Substrata
Archaeological Geophysical Surveyors

An archaeological magnetometer survey

Sections of a proposed A382-A383 link road, Newton Abbot, Devon

Centred on NGR (E/N): 283640,72980 and 283090,72500

Report: 1704NEW-R-1

Ross Dean BSc MSc MA MCIfA

16 May 2017

Substrata Ltd
Langstrath
Goodleigh
Barnstaple
Devon EX32 7LZ
Tel: 01271 342721
Email: geophysics@substrata.co.uk
Web: substrata.co.uk

Client
SLR Consulting Ltd
Langford Lodge
109 Pembroke Road
Clifton
Bristol BS8 3EU

Contents

Figures

Tables

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:	between 11 April and 17April 2017
Area:	4.5ha
Lead surveyor:	Mark Edwards BA
Author:	Ross Dean BSc MSc MA MIfA

1.2 Clients

SLR Consulting Ltd, Langford Lodge, 109 Pembroke Road, Clifton, Bristol BS8 3EU

1.3 Location

Site:	Sections of a proposed A382-A383 link road
Civil Parish:	Newton Abbot
District:	Teignbridge
County:	Devon
Nearest Postcode:	TQ12 6QA
NGR:	SX 83640 72980 (point)
NGR (E/N):	283640,72980 (point)

1.4 Archive

OASIS number:	substrat1-285098
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, hereafter referred to as the survey area. It has been prepared for SLR Consulting Ltd on behalf of Devon County Council Engineering Design Group. The survey area location is shown in Figure 1.

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.

Fourteen magnetic anomaly groups were mapped as representing potential archaeological deposits or features. Of these, one group represents a field boundary recorded on historical maps up to and including the 1:10,000 Ordnance Survey map of 1986-87. Two groups may represent archaeological features, possibly filled ditches, which do not conform to the adjacent modern field boundaries.

The remaining anomaly groups are linear and curvilinear anomalies that often denote fragments of former field or enclosure boundaries of unknown date and possibly of more than one phase of past land management.

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 proposed route is 2.25 km in length and the red line boundary for construction of the road is approximately 20m wide. The magnetometer survey area comprises two areas along the route, designated the 'northern area' and 'southern area' in the report text. They are shown in Figure 1.

The proposed road scheme is located in a rural setting, made up of enclosure fields and dispersed farmsteads, between the A382 and A383 in South Devon. The current road is single track for most of its length, with some passing places, and a wider section at the eastern, Froches Cross end. At the western end south of Mead Farm, the route runs through undeveloped enclosure fields, before re-joining the current road south of the houses on Howton Lane and north of the football fields.

4.2 Geology

The bedrock across the site is slate, lava and tuff of the Devonian and Carboniferous Gurrington Slate Formation. Some patches of microgabbro of the Devonian and Permian Southwest England Minor Intrusive Suite occur in the vicinity. Superficial deposits of Quaternary alluvium are recorded in the source consulted where streams cross the survey areas. These typically comprise soft to firm consolidated, compressible silty clay. Layers of silt, sand, peat and basal gravel can also occur. A stronger, desiccated surface zone may be present (British Geological Survey, undated).

5 Archaeological background

A comprehensive analysis of the historical and archaeological background to the proposed development area of which this survey area is a part can be found in SLR (2016).

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 changes 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

Figures 2 to 5 show the interpretation of the survey data. Figures 3 to 5 include the identifying number of each anomaly group. 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.

Figures 2 to 5 and Table 1 comprise the analysis of the survey data.

Figures 6 to 9 are plots of processed data as specified in Table 3. Figures 10 to 12 are plots of the minimally processed 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 within the survey area was restricted as shown in the figures due to the presence of magnetic materials. Un-mapped strong magnetic responses shown in Figures 6 to 9 are likely to relate to these materials except where otherwise indicated in Figures 2 to 5 and Table 1.

Anomaly characterisation and mapping

There are a number of anomaly groups that could be interpreted as relating to large postholes or pits although most will have natural origins. Anomalies of this sort were mapped as potential archaeology when they were associated with other significant anomaly groups or otherwise formed recognisable patterns as listed in Table 1.

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.

Data trends

A number of parallel, linear, anomaly groups can be seen in the shade plots of the data (Figures 6 to 9). Unless otherwise indicated in Figures 2 to 5, these are likely to relate to relatively recent ploughing disturbance and are only recorded in the analysis if they could be confused with potential archaeological deposits.

6.3.2 Data relating to historic maps and other records

Magnetic anomaly group **5** (Figure 3) coincides with, and likely represents, a field boundary recorded on the 1847 Highweek tithe map and on later historical maps up to and including the Ordnance Survey 1986-87 1:10,000 map. The anomaly pattern suggests that the boundary may have been a Devon bank with traces of the two flanking ditches remaining.

6.3.3 Data with no previous archaeological provenance

Magnetic anomaly groups **6** and **7** (Figure 4) are distinct in the dataset and do not conform to the orientation of adjacent field boundaries. They may well represent archaeological features such as filled, former ditches.

All the remaining anomaly groups mapped as representing potential archaeological deposits have characteristics typical of fragmented remains of former field boundaries and smaller enclosures of unknown origin and likely from more than one phase of past land management.

6.4 Conclusions

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

Fourteen magnetic anomaly groups were mapped as representing potential archaeological deposits or features. Of these, one group (5) represents a field boundary recorded on historical maps up to and including the 1:10,000 Ordnance Survey map of 1986-87. Two groups (6 and 7) may represent archaeological features, possibly filled ditches, which do not conform to the adjacent modern field boundaries.

The remaining anomaly groups are linear and curvilinear anomalies that often denote fragments of former field or enclosure boundaries of unknown date and possibly of more than one phase of past land management.

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 Andrew Burn of SLR Consulting Ltd for commissioning us to complete this survey.

