

Substrata

Archaeological Geophysical Surveyors

An archaeological magnetometer survey

Eden Project, St Blazey, Cornwall

Centred on NGR (E/N): 204584,054748 (point)

Report: 1610EDE-R-1

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Project archive

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.....	DW Consulting TerraSurveyor 3 formats
Final data processing data plots and metadata.....	DW Consulting TerraSurveyor 3 formats
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

Website: substrata.co.uk

For an overview of Substrata, our archaeological geophysical surveying techniques and the results we obtain.

1 Survey description and summary

1.1 Survey

Type: twin-sensor fluxgate gradiometer
Date: 19 November 2016
Survey area: 0.5ha
Lead surveyor: Mark Edwards BA
Author: Ross Dean BSc MSc MA MifA

1.2 Clients

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

1.3 Location

Site: Eden Project
Hamlet: Bodelva
Civil Parish: Plot A: Carlyon
Plot B: St. Blazey
County: Cornwall
Nearest Postcode: PL26 8YA
NGR: SX 046 547 (point)
NGR (E/N): 204584,054748 (point)

1.4 Archive

OASIS number: substrat1-273379
Archive: At the time of writing, the archive of this survey will be held by Substrata. Depending on local authority policy, an archive of the unprocessed data may be deposited with the Archaeological Data Service

1.5 Introduction

This report presents the results of an archaeological magnetometer survey at the above site. It has been prepared for AC Archaeology Ltd on behalf of The Eden Project in advance of a proposed commercial development. The survey area location is shown in Figure 1.

An historic environment assessment was completed by AC Archaeology Ltd in September 2014 (Meaton, 2014) in which the three plots of land comprising the site were designated Plots A, B and C. Plots A and B (Figure 2) are the subject of this survey.

1.6 Summary

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

Five magnetic anomaly groups were mapped as representing possible archaeological deposits or features. One group is very likely to represent filled-in former mine shafts and a china clay pit recorded on historical Ordnance Survey maps. An adjacent anomaly group may denote the position of the Charlestone Leat which is thought to pass through the survey area. One group may represent ground disturbance or buried features, possibly associated with the former extraction activities within the survey area. The other two groups may represent archaeological deposits or relatively recent disturbance.

2 Survey aims and objectives

2.1 Aims

To establish the presence or absence, extent and character of any archaeological features and deposits within the survey area.

2.2 Survey objectives

1. Complete a magnetometer 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 survey area about the location and possible archaeological character of the recorded anomalies.

3 Standards

The standards used to complete this survey are defined by the Chartered Institute for Archaeologists (2014a) and Historic England (2010). The codes of approved practice that were followed are those of the Chartered Institute for Archaeologists (2014b) and Archaeology Data Service (undated).

4 Site description

4.1 Landscape and land use

The application area is located in the grounds of the Eden Project, which is situated in the historic parish of St. Blazey approximately 1.5km to the northeast of St. Austell (Meaton, 2014: 2). The site falls within the current parishes of St Blazey and Carlyon.

The survey area comprises two agricultural fields (Plots A and B, Figure 2) situated between 115m and 105m AOD on an east facing slope, with flat ground on the north and east sides of Plot A. Surrounding the site to the north, west and southwest there are enclosed fields and to the south and east development associated with the Eden Project. The site is bounded to the west and north by fields and roads associated with Vounder Farm; the farm itself is located immediately to the northeast (ibid).

4.2 Geology

The solid geology across the site comprises granite of the Permian and Carboniferous St Austell Intrusion. Superficial deposits for the site are not recorded (British Geological Survey, undated).

5 Archaeological background

5.1 Historic landscape characterisation

Enclosed Medieval Farmland.

‘The agricultural heartland, 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. Tends to be on relatively sheltered land, not too steep and not too poorly drained, but can extend onto the edges of high downs. Networks of winding lanes and roads, often deeply cut by the passage of people, animals and vehicles over centuries or thousands of years. These connect farming settlements whose layouts are typically irregular, often clearly shrunken from hamlets; some are still hamlets. Churchtowns and a few larger villages are scattered through the type which also contains, or surrounds, most of the county’s ancient towns (Meaton, 2014: 15, after Cornwall County Council).

