Woodbury Castle Gradiometer Survey, March 2009

1.0 Introduction

The survey was carried out at Woodbury Castle Hillfort in Devon (OS grid ref SY 0330 8737) on behalf of Terrain Archaeology, as part of a programme of research and restoration of the site commissioned by Clinton Devon Estates, English Heritage and Natural England. Woodbury Castle is a scheduled monument and the survey covered the whole of the scheduled area within the ramparts.

The hillfort is situated on the western crest of a narrow, fairly flat hilltop at 172m OD. The geology of the site is Triassic Pebbled Heath and the area is managed by the East Devon Pebbled Heath Conservation Trust.

The work was carried out by Liz Caldwell and Nigel Harvey of GeoFlo.

1.1 Equipment

Fluxgate gradiometer – Bartington Grad 601-2

The Bartington Grad 601-2 is a dual system gradiometer, a form of magnetometer. It comprises two sensor rods carried on a rigid frame, each sensor including two fluxgates aligned at 90° to each other, one set 1m above the other. It measures variations in the magnetic field between the two fluxgates, recorded in *nanoTesla* (nT) at each sampling point within a grid. The manufacturer claims a depth range of approximately three metres. The instrument is most effective when carried at a consistent height, not exceeding 0.3m above the ground.

Magnetometers are especially effective for discovering thoroughly decayed organic materials, such as those which accumulate in ditches and pits, and matter exposed to intensive firing, including industrial areas, hearths and larger ceramics. All of these are likely to give a positive magnetic response, sometimes with a negative halo, giving a dipolar effect. Non-igneous stone features, such as walls and banks, are usually perceived as negative anomalies against a background enhanced by decayed organics.

Software – Geoscan Geoplot 3.00p

Geoplot 3.00p allows the presentation of data in four graphical forms: dot-density, grey scale, pattern and X-Y (or *trace*) plots. The latter are particularly effective when used in conjunction with other graphical modes to emphasise ferrous magnetic anomalies or other distortions which show as accentuated peaks or troughs. The programme supports statistical analysis and filtering of the data.

1.2 Field method

The area covered by the survey was divided into 20m squares. The base line had already been marked before GeoFlo's arrival on site so that it could be tied in with the concurrent earthwork survey using a Topcon GTS 212 Total Station System, and subsequently located on the OS grid. The co-ordinates for the base line were provided independently post-survey. (see **Note** at end of report).

Readings were logged at 0.25m intervals along north to south traverses set 1m apart, in a zig zag pattern.

1.3 Processing method

Preliminary processing revealed extensive impact from modern ferrous magnetic features in the northern part of the survey area, characterised by sharp dipolar fluctuations ranging from approximately 15nT to over 3000nT. Two processing sequences were carried out to mitigate the impact of modern ironwork.

1) Readings exceeding 30nT either side of 0 were replaced by null (dummy) entries.
2) Any anomalous isolated readings were similarly replaced.
3) Typical regular error due to the zig zag operation of the gradiometer was removed.
4) The mean reading for every traverse was reset to 0.
5) The asymmetric data collection pattern was mitigated by the positive interpolation of data points along the Y axis using the calculation of sinX/X.

2.0 The survey area

The grid comprises 38 contiguous whole and partial squares covering the whole of the scheduled area within the ramparts (Fig 1 - Areas B and C). It was bounded on all sides by the banks of the hillfort ramparts.

Visible ferrous magnetic disturbance was provided by a well with a metal breather pipe to the northwest of Area C, and the partially buried remains of a barbed wire fence to the southeast of Area B.

The southern part of the interior was planted with mature beech trees. They were sufficiently far apart to have a minimal impact on carrying out the survey, but their presence is likely to result in some damage to the subsurface archaeology.

2.1 Results *(Figs 2 & 3)*

The major dipolar anomalies covering most of the northern part of the survey area (**Q**) are due to the former presence of a cottage which was demolished 8 years ago with a buried barbed wire fence running east-west along the former boundary of the cottage. The dipolars represented by **O** and **P** are due to the well and pipeline, respectively.

There is a general scatter of ferrous magnetic anomalies throughout the southern survey area most likely due to buried modern metal objects. The modern disturbance creates a certain amount of ambiguity in the analysis of smaller isolated anomalies which could otherwise be interpreted as pits containing thermo remanent material.

The results are also interspersed with irregular anomalies probably caused by ferrous material dropping out of solution possibly where there has been ponding, creating pit-like anomalies. This leads to ambiguity in the interpretation of anomalies which could be indicative of pits but are more likely to be small scale localised ponding.

2.1(i) Positive anomalies

A Curvilinear anomaly within a range of 1 to 3nT. Within normal range for a gully. Possible bedding or drip gully for a roundhouse with possible entrance post settings in the southwest instead of the more usual southeast.

B & C Curvilinear anomalies within a range of 1 to 3nT. Within normal range a gully. Possibly representing part of bedding or drip gullies for circular structures from different occupation phases, but the survey results in this area are very disturbed.

D Two circular anomalies within a range of 1 to 3nT. Within normal range for small pits or postholes. Possible entrance post settings for structure **A**.

E Anomaly within a range of 2.5 to 12nT. Within normal range for a pit containing thermo remanent material or possible hearth for structure **A**.

F Circular anomaly within a range of 2.5 to 11nT. Within normal range for a pit with thermo remanant material.

G A group of discrete anomalies within a range of 2 to 6nT. Within normal range for pits or postholes incorporating lower range thermo remanent material.

H Diffuse and amorphous anomaly within a range of 1.5 to 8nT running east-west across the survey area towards a boggy area in the southeast corner of the hillfort. Possibly caused by shallow pits and scoops filled with humic material and occupation debris, or the diffuse remains of former trackway.

I, J & K Narrow linear anomalies within a range of 1.5 to 3nT but peaking as high as 8nT in places. Within normal range for gullies created by the flow of water. Likely to be natural phenomena but possibly influenced by human activity.

L Parallel rows of roughly circular anomalies within a range of 1.5 to 6nT. Within the range for possible pits or postholes with lower range thermo remanence.

2.1(ii) Negative anomalies

M Curvilinear anomaly within a range of -1 to -3.5nT. Within normal range for a stone wall or stone-filled ditch or gully. Possible circular structure with stone footings.

N Narrow linear within a range of -1 to -3.5nT. Probable modern plastic pipeline or cable.

3.0 Conclusion

The degree of confidence in identified anomalies varies from low to moderately high. The scattering of modern metallic debris across the survey area makes the identification of smaller archaeological anomalies uncertain, as does the naturally deposited ferrous magnetic material caused by small scale localised ponding.

The general northwest–southeast linear trends may, however, be a reflection of human activity. The possible relationship between some of the anomalies and their appearance, orientation and location are also in favour of their archaeological significance.

Note: The O.S. co-ordinates that were subsequently supplied for the position of the baseline were taken from the RCHM 1999 earthwork survey map. The geophysical survey has therefore been located using the RCHM map rather than the one supplied when the survey was commissioned (Fig 4).

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