ARCHAEOLOGICAL SERVICES WYAS

# Great Glen Crematorium and Burial Site
# Great Glen
# Leicestershire

## Geophysical Survey

Report no. 2495

July 2013

Client: Hyder Consulting (UK) Ltd

REGISTERED IA ORGANISATION

# Great Glen Crematorium and Burial Site
# Great Glen
# Leicestershire

## Geophysical Survey and Fieldwalking

*Summary*

*A geophysical (magnetometer) survey, covering 10.5 hectares of land to the south of Great Glen was carried out to inform the submission of a planning application for the proposed development of a crematorium and burial site. The site lies within a landscape containing a variety of site types from prehistoric, Roman and medieval periods. No anomalies of obvious archaeological potential have been identified by the survey although ridge and furrow regimes, and a probable former field boundary, are thought to relate to a medieval open field system. A programme of fieldwalking undertaken upon completion of the survey recovered 112 sherds of medieval pottery with the main concentration focused towards the historic medieval core of Great Glen. A single sherd of Roman Samian ware was also recovered. On the basis of these investigations, the archaeological potential of the site is considered to be low.*

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## Report Information

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| Client: | Hyder Consulting (UK) Ltd |
| Address: | Cresswell Associates, The Mill, Brimscombe Port, Stroud, GL5 2QG |
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| Museum Accession No.: | X.A93.2013 |
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Authorisation for distribution: ------------------------------------------------------


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# 1 Introduction

Archaeological Services WYAS (ASWYAS) was commissioned by Sarah Woodget of Hyder Consulting (UK) Ltd, to undertake a geophysical (magnetometer) and fieldwalking survey of land at Great Glen, Leicestershire (see Fig. 1) to inform the submission of a planning application for the proposed development of a crematorium and burial site. The work was undertaken in accordance with guidance contained within the National Planning Policy Framework (2012) and in line with current best practice (Institute for Archaeologists 2009 and 2010; David *et al.* 2008). The survey was carried out between July 2nd and July 4th 2013 to provide additional information on the archaeological resource of the site.

### Site location, topography and land-use

The Proposed Development Area (PDA) is situated on land to the south of Great Glen, approximately 10km south-east of Leicester, centred at SP 659 970. It is bound to the south by the A6 Leicester Road, by arable fields fronting onto London Road to the north and by open farmland to the east and west (see Fig. 2). The site comprised two fields containing a young arable crop (see plates). In total, 10.5 hectares were available for survey.

The survey area is situated on a gentle west-facing gradient at between 118m above Ordnance Datum (aOD) at the east of the PDA and around 105m aOD at the west.

### Soils and geology

The underlying bedrock comprises Charmouth Mudstone Formation – Mudstone overlain by superficial deposits of Oadby Member - Diamicton (British Geological Survey 2013). The soils in this area are classified in the Ragdale association, characterised as slowly permeable, seasonally waterlogged clays and fine loams (Soil Survey of England and Wales 1983).

# 2 Archaeological and Historical Background

No known heritage assets are recorded within the PDA. However, an Archaeological Desk-based Assessment for the site (Hyder 2012) concluded that there is considerable evidence in the surrounding landscape for archaeological activity from the prehistoric to medieval periods. Great Glen is mentioned in the Domesday book, the supposed historic settlement core of the village being 300m to the north of the PDA. Medieval heritage assets include earthworks interpreted as belonging to a shrunken medieval village and evidence of medieval open field systems in the form of ridge and furrow cultivation.

To the north-west of the PDA, previous investigations identified the site of a possible Roman villa.

# 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 identified within the specific area to be impacted by the proposed development and to help inform further strategies should they be required.

Specifically, the objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to therefore determine the presence/absence and extent of any buried archaeological features; and
- to prepare a report summarising the results of the survey.

In order to achieve these aims detailed (recorded) magnetometer survey was carried out over the PDA, an area of 10.5 hectares.

The specific aims of the fieldwalking were:

- to locate and record any clusters of pottery (or other artefacts) that might reflect areas of archaeological activity.

**Magnetometer survey**

The geophysical survey site grid was established using survey grade GPS equipment with corrections obtained through the Trimble Virtual Reference Station (VRS) network, or with a Trimble 5600 Total Station. The site grid was tied into the Ordnance Survey National Grid so that the grid can be accurately re-located during any later stages of archaeological investigation.

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.

**Fieldwalking**

The fieldwalking was carried out over the available area, an area of 10.5 hectares. The grid used for the magnetometer survey (described above and as specified in the agreed Project Design) was adopted for the fieldwalking, with points set out at 60m intervals along the X and Y axes. Ranging poles were positioned at 20m intervals along the X axis and the gridded areas systematically walked on traverses 10m apart. Each artefact was individually bagged and the Ordnance Survey co-ordinates, obtained using a Geko hand-held GPS, written on the finds bag. The co-ordinates obtained in this way are accurate to +/- 5m. Material that obviously dates from the 20th and 21st centuries was not collected. Approximate spot-dating was undertaken by an in-house archaeologist and the finds catalogued and archived at Archaeological Services WYAS.

**Reporting**

A general site location plan, incorporating the 1:50000 Ordnance Survey (OS) mapping, is shown in Figure 1. Figure 2 is a large scale (1:5000) location plan displaying the processed magnetic data. Figure 3 is an overall data interpretation plot at the same scale. The results of the fieldwalking are depicted as a finds distribution plot on Figure 4 at a scale of 1:3000. Detailed data plots ('raw' and processed) and full interpretative figures are presented at a scale of 1:1000 in Figures 5 to 10 inclusive.

