



**magnitude
surveys**

**Geophysical Survey Report
of
Holt Road, Wrexham**

**For
CgMs Heritage (Part of RPS Group)**

**On Behalf Of
[Client's Client]**

Magnitude Surveys Ref: MSSJ464

May 2019



**magnitude
surveys**

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Draft 1.1	Initial draft to line manager	Hugo Kesterton BSc (Hons)	Hugo Kesterton BSc (Hons)	Leanne Swinbank, BA ACIfA	03 June 2019
Draft 1.2	Corrections	Julia Cantarano Ingénieur PCIfA	N/A	Finnegan Pope-Carter BSc (Hons) MSc FGS	03 June 2019

Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c. 28 ha area of land at Holt Road, Wrexham, of which a c. 0.6ha area was too steep and overgrown to allow for survey. A fluxgate magnetometer survey has been successfully completed, with the results primarily reflecting the modern and historic use of the site as agricultural land, as well as clearly representing natural geological variation as a result of changes in the topography and superficial deposits of the site. Anomalies of undetermined origins have been identified in three areas of the site, comprising weakly enhanced fragmentary linear and curvilinear anomalies that neither correspond with mapped features nor share a clear alignment with detected agricultural anomalies. A modern service and debris spreads relating to ground levelling are also represented in the results of the survey.

Contents

Abstract.....	2
List of Figures	4
1. Introduction	5
2. Quality Assurance	5
3. Objectives.....	5
4. Geographic Background.....	6
5. Archaeological Background.....	7
6. Methodology.....	7
6.1. Data Collection.....	7
6.2. Data Processing.....	8
6.3. Data Visualisation and Interpretation.....	8
7. Results.....	8
7.1. Qualification.....	9
7.2. Discussion.....	9
7.3. Interpretation.....	10
7.3.1. General Statements	10
7.3.2. Magnetic Results - Specific Anomalies.....	10
8. Conclusions	11
9. Archiving	12
10. Copyright.....	12
11. References	12

List of Figures

Figure 1:	Site Location	1:25,000 @ A4
Figure 2:	Location of Survey Area	1:5,000 @ A3
Figure 3:	Magnetic Gradient (Overview)	1:2,500 @ A3
Figure 4:	Magnetic Total Field (Lower Sensor)	1:2,500 @ A3
Figure 5:	Magnetic Interpretation (Overview)	1:2,500 @ A3
Figure 6:	Magnetic Interpretation Over Satellite Imagery	1:3,000 @ A3
Figure 7:	Magnetic Interpretation Over Historic Maps	1:3,000 @ A3
Figure 8:	Magnetic Gradient (Northwest)	1:1,250 @ A3
Figure 9:	Magnetic Interpretation (Northwest)	1:1,250 @ A3
Figure 10:	XY Trace Plot (Northwest)	1:1,250 @ A3
Figure 11:	Magnetic Gradient (Northeast)	1:1,250 @ A3
Figure 12:	Magnetic Interpretation (Northeast)	1:1,250 @ A3
Figure 13:	XY Trace Plot (Northeast)	1:1,250 @ A3
Figure 14:	Magnetic Gradient (Southwest)	1:1,250 @ A3
Figure 15:	Magnetic Interpretation (Southwest)	1:1,250 @ A3
Figure 16:	XY Trace Plot (Southwest)	1:1,250 @ A3
Figure 17:	Magnetic Gradient (Southeast)	1:1,250 @ A3
Figure 18:	Magnetic Interpretation (Southeast)	1:1,250 @ A3
Figure 19:	XY Trace Plot (Southeast)	1:1,250 @ A3

1. Introduction

- 1.1. Magnitude Surveys Ltd (MS) was commissioned by CgMs Heritage (Part of RPS Group) to undertake a geophysical survey on a c. 28ha area of land at Holt Road, Wrexham (SJ 3614 5144), of which a c. 0.6ha area towards the northeast corner of the site could not be surveyed due to unsuitable ground conditions.
- 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. This survey was conducted in line with a WSI produced by Magnitude Surveys (2019) and approved by the county archaeologist.
- 1.5. The survey commenced on 23/05/2019 and took two days 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 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 adjacent to the east of the town of Wrexham (Wrexham County Borough, Wales) at approximately 3km northeast of the town centre (Figure 1). Survey was undertaken over eight fields, bounded by the A534 and Sryt Holt roads to the north, further fields to the east, Bryn Estyn road to the south and residential buildings to the west (Figure 2). The topography of the site was a gentle slope downwards from north to south across the site.

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	Arable field with a young maize crop. The terrain slopes downhill towards the south.	This area is bound along all sides by hedgerows and a line of telegraph poles transects the centre of the area NW-SE.
2	Arable field with a young maize crop. The terrain slopes upwards to the centre of the area forming a ridge running sub E-W along the centre of the field. A slope also runs upwards to the southeast and southwest corners of the area.	The area is bound by ditch and treeline to the north and east, a ditch and treeline and metal fence to the west and hedge to the south. A line of telegraph poles transects the survey area from near the centre of the eastern boundary towards the north-western corner.
3	Arable field with a young maize crop. The terrain has a general slope down from north to south, with a rise along the southern boundary.	The area is bound along all sides by hedgerows and a line of telegraph poles transect the survey area NW-SE.
4	Fallow field with tall grass and weeds. The terrain slopes steeply downhill from the centre of the area towards the south-western corner.	The area is bound on all sides by a wire fence, and telegraph cables cross the northern corner sub NW-SE.
5	Arable field with a young maize crop. The terrain slopes upward from the centre of the survey area to the eastern and western boundaries.	The area is bound along sides by hedgerows, except for a segment of brick walling encompassing a residential property that abuts the survey area along the southern boundary. A line of telegraph pole transects the survey area NW-SE across the SW corner and the centre of the survey area.
6	Fallow field with tall grass and weeds. The terrain slopes steeply downhill to the south.	The area is bound by wire fence along all sides and telegraph cables cross the centre of the field sub N-S.
7	Arable field with a young maize crop. The terrain slopes gently downhill towards the south. A c. 0.6ha area to the northwest was unsurveyable due to a very steep slope and extensive nettle cover.	The area is bound by hedgerows to the west, south and east, and wire fence along the northern boundary.

