

Substrata

Archaeological Geophysical Surveyors

An archaeological gradiometer survey

**Land at Scorsham Farm, Stratton
Bude, Cornwall**

Ordnance Survey E/N: 224994,105090 (point)

Report: 140627

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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: 3 June 2013
Area surveyed: 1.33 ha
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 Scorsham Farm, Stratton, Bude
Civil Parish: Launcells
County: Cornwall
Nearest Postcode: EX23 9NP
NGR: SS 249 050
Ordnance Survey E/N: 224994,105090 (point)
OASIS number: substrata1-182603
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 in support of a forthcoming planning application for a wind turbine with access track. The location of the site is shown in Figure 4 and the proposed development in Figure 5.

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

Twenty-two magnetic anomaly groups pertaining to potential archaeology were recorded. None of the anomaly groups recorded related to features mapped by the Ordnance Survey on historical or modern maps. Two of the groups are likely to represent the footings of Cornish bank field boundaries removed before 1855. One group may represent a line of three pits. Four of the groups are likely to relate to disturbance resulting from ploughing and three of these may reflect ridge-and-furrow cultivation. The remaining magnetic anomaly groups recorded during the survey are most likely to relate to various phases of former fields and other enclosures not recorded on historical Ordnance Survey maps.

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

The survey area lies within one field bordered to the north by Scorsham Wood, the east and west by farmland and by the A3072 to the south. From relatively flat ground the gradient descends from south to north as shown in Figure 4.

Land use at the time of the survey

Grass pasture.

Geology

The site is located on a solid geology of sandstones of the Carboniferous Bude Formation with bands of mudstone and siltstone of the same formation to the north of the survey area. The rocks are grey thick-bedded, somewhat argillaceous and silty sandstones, in laterally discontinuous internally massive beds 1-5m thick and commonly amalgamated into units up to 10m thick. When weathered the sandstones become buff and friable. Very thick beds of slumped and de-stratified strata are also present. Grey mudstones occur as interbeds up to 1m thick but locally packets of darker mudstone up to 20m thick with thin ironstone beds and bundles of thin sandstones are present, especially in the upper part of the Formation. Five named beds of black sulphurous "shales" with goniatite-bearing calcareous nodules occur within the Formation. Thin units of thin- to medium-bedded siltstones with Xithosurid trails are also present. The superficial geology is not recorded in the source used (British Geological Survey, undated).

5 Archaeological background

The field containing the survey area is designated as 'Farmland: Medieval'. This is the agricultural heartland of Cornwall, with farming settlements documented before the 17th century AD and whose field patterns are morphologically distinct from the generally straight-sided fields of later enclosure. Either medieval or prehistoric origins are likely (Cornwall Council, undated).

Appendix 4 provides a short summary of information obtained from the Cornwall and Scilly Historic Environment Record (HER) within approximately 500m of the proposed development site and relevant to the understanding of the gradiometer survey. Except where specifically cited, this information was obtained using the Heritage Gateway (English Heritage, undated).

The reader is advised that this summary should not be used outside the context of this report and is referred to the Cornwall and Scilly HER for informed provision of the record.

The location of a Post-Medieval house close to the A3072 has been recorded within the survey field approximately 170m south-south-east of the proposed turbine location. No remains are extant (HER 170464).

The settlement and manor of Thurlibeer is first recorded in the Domesday survey of 1086. It lies some 574m southeast of the proposed turbine location. 'Thurlibeer' is an English name which seems to mean 'pierced grove' (HER 396). The field bordering the A3072 and east of the survey field may have been called 'Higher Windmill' and may refer to the one time existence of a windmill here (HER 442). The remains of a field system are visible on aerial photographs and were plotted as part of the National Mapping Programme. The remains lie 600m southwest of the turbine site, are sited within an area of Anciently Enclosed Land and are likely to be Medieval in origin (HER 70525).

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. 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.

