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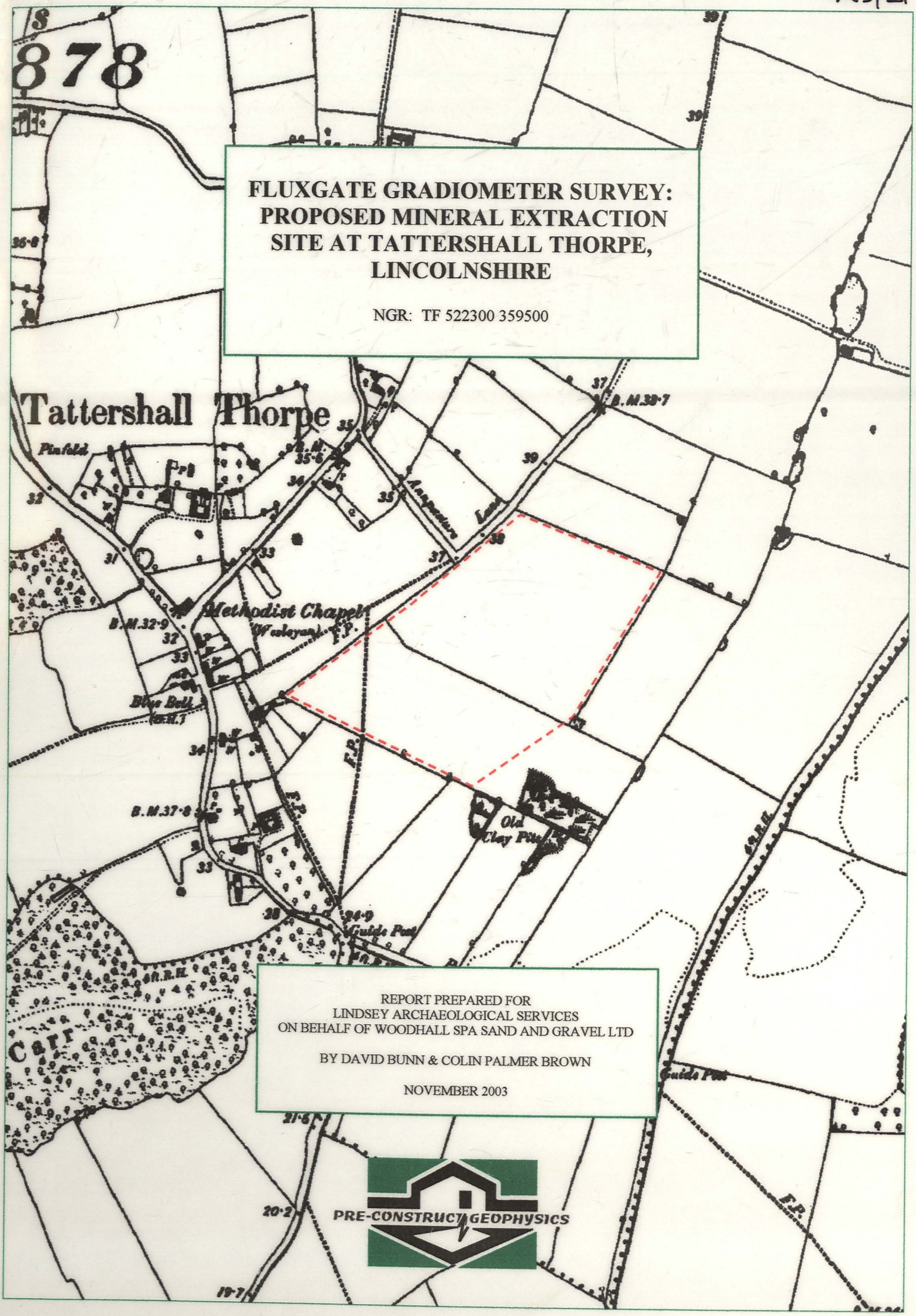


# FLUXGATE GRADIOMETER SURVEY: PROPOSED MINERAL EXTRACTION SITE AT TATTERSHALL THORPE, LINCOLNSHIRE

NGR: TF 522300 359500

REPORT PREPARED FOR
LINDSEY ARCHAEOLOGICAL SERVICES
ON BEHALF OF WOODHALL SPA SAND AND GRAVEL LTD

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PRE-CONSTRUCT GEOPHYSICS

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PRE-CONSTRUCT GEOPHYSICS

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## *Summary*

- *A fluxgate gradiometer survey was carried out on the site of a proposed sand and gravel quarry at Tattershall Thorpe, Lincolnshire.*

- *The survey recorded a series of magnetic anomalies that appear to reflect some form of previous occupation of the area, even though the resolution of many features was compromised by a poor magnetic contrast with the surrounding geology.*

- *At least three phases of activity have been tentatively identified. Two of these appear to reflect ridge and furrow; the third being a field system of a different period. Spatial and morphological relationships suggest that the ridge and furrow was earlier. A series of linear and circular anomalies may reflect the earliest occupation of the area, although interpretations are offered with caution.*

- *Areas of discrete magnetic variation may be evidence of past quarrying activities in the locality.*


