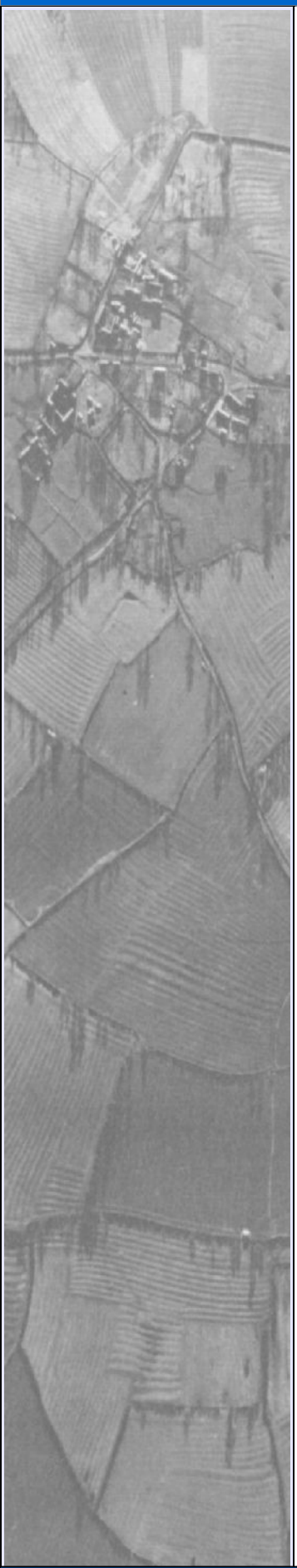

Highnam Farm
Highnam
Gloucestershire

MAGNETOMETER SURVEY REPORT

for

Cotswold Archaeology

Kerry Donaldson & David Sabin

December 2016

Ref. no. J697

ARCHAEOLOGICAL SURVEYS LTD

Highnam Farm
Highnam
Gloucestershire

Magnetometer Survey Report

for

Cotswold Archaeology

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 – 1st, 2nd, 5th, 8th & 9th December 2016
Ordnance Survey Grid Reference – **SO 78340 19345**

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SUMMARY

A detailed magnetometer survey was carried out by Archaeological Surveys Ltd over an area of land at Highnam in Gloucestershire ahead of a proposed solar farm development. The survey located a number of positive linear and discrete anomalies and a possible curvilinear response that generally lack a coherent morphology preventing confident interpretation. Several other uncertain linear anomalies may relate to former field boundaries and other anomalies relate to formerly mapped field boundaries as well as land drains and agricultural activity. Magnetic debris is widespread but most notable in the central northern part of the site. It is associated with iron slag that could be consistent with iron production, although the geophysical survey has not provided clear evidence of surviving industrial structures within the site.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Cotswold Archaeology to undertake a magnetometer survey of an area of land at Highnam Farm, Highnam, Gloucestershire. The site has been outlined for a proposed development of a solar farm and the survey forms part of an archaeological assessment of the site.

1.1.2 The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Archaeological Surveys (2016) and approved by Charles Parry, Archaeologist for Gloucestershire County Council, prior to commencing the survey.

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 development of the site. The methodology is considered an efficient and effective approach to archaeological prospection.

1.2.2 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 Site location, description and survey conditions

1.3.1 The site is located at Highnam Farm, to the west of Two Mile Lane and north of the A40, Highnam, Gloucestershire. It is centred on Ordnance Survey National Grid Reference (OS NGR) SO 78340 19345 , see Figs 01 and 02.

1.3.2 The geophysical survey covers approximately 16ha within the western part of a single arable field that contained stubble at the time of survey. The survey area covers the solar arrays, construction compound and an access track extending westwards from the eastern field boundary. The site contains several mature trees which are located along the lines of former field boundaries. The survey area is generally flat with a slight slope down towards the south and east. There is a shallow depression within the central northern part of the area.

1.3.3 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data. Weather conditions during the survey were mainly fine.

Plate 1: Survey area looking north west

1.4 Site history and archaeological potential

1.4.1 A Historic Environment Assessment has been carried out for the site (CgMs, 2014) which outlines that there are no designated or undesignated heritage assets within the site and that it has not been subject to previous archaeological investigations.

