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Engineering Archaeological Services Ltd.

Tyddyn Fletcher, Caernarfon, Gwynedd:
Fluxgate Gradiometer Survey

Commissioned by
CR Archaeology

Analysis by
I.P. Brooks
Engineering Archaeological Services Ltd

EAS Client Report 2024/19

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List of Illustrations

NGR

Centred on:

Area 1: SH 49247 62751
Area 2: SH 49283 62814

Location and Topography (Figures 1 and 2)

The survey area was located, approximately 1.5 km to the east of the centre of Caernarfon, to the eastern side of the A 4086 Llanberis Road and to the west of the Cibyn Industrial Estate. Consisting of two linked fields partly defined by overgrown hedges the survey area was under rough grazing at the time of the survey. In some areas the fields included dense patches of thistles or *juncas* type reeds or grasses which made these areas of the fields unsuitable. This particularly effected the south western corner of the southern field and the central area of the northern field. It is possible that the *juncas* type vegetation in the northern field marked the position of a silted-up pond as the ground between the plants was very wet.

At occasional points within both fields were a series of upright metal pipes, set in concrete which are assumed to be for measuring the local water table.

The underlying geology is the Ordovician, Nant Ffrancon Subgroup of Siltstones with Devensian Till over (https://geologyviewer.bgs.ac.uk/).

Survey took place between 28/08/2024 and 29/08/2024.

Archaeological Background

It is intended to develop the survey area for housing, by Adra; however, it is on the presumed line of the Roman Road from *Canovium* to *Segontium* (PRN 17856) and is only 780 m NW of *Segontium*, itself.

Aims of Survey

1. To record any geophysical anomalies within the survey area which may be related to archaeological activity.

SUMMARY OF RESULTS

The fluxgate gradiometer survey, of approximately 1.4 Ha, off Llanberis Road, Caernarfon were commissioned by CR Archaeology in advance of a proposed housing development by Adra. Only a limited number of magnetic anomalies of probable archaeological origins were located, one of which probably marks the line of the Roman Road from Canovium to Segontium (PRN 17856). Other anomalies probably are the effect of either modern agricultural practices or the quantity of modern metallic rubbish in the fields.

The fieldwork took place between 28/08/2024 and 29/08/2024.

Comisiynwyd arolwg gradiometer fflwcs o tua 1.4 Ha, oddi ar Ffordd Llanberis, Caernarfon gan CR Archaeology cyn datblygiad tai arfaethedig gan Adra. Nifer cyfyngedig yn unig o anomaleddau magnetig, o darddiad archeolegol tebygol, a ddarganfuwyd, ac mae'n debyg bod un ohonynt yn nodi llinell y Ffordd Rufeinig o Canovium i Segontium (PRN 17856). Mae'n debyg fod anomaleddau eraill yn ganlyniad naill ai arferion amaethyddol modern neu sbwriel metelaidd modern yn y caeau.

Digwyddodd y gwaith maes rhwng 28/08/2024 a 29/08/2024.

Methods

The survey was based on a series of thirty-seven, 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 survey was undertaken in two area which were separated by a heavily overgrown hedge, several meters wide.

A limited number of soil samples were taken to access the Magnetic Susceptibility on the site (Figure 9). These were dried out in a warming oven, sieved, and processed using a Bartington MS2 Magnetic Susceptibility Meter.

Survey Results:

Area

Area 1: 0.88 Ha
Area 2: 0.53 Ha

Display

The results are displayed as a grey and colour scale images (Figures 5 -7) and as a X-Y trace plot (Figure 8). The interpretation plot is shown as Figure 9. The Magnetic Susceptibility results are summarised on Figure 10 and the survey, as a whole, is summarised on Figure 11.

Results:

Fluxgate Gradiometer Survey

Area 1

The grey scale plot of Area 1 has numerous ferromagnetic anomalies which are shown in blue on Figure 5. These are largely the result of modern rubbish scattered across the field such as a pressurised gas bottle which is show as Anomaly B. Anomaly A marks the position of a vertical metal pipe, mounted in concrete, which is assumed to be a "dip well" for measuring the water table.

There are only two anomalies which are probably of archaeological origins. Anomaly C is a broad band of slight magnetic disturbance, 10 m wide, running NE – SW across the survey area. This is probably the line of the Roman Road. The other anomaly (Anomaly D) is a linear anomaly running NNW – SSE. This anomaly appears to continue into Area 2 where it is recorded as Anomaly H (Figure 8). This anomaly corresponds with a plastic water supply pipe which is known to cross the development area.

There are also two, parallel, linear anomalies in the western corner of Area 1. These can be directly related to the tracks from heavy machinery leading from the gate in the corner of the field.

