

GEOPHYSICAL SURVEY REPORT

Bognor Regis Golf Club, Bognor Regis, West Sussex

Client

Orion Heritage

For

Hallam Land Management Ltd (SE)

OASIS Ref.

sumogeop1-503555

Survey Report

04634

Date

December 2021



Survey Report 04634: Site Name Bognor Regis Golf Club, Bognor Regis, West Sussex

Survey dates 29-30 November 2021
6-10 December 2021

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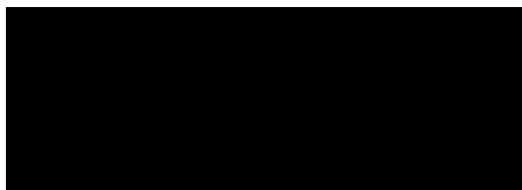


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2. SURVEY TECHNIQUE & DATA PROCESSING

Detailed magnetic survey (magnetometry) was chosen as the most efficient and effective method of locating the type of archaeological anomalies which might be expected at this site.

Bartington Grad 601-2	Traverse Interval 1.0m	Sample Interval 0.25m
Bartington Cart System	Traverse Interval 1.0m	Sample Interval 0.125m

The only processes performed on data are the following unless specifically stated otherwise:

Zero Mean Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes instrument striping effects and edge discontinuities over the whole of the data set.
Step Correction (De-stagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.

3 SUMMARY OF RESULTS

- 3.1 A magnetometer survey of some 71 hectares of land east of Bognor Regis has identified a several complexes of rectilinear enclosures of archaeological interest plus an unusual oval enclosure. These probably indicate small farmsteads of unconfirmed date, but possibly Iron Age or Romano-British based on their form. The oval feature appears to comprise a small ditch surrounding a D-shaped feature and possible pits. Numerous former field boundaries are visible and geological responses are prevalent across the survey area.

4 INTRODUCTION

- 4.1 **SUMO Geophysics Ltd** were commissioned to undertake a geophysical survey of an area outlined for development. This survey forms part of an archaeological investigation being undertaken by **Orion Heritage** on behalf of **Hallam Land Management Ltd (SE)**

4.2 Site details

NGR / Postcode	SU 98830 00977 / PO22 6JP
Location	The site is located to the north of Ancton, Middleton-on-Sea, at the eastern edge of Bognor Regis. Occupying some 61ha the northern limit is the A259 road, the western and eastern limits comprise farmland and residential housing on Ancton Way forms the southern boundary.
HER	West Sussex
OASIS Ref.	sumogeop1-503555
District	Arun District Council
Parish	Middleton-on-Sea CP / Climping CP
Topography	Generally level varying between 2 and 4m aOD
Current Land Use	Arable agriculture
Geology (BGS 2021)	Solid: Lewes Nodular Chalk, Seaford Chalk, Newhaven Chalk, Culver Chalk and Portsdown Chalk Formations (undifferentiated) - chalk Superficial: River Terrace Deposits - sand, silt and clay plus in south-east: Raised Beach Deposits sand and gravel
Soils (CU 2021)	Soilscape 22: Loamy soils with naturally high groundwater
Archaeology (OH 2021)	A historic environment desk-based assessment has been carried out by Orion Heritage . Evidence for Prehistoric land surfaces have been detected during excavations of the Bognor Regis to Littlehampton pipeline to the north west of the site and land utilisation from the Bronze Age onwards is indicated in many of the excavations within the study area. The study site is bisected by the Ryebank Rife stream and sits within a known archaeological landscape. The site is deemed to have a low potential to contain Medieval archaeological features and a high potential to contain Post-Medieval archaeological features. There is a moderate potential for remains of all other periods.
Survey Methods	Magnetometer survey (fluxgate gradiometer)
Study Area	c. 71 ha

4.3 Aims and Objectives

To locate and characterise any anomalies of possible archaeological interest within the study area.

5 RESULTS

The survey has been divided into six survey areas (Areas 1-6) and specific anomalies have been given numerical labels [1] [2] which appear in the text below, as well as on the Interpretation Figure(s).

5.1 **Probably / Possible Archaeology**

5.1.1 In Area 1, in the north-western extremity of the survey, there is a complex of linear anomalies which form a series of conjoined ditched enclosures, extending up to 2 hectares in size. The largest enclosure [1] (42m x 46m) joins with another [2] (30m x 39m) to the east. A long ditch [3] appears to form a track along the northern boundary to the 'site'; it extends some 60m beyond the north-east corner of [2] and there is a suggestion it turns through a right angle and follows the ditch at [4]. The core of activity seems to be in and around the enclosures [1] and [2]; the magnetic anomalies here are noticeably stronger and this is often a sign that the ditch fills are more enhanced because of past human activity on the site. The accumulation of rubbish deposits and burnt materials in the ditches leads to the raised magnetism. Ditches further away from this core are often magnetically weaker and this 'habitation' effect (Gaffney and Gater 2003) appears to be present in these results. Thus, the linear anomalies and trends [5, 6, 7 and 8] which form additional enclosures to the south are not so well-defined. Alternatively, the results could reflect differential ploughing in the field. Whatever the explanation, the results appear to stop at the Ryebank Rife stream.

5.1.2 In Area 2, there is a smaller concentration of rectilinear enclosures which are deemed to be of archaeological interest. A square feature [9] c.30m x 30m is sub-divided into two or three elements and to the west is a second enclosure [10] c.11m x 20m. To the north are other linear responses [11] indicative of ditches and probably former enclosures; to the south is a long ditch [12] which forms an open-sided feature though the fourth side may have been ploughed out. At [13] is a curvilinear trend which could be an oval enclosure of archaeological interest; although poorly defined the feature appears to be approximately 40m across.

5.1.3 Straddling Areas 4 and 5 are several linear trends indicating more enclosures of possible archaeological interest. The presence of an existing boundary (A) and two former field divisions (B and C) are partially obscuring the results especially on the eastern side; but a trapezoidal shape is discernible. Parallel linear responses [14] indicate a possible track which forms the western limits of the complex comprising two main enclosures, one [15] measuring c.35m x 50m and a second to the east [16] c.15m x 25m. It is unclear if the linears [17] are part of the same site.

5.1.4 In Area 5 there are some unusual magnetic responses which are of probable archaeological interest. They comprise an irregular oval-shaped outer ditch [18] which surrounds a D-shaped anomaly. There may be a ring of pits between the two features, however, there are similar isolated anomalies scattered through the data and they may simply be a chance occurrence.

5.2 **Uncertain**

5.2.1 There are a number of uncertain responses across the site, which is not unexpected given the overall size of the survey. The responses generally comprise linear and curvilinear trends which are probably agricultural or natural in origin, though an archaeological cause cannot be totally ignored.

5.3 **Former Field Boundary**

- 5.3.1 Several linear trends or narrow strips of ferrous type responses are present and they coincide with former field boundaries visible on historic mapping and on aerial imagery (see Figures 9 and 10). It is also interesting to note that the footprints of some of the smaller fields are visible as varying levels of magnetic enhancement.

5.4 **Natural / Geological**

- 5.4.1 Throughout the data are amorphous magnetic responses; these reflect both the underlying chalk and the raised beach deposits in the south-east where the geological effects are particularly enhanced.

