

GEOPHYSICAL SURVEY REPORT

Land off St Georges Avenue, Havant

Client

RPS Consulting Services

For

BDW Southampton

Survey Report

SUMO-03192

Date

June 2021



Survey Report 03192: Land off St Georges Avenue, Havant

Survey dates 2 -3 June 2021

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Report Date 25 June 2021

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TABLE OF CONTENTS

1	LIST OF FIGURES	1
2	SURVEY TECHNIQUE	1
3	SUMMARY OF RESULTS	2
4	INTRODUCTION	2 - 3
5	RESULTS	3
6	DATA APPRAISAL & CONFIDENCE ASSESSMENT	4
7	CONCLUSION	4
8	REFERENCES	4

Appendix A Technical Information: Magnetometer Survey Methods, Processing and Presentation

Appendix B Technical Information: Magnetic Theory

1. LIST OF FIGURES

Figure 01	NTS	Site Location
Figure 02	1:1500	Magnetometer Survey - Greyscale Plot
Figure 03	1:1500	Magnetometer Survey - Colour Plot
Figure 04	1:1500	Magnetometer Survey - Interpretation
Figure 05	1:3000	Magnetometer Survey - Greyscale Plot / Interpretation / Recorded Cropmarks / 1866 Ordnance Survey Mapping
Figure 06	1:2000	Magnetometer Survey - Greyscale Plot / Interpretation / Recorded Cropmarks (RPS2021)
Figure 07	1:1500	Minimally Processed Data - Greyscale Plot
Figure 08	1:1500	XY Trace Plots (clipped at +/-15nT)

2. SURVEY TECHNIQUE

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

3 SUMMARY OF RESULTS

- 3.1 A magnetometer survey of 6 ha of land off St Georges Avenue, Havant has not recorded any magnetic responses that could be interpreted as being of definite archaeological interest. However, very weak trends and possible pit-like responses are visible in the magnetic data which might be anthropogenic; such an interpretation is only considered because a series of undated cropmarks have been identified at this location (though the two datasets do not correlate). Other modern processes, such as ploughing, could be the cause of the weak responses. Three former field boundaries have been detected in the dataset along with one land drain and a service pipe.

4 INTRODUCTION

- 4.1 **SUMO Geophysics Ltd** were commissioned to undertake a geophysical survey of an area outlined for residential development. This survey forms part of an archaeological investigation being undertaken by **RPS Consulting Services** on behalf of **BDW Southampton**.

4.2 Site details

NGR / Postcode	SU 73211 06320 / PO9 2SA
Location	The site is located 1.5km west of Emsworth and 1.5km east of Havant. The survey area is bounded to the south-east by the A27, to the west by houses off Castle Avenue and to the north by a railway line.
HER	Hampshire County Council
District	Havant
Parish	Non-Civil parish
Topography	Flat
Current Land Use	Arable agriculture
Geology (BGS 2021)	Bedrock: London Clay Formation - clay, silt and sand Superficial: River Terrace Deposits (undifferentiated) - sand, silt and clay
Soils (CU 2021)	Soilscape 22: Loamy soils with naturally high groundwater.
Archaeology (RPS 2021)	The nearest designated archaeological assets to the study site comprise two Scheduled Monuments located over 650m to the south. In terms of relevant local designations, the study site is not located within an Area of (High) Archaeological Potential as defined by Havant Borough. Based on current evidence, a moderate to high archaeological potential has been identified at the study site for the Roman period, with a moderate potential across a majority of the site, increasing to high nearest to the Roman road at the southern boundary. A low to moderate potential is identified for the Bronze Age and Iron Age, with a moderate potential identified for Saxon and Medieval period agricultural activity and land division. A series of undated cropmarks, including a possible rectilinear enclosure, have also been identified in the eastern part of the site, of uncertain origin, date, or function. If present at the site, it is considered likely that archaeological remains would be of a local or possibly regional significance. Past ground disturbance at the site is likely to have been widespread as a result of arable farming throughout the Post Medieval and Modern periods.
Survey Methods	Magnetometer survey (fluxgate gradiometer)
Study Area	6 ha

4.3 **Aims and Objectives**

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

5 **RESULTS**

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 **Probable Archaeology**

- 5.1.1 No magnetic responses have been recorded that could be interpreted as being of definite archaeological interest.

