Substrata
Archaeological Geophysical Surveyors

An archaeological magnetometer survey

Land at Exeter Golf Club with 2017 additional area Newcourt Drive, Exeter

Centred on NGR (E/N): 295740,090080 (point)

Report: 1705NEW-R-1

Ross Dean BSc MSc MA MCIfA

1 July 2017

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Project archive

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    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:	20 to 22 May 2016 and 5 May 2017
Area:	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:	Land at Exeter Golf Club with 2017 additional area, Newcourt Drive
Non-metropolitan District:	Exeter
County:	Devon
Nearest Postcode:	EX2 7AU
NGR:	SX 95740 90080 (point)
Ordnance Survey NGR (E/N):	295740,090080 (point)

1.4   Archive

OASIS number:	substrat1-286346
Archive:	At the time of writing, the archive of this survey will be held by Substrata.

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 AC Archaeology Ltd on behalf of clients. The survey area location is shown in Figure 1.

This report is an update of an earlier report (Dean 2016b) to include an additional area of approximately 0.47ha originally covered by a bund.

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.

No new potential archaeological features were recorded during the additional survey. Two potential linear features recorded in the 2016 survey were found to extend into the additional area. Both of these are most likely to be former field or enclosure boundaries.

Fifty-eight magnetic anomaly groups were mapped as representing possible archaeological deposits or features and two distinct trends in the data were identified as possible historical ridge-and-furrow ploughing. Of the fifty-eight anomaly groups, one distinct sub-circular group is most likely to represent a ring ditch, round house or similar archaeological feature and one adjacent group may represent a second such feature although it is far less clear. A cluster of anomalies lying between these two groups may be indicative of a body of large postholes or pits. A third sub-circular group may represent a stony deposit ringed by a ditch. Three anomaly groups may represent in-situ, strongly heated deposits such as those from kilns or furnaces. A number of areas of enhanced magnetic responses were mapped as possible areas of archaeological deposits that cannot be further characterised. One strong magnetic response coincides with a modern golf practice distance marker but its characteristics indicate a possible archaeological origin. The remaining mapped anomaly groups are most likely to represent linear and curvilinear deposits, such as former ditches or banks, of unknown period but removed before 1840 and probably from 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 survey area (Figure 1) comprises a practice golf driving area within the Exeter Golf and Country Club. The land lies at approximately 20m AOD and slopes gently to the south. The area is bounded to the north by the site of the Royal Devon and Exeter NHS Foundation Trust headquarters, to the east by a modern housing estate, the Admiral Way road to the south and golf course grounds to the west.

4.2 Geology

The survey area has a solid geology of the Permian Dawlish Sandstone Formation which comprises cross-bedded reddish brown sands and sandstones with intercalated thin lenses and beds of breccia and mudstone. The superficial geology is Quaternary River Terrace Deposits which generically comprise sand and gravel, locally with lenses of silt, clay or peat (British Geological Survey, undated).

5 Archaeological background

5.1 Definitions

5.1.1 Heritage assets

Archaeological sites, buildings, historic parks and gardens, conservation areas, registered battlefields and other aspects of the historic environment that are significant because of their historic, archaeological, architectural or artistic interest are considered heritage assets. Designated heritage assets are afforded protection as either scheduled monuments, listed buildings or through their inclusion within conservation areas. Non-designated heritage assets are potential archaeological remains and historic landscapes.

5.1.2 Historic Environment Records (HERs) are sources of, and signposts to, information relating to landscapes, buildings , monuments, sites, places, areas and archaeological finds spanning more than 700,000 years of human endeavour. Based mainly in local authorities, they are used for planning and development control but they also fulfil an educational role (Historic England, undated b).

5.1.2 Archaeological periods

Archaeological periods use in this report are defined as follows:

Prehistoric: before AD 43

Palaeolithic: circa 500,000 BC to circa 10,000 BC

Mesolithic: circa 10,000 BC to circa 4,000 BC

Neolithic: circa 4,000 BC to 2,200 BC

Bronze Age: circa 2,200 BC to circa 700 BC

Iron Age: circa 700 BC to AD 43

Romano-British: AD 43 to circa AD 410

Early Medieval: circa AD 410 to AD 1066

Medieval: AD 1066 to AD 1540

Post-medieval: AD 1540 to AD 1901

Modern: AD 1901 onwards

5.1.3 Grid references, distances and bearings

The centre of the survey area is provided in Section 1 as a twelve figure National Grid easting/ northing (E/N) and as a ten figure National Grid reference (NGR), both of which define a 1m square with its south-western corner on the reference point. Eight figure NGRs define a 10m square. Six figure NGRs a 100m square and so on. The distances and bearings provided below are relative to the south-western corner of the square defined by the NGR quoted.

All distances and bearings provided below are relative to the Ordnance Survey NGR centre point of the site recorded in Section 1.

5.2 Historic landscape characterisation

Modern enclosures.

These modern enclosures replace an earlier area of historic parkland, elements of which may be retained within them (Turner, 2015).

5.3 Historical and archaeological background

The following is a short summary of information obtained from Farnell and Fairclough (undated) and the Devon Historic Environment Record (HER) within approximately 500m of the survey area and relevant to the understanding of the geophysical survey. Except where specifically cited, this information was obtained using the Heritage Gateway portal (Historic England, undated a).

5.3.1 Heritage assets within the survey area

There are no heritage assets recorded in the HER within the survey area.

5.3.2 Heritage assets within 500m of the survey area

The prehistoric period is well documented within the surrounding area. Excavations to the east of the site at Newcourt Drive, Exeter exposed evidence of multi-phase prehistoric activity. A pit produced sherds of an Early Bronze Age collared urn and worked flint. A substantial field boundary was dated to the Middle Bronze Age and represented the continuation of a field system recorded on the adjacent site of the former Royal Naval Supply Depot. A ring gully produced a small assemblage of Middle to Late Iron Age pottery. Two additional feature groups; a pit alignment and pit cluster were poorly dated although radiocarbon dates from the pit alignment indicate a date sometime after the Early Bronze Age.

The surrounding land to the north, east and west have been subjected to considerable previous archaeological work accompanying development or proposed schemes. A desk-based assessment of the area was carried out in 2006 and concluded that there was high potential for prehistoric activity. Subsequent geophysical survey of the site and fields to the north, identified linear features and possible enclosures throughout the surveyed area. Trial trenching on the site recorded ditches and several possible pits and postholes. All were poorly dated at the time.

Excavations to the east, on the site of the former Royal Naval Supply Depot, exposed Neolithic pits and Bronze Age ditches. Further to the north, excavations in advance of the construction of Newcourt Way exposed a square Bronze Age enclosure and post-built roundhouse structure. The site of a possible ring ditch of probable Prehistoric date, visible as a cropmark ditch on specialist oblique aerial photographs, lies 423m east of the site on the bearing North 49 degrees (Historic Environment Record MDV28623, National Grid Reference SX 961 903). A possible curvilinear anomaly has been recorded 423m on N59 (HER MDV 113997, SX 961 904). A possible Bronze Age ring ditch 423m on N59 is shown on aerial photographs as a linear cropmark (MDV113355, SX 961 904). A recorded archaeological anomaly that may represent a large pit is sited 482m on N49 (MDV113998, SX 961 904). Evidence from a geophysical survey some 511m N65 of the site shows archaeological anomalies indicating former field boundaries, enclosure boundaries and Devon banks (MDV113999, SX 962 903).

