Substrata
Archaeological Geophysical Surveyors

An archaeological gradiometer survey

# Land off Morleigh Cross, Morleigh, Totnes, Devon

Ordnance Survey (E/N): 276840,52750 (point)

Report: 141020

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20 October 2014

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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: | June 2014 |
| Area surveyed: | 0.5ha |
| Lead surveyor: | Ross Dean BSc MSc MA MIfA |

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

Location

| | |
|---|---|
| Site: | Land off Morleigh Cross, Morleigh |
| Parish: | Halwell and Moreleigh |
| District: | South Hams |
| County: | Devon |
| Nearest Postcode: | TQ9 7JQ |
| NGR: | SX 768 527 |
| Ordnance Survey E/N: | 276840,52750 (point) |

Archive

| | |
|---|---|
| OASIS number: | substrat1-192937 |
| 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. The location of the proposed development area is shown in Figure 1.

*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 relating to possible archaeological deposits or features. No further archaeological provenance for these anomalies could be ascertained from the survey data set.*

# 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

The *Survey Area* (Figure 1) is located in the north-western corner of a field (the *Survey Field*) on the eastern side of the village of Morleigh. The Survey Area is bounded by hedged banks to the east and north along two minor roads intersecting at Morleigh Cross which itself lies on the north-western apex of the Survey Field and Survey Area. Open pasture bound the Survey Area to the east and south. A farm with various buildings lies across the road to the west of the Survey Area. A village hall is situated across the northern road. Residential properties of the village of Morleigh lie to the west of Morleigh Cross.

The Survey Field was under pasture at the time of the survey.

Geology

The Survey Area is located on a solid geology of slate, siltstone and sandstone of the Devonian Meadfoot Group. The rocks comprise dark shales and siltstones with sporadic grey-brown sandstones and beds of decalcified shell debris. The upper part of the group exhibits red coloration in places. The superficial geology is not recorded in the source used (British Geological Survey, undated).

# 5 Archaeological background

What follows is a short summary of information obtained from the Devon and Dartmoor Historic Environment Record (HER) within 500m of the Survey Area and deemed relevant to the understanding of the gradiometer survey. Except where specifically stated, this information was obtained using the Heritage Gateway (English Heritage, undated). The HER entries cited below are summarised in Appendix 4.

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.

Historical Landscape Characterisation

The Survey Field is classified as '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).

Heritage Assets within the Survey Area

There are no recorded heritage assets within the Survey Area although one worked flint was recovered in the Survey Field during a fieldwalking survey in advance of the laying of a pipeline (MDV44476).

Heritage Assets close to the Survey Area

A number of Modern (A.D. 1751 to A.D. 2009) HER entries lie within the village of Morleigh including two listed buildings, two boundary stones, a Vicarage, a blacksmiths workshop, a chapel and a milestone.

Approximately 600m south-south-east of the survey area two pits, a linear spread of quartz gravel, four small burnt patches and two substantial linear features were revealed during topsoil stripping as part of archaeological recording and monitoring at Stanborough Farm (EDV5200). These assets were undated but may be part of a Prehistoric (between 698000 B.C. and A.D. 42) farming landscape (MDV80548).

A parish boundary to the north of Morleigh also served as a manorial boundary and may be of Saxon origin (MDV44473 and MDV44474).

Previous Studies

Reed, S. J. and Turton, S. D. (1991) Archaeological recording on the South West Water Crabadon Cross to Stanborough water pipeline/(1991)3/ (EMAFU report 91.34).

A worked flint was recorded within the Survey Field during this work (MDV44476).

EDV5200: Archaeological Monitoring and Recording at Stanborough Farm, Halwell.
Two small undated pits, a linear spread of quartz gravel, four small burnt patches and two substantial linear features though to be part of a Prehistoric (between 698000 B.C. and A.D. 42) farming landscape were recorded approximately 600m south of the Survey Area (MDV80548).

# 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 is provided in Figures 2 and 3.

## 6.2 Discussion

Refer to Figures 1 and 2. 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
Anomalies though to relate to natural features were not mapped. Recent man-made objects such as manholes, water management equipment, drain, cables and other services have not been mapped except where they comprise significant magnetic responses across the dataset in which case they are summarised in Table 1.

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
There were no magnetic anomaly groups relating to previously mapped features.

