# LAND OFF ST ANNE'S LANE, CWMFFRWD, CARMARTHENSHIRE: GEOPHYSICAL SURVEY





Prepared by Dyfed Archaeological Trust for David Jones





# **DYFED ARCHAEOLOGICAL TRUST**

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# LAND OFF ST ANNE'S LANE, CWMFFRWD, CARMARTHENSHIRE: GEOPHYSICAL SURVEY

By

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# LAND OFF ST ANNE'S LANE, CWMFFRWD, CARMARTHENSHIRE: GEOPHYSICAL SURVEY

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# LAND OFF ST ANNE'S LANE, CWMFFWRD, CARMARTHENSHIRE: GEOPHYSICAL SURVEY

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# LAND OFF ST ANNE'S LANE, CWMFFRWD, CARMARTHENSHIRE: GEOPHYSICAL SURVEY

#### EXECUTIVE SUMMARY

DAT Archaeological Services were commissioned to undertake a geophysical survey on land off St Anne's Lane, Cwmffrwd on land proposed for housing development. The archaeological potential of the site was enhanced because of evidence that the Roman road known as Via Julia Martima passes through the development area.

The geophysical survey has not provided evidence of any certain archaeological features within the development area, nor further evidence for a Roman road.

A possible small square enclosure has been detected that could require further investigation to determine its origin.

#### CRYNODEB GWEITHREDOL

Comisiynwyd Gwasanaethau Archaeolegol YAD i gynnal arolwg geoffisegol ar dir yn agos Heol St Anne's, Cwmffrwd ar dir ar gyfer datblygu tai arfaethedig. Gwellwyd potensial archeolegol y safle oherwydd tystiolaeth bod y ffordd Rufeinig o'r enw Via Julia Martima yn mynd trwy'r ardal ddatblygu.

Nid yw'r arolwg geoffisegol wedi darparu tystiolaeth o unrhyw nodweddion archeolegol sicr o fewn yr ardal ddatblygu, na thystiolaeth bellach ar gyfer ffordd Rufeinig.

Mae lloc sgwâr bach posibl wedi'i ganfod a allai fod angen ei ymchwilio ymhellach i darganfod ei gwreiddyn.

# LAND OFF ST ANNE'S LANE, CWMFFRWD, CARMARTHENSHIRE: GEOPHYSICAL SURVEY

#### 1. INTRODUCTION

#### 1.1 Project Commission

- 1.1.1 DAT Archaeological Services were commissioned by David Jones to undertake a geophysical survey on land off St Anne's Lane, Cwmffrwd, Carmarthenshire (centred on NGR SN 4235 1688; Figure 1). The development area comprises a single enclosed field laid to grass covering an area of approximately 1.2ha within the village of Cwmffrwd.
- 1.1.2 A planning application (Ref No PL/01879) for up to 27 residential dwellings with all matters reserved has been submitted to Carmarthenshire County Council Planning Authority. The Development Management section of Dyfed Archaeological Trust (DAT-DM), in their capacity as archaeological advisors to the planning authority, have recommended that the site should be archaeologically evaluated prior to determination through a phased scheme of investigation.
- 1.1.3 Following discussion with DAT-DM it has been agreed that Phase 1 would be the undertaking of a geophysical survey to determine the likely presence or absence of archaeological remains within the site area. Phase 2 would be needed if potential archaeological remains were identified within the development area following the survey and would comprise a trial trench evaluation. Phase 3 would incorporate any subsequent archaeological mitigation that might be needed at the site, such as archaeological excavation, the redesign of proposals to avoid archaeology or an archaeological watching brief during construction.
- 1.1.4 This report presents the results of the geophysical survey as the first stage of evaluating the site. The results of this survey will inform whether a targeted evaluation of the area is necessary.
- 1.1.5 The results of the geophysical survey should provide further information on the archaeological potential of the site through the identification of subsurface features that could be indicative of archaeology.
- 1.1.6 The geophysical survey was undertaken on 26<sup>th</sup> April 2022 using a fluxgate gradiometer which detects subtle variations in the earth's magnetic field, that can indicate the presence of buried features such as ditches, pits, walls or postholes.

