Geophysical Survey Report

Land at Elm Lane, Copdock

For

RPS

On Behalf Of

Concertus Ltd.

Magnitude Surveys Ref: MSSTM1101

OASIS Number: magnitud1-502535

Parish Code: COP 043

November 2021

magnitude surveys

Unit 17, Commerce Court

Challenge Way

Bradford

BD4 8NW

01274 926020

info@magnitudesurveys.co.uk

Report By:

Krasimir Dyulgerski BA MRes

Report Approved By:

Finnegan Pope-Carter BSc (Hons) MSc FGS

Issue Date:

05 November 2021

Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of c. 12.5ha area of land at Elm Lane, Copdock, Suffolk. A fluxgate gradiometer survey was successfully carried out across c. 10ha; the remainder was not surveyed due to the presence of overgrown vegetation, livestock, and allotments. No anomalies of probable or possible archaeological origin have been detected. The survey has primarily identified anomalies related to natural variations in the underlying soil and geology. Agricultural activity has been identified in the form of a former field boundary as well as modern ploughing trends and field drains. Isolated anomalies classified as 'Undetermined' were identified within the survey area and while they might be caused by natural or agricultural processes an archaeological origin cannot be excluded. The impact of modern activity is limited to magnetic disturbance around fences at field edges and spreads of ferrous debris within the recorded horse paddocks.

Contents

List of Figures

1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by RPS on behalf of Consertus Ltd to undertake a geophysical survey over a c. 12.4ha area of land at Elm Lane, Copdock, Suffolk (TM 1153 4151)

1.2. The geophysical survey comprised hand-pulled, cart-mounted 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 (Adams 2021).

1.5. The survey commenced on 25th October 2021 and took 3 days 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. 250m north of Copdock (Figure 1). Gradiometer survey was undertaken across 8 arable and pasture fields. The survey area is surrounded by Back Lane to the north, Elm Lane to the west and London Road to the south. There were also a series of allotments to the south of the survey area (Figure 2). Approximately 2.1ha could not be surveyed due to adverse ground conditions and the presence of allotments.

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	The survey area consisted of a pasture field that sloped downwards to the northwest.	The field was bordered to the northeast by wooden and metal fences, and on all other sides by hedgerows. A pair of trees were present near the centre of the field. Power lines crossed the centre of the field from northwest to southeast.
2	The survey area consisted of a pasture field that sloped downwards from south to north.	The field was bordered on the northwest by an electric fence, and on all other sides by hedges.
3	The survey area consisted of a pasture field that sloped downwards from south to north.	The field was bordered on the northwest by an electric fence, and on all other sides by hedges.
4	The survey area consisted of a pasture field that sloped downwards from south to north.	The field was bordered on the southeast by an electric fence, and on all other sides by hedges. A group of bushes were present in the south of the Area.
5	The survey area consisted of a pasture field that sloped downwards from south to north.	The field was bordered on the southeast by an electric fence, and on all other sides by hedges.
6	The survey area consisted of an arable field that sloped downwards from west to east.	The field was bordered on all sides by a wire fence. Power lines crossed the south of the field from northwest to southeast.
7	The survey area consisted of a flat overgrown grass field.	The field was bordered to the northwest by a wire fence, and on all other sides by trees and hedges. A group of trees was present in the west of the field, and zones of brambles were present near the centre of the area.
8	The survey area consisted of an arable field that sloped downwards from south to north	The field was bordered on all sides by hedges. A section at the northern end was fenced off as a horse paddock and could not be surveyed due to the presence of livestock.

4.3. The underlying geology comprises of Red Crag Formation - Sand. Superficial deposits of sand and gravel of the Lowesoft Formation have been recorded in Areas 2, 3, 4, 5, 6, 8 and the southwest part of Area 1. The remaining survey area (Area 7 and 1) are overlain by Lowesoft Formation- Diamicton (British Geological Survey, 2021).

4.4. Freely draining slightly acid and loamy soils are present across the survey area (Soilscapes, 2021).

5. Archaeological Background

5.1. The following is a summary of an archaeological desk based assessment produced and provided by RPS (Hawkins 2021).

5.2. No known archaeological features or activity are recorded within the survey area. However, previous archaeological investigations in close vicinity of the survey area have identified features of possible prehistoric origin, conjectured to be barrows. These investigations also identified a windmill mound of Medieval/ post-Medieval origin c.325m to the south of the site.

