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Engineering Archaeological Services Ltd.

Land at Cae'r Felin, Pencarnisiog, Ty Croes, Ynys Môn

Geophysical Survey

Commissioned by

CR Archaeology

Analysis by

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Engineering Archaeological Services Ltd

EAS Client Report 2020/10

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List of Illustrations

NGR

Centred on: SH 35455 73798

Location and Topography (Figures 1 and 2)

The survey area is located approximately 280 m NW of the village centre of Pencarnisiog, Ynys Môn. The eastern side of the survey area is defined by a minor road between Pencarnisiog and Dothan, whilst the other boundaries divide the survey area from other fields. The survey occupies the northern sector of a large, rectilinear field and the attached linear extension which runs to the north-east. There is a low ridge, approximately 6 m high, running SW – NE with its ridge along the northern side of the survey area. At the time of the survey the field was under pasture with relatively short grass.

The survey took place on 25th – 26th October 2020.

Archaeological Background

It is intended to construct a new camp site for 31 touring caravans and 6 camping pods, together with the associated access tracks, landscaping, toilet and shower block and private treatment plant at Cae'r Felin, Pencarnisiog, Ty Croes, Ynys Môn (Planning Application SCR/2020/59). As part of the planning process the Gwynedd Archaeological Planning Service recommended an initial evaluation comprising a geophysical survey and desk-top study.

Aims of Survey

1. To investigate, define and record any potentially archaeological features within the survey areas.

SUMMARY OF RESULTS

An extensive complex of magnetic anomalies has been located within the proposed development area which appears to represent a previous field system together with a series of circular anomalies which probably pre-date the field systems. Marked magnetic disturbance along the eastern boundary of the field can be related to materials stored along this boundary seen on the Google Earth images between 24/3/2017 and 7/8/2018.

Patrwm helaeth o anomaleddau magnetig wedi'u lleoli yn yr ardal ddatblygu arfaethedig. Ymddengys fod hwn yn cynrychioli system o gaeau blaenorol. Cyfres o anghysonderau crwn sydd fwy na thebyg yn hyn na'r systemau caeau. Gall aflonyddwch magnetig amlwg ar hyd ffin ddwyreiniol y cae fod yn gysylltiedig â deunyddiau a gafodd eu storio ar hyd y ffin hon a welir ar ddelweddau Google Earth rhwng 24/3/2017 a 7/8/2018.

Methods

The survey was based on a series of seventy-five, 20 x 20 m squares laid out as in Figure 2. Readings were taken with a Geoscan FM256 Fluxgate Gradiometer at 0.25 m intervals along transects 1 m apart. The surveys were downloaded onto a laptop, on site, and processed using Geoscan Research "Geoplot" v.4.00. The X - Y plots were produced by exporting the data and processing it using Golden Software "Surfer" v. 10.7.972. The filled colour contour plot of Anomaly G was also produced using Golden Software "Surfer" v. 10.7.972.

The survey area was divided into two areas, for ease of access (Figures 2 and 3). Area 1 comprised the bulk of the development area, whilst Area 2 included the narrow neck of land leading towards the pond, north east of the main survey area.

A limited number of soils samples were taken, within Area 1, to access the Magnetic Susceptibility on the site. These were dried in a warming oven, sieved and processed using a Bartington MS2 Magnetic Susceptibility Meter.

Survey Results:

Area

Area 1: 1.89 Ha.

Area 2: 0.51 Ha

Display

The results are displayed as grey scale images (Figures 3, 4 and 8) and as X-Y trace plots (Figures 5 and 9). The filled colour contour plot of Anomaly G is shown as Figure 7. The interpretation plots are shown as Figure 6 and 10. The location of the Magnetic Susceptibility samples are shown on Figure 11 and the results on Figure 12 and the survey, as a whole, is summarised on Figure 13.

Results:

Fluxgate Gradiometer Survey

Area 1 (Figures 4 – 7)

Area 1 comprised the bulk of the survey area, covering the large, sub-rectangular field immediately east of the minor road between Pencarnisiog and Dothan. The ferromagnetic responses within the survey are shown in blue on Figure 6. Anomalies A and B, area alongside the roadside boundary of the survey area and also correspond to stacked items along the field boundary seen in the Google Earth images between 24/3/2017 and 7/8/2018. Anomaly C, however, is probably the result of the proximity of the fence along the boundary. There are also five, discrete, high value anomalies (Anomalies D, E, F. G and H) which group along the western side of the Area 1. Most of these are probably the result of metal object within the plough-soil, however, Anomaly G has a different magnetic signature. The survey of this anomaly was re-processed as a filled colour contour plot (Figure 7) which suggests it may be the result of an *in situ* burnt feature such as a hearth or oven.

This technique was developed by Crew (1997, 1998) at the prehistoric ironworking site of Crawcwellt, Merioneth, to clarify the location and nature of strong magnetic anomalies, particularly to identify the location of *in situ* burnt features associated with ironworking, such as furnaces, smithing hearths and ore roasting areas.

The raw gradiometer data is imported into Golden Software Inc. "Surfer" v.10.7.972and is used to produce a filled contour plot, with a non-linear scale, so that the high positive and low negative readings are emphasised. The scale is selected according to the maxima and minima of the readings, to show *in situ* features in the best possible manner. The clearest results are generally achieved with a scale which doubles, or halves, at each step. In colour the positive readings are represented in shades of yellow to red and the negative readings in shades of blue. The mid-range positive values are represented as grey tones. Areas of burning such as furnaces or hearths, which are still *in situ*, give north-south oriented dipolar signals because of the relatively strong remanent magnetism of the feature. The key element for the recognition of *in situ* features is the occurrence of a discrete negative signal, which in well-defined features can occur as a halo around the northern side of the positive signal.

The survey area is divided into a series of rectilinear area by a series of linear anomalies (Anomalies I - M) which presumably mark a series of lost field boundaries. Each of these anomalies consist of two parallel anomalies between 3 and 3.5 m apart suggesting significant field boundaries, possibly clawdd wall type boundaries. Possibly cutting this field system is a similar, parallel anomaly feature (Anomaly N), however the two linear anomalies run approximately 4.5 – 5.0 m apart suggesting this may be a lane rather than a field boundary. It runs WNW for 47.5 m before turning to the south to run SW for at least 37 m and probably 52 m where it extends beyond the survey area.

Within the survey area are a series of ten possible circular anomalies varying in diameter between 6 and 25 m (see below)

Anomaly	Approximate Diameter
O	12 m
P	13.5 m
Q	11 m
R	7.5 m
S	13 m
T	10 m
U	19.5 m
V	25 m
W	6 m
X	14.5 m

These circular anomalies appear to fall within three rough size ranges, below 8 m, between 12 and 14.5 m and above 19 m. The smaller and middle range sizes could represent possible circular buildings, whilst the larger anomalies are probably enclosures. It is noticeable that the majority of these circular anomalies fall within areas of variable magnetic background (Anomalies Y and Z) which may reflect the level of activity in these areas.

There are also a series of feint, parallel, linear anomalies which are shown in green on Figure 6. It is assumed these are the result of modern agricultural practices and probably reflect the direction of ploughing within the field.

Area 2 (Figure 8 – 10)

Area 2 consists of a narrow neck of land running SSW – NNE towards a pond, just outside the survey area. At its southern end this area is only 11.75 m wide, whilst it widens to 50.26 m towards its northern end. The restricted space means that it is difficult to define and magnetic anomalies, at least in part because of the effect of metal fences on either side of the survey area. One anomaly, however, (Anomaly AA, Figure 10) was located at the northern end of the survey area. This was a feint, circular anomaly approximately 27 m in diameter, which given its size is likely to be an enclosure.

Magnetic Susceptibility (Figures 11 - 12)

Twenty-five, small, soil samples were taken for Magnetic Susceptibility analysis. It was not possible, however, to obtain a subsoil sample for comparison. Both volume susceptibility (direct reading of the samples) and mass susceptibility (reading compensated for the varying mass of the samples) is given below. The location of the samples is shown on Figure 11 and the results on Figure 12.