Data with no previous provenance
The magnetic anomaly groups identified as relating to possible archaeological deposits or features comprised one rectilinear group (group **1**) and four linear groups (**2 to 5**). No further archaeological provenance could be ascertained for these groups from the survey data set.

Repeated, parallel trends recorded in the data set are likely to relate to relatively recent ploughing disturbance (group **101**).

## 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 relating to possible archaeological deposits or features. No further archaeological provenance for these anomalies could be ascertained from the survey data set.

## 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* [October 2014]

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

Dean, R. (2014) *A gradiometer survey method statement, Land off Morleigh Cross, Morleigh, Totnes, Devon,* Substrata unpublished document

Devon County Council (undated) *Historic Landscape Characterisation*, [Online], Available: http://gis.devon.gov.uk/basedata/viewer.asp?DCCService=hlc [October 2014]

English Heritage (undated) *Heritage Gateway*, [Online], Available: http://www.heritagegateway.org.uk/Gateway/advanced_search.aspx [October 2014]

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
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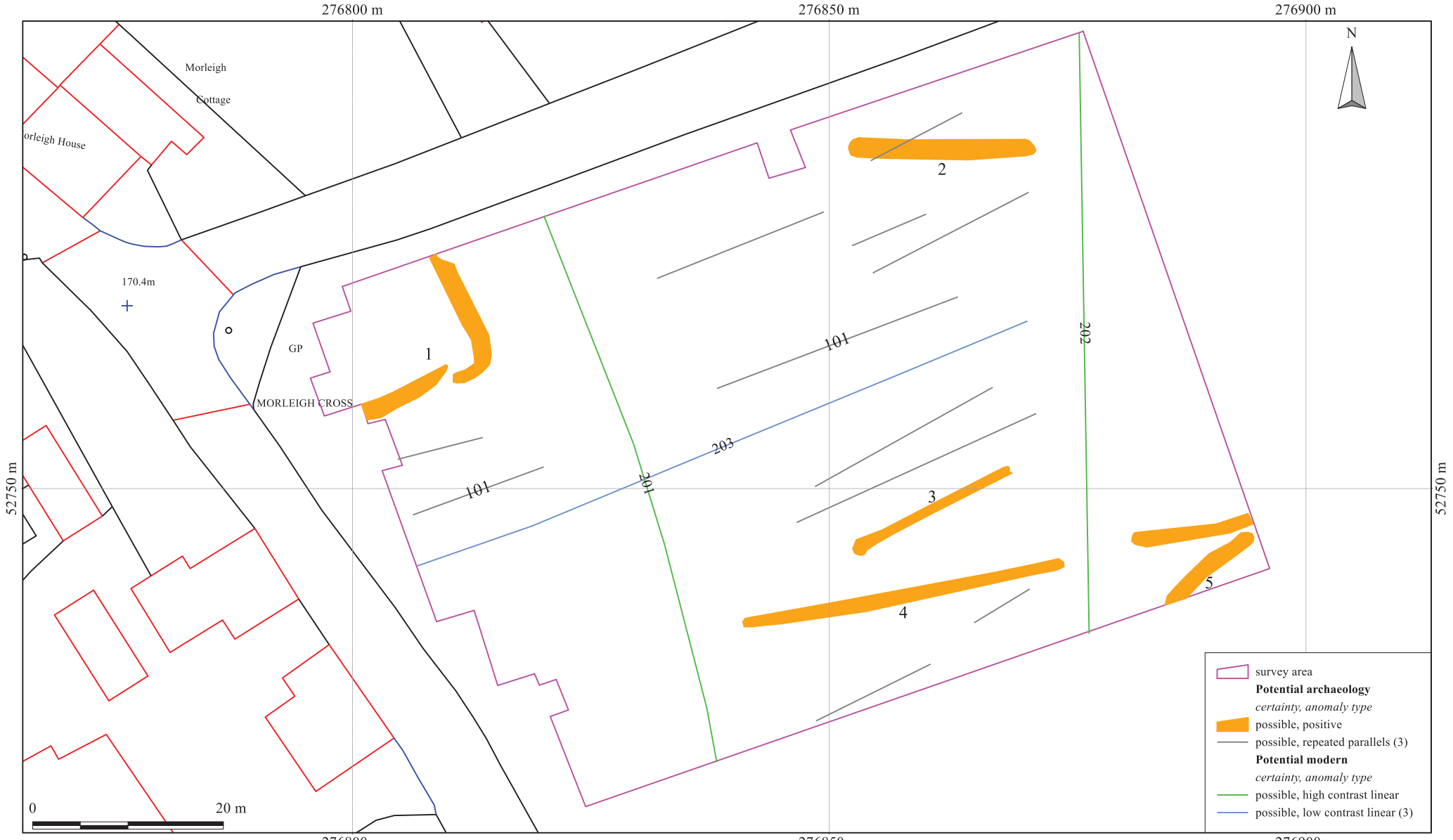
| anomaly group | associated anomalies | anomaly characterisation certainty & class | anomaly form | additional archaeological characterisation | comments |
|---|---|---|---|---|---|
| 1 | | possible, positive | rectilinear | | anomaly groups may represent a single multi-linear or rectilinear deposit |
| 2 | | possible, positive | linear | | |
| 3 | | possible, positive | linear | | |
| 4 | | possible, positive | disrupted linear | | |
| 5 | | possible, positive | linear | | |
| 101 | | possible, parallel linears | | ploughing disturbance | anomalies are most likely to reflect relatively recent sub-soil disturbance by ploughing |
| 201 | | possible, high contrast linear | | service | possible, high contrast linear |
| 202 | | possible, high contrast linear | | service | iron or steel pipe or cable |
| 203 | | possible, low contrast linear | | service trench | anomalies suggest a service trench such as that used for modern non-ferrous water pipes |

