

**Land to the west of Royston Road
Barkway
Hertfordshire**

MAGNETOMETER SURVEY REPORT

for

Arbora Homes

Kerry Donaldson & David Sabin

September 2017

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ARCHAEOLOGICAL SURVEYS LTD

**Land to the west of Royston Road
Barkway
Hertfordshire**

Magnetometer Survey Report

for

Arbora Homes

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Primary archive location - Archaeological Surveys Ltd, Yatesbury, Wiltshire

Survey date – 18th August 2017

Ordnance Survey Grid Reference – **TL 38200 36280**



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CONTENTS

SUMMARY.....	1
1 INTRODUCTION.....	1
1.1 Survey background.....	1
1.2 Survey objectives and techniques.....	1
1.3 Site location, description and survey conditions.....	2
1.4 Site history and archaeological potential.....	3
1.5 Geology and soils.....	4
2 METHODOLOGY.....	4
2.1 Technical synopsis.....	4
2.2 Equipment configuration, data collection and survey detail.....	5
2.3 Data processing and presentation.....	6
3 RESULTS.....	7
3.1 General assessment of survey results.....	7
3.2 Statement of data quality and factors influencing the interpretation of anomalies....	7
3.3 Data interpretation.....	8
3.4 List of anomalies	9
4 DISCUSSION.....	10
5 CONCLUSION.....	11
6 REFERENCES.....	11
Appendix A – basic principles of magnetic survey.....	13
Appendix B – data processing notes.....	14
Appendix C – survey and data information.....	14
Appendix D – digital archive.....	15

Appendix E – copyright and intellectual property.....16

Appendix F – Hertfordshire Historic Environment Record Summary Sheet.....17

Appendix G – OASIS data collection form.....18

LIST OF FIGURES

Fig 01 Map of survey area (1:25 000)

Fig 02 Referencing information (1:1000)

Fig 03 Greyscale plot of minimally processed magnetometer data (1:1000)

Fig 04 Greyscale plot of filtered magnetometer data (1:1000)

Fig 05 Abstraction and interpretation of magnetic anomalies (1:1000)

Fig 06 Greyscale plot of filtered magnetometer data abstraction and interpretation of magnetic anomalies showing approximate line of mast clearance zone (1:1250)

LIST OF PLATES

Plate 1: Survey area looking south-east.....3

LIST OF TABLES

Table 1: List and description of interpretation categories.....9

SUMMARY

A geophysical survey, comprising detailed magnetometry, was carried out by Archaeological Surveys Ltd at Barkway in Hertfordshire. The south-eastern part of the site is being considered for a potential residential development, but a larger site was subject to survey in order to place any anomalies within context. The results of the survey demonstrate the presence of two parallel positive linear anomalies that appear to relate to parallel ditches, possibly indicating a trackway. Further positive linear anomalies have also been located in the western part of the site, and although they may relate to cut features, they are likely to continue further to the west beyond the site boundary and cannot be confidently interpreted. A broad zone of slight magnetic enhancement within the northern part of the site relates to natural variation in the soil or shallow geology, and other slightly stronger linear and discrete anomalies within this zone may also have a natural origin. Several anomalies appear to relate to discrete pit-like responses which contain magnetically enhanced material, although it is not clear if they relate to anthropogenic activity or to increased depth of topsoil within naturally formed depressions. A small number of amorphous positive responses in the southern part of the site indicate some form of infilled ground disturbance, possibly former quarrying although a natural origin is possible.

1 INTRODUCTION

1.1 *Survey background*

- 1.1.1 Archaeological Surveys Ltd was commissioned by Shelley Coffey of Rural Solutions, on behalf of Arbora Homes, to undertake a magnetometer survey of an area of land to the west of Royston Road, Barkway, Hertfordshire. The survey would provide information on the archaeological potential of land likely to be disturbed by a potential residential development. An outline planning application (No:17/00700/1) was refused by North Hertfordshire District Council, with the archaeological consultation response indicating that there needed to be archaeological investigation to include geophysical survey, and subsequent field evaluation, in order to allow for an informed decision to be made on the archaeological resource.
- 1.1.2 The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Archaeological Surveys (2017). The WSI has been submitted to the client and provides a framework against which the results of the survey can be measured.

1.2 *Survey objectives and techniques*

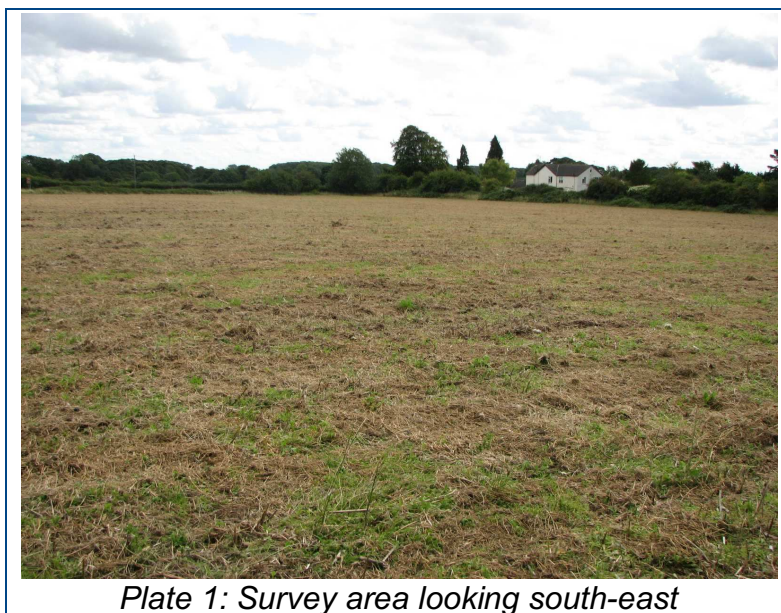
- 1.2.1 The objectives of the survey are to use non-intrusive geophysical techniques to establish the presence/absence, extent, condition, character, quality and date of any archaeological deposits within the proposed development area.

The public open space at the north-western end of the site will also be surveyed in order to maximise the information gathered and put anomalies in context.

- 1.2.2 The survey and report generally follow the recommendations set out by: English Heritage (2008) *Geophysical survey in archaeological field evaluation*; European Archaeological Council (2015) *Guidelines for the Use of Geophysics in Archaeology*; Institute for Archaeologists (2002) *The use of Geophysical Techniques in Archaeological Evaluations*; Chartered Institute for Archaeologists (2014) *Standard and Guidance for Archaeological Geophysical Survey* and Gurney, D. (2003) *Standards for Field Archaeology in the East of England*.