8	Arable field with a young maize crop. The terrain undulates, predominantly sloping downhill towards the west.	The area is bound by hedgerows along the western, southern and eastern edges, trees and a ditch along the north-eastern edge, and a wire fence along the northern boundary. Telegraph cables cross the field in multiple directions in the eastern half of the survey area.
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4.3. The underlying geology comprises mudstone, sandstone and conglomerate of the Salop Formation across the site. Superficial deposits consist of sand and gravel of the Glaciofluvial Sheet Deposit, Devensian. (British Geological Survey, 2019).

4.4. The soils consist of freely draining slightly acid sandy soils (Soilscapes, 2019).

5. Archaeological Background

5.1. The following archaeological background summarises a search of the online resource Archwilio for the site and a 1km radius around the site (The Welsh Archaeological Trusts 2019).

5.2. Within the surveyed area no heritage assets have been recorded though an infilled Post-Medieval marl pit is located within the woodland located between the Areas 1, 2, 3 and 8 (82628).

5.3. Evidence of Prehistoric and Roman activity around the site is restricted to findspots for a Roman brooch (54925) and Bronze Age socketed axe (54933) c. 500m northeast of the site. Evidence for Medieval and Post-Medieval activity is identifiable with Medieval ridge and furrow c. 1km to the east of site (128243), a holloway c. 500m south of the site (826827), a findspot of glazed Medieval tile c. 500m northeast of site (85739), and findspots of Medieval and Post-Medieval coins c. 500m northeast of site (113522, 118433, 118442, 118447, 118456, 118459 and 88798) and c. 500m north of the site (120232, 120233 and 54837).

5.4. Layout of field boundaries across the site in historic OS maps, with the exception of Areas 4 and 6, is very similar to modern organisation of fields. Three additional east-west field boundaries in the 1st and 2nd ed. OS maps (Figure 7) transect the centres of Areas 3 and 7, and the southern end of Area 1. The present layout of Areas 4 and 6 is strongly influenced by the location of the roundabout along the A534, not present in historic OS maps. In the 1st ed. OS map Areas 4 and 6 lie within a larger field, which is divided into four fields in the 2nd ed. OS map.

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-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.

6.2. 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 plots (Figures

10, 14, 16 & 19). 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 6) and historic maps (Figure 7)

7.2.2. The fluxgate magnetometer survey has been successfully completed across the site, and no anomalies of archaeological origin have been identified. The site is primarily characterised by natural geological variation and agricultural activity. The natural anomalies generally comprise wide bands most clearly visible in the magnetic total field (Figure 4), which are also clearly visible on satellite imagery (Figure 6), and are reflective of variations in the sand and gravel superficial deposits of the site along slopes in its topography. Modern activity includes a service which has been detected running north-south along the western edge of the site, and magnetic disturbance from features such as metal fencing, which is generally contained to the edges of fields.

7.2.3. Several anomalies of undetermined origin have been detected in multiple areas of the site. These are fragmentary and weakly enhanced, and lack an alignment with the generally more enhanced agricultural anomalies of the site; as such, these have been unable to be classified more specifically than "Undetermined".

7.2.4. Agricultural anomalies have been detected across much of the site. These include former field boundaries, ridge and furrow, and modern ploughing regimes which are generally represented on aerial photographs between 2006 and 2019 (Google Earth, 2019).

7.2.5. Two large debris spreads have been identified at the northern edge of the centre of the survey area. These spreads, which coincide with an historic field boundary (Figure 7), and many be representative of ground levelling for agricultural purposes. Alternatively, they may be related to material dumping associated with the construction of the road directly north of the site, which a strip of debris in Area 8 appears to lead from. Different material has been used to create each spread, resulting in their differing appearance in the magnetic data.

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 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 than 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.

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. **Agricultural** – Historic field boundaries have been identified in Areas 1, 2, 3, 7 and 8. [1a], [3a] and [7a] correspond with boundaries recorded on 2nd Edition OS Mapping (Figure 7). [1b], [2a], [3b], [3c], [7b] and [8a] run parallel to recorded field boundaries on historic mapping, and as such probably comprise unrecorded field boundaries.

8. Conclusions

- 8.1. The fluxgate magnetometer survey has been successfully completed across the majority of the survey area, with the exception of a c. 0.6ha area towards the northeast corner, which was unsuitable for survey. The survey has primarily identified agricultural activity and natural geological variations, in addition to some anomalies of undetermined origin and a modern service. Magnetic disturbance is minimal across the site, with the exception of Area 8.
- 8.2. The agricultural anomalies primarily relate to historic mapped features or extensions of them beyond their recorded extents, and modern ploughing. Evidence of a ridge and furrow regime has been identified which probably relates to a field which appears on historic mapping in Area 5.
- 8.3. Natural anomalies relating to variations in the geology of the site have been identified across the majority of the survey area, generally comprising weakly enhanced magnetic bands and a generally mottled background texture across the site. These generally align with varying slopes in the topography of the site.
- 8.4. Anomalies of undetermined origin have been identified in Areas 3, 4 and 7, which do not appear to relate to agricultural anomalies which have been detected. Their fragmentary and weakly enhanced appearance has prevented a more confident classification of these anomalies.
- 8.5. A modern subsurface service has been detected running north-south along the western edge of the site. Spreads of magnetic debris towards the northern boundary of the centre of the survey area probably relate to ground levelling events or the deposition of construction-related materials.

