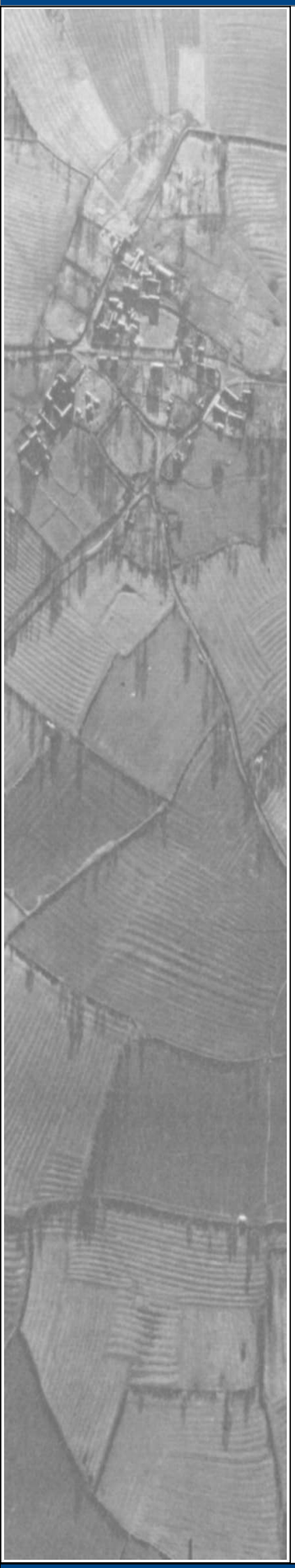
Archaeological Surveys
Specialist Geophysical Surveyors



Brandiers Farm
Minety
Wiltshire

MAGNETOMETER SURVEY REPORT

for

Cotswold Archaeology

Kerry Donaldson & David Sabin

December 2021

Ref. no. J888

ARCHAEOLOGICAL SURVEYS LTD

Brandiers Farm
Minety
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 date – 26th November 2021
Ordnance Survey Grid Reference – **SU 01500 91580**

Archaeological Surveys Ltd
1 West Nolands, Nolands Road, Yatesbury, Calne, Wiltshire, SN11 8YD
Tel: 01249 814231 Fax: 0871 661 8804
Email: info@archaeological-surveys.co.uk
Web: www.archaeological-surveys.co.uk

CONTENTS

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

SUMMARY

A detailed magnetometry survey was carried out over the site a possible Roman tile kiln at Brandiers Farm near Minety. The kiln has been identified from the location of several Roman tiles and possible kiln wall fragments that correspond to a low mound. The results of the survey indicate widespread magnetic debris that is consistent with kiln debris. Although there are a number of discrete positive responses that are positioned on the southern edge of the mound, it is not clear if they relate to features associated with intense burning, or dumps of burnt material. The site contains evidence for cut features, which along with the magnetic debris have been truncated by the furrows and overlain by the ridges of the ridge and furrow cultivation.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Cotswold Archaeology, on behalf of Mr Lavery, to undertake a magnetometer survey of an area of land at Brandiers Farm near Minety in Wiltshire. The site contains a mound and Roman tile and potential structural remains have previously been identified, indicating the location of a potential Roman kiln.

1.2 Survey objectives and techniques

1.2.1 The objective of the survey was to use magnetometry to locate geophysical anomalies that may relate to the kiln and possibly further associated features. The methodology is considered an efficient and effective approach to archaeological prospection.

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) (updated 2020) *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 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 at Brandiers Farm to the north west of Minety in Wiltshire. It is centred on Ordnance Survey National Grid Reference (OS NGR) SU 01500 91580, see Figs 01 and 02.

1.4.2 The geophysical survey covers approximately 2ha of grassland within two fields that are connected at the northern end, but generally separated by a wide hedgerow. The mound is mainly located in the north western part of the eastern field (Area 2), but extends partially under the dividing hedge. The survey areas also contain extant ridge and furrow and a linear ditch has recently been dug within the western part of the western field (Area 1) which prevented survey along a narrow strip. A short distance to the west of the ditch a strip of tall vegetation and saplings was also unsurveyable. A small zone within the north eastern part of Area 1 was also unsurveyable due to rough ground and tall vegetation.

1.4.3 The survey areas tend to slope down gently towards the north with a strip of flatter, higher ground running across the southern part of Area 1. Some modern ferrous objects were present within the hedgerow dividing the site, the landowner removed some disused wire net fencing that was located on the mound during the course of the survey; it is possible that some modern ferrous material remained hidden within vegetation in this area. The majority of the site had been recently mown.