Sample	Volume susceptibility χ_v	Mass susceptibility χ_m
Grid 1	104	146.1
Grid 3	110	162.5
Grid 6	132	185.1
Grid 8	193	220.1
Grid 10	126	160.5
Grid 12	162	185.1
Grid 14	147	207.0
Grid 16	127	178.6
Grid 18	179	229.5
Grid 21	179	242.9
Grid 23	185	228.1
Grid 25	178	331.5
Grid 27	145	206.8
Grid 29	169	249.6
Grid 31	183	261.1
Grid 33	214	296.8
Grid 35	170	245.3
Grid 37	156	251.2
Grid 39	175	236.2
Grid 41	125	197.2
Grid 43	157	226.2
Grid 45	133	206.5
Grid 47	132	186.2
Grid 49	195	331.6
Grid 51	129	214.3
Grid 53	166	251.1

The samples, as measured, are generally of moderate to high values suggesting that, the conditions for magnetic survey were suitable.

Assuming a consistent geological regime across the survey area the magnetic susceptibility can be used as a proxy for the level of archaeological activity (Clark, 1996, 99). The reading from Cae'r Felin generally follow the density of archaeological anomalies recorded in the Fluxgate Gradiometer survey with higher readings in areas with greater numbers of magnetic anomalies. The exception is Grid 25, on the eastern boundary of Area 1 which has an enhanced reading of 331.5. It is possible that this reading may be related to relatively modern activity close to the boundary, however, this is speculation.

Conclusions (Figure 10)

It is a fundamental axiom of archaeological geophysics that the absence of features in the survey data does not mean that there is no archaeology present in the survey area only that the techniques used have not detected it.

The is evidence for considerable archaeological activity within the survey area at Cae'r Felin, Pencarnisiog, Ty Croes, Ynys Môn. Whilst it is not possible to determine the stratigraphical relationship between magnetic anomalies, the form and style of the anomalies would suggest at least three phases of activity represented within the survey. The probable rectilinear field system (Anomalies I - M) can be demonstrated to predate the fields recorded in the 1844 Tithe Map of Llanfaelog which shows a field pattern the same as the current pattern (https://places.library.wales/browse/53.235/-4.464/14?page=1&alt=&alt=&leaflet-base-layers_66=on). Probably post-dating this field system (but predating the Tithe Map) is the possible lane (Anomaly N) which appears to disrupt the magnetic signature of Anomaly M which is part of the rectilinear field system.

Probably prehistoric in origins are the series of circular anomalies (Anomalies O – X and AA) and the associated areas of magnetic disturbance (Anomalies Y and Z) which appear to possibly be a series of circular buildings and their associated enclosures. Also, within this possible phase of activity is the high value, dipolar anomaly (Anomaly G) which may be an *in situ* high temperature feature such as a hearth, oven or furnace.

References

Clark, A. 1996. *Seeing beneath the soil prospecting methods in archaeology.* Routledge, London

Crew, P. 1997. Geophysical surveys and furnace location at ironworking sites. in Crew, P. and Crew S. (eds.) *Early ironworking in Europe: archaeology and experiment.* Occasional Paper No. 3, Plas Tan y Bwlch, Maentwrog, 113 – 115.

Crew, P. 1998. Excavations at Crawcwellt, West Merioneth. 1990 – 1998: a late prehistoric upland ironworking settlement. *Archaeology in Wales 39,* 22 – 35.

Acknowledgements

This survey was commissioned by CR Archaeology, based on recommendations made by Tom Fildes of the Gwynedd Archaeological Planning Service. The help of Matt Jones with the fieldwork is gratefully acknowledged

Techniques of Geophysical Survey:

Magnetometry:

This relies on variations in soil magnetic susceptibility and magnetic remanence which often result from past human activities. Using a Fluxgate Gradiometer these variations can be mapped, or a rapid evaluation of archaeological potential can be made by scanning.

Resistivity:

This relies on variations in the electrical conductivity of the soil and subsoil which in general is related to soil moisture levels. As such, results can be seasonally dependant. Slower than Magnetometry this technique is best suited to locating positive features such as buried walls that give rise to high resistance anomalies.

Resistance Tomography

Builds up a vertical profile or pseudo-section through deposits by taking resistivity readings along a transect using a range of different probe spacings.

Magnetic Susceptibility:

Variations in soil magnetic susceptibility occur naturally but can be greatly enhanced by human activity. Information on the enhancement of magnetic susceptibility can be used to ascertain the suitability of a site for magnetic survey and for targeting areas of potential archaeological activity when extensive sites need to be investigated. Very large areas can be rapidly evaluated and specific areas identified for detailed survey by gradiometer.

Instrumentation:

1. Fluxgate Gradiometer - Geoscan FM256

2. Resistance Meter - Geoscan RM15

3. Magnetic Susceptibility Meter - Bartington MS2

4. Geopulse Imager 25 - Campus

Methodology:

For Gradiometer and Resistivity Survey 20m x 20m or 30m x 30m grids are laid out over the survey area. Gradiometer readings are logged between 0.25m and 1m intervals along traverses 1m apart. Resistance meter readings are logged at 0.5m or 1m intervals. Data is down-loaded to a laptop computer in the field for initial configuration and analysis. Final analysis is carried out back at base.

For scanning transects are laid out at 10m intervals. Any anomalies noticed are where possible traced and recorded on the location plan.

For Magnetic Susceptibility survey, a large grid is laid out and readings logged at 20m intervals along traverses 20m apart, data is again configured and analysed on a laptop computer.

Copyright:

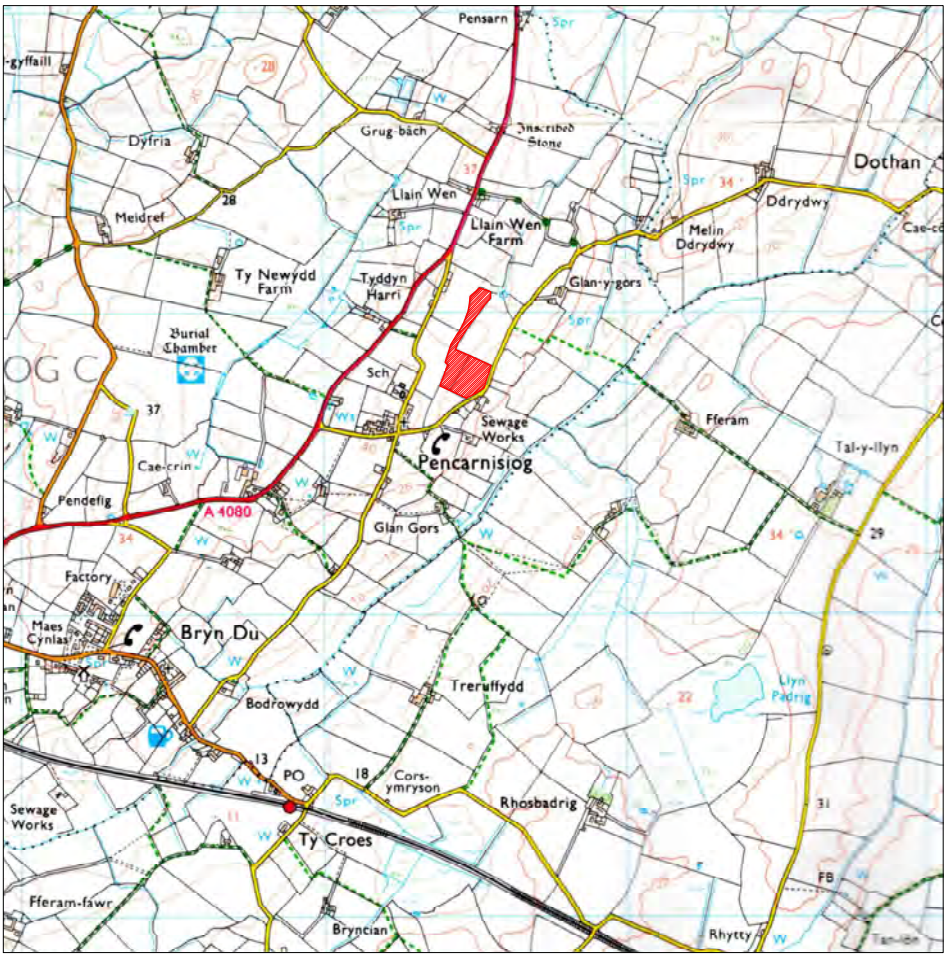


Figure 1: Location
Scale 1:25,000

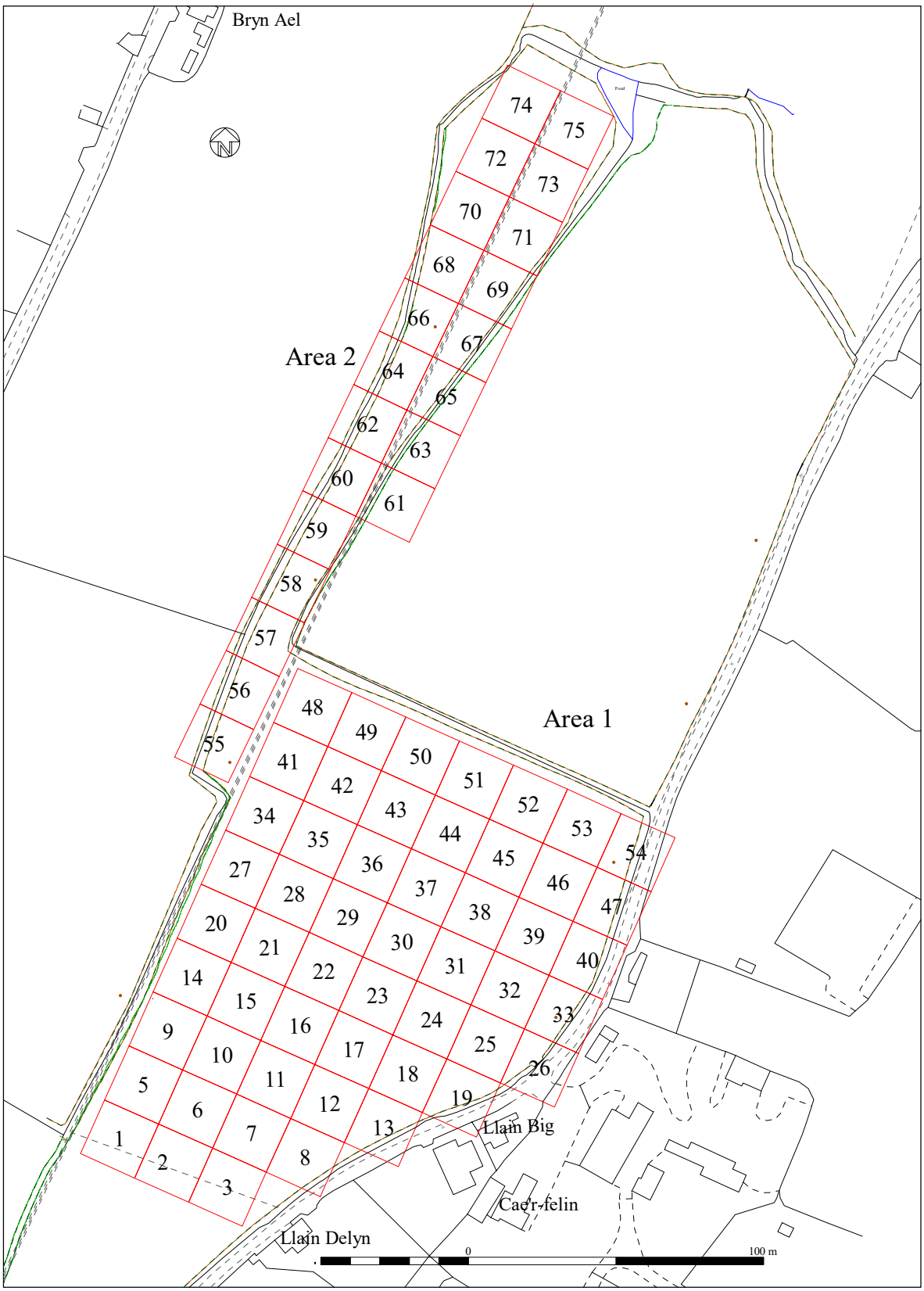


Figure 2: Location of the Survey Grid
Scale 1:2,000

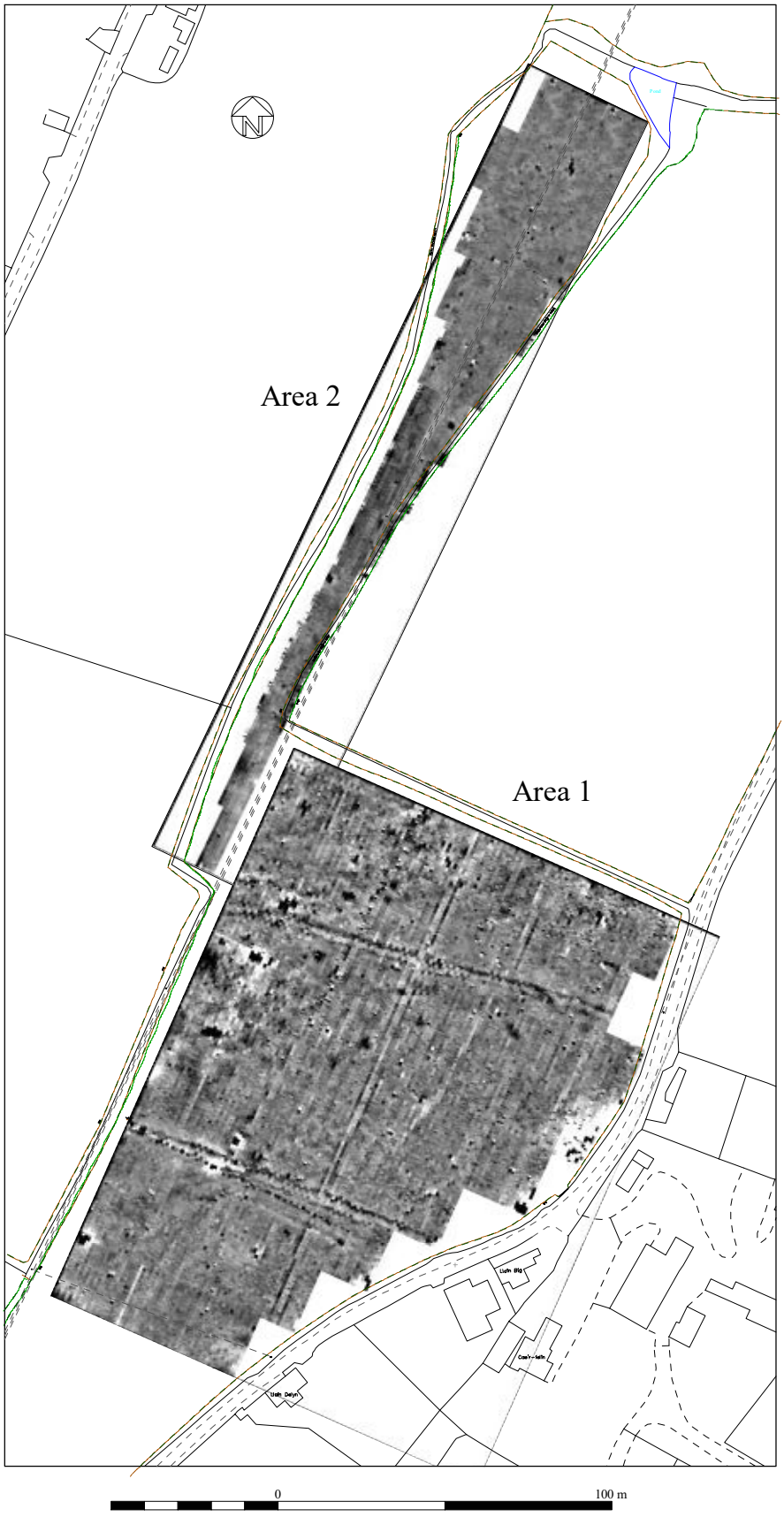