1.3 Site location, description and survey conditions

- 1.3.1 The site is located on land to the west of Royston Road, Barkway, Hertfordshire. It is centred on Ordnance Survey National Grid Reference (OS NGR) TL 38200 36280, see Figs 01 & 02. The proposed residential development is outlined only for the south-eastern part of the field, the north-western part of the site will remain public open space allowing for a 121m radius clearance zone from the telecoms mast to the west (see Fig 06).
- 1.3.2 The geophysical survey covers approximately 2.7ha of agricultural land. Prior to the survey a cover of wild vegetation had been mown resulting in short ground cover. The land is elevated at approximately 150m AODN and slopes down gently towards the south but with land immediately to the north of the site falling more steeply and marking the northern edge of an easterly extension to the Chiltern Hills. Immediately to the west of the site there is a wireless station with a tall mast and buildings within a compound surrounded by wire mesh. To the east and north-east the site is bounded by a ditch and occasional trees, with a residential area to the south beyond a hedgerow and arable land to the south-west.



- 1.3.3 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data. The very tall mast to the west of the site was considered likely to produce magnetic disturbance, and the orientation of the survey was chosen to minimise this. Weather conditions during the survey were mainly fine.

1.4 *Site history and archaeological potential*

- 1.4.1 The site lies within close proximity to a number of archaeological sites indicating that there is significant archaeological potential for the site to contain further archaeological features. The Hertfordshire Historic Environment Record (HER) outlines that it lies just to the east of a cropmark of a ring ditch relating to a probable Bronze Age round barrow (HER: 6514) and a prehistoric trackway (HER: 7792). During an evaluation and field walking survey at Newsalls Park Stud Farm to the north, several undated archaeological features and scatters of Roman, medieval and post-medieval pottery were identified (HER: 11437). Geophysical survey and archaeological evaluation on land immediately to the east of Royston Road, identified a number archaeological features comprising pits, postholes and ditches containing Middle Bronze Age, Early Iron Age and Roman pottery (HER: 31209 & HER: 31210).
- 1.4.2 Located approximately 400m south-west of the site at Manyons Farm is evidence of late Iron Age and early to middle medieval occupation including a Saxo-Norman building identified during a watching brief along the line of the Royston to Buntingford gas pipeline in 1980 (HER: 6515, 6516 and 6517). The site of a post-medieval windmill and smock mill are located just to the south and east of the site (HER: 1536, HER: 5982). The site also lies immediately to the east of former RAF Barkway and wireless mast which was a monitoring station of the Eastern Chain of the GEE navigation system during the Second World War. It was later used by the United States Airforce in Europe and the site closed in 2011.

1.4.3 There are several regional research frameworks for the east of England (Glazebrook (1997), Brown & Glazebrook (2000), Medlycott & Brown (2008) and Medlycott (2011)). They have identified that the main issues for the Neolithic and Bronze Age periods are based on the development of farming and associated monuments and their interrelationships. The transition between Bronze Age and Iron Age and tribal distinctions and research into rural settlement in the Roman period have also been identified. Further information on population distribution, density and settlement in the Saxon and medieval periods is also an issue. The impact of the military within eastern England is also considered to be of importance. Given the archaeological potential of adjacent areas as outlined above, the magnetometer survey may locate additional and associated features which may help with further research.

1.5 *Geology and soils*

1.5.1 The underlying solid geology across the site is Lewes Nodular Chalk Formation and Seaford Chalk Formation with overlying deposits of Lowestoft Formation - Diamicton (Till) (BGS, 2017). The overlying till deposits are variable and date to the Anglian Stage of the Pleistocene; they are characterised by their chalk and flint content.

1.5.2 The overlying soil across the survey area is from the Hanslope association and is a typical calcareous pelosol. It consists of a slowly permeable, calcareous clayey soil (Soil Survey of England and Wales, 1983).

1.5.3 Magnetometry survey carried out across similar soils has produced variable results. Natural variability in the nature of the Lowestoft Formation may produce magnetic anomalies.

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 (FGM650) spaced 0.5m apart with readings recorded at 20 Hz. The cart is pushed at walking speed and not towed. Each sensor is not zeroed in the field as the vertical axis alignment is precisely fixed leaving sensor offsets that are removed during data processing. The fixing of the vertical alignment ensures the sensors are not unduly influenced by localised magnetic fields and that the vertical component of a magnetic anomaly is measured. The gradiometers have a range of recording data between ± 0.1 nT and $\pm 10,000$ nT. They are linked to a Leica GS10 RTK GPS with data recorded by SENSYS MAGNETO@MXPDA software on a rugged PDA computer system.
- 2.2.2 Due to the fixed offsets within the fluxgate sensors, as a result of the manufacturing and tensioning process, the survey data do not provide a visually useful dataset until a zero median traverse algorithm is applied. It is recognised that this has the potential to affect some anomalies detrimentally by removing linear features orientated parallel to survey transects. However, this has not been noted as a particular problem with the system due to the high resolution data collection, generally long length of traverses and variability within the magnetic characteristics of a linear anomaly.
- 2.2.3 Data are collected along a series of parallel survey transects to achieve 100% coverage of the surveyable land. The length of each transect is variable and relates to the size of the survey area and other factors including ground conditions. A visual display allows accurate placing of transects and helps maintain the correct separation between adjacent traverses. 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).
- 2.2.4 Fluxgate sensors are highly sensitive to temperature change and this is manifest as drift during the course of a survey. This can be particularly noticeable during the morning as temperatures rise and the equipment warms or cools. Sensor drift within the course of a traverse will appear as a line trending from negative to positive after processing with a zero median traverse algorithm. To remove the potential for

temperature drift data were collected after a 20 minute stabilisation period and traverses were limited to a time of generally <100s.

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. The software effectively allocates a geographic position for each data point and can compensate for fixed offsets present within the FGM650 sensors. The offsets are positive or negative values present on all fluxgate gradiometer sensors. Some systems use manual or electronic balancing to effectively zero the sensors; however, this is a short term measure that is prone to drift through temperature changes and vibration and can easily be incorrectly set due to localised magnetic fields. The FGM650 sensors are very accurately aligned to the vertical magnetic gradient and are highly stable showing negligible drift on long traverses. The offset values are removed using TerraSurveyor software.
- 2.3.2 Survey tracks are analysed and georeferenced raw data (UTM Z30N) are then exported in ASCII format for further analysis and display within TerraSurveyor. The removal of offset values (compensation) of the sensors is also carried out in TerraSurveyor using a zero median traverse function. Data are then considered to be minimally processed. Note: without the zero median traverse function it is not possible to create a meaningful data plot as all sensors have a different offset value. 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 The minimally processed data are collected between limits of $\pm 10000\text{nT}$ and clipped for display at $\pm 5\text{nT}$ (Fig 03). Data are interpolated to a resolution of effectively 0.5m between tracks and 0.15m along each survey track.
- 2.3.4 Additional data processing has been carried out in the form of high pass filtering (Fig 04). This effectively removes low frequency variation along a traverse that has been caused by large magnetic bodies. Data treated to additional processing has been compared to unprocessed data to ensure that no significant anomalies have been removed.
- 2.3.5 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 processing.
- 2.3.6 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. With regard to the Sensys MXPDA, minimally processed data is considered by the manufacturer to be data that is

compensated by SENSYS MAGNETO DLMGPS software, see 2.3.1 and 2.3.2. Note: traceplots are not considered to be appropriate as they do not provide an accurate or useful assessment of the magnetic anomalies due to very high density of data collection.