5.2 **Possible Archaeology / Uncertain**

- 5.2.1 A number of weak linear trends and pit-like responses have been recorded in the dataset which very tentatively appear to form possible enclosures, ditches and trackways. The slightly stronger anomalies [1] have been assigned to *Possible Archaeology*, whereas the ephemeral responses have been downgraded too *Uncertain*. A series of undated cropmarks have been identified in this vicinity (see Figure 05); however, none of the magnetic anomalies correspond with the cropmarks (see Figure 06). One cropmark does appear to be due to a former field boundary (see 5.3). Morphologically, the responses could be anthropogenic in nature; however, without the recorded cropmarks an archaeological explanation would probably have been discarded. Modern agricultural processes, such as ploughing, could easily have caused the weaker trends.

5.3 **Former Field Boundary**

- 5.3.1 Three linear anomalies in the dataset correspond with the positions of former field boundaries that are recorded on historic mapping (see Figure 05). The easternmost former boundary corresponds with a recorded cropmark in the HER (see Figure 05).

5.4 **Agricultural – Land Drains**

- 5.4.1 A chain of weak dipolar responses is visible in the magnetic data which is likely to be due to a land drain.

5.5 **Service**

- 5.5.1 A weak negative linear response is visible in the north-west of the survey. A large ferrous anomaly has also been detected along its course which indicates that it could mark the route of a cable or service pipe.

5.6 **Ferrous / Magnetic Disturbance**

- 5.6.1 Two small areas of magnetic disturbance have been detected and could be the product of modern processes, possibly agricultural or associated with the former field boundary. The ferrous response in the north is due to a substantial fence which surrounds with the railway line. 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 poor. While the results from this survey indicate the presence of very weak linear trends and possible pit like responses of archaeological origin the results do not showed the postulated cropmarks.

