Geophysical Survey Report

of

Land at Beccles Road

Loddon, Norfolk

For

RPS Group

On Behalf Of

Hopkins Homes

Magnitude Surveys Ref: MSTM1091

HER Event Number: ENF152010

Consultation Number: CNF49485

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Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c. 7.2ha area of land at Beccles Road, Loddon, Norfolk. A fluxgate gradiometer survey was successfully completed across the survey area, with the exception of c. 0.5ha, which was not surveyed due to unsuitable ground conditions. The survey detected anomalies of a possible archaeological origin in the form of partial enclosures which appears to make up a multiphase field system. Anomalies have been detected and interpretated as possible extraction, connected to identified historical quarry pits in the wider environs. Agricultural anomalies have been detected as a mapped field boundary and modern ploughing. Variation in the natural geology and magnetic enhancement from superficial deposits have been detected. Several anomalies of undetermined origin have been detected that may be of agricultural or natural origin but may also be related to possible archaeological or quarrying activity.

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1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by RPS Group on behalf of Hopkins Homes to undertake a geophysical survey over a c. 7.2ha area of land off Beccles Road, Loddon, Norfolk (TM 3680 9825).

1.2. The geophysical survey comprised quad-towed, 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 (Rigby, 2021).

1.5. The survey commenced on 02/12/2021 and was completed on the same 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 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. 500m southeast of Loddon, Norfolk (Figure 1). Gradiometer survey was undertaken across a single field under arable cultivation. The survey area was located immediately west of Beccles Road and housing off Mill Road and Norton Road, with a belt of woodland bordering the survey area to the east (Figure 2). An area of c. 0.5ha was not surveyed due to overgrown vegetation and uneven ground conditions.

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	The area consists of a stubble arable field, generally sloped to the south.	The area was bordered by garden fencing to the north and west, woodland to the east, and hedgerows to the south. Overgrown vegetation was located along the western perimeter of the survey area and was not surveyed.

4.3. The underlying geology comprises Crag Group sand and gravel. (British Geological Survey, 2022).

4.4. The survey area crosses three bands of superficial deposits. From west to east these include: undifferentiated sand and gravel of the Crag Group and Bytham Sand and Gravel Formation; sand of the Happisburgh Glacigenic Formation; and diamicton glacial till of the Lowestoft Formation (British Geological Survey, 2022).

4.5. The soils consist of lightly acid loamy and clayey soils, with impeded drainage (Soilscapes, 2022).

5. Archaeological Background

5.1. The following is a summary of an archaeological desk-based assessment produced and provided by RPS Group (Mortimer, 2019).

5.2. Within the survey area, a programme of fieldwalking was carried out and recorded pottery sherds of different periods in the centre-east of the survey area; one prehistoric, 122 Romano-British (predominantly local greywares), and two Middle Saxon (HER 21543). Additionally, eight flint implements were also recorded. Also, in the centre-east of the survey area, possible cropmarks identified on Google Earth imagery may relate to prehistoric or Romano-British features, including a potential rectilinear structure or small enclosure.

5.3. A possible Roman villa or bathhouse is located c. 850m south of the survey area, indicated by quantities of Roman pottery, CBM, coins and metalwork (HER 17982). Further Romano-British pottery, coins and other material have been found throughout the surrounding area. Various medieval finds have been recovered through fieldwalking in the surrounding area, as well as evidence of Early Anglo-Saxon burials (brooches).

5.4. Evidence of deserted Medieval settlements have been recorded by fieldwalking scatters of pottery in four locations within a 1km radius of the survey area, these are: c. 400m to the north (HER 21541), c. 550m to the northeast (HER 21544), c. 1km to the northeast (HER 21538) and c. 600m to the southwest (HER 19488).

5.5. Map regression shows the site subdivided into three fields on historical mapping from 1838, with the removal of one boundary leaving behind two fields by 1886, by which time a small quarry pit was recorded to the southeast of the survey area.

