Substrata
Archaeological Geophysical Surveyors

An archaeological gradiometer survey

Widening of A382 from Drum Bridge to Whitehill Cross and completion of Jetty Marsh Link

Report: 150121

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21 January 2015

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Accompanying CD-ROM

1 Survey description and summary

1.1 Survey

Type:	twin-sensor fluxgate gradiometer
Date:	between 10 November 2014 and 13 January 2015
Area:	18.8ha subject to alterations imposed by land access, flooding and area extensions to provide viable survey data in places
Lead surveyor:	Ross Dean BSc MSc MA MIfA

1.2 Client

SLR Consulting Ltd, 69 Polsloe Road, Exeter, Devon EX1 2NF

1.3 Location

Site:	Widening of A382 from Drum Bridge to Whitehill Cross and completion of Jetty Marsh Link
Town & Civil Parish:	Teigngrace and Newton Abbot
District:	Teignbridge
County:	Devon
Nearest Postcode:	A382 widening: TQ12 6TS to TQ12 2FY Jetty Marsh Link: TQ12 6QX to TQ12 3QJ
NGR:	A382 widening: SX 829 751 to SX 854 725 (points) Jetty Marsh Link: SX 854 726 to SX 856 733 (points)
Ordnance Survey E/N:	A382 widening: NGR 282982,075189 to 285480,072582 (points) Jetty Marsh Link: NGR 285472,072639 to 285668,073324. (points)

1.4 Archive

OASIS number:	substrat1-201074
Archive:	At the time of writing, the archive of this survey will be held by Substrata.

1.5 Introduction

This report was commissioned by SLR Consulting Ltd on behalf of Devon County Council Engineering Design Group as part of a forthcoming application for outline planning permission. The location of the designated survey areas within the proposed development area are shown in Figure 1. The development includes the widening of the A382 between Drum Bridge and Whitehill Cross and the construction of the Jetty Marsh Link road.

1.6 Summary

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

Thirty-eight magnetic anomaly groups were identified as relating to possible archaeological deposits or features. The majority are most likely to relate to former field boundaries and other enclosures. Seven anomaly groups situated between Stover Park and Forches Cross lie north-east of a Prehistoric, double-ditched, rectangular enclosure recorded as cropmarks (DCCHER entry MDV9212). They are by far the most complex set of anomaly groups encountered during the survey and their proximity to the Prehistoric enclosure demands that they be treated as relating to potential archaeological deposits. A further group in the area may reflect a former ditches track or routeway. Two anomaly groups, situated between Forches Cross and Bowerlands, are grouped in clusters that may warrant further investigation. One group, situated between Bowerlands and Exeter Cross, is typical of magnetic responses relating to former ridge-and-furrow or terrace cultivation.

Magnetic anomaly groups are relatively sparse across the Jetty Marsh area. This could be because magnetic minerals have been altered and removed in the wet ground conditions encountered in this area and, given the marshy conditions, that the area does not have a large density of archaeological deposits of a type detectable by magnetic surveying. The three groups that are clear are most likely to relate to former field drainage ditches.

2 Survey aims and objectives

2.1 Aims

1. Contribute to the informing of the design of the scheme and the location and scope of the archaeological mitigation required by the impact of the development.

2.2 Objectives

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

3 Standards

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

4 Site description

4.1 Location, land use and topography

The location of the designated survey areas within the proposed development area are shown in Figure 1. The application area is situated north of Newton Abbot between NGR 282982,075189 to 285480,072582 (areas 1 to 4) and NGR 285472,072639 to 285668,073324 (area 5).

Area 1 is situated on the Stover golf course. Areas 2 to 4 comprise agricultural land under pasture at the time of the survey. Area 5 was also pasture at the time of the survey with its eastern side subject to regular flooding creating meadowland.

The height of the land varies from 23m AOD at the northern end of Stover golf course (area 1) to 4.6m AOD at Teignbridge Crossing (area 5) with gentle slopes in between rising as high as 45m AOD at The Lodge of Stover School (area 2) and 39m AOD at Forches Cross (areas 2 and 3).

4.2 Geology

The application area is located on a solid geology of the Palaeogene Bovey Formation which is comprised of sand, silt and clay. Superficial Quaternary alluvium deposits are found in area 1 (Stover golf course), the northern end of area 4 (Bowerlands to Exeter Cross) and area 5 (Jetty Marsh). These deposits are normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel. A stronger, desiccated surface zone may be present (British Geological Survey, undated).

5 Archaeological background

A comprehensive report of the historical environment is provided in Smart (2014).

6 Results, discussion and conclusions

This survey was designed to record magnetic anomalies. The anomalies themselves cannot be regarded as actual archaeological features and the dimensions of the anomalies shown do not represent the dimensions of any associated archaeological features. The analysis presented below identifies and characterises anomalies and anomaly groups that may relate to archaeological deposits and structures.

The reader is referred to section 7.

6.1 Results

The survey areas were designated 1 to 5 as shown in Figure 1.

Figures 2 to 7 show the interpretation of the survey data across survey areas 1 to 5. They include the anomaly groups identified as relating to archaeological deposits along with their numbers. Table 1 is an extract from a detailed analysis of the survey data provided in the attribute tables of the GIS project on the accompanying CD-ROM.

Figures 2 to 7 along with Table 1 comprises the analysis of the survey data. Plots of the processed data are provided in Figures 8 to 13.

6.2 Discussion

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

6.2.1 General points

Anomalies thought to relate to natural features were not mapped except in area 5 where a number of palaeochannels and springs were recorded as such features can have archaeological relevance. The features are listed in Table 1 but are not discussed below except where they relate to recorded anomalies reflecting potential archaeological deposits.

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.

There are numerous anomaly groups that could be interpreted as relating to large 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 to form recognisable patterns.

Data collection along the survey area edges was restricted as shown in Figures 2 to 13 due to the presence of magnetic materials in and adjacent to field and roadside boundaries. The proximity of the existing roads meant that occasional interference was experienced from passing vehicles. Strong magnetic responses mapped close to the field and roadside boundaries are likely to relate to these materials and circumstances except where indicated otherwise in Figure 1.

6.2.2 Area 1, Newton Abbot (Stover) Golf Course (Figures 2 and 8)

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

No magnetic anomaly groups corresponded with features recorded on historical maps or heritage assets recorded in the Devon County Council Historical Environment Record.

Data with no previous archaeological provenance
Magnetic anomaly group **37** is most likely to represent an extension of an extant, modern field boundary.

6.2.3 Area 2, Stover Park to Forches Cross (Figures 3 and 9)
Data relating to historical maps and other records
No magnetic anomaly groups corresponded with features recorded on historical maps or heritage assets recorded in the Devon County Council Historical Environment Record.

Data with no previous archaeological provenance
The majority of magnetic anomaly groups mapped as relating to potential archaeological deposits are linear and curvilinear groups that are most likely to relate to past field boundaries or other enclosures of unknown date.

Groups **1 and 2** may relate to parallel linear deposits such as those defining a former track or routeway.

Group **8**, while faint, has a distinct, disrupted curvilinear pattern that may relate to an archaeological deposit although more recent origins, such as vehicle tracks, cannot be ruled out.

Anomaly groups **10 to 16** lie north-east of a Prehistoric, double-ditched, rectangular enclosure recorded as cropmarks (DCCHER entry MDV9212). They are by far the most complex set of anomaly groups encountered during the survey and their proximity to the Prehistoric enclosure demands that they be treated as relating to potential archaeological deposits.

6.2.4 Area 3, Forches Cross to Bowerlands (Figures 4 and 10)
Data relating to historical maps and other records
No magnetic anomaly groups corresponded with features recorded on historical maps or heritage assets recorded in the Devon County Council Historical Environment Record.