Further 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 survey methodology, report and any recommendations comply with the Project Design (Harrison 2013), and 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

**Geophysical (magnetometer) Survey** (see Figs 5 – 10 inclusive)

The geophysical survey has identified numerous anomalies within a relatively uniform, low magnitude, magnetic background. For clarity the interpretation of the results will be described according to the causes of the identified anomalies.

**Ferrous Anomalies**

Individual iron 'spike' anomalies are ubiquitous across the whole of the site, as they are on most rural fields. These anomalies are caused by ferrous debris on the surface of the field or incorporated into the plough soil. Unless there is any other supporting evidence for an archaeological interpretation, or any obvious clustering that might imply an archaeological origin, they are not considered to be archaeologically significant.

Magnetic disturbance at the perimeters of the fields across the PDA relates to fencing and ferrous material within the adjacent field boundaries and is of no archaeological importance. The broad area of magnetic disturbance, **A**, within Sector 1, corresponds to the location of a former pond depicted on the first edition Ordnance Survey map of 1887 and is caused by the enhanced magnetic material used to backfill the pond.

**Agricultural Anomalies**

Ordnance Survey mapping shows that the current layout of fields within the PDA has not changed in the last 130 years, albeit with the exception of the removal of the pond (**A**) discussed above.

Series of parallel linear trend anomalies have been identified across much of the site on a variety of differing alignments. The more widely spaced, and slightly sinuous trends within the east of Sector 1 and the west of Sector 2 are interpreted as being due to the medieval and post-medieval agricultural practice of ridge and furrow cultivation. The characteristic striped appearance to the data is a result of the magnetic contrast between the now soil-filled furrows and the former ridges. More closely spaced linear trend anomalies are also evident within the west of Sector 1. These are due to recent ploughing.

Within the north-western part of Sector 1 a ‘speckled’ curvilinear trend anomaly, **B**, is discernable. This is thought to indicate a field drain; the ‘speckled’ effect is likely to relate to the contrast between the gravel-filled drain and the surrounding subsoil. Further south, within Sector 2, a low magnitude fragmentary linear anomaly, **C**, can be seen separating two separate regimes of ridge and furrow cultivation. This is likely to be due to a former soil-filled boundary ditch which was removed prior to the publication of the first edition Ordnance Survey map in 1887.

**Geological Anomalies**

Numerous small discrete anomalies, characterised as localised areas of magnetic enhancement, have been identified across the survey area. The lack of any apparent pattern suggests these anomalies have a geological origin, being due to localised variations in the underlying geology. Clusters of broad and amorphous, high-magnitude magnetic anomalies, **D**, have been identified within the north-eastern part of of Sector 1. These anomalies may simply be the cause of near-surface geological variation, although given the presence of a pond (and former ponds) in close proximity, it is thought possible that these clusters may indicate former areas of temporary extraction, perhaps clay pits, now back-filled.

Several weak curvilinear trends within Sector 2 show no clear archaeological pattern and are thought to indicate localised variations in the soils.

**Fieldwalking** (see Fig. 4)

The fieldwalking was carried out following the ploughing and seeding of the whole survey area with low crop growth visible (see plates). Ground conditions were good and visibility deemed to be high.

The fieldwalking recovered a varied assemblage of material the majority of which comprised pottery. In addition a few pieces of flint, clay pipe, animal bone, iron material and glass were also recovered. No obvious clustering of finds has been identified with the material recovered being consistent with a normal background scatter that would be present as a result of manuring or night soiling and is therefore not considered to be of any archaeological potential.

One sherd of Samian pottery was recovered from close to the western site boundary, whilst 112 sherds of medieval pottery were recovered, predominantly from within the northernmost field. These surface finds are consistent with the results of the geophysical survey which identified residual traces of ridge and furrow cultivation, forming part of a wider medieval open field system.

A background scatter of 14 flint pieces has also been recovered from all parts of the survey area; a few of which may be worked.

All of the material recovered from fieldwalking showed signs of abrasion, probably as a result of ploughing and weathering. The material is not, therefore, indicative of primary deposition.

## 5 Discussion and Conclusions

No anomalies with likely archaeological potential have been identified by the geophysical survey. Anomalies indicative of ridge and furrow cultivation have been clearly identified across much of the survey area, and a probable former field boundary identified, which is thought to relate to the wider medieval open field system. Anomalies indicative of geological variation and modern agricultural practices have also been identified throughout the PDA. The objects recovered during the fieldwalking substantiate the geophysical survey results. No obvious clustering of finds has been recorded. In total, 112 sherds of medieval pottery were recovered, predominantly from the northernmost field, in closest proximity to the historical medieval core of Great Glen. One sherd of Samian pottery was recovered from close to the western boundary of the PDA.

On the basis of the geophysical survey and fieldwalking, the archaeological potential of the site is thought to be low, although agricultural features associated with a medieval open field system may be encountered throughout.

