magnitude surveys

Geophysical Survey Report

of

Marks Tey Station

Marks Tey

Essex

For

L-P Archaeology

On Behalf Of

MLM Rail

Magnitude Surveys Ref: MSTL276

HER Event Number: ECC4180

April 2018

Unit 17, Commerce Court

Challenge Way

Bradford

BD4 8NW

01274 926020

info@magnitudesurveys.co.uk

Report Written by:

Freddie Salmon BSc

Figures Produced by:

Freddie Salmon BSc

Report Checked by:

Graeme Attwood MSc MCIfA

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Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c. 0.56 ha area of land north Marks Tey Railway Station. A fluxgate magnetometer survey was successfully completed, and no anomalies thought to be of probable or possible archaeological origin have been detected. The geophysical results primarily reflect ferrous or fired debris within the topsoil and the wire boundary fences present at the time of survey. A line of ferrous responses does reflect the line of a former field boundary denoted on historic mapping. Several linear responses have been categorised as undetermined due to the ambiguous nature of the response.

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1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by L-P Archaeology on behalf of MLM Rail to undertake a geophysical survey on a c.0.56ha area of land at Marks Tey Railway Station, Marks Tey, Essex (TL 9157 2402).

1.2. The geophysical survey comprised hand-pulled, cart-mounted GNSS-positioned fluxgate magnetometer survey.

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, 2014) and the European Archaeological Council (Schmidt et al., 2015).

1.4. The survey commenced on 16 April 2018 and took 1 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 of Archaeological Prospection).

2.2. Director Graeme Attwood is a Member of CIfA, as well as the Secretary of GeoSIG, the CIfA Geophysics Special Interest Group. Director Finnegan Pope-Carter is a Fellow of the London Geological Society, the chartered UK body for geophysicists and geologists, as well as a member of GeoSIG, the CIfA Geophysics Special Interest Group. Director Chrys Harris has a PhD in archaeological geophysics from the University of Bradford and is the Vice-Chair of the International Society for Archaeological Prospection.

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

3. Objectives

3.1. The geophysical survey aimed to assess the subsurface archaeological potential of the survey area.

4. Geographic Background

4.1. The site is located, c. 8km west of Colechester, Essex, the survey area was undertaken over a single flat pasture field immediately north of Marks Tey railway station. (Figure 1). The area was bounded by a wire fence and hedgerows to the north, west and south with the field continuing to the east (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	Flat, short pasture	An electricity pole was located in the central north section of the field with the wires crossing in an off east-west orientation. An earlier scheme of bore-holing left two patches of uneven ground in the northwest and southeast of the survey area.

4.3. The underlying geology comprises of London Clays, no superficial geology is recorded as diamiticon clay deposits of the Lowestoft formation (British Geological Survey, 2018).

4.4. The soils consist of slightly acidic loamy and clayey soils with impeded drainage (Soilscapes, 2018).

5. Archaeological Background

5.1. The following archaeological background summarises a heritage desk-based assessment produced by L-P Archaeology (Pearce, 2018). No previous archaeological work has been undertaken and there are no recorded designated or non-designated heritage assets within the bounds of the survey area.

5.2. Within the surrounding 1km search area, pre-historic activity is widespread, although the majority of this activity is reflected through individual findspots rather than features. To the south, along the route of the trainline, a prehistoric hand axe (MCC7659) was discovered. Many findspots have been located along an earlier course of the river and are unlikely to be in-situ, rather they have been deposited via fluvial action. 'Palaeolithic implements' (MCC7614) are among those thought to have been distributed this way. The only evidence of prehistoric settlement within the wider search area was in the form of several burnt flint marks (MCC8614) at Marks Tey Hall; despite suggesting settlement it is impossible to determine if it was merely transient or more long term.

5.3. During the 19th century, two coin hoards (MCC7550/NRHE3844158) were discovered whilst ploughing fields approximately 300m to the south west and 375m to the north east of the site. Both hoards were contained inside Iron-Age vessels.

5.4. Within the immediate vicinity of the site to the north east, field walking has uncovered numerous Roman pottery sherds, tile and tesserae (MCC4149/5316). The route of several Roman Roads, pass within the vicinity of site, including the intersection of. Adjacent to the site on Church Farm, behind Marks Tey station, a single coin and a brooch were Identified

5.5. There have been no archaeological findings within the site or the wider search area pertinent to medieval activity. It is likely the site lay within the agricultural hinterland.

6. Methodology

6.1. Data Collection

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

6.1.2. 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

6.1.3. The magnetic data were collected using MS' bespoke hand-pulled cart system OR hand-carried GNSS-positioned system].