9 Bibliography

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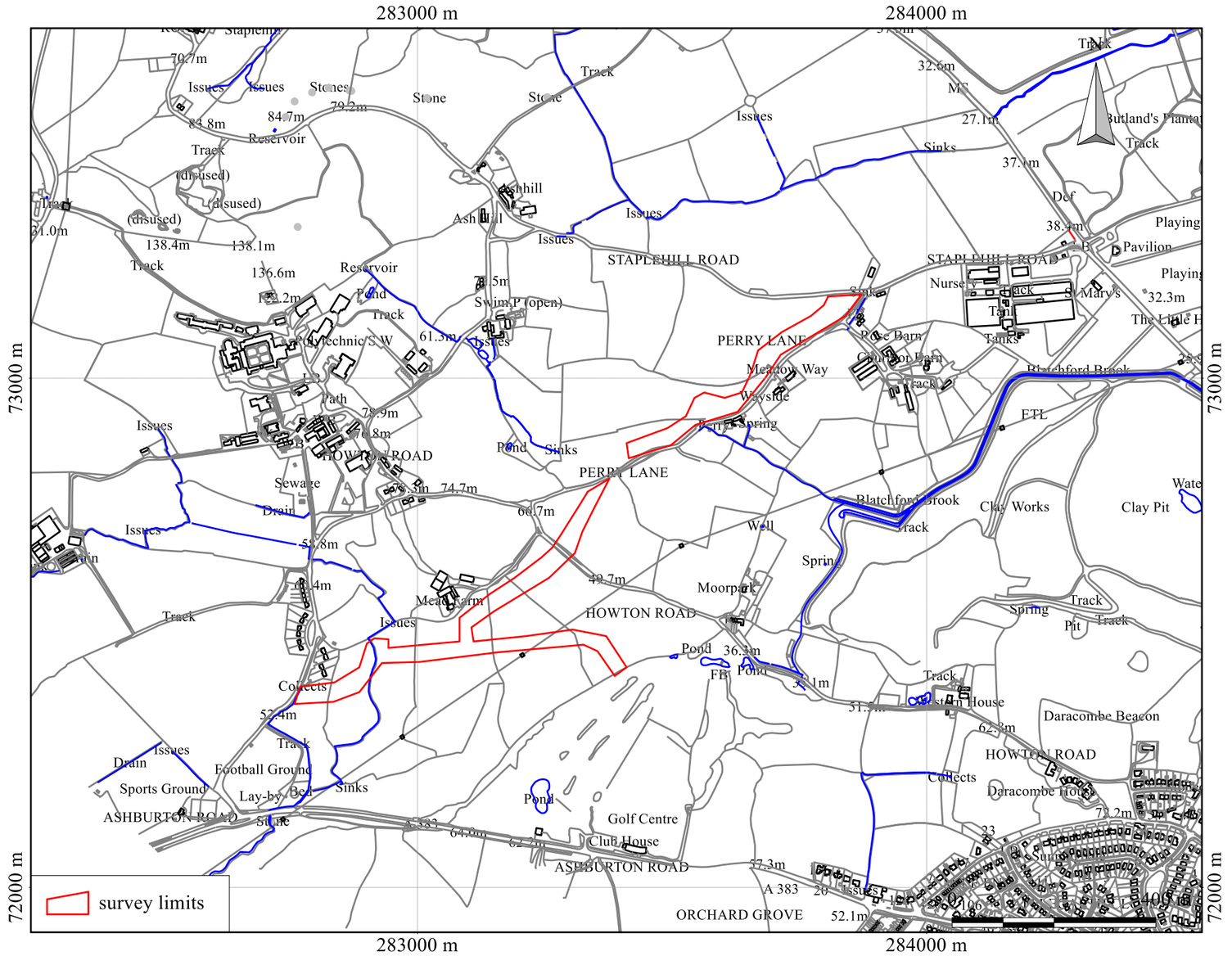
Appendix 1 Figures

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.



British Grid
centre X: 283390.77 m, centre Y: 72799.55 m

Scale: 1:10000 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological magnetometer survey
Sections of a proposed A382-A383 link road, Newton Abbot, Devon
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Figure 1: location map

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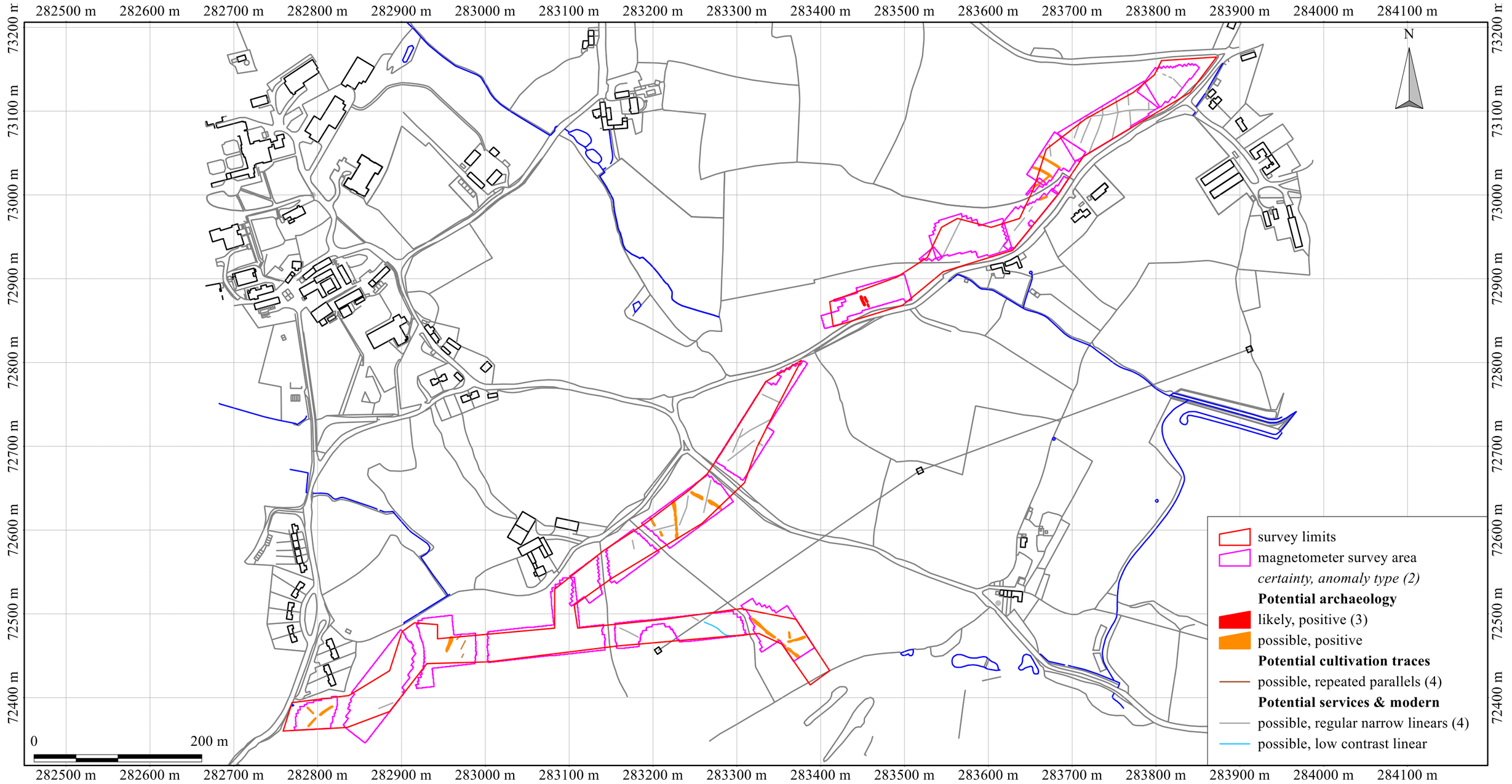
Barnstaple, Devon EX32 7LZ
Tel: 01271 342721
Email: geophysics@substrata.co.uk
Web: substrata.co.uk