Data with no previous archaeological provenance
The majority of magnetic anomaly groups mapped as relating to potential archaeological deposits are linear and curvilinear groups that are most likely to relate to past field boundaries or other enclosures of unknown date. Of these, groups **19 to 21** and **22 to 28** are in clusters that warrant further investigation.

6.2.5 Area 4, Bowerlands to Exeter Cross (Figures 5 and 11)
Data relating to historical maps and other records
No magnetic anomaly groups corresponded with features recorded on historical maps or heritage assets recorded in the Devon County Council Historical Environment Record.

Data with no previous archaeological provenance
The majority of magnetic anomaly groups mapped as relating to potential archaeological deposits are linear and curvilinear groups that are most likely to relate to past field boundaries or other enclosures of unknown date.

Group **30** may relate to archaeological deposits but may represent recently disturbed ground within the vicinity of possible field drains or service trenches.

Group **31** has been mapped as potentially relating to archaeological deposits but may relate to recent ground disturbance.

Group **32** is typical of magnetic responses relating to former ridge-and-furrow or terrace cultivation. These groups can be considered in the context of a series of broad banks have been recorded in a Plantation north of Gavricks Copse to the north-west of survey area 1 at National Grid reference SX 8312 7485 (point). These are thought to be dumps from adjacent quarries but some are very regular and could have different origins (DCCHER MDV9152).

6.2.6 Area 5, Jetty Marsh (Figures 6, 7, 12 and 13)

Data relating to historical maps and other records

No magnetic anomaly groups corresponded with features recorded on historical maps or heritage assets recorded in the Devon County Council Historical Environment Record.

Data with no previous archaeological provenance

Magnetic anomaly groups are relatively sparse in survey area 5. This could be because magnetic minerals have been altered and removed in the wet ground conditions encountered in this area and, given the marshy conditions, that the area does not have a large density of archaeological deposits of a type detectable by magnetic surveying.

Group **33** is a straight, linear anomaly that by its form possibly related to an archaeological deposit such as a ditch or, given its form (Figure 12) and proximity to an anomaly reflecting a palaeochannel (groups 205, Figure 6), a straightened or adapted palaeochannel.

Group **34** (Figures 7 and 13) coincides with extant earthworks that are most likely to be former field drainage ditches and, possibly, associated small enclosures. Group 35 is adjacent and very similar in form. This group is also most likely to represent former drainage ditches.

Group **38** (Figures 7 and 13) is similar in form to groups 34 and 35 but, given its location on slightly higher ground, it may represent either drainage ditches or other linear archaeological features.

6.3 Conclusions

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

Thirty-eight magnetic anomaly groups were identified as relating to possible archaeological deposits or features. The majority are most likely to relate to former field boundaries and other enclosures. Seven anomaly groups situated between Stover Park and Forches Cross lie north-east of a Prehistoric, double-ditched, rectangular enclosure recorded as cropmarks (DCCHER entry MDV9212). They are by far the most complex set of anomaly groups encountered during the survey and their proximity to the Prehistoric enclosure demands that they be treated as relating to potential archaeological deposits. A further group in the area may reflect a former ditches track or routeway. Two anomaly groups, situated between Forches Cross and Bowerlands, are grouped in clusters that may warrant further investigation. One group, situated between Bowerlands and Exeter Cross, is typical of magnetic responses relating to former ridge-and-furrow or terrace cultivation.

Magnetic anomaly groups are relatively sparse across the Jetty Marsh area. This could be because magnetic minerals have been altered and removed in the wet ground conditions encountered in this area and, given the marshy conditions, that the area does not have a large density of archaeological deposits of a type detectable by magnetic surveying. The three groups that are clear are most likely to relate to former field drainage ditches.

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 Helen Smart of SLR Consulting Ltd for commissioning us to complete this survey.

9 Bibliography

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Appendix 1 Analysis table and supporting plots

General Guidance

The anomalies represented in the survey plots provided in this appendix are magnetic anomalies. The apparent size of such anomalies and anomaly patterns are unlikely to correspond exactly with the dimensions of any associated archaeological features.

A rough rule for interpreting magnetic anomalies is that the width of an anomaly at half its maximum reading is equal to the width of the buried feature, or its depth if this is greater (Clark, 2000: 83). Caution must be applied when using this rule as it depends on the anomalies being clearly identifiable and distinct from adjacent anomalies. In northern latitudes the position of the maximum of a magnetic anomaly will be displaced slightly to the south of any associated physical feature.

