



WYAS
**Archaeological
Services**

City Fields

Wakefield

West Yorkshire

Geophysical Survey

Report no. 3044
November 2017

Client: MAP Archaeological Practice



City Fields, Wakefield, West Yorkshire

Geophysical Survey

Summary

A geophysical (magnetometer) survey, covering approximately 4.6 hectares, was undertaken on land to the south of Wakefield Eastern Relief Road, approximately 3km northeast of Wakefield city centre, West Yorkshire. This was part of a programme of archaeological works in advance of a proposed development. The magnetic survey has detected anomalies of an archaeological origin consisting of linear ditches, enclosures; including a 'D' shaped enclosure, pits and also responses which may be associated with the site of St Swithin's Chantry. Probable archaeological remains have also been recorded throughout.

Agricultural and ferrous responses have been recorded throughout the site and are not thought to be of archaeological interest. Overall the archaeological potential of the site is high.

Report Information

Client: MAP Archaeological Practice Ltd
 Address: Showfield Lane, Malton, North Yorkshire, YO17 6BT
 Report Type: Geophysical Survey
 Location: City Fields, Wakefield
 County: West Yorkshire
 Grid Reference: SE 34707 22258
 Period(s) of activity: Prehistoric/ Roman/ Modern
 Report Number: 3044
 Project Number: 6892
 Site Code: WCF17
 OASIS ID: Archaeol11-301503
 Date of fieldwork: November 2017
 Date of report: November 2017
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 Fieldwork: Alastair Trace BSc MSc
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 Report: Christopher Sykes BA MSc MCIfA & Emma Brunning
 Illustrations: Alastair Trace and Christopher Sykes
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Authorisation for
distribution: -----



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Contents

Report information	ii
Contents	iii
List of Figures	iv
List of Plates	iv
1 Introduction	1
Site location, topography and land-use	1
Soils and geology	1
2 Archaeological Background	1
3 Aims, Methodology and Presentation	2
Magnetometer survey	2
Reporting	2
4 Results and Discussion	3
Geological anomalies	3
Agricultural anomalies	3
Ferrous anomalies	3
Possible archaeological anomalies	4
Archaeological anomalies	4
5 Conclusions	5

Figures

Appendices

Appendix 1: Magnetic survey - technical information

Appendix 2: Survey location information

Appendix 3: Geophysical archive

Appendix 4: Oasis form

Bibliography

List of Figures

- 1 Site location (1:50000)
- 2 Survey location showing greyscale magnetometer data and First Edition OS mapping (1:2000 @ A3)
- 3 Processed greyscale magnetometer data (1:1250 @ A3)
- 4 XY trace plot of minimally processed magnetometer data (1:1250 @ A3)
- 5 Interpretation of magnetometer data (1:1250 @ A3)

List of Plates

- 1 General overview of survey area, facing northwest
- 2 General overview of survey area, facing southeast
- 3 General overview of survey area, facing northwest
- 4 General overview of survey area, facing northwest

1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by MAP Archaeological Practice to undertake a geophysical (magnetometer) survey on agricultural land to the south of Wakefield Eastern Relief Road. This is in advance of a proposed development. Guidance contained within the National Planning Policy Framework (DCLG 2012) was followed, in line with current best practice (CifA 2014; David *et al.* 2008). The survey was carried out on 9th November 2017.

Site location, topography and land-use

The site is located approximately 3km to the northeast of Wakefield city centre (see Fig. 1) and approximately 18km to the southeast of Leeds. It is bounded to the north by Wakefield Eastern Relief Road, to the south by residential properties and to the west by newly constructed residential properties. Agricultural fields adjoin the southeastern boundary. Ground cover consisted of a young arable crop. The survey area, totaling approximately 4.6ha, is centred at SE 34707 22258 and the topography of this site gently slopes from the south to the north with an (aOD) of *c.* 40m in the west to *c.* 35m in the east.

Soils and geology

The underlying bedrock geology comprises of the Pennine Middle Coal Measures Formation, a sedimentary mudstone, with no superficial deposits recorded (BGS 2017). Soils of the area belong to the Dale association (411b) consisting of slowly permeable seasonally waterlogged clayey fine loams (SSEW 1983).

2 Archaeological Background

An examination of Pastscape (www.pastscape.org.uk) and data collected from the English Heritage (EH) National Mapping Programme of 2010 (Roberts 2010) highlighted a network of field systems and enclosures to the east of the survey area. Excavation work, undertaken by ASWYAS *c.* 350m to the northwest of the survey area revealed an enclosure and field boundaries (Scales and Williams 2016).

