Substrata
Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Land at Barnards Hill Lane

Seaton, Devon

Ordnance Survey E/N: 323935, 91260 (point)

Report: 130812
Ross Dean BSc MSc MA MIfA
15 August 2013

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AutoCAD version of the survey interpretation ..... AutoCAD DWG

1 Survey description and summary

Type of survey: twin-sensor fluxgate gradiometer
Date of survey: 26 July 2013
Area surveyed: 0.6ha.
Lead surveyor: Ross Dean BSc MSc MA MIfA

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

Location

Site:	Land at Barnards Hill Lane
Town:	Seaton
District:	East Devon
County:	Devon
NGR:	SY 23935 91260
Ordnance Survey E/N:	323935, 91260 (point)
OASIS number:	substrat1-157339
Archive:	At the time of writing, the archive of this survey will be held by Substrata.

Summary
This report was commissioned by AC Archaeology Ltd on behalf of clients and was produced by Substrata in preparation for submission of a forthcoming planning application.

No magnetic anomalies relating to possible archaeological deposits or features were identified in the data set.

The magnetic contrast across the survey area was sufficient, under normal conditions, to distinguish between anomalies representing potential archaeology and natural deposits. In this case, data collected at the northern boundary of the survey area was compromised by interference caused by highly magnetic material in the boundary itself. Data from the southern edge of the site was compromised by high levels of magnetic interference from an underground cable or ferrous pipe (figures 2 and 3). Relatively recent ground disturbance was detectable across the rest of the site implying that, had they been present, any large archaeological deposits such as ditches and walls would have been detected away from the northern and southern boundaries.

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 is one field, approximately 45m to 55m O.D., bounded to the north by allotments, to the east by Barnard's Hill Lane and a housing estate, to the south by housing and to the west by a caravan park. The field boundaries include a significant amount of ferrous material which restricted data collection at the northern boundary of the survey area.

Land use at the time of the survey
Grass and rough ground.

Geology
The site is located on a solid geology of the Brandscombe Mudstone Formation which comprises mudstone and siltstone coloured red-brown with common grey-green reduction patches and spots (British Geological Survey, undated).

The drift geology across the site is Quaternary sand and gravel, locally with lenses of silt, clay or peat and organic material (ibid.)

Historic Landscape Characterisation
Modern enclosures adapting post-medieval fields. Modern enclosures that have been created by adapting earlier fields probably of post-medieval date (Devon County Council, undated).

Known archaeological sites within or adjacent to the survey area
While there is an abundance of Historical Environment Record (HER) entries for the area around the survey site, there are no entries within the survey area or immediately adjacent to its boundaries.

Three entries located nearby give a context for the survey:

MDV80938:	Bacon's Barn marked on the 1880s to 1890s 25 inch Ordnance Survey map. SY 2408 9117 (20m by 16m).
MDV14050:	Neolithic flint scatter in Barnard's Hill Lane. SY 2411 9110 (point).
MDV14400:	Honeyditches Multiphase Settlement; excavations undertaken between 1860 to 1987have produced evidence of Mesolithic to Medieval occupation including a Late Iron Age settlement and a Roman Villa. SY 2376 9095 (424m by 286m). EDV4288

Previous fieldwork within or adjacent to the survey area
There is one Event Record entry associated with the above HERs:

EDV4288:	Uppacott, Hareoath Hill, Seaton; Archaeological intervention/watching brief.

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.

No magnetic anomalies relating to possible archaeological deposits or features were identified in the data set.