Area 2

Area 2 similarly had a range of ferromagnetic anomalies which are the result of modern rubbish in the field. Two of these anomalies (Anomalies F and G, Figure 8) were the direct responses to vertical metal pipes within the field.

Only one anomaly of probable archaeological origins was located (Anomaly H, Figure 8). This continues the line of Anomaly D within Area 1 (Figure 5). There are also two feint linear anomalies within the grey scale plot. Both of these lead from gaps in the hedge between the two fields and are probably related to modern agricultural practice.

Magnetic Susceptibility (Figure 10)

Nineteen, small, soil samples were taken for Magnetic Susceptibility analysis, two of which were from areas which had already been disturbed, by possible metal detecting activity. These two samples were of the underlying till, brought to the surface in Grids 19 and 33 (Figure 9).

Both volume susceptibility (direct reading of the samples) and mass susceptibility (reading compensated for the varying mass of the samples) is given below. The results are shown on Figure 10.

Sample	Volume susceptibility χ_v	Mass susceptibility χ_m
Area 1		
1	24	37.3
3	76	78.6
5	128	135.2
7	19	20.8

Sample	Volume susceptibility χ_v	Mass susceptibility χ_m
9	96	103.8
11	159	177.5
13	26	28.2
15	30	31.0
17	128	138.5
19 sub-soil	10	10.5
21	79	82.0
Area 2		
23	37	42.9
25	14	17.8
27	11	13.1
29	15	21.4
31	38	42.1
33 sub-soil	12	20.9
35	67	79.0
37	35	37.8

The readings are highly variable, however there appears to be a difference between the sub-soil and topsoil samples suggesting the area is suitable for magnetic survey. The high value readings tend to concentrate in the western side of Area 1, which is an unexpected pattern. 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), however, the distribution of high value samples is away from the known archaeology in the field. This pattern may be a reflection of the accumulation of soil against the wall along the western side of the field, or it may reflect archaeological activity not recorded in the fluxgate gradiometer survey.

Conclusions (Figure 8)

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 main feature expected to cross the survey area is the Roman Road, RR67c from *Segontium* to *Deva* (Chester) (Hopewell 2018, 27) which had intermediate stations at *Conovium* in the Conwy Valley and *Varis* (probably St Asaph). Where this road crosses the survey area it is recorded as PRN 17856 in the regional Historic Environment Record. Hopewell (2018, 28) suggests there is evidence for a very low *agger* on Environmental Agency lidar data running through the southern edge of the fields to the north-west of Cibyn industrial estate, however, no physical sign of the *agger* was observed within the survey area. The grey scale plot, however shows a broad area of magnetic disturbance (Anomaly C, Figure 5) which is on the projected line of the Roman Road and probably marks its alignment. The only other anomaly, of assumed archaeological origin, can be related to a UPVC watermain known to cross the survey area. Other anomalies within the surveys can be related to modern disturbance or agricultural practice within the fields.

The magnetic susceptibility samples, however, show a concentration of high value samples in the western side of Area 1, away from the probable line of the Roman Road, which may suggest undetected archaeological activity.

References

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

Hopewell, D. 2013. *Roman Roads in North-West Wales.* Gwynedd Archaeological Trust. Bangor

Acknowledgements

This survey was commissioned by CR Archaeology. The project was monitored by J. Emmett for the Gwynedd Archaeological Planning Service.

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:

