

Tannery site, Machynlleth
Geophysical Survey Report (Radar)
Produced for Clwyd-Powys Archaeological Trust

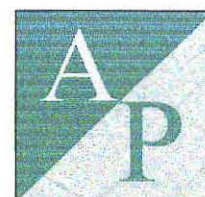
MTR071

24th January

M Lafuente
M Roseveare

January 2008

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Date passed to HER -
Confidential until -
Added to CPAT bibliography? -
Project area digitised? -
Ready for filing (record complete)? -~~



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Confidential until -
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Project area digitised? -
Ready for filing (record complete)? -

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Mapping Our Heritage



Non-Technical Summary

ArchaeoPhysica was commissioned by the Clwyd-Powys Archaeological Trust on behalf of the Museum of Modern Art (MOMA) to undertake a systematic radar survey inside the building known as 'The Old Tannery', located in Maes Glas area and identified as a tannery on the Ordnance Survey 1st edition map of 1889. The survey was intended to detect and record buried structures related to the tannery, such as pits and drains, before the restoration works in the building start. In addition a radar profile was undertaken outside the building to determine the location of five pits depicted on early mapping.

The early mapping depicted an L-shape building, partly enclosing a yard area with five tanning pits, and documentation suggests that it was built c. 1819. The 2nd edition of the Ordnance Survey map (1901) still depicted the building but did not identify it as a tannery, suggesting that the business had ceased. Today, only the southern range of the building survives.

The use of the radar technique permitted the location of anomalies beneath the present floor of the building, identifiable with a previous floor and archaeological structures above and beneath it. Some of these anomalies could be identified with pits used in the tanning industry and two others could be drains. Examination of the external and internal structure of the building, as well as material visible in a hole cut into the floor, permitted approximate depths to be assigned to some of these features.

January 2008



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1 Introduction

Location

Country	Wales
County	Powys
Nearest Town	Machynlleth
Landholding	Building plot

Parties involved

1.1 The Clwyd-Powys Archaeological Trust (CPAT) commissioned ArchaeoPhysica to undertake geophysical survey of 'The Old Tannery' at Maes Glas in Machynlleth on behalf of the Museum of Modern Art at Y Tabernacle. They hope to convert the building into mixed gallery and workshop space on two floors.

1.2 We would like to acknowledge the support of Nigel Jones, Senior Project Archaeologist at CPAT, throughout this work.

Purpose

1.3 The primary purpose of the survey is to investigate the floor of the existing building and to locate the tannery pits outside it, which were depicted on an early map (1889). At the time of commissioning it was not known what might lay beneath the modern concrete floor which clearly rests upon a substantial depth of modern fill in at least the western part of the building.

Summary of methodology

Instruments & survey resolution

1.4 It was agreed between CPAT and ArchaeoPhysica that survey would be undertaken by means of Ground Penetrating Radar at the highest resolution possible in the time available, essentially one day of fieldwork.

1.5 The system used was the GSSI SIR-3000 radar, with a spatial resolution of 0.02m along lines 0.5m apart and a depth (time window) of 70ns. Two antennae were used: 400MHz both along the short and the long axis of the building, and 270MHz just along the long axis. In the event the data from the 270MHz was found to be influenced by some external source and also lacked sufficient vertical resolution. It has not been used in this report as the 400MHz was found to be adequate.

1.6 High pass and low pass filters were applied during the collection of data, at 200MHz and 800MHz frequencies for the 400MHz antenna, and at 135MHz and 540MHz, for the 270MHz antenna.

1.7 The set out of the survey grid was achieved using tapes as the distances inside the building were small enough to avoid significant error. This was tied into the south wall of the building, the origin being the internal southwest corner. Nigel Jones of CPAT kindly provided his ground plan to use for the analysis and display of the radar data.

Constraints & variations

1.8 There were no departures from the agreed methodology.

1.9 The apparent depths of structures may vary due to the nature of the overburden. This, and the potentially very inhomogenous fill of large features, can make depth estimation approximate. Materials with significant water content will attenuate the signal and depth penetration may be reduced. This is likely where the pits are rock-cut and trap groundwater or contain residual organic material. Where the antenna cannot maintain a flat position in close contact with the ground the data quality may be reduced.



2 Context

Archaeology

2.1 There is no direct evidence of the presence of tanning structures beneath the present floor of 'The Old Tannery' building, but the desk-assessment made from direct correspondence with Nigel Jones, which provided background information about the tanning industry in Machynlleth based on L. A. Leigh 2007, J. G. Jenkins 1973 and H. R. Procter 1914, early cartography, and plans of other 19th century tanneries in Wales suggests that these kind of features could have existed. These could be pits for lime in which hides were soaked to remove hair and residual flesh and the stones or benches over which hides were rubbed to scrape off flesh.

2.2 According to Nigel Jones, the building could have been built in 1819, from a date stone 'John Williams 1819', and was definitely in use in 1889, but not in 1901.

2.3 The Ordnance Map 1st edition (1889) depicts an L-shaped building in the same location were 'The Old Tannery' building is, and a courtyard in its northern side, which contains five tanning pits. It is defined as a tannery on that map, but not in the Ordnance Map 2nd edition (1901), suggesting a cessation in the tanning activity.

2.4 A test pit recently dug next to the inner face of the masonry blocking the door located in the southern wall of the building, facing Wesley Lane, allowed us to measure the thickness of the present concrete floor and to check the nature of the material immediately underneath it, which is 80cm of rubble material. This smells strongly of tannery waste although why this is the case for this material is not totally clear.

