

GEOPHYSICAL SURVEY AT STRATA FLORIDA ABBEY, CEREDIGION



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February 2009

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Project metadata	
Survey Name	Geophysical Survey at Strata Florida Abbey
Survey Purpose	To conduct magnetometry survey in 4 separate areas in vicinity of abbey remains.
Spatial Coverage	centred on SN 747654
Country	Wales, UK
Duration	February 2009
Weather	Snow, frost.
Soil condition	Well drained
Land use	Pasture
Monument type	Cistercian abbey precinct.
Monument period	12th century
Survey Director	Jemma Bezant
Geophysical surveyors	Jemma Bezant, Roderick Bale, Robert Williams-Day.
Client	Cadw
Survey Type	Magnetometer
Instrumentation	Bartington magnetic gradiometer Grad601/2
Area surveyed	18.3 acres
Method of coverage	30 x 30 metre grids walked in zig-zag format
Traverse interval	1m
Sample interval	0.125m
Spatial accuracy	Grid layout to within \pm 10cm. Geolocation onto base maps to \pm 1 metre.
Sample accuracy	Automatic trigger whilst walking, 0.1 nT sensitivity
Data Files	Raw data deposited with client. Each grid is recorded as ascii data (xyz) in DAT file format. Metadata for each grid is recorded separately as text in HDR file format.
Digital treatment	Downloaded as xyz format via Grad601 v.3. Each grid

	imported into Archeosurveyor and clipped to around ± 6 nT. De spiked, adjusted for striping and cropped in Adobe Photoshop CS3. Composites bitmaps retained in TIF file format.
Grid pegs	Ca Gwair SN 74570 65787 and 74303 65863, Hen Fynwent SN 74849 65799 and 74776 65708, Fagwrn y Dwr SN 74696 65860 and 74638 65852.
Geolocation	Survey grid positions recorded using total station survey (Leica TPS1200) then geolocated to OS Landline map base via ArcMap v9.2

Summary

Dr Jemma Bezant was contracted to carry out a fluxgate gradiometer survey at Strata Florida Abbey on behalf of Cadw. Previous surveys (Bezant 2007) to the meadow surrounding the abbey site had been carried out by the Department of Archaeology and Anthropology, University of Wales, Lampeter producing good results and the methodologies established in that project have been adopted for the present survey.

Scope

This report details the methods and results of a geophysical survey. It is customary to provide an interpretation of the results and this is provided here but in the form of a technical, rather than a research report; the implication and analysis of the interpretations remains to be met elsewhere.

Acknowledgements

Thanks must go to the landowners; Dai and Eleri Arch. The field survey team worked extremely hard, often in blizzard conditions! Thanks go to Roderick Bale, Nigel Nayling and Robert Williams-Day.

