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HORSELEYS FIELD, HAMBLEDEN, BUCKINGHAMSHIRE
REPORT ON GEOPHYSICAL SURVEY, JULY 2009

Andrew Payne

ARCHAEOLOGICAL SCIENCE

ENGLISH HERITAGE

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SUMMARY

A fluxgate magnetometer survey was carried out in the environs of a scheduled Roman villa site at Yewden Lodge, Buckinghamshire, with the aim of training a volunteer-based group from Chiltern Archaeology to employ the technique further to inform their future research on the Romano-British settlement pattern in the Hambleden Valley. The magnetometer survey was targeted over a pasture field (Horseleys) where outlying elements of the previously excavated Yewden villa complex in the form of enclosures, trackways and a possible Romano-British shrine are visible on aerial photographs and in previous earth resistance results. The magnetometer survey confirmed the presence of ditched enclosures in the south-west area of Horseleys Field, one of which contains internal positive anomalies possibly indicative of large pits, quarries or industrial features. A multiple ditched square enclosure to the north, interpreted as a shrine feature from the earlier earth resistance survey and aerial photography, was only marginally resolved as a loose cluster of indistinct positive magnetic anomalies.

CONTRIBUTORS

The field work was conducted by a team from Chiltern Archaeology as a training exercise under the instruction and supervision of Andy Payne of the English Heritage Geophysical Survey Team. The Chiltern Archaeology group was led by Jill Eyers and the following team members all contributed to the survey at various stages during the week long training: Jill Eyers, Tony Eustace, Keith Spencer, John Clutterbuck, Ann Benhamed, Sue Winter, Rick Magaldi, Frances Magaldi, Linda Bartlett, Martin Dixon, Alfred Waller, Raihana Ehsanullah, Alan Jones, Marian Carr, Alan Winchcomb, Bev Cabot, Iris Hunt, Mary Webb, Edna Large, Georgina Lomnitz. Paul Linford subsequently provided helpful advice on data processing.

ACKNOWLEDGEMENTS

The author wishes to thank the landowner of Horseleys field, Jill Eyers and the Chiltern Archaeology team for the time and effort put in to conducting the survey.

ARCHIVE LOCATION

Fort Cumberland.

DATE OF FIELDWORK AND REPORT

The magnetometer survey fieldwork was conducted between 20th and 24th July 2009. The report on the fieldwork was completed on 17th May 2010. The cover photograph shows members of the Chiltern Archaeology group undertaking fluxgate magnetometer survey in the Horseleys area of the Hambleden Valley near Yewden Lodge Roman villa.

CONTACT DETAILS

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INTRODUCTION

A fluxgate magnetometer survey was carried out in the environs of a scheduled Roman villa site at Yewden Lodge, Bucks (SAM 27160, NGR SU 784855). The survey was undertaken in response to a request from Jill Eyers of Chiltern Archaeology for assistance with preparing a largely volunteer-based local archaeological research group, to undertake their own magnetometer surveys to explore the wider environs of two neighbouring scheduled Roman villa sites (Yewden and Mill End). The magnetometer survey was designed to augment previous earth resistance survey of the two main villa sites carried out by the Chiltern Archaeology group in 2008 and to support continuing research into the Romano-British settlement pattern of the Hambleden Valley area (Chiltern Archaeology 2008 ; Payne 2009).

The Hambleden Valley is located immediately north of the River Thames in the Chiltern Hills Area of Outstanding Natural Beauty (AONB) between the towns of Henley and Marlow in Buckinghamshire. The valley was favoured for settlement in the Roman period and is notable for the presence of neighbouring Roman villa sites; the Yewden site having been previously excavated in the early years of the 20th century and the other at Mill End (SAM 27152, NGR SU 786848) known from parch-marks visible on aerial photographs (Farley 1983 ; Chiltern Archaeology 2008). The valley contains a small spring-fed tributary stream known as the Hamble Brook draining south from the Chiltern uplands into the River Thames near Mill End.

The magnetometer survey was targeted over a pasture field (Horseleys) on the flat valley floor adjacent to the Hamble Brook and directly east of the field containing the Yewden Lodge Roman villa. This site was substantially excavated in 1912 (Cocks 1921) and was shown to be in use from the 1st to the 4th centuries, consisting of a complex of three principal buildings containing tessellated pavements and bath structures within a surrounding walled courtyard as well as numerous pits, ovens and burials.

Aerial photographic (AP) evidence (for example NMR4632, SU/7885/42) suggests that Horseleys Field contains several ditched enclosures with adjoining trackways associated with the nearby villa, as well as the in-filled channel of the Hamble Brook. It was expected that the former course of the river, which previously ran through the centre of the survey area, may well have reduced the geophysical response due to an accumulation of alluvial overburden. Parts of Horseleys Field are also protected by scheduling, including a multiple ditched square or rectilinear enclosure interpreted as a Romano-British shrine (Chiltern Archaeology 2008) to the north and now bisected by the modern course of the Hamble Brook. The presence of the stream presents difficulties for using ground based prospection methods, but the enclosure was partially mapped by earth resistance survey in 2008 (Chiltern Archaeology 2008).