British Grid
centre X: 283322.87 m, centre Y: 72762.62 m

Scale: 1:4500 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 2: survey interpretation overview, entire area

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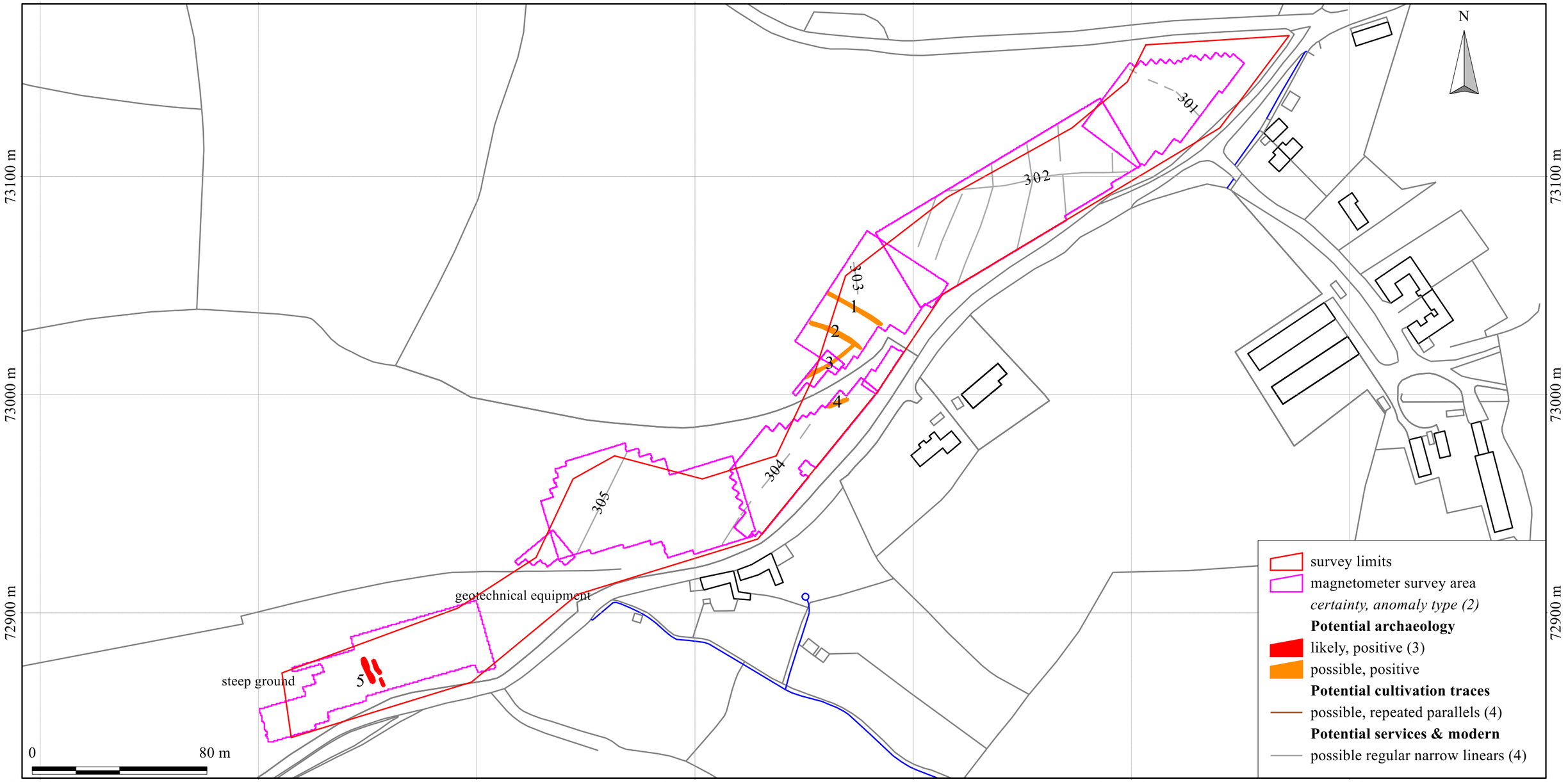
Web: substrata.co.uk



British Grid
centre X: 283640.81 m, centre Y: 73001.67 m

Scale: 1:1800 @ 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. 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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Report: 1704NEW-R-1

