Substrata
Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Land near Grovelands Way Warminster, Wiltshire

Ordnance Survey (E/N): 386270,145330 (point)

Report: 141106

Ross Dean BSc MSc MA MIfA

06 November 2014

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Accompanying CD-ROM

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- GIS project ..... Manifold 8 '.map' file
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AutoCAD version of the survey interpretation ..... AutoCAD DXF

1 Survey description and summary

1.1 Survey

Type:	twin-sensor fluxgate gradiometer
Date:	7 and 8 October 2014
Application area:	10ha
Lead surveyor:	Ross Dean BSc MSc MA MIfA

1.2 Client

AC Archaeology Ltd, Manor Farm Stables, Chicklade, Hindon, Nr. Salisbury, Wiltshire SP3 5SU

1.3 Location

Site:	Land near Grovelands Way
Town & Civil Parish:	Warminster
District:	West Wiltshire
Unitary Authority:	Wiltshire
Nearest Postcode:	BA12 7RR
NGR:	ST 862 453
Ordnance Survey E/N:	386270,145330 (point)

1.4 Archive

OASIS number:	substrat1-194395
Archive:	At the time of writing, the archive of this survey will be held by Substrata.

1.5 Introduction

This report was commissioned by AC Archaeology Ltd on behalf of Greensquare Group. It has been prepared as part of a programme of work in support of a forthcoming planning application for the construction of housing, associated infrastructure and a wetland habitat at the above site. The location of the survey area is shown in Figure 4.

1.6 Summary

The magnetic contrast across the area was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses. Three magnetic anomaly groups were identified as relating to possible archaeological deposits or features but no further archaeological characterisation could be established.

2 Survey aims and objectives

2.1 Aims

1. Define and characterise and detectable archaeological remains on the site.
2. Inform any future archaeological investigation of the area.

2.2 Objectives

1. Complete a gradiometer survey across agreed parts of the application area.
2. Identify any magnetic anomalies that may be related to archaeological deposits, structures or artefacts.
3. Within the limits of the techniques and dataset, archaeologically characterise any such anomalies or patterns of anomalies.
4. Accurately record the location of the identified anomalies.
5. Produce a report based on the survey that is sufficiently detailed to inform any subsequent development on the site about the location and possible archaeological character of the recorded anomalies.

3 Standards

The standards used to complete this survey are defined by the Institute for Archaeologists (2011). The codes of approved practice that were followed are those of the Institute for

Archaeologists (2008 and 2009) and Archaeology Data Service/Digital Antiquity Guides (undated). The document text was written using the house style of the Institute for Archaeologists (Institute for Archaeologists, undated).

4 Site description

4.1 Landscape and land use

The proposed application area currently comprises seven land parcels totalling 11.8 hectares in area, five of which were subject to geophysical survey (Figure 4). The application area lies at between 115 and 119m O.D and was under rough pasture at the time of the survey.

4.2 Geology

The application area is located on a solid geology of the Cretaceous Boyne Hollow Chert Member which comprises glauconitic sand and sandstone with regularly developed interbedded nodular and tabular chert up to 0.4m thick. The superficial geology is Quaternary alluvium which is typically soft to firm consolidated, compressible silty clay but can contain layers of silt, sand, peat and basal gravel. A stronger, desiccated surface zone may be present (British Geological Survey, undated).

5 Archaeological background

A comprehensive description of all designated and non-designated heritage assets within a suitable study area around the application area can be found in the AC Archaeology Ltd Historic Environment Assessment for this programme of work (Cottam, 2014). The following is a short interpretation of information obtained from the Assessment relevant to the geophysical survey area.

The reader is advised that this summary should not be used outside the context of this report and is referred to the Wiltshire Historical Environment Record (HER).

5.1 Heritage Assets within the Application Area

There are no designated assets within the application area. A number of the hedgerows within, and forming boundaries to, the application area are considered to be historic hedgerows.

There are three non-designated heritage assets within the application area. These comprise the location of a post-medieval building shown on the tithe map, and cropmarks and earthworks of probable former field boundaries and water meadows.