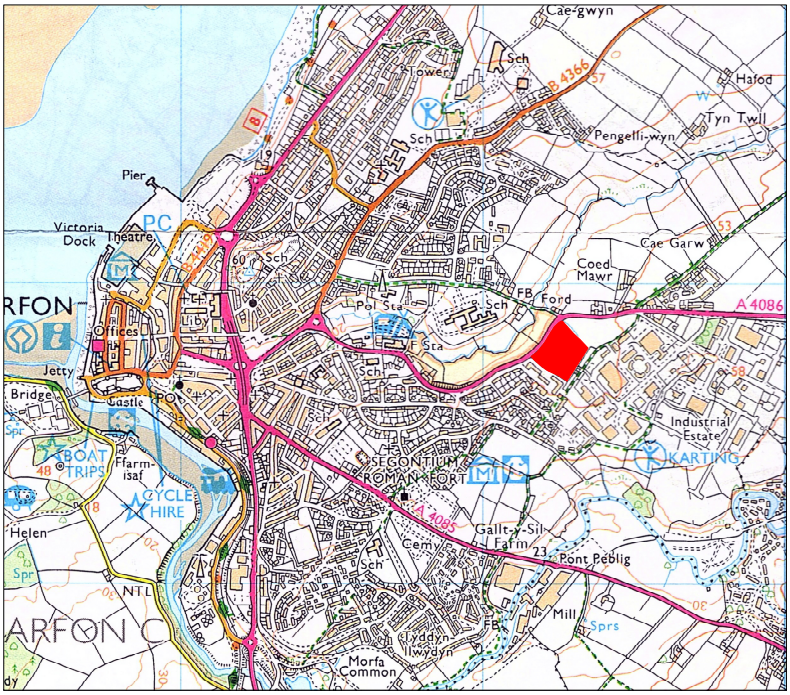

Figure 1: Location
Scale 1:25,000

0 50 m

Figure 2: Location of the Survey
Scale 1:1500

