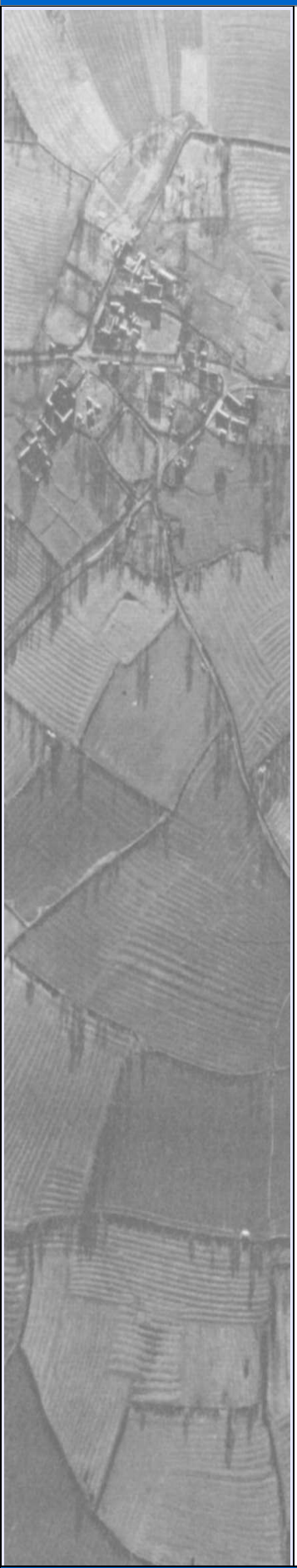

Dunkley's Farm & Cherry Tree Farm
Dunchurch
Warwickshire

MAGNETOMETER SURVEY REPORT

for

Archaeology Warwickshire

Kerry Donaldson & David Sabin

July 2015

Ref. no. 612

ARCHAEOLOGICAL SURVEYS LTD

Dunkley's Farm & Cherry Tree Farm
Dunchurch
Warwickshire

Magnetometer Survey Report

for

Archaeology Warwickshire

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Primary archive location - Archaeological Surveys Ltd, Yatesbury, Wiltshire

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Ordnance Survey Grid Reference – **SP 48300 72350**

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SUMMARY

A detailed magnetometer survey was carried out by Archaeological Surveys Ltd on land at Dunkley's Farm and Cherry Tree Farm near Dunchurch in Warwickshire. A total of ten survey areas amounting to approximately 23ha were covered. The results of the survey show a large number of discrete positive responses that relate to pit-like features; however, they are widespread and numerous, lacking any coherent morphology, which may indicate that they relate to natural features. Several of the survey areas contain weakly positive linear anomalies some of which are not oriented parallel with any existing or formerly mapped land boundaries; however, the majority also do not appear to extend beyond the confines of the existing boundaries. The linear anomalies are either weak, short or fragmented and again lack a coherent morphology which prevents confident interpretation.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Archaeology Warwickshire, on behalf of Amec Foster Wheeler Environment and Infrastructure UK Ltd, to undertake a magnetometer survey of an area of land at Dunkley's Farm and Cherry Tree Farm, Dunchurch, Warwickshire. The site has been outlined for a potential residential development and the survey forms part of an archaeological assessment of the site. The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Archaeology Warwickshire (2015).

1.2 Survey objectives and techniques

1.2.1 The objective of the survey was to use magnetometry to locate geophysical anomalies in order to determine if there are any significant archaeological remains in the area to be developed; to form an understanding of their value and their potential to shed light on the subsequent development of the area. The methodology is considered an efficient and effective approach to archaeological prospection.

1.2.2 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*. The work has been carried out to the Chartered Institute for Archaeologists (2014) *Standard and Guidance for Archaeological Geophysical Survey.*

1.3 Site location, description and survey conditions

1.3.1 The site is located at Dunkley's Farm, to the east of Cawston Lane and Cherry

Tree Farm to the north of Northampton Lane in Dunchurch, near Rugby, Warwickshire. It is centred on Ordnance Survey National Grid Reference (OS NGR) SP 48300 72350, see Figures 01 and 02.

1.3.2 The geophysical survey covers approximately 23ha within 10 main land parcels, labelled Areas 1 -10 for the purposes of the survey and report. The ground cover consisted of grass with areas grazed by cattle and horses and some left for cropping. Area 9 was split into several small paddocks one of which was not suitable for survey due to the presence of a bull. Several small paddocks within Areas 9 and 10 were also unsurveyable due to tall grass and thistles. The application site covers approximately 29ha including the two farms and their associated buildings, which did not form part of the survey. The most northerly part of the site contained a number of horses and small paddocks and was not available for survey.