5.5 **Magnetic Disturbance / Ferrous**

- 5.5.1 Magnetic disturbance and a strong ferrous response [10] in Area 5 coincide with the location of a forming structure known as North Barn marked on old mapping (see Figure 10).
- 5.5.2 Area 6 is magnetically disturbed possibly as a result of green waste being spread across the field. The exact cause is uncertain but the responses are thought to be modern in origin.
- 5.5.3 Smaller scale ferrous anomalies ("iron spikes") are present throughout the data and are characteristic of small pieces of ferrous debris (or brick / tile) in the topsoil; they are commonly assigned a modern origin. Only the most prominent of these are highlighted on the interpretation diagram.

6 DATA APPRAISAL & CONFIDENCE ASSESSMENT

- 6.1 Historic England guidelines (EH 2008) Table 4 states that the typical magnetic response on the local soils / geology is variable. The results from this survey indicate the presence of a variety of magnetic anomalies associated with differing archaeological features. As a consequence, the technique is deemed to have worked well though modern disturbance in Area 6 and the geological responses may have masked some archaeological features.

7 CONCLUSION

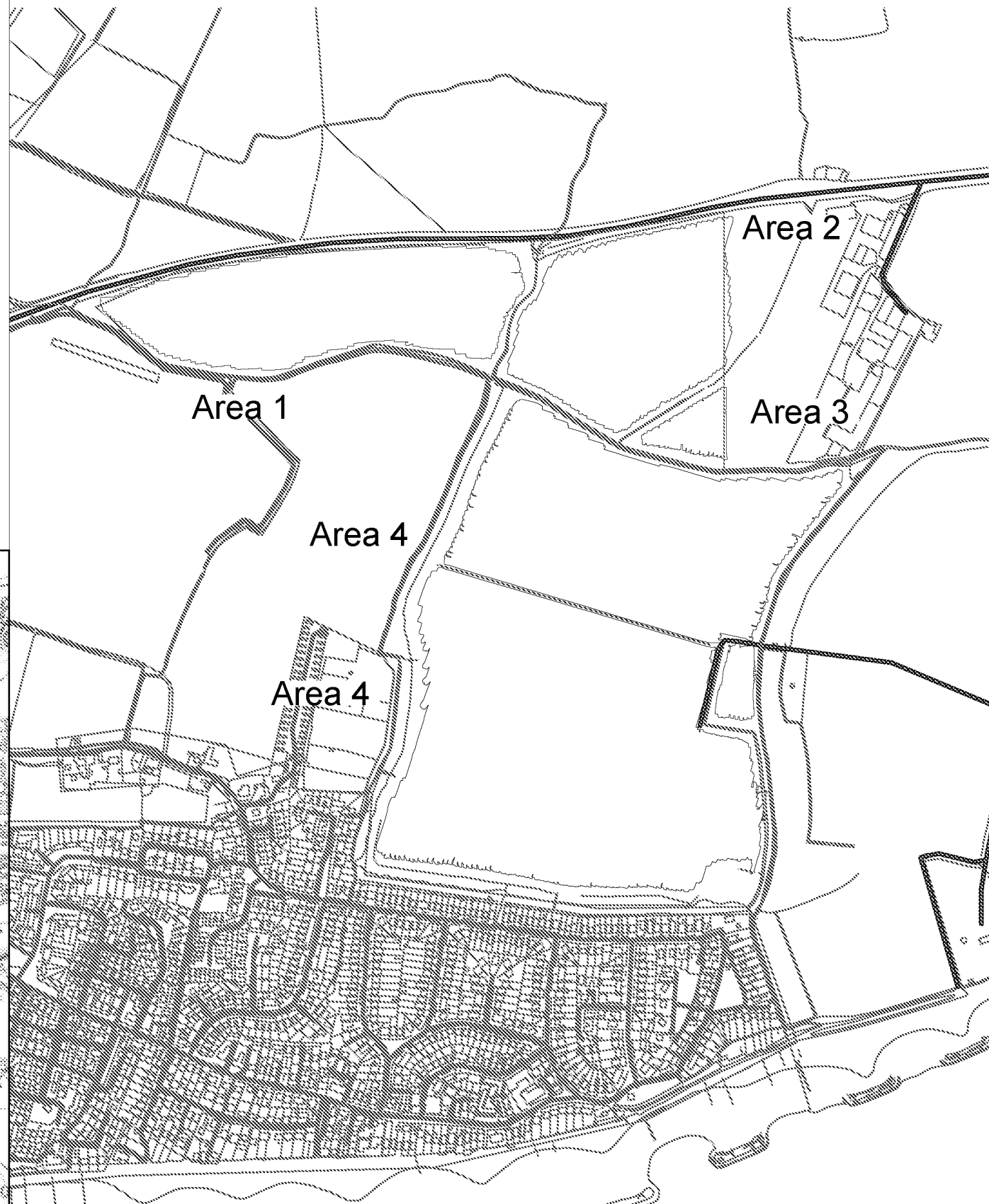
- 7.1 The survey has identified three groups of enclosures forming possible habitation sites, with small paddocks and fields, which are clearly of archaeological interest. In addition, an oval enclosure is visible encircling a D-shaped feature and possible pits; this is thought to be archaeological but its interpretation is unclear. Numerous former field boundaries recorded on old maps have been recorded and the location of a former barn confirmed. Natural, geological effects are visible throughout and Area 6 is magnetically disturbed throughout.

8 REFERENCES

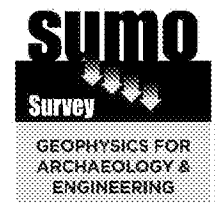
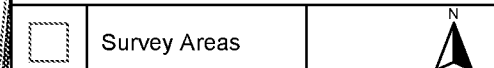
- BGS 2020 British Geological Survey, Geology of Britain viewer [accessed 25/11/2021] *website:* (<http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps>)
- ClfA 2014 *Standard and Guidance for Archaeological Geophysical Survey*. Amended 2016. ClfA Guidance note. Chartered Institute for Archaeologists, Reading
http://www.archaeologists.net/sites/default/files/ClfAS%26GGeophysics_2.pdf
- CU 2020 The Soils Guide. Available: www.landis.org.uk. Cranfield University, UK. [accessed 25/11/2021] *website:* <http://mapapps2.bgs.ac.uk/ukso/home.html>
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- EH 2008 *Geophysical Survey in Archaeological Field Evaluation*. English Heritage, Swindon
<https://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf/>
- Gaffney & Gater 2003 *Revealing the Buried Past, Geophysics for Archaeologists*, Chris Gaffney and John Gater, The History Press, reprinted 2010
- OH 2021 *Ducklington Farm, South Witney, Historic Environment Desk-Based Assessment*, Orion Heritage Report PN3064/HEDBA/1, unpublished.

