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**Chollerford Recreation Ground  
Chollerford  
Northumberland**

**Geophysical Survey**

Report no. 2436

February 2013

Client: Riverside Group



# Chollerford Recreation Ground

## Chollerford

## Northumberland

### Geophysical Survey

#### *Summary*

*A geophysical (magnetometer) covering approximately 0.5 hectares was carried out adjacent to the George Hotel, Chollerford in advance of the determination of a planning application for a proposed housing development. The data is characterised by very strong magnetic responses indicative of ferrous contamination and geological variation. No anomalies of archaeological potential have been identified and therefore, based on the results of the survey, the site is considered to have a low archaeological potential.*



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## Report Information

Client: Riverside Group  
Address: Riverside Consultancy Services, 2 Estuary Boulevard, Estuary  
Commerce Park, Speke, Liverpool, L24 8RF  
Report Type: Geophysical survey  
Location: Chollerford  
County: Northumberland  
Grid Reference: NY 9195 7070  
Period(s) of activity:  
represented  
Report Number: 2436  
Project Number: 4016  
Site Code: CHN12  
OASIS ID: archaeol11-143575  
Planning Application No.: pre-application  
Museum Accession No.: n/a  
Date of fieldwork: February 1st 2013  
Date of report: February 2013  
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Fieldwork: David Harrison BA MSc MIfA  
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Authorisation for  
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## **1 Introduction**

Archaeological Services WYAS was commissioned by Paul Elliott of Anthony Watson Chartered Architects on behalf of their client, Riverside Group, to carry out a geophysical (magnetometer) survey in Chollerford, Northumberland (see Fig. 1) in advance of the submission of a planning application for a residential housing development at the site. The work was undertaken in accordance with guidance contained within the National Planning Policy Framework (2012), paragraph 128, and in line with current best practice. The survey was carried out on February 1st 2013.

### **Site location, topography and land-use**

The proposed development area (PDA) is situated in Chollerford immediately to the north of the George Hotel, which bounds the site to the south, and within 100m of the River North Tyne. The PDA comprised an irregular shaped block of land, centred at NY 9195 7067, approximately 0.5 hectares in extent which was not cultivated at the time of survey and which comprised tussocky short grass, partially overgrown in places (see plates). Recent mapping suggests that at least the northern part of the site has been used as a recreation ground until relatively recently. The site was flat at approximately 54m above Ordnance Datum.

### **Geology and soils**

The underlying bedrock geology comprises sandstones of the Alston Formation overlain by superficial deposits of river terrace deposits of silt, sand and gravel (British Geological Survey 2013). The soils are classified in the Nercwys association which are described as deep, fine loams with slowly draining subsoils (Soil Survey of England and Wales 1983).

## **2 Archaeological background**

An archaeological desk-based assessment (Welsh 2012) carried out by AAG Archaeology reported that there no known archaeological remains within the site boundary. Two cropmark enclosures, one at Chesters and one 100m north-east of the PDA, suggest prehistoric activity in the vicinity. However, the main archaeological potential of the site derives from its location on the military road from Carlisle to Newcastle adjacent to a river which makes Chollerford a possible location for a Roman military camp; the Roman fort at Chesters lies approximately 1km to the west of the PDA.

## **3 Aims, Methodology and Presentation**

The general objective of the geophysical survey was to provide information about the presence/absence, character, and extent of any archaeological remains within the PDA that

will be impacted by the proposed development and therefore to help inform further strategies should they be required.

In order to achieve these aims detailed (recorded) magnetometer survey was carried out over the whole of the PDA that was suitable for survey, an area of approximately 0.5 hectares.

### **Magnetometer survey**

Bartington Grad601 magnetic gradiometers were used during the survey taking readings at 0.25m intervals on zig-zag traverses 1m apart within 30m by 30m grids so that 3600 readings were recorded in each grid. These readings were stored in the memory of the instrument and later downloaded to computer for processing and interpretation. Geoplot 3 (Geoscan Research) software was used to process and present the data. Further details are given in Appendix 1.

