GEOPHYSICAL SURVEY REPORT

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SUMO Survey Services
SUMO Group Member

Project name:

Dolbenmaen

Client:

Gwynedd Archaeological Trust

March 2013

Job ref:

J3297

Report author:

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GEOPHYSICAL SURVEY REPORT

Project name:
Dolbenmaen
Client:
Gwynedd Archaeological Trust

Job ref:
J3297

Techniques:
Detailed magnetic survey – Gradiometry

Survey date:
27th February - 1st March 2013

Site centred at:
SH 498 431

Post code:
LL51 9RJ

Field team:
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TABLE OF CONTENTS

LIST OF FIGURES 3
1 SUMMARY OF RESULTS 4
2 INTRODUCTION 4
2.1 Background synopsis 4
2.2 Site location 4
2.3 Description of site 4
2.4 Geology and soils 4
2.5 Site history and archaeological potential 5
2.6 Survey objectives 6
2.7 Survey methods 6
2.8 Processing, presentation and interpretation of results 6
2.8.1 Processing 6
2.8.2 Presentation of results and interpretation 7
3 RESULTS 7
3.1 Probable Archaeology 7
3.2 Possible Archaeology 8
3.3 Other Anomalies 8
4 CONCLUSION 9
5 REFERENCES 10
APPENDIX A – METHODOLOGY & SURVEY EQUIPMENT 11
APPENDIX B – BASIC PRINCIPLES OF MAGNETIC SURVEY 12
APPENDIX C – GLOSSARY OF MAGNETIC ANOMALIES 13

LIST OF FIGURES

Figure 1	1:25 000	Location Plan of Survey Area
Figure 2	1:2500	Location of Survey Grids and Referencing
Figure 3	1:1250	Plot of Minimally Processed Gradiometer Data- West
Figure 4	1:1250	Abstraction and Interpretation of Gradiometer Anomalies- West
Figure 5	1:1250	Plot of Minimally Processed Gradiometer Data- East
Figure 6	1:1250	Abstraction and Interpretation of Gradiometer Anomalies- East
Figure 7	1:2000	Colour Plot of Gradiometer Data Showing Extreme Values
Figure 8	1:2000	Plot of Minimally Processed Gradiometer Data
Figure 9	1:2000	Abstraction and Interpretation of Gradiometer Anomalies

1 SUMMARY OF RESULTS

The geophysical survey undertaken over 7ha of agricultural land near Dolbenmaen has identified a number of ditched features of a probable archaeological origin. Features interpreted as former field boundaries are evident throughout the site and anomalies possibly indicative of prehistoric farmstead activity can be noted in the central region.

A large number of anomalies interpreted as being of a *possible* as opposed to *probable* archaeological origin have also been identified within the survey data.

2 INTRODUCTION

2.1 *Background synopsis*

Stratascan were commissioned to undertake a geophysical survey of an area outlined for development. This survey forms part of an archaeological investigation being undertaken by Gwynedd Archaeological Trust.

2.2 *Site location*

The site is located near Dolbenmaen, Gwynedd at OS ref. SH 498 431.

2.3 *Description of site*

The survey area comprises approximately 7ha of relatively flat agricultural land near Dolbenmaen. The A487 highway forms the northern limits of the site.

2.4 *Geology and soils*

The underlying geology is Felsic Tuff including rhyolitic and dacitic (British Geological Survey, Bedrock Geology UK South, 2007). The drift geology is boulder clay (British Geological Survey, First Edition Quaternary, 1977).

The overlying soils are known as East Keswick 1 which are typical brown earths. These consist of deep, well drained fine loamy soils (Soil Survey of England and Wales, Sheet 2 Wales).

2.5 *Site history and archaeological potential*

The following is an extract from a project design provided by the client (Gwynedd Archaeological Trust, 2013):

*GAT has completed an archaeological assessment report and ground investigation watching brief report in advance of the proposed works (Reports **1092** and **1098** respectively). The assessment characterised a study area within a rich archaeological landscape with thirty known sites of archaeological significance within a 500m radial zone. A large rock outcrop was identified in the Zone B field (cf. Figure 01), which appears from a combination of place name evidence and historic literature to have been used as an early medieval assembly mound. The remainder of the area was characterised by improved pasture separated by cloddiau (field boundaries) of post-medieval date. The archaeological and historical background is reproduced from report **1092** below.*

The evidence for prehistoric occupation within the vicinity of the proposed development area is slight. The nearest confirmed prehistoric sites are the hut groups (PRN 145 SH 4994 4345) and (PRN 170 SH 5019 4276) 450m NE and 450m SE respectively. The Scheduled Ancient Monument of Craig-y-Tyddyn Camp (CN 046; SH 50594271) lies approximately 715m to the south east of the assessment area. It is possible; therefore that evidence of prehistoric activity may survive below ground in the vicinity of the proposed development, occupying as it does the lower ground between these two hut groups, the later agricultural improvement of this land may well have truncated or obscured the evidence for earlier occupation of the landscape. The line of the proposed Roman Road from Segontium - Pen Llystyn - Tomen y Mur may lie under the present A487 (T) although there is no direct evidence of occupation from the Roman period within the vicinity of the proposed development area. The nearest confirmed Roman site is Pen Llystyn fort (PRN 144 SH 4809 4492), approximately 2.3 km to the NW. The sparseness of the evidence may reflect a lack of investigation rather than a lack of settlement activity relating to these periods.

Scheduled Ancient Monument (CN 063; SH50654307) castle earthwork which marks the site of the medieval llys of Dolbenmaen is approximately 830m to the west of the proposed development area (PRN 161 SH 50654037). The western boundary of the land which made up the llys complex comes within 350m of the eastern boundary of the proposed development (GAT Report 790: 09). The geological outcrop and associated earth mound known as Pen Bryn yr Orsedd which is situated in Field 02 may have served as an assembly mound for the retinue of a peripatetic early medieval court. Pen Bryn yr Orsedd translates as 'The Seat on top of the Hill', and assembly mounds which have similar characteristics are known from England, Scotland, Ireland and the Isle of Man (GAT Report 790: 09). An assembly mound near Llangollen is currently subject to a programme of archaeological work as part of 'Project Eliseg'. In the case of 'Project Eliseg', the mound is topped by the remains of a stone cross, and academic work on the social context for the mound and the cross has recently been published (GAT Report 790: 09). The place name 'Dol Pen Maen' is mentioned in the medieval story of 'Math and Mathonwy' as a point where hostages were exchanged between two high – status families (GAT Report 790: 09). Dolbenmaen / Dol Pen Maen translates as 'The Meadow with the Rock at the Head', and the rock in this instance may be Pen Bryn yr Orsedd.

An Exchequer survey dated 1589-90 shows that the boundary of the township of Dolbenmaen was almost exactly the same as the parish as given of the Tithe Map of 1838 (GAT Report 790: 09). The assessment area is recorded by the 17th century as being part of a farm known as Tyddyn Rhwng y Ddwyryd. In 1637 the lands were demised to John Griffith of Cefn Amlwch by his father in law Sir Richard Trevor, by which time, or shortly after, the lands were purchased from the Crown. John Griffith's heir and brother sold the township in 1719 to Williams Brynker, son of James Brynker of Brynkir. A rental of 1721 includes the farm of Plas Dolbenmaen, which is the earliest found reference of the farm under this name. William ran into financial problems, and the lands with the exception of Dolwgan, were sold to William Owen of Clenennau and Brogyntyn in 1736, and so passed by marriage to the Ormesby (later Ormesby-Gore) family (GAT Report 790: 09).

