



**magnitude
surveys**

**Geophysical Survey Report
Orton Road, Warton,
Warwickshire**

**For
RPS Consulting Services Ltd.**

**On Behalf Of
Richborough**

Magnitude Surveys Ref: MSSK1954

HER Event Number: TBC

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February 2025



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Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of c. 5.4ha of land at Orton Road, Warton, Warwickshire. A fluxgate gradiometer survey was successfully completed, with no anomalies of archaeological origin detected. However, agricultural anomalies related to historical ridge and furrow cultivation, drainage features, and a mapped pond were identified, along with natural anomalies likely linked to the underlying geology. Modern interference was minimal, limited to field boundaries due to metal fencing.

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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. 5.4ha area of land at Orton Road, Warton, Warwickshire (SK 27992 03293).
- 1.2. The geophysical survey comprised hand-carried 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 (Darlington, 2025).
- 1.5. The survey commenced on 24th of January 2025 and was completed 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 has served as 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 Chair of the Archaeological Prospection Community 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. 0.4km southwest of Warton, Warwickshire (Figure 1). Gradiometer survey was undertaken across one field under arable cultivation. The survey area is bordered by Church Road to the north and west, Orton Road to the south, and buildings and agricultural fields to the east (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	Pasture field gently sloping downwards to the west.	The area was bordered by hedgerows on all sides, except for the north and southeastern corner, which were bordered by metal fencing. Additionally, a gate was present to the south, and a wooden fence lined parts of the eastern boundary.

4.3. The underlying geology comprises of two lithological units. The eastern half of the area is underlain by sandstone from the Helsby Sandstone Formation, while the western half is underlain by mudstone from the same formation. Superficial deposits are recorded only in the western half of the survey area, comprising gravel, clay, silt, and sand from the Head Formation (British Geological Survey, 2025).

4.4. The soils consist of freely draining, slightly acidic sandy soils in the western and slightly acidic loamy and clayey soils with impeded drainage in the east of the survey area (Soilscapes, 2025).

5. Archaeological Background

5.1. The following is a summary of a Desk-Based Assessment produced and provided by RPS (Behrendt, 2025).

5.2. Prehistoric activity near the survey area includes isolated Palaeolithic finds (MWA12839, MWA12233) and a Bronze Age scraper (MWA21168). A site with intermittent use from the Mesolithic to the Iron Age (MWA5760) is recorded c. 800m south, while late Bronze Age to early Iron Age activity (MWA31803) was identified directly east and c. 150m further east of the survey area through trial trenching. A possible settlement from the Late Bronze Age to the Roman period (MWA220) is recorded c. 700m northwest. Undated cropmarks (MWA6728) c. 250m northwest may be of prehistoric origin.

5.3. Roman activity has been recorded within a 0.5km radius of the site through metal detecting, including Roman coins (MWA21165, MWA20781, MWA8313) and metal objects such as brooches (MWA20664, MWA14057, MWA20667). A possible Roman settlement is located approximately 700m northwest.

5.4. The site was part of Warton's agricultural hinterland in the Medieval period, with ridge and furrow cultivation identified through geophysical survey. Warton's Medieval settlement core (MWA9578) is c. 250m northeast, and the possible site of Stiper's Hill Castle (MWA13154) is c. 700m southwest. Metal-detected Medieval finds, including coins and a token (MWA21166, MWA20644, MWA20648, MWA10135), were recorded nearby but not within the survey area.

5.5. Post-Medieval finds (MWA21167) within the environs of the survey area include a token and coin.

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-carried GNSS-positioned system.

6.1.4.1. 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.

6.1.4.2. 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 lower sensors (Figures 3 & 4). 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 (2025) 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 successfully undertaken across the survey area. No anomaly of an archaeological origin was identified within the survey area. Anomalies of agricultural and natural origin were detected. Modern interference is limited to the field boundaries and caused by metal fencing.

7.2.3. Evidence of agricultural use has been identified within the survey area, including a former pond, ridge and furrow cultivation and drainage features (Figure 5).