Figure 3: survey interpretation, northern area

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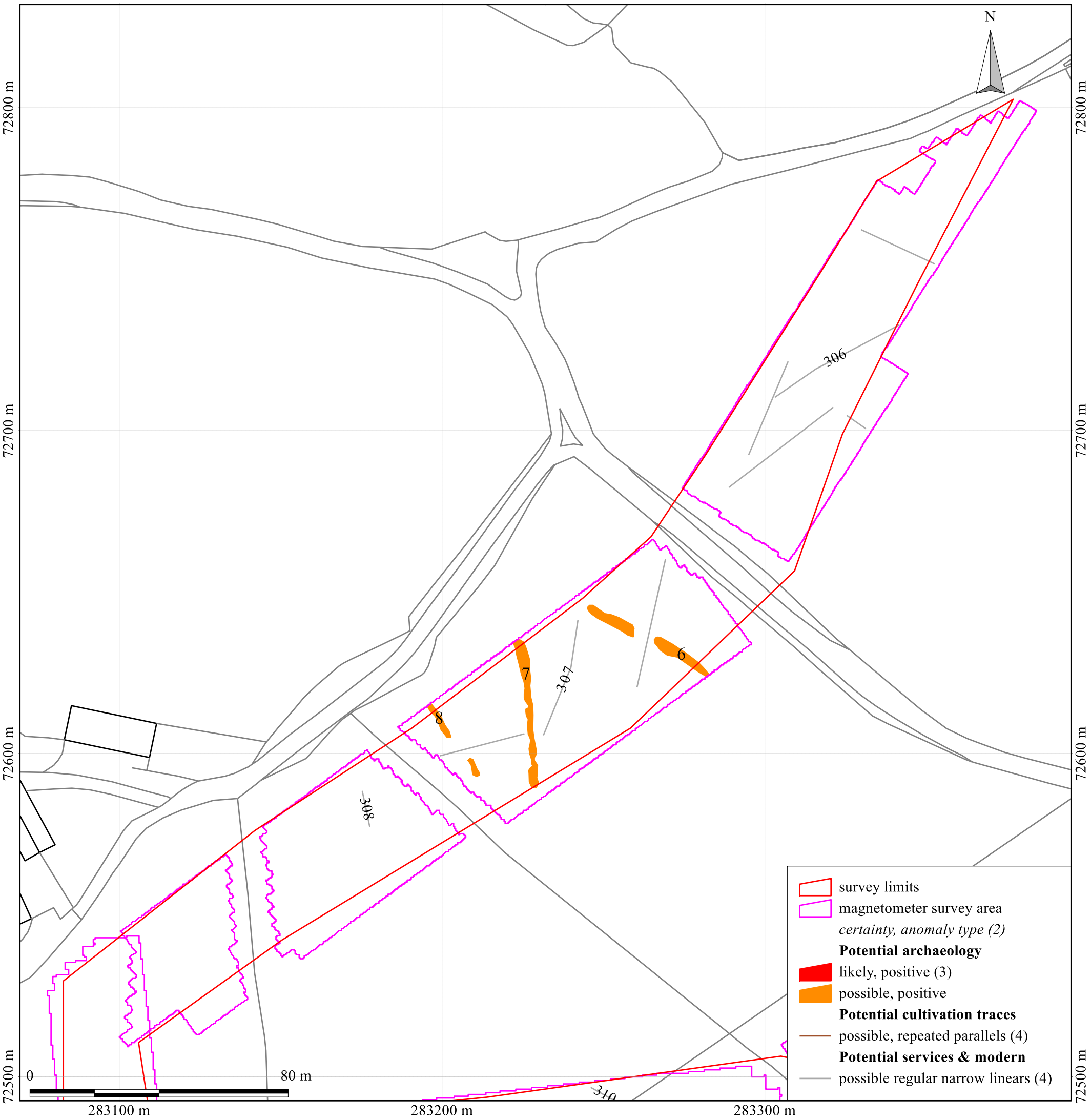

British Grid
centre X: 283232.05 m, centre Y: 7266

Scale: 1:1200 @ A3. Spatial Units: Meter. Do not scale off this drawing

Notes:
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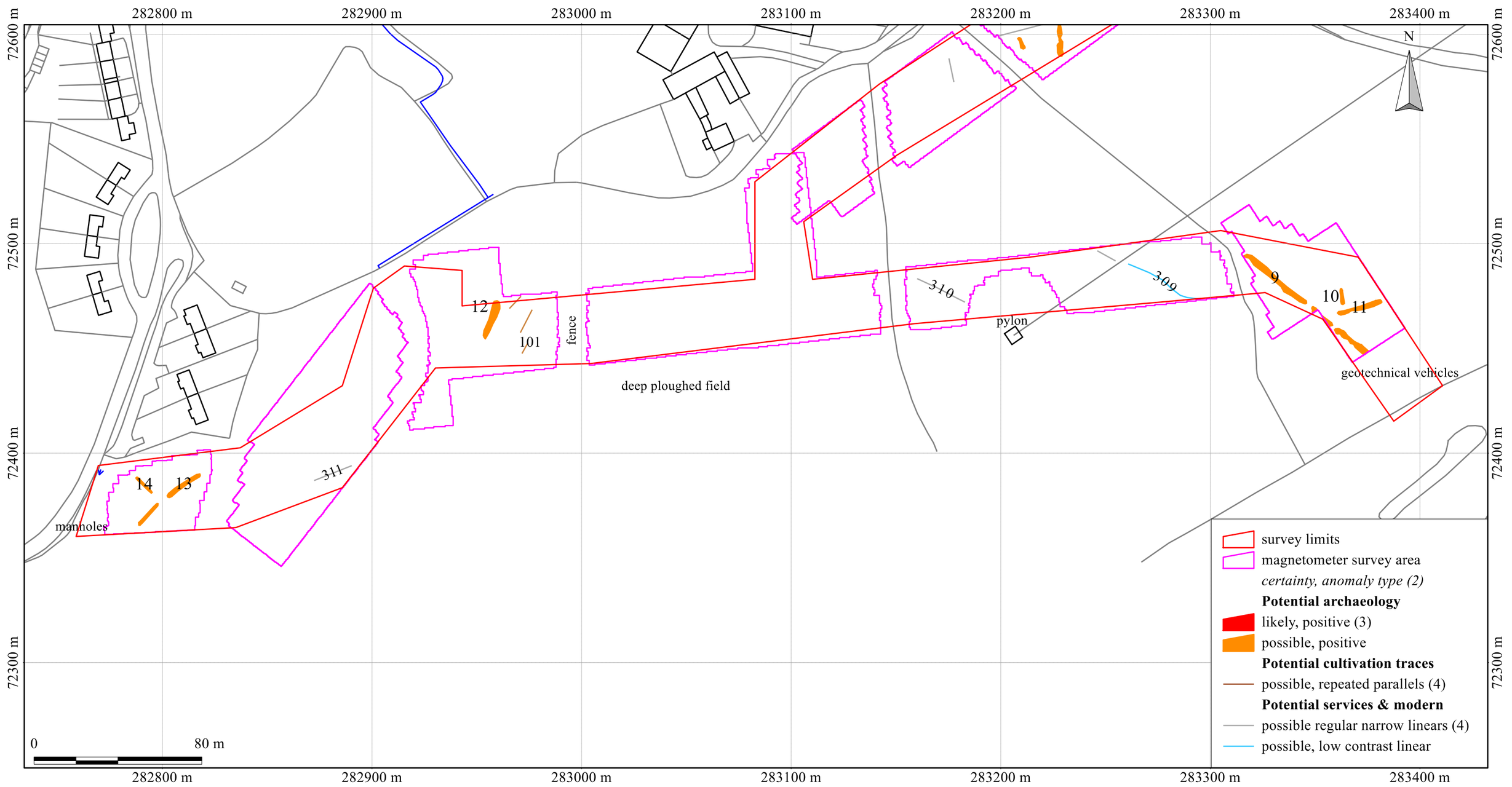
Tel: 01271 342721
Email: geophysics@substrata.co.uk
Web: substrata.co.uk