Table 1: data analysis




British Grid
centre X: 276839.27 m, centre Y: 52756.46 m

Scale: 1:400 @ 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

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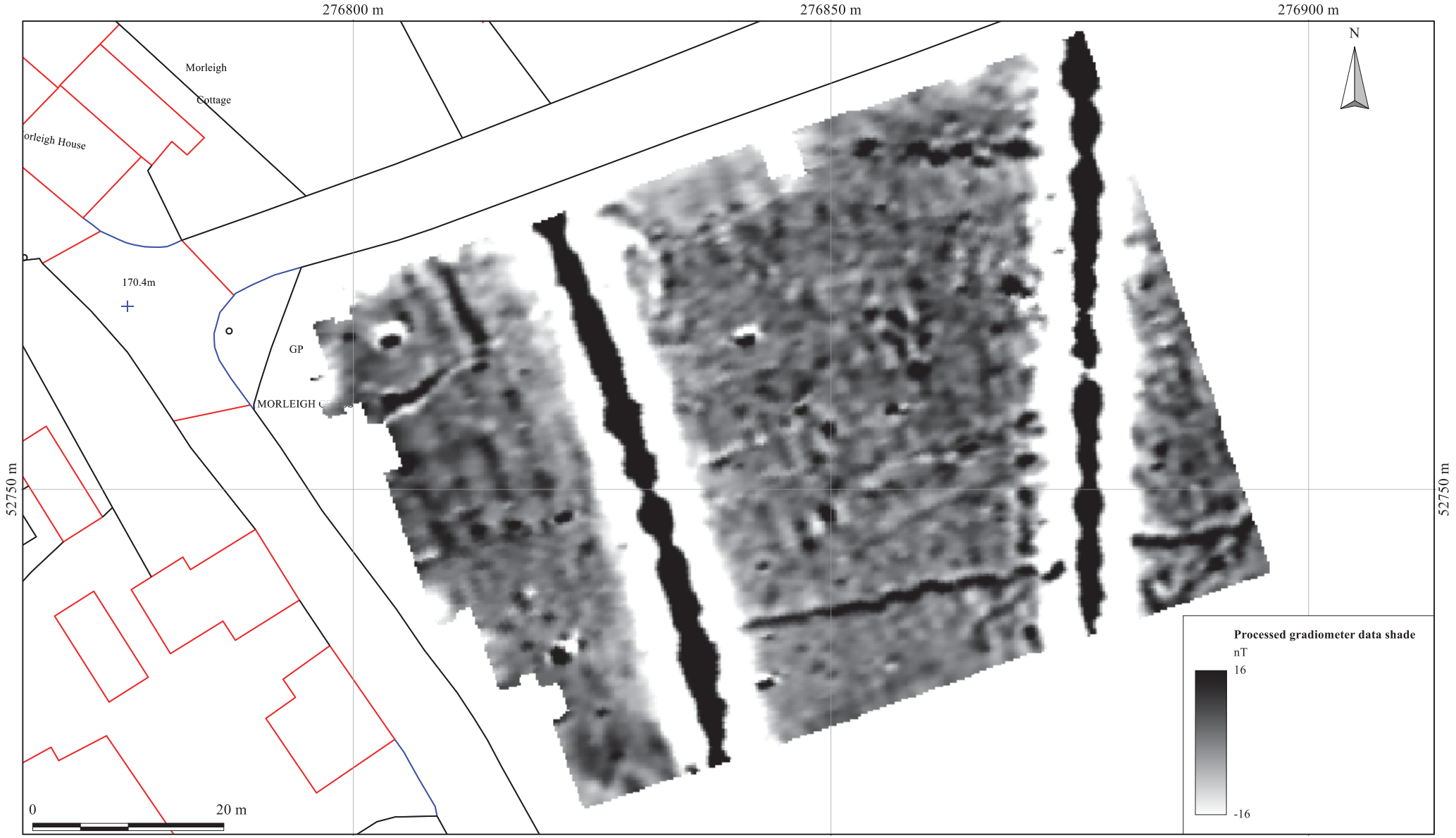


