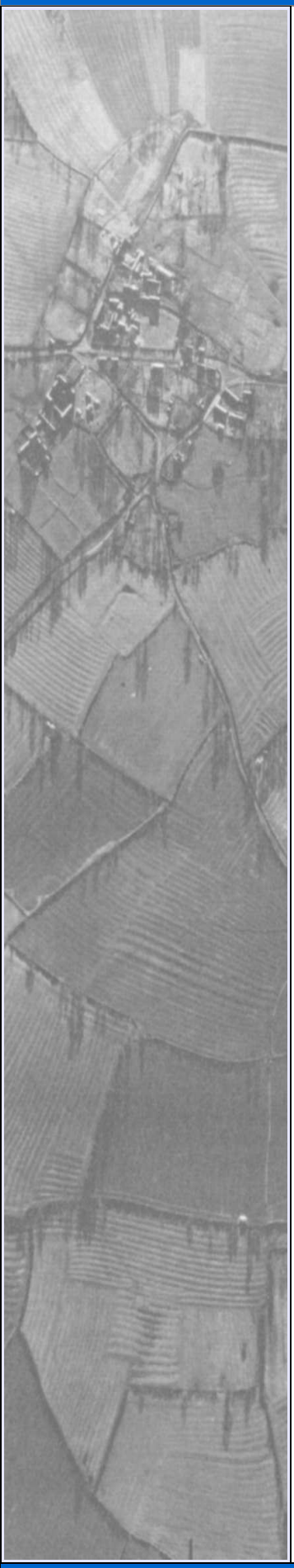

Ruddle Court Farm
Newnham
Gloucestershire

MAGNETOMETER SURVEY REPORT

for

Border Archaeology

Kerry Donaldson & David Sabin

August 2018

Ref. no. J761

ARCHAEOLOGICAL SURVEYS LTD

Ruddle Court Farm
Newnham
Gloucestershire

Magnetometer Survey Report

for

Border 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 – 10th August 2018
Ordnance Survey Grid Reference – **SO 68165 10575**

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CONTENTS

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

SUMMARY

A detailed magnetometer survey was carried out by Archaeological Surveys Ltd, at the request of Border Archaeology, over 2ha at Ruddle Court Farm, Newnham in Gloucestershire. The results indicate the presence of several areas of very highly magnetic responses which could indicate former iron smelting. One is situated on the south western edge of the site and contains a number of strong responses in a linear formation with a zone of magnetic debris to the east. Further east is a widespread area of amorphous magnetic responses bounded by a linear feature. This zone does contain several strongly magnetic discrete anomalies but it is not clear if they relate to in-situ features or dumped or redeposited material. To the north east are two groups of strongly magnetic responses generally arranged in fragmented linear groups and associated with widespread magnetic debris. These linear groups containing strongly magnetic discrete responses that may also be indicative of former iron smelting. In the western part of the site, magnetic debris appears to be associated with former buildings mapped during the early 19th century.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Border Archaeology to undertake a magnetometer survey of an area of land at Ruddle Court Farm, Newnham in Gloucestershire. The site has been outlined for a proposed development of a new dairy cow accommodation building, milking parlour, silage bunker and slurry lagoon. The survey forms part of an archaeological assessment of the site by Border Archaeology.

1.1.2 The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Border Archaeology (2018) and approved by Charles Parry, Archaeologist for Gloucestershire County 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.

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

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

aims and objectives of a survey is, therefore, often impossible to predetermine.

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

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

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

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

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

1.4 Site location, description and survey conditions

1.4.1 The site is located at Ruddle Court Farm, to the south west of Newnham in Gloucestershire. It is centred on Ordnance Survey National Grid Reference (OS NGR) SO 68165 10575, see Figs 01 and 02.

1.4.2 The geophysical survey covers approximately 2ha of pasture mainly within the western half of a larger field with a very small zone of survey along the eastern edge of the field immediately to the west. The surveyed area is split by a track and hedging towards the western edge. The land rises to the north from the base of a valley at the southern end of the site. A patch of open soil near the south western corner was noted and this is related to a spread of material recently removed from a field ditch to the west. Small patches of dumped soil and rough vegetation prevented survey close to the southern and western field boundaries. A small area of open soil in the eastern part of the

site relates to a recently removed tree stump. Two very small patches could not be surveyed due to electricity poles located near the north eastern boundary and machinery in the northern part of the site.

Plate 1: Survey area looking south west

1.4.3 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data. Weather conditions during the survey were wet due to persistent rain.