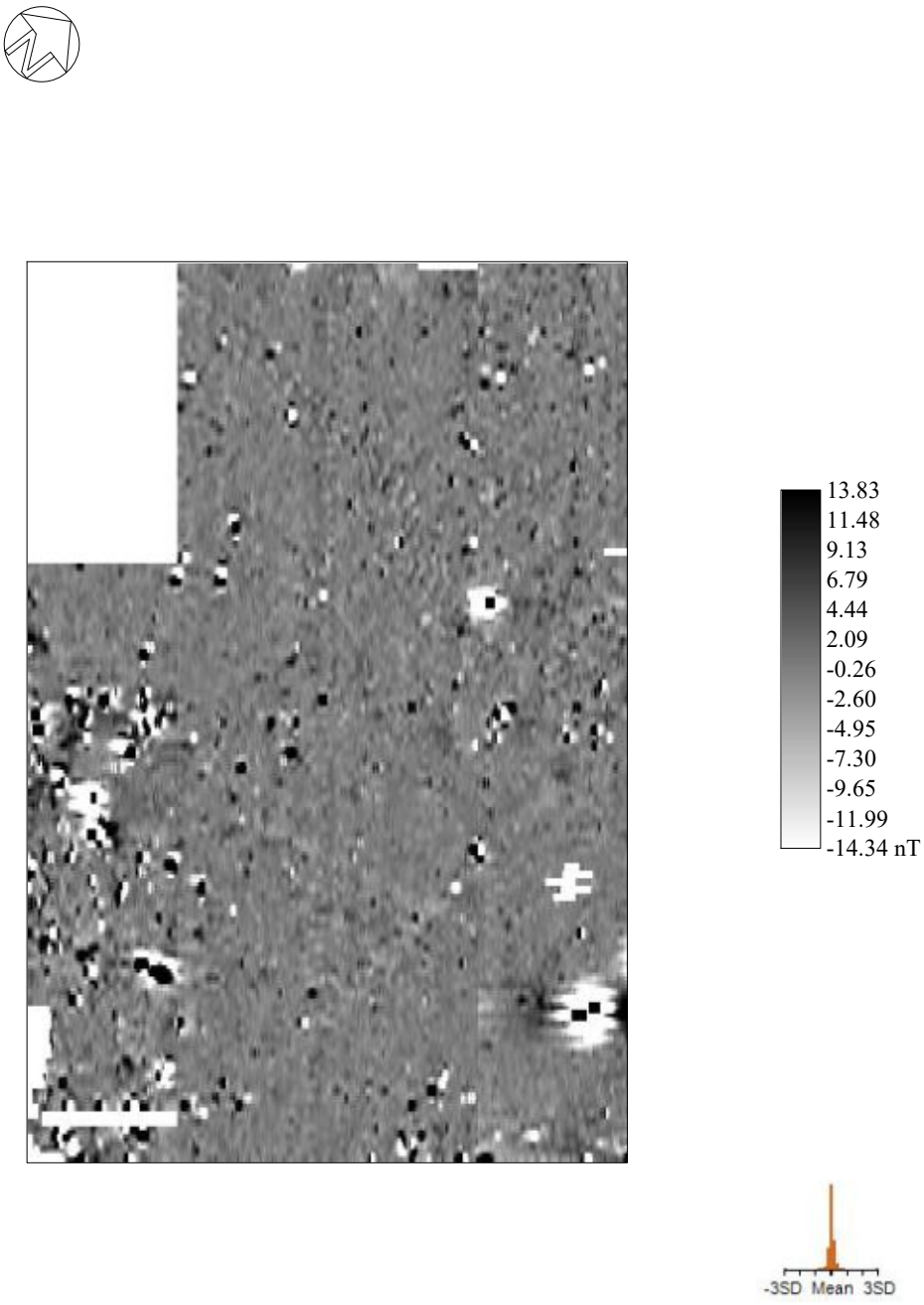

Figure 3: Area 1 Grey Scale Plot
Scale 1:1000

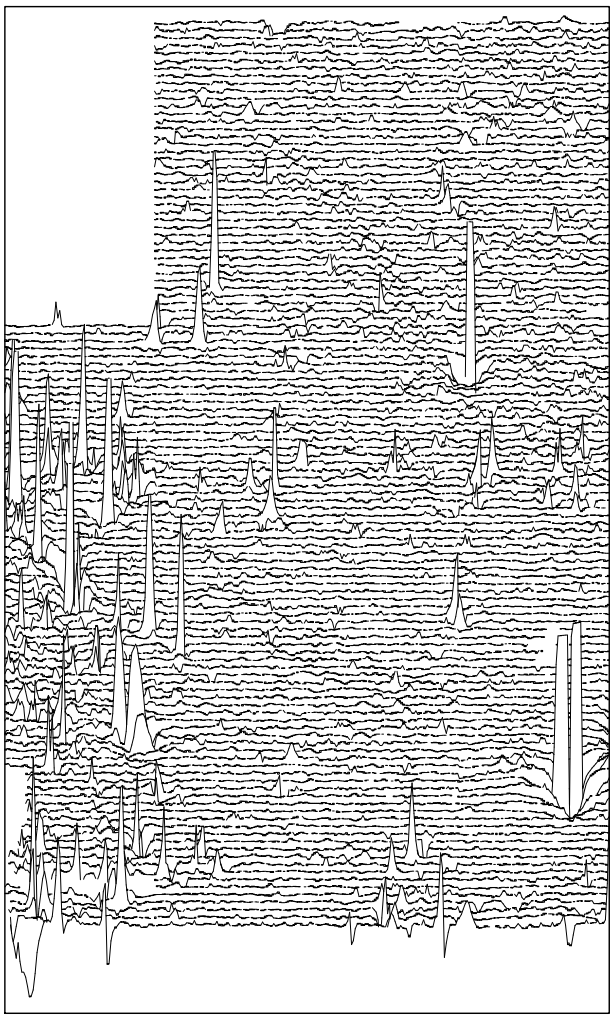

Figure 4: Area 1, X-Y Plot
Scale 1:1000