British Grid
centre X: 276839.27 m, centre Y: 52756.46 m

Scale: 1:400 @ A3. Spatial Units: Meter. Do not scale off this drawing



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Figure 2: shade plot of processed data

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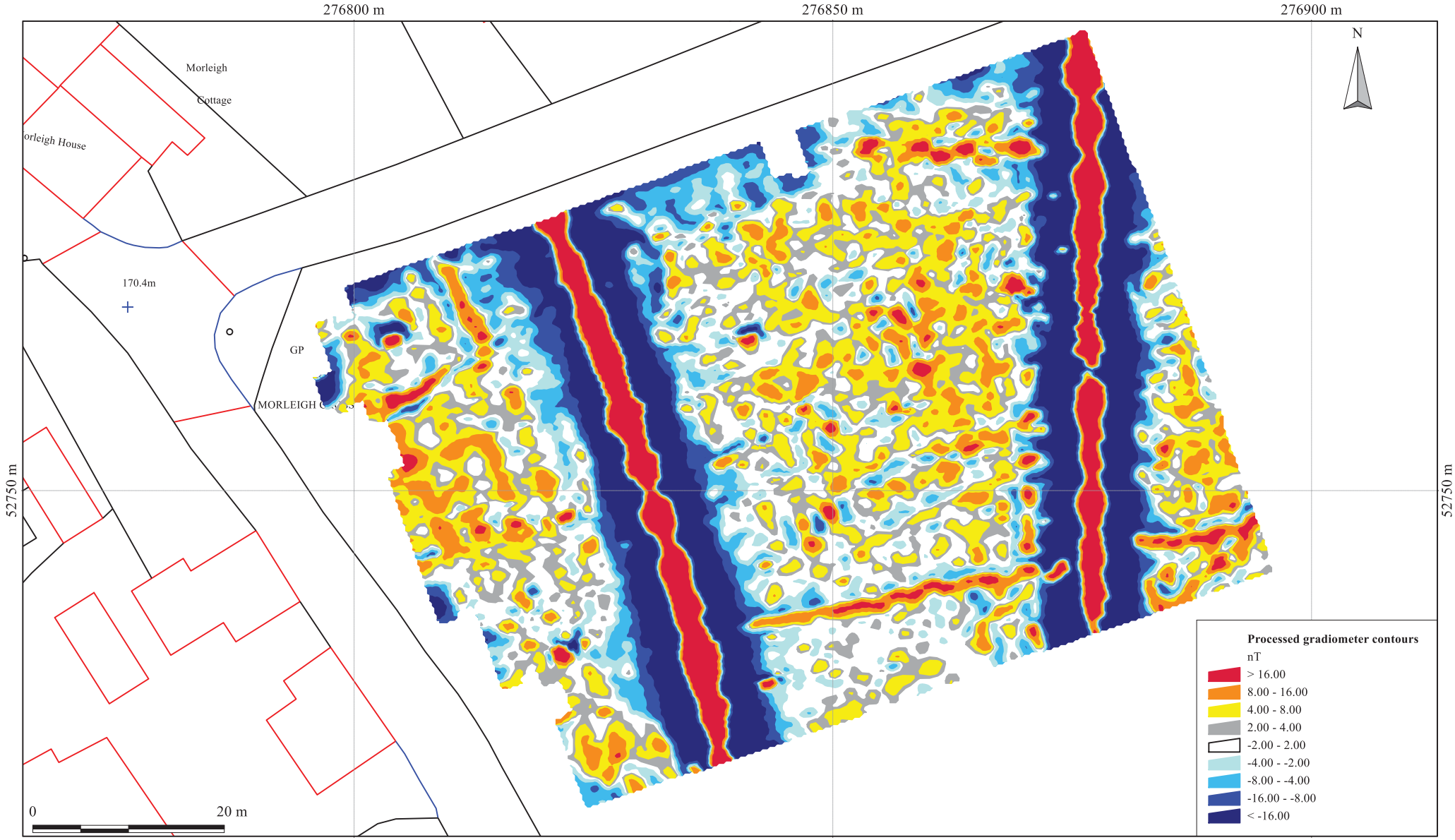