- 2.3.7 The raster images are combined with base mapping using ProgeCAD Professional 2016, 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.
- 2.3.8 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.
- 2.3.9 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 the survey area. Where further interpretation is possible, or where a number of possible origins should be considered, more subjective discussion is set out in Section 4.
- 2.3.10 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 approximately 2.7ha within a single pasture field.
- 3.1.2 Magnetic anomalies located can be generally classified as positive linear responses of archaeological potential, positive anomalies of an uncertain origin, anomalies relating to ground disturbance, anomalies with a natural origin, areas of magnetic disturbance and strong discrete dipolar anomalies relating to ferrous objects.
- 3.1.3 Anomalies located within each survey area have been numbered and are described in 3.4 below with subsequent discussion in Section 4.

3.2 *Statement of data quality and factors influencing the interpretation of anomalies*





- 3.2.1 Data are considered representative of the magnetic anomalies present within the site. The north-western part of the survey area contains magnetic disturbance caused by the radio mast at Barkway wireless station. The mast is

only 20m from the western edge of the site and is approximately 100m in height. Its steel construction creates a substantial magnetic anomaly affecting the vertical gradiometers up to 100m or so from its base. Buildings and other ferrous objects associated with the station have caused stronger but more localised magnetic disturbance along the north-western side of the site. The lower magnitude disturbance from the mast appears unlikely to have obscured anomalies of archaeological potential; however, strong disturbance adjacent to the boundary fence of the wireless station may obscure anomalies within very localised zones at the edge of the field.

3.2.2 Several broad linear anomalies of low or very low magnitude can be seen in the data trending north west to south east across the field. It is considered likely that these relate to natural variations in the underlying geology, possibly within the Lowestoft Formation till.

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.

Report sub-heading CAD layer names and plot colour	Description and origin of anomalies
<i>Anomalies with archaeological potential</i> AS-ABST MAG POS LINEAR ARCHAEOLOGY 	Anomalies have the characteristics (mainly morphological) of a range of archaeological features such as pits, ring ditches, enclosures, etc.
<i>Anomalies with an uncertain origin</i> AS-ABST MAG POS 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.
<i>Anomalies associated with magnetic debris</i> 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. Strong discrete dipolar anomalies are responses to ferrous objects within the topsoil.
<i>Anomalies with a modern origin</i>	The magnetic response is often strong and dipolar indicative of ferrous material and may be associated with extant above




AS-ABST MAG DISTURBANCE		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.
Anomalies associated with ground disturbance AS-ABST MAG GROUND DISTURBANCE		Magnetically variable anomalies, which may be negative, indicating a response to geology/drift deposits and/or positive indicating an increased depth of topsoil. Very strongly magnetic anomalies are a response to highly magnetic material which can be used to infill a depression. A negative response may be a response to a band of rock near the surface, or at the edge of a depression.
Anomalies with a natural origin AS-ABST MAG NATURAL FEATURES		Naturally formed magnetic anomalies 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 <u>almost impossible to distinguished from pit-like anomalies with an anthropogenic origin</u> . Fluvial, glacial and periglacial processes may be responsible for their formation within drift material and subsoil.

Table 1: List and description of interpretation categories

3.4 List of anomalies

Area centred on OS NGR 538200 236280 see Figs 03 – 06.

Anomalies of archaeological potential

(1 & 2) - Two positive linear anomalies appear to relate to linear ditches flanking a former trackway. Their western extent is not clearly defined. It is possible that the northern ditch, anomaly (1) extends towards the north-west (3); however, this also corresponds with anomalies caused by geology/drift deposits (10), and it may continue westwards as fragmented anomalies (4). The southern ditch, anomaly (2), appears to split into two near the eastern edge of the field.

Anomalies with an uncertain origin

(3) - Fragmented positive linear anomalies appear to bound a distinct zone of magnetic responses that lie to the south. They are stronger than the zone of natural responses with a magnitude of 3-5nT, similar to anomalies (1) & (2), where as the natural zone is generally less than 1nT. It is not clear, therefore, if these linear anomalies are natural in origin or if they relate to a continuation of the northern trackway ditch (1).

(4) - Weakly positive linear or fragmented linear anomalies could relate to the western extent of anomaly (1) although they are poorly defined.

(5) - A fragmented positive linear anomaly could relate to a cut feature, but it is not well defined and a natural origin is possible.

(6) - Positive linear anomalies located at the western edge of the survey area may relate to cut, ditch-like features; however, they do not appear to extend further east although they may continue beyond the western site boundary.

(7) - A narrow, weakly positive, linear anomaly extends northwards from the southern edge of the survey area. It could relate to a cut, linear ditch, possibly truncated by anomaly (9), but this is uncertain.

(8) - A number of discrete, pit-like anomalies have been located within the site, primarily close to or within the zone of natural responses. However, they are more magnetically enhanced, with a response of 5-10nT, which could indicate a fill with material produced by anthropogenic activity.

Anomalies associated with ground disturbance

(9) - The survey area contains at least three amorphous areas containing magnetically enhanced fills. This type of response may indicate ground disturbance through quarrying, although a natural origin is possible.

Anomalies with a natural origin

(10) - A well defined weakly positive zone extends across the central part of the site. This appears to relate to a band of natural material within the underlying geology/drift deposits.

Anomalies associated with magnetic debris

(11) - The site contains widespread and numerous strong, discrete, dipolar anomalies which are responses to ferrous and other magnetically thermoremanent objects within the topsoil. Such material is generally incorporated into the soil through the process of manuring.

Anomalies with a modern origin

(12) - Magnetic disturbance is a response to ferrous material within adjacent fencing, the mast to the west and moving vehicles/services to the east.

4 DISCUSSION

4.1.1 The northern part of the site contains two positive linear anomalies (1 & 2) that are generally parallel. The anomalies are situated 10.5m apart and could indicate a trackway. Such trackways can date from the prehistoric and Roman periods. The western extent of (1) is not clear, it may continue westwards as (4) or possibly diverge to the north-west as (3). Anomaly (3) also appears to bound a zone of natural magnetic enhancement (10) and, therefore, it is not

clear if (3) relates to cut features, or naturally formed features. The eastern end of linear anomalies (1 & 2) just extend within northern part of the proposed development area as defined by the mast clearance zone (see Fig 06).

- 4.1.2 Other positive linear anomalies can also be seen in the western part of the survey area (5 & 6), and although these may relate to cut features, their full extent is unclear as they are likely to continue to the west beyond the site boundary.

