Substrata
Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Land at Collaton Down, Blackawton South Hams, Devon

Ordnance Survey (E/N): 279510,53340 (point)

Report: 140829

Ross Dean BSc MSc MA MIfA

29 August 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

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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

Type of survey:	twin-sensor fluxgate gradiometer
Date of survey:	12 to 14 August 2014
Area surveyed:	3.3ha
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 Collaton Down
Parish:	Blackawton
District:	South Hams
County:	Devon
Nearest Postcode:	TQ9 7DW
NGR:	SX 795 533
Ordnance Survey E/N:	279510,53340 (point)
OASIS number:	substrat1-88688
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 has been prepared as part of a programme of work in support of a forthcoming planning application for a solar farm at the above site. The location of the proposed development area is shown in Figure 4.

The magnetic contrast across the area was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses. Five magnetic anomaly groups were identified as pertaining to archaeological deposits or structures. Two groups are likely to represent former ridge-and-furrow ploughing. The remaining three anomaly groups have patterns typical of anomalies representing former field and enclosure boundaries of unknown date and archaeological provenance.

2 Survey aims and objectives

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.

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

Landscape and land use
A location plan is provided in Figure 4, appendix 1. The field and proposed access route were under grass pasture at the time of the survey.

Geology
The site is located on a solid geology of the Devonian Staddon Formation. The formation comprises medium to thick beds (1-4m) of fine- to medium-grained sandstone, thickening and coarsening upwards with thin interbedded grey mudstone and siltstone. The superficial geology is not recorded in the source used (British Geological Survey, undated).

5 Archaeological background

A comprehensive description of the heritage assets within a 2.2km radius of the site can be found in the AC Archaeology Ltd Historic Impact Assessment for this programme of work (Merton, C. and Lutescu-Jones, P., 2014). The following is a short interpretation of information obtained from the Historic Environment Assessment relevant to the immediate survey area. The reader is advised that this summary should not be used outside the context of this report and is referred to the Devon HER for informed provision of the record.

There are no heritage assets recorded within or immediately adjacent to the survey area. The village of Collaton, approximately 350m to the south of the survey area (Figure 4), was a documented Medieval settlement (HER entry MDV58476). Halwell Camp Hillfort (English Heritage reference 1019237) lies approximately 900m to the west of the survey area. It comprises a sub-circular, univallate hillfort divided into two parts by the Dartmouth to Halwell Road and two Late-Neolithic to Late Bronze Age bowl barrows which form part of the Bickleigh Brake linear barrow cemetery (English Heritage reference 1019238) which lies approximately 1km to the northwest of the survey area.

Historical Landscape Characterisation
Barton Fields
These relatively large, regular enclosures seem likely to have been laid out between the fifteenth and eighteenth centuries. Some curving boundaries may be following earlier divisions in the pre-existing medieval fields. In Cornwall these are sometimes called Barton fields (Devon County Council, undated).

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

The reader is referred to section 7.

6.1 Results

Figure 1 shows the interpretation of the survey across the Fields 1 to 3that comprise the survey area. It includes the anomaly groups identified as pertaining 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 Figures 2 and 3 (Appendix 1).

Site: An archaeological gradiometer survey
Land at Collaton Down
Blackawton, South Hams, Devon
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anomaly group	associated anomalies	anomaly characterisation certainty & class	anomaly form	comments
1	parallel linears		ploughing disturbance	anomaly groups are likely to represent ploughing disturbance, possibly ridge-and-furrow
2	possible positive	linear		
3	possible positive	linear		
4	possible positive	disrupted linear		
5	parallel linears		ploughing disturbance	anomaly groups are likely to represent ploughing disturbance, possibly ridge-and-furrow

Table 1: data analysis

279500 m 279600 m 279700 m

53400 m

53300 m

N

Potential archaeology

certainty, anomaly type

possible positive

possible repeated parallels (3)

1

2

3

4

5

0 40 m

British Grid
centre X: 279602.24 m, centre Y: 53343.64 m

Scale: 1:1000 @ 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. Representative; not all instances are mapped.
4. 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

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

6.2 Discussion

Refer to Figure 1 (this section) and Figure 2 (appendix 1). Not all anomalies or anomaly groups identified in the survey dataset are necessarily 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 the data analysis (Table 1).

General points
There are distinct, parallel, closely spaced, linear patterns in the survey data that follow the trends of the extant field boundaries across all three fields (Figures 2 and 3). These patterns are likely to reflect relatively recent ploughing and farm vehicle tracks.

Anomalies though to relate to natural features were not mapped. Recent man-made objects such as manholes, water management equipment or drains have not been mapped except where they comprise significant magnetic responses across the dataset.

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 items except where indicated otherwise in Figure 1.

Data relating to historical maps and other records
No magnetic anomaly groups coincided with previously recorded items.

Data with no previous provenance
Anomaly groups **1 and 5** are likely to represent ridge-and-furrow cultivation.

Although isolated and therefore difficult to characterise archaeologically, anomaly groups **2, 3 and 4** have linear patterns typical of anomalies representing former field and enclosure boundaries of unknown date and archaeological provenance.

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. Five magnetic anomaly groups were identified as pertaining to archaeological deposits or structures. Two groups are likely to represent former ridge-and-furrow ploughing. The remaining three anomaly groups have patterns typical of anomalies representing former field and enclosure boundaries of unknown date and archaeological provenance.

