Substrata
Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Land at Ridge Cross, Stockland, Devon National grid coordinates (centred on) 322370, 101690

Report: 130329
Ross Dean BSc MSc MA MIfA
29 March 2013

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

Client:
Bright Farming Ltd.
Oak View
Broadhayes Farm
Stockland
Honiton
Devon EX14 9EL

Contents

Figures

Tables

Accompanying CD-ROM

Report ..... Adobe PDF format
Copies of report figures ..... Adobe PDF format
Data Files and grid plan
  Survey areas and grids ..... Adobe PDF format
  Data files ..... grid files generated using DW Consulting ArcheoSurveyor2
Minimal processing data plots and metadata ..... Adobe PDF format
GIS project, shape files and classification schema
  GIS project and shape files ..... ESRI standard
  GIS classification schema ..... Adobe PDF format
AutoCAD version of the survey interpretation ..... AutoCAD 2004 DWG

1 Survey description and summary

Type of survey: twin-sensor fluxgate gradiometer
Date of survey: between 27 February and 6th March 2013
Area surveyed: 7.6ha.
Lead surveyor: Ross Dean BSc MSc MA MIfA

Client
Bright Farming Ltd, Oak View, Broadhayes Farm, Stockland, Honiton, Devon EX14 9EL

Location

Site:	Land at Ridge Cross,
Parish:	Stockland
District:	East Devon
County:	Devon
NGR:	SX 2237 0169 (point)
NG coordinates:	322370, 101690 (point)
OASIS number:	substrat1-147089
Archive:	At the time of writing, the archive of this survey will be held by Substrata but this will change during 2013. There is a forthcoming requirement from Devon County Council Historic Environment Service that all project such as this have a digital archive held by a recognised archiving service. Please contact Substrata to find details of which service was chosen for this and future surveys.

Summary
This report was commissioned by Mr C.P. Clarke of Arrowhead Archaeology, 10 West Allington, Bridport, Dorset DT6 5BG on behalf the clients and was produced by Substrata in preparation for submission of a forthcoming planning application.

The magnetic contrast across the survey areas, while relatively low, was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses. With the level of response found on this site, it is likely that most of the larger features will be recorded in the data set but some deeply buried or relatively small potential features such as smaller post-holes may be missed. A total of 39 magnetic anomaly groups were identified as pertaining to potential archaeology.

Five of these anomaly groups relate to former field boundaries removed sometime after 1990. Two relate to closely situated areas of possible craft or industrial archaeological deposits. Sixteen are typical of possible pits or similar archaeological deposits although it is likely that some of these will prove to be natural deposits. The remaining anomaly groups are linear patterns that typically denote former field and enclosure boundaries disrupted by later cultivation activities such as ploughing. It is likely that these will relate to archaeological features predating the current field system.

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

Survey Objectives
1. Complete a gradiometer survey across agreed parts of the survey 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.

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).

2 Site description

Landscape
The survey area comprises one field at Ridge Cross, Stockland Hill. The field slopes gently to south and lies between approximately 230m and 200m O.D. It is bound by the is bounded by hedged banks with neighbouring fields to the north and east and minor roads to the west and south. A large modern barn is situated at the south eastern corner of the survey area.

Land use at the time of the survey
Newly planted crops.

Geology
The site is located on a solid geology of Cretaceous Upper Greensand under Clay-with-Flints (in part Eocene) (British Geological Survey, 1984). The Clay-with-Flints Formation is in this area a residual deposit formed from bedrock strata of the Upper Greensand Formation. It is unbedded and heterogenous. The deposit locally comprises sand and clayey sand containing angular, shattered blocks of chert (British Geological Survey, undated)

Soils
The survey area has palao-argillic stagnogley soils of the Dunkeswell Association. These soils were subjected to reclamation and cultivation following enclosure and, as a result, have a humose topsoil over stony silty clay loam with slightly stony clay at between 0.45m and 1m below ground level (Soil Survey of England and Wales, 1983; Findley et al, 1983: 156-7).