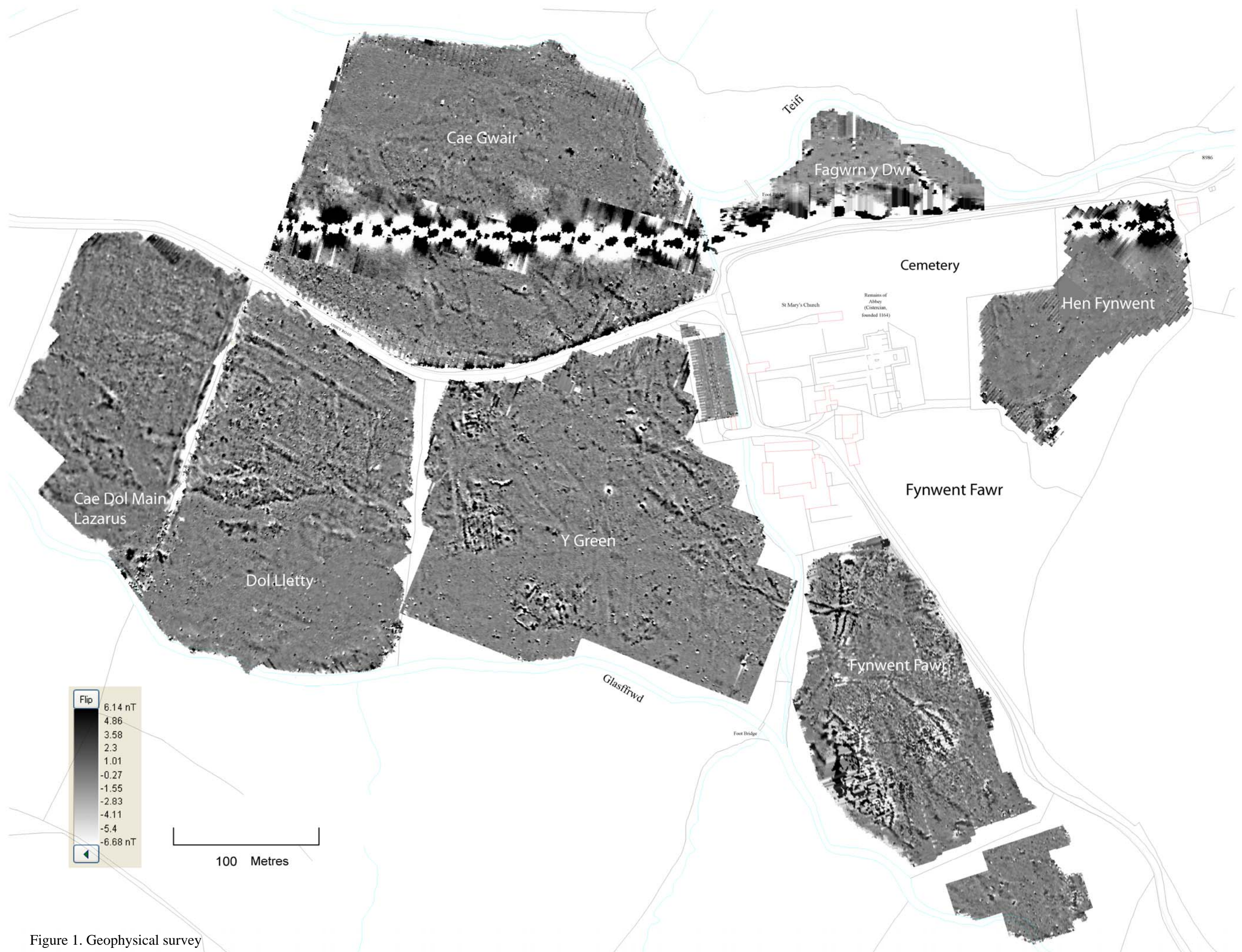


Figure 1. Geophysical survey



Figure 2. Interpretation

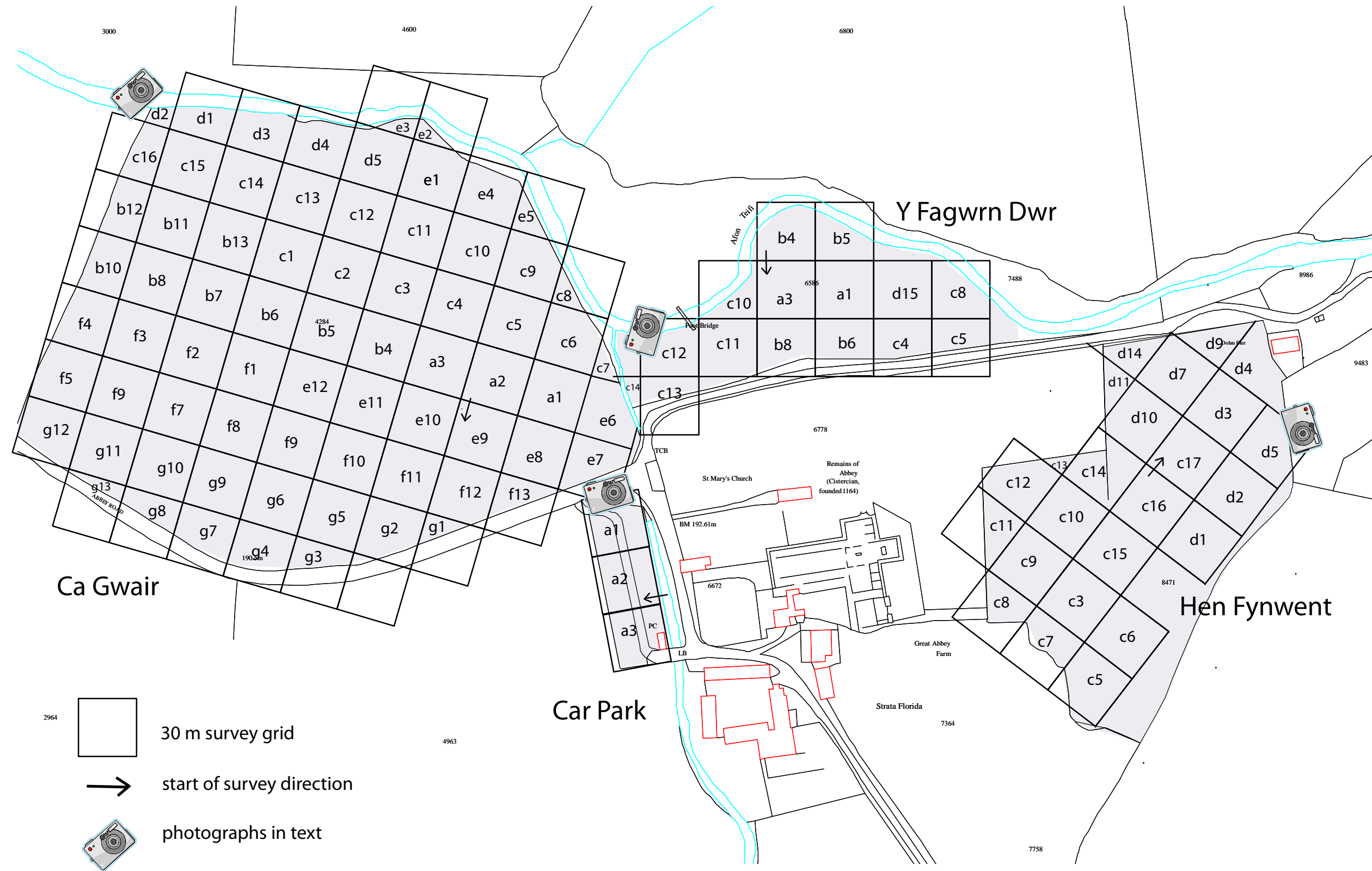


Figure 3. Grid locations

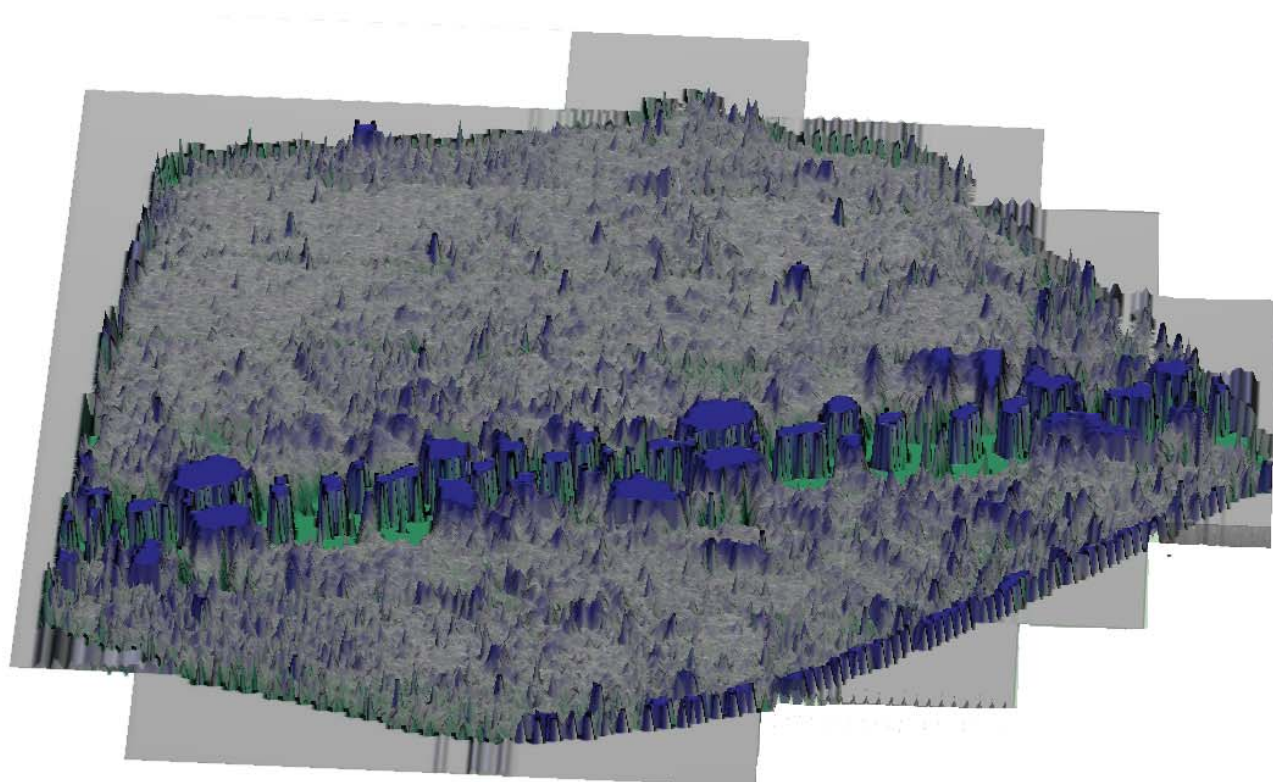


Figure 4 Ca Gwair 3D trace

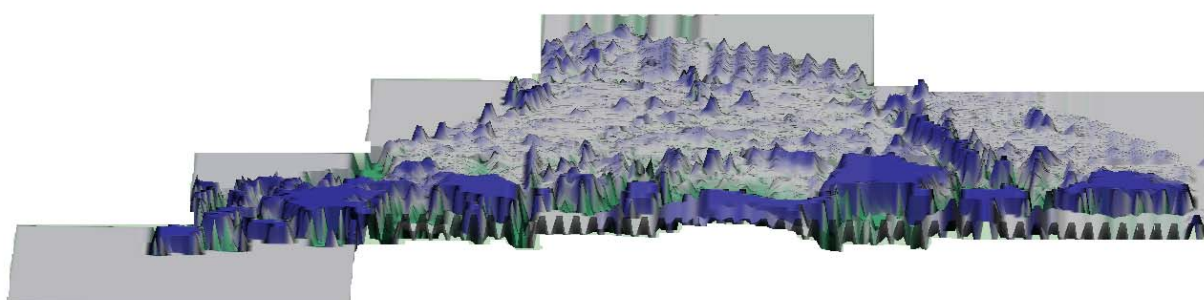


Figure 5 Fagwrn y Dwr 3D trace

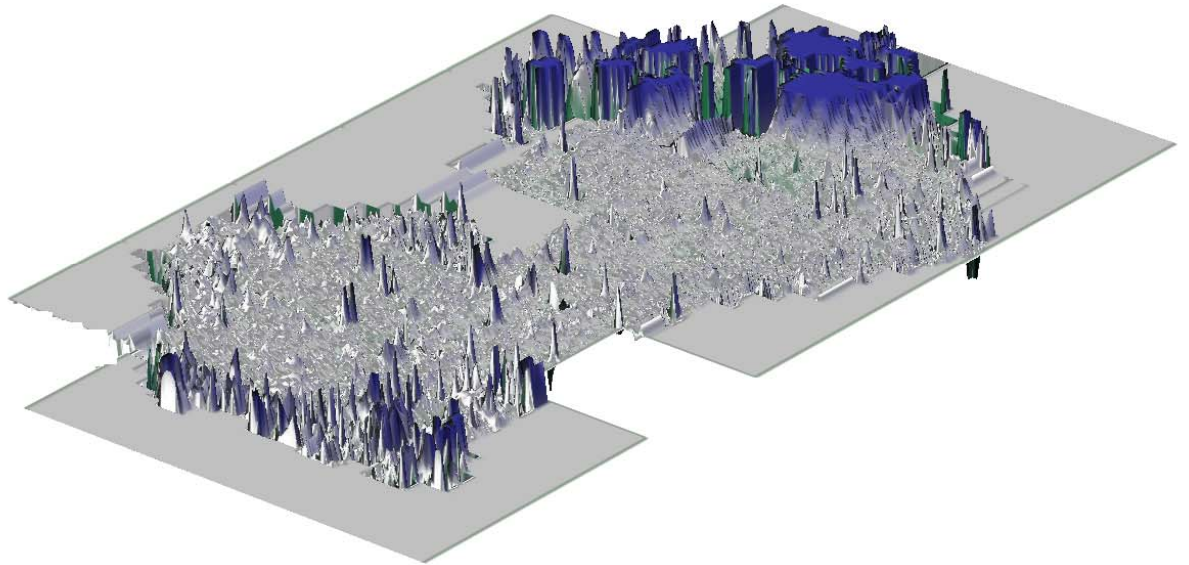


Figure 6 Hen Fynwent 3D trace

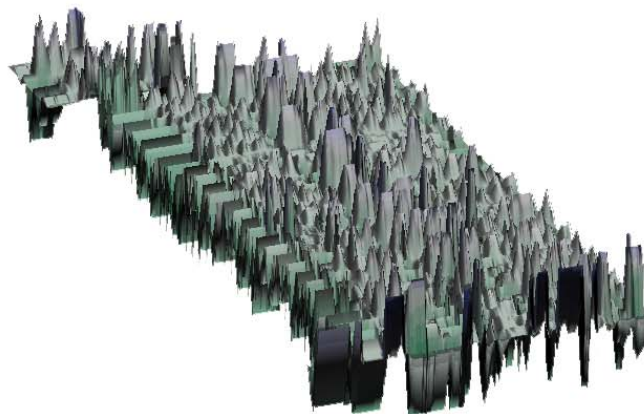


Figure 7 Car Park 3D trace

1 The Site

The Cistercian Abbey of Strata Florida SN 747654 is sited in the upper reaches of the Teifi Valley in Ceredigion, west Wales, just north-east of the small market town of Tregaron. The abbey was founded sometime in the late 12th century and came under the patronage of Rhys ap Gruffudd, the powerful ruler of the