Geophysical Survey Report

Of

Land at Meadowbrook, Mill Lane, Stebbing, Essex

For

Cotswold Archaeology Milton Keynes

On Behalf Of

Montare

Magnitude Surveys Ref: MSTL871

HER Event Number: TBC

OASIS Number: TBC

February 2021

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Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c. 4.86ha of land at Meadowbrook, Mill Lane, Stebbing, Essex. A fluxgate gradiometer survey was successfully completed across the survey area, with the exception of c. 1.9ha that could not be surveyed due to unsuitable ground conditions. Possible archaeological activity has been identified as linear and curvilinear anomalies. These may relate to external elements of an adjacent motte castle; however, modern activity or natural processes cannot be discounted as a potential causes. An anomaly aligning with a mapped historical footpath has also been detected. Modern interference comprised magnetic disturbance relating to current field boundaries, while discrete pockets of disturbance have been interpreted as possibly relating to landscaping activities of undetermined date.

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1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by Cotswold Archaeology on behalf Montare to undertake a geophysical survey over a c. 4.86ha area of land at Meadowbrook, Mill Lane, Stebbing, Essex (TL 6581 2458).

1.2. The geophysical survey comprised MS's quad-towed cart system and hand-carried GNSS-positioned fluxgate gradiometer survey. Magnetic survey is the standard primary geophysical method for archaeological applications in the UK due to its ability to detect a range of different features. The technique is particularly suited for detecting fired or magnetically enhanced features, such as ditches, pits, kilns, sunken featured buildings (SFBs) and industrial activity (David *et al*., 2008).

1.3. The survey was conducted in line with the current best practice guidelines produced by Historic England (David *et al*., 2008), the Chartered Institute for Archaeologists (CIfA, 2020) and the European Archaeological Council (Schmidt *et al.,* 2015).

1.4. It was conducted in line with a WSI produced by MS (Dyulgerski, 2021).

1.5. The survey commenced on 3/2/2021 and was completed that day.

2. Quality Assurance

2.1. Magnitude Surveys is a Registered Organisation of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, and a corporate member of ISAP (International Society for Archaeological Prospection).

2.2. The directors of MS are involved in cutting edge research and the development of guidance/policy. Specifically, Dr Chrys Harris has a PhD in archaeological geophysics from the University of Bradford, is a Member of CIfA and is the Vice-Chair of the International Society for Archaeological Prospection (ISAP); Finnegan Pope-Carter has an MSc in archaeological geophysics and is a Fellow of the London Geological Society, as well as a member of GeoSIG (CIfA Geophysics Special Interest Group); Dr Kayt Armstrong has a PhD in archaeological geophysics from Bournemouth University, is a Member of CIfA, the Editor of ISAP News, and is the UK Management Committee representative for the COST Action SAGA; Dr Paul Johnson has a PhD in archaeology from the University of Southampton, has been a member of the ISAP Management Committee since 2015, and is currently the nominated representative for the EAA Archaeological Prospection Community to the board of the European Archaeological Association.

2.3. All MS managers, field and office staff have degree qualifications relevant to archaeology or geophysics and/or field experience.

3. Objectives

3.1. The objective of this geophysical survey was to assess the subsurface archaeological potential of the survey area.

4. Geographic Background

4.1. The survey area comprised a c. 4.86ha area of land at Meadowbrook Lane, Stebbing, Essex (Figure 1). Gradiometer survey was undertaken across two fields under pasture. The survey area was bisected by small, unnamed track and was bounded by High Street to the east and by gardens and further fields to the north, west and south (Figure 2). The presence of an orchard along with overgrown vegetation in the west of Area 2 prevented survey on over c. 1.9ha of land (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	The survey area consisted of a pasture field. A depression running northeast to southwest was located in the centre of the field. Small areas located along the southern boundary of the survey area could not be surveyed due to overgrown vegetation and debris.	The survey area was bounded on all sides by hedges and trees.
2	The survey area consisted of grassland gently sloping down towards the west.	The area was bounded by trees, metal and wooden fencing to the north, by metal and wooden fencing to the east, by trees and wooden fencing to the south, and by trees to the west. A bank ran north-south along the western edge of the survey area. A well was noted in the southern half of the western boundary.

