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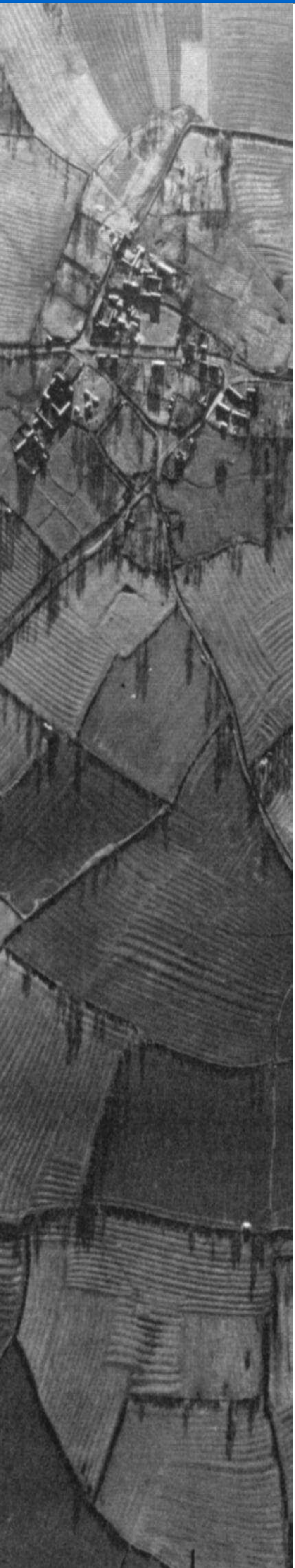

MOD Bicester
Graven Hill
Oxfordshire

MAGNETOMETER SURVEY REPORT

for

Entec UK Ltd

David Sabin and Kerry Donaldson

January 2011

Ref. no.347

ARCHAEOLOGICAL SURVEYS LTD

MOD Bicester Graven Hill
Oxfordshire

Magnetometer Survey

for

Entec UK Ltd

Fieldwork by David Sabin, Jack Cousins, Francis Sabin & Richard Grove
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Survey date - **from 22nd December 2010 to 26th January 2011**
Ordnance Survey Grid Reference – **SP 588 206**

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SUMMARY

A magnetometer survey was carried out at MOD Bicester, Graven Hill at the request of Entec UK Ltd on behalf of Defence Estates. The site has been identified by Defence Estates for possible residential redevelopment. The site covers approximately 30ha, and approximately half was surveyed using alternate 30m wide transects. The survey located widespread magnetic anomalies associated with the use of the site as a military establishment from WWII. Positive linear, curvilinear and discrete anomalies within Area H east, in the centre of the site, may have some potential to relate to former cut features. Further to the east, in Area I, a positive linear anomaly crosses the site from west to east, and is in the vicinity of a former field boundary and trackway that is marked further west on early Ordnance Survey mapping as the line of the Roman Akeman Street. However, it cannot be confidently determined that this anomaly relates directly to the Roman road.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Entec, on behalf of Defence Estates, to undertake a magnetometer survey of an area at MOD Bicester, Graven Hill, Oxfordshire. The site has been identified as potentially suitable for residential redevelopment. The survey forms part of an archaeological assessment of the site.

1.2 Survey objectives and techniques

1.2.1 The objective of the survey was to use magnetometry to locate geophysical anomalies that may be archaeological in origin, so that they may be assessed prior to development of the site.

1.2.2 The methodology is considered an efficient and effective approach to archaeological prospection. The survey and report generally follow the recommendations set out by: English Heritage, 2008, *Geophysical survey in archaeological field evaluation;* and Institute for Archaeologists, 2002, *The use of Geophysical Techniques in Archaeological Evaluations*.

1.3 Site location, description and survey conditions

1.3.1 The site covers approximately 30ha within MOD Bicester surrounding Graven Hill, Oxfordshire and is centred on Ordnance Survey National Grid Reference (OS NGR) SP 589 206, see Figures 01 and 02.

1.3.2 The geophysical survey covers an area of approximately 14ha split within 9 fields and labelled Areas D to J. The survey was carried out over an approximate 50% sample using 30m alternate traverses oriented north to south across the site.

1.3.3 Area D consists of approximately 1.6ha of grassland, Area E consists of approximately 1.2ha of grass, Area F is approximately 0.8ha grass and Area G is approximately 0.9ha within a sports field. Area H is approximately 4.7ha, split within three separate fields; Area H east, north and west. Area I is approximately 2.3ha of grass and Area J is approximately 2.2ha also on grass. The grassed areas are frequently used for army training and are maintained by periodic grazing and mowing.

1.3.4 The geophysical survey was hindered and restricted in places by tall grass, thistles and thorn bushes. Weather conditions during the survey were variable but often very cold with periods of snow.

1.4 Site history and archaeological potential

1.4.1 There are no known sites or findspots within the site itself; however, the western edge of the site lies within 750m of the Roman Town of Alchester (SAM OX18). This includes the remains of a vexillation fort and town with a cemetery to the east and further Iron Age-Romano British settlement to the north.

1.4.2 A previous geophysical survey carried out within E Site immediately to the north, located a number of geophysical anomalies close to the edge of the site that may relate to archaeological features (Archaeological Surveys, 2010).

1.4.3 In the vicinity, there is varying evidence for archaeological sites. It has been proposed that the site of Graven Hill is an Iron Age hill fort although there is no archaeological evidence to support this. The suggested line of the Roman road, Akeman Street, is believed to extend across the north of the site towards the Roman town of Alchester. To the north east of the site are the remains of the Deserted Medieval Village of Wretchwick (SAM 28148).