Welsh Kingdom of Deheubarth. It became the largest monastic estate in Wales and the vast upland Cambrian sheepwalks stretched as far east as Rhayader. The abbey site today is part of an active rural agricultural community providing leisure and spiritual pursuits for a wide audience. The site was far from remote. Its position at the hub of many upland routes but with good access to coastal granges was no accident and the abbey was well-placed to exploit the wider landscape and to manage and perhaps redistribute surplus from their demesne centre.



Fig 8 Location map

The Teifi anticline region is characterised by Silurian mudstones and sandstones (Bowen 1994). A recent report (Hartnup 2008) commissioned by University of Wales, Lampeter's Department of Archaeology and Anthropology looked in detail at the soil types surrounding the abbey. Two of the four areas surveyed, Ca Gwair and Y Fagwrn Dwr, lie on the wet Teifi alluvium (Conway series) whilst areas closer to the conventual remains; Yr Hen Fynwent and the car park area carved out of Y Green, are on slightly higher, flat and well-drained brown earths of the Reidol series.

1.2 Background and Context: Remote sensing in the Strata Florida Environs

Wide ranges of physical and historical data have been generated since the inception of the Strata Florida Research Project by the Department of Archaeology and Anthropology in 2004. A series of evaluatory excavations in and around the abbey precinct have formed part of a teaching programme over several fieldwork seasons under the direction of Professor David Austin. During the summer of 2007, an area of 35 acres within the abbey's southern precinct area were geophysically surveyed in order to define the extent and character of any subsurface features. The southern precinct area was targeted because it has already formed the focus of excavation and survey for a number of seasons. For example, an 18th century estate map indicated the presence of a building complex along the abbey approach road. Excavation confirmed the presence of structural remains and the geophysical survey has clarified the extent and character of two other substantial building complexes in this field (Y Green). The results of that project will be combined with this survey to provide a complete geophysical survey of the immediate abbey's vicinity.