6.1.3.1. MS' cart system was comprised of Bartington Instruments Grad 13 Digital Three-Axis Gradiometers. Positional referencing was through a Hemisphere S321 GNSS Smart Antenna RTK GPS outputting in NMEA mode to ensure high positional accuracy of collected measurements. The Hemisphere S321 GNSS Smart Antenna is accurate to 0.008m + 1ppm in the horizontal and 0.015m + 1ppm in the vertical.

6.1.3.2. 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.

6.1.3.3. 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.

6.2. Data Processing

6.2.1. Magnetic data were processed in bespoke in-house software produced by MS. Processing steps conform to Historic England's standards for "raw or minimally processed data" (see sect 4.2 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 upper and/or 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 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 in 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, historic maps, LiDAR data, and soil and geology maps. Google Earth (2018) was consulted as well, to compare the results with recent land usages.

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 of further work in order to constantly improve our knowledge and service.

7.2. Discussion

7.2.1. The geophysical results are presented in consideration with satellite imagery (Figure 5) and historic maps (Figure 6). The fluxgate magnetometer survey has responded well to the environment of the survey area. The data has revealed an area that is magnetically quiet with few anomalous responses. The results predominately reflect near surface ferrous/fired debris in the form of small dipolar spikes, while wire boundary fencing to the north and south of the survey area have caused ferrous 'halos' along the edges of the survey area. A line of ferrous responses can be determined orientated sub north south and parallel to the eastern survey boundary; these collocate well with a former boundary marked on the 2nd edition Ordnance Survey map (Figure 6). This boundary can also be seen as a parch mark visible in the satellite imagery (Figure 5).

7.2.2. Several linear responses have been categorised as undetermined, these are likely to be agricultural or natural in origin; however, in this case, due to the small size of the survey area and reduced contextual data it is not possible to determine which.

7.3. Interpretation

7.3.1. General Statements

7.3.1.1. **Undetermined** – Anomalies are classified as Undetermined when the anomaly origin is ambiguous through the geophysical results and there is no supporting or correlative evidence to warrant 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 not ferrous in nature.

7.3.1.2. **Ferrous (Discrete/Spread)** – Discrete ferrous-like, dipolar anomalies are likely to be the result of modern metallic disturbance on or near the ground surface. A ferrous spread refers to a concentrated deposition of these discrete, dipolar anomalies. Broad dipolar ferrous responses from modern metallic features, such as fences, gates, neighbouring buildings and services, may mask any weaker underlying archaeological anomalies should they be present.

8. Conclusions

8.1. The fluxgate magnetometer survey has responded well to the survey area, detecting an area with generally quiet background response. The small size of the survey area provides little context for the few anomalies detected leading to the use of the category undetermined for those that do not have a clear origin.

8.2. Wire boundary fences to the north and south of the survey area have created large ferrous 'halos' with smaller ferrous spikes being recorded in the data throughout the area. An alignment of ferrous responses and corresponds to a former field boundary denoted on historic mapping. Several linear trends have been detected, these are likely to be agricultural or natural in origin, however it is not possible to be certain which category is the more likely, hence the classification as undetermined.

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 the any dictated time embargoes.