9 ARCHIVE

- 9.1 The minimally processed data, data images, XY traces and a copy of this report are stored in **SGL**'s digital archive, on an internal RAID configured NAS drive in the Midland's Office. These data are also backed up to the Cloud for off-site storage.
- 9.2 The Grey Literature will be archived with OASIS and the relevant HER within a period of 12 months



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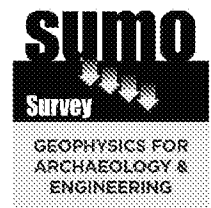
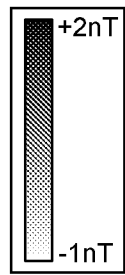
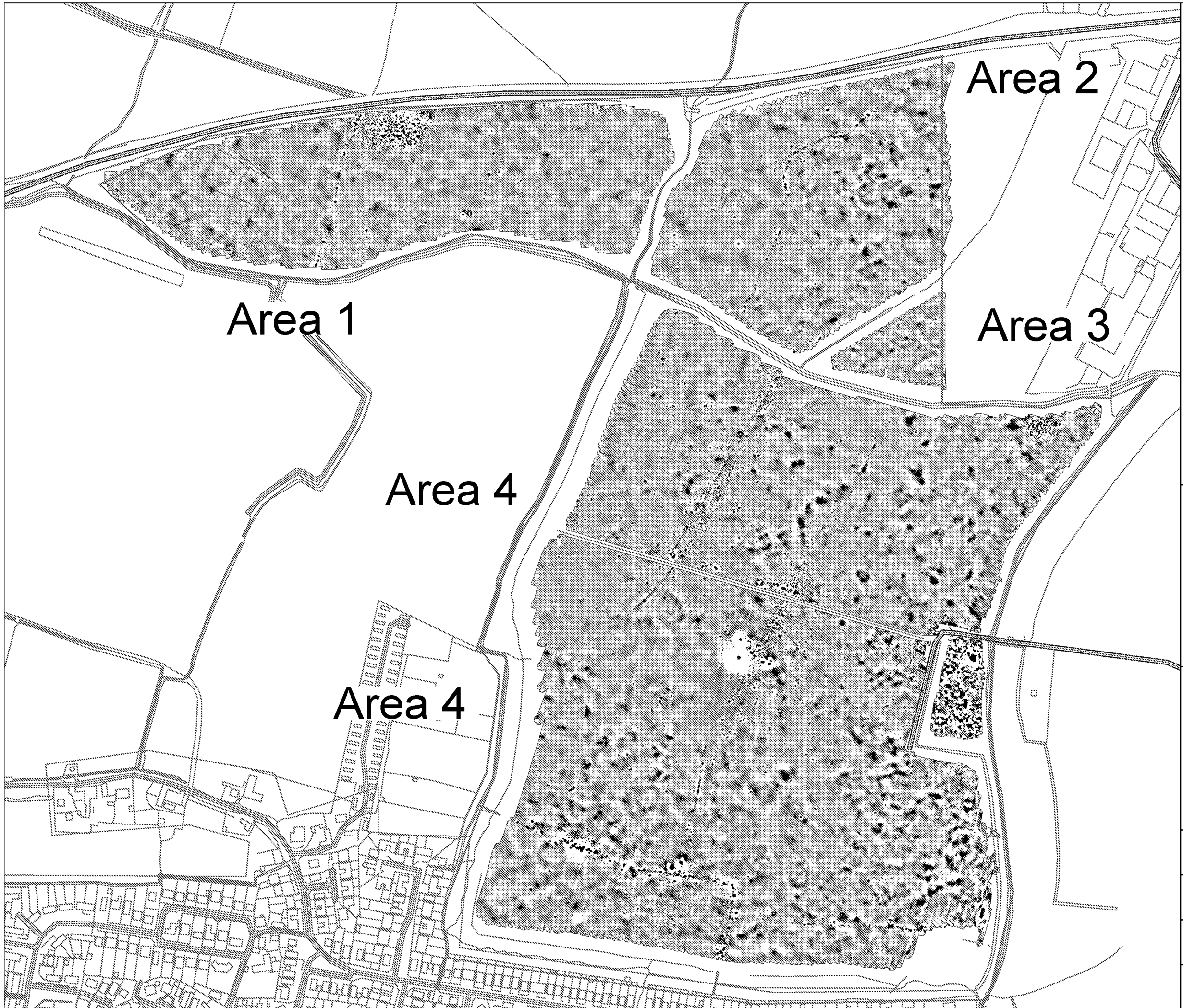
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Client: Orion Heritage Ltd

Project:	04634 - Bognor Regis Golf Club, Bognor Regis, West Sussex
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Fig No:
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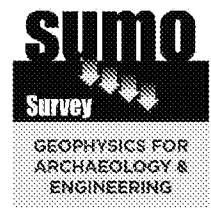
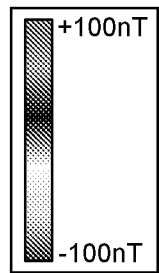
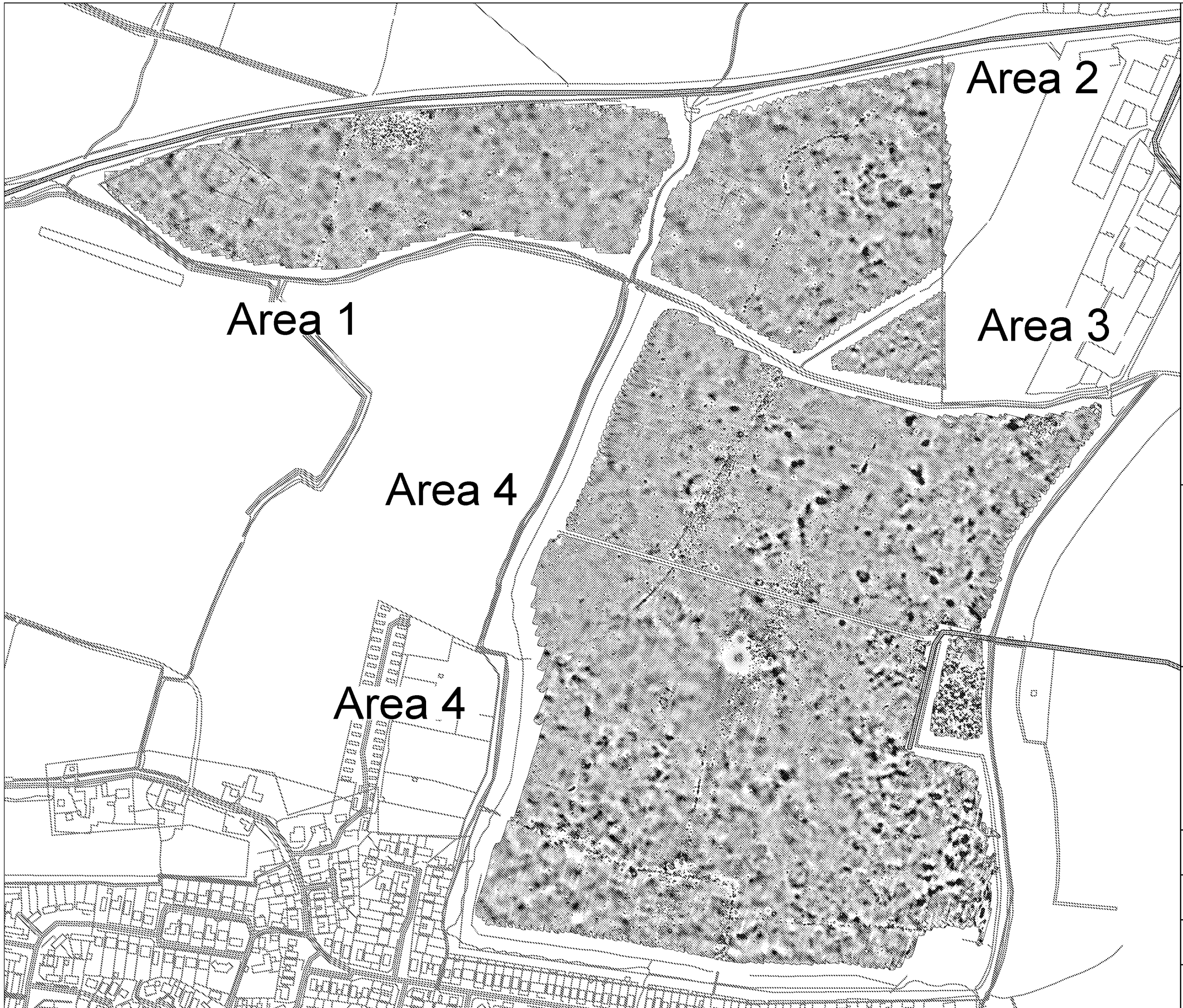
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Client:
Orion Heritage Ltd

