GEOPHYSICAL SURVEY REPORT G1699

Land at Sully, Vale of Glamorgan

Client:

Cotswold Archaeology

On Behalf Of:

savills

GSB PROSPECTION Ltd

Celebrating over 30 years at the forefront of Archaeological Geophysics

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GEOPHYSICAL SURVEY REPORT

Project name:	Land at Sully, Vale of Glamorgan
Job ref:	G1699
Client:	Cotswold Archaeology
Survey dates:	11 November 2016
Report date:	16 November 2016
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SUMO Survey Services
SUMO Group Member

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DIGITAL CONTENT (CD)

- Minimally Processed Greyscale Images and XY Trace Plots in DWG format
- DWG Viewer
- Digital Copies of Report Text and Figures (both PDF and native formats)

1 SUMMARY OF RESULTS

There are no indications in the magnetic data of any archaeological features. Most the responses are indicative of naturally magnetic deposits. There are a few responses classified as being of uncertain origin; they could be natural or agricultural. A pipe crosses the corner of the survey area.

2 INTRODUCTION

2.1 Background synopsis

GSB Prospection Ltd. was commissioned to undertake a geophysical survey of an area proposed for residential development. This survey forms part of an archaeological investigation being undertaken by **Cotswold Archaeology** on behalf of **Savills (Wales)**.

2.2 Site Details

NGR / Postcode	ST 161 684 / CF64 5
Planning Reference	2013/01279
Location	The site is located approximately 3km east of the centre of Barry and 550m north of the Bristol Channel. It is on the north-eastern edge of Sully, bounded to the east by Swanbridge Road and to the west by residential properties. Farmland lies to the south and north, with a disused railway and Cog Road beyond.
HER/SMR	Glamorgan Gwent HER
District	Vale of Glamorgan
Topography	Flat, moderate gradient
Current Land Use	Young wheat crop
Soils	Malham 2 (541p) association well drained often stoneless silty soils; bare rock (SSEW 1983).
Geology	Mercia Mudstone Group (marginal Facies) – conglomerate. No recorded superficial deposits. (BGS 2016).
Archaeology	A Neolithic flint scatter is recorded within the site, and an “Old Kiln” is shown to the south of the survey area on the 1846 Sully Tithe map (CA 2013).
Survey Methods	Detailed magnetometer survey (fluxgate gradiometer).
Study Area	6.8ha

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 (EH 2008) (then English Heritage) and the Chartered Institute for Archaeologists (IfA 2002 & CIfA 2014).

3.2 Survey methods

Detailed magnetic survey was chosen as an efficient and effective method of locating archaeological anomalies.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1m	0.25m

More information regarding this technique is included in Appendix A

This project was carried out in accordance with a Written Scheme of Investigation submitted to Glamorgan Gwent Archaeological Trust.

3.3 Data 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 greyscale plot of processed data. Magnetic anomalies have been identified, interpreted and plotted onto the 'Interpretation' drawings. The minimally processed data are provided as a greyscale image on the CD together with an XY trace plot in CAD format. A CAD viewer is also provided.

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 There are no indications in the data of Probable or Possible Archaeology.

4.2 Most the responses are indicative of natural deposits; the linear and curvilinear anomalies, which cross the majority of the survey area, are typical of former estuarine or alluvial deposits, or of where thin soils cover the bedrock. Given the proximity of the Bristol Channel, the results are not unexpected.

4.3 At the eastern edge of the survey there is an unusual curving linear anomaly; it could be a ditch or drain, or a former field division. It is roughly parallel to the eastern boundary. An archaeological origin does not seem likely; it could be agricultural or perhaps a service trench. As such, it is placed in the *Uncertain Origin* interpretation category. The same applies to another linear which runs at a slight angle to this anomaly.

4.4 Elsewhere in the data are several other anomalies and trends of uncertain origin. They form no pattern or shape and are probably agricultural or natural.

