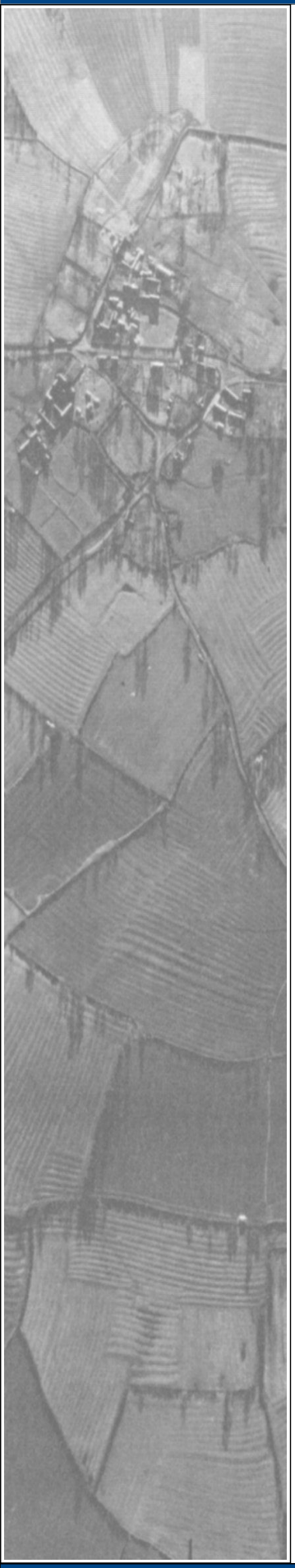

Land off Kenn Road
Yatton
North Somerset

MAGNETOMETER SURVEY REPORT

for

Cotswold Archaeology

Kerry Donaldson & David Sabin

August 2022

Ref. no. J925

ARCHAEOLOGICAL SURVEYS LTD

Land off Kenn Road
Yatton
North Somerset

MAGNETOMETER SURVEY REPORT

for

Cotswold Archaeology

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

Survey dates – 1st to 4th August 2022
Ordnance Survey Grid Reference – **ST 41635 67435**

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SUMMARY

A detailed magnetometry survey was carried out over 8.2ha on land off Kenn Road, Yatton in North Somerset by Archaeological Surveys Ltd. The full extent of the site could not be surveyed due to the presence of trees and scrub in the north western corner which prevented survey. The results indicate the presence of anomalies of archaeological potential in the southern part of the site that appear associated with industrial activity. To the north, the majority of the anomalies are associated with naturally formed features and extant and infilled drainage channels or grypes. A small number of positive linear anomalies have also been located, but these lack a clear morphology.

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 off Kenn Road, Yatton, North Somerset. The site has been outlined for the proposed relocation of the Yatton Rugby Football Club (North Somerset Council planning application no: 22/P/0456/FUL) and the survey forms part of an archaeological assessment. The site includes six areas of grassland that were suitable for survey and also a triangular land parcel in the north west which was overgrown with trees and scrub and therefore unsuitable for survey.

1.1.2 The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Archaeological Surveys (2022) and approved by Cat Lodge, Senior Archaeologist at North Somerset Council, prior to commencing the fieldwork.

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 Archaeological Surveys Ltd is a Registered Organisation with the Chartered Institute for Archaeologists and both company directors are Members of the Chartered Institute for Archaeologists (MCIfA) and have therefore been assessed for their technical competence and ethical suitability and abide by the CIfA Codes of Conduct. 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 to the north of the B3133 North End Road and east of Kenn Road on the northern edge of Yatton in North Somerset. It is centred on Ordnance Survey National Grid Reference (OS NGR) ST 41635 67435, see Figs 01 and 02.

1.4.2 The geophysical survey covers approximately 8.2ha within 6 grassland fields. Areas 1 to 4 were surveyed in entirety, with only the northern part of Area 5 and a 10m corridor in Area 6 surveyed within the red-line boundary.

