Geophysical Survey Report

of

Land south of Meadow Lane,

Ryhall, Rutland

For

Oxford Archaeology

On Behalf Of

Manor Oak Homes

Magnitude Surveys Ref: MSTF457

HER Event Number: ELE10763

March 2019

magnitude surveys

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Version	Purpose/Revision	Author	Interpretation/Figures	Checked By	Date Issued
Draft 1.0	Initial draft	Robert Legg BSc MSc	Peter Turner BSc MSc Robert Legg BSc MSc	Marta Fortuny BA MA	19 March 2019
Draft 1.1	Update after internal review	Peter Turner BSc MSc	Peter Turner BSc MSc	Finnegan Pope-Carter BSc MSc FGS	19 March 2019
Draft 1.2	Figure and text revisions for style and clarity	Dr. Chrys Harris MCIfA	Marta Fortuny BA MA	Finnegan Pope-Carter BSc MSc FGS	20 March 2019
Final 2.0	No client corrections	N/A	N/A	Leanne Swinbank BA ACIfA	21 March 2019
Final 2.1	Manor Oak Homes comments	Leanne Swinbank BA ACIfA	N/A	Leanne Swinbank BA ACIfA	29 March 2019

Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c. 3.3ha area of land south of Meadow Lane, Ryhall, Rutland. A fluxgate magnetometer survey was successfully completed. An area of probable archaeological activity has been identified in the form of two ring ditches and a potential trackway. Further anomalies of a possible archaeological origin may represent ditches or land divisions. The survey results also reflected a complex palimpsest of natural processes with anomalies associated with alluvial activity and geology; this has complicated the interpretation of anthropogenic versus natural anomalies in some areas. Although the ring ditches and potential trackway are very distinct. A significant part of the south-eastern part of the site has been disturbed

by industrial and modern activity. Anomalies associated with agricultural activity have also been identified. These reflect former field boundaries and weak modern ploughing trends.

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List of Figures

1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by Oxford Archaeology on behalf of Manor Oak Homes to undertake a geophysical survey on a c. 3.3ha area of land off Meadow Lane, Ryhall, Rutland (TF 0350 1017).

1.2. The geophysical survey comprised hand-carried 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 was conducted in line with a written scheme of investigation produced by MS in advance of survey commencement (Magnitude Surveys, 2019).

1.5. The survey commenced on 12/03/2019 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 of Archaeological Prospection).

2.2. Director Dr. Chrys Harris is a Member of CIfA, has a PhD in archaeological geophysics from the University of Bradford and is the Vice-Chair of ISAP. 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. Reporting Analyst Dr. Kayt Armstrong is a Member of CIfA, has a PhD in archaeological geophysics from Bournemouth University, is the Vice Conference Secretary and Editor of ISAP News for ISAP, and is the UK Management Committee representative for the COST Action SAGA.

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. 0.7km from the centre of the village of Ryhall (Figure 1). Survey was undertaken over a single field bounded by residential buildings to the north, the A6121 to the west, Belmesthorpe road to the south, and further fields and the River Gwash to the east (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	Flat, young crop.	Bounded by trees and hedges to the north and west, a road to the south, and trees and hedges and a river to the east. Six devices to scare birds were located in the centre of the area.

4.3. The underlying geology comprises limestone of the Lower Lincolnshire Limestone Member. Superficial deposits consist of River Terrace Deposits of sand and gravel from the south-west to north-east across the centre of the site, and a band of Alluvium clay, silt, sand and gravel in the south-east corner of the site (British Geological Survey, 2019).

4.4. The soils consist of shallow lime-rich soils over chalk or limestone across most of the site, and loamy and clayey floodplain soils with naturally high groundwater to the east of the site towards the river (Soilscapes, 2019).

5. Archaeological Background

5.1. The following section summaries the Archaeological Assessment provided by the client (John Samuels Archaeological Consultants, 1997).