5.2 Summary of archaeological background

The following is taken from the summary of an historic environment assessment prepared by AC Archaeology on behalf of the Eden Project (Meaton, 2014: 1). The survey area was considered within a wider 1000m study area.

There are seven designated assets and areas located within the study area. These comprise an element of the Cornwall and West Devon Mining Landscape World Heritage Site, the Luxulyan Valley Area of Great Historic Value and five Grade II Listed buildings. These are considered to be of Very High, High and Medium significance respectively. The Charlestown Leat element of the World Heritage Site was tunnelled underground through a culvert across the northern half of Plot A, although its exact course and depth are unknown.

There are eighty-three previously recorded non designated heritage assets identified within the study area. These include limited evidence for Bronze Age activity, as well as Iron Age Rounds and medieval settlements with nearby Medieval remnant strip fields systems and outlying structures such as crosses and a mill. Post-medieval sites predominantly relate to agriculture, settlement and industry, particularly china clay mining which was prevalent across the study area during the nineteenth century. The only non-designated asset recorded within the application area was a possible Bronze Age barrow within an area recently developed as a car park for the Eden Project. All non-designated assets are classified as being of low, negligible or unknown significance, except for the upstanding remains of a possible Iron Age Round at Restineas which is considered to be of medium significance.

Two previously unrecorded sites have been identified in the application area from historic mapping. In the northern half of Plot A china clay pits and shafts are recorded and in the southwest corner Plot A and northwest corner of Plot B earthworks were also noted, again forming part of a china clay works. These have been infilled. Both sites are considered to be of low heritage significance. All of the hedgerows forming boundaries to the application area are considered to be historic with possible medieval origins.

It is considered that there is low potential for hitherto unrecorded archaeological deposits to be present within the application area.

6 Results, discussion and conclusions

6.1 Scope and definitions

This survey was designed to record magnetic anomalies. A magnetic anomaly is a local variation in the Earth's magnetic field. Such variations can result from variations in the magnetism of underlying solid geology, superficial geology and other near-surface deposits including those altered and created by past human activities. Near-surface artefacts can also create magnetic anomalies.

The terms 'archaeological deposit', 'structure' and 'feature' refer to any artefacts, material deposits or disturbance of natural deposits thought to be the result of human activity, excluding recent land maintenance and farming.

Magnetic anomalies cannot be regarded as physical archaeological deposits, structures or features and the dimensions of the anomalies shown do not represent the dimensions of any associated archaeology.

The analysis presented below identifies and characterises anomalies and anomaly groups that may relate to archaeological deposits, structures and features.

The reader is referred to section 7.

6.2 Results

The survey area was sub-divided into Plots A and B following the nomenclature adopted for this site by AC Archaeology Ltd (Meaton, 2014).

Figure 2 shows the interpretation of the survey data. It includes the anomaly groups identified as possibly relating to archaeological deposits along with their identifying numbers. Table 1 is an extract of the detailed analysis of the survey data sourced from the attribute tables of the GIS project provided in the project archive.

Figure 2 and Table 1 comprise the analysis of the survey data.

Figure 3 is a plot of processed data as specified in Table 3. Figure 4 is a plot of the unprocessed data.

6.3 Discussion

6.3.1 General points

Discussion scope

Not all anomalies or anomaly groups identified in Table 1 are necessarily discussed below. All identified anomaly groups are recorded in the GIS project held the survey archive.

Data collection

Data collection along the survey area edges and internal field boundaries was restricted as shown in the figures due to the presence of magnetic materials within and adjacent to boundaries. Strong magnetic responses mapped close to the boundaries are likely to relate to these materials except where otherwise indicated in Figure 2 and Table 1.

Surveying was restricted by thick vegetation around the edges of the fields and wet areas in the north west corner of Plot A.

