

GEOPHYSICAL SURVEY REPORT

Braunston Road, Oakham, Rutland

Client

Cotswold Archaeology
For

Jeakins Weir Ltd

OASIS Ref.

sumogeop1-502960

Survey Report

SUMO-04501

Date

November 2021



Survey Report 04501 Braunston Road, Oakham, Rutland

Survey dates	4 -5 November 2021
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Report Date	22 November 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
5	RESULTS	3
6	DATA APPRAISAL & CONFIDENCE ASSESSMENT	4
7	CONCLUSION	4
8	REFERENCES	5

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	1:2000	Magnetometer Survey - Greyscale Plot
Figure 03	1:2000	Magnetometer Survey - Colour Plot
Figure 04	1:2000	Magnetometer Survey - Interpretation
Figure 05	1:3500	Magnetometer Survey - Greyscale Plot / Interpretation / 1959 Nation Grid Maps / LiDAR Data Plot
Figure 06	1:2000	Minimally Processed Data – Greyscale Plot
Figure 07	1:2000	XY Trace Plot (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 The magnetic survey at Braunston Road, Oakham covered an area of approximately 7.5 hectares and confirmed that a ditched enclosure of archaeological interest (HER 5627) still survives. Measuring some 65m x 75m the rectilinear feature has an entrance in the south-east corner and possibly surrounds internal features. Ridge and furrow cultivation patterns are visible across the site and these indicate where there were former field boundaries existed. There are a few uncertain responses in the data, some of which could be archaeological. A modern service pipe crosses the survey area

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 **Cotswold Archaeology** on behalf of **Jeakins Weir Ltd**.

4.2 Site details

NGR / Postcode	SK 8467 0843 / LE15 6RU
Location	Oakham lies at the junction of the A606 and A6003 roads some 17kms west of Stamford. The site under investigation lies on the western outskirts of the town north of Braunston Road. Residential housing forms the eastern limits while agricultural fields lie to the north, south and west.
HER	Leicestershire and Rutland HER
OASIS Ref	sumogeop1-502960
District	Rutland
Parish	Oakham CP
Topography	Undulating
Current Land Use	Pasture
Geology (BGS 2021)	Solid: Whitby Mudstone Formation Superficial: None recorded
Soils (CU 2021)	Soilscape 18 – slowly permeable -loamy and clayey soils
Archaeology (CA 2021)	In July 2021 Cotswold Archaeology was commissioned to produce a Heritage Appraisal for Land at Braunston Road, Oakham, Rutland. Cropmarks (<i>MLE 5627</i>) interpreted as evidence of the buried remains of Iron Age settlement enclosures or possible later medieval activity has been identified extending into the western portion of the Site. The surrounding landscape includes known evidence of, and further potential for, buried archaeological remains of Iron Age and Roman period rural settlement activity. The topographic elevation and the proximity to water sources make the Site a favourable location for prehistoric settlement. If present, these buried archaeological remains would have heritage significance due to their evidential value, although their relative importance will depend on their state of survival and also their date. Further to this, there is the potential for the buried remains of degraded (plough damaged) medieval ridge and furrow to survive within the Site. These remains would be of very limited heritage importance based on their limited evidential value.
Survey Methods	Magnetometer survey (fluxgate gradiometer)
Study Area	c. 7.5 ha

4.3 **Aims and Objectives**

To locate and characterise any anomalies of possible archaeological interest within the study area; to assess whether the easternmost cropmark enclosure still survives as a feature in the ground.

5 **RESULTS**

Specific anomalies of interest have been given numerical labels [1] [2] which appear in the text below, as well as on the Interpretation Figure(s).

5.1 **Archaeology**

5.1.1 Very clear linear anomalies are visible in the data [1] towards the central western area of the site on a raised area of ground. The responses are indicative of ditches which form part of a rectilinear enclosure which has rounded corners. There appears to be a break or entrance at [2] where the ditches are slightly offset; the presence of a strong linear anomaly ploughing furrow (see below 5.4) is partially obscuring the data. There are suggestions of internal features in the form of a small arc of ditch and pits, though once again the ridge and furrow cultivation is masking the results. The dimensions of the enclosure are 65m x 75m. As such, the responses clearly equate with the easternmost enclosure recorded in aerial photographs (HER 5627) and interpreted as possibly being Iron Age in date.

5.2 **Uncertain**

5.2.1 There are suggestions in the data of responses forming an arc of enhanced magnetic readings [3] and weak rectilinear responses [4] which are difficult to interpret. While archaeological interpretations cannot be discounted the responses may simply be an agricultural effect resulting from the ridge and furrow cultivation.

5.3 **Former Field Boundary (Corroborated / Conjectural)**

5.3.1 Changes in the direction or density of plough furrows plus narrow bands of magnetic noise coincide with former boundaries visible on historic mapping dating from 1888 to 1967 and LiDAR imagery (see Figure 05).

5.3.2 A couple of linear responses are visible in the dataset, which can also be seen in the Lidar imagery (see Figure 05) which have been interpreted as conjectural former field boundaries.

5.4 **Agricultural – Ridge and Furrow**

5.4.1 Parallel and, in places, slightly curving linear anomalies are visible across the whole of the survey area. These equate with differing phases of ridge and furrow cultivation which in turn reflect earlier sub- divisions of the site. It is also interesting to note how these field plots have differing 'background magnetic levels' perhaps associated with differing intensities of night soiling in the past.

5.6 **Ferrous / Service Pipe**

5.6.1 A linear chain of dipole anomalies running across the site marks the route of a buried service, a probable small ferrous pipe. Two strong magnetic responses along the eastern boundary coincide with electricity pylons.

- 5.6.2 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 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