2.5 The only visible remains of the depicted building are its southern range, part of the western wall of the eastern range and the courtyard. The northern wall of the standing building contains five doors and four louvered windows above them, which are aligned with the external pits. The doors on the ground floor seem to connect the inside of the building with the courtyard and the five depicted external tanning pits.

2.6 Externally there is a small blocked opening at the base of the south wall near the west end and below the threshold level of the blocked door. For the purposes of the report it has been assumed to be the remains of a drain because a continuation of the structure was found internally and its situation below floor level makes this likely.

Environmental

Weather

2.7 As this survey was conducted mainly inside the building and within foundations that probably penetrate deep into the soil the subsurface is likely to remain fairly independent of weather conditions. The response of the ground to the radar is therefore likely to be fairly constant over time.

Topography

2.8 The concrete floor of the building is modern and slightly raked towards the centre for drainage, however, not significantly so. It is raised at least 80cm above the door threshold from Wesley Lane but is slightly lower than the courtyard level to the north. The floor level throughout the building is level.

2.9 This hides a complexity in that both the courtyard and the western room have been partly filled with demolition rubble from the east range which was removed some years ago. The depth to the original courtyard surface is not known and the level of the tannery floor in the western room only approximately so. The radar data has been able to inform upon the latter and also that the tannery floor in the central room is much higher. This may be confirmed by the height of the blocked doorway between the two rooms.



2.10 The surface of the courtyard contained rubble and slate stones, which were an impediment to undertake a detailed radar survey of the whole area. Instead, a single profile was taken but with a debateable result.

Hydrology

2.11 Natural drainage is southwards past the building but also slightly to the west. There is a stream or major drain beneath the road east of the tannery buildings and it is thought that Wesley lane may once have contained an open sewer (Nigel Jones, *pers comm.*). The rock is very close to the surface where observed so surface water most likely predominates in the vicinity of the buildings, however, ground flow where it exists will be impeded by foundations and trapped within filled tannery pits. The potential for waterlogging and preservation of material in slightly acidic groundwater may be quite high within the tannery courtyard.

Geology and soils

2.12 The bedrock is the local slate with a slight inclination of the bedding in the area of the tannery and little if any inclusions or veining visible. It is thus unlikely to reflect radar as the bedding planes are too finely separated and we would expect it to be a net absorber of radiation.

2.13 The soils are described by the National Soils Research Institute as freely draining acid loamy soils over rock, however, their relevance is limited as all of the area surveyed is known to be made ground, probably directly over rock. The fact that they are acid does however suggest that hair and hide may have been preserved.



3 Discussion

Results

3.1 For an explanation of the data processing see [Process Documentation](#) in the appendices.

Archaeological evidence

3.2 The radar data suggests the existence of four different phases in the occupation of the building. The most recent one is a layer of late filling material, approximately 80cm thick, which can be seen in the test pit recently excavated (Slices 1 to 7: 0m - 0.74m).

3.3 Anomalies [3 – 5](#) seem to represent weak reflectors close to the concrete floor and may represent sinkage voids below this. It should be noted that all but the shallowest data from the central room is relatively uniform and it is thought that this represents the slate rock, much closer to the modern floor level in this room than the western. This would help to explain why the blocked door opening between these rooms is almost normal height despite the depth of fill to the west. Central within the northern part of this room is apparently a metal mass [6](#) that might represent the remains of some sort of structure. It has been interpreted as metal because it shields the ground beneath it from the radar.

3.4 Against the west gable of the western room is anomaly [1](#) which has proved enigmatic. It appears to be a spurious reflection off the underside of the staircase as it mirrors its form in terms of distance from the antenna. However, we cannot be entirely certain.

3.5 The second phase lies underneath this fill and covers the third phase which is identified as contemporary with operation of the tannery. It contains traces of structure that may be contemporary with the tannery or post-date it, e.g. linear [2](#) which appears to be the base of a wall dividing the interior of the west room. It is identifiable in slices 8 to 11: 0.71m - 1.14m and from this it would appear that the floor of the tannery is approximately 1m below the modern surface, plus or minus 0.1m. The exact date and function of this possible wall is unknown but it could be part of the tannery structure.

3.6 The third phase contains anomalies identifiable with archaeological remains related to the tannery and can be considered to represent materials set onto and into the tannery floor. It can be identified as the floor of the western room and the deposits immediately below, including probable drain [10](#) and perhaps another, a little deeper, at [11](#). It is a 50cm thick layer that starts at approximately 1m below the surface and contains different high amplitude anomalies which could be identified with tannery structures, slices 12 to 21: 1.11m - 1.65m.

3.7 Three linear anomalies [7 - 9](#), parallel to each other, and other slightly squared anomalies appear in the third phase but may not relate to the operation of the tannery because they overlap the fill within the tannery pits. It is not known what these represent, except that each is a strong reflector and likely to be a contrasting material with the fill around them. Masonry would exhibit this response though interpretation as such remains conjecture.