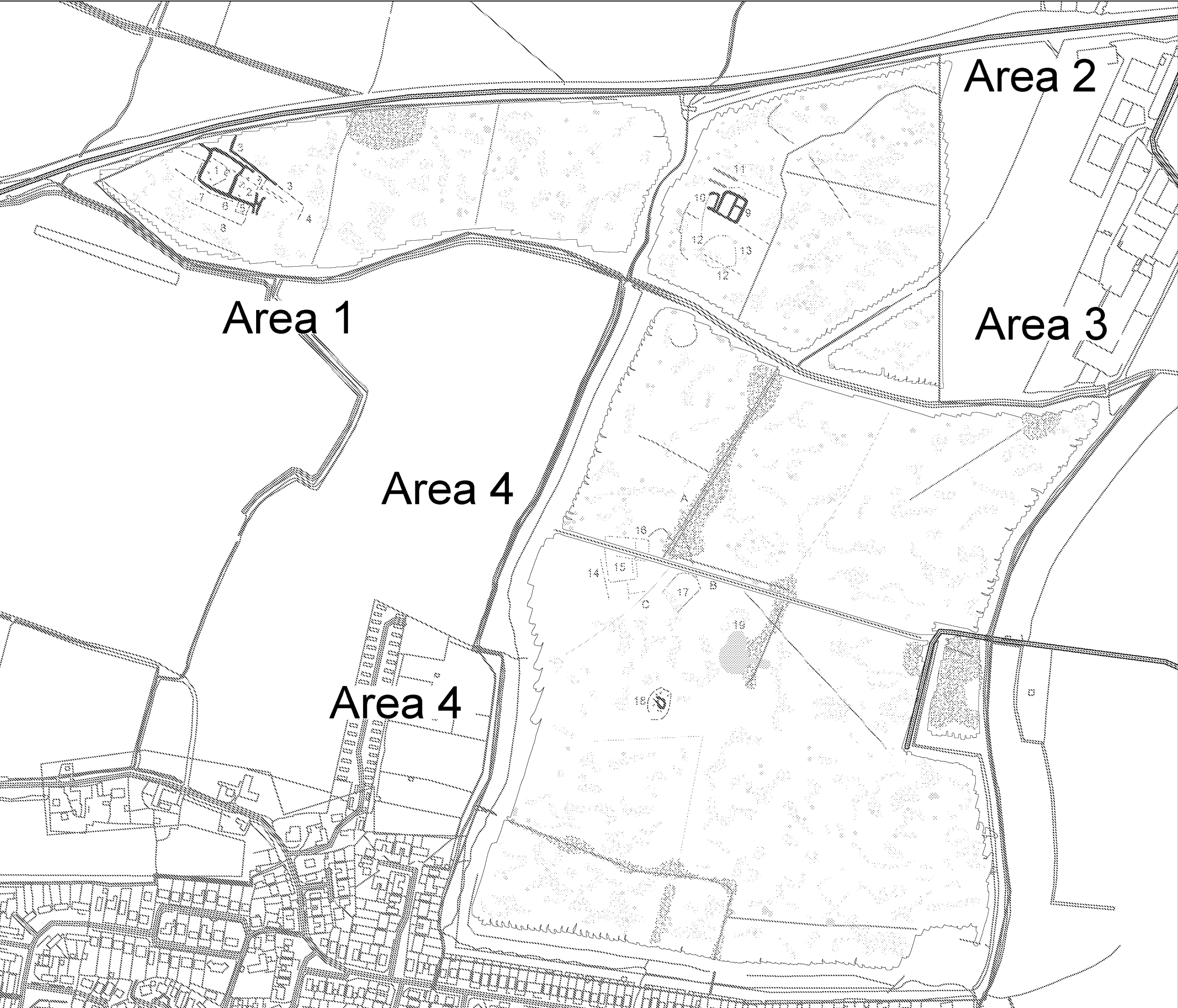
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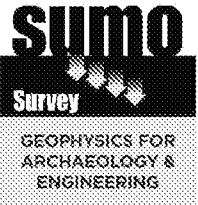