Anomaly characterisation and mapping

There are a number of anomaly groups that could be interpreted as relating to postholes or pits although most will have natural origins. Anomalies of this sort are only mapped as potential archaeology if they are clustered in groups or otherwise form recognisable patterns.

Anomalies thought to relate to natural features and 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.

Numerous dipole magnetic anomalies are scattered across the data set. These are likely to represent recent ferrous objects. They are only mapped if they could influence the analysis of anomaly groups thought to have an archaeological origin.

6.3.2 Data relating to historic maps and other records

Magnetic anomaly group **1** coincides with an area of former mine shafts and a china clay pit recorded on historical Ordnance Survey maps between 1881 and 1963. It is very likely that the anomaly group represents rubble fill and ferrous deposits such as iron and steel scrap.

Group **2** may represent a tunnelled section of the Charlestone Leat (Section 5.2) thought to pass through Plot A.

6.3.3 Data with no previous archaeological provenance

Group **3** is a linear anomaly of the type often associated with a former track or ditch.

Group **4** may represent archaeological deposits or associated ground disturbance.

Anomaly group **5** may represent a stony deposit with associated edge disturbance which could indicate a former track or wall footing although ground disturbance from a relatively recent service trench would produce a very similar anomaly pattern.

6.4 Conclusions

Five magnetic anomaly groups were mapped as representing possible archaeological deposits or features. One group (1) is very likely to represent filled-in former mine shafts and a china clay pit recorded on historical Ordnance Survey maps. An adjacent anomaly group (2) may denote the position of the Charlestone Leat which is thought to pass through the survey area. One group (4) may represent ground disturbance or buried features, possibly associated with the former extraction activities within the survey area. The other two groups (3 and 5) may represent archaeological deposits or relatively recent disturbance.

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.

Substrata Ltd 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). This report contains material that is non-Substrata Limited copyright or the intellectual property of third parties. Such material is labelled with the appropriate copyright and is non-transferrable by Substrata Ltd.

8 Acknowledgements

Substrata would like to thank Andrew Passmore of AC Archaeology Ltd for commissioning us to complete this survey.

9 Bibliography

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Historic England (2010) *Geophysical Survey in Archaeological Field Evaluation*, [Online], Available: <https://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf/> [December 2016]

Meaton, C. (2014) *Eden Project, St Blazey, Cornwall Centred on SX 04584 54748, Historical Environment Assessment*. AC Archaeology Ltd unpublished report ACD946/1/0

