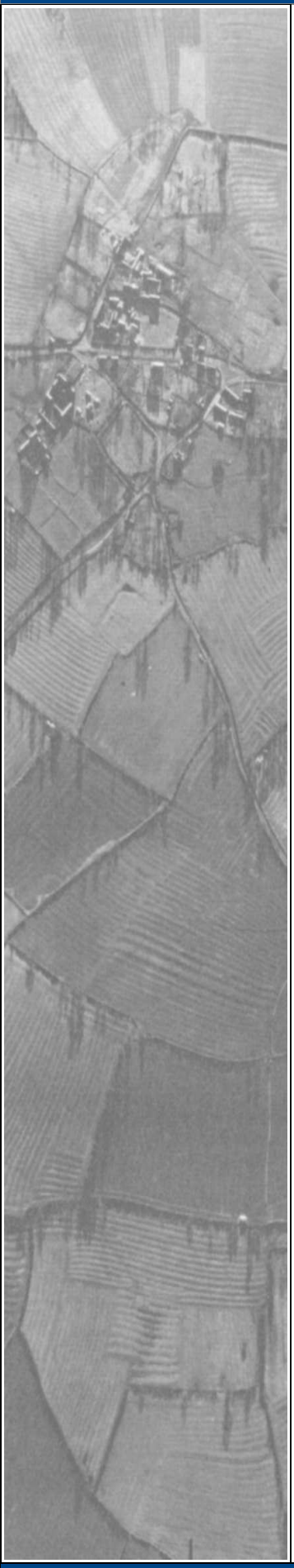

Rowdeford School
Rowde
Wiltshire

MAGNETOMETER SURVEY REPORT

for

Cotswold Archaeology

Kerry Donaldson & David Sabin

July 2020

Ref. no. J823

ARCHAEOLOGICAL SURVEYS LTD

Rowdeford School
Rowde
Wiltshire

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 – 18th & 19th June 2020
Ordnance Survey Grid Reference – **ST 97820 63505**

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CONTENTS

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

SUMMARY

A geophysical survey was carried out by Archaeological Surveys Ltd, at the request of Cotswold Archaeology, on land to the north of Rowdeford School near Rowde, Wiltshire. The results of the detailed magnetometry revealed widespread linear, rectilinear, curvilinear and discrete responses, but the majority lack a coherent morphology and are of uncertain origin. Some discrete responses could indicate an association with burning and other responses are likely to relate to tree removal. At the eastern edge of the site there is a strong, discrete response that is surrounded by a sub-circular feature approximately 4.2m wide, with several other linear anomalies nearby. The magnitude of the response indicates that they may be an association with burning, possibly industrial activity.

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 to the north of Rowdeford School near Rowde, Wiltshire. The site has been outlined for a proposed development of a new school and the survey forms part of an archaeological assessment.

1.1.2 The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Archaeological Surveys (2020) and approved by Neil Adam, Assistant County Archaeologist for Wiltshire 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 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 follow the recommendations set out by: 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.* Note: currently Historic England (2018) no longer support the guidelines set out in English Heritage (2008) *Geophysical survey in archaeological field evaluation* and there are currently no plans to update the document. As a consequence other sources of written guidance referring to this document may be out of date and/or contain unsupported information (e.g. Chartered Institute for Archaeologists, 2014).

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 line formats, and broken or fragmented lines used in interpretive plots may well correspond closely with truncation of archaeological features.

1.4 Site location, description and survey conditions

1.4.1 The site is located on agricultural land to the north and north east of Rowdeford School, Rowde, Wiltshire . It is centred on Ordnance Survey National Grid Reference (OS NGR) ST 97820 63505, see Figs 01 and 02.

1.4.2 The geophysical survey covers approximately 6.5ha of grassland within two fields labelled Areas 1 and 2 for the purposes of this report. The western field, Area 1, lies immediately to the north of the school grounds and is separated from them by a hedgerow and fencing. The western boundary is a broad margin of mature trees located between the survey area and the A342. Residential dwellings lie adjacent to the north western corner with further hedgerows and fencing forming the northern and eastern boundaries. Several large trees and some electricity poles are located within the field itself. An agricultural access track enters the field near the north western corner and continues to the south east.