1.4.2 Situated approximately 300m east of the site is the location of a Romano-British pottery scatter (HER 5667), and the A40, bounding the southern part of the site, is thought to follow the line of a Roman road (NMR 1161622) with other possible sections of Roman road recorded within 1km of the site. The main focus for medieval settlement was around the village of Highnam and

Highnam Court with ridge and furrow indicated in the fields to the north and east of the site and the ancient woodlands of Highnam Woods bounding the site to the west. The site of a Holy Well (HER 36422) is located at the south east corner. There is Civil War activity including the siege of Highnam House (HER 28415) to the east and Civil war earthworks just to the south west of the site (HER 7127). Early mapping shows the site split into at least 10 land parcels, although all were removed in the 20th century.

1.4.3 From the desk-based evidence it appears that there is a low potential for the site to contain archaeological remains other than those from the Roman period. The site may also contain evidence for agricultural activity and formerly mapped land boundaries. However, there is always potential for the survey to locate geophysical anomalies that relate to previously unrecorded archaeological features, should they be present within the site.

1.4.4 The surface conditions within the site were suitable for the observation of cultural material during the course of the survey, although both low angle sunlight and more dense areas of stubble, leaves, etc. often restricted the amount of the soil surface that was visible. Iron slag was frequently observed over much of the site but with a concentration in the central northern part. The slag was dense and heavy indicating a high iron content and occasionally contained evidence of a molten flow. Some of the larger pieces were approximately fist-sized. The material also appeared abraded and weathered perhaps indicative of age.

1.4.5 No significant scatters of pottery were noted across the site. No material identifiable as Romano-British was observed. Several sherds were identifiable as late medieval to early post medieval (black glazes).

1.4.6 The central eastern part of the site contained a dense scatter of Lias Limestone in the south eastern corner of a former field. The material may relate to a former structure or ground consolidation. A pre-decimal halfpenny of George V was observed within the scatter. A fragment of anti-aircraft shell was also observed nearby. A WWII heavy anti-aircraft battery was located a short distance to the east of the site (HER 27046).

1.5 Geology and soils

1.5.1 The underlying solid geology across the site are Lower Lias Clays (Blue Lias Formation and Charmouth Mudstone Formation) with no mapped overlying deposits, but 4th River Terrace sands and gravels located to the north east (BGS, 1975). Observations during the survey indicated the presence of pebbles and sandy material suggesting at least a thin layer of overlying superficial deposits.

1.5.2 The overlying soil across the survey area is from the Evesham 1 association and is a typical calcareous pelosol. It consists of a slowly permeable calcareous clayey soil (Soil Survey of England and Wales, 1983). The

possible presence of a thin layer of superficial deposits may have altered the characteristics of the soil.

1.5.3 Magnetometry survey carried out across similar soils has produced variable results. At times there can be a low magnetic contrast between the fill of cut features and the material into which they are cut; however, areas containing long term occupation and/or industrial activity can result in magnetically enhanced features. 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 is manifest 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 ±3nT. Data are interpolated to a resolution of effectively 0.5m between tracks and 0.15m along each survey track.

2.3.4 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.

2.3.5 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 is considered by the manufacturer to be data that is 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 very high density of data collection.

2.3.6 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.

2.3.7 An abstraction and interpretation is also 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.

2.3.8 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 the survey area. Where further interpretation is possible, or where a number of possible origins should be considered, more subjective discussion is set out in Section 4.

2.3.9 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 approximately 16ha within the western half of a single arable field.

3.1.2 Magnetic anomalies located can be generally classified as positive 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 have been numbered and are described below with subsequent discussion in Section 4.

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 Widespread low to moderately strong magnetic debris is present across the site. This relates to the iron slag referred to in 1.4.4. Some individual pieces of slag were tested with the magnetometer and gave a strong response. The widespread distribution of the magnetic debris, and its association with former cultivation marks, may indicate significant truncation and disturbance by arable cultivation.

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, a basic key is indicated to allow cross referencing to the abstraction and interpretation plot. CAD layer names are included to aid reference to associated digital files (.dwg/.dxf). Sub-headings are then used to group anomalies with similar characteristics within the survey area.