5 CONCLUSION

- 5.1.1 The results of the detailed magnetometer survey demonstrate the presence of two parallel linear anomalies in the northern part of the site that appear to relate to linear ditches flanking a trackway. Although it is not possible to date the ditches from the geophysics, it is likely that they extend beyond the eastern limit of the site, possibly indicating that they pre-date the existing layout of the site. These type of trackways often date to the prehistoric and/or Roman periods. The western extent of the northern linear anomaly is unclear, partly due to fragmentation and partly due to a zone of magnetic enhancement relating to a natural feature.
- 5.1.2 Other positive linear and discrete responses have also been located, but these either lack a coherent morphology, or are situated within the zone of naturally formed anomalies and are, therefore, uncertain in origin. In the southern half of the site there are a small number of amorphous responses that could indicate ground disturbance, possibly associated with quarrying, although a natural origin is possible.

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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 thermoremanent 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.

Thermoremanent 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. Thermoremanent features include ovens, hearths, and kilns. In addition thermoremanent 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 $\pm 5\text{nT}$ and $\pm 3\text{nT}$ 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, modern agricultural features and other large magnetic bodies within or adjacent to survey areas.

Low Pass Filtering

A mathematical process used to remove high frequency anomalies relating to uneven ground, vibration, etc.

Appendix C – survey and data information

Minimally processed data

Filename: J727-mag-proc.xcp
 Description: Imported as Composite from: J727-mag.asc
 Instrument Type: Sensys DLMGPS
 Units: nT
 UTM Zone: 31U
 Survey corner coordinates (X/Y): OSGB36
 Northwest corner: 538117.663606408, 236422.574459362 m
 Southeast corner: 538286.263606408, 236194.424459362 m
 Collection Method: Randomised
 Sensors: 5
 Dummy Value: 32702
 Source GPS Points: 773000

Dimensions
 Composite Size (readings): 1124 x 1521
 Survey Size (meters): 169 m x 228 m
 Grid Size: 169 m x 228 m
 X Interval: 0.15 m
 Y Interval: 0.15 m

Stats
 Max: 5.53
 Min: -5.50
 Std Dev: 1.52
 Mean: 0.09
 Median: 0.03
 Composite Area: 3.8466 ha
 Surveyed Area: 2.5904 ha

PROGRAM
 Name: TerraSurveyor
 Version: 3.0.23.0

Processes: 1
 1 Base Layer

GPS based Proce4
 1 Base Layer.
 2 Unit Conversion Layer (Lat/Long to OSGB36).
 3 DeStripe Median Traverse:
 4 Clip from -5.00 to 5.00 nT

Filtered magnetometer data

Filename: J727-mag-proc-hpf.xcp
 Description: Imported as Composite from: J727-mag.asc

Stats
 Max: 5.53
 Min: -5.50
 Std Dev: 1.33
 Mean: 0.07
 Median: 0.01
 Composite Area: 3.8466 ha
 Surveyed Area: 2.5904 ha

Processes: 1
 1 Base Layer

GPS based Proce5
 1 Base Layer.
 2 Unit Conversion Layer (Lat/Long to OSGB36).
 3 DeStripe Median Traverse:
 4 High pass Uniform (median) filter: Window dia: 300
 5 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.

A printed copy of the report and a PDF copy will be supplied to the Hertfordshire Historic Environment Record. The report will also be uploaded to the Online Access to the Index of archaeological investigationS (OASIS). Digital data can be supplied to the Hertfordshire Historic Environment Unit with any charges covered by the client.

Archive contents:

Geophysical data Area 1 - path: J727 Barkway\Data\				
Path and Filename	Software	Description	Date	Creator
barkway1\MX\ .prm .dgb .disp	Sensys MXPDA	Proprietary data formats representing magnetometer survey traverses logged to a PDA.	18/08/17	D.J.Sabin
barkway1\MX\J727-mag.asc	Sensys DLMGPS	ASCII CSV (tab) file representing survey Area 1 in eastings, northings (UTM Z30N), magnetic measurement, traverse file and sensor number.	25/08/17	K.T.Donaldson
Mag\comps\J727-mag.xcp	TerraSurveyor 3.0.23.0	Composite data file derived from ASCII CSV.	25/08/17	K.T.Donaldson
Mag\comps\J727-mag-proc.xcp	TerraSurveyor 3.0.23.0	Minimally processed (compensated) data file.	25/08/17	K.T.Donaldson
Mag\comps\J727-mag-proc-hpf.xcp	TerraSurveyor 3.0.23.0	Processed data file. High pass filtered to remove magnetic disturbance created by radio mast.	25/08/17	K.T.Donaldson
Graphic data - path: J727 Barkway\Data\				
Mag\graphics\ J727-mag-proc-5nT.tif	TerraSurveyor 3.0.23.0	TIF file showing a minimally processed greyscale plot clipped to $\pm 5nT$.	25/08/17	K.T.Donaldson
Mag\graphics\ J727-mag-proc-5nT.tfw	TerraSurveyor 3.0.23.0	World file for georeferencing TIF to OSGB36.	25/08/17	K.T.Donaldson
Mag\graphics\ J727-mag-proc-hpf-5nT.tif	TerraSurveyor 3.0.23.0	TIF file showing a high pass filtered greyscale plot clipped to $\pm 5nT$.	25/08/17	K.T.Donaldson
Mag\graphics\ J727-mag-proc-hpf-5nT.tfw	TerraSurveyor 3.0.23.0	World file for georeferencing TIF to OSGB36.	25/08/17	K.T.Donaldson
CAD data - path: J727 Barkway\CAD\				
J727 version 1.dwg	ProgeCAD 2016	CAD file for creating plots of greyscales, abstraction, interpretation and mapping. Grid coordinates as OSGB. AutoCAD 2010 format.	16/08/17	K.T.Donaldson
Text data - path: J727 Barkway\Documentation\				
J727 report.odt	OpenOffice.org 3.0.1 Writer	Report text as an Open Office document.	30/08/17	K.T.Donaldson

Appendix E – copyright and intellectual property

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Appendix F – Hertfordshire Historic Environment Record Summary Sheet

