

GEOPHYSICAL SURVEY REPORT

Land at Hospital Cross, Helston Downs, Helston

Client

PEGASUS GROUP

For

PARSONAGE DEVELOPMENTS LTD

OASIS Ref.

sumogeop1-503392

Survey Report

05318

Date

December 2021



Survey Report 05318: Site Name Land at Hospital Cross, Helston Downs, Helston

Survey dates	29-30 November 2021
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Report Date	15 December 2021
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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

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 2.4 hectares of land at Hospital Cross, Helston, has identified no responses which could be interpreted as being of archaeological interest. Weak uncertain trends could be indicative of ridge and furrow or a result of minor magnetic variations in the underlying geology.

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 **Pegasus Group** on behalf of **Parsonage Developments Ltd**.

4.2 Site details

NGR / Postcode	SW 6677 2629 / TR13 0QA
Location	The site lies on the south eastern outskirts of Helston, Cornwall, immediately south-east of the junction between the A394 becomes the A3083. RAF Culdrose forms the southern boundary and Culdrose Manor and a Retail Park the northern limits.
HER	Cornwall
OASIS Ref.	sumogeop1-503392
District	Cornwall
Parish	Helston
Topography	Generally level at 67 to 73m aOD
Current Land Use	Pasture
Geology (BGS 2021)	Solid: Mylor Slate Formation - Slate and Siltstone Superficial: None-recorded
Soils (CU 2021)	Soilscape 6 freely draining slightly acid loamy soils
Archaeology (PG 2021)	There have been no recorded archaeological remains within the site from any period. The nearest identified feature, a purported prehistoric bivallate enclosure plotted immediately south of the site, has been demonstrated to correspond with the location of a modern cycle track that is no longer extant. No significant archaeological remains or features have been recorded in the immediate vicinity of the site. There is recorded evidence of prehistoric, Romano-British, and medieval activity in the wider locality; however, based on the information available, there is no indication that such activity extended into the site.
Survey Methods	Magnetometer survey (fluxgate gradiometer)
Study Area	c. 2.4ha

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 three survey areas (Areas 1-3)

5.1 **Probable / Possible Archaeology**

5.1.1 The survey has not identified any magnetic responses which could be interpreted as being of definite archaeological interest.

5.2 **Uncertain**

5.2.1 There are several uncertain responses across the site which comprise linear trends in the data. None of these are thought to be archaeological, though such an interpretation cannot be entirely ruled out. It is more likely that they are geological or agricultural in origin.

5.2.2 Parallel weak trends are either indicative of former ridge and furrow cultivation, more recent ploughing, or perhaps simply variations in the geological bedding

5.3 **Ferrous**

5.3.1 Positive linear responses along the north-western limit of the survey could indicate a buried service (perhaps outside the boundary) or the barbed wire fence itself. Elsewhere, ferrous responses close to boundaries are due to adjacent fences and gates.

5.3.2 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 magnetic anomalies associated with either the geology or ploughing. There is no *a priori* reason why archaeological features would not have been recorded if present.

