LAND AT CHERKLEY COURT
LEATHERHEAD
SURREY

Geophysical Survey Report

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Summary

A detailed gradiometer survey was conducted over land at Cherkley Court, near Leatherhead, Surrey. The eastern part of the site is bisected by Stane Street, a Roman road and Scheduled Ancient Monument (SAM SU40) although it will not be impacted directly by the proposed development; a series of barrows lies within the site, and all bar one, designated SAM SU58, lie outside of areas of proposed development. The work was commissioned by CgMs Consulting ahead of the proposed development of a new golf course.

The geophysical survey covered 19.1ha and has demonstrated the presence of occasional anomalies of probable archaeological interest within the site, along with other anomalies of possible archaeological interest and regions of increased magnetic response.

Amongst the archaeological anomalies identified are a number relating to a probable relict field system near the centre of the Site, and it appears as thought there has been several distinct phases of agricultural activity at the site. Several probable former field boundaries also appear within the surveyed areas.

A long linear anomaly near the centre of site may be of archaeological interest, although its character suggests that it may actually be geological in origin. A further ditch-like feature near the southeastern extent of the site has been interpreted as being archaeological in origin. Other discrete pit-like anomalies may also be of archaeological interest.

A number of regions of increased magnetic response appear within the datasets, and some of these may be of archaeological interest. These regions are much stronger along the main drive, and it appears as though modern debris has been deposited along its route. The effect of this has been to mask any weaker archaeological anomalies that may be present, including that of the putative barrow designated SAM SU58. It has not been possible to identify this monument nor to comment upon its survival.

A modern service appears in several survey areas towards the eastern extent of the survey areas. Elsewhere, numerous ploughing trends indicate relict field systems and the agricultural scheme in place before the reversion of the Site to pasture. Magnetically weak linear trends appear throughout the dataset, and may relate to former agricultural activity. The detection of these ephemeral features provides confidence that geophysical survey would have been capable of detecting the responses from more substantial archaeological features should any have been present within the survey areas.

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The detailed gradiometer survey was commissioned by CgMs Consulting, and the assistance of Matthew Smith is gratefully appreciated in this respect.

The fieldwork was undertaken by Ben Urmston, Ross Lefort, Patrick Dresch, Hannah Brown, Genevieve Shaw and Sophie Thorogood. Ben Urmston processed and interpreted the geophysical data in addition to writing this report. The geophysical work was quality controlled by Dr. Paul Baggaley. Illustrations were prepared by Ken Lymer. The project was managed on behalf of Wessex Archaeology by Richard Greatorex.

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1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by CgMs Consulting to carry out a geophysical survey over land at Cherkley Court, near Leatherhead, Surrey, hereafter 'the Site' (**Figure 1**). The project was commissioned to assess the archaeological potential of this area in support of planning application for the proposed development of a new golf course and associated infrastructure. The Site is approximately centred on National Grid Reference (NGR) 518075 154815.

1.1.2 The aim of the project was to establish the presence/absence, extent and character of detectable archaeological remains within the survey areas.

1.1.3 This report presents a brief description of the methodology followed, the detailed survey results and the archaeological interpretation of the geophysical data.

1.2 Survey areas

1.2.1 The Site lies approximately 2.5km southeast of Leatherhead, Surrey, and occupies gently undulating pasture land to the north of Cherkley Court, sloping from around 75m OD to around 115m OD from north to south.

1.2.2 The Site comprises a number of fields currently under pasture, with dense undergrowth bordering each of the fields and appearing elsewhere in isolated pockets. Twenty one areas were surveyed, although undergrowth, trees and fencing prevented full access to the entirety of the majority of the blocks. In total, 19.1ha of the proposed areas was suitable for gradiometer survey.

1.2.3 The soils underlying the Site are most likely brown rendzina soils of the 343g (Newmarket 2) association (SSEW 1983), overlying chalk bedrock. Soils in such geological settings have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

1.3 Survey areas

1.3.1 The proposed scheme falls within an area of Surrey with an extensive archaeological and historical heritage, which is reflected in the relative density of known sites recorded within the area. The potential for the survival of deposits relating to such activity is likely to be high, notwithstanding recent agricultural and development activity.

1.3.2 Several Scheduled Monuments exist within the Site, comprising several bowl barrows, a Roman road and a further tumulus. Of these, only one of the tumuli falls within the proposed geophysical survey areas.

1.3.3 The monument, designated SAM SU58 (**Figure 1**), is the possible site of a barrow, although no traces of the original earthworks are visible at the surface. It is likely that ploughing or other levelling has truncated the above ground elements. Geophysical survey over such monuments in similar settings has been successful in detecting the remnants of barrow ditches and internal features.