A previous geophysical investigation over part of the survey area identified some features which were conjecturally associated with the wider network of cropmarks to the west (Phase SI 2013).

A Bronze Age hoard of axes (Monument Number 904478) was dredged from the River Calder in 1914.

Medieval to post-Medieval ridge and furrow has been identified to the northeast of the survey area.

St Swithin's Well, to the east of the survey area, has been identified. This feature is associated with St Swithin's Chantry, mentioned in the 13th century and demolished in 1571.

3 Aims, Methodology and Presentation

The main aim of the geophysical survey was to provide additional information on the known archaeology within the area. To achieve this, a magnetometer survey covering all available parts of the PDA was undertaken (see Fig. 2).

The general 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.

Magnetometer survey

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble R6 model). The survey was undertaken using Bartington Grad601 magnetic gradiometers. These were employed taking readings at 0.25m intervals on zig-zag traverses 1.0m 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 (OS) mapping, is shown in Figure 1. Figure 2 shows a more detailed site location plan and First Edition mapping, at a scale of 1:2000. The processed and minimally processed data, together with an interpretation of the survey results are presented in Figures 3 to 5 inclusive at a scale of 1:1250.

Technical information on the equipment used, data processing and survey methodologies are given in Appendix 1. Technical information on locating the survey area is provided in Appendix 2. Appendix 3 describes the composition and location of the archive. A copy of the completed OASIS form is included in Appendix 4.

The survey methodology, report and any recommendations comply with guidelines outlined by English Heritage (David *et al.* 2008) and by the Chartered Institute for Archaeologists

(CIFA 2014). 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 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 to 5)

Archaeological anomalies

The magnetic survey has detected anomalies which have a definite archaeological origin comprising enclosures, linear ditches and numerous pits. Towards the west of the survey area a D-shaped enclosure (**A1**) has been identified, measuring 25m by 18m, making it slightly smaller than those identified via cropmark evidence (Roberts 2010, 28). This feature appears to be appended to a long linear ditch **A2** which measures at least 60m in length.

Linear responses (**A3**) may form a rectilinear enclosure measuring 36m by 28m, and possibly predates the D-shaped enclosure which appears to cut through the northern arm. Further ditch (**A4**) is on the same alignment as **A2** and **A3** and could therefore be associated.

To the east of the above anomalies, (**A4**) has been recorded comprising a double ditch feature, and whilst it broadly correlates with the First Edition OS mapping (Fig. 2), it is of such a significant size and magnetic strength that it has been characterised as archaeological. It reflects the alignment of the D-shaped enclosure and the associated other ditches.

To the southeast of the survey area, along the western boundary, a collection of magnetically positive features have been identified (**A5**). They appear to create a series of small enclosures which measure approximately 64m by 23m. They sit within an area identified as the location for St Swithin's Chantry, and may be filled-in ditches associated with the demolition of the building. Alternatively, they may form part of the wider landscape of prehistoric field boundaries, as noted to the northeast.

Possible archaeological anomalies

Possible archaeological anomalies have been identified throughout the survey area in the form of pits and fragmented ditches. These responses have been interpreted as possible archaeology as they do not form any identifiable features.

Some anomalies close to the identified former field boundaries are deemed to have a possible archaeological origin, but as the magnetic response is similar to that of geological material, they may relate to the removal of the field boundaries.

The fragmentary collection of responses in the southwest corner of the survey area (**P1**) are considered to be part of the archaeological activity immediately above it. Given their location in an area of ground and magnetic disturbance and plough damage, however, a possible archaeological interpretation is given.

Geological anomalies

Throughout the survey area, there are scatters of geological anomalies. They are more prominent in areas where former field boundaries have been removed and the underlying material has been brought to the surface. The anomalies are thought to be caused by variations in soil depth.

Agricultural anomalies

Faint cultivation anomalies have been detected across the survey area. These are considered to be modern in origin, rather than ridge and furrow, given the straight and close-nature of the furrows.

Ridge and furrow anomalies have been identified within the central portion of the survey area, based on the magnetic strength of the response and size, in comparison to the modern plough anomalies.

Two former field boundaries have been revealed in the survey area which correspond well with First Edition OS mapping.