### **Reporting**

A general site location plan, incorporating the 1:50000 Ordnance Survey map is shown in Figure 1. A larger scale (1:1000) plan showing the magnetometer data is presented in Figure 2. The data are presented in greyscale, XY trace plot and interpretation formats in Figures 3, 4 and 5 at a scale of 1:500.

Technical information on the equipment used, data processing and survey methodologies are given in Appendix 1 and Appendix 2. Appendix 3 describes the composition and location of the site archive.

The geophysical survey methodology, report and any recommendations comply with guidelines outlined by English Heritage (David *et al.* 2008) and by the Institute for Archaeologists (IfA 2010). All figures reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

*The figures in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All figures are presented to most suitably display and interpret the data from this site based on the experience and knowledge of Archaeological Services staff.*

## **4 Results and Discussion** (see Figs 3, 4 and 5)

### **Ferrous anomalies**

Ferrous anomalies, either as individual 'spikes' or more extensive areas of magnetic disturbance, are typically caused by ferrous (magnetic) debris, either on the ground surface or

mixed in with the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as ferrous debris is common on rural sites, often being present as a consequence of manuring or tipping/infilling. On this site the data is dominated by areas of magnetic disturbance along the southern and western edge of the site with a third in the centre of the survey area. This magnetic disturbance is likely to be caused by a combination of the proximity of the buildings and structures to the immediate south of the survey area, ferrous material in the boundaries themselves and possible ground disturbance.

### **Geological anomalies**

Throughout the site broader areas of enhanced magnetic response have been identified. These anomalies are either interpreted as geological in origin, being due to variation in the composition of the soils and superficial river terrace deposits, specifically the presence of magnetic gravels and river cobbles.

## **5 Conclusions**

It is always difficult to accurately interpret the data and assess the archaeological potential of relatively small sites. On this site the extent of the magnetic disturbance, which will potentially 'mask' the much weaker response from any archaeological features, if present, makes interpretation and assessment even more problematic. The strong responses caused by the river terrace deposits are another complicating factor. Nevertheless no anomalies of archaeological potential have been identified by the survey and on this basis the archaeological potential of the site is assessed as low. However, it should be recognised that the site is situated in a landscape of high archaeological potential and therefore some archaeological potential cannot be dismissed.