Report sub-heading **CAD layer names and plot colour**	**Description and origin of anomalies**
Anomalies with an uncertain origin AS-ABST MAG POS LINEAR UNCERTAIN AS-ABST MAG POS DISCRETE UNCERTAIN AS-ABST MAG POS UNCERTAIN 	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. 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 AS-ABST MAG BOUNDARY AS-ABST MAG LAND DRAIN	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 a ceramic land drain.
Anomalies with an agricultural origin AS-ABST MAG AGRICULTURAL	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.
Anomalies associated with magnetic debris AS-ABST MAG DEBRIS AS-ABST MAG STRONG DIPOLAR	Magnetic debris often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. It often occurs where there has been dumping or ground make-up and is 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, or hearths 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 AS-ABST MAG DISTURBANCE AS-ABST MAG SERVICE	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 such 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 and with hysteresis 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 centred on OS NGR 378340 219345, see Figs 03 – 10.

Anomalies with an uncertain origin

(1) - Located at the western end of the proposed access track are weakly positive linear anomalies possibly forming a curvilinear feature (Fig 06). It is located 9m north west of an "L" shaped positive linear anomaly with a pit-like response to the north. Although the morphology is not clear, an archaeological origin should be considered for these anomalies.

(2) - A positive linear anomaly and a number of discrete positive responses can be seen crossing the central part of the proposed access track (Fig 06). The linear anomaly is parallel with other former field boundaries, such as (9); however, none have been mapped in this position since 1841. It is not certain if it relates to a boundary removed prior to 1841 or an earlier feature.

(3) - At the eastern end of the proposed access track is a positive linear anomaly oriented west south west to east north east. It appears to end abruptly at a strong dipolar response, and it is possible that it is associated with a former field boundary, mapped in the 1840s.

(4) - To the east of anomaly (3) are a number of parallel positive linear anomalies. Due to the limited width of the access track it is not possible to determine the full extent and layout of the anomalies, and while unmapped field boundaries may be possible for some, their archaeological potential should be considered.

(5) - A zone containing positive curvilinear and discrete responses is located in the southern part of the site (Fig 06). A similar but smaller zone is located a short distance to the east. Although the anomalies are not clear, it is possible that they have an archaeological origin.

(6) - In the central eastern part of the survey area are weakly positive responses. Their morphology is unclear, and while an association with agricultural activity is possible, the origin of the magnetic enhancement is uncertain.

(7) - In the northern part of the survey area is a positive linear anomaly (Fig 10). A former field boundary is mapped in the vicinity in the 1840s, but it is not clear if this is associated.

(8) - A number of weak, discrete, positive anomalies are located within the survey area. Several are close to ceramic land drains and it is possible that they relate to broken land drains.

Anomalies associated with land management

(9-14) - The survey area contains a number of weakly positive linear anomalies that relate to formerly mapped field boundaries. However, anomaly (9) extends further north than has been previously mapped and indicates that it was removed prior to the 1840s.

(15 & 16) - The site contains ceramic land drains, oriented in a herringbone pattern (15) in the northern part of the site and parallel with the western field boundary (16) further south.

Anomalies with an agricultural origin

(17) - In the northern part of the survey area, a group of closely spaced (2.5-3m) parallel linear anomalies are more magnetically enhanced then other agricultural anomalies (18). They appear to have been truncated by land boundary (14) and

although it is possible that they may relate to ridge and furrow, they are very closely spaced. A patch of magnetic debris is evident to the south (20) and slag was widespread within this zone of agricultural anomalies (see 1.4.4) The linear anomalies may well have been formed by spreading of magnetically enhanced soil during cultivation. If the slag relates to early iron smelting then it is possible that temporary structures associated with this have been truncated and spread within the topsoil. Where cultivation has brought clayey subsoil of low magnetic susceptibility into the topsoil, a series of negative linear anomalies within the highly magnetic material has been produced.

(18) - Agricultural anomalies indicate different orientations of cultivation trend.

Anomalies associated with magnetic debris

(19) - A patch of strongly magnetic debris in the southern part of the survey area is a response to ferrous material used to infill a pond.

(20) - The patch of strong magnetic debris coincides with the junction of four former field boundaries and a dense scatter of Lias Limestone fragments perhaps indicative of ground consolidation or a former structure (see 1.4.6).

(21) - Magnetic debris located on former field boundary (14). The anomaly was targeted with ground observations aided by GNSS positioning at the end of the survey. Some slag, charcoal and burnt stone was observed. It is unclear as to whether the material was significant given the widespread presence of slag within the site and the location of a removed field boundary where dumping and burning may have occurred.

(22) - Strong dipolar responses relate to ferrous objects within the topsoil.

Anomalies with a modern origin

(23) - A strong, multiple dipolar, linear anomaly extends across the southern part of the survey area and relates to a buried service.