The land use in Horseleys Field is water meadow pasture and riverine deposits would be expected in the area of the in-filled channel of the Hamble Brook. The local soils are predominantly of the Andover 1 Association (well drained calcareous silty soils) developed over Middle Chalk overlain by superficial valley gravel or Head deposits (Geological Survey of England and Wales 1905; Soil Survey of England and Wales 1983).

METHOD

The magnetometer survey was conducted using Geoscan FM36 fluxgate gradiometers over a grid of 30m squares (Figure 1) initially set out over the survey area by Chiltern Archaeology and subsequently recorded using a Trimble 4800 series survey grade Global Positioning System (GPS). Fluxgate gradiometer readings were recorded at 0.25m intervals along successive parallel traverses aligned north-south and separated by 1.0m using the 0.1 nanotesla (nT) resolution setting of the instrument (Note 2, Annex 1). The data collected by the volunteer team was periodically downloaded and plotted on the screen of a portable computer using Geoplot version 3.0 to monitor progress and to display the data as the survey progressed.

The magnetometer data is presented in linear greyscale and traceplot form in Figures 2 and 3 after post acquisition processing, that included the initial truncation of extreme values outside the range of ±50 nT and the setting of each traverse to a zero mean, to remove any effects of directional sensitivity and instrument drift. In addition, periodic motion induced noise present in the data related to the gait of the individual volunteer operators has been minimised through the application of a band-pass filter in the frequency domain (Scollar *et al.* 1990, 508). Further processing to reduce the strong localized magnetic effects of near surface iron objects was applied through the use of a 1.5m radius threshold median filter and additional smoothing by the use of a 0.75m radius Gaussian low-pass filter (Figure 4; Scollar *et al.* 1986).

RESULTS

A graphical summary of significant magnetic anomalies discussed in the text is presented in Figure 5, with individual responses identified by the prefix [m].

A series of positive ditch-type anomalies [m1-m2] form a pair of irregular enclosures, possibly with an adjacent trackway [m3]. In general, the magnetic response is weak (<3nT) and the anomalies appear to fade out entirely as they approach the former course of the river to the east and may have been either truncated or obscured by riverine erosion or alluvial deposition. The former course of the river is visible in the AP record and in the earlier Chiltern Archaeology earth resistance survey, but is not resolved in the magnetometer data.

A number of more intense positive responses [m4] are found included within segments of the ditch of [m1] and as discrete, internal responses [m5] within the enclosure. The magnitude of these discrete anomalies (>20nT) suggests semi-industrial activity, associated with burning which may have contributed to the localised magnetic enhancement of the adjacent enclosure ditches in these areas. Both enclosures and the trackway [m1-3] are better defined in the magnetic data than in the previous Chiltern Archaeology earth resistance data due, perhaps, to more variable underlying geological effects.

A second focus of probable archaeological activity is centred around [m6] consisting of a loose cluster of indistinct positive magnetic anomalies possibly associated with the square enclosure known from aerial photography, although this is not resolved in the magnetic data. However, the enclosure was defined in the earlier earth resistance data despite being partly obscured to the west by the low resistance response to the former course of the Hamble Brook (Chiltern Archaeology 2008).

An area of disturbed magnetic response and a concentration of localised positive anomalies [m7] may indicate the presence of possible buildings or occupation activity, perhaps representing an extension of the main villa area of settlement. Magnetic noise at [m8] corresponds with a slight mound visible on the surface and could, potentially, be significant but is difficult to fully interpret from the current data.

Linear anomalies [m9] are probably associated with an earthwork feature visible on the surface as an open ditch (dry at the time of the survey but probably functioning as a seasonal drainage channel), which are also visible in the previous earth resistance coverage (Chiltern Archaeology 2008).

There is also a high incidence of small scale ferrous material scattered across the survey area, evident through the numerous localised intense positive and negative magnetic anomalies (or 'iron spikes') recorded, but it is unclear whether these are due to a modern origin or not.

CONCLUSION

The distribution of magnetic anomalies suggests two main foci of activity in the field that coincide well with the previous aerial photographic evidence (photo reference NMR4632; SU/7885/42). In the south of Horseleys Field, the magnetometer survey indicates a pair of ditched enclosures apparently with adjoining trackways, one containing substantial internal positive anomalies, possibly indicative of large pits, quarries or industrial features. There is also more limited magnetic evidence for archaeological activity in the vicinity of the square enclosure visible on aerial photographs further to the north, previously interpreted as a possible Romano-British temple or shrine. The magnetic evidence for this enclosure is indistinct probably due to the close proximity of the Hamble Brook to the east. These results confirm the information previously available from aerial photography for the wider pattern of Roman period settlement in the Hambleden Valley associated with the two main villa sites and also appear to confirm the validity of the two extensions of the scheduled area of the main villa into Horseleys Field. This field work also met a primary aim to provide training for the Chiltern Archaeology group to enable them to undertake their own more extensive magnetometer surveys in the future and contribute to the longer term goals of their research.

