

# **GEOPHYSICAL SURVEY REPORT**

**Ashington, West Sussex**

Client

**Archaeology South-East**

Survey Report

**16435**

Date

**December 2019**



## Survey Report 16435: Ashington, West Sussex

<b>Survey dates</b>	19 November 2019
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<b>Report Date</b>	4 December 2019
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### 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 detailed magnetometer survey was conducted over approximately 2.5 ha of land at Ashington, West Sussex. Several anomalies of archaeological interest have been identified and include tentative evidence for a bath-house / structure which is likely to be associated with the scheduled Roman building (NHLE 1005826) to the west. Thermoremanent anomalies indicative of kilns, ovens or even a furnace have also been detected, along with several ditch-type anomalies and possible pits.

### 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 **Archaeology South-East**.

#### 4.2 Site details

NGR / Postcode	TQ 126 157 / RH20 3JX
Location	The site is located to the south-west of Ashington, to the west of Church Close. Church Land lies to the north of the site, while a small watercourse and spring bound the site to the south.
HER	West Sussex
District	Horsham
Parish	Ashington CP
Topography	Gently sloping down from west to east and north to south.
Current Land Use	Pasture
Geology (BGS 2019)	Bedrock: Weald Clay Formation - mudstone is present across the majority of the site; Atherfield Clay Formation - mudstone is recorded over the western extent. Superficial: Head - clay, silt, sand and gravel lie in the eastern half of the site; no superficial deposits are present in the west.
Soils (CU 2019)	Soilscape 18: slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soils.
Archaeology (ASE 2019)	The Scheduled remains of a large Roman building (NHLE 1005826), interpreted as a villa, is located immediately to the west of the site. The monument includes a Roman building surviving as below-ground remains and dates from the second century AD. A partial excavation in 1947 identified the foundations of a substantial flint and mortar building. Outside of the building, a small number of Roman coins were found. In 1999, a geophysical survey, conducted by English Heritage, confirmed the location of the building, which was thought to extend to the east (EH 1999).
Survey Methods	Magnetometer survey (fluxgate gradiometer)
Study Area	2.5 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.*

### 5.1 **Probable / Possible Archaeology**

- 5.1.1 A negative rectilinear response [1] is visible at the eastern edge of the site and is indicative of structural remains, i.e. a wall or foundations measuring some 20m across. The response is surrounded by an area of strong magnetic anomalies [2], suggestive of fired brick / tile or other burnt deposits. Immediately north of [1] there is a very strong thermoremanent response [3] which is indicative of a possible furnace for heating the building. If correct, such an interpretation could indicate that the responses are a bath-house separated from the main villa (NHLE 1005826) which lies to the west. Alternatively, the anomalies might be due to a kiln or workshop. The presence of the nearby stream would be a good supply of water for either function.
- 5.1.2 An additional thermoremanent response [4] has been detected to the north of the above features. This response is considerably weaker; it is more likely to be a result of a smaller kiln or oven, though there appears to be a lack of other archaeological features in the immediate vicinity.
- 5.1.3 A few positive linear anomalies [5] have been detected and are indicative of former cut features, i.e. ditches. They likely form part of a field system in the land surrounding the Roman building (NHLE 1005826), though their alignment around the tentative bath-house [1] is confusing; they could perhaps relate to a later ditch cutting into the structure. Further weak linear trends are also visible in the data, though these are less clear and have been interpreted as having possible archaeological origins.
- 5.1.4 A cluster of discrete positive anomalies, an area increased magnetic response and weak linear trends [6] have been detected at the south-western edge of the site. These correspond in location with the responses identified in the previous geophysical survey (EH 1999) which were interpreted as forming the eastern extent of the Roman building (NHLE 1005826). The responses at [6] lack clarity and are of low-moderate strength. That, combined with their location at the edge of the survey area, which makes further interpretation difficult, has led to their interpretation as being of 'possible' archaeological origin.
- 5.1.5 A strongly enhanced discrete response [7] has been detected to the north-west of the rectilinear building [1] and possible kiln / furnace [3]. The response appears to be more ferrous in its characteristics, rather than thermoremanent; however, its proximity to the possible furnace [3] to its east indicates that it may be of archaeological interest.
- 5.1.6 A few discrete positive responses [8] are visible in the data. They are indicative of small former cut features and could reflect former backfilled pits.
- 5.1.7 An area of very slightly increased magnetic response [9] has been detected near the centre of the site. The response was suggested by English Heritage (1999) as possible building remains; however, the responses are very weak in comparison to those elsewhere on the site e.g. [1-2]. It is suggested that the area of increased response is perhaps related to much more ephemeral features, including possible timber structures.