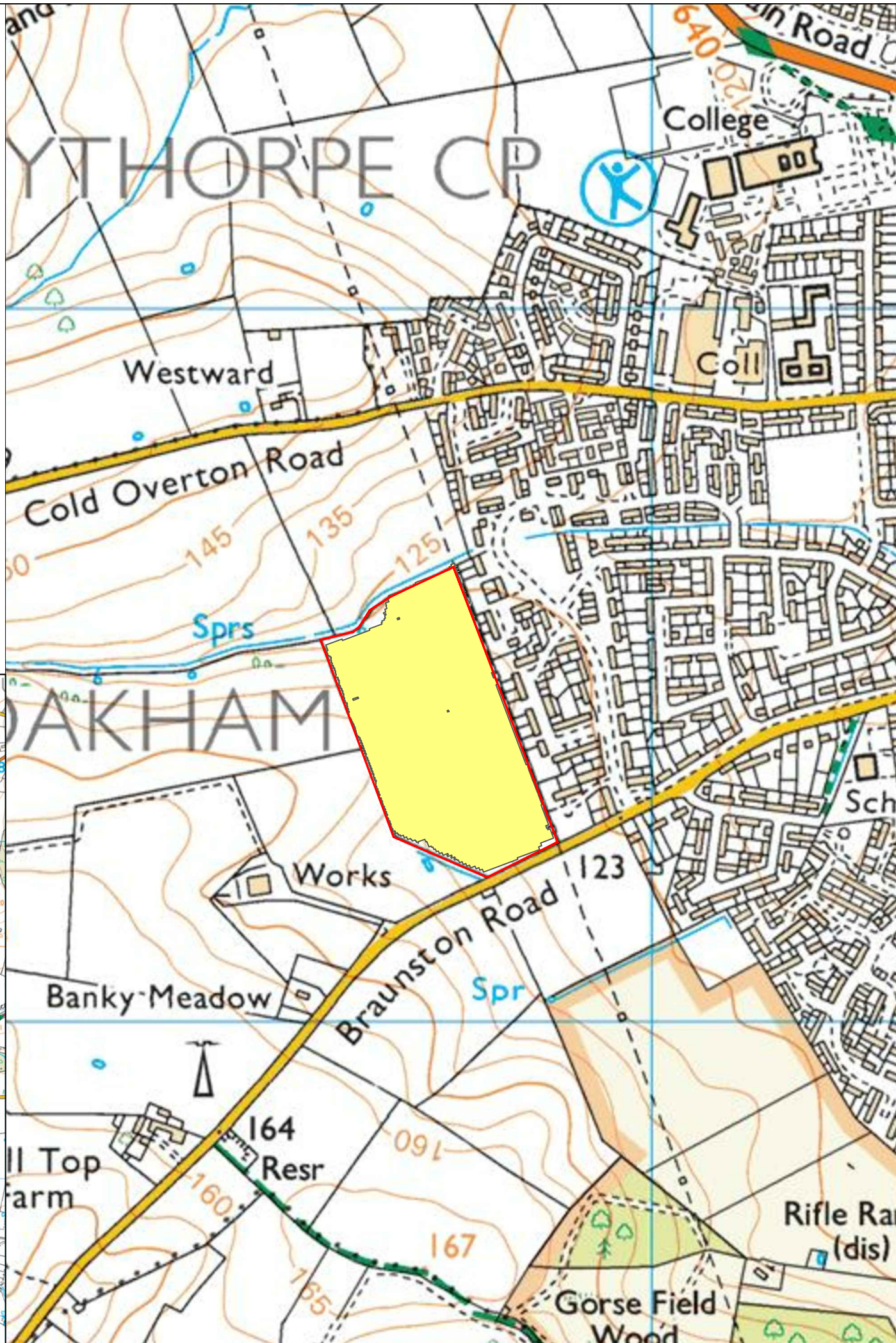
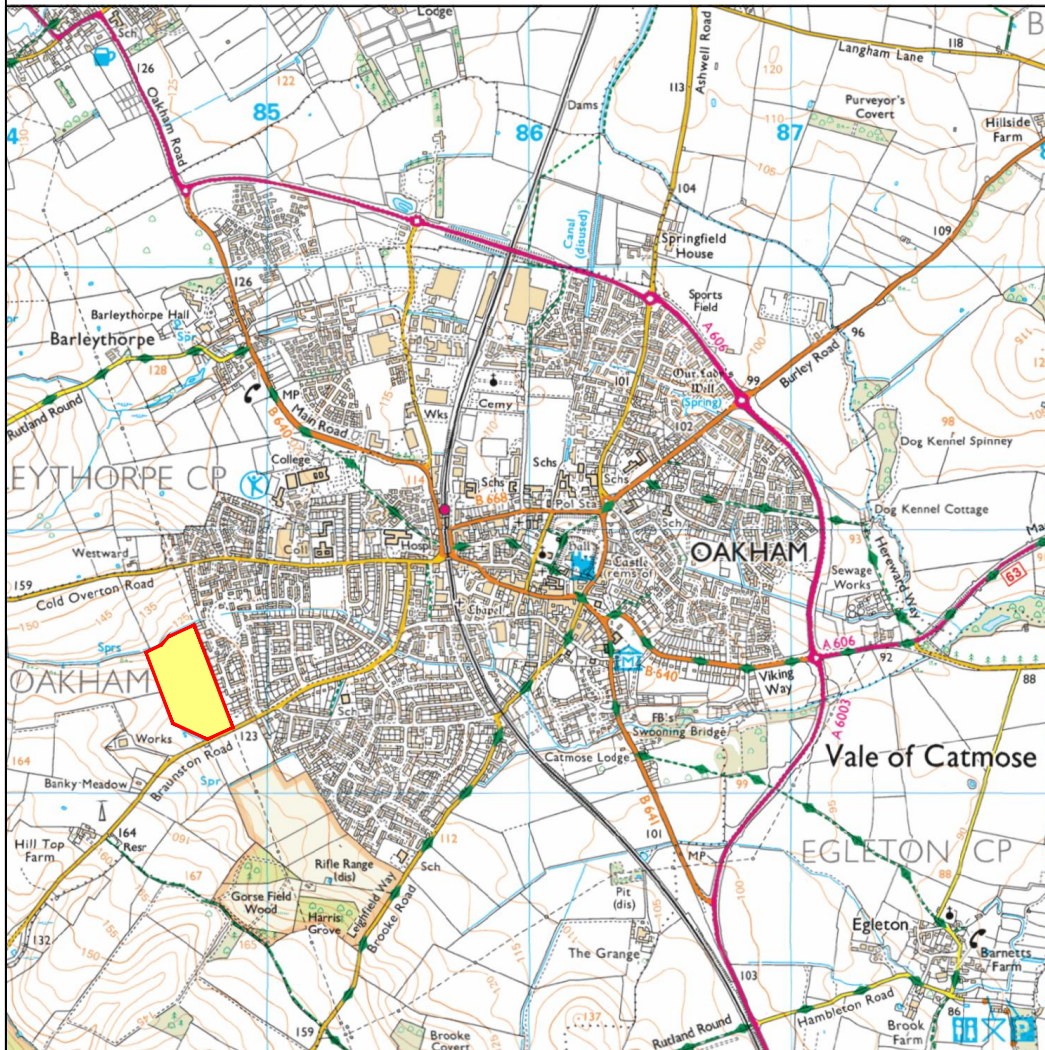
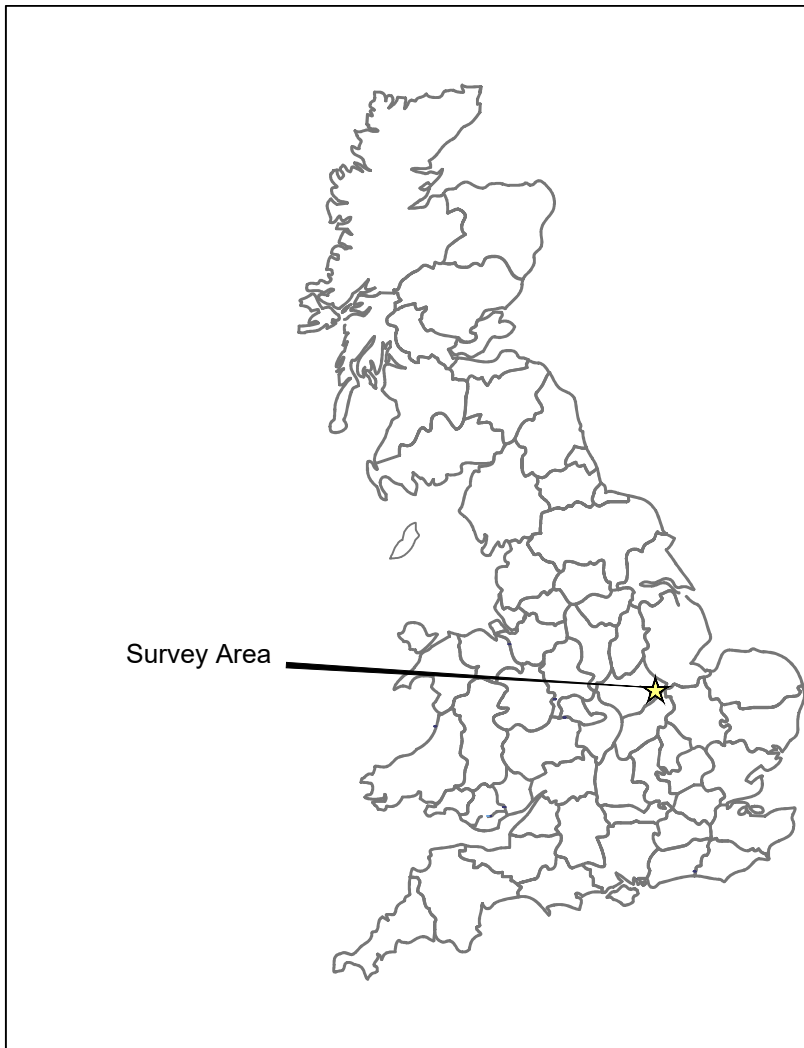
- 6.1 Historic England guidelines (EH 2008) Table 4 states that the typical magnetic response on the local soils / geology is variable. The results from this survey indicate the presence of the enclosure recorded in the local HER plus ridge and furrow. Consequently, the technique is deemed to have worked effectively.
- 6.2 It should be noted that the magnetic anomalies associated with the enclosure (thought to be Iron Age) appear to 'overly' the ridge and furrow ploughing lines (thought to be post-medieval); Unless the dating of the features is incorrect, the results demonstrate that magnetic anomalies cannot be used to infer relative dates

