43716 - Med
43717 - Undated
43718 - Post Med.

98/2

LAND AT WEST END, ORBY, NR. SKEGNESS, LINCOLNSHIRE

Gradiometer Survey

(Survey Ref : 1420198/ORL/BFS)

JANUARY 1998

Produced by

OXFORD ARCHAEOTECHNICS LIMITED

under the direction of

A.E. Johnson *BA(Hons)*

Commissioned by

Lindsey Archaeological Services

on behalf of

Mrs. H.J. Rhodes

OXFORD ARCHAEOTECHNICS

12 Friars Lane
LINCOLN LN2 5AL
Tel: 01522 575292 Fax: 01522 530724

EVENT 41438
SOURCE 413462

43716
43717
43718

Specialist Archaeological Field Evaluation

OXFORD ARCHAEOTECHNICS
Noke
Oxford OX3 9TX

Tel / Fax 01865 375536
Mobile 0831 383295
Email archaeotechnics@dial.pipex.com

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SUMMARY

Magnetometer (gradiometer) survey was carried out on a 0.5 ha area of land at West End, Orby, near Skegness, Lincolnshire, in advance of proposed housing development.

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.

Anomalies representing traces of ridge and furrow cultivation were recorded, together with a former boundary, probably marked by a trackway. Local pockets of magnetic debris deriving from a (relatively) recently demolished structure, possibly the site of a mapped Primitive Methodist Chapel, were also recorded, together with further weak anomalies which probably represent agricultural features, and a few possible dispersed pits.

1. INTRODUCTION

1.1 Geophysical survey was commissioned by Lindsey Archaeological Services on behalf of Mrs. H.J. Rhodes in advance of proposed housing development. The survey area (centred on NGR 548792 367280) comprises a small (roughly square) paddock, c.0.5 ha in area, fronting Gunby Road on the western outskirts (West End) of the village of Orby. The location is shown on Fig. 1. The fieldwork was carried out in January 1998.

1.2 The geology comprises marine silts. The land was pasture at the time of survey. The ground surface within the northern half of the field retains the 'corrugated' pattern characteristic of Medieval ridge and furrow cultivation.

1.3 The survey, comprising detailed magnetometry (using a fluxgate gradiometer), aimed to identify activity areas and characterise 'cut' features and structural remains. An explanation of the techniques used, and the rationale behind their selection, is included in an Appendix to the present report.

1.4 Property deeds in possession of the landowner show the location of a former Primitive Methodist Chapel situated within the southeast angle of the paddock, close to the modern road. The chapel, which is believed to have been of mud and stud construction, measuring some 10 x 8 m, was demolished before 1890 (information from Lindsey Archaeological Services). Although buildings of mud and stud construction with little or no 'cut' foundations would be unlikely to be visible to the magnetometer, it was anticipated that the location of former buildings (not only the chapel but any other buildings along the road frontage) might be identifiable from increased magnetic 'activity' areas (created by building debris, fired or burnt material, or services such as drains, paths etc.) associated with them.

2. MAGNETIC SURVEY DESIGN

2.1 Several *in situ* topsoil magnetic susceptibility measurements were taken using a Bartington Instruments MS2 meter with an 18.5 cm loop to determine the magnetic susceptibility and contrasts of the topsoils.

2.2 Detailed magnetometer (gradiometer) survey was carried out using 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.

2.3 The survey grids were set back from the modern road and property boundaries to avoid the magnetic effects of the wire fencing and excessive modern contamination (electricity poles, cattle troughs, gateways etc.) adjacent to the road. The precise location of the survey grids is shown on Fig. 2.

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

2.5 Magnetometer data have been presented as grey scale and raw data stacked trace plots (Figs. 3 & 5); and an interpretation of results is shown on Fig. 4.

3. SURVEY RESULTS (Figs. 3 - 5)

3.1 *In situ* measurement of topsoil magnetic susceptibility levels within the northern part of the paddock, avoiding obvious modern contamination and ferrous sources visible closer to the road, displayed low topsoil magnetic susceptibility levels, ranging between 10 and 14 SI:volume susceptibility units (x 10^{-5}).

3.2 Despite the relatively low magnetic properties of the topsoils, the site responded favourably to magnetometer (gradiometer) survey.

3.3 The northern half of the survey area displays a number of subtle parallel linears (spaced at c.7 m centres) on a northnorthwest - southsoutheast alignment representing the furrow bases of former (probably Medieval) ridge and furrow cultivation, vestigial traces of which are still visible on the field surface. There is a slight suggestion that the pattern continues (albeit as weakly magnetic signals) into the southern part of the survey area.