Figure 3: Location of the Survey
Scale 1:2,000

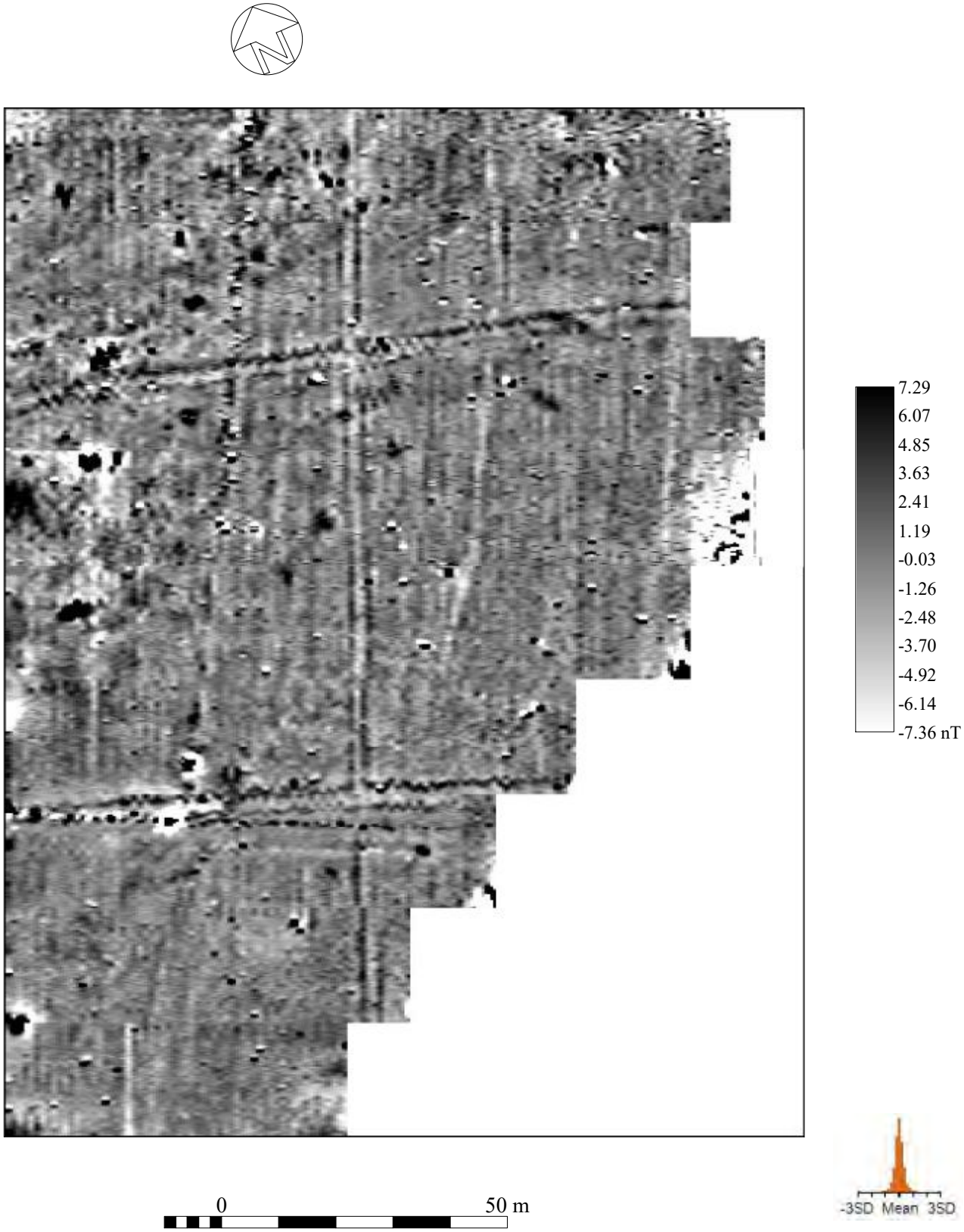


Figure 4: Area 1, Grey Scale Plot
Scale 1:1,000

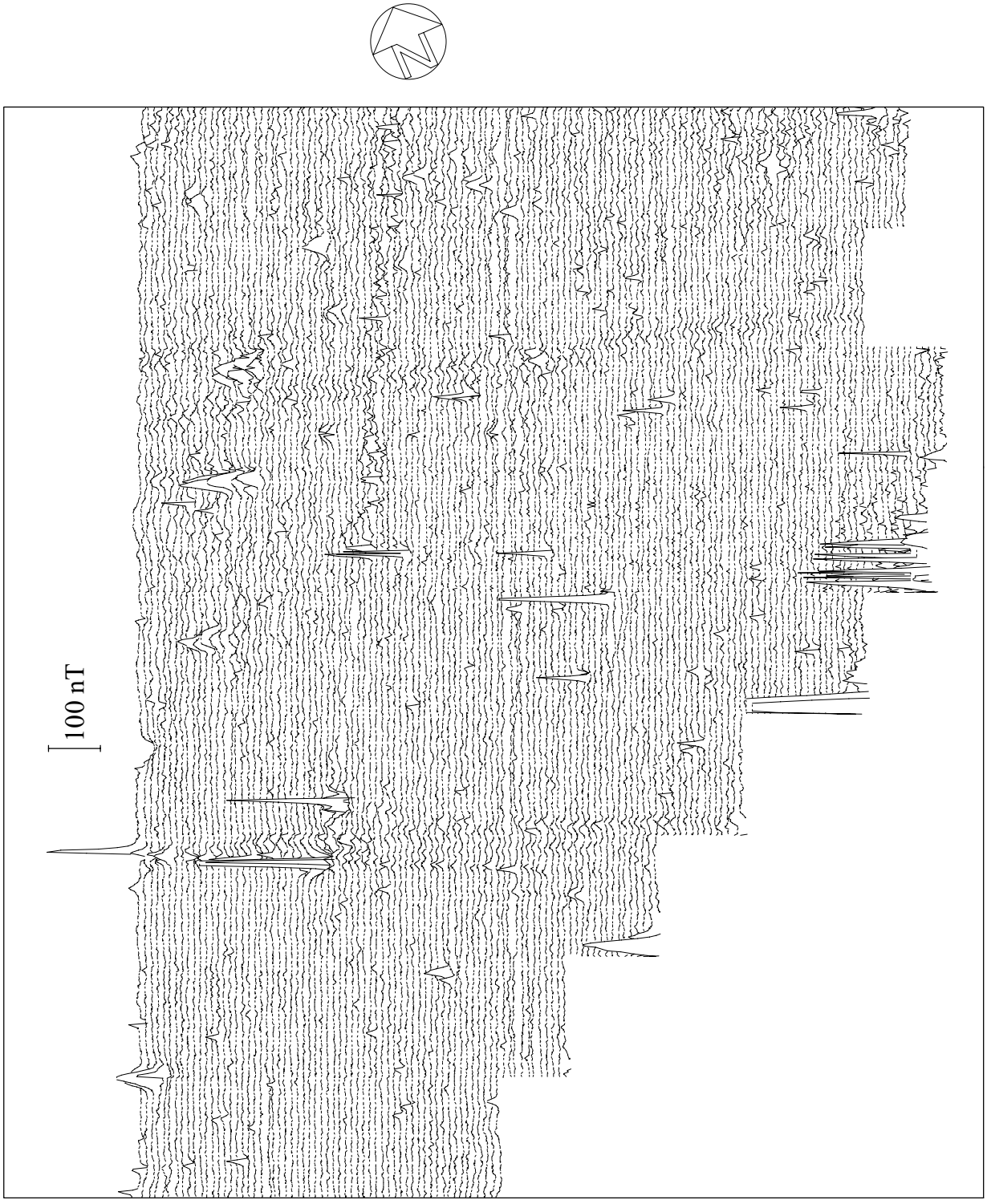
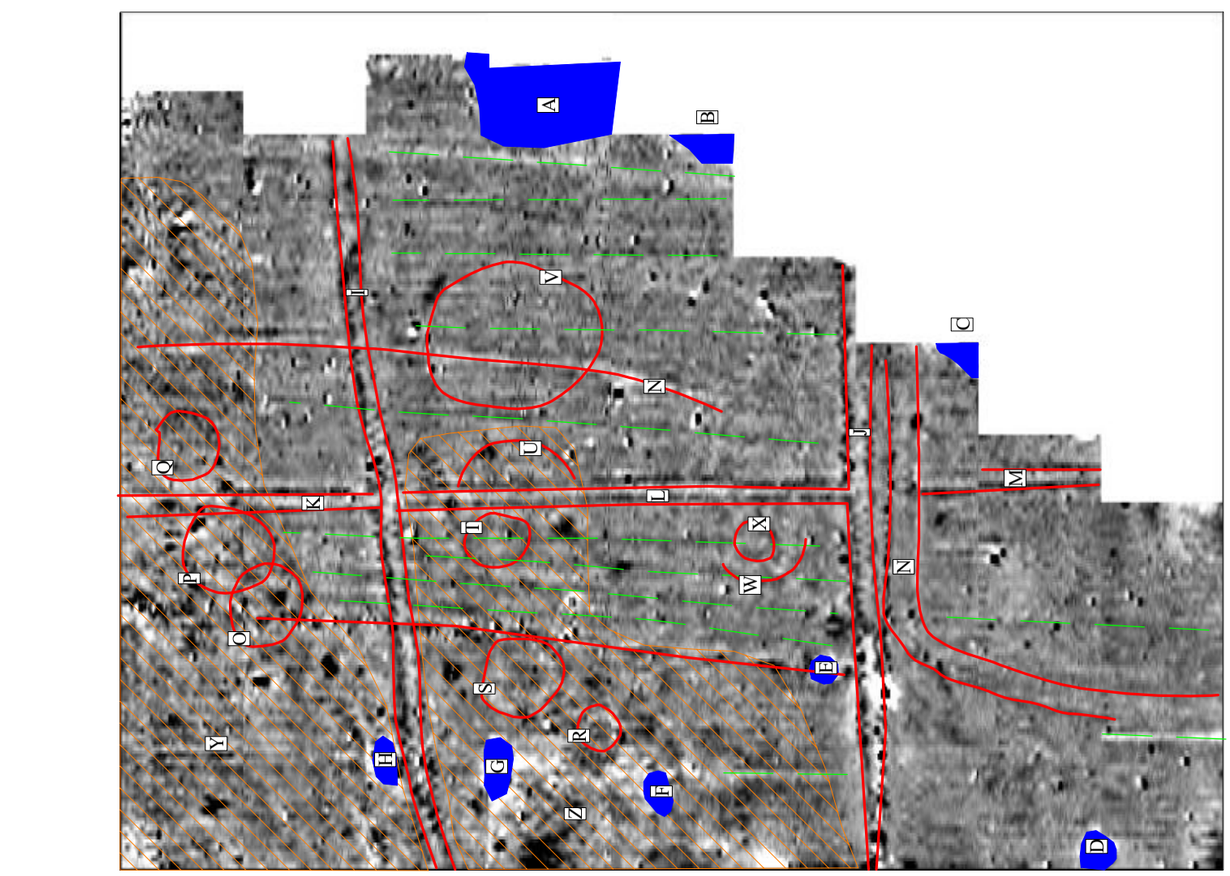