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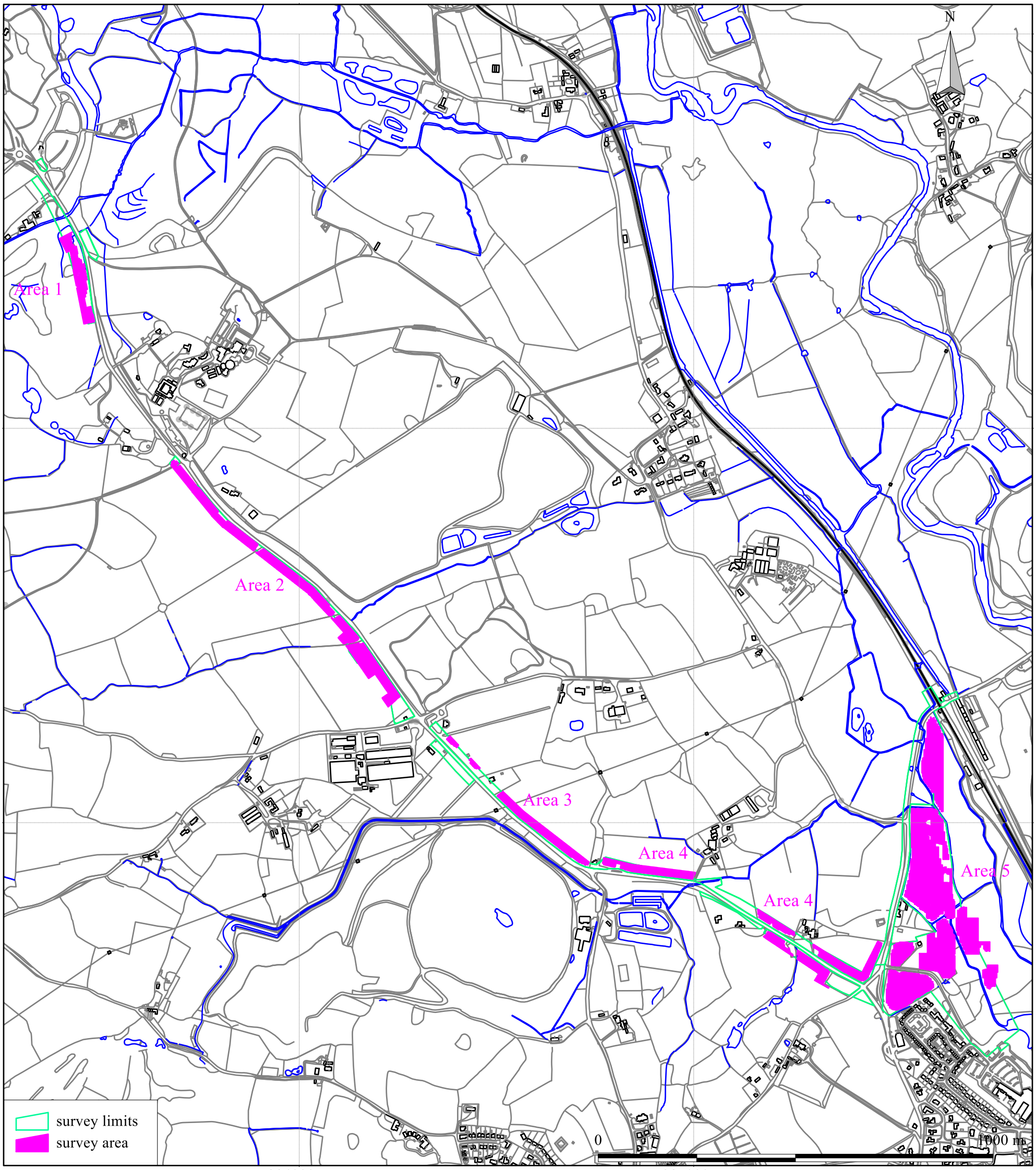
survey area	anomaly group	associated anomalies	anomaly characterisation certainty & class	anomaly form	additional archaeological characterisation	comments	supporting evidence
1	37		possible, positive	linear			
	121		possible, low contrast linear		service		
	122		possible, low contrast linear		service		
	123		possible, mixed spread		service trench with rubble and ferrous material fill		
	124		possible, high contrast linear		service steel or iron pipe, cable or drain		
	125		possible, low contrast linear		golf course drain		
	126		possible, regular narrow linears		golf course drainage		
	127		possible, low contrast linear		golf course drain		
	128		possible, low contrast linear		golf course drain		
2	1		possible, positive	disrupted linear			
	2		possible, positive	disrupted linear			
	3		possible, positive	linear			
	4		possible, positive	irregular	surface or large pit	anomaly group could represent archaeological or natural deposits	
	5		possible, positive	disrupted linear			
	6		possible, positive	linear			
	7		possible, positive	linear			
	8		possible, positive	disrupted curvilinear			
	9		possible, positive	linear			
	10		possible, positive	disrupted linear		anomaly group lies north-east of a Prehistoric, double-ditched, rectangular enclosure	DCCHER MDV9121
	11		possible, positive	linear		anomaly group lies north-east of a Prehistoric, double-ditched, rectangular enclosure	DCCHER MDV9121
	12		possible, negative	linear		anomaly group lies north-east of a Prehistoric, double-ditched, rectangular enclosure	DCCHER MDV9121
	13		possible, negative	linear		anomaly group lies north-east of a Prehistoric, double-ditched, rectangular enclosure	DCCHER MDV9121
	14		possible, positive	linear		anomaly group lies north-east of a Prehistoric, double-ditched, rectangular enclosure	DCCHER MDV9121
	15		possible, positive	linear		anomaly group lies north-east of a Prehistoric, double-ditched, rectangular enclosure	DCCHER MDV9121
	16		possible, positive	curvilinear		anomaly group lies north-east of a Prehistoric, double-ditched, rectangular enclosure	DCCHER MDV9121
	17		possible, positive	linear			
	101		possible, high contrast linear		service steel or iron pipe, cable or drain		
	102		possible, high contrast linear		service steel or iron pipe, cable or drain		
	103		possible, high contrast linear		service steel or iron pipe, cable or drain		
	104		possible, high contrast linear		service steel or iron pipe, cable or drain		
3	18		possible, positive	disrupted linear			
	19		possible, positive	disrupted linear			
	20		possible, positive	linear			
	21		possible, positive	linear			
	22		possible, positive	linear			
	23		possible, positive	disrupted linear			
	24		possible, positive	linear			
	25		possible, positive	disrupted curvilinear			
	26	27	possible, positive	linear		anomaly group may be an extension of group 27	
	27	26	possible, positive	linear		anomaly group may be an extension of group 26	
	28		possible, positive	linear			
4	29		possible, positive	curvilinear			
	30		possible, positive & negative	linear		anomaly groups may represent archaeology or recently disturbed ground and field drains	
	31		possible, negative	curvilinear			
	32		possible, repeated parallels		cultivation traces	anomaly groups represent ridge-and-furrow or similar cultivation	
	105		possible, high contrast linear		service steel or iron pipe, cable or drain		
	106		possible, high contrast linear		service steel or iron pipe, cable or drain		
	107		possible, high contrast linear		service steel or iron pipe, cable or drain		
	108		possible, low contrast linear		field drain or service trench		
	109		possible, low contrast linear		field drain or service trench		
	110		possible, low contrast high		service		
5	33		possible, positive	linear		anomaly group may represent a ditch, straightened palaeochannel or a natural palaeochannel	
	34		likely, negative	multilinear	drainage ditches	anomaly groups coincide with extant earthworks, probably former drainage ditches of unknown origin	
	35		possible, negative	multilinear	drainage ditches	anomaly groups probably represent former drainage ditches of unknown origin	
	36		possible, mixed spread	linear	drainage ditch	anomaly group probably represents a former drainage ditch of unknown origin subsequently filled with rubble	
	38		possible, negative	multilinear		anomalies may represent drainage ditches similar of those mapped to the east or other linear feature	
	111		possible, mixed spread		rubble, landfill or near-surface geology		
	112		possible, mixed spread		rubble, landfill or near-surface geology		
	113		possible, regular narrow linears		field drains		
	114		possible, mixed spread		rubble, landfill or near-surface geology		
	115		possible, regular narrow linear		field drains		
	116		possible, regular narrow linear		field drains		
	117		possible, low contrast high		service		
	118		possible, regular narrow linears		field drains		
	119		possible, dipole		steel or iron object	anomaly group mapped to avoid confusion with potential archaeology	
	120		possible, high contrast linear		service steel or iron pipe, cable or drain		
	201		possible, sinuous broad linear		palaeochannel	anomalies mapped as palaeochannels can have archaeological significance	
	202		possible, sinuous broad linear		palaeochannel	anomalies mapped as palaeochannels can have archaeological significance	
	203		possible, sinuous broad linear		palaeochannel	anomalies mapped as palaeochannels can have archaeological significance	
	204		possible, sinuous broad linear		palaeochannel	anomalies mapped as palaeochannels can have archaeological significance	
	205		possible, sinuous broad linear		palaeochannel	anomalies mapped as palaeochannels can have archaeological significance	
	206		possible, sinuous broad linear		palaeochannel	anomalies mapped as palaeochannels can have archaeological significance	
	207		possible, sinuous broad linear		palaeochannel	anomalies mapped as palaeochannels can have archaeological significance	
	208		possible, weak broad dipolar		spring	anomalies mapped as springs can have archaeological significance	
	209		possible, weak broad dipolar		spring	anomalies mapped as springs can have archaeological significance	
	210		possible, sinuous broad linear		palaeochannel	anomalies mapped as palaeochannels can have archaeological significance	

Table 1: data analysis



British Grid
centre X: 284554.58 m, centre Y: 73602.72 m

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

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Figure 1: location map and survey area designations