5.3. An extraction pit and bank of unknown date are recorded c.650m to the north-west of the site.

5.4. The site lies within the agricultural bounds of Copdock and is believed to have been under cultivation throughout the Medieval period. The site is considered to have a high potential to contain evidence of medieval agricultural usage.

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-pulled GNSS-positioned cart system.

6.1.4.1. MS' cart 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.

6.1.4.2. 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 (Figures 5 & 8). 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 (2021) 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 4).

7.2.2. A fluxgate gradiometer survey was successfully carried out across c. 10.3ha of pasture and arable land at Elm Lane, Copdock, Suffolk. Approximately 2.1 ha could not be surveyed due to overgrown vegetation, livestock, and the presence of allotments. Modern interference is limited to magnetic disturbance around fences at the field edges and scatters of ferrous material in the horse paddocks. No anomalies of probable or possible archaeological origin have been identified.

7.2.3. The survey has primarily detected natural variations in the underlying soil and geology, likely caused by colluvial processes acting upon the unconsolidated sediments of the superficial geology.

7.2.4. Historical agricultural activity has been identified as a linear anomaly in Area 6 that corresponds with a former field boundary (Figure 9). Modern agricultural activity has been detected as lines of cultivation and field drains.

7.2.5. Multiple anomalies of an undetermined origin have been detected (Figure 6 & 9). These vary in magnetic signal and shape, but all lack contextual evidence with which to support a more confident interpretation. The anomalies are likely caused by agricultural processes or natural variation; however, an archaeological origin cannot be excluded.

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. **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 (Strong/Weak and Trend)** – A linear anomaly has been recorded running in a northwest-southeast direction through the centre of Area 1 (Figure 9). The anomaly, which exhibits a strong magnetic signal, has the morphology of a cut feature with magnetically enhanced fill such as a ditch. This anomaly corresponds with a former field boundary on historical OS mapping and interpreted as such (Figure 4). A second linear anomaly exhibiting a weak negative magnetic signal have also been identified (Figure 6). This anomaly which runs parallel to the northern boundary of Area 6 has been interpreted as either a field drain or a former boundary ditch.

7.3.2.2. **Drainage Feature** – A number of weakly dipolar parallel linear anomalies running in a northwest-southeast alignment have been identified in the southern part of Area 1 (Figure 9). Due to their straight morphology and consistent spacing these anomalies have been interpreted as field drains.

7.3.2.3. **Natural (Strong/Weak and Zone)** – Across the survey area multiple weakly enhanced amorphous anomalies have been identified. These variations in the magnetic background likely correspond with the colluvial transportation and deposition of fine-grained superficial material within the site, relating to local topography.

7.3.2.4. **Undetermined (Weak)** – Several weak linear and curvilinear anomalies have been identified within the survey area (Figure 9 & 6). These anomalies appear in relative isolation with little or no supporting context to support a confident interpretation. These may have been caused by agricultural, modern or natural processes; however, an archaeological origin cannot be entirely excluded.

8. Conclusions

8.1. A fluxgate gradiometer survey has been successfully undertaken across the site, with the exception of a few areas that could not be accessed due to overgrown vegetation, livestock and allotments. Interference from modern sources is limited to magnetic disturbance around fences at the field edges and scatters of ferrous material in the horse paddocks. No anomalies of probable or possible archaeological activity have been detected.

8.2. The survey has primarily detected natural variations in the soil and geology underlying the site, though the background is generally quiet, and this is unlikely to obscure any anomalies of archaeological origin.

8.3. The survey has also detected historical agricultural activity in the form of a former field boundary recorded on the historical OS mapping. Modern ploughing trends and filed drains have also been detected.

8.4. Anomalies of undetermined origins have also been detected. However, it has not been possible to definitively determine whether these anomalies are the result of archaeological, agricultural or modern practices.

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

British Geological Survey, 2021. Geology of Britain. Copdock, Suffolk. [http://mapapps.bgs.ac.uk/geologyofbritain/home.html/]. Accessed 01/11/2021.

