Lufton Villa, Yeovil, Somerset
Geophysical survey, March 2009

1.0 Introduction

The survey was carried out at Lufton Villa, near Yeovil on behalf of Dr. James Gerrard, as part of a re-evaluation of the site in order to answer questions about the extent and nature of the site and its relationship with the surrounding landscape. The villa is situated 4.5km northwest of Yeovil on Lower Jurassic silts and marls (Fig 1).

The work was carried out by members of the South Cadbury Environs Project and the Yeovil Archaeological and Local History Society.

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.

Resistivity meter – TR/CIA Resistance Meter

A twin probe array was used, with mobile probes at a fixed separation of 500mm and two remote probes of variable spacing. The meter range was 200 Ohm, and minimal filtration was employed to remove any effects of mains electrical earth currents.

Resistivity meters work by measuring the resistance to the passing of an electrical current through the ground from one probe to another. Different buried components in the ground have different degrees of conductivity or resistance. Water is the best conductor in the soil so in effect so the method is also dependent on the amount of moisture present. As a consequence it can be susceptible to geological and seasonal variations. It is effective in the identification of stone structural remains, organically rich deposits and cut linear features or large pits, where there is sufficient contrast between features and the surrounding buried environment.

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 was divided into 20m squares orientated according to the Ordnance Survey grid (Figs 2 & 3). For gradiometry readings were logged at 0.25m intervals along east to west traverses set 1m apart, in a zig zag pattern. For resistivity readings were logged at 1m intervals along north to south traverses set 1m apart, in a zig zag pattern.

1.3 Gradiometer processing method

Preliminary processing revealed some areas of modern ferrous magnetic features, 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.

1.4 Resistivity processing method

1) Isolated high or low readings (noise spikes) were replaced by the mean reading.
2) The impact of geological variation was reduced by the application of a uniform high pass filter with a radius of 8 readings in the X and Y directions.
3) Data were smoothed and weak anomalies highlighted by the application of a low pass filter with a radius of 1 reading in the X and Y directions.
4) Further smoothing was achieved by the positive interpolation of data points along the Y and X axes, using the calculation of sinX/X.

2.0 The survey area

The grid comprises 125 contiguous whole and partial squares covering the scheduled area and part of the surrounding fields to the east, west and south (Fig 2). The whole grid was surveyed by gradiometer but only 25 squares were subjected to resistivity (Fig 3).

Visible ferrous magnetic disturbance was provided by the English Heritage notice board at the southwest corner of the scheduled area, and two electricity cable poles, one towards the south-western extent of the survey area and the other beside the ditch that separated the east and west fields.

2.1 Gradiometry Results *(Figs 4 and 5)*

The villa itself shows as distinct area of dipolar anomalies due to fired bricks, tiles, ovens and furnaces associated with the former building. The 1946–1952 excavations have caused further disturbance. The majority of the rooms are indistinct, but it is possible to pick out certain structural features which show as negative anomalies.

The surrounding fields reveal an east-west linear trend across the survey area to the north of the villa site, comprising positive and negative linear anomalies with some associated areas of strong dipolar responses. This could be indicative of enclosures and bedding trenches for timber and/or stone structures with robbed out stone footings. The dipolar anomalies are a possible reflection of associated industrial activity, possibly connected with the later phase of industrial activity in the villa. The anomalies appear to have been partially destroyed by ploughing or buried by soil movement.

There is a general scatter of thermo remanent material across the whole of the survey area, probably caused by building rubble and industrial activity associated with the villa and other possible structures.

Major anomaly **(i)** is due to the presence of a spring creating a localised wet and boggy area. The high dipolar readings could be caused by ferrous magnetic material dropping out of solution but given its location, as a natural spring adjacent to the villa, the readings could possibly be due to metallic votive offerings deposited in the water.

Major dipolar anomaly **(ii)** is due to an electricity cable pole. Anomaly **(iii)** is most likely modern ferrous magnetic disturbance related to the extensive drainage work that has recently taken place in the ditches along this side of the field. The anomalies to either side of the ditch along the southern field boundary are also indicative of disturbed ground (Fig 5 **r** - **z**). The rest of the survey area reveals little impact from modern ferrous disturbance.

There is a major drainage system running northwest to southeast across most of the survey area. The parallel ditches associated with this give rise a certain amount of ambiguity in the identification of some archaeological anomalies running along the same alignment (Fig 8).

