus lies within the southwestern angle of the survey area close to the quarry edge, where a block of soils extending over an area of some 60 x 20 m exceeds 100 SI units. The general patterns of topsoil enhancement within this focus conform broadly with the locations of underlying 'cut' features identified by subsequent gradiometer survey (see gradiometer survey Area 2 below). The apparent 'low' zone running along the western side of this spread of more magnetic topsoils is due to material with a lower magnetic susceptibility derived from the tail of the quarry bund becoming incorporated into the topsoils along the boundary of the survey area.

3.7 Between these principal zones of strong magnetic susceptibility patterning, soil magnetism drops markedly, and the gradiometer scanning over these 'weaker' zones did not suggest any strong foci of underlying activity.

MAGNETOMETER (GRADIOMETER) SURVEY

3.8 The survey area was scanned by gradiometer on 25 m traverses. Gridded gradiometer survey was carried out in four areas, all of which were selected because they displayed enhanced topsoil magnetic susceptibility and gradiometer scanning anomalies. In addition, Area 1 was extended to include a relatively low zone of magnetic susceptibility to the east of the present quarry as a control area. A total area of 1.53 ha was investigated by detailed

gradiometer grids, their location is shown on Fig. 2 and a summary of results on Fig. 10.

3.9 Almost all the anomalies were positive, with the majority not exceeding +4 nT, although a few isolated features produced signals up to +10 nT, probably due to the incorporation of burnt material in their infilling.

3.10 The relationship between the magnetometer survey results and archaeological features excavated by Lindsey Archaeological Services in advance of the existing quarry (Tipper 1994) is shown on Fig. 11.

AREA 1 (Figs. 5, 7 & 8)

3.11 Six 30 m square survey grids (0.54 ha) in an L-shaped configuration were located to investigate a spread of relatively higher magnetically susceptible soils and gradiometer scanning anomalies lying within the southernmost angle of the survey area.

3.12 The strongest and more coherent magnetic anomalies lie with 15 m of the tail of the bund marking the eastern boundary of the existing quarry. The principal magnetic feature is an enclosure ditch running roughly north-south, parallel with and 10 m to the east of the bund, which is clearly visible for a distance of 15 m, and which continues south albeit less distinctly for perhaps a further 20 m, a further element can be seen abutting this enclosure ditch 15m from the northern boundary of the survey area. The principal enclosure ditch may be the same feature which is visible in Area 2 (see 3.16 below) some 60 m further north.

3.13 Further magnetic anomalies indicative of pitting or disturbed ground visible along the western edge of the survey area close to the quarry bund are confined, for the most part, within or along the line of this enclosure.

3.14 Over the rest of this survey area a few dispersed pits and weak lineations are indicated on Fig. 8.

AREA 2 (Figs. 5, 7 & 8)

3.15 Three 30 m square survey grids (0.18 ha) were located to investigate a spread of magnetically 'enhanced' soils close to the northeastern angle of the existing quarry.

3.16 The gradiometer plot shows what appears to be a continuation of the linear observed in Area 1, running northnorthwest-southsoutheast for a distance of some 40 m, before abutting a second enclosure, part of whose southern side and southeast angle are visible. What appears to be a narrow causeway (c.2 m wide) is visible through the eastern ditch of the northern enclosure at a distance of approximately 12 m from its southeast angle.

3.17 Both enclosures can be seen to contain pits, two of which are quite substantial (3 - 4 m in length). The northernmost enclosure contains within its southeast angle a pattern of weak positive anomalies which may represent the foundation trenches of structures; this pattern defines a rectangular area measuring some 35 x 10 m. These features are barely perceptible on the grey shade plot (Fig. 5), but more obvious on the stacked trace plot (Fig. 7).

AREA 3 (Figs. 6, 7 & 9)

3.18 Seven 30 m square survey grids (0.63 ha), in an elongated L-shaped configuration, were located to investigate the northward extension of the known triple ditch system beyond the quarry at a point where the ditches appear discontinuous on the aerial photographs. The survey grids were also positioned to investigate an area of topsoil magnetic susceptibility patterning at the extreme west end of the proposed extension (see 3.4 above).

3.19 The gradiometer revealed numerous linear features, including both a section of the triple ditch system, and a relatively strong anomaly showing the location of an outlying ditch some 50 m to the west. This ditch is approximately 2 m in width. These features are also known from previous excavation to the south and from aerial photography (Field 1994) (Fig. 11).

3.20 Within the northern extension of the survey block all three of the triple ditches can be seen, spaced 10 m apart. The most westerly of the group, however, only appears to extend 30 m south into the gradiometer survey area, although there is the slightest suggestion of a weak positive anomaly continuing from a point (the location of a possible pit) some 10 m south of the location where the westernmost ditch apparently terminates. This weak anomaly could possibly represent an infilled section of ditch, which could conceivably be projected towards the termination of the central of the three ditches excavated in the previous phase of quarry extension.

3.21 There is considerable 'scarring', indicative of disturbed ground, represented by positive and negative anomalies giving a mottled appearance within the northernmost projection of the survey block. The patterning can be seen to relate to a series of diffuse southwest-northeast lineations, which can be traced

on the plot for a distance of over 100 m. They have the general appearance of trackways, but may equally represent multiple parallel ditches, and perhaps dispersed bank material. The principal elements are represented by two weak positive anomalies, which are 2 - 3 m wide at the southwest increasing in width and becoming more diffuse to the northeast. These anomalies may represent shallow intrusions or ditches infilled with material of relatively low magnetic susceptibility. They run roughly parallel, 10 m apart. A third ditch is represented by a stronger (and up to 2 m wide) anomaly which is visible for 30 m crossing the northwest angle of the survey grid; it appears as a pair of closely parallel elements for part of its length.

3.22 The stacked trace plot (Fig. 7) clearly shows a distinct difference in the magnetic character of the triple ditch system on either side of the southernmost of the diffuse linears: the magnetic identity of the triple ditches is stronger to the north, suggesting some differential activity on either side of this feature. It may be that to the north the triple ditches have silted naturally, whilst to the south they may have been partly or wholly infilled with material of lower susceptibility. There is clearly, therefore, some (as yet unknown) contemporary inter-relationship between the triple ditch system and the wide diffuse elements. The outlying ditch which runs broadly parallel and some 50 m west of the triple ditches appears to run across these diffuse linears.

3.23 Some pit forms and weak linears have also been recorded, notably at the west end of this survey area.

AREA 4 (Figs. 6, 7 & 9)

3.24 A single 30 x 30 m survey grid was sited to investigate a spread of soils showing magnetic enhancement within the northeastern angle of the survey area.

3.25 The focus of these more magnetic soils revealed an underlying curvilinear ditch, presumably part of an enclosure, with a number of further anomalies indicative of pit forms.

4. CONCLUSIONS

4.1 Both topsoil magnetic susceptibility mapping and gradiometer survey suggest that to the east of the existing quarry the principal areas of archaeological potential lie in proximity to the present extraction area. One enclosure visible close to the northeastern edge of the quarry extends 50 m further east and may contain features suggesting the location of a former structure, whilst towards the southern end of the survey area an enclosure ditch some 10 m from the eastern bund generally marks the easternmost extent of the concentration of archaeological features excavated during the previous phase of quarry expansion.

4.2 Stronger magnetic patterning was recorded in the area north and northeast of the quarry, where a number of substantial underlying 'cut' features, including the continuation of the triple ditch system together with a series of diffuse linears were located; the relationship between the triple ditches and the diffuse linears remains uncertain. At least one further enclosure is present within the zone of magnetically enhanced soils which characterise the valley bottom. It must be anticipated that additional features will be present in the vicinity of the enclosure, and perhaps others are dispersed within this zone of magnetically enhanced soils.

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Topsoil magnetic susceptibility mapping and magnetometer survey by Oxford Archaeotechnics Limited under the direction of A.E. Johnson *BA(Hons)*, with D. Chambers *BA(Hons)*.

APPENDIX - MAGNETIC TECHNIQUES: GENERAL PRINCIPLES

A1.1 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.

A1.2 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.

A1.3 The tendency of most human activity is to increase soil magnetic susceptibility locally. 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.

A1.4 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 further modify the susceptibility of soils 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.

A1.5 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.