1.4.3 The area is generally low lying land at around 6m AODN. The fields are bounded by hedgerows and drainage ditches; Areas 3 - 5 contain shallow, parallel, linear ditches known as grypes which are constructed to assist land

drainage. Areas 1 and 2 appear to have been levelled. The north western part of Area 1 contains a tall steel pylon, and there is a gravel track and area of hard standing at the western side of Area 1 extending south along the western side of Area 4 to a gated entrance off the B3133. A steel container was present at the northern side of Area 4.

1.4.4 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data. Survey was occasionally impeded by haylage bales within Area 5 and by overgrown field boundaries and corners. Several sources of magnetic disturbance were identified and include a steel pylon, goalposts, container, gates and fencing, survey was avoided in the immediate vicinity. Weather conditions during the survey were fair weather cloud with sunny intervals.

Plate 1: Survey Area 1 looking north west

Plate 2: Northern part of Area 5 looking south west

1.5 Site history and archaeological potential

1.5.1 A Heritage Statement (Pegasus Group, 2021) has been prepared for the site which outlines that the majority of the site was under pastoral and arable use in 1841, except for the north western corner of the site which although recorded in the Tithe Apportionment as in arable use, was named 'Brickyard'. Two further fields situated 30m and 120m north of the site are also named 'Brickyards". The north western corner of the site is currently under scrubland which prevented survey.

1.5.2 Geophysical surveys have been carried out within the northernmost field (Area 2) which located possible rectilinear anomalies towards the north western corner (YCCART, 2021) and within the southern field which located a number of rectilinear anomalies and magnetic enhancement indicating possible occupation, although the resistivity survey did not locate any corresponding anomalies (YCCART, 2019). The majority of the fields contain grypes which are a system of parallel drainage channels.

1.5.3 In the wider vicinity a number of archaeological features were located during geophysical surveys and intrusive investigation ahead of the Chestnut Park development situated between 50m and 700m to the south east. This included a small number of Early Bronze Age features, c450m south east and a Late Iron Age and Romano-British settlement c500m to the south east.

1.6 Geology and soils

1.6.1 The underlying solid geology across the site is mudstone and halitestone from

the Mercia Mudstone Group with overlying tidal flat deposits of clay and silt within the north western field (Area 1) (BGS, 2022).

1.6.2 The overlying soil across the majority of the site is from the Whimple 1 association and is a stagnogleyic argillic brown earth. It consists of a reddish, fine loamy over clayey soil with slowly permeable subsoils and slight seasonal waterlogging. The soils over the tidal flat deposits in the north western part of the site are from the Newchurch 2 association which are pelo-calcareous alluvial gley soils and consist of a deep, stoneless, mainly calcareous clayey soils (Soil Survey of England and Wales, 1983).

1.6.3 Magnetometry survey carried out across similar soils has produced variable results as mudstone geologies can be associated with low magnetic susceptibility, although areas of long term occupation or industrial activity can alter the soils sufficiently and may support good magnetic contrast. Marine alluvial environments can be associated with naturally formed features which at times can be difficult to distinguish from those with an anthropogenic origin. The underlying geology and soils are therefore considered acceptable for magnetic survey.

1.6.4 Observation of the surface topsoil within Areas 3 and 5 during the course of the survey indicated that it did not appear consistent with the descriptions offered by the Soil Survey. This may indicate alteration of the soil through long term incorporation of waste materials possibly to improve the land for crop production. Alternatively, soil dumping to raise the surface slightly between the drainage grypes is possible.

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®MXCOMPACT 7 channel cart-based system. The instrument has 7 fluxgate gradiometers (FGM650) spaced 0.5m apart with readings recorded at 20Hz for Areas 1, 2 & 4 and at 100Hz for Areas 3, 5 & 6. 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®MXCOMPACT 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®MXCOMPACT 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 ±3nT. Data are interpolated to a resolution of effectively 0.5m between tracks and 0.15m along each survey track.

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

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

2.3.6 A TIF file is produced by TerraSurveyor software along with an associated world file (.TFW) that allows automatic georeferencing (OSGB36 datum) when using GIS or CAD software. The main form of data display used in the report is the minimally processed greyscale plot. With regard to the Sensys MXCOMPACT, 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.

2.3.7 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.