Chartered Institute for Archaeologists, 2020. Standards and guidance for archaeological geophysical survey. CIfA.

David, A., Linford, N., Linford, P. and Martin, L., 2008. Geophysical survey in archaeological field evaluation: research and professional services guidelines (2nd edition). Historic England.

Google Earth, 2021. Google Earth Pro V 7.1.7.2606.

Hawkins, H., 2021. Archaeological desk based assessment: land at Elm Lane, Copdock, Suffolk. RPS.

Olsen, N., Toffner-Clausen, L., Sabaka, T.J., Brauer, P., Merayo, J.M.G., Jorgensen, J.L., Leger, J.M., Nielsen, O.V., Primdahl, F., and Risbo, T., 2003. Calibration of the Orsted vector magnetometer. Earth Planets Space 55: 11-18.

Schmidt, A. and Ernenwein, E., 2013. Guide to good practice: geophysical data in archaeology (2nd edition). Oxbow Books: Oxford.

Schmidt, A., Linford, P., Linford, N., David, A., Gaffney, C., Sarris, A. and Fassbinder, J., 2015. Guidelines for the use of geophysics in archaeology: questions to ask and points to consider. EAC Guidelines 2. European Archaeological Council: Belgium.

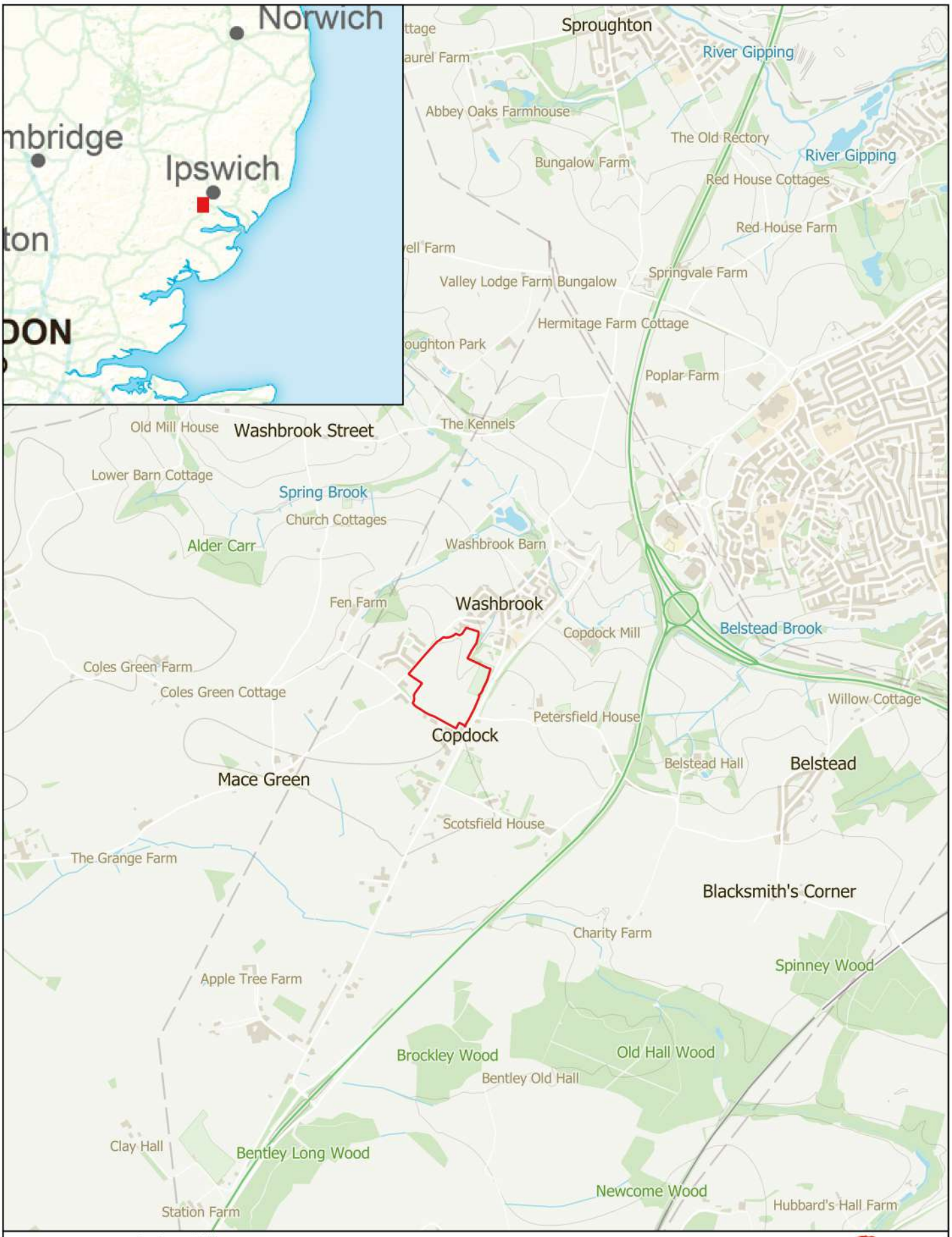
Soilscapes, 2021. Copdock, Suffolk. Cranfield University, National Soil Resources Institute. [http://landis.org.uk]. Accessed 01/11/2021.