4.5 In the middle of the northern half of the survey area a short linear anomaly aligned north-south coincides with a former field division marked on old mapping.

4.6 A few ploughing trends are visible in the data.

4.7 Ferrous responses coincide with a pipe in the south-east corner of the field.

4.8 Other ferrous responses, along the survey edges, are the result of fences; these can mask magnetically weaker features. Smaller ferrous anomalies, or 'magnetic spikes' indicate small ferrous metal objects and are likely to be modern rubbish.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

5.1 Historic England Guidelines (EH 2008) Table 4 states that mudstones tend to produce poor magnetic responses, but that results can be variable. On this site, natural features, a former boundary and plough lines have all been detected, indicating that magnetometry has successfully mapped features and is likely to have detected any anomalies of archaeological origin, if present.

6 CONCLUSION

6.1 No probable or possible archaeology has been identified in the magnetic data.

6.2 A few anomalies and trends have an uncertain origin.

6.3 Natural magnetic responses dominate the results.

6.4 A former field boundary and a pipe have been recorded.

7 REFERENCES

BGS 2016 British Geological Survey *website*: (http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps) Geology of Britain viewer. [Accessed 25/10/2016]

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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

SSEW 1983 *Soils of England and Wales. Sheet 2, Wales*. Soil Survey of England and Wales, Harpenden.

Site Location

N

Title:

Site Location Diagram

Client:

Cotswold Archaeology

Project:

G1699 Land at Sully,
Vale of Glamorgan

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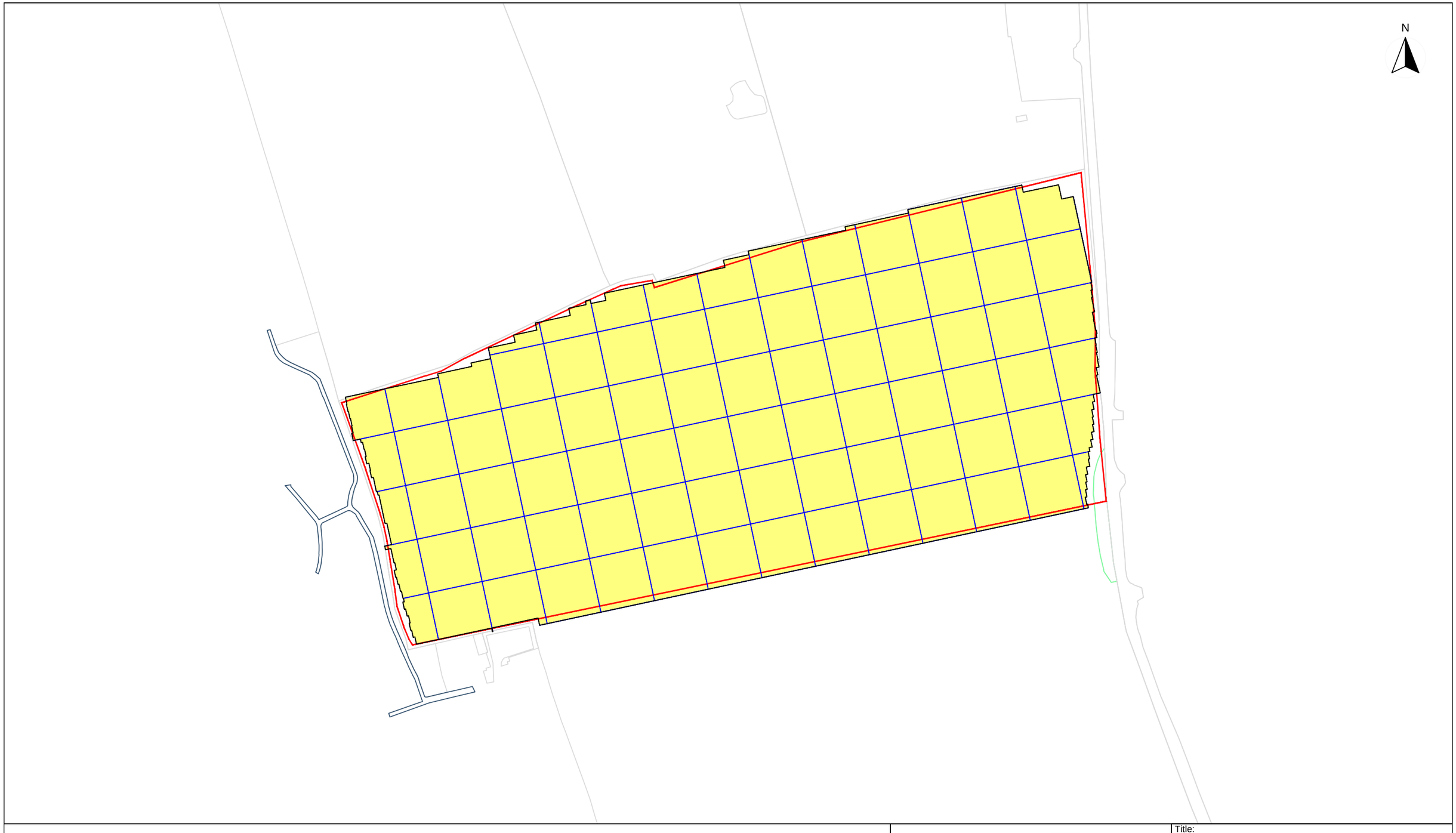
Scale: 0 metres 2000