5.2. The archaeological assessment considered the site to be of regional importance. Aerial photographic analysis was carried out, and cropmarks were identified in the vicinity of survey area. An interpretation of three potential ring ditches, a pit alignment and parallel ditches was derived from the aerial photographic analysis. The pit alignment and ditches continue to the north into what is now an area of residential buildings; cropmarks of three further ring ditches were identified in this location.

5.3. Evidence for further archaeology in the vicinity of the site, include the ploughed out remains of at least two Bronze Age barrows, possibly three further barrows of unknown date, and recent quarrying.

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	0.5m	200Hz reprojected to 0.125m

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

6.1.3.1. MS' 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.

6.1.3.2. 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.

6.1.4. The survey was requested at a 0.5m sensor spacing due to known crop-mark evidence that indicates the presence of archaeology.

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 9). 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 (2019) was consulted as well, to compare the results with recent land usages.

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 will be 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 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 7) and historic maps (Figure 8).

7.2.2. A geophysical survey has been successfully completed across survey area. Anomalies of an archaeological, agricultural, industrial, and modern origin have been identified against an enhanced natural background.

7.2.3. The survey results reveal a relatively complex natural background. Two palaeochannels have been identified: one on a north-south alignment at the eastern end of the survey area and the other on a NW-SE alignment through the centre of the survey area. Along the north-eastern edge of the survey area, towards the River Gwash, the natural background is comparatively quiet compared to the remainder of the site. Numerous small, discrete and weak amorphous anomalies across the site likely result from a palimpsest of natural processes; these may reflect variations in the superficial sand and gravel deposits or dissolution hollows in the limestone geology. The proliferation of these small, discrete anomalies across the survey area has complicated the identification of similar anomalies of an archaeological origin. The magnetic anomaly representing a small archaeological pit, for example, can look identical to that of a small anomaly of a natural origin.

7.2.4. Anomalies associated with the historic agricultural and industrial utilisation of the landscape have been identified across the site. Two linear anomalies directly correlate with the location of former field boundaries recorded on the 2nd ed OS map. Abutting the edge of another historic field boundary in the south-eastern part of site is a c. 70m x 44m rectangular area of disturbance that is indicative of debris material backfilled into a former quarry. Other similar but smaller areas of magnetic disturbance around the historic field boundaries may result from similar material. Magnetic disturbance around the edges of the field can be associated with extant metallic structures along the boundaries.

7.2.5. An area of archaeological activity is prominent through the centre of the survey area. A potential trackway has been detected running through the centre of the survey area, before curving to the north-east. Two coherent ring ditches are located on either side. These features have been classified as possessing a probable archaeological origin. Further anomalies of a possible archaeological origin have also been identified; although the specific function or relative period for these anomalies is less clear. Shorter linear anomalies that appear to respect the potential trackway and a historic field boundary may represent a field system earlier than the divisions outlined in the 2nd ed. OS map.

7.2.6. Anomalies classified as 'Undetermined' are more ambiguous in origin and may represent a combination of archaeological, agricultural, natural, or modern processes.

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. **Magnetic Disturbance** – The strong anomalies produced by extant metallic structures along the edges of the field and by services that cross the survey area have been classified as 'Magnetic Disturbance'. These magnetic 'haloes will obscure the response of any weaker underlying features, should they be present, often over a greater footprint that the structure they are being caused by.

7.3.1.3. **Ferrous (Spike)** – Discrete ferrous-like, dipolar anomalies are likely to be the result of isolated modern metallic debris on or near the ground surface.

7.3.1.4. **Ferrous/Debris (Spread)** – A ferrous/debris spread refers to a concentrated deposition of discrete, dipolar ferrous anomalies and other highly magnetic material. The debris causing this spread of dipolar anomalies is likely to be an accumulation of agricultural material added to the track to consolidate it.

7.3.1.5. **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.