LIST OF ENCLOSED FIGURES

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ANNEX 1: NOTES ON STANDARD PROCEDURES

1) Earth Resistance Survey

Each 30 metre grid square is surveyed by making repeated parallel traverses across it, all aligned parallel to one pair of the grid square's edges, and each separated by a distance of 1 metre from the last; the first and last traverses being 0.5 metres from the nearest parallel grid square edge. Readings are taken along each traverse at 1 metre intervals, the first and last readings being 0.5 metres from the nearest grid square edge.
Unless otherwise stated the measurements are made with a Geoscan RM15 earth resistance meter incorporating a built-in data logger, using the twin electrode configuration with a 0.5 metre mobile electrode separation. As it is usually only relative changes in earth resistance that are of interest in archaeological prospecting, no attempt is made to correct these measurements for the geometry of the twin electrode array to produce an estimate of the true apparent resistivity. Thus, the readings presented in plots will be the actual values of earth resistance recorded by the meter, measured in Ohms (Ω). Where correction to apparent resistivity has been made, for comparison with other electrical prospecting techniques, the results are quoted in the units of apparent resistivity, Ohm-m (Ωm).

Measurements are recorded digitally by the RM15 meter and subsequently transferred to a portable laptop computer for permanent storage and preliminary processing. Additional processing is performed on return to Fort Cumberland using desktop workstations.

2) Magnetometer Survey

Each 30 metre grid square is surveyed by making repeated parallel traverses across it, all parallel to that pair of grid square edges most closely aligned with the direction of magnetic N. Each traverse is separated by a distance of 1 metre from the last; the first and last traverses being 0.5 metre from the nearest parallel grid square edge. Readings are taken along each traverse at 0.25 metre intervals, the first and last readings being 0.125 metre from the nearest grid square edge.

These traverses are walked in so called 'zig-zag' fashion, in which the direction of travel alternates between adjacent traverses to maximise survey speed. Where possible, the magnetometer is always kept facing in the same direction, regardless of the direction of travel, to minimise heading error. However, this may be dependent on the instrument design in use.

Unless otherwise stated the measurements are made with either a Bartington Grad601 or a Geoscan FM36 fluxgate gradiometer which incorporate two vertically aligned fluxgates, one situated either 1.0m or 0.5 metres above the other; the bottom fluxgate is carried at a height of approximately 0.2 metres above the ground surface. Both instruments incorporate a built-in data logger that records measurements digitally; these are subsequently transferred to a portable laptop computer for permanent storage and preliminary processing. Additional processing is performed on return to Fort Cumberland using desktop workstations.

It is the opinion of the manufacturer of the Geoscan instrument that two sensors placed 0.5 metres apart cannot produce a true estimate of vertical magnetic gradient unless the bottom sensor is far removed from the ground surface. Hence, when results are presented, the difference between the field intensity measured by the top and bottom sensors is quoted in units of nano-Tesla (nT) rather than in the units of magnetic gradient, nano-Tesla per metre (nT/m).

3) Resistivity Profiling

This technique measures the electrical resistivity of the subsurface in a similar manner to the standard resistivity mapping method outlined in note 1. However, instead of mapping changes in the near surface resistivity over an area, it produces a vertical section, illustrating how resistivity varies with increasing depth. This is possible because the resistivity meter becomes sensitive to more deeply buried anomalies as the separation between the measurement electrodes is increased. Hence, instead of using a single, fixed electrode separation as in resistivity mapping, readings are repeated over the same point with increasing separations to investigate the resistivity at greater depths. It should be noted that the relationship between electrode separation and depth sensitivity is complex so the vertical scale quoted for the section is only approximate. Furthermore, as depth of investigation increases the size of the smallest anomaly that can be resolved also increases.

Typically a line of 25 electrodes is laid out separated by 1 or 0.5 metre intervals. The resistivity of a vertical section is measured by selecting successive four electrode subsets at increasing separations and making a resistivity measurement with each. Several different schemes may be employed to determine which electrode subsets to use, of which the Wenner and Dipole-Dipole are typical examples. A Campus Geopulse earth resistance meter, with built in multiplexer, is used to make the measurements and the Campus Imager software is used to automate reading collection and construct a resistivity section from the results.