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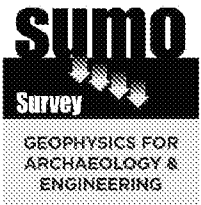
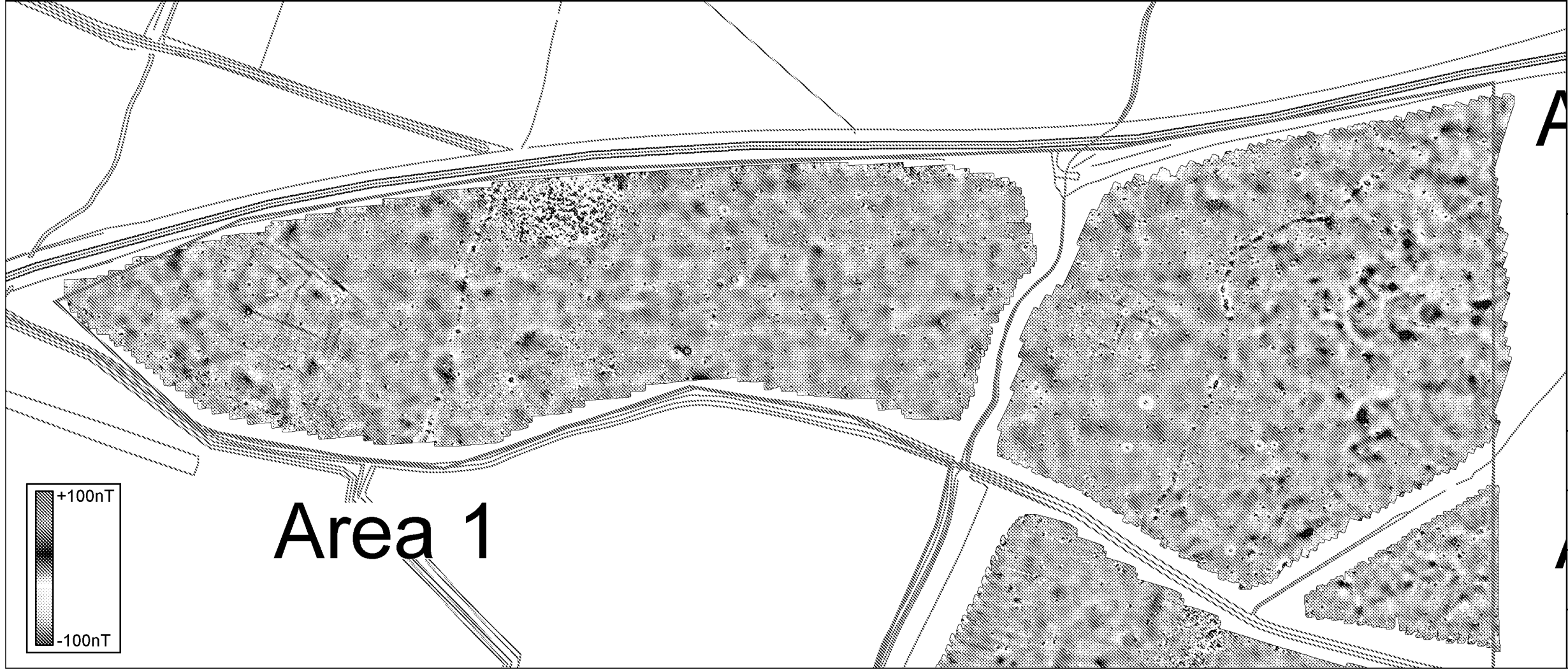


KEY

	Probable archaeology (discrete anomaly / trend)
	Possible archaeology (discrete anomaly / trend)
	Uncertain Origin (trend)
	Former field boundary (corroborated)
	Former field boundary (conjectural)
	Land drain
	Natural (e.g. geological / pedological)
	Magnetic disturbance
	Ferrous



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Client: Orion Heritage Ltd	
Project: 04634 - Bognor Regis Golf Club, Bognor Regis, West Sussex	
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Project: 04634 - Bognor Regis Golf Club, Bognor Regis, West Sussex	
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Area 1

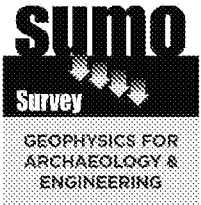


Area 1

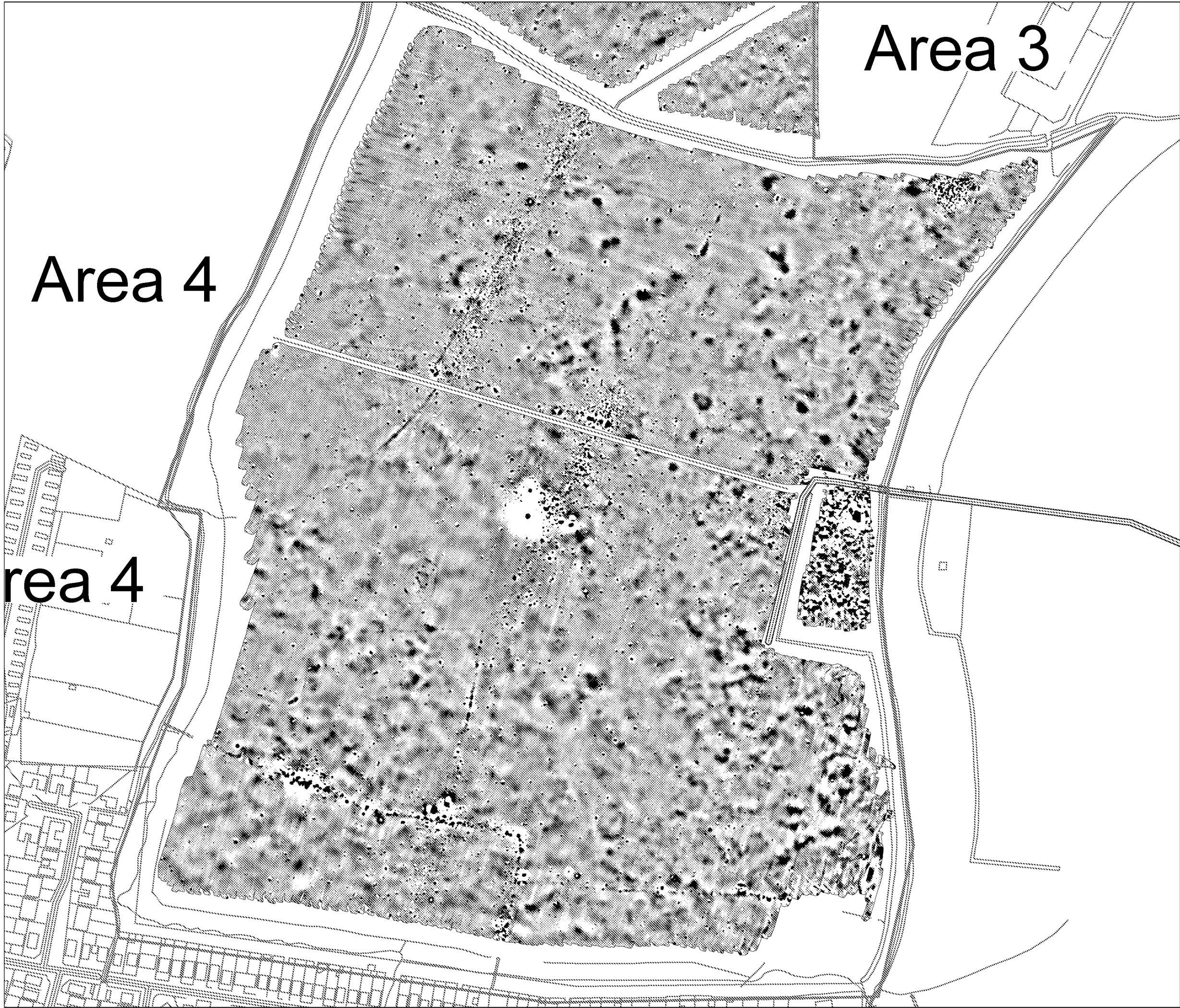


KEY

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	Possible archaeology (discrete anomaly / trend)
	Uncertain Origin (trend)
	Former field boundary (corroborated)
	Former field boundary (conjectural)
	Land drain
	Natural (e.g. geological / pedological)
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	Ferrous



