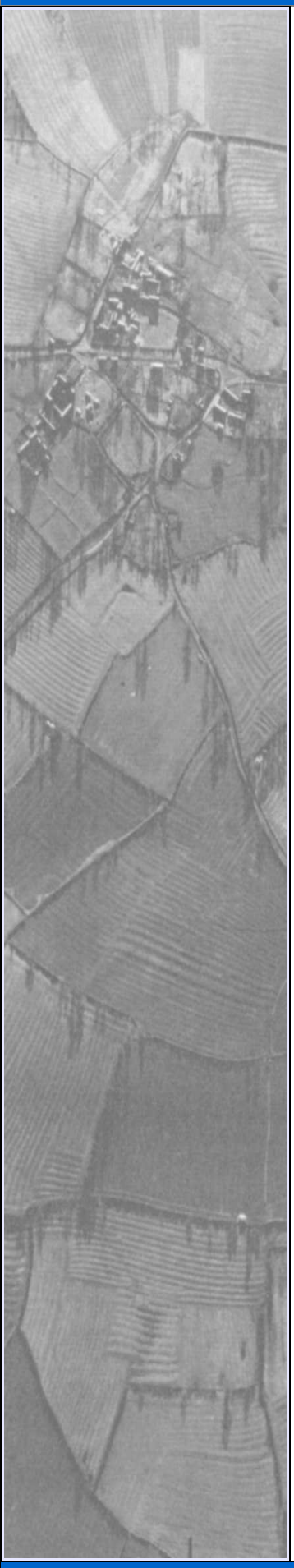

Wanborough Roman Town
Wanborough
Swindon

MAGNETOMETER AND EARTH RESISTANCE SURVEY REPORT

for

Swindon Borough Council

David Sabin and Kerry Donaldson

January 2015

Ref. no. 581

ARCHAEOLOGICAL SURVEYS LTD

Wanborough Roman Town
Wanborough
Swindon

Magnetometer and Earth Resistance Survey

for

Swindon Borough Council

Fieldwork by David Sabin
Report by David Sabin BSc (Hons) MIFA and Kerry Donaldson BSc (Hons)

Survey dates – 10th & 17th December 2014 & 6th January 2015
Ordnance Survey Grid Reference – **SU 19623 85311**

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

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SUMMARY

A detailed magnetometry survey was carried out over a 2ha field within the scheduled area of the Roman town at Wanborough, Swindon. An earth resistance survey was also undertaken over a 1ha area within the western and southern parts of the field. The magnetometer survey located a possible former channel of the Dorcan stream and widespread magnetic debris which may indicate modern magnetic contamination. Some magnetic anomalies did appear to correspond to resistivity anomalies, although they lack a coherent morphology. The difference between high and low resistance responses was very small due to waterlogged conditions, but several zones of relatively high response may indicate former structures, or possible roads or trackways, although these again are indistinct.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Swindon Borough Council upon instruction from Melanie Pomeroy-Kellinger, County Archaeologist for Wiltshire Council, to undertake a geophysical survey of an area of land adjacent to Lotmead Farm, Wanborough, Swindon. The survey area lies within a 2ha field under the ownership of Swindon Borough Council. It is located within the scheduled area for the site of the Roman Town, West of Wanborough House (List Entry No: 1004684/ AM 888). The survey was carried out with a licence from English Heritage under Section 42 of the 1979 Ancient Monuments and Archaeological Areas Act (as amended by the National Heritage Act 1983).

1.1.2 A previous geophysical survey was carried out across land immediately adjacent at Lotmead Farm by Archaeological Surveys in 2013. It covered part of the scheduled area for the Roman town believed to be *Durocornovium*, and a Section 42 licence was also granted by English Heritage for the previous work. This land was under different ownership and survey was carried out as part of a separate two phase project that also involved a wider survey over 140ha to the north east of the scheduled area (Archaeological Surveys, 2014a).

1.1.3 The aim of this survey was to infill a land parcel that is within the scheduled area but under the ownership of Swindon Borough Council. The survey is intended to inform Swindon Borough Council, their archaeological advisors and English Heritage of the extent and nature of the Roman town in this location and to link to the existing geophysical survey data of the surrounding area.

1.1.4 The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Archaeological Surveys (2014b) and issued to English Heritage as part of the application for the Section 42 licence.

1.2 Survey objectives and techniques

1.2.1 The objective of the survey was to use magnetometry and earth resistance survey (resistivity) to locate geophysical anomalies that may be archaeological in origin, so that they may be assessed along with those located by previous survey in the surrounding area. The methodology is considered an efficient and effective approach to archaeological prospection.

1.2.2 The entire field was subject to a detailed magnetometer survey, with a 1ha area targeted with earth resistance along the western and south western parts of the field. Roman buildings had been located by previous geophysical survey in the field immediately west of the site (*mansio* and bath house) (Archaeological Surveys, 2013). The south western part of the field was considered to have a high potential for possible structures due to the close proximity of Ermin Street.

1.2.3 The survey and report generally follow the recommendations set out by: English Heritage (2008) *Geophysical survey in archaeological field evaluation;* and Institute for Archaeologists (2002) *The use of Geophysical Techniques in Archaeological Evaluations*. The work has been carried out to the Institute for Archaeologists (2011) *Standard and Guidance for Archaeological Geophysical Survey.*

1.3 Site location, description and survey conditions

1.3.1 The site is located within the parish of Wanborough, on the eastern edge of Swindon. It comprises a single 2ha pasture field, surrounded by Lotmead Farm to the east, north and west and Wanborough Road (Ermin Street) to the south. It is centred on Ordnance Survey National Grid Reference (OS NGR) SU 19623 85311, see Figures 01 and 02.

Plate 1: Southern part of survey area looking north west

1.3.2 The ground conditions across the site were less than optimum for the collection of magnetometry and earth resistance data, with waterlogging across much of the field. The surface also contained deep ruts in places. Weather conditions during the survey were mainly fine.

