Substrata
Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Land on Bleadon Hill
Weston-super-Mare, Somerset

Ordnance Survey E/N: 333450,157750 (point)

Report: 141217

Ross Dean BSc MSc MA MIfA

17 December 2014

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Accompanying CD-ROM

1 Survey description and summary

1.1 Survey

Type:	twin-sensor fluxgate gradiometer
Date:	19 & 20 November 2014
Area:	3.775ha
Lead surveyor:	Ross Dean BSc MSc MA MIfA

1.2 Client

Oakford Archaeology, 44 Hazel Road, Exeter, Devon EX2 6HN

1.3 Location

Site:	Land on Bleadon Hill
Town & Civil parish:	Weston-super-Mare
Unitary Authority:	North Somerset
Nearest Postcode:	BS24 9JT
NGR:	ST 334 5777
Ordnance Survey E/N:	333450,157750 (point)

1.4 Archive

OASIS number:	substrat1-198350
Archive:	At the time of writing, the archive of this survey will be held by Substrata.

1.5 Introduction

This report was commissioned by Oakford Archaeology on behalf of clients. It has been prepared as part of a programme of work in support of a forthcoming planning application at the above site. The work was commissioned on the advice of the Archaeology Officer North Somerset Council in line with the approach set out in para 128 of the National Planning Policy Framework. The location of the proposed development area (the Application Area) is shown in Figure 4.

1.6 Summary

The magnetic contrast across the area was sufficient to be able to differentiate between anomalies representing possible archaeological features and background magnetic responses.

Fifty-one magnetic anomaly groups were characterised as having potential archaeological significance. The majority of these are most likely to reflect former field and other enclosure boundaries. In this case they may be associated with a local, mapped, once extensive Prehistoric field system. Thirteen of the anomalies may represent pits are and one may represent a large pit or surface.

2 Survey aims and objectives

2.1 Aims

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

2.2 Objectives

1. Complete a gradiometer survey across agreed parts of the application area.
2. Identify any magnetic anomalies that may be related to archaeological deposits, structures or artefacts.
3. Within the limits of the techniques and dataset, archaeologically characterise any such anomalies or patterns of anomalies.
4. Accurately record the location of the identified anomalies.
5. Produce a report based on the survey that is sufficiently detailed to inform any subsequent development on the site about the location and possible archaeological character of the recorded anomalies.

3 Standards

The standards used to complete this survey are defined by the Institute for Archaeologists (2011). The codes of approved practice that were followed are those of the Institute for Archaeologists (2008 and 2009) and Archaeology Data Service/Digital Antiquity Guides (undated). The document text was written using the house style of the Institute for Archaeologists (Institute for Archaeologists, undated).

4 Site description

4.1 Landscape and land use

The application area lies 750m to the north-west of Bleadon and covers an area of approximately 3.77 hectares. The site lies between 60m and 80m AOD on a limestone ridge overlooking the Somerset Levels and the flood plain of the River Axe immediately to the south.

At the time of the survey the site consisted of two fields which had been used as pasture. They are bounded to the north by Bleadon Hill Road and Hillcote estate and to the west by a housing estate.

4.2 Geology

The application area is located on a solid geology of the Carboniferous Black Rock Limestone Subgroup. These are typically thin- to thick-bedded, dark grey to black, foetid, fine- to coarse-grained skeletal (mainly crinoid) packstones with subordinate thin beds of shaly argillaceous skeletal packstone and mudstone. Volcanic tuffs are present in the lower part of the Subgroup in the Weston super Mare area. The superficial geology is not recorded in the source used (British Geological Survey, undated).

5 Archaeological background

A comprehensive account of the archaeological background is provided in an archaeological assessment completed by Oakfield Archaeology as part of the programme of work supporting the application (Steinmetzer, 2014). The following are brief extracts from the assessment.

5.1 Historical Landscape Characterisation

Unenclosed grassland until the 19th century (North Somerset Historic Environment Record).

5.2 Heritage Assets within the Application Area

Martin Hilliar found large numbers of worked flints and flakes from the ploughed surface of the two fields that comprise the application area. A large number of flakes and flint implements including a core were found and the area may have been a flint working site. Several other objects have been found including a tanged arrowhead and flakes, a scraper; flake, microliths and a flint knife (North Somerset Historic Environment Record MNS32 National Heritage Listing 192550, NGR ST 3346 5775)

5.3 Heritage Assets adjacent to the Application Area

Bleadon Hill seems to have been covered by an extensive system of rectangular fields that appear to be of an Iron Age-Romano-British date. Much of the system has been ploughed out MNS26, NGR ST 3352 5759 and MNS27, NGR ST 3340 5800).