5.2 Heritage Assets close to the Application Area

Across the broader study area considered in the Assessment are a number of findspots, of Prehistoric, Romano-British, Medieval and Post-medieval date along with the site of the Early-medieval settlement around the Minster church. There is currently no evidence that the application area formed part of this early settlement or of any subsequent expansion of it, and it appears that the area always formed part of the settlement's agricultural hinterland.

6 Results, discussion and conclusions

This survey was designed to record magnetic anomalies. The anomalies themselves cannot be regarded as actual archaeological features and the dimensions of the anomalies shown do not represent the dimensions of any associated archaeological features. The analysis presented below identifies and characterises anomalies and anomaly groups that may relate to archaeological deposits and structures.

The reader is referred to section 7.

6.1 Results

Figure 1 shows the interpretation of the survey data. It includes the anomaly groups identified as relating to archaeological deposits along with their numbers. Table 1 is an extract from a detailed analysis of the survey data provided in the attribute tables of the GIS project on the accompanying CD-ROM.

Figure 1 along with Table 1 comprises the analysis of the survey data. A plot of the processed data is provided in Figure 2.

6.2 Discussion

Not all anomalies or anomaly groups identified in Table 1 are necessarily discussed below. All identified anomaly groups are recorded in the GIS project on the accompanying CD-ROM.

General points

Anomalies though to relate to natural features were not mapped. Recent man-made objects such as manholes, water management equipment, drains, cables and other services were only mapped where they comprised significant magnetic responses across the dataset that needed clarification. If mapped, they are listed in Table 1 but are not discussed below.

Data collection along the field edges was restricted as shown in Figures 1 and 2 due to the presence of magnetic materials in and adjacent to the field boundaries. Strong magnetic responses mapped close to the field boundaries are likely to relate to these materials except where indicated otherwise in Figure 1. Data collection was also restricted by the width and density of some of the field boundaries as well as to the density of vegetation and water-logging across localised areas. Figure 3 provides a view of the limitations imposed by the field boundaries.

Data relating to historical maps and other records

Anomaly group **4** may relate to earthworks identified during examination of aerial photographs untaken by AC Archaeology Ltd as part of this programme of work (Cotton, 2014). The earthworks are likely to represent to the remains of a water management system of unknown date.

Data with no previous archaeological provenance

Group **1** may relate to either a palaeochannel or an archaeological deposit or structure that may follow such a channel. Groups **2 and 3** possibly relate to archaeological linear deposits but further archaeological characterisation is not possible because of magnetic interference from adjacent modern services.

6.3 Conclusions

The magnetic contrast across the area was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses. Three magnetic anomaly groups were identified as relating to possible archaeological deposits or features but no further archaeological characterisation could be established.

7 Disclaimer and copyright

The description and discussion of the results presented in this report are the authors, based on his interpretation of the survey data. Every effort has been made to provide accurate descriptions and interpretations of the geophysical data set. The nature of archaeological geophysical surveying is such that interpretations based on geophysical data, while informative, can only be provisional. Geophysical surveys are a cost-effective early step in the multi-phase process that is archaeology. The evaluation programme of which this survey is part may also be informed by other archaeological assessment work and analysis. It must be presumed that more archaeological features will be evaluated than those specified in this report.

8 Acknowledgements

Substrata would like to thank Peter Cox of AC Archaeology Ltd for commissioning us to complete this survey.

9 Bibliography

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Clark, A. (2000) *Seeing Beneath the Soil, Prospecting methods in archaeology*, London: Routledge

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Dean, R. (2014) *A gradiometer survey method statement, Land anear Grovelands Way, Warminster, Wiltshire,* Substrata unpublished document

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Institute for Archaeologists (2009) *Code of conduct*. Reading: Author [Online], Available: http://www.archaeologists.net/sites/default/files/node-files/code_conduct.pdf [October 2014]

Institute for Archaeologists (2008) *Code of approved practice for the regulation of contractual arrangements in archaeology*. Reading: Author [Online], Available: http://www.archaeologists.net/sites/default/files/node-files/ifa_code_practice.pdf [October 2014]

Appendix 1 Analysis table and supporting plots

General Guidance

The anomalies represented in the survey plots provided in this appendix are magnetic anomalies. The apparent size of such anomalies and anomaly patterns are unlikely to correspond exactly with the dimensions of any associated archaeological features.