Evidence of a possible Early Bronze Age to Roman enclosure has been identified from cropmarks approximately 381m on N72 (MDV113336, SX 961 902). Other evidence of Roman activity in the area is documented at 397m on N323 where a base of Roman Samian vessel was found near Old Rydon Lane (MDV 61429, SX 955 904).

A ring ditch of probable Prehistoric date is visible as a cropmark ditch on oblique aerial photographs of 1985 within Exeter Golf and Country Club, Lower Wear at 244m on N138 (MDV 38796, SX 959 899). Other later field boundaries of Medieval date have been recorded within the golf course (MDV105551, SX 949 899).

Numerous undated ditches, pits and postholes were recorded across the area, and there would appear to be at least three phases or activity, but probably more approximately 581M on N229 (MDV106152, SX 953 897). Other ditches which are probably associated with Medieval and later field systems were also excavated including some features that appear to correspond to a boundary marked on the 1840's Tithe Map, flint scatterings are also recorded in the vicinity. North-East of Seabrook House, 651m on N222 from the site is the possible remains of a lynchet, now visible as earthwork (MDV 103436, SX 953 896).

A gravel pit is recorded within an area now occupied by Topsham Golf Course, some 387m on N171 from the site, is shown on the First and Second Edition 25-inch Ordnance Survey maps (MDV110649, SX 958 897).

Bordering the site to north (MDV87463/MDV72356, SX 957 902) is Newcourt House which is a grade II listed Square Stucco mansion, probably late eighteenth century.
Surrounding the site and in very close proximity is the recorded remains of a WWII United States Naval Amphibious Supply Base (MDV55091, SX 954 896). The former United States naval stores depot is visible as a range of structures on aerial photographs from 1945 onwards and on digital images derived from aerial photographs taken from 1999 onwards at Countess Wear, Exeter. The former site has been completely cleared and partly redeveloped for housing by 2012.

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 chemistry or 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 actual 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 (see also Section 7).

6.2 Results

Figures 2 to 4 show the interpretation of the survey data. They include the anomaly groups identified as possibly relating to archaeological deposits. The group identifying numbers are shown in Figures 3 and 4. 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 4 and Table 1 comprise the analysis of the survey data.

Figures 5 to 7 are plots of processed data as specified in Table 3. Figures 8 and 9 are plots 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 was restricted as shown in the figures due to the presence of magnetic materials adjacent to the survey area. Strong magnetic responses mapped close to survey boundaries are likely to relate to these materials except where otherwise indicated in Figures 2 to 4.

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 are normally only mapped as potential archaeology if they are clustered in groups and form recognisable patterns. One cluster (group 47 in Figure 3) was chosen as an example of possible archaeological deposits as discussed below.

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.

Anomalies thought to relate to natural features were not mapped.

Numerous dipole magnetic anomalies are scattered across the data set. These are likely to represent recent ferrous objects and are not usually mapped. Three of these groups (40, 45 and 49) were mapped as discussed below.

<u>Data trends</u>
Two distinct trends are present in the data running northeast to southwest and northwest to southeast (Figures 5 to 7). Although not assigned group numbers, they are mapped in Figures 2 to 4 as they are likely to represent cultivation traces and possibly ridge-and-furrow ploughing.

6.3.2 Data relating to historic maps and other records

Group **1** is a clear remnant of ditches that once flanked a removed section of an otherwise extant field boundary. No other magnetic anomaly groups pertaining to known heritage assets were recorded. All the possible former field boundaries discussed below were not mapped on the 1840 Topsham Tithe map or on later historical Ordnance Survey maps, implying that they were removed before 1840.

6.3.3 Data with no previous archaeological provenance

Magnetic anomaly groups **6**, **7**, **10**, **17** to **19**, **23**, **24**, **28**, **31 to 33**, **35**, **44**, **48** and **55** were mapped as areas of distinct enhanced magnetic response compared to the general pattern of background anomalies. These areas can, on occasion, be indicative of archaeological deposits but cannot be characterised further.

Group **21** may represent archaeological features such as a sub-circular ditch surrounding a stony deposit although a modern origin associated with the golf practice range across the survey area cannot be ruled out.

Groups **29**, **50** and **51** have characteristics that are often associated with in-situ, highly heated deposits such as those from kilns or furnaces. Anomaly **49** is a dipole which is indicative of a buried ferrous object. Most such anomalies relate to recent items such as, in a rural context, horse shoes or tractor parts. In this case the proximity of group 49 to the possible heated deposits 50 and 51 mean that it may relate to possible iron production although a recent origin is much more likely.

Anomaly group **39**, although disrupted by the dipole anomaly group **40**, is clear in the data and has characteristics indicative of a ring ditch, round house or similar archaeological feature. As with group 49, the proximity of group 40 to 39 could mean that group 40 has an archaeological context although it is more likely that group 40 represents recent ferrous material. Adjacent to group 39 is a cluster of anomalies that have characteristics associated with pits or large postholes (group **47**). This cluster is by no means unique in the data but, given that none of the clusters have a recognisable pattern beyond their clustering, this one has been mapped as more likely than the rest to represent archaeological deposits because of its proximity to group 39. Group **46** has a curvilinear shape, interrupted by group **45**, which could imply a remnant sub-circular archaeological deposit but this is by not certain.

Group **53** is most likely to represent a disrupted linear deposit such as a former ditch but may represent a line of pits.

Anomaly group **57** coincides with a golf distance indicator comprising a white board similar to two other target boards elsewhere in the survey area. While the two other boards had no discernible magnetic response, this board sits over a large negative magnetic anomaly. Such anomalies are often associated with rubble-filled shafts such as mine or well shafts. In this case, given the golfing context, the anomaly may relate to a modern feature or even the target board itself but an archaeological origin cannot be ruled out.

The other magnetic anomaly groups mapped as representing potential archaeology are likely to represent linear and curvilinear deposits and features, such as former ditches or banks, of unknown period and probably 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.

No new potential archaeological features were recorded during the additional survey. Two potential linear features (2 and 36) recorded in the 2016 survey were found to extend into the additional area. Both of these are most likely to be former field or enclosure boundaries.

Fifty-eight magnetic anomaly groups were mapped as representing possible archaeological deposits or features and two distinct trends in the data were identified as possible historical ridge-and-furrow ploughing. Of the fifty-eight anomaly groups, one distinct sub-circular group is most likely to represent a ring ditch, round house or similar archaeological feature and one adjacent group may represent a second such feature although it is far less clear. A cluster of anomalies lying between these two groups may be indicative of a body of large postholes or pits. A third sub-circular group may represent a stony deposit ringed by a ditch. Three anomaly groups may represent in-situ, strongly heated deposits such as those from kilns or furnaces. A number of areas of enhanced magnetic responses were mapped as possible areas of archaeological deposits that cannot be further characterised. One strong magnetic response coincides with a modern golf practice distance marker but its characteristics indicate a possible archaeological origin. The remaining mapped anomaly groups are most likely to represent linear and curvilinear deposits, such as former ditches or banks, of unknown period but removed before 1840 and probably from 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.