7 CONCLUSION

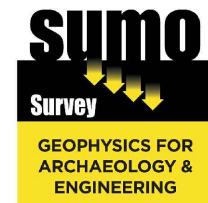
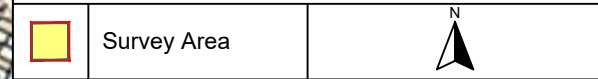
- 7.1 The magnetic survey at Braunston Road, Oakham has identified an enclosure recorded in the HER. Measuring some 65m x 75m the rectilinear feature with rounded corners appears to have an entrance in the south-east corner. There are suggestions of internal features but the results are partially obscured by ridge and furrow cultivation ploughing which extends across the site. There are a few uncertain responses in the data, some of which could be archaeological. Former field boundaries are visible where the ridge and furrow patterns change orientation. A modern service pipe crosses the survey area.

8 REFERENCES

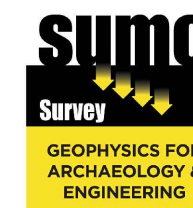
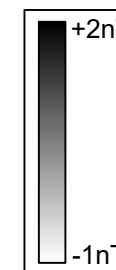
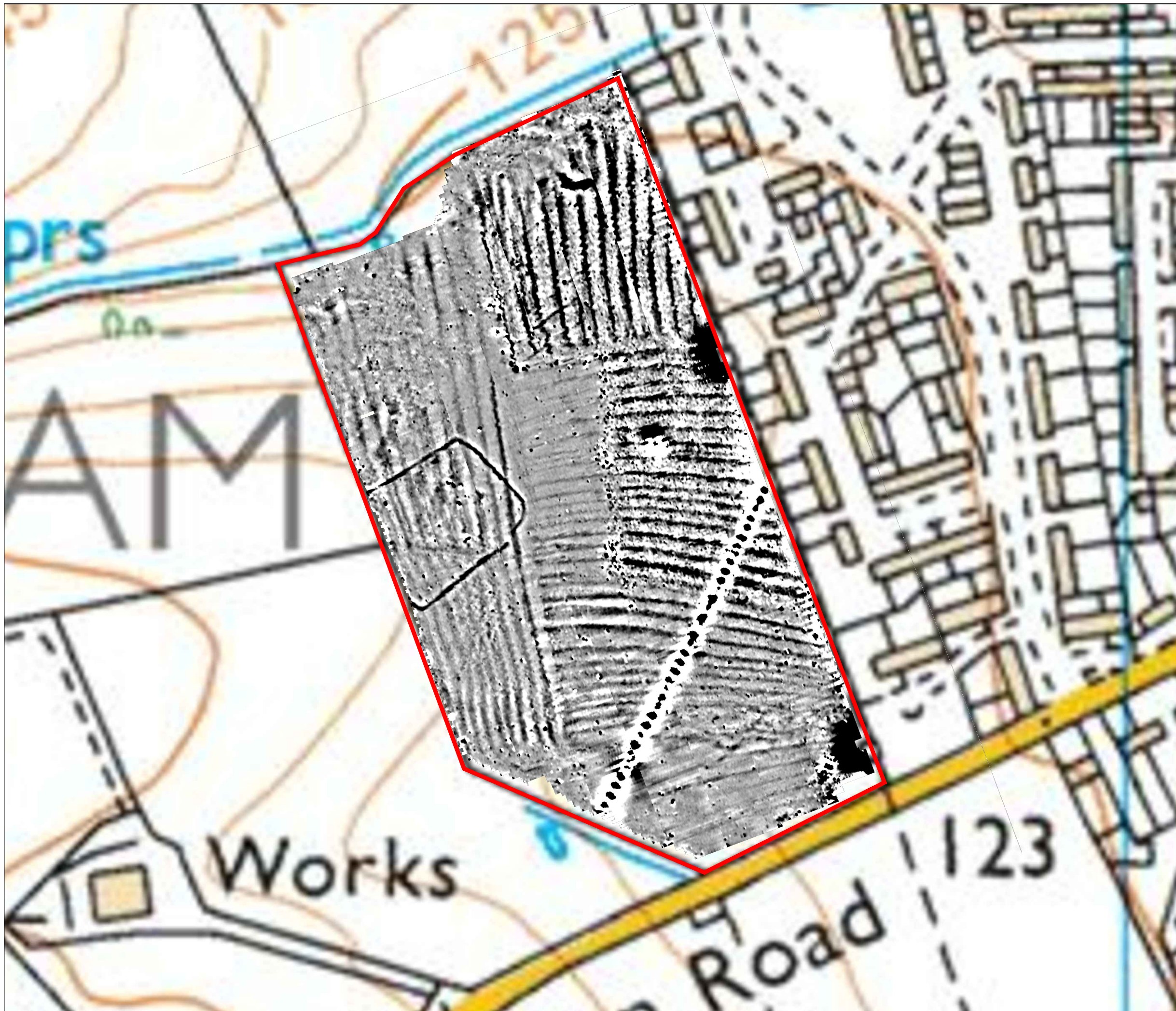
- BGS 2020 British Geological Survey, Geology of Britain viewer [accessed 19/11/2021] *website:* (<http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps>)
- CA 2021 Land at Braunston Road Oakham Rutland: Heritage Appraisal. Cotswold Archaeology, Cirencester
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<https://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf/> now withdrawn