3.4 Running almost centrally across the survey area, perpendicular to the ridge and furrow, is a broad (c.5 m wide) zone of strong magnetic activity, producing signals which are not dissimilar to those generated by brick or similar (fired) debris. The pattern is consistent with a trackway or (just possibly) a collapsed wall.

3.5 South of the broad linear, approaching the modern road, the gradiometer plot shows two apparently rectilinear areas of disturbed ground containing magnetic debris. The signals are consistent with magnetic material such as brick, roof tile debris, or ferrous material, and may also include burnt clay. Several more subtle lineations are also visible in this area.

3.6 Adjacent to the road, the gradiometer plot shows strong magnetic 'wipeout' resulting from wire fencing and an electricity pole at the southwestern angle and from a steel cattle feeder close to the southeastern angle.

3.7 There is a general litter of ferrous debris across the site which is typical of land in proximity to modern dwellings and a road frontage.

4. CONCLUSIONS

4.1 The magnetic evidence confirms that the northern half of the survey area is covered by traces of former (probable Medieval) ridge and furrow cultivation; few other features are visible in this area.

4.2 The band of highly magnetic material which crosses the centre of the survey area probably represents a former land division or trackway, whose line is preserved in the rear boundaries of a row of properties fronting Gunby Road, immediately east of the survey area.

4.3 South of this boundary, approaching the road, two pockets of intense magnetic activity and several lineations associated with dispersed debris, may relate to the site of the former Methodist Chapel.

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ACKNOWLEDGEMENTS

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 1 - 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 Map 122, and OS 1:10,000 Sheet TF46NE.

Figure 2. Location of magnetometer survey grids. Scale 1:1250.

Figure 3. Magnetometer (gradiometer) survey: grey scale plot (Geoscan Research Geoplot Licence No. GPB 885-6). Scale 1:500.

Figure 4. Magnetometer (gradiometer) survey: interpretation (Geoscan Research Geoplot Licence No. GPB 885-6). Scale 1:500.

Figure 5. Magnetometer (gradiometer) survey: stacked trace plot (raw data (Geoscan Research Geoplot Licence No. GPB 885-6). Scale 1:500.