Between the production of the Tithe Map in 1839 (GAT Report 790: Figure 03) and the 3rd Edition of the Ordnance Survey Map in 1915 (GAT Report 790: Figure 06), the field system within the assessment area saw several changes through the planting and grubbing up of field boundaries. The name Pen Bryn yr Orsedd in reference to the rock outcrop is not recorded on the 1st Edition O.S. map but does appear on the 2nd Edition.

2.6 *Survey objectives*

The objective of the survey was to locate any features of a possible archaeological origin in order that they may be assessed prior to development.

2.7 *Survey methods*

This report and all fieldwork have been conducted in accordance with both the English Heritage guidelines outlined in the document: *Geophysical Survey in Archaeological Field Evaluation, 2008* and with the Institute for Archaeologists document *Standard and Guidance for Archaeological Geophysical Survey.*

Detailed magnetic survey (gradiometry) was used as an efficient and effective method of locating archaeological anomalies. More information regarding this technique is included in the Methodology section below and in Appendix A.

2.8 *Processing, presentation and interpretation of results*

2.8.1 *Processing*

Processing is performed using specialist software. This can emphasise various aspects contained within the data but which are often not easily seen in the raw data. Basic processing of the magnetic data involves 'flattening' the background levels with respect to adjacent traverses and adjacent grids. Once the basic processing has flattened the background it is then possible to carry out further processing which may include low pass filtering to reduce 'noise' in the data and hence emphasise the archaeological or man-made anomalies.

The following schedule shows the basic processing carried out on all minimally processed gradiometer data used in this report:

1. *Destripe* (Removes striping effects caused by zero-point discrepancies between different sensors and walking directions)
2. *Destagger* (Removes zigzag effects caused by inconsistent walking speeds on sloping, uneven or overgrown terrain)

2.8.2 Presentation of results and interpretation

The presentation of the data for each site involves a print-out of the minimally processed data both as a greyscale plot and a colour plot showing extreme magnetic values. Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site.

3 RESULTS

The detailed magnetic gradiometer survey conducted at Dolbenmaen has identified a number of anomalies that have been characterised as being either of a *probable* or *possible* archaeological origin.

The difference between *probable* and *possible* archaeological origin is a confidence rating. Features identified within the dataset that form recognisable archaeological patterns or seem to be related to a deliberate historical act have been interpreted as being of a probable archaeological origin.

Features of possible archaeological origin tend to be more amorphous anomalies which may have similar magnetic attributes in terms of strength or polarity but are difficult to classify as being archaeological or natural.

The following list of numbered anomalies refers to numerical labels on the interpretation plots.

*3.1 **Probable Archaeology***

1-8 A number of positive linear anomalies have been identified in the central region of the survey area. These anomalies are indicative of cut features and are likely to be related to ditches of an archaeological origin. Anomaly **1** is a circular feature measuring approximately 10m in diameter and may be related to the drip gully of a roundhouse. Anomalies **2**-**8** are linear in character and may be related to ancient field systems.

9-12 Four negative anomalies of a probable archaeological origin can also be noted in the central region of the survey area. These anomalies are likely to be related to ploughed out earthworks. In places these features seem to have associated positive anomalies which may suggest the presence of some form of bank and ditch arrangement.

13-21 Several linear anomalies are evident throughout the survey area. These anomalies have been interpreted as former field boundaries.

3.2 Possible Archaeology

22 A large number of positive linear and area anomalies have been identified throughout the survey area with particular concentrations in the central and eastern regions of the site. These anomalies may be related to cut features of a possible archaeological origin. However; the amorphous nature of these anomalies means that a natural origin cannot be ruled out at this stage.

23 Several negative anomalies can be noted in the eastern limits of the site. These anomalies may be related to ploughed out earthworks, such as banks of a possible archaeological origin.

24 Two possible thermoremanent features are evident in the central region of the survey area. These anomalies may be related to former hearths, kilns or areas of burnt material.

3.3 Other Anomalies

25 These two areas of magnetic enhancement are likely to be related to spreads of magnetic debris.

26 These closely centred positive linear anomalies are characteristic of plough activity.

27 Areas of magnetic disturbance are the result of substantial nearby ferrous metal objects such as fences and underground services. These effects can mask weaker archaeological anomalies.

28 Large swathes of magnetic variation can be noted in the survey area. This variation is likely to be of a geological or pedological origin.

4 CONCLUSION

The detailed magnetic gradiometer survey undertaken over an area of land near Dolbenmaen has identified a number of anomalies of a probable archaeological origin. Former banks and ditched features, including a circular anomaly, evident in the central region of the survey area may suggest the presence of prehistoric farmstead activity immediately to the north and east of the present water treatment works.

A large number of other anomalies are also evident in the eastern and central regions of the site. These anomalies may be related to cut features, such as pits and ditches, of an archaeological origin; however their amorphous character means that a natural origin cannot be ruled out at this stage.

A large number of modern services cross the survey area. The magnetic disturbance associated with these services may mask the weaker, more subtle responses of any archaeological anomalies in close proximity to them.

5 REFERENCES

British Geological Survey South Sheet, 1977. *Geological Survey Ten Mile Map, South Sheet First Edition (Quaternary).* Institute of Geological Sciences.

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Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 2 Wales*.

English Heritage, 2008. *Geophysical Survey in Archaeological Field Evaluation.*

Gwynedd archaeological trust (2013) *Dolbenmaen WTW,Garndolbenmaen, Project Design for Archaeological Evaluation: Geophysical Survey (G2293)*

Institute For Archaeologists. *Standard and Guidance for Archaeological Geophysical Survey.* http://www.archaeologists.net/sites/default/files/nodefiles/Geophysics2010.pdf

APPENDIX A – METHODOLOGY & SURVEY EQUIPMENT

Grid locations

The location of the survey grids has been plotted together with the referencing information. Grids were set out using a Leica 705auto Total Station and referenced to suitable topographic features around the perimeter of the site or a Leica Smart Rover RTK GPS.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. A SmartNet RTK GPS uses Ordnance Survey's network of over 100 fixed base stations to give an accuracy of around 0.01m.

Survey equipment and gradiometer configuration

Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTeslas (nT) in an overall field strength of 48,000nT, can be accurately detected using an appropriate instrument.

The mapping of the anomaly in a systematic manner will allow an estimate of the type of material present beneath the surface. Strong magnetic anomalies will be generated by buried iron-based objects or by kilns or hearths. More subtle anomalies such as pits and ditches can be seen if they contain more humic material which is normally rich in magnetic iron oxides when compared with the subsoil.

To illustrate this point, the cutting and subsequent silting or backfilling of a ditch may result in a larger volume of weakly magnetic material being accumulated in the trench compared to the undisturbed subsoil. A weak magnetic anomaly should therefore appear in plan along the line of the ditch.

The magnetic survey was carried out using a dual sensor Grad601-2 Magnetic Gradiometer manufactured by Bartington Instruments Ltd. The instrument consists of two fluxgates very accurately aligned to nullify the effects of the Earth's magnetic field. Readings relate to the difference in localised magnetic anomalies compared with the general magnetic background. The Grad601-2 consists of two high stability fluxgate gradiometers suspended on a single frame. Each gradiometer has a 1m separation between the sensing elements so enhancing the response to weak anomalies.

Sampling interval

Readings were taken at 0.25m centres along traverses 1m apart. This equates to 3600 sampling points in a full 30m x 30m grid.

