GEOPHYSICAL SURVEY REPORT

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SUMO Survey Services
SUMO Group Member

Project name:
South of Witney Road, Long Hanborough, Oxfordshire

Client:
John Moore Heritage Services

Job ref:
J10460

November 2016

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Survey date: **25-26 October 2016**	Report date: **November 2016**
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TABLE OF CONTENTS

LIST OF FIGURES

1 SUMMARY OF RESULTS

A detailed gradiometry survey was conducted over approximately 7.1 hectares of arable land. No features of archaeological origin have been identified. Evidence of ridge and furrow cultivation and modern ploughing suggest that the site has a largely agricultural past. A small number of linear anomalies are of uncertain origin, though are likely to be agricultural or natural. The remaining responses include areas of natural magnetic variation and magnetic disturbance from nearby ferrous objects.

2 INTRODUCTION

2.1 Background synopsis

Stratascan 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 John Moore Heritage Services.

2.2 Site Details

NGR / Postcode	SP 414 139 / OX29 8QL
Location	The site is located to the west of Long Hanborough, Oxfordshire. Witney Road forms the northern boundary of the site, with residential housing to the east, an open boundary on to agricultural land to the west and a stream to the south.
HER/SMR	Oxfordshire
District	West Oxfordshire
Parish	Hanborough CP
Topography	The site lies at a height of approximately 100m AOD, rising gently to around 105m in the north-west and sloping down to about 95m in the south-east.
Current Land Use	Arable across the large western field with overgrown scrub in the smaller, eastern field.
Weather Conditions	Overcast, dry
Soils	The overlying soils are known as Essendon (714d) which are typical paleo-argillic stagnogley soils. These consist of coarse loamy over clayey soils (Soil Survey of England and Wales, Sheet 6 South East England).

Geology	The underlying geology across the majority of the site comprises mudstone of Kellaways Clay Member. Across the west of the area the geology comprises mudstone of Oxford Clay Formation and West Walton Formation, with an area of Kellaways Sand Member – sandstone and siltstone running down the centre of the site. No superficial deposits are recorded across the majority of the site, though a small area of Northern Drift Formation sand and gravel is recorded in the west of the site (British Geological Survey website).
Archaeology	Extract from "Land at Witney Road, Long Hanborough, Oxfordshire – Archaeological Desk-Based Assessment" (TVAS, 2014): *"There are no heritage assets on the site and it remains to establish if there may be potential for previously unknown heritage assets…In this regard, the Roman period seems to be fairly well represented in the surrounding areas, and perhaps there is an increased chance of Roman deposits being present. Given the size of the proposal site, it is suggested that the generalized potential for archaeological remains is high.* *Cartographic evidence for previous land-use on the site indicates that most of it has remained undeveloped farmland since mapping began and there is no evidence to suggest that the eastern margins have been quarried for gravel."*
Survey Methods	Detailed magnetic survey (gradiometry)
Study Area	c. 7.9 hectares – approximately 0.8 hectares in the east could not be surveyed due to overgrown vegetation.

2.3 Aims and objectives

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

3 METHODS, PROCESSING & PRESENTATION

3.1 Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (2008) and the Chartered Institute for Archaeologists (2002 & 2014).

Stratascan Ltd are a Registered Organisation with the CIfA and are committed to upholding its policies and standards.

3.2 Survey methods

Due to the potential for possible Roman remains, detailed magnetic survey was used as an efficient and effective method of locating archaeological anomalies.

More information regarding this technique is included in Appendix A.

3.3 Processing

The following schedule shows the basic processing carried out on the data used in this report:

1. *De-stripe*
2. *De-stagger*

3.4 Presentation of results and interpretation

The presentation of the data for each site involves a plot of the minimally processed data as a greyscale plot and a colour plot showing extreme magnetic values. Magnetic anomalies have been identified and plotted onto the 'Interpretation of Anomalies' drawing.

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 very specific known features documented in other sources, this is done (for example: Abbey Wall, Roman Road). For the generic categories levels of confidence are indicated, 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".

4 RESULTS

The detailed magnetic gradiometer survey conducted at Long Hanborough has not identified any anomalies that have been characterised as being of *probable* or *possible* archaeological origin. The following list of numbered anomalies refers to numerical labels on the interpretation plots.