Ferrous anomalies

Ferrous anomalies, as individual 'spikes', or as large discrete areas are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris or material is common on rural sites, often being present as a consequence of manuring or tipping/infilling. There is no obvious pattern or clustering to their distribution in this survey to suggest anything other than a random background scatter of ferrous debris in the plough-soil.

Responses (**F1**) correlate to the location of St Swithin's Cottage marked on mapping dating from 1893. The cottage no longer appears on the map of 1972-1982. The response is likely to be from the demolition rubble.

Other areas of magnetic disturbance have been detected around the southern periphery of the survey area. This is likely to have been caused by ground disturbance during the creation of nearby residential housing.

A dipolar anomaly, projecting southwards from the relief road, has been identified and is considered to be a modern service pipe.

5 Conclusions

The magnetic survey has identified a number of anomalies of archaeological origin in the form of D-shaped and rectangular enclosures and ditch lengths. These are probably associated with the wider cropmark evidence to the east and excavated remains to the west.

Additionally a handful of anomalies have a strong magnetic response that may be associated with the demolition and destruction of St Swithin's Chapel, which is recorded to the southeast of the survey area.

In conclusion anomalies interpreted as archaeological or potentially archaeological have been identified throughout the site, along with those of a geological origin. Former field boundaries and magnetic disturbance associated with modern house building have also been identified.

On this basis the site overall can be said to have a high archaeological potential.