3.8 Underneath this layer, high amplitude anomalies [12 – 17](#) suggest the presence of archaeological remains beneath the tannery floor, identifiable as the fills of six pits excavated into the bedrock, slices 22 to 30: 1.62 - 3.03m. The three dimensional form of these is complex and reflects significant variations in the fill material, however, they appear to become more uniform at depth. It should be noted that the northern fills [12](#), [13](#) and [16](#) appear quite differently to the southern, with much stronger reflections throughout their depth which suggests a more variable nature. The southern fills are more uniform by comparison. The fill is likely to be rubble although residual hides cannot be ruled out if the fill is waterlogged.

3.9 The pits are marked by six slightly squared anomalies in the deepest levels, which are organised in two rows of three along the East – West walls of the building, and are parallel to the row of five pits located in the courtyard to the north, according to OS map 1st edition (1889). Each has a size that seems a multiple of a whole number of imperial feet, mostly five or six. They are undoubtedly elements of the tanning process though exactly what is open to conjecture. The

fact that there are no pits in the eastern room might imply that this structure was related to the preparation of the hides and as it communicates directly with the western room perhaps these pits represent an early stage in the overall process.

3.10 The profile conducted with the 270 MHz antenna outside the building and across the line of the pits depicted in 1889 confirms that reflections do occur at depth and that the pits are likely to survive in approximately the location depicted on the maps. However, the data is not sufficiently clear to offer further diagnostic information although we will continue to examine it. The impression is not of a series of pits but rather one large excavation which was presumably subdivided in use.

Caveats

3.11 Geophysical survey is literally that, a systematic measurement of some physical property related to the earth. There are numerous sources of disturbance of this property, some due to archaeological features, some due to the measuring method, and others that relate to the environment in which the measurement is made. No disturbance, or 'anomaly', is capable of providing an unambiguous and comprehensive description of a feature, in particular in archaeological contexts where there are a myriad of factors involved.

3.12 The measured anomaly is generated by the presence or absence of certain materials within a feature, not by the feature itself. Not all archaeological features produce disturbances that can be detected by a particular instrument or methodology. For this reason, the absence of an anomaly must never be taken to mean the absence of an archaeological feature. The best surveys are those which use a variety of techniques over the same ground at resolutions adequate for the detection of a range of different features.

3.13 Where the specification is by a third party ArchaeoPhysica will always endeavour to produce the best possible result within any imposed constraints and any perceived failure of the specification remains the responsibility of that third party.

3.14 Where third party sources are used in interpretation or analysis ArchaeoPhysica will endeavour to verify their accuracy within reasonable limits but responsibility for any errors or omissions remains with the originator.

3.15 Any recommendations are made based upon the skills and experience of staff at ArchaeoPhysica and the information available to them at the time. ArchaeoPhysica is not responsible for the manner in which these may or may not be carried out, nor for any matters arising from the same.

Recommendations

3.16 There are no recommendations to be made except that if the courtyard could be cleared and the rubble levelled off or capped then further radar survey is likely to reveal any further pits buried beneath the modern fill and within the demolished east range.

Bibliography

Jenkins, J. G., 1973. "The Rhaeadr Tannery", National Museum of Wales, Welsh Folk Museum.

Leigh, L. A., 2007. "Yr Hen Danerdy: The Old Tannery. A History of the Leather Industry in Machynlleth, 1610-1900", Montgomeryshire Collections 95, 103-110.

Procter, H. R., 1914. "The Making of Leather", Cambridge: Cambridge University Press.



Appendices

Survey metadata

Project information

Project Name	The Old Tannery, Maes Glas Machynlleth
Project Code	MTR071
Client	Clwyd-Powys Archaeological Trust
Fieldwork Dates	13/12/07 - 14/12/07
Personnel – field	Martin Roseveare, Anne Roseveare, Maria Lafuente
Personnel – processing	Maria Lafuente
Personnel – reporting	Maria Lafuente, Martin Roseveare
Draft Report Date	24/01/08
Final Report Date	25/01/08

Location

Country	Wales
County	Powys
Nearest Town	Machynlleth
Landholding	Building plot south of Maes Glas and north of Wesley Lane
Central Co-ordinates	N/A

Environmental data

Geology – Soil	N/A - made ground and concrete floor
Geology – Parent	Ordovician: Bala, Llandeilo and Arenig beds
Topography	Fairly level
Hydrology	Free draining
Current Land Use	Within and adjacent to building
Historic Land Use	Tannery
Vegetation Cover	N/A
Sources of Interference	None conclusively identified

Geodetic data

Projection	Orthogonal
Co-ordinate System	Local, metric
Bearing	N/A
Precision	0.02m
Instrument Used	Tapes
Reference Points	SW internal corner of western room of south range, at floor level
References Definition	N/A

Process documentation

Radar

Measured Variable	Reflected energy (with time)
Instrument	SIR3000 plus appropriate frequency antenna(e)
Configuration	
QA Procedure	Static test (unrecorded) – result normal for 400MHz, possible external interference at 270MHz
Data Source Format	GSSI SIR-3000 DZT



3.17 Data was processed using GPR Slice 5.0 by importing each profile, examining each pre-stack and then stacking with a final cell size of 0.1m and thickness of 17 samples (2.3ns). Orthogonal profiles at 0.5m centres were combined into a single stack.

3.18 The stack was visualised as a horizontal time (i.e depth) sequence, sliced in various directions and also as 3D volumes isolated by reflection amplitude. Between these, the 3D form of each reflection was examined and these grouped to form features which could then be interpreted in an archaeological sense. Individual profiles were examined as raw data and with constant time events removed ('background' removal).