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Client:	Cotswold Archaeology	
Project:	04501 - Braunston Road, Oakham, Rutland	
Scale:	NOT TO SCALE	Fig No: 01



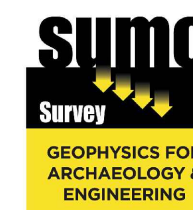
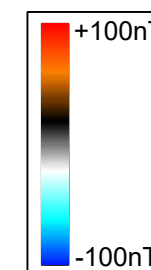
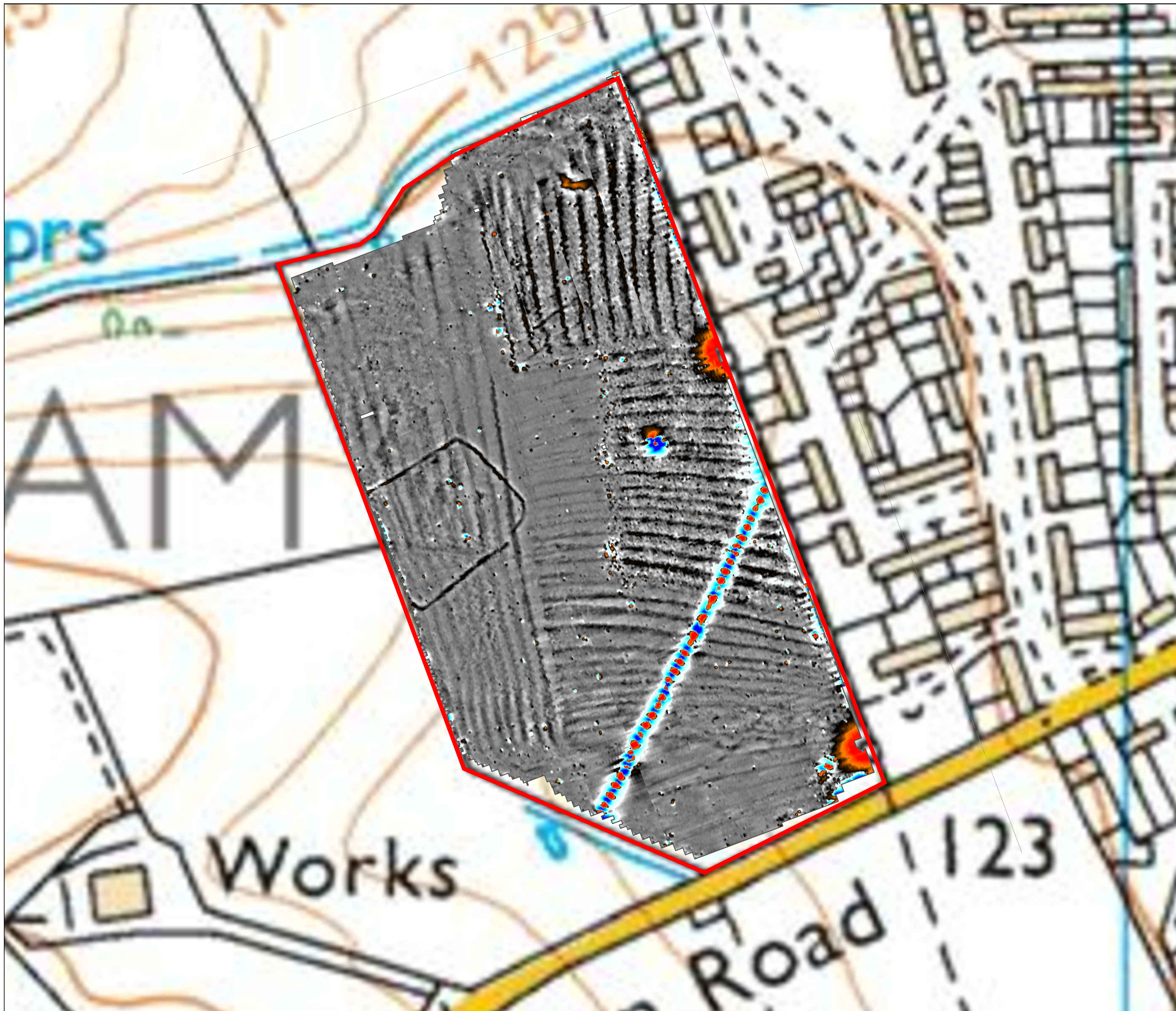
Title: Magnetometer Survey - Greyscale Plot