7 CONCLUSION

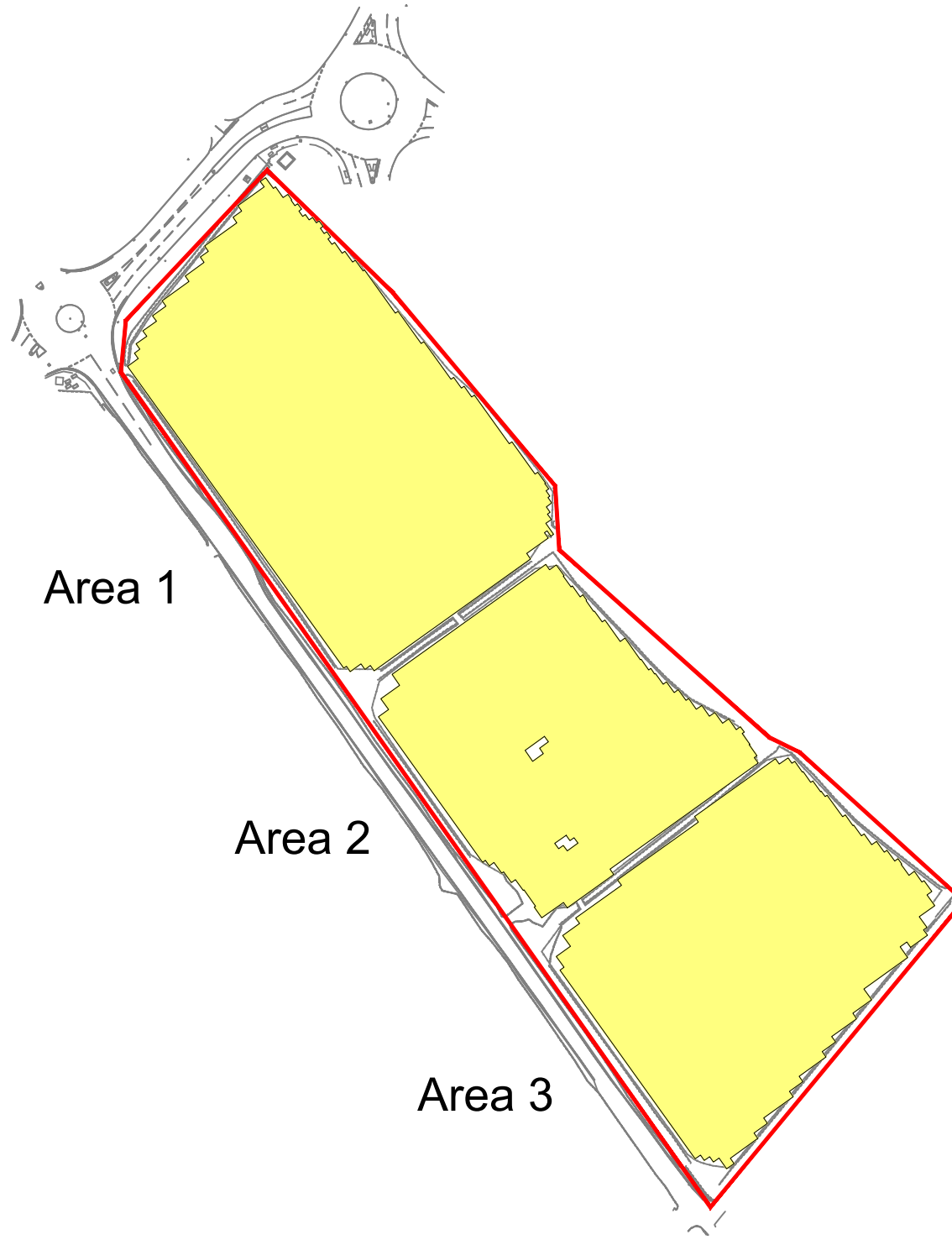
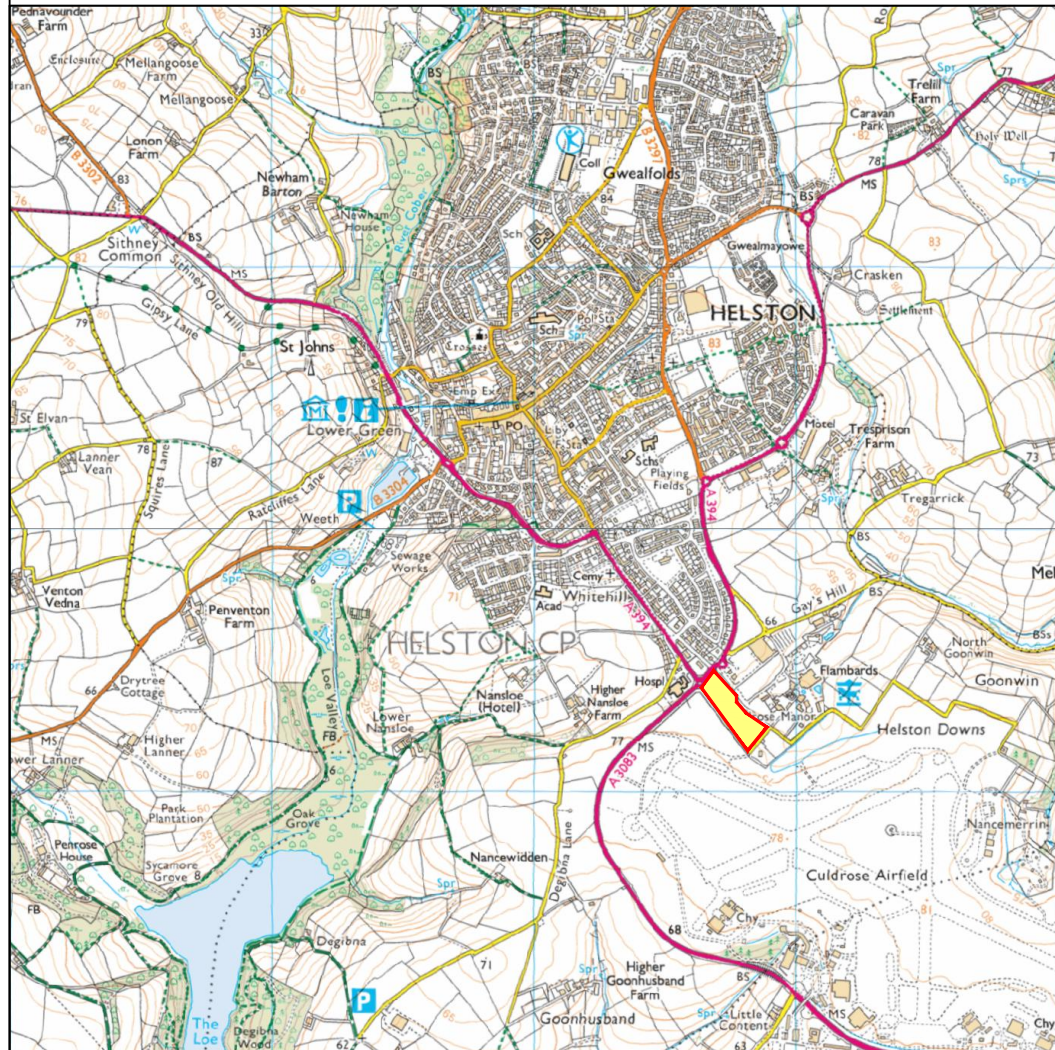
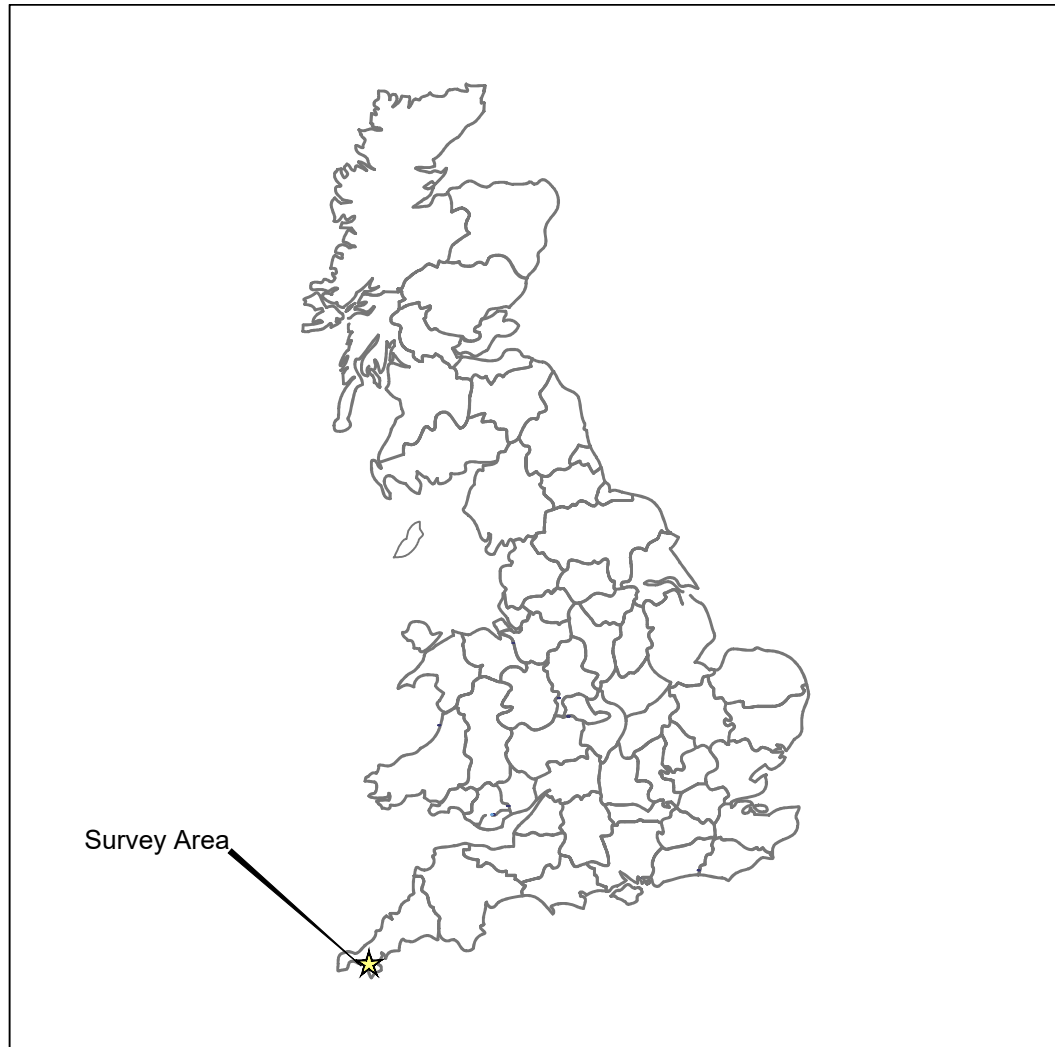
7.1 The magnetometry survey has not identified any responses of definite archaeological interest. A number of responses have been assigned to the category of uncertain; these are likely to be due to ridge and furrow cultivation or geological variations.