4.3. The underlying geology comprises clay, silt and sand from the London Clay Formation throughout. Several bands of different superficial deposits run through the survey area. Area 1 is primarily comprised of sand and gravel from the Kesgrave catchment subgroup, with a band of clay, silt, sand and gravel head deposits running along its southern end. Area 2 comprises sand and gravel from the Kesgrave catchment subgroup in the east, which corresponds with the surveyable extent of this area; a band of clay, silt, sand and gravel head deposits in the centre; and a band of alluvial clay, silt, sand and gravel in the west (British Geological Survey, 2021).

4.4. The soils consist of freely draining slightly acid loamy soils (Soilscapes, 2021).

5. Archaeological Background

5.1. The following is a summary of a communication provided by Cotswold Archaeology (Blick, pers. comm 2021), itself derived from information contained on the National Heritage List for England (NHLE) website and the Essex online HER search. However, no information was provided on the extent of the area studied for this summary.

5.2. No features of archaeological origin were identified within the survey area itself; however, Area 1 lies immediately east of a scheduled motte castle, known as 'The Mount'. To date, no associated bailey has been identified and it is unclear if a bailey ever existed with this motte.

5.3. An associated medieval village was located to the southeast of the motte and extended southwards towards the Grade I Church of St Mary located c. 750m southwest of Area 1. There is no evidence that medieval settlement activity occurred within the survey area, and it is possible that it formed part of the agricultural hinterland of the nearby settlement and Motte.

5.4. Historical cartographic sources suggest the survey area has formed part of the agricultural landscape since at least the mid-19th century. The post-medieval parkland of Stebbing Park extends to the west of Area 1 and the Grade II Listed Stebbing Park House is located c.70m to the southwest of Area 2 and has 16th-century origins.

6. Methodology

6.1. Magnetometer surveys are generally the most cost effective and suitable geophysical technique for the detection of archaeology in England. Therefore, a magnetometer survey should be the preferred geophysical technique unless its use is precluded by any specific survey objectives or the site environment. For this site, no factors precluded the recommendation of a standard magnetometer survey. Geophysical survey therefore comprised the magnetic method as described in the following section.

6.2. Data Collection

6.2.1. Geophysical prospection comprised the magnetic method as described in the following table.

6.2.2. Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic	Bartington Instruments Grad-13 Digital Three-Axis Gradiometer	1m	200Hz reprojected to 0.125m

6.2.3. The magnetic data were collected using MS' bespoke quad-towed cart system and hand-carried GNSS-positioned system.

6.2.3.1. MS' cart and hand-carried system was comprised of Bartington Instruments Grad 13 Digital Three-Axis Gradiometers. Positional referencing was through a multi-channel, multi-constellation GNSS Smart Antenna RTK GPS outputting in NMEA mode to ensure high positional accuracy of collected measurements. The RTK GPS is accurate to 0.008m + 1ppm in the horizontal and 0.015m + 1ppm in the vertical.

6.2.3.2. Magnetic and GPS data were stored on an SD card within MS' bespoke datalogger. The datalogger was continuously synced, via an in-field Wi-Fi unit, to servers within MS' offices. This allowed for data collection, processing and visualisation to be monitored in real-time as fieldwork was ongoing.

6.2.3.3. A navigation system was integrated with the RTK GPS, which was used to guide the surveyor. Data were collected by traversing the survey area along the longest possible lines, ensuring efficient collection and processing.

6.3. Data Processing

6.3.1. Magnetic data were processed in bespoke in-house software produced by MS. Processing steps conform to the EAC and Historic England guidelines for 'minimally enhanced data' (see Section 3.8 in Schmidt *et al.*, 2015: 33 and Section IV.2 in David *et al.,* 2008: 11).

Sensor Calibration – The sensors were calibrated using a bespoke in-house algorithm, which conforms to Olsen *et al.* (2003).

Zero Median Traverse – The median of each sensor traverse is calculated within a specified range and subtracted from the collected data. This removes striping effects caused by small variations in sensor electronics.

Projection to a Regular Grid – Data collected using RTK GPS positioning requires a uniform grid projection to visualise data. Data are rotated to best fit an orthogonal grid projection and are resampled onto the grid using an inverse distance-weighting algorithm.

Interpolation to Square Pixels – Data are interpolated using a bicubic algorithm to increase the pixel density between sensor traverses. This produces images with square pixels for ease of visualisation.