1.4 Site history and archaeological potential

1.4.1 The site lies within the scheduled area of the *Roman Town West of Wanborough House.* This covers approximately 25ha in several plots of land mainly within Covingham, Lotmead and Nythe Farms, but much of the evidence for the site comes from excavations associated with the extension of the A419 and adjacent developments which is not within the scheduled area and the town may extend to between 40ha and 60ha in total. There is some conjecture that it relates to the Roman town of *Durocornovium*, listed in the 3rd Century Antonine Itinerary. An overview of the archaeological investigations of the Roman town was compiled for English Heritage by the Wiltshire County Archaeology Service in 2004 and has been summarised below.

1.4.2 The first mention of a Roman settlement was by John Aubrey who noted building remains, black ash and a hoard of over 2000 1st and 2nd century coins found in the 17th century. Sir Richard Colt Hoare produced a plan of the site showing pottery scatters and indications of buildings and earthworks in 1821, and named the site as the Roman town of *Nidum.* Test pitting and fieldwalking was undertaken by AD Passmore in the 1920s with a further 216 test pits by Ernest Greenfield in 1966 during the upgrading of the A419 (Ermin Street). An extended phase of work also began in 1966 under the direction of John Wacher concentrating on a section of Ermin Street within the Roman town. Aerial photographs taken by Bryn Walters in 1976 showed parchmarks of a *mansio* building, and adjacent probable bath house, in the central part of the site. Field investigations also indicated metalled roads extending eastwards into the current survey area. The combined investigations revealed a building, ditches, pits, pottery and other cultural material that showed several phases of development within the town.

1.4.3 The earliest phase is the construction of Ermin Street during the reign of the Emperor Nero (AD55-68), with at least one wooden building present and quantities of metalwork and dumped pottery possibly indicating a military presence, but there are no associated fortifications yet identified. After a period of at least 20 years, there is another phase of timber building and construction of side streets extending away from Ermin Street in the 1st and 2nd centuries. After AD200 it is still likely that many of the buildings were constructed of timber, with sarsen foundations and platforms used to raise them above any flooding level. Development continued throughout the 3rd century, with the widening of Ermin Street, the replanning of a gridded street pattern and the construction of stone buildings including the *mansio* and bath house. The large quantities of cultural material indicate that there were some crafts in the form of metalworking and woodworking, very few agricultural

implements and a significant number of finds associated with transportation. It appears that the town must have relied on trade and commerce, rather than industrial activity.

1.4.4 The survey area lies within the Roman town, immediately south east of the *mansio* building. This was subject to a previous geophysical survey (Archaeological Surveys, 2013) which showed that although there was a good magnetic response to cut features, such as ditches and pits and also to burnt material, there was a lack of a magnetic response to the structural remains associated with the *mansio*. A targeted earth resistance survey had a good response to the building's foundations, showing the overall plan and internal detail of a building 34m by 50m and a structural link between the *mansio* and the bath house.

1.4.5 There is a Wiltshire Historic Environment Record (HER) that indicates metalled road surfaces were recorded within the sides of the Dorcan stream at the edge of the current survey area. There is therefore a very high potential for the site to contain archaeological features relating to the Roman town.

1.4.6 During the course of the survey, a number of small sarsen stones (<0.5m in visible length) projecting above the field surface by a few centimetres were noted. There is some evidence for soil disturbance and stripping across the whole field and/or southern part of the field during the 1970s (Bernard Philips & Bryn Walters pers. comm). The sarsens were observed within both the northern and southern parts of the field possibly supporting evidence for widespread ground disturbance.

1.4.7 The base and sides of the Dorcan stream were observed due to low water levels and generally low levels of vegetation. The section of stream passing the central part of the field appeared to contain numerous fragments of Roman pottery with sherds of colour-coated New Forest Ware identified amongst others. There was no real evidence of structural material or surfaces within the stream or the sides of the stream. However, it is clear that there is much dumped material (e.g. asbestos sheeting fragments) within the base of the stream and alluvial material deposited along the sides that could easily mask Roman features.

1.5 Geology and soils

1.5.1 The underlying geology is mudstone from the Ampthill and Kimmeridge Clay Formation, but the survey area contains overlying alluvial deposits associated with the Dorcan stream.

1.5.2 The overlying soil across the survey area is from the Denchworth association and is a typical pelo stagnogley. It consists of a slowly permeable, seasonally waterlogged, clayey soil (Soil Survey of England and Wales, 1983).

1.5.3 Magnetometer surveys carried out on similar soils and geologies have

demonstrated that there can be a good contrast between the fill of cut features and the material into which they are cut, although there is often very low magnetic susceptibility resulting in very weak anomalies especially within alluvium.

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).

2.1.5 The electrical resistance or resistivity of the soil depends upon the moisture content and distribution within the soil. Buried features such as walls can affect the moisture distribution and are usually more moisture resistant than other features such as the infill of a ditch. A stone wall will generally give a high resistance response and the moisture retentive content of a ditch can give a low resistance response. Localised variations in resistance are measured in ohms (Ω) which is the SI unit for electrical impedance or resistance.

2.1.6 The Twin Probe configuration used in this survey is favoured for archaeological prospection and can give a response to features up to 1m in depth with a mobile probe separation of 0.5m.

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 spaced 0.5m apart with readings recorded at 20 Hz. The gradiometers have a range of recording data between 0.1nT and 10,000nT. The system is linked to a Leica GS10 RTK GPS with data recorded by SENSYS MAGNETO®MXPDA software on a rugged PDA computer system.

2.2.2 Data are collected along a series of parallel survey transects wherever possible. 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.

2.2.3 The earth resistance survey was carried out using Geoscan Research Ltd RM85 resistance meter using a mobile parallel twin probe array with a 0.5m electrode separation. Data were recorded at 1m intervals along traverses separated by 1m. The instrument was set to filter stray earth currents which can cause errors within the resistance measurements.

2.2.4 The earth resistance survey grids were set out to the Ordnance Survey OSGB36 datum using a Leica GS10 RTK GPS. The GPS is used in conjunction with Leica's SmartNet service, where positional corrections are sent via a mobile telephone link. Positional accuracy of around 10 – 20mm is possible using the system.

2.3 Data processing and presentation

2.3.1 Magnetic data collected by the MAGNETO®MXPDA cart-based system are initially prepared and automatically compensated using SENSYS MAGNETO®DLMGPS software. Georeferenced raw data are then exported in ASCII format for further analysis and display using TerraSurveyor.