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>
- 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
<https://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf/>
- PG 2017/21 *Land At Hospital Cross, Helston Downs, Helston, Heritage Desk-Based Assessment*, Pegasus Group P20-2107 | JULY 2021, unpublished document.

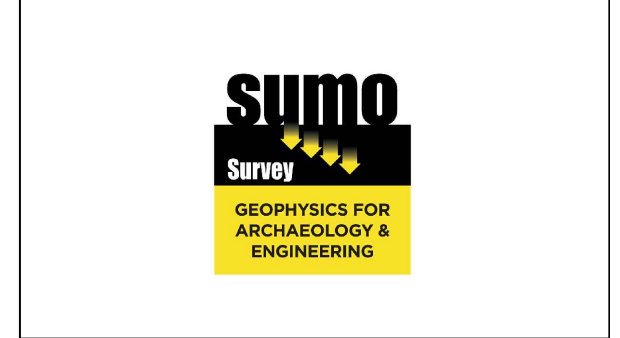
9 ARCHIVE

- 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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	Survey Areas	
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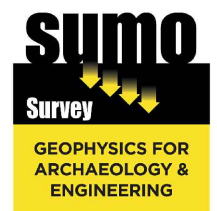
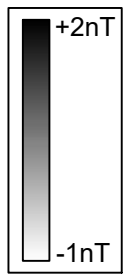
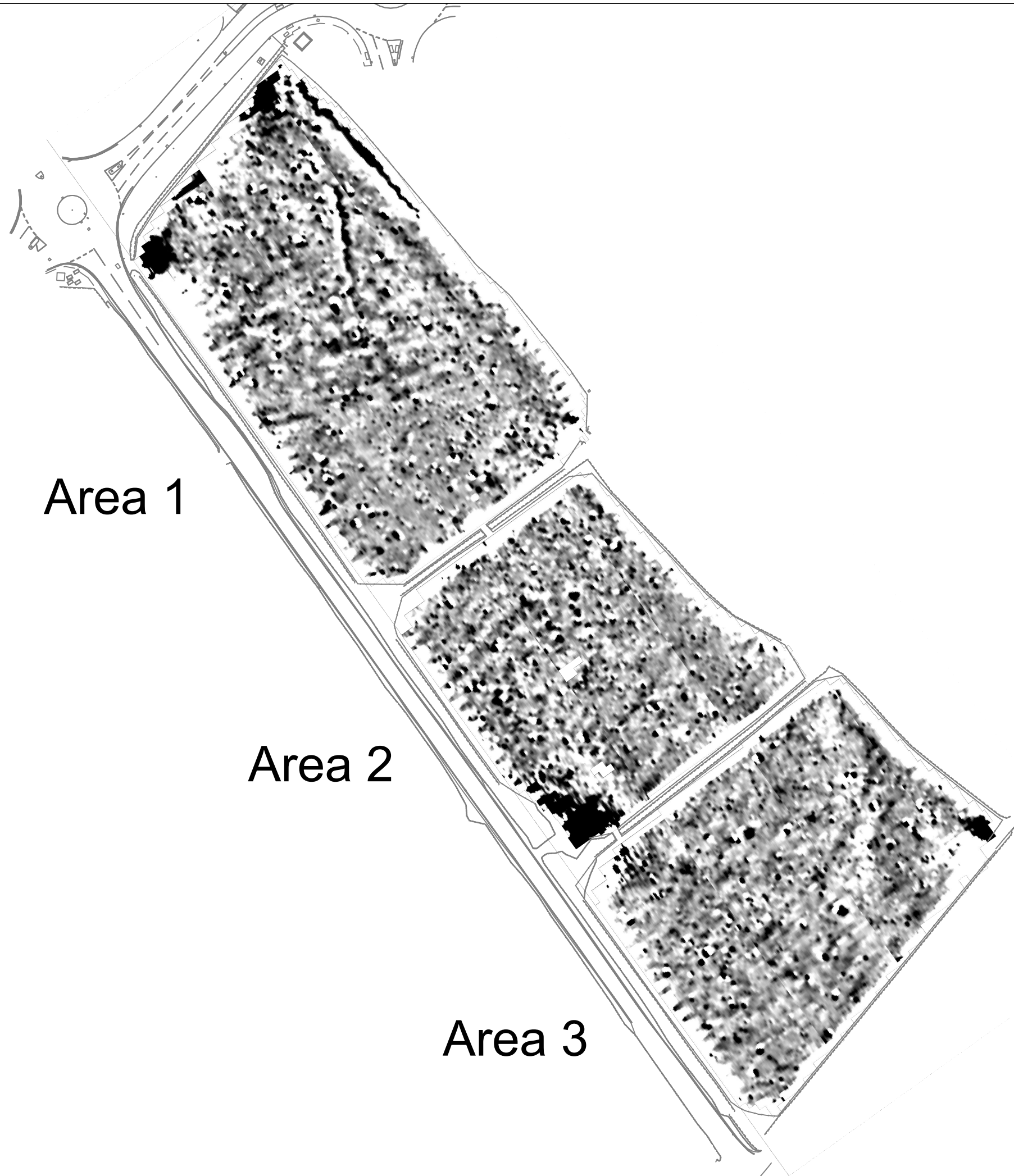


