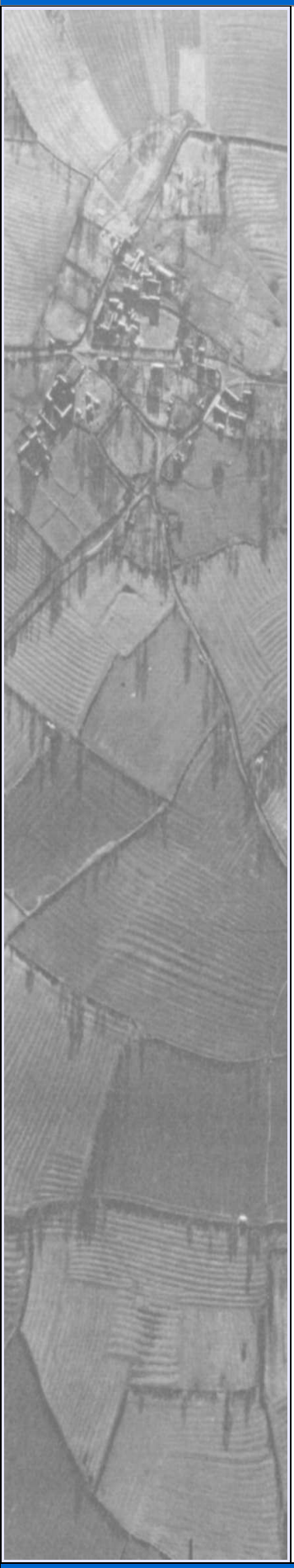

Warwick School
Myton Road
Warwick

MAGNETOMETER SURVEY REPORT

for

Archaeology Warwickshire

Kerry Donaldson & David Sabin

July 2018

Ref. no. J753

ARCHAEOLOGICAL SURVEYS LTD

Warwick School
Myton Road
Warwick

Magnetometer Survey Report

for

Archaeology Warwickshire

Fieldwork by David Sabin BSc (Hons) MCIfA
Report by Kerry Donaldson BSc (Hons)
Report checked by David Sabin
Primary archive location - Archaeological Surveys Ltd, Yatesbury, Wiltshire

Survey dates – 30th April & 30th May 2018
Ordnance Survey Grid Reference – **SP 29325 64430**

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SUMMARY

Detailed magnetometry was carried out by Archaeological Surveys Ltd within the sports fields at Warwick School. A Roman building had been recently discovered by Archaeology Warwickshire within the site, and the survey was commissioned in order to determine the archaeological potential of a part of the sports field that had been outlined for upgrading (Area 2). Further survey was also carried out in the wider area in order to assess the archaeological potential within the rest of the site (Areas 1, 3 & 4). The results demonstrate widespread magnetic contamination through use of the sports fields and probably ground consolidation and make-up. Although a number of positive discrete and linear anomalies have been located throughout the site, the majority lack a coherent morphology preventing confident interpretation. Subsequent evaluation within Area 2 revealed a number of cut features including possible enclosure ditches and gullies; however, there was no clear correlation between the evaluation and the geophysical survey results. One L-shaped positive linear anomaly within Area 3 may relate to a possible enclosure ditch that has been partially truncated by later ridge and furrow.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Archaeology Warwickshire, to undertake a magnetometer survey of an area of land at Warwick School. The site has been outlined for a proposed upgrading of the sports pitches and the survey forms part of an archaeological assessment of the site.

1.1.2 Within the school grounds, archaeological excavation by Archaeology Warwickshire has revealed a stone built Roman aisled barn or possible villa. The survey was commissioned initially to survey a sports pitch (Area 2) which is to be upgraded to the south east of the Roman building, with subsequent survey to be carried out over other available areas within the sports fields. Subsequent evaluation by Archaeology Warwickshire in Area 2, revealed a number of possible enclosure ditches and gullies that could not be identified within the geophysical survey. The results of the survey demonstrate that a significant proportion of the site is covered with magnetic contamination and there may be poor magnetic contrast associated with former cut features. As a consequence parts of the site were unsurveyed due to the likelihood that results would be poor.

1.2 Survey objectives and techniques

1.2.1 The objective of the survey was to use magnetometry to locate geophysical anomalies that may be archaeological in origin so that they may be assessed prior to the upgrading of the sports pitches and to inform any future land

management within the site.

1.2.2 The methodology is considered an efficient and effective approach to archaeological prospection.

1.2.3 Geophysical survey can provide useful information on the archaeological potential of a site; however, the outcome of any survey relies on a number of factors and as a consequence results can vary. The success in meeting the aims and objectives of a survey is, therefore, often impossible to predetermine.

1.3 Standards, guidance and recommendations for the use of this report

1.3.1 The survey and report generally follow the recommendations set out by: English Heritage (2008) *Geophysical survey in archaeological field evaluation;* European Archaeological Council (2015) *Guidelines for the Use of Geophysics in Archaeology;* Institute for Archaeologists (2002) *The use of Geophysical Techniques in Archaeological Evaluations*. The work has been carried out to the Chartered Institute for Archaeologists (2014) *Standard and Guidance for Archaeological Geophysical Survey.*

1.3.2 Archaeological Surveys Ltd provide a detailed geophysical survey report and it is recommended that where possible the contents should be considered in full. The Summary provides a brief overview of the results with more detail available in the Discussion and/or Conclusion. The *List of anomalies* within the Results provides a detailed assessment of the anomalies within separate categories which can be useful in inferring a level of confidence to the interpretation. Quality and factors influencing the interpretation of anomalies is also set out within the results.

1.3.3 It is recommended that the full report should always be considered when using data and interpretation plots; where this is not possible, in the field for example, the abstraction and interpretation plots should retain their colour coding and be used with a corresponding legend.

1.3.4 Where targeting of anomalies by excavation is to be carried out, care should be taken to place trenches over solid lines or features visible on the abstraction and interpretation plots. Archaeological Surveys abstraction and interpretation avoids the use of dashed or dotted lines; broken or fragmented anomalies may well correspond closely with subsurface truncation.