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

Site: An archaeological gradiometer survey
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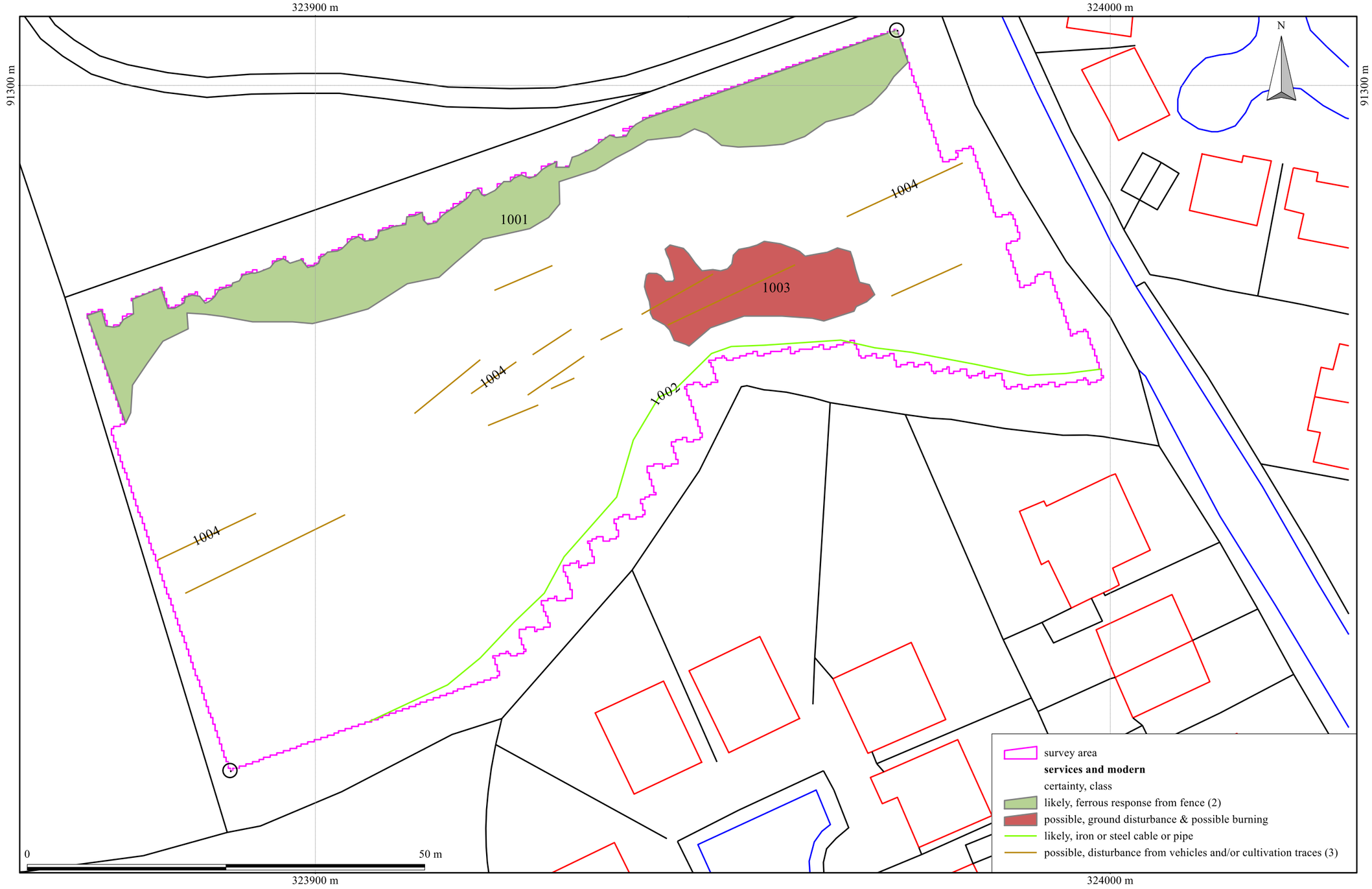
anomaly group	anomaly characterisation certainty & class	additional archaeological characterisation	comments	supporting evidence
1001	likely, dipole	modern boundary	strong ferrous response from fence containing steel or iron	surveyor observation
1002	likely, high contrast linear	service cable or pipe	service with steel or iron in the construction	
1003	possible, positive spread	ground disturbance/recent burning	area subject to recent burning and disturbance- no other reason for anomalies obvious from the data set	surveyor observation
1004	possible, repeated parallels	cultivation traces	anomalies indicate either recent ground disturbance by, e.g., vehicles, ploughing or a mix of both	

Table 1: data analysis



British Grid
centre X: 323946.91 m, centre Y: 91254.85 m

Scale: 1:500 @ 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 " have supporting evidence e.g. historical maps and or visible earthworks.
3. Representative; not all instances are mapped.
4. Anomalies likely to represent geological or other natural deposits are not mapped.

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Figure 1: survey interpretation

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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.

No magnetic anomalies relating to possible archaeological deposits or features were identified in the data set.

3.3 Conclusions

The magnetic contrast across the survey area was sufficient, under normal conditions, to distinguish between anomalies representing potential archaeology and natural deposits.

In this case, data collected at the northern boundary of the survey area was compromised by interference caused by highly magnetic material in the boundary itself. Data from the southern edge of the site was compromised by high levels of magnetic interference from an underground cable or ferrous pipe (figures 2 and 3). Relatively recent ground disturbance was detectable across the rest of the site implying that, had they been present, any large archaeological deposits such as ditches and walls would have been detected away from the northern and southern boundaries.