4 DISCUSSION

4.1.1 The detailed magnetometer survey located a number of positive linear, discrete and possible curvilinear responses in the southern part of the site. However they lack clarity and cannot be confidently characterised, but it is possible that some relate to cut features with archaeological potential (1).

4.1.2 Several linear anomalies relate to formerly mapped field boundaries, while others have not been mapped but are parallel with and/or join those that are mapped and so have also been interpreted as field boundaries. Where there is some inconsistency with the position of mapped field boundaries, a small number of linear anomalies are considered as uncertain in origin (3 & 7).

4.1.3 The site also contains evidence for discrete patches of magnetic debris. While one corresponds to an infilled pond (19) in the southern part of the site, two other patches (20 & 21) are situated either along or at the junction of former field boundaries. The larger zone (20) is associated with a dense scatter of Lias Limestone and some pieces of iron or steel of relatively modern agricultural origin were noted, along with a halfpenny of George V. It is possible that this is an area of ground consolidation or the site of a former agricultural building, though none are mapped. The smaller zone of debris further to the north (21) appeared to be associated with some slag, charcoal and burnt stone. It is unclear whether the slag is significant as it is widespread in the vicinity, and the evidence of burning may be associated with the removal of the field boundary.

4.1.4 Observations of iron slag during the course of the survey have been referred to in 1.4.4. The most dense area appears to be to the north of the central part of the survey area and to some degree contained to the south and east by former field boundaries (13) and (14) respectively; however, lower densities of similar slag were encountered within virtually all parts of the field. The slag appears to contain a high percentage of iron as attested by its weight and magnetic response. Some pieces appeared to contain flow structure possibly indicative of tap slag. There does not appear to be any clear evidence from the geophysical data of surviving industrial structures and the origin of the material is uncertain.

5 CONCLUSION

5.1.1 The results of the magnetometer survey indicate a small number of positive linear and discrete anomalies and a possible curvilinear anomaly in the southern part of the site. While they lack a clear and coherent morphology, their archaeological potential should be considered.

5.1.2 The majority of the other anomalies relate to former field boundaries, land drains, agricultural activity and magnetic debris. The debris appears as very widespread moderate to low level dipolar responses with some patches of higher magnitude material. Iron slag observed during the course of the survey may indicate early iron production, although there is no clear evidence of surviving structures which may have been removed by subsequent ploughing.

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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 field. The difference between the two sensors will relate to the strength 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

Minimally processed magnetometry data

Filename: J697-mag-proc.xcp
Description: Imported as Composite from: J697-mag.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y): OSGB36
Northwest corner: 378042.834762712, 219769.705177167 m
Southeast corner: 378731.484762712, 218959.405177167 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 4515100

Dimensions
Composite Size (readings): 4591 x 5402
Survey Size (meters): 689 m x 810 m
Grid Size: 689 m x 810 m
X Interval: 0.15 m
Y Interval: 0.15 m

Stats
Max: 3.00
Min: -3.00
Composite Area: 55.801 ha
Surveyed Area: 16.079 ha

PROGRAM
Name: TerraSurveyor
Version: 3.0.31.3

GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (UTM to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 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.

A copy of the report in PDF/A format will be supplied to the Gloucestershire Historic Environment Record, together with a DXF of the survey boundary. The report will also be uploaded to the Online AccesS to the Index of archaeological investigationS (OASIS).

Archive contents:

Geophysical data - path: J697 Highnam Farm\Data				
Path and Filename	**Software**	**Description**	**Date**	**Creator**
high1\MX\ .prm .dgb .disp	Sensys MXPDA	Proprietary data formats representing magnetometer survey traverses logged to a PDA.	1-9/12/16	D.J.Sabin
high1\MX\J697-mag.asc	Sensys DLMGPS	ASCII CSV (tab) file representing survey area in eastings, northings (UTM Z30N), magnetic measurement, traverse file and sensor number.	10/12/16	D.J.Sabin
Mag\comps\J697-mag-.xcp	TerraSurveyor 3.0.23.0	Composite data file derived from ASCII CSV.	10/12/16	D.J.Sabin
Mag\comps\J697-mag-proc.xcp	TerraSurveyor 3.0.23.0	Processed composite data file (zmt and clipping to ±3nT).	10/12/16	D.J.Sabin
Graphic data - path: J697 Highnam Farm\Data				
Mag\graphics\ J697-mag-proc.tif	TerraSurveyor 3.0.23.0	TIF file showing a minimally processed greyscale plot clipped to ±3nT.	10/12/16	D.J.Sabin
Mag\graphics\ J697-mag-pro.tfw	TerraSurveyor 3.0.23.0	World file for georeferencing TIF to OSGB36.	10/12/16	D.J.Sabin
CAD data - path: J697 Highnam Farm\CAD				
J697 version 2.dwg	ProgeCAD 2016	CAD file for creating plots of greyscales, abstraction, interpretation and mapping. Grid coordinates as OSGB. AutoCAD 2010 format.	01/12/16	K.T.Donaldson
Text data - path: J697 Highnam Farm\Documentation				
J697 report.odt	OpenOffice.org 3.0.1 Writer	Report text as an Open Office document.	22/12/16	K.T.Donaldson