Site name and address: Land to the west of Royston Road, Barkway, Hertfordshire		
County: Hertfordshire		District: North Hertfordshire
Village/Town: Barkway		Parish: Barkway
Planning application reference: 17/00700/1		
HER Enquiry reference:		
Funding source: Developer		
Nature of application: Proposed residential development		
Present land use: Agricultural		
Size of application area: 1.4ha		Size of area investigated: 2.7ha
NGR (to 8 figures minimum): TL 38200 36280		
Site code (if applicable):		
Site director/Organization: Archaeological Surveys Ltd		
Type of work: Geophysical survey (magnetometry)		
Date of work:	Start:18/08/17	Finish: 18/08/17
Location of finds & site archive/Curating museum: Data archive, Archaeological Surveys Ltd, 1 West Nolands, Nolands Road, Yatesbury, SN11 8YD		
Related HER Nos:		Periods represented:
Relevant previous summaries/reports:		
<p>Summary of fieldwork results: Only the south-eastern part of the site is being considered for a potential residential development, but a larger site was subject to survey in order to place any anomalies within context. The results of the survey demonstrate the presence of two parallel positive linear anomalies that appear to relate to parallel ditches, possibly indicating a trackway. Further positive linear anomalies have also been located in the western part of the site, and although they may relate to cut features, they are likely to continue further to the west beyond the site boundary and cannot be confidently interpreted. A broad zone of slight magnetic enhancement within the northern part of the site relates to natural variation in the soil or shallow geology, and other slightly stronger linear and discrete anomalies within this zone may also have a natural origin. Several anomalies appear to relate to discrete pit-like responses which contain magnetically enhanced material, although it is not clear if they relate to anthropogenic activity or to increased depth of topsoil within naturally formed depressions. A small number of amorphous positive responses in the southern part of the site indicate some form of infilled ground disturbance, possibly former quarrying although a natural origin is possible.</p>		
Author of summary:Kerry Donaldson		Date of summary: 04/09/17

Appendix G – OASIS data collection form

OASIS ID: archaeol20-300123	
Project name	Land to the west of Royston Road, Barkway, Hertfordshire, Magnetometer Survey Report
Short description of the project	A geophysical survey, comprising detailed magnetometry, was carried out by Archaeological Surveys Ltd at Barkway in Hertfordshire. The south-eastern part of the site is being considered for a potential residential development, but a larger site was subject to survey in order to place any anomalies within context. The results of the survey demonstrate the presence of two parallel positive linear anomalies that appear to relate to parallel ditches, possibly indicating a trackway. Further positive linear anomalies have also been located in the western part of the site, and although they may relate to cut features, they are likely to continue further to the west beyond the site boundary and cannot be confidently interpreted. A broad zone of slight magnetic enhancement within the northern part of the site relates to natural variation in the soil or shallow geology, and other slightly stronger linear and discrete anomalies within this zone may also have a natural origin. Several anomalies appear to relate to discrete pit-like responses which contain magnetically enhanced material, although it is not clear if they relate to anthropogenic activity or to increased depth of topsoil within naturally formed depressions. A small number of amorphous positive responses in the southern part of the site indicate some form of infilled ground disturbance, possibly former quarrying although a natural origin is possible.
Project dates	Start: 18-08-2017 End: 18-08-2017
Previous/future work	Not known / Yes
Any associated project reference codes	J727 - Contracting Unit No.
Type of project	Field evaluation
Monument type	DITCH Uncertain
Significant Finds	NONE None
Methods & techniques	"Geophysical Survey"
Development type	Housing estate
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Not known / Not recorded
Solid geology	CHALK (INCLUDING RED CHALK)
Drift geology	BOULDER CLAY AND MORAINIC DRIFT
Techniques	Magnetometry
Project location	England
Site location	HERTFORDSHIRE NORTH HERTFORDSHIRE BARKWAY Land west of Royston Road, Barkway, Hertfordshire
Study area	2.7 Hectares
Site coordinates	TL 38200 36280 52.007281296835 0.013715797065 52 00 26 N 000 00 49 E Point
Name of Organisation	Archaeological Surveys Ltd
Project design originator	Archaeological Surveys Ltd
Project director/manager	Archaeological Surveys Ltd
Project archives	
Physical Archive Exists?	No
Digital Archive recipient	Archaeological Surveys Ltd
Digital Contents	"Survey"
Digital Media available	"GIS","Geophysics","Images raster / digital photography","Images vector","Text"
Paper Archive Exists?	No
Publication type	Grey literature (unpublished document/manuscript)
Title	Land west of Royston Road, Barkway, Hertfordshire, Magnetometer Survey Report
Author(s)/Editor(s)	Donaldson, K. and Sabin, D.
Other bibliographic details	Report ref J727
Date	2017
Issuer or publisher	Archaeological Surveys Ltd
Entered by	Kerry Donaldson (kerry.donaldson@archaeological-surveys.co.uk)
Entered on	06/11/01

Geophysical Survey Land west of Royston Road Barkway Hertfordshire

Map of survey area

Reproduced from OS Explorer map no.194 1:25 000
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Controller of Her Majesty's Stationery Office.
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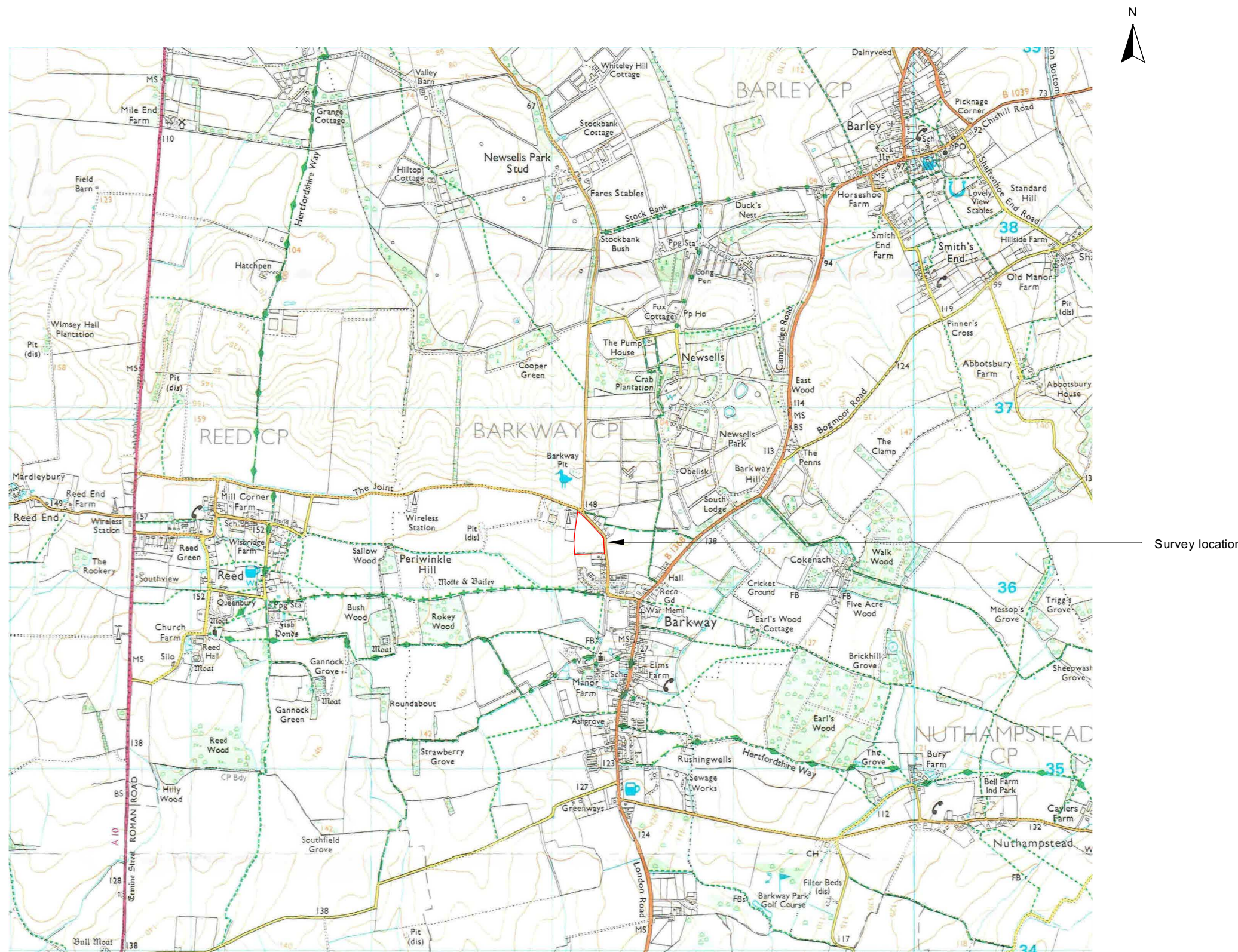
● Survey location