2.3.2 The data are collected at ±10000nT and clipped for display at ±20nT. Data are resampled to a resolution of effectively 0.5m between tracks and 0.15m along each survey track. Appendix C contains specific information concerning the survey and data attributes and is derived directly from TerraSurveyor. Reference should be made to Appendix B for further information on any processes, such as clipping, carried out on the data.

2.3.3 A TIFF file is produced by TerraSurveyor software along with an associated world file (.TFW) that allows automatic georeferencing (OSGB36) when using GIS or CAD software. The main form of data display used in the report is the minimally processed greyscale plot.

2.3.4 Data logged by the resistance meter are downloaded and processed within TerraSurveyor software. Raw data are analysed and displayed within the report as well as processed data. The following processing has been carried out on data in this survey:

- raw earth resistance data have been clipped at 1SD between 0.47Ω and 5.29Ω,
- processed data have been clipped between 1.7Ω and 4Ω to enhance any possible archaeological anomalies,
- data have been "despiked" in order to remove spurious high contact responses.

2.3.5 The main form of data display prepared for this report is the greyscale plot followed by an abstraction and interpretation plot. Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing.

2.3.6 The raster images are combined with base mapping using ProgeCAD Professional 2009 and AutoCAD LT 2007, creating DWG file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical quality. Quality can be compromised by rotation of graphics (resistivity only) in order to allow the data to be orientated with respect to grid north; this is considered acceptable as the survey results are effectively georeferenced allowing relocation of features using GPS, resection method etc.

2.3.7 An abstraction and interpretation is offered for all geophysical anomalies located by the survey. 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.

2.3.8 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 – magnetometry

3.1.1 The detailed magnetic survey was carried out over approximately 2ha within a single pasture field.

3.1.2 Magnetic anomalies located can be generally classified as positive anomalies of an uncertain origin, anomalies with a natural origin, areas of magnetic debris and strong discrete dipolar anomalies relating to ferrous objects.

3.2 Statement of data quality – magnetometry

3.2.1 Data are considered representative of the magnetic anomalies present within the site. There are no significant defects within the dataset.

3.3 Data interpretation – magnetometry

3.3.1 The list of sub-headings below attempts to define a number of separate categories that reflect the range and type of features located during the survey. A basic explanation of the characteristics of the magnetic anomalies is set out for each category in order to justify interpretation, a basic key is indicated to allow cross referencing to the abstraction and interpretation plot. CAD layer names are included to aid reference to associated digital files (.dwg/.dxf). Sub-headings are then used to group anomalies with similar characteristics.

Report sub-heading CAD layer names and plot colour	**Description and origin of anomalies**
Anomalies with an uncertain origin AS-ABST MAG POS LINEAR UNCERTAIN AS-ABST MAG POS DISCRETE UNCERTAIN AS-ABST MAG POS AREA UNCERTAIN 	The category applies to a range of anomalies where there is not enough evidence to confidently suggest an origin. Anomalies in this category may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered. Positive anomalies are indicative of magnetically enhanced soils that may form the fill of 'cut' features or may be produced by accumulation within layers or 'earthwork' features; soils subject to burning may also produce positive anomalies. Negative anomalies are produced by material of comparatively low magnetic susceptibility such as stone and subsoil.
Anomalies associated with magnetic debris AS-ABST MAG DEBRIS AS-ABST MAG STRONG DIPOLAR 	Magnetic debris often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. It often occurs where there has been dumping or ground make-up and is related to magnetically thermoremnant materials such as brick or tile or other small fragments of ferrous material. This type of response is occasionally associated with kilns, furnace structures, or hearths and may therefore be archaeologically significant. It is also possible that the response may be caused by natural material such as certain gravels and fragments of igneous or metamorphic rock. Strong discrete dipolar anomalies are responses to ferrous objects within the topsoil.
Anomalies with a natural origin AS-ABST MAG NATURAL FEATURES	Naturally formed magnetic anomalies are 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 distinguished 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 magnetometry interpretation categories

3.4 General assessment of survey results – resistivity

3.4.1 The earth resistance survey was carried out over approximately 1ha along the western and southern parts of the field within areas considered likely to be of greater archaeological potential.

3.4.2 Resistive responses can be generally classified as high and low resistance

anomalies of possible archaeological potential.

3.5 Statement of data quality – resistivity

3.5.1 Data are considered representative of the resistive anomalies present within the site. The area was waterlogged during the course of the survey and this is likely to have suppressed resistive contrast across the site.

3.6 Data interpretation – resistivity

3.6.1 The listing of sub-headings below attempts to define a number of separate categories that reflect the range and type of features located during the earth resistance survey. A basic explanation of the characteristics of the anomalies is set out for each category in order to justify interpretation, a basic key is indicated to allow cross reference to the abstraction and interpretation plot. Sub-headings are then used to group anomalies with similar characteristics.

Report sub-heading CAD layer names and plot colour	**Description and origin of anomalies**
Anomalies with archaeological potential AS-ABST RES HIGH ARCHAEOLOGY AS-ABST RES LOW ARCHAEOLOGY	Anomalies have the characteristics (mainly morphological) of a range of archaeological features such as enclosures, structures, ring ditches, etc.. High resistance may indicate structural material (e.g. stone); low resistance may relate to the moisture retentive fill of cut features.
AS-ABST RES HIGH MODERN	Zones of high resistance that are associated with identifiable modern rubble and debris.

Table 2: List and description of resistivity interpretation categories

3.7 List of anomalies – magnetometry

Area centred on OS NGR 419623 185311, see Figures 03 - 06

Anomalies with an uncertain origin

(1) – A group of positive linear, discrete and diffuse anomalies are located close to the south western corner of the survey area. Several of them may correspond to high resistance anomalies, and although they are situated close to modern rubble and a former stable, it is possible that they are related to features with an archaeological origin.

(2) – There are a small number of weakly positive linear anomalies mainly seen in the north eastern corner of the survey area. It is not possible to determine if they relate to cut features.

(3) – A small cluster of positive linear anomalies are located at the western edge of the survey area. Due to their limited size it is not possible to determine their origin,

but they are close to the *mansio,* which is located immediately to the west, and an archaeological origin should be considered.