Figure 4: survey interpretation, southern area, northern section



British Grid
centre X: 283083.22 m, centre Y: 72427.16 m

Scale: 1:1800 @ 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.
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Centred on NGR (E/N): 283640,72980 and 283090,72500
Report: 1704NEW-R-1

Figure 5: survey interpretation, southern area, southern section

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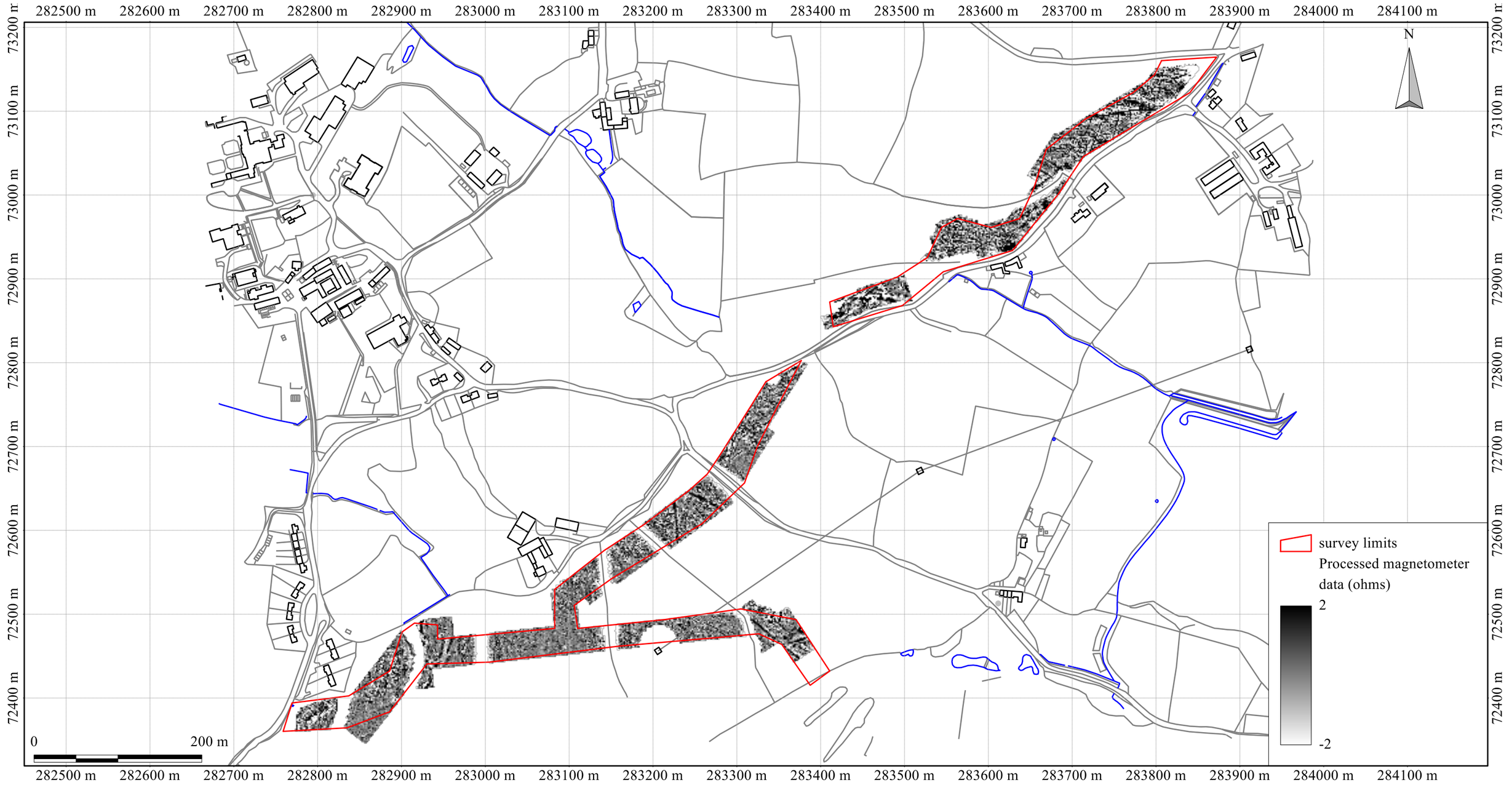
Web: substrata.co.uk



British Grid
centre X: 283322.87 m, centre Y: 72762.62 m

Scale: 1:4500 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 6: shade plot of processed data, entire area

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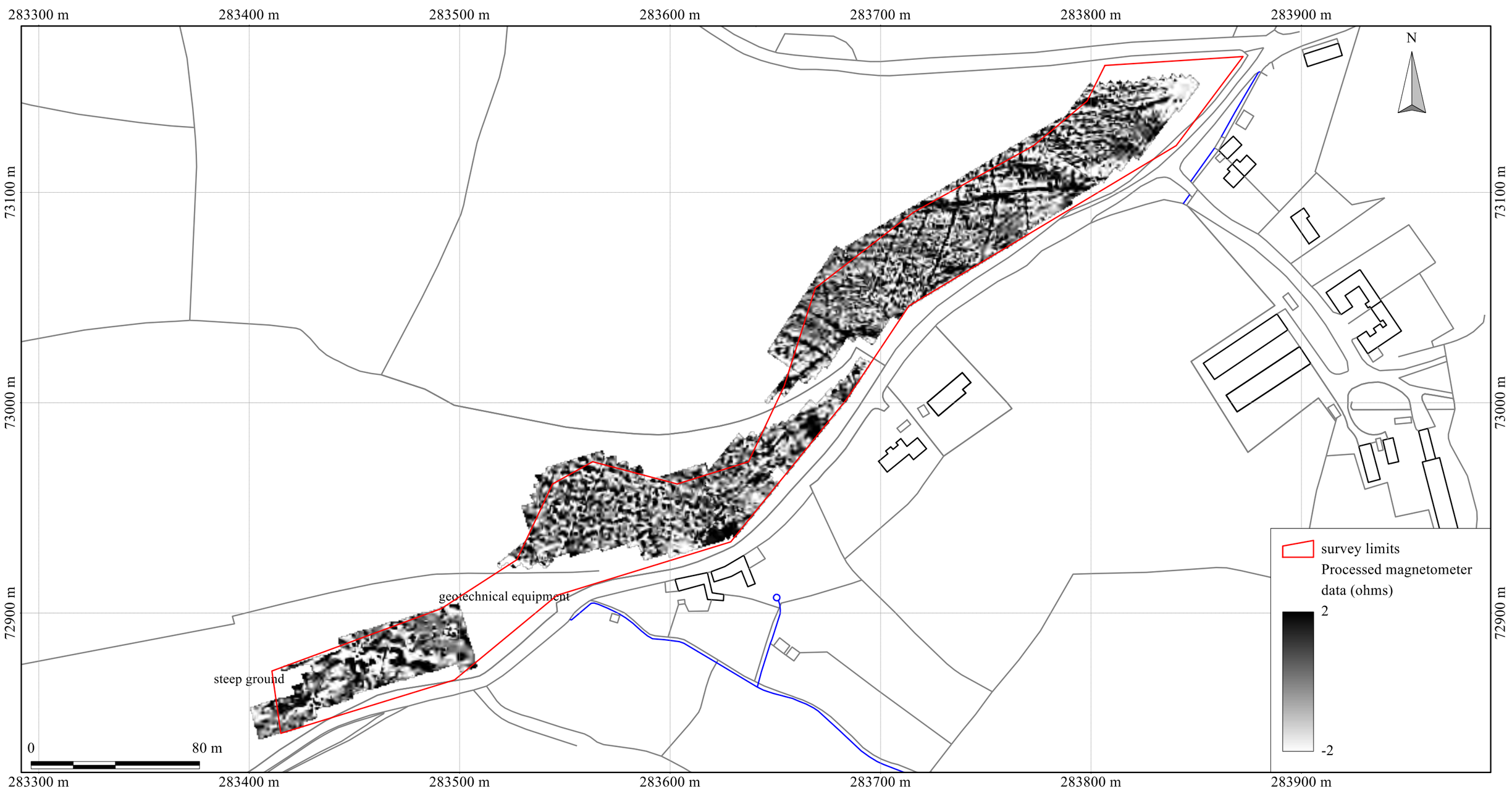
Email: geophysics@substrata.co.uk
Web: substrata.co.uk