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.

For the purposes of clear reporting, the application area was labelled Area 1 and Area 2 as shown in Figure 1.

Figure 1 along with Table 1 comprises the analysis of the survey data. Plots of the processed data are provided in Figures 2 and 3.

6.2 Discussion

Not all anomalies or anomaly groups identified in Table 1 are necessarily discussed below. All identified anomaly groups are recorded in the GIS project on the accompanying CD-ROM.

<u>General points</u>

Anomalies though to relate to natural features were not mapped. Recent man-made objects such as manholes, water management equipment, drains, cables and other services were only mapped where they comprised significant magnetic responses across the dataset that needed clarification. If mapped, they are listed in Table 1 but are not discussed below.

Data collection along the field edges was restricted as shown in Figures 1 to 3 due to the presence of magnetic materials in and adjacent to the field boundaries. Strong magnetic responses mapped close to the field boundaries are likely to relate to these materials except where indicated otherwise in Figure 1.

Two parallel, closely spaced, linear set of anomalies trending approximately west to east in Area 1 and west-north-west to east-south-east in Area 2 (Figures 2 and 3) are likely to represent sub-soil disturbance due to ploughing of unknown date.

<u>Data relating to historical maps and other records</u>

No magnetic anomaly groups coincide with features recorded on historical Ordnance Survey maps.

The majority of the mapped anomalies are linear magnetic groups with characteristics typical of anomalies reflecting former field and other enclosure boundaries. Their orientation suggests that they may be associated with a local, mapped former extensive field system of rectangular fields of possibly dating from the Iron Age or Romano-British periods and now mainly ploughed out (North Somerset Historic Environment Records MNS26 and MNS27).

<u>Data with no previous archaeological provenance</u>

A number of anomalies representing possible pits are present (groups 15 to 18 in Area 1, groups 32 to 35, 38 to 40, 42 and 45 in Area 2). Group 44 in Area 2 may represent a large pit or surface.

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.

Fifty-one magnetic anomaly groups were characterised as having potential archaeological significance. The majority of these are most likely to reflect former field and other enclosure boundaries. In this case they may be associated with a local, mapped, once extensive Prehistoric field system. Thirteen of the anomalies may represent pits are and one may represent a large pit or surface.

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 Marc Steinmetzer of Oakford Archaeology 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 [November 2014]

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

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

Dean, R. (2014) *A gradiometer survey method statement, Land on Bleadon Hill, Weston-super-Mare, Somerset,* Substrata unpublished document

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]

Steinmetzer, M. (2014) *Archaeological assessment of land on Bleadon Hill, Weston-super-Mare, Somerset*, Unpublished Oakford Archaeology report 14-08, Project 1200

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.