1.3.3 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data. Weather conditions during the survey were variable but generally fine and warm.

Plate 1: Area 7 looking south west

Plate 2: Area 9 looking north west

1.4 Site history and archaeological potential

1.4.1 The site does not contain any designated or non-designated heritage assets; however, findspots of a single bronze axe head and an assemblage of Romano-British finds have been recorded to the south west of the site. Aerial photographs show a complex of cropmark features to the north and north west of the site. These may relate to possible prehistoric and/or Romano-British enclosures and boundaries.

1.4.2 The lack of sites or findspots may indicate that there is low potential for the survey to locate archaeology. However, magnetometry may locate previously unrecorded archaeological features, should they exist within the site.

1.5 Geology and soils

1.5.1 The underlying geology is Charmouth Mudstone Formation with overlying Dunsmore Sands and Gravels (BGS, 2013).

1.5.2 The overlying soil across the site is from the Arrow association and is a gleyic brown earth. It consists of a deep, permeable, coarse, loamy soil affected by ground water (Soil Survey of England and Wales, 1983).

1.5.3 Magnetometry carried out over similar geology and soil has produced variable results as there can be poor magnetic contrast between cut features and the material into which they are cut. Drift deposits can cause naturally formed anomalies that may be difficult to distinguish from those with an anthropogenic

origin. The site is, however, considered suitable for magnetic survey.

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 a SENSYS MAGNETO®MXPDA 5 channel cart-based system. The instrument has 5 fluxgate gradiometers spaced 0.5m apart with readings recorded at 20Hz. The gradiometers have a range of recording data between 0.1nT and 10,000nT. The system is linked to a Leica GS10 RTK GPS with data recorded by SENSYS MAGNETO®MXPDA software on a rugged computer.

2.2.2 Data are collected along a series of parallel survey tracks wherever possible. The length of each track is variable and relates to the size of the survey area and other factors including ground conditions. A visual display aids accurate placing of tracks and their separation.

2.2.3 Data are not collected within fixed grids and data points are considered to be random even though the data are collected in a systematic manner covering all accessible areas (Aspinall, Gaffney and Schmidt, 2009).

2.3 Data processing and presentation

2.3.1 Magnetic data collected by the MAGNETO®MXPDA cart-based system are initially prepared using SENSYS MAGNETO®DLMGPS software. Survey tracks are analysed and georeferenced raw data (UTM Z30N) are then exported in ASCII format for further analysis and display using TerraSurveyor.

2.3.2 The data are collected between limits of ±10000nT and clipped for display at ±5nT. Data are interpolated to a resolution of effectively 0.5m between tracks and 0.15m along each survey track. A zero median traverse function is required in order to remove fixed offset values present within the sensors which do not undergo a zeroing procedure in the field. The approach ensures that the gradiometer sensors are very accurately aligned and fixed to the vertical magnetic field and are not influenced by localised magnetic fields or disturbed by vibration. Although a zero median traverse algorithm can remove anomalies aligned with the survey tracks, in practice this rarely occurs due to the use of long traverses, high resolution measurement and variability within the magnetic susceptibility of long linear features.

2.3.3 Appendix C contains metadata concerning the survey and data attributes and is derived directly from TerraSurveyor. Reference should be made to Appendix B for further information on any processes, such as clipping, carried out on the data.

2.3.4 A TIF file is produced by TerraSurveyor software along with an associated world file (.TFW) that allows automatic georeferencing (OSGB36 datum) when using GIS or CAD software. The main form of data display used in the report is the minimally processed greyscale plot.

2.3.5 The raster images are combined with base mapping using ProgeCAD Professional 2014, creating DWG (2010) file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical quality. The CAD plots are effectively georeferenced facilitating relocation of features using GPS, resection method, etc.

2.3.6 An abstraction and interpretation is also drawn and plotted for all geophysical anomalies located by the survey. Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing.

2.3.7 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.

2.3.8 A digital archive is produced with this report, see Appendix D below. The main archive is held at the offices of Archaeological Surveys Ltd.

3 RESULTS

3.1 General assessment of survey results

3.1.1 The detailed magnetic survey was carried out over a total of 10 survey areas covering approximately 23ha.

3.1.2 Magnetic anomalies located can be generally classified as positive and negative anomalies of an uncertain origin, linear anomalies of an agricultural origin, anomalies with a natural 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.