Site centred on OS NGR
TL 38200 36280

SCALE 1:25 000



SCALE TRUE AT A3



**Geophysical Survey
Land west of Royston Road
Barkway
Hertfordshire**

Referencing information

Referencing grid to OSGB36 datum at 50m intervals

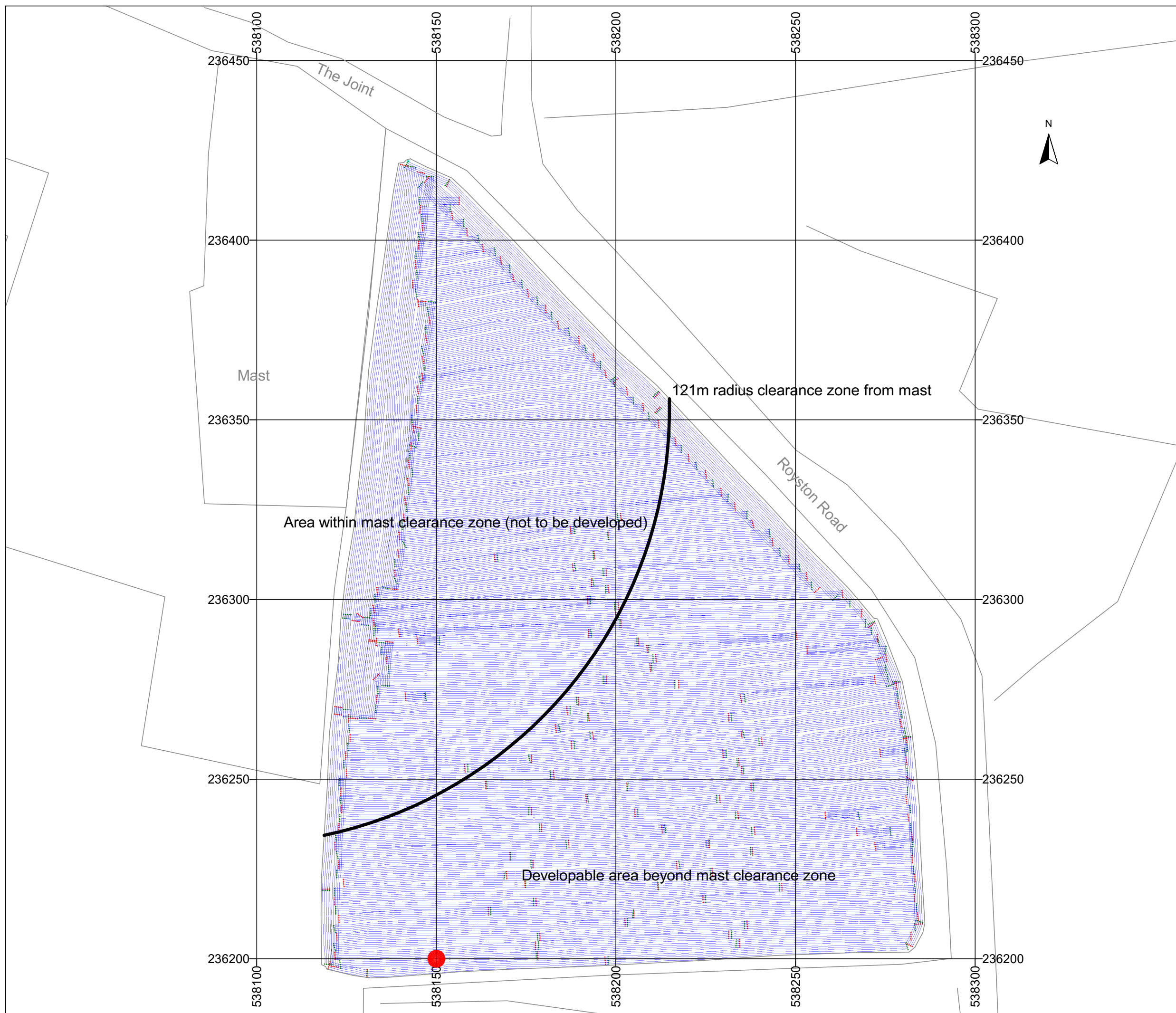
Data collected at 20Hz and georeferenced to ETRS89 zone 30 with conversion to OSGB36 using OSTN02