5.6. The remains of a Cold War Royal Observer Corps post, believed to have been in use between 1961 and 1968, survive in the field immediately east of the survey area, and were recorded in aerial photographs along with a small group of structures and earthworks that may have marked the site of a WWII observation post (HER 21511).

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 quad-towed 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 (Figure 7). 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 survey was carried out over a 7.2ha area of land at Beccles Road, Loddon, Norfolk. An area of c. 0.5ha was not surveyed due to unsuitable ground conditions. Anomalies of possible archaeological origin have been detected, along with possible quarry activity. Additionally, anomalies of an agricultural, natural, and undetermined origin have been detected. The impact of magnetic disturbance is limited to field edges.

7.2.3. Possible archaeological anomalies have been detected across the survey area, as partial and fragmented enclosures. The variation in orientation and magnetic signal of these anomalies may suggest a multiphase field system. This interpretation is further evidenced by the Romano-British pottery and cropmarks within the survey area (Section 5.2).

7.2.4. Modern agricultural practices visible in the data as agricultural trends may be masking low magnitude linear and discrete anomalies of possible archaeological origin and has limited the certainty of the anomalies detected. Two former field boundaries have been identified, one recorded on the 2nd edition OS mapping bisecting the survey area (Figure 6) and the other on earlier 1838 historical mapping (Section 5.5).

7.2.5. Anomalies exhibiting characteristic of cut features have been detected and with additional evidence of the identification of a small quarry pit to the southeast of the survey area on historical mapping, they have been interpreted as possible extraction activity.

7.2.6. Some anomalies have been identified as having a natural origin. Whilst they have a similar magnetic infill to the anomalies identified as possible quarries, they have ill-defined edges, indicating that they are not anthropogenic in origin and are likely natural

deposits. A spread of magnetic enhancement along the southern edge of the survey area collocates with superficial deposits of sand and gravel (Section 4.4).

7.2.7. Undetermined anomalies have been detected across the survey area, most of which may possibly be related to the partial enclosures or quarrying activity; however, their magnetic signal and positioning may also suggest an agricultural origin. An anomaly on the southern edge of the survey area is a possibly further natural deposit, however its morphology could be suggestive of an anthropogenic feature, therefore 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. **Possible Archaeology** – Several weak linear and rectilinear anomalies have been detected across the survey area (Figures 4 and 5). These anomalies are characteristic of ditches with magnetically enhanced fill, that are indicative of partial enclosures and collocate with finds and cropmarks identified within the survey area (Section 5). Therefore, the anomalies have been classified as possible archaeological origin, however, their weak magnetic signal and their fragmentation, make their categorisation uncertain.

7.3.2.2. **Agricultural (Weak & Trend) –** Weak linear anomalies have been identified across the centre and in the north of the survey area, orientated east to west

and north to south. These anomalies make up two former field boundaries identified on the 2nd Edition OS map (Figure 6) and 1838 historical mapping (Section 5.5). Linear trends have been detected orientated north to south throughout the survey area (Figures 4 and 5) and are visible on satellite imagery (Figure 6), these anomalies are interpretated as modern ploughing trends. The anomalies are extensive across the survey area and a representative amount have been picked out to their show presence.

7.3.2.3. **Possible Quarry** – Multiple amorphous anomalies of varying sizes have been identified within the survey area. The anomalies are characterised by a distinct contrast between their magnetically enhanced infill and the magnetic background and is indicative of areas of extraction. The morphology and magnetic signal of these anomalies are suggestive of possible quarrying activity, this interpretation is supported by a quarry immediately to the east of the survey area, identified on historical mapping (Figure 6).

7.3.2.4. **Natural (Weak & Spread)** – Weak anomalies have been detected in the south of the survey area (Figure 5), their ill-defined edges and weak magnetic signal (Figure 4), are indicative of natural deposits of the background geological material (Section 4). A spread of magnetic enhancement has also been identified along the southern boundary of the survey area (Figures 4 and 5). This spread correlates with superficial deposits of sand and gravel (Section 4.4).

