

# GEOPHYSICAL SURVEY REPORT

## Imberhorne Farm, East Grinstead, West Sussex

Client

**Orion Heritage Ltd** 

For

**Welbeck Strategic Land** 

Survey Report

06028

OASIS Ref. No.

sumogeop1-504502

Date

**09 February 2022** 



## Survey Report 06028: Imberhorne Farm, East Grinstead, West Sussex

Survey dates 16 - 17 December 2021

5 -14 January 2022 18 January 2022

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**Report Date** 09 February 2022

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Job ref: 06028 Date: 09 February 2022

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## 3 SURVEY TECHNIQUE

3.1 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
Tr

Step Correction When gr

(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.

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#### 4 SUMMARY OF RESULTS

4.1 A magnetometer survey of some 44ha of land at Imberhorne Farm, East Grinstead has not identified any anomalies of archaeological interest. A few uncertain responses have been recorded along with a range of anomalies reflecting former boundaries and different agricultural elements, including ploughing and land drains. A former building and pond have resulted in small areas of magnetic disturbance. Variations in the bedrock and superficial deposits are visible as broad areas of amorphous magnetic responses.

#### 5 INTRODUCTION

5.1 **SUMO Geophysics Ltd** were commissioned to undertake a geophysical survey of an area outlined for residential and associated development. This survey forms part of an archaeological investigation being undertaken by **Orion Heritage Ltd** on behalf of **Welbeck Strategic Land** and forms the second phase of geophysical survey at the site.

#### 5.2 Site Details

NGR / Postcode TQ 3645 3863 / RH19 2PT (Gullege)

Location The site is located due west of East Grinstead on Imberhorne Farm;

it is surrounded by agricultural fields or woodland on all sides. Hophurst Lane and Felbridge Road lie to the west and north; Felbridge is located to the north-east, Imberhorne Lane to the east

and the Sussex Border Path / Worth Way is south of the site.

HER West Sussex County
OASIS Ref. No. sumogeop1-504502
District West Sussex County
Parish East Grinstead CP

Topography Undulating

Land Use Arable agriculture

Geology Bedrock: Upper Tunbridge Wells Sand Formation – sandstone and

(BGS 2022) siltstone interbedded - fluvial, palustrine and shallow-marine in origin

(majority of site); Grinstead Clay Member - Mudstone (southern

limits)

Superficial: None recorded (most of site); Head - Clay, Silt, Sand

and Gravel (zone in Area 3)

Soils (CU 2022) Soilscape 8: slightly acid loamy and clayey soils with impeded

drainage (most of survey area); Soilscape 18: slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils

(south of Area 1).

Archaeology No scheduled sites or other known heritage assets lie within the

survey area. Previous magnetometer survey in fields immediately east of the site recorded a general lack of responses of interest, with the exception of a sole rectilinear anomaly interpreted as being 'likely of anthropogenic origin'. (Magnitude 2018) Clay extraction is

recorded to the south and south-east of the site.

Survey Methods Magnetometer survey (fluxgate gradiometer)

Study Area c.44 ha

#### 5.3 Aims and Objectives

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

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#### 6 RESULTS

6.1 The survey has been divided into three survey areas (Areas 1-3) and specific anomalies have been given numerical labels [1] [2] which appear in the text below, as well as on the Interpretation Figure(s).

## 6.2 Probable / Possible Archaeology

6.2.1 No magnetic responses have been recorded that could be interpreted as being of definite archaeological interest. None of the responses are similar to those which were interpreted as being archaeological in the earlier magnetic survey to the east (Magnitude 2018).

#### 6.3 Uncertain

- 6.3.1 Parallel linear anomalies [1] in Area 1 would appear to mark the course of a former trackway some 10m to the east of the field boundary with Area 2; such a feature is visible on early Ordnance Survey (OS) maps, but it is mapped much closer to the N-S boundary than in the magnetic data. As a consequence, the magnetic results could indicate a trackway of much earlier / later date or the responses might be associated with a more recent ploughing headland, hence the uncertain interpretation.
- 6.3.2 A very narrow, triangular-shaped, slightly increased magnetic response [2] appears to bisect the northern half of Area 2 and terminate at former boundary [6]; as such it could be a former boundary itself, but none are mapped in this location. At the point where [2] meets [6] there is a strong ferrous response; this may have been the site of a drinking trough in which case [2] could mark the course of a plastic pipe. Therefore, response [2] is assigned an uncertain interpretation category. At [3] there is a cluster of uncertain responses which includes a tentative small arc and linear trends. An archaeological origin seems unlikely but cannot be totally ignored; the responses could simply be agricultural or geological in origin.
- 6.3.3 Elsewhere in the data are other linear and curvilinear anomalies which form no particular patterns and lack a defined shape of anomaly which would indicate an archaeological origin; hence the uncertain characterisation.

#### 6.4 Former Field Boundary – Corroborated / Conjectural

6.4.1 Several linear magnetic responses [4], [5], [6], [7], [8] and [9] coincide former field boundaries recorded on OS maps of varying dates. A similar response [10] runs between two existing boundaries but is not visible on mapping, hence the conjectural interpretation.

## 6.5 Agricultural – Ploughing / Land Drains

6.5.1 Faint parallel trends in Area 1 indicate modern ploughing, while in Area 3 strong linears aligned ~E-W and weaker linears orientated ~N-S indicate land drains.

#### 6.6 Natural / Geological

6.6.1 Differing bands of fluvial bedrock deposits and localised variations in the Head deposits result in the amorphous, washed-out magnetic responses visible in all the survey areas.

#### 6.7 Pipe / Magnetic Disturbance / Ferrous

- 6.7.1 A chain of dipole anomalies [11] marks the line of a small pipe and two discrete areas of disturbance are associated with a former building [12] and an old pond [13], the latter two being visible on OS maps.
- 6.7.2 Ferrous responses close to boundaries are due to adjacent fences and gates. Smaller scale ferrous anomalies ("iron spikes") are present throughout the data and are characteristic of small

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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.

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#### 7 DATA APPRAISAL & CONFIDENCE ASSESSMENT

7.1 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 a range of magnetic responses which indicate that there is no *a priori* reason why archaeological features would not have been detected.

#### 8 CONCLUSION

8.1 The magnetometer survey has not recorded any magnetic responses that could be interpreted as being of definite archaeological interest. There are a few uncertain responses in the data, however, none of these are similar to the archaeological anomalies identified in the earlier magnetic survey (Magnitude 2018). Former field boundaries, an old building, an infilled pond, natural / geological responses, ploughing effects, land drains and a small pipe are all visible in the results.

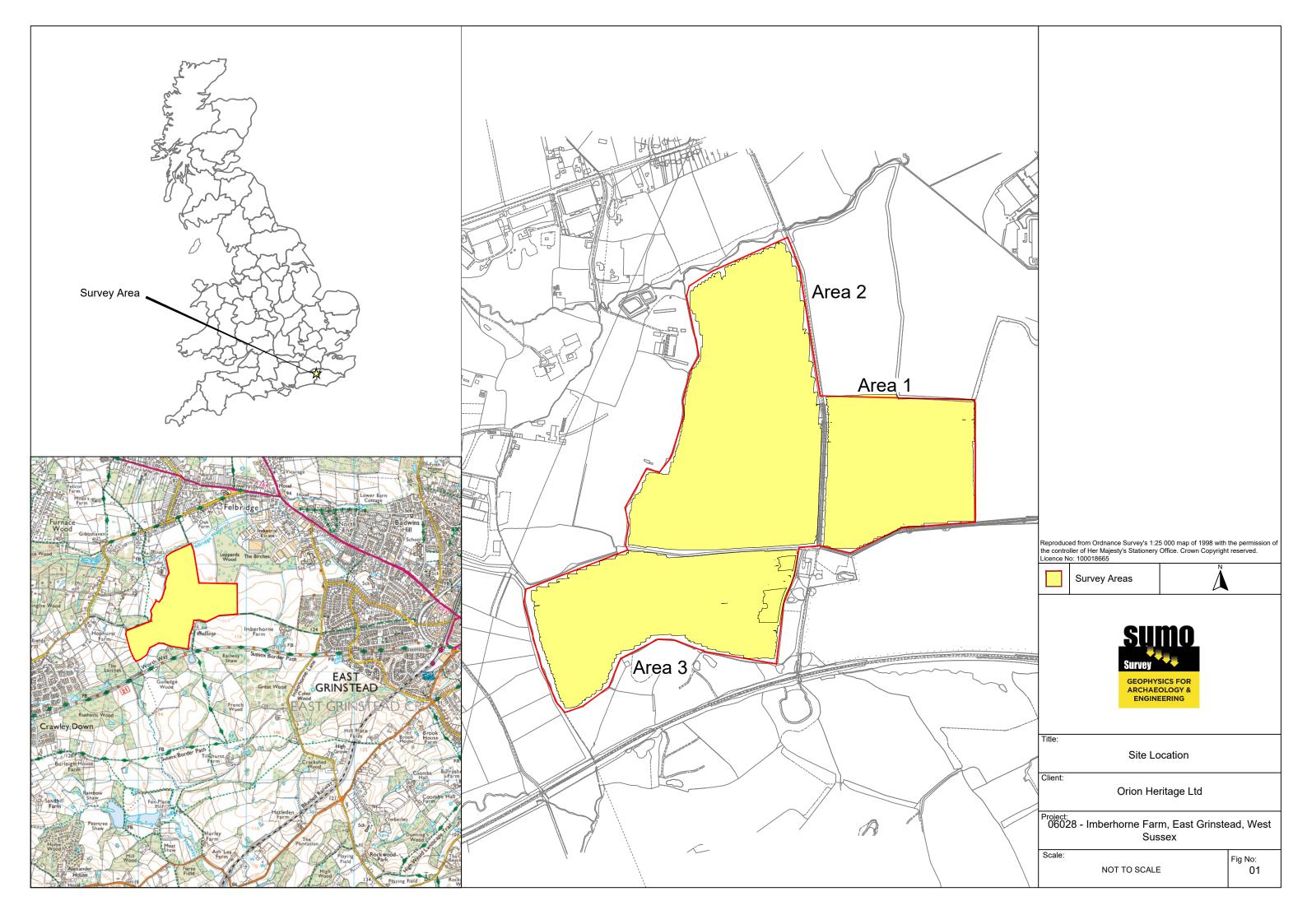
Job ref: 06028 Client: Orion Heritage Ltd Date: 09 February 2022