1.4 Site location, description and survey conditions

1.4.1 The site is located within the grounds of Warwick School, Myton Road in Warwick. It is centred on Ordnance Survey National Grid Reference (OS NGR) SP 29325 64430, see Figs 01 and 02.

1.4.2 The geophysical survey covers approximately 7ha within four main areas of

sports pitches. Area 1 lies in the eastern part of the site, Area 2 was the main area outlined for upgrading of the sports pitch, and Areas 3 and 4 were situated to the south west and east of the recently revealed Roman building.

1.4.3 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data; however, numerous modern sources of magnetic disturbance associated with sports paraphernalia were identified. Weather conditions during the survey were mainly fine.

1.5 Site history and archaeological potential

1.5.1 A new development, undertaken as part of the "Project One Campus" by Warwick Independent Schools Foundation, is being carried out within the school grounds in order to relocate King's High School to the main Warwick School campus. During archaeological investigations by Archaeology Warwickshire, sandstone foundations of a 28m by 14.5m Roman building were uncovered, which may form part of a substantial villa estate dating from the 2nd century. Evidence for corn drying ovens were also discovered, with the site falling out of use by the 4th century. There is, therefore, a high potential for the surrounding area to contain further archaeological features that may be associated with the possible villa complex.

1.6 Geology and soils

1.6.1 The underlying geology is Triassic siltstone, mudstone and sandstone from the Tarporley Siltstone Formation with overlying river terrace deposits across the majority of the site and alluvial deposits across Area 1 in the eastern part of the site (BGS, 2017).

1.6.2 The overlying soil across the majority of the site is from the Wick 1 association and is a typical brown earth. It consists of a deep, well drained, coarse, loamy and sandy soil, locally affected by groundwater. The soil across the southern half of Areas 2 and 3 is from the Dunnington Heath association and is a stagnogleyic, argillic brown earth. It consists of a reddish, coarse and fine loamy over clayey soil (Soil Survey of England and Wales, 1983).

1.6.3 The underlying geology and soils can be associated with low magnetic contrast and low levels of magnetic susceptibility due to high groundwater levels. However, cut features of archaeological potential may be located where human activity has altered the magnetic characteristics of the soil sufficiently. The underlying geology and soils are, therefore, considered acceptable for magnetic survey.

2 METHODOLOGY

2.1 Technical synopsis

2.1.1 Magnetometry survey records localised magnetic fields that can be associated with features formed by human activity. Magnetic susceptibility and magnetic thermoremnance are factors associated with the formation of localised fields. Additional details are set out below and within Appendix A.

2.1.2 Iron minerals within the soil may become altered by burning and the break down of biological material; effectively the magnetic susceptibility of the soil is increased, and the iron minerals become magnetic in the presence of the Earth's magnetic field. Accumulations of magnetically enhanced soils within features, such as pits and ditches, may produce magnetic anomalies that can be mapped by magnetic prospection.

2.1.3 Magnetic thermoremnance can occur when ferrous minerals have been heated to high temperatures such as in a kiln, hearth, oven etc. On cooling, a permanent magnetisation may be acquired due to the presence of the Earth's magnetic field. Certain natural processes associated with the formation of some igneous and metamorphic rock may also result in magnetic thermoremnance.

2.1.4 The localised variations in magnetism are measured as sub-units of the Tesla, which is a SI unit of magnetic flux density. These sub-units are nano Teslas (nT), which are equivalent to 10^{-9} Tesla (T).

2.2 Equipment configuration, data collection and survey detail

2.2.1 The detailed magnetic survey was carried out using a SENSYS MAGNETO®MXPDA 5 channel cart-based system. The instrument has 5 fluxgate gradiometers (FGM650) spaced 0.5m apart with readings recorded at 20 Hz. The cart is pushed at walking speed and not towed. Each sensor is not zeroed in the field as the vertical axis alignment is precisely fixed leaving sensor offsets that are removed during data processing. The fixing of the vertical alignment ensures the sensors are not unduly influenced by localised magnetic fields and that the vertical component of a magnetic anomaly is measured. The gradiometers have a range of recording data between ±0.1nT and ±10,000nT. They are linked to a Leica GS10 RTK GPS with data recorded by SENSYS MAGNETO®MXPDA software on a rugged PDA computer system.

2.2.2 Due to the fixed offsets within the fluxgate sensors, as a result of the manufacturing and tensioning process, the survey data do not provide a visually useful dataset until a zero median traverse algorithm is applied. It is recognised that this has the potential to affect some anomalies detrimentally by removing linear features orientated parallel to survey transects. However, this has not been noted as a particular problem with the system due to the high resolution data collection, generally long length of traverses and variability within the magnetic characteristics of a linear anomaly.

2.2.3 Data are collected along a series of parallel survey transects to achieve 100% coverage of the surveyable land. The length of each transect is variable and relates to the size of the survey area and other factors including ground conditions. A visual display allows accurate placing of transects and helps maintain the correct separation between adjacent traverses. Data are not collected within fixed grids and data points are considered to be random even though the data are collected in a systematic manner covering all accessible areas (Aspinall, Gaffney and Schmidt, 2009).

2.2.4 Fluxgate sensors are highly sensitive to temperature change and this manifests as drift during the course of a survey. This can be particularly noticeable during the morning as temperatures rise and the equipment warms or cools. Sensor drift within the course of a traverse will appear as a line trending from negative to positive after processing with a zero median traverse algorithm. To remove the potential for temperature drift, data were collected after a 20 minute stabilisation period and traverses were limited to a time of generally <100s.

2.3 Data processing and presentation

2.3.1 Magnetic data collected by the MAGNETO®MXPDA cart-based system are initially prepared using SENSYS MAGNETO®DLMGPS software. The software effectively allocates a geographic position for each data point and can compensate for fixed offsets present within the FGM650 sensors. The offsets are positive or negative values present on all fluxgate gradiometer sensors. Some systems use manual or electronic balancing to effectively zero the sensors; however, this is a short term measure that is prone to drift through temperature changes and vibration and can easily be incorrectly set due to localised magnetic fields. The FGM650 sensors are very accurately aligned to the vertical magnetic gradient and are highly stable showing negligible drift on long traverses. The offset values are removed using TerraSurveyor software.