1.4.4 The site has been in military use since WWII where it was part of the US Army “Operation Bolero”. Several Nissen hut and Romney hut camps were established as well as a depot. It was subsequently used for housing German prisoners of war (Thomas, 2003).

1.5 Geology and soils

1.5.1 The underlying geology over the northern and southern parts of the site (Areas D, E, F and G and the northern half of Areas H and I) is the Peterborough member of the Oxford Clay formation consisting of mudstone, with the Stewartby member of the Oxford Clay formation underlying the rest of the site (Area J and the southern half of Areas H and I) (BGS, 2010).

1.5.2 The overlying soils across the site are from the Denchworth association which are pelo-stagnogley soils. They consist of slowly permeable, seasonally waterlogged clayey soils (Soil Survey of England and Wales, 1983).

1.5.3 The geology and soils are considered to provide useful conditions for magnetic survey. Previous magnetometry surveys have located archaeological features in very similar conditions.

2 METHODOLOGY

2.1 Technical synopsis

2.1.1 Magnetometry survey records localised magnetic fields that can be associated with features formed by human activity. Magnetic susceptibility and magnetic thermoremnance are factors associated with the formation of localised fields. Additional details are set out below and within Appendix A.

2.1.2 Iron minerals within the soil may become altered by burning and the break down of biological material; effectively the magnetic susceptibility of the soil is increased, and the iron minerals become magnetic in the presence of the Earth's magnetic field. Accumulations of magnetically enhanced soils within features, such as pits and ditches, may produce magnetic anomalies that can be mapped by magnetic prospection.

2.1.3 Magnetic thermoremnance can occur when ferrous minerals have been heated to high temperatures such as in a kiln, hearth, oven etc. On cooling, a permanent magnetisation may be acquired due to the presence of the Earth's magnetic field. Certain natural processes associated with the formation of some igneous and metamorphic rock may also result in magnetic thermoremnance.

2.1.4 The localised variations in magnetism are measured as sub-units of the Tesla, which is a SI unit of magnetic flux density. These sub-units are nano Teslas (nT), which are equivalent to 10^{-9} Tesla (T).

2.2 Equipment configuration, data collection and survey detail

2.2.1 The detailed magnetic survey was carried out using Bartington Grad601-2 gradiometers. The instruments effectively measure a magnetic gradient between two fluxgate sensors mounted vertically 1m apart. Two sets of sensors are mounted on a single frame 1m apart horizontally.

2.2.2 The instruments are extremely sensitive and are able to measure magnetic variation to 0.01nanoTesla (nT), with an effective resolution of 0.03nT. The data are limited to ±100nT when surveying with the highest sensitivity. All readings are saved to an integral data logger for analysis and presentation.

2.2.3 The instruments are operated according to the manufacturer's instructions with consideration given to the local conditions. An adjustment procedure is required, prior to collection of data, in order to balance the sensors and remove the effects of the Earth's magnetic field; further adjustment is required during the survey due to instrument drift often associated with temperature change.

2.2.4 It can be very difficult to obtain optimum balance for the sensors due to localised magnetic vectors that may be associated with large ferrous objects, geological/pedological features, 'magnetic debris' within the topsoil and natural temperature fluctuations. Imperfect balance results in a heading error often visible as striping within the data; this can be effectively removed by software processing and generally has little effect on the data unless extreme.

2.2.5 The Bartington gradiometers undergo regular servicing and calibration by the manufacturer. A current assessment of the instruments is shown in Table 1 below.

Sensor type and serial numbers	Bartington Grad - 01 – 1000 Nos. 084, 085, 242 and 396
Date of certified calibration/service	Sensors 084 and 085 - 6th August 2010 (due Aug 2012) Sensors 242 and 396 - 3rd December 2009 (due Dec 2011)
Bandwidth	12Hz (100nT range) both sensors
Noise	<100pT peak to peak
Adjustable errors	<2nT

Table 1: Bartington fluxgate gradiometer sensor calibration results

The instruments were considered to be in good working order prior to the survey, with no known faults or defects.

2.2.6 Data were collected at 0.25m centres along traverses 1m apart. The survey area was separated into 30m by 30m grids (900m²) giving 3600 recorded measurements per grid. The site was sampled at 50% by surveying alternate 30m wide transects oriented north to south. This sampling interval is very effective at locating archaeological features and is the recommended methodology for archaeological prospection (English Heritage, 2008).

2.2.7 The survey grids were set out set out parallel to field boundaries in order to minimise partial grids. This was to the Ordnance Survey OSGB36 datum using a Penmap RTK GPS. The GPS is used in conjunction with Topcon's TopNet service, where positional corrections are sent via a mobile telephone link. Positional accuracy of around 10 – 20mm is possible using the system. The instrument is regularly checked against the ETRS89 reference framework using Ordnance Survey ground marker C1ST7784 (Horton).

2.3 Data processing and presentation

2.3.1 Magnetometry data downloaded from the Grad 601-2 data logger are analysed and processed in specialist software known as ArcheoSurveyor. The software allows greyscale and trace plots to be produced for presentation and display. Survey grids are assembled to form an overall composite of data (composite file) creating a dataset of the complete survey area. Appendix C contains specific information concerning the survey and data attributes and is derived directly from ArcheoSurveyor; this should be used in conjunction with information provided by Figure 02.

2.3.2 Only minimal processing is carried out in order to enhance the results of the survey for display. Raw data are always analysed, as processing can modify anomalies. The following schedule sets out the data and image processing used in this survey:

- clipping of the raw data at ±30nT to improve greyscale resolution,
- clipping of processed data at either ±5nT or ±2nT to enhance low magnitude anomalies,
- zero median/mean traverse is applied in order to balance readings along each traverse.

Reference should be made to Appendix B for further information on the specific processes carried out on the data. Appendix C metadata includes details on the processing sequence used for each survey area.