7.2.4. Variations in the underlying geology and soils have been identified. These are visible in the total magnetic field data as amorphous anomalies, likely related to the underlying bedrock (Section 4.3).

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.

7.3.2. Magnetic Results - Specific Anomalies

- 7.3.2.1. **Agricultural (Spread)** – A band of discrete magnetic disturbance, surrounded by negative halo, has been detected in the east of Area 1 (Figure 4). This anomaly corresponds with a former pond visible on the historical OS mapping (Figure 6).
- 7.3.2.2. **Agricultural (Ridge & Furrow)** – Positive linear anomalies were detected across the survey area, aligning northeast to southwest (Figure 4). These anomalies run parallel to one another and to the former field boundary, as depicted on the historical map (Figure 6). The collective appearance of these anomalies is indicative of historical ridge and furrow cultivation.
- 7.3.2.3. **Drainage Feature** – A rectilinear anomaly has been identified on the eastern boundary of the survey area. This anomaly exhibits dipolar magnetic signals typical of a ceramic pipe.
- 7.3.2.4. **Natural (Weak)** - In the eastern and western parts of the survey area, weakly enhanced discrete positive anomalies forming bands have been identified, most apparent in the Total Field plot (Figure 3). These bands are likely caused by the decomposition of the underlying bedrock within the survey area.

8. Conclusions

- 8.1. A fluxgate gradiometer survey was successfully completed across c. 5.4ha area of land at Orton Road, Warton, Warwickshire. No anomaly of an archaeological origin was identified within the survey area. Anomalies of agricultural and natural origins were identified. Modern disturbance was limited to the survey boundaries, caused by metal fencing.
- 8.2. Evidence of agricultural activity was detected, including a former mapped pond, ridge and furrow cultivation, and drainage feature.
- 8.3. Variations in the underlying geology and soils were detected within the survey area, likely caused by the underlying bedrock.

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	MSSK1954
Project Name	Orton Road, Warton, Warwickshire
Client	RPS Consulting Ltd
Grid Reference	SK 27992 03293
Survey Techniques	Magnetometry
Survey Size (ha)	5.4ha (Magnetometry)
Survey Dates	2021-01-24 to 2021-01-24
Project Lead	King Yin Kennis Ho MSc
Project Officer	King Yin Kennis Ho MSc
HER Event No	N/A
OASIS No	N/A
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	TF	LAG	05 February 2025
0.2	Draft following Director Approval	TF	PSJ	07 February 2025
1.0	Final		LAG	19 February 2025



MSSK1954 - Orton Road, Warton

Figure 1 - Geophysical Survey Location

1:25,000 @ A4

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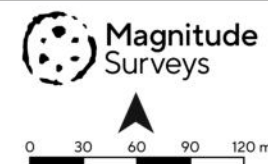
 Geophysical Site