A1.6 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 these are cancelled out. In order to produce good results, the magnetic

susceptibility contrast between features and their surroundings must be reasonably high, 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' ('scanning') of larger areas (where the operator directly monitors the changing magnetic field and pinpoints specific anomalies).

A1.7 *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.

A1.8 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.

A1.9 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 agricultural 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).

A1.10 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.

A1.11 As well as locating specific sites, topsoil magnetic susceptibility survey frequently provides information relating to 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 or strip 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.

A1.12 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).

FIGURE CAPTIONS

Figure 1. Location maps. Scale 1:50,000 and 1:5,000. Based upon OS 1:50,000 Maps 121 & 130, and OS 1:2500 Sheets TF 0351 & 0352, reduced to 1:5000 scale.

Figure 2. Location of survey areas and local survey grid. Based upon OS 1:2500 Sheets TF 0351 & 0352. Scale 1:2500.

Figure 3. Topsoil magnetic susceptibility survey: grey scale plot. Based upon OS 1:2500 Sheets TF 0351 & 0352. Scale 1:2500.

Figure 4. Topsoil magnetic susceptibility survey: colour contour plot. Based upon OS 1:2500 Sheets TF 0351 & 0352. Scale 1:2500

Figure 5. Gradiometer survey. Areas 1 & 2: grey shade plots (Geoscan Research Geoplot Licence No. GPB 885-6). Scale 1:1000.

Figure 6. Gradiometer survey. Areas 3 & 4: grey shade plots (Geoscan Research Geoplot Licence No. GPB 885-6). Scale 1:1000.

Figure 7. Gradiometer survey. Areas 1 - 4: stacked trace plots: raw data (Geoscan Research Geoplot Licence No. GPB 885-6). Scale 1:1000.

Figure 8. Gradiometer survey. Areas 1 & 2: interpretation (Geoscan Research Geoplot Licence No. GPB 885-6). Scale 1:1000.

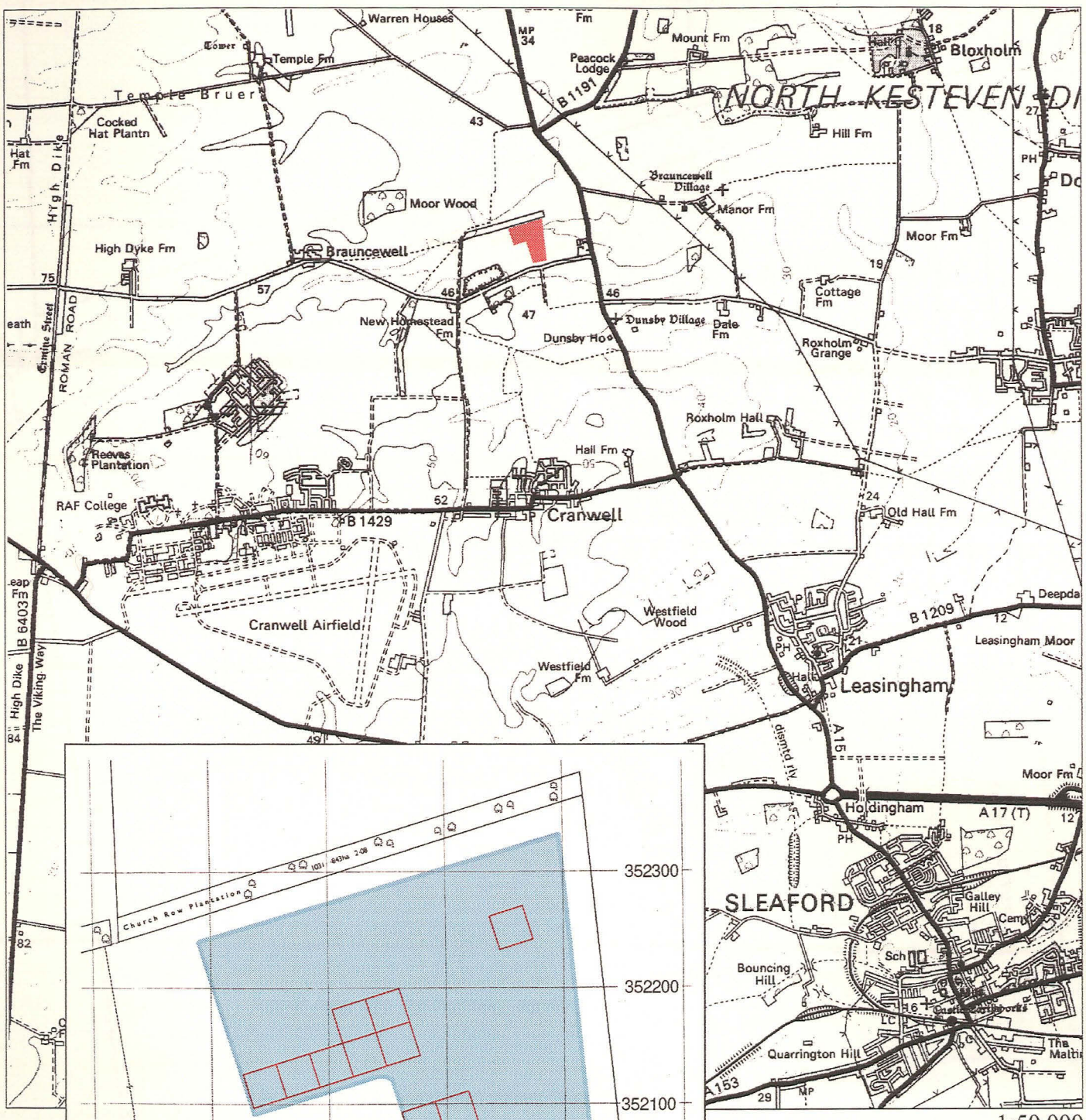
Figure 9. Gradiometer survey. Areas 3 & 4: interpretation (Geoscan Research Geoplot Licence No. GPB 885-6). Scale 1:1000.

Figure 10. Gradiometer survey. Areas 1 - 4: overview (Geoscan Research Geoplot Licence No. GPB 885-6). Based upon OS 1:2500 Sheets TF 0351 & 0352. Scale 1:2500.

Figure 11. Relationship between gradiometer survey and previous archaeological excavation (after Tipper 1994). Based upon OS 1:2500 Sheets TF 0351 & 0352. Scale 1:2500.

Brauncewell Limestone Quarry, Lincolnshire: Proposed Extension

Topsoil magnetic susceptibility & magnetometer (gradiometer) survey



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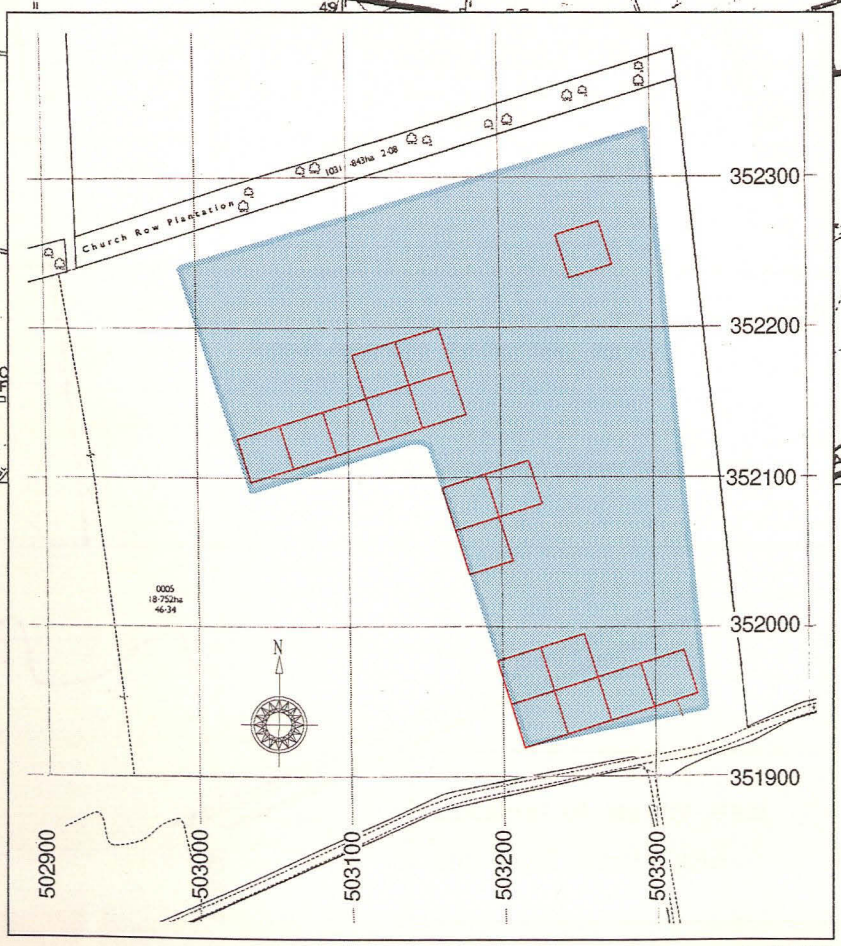
Location