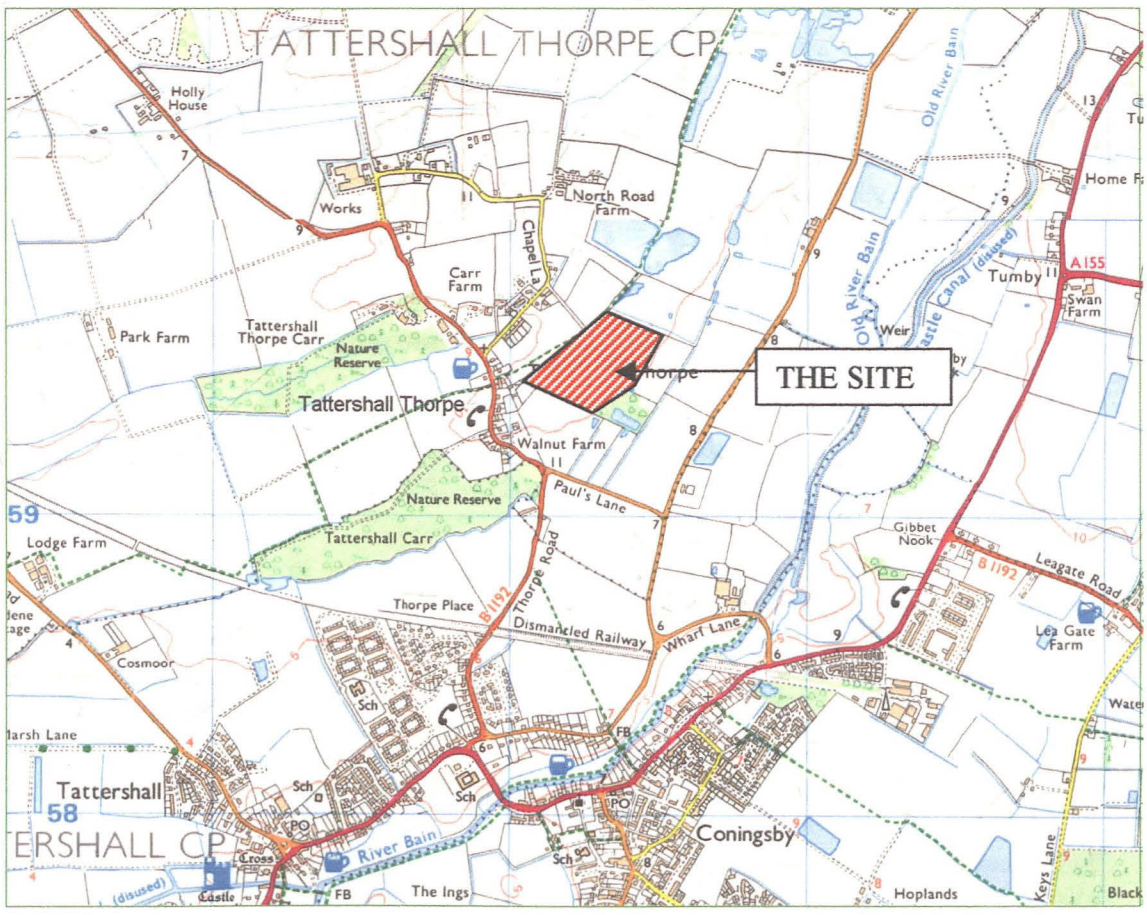


**Fig.1: Location of site 1:25000**

## 1.0 Introduction

Pre-Construct Geophysics was commissioned by Lindsey Archaeological Sevices (on behalf of Woodhall Spa Sand and Gravel Ltd) to undertake a fluxgate gradiometer survey on land at Tattershall Thorpe, Lincolnshire. This work was carried out as part of an archaeological evaluation, conducted to discharge a requirement of English Heritage and Lincolnshire County Council, which was placed upon a planning application for sand and gravel extraction.

The survey methodology was based upon guidelines set out in the English Heritage document *Geophysical Survey in Archaeological Field Evaluation* (David, 1995).

## 2.0 Location and Description (Figs. 1 and 2)

Tattershall Thorpe lies at the southwestern edge of the Lincolnshire Wolds in the valley of the River Bain; approximately 29km to the southeast of Lincoln. The site is situated to the southeast of the village, to the east of Annpasture Lane, and it comprises c. 8ha of arable land. Ground cover at the time of survey comprised part stubble and part cultivated land. A group of abandoned clay pits lie to the south-east of the survey area. Part of this area is currently woodland.

The underlying drift geology of the area comprises Kimmeridge Clay, overlying drift deposits of Lower River Terrace sands and gravels (B.G.S.1995).

Gravel terraces can be problematic to magnetic surveys: iron pans and concretions, for example, can themselves feature as magnetic anomalies and they can also reduce the overall magnetic susceptibility contrast with the topsoil.

## 3.0 Archaeological background

This section is based on information contained within a document *Proposed mineral Extraction on Land East of Annpasture Lane, Tattershall Thorpe, Lincolnshire,* Archaeological Specification (LAS 2003).

There are no records of archaeological remains on the site, although extensive local mineral extraction has exposed evidence of raw flint procurent; from the fluvio-glacial sands and gravels. This activity appears to date from late Mesolithic / early Neolithic periods.

Traces of Neolithic occupation have been identified at Tattershall Thorpe (east of Kirkby Lane) and at Kirkby on Bain, which is c.3km to the north-east of the site.

A double ditched enclosure lies to the immediate northwest of the site. Excavation of this during the 1970's revealed Iron Age pottery within the defining ditches. The site now enjoys statutory protection as a Scheduled Ancient Monument.