2.3.3 An abstraction and interpretation is offered for all geophysical anomalies located by the survey. A brief summary of each anomaly, with an appropriate reference number, is set out in list form within the results (Section 3) to allow a rapid and objective assessment of features within each survey area.

2.3.4 The main form of data display used in this report is the greyscale plot. Both 'raw' and 'processed' data have been shown followed by an abstraction and interpretation plot. Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing.

2.3.5 Graphic raster images in bitmap format (.BMP) are initially prepared in ArcheoSurveyor. Regardless of survey orientation, data captured along each traverse are displayed and processed by ArcheoSurveyor from left to right. Prior to displaying against base mapping, raster graphics require a rotation in AutoCAD of 90° to restore north to the top of the i mage.

2.3.6 The raster images are combined with base mapping using ProgeCAD Professional 2009 and AutoCAD LT 2007, creating DWG file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical quality. Quality can be compromised by rotation of graphics in order to allow the data to be orientated with respect to grid north; this is considered acceptable as the survey results are effectively georeferenced allowing relocation of features using GPS, resection method etc.. A digital archive, including raster images, is produced with this report allowing separate analysis if necessary, see Appendix D below.

3 RESULTS

3.1 General overview

3.1.1 The detailed magnetic survey was carried out over nine fields within labelled D to G with Area H split into east, north and west. Geophysical anomalies located can be generally classified as positive and negative linear anomalies of an uncertain origin, linear anomalies of an agricultural origin, areas of magnetic debris and disturbance, strong discrete dipolar anomalies relating to ferrous objects and strong multiple dipolar linear anomalies relating to buried services or pipelines. Anomalies located within each survey area have been numbered and are described below with subsequent discussion in Section 4.

3.1.2 Data are considered to be of good quality with minor positional errors, caused by uneven ground, ruts, tall vegetation etc., unlikely to have degraded quality significantly. Magnetic disturbance has been caused by modern above ground ferrous objects.

3.1.3 The listing of sub-headings below attempts to define a number of separate categories that reflect the range and type of features located during the survey. A basic explanation of the characteristics of the magnetic anomalies is set out for each category in order to justify interpretation, a basic key is indicated to allow cross reference to the abstraction and interpretation plot. CAD layer names are included to aid reference to associated digital files (.dwg/.dxf). Sub-headings are then used to group anomalies with similar characteristics for each survey area.

Report sub-heading CAD layer names and plot colour	**Description and origin of anomalies**
Anomalies with an uncertain origin AS-ABST MAG POS LINEAR UNCERTAIN AS-ABST MAG NEG LINEAR UNCERTAIN AS-ABST MAG POS DISCRETE UNCERTAIN	The category applies to a range of anomalies where <u>there is not enough evidence to confidently suggest an origin</u>. Anomalies in this category <u>may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered</u>. Positive anomalies are indicative of magnetically enhanced soils that may form the fill of 'cut' features or may be produced by accumulation within layers or 'earthwork' features; soils subject to burning may also produce positive anomalies. Negative anomalies are produced by material of comparatively low magnetic susceptibility such as stone and subsoil.
Anomalies relating to land management AS-ABST MAG BOUNDARY	Anomalies are mainly linear and may be indicative of the magnetically enhanced fill of cut features (i.e. ditches). The anomalies may be long and/or form rectilinear elements and they may relate to topographic features or be visible on early mapping. Associated agricultural anomalies (e.g. headlands, plough marks and former ridge and furrow) may support the interpretation.
Anomalies with an agricultural origin AS-ABST MAG RIDGE AND FURROW	The anomalies are often linear and form a series of parallel responses or are parallel to extant land boundaries. Where the response is broad, former ridge and furrow is likely; narrow response is often related to modern ploughing.

Anomalies associated with magnetic debris AS-ABST MAG DEBRIS AS-ABST MAG STRONG DIPOLAR	Magnetic debris often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. It often occurs where there has been dumping or ground make-up and is related to magnetically thermoremnant materials such as brick or tile or other small fragments of ferrous material. This type of response is occasionally associated with kilns, furnace structures, or hearths and may therefore be archaeologically significant. It is also possible that the response may be caused by natural material such as certain gravels and fragments of igneous or metamorphic rock. Strong discrete dipolar anomalies are responses to ferrous objects within the topsoil.
Anomalies with a modern origin AS-ABST MAG DISTURBANCE AS-ABST MAG SERVICE	The magnetic response is often strong and dipolar indicative of ferrous material and may be associated with extant above surface features such as wire fencing, cables, pylons etc.. Often a significant area around such features has a strong magnetic flux which may create magnetic disturbance; such disturbance can effectively obscure low magnitude anomalies if they are present. Fluxgate sensors may respond erratically and with hysteresis adjacent to strong magnetic sources. Buried services may produce characteristic multiple dipolar anomalies dependant upon their construction.

Table 2: List and description of interpretation categories

3.2 Area D

Field centred on OS NGR 458435, 220635, see Figures 05 & 06.

Anomalies with an uncertain origin

(1) – The survey area contains several positive linear anomalies with no coherent pattern. The area was part of the WWII US Army “Bolero” camp and subsequent POW camp, spread over the site of Graven Hill. It is likely that these are associated with this use of the site, although this is not certain.

Anomalies associated with magnetic debris

(2) – Widespread patches of magnetic debris indicate the presence of magnetically thermoremnant material likely to be associated with demolished Nissen and Romney huts and associated infrastructure .

Anomalies with a modern origin

(3) – Magnetic disturbance from buried services and other ferrous material.

3.3 Area E

Field centred on OS NGR 458860, 220830, see Figures 06 & 07.

