



ARCHAEOLOGICAL  
SERVICES  
WYAS

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**Nosterfield Gravel Quarry**  
**Nosterfield**  
**North Yorkshire**

*Gradiometer Survey*

*July 1997*

CLIENT

**Mike Griffiths & Associates**

**Nosterfield Gravel Quarry,  
Nosterfield,  
North Yorkshire.**

*Gradiometer Survey*

*by*

*Alistair Webb BA*

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# **Nosterfield Gravel Quarry,**

**Nosterfield.**

**(SE 286 805 centred)**

## *Gradiometer Survey*

### **1. Summary**

#### *Client*

Mike Griffiths & Associates  
Consulting Archaeologists  
57 Langholm Crescent  
Darlington  
County Durham  
DL3 7SX.

#### *Objectives*

To gather sufficient information to establish the location and extent of any archaeological features (particularly pits) within the proposal area, and, where possible, to characterise the archaeology located in this way.

#### *Method*

To achieve these objectives a detailed gradiometer survey was carried out over a 1 hectare area using a Geoscan FM36 fluxgate gradiometer.

#### *Results and Conclusions*

The gradiometer survey identified three responses which it was thought could be caused by pits as well as an area of enhanced magnetic response. A negative linear anomaly was also identified. This is probably caused by a plastic service pipe.

## **2. Introduction & Archaeological Background**

**2.1** Archaeological Services (WYAS) was commissioned by Mike Griffiths and Associates, Consulting Archaeologists, to carry out a gradiometer survey on a 1ha site at Nosterfield Gravel Quarry, operated by RMC/Tilcon Ltd., in advance of the projected expansion of the extraction area.

**2.2** The quarry lies about 1km east of Nosterfield to the north of the B6267 in a particularly rich archaeological landscape. Three aligned henge earthworks lie immediately south of the quarry, south and west of the village of Thornborough, and there are numerous other tumuli in the immediate vicinity indicating the importance of the area in prehistory. Within the quarry site itself previous excavations revealed a prehistoric pit alignment which it was thought might continue into the current application area.

**2.3** The aim of the survey was twofold; firstly to see if gradiometry was an appropriate evaluation technique on gravel geology and secondly to see whether discrete archaeological features, such as pits, could be identified.

**2.4** At the time of survey, March 18th 1997, the site was under short grass.

## **3. Results & Discussion**

### ***3.1 The Presentation of the Results***

**3.1.1** The gradiometer data is presented as a greyscale plot overlain on a 1:1250 plot of the site survey in Figure 2 and in dot density and X-Y trace formats at a scale of 1:500 in Figures 3 and 4. The data is interpreted in Figure 5.

### ***3.2 The Gradiometer Survey (Figs 3 & 4)***

**3.2.1** The most obvious anomalies in the magnetic data are the isolated positive/negative (dipolar) responses which are common across the whole site. These responses are caused by ferrous material on the ground surface and in the topsoil. They are not normally archaeologically significant.

**3.2.2** Three isolated responses have been identified which it is thought could reflect discrete features such as pits. These anomalies differ from "iron spikes" in that the response is positive, not dipolar, and is often seen on more than one traverse ("iron spikes" are generally only detected on one traverse). The positive response is due to the fill of the feature having a higher magnetic susceptibility than the surrounding topsoil.

**3.2.3** A more general area of enhanced susceptibility has also been detected. This probably reflects an area of burning.

**3.2.4** One negative, curvi-linear, anomaly has been detected at the far eastern edge of the site. This is probably due to a plastic service pipe.