Extensive cropmarks have been recorded in fields adjacent to the site. Many of these have been quarried away and cannot therefore be dated, although it is possible that

they indicate Late Iron Age/Romano-British field systems. It is not known whether such features lie within the proposed development area.

## 4.0 Methodology

Detailed area survey using a fluxgate gradiometer is a non-intrusive means of evaluating the archaeological potential of a site. The fluxgate gradiometer detects magnetic anomalies caused by areas of high or low magnetic susceptibility. These areas are caused by changes in the composition of the subsoil or the underlying geology. Archaeological features are the result of man-made changes to the composition of the soil and the introduction of intrusive materials such as brick and stone. These features create detectable magnetic anomalies. In addition, activities, which involve heating and burning, will create magnetic anomalies, as will the presence of ferrous metal objects. By examining the anomalies detected by a fluxgate gradiometer survey, geophysicists can often translate the data into archaeological interpretation.

The area survey was conducted using a Bartington Grad – 01 – 1000 dual fluxgate gradiometers with DL601 data loggers set to take 4 readings per metre (a sample interval of 0.25m). The zigzag traverse method of survey was used, with 1m wide traverses across 30m x 30m grids. The sensitivity of the machine was set to detect magnetic variation in the order of 0.1 nanoTesla..

The data from the survey was processed using *Geoplot* version 3.0. It was clipped to reduce the distorting effect of extremely high or low readings caused by discrete pieces of ferrous metal on the site. The data has been processed using zero mean functions to correct the unevenness of the plots in order to give a smoother graphical appearance. The data was also processed using an algorithm to remove magnetic spikes, thereby minimising the effect of extreme readings caused by ferrous debris, and spurious effects resulting from the inherent magnetism of some soils.

The results are plotted as greyscale and images (Figs. 4-7).

| | |
|---|---|
| Instruments | Bartington Grad – 01 – 1000 dual fluxgate gradiometers, with DL601 data logger |
| Grid size | 30m x 30m |
| Sample interval | 0.25m |
| Traverse interval | 1.0m |
| Traverse method | Zigzag |
| Sensitivity | 0.1nT |
| Processing Software | Geoplot (v.3.0) |
| Weather conditions | Fair, blustery |
| Area Surveyed | 8ha |
| Date of survey | 7/10/03 –8/10/03 |
| Survey personnel | David Bunn, Peter Heykoop, Peter Masters |
| National Grid Reference | Centred on TF 522300 359500 |