10. Copyright

10.1. Copyright and the 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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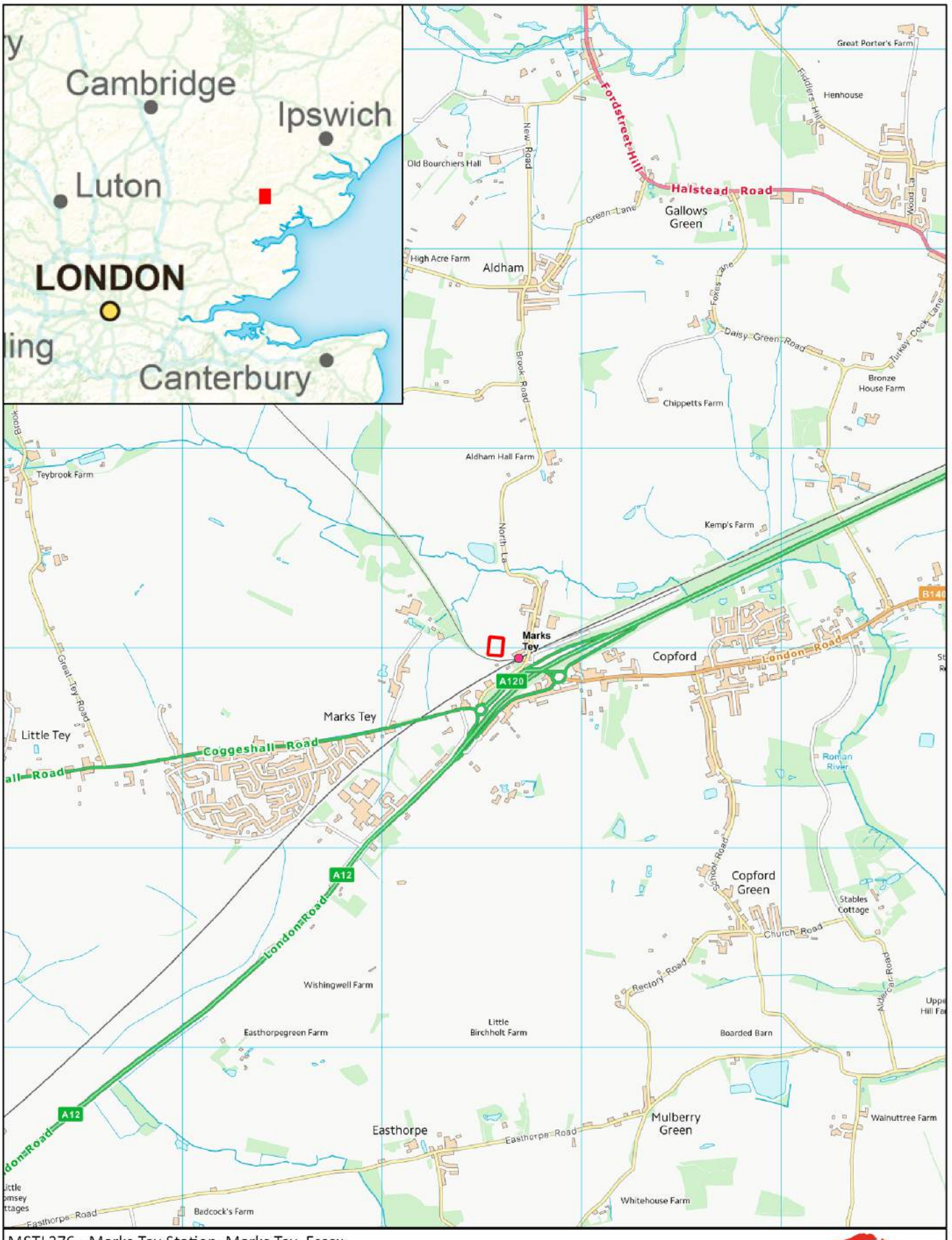

MSTL276 - Marks Tey Station, Marks Tey, Essex
Figure 1 - Site Location
1:25,000 @ A4