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8   Acknowledgements

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

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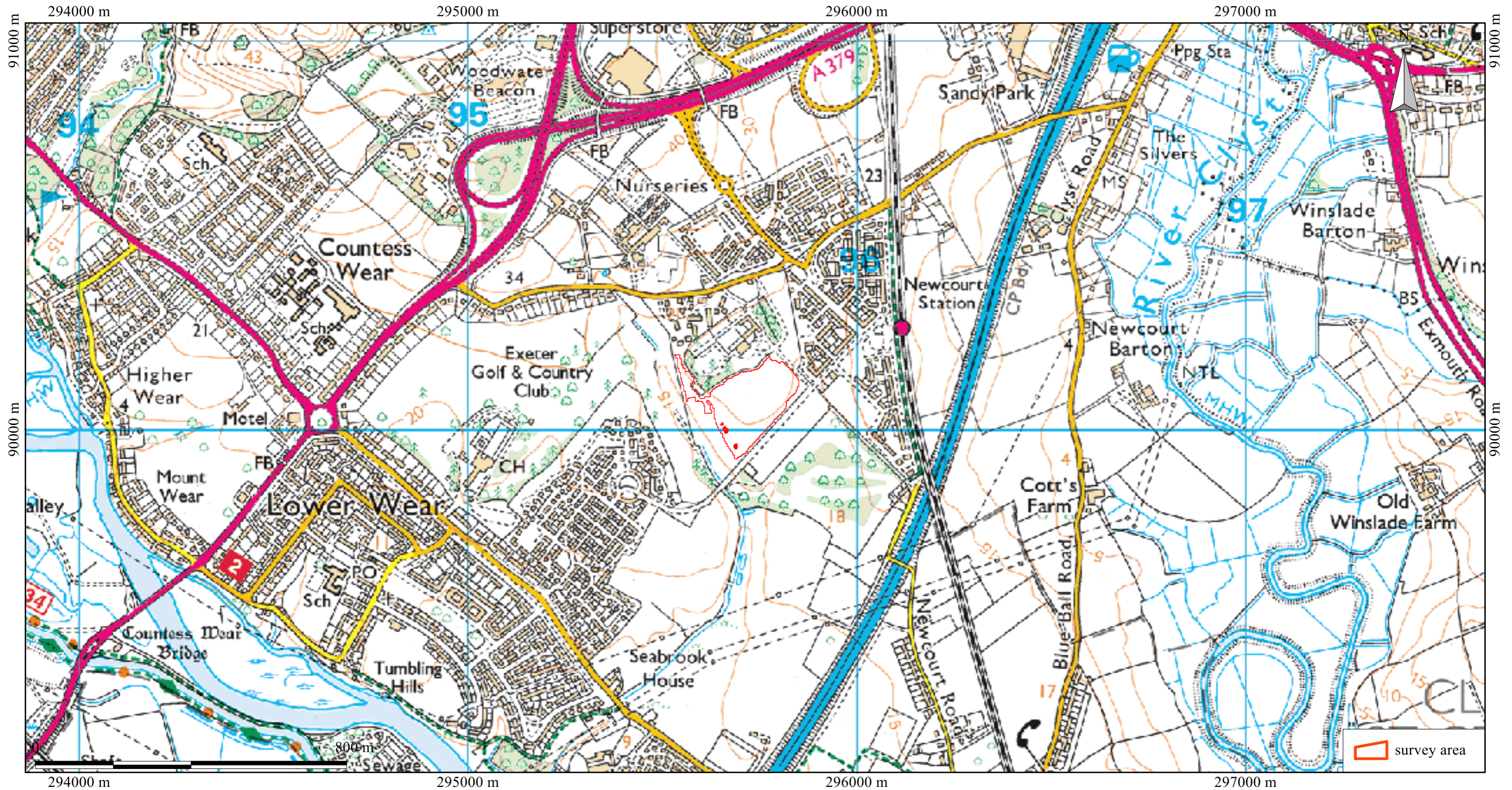
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Appendix 1   Supporting plots

<u>General Guidance</u>

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.

Superstore

Woodwater Beacon

A379

Sandy Park

Nurseries

Ppg Sta

The Silvers

Winslade Barton

Countess Wear

Newcourt Station

Newcourt Barton

Exeter Golf & Country Club

Higher Wear

Motel

Mount Wear

Lower Wear

CH

Cott's Farm

Old Winslade Farm

Countess Wear Bridge

Seabrook House

Tumbling Hills

Newcourt Road

Blue Ball Road

Sewage

River Clyst

Exmouth R

survey area

British Grid
centre X: 295738.75 m, centre Y: 90081.25 m

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

Geophysical survey: Copyright Substrata
Base map: Copyright West Country Land Surveyors Ltd

An archaeological magnetometer survey
Land at Exeter Golf Club with 2017 additional area
Newcourt Drive, Exeter
Centred on NGR (E/N): 295740,090080 (point)
Report: 1705NEW-R-1

Figure 1: location map

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

Axis labels (top): 295500 m · 295600 m · 295700 m · 295800 m · 295900 m
Axis labels (left/right): 90200 m · 90100 m · 90000 m

N

Legend

- survey area

Potential archaeology
certainty, anomaly type (2)

- likely, positive (3)
- possible, positive
- possible, negative
- possible, enhanced
- possible, north-south high-low
- possible, dipole
- possible, repeated parallels (4)