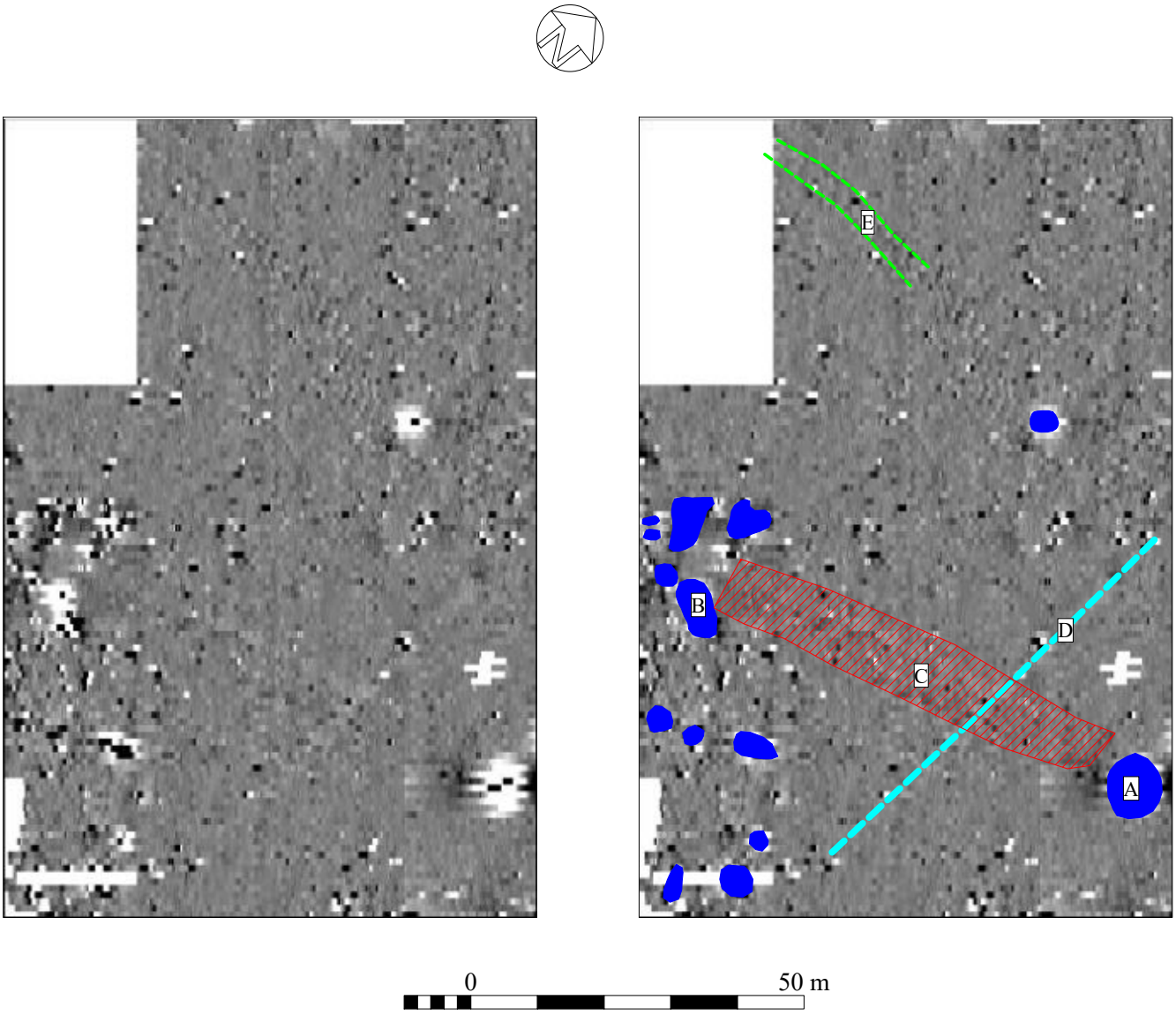

Figure 5: Area 1, Interpretation
Scale 1:1000

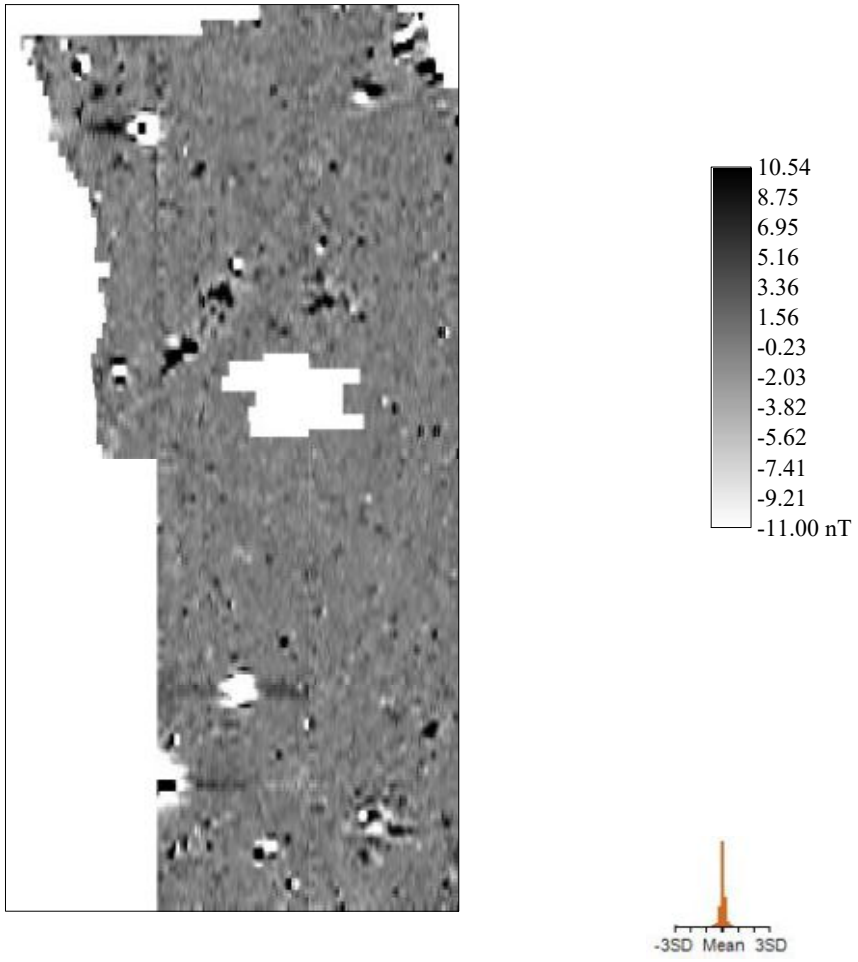