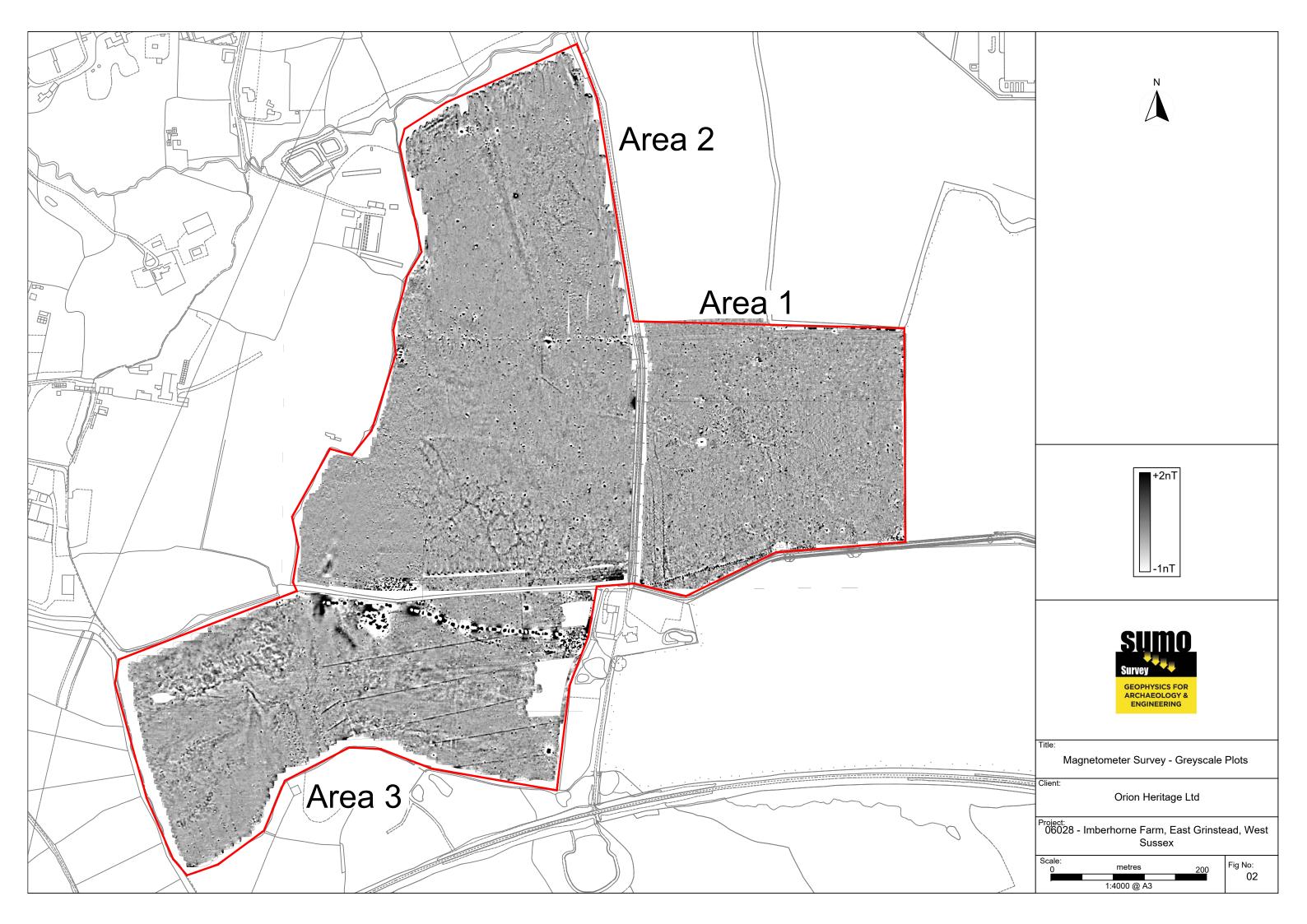
#### 9 **REFERENCES**

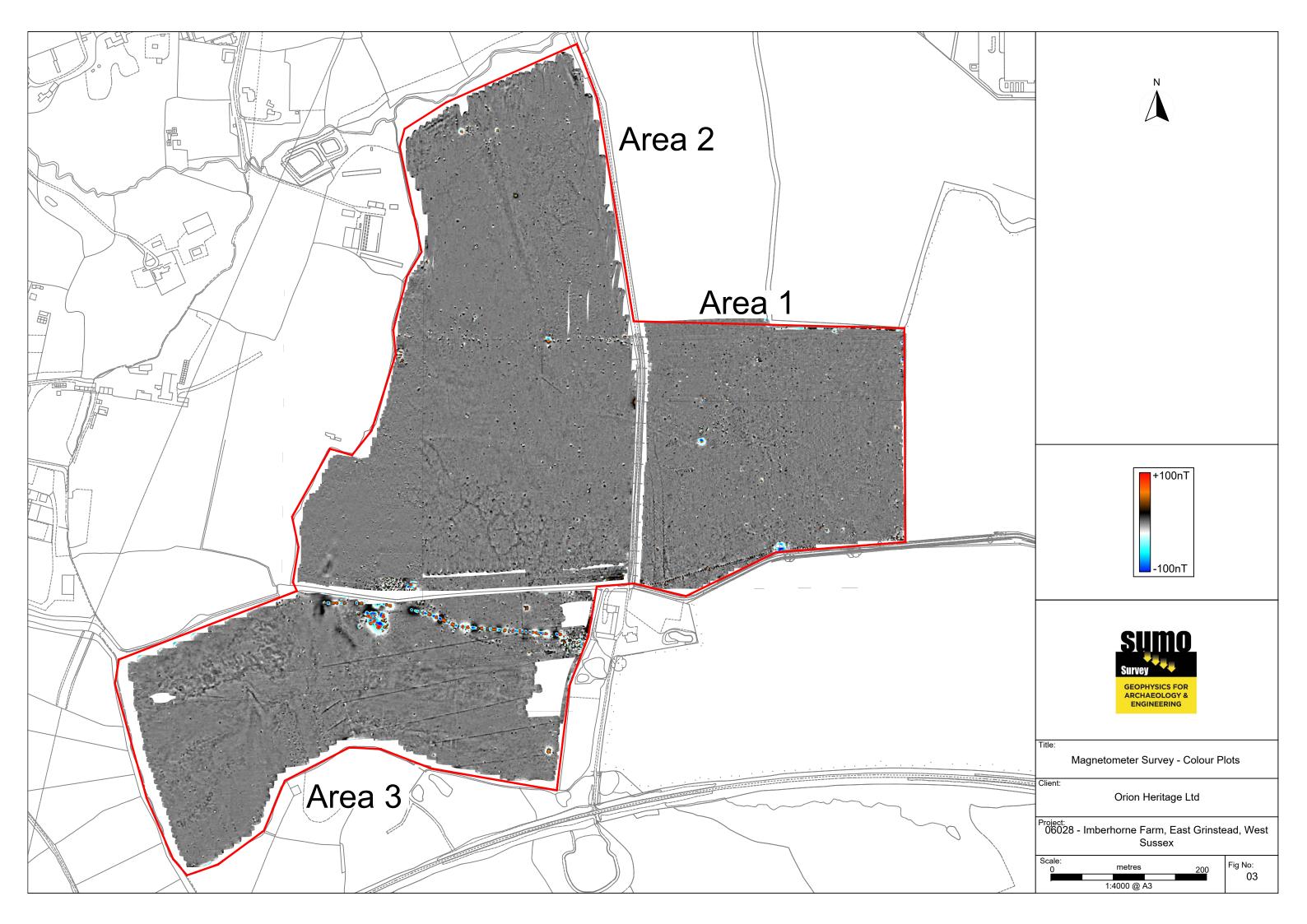
BGS 2022	British Geological Survey, Geology of Britain viewer [accessed 01/02/2022] website: (http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps)
CIfA 2014	Standard and Guidance for Archaeological Geophysical Survey. Amended 2020. CIfA Guidance note. Chartered Institute for Archaeologists, Reading <a href="http://www.archaeologists.net/sites/default/files/CIfAS%26GGeophysics">http://www.archaeologists.net/sites/default/files/CIfAS%26GGeophysics</a> 2.pdf
CU 2022	The Soils Guide. Available: www.landis.org.uk. Cranfield University, UK. [accessed 01/02/2022] website: <a href="http://mapapps2.bgs.ac.uk/ukso/home.html">http://mapapps2.bgs.ac.uk/ukso/home.html</a>
EAC 2016	EAC Guidelines for the Use of Geophysics in Archaeology, European Archaeological Council, Guidelines 2.
EH 2008	Geophysical Survey in Archaeological Field Evaluation. English Heritage, Swindon <a href="https://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf/">https://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf/</a>
Magnitude 2018	Geophysical Survey Report of Imberhorne Farm, East Grinstead, West Sussex, Magnitude Surveys Report MSTQ353, unpublished.