3.2 Statement of data quality

3.2.1 Data are considered representative of the magnetic anomalies present within the site. There are no significant defects within the dataset. Localised areas of magnetic debris and disturbance have the potential to obscure anomalies of archaeological potential although this appears unlikely.

3.3 Data interpretation

3.3.1 The list 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 referencing 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 there is not enough evidence to confidently suggest an origin. Anomalies in this category may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered. 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 AS-ABST MAG LAND DRAIN 	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. Land drains can appear in a classic herringbone pattern of interconnected multiple dipolar linear anomalies, or as

	parallel linear anomalies. The multiple dipolar response indicates a ceramic land drain.
Anomalies with an agricultural origin AS-ABST MAG AGRICULTURAL 	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 with a natural origin AS-ABST MAG NATURAL FEATURES	Naturally formed magnetic anomalies are are caused by localised variability in the magnetic susceptibility of soils, subsoils and other drift or solid geologies. Anomalies may be amorphous, linear or curvilinear and may appear 'fluvial' or discrete; the latter are almost impossible to distinguished from pit-like anomalies with an anthropogenic origin. Fluvial, glacial and periglacial processes may be responsible for their formation within drift material and subsoil. Igneous and metamorphic activity can lead to anomalies within more solid geology.
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 1: List and description of interpretation categories

3.4 List of anomalies - Area 1

Area centred on OS NGR 448482 272075, see Figures 05 & 06.

Anomalies with an uncertain origin

(1) - The survey area contains a small number of positive linear anomalies. They do not have a coherent form or pattern and are generally very weak (<1nT).

(2) - A large number of discrete positive responses are located within the survey area. They have a response of 10-15nT, with some peaking at 35-60nT. It is possible that they are associated with natural features, such as tree throw pits, although their moderately strong response may indicate an association with

burning.

Anomalies associated with magnetic debris

(3) - Magnetic debris at the north western corner of the field is likely to relate to modern ground consolidation.

(4) - The survey area contains widespread and numerous strong, discrete, dipolar anomalies that relate to ferrous and other magnetically thermoremnant objects within the topsoil. The majority of the survey areas contain large numbers of these responses indicating that the material has been incorporated through the process of manuring.

Anomalies with a modern origin

(5) - A strong, multiple dipolar, linear anomaly extends across the survey area from east to west and relates to a buried water pipe. It continues westwards into Area 7.

3.5 List of anomalies - Area 2

Area centred on OS NGR 448358 272250, see Figures 06 & 07.

Anomalies with an uncertain origin

(6 & 7) - Two weakly positive linear anomalies can be seen in the north western part of the survey area. They have a response of around 1.5nT, and appear to be fragmented. Other linear anomalies are parallel with them at the northern end of anomaly (7). While this type of response may indicate cut, ditch-like features, they do not appear to extend northwards or westwards beyond Area 2 into adjacent survey areas. It is possible that they relate to former field boundaries, and although this part of the site has been sectioned off into smaller land parcels in the past, the orientation of the former land divisions seen on aerial images is slightly different to these anomalies.

(8) - A positive linear anomaly, with an east north east to west south west orientation is located in the south eastern part of the survey area. It is possible that it relates to a cut, ditch-like feature; however, it does not appear to extend eastwards into Area 3, stopping close to the field boundary. Other short, positive linear anomalies of uncertain origin are located close to it.

(9) - A short, weakly positive linear anomaly may relate to a former field boundary. This part of the site was sub-divided into smaller land parcels until recently.

(10) - The survey area contains a number of discrete positive responses with no coherent patter or grouping. They have a similar form and response to anomalies (2) seen in Area 1, possibly indicating a natural origin, such as tree throw pits.

Anomalies associated with magnetic debris

(11) - A linear zone of weakly magnetic debris can be seen in the eastern part of the survey area. This lies close to, but not on the line of, a recently removed land division. This response relates to a spread of weakly magnetically thermoremnant material.

(12) - Strongly magnetic debris is located in the north western corner of the survey area. The response is caused by strongly magnetically thermoremnant and ferrous material and correlates with an uneven area within the field.

3.6 List of anomalies - Area 3

Area centred on OS NGR 448515 272195, see Figures 05 & 06.