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

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

2.3.10 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:55, Altitude:45, Z factor:10), (Fig 12).

2.3.11 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 6 survey areas covering approximately 8.2ha.

3.1.2 Magnetic anomalies located can be generally classified as positive linear and discrete positive responses of archaeological potential, positive anomalies of an uncertain origin, anomalies associated with land management, anomales with a natural origin, linear anomalies of an agricultural 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 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 Magnetic disturbance from modern ferrous objects is of limited extent and unlikely to obscure archaeologically significant anomalies. Several of the survey areas contain linear and amorphous anomalies relating to naturally formed features, and it is acknowledged that these can be difficult to separate from anomalies of anthropogenic origin. In addition, naturally formed anomalies may relate to environments exploited by humans in the past and may contain material that preserves useful environmental indicators.

3.2.3 The survey has located a number of anomalies that appear to demonstrate the presence of useful magnetic contrast between the fill of former cut features and the adjacent natural soil, subsoil or solid geology. In order to provide further understanding of the magnetic characteristics of the soil, two topsoil samples were taken and their mass specific magnetic susceptibility was measured using a Bartington MS2 meter with MS2B sensor. A sample from Area 3, where no archaeological anomalies were recorded, produced an average low frequency mass specific magnetic susceptibility (X_{lf}) of 7.4 $10^{-8}m^3kg^{-1}$; a sample from Area 5 where anomalies of archaeological potential were located produced a value of 9.4 $10^{-8}m^3kg^{-1}$. The Area 3 value is consistent with a clay soil with an unremarkable level of enhancement. The Area 5 value, although clearly higher, is not particularly remarkable and could relate to the incorporation of waste material into the topsoil as part of agricultural soil improvement; however, this contrasts with the nature of the magnetic anomalies located by the magnetometry in this area, which could indicate very little mixing between the topsoil and more magnetic deeper material or perhaps ground make-up with material of low magnetic susceptibility from elsewhere. The limited number of samples measured limits confidence in any interpretation and was not the primary objective of the work.

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.
Anomalies with an uncertain origin	The category applies to a range of anomalies where there is not enough evidence to confidently suggest an origin. Anomalies in this category may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered. Morphology may be unclear or uncharacteristic and there may be a lack of additional supporting information. Positive anomalies are indicative of magnetically

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

Table 1: List and description of interpretation categories

3.4 List of anomalies - Area 1

Area centred on OS NGR 341540 167585, see Figs 03 – 08.

Anomalies associated with land management

(1) – A series of negative linear anomalies relate to former drainage channels, known as grypes, these have been mostly levelled in this area.

Anomalies with a natural origin

(2) – Sinuous anomalies within Area 1 relate to responses to former channels within the underlying tidal flat deposits.

Anomalies associated with magnetic debris

(3) – Magnetically thermoremnant material has been used to partially infill the grypes

(4) – Strong, discrete, dipolar anomalies are a response to ferrous and other magnetically thermoremnant objects within the topsoil. They are very widespread and numerous.

Anomalies with a modern origin

(5) – Magnetic disturbance from goal posts and an electricity pylon.

3.5 List of anomalies - Area 2

Area centred on OS NGR 341660 167615, see Figs 03 – 08.

Anomalies with an uncertain origin

(6) – Area 2 contains a small number of positive linear anomalies which could relate to cut features, although an association with agricultural activity is possible.

Anomalies with a natural origin

(7) – A zone of magnetic enhancement at the western edge of the field is a response to the edge of the former tidal flats.

Anomalies associated with magnetic debris

(8) – A small patch of magnetic debris is evident towards the north west corner. The entire area contains widespread and numerous strong, discrete, dipolar anomalies.

3.6 List of anomalies - Area 3

Area centred on OS NGR 341770 167520, see Figs 03 – 08.

Anomalies with an uncertain origin

(9) – Area 3 contains a small amount of weakly positive linear anomalies. It is not possible to determine their origin.

Anomalies associated with land management

(10) – Negative linear anomalies are a response to the grypes within the field.