British Grid
centre X: 283640.81 m, centre Y: 73001.67 m

Scale: 1:1800 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Report: 1704NEW-R-1

Figure 7: shade plot of processed data, northern area

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Tel: 01271 342721
Email: geophysics@substrata.co.uk
Web: substrata.co.uk

283100 m
283200 m
283300 m
72800 m
72700 m
72600 m
72500 m
N
survey limits
Processed magnetometer data (ohms)
2
-2
0
80 m

British Grid
centre X: 283232.05 m, centre Y: 7266

Scale: 1:1200 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Barnstaple, Devon EX32 7LZ
Tel: 01271 342721
Email: geophysics@substrata.co.uk
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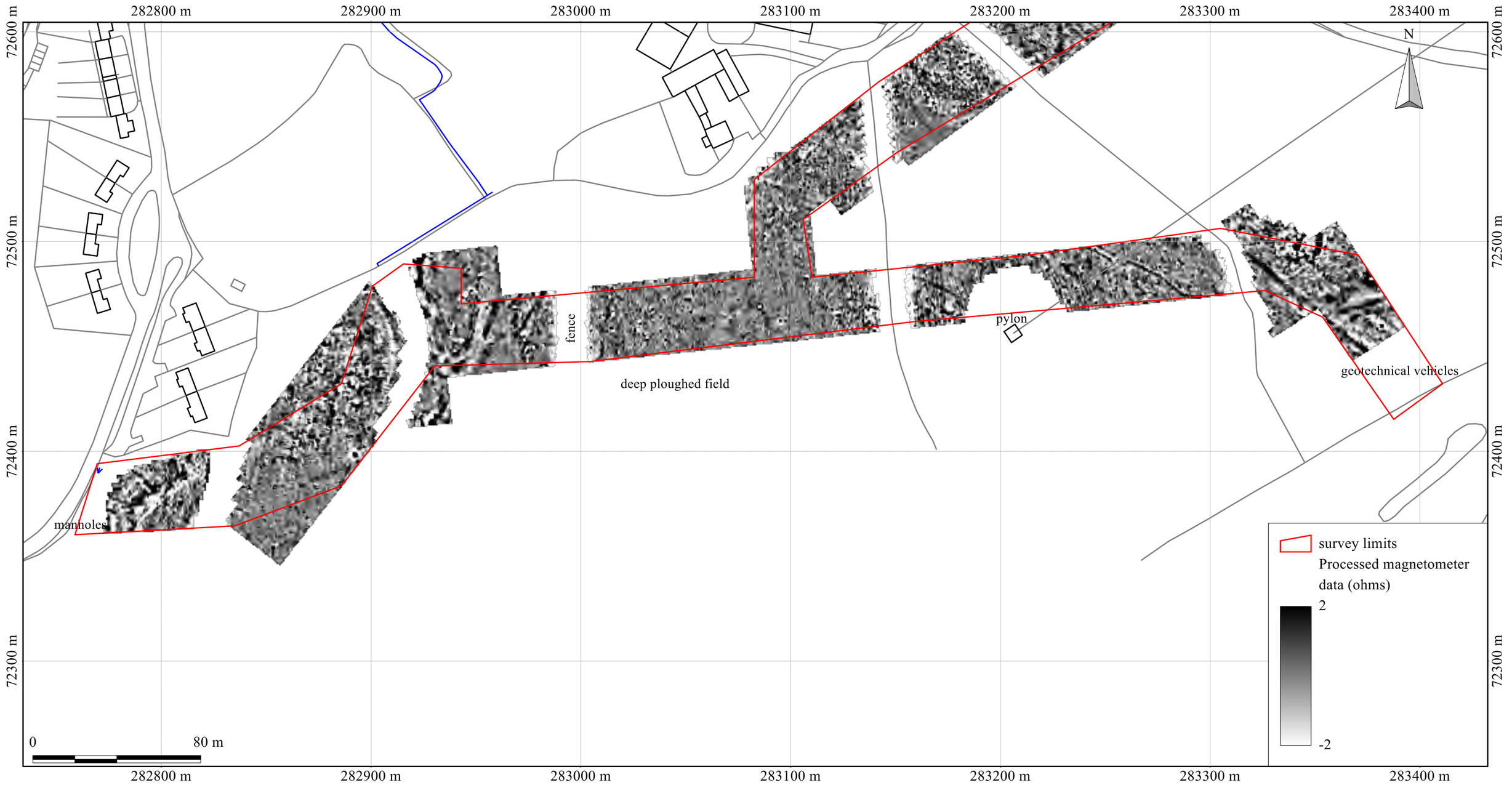
Figure 8: shade plot of processed data, southern area, northern section



British Grid
centre X: 283083.22 m, centre Y: 72427.16 m

Scale: 1:1800 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological magnetometer survey
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Report: 1704NEW-R-1