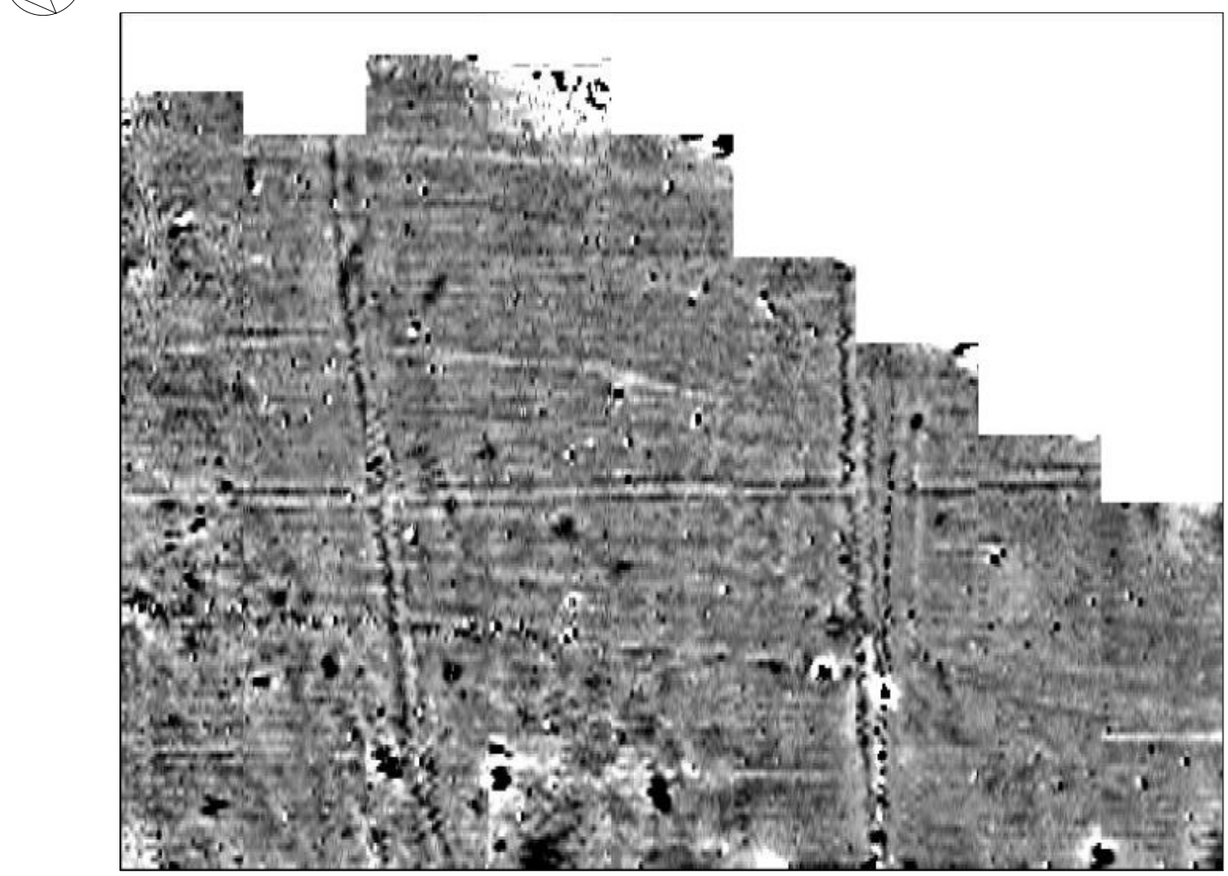


Figure 5: Area 1, X - Y Plot
Scale 1:1,000





Ferromagnetic response
Linear anomaly
Linear anomaly (probably agricultural)
Area of magnetic disturbance