Anomalies associated with magnetic debris

(11) – Magnetic debris at the ends of the grypes is a response to magnetically

thermoremnant material used to infill the ends of the channels.

(12) – Magnetic debris along the centre of the survey area has been used to infill a former ditch or grype.

3.7 List of anomalies - Area 4

Area centred on OS NGR 341620 167480, see Figs 03 – 08.

Anomalies with an uncertain origin

(13) – A number of positive linear and discrete responses are located in the centre of the survey area. Although it is possible that they have a natural origin, the response is up to 10nT indicating moderate levels of magnetic enhancement compared to anomalies (15) at generally between 0.5-5nT, and an anthropogenic origin is possible.

Anomalies associated with land management

(14) – Negative linear anomalies and linear zones of magnetic debris relate to extant and infilled grypes.

Anomalies with a natural origin

(15) – The survey area contains linear, discrete and amorphous positive responses. Although no tidal flat deposits are mapped within this area, the response appears typical of those associated with naturally formed alluvial features and those associated with waterlogging.

3.8 List of anomalies - Area 5

Area centred on OS NGR 341615 167380, see Figs 09 – 11.

Anomalies of archaeological potential

(16) – A number of positive linear and discrete anomalies are associated with widespread magnetic debris (17) and relate to magnetically enhanced features possibly relating to industrial activity.

(17) – A large zone of magnetic debris relates to a spread of magnetically thermoremnant material such as brick or tile that is directly associated with positive linear and discrete anomalies (16). The spread of material is indicative of a widespread distribution of material associated with industrial activity.

(18) – A positive linear anomaly contains very strongly magnetic responses towards the southern end (85-200nT) with much lower levels of magnetic enhancement towards the north (0.5nT). The strength of the anomaly towards the southern end could indicate an association with intense burning/industrial activity.

Anomalies with an uncertain origin

(19) – A number of weakly positive linear and discrete anomalies are located in the north eastern part of Area 5. Their weak response and lack of coherent morphology does not allow for confident interpretation.

Anomalies with an agricultural origin

(20) – Linear anomalies that relate to agricultural activity.

3.9 List of anomalies - Area 6

Area centred on OS NGR 341697 167223, see Figs 09 – 11.

Anomalies with an uncertain origin

(21) – Three positive linear anomalies are located in the centre of the survey area. Such responses could relate to infilled cut features but this is not certain.

Anomalies with an agricultural origin

(22) – A positive linear anomaly extends parallel with and adjacent to the eastern field boundary and is likely to relate to agricultural activity.

Anomalies associated with magnetic debris

(23) – Much of Area 6 contains magnetic debris likely to be associated with dumped material.

4 CONCLUSION

4.1.1 The geophysical survey located a number of positive linear and discrete responses and widespread weakly magnetic debris that is likely to be associated with industrial activity in the southern part of the site. There is no surface expression of the anomalies and they may be of some antiquity as they appear to predate the grypes (land drainage channels). A mass specific magnetic susceptibility measurement of topsoil overlying the anomalies revealed only low-level magnetic enhancement; this may infer a sealed

horizon containing archaeological features and very little mixing of magnetic material with the overlying topsoil.

4.1.2 Elsewhere there are a number of weakly positive linear anomalies, but these tend to lack a clear and coherent morphology. Anomalies associated with naturally formed features within the tidal flats in the northern part of the site are evident, but similar anomalies can also be seen towards the centre of the site. Linear anomalies and zones of magnetic debris are associated with extant and infilled grypes that cross much of the site.

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Appendix A – basic principles of magnetic survey

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

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

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

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

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

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

Appendix B – data processing notes

Clipping

Minimum and maximum values are set and replace data outside of the range with those values. Extreme values are removed improving colour or greyscale contrast associated with data values that may be archaeologically significant. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