9. Archiving

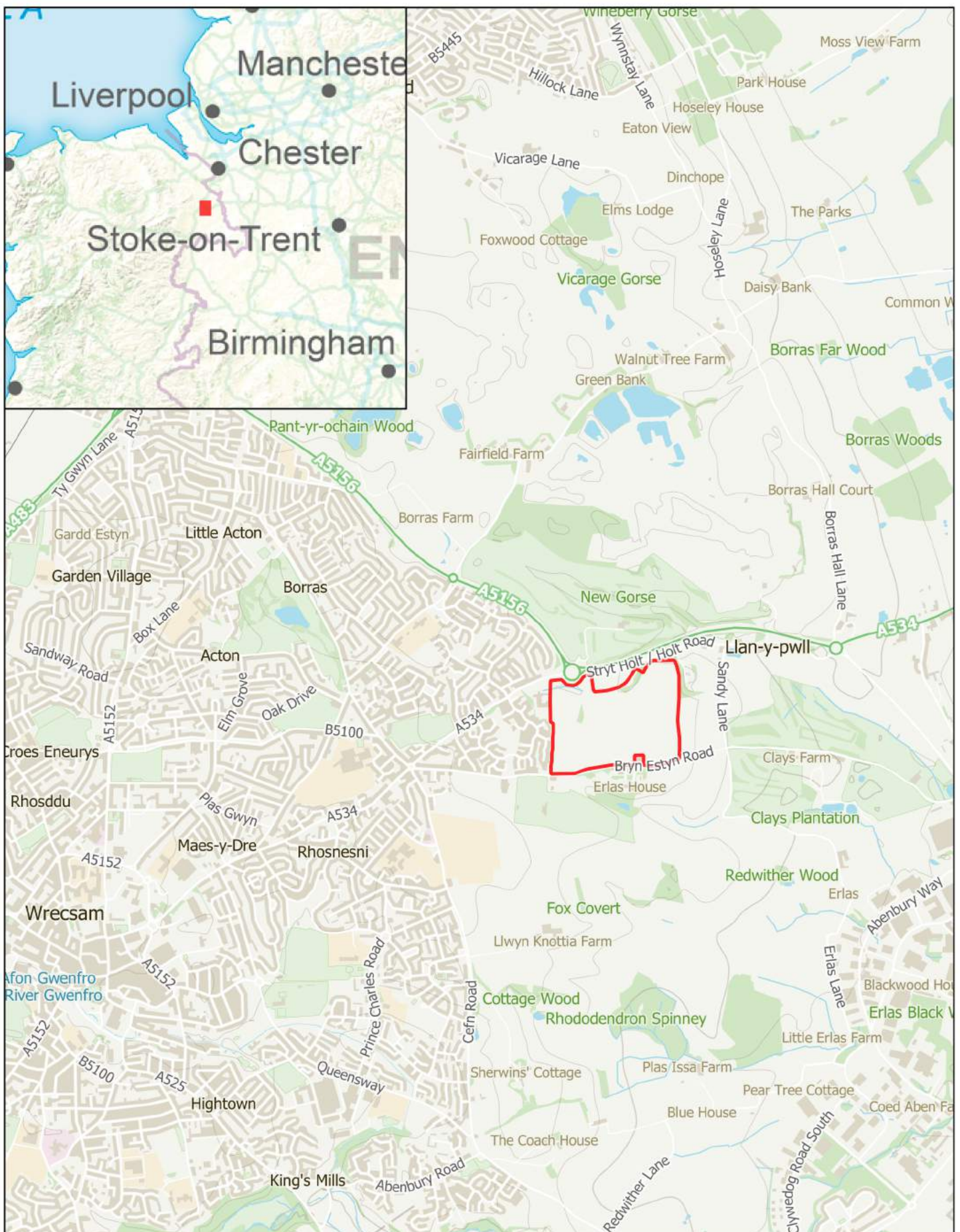
- 9.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013). This stores the collected measurements, minimally processed data, georeferenced and un-georeferenced images, XY traces and a copy of the final report.
- 9.2. MS contributes reports to the ADS Grey Literature 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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MSSJ464 - Holt Road, Wrexham

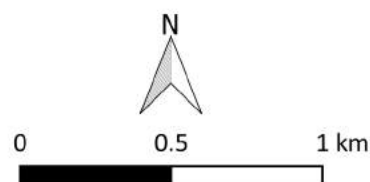
Figure 1 - Site Location

1:25,000 @ A4

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 Site Boundary

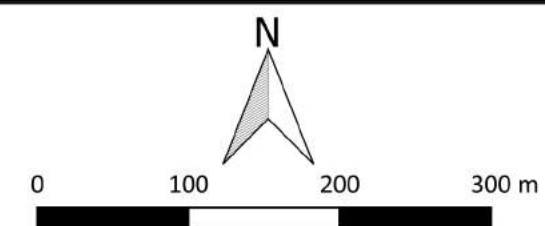


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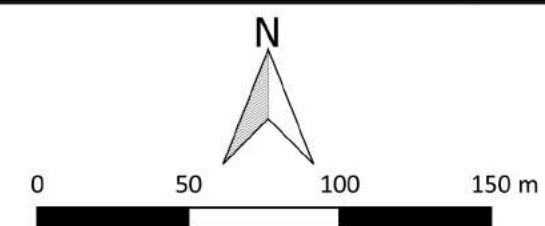
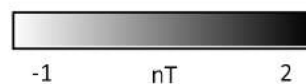
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 Figure 2 - Location of Survey Area
 1:5,000 @ A3
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- Survey Extent
- Unsurveyable