Scale bar: 0 — 80 m

British Grid
centre X: 295702.26 m, centre Y: 90056.94 m

Scale: 1:1500 @ A3. Spatial Units: Meter. Do not scale off this drawing

Geophysical survey: Copyright Substrata
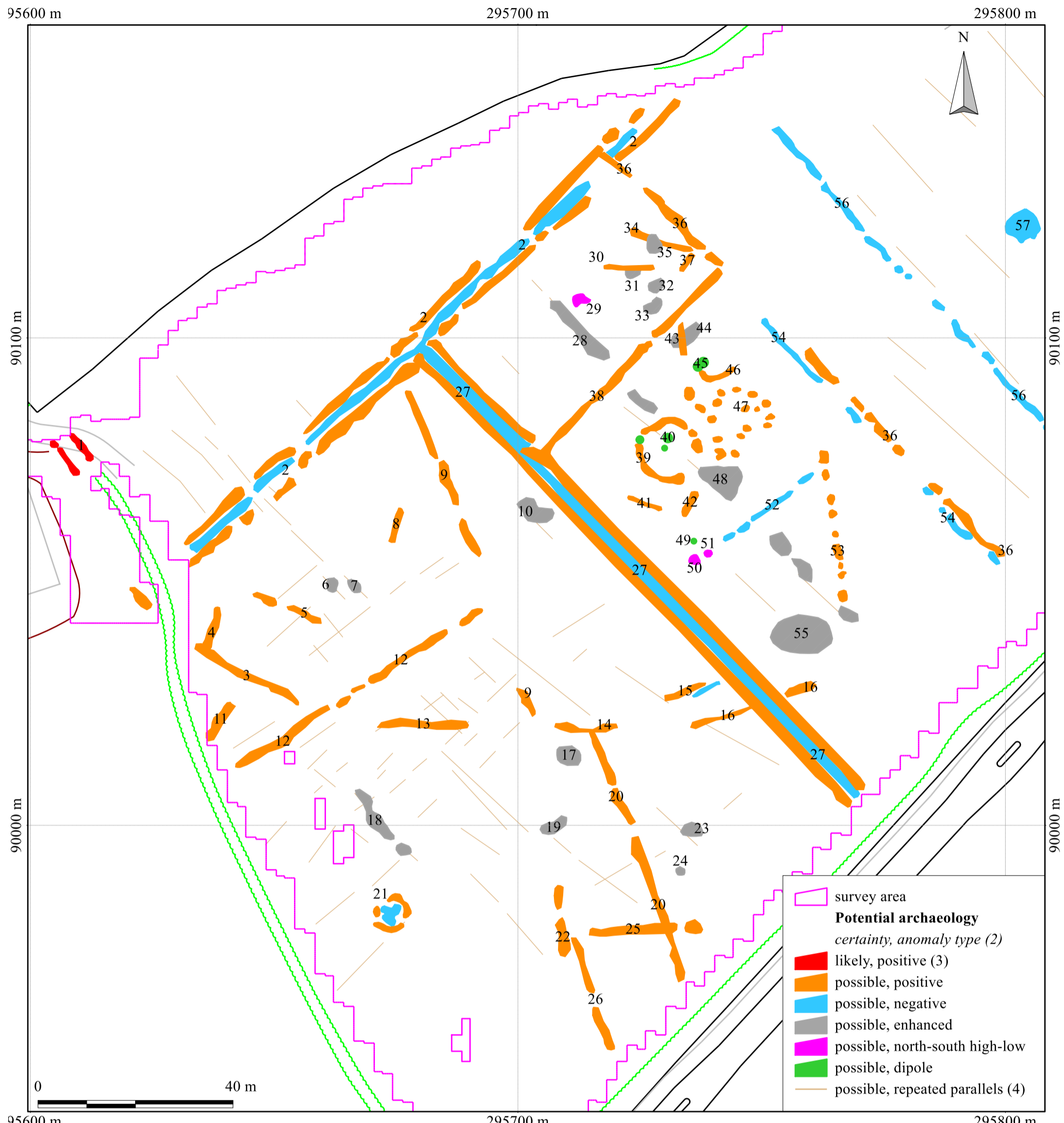Base map: Copyright West Country Land Surveyors Ltd

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, entire area

95600 m   295700 m   295800 m

N

90100 m   90100 m

90000 m   90000 m

0   40 m

95600 m   295700 m   295800 m

Legend

survey area

Potential archaeology
certainty, anomaly type (2)
likely, positive (3)
possible, positive
possible, negative
possible, enhanced
possible, north-south high-low
possible, dipole
possible, repeated parallels (4)

British Grid
centre X: 295703.79 m, centre Y: 90052.73 m

Geophysical survey: Copyright Substrata
Base map: Copyright West Country Land Surveyors Ltd

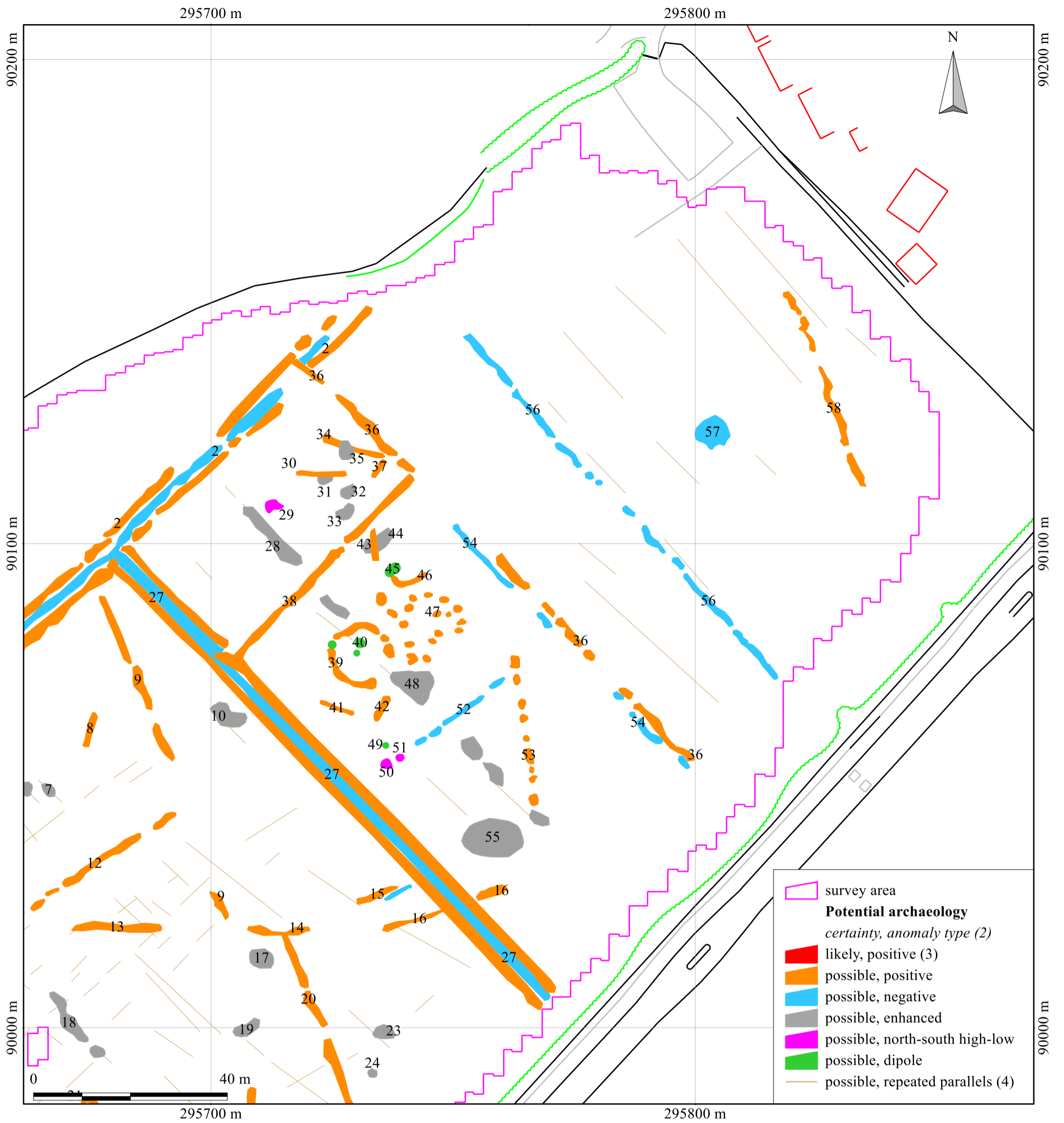Scale: 1:800 @ A3. Spatial Units: Meter. Do not scale off this drawing

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

Figure 3: survey interpretation, western view

Map labels and coordinates

295700 m 295800 m

90200 m 90200 m

90100 m 90100 m

90000 m 90000 m

N

295700 m 295800 m

British Grid
centre X: 295765.60 m, centre Y: 90095.70 m

0   40 m

Scale: 1:800 @ A3. Spatial Units: Meter. Do not scale off this drawing

Geophysical survey: Copyright Substrata
Base map: Copyright West Country Land Surveyors Ltd

Legend

survey area

Potential archaeology
certainty, anomaly type (2)

likely, positive (3)
possible, positive
possible, negative
possible, enhanced
possible, north-south high-low
possible, dipole
possible, repeated parallels (4)