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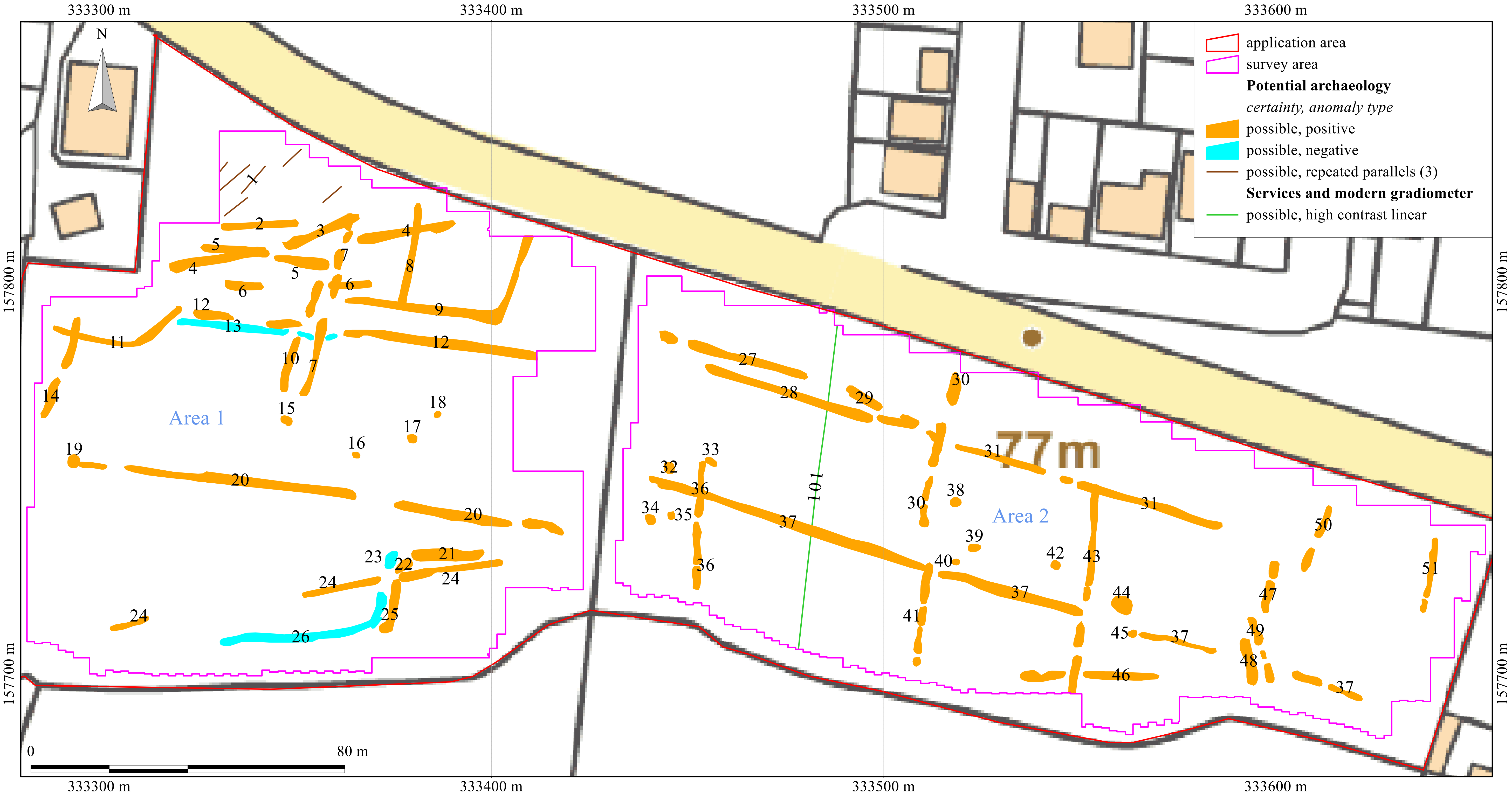
field number	anomaly group	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
1	1	possible, repeated parallels		ploughing disturbance or field drainage		
	2	possible, positive	linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	3	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	4	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	5	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	6	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	7	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	8	possible, positive	linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	9	possible, positive	return		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	10	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	11	possible, positive	curvilinear			
	12	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	13	possible, negative	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	14	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	15	possible, positive	oval	pit	anomaly group may relate to an archaeological deposit such as a filled pit or to a similar natural deposit	
	16	possible, positive	oval	pit	anomaly group may relate to an archaeological deposit such as a filled pit or to a similar natural deposit	
	17	possible, positive	oval	pit	anomaly group may relate to an archaeological deposit such as a filled pit or to a similar natural deposit	
	18	possible, positive	oval	pit	anomaly group may relate to an archaeological deposit such as a filled pit or to a similar natural deposit	
	19	possible, positive	oval	pit	anomaly group may relate to an archaeological deposit such as a filled pit or to a similar natural deposit	
	20	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	21	possible, positive	linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	22	possible, positive	linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	23	possible, negative	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	24	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	25	possible, positive	linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	26	possible, negative	linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
2	27	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	28	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	29	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	30	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	31	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	32	possible, positive	oval	pit	anomaly group may relate to an archaeological deposit such as a filled pit or to a similar natural deposit	
	33	possible, positive	oval	pit	anomaly group may relate to an archaeological deposit such as a filled pit or to a similar natural deposit	
	34	possible, positive	oval	pit	anomaly group may relate to an archaeological deposit such as a filled pit or to a similar natural deposit	
	35	possible, positive	oval	pit	anomaly group may relate to an archaeological deposit such as a filled pit or to a similar natural deposit	
	36	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	37	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	38	possible, positive	oval	pit	anomaly group may relate to an archaeological deposit such as a filled pit or to a similar natural deposit	
	39	possible, positive	oval	pit	anomaly group may relate to an archaeological deposit such as a filled pit or to a similar natural deposit	
	40	possible, positive	oval	pit	anomaly group may relate to an archaeological deposit such as a filled pit or to a similar natural deposit	
	41	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	42	possible, positive	oval	pit	anomaly group may relate to an archaeological deposit such as a filled pit or to a similar natural deposit	
	43	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	44	possible, positive	oval	large pit or surface	anomaly group may relate to an archaeological deposit such as a filled pit, a surface or to a similar natural deposit	
	45	possible, positive	oval	pit	anomaly group may relate to an archaeological deposit such as a filled pit or to a similar natural deposit	
	46	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	47	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	48	possible, positive	linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	49	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	50	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27
	51	possible, positive	disrupted linear		anomaly groups probably relate to linear deposits which in turn may be associated with a former extensive system of rectangular fields	HER MNS26 & MNS27

