GEOPHYSICAL SURVEY REPORT

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Project name:

Land to the North of Church Park, Wadebridge, Cornwall

Client:

Cotswold Archaeology

Job ref:

J10073

July 2016

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Project name: **Land to the North of Church Park, Wadebridge, Cornwall** Client: **Cotswold Archaeology**	Job ref: **J10073**
Survey date: **28th - 30th June 2016**	Report date: **July 2016**
Field team: **Richard Fleming** **Lukasz Krawec** BSc **Christian Adams** BA (Hons) **Sonia Kostrzewska** MA **Jack Larner** **Samuel Wood**	Project Manager: **Simon Haddrell** BEng(Hons) AMBCS PCIfA
Report written by: **Rebecca Davies** BSc (Hons)	Report approved by: **Peter Barker** CEng MICE MCIWEM MCIfA FCInstCES
CAD illustrations by: **Rebecca Davies** BSc (Hons)	Site Director: **Peter Barker** CEng MICE MCIWEM MCIfA FCInstCES
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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 27.5 hectares of mixed arable farmland and grassland. An area of later prehistoric or Romano-British settlement has been identified. A number of linear and curvilinear anomalies may relate to small enclosures, while further linear anomalies are representative of a field system. Small discrete anomalies, indicative of backfilled pits, provide further evidence of settlement on the site. Small, sub-circular anomalies are likely to be archaeological, and may relate to former hut circles, though their exact origin is uncertain. Further linear anomalies across the site may be related to an early field system or additional areas of settlement activity, though the exact origin of these features cannot be determined with confidence. A number of discrete areas of moderate strength may be archaeological in origin, though their exact origin is uncertain and they may relate to the underlying geology. Former field boundaries, ridge and furrow cultivation and evidence of modern ploughing indicate the site has been used for agricultural purposes since the medieval period. The remaining features are natural or modern in origin and include areas of natural magnetic variation, underground services, made ground, magnetic disturbance from nearby ferrous objects, and magnetic spikes which are likely to be modern rubbish.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned to undertake a geophysical survey of an area outlined for development. This survey forms part of an archaeological investigation being undertaken by Cotswold Archaeology.

2.2 Site Details

NGR / Postcode	SX 007 718 / PL27 6HY
Location	The site is located to the east of Wadebridge, Cornwall. Treworder Lane forms the north-eastern boundary of the site, with the A389 running along the south-western edge of the site. Trelawney Garden Centre lies to the south of the site and an area of woodland lies to the east.
HER/SMR	Cornwall
Unitary Authority	Cornwall
Parish	Egloshayle Civil Parish
Topography	The north of the site lies atop a hill, and slopes down towards the west, south, and east from approximately 60m AOD to 25m AOD in the south-east.

Current Land Use	Mixed arable farmland and grassland.
Weather Conditions	Overcast, mostly dry
Soils	The overlying soils across the majority of the site are known as Powys which are typical brown rankers, while the soils across the west of the site are known as Trusham, which are typical brown earths. The Powys soils consist of well drained loamy soils over rock, and the Trusham soils consist of fine loamy soils over deeply weathered rock (Soil Survey of England and Wales, Sheet 5 South West England).
Geology	The underlying geology across the majority of the site comprises slate and siltstone of Trevose Slate Formation and Rosenum Formation (undifferentiated). Three Unnamed Igneous Intrustions comprising microgabbro are recorded in the north, centre and south of the site. No superficial deposits are recorded across the majority, though a small area of Head – clay, silt, sand and gravel, is recorded along the southern and south-western boundary (British Geological Survey website).
Archaeology	Information from Cornwall Historic Environment Record and Cotswold Archaeology's Environment Statement (draft) (2016) identify a number of prehistoric, Iron Age, Roman, and medieval remains within the area surrounding the site. A small number of previous archaeological investigations within the wider landscape have been carried out, but have not identified any archaeological remains. No Palaeolithic or Mesolithic artefacts or features are recorded within the site or wider study area, however the site's location near to a river valley means that a potential for the presence of Mesolithic finds cannot be ruled out. Within the site and its wider setting, Neolithic and Bronze Age activity is predominantly represented by funerary monuments, such as barrows. A cropmark of a sub-circular, univallate enclosure, approximately 12m in diameter, is recorded towards the summit of the hill within the site (MCO21690). The size and location of the feature is consistent with those of Bronze Age barrows, though no further earthworks associated with the barrow have been observed through subsequent walkover survey, or on Lidar imagery. Within the wider landscape, a further barrow is recorded at Middle Treworder (MCO50353), approximately 22m to the north. A bowl barrow (MCO26206) is recorded as a scheduled monument to the north-east of of Gonvena House, c. 1.3km to the north-west of the site. Archaeological evidence within the study area and wider landscape indicates an intensification of settlement during the later prehistoric and Roman periods. An Iron Age hillfort at Killibury Castle (MCO17991) is recorded c. 1.6km to the north-east of the site. Several Iron Age or Romano-British rounds are recorded within the area surrounding the site. The closest to the site is at Lower Treworder, c. 300m to the east (MCO52006). Within the wider landscape, rounds are recorded to the north and south-east of the site (MCO50154, MCO52003).