0
50 m

Figure 6: Area 1, Interpretation
Scale 1:1,000

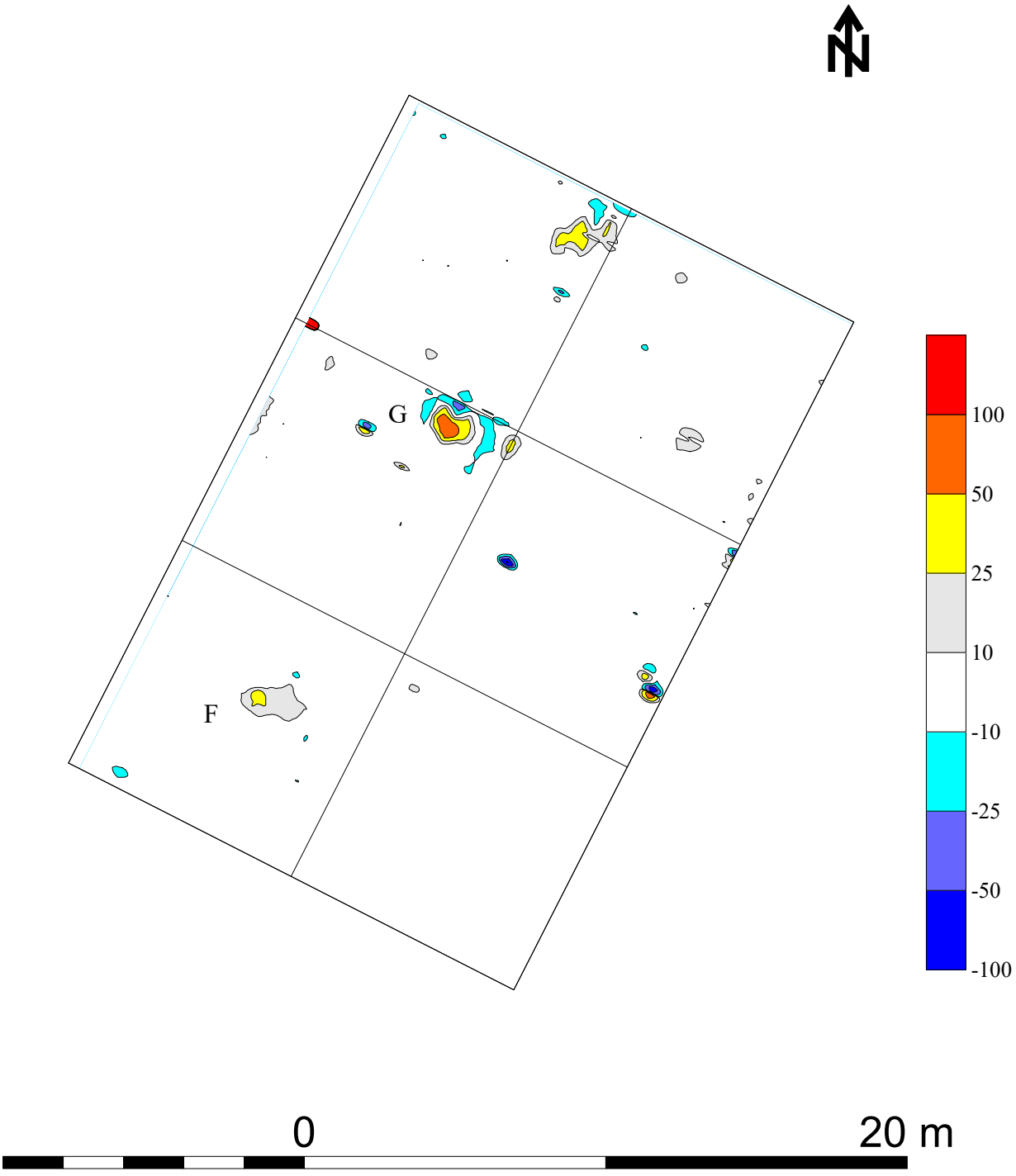


Figure 7: Colour Contour Plot of Anomaly G
Scale 1:500

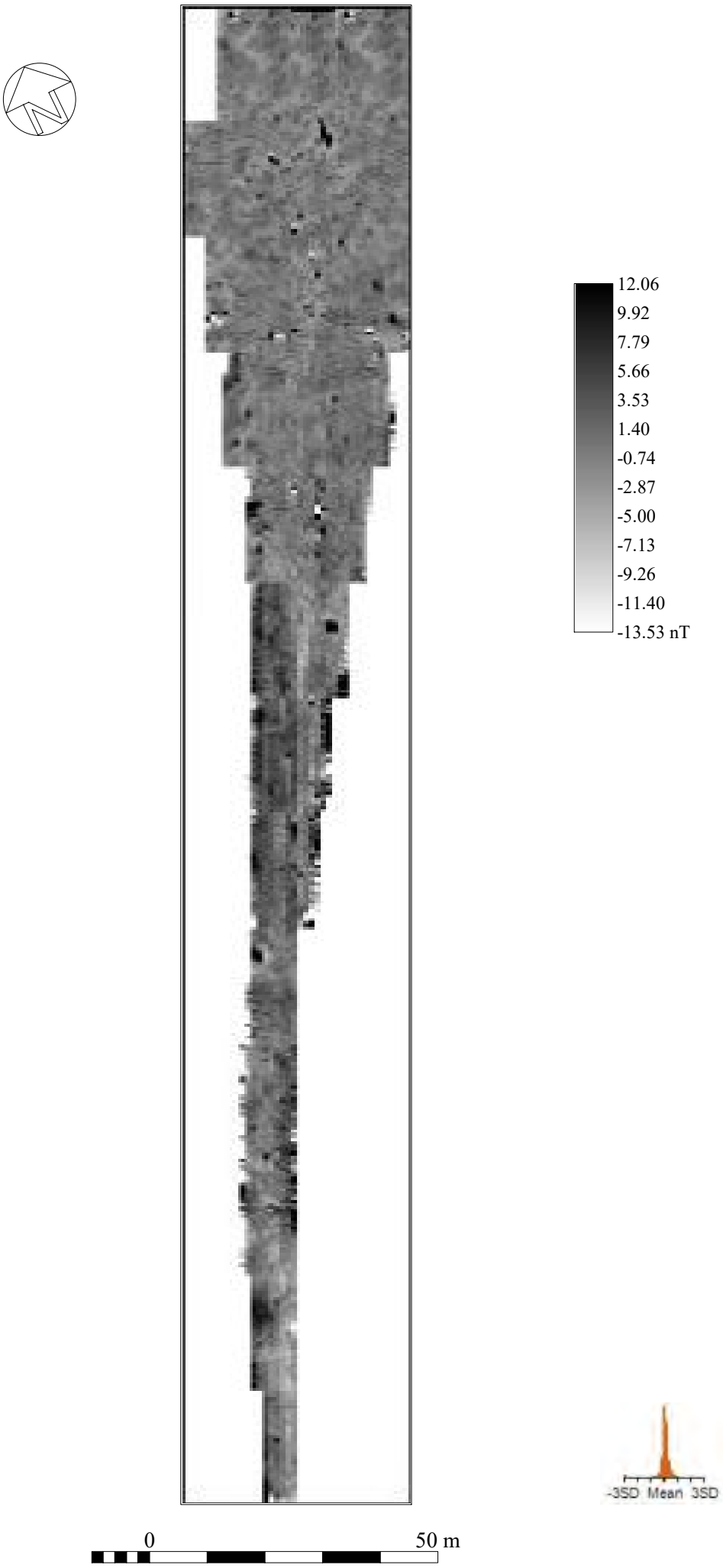


Figure 8: Area 2, Grey Scale Plot
Scale 1:1,000

