

**St Lawrence Church
Lechlade-on-Thames
Gloucestershire**

A REPORT ON A GROUND PENETRATING RADAR SURVEY

for

St Lawrence Church PCC

David Sabin and Kerry Donaldson

September 2018

Ref. no. J760

ARCHAEOLOGICAL SURVEYS LTD

**St Lawrence Church
Lechlade-on-Thames
Gloucestershire**

Ground Penetrating Radar Survey

for

St Lawrence Church PCC

Report and fieldwork by
David Sabin BSc (Hons) MCI(A) and Kerry Donaldson BSc (Hons)

Survey date - 25th August 2018
Ordnance Survey Grid Reference - **SU 21495 99505**



Archaeological Surveys Ltd
1 West Nolands, Nolands Road, Yatesbury, Calne, SN11 8YD
Tel: 01249 814231 Fax: 0871 661 8804
Email: info@archaeological-surveys.co.uk
Web: www.archaeological-surveys.co.uk

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SUMMARY

A ground penetrating radar survey was carried out by Archaeological surveys Ltd at St Lawrence Church, Lechlade-on-Thames in Gloucestershire. The survey covered the majority of the interior of the church and a small zone outside immediately to the north. The results indicate the presence of graves and vaults within both the north and south aisles and within the chancel. Several other small zones containing planar, hyperbolic and complex reflections were located within the church and outside, but they could not be confidently interpreted. A number of shallow linear anomalies are likely to relate to former ventilation or heating channels. Several very small areas of high magnitude GPR reflections are likely to indicate shallow voids.

1 INTRODUCTION

1.1 *Survey background*

- 1.1.1 Archaeological Surveys Ltd was commissioned by St Lawrence Church parochial church council (PCC), Lechlade-on-Thames, Gloucestershire to undertake a ground penetrating radar (GPR) survey. The PCC have plans to upgrade the heating system and other facilities, and the GPR survey aims to determine if there are any vaults or voids under the existing floor.
- 1.1.2 The church was subject to refurbishment in 1882 which included the infilling of vaults, sealing the interior with a 6 inch thick concrete floor and overlaying with tiles.

1.2 *Survey objectives and techniques*

- 1.2.1 The objective of the survey was to use GPR to locate geophysical anomalies that may indicate any vaults, voids or other buried sub-surface remains, so that they may be assessed prior to any groundworks relating to the planned heating and facilities upgrade works.
- 1.2.2 The methodology is considered an efficient and effective approach to archaeological prospection. The survey and report generally follow the recommendations set out by: *EAC Guidelines for the Use of Geophysics in Archaeology*, European Archaeological Council, 2015, and the Chartered Institute for Archaeologists 2014: *Standard and guidance for archaeological geophysical survey*.
- 1.2.3 Archaeological Surveys Ltd carries out ground penetrating radar surveys under a Wireless Telegraphy Act licence from Ofcom (No. 078907/01). It is operated in accordance with Ofcom regulations (OfW 350 Requirements and Guidance Notes for Ground Probing Radar).

1.3 Site location, description and survey conditions

- 1.3.1 The site is located at St Lawrence Church, Lechlade, Gloucestershire. Ordnance Survey National Grid Reference (OS NGR) SU 21495 99505, see Fig 01.
- 1.3.2 The geophysical survey covers all accessible areas of floor inside the church and includes the majority of the nave and north and south aisles (Areas 1, 2 & 4), the western part of the chancel (Areas 6 & 7) and majority of the tower (Areas 3 & 8) and northern porch floors (Area 5), see Figs 02 & 03. Approximately 75m² was surveyed outside the church immediately to the north (Area 9).
- 1.3.3 The floor of the nave, north aisle, south aisle and chancel is surfaced with tile with some gridded channels in the southern aisle and western part of the nave. There are two ledgerstones in the north aisle and one in the south aisle. The tower floor is mainly surfaced with ledgerstones presumed to have been moved from elsewhere and the north porch floor is covered with flagstones that are uneven due to wear and weathering. The external survey area (Area 9) includes a path of concrete slabs and an uneven area of grass that contains several drain grills.
- 1.3.4 The surface conditions were generally considered to be favourable for the collection of ground penetrating radar data. However, the pews within the nave and north and south aisles required movement in order to collect data along traverses. The orientation of the traverses was, therefore, determined by accessibility.