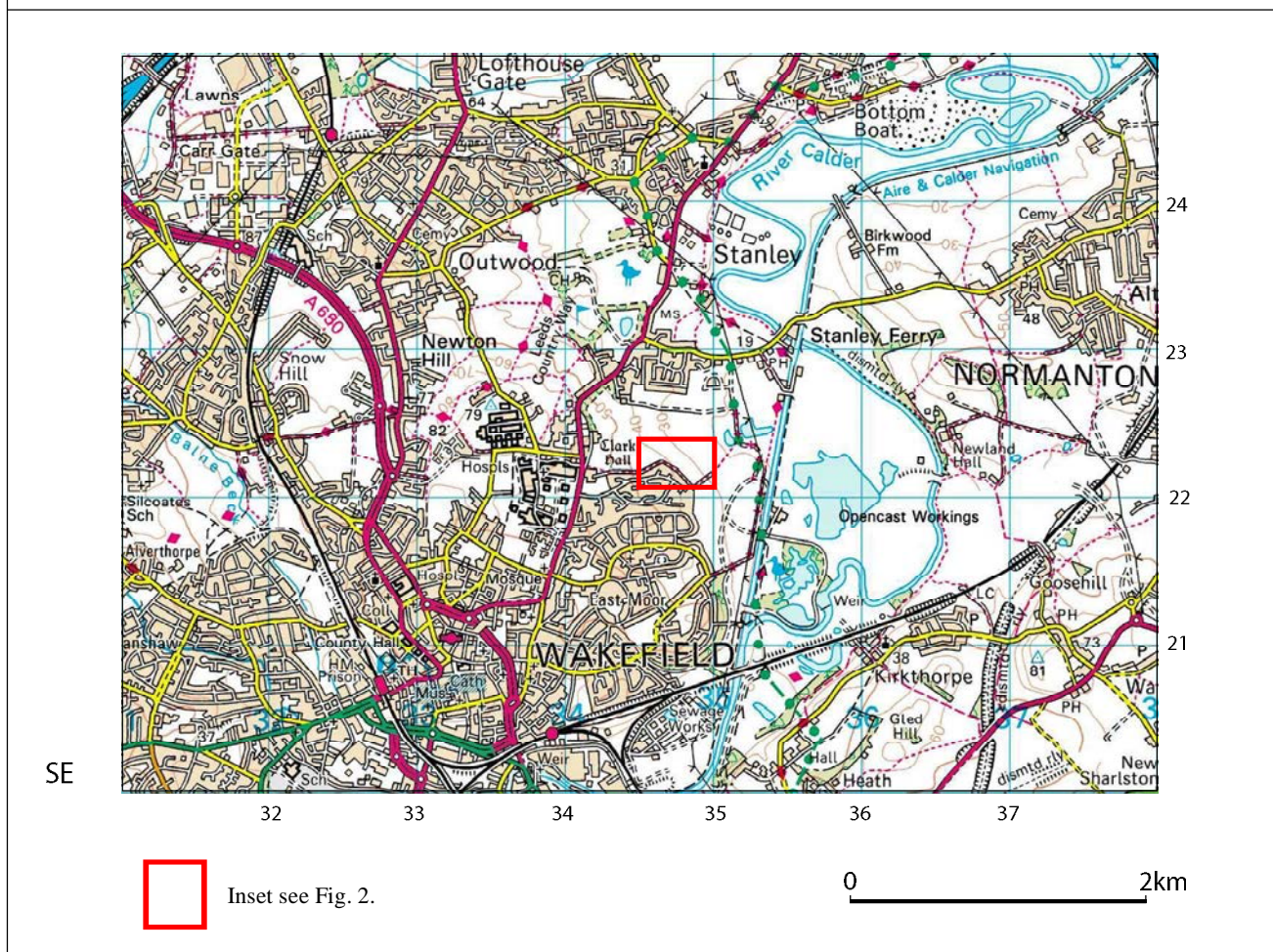
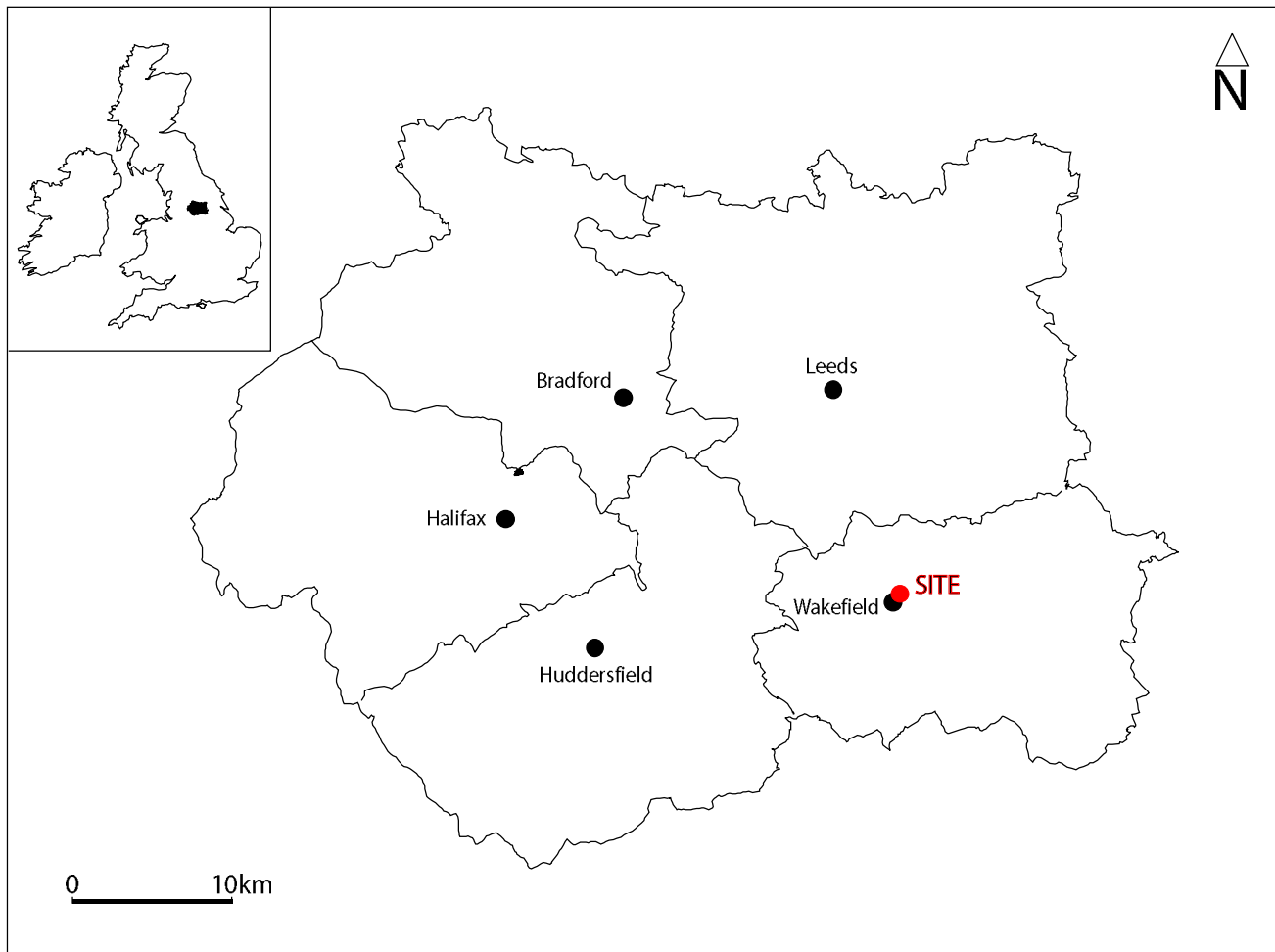