***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.***

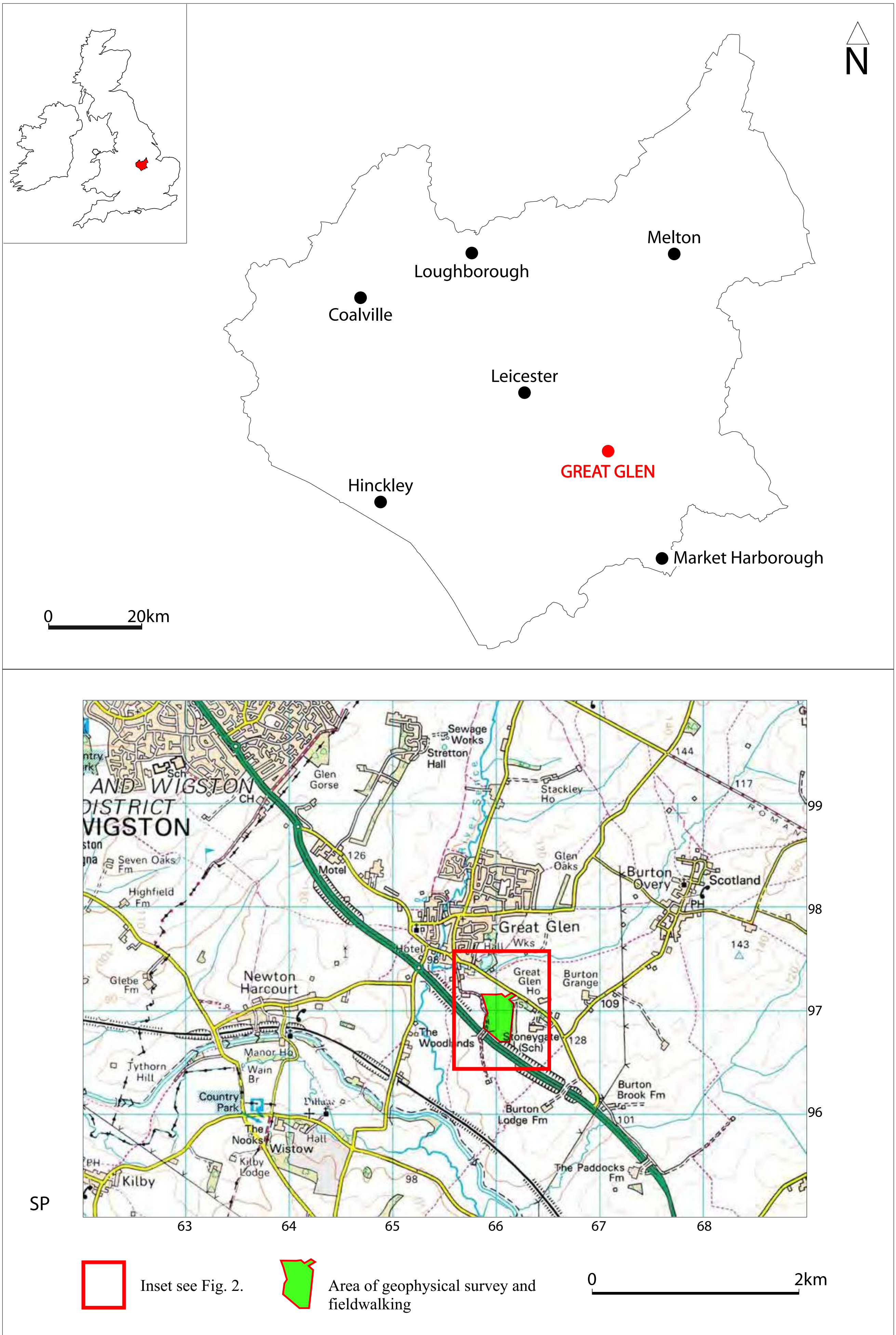


*Fig. 1. Site location*


*Fig. 2. Site location showing greyscale magnetometer data (1:5000 @ A4)*