Anomalies with an uncertain origin

(13) - A weakly positive fragmented linear anomaly extends across much of the southern part of the survey area. It is possible that this relates to a cut, ditch-like feature.

(14) - The survey area contains a number of weakly positive and negative linear anomalies. They do not appear to have any coherent morphology or pattern and it is not possible to determine their origin.

(15) - A number of discrete positive responses are evident within the survey area. It is possible that they relate to natural features, such as tree throw pits, although there is a line of them extending northwards from anomaly (13).

Anomalies associated with magnetic debris

(16) - The entire survey area contains numerous ferrous and other magnetically thermoremnant objects within the topsoil with a patch evident towards the western edge of the field. These are likely to be associated with material spread through the process of manuring.

3.7 List of anomalies - Area 4

Area centred on OS NGR 448430 272350, see Figures 09 & 10.

Anomalies with an uncertain origin

(17) - Positive linear anomalies with a dendritic form can be seen in the eastern part of the survey area. The response is partly dipolar, and the layout may indicate land drains, although they are a very small, isolated group.

(18) - A group of discrete positive responses are located towards the northern edge of the survey area. They have a response of 10-15nT. A number of other discrete responses are evident throughout the survey area. These are similar to those seen elsewhere within the site.

(19) - A negative linear anomaly extends for at least 50m north eastwards from the south western corner of the survey area. It corresponds to a mark seen on aerial photographs; however, it is not possible to determine if it relates to a drain, pipe, rut or other feature. A number of positive linear anomalies are also evident, but again they lack a coherent morphology.

Anomalies associated with land management

(20) - A positive linear anomaly with a line of associated strong, discrete, dipolar anomalies is a response to a recently removed field boundary.

Anomalies with an agricultural origin

(21) - A series of parallel linear responses are associated with agricultural activity.

Anomalies with a natural origin

(22) - Much of the site contains magnetically variable responses which are generally very weak. A more apparent zone is located in the northern part of the survey area, with a response of approximately ±1nT, and is related to natural variations within the underlying drift deposits.

Anomalies associated with magnetic debris

(23) - The survey area contains numerous strong, discrete, dipolar anomalies with a linear zone of these towards the centre.

3.8 List of anomalies - Area 5

Area centred on OS NGR 448045 272465, see Figures 11 & 12.

Anomalies with an uncertain origin

(24) - A group of positive linear and discrete responses are located in the central southern part of the survey area. It is not possible to determine if they relate to cut features, or if they are natural in origin.

(25) - A weakly positive linear anomaly is located in the south western part of the survey area. Others can be seen further to the north east. It is possible that they are associated with cut features; however, they are very indistinct, partly due to the presence of natural, variable responses.

Anomalies with a modern origin

(26) - A strong, multiple, dipolar, linear anomaly is a response to a buried service or pipe which extends south eastwards into Area 6 (28).

3.9 List of anomalies - Area 6

Area centred on OS NGR 448085 272372, see Figures 11 & 12.

Anomalies with an uncertain origin

(27) - The survey area contains a small number of discrete positive responses.

Anomalies with a modern origin

(28) - A service or pipe extends south eastwards from Area 5 and then links to a second service or pipe extending along the south eastern edge of the survey area.

3.10 List of anomalies - Area 7

Area centred on OS NGR 448263 272045, see Figures 13 & 14.

Anomalies with an uncertain origin

(29) - The survey area contains a number of discrete, pit-like responses. As elsewhere, they may relate to natural features.

Anomalies with an agricultural origin

(30) - A number of parallel linear anomalies extend across the survey area. They may relate to agricultural activity, land drainage or land division.

Anomalies associated with magnetic debris

(31) - A zone of very strongly magnetic debris can be seen in the north eastern corner of the survey area. This was until recently a small paddock, or horse training area, and magnetically thermoremnant material has been distributed across it.

Anomalies with a modern origin

(32) - A water pipe extends across the southern part of the survey area and continues as anomaly (5) within Area 1 to the east.

3.11 List of anomalies - Area 8

Area centred on OS NGR 448160 272320, see Figures 15 & 16.

Anomalies with an uncertain origin

(33) - A number of small, pit-like responses are located in the survey area.

(34) - Two weakly positive linear anomalies, may relate to cut features, agricultural anomalies or former land division.

Anomalies with a modern origin

(35) - A modern pipe of service crosses the eastern part of the survey area and continues southwards into Area 9.

3.12 List of anomalies - Area 9

Area centred on OS NGR 448210 272195, see Figures 17 & 18.