Appendix 1 Figures

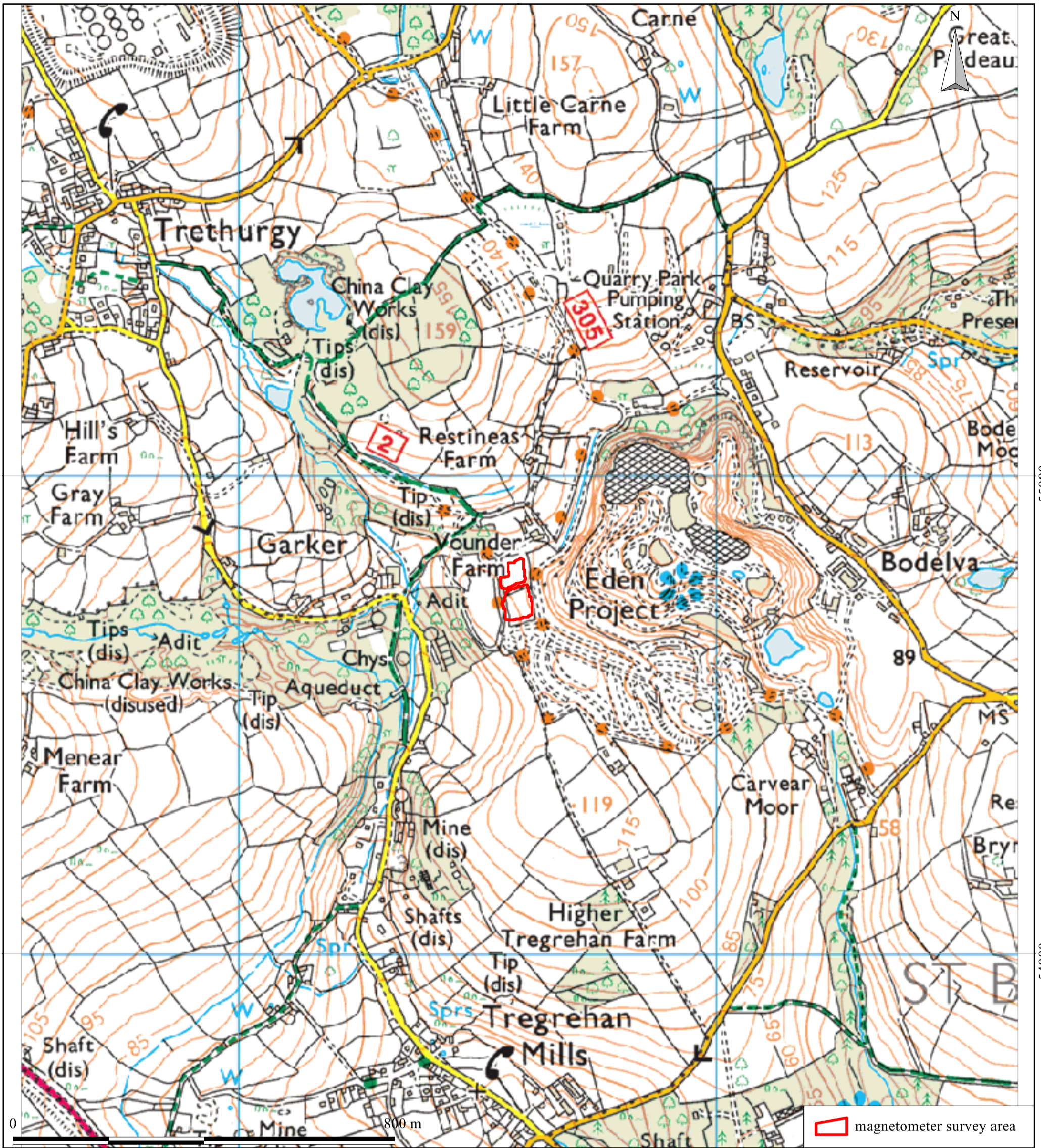
General Guidance

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 (see Section 6.1).

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.