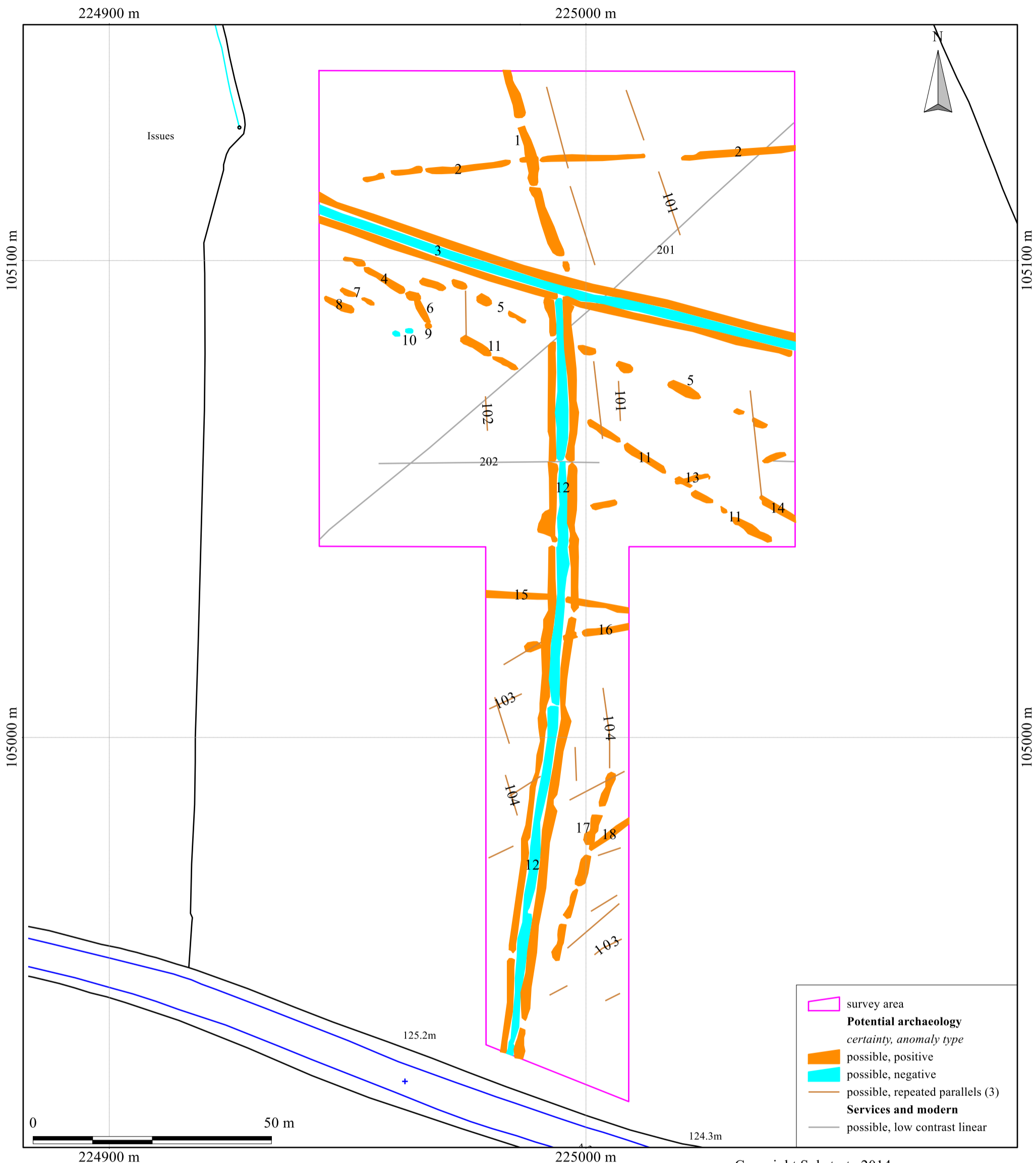
Figure 1 and Table 1 together comprise the analysis of the survey data.

Plots of the processed data is provided in Figures 2 and 3 (appendix 1).

