Substrata

Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Land at St Ann's Chapel, Bigbury South Hams, Devon

Ordnance Survey (E/N): 266360,47120 (point)

Report: 141112

Ross Dean BSc MSc MA MIfA

13 November 2014

Substrata
Archaeological Geophysical Surveyors
15 Horizon View, Bath Hotel Road
Westward Ho!
Bideford
Devon EX39 1GX
Tel: 07788627822
Email: geophysics@substrata.co.uk
Web: substrata.co.uk

Client:
AC Archaeology Ltd
4 Halthaies Workshops
Bradninch
Nr Exeter
Devon EX5 4QL
Tel: 01392 882410
Web: acarchaeology.co.uk

Contents

Figures

Tables

Accompanying CD-ROM

Report ..... Adobe PDF format
Copies of report figures ..... Adobe PDF format
Raw and processed grid & composite files ..... DW Consulting TerraSurveyor 3 formats
Minimal processing data plots and metadata ..... Adobe PDF format
GIS project, shape files and classification schema
- GIS project ..... Manifold 8 '.map' file
- GIS shape files ..... ESRI standard
- GIS classification schema ..... Adobe PDF format

AutoCAD version of the survey interpretation ..... AutoCAD DXF

1 Survey description and summary

1.1 Survey

Type:	twin-sensor fluxgate gradiometer
Date:	27 August 2014
Area:	1ha
Lead surveyor:	Ross Dean BSc MSc MA MIfA

1.2 Client

AC Archaeology Ltd, 4 Halthaies Workshops, Bradninch, Nr Exeter, Devon EX5 4QL

1.3 Location

Site:	Land at St Ann's Chapel
Civil parish:	Bigbury
District:	South Hams
County:	Devon
Nearest Postcode:	TQ7 4HQ
NGR:	SX 663 471
Ordnance Survey E/N:	266360,47120 (point)

1.4 Archive

OASIS number:	substrat1-195096
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 clients. It has been prepared as part of a programme of work in support of a forthcoming planning application at the above site. The location of the proposed development 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. Twenty-two magnetic anomaly groups were identified as relating to possible archaeological deposits or features. Of these, one coincides with a former field boundary mapped by the Ordnance Survey between 1886 and 1953-54. One group may represent a curvilinear field boundary with no relation to the current field system or possibly part of an enclosure, again at odds with the current field pattern. A set of two and possibly four anomaly groups appear to define two sides of a rectilinear enclosure which may have more than one feature defining the boundary or more than one phase of boundary. There is a distinct anomaly group with a sub-circular pattern which may represent an archaeological deposit. Given the presence of barrows in the vicinity, this group should be viewed as potentially archaeologically significant. Two further groups may represent deposits relating to barrows although alternative origins such as compact surfaces or large pits of archaeological or natural origin cannot be ruled out. A further two groups may represent archaeological pits although they may have a natural origin. The remaining magnetic anomaly groups identified as representing potential archaeological deposits or structures have characteristics typical of anomalies reflecting more than one phase former field and other enclosure boundaries.

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 application area lies at approximately 120m O.D. within one field on the southern side of the hamlet of St Ann's Chapel to the north of the village of Bigbury as shown in Figure 4. The survey area is bound to the east by village infrastructure and the B3392 and to the north by a minor road. To the west and south is the remainder of the field.

At the time of the survey the field was under grass and the survey area was divided by a wire fence.

4.2 Geology

The application area is located on a solid geology of the Devonian Dartmouth Group. In the Plymouth region, the Dartmouth Group is divided into the Whitsand Bay Formation and the Bin Down Formation; this is an intercalation towards the top of the Whitsand Bay Formation. The Whitsand Bay Formation comprises reddish purple mudstone and silty mudstone, green silty mudstone to muddy siltstone, green to mauve siltstone, grey-green with some purple sandstone and off-white to pale green quartzite. The Bin Down Formation includes grey to dark grey cleaved mudstone, grey siltstone and pale grey quartzitic sandstone. Interbedded with these sedimentary rocks are basaltic lavas and volcaniclastic beds including tuff and hyaloclastite.

The superficial geology was not recorded in the source used (British Geological Survey, undated).

5 Archaeological background

The following is a short summary of information obtained from the Devon and Dartmoor Historic Environment Record (HER) within 250m of the survey area and deemed relevant to the understanding of the gradiometer survey.