Depth of scan and resolution

The Grad 601-2 has a typical depth of penetration of 0.5m to 1.0m, though strongly magnetic objects may be visible at greater depths. The collection of data at 0.25m centres provides an optimum methodology for the task balancing cost and time with resolution.

Data capture

The readings are logged consecutively into the data logger which in turn is daily down- loaded into a portable computer whilst on site. At the end of each site survey, data is transferred to the office for processing and presentation.

APPENDIX B – BASIC PRINCIPLES OF MAGNETIC SURVEY

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock.

Weakly magnetic iron minerals are always present within the soil and areas of enhancement relate to increases in *magnetic susceptibility* and permanently magnetised *thermoremanent* material.

Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremanence is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremanent archaeological features can include hearths and kilns and material such as brick and tile may be magnetised through the same process.

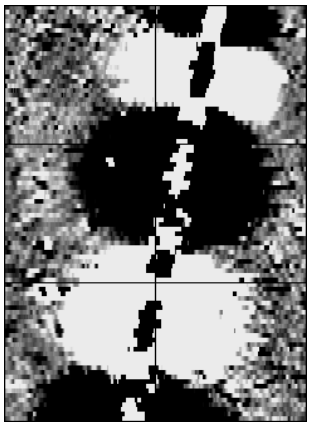
Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried field. The difference between the two sensors will relate to the strength of a magnetic field created by a buried feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity, disturbance from modern services etc.

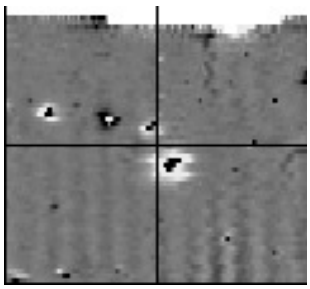
APPENDIX C – GLOSSARY OF MAGNETIC ANOMALIES

Bipolar



A bipolar anomaly is one that is composed of both a positive response and a negative response. It can be made up of any number of positive responses and negative responses. For example a pipeline consisting of alternating positive and negative anomalies is said to be bipolar. See also dipolar which has only one area of each polarity. The interpretation of the anomaly will depend on the magnitude of the magnetic field strength. A weak response may be caused by a clay field drain while a strong response will probably be caused by a metallic service.

Dipolar

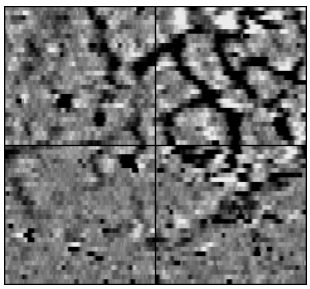


This consists of a single positive anomaly with an associated negative response. There should be no separation between the two polarities of response. These responses will be created by a single feature. The interpretation of the anomaly will depend on the magnitude of the magnetic measurements. A very strong anomaly is likely to be caused by a ferrous object.

Positive anomaly with associated negative response

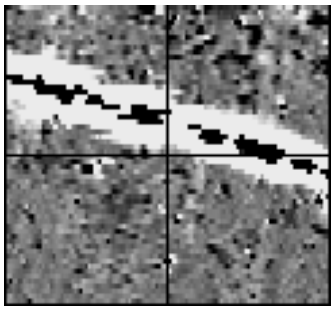
See bipolar and dipolar.

Positive linear



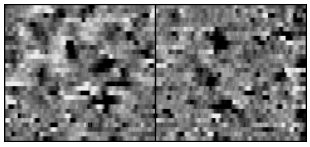
A linear response which is entirely positive in polarity. These are usually related to in-filled cut features where the fill material is magnetically enhanced compared to the surrounding matrix. They can be caused by ditches of an archaeological origin, but also former field boundaries, ploughing activity and some may even have a natural origin.

Positive linear anomaly with associated negative response



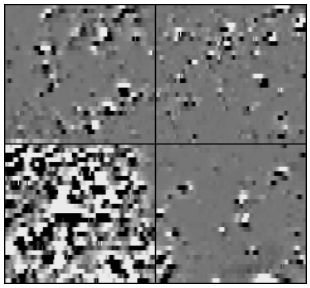
A positive linear anomaly which has a negative anomaly located adjacently. This will be caused by a single feature. In the example shown this is likely to be a single length of wire/cable probably relating to a modern service. Magnetically weaker responses may relate to earthwork style features and field boundaries.

Positive point/area



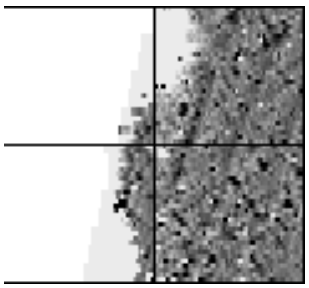
These are generally spatially small responses, perhaps covering just 3 or 4 reading nodes. They are entirely positive in polarity. Similar to positive linear anomalies they are generally caused by in-filled cut features. These include pits of an archaeological origin, possible tree bowls or other naturally occurring depressions in the ground.

Magnetic debris



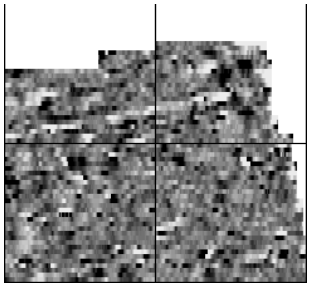
Magnetic debris consists of numerous dipolar responses spread over an area. If the amplitude of response is low (+/-3nT) then the origin is likely to represent general ground disturbance with no clear cause, it may be related to something as simple as an area of dug or mixed earth. A stronger anomaly (+/-250nT) is more indicative of a spread of ferrous debris. Moderately strong anomalies may be the result of a spread of thermoremanent material such as bricks or ash.

Magnetic disturbance



Magnetic disturbance is high amplitude and can be composed of either a bipolar anomaly, or a single polarity response. It is essentially associated with magnetic interference from modern ferrous structures such as fencing, vehicles or buildings, and as a result is commonly found around the perimeter of a site near to boundary fences.

Negative linear

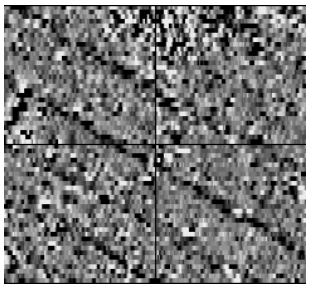


A linear response which is entirely negative in polarity. These are generally caused by earthen banks where material with a lower magnetic magnitude relative the background top soil is built up. See also ploughing activity.

Negative point/area

Opposite to positive point anomalies these responses may be caused by raised areas or earthen banks. These could be of an archaeological origin or may have a natural origin.

Ploughing activity



Ploughing activity can often be visualised by a series of parallel linear anomalies. These can be of either positive polarity or negative polarity depending on site specifics. It can be difficult to distinguish between ancient ploughing and more modern ploughing, clues such as the separation of each linear, straightness, strength of response and cross cutting relationships can be used to aid this, although none of these can be guaranteed to differentiate between different phases of activity.

Polarity

Term used to describe the measurement of the magnetic response. An anomaly can have a positive polarity (values above 0nT) and/or a negative polarity (values below 0nT).

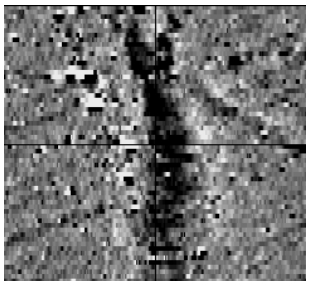
Strength of response

The amplitude of a magnetic response is an important factor in assigning an interpretation to a particular anomaly. For example a positive anomaly covering a 10m^2 area may have values up to around 3000nT, in which case it is likely to be caused by modern magnetic interference. However, the same size and shaped anomaly but with values up to only 4nT may have a natural origin. Colour plots are used to show the amplitude of response.