Anomalies with a natural origin

(4) – Much of the survey area contains anomalies associated with former channels of the Dorcan stream. This may have been canalised some time prior to the early 19th century as it has been mapped as a straight channel some 60m to the east since at least 1821. It is not possible to determine the age of the palaeochannel or if it is contemporary with the Roman town occupation.

Anomalies associated with magnetic debris

(5) – The survey area contains large zones of magnetic debris with very strong responses. These appear to relate to ferrous material within magnetic debris that may have been dumped on site. It is possible that there is some association with the former stream channel (4).

(6) – A zone of magnetic debris along the south western edge of the survey area is associated with a raised mound appearing to be associated with a former stables within this part of the site.

(7) – Associated with anomalies (5) are a large number of strong, discrete, dipolar anomalies that relate to ferrous and other magnetically thermoremnant objects within the topsoil.

3.8 List of anomalies – resistivity

Area centred on OS NGR 419065 185288, see Figures 07 & 08.

Anomalies of archaeological potential

(8) – Within the south western corner of the survey area are a number of high resistance anomalies that may relate to former structural remains. They lack a coherent form; however, their orientation and location indicate that they may have archaeological potential.

(9) – Two high resistance linear anomalies appear to either extend over, under or be associated with anomalies (8). It is not possible to determine their function, but an archaeological origin should be considered.

(10) – In the central and north western part of the survey area are two parallel high resistance linear anomalies, lower resistance anomalies are located immediately adjacent to them. There is only a small difference between the high and low resistance responses, but an overall linear trend with a similar orientation to trackways and roads within the Roman town can be seen.

(11) – Within the southern part of the survey area are a number of amorphous high resistance anomalies. Their form is incoherent and they do not have a highly resistive response; however, it is possible that they may be associated with former structural remains.

(12) – Located at the north western corner of the survey area is a small zone of high resistance. It is not possible to determine the form or function of the anomaly, but given the close proximity of the *mansio* to the west, an archaeological origin is possible.

(13) – A low resistance response is located close to the western edge of the survey area. Due to the location of the *mansio* and bath house immediately to the west an archaeological origin is possible.

Anomalies with a modern origin

(14) – An area of high resistance is associated with modern rubble.

4 CONCLUSION

4.1.1 The detailed magnetometer survey located a former channel of the Dorcan stream, together with widespread magnetic debris. It is possible that alluvial deposits and damp conditions have resulted in very low levels of magnetic susceptibility and a lack of magnetic contrast. There is also some evidence that the field surface may have been disturbed in the recent past. Several positive anomalies have been located in the south western corner, and although modern material is situated in the vicinity, it is possible that they relate to features with an archaeological origin. High resistance anomalies are also located in this part of the field and several of them may correspond to the magnetic responses.

4.1.2 Although there was a limited range between high resistance (5 Ω) and low resistance (2 Ω) responses, there are several amorphous high resistance responses, primarily within the southern part of the site. It is possible that these relate to former structural remains, although well defined walling foundations, similar to those seen associated with the *mansio* and bath house buildings immediately to the west, are not visible within this data set. This may be due to the waterlogged conditions being less than optimum for the collection of earth resistance data.

4.1.3 High resistance linear anomalies could be seen in the data with a north west to south east trend. It is possible that these are associated with former tracks or roads; however, corresponding responses cannot be seen in the magnetometry data.

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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 gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the upper sensor measures the Earth's magnetic field as does the lower sensor but this is influenced to a greater degree by any localised buried field. The difference between the two sensors will relate to the strength the magnetic field created by the buried feature. If no enhanced feature is present the field measured by both sensors will be similar and the difference close to zero.

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 ±15nT and ±10nT 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 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 slight differences between the set-up and stability of gradiometer sensors and can remove striping. The process can remove archaeological features that run along a traverse so data analysis is also carried out prior its application.

High Pass Filtering

A mathematical process used to remove low frequency anomalies relating to survey tracks and modern agricultural features.

Appendix C – survey and data information

Magnetometry

COMPOSITE
Filename: J581-mag-proc.xcp
Description: Imported as Composite from: J581-mag.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):
Northwest corner: 419530.120463354, 185426.957904984 m
Southeast corner: 419714.850463354, 185210.637904984 m
Direction of 1st Traverse: 90 deg
Collection Method: Parallel
Sensors: 1
Dummy Value: 32702

Source GPS Points: 648600

Dimensions
Composite Size (readings): 1421 x 1664
Survey Size (meters): 185 m x 216 m
Grid Size: 185 m x 216 m
X Interval: 0.13 m
Y Interval: 0.13 m

Stats
Max: 22.10
Min: -22.00
Std Dev: 7.77
Mean: -0.04
Median: 0.00
Composite Area: 3.9961 ha
Surveyed Area: 2.0164 ha

PROGRAM
Name: TerraSurveyor
Version: 3.0.23.0

Processes: 1
1 Base Layer

GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 High pass Uniform (median) filter: Window dia: 200
4 Clip from -20.00 to 20.00 nT

Raw resistivity

COMPOSITE
Filename: J581-res-raw.xcp
Description:
Instrument Type: GeoScan (Resistance)
Units: Ohm
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 1
Dummy Value: 2047.5

Dimensions
Composite Size (readings): 150 x 120
Survey Size (meters): 150 m x 120 m
Grid Size: 30 m x 30 m
X Interval: 1 m
Y Interval: 1 m

Stats
Max: 5.29
Min: 0.47
Std Dev: 0.52
Mean: 2.82
Median: 2.75
Composite Area: 1.8 ha
Surveyed Area: 0.9574 ha

PROGRAM
Name: TerraSurveyor
Version: 3.0.25.0

Processes: 3
1 Base Layer
2 Search & Replace 32702 With: Dummy
3 Clip at 1.00 SD

Processed resistivity

COMPOSITE
Path: C:\Business\Jobs\J581 Wanborough\Data\Res\comps\
Filename: J581-res-proc2.xcp
Description:
Instrument Type: GeoScan (Resistance)
Units: Ohm
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 1
Dummy Value: 2047.5

Dimensions
Composite Size (readings): 150 x 120
Survey Size (meters): 150 m x 120 m
Grid Size: 30 m x 30 m
X Interval: 1 m
Y Interval: 1 m

Stats
Max: 4.00
Min: 1.70
Std Dev: 0.45
Mean: 2.80
Median: 2.74
Composite Area: 1.8 ha
Surveyed Area: 0.9574 ha

Processes: 5
1 Base Layer
2 Search & Replace 32702 With: Dummy
3 Despike Threshold: 1 Window size: 3x3
4 Clip at 3.00 SD
5 Clip from 1.70 to 4.00 Ohm

Appendix D – digital archive

Archaeological Surveys Ltd hold the primary digital archive at their offices in Wiltshire (see inside cover for address). 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.