Client: Cotswold Archaeology

Project: 04501 - Braunston Road, Oakham, Rutland

Scale: 0 metres 100
1:2000 @ A3

Fig No: 02



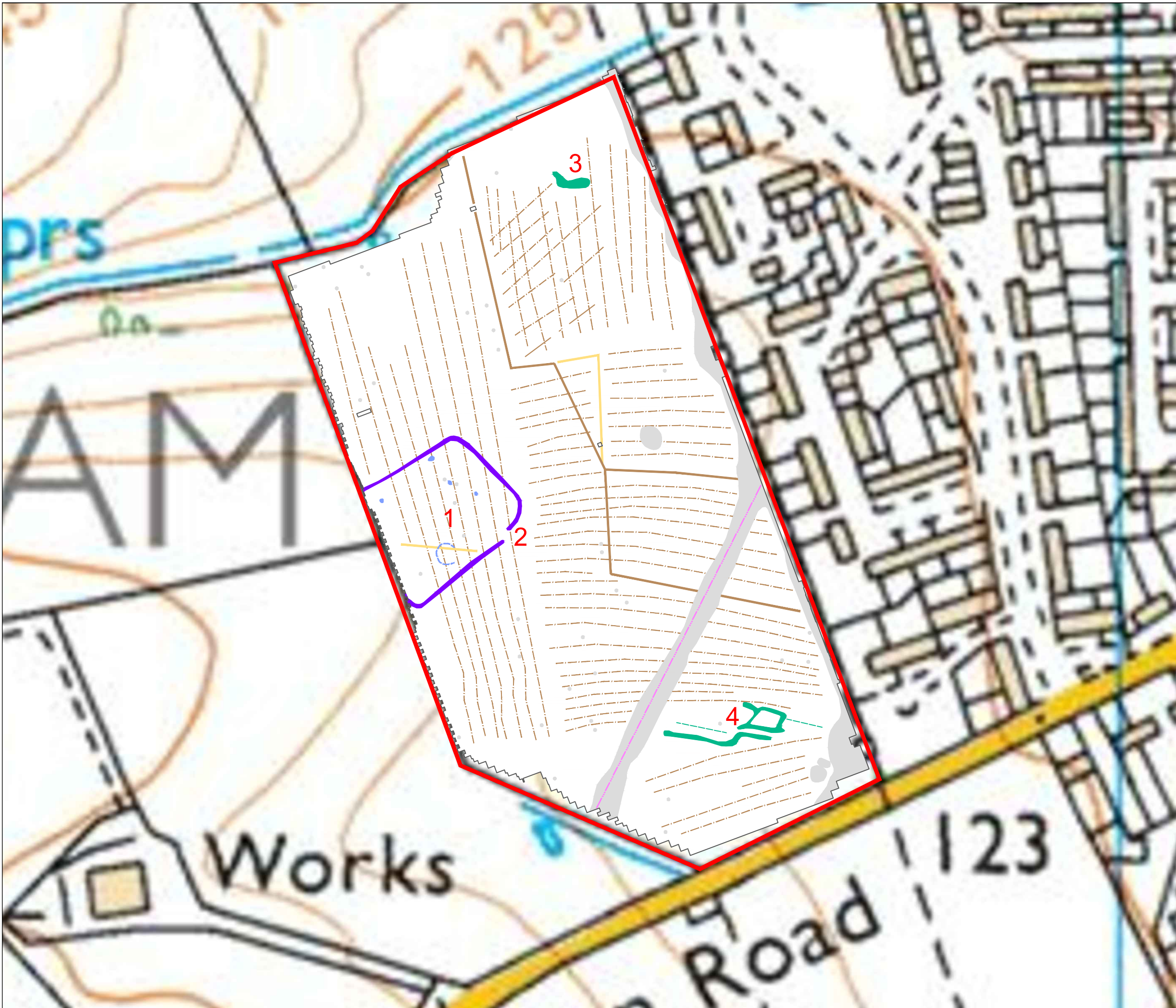
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Client: Cotswold Archaeology









Project: 04501 - Braunston Road, Oakham, Rutland

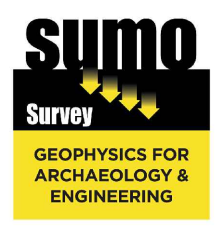
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Fig No: 03



KEY

	Probable archaeology (discrete anomaly)
	Possible archaeology (discrete anomaly / trend)
	Uncertain Origin (discrete anomaly / trend)
	Former field boundary (corroborated)
	Former field boundary (conjectural)
	Agriculture (ridge and furrow)
	Service
	Ferrous