2 METHODOLOGY

2.1 Introduction

2.1.1 A geophysical specification was prepared by Wessex Archaeology to investigate the Site. The methodology consisted of detailed magnetometer survey conducted using a Bartington Grad601-2 dual fluxgate gradiometer system. The survey was conducted in accordance with English Heritage guidelines (2008).

2.1.2 The geophysical survey was conducted in two phases by Wessex Archaeology's in-house geophysics team from 25th June to 11th August 2011. Ground conditions for survey varied between open pasture to overgrown areas; in places, dense vegetation hampered survey; the data quality does not appear to have been affected greatly however.

2.2 Method

2.2.1 Individual survey grid nodes were established at 20m x 20m intervals using a Leica Viva RTK GNSS system, which is precise to approximately 0.02m and therefore exceeds English Heritage recommendations (2008).

2.2.2 The magnetometer survey was conducted using a Bartington Grad601-2 fluxgate gradiometer instrument, with two sensors deployed vertically 1m apart. Data were collected in at 0.25m intervals along transects spaced 1m apart with an effective sensitivity of 0.03nT, in accordance with EH guidelines (2008). Data were collected in the zigzag manner.

2.2.3 Data from the survey was subject to minimal data correction processes. These comprise a zero mean traverse function (±5nT thresholds) applied to correct for any variation between the two Bartington sensors used, and a de-step function to account for variations in traverse position due to varying ground cover and topography. These two steps were applied to all survey areas, with no interpolation applied.

2.2.4 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 2**.

3 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

3.1 Introduction

3.1.1 The gradiometer survey has been successful in identifying anomalies of definite, probable and possible archaeological interest, along with modern services and regions of increased magnetic response. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:2000 (**Figure 3**). The data are displayed at -2nT (white) to +3nT (black) for the greyscale image and ±25nT at 25nT per cm for the XY trace plots.

3.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figure 3**). Full definitions of the interpretation terms used in this report are provided in **Appendix 3**.

3.1.3 Numerous ferrous anomalies are visible throughout the detailed survey dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.

3.2 Magnetometer Survey Results and Interpretation

3.2.1 Area A is characterised by a relatively quiet magnetic background, with numerous small scale ferrous responses throughout, which probably relate to former land use. These ferrous responses are concentrated around two stands of trees, at the centre (**4000**) and towards the southeastern corner (**4001**). Ferrous anomalies **4001** are larger and more coherent than others nearby, and may be associated with archaeological activity.

3.2.2 The magnetic background has a mottled appearance, with numerous responses indicating local magnetic enhancement. These responses are not typical of pits and are more likely to represent a geological or pedological origin. In similar geological settings, the remnants of tree throws have been demonstrated to have relatively strong magnetic signatures and a similar explanation may be the case at this Site. Elsewhere, linear trends can be observed in the data, although they contrast weakly with the magnetic background.

3.2.3 The magnetic background of Areas B and C are similarly quiet. Area B shows a similar frequency of ferrous responses to Area A, and it is interesting to note that Area C has much fewer ferrous anomalies. An extended series of ferrous anomalies **4002** is located towards the southeastern corner of this area, and may be archaeological interest.

3.2.4 Within Area D, a region of increased magnetic response **4003** lies towards the southwestern extent. Whilst it is possible that this increase is due to archaeological activity, the anomaly is also consistent with made ground. Smaller regions of increased response can be seen at the southeastern corner.

3.2.5 Ploughing trends, aligned NE-SW, are visible within Area D, particularly towards the north. Elsewhere, weak linear trends probably relate to former land use.

3.2.6 The magnetic background of Area E is quiet, with relatively few ferrous responses. Ploughing trends **4004**, oriented approximately E-W, are visible throughout the area.

3.2.7 Area F, lying on both sides of a field boundary, has a quiet magnetic background. A number of pit-like anomalies **4005** appear within the eastern portion of the area; these are of possible archaeological interest, although it is conceivable that these responses relate to tree throws as discussed above.

3.2.8 Two collinear regions of increased magnetic response, **4006** and **4007**, are aligned E-W through the centre of Area G; it is likely that these anomalies are associated with a former field boundary. However, the dataset from Area G is dominated by modern service **4008**, aligned NNW-SSE at the southern extent of the area and curving northwards at its centre.

3.2.9 Several regions of increased magnetic response, marked by **4009** and **4010**, appear within Area H. The easternmost of these, **4010**, is coincident with the main drive through the estate and is likely to relate to the construction of the road. The two westernmost regions, **4009**, are more limited in both magnitude and extent, and may therefore be of some archaeological interest. Elsewhere within the dataset, isolated pit-like features are visible, along with ploughing trends oriented NE-SW.