Site: An archaeological gradiometer survey
 Land at Scorsham Farm, Stratton, Bude
 Ordnance Survey (E/N): 224994,105090 (point)
 Report 160627

anomaly group	associated anomalies	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
1		possible, positive	disrupted linear			
2		possible, positive	disrupted linear			
3		possible, positive & negative	linear	field boundary	anomaly group probably represents a Cornish bank (a stone-revetted earthen bank with flanking ditches) not mapped on the OS first edition or later OS maps	1885 Ordnance Survey 1st edition and later OS maps
4		possible, positive	disrupted linear			
5		possible, positive	disrupted linear			
6		possible, positive	linear			
7		possible, positive	disrupted linear			
8		possible, positive	linear			
9	10	possible, positive	oval	pit	along with group 10 may indicate a group of pits	
10	9	possible, negative	oval	pit	along with group 9 may indicate a group of pits	
11		possible, positive	disrupted linear			
12		possible, positive & negative	disrupted linear	field boundary	anomaly group probably represents a Cornish bank (a stone-revetted earthen bank with flanking ditches) not mapped on the OS first edition or later OS maps	1885 Ordnance Survey 1st edition and later OS maps
13		possible, positive	disrupted linear			
14		possible, positive	linear			
15		possible, positive	disrupted linear			
16		possible, positive	disrupted linear			
17		possible, positive	disrupted linear			
18		possible, positive	disrupted linear			
101		possible, repeated parallels		cultivation traces	anomaly group may represent former ridge-and-furrow ploughing	
102		possible, repeated parallels		cultivation traces		
103		possible, repeated parallels		cultivation traces		
104		possible, repeated parallels		cultivation traces		
201		possible, low contrast linear		service trench		
202		possible, low contrast linear		service trench		

Table 1: data analysis



British Grid
centre X: 224986.22 m, centre Y: 105031.75 m

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Base map: Crown Copyright & Database Right
Licence number 1000222432

Scale: 1:800 @ 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 deposit

6.2 Discussion

Refer to Figure 1 (this section) and Figures 2 and 3 (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

Anomalies thought to relate to natural features were not mapped.

Data collection along the southern field boundary was restricted as shown in the figures due to the presence of magnetic materials and objects in and adjacent to the field boundary and gate.

Data relating to historical maps and other records

None of the magnetic anomaly groups recorded relate to features mapped by the Ordnance Survey on historical or modern maps.

Data with no previous provenance

Magnetic anomaly groups **3 and 12** are likely to reflect the footings of former Cornish banks. These are field boundaries comprising a stone revetted earthen bank and flanking ditches. No such boundaries were recorded on the Ordnance Survey first edition published in 1885 or later Ordnance Survey maps.

Groups **9 and 10** may reflect a group of pits.

Group **101** exhibit characteristics typical of deposits disturbed by former ridge-and-furrow cultivation. This may also be true of groups **102 and 104**. Group **103** may also represent former ploughing disturbance.

The remaining magnetic anomaly groups characterised as potential archaeological deposits are most likely to relate to various phases of former fields and other enclosures not recorded on historical Ordnance Survey maps.

6.3 Conclusions

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

Twenty-two magnetic anomaly groups pertaining to potential archaeology were recorded. None of the anomaly groups recorded related to features mapped by the Ordnance Survey on historical or modern maps. Two of the groups are likely to represent the footings of Cornish bank field boundaries removed before 1855. One group may represent a line of three pits. Four of the groups are likely to relate to disturbance resulting from ploughing and three of these may reflect ridge-and-furrow cultivation. The remaining magnetic anomaly groups recorded during the survey are most likely to relate to various phases of former fields and other enclosures not recorded on historical Ordnance Survey maps.

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.

Ross Dean, trading as Substrata, will assign copyright to the client upon written request but retains the right to be identified as the author of all project documentation and reports as defined in the Copyright, Designs and Patents Act 1988 (Chapter IV, s.79).

8 Acknowledgements

Substrata would like to thank Dr Paula Lutescu-Jones 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 [March 2014]

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

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

Dean, R. (2013) *A gradiometer survey methodology statement, Land at Scorsham Farm, Stratton, Bude, Cornwall*. Substrata unpublished document

Cornwall Council (undated) *Cornwall Council interactive mapping website*, [Online], Available: <http://gis.devon.gov.uk/basedata/viewer.asp?DCCService=hlc> [June 2014]

English Heritage (undated) *Heritage Gateway*, [Online], Available: <http://mapping.cornwall.gov.uk/website/ccmap/> [June 2014]

Institute for Archaeologists (undated) *IfA house style*, [Online], Available: http://www.archaeologists.net/sites/default/files/node-files/ifa_house_style.pdf [March 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> [March 2014]

Institute for Archaeologists (2009) *Code of conduct*. Reading: Author [Online], Available: http://www.archaeologists.net/sites/default/files/node-files/code_conduct.pdf [March 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 [March 2014]

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.