Anomalies with an uncertain origin

(4) – Positive linear anomalies may be associated with the wartime use of the site, although this is not certain.

Anomalies associated with magnetic debris

(5) – Widespread patches of magnetic debris indicate the presence of magnetically thermoremnant material likely to be associated with the wartime use of the site.

Anomalies with a modern origin

(6) – Magnetic disturbance from buried services and other ferrous material.

3.4 Area F

Field centred on OS NGR 459365, 220770, see Figures 09 & 10.

Anomalies associated with land management

(7) – A positive linear anomaly possibly associated with a former land boundary marked on 19th century Ordnance Survey mapping.

Anomalies with an agricultural origin

(8) – Linear anomalies are likely to relate to former ridge and furrow.

Anomalies associated with magnetic debris

(9) – Widespread patches of magnetic debris indicate the presence of magnetically thermoremnant material.

3.5 Area G

Field centred on OS NGR 459215, 220110, see Figures 11 & 12.

Anomalies with an uncertain origin

(10) – Area G contains many discrete positive and positive and negative linear and possible rectilinear anomalies. It is not possible to determine the origin of these anomalies from their morphology. The survey area has been in use as a sports field and it is possible that some of these anomalies are associated with this use,

but this is uncertain.

Anomalies associated with magnetic debris

(11) – Magnetic debris indicates the presence of magnetically thermoremnant material, some of which is associated with the use of the site as a sports field.

3.6 Area H north

Field centred on OS NGR 458800, 220715, see Figures 13 & 14.

Anomalies with an uncertain origin

(12) – A series of very weakly positive linear anomalies, located in the central part of the survey area, may be associated with former agricultural activity.

Anomalies associated with magnetic debris

(13) – Magnetic debris is located over much of the survey area and relates to material likely to have been associated with former wartime use of the site.

Anomalies with a modern origin

(14) – The survey area contains several strong multiple dipolar linear anomalies relating to buried services probably associated with the wartime military camp.

3.7 Area H west

Field centred on OS NGR 458660, 221560, see Figures 13 & 14.

Anomalies with an uncertain origin

(15) – Positive linear and curvilinear anomalies likely to be associated with other material within the survey area derived from the WWII camp on, and adjacent, to the site.

Anomalies associated with magnetic debris

(16) – Widespread patches of very strong magnetic debris indicate the presence of ferrous and other magnetically thermoremnant material.

Anomalies with a modern origin

(17) – Magnetic disturbance from ferrous material and buried services.

3.8 Area H east

Field centred on OS NGR 459005, 220590, see Figures 15 &16.

Anomalies with an uncertain origin

(18) – Positive linear, curvilinear and discrete anomalies located in the southern part of the area. These may indicate cut features, such as ditches and pits.

(19) – Weak positive linear anomalies, located in the south eastern part of the survey area, may have a similar origin to anomalies (18), but this is not certain.

(20) – Very weak positive linear anomalies with an uncertain origin.

(21) – A positive linear anomaly in the vicinity of anomalies (18) may be associated. However, it appears to terminate with a strong dipolar anomaly, indicating ferrous material.

3.9 Area I

Field centred on OS NGR 459275, 220605, see Figures 17 & 18.

Anomalies with an uncertain origin

(22) – A relatively strongly positive linear anomaly, with some associated negative response, crosses the survey area oriented west to east. This anomaly is in the vicinity of a break of slope within the field and is marked as the route of the Roman road, Akeman Street on former Ordnance Survey mapping. This was subsequently removed between 1975 and 1989.

(23) – Positive linear anomalies, partially obscured by the widespread magnetic debris, may be associated with the modern use of the site.

Anomalies associated with magnetic debris

(24) – Widespread patches of very strong magnetic debris indicate the presence of ferrous and other magnetically thermoremnant material. This is likely to be derived from military buildings removed sometime after 1976.

Anomalies with a modern origin

(25) – Magnetic disturbance from ferrous material and buried services associated with former military buildings.

3.10 Area J

Field centred on OS NGR 459215, 220360, see Figures 19 & 20.

Anomalies associated with magnetic debris

(26) – Widespread patches of very strong magnetic debris indicate the presence of ferrous and other magnetically thermoremnant material derived from former military buildings.

Anomalies with a modern origin

(27) – Magnetic disturbance from ferrous material and buried services.

4 DISCUSSION

4.1.1 The detailed magnetometer survey located widespread magnetic debris and disturbance caused by material associated with demolished buildings. The Graven Hill site was used during WWII as part of the US Army “Operation Bolero” and the site housed the central ordnance depot and camps made up of collections of Nissen and Romney huts. These appear to have been used for German prisoners of war working parties attached to the wartime depot (Thomas, 2003).

4.1.2 All the survey areas contain evidence for this occupation of the site, and the debris and disturbance may have obscured lower magnitude anomalies. The majority of the survey areas also contain positive linear anomalies and it is possible that the relate to the military use of the site. However, they either do not have coherent morphology, or they are weak or partially obscured and so their origin cannot be determined.

4.1.3 Within Area H (east) in the central part of the site, the magnetic debris is less abundant and several positive linear, curvilinear and discrete anomalies have been located. It is possible that these relate to cut features with some archaeological potential, although a modern origin cannot be ruled out. Within Area I to the east, a positive linear anomaly extends from east to west across the northern part of the survey area. A former trackway and field boundary is marked in this position on early Ordnance Survey mapping, and the western extension of this is marked as the route of Akeman Street. It is possible that this anomaly is associated with the boundary feature.

4.1.4 Area G, to the south of the site, occupies a sports field, with evidence for terracing. The survey area contains widespread positive and negative anomalies and although it is possible that they relate to the modern use of the site, their origin cannot be confidently determined.