Title: Site Location

Client: Pegasus Group

Project: 05318 - Land at Hospital Cross, Helston Downs, Cornwall

Scale: NOT TO SCALE	Fig No: 01
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Title:
Magnetometer Survey - Greyscale Plots

Client:
Pegasus Group

Project:
05318 - Land at Hospital Cross, Helston Downs,
Cornwall

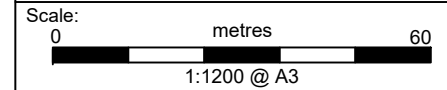
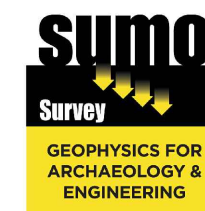
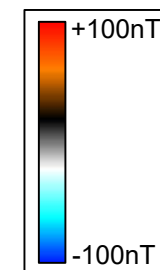
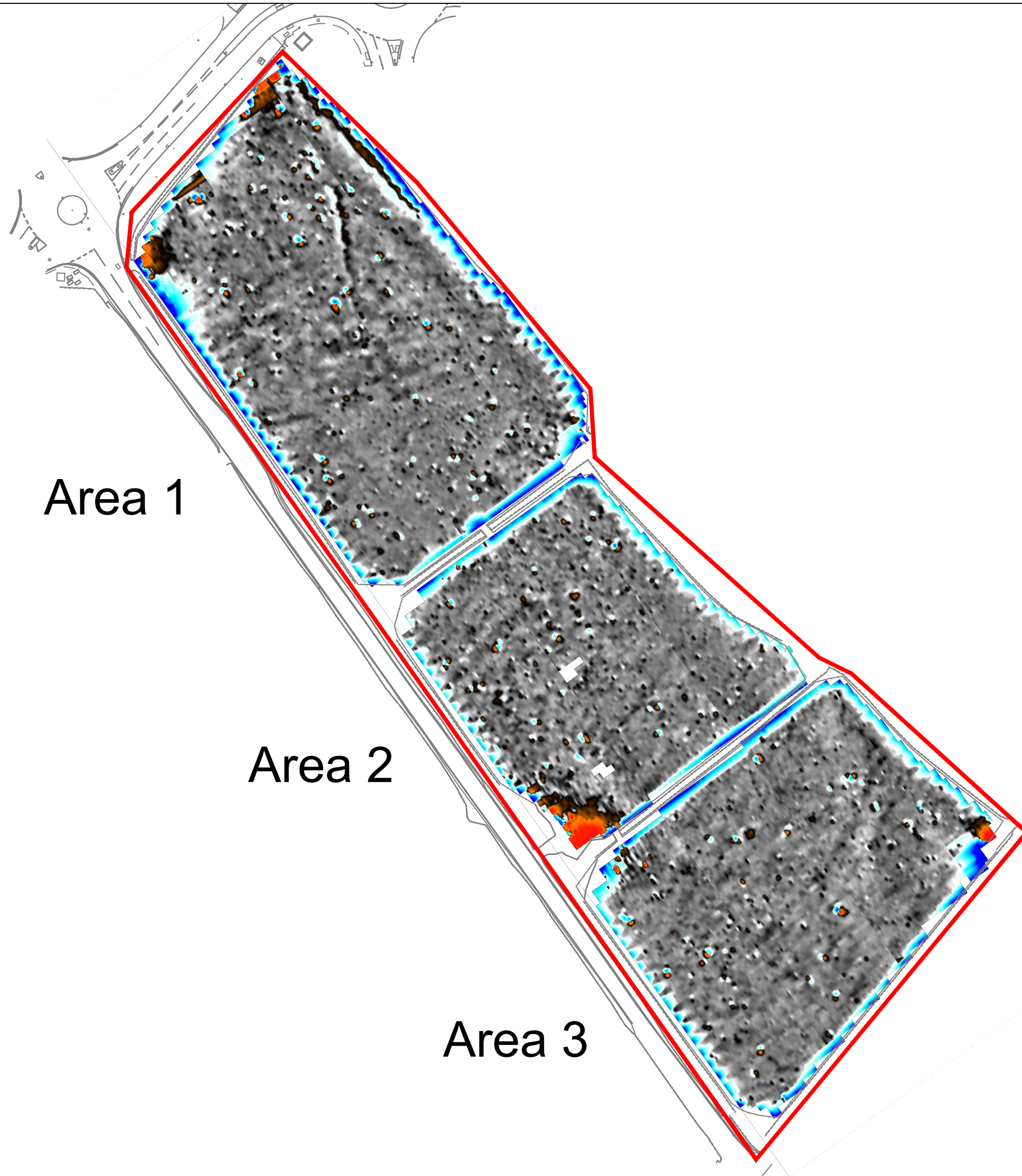