Table 1: data analysis



British Grid
centre X: 333467.58 m, centre Y: 157770.13 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

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British Grid
centre X: 333467.58 m, centre Y: 157770.13 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

Substrata
15 Horizon View, Bath Hotel Road
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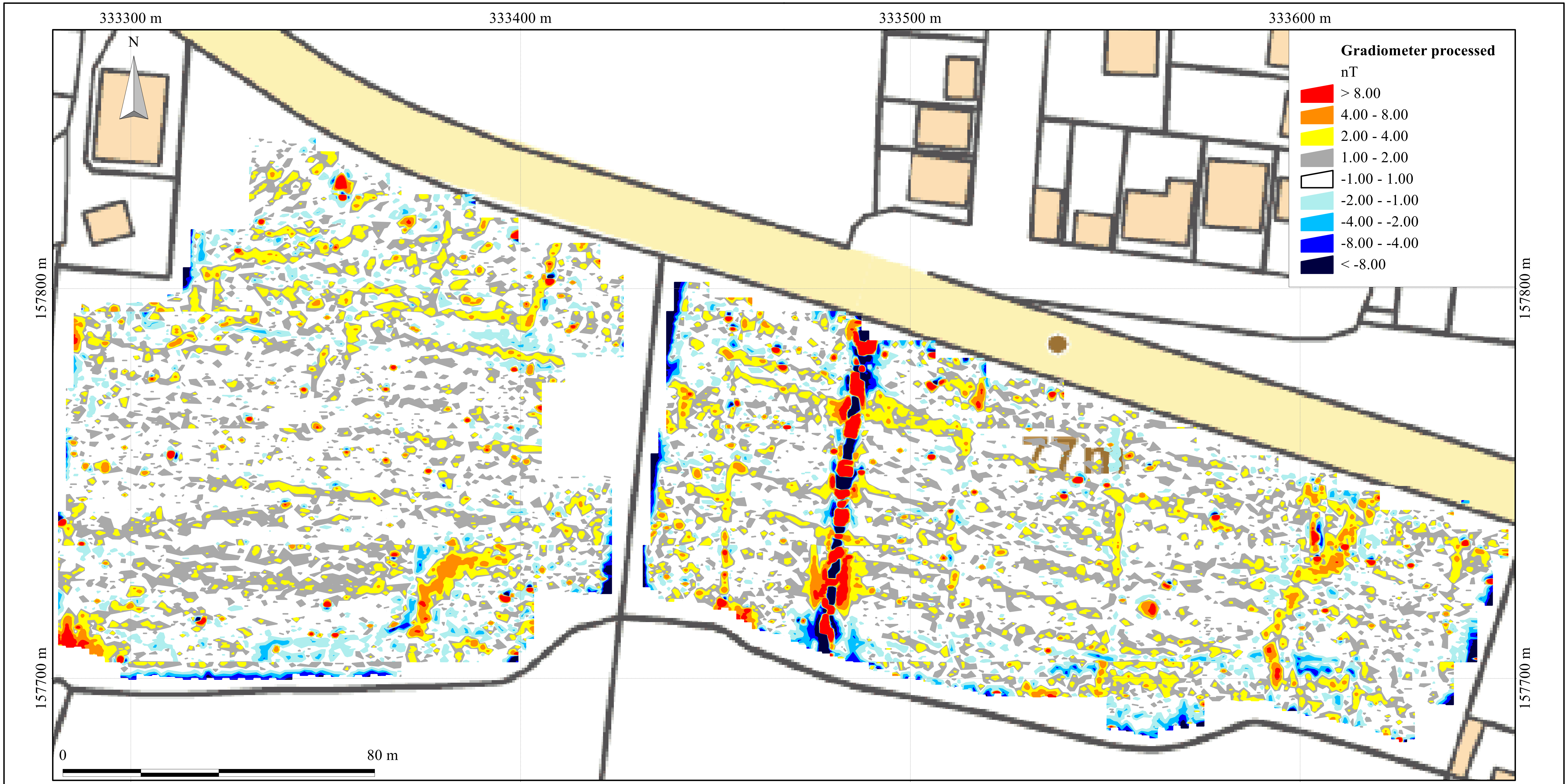
Tel: 07788627822
Email: geophysics@substrata.co.uk
Web: substrata.co.uk