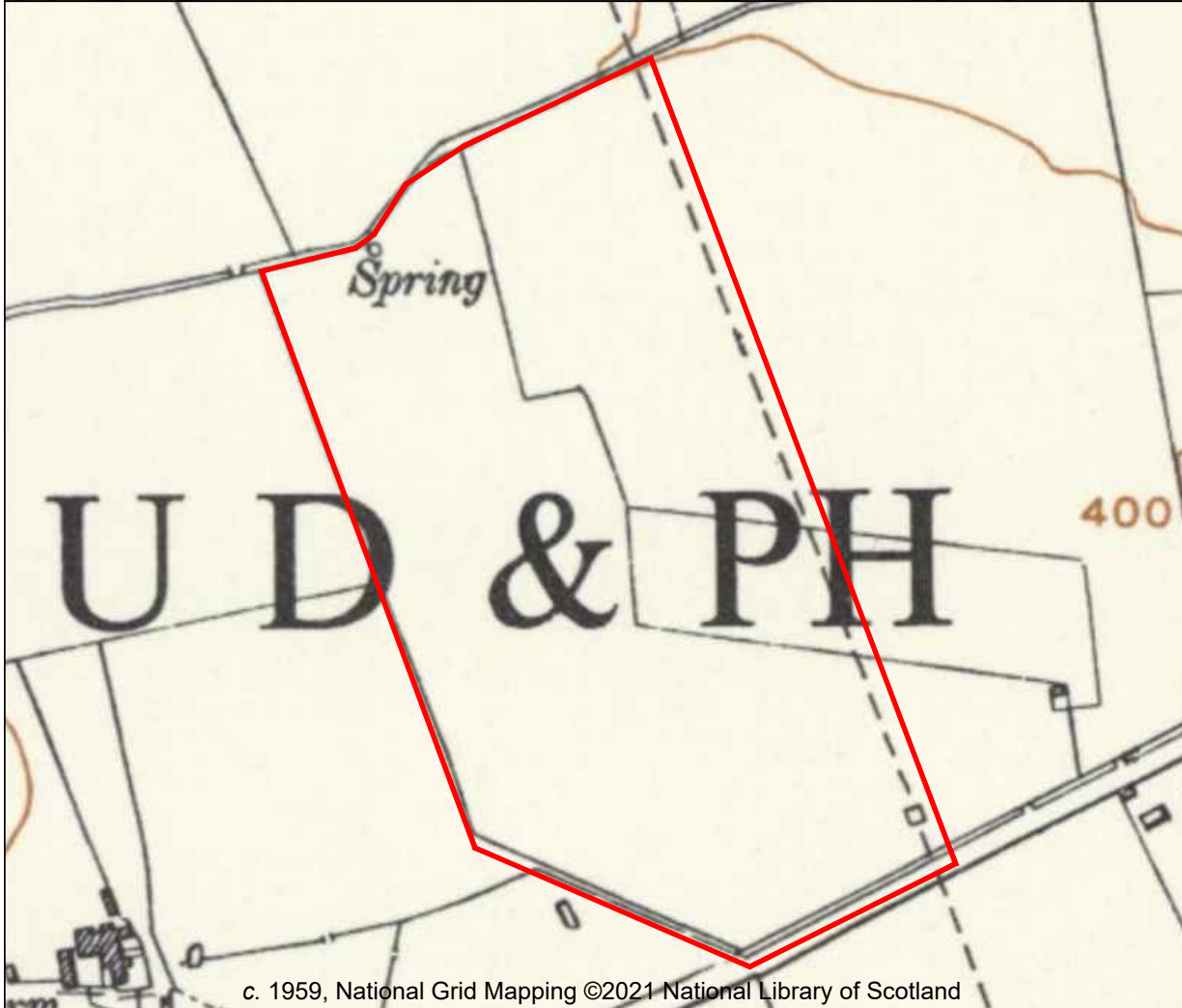
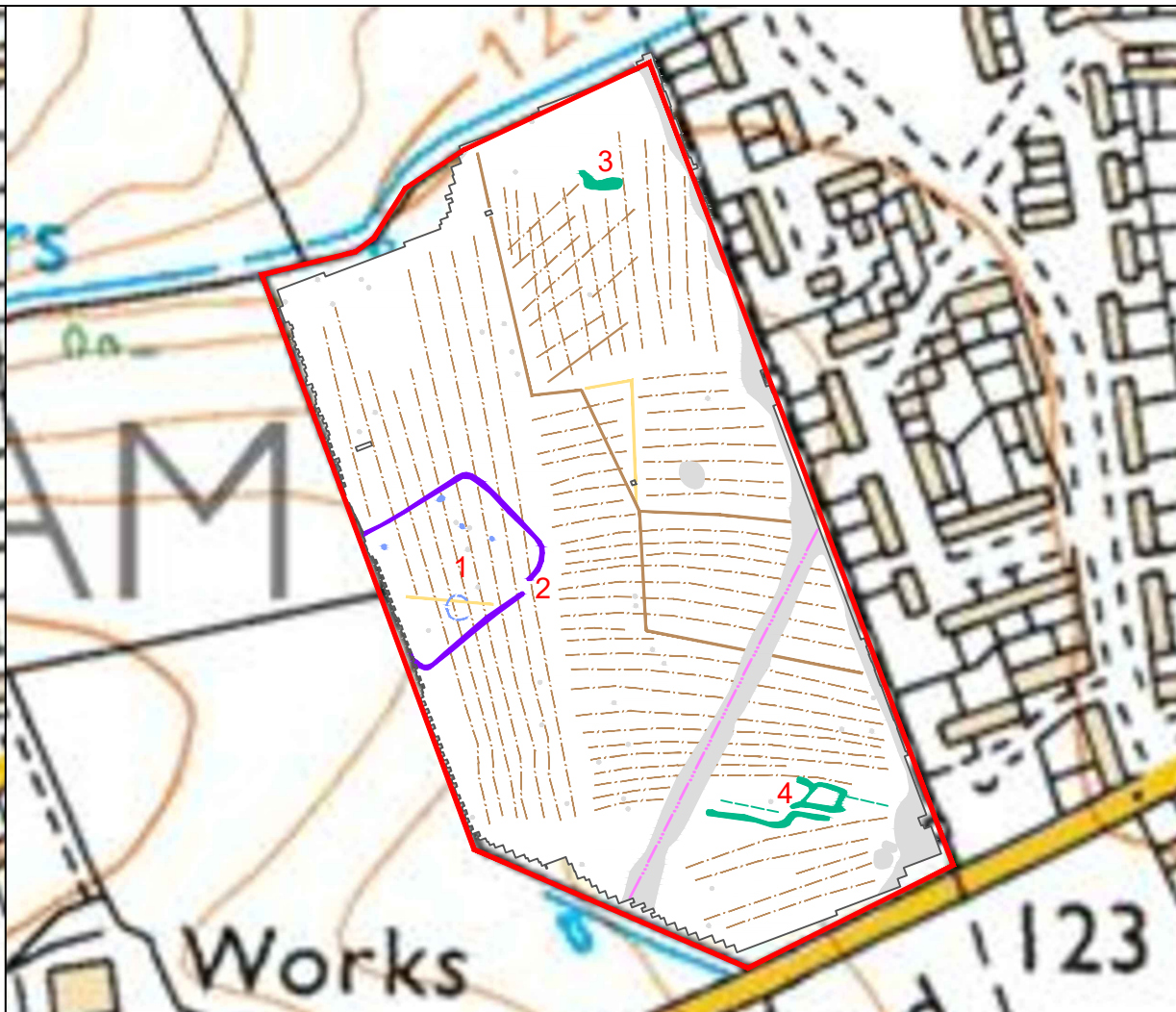
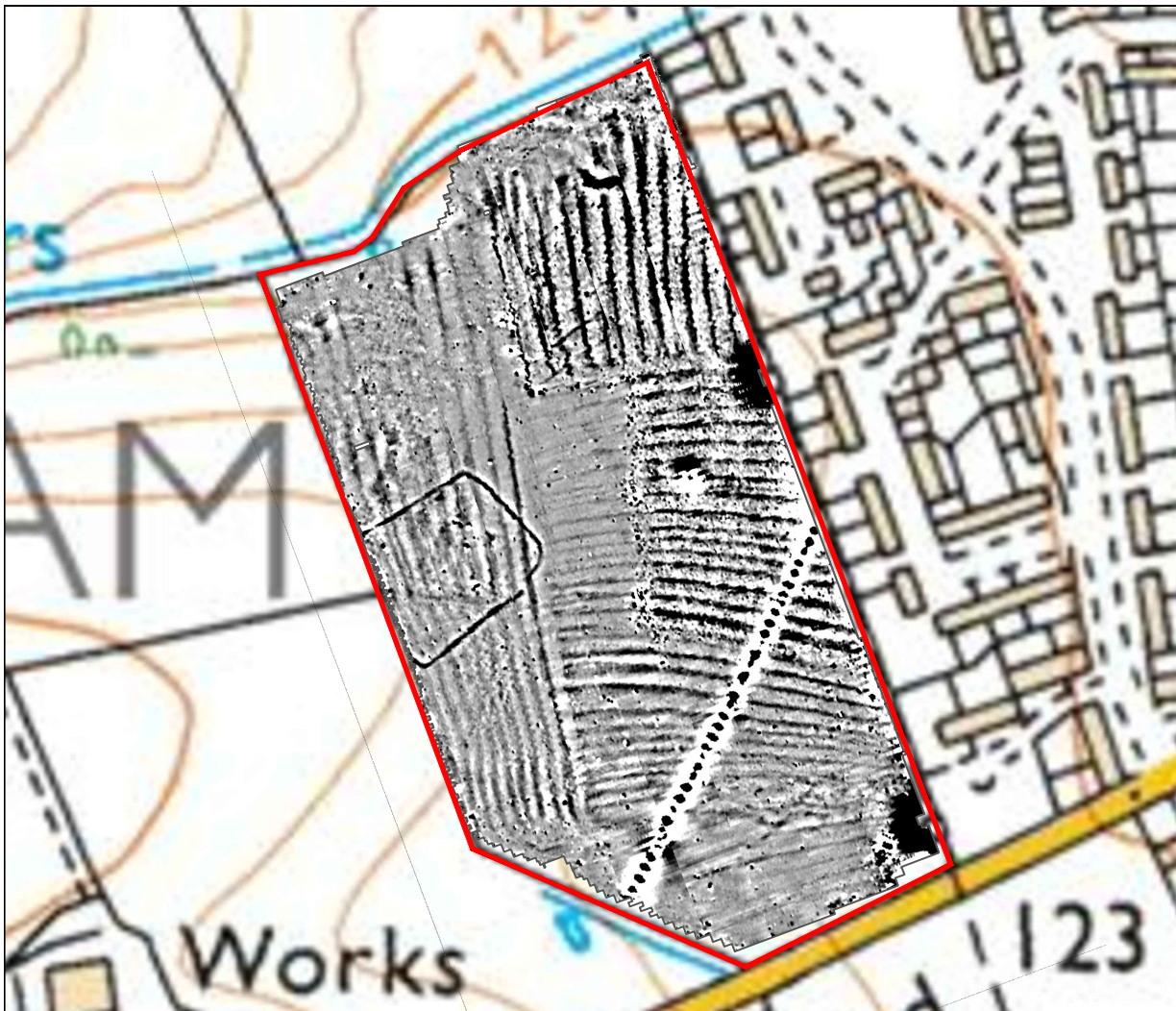
Title: Magnetometer Survey - Interpretation