Anomalies with an uncertain origin

(36) - The survey area contains a number of discrete, pit-like responses.

(37) - A number of short, positive linear anomalies with no coherent form or pattern have been located within the survey area.

Anomalies associated with land management

(38) - Several weakly dipolar linear anomalies relate to land drainage.

3.13 List of anomalies - Area 10

Area centred on OS NGR 448232 272540, see Figures 19 & 20.

Anomalies with an uncertain origin

(39 & 40) - A positive linear anomaly can be seen in the eastern part of the survey area (39), with another joining it on its western side (40). These anomalies appear to relate to cut, ditch-like features; however, anomaly (39) extends between two former gravel pits, now ponds, one within the survey area and one just beyond to the south east and an association with pipes or drainage should be considered. It is also possible that anomaly (39) has an association with anomaly (42) to the north west of the pond.

(41) - A small number of discrete positive responses can be seen in the survey area.

Anomalies associated with land management

(42) - A partly positive linear anomaly and partly weakly dipolar linear anomaly extends from a zone of magnetic debris (44) towards the north west. This is on a similar orientation and may be a continuation of anomaly (39); however, the dipolar response indicates that it relates to a ceramic land drain or pipe.

Anomalies with a natural origin

(43) - The area contains magnetically variable responses most evident in the northern and eastern sections. These anomalies relate to natural variation within the underlying gravels.

Anomalies associated with magnetic debris

(44) - A zone of magnetic debris to the north of the pond is related to dumped material.

Anomalies with a modern origin

(45) - A pipe extends towards, or from the pond within the central part of the survey area.

4 DISCUSSION

4.1.1 Area 1, located in the south eastern part of the site, within Cherry Tree Farm, contains a large number of pit-like responses. The have no coherent form or pattern and may relate to natural features. Short positive linear anomalies also lack a coherent layout and cannot be confidently attributed to cut features. A water pipe also crosses the survey area.

4.1.2 Areas 2 and 3 lie to the north of Area 1 and both contain a number of weakly positive linear anomalies. Within Area 2, two such anomalies may join to form a rectilinear feature; however, they do not appear to extend northwards and westwards and are confined within the existing field layout. There is no mapped record of linear field boundaries with the same orientation. Other linear anomalies within the two areas are generally short and lack a coherent morphology. A number of pit-like responses are also evident, and as elsewhere, may relate to natural features. Magnetic debris is also located within the two areas, some is very strong and relates to dumped modern material, other zones are much weaker.

4.1.3 Area 4 is located in the eastern part of Cherry Tree Farm and contains an

unusual dendritic arrangement of positive linear anomalies. They may have some dipolarity and it is possible that the relate to land drains, although they do not extend far. A number of short positive and negative linear anomalies are also evident, but they lack a coherent morphology. A zone of weakly magnetically variable responses relates to natural variations within the underlying geology/sands and gravels. Other stronger discrete anomalies appear pit-like in form, but it is possible that these too relate to natural features.

4.1.4 Areas 5 & 6 are situated at the north western edge of the site within Dunkley's Farm and Area 8 to the south in Cherry Tree Farm. Area 5 contains a number of weakly positive linear, possible curvilinear and discrete responses, but they are poorly defined. Area 6 contains a small number of discrete positive responses and a buried service. Area 8 also contains pit-like responses and two weakly positive linear anomalies along with a service.

4.1.5 Area 7 lies in the south western part of the site within Cherry Tree Farm. It contains a number of discrete positive responses and two positive linear anomalies. A steel water pipe crosses the survey area and a number of linear anomalies that appear to relate to agricultural cultivation or gullies.

4.1.6 Area 9 contains many small paddocks, some of which were unsurveyable. A number of land drains are located with the area, and several discrete positive responses and positive linear anomalies. However, these lack a coherent morphology preventing confident interpretation.

4.1.7 Area 10 is situated in the northern part of the site within Dunkley's Farm. A former gravel pit, now a pond, and patches of tall weeds prevented survey across the whole survey area. Two positive linear anomalies can be seen at the eastern edge, and while this type of response may indicate cut linear ditches, one of these linear anomalies is situated between the pond in the field and another pond immediately to the east. Other short positive linear responses can also be seen, as well as zones of natural features.