- 5.1.8 An area of increased magnetic response and a single linear anomaly have been identified at the north-west of the site. These are of possible archaeological interest simply due to their proximity close to other features. However, there does appear to be a ferrous component to the responses, suggesting a modern origin.

## 5.2 ***Ferrous / Magnetic Disturbance***

- 5.2.1 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 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 generally good. The results from this survey indicate the presence of structural remains, ditches and thermoremanent responses. Consequence the technique is deemed to have been effective and is likely to have detected any archaeological features, if present.

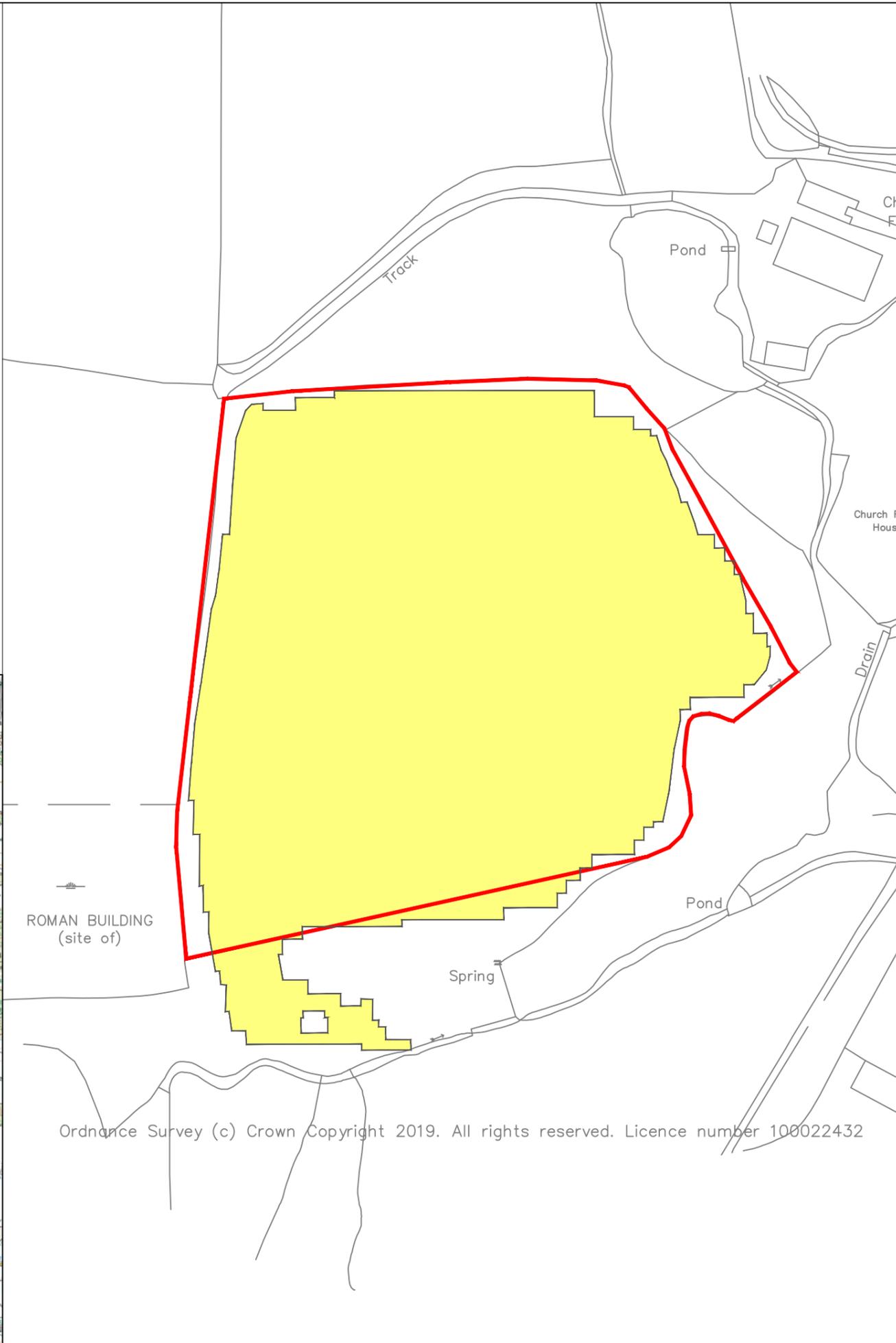
## 7 **CONCLUSION**

- 7.1 The survey at Ashington has identified a complex of anomalies including a probable building, fired brick and tile remains, and a furnace or kiln. These could equate to a bath-house associated with the Roman villa (NHLE 1005826) which lies to the west, or alternatively they may indicate a workshop with a kiln or ovens.
- 7.2 Elsewhere, an additional, smaller kiln / oven has been mapped, along with a number of ditches, smaller pit-like responses and areas of increased magnetic response, possibly indicating more ephemeral structures.

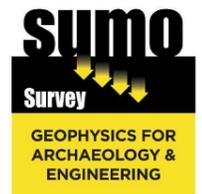
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[http://www.archaeologists.net/sites/default/files/ClfAS%26GGeophysics\\_2.pdf](http://www.archaeologists.net/sites/default/files/ClfAS%26GGeophysics_2.pdf)
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Survey Area

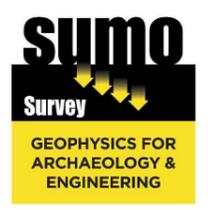
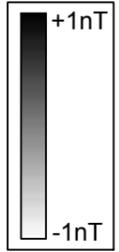


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Title:	Site Location	
Client:	Archaeology South-East	
Project:	16435 - Ashington, West Sussex	
Scale:	NOT TO SCALE	Fig No: 01