2.1(i) Positive magnetic anomalies

1a Site of Roman villa. Readings within a range of 4 to 24nT due to previously discussed thermo remanent material. There are also a number of distinct negative anomalies (see **A** – **C** below). The characteristic thermo remanent response spreads several metres beyond the 1950's excavation plan in all directions, possible disturbance caused by robbing and the spread of thermo remanent rubble from ploughing and excavation (Fig 9).

1b Large irregular anomaly with strong thermo remanent deposits, within a range of 3 to 20nT. The anomaly appears very similar to the villa but is of a slightly different magnetic character. There is no similarly strong response to this anomaly in the resistivity survey results, which suggests the high magnetic response is not due to fired stone building material and rubble, but could be dumps of ash, clinker and other thermo remanent by-products of industrial activity in the villa which do not give a high resistivity response.

2 A large group of amorphous anomalies largely within a range of 1 to 3nT but interspersed with negative anomalies (see **E** below). Within normal range for pits or occupation debris indicative of anthropogenic activity.

3 Three irregular anomalies, the southern two within a range of 1.5 to 4 nT and the northern 3 to 14nT. Within the range for pits or cut features, the north one indicative of strong thermo remanent local deposit.

4 Discrete group of linear and roughly circular anomalies. The linears within a range of 1 to 2.5nT, within the normal range for ditches. The circular anomalies are within a range of 5 to 11nT, within the higher range for pits incorporating thermo remanent residues.

5 Group of irregular anomalies within the range of 1 to 5nT. Within the range for pits/cut features and lower range thermo remanence.

6 Weak linear anomaly within a range of 0.5 to 1nT. Within normal range for a ditch.

7 A group of three linears within a range of 1 to 2nT. Within the range for ditches or gullies.

8 Linear within a range of 1 to 1.5nT. Within normal range for a small ditch or gully.

9 Linear within a range of 0.5 to 1.5nT. Within normal range for a ditch. Possibly part of the field drainage system, but appears to lie between two drainage ditches and on a slightly different alignment.

10 Linear anomaly within a range of 1 to 1.5nT. Within normal range for a ditch.

11 Two contiguous linears abutting at right angles to each other. Both within a range of 1 to 2nT. Within normal range for ditches.

12 Small linear anomaly within a range of 1 to 1.5nT. Within the range of a small ditch or gully.

13 Small curvilinear anomaly within a range of 1 to 2.5nT. Within normal range for a gully. Possible association with **F** (see below).

14 Irregular anomaly within a range of 3 to 9nT. Within normal range for cut feature fills with thermo remanent deposit.

15 Curvilinear anomaly within range of 1 to 1.5nT. Within normal range for a gully.

16 Linear anomaly within a range of 1 to 2nT. Within normal range for a ditch, but terminating in a localised thermo remanent deposit at the southern end, generally within a range of 4 to 7nT but peaking as high as 15nT. Possible disturbance related to the field boundary ditch.

17 Three roughly circular anomalies, the east and west within a range of 1 to 4nT but the central one within a range of 3 to 18nT. All within normal range for pits, but the central one incorporating strong thermo remanent residues.

18 Linear anomaly within a range of 2 to 6nT. Within normal range for a ditch. Possibly associated with the adjacent predominantly negative anomaly **v** probably caused by disturbance connected with the drainage ditch along the field boundary.

19 Linear anomaly within a range of 3 to 8nT. Within normal range for a ditch incorporating thermo remanent deposits.

20 & 21 Three roughly parallel linear anomalies running north-south and apparently terminating at the ditch at the field boundary. Within a range of 1 to 4nT but the eastern one peaking as high as 8nT in places. Within normal range for ditches incorporating localised thermo remanent deposits. The ditches are of different alignment and magnetic character to the anomalies in the field to the north. An extension of the survey in this field is recommended.

22 & 23 Group of amorphous anomalies within a range of 3 to 12nT, interspersed with negative anomalies (see **L** below). Within the range for pits or cut features with deposits of thermo remanent material, possible rubble spread associated with the villa.

24 Linear anomaly within a range of 1 to 2.5nT. Within the normal range for a ditch.

25 Group of irregular anomalies within a range of 3 to 5nT. Within the normal range for lower level thermo remanence, possible pits or occupation debris.

26 Circular anomaly within a range of 2 to 4nT. Within normal range for a pit.

27 Two diffuse and irregular anomalies within a range of 1 to 2nT. Within the range for cut features or occupation debris.

28 Linear anomaly within a range of 1.5 to 4nT. Within normal range for a ditch. Appears have an association with anomaly **(i),** possibly indicative of water management associated with the spring.