2.3.2 Survey tracks are analysed and georeferenced raw data (UTM Z30N) are then exported in ASCII format for further analysis and display within TerraSurveyor. The removal of offset values (compensation) of the sensors is also carried out in TerraSurveyor using a zero median traverse function. Data are then considered to be minimally processed. Note: without the zero median traverse function it is not possible to create a meaningful data plot as all sensors have a different offset value. Although a zero median traverse algorithm can remove anomalies aligned with the survey tracks, in practice this rarely occurs due to the use of long traverses, high resolution measurement and variability within the magnetic susceptibility of long linear features.

2.3.3 The minimally processed data are collected between limits of ±10000nT and clipped for display at ±5nT for Areas 2, 3 and 4 and at ±20nT for Area 1. Data are interpolated to a resolution of effectively 0.5m between tracks and 0.15m along each survey track.

2.3.4 Additional data processing has been carried out in the form of high pass filtering. This effectively removes low frequency variation along a traverse that has been caused by large magnetic bodies, cultivation or rapid temperature change. Data treated to additional processing has been compared to unprocessed data to ensure that no significant anomalies have been removed.

2.3.5 Appendix C contains metadata concerning the survey and data attributes and is derived directly from TerraSurveyor. Reference should be made to Appendix B for further information on processing.

2.3.6 A TIF file is produced by TerraSurveyor software along with an associated world file (.TFW) that allows automatic georeferencing (OSGB36 datum) when using GIS or CAD software. The main form of data display used in the report is the minimally processed greyscale plot. With regard to the Sensys MXPDA, minimally processed data are considered by the manufacturer to be data that are compensated by SENSYS MAGNETO DLMGPS software, see 2.3.1 and 2.3.2. Note: traceplots are not considered to be appropriate as they do not provide an accurate or useful assessment of the magnetic anomalies due to the very high density of data collection.

2.3.7 The raster images are combined with base mapping using ProgeCAD Professional 2016, creating DWG (2010) file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical quality. The CAD plots are effectively georeferenced facilitating relocation of features using GPS, resection method, etc.

2.3.8 An abstraction and interpretation is drawn and plotted for all geophysical anomalies located by the survey. Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing. Appendix E sets out CAD layer names with colour and graphic content for each interpretation category, see 3.3.

2.3.9 A brief summary of each anomaly, with an appropriate reference number, is set out in list form within the results (Section 3) to allow a rapid and objective assessment of features within each survey area.

2.3.10 A digital archive is produced with this report, see Appendix D below. The main archive is held at the offices of Archaeological Surveys Ltd.

3 RESULTS

3.1 General assessment of survey results

3.1.1 The detailed magnetic survey was carried out over a total of four survey areas covering approximately 7ha.

3.1.2 Magnetic anomalies located can be generally classified as positive linear and discrete positive responses of archaeological potential, positive and negative anomalies of an uncertain origin, anomalies associated with land management, linear anomalies of an agricultural origin, areas of magnetic debris and disturbance, strong discrete dipolar anomalies relating to ferrous objects and strong multiple dipolar linear anomalies relating to buried services or pipelines.

3.1.3 Anomalies located within each survey area have been numbered and are described in 3.4 below.

3.2 Statement of data quality and factors influencing the interpretation of anomalies

3.2.1 Data are considered representative of the magnetic anomalies present within the site. There are no significant defects within the dataset.

3.2.2 Magnetic debris is widespread and likely to relate to modern ferrous and magnetically thermoremnant material within the soil. It has the potential to obscure weak anomalies of archaeological potential where it occurs in dense patches. Zones of magnetic disturbance surround modern ferrous objects/structures and also have the potential to obscure anomalies of archaeological potential.

3.2.3 Given the archaeological potential immediately adjacent to the survey areas, only a small number of low magnitude fragmented linear anomalies were located. The results of magnetic survey from other sites in the vicinity with similar geology and soil have demonstrated clear anomalies related to archaeological potential. It is considered possible that the soils at this site are subject to relatively high levels of ground water, and periodic waterlogging, which have produced comparatively poor conditions for the formation of magnetic anomalies.

3.3 Data interpretation

3.3.1 The list of sub-headings below attempts to define a number of separate categories that reflect the range and type of features located during the survey. A basic explanation of the characteristics of the magnetic anomalies is set out for each category in order to justify interpretation, see Table 1.

Interpretation category	Description and origin of anomalies
Anomalies with archaeological potential	Anomalies have the characteristics (mainly morphological) of a range of archaeological features such as pits, ring ditches, enclosures, etc. The category is used where there is a high level of confidence which may be due to additional supporting information where morphology is unclear or uncharacteristic.
Anomalies with an uncertain origin	The category applies to a range of anomalies where there is not enough evidence to confidently suggest an origin. Anomalies in this category may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered. Morphology may be unclear or uncharacteristic and there may be a lack of additional

	supporting information. Positive anomalies are indicative of magnetically enhanced soils that may form the fill of 'cut' features or may be produced by accumulation within layers or 'earthwork' features; soils subject to burning may also produce positive anomalies. Negative anomalies are produced by material of comparatively low magnetic susceptibility such as stone and subsoil.
Anomalies relating to land management	Anomalies are mainly linear and may be indicative of the magnetically enhanced fill of cut features (i.e. ditches). The anomalies may be long and/or form rectilinear elements and they may relate to topographic features or be visible on early mapping. Associated agricultural anomalies (e.g. headlands, plough marks and former ridge and furrow) may support the interpretation. Land drains can appear in a classic herringbone pattern of interconnected multiple dipolar linear anomalies, or as parallel linear anomalies. The multiple dipolar response indicates ceramic land drains.
Anomalies with an agricultural origin	The anomalies are often linear and form a series of parallel responses or are parallel to extant land boundaries. Where the response is broad, former ridge and furrow is likely; narrow response is often related to modern ploughing. This category does not include agricultural features of early date or considered to be of archaeological potential (e.g. animal stockades, enclosures, farmsteads, etc).
Anomalies associated with magnetic debris	Magnetic debris often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. They often occur where there has been dumping or ground make-up and are related to magnetically thermoremnant materials such as brick or tile or other small fragments of ferrous material. This type of response is occasionally associated with kilns, furnace structures, hearths and nail spreads from former wooden structures or rooves and may, therefore, be archaeologically significant. It is also possible that the response may be caused by natural material such as certain gravels and fragments of igneous or metamorphic rock. Strong discrete dipolar anomalies are responses to ferrous objects within the topsoil.
Anomalies with a modern origin	The magnetic response is often strong and dipolar indicative of ferrous material and may be associated with extant above surface features such as wire fencing, cables, pylons etc.. Often a significant area around these features has a strong magnetic flux which may create magnetic disturbance; such disturbance can effectively obscure low magnitude anomalies if they are present. Fluxgate sensors may respond erratically adjacent to strong magnetic sources. Buried services may produce characteristic multiple dipolar anomalies dependant upon their construction.