0 100m

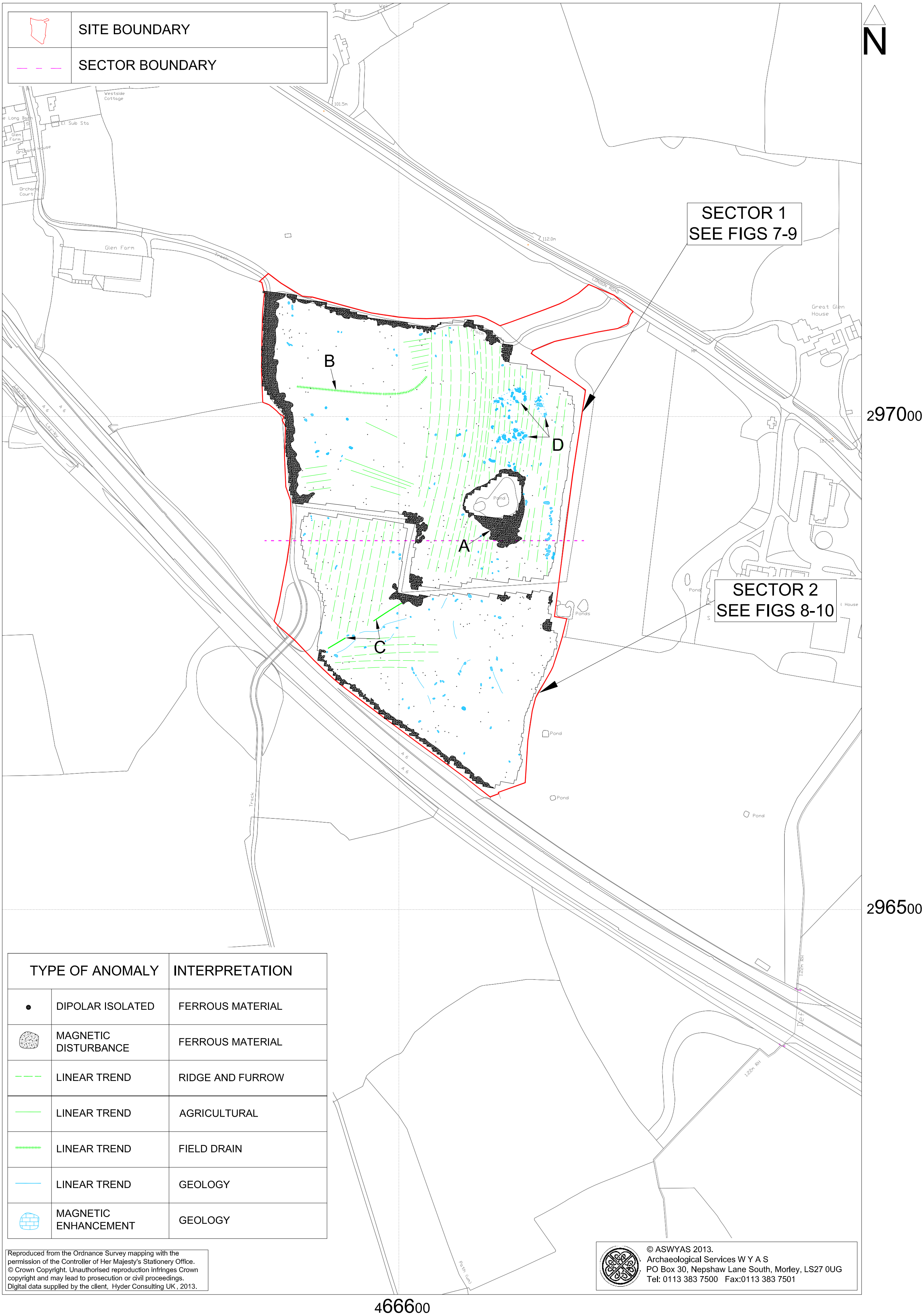


*Fig. 3. Overall interpretation of magnetometer data (1:5000 @ A4)*

0 100m

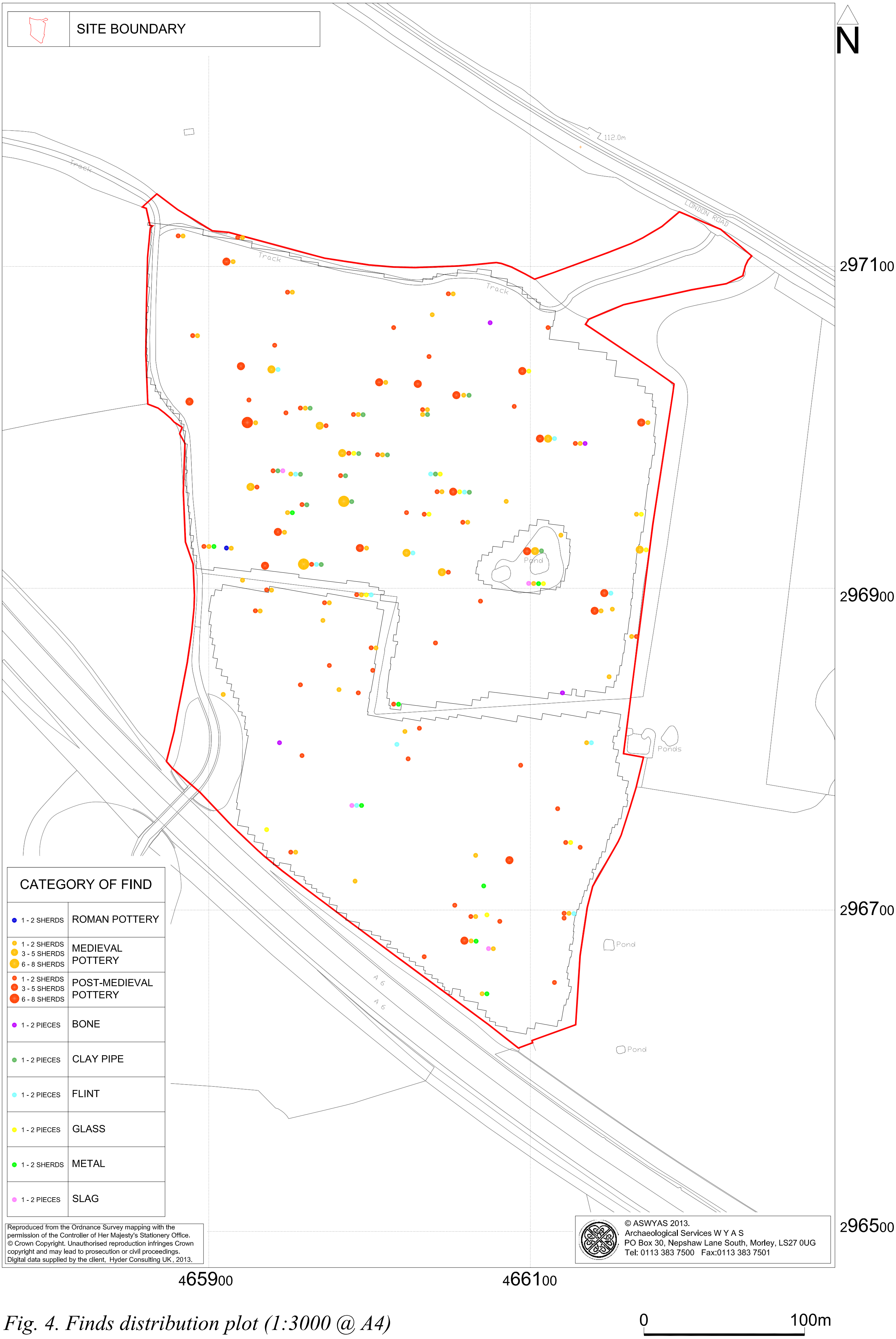