Historic 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)

Known archaeological sites in the survey area
The information from which this summary is constructed was provided by Devon County Council Historic Environment Service (DCCHES) on 28th March 2013. Please refer to the DCCHES for the complete record should any further work be undertaken.

There is one Historical Environment Record (HER) entry within the survey area:

- MDV59986 Artefact Scatter, Prehistoric; 7 flints including 1 scraper. NGR ST 223 021 (point).

Three other entries relate to the field in which the survey took place, all lie just to the west of the survey area:

- MDV50513 Artefact Scatter, Prehistoric; 33 worked flints, 15 flint and 18 chert including flint: 2 scrapers, 2 serrated blades, 1 serrated flake; chert: 3 scrapers.

NGR ST 2224 0208 (point).

- MDV50514 Findspot, Prehistoric; two worked flints and 1 chert scraper. NGR ST2222 0180 (point).
- MDV25657 Artefact Scatter, Prehistoric; 40 to 50 worked flints including 3 or 4 cores, 2 scrapers, 3 backed blades and 13 blades. NGR ST 2220 0191 (point).

Of the many other entries relating to places within 1000m of the survey area, two close to the survey suggest that the area may be of particular archaeological interest:

- MDV1913 Hill Fort Stockland Great Castle; Iron Age Hillfort with extant earthworks on the northern side. NGR (centred on) ST 2259 0256 (285m by 297m)
- MDV20328 Linear Earthworks; unknown date; a stone causeway running east-west, 2m wide and c.130m long with spatially associated parallel tracks and a mound. NGR ST 229 019 (point)

Previous fieldwork within the survey area

No formal programmes of archaeological work are recorded in the HER that directly relate to the survey area.

3. 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 attempts to identify and characterise anomalies and anomaly groups that may pertain to archaeological deposits and structures.

The reader is referred to section 4.

3.1 Results

Figure 1 (this section) shows the interpretation of the survey and 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 and table 1 comprise the analysis and interpretation of the survey data.

The processed gradiometer data is presented in figure 2, appendix 1.

Survey data analysis

Site: An Archaeological Gradiometer Survey
Land at Ridge Cross, Stockland, Devon
National grid coordinates (centred on) 322370, 101960
Report: 130329

anomaly group	characterisation certainty	anomaly class	anomaly form	additional archaeological characterisation	comments	supporting evidence
1	possible	positive/negative/positive	linear	field boundary - Devon bank type		
2	possible	positive	linear			
3	possible	positive/negative/positive	linear	field boundary - Devon bank type		
4	likely	positive/negative/positive	linear	field boundary - Devon bank type	anomaly groups represent a field boundary mapped on all OS maps between 1889 and 1990 - removed so time after 1990	OS maps: 1889 to 1990
5	possible	positive/negative/positive	linear	field boundary - Devon bank type		
6	likely	positive/negative/positive	linear	field boundary - Devon bank type	anomaly groups represent a field boundary mapped on all OS maps between 1889 and 1990 - removed so time after 1990	OS maps: 1889 to 1990
7	possible	positive	oval	large pit or deposit		
8	possible	positive	linear			
9	likely	positive/negative/positive	linear	field boundary - Devon bank type	anomaly groups represent a field boundary mapped on all OS maps between 1889 and 1990 - removed so time after 1990	OS maps: 1889 to 1990
10	possible	positive	linear			
11	possible	positive	linear			
12	possible	positive	oval	large pit or deposit		
13	possible	positive	oval	large pit or deposit		
14	possible	positive	oval	large pit or deposit		
15	possible	positive	oval	large pit or deposit	two anomaly groups	
16	possible	positive	double linear	track or routeway		
17	possible	positive	linear			
18	possible	positive	oval	large pit or deposit		
19	possible	positive	linear			
20	possible	positive	oval	large pit or deposit		
21	possible	positive	linear			
22	likely	positive/negative/positive	linear	field boundary - Devon bank type	anomaly groups represent a field boundary mapped on all OS maps between 1889 and 1990 - removed so time after 1990	OS maps: 1889 to 1990
23	possible	positive	oval	large pit or deposit		
24	possible	positive	oval	large pit or deposit		
25	possible	positive	linear			
26	possible	positive/negative/positive	linear	field boundary - Devon bank type		
27	possible	positive	oval	large pit or deposit	two anomaly groups	
28	possible	positive				
29	possible	positive	oval	large pit or deposit		
30	possible	positive	oval	large pit or deposit		
31	possible	positive	linear			
32	likely	positive/negative/positive	linear	field boundary - Devon bank type	anomaly groups represent a field boundary mapped on all OS maps between 1889 and 1990 - removed so time after 1990	OS maps: 1889 to 1990
33	possible	high contrast	irregular	industrial/craft deposits		
34	possible	high contrast	irregular	industrial/craft deposits		
35	possible	positive	linear			
36	possible	positive	oval	large pit or deposit		
37	possible	positive	oval	large pit or deposit		
38	possible	positive	oval	large pit or deposit		
39	possible	positive	oval	large pit or deposit		