	No features associated with settlement, i.e. hut circles, are recorded within the study area, although such features are extensively recorded across Cornwall. While no such remains are recorded within the site, the presence of later prehistoric and Roman rounds within the area surrounding the site suggests that there is some potential for remains associated with settlement or agriculture to be present within the site. Approximately 1km east of the site, a univallate enclosure (MCO50152), approximately 100m x 75m has been identified on aerial photographs. The size, shape and location of the feature indicate that this may represent a Roman auxiliary fort, similar to that at Nanstallon, c. 5km south east (Monument No. 1007273). Medieval remains within the landscape surrounding the site principally include settlements, and associated agricultural activity. The early medieval settlement of Treworder (MCO26003), to the east of the site, is first recorded in 1278, however it is thought likely that medieval occupation in this area may be considerably earlier, reflecting a continuation of settlement from the prehistoric period. Further settlements of medieval origin in the wider landscape include Trenant (MCO26174), Trevarner (MCO26054), Treraven (MCO26194), Tredannick (MCO26051) and Pendavey (MCO26004). Extensive parts of the landscape around the site were re-organised into field systems in the medieval period, with the northern and north-western parts of the site located within an agricultural landscape established in this period.
Survey Methods	Detailed magnetic survey (gradiometry)
Study Area	c.28 hectares, though a small area of approximately 0.5 hectares could not be surveyed due to horses.

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 high potential for prehistoric, later prehistoric, Roman, and medieval 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. *Destripe*
2. *Destagger*

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 Wadebridge has identified a number of anomalies that have been characterised as being either of a *probable* or *possible* archaeological origin. The following refers to numerical labels on the interpretation plots.

4.1 Probable Archaeology

A number of positive linear and curvilinear anomalies **[1]** in the north-east of the site are indicative of former cut features, such as ditches. It is likely that these represent an area of settlement activity, comprising small enclosures, pits **[4]** and areas of enhanced magnetic response **[5]**. These features are consistent with later prehistoric settlement activity. Further positive linear anomalies **[2]** in the centre of the site are also indicative of former cut features, such as ditches, and appear to form an area of possible settlement activity and associated field system. A curved, negative linear anomaly **[7]** is indicative of a former bank or earthwork and is likely related to the settlement or agricultural activity of Anomaly 2. The date of the field system and possible settlement is unclear; however, the features are on a different alignment to current and former field boundaries across the site suggesting they have earlier origins. A positive linear

anomaly and associated negative response **[3]** is visible running across the centre and north-west of the site. This is indicative of a banked ditch. It is unclear as to whether this feature is related to a former field boundary, or forms part of an earlier field system, such as Anomaly **[2]**. Though predominantly dispersed among the settlement in the north-east, further small discrete anomalies, representative of backfilled pits **[4]** are present across the site, providing further evidence of settlement activity. Six, sub-circular anomalies, c. 4.5m – 6m in diameter, with pits at their centre **[6]** are visible near the centre of the site. These are possibly indicative of small hut circles or barrows, though are smaller than many similar features recorded elsewhere in Cornwall, and as such their exact origin is uncertain.

