GEOPHYSICAL SURVEY REPORT

STRATASCAN™

SUMO Survey Services
SUMO Group Member

Project name:
Congresbury, North Somerset

Client:
CgMs Consulting

Job ref:
J10495

December 2016

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Project name: **Congresbury, North Somerset** Client: **CgMs Consulting**	Job ref: **J10495**
Survey date: **10th November 2016**	Report date: **December 2016**
Field team: **Lukasz Krawec** BSc **Stewart Hawthorne** BA **Olivier Vansassenbrouck** BSc	Project Manager: **Simon Haddrell** BEng(Hons) AMBCS PCIfA
Report written by: **Rebecca Davies** BSc (Hons)	Report approved by: **David Elks** MSc ACIfA
CAD illustrations by: **Rebecca Davies** BSc (Hons)	Site Director: **Dr John Gater** MCIfA FSA
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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

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1 SUMMARY OF RESULTS

A detailed gradiometry survey was conducted over approximately 3.4 hectares of grassland. Evidence of possible industrial activity has been identified, though the exact origin of the responses is uncertain. Former field boundaries and ridge and furrow suggest the site has a largely agricultural past. The remaining features include areas of natural magnetic variation, underground services and 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 CgMs Consulting.

2.2 Site Details

NGR / Postcode	ST 446 641 / BS49 5AN
Location	Congresbury, North Somerset
HER/SMR	Somerset
Planning Authority / Ref	North Somerset Council
Unitary Authority	North Somerset
Parish	Congresbury CP
Topography	The site slopes gradually down from north to south.
Current Land Use	Grassland
Weather Conditions	Sunny, clear
Soils	The overlying soils are known as Comton which are typical pelo-alluvial gley soils. These consist of stoneless, mostly reddish clayey soils affected by groundwater (Soil Survey of England and Wales, Sheet 5, South West England).
Geology	The underlying geology across the majority of the site comprises mudstone and halite-stone of the Mercia Mudstone Group. An outcrop of ooidal limestone of the Oxwich Head Limestone Formation is recorded in the west of the area. No drift geology is recorded (British Geological Survey website).
Archaeology	A desk-based assessment of the site (CgMs, 2016) concluded that the site had a moderate potential to contain prehistoric and Roman evidence of

	no more than local significance. Recent geophysical survey (Archaeological Surveys, 2015) and trial trenching (Archaeology South-East, 2016) at Cobthorn Way, c.100m to the south of the site, also identified evidence of Roman metalworking activity.
Survey Methods	Detailed magnetic survey (gradiometry)
Study Area	c. 3.4 hectares

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 moderate potential for 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 Congresbury has identified a number of anomalies that have been characterised as being of *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

A number of discrete, high amplitude responses **[1]** focussed on top of the limestone outcrop in the west of the site. It is possible that the responses are a result of industrial activity, such as kilns or furnaces, of Roman or later date.

4.3 Medieval/Post-Medieval Agriculture

Three weak, dipolar linear anomalies **[2-4]** in the centre of the area are related to former field boundaries, visible on available OS mapping. Anomalies 2 & 3 are visible from 1884 to 1904, and Anomaly 4 is visible from 1884 to 1960.

Widely spaced, slightly curved, parallel linear anomalies **[5-6]** are visible across the survey area and are a result of ridge and furrow cultivation. The cultivation is oriented approximately north-south **[5]** in the east, and approximately east-west **[6]** in the north-west of the site. Magnetically weak, parallel linear anomalies **[7]** in the south-east are a result of modern agricultural activity, such as ploughing.

4.4 Other Anomalies

A weak positive linear anomaly **[8]** in the south-west of the site may be associated with a former cut feature, such as a ditch, though its exact origin is uncertain. It may equally be a result of more recent agricultural activity.

Areas of enhanced magnetic response **[9]** in the west of the area correspond with the location of the limestone outcrop, and are therefore likely to be natural in origin.

A high amplitude linear anomaly **[10]** in the west of the site is related to a 33” raw water main, while a further underground service is visible in the north. Areas of magnetic disturbance around the edge of the site are a result of nearby ferrous metal objects, such as fencing.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

Mercia Mudstone geologies can provide variable results for magnetic survey, while limestone geologies generally provide good results. In this instance, the detection of possible industrial activity and medieval agricultural activity suggests that the geologies are conducive to magnetic survey and that the survey has been effective. This is further supported by the positive results from the archaeological works at Cobthorn Way to the south (Archaeological Surveys, 2015; Archaeology South-East, 2016).

6 CONCLUSION

The survey at Congresbury has not identified any probable archaeological remains. Areas of possible industrial activity have been detected on the distinct limestone outcrop. These may reflect the truncated remains of kilns or furnaces of Roman, or later, date. Former field boundaries and evidence of ridge and furrow indicate that the site has been used for agricultural purposes since the medieval period.

The remaining features are natural or modern and include areas of natural magnetic variation; a result of the limestone outcrop, underground services and areas of magnetic disturbance from nearby ferrous objects.

7 REFERENCES

Archaeology South-East, 2016. *Archaeological Evaluation Report – Land at Cobthorn Way, Congresbury, Somerset*

Archaeological Surveys Ltd, 2015. *Land off Cobthorn Way, Congresbury, North Somerset – Magnetometer Survey Report*

British Geological Survey, n.d., *website*: (http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps) Geology of Britain viewer. [Accessed 30/11/2016]

CgMs Consulting, 2016. *Land off Wrington Lane, Congresbury, North Somerset – Archaeological Desk-Based Assessment*

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 5 South West England*

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

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

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