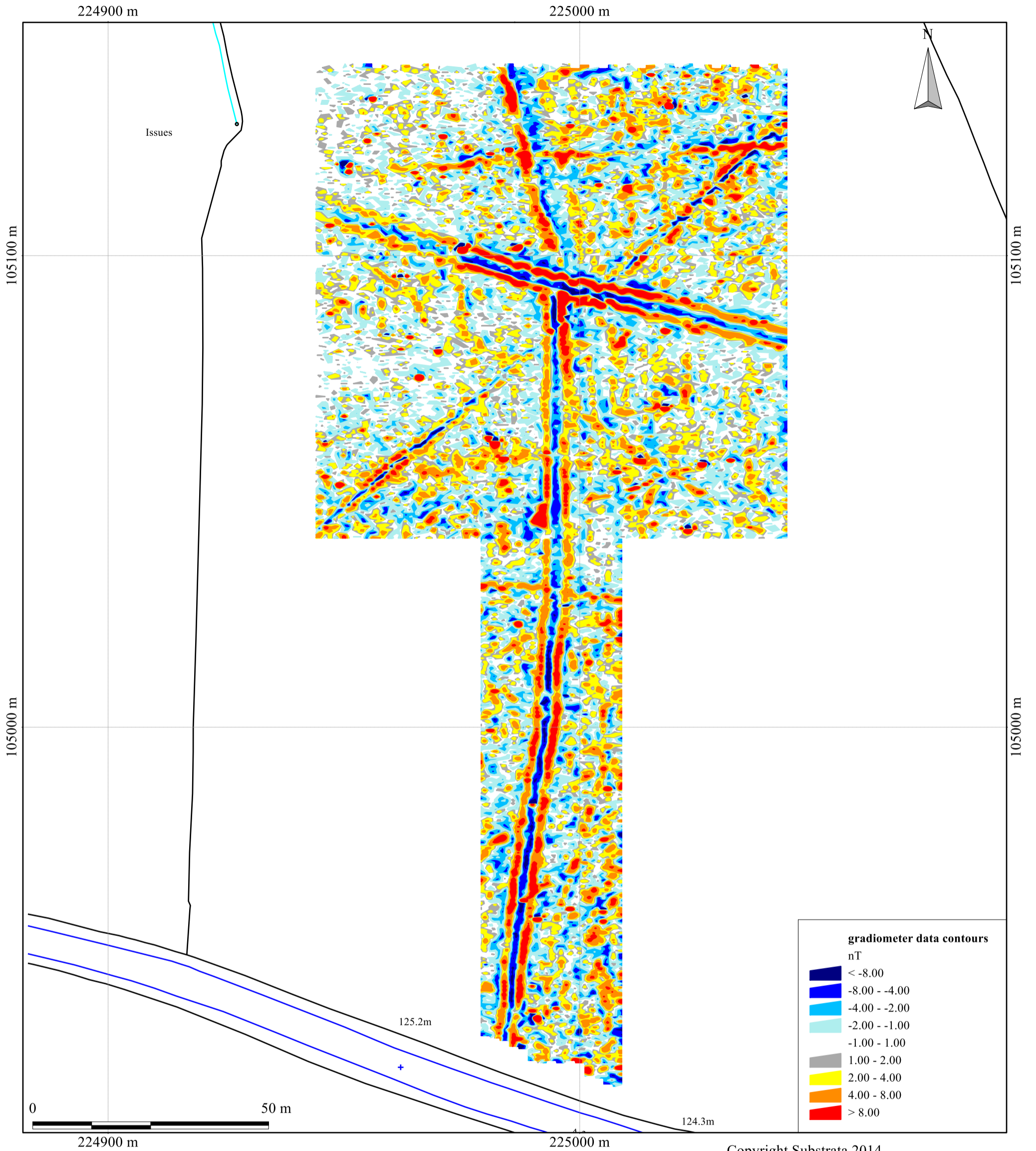
A rough rule for interpreting magnetic anomalies is that the width of an anomaly at half its maximum reading is equal to the width of the buried feature, or its depth if this is greater (Clark, 2000: 83). Caution must be applied when using this rule as it depends on the anomalies being clearly identifiable 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: 224986.22 m, centre Y: 105031.75 m