*Fig. 4. Finds distribution plot (1:3000 @ A4)*

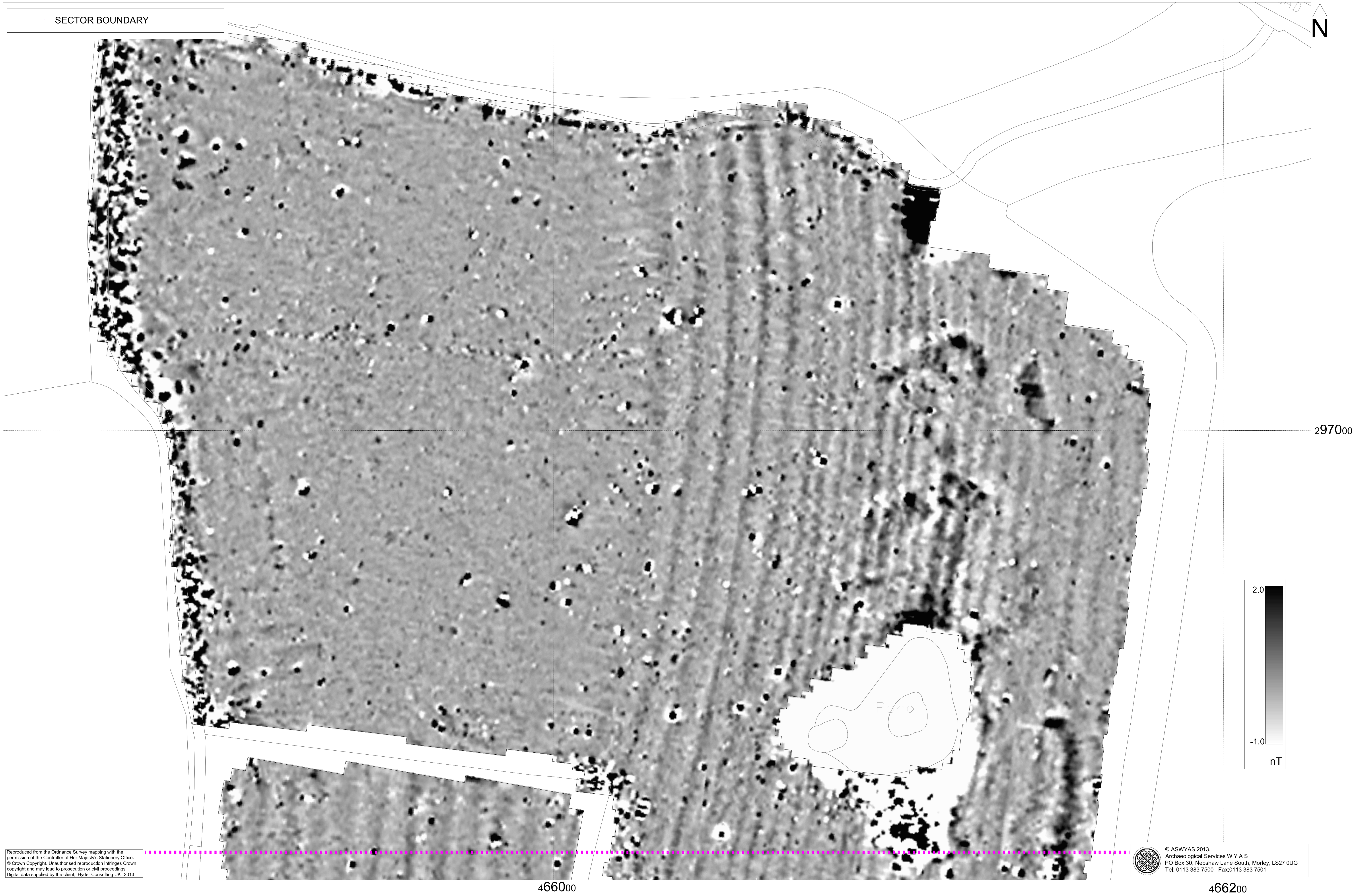




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*Fig. 5. Processed greyscale magnetometer data; Sector 1 (1:1000 @ A3)*