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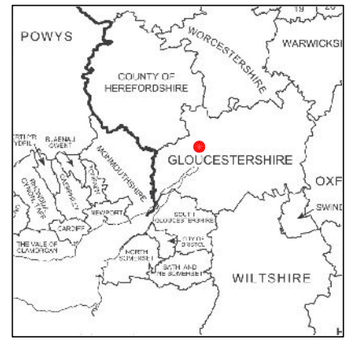
Geophysical Survey
Highnam Farm
Highnam
Gloucestershire

Map of survey area



Survey location

Site centred on OS NGR
SO 78340 19345

Reproduced from OS Explorer map nos.OL45 & 179
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of The Controller of Her Majesty's Stationery Office.
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SCALE 1:25 000

0m 500m 1000m

SCALE TRUE AT A3

FIG 01

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Geophysical Survey
Highnam Farm
Highnam
Gloucestershire

Referencing information

Referencing grid to OSGB36 datum at 100m intervals

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

● 378400 219000

SCALE 1:4000

0m 40 80 120 160 200m

SCALE TRUE AT A3

FIG 02

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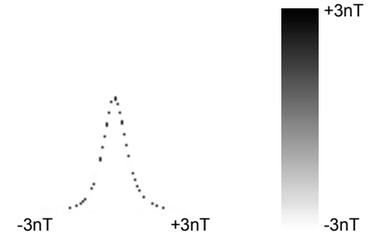
Highnam Farm
Highnam
Gloucestershire

Greyscale plot of minimally processed magnetometer data



N

The Old Bakery

Two Mile Lane

Highnam Woods

Milestones

A40

A40

SCALE 1:3000

0m 30 60 90 120 150m

SCALE TRUE AT A3

FIG 03

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Geophysical Survey
Highnam Farm
Highnam
Gloucestershire

Abstraction and interpretation of magnetometer anomalies

- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Positive linear anomaly - land drain
- Positive linear anomaly - former field boundary
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:3000