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

5.1 Historical Landscape Characterisation

'Modern enclosures adapting Post-medieval fields': modern enclosures that have been created by adapting earlier fields of probable Post-medieval date.
(Devon County Council, undated).

5.2 Heritage Assets within the Survey Area

There are no heritage assets recorded within the application area.

5.3 Heritage Assets close to the Survey Area

Within the field and to the south of the survey area is a sub-rectangular Prehistoric enclosure measuring about 60m by 50m with double ditched or recut ditched sides on the northwest and southeast sides (HER MDV50110). A Neolithic long barrow (MDV36059) and two Late Neolithic to Early Bronze Age bowl barrows (MDV36060 and MDV16575) are grouped to the southeast of the survey area and across the B3392. The remains of St. Ann's Chapel, thought to date from the 15th century, are incorporated in a group of buildings of various dates that now form part of the Old Chapel Inn to the north of the survey area.

5.4 Previous Historical Environment work

EDV4474: An earthwork survey at Bigbury undertaken in 2003 to 2004 to record building platforms to the south of the survey field on the edge of Bigbury Village. These are recorded in the HER entry MDV75167.

EDV5240: An assessment of the historic fabric of the Old Chapel Inn, St Ann's Chapel published in 2011.

EDV5319: An archaeological evaluation of the former Old Chapel Inn was undertaken in March 2011 in advance of a proposed development. No archaeological features or deposits were found.

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. Plots of the processed data are provided in Figures 2 and 3.

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 to 3 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.

The two sets of closely spaced, parallel anomaly trends running approximately northeast to southwest and northwest to southeast are likely to be the result of ground disturbance caused by relatively recent ploughing.

Data relating to historical maps and other records

Magnetic anomaly group **8** coincides with a former field boundary mapped by the ordnance survey between 1886 and 1953-54. The group is most likely to represent a Devon bank which comprises an earthen bank with stone-lined sides and flanking ditches.

Data with no previous archaeological provenance

Anomaly group 4 stands out in the dataset as a clearly defined curvilinear pattern with a possible break. This may represent either a field boundary with no relation to the extant field system or possibly part of an enclosure, again at odds with the current field pattern.

Group **12** is also distinct and appears to represent to sides of a possibly rectilinear enclosure. Group **14** is closely associated with group 12 and it is not clear whether they represent the same archaeological deposit or two related deposits such as a bank and ditch. Groups **13 and 15** may also be associated with group 12 although this is less certain. Cropmark evidence exists for a sub-rectangular Prehistoric enclosure to the to south of the survey area within the same field (see Section 5).

Group **18** appears to have a sub-circular pattern and is clear in Figures 2 and 3. This pattern may represent an archaeological deposit or a fortuitously arranged set of anomalies smoothed out during data processing. Given the presence of barrows in the vicinity, this group should be viewed as possibly archaeologically significant (see Section 5).

Groups **19 and 20** are clear in the dataset and may represent archaeological pits although a natural origin may apply.

Groups **21 and 22** lie close together. They may represent deposits such as large pits of archaeological or natural origins. Their relatively large size suggests, however, that they may relate to other archaeological features such as compact surfaces or possibly the remnants of two barrows, three of which are mapped in an adjacent field (see Section 5).

The remaining magnetic anomaly groups identified as representing potential archaeological deposits or structures have characteristics typical of anomalies reflecting more than one phase former field and other enclosure boundaries.

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. Twenty-two magnetic anomaly groups were identified as relating to possible archaeological deposits or features. Of these, one coincides with a former field boundary mapped by the Ordnance Survey between 1886 and 1953-54. One group may represent a curvilinear field boundary with no relation to the current field system or possibly part of an enclosure, again at odds with the current field pattern. A set of two and possibly four anomaly groups appear to define two sides of a rectilinear enclosure which may have more than one feature defining the boundary or more than one phase of boundary. There is a distinct anomaly group with a sub-circular pattern which may represent an archaeological deposit. Given the presence of barrows in the vicinity, this group should be viewed as potentially archaeologically significant. Two further groups may represent deposits relating to barrows although alternative origins such as compact surfaces or large pits of archaeological or natural origin cannot be ruled out. A further two groups may represent archaeological pits although they may have a natural origin. The remaining magnetic anomaly groups identified as representing potential archaeological deposits or structures have characteristics typical of anomalies reflecting more than one phase former field and other enclosure boundaries.

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 John Valentin of AC Archaeology Ltd for commissioning us to complete this survey.