1.4.3 Area 2 lies immediately to the east of Area 1 and to the north east of the school. Field boundaries are hedgerows and fencing with areas of woodland

located immediately to the east and south. The area contains two large trees.

Plate 1: Area 1 looking south west

Plate 2: Area 2 looking east

1.4.4 Both areas are generally flat although a broad linear depression running north to south is visible in the western part of Area 1 with a similar feature visible mainly near the south western corner of Area 2. At the time of survey it was considered likely that these were naturally formed features possibly caused by

fluvial action. The southern edge of Area 2 was notably waterlogged and boggy despite the very dry Spring conditions prior to the survey; however, this may have been exacerbated by very heavy rainfall on the first day of survey. During the second day of survey generally fine conditions prevailed.

1.4.5 The ground conditions across the site were considered to be favourable for the collection of magnetometry data due to mainly short grass cover. A number of modern steel objects within or immediately adjacent to the survey areas were identified as potential sources of localised magnetic disturbance.

1.5 Site history and archaeological potential

1.5.1 There are no recorded sites or findspots within the site or immediate environs; however, there are widespread archaeological features dating to the prehistoric and Roman periods within the wider vicinity. These include cropmarks for settlement features at Rowde Farm, 450-800m to the south and south east, a multi-phase site at Mother Anthony's Well, 1.7km to the north north east and widespread features around Bromham and the Roman town of *Verlucio*, 2.3-3.6km to the north. The site is likely to have been utilised for agriculture from the medieval period onwards and was part of the grounds associated with Rowdeford House, an early 19th century Grade II listed building, now part of Rowdeford School.

1.6 Geology and soils

1.6.1 The underlying solid geology across the site is Lower Greensand (BGS, 2017). Possible former fluvial channels were identified, see 1.4.4.

1.6.2 The overlying soil across the majority of the survey area is from the Banbury association and is a ferritic brown earth consisting of a well drained, brashy, fine and coarse, loamy, ferruginous soil over ironstone (Soil Survey of England and Wales, 1983).

1.6.3 Ferruginous soils produce very strong magnetic contrast between the fill of cut features and the material into which they are cut. The underlying geology and soils are, therefore, considered good to very good 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 (also known as thermoremanence) are factors associated with the formation of localised fields.

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). Additional details are set out in 2.2 below and within Appendix A.

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 20Hz. 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 ±8000nT. They are linked to a Leica GS10 RTK GNSS 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 the 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 ±8000nT and clipped for display at ±5nT. 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 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. In addition, traceplots cannot be meaningfully plotted against base mapping and in areas of complexity traces may be lost or highly confused. Traceplots may be used to demonstrate characteristic magnetic profiles across discrete features where it is considered beneficial.

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 GNSS, resection method, etc.

2.3.7 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.

2.3.8 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 each survey area.

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 a total of two survey areas covering approximately 6.5ha.

3.1.2 Magnetic anomalies located can be generally classified as positive and negative anomalies of an uncertain origin, anomalies associated with land management, linear anomalies of an agricultural origin, anomalies relating to quarrying, anomalies with a natural origin, areas of magnetic debris and disturbance and strong discrete dipolar anomalies relating to ferrous objects.

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 Localised magnetic disturbance adjacent to field boundaries has been caused by modern ferrous objects and services. It is unlikely to obscure anomalies of archaeological potential. Moderate levels of magnetic debris appear widespread with some more concentrated zones within Area 1. The source of the material is uncertain, and it may have been introduced during conditioning of the soil. It is unlikely to obscure significant anomalies.

3.2.3 The soils were considered to be good to very good for magnetic survey and certainly anomalies with moderately strong levels of magnetic contrast were revealed. However, many anomalies may be associated with former cultivation and natural features, and it may not be possible to confidently determine the origin of some.