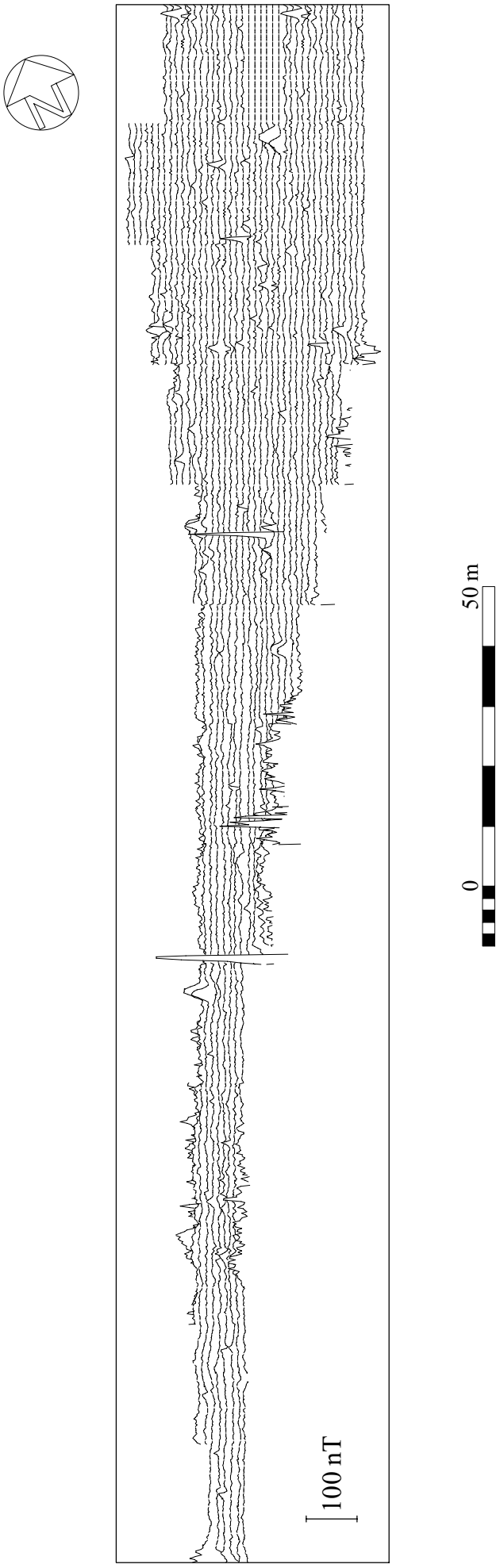


Figure 9: Area 2, X - Y Plot
Scale 1:1,000

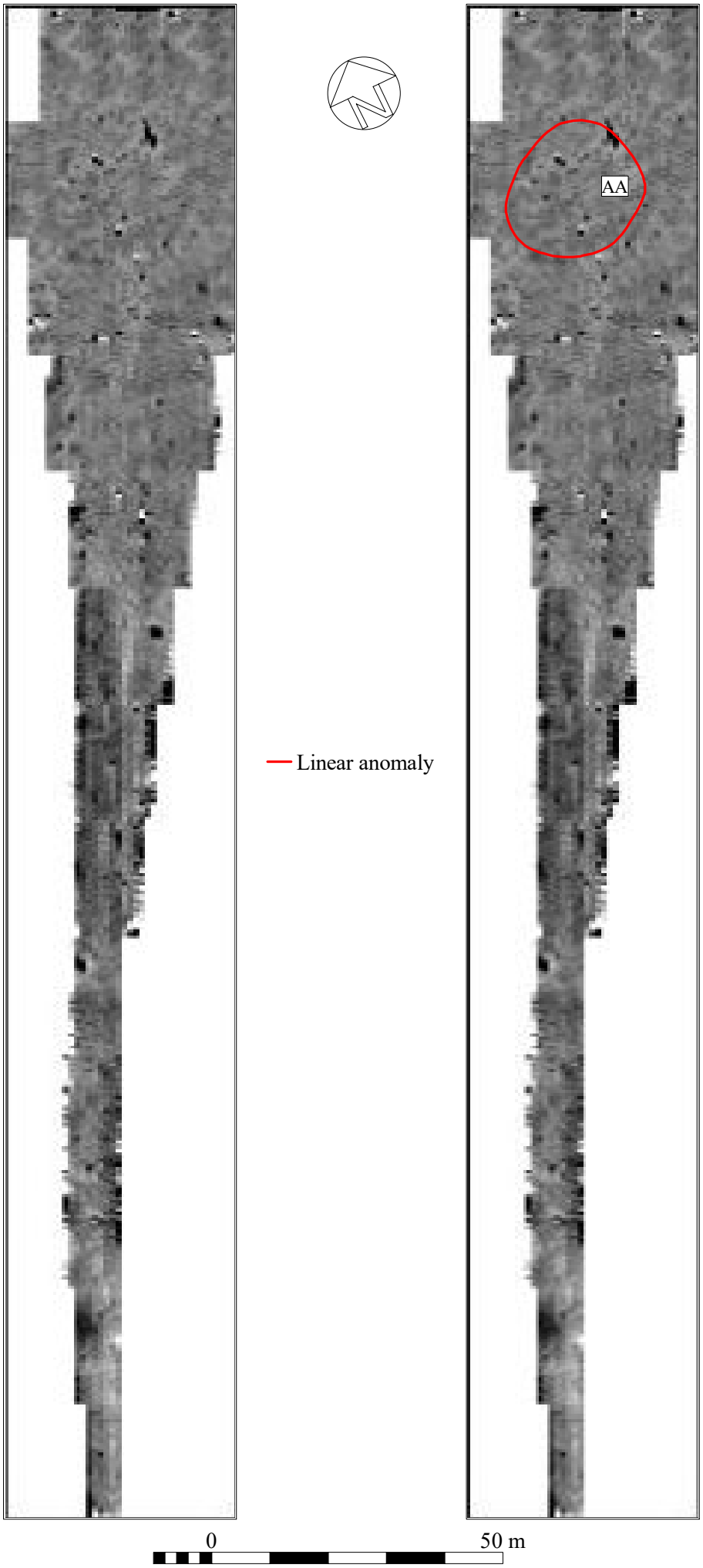


Figure 10: Area 2, Interpretation
Scale 1:1,000

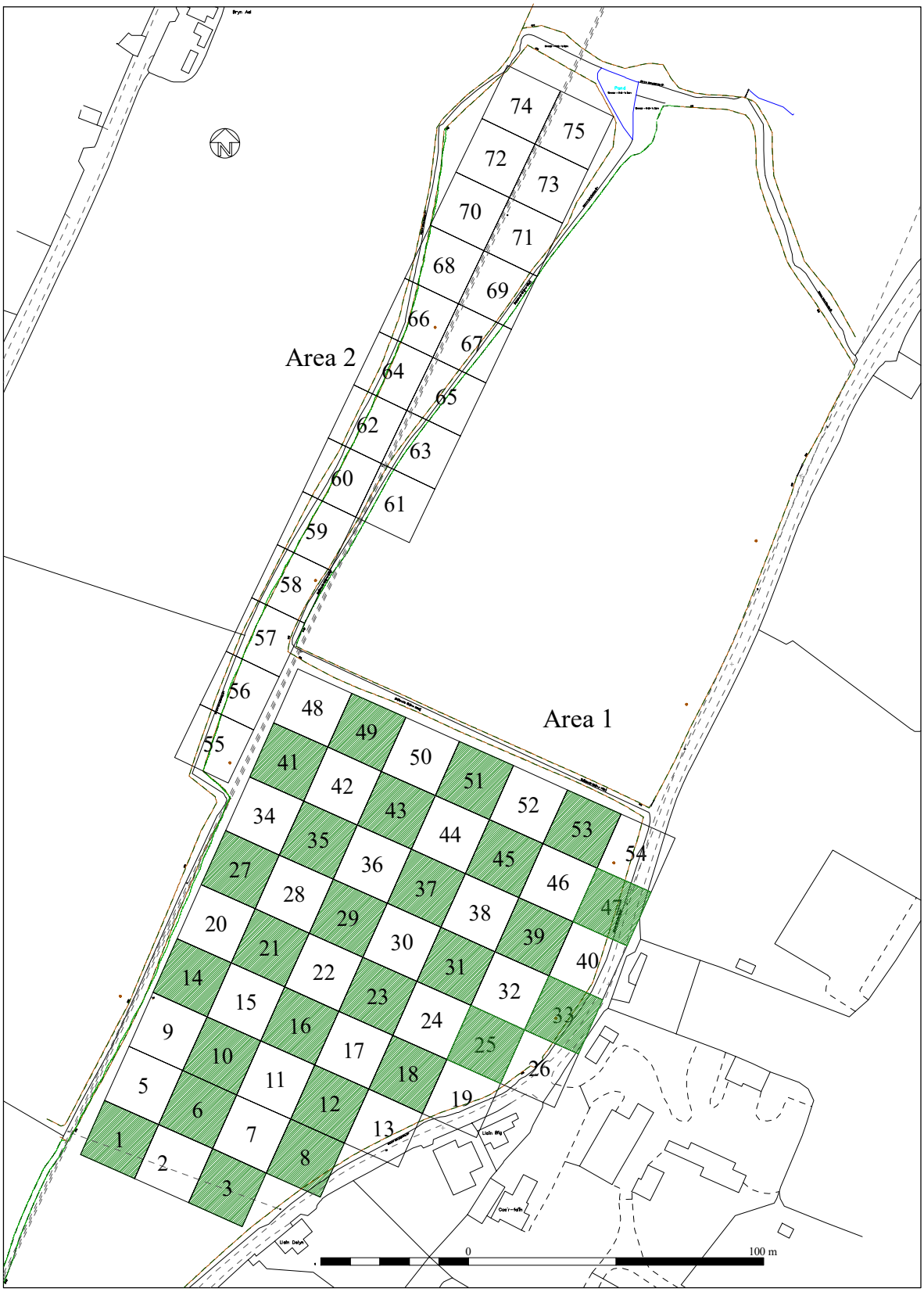