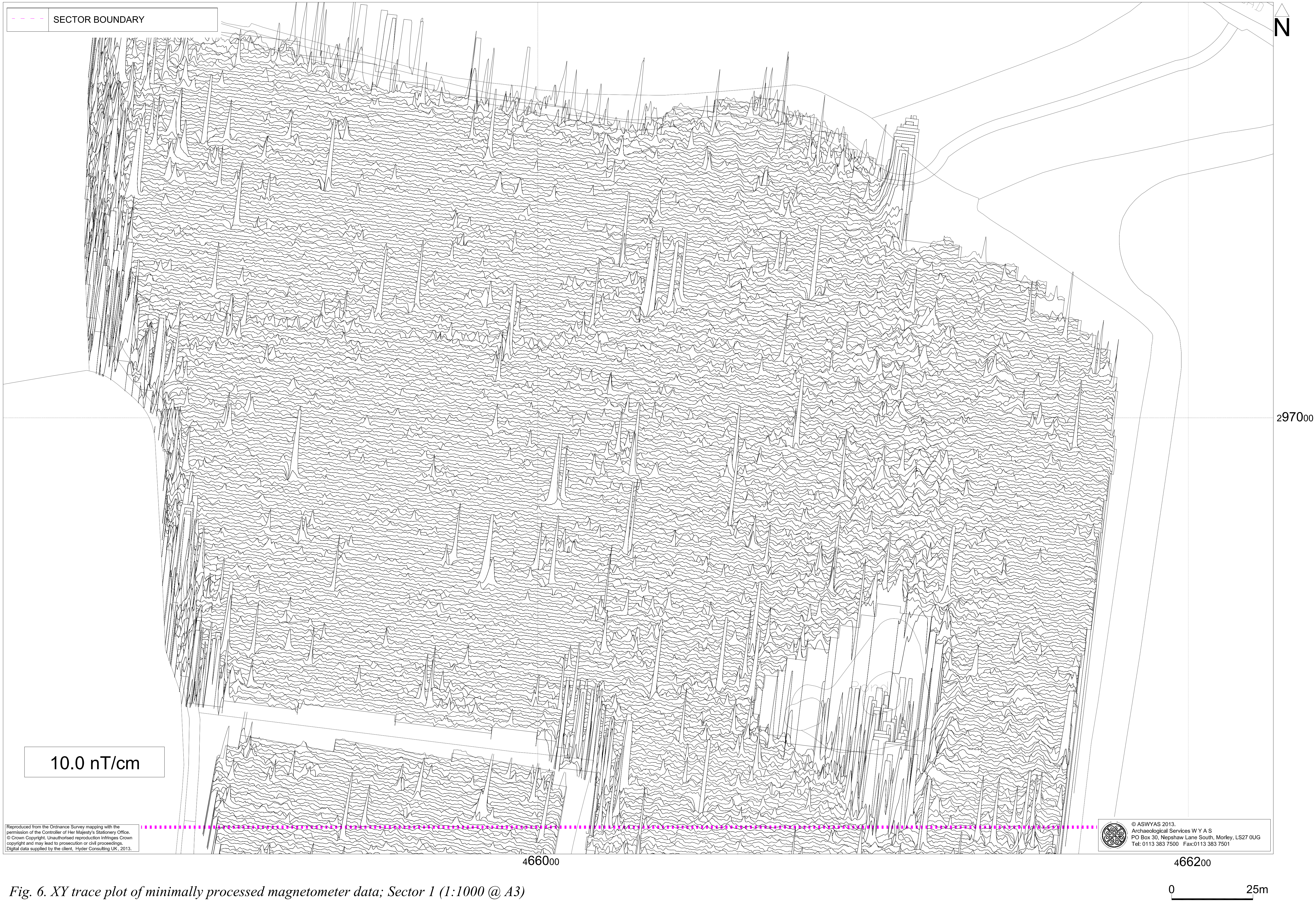


*Fig. 6. XY trace plot of minimally processed magnetometer data; Sector 1 (1:1000 @ A3)*