12. Project Metadata

MS Job Code	MSTM1101
Project Name	Land at Elm Lane, Copdock
Client	RPS
Grid Reference	TM 1153 4151
Survey Techniques	Magnetometry
Survey Size (ha)	12.4 ha
Survey Dates	2021-10-25 to 2021-10-28
Project Lead	Christian Adams BA MSc ACIfA
Project Officer	Christian Adams BA MSc ACIfA
HER Event No	COP 043
OASIS No	magnitud1-502535
S42 Licence No	N/A
Report Version	1.0

13. Document History

Version	Comments	Author	Checked By	Date
0.1	Initial draft for Project Lead to Review	PJT, MS	CA	05 November 2021
0.2	Draft for Director Approval	KD	FPC	05 November 2021
1.0	Report issued as Final	CA	CA	08 November 2021



MSTM1101 - Copdock, Suffolk
Figure 1 - Site Location
1:25,000 @ A4

Site Boundary

N

0 0.5 1 km

magnitude surveys

611000

612000

242000

242000

Fen Farm

Washbrook

Play Space

Play Space

Copdock Primary School

Area 8

Area 6

Area 5

Area 3

Allotments

Area 4

Area 2

Area 7

Area 1

St Peter's Church

Petersfield House

Copdock

Tennis Court

Playing Field

MSTM1101 - Copdock, Suffolk
Figure 2 - Location of Survey Area
1:4,000 @ A3

Survey Extents

Unsurveyable Areas

N

0 100 200 300 m

magnitude surveys

611000
611500
612000
242000
242000
Area 8
Play Space
Copdock Primary School
Area 5
Area 3
Area 6
Allotments
Area 4
Area 2
Area 7
Area 1
St Peter's Church
241500
241500
Copdock

MSTM1101 - Copdock, Suffolk
Figure 3 - Magnetic Total Field (Lower Sensor) (Overview)
1:3,000 @ A3

48,998 nT 49,003

N

0 50 100 150 m

magnitude surveys

611000
611500
612000
242000
241500
Fen Cottages
F.P.
Back Lane
Post
Westhill House
G.P
P
W
88
B.M. 104·9
School
M.P
Ipswich ... 4
Colchester 14
100
148
Copdock Hall
B.M. 133·8
B.M. 158·7
143
P.O.
Smithy
MSTM1101 - Copdock, Suffolk
Figure 4 - Magnetic Interpretation Over Historical Maps (Overview)
1:3,000 @ A3

Contains historical mapping © CLS Data 2021: Ordnance Survey, 6" 2nd edition c. 1882-1913
Agricultural (Strong)
Agricultural (Weak)
Magnetic Disturbance
Ferrous/Debris (Spread)
Natural (Spread)
Natural (Strong)
Natural (Weak)
Undetermined (Weak)
Agricultural (Trend)
Drainage Feature
Ferrous (Spike)
N
0
50
100
150 m
magnitude surveys