3.19 No filtering or similar processing of the data was necessary beyond the bandpass filter applied during acquisition.



Archive data

Introduction

3.20 ArchaeoPhysica maintains an archive for all its projects, access to which is permitted for research purposes. Copyright and intellectual property rights are retained by ArchaeoPhysica on all material it has produced, the client having full licence to use such material as benefits their project.

3.21 Access is by appointment only. Some content is restricted and not available to third parties. There is no automatic right of access to this archive by members of the public. Some material retains commercial value and a charge may be made for its use. An administrative charge may be made for some enquiries, depending upon the exact nature of the request.

General description

3.22 The archive contains all survey and project data, communications, field notes, reports and other related material including copies of third party data (e.g. CAD mapping, etc) in digital form. Many are in proprietary formats while report components are available in PDF format.

3.23 In addition, there are paper elements to some project archives, usually provided by the client. Nearly all elements of the archive that are generated by ArchaeoPhysica are digital.

File types

Extension	Associated Software or Format Information	Example Content
.38b	Geomar TrackNav38b format	EM38B downloads
.823	Geomar TrackNav823 format	Magnetometer downloads
.asc	Geomar TrackNav conversion format	Data downloads
.bin	Geometrics MagMap2000 (version specific)	Magnetometer downloads
.csv	ASCII comma-separated data	Various data files
.ctm	GPR-Slice internal data format	GPR topographic corrections
.dat	Generic ASCII data (may not be human readable)	Magnetometer downloads, GPR profiles & slices
.doc	Microsoft Word document (Office 97 and newer)	Report documents
.dwg	Autodesk AutoCAD format (version specific)	Plans & digitised maps
.dxf	ASCII Drawing eXchange Format	Plans & digitised maps
.dzt	GSSI RADAN (version specific)	GPR data (profiles)
.dzt	GPR-Slice internal data format	GPR data (profiles)
.grd	Golden Software Surfer 7 binary or ASCII grid	Survey data
.html	ASCII HyperText Markup Language file	Report files, web pages
.info	APrad conversion parameter format	GPR profile metadata
.inv	RES2DINV format	ERT inversion files
.ivp	RES2DINV parameter format	ERT inversion metadata
.log	GPR-Slice log file format	GPR profile and slice metadata
.map	Manifold GIS 6.5 and newer (version specific)	Project data
.mdb	Microsoft Access document (Office 97 and newer)	Database files
.mdi	Microsoft Office Document Imaging format	Report documents
.mrk	GPR-Slice internal mark data	GPR data positioning
.pdf	Adobe Acrobat Format (version 6 and newer)	Report files
.r15	Geoscan Research RM15 download (sequential ASCII)	Data files
.shp	MapInfo vector data	Shape file output
.srf	Golden Software Surfer document (version 8)	Project data
.stn	Geometrics MagMap2000 ASCII data	Processed magnetic data
.txt	Generic human readable ASCII data	Notes etc.
.xls	Microsoft Excel document (Office 97 and newer)	Spreadsheet files
.xml	AP System or Manifold GIS	Logs, palettes, MS .NET files

3.24 The files listed above represent the usual content of digital archives held by ArchaeoPhysica.



Dissemination

3.25 It is the client's responsibility to ensure that reports are distributed to all parties with a necessary interest in the project, e.g. local government offices, including the HER where present. ArchaeoPhysica reserves the right to display data from projects on its website and in other marketing or research publications, usually with the consent of the client. Information that might locate the project is normally removed unless otherwise authorised by the client.



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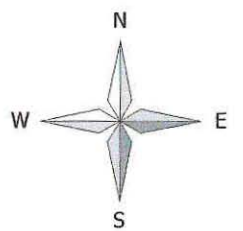
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**The Old Tannery
Machnynlleth**