Thermoremanent response

A feature which has been subject to heat may result in it acquiring a magnetic field. This can be anything up to approximately +/-100 nT in value. These features include clay fired drains, brick, bonfires, kilns, hearths and even pottery. If the heat application has occurred in situ (e.g. a kiln) then the response is likely to be bipolar compared to if the heated objects have been disturbed and moved relative to each other, in which case they are more likely to take an irregular form and may display a debris style response (e.g. ash).

Weak background variations



Weakly magnetic wide scale variations within the data can sometimes be seen within sites. These usually have no specific structure but can often appear curvy and sinuous in form. They are likely to be the result of natural features, such as soil creep, dried up (or seasonal) streams. They can also be caused by changes in the underlying geology or soil type which may contain unpredictable distributions of magnetic minerals, and are usually apparent in several locations across a site.

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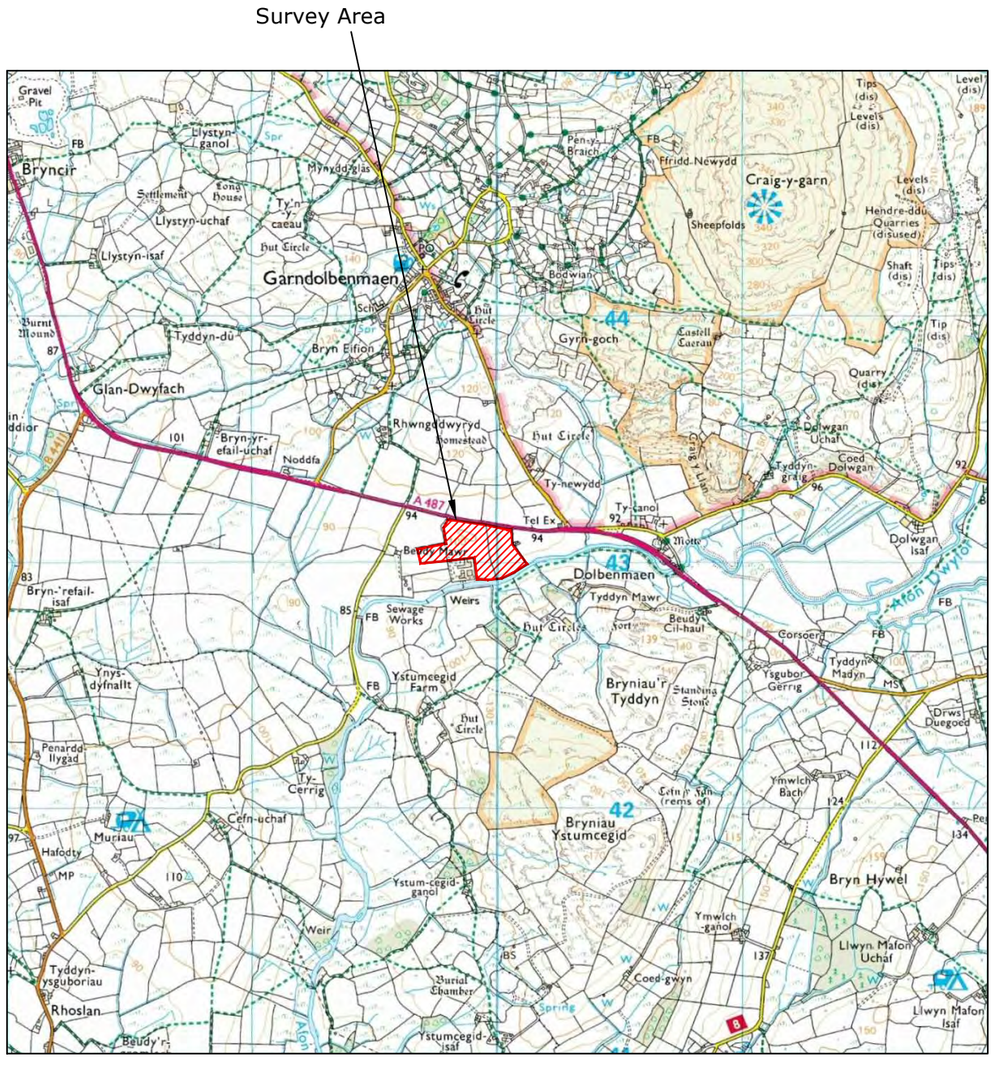
OS 100km square = SH



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Site centred on NGR: SH 498 431

Client: GWYNEDD ARCHAEOLOGICAL TRUST

Project Title: GEOPHYSICAL SURVEY - DOLBENMAEN

Job No. 3297

Subject: LOCATION PLAN OF SURVEY AREA

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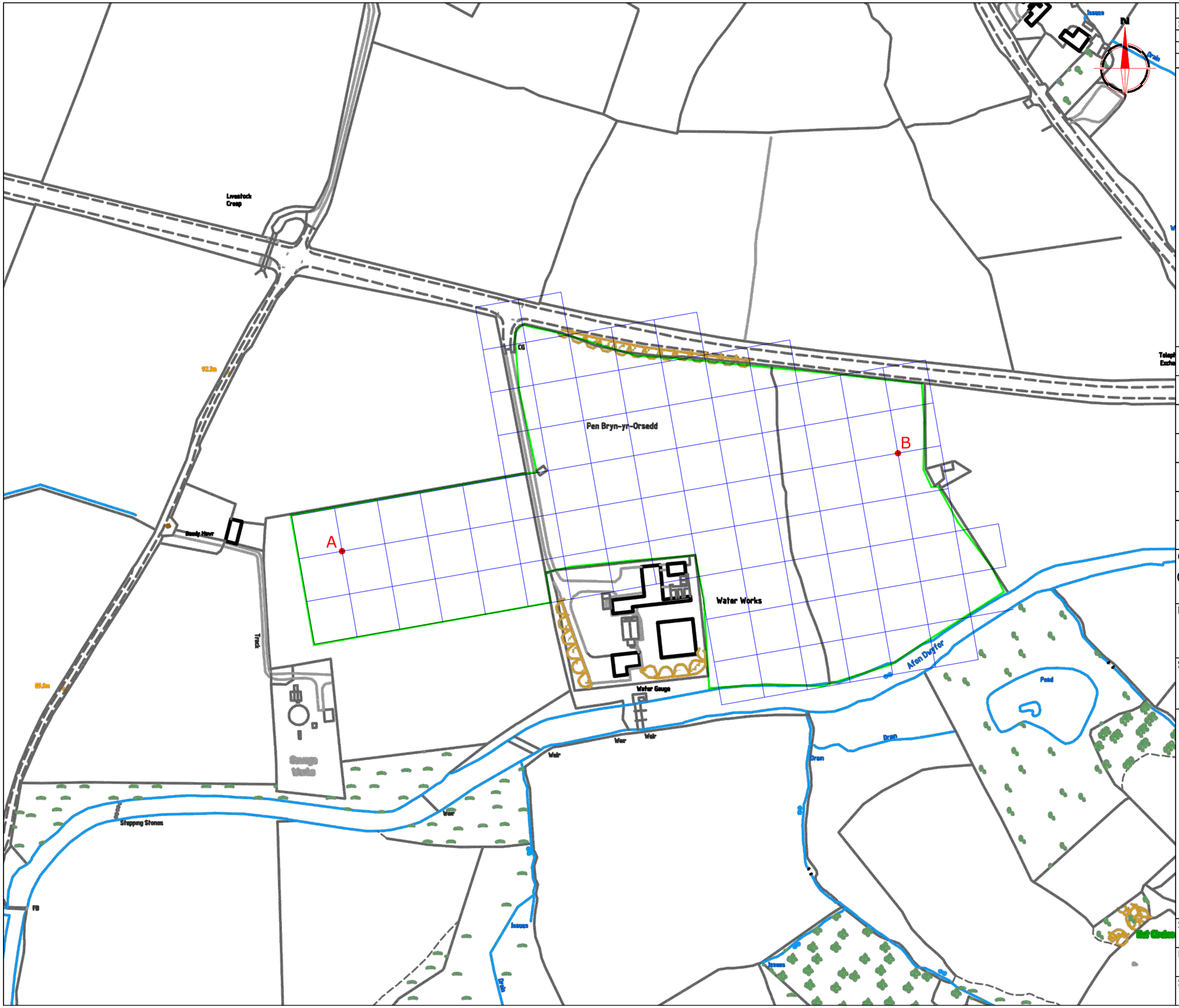
Scale: 1:25000 (0m 500 1000m)