### ***Disclaimer***

***The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits.***



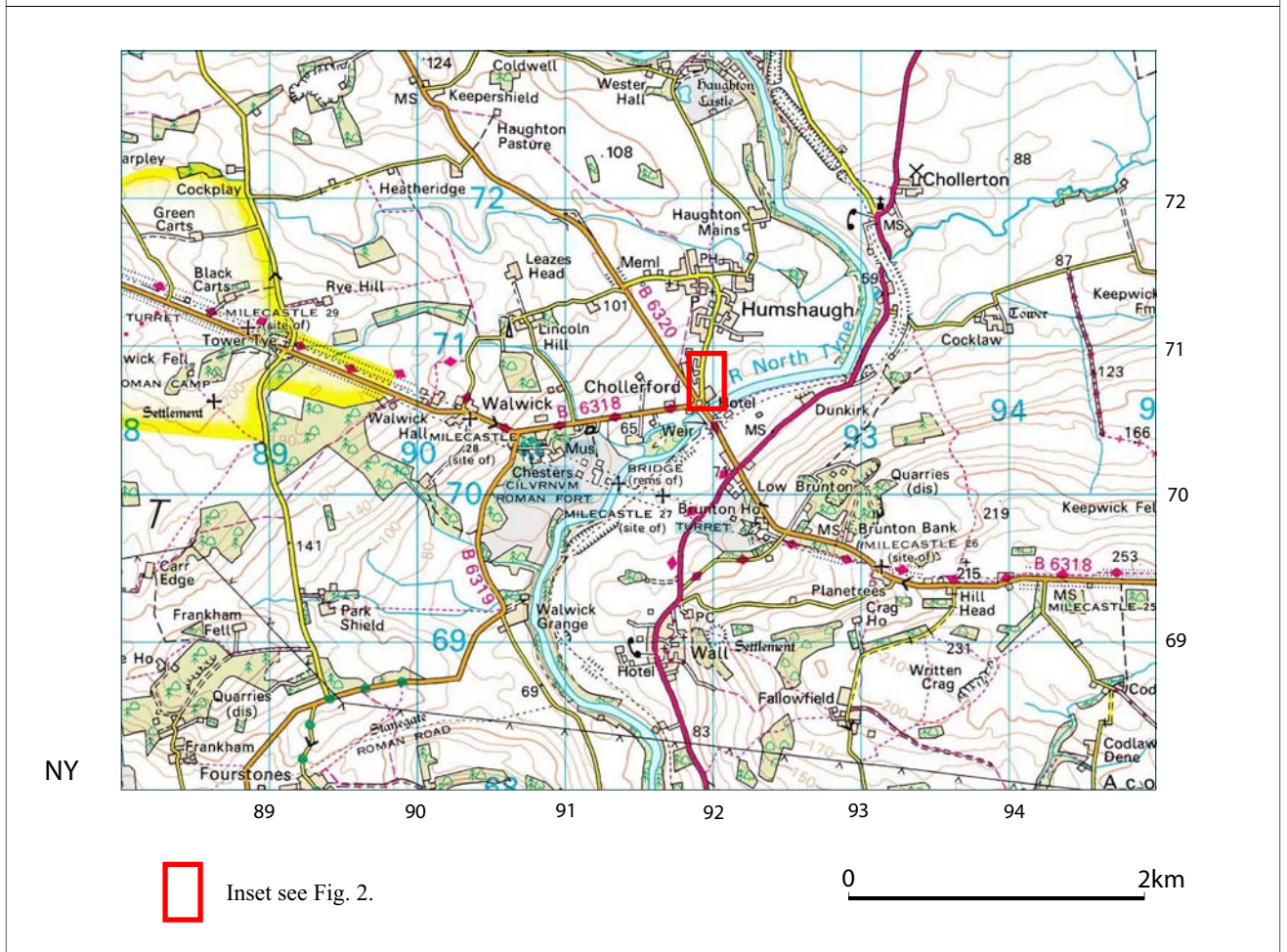
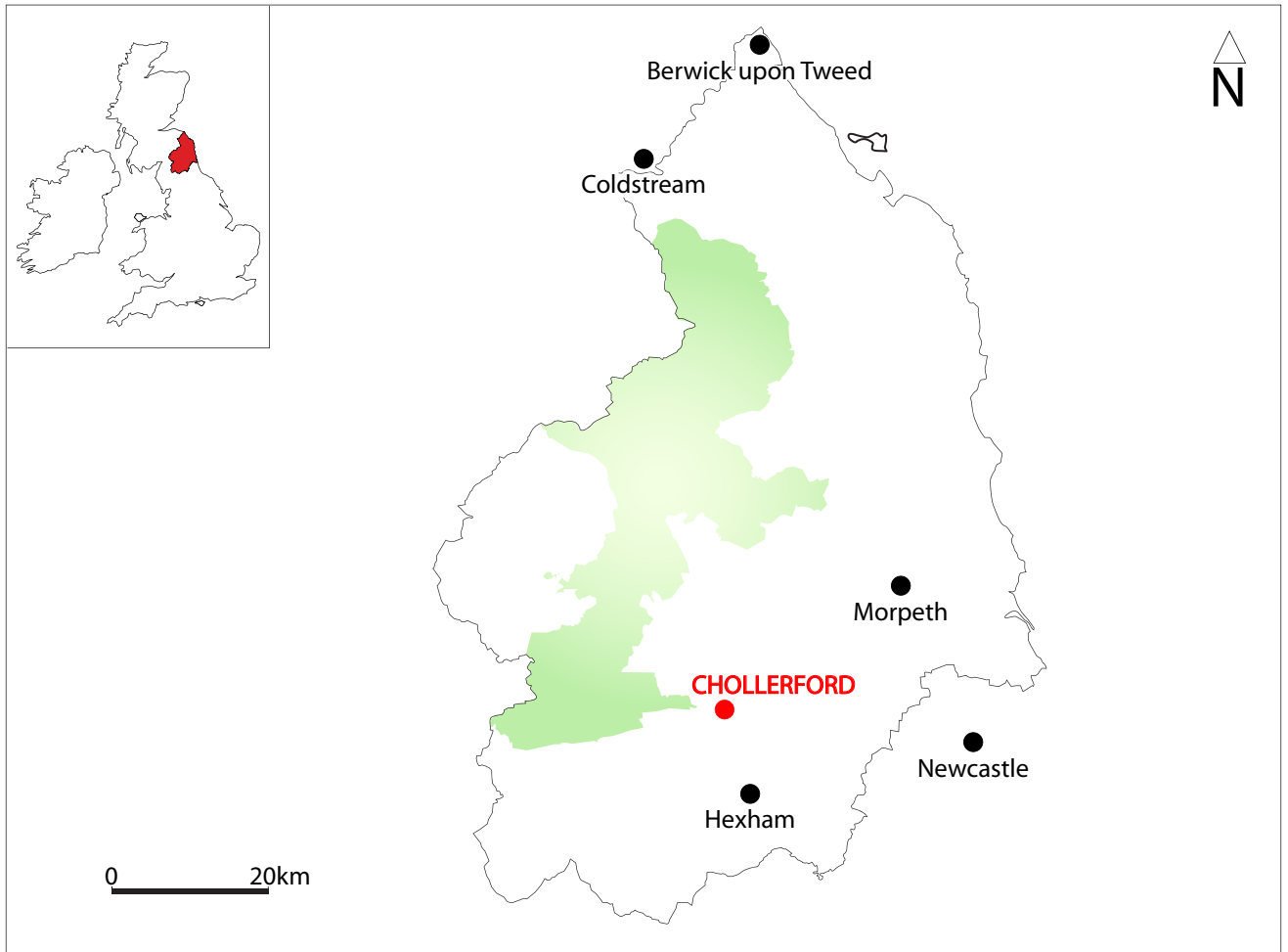