9 Bibliography

Archaeology Data Service/Digital Antiquity Guides to Good Practice (undated): *Geophysical Data in Archaeology* [Online], Available: http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_Toc [July 2014]

British Geological Survey (undated) *Geology of Britain viewer [Online], Available: http://www.bgs.ac.uk/discovering Geology/geologyOfBritain/viewer.html* [November 2014]

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

Dean, R. (2014) *A gradiometer survey method statement, Land at St Ann's Chapel, Bigbury, Devon,* Substrata unpublished document

Devon County Council (undated) *Historic Landscape Characterisation*, [Online], Available: http://gis.devon.gov.uk/basedata/viewer.asp?DCCService=hlc [November2014]

Institute for Archaeologists (undated) *IfA house style*, [Online], Available: http://www.archaeologists.net/sites/default/files/node-files/ifa_house_style.pdf [October 2014]

Institute for Archaeologists (2011) *Standard and guidance archaeological geophysical survey*. Reading: Author [Online], Available: http://www.archaeologists.net/sites/default/files/node-files/Geophysics2010.pdf [October 2014]

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

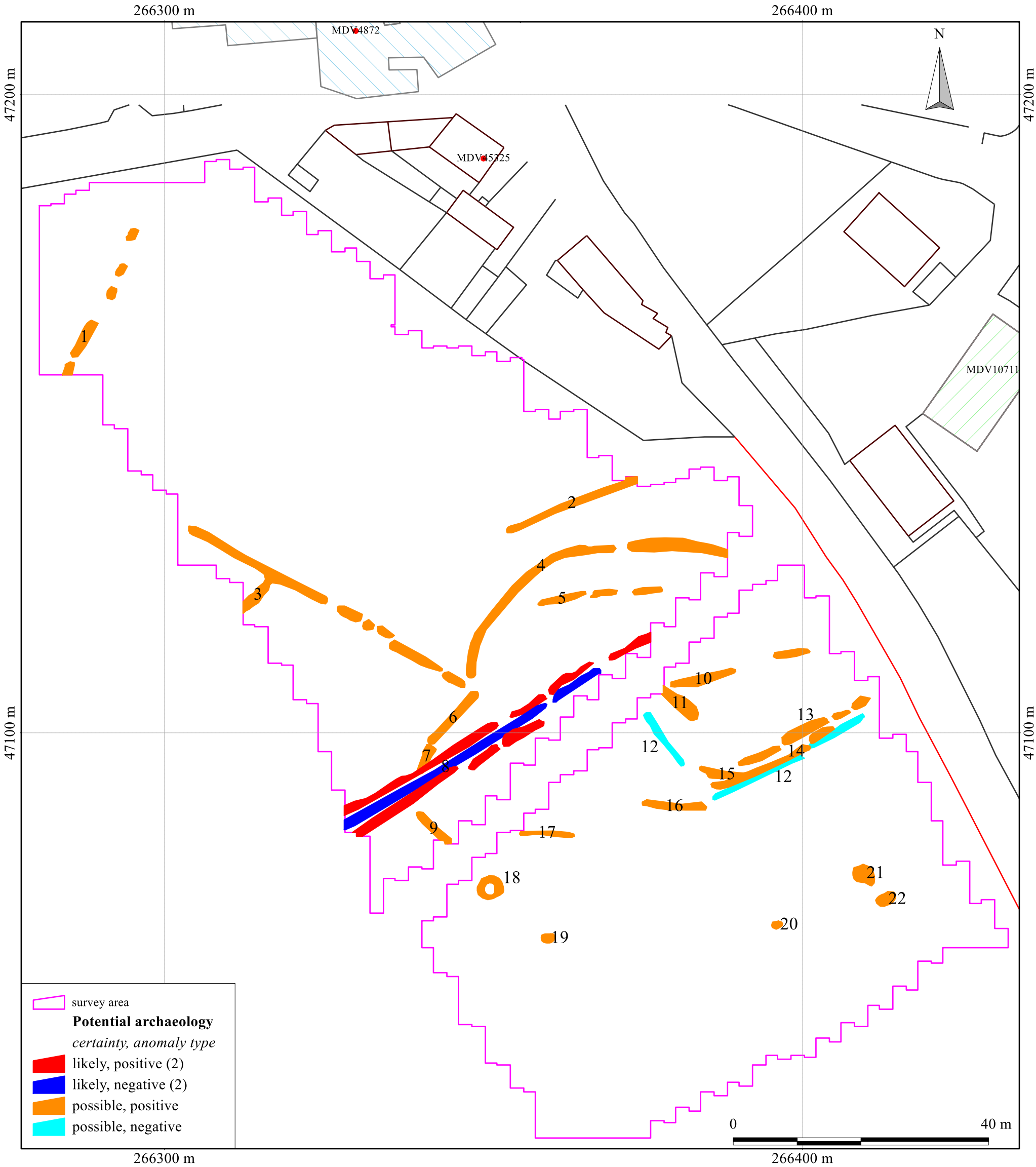
The anomalies represented in the survey plots provided in this appendix are magnetic anomalies. The apparent size of such anomalies and anomaly patterns are unlikely to correspond exactly with the dimensions of any associated archaeological features.