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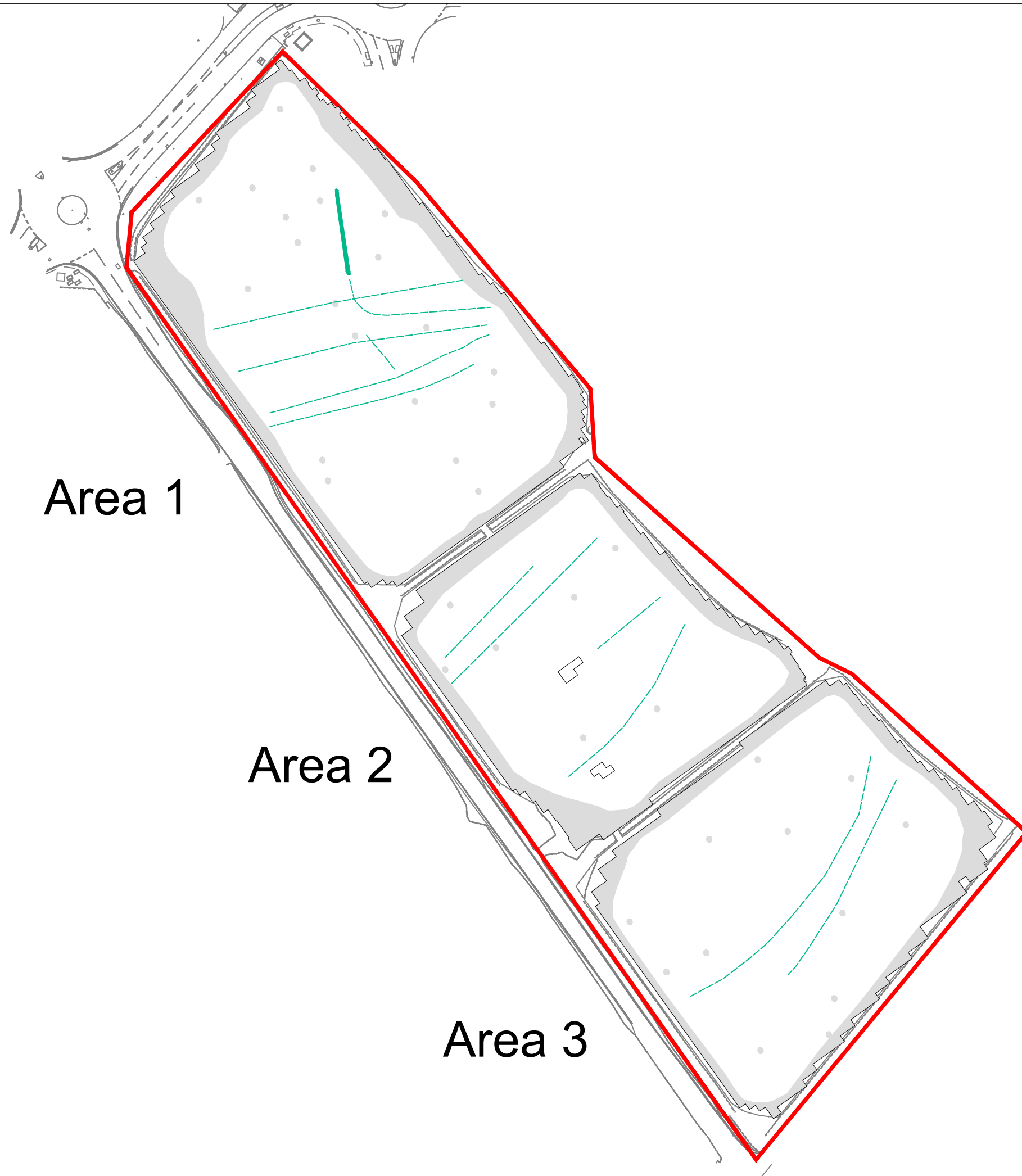
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Client: Pegasus Group



Project: 05318 - Land at Hospital Cross, Helston Downs, Cornwall

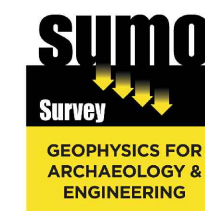
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Fig No: 03