Fig. 1. Site location

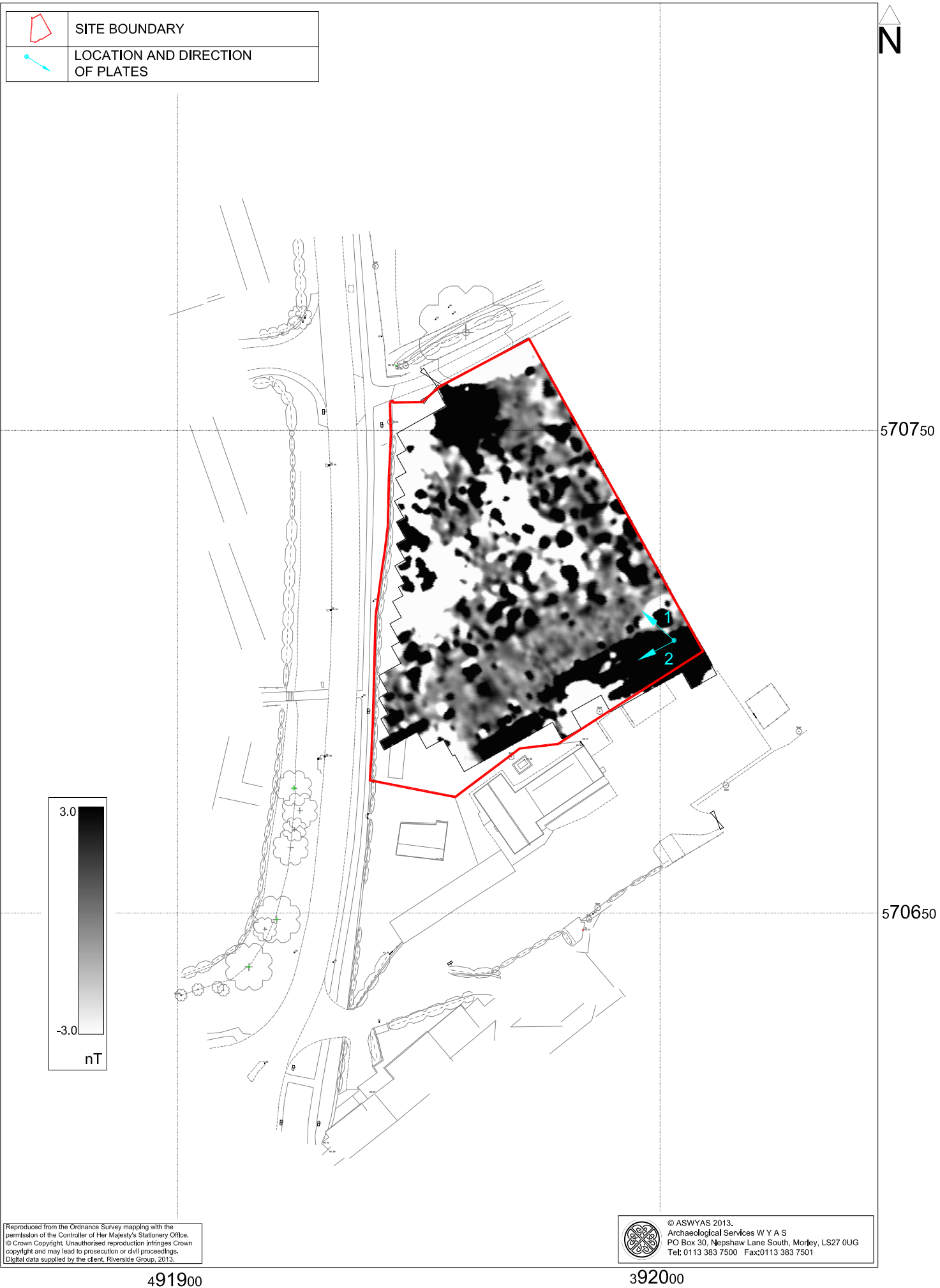


Fig. 2. Site location showing greyscale magnetometer data (1:1000 @ A4)