1.5 Site history and archaeological potential

1.5.1 There are a number of prehistoric, Roman and medieval sites within a 2km radius, although none are recorded within the site. Traces of Roman paving are recorded on the Ordnance Survey 1st Edition map along the line of the current A48 situated 360m to the east of the site. The1839 tithe map shows at least two buildings and several land boundaries within the western part of the site. The current land division is in existence by the 1881 Ordnance Survey 1st Edition with the current southern land boundary appearing to relate to a canalised watercourse that is not indicated on the tithe map. One of the structures is still evident on the 1st Edition map.

1.5.2 The Gloucestershire Historic Environment Record indicates that the field to the north has the post-medieval name of Ashfield or Ashmeadow which may indicate industrial activity. The Forest of Dean has a long history of iron working (Hoyle et al, 2007), with exploitation of iron ore within scowles located on higher ground to the west. A scowle is a landscape feature traditionally interpreted as the remains of early open-cast iron ore extraction. They are found within the outcrops of Carboniferous Limestone at the edge of the

central Forest. There is some evidence for Iron Age iron working at Soudley Camp and a number of Roman iron working sites around the Forest. This continued into the post-medieval period with Great Western Iron Works situated at Upper Soudley 1.6km to the south west with the former tramway between the iron works and Bullo Pill later becoming the Forest of Dean Branch of the Great Western Railway which lies 450m to the south of the site.

1.5.3 During the course of the survey iron slag was noted within soil removed from the ditch running along the western side of the site. Observations within the ditch revealed a clean west facing section containing iron slag, similar to tap slag, and a layer of Carboniferous limestone. At the south western corner of the field, just beyond the site boundary, a section of recently exposed stone wall was visible.

1.6 Geology and soils

1.6.1 The underlying geology is from the Mercia Mudstone Group with some alluvium along the southern edge of the site (BGS, 2018).

1.6.2 The overlying soil across the majority of the site is from the Whimple 3 association and is a stagnogleyic argillic brown earth. It consists of a reddish, fine loamy or silty over clayey soil with a slowly permeable subsoil. Along the eastern edge of the site the soil is from the Brockhurst 2 association and is a typical stagnogley soil consisting of a slowly permeable, seasonally waterlogged, reddish, 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 may be located where human activity has altered the magnetic characteristics of the soil sufficiently. The underlying geology and soils are, therefore, considered acceptable for magnetic survey.

2 METHODOLOGY

2.1 Technical synopsis

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

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

be mapped by magnetic prospection.

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

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

2.2 Equipment configuration, data collection and survey detail

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

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

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

2.2.4 Fluxgate sensors are highly sensitive to temperature change and this manifests as drift during the course of a survey. This can be particularly noticeable during the morning as temperatures rise and the equipment warms or cools. Sensor drift within the course of a traverse will appear as a line trending from negative to positive after

processing with a zero median traverse algorithm. To remove the potential for temperature drift, data were collected after a 20 minute stabilisation period and traverses were limited to a time of generally <100s.

2.3 Data processing and presentation

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

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

2.3.3 The minimally processed data are collected between limits of ±10000nT and clipped for display at ±30nT and also ±100nT with anomalies ±80nT highlighted to indicate the highly magnetic responses. 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.

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

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

2.3.9 A digital archive is produced with this report, see Appendix D below. The main archive is held at the offices of Archaeological Surveys Ltd. Under the Gloucestershire Archaeological Archive Standards (Paul, 2017) the digital data will also be archived with the Archaeology Data Service (ADS) and the report will be uploaded to Online AccesS to the Index of archaeological investigationS (OASIS) to be included in the ADS grey literature library.

3 RESULTS

3.1 General assessment of survey results

3.1.1 The detailed magnetic survey was carried out over a total of 2ha, the majority within a single pasture field but with a small zone located within a second pasture field immediately west of the main area.

3.1.2 Magnetic anomalies located can be generally classified as positive and negative responses of archaeological potential, positive anomalies of an uncertain origin, areas of magnetic debris 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 Widespread magnetic debris is visible within the data and although this can be associated with modern ferrous material and dumping, it is also typical of early industrial activity. Given the widespread nature of early iron working within this region, combined with observations of dense iron slag, on this occasion the interpretation set out below considers the debris to be archaeologically significant and unlikely to relate to more recent contamination.