5 CONCLUSION

5.1.1 The detailed magnetometer survey was carried out over 23ha within ten survey areas and located a large number of discrete positive responses across the site. They do not appear to have a coherent morphology or pattern. It is likely that the majority relate to natural features, either associated with glacial/periglacial processes or possible tree throw pits. However, many of these pit-like responses are moderately enhanced which may indicate an association with burning. Zones of weakly magnetically variable responses, relating to natural variations within the underlying sand and gravel deposits, can be seen within the site.

5.1.2 A number of the survey areas contain weakly positive linear anomalies, and while this type of response may indicate cut linear ditches, the majority of them are confined within the existing land boundaries possibly indicating an association with agricultural activity. Many others are weak, short or fragmented and cannot be confidently interpreted.

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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 SENSYS gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 65cm apart. The instrument is carried about 10-20cm 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.

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 ±20nT and ±10nT 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 (destripe) 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 differences between the baseline value of gradiometer sensors.

High Pass Filtering

A mathematical process used to remove low frequency anomalies relating to survey tracks and modern agricultural features.

Appendix C – survey and data information

Area 1

COMPOSITE
Path: C:\Business\Jobs\J612 Dunchurch\Data\Area 1\comps\
Filename: J612-mag-Area1-proc.xcp
Description: Imported as Composite from: J612-mag-Area1.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 448354.155011041, 272153.245169244 m
Southeast corner: 448600.305011041, 271991.095169244 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 4231500

Dimensions
Composite Size (readings): 1641 x 1081
Survey Size (meters): 246 m x 162 m
Grid Size: 246 m x 162 m
X Interval: 0.15 m
Y Interval: 0.15 m

Stats
Max: 5.00
Min: -5.00
Std Dev: 2.04
Mean: -0.07
Median: -0.14
Composite Area: 3.9913 ha
Surveyed Area: 2.944 ha

Processes: 2
1 Base Layer
2 Clip from -5.00 to 5.00 nT

GPS based Proce2
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).

Area 2

COMPOSITE
Path: C:\Business\Jobs\J612 Dunchurch\Data\Area 2\comps\
Filename: J612-mag-Area2-proc.xcp
Description: Imported as Composite from: J612-mag-Area2.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 448252.66257447, 272336.854360144 m
Southeast corner: 448456.18257447, 272140.854360144 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 3693750

Dimensions
Composite Size (readings): 1272 x 1225
Survey Size (meters): 204 m x 196 m
Grid Size: 204 m x 196 m
X Interval: 0.16 m
Y Interval: 0.16 m

Stats
Max: 5.53
Min: -5.50
Std Dev: 1.65
Mean: -0.08
Median: -0.09
Composite Area: 3.989 ha
Surveyed Area: 2.2475 ha

Processes: 1
1 Base Layer

GPS based Proce3
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 Clip from -5.00 to 5.00 nT

Area 3

COMPOSITE
Path: C:\Business\Jobs\J612 Dunchurch\Data\Area 3\comps\
Filename: J612-mag-Area3-proc.xcp
Description: Imported as Composite from: J612-mag-Area3.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 448440.841214967, 272268.414418985 m
Southeast corner: 448592.191214967, 272148.114418985 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 2281750

Dimensions
Composite Size (readings): 1009 x 802
Survey Size (meters): 151 m x 120 m
Grid Size: 151 m x 120 m
X Interval: 0.15 m
Y Interval: 0.15 m

Stats
Max: 5.53
Min: -5.50
Std Dev: 1.60
Mean: -0.06
Median: -0.09
Composite Area: 1.8207 ha
Surveyed Area: 1.408 ha

Processes: 1
1 Base Layer

GPS based Proce3
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 Clip from -5.00 to 5.00 nT

Area 4

COMPOSITE
Path: C:\Business\Jobs\J612 Dunchurch\Data\Area 4\comps\
Filename: J612-mag-Area4-proc.xcp
Description: Imported as Composite from: J612-mag-Area4.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 448258.587245457, 272449.330953835 m
Southeast corner: 448583.187245457, 272245.930953835 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 6202750

Dimensions
Composite Size (readings): 2164 x 1356
Survey Size (meters): 325 m x 203 m
Grid Size: 325 m x 203 m
X Interval: 0.15 m
Y Interval: 0.15 m

Stats
Max: 5.53
Min: -5.50
Std Dev: 1.41
Mean: -0.07
Median: -0.09
Composite Area: 6.6024 ha
Surveyed Area: 3.9817 ha