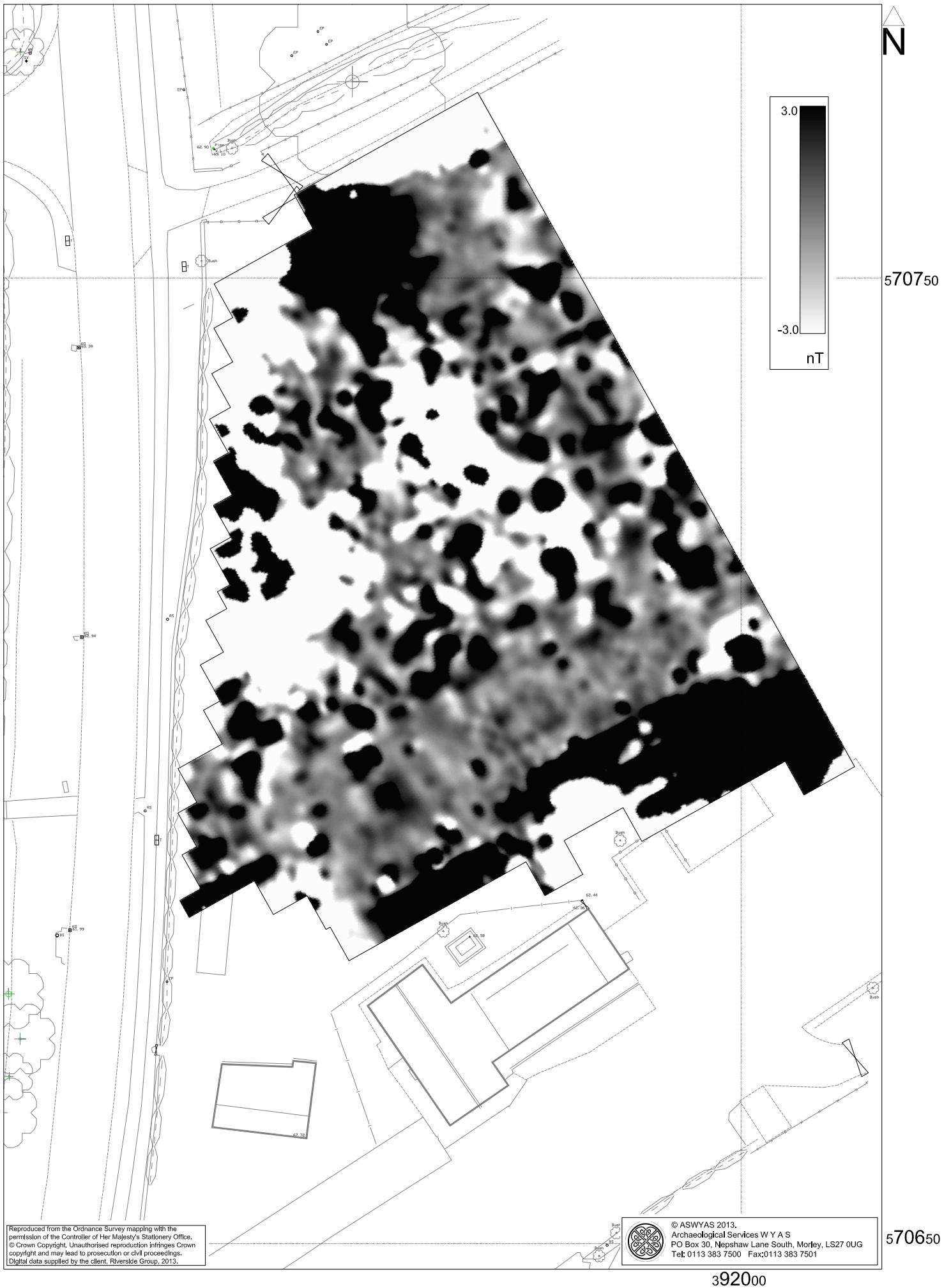


Fig. 3. Processed greyscale magnetometer data (1:500 @ A4)





Fig. 4. XY trace plot of minimally processed magnetometer data (1:500 @ A4)