7 CONCLUSION

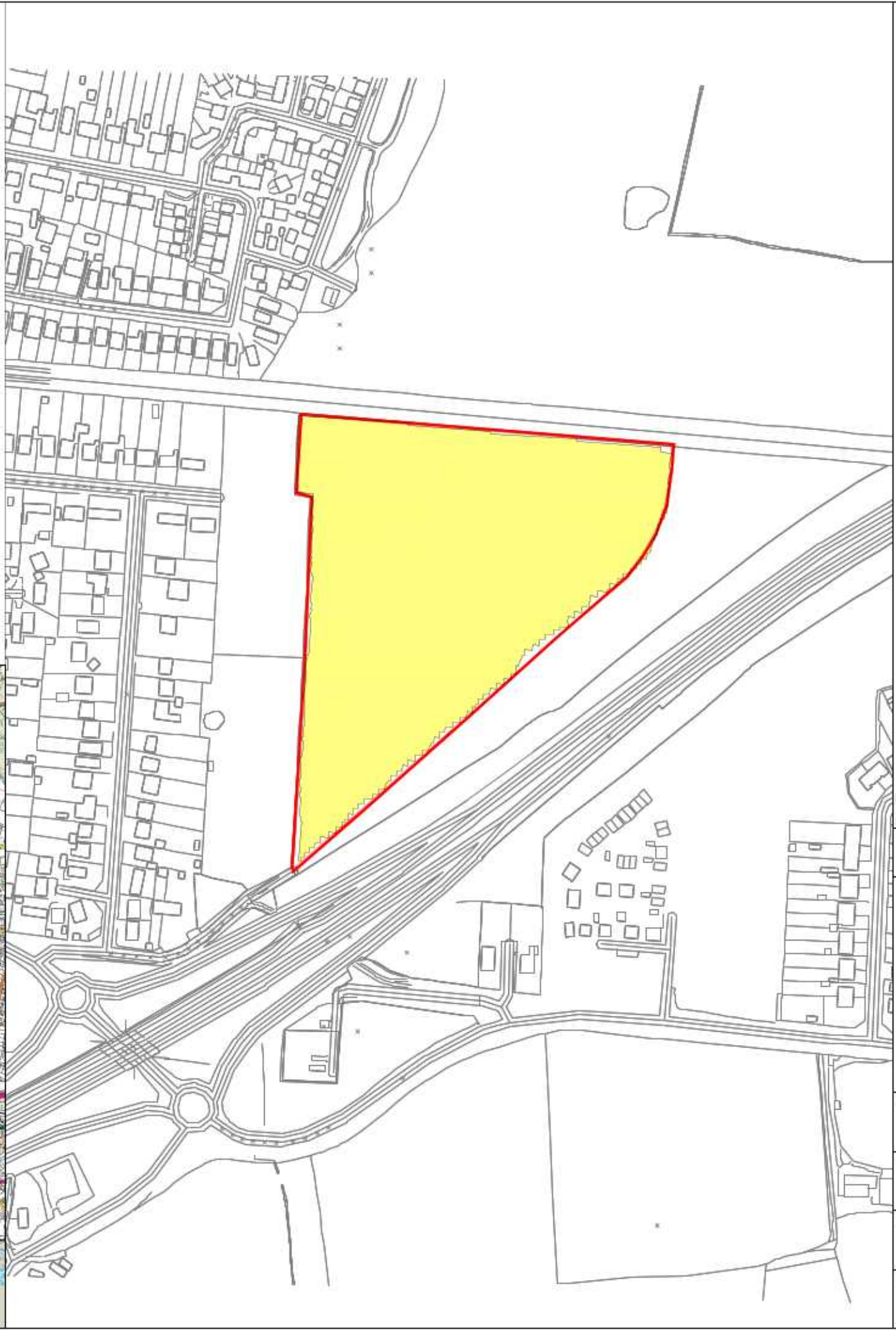
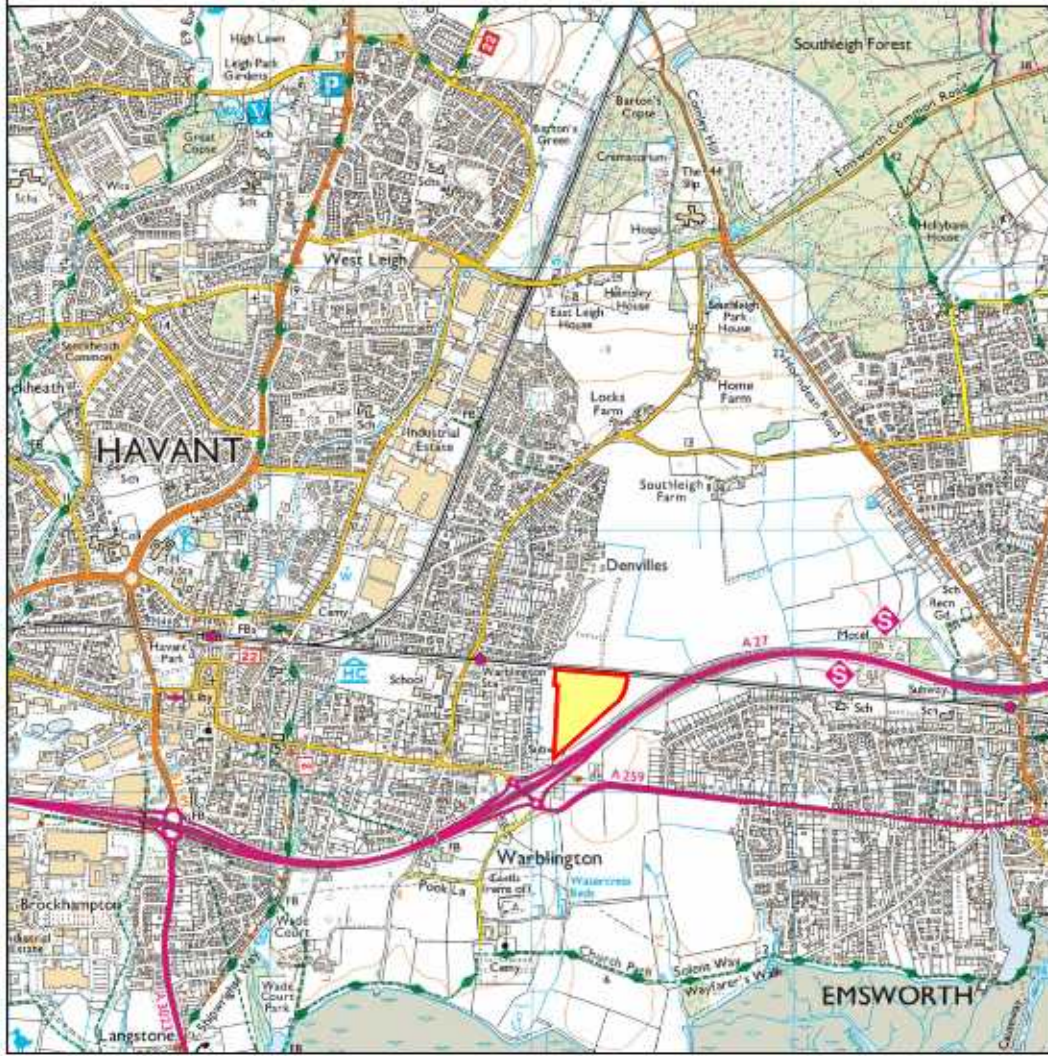
- 7.1 The magnetometer survey has not recorded any magnetic responses that could be interpreted as being of definite archaeological interest. Although weak trends and pit-like responses which could anthropogenic are visible in the dataset, many of the trends have been downgraded to *Uncertain* as they are barely discernible; they could all be due to modern agricultural processes. Three former field boundaries have been detected in the dataset along with a land drain and a service pipe.