3.2.10 A curvilinear anomaly, **4011**, aligned approximately WNW-ESE and probably archaeological in origin, extends across the northern portion of Area I. It is possible that this linear represents a former boundary or part of a relict field system; further weak linear anomalies towards the east of **4011** and other trends on similar alignments may indicate extensions of the fields. Further linear anomalies **4012** and **4013**, also in Area I, are aligned approximately NW-SE and are likely to represent a continuous feature but are less well defined than **4011**. It is possible that these anomalies are archaeological in origin, although their broad responses are also consistent with a superficial geological feature, such as a former channel.

3.2.11 Several regions of increased magnetic response within Area I, near **4014**, **4015** and **4016**, may be archaeological in origin. However, the responses are consistent with made ground and it is possible that they are modern in provenance; this is particularly the case for the region to the east of **4011**, which is adjacent to the main drive. Numerous ploughing trends are oriented NE-SW, a similar alignment to those seen in Areas D and H.

3.2.12 Area J is dominated by a linear region of increased magnetic response **4017**, which forks near its southern extent; this is likely to represent a former track or infilled boundary. Ploughing trends south of **4017** are on the same alignment, supporting this interpretation. A linear anomaly **4018** is relatively poorly defined, although it shares an alignment with the adjacent field boundary, suggesting it may relate to the remnants of a former boundary. Given that **4018** is also on the same orientation as Stane Street to the east, it is of possible archaeological interest.

3.2.13 A modern service **4021** is aligned NNW-SSE through Area K and is likely to relate to the same service seen to the north in Area G (**4008**) and to the south in Area M (**4024**). A region of increased magnetic response **4019** appears to the northeast of Area K and is of unknown origin; a further region of increased response **4020** lies adjacent to the main drive and is likely to be modern in origin.

3.2.14 The dataset from Area L shows increased magnetic response throughout (**4022**), suggesting widespread deposits of modern debris. As this is largely in the vicinity of the main drive, it is thought to be modern in origin.

3.2.15 A region of increased magnetic response **4023** extends along the southern boundary of Area M; as it is adjacent to the main drive, it is considered to relate to made ground. Modern service **4024**, aligned NW-SE, is likely to form part of a continuous service along with **4008** (Area G) and **4021** (Area K).

3.2.16 A linear anomaly **4025**, aligned NE-SW, extends across Area N. Given the frequency of ferrous anomalies within and adjacent to this anomaly, it is thought to represent an infilled boundary ditch. The eastern portion of Area N is dominated by strong magnetic disturbance, coincident with a shallow slope; it is highly likely that this is associated with dumping of material such as demolition debris. The putative barrow, designated SAM SU58, is located within this region of disturbance, and any anomalies associated with archaeological features will have been masked by the magnetic disturbance.

3.2.17 Area O was challenging for geophysical survey, with extensive overgrowth and animal burrows preventing access to much of the survey area. The data show regions of increased magnetic response, probably associated with made ground, with only small windows of quieter magnetic background visible (**4026**).

3.2.18 Data collection in Area P was similarly hampered by the presence of hawthorn bushes along the western portion of the survey area. However, a ditch-like anomaly **4027**, oriented approximately N-S, is apparent near the western survey boundary. This has been interpreted as being archaeological in origin, given that few traces were visible at the surface of the field; it is possible that it relates to a former boundary or trackway, however. Towards the centre of Area P, a region of increased magnetic response **4028** is visible, which is of possible archaeological interest.

4 CONCLUSION

4.1.1 The detailed gradiometer survey has been successful in detecting a number of anomalies of definite, probable and possible archaeological potential within the study area and can therefore be considered to have successfully fulfilled the aims as set out in the geophysical specification.

4.1.2 The range of anomalies identified by this survey includes strong and well-defined responses, along with much weaker magnetic trends. In particular, the detection of trends relating former ploughing indicates that gradiometer survey is capable of detecting even ephemeral features in this geological setting. The identification of such features therefore increases confidence that geophysical survey would have been capable of detecting the responses from more substantial archaeological features should any have been present within the survey areas.

4.1.3 A probable relict field system has been identified near the centre of the Site in Area I. Assuming that anomaly **4011** represents part of a field system, this suggests several phases of activity, as the land is currently under pasture and the ploughing trends visible across Areas D, H and I is on a different alignment from **4011**. Other possible former field boundaries appear in Areas G, J, N and P, and it is possible that historic map regression may indicate possible dates for these features.

4.1.4 It is possible to interpret linear anomaly **4012**, aligned NW-SE across Area I, as being of possible archaeological interest. Its response is rather broad and poorly defined at its edges, which a typically characteristic of natural geological features.

4.1.5 A curvilinear ditch-like feature **4027** (Area P) has been interpreted as being archaeological in origin, as there does not appear to be any significant topographic feature coincident with the anomaly. However it is possible that it represents a former field boundary.