**Table 1: Summary of survey parameters**

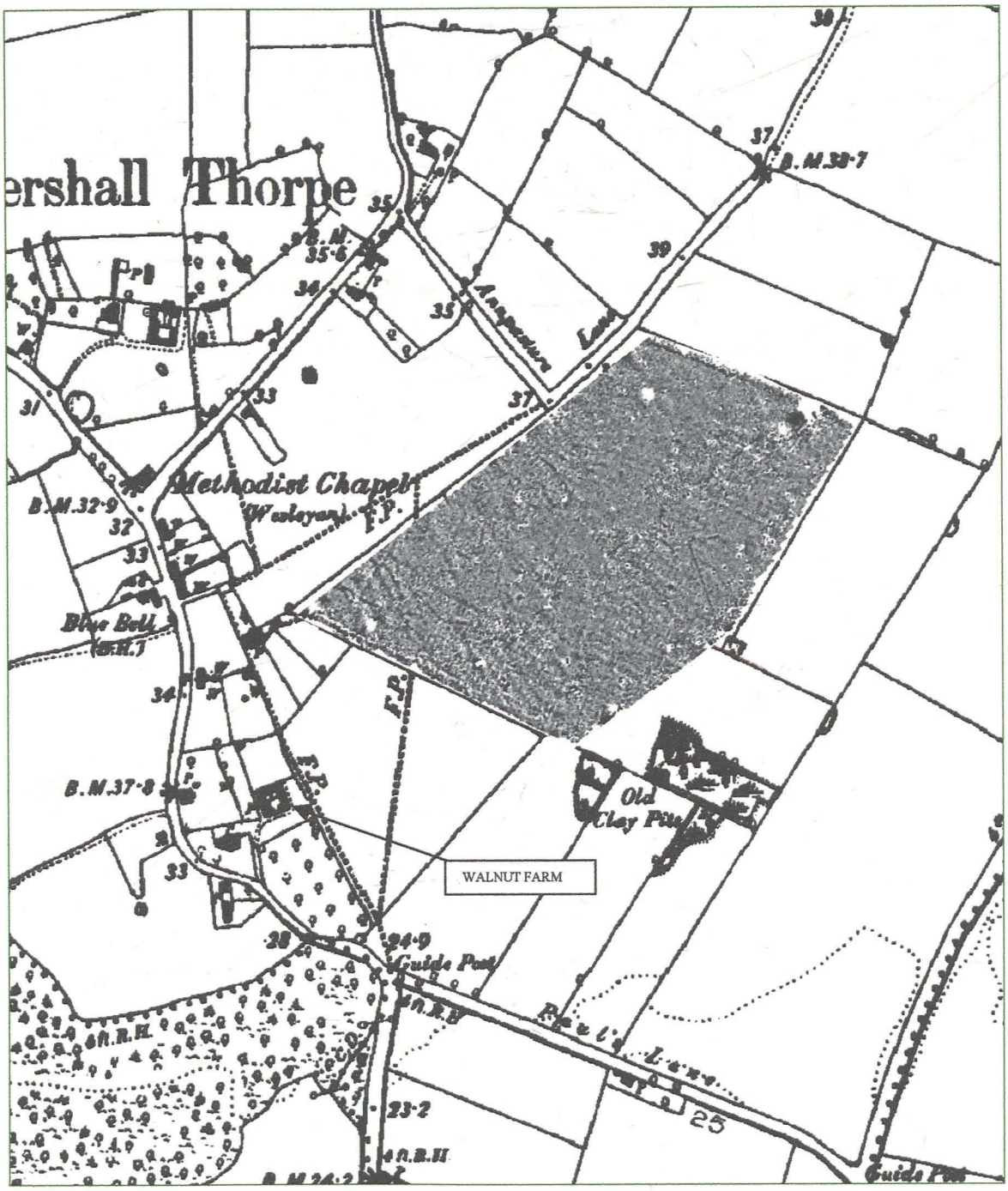


**Fig.3: Greyscale image superimposed over 1st edition Ordnance Survey Map (1881)**

## 5.0 **Results** (Figs. 2-7)

The survey detected a scatter of strong, ferrous-type, magnetic anomalies (examples circled in red), two of which correspond to metal bore-hole caps (**1-2**). A discrete zone of strong magnetic variation (**3**) was produced by a large set of modern disc harrows. An extensive linear anomaly (blue) along the north-eastern edge of the field corresponds to a compacted farm track.

The survey identified a wide range of anomalies that do not relate to any known features: magnetically strong dipolar/positive/negative anomalies (Figs.5, 7, examples circled in red) signify ferrous debris, such as horseshoes and ploughshares and other fragments of agricultural machinery. Some of these ferrous objects have induced linear distortion of the data (dark blue).

Weaker, though magnetically similar, examples could reflect small ferrous items, ceramic materials (e.g. brick/tile) or (on this site) iron concretions within the gravels. None of the latter was apparent in bore-hole samples (information supplied by Woodhall Spa Sand and Gravel Ltd). A spread of these types of anomalies occurs along the south-east edge of the survey (**4**), where a ditch defines the site boundary (Fig.2). They may denote materials excavated from the drain during maintenance.

Other discrete anomalies could be indicative of pits, or possibly increases in topsoil depth. It is also possible that some signify areas of burning. On the trace plot (Fig.5), the latter are distinguishable from the ferrous types by their smoother, and predominately magnetically positive, appearance (examples circled in blue).

Further processing, whereby the data was constrained within a narrow band of magnetic variation (+/-1 nanotesla), has enhanced the resolution of weaker anomalies. Their relative weakness possibly reflects a general lack of magnetic contrast between upper and underlying deposits (see Section 2.0).

These weaker features include a series of linear anomalies that were recorded in the southern part of the site. Elements of Group A (shown red) align in parallel and perpendicular fashion to the south-western, north-eastern and eastern boundaries of the site. This could imply that they represent remnants of a more complex field system. The first edition Ordnance Survey map of 1881 (figure 3) depicts land divisions within the small field that lies to the south-west of the survey. Elements of Group A may be traces of a former continuation of this smaller field system, for example, fragmented linear anomaly **5**. It is also possible that components of Group A (e.g. **6-8**) are merely cultivation scars (slight traces of cultivation were recorded across the site (examples shown purple)). Of these, anomaly group D share an alignment with the south-western and north-eastern field boundaries. It is tentatively suggested that another set of cultivation marks (D1) runs parallel to the eastern edge of the site (excluding the wooded area in the south-east corner that does not appear within the site boundaries on the early OS map). Neither group respects the current western boundary, which is an obvious modern cultivation baseline.

Elements of anomaly Group A cut, or are cut by, a series of parallel linear features (Group B, shown green). These probably indicate traces of ploughed out ridge and furrow. They do not align with any current boundaries and appear to extend beyond

the existing south-western boundary (see **9**). They align with a former path/track that once lay to the north of Walnut Farm (see Fig. 3 and front cover). Putative furrows **10** and **11** are curvilinear. This suggests that they are approaching a former headland that may have lain to the immediate south-west of the site. Faint traces of a similarly aligned linear (**12**) were detected to the immediate south-east of Annpasture lane. This feature appears in isolation, and it may reflect a former continuation of the lane (possibly as a field boundary) toward an area containing abandoned clay pits, which lies to the south-east of the site.

The survey detected a linear anomaly close to, and parallel with, the south-west edge of the field (orange). A short section of this feature appears to reflect a ditch that may have flanked the northern side of the boundary. This is shown clearly in the trace plot (Fig.5). It does not easily relate to the ridge and furrow and probably post-dates it.

A linear anomaly (**13**, green) was detected in the eastern part of the site. A second linear (**14**) may conjoin with this feature to form the corner of an L-shaped, (possibly enclosed) feature. This interpretation is offered tentatively, as the regular nature of **13** and its south-eastern projection toward a pond (as depicted on early and modern maps, figures 2 and 3), could indicate a relatively recent origin, possibly as a sub-surface drain rather than a formal land division.

A number of other ephemeral linear and curvilinear anomalies were recorded (Group C, shown as yellow). Linear **14** has been included in this group, given its uncertain relationship to linear anomaly **13** (see above). These anomalies cannot be reconciled to existing boundaries or features.

Linears **15** and **16** may be remnants of the same feature, possibly a ditch, although the resolution of **16** is poor. Other linear anomalies appear to occur in random fashion, and may include variations that have been induced by natural inconsistencies, particularly in the mid-western and northern parts of the site. Among the clearest is a 'U-shaped', partially enclosed, feature (**17**). Less apparent, and only tentatively flagged, is a barely discernable circular anomaly (**18**, approximately 30m in diameter) that was detected to the east of **17**.