1:50000 @ A4

Fig No: 1



Magnetometer Survey Area
Showing 30m Grids

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Title:
Location of Survey Area

Client:
Cotswold Archaeology

Project:
G1699 Land at Sully, Vale of Glamorgan

Scale: 0 metres 80
1:2000 @ A3

Fig No:
2

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Title:
Magnetometer Survey
Greyscale Plot

Client:
Cotswold Archaeology

Project:
G1699 Land at Sully, Vale of Glamorgan

Scale: 0 metres 50
1:1250 @ A3

Fig No:
3

N

Uncertian Origin
(discrete anomaly / trend)

Natural
(discrete anomaly / trend)

Former Field Boundary - Mapped

Ploughing

Pipe

Ferrous

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Title:
Magnetometer Survey
Interpretation

Client:
Cotswold Archaeology

Project:
G1699 Land at Sully, Vale of Glamorgan

Scale: 0 metres 50
1:1250 @ A3

Fig No:
4

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.

For CARTEASY^{N} collected data each data point had its position recorded using a Trimble R10 Real Time Kinematic (RTK) VRS Now GNSS GPS system. The geophysical survey area is georeferenced relative to the Ordnance Survey National Grid.

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
Magnetometer	CartEasy^{N} cart system (Bartington Grad 601 sensors)	0.75m	0.125m

Instrumentation: Bartington *Grad*601-2 / GSB CARTEASY^{N} Cart system
Both the Bartington and CARTEASY^{N} 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 CARTEASY^{N} system has four gradiometer units mounted at 0.75m intervals across its frame – rather than working in grids, the cart uses an on-board survey grade GNSS for positioning. The cart system allows for the collection of topographic data in addition to the magnetic field measurements.

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.
Interpolation	When geophysical data are presented as a greyscale, each data point is represented as a small square. The resulting plot can sometimes have a 'blocky' appearance. The interpolation process calculates and inserts additional values between existing data points. The process can be carried out with points along a traverse (the x axis) and/or between traverses (the y axis) and results in a smoother greyscale image.

Display

XY Trace Plot	This involves a line representation of the data. Each successive row of data is equally incremented in the Y axis, to produce a stacked profile effect. This display may incorporate a hidden-line removal algorithm, which blocks out lines behind the major peaks and can aid interpretation. The advantages of this type of display are that it allows the full range of the data to be viewed and shows the shape of the individual anomalies. The display may also be changed by altering the horizontal viewing angle and the angle above the plane.
Greyscale 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.

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.

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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