Table 1: data analysis

Substrata
Archaeological Geophysical Surveyors
15 Horixon View, Bath Hotel Road, Westward Ho!
Bideford, Devon EX39 1GX
mob: 07788627822
email: geophysics@substrata.co.uk

An Archaeological Gradiometer Survey
Land at Ridge Cross, Stockland, Devon
National grid coordinates (centred on) 322370, 101960
Report: 130329

N

Legend

- gradiometer survey area

gradiometer potential archaeology

- likely archaeology, positive anomaly (4)
- likely archaeology, negative anomaly (4)
- possible archaeology, positive anomaly
- possible archaeology, negative anomaly
- possible archaeology, high contrast anomalies
- possible archaeology , repeated parallels (2, 5)

gradiometer services & modern disturbance

- likely, observed ground disturbance

gradiometer potential natural

- possible natural, spring

Notes:
1. All interpretations are provisional and represent potential archaeological deposits.
2. Representative of trends; only anomalies relevant to potential archaeology are recorded.
3. Anomalies likely to represent very recent ground disturbance are not highlighted.
4. Filled circles used to define anomalies are symbols and do not indicate possible circular archaeological features unless specifically indicated in the text.
5. The domanant recent ploughing trend is approximately not shown here for clarity.

0 25 50 100 Meters

Figure 1: survey interpretation

3.2 Discussion

Refer to figures 1 (this section) and 2 (appendix 1).

Not all anomalies or anomaly groups identified in the survey dataset are discussed below. All identified anomaly groups are recorded in the GIS project on the accompanying CD-ROM. Those anomaly groups possibly representing archaeological deposits are included in data analysis table 1.

Anomaly groups **4**, **6**, **9**, **22** and **32** are very likely to relate to former field boundaries recorded on all editions of the Ordnance Survey maps produced between 1889 and 1990. These boundaries were Devon Banks removed sometime after 1990.

Groups **1**, **3**, **5** and **26** are likely to relate to former Devon Bank field boundaries not recorded on any Ordnance Survey historical map.

While no clear evidence was recorded for a westwards extension of the linear earthwork MDV20328 found in a field to the east (see section 2 for a summary of the relevant Historic Environment Record entry), anomalies **16** and **17** are on a similar alignment.

Groups **33** and **34** have a relatively high contrast compared to the rest of the field and are typical of areas with archaeological deposits relating to former craft or industrial activities.

Anomaly groups **7**, **12 to 15**, **18**, **20**, **23**, **24**, **27**, **29**, **30** and **36 to 39** may represent large pits or similar archaeological deposits although it is likely that some of these will prove to be natural deposits.

The remaining anomaly groups identified as possible archaeological deposits or features are linear patterns that typically denote former field and enclosure boundaries disrupted by later cultivation activities such as ploughing. None are recorded on the historical Ordnance Survey maps and should be considered as pre-dating the current field system.

3.3 Conclusions

The magnetic contrast across the survey areas, while relatively low, was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses. With the level of response found on this site, it is likely that most of the larger features will be recorded in the data set but some deeply buried or relatively small potential features such as smaller post-holes may be missed. A total of 39 magnetic anomaly groups were identified as pertaining to potential archaeology.