4.1 Probable Archaeology

No probable archaeology has been identified within the survey area.

4.2 Possible Archaeology

No possible archaeology has been identified within the survey area.

4.3 Medieval/Post-Medieval Agriculture

Widely spaced, slightly curved, parallel linear anomalies **[1]** across the site are a result of ridge and furrow cultivation. Magnetically weak, closely spaced, parallel linear anomalies **[2]** are a result of modern agricultural activity, such as ploughing.

4.4 Other Anomalies

A small number of weak, positive linear anomalies **[3]** across the area are of uncertain origin. These may be a result of agricultural activity, or be of natural origin.

Sinuous areas of enhanced magnetic response **[4]** across the site are likely to be natural (i.e. geological or pedological) in origin.

Areas of magnetic disturbance around the edges of the site are a result of nearby substantial ferrous objects, such as fences and gates. Smaller ferrous anomalies are likely to be modern rubbish.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

Mudstone geologies, such as those present across the site, can provide variable results for magnetic survey. In this instance, the responses from the ridge and furrow cultivation are relatively weak, suggesting that the underlying geology is not fully conducive to magnetic survey. However, it is likely that any moderate strength archaeological anomalies would have been detected should they be present.

6 CONCLUSION

The survey at Long Hanborough has not identified any anomalies of archaeological origin. Extensive areas of ridge and furrow cultivation along with evidence of modern ploughing indicate that the site has been used for agricultural purposes since the medieval period, corresponding with information provided in the desk-based assessment. A small number of linear anomalies are of uncertain origin, though are more likely to be agricultural or natural than archaeological. The remaining features are natural or modern and include areas of natural magnetic variation and magnetic disturbance from nearby ferrous metal objects.

7 REFERENCES

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Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 6 South East England*

Thames Valley Archaeological Services (TVAS), 2014. *Land at Witney Road, Long Hanborough, Oxfordshire – Archaeological Desk-Based Assessment*

Appendix A - Technical Information: Magnetometer Survey Method

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 Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set.
Step Correction (Destagger)	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.

Interpretation Categories

In certain circumstances (usually when there is corroborative evidence from desk based or excavation data) very specific interpretations can be assigned to magnetic anomalies (for example, *Roman Road, Wall,* etc.) and where appropriate, such interpretations will be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

Archaeology/Probable Archaeology	This term is used when the form, nature and pattern of the response are clearly or very probably archaeological and /or if corroborative evidence is available. These anomalies, whilst considered anthropogenic, could be of any age.
Possible Archaeology	These anomalies exhibit either weak signal strength and / or poor definition, or form incomplete archaeological patterns, thereby reducing the level of confidence in the interpretation. Although the archaeological interpretation is favoured, they may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Industrial / Burnt-Fired	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal- working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
Former Field Boundary (probable & possible)	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.
Ridge & Furrow	Parallel linear anomalies whose broad spacing suggests ridge and furrow cultivation. In some cases the response may be the result of more recent agricultural activity.
Agriculture (ploughing)	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
Land Drain	Weakly magnetic linear anomalies, quite often appearing in series forming parallel and herringbone patterns. Smaller drains will often lead and empty into larger diameter pipes and which in turn usually lead to local streams and ponds. These are indicative of clay fired land drains.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.
Magnetic Disturbance	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present. They are presumed to be modern.
Service	Magnetically strong anomalies usually forming linear features indicative of ferrous pipes/cables. Sometimes other materials (e.g. pvc) cause weaker magnetic responses and can be identified from their uniform linearity crossing large expanses.
Ferrous	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.
Uncertain Origin	Anomalies which stand out from the background magnetic variation, yet whose form and lack of patterning gives little clue as to their origin. Often the characteristics and distribution of the responses straddle the categories of *Possible Archaeology* and *Possible Natural* or (in the case of linear responses) *Possible Archaeology* and *Possible Agriculture*; occasionally they are simply of an unusual form.

Where appropriate some anomalies will be further classified according to their form (positive or negative) and relative strength and coherence (trend: weak and poorly defined).

Appendix B - Technical Information: Magnetic Theory

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock. Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTeslas (nT) in an overall field strength of 48,000nT, 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 and 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 field. The difference between the two sensors will relate to the strength of a magnetic field created by a buried 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, disturbance from modern services etc.

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