7.3.2.5. **Undetermined** – A positive anomaly [**1a**] has been detected on the southern perimeter of the survey area (Figures 4 and 5). The anomaly exhibits anthropogenic characteristics in its morphology, allowing for a possible archaeological origin. However, it has a magnetic signal strength like that of the possible quarry pits, therefore, an agricultural or natural origin is similarly likely. Further weak linear and strong discrete anomalies have been identified across the survey area (Figure 5). These anomalies may be related to the possible archaeological anomalies identified; however, an agricultural or natural origin may also be likely. Therefore, these anomalies have been categorised as 'Undetermined'.

8. Conclusions

8.1. A fluxgate gradiometer survey was conducted across c. 7.2 ha of land at Beccles Road, Loddon, Norfolk. There was c. 0.5ha of survey area was not surveyed due to unsuitable ground conditions. Anomalies of possible archaeological and quarrying activity have primarily been detected, as well as anomalies of agricultural, natural, and undetermined origin. Modern interference from ploughing trends detected across the survey area, may have obscured any weaker anomalies. Magnetic disturbance has been limited to field edges.

8.2. Possible archaeological anomalies have been identified across the entire survey area as partial enclosures, likely forming a multiphase field system.

8.3. Possibly quarry pits have been detected within the survey area in connection with extraction activity in the wider environs.

8.4. Agricultural activity has been identified as a mapped former field boundary and modern ploughing trends.

8.5. Natural variations have been detected and interpreted as enhancement from the background geology and superficial deposits of sand and gravel.

8.6. Undetermined anomalies have been detected across the survey area and whilst they may be related to agricultural activity, quarrying, or natural deposits, 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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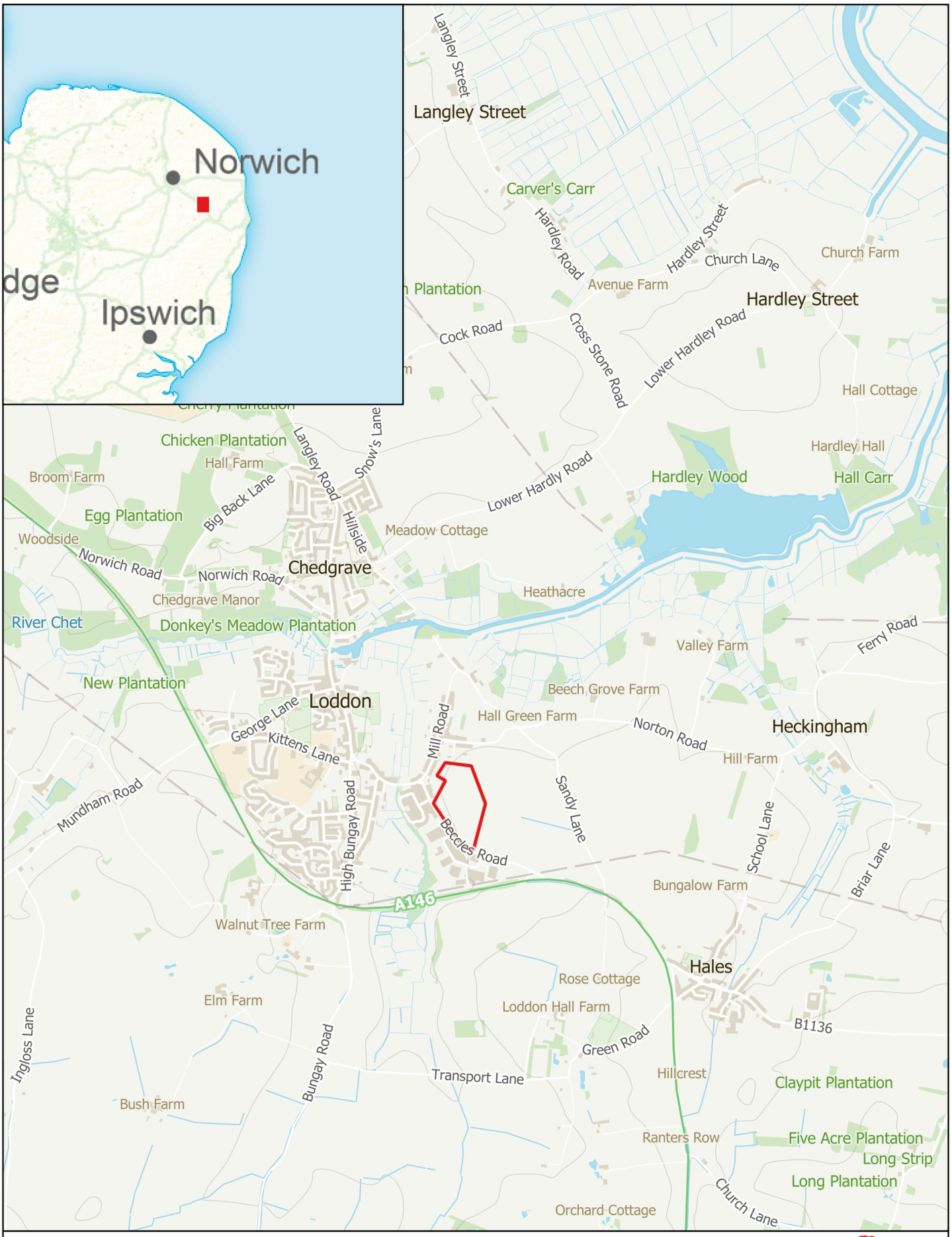
12. Project Metadata