Table 1: List and description of interpretation categories

3.4 List of anomalies - Area 1

Area centred on OS NGR 429547 264497, see Figs 06 & 07.

Anomalies with an uncertain origin

(1) - A small number of positive responses are located close to the south eastern corner of the survey area. They are likely to relate to dumped material associated with nearby magnetic debris.

Anomalies associated with land management

(2) - A series of weakly positive linear anomalies appear to be contained within a former bounded sports field area. They may relate to land drains or possibly former ridge and furrow cultivation.

Anomalies associated with magnetic debris

(3) - The majority of the survey area contains very strongly magnetic debris which has been dumped on site and used for ground consolidation or make-up. It is possible that it has obscured weaker anomalies.

(4) - Widespread and numerous strong, discrete, dipolar anomalies are responses to ferrous and other magnetically thermoremnant objects. They are located within all of the survey areas.

3.5 List of anomalies - Area 2

Area centred on OS NGR 429305 264430, see Figs 08 & 09.

Anomalies with an uncertain origin

(5) - The survey area contains a small number of positive anomalies, with a group that includes some negative responses. They lack a coherent morphology preventing confident interpretation as cut features, some may relate to the use of the site as a sports field.

(6) - A band of weakly positive amorphous responses extends through the eastern part of the survey area. The origin of the anomalies is uncertain.

Anomalies with an agricultural origin

(7) - A series of parallel linear anomalies relate to former ridge and furrow.

Anomalies with a modern origin

(8) - Pairs of strong, discrete, dipolar anomalies and associated magnetic disturbance are a response to goal posts. A line of strong, discrete, dipolar responses along the eastern edge of the survey area may relate to a former fence line.

3.6 List of anomalies - Area 3

Area centred on OS NGR 429143 264328, see Figs 08 & 09.

Anomalies of archaeological potential

(9) - An L-shaped, fragmented positive linear anomaly is located in the south western part of Area 3. It appears to have been truncated by ridge and furrow (15) which would indicate that it pre-dates this type of arable cultivation. The anomaly may relate to an enclosure ditch.

(10) - Adjacent to anomaly (9) are a number of discrete positive responses. They appear to relate to pit-like features and their close proximity to anomaly (9) may support the possibility of them relating to archaeological features.

Anomalies with an uncertain origin

(11) - A number of pit-like responses have been located within the survey area. Due to widespread magnetic contamination it is not possible to clearly determine their origin. While they may relate to relatively modern responses, an archaeological origin is possible.

(12) - A positive linear anomaly is located in the northern part of the survey area. While it may be associated with former ridge and furrow, it may relate to a ditch-like feature with a possible archaeological origin.

(13) - A number of positive linear anomalies have been located, with several in the northern part of the survey area. However, the widespread magnetic contamination and lack of coherent morphology prevents confident interpretation.

Anomalies associated with land management

(14) - A positive linear anomaly extends cross the survey area and relates to a formerly mapped field boundary.

Anomalies with an agricultural origin

(15) - A series of parallel linear anomalies relate to former ridge and furrow cultivation. They appear to have truncated anomaly (9).

Anomalies associated with magnetic debris

(16) - Magnetic debris is very widespread in the northern part of the survey area, with patches in the east and west also. The magnetic debris may have obscured any weaker anomalies in the vicinity.

3.7 List of anomalies - Area 4

Area centred on OS NGR 429251 264557, see Figs 10 & 11

Anomalies with an uncertain origin

(17) - The survey area contains a number of positive linear and discrete anomalies, While these may relate to cut features, their lack of coherent morphology and the modern magnetic contamination, especially in the northern part of the site, prevents confident interpretation.

(18 & 19) - A number of very weakly positive linear anomalies can be seen within the survey area. This type of response can relate to agricultural activity, but they cross the ridge and furrow (20). One positive linear anomaly (19), may be an extension of the pipe (21).

Anomalies with an agricultural origin

(20) - Parallel linear anomalies relate to former ridge and furrow.

Anomalies with a modern origin

(21) - A number of services are evident in the northern part of the survey area.

4 CONCLUSION

4.1.1 Detailed magnetometry was carried out within an area outlined for upgrading of a sports pitch (Area 2) with further survey carried out elsewhere within the existing sports fields in order to further understanding of the archaeological potential of the wider site. Although several weakly positive anomalies were located within Area 2, they lack a clear morphology and cannot be confidently interpreted. The entire site is subject to widespread magnetic contamination and this may have obscured weaker anomalies.

4.1.2 A fragmented positive linear anomaly in the south western part of the site (Area 3) appears to relate to a possible enclosure ditch that has been truncated by later ridge and furrow. A number of adjacent pits may be associated with the enclosure ditch. Elsewhere, a number of positive linear and discrete anomalies have been located, but it has not been possible to provide additional interpretation.

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Appendix A – basic principles of magnetic survey

Iron minerals are always present to some degree within the topsoil and enhancement associated with human activity is related to increases in the level of magnetic susceptibility and thermoremnant material. Magnetic susceptibility is an induced magnetism within a material when it is in the presence of a magnetic field. This can be thought of as effectively permanent due to the presence of the Earth's magnetic field. Thermoremnant magnetism occurs when ferrous material is heated beyond a specific temperature known as the Curie Point. Demagnetisation occurs at this temperature with re-magnetisation by the Earth's magnetic field upon cooling.