7.3.2. Magnetic Results - Specific Anomalies

7.3.2.1. **Archaeology (Probable) –** Bending to the north-east through the centre of the survey is a parallel alignment of discrete and continuous magnetic anomalies [**1a**]. The continuous component of [**1a**] is characterised by weakly magnetic linear anomalies ('Archaeology Probable – Weak'), typical of ditch or similar feature. The discrete components of [**1a**] are characterised by smaller, circular

stronger magnetic anomalies ('Archaeology Probable – Strong'), typical of pits or similar features. The distinction between these two types of anomalies is important, as it could indicate pit-like features cut into a ditch. The southern section of this feature is partially obscured by the halo from the in-filled quarry. It is not clear from the survey results whether this historic/modern disturbance truncates the feature itself.

7.3.2.2. **Archaeology (Possible) –** A parallel series of linear anomalies in the south-western part of the site appear to run perpendicular to the western side of [**1a**]. However, it is not clear whether these sets of features are contemporary or whether the parallel series in the south-west represent later land divisions.

7.3.2.3. **Archaeology (Probable) –** Two ring ditches have been identified towards the centre of the survey area, either side of [**1a**]. The larger of the two [**1b**] has a diameter of c.25m and the smaller [**1c**] a diameter of c.13m. Though the entire shape of [**1b**] cannot be discerned due to disturbances associated with an in-filled quarry immediately south. Smaller discrete anomalies within [**1b & 1c**] could reflect pits or other associated features.

7.3.2.4. **Agricultural –** Two generally weak linear anomalies in the northern and eastern parts of the survey area [**1d**] correlate with former field boundaries recorded on historic maps (Figure 8).

7.3.2.5. **Archaeology (Possible) –** In the eastern part of site, [**1d**] runs parallel to a footpath also recorded on historic maps. A weak linear positive magnetic anomaly has been detected along the location of this footpath. However, this type of response is not typical of such a feature. Therefore, a possible archaeological origin has been ascribed, given the context of the surrounding archaeology.

7.3.2.6. **Archaeology (Possible) –** In the north-eastern part of site, a series of parallel linear positive anomalies appear to abut [**1d**] at 90°. These anomalies do not correlate with any mapped features, but the size and type of response is suggestive of smaller land parcel divisions.

7.3.2.7. **Archaeology (Possible) –** A very strong linear anomaly with a sharp edge [**1e**] has been detected on a similar alignment to the historic field boundaries [**1d**] but is distinct from the surrounding anomalies. Given the magnetic enhancement and defined shape of this anomaly, an anthropogenic origin is almost certain. Although whether this is archaeological or industrial is less clear.

8. Conclusions

8.1. A fluxgate magnetometer survey has successfully been completed across the site. The survey results present a complex background, which reflects a palimpsest of various natural processes. This has made it difficult to disentangle weaker or smaller pit-like anomalies from the natural background, due to the similarities in magnetic response. However, greater confidence is ascribed to those within and around the vicinity of more coherent archaeological features.

8.2. A sizeable portion of the south-eastern part of the site is disturbed from apparent quarrying or industrial activity. However, outside of this, modern interference is generally limited to the perimeter of the field.

8.3. Agricultural activity has been identified in the form of former field boundaries recorded on historic maps and weak modern ploughing trends.

8.4. Archaeological activity has been identified across the site. The most coherent features are ascribed as 'probable' archaeological origin and appear to reflect ring ditches and a potential trackway feature. The potential trackway feature is complex in nature, as it is defined by anomalies typical of ditch-like and pit-like features. Anomalies of a less certain archaeological origin have been classified as 'possible'. These are generally characteristic of soil-filled cut features and may represent earlier land divisions.

8.5. Anomalies classified as 'Undetermined' in origin may represent a combination of archaeological, agricultural, industrial, or natural processes.

9. Archaeological Recommendations

9.1. The geophysical survey has shown that the proposed site south of Meadow Lane, Ryall, Rutland contains a variety of anomalies attributed to both natural processes (i.e. geological variations and palaeochannels) and those of probable archaeological origin.

9.2. Whilst this survey has highlighted the archaeological potential of the site, it should not preclude it from being considered immediately for forthcoming development, subject to further archaeological investigations taking place.