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

Area 1 minimally processed data
Filename: J925-mag-Area1-proc.xcp
Description: Imported as Composite from: J925-mag-Area1.asc
Instrument Type: Sensys DLMGPS
Units:
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 341468.24, 167651.05m
Southeast corner: 341612.39, 167518.75 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702
Dimensions
Survey Size (meters): 144 m x 132 m
X&Y Interval: 0.15 m
Source GPS Points: Active: 369364, Recorded: 369364
Data collection: 20Hz
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.25
Mean: 0.07
Median: 0.00
Composite Area: 1.9071 ha
Surveyed Area: 1.276 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 -3.00 to 3.00
Area 1 filtered data
Filename: J925-mag-Area1-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.10
Mean: 0.05
Median: 0.00
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -3.00 to 3.00

Area 2 minimally processed data
Filename: J925-mag-Area2-proc.xcp
Northwest corner: 341610.68, 167671.58 m
Southeast corner: 341706.68 167556.23 m
Dimensions
Survey Size (meters): 96 m x 115 m
X&Y Interval: 0.15 m
Source GPS Points: Active: 272260, Recorded: 272260
Data collection: 20Hz
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.13
Mean: 0.03
Median: 0.04
Composite Area: 1.1074 ha
Surveyed Area: 0.9937 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00
Area 2 filtered data
Filename: J925-mag-Area2-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.08
Mean: 0.02
Median: 0.03
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -3.00 to 3.00

Area 3 minimally processed data
Filename: J925-mag-Area3-proc.xcp
Northwest corner: 341713.27, 167601.19 m
Southeast corner: 341832.375, 167421.29 m
Dimensions
Survey Size (meters): 119 m x 180 m
X&Y Interval: 0.1 m
Source GPS Points: Active: 2639298, Recorded: 2639298
Data collection: 100Hz
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.07
Mean: 0.01
Median: 0.00
Composite Area: 2.1426 ha
Surveyed Area: 1.7183 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00

Area 3 filtered data
Filename: J925-mag-Area3-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.02
Mean: 0.01
Median: 0.00
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 1500
5 Clip from -3.00 to 3.00

Area 4 minimally processed data
Filename: J925-mag-Area4-proc.xcp
Northwest corner: 341516.87, 167559.05 m
Southeast corner: 341715.02, 167408.60 m
Dimensions
Survey Size (meters): 198 m x 150 m
X&Y Interval: 0.15 m
Source GPS Points: Active: 780488, Recorded: 780488
Data collection: 20hz
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.04
Mean: 0.03
Median: 0.01
Composite Area: 2.9812 ha
Surveyed Area: 2.3864 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00

Area 4 filtered data
Filename: J925-mag-Area4-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 0.98
Mean: 0.03
Median: 0.01
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -3.00 to 3.00

Area 5 minimally processed data
Filename: J925-mag-Area5-proc.xcp
Northwest corner: 341517.11, 167426.85 m
Southeast corner: 341704.61, 167179.05 m
Dimensions
Survey Size (meters): 188 m x 248 m
X&Y Interval: 0.1 m
Source GPS Points: Active: 4756209, Recorded: 4756209
Data collection: 100Hz

Stats
Max: 55.25
Min: -55.00
Std Dev: 3.62
Mean: 0.02
Median: 0.01
Composite Area: 4.6463 ha
Surveyed Area: 3.2002 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 Clip from -50.00 to 50.00
Stats
Max: 3.00
Min: -3.00
Std Dev: 1.24
Mean: 0.01
Median: 0.01

Area 5 filtered data
Filename: J925-mag-Area5-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.16
Mean: 0.00
Median: -0.01
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 1500
5 Clip from -3.00 to 3.00

Area 6 minimally processed data

Filename: J925-mag-Area6-proc.xcp
Northwest corner: 341669.53, 167285.38 m
Southeast corner: 341706.13, 167161.48 m
Dimensions
Survey Size (meters): 36.6 m x 124 m
X&Y Interval: 0.1 m
Source GPS Points: Active: 481733, Recorded: 481733
Data collection: 100Hz
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.75
Mean: 0.02
Median: 0.05
Composite Area: 0.45347 ha
Surveyed Area: 0.3346 ha
GPS based Proce4

1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00

Area 6 filtered data
Filename: J925-mag-Area6-proc-hpf-lpf.xcp

Stats
Max: 3.32
Min: -3.30
Std Dev: 1.66
Mean: 0.02
Median: 0.02
GPS based Proce6
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to UTM).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 1500
5 Lo pass Uniform (median) filter: Window dia: 18
6 Clip from -3.00 to 3.00