Client: Cotswold Archaeology









Project: 04501 - Braunston Road, Oakham, Rutland

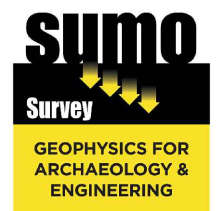
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Fig No: 04



KEY

	Probable archaeology (discrete anomaly)
	Possible archaeology (discrete anomaly / trend)
	Uncertain Origin (discrete anomaly / trend)
	Former field boundary (corroborated)
	Former field boundary (conjectural)
	Agriculture (ridge and furrow)
	Service
	Ferrous



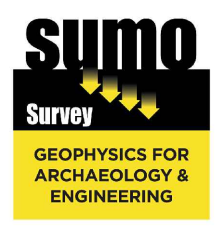
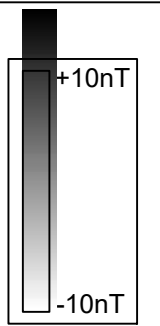
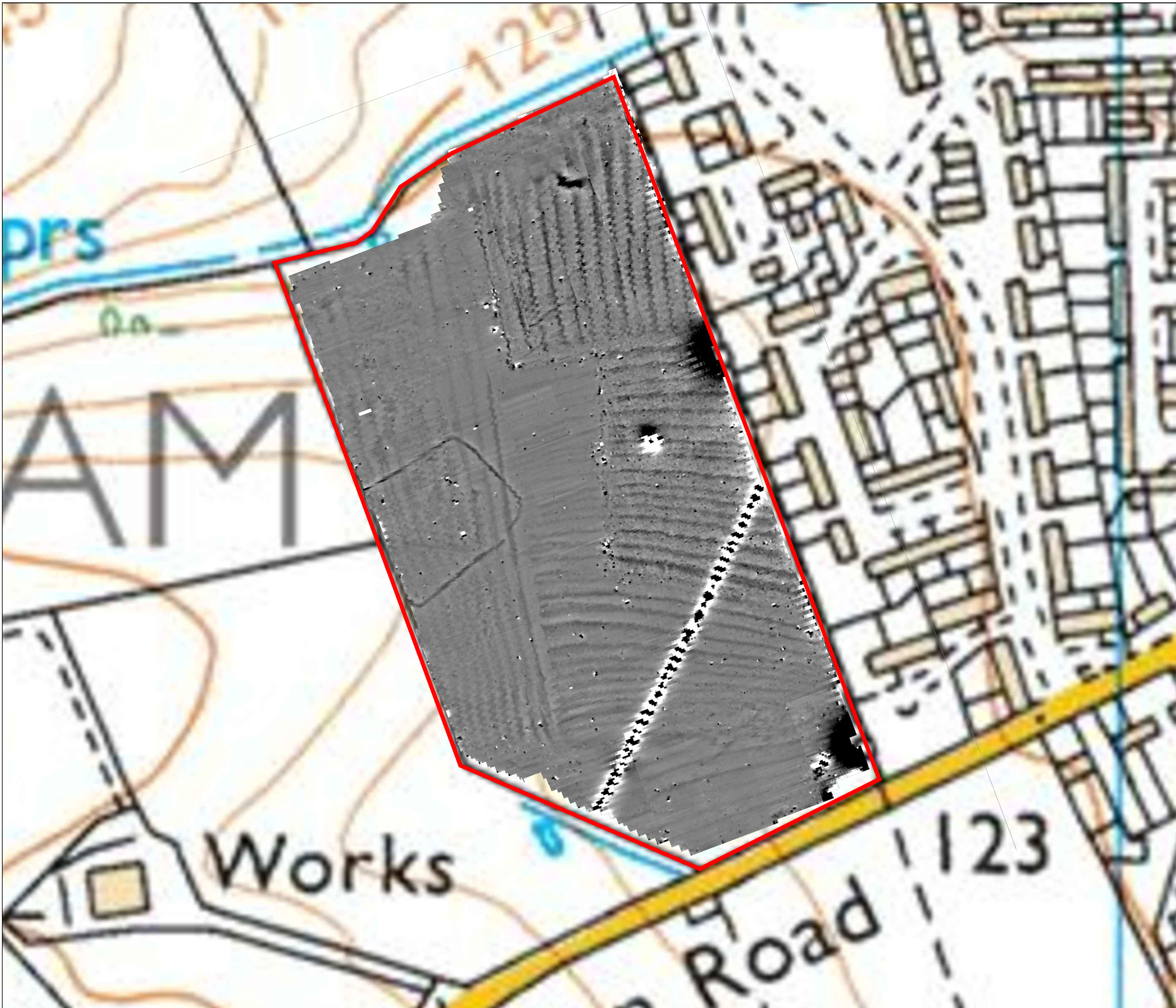
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Client: Cotswold Archaeology