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.

Site: An archaeological gradiometer survey
Land at St Ann's Chapel, Bigbury, South Hams, Devon
Ordnance Survey (E/N): 266360,47120 (point)
Report: 141112

anomaly group	associated anomalies	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
1		possible, positive	disrupted linear			
2		possible, positive	linear			
3		possible, positive	disrupted complex linear			
4		possible, positive	disrupted curvilinear	enclosure or field boundary		
5		possible, positive	disrupted linear			
6		possible, positive	linear			
7		possible, positive	linear			
8		likely, pos/neg/pos		field boundary	anomaly groups coincide with a field boundary field boundary mapped between 1886 and 1953-54; the anomaly pattern represents a Devon bank which comprises an earthen bank with stone sides and flanking ditches.	Ordnance Survey maps 1886 1:2500 to 1953-54 1:10560
9		possible, positive	linear			
10		possible, positive				
11		possible, positive				
12	13 14 15	possible, negative	rectilinear	enclosure	anomaly group may be associated with 14; not clear whether they represent one or two archaeological deposits	
13	12 14 15	possible, positive	disrupted linear		anomaly group may be associated with groups 12 and 14	
14	12 13 15	possible, positive	disrupted linear	enclosure	anomaly group may be associated with 12; not clear whether they represent one or two archaeological deposits	
15	12 13 14	possible, positive	linear		anomaly group may be associated with groups 12 and 14	
16		possible, positive	linear			
17		possible, positive	linear			
18		possible, positive	sub-circular	ring ditch or roundhouse	anomaly group may represent an archaeological deposit or may be a coincidently placed set of anomalies	
19		possible, positive	oval	pit		
20		possible, positive	oval	pit		
21		possible, positive	oval	barrow, compact surface or large pit		
22		possible, positive	oval	barrow, compact surface or large pit		

Table 1: data analysis



British Grid
centre X: 266355.77 m, centre Y: 47123.12 m

Scale: 1:600 @ 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 deposit

An archaeological gradiometer survey
Land at St Ann's Chapel, Bigbury, South Hams, Devon
Ordnance Survey (E/N): 266360,47120 (point)
Report: 141112

Figure 1: survey interpretation

Substrata
15 Horizon View, Bath Hotel Road
Westward Ho!, Bideford, Devon EX39 1GX
Tel: 07788627822
Email: geophysics@substrata.co.uk
Web: substrata.co.uk