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British Grid
 centre X: 224986.22 m, centre Y: 105031.75 m

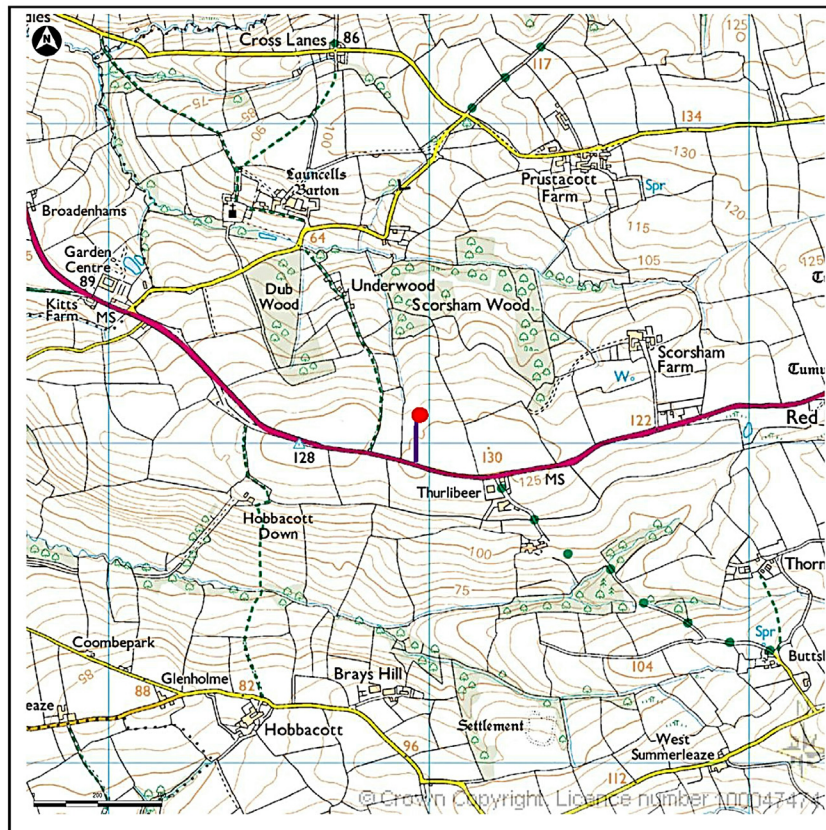
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Figure 3: contour plot of processed data

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KEY	
Turbine Position	●
Access Route	—