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
FEB 2013	RAJS	01



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

	Survey area
	Survey grid
A	GPS referencing point

OS GRID REFERENCES

A	249663.25 , 343017.98
B	250047.34 , 343085.63

Client
GWYNEDD ARCHAEOLOGICAL TRUST

Project Title — Job No. 3297
GEOPHYSICAL SURVEY - DOLBENMAEN

Subject
LOCATION OF SURVEY GRIDS AND REFERENCING

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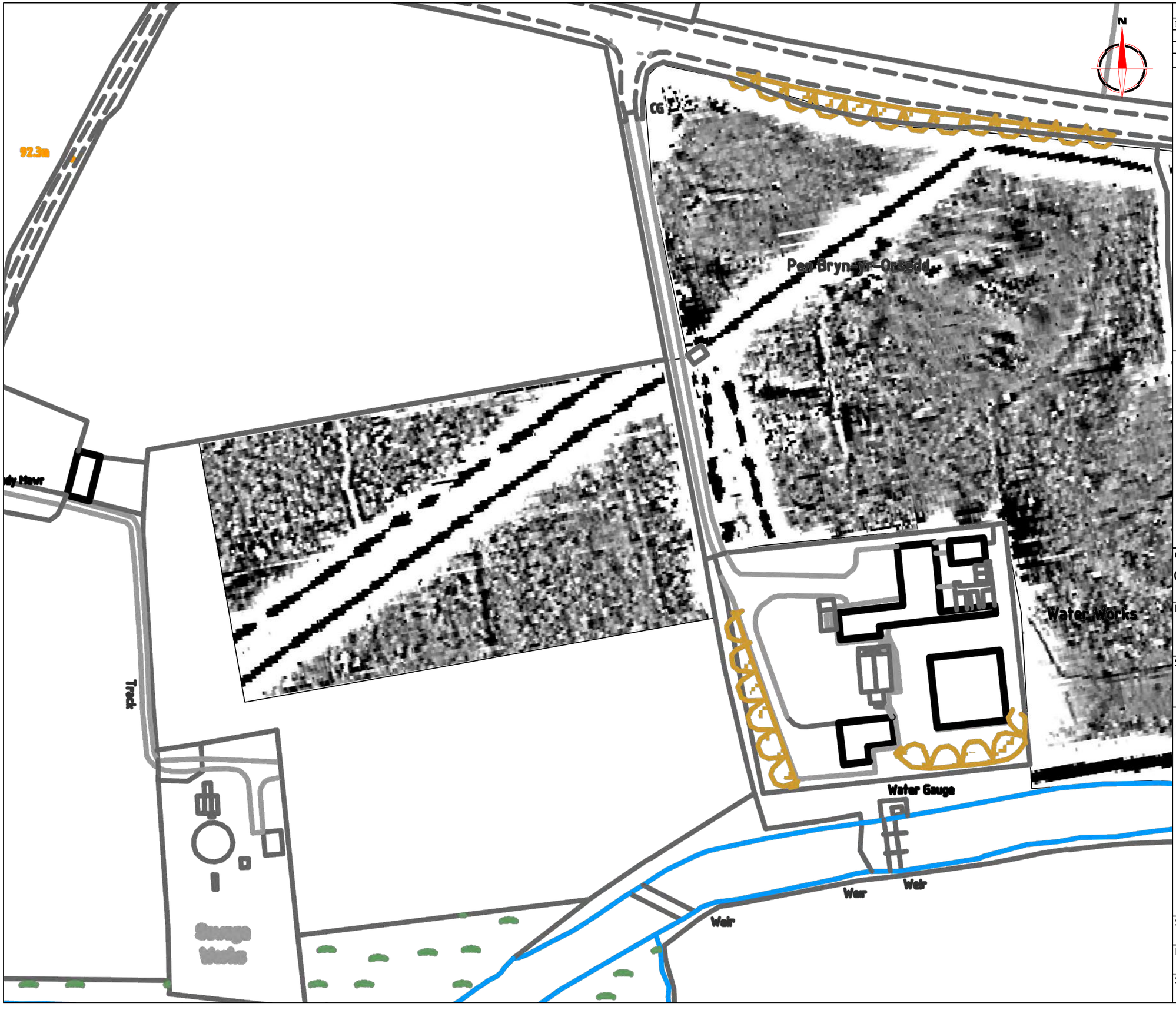
Scale 1:2500 (0m, 50, 100m)

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
FEB 2013	RAJS	02



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +5nT (black)
Minimum -5nT (white)