1:5,000

Topsoil magnetic susceptibility survey

Magnetometer (gradiometer) survey

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FIG. 1

Brauncewell Limestone Quarry, Lincolnshire: Proposed Extension

Topsoil magnetic susceptibility & magnetometer (gradiometer) survey

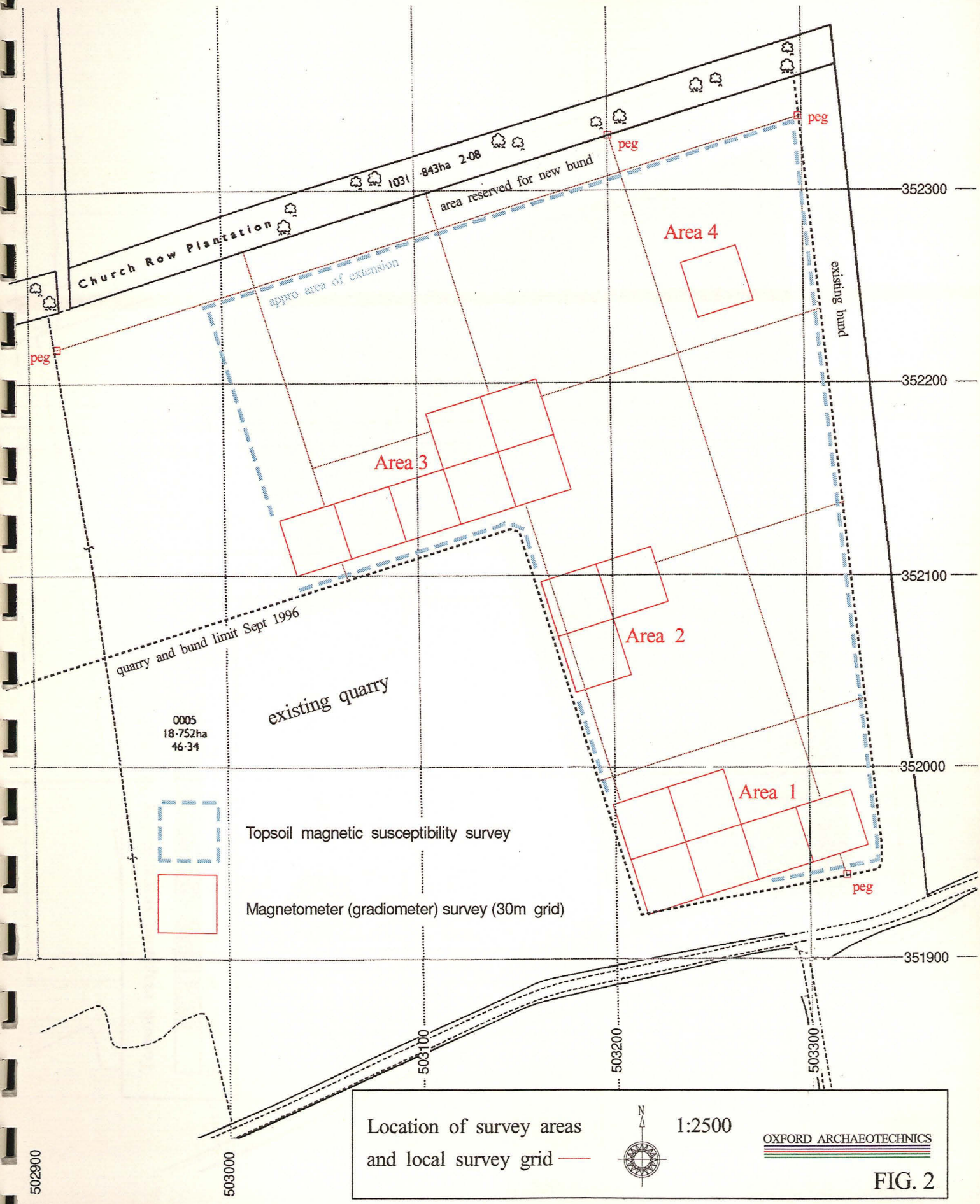

FIG. 2

Brauncewell Limestone Quarry, Lincolnshire: Proposed Extension