Fig. 1. Site location

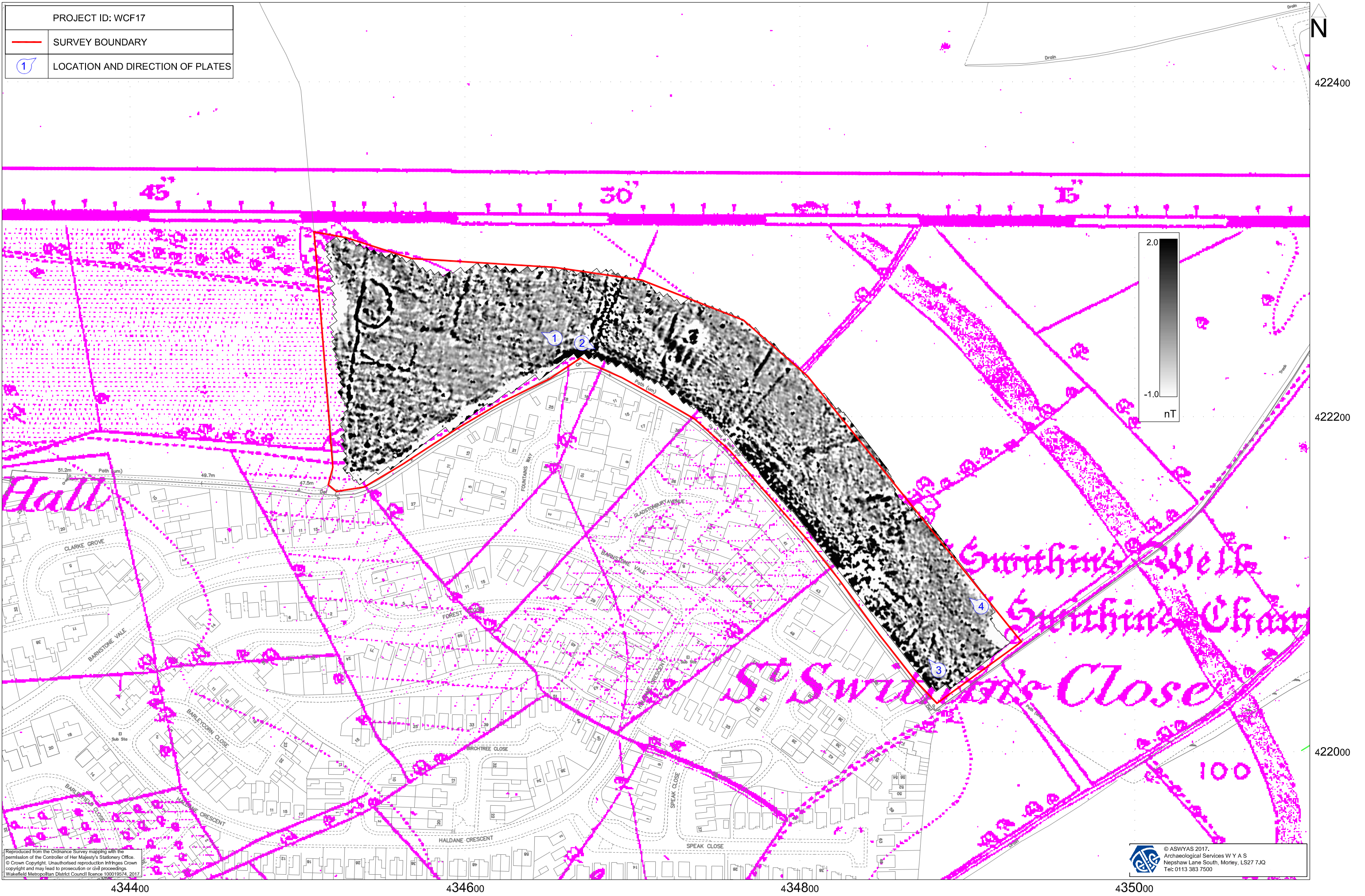
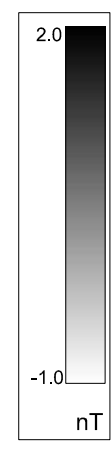