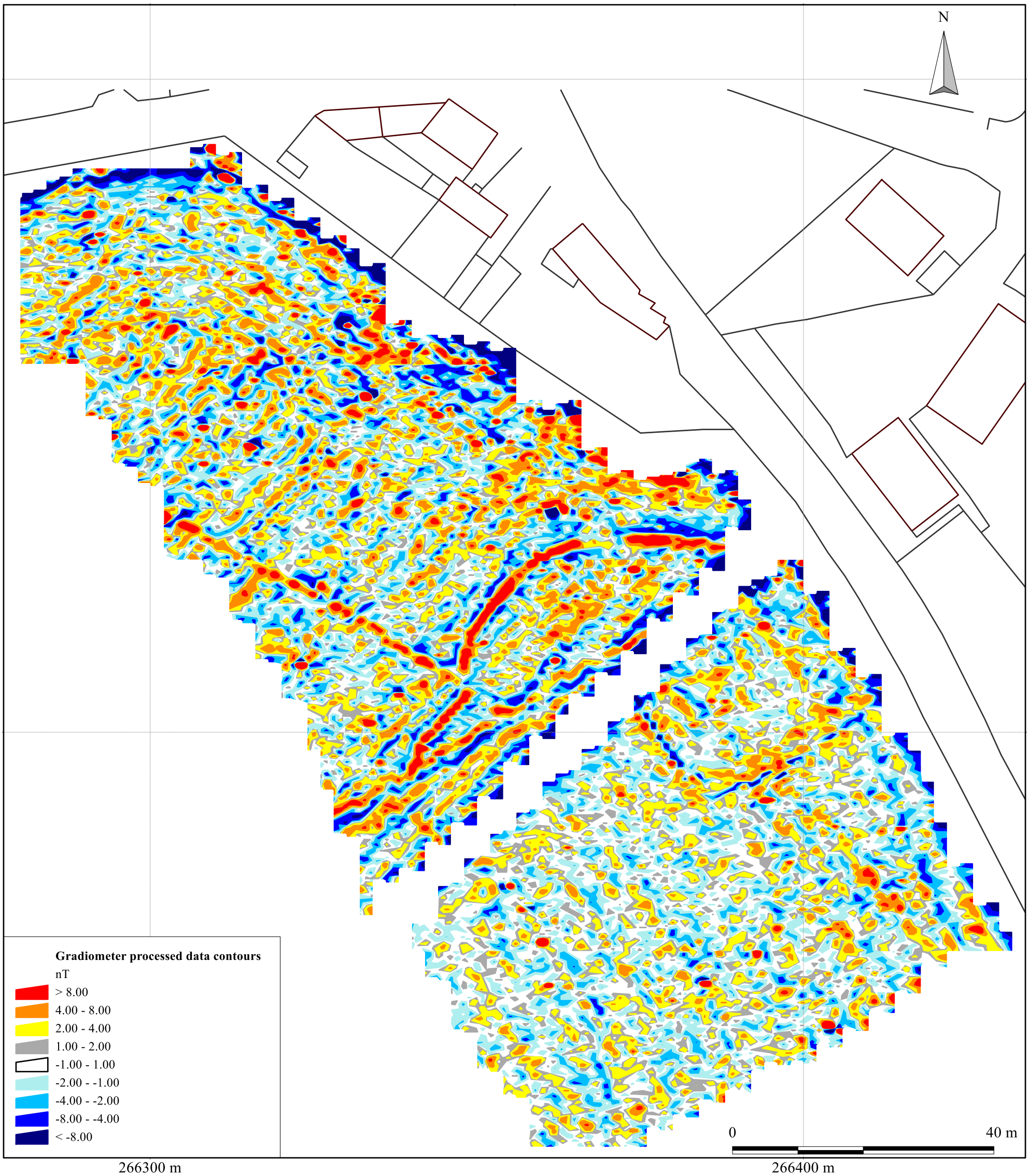
British Grid
centre X: 266355.77 m, centre Y: 47123.12 m

Scale: 1:600 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological gradiometer survey
Land at St Ann's Chapel, Bigbury, South Hams, Devon
Ordnance Survey (E/N): 266360,47120 (point)
Report: 141112

Figure 2: shade plot of processed data

Substrata
15 Horizon View, Bath Hotel Road
Westward Ho!, Bideford, Devon EX39 1GX
Tel: 07788627822
Email: geophysics@substrata.co.uk
Web: substrata.co.uk