204000 m

205000 m



55000 m

55000 m

54000 m

54000 m

204000 m

205000 m

British Grid
centre X: 204587.54 m, centre Y: 54790.61 m

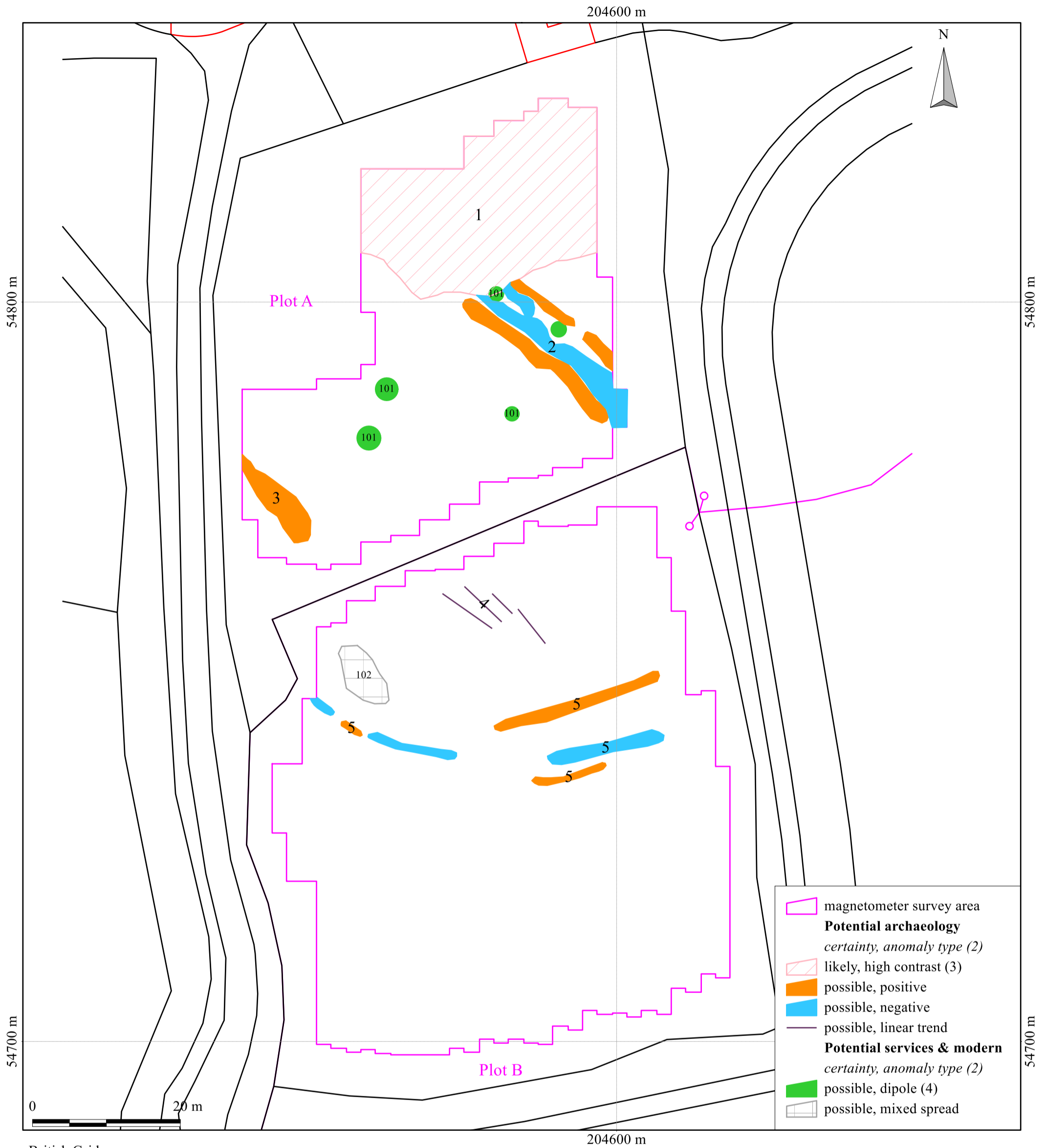
Geophysical survey: Copyright Substrata Limited.
Base map: Ordnance Survey (c) Crown Copyright 2016.
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Scale: 1:8000 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological magnetometer survey
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Centred on NGR (E/N) 204584,054748
Report: 1610EDE-R-1

Figure 1: location map

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British Grid
centre X: 204587.16 m, centre Y: 54762.89 m

Geophysical survey: Copyright Substrata Limited.
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Scale: 1:500 @ A3. Spatial Units: Meter. Do not scale off this drawing