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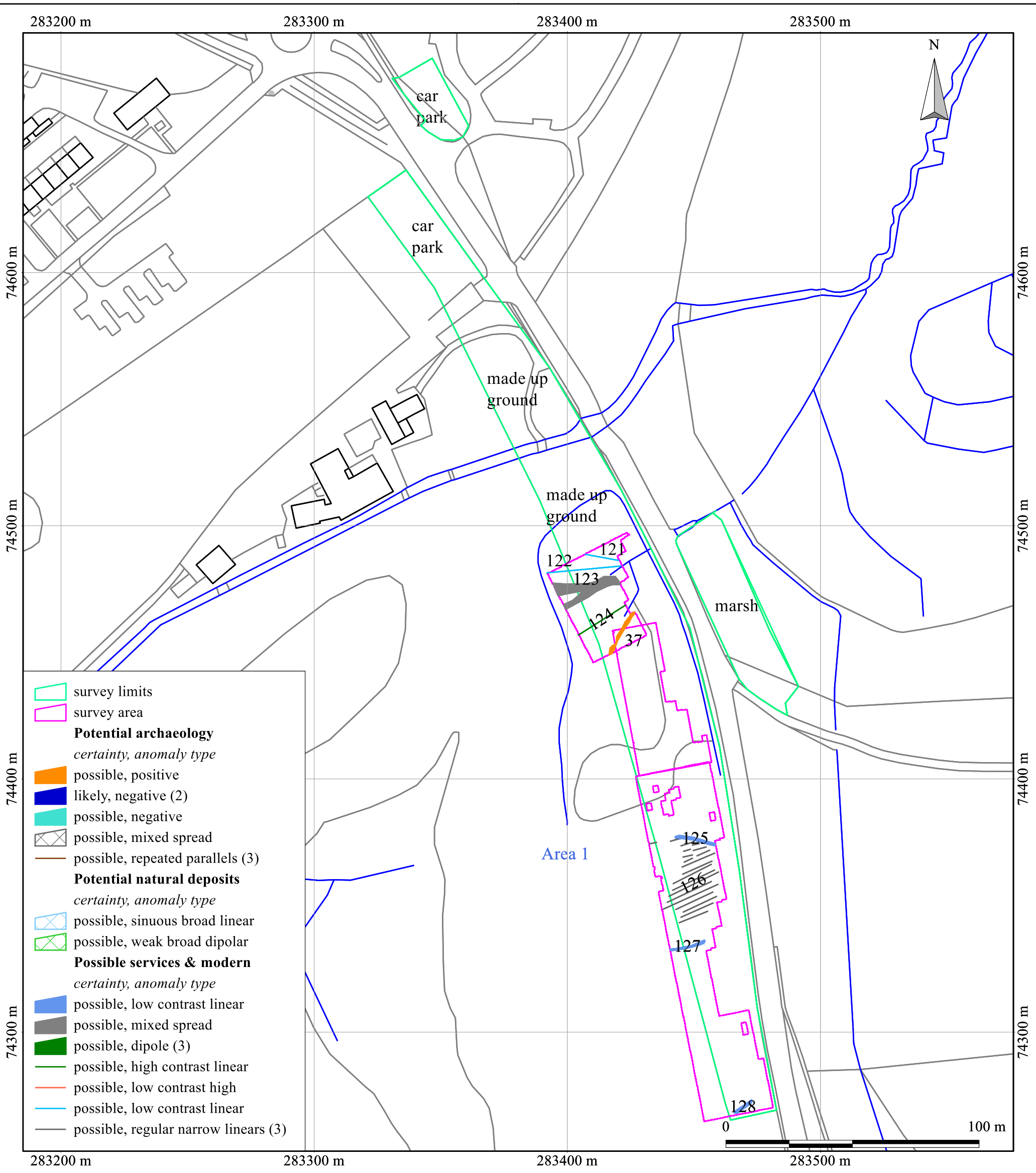

British Grid
centre X: 283380.63 m, centre Y: 74473.83 m

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

Notes:
1. All interpretations are provisional and represent potential archaeological deposits.
2. Anomalies designated "likely archaeology" have supporting evidence e.g. historical maps and or visible earthworks.
3. Representative; not all instances are mapped.
4. Anomalies likely to represent geological or other natural deposits are not mapped unless relevant to potential archaeological events or deposit

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Figure 2: survey interpretation
Survey area 1: Stover golf course

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283700 m 283800 m 283900 m 284000 m 284100 m 284200 m

73900 m 73800 m 73700 m 73600 m 73500 m 73400 m 73300 m

N

101 1 2 3 4 5 6 7 8 102 9 103 10 11 12 13 104 14 15 104 16 17 104

Area 2

No access

0 100 m

survey limits
survey area
Potential archaeology
certainty, anomaly type
possible, positive
possible, negative
possible, repeated parallels (3)
Potential natural deposits
certainty, anomaly type
possible, sinuous broad linear
possible, weak broad dipolar
Possible services & modern
certainty, anomaly type
possible, mixed spread
possible, high contrast linear
possible, low contrast high
possible, low contrast linear
possible, regular narrow linears

British Grid
centre X: 283949.18 m, centre Y: 73580.75 m

Scale: 1:2500 @ A3. Spatial Units: Meter. Do not scale off this drawing

Notes:
1. All interpretations are provisional and represent potential archaeological deposits.
2. Anomalies designated "likely archaeology" have supporting evidence e.g. historical maps and or visible earthworks.
3. Representative; not all instances are mapped.
4. Anomalies likely to represent geological or other natural deposits are not mapped unless relevant to potential archaeological events or deposit

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Figure 3: survey interpretation
Survey area 2: Stover Park to Forches Cross

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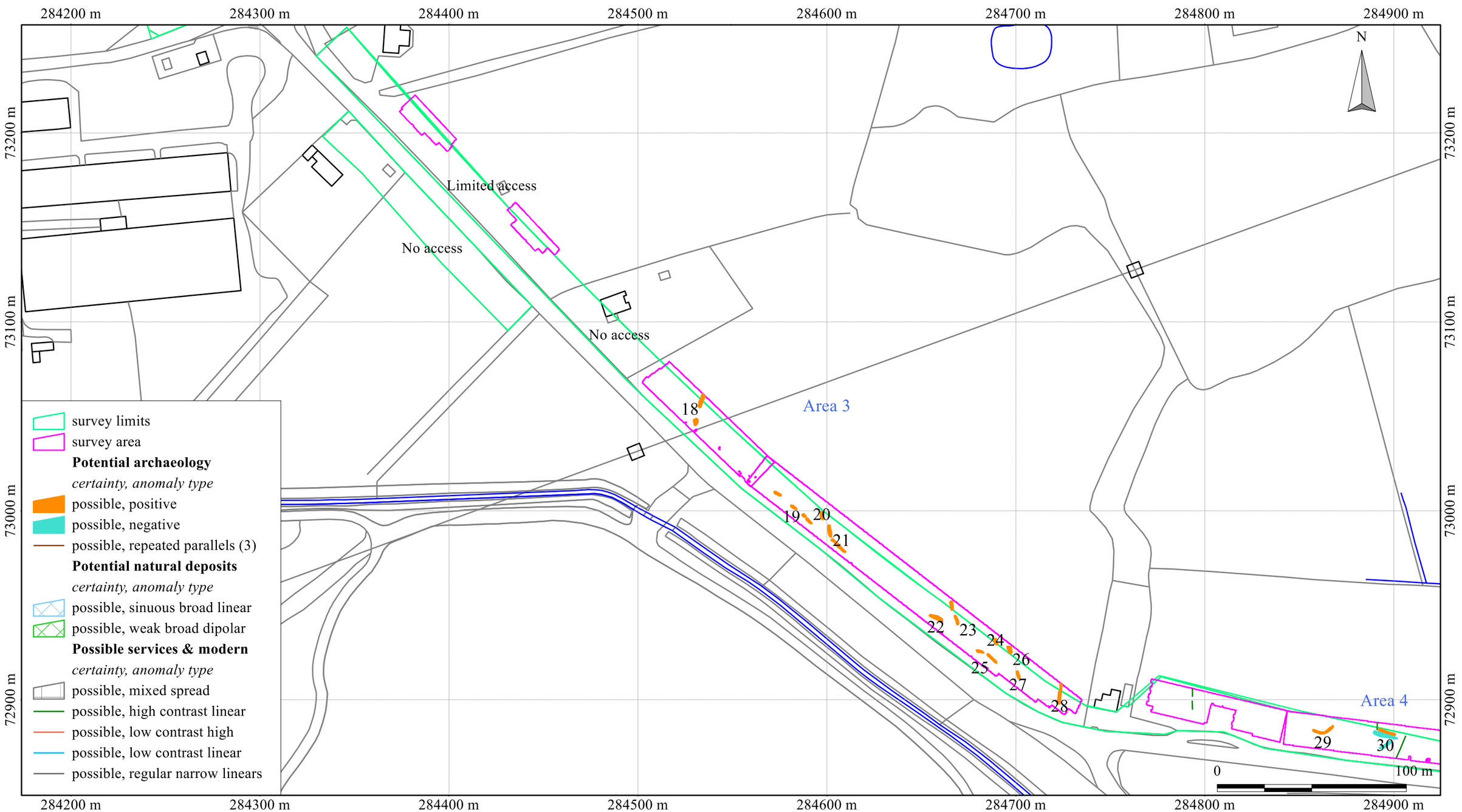

British Grid
centre X: 284549.26 m, centre Y: 73053.28 m

Scale: 1:2000 @ A3. Spatial Units: Meter. Do not scale off this drawing

Notes:
1. All interpretations are provisional and represent potential archaeological deposits.
2. Anomalies designated "likely archaeology" have supporting evidence e.g. historical maps and or visible earthworks.
3. Representative; not all instances are mapped.
4. Anomalies likely to represent geological or other natural deposits are not mapped unless relevant to potential archaeological events or deposits.