Figure 6: Area 2, Grey Scale Plot
Scale 1:1000

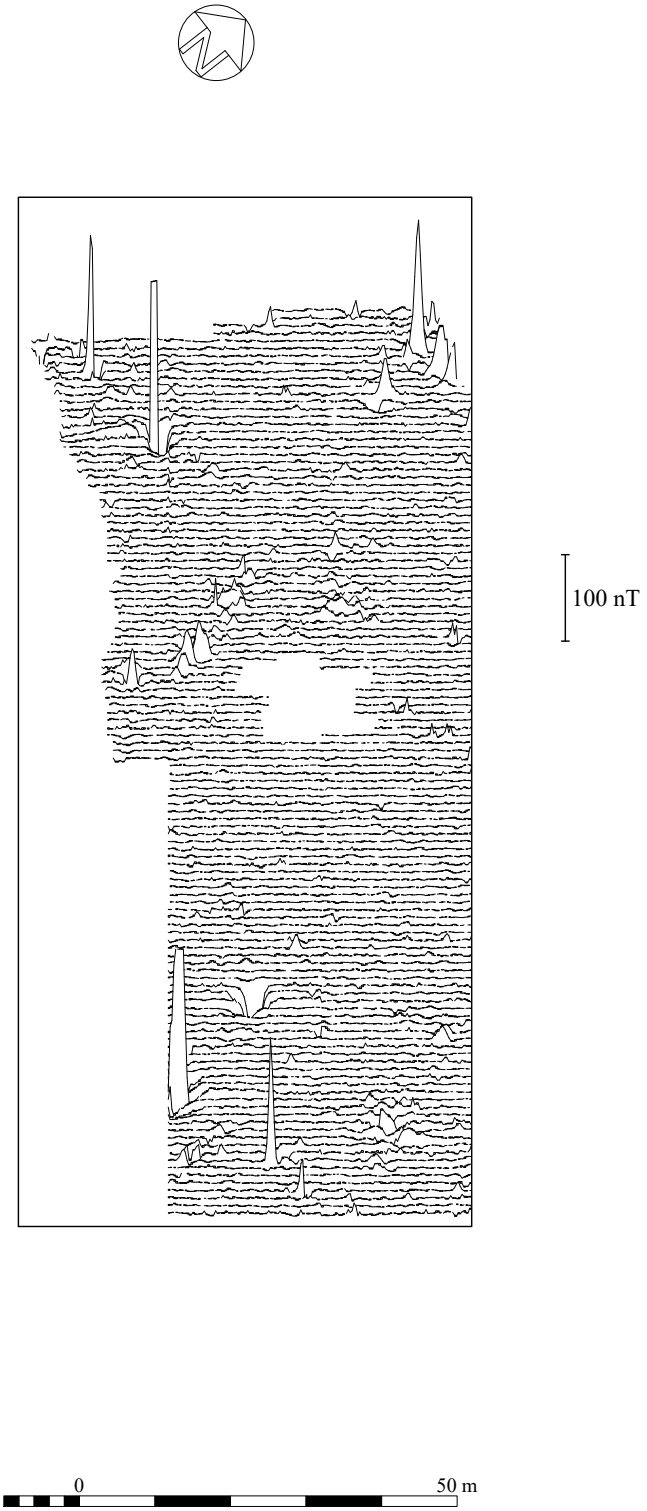

Figure 7: Area 2, X-Y Plot
Scale 1:1000

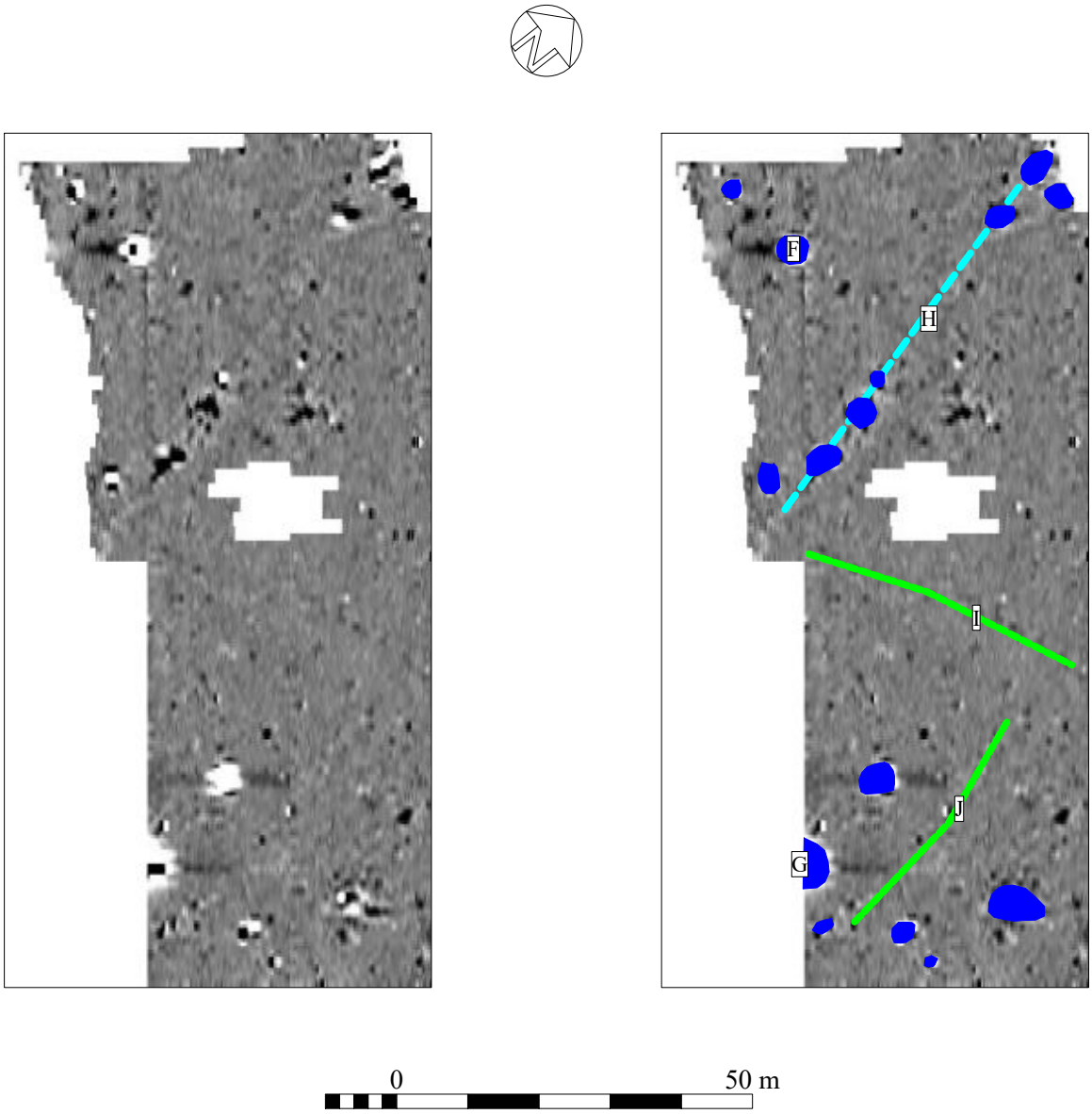