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

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 [July 2013]

British Geological Survey (undated) *Digital Geological Map of Great Britain (DiGMapGB-625) dataset at 1:625 000 [Online], Available: http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html* [August 2013]

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

Dean, R. (2013) *A gradiometer survey project design: Land at Barnards Hill Lane, Seaton, Devon,* Substrata unpublished document

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

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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 [April 2013]

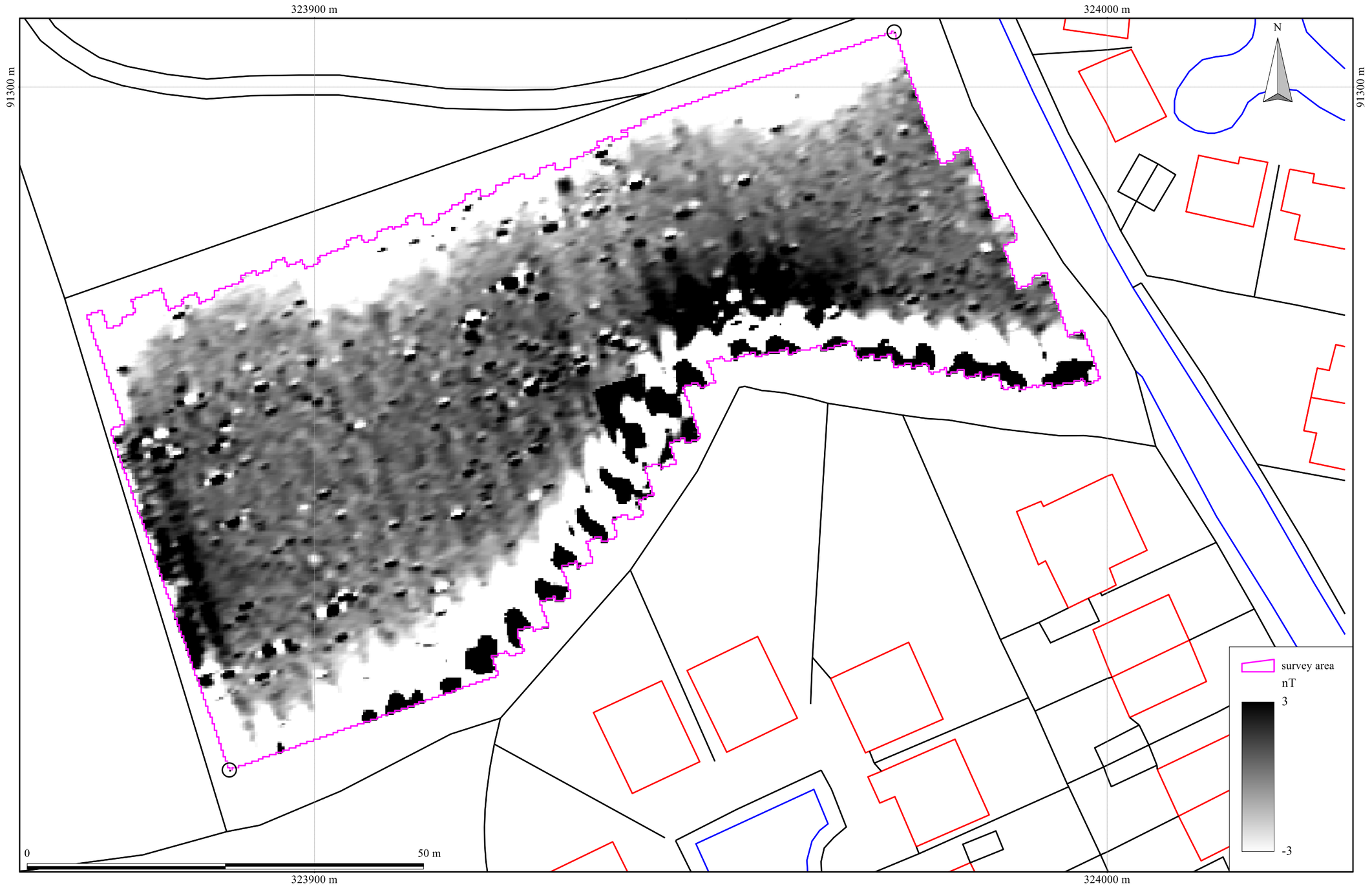
Institute for Archaeologists (2008) *Code of approved practice for the regulation of contractual arrangements in archaeology*. Reading: Author [Online], Available: http://www.archaeologists.net/sites/default/files/node-files/ifa_code_practice.pdf [April 2013]

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.