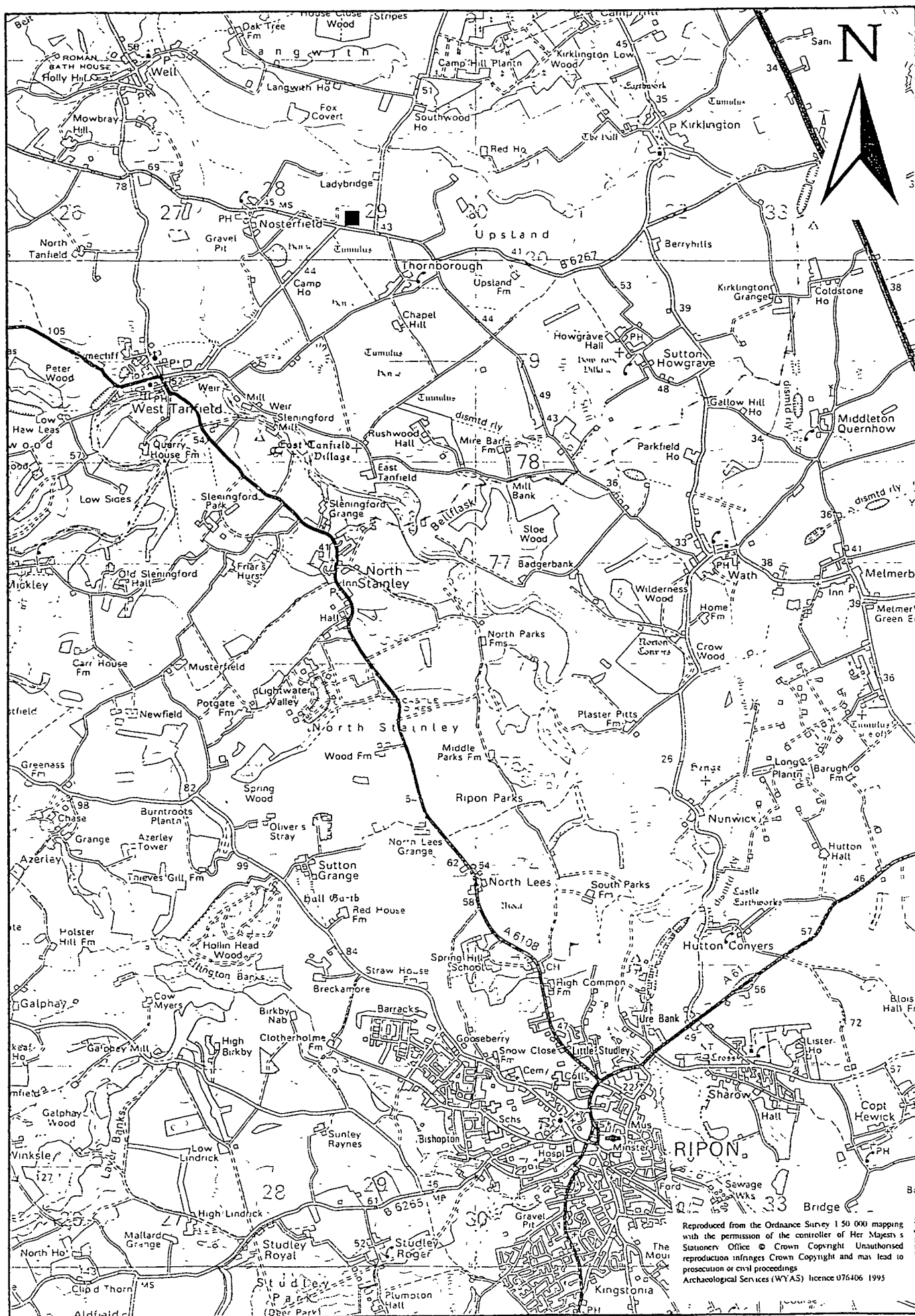


Fig. 1 Site location

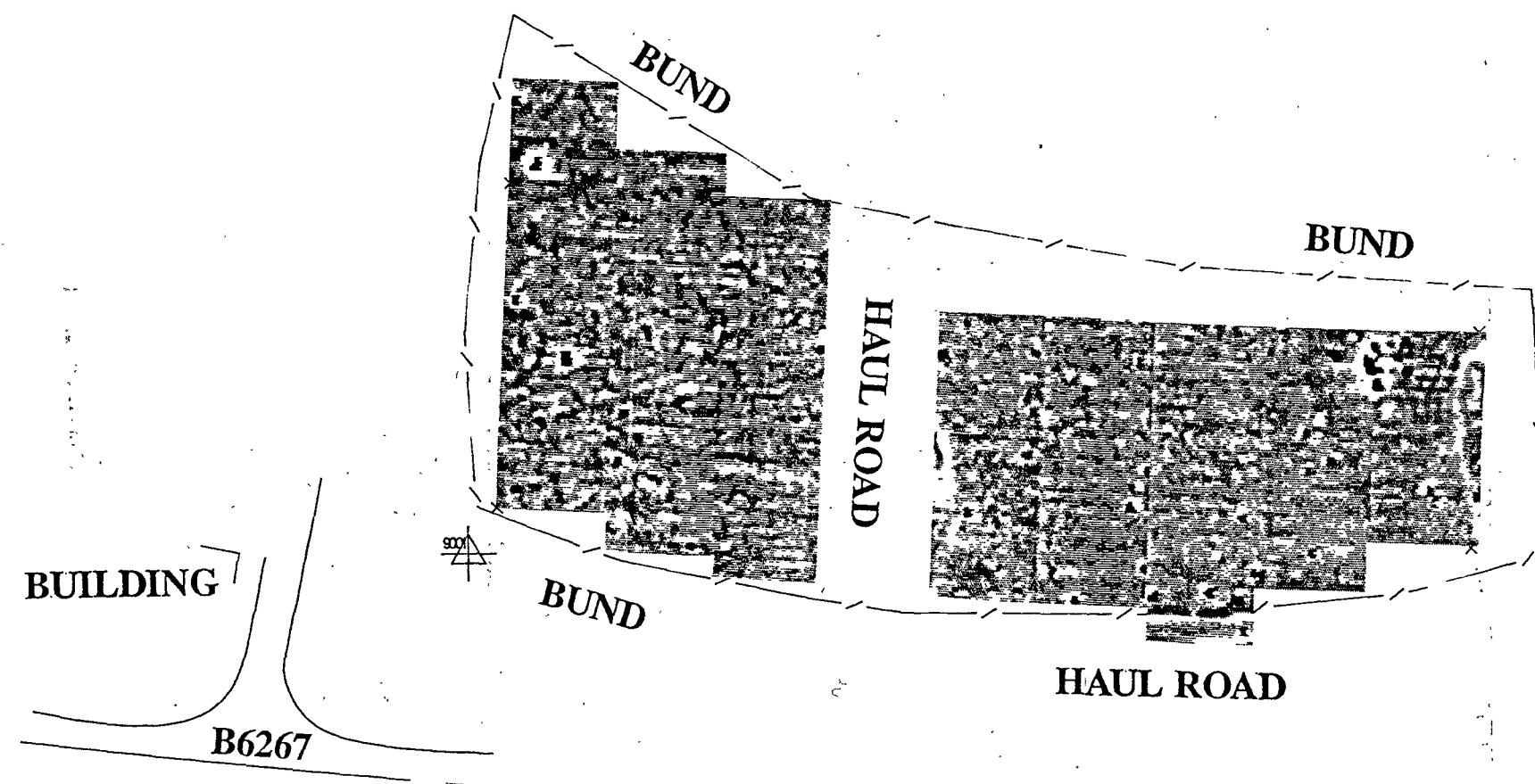


Fig. 2 Site location showing gradiometer data



Fig. 3 Dot density plot of the gradiometer data