8 REFERENCES

- BGS 2021 British Geological Survey, Geology of Britain viewer [accessed 10/06/2021] *website*: (<http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps>)
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Survey Area



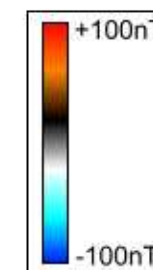
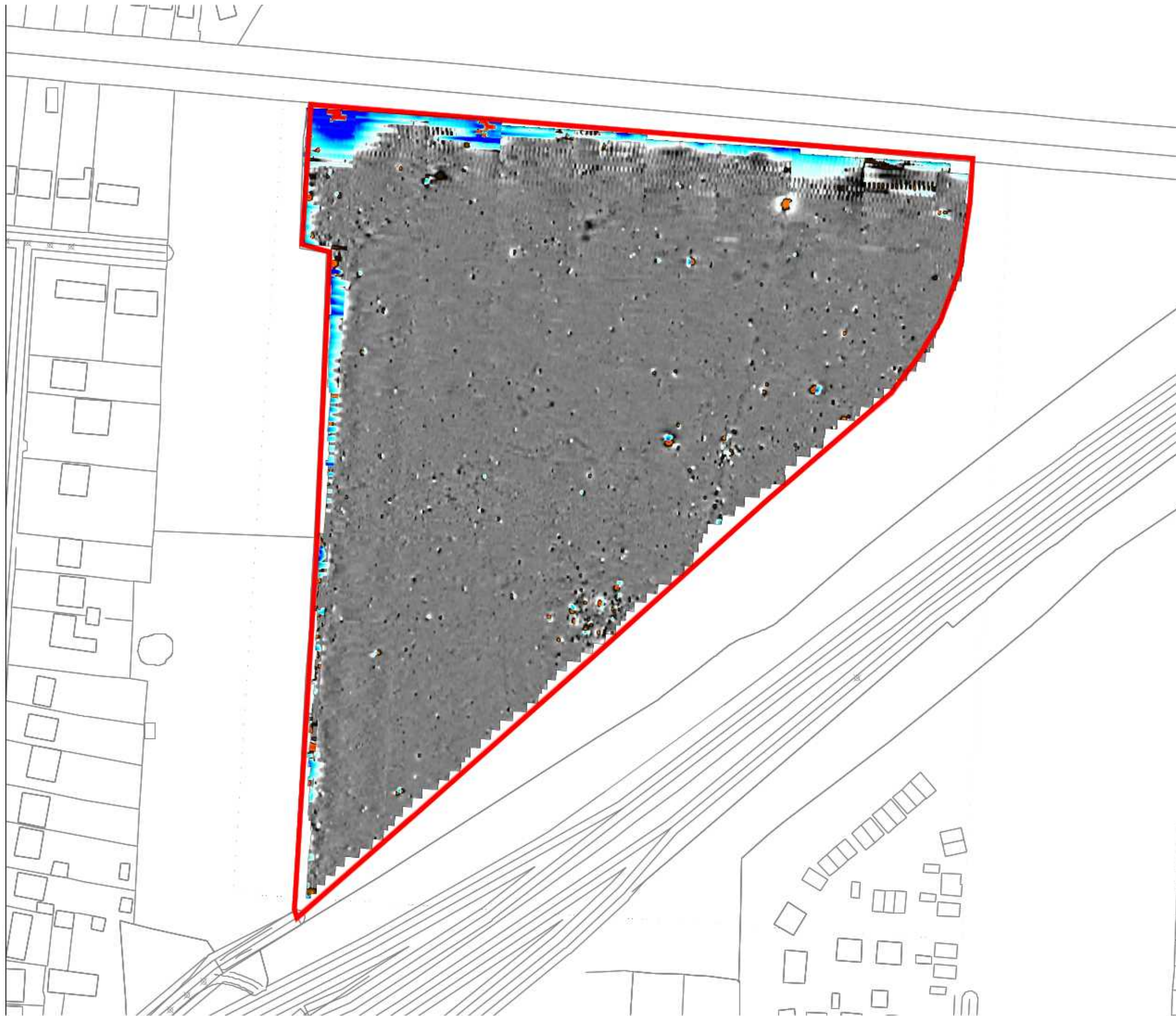
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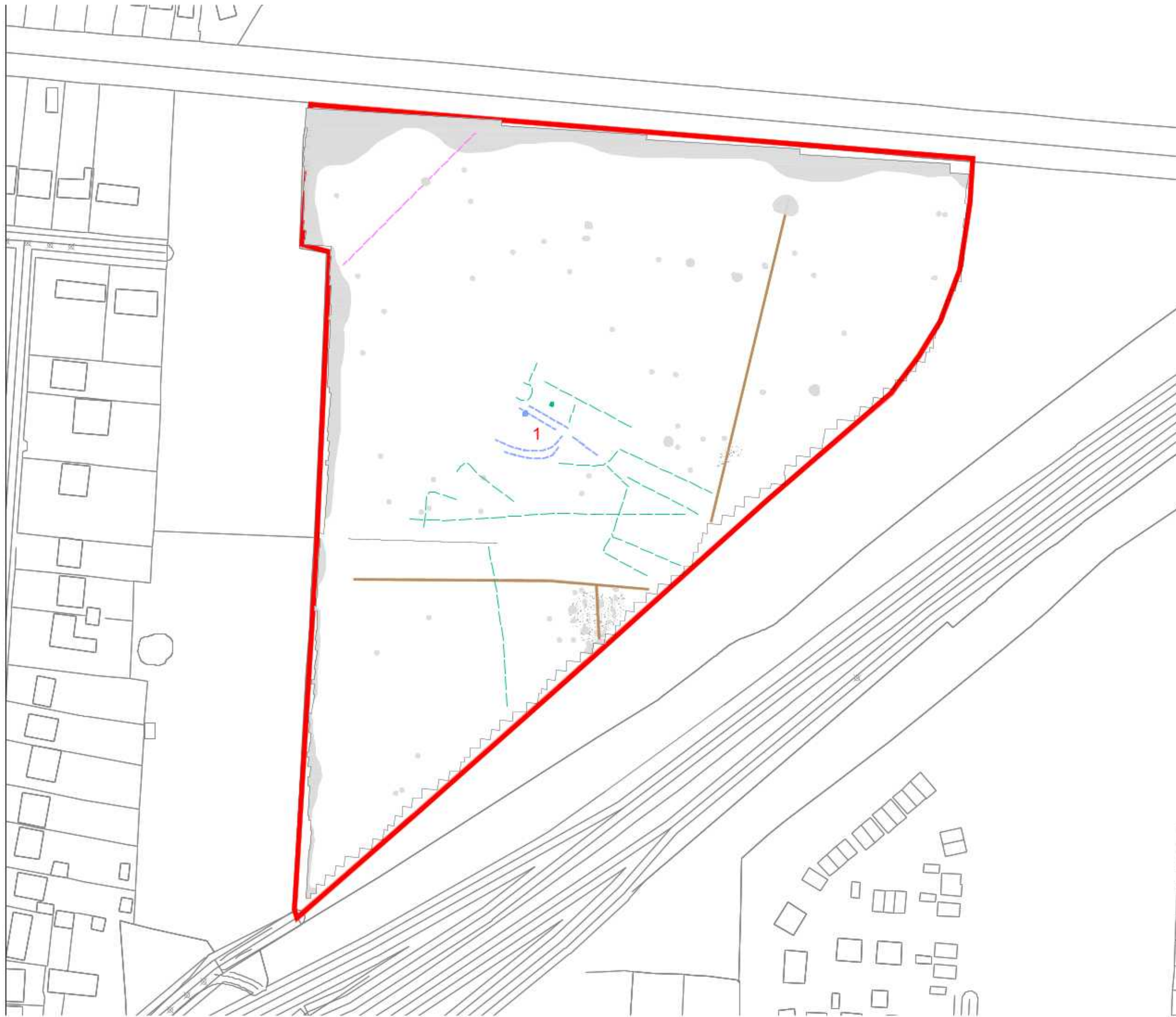
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Client: RPS Consulting Services	
Project: 03192 - Land off St Georges Avenue, Havant	
Scale: NOT TO SCALE	Fig No: 01