Enhancement of magnetic susceptibility can occur in areas subject to burning and complex fermentation processes on biological material; these are frequently associated with human settlement. Thermoremnant features include ovens, hearths, and kilns. In addition thermoremnant material such as tile and brick may also be associated with human activity and settlement.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil can create an area of enhancement compared with surrounding soils and subsoils into which the feature is cut. Mapping enhanced areas will produce linear and discrete anomalies allowing an assessment and characterisation of hidden subsurface features.

It should be noted that areas of negative enhancement can be produced from material having lower magnetic properties compared to the topsoil. This is common for many sedimentary bedrocks and subsoils which were often used in the construction of banks and walls etc. Mapping these 'negative' anomalies may also reveal archaeological features.

Magnetic survey or magnetometry can be carried out using a fluxgate gradiometer and may be referred to as gradiometry. The SENSYS gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 65cm apart. The instrument is carried about 10-20cm above the ground surface and the upper sensor measures the Earth's magnetic field as does the lower sensor but this is influenced to a greater degree by any localised buried magnetic field. The difference between the two sensors will relate to the strength of the magnetic field created by the buried feature.

There are a number of factors that may affect the magnetic survey and these include soil type, local geology and previous human activity. Situations arise where magnetic disturbance associated with modern services, metal fencing, dumped waste material etc., obscures low magnitude fields associated with archaeological features.

Appendix B – data processing notes

Clipping

Minimum and maximum values are set and replace data outside of the range with those values. Extreme values are removed improving colour or greyscale contrast associated with data values that may be archaeologically significant. It has been found that clipping data to ranges between ±5nT and ±3nT often improves the appearance of features associated with archaeology. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

Zero (destripe) Median/Mean Traverse

The median (or mean) of each traverse is calculated ignoring data outside a threshold value, the median (or mean) is then subtracted from the traverse. The process is used to equalise differences between the baseline value of gradiometer sensors.

High Pass Filtering

A mathematical process used to remove low frequency anomalies relating to survey tracks, modern agricultural features and other large magnetic bodies within or adjacent to survey areas.

Low Pass Filtering

A mathematical process used to remove high frequency anomalies relating to uneven ground, vibration, etc.

Appendix C – survey and data information

Area 1 minimally processed data

Filename: J753-mag-Area1-proc.xcp
Description: Imported as Composite from: J753-mag-Area1.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y): OSGB36
Northwest corner: 429465.91, 264574.58 m
Southeast corner: 429632.41, 264426.83 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702
Source GPS Points: 380700
Dimensions
Composite Size (readings): 1110 x 985
Survey Size (meters): 167 m x 148 m
Grid Size: 167 m x 148 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 22.10
Min: -22.00
Std Dev: 9.60
Mean: 0.11
Median: 0.21
Composite Area: 2.46 ha
Surveyed Area: 1.3904 ha
PROGRAM
Name: TerraSurveyor
Version: 3.0.23.0
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -20.00 to 20.00 nT

Area 1 filtered data

Filename: J753-mag-Area1-proc-hpf.xcp
Max: 22.10
Min: -22.00
Std Dev: 9.35
Mean: 0.19
Median: 0.13
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -20.00 to 20.00 nT

Area 2 minimally processed data

Filename: J753-mag-Area2-proc.xcp
Description: Imported as Composite from: J753-mag-Area2.asc
Northwest corner: 429231.38, 264515.04 m
Southeast corner: 429383.03, 264341.04 m
Source GPS Points: 380400
Composite Size (readings): 1011 x 1160
Survey Size (meters): 152 m x 174 m
Grid Size: 152 m x 174 m
X Interval: 0.15 m
Y Interval: 0.15 m
Max: 5.53
Min: -5.50
Std Dev: 2.71
Mean: -0.18
Median: 0.09
Composite Area: 2.6387 ha
Surveyed Area: 1.4111 ha
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -5.00 to 5.00 nT

Area 2 filtered data

Filename: J753-mag-Area2-proc-hpf.xcp
Max: 5.53
Min: -5.50
Std Dev: 2.57
Mean: -0.16
Median: 0.05
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -5.00 to 5.00 nT

Area 3 minimally processed data

Filename: J753-mag-Area3-proc.xcp
Description: Imported as Composite from: J753-mag-Area3.asc
Northwest corner: 429020.37, 264432.75 m
Southeast corner: 429275.52, 264227.55 m
Source GPS Points: 683600
Composite Size (readings): 1701 x 1368
Survey Size (meters): 255 m x 205 m
Grid Size: 255 m x 205 m
X Interval: 0.15 m
Y Interval: 0.15 m
Max: 5.53
Min: -5.50
Std Dev: 2.50
Mean: -0.13
Median: 0.03
Composite Area: 5.2357 ha
Surveyed Area: 2.677 ha
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -5.00 to 5.00 nT

Area 3 filtered data

Filename: J753-mag-Area3-proc-hpf.xcp
Max: 5.53
Min: -5.50
Std Dev: 2.36
Mean: -0.09
Median: 0.00
Composite Area: 5.2357 ha
Surveyed Area: 2.677 ha
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -5.00 to 5.00 nT

Area 4 minimally processed data

Filename: J753-mag-Area4-proc.xcp
Description: Imported as Composite from: J753-mag-Area4.asc
Northwest corner: 429185.66, 264642.31 m
Southeast corner: 429338.965, 264457.51 m
Source GPS Points: 365800
Composite Size (readings): 1022 x 1232
Survey Size (meters): 153 m x 185 m
Grid Size: 153 m x 185 m
X Interval: 0.15 m
Y Interval: 0.15 m
Max: 5.53
Min: -5.50
Std Dev: 3.14
Mean: 0.04
Median: 0.08
Composite Area: 2.833 ha
Surveyed Area: 1.3725 ha
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -5.00 to 5.00 nT

Area 4 filtered data

Filename: J753-mag-Area4-proc-hpf.xcp
Stats
Max: 5.53
Min: -5.50
Std Dev: 2.63
Mean: -0.06
Median: 0.01
Composite Area: 2.833 ha
Surveyed Area: 1.3725 ha
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -5.00 to 5.00 nT

Appendix D – digital archive

Archaeological Surveys Ltd hold the primary digital archive at their offices in Wiltshire. Data are backed-up onto an on-site data storage drive and at the earliest opportunity data are copied to CD ROM for storage on-site and off-site.