British Grid
centre X: 333467.58 m, centre Y: 157770.13 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
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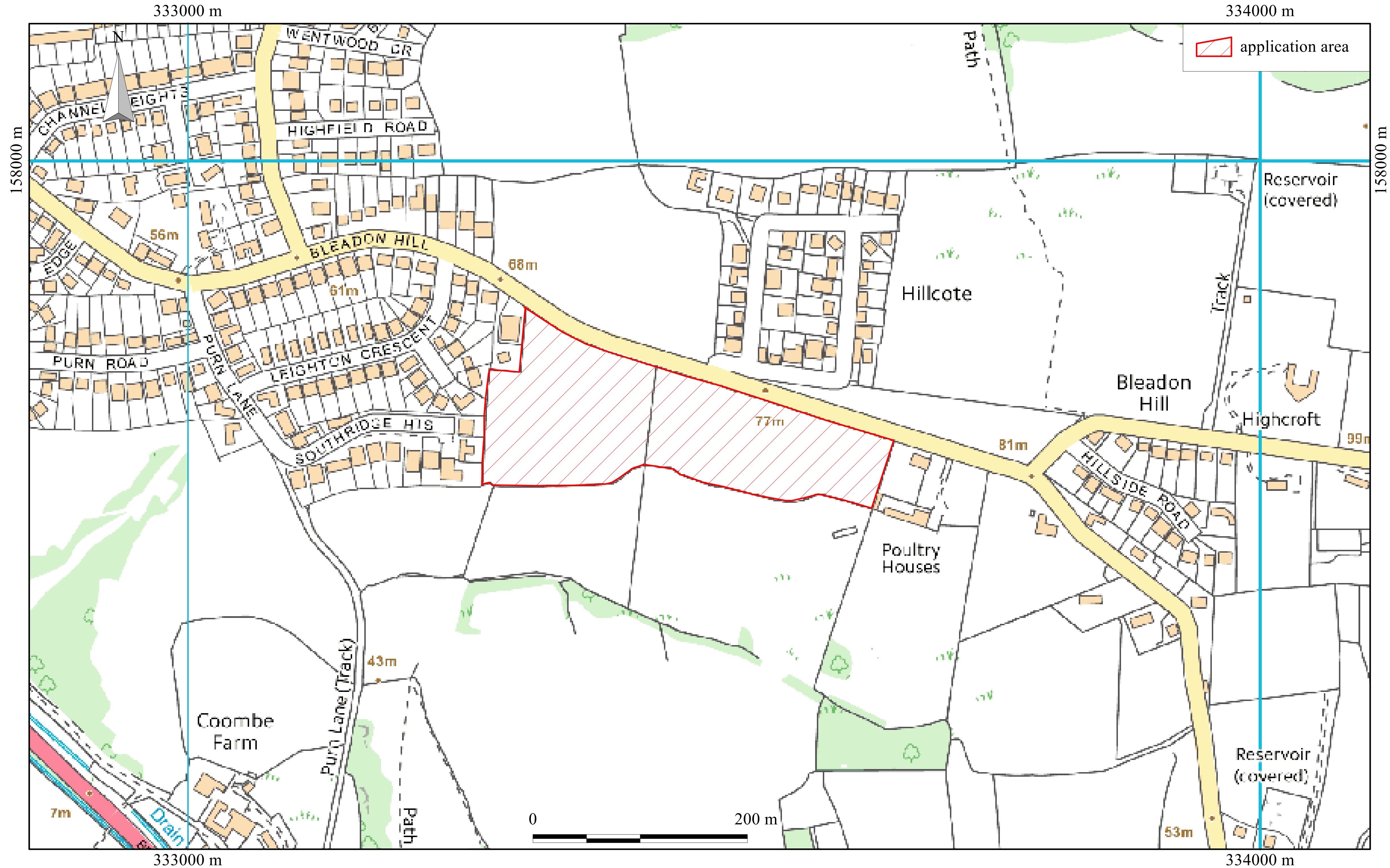