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]

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

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Merton C. and Lutescu-Jones, P. (2014) *A proposed solar farm at Collaton Down, Blackawton, Devon: Historic Environment Impact Assessment,* AC Archaeology unpublished report ACD978/1/0

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.

279500 m 279600 m 279700 m

N

Gradiometer processed data shade
nT
2.5
-2.5

53400 m

53300 m

0 40 m

British Grid
centre X: 279602.24 m, centre Y: 53343.64 m

Scale: 1:1000 @ 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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15 Horizon View, Bath Hotel Road
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Email: geophysics@substrata.co.uk
Web: substrata.co.uk

279500 m 279600 m 279700 m

53400 m

53300 m

N

Gradiometer processed data contours

nT

< -8.00

-8.00 - -4.00

-4.00 - -2.00

-2.00 - -1.00

-1.00 - 1.00

1.00 - 2.00

2.00 - 4.00

4.00 - 8.00

> 8.00

0 40 m

279500 m 279600 m 279700 m

British Grid
centre X: 279602.24 m, centre Y: 53343.64 m

Scale: 1:1000 @ A3. Spatial Units: Meter. Do not scale off this drawing

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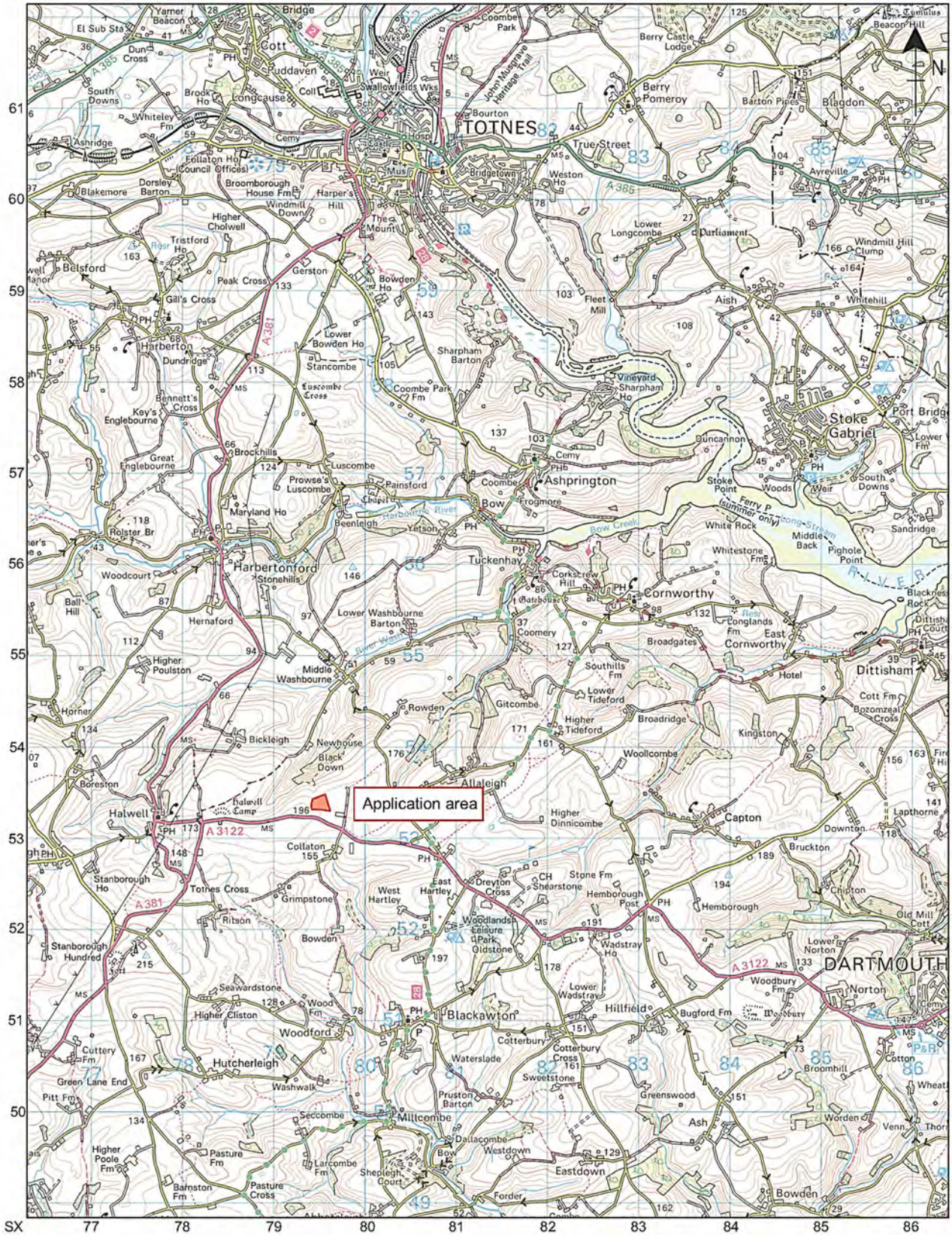
Figure 3: contour plot of processed data

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



PROJECT

Land at Collaton Down, Blackawton, Devon

TITLE

Figure 4: site location

AC archaeology

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
Field Stats Max: 119.87 Min: -119.09 Std Dev: 3.50 Mean: 0.09 Median: 0.00 **Proposed access** Stats Max: 188.67 Min: -192.62 Std Dev: 7.66 Mean: -0.34 Median: 0.00 Surveyed Area: 3.3 ha Processes (both areas): 4 1 Base Layer 2 Clip at 3.00 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.

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.