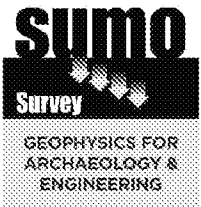
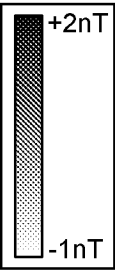
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Project: 04634 - Bognor Regis Golf Club, Bognor Regis, West Sussex	
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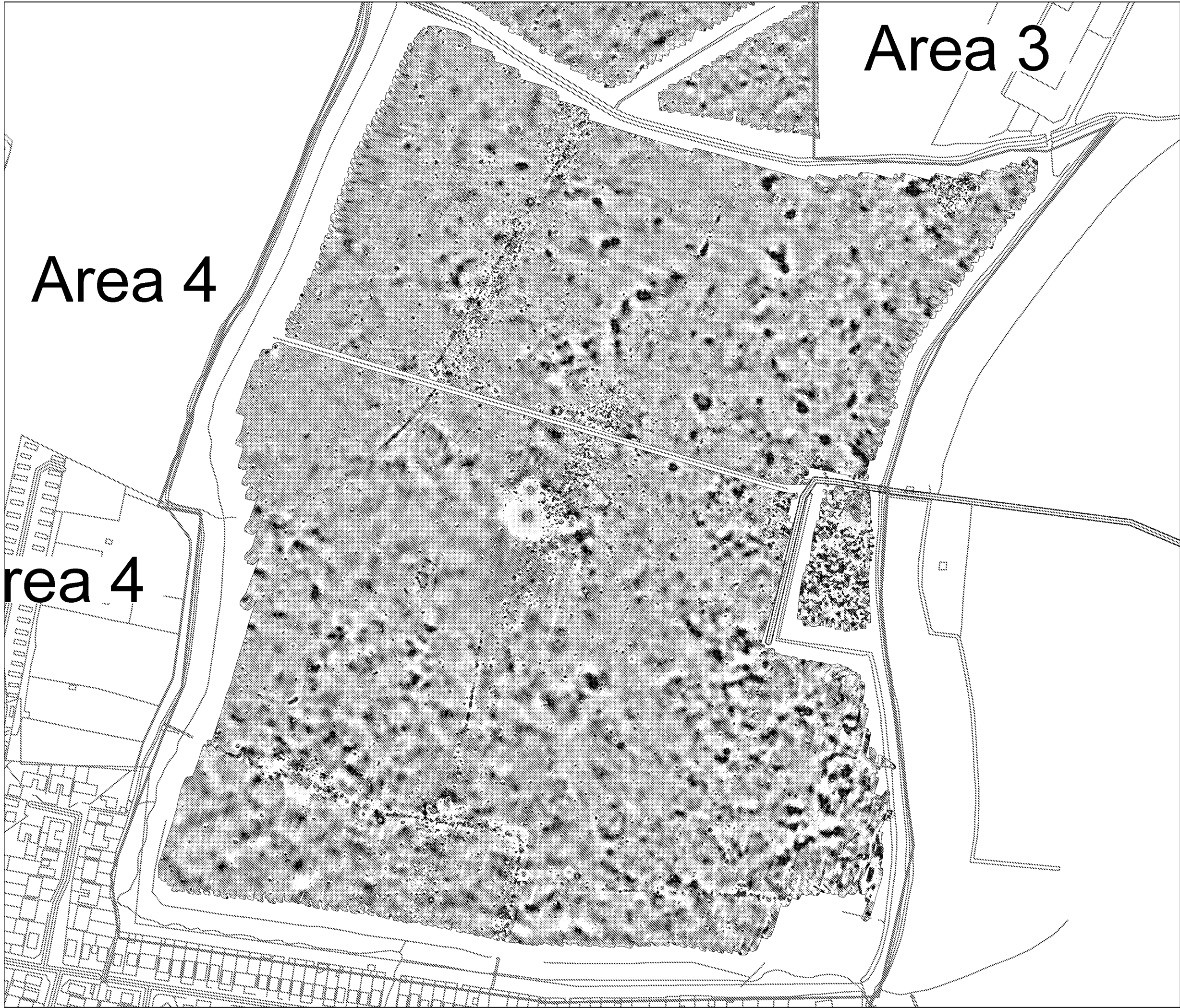
Area 3

Area 4

Area 4



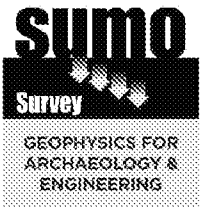
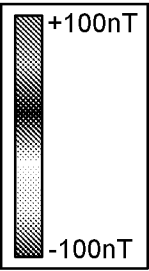
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Client: Orion Heritage Ltd	
Project: 04634 - Bognor Regis Golf Club, Bognor Regis, West Sussex	
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Area 3

Area 4

Area 4

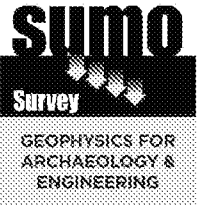


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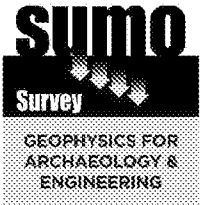


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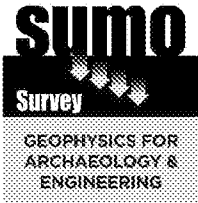
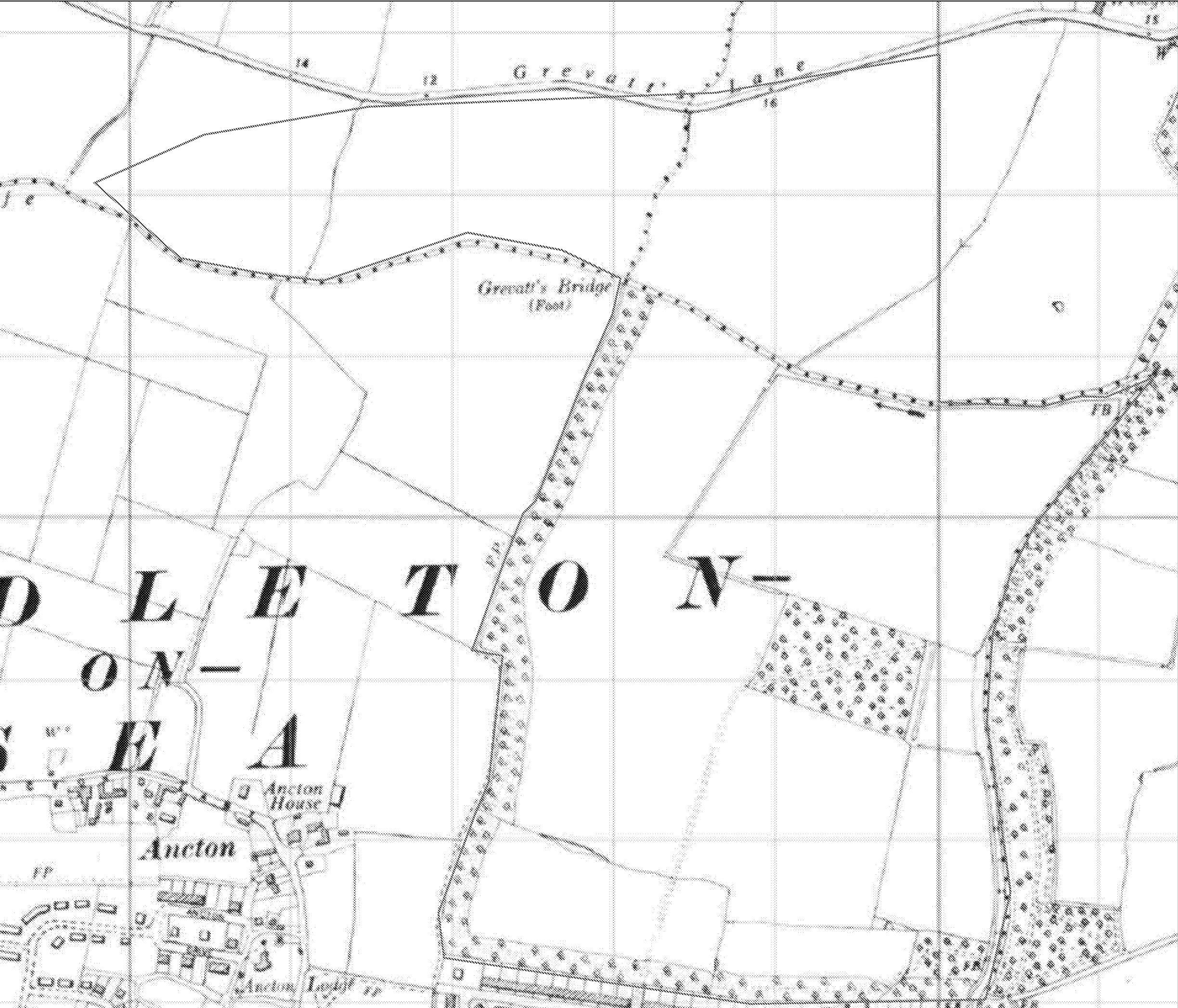
	Probable archaeology (discrete anomaly / trend)
	Possible archaeology (discrete anomaly / trend)
	Uncertain Origin (trend)
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	Former field boundary (conjectural)
	Land drain
	Natural (e.g. geological / pedological)
	Magnetic disturbance
	Ferrous