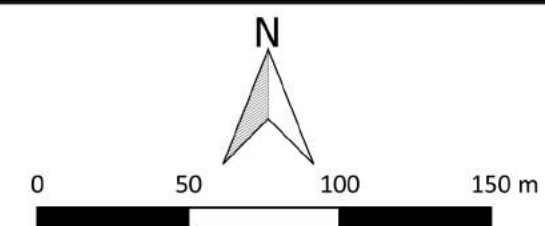


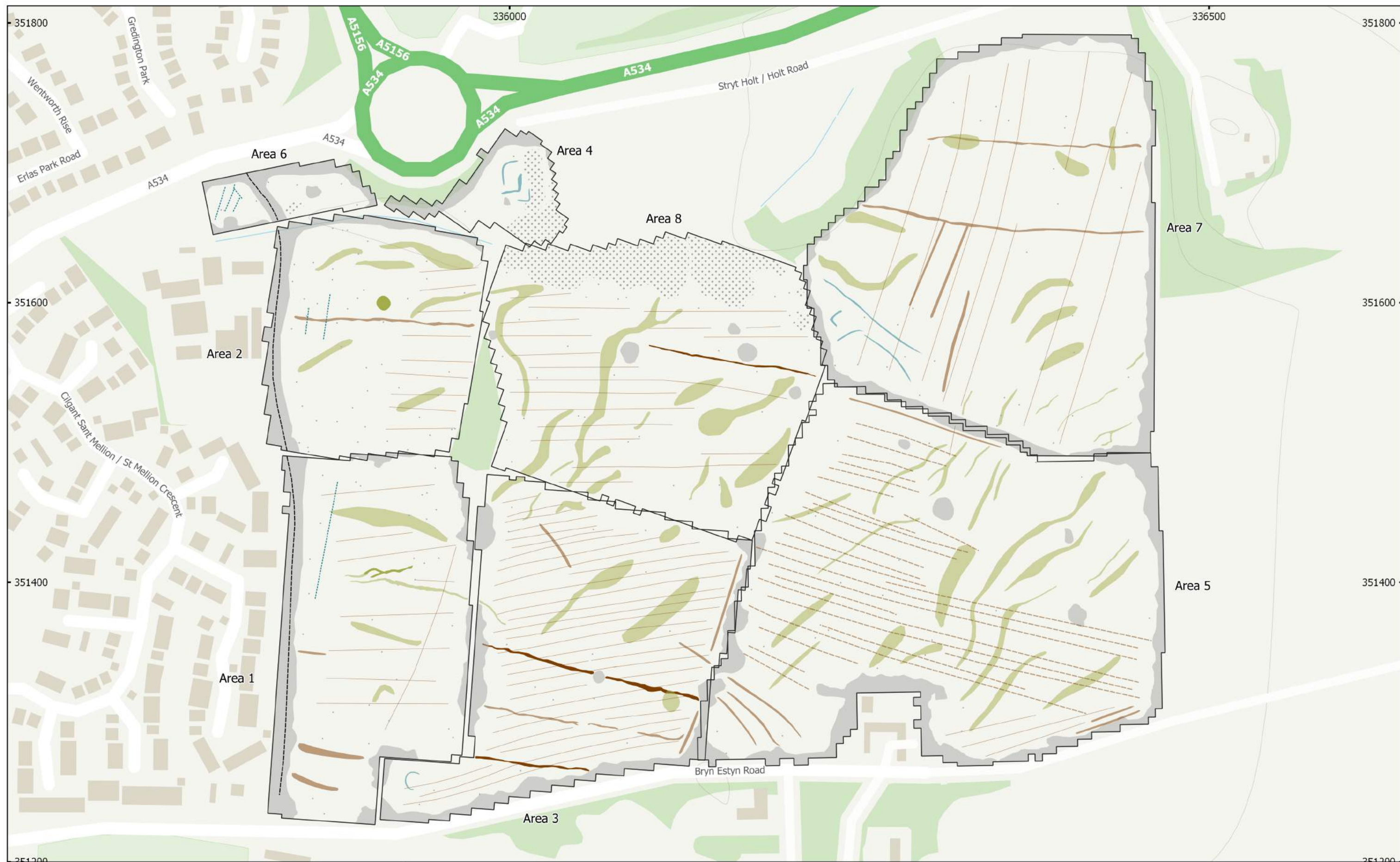
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 Figure 3 - Magnetic Gradient (Overview)
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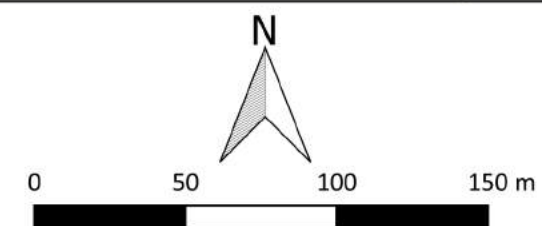
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 Figure 4 - Magnetic Total Field (Lower Sensor) (Overview)
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 Figure 5 - Magnetic Interpretation (Overview)
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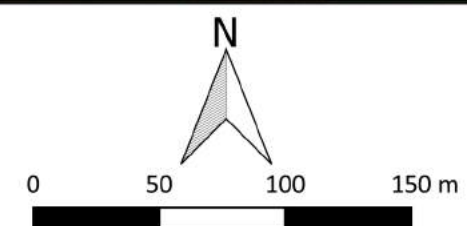
- | | | |
|-----------------------|-------------------------|--------------------------|
| Agricultural (Strong) | Natural (Weak) | Ridge and Furrow (Trend) |
| Agricultural (Weak) | Magnetic Disturbance | Undetermined (Trend) |
| Undetermined (Weak) | Ferrous/Debris (Spread) | Service |
| Natural (Strong) | Agricultural (Trend) | Ferrous (Spike) |