Area 5

COMPOSITE
Path: C:\Business\Jobs\J612 Dunchurch\Data\Area 4\comps\
Filename: J612-mag-Area4-proc.xcp
Description: Imported as Composite from: J612-mag-Area4.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB236
Northwest corner: 448258.587245457, 272449.330953835 m
Southeast corner: 448583.187245457, 272245.930953835 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 6202750

Dimensions
Composite Size (readings): 2164 x 1356
Survey Size (meters): 325 m x 203 m
Grid Size: 325 m x 203 m
X Interval: 0.15 m
Y Interval: 0.15 m

Stats
Max: 5.53
Min: -5.50
Std Dev: 1.41
Mean: -0.07
Median: -0.09
Composite Area: 6.6024 ha
Surveyed Area: 3.9817 ha

Area 5

COMPOSITE
Path: C:\Business\Jobs\J612 Dunchurch\Data\Area 5\comps\
Filename: J612-mag-Area5-proc.xcp
Description: Imported as Composite from: J612-mag-Area5.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y): OSGB36
Northwest corner: 447975.405269014, 272550.420390898 m
Southeast corner: 448127.865269014, 272369.520390898 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 2309000

Dimensions
Composite Size (readings): 847 x 1005
Survey Size (meters): 152 m x 181 m
Grid Size: 152 m x 181 m
X Interval: 0.18 m
Y Interval: 0.18 m

Stats
Max: 5.53
Min: -5.50
Std Dev: 1.54
Mean: -0.05
Median: -0.08
Composite Area: 2.758 ha
Surveyed Area: 1.5029 ha

Processes: 1
1 Base Layer

GPS based Proce3
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 Clip from -5.00 to 5.00 nT

Area 6

COMPOSITE
Path: C:\Business\Jobs\J612 Dunchurch\Data\Area 6\comps\
Filename: J612-mag-Area6-proc.xcp
Description: Imported as Composite from: J612-mag-Area6.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 448043.778047005, 272433.452636507 m
Southeast corner: 448123.728047005, 272312.102636507 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 1067000

Dimensions
Composite Size (readings): 533 x 809
Survey Size (meters): 80 m x 121 m
Grid Size: 80 m x 121 m
X Interval: 0.15 m
Y Interval: 0.15 m

Stats
Max: 5.53
Min: -5.50
Std Dev: 2.02
Mean: -0.03
Median: -0.11
Composite Area: 0.97019 ha
Surveyed Area: 0.56822 ha

Processes: 1
1 Base Layer

GPS based Proce3
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 Clip from -5.00 to 5.00 nT

Area 7

COMPOSITE
Path: C:\Business\Jobs\J612 Dunchurch\Data\Area 7\comps\
Filename: J612-mag-Area7-proc.xcp
Description: Imported as Composite from: J612-mag-Area7.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 448185.14582081, 272124.217720376 m
Southeast corner: 448327.49582081, 271980.667720376 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 1896000

Dimensions
Composite Size (readings): 949 x 957
Survey Size (meters): 142 m x 144 m
Grid Size: 142 m x 144 m
X Interval: 0.15 m
Y Interval: 0.15 m

Stats
Max: 5.53
Min: -5.50
Std Dev: 2.46
Mean: -0.10
Median: -0.08
Composite Area: 2.0434 ha
Surveyed Area: 1.2285 ha

Processes: 1
1 Base Layer

GPS based Proce3
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 Clip from -5.00 to 5.00 nT

Area 8

COMPOSITE
Path: C:\Business\Jobs\J612 Dunchurch\Data\Area 8\comps\
Filename: J612-mag-Area8.xcp
Description: Imported as Composite from: J612-mag-Area8-proc.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 448076.380962122, 272379.119815977 m
Southeast corner: 448258.360962122, 272254.379815977 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 1510750

Dimensions
Composite Size (readings): 1011 x 693
Survey Size (meters): 182 m x 125 m
Grid Size: 182 m x 125 m
X Interval: 0.18 m
Y Interval: 0.18 m

Stats
Max: 5.53
Min: -5.50
Std Dev: 2.04
Mean: -0.09
Median: -0.05
Composite Area: 2.27 ha
Surveyed Area: 0.97527 ha

Processes: 1
1 Base Layer

GPS based Proce3
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 Clip from -5.00 to 5.00 nT

Area 9

COMPOSITE
Path: C:\Business\Jobs\J612 Dunchurch\Data\Area 9\comps\
Filename: J612-mag-Area9.xcp
Description: Imported as Composite from: J612-mag-Area9-proc.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 448098.187190951, 272276.073884173 m