6.4. Data Visualisation and Interpretation

6.4.1. This report presents the gradient of the sensors' total field data as greyscale images, as well as the total field data from the lower sensors. The gradient of the sensors minimises external interferences and reduces the blown-out responses from ferrous and other high contrast material. However, the contrast of weak or ephemeral anomalies can be reduced through the process of calculating the gradient. Consequently, some features can be clearer in the respective gradient or total field datasets. Multiple greyscale images of the gradient and total field at different plotting ranges have been used for data interpretation. Greyscale images should be viewed alongside the XY trace plot (Figure 7). XY trace plots visualise the magnitude and form of the geophysical response, aiding anomaly interpretation.

6.4.2. Geophysical results have been interpreted using greyscale images and XY traces in a layered environment, overlaid against open street maps, satellite imagery, historical maps, LiDAR data, and soil and geology maps. Google Earth (2021) was also consulted, to compare the results with recent land use.

6.4.3. Geodetic position of results – All vector and raster data have been projected into OSGB36 (ESPG27700) and can be provided upon request in ESRI Shapefile (.SHP) and Geotiff (.TIF) respectively. Figures are provided with raster and vector data projected against OS Open Data.

7. Results

7.1. Qualification

7.1.1. Geophysical results are not a map of the ground and are instead a direct measurement of subsurface properties. Detecting and mapping features requires that said features have properties that can be measured by the chosen technique(s) and that these properties have sufficient contrast with the background to be identifiable. The interpretation of any identified anomalies is inherently subjective. While the scrutiny of the results is undertaken by qualified, experienced individuals and rigorously checked for quality and consistency, it is often not possible to classify all anomaly sources. Where possible, an anomaly source will be identified along with the certainty of the interpretation. The only way to improve the interpretation of results is through a process of comparing excavated results with the geophysical reports. MS actively seek feedback on their reports, as well as reports from further work, in order to constantly improve our knowledge and service.

7.2. Discussion

7.2.1. The geophysical results are presented in combination with satellite imagery and historical maps (Figure 6).

7.2.2. The geophysical survey was successfully completed across the accessible portion of the survey area, though c. 1.9ha could not be surveyed due to unsuitable ground conditions and overgrown vegetation. The fluxgate gradiometer survey has generally responded well to the environment of the survey area. Anomalies interpreted as possible archaeology have been identified, as well as anomalies likely relating to park landscaping. Anomalies of natural origin have been detected which likely relate to variations in the superficial geology and soils.

7.2.3. Magnetic disturbance has been recorded but is largely limited to the field edges. Areas of ferrous debris recorded in the north-western section of the survey area have the potential to obscure weaker underlying anomalies. These anomalies broadly correlate with an extant embankment, suggesting that they may relate to landscaping of the park. Additionally, some minor processing artefacts were present in the data from the southeast of the survey area, which are the result of interference from strong ferrous sources. The remaining survey area exhibited a relatively quiet magnetic background which aided in the identification of weak anomalies of potential archaeological origin.

7.2.4. Anomalies of possible archaeological origin have been recorded across the survey area (Figure 5). These consist of linear and curvilinear anomalies of varying strengths, along with linear concentrations of discrete anomalies. The anomalies do not correspond with any features visible in historical mapping or satellite imagery and have tentatively been interpreted as relating to the medieval motte castle located to the west of Area 1 due to their proximity (see Section 5). However, some of these anomalies may be associated with more

recent landscaping of the survey area, or alternatively indicate an interface between soil types along the slope in Area 1.

7.2.5. A spread of anomalies has been detected that are likely to relate to a former footpath as they correspond to the location of a footpath depicted on the 2nd Edition OS Maps (Figure 5).

7.3. Interpretation

7.3.1. General Statements

7.3.1.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually.

7.3.1.2. **Ferrous (Spike)** – Discrete dipolar anomalies are likely to be the result of isolated pieces of modern ferrous debris on or near the ground surface.

7.3.1.3. **Ferrous/Debris (Spread)** – A ferrous/debris spread refers to a concentration of multiple discrete, dipolar anomalies usually resulting from highly magnetic material such as rubble containing ceramic building materials and ferrous rubbish.