Land at West End, Orby, Skegness, Lincolnshire

Magnetometer survey: location

FIG. 1

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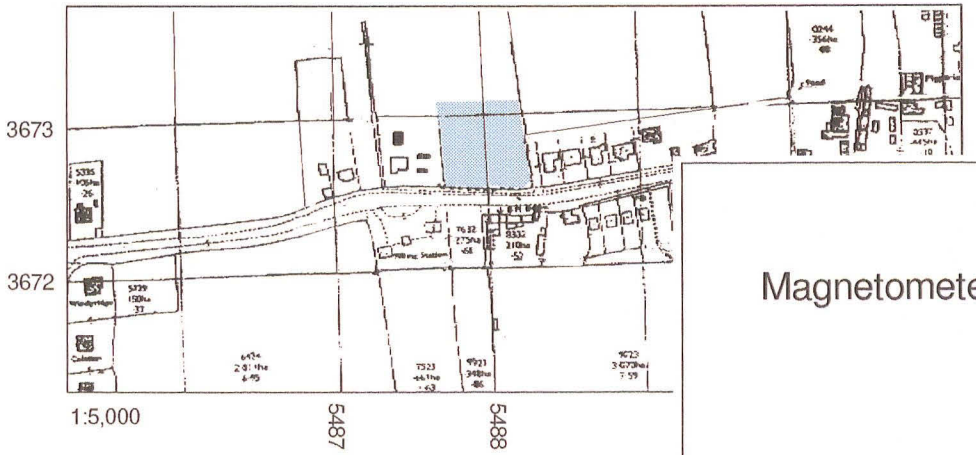
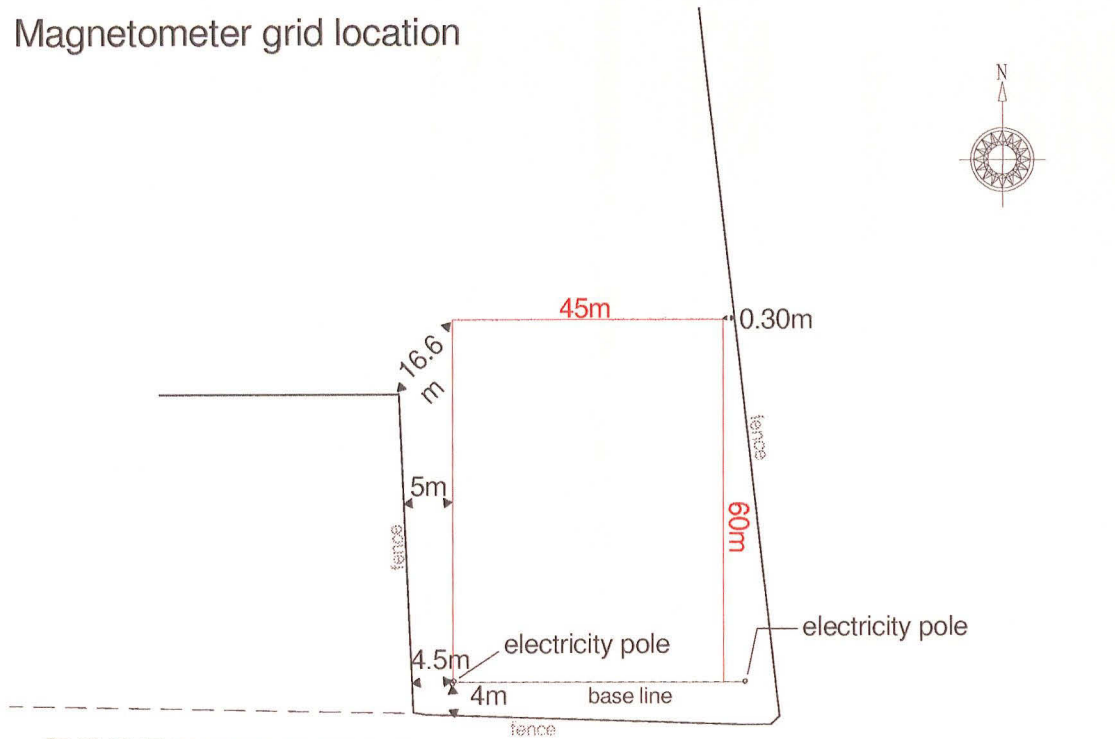
Land at West End, Orby, Skegness, Lincolnshire

Magnetometer survey grids: location



Magnetometer grid location



Gradiometer grids stood off fencing to avoid magnetic effects of wire

1:1250 Baseline established between existing electricity poles as shown on sketch plot

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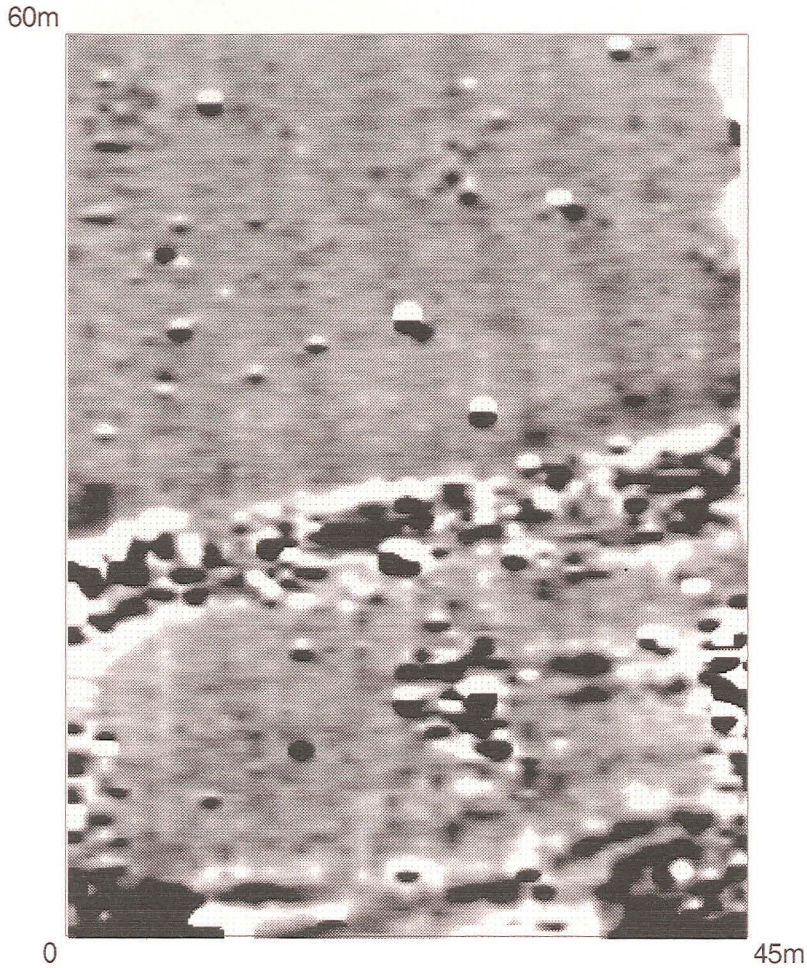
FIG. 2