Surveys are reported on in hardcopy (recycled paper) using A4 for text and A3 for plots (all plots are scaled for A3). A printed copy and PDF copy will be sent to the English Heritage Southwest Casework team, and a PDF copy to the English Heritage geophysics team. A printed report will also be sent to the Wiltshire Historic Environment Record (HER) and a PDF copy uploaded to Oasis.

This report has been prepared using the following software on a Windows XP platform:

- TerraSurveyor version 3.0.23.0 (geophysical data analysis),
- SENSYS MAGNETO®ARCH version 1.00-04(geophysical data analysis),
- ProgeCAD Professional 2014 (report graphics),
- AutoCAD LT 2007 (report figures),
- OpenOffice.org 3.0.1 Writer (document text),
- PDF Creator version 0.9 (PDF)

Digital data produced by the survey and report include the following files:

- TerraSurveyor grid and composite files for all geophysical data,
- CSV files for raw and processed composites,

- geophysical composite file graphics as Tiff images,
- AutoCAD DWG files in 2000 and 2007 versions,
- report text as OpenOffice.org ODT file,
- report text as Word 2000 doc file,
- report text as rich text format (RTF),
- report text as PDF / PDF/A,
- PDFs of all figures.

ENGLISH HERITAGE

English Heritage Geophysical Survey Database Questionnaire

Survey Details

Name of Site: Site of Roman Town, West of Wanborough House (Report title: Wanborough Roman Town, Wanborough, Swindon)

County: Wiltshire (Swindon Borough)

NGR Grid Reference (Centre of survey to nearest 100m):
SU 196 853

Start Date: 10th December 2014 End Date: 6th January 2015

Geology at site (Drift and Solid):

Alluvial deposits with sands and gravels overlying Ampthill and Kimmeridge Clay.

Known archaeological Sites/Monuments covered by the survey
(Scheduled Monument No. or National Archaeological Record No. if known)

Monument No: 1004684/SM SW 888

Archaeological Sites/Monument types detected by survey
(Type and Period if known. "?" where any doubt).

Roman structures? Roman ditches? Roman roads/tracks?

Surveyor (Organisation, if applicable, otherwise individual responsible for the survey):

Archaeological Surveys Ltd (David Sabin and Kerry Donaldson)

Name of Client, if any:

Swindon Borough Council

ENGLISH HERITAGE

Purpose of Survey:

To inform Swindon Borough Council, their archaeological advisors and English Heritage of the extent and nature of the Roman town in this location and to link to the existing geophysical survey data of the surrounding area.

Location of:

a) Primary archive, i.e. raw data, electronic archive etc:

Archaeological Surveys Ltd, 1 West Nolands, Nolands Road, Yatesbury, Calne, SN11 8YD

b) Full Report:

As above and also sent to Wiltshire HER.

ENGLISH HERITAGE

Technical Details

(Please fill out a separate sheet for each survey technique used)

Type of Survey (Use term from attached list or specify other):

Magnetometer

Area Surveyed, if applicable (In hectares to one decimal place):

2ha

Traverse Separation, if regular: **Reading/Sample Interval:**

0.5m 0.20m

Type, Make and model of Instrumentation:

Sensys Magneto MXPDA – (5 fluxgate gradiometers)

For Resistivity Survey:

Probe configuration:

Probe Spacing:

Land use at the time of the survey (Use term/terms from the attached list or specify other):

Grassland - Pasture

ENGLISH HERITAGE

Technical Details

(Please fill out a separate sheet for each survey technique used)

Type of Survey (Use term from attached list or specify other):

Resistivity

Area Surveyed, if applicable (In hectares to one decimal place):

0.1ha

Traverse Separation, if regular: **Reading/Sample Interval:**

1m 1m

Type, Make and model of Instrumentation:

Geoscan Research Ltd RM85

For Resistivity Survey:

Probe configuration: Twin probe

Probe Spacing: 0.5m

Land use at the time of the survey (Use term/terms from the attached list or specify other):

Grassland - Pasture

Additional Remarks (Please mention any other technical aspects of the survey that have not been covered by the above questions such as sampling strategy, non standard technique, problems with equipment etc.):

List of terms for Survey Type

Magnetometer (includes gradiometer)