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 general 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 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	Magnetic debris often appears as areas containing many small dipolar

debris	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.
Anomalies with a natural origin	Naturally formed magnetic anomalies are caused by localised variability in the magnetic susceptibility of soils, subsoils and other drift or solid geologies. Anomalies may be amorphous, linear or curvilinear and may appear 'fluvial' or discrete; the latter are almost impossible to distinguish from pit-like anomalies with an anthropogenic origin. Fluvial, glacial and periglacial processes may be responsible for their formation within drift material and subsoil. Igneous and metamorphic activity can lead to anomalies within more solid geology.
Anomalies associated with ground disturbance/quarrying	Magnetically variable anomalies which may be negative indicating a response to geology/drift deposits and/or positive indicating an increased depth of topsoil. Very strongly magnetic anomalies are a response to highly magnetic material of modern origin which can be used to infill a quarry depression. It should be considered that former quarry pits may be of archaeological potential.

Table 1: List and description of interpretation categories

3.4 List of anomalies - Area 1

Area centred on OS NGR 397720 163520, see Figs 03 - 06.

Anomalies with an uncertain origin

(1) - In the northern part of the survey area are two clusters of positive and negative linear and rectilinear anomalies. They are weak and poorly defined. This type of response can relate to former gardens or small agricultural plots, but none have been mapped within the area. Several other positive linear anomalies are located throughout the survey area, but they generally lack a coherent morphology.

(2) - Extending south eastwards from the northern edge of the survey area is a fragmented positive linear anomaly. Where it appears to cross a central naturally formed anomaly (13), it appears to be a negative anomaly. This could relate to a cut feature, but its date and function is uncertain.

(3) - In the western part of the survey area is a weakly positive curvilinear anomaly. It has been disturbed by agricultural activity (11) and is not clearly defined. Other weakly positive curvilinear anomalies are located to the north. It is possible that these anomalies are associated with the removal of former trees.

(4)- In the central, southern part of the survey area are a number of discrete positive responses and some associated negative curvilinear responses. These anomalies could be associated with burning, but their origin is uncertain.

(5) - The survey area contains a number of discrete positive anomalies. Although they could relate to the removal of trees, they generally do not correlate with the position trees appearing on early mapping or aerial photographs, and while some have a response of 4-10nT, several are over 35nT indicating a possible association with burning.

(6) - A negative linear anomaly extends through much of the eastern part of the survey area. This type of response can be associated with a buried service, but it does not extend further north than the negative rectilinear anomalies (1) located in the north west and an association with them is possible.

(7) - Two parallel, negative, linear anomalies extend from the central part of the survey area towards the south west. Although these anomalies can be associated with features such as a pipeline easement or broad track, they are of uncertain origin.

Anomalies associated with land management

(8) - A partly positive and partly negative linear anomaly appears to relate to a possible former field boundary. Although none has been mapped in this position from the 1840s onwards, it does appear to be a continuation of an anomaly recorded in Area 2 to the east.

(9 & 10) - Two trackways, associated with Rowdeford House to the south, extend through the survey area. Anomaly (9) has been consolidated with magnetic material, while anomaly (10) appears to be made of material with a lower magnetic susceptibility than the surrounding soil (eg subsoil, stone).

Anomalies with an agricultural origin

(11) - Two orientations of parallel linear anomalies can be seen primarily in the western part of the site and are modern in origin.

Anomalies associated with quarrying/ground disturbance

(12) - Magnetically variable responses in the far south western corner of the survey area appear to relate to former quarrying.

Anomalies with a natural origin

(13) - A broad magnetically enhanced zone can be seen extending through the centre of the survey area. It appears to continue northwards as a cropmark feature on aerial photographs and is likely to relate to a former channel-like feature.

3.5 List of anomalies - Area 2

Area centred on OS NGR 397945 163515, see Figs 03 & 04.