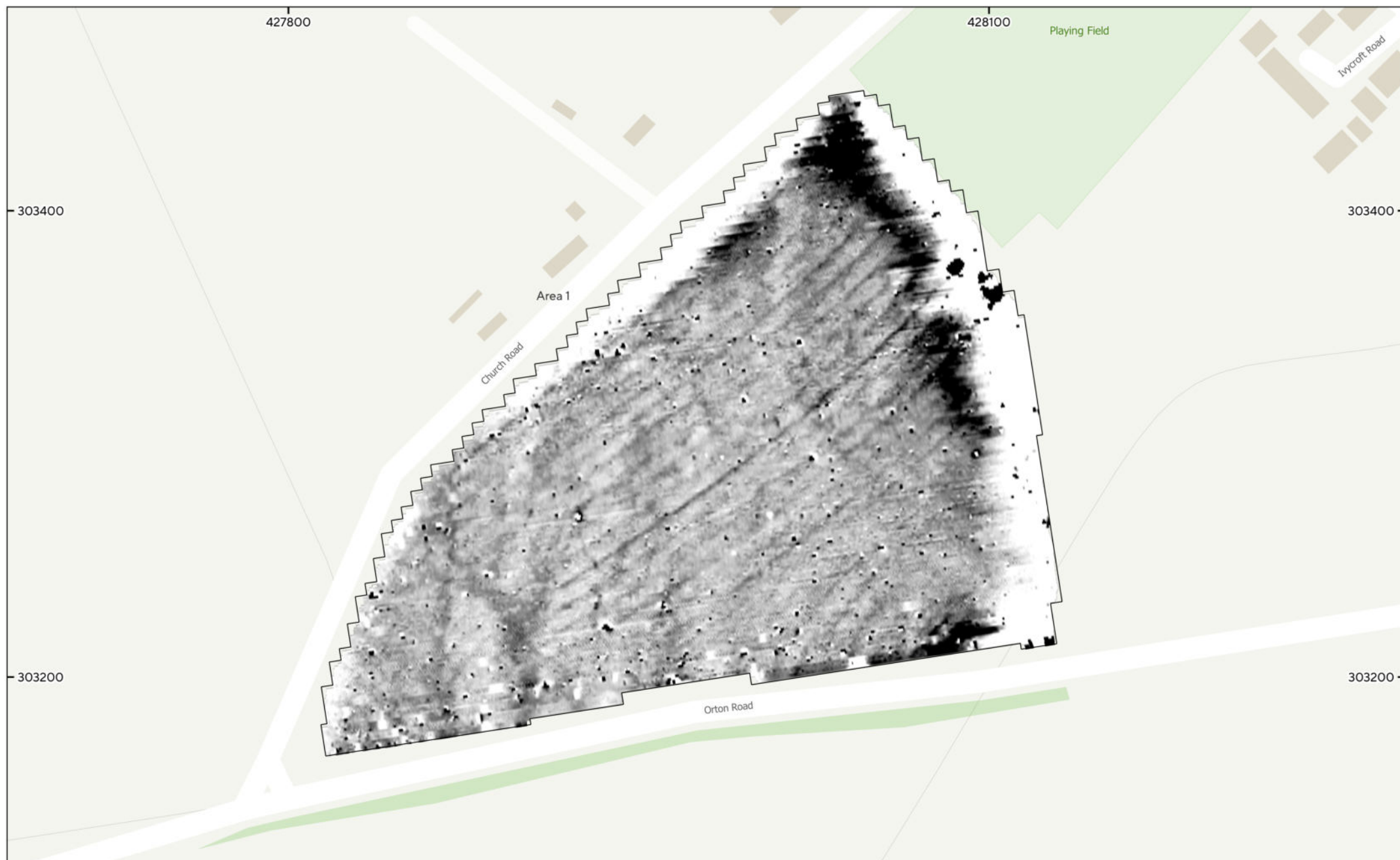




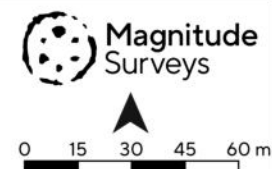
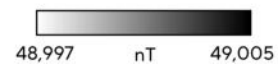
MSSK1954 - Orton Road, Warton
Figure 2 - Geophysical Survey Area
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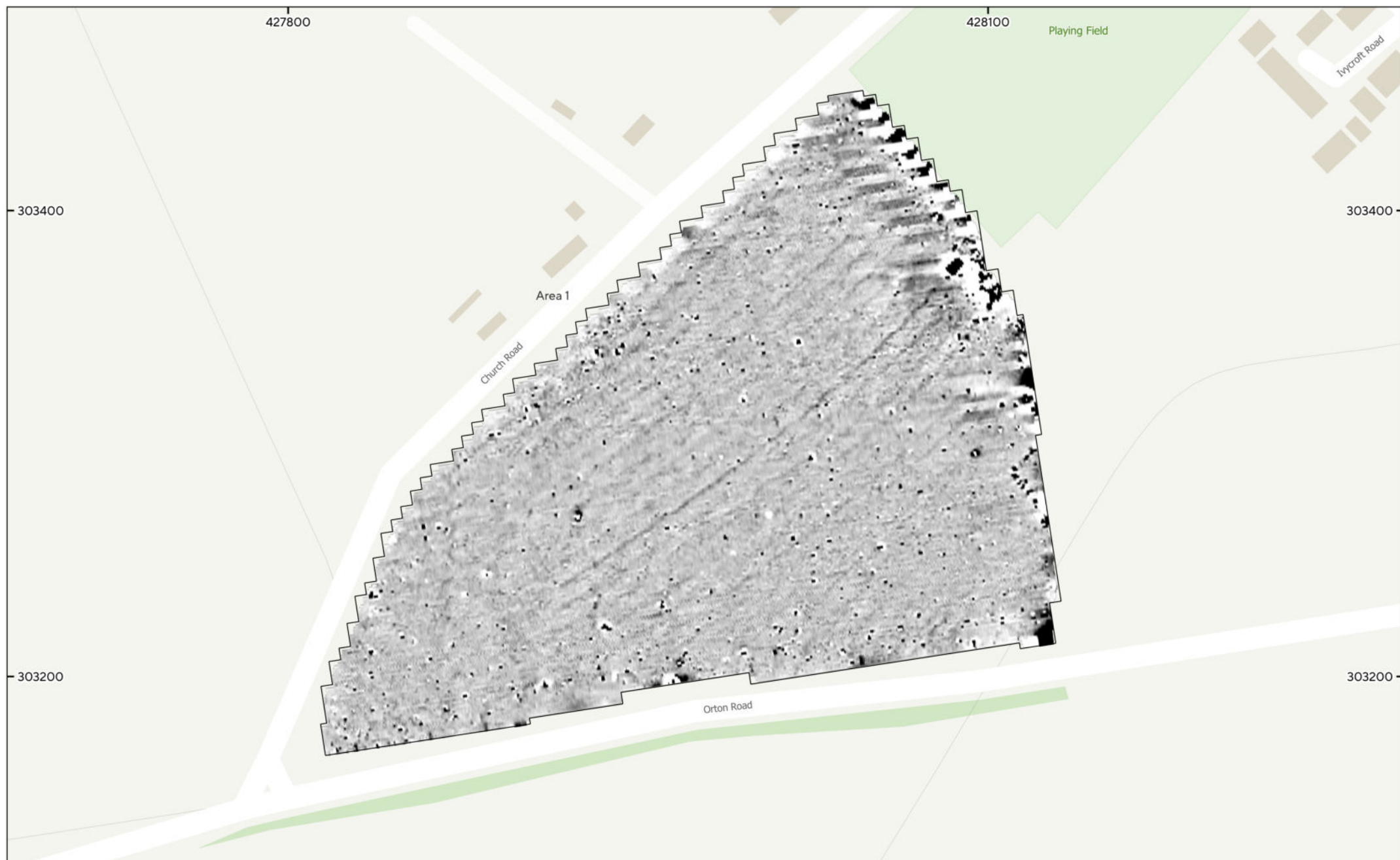
 Survey Extent



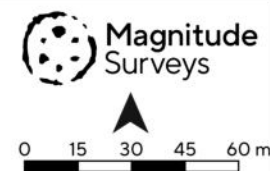
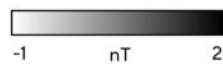


MSSK1954 - Orton Road, Warton
 Figure 3 - Magnetic Total Field (Lower Sensor)
 1:1,500 @ A3
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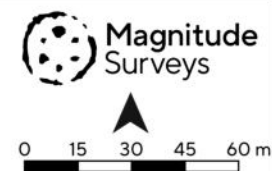
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Figure 4 - Magnetic Gradient
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MSSH1954 - Orton Road, Warton
 Figure 5 - Magnetic Interpretation
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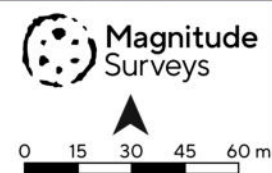
- | | |
|-----------------------|--------------------------|
| Agricultural (Spread) | Ridge and Furrow (Trend) |
| Magnetic Disturbance | Drainage Feature |
| Natural (Spread) | Ferrous (Spike) |