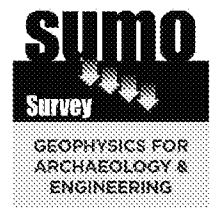
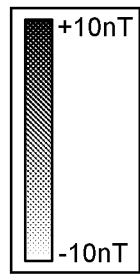
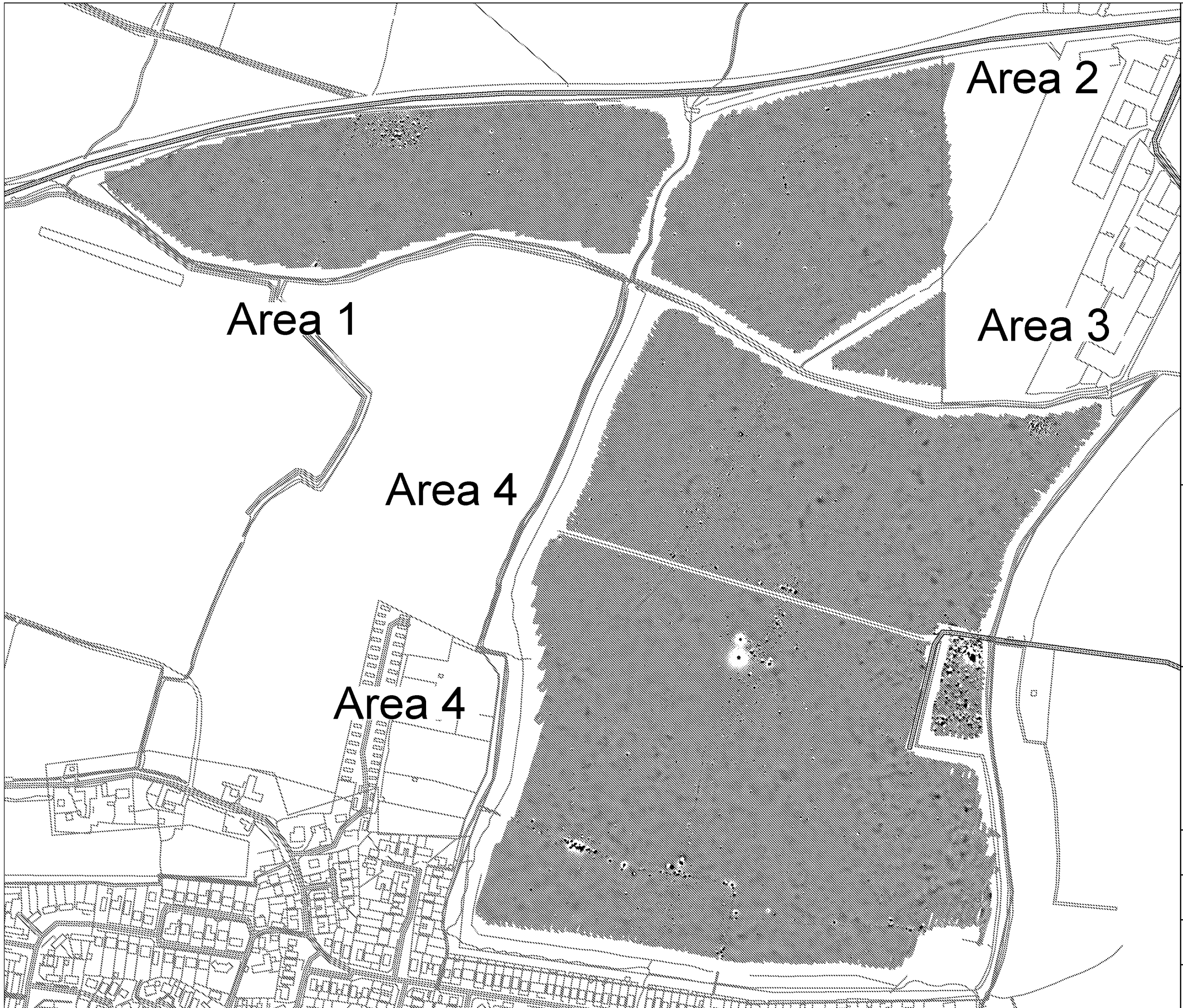
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Client: Orion Heritage Ltd	
Project: 04634 - Bognor Regis Golf Club, Bognor Regis, West Sussex	
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Client: Orion Heritage Ltd	
Project: 04634 - Bognor Regis Golf Club, Bognor Regis, West Sussex	
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Title: 1961 Ordnance Survey Mapping (GI 2021)	
Client: Orion Heritage Ltd	
Project: 04634 - Bognor Regis Golf Club, Bognor Regis, West Sussex	
Scale: 0 metres 225 1:4500 @ A3	Fig No: 11



Title:
Minimally Processed Data - Greyscale Plots

Client:
Orion Heritage Ltd

Project:
04634 - Bognor Regis Golf Club, Bognor Regis,
West Sussex

Scale: 0 metres 225
1:4500 @ A3
Fig No: 12

Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (EH 2008) (then English Heritage), the Chartered Institute for Archaeologists (CIfA 2014) and the European Archaeological Council (EAC 2016).