Anomalies with an uncertain origin

(14) - Located close to the eastern edge of the survey area is a discrete positive anomaly with a response of 25-50nT surrounded by a sub-circular response of 15-25nT. The discrete response has a diameter of 1.6m and the outer sub-circular response has an outer diameter of 4.2m. Other short positive linear and discrete responses are located to the east and south. The strength of the anomalies indicates a possible association with burning and industrial activity should be considered.

(15) - A number of discrete positive responses can be seen within the survey area. It is not possible to determine if they are natural, relate to removed trees or if they have an anthropogenic origin. The survey area also contains several positive linear anomalies and while many appear in the vicinity of the pit-like anomalies they generally lack a coherent morphology and their origin is uncertain.

(16) - In the north eastern part of the survey area there are a number of parallel positive and negative linear anomalies. They appear only to extend southwards towards, but not beyond anomaly (19), and it is possible that they relate to former ridge and furrow cultivation.

(17) - A positive linear anomaly extends northwards towards, but not joining anomaly (19). It is possible that it relates to another unmapped field boundary, but this is uncertain.

Anomalies associated with land management

(18) - An oval-shaped, positive linear anomaly relates to a formerly mapped field boundary that enclosed a group of trees on the 1840s tithe map. This boundary had been removed by the 1880s, but the group of trees is still mapped.

(19) - A positive linear anomaly extends across the northern part of the survey area and appears to form the southern edge of former oval-shaped boundary feature (18). Although not mapped on the tithe map or later, it does appear to relate to a former field boundary which extends westwards into Area 1 as anomaly (8).

Anomalies associated with magnetic debris

(20) - A patch of magnetic debris appears to lie within the confines of former oval-shaped boundary (18). This type of response could indicate that it relates to the burning of trees. A similar patch of magnetic debris can be seen at the eastern edge on the possible former boundary (19).

(21) - Extending along the eastern side of the site are a line of eight strongly magnetic anomalies (75-200nT). They appear to extend along the line of a footpath and this type of response is often associated with the remains of former fenceposts which may once have bounded it.

4 CONCLUSION

4.1.1 The detailed magnetometer survey located a number of anomalies throughout the site, but it is not possible to confidently determine their archaeological potential. Within Area 1 in the west, there are groups of positive and negative linear and rectilinear anomalies of uncertain origin that may be associated with former agricultural activity. Several curvilinear responses were also located but it is possible these could have an association with the removal of trees. A broad positive response appears to relate to a broad natural feature and there appears to be a zone of quarrying in the far south western corner.

4.1.2 At the eastern edge of Area 2 there is a discrete positive response that is surrounded by a sub-circular feature which could have an association with burning and possible industrial activity. It is possible that some discrete responses within the site are associated with tree removal, but some could have archaeological potential. An oval-shaped enclosure relates to a formerly mapped feature that once contained trees, and magnetic debris within could be associated with their burning after removal. Another possible boundary feature extends through both survey areas and appears to pre-date the current field layout and may have former ridge and furrow extending towards it from the north east; although unmapped, it may be a post-medieval feature.

5 REFERENCES

Archaeological Surveys, 2020. *Rowdeford School, Rowde, Wiltshire, Geophysical Survey Written Scheme of Investigation.* Unpublished typescript document.

Aspinall, A., Gaffney, C. and Schmidt, A. 2009. *Magnetometry for Archaeologists*. Lanham (US), AltaMira Press.

British Geological Survey, 2017. *Geology of Britain 3D (Beta version), 1:50 000 scale [online]* available from http://mapapps.bgs.ac.uk/geologyofbritain3d/index.html? [accessed 10/6/2020].

Chartered Institute for Archaeologists, 2014. *Standard and Guidance for archaeological geophysical survey*. CIfA, University of Reading.

Cotswold Archaeology, 2019. *Rowdeford School, Rowde, Wiltshire, Heritage Appraisal.* CA report: 19016. Draft typescript document.

European Archaeological Council, 2015. *EAC Guidelines for the Use of Geophysics in Archaeology: Questions to Ask and Points to Consider.* Europae Archaeologia Consilium and Association Internationale sans But Lucratif, Belgium.