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Project: 03192 - Land off St Georges Avenue, Havant	
Scale: 0 metres 75 1:1500 @ A3	Fig No: 02

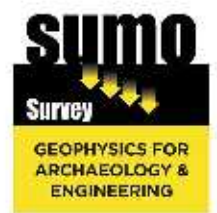


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Scale:	0 metres 75 1:1500 @ A3	Fig No: 03



KEY

	Possible Archaeology (Trend)
	Uncertain Origin (Anomaly / Trend)
	Former Field Boundary (Corroborated)
	Land drain
	Service
	Magnetic Disturbance
	Ferrous

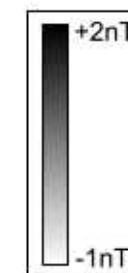


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Project:	03192 - Land off St Georges Avenue, Havant	
Scale:	 1:1500 @ A3	Fig No: 04



(RPS 2021)

(RPS 2021)



KEY

	Possible Archaeology (Trend)
	Uncertain Origin (Anomaly / Trend)
	Former Field Boundary (Corroborated)
	Land drain
	Service
	Magnetic Disturbance
	Ferrous



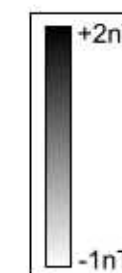
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Client: RPS Consulting Services

Project: 03192 - Land off St Georges Avenue, Havant

Scale: 0 metres 150
1:3000 @ A3

Fig No: 05



KEY

	Possible Archaeology (Trend)
	Uncertain Origin (Anomaly / Trend)
	Former Field Boundary (Corroborated)
	Land drain
	Service
	Magnetic Disturbance
	Ferrous



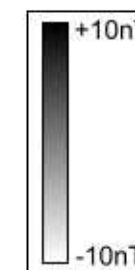
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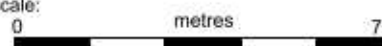
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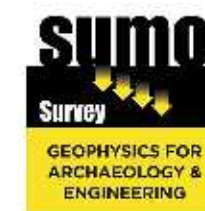
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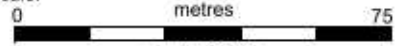
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Fig No: 06



Title:	Minimally Processed Data - Greyscale Plots	
Client:	RPS Consulting Services	
Project:	03192 - Land off St Georges Avenue, Havant	
Scale:	 1:1500 @ A3	Fig No: 07



Title:	XY Trace Plots (clipped at +/-15nT)	
Client:	RPS Consulting Services	
Project:	03192 - Land off St Georges Avenue, Havant	
Scale:	 1:1500 @ A3	Fig No: 08

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.

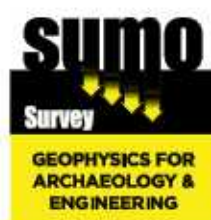
Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological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



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

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