3.3 Data interpretation

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

Interpretation category	Description and origin of anomalies
Anomalies with archaeological potential	Anomalies have the characteristics (mainly morphological) of a range of archaeological features such as pits, ring ditches, enclosures, etc. The category is used where there is a high level of confidence which may be due to additional supporting information where morphology is unclear or uncharacteristic.
Anomalies with an uncertain origin	The category applies to a range of anomalies where there is not enough evidence to confidently suggest an origin. Anomalies in this category may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered. Morphology may be unclear or uncharacteristic and there may be a lack of additional supporting information. Positive anomalies are indicative of magnetically enhanced soils that may form the fill of 'cut' features or may be produced by accumulation within layers or 'earthwork' features; soils subject to burning may also produce positive anomalies. Negative anomalies are produced by material of comparatively low magnetic susceptibility such as stone and subsoil.
Anomalies relating to land management	Anomalies are mainly linear and may be indicative of the magnetically enhanced fill of cut features (i.e. ditches). The anomalies may be long and/or form rectilinear elements and they may relate to topographic features or be visible on early mapping. Associated agricultural anomalies (e.g. headlands, plough marks and former ridge and furrow) may support the interpretation. Land drains can appear in a classic herringbone pattern of interconnected multiple dipolar linear anomalies, or as parallel linear anomalies. The multiple dipolar response indicates ceramic land drains.
Anomalies 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.

Table 1: List and description of interpretation categories

3.4 List of anomalies

Area centred on OS NGR 368165 210575, see Figs 03 – 05.

Anomalies of archaeological potential

(1) - A very strongly positive discrete response (700nT) is situated just beyond the southern edge of the proposed application area. Strong, more linear anomalies appear to lead from it to the north and north east and these have a response of 300-400nT. It is possible that the discrete response relates to a former iron furnace or bloomery, with the linear responses relating to possible tapping channels.

(2) - Situated just to the north of anomaly (1), within the application area, are a series of discrete, strongly positive anomalies. They generally have a response of 200-300nT and there also appears to be associated negative responses. It is likely that these anomalies are also associated with iron working, possibly further furnaces.

(3) - A fragmented, positive linear anomaly extends from the western edge to towards the south eastern corner of the survey area. It bounds a zone containing numerous strongly magnetic responses (4) and has an associated negative response just to the north. It is weak and indistinct in the west, with a response of 2-12nT, but where is bounds anomalies (4) the response is over 150nT, indicating that it contains strongly magnetic material. The anomalies appear to relate to a former boundary feature.

(4) - A zone of strongly magnetic anomalies with a response of 50-150nT relates to highly magnetic material. It is not clear if they relate to in-situ features, such as pits and/or areas of burning or if the material has been dumped or re-deposited. Although such material can be modern in origin, there is potential that this is associated with former iron working and an archaeological origin should be considered.

(5) - A positive linear anomaly extending north westwards from a zone of magnetic debris (12). This appears to relate to the enhanced fill of a cut feature, and it is possible that other weaker linear anomalies close by are associated.

(6) - Anomalies appear in a fragmented linear formation and have a response of 20nT at the northern end and over 40nT at the southern end. It appears to relate to industrial activity and widespread magnetic debris is evident in the data but has not been abstracted.

(7) - Situated less than 20m south east of anomalies (6) are a group of strongly positive responses. They appear in fragmented linear groups or clusters, generally over 100nT, with discrete anomalies peaking at over 250nT possibly suggesting iron smelting furnaces. The anomalies are associated with a large zone of magnetic debris which covers the majority of the north eastern part of the site.

(8) - The survey area contains a number of isolated discrete positive responses. They may relate to pits or areas of burning.

Anomalies with an uncertain origin

(9) - Weakly positive linear anomalies could be a continuation of anomaly (5). They are situated within an area defined by former land boundaries mapped in 1839 but removed by 1881.

(10) - A fragmented weakly positive linear anomaly is located in the north western part of the survey area. It is generally parallel with anomaly (6) and could relate to a further cut feature with archaeological potential.

Anomalies associated with magnetic debris

(11) - Located in the south western corner of the survey area is a zone of magnetic debris directly associated with anomalies (1) & (2). It would appear to relate to waste material associated with possible iron smelting.

(12) - A zone of magnetic debris to the north of anomalies (3) and (4) may be associated with them. However, modern dumped material is also possible.

(13) - Patches of magnetic debris in the western part of the site are situated in the same location as several small buildings indicated on the 1839 tithe map, with only one in existence by the 1881 1st Edition Ordnance Survey map.

(14) - A patch of magnetic debris towards the centre of the survey area is situated in the vicinity of a former field boundary marked on the tithe map and is likely to be associated.

(15) - The whole of the north eastern part of the site contains widespread magnetic debris. Anomaly (15) represents the zone with the strongest response. There is an association with anomalies (6) and (7) and it supports the likelihood of them relating to industrial activity.