Plate 1: Nave looking east

1.4 Site history and archaeological potential

- 1.4.1 The Grade I listed parish church of St Lawrence (Historic England List entry no 1155874) was founded in the 13th century but was completely rebuilt between 1470 and 1476, with some 16th century additions including the tower and north porch. The church was restored in 1882 under plans by architects Frederick Waller and Sons of Gloucester by builder Alfred Groves of Milton under Wychwood. The specification outlined the sealing of any open graves, ramming them with soil and laying a 6 inch thick layer of concrete over the entire floor. A plan of the position of gravestones was required to be delivered to the vicar as a record, but it is not known if this was done. None of the gravestones were to be removed from the church.
- 1.4.2 The existing ledgerstones include: Edward Bathurst d1674, situated near the western end of the north aisle; John Townsend, Ellen, his wife and six children c1458, a ledgerstone with two brasses at the eastern end of the north aisle and Robert Hitchman c1510 and wife with one brass towards the eastern end of the south aisle, close to the chapel of St Blaise. At least four ledgerstones are located in the tower floor with two others on the northern wall of the tower. Several wall memorials indicate the presence of nearby burials including: Richard Ainge of Church house, d1778, to the west of the north door; Richard Bowles, d1804, on the south western wall; William Wace, d1792, whose memorial is located close to the southern door, but stating that his vault lies near the chancel; Anne Simons, d1769 on the southern wall of the chancel.
- 1.4.3 The Gloucestershire Historic Environment Record indicates that the Salt Way, a Roman and possibly prehistoric route passes through the long axis of the church. The path to the north of the church is also recorded as a medieval trackway and is known as Shelley's Walk after the poem "*A Summer Evening Churchyard, Lechlade*" was written by Percy Bysshe Shelley in 1815.
- 1.4.4 The location of a number of ledgerstones within the floor and wall memorials indicate that there were a number of burials and vaults that would have been consolidated and covered with 6 inches of concrete during the 1882 works. It is also possible that the previous medieval church underlies the present building. There is, therefore, potential for the GPR survey to locate buried features associated with burials and possibly the older church foundations.

1.5 Geology and soils

- 1.5.1 The underlying geology is mudstone from the Oxford Clay Formation with overlying sand and gravel deposits from the Summertown-Radley sand and gravel member (BGS, 2017).
- 1.5.2 The overlying soil across the site is from the Badsey 1 association which is a typical brown calcareous earth. It consists of a well drained, calcareous and non-calcareous, fine, loamy soil over limestone gravel (Soil Survey of England and Wales, 1983).

- 1.5.3 GPR depth can be severely reduced by clay but the overlying sand and gravel deposits are likely to allow good penetration which may be limited by a shallow water table.

2 METHODOLOGY

2.1 *Technical synopsis*

- 2.1.1 Ground penetrating radar systems transmit an electromagnetic wave into the ground and record the time delay and amplitude of reflections from buried features. Reflections occur from changes in conductivity or dielectric permittivity.
- 2.1.2 Electromagnetic waves are increasingly attenuated as frequency increases and, therefore, lower frequencies provide greater penetration into the subsurface. However, the longer wavelengths associated with lower frequencies reduce the resolution of buried features. Typical frequencies chosen for archaeological prospection are around 500 and 200 MHz.

2.2 *Equipment configuration and data collection*

- 2.2.1 Ground penetrating radar data were acquired using an Utsi Electronics Groundvue 3A system running with a 400MHz shielded antenna. The system utilises a wheeled encoder system on a small cart. A dielectric constant of 10 was used in the field to set up the instrument and view data. The value is for display purposes only and does not affect the recorded data. A value of 80ns (nanoseconds) was chosen for the time sweep (two way GPR signal travel time) in order to balance potential depth of penetration and resolution.
- 2.2.2 Data were collected from scans recorded at 0.0295m along traverses separated by 0.25m. The data captured along each traverse were logged to an internal disk drive to allow further processing and analysis.

2.3 *Survey grid and base mapping*

- 2.3.1 Ground penetrating radar data were collected along traverses originating from several baselines representing nine separate survey areas, see Figs 02 & 03.
- 2.3.2 Base mapping was digitised from a scanned paper plan supplied by the client and baselines with traverses were mapped from site measurements. The survey traverses and baselines were set out using tape measures with reference to appropriate physical features visible on the base mapping. The orientation of traverses was determined by the presence of pews within the nave and north and south aisles.

2.4 *Data processing*

2.4.1 Ground penetrating radar data were analysed using REFLEX v8 software. Each traverse was analysed as an individual profile to allow a manual assessment of anomalies. In addition, profiles across each survey area were combined and processed in order to create time slices showing the variation in reflector amplitude at various depths. The following processing has been carried out on GPR data captured during this survey:

- background removal - improves the appearance of the data by removal of strong horizontal bands,
- gain - increased with time in order to amplify weaker reflections from deeper features,
- bandpass filtering - lowers noise by the removal of energy below 200MHz and above 800MHz.

2.4.2 Time slices were analysed using both absolute and envelope reflectivity strengths. The latter use a square root function of the energy at an instant in time and is generally the preferred option; however, occasionally the absolute values provide more detailed anomalies.

2.5 *Data presentation*

2.5.1 An abstraction and interpretation is offered for all geophysical anomalies located by the survey. A brief summary of each anomaly, with an appropriate reference number, is set out in list form within the results (Section 3) to allow a rapid and objective assessment of features within each survey area