9.3. A detailed strategy to mitigate against the impact of development on the heritage assets identified within the area of the proposed development can be developed in consultation with the Historic and Natural Environment Team at Leicestershire County Council (HNET LCC). The HNET LCC will provide advice on request in regard to how to carry this forward. A trial trench evaluation would be the initial requirement in order to test the results of the geophysical survey and gain a better understanding of the levels of preservation and the date of those archaeological remains.

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 the any dictated time embargoes.

11. Copyright

11.1. 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.

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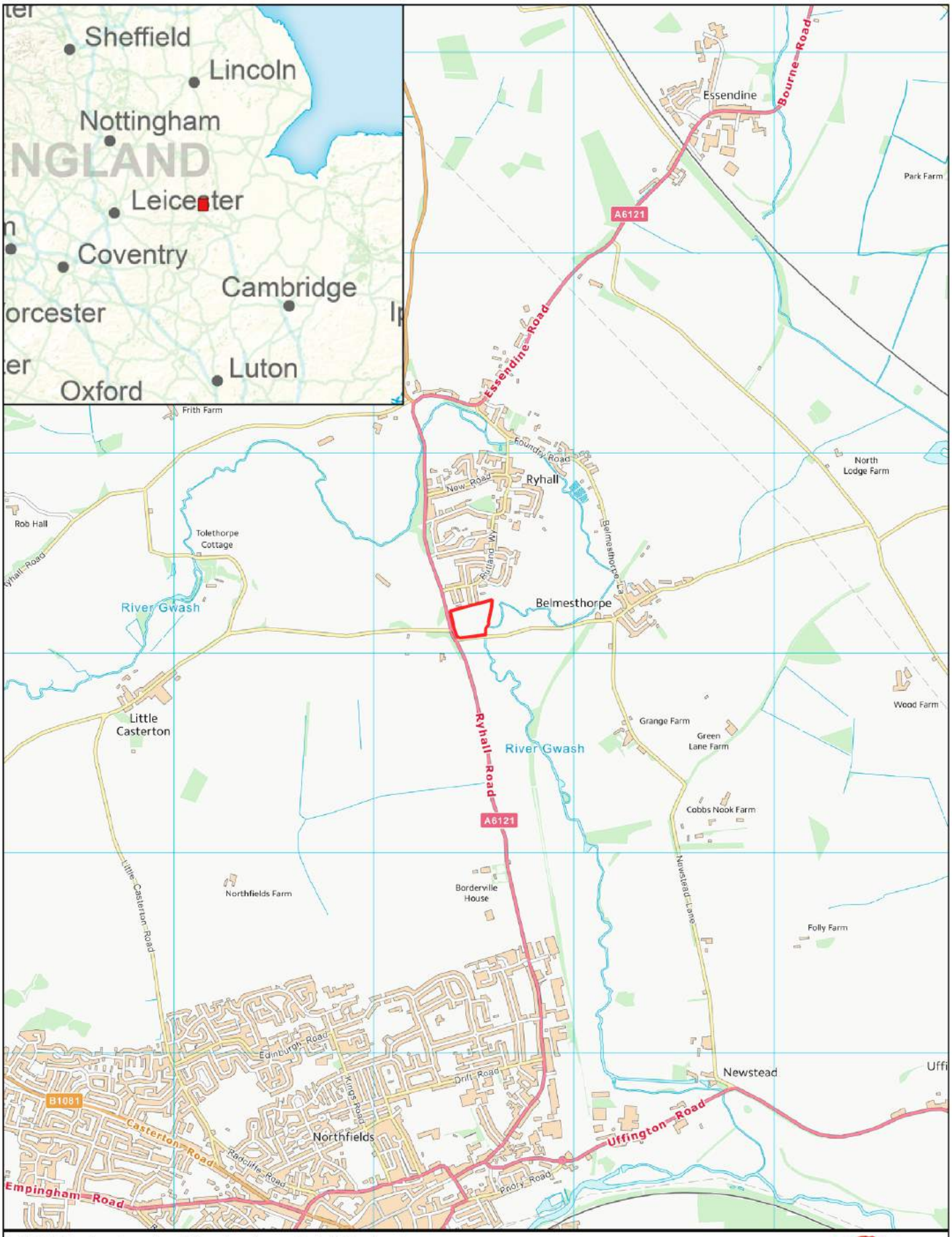