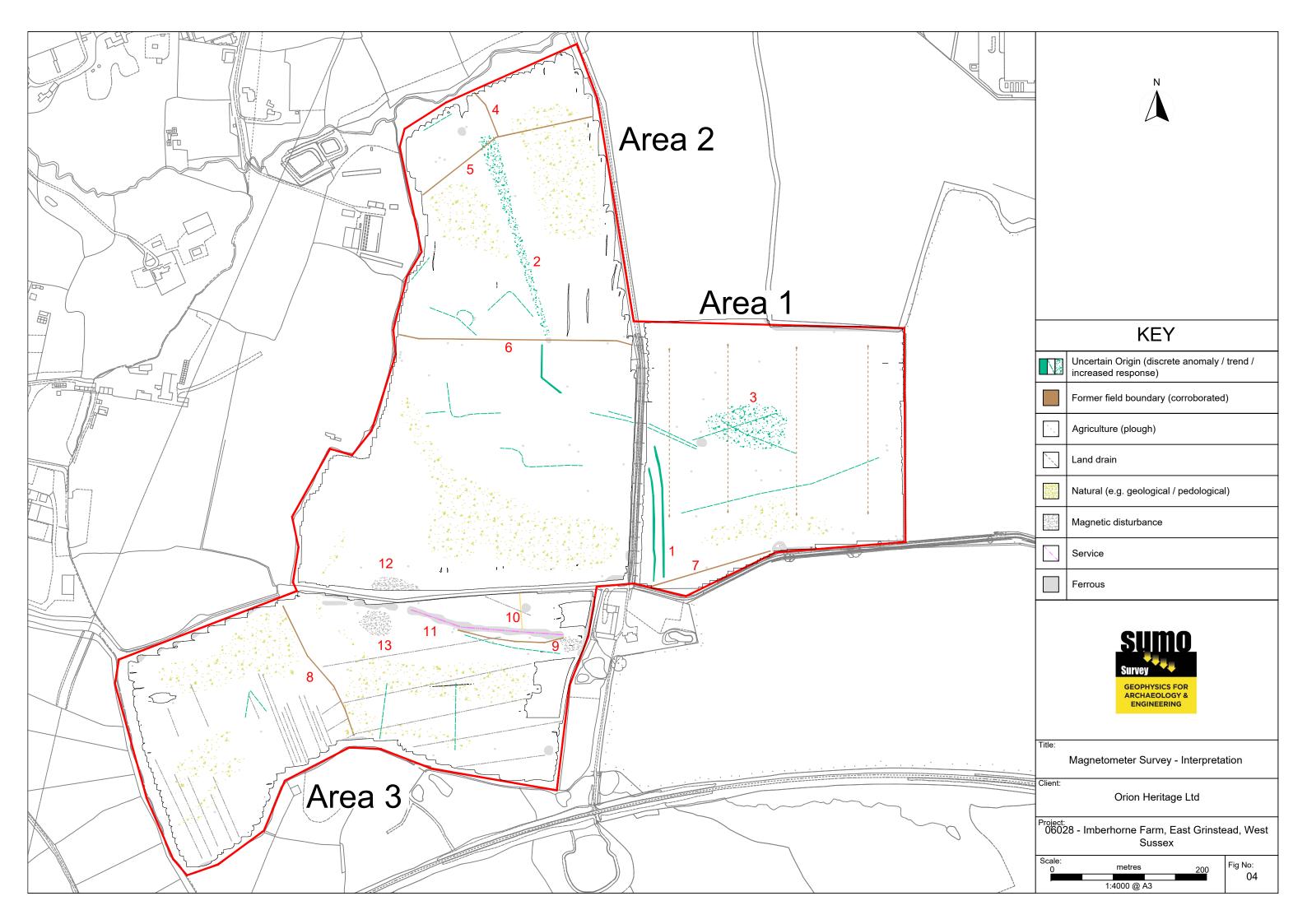
#### 10 **ARCHIVE**

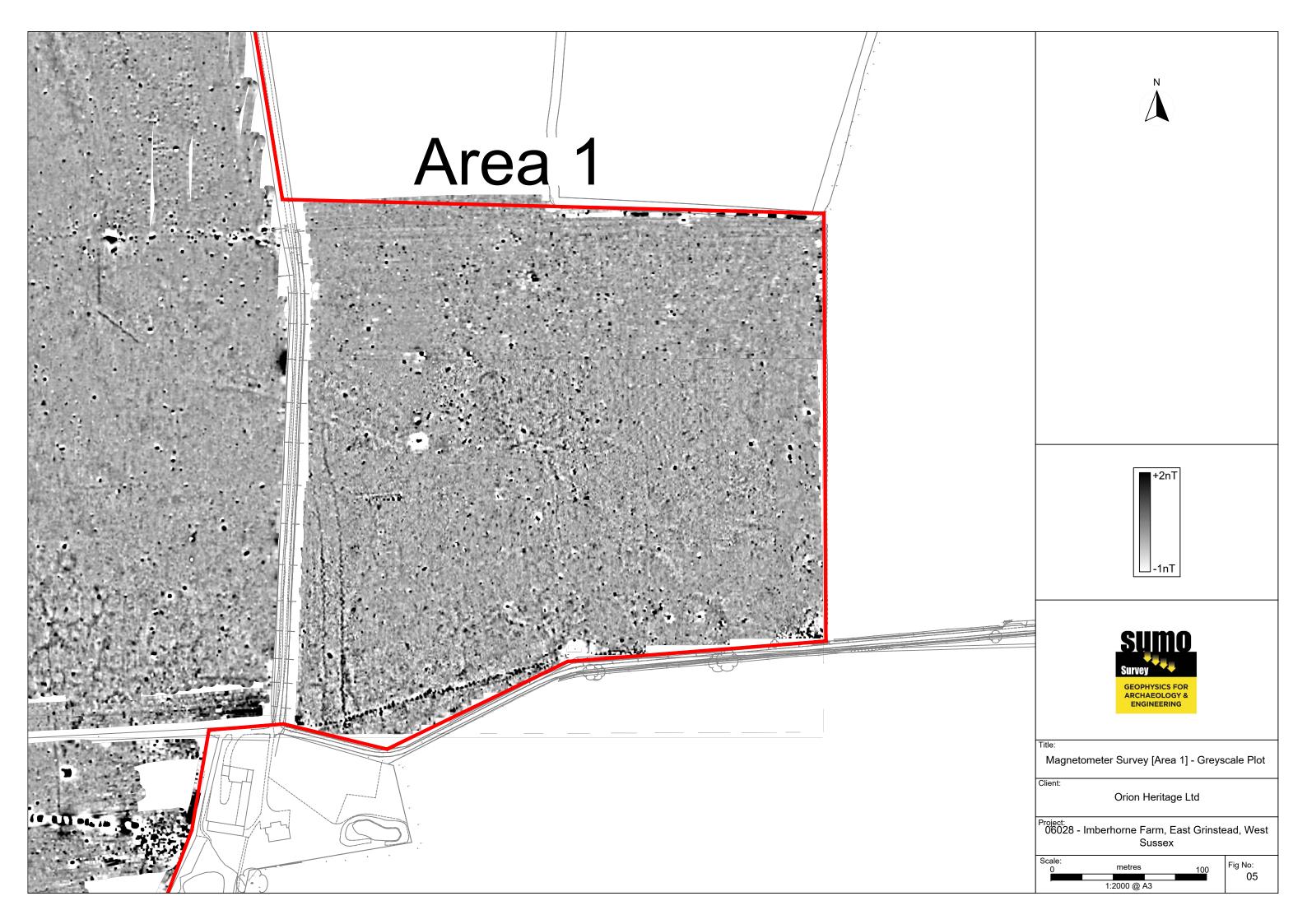
- The minimally processed data, data images, XY traces and a copy of this report are stored in 10.1 SUMO Geophysics Ltd.'s digital archive, on an internal RAID configured NAS drive in the Midland's Office. These data are also backed up to the Cloud for off-site storage.
- 10.2 The Grey Literature will be archived with OASIS and the relevant HER within a period of 12 months