Grid Positioning

For hand held gradiometers the location of the survey grids has been plotted together with the referencing information. Grids were set out using a Trimble R8 Real Time Kinematic (RTK) VRS Now GNSS GPS system.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. This results in an accuracy of around 0.01m.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1m	0.25m

Instrumentation: Bartington Grad 601-2

Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted vertically, set 1.0m apart. The fluxgate gradiometer suppresses any diurnal or regional effects. The instruments are carried, or cart mounted, with the bottom sensor approximately 0.1-0.3m from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. Generally, features up to 1m deep may be detected by this method, though strongly magnetic objects may be visible at greater depths. The Bartington instrument can collect two lines of data per traverse with gradiometer units mounted laterally with a separation of 1.0m. The readings are logged consecutively into the data logger which in turn is daily down-loaded into a portable computer whilst on site. At the end of each site survey, data is transferred to the office for processing and presentation.

Data Processing

Zero Mean	This process sets the background mean of each traverse within each grid to zero.
Traverse	The operation removes striping effects and edge discontinuities over the whole of the data set.
Step Correction (De-stagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.

Display

Greyscale/ Colourscale Plot	This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly, all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.
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Presentation of results and interpretation

The presentation of the results includes a 'minimally processed data' and a 'processed data' greyscale plot. Magnetic anomalies are identified, interpreted and plotted onto the 'Interpretation' drawings.

When interpreting the results, several factors are taken into consideration, including the nature of archaeological features being investigated and the local conditions at the site (geology, pedology, topography etc.). Anomalies are categorised by their potential origin. Where responses can be related to other existing evidence, the anomalies will be given specific categories, such as: Abbey Wall or Roman Road. Where the interpretation is based largely on the geophysical data, levels of confidence are implied, for example: Probable, or Possible Archaeology. The former is used for a confident interpretation, based on anomaly definition and/or other corroborative data such as cropmarks. Poor anomaly definition, a lack of clear patterns to the responses and an absence of other supporting data reduces confidence, hence the classification Possible.

Interpretation Categories

In certain circumstances (usually when there is corroborative evidence from desk-based or excavation data) very specific interpretations can be assigned to magnetic anomalies (for example, *Roman Road, Wall*, etc.) and where appropriate, such interpretations will be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

<i>Archaeology / Probable Archaeology</i>	This term is used when the form, nature and pattern of the responses are clearly or very probably archaeological and /or if corroborative evidence is available. These anomalies, whilst considered anthropogenic, could be of any age.
<i>Possible Archaeology</i>	These anomalies exhibit either weak signal strength and / or poor definition, or form incomplete archaeological patterns, thereby reducing the level of confidence in the interpretation. Although the archaeological interpretation is favoured, they may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
<i>Industrial / Burnt-Fired</i>	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal-working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
<i>Former Field Boundary (probable & possible)</i>	Anomalies that correspond to former boundaries indicated on historic mapping, or which are clearly a continuation of existing land divisions. Possible denotes less confidence where the anomaly may not be shown on historic mapping but nevertheless the anomaly displays all the characteristics of a field boundary.
<i>Ridge & Furrow</i>	Parallel linear anomalies whose broad spacing suggests ridge and furrow cultivation. In some cases, the response may be the result of more recent agricultural activity.
<i>Agriculture (ploughing)</i>	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
<i>Land Drain</i>	Weakly magnetic linear anomalies, quite often appearing in series forming parallel and herringbone patterns. Smaller drains may lead and empty into larger diameter pipes, which in turn usually lead to local streams and ponds. These are indicative of clay fired land drains.
<i>Natural</i>	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.
<i>Magnetic Disturbance</i>	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present.
<i>Service</i>	Magnetically strong anomalies, usually forming linear features are indicative of ferrous pipes/cables. Sometimes other materials (e.g. pvc) or the fill of the trench can cause weaker magnetic responses which can be identified from their uniform linearity.
<i>Ferrous</i>	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.
<i>Uncertain Origin</i>	Anomalies which stand out from the background magnetic variation, yet whose form and lack of patterning gives little clue as to their origin. Often the characteristics and distribution of the responses straddle the categories of <i>Possible Archaeology / Natural</i> or (in the case of linear responses) <i>Possible Archaeology / Agriculture</i> ; occasionally they are simply of an unusual form.

Where appropriate some anomalies will be further classified according to their form (positive or negative) and relative strength and coherence (trend: weak and poorly defined).

Appendix B - Technical Information: Magnetic Theory

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock. Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.1 nanoTeslas (nT) in an overall field strength of 48,000 (nT), can be accurately detected.

Weakly magnetic iron minerals are always present within the soil and areas of enhancement relate to increases in *magnetic susceptibility* and permanently magnetised *thermoremanent* material.

Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremanence is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremanent archaeological features can include hearths and kilns; material such as brick and tile may be magnetised through the same process.

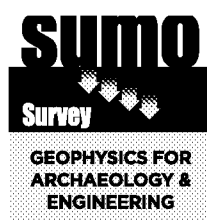
Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried feature. The difference between the two sensors will relate to the strength of a magnetic field created by this feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity and disturbance from modern services.

Summary for sumogeop1-503555

OASIS ID (UID)	sumogeop1-503555
Project Name	Geophysical Survey at Bognor Regis Golf Club, Bognor Regis, West Sussex
Activity type	Geophysical Survey, MAGNETOMETRY SURVEY
Project Identifier(s)	04634
Planning Id	
Reason For Investigation	Planning requirement
Organisation Responsible for work	SUMO Geophysics Ltd.
Project Dates	29-Nov-2021 - 10-Dec-2021
Location	Bognor Regis Golf Club, Bognor Regis, West Sussex NGR : SU 98650 01077 LL : 50.8008690230526, -0.601488396867321 12 Fig : 498650,101077
Administrative Areas	Country : England County : West Sussex District : Arun Parish : Yapton Parish : Climping Parish : Middleton-on-Sea
Project Methodology	A temporary grid system will be established over the site and marked out using canes. The location of the grid will be set out using an RTK GPS system theoretically accurate to some 0.01m and referenced to OS co-ordinates. Data will be collected using a cart carrying four paired Bartington magnetic sensors. Four sensors mounted 1m horizontally apart and very accurately aligned to nullify the effects of the earth's magnetic field. Readings relate to the difference in localised magnetic anomalies compared with the general magnetic background. Each data point is geographically referenced using an on-board Trimble RTK survey grade GPS system. Readings will be taken at 0.125m centres along traverses 1.0m apart. Readings relate to the difference in localised magnetic anomalies compared with the general magnetic background.
Project Results	The survey has identified three groups of enclosures forming possible habitation sites, with small paddocks and fields, which are clearly of archaeological interest. In addition, an oval enclosure is visible encircling a D-shaped feature and possible pits; this is thought to be archaeological but its interpretation is unclear. Numerous former field boundaries recorded on old maps have been recorded and the location of a former barn confirmed. Natural, geological effects are visible throughout and Area 6 is magnetically disturbed throughout.
Keywords	Ditch - UNCERTAIN - FISH Thesaurus of Monument Types Enclosure - UNCERTAIN - FISH Thesaurus of Monument Types Field Boundary - POST MEDIEVAL - FISH Thesaurus of Monument Types
HER	West Sussex HER - unRev - STANDARD
HER Identifiers	
Archives	



- Archaeological
- Geophysical
- Laser Scanning
- Measured Building
- Topographic
- Utility Mapping

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