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 Figure 6 - Magnetic Interpretation Over Satellite Imagery
 1:3,000 @ A3
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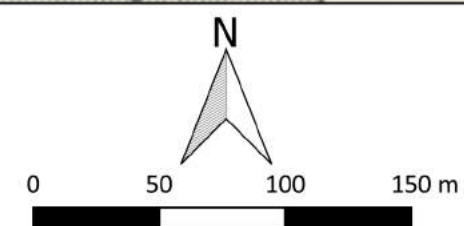
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|-----------------------|-------------------------|--------------------------|
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| Agricultural (Weak) | Magnetic Disturbance | Undetermined (Trend) |
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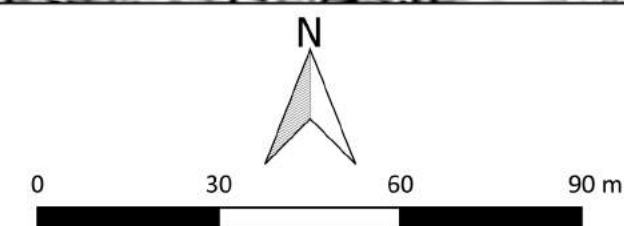
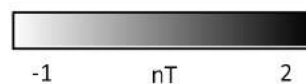
MSSJ464 - Holt Road, Wrexham
 Figure 7 - Magnetic Interpretation Over Historic Maps
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 Contains historic maps: Ordnance Survey, 6" 2nd edition c. 1882-1913 ©
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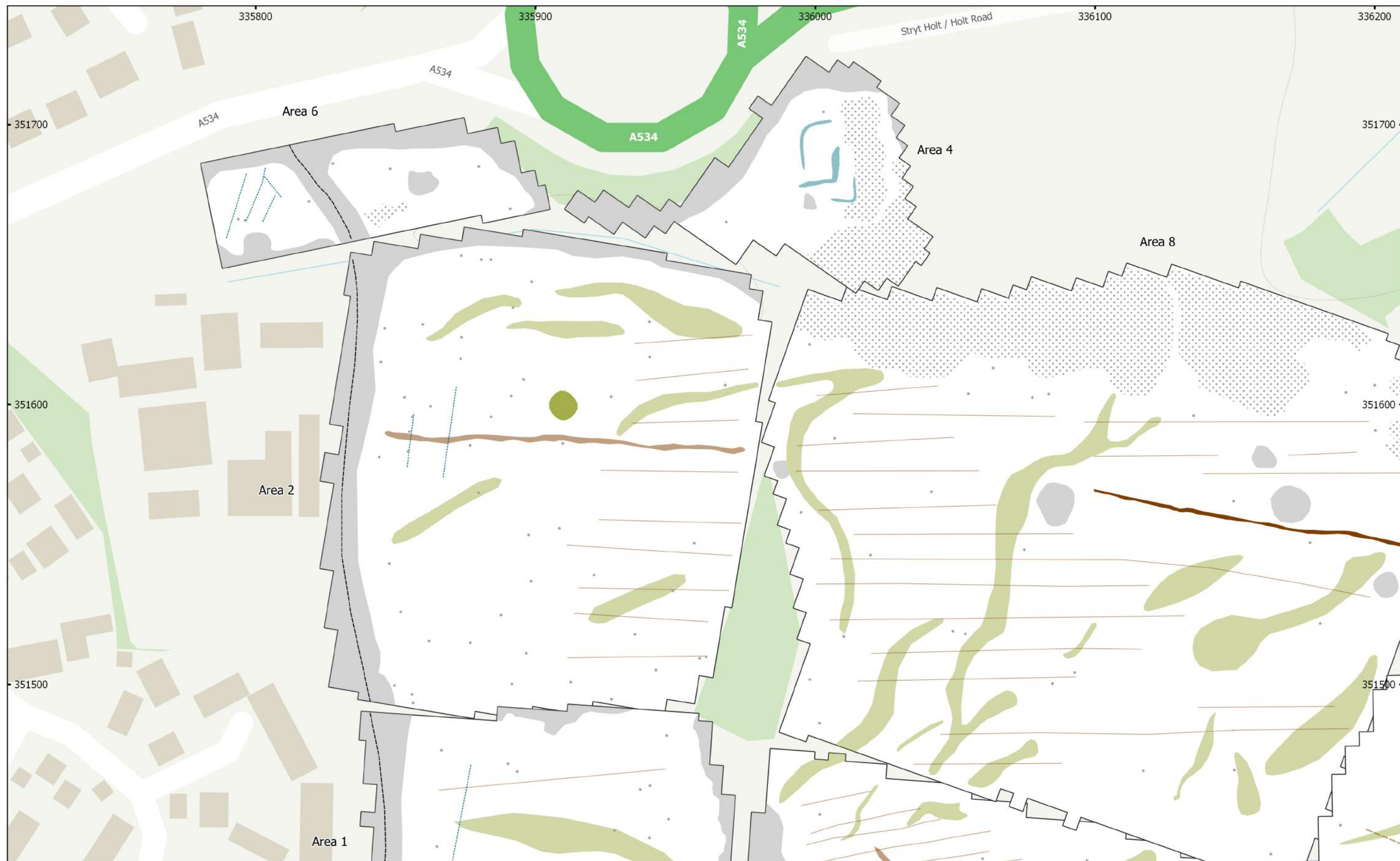
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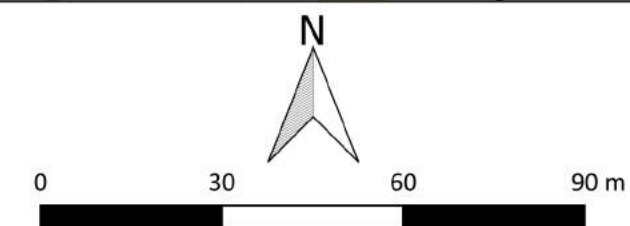
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 Figure 8 - Magnetic Gradient (Northwest)
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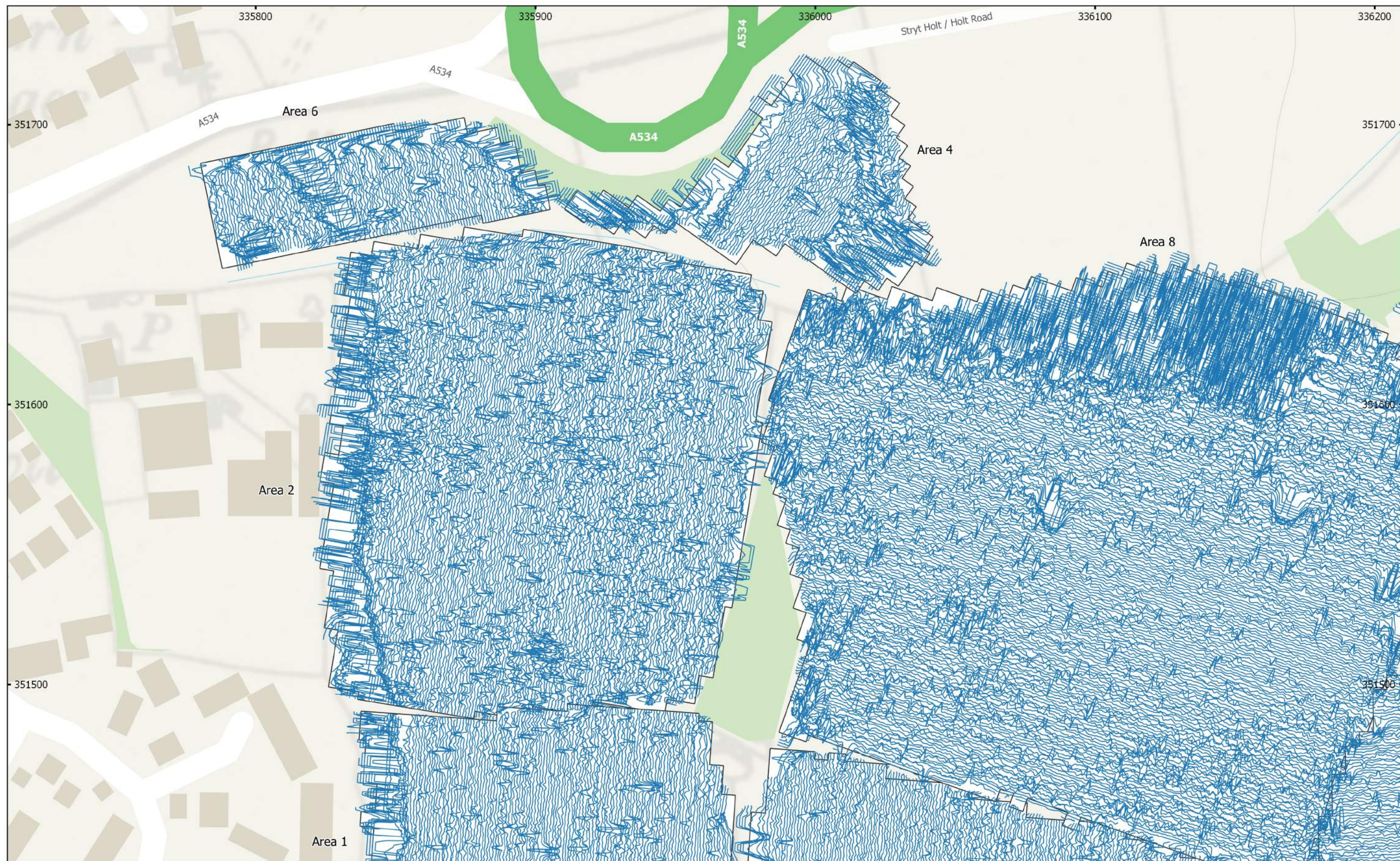