Figure 1

HORSELEYS FIELD, HAMBLEDEN, BUCKINGHAMSHIRE

Location of fluxgate magnetometer survey, July 2009

SU 7885

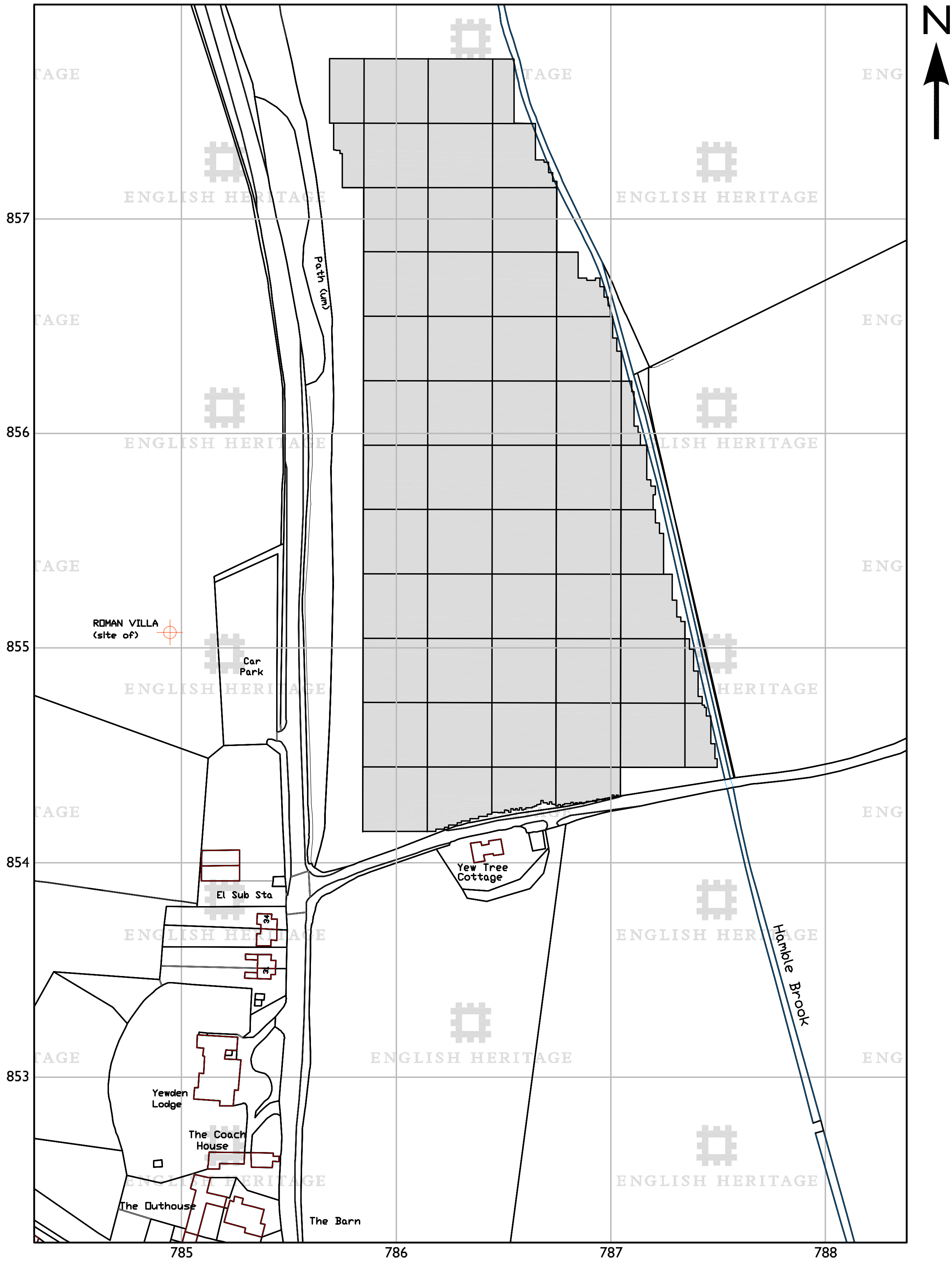

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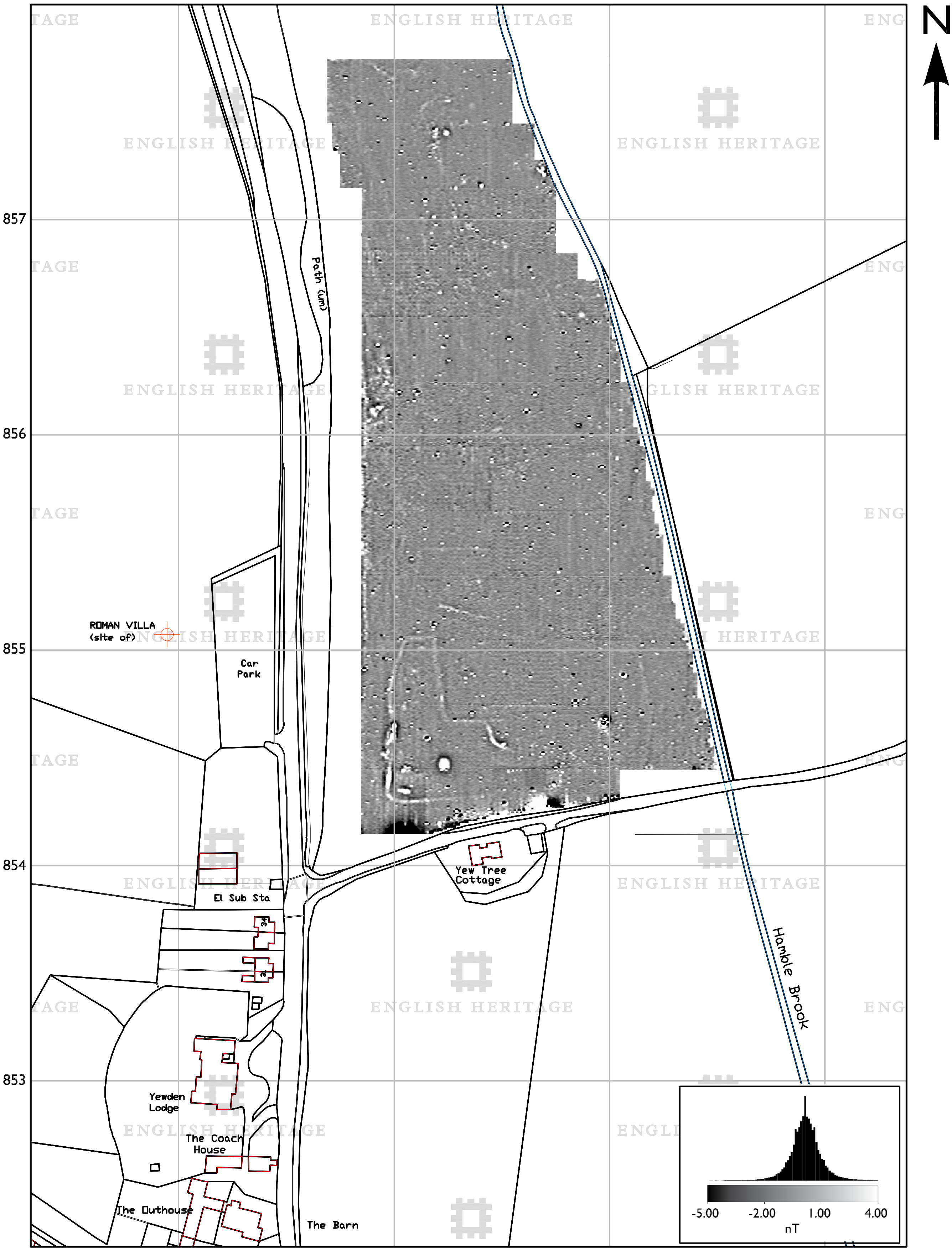
Figure 2