1.4.4 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 2 looking south with the low kiln mound to the centre right of the image

1.5 Site history and archaeological potential

1.5.1 The Wiltshire Historic Environment Record outlines that the site contains a possible Roman kiln identified from scatters of Roman tile and possible structural remains (MWI64354). A similar Roman kiln site is located 2km to the north west at Park Farm near Oaksey (MWI5576) (Scheduled monument list entry no. 1004702).

1.5.2 During the course of the survey small fragments of terracotta were visible in the soil over the mound, but no pottery or tile. Within the western field (Area 1) a recently constructed or cleaned, shallow ditch was inspected as it appeared to contain numerous pottery sherds, some terracotta fragments and pieces of limestone. Although few of the sherds could be confidently identified, the fabric appeared to be consistent with medieval pottery and part of a base with leg is likely to originate from a medieval Minety ware tripod pitcher or cooking pot. One sherd was irregular in shape and may indicate a waster, a large block of fired clay was also present which may relate to kiln furniture; this material may infer the presence of a medieval pottery kiln within the vicinity. The medieval material was observed just over 100m south west of the mound at SU 01427 91552. Personal communication with an adjacent landowner indicated a scatter of Roman material at SU 01381 91506 just beyond the south western part boundary of Area 1.

1.6 Geology and soils

1.6.1 The underlying geology is mudstone from the Oxford Clay Formation (BGS,

2017).

1.6.2 The overlying soil across the site is from the Wickham 2 association and is a typical stagnogley soil. It consists of a slowly permeable, seasonally waterlogged, fine, loamy over clayey soil (Soil Survey of England and Wales, 1983).

1.6.3 The underlying geology and soils are frequently associated with low magnetic contrast and low levels of magnetic susceptibility. However, cut features of archaeological potential and features associated with industrial activity 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 (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 measurement range of ±8000nT, although the recorded range is ±3000nT, and resolution is around 0.1nT. 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 ±3000nT and clipped for display at ±5nT and ±20nT. 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 2021, creating DWG (2018) 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. 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 The abstraction and interpretation procedure has been supported by analysis of a digital terrain model plot derived from the Environment Agency's LiDAR data. Shaded relief plots and contours are created using Surfer 15 (Azimuth:95, Altitude:200, Z factor:10), (Fig 06).

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 2 survey areas covering approximately 2ha.

3.1.2 Magnetic anomalies located can be generally classified as positive and negative responses of archaeological potential, magnetic debris of archaeological potential, positive and negative anomalies of an uncertain origin, linear anomalies of an agricultural origin, anomalies associated with land management 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 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 Pottery kilns are frequently highly magnetic features due to changes within iron minerals within clay during firing at high temperatures. Kiln structures and surrounding soils are also usually highly magnetic. A broad assessment of the variation in magnetism across the site was attempted by measuring the mass specific magnetic susceptibility of a small number of soil samples using a Bartington MS2 with MS2B sensor. Samples included topsoil from the mound, topsoil from the northern part of Area 1 well away from the mound, and clay subsoil from the recently constructed ditch in Area 1. The results were unusual and not as predicted. The average value (X_{lf}) obtained from a subset of the topsoil samples over the mound was 4.5 $10^{-8}m^3kg^{-1}$; from the topsoil in the northern part of Area 1 the average value was 4.7 $10^{-8}m^3kg^{-1}$; from the natural

clay subsoil the average value was 6.5 $10^{-8}m^3kg^{-1}$. A small piece of fired clay originating from the topsoil over the mound was measured as 543.9 $10^{-8}m^3kg^{-1}$.

3.2.3 Interpretation of the magnetic susceptibility values recorded is tentative. Soils associated with a kiln structure should produce very high values instead of the very low values recorded here. It is clear that the topsoil does contain fired clay fragments as they are visible within it, and it is significantly darker than topsoil from other parts of the site; however, the very low values indicate the soil has almost no magnetically enhanced material present, the dark colouring may, therefore, relate to charcoal/ash or a thick layer of organic material. The low values may also imply very little mixing between the topsoil horizon and material below. The comparatively higher values of the subsoil from Area 1 are also unusual but can occur where soils are acidic and iron minerals have moved through the topsoil into a subsoil layer.

3.2.4 The unusual and unexpected magnetic susceptibility values obtained may not be fully representative but could assist the interpretation of magnetometry anomalies and processes affecting the kiln structure once abandoned.