Resistivity

Resistivity Profile

Magnetic Susceptibility

Electro-Magnetic Survey

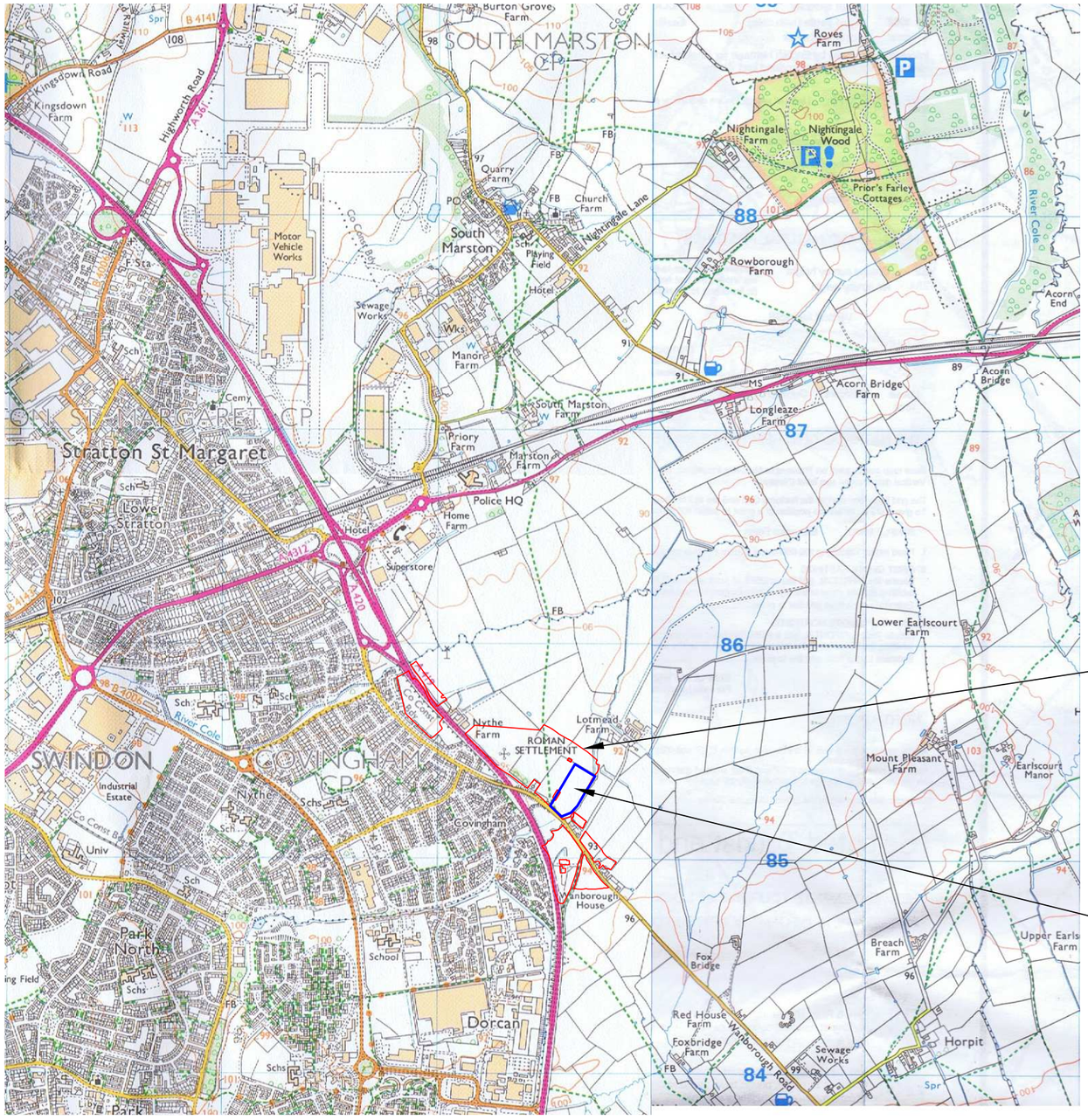
Ground Penetrating Radar

Other (please specify)

ENGLISH HERITAGE

List of terms for Land Use:

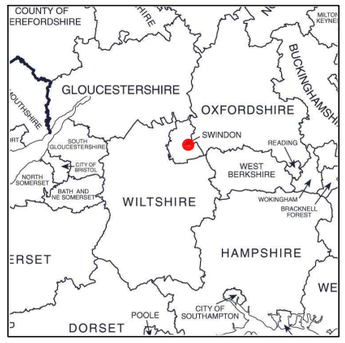
Arable
Grassland - Pasture
Grassland - Undifferentiated
Heathland
Moorland
Coastland - Inter-Tidal
Coastland - Above High Water
Allotment
Archaeological Excavation
Garden
Lawn
Orchard
Park
Playing Field
Built-Over
Churchyard
Waste Ground
Woodland
Other (please specify)



Archaeological Surveys Ltd

Geophysical Survey
Wanborough Roman Town
Wanborough
Swindon

Map of survey area



● Survey location

Site centred on OS NGR
SU 19623 85311

SCALE 1:25 000

0m 500m 1000m

SCALE TRUE AT A3

FIG 01

Archaeological Surveys Ltd

Geophysical Survey
Wanborough Roman Town
Wanborough
Swindon

Referencing information

Referencing grid to OSGB36 datum at 50m intervals for magnetometry data

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

Scheduled area

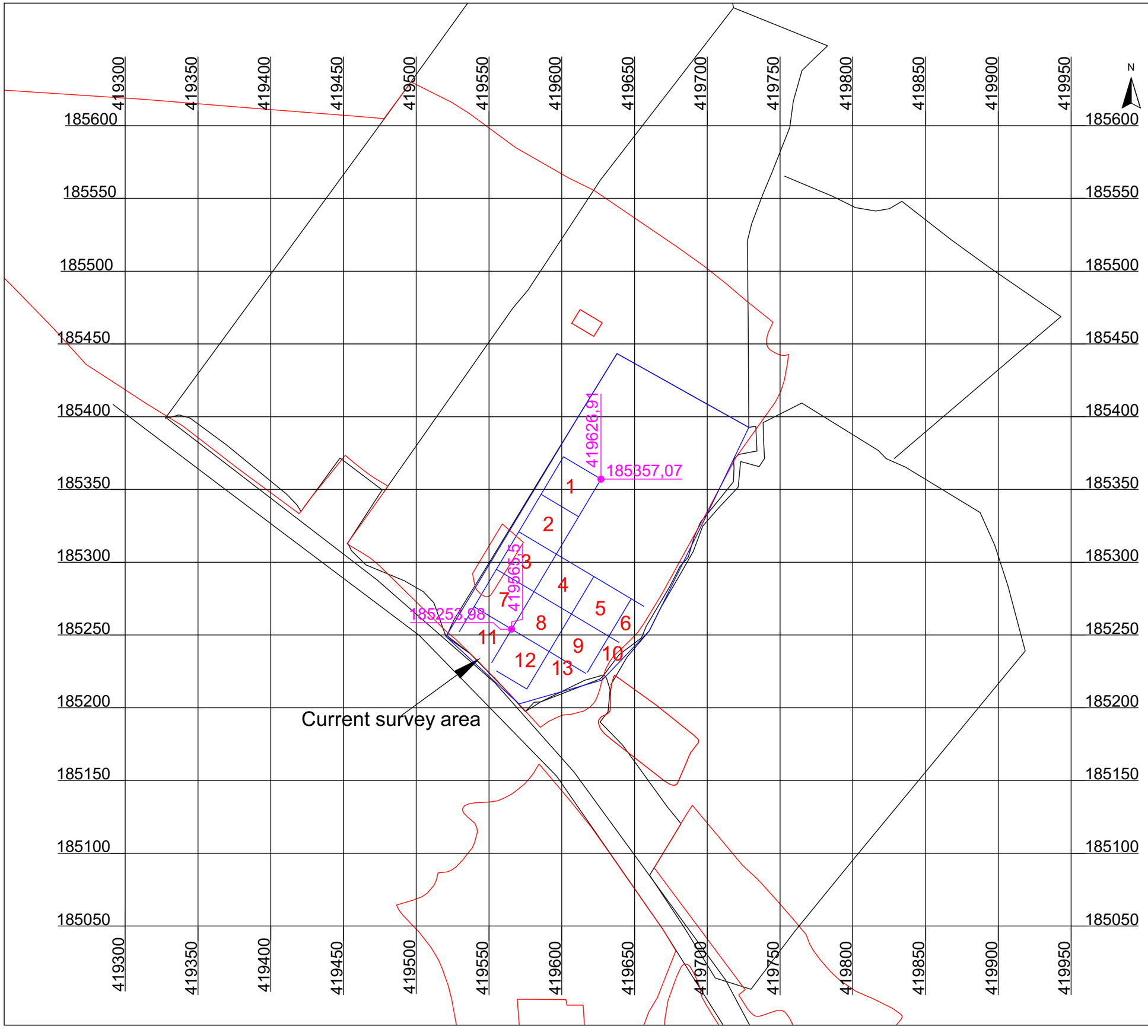
2 Resistivity grid number (30m grids)