Land at West End, Orby, Skegness, Lincolnshire

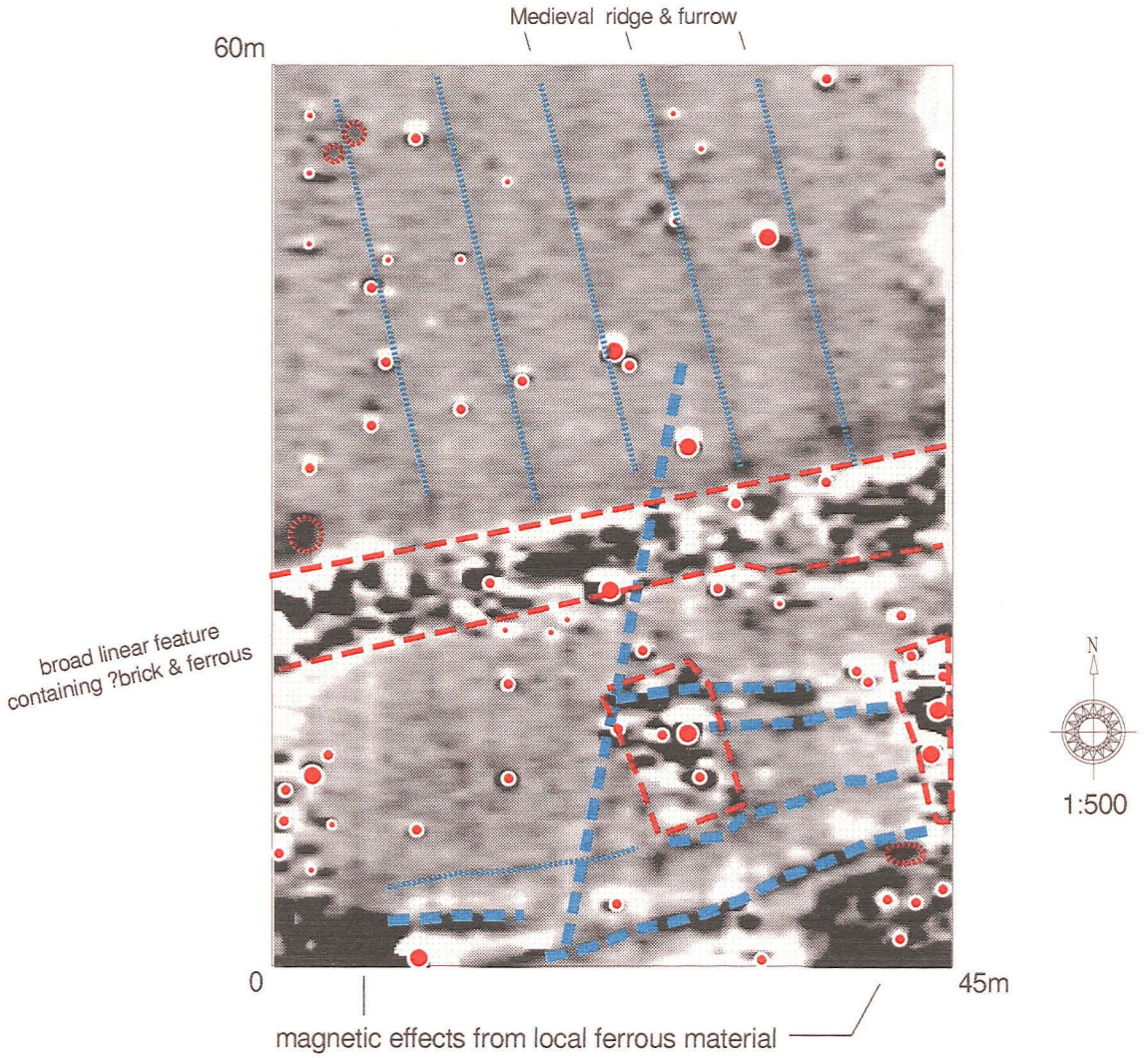
Gradiometer grey shade plot



OXFORD ARCHAEOTECHNICS FIG. 3

Land at West End, Orby, Skegness, Lincolnshire

Gradiometer grey shade plot: interpretation



Interpretation

Linear and curvilinear features

Weak linear and curvilinear features, including agricultural striations

Ferrous material

Possible pits

-2 -1.5 -1 -0.5 0 0.5 1 1.5 2 nT

Areas of disturbed ground & debris