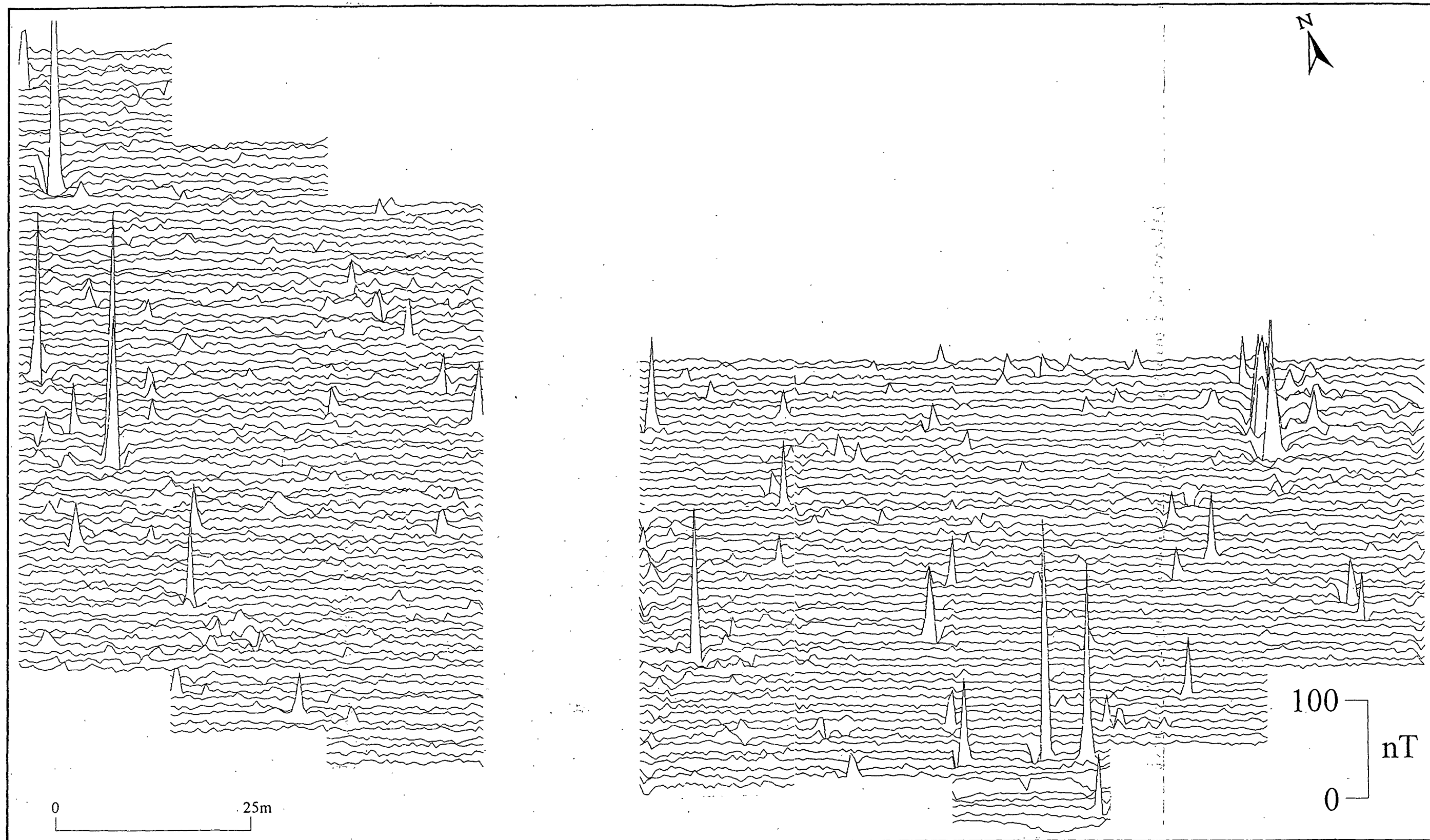


Fig. 4 X-Y trace plot of the gradiometer data



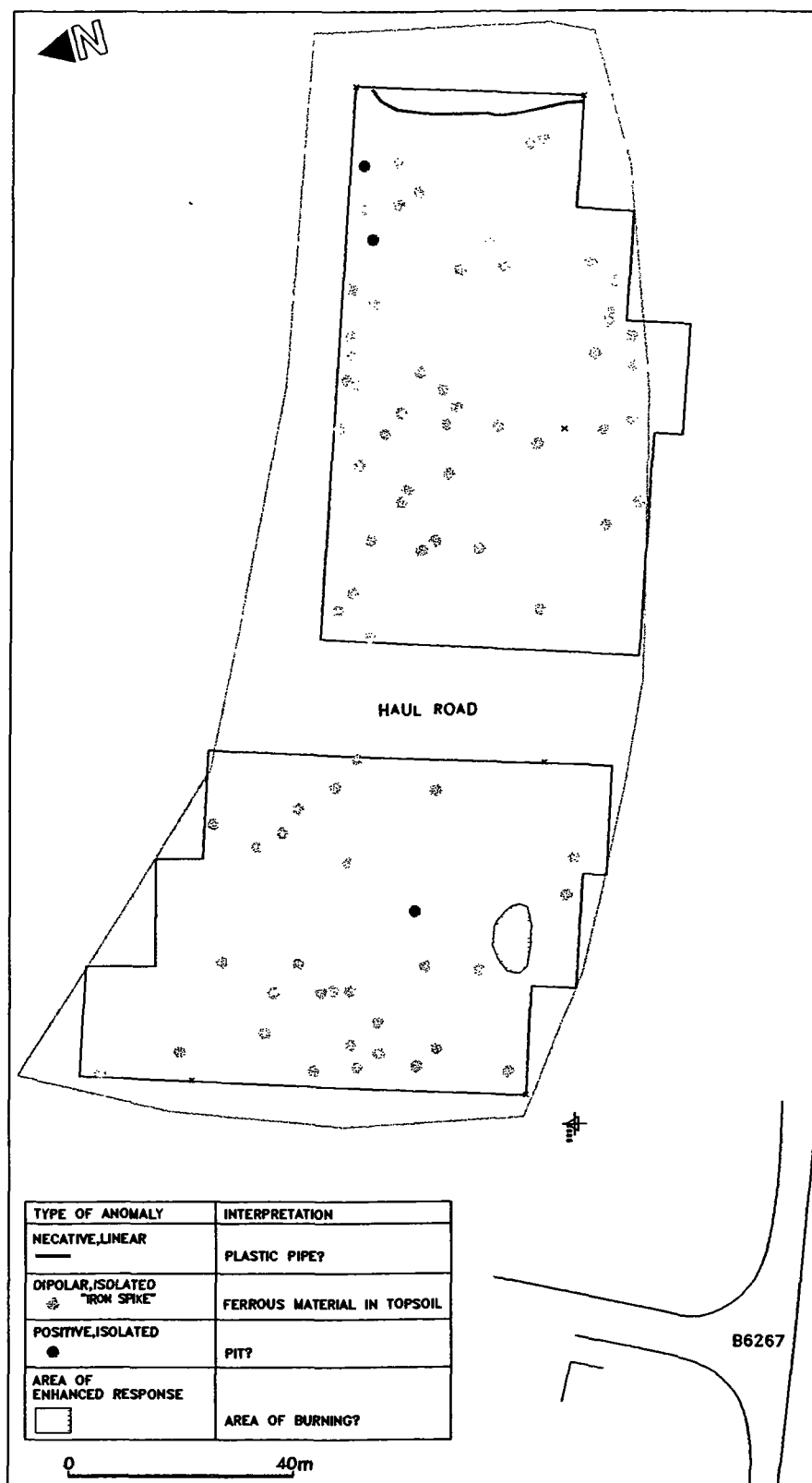


Fig.5 Interpretation of gradiometer data

## **4. Conclusion**

**4.1** The gradiometer survey has shown that both discrete and linear features can be detected on a gravel substrate.

**4.2** The isolated positive anomalies could be pit features.

*The results and subsequent interpretation of geophysical surveys should not be treated as an absolute representation of the underlying archaeology. It is normally only possible to prove the archaeological nature of anomalies through intrusive means such as by trial excavation.*