0m 30 60 90 120 150m

SCALE TRUE AT A3

FIG 04

N

The Old Bakery

Two Mile Lane

Highnam Woods

A40

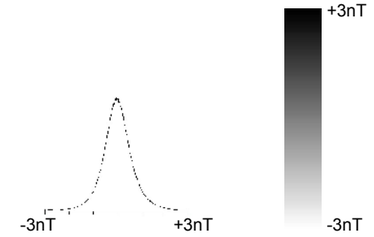
Milestones

A40

Archaeological Surveys Ltd

Geophysical Survey
Highnam Farm
Highnam
Gloucestershire

Greyscale plot of minimally processed magnetometer data - south



SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 05

Archaeological Surveys Ltd

Geophysical Survey
Highnam Farm
Highnam
Gloucestershire

Abstraction and interpretation of magnetometer anomalies - south

N

1
2
3
4
5
6
9
10
11
16
18
19
23

Milestones

A40

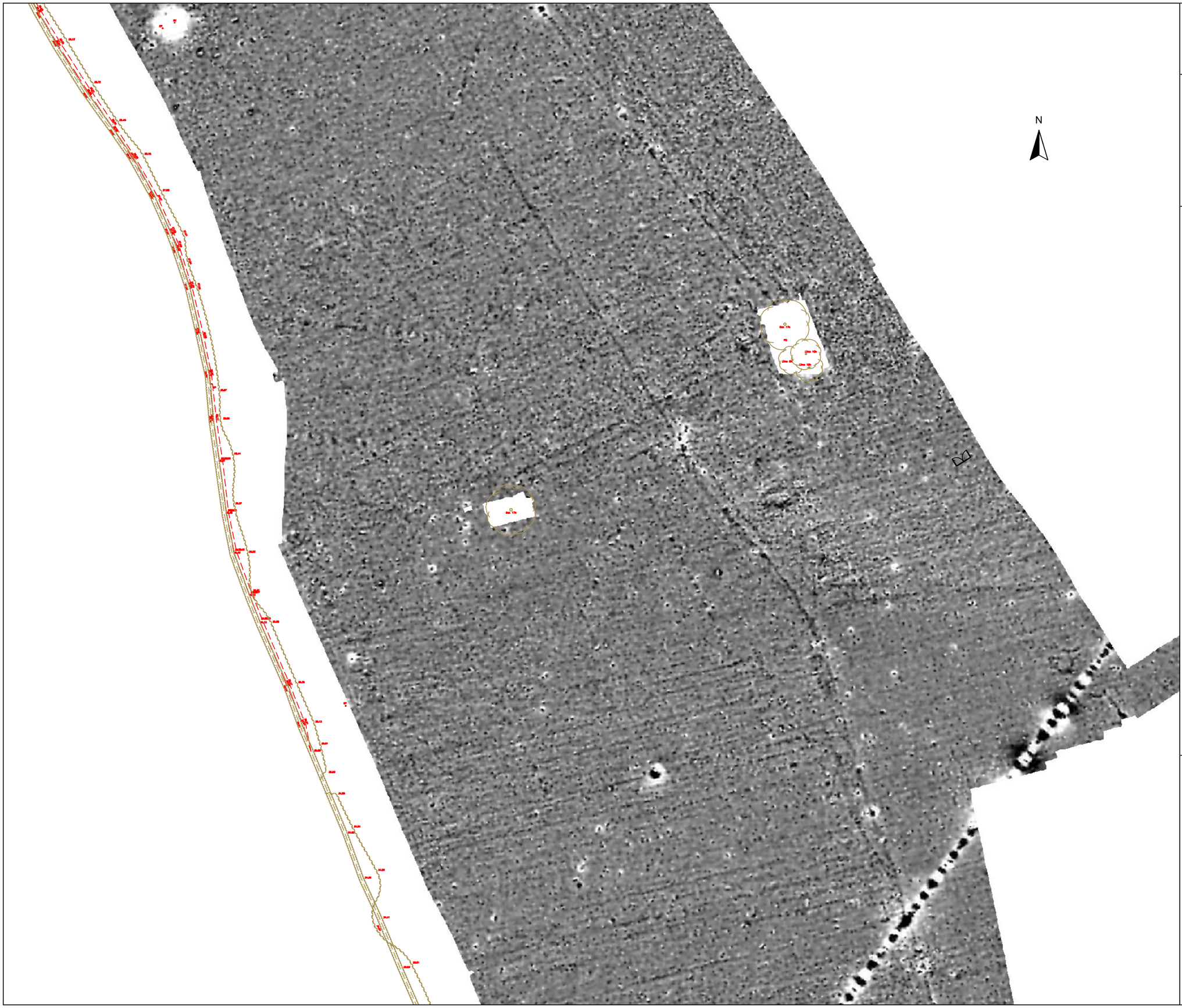
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Positive linear anomaly - land drain
- Positive linear anomaly - former field boundary
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 06



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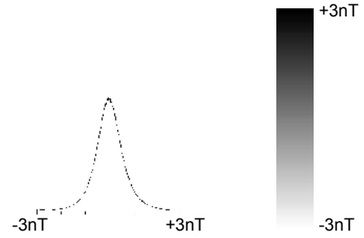
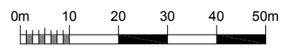
Gloucestershire

Greyscale plot of minimally processed magnetometer data - centre



SCALE 1:1250



SCALE TRUE AT A3

FIG 07

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Highnam Farm
Highnam
Gloucestershire