Topsoil magnetic susceptibility survey: Grey shade plot

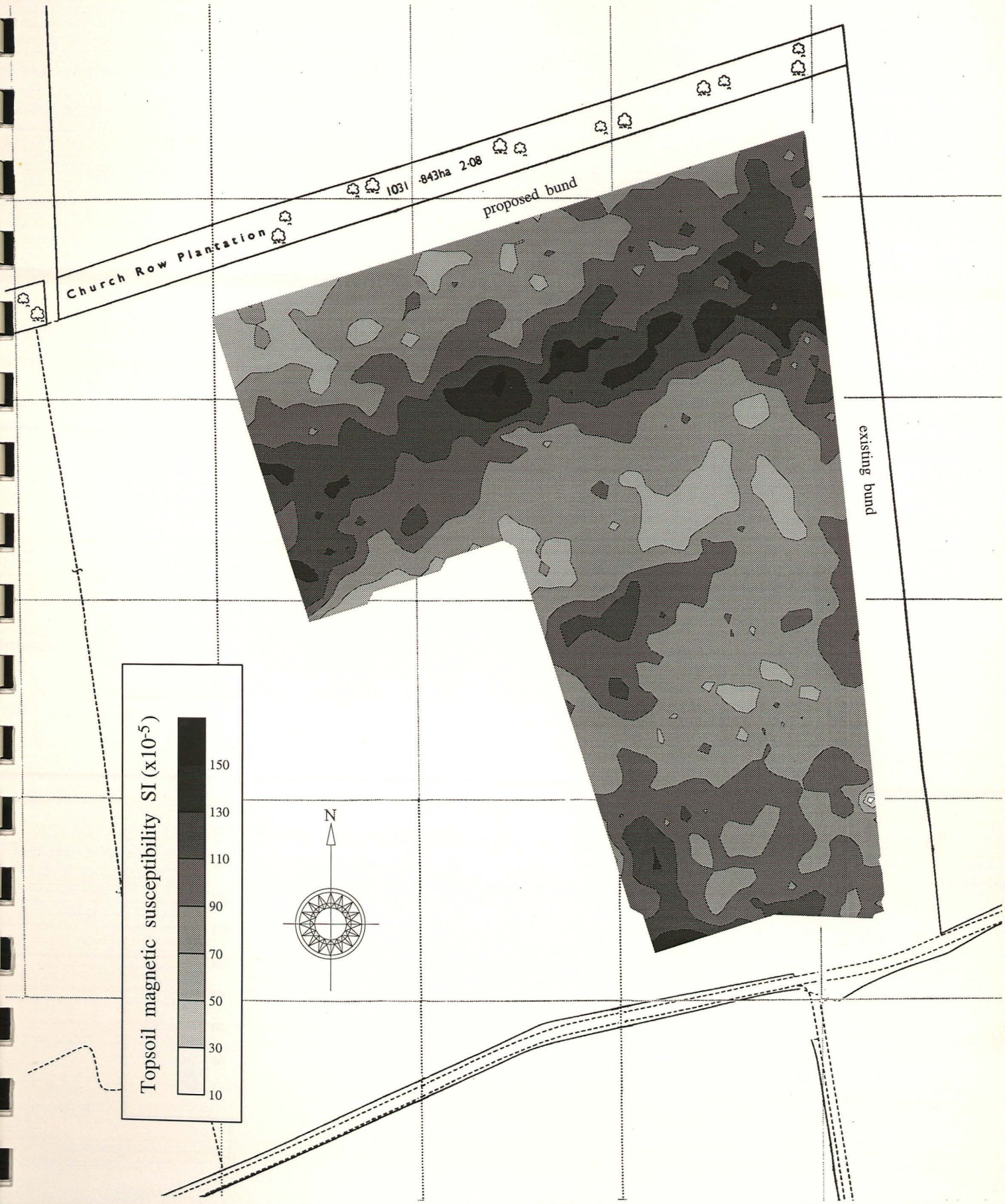

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FIG. 3

Brauncewell Limestone Quarry, Lincolnshire: Proposed Extension

Topsoil magnetic susceptibility survey: principal magnetic foci

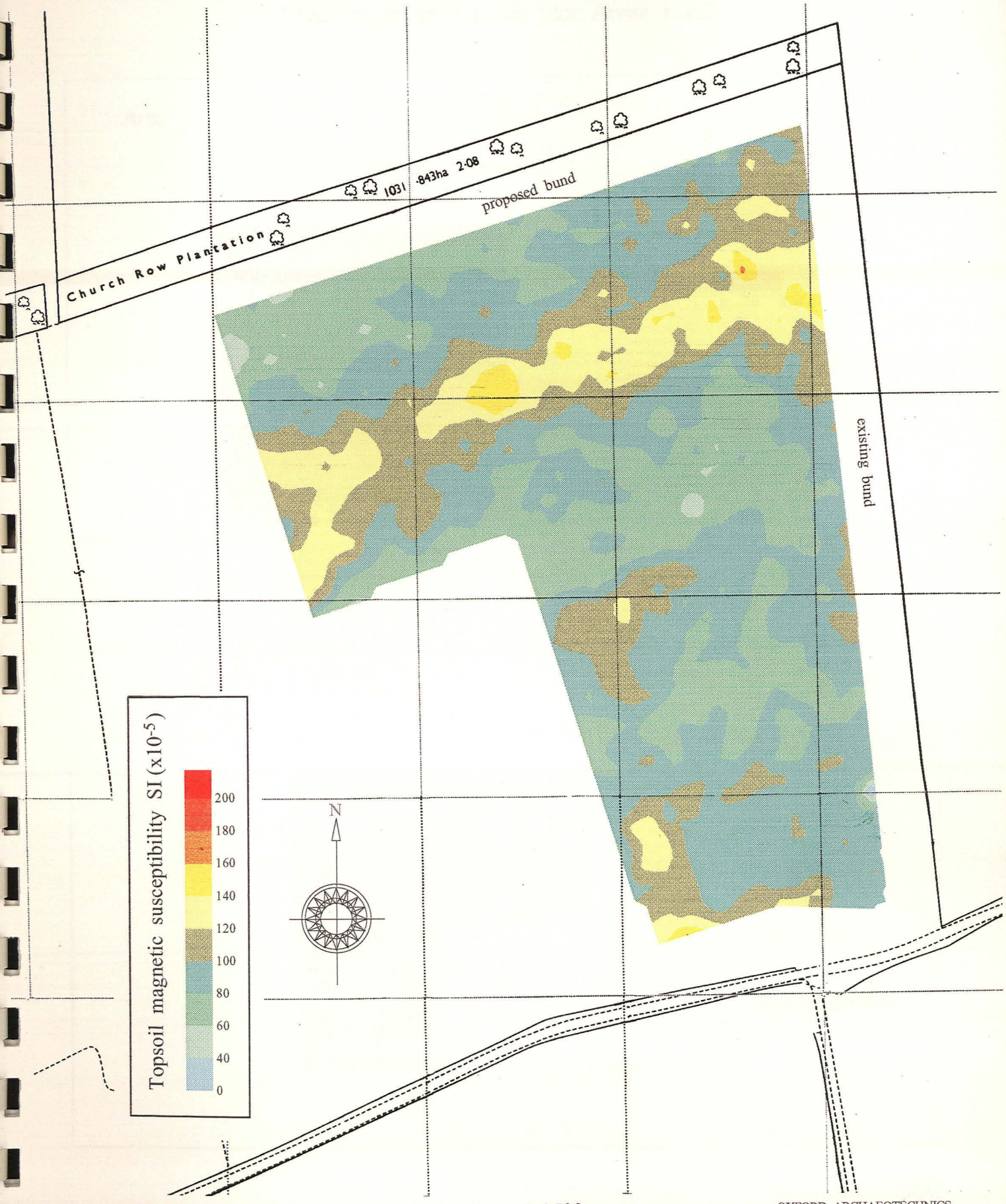

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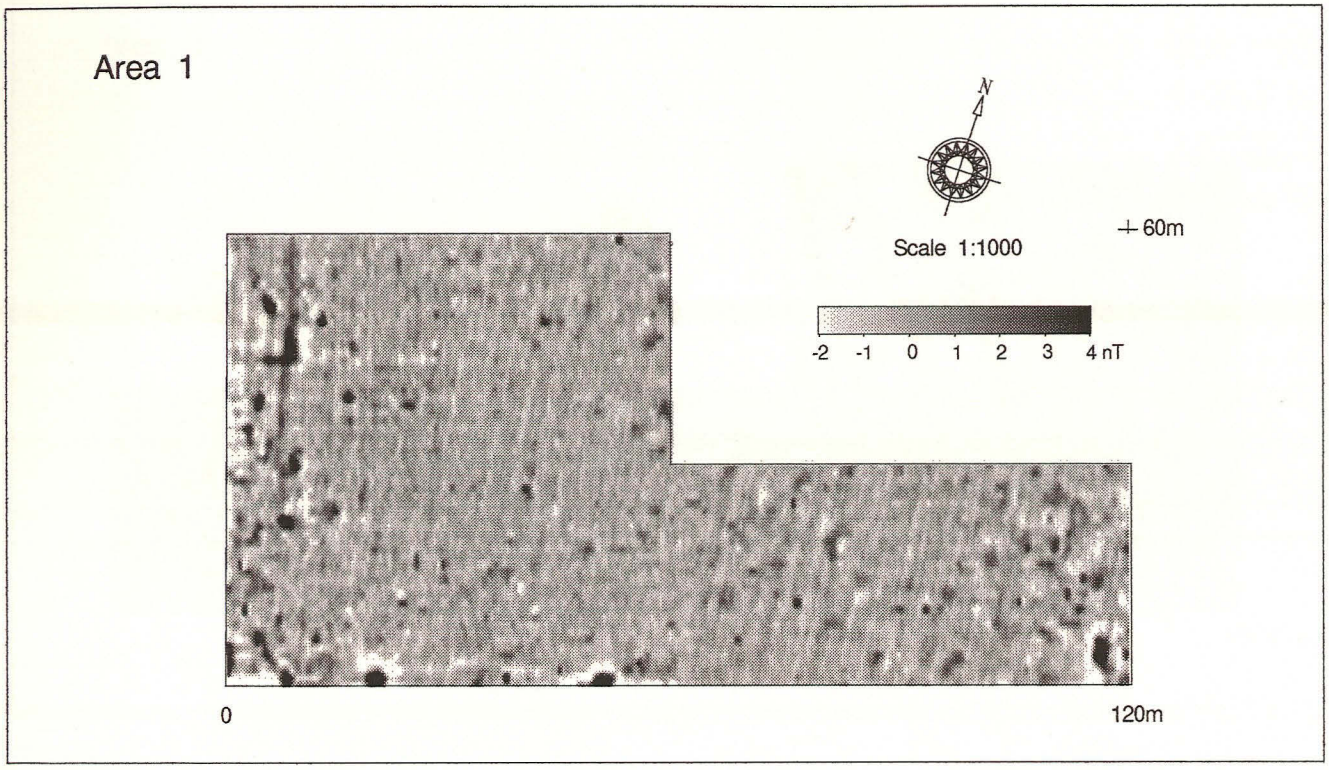
FIG. 4