Figure 9: shade plot of processed data, southern area, southern section

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Tel: 01271 342721
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British Grid
centre X: 283645.36 m, centre Y: 73005.53 m

Scale: 1:1800 @ A3. Spatial Units: Meter. Do not scale off this drawing

Processing:
Automatic interpolation x=y on export to GIS

An archaeological magnetometer survey
Sections of a proposed A382-A383 link road, Newton Abbot, Devon
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Report: 1704NEW-R-1

Figure 10: shade plot of minimally processed data, northern area

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Tel: 01271 342721
Email: geophysics@substrata.co.uk
Web: substrata.co.uk

283100 m
283200 m
283300 m
72800 m
72700 m
72600 m
72500 m
N
0
80 m
survey limits
Unprocessed magnetometer data (ohms)
2
-2

British Grid
centre X: 283231.58 m, centre Y: 7266

Scale: 1:1200 @ A3. Spatial Units: Meter. Do not scale off this drawing

Processing:
Automatic interpolation x=y on export to GIS

An archaeological magnetometer survey
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Centred on NGR (E/N): 283640,72980 and 283090,72500
Report: 1704NEW-R-1

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Barnstaple, Devon EX32 7LZ
Tel: 01271 342721
Email: geophysics@substrata.co.uk
Web: substrata.co.uk

Figure 11: shade plot of minimally processed data, southern area, northern section

British Grid
centre X: 283101.08 m, centre Y: 72459.03 m

Scale: 1:1800 @ A3. Spatial Units: Meter. Do not scale off this drawing

Processing:
Automatic interpolation x=y on export to GIS

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Report: 1704NEW-R-1

Figure 12: shade plot of minimally processed data, southern area,southern section

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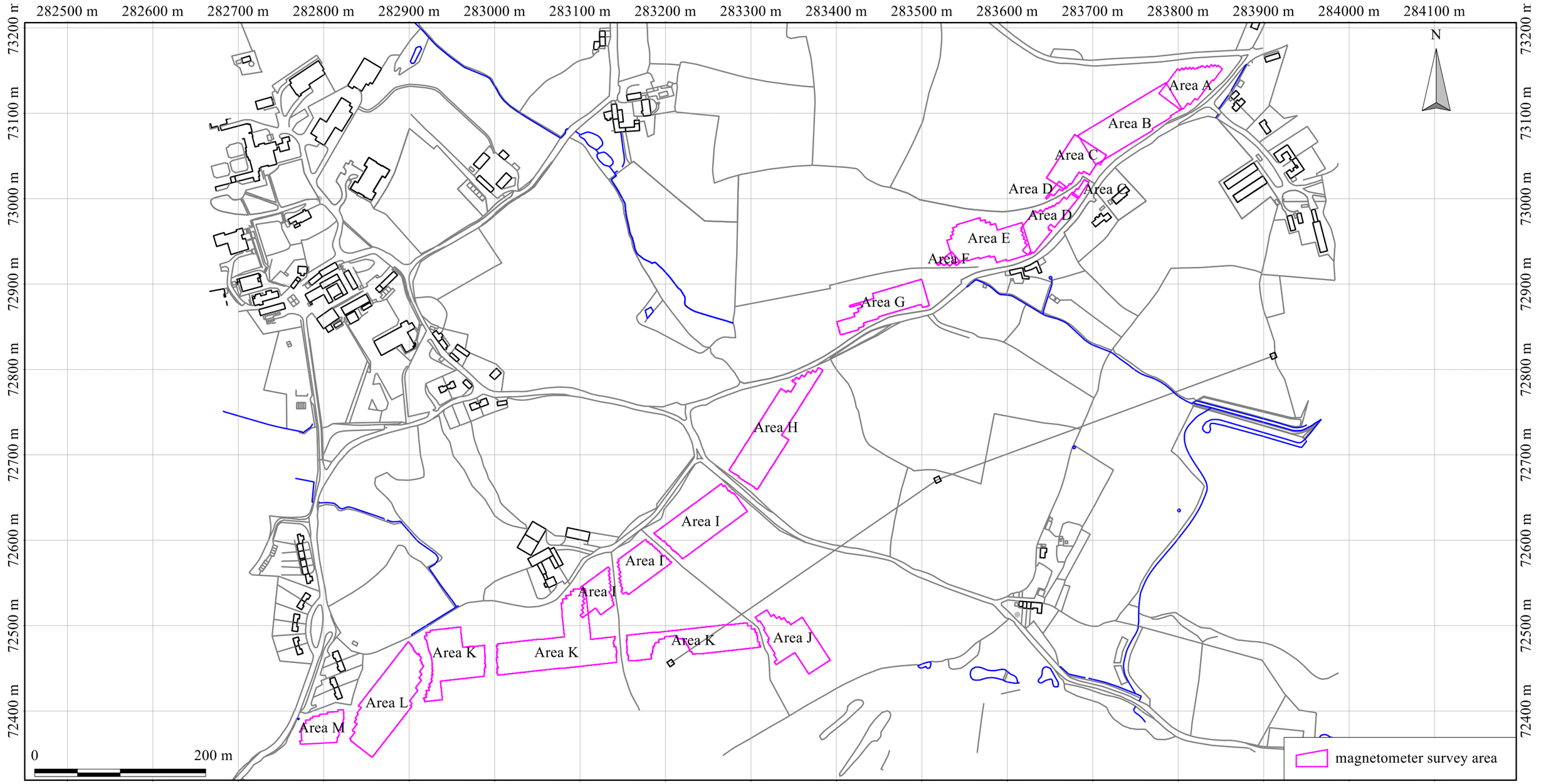
Web: substrata.co.uk



British Grid
centre X: 283322.87 m, centre Y: 72762.62 m

Scale: 1:4500 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 13: survey areas

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Langstrath, Goodleigh
Barnstaple, Devon EX32 7LZ
Tel: 01271 342721
Email: geophysics@substrata.co.uk
Web: substrata.co.uk