Turbine Location	
Turbine 1	224994,105090


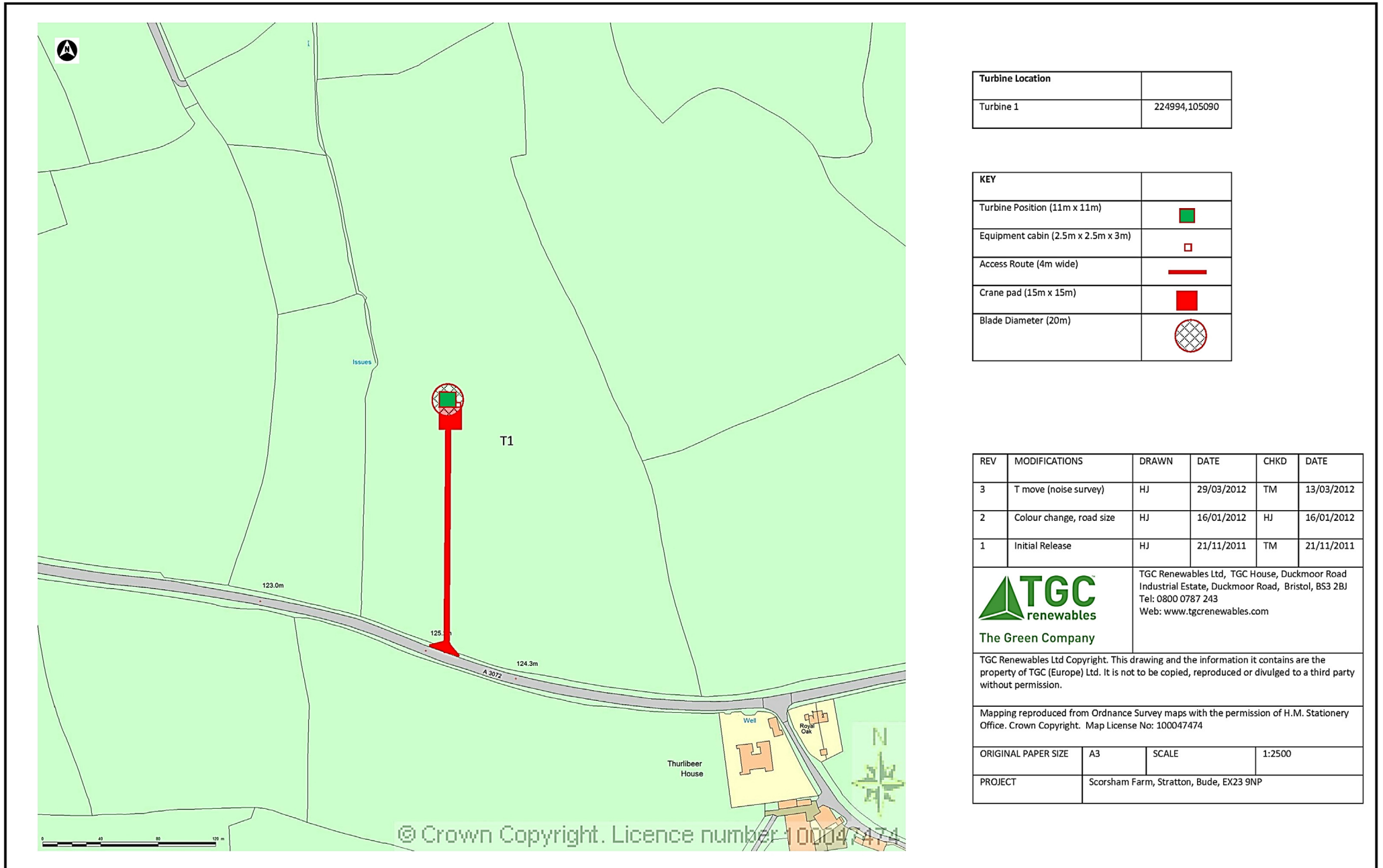
REV	MODIFICATIONS	DRAWN	DATE	CHKD	DATE
R1	Initial Release	HJ	16/01/2012	TM	16/01/2012
		TGC Renewables Ltd, TGC House, Duckmoor Road Industrial Estate, Duckmoor Road, Bristol, BS3 2BJ Tel: 0800 0787 243 Web: www.tgcrenewables.com			
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ORIGINAL PAPER SIZE		A3	SCALE	1:25,000	
LOCATION PLAN	PROJECT	57-27-WD	NAME	Scorsham Farm, Stratton, Bude, EX23 9NP	

Figure 4: site location



Turbine Location	
Turbine 1	224994,105090

KEY	
Turbine Position (11m x 11m)	
Equipment cabin (2.5m x 2.5m x 3m)	
Access Route (4m wide)	
Crane pad (15m x 15m)	
Blade Diameter (20m)	

REV	MODIFICATIONS	DRAWN	DATE	CHKD	DATE
3	T move (noise survey)	HJ	29/03/2012	TM	13/03/2012
2	Colour change, road size	HJ	16/01/2012	HJ	16/01/2012
1	Initial Release	HJ	21/11/2011	TM	21/11/2011

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ORIGINAL PAPER SIZE	A3	SCALE	1:2500
PROJECT	Scorsham Farm, Stratton, Bude, EX23 9NP		