SCALE 1:2500

0m 50 100m

SCALE TRUE AT A3

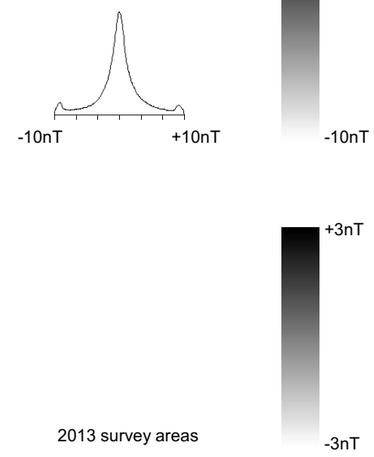
FIG 02



Archaeological Surveys Ltd

Geophysical Survey
Wanborough Roman Town
Wanborough
Swindon

Greyscale plot of minimally processed magnetometer data



2013 survey areas

N

Current survey area

SCALE 1:2500

0m 50 100m

SCALE TRUE AT A3

FIG 03

Archaeological Surveys Ltd

Geophysical Survey
Wanborough Roman Town
Wanborough
Swindon

Abstraction and interpretation of magnetometer and resistance anomalies

- Positive linear anomaly - cut feature of archaeological potential
- Positive linear anomaly - possible ditch-like feature
- Negative linear anomaly - material of low magnetic susceptibility
- Discrete positive response - cut feature of archaeological potential
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material
- Magnetically variable response - material of archaeological potential
- Variable magnetic response - former stream channel
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object
- High resistance linear anomaly - structural remains
- High resistance linear anomaly - of archaeological potential
- High resistance linear anomaly - edge of modern cultivation
- Area of high resistance - of archaeological potential
- Area of low resistance - of archaeological potential
- Area of high resistance - modern rubble

SCALE 1:2500

0m 50 100m

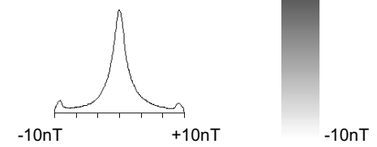
SCALE TRUE AT A3

FIG 04

Archaeological Surveys Ltd

Geophysical Survey
Wanborough Roman Town
Wanborough
Swindon

Greyscale plot of minimally processed magnetometer data



N

Current survey area

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 05

Archaeological Surveys Ltd

Geophysical Survey
Wanborough Roman Town
Wanborough
Swindon

Abstraction and interpretation of magnetometer anomalies

N

12

13

10

8

7

9

11

Current survey area

- Positive linear anomaly - possible ditch-like feature
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material
- Variable magnetic response - of natural origin
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Strong dipolar anomaly - ferrous object

