Geophysical Survey Report

Of

Land at Newbold Verdon

For

RPS

On Behalf Of

Richborough

Magnitude Surveys Ref: MSSK1741

HER Event Number: TBC

March 2024

3 Captain Street

Bradford

BD1 4HA

01274 926020

info@magnitudesurveys.co.uk

Report By:

William Syson BA (Hons), MSc

Report Approved By:

Finnegan Pope-Carter BSc (Hons) MSc FGS

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Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of c. 6.3ha of land at Newbold Verdon, Leicestershire. A fluxgate gradiometer survey was successfully completed across the survey area. Former mapped field boundaries have been identified within the survey area, reflecting long-term agricultural usage. An anomaly of natural origin has been identified within the survey area and likely represents variations in the superficial deposits. No anomalies suggestive of archaeological features were identified; however, anomalies of undetermined origin have been identified across the survey area. These are considered more likely to be agricultural and/or natural in origin but an archaeological origin cannot be entirely ruled out. Magnetic disturbance is predominantly limited to the field boundaries where any weaker anomalies, if present, may have been masked.

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1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by RPS on behalf of Richborough to undertake a geophysical survey over a c. 6.3ha area of Land East of Brascote Lane, Newbold Verdon, Leicestershire (SK 44884 03293). C. 1.2ha could not be surveyed due to overgrown vegetation.

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 (Howarth, 2024).

1.5. The survey commenced on 16/02/2024 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 and a Member of CIfA, 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 directly south of Newbold Verdon, Leicestershire (Figure 1). A gradiometer survey was undertaken across one field under pasture. The survey area was bordered by residential buildings to the north, playing fields to the east and agricultural fields to the south and west. A stream ran along the southern boundary of the survey area (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	The survey area consisted of a pasture field sloping down to the southwest.	The survey area was bordered by trees and hedges to the south and east with wire and wooden fencing to the north and west. Two manhole covers were identified in the east of the survey area. Due to overgrown vegetation in the west, north and east, small sections of the survey area were unable to be surveyed.

4.3. The underlying geology comprises of mudstone from the Gunthorpe Member. Superficial deposits comprised of an alluvium deposit of clay, silt, sand and gravel to the south of the survey area with glaciofluvial deposits of sand and gravel to the north (British Geological Survey, 2024).

4.4. The soils consist of loamy soils with naturally high groundwater (Soilscapes, 2024).

5. Archaeological Background

5.1. The following is a summary of a Heritage Statement produced and provided by RPS (Behrendt, 2024).

5.2. Prehistoric activity has been extensively recorded within c. 1km of the survey area. Pits containing potsherds and charcoal that date to the Bronze Age have been identified c. 550-600m to the south, as well as a Bronze Age barrow, c. 130m to the east of these features. A geophysical survey conducted c. 600m to the southwest of the survey area identified a ring ditch and cremation also dating to the Bronze Age. An Iron Age enclosure has been recorded through geophysical survey, c. 150m southwest of the survey area; trial trenching of the same feature has uncovered Iron Age potsherds confirming this interpretation, as well as several undated features that possibly relate to this enclosure. Cropmarks exhibiting a prehistoric pit alignment have been identified c.50m outside of the south-eastern edge of the survey area, although from which specific period of prehistory is undetermined.

5.3. Romano-British activity is limited to four pottery kilns of Romano-British origin located c. 600m southwest of the survey area.

5.4. Early to late medieval activity is limited to a couple of settlements. The nearby settlement of Newbold Verdon is recorded as being c. 220m to the north of the site as far back as the Domesday Book (1086), alongside the deserted medieval settlement of Brascote which was located c. 600m to the southwest. A scheduled monument moated site has also been identified c. 500m northwest of the survey area, containing a medieval manor house which was indicated by finds during a 1981 excavation.

5.5. An undated pit and road surface were identified during a watching brief c.50m north of the site.

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 cart system GNSS-positioned 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 6). XY trace plots visualise the magnitude and form of the geophysical response, aiding anomaly interpretation.

6.3.2. Geophysical results have been interpreted using greyscale images and XY traces in a layered environment, overlaid against open street maps, satellite imagery, historical maps, LiDAR data, and soil and geology maps. Google Earth (2024) 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 7).

7.2.2. The fluxgate gradiometer survey responded well to the environment and was successfully completed across the site. Natural variations in the background variations in the superficial deposits have been detected across the survey area. The impact of modern activity on the site is relatively minimal and restricted to the field boundaries. No anomalies of archaeological origin have been identified within the survey area.

7.2.3. Linear anomalies have been located within the north, centre and west of the survey area. These correspond with former field boundaries visible on historical OS maps (Figure 7)'.