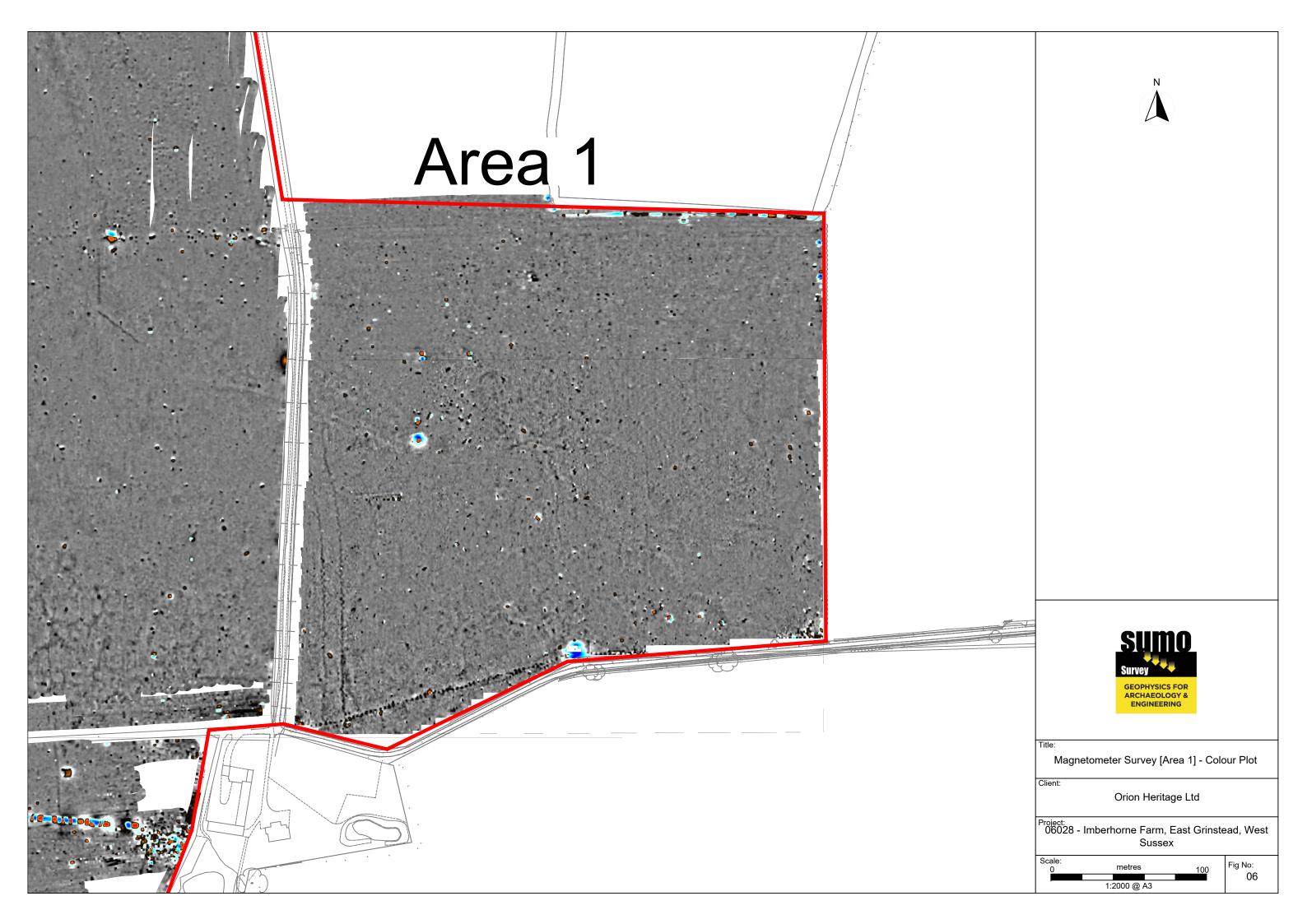




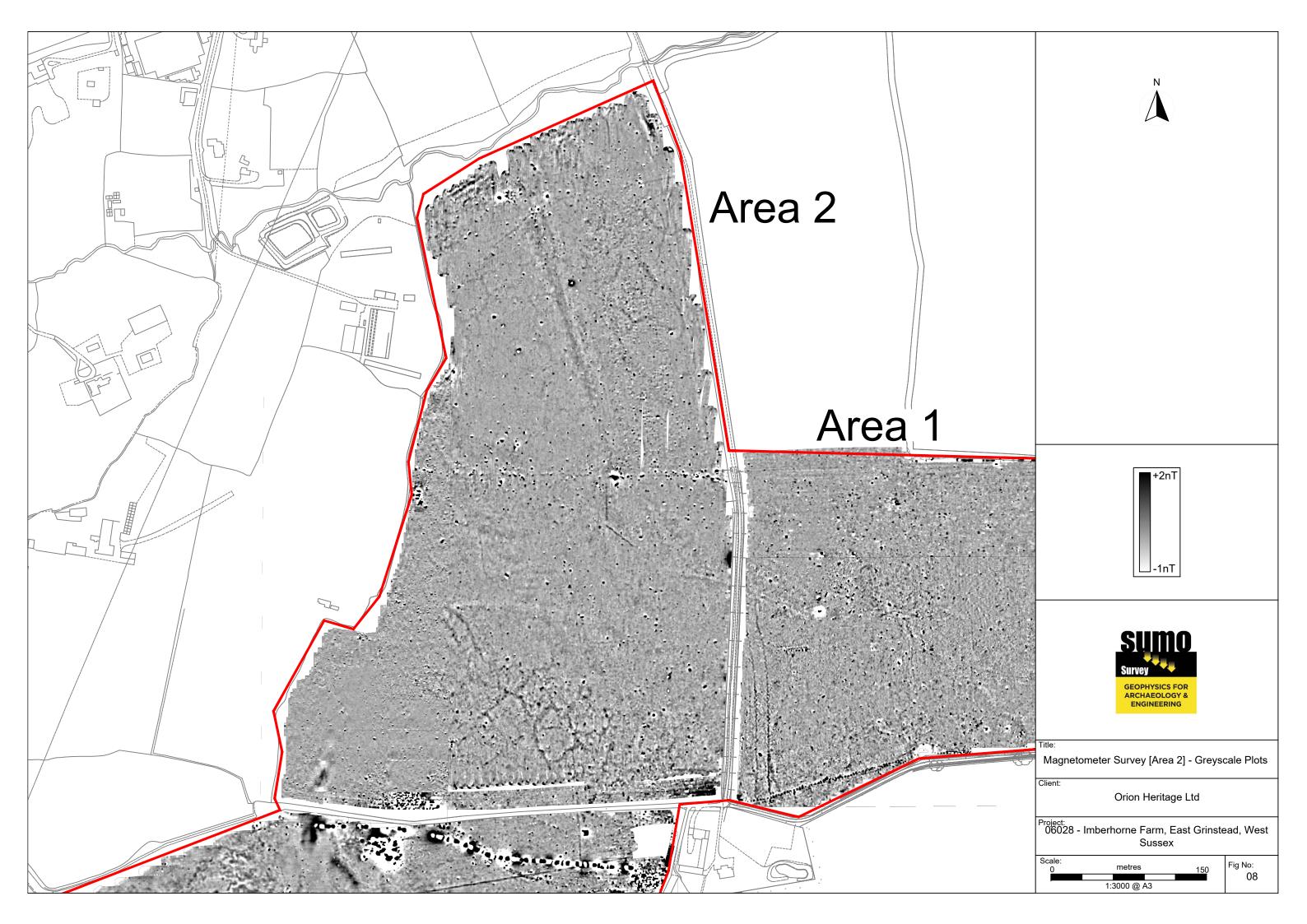


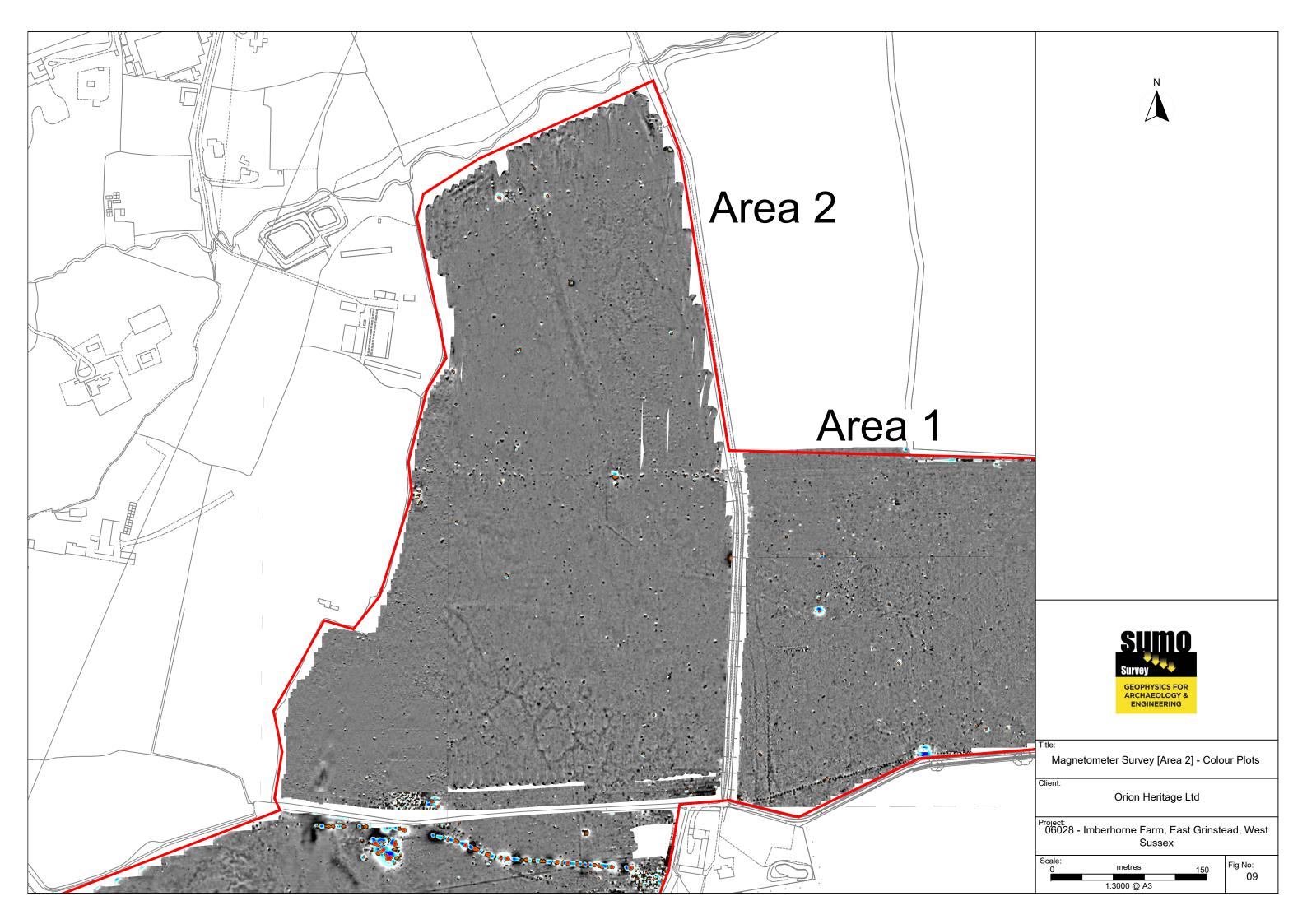


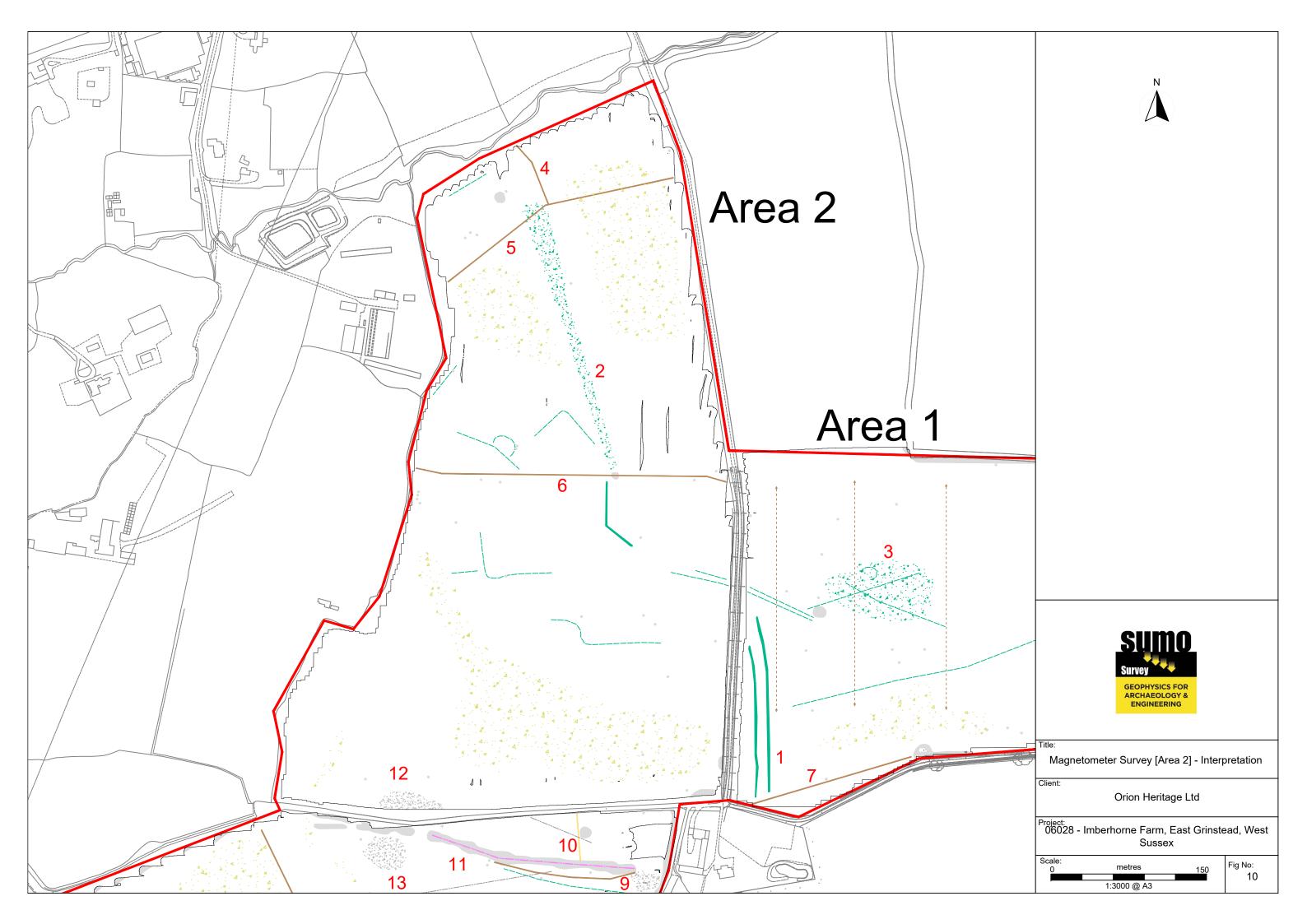


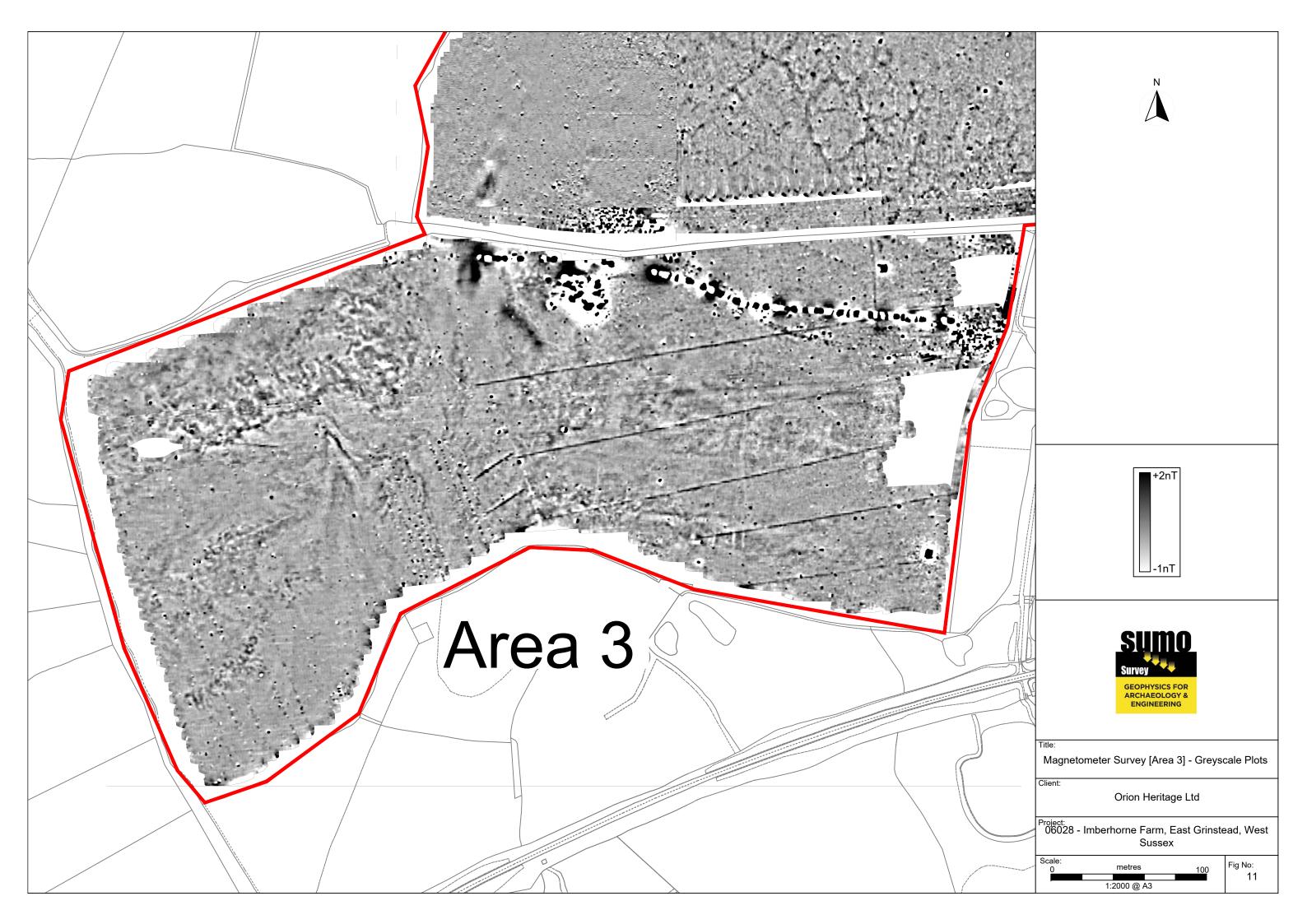


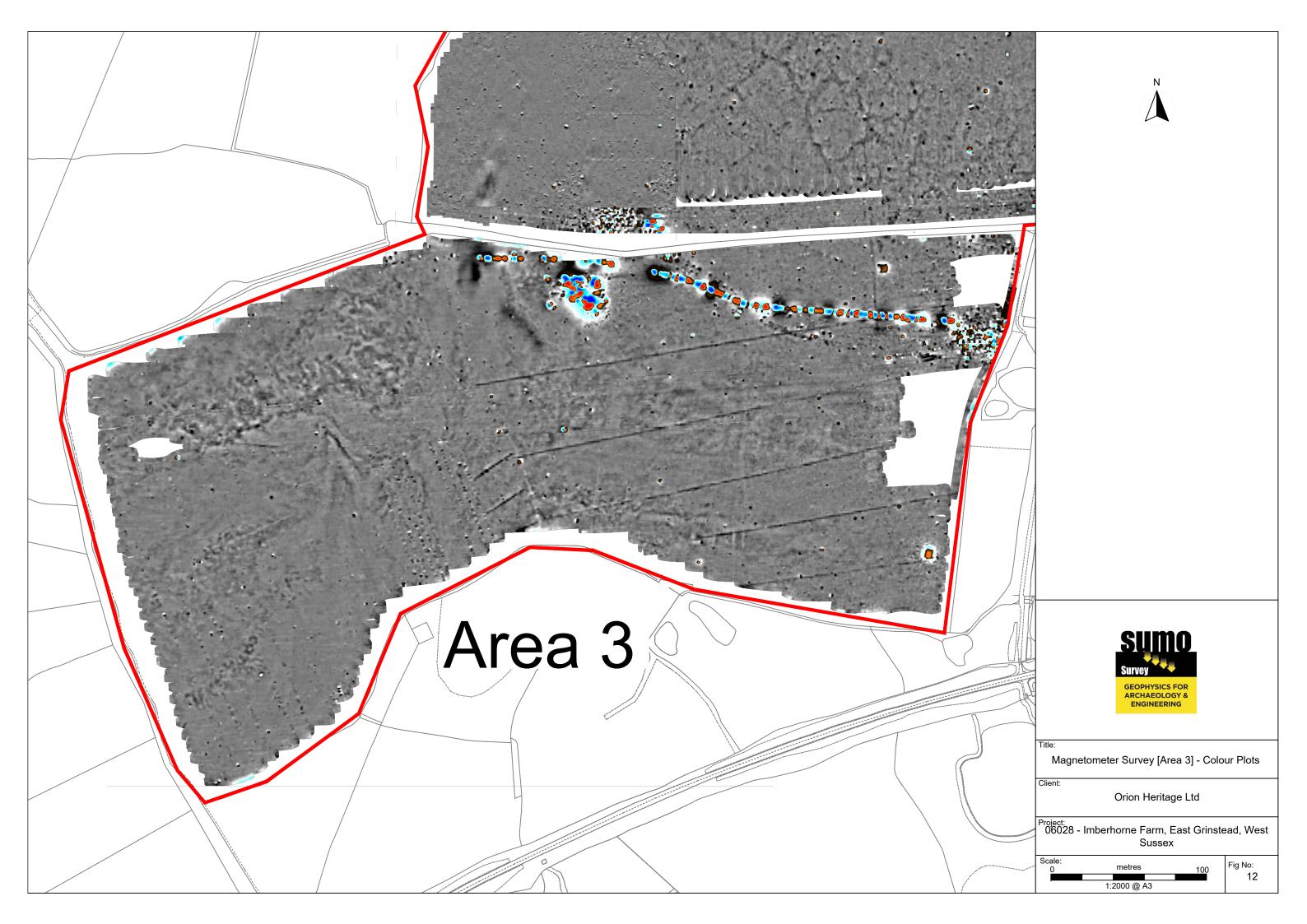


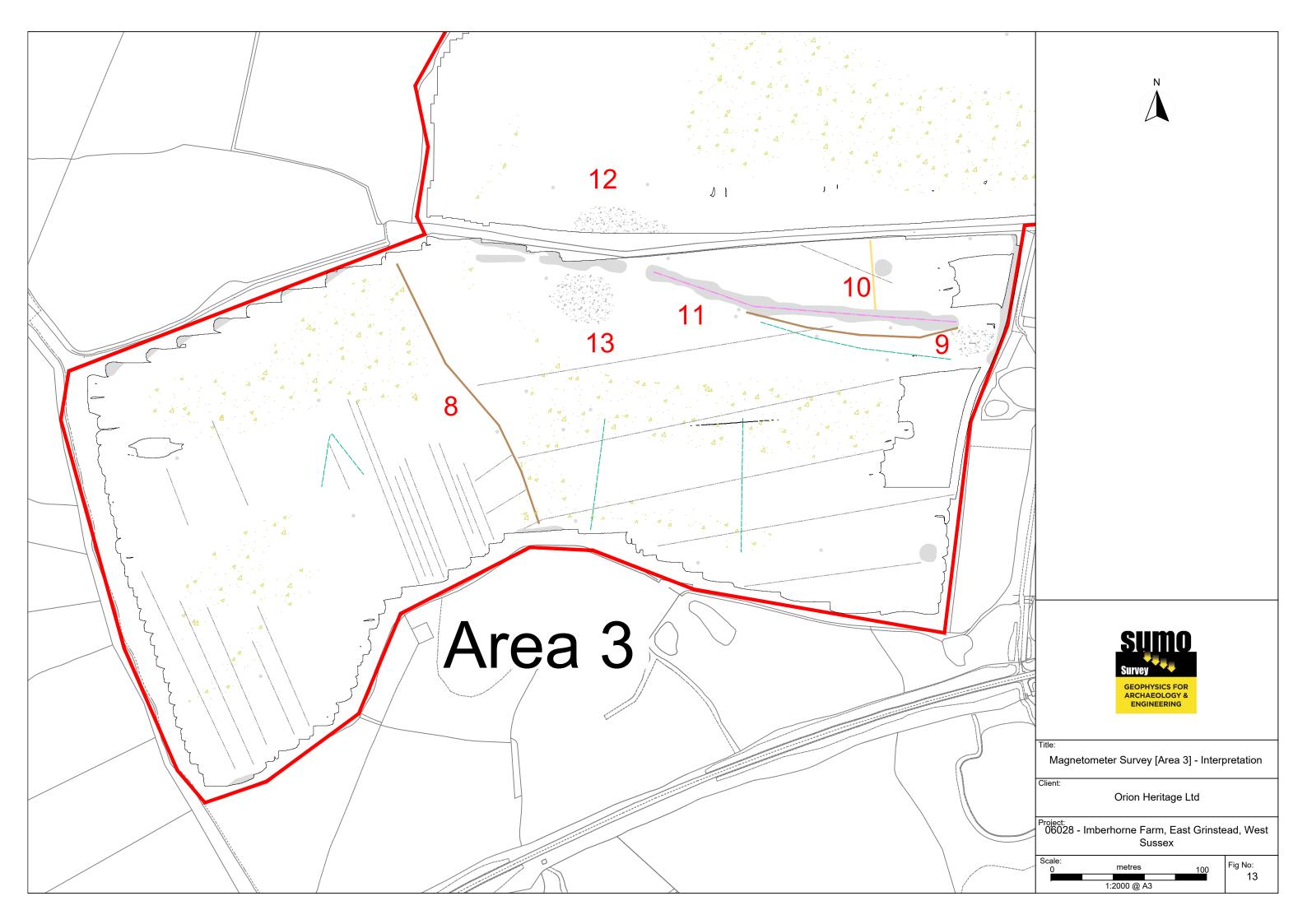


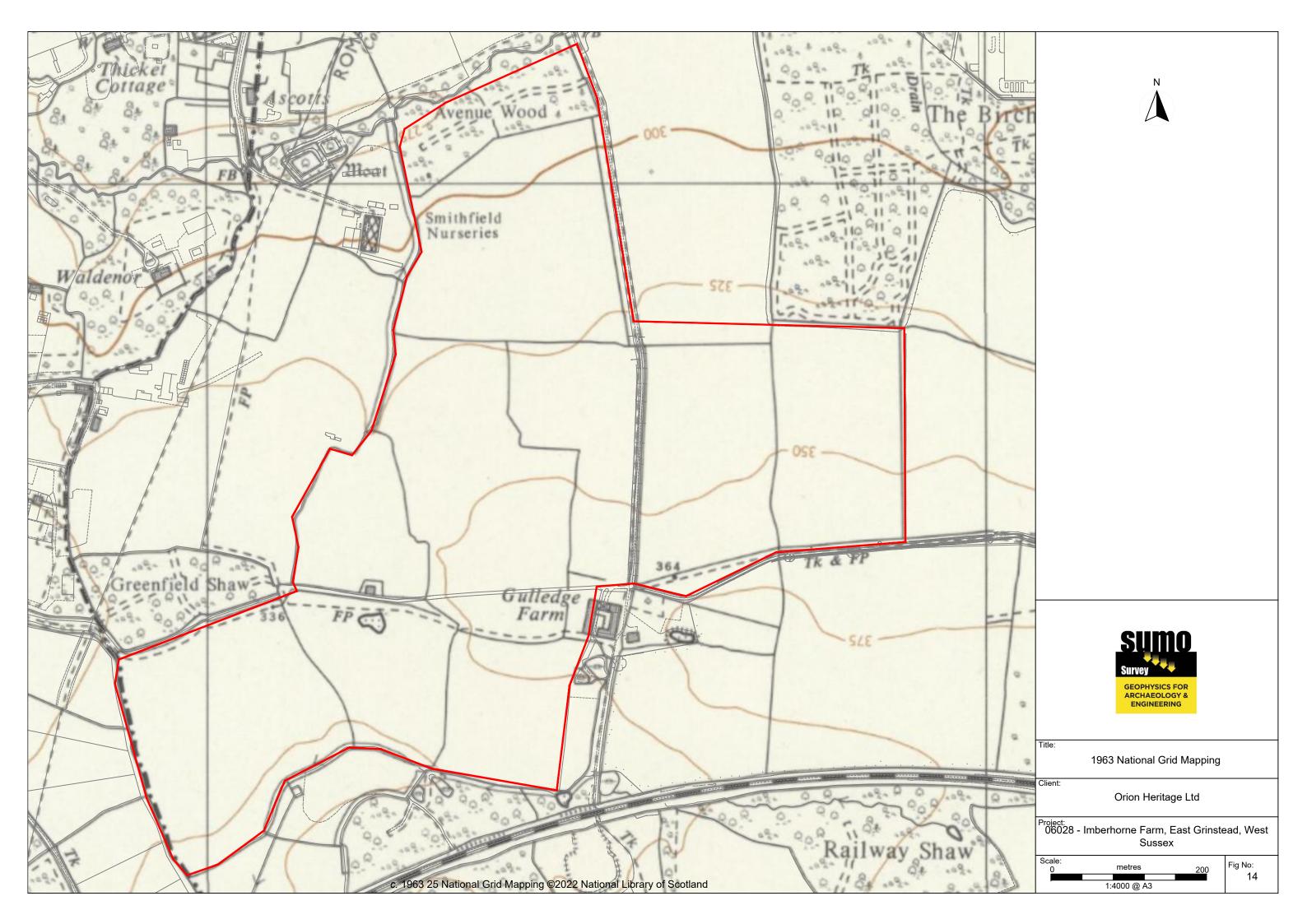
















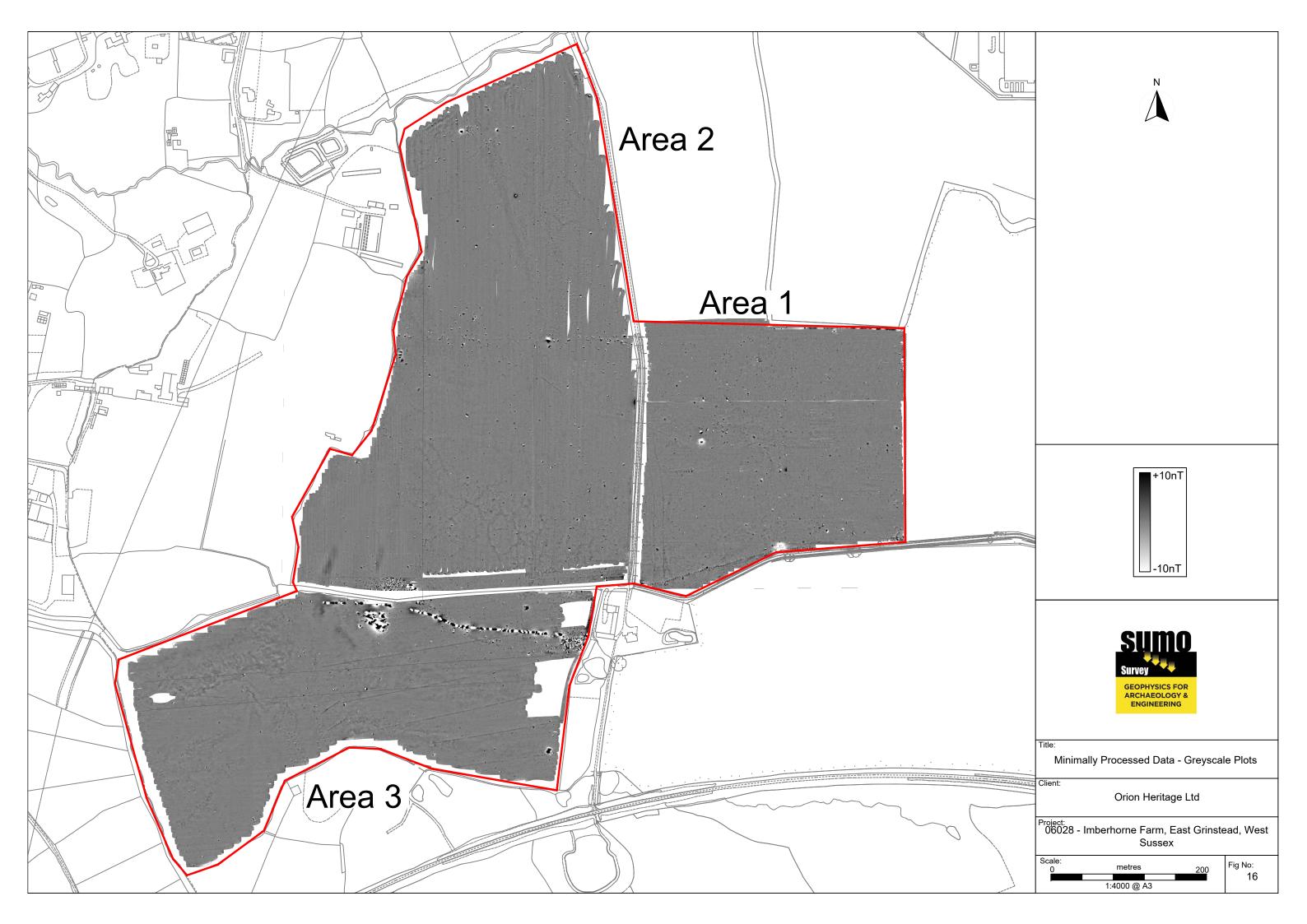


2021 Aerial Imagery

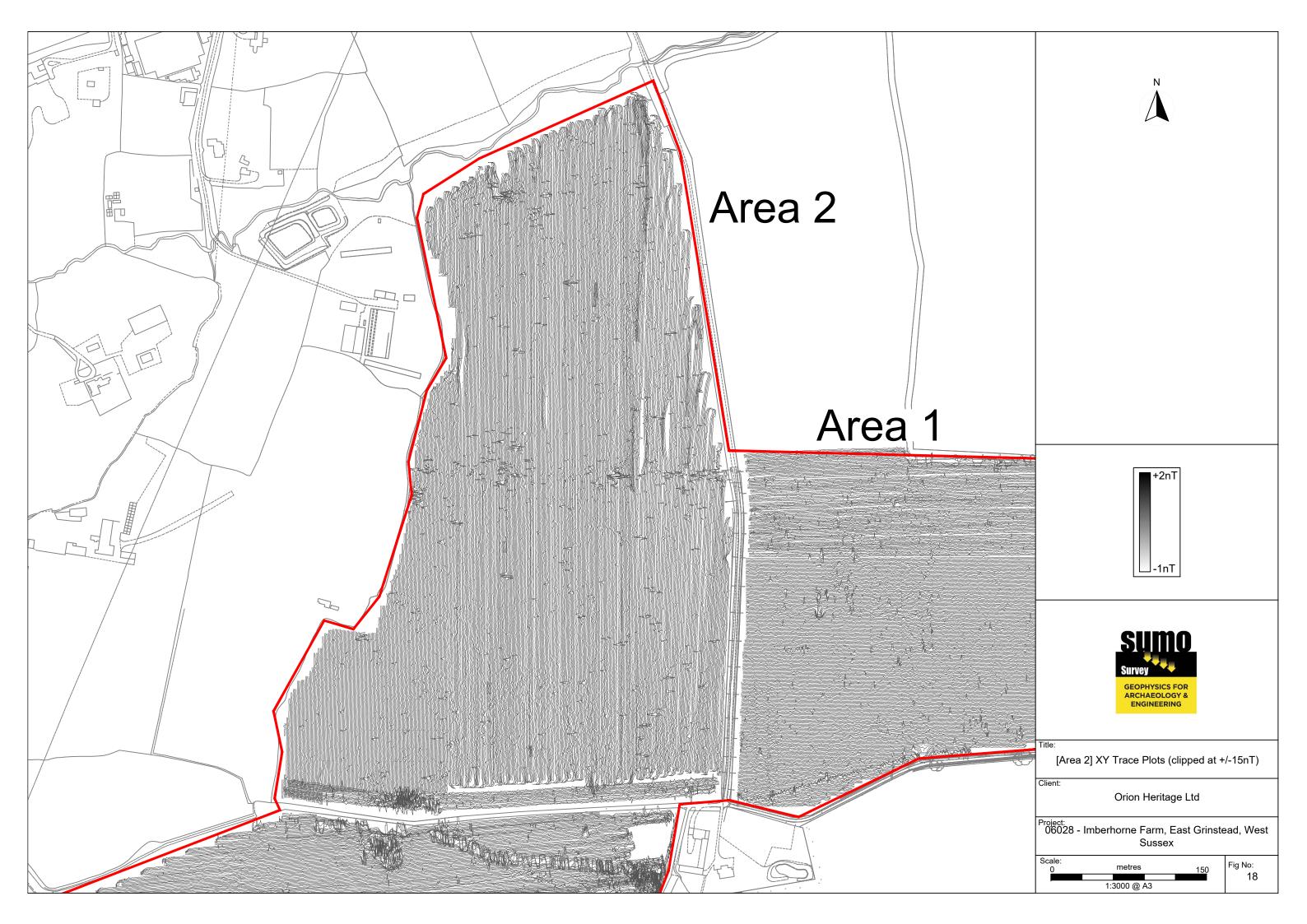
Orion Heritage Ltd

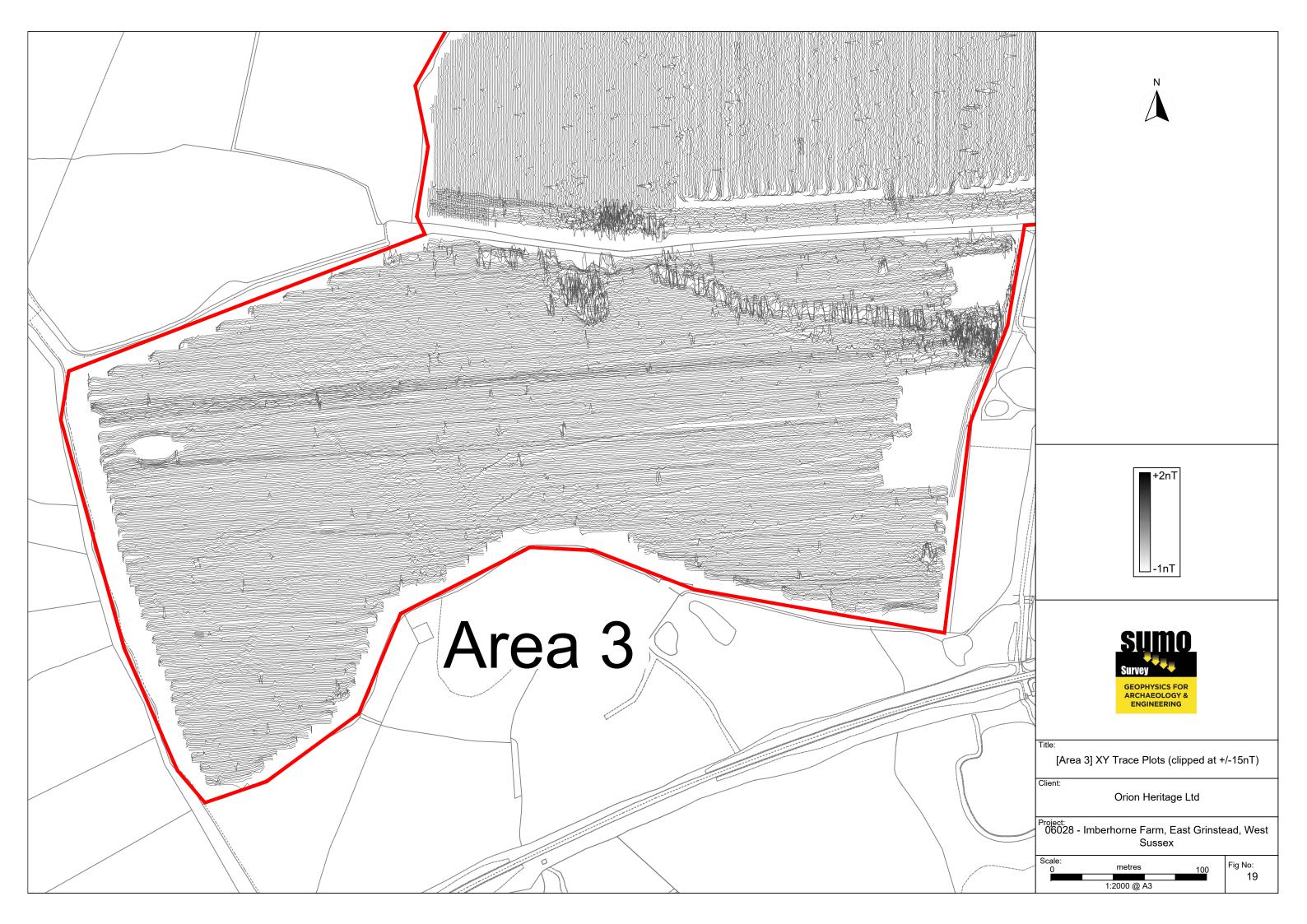
Project: 06028 - Imberhorne Farm, East Grinstead, West Sussex

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#### 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 rebroadcasts 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 Traverse This process sets the background mean of each traverse within each grid to zero. 