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
3. Anomalies designated "likely archaeology" have supporting evidence e.g. historical maps and or visible
4. Representative; not all instances are mapped.
5. Anomalies likely to represent geological or other natural deposits are not mapped unless relevant to pote

Figure 4: survey interpretation, eastern view
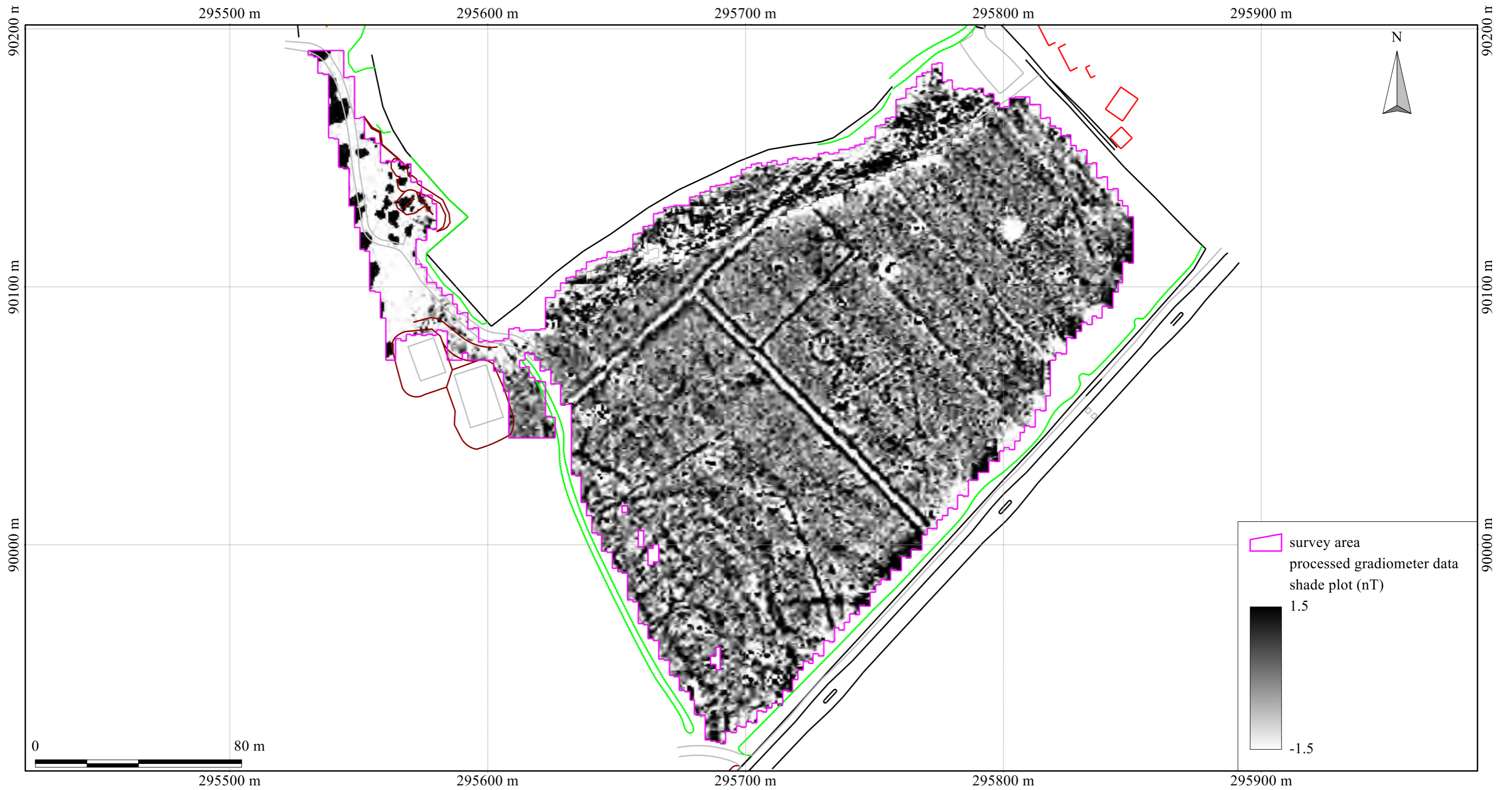
Figure 5: processed gradiometer data, entire area

Map labels and annotations:

- 295500 m, 295600 m, 295700 m, 295800 m, 295900 m (top and bottom axes)
- 90200 m, 90100 m, 90000 m (left and right axes)
- N (north arrow)

Legend:
- survey area
- processed gradiometer data
- shade plot (nT)
  - 1.5
  - -1.5

Scale bar: 0 — 80 m

British Grid
centre X: 295702.26 m, centre Y: 90056.94 m

Scale: 1:1500 @ A3. Spatial Units: Meter. Do not scale off this drawing

Geophysical survey: Copyright Substrata
Base map: Copyright West Country Land Surveyors Ltd

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95600 m   295700 m   295800 m

90100 m

90000 m

survey area
processed gradiometer data
shade plot (nT)

1.5

-1.5

0   40 m

95600 m   295700 m   295800 m

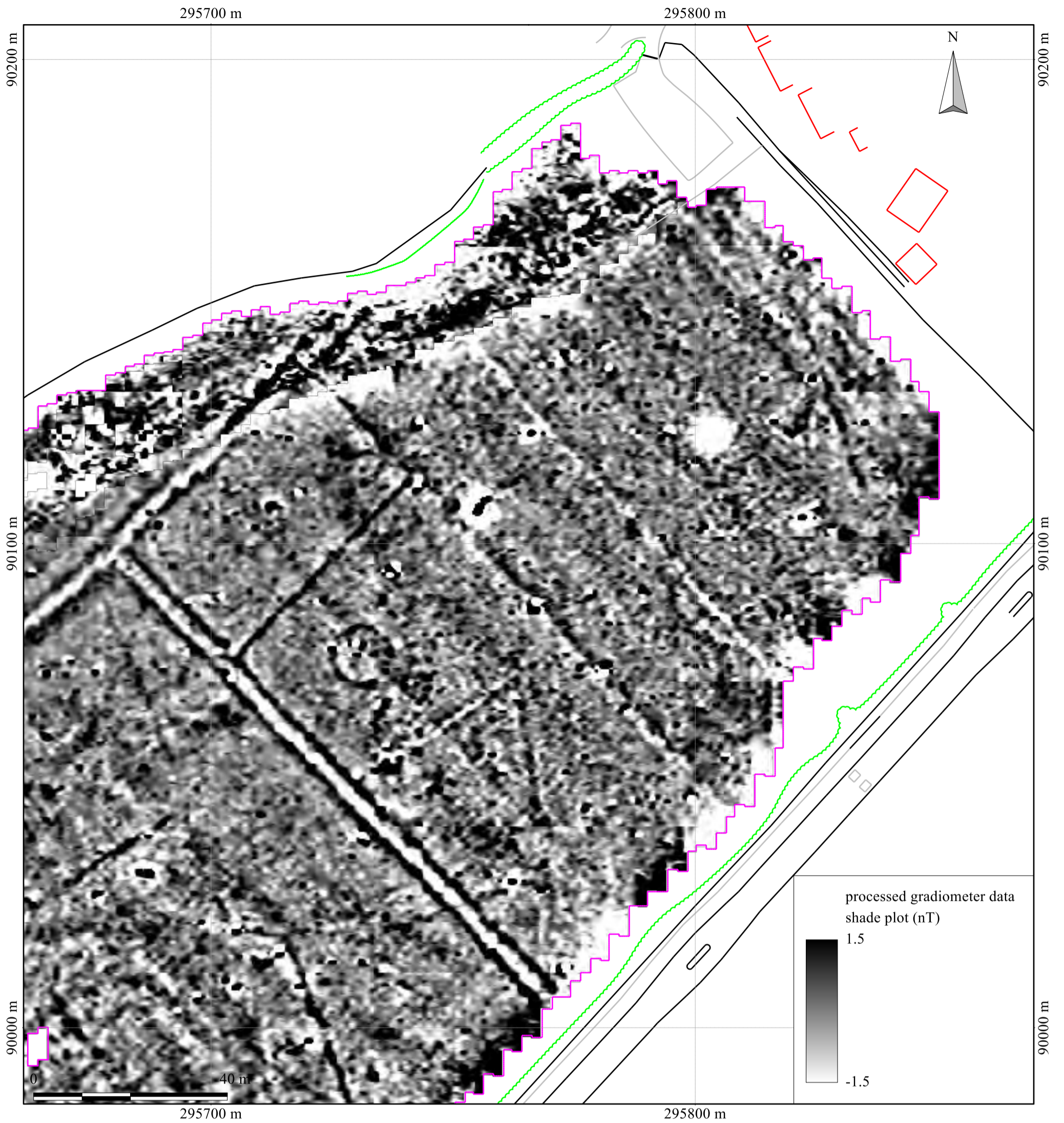British Grid
centre X: 295703.79 m, centre Y: 90052.73 m