KEY

-  Uncertain Origin (discrete anomaly / trend)
-  Ferrous



Title: Magnetometer Survey - Interpretation

Client: Pegasus Group

Project: 05318 - Land at Hospital Cross, Helston Downs, Cornwall

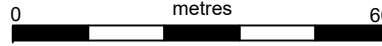
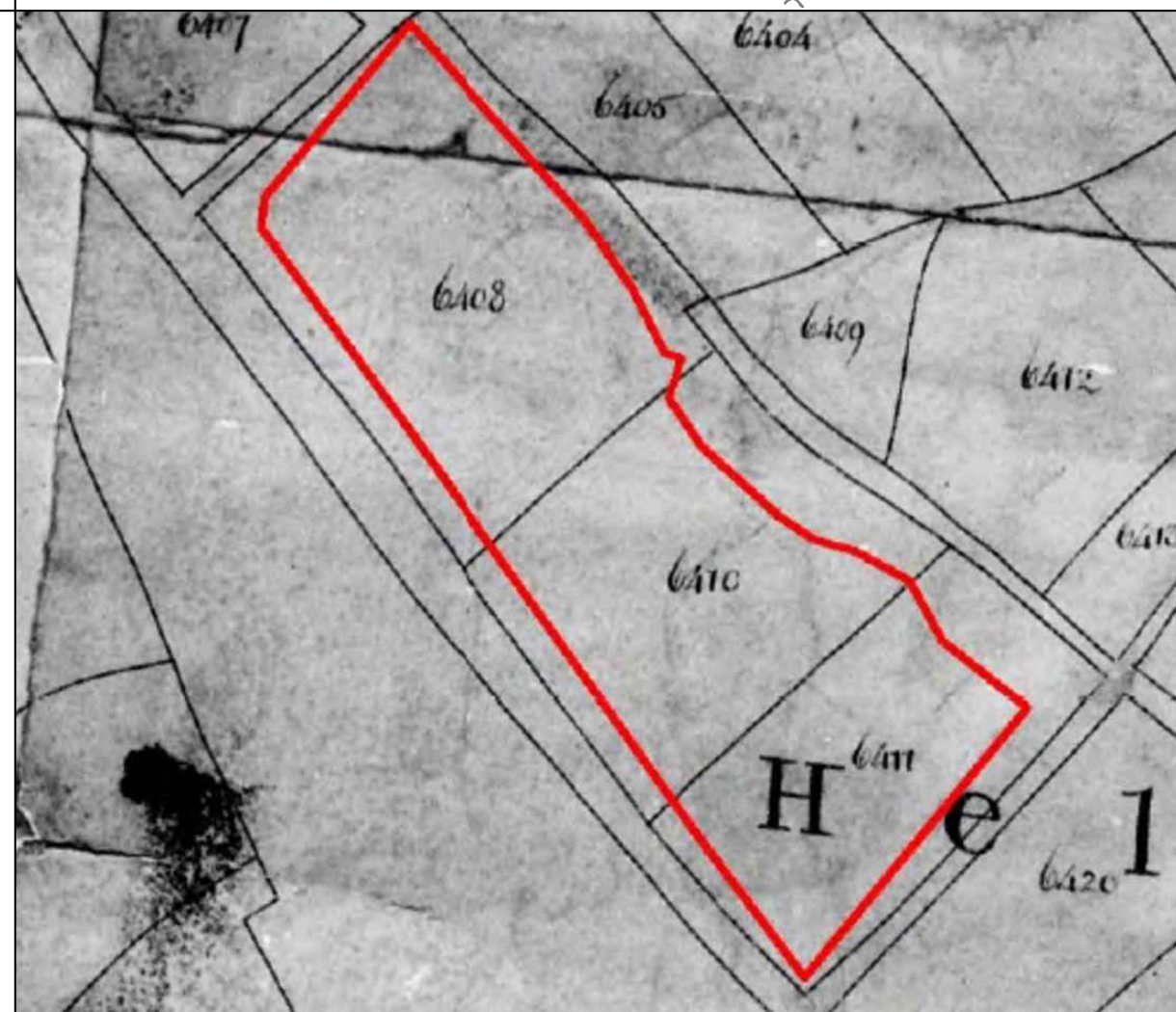
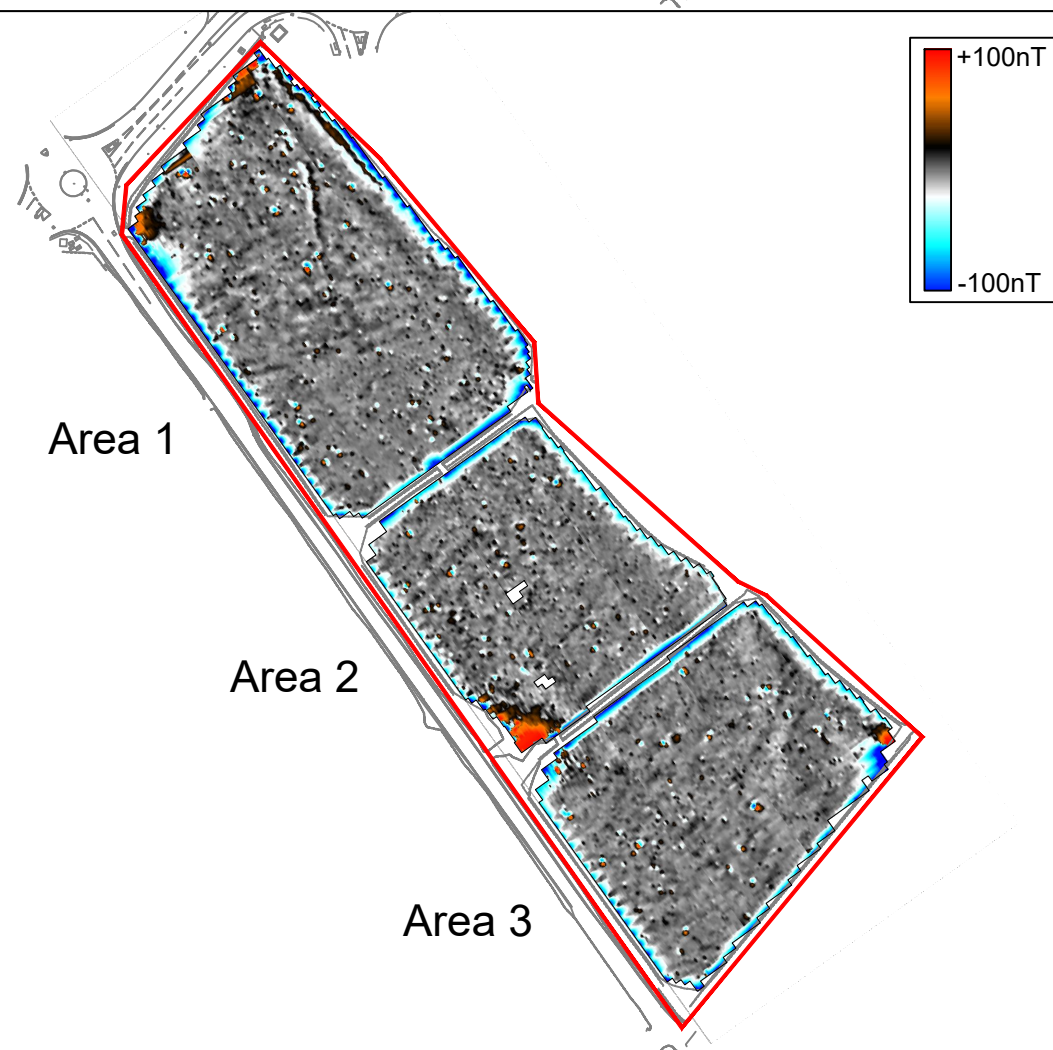
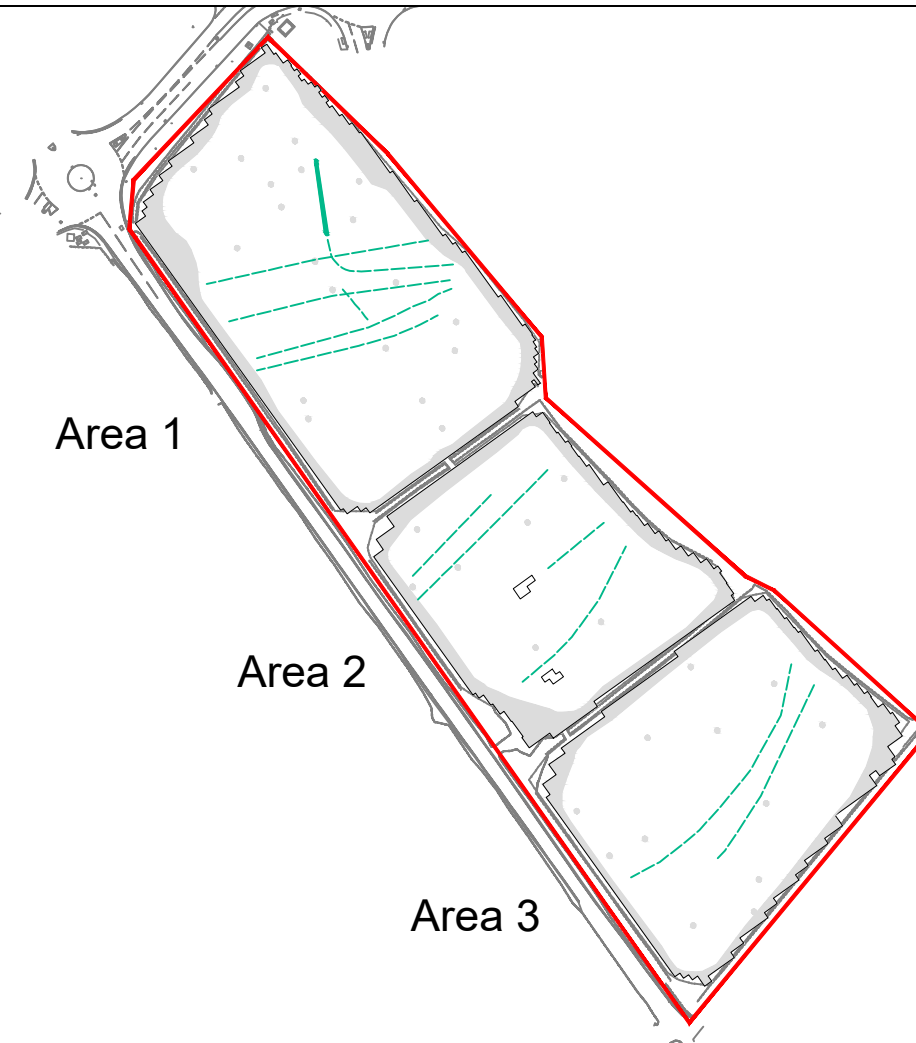