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 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. Magnetic debris is related to magnetically thermoremnant materials such as brick or tile or other small fragments and can be associated with kilns, furnace structures, hearths
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	Strong discrete dipolar anomalies are responses to ferrous objects within the topsoil.

Table 1: List and description of interpretation categories

3.4 List of anomalies

Site centred on OS NGR 401500 191580, see Figs 03 – 05.

Anomalies of archaeological potential

(1) – Area of moderately strongly magnetic debris corresponds to the low mound within the field. There are positive and negative linear anomalies that could relate to structural elements and several discrete responses of 20-40nT that could relate to discrete areas of burning, or discrete dumps of burnt material towards the south eastern edge of the mound. The anomalies are consistent with material derived from a kiln structure the centre of which could be situated beneath the hedgerow that separates the two fields.

(2) – Widespread zone of weakly magnetic debris surrounding the stronger magnetic debris (1) relating to a spread of kiln waste. The widespread distribution of the material appears to indicate a large volume of material possibly derived over a period of time.

(3) – A linear row of discrete positive and negative anomalies appears to bound the edge of the magnetic debris (2). The positive responses suggest pit-like features, the negative response possible stones, and they form a line that extends either side of the hedge.

(4) – Within the central and western part of the western field (Area 1) are a number of zones of magnetic debris that appear to have been preserved beneath the ridge and furrow and could relate to further kiln debris.

(5) – An L-shaped positive rectilinear anomaly appears to have been truncated by and, therefore, pre-date the ridge and furrow within Area 1.

Anomalies with an uncertain origin

(6) – A number of narrow, weakly positive linear anomalies are located in the south western part of the site. They appear to have been truncated by ridge and furrow and it is possible that they relate to cut features with archaeological potential.

(7) – The north western part of Area 1 contains a number of positive and negative linear anomalies. They are poorly defined but could relate to cut features with archaeological potential.

(8) – Area 1 contains a number of negative linear anomalies, some have a similar north west to south east orientation to anomalies (6) while others are oriented east

to west.

Anomalies with an agricultural origin

(9) – The site contains anomalies associated with ridge and furrow. The ridges have preserved the underlying archaeological features and magnetic debris, while the furrows have truncated them.

Anomalies associated with land management

(10) – A negative linear anomaly extends through the centre of Area 1 from north to south. It has truncated the ridge and furrow in the southern part of the survey area and relates to a field boundary mapped on the 1840s tithe map.

Anomalies associated with magnetic debris

(11 & 12) – A strong, discrete, dipolar response is evident at the edge of the area of magnetic debris (1) in the north western part of Area 2 (11). A similar response can be seen close to the eastern edge of the survey area (12). It is not possible to determine if they relate to a feature associated with intense burning or if they relate to modern buried objects.

4 DISCUSSION

4.1.1 The survey has located widespread magnetic debris in the north eastern part of the site which corresponds to a low mound seen within the field and visible on LiDAR imagery (Fig 06). The response is stronger towards the centre (1), and is associated with a number of positive and negative linear and rectilinear anomalies which could relate to former structural remains. A number of discrete anomalies with a response of 20-40nT could be associated with intense burning, although it is not clear if they relate to in-situ features or purely dumps of burnt material derived from the kiln. A discrete strong, dipolar response (11) is situated within the magnetic debris, but it is not possible to determine if it relates to the kiln or if it relates to a modern object. Weaker magnetic debris (2) is widely distributed throughout much of the site and has been preserved beneath the ridges and truncated by the furrows of the ridge and furrow. A number of small concentrations of magnetic debris are evident in the western part of the site (4), some distance from the main kiln site. Numerous medieval pottery sherds were observed within a recently cut ditch within this part of the site, including part of a tripod pitcher or cooking pot in typical Minety ware (see 1.5.2).

4.1.2 A number of positive and negative responses appear to relate to archaeological features. These include a row of discrete positive and negative responses (3), that form a line that appears to bound the southern edge of the zone of weakly magnetic debris (2). They are regularly spaced about 2m

apart and the positive response indicates a pit or post-hole, while the negative anomaly would indicate material that is less magnetically enhanced than the surrounding soil such as sub-soil or stone. It is not clear what they relate to but, as they can be seen on both sides of the dividing hedgerow, it appears that they pre-date this boundary feature. The site also contains a number of linear anomalies that appear to relate to pits and ditches (5) with others less clearly defined, but could also relate to features with archaeological potential (6 & 7).