British Grid
centre X: 323946.91 m, centre Y: 91254.85 m

Scale: 1:500 @ 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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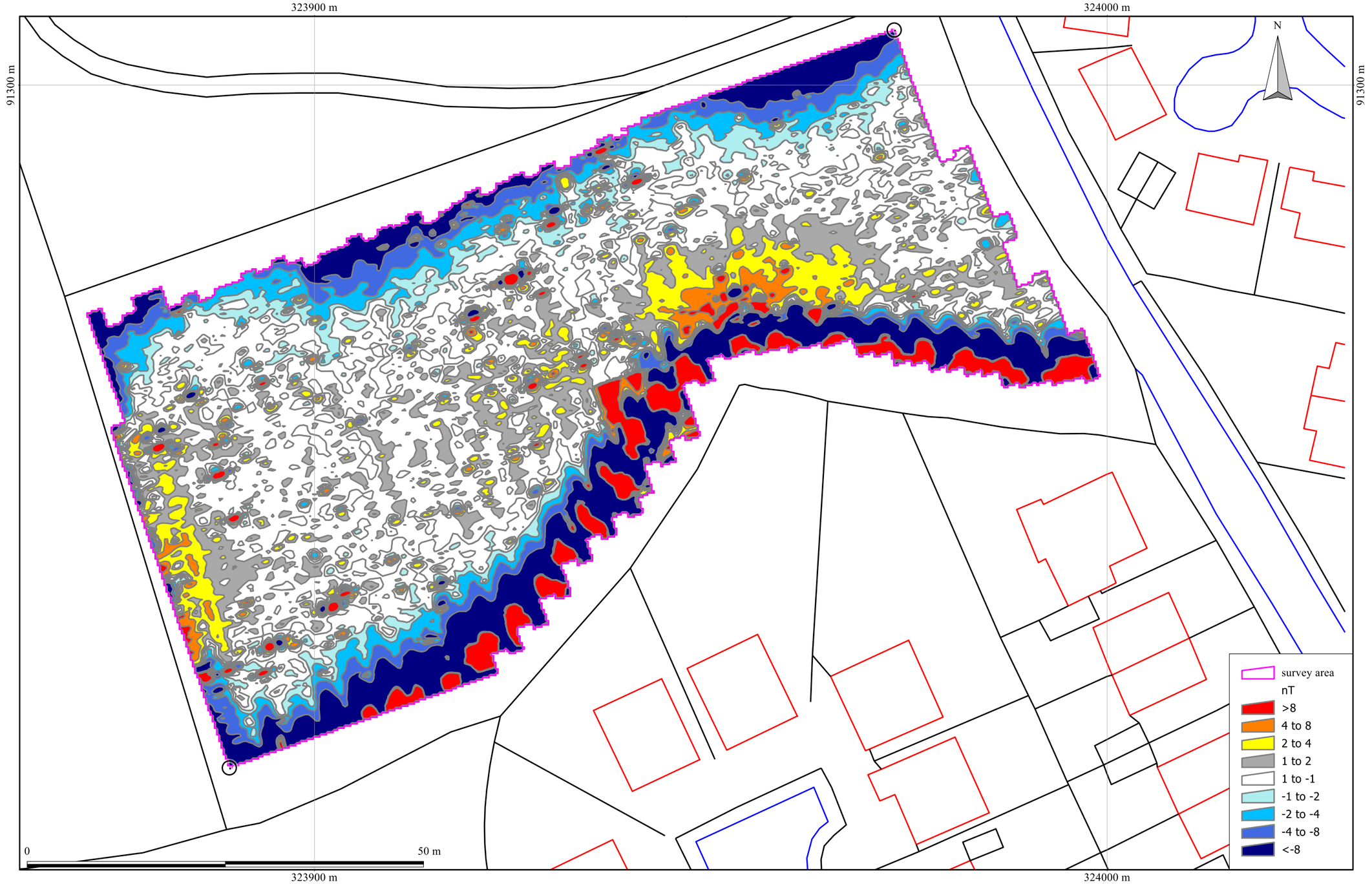

British Grid
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Scale: 1:500 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 3: filled contour plot of processed data

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Appendix 2 Methodology

<table>
<tr><th colspan="2">Table 2: methodology</th></tr>
<tr><td colspan="2">Documents
Project design: Dean (2013)</td></tr>
<tr><td colspan="2">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.</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.</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
DW Consulting TerraSurveyor3
ArcGIS 9.3
Microsoft Corp. Office Publisher 2003.</td></tr>
</table>

Appendix 3 Data processing

Table 3: gradiometer survey - processed data metadata

SITE
Name: Barnards Hill Lane
Location: Seaton, Devon
MapRef: 323935, 91260

Description:
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

Dimensions
Composite Size (readings): 240 x 120
Survey Size (meters): 60 m x 120 m
Grid Size: 30 m x 30 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 527.46
Min: -296.95
Std Dev: 49.03
Mean: -1.17
Median: 0.00
Composite Area: 0.72 ha
Surveyed Area: 0.53405 ha

PROGRAM
Name: TerraSurveyor
Version: 3.0.22.7

Processes: 5
1 Base Layer
2 Clip at 1.00 SD
3 Clip at 4.00 SD
4 DeStripe Median Sensors: All
5 De Stagger: Grids: All Mode: Both By: -3 intervals

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.