Abstraction and interpretation of magnetometer anomalies - centre

N

22

15

6

10

16

9

1

18

23

11

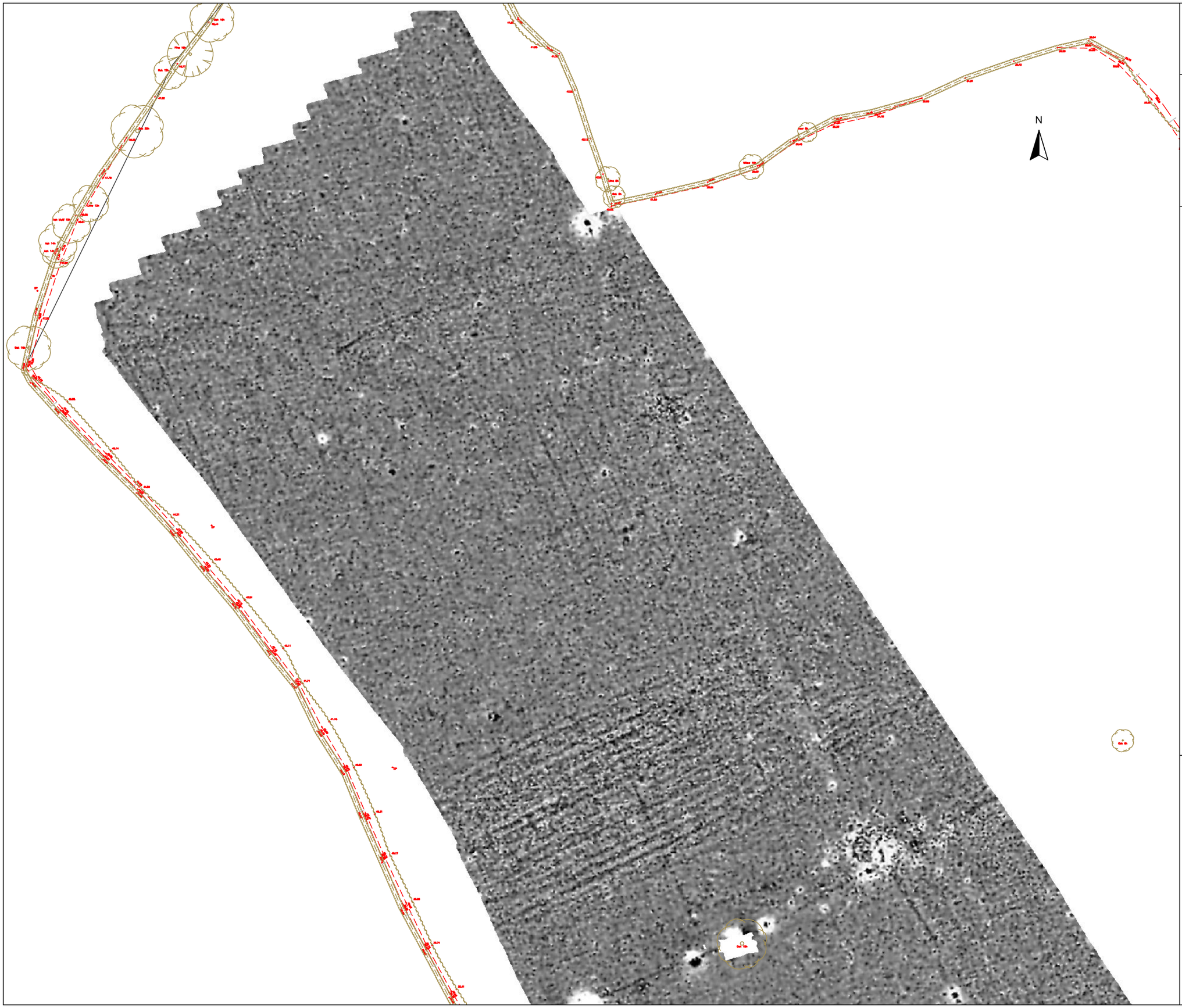
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Positive linear anomaly - land drain
- Positive linear anomaly - former field boundary
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 08



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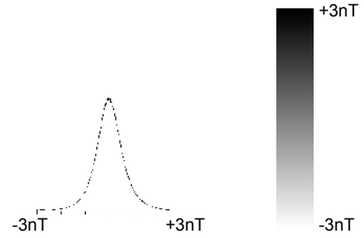
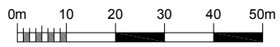
Highnam
Gloucestershire

Greyscale plot of minimally processed magnetometer data - north



SCALE 1:1250



SCALE TRUE AT A3

FIG 09

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Geophysical Survey
Highnam Farm
Highnam
Gloucestershire

Abstraction and interpretation of magnetometer anomalies - north

- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Positive linear anomaly - land drain
- Positive linear anomaly - former field boundary
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 10