4 DISCUSSION

4.1.1 The Forest of Dean has a history of iron smelting, with the exploitation of iron ore from scowles, situated over 1km to the west and at least 144 iron smelting bloomery sites recorded (Hoyle et al, 2007). Although the site does not lie on the higher ground associated with mineral deposits, there is evidence from the results for iron smelting, with several discrete, strongly magnetic anomalies, generally laid out in linear groups. One group of such features (1) & (2) are situated just on the south western edge of the proposed application area and

appear as discrete, strongly magnetic anomalies, with associated negative anomalies possibly indicating former structures. The anomalies are between 1.2m and 3m across. A zone of magnetic debris is evident on the eastern side of them.

4.1.2 Located 45m to the east of anomalies (1) & (2) are another group of strongly magnetic responses (3) that are bounded to the north by linear anomalies (4). While the responses are highly magnetic and there are linear and discrete elements, much of the general response is amorphous. It is not clear, therefore, if it relates to dumped iron working waste in-situ, or if it relates to redeposited material. There are, however, a number of discrete responses of between 200-500nT which could indicate that there are further iron smelting furnaces associated.

4.1.3 In the north eastern part of the site there is widespread magnetic debris, with only the strongest area abstracted (15). It is associated with anomalies (6) and (7) which relate to fragmented linear groups and discrete anomalies with a response of 100-200nT. This type of linear arrangement of discrete strongly magnetic features may be indicative of further iron smelting furnaces with a widespread distribution of the resulting magnetic slag being spread over a long period of time.

5 CONCLUSION

5.1.1 The geophysical survey has located evidence for possible iron working within the site. Within the south western corner, just within and outside of the application area, are several very strongly magnetic anomalies that could relate to iron smelting furnaces. Immediately to the east is an associated zone of magnetic debris relating to waste material. Further east is a zone of strongly magnetic responses that are more amorphous but which also contains several very strong, discrete responses. It is not clear if this relates to iron working material in-situ or if it has been dumped or re-deposited.

5.1.2 In the north eastern part of the site are two sets of strongly magnetic anomalies within fragmented linear formations associated with widespread magnetic debris. These may also indicate early iron working activity within this part of the site.

5.1.3 Further patches of magnetic debris in the western part of the site are likely to be associated with former buildings mapped in the 19th century.

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Appendix A – basic principles of magnetic survey

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

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

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

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

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

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

Appendix B – data processing notes

Clipping

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

Zero (destripe) Median/Mean Traverse

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

High Pass Filtering

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

Low Pass Filtering

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

Appendix C – survey and data information

Minimally processed data clipped at ±30nT

Filename: J761-mag-proc.xcp
Description: Imported as Composite from: J761-mag.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 368063.88, 210652.88m
Southeast corner: 368247.48, 210496.40 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702
Source GPS Points: 581900
Dimensions
Composite Size (readings): 1530 x 1304
Survey Size (meters): 184 m x 156 m
Grid Size: 184 m x 156 m
X Interval: 0.12 m
Y Interval: 0.12 m
Stats
Max: 33.15
Min: -33.00
Std Dev: 8.29
Mean: 0.20
Median: 0.08
Composite Area: 2.873 ha
Surveyed Area: 1.949 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -30.00 to 30.00 nT

Minimally processed data clipped at ±100nT

Filename: J761-mag-proc.xcp
Stats
Max: 110.50
Min: -110.00
Std Dev: 12.38
Mean: 0.43
Median: 0.15
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -100.00 to 100.00 nT

Appendix D – digital archive

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

A copy of the report in PDF/A format will be supplied to the Gloucestershire Historic Environment Record, together with a DXF of the survey boundary. In order to comply with the Gloucestershire Archaeological Archive Standards (Paul, 2017) the data will be archived with the Archaeology Data Service (ADS) and the report uploaded to Online AccesS to the Index of archaeological investigationS (OASIS) in the formats stated below for archiving:

Archive contents:

File type	Naming scheme	Description
Data	J761-mag.asc J761-mag.xcp J761-mag-proc.xcp	Raw data as ASCII CSV TerraSurveyor raw data TerraSurveyor minimally processed data
Graphics	J761-mag-proc.tif	Image in TIF format
Drawing	J761-**CAD**.dwg	CAD file in 2010 dwg format
Report	J761 report.odt	Report text in Open Office odt format