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Figure 4: survey interpretation
Survey area 3: Forches Cross to Bowerlands

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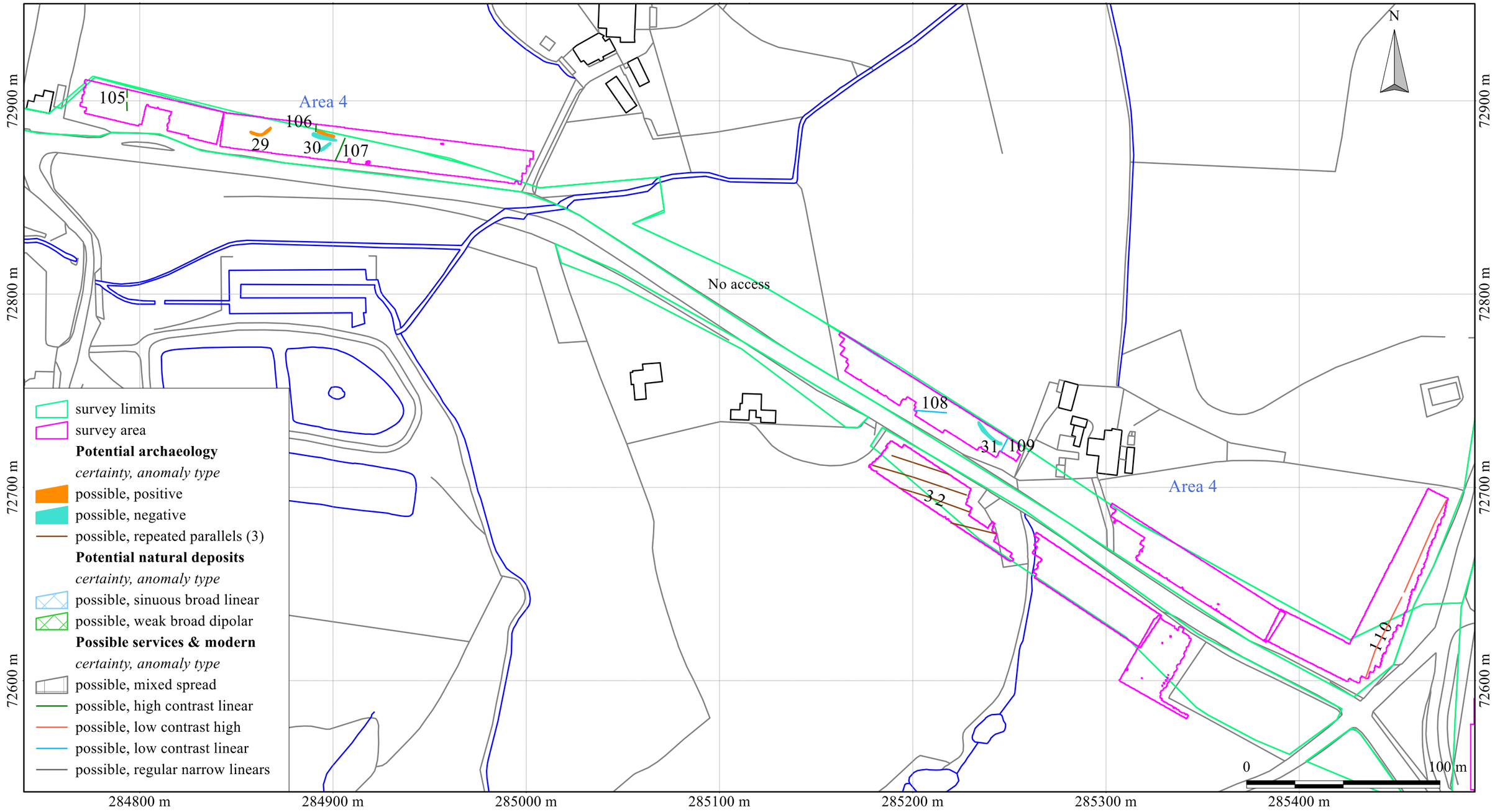

British Grid
centre X: 285115.47 m, centre Y: 72746.36 m

Scale: 1:2000 @ A3. Spatial Units: Meter. Do not scale off this drawing

Notes:
1. All interpretations are provisional and represent potential archaeological deposits.
2. Anomalies designated "likely archaeology" have supporting evidence e.g. historical maps and or visible earthworks.
3. Representative; not all instances are mapped.
4. Anomalies likely to represent geological or other natural deposits are not mapped unless relevant to potential archaeological events or deposits.

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Figure 5: survey interpretation
Survey area 4: Bowerlands to Exeter Cross

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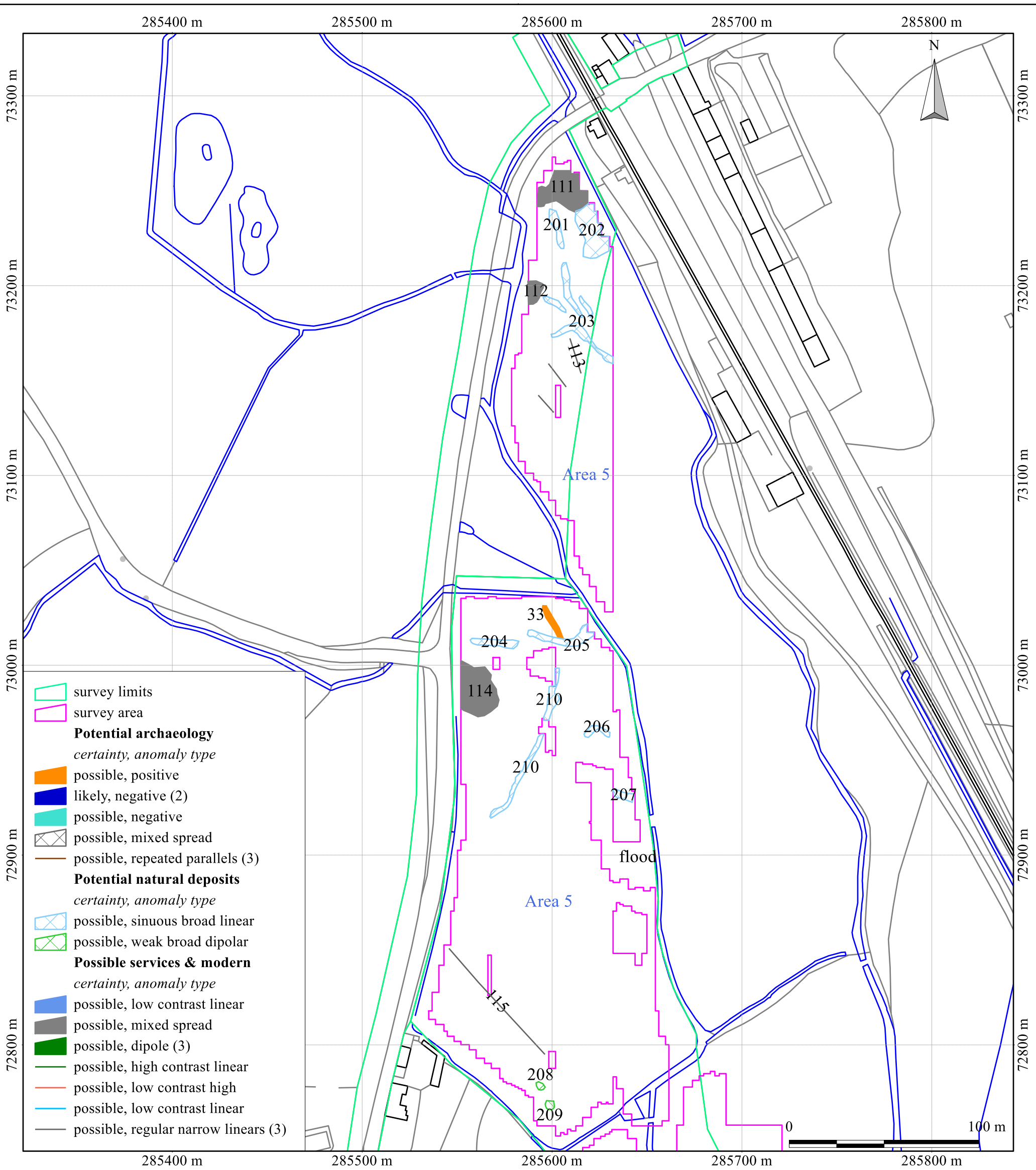