Figure 8: Area 2, Interpretation
Scale 1:1000

Figure 9: Location of the Magnetic Susceptibility Samples
Scale 1:1,500

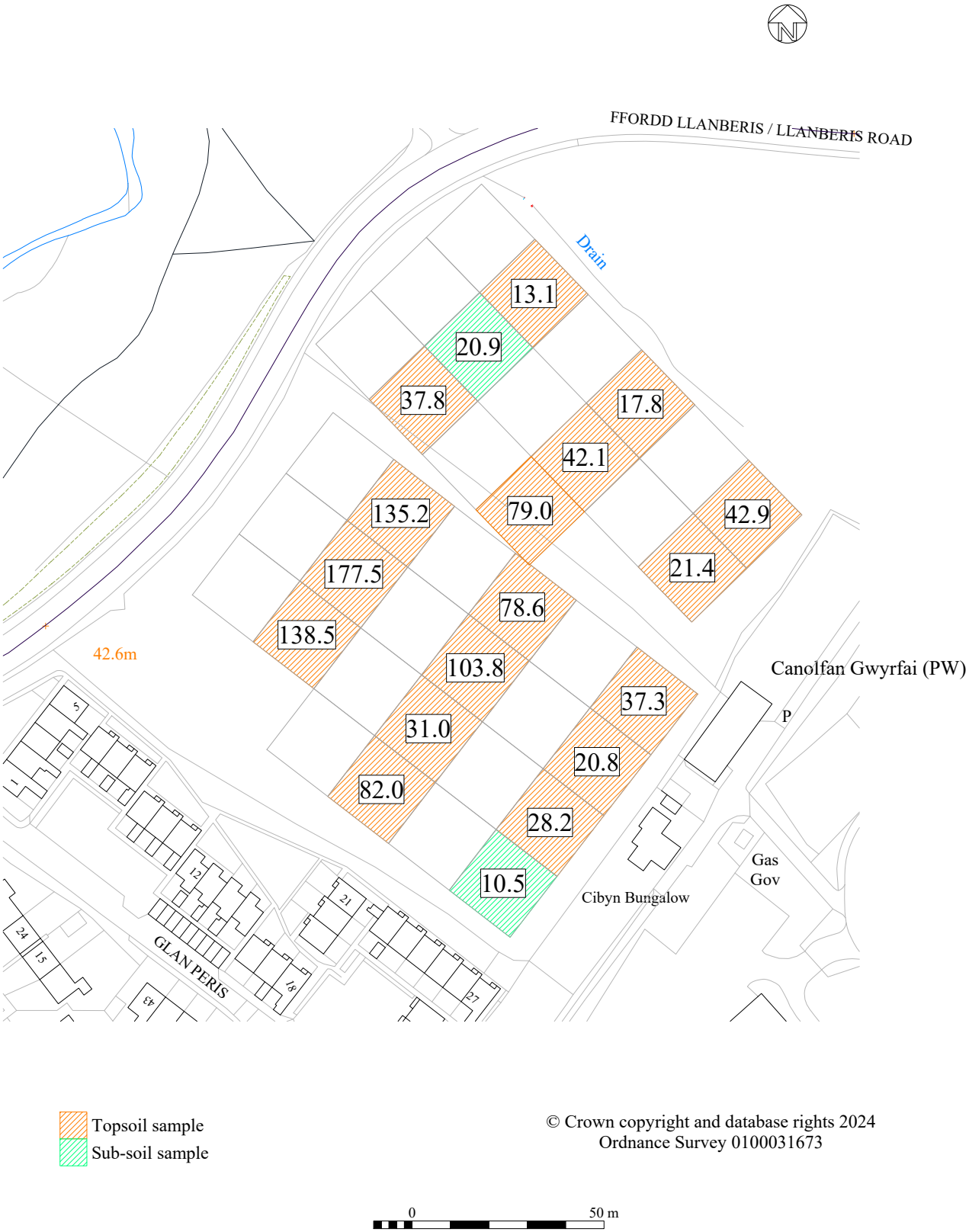