Fig. 2. Survey location showing greyscale magnetometer data and First Edition OS mapping (1:2000 @ A3)



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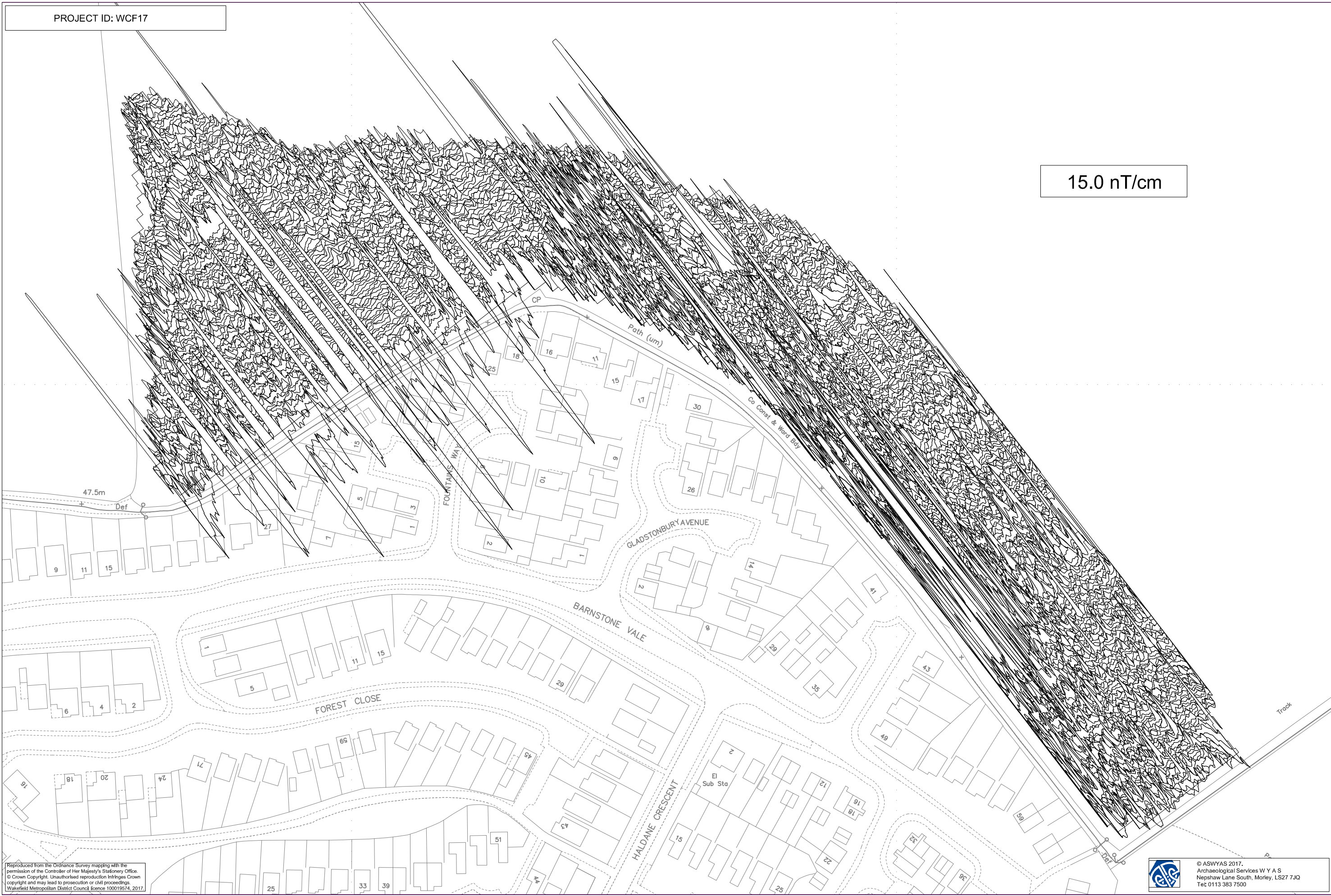
Fig. 3. Processed greyscale magnetometer data (1:1250 @ A3)