MTR071

DWG 01

Location of GPR profiles

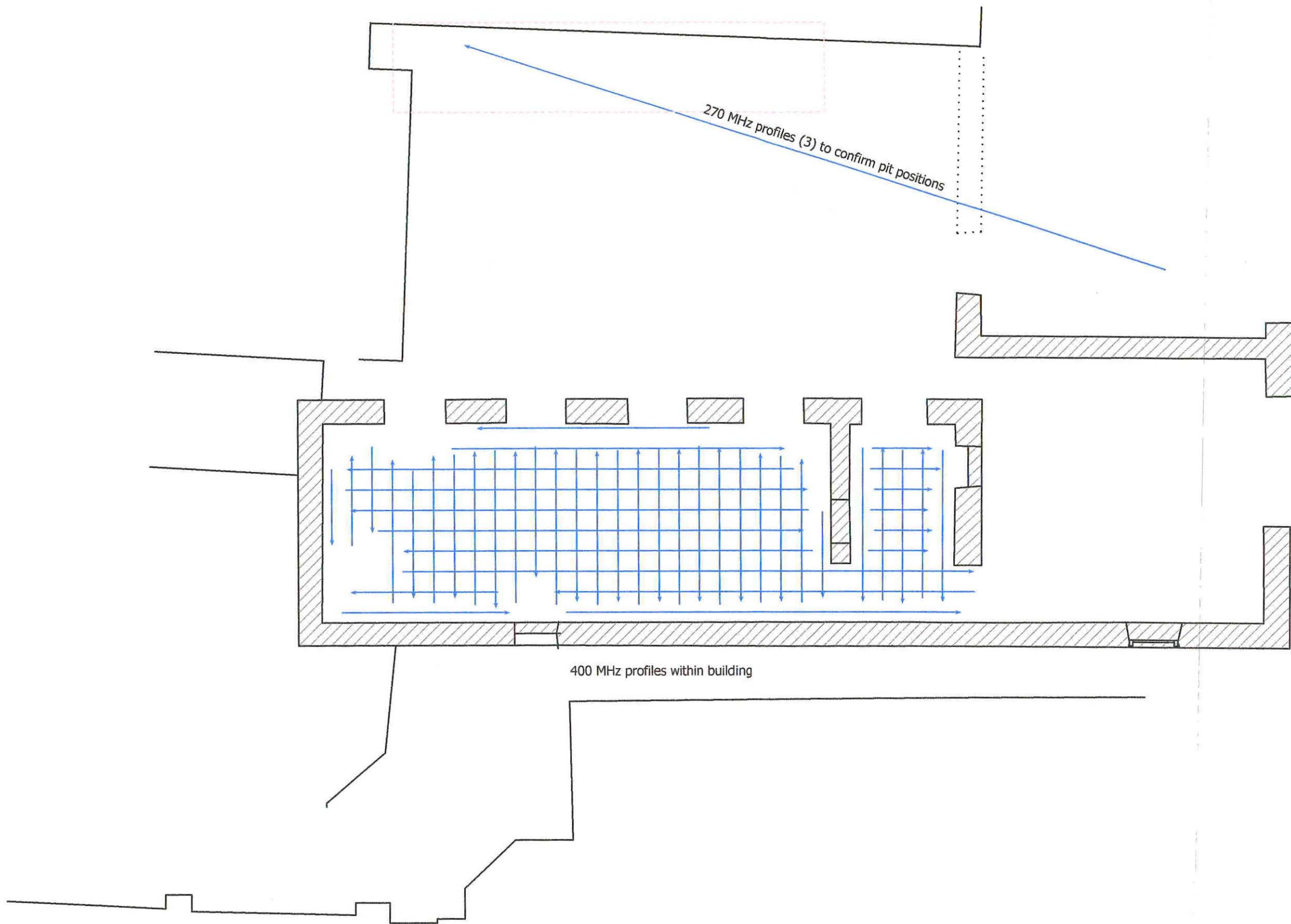


Orthographic
Centre X: 7.84 m
Centre Y: 3.35 m

Scale: 1:100 @ A3
Spatial Units: Meter

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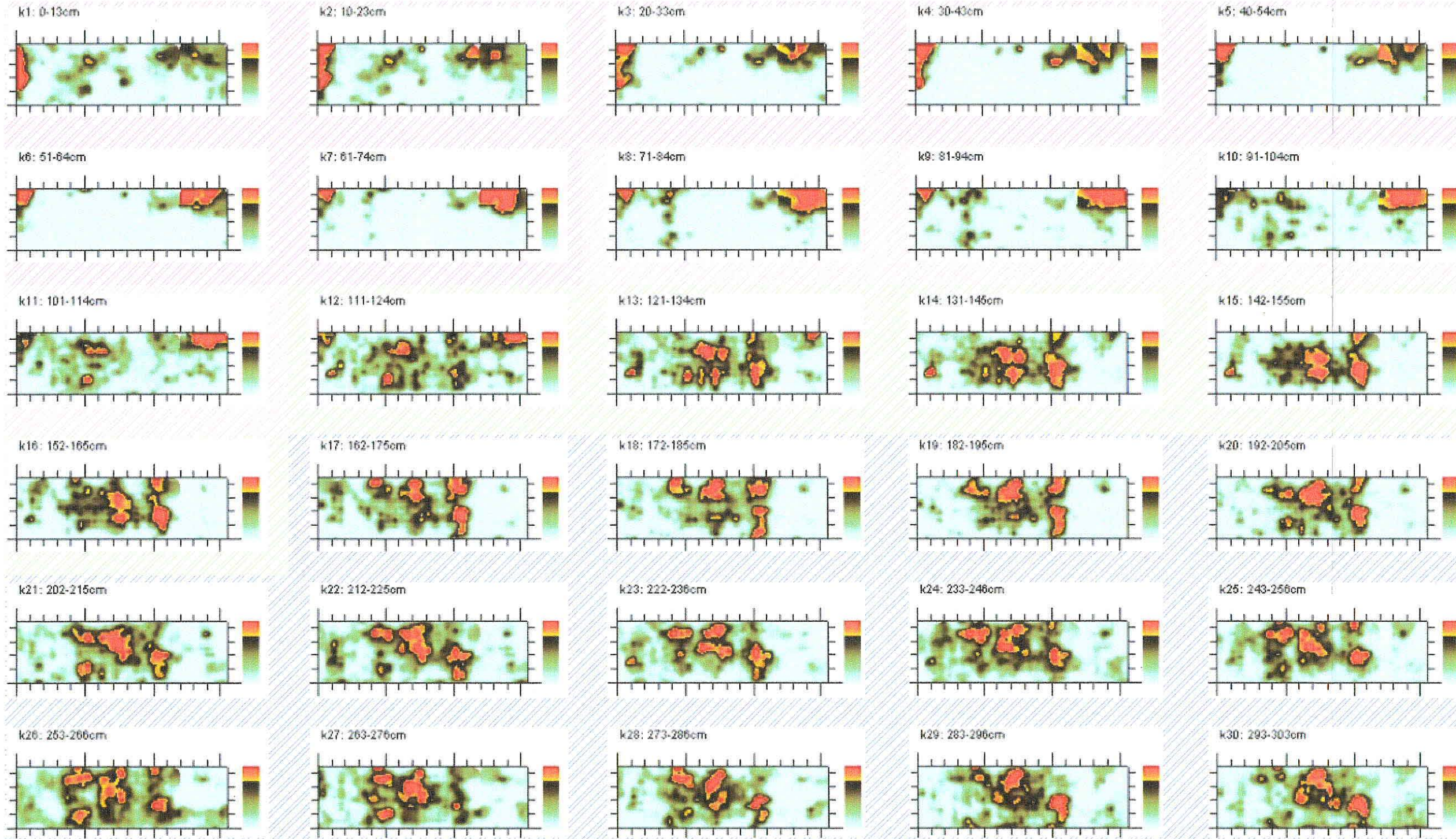
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Machnynlleth