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 North Somerset 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	J925-mag-**[area number/name]**.asc J925-mag-**[area number/name]**.xcp J925-mag-**[area number/name]**-proc.xcp	Raw data as ASCII CSV TerraSurveyor raw data TerraSurveyor minimally processed data
Graphics	J925-mag-**[area number/name]**-proc.tif	Image in TIF format
Drawing	J925-**[version number]**.dwg	CAD file in 2018 dwg format
Report	J925 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 LINEAR ARCHAEOLOGY		Red 255,0,0	Polyline or polygon (solid)
AS-ABST MAG STRONG DISCRETE ARCHAEOLOGY		63,0,253	Polyline or polygon (solid)
AS-ABST MAG DEBRIS ARCHAEOLOGY		153, 0, 76	Polygon (cross hatched ANSI37)
Anomalies with an uncertain origin			
AS-ABST MAG POS LINEAR UNCERTAIN		255,127,0	Line, polyline or polygon (solid)
AS-ABST MAG POS DISCRETE UNCERTAIN		255,127,0	Solid donut, point or polygon (solid)
AS-ABST MAG POS UNCERTAIN		255,127,0	Polygon (cross hatched ANSI37)
Anomalies relating to land management			
AS-ABST MAG EXTANT DRAIN		0, 153,204	Line, polyline or polygon (solid or partly cross hatched ANSI38)
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)
Anomalies with a natural origin			
AS-ABST MAG NATURAL FEATURES		Yellow 255,255,0	Polygon (cross hatched ANSI37)

Table 3: CAD layering

Appendix F – copyright and intellectual property

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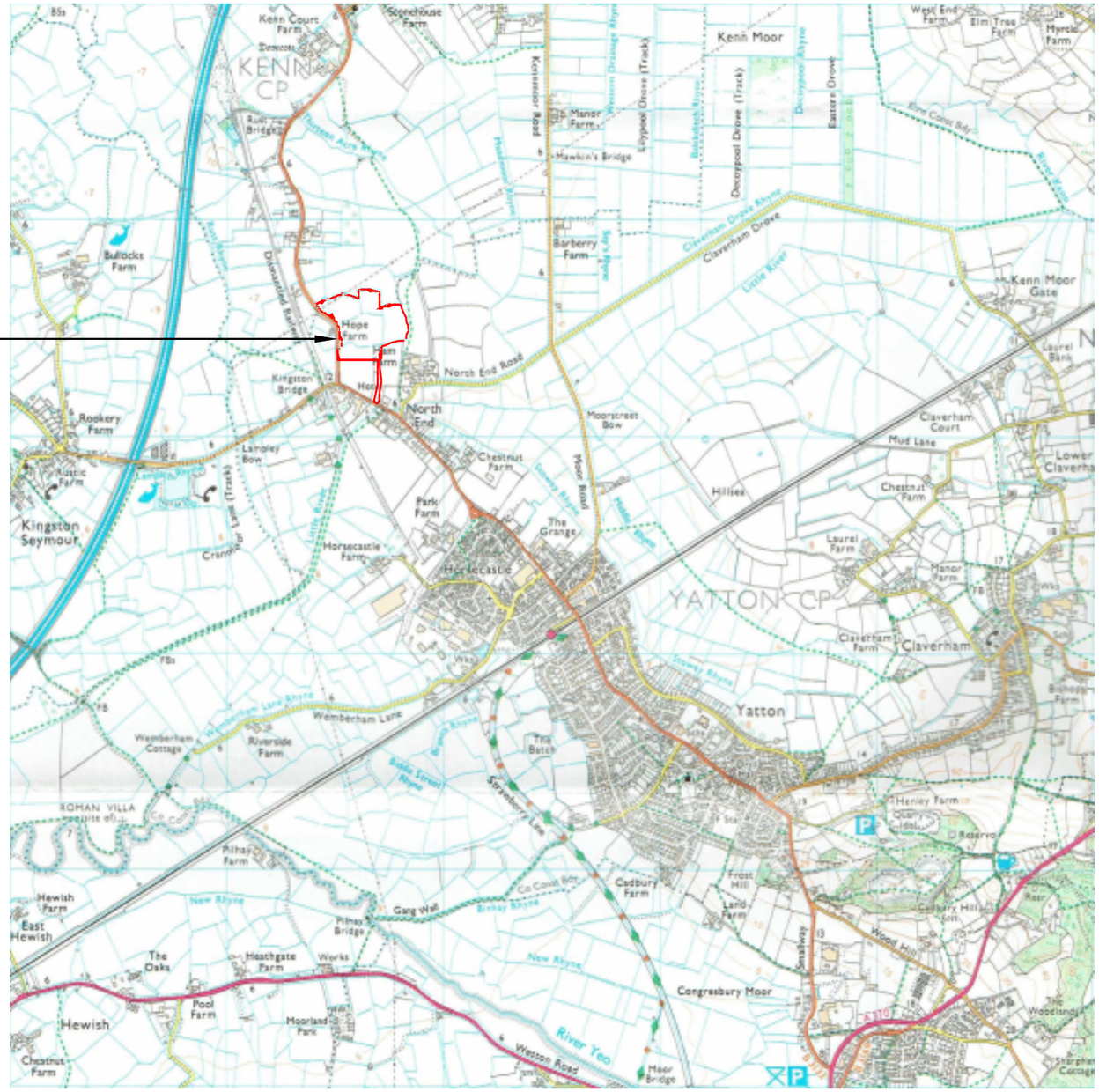
www.archaeological-surveys.co.uk
info@archaeological-surveys.co.uk
Tel: 01249 814 231