Figure 10: Magnetic Susceptibility Results
Scale 1:1,500

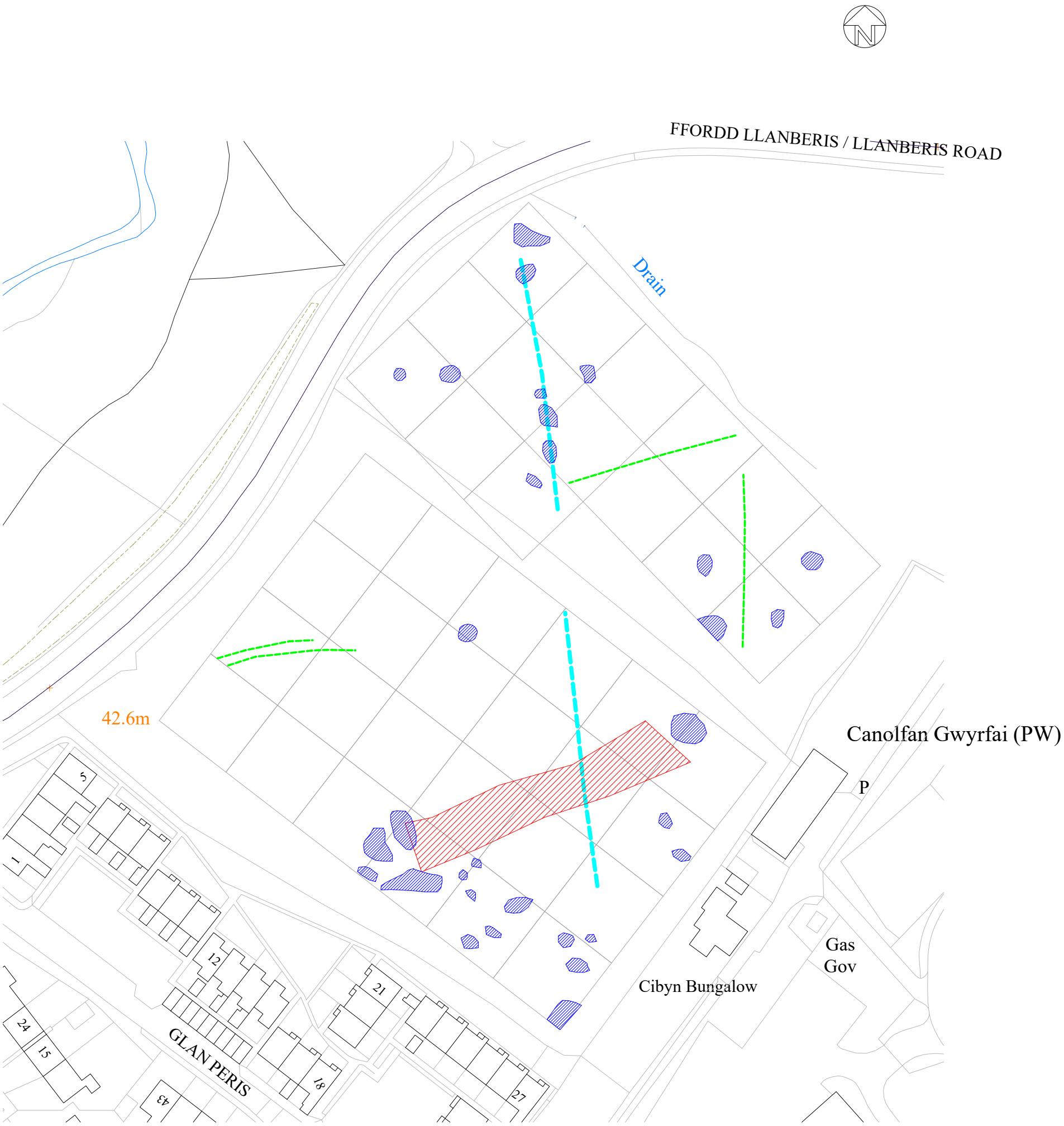

Figure 11: Summary
Scale 1:1,500