British Grid
centre X: 285582.19 m, centre Y: 73038.46 m

Scale: 1:2000 @ A3. Spatial Units: Meter. Do not scale off this drawing

Notes:
1. All interpretations are provisional and represent potential archaeological deposits.
2. Anomalies designated "likely archaeology" have supporting evidence e.g. historical maps and or visible earthworks.
3. Representative; not all instances are mapped.
4. Anomalies likely to represent geological or other natural deposits are not mapped unless relevant to potential archaeological events or deposit

An archaeological gradiometer survey
Widening of A382 from Drum Bridge to Whitehill Cross
and completion of Jetty Marsh Link
Report: preliminary 07/01/2015

Figure 6: survey interpretation
Survey area 5 North: Jetty Marsh

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15 Horizon View, Bath Hotel Road
Westward Ho!, Bideford, Devon EX39 1GX
Tel: 07788627822
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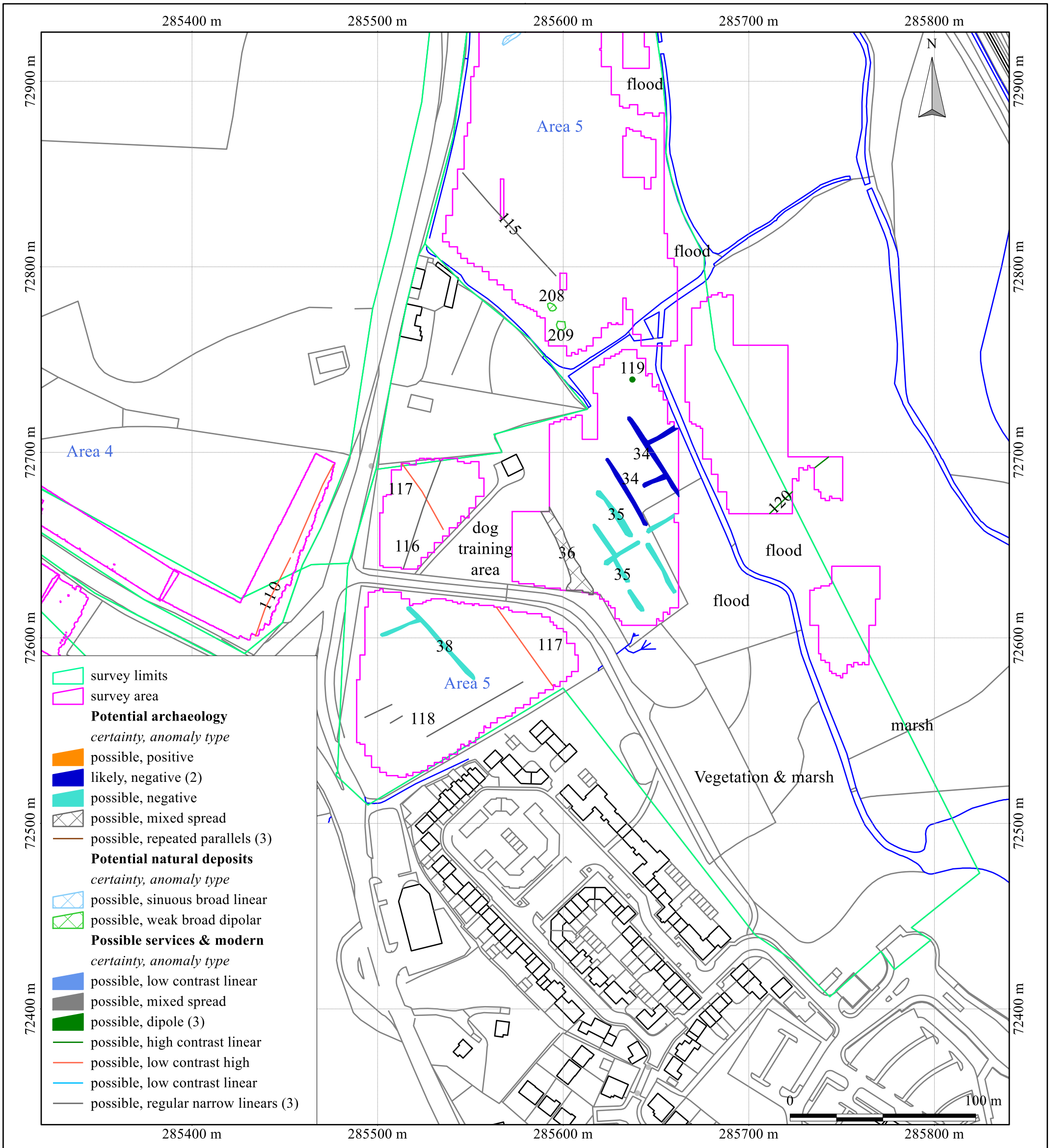

British Grid
centre X: 285579.55 m, centre Y: 72632.06 m

Scale: 1:2000 @ A3. Spatial Units: Meter. Do not scale off this drawing

Notes:
1. All interpretations are provisional and represent potential archaeological deposits.
2. Anomalies designated "likely archaeology" have supporting evidence e.g. historical maps and or visible earthworks.
3. Representative; not all instances are mapped.
4. Anomalies likely to represent geological or other natural deposits are not mapped unless relevant to potential archaeological events or deposit

An archaeological gradiometer survey
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Figure 7: survey interpretation
Survey area 5 South: Jetty Marsh

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283200 m 283300 m 283400 m 283500 m

74600 m
74500 m
74400 m
74300 m

N

car park

made up ground

made up ground

marsh

Area 1

survey limits
Stover golf course
nT
2
-2

0 100 m

British Grid
centre X: 283380.63 m, centre Y: 74473.83 m

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

An archaeological gradiometer survey
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Figure 8: shade plot of processed data
Survey area 1: Stover golf course

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283700 m 283800 m 283900 m 284000 m 284100 m 284200 m

73900 m 73800 m 73700 m 73600 m 73500 m 73400 m 73300 m

N

Area 2

No access

survey limits
Stover Park - Forches Cross
nT
4
-4

0 100 m

British Grid
centre X: 283949.18 m, centre Y: 73580.75 m

Scale: 1:2500 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological gradiometer survey
Widening of A382 from Drum Bridge to Whitehill Cross
and completion of Jetty Marsh Link
Report: 150121