Survey location



N

Gloucestershire
South Gloucestershire
North Somerset
B&NES
Wiltshire
Somerset

Survey location

Site centred on OS NGR
ST 41635 67435

SCALE 1:25 000

0m 500m 1000m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 01

Archaeological Surveys
Specialist Geophysical Surveyors

Geophysical Survey
Land off Kenn Road
Yatton
North Somerset

Map of survey area

Archaeological Surveys
Specialist Geophysical Surveyors

Geophysical Survey
Land off Kenn Road
Yatton
North Somerset

Referencing information

Referencing grid to OSGB36 datum at 50m intervals

341600 167500

Survey tracks

Survey track start

Survey track stop

Development boundary

SCALE 1:2000

0m 20 40 60 80 100m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 02

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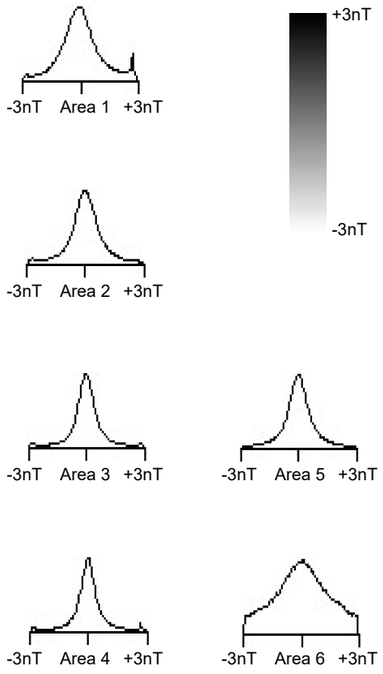
Yatton
North Somerset

Greyscale plot of minimally processed magnetometer data



SCALE 1:2000

0m 20 40 60 80 100m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 03

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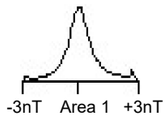
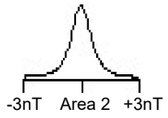
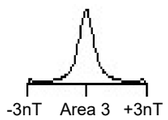
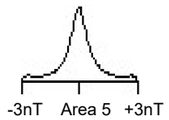
Yatton
North Somerset

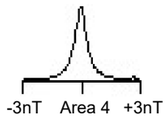
Greyscale plot of filtered magnetometer data