Brauncewell Limestone Quarry, Lincolnshire: Proposed Extension

Topsoil magnetic susceptibility & magnetometer (gradiometer) survey

Gradiometer grey shade plot: Areas 1 & 2



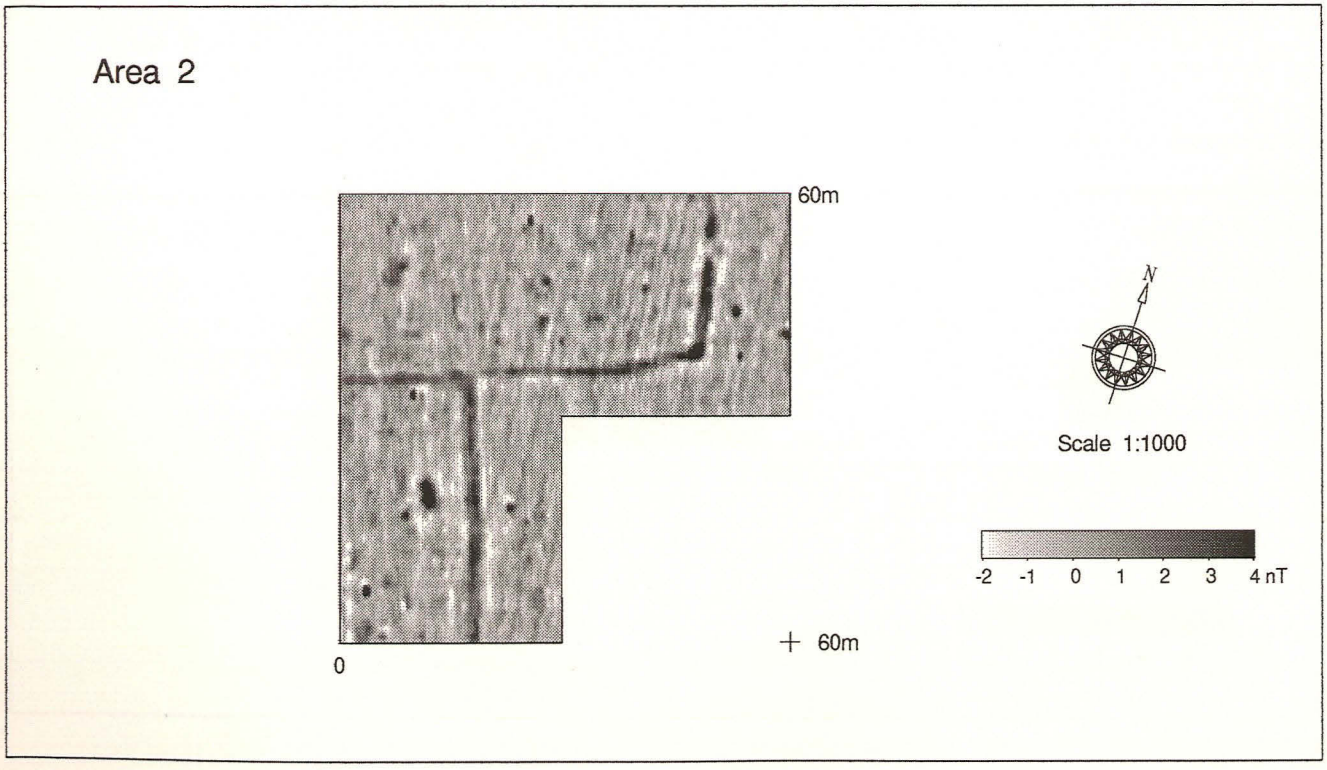


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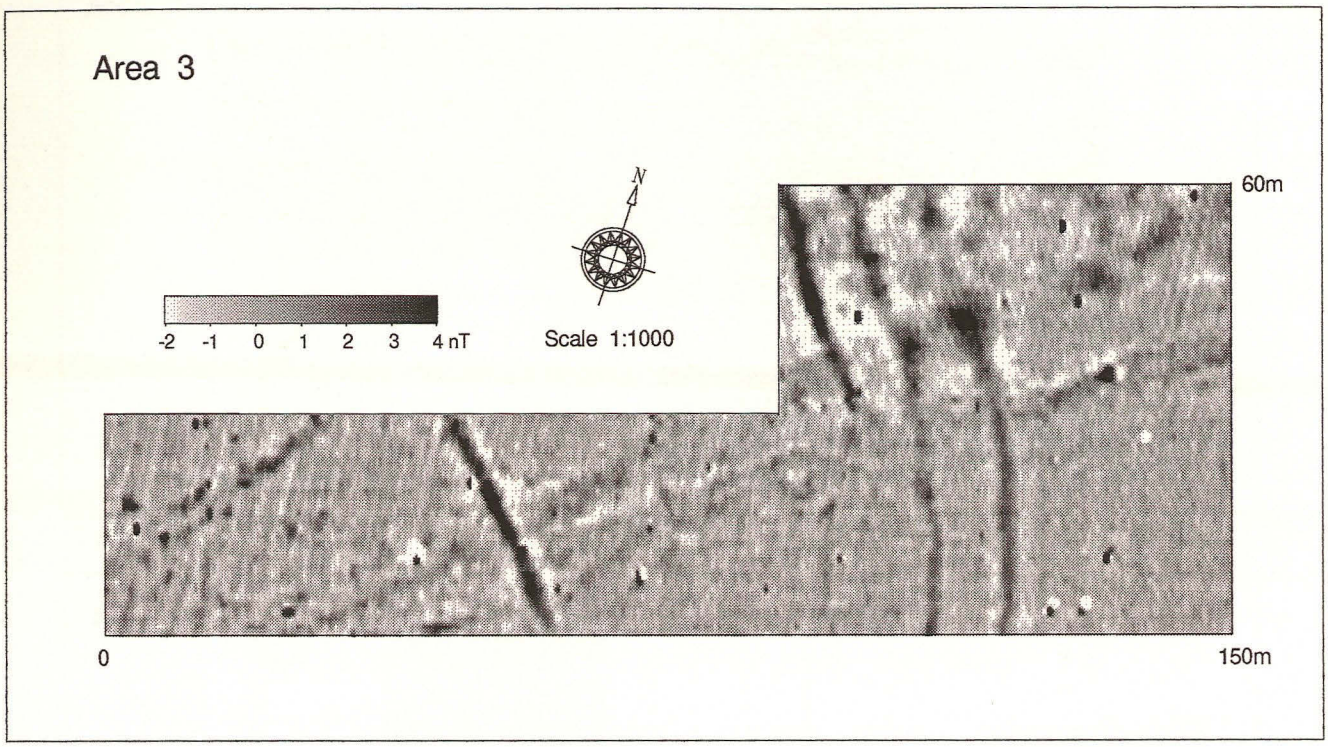
FIG. 5