A rough rule for interpreting magnetic anomalies is that the width of an anomaly at half its maximum reading is equal to the width of the buried feature, or its depth if this is greater (Clark, 2000: 83). Caution must be applied when using this rule as it depends on the anomalies being clearly identifiable and distinct from adjacent anomalies. In northern latitudes the position of the maximum of a magnetic anomaly will be displaced slightly to the south of any associated physical feature.

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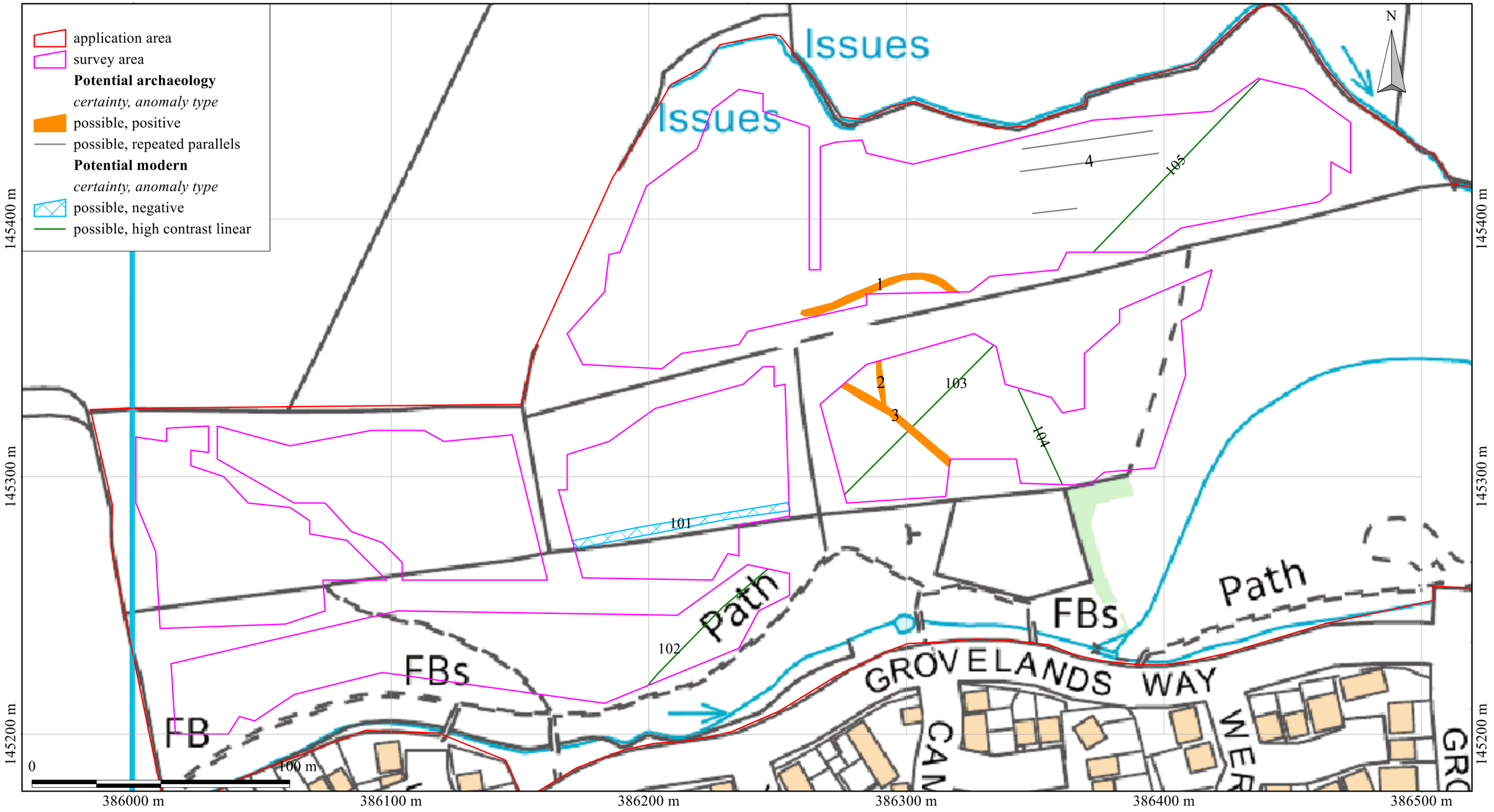
anomaly group	associated anomalies	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
1		possible, positive	curvilinear	palaeochannel or archaeological deposit	anomaly group may represent a palaeochannel or a former boundary following such a channel	
2		possible, positive	linear		anomaly group masked by high responses from modern services	
3		possible, positive	linear		anomaly group masked by high responses from modern services	
4		possible, repeated parallels		cultivation or water management traces		Earthworks noted during aerial photography analysis by AC Archaeology Ltd 2014 (Cottam 2014, ACW647/1/0)
101		possible, negative		footings from modern field boundary		
102		possible, high contrast linear		ferrous cable, pipe or drain		
103		possible, high contrast linear		ferrous cable, pipe or drain		
104		possible, high contrast linear		ferrous cable, pipe or drain		
105		possible, high contrast linear		ferrous cable, pipe or drain		