5 CONCLUSION

5.1.1 The magnetometer survey located widespread highly magnetic anomalies derived from former military buildings that occupied the site, during and after WWII. This magnetic debris and disturbance may have obscured lower magnitude anomalies, and although positive linear anomalies do exist in the majority of the survey areas, they cannot be confidently interpreted.

5.1.2 Several positive linear, curvilinear and discrete anomalies located in the centre of the site (Area H east) may relate to cut features. Their morphology prevents confident interpretation beyond the possibility that they are related to ditch-like and pit-like features.

5.1.3 In Area I, to the east, a positive linear anomaly crosses the site in the vicinity of a former field boundary associated with a trackway indicated on early Ordnance Survey mapping. The projected line westwards of this feature is marked as the route of Roman Akeman Street on former Ordnance Survey mapping; however, parts of the anomaly are strongly enhanced suggesting the presence of ferrous material perhaps related to services or fencing.

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Appendix A – basic principles of magnetic survey

Iron minerals are always present to some degree within the topsoil and enhancement associated with human activity is related to increases in the level of magnetic susceptibility and thermoremnant material.

Magnetic susceptibility is an induced magnetism within a material when it is in the presence of a magnetic field. This can be thought of as effectively permanent due to the presence of the Earth's magnetic field.

Thermoremnant magnetism occurs when ferrous material is heated beyond a specific temperature known as the Curie Point. Demagnetisation occurs at this temperature with re-magnetisation by the Earth's magnetic field upon cooling.

Enhancement of magnetic susceptibility can occur in areas subject to burning and complex fermentation processes on biological material; these are frequently associated with human settlement. Thermoremnant features include ovens, hearths, and kilns. In addition thermoremnant material such as tile and brick may also be associated with human activity and settlement.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil can create an area of enhancement compared with surrounding soils and subsoils into which the feature is cut. Mapping enhanced areas will produce linear and discrete anomalies allowing an assessment and characterisation of hidden subsurface features.

It should be noted that areas of negative enhancement can be produced from material having lower magnetic properties compared to the topsoil. This is common for many sedimentary bedrocks and subsoils which were often used in the construction of banks and walls etc. Mapping these 'negative' anomalies may also reveal archaeological features.

Magnetic survey or magnetometry can be carried out using a fluxgate gradiometer and may be referred to as gradiometry. The gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the upper sensor measures the Earth's magnetic field as does the lower sensor but this is influenced to a greater degree by any localised buried field. The difference between the two sensors will relate to the strength the magnetic field created by the buried feature. If no enhanced feature is present the field measured by both sensors will be similar and the difference close to zero.

There are a number of factors that may affect the magnetic survey and these include soil type, local geology and previous human activity. Situations arise where magnetic disturbance associated with modern services, metal fencing, dumped waste material etc., obscures low magnitude fields associated with archaeological features.

Appendix B – data processing notes

Clipping

Minimum and maximum values are set and replace data outside of the range with those values. Extreme values are removed improving colour or greyscale contrast associated with data values that may be archaeologically significant. It has been found that clipping data to ranges between ±5nT and ±1nT often improves the appearance of features associated with archaeology. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

Zero Median/Mean Traverse

The median (or mean) of each traverse is calculated ignoring data outside a threshold value, the median (or mean) is then subtracted from the traverse. The process is used to equalise slight differences between the set-up and stability of gradiometer sensors and can remove striping. The process can remove archaeological features that run along a traverse so data analysis is also carried out prior its application.

De-stagger

Compensates for small positional errors within data collection by shifting the position of the readings along each traverse by a specified amount. Data lost at the end of each traverse are extrapolated from adjacent value in the same row.

Deslope

Corrects for striping and distortion caused by metal objects/services etc.. The process calculates a curve based on a polynomial best fit mathematical function for each traverse. This curve is then subtracted from the actual data.

FFT (Fast Fourier Transform) spectral filtering

A mathematical process used to determine the frequency components of a traverse. Repetitive features, such as plough marks, produce characteristic spectral zones that can be suppressed allowing greyscale images to appear clearer.

Appendix C – survey and data information

Area A Field 1 raw data

COMPOSITE
Filename: J332-mag-Field1-raw.xcp

Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 16/08/2010
Assembled by: on 16/08/2010
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 240 x 240
Survey Size (meters): 60 m x 240 m
Grid Size: 30 m x 30 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 10.50
Mean: -3.85
Median: -0.77
Composite Area: 1.44 ha
Surveyed Area: 0.6689 ha

Processes: 2
1 Base Layer
2 Clip from -30.00 to 30.00 nT

Source Grids: 13
1 Col:0 Row:2 07.xgd
2 Col:0 Row:3 08.xgd
3 Col:0 Row:4 15.xgd
4 Col:0 Row:5 16.xgd
5 Col:0 Row:6 17.xgd
6 Col:1 Row:0 01.xgd
7 Col:1 Row:1 02.xgd
8 Col:1 Row:2 03+05.xgd
9 Col:1 Row:3 04+06.xgd
10 Col:1 Row:4 09+13.xgd
11 Col:1 Row:5 10+14.xgd
12 Col:1 Row:6 11.xgd
13 Col:1 Row:7 12.xgd

Area A Field 1 processing

COMPOSITE
Filename: J332-mag-Field1-proc.xcp

Processes: 4
1 Base Layer
2 Clip from -30.00 to 30.00 nT
3 DeStripe Median Traverse: Grids: All
4 Clip from -3.00 to 3.00 nT

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.75
Mean: -0.31
Median: 0.00