Geophysical survey: Copyright Substrata
Base map: Copyright West Country Land Surveyors Ltd

Scale: 1:800 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological magnetometer survey
Land at Exeter Golf Club with 2017 additional area
Newcourt Drive, Exeter
Centred on NGR (E/N): 295740,090080 (point)
Report: 1705NEW-R-1

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

Figure 6: processed gradiometer data, western view

295700 m   295800 m

90200 m   90200 m

N

90100 m   90100 m

90000 m   90000 m

processed gradiometer data
shade plot (nT)

1.5

-1.5

0   40 m

295700 m   295800 m

British Grid
centre X: 295765.60 m, centre Y: 90095.70 m

Geophysical survey: Copyright Substrata
Base map: Copyright West Country Land Surveyors Ltd

Scale: 1:800 @ A3. Spatial Units: Meter. Do not scale off this drawing

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Figure 7: processed gradiometer data, eastern view

0°

3000 nT
1.5
0.9
0.5
0.2
0
-0.3
-0.6
-1
-2
-3000 nT
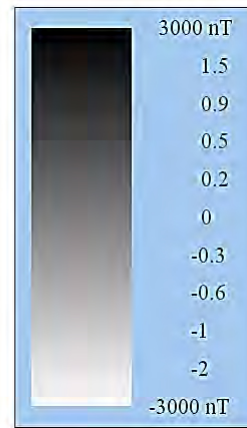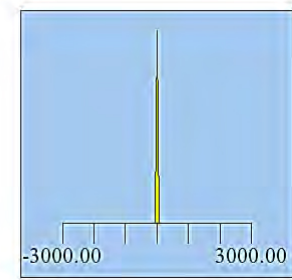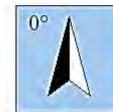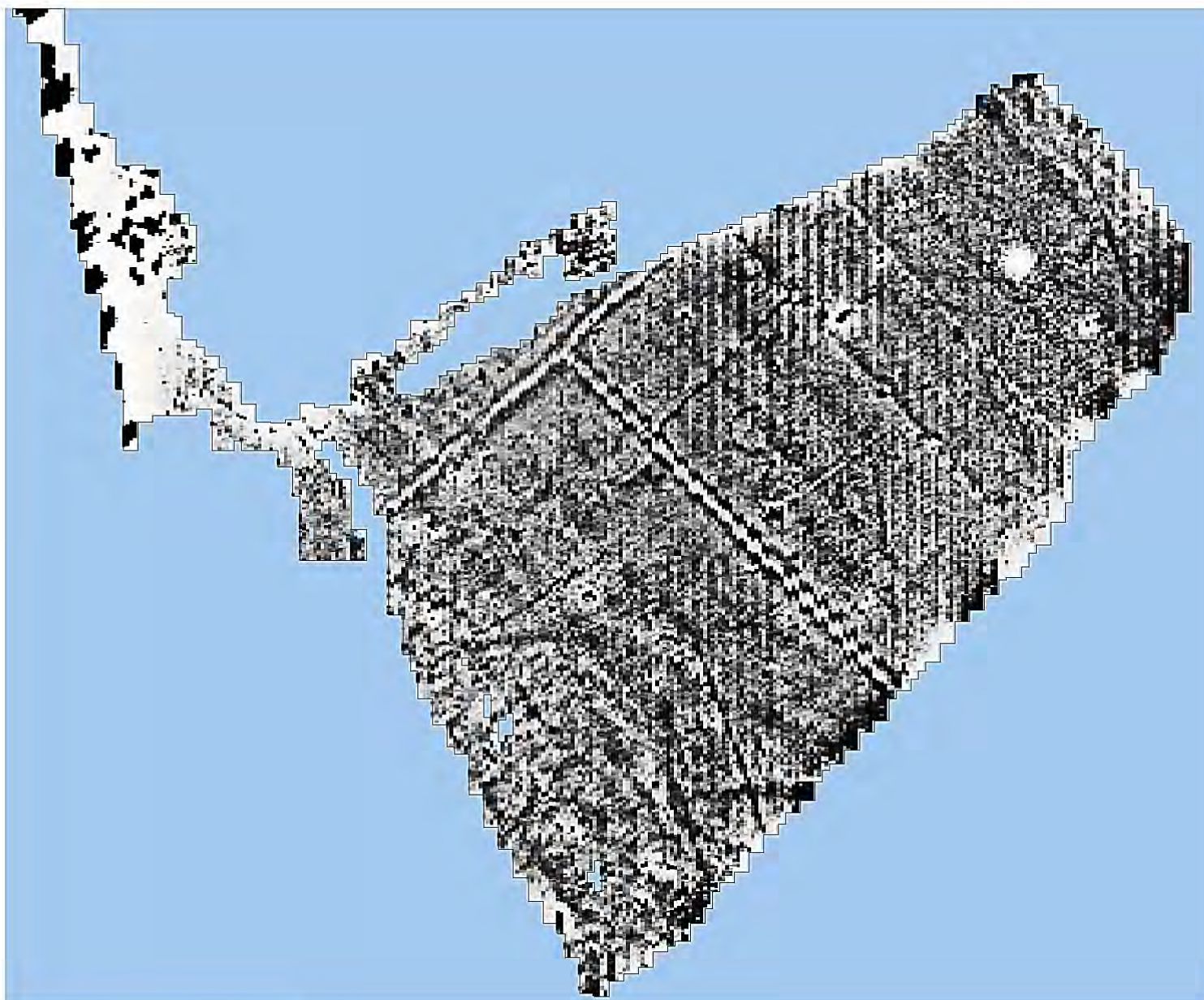
Instrument Type: Bartington Grad 610
Units: nT
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
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: 244.95
Mean: -2.41
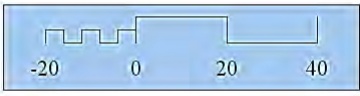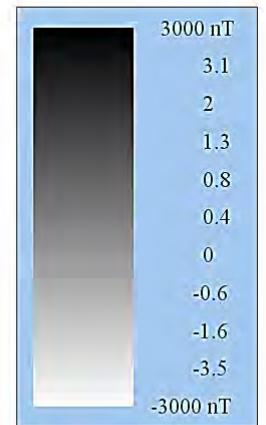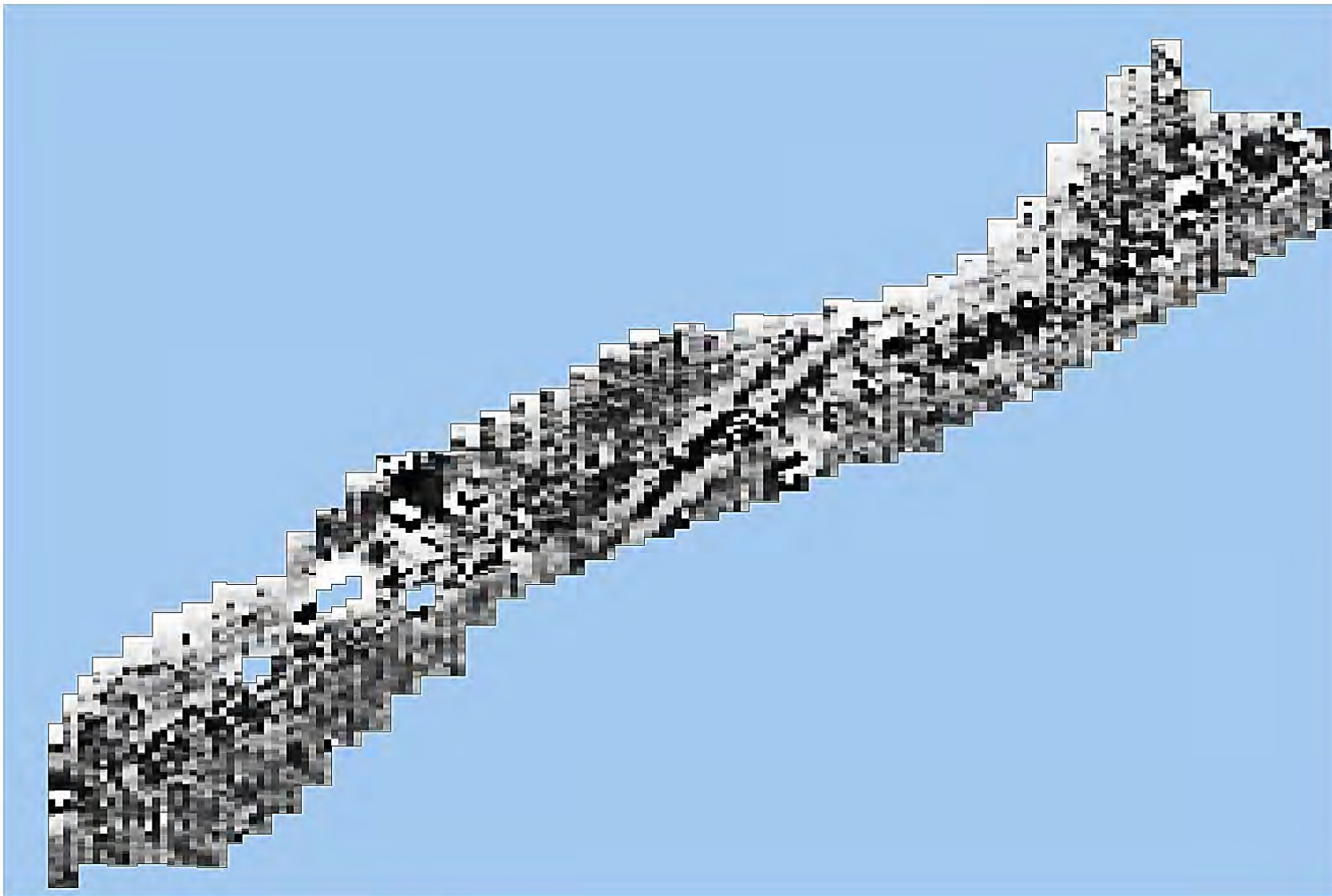Median: 0.00