Table 2: Archive metadata

Appendix E – CAD layers for abstraction and interpretation plots

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

Report sub-heading and associated CAD layer names	Colour with RGB index		Layer content
Anomalies with archaeological potential			
AS-ABST MAG POS DISCRETE ARCHAEOLOGY		Red 255,0,0	Solid donut, point or polygon (solid)
AS-ABST MAG POS ARCHAEOLOGY		Red 255,0,0	Polygon (cross hatched ANSI37)
AS-ABST MAG NEG LINEAR ARCHAEOLOGY		127,0,255	Line, polyline or polygon (solid)
AS-ABST MAG STRONG POS ARCHAEOLOGY		255,0,255	Line, polyline or polygon (solid)
Anomalies with an uncertain origin			
AS-ABST MAG POS LINEAR UNCERTAIN		255,127,0	Line, polyline or polygon (solid)
AS-ABST MAG POS DISCRETE UNCERTAIN		255,127,0	Solid donut, point or polygon (solid)
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)

Table 3: CAD layering

Appendix F – copyright and intellectual property

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Archaeological Surveys Ltd

Geophysical Survey
Ruddle Court Farm
Newnham
Gloucestershire

Map of survey area

Survey location

Site centred on OS NGR
SO 68165 210575

SCALE 1:25 000

0m 500m 1000m

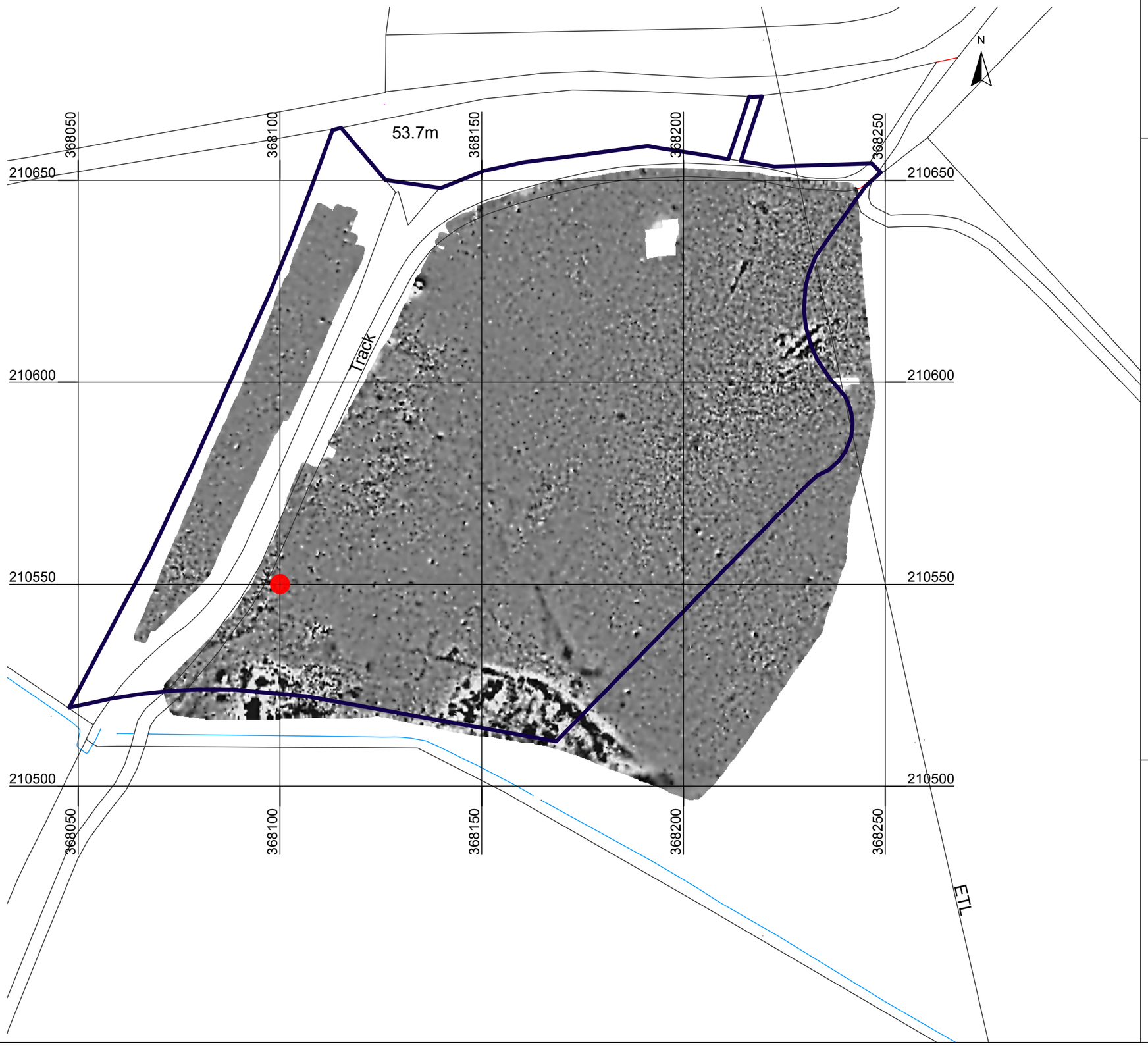
SCALE TRUE AT A3

FIG 01

Archaeological Surveys Ltd

Geophysical Survey
Ruddle Court Farm
Newnham
Gloucestershire

Referencing information



Referencing grid to OSGB36 datum at 50m intervals

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

368100 210550

Development boundary

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 02

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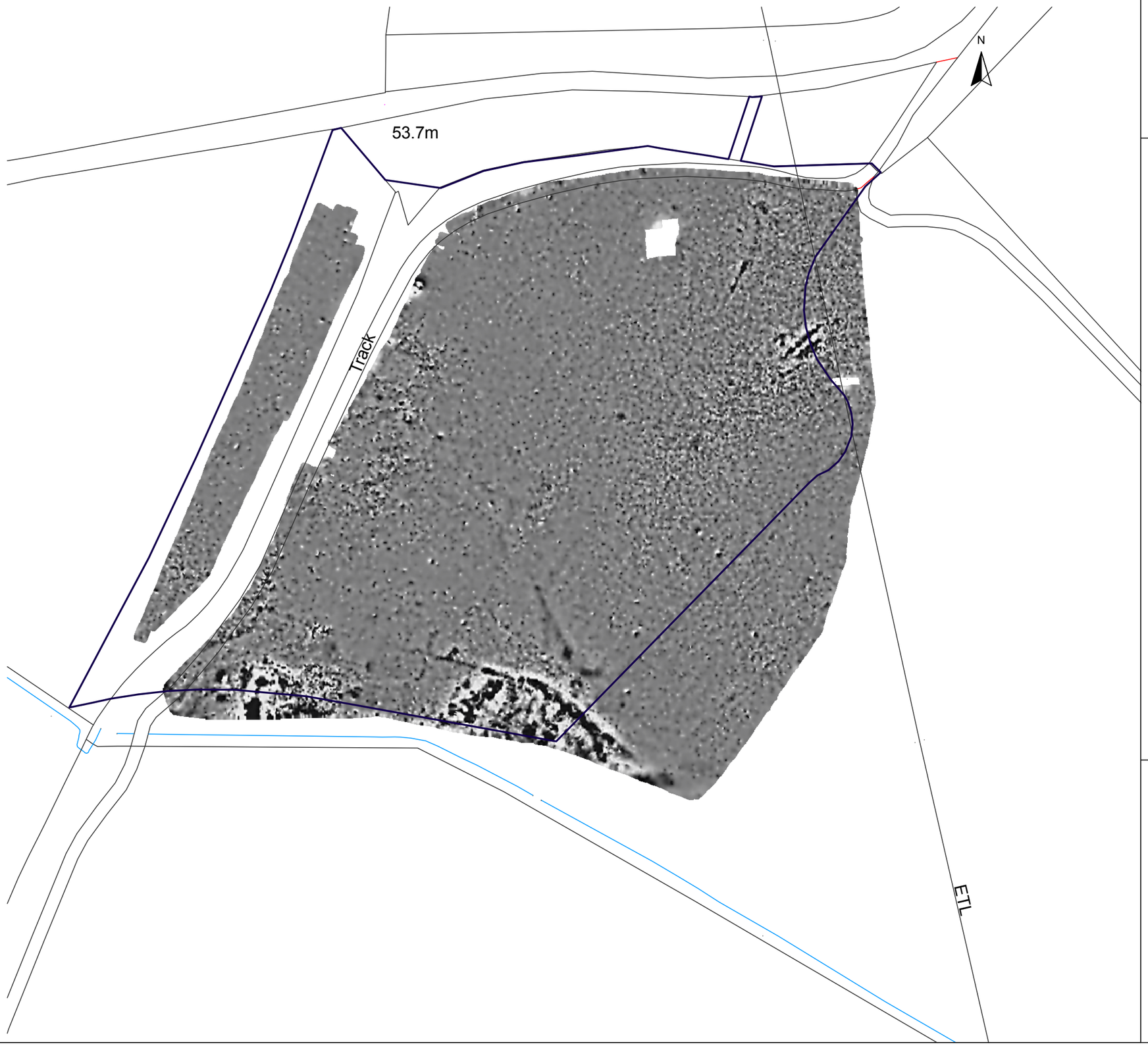
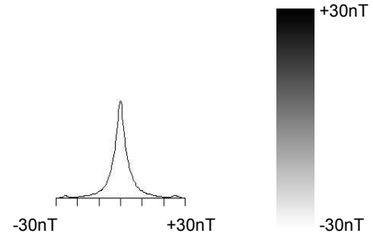
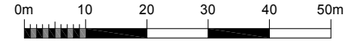
Geophysical Survey
Ruddle Court Farm
Newnham
Gloucestershire