Three printed copies of the report and a PDF copy will be supplied to the Warwickshire Historic Environment Record. The report will also be uploaded to the Online AccesS to the Index of archaeological investigationS (OASIS). A summary of the survey will also be supplied to *West Midlands Archaeology.*

Archive contents:

File type	Naming scheme	Description
Data	J753-mag-**[area number/name]**.asc J753-mag-**[area number/name]**.xcp J753-mag-**[area number/name]**-proc.xcp J753-mag-**[area number/name]**-proc-hpf.xcp	Raw data as ASCII CSV TerraSurveyor raw data TerraSurveyor minimally processed data TerraSurveyor high pass filtered data
Graphics	J753-mag-**[area number/name]**-proc.tif J753-mag-**[area number/name]**-proc-hpf.tif	Image in TIF format
Drawing	J753-**[version number]**.dwg	CAD file in 2010 dwg format
Report	J753 report.odt	Report text in Open Office odt format

Table 2: Archive metadata

Appendix E – CAD layers for abstraction and interpretation plots

The table below sets out Archaeological Surveys Ltd CAD layer names with associated colours and graphical content. Where CAD files are available layers may be extracted for further CAD/GIS use. Note: hatched polygon boundaries are contained within layers with the RGB colour code 254, 255, 255 (near white) in order to prevent their visibility.

Report sub-heading and associated CAD layer names	Colour with RGB index		Layer content
Anomalies with archaeological potential			
AS-ABST MAG POS DISCRETE ARCHAEOLOGY		Red 255,0,0	Solid donut, point or polygon (solid)
AS-ABST MAG POS ENCLOSURE DITCH		127,0,255	Line, polyline or polygon (solid)
Anomalies with an uncertain origin			
AS-ABST MAG POS LINEAR UNCERTAIN		255,127,0	Line, polyline or polygon (solid)
AS-ABST MAG NEG LINEAR UNCERTAIN		Blue 0,0,255	Line, polyline or polygon (solid)
AS-ABST MAG POS DISCRETE UNCERTAIN		255,127,0	Solid donut, point or polygon (solid)
AS-ABST MAG POS UNCERTAIN		255,127,0	Polygon (cross hatched ANSI37)
Anomalies relating to land management			
AS-ABST MAG BOUNDARY		127,0,0	Line, polyline or polygon (solid or cross hatched ANSI37)
Anomalies with an agricultural origin			
AS-ABST MAG RIDGE AND FURROW		0,127,63	Line, polyline or polygon (cross hatched ANSI37)
Anomalies associated with magnetic debris			
AS-ABST MAG DEBRIS		132, 132, 132	Polygon (cross hatched ANSI37)
AS-ABST MAG STRONG DIPOLAR		132, 132, 132	Solid donut, point or polygon (solid)
Anomalies with a modern origin			
AS-ABST MAG DISTURBANCE		132, 132, 132	Polygon (hatched ANSI31)
AS-ABST MAG SERVICE		132, 132, 132	Line or polyline

Table 3: CAD layering

Appendix F – copyright and intellectual property

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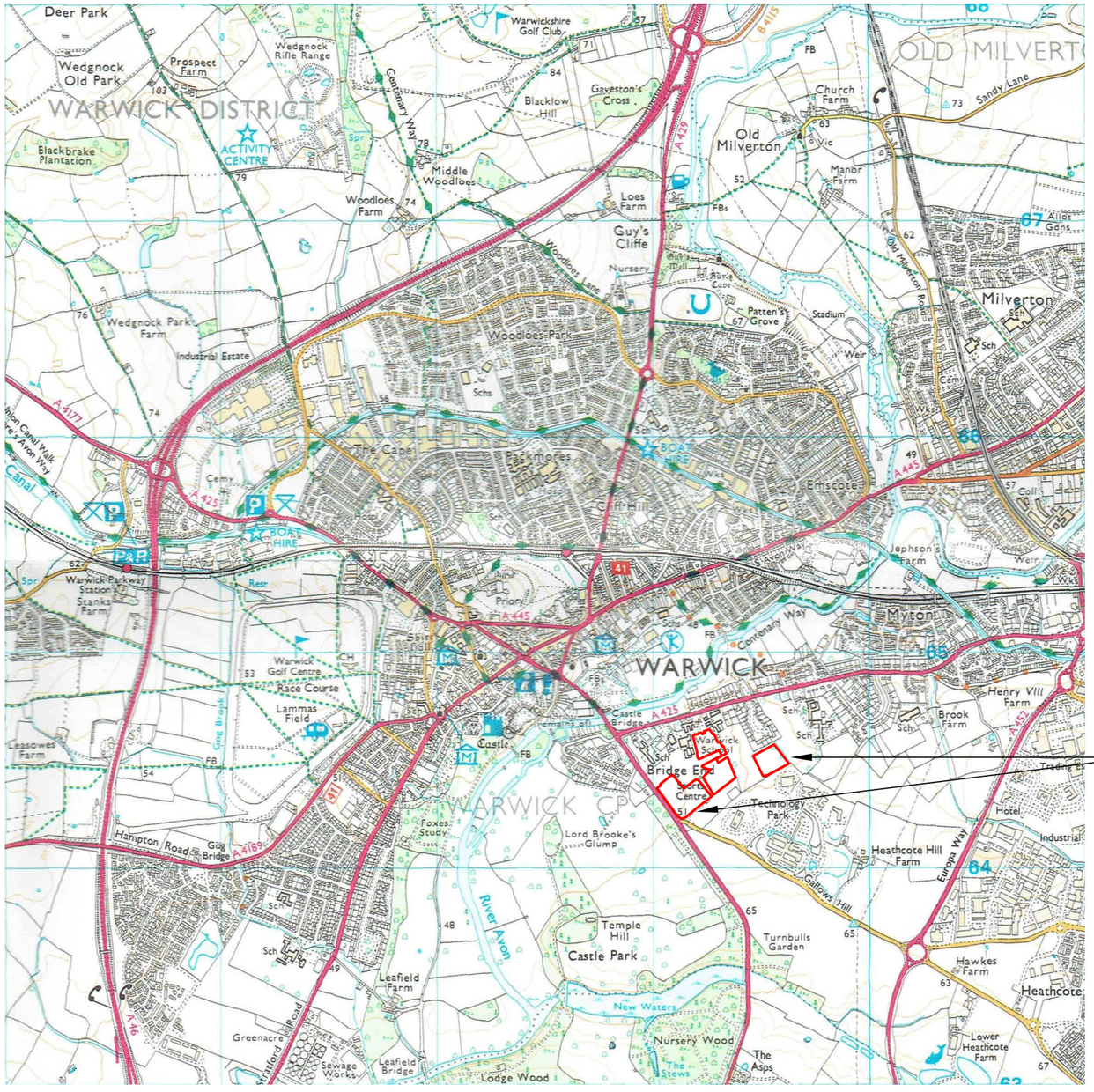
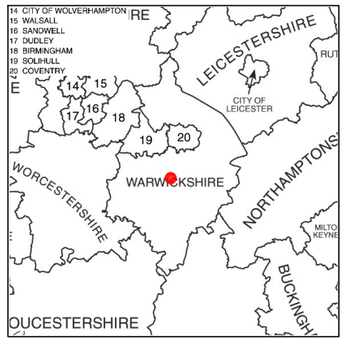