PROJECT ID: WCF17



15.0 nT/cm

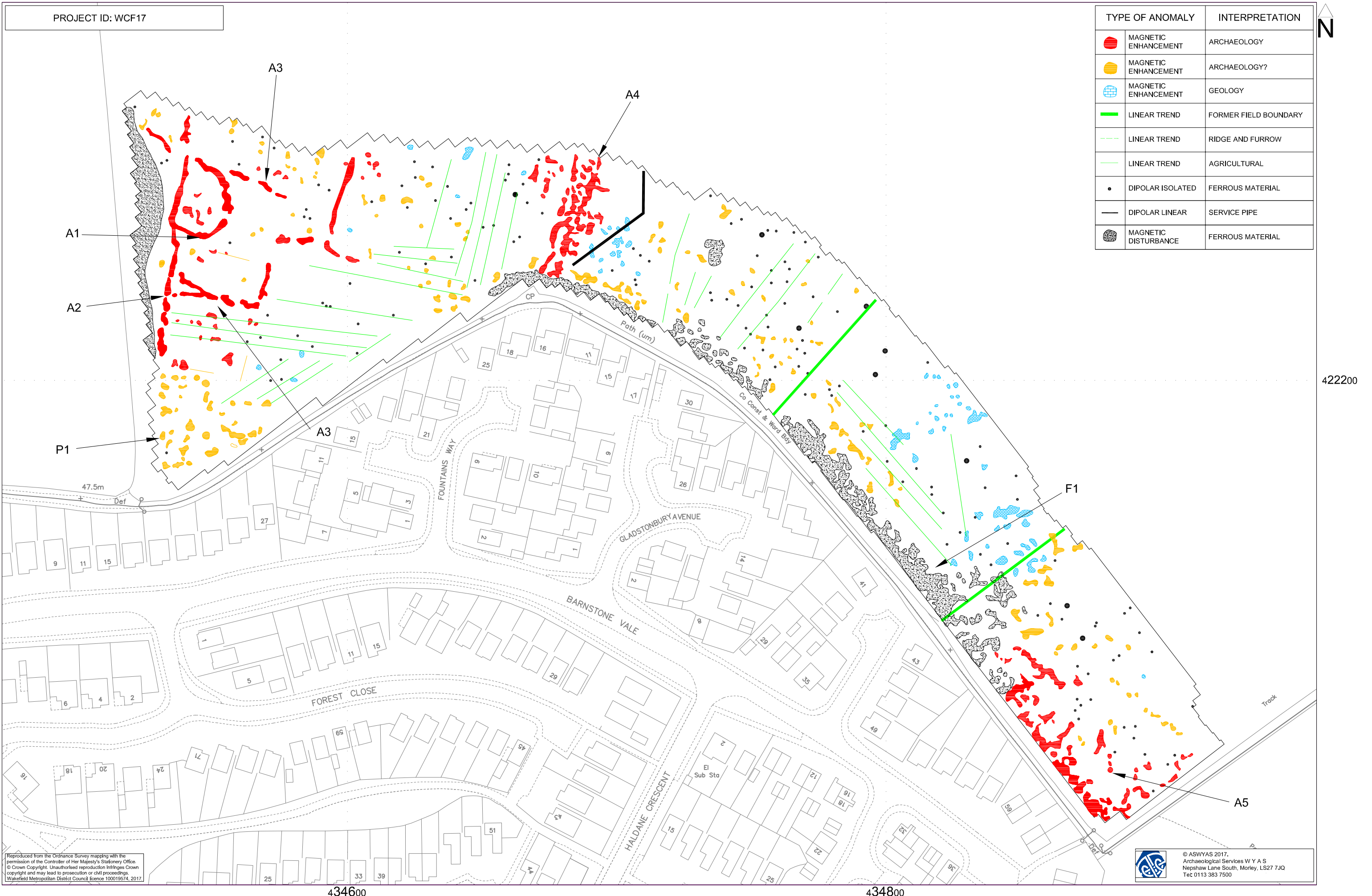


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Fig. 4. XY trace plot of minimally processed magnetometer data (1:1250 @ A3)

0 50m



PROJECT ID: WCF17

TYPE OF ANOMALY		INTERPRETATION
	MAGNETIC ENHANCEMENT	ARCHAEOLOGY
	MAGNETIC ENHANCEMENT	ARCHAEOLOGY?
	MAGNETIC ENHANCEMENT	GEOLOGY
	LINEAR TREND	FORMER FIELD BOUNDARY
	LINEAR TREND	RIDGE AND FURROW
	LINEAR TREND	AGRICULTURAL
	DIPOLAR ISOLATED	FERROUS MATERIAL
	DIPOLAR LINEAR	SERVICE PIPE
	MAGNETIC DISTURBANCE	FERROUS MATERIAL