Area A Field 2 raw data

COMPOSITE
Filename: J332-mag-Field2-raw.xcp

Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 16/08/2010
Assembled by: on 16/08/2010
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 480 x 210
Survey Size (meters): 120 m x 210 m
Grid Size: 30 m x 30 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 2.86
Mean: -0.28
Median: -0.10
Composite Area: 2.52 ha
Surveyed Area: 1.7849 ha

Processes: 2
1 Base Layer
2 Clip from -30.00 to 30.00 nT

Source Grids: 27
1 Col:0 Row:0 13.xgd
2 Col:0 Row:1 14.xgd
3 Col:0 Row:2 15.xgd
4 Col:0 Row:3 16.xgd
5 Col:0 Row:4 17.xgd
6 Col:0 Row:5 18.xgd
7 Col:0 Row:6 19.xgd
8 Col:1 Row:0 09.xgd
9 Col:1 Row:1 10.xgd
10 Col:1 Row:2 11.xgd
11 Col:1 Row:3 12.xgd
12 Col:1 Row:4 20.xgd
13 Col:1 Row:5 21.xgd
14 Col:1 Row:6 22.xgd
15 Col:2 Row:0 05.xgd
16 Col:2 Row:1 06.xgd
17 Col:2 Row:2 07.xgd
18 Col:2 Row:3 08.xgd
19 Col:2 Row:4 23.xgd
20 Col:2 Row:5 24.xgd
21 Col:2 Row:6 25.xgd
22 Col:3 Row:0 01.xgd
23 Col:3 Row:1 02.xgd
24 Col:3 Row:2 03.xgd
25 Col:3 Row:3 04.xgd
26 Col:3 Row:4 26.xgd
27 Col:3 Row:5 27.xgd

Area A Field 2 processing

COMPOSITE
Filename: J332-mag-Field2-proc.xcp

Stats
Max: 3.00
Min: -3.00
Std Dev: 0.87
Mean: 0.02
Median: 0.00

Processes: 12
1 Base Layer
2 Clip from -30.00 to 30.00 nT
3 DeStripe Median Traverse: Grids: 15.xgd 16.xgd 17.xgd 18.xgd 19.xgd 11.xgd 12.xgd 20.xgd 21.xgd 22.xgd 07.xgd 08.xgd 23.xgd 24.xgd 25.xgd 03.xgd 04.xgd 26.xgd 27.xgd
4 DeStripe Median Traverse: Grids: 10.xgd 06.xgd
5 DeStripe Median Traverse: Grids: 09.xgd 05.xgd
6 DeStripe Median Traverse: Grids: 01.xgd 02.xgd
7 DeStripe Median Sensors: 14.xgd
8 Clip from -3.00 to 3.00 nT
9 De Stagger: Grids: 01.xgd Mode: Both By: 1 intervals
10 De Stagger: Grids: 17.xgd Mode: Both By: 1 intervals
11 De Stagger: Grids: 24.xgd Mode: Both By: 1 intervals
12 De Stagger: Grids: 02.xgd Mode: Both By: 1 intervals

Area A Field 3 raw data

COMPOSITE
Filename: J332-mag-Field3-raw.xcp

Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 18/08/2010
Assembled by: on 18/08/2010
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 600 x 450
Survey Size (meters): 150 m x 450 m
Grid Size: 30 m x 30 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 5.66
Mean: -0.43
Median: -0.29
Composite Area: 6.75 ha
Surveyed Area: 4.6442 ha

Processes: 2
1 Base Layer
2 Clip from -30.00 to 30.00 nT

Source Grids: 63
1 Col:0 Row:0 13.xgd
2 Col:0 Row:1 14.xgd
3 Col:0 Row:2 15.xgd
4 Col:0 Row:3 16.xgd
5 Col:0 Row:4 17.xgd
6 Col:0 Row:5 18.xgd
7 Col:0 Row:6 19.xgd
8 Col:0 Row:7 20.xgd
9 Col:0 Row:8 45.xgd
10 Col:0 Row:9 46.xgd
11 Col:0 Row:10 47.xgd
12 Col:0 Row:11 48.xgd
13 Col:0 Row:12 49.xgd
14 Col:0 Row:13 50.xgd
15 Col:0 Row:14 51.xgd
16 Col:1 Row:0 09.xgd
17 Col:1 Row:1 10.xgd
18 Col:1 Row:2 11.xgd
19 Col:1 Row:3 12.xgd
20 Col:1 Row:4 21.xgd
21 Col:1 Row:5 22.xgd
22 Col:1 Row:6 23.xgd
23 Col:1 Row:7 24.xgd
24 Col:1 Row:8 41.xgd
25 Col:1 Row:9 42.xgd
26 Col:1 Row:10 43.xgd
27 Col:1 Row:11 44.xgd
28 Col:1 Row:12 52.xgd
29 Col:1 Row:13 53.xgd
30 Col:1 Row:14 54.xgd
31 Col:2 Row:0 05.xgd
32 Col:2 Row:1 06.xgd
33 Col:2 Row:2 07.xgd
34 Col:2 Row:3 08.xgd
35 Col:2 Row:4 25.xgd
36 Col:2 Row:5 26.xgd
37 Col:2 Row:6 27.xgd
38 Col:2 Row:7 28.xgd
39 Col:2 Row:8 37.xgd
40 Col:2 Row:9 38.xgd
41 Col:2 Row:10 39.xgd
42 Col:2 Row:11 40.xgd
43 Col:2 Row:12 55.xgd
44 Col:2 Row:13 56.xgd
45 Col:2 Row:14 57.xgd
46 Col:3 Row:0 01.xgd
47 Col:3 Row:1 02.xgd
48 Col:3 Row:2 03.xgd
49 Col:3 Row:3 04.xgd
50 Col:3 Row:4 29.xgd
51 Col:3 Row:5 30.xgd
52 Col:3 Row:6 31.xgd
53 Col:3 Row:7 32.xgd
54 Col:3 Row:8 33.xgd
55 Col:3 Row:9 34.xgd
56 Col:3 Row:10 35.xgd
57 Col:3 Row:11 36.xgd
58 Col:3 Row:12 58.xgd
59 Col:3 Row:13 59.xgd
60 Col:3 Row:14 60.xgd
61 Col:4 Row:12 61.xgd
62 Col:4 Row:13 62.xgd
63 Col:4 Row:14 63.xgd