PROGRAM
Name: TerraSurveyor
Version: 3.0.29.3

Processes: 1
  1 Base Layer

-20   0   20   40

Figure 8: shade plot of unprocessed data, 2016 survey

0°

3000 nT
3.1
2
1.3
0.8
0.4
0
-0.6
-1.6
-3.5
-3000 nT

Instrument type: Bartington grad601-2
Units: nT
Direction of 1st Traverse: 0 deg
Collection Method: ZigZag
Sensors: 2 @ 0.00 m spacing.
Dummy Value: 32702
Dimensions
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: 181.88
Mean: -2.53
Median: 0.40
Surveyed Area: 0.4793 ha
PROGRAM
Name: TerraSurveyor
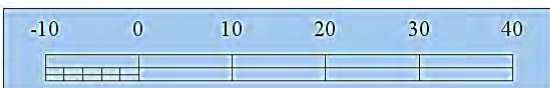Version: 3.0.31.

Processes: 1
 1   Base Layer

-10   0   10   20   30   40

Figure 9: shade plot of unprocessed magnetometer data, 2017 survey area

Appendix 2   Tables

Site: An archaeological magnetometer survey
Land at Exeter Golf Club with additional area, Newcourt Drive, Exeter
Centred on NGR (E/N): 295740,090080 (point)
Report: 1705NEW-R-1