422200

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434600

434800

Fig. 5. Interpretation of magnetometer data (1:1250 @ A3)

0 50m



Plate 1. General overview of survey area, facing northwest



Plate 2. General overview of survey area, facing southeast



Plate 3. General overview of survey area, facing northwest



Plate 4. General overview of survey area, facing northwest

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. Areas of human occupation or settlement can then be identified by measuring the magnetic susceptibility of the topsoil because 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.

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 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: Gradiometer Survey

The main method of using the fluxgate gradiometer for commercial evaluations is referred to as *detailed survey* and requires the surveyor to walk at an even pace carrying the instrument within a grid system. A sample trigger automatically takes readings at predetermined points, typically at 0.25m intervals, on traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation.

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 0.5m 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.

The gradiometer data have been presented in this report in processed greyscale format. The data in the greyscale images have 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.

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.

Appendix 2: Survey location information

An initial survey station was established using a Trimble VRS differential Global Positioning System (Trimble R6 model). The data was geo-referenced using the geo-referenced survey station with a Trimble RTK differential Global Positioning System (Trimble R6 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.

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 CS6 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 West Yorkshire Historic Environment Record).

Appendix 4: Oasis form

OASIS DATA COLLECTION FORM: England

[List of Projects](#) | [Manage Projects](#) | [Search Projects](#) | [New project](#) | [Change your details](#) | [HER coverage](#) | [Change country](#) | [Log out](#)

[Printable version](#)

OASIS ID: archaeol11-301503

Project details

Project name	City Fields, Wakefield
Short description of the project	A geophysical (magnetometer) survey, covering approximately 4.6 hectares, was undertaken on land to the south of Wakefield Eastern Relief Road, approximately 3km northeast of Wakefield city centre, West Yorkshire. This was part of a programme of archaeological works in advance of a proposed development. The magnetic survey has detected anomalies of an archaeological origin consisting of linear ditches, enclosures; including a 'D' shaped enclosure, pits and also responses which may be associated with the site of St Swithin's Chantry. Probable archaeological remains have also been recorded throughout. Agricultural and ferrous responses have been recorded throughout the site and are not thought to be of archaeological interest. Overall the archaeological potential of the site is high.
Project dates	Start: 09-12-2017 End: 09-12-2017
Previous/future work	Yes / Not known
Any associated project reference codes	6892 - Sitecode
Type of project	Field evaluation
Monument type	ENCLOSURES Late Prehistoric
Monument type	FIELD SYSTEM Late Prehistoric
Monument type	CHANTRY Medieval
Significant Finds	ENCLOSURES Late Prehistoric
Significant Finds	CHANTRY Medieval
Methods & techniques	"Geophysical Survey"
Development type	Housing estate
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Not known / Not recorded
Solid geology (other)	Pennine Middle Coal Measures Formation
Drift geology	CLAY WITH FLINTS
Techniques	Magnetometry

Project location

Country	England
Site location	WEST YORKSHIRE WAKEFIELD WAKEFIELD City Fields, Wakefield
Study area	4.6 Hectares
Site coordinates	SE 347 222 53.694861747418 -1.474412272841 53 41 41 N 001 28 27 W Point
Height OD / Depth	Min: 35m Max: 40m

Project creators

Name of Organisation	Archaeological Services WYAS
Project brief originator	MAP Archaeological Practice Ltd
Project design originator	MAP Archaeological Practice Ltd
Project director/manager	E Brunning
Project supervisor	A. Trace

Project archives

Physical Archive Exists?	No
Digital Archive recipient	MAP Archaeological Practice
Digital Contents	"Survey"
Digital Media available	"Geophysics","Images raster / digital photography","Text"
Paper Archive Exists?	No

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	City Fields, Wakefield
Author(s)/Editor(s)	Sykes, C.
Author(s)/Editor(s)	Brunning, E
Date	2017
Issuer or publisher	ASWYAS
Place of issue or publication	Leeds
Description	A4 report with A3 figures
Entered by	Emma Brunning (emma.brunning@aswyas.com)
Entered on	20 November 2017

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