MTR071

DWG 02

Horizontal Amplitude
Slices



Slice Sets

Coloured by basic context
post-tannery fill

base of post-tannery fill

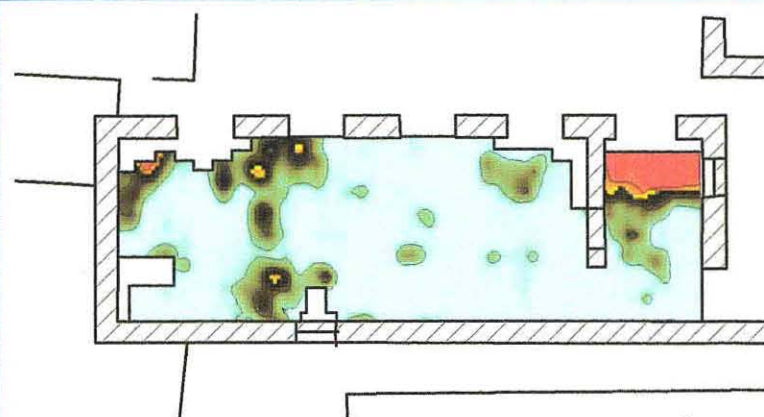
on and into tannery floor

below tannery floor and into rock

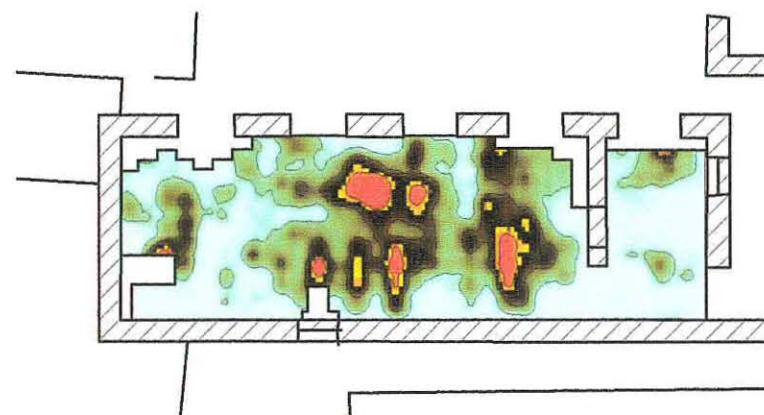
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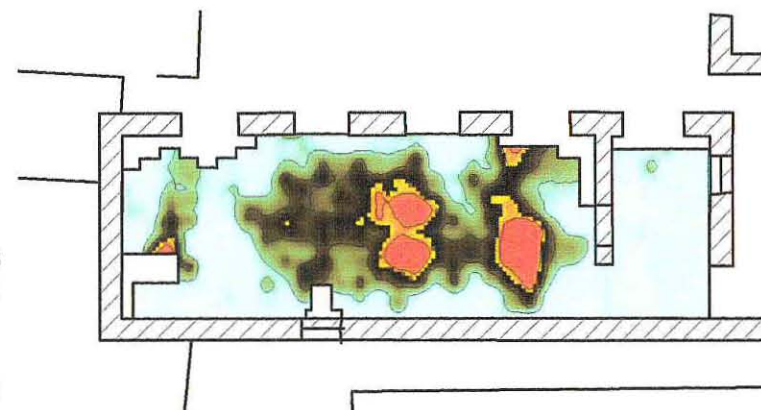
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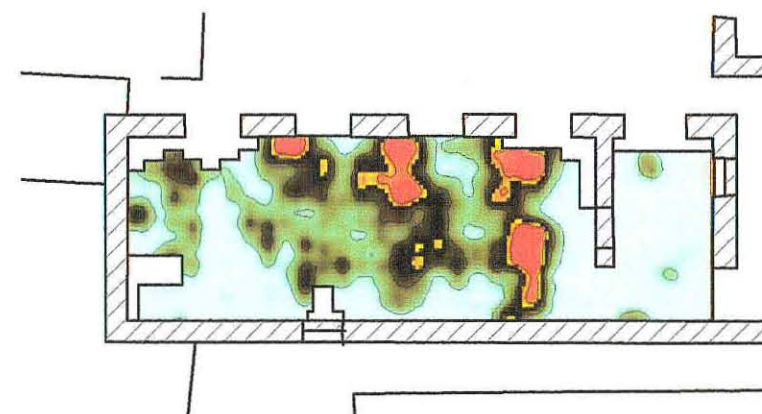
81 - 94 cm depth
above tannery floor