Figure 5: proposed site development plan

Appendix 2 Methodology Summary

Table 2: methodology summary	
<p>Documents Survey methodology statement: Dean (2013)</p>	
<p>Methodology</p> <ol style="list-style-type: none"> 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. 	
<p>Grid <i>Method of Fixing:</i> DGPS set-out using pre-planned survey grids and Ordnance Survey coordinates. <i>Composition:</i> 30m by 30m grids <i>Recording:</i> Geo-referenced and recorded using digital map tiles.</p>	
<p>Equipment <i>Instrument:</i> Bartington Instruments grad601-2 <i>Firmware:</i> version 6.1</p>	<p>Data Capture <i>Sample Interval:</i> 0.25-metres <i>Traverse Interval:</i> 1 metre <i>Traverse Method:</i> zigzag <i>Traverse Orientation:</i> GN</p>
<p>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</p>	

Appendix 3 Data processing

Table 3: gradiometer survey - processed data metadata, proposed turbine location	
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:	90.38
Min:	-89.67
Std Dev:	3.91
Mean:	0.27
Median:	0.02
Surveyed Area:	1.0024 h
Processes: 5	
1 Base Layer	
2 Clip at 4.00 SD	
3 De Stagger: Grids: All Mode: Both By: -3 intervals	
4 DeStripe Median Sensors: All	
5 Interpolate: Match X & Y Doubled	

Table 4: gradiometer survey - processed data metadata, proposed access route	
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:	53.66
Min:	-52.31
Std Dev:	4.02
Mean:	0.35
Median:	0.07
Surveyed Area:	0.3321 ha
Processes: 4	
1 Base Layer	
2 De Stagger: Grids: All Mode: Both By: -2 intervals	
3 DeStripe Median Sensors: All	
4 Interpolate: Match X & Y Doubled.	

Appendix 4 Summary of relevant entries from the Cornwall and Scilly Historic Environment Record (HER) within 500m of the proposed development site

Source: Heritage Gateway (English Heritage, undated 1).

The reader is advised that this summary should not be used outside the context of this report and is referred to the Cornwall and Scilly HER for informed provision of the record.

HER Number: 170464

Name: THURLIBEER - Post Medieval house

Grid Reference: SS 2504 0493 (within survey field, 170m at N164.7 from proposed turbine location)

Protected Status: None recorded

Monument Types: HOUSE (Post Medieval - 1540 AD to 1900 AD)

A house is shown in 1813 alongside a road northwest of Thurlibeer Farm. No remains are extant; the road has been widened and the NGR is approximate.

HER Number: 396

Name: THURLIBEER - Early Medieval settlement, Medieval settlement, Medieval manor

Summary

Grid Reference: SS 2535 0464 (574m at N141.7 from proposed turbine location)

Monument Types:

SETTLEMENT (Early Medieval - 410 AD to 1065 AD)

MANOR (First mentioned, Medieval - 1066 AD to 1539 AD)

SETTLEMENT (First mentioned, Medieval - 1066 AD to 1539 AD)

The settlement and manor of Thurlibeer is first recorded in the Domesday survey of 1086. Thurlibeer is an English name which seems to mean 'pierced grove'

HER Number: 442

Name: HIGHER WINDMILL - Medieval windmill, Post Medieval windmill

Grid Reference: SS 2525 0505 (257m at N98.9 from proposed turbine location)

Monument Types: WINDMILL? (Medieval to 19th Century - 1066 AD to 1900 AD)

According to Richard Heard the field indicated by the grid ref is called higher windmill. The name may refer to the one time existence of a windmill here.

HER Number: 70525

Name: HOBACOTT - Early Medieval field system, Medieval field system

Grid Reference: SS 2461 0462 (607m at N219.2 from proposed turbine location)

Monument Types:

FIELD SYSTEM (Early Medieval to Modern - 410 AD to 2050 AD)

FIELD SYSTEM? (Medieval - 1066 AD to 1539 AD)

The remains of a field system are visible on aerial photographs and were plotted as part of the NMP. The remains are sited within an area of Anciently Enclosed Land and are likely to be Medieval in origin

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 is 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.