29 Irregular anomalies in a roughly east-west linear alignment ranging from 1.5 to 4nT but with the larger anomaly to the east peaking at 9nT. Within the normal range for pits with occupation debris or thermo remanent deposits.

30 Linear anomaly within a range of 1.5 to 5.5nT rising towards the south-western end to 12nT. Within normal range for a ditch with strong localised thermo remanent deposit.

31 Rectilinear anomaly within a range of 0.5 to 2.5nT. Within the range for a ditch, possible small enclosure abutting **33.**

32 Irregular anomaly within a range of 1.5 to 3nT. Within the normal range for a pit or cut feature.

33 Linear anomaly within a range of 1 to 2nT but peaking as high as 14nT where it intersects with **35**. Within normal range for a ditch with strong local thermo remanent deposit. Appears to be associated with a number of other anomalies on a general east-west trend across the field, possibly continuing into the field to the west.

34 Large circular anomaly within a range of 1.5 to 3nT. Within normal range for a pit.

35 Linear anomaly abutting **33** within a range of 1.5 to 2nT rising to 13nT where it intersects with thermo remanent deposit in **33.** Within normal range for a ditch.

36 A group of discrete anomalies within a range of 1.5 to 3nT. Within the range for cut features with occupation debris.

37 Small linear anomaly within a range of 2 to 3.5nT. Within the range for a ditch. Possible enclosure and/or rectilinear structure associated with thermo remanent deposit **c** and linears **33** and **I**.

38 Curvilinear anomaly within a range of 1 to 2nT. Within normal range for a ditch.

39 Linear anomaly within a range of 1.5 to 2nT. Within normal range for a ditch.

40 Roughly circular anomaly within a range of 5 to 15nT. Within the range for a pit with strong thermo remanent deposit.

41 Rectilinear anomaly within a range of 1 to 3.5nT, fainter on the eastern side. Within normal range for enclosure ditch.

42 Group of amorphous anomalies within a range of 2 to 3nT. Within the range for cut features with occupation debris.

43 Irregular anomaly within the range of 2 to 5nT. Within normal range for lower level thermo remanence, but possibly associated with disturbance along field boundary.

44 Irregular anomaly within a range of 3 to 9nT. Within the range for strong thermo remanent deposit. Possible association with **J** (see below).

a – e Discrete and irregular anomalies within a range of 2 to 6nT but peaking as high as 11 or 12nT in places. Within the range for strong thermo remanent deposits.

2.1(ii) Negative magnetic anomalies

A Linear within a range of -1 to -4nT. Within the range for stone filled feature. Corresponds roughly with position of corridor wall on excavation plan of villa but is less defined because of surrounding thermo remanent disturbance.

B Linear within a range of -1 to -4nT. Within the normal range for stone filled feature. Some correlation to position of the room adjacent to the bath house on excavation plan.

C Curvilinear anomaly within a range of -1 to -3.5nT. Within the normal range for stone feature. The general area appears to correspond with position of the bath house on excavation plan.

D Weak linear anomaly within a range of -1 to -1.5nT. Possible non-ferrous pipeline.

E Scatter of amorphous anomalies associated with **2.** Within the range of -1 to -3nT. Indicative of non-magnetic stone or building rubble, probably lias.

F Three contiguous linears within a range of -0.5 to -2nT. Within the range for stone filled ditches or gullies. Possibly connected with field drainage system but could be stone footings for structure or enclosure wall.

G Linear within the range of -0.5 to -1nT. Within the range for a stone filled ditch or gully.

H Linear within the range of -0.5 to -1nT. Within the range for a stone filled ditch or gully. Possible association with anomaly **X** or area of ferrous magnetic deposits **e**.

I Two contiguous linears within a range of -1 to -1.5nT. Within the range for stone filled ditches or gullies. Could be associated with field drainage system but the point at which they intersect suggests an association with linear **33** and also possibly with thermo remanent deposit **c.**

J Curvilinear anomaly within the range of -1 to -2nT. Within the range for a stone filled ditch or gully. Possible association with strongly thermo remanent anomaly **44**.

K Irregular anomaly within a range of -1 to -3nT. Consistent with deposit of non-magnetic stone, possibly lias, or stone filled pit or gully.

L Scatter of irregular anomalies associated with **22** and **23,** within a range of -1 to -2.5nT. Consistent with non-ferrous stone, possible rubble spread.

q – z Large amorphous anomalies within a range of -3 to -13nT interspersed with strong dipolar responses. Indicative of redeposited material and ferrous magnetic debris associated with the field boundary and ditch.