- 538150 236200
- Survey tracks
- ⋯ Survey track start
- ⋯ Survey track stop

SCALE 1:1000

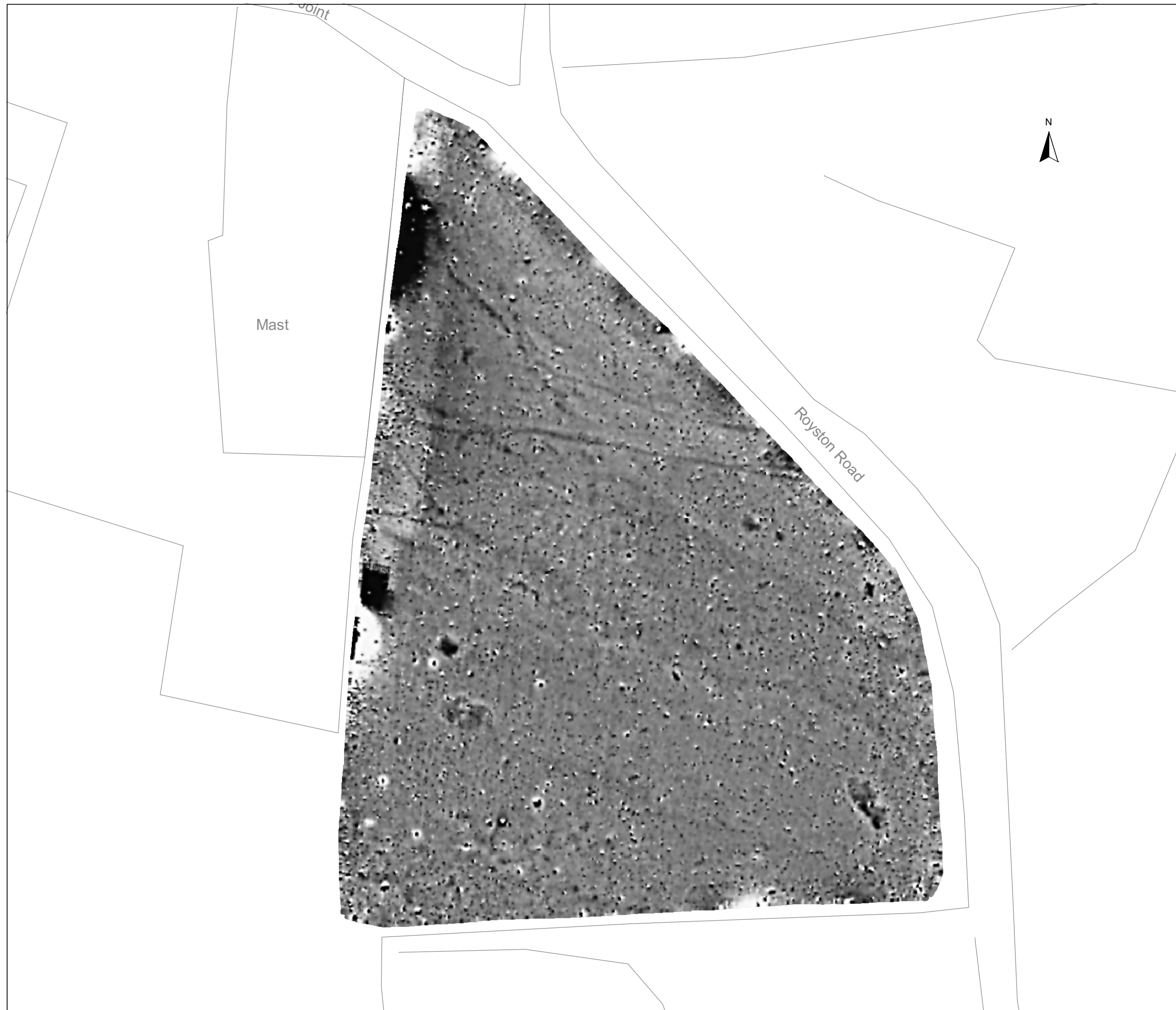
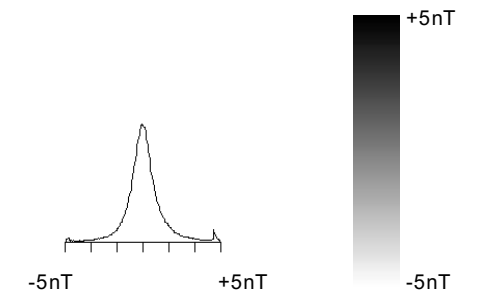


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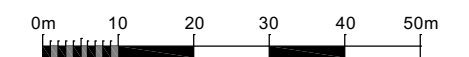


**Geophysical Survey
Land west of Royston Road
Barkway
Hertfordshire**

**Greyscale plot of minimally
processed magnetometer data**



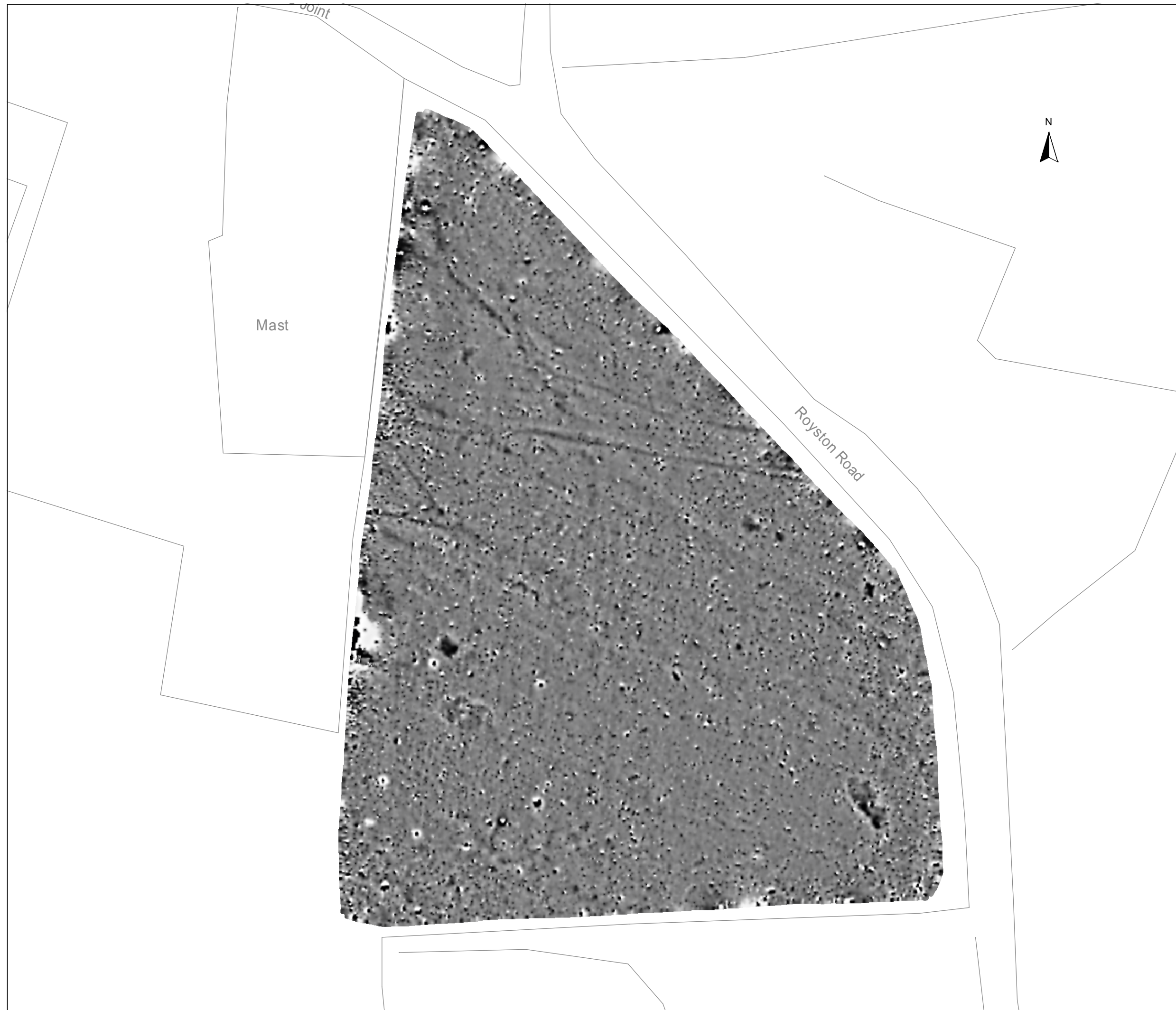
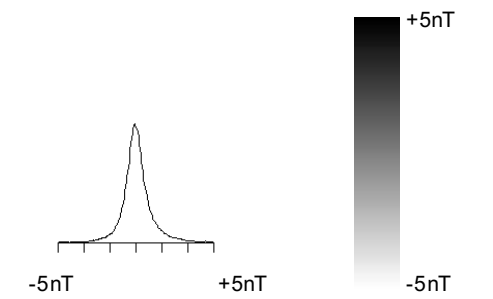
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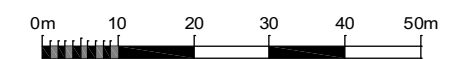
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**Geophysical Survey
Land west of Royston Road
Barkway
Hertfordshire**