5 CONCLUSION

5.1.1 The detailed magnetic survey has located widespread magnetic debris within much of the site which is consistent with the response to a well distributed spread of kiln waste. There are a number of discrete, moderately strong responses within the magnetic debris, but it is not clear if these relate to features directly associated with burning or dumps of burnt material. Positive and negative linear and rectilinear anomalies could be associated with structural remains, but they lack a clearly defined morphology. A strong, dipolar response could be associated with the kiln; however, it is situated close to the field hedge where modern ferrous objects had been located and it is possible that the strong dipolar response relates to a modern buried object.

5.1.2 Smaller patches of magnetic debris appear to have been preserved under the ridges of the ridge and furrow in the western part of the site. Other linear, rectilinear and discrete responses appear to relate to features with archaeological potential, although they generally lack a coherent form.

6 REFERENCES

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 4/12/2021].

Chartered Institute for Archaeologists, 2014 (updated 2020). *Standard and Guidance for archaeological geophysical survey*. CIfA, University of Reading.

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.

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

Area 1

Filename: J888-mag-Area1-proc.xcp
Description: Imported as Composite from: J888-mag-Area1.asc
Instrument Type: Sensys DLMGPS
Units:
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 401390.96, 191661.77 m
Southeast corner: 401518.76, 191482.67 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702
Dimensions
Survey Size (meters): 128 m x 179 m
X&Y Interval: 0.15 m
Source GPS Points: Active: 410800, Recorded: 410800
Stats
Max: 5.53
Min: -5.50
Std Dev: 1.20
Mean: 0.01
Median: 0.00
Composite Area: 2.2889 ha
Surveyed Area: 1.4382 ha
PROGRAM
Name: TerraSurveyorPre
Version: 3.0.36.24
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 Clip from -5.00 to 5.00

Stats
Max: 22.10
Min: -22.00
Std Dev: 1.88
Mean: 0.04
Median: -0.01
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 Clip from -20.00 to 20.00

Area 2

Filename: J888-mag-Area2-proc.xcp
Northwest corner: 401499.37, 191691.12 m
Southeast corner: 401609.62, 191541.42 m
Dimensions
Survey Size (meters): 110 m x 150 m
X&Y Interval: 0.15 m
Source GPS Points: Active: 219290, Recorded: 219290
Stats
Max: 5.53
Min: -5.50
Std Dev: 1.79
Mean: -0.03
Median: 0.01
Composite Area: 1.6504 ha
Surveyed Area: 0.76296 ha
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 Clip from -10.00 to 10.00
5 Clip from -5.00 to 5.00

Stats
Max: 22.10
Min: -22.00
Std Dev: 3.37
Mean: -0.05
Median: 0.02
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 Clip from -20.00 to 20.00

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 greyscale images and abstraction layers made available 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	J888-mag-**[area number/name]**.asc J888-mag-**[area number/name]**.xcp J888-mag-**[area number/name]**-proc.xcp	Raw data as ASCII CSV TerraSurveyor raw data TerraSurveyor minimally processed data
Graphics	J888-mag-**[area number/name]**-proc.tif	Image in TIF format
Drawing	J888-**[version number]**.dwg	CAD file in 2018 dwg format
Report	J888 report.odt	Report text in LibreOffice 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 ARCHAEOLOGY		Red 255,0,0	Polygon (cross hatched ANSI37)
AS-ABST MAG POS LINEAR ARCHAEOLOGY		Red 255,0,0	Polyline or polygon (solid)

AS-ABST MAG STRONG MAGNETIC DEBRIS ARCHAEOLOGY	153, 0, 76	Polygon (cross hatched ANSI37)
AS-ABST MAG WEAK MAGNETIC DEBRIS ARCHAEOLOGY	204, 127, 102	Polygon (cross hatched ANSI37)
AS-ABST MAG NEG LINEAR ARCHAEOLOGY	127,0,255	Line, polyline or polygon (solid)
AS-ABST MAG NEG DISCRETE ARCHAEOLOGY	127,0,255	Donut (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)
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 STRONG DIPOLAR	132, 132, 132	Solid donut, point or polygon (solid)

Table 3: CAD layering

Appendix F – copyright and intellectual property

This report may contain material that is non-Archaeological Surveys Ltd copyright (eg Ordnance Survey, Crown Copyright) or the intellectual property of third parties, which we are able to provide for limited reproduction under the terms of our own copyright licences, but for which copyright itself is non-transferable by Archaeological Surveys Ltd. Users remain bound by the conditions of the Copyright, Design and Patents Act 1988 with regard to multiple copying and electronic dissemination of this report.