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.

## 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.

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#### **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.

Archaeology / Probable Archaeology

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.

Possible Archaeology

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.

Industrial / Burnt-Fired 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, metalworking areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.

Former Field & possible)

Anomalies that correspond to former boundaries indicated on historic mapping, or Boundary (probable 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.

Ridge & Furrow

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.

**Agriculture** (ploughing) Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.

Land Drain

Weakly magnetic linear anomalies, guite 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.

Natural

These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.

Magnetic Disturbance Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present.

Service

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.

**Ferrous** 

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.

Uncertain Origin

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 *Possible* Archaeology / Natural or (in the case of linear responses) Possible Archaeology / Agriculture; 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 sumogeop1-504502**

OASIS ID (UID)	sumogeop1-504502
Project Name	Geophysical Survey at Imberhorne Farm, East Grinstead, West Sussex
Activity type	Geophysical Survey, MAGNETOMETRY SURVEY
Project Identifier(s)	06028
Planning Id	
Reason For Investigation	Planning requirement
Organisation Responsible for work	SUMO Geophysics Ltd.
Project Dates	16-Dec-2021 - 18-Jan-2022
Location	Imberhorne Farm, East Grinstead, West Sussex
	NGR : TQ 36389 38597
	LL: 51.1304206450582, -0.052177495216453
	12 Fig : 536389,138597
Administrative Areas	Country: England
	County: West Sussex
	District : Mid Sussex
	Parish : East Grinstead
	Parish: Worth
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 magnetometer survey has not recorded any magnetic responses that could be interpreted as being of definite archaeological interest. There are a few uncertain responses in the data, however, none of these are similar to the archaeological anomalies identified in the earlier magnetic survey (Magnitude 2018). Former field boundaries, an old building, an infilled pond, natural / geological responses, ploughing effects, land drains and a small pipe are all visible in the results.
Keywords	Pipeline - 20TH CENTURY - FISH Thesaurus of Monument Types
	Plough Marks - POST MEDIEVAL - FISH Thesaurus of Monument
	Types
LIED	Drain - POST MEDIEVAL - FISH Thesaurus of Monument Types
HER	West Sussex HER - unRev - STANDARD
HER Identifiers	



- Laser Scanning
- Archaeological Geophysical Measured Building Topographic

  - TopographicUtility Mapping