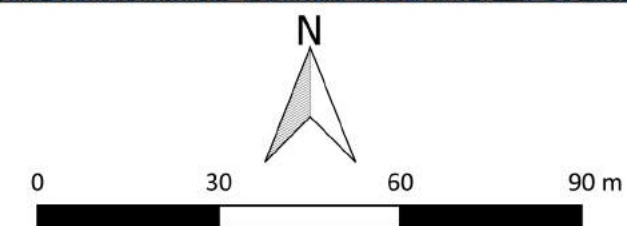
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| Natural (Strong) | Agricultural (Trend) | Ferrous (Spike) |



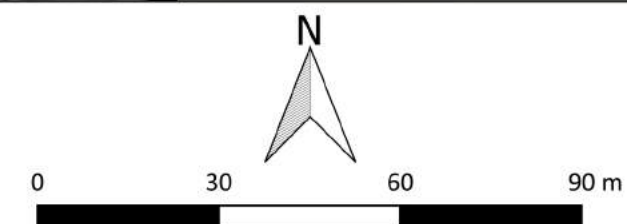
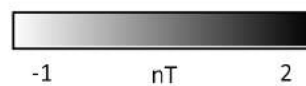


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Figure 10 - XY Trace Plot (Northwest)
25nT/cm at 1:1,250 @ A3
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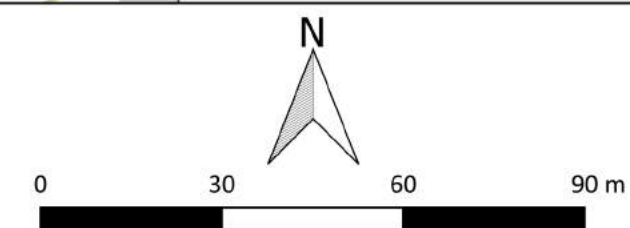
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 Figure 11 - Magnetic Gradient (Northeast)
 1:1,250 @ A3
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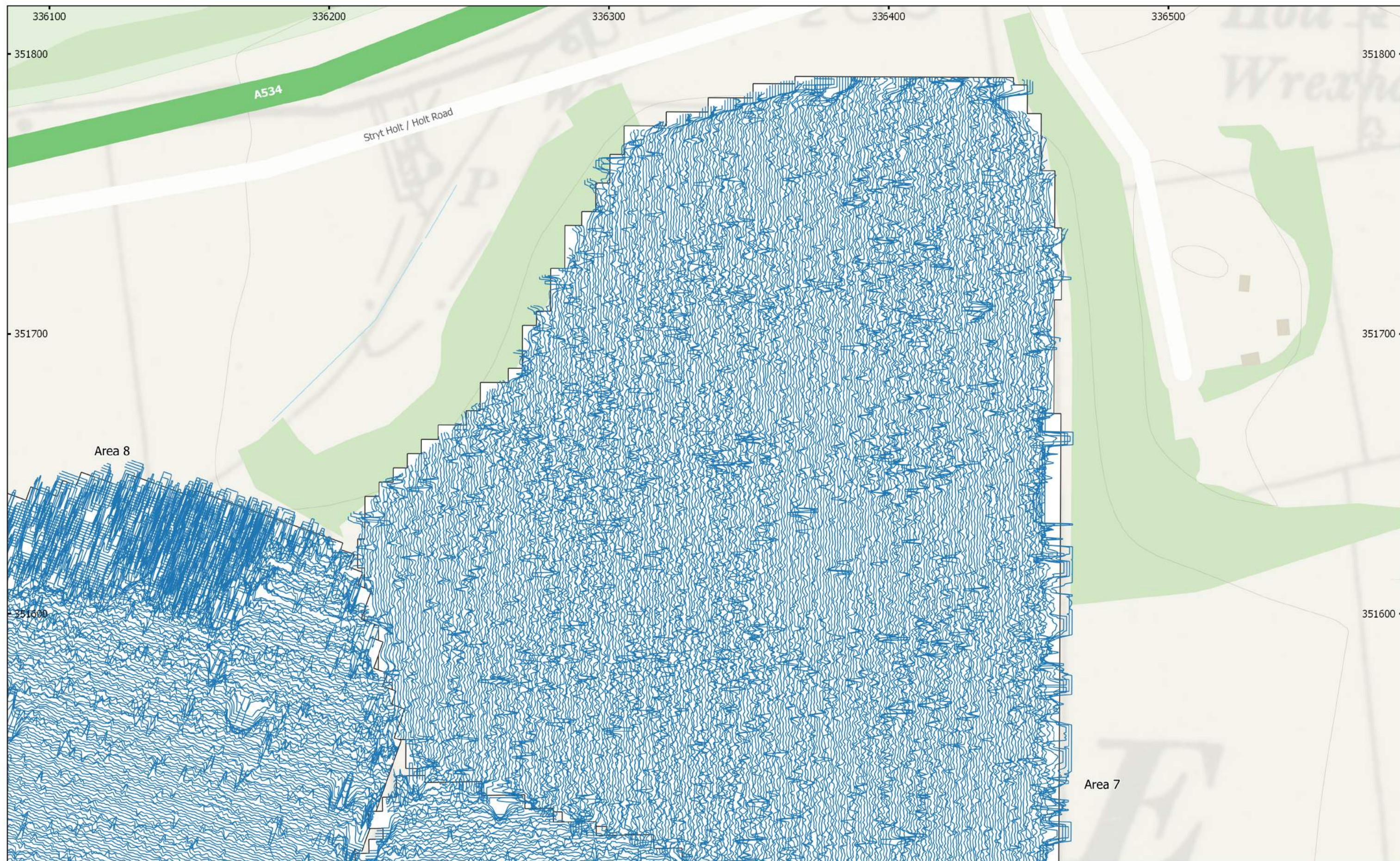