7.3.1.4. **Magnetic Disturbance** – The strong anomalies produced by extant metallic structures, typically including fencing, pylons, vehicles and service pipes, have been classified as 'Magnetic Disturbance'. These magnetic 'haloes' will obscure weaker anomalies relating to nearby features, should they be present, often over a greater footprint than the structure causing them.

7.3.1.5. **Data Artefact** – Data artefacts usually occur in conjunction with anomalies with strong magnetic signals due to the way in which the sensors respond to very strong point sources. They are usually visible as minor 'streaking' following the line of data collection. While these artefacts can be reduced in post-processing through data filtering, this would risk removing 'real' anomalies. These artefacts are therefore indicated as necessary in order to preserve the data as 'minimally processed'.

7.3.2. Magnetic Results - Specific Anomalies

7.3.2.1. **Possible Archaeology (Strong and Weak)** – In Area 1 a number of linear and discrete anomalies have been identified in the western half of the area (Figure 5). The two northern most [**1a**], run broadly parallel along an east-west path with a separation of c. 8m. The southernmost of these two anomalies exhibits a stronger magnetic signal. A second pair of parallel anomalies [**1b**] are recorded running broadly northeast-southwest, with a separation of c. 9m. The linear anomalies have been interpreted as potential ditches or a broader feature; however, the north-south pair [**1b**] demarcates a depression which was recorded by the field team (see Section 4.2). It is therefore feasible that [**1b**] is of natural origin or relates to a later re-purposing of the depression as part of the motte infrastructure.

7.3.2.2. **Possible Archaeology (Strong and Weak) –** In Area 1 a series of linear anomalies [**1c**], runs broadly east-west intersecting the parallel north-south

anomalies [**1b**]. These anomalies have also been interpreted as ditches. Additionally, two weak curvilinear anomalies [**1d**] have also been identified to the west of [**1b**]. It is conceivable these anomalies [**1a**-**1d**] may be related to modern park landscaping; however, with the possible exception noted above [**1b**], none of the observed anomalies align with any recorded features in this area and are therefore suggestive of a possible archaeological origin.

7.3.2.3. **Possible Archaeology (Strong, Weak and Spread)** – In Area 2, several weak linear anomalies [**2a**] and two linear concentrations of discrete anomalies appear to intersect (Figure 5)**.** The anomalies exhibit positive magnetic signals of varying strengths, which is indicative of cut features such as ditches. While it is possible that these anomalies are associated with park landscaping, it cannot be discounted that these anomalies relate to the medieval motte castle to the south**.**

7.3.2.4. **Mapped Former Footpath (Spread)** – A band of dipolar anomalies have been detected in the southern section of Area 2 [**2b**] (Figure 5). This anomaly corresponds with a mapped historical footpath running through the area in an east-west direction (Figure 6).

7.3.2.5. **Ferrous / Debris (Spread) –** A concentration of dipolar anomalies has been identified in two locations within Area 2 [**2c**] (Figure 5). The strong anomalies are characteristic of highly magnetic material which may have been used in this location for landscaping. A bank of unknown date is located along the western edge of Area 2, which aligns with these anomalies suggesting that was an area of made ground (see Section 4.2).

8. Conclusions

8.1. A fluxgate gradiometer survey was undertaken across the survey area, with the exception of c. 1.9ha due to unsuitable ground conditions. The geophysical survey responded well to the survey environment and has detected a range of anomalies of possible archaeological, natural and modern origin. Modern interference is limited to magnetic disturbance at the edges of the fields and isolated areas of strong anomalies relating to potential landscaping activity of unknown date. The latter may have masked weaker underlying anomalies.

8.2. Anomalies of possible archaeological origin have been identified and have been tentatively interpreted as being associated with the adjacent motte castle. However, it is also possible that these anomalies indicate recent landscaping activities or natural processes. A mapped former footpath was also identified.

10. Archiving

10.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013). This stores the collected measurements, minimally processed data, georeferenced and un-georeferenced images, XY traces and a copy of the final report.

10.2. MS contributes reports to the ADS Grey Literature Library upon permission from the client, subject to any dictated time embargoes.

11. Copyright

11.1. Copyright and intellectual property pertaining to all reports, figures and datasets produced by Magnitude Services Ltd is retained by MS. The client is given full licence to use such material for their own purposes. Permission must be sought by any third party wishing to use or reproduce any IP owned by MS.