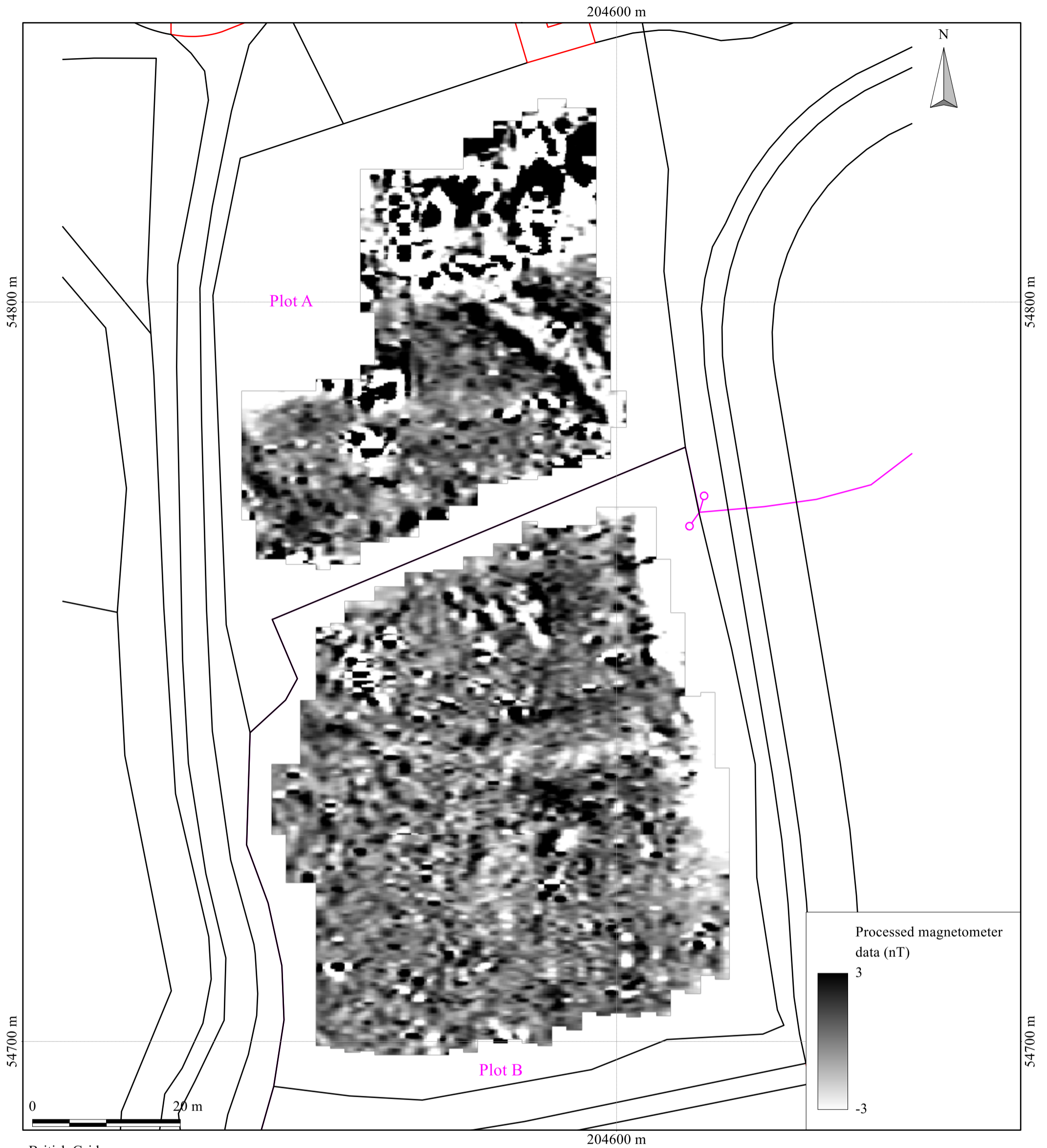
Notes:

1. All interpretations are provisional and represent potential archaeological deposits.
2. 'Anomaly type' is a description of the magnetic anomaly. See the report text or GIS for an archaeological characterisation.
3. Anomalies designated "likely archaeology" have supporting evidence e.g. historical maps and or visible earthworks.
4. Representative; not all instances are mapped.
5. 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 2: survey interpretation