# **1.2.** Scope of the Project

- 1.2.1 The aim of the project was:
  - To identify the presence/absence of any potential archaeological deposits through an initial gradiometer survey.
  - To establish the character and extent of any potential archaeological remains within the site area that could be affected by the proposed works.
  - To prepare a report and archive the results of the geophysical survey.

# **1.3 Report Outline**

1.3.1 This report provides a summary and discussion of the geophysical survey and its results and puts those results within their regional and national context.

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#### 1.4 Abbreviations

1.4.1 Sites recorded on the regional Historic Environment Record (HER) are identified by their Primary Record Number (PRN) and located by their National Grid Reference (NGR). Sites recorded on the National Monument Record (NMR) held by the Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW) are identified by their National Primary Record Number (NPRN). Altitude is expressed to Ordnance Datum (OD). References to cartographic and documentary evidence and published sources will be given in brackets throughout the text, with full details listed in the sources section at the rear of the report.

# 1.5 Illustrations

1.5.1 Printed map extracts are not necessarily produced to their original scale.

# 1.6 Timeline

1.6.1 The following timeline (Table 1) is used within this report to give date ranges for the various archaeological periods that may be mentioned within the text.

Period	Approximate date	
Palaeolithic -	<i>c</i> .450,000 – 10,000 BC	
Mesolithic –	<i>c</i> . 10,000 – 4400 BC	Pre
Neolithic –	<i>c</i> .4400 – 2300 BC	hist
Bronze Age –	<i>c</i> .2300 – 700 BC	orio
Iron Age –	<i>c</i> .700 BC – AD 43	0
Roman (Romano-British) Period –	AD 43 - <i>c.</i> AD 410	
Post-Roman / Early Medieval Period -	<i>c</i> . AD 410 – AD 1086	_
Medieval Period –	1086 - 1536	Hist
Post-Medieval Period <sup>1</sup> –	1536 - 1750	ori
Industrial Period –	1750 - 1899	C
Modern –	20 <sup>th</sup> century onwards	

Table 1: Archaeological and Historical Timeline for Wales

<sup>&</sup>lt;sup>1</sup> The post-medieval and industrial periods are combined as the post-medieval period on the Regional Historic Environment Record as held by Dyfed Archaeological Trust



Figure 1: Site location. © OpenStreetMap contributors.

#### 2. THE SITE

#### 2.1 Site Location, Topography and Historical Background

- 2.1.1 The proposed development was situated on land off St Anne's Lane. The development comprised a single, irregularly shaped enclosed field laid to grass (Photographs 1 and 2) covering an area of approximately 1.2ha within the village of Cwmffrwd.
- 2.1.2 The development site sloped gradually from 76.25m OD in the south to 63.75m OD in the north. The bedrock geology comprised Milford Haven Group Argillaceous rocks and sandstone and conglomerate, interbedded. This is a sedimentary rock formed approximately 318 319 million years ago in the Devonian and Silurian periods in a local environment dominated by rivers.
- 2.1.3 The superficial deposits comprise Till, Devensian Diamicton formed approximately up to 2 million years ago in the quaternary period in local environments dominated by ice age conditions (British Geological Survey).
- 2.1.4 The archaeological potential of the development area was highlighted because of the evidence for a Roman Road passing through the development area (Figure 2). The road is called the Via Julia Maritima (PRN 7459). The line of the road was first observed in 1976, but confirmed from air survey in 1986, by TA James. It appears to be part of a road linking Carmarthen to Loughor taking in Kidwelly. At the time of the survey there were no obvious indications on the ground of the line of the Roman road.
- 2.1.5 LiDAR coverage for the site was made available via Natural Resources of Wales on an open government licence at a resolution of 1.0m. No archaeological features were discernible within the development boundaries.
- 2.1.6 The earliest map source consulted of the development area was the Tithe Map for the Parish of Llandefailog in the County of Carmarthen (1844). The field is shown as a larger area referred to as Cae Saer. No features of archaeological interest were annotated within the development boundaries nor wider area.
- 2.1.7 The OS six-inch map (1887) shows the field boundaries as they are today, and the area depicted as rough ground. All maps produced since this show no change.