Client
GWYNEDD ARCHAEOLOGICAL TRUST

Project Title
GEOPHYSICAL SURVEY - DOLBENMAEN

Job No. 3297

Subject
PLOT OF MINIMALLY PROCESSED GRADIOMETER DATA- WEST

STRATASCAN™
GEOPHYSICS FOR ARCHAEOLOGY AND ENGINEERING
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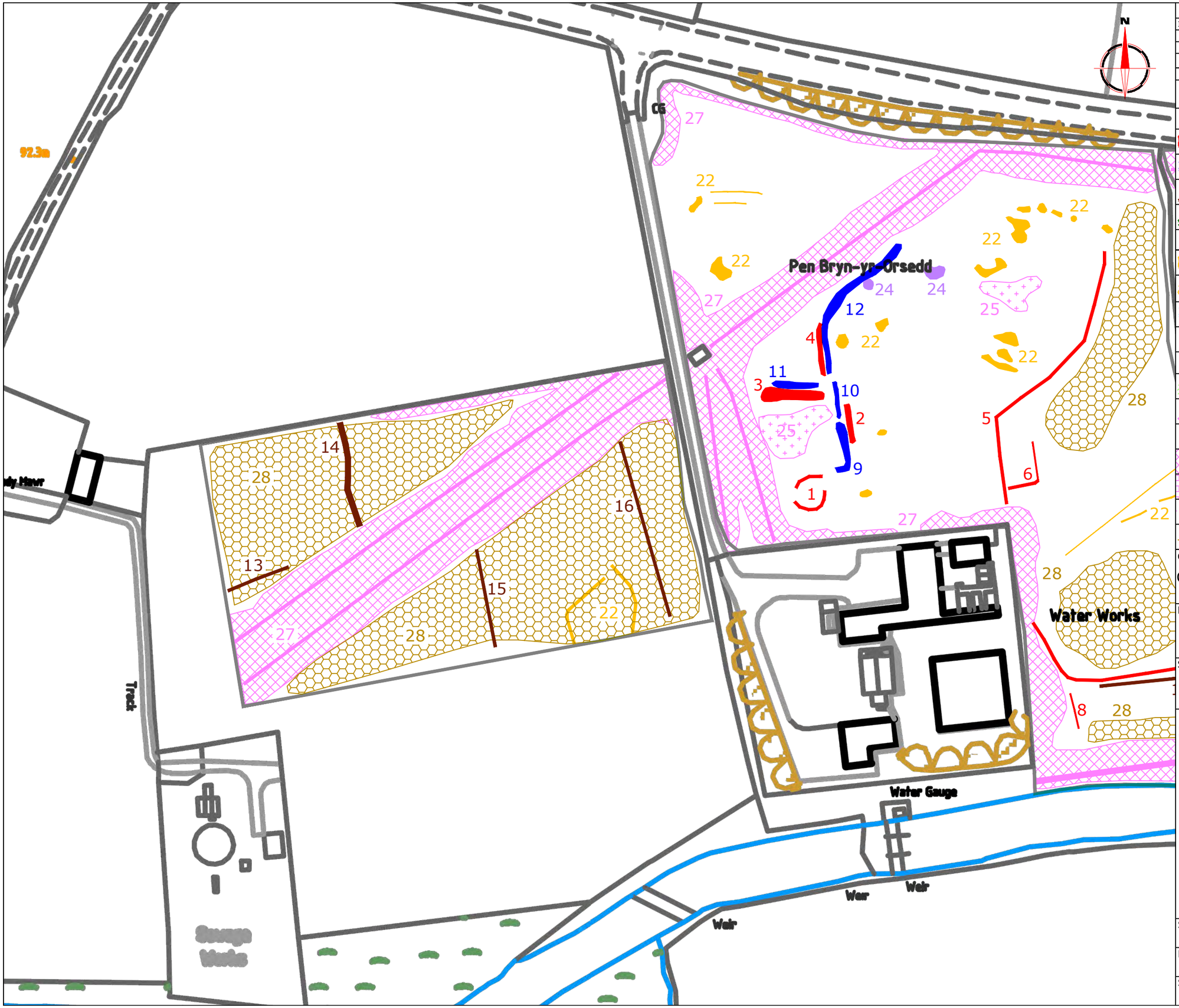
SUMO GROUP MEMBER

Scale 1:1250

0m 10 20 30 40 50m

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
FEB 2013	RAJS	03



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

PROBABLE ARCHAEOLOGY

- Positive anomaly / weak positive anomaly - probable cut feature of archaeological origin
- Negative anomaly / weak negative anomaly - probable bank or earthwork of archaeological origin
- Linear anomaly probably related to former field boundary
- Widely spaced curving parallel linear anomalies - probably related to ridge-and-furrow

POSSIBLE ARCHAEOLOGY

- Positive anomaly / weak positive anomaly - possible cut feature of archaeological origin
- Area of pit-like anomalies of a possible archaeological origin
- Negative anomaly / weak negative anomaly - possible bank or earthwork of archaeological origin
- Moderate strength discrete anomaly - possible thermoremanent feature

OTHER ANOMALIES

- Closely spaced parallel linear anomalies - probably related to agricultural activity such as ploughing
- Linear anomaly - probably related to pipe, cable or other modern service
- Magnetic spike - probable ferrous object
- Magnetic disturbance associated with nearby metal object such as service or field boundary
- Strong magnetic debris - possible disturbed or made ground
- Scattered magnetic debris
- Area of amorphous magnetic variation - probable natural (e.g. geological or pedological) origin

Client

GWYNEDD ARCHAEOLOGICAL TRUST

Project Title — Job No. 3297

GEOPHYSICAL SURVEY - DOLBENMAEN

Subject

ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES- WEST

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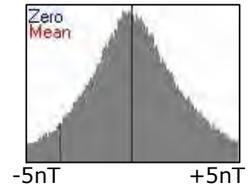
Scale		
1:250	0m 10 20 30 40 50m	
Plot: A3	Checked by: DGE	Issue No.: 01
Survey date: FEB 2013	Drawn by: RAJS	Figure No.: 04

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +5nT (black)
Minimum -5nT (white)



Client
GWYNEDD ARCHAEOLOGICAL TRUST

Project Title — Job No. 3297
GEOPHYSICAL SURVEY - DOLBENMAEN

Subject
PLOT OF MINIMALLY PROCESSED GRADIOMETER DATA- EAST

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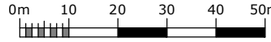
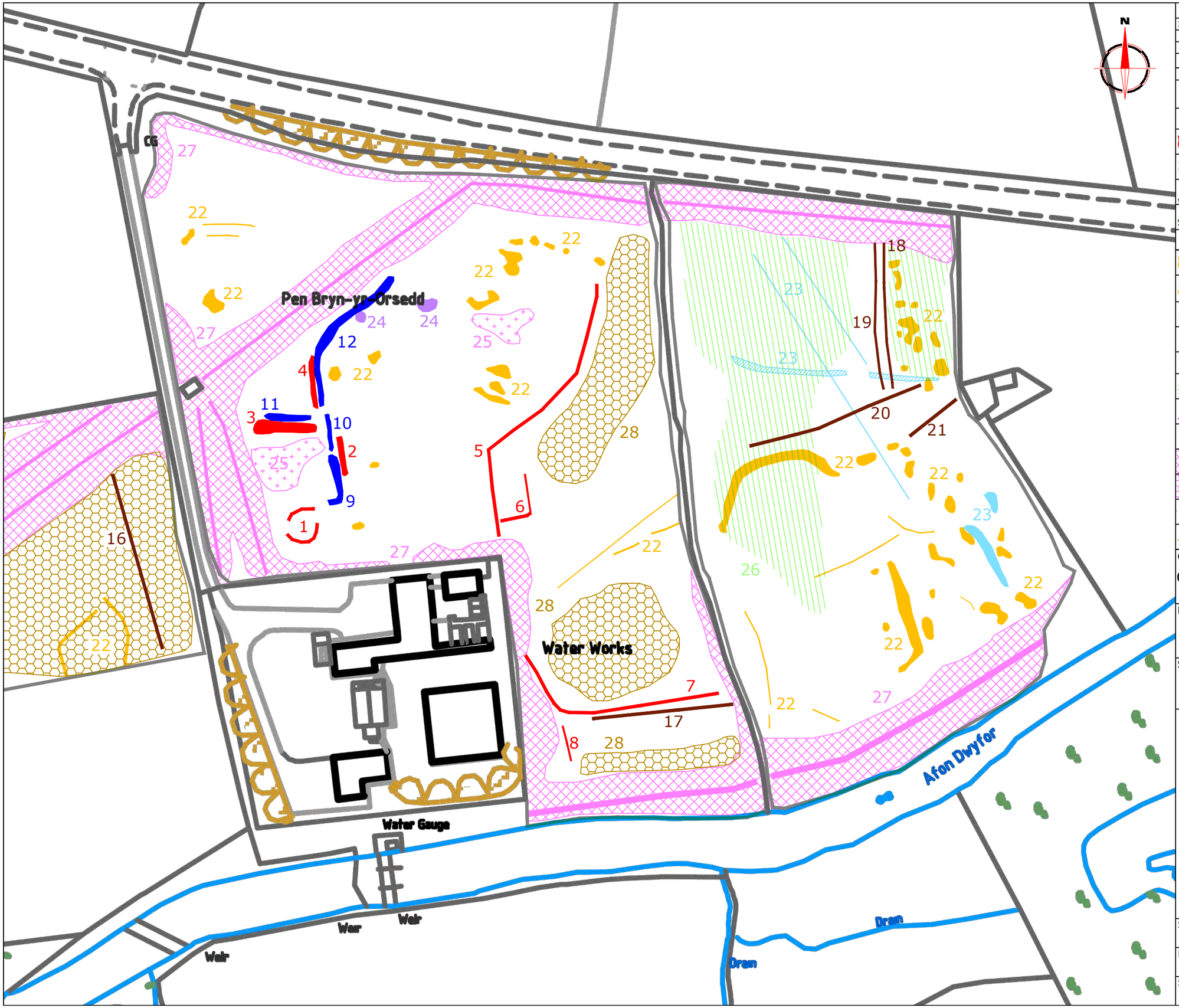
Scale 1:1250



Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
FEB 2013	RAJS	05



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

PROBABLE ARCHAEOLOGY

- Positive anomaly / weak positive anomaly - probable cut feature of archaeological origin
- Negative anomaly / weak negative anomaly - probable bank or earthwork of archaeological origin
- Linear anomaly probably related to former field boundary
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POSSIBLE ARCHAEOLOGY

- Positive anomaly / weak positive anomaly - possible cut feature of archaeological origin
- Area of pit-like anomalies of a possible archaeological origin
- Negative anomaly / weak negative anomaly - possible bank or earthwork of archaeological origin
- Moderate strength discrete anomaly - possible thermoremanent feature

OTHER ANOMALIES

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- Scattered magnetic debris
- Area of amorphous magnetic variation - probable natural (e.g. geological or pedological) origin

Client

GWYNEDD ARCHAEOLOGICAL TRUST

Project Title — Job No. 3297

GEOPHYSICAL SURVEY - DOLBENMAEN

Subject

ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES- EAST

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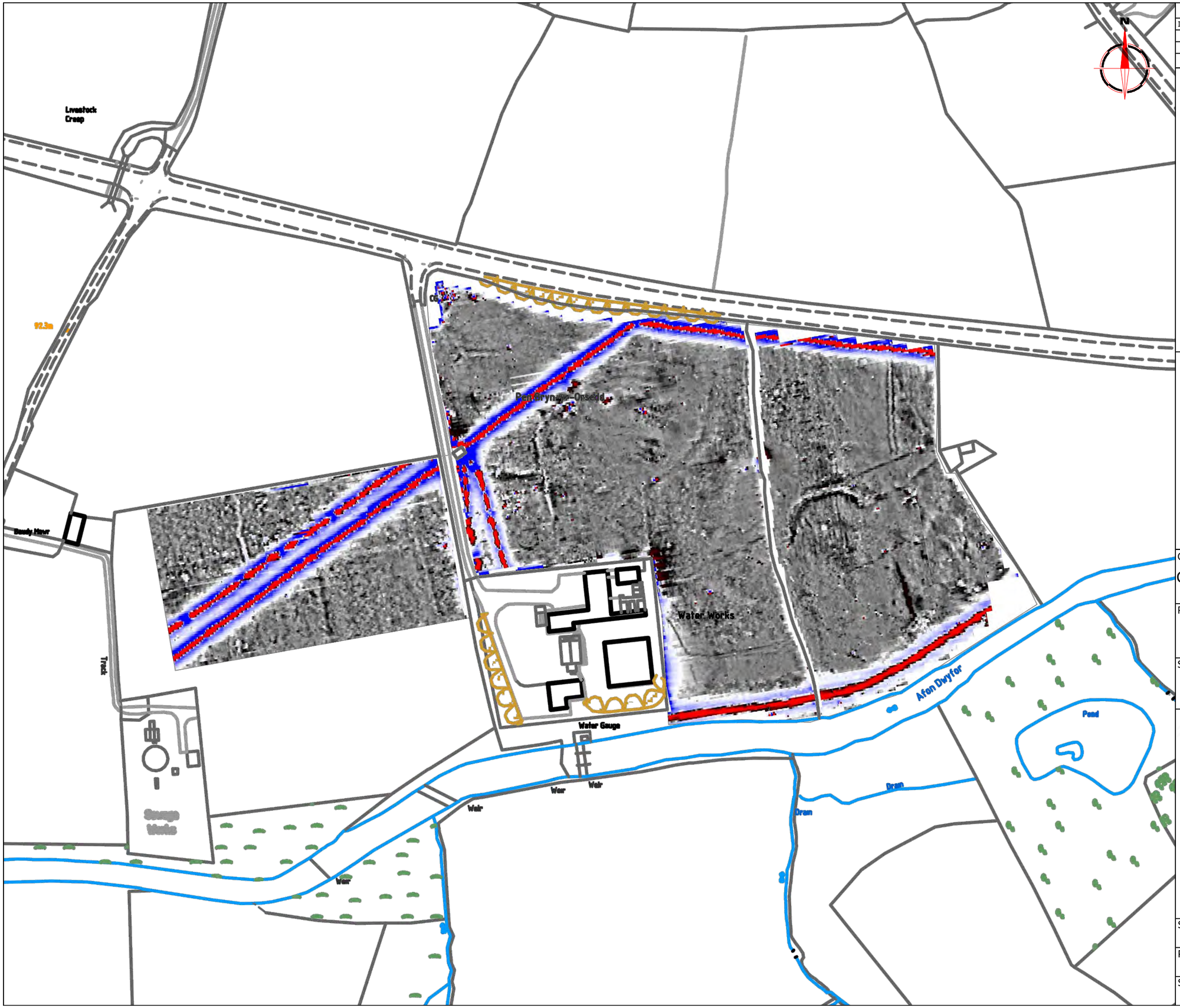
Scale 1:1250 (0m 10 20 30 40 50m)

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
FEB 2013	RAJS	06



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +100nT (red)
Minimum -100nT (blue)