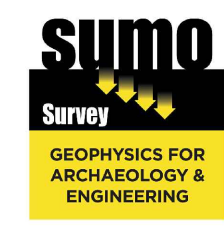
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Fig No: 04



KEY

-  Uncertain Origin (discrete anomaly / trend)
-  Ferrous



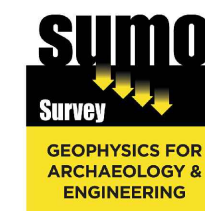
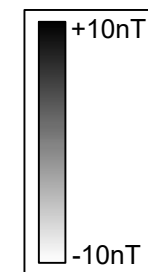
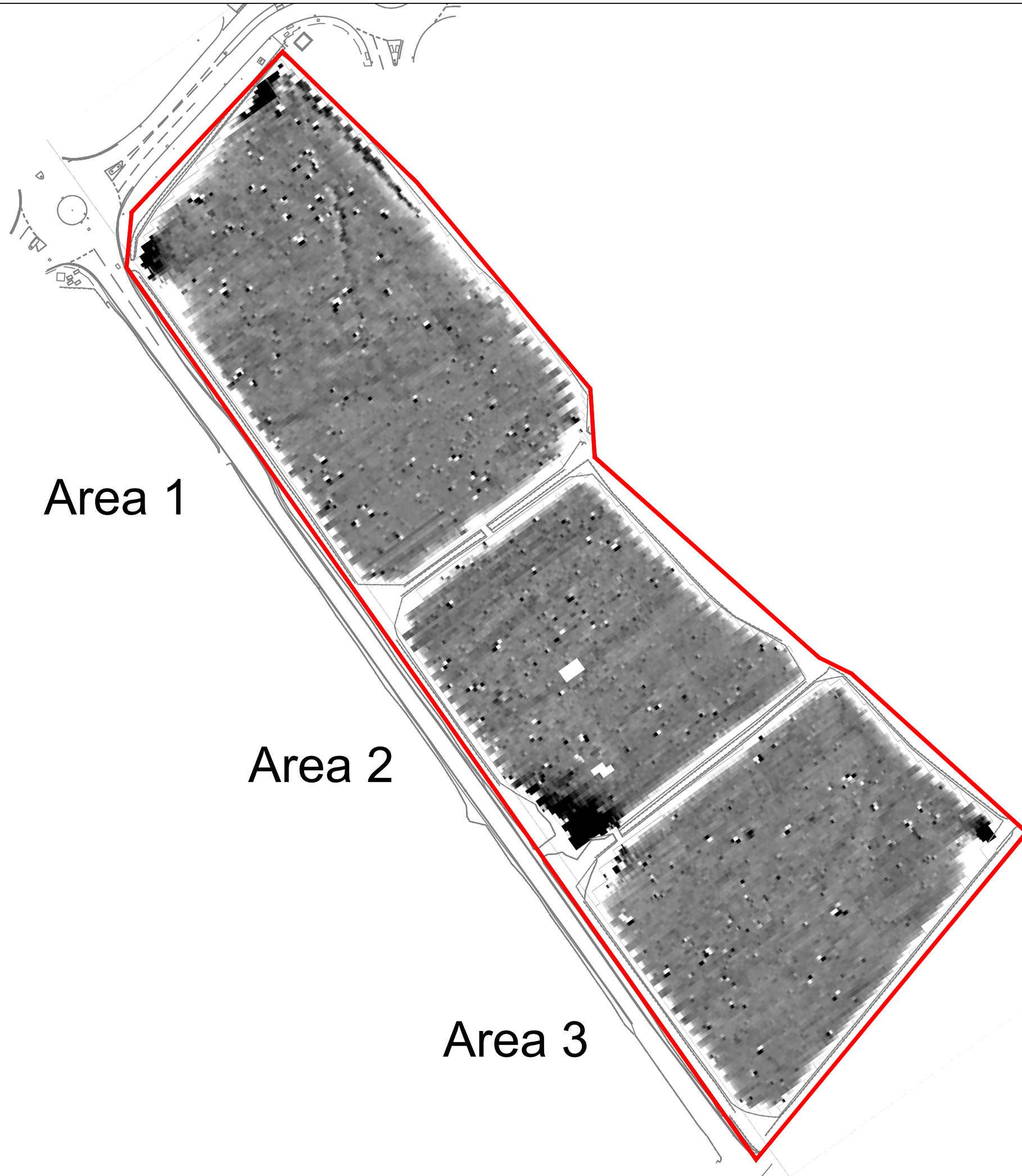
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Client: Pegasus Group