Land off St Anne's Lane, Cwmffrwd, Carmarthensire Geophysical Survey



**Photograph 1:** View south across the development site.



**Photograph 2:** View roughly southeast across the development site.

# Land off St Anne's Lane, Cwmffrwd, Carmarthensire Geophysical Survey



Figure 2: Suggested line of the Via Julia Maritima Roman road

#### 3. METHODOLOGY

# 3.1 Data Collection

- 3.1.1 The geophysical survey was conducted by an experienced archaeological surveyor using a fluxgate gradiometer with two sensors at 1m spacing and with a DL601 data logger. The gradiometer's sensitivity was set to detect a magnetic variation in the order of 0.1 nanoTesla.
- 3.1.2 Data was collected within a controlled grid that the surveyors physically marked out on the ground to within 0.1m+/- accuracy. The survey grid was tied into the Ordnance Survey (OS) grid using a Trimble R8s integrated GNSS system with a TSC3 controller.

# 3.2 Ground Coverage

3.2.1 Geophysical survey methods rely on a contrast in the physical properties between buried archaeological remains and the surrounding soil. Therefore, to best characterise archaeological features, it is often necessary to survey a large enough area that not only captures any possible targets but also incorporates a sufficient area of natural background response. Typically, the size of the survey area is constrained by external influences that can adversely impact the survey data (i.e. chain-link fences, telegraph poles, modern field boundaries, etc.). To minimise the effect these can have, up to 5m from field boundaries is maintained during the survey, although a greater distance may be required for larger modern ferrous objects, such as pylons.

#### 3.3 Resolution

3.3.1 Data was collected in 30m x 30m grids using the zigzag traverse method with a sample interval (x-axis) of 0.25m (four readings per metre) and a line separation (y-axis) of 1m.

# 3.4 Data Processing

- 3.4.1 The data was processed using *Terrasurveyor 3.0.36.1* and is presented with a minimum of processing.
- 3.4.2 Typically, the data is "de-striped" to remove any striping effect caused by an imbalance between the two sensors. It is then "clipped" to remove high values caused by ferrous objects, which tend to hide fine details and obscure archaeological features.
- 3.4.3 Other processing functions may include "de-staggering" the data. This is to correct line displacement errors caused by variations in the traversal rate, resulting in the sensors being in the incorrect position when taking a reading. Finally, the data may be "interpolated" followed by a "low pass filter". The gradiometer collects readings every 0.25m along the transect (x-axis) and 1.0m (or 0.25m in the higher resolution surveys), this results in an imbalanced grid, so by interpolating the data and choosing to match the x and y-axis by an increased factor the grid becomes more balanced. The "low pass filter" is used cautiously to smooth the data without removing any evidence for archaeology.

# 3.5 Data Presentation and Interpretation

- 3.5.1 Data is presented with a minimum of processing as a grey-scale plot overlaid on local topographical features. The main magnetic anomalies have been identified using a combination of the grey-scale plots at different stages of processing and XY traces, which aid in interpretation by allowing for visualisation of the magnitude and form of a geophysical anomaly.
- 3.5.2 The results have been compared to available sources (satellite imagery, aerial photographs, historic maps etc.) to increase confidence levels, and an interpretation of the results has been formulated. In some instances, it is possible to provide a very specific interpretation of a geophysical anomaly, such as where its character or form is well documented, its existence was

known of before the survey, or corroborative evidence can be found. In other cases, a broader categorisation of interpretation is required (outlined in Table 2). Often, looking at the results as a whole and the environs within which they sit provides greater context and aids in interpreting individual features.