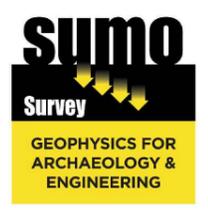
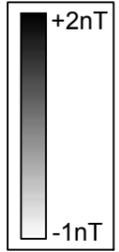
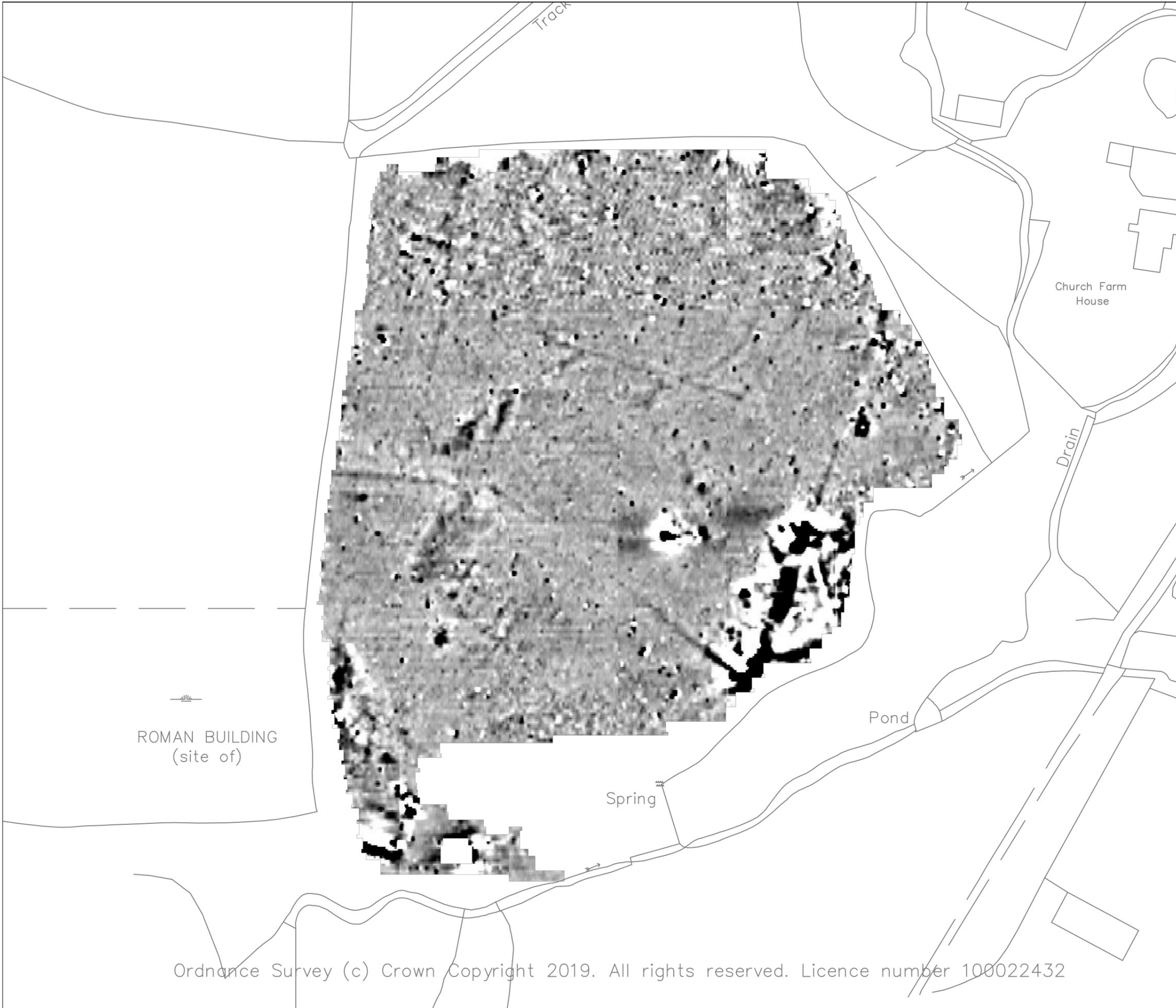
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Client: Archaeology South-East

Project: 16435 - Ashington, West Sussex

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1:1000 @ A3

Fig No: 02



Title:  
Magnetometer Survey - Greyscale Plot [2]