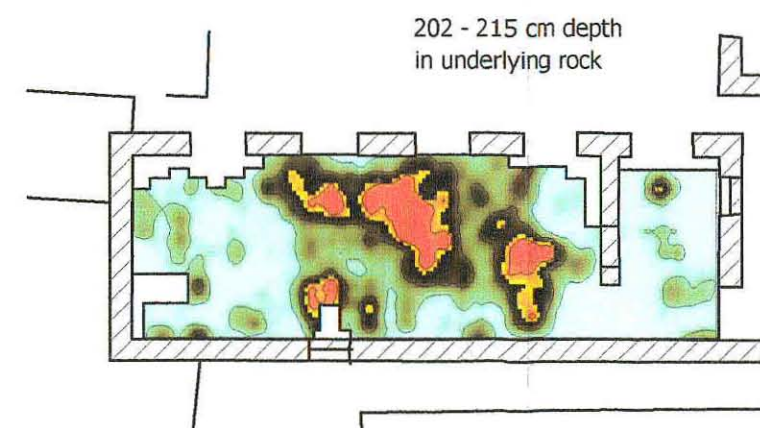
121 - 134 cm depth
at and just below tannery floor



142 - 155 cm depth
below tannery floor



162 - 175 cm depth
below tannery floor



202 - 215 cm depth
in underlying rock

The shallowest slice is through the fill material supporting the concrete floor and as expected from observation of an exposed section it is a fairly uniform material with the odd larger inclusion or metal object apparent as variation from the pale blue colour representing low reflection intensity. Just to the left of the blocked doorway in the south wall can be seen a linear reflector that is most probably a thin dividing wall. It doesn't pass below the tannery floor so could represent an addition after disuse. The reflection in the northwest corner is spurious and seems to be a reflection from the underside of the stairs. In the eastern room a strong reflection near the north wall may represent a rubble fill or perhaps the upper surface of the bedrock.

By 120cm depth the radar has imaged through the tannery floor and is 'seeing' reflections off thin bar-like structures in the floor and the uppermost fills of the tanning pits which are just becoming visible as a disturbed area central within the building. The low response in the eastern room confirms that the rock in here is much higher and probably immediately beneath the tannery floor, itself similar to the existing level.

These pits become more visible with depth where they contrast strongly with the rock into which they are cut. Strength of radar reflection is a measure of inhomogeneity thus these fills are inhomogeneous, perhaps layers of different materials. The third and fourth slices show variations corresponding to six pits grouped with four central to the western room and a further pair between these and the eastern room. More clear images of the pits themselves are presented elsewhere in the report. It is notable how little space must have been available inside the room; there is no more than 1m between the southern doorway and the southwestern pit.

The fifth slice at 2m below the present floor can be fairly safely assumed to be within the rock and penetration by the radar was to around 3m. At this depth the relatively uniform nature of the bedrock is evident except within the centre of the survey where the fills of the pits create a zone of disturbance. This zone should not be taken to suggest the pits are interlinked, merely that dispersal of the radar beam at this depth means horizontal resolution is limited and the edges of the individual pits cannot be resolved.

The five slices shown display the change in reflected wave intensity with increasing time and hence depth. A basic calibration of time with respect to depth has been made using visible features of the building. Each slice is made up of 17 averaged samples through a volume 2.3ns (equating to about 13cm) thick. At 400MHz this is a little over half a wavelength in the ground which is nearing the limit of vertical resolution. If the tannery floor was thinner than this, perhaps slate flags, it would not itself be resolvable.



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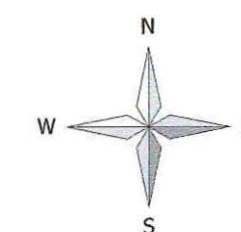
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**The Old Tannery
Machnynlleth**