Five of these anomaly groups relate to former field boundaries removed sometime after 1990. Two relate to closely situated areas of possible craft or industrial archaeological deposits. Sixteen are typical of possible pits or similar archaeological deposits although it is likely that some of these will prove to be natural deposits. The remaining anomaly groups are linear patterns that typically denote former field and enclosure boundaries disrupted by later cultivation activities such as ploughing. It is likely that these will relate to archaeological features predating the current field system.

4 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.

5 Acknowledgements

Substrata would like to thank Phil Clarke of Arrowhead Archaeology for acting on behalf of Bright Farming Ltd in the commissioning of the survey and for his project management throughout.

6 References

Archaeology Data Service/Digital Antiquity Guides to Good Practice (undated): *Geophysical Data in Archaeology* [Online], Available: http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_Toc [March 2013]

British Geological Survey (1995) *Exeter, England and Wales Sheet 325 Solid and Drift Geology 1:50 000*, Keyworth, Nottingham

British Geological Survey (undated) *The British Geological Survey Lexicon of Named Rock Units* [Online], Available: http://www.bgs.ac.uk/lexicon/lexicon.cfm?pub=CWF [March 2013]

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

Dean, R. (2013) A gradiometer survey method statement for a geophysical survey across land at Ridge Farm, Stockland, Devon, Substrata unpublished document

Devon County Council (undated) *Historic Landscape Characterisation*, [Online], Available: http://gis.devon.gov.uk/basedata/viewer.asp?DCCService=hlc [March 2013]

Findlay, D.C., Colborne, G.J.N., Cope, D.W., Harrod, T.R., Hogan, D.V. and Staines, S.J. (1984) *Soil survey of England and Wales bulletin 14 Soils and their use in south west England*, Harpenden: The Soil Survey of England and Wales

Institute for Archaeologists (undated) *IfA house style*, [Online], Available: http://www.archaeologists.net/sites/default/files/node-files/ifa_house_style.pdf [March 2013]

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 [March 2013]

Institute for Archaeologists (2009) *Code of conduct*. Reading: Author [Online], Available: http://www.archaeologists.net/sites/default/files/node-files/code_conduct.pdf [March 2013]

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 [March 2013]

Soil Survey of England and Wales (1983) *Soils of South West England Sheet 5* 1:250 000, Southampton: Ordnance Survey