Client:  
Archaeology South-East

Project:  
16435 - Ashington, West Sussex

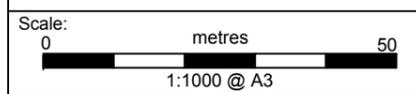
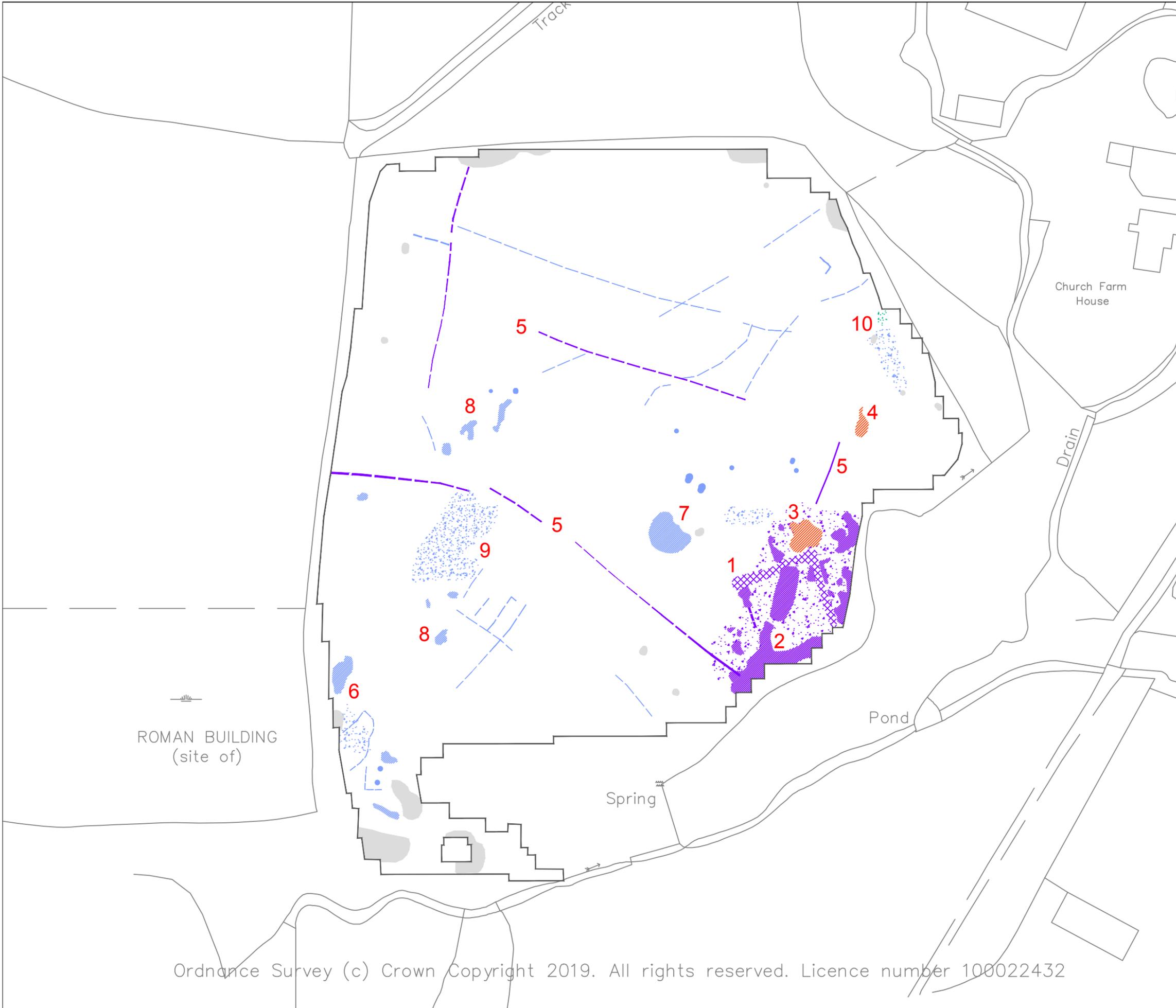
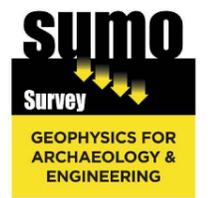


Fig No:  
03



**KEY**

	Probable archaeology (discrete anomaly / negative anomaly / increased response / trend)
	Thermoremanent response (probable kiln / oven / furnace)
	Possible archaeology (discrete anomaly / trend / area of increased response)
	Ferrous