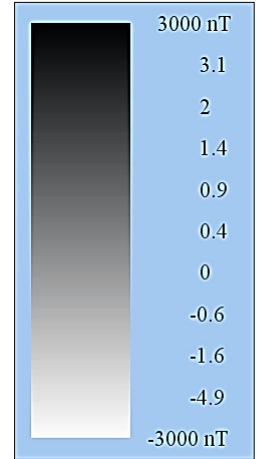
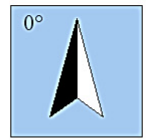
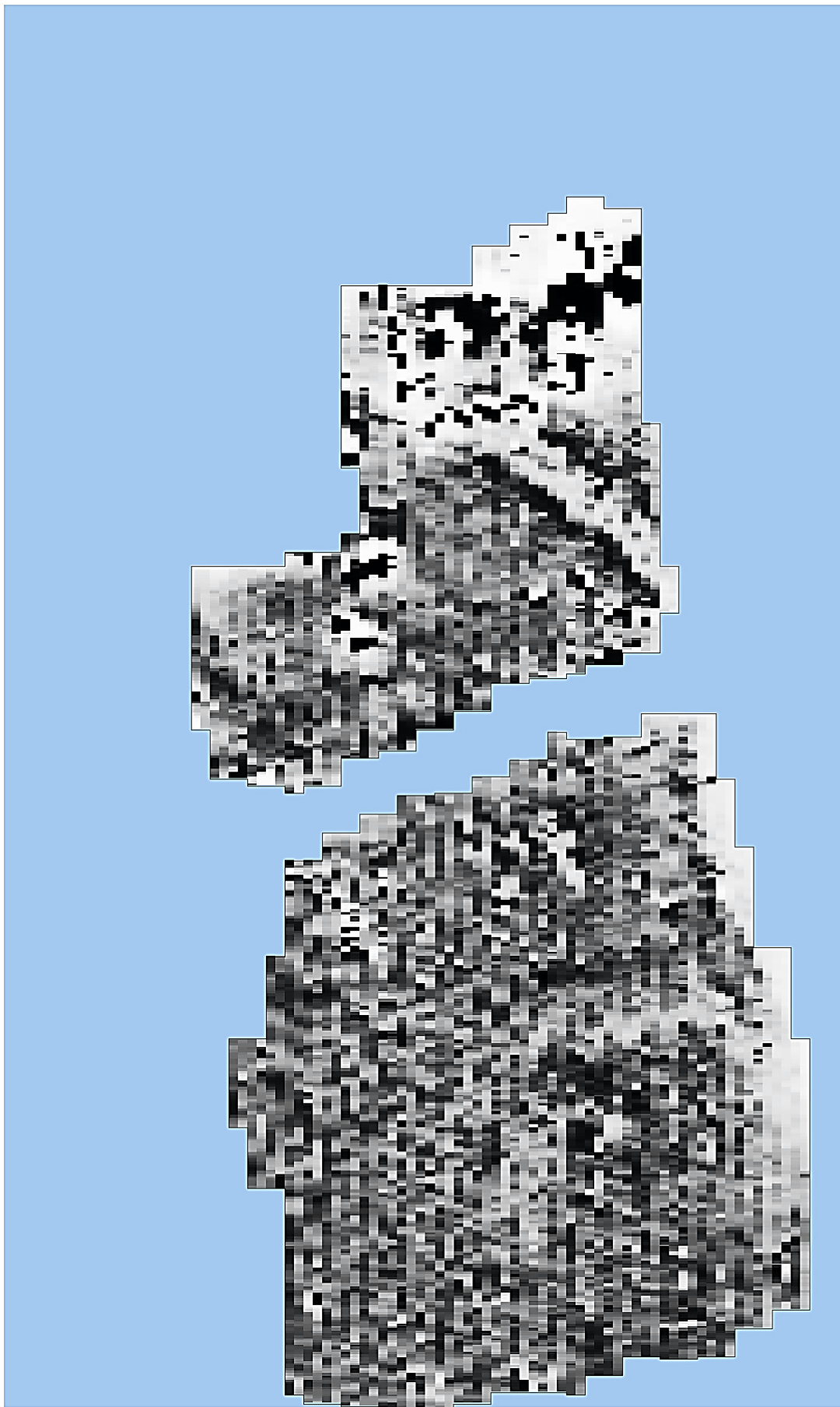
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British Grid
 centre X: 204587.16 m, centre Y: 54762.89 m

Geophysical survey: Copyright Substrata Limited.
 Base map: Ordnance Survey (c) Crown Copyright 2016.
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Scale: 1:500 @ A3. Spatial Units: Meter. Do not scale off this drawing