Brauncewell Limestone Quarry, Lincolnshire: Proposed Extension

Topsoil magnetic susceptibility & magnetometer (gradiometer) survey

Gradiometer grey shade plot: Areas 3 & 4



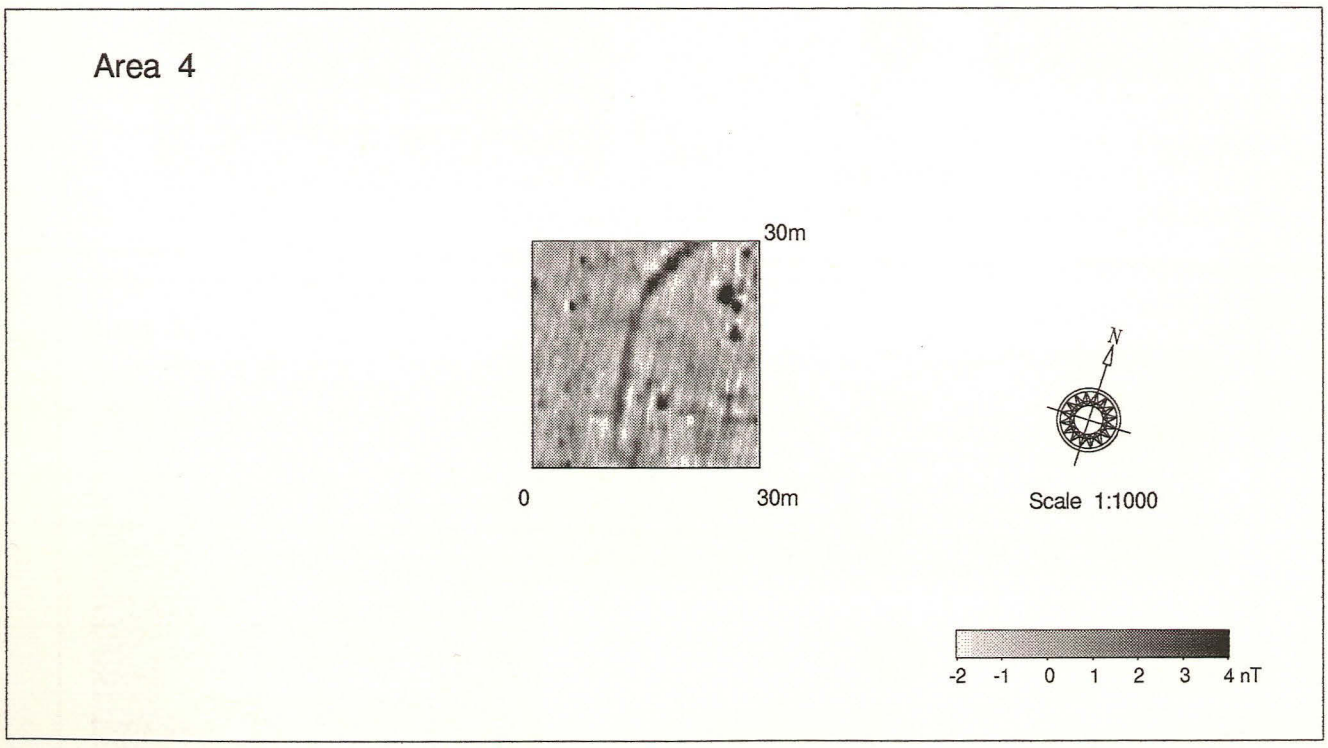


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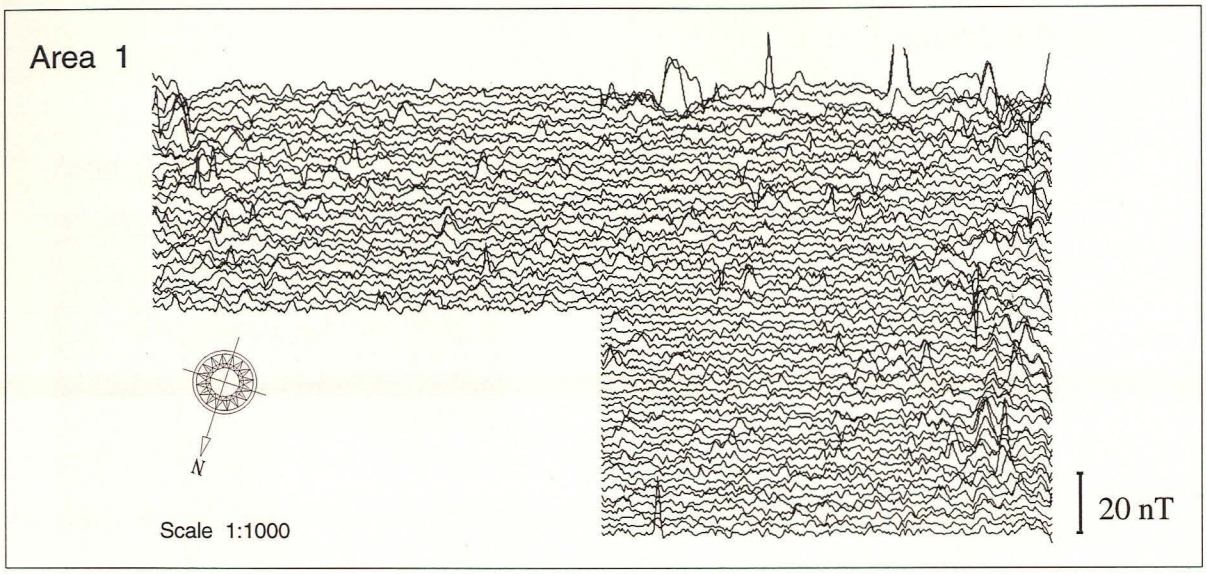
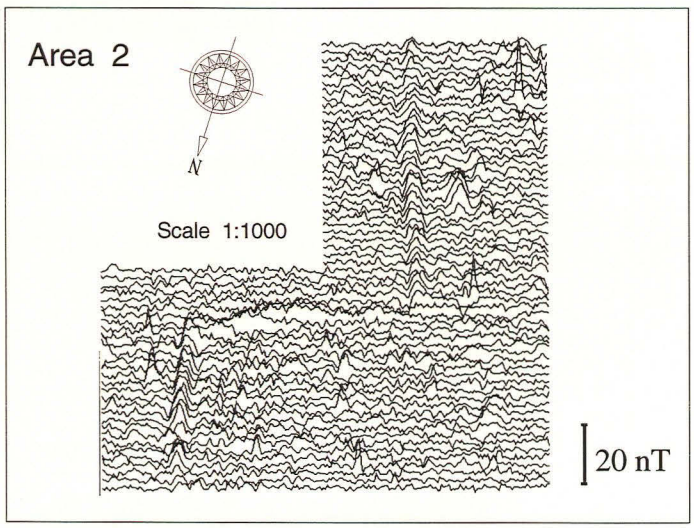
FIG. 6

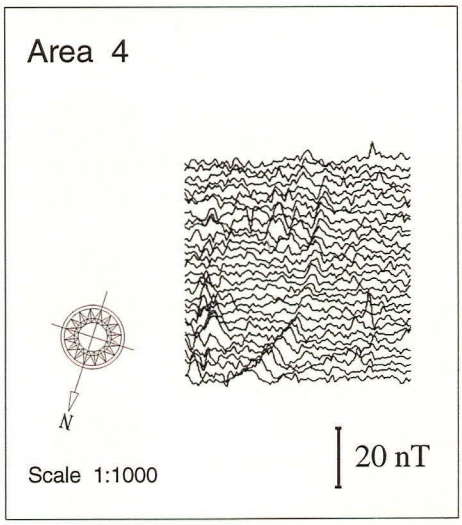
Brauncewell Limestone Quarry, Lincolnshire: Proposed Extension