12. References

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13. Project Metadata

MS Job Code	MSTF871
Project Name	Meadowbrook Lane, Mill Lane Stebbing, Essex
Client	Cotswold Archaeology
Grid Reference	TF11570539
Survey Techniques	Magnetometry
Survey Size (ha)	4.86ha (Magnetometry)
Survey Dates	2021-02-03
Project Lead	Krasimir Dyulgerski BA MRes
Project Officer	Krasimir Dyulgerski BA MRes
HER Event No	TBC
OASIS No	TBC
Report Version	0.4

14. Document History

Version	Comments	Author	Checked By	Date
0.1	Initial draft for Project Lead to Review	RK, PT	KD	09 February 2021
0.2	Corrections from Project Lead to review	RK	KD	10 February 2021
0.3	Corrections from Project Lead, draft for Director approval.	RK	KD, KA	10 February 2021
0.4	Corrections from Director	RK & LB	KA	12 February 2021

MSTL871: Land at Meadowbrook, Mill Lane, Stebbing, Essex
Figure 1 - Site Location
1:25,000 @ A4

Site Boundary

N

0 0.5 1 km

magnitude surveys

565000
565500
566000
566500
225000
224500
224000
Allotments
Clay Lane
Brookfields
Brookfields
B1057
Hicks' Plantation
Pound Gate
Garden Fields
Area 2
Area 1
Stebbing Primary School
High Street
Holly Tree House
Whitehouse Road
Stebbing
Playing Field
Bowling Green
Play Space
Mill Lane
High Street
Warehouse Road
Watch House Road
St Mary's Church
Church End
The Fir Wood

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Figure 2 - Location of Survey Areas
1:5,000 @ A3

Survey Extent
Unsurveyable

N
0 100 200 300 m

magnitude surveys

565600
565800
566000
224600
224400
Park Side
Garden Fields
Area 2
Area 1
Stebbing Primary School
High Street

MSTL871: Land at Meadowbrook, Mill Lane, Stebbing, Essex
Figure 3 - Magnetic Total Field (Lower Sensor)
1:1,500 @ A3

48,997 nT 49,005

N

0 50 100 150 m

magnitude surveys

565600
565800
566000
224600
224400
Park Side
Garden Fields
Area 2
Area 1
Stebbing Primary School
High Street

MSTL871: Land at Meadowbrook, Mill Lane, Stebbing, Essex
Figure 4 - Magnetic Gradient
1:1,500 @ A3

-1 nT 2

N

0 50 100 150 m

magnitude surveys

565600
565800
566000
224600
224400
Park Side
Garden Fields
High Street
Stebbing Primary School
2c
2a
2a
2c
2b
Area 2
1a
1c
1d
1b
Area 1

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Figure 5 - Magnetic Interpretation
1:1,500 @ A3

Archaeology Possible (Strong)
Archaeology Possible (Weak)
Archaeology Possible (Spread)
Mapped Former Footpath (Spread)
Natural (Zone)
Magnetic Disturbance
Ferrous/Debris (Spread)
Data Artefact
Ferrous (Spike)

N
0
50
100
150 m

magnitude surveys

565500
565800
566100
566400
224700
224400
Area 2
Area 1
Sand Pit
Down Farm
The Downs
Stebbing Park
Moat
School
Whitehart Farm
B.M. 227·6
B.M. 200·7
B.M. 250·3
200
279
MSTL871: Land at Meadowbrook, Mill Lane, Stebbing, Essex
Figure 6 - Magnetic Interpretation Over Historical Maps and Satellite Imagery
1:3,000 @ A3

Archaeology Possible (Strong)
Archaeology Possible (Weak)
Archaeology Possible (Spread)
Mapped Former Footpath (Spread)
Natural (Zone)
Magnetic Disturbance
Ferrous/Debris (Spread)
Data Artefact
Ferrous (Spike)
N
0
50
100
150 m
magnitude surveys

565600
565800
566000
224600
224400
Park Side
Garden Fields
Area 2
Area 1
Stebbing Primary School
High Street

MSTL871: Land at Meadowbrook, Mill Lane, Stebbing, Essex
Figure 7 - XY Trace Plot
30nT/cm at 1:1,500 @ A3

N
0
50
100
150 m

magnitude surveys