Archaeological features	
Archaeology	Where the character and form of response are archaeological in origin or corroborative evidence exists (i.e. historical sources, excavation, etc.). These are typically made up of linear/curvilinear/rectilinear anomalies. This category also includes pits with a discernible arrangement, grouping or association with an archaeological feature to suggest an archaeological origin.
Industrial/area of burning	Where an anomaly has a strong magnetic response that could be evidence of kilns, heaths etc, their shape, form and context may aid interpretation. Caution should be observed as often a similar response can be produced from modern ferrous material.
Possible archaeological feature	
Possible archaeology	Where an archaeological response is favoured, but the response is weak or incomplete and lacks any distinguishing characteristics akin to an archaeological feature. This category also includes possible pits with no discernible pattern, grouping or association with an archaeological feature. They may be of archaeological origin, but they are also likely to represent natural features such as tree throws (former root bole of a tree shrub).
Area of enhanced magnetic activity	An area that exhibits increased magnetic variations with no discernible pattern or cause. This may have an archaeological origin or a result of geological variation.
Agricultural features	
Former field boundary	A linear anomaly is often seen as a positive response (bank) flanked either side by a negative (response) ditches. These can usually be attributed to former boundaries depicted on historical maps.
Ridge and furrow	A series of regular linear anomalies with consistent broad spacing. If they run parallel with existing field boundaries this might suggest a recent activity.
Plough lines	A series of regular linear anomalies with consistent narrow spacing. If they run parallel with existing field boundaries this might suggest a recent activity.

**Table 2:** Categories of interpretation for geophysical anomalies.

Field drains	A series of regularly spaced linear anomalies.
Non-archaeological features	
Magnetic interference	An external source that affects the survey data. Usually occurs along the edges of surveys near fences containing ferrous material or around pylons and from subsurface utilities.
Ferrous	These may be associated with an artefact of archaeological interest but generally unless they form a pattern or a part of a larger feature they are regarded as not significant. They are usually the result of miscellaneous modern ferrous-rich debris, such as brick and tile fragments, and objects such as horseshoes or broken ploughshares, which lie within the topsoil and result in a dipole response.
Natural / Geology	These natural variations can cause significant variations in magnetic readings.

#### 4. **RESULTS**

4.1 The geophysical survey results are presented as a grey-scale plot overlaid on a topographical map in Figure 3. The interpretation of the results is provided in Figure 4. In total, an area of 2.25ha was surveyed.

#### Archaeological Features

4.2 No features of clear archaeological origin were identified.

#### Possible Archaeological Features

- 4.3 Trends have been identified within the survey that have ambiguous origins. Their shape tends to be amorphous with no clear archaeological characteristics, making them difficult to interpret and difficult to characterise as archaeological or not. Typically, these are discrete features with no correlation to other identified features, although an archaeological origin is possible the large amount of modern disturbance and interference within the area suggests they too are more recent.
- 4.4 Feature 1, to the north of the survey area, possibly represents an archaeological feature a small, enclosed area demarcated by a low magnetic response. The area is square in shape measuring c. 6m x 6m with several possible pit features within.

#### Non-Archaeological features

#### Magnetic interference

- 4.5 Large areas of magnetic variation can be seen across the survey area with no regular shape or patterning, thus likely caused by modern disturbance.
- 4.6 Discrete dipolar anomalies (ferrous spikes) are frequently seen throughout the survey area. These are likely caused by ferrous material on or within the surface of the topsoil such as horseshoes and ploughshares etc.
- 4.7 Typically where magnetic interference occurs around the edges of the survey area it is because the survey has encroached near field boundaries that contain metallic items. This can be seen in several places along the edges of the eastern and northern boundaries of the survey.

# 5. SUMMARY OF RESULTS

- 5.1 The geophysical survey at land off St Anne's Lane in the village of Cwmffrwd has not identified any anomalies or features of definite archaeological origin. Specifically, no evidence of the projected roman road through the development site has been observed.
- 5.2 A small possible enclosure has been identified to the north of the survey area that may be archaeological, but any distinct characteristics are unclear. Further investigative archaeological works would be required to ascertain the character of this anomaly.



Figure 3: Grey-scale plot of the geophysical survey results.

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Figure 4: Interpretation plot of geophysical survey results.