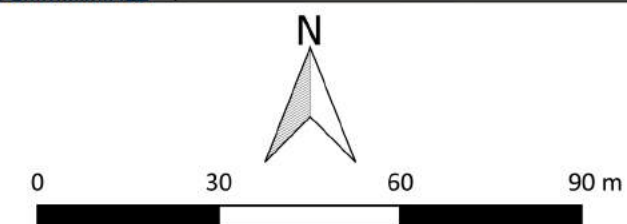
MSSJ464 - Holt Road, Wrexham
 Figure 12 - Magnetic Interpretation (Northeast)
 1:1,250 @ A3
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- | | | |
|-----------------------|-------------------------|--------------------------|
| Agricultural (Strong) | Natural (Weak) | Agricultural (Trend) |
| Agricultural (Weak) | Magnetic Disturbance | Ridge and Furrow (Trend) |
| Undetermined (Weak) | Ferrous/Debris (Spread) | Ferrous (Spike) |



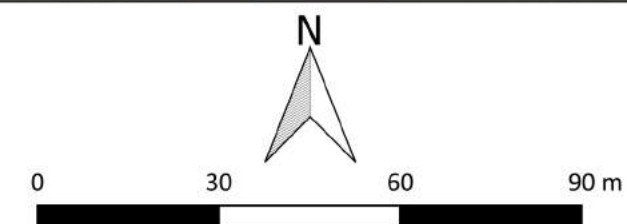
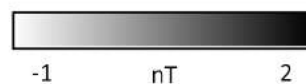


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Figure 13 - XY Trace Plot (Northeast)
25nT/cm at 1:1,250 @ A3
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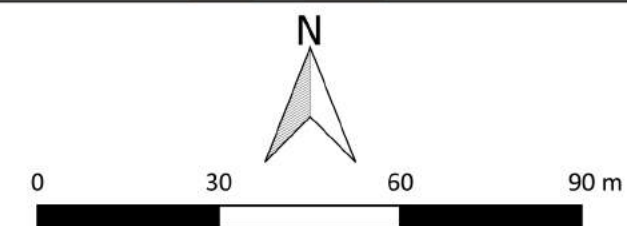
MSSJ464 - Holt Road, Wrexham
Figure 14 - Magnetic Gradient (Southwest)
1:1,250 @ A3
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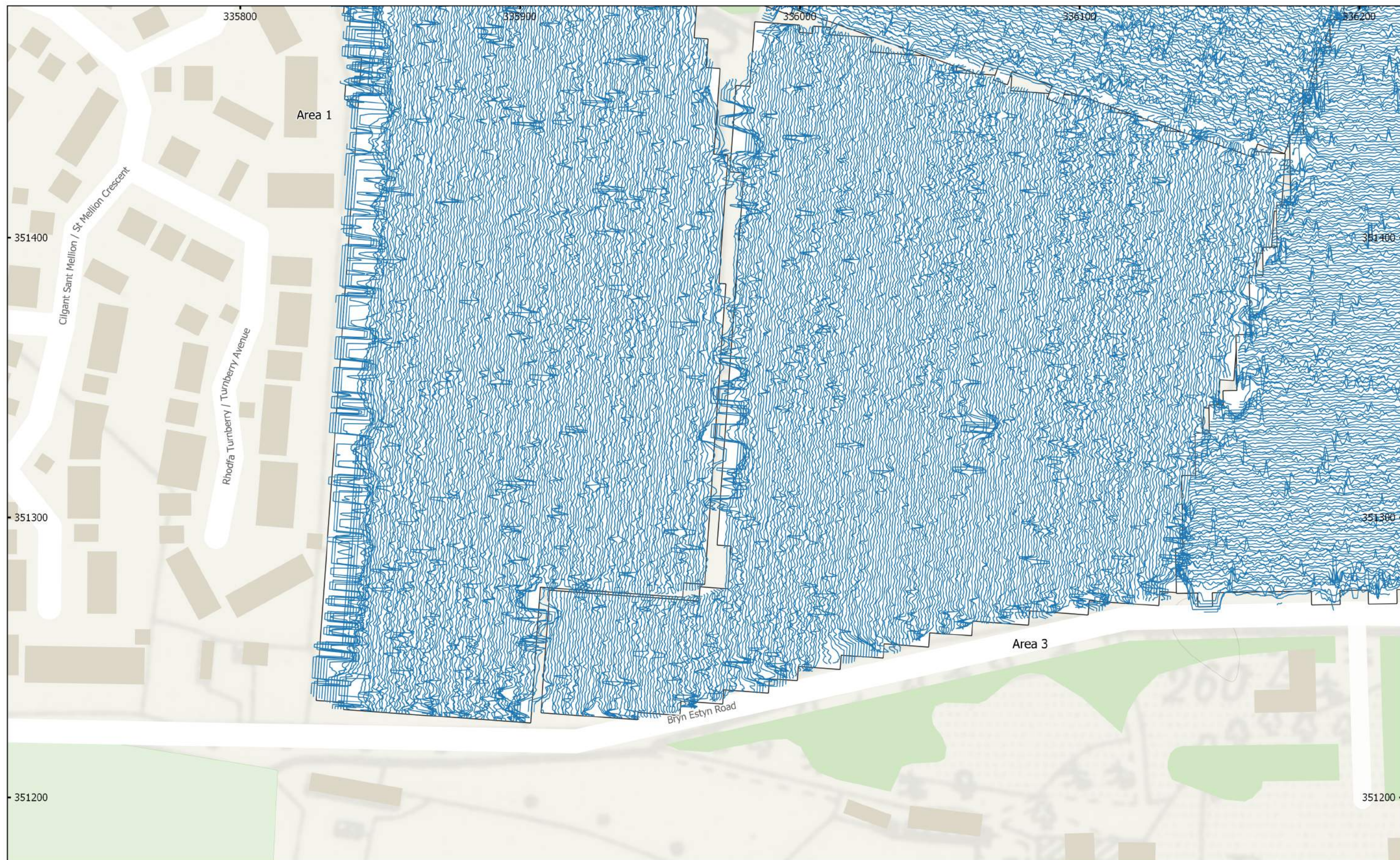