Historic England, 2018. Geophysical Survey Advice [online] available from https://historicengland.org.uk/advice/technical-advice/archaeological-science/geophysics/ [accessed July 2018].

Institute for Archaeologists, 2002. *The use of Geophysical Techniques in Archaeological Evaluations*. IfA Paper No. 6. IfA, University of Reading.

Schmidt, A., 2013. *Geophysical Data in Archaeology: A Guide to Good Practice.* Oxbow Books.

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 5 South West England.*

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. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

Despike

Removal of data points that exceed the mean/median/threshold by selecting a window size of data points and replace by mean/median/threshold. Magnetic spikes can be caused iron objects on the surface or within the topsoil. Despike can improve the appearance of data and remove extreme readings that may affect further processing.

High Pass Filter

Removes low frequency anomalies within the data that are not considered to be archaeologically significant and may be natural in origin. A window passes over the data, the mean of all the data within the window is subtracted from the centre value. The size of the window is adjusted as is the weighting which may be uniform or Gaussian. The process is used to improve the visibility of anomalies of interest.

Low Pass Filter

Removes high frequency anomalies or 'noise' within datasets and provides a smoother output. A window passes over the data, the mean of all the data within the window is used to replace the centre value. The size of the window is adjusted as is the weighting. The process is used to improve the visibility of anomalies of interest.

Zero Median/Mean Traverse

The median (or mean) of data from 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 offset values of the gradiometer sensors. The process can remove archaeological features that run along a traverse but with the high resolution datasets created by the Sensys FGM650 sensors and the method of data collection this has not been a notable problem. In fact, the removal of offsets using software avoids carrying out a balancing procedure on site, which inevitably can never be done in magnetically clean conditions and results in improperly aligned fluxgate sensors and/or electronic adjustment values.

Appendix C – survey and data information

Filename: J823-mag-Area1-proc.xcp
Description: Imported as Composite from: J823-mag-Area1.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 397582.72, 163612.16m
Southeast corner: 397868.77, 163412.21 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702
Source GPS Points: 988400
Dimensions
Composite Size (readings): 1907 x 1333
Survey Size (meters): 286 m x 200 m
Grid Size: 286 m x 200 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 5.53
Min: -5.50
Std Dev: 2.13
Mean: 0.04
Median: 0.01
Composite Area: 5.7196 ha
Surveyed Area: 3.2957 ha
GPS based Proce4
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

Filename: J823-mag-Area2-proc.xcp
Description: Imported as Composite from: J823-mag-Area2.asc
Northwest corner: 397835.75, 163614.53 m
Southeast corner: 398057.15, 163425.83 m
Source GPS Points: 758400
Dimensions
Composite Size (readings): 1476 x 1258
Survey Size (meters): 221 m x 189 m
Grid Size: 221 m x 189 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 5.53
Min: -5.50
Std Dev: 1.57
Mean: 0.03
Median: 0.03
Composite Area: 4.1778 ha
Surveyed Area: 2.7557 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 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.

A PDF copy will be supplied to the Wiltshire Historic Environment Record with the greyscale images as TIFs with TFWs and abstraction layers made available as a DWG on request. The report will also be uploaded to the Online AccesS to the Index of archaeological investigationS (OASIS).

Archive contents:

File type	Naming scheme	Description
Data	J823-mag-**[area number/name]**.asc J823-mag-**[area number/name]**.xcp J823-mag-**[area number/name]**-proc.xcp	Raw data as ASCII CSV TerraSurveyor raw data TerraSurveyor minimally processed data
Graphics	J823-mag-**[area number/name]**-proc.tif	Image in TIF format
Drawing	J823-**[version number]**.dwg	CAD file in 2010 dwg format
Report	J823 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 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)
Anomalies relating to land management			
AS-ABST MAG BOUNDARY		127,0,0	Line, polyline or polygon (solid or cross hatched ANSI37)
AS-ABST MAG PATH/ROAD/TRACK		0, 153,153	Line, polyline or polygon (solid or partly cross hatched ANSI38)
AS-ABST MAG LAND DRAIN		Cyan 0,255,255	Line or polyline
Anomalies with an agricultural origin			
AS-ABST MAG AGRICULTURAL		Green 0,255,0	Line or polyline
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
Anomalies with a natural origin			
AS-ABST MAG NATURAL FEATURES		Yellow 255,255,0	Polygon (cross hatched ANSI37)
Anomalies associated with ground disturbance/quarrying			
AS-ABST MAG QUARRYING/ GROUND DISTURBANCE		255223127	Polygon (net)