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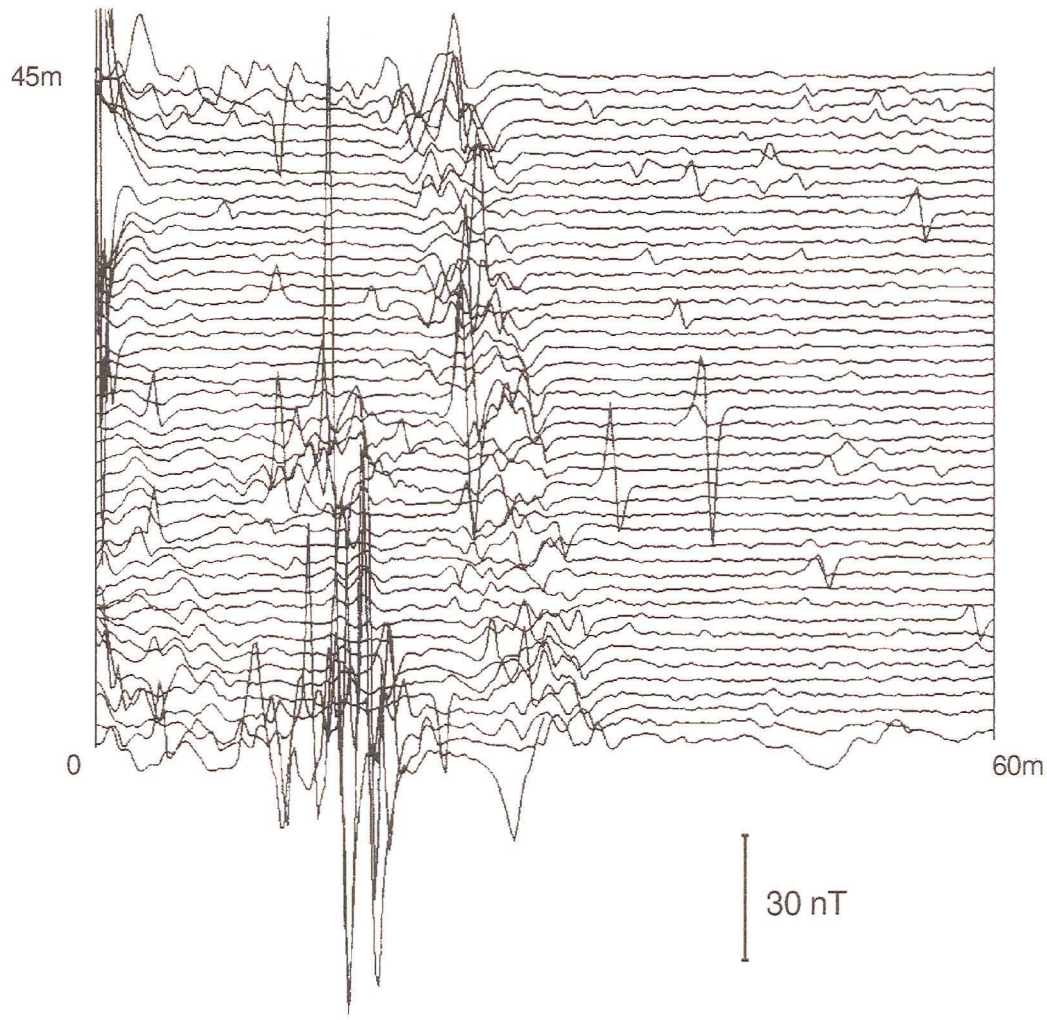
Land at West End, Orby, Skegness, Lincolnshire

Gradiometer stacked trace plot (raw data)



INTERNAL QUALITY CHECK

Survey Reference	1420198/ORL/BFS		
Primary Author		Date	30/1/98
Checked By	APJ	Date	30.01.98
Checked By		Date	
Further Corrections		Date	

OXFORD ARCHAEOTECHNICS
Noke
Oxford OX3 9TX

Tel / Fax 01865 375536
Mobile 0831 383295
Email archaeotechnics@dial.pipex.com