anomaly group	associated anomalies	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments
1		likely, positive	disrupted double linear	flanking ditches of a field boundary	anomaly groups are likely to reflect a removed section of otherwise extant field boundary
2		possible, positive	disrupted double linear	flanking ditches of a Devon bank field boundary	
2		possible, negative	disrupted linear	rubble from former Devon bank field boundary	
3		possible, positive	disrupted curvilinear		
4		possible, positive	linear		
5		possible, positive	disrupted linear		
6		possible, enhanced	oval	possible area of archaeological deposition	
7		possible, enhanced	oval	possible area of archaeological deposition	
8		possible, positive	linear		
9		possible, positive	disrupted linear		
10		possible, enhanced	irregular	possible area of archaeological deposition	
11		possible, positive	linear		
12		possible, positive	disrupted linear		
13		possible, positive	linear		
14		possible, positive	curvilinear		
15		possible, positive	linear		anomaly group comprises a positive and a negative linear anomaly grouping
15		possible, negative	linear		anomaly group comprises a positive and a negative linear anomaly grouping
16		possible, positive	disrupted linear		
17		possible, enhanced	oval	possible area of archaeological deposition	
18		possible, enhanced	disrupted broad linear	possible area of archaeological deposition	
19		possible, enhanced	broad linear	possible area of archaeological deposition	
20		possible, positive	disrupted linear		
21		possible, negative	irregular	possible ring ditch with stony central area	anomaly group clear but characterisation not certain
21		possible, positive	disrupted subcircular	possible ring ditch with stony central area	anomaly group clear but characterisation not certain
22		possible, positive	disrupted linear		
23		possible, enhanced	oval	possible area of archaeological deposition	
24		possible, enhanced	oval	possible area of archaeological deposition	
25		possible, positive	disrupted linear		
26		possible, positive	disrupted linear		
27		possible, negative	linear	rubble from former Devon bank field boundary	
27		possible, positive	disrupted double linear	flanking ditches of a Devon bank field boundary	
28		possible, enhanced	disrupted broad linear	possible area of archaeological deposition	anomaly group may represent a linear feature or former ridge-and-furrow disturbing magnetically enhanced deposits
29		possible, north-south high-low		possible in-situ heated deposits	anomaly group has characteristics consistent with in-situ heated deposits such as those from a kiln or furnace
30		possible, positive	linear		
31		possible, enhanced	oval	possible area of archaeological deposition	
32		possible, enhanced	oval	possible area of archaeological deposition	
33		possible, enhanced	oval	possible area of archaeological deposition	
34		possible, positive	linear		
35		possible, enhanced	oval	possible area of archaeological deposition	
36	54	possible, positive	disrupted linear		anomaly group represents either a linear feature and may be associated with group 54 or it may represent former 'ridge-and furrow passing over magnetically enhanced deposits
37		possible, positive	linear		
38		possible, positive	disrupted linear	possible field boundary	
39		possible, positive	disrupted subcircular	ring ditch or round house gully	
40		possible, dipole		ferrous material	anomalies are mapped because they cause some disruption to group 39 but also because, given their proximity to 39, 'they may denote iron with archaeological context although a modern origin is very likely
41		possible, positive	linear		
42		possible, positive	linear		
43		possible, positive	linear		
44		possible, enhanced	broad linear		
45	46	possible, dipole		ferrous material	
46	45	possible, positive	possible partial subcircular		anomaly group is more likely to be coincidental in shape but needs to be included given the adjacent anomaly 39
47		possible, positive	cluster of ovals	possible pit/posthole cluster	these anomalies have been mapped as an example of a number of similar anomaly clusters across the site as they are 'close to group 39 - it is not certain if they are natural or archaeological in origin
48		possible, enhanced	irregular	possible area of archaeological deposition	
49		possible, dipole		ferrous material	anomaly is mapped because they may denote iron with archaeological context although a modern origin is very likely
50		possible, north-south high-low		possible in-situ heated deposits	anomaly group has characteristics consistent with in-situ heated deposits such as those from a kiln or furnace
51		possible, north-south high-low		possible in-situ heated deposits	anomaly group has characteristics consistent with in-situ heated deposits such as those from a kiln or furnace
52		possible, negative	disrupted linear		
53		possible, positive	disrupted linear or line of pits		
54	36	possible, negative	disrupted linear	possible field boundary	
55		possible, enhanced	irregular	possible area of archaeological deposition	
56		possible, negative	disrupted linear	possible field boundaries	
57		possible, negative	subcircular	shaft, well or hollow filled with stony material or former golf sand pit?	anomaly group is unusual with a high negative central point surrounded by relatively high negative responses - could be a filled shaft
58		possible, positive	disrupted linear		

Table 1: data analysis

Documents	
Survey methodology statement: Dean (2016a) and 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	*Sample Interval:* 0.25m
Firmware: version 6.1	*Traverse Interval:* 1 metre
	Traverse Method: zigzag
	Traverse Orientation: GN

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

Appendix 3   Data processing

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

2016 survey

Stats

Max:	115.42
Min:	-117.05
Std Dev:	14.13
Mean:	-0.74
Median:	-0.06

Processes: 24
1   Base Layer
2   Clip at 1.00 SD
3   De Stagger: Grids: All Mode: Both By: -1 intervals
4   De Stagger: Grids: c3.xgd c2.xgd c1.xgd   Mode: Both By: -1 intervals
5   De Stagger: Grids: b20.xgd b21.xgd b28.xgd   Mode: Both By: -1 intervals
6   De Stagger: Grids: b1.xgd b2.xgd b3.xgd b4.xgd   Mode: Both By: -1 intervals
7   De Stagger: Grids: b1.xgd b2.xgd b3.xgd   Mode: Both By: -1 intervals
8   De Stagger: Grids: b5.xgd   Mode: Both By: -1 intervals
9   De Stagger: Grids: b13.xgd   Mode: Both By: -2 intervals
10 De Stagger: Grids: a23.xgd a22.xgd a21.xgd a20.xgd a19.xgd a18.xgd   Mode: Both By: -1 intervals
11 De Stagger: Grids: a9.xgd a10.xgd a11.xgd a12.xgd a13.xgd a14.xgd a7+a8.xgd Mode: Both By: -1 intervals
12 De Stagger: Grids: a1.xgd a2.xgd   Mode: Both By: -1 intervals
13 De Stagger: Grids: a4+a5.xgd a6.xgd   Mode: Both By: -1 intervals
14 De Stagger: Grids: c5.xgd c10.xgd c7.xgd c6.xgd c11.xgd c8.xgd c12.xgd c9.xgd c13.xgd   Mode: Both By: -1 intervals
15 DeStripe Median Sensors: Grids: a9.xgd a23.xgd b1.xgd a10.xgd a22.xgd b2.xgd b15.xgd a1.xgd a11.xgd a21.xgd b3.xgd b14.xgd b16.xgd a2.xgd a12.xgd a20.xgd b4.xgd b13.xgd b17.xgd b20.xgd c5.xgd a3+c4.xgd a13.xgd a19.xgd b5.xgd b12.xgd b18.xgd b21.xgd c6.xgd a4+a5.xgd a14.xgd a18.xgd b6.xgd b11.xgd b19.xgd b28.xgd c3.xgd a6.xgd a7+a8.xgd a16+a17.xgd b7.xgd b10.xgd b22.xgd b27.xgd c2.xgd a15.xgd b8.xgd b9.xgd b23.xgd b26.xgd c1.xgd b24.xgd b25.xgd
16 Edge Match (Area: Top 180, Left 840, Bottom 209, Right 959) to Left edge
17 Edge Match (Area: Top 210, Left 840, Bottom 239, Right 959) to Left edge
18 Edge Match (Area: Top 270, Left 360, Bottom 299, Right 479) to Right edge
19 Edge Match (Area: Top 240, Left 360, Bottom 269, Right 479) to Right edge
20 Edge Match (Area: Top 60, Left 600, Bottom 89, Right 719) to Left edge
21 De Stagger: Grids: a3+c4.xgd a13.xgd a4+a5.xgd a14.xgd a6.xgd a7+a8.xgd Mode: Both By: 1 intervals
22 De Stagger: Grids: a3+c4.xgd Mode: Both By: 1 intervals
23 Interpolate: Match X & Y Doubled.
24 Clip at 5.00 SD

2017 survey

Stats

Max:	13.19
Min:	-13.38
Std Dev:	3.22
Mean:	-0.09
Median:	0.02

Processes: 8
1   Base Layer
2   Clip at 1.00 SD
3   Clip at 1.00 SD
4   De Stagger: Grids: All Mode: Both By: -2 intervals
5   DeStripe Median Traverse: Grids: All
6   Range Match (Area: Top 0, Left 120, Bottom 29, Right 239) to Left edge
7   Interpolate: X & Y Doubled.
8   Clip at 4.00 SD

Table 3: magnetometer survey - processed data metadata