4.2 Possible Archaeology

A number of positive linear, curvilinear and rectilinear anomalies **[8-15]** are visible across the site. These are indicative of former cut features such as ditches; however, their origin cannot be determined with confidence. It is possible that they represent areas of settlement activity or form parts of former field systems, though it is also possible that they are natural or agricultural in origin. Two alignments of small discrete positive anomalies **[16-17]** in the centre and south respectively of the site may be related to prehistoric pit alignments, though these may also be natural in origin. A number of further small discrete positive anomalies, some in clusters, **[18]** across the site may also be related to former backfilled pits; however their exact origin cannot be determined with confidence. A number of areaa of enhanced magnetic variation **[19]** across the site may be archaeological in origin, possibly related to industrial activity, however they may also be natural in origin.

4.3 Medieval/Post-Medieval Agriculture

Evidence of ridge and furrow cultivation **[20]** is visible in the north of the site in the form of widely spaced, slightly curved, parallel linear anomalies, while evidence of modern ploughing **[21]** is visible across much of the site in the form of magnetically weak, closely spaced, parallel linear anomalies. A number of positive linear anomalies **[22-36]** are visible across the site, some of which comprise a double ditch. These are related to former field boundaries, characteristically Cornish, and are visible on available historic OS mapping. Anomalies 22-29 are visible from 1884 to 1963 and Anomalies 30-36 are visible from 1884 to 1984. Several further positive linear anomalies **[37]** across the site are likely related to former field boundaries, but are not visible on available mapping.

4.4 Other Anomalies

A number of areas of amorphous magnetic variation **[38]** are visible across the site. These are likely to be natural in origin. A strong bipolar linear anomaly **[39]** and negative linear anomaly **[39a]** are likely to be related to underground services. The latter is likely to be related to a non-ferrous pipe, while the former is likely to be a pipe or cable. An area of strong magnetic debris **[40]** in the west of the site is indicative of an area of made ground, and is likely to be modern. Areas of magnetic disturbance **[41]** are the result of substantial nearby ferrous metal objects, such as underground services or fences. The effects of this disturbance have the potential to mask weaker archaeological anomalies, but have not affected a significant proportion of the area on this site. Magnetic spikes **[42]** indicate ferrous metal objects and are likely to be modern rubbish.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

Slate geologies in Cornwall generally provide good results for gradiometer survey. In this instance, there is a relatively high contrast between archaeological features and the background magnetic response. There is no evidence of the Bronze Age barrow (MCO21690) recorded within the site. It is possible that the feature has been truncated by modern ploughing which is present across the area. Despite this, a number of archaeological anomalies have been detected and it is likely that the survey has been effective.

6 CONCLUSION

The survey at Wadebridge has identified a number of anomalies consistent with later prehistoric or Romano-British settlement. The Bronze Age barrow (MCO21690) has not been identified. A number of linear and curvilinear anomalies may relate to small enclosures, while further linear anomalies are representative of a field system. It is unclear whether the areas of settlement activity and field system are contemporary, though it is likely that the field system pre-dates the medieval field system visible across the site. Small discrete anomalies, indicative of backfilled pits, provide further evidence of settlement on the site. Small, sub-circular anomalies are likely to be archaeological, and may relate to former hut circles or barrows. The size of these features is not consistent with other hut circles in Cornwall, and as such their origin cannot be determined. Further linear anomalies across the site may be related to an early field system or additional areas of settlement activity, though the exact origin of these features cannot be determined with confidence. Several areas of enhanced magnetic response may be a result of former settlement or industrial activity, though their exact origin is uncertain. A number of former field boundaries, evidence of ridge and furrow cultivation, and modern ploughing, support the likelihood of the site being used for agricultural purposes since the medieval period. The remaining features are natural or modern in origin and include areas of natural magnetic variation, underground services, made ground, magnetic disturbance from nearby ferrous objects, and magnetic spikes which are likely to be modern rubbish.

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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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