HORSELEYS FIELD, HAMBLEDEN, BUCKINGHAMSHIRE

Location of Magnetometer Survey, July 2009

SU 7885



0 150m

1:2500

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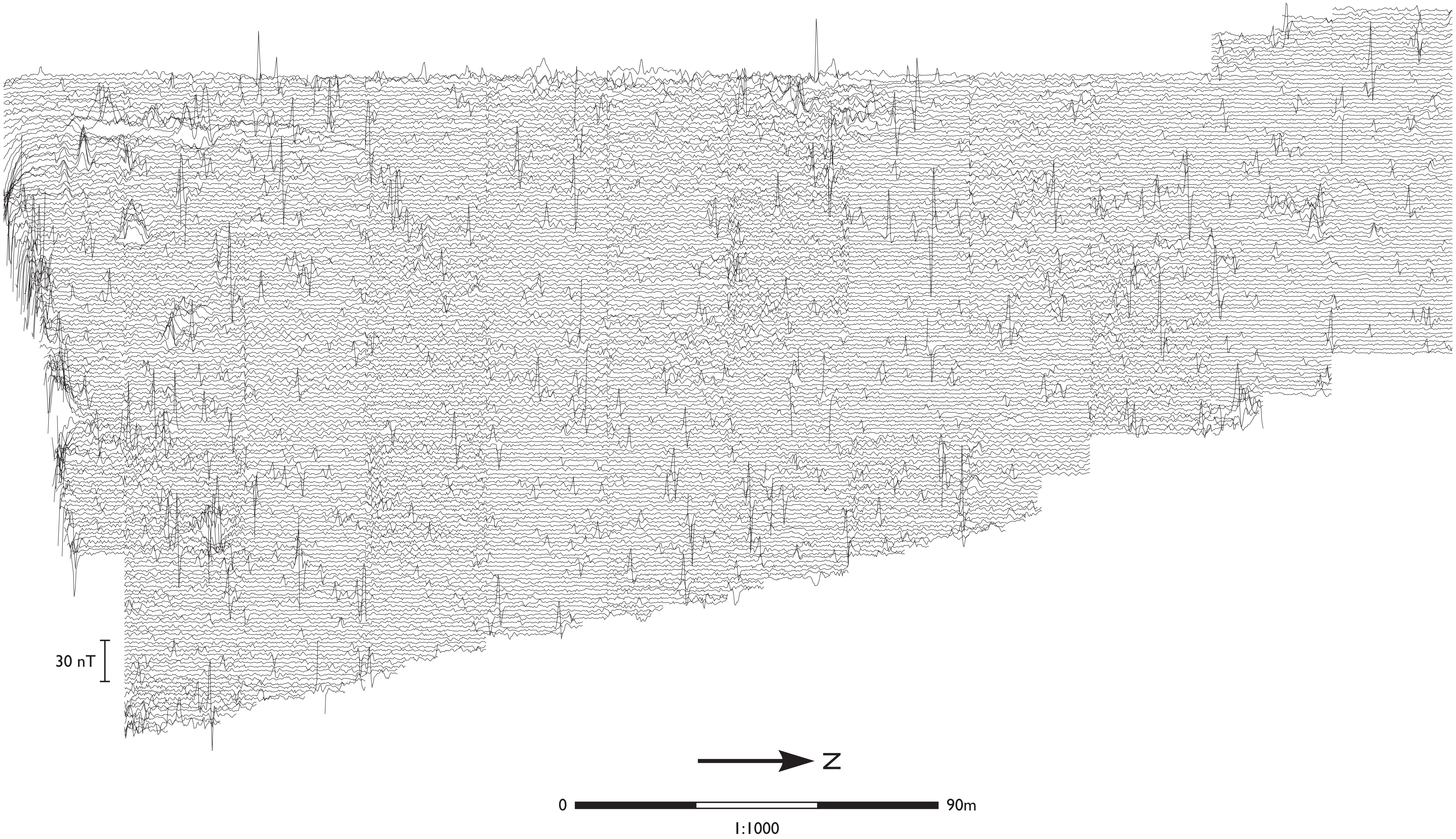
HORSELEYS FIELD, HAMBLEDEN, BUCKINGHAMSHIRE
Magnetometer survey, July 2009