7.2.4. An amorphous anomaly has been identified in the south of the survey area (Figure 5). The anomalies weak signal strength and irregular morphology is suggestive of a natural origin and may represent variations in the superficial deposits.

7.2.5. Linear anomalies of an undetermined origin have been identified across the survey area (Figure 5). The anomalies present a very weak signal and lack the contextual evidence required for a confident classification. Although they are likely natural or agricultural in origin, an archaeological origin cannot be ruled out entirely.

7.2.6. Two discrete anomalies have been identified in the northeast of the survey area (Figure 5). These correspond with manhole covers visible at the time of the survey (see 4.4.2).

7.3.Interpretation

7.3.1. General Statements

7.3.1.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually.

7.3.1.2. **Ferrous (Spike)** – Discrete dipolar anomalies are likely to be the result of isolated pieces of modern ferrous debris on or near the ground surface.

7.3.1.3. **Magnetic Disturbance** – The strong anomalies produced by extant metallic structures, typically including fencing, pylons, vehicles and service pipes, have been classified as 'Magnetic Disturbance'. These magnetic 'haloes' will obscure weaker anomalies relating to nearby features, should they be present, often over a greater footprint than the structure causing them.

7.3.1.4. **Undetermined** – Anomalies are classified as Undetermined when the origin of the geophysical anomaly is ambiguous and there is no supporting contextual evidence to justify a more certain classification. These anomalies are likely to be the result of geological, pedological or agricultural processes, although an

archaeological origin cannot be entirely ruled out. Undetermined anomalies are generally distinct from those caused by ferrous sources.

7.3.2. Magnetic Results - Specific Anomalies

7.3.2.1. **Agricultural (Strong/Weak/Spread)** – Across the survey area, a series of strong and weak linear anomalies were identified (Figures 3-8). While the field boundaries in the east of the survey area are characterised by a weakly positive magnetic signal, the mapped boundary in the west is visible as a strongly positive linear anomaly associated with a concentration of mixed, ferrous debris (Figures 4 & 6). This suggests that it may have been backfilled with magnetic debris.

7.3.2.2. **Manhole** – In the northeastern corner of the survey area, extant manholes were recorded which are visible within the data (Figures 3-8). This caused a magnetic disturbance visible in the data as two discrete anomalies.

7.3.2.3. **Natural (Weak)** – A anomaly of natural origin was identified in the east of the survey area (Figures 3-8). Due to the anomalies' weak signal, large size and irregular morphology, it is probable that they are natural in origin.

8. Conclusions

8.1. A fluxgate gradiometer survey was successfully completed across the c. 6.3ha of land at Newbold Verdon, Leicestershire. Anomalies of an agricultural, natural, and undetermined origin were present. Modern disturbance is limited to survey boundaries where any weaker anomalies, if present, may have been masked.

8.2. Agricultural activity in the form of field boundaries has been identified across the survey area.

8.3. Linear anomalies classified as undetermined have been recorded in the central, south, and east of the survey area. A lack of context and the weak signal strength of these anomalies has meant that a confident interpretation or classification cannot be made, however, agricultural or natural origins is most likely, however, an archaeological origin for these features cannot be entirely excluded.