British Grid
centre X: 333477.29 m, centre Y: 157742.42 m

Scale: 1:4000 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 4: location map

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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 *Firmware:* version 6.1	*Sample Interval:* 0.25-metres *Traverse Interval:* 1 metre *Traverse Method:* zigzag *Traverse Orientation:* GN

Data Processing, Analysis and Presentation Software
IntelliCAD Technology Consortium IntelliCAD 7.2 DW Consulting TerraSurveyor3 Manifold System 8 GIS Microsoft Corp. Office Excel 2013 Microsoft Corp. Office Publisher 2013 Adobe Systems Inc Adobe Acrobat 9 Pro Extended

Appendix 3 Data processing

Table 3: gradiometer survey - processed data metadata

SITE
Instrument Type: Bartington Grad 610
Units: nT
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

PROGRAM
Name: TerraSurveyor
Version: 3.0.25.1

Stats
Max: 38.20
Min: -38.00
Std Dev: 3.28
Mean: 0.50
Median: 0.51
Surveyed Area: 3.775ha

Processes: 42
1 Base Layer
2 Clip at 1.00 SD
3 Clip at 5.00 SD
4 De Stagger: Grids: All Mode: Both By: -2 intervals
5 De Stagger: Grids: ba25.xgd Mode: Both By: -1 intervals
6 DeStripe Median Traverse: Grids: All Threshold: 1.5 SDs
7 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 36, Left 564, Bottom 50, Right 719)
8 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 51, Left 674, Bottom 63, Right 719)
9 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 126, Left 311, Bottom 146, Right 406)
10 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 124, Left 142, Bottom 134, Right 191)
11 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 144, Left 239, Bottom 147, Right 320)
12 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 147, Left 376, Bottom 150, Right 543)
13 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 7, Left 489, Bottom 29, Right 523)
14 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 240, Left 45, Bottom 270, Right 83)
15 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 296, Left 58, Bottom 313, Right 79)
16 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 350, Left 38, Bottom 359, Right 75)
17 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 132, Left 399, Bottom 148, Right 432)
18 De Stagger: Grids: bb4.xgd Mode: Both By: 2 intervals
19 De Stagger: Grids: bb12.xgd bb13.xgd bb20.xgd bb21.xgd bb26.xgd bb1.xgd bb3.xgd bb11.xgd bb14.xgd bb19.xgd bb22.xgd bb25.xgd bb27.xgd bb2.xgd bb4.xgd bb10.xgd bb15.xgd bb18.xgd bb23.xgd bb24.xgd bb28.xgd bb5.xgd bb8.xgd bb9.xgd bb16.xgd bb17.xgd bb6.xgd bb7.xgd Mode: Both By: -1 intervals
20 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 59, Left 658, Bottom 68, Right 680)
21 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 50, Left 658, Bottom 60, Right 676)
22 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 68, Left 644, Bottom 74, Right 674)
23 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 74, Left 631, Bottom 79, Right 664)
24 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 79, Left 622, Bottom 88, Right 644)
25 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 87, Left 608, Bottom 89, Right 622)
26 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 109, Left 576, Bottom 120, Right 600)
27 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 120, Left 550, Bottom 140, Right 578)
28 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 141, Left 519, Bottom 148, Right 562)
29 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 159, Left 510, Bottom 170, Right 535)
30 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 169, Left 494, Bottom 179, Right 514)
31 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 210, Left 450, Bottom 226, Right 473)
32 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 227, Left 432, Bottom 240, Right 458)
33 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 240, Left 411, Bottom 260, Right 441)
34 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 260, Left 386, Bottom 270, Right 421)
35 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 270, Left 378, Bottom 285, Right 410)
36 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 286, Left 361, Bottom 300, Right 380)
37 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 294, Left 344, Bottom 300, Right 359)
38 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 300, Left 332, Bottom 315, Right 360)
39 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 315, Left 314, Bottom 330, Right 350)
40 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 330, Left 296, Bottom 341, Right 331)
41 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 341, Left 276, Bottom 359, Right 305)
42 Search & Replace From: -100 To: 100 With: Dummy (Area: Top 360, Left 256, Bottom 373, Right 282)