2. Methodology

This project has been conducted in accordance with English Heritage (1991) guidelines for geophysical survey. A total of 18.3 acres were surveyed over four separate areas. A base line was established along the longest axis of each of the four survey areas and these were marked by two permanent pegs in order to allow for any subsequent reconstruction of the survey grid. The base line was laid out to encompass the maximum extent of each field and at an oblique angle to any expected archaeological alignments to allow survey across, rather than along, any linear features. Total station (Leica TPS1200) *stakeout* function was then employed to accurately ($\pm 10\text{cm}$) locate the corners of each 30 metre grid square, perpendicular to the base line. The corners of each grid square were marked with temporary wooden canes and further survey of field boundaries, roads and buildings for instance were used to locate the grid to Ordnance Survey base maps. This method of total station grid layout greatly reduced overall survey time and increased accuracy over the larger survey areas. Whilst an investment in the expertise necessary to operate such technology is necessary, the benefits over manual, hand tape methods are vastly increased grid accuracy, especially over large survey areas such as Ca Gwair. (NB this method was not used for instance in the car park area which was small, complex and the expectedly poor results precluded the investment in setting up the total station). With any type of field survey there is always a tension between the level of precision required and the time and resource spent achieving it. As such, the survey location maps provide an accurate location of subsurface features but with a maximum error tolerance of ± 1 metres within each individual grid. This is because the method of ‘walking’ survey employed by this kind of geophysical technique itself is only as accurate as the operator’s judgment along each 30 metre traverse and can typically generate errors along each traverse of up to 1 metre in the traverse direction. It is usually recommended therefore that excavation of any archaeological features is preceded by a higher resolution geophysical survey carried out using the excavation grid to allow for the utmost accuracy. In practice this is usually forgone and a degree of tolerance is accepted.

The survey was carried out using a Bartington Grad601 which is a magnetic gradiometer in the dual configuration to allow for rapid and accurate survey. Each sensor assembly contains two fluxgate magnetometers with a one metre vertical separation providing an enhanced depth response. This technique is ideal for the prospection of 'noisy' archaeological areas that might contain built structures with both domestic occupation and industrial activity. It is also capable of detecting more subtle features such as ditches and former river channels.

Each 30m grid was surveyed at a traverse interval of 1m with a sampling interval of 8 readings per metre in a zig-zag format in order to give high resolution results. The Grad601 includes an on-board datalogger and data were downloaded as tab delimited ascii data in xyz format via the Grad601 data download software (v316). A copy of the raw data in this format has been deposited with the client. The data were processed using Archeosurveyor2 and was subsequently adjusted to reduce striping and de-spiked to remove spuriously high 'iron spikes' ¹. The data are reproduced here as greyscale bitmaps of readings clipped to a range of around ± 6 nT (nanotesla). The readings are presented with positive magnetic responses shown in black and negative responses as white. The signal produced by ferrous metallic objects go from a positive to negative reading over a very short space producing a 'spike', in the data characterised by a black-white signal. The character of such an object remains unknown and may be medieval or modern but similar positive readings without the familiar bipolar responses can be useful to determine areas of burning or firing at high temperatures for example. The greyscale bitmaps were cropped using Adobe Photoshop CS3 and were exported as gif file formats. This allowed the positioning of adjacent survey plots without overlap at corners and edges. This positioning was effected via ArcMap v9.2 where the surveys have been accurately geolocated (typically ± 1 metre) onto the Ordnance Survey Landline basemap.

¹ A large diameter water main serving the reservoir upstream at Llyn Teifi Lakes through the survey area. This has corrupted the data considerably making data processing and the identification of features to within 15 metres problematic.

3. Results

The approach road to the abbey currently runs centrally along the valley and it was two fields to the north of this, Ca Gwair and Fagwrn Y Dwr that were surveyed as well as an area to the rear of the abbey cemetery at Y Hen Fynwent plus the current visitors car park in front of the abbey which represents an intake from Y Green. This amounts to 18.3 acres over four separate areas and, along with previous survey, completes the immediate vicinity of the abbey itself ².