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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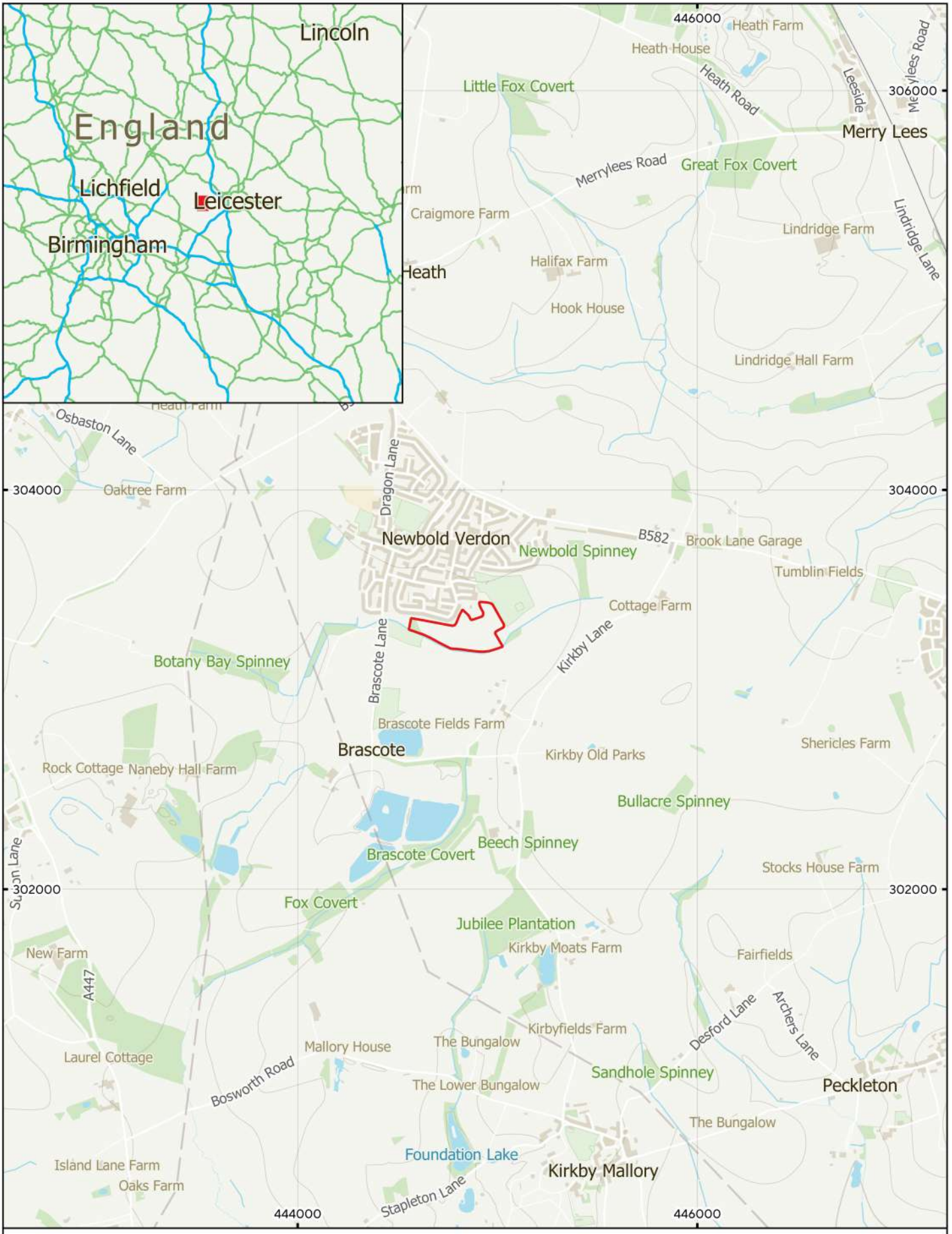
12. Project Metadata

MS Job Code	MSSK1741
Project Name	Land East of Brascote Lane, Newbold Verdon
Client	RPS Group
Grid Reference	SK 44884 03293
Survey Techniques	Magnetometry
Survey Size (ha)	6.3ha (Magnetometry)
Survey Dates	2024-02-16
Project Lead	Isabella Carli BA MA PCIfA
Project Officer	Joseph Howarth MSc
HER Event No	TBC
OASIS No	N/A
S42 Licence No	N/A
Report Version	0.4

13. Document History

Version	Comments	Author	Checked By	Date
0.1	Initial draft for Project Lead to Review	WS	IT, JH	27 February 2024
0.2	Edits following Project Office Feedback	HM	IC	29 February 2024
0.3	Comments from Project Lead	HM	IC, JH	29 February 2024
0.4	Amendments following Client Feedback	JH	JH	04 March 2024



MSSK1741 - Land at Newbold Verdon
Figure 1 - Geophysical Survey Location
1:25,000 @ A4

Geophysical Site

MSSK1741 - Land at Newbold Verdon
Figure 2 - Geophysical Survey Area
1:5,000 @ A3

Survey Extent

Magnitude Surveys

0 50 100 150 200 m

444750

445000

Mallory Close

Barbara Avenue

Rush Close

Willow Close

Arnold's Crescent

Playing Field

303250

303250

Area 1

MSSK1741 - Land at Newbold Verdon
Figure 3 - Magnetic Total Field (Lower Sensor)
1:1,500 @ A3

48,997 nT 49,005

Magnitude Surveys

0 15 30 45 60 m

444750

445000

Mallory Close

Barbara Avenue

Rush Close

Willow Close

Arnold's Crescent

Playing Field

303250

303250

Area 1

MSSK1741 - Land at Newbold Verdon
Figure 4 - Magnetic Gradient
1:1,500 @ A3

-1 nT 2

Magnitude Surveys

0 15 30 45 60 m

444750

445000

Mallory Close

Barbara Avenue

Rush Close

Willow Close

Arnold's Crescent

Playing Field

303250

303250

Area 1

MSSK1741 - Land at Newbold Verdon
Figure 5 - Magnetic Interpretation
1:1,500 @ A3

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

Magnitude Surveys

0 15 30 45 60 m

444750

445000

Mallory Close

Barbara Avenue

Rush Close

Willow Close

Arnold's Crescent

Playing Field

303250

303250

Area 1

MSSK1741 - Land at Newbold Verdon
Figure 6 - XY Trace Plot
30nT/cm at 1:1,500 @ A3