British Grid
centre X: 276839.27 m, centre Y: 52756.46 m

Scale: 1:400 @ A3. Spatial Units: Meter. Do not scale off this drawing



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Figure 3: contour plot of processed data

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## 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** | **Data Capture** |
|---|---|
| *Instrument:* Bartington Instruments grad601-2<br>*Firmware:* version 6.1 | *Sample Interval:* 0.25-metres<br>*Traverse Interval:* 1 metre<br>*Traverse Method:* zigzag<br>*Traverse Orientation:* GN341 |

**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<br>Instrument Type: Bartington Grad 610<br>Units: nT<br>Direction of 1st Traverse: 0 deg<br>Collection Method: ZigZag<br>Sensors: 2 @ 1.00 m spacing.<br>Dummy Value: 32702<br><br>PROGRAM<br>Name: TerraSurveyor<br>Version: 3.0.25.1 |
| Stats<br>Max: 20.00<br>Min: -20.00<br>Std Dev: 11.15<br>Mean: -1.60<br>Median: 0.07<br>Surveyed Area: 0.48675 ha<br><br>Processes: 6<br>1 Base Layer<br>2 Clip from -85.00 to 111.00 nT<br>3 De Stagger: Grids: All Mode: Both By: -3 intervals<br>4 DeStripe Median Sensors: All<br>5 Interpolate: Match X & Y Doubled.<br>6 Clip from -20.00 to 20.00 nT |

# Appendix 4 Summaries of cited Devon and Dartmoor Historical Environment Entries

HER Number: MDV80548
Name: Pits and Linear Features at Stanborough Farm
Summary:
Two small undated pits, a linear spread of quartz gravel, four small burnt patches and two substantial linear features were revealed during topsoil stripping to the south of Stanborough Farm.
Location Grid Reference: SX 771 522
Civil Parish: Halwell and Moreleigh
District: South Hams
Protected Status: none recorded
Monument Type(s) and Dates: ARCHAEOLOGICAL FEATURE (Unknown date)
Full description:
Green, T., Morris, B. and Walls, S. (2010) *Stanborough Farm, Halwell, Devon: Results of a Desk-Based Assessment and Archaeological Monitoring and Recording* (Report - non-specific)
Two small undated pits, a linear spread of quartz gravel, four small burnt patches and two substantial linear features were revealed during topsoil stripping. The two linear features crossed the site from north-west to south-east, and probably represent an early field boundary cut by a later holloway. Neither feature could be dated, but they probably predate the current historic fieldscape, and could therefore relate to the prehistoric and early medieval monuments in and around Stanborough Camp. The small assemblage of finds suggests this land was never intensively used, and that it has largely been used for grazing.
Associated Monuments: none recorded
Associated Finds:
FDV1898 - SHERD (Unknown date)
FDV1899 - WORKED OBJECT (Neolithic - 4000 BC to 2201 BC)
Associated Events:
EDV5200 - Archaeological Monitoring and Recording at Stanborough Farm, Halwell

HER Number: MDV44473 & 44474
Summary: Parish boundary also served as manorial boundary. Possibly of Saxon origin.
Location Grid Reference: SX 763 531
Civil Parish Halwell and Moreleigh
District South Hams
Protected Status: none recorded
Monument Type(s) and Dates: PARISH BOUNDARY (Unknown date)

HER Number: MDV44476
Summary: Fieldwalking of pipeline corridor produced a worked flint
Location Grid Reference: SX 768 527
Civil Parish: Halwell and Moreleigh
District: South Hams
Protected Status: none recorded
Monument Type(s) and Dates: ARTEFACT SCATTER (Prehistoric - 698000 BC to 42 AD (Between))

# Appendix 5 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.