Appendix 2 Tables

Site: An archaeological magnetometer survey
Sections of a proposed A382-A383 link road, Newton Abbot, Devon
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anomaly group	associated anomalies	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
1		possible, positive	linear	archaeological or recent deposits		
2		possible, positive	curvilinear	archaeological or recent deposits		
3		possible, positive	curvilinear			
4		possible, positive	linear			
5		likely, positive	double linear	field boundary: possibly a Devon bank	anomaly group coincides with a field boundary recorded on historical maps	1847 Highweek tithe map, OS maps 1888-90:2500 to 1986-87 1:10000
6	7?	possible, positive	disrupted linear		anomaly groups are distinct in the dataset compared to the other groups mapped as potential archaeological deposits	
7	6?	possible, positive	linear		anomaly groups are distinct in the dataset compared to the other groups mapped as potential archaeological deposits	
8		possible, positive	disrupted linear			
9		possible, positive	linear		anomaly group appears to represent an extension of an extant field boundary	
10		possible, positive	linear			
11		possible, positive	linear			
12		possible, positive	linear			
13		possible, positive	disrupted curvilinear			
14		possible, positive	linear	archaeological deposit or modern service		
101		possible, repeated parallels		cultivation traces	anomaly groups are likely to represent relatively recent ploughing disturbance	
301		possible, regular narrow linears		field drain		
302		possible, regular narrow linears		field drain		
303		possible, regular narrow linears		field drain		
304		possible, regular narrow linears		field drain		
305		possible, regular narrow linears		field drain		
306		possible, regular narrow linears		field drain		
307		possible, regular narrow linears		field drain		
308		possible, regular narrow linears		field drain		
309		possible, low contrast linear		service trench		
310		possible, regular narrow linears		field drain		
311		possible, regular narrow linears		field drain		

Table 1: data analysis

Documents
Survey methodology statement: Dean (2017)

Methodology

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.

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:* 0.25m *Traverse Interval:* 1 metre *Traverse Method:* zigzag *Traverse Orientation:* along proposed road line

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

Table 2: methodology summary

SITE
Instrument Type: Bartington Grad-601 gradiometer
Units: nT
Direction of 1st Traverse: see below
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

PROGRAM
Name: TerraSurveyor
Version: 3.0.31.0

Area A		Processes: 7
Max:	54.21	1 Base Layer
Min:	-59.45	2 Clip at 1.00 SD
Std Dev:	5.85	3 De Stagger: Grids: All Mode: Both By: -1 intervals
Mean:	-1.07	4 DeStripe Median Traverse: Grids: a6.xgd a5.xgd a4.xgd
Median:	-0.31	5 DeStripe Median Traverse: Grids: a2.xgd
		6 DeStripe Median Traverse: Grids: a3.xgd
		7 Interpolate: Match X & Y Doubled.
Area B		Processes: 5
Max:	42.28	1 Base Layer
Min:	-36.61	2 Clip at 1.00 SD
Std Dev:	3.11	3 De Stagger: Grids: All Mode: Both By: -1 intervals
Mean:	0.30	4 DeStripe Median Traverse: Grids: All
Median:	0.03	5 Interpolate: Match X & Y Doubled.
Area C		Processes: 5
Max:	24.31	1 Base Layer
Min:	-18.51	2 Clip at 4.00 SD
Std Dev:	2.31	3 De Stagger: Grids: b5.xgd b6.xgd Mode: Both By: -1 intervals
Mean:	0.05	4 DeStripe Median Traverse: Grids: All
Median:	0.00	5 Interpolate: Match X & Y Doubled.
Area D		Processes: 5
Max:	37.03	1 Base Layer
Min:	-24.88	2 Clip at 4.00 SD
Std Dev:	3.28	3 De Stagger: Grids: All Mode: Both By: -1 intervals
Mean:	0.20	4 DeStripe Median Traverse: Grids: All
Median:	0.00	5 Interpolate: Match X & Y Doubled.
Area E		Processes: 5
Max:	15.42	1 Base Layer
Min:	-16.03	2 Clip at 3.00 SD
Std Dev:	2.43	3 De Stagger: Grids: All Mode: Both By: -2 intervals
Mean:	0.18	4 DeStripe Median Traverse: Grids: All
Median:	0.01	5 Interpolate: Match X & Y Doubled.
Area F		Processes: 5
Max:	177.86	1 Base Layer
Min:	-37.04	2 Clip at 1.00 SD
Std Dev:	11.39	3 De Stagger: Grids: All Mode: Both By: -2 intervals
Mean:	0.24	4 DeStripe Median Traverse: Grids: All
Median:	0.07	5 Interpolate: Match X & Y Doubled.
Area G		Processes: 5
Max:	90.16	1 Base Layer
Min:	-85.44	2 Clip at 1.00 SD
Std Dev:	5.98	3 De Stagger: Grids: All Mode: Both By: -1 intervals
Mean:	0.28	4 DeStripe Median Traverse: Grids: All
Median:	0.02	5 Interpolate: Match X & Y Doubled.
Area H		Processes: 5
Max:	45.09	1 Base Layer
Min:	-121.49	2 Clip at 1.00 SD
Std Dev:	3.10	3 De Stagger: Grids: All Mode: Both By: -1 intervals
Mean:	0.06	4 DeStripe Median Traverse: Grids: All
Median:	0.01	5 Interpolate: Match X & Y Doubled.
Area I		Processes: 5
Max:	91.76	1 Base Layer
Min:	-63.05	2 Clip at 1.00 SD
Std Dev:	2.67	3 De Stagger: Grids: All Mode: Both By: -1 intervals
Mean:	0.02	4 DeStripe Median Traverse: Grids: All
Median:	0.00	5 Interpolate: Match X & Y Doubled.
Area J		Processes: 5
Max:	92.09	1 Base Layer
Min:	-136.72	2 Clip at 1.00 SD
Std Dev:	4.11	3 De Stagger: Grids: All Mode: Both By: -1 intervals
Mean:	0.17	4 DeStripe Median Traverse: Grids: All
		5 Interpolate: Match X & Y Doubled
Area K		Processes: 5
Max:	16.61	1 Base Layer
Min:	-20.74	2 Clip at 3.00 SD
Std Dev:	1.48	3 De Stagger: Grids: All Mode: Both By: -2 intervals
Mean:	0.04	4 DeStripe Median Traverse: Grids: All
Median:	0.01	5 Interpolate: Match X & Y Doubled.
Area L		Processes: 5
Max:	18.88	1 Base Layer
Min:	-15.90	2 Clip at 3.90 SD
Std Dev:	1.41	3 De Stagger: Grids: All Mode: Both By: -2 intervals
Mean:	0.06	4 DeStripe Median Traverse: Grids: All
Median:	0.01	5 Interpolate: Match X & Y Doubled.
Area M		Processes: 5
Max:	10.88	1 Base Layer
Min:	-9.35	2 Clip at 3.00 SD
Std Dev:	1.86	3 De Stagger: Grids: All Mode: Both By: -1 intervals
Mean:	0.07	4 DeStripe Median Traverse: Grids: All
Median:	0.01	5 Interpolate: Match X & Y Doubled.

Table 3: processed data metadata (see Figure 13 for survey areas)