Area A Field 3 processing

COMPOSITE
Filename: J332-mag-Field3-proc.xcp

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.12
Mean: 0.01
Median: 0.00

Processes: 7
1 Base Layer

2 Clip from -30.00 to 30.00 nT
3 DeStripe Median Traverse: Grids: 13.xgd 14.xgd 15.xgd 16.xgd 17.xgd 18.xgd 19.xgd 20.xgd 09.xgd 10.xgd 11.xgd 12.xgd 21.xgd 22.xgd 23.xgd 24.xgd 05.xgd 06.xgd 07.xgd 08.xgd 25.xgd 26.xgd 27.xgd 28.xgd 01.xgd 02.xgd 03.xgd 04.xgd 29.xgd 30.xgd 31.xgd 32.xgd
4 DeStripe Median Traverse: Grids: 47.xgd 48.xgd 49.xgd 50.xgd 51.xgd 43.xgd 44.xgd 52.xgd 53.xgd 54.xgd 39.xgd 40.xgd 55.xgd 56.xgd 57.xgd 35.xgd 36.xgd 58.xgd 59.xgd 60.xgd 61.xgd 62.xgd 63.xgd
5 DeStripe Median Traverse: Grids: 41.xgd 42.xgd 37.xgd 38.xgd 33.xgd 34.xgd
6 DeStripe Mean Traverse: Grids: 45.xgd 46.xgd
Threshold: 0.5 SDs
7 Clip from -3.00 to 3.00 nT

Area A Field 4 raw data

COMPOSITE
Filename: J332-mag-Field4-raw.xcp

Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 18/08/2010
Assembled by: on 18/08/2010
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 600 x 450
Survey Size (meters): 150 m x 450 m
Grid Size: 30 m x 30 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 5.28
Mean: -0.43
Median: -0.15
Composite Area: 6.75 ha
Surveyed Area: 3.1239 ha

Processes: 2
1 Base Layer
2 Clip from -30.00 to 30.00 nT

Source Grids: 49
1 Col:0 Row:0 01.xgd
2 Col:0 Row:1 02.xgd
3 Col:0 Row:2 03.xgd
4 Col:0 Row:3 04.xgd
5 Col:0 Row:4 08.xgd
6 Col:0 Row:5 09.xgd
7 Col:0 Row:6 10.xgd
8 Col:0 Row:7 11.xgd
9 Col:0 Row:8 20.xgd
10 Col:0 Row:9 21.xgd
11 Col:0 Row:10 22.xgd
12 Col:0 Row:11 23.xgd
13 Col:0 Row:12 36.xgd
14 Col:0 Row:13 37.xgd
15 Col:0 Row:14 38.xgd
16 Col:1 Row:1 05.xgd
17 Col:1 Row:2 06.xgd
18 Col:1 Row:3 07.xgd
19 Col:1 Row:4 12.xgd
20 Col:1 Row:5 13.xgd
21 Col:1 Row:6 14.xgd
22 Col:1 Row:7 15.xgd
23 Col:1 Row:8 24.xgd
24 Col:1 Row:9 25.xgd
25 Col:1 Row:10 26.xgd
26 Col:1 Row:11 27.xgd
27 Col:1 Row:12 39.xgd
28 Col:1 Row:13 40.xgd
29 Col:1 Row:14 41.xgd
30 Col:2 Row:4 16.xgd
31 Col:2 Row:5 17.xgd
32 Col:2 Row:6 18.xgd
33 Col:2 Row:7 19.xgd
34 Col:2 Row:8 28.xgd
35 Col:2 Row:9 29.xgd
36 Col:2 Row:10 30.xgd
37 Col:2 Row:11 31.xgd
38 Col:2 Row:12 42.xgd
39 Col:2 Row:13 43.xgd
40 Col:2 Row:14 44.xgd
41 Col:3 Row:8 32.xgd
42 Col:3 Row:9 33.xgd
43 Col:3 Row:10 34.xgd
44 Col:3 Row:11 35.xgd
45 Col:3 Row:12 45.xgd
46 Col:3 Row:13 46.xgd
47 Col:3 Row:14 47.xgd
48 Col:4 Row:13 48.xgd
49 Col:4 Row:14 49.xgd

Area A Field 4 processing

COMPOSITE
Filename: J332-mag-Field4-proc.xcp

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.17
Mean: -0.06
Median: 0.00

Processes: 8
1 Base Layer
2 Clip from -30.00 to 30.00 nT
3 DeStripe Median Traverse: Grids: 01.xgd 02.xgd 03.xgd 04.xgd 08.xgd 09.xgd 10.xgd 11.xgd 20.xgd 21.xgd 22.xgd 23.xgd 36.xgd 37.xgd 38.xgd 05.xgd 06.xgd 07.xgd 12.xgd 13.xgd 14.xgd 15.xgd 24.xgd 25.xgd 26.xgd 27.xgd 39.xgd 40.xgd 41.xgd 16.xgd 17.xgd 18.xgd 19.xgd 28.xgd 29.xgd 30.xgd 31.xgd 42.xgd 43.xgd 44.xgd
4 DeStripe Median Traverse: Grids: 32.xgd 33.xgd
5 DeStripe Median Traverse: Grids: 45.xgd 46.xgd 47.xgd
6 DeStripe Mean Traverse: Grids: 34.xgd 35.xgd
Threshold: 0.5 SDs
7 DeStripe Median Traverse: Grids: 48.xgd 49.xgd
8 Clip from -3.00 to 3.00 nT