## 6.0 Conclusions

A generally poor magnetic contrast between potentially significant geophysical anomalies and the soils across the site has prevented a clear interpretation of many of the features that were identified by the survey. However, the investigation has tentatively identified different phases of activity. Traces of what could represent the earliest occupation of the area may feature as a series of linear and circular anomalies (Group C). None of these appear to respect modern boundaries. Some exhibit minimal magnetic variation, and have been labelled with caution, as it is also possible that natural inconsistencies account for some of this variation.

Other features probably reflect traces of ridge and furrow ploughing: part of a system that may have extended beyond the current southern field boundary. They also align with a section of Annpasture lane.

The southern boundary (and possibly others beyond it) shares spatial characteristics with a third set of linear anomalies, most of which were recorded in the southern half of the field. These may have formed part of a smaller field system.

A number of discrete, localised anomalies (some grouped) may reflect pits. On this site, this may be evidence of flint or clay quarrying.

## 7.0 Acknowledgements

Pre-Construct Geophysics would like to thank Lindsey Archaeological Services for this commission.

## 8.0 References

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Clark, A. J. 1990 *Seeing beneath the soil.* London, Batsford.

David, A. 1995 Research & Professional Services Guidelines No **1**: *Geophysical Survey in Archaeological Field Evaluation. London,* English Heritage.

LAS 2003. Proposed Mineral Extraction on Land East of Annpasture Lane, Tattershall Thorpe, Lincolnshire**.** Archaeological Specification. Unpublished.