Topsoil magnetic susceptibility & magnetometer (gradiometer) survey

Gradiometer survey, stacked trace plots areas 1-4: Raw data







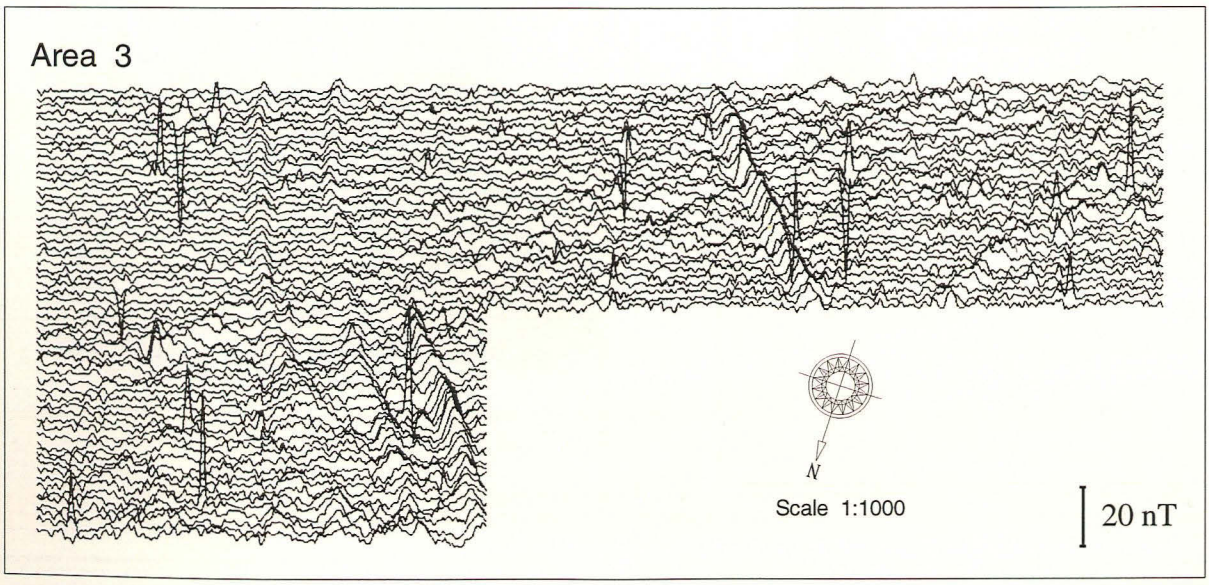


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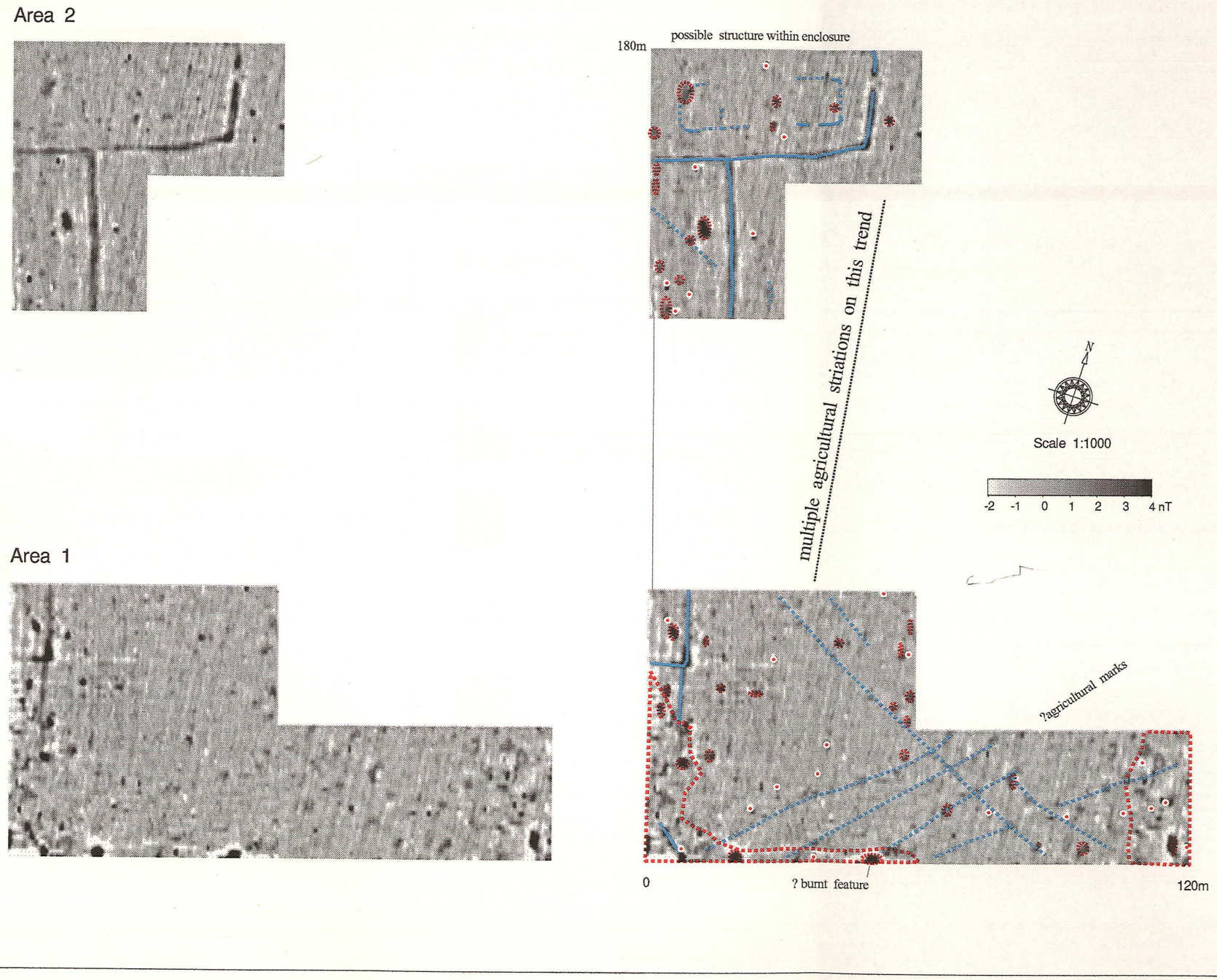
FIG. 7

Braunceweil Limestone Quarry
Lincolnshire
Proposed Extension

Gradiometer Survey, Grey Shade Plots,
Areas 1 & 2



Interpretation

- Linear and curvilinear features
- Weak linear and curvilinear features, including agricultural striations
- Possible pits
- Ferrous material
- Areas of disturbed ground

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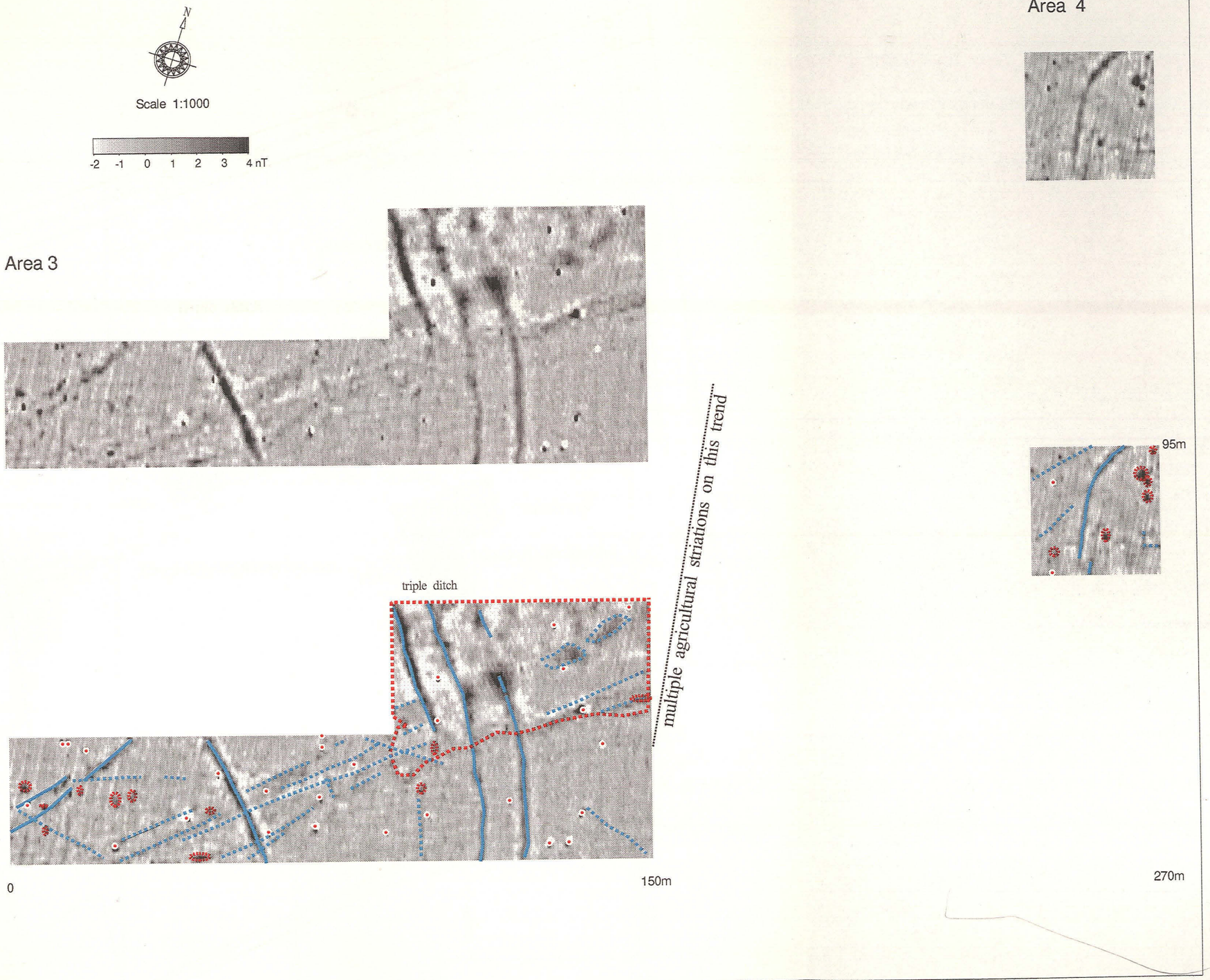
Fig. 8