MS Job Code	MSTM1091
Project Name	Land at Beccles Road, Loddon
Client	RPS Group
Grid Reference	TM 3680 9825
Survey Techniques	Magnetometry
Survey Size (ha)	7.2ha (Magnetometry)
Survey Dates	2021-12-02
Project Lead	Leigh A. Garst BFA MSc
Project Officer	Leigh A. Garst BFA MSc
HER Event No	ENF152010
OASIS No	TBC
S42 Licence No	N/A
Report Version	1.0

13. Document History

Version	Comments	Authors	Checked By	Date
0.1	Initial draft for Project Lead to Review	LT, EB	LAG	08 December 2021
0.2	Second draft for Director to Review	LT, EB	LAG	09 December 2021
1.0	Final	LAG	LAG	13 December 2021



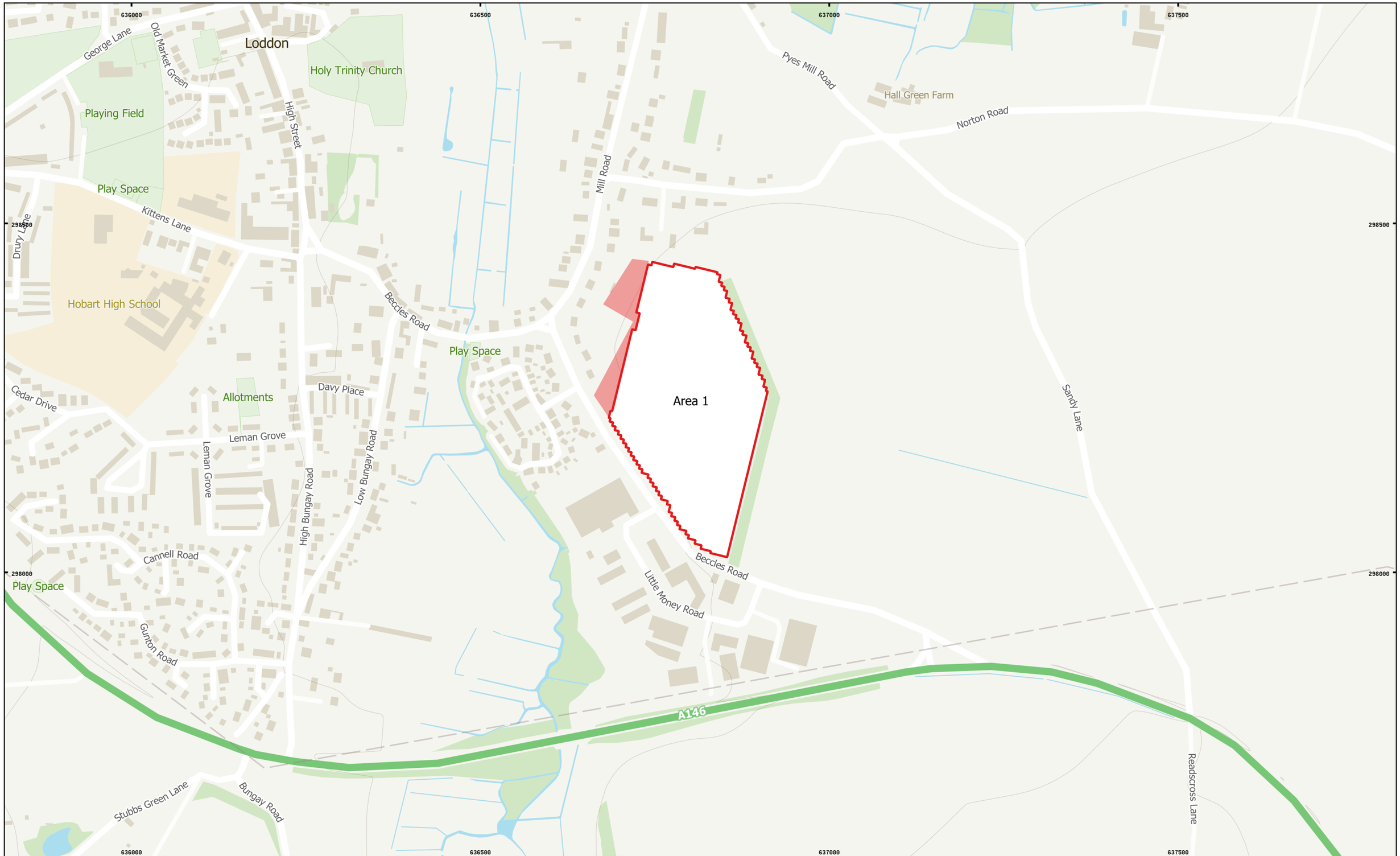
MSTM1091 - Land at Beccles Road, Loddon
Figure 1 - Site Location
1:25,000 @ A4

Site Boundary

N

0 0.5 1 km

magnitude surveys



MSTM1091 - Land at Beccles Road, Loddon
Figure 2 - Location of Survey Area
1:5,000@ A3

Survey Extent
Unsurveyable Areas

N

0 100 200 300 m

magnitude surveys

MSTM1091 - Land at Beccles Road, Loddon
Figure 3 - Total Field (Lower Sensor)
1:1,500 @ A3

48,990 nT 49,020

N

0 50 100 150 m

magnitude surveys

Browns Grove
Town Farm Drive
Mill Road
Little Money Road
Beccles Road
Little Money Road
Area 1

MSTM1091 - Land at Beccles Road, Loddon
Figure 4 - Magnetic Gradient
1:1,500 @ A3

-1 nT 2

N

0 50 100 150 m

magnitude surveys

MSTM1091 - Land at Beccles Road, Loddon
Figure 5 - Magnetic Interptation
1:1,500 @ A3

- Archaeology Possible (Weak)
- Agricultural (Weak)
- Possible Quarry
- Natural (Weak)
- Natural (Zone)
- Magnetic Disturbance
- Ferrous/Debris (Spread)
- Undetermined (Strong)
- Undetermined (Weak)
- Agricultural (Trend)
- Ferrous (Spike)