Appendix 1 Supporting plots

General Guidance

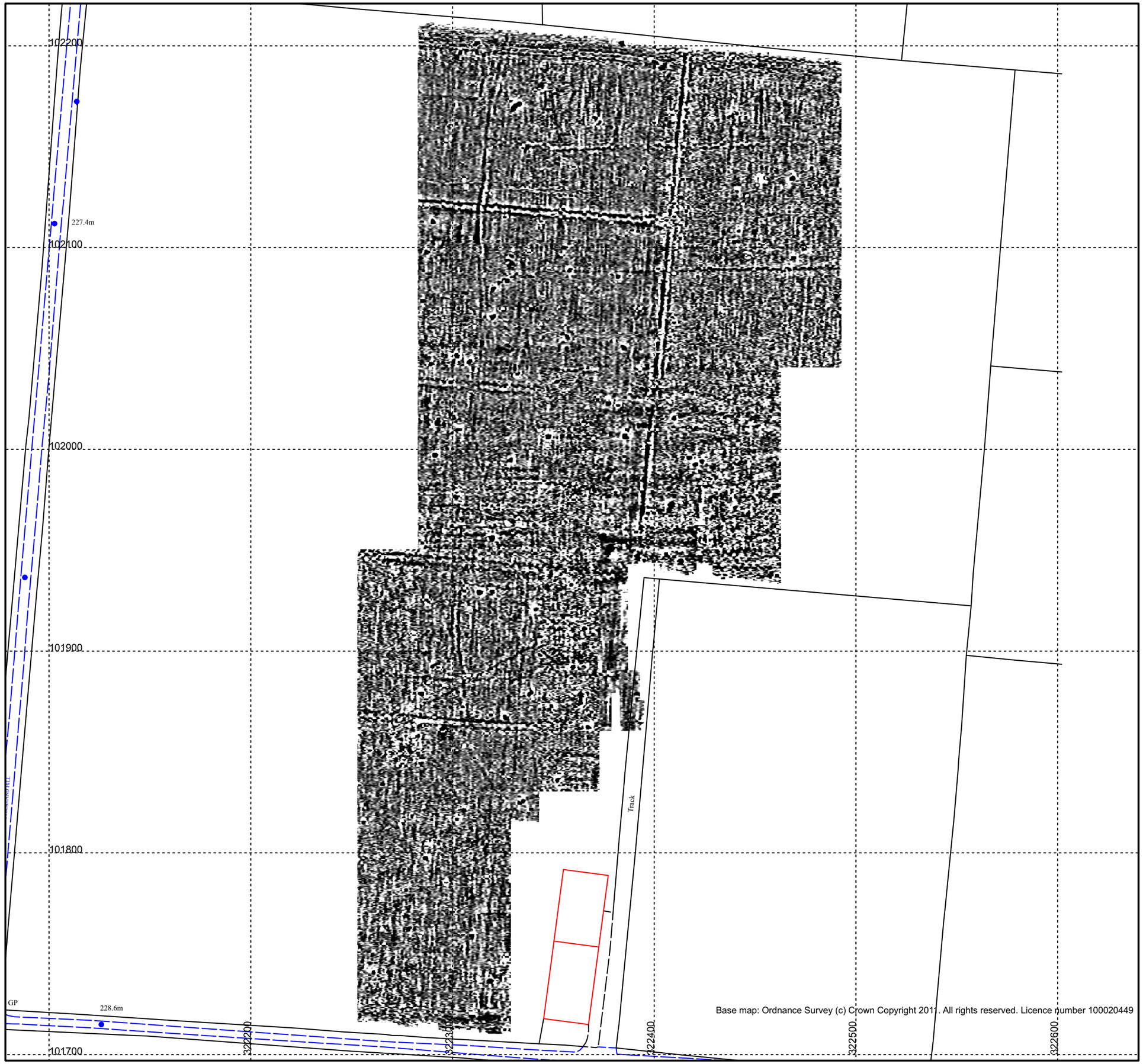
The anomalies represented in the survey plots provided in this appendix are magnetic anomalies. The apparent size of such anomalies and anomaly patterns are unlikely to correspond exactly with the dimensions of any associated archaeological features.

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.

Substrata
Archaeological Geophysical Surveyors

15 Horixon View, Bath Hotel Road, Westward Ho!
Bideford, Devon EX39 1GX
mob: 07788627822
email: geophysics@substrata.co.uk

An Archaeological Gradiometer Survey
Land at Ridge Cross, Stockland, Devon
National grid coordinates (centred on) 322370, 101960
Report: 130329



N

Legend

gradiometer processed data (nT)

Value

High : 1.5

Low : -1.5

0 25 50 100 Meters

Figure 1: shade plot of processed data

Appendix 2 Methodology

Table 2: methodology	
Documents Project design: Dean (2013)	
Methodology 1. The work was undertaken in accordance with the project design. 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.	
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 DW Consulting TerraSurveyor 3 ArcGIS 9.3 Microsoft Corp. Office Publisher 2003.	

Appendix 3 Data processing

Table 3: gradiometer survey - processed data metadata
Software: DW Consulting TerraSurveyor v 3.0.19.16

Stats

Max:	167.39
Min:	-166.94
Std Dev:	4.18
Mean:	0.15
Median:	0.00

Processes: 4

1 Base Layer
2 Clip at 4.00 SD
3 De Stagger: Grids: All Mode: Both By: -3 intervals
4 DeStripe Median Sensors: All

Note: interpolation match x & y doubled is completed during export from TerraSurveyor to georeferenced ERSI format

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 magnetised 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.