Area B Field 5 raw data

COMPOSITE
Filename: J332-mag-Field5-raw.xcp

Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 19/08/2010
Assembled by: on 19/08/2010
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 480 x 240
Survey Size (meters): 120 m x 240 m
Grid Size: 30 m x 30 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 7.80
Mean: -1.14
Median: -0.05
Composite Area: 2.88 ha
Surveyed Area: 1.6358 ha

Processes: 2
1 Base Layer
2 Clip from -30.00 to 30.00 nT

Source Grids: 29
1 Col:0 Row:0 26.xgd
2 Col:0 Row:1 27.xgd
3 Col:0 Row:2 28.xgd
4 Col:0 Row:3 29.xgd
5 Col:0 Row:4 19.xgd
6 Col:0 Row:5 20.xgd
7 Col:0 Row:6 21.xgd
8 Col:1 Row:0 22.xgd
9 Col:1 Row:1 23.xgd
10 Col:1 Row:2 24.xgd
11 Col:1 Row:3 25.xgd
12 Col:1 Row:4 15.xgd
13 Col:1 Row:5 16.xgd
14 Col:1 Row:6 17.xgd
15 Col:1 Row:7 18.xgd
16 Col:2 Row:1 04.xgd
17 Col:2 Row:2 05.xgd
18 Col:2 Row:3 06.xgd
19 Col:2 Row:4 11.xgd
20 Col:2 Row:5 12.xgd
21 Col:2 Row:6 13.xgd
22 Col:2 Row:7 14.xgd
23 Col:3 Row:1 01.xgd
24 Col:3 Row:2 02.xgd
25 Col:3 Row:3 03.xgd
26 Col:3 Row:4 07.xgd
27 Col:3 Row:5 08.xgd
28 Col:3 Row:6 09.xgd
29 Col:3 Row:7 10.xgd

Area B Field 5 processing

COMPOSITE
Filename: J332-mag-Field5-proc.xcp

Stats
Max: 3.00
Min: -3.00
Std Dev: 1.50
Mean: -0.18
Median: -0.03
Composite Area: 2.88 ha
Surveyed Area: 1.6357 ha

Area C Field 6 raw data

COMPOSITE
Filename: J332-mag-Field6-raw.xcp

Instrument Type: Bartington (Gradiometer)
Units: nT
Surveyed by: on 19/08/2010
Assembled by: on 19/08/2010
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 32702

Dimensions
Composite Size (readings): 240 x 120
Survey Size (meters): 60 m x 120 m
Grid Size: 30 m x 30 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 30.00
Min: -30.00
Std Dev: 7.69
Mean: -0.25
Median: 0.42
Composite Area: 0.72 ha
Surveyed Area: 0.5997 ha

Processes: 2
1 Base Layer
2 Clip from -30.00 to 30.00 nT

Source Grids: 8
1 Col:0 Row:0 01.xgd
2 Col:0 Row:1 02.xgd
3 Col:0 Row:2 03.xgd
4 Col:0 Row:3 04.xgd
5 Col:1 Row:0 05.xgd
6 Col:1 Row:1 06.xgd
7 Col:1 Row:2 07.xgd
8 Col:1 Row:3 08.xgd

Area C Field 6 processing

COMPOSITE
Filename: J332-mag-Field6-proc.xcp

Processes: 4
1 Base Layer
2 Clip from -30.00 to 30.00 nT
3 DeStripe Median Traverse: Grids: All
4 Clip from -3.00 to 3.00 nT

Appendix D – digital archive

Archaeological Surveys Ltd hold the primary digital archive at Castle Combe, Wiltshire (see inside cover for address). Data are backed-up onto an on-site data storage drive and at the earliest opportunity data are copied to CD ROM for storage on-site and off-site. Digital data are also supplied to the client on CD ROM, see below.

Surveys are reported on in hardcopy (recycled paper) using A4 for text and A3 for plots (all plots are scaled for A3). The distribution of both hardcopy report and digital data is considered the responsibility of the Client unless explicitly stated in the survey Brief, Written Scheme of Investigation or other contractual agreement.

This report has been prepared using the following software on a Windows XP platform:

- ArcheoSurveyor version 2.5.9.4 (geophysical data analysis),
- ProgeCAD Professional 2009 (report graphics),
- AutoCAD LT 2007 (report figures),
- OpenOffice.org 3.0.1 Writer (document text),
- PDF Creator version 0.9 (PDF archive).

Digital data are supplied on CD ROM which includes the following files:

- ArcheoSurveyor grid and composite files for all geophysical data,
- CSV files for raw and processed composites,
- geophysical composite file graphics as Bitmap images,
- AutoCAD DWG files in 2000 and 2007 versions,
- report text as OpenOffice.org ODT file,
- report text as Word 2000 doc file,
- report text as rich text format (RTF),
- report text as PDF,
- PDFs of all figures.

The CD ROM structure is formed from a tree of directories under the title J347 Bicester – CD. Directory titles include Data, Documentation, CAD, PDFs and Photos. Multiple directories exist under Data and hold Grid, Composite and Graphic files with CSV composite data held in Export.

The CAD file contains externally referenced graphics that are rotated with separate A3 size layouts for each figure. Layouts are fixed using frozen layers and named views allowing straightforward plotting or analysis on screen. (Note – CAD files are prepared using AutoCAD's e Transmit function to produce a directory containing the digital drawing along with any externally referenced graphics which may need reloading).