**Greyscale plot of filtered
magnetometer data**










SCALE 1:1000

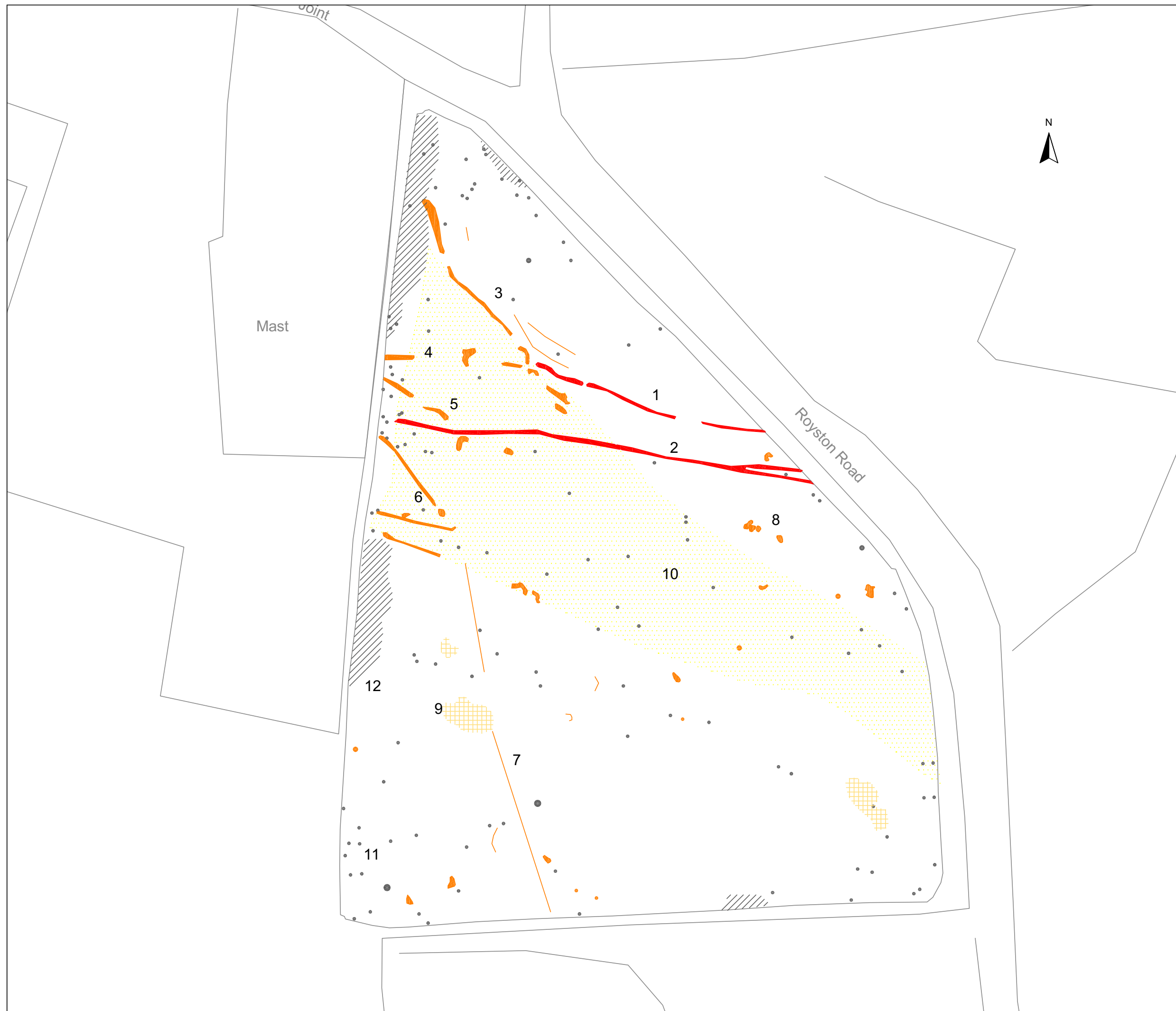


SCALE TRUE AT A3

**Geophysical Survey
Land west of Royston Road
Barkway
Hertfordshire**

**Abstraction and interpretation of
magnetic anomalies**

-  Positive linear anomaly - cut feature of archaeological potential
-  Positive linear anomaly - possible ditch-like feature
-  Discrete positive response - possible pit-like feature
-  Positive response - ground disturbance / possible quarrying
-  Zone of weakly magnetic response - of natural origin
-  Magnetic disturbance from ferrous material
-  Strong dipolar anomaly - ferrous object










SCALE 1:1000



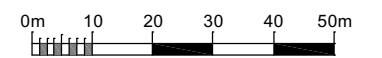
SCALE TRUE AT A3

**Geophysical Survey
Land west of Royston Road
Barkway
Hertfordshire**

**Abstraction and interpretation of
magnetic anomalies showing
approximate line of mast
clearance zone**

-  Positive linear anomaly - cut feature of archaeological potential
-  Positive linear anomaly - possible ditch-like feature
-  Discrete positive response - possible pit-like feature
-  Positive response - ground disturbance / possible quarrying
-  Zone of weakly magnetic response - of natural origin
-  Magnetic disturbance from ferrous material
-  Strong dipolar anomaly - ferrous object

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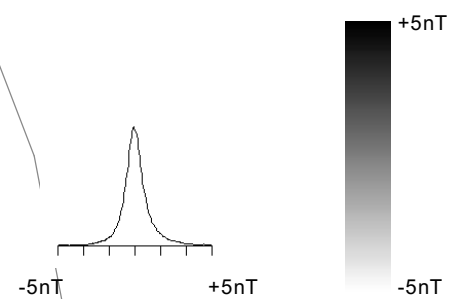
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**Greyscale plot of filtered
magnetometer data**

Area within mast clearance zone (not to be developed)

121m radius clearance zone from mast

Developable area beyond mast clearance zone



The Joint

Area within mast clearance zone (not to be developed)

121m radius clearance zone from mast

Developable area beyond mast clearance zone



The Joint

Mast

Mast