MSTF457 - Land south of Meadow Lane, Ryhall, Rutland
Figure 1 - Site Location
1:25,000 @ A4

Site Boundary

N

0 0.5 1 km

magnitude surveys

503000

504000

Spinney Lane

Spinney Close

Coppice Road

Coppice Road

Meadows Playing Field

St Tibba Way

Rutland Way

Parkfield Road

Belmesthorpe Lane

A6121

Burley Road

Beech Drive

Meadow Lane

River Gwash

Shepherd's Walk

Castle Rise

Home Farm

A6121

Newstead Lane

A6121

Newstead Lane

310000

310000

MSTF457 - Land south of Meadow Lane, Ryhall, Rutland
Figure 2 - Location of Survey Area
1:4,000 @ A3

Survey Extent

N

0 100 200 300 m

magnitude surveys

503300
503400
503500
503600
310200
310100
Beech Drive
Meadow Lane
A6121
A6121

MSTF457 - Land south of Meadow Lane, Ryhall, Rutland
Figure 3 - Magnetic Total Field (Lower Sensor)
1:1.000 @ A3

48,900 nT 49,200

N

0 25 50 75 m

magnitude surveys

503300
503400
503500
503600
310200
310100
Beech Drive
Meadow Lane
A6121
A6121

MSTF457 - Land south of Meadow Lane, Ryhall, Rutland
Figure 4 - Magnetic Gradient (narrow plotting range)
1:1,000 @ A3

-1 nT 2

N

0 25 50 75 m

magnitude surveys

503300
503400
503500
503600
310200
310100
Beech Drive
Meadow Lane
A6121
A6121

MSTF457 - Land south of Meadow Lane, Ryhall, Rutland
Figure 5 - Magnetic Gradient (wide plotting range)
1:1,000 @ A3

-3 nT 5

N

0 25 50 75 m

magnitude surveys

503300
503400
503500
503600
310200
310100
Beech Drive
Meadow Lane
A6121
1a
1d
1e
1b
1c

MSTF457 - Land south of Meadow Lane, Ryhall, Rutland
Figure 6 - Magnetic Interpretation
1:1,000 @ A3

Archaeology Probable (Strong)
Archaeology Probable (Weak)
Archaeology Possible (Strong)
Archaeology Possible (Weak)
Agricultural (Strong)
Agricultural (Weak)
Undetermined (Strong)
Undetermined (Weak)
Natural (Strong)
Natural (Weak)
Magnetic Disturbance
Ferrous/Debris (Spread)
Agricultural (Trend)

N
0 25 50 75 m

magnitude surveys

503400 503500 503600

310300 310200 310100 310000

MSTF457 - Land south of Meadow Lane, Ryhall, Rutland
Figure 7 - Magnetic Interpretation Over Satellite Imagery
1:1,500 @ A3

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

N

0 40 80 120 m

magnitude surveys

503200 503300 503400 503500 503600 503700

310300 310200 310100 310000

113 M.S Stamford 2

F.P

G.P

99

MSTF457 - Land south of Meadow Lane, Ryhall, Rutland
Figure 8 - Magnetic Interpretation Over Historic Maps
1:1,500 @ A3

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

N

0 40 80 120 m

magnitude surveys

503300
503400
503500
503600
310200
310100
Beech Drive
Meadow Lane
A6121
A6121

MSTF457 - Land south of Meadow Lane, Ryhall, Rutland
Figure 9 - XY Trace Plot
90nT/cm at 1:1,000 @ A3

N
0
30
60
90 m

magnitude surveys