## **Acknowledgements**

Project Management: A. Webb BA

Geophysical Survey: J. Nicholls BA MSc, A. Webb BA

Report: A. Webb BA

Graphics: H. Boyd HND  
July 1997

## **Appendix**

*Appendix 1* Gradiometer Survey: technical information & methods

# Appendix 1

## Gradiometer Survey: technical information & methods

### 1. *Technical Information*

1.1 Iron makes up about 6% of the Earth's crust mostly dispersed through soils, clays and rocks as chemical compounds which are weakly magnetic. Human activities can redistribute these compounds and change (enhance) others into more magnetic forms. These anthropogenic processes result in small localised anomalies in the Earth's magnetic field which are detectable by a gradiometer.

1.2 In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of the topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic (iron minerals) to concentrate in the topsoil thereby making it more magnetic than the subsoil or bedrock. Linear features cut into the subsoil or solid geology, *e.g* ditches, that have silted up or been backfilled with topsoil will produce a positive magnetic response relative to the background soil levels. Discrete features such as pits can also be detected. Less magnetic material such as masonry or plastic service pipes which intrude into the topsoil will give a negative magnetic response relative to the general background level.

1.3 The magnetic susceptibility of the soil can also be enhanced significantly by heating. This can lead to the detection of features such as hearths or kilns.

1.4 The highest responses are usually due to iron objects in the topsoil. These produce a response characterised by a rapid change from positive to negative readings (iron "spikes").

1.5 The types of response mentioned above can be divided into the five main categories which are described below:

1.     **Iron Spikes (Dipolar Anomalies)**  
These responses are referred to as dipolar and are caused by buried iron objects. Little emphasis is usually given to such responses as iron objects of recent origin are common on agricultural sites.
2.     **Rapid, strong variations in magnetic response**  
Also referred to as areas of magnetic disturbance these can be due to a number of different types of feature. They are usually associated with burnt material such as industrial waste or other strongly magnetic material. It is not always easy to determine their date of origin without supporting information.

3. **Positive, linear responses**  
The strength of these responses varies depending on the underlying geology. They are commonly caused by ancient ditches or by more recent field drains.
4. **Isolated positive responses**  
These exhibit a magnitude of between 2nT and 300nT and, dependent on the strength of their response, can be due to pits, hearths, ovens or kilns. They can also be due to natural features on certain geologies. It is, therefore, very difficult to establish an anthropogenic origin without an intrusive means of examining the features.
5. **Negative linear anomalies**  
These are normally very faint and are commonly caused by features such as plastic water pipes which are much less magnetic than the surrounding soils and geology. They too can be caused by natural features on some geologies.

## **2. Methodology**

2.1 There are two methods of using the fluxgate gradiometer. The first of these is referred to as *scanning* and requires the operator to visually identify anomalous responses on the instrument display whilst covering the site in widely spaced traverses, typically 10m - 15m. The instrument logger is not used and there is therefore no data collection. This method is used as a means of selecting areas for detailed survey when only a percentage sample of the whole site is to be surveyed. Scanning can also be used to map out the full extent of features located during a sample detailed survey.

2.2 The second method is termed *detailed survey* and this employs the use of a sample trigger to automatically take readings at predetermined points, typically at 0.5m intervals, on zig-zag traverses usually 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation. This method was employed during the survey.

2.3 A Geoscan FM36 fluxgate gradiometer and ST1 sample trigger was used to take readings at 0.5m intervals on zig-zag traverses 1m apart within grids measuring 20m by 20m, 800 readings therefore being taken within each 20m grid square. In-house software (Geocon Version 9) was used to interpolate the "missing" line of data so that 1600 readings in total were obtained for each complete grid.