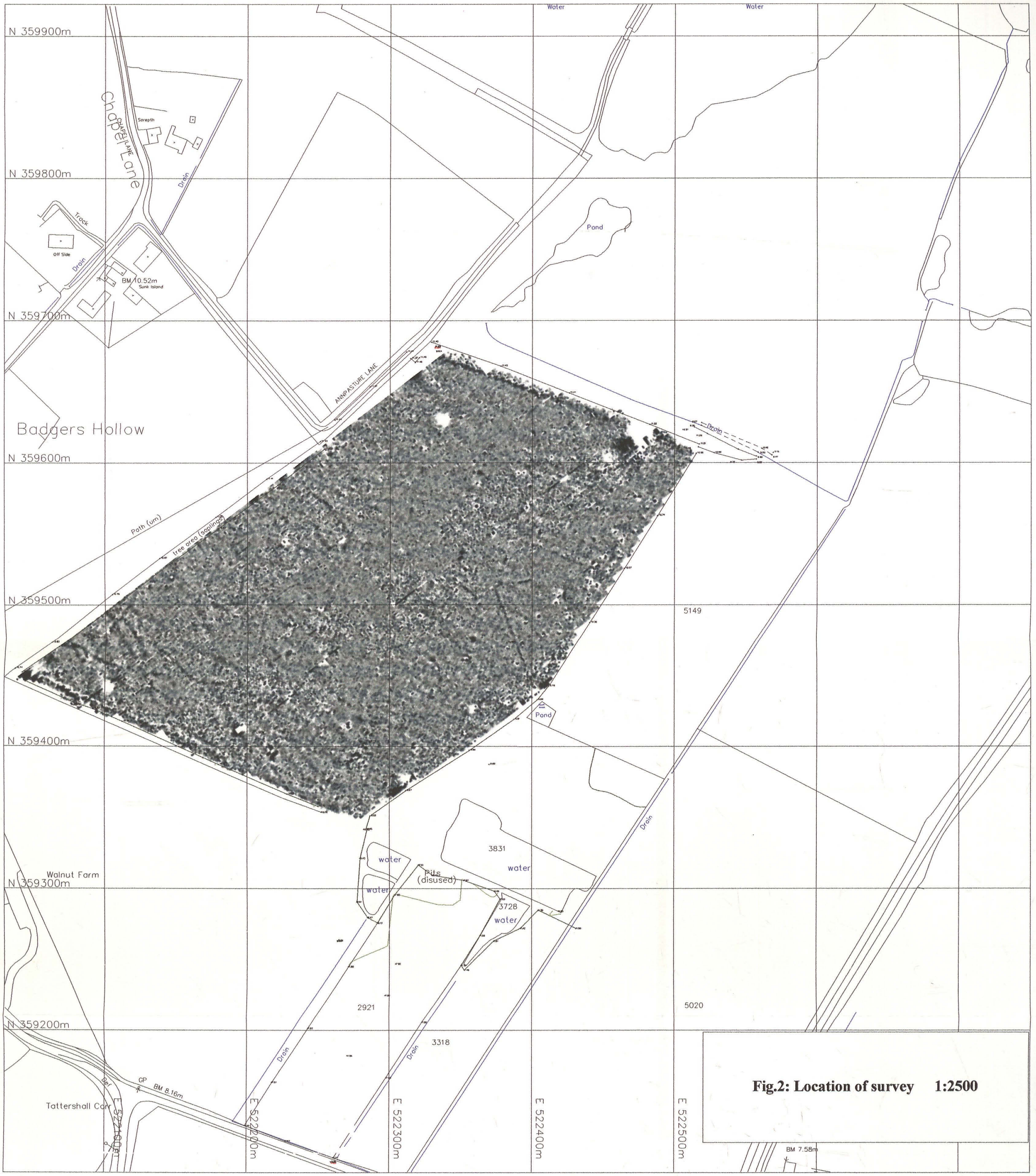



**Fig.2: Location of survey 1:2500**

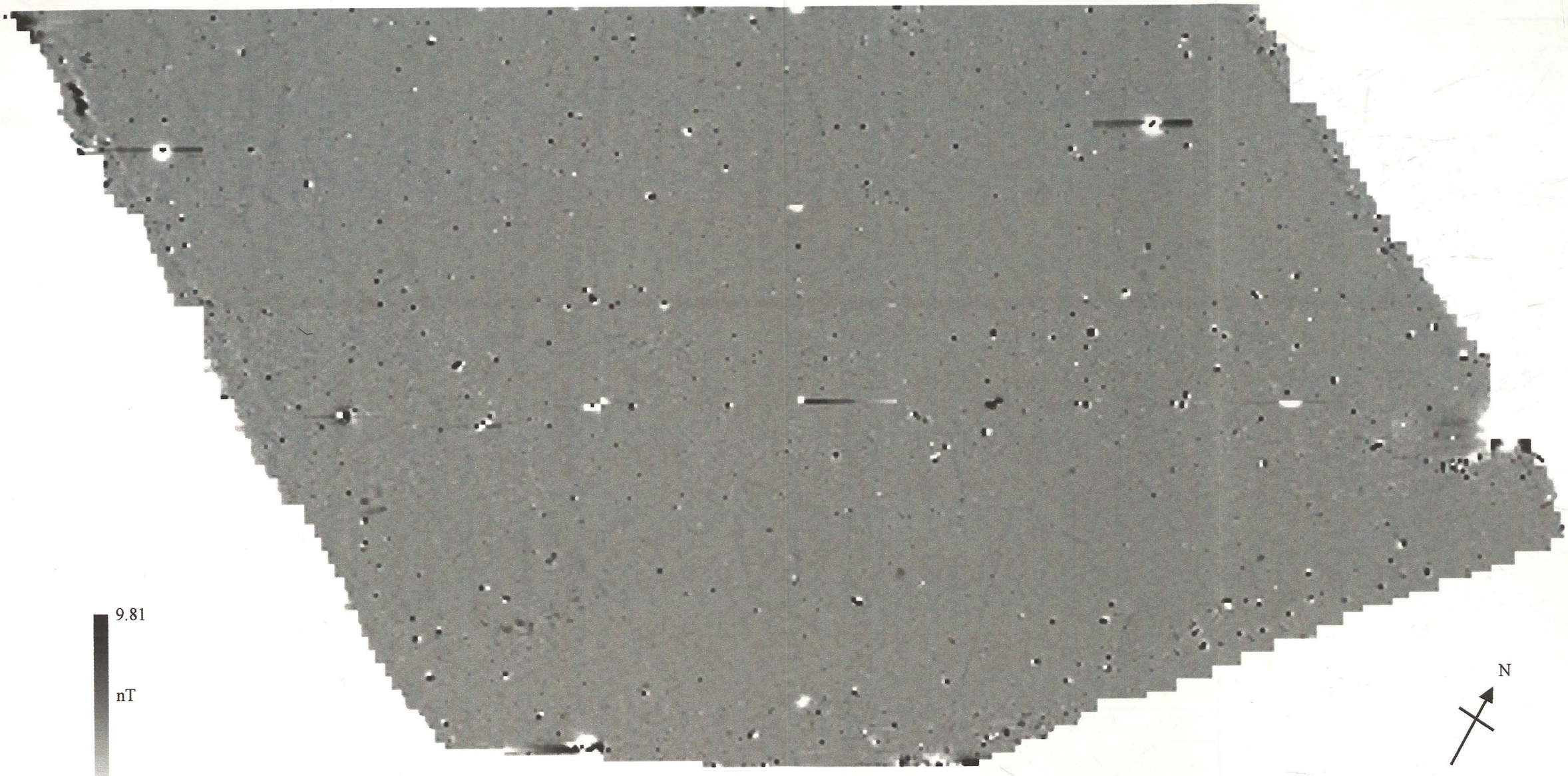



**Fig.4: Unclipped data 1:1250**

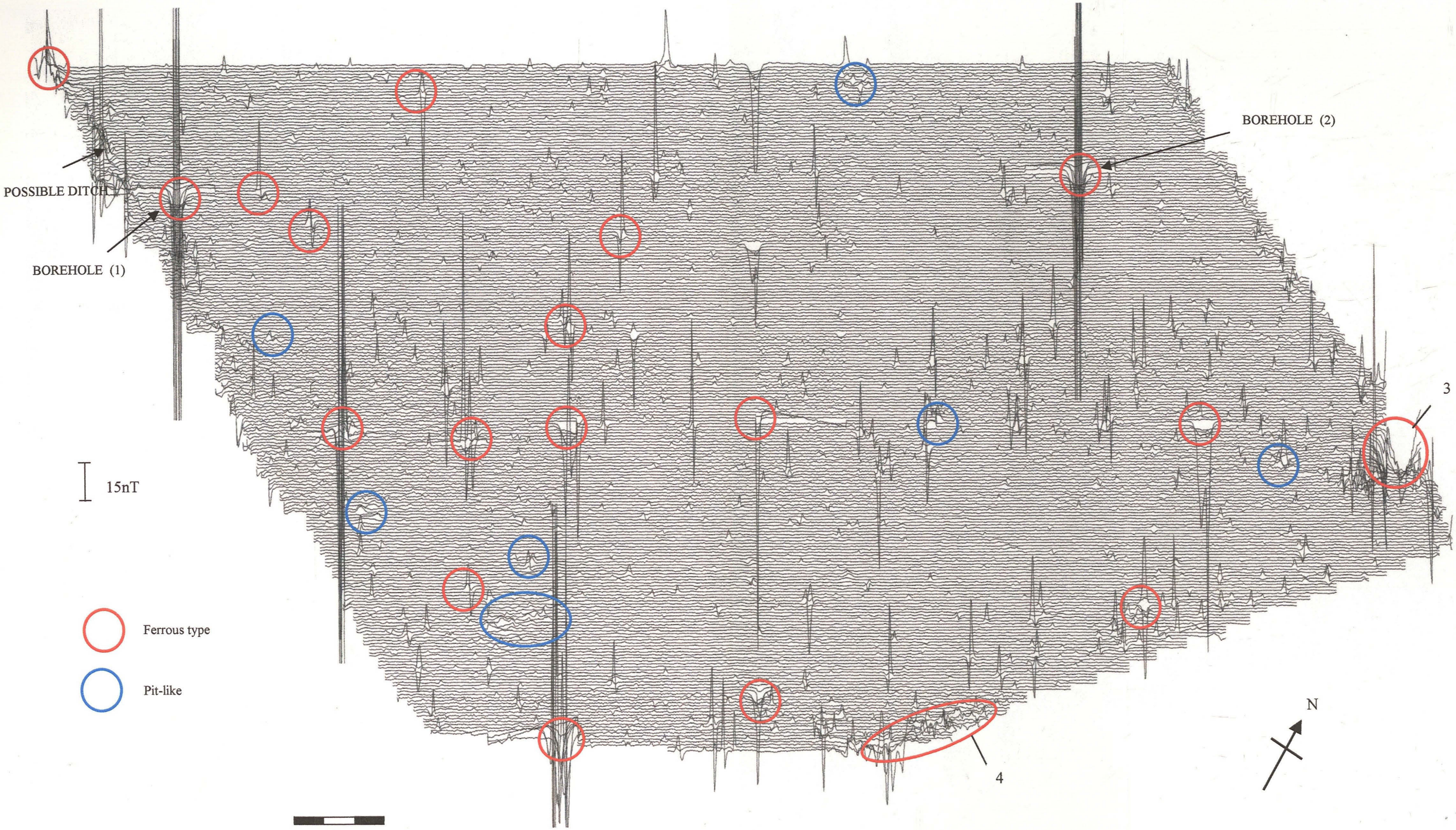