Figure 3(A)

Traceplot of range truncated data (-50 to 50 nT)
after initial drift and periodic defect correction



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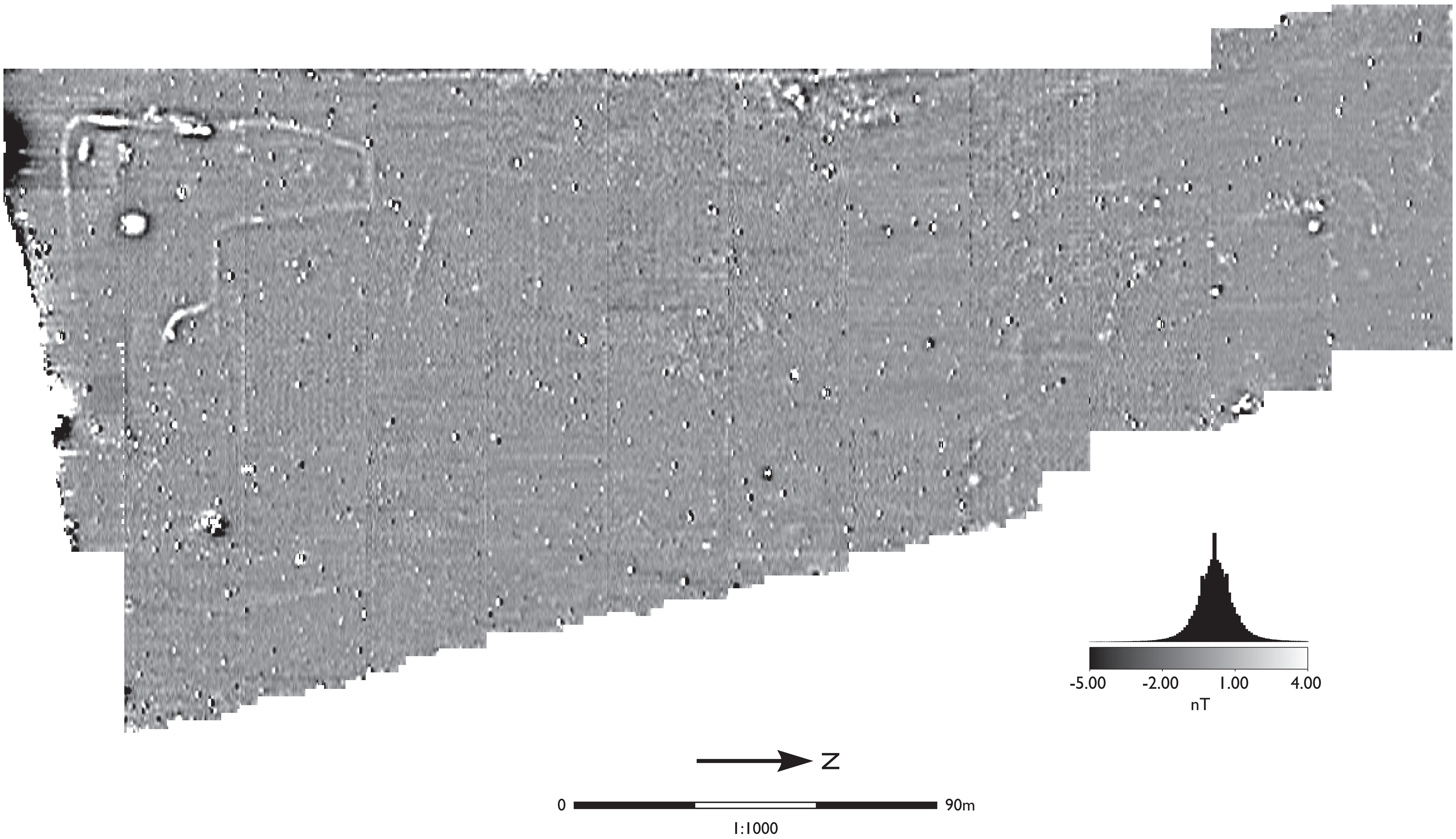
Magnetometer survey, July 2009