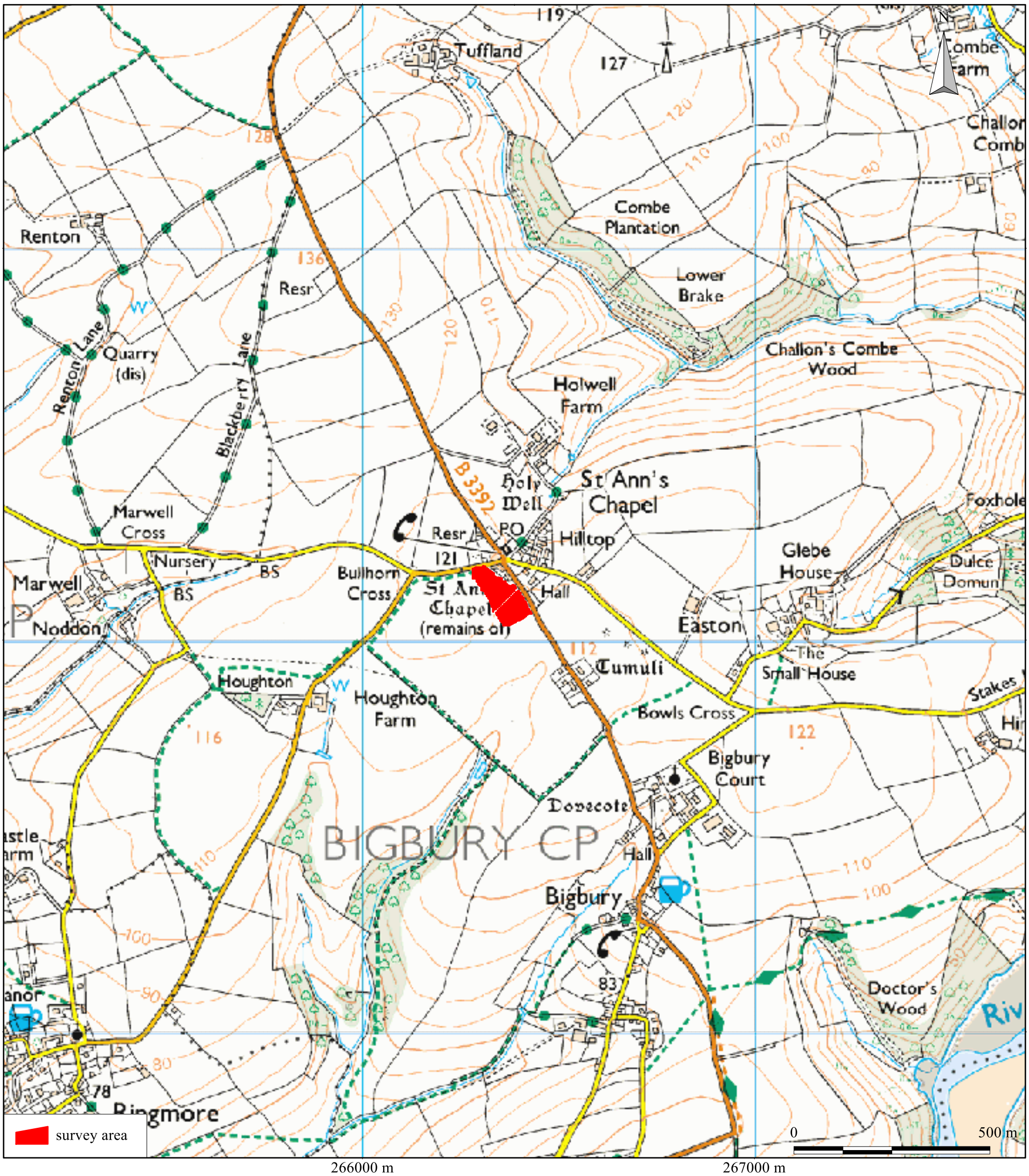
British Grid
centre X: 266355.77 m, centre Y: 47123.12 m

Scale: 1:600 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological gradiometer survey
Land at St Ann's Chapel, Bigbury, South Hams, Devon
Ordnance Survey (E/N): 266360,47120 (point)
Report: 141112

Figure 3: contour plot of processed data

Substrata
15 Horizon View, Bath Hotel Road
Westward Ho!, Bideford, Devon EX39 1GX
Tel: 07788627822
Email: geophysics@substrata.co.uk
Web: substrata.co.uk



British Grid
centre X: 266387.84 m, centre Y: 47150.03 m

Scale: 1:10000 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological gradiometer survey
Land at St Ann's Chapel, Bigbury, South Hams, Devon
Ordnance Survey (E/N): 266360,47120 (point)
Report: 141112

Figure 4: location map

Substrata
15 Horizon View, Bath Hotel Road
Westward Ho!, Bideford, Devon EX39 1GX
Tel: 07788627822
Email: geophysics@substrata.co.uk
Web: substrata.co.uk

Appendix 2 Methodology Summary

Table 2: methodology summary	
Documents Survey methodology statement: Dean (2014)	
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.	
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.	
Equipment *Instrument:* Bartington Instruments grad601-2 *Firmware:* version 6.1	**Data Capture** *Sample Interval:* 0.25-metres *Traverse Interval:* 1 metre *Traverse Method:* zigzag *Traverse Orientation:* GN
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	

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: 93.36 Min: -87.16 Std Dev: 4.69 Mean: -0.05 Median: 0.00 Surveyed Area: 1.0452 ha Processes: 4 1 Base Layer 2 Clip at 5.00 SD 3 De Stagger: Grids: All Mode: Both By: -2 intervals 4 DeStripe Median Sensors: All 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.

<u>Bartington grad601-2 gradiometers</u>

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.

<u>Multiple sensor arrays</u>

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.