Figure 11: Location of the Magnetic Susceptibility Samples
Scale 1:2,000

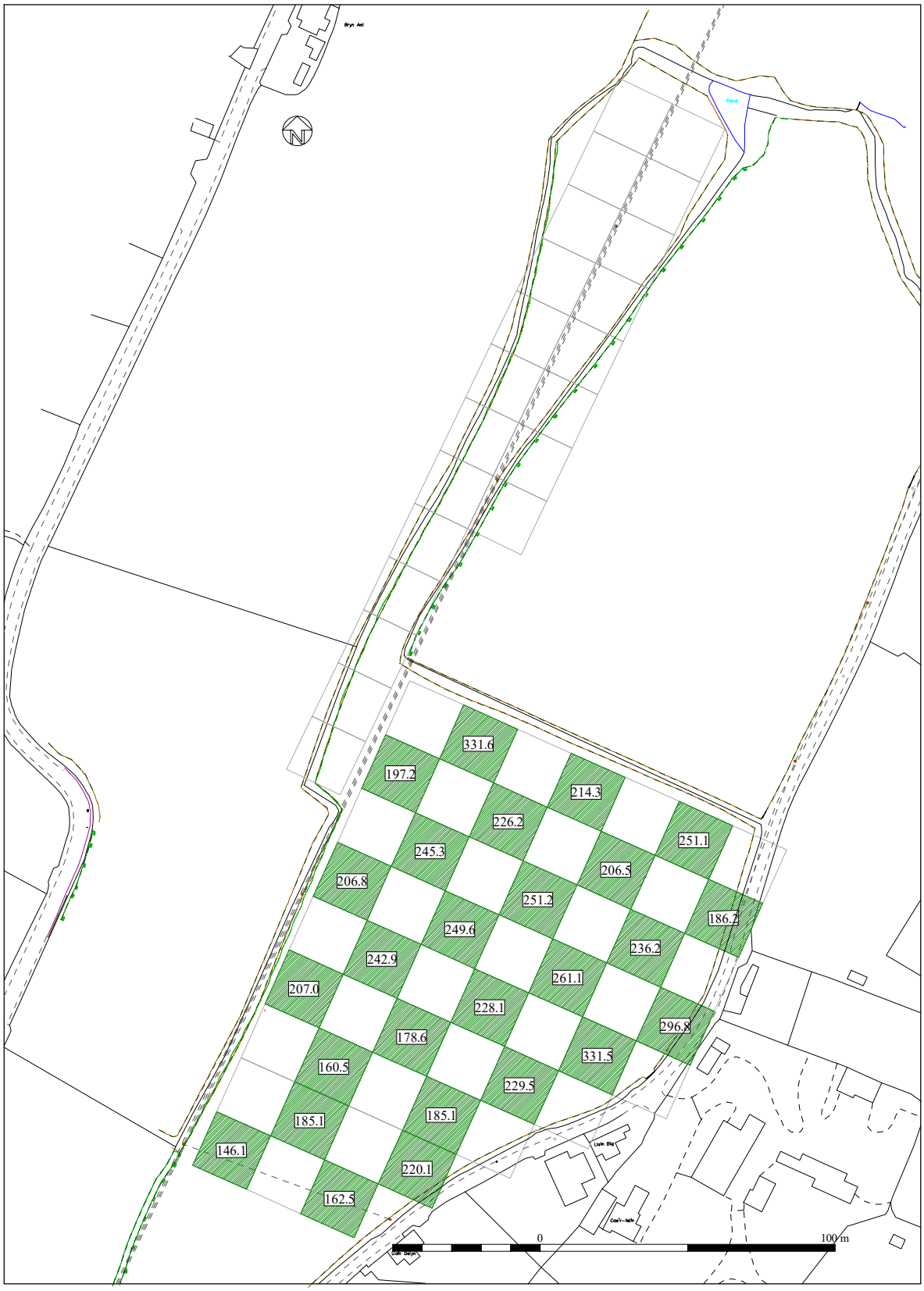


Figure 12: Magnetic Susceptibility Results
Scale 1:2,000

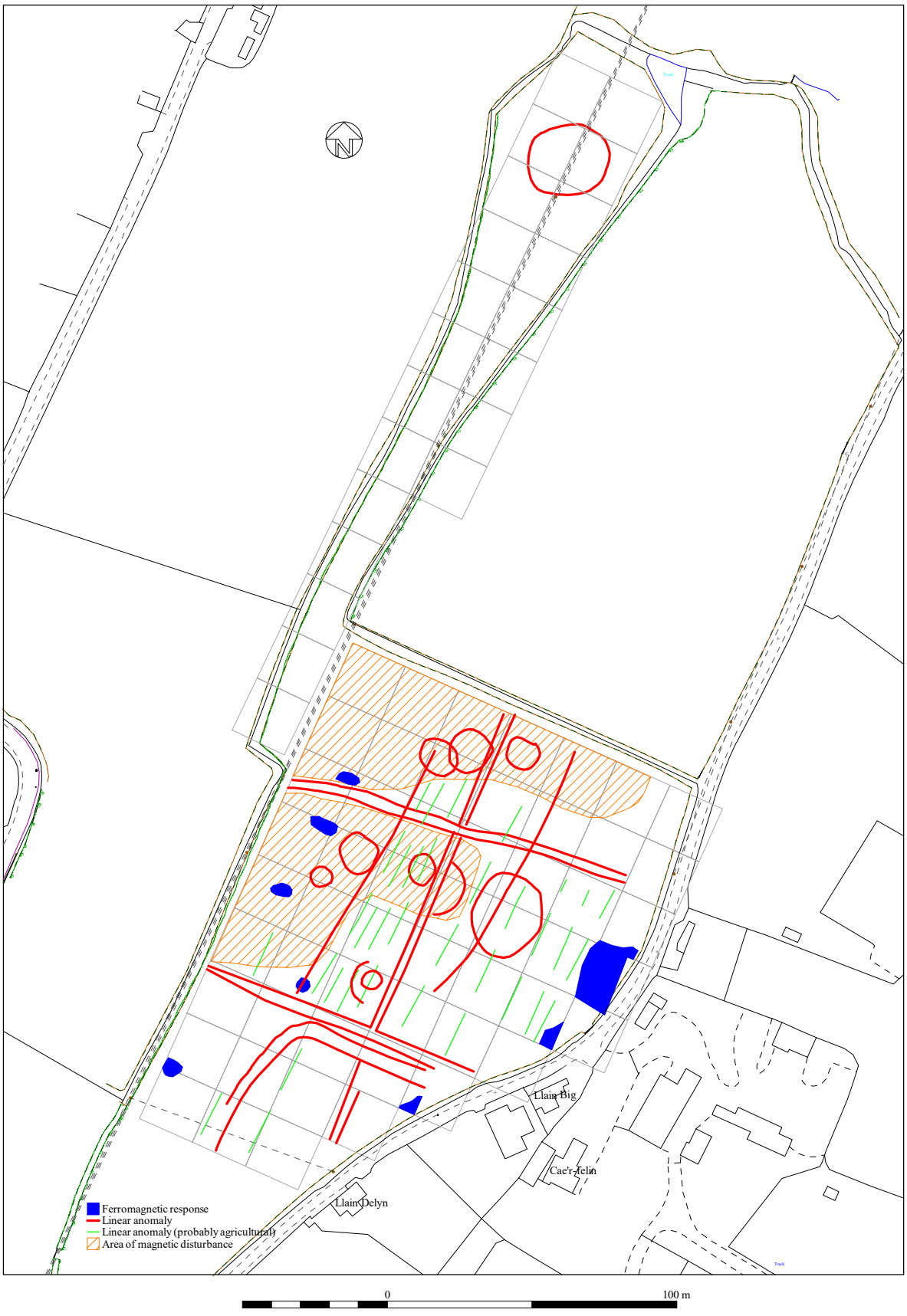


Figure 13: Summary
Scale 1:2,000