N

0 50 100 150 m

magnitude surveys

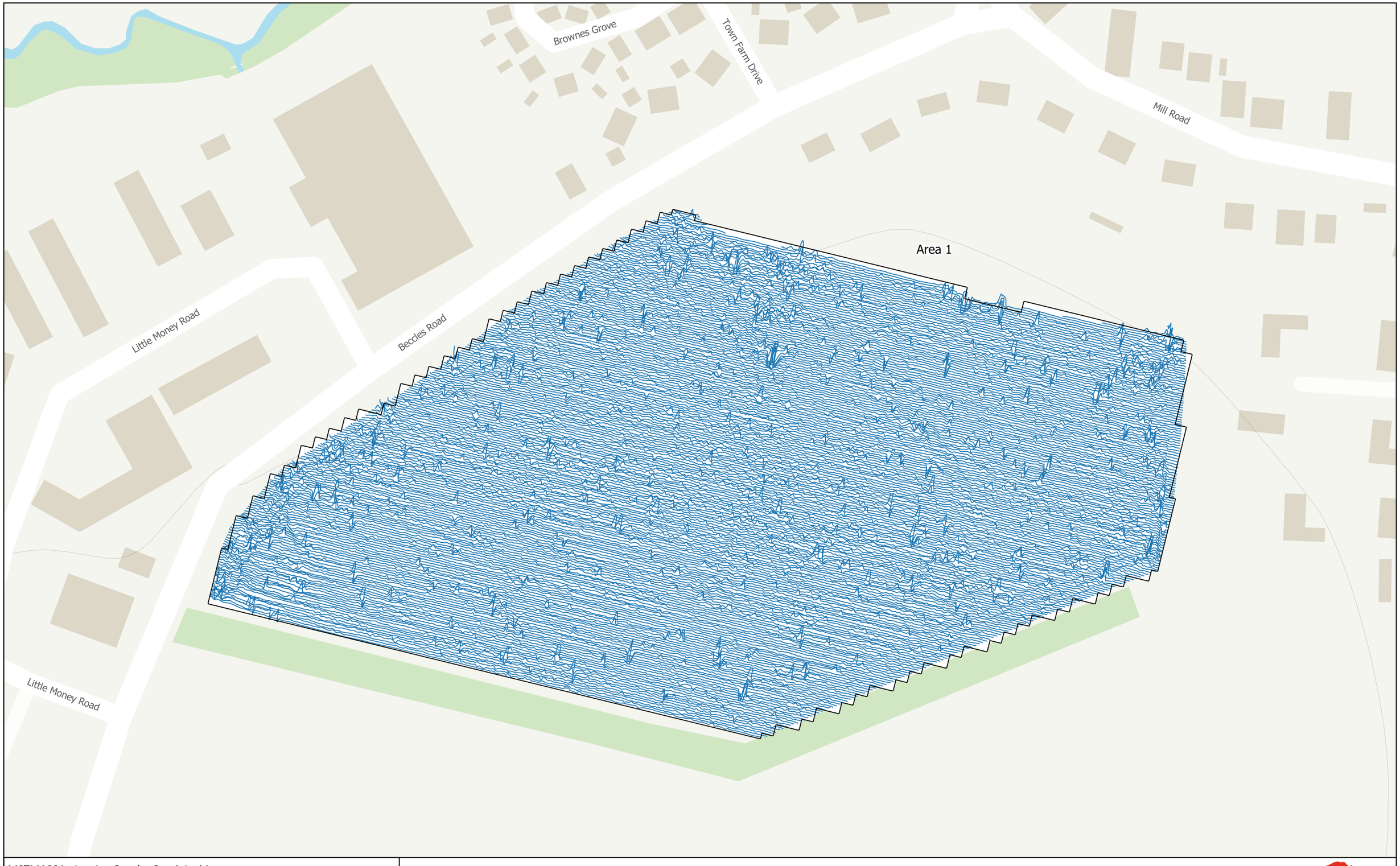
MSTM1091 - Land at Beccles Road, Loddon
Figure 6 - Magnetic Interpretation Over Historical Maps and Satellite Imagery
1:3,000 @ A3

- Archaeology Possible (Weak)
- Agricultural (Weak)
- Possible Quarry
- Natural (Weak)
- Natural (Zone)
- Magnetic Disturbance
- Ferrous/Debris (Spread)
- Undetermined (Strong)
- Undetermined (Weak)
- Agricultural (Trend)
- Ferrous (Spike)

N

0 100 200 300 m

magnitude surveys



MSTM1091 - Land at Beccles Road, Loddon
Figure 7 - XY Trace Plot
10nT/cm at 1:1,500 @ A3

N

0 50 100 150 m

magnitude surveys