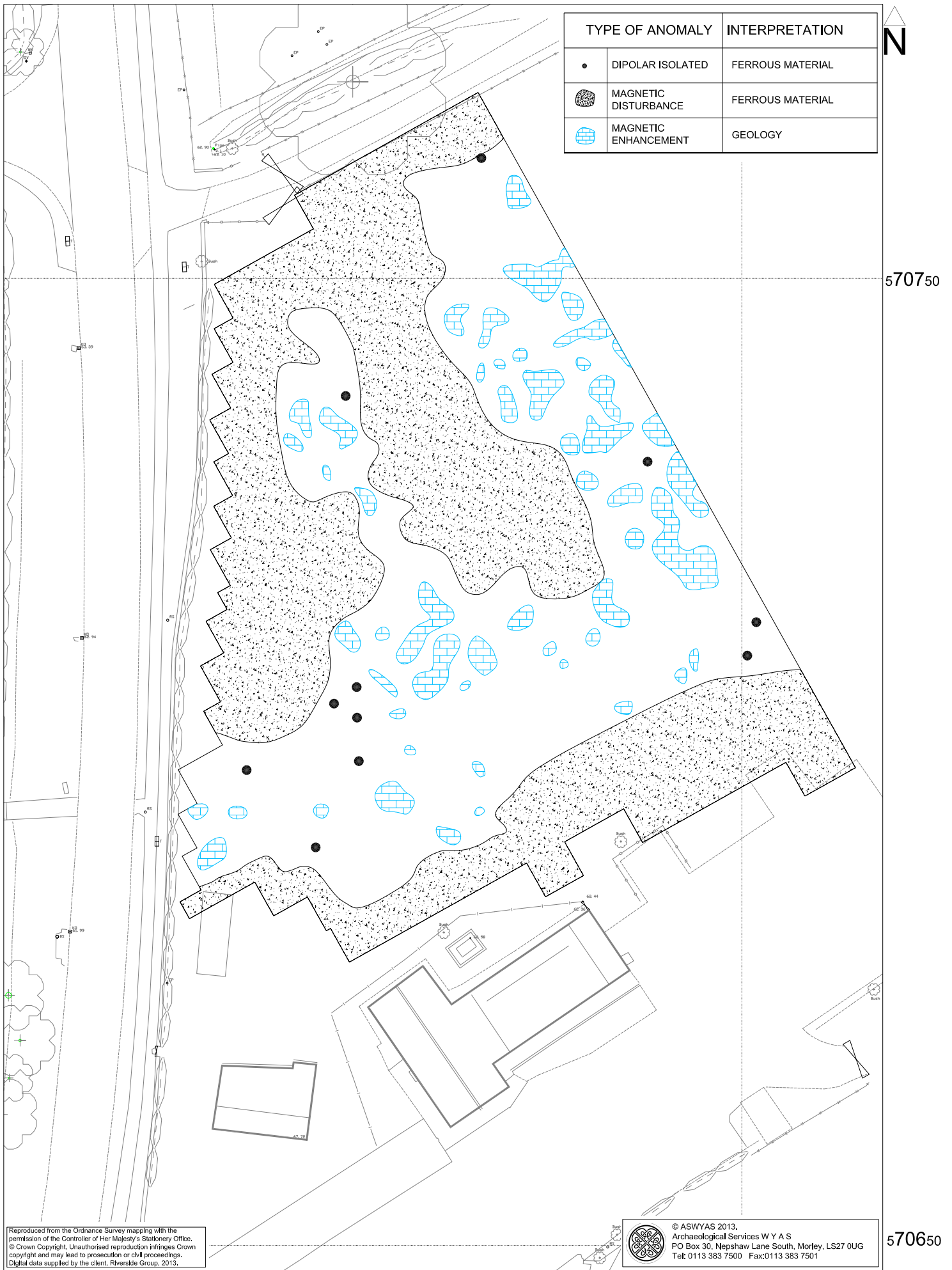


Fig. 5. Interpretation of magnetometer data (1:500 @ A4)

0 10m



*Plate 1. General view of survey area, looking north-west*



*Plate 2. General view of survey area, looking south-west*



## **Appendix 1: Magnetic survey - technical information**

### **Magnetic Susceptibility and Soil Magnetism**

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

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 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 ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. The magnetic susceptibility of a soil can also be enhanced by the application of heat and the fermentation and bacterial effects associated with rubbish decomposition. The area of enhancement is usually quite large, mainly due to the tendency of discard areas to extend beyond the limit of the occupation site itself, and spreading by the plough. An advantage of magnetic susceptibility over magnetometry is that a certain amount of occupational activity will cause the same proportional change in susceptibility, however weakly magnetic is the soil, and so does not depend on the magnetic contrast between the topsoil and deeper layers. Susceptibility survey is therefore able to detect areas of occupation even in the absence of cut features. On the other hand susceptibility survey is more vulnerable to the masking effects of layers of colluvium and alluvium as the technique, using the Bartington system, can generally only measure variation in the first 0.15m of ploughsoil.

### **Types of Magnetic Anomaly**

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

#### *Isolated dipolar anomalies (iron spikes)*

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

#### *Areas of magnetic disturbance*

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

#### *Linear trend*

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

#### *Areas of magnetic enhancement/positive isolated anomalies*

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

#### *Linear and curvilinear anomalies*

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.