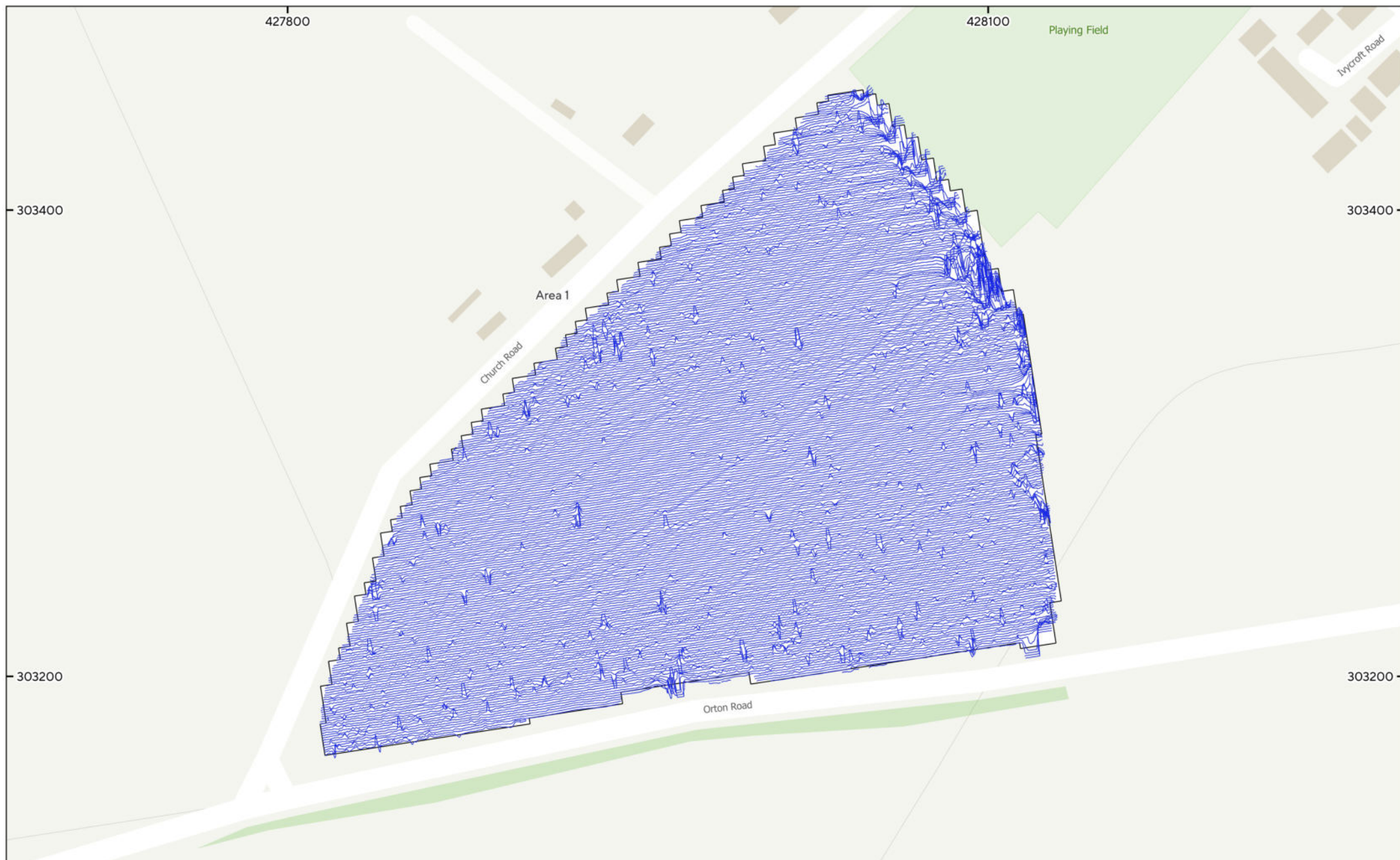




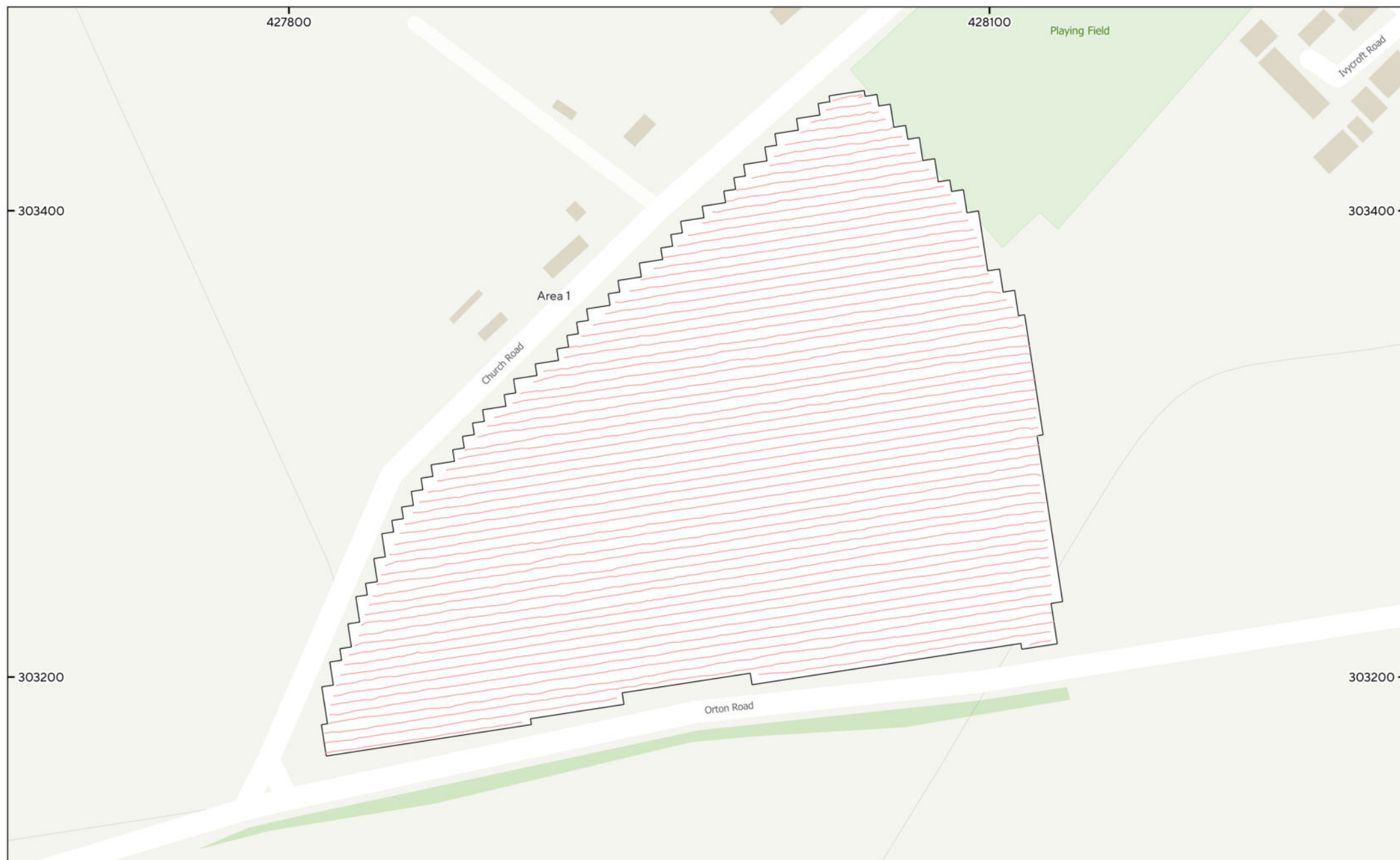
MSSK1954 - Orton Road, Warton
 Figure 6 - Magnetic Interpretation Over Historical Maps and
 Satellite Imagery
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- | | |
|-----------------------|--------------------------|
| Agricultural (Spread) | Ridge and Furrow (Trend) |
| Magnetic Disturbance | Drainage Feature |
| Natural (Spread) | Ferrous (Spike) |





MSSK1954 - Orton Road, Warton
Figure 7 - XY Trace Plot
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MSSK1954 - Orton Road, Warton
Figure 8 - GNSS Lines
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