611200

611400

611600

241800

241800

Play Space

Area 8

Area 5

Area 3

Area 6

Area 4

Area 2

Allotments

MSTM1101 - Copdock, Suffolk
Figure 5 - Magnetic Gradient (North)
1:1,500 @ A3

-1 nT 2

N

0 25 50 75 m

magnitude surveys

611200
611400
611600
241800
241800
Area 8
Area 5
Area 3
Area 6
Area 4
Area 2
Play Space
Allotments

MSTM1101 - Copdock, Suffolk
Figure 6 - Magnetic Interpretation (North)
1:1,500 @ A3

Agricultural (Weak)
Magnetic Disturbance
Ferrous/Debris (Spread)
Natural (Spread)
Natural (Strong)
Natural (Weak)
Undetermined (Weak)
Agricultural (Trend)
Ferrous (Spike)

N

0 25 50 75 m

magnitude surveys

611200
611400
611600
241800
241800
Play Space
Area 8
Area 5
Area 6
Area 3
Area 4
Area 2
Allotments
MSTM1101 - Copdock, Suffolk
Figure 7 - XY Trace Plot (North)
30nT/cm at 1:1,500 @ A3

N
0
25
50
75 m
magnitude surveys

611200
611400
611600
241600
241400
Area 6
Area 3
Allotments
Area 4
Area 2
Area 7
Area 1
Copdock

MSTM1101 - Copdock, Suffolk
Figure 8 - Magnetic Gradient (South)
1:1,500 @ A3

-1 nT 2

N

0 25 50 75 m

magnitude surveys

611200
611400
611600
241600
241400
Area 6
Area 7
Area 4
Area 3
Area 2
Area 1
Allotments
Copdock

MSTM1101 - Copdock, Suffolk
Figure 9 - Magnetic Interpretation (South)
1:1,500 @ A3

Agricultural (Strong)
Agricultural (Weak)
Magnetic Disturbance
Ferrous/Debris (Spread)
Natural (Spread)
Natural (Weak)
Undetermined (Weak)
Agricultural (Trend)
Drainage Feature
Ferrous (Spike)

N
0 25 50 75 m

magnitude surveys

611200
611400
611600
Area 6
Area 3
Allotments
Area 4
Area 2
241600
241600
Area 7
Area 1
Copdock
241400
241400

MSTM1101 - Copdock, Suffolk
Figure 10 - XY Trace Plot (South)
30nT/cm at 1:1,500 @ A3

N

0 25 50 75 m

magnitude surveys

Summary for magnitud1-502535

OASIS ID (UID)	magnitud1-502535
Project Name	Geophysical Survey at Copdock, Suffolk
Activity type	Geophysical Survey, MAGNETOMETRY SURVEY
Project Identifier(s)	MSTM1101
Planning Id	
Reason For Investigation	Planning requirement
Organisation Responsible for work	Magnitude Surveys Ltd
Project Dates	25-Oct-2021 - 27-Oct-2021
Location	Copdock, Suffolk NGR : TM 11469 41690 LL : 52.0332776481105, 1.08151433618789 12 Fig : 611469,241690
Administrative Areas	Country : England County : Suffolk District : Babergh Parish : Copdock and Washbrook
Project Methodology	Magnetometer survey carried out over c. 12.5ha using hand-carried GNSS-positioned bespoke fluxgate gradiometer system.

Project Results	Magnitude Surveys was commissioned to assess the subsurface archaeological potential of c. 12.5ha area of land at Elm Lane, Copdock, Suffolk. A fluxgate gradiometer survey was successfully carried out across c. 10ha; the remainder was not surveyed due to the presence of overgrown vegetation, livestock, and allotments. No anomalies of probable or possible archaeological origin have been detected. The survey has primarily identified anomalies related to natural variations in the underlying soil and geology. Agricultural activity has been identified in the form of a former field boundary as well as modern ploughing trends and field drains. Isolated anomalies classified as 'Undetermined' were identified within the survey area and while they might be caused by natural or agricultural processes an archaeological origin cannot be excluded. The impact of modern activity is limited to magnetic disturbance around fences at field edges and spreads of ferrous debris within the recorded horse paddocks.
Keywords	
HER	Suffolk HER - unRev - STANDARD
HER Identfiers	COP 043
Archives	