Southeast corner: 448286.737190951, 272078.523884173 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 2774000

Dimensions
Composite Size (readings): 1257 x 1317
Survey Size (meters): 189 m x 198 m
Grid Size: 189 m x 198 m
X Interval: 0.15 m
Y Interval: 0.15 m

Stats
Max: 5.53
Min: -5.50
Std Dev: 1.61
Mean: -0.06
Median: -0.09
Composite Area: 3.7248 ha
Surveyed Area: 1.8274 ha

Processes: 1
1 Base Layer

GPS based Proce3
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 Clip from -5.00 to 5.00 nT

Area 10

COMPOSITE
Path: C:\Business\Jobs\J612 Dunchurch\Data\Area 10\comps\
Filename: J612-mag-Area10-proc-hpf.xcp
Description: Imported as Composite from: J612-mag-Area10.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):
Northwest corner: 448142.260736821, 272673.762409026 m
Southeast corner: 448346.500736821, 272433.762409026 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702

Source GPS Points: 746700

Dimensions
Composite Size (readings): 1702 x 2000
Survey Size (meters): 204 m x 240 m
Grid Size: 204 m x 240 m
X Interval: 0.12 m
Y Interval: 0.12 m

Stats
Max: 5.53
Min: -5.50
Std Dev: 1.53
Mean: 0.04
Median: 0.01
Composite Area: 4.9018 ha
Surveyed Area: 2.0893 ha

Processes: 1
1 Base Layer

GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 High pass Uniform (median) filter: Window dia: 300
4 Clip from -5.00 to 5.00 nT

Appendix D – digital archive

Archaeological Surveys Ltd hold the primary digital archive at their offices in Wiltshire. 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.

Three printed copies of the report and a PDF copy will be supplied to the Warwickshire Historic Environment Record. The report will also be uploaded to the Online AccesS to the Index of archaeological investigationS (OASIS). A summary of the survey will also be supplied to *West Midlands Archaeology.*

Archive contents:

Geophysical data - path: J612 Dunchurch\Data				
Path and Filename	**Software**	**Description**	**Date**	**Creator**
dunchurch1\MX\ to dunchuch10\MX .prm, .dgb, .disp	Sensys MXPDA	Proprietary data formats representing magnetometer survey traverses logged to a PDA.	18/05/15 to 03/07/15	D.J.Sabin
dunchurch1\MX\J612-mag-Area1.asc to dunchuch10\MX\J612-mag-Area10.asc	Sensys DLMGPS	ASCII CSV (tab) file representing survey Area 1 in eastings, northings (UTM Z30N), magnetic measurement, traverse file and sensor number.	18/05/15 to 03/07/15	D.J.Sabin
Area1\comps\J612-mag-Area1.xcp to Area10\comps\J612-mag-Area10.xcp	TerraSurveyor 3.0.23.0	Composite data file derived from ASCII CSV.	18/05/15 to 03/07/15	K.T.Donaldson
Area1\comps\J612-mag-Area1-proc.xcp to Area10\comps\J612-mag-Area10-proc.xcp	TerraSurveyor 3.0.23.0	Processed composite data file (zmt and clipping to ±5nT).	18/05/15 to 03/07/15	K.T.Donaldson
Graphic data - path: J612 Dunchurch\Data				
Area1\graphics\ J612-mag-Area1-proc.tif to Area10\graphics\ J612-mag-Area10-proc.tif	TerraSurveyor 3.0.23.0	TIF file showing a minimally processed greyscale plot clipped to ±3nT.	01/06/15 to 13/07/15	K.T.Donaldson
Area1\graphics\ J612-mag-Area1-proc.tfw to Area10\graphics\ J612-mag-Area10-proc.tfw	TerraSurveyor 3.0.23.0	World file for georeferencing TIF to OSGB36.	01/06/15 to 13/07/15	K.T.Donaldson
CAD data - path: J612 Dunchurch\CAD				
J612 version 1.dwg	ProgeCAD 2014	CAD file for creating plots of greyscales, abstraction, interpretation and mapping. Grid coordinates as OSGB. AutoCAD 2010 format.	02/06/15	K.T.Donaldson
Text data - path: J612 Dunchurch\Documentation				
J612 report.odt	OpenOffice.org 3.0.1 Writer	Report text as an Open Office document.	25/06/15	K.T.Donaldson

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