Greyscale plot of minimally processed magnetometer data clipped at ±30nT



SCALE 1:1000

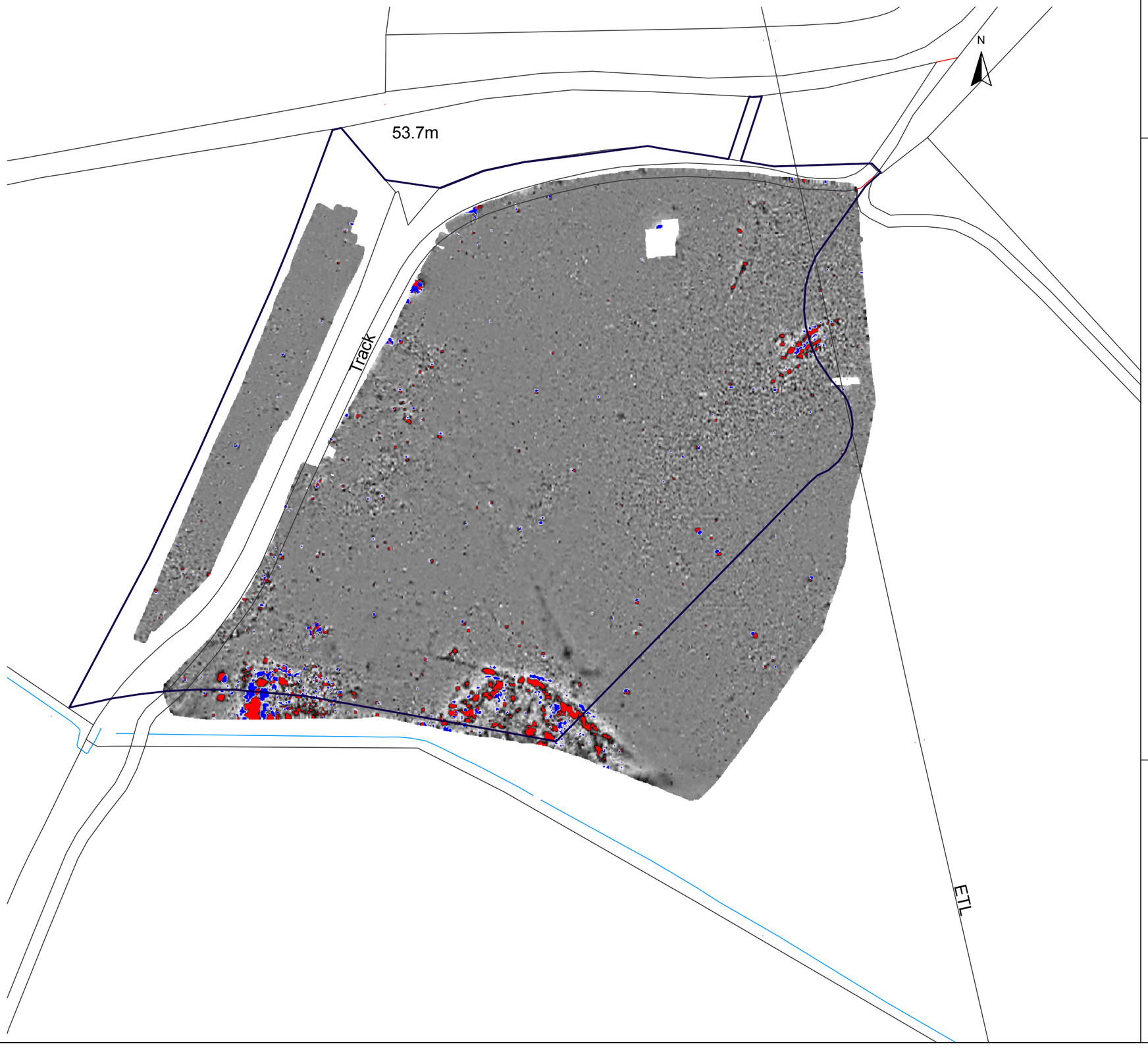


SCALE TRUE AT A3

FIG 03

Archaeological Surveys Ltd

Geophysical Survey
Ruddle Court Farm
Newnham
Gloucestershire



Greyscale plot of minimally processed magnetometer data clipped at ±100nT

+100nT
-100nT
-100nT
+100nT

SCALE 1:1000

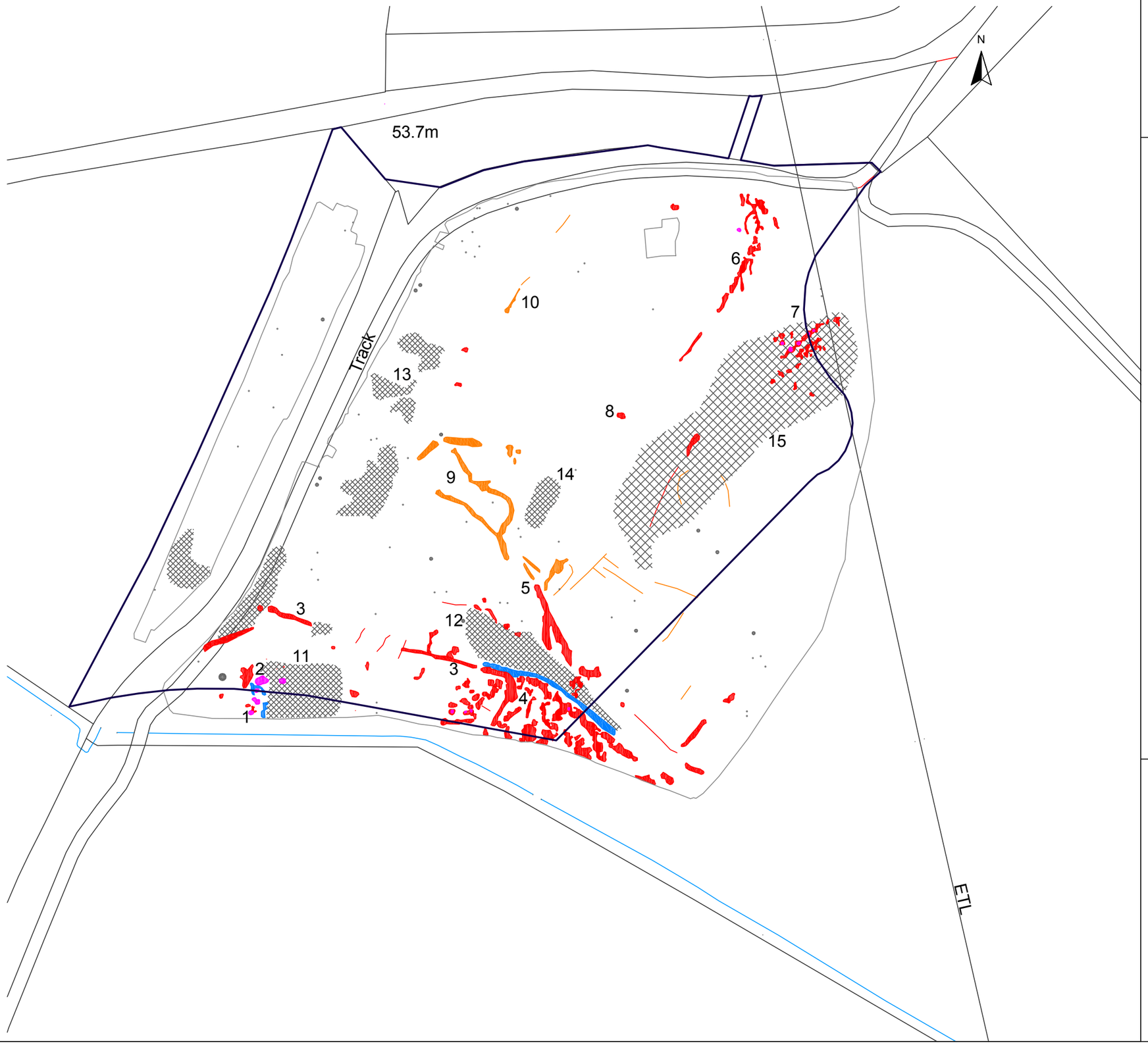
0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 04

Archaeological Surveys Ltd

Geophysical Survey
Ruddle Court Farm
Newnham
Gloucestershire



Abstraction and interpretation of magnetic anomalies

- Positive linear anomaly - cut feature of archaeological potential
- Negative linear anomaly - of archaeological potential
- Positive linear anomaly - possible ditch-like feature
- Discrete positive response - pit or area of burning with archaeological potential
- Discrete strong positive response - possible iron smelting furnace
- Discrete positive response - possible pit-like feature or area of burning
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 05