Magnitude Surveys

0 15 30 45 60 m

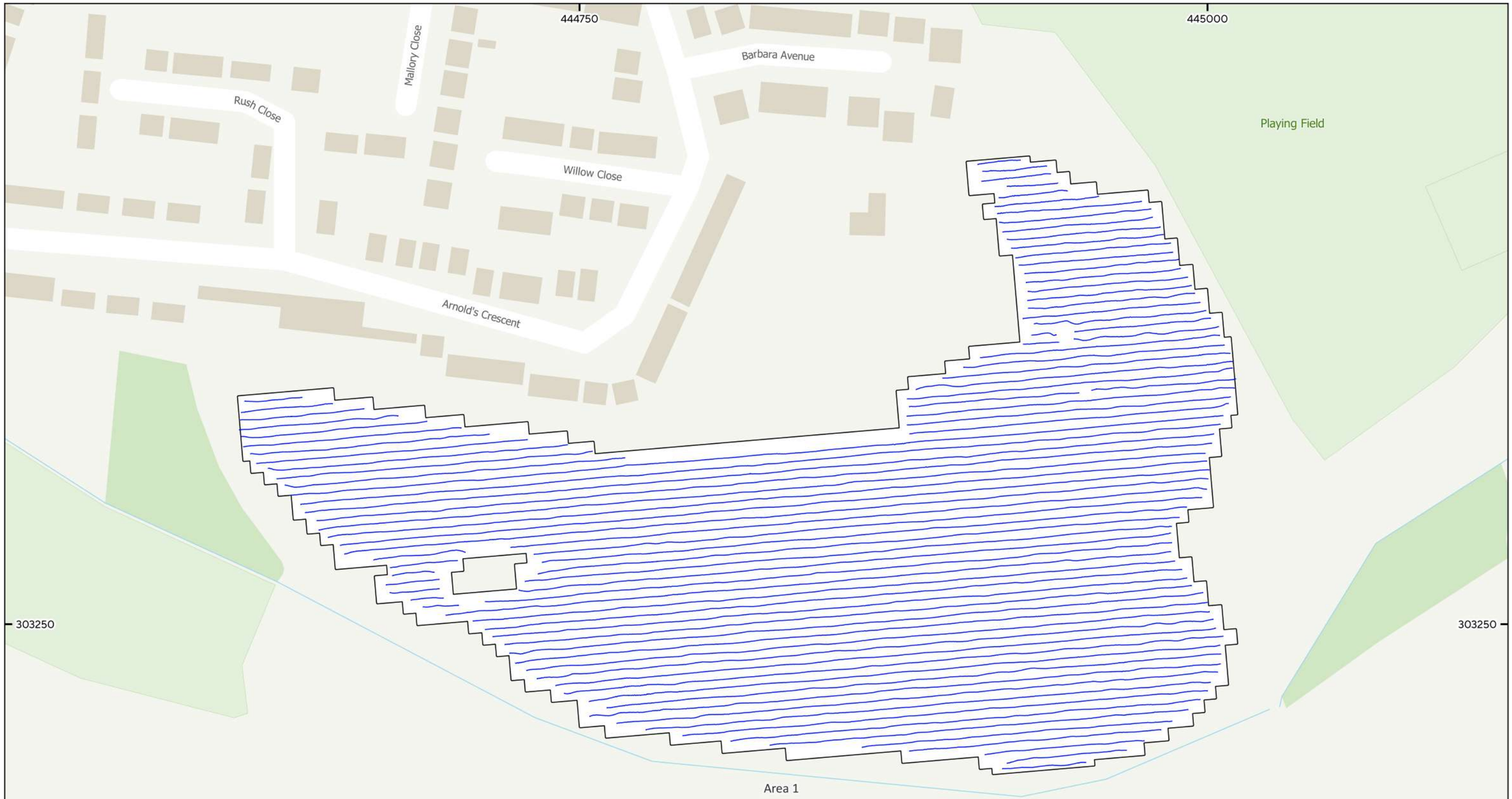
444400
444800
445200
303600
303200
B.M. 429.0
B.M. 408.8
Almshouses
Old Mill Inn
Windmill
Area 1
F.P.
424
427
B.M. 4

MSSK1741 - Land at Newbold Verdon
Figure 7 - Magnetic Interpretation over Historical Maps and Satellite Imagery
1:3,000 @ A3

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

Magnitude Surveys

0 30 60 90 120 m



MSSK1741 - Land at Newbold Verdon
Figure 8 - GNSS Lines
1:1,500 @ A3

Magnitude Surveys

0 15 30 45 60 m