Site Boundary

N

0 0.5 1 km

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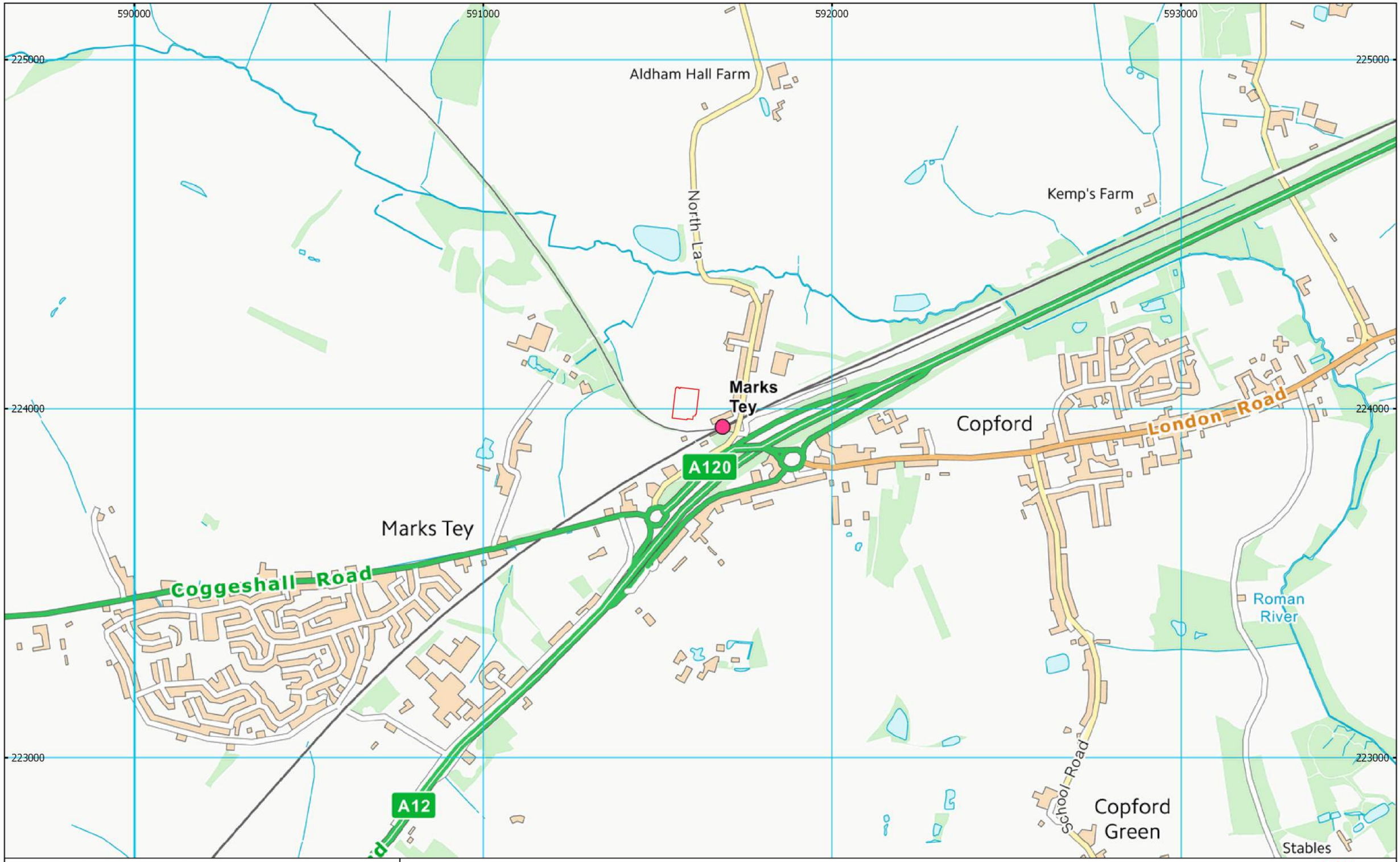

MSTL276 - Marks Tey Station, Marks Tey, Essex
Figure 2 - Location of Survey Area
1:10,000 @ A3

Survey Extent

N

0 250 500 750 m

magnitude surveys

591400
591500
591600
591700
224100
224000
223900

MSTL276 - Marks Tey Station, Marks Tey, Essex
Figure 3 - Magnetic Greyscale
1:1,000 @ A3

-2 nT 3

N

0 25 50 75 m

magnitude surveys

591400
591500
591600
591700
224100
224000
223900

Ma
Tey

MSTL276 - Marks Tey Station, Marks Tey, Essex
Figure 4 - Magnetic Interpretation
1:1000@ A3

Ferrous (Dipolar)
Ferrous Spike
Undetermined (Trend)

N
0 15 30 45 m

magnitude surveys

591400
591500
591600
591700
224100
224000
223900

MSTL276 - Marks Tey Station, Marks Tey, Essex
Figure 5 - Magnetic Interpretation Over Satellite Imagery
1:1000 @ A3

Ferrous (Dipolar)
Ferrous Spike
Undetermined (Trend)

N

0 15 30 45 m

magnitude surveys

591300 591400 591500 591600 591700 591800

224100 224100

224000 224000

223900 223900

TRAMWAY BRANCH

B.P

S.P

B.M. 132·8

S.B.

Marks Tey Junction

S.P

S.P

S.P

Malthouse Station

STATION

MSTL276 - Marks Tey Station, Marks Tey, Essex
Figure 6 - Magnetic Interpretation Over Historic Maps
1:1,500 @ A3

Contains historic maps: Ordnance Survey, 6" 2nd edition c. 1882-1913 © National Library of Scotland

Ferrous (Dipolar)
Ferrous Spike
Undetermined (Trend)

N

0 25 50 75 m

magnitude surveys

591400
591500
591600
591700
224100
224000
223900

MSTL276 - Marks Tey Station, Marks Tey, Essex
Figure 7 - XY Trace Plot
30nT/cm at 1:500 @ A3

N
0 15 30 45 m

magnitude surveys

591500 591600 591500 591600

224100 224100 224100 224100

224000 224000 224000 224000

MSTL276 - Marks Tey Station, Marks Tey, Essex
Figure A1 - Magnetic Greyscale - Repeated Lines
1:1,000 @ A3

-2 nT 3

N

0 25 50 75 m

magnitude surveys