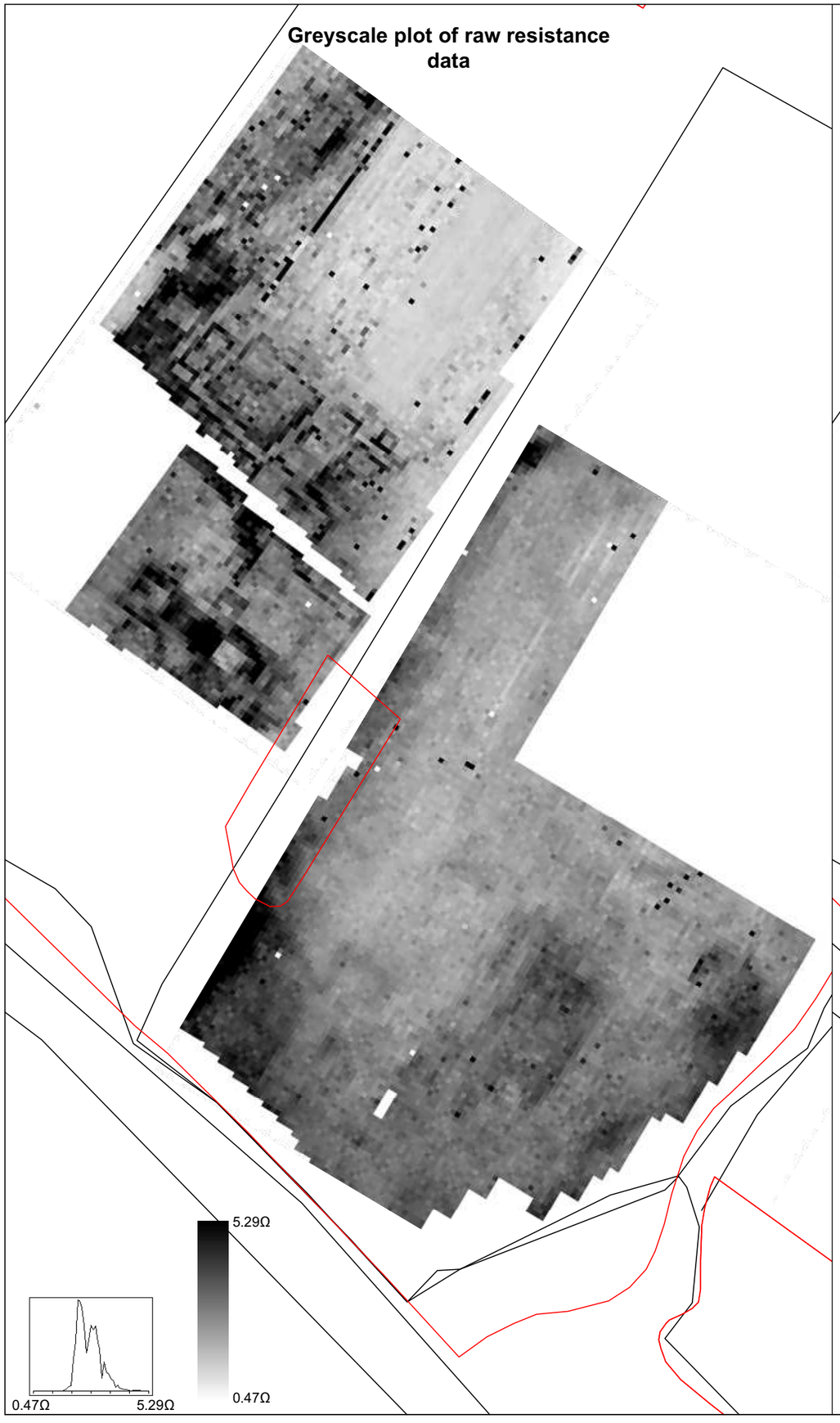
SCALE 1:1000

0m 10 20 30 40 50m

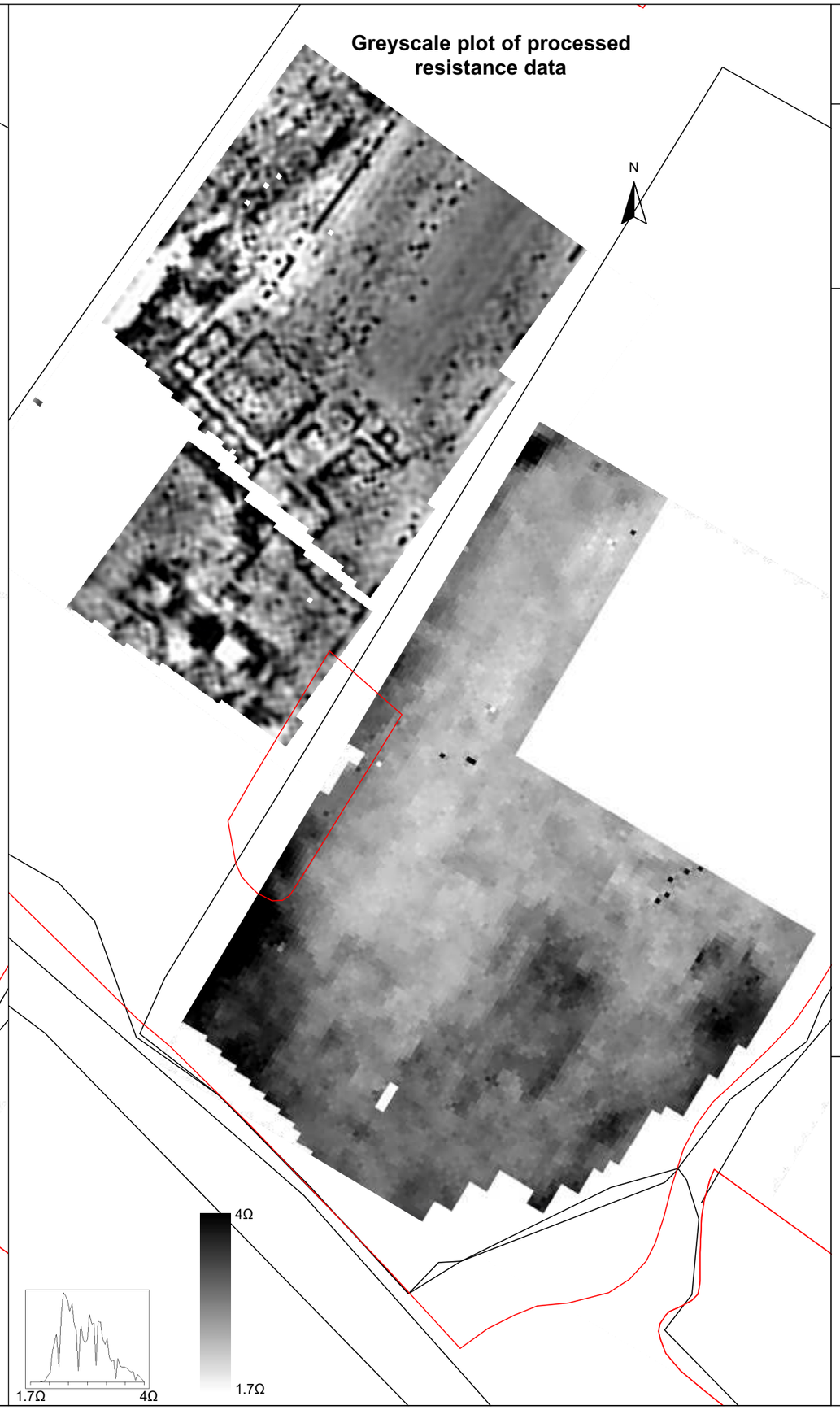
SCALE TRUE AT A3

FIG 06

Greyscale plot of raw resistance data



Greyscale plot of processed resistance data



Archaeological Surveys Ltd

Geophysical Survey
Wanborough Roman Town
Wanborough
Swindon

Greyscale plot of processed resistance data

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 07

Archaeological Surveys Ltd

Geophysical Survey
Wanborough Roman Town
Wanborough
Swindon

Abstraction and interpretation of resistance anomalies

- High resistance linear anomaly - structural remains
- High resistance linear anomaly - of archaeological potential
- High resistance linear anomaly - of uncertain origin
- High resistance linear anomaly - edge of modern cultivation
- Area of high resistance - of archaeological potential
- Area of low resistance - of archaeological potential
- Area of high resistance - modern rubble

N

12
13
10
14
8
11
9

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 08