Figure 9: shade plot of processed data
Survey area 2: Stover Park to Forches

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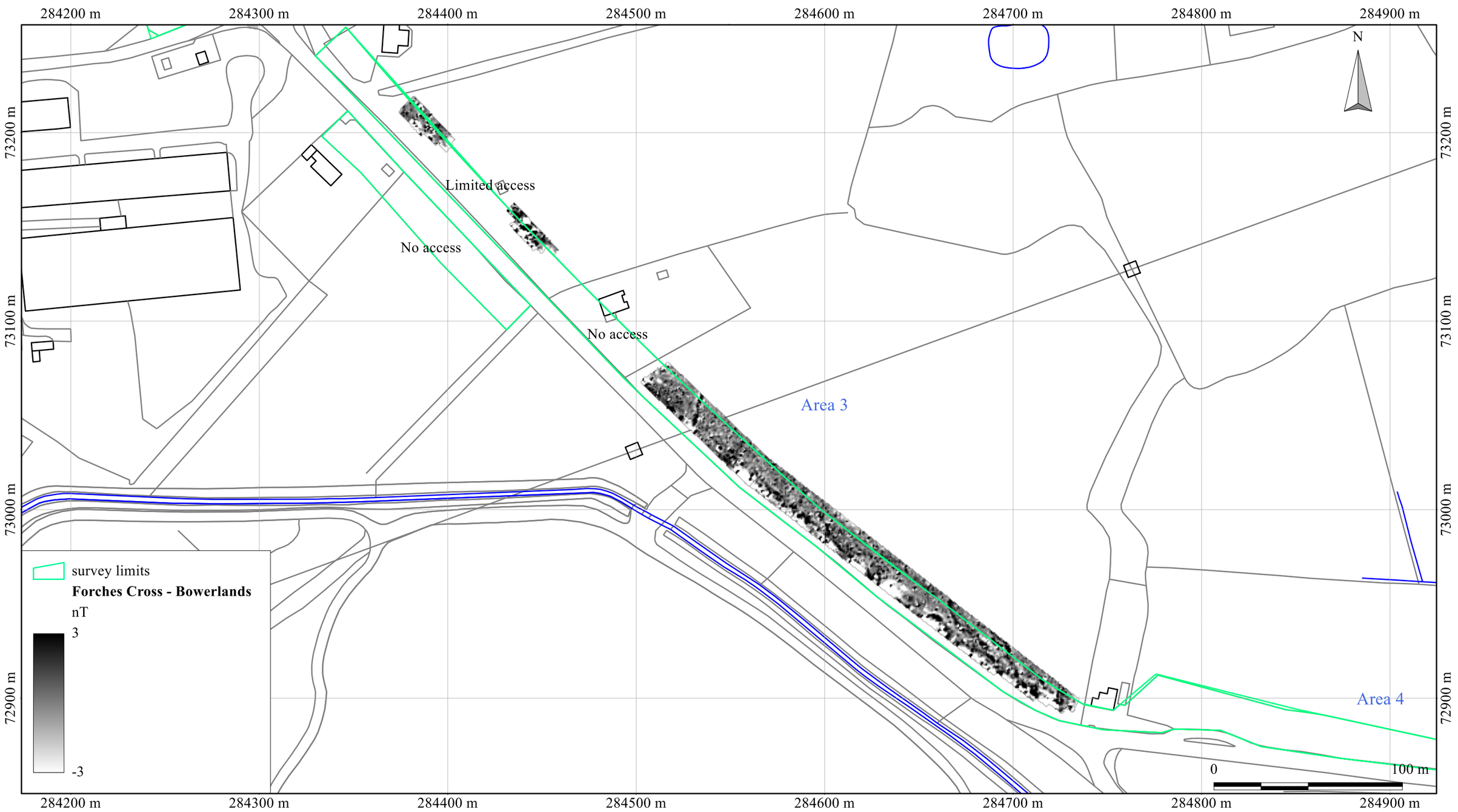

British Grid
centre X: 284549.26 m, centre Y: 73053.28 m

Scale: 1:2000 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological gradiometer survey
Widening of A382 from Drum Bridge to Whitehill Cross
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Report: 150121

Figure 10: shade plot of processed data
Survey area 3: Forches Cross to Bowerlands

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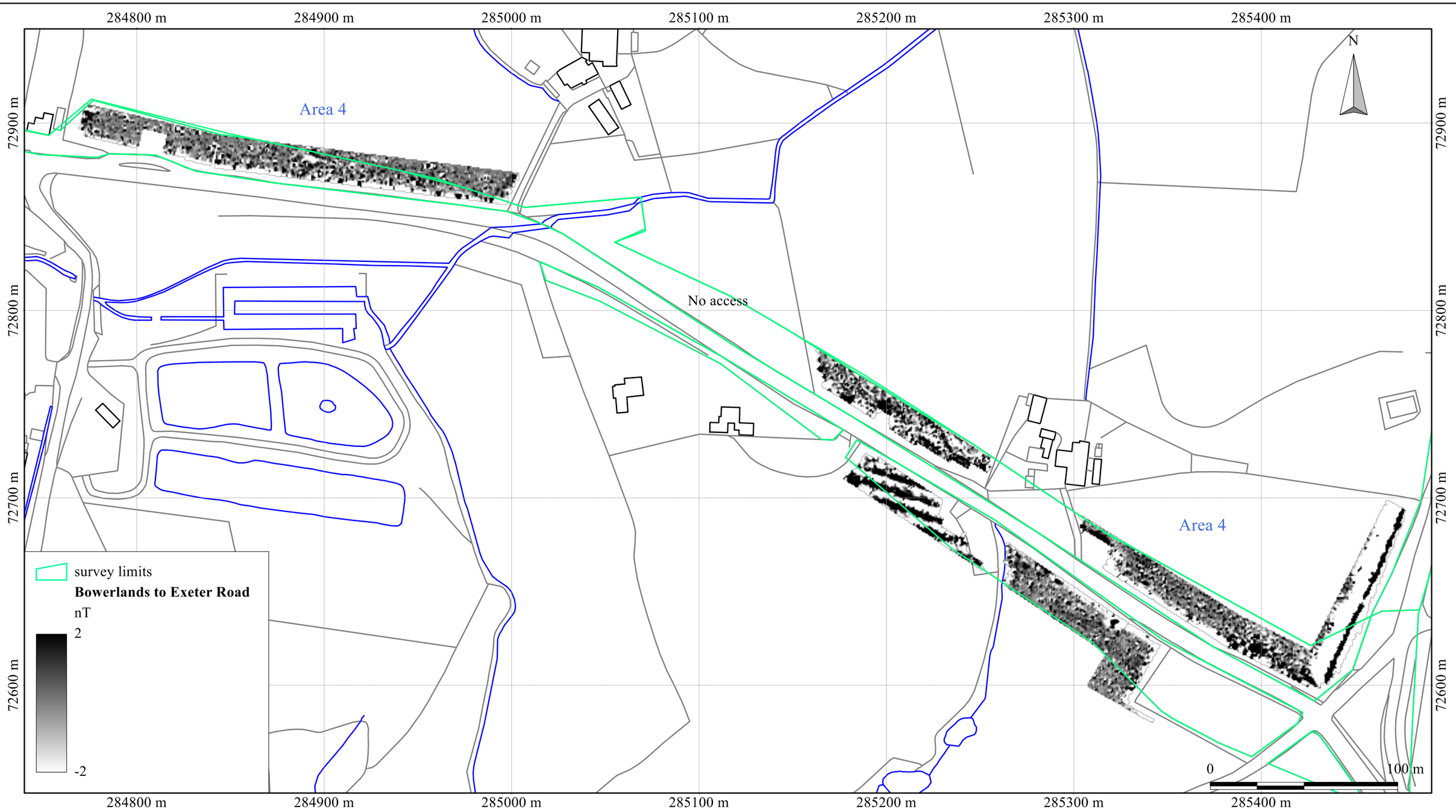