Survey location

Archaeological Surveys Ltd

Geophysical Survey
Warwick School
Myton Road
Warwick

Map of survey area



● Survey location

Site centred on OS NGR
SP 29325 64430

SCALE 1:25 000

0m 500m 1000m

SCALE TRUE AT A3

FIG 01

Archaeological Surveys Ltd

Geophysical Survey
Warwick School
Myton Road
Warwick

Referencing information

Referencing grid to OSGB36 datum at 50m intervals

Data collected at 20Hz and georeferenced to ETRS89 zone 30 with conversion to OSGB36 using OSTN02

● 429300 264400

Area 1

Area 2

Area 3

Area 4

429000 429050 429100 429150 429200 429250 429300 429350 429400 429450 429500 429550 429600

264700 264650 264600 264550 264500 264450 264400 264350 264300 264250 264200

N

SCALE 1:2000

0m 20 40 60 80 100m

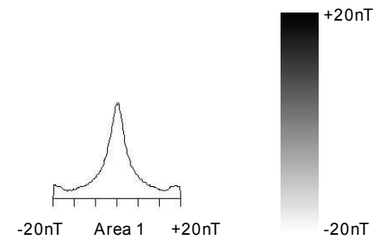
SCALE TRUE AT A3

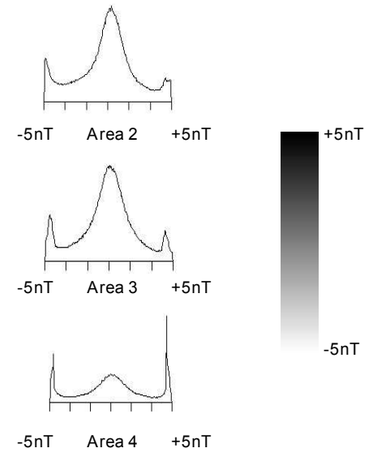
FIG 02

Archaeological Surveys Ltd

Geophysical Survey
Warwick School
Myton Road
Warwick

Greyscale plot of minimally processed magnetometer data





SCALE 1:2000

0m 20 40 60 80 100m

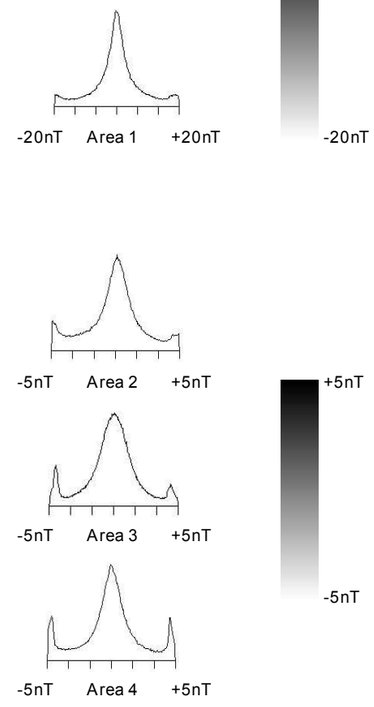
SCALE TRUE AT A3

FIG 03

Archaeological Surveys Ltd

Geophysical Survey
Warwick School
Myton Road
Warwick

Greyscale plot of filtered magnetometer data



Area 1

Area 2

Area 3

Area 4

N

SCALE 1:2000

0m 20 40 60 80 100m

SCALE TRUE AT A3

FIG 04

Archaeological Surveys Ltd

Geophysical Survey
Warwick School
Myton Road
Warwick

Abstraction and interpretation of magnetic anomalies

- Positive rectilinear anomaly - possible enclosure with archaeological potential
- Positive linear anomaly - possible ditch-like feature
- Negative linear anomaly - material of low magnetic susceptibility
- Linear anomaly - ridge and furrow
- Positive linear anomaly - former field boundary
- Positive linear anomaly - possible land drain
- Discrete positive response - pit-like feature with archaeological potential
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Multiple dipolar linear anomaly - service/cable
- Strong dipolar anomaly - ferrous object

