Geophysical Survey Report

Thurlow

Horseheath, Cambridgeshire

For

SLR Consulting

On Behalf Of

CLIENT'S CLIENT

Magnitude Surveys Ref: MSTL1205

OASIS Number: TBC

Parish Code: TBC

April 2022

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Abstract

Magnitude Surveys was commissioned to assess the subsurface potential of a c. 8.6ha area of land at Spring Grove Farm, Withersfield, north west of Haverhill, Suffolk A magnetometer survey was successfully undertaken across part of the survey area, with c. 4.6ha unable to be surveyed due to overgrown vegetation. The remaining area will be surveyed at a later date once available. The survey identified anomalies of an agricultural origin, with modern ploughing trends across the survey area. Anomalies of undetermined origin have been identified across the survey area, and while they are likely to be modern or agricultural in origin, an archaeological explanation cannot be ruled out. The impact of modern activity is limited to the edges of the survey area, and around a service pipeline in the west. Natural variations appear in the centre of the survey area, related to topographical changes across the survey area.

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1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by SLR Consulting on behalf of Client's Client to undertake a geophysical survey over a c. 8.6ha area of land at Thurlow, Horseheath, Cambridgeshire (TL 64197 46928).

1.2. The geophysical survey comprised 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 (Stoddart, 2022).

1.5. The survey commenced on 22/03/2022 and took one day to complete.

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 Paul Johnson has a PhD in archaeology from the University of Southampton, is a Fellow of the Society of Antiquaries of London, 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 was located c. 2.8km northwest of the centre of Haverhill (Figure 1). Gradiometer survey was undertaken across one field under arable cultivation. The survey area was bordered to the north and east by arable fields, to the south by trees and the A1307, and to the west by water courses and further arable fields (Figure 2). An area totalling c. 4.6ha was unable to be surveyed due to overgrown vegetation.

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	The survey area was a field under arable cultivation, sloping down to the northwest.	The survey area was bordered by treelines on the north and south. The field extended to the east and west.

4.3. The underlying geology comprises chalk of the Lewes Nodular Chalk Formation and Seaford Chalk Formation. Superficial deposits consist of diamicton of the Lowestoft Formation (British Geological Survey, 2022).

4.4. The soils consist of lime-rich loamy and clayey soils with impeded drainage (Soilscapes, 2022).

5. Archaeological Background

5.1. Awaiting Background Information (DBA or other) from Client.

6. Methodology

6.1. Data Collection

6.1.1. 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.

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

6.1.3. 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

6.1.4. The magnetic data were collected using MS' bespoke hand-carried GNSS-positioned system.

6.1.4.1. MS' hand-carried system was comprised of Bartington Instruments Grad 13 Digital Three-Axis Gradiometers. Positional referencing was through a multichannel, 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.

6.1.4.2. 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.

6.1.4.3. 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.

6.2. Data Processing

6.2.1. 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.

6.3. Data Visualisation and Interpretation

6.3.1. 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 6). XY trace plots visualise the magnitude and form of the geophysical response, aiding anomaly interpretation.

6.3.2. 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 (2022) was also consulted, to compare the results with recent land use.

6.3.3. 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. A fluxgate gradiometer was successfully completed across part of the survey area, with an area totalling c. 4.6ha unable to be surveyed due to overgrown vegetation. The survey has responded well to the environment of the survey area and has detected agricultural and undetermined anomalies (Figure 5). Magnetic disturbance is present in the survey area, mostly at field boundaries, and around buried services in the west and north. A zone of natural variation, most visible in the Total Field (Figure 3) has been identified across the centre of the survey area that aligns with the topographical slope. This band is likely caused by colluvial processes.

7.2.3. Agricultural activity has been identified across the survey area, with weak linear trends detected running approximately east to west across the survey area. These trends correlate with the modern ploughing that can be seen on satellite imagery (Figure 7).

7.2.4. Across the survey area, a series of predominantly weak positive linear and curvilinear anomalies have been identified, along with a strong discrete anomaly in the southwest (Figure 5). These anomalies do not collocate with any features marked on satellite imagery or historical maps, and due to the small survey area and lack of any further context, they have been classified as undetermined, although an agricultural or archaeological origin cannot be ruled out.

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. **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.

7.3.1.4. **Undetermined** – Anomalies are classified as Undetermined when the origin of the geophysical anomaly is ambiguous and there is no supporting contextual evidence to justify a more certain classification. These anomalies are likely to be the result of geological, pedological or agricultural processes, although an archaeological origin cannot be entirely ruled out. Undetermined anomalies are generally distinct from those caused by ferrous sources.

7.3.2. Magnetic Results - Specific Anomalies

7.3.2.1. **Agricultural (Trend)** – Across the survey area, weak parallel linear anomalies have been identified running approximately east to west (Figure 5). These collocate with the direction of modern ploughing visible in satellite imagery (Figure 7).

7.3.2.2. **Undetermined (Strong & Weak)** – Across the survey area, weak linear and curvilinear anomalies along with a strong, discrete anomaly have been identified (Figure 5). They do not correspond with any features marked on historical OS maps or satellite imagery (Figure 7). Due to their ambiguous origin, and the fact that these anomalies do not form a coherent shape, they have been categorised as Undetermined. However, an archaeological or agricultural cannot be ruled out.

7.3.2.3. **Natural (Spread)** – In the centre of the survey area, a zone of more enhanced material has been identified, most visible in the Total Field (Figure 3). This amorphous band runs across the slope noted at the time of survey and is likely caused by the movement and accumulation of enhanced superficial deposits downhill.