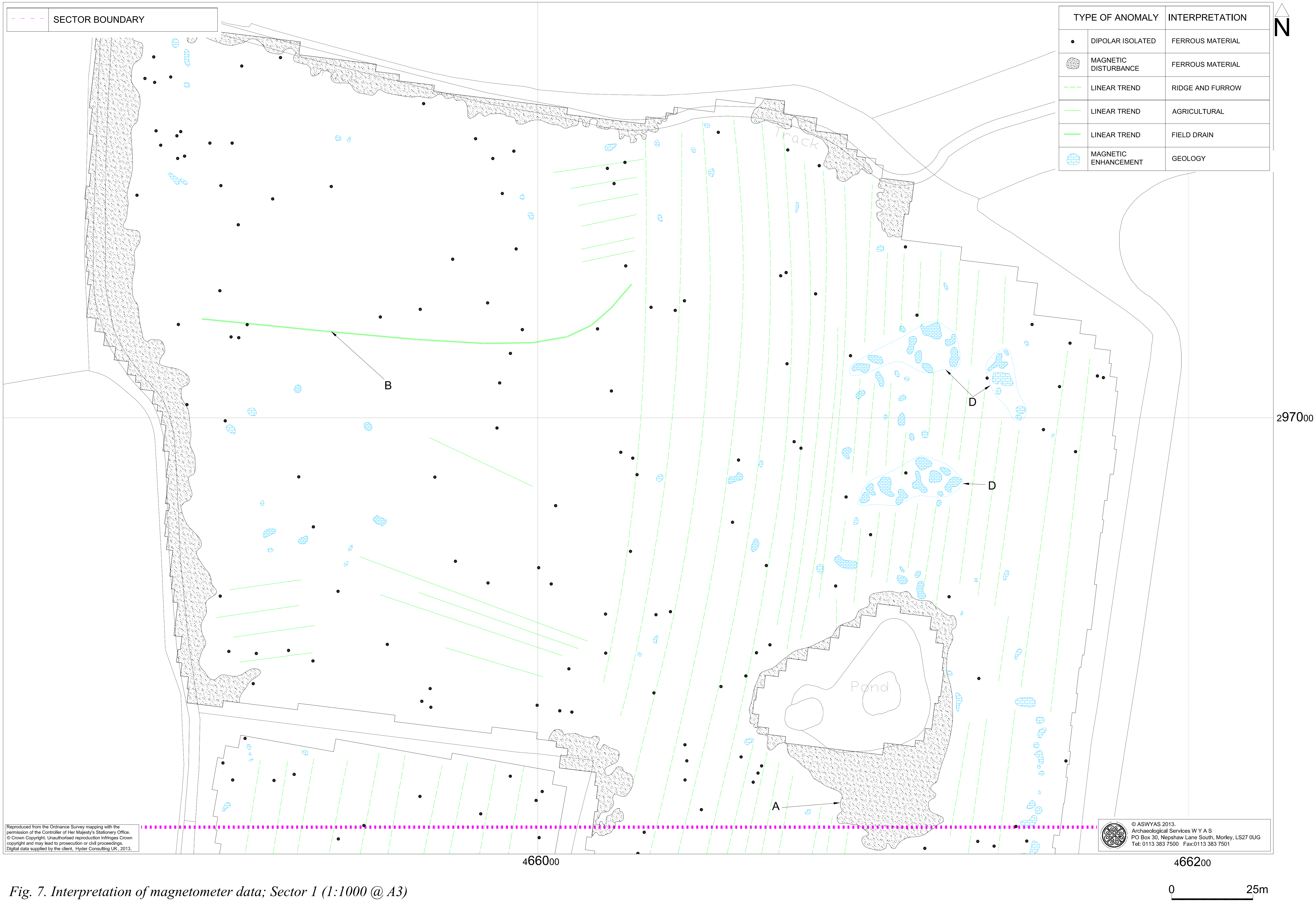


*Fig. 7. Interpretation of magnetometer data; Sector 1 (1:1000 @ A3)*

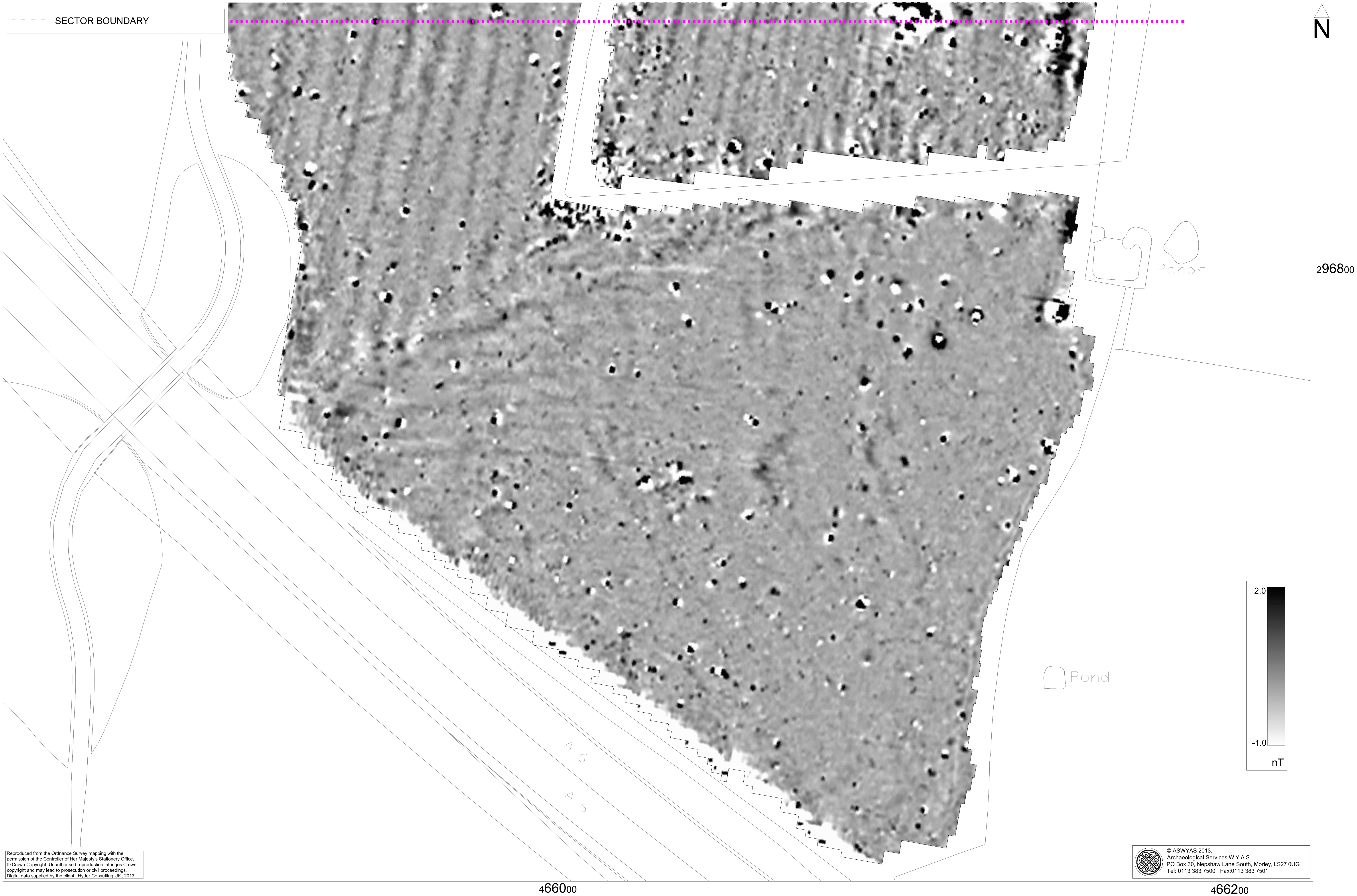


*Fig. 8. Processed greyscale magnetometer data; Sector 2 (1:1000 @ A3)*

0 25m



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*Fig. 9. XY trace plot of minimally processed magnetometer data; Sector 2 (1:1000 @ A3)*

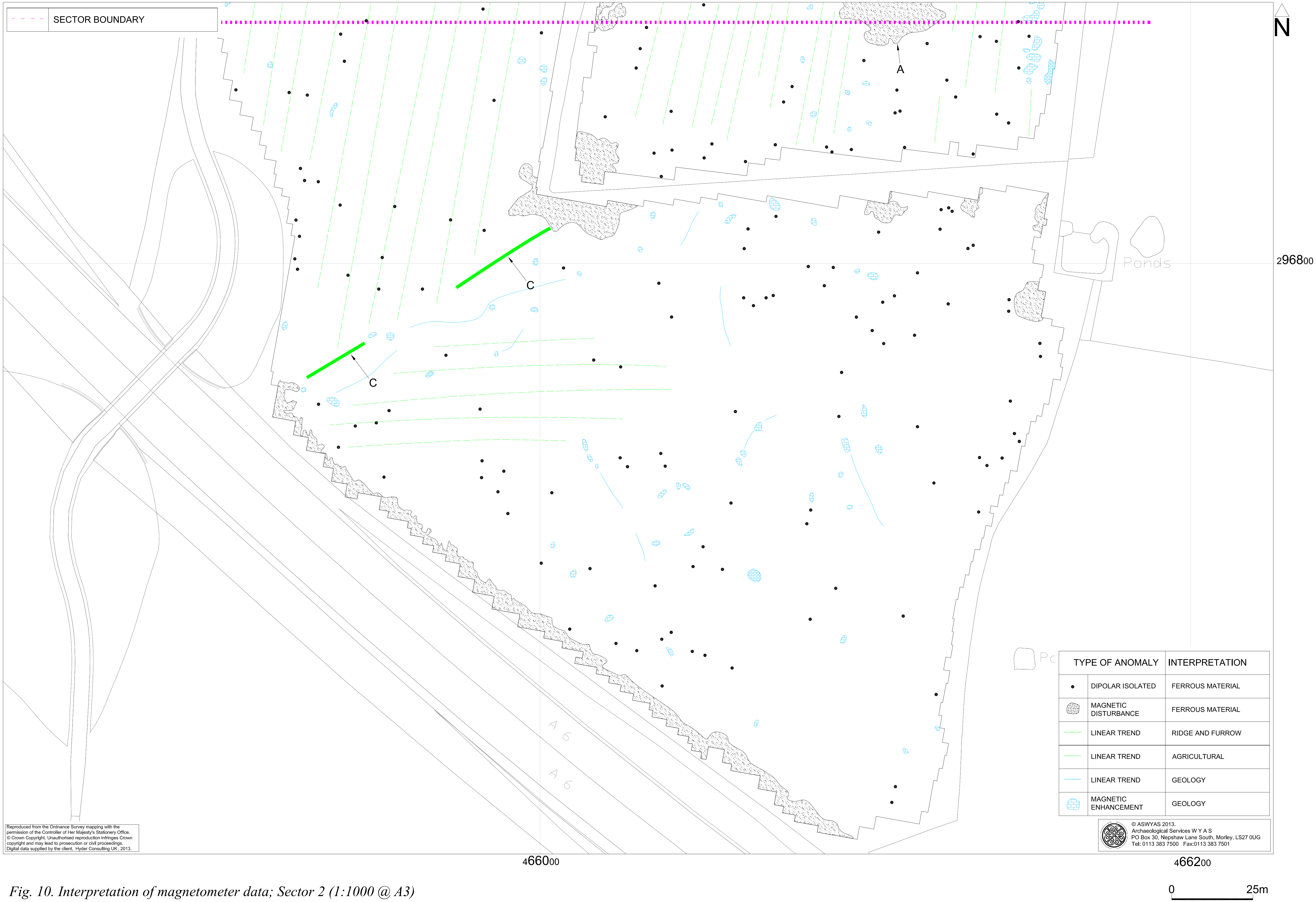


*Fig. 10. Interpretation of magnetometer data; Sector 2 (1:1000 @ A3)*

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

*Plate 2. General view of Sector 2, 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 it 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 then 0.01m. The locations of the survey grid and anomalies are available as a DXF file. The internal accuracy of these markers is better than 0.01m.

***Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.***

## 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 Leicestershire Historic Environment Record).

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