Table 3: CAD layering

Appendix F – copyright and intellectual property

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Tel: 01249 814 231

Archaeological Surveys

Specialist Geophysical Surveyors

Geophysical Survey
Rowdeford School
Rowde
Wiltshire

Map of survey area

● Survey location

Site centred on OS NGR
ST 97820 63505

SCALE 1:25 000

0m 500m 1000m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 01

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397500 397550 397600 397650 397700 397750 397800 397850 397900 397950 398000 398050 398100

163700
163650
163600
163550
163500
163450
163400
163350
163300
163250

Area 1

Area 2

N

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Referencing information

Referencing grid to OSGB36 datum at 50m intervals

397600 163450

Survey tracks

Survey track start

Survey track stop

SCALE 1:2000

0m 20 40 60 80 100m

SCALE TRUE AT A3

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KTD	DJS	FIG 02

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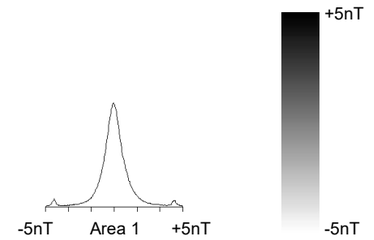
Greyscale plot of minimally processed magnetometer data



SCALE 1:1500

0m 10 20 30 40 50m

SCALE TRUE AT A3

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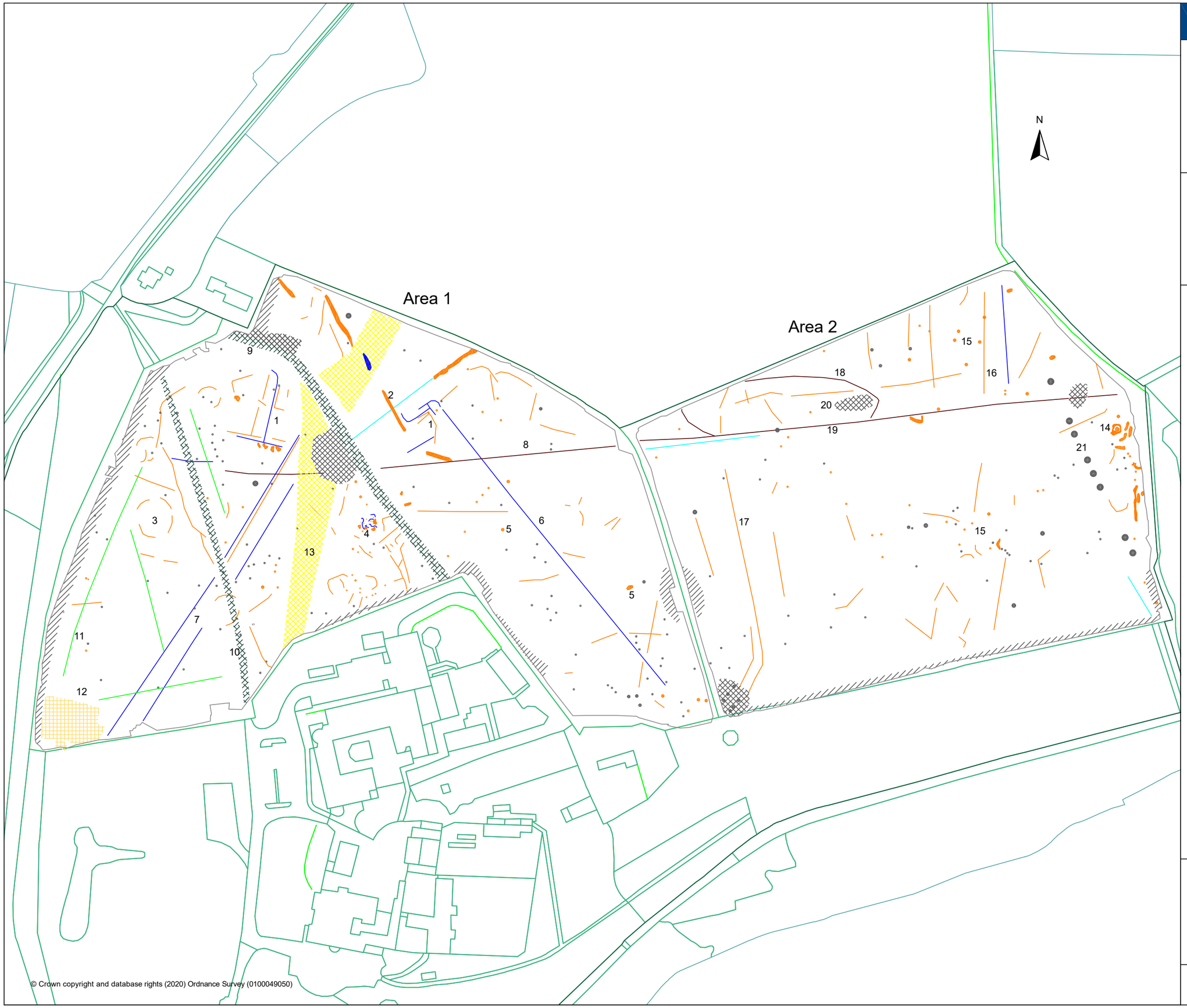
Abstraction and interpretation of magnetic anomalies