7.3.2.4. **Service** – In the western and northern edge of the survey area, two strong dipolar linear anomalies have been identified (Figure 5). These anomalies exhibit the magnetic characteristics of buried services.

8. Conclusions

8.1. A fluxgate gradiometer survey has been carried out across part of the survey area, with c. 4.6ha unable to be surveyed due to unsuitable ground conditions. The survey identified a series of anomalies of both agricultural and undetermined origin. Modern disturbance has been identified around the edges of the survey area, and around buried services in the west and north. Natural variations have been identified in the centre of the survey area as a result of topographical changes.

8.2. Evidence of modern agricultural activity was detected in the form of modern ploughing.

8.3. Anomalies of an undetermined origin have been identified across the survey area. A more conclusive classification cannot be provided from the geophysical data alone, due to the lack of any further diagnostic supportive evidence. Whilst these anomalies are likely to have a modern or agricultural origin, an archaeological origin cannot be ruled out.

9. Archiving

9.1. 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.

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

10. Copyright

10.1. 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.

11. References

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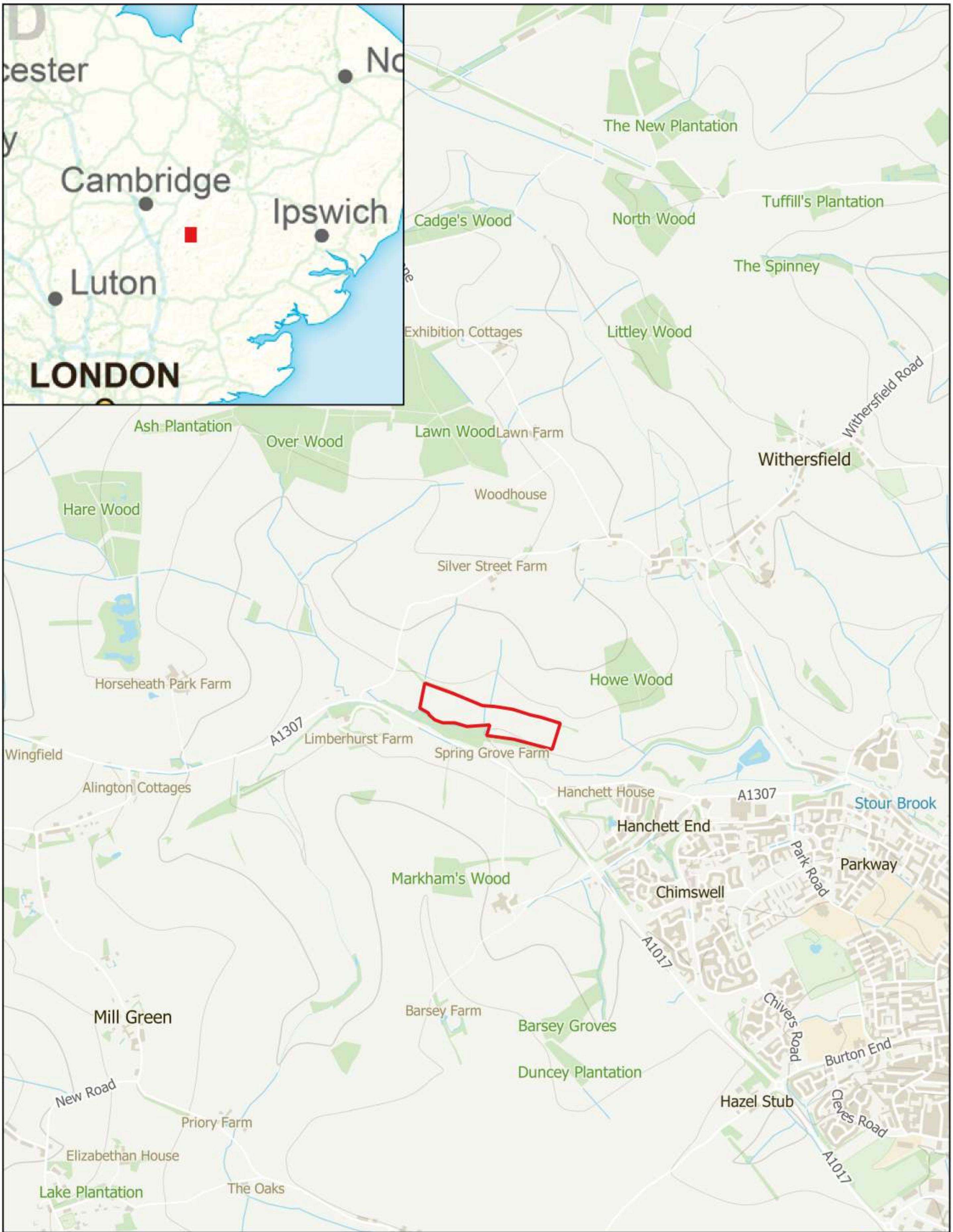
12. Project Metadata

MS Job Code	MSTL1205
Project Name	Thurlow
Client	SLR Consulting
Grid Reference	TL 64197 46928
Survey Techniques	Magnetometry
Survey Size (ha)	8.6ha (Magnetometry)
Survey Dates	2022-03-22
Project Lead	Krasimir Dyulgerski BA MRes
Project Officer	Krasimir Dyulgerski BA MRes
HER Event No	TBC
OASIS No	TBC
S42 Licence No	N/A
Report Version	0.2

13. Document History

Version	Comments	Author	Checked By	Date
0.1	Initial draft for Project Lead to Review	AL	KD	25 April 2022
0.2	Draft for Director Sign off	KD	FPC	26 April 2022



MSTL1205 Thurlow
Figure 1 - Site Location
1:25,000 @ A4

magnitude surveys