GEOPHYSICAL SURVEY REPORT

STRATASCAN™

SUMO Survey Services SUMO Group Member

Project name:

Grange Lane, Littleport, Cambridgeshire

Client:

Oxford Archaeology East

Job ref:

J10756

January 2017

GEOPHYSICAL SURVEY REPORT

Project name: **Grange Lane, Littleport, Cambridgeshire** Client: **Oxford Archaeology East**		Job ref: **J10756**
Survey date: **3-6, 11 January 2017**		Report date: **26 January 2017**
Field team: **Rob Knight** BA **Adam Clark** BA **Tom Cockcroft** MSc		Project Manager: **Simon Haddrell** BEng(Hons) AMBCS PCIfA
Report written by: **Dr John Gater** MCIfA FSA		Report approved by: **David Elks** MSc ACIfA
CAD illustrations by: **Rebecca Davies** BSc		Site Director: **Dr John Gater** MCIfA FSA
Version number and issue date:		Amendments:
V1	01/02/2017	

SUMO Survey Services
SUMO Group Member

STRATASCAN LTD
Vineyard House Upper Hook Road Upton upon Severn
Worcestershire WR8 0SA United Kingdom

T: 01684 592266 F: 01684 594142
info@stratascansumo.com www.stratascan.co.uk

TABLE OF CONTENTS

LIST OF FIGURES

1 SUMMARY OF RESULTS

Although there are no anomalies falling into the category of *probable* or *possible* archaeology, there is a plethora of responses associated with ridge and furrow cultivation. This clearly covered most of the site and former fields have been identified. A number of anomalies have been classified as having an uncertain origin; in a less rich archaeological landscape these responses would probably have been earmarked as being agricultural or natural in origin.

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 Oxford Archaeology East on behalf of Manor Oak Homes.

2.2 Site Details

NGR / Postcode	TL 555 860 / CB6 1HW
Location	The proposed development area is located on the south west side of Littleport, which is located between Ely and Downham Market. The site lies on the northernmost tip of the 'Isle of Ely' and occupies three large fields set in a piece of land between the A10 to the west and Grange Road to the south.
HER/SMR	Cambridgeshire
District	East Cambridgeshire
Parish	Littleport
Topography	Generally level; it occupies an area of high ground elevated above the surrounding low-lying fen floor.
Current Land Use	Arable
Weather Conditions	Overcast / occasional showers
Soils	Soils: Ashley (527q) – Stagnogleyic argillic brown earths (Soil Survey of England and Wales, Sheet 4, Eastern England).
Geology	Bedrock: Kimmeridge Clay Formation – Mudstone. Superficial: Oadby Member - Diamicton (British Geological Survey website).
Archaeology	The proposed development area lies adjacent to a known rich, multi-period archaeological landscape. Undated ditches were excavated in advance of the development of the balancing lagoon at the western boundary of the site; prehistoric to Roman sites are known along the northern edge of the island, along Wisbech Road. The site is considered to have a high potential for archaeological remains. (CHET 2016).
Survey Methods	Magnetometer survey (fluxgate gradiometer – handheld and cart system)
Study Area	*c.* 29 ha

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

Detailed magnetic survey was used as a proven efficient and effective method of locating archaeological anomalies associated with cut features like ditches and pits. The area was investigated using a cart system where field conditions permitted; elsewhere hand-held instruments were employed. More information on these systems 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

4.1 Probable / Possible Archaeology

No *probable* or *possible* archaeology has been identified within the survey area.

4.2 Medieval/Post-Medieval Agriculture

Parallel and widely spaced anomalies dominate the results from all three fields; the responses are indicative of former ridge and furrow cultivation. The cultivation patterns show little respect for the modern field boundaries, clearly crossing these features and also following differing alignments. It is possible to infer the shape and size of former, unmapped, fields in medieval and later times. There is only one zone without ridge and furrow ploughing; this is located at the northern tip of the south-western field.

4.3 *Other Anomalies*

There are several straight linear anomalies in the data; these either indicate confirmed former field boundaries, where marked on old maps, or conjectural field divisions, where there is no supporting map evidence. A service pipe is visible in the data bisecting the south-western field. A third linear anomaly, in the northern field, comprises differing magnetic components and these are thought to represent an old track-come-boundary.

Other linear magnetic responses have been classified as having an *uncertain origin*. They follow different alignments to the ridge and furrow, but could indicate effects from more recent agricultural activity. The lack of any shape or form to these magnetic anomalies makes an archaeological interpretation unlikely. The same uncertainty applies to the circular and curvilinear anomalies in the south-western field which could be a result of localised variations in the magnetic gravels. While an archaeological cause cannot be totally ignored, this seems unlikely.

Areas of ferrous responses along the survey edges are the result of nearby fences, particularly along the northern survey boundary where there is a very strong ferrous response. The effects of this disturbance and other ferrous disturbance within the survey area can mask weaker archaeological anomalies. Smaller ferrous anomalies, or 'magnetic spikes', indicate small ferrous metal objects and are likely to be modern rubbish in the topsoil.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

Mudstone geologies and gravel deposits are classified as generally providing an average response for magnetic survey. In this instance, the mapping of former field boundaries and the very clear ridge and furrow results suggest that, if present, archaeological features pertaining to prehistoric or Romano British settlement would have been identified. Saxon remains are more difficult to detect; more ephemeral archaeological features may have been masked by the ridge and furrow cultivation.

6 CONCLUSION

The survey at Littleport has mapped ridge and furrow cultivation patterns over most of the site. The results are very clear and it is possible to identify earlier agricultural fields.

A few anomalies have been classified as having an *uncertain origin*. While an archaeological cause cannot be dismissed, such an interpretation is perhaps less likely than an agricultural or natural origin.

7 REFERENCES

British Geological Survey, n.d., *website*: (http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps) Geology of Britain viewer. [Accessed 26/01/2017]

CHET 2016. *Design Brief for Archaeological Evaluation, Land North of Grange Lane (incl LIT2), Littleport,* Cambridge Historic Environment Team, unpublished design brief, 21st Dec 2016.

Chartered Institute for Archaeologists. *Standard and Guidance for Archaeological Geophysical Survey. (*http://www.archaeologists.net/sites/default/files/CIfAS&GGeophysics_1.pdf)

English Heritage, 2008. *Geophysical Survey in Archaeological Field Evaluation.*

IfA 2002. The Use of Geophysical Techniques in Archaeological Evaluations, IFA Paper No 6, C. Gaffney, J. Gater and S. Ovenden. Institute for Archaeology, Reading

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 4 Eastern England*

Appendix A - Technical Information: Magnetometer Survey Method

Cart collection

Every point that is recorded is referenced using a Trimble R8 RTK GNSS 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.

Survey equipment and gradiometer configuration

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 using an appropriate instrument.

The magnetic survey was carried out using a Bartington magnetometer cart system utilizing Bartington 1000L Gradiometer sensors. The instrument consists of two fluxgates 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.

Sampling interval

For cart collected data readings were taken at intervals of 0.125m along traverses 0.75m apart.

Depth of scan and resolution

The Bartington magnetometer cart system collects data at 10Hz which approximates 0.125m.

Data capture

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.

Survey services you can rely on

sumo Survey Services

Your Survey Partner

For a complete and complementary range of survey services.

Survey services you can rely on

- Archaeological
- As Built Records
- Boundary Disputes
- CCTV
- Geophysical
- Laser Scanning
- Measured Building
- Pipeline Routes
- Railway
- Retrofit
- Setting Out
- Statutory Plan Collation
- Topographic
- Utility Mapping
- UXO Detection
- Void Detection