Instrument Type: Bartington Gradient 601
 Units: nT
 Direction of 1st Traverse: 0 deg
 Collection Method: ZigZag
 Sensors: 2 @ 0.00 m spacing
 Dummy Value: 32702
 Grid Size: 30 m x 30 m
 X Interval: 0.25 m
 Y Interval: 1 m

Stats
 Max: 3000.00
 Min: -3000.00
 Std Dev: 236.82
 Mean: 3.10
 Median: 0.40

PROGRAM
 Name: TerraSurveyor
 Version: 3.0.31.0

Processes: 1
 1 Base Layer

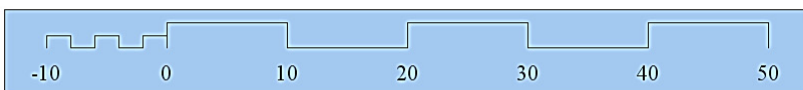


Figure4: shade plot of unprocessed data

Appendix 2 Tables

Site: An archaeological magnetometer survey
 Eden Project, St Blazey, Cornwall
 Centred on NGR (E/N) 204584,054748
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plot	anomaly group	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
A	1	likely, high contrast	irregular	area of rubble and ferrous material	anomaly group coincides with an area of mine shafts and china clay pits recorded on historical Ordnance Survey maps but not on the 1840 tithe map	1840 St Blazey tithe map, Ordnance Survey maps 1881 1:2500 to 1963 1:10560, Meaton (2014)
	2	possible, positive/negative/positive	linear	possible tunnelled leat	the anomaly groups may be associated with the Charleston Leat which was tunnelled through the northern part of Plot A; the course and depth are unknown	Meaton (2014: 9, Fig 2)
	3	possible, positive	broad linear			
	101	possible, dipole		ferrous material of unknown provenance		
B	4	possible, linear trend		ground disturbance of unknown period or origin		
	5	possible, positive & negative	disrupted curvilinear	stony deposit or recent service	anomaly groups may represent archaeological deposits such as a track or stony footing but could represent a relatively recent service trench	
	102	possible, mixed spread	broad linear	recently made-up ground		

Table 1: data analysis

<p>Documents Survey methodology statement: Dean (2016)</p>	
<p>Methodology</p> <ol style="list-style-type: none"> 1. The work was undertaken in accordance with the survey methodology statement. The geophysical (magnetometer) survey was undertaken with reference to standard guidance provided by the Chartered Institute for Archaeologists (2014) and Archaeology Data Service (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. <i>DGPS used:</i> Spectra Precision PM5V2 GPS with external antenna and survey pole and DigiTerra Explorer 7 as the survey control program.</p>	
<p>Equipment <i>Instrument:</i> Bartington Instruments grad601-2 <i>Firmware:</i> version 6.1</p>	<p>Data Capture <i>Sample Interval:</i> 0.25m <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 8.0 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>	

Table 2: methodology summary

<p>SITE</p> <p>Instrument Type: Bartington Grad-601 gradiometer</p> <p>Units: nT</p> <p>Direction of 1st Traverse: see below</p> <p>Collection Method: ZigZag</p> <p>Sensors: 2 @ 1.00 m spacing.</p> <p>Dummy Value: 32702</p> <p>PROGRAM</p> <p>Name: TerraSurveyor</p> <p>Version: 3.0.31.0</p>	
<p>Stats</p> <p>Max: 423.23</p> <p>Min: -404.99</p> <p>Std Dev: 22.43</p> <p>Mean: 0.32</p> <p>Median: 0.02</p>	<p>Processes: 6</p> <p>1 Base Layer</p> <p>2 Clip at 1.00 SD</p> <p>3 DeStripe Median Sensors: Grids: All</p> <p>4 De Stagger: Grids: a4.xgd a7.xgd Mode: Both By: -2 intervals</p> <p>5 De Stagger: Grids: a3.xgd a8.xgd Mode: Both By: -2 intervals</p> <p>6 Interpolate: Match X & Y Doubled.</p>

Table 3: processed data metadata