Brauncewell Limestone Quarry
Lincolnshire
Proposed Extension

Gradiometer Survey, Grey Shade Plots,
Areas 3 & 4



Interpretation

- Linear and curvilinear features
- Weak linear and curvilinear features, including agricultural striations
- Possible pits
- Ferrous material
- Areas of disturbed ground

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Fig. 9

Brauncewell Limestone Quarry, Lincolnshire: Proposed Extension

Topsoil magnetic susceptibility & magnetometer (gradiometer) survey: overview

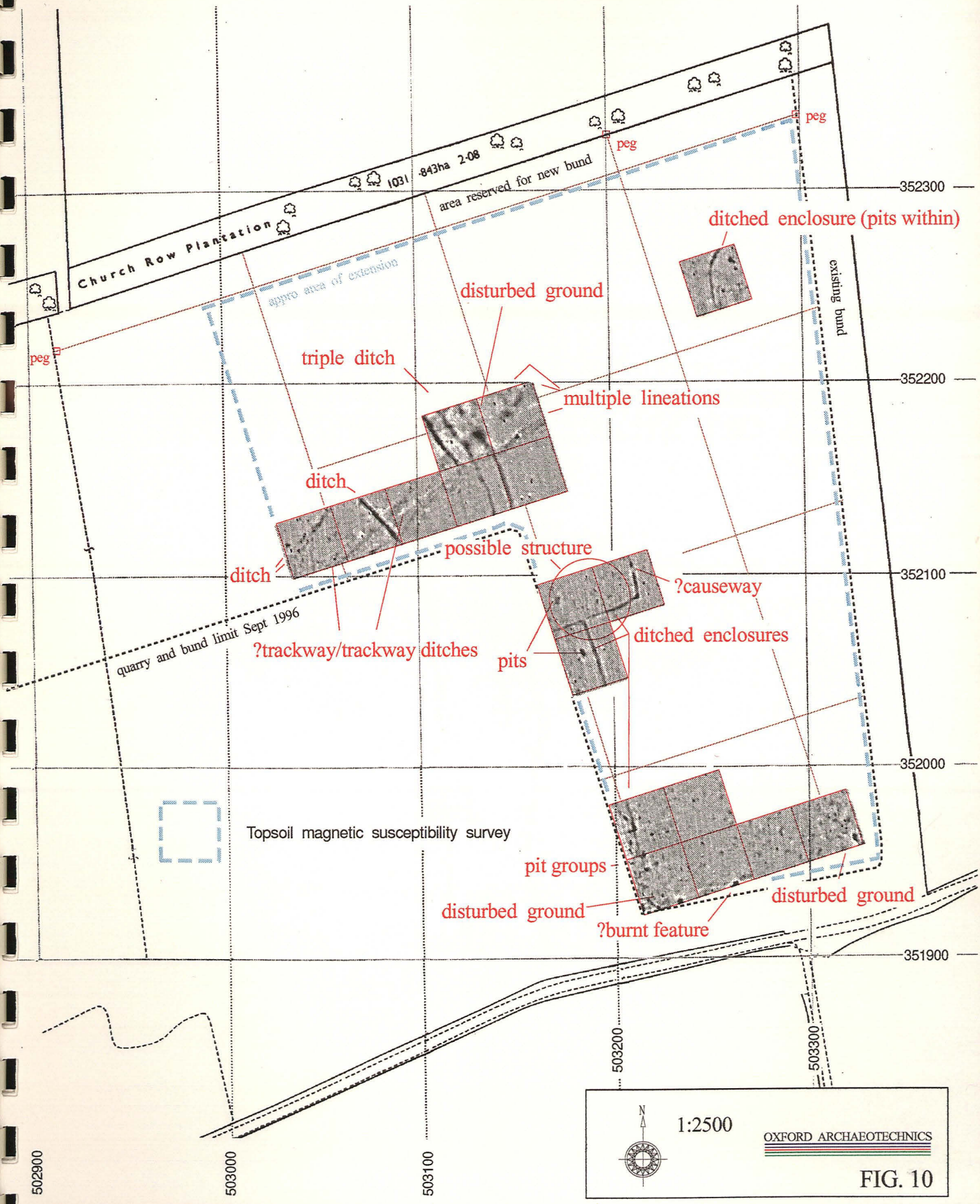
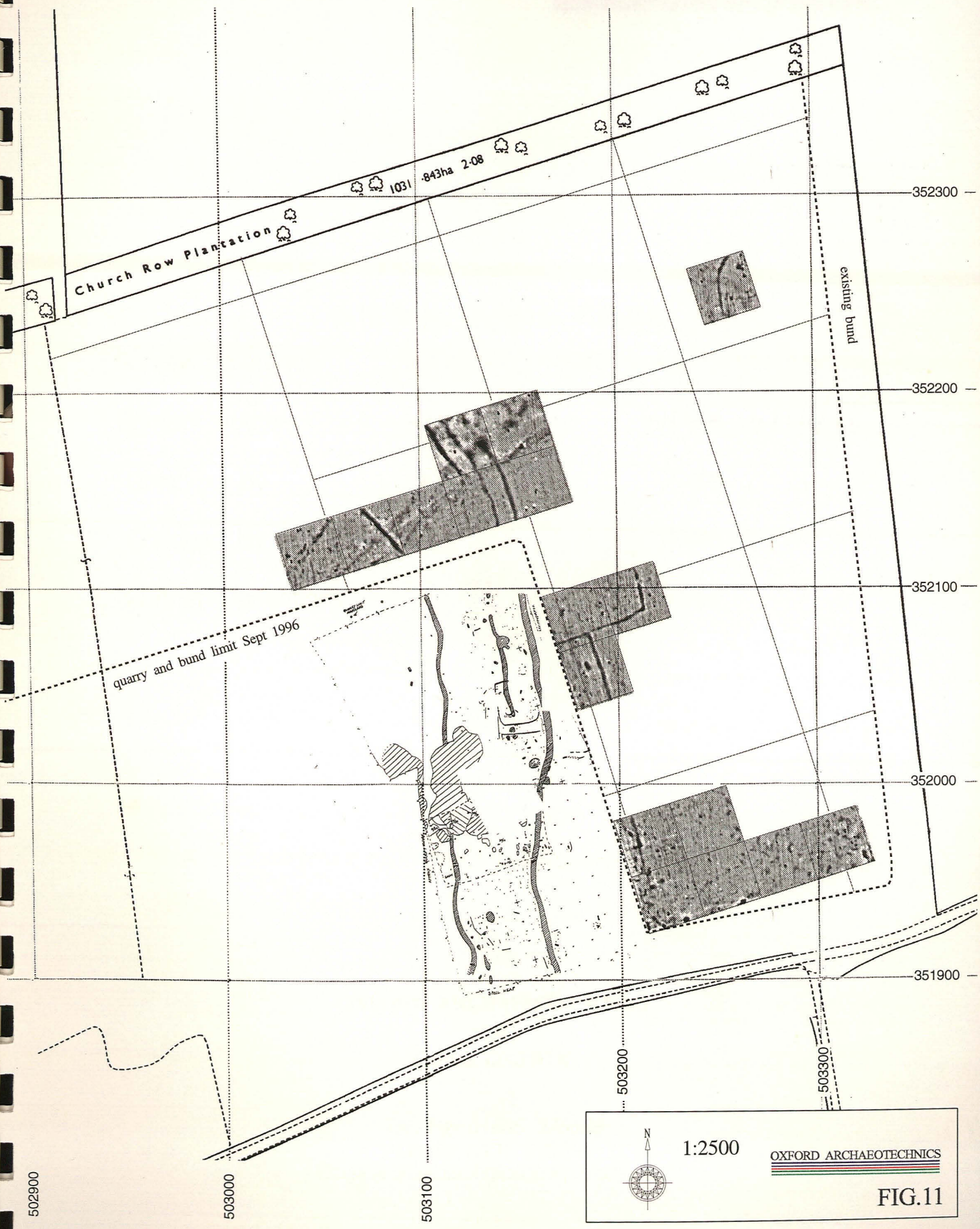


FIG. 10

Brauncewell Limestone Quarry, Lincolnshire: Proposed Extension

Relationship between gradiometer survey & previous archaeological excavation (after Tipper 1994)



INTERNAL QUALITY CHECK

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Primary Author	[illegible]	Date	4/10/96
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Further Corrections		Date	

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