British Grid
centre X: 285115.47 m, centre Y: 72746.36 m

Scale: 1:2000 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological gradiometer survey
Widening of A382 from Drum Bridge to Whitehill Cross
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Figure 11: shade plot of processed data
Survey area 4: Bowerlands to Exeter Cross

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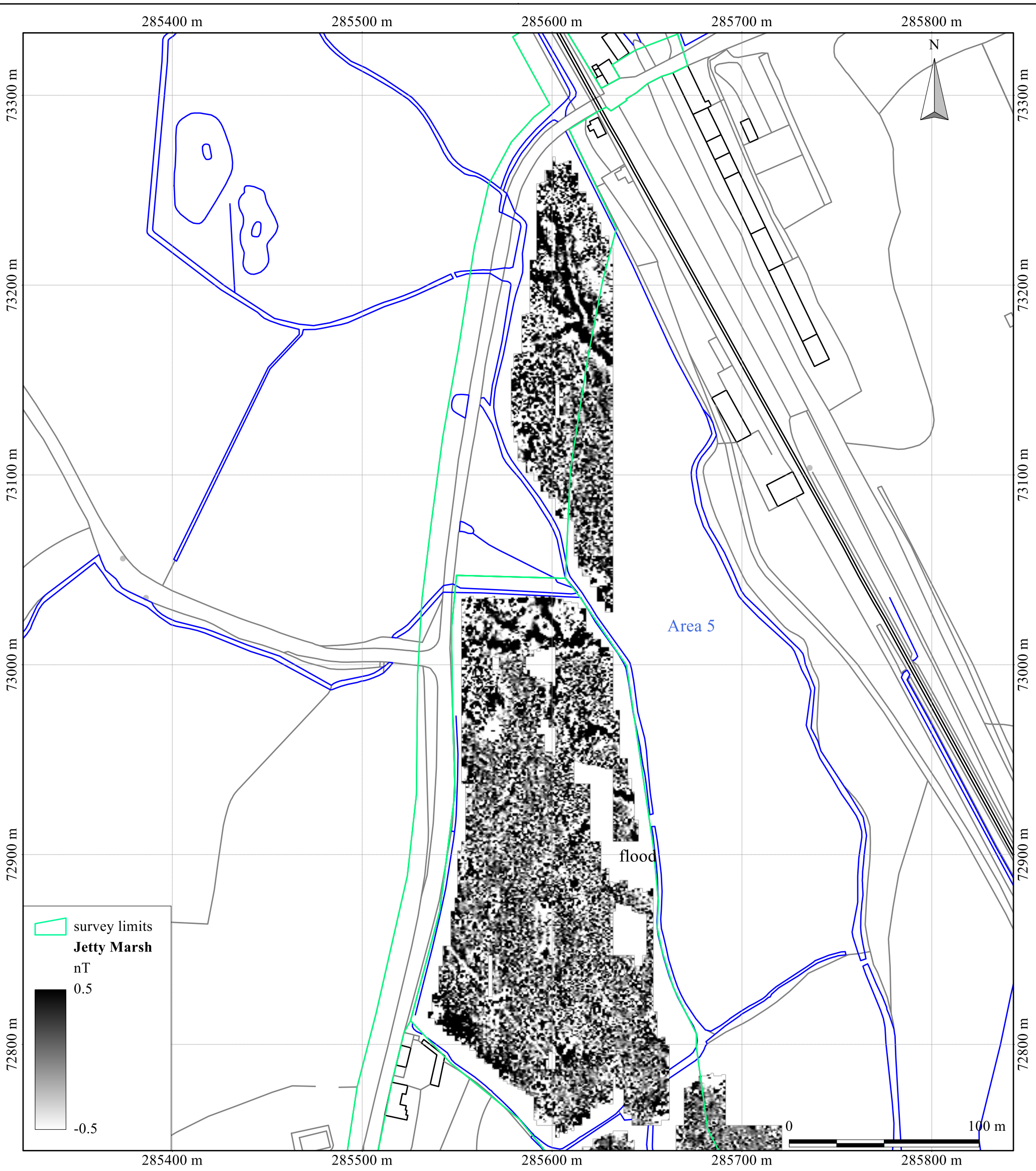

British Grid
centre X: 285582.19 m, centre Y: 73038.46 m

Scale: 1:2000 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological gradiometer survey
Widening of A382 from Drum Bridge to Whitehill Cross
and completion of Jetty Marsh Link
Report: preliminary 07/01/2015

Figure 12: shade plot of processed data
Survey area 5 North: Jetty Marsh

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285400 m 285500 m 285600 m 285700 m 285800 m

72900 m 72800 m 72700 m 72600 m 72500 m 72400 m

N

flood

flood

Area 5

dog training area

flood

flood

marsh

Vegetation & marsh

survey limits
Jetty Marsh
nT
0.5
-0.5

0 100 m

British Grid
centre X: 285579.55 m, centre Y: 72632.06 m

Scale: 1:2000 @ A3. Spatial Units: Meter. Do not scale off this drawing

An archaeological gradiometer survey
Widening of A382 from Drum Bridge to Whitehill Cross
and completion of Jetty Marsh Link
Report: preliminary 07/01/2015

Figure 13: shade plot of processed data
Survey area 5 South: Jetty Marsh

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Appendix 2 Methodology Summary

<table>
<tr><th colspan="2">Table 2: methodology summary</th></tr>
<tr><td colspan="2">Documents
Survey methodology statement: Dean (2014)</td></tr>
<tr><td colspan="2">Methodology
1. The work was undertaken in accordance with the survey methodology statement. The geophysical (gradiometer) survey was undertaken with reference to standard guidance provided by the Institute for Archaeologists (2011) and Archaeology Data Service/Digital Antiquity Guides (undated).
2. The survey grid location information and grid plan was recorded as part of the project in a suitable GIS system.
3. Data processing was undertaken using appropriate software, with all anomalies being digitised and geo-referenced. The final report included a graphical and textual account of the techniques undertaken, the data obtained and an archaeological interpretation of that data and conclusions about any likely archaeology.</td></tr>
<tr><td colspan="2">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.</td></tr>
<tr><td>Equipment
Instrument: Bartington Instruments grad601-2
Firmware: version 6.1</td><td>Data Capture
Sample Interval: 0.25-metres
Traverse Interval: 1 metre
Traverse Method: zigzag
Traverse Orientation: varied</td></tr>
<tr><td colspan="2">Data Processing, Analysis and Presentation Software
IntelliCAD Technology Consortium IntelliCAD 7.2
DW Consulting TerraSurveyor3
Manifold System 8 GIS
Microsoft Corp. Office Excel 2013
Microsoft Corp. Office Publisher 2013
Adobe Systems Inc Adobe Acrobat 9 Pro Extended</td></tr>
</table>

Appendix 3 Geophysical surveying techniques

1 Introduction

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

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

2 Magnetometer surveying

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

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

Bartington grad601-2 gradiometers

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

Multiple sensor arrays

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

3 Earth resistance surveying

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

Resistance to electrical current flow in the ground depends on the moisture content and structure of the soil and other materials buried beneath the surface. For example, the higher the moisture content of a soil, the less resistant it is to electrical current flow. A ditch completely buried beneath the present ground surface is likely to have an infill soil different to that surrounding the ditch in terms of compactness and composition. As a result, the soil filling the buried ditch will retain moisture in a different way to the surrounding soil which means it will

have an electrical resistance at variance with the surrounding environment. By passing a small current through the ground it is possible to detect, record, plot and interpret such changes in electrical resistance.

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