+100nT

-100nT

Client

GWYNEDD ARCHAEOLOGICAL TRUST

Project Title — Job No. 3297

GEOPHYSICAL SURVEY - DOLBENMAEN

Subject

COLOUR PLOT OF GRADIOMETER DATA SHOWING EXTREME VALUES

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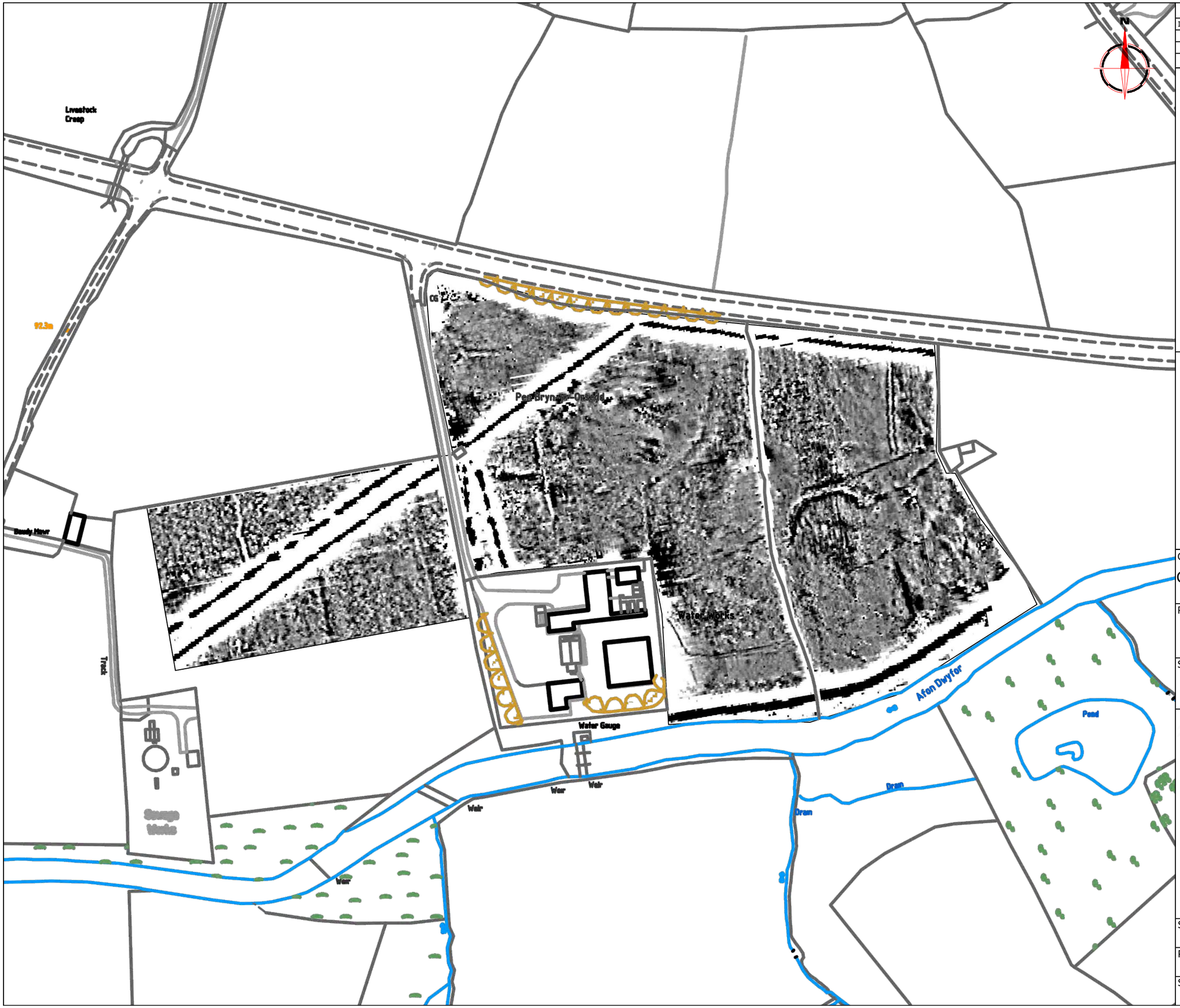
SUMO GROUP MEMBER

Scale 1:2000 (0m 20 40 60 80 100)

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
FEB 2013	RAJS	07

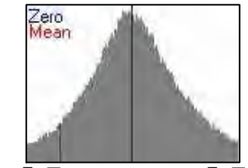


Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +5nT (black)
Minimum -5nT (white)



Client
GWYNEDD ARCHAEOLOGICAL TRUST

Project Title — Job No. 3297
GEOPHYSICAL SURVEY - DOLBENMAEN

Subject
PLOT OF MINIMALLY PROCESSED GRADIOMETER DATA

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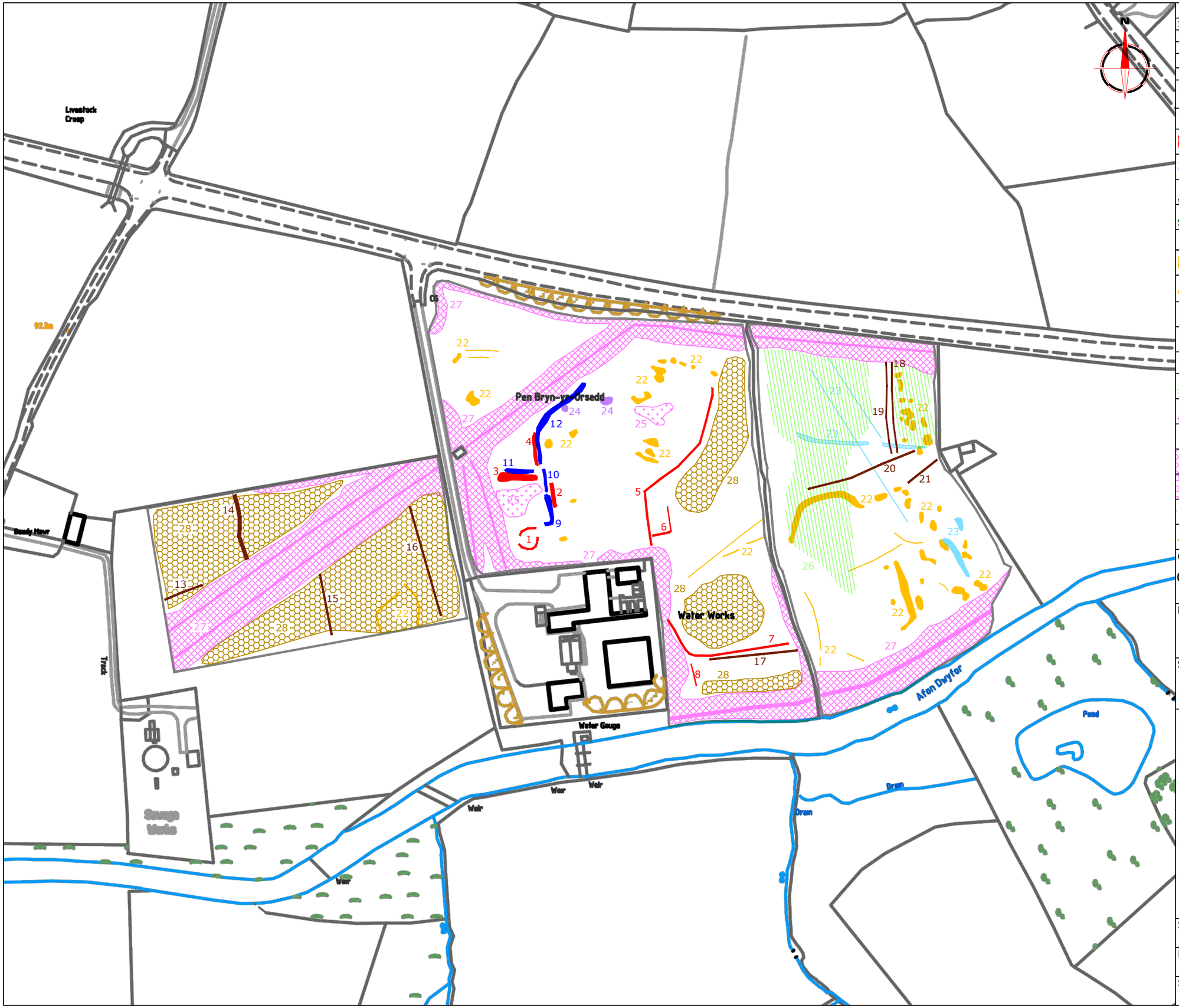
SUMO GROUP MEMBER

Scale 1:2000 (0m 20 40 60 80 100m)

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
FEB 2013	RAJS	08



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

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Client

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GEOPHYSICAL SURVEY - DOLBENMAEN

Subject

ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES

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Scale 1:2000 (0m 20 40 60 80 100m)

Plot	Checked by	Issue No.
A3	DGE	01
Survey date	Drawn by	Figure No.
FEB 2013	RAJS	09