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- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Positive/weak multiple dipolar linear anomaly - possible land drain
- Positive linear anomaly - former field boundary
- Negative linear anomaly - material of low magnetic susceptibility
- Discrete positive response - magnetically enhanced feature
- Negative anomaly / magnetic debris - former trackway
- Magnetically variable response - possible former quarrying
- Positive response - of natural origin
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1500

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 04

Area 1

N

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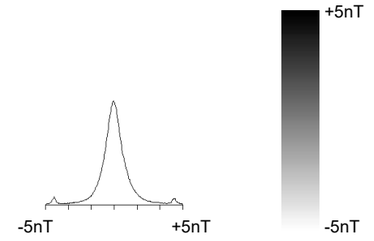
Greyscale plot of minimally processed magnetometer data - Area 1



SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 05

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Area 1

N

9
1
2
1
8
3
4
13
5
6
17
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7
11
10
12

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Abstraction and interpretation of magnetic anomalies - Area 1

- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Positive/weak multiple dipolar linear anomaly - possible land drain
- Positive linear anomaly - former field boundary
- Negative linear anomaly - material of low magnetic susceptibility
- Discrete positive response - magnetically enhanced feature
- Negative anomaly / magnetic debris - former trackway
- Magnetically variable response - possible former quarrying
- Positive response - of natural origin
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