### **Methodology: Magnetic Susceptibility Survey**

There are two methods of measuring the magnetic susceptibility of a soil sample. The first involves the measurement of a given volume of soil, which will include any air and moisture that lies within the sample, and is termed volume specific susceptibility. This method results in a bulk value that is not necessarily fully representative of the constituent components of the sample. For field surveys a Bartington MS2 meter with MS2D field loop is used due to its speed and simplicity. The second technique overcomes this potential problem by taking into account both the volume and mass of a sample and is termed mass specific susceptibility. However, mass specific readings cannot be taken in the field where the bulk properties of a soil are usually unknown and so volume specific readings must be taken. Whilst these values are not fully representative they do allow general comparisons across a site and give a broad indication of susceptibility changes. This is usually enough to assess the susceptibility of a site and evaluate whether enhancement has occurred.

### **Methodology: Gradiometer Survey**

There are two main methods of using the fluxgate gradiometer for commercial evaluations. The first of these is referred to as *magnetic scanning* and requires the operator to visually identify anomalous responses on the instrument display panel whilst covering the site in widely spaced traverses, typically 10m apart. The instrument logger is not used and there is therefore no data collection. Once anomalous responses are identified they are marked in the field with bamboo canes and approximately located on a base plan. This method is usually employed as a means of selecting areas for detailed survey when only a percentage sample of the whole site is to be subject to detailed survey.

The disadvantages of magnetic scanning are that features that produce weak anomalies (less than 2nT) are unlikely to stand out from the magnetic background and so will be difficult to detect. The coarse sampling interval means that discrete features or linear features that are parallel or broadly oblique to the direction of traverse may not be detected. If linear features are suspected in a site then the traverse direction should be perpendicular (or as close as is possible within the physical constraints of the site) to the orientation of the suspected features. The possible drawbacks mentioned above mean that a 'negative' scanning result should be validated by sample detailed magnetic survey (see below).

The second method is referred to as *detailed survey* and employs the use of a sample trigger to automatically take readings at predetermined points, typically at 0.25m intervals, on zig-zag traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation. Detailed survey allows the visualisation of weaker anomalies that may not have been detected by magnetic scanning.

During this survey a Bartington Grad601 magnetic gradiometer was used taking readings on the 0.1nT range, at 0.25m intervals on zig-zag traverses 1m apart within 30m by 30m square

grids. The instrument was checked for electronic and mechanical drift at a common point and calibrated as necessary. The drift from zero was not logged.

### **Data Processing and Presentation**

The detailed gradiometer data has been presented in this report in XY trace and greyscale formats. In the former format the data shown is 'raw' with no processing other than grid biasing having been done. The data in the greyscale images has been interpolated and selectively filtered to remove the effects of drift in instrument calibration and other artificial data constructs and to maximise the clarity and interpretability of the archaeological anomalies.

An XY plot presents the data logged on each traverse as a single line with each successive traverse incremented on the Y-axis to produce a 'stacked' plot. A hidden line algorithm has been employed to block out lines behind major 'spikes' and the data has been clipped. The main advantage of this display option is that the full range of data can be viewed, dependent on the clip, so that the 'shape' of individual anomalies can be discerned and potentially archaeological anomalies differentiated from 'iron spikes'. Geoplot 3 software was used to create the XY trace plots.

Geoplot 3 software was used to interpolate the data so that 3600 readings were obtained for each 30m by 30m grid. The same program was used to produce the greyscale images. All greyscale plots are displayed using a linear incremental scale.

## **Appendix 2: Survey location information**

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble 5800 model). The accuracy of this equipment is better than 0.01m. The survey grids were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if co-ordinates are measured off hard copies of the mapping rather than using the digital co-ordinates.

*Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party or for the removal of any of the survey reference points.*

### **Appendix 3: Geophysical archive**

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Microsoft Word 2000), and graphics files (Adobe Illustrator CS2 and AutoCAD 2008) files; and
- a full copy of the report.

At present the archive is held by Archaeological Services WYAS although it is anticipated that it may eventually be lodged with the Archaeology Data Service (ADS). Brief details may also be forwarded for inclusion on the English Heritage Geophysical Survey Database after the contents of the report are deemed to be in the public domain (i.e. available for consultation in the Northumberland Historic Environment Record).

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