Note: converting the gradiometer data into ESRI GIS files imposed an x=y interpolation on the entire dataset

Appendix 4 Geophysical surveying techniques

1 Introduction

Substrata offers magnetometer and earth resistance surveying. We also provide other archaeology-specific geophysical surveys such as ground penetrating radar and resistivity. The particular method or combination of methods used depends on local soil conditions and the survey requirements. These methods are capable of delivering fast and accurate assessments of the archaeology of both large and small sites.

Further details can be found on our website at www.substrata.co.uk.

2 Magnetometer surveying

Standard magnetometer surveys are the workhorse of archaeological surveying when speed and cost-effectiveness are important. Identifiable archaeological features include areas of occupation, hearths, kilns, furnaces, ditches, pits, post-holes, ridge-and-furrow, timber structures, wall footings, roads, tracks and similar buried features.

Magnetometer surveying is used to detect and map small changes in the earth's magnetic field caused by concentrations of ferrous-based minerals within the soil and subsoil, and by materials buried beneath the surface. While most of these changes are too small to affect a compass needle, they can be detected and mapped by sensitive field equipment. During surveys the different magnetic properties of top-soils, sub-soils, rock formations and archaeological features are recorded as variations against a background value. Subsequently magnetic anomalies resulting from potential archaeology can be identified and interpreted.

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

A gradiometer is a type of magnetometer and is sensitive to relatively small changes in the earth's magnetic field. Our primary surveying instruments are Bartington Grad601-2 (dual sensor) fluxgate gradiometers with automatic data loggers. They are specifically designed for field use by archaeologists. The Bartington gradiometers provide proven technology in archaeological magnetic surveying and offer fast, accurate set-up and survey rates. They are sensitive to depths of between 0 and 1.5m below ground level, with optimum sensitivity at depths of 1m or less.

<u>Multiple sensor arrays</u>

A technique relatively new to commercial archaeological surveying but well understood in academic circles involves the use of multiple magnetometer sensors towed behind a quad bike or similar vehicle. With multiple sensors and the use of on-board GPS units, it is possible to achieve faster survey rates at competitive commercial rates when compared to the use of multiple instruments and the techniques discussed above provided the ground is suitable for the vehicle and array. Substrata is pleased to announce that we now offer this service on suitable larger sites

3 Earth resistance surveying

Earth resistance surveying is an excellent tool for detecting buried archaeology. Its relatively slow rate of survey compared to magnetometer surveys means that it usually employed in commercial surveys when a detailed understanding of buried building remains is required. This technique measures changes in the electrical resistance of the ground being surveyed. In practice, the recording of differences in the electrical resistance of near-surface deposits and structures allows the detection and interpretation of masonry and brick foundations, paving and floors, drains and other cavities, large pits, building platforms, robber trenches, ditches, graves and similar buried features.

Resistance to electrical current flow in the ground depends on the moisture content and structure of the soil and other materials buried beneath the surface. For example, the higher the moisture content of a soil, the less resistant it is to electrical current flow. A ditch completely buried beneath the present ground surface is likely to have an infill soil different to that surrounding the ditch in terms of compactness and composition. As a result, the soil filling the buried ditch will retain moisture in a different way to the surrounding soil which means it will have an electrical resistance at variance with the surrounding environment. By passing a small current through the ground it is possible to detect, record, plot and interpret such changes in electrical resistance.

For earth resistance surveying Substrata uses the Geoscan Research RM15 series multi-probe resistance meters and purpose-built automatic data-loggers. The Geoscan MPX15 multiplexer is an integral part to the instrument configuration and facilitates multi-probe arrays which speed up survey area coverage rates and, if required, facilitate simultaneous multiple-depth data collection.