Table 1: data analysis



British Grid
centre X: 386238.13 m, centre Y: 145330.75 m

Scale: 1:1500 @ A3. Spatial Units: Meter. Do not scale off this drawing

Notes:

1. All interpretations are provisional and represent potential archaeological deposits.
2. Anomalies designated "likely archaeology" have supporting evidence e.g. historical maps and or visible earthworks.
3. Anomalies likely to represent geological or other natural deposits are not mapped unless relevant to potential archaeological events or deposits.

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Figure 1: survey interpretation

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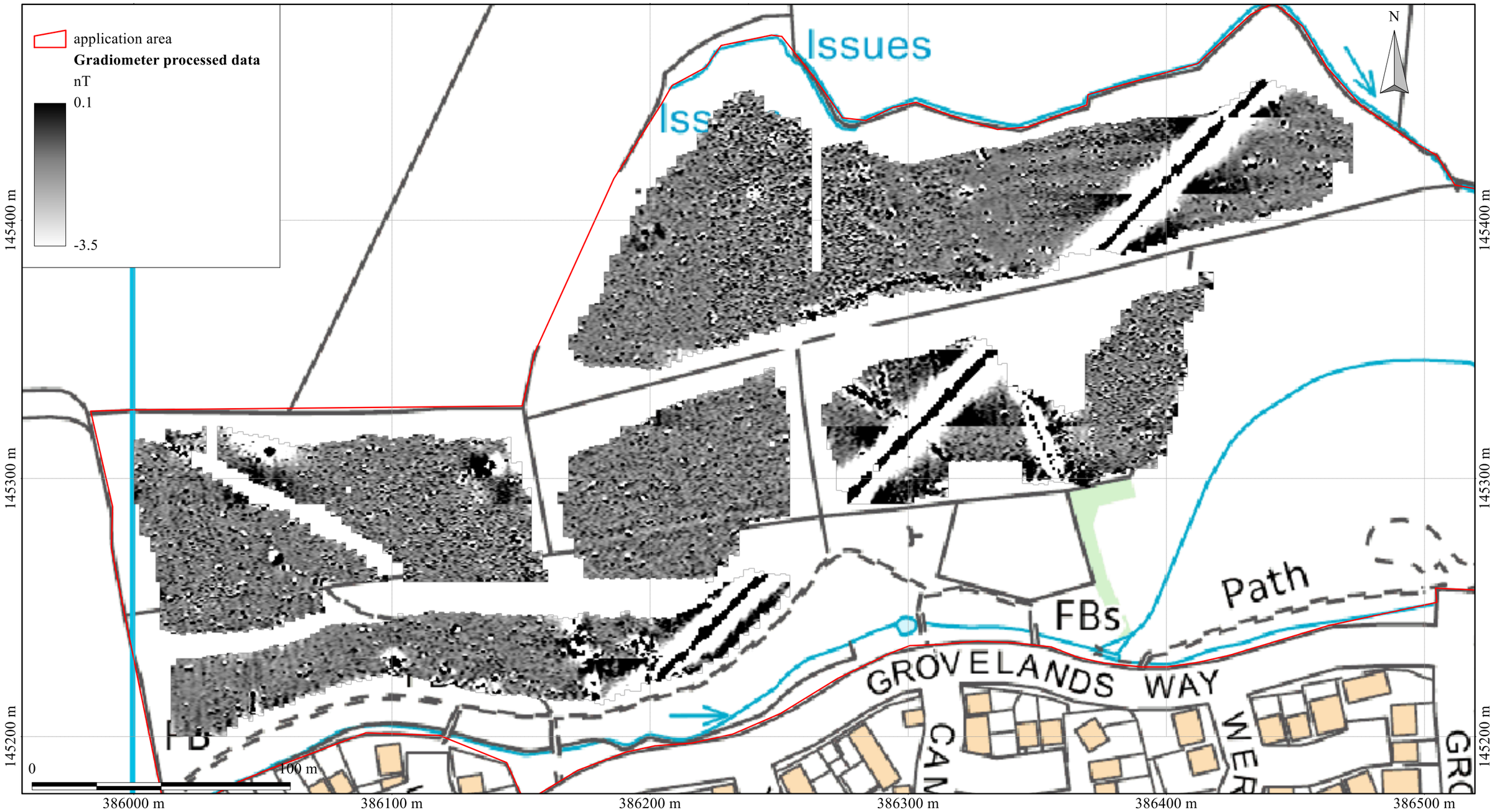