Title: Magnetometer Survey - Interpretation

Client: Archaeology South-East

Project: 16435 - Ashington, West Sussex

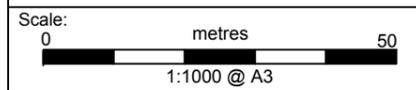
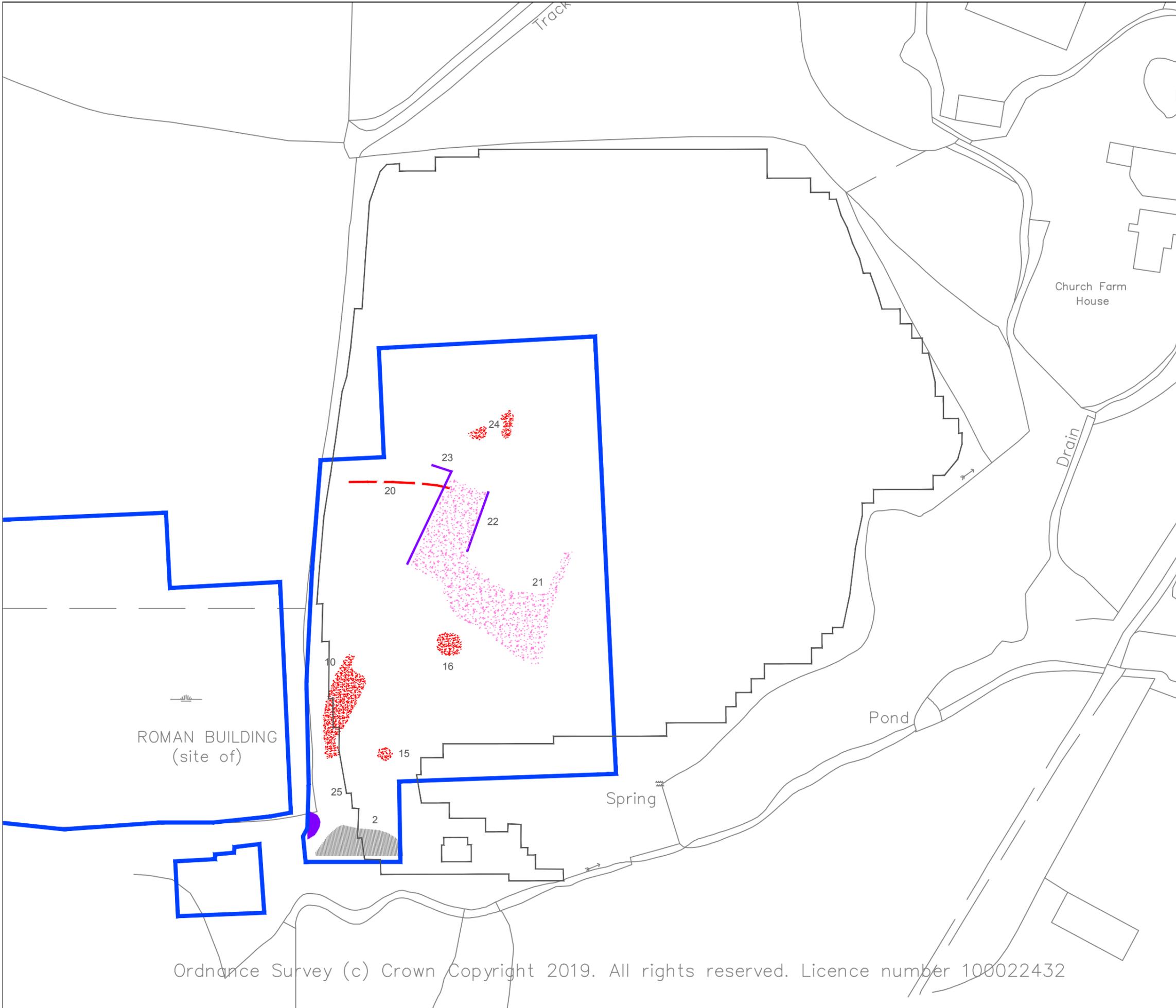
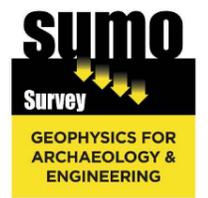


Fig No: 04



**KEY**

	Previous magnetometer survey area
	Positive magnetic anomaly
	Negative magnetic anomaly
	Tentative magnetic anomaly
	Magnetic disturbance
	(Tentative) Positive linear magnetic anomaly



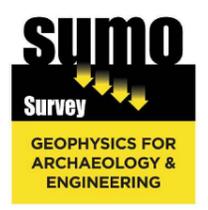
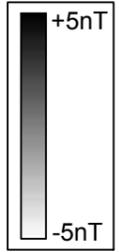
Title: English Heritage (1999) - Magnetometer Interpretation

Client: Archaeology South-East

Project: 16435 - Ashington, West Sussex

Scale: 0 metres 50  
1:1000 @ A3

Fig No: 05



Title: Minimally Processed Data - Greyscale Plot

Client: Archaeology South-East

Project: 16435 - Ashington, West Sussex

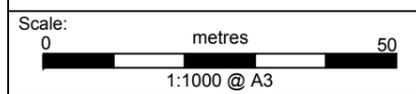


Fig No: 06

## 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 &amp; 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 &amp; 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.

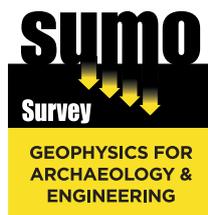
Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological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