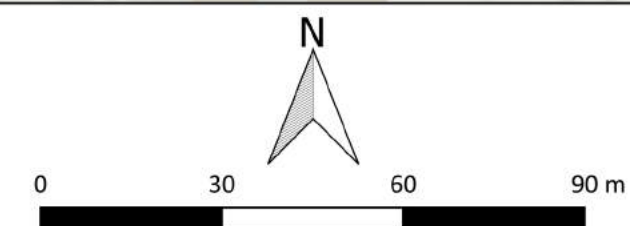
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 Figure 15 - Magnetic Interpretation (Southwest)
 1:1,250 @ A3
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- | | | |
|---|--|--|
| Agricultural (Strong) | Natural (Weak) | Undetermined (Trend) |
| Agricultural (Weak) | Magnetic Disturbance | Service |
| Undetermined (Weak) | Agricultural (Trend) | • Ferrous (Spike) |
| Natural (Strong) | Ridge and Furrow (Trend) | |



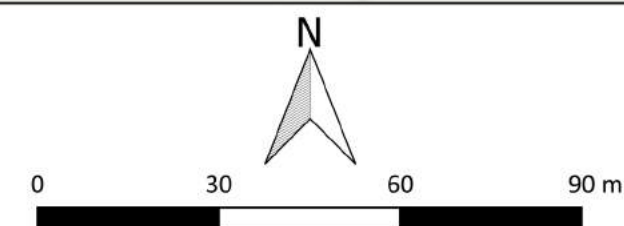
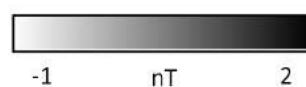


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Figure 16 - XY Trace Plot (Southwest)
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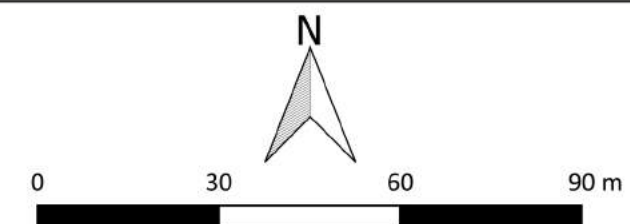
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 Figure 17 - Magnetic Gradient (Southeast)
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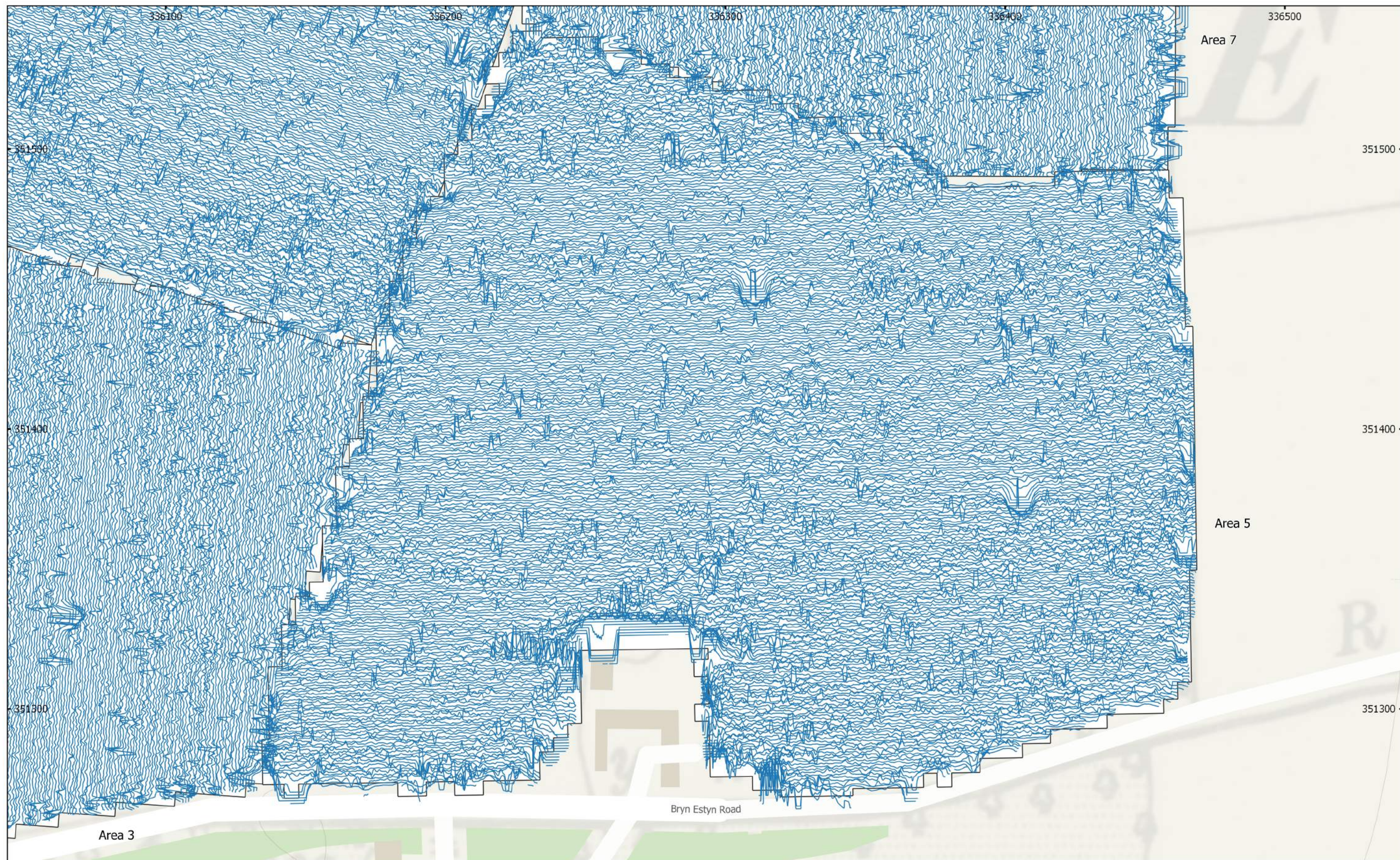




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 Figure 18 - Magnetic Interpretation (Southeast)
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- | | | |
|-----------------------|----------------------|--------------------------|
| Agricultural (Strong) | Natural (Weak) | Ridge and Furrow (Trend) |
| Agricultural (Weak) | Magnetic Disturbance | Ferrous (Spike) |
| Undetermined (Weak) | Agricultural (Trend) | |





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Figure 19 - XY Trace Plot (Southeast)
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