**Fig.5: Trace plot 1:1250**

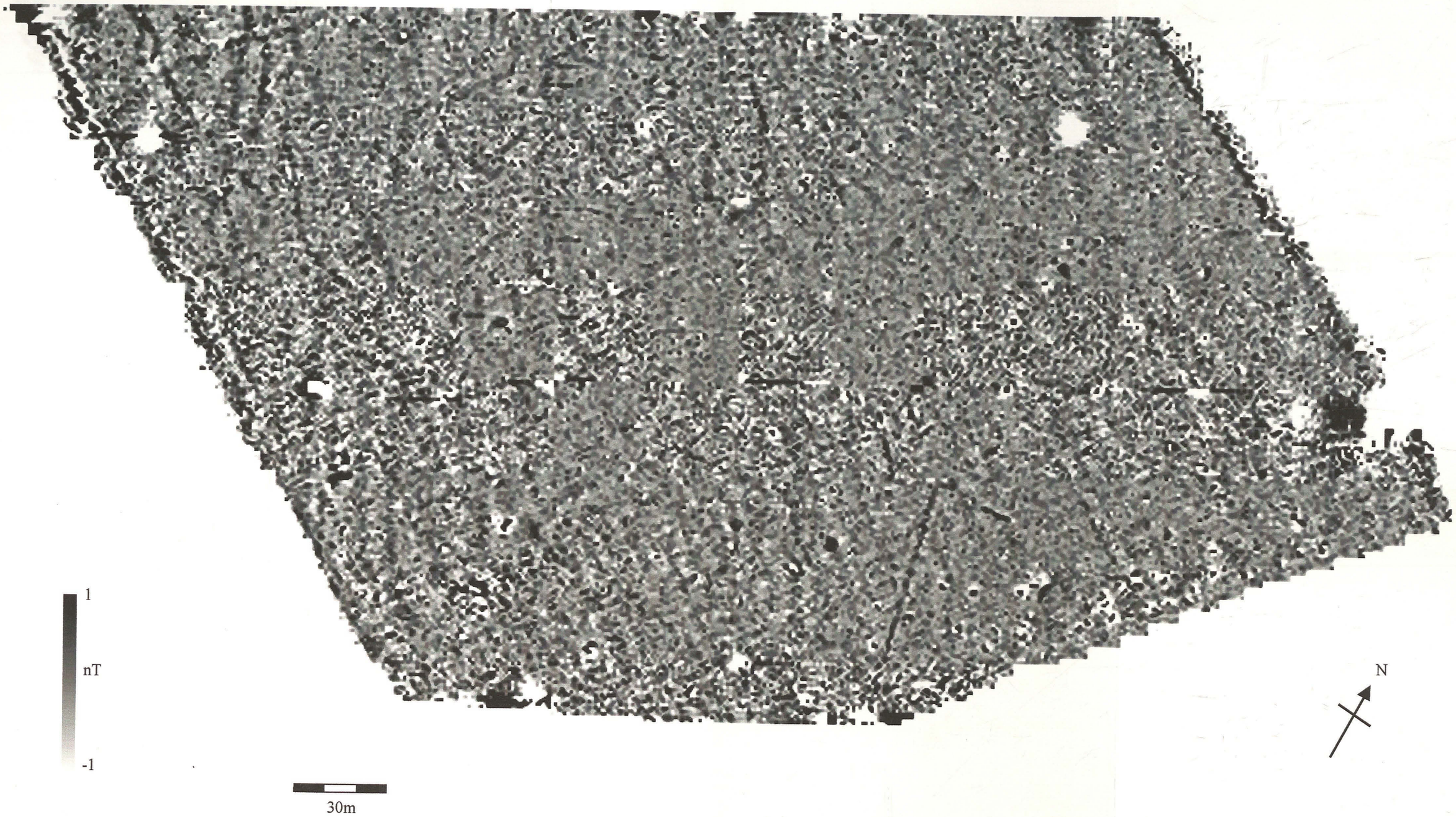
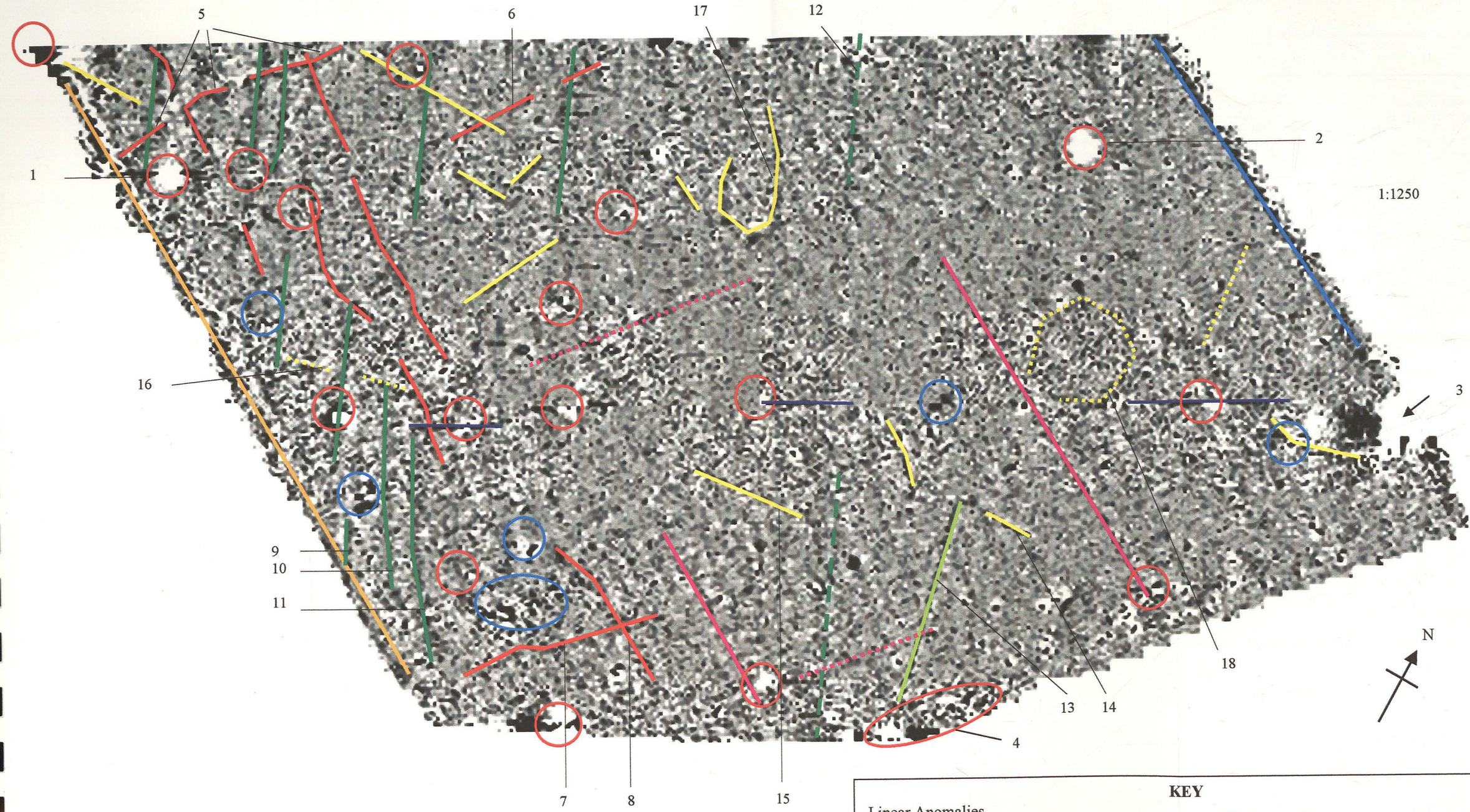



**Fig.6: Enhanced greyscale image 1:1250**




**KEY**

Linear Anomalies

Group A, Group C — Ditches/land divisions

Group B — Ridge and furrow ?Former track

Group D, Group D1 — Other traces of cultivation

Track (Modern)

Discrete Anomalies

Ferrous type + distorting effects of

Pit-like

**Fig.7: Interpretive image 1:1250**