Archaeological Surveys Ltd shall retain intellectual property rights for the materials and records created as part of this project. A non-exclusive, transferable, sub-licensable, perpetual and royalty-free licence shall be granted to the client on full payment of works in order for them to use, reproduce and enhance the reports, documentation, graphics and illustrations produced as part of this project for the purpose for which they were commissioned. Copyright licence will also be granted to the local authority for planning use and within in the Historic Environment Record for public dissemination upon payment by the client. Any document produced to meet planning requirements may be freely copied for planning, development control, research and outreach purposes without recourse to the originator, subject to all due and appropriate acknowledgements being provided and to the terms of the original contract with the client. Archaeological Surveys Ltd shall retain the right to be identified as the author and originator of the material.

The report, data and any associated material produced by Archaeological Surveys Ltd cannot be freely used for any commercial activity other than those set out above. Any unauthorised use will be considered to be in breach of copyright.

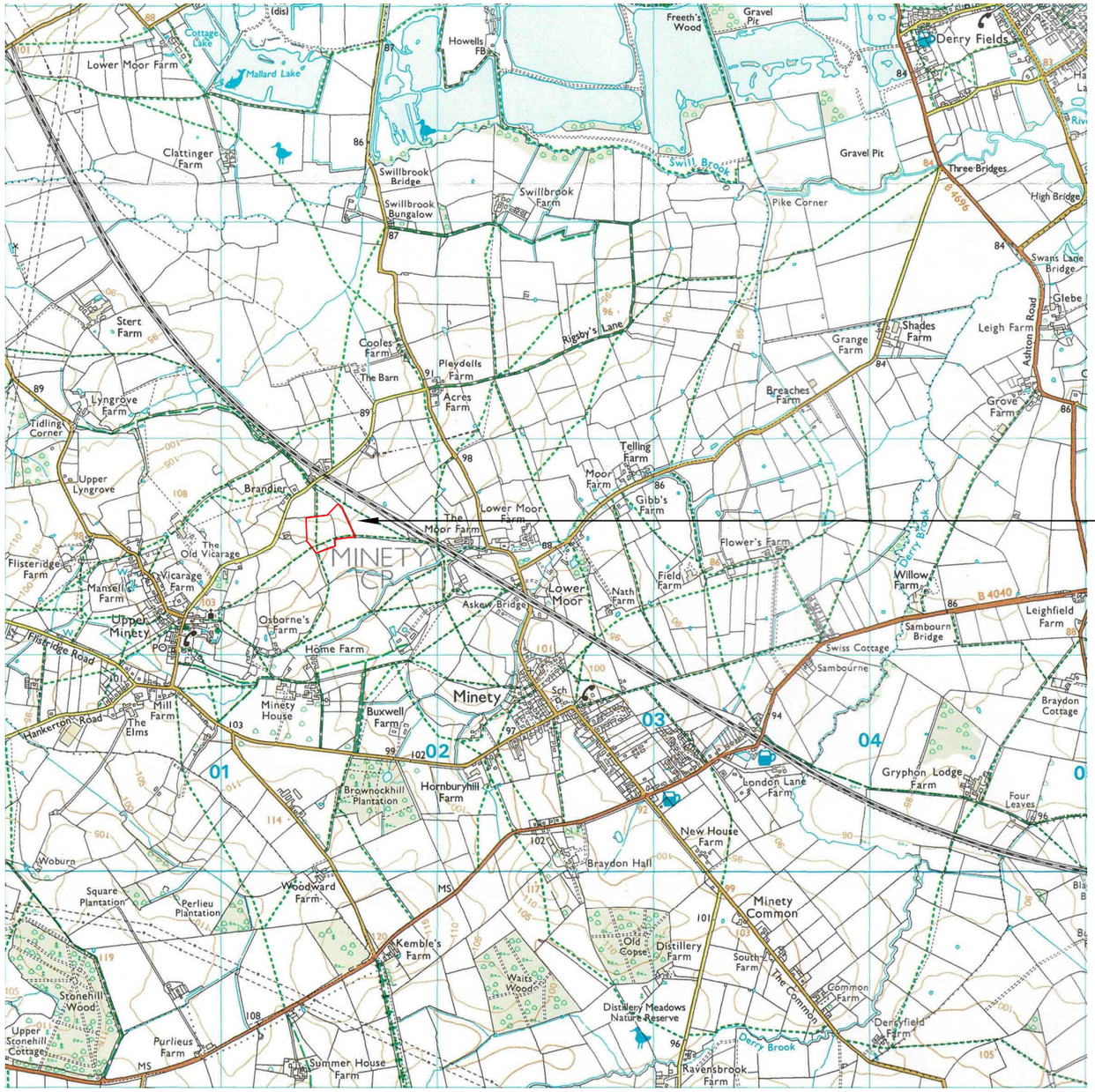
Title of Goods remains with Archaeological Surveys Ltd until payment has cleared. Late payment may jeopardise any planning decision as there will be no transfer of title, licensing or any other right of copy or use of this report. Archaeological Surveys Ltd do not give permission for use of the report and associated data in cases of late payment. Any such use will be considered to be in breach of copyright. Late payment may also incur interest at 8% over the Bank of England base rate. Non-payment will be pursued by legal action.