#### 6. SOURCES

CIfA, 2014 Chartered Institute of Field Archaeologists Standards and Guidance for Archaeological Geophysical Survey

National Standard and Guidance for Collecting and Depositing Archaeological Archives in Wales 2017. <u>http://www.welshmuseumsfederation.org/en/news-archive/resources-</u> <u>landing/Collections/national-standard-and-guidance-for-collecting-and-</u> <u>depositing-archaeological-archives-in-wales-2017.html</u>

#### **Online resources**

British Geological Survey, n.d. *Geology of Britain viewer* [online] available at <<u>http://mapapps.bgs.ac.uk/geologyofbritain/home.html</u>> Accessed 14<sup>th</sup> February 2020

#### **APPENDIX I:**

# LAND OFF ST ANNE'S LANE, CWMFFRWD, CARMARTHENSHIRE -

#### PLANNING APPLICATION PL/01879

#### WRITTEN SCHEME OF INVESTIGATION FOR GEOPHYSICAL SURVEY

#### 1 Introduction

- 1.1 This Written Scheme of Investigation (WSI) presents a proposed methodology for a geophysical survey within an area proposed for the development of 27 residential dwellings on land off St Anne's Lane, Cwmffrwd, Carmarthenshire (centred on NGR SN 4234 1687; Figure 1). The site comprises an enclosed arable field covering an area approximately 1.2ha within the village of Cwmffrwd.
- 1.2 A planning application (Ref No PL/01879) for up to 27 residential dwellings with all matters reserved has been submitted to Carmarthenshire County Council Planning Authority. The Development Management section of Dyfed Archaeological Trust (DAT-DM), in their capacity as archaeological advisors to the planning authority, have recommended that the site should be archaeologically evaluated prior to determination through a phased scheme of investigation commencing with a geophysical survey.
- 1.3 Following discussion with DAT-DM it has been agreed that the scheme of works at the site should use a phased approach. Phase 1 would be the undertaking of a geophysical survey to determine the likely presence or absence of archaeological remains within the site area. Phase 2 would be needed if potential archaeological remains were identified within the development area following the survey and would comprise a trial trench evaluation. Phase 3 would incorporate any subsequent archaeological mitigation that might be needed at the site, such as archaeological excavation, the redesign of proposals to avoid archaeology or an archaeological watching brief during construction.
- 1.4 The archaeological potential of the development area is raised because of the evidence for a Roman Road passing through the development area (Figure 1). The road is called the Via Julia Maritima (PRN 7459). The line of the road was first observed in 1976, but confirmed from air survey in 1986, by TA James. It appears to be part of a road linking Carmarthen to Loughor taking in Kidwelly.
- 1.5 The results of the geophysical survey should provide further information of the archaeological potential of the site through the identification of subsurface features which could be indicative of archaeology. Using a gradiometer, a rapid scan of the site area will be undertaken, which through the measurement of tiny variations in the earth's magnetic field, can indicate the presence of buried features such as ditches, pits, walls or postholes, which are not visible on the ground surface.
- 1.6 The survey will be carried out using a fluxgate gradiometer, which detects variations in the earth's magnetic field. Reading will be taken at a medium resolution on traverses 1.0m wide and every 0.25m within a 30m x 30m grid across the field. A Trimble TST will be used to tie the survey grid into the local Ordnance Survey grid. This resolution enables a relatively speedy survey to be carried out (using a single gradiometer and team of two) and provides good results, assuming that the geology of the area will be conducive to gradiometer survey and that the site does not contain obstructions that would make an even walking pace impossible.
- 1.7 This Written Scheme of Investigation is in accordance with the relevant Institute for Archaeologists Standard and Guidance for archaeological geophysical survey (Chartered Institute for Archaeologists (CIfA 2014).

- 1.8 The Trust always operates to best professional practice. DAT Archaeological Services has its own Health and Safety Policy, and all works are covered by appropriate Employer's Liability and Public Liability Insurances. Copies of all are available on request.
- 1.9 **Dyfed Archaeological Trust is a CIfA Registered Organisation**.
- 1.10 All permanent staff members of DAT Archaeological Services are CSCS<sup>2</sup> registered.

# 2 AIM AND OBJECTIVES OF THE PROJECT

2.1 This document provides a scheme of works for:

#### The implementation of a geophysical survey within the development area on and off St Anne's Lane, Cwmffrwd, Carmarthenshire. A report and archive of the results will be prepared.