2.2 Resistivity results (Figs 6 and 7)

The villa shows as a distinct area of high and low resistance anomalies. The results have been adversely affected by excavation, and are suggestive of backfill, alternating areas of high and low resistance materials which could correspond to dumps of rubble and soil. They appear to roughly coincide with areas of archaeology but although the outline of the villa is clearly discernible it is difficult to make any firm interpretation of the interior layout.

In contrast to the gradiometry results the survey did not detect any significant anomalies to the southwest of the villa.

2.2(i) Higher resistivity anomalies

A Location of villa, readings varying from 3 to 11.5 ohm. Readings are within the range for buried stone rubble and walls. Close inspection of areas of high resistivity within the villa reveal some correlation with negative magnetic responses in the gradiometry survey results.

B Linear anomaly with readings of 2 to 6.5 ohm. Readings within range for stone wall/rubble. Appears to correspond with location of wall along villa corridor.

C Linear anomaly with readings from 0.5 to 2 ohm. Within the range for stone wall or stone filled ditch or gully. Possibly connected with field drainage system

D & E Linear anomalies abutting **C** but on different alignments. Readings from 0.5 to 1.5 ohm. Within the range for stone walls or stone filled ditches or gullies.

F Linear anomaly, readings from 1 to 1.5 ohm. Within the range for stone wall or stone filled ditch or gully. Possible enclosure wall. Possible association with **N**.

G Linear anomaly with readings from 1.5 to 4 ohm. Corresponds with position of footpath along the edge of the field.

H Amorphous anomaly, readings from 5.5 to 7 ohm. Within the range for buried stone debris.

I Amorphous anomaly with readings from 2 to 4.5 ohm. Associated with low resistance anomaly **7** and corresponds with magnetic anomaly **(i)**. Within the range for buried stone/rubble, possibly associated with drainage of spring/bog.

J Linear anomaly with readings from 1 to 2 ohm. Corresponds with field drainage ditch in gradiometry results (see Fig 8).

K Amorphous anomaly with readings ranging from 1.5 to 6 ohm. Within the range for stone/rubble, possible disturbance related to ditch/field boundary.

L & M Amorphous anomalies with readings from 1.5 to 5.5 ohm. Correspond roughly with negative magnetic anomalies **r – z**. Readings within the range for rubble and redeposited material associated with the field boundary and ditch.

N Large, amorphous area of high resistivity interspersed with patches of low resistivity. Readings generally from 1 to 3 ohm. Corresponds with anomaly **1b** in gradiometry survey. Possible dump of ash and clinker from industrial processes, resulting in deposits of different materials with high and low resistivity. (See comments in **1b** above).

2.2(ii) Lower resistivity anomalies

1– 3 Amorphous anomalies reading from -3 to -7 ohm. Within the range for ditches or disturbed ground, possibly associated with excavation backfill. **2** and **3** roughly correspond with location of corridor on excavation plan.

4 & 5 Linear anomalies with readings from -3 to -7 ohm. Within the range for ditches. Their position around the villa suggests a possible relation to the location of the excavation trench as they do not extend around the southern end of the villa which was not fully excavated.

6 Linear anomaly with readings from -1.5 to -3 ohm, dropping to -7 ohm at the field boundary. Within the range for disturbed ground associated with the field boundary and drainage ditches.

7 Large, amorphous anomaly. Readings from -1 to -3 ohm. Site of spring/boggy area. Corresponds with magnetic anomaly **(i)**.

8 Linear anomaly with readings from -1 to -2 ohm. Within range for a ditch. Possibly associated with drainage/water management for spring site.

9 Amorphous anomaly with readings from -0.5 to -2.5 ohm. Within range for disturbed ground causing differences in moisture content of the soil, possibly relating to archaeological features.

10 Linear anomaly with readings from -1 to -2 ohm. Within normal range for a ditch. Corresponds with magnetic anomaly **18**.

11 & 12 Amorphous anomalies with readings from -1.5 to -3 ohm. Within the range for ground disturbance associated with drainage ditch.

3.0 Conclusion

The degree of confidence in identified anomalies is generally fairly high. The overlay of the villa onto the results of both surveys (Fig 9) suggests it could extend several metres further south than recorded on the 1950's excavation plan, but there is an element of uncertainty about the precise location and layout of the villa in both surveys due to subsequent disturbance caused by excavation and rubble spread.

There are demonstrable archaeological features in the surrounding fields indicative of anthropogenic activity, possibly associated with the industrial activity that took place in the later phases of villa occupation.

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