3.1 Ca Gwair



The water pipeline is the most visible feature of the project, running east-west centrally through Ca Gwair (*hay field*) and can actually be seen in oblique light as a slight linear rise. This facility was constructed during the first half of the 20th century and we can only speculate on the possible disruption of archaeological features during

² Part of Hen Fynwent to the immediate south of the abbey remains unsurveyed at this time. It comprises earthwork and rubble piles thought to relate to the clearance and excavation of the abbey since the 19th century. This field has also been used in the recent past for agriculturally 'noisy' purposes; tipping, digging and dumping and, as such, would be a poor candidate for magnetic survey. However, aerial survey and excavation to a built feature to the extreme south of this area indicate a high likelihood of medieval buildings and other activity and it is also likely, given the remnant footprint of the cloister range that part of the conventual buildings extend into this area.

this work. This field is level and gently undulating, falling only slightly to the north and the Teifi river. A former river channel is visible across the north-western corner of the field and this corner is also relatively quiet in terms of survey ‘noise’. Historically it seems, activity was away from the water’s edge and was concentrated more strongly along its southern edge and boundary with the road and can be seen as a series of irregular linear features radiating into the field from the road area.

3.2 Fagwrn y Dwr

The name of this field suggests the presence of a built structure as *fagwr* is derived from *magwyr* meaning ‘wall’ but which is also often applied to the ruinous remains of old buildings. The presence again of the water pipeline running along the inside of the hedgeline, parallel to the road, precludes the identification of any archaeological features within this narrow field. The course of a relict river channel has produced a strongly positive bipolar response and it is possible that this is due to run-off from ore processing in this lead-rich area or may be indicative of another form of industrial processing.



3.3 Yr Hen Fynwent

Hen Fynwent or old cemetery extends beyond the current cemetery, east towards Cornwall Fach bungalow which itself is on the site of a possible medieval building



depicted as a gatehouse-type structure on an 18th century estate map (NLW 1765 uncatalogued Nanteos estate map). Unfortunately, the area closest to the bungalow has also been disturbed by the water pipeline plus domestic drainage and waste water provision. A modern stone wall runs part-way north-south across Hen Fynwent and acts as an extension to the modern cemetery though presumably the medieval burial grounds were situated here also and enclosed. Archaeological activity appears to be mostly confined to the area in the west, closest to the abbey. A series of dark, irregularly linear responses appear to be negative features, perhaps ditch features. A faint negative response, again on the same alignment as the current boundary enclosures around the abbey also appears faintly on the ground as a slight rise and this would be a possible candidate for early enclosure bank or wall or other stone-built structure.

3.4 The car park

The current car park represents an area taken from Y Green and is fenced and partially tarmaced. A toilet block building is also present with its associated services and these, along with the expected ‘noise’ one would expect of such a high traffic area has precluded successful magnetic survey. This is unfortunate: sited close to, and

directly in front of the abbey entrance, the expectation of archaeological features remains quite high and we must expect a continuation or intensification of the kind of subsurface activity seen in less-disturbed areas of Y Green.



4. Conclusions

Beyond the footprint of the water pipeline, the survey has produced clear results and, with the 2007 (Bezant) survey, successfully completes the geophysical investigation of the abbey vicinity. Monastic occupation appears to be largely focussed in the immediate vicinity of the abbey especially on the well-drained soils of Y Green where three substantial building complexes lie to the west ('occupation zone'). The wetter soils within Ca Gwair and Y Fagwrn Dwr (and parts of Cae Dol Main Lazarus and Dol Llety) seem to have precluded any similar stone-built buildings but more ephemeral structures cannot be ruled out, nor can we be sure about anything in the path of the water pipeline. These areas outside the main occupation still demonstrate considerable activity ('activity zone') which might be related to agriculture, horticulture, manufacturing or any other type of activity associated with a busy medieval abbey.

5. References

Bezant, J. 2007 Geophysical Survey at Strata Florida Abbey, Henfynachlog Farm and Troedyrhiw Upland Settlement, Ceredigion. *Archaeology in Wales* **47**.

Bowen, D. Q. 1994 The Land of Cardiganshire. In Davies, J. L. and Kirby, D. P. 1994 *Cardiganshire County History Volume 1. From the Earliest Times to the Coming of the Normans*. Cardiff: Cardiganshire Antiquarian Society & RCAHMW on behalf of the University of Wales Press.

English Heritage 1991 *Geophysical Survey in Archaeological Field Evaluation*, English Heritage Research & Professional Guidelines.

Hartnup, R. 2008 *Soils of the land surrounding Strata Florida Abbey*. Unpublished client report.