- 2.2 The general aims of the overall archaeological investigations are:
  - To determine the presence or absence of archaeological deposits or remains,
  - To record the character, date location and preservation of any archaeological remains
  - on site that are affected by the proposed new works,
  - To record the nature and extent of any previous damage to archaeological deposits or
  - remains on site in the area of the new works.
- 2.3 The specific aims of the investigation are:
  - To undertake a geophysical survey using gradiometer of the entire development area,
  - To determine the likely presence or absence of any archaeological remains within the
  - proposed development area,
  - To establish the character and extent of any potential archaeological remains within the
  - site area that could be affected by the proposed works;
  - To inform the need (or otherwise) for any future archaeological works on the site by
  - means of an illustrated report on the geophysical survey.
- 2.4 The objectives of the project are:
  - to undertake work in accordance with national best practice and guidelines,
  - to archaeologically record through geophysical survey, any deposits, features or
  - structures of significance,
  - to analyse any remains with reference to the existing documentary evidence for

<sup>&</sup>lt;sup>2</sup> Construction Skills Certification Scheme (Health and Safety Tested)

- historical development and land use,
- to produce a written account to include: summary; site description; anomaly
- descriptions, possible interpretation and conclusions,
- Provide an ordered archive.
- 2.5 The following tasks will be completed:
  - Provision of a Written Scheme of Investigation to outline the methodology for the geophysical survey which DAT Archaeological Services will undertake (this document);
  - To identify the presence/absence of any potential archaeological deposits through gradiometer survey;
  - To use the information obtained to design a specification for future mitigation at the site, which will enable any identified remains to be appropriately investigated and recorded where they will be affected by the proposed development.



**Figure 1:** Location map of development area (outlined in red) showing the line of the Roman road (PRN 7459). Location plan provided by client.

# **3 GEOPHYSICAL SURVEY METHODOLOGY**

- 3.1 The results of the geophysical survey should provide further information of the archaeological potential of the site through the identification of subsurface features which could be indicative of archaeology. The aim of the survey is to assess, characterise and locate surviving below ground archaeology.
- 3.2 A localised site grid using 20m x 20m or 30m x 30m grids will be established and marked out physically on the ground to within 0.1m+/- accuracy. The survey grid

will be tied into the Ordnance Survey (OS) grid using a Trimble R8s integrated GNSS system with TC $\pounds$  controller.

- 3.3 A fluxgate gradiometer will be used for the survey, which detects subtle variations in the earth's magnetic field. Technical information is given in Appendix I at the end of this document.
- 3.4 Data is collected using the zigzag traverse method within each grid with a sample interval (x-axis) of 0.25m (four readings per meter) and a line separation (y-axis) of 1.0m. The line separation is reduced to 0.5m traverses if greater resolution is required.
- 3.5 Ground coverage is important to aid with interpretation and as large of a survey area as practicable possible will be surveyed. But efforts will be made to keep a suitable distance from external ferrous sources that could impact adversely upon the results.
- 3.6 The data will be processed using *Terrasurveyor 3.0.36.1* and presented with a minimum of processing as a grey-scale plot. The main magnetic anomalies will be identified and plotted onto the local topographical features.
- 3.7 The survey results and interpretation diagrams should not be seen as a definitive model of what lies beneath the ground surface, not all buried features will provide a magnetic response that can be identified by the gradiometer. In interpreting those features that are recorded the shape is the principal diagnostic tool, along with comparison with known features from other surveys. The intensity of the magnetic response could provide further information, a strong response for example indicates burning, high ferric content or thermoremnancy in geology. The context may provide further clues but the interpretation of many of these features is still largely subjective.
- 3.8 All measurements given will be approximate as accurate measurements are difficult to determine from fluxgate gradiometer surveys. The width and length of identified features can be affected by its relative depth and magnetic strength.
- 3.9 The interpretation diagrams will be used to identify the presence/absence of any potential archaeological deposits and features and will help decide whether further archaeological investigation is necessary in this area.
- 3.10 The interpretation diagrams will be used to identify the presence/absence of any potential archaeological deposits and features and will help decide whether further archaeological mitigation is necessary in this area, following discussions with the archaeological advisor to the planning authority.