4.1.6 A number of discrete pit-like anomalies were identified in several of the datasets, e.g. **4005** (Area F). It is possible that these anomalies are archaeological in origin, although there does not appear to be any coherency to their distribution. A small region of magnetic disturbance **4002** (Area C) is markedly different from other anomalies in its vicinity, and is consistent with the response from an industrial feature; it is therefore of possible archaeological interest.

4.1.7 The magnetic background across the Site is generally quiet, although frequent ferrous anomalies are apparent in some of the survey areas. Numerous regions of increased magnetic response are visible, particularly along the line of the main drive through the estate. It is possible that these are archaeological in origin, as accumulations of archaeological deposits can result in such deposits although typically other archaeological features are present in the vicinity.

4.1.8 Where the increased responses are adjacent to the extant roads and tracks, it is considered that these anomalies are more likely to be the result of modern made ground. The effect of this has been to mask any weaker archaeological anomalies that may be present, including that of the putative barrow designated SAM SU58, and therefore it has not been possible to determine the level of survival of the monument below the modern debris.

4.1.9 A modern service extends across the site from Area G through Areas K and M.

4.1.10 Elsewhere, numerous ploughing trends indicate relict field systems and the agricultural scheme in place before the reversion of the Site to pasture. Linear trends appear throughout the dataset, and may relate to former agricultural activity.

5 REFERENCES

English Heritage, 2008, *Geophysical Survey in Archaeological Field Evaluation*. Research and Professional Service Guideline No 1, 2nd edition.

Soil Survey of England and Wales, 1983. *Soils of South East England: Sheet 6*. 1:250,000

APPENDIX 1: SURVEY EQUIPMENT AND DATA PROCESSING

Survey Methods and Equipment

The magnetic data for this project was acquired using a Bartington 601-2 dual magnetic gradiometer system. This instrument has two sensor assemblies fixed horizontally 1m apart allowing two traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 1m separation, and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.

The gradiometers have an effective resolution of 0.03nT over a ±100nT range, and measurements from each sensor are logged at intervals of 0.25m. All of the data are stored on an integrated data logger for subsequent post-processing and analysis.

Wessex Archaeology undertakes two types of magnetic surveys: scanning and detail. Both types depend upon the establishment of an accurate 20m or 30m site grid, which is achieved using a Leica Viva RTK GNSS instrument and then extended using tapes. The Leica Viva system receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02m in real-time and therefore exceed the level of accuracy recommended by English Heritage (2008) for geophysical surveys.

Scanning surveys consist of recording data at 0.25m intervals along transects spaced 10m apart, acquiring a minimum of 80 data points per transect. Due to the relatively coarse transect interval, scanning surveys should only be expected to detect extended regions of archaeological anomalies, when there is a greater likelihood of distinguishing such responses from the background magnetic field.

The detail surveys consist of 20m x 20m or 30m x 30m grids, and data are collected at 0.25m intervals along traverses spaced 1m apart. These strategies give 1600 or 3600 measurements per 20m or 30m grid respectively, and are the recommended methodologies for archaeological surveys of this type (English Heritage, 2008).

Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. In this case, data were collected at 0.125m intervals along traverses spaced 0.25m apart, resulting in 28800 readings per 30m grid, exceeding that recommended by English Heritage (2008) for characterisation surveys.

Post-Processing

The magnetic data collected during the detail survey are downloaded from the Bartington system for processing and analysis using both commercial and in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

As the scanning data are not as closely distributed as with detailed survey, they are georeferenced using the GPS information and interpolated to highlight similar anomalies in adjacent transects. Directional trends may be removed before interpolation to produce more easily understood images.

Typical data and image processing steps may include:

- Destripe – Applying a zero mean traverse in order to remove differences caused by directional effects inherent in the magnetometer;
- Destagger – Shifting each traverse longitudinally by a number of readings. This corrects for operator errors and is used to enhance linear features;
- Despike – Filtering isolated data points that exceed the mean by a specified amount to reduce the appearance of dominant anomalous readings (generally only used for earth resistance data)

Typical displays of the data used during processing and analysis:

- XY Plot – Presents the data as a trace or graph line for each traverse. Each traverse is displaced down the image to produce a stacked profile effect. This type of image is useful as it shows the full range of individual anomalies.
- Greyscale – Presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.

APPENDIX 2: GEOPHYSICAL INTERPRETATION

The interpretation methodology used by Wessex Archaeology separates the anomalies into two main categories: archaeological and unidentified responses.

The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:

- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Probable archaeology – used for features which give a clear response but which form incomplete patterns.
- Possible archaeology – used for features which give a response but which form no discernable pattern or trend.

The unidentified category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend – used for low amplitude or indistinct linear anomalies.
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.

Finally, services such as water pipes are marked where they have been identified.