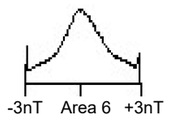












SCALE 1:2000

0m 20 40 60 80 100m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 04

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North Somerset

Abstraction and interpretation of magnetic anomalies

- Positive linear anomaly - cut feature / feature associated with burning of archaeological potential
- Positive linear anomaly - possible ditch-like feature
- Negative linear anomaly - extant drainage channel (grype)
- Linear anomaly - of agricultural origin
- Discrete positive response - cut feature / feature associated with burning of archaeological potential
- Strong positive response - feature associated with burning of archaeological potential
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant material of archaeologial potential
- Variable magnetic response - of natural origin
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:2000

0m 20 40 60 80 100m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 05

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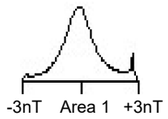
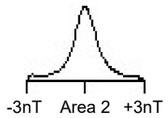
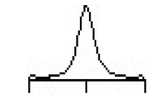
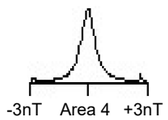
North Somerset

Greyscale plot of minimally processed magnetometer data









SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 06

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Geophysical Survey
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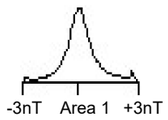
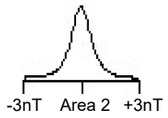
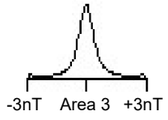
Yatton
North Somerset

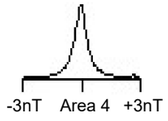
Greyscale plot of filtered magnetometer data



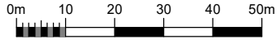


+3nT





SCALE 1:1250



SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 07

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Yatton
North Somerset

Abstraction and interpretation of magnetic anomalies - north

Area 1
Area 2
Area 3
Area 4
Area 5
Unsurveyable
B3133 kenn road
N
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

- Positive linear anomaly - cut feature / feature associated with burning of archaeological potential
- Positive linear anomaly - possible ditch-like feature
- Negative linear anomaly - extant drainage channel (grype)
- Linear anomaly - of agricultural origin
- Discrete positive response - cut feature / feature associated with burning of archaeological potential
- Strong positive response - feature associated with burning of archaeological potential
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- Variable magnetic response - of natural origin
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 08

Archaeological Surveys
Specialist Geophysical Surveyors

Geophysical Survey
Land off Kenn Road
Yatton
North Somerset

Greyscale plot of minimally processed magnetometer data - south

-3nT Area 5 +3nT

+3nT

-3nT

-3nT Area 6 +3nT

SCALE 1:1000

0m 10 20 30 40 50m

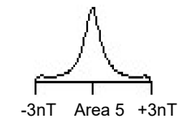
SCALE TRUE AT A3

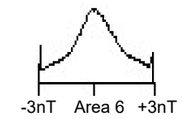
DRAWN BY	CHECKED BY	
KTD	DJS	FIG 09

Archaeological Surveys
Specialist Geophysical Surveyors

Geophysical Survey
Land off Kenn Road
Yatton
North Somerset

Greyscale plot of filtered magnetometer data - south





SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 10

Archaeological Surveys
Specialist Geophysical Surveyors

Geophysical Survey
Land off Kenn Road
Yatton
North Somerset

Abstraction and interpretation of magnetic anomalies - south

N

20
19
17
18
16
Area 5
23
Area 6
21
22
B3133 kenn road
10.1m
Smith's Forge
Industrial Estate
Bridge
House
Pond
The Grange
B3133 Ne

- Positive linear anomaly - cut feature / feature associated with burning of archaeological potential
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Discrete positive response - cut feature / feature associated with burning of archaeological potential
- Strong positive response - feature associated with burning of archaeological potential
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant material of archaeologial potential
- 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 11

Archaeological Surveys
Specialist Geophysical Surveyors

Geophysical Survey
Land off Kenn Road
Yatton
North Somerset

Digital Terrain Model

Derived from Environment Agency's LiDAR data 1m resolution

SCALE 1:2000

0m 20 40 60 80 100m

SCALE TRUE AT A3

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KTD	DJS	FIG 12