# 4 **POST-FIELDWORK REPORTING AND ARCHIVING**

- 4.1 An archive will be prepared if it meets the requirements of the Dyfed Archaeological Trust archive retention policy (2018). If it does, then data recovered during the evaluation will be collated into a site archive structured in accordance with the specifications in Archaeological Archives: a guide to best practice in creation, compilation, transfer and curation (Brown 2011), and the procedures recommended by the National Monuments Record, Aberystwyth. The National Standards for Wales for Collecting and Depositing Archaeological Archives produced by the Federation of Museums and Art Galleries of Wales will also be adhered to. Digital archives will be collated using the Royal Commission on the Ancient and Historical Monuments of Wales systems (2015) and deposited with the RCAHMW. The Guidance for the Submission of Data to the Welsh Historic Environment Records (HERs) shall be followed.
- 4.2 The results of the fieldwork will be assessed in local, regional and wider contexts.

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- 4.3 The results will be used to inform subsequent design considerations of the proposed development so that they can aim to avoid impacts upon any archaeological remains or that further archaeological mitigation can be implemented before such remains are disturbed.
- 4.4 A summary of the project results, excluding any confidential information, may be prepared for wider dissemination (e.g. Archaeology in Wales and special interest and period-specific journals).
- 4.5 The report will be prepared to follow the Standard and Guidance for Archaeological Geophysical Survey (CIFA S&G: AWB 2014).
- 4.6 Digital copies of the report will be provided to the client, as well as the Dyfed Archaeological Trust Development Management.

# 5 STAFF

- 5.1 The project will be managed by Fran Murphy MCIfA.
- 5.2 The on-site works will be undertaken by experienced archaeologists, from DAT Archaeological Services.

# 6 QUALITY ASSURANCE

- 6.1 DAT Archaeological Services has considerable experience of undertaking all categories of archaeological fieldwork and always operates to best professional practice; adhering to CIfA guidelines where appropriate. The Trust is a Registered Organisation with CIfA and all staff abide by their code of conduct and adhere to their relevant standards and guidance.
- 6.2 DAT Archaeological Services operate robust internal monitoring procedures that ensure that the standard of each project is maintained from commencement to completion.

# 7 MONITORING

- 7.1 The fieldwork may require monitoring by the archaeological advisor to the planning authority, Dyfed Archaeological Trust Development Management, who should be told of the commencement of the works. The fieldwork may also need to be monitored by the Head of DAT Archaeological Services.
- 7.2 All parties should be provided with free access to the site at any time during the geophysical survey.

# 8 HEALTH AND SAFETY

- 8.1 All permanent members of staff should be CSCS registered.
- 8.2 Service information should be obtained prior to the start of the works.
- 8.3 A health and safety risk assessment must be prepared prior to the works commencing to ensure that all potential risks are minimised.
- 8.4 The site staff will go through the health and safety risk assessment prior to works commencing and all site staff must sign the document to confirm that they have read, understood and will comply with the document.
- 8.5 All site inductions, H&S procedures, H&S constraints and site rules of the client or any on-site contractor should be made known to the archaeological staff at the start of the works.
- 8.6 All relevant health and safety regulations must be followed, including compliance with Welsh Government guidelines on working practices during the current Covid-19 Pandemic, and guidance issued by CIFA.

- 8.7 CIfA recommends that ROs should ensure that their own risk assessments and local site operating procedures take account of <u>Prospect's COVID-19 site working advice</u> (updated 4 May).. If the site cannot operate in line with this guidance it must not open or continue to stay open.
- 8.8 The project risk assessment should detail the precautions put in place to reduce the spread of Covid-19 coronavirus during fieldwork.
- 8.9 Safety helmets, high visibility vests and boots are to be used by all site personnel as necessary. The developer will make all site staff aware of any other PPE that may be required.
- 8.10 Working with machinery: all staff must ensure that their presence on site is communicated to all relevant site contractor staff, especially the machine operator. The archaeologist observing the topsoil stripping by machine will establish a safe working procedure with the machine operator at the start of work. This will include explaining the purpose of the works itself and the method by which the trenches shall be machined. This will include ensuring that the machine driver is aware that topsoil is stripped carefully to avoid disturbing archaeology. This will also include discussing the methodology for safe working, ensuring that no machining is done without an archaeologist being present.