SCALE 1:2000

0m 20 40 60 80 100m

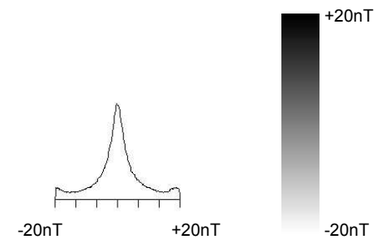
SCALE TRUE AT A3

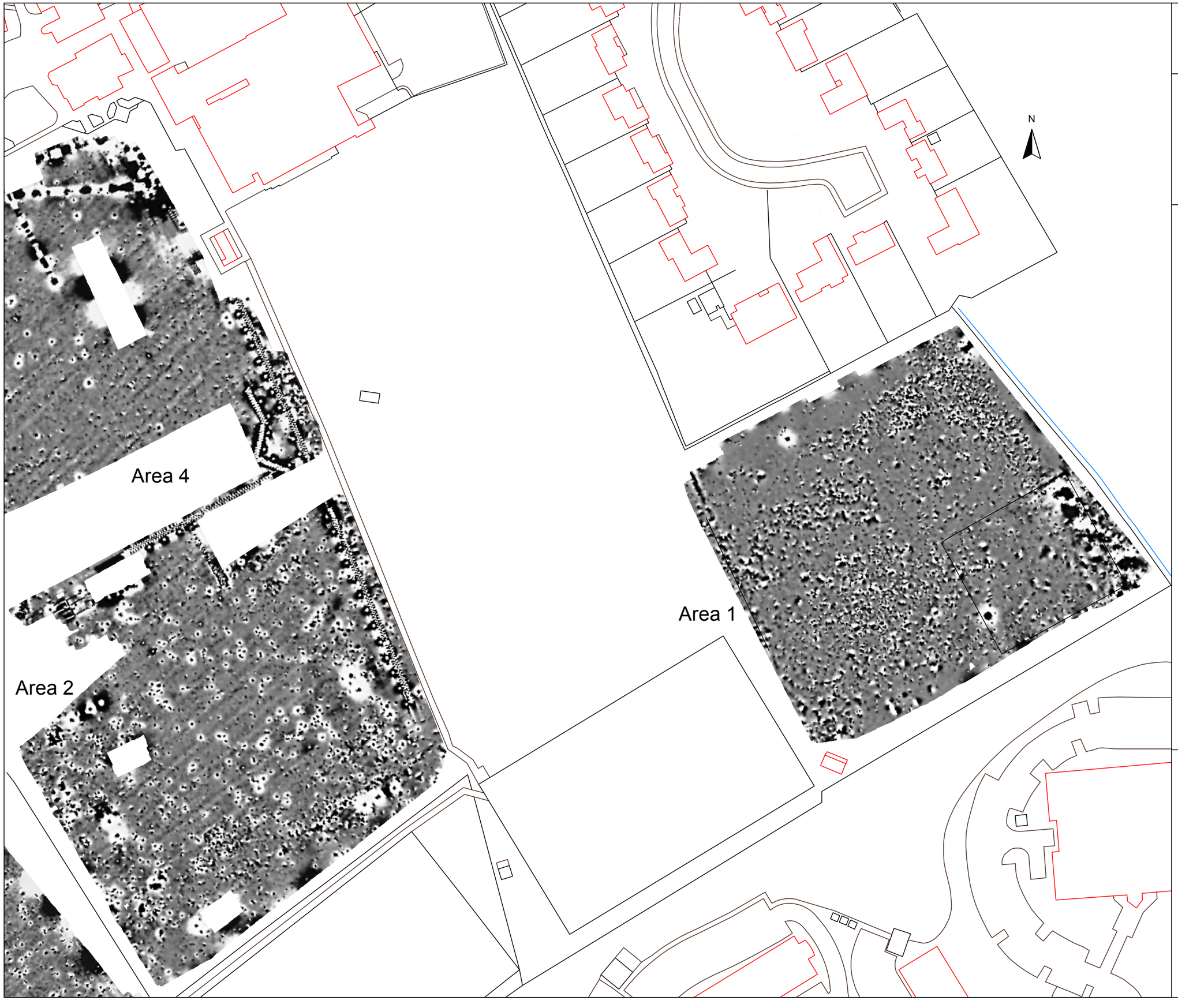
FIG 05

Archaeological Surveys Ltd

Geophysical Survey
Warwick School
Myton Road
Warwick

Greyscale plot of filtered magnetometer data - Area 1





SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 06

Archaeological Surveys Ltd

Geophysical Survey
Warwick School
Myton Road
Warwick

Abstraction and interpretation of magnetic anomalies - Area 1

- Positive linear anomaly - possible ditch-like feature
- Positive linear anomaly - possible land drain
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 07

Area 4

Area 2

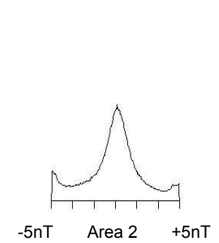
Area 3

N

Archaeological Surveys Ltd

Geophysical Survey
Warwick School
Myton Road
Warwick

Greyscale plot of filtered magnetometer data - Areas 2 & 3



SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 08

Archaeological Surveys Ltd

Geophysical Survey
Warwick School
Myton Road
Warwick

Abstraction and interpretation of magnetic anomalies - Areas 2 & 3

- Positive rectilinear anomaly - possible enclosure with archaeological potential
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - ridge and furrow
- Positive linear anomaly - former field boundary
- Negative linear anomaly - material of low magnetic susceptibility
- Discrete positive response - pit-like feature of archaeological potential
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - service / cable
- Strong dipolar anomaly - ferrous object

SCALE 1:1250

0m 10 20 30 40 50m

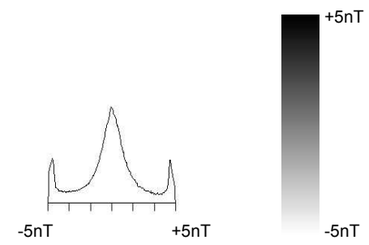
SCALE TRUE AT A3

FIG 09

Archaeological Surveys Ltd

Geophysical Survey
Warwick School
Myton Road
Warwick

Greyscale plot of filtered magnetometer data - Area 4



N

Area 4

Area 2

Area 3

SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 10

Archaeological Surveys Ltd

Geophysical Survey
Warwick School
Myton Road
Warwick

Abstraction and interpretation of magnetic anomalies - Area 4

N

Area 4

Area 2

Area 3

21
17
19
18
20
5
6
7
8
12
16
14
13
11

- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - ridge and furrow
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - service / cable
- Strong dipolar anomaly - ferrous object

SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 11