Project: 05318 - Land at Hospital Cross, Helston Downs, Cornwall

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Fig No: 05



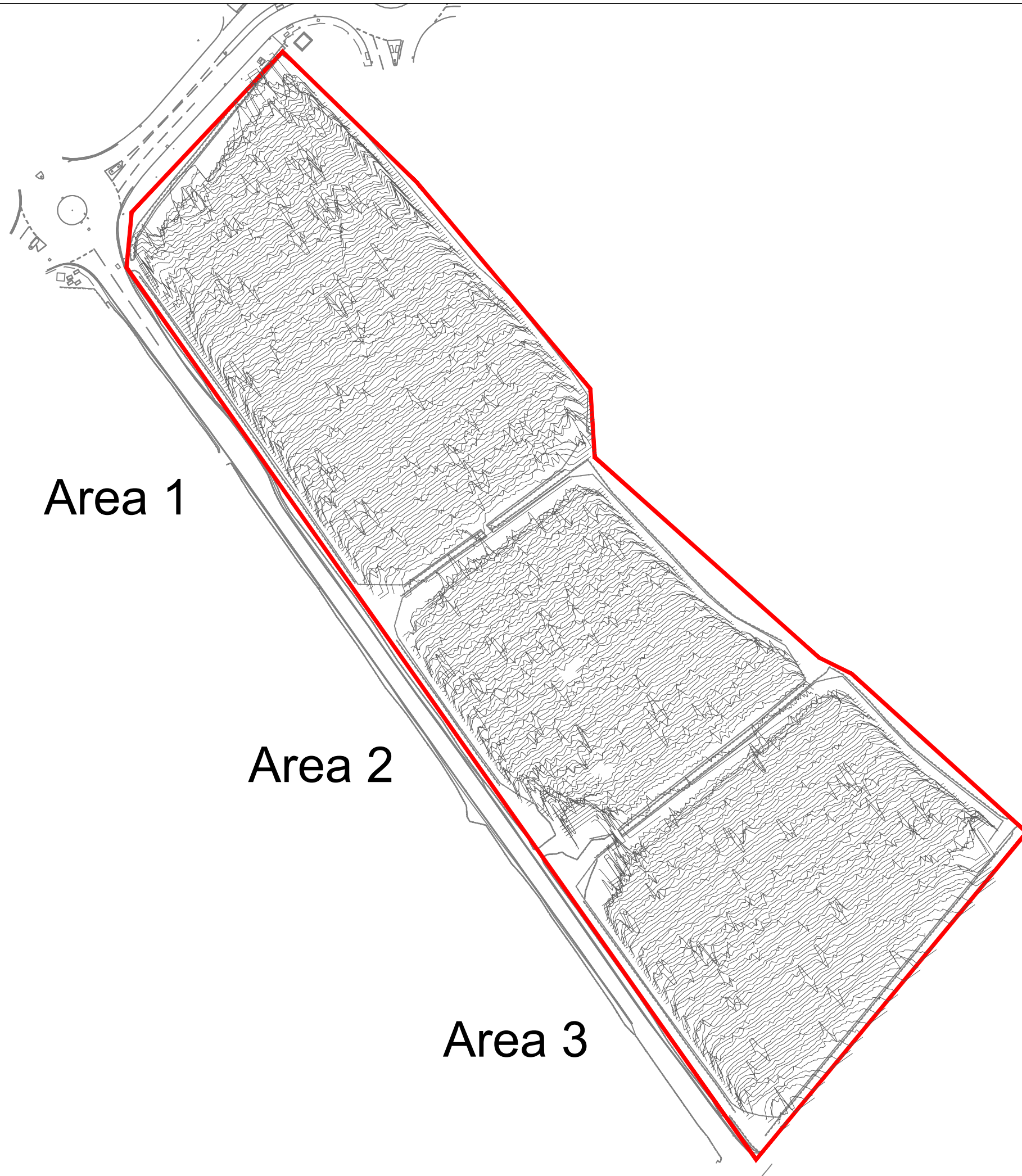
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Minimally Processed Data - Greyscale Plots

Client:
Pegasus Group

Project:
05318 - Land at Hospital Cross, Helston Downs,
Cornwall

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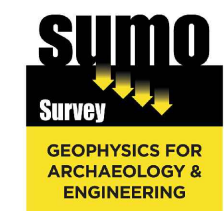
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06



Area 1

Area 2

Area 3



Title:
XY Trace Plots (clipped at +/-15nT)

Client:
Pegasus Group

Project:
05318 - Land at Hospital Cross, Helston Downs,
Cornwall

Scale:
0 metres 60
1:1200 @ A3

Fig No:
07

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.

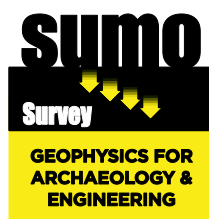
Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement 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 sumogeop1-503392

OASIS ID (UID)	sumogeop1-503392
Project Name	Geophysical Survey at Land at Hospital Cross, Helston Downs, Helston
Activity type	Geophysical Survey, MAGNETOMETRY SURVEY
Project Identifier(s)	05318
Planning Id	
Reason For Investigation	Planning requirement
Organisation Responsible for work	SUMO Geophysics Ltd.
Project Dates	29-Nov-2021 - 29-Nov-2021
Location	Land at Hospital Cross, Helston Downs, Helston NGR : SW 66770 26308 LL : 50.0909954303671, -5.2620729504264 12 Fig : 166770,26308
Administrative Areas	Country : England County : Cornwall District : Cornwall Parish : Helston
Project Methodology	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 coordinates. Hand Held: Data will be collected using a Bartington Grad 601-2. The instrument consists of two paired sensors (see below) and readings are logged at 0.25m centres along traverses 1.0m apart across 30m grids. The collection of data at 0.25m centres provides an appropriate methodology balancing cost and time with resolution as per Historic England guidelines. Two 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.
Project Results	A magnetometer survey of 2.4 hectares of land at Hospital Cross, Helston, has identified no responses which could be interpreted as being of archaeological interest. Weak uncertain trends could be indicative of ridge and furrow or a result of minor magnetic variations in the underlying geology.
Keywords	
HER	Cornwall and Scilly HER - unRev - STANDARD
HER Identifiers	
Archives	



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

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