#### 9 ARBITRATION

9.1 Any dispute or disagreement arising out of a contract in relation to this work shall be referred for a decision to the Chartered Institute of Archaeologist's arbitration scheme.

# **APPENDIX I – TECHNICAL INFORMATION**

The survey will be carried out using a Bartington Grad601-2 dual Fluxgate Gradiometer, which uses a pair of Grad-01-100 sensors. These are high stability fluxgate gradient sensors with a 1.0m separation between the sensing elements, giving a strong response to deeper anomalies.

The instrument detects variations in the earth's magnetic field caused by the presence of iron in the sub-surface material. This is usually in the form of weakly magnetised iron oxides, which tend to be concentrated in the topsoil. Features cut into the subsoil and backfilled or silted with topsoil therefore contain greater amounts of iron and can therefore be detected with the gradiometer. There are also other processes and materials that can produce detectable anomalies. The most obvious is the presence of pieces of iron in the soil or immediate environs, which usually produce very high readings. Features such as hearths or kilns also produce strong readings because fired clay acquires a permanent thermo-remnant magnetic field upon cooling.

The Bartington Grad601 is a hand-held instrument and readings are taken automatically as the operator walks at a constant speed along a series of fixed length traverses. The sensor consists of two vertically aligned fluxgates set 1.0m apart. Their Mumetal cores are driven in and out of magnetic saturation by an alternating current passing through two opposing driver coils. As the cores come out of saturation, the external magnetic field can enter them producing an electrical pulse proportional to the field strength in a sensor coil. The high frequency of the detection cycle produces what is in effect a continuous output (Clark 1996).

The gradiometer can detect anomalies down to a depth of approximately one metre. The magnetic variations are measured in nanoTeslas (nT). The earth's magnetic field strength is about 48,000 nT; typical archaeological features produce readings of below 15nT although burnt features and iron objects can result in

changes of several hundred nT. The instrument is capable of detecting changes as low as 0.1nT.

The gradiometer includes an on-board data-logger. Readings in the surveys will be taken along parallel traverses of one axis of a grid made up of 30m x 30m squares. The traverse intervals will be set 0.5m apart. Readings are logged at intervals of 0.25m along each traverse giving 3200 readings per grid square (medium resolution on 0.5m traverses),

A Trimble GPS will be used to set out the survey grid and to tie the survey grid into the local Ordnance Survey grid. The grid will be marked out with the use of temporary bamboo canes and small plastic pegs. All markers will be removed from site once the surveys are complete.

Processing will be performed using *TerraSurveyor 3.0*. The data will be presented with a minimum of processing. The presence of high values caused by ferrous objects, which tend to hide fine details and obscure archaeological features, will be 'clipped' to remove the extreme values allowing the finer details to show through.

The processed data will be presented as grey-scale plots overlaid on local topographical features. Raw data and trace plots (x-y) will also be provided. The main magnetic anomalies will be identified and plotted onto the local topographical features as a level of interpretation.

The resulting survey results and interpretation diagrams should not be seen as a definitive model of what lies beneath the ground surface, not all buried features will provide a magnetic response that can be identified by the gradiometer. In interpreting those features that are recorded the shape is the principal diagnostic tool, along with comparison with known features from other surveys. The intensity of the magnetic response could provide further information, a strong response for example indicates burning, high ferric content or thermoremnancy in geology. The context may provide further clues but the interpretation of many of these features is still largely subjective.

All measurements given will be approximate as accurate measurements are difficult to determine from fluxgate gradiometer surveys. The width and length of identified features can be affected by its relative depth and magnetic strength.

The interpretation diagrams will be used to identify the presence/absence of any potential archaeological deposits and features and will help decide whether further archaeological mitigation is necessary in this area, following discussions with the archaeological advisor to the planning authority.