Project: 04501 - Braunston Road, Oakham, Rutland

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1:3500 @ A3

Fig No: 05



Title: Minimally Processed Data - Greyscale Plot

Client: Cotswold Archaeology

Project: 04501 - Braunston Road, Oakham, Rutland

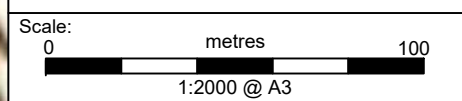
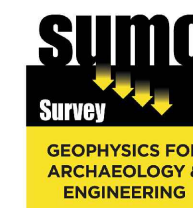
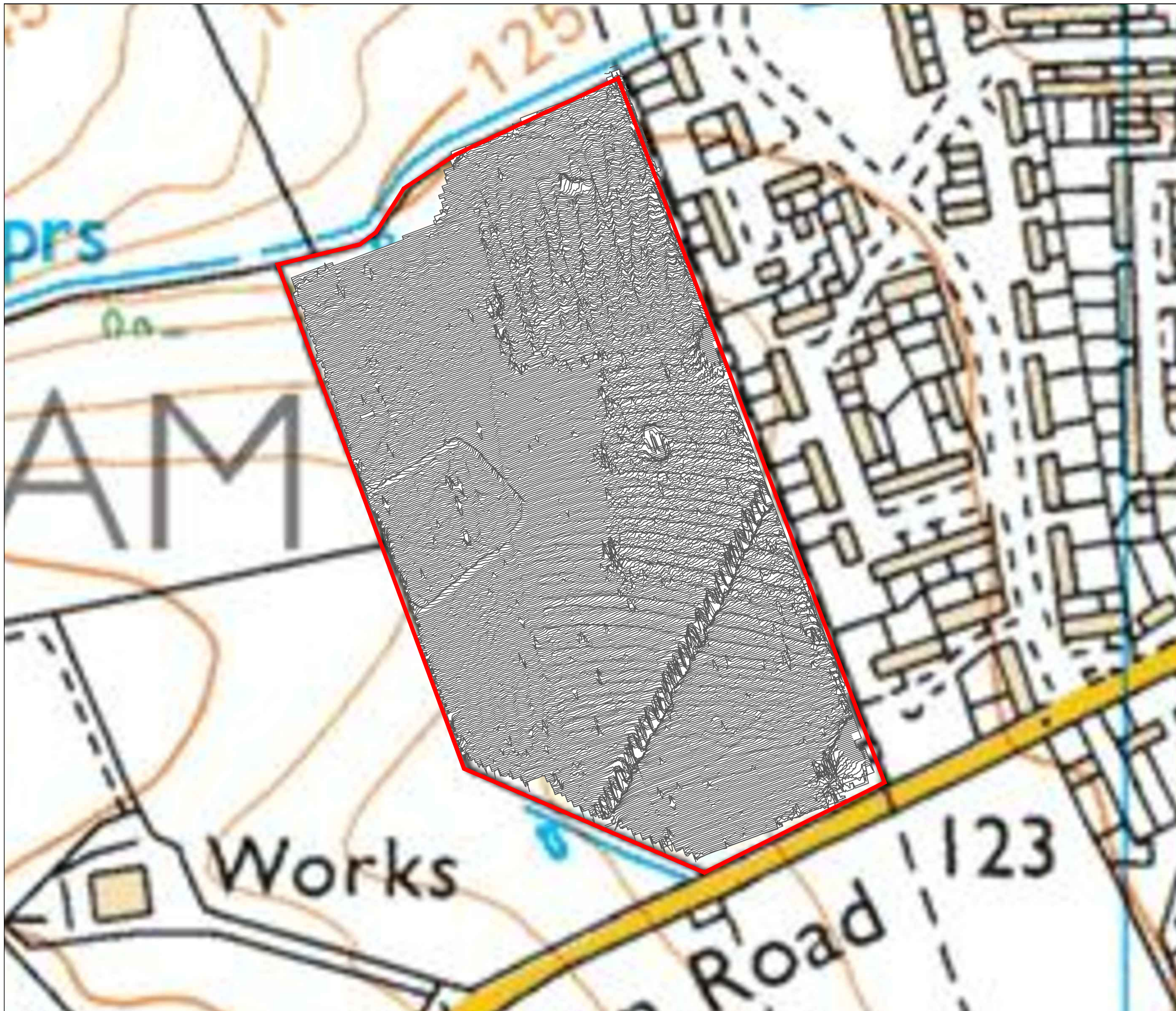


Fig No: 06



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

Client:
Cotswold Archaeology

Project:
04501 - Braunston Road, Oakham, Rutland

Scale:
0 metres 100
1:2000 @ 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.

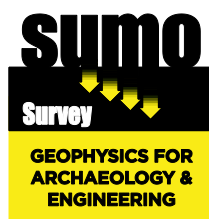
Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same 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 sumogeop1-502960

OASIS ID (UID)	sumogeop1-502960
Project Name	Geophysical Survey at Braunston Road, Oakham, Rutland
Activity type	Geophysical Survey, MAGNETOMETRY SURVEY
Project Identifier(s)	04501
Planning Id	
Reason For Investigation	Planning requirement
Organisation Responsible for work	SUMO Geophysics Ltd.
Project Dates	04-Nov-2021 - 05-Nov-2021
Location	Braunston Road, Oakham, Rutland NGR : SK 84702 08410 LL : 52.6667944653006, - 0.748933980602489 12 Fig : 484702,308410
Administrative Areas	Country : England County : Rutland District : Rutland Parish : Oakham
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. 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	The magnetic survey at Braunston Road, Oakham has identified an enclosure recorded in the HER. Measuring some 65m x 75m the rectilinear feature with rounded corners appears to have an entrance in the south-east corner. There are suggestions of internal features but the results are partially obscured by ridge and furrow cultivation ploughing which extends across the site. There are a few uncertain responses in the data, some of which could be archaeological. Former field boundaries are visible where the ridge and furrow patterns change orientation. A modern service pipe crosses the survey area.
Keywords	Ridge And Furrow - POST MEDIEVAL - FISH Thesaurus of Monument Types Enclosure - UNCERTAIN - FISH Thesaurus of Monument Types Pit - UNCERTAIN - FISH Thesaurus of Monument Types Ring Ditch - UNCERTAIN - FISH Thesaurus of Monument Types Field Boundary - POST MEDIEVAL - FISH Thesaurus of Monument Types Pipeline - 20TH CENTURY - FISH Thesaurus of Monument Types
HER	Leicestershire HER - unRev - STANDARD
HER Identifiers	
Archives	



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

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