www.archaeological-surveys.co.uk
info@archaeological-surveys.co.uk
Tel: 01249 814 231

Archaeological Surveys
Specialist Geophysical Surveyors

Geophysical Survey
Brandiers Farm
Minety
Wiltshire

Map of survey area



Site centred on OS NGR
SU 01500 91580

SCALE 1:25 000

0m 500m 1000m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 01

401350 401400 401450 401500 401550 401600 401650

191700 191650 191600 191550 191500 191450

Area 1

Area 2

N

Archaeological Surveys
Specialist Geophysical Surveyors

Geophysical Survey
Brandiers Farm
Minety
Wiltshire

Referencing information

Referencing grid to OSGB36 datum at 50m intervals

401500 191600

Survey tracks

Survey track start

Survey track stop

SCALE 1:1000

0m 10 20 30 40 50m

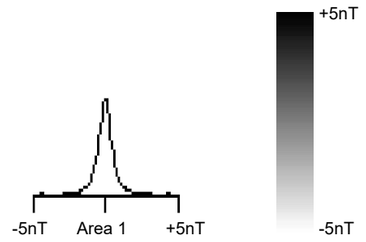
SCALE TRUE AT A3

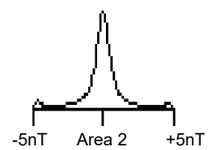
DRAWN BY	CHECKED BY	
KTD	DJS	FIG 02

Archaeological Surveys
Specialist Geophysical Surveyors

Geophysical Survey
Brandiers Farm
Minety
Wiltshire

Greyscale plot of minimally processed magnetometer data clipped at ±5nT





SCALE 1:1000

0m 10 20 30 40 50m

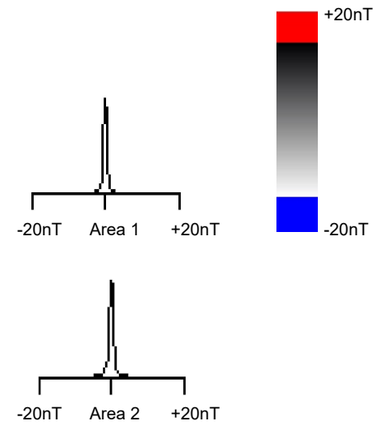
SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 03

Archaeological Surveys
Specialist Geophysical Surveyors

Geophysical Survey
Brandiers Farm
Minety
Wiltshire

Greyscale plot of minimally processed magnetometer data clipped at ±20nT



SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 04

Archaeological Surveys
Specialist Geophysical Surveyors

Geophysical Survey
Brandiers Farm
Minety
Wiltshire

Abstraction and interpretation of magnetic anomalies

N

Area 1

Area 2

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

- Positive linear anomaly - cut feature of archaeological potential
- Negative linear anomaly - material of low magnetic susceptibility of archaeological potential
- Positive linear anomaly - possible ditch-like feature
- Negative linear anomaly - material of low magnetic susceptibility
- Linear anomaly - ridge and furrow
- Negative linear anomaly - former field boundary
- Discrete positive response - cut / burnt feature of archaeological potential
- Discrete negative response - of archaeological potential
- Discrete positive response - possible pit-like feature
- Strong dipolar anomaly - ferrous / magnetically thermoremnant object
- Strong magnetic debris - of archaeological origin
- Weak magnetic debris - of archaeological origin

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 04

Archaeological Surveys
Specialist Geophysical Surveyors

Geophysical Survey
Brandiers Farm
Minety
Wiltshire

Digital Terrain Model

Derived from Environment Agency's LiDAR data 1m resolution

SCALE 1:2000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 06