MTR071

DWG 03

Selected Timeslices



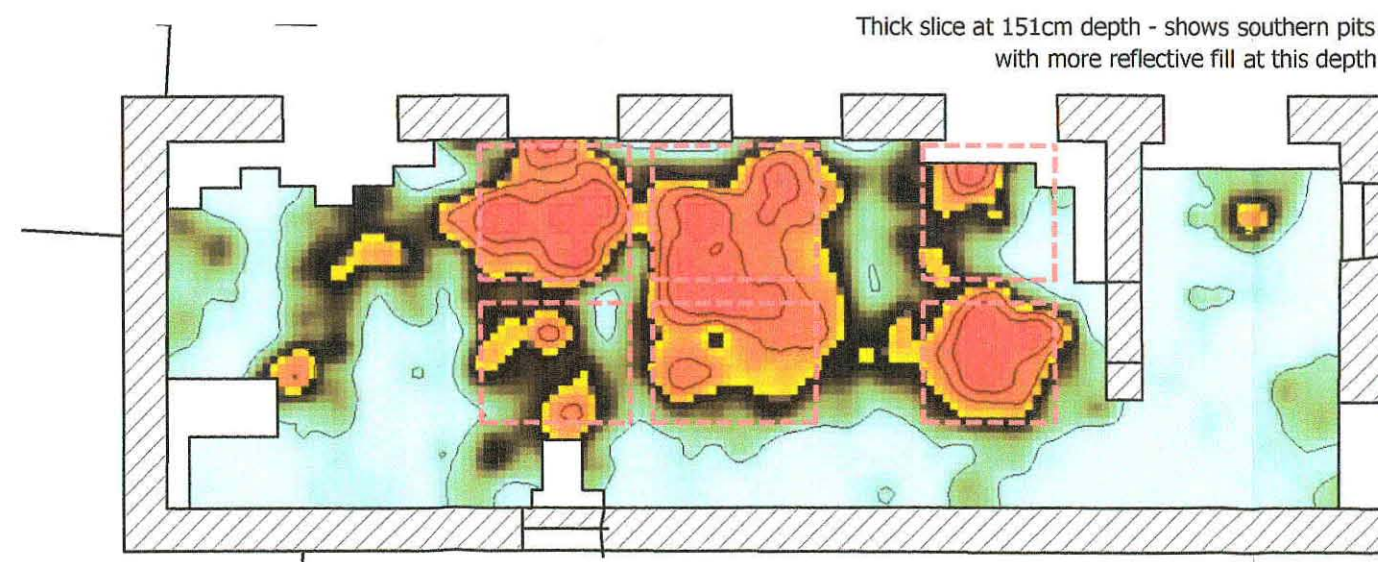
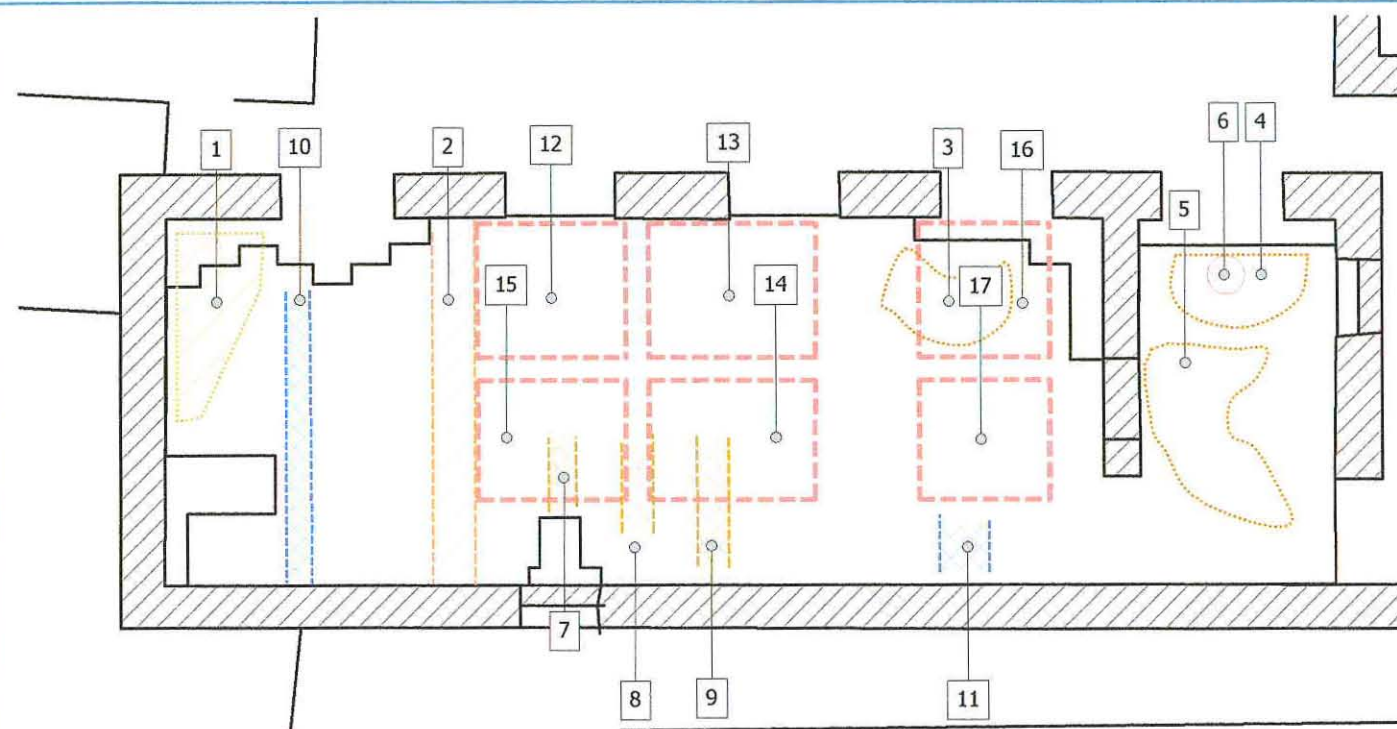
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Orthographic
Centre X: 7.84 m
Centre Y: 3.35 m

Scale: 1:200 @ A3
Spatial Units: Meter

File: Primary.map from ITHACA
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All interpretive detail is depicted based upon the available knowledge of the structure and the technical knowledge and experience brought to the project by ArchaeoPhysica. As such it remains an interpretation and subject to revision if new information comes to light.



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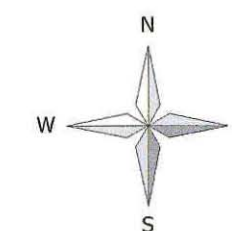
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Y Loteri Genedlaethol
trwy Gronfa Dreftadaeth y Loteri

The Old Tannery
Machnynlleth

MTR071

DWG 04

Summary Interpretation



Orthographic
Centre X: 7.84 m
Centre Y: 3.35 m

Scale: 1:100 @ A3
Spatial Units: Meter

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