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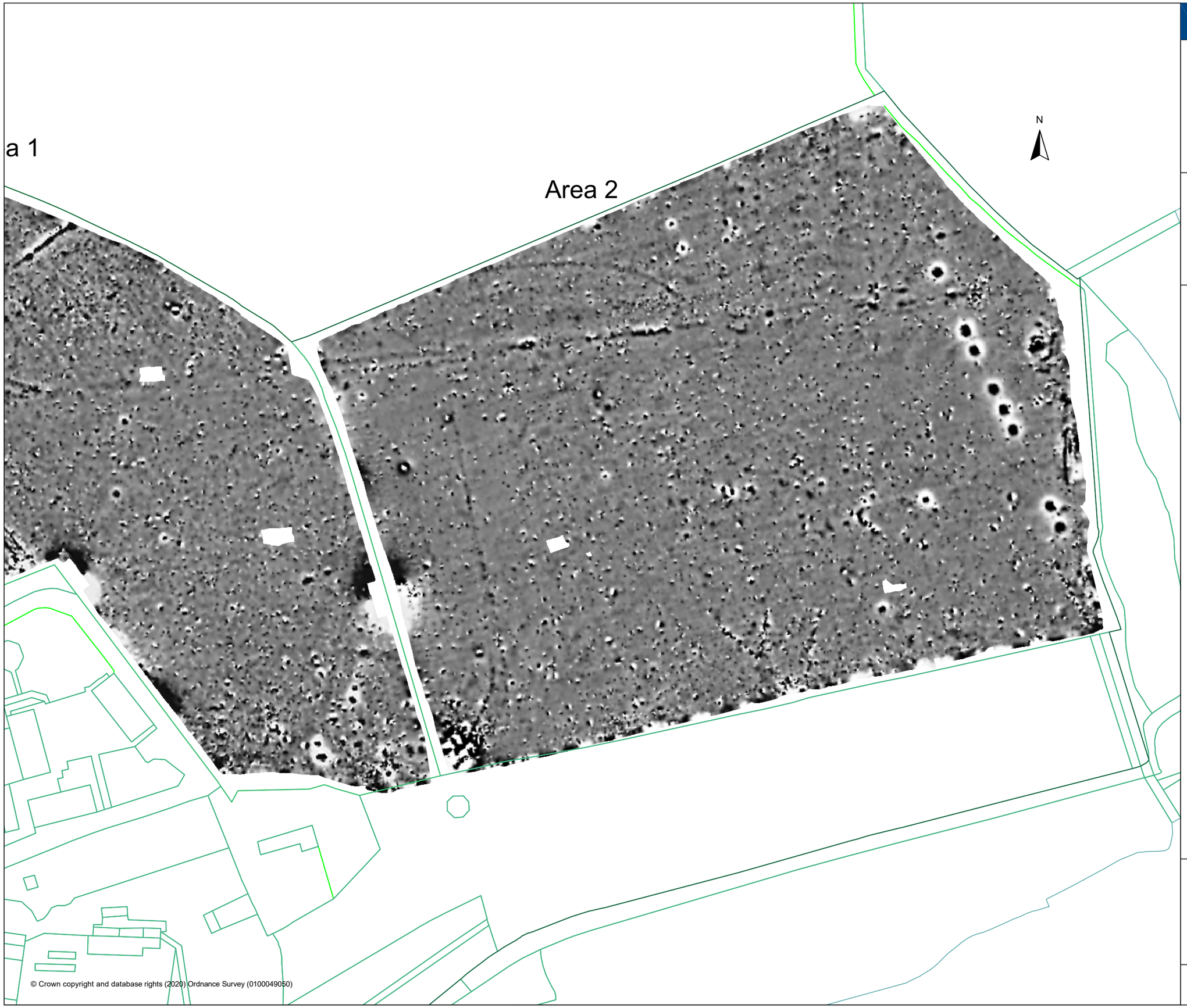
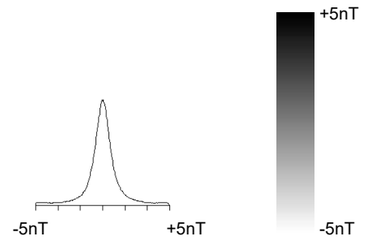
Greyscale plot of minimally processed magnetometer data - Area 2





SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

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KTD	DJS	FIG 07

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Abstraction and interpretation of magnetic anomalies - Area 2

a 1

Area 2

N

1
8
6
5
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16
15
14
21

- Positive linear anomaly - possible ditch-like feature
- Positive/weak multiple dipolar linear anomaly - possible land drain
- Positive linear anomaly - former field boundary
- Discrete positive response - magnetically enhanced feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

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KTD	DJS	FIG 08

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