Figure 3(B)

Greyscale image of range truncated (-50 to 50 nT)
data after initial drift and periodic defect correction



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Magnetometer survey, July 2009

Figure 4

Greyscale image of despiked and smoothed data

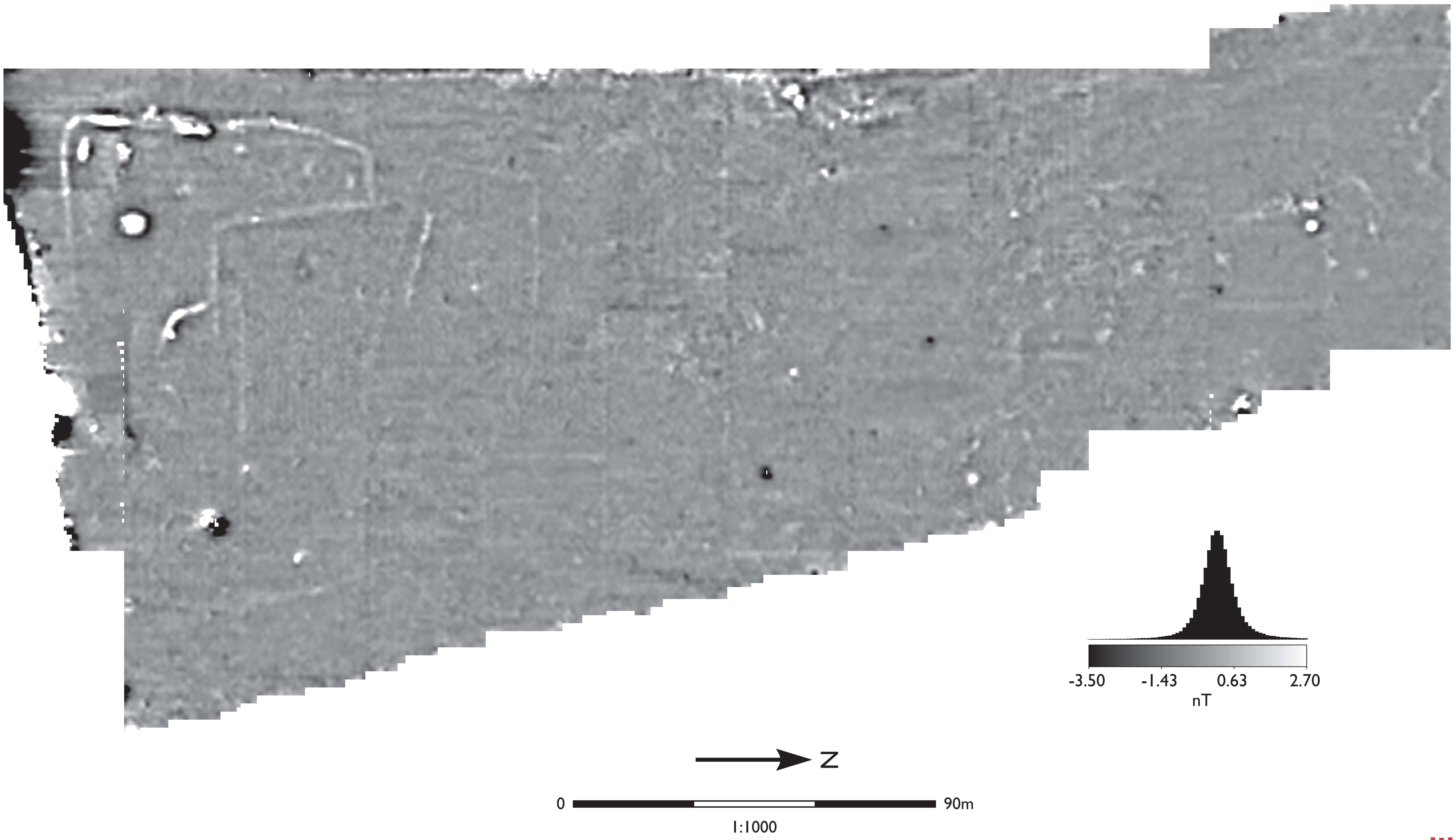

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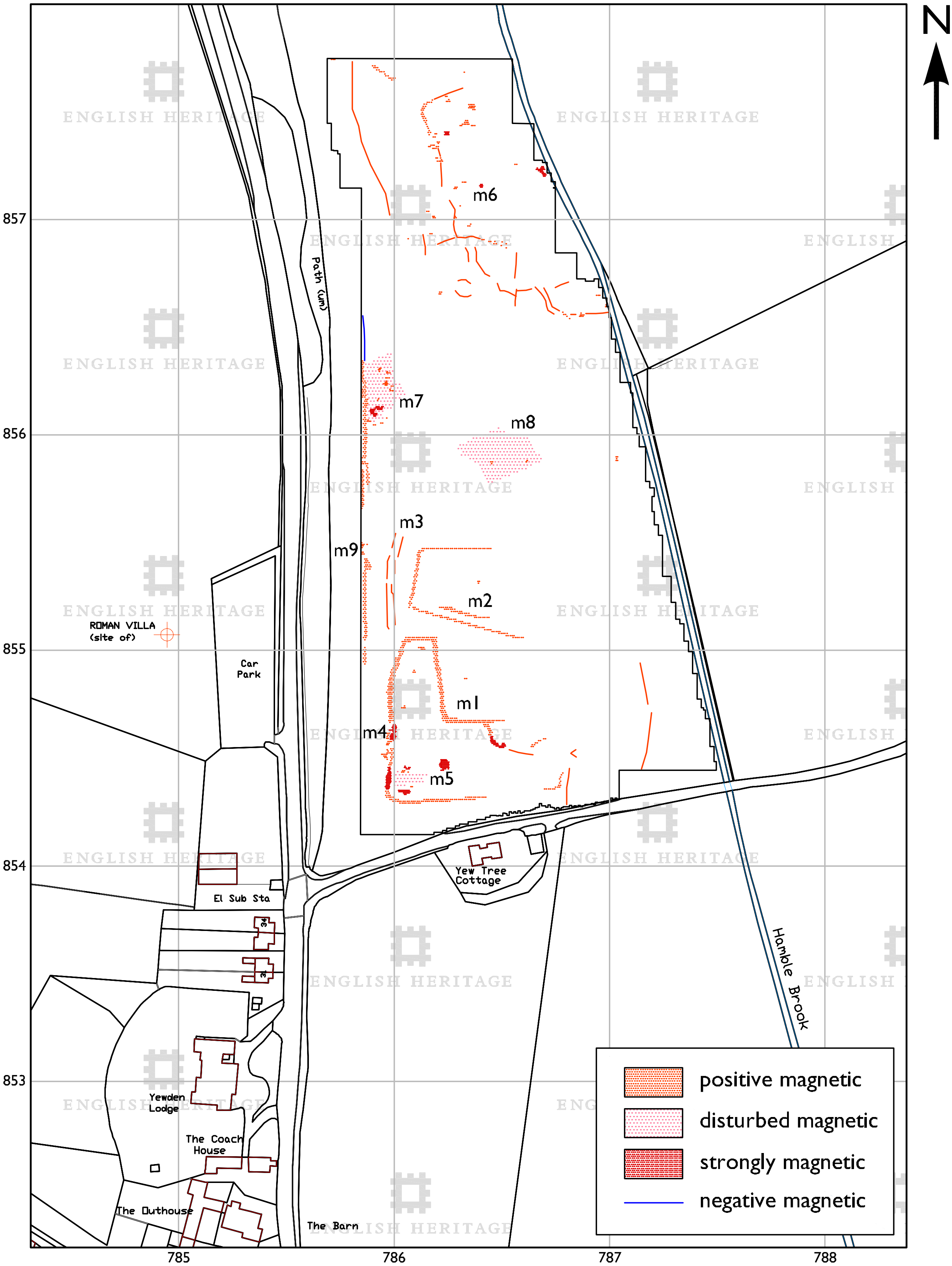
Figure 5

HORSELEYS FIELD, HAMBLEDEN, BUCKINGHAMSHIRE

Graphical summary of significant magnetic anomalies

SU 7885



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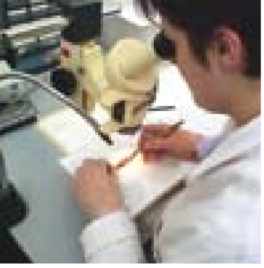
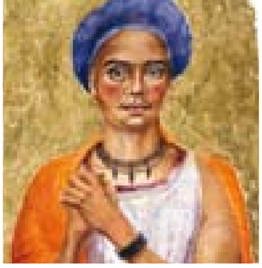



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