British Grid
centre X: 386238.13 m, centre Y: 145330.75 m

Scale: 1:1500 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 2: shade plot of processed data

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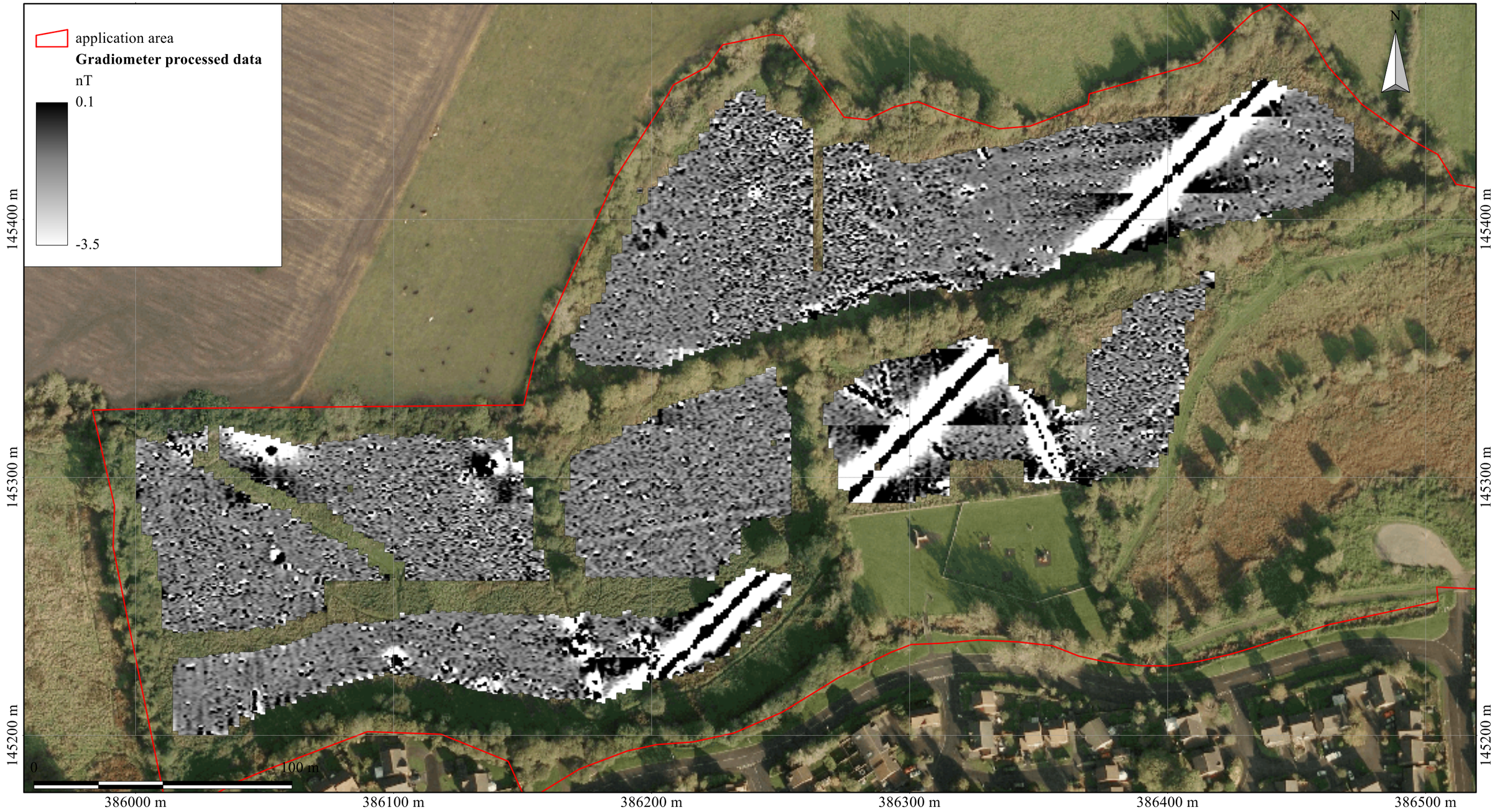

British Grid
centre X: 386238.13 m, centre Y: 145330.75 m

Scale: 1:1500 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 2: shade plot of processed data over 25cm aerial photograph

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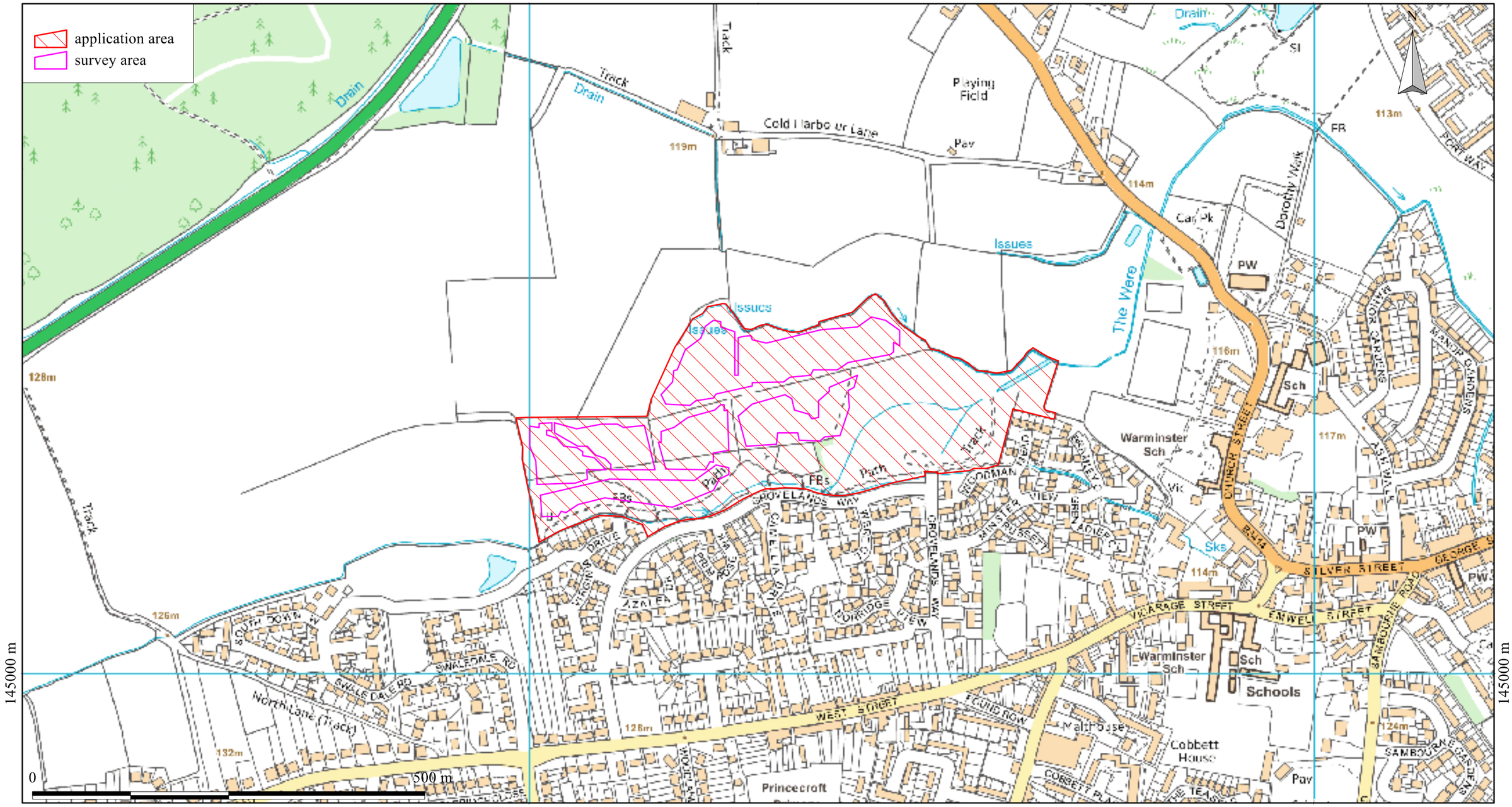

British Grid
centre X: 386292.12 m, centre Y: 145344.49 m

Scale: 1:5000 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 4: location map

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Appendix 2 Methodology Summary

<table>
<tr><th colspan="2">Table 2: methodology summary</th></tr>
<tr><td colspan="2">Documents
Survey methodology statement: Dean (2014)</td></tr>
<tr><td colspan="2">Methodology
1. The work was undertaken in accordance with the survey methodology statement. The geophysical (gradiometer) survey was undertaken with reference to standard guidance provided by the Institute for Archaeologists (2011) and Archaeology Data Service/Digital Antiquity Guides (undated).
2. The survey grid location information and grid plan was recorded as part of the project in a suitable GIS system.
3. Data processing was undertaken using appropriate software, with all anomalies being digitised and geo-referenced. The final report included a graphical and textual account of the techniques undertaken, the data obtained and an archaeological interpretation of that data and conclusions about any likely archaeology.</td></tr>
<tr><td colspan="2">Grid
Method of Fixing: DGPS set-out using pre-planned survey grids and Ordnance Survey coordinates.
Composition: 30m by 30m grids
Recording: Geo-referenced and recorded using digital map tiles.
DGPS used: Spectra Precision PM5V2 GPS with external antenna and survey pole and DigiTerra Explorer 7 as the survey control program.</td></tr>
<tr><td>Equipment
Instrument: Bartington Instruments grad601-2
Firmware: version 6.1</td><td>Data Capture
Sample Interval: 0.25-metres
Traverse Interval: 1 metre
Traverse Method: zigzag
Traverse Orientation: GN</td></tr>
<tr><td colspan="2">Data Processing, Analysis and Presentation Software
IntelliCAD Technology Consortium IntelliCAD 7.2
DW Consulting TerraSurveyor3
Manifold System 8 GIS
Microsoft Corp. Office Excel 2013
Microsoft Corp. Office Publisher 2013
Adobe Systems Inc Adobe Acrobat 9 Pro Extended</td></tr>
</table>

Appendix 3 Data processing

Table 3: gradiometer survey - processed data metadata
SITE Instrument Type: Bartington Grad 610 Units: nT Direction of 1st Traverse: 0 deg Collection Method: ZigZag Sensors: 2 @ 1.00 m spacing. Dummy Value: 32702 PROGRAM Name: TerraSurveyor Version: 3.0.25.1
Stats Max: 13.80 Min: -17.51 Std Dev: 4.44 Mean: -1.81 Median: -1.30 Processes: 8 1 Base Layer 2 Search & Replace From: -3000 To: 3000 With: Dummy (Area: Top 190, Left 208, Bottom 236, Right 242) 3 Search & Replace From: -3000 To: 3000 With: Dummy (Area: Top 89, Left 204, Bottom 175, Right 238) 4 Search & Replace From: -3000 To: 3000 With: Dummy (Area: Top 331, Left 362, Bottom 359, Right 424) 5 Clip from -100.00 to 100.00 nT 6 De Stagger: Grids: All Mode: Both By: -2 intervals 7 DeStripe Median Traverse: Grids: All Threshold: 1.5 SDs 8 Clip at 1.00 SD Note: converting the gradiometer data into ESRI GIS files imposed an x=y interpolation on the entire dataset

Appendix 4 Geophysical surveying techniques

1 Introduction

Substrata offers magnetometer and earth resistance surveying. We also provide other archaeology-specific geophysical surveys such as ground penetrating radar and resistivity. The particular method or combination of methods used depends on local soil conditions and the survey requirements. These methods are capable of delivering fast and accurate assessments of the archaeology of both large and small sites.

Further details can be found on our website at www.substrata.co.uk.

2 Magnetometer surveying

Standard magnetometer surveys are the workhorse of archaeological surveying when speed and cost-effectiveness are important. Identifiable archaeological features include areas of occupation, hearths, kilns, furnaces, ditches, pits, post-holes, ridge-and-furrow, timber structures, wall footings, roads, tracks and similar buried features.

Magnetometer surveying is used to detect and map small changes in the earth's magnetic field caused by concentrations of ferrous-based minerals within the soil and subsoil, and by materials buried beneath the surface. While most of these changes are too small to affect a compass needle, they can be detected and mapped by sensitive field equipment. During surveys the different magnetic properties of top-soils, sub-soils, rock formations and archaeological features are recorded as variations against a background value. Subsequently magnetic anomalies resulting from potential archaeology can be identified and interpreted.

Bartington grad601-2 gradiometers

A gradiometer is a type of magnetometer and is sensitive to relatively small changes in the earth's magnetic field. Our primary surveying instruments are Bartington Grad601-2 (dual sensor) fluxgate gradiometers with automatic data loggers. They are specifically designed for field use by archaeologists. The Bartington gradiometers provide proven technology in archaeological magnetic surveying and offer fast, accurate set-up and survey rates. They are sensitive to depths of between 0 and 1.5m below ground level, with optimum sensitivity at depths of 1m or less.

Multiple sensor arrays

A technique relatively new to commercial archaeological surveying but well understood in academic circles involves the use of multiple magnetometer sensors towed behind a quad bike or similar vehicle. With multiple sensors and the use of on-board GPS units, it is possible to achieve faster survey rates at competitive commercial rates when compared to the use of multiple instruments and the techniques discussed above provided the ground is suitable for the vehicle and array. Substrata is pleased to announce that we now offer this service on suitable larger sites

3 Earth resistance surveying

Earth resistance surveying is an excellent tool for detecting buried archaeology. Its relatively slow rate of survey compared to magnetometer surveys means that it usually employed in commercial surveys when a detailed understanding of buried building remains is required. This technique measures changes in the electrical resistance of the ground being surveyed. In practice, the recording of differences in the electrical resistance of near-surface deposits and structures allows the detection and interpretation of masonry and brick foundations, paving and floors, drains and other cavities, large pits, building platforms, robber trenches, ditches, graves and similar buried features.

Resistance to electrical current flow in the ground depends on the moisture content and structure of the soil and other materials buried beneath the surface. For example, the higher the moisture content of a soil, the less resistant it is to electrical current flow. A ditch completely buried beneath the present ground surface is likely to have an infill soil different to that surrounding the ditch in terms of compactness and composition. As a result, the soil filling the buried ditch will retain moisture in a different way to the surrounding soil which means it will

have an electrical resistance at variance with the surrounding environment. By passing a small current through the ground it is possible to detect, record, plot and interpret such changes in electrical resistance.

For earth resistance surveying Substrata uses the Geoscan Research RM15 series multi-probe resistance meters and purpose-built automatic data-loggers. The Geoscan MPX15 multiplexer is an integral part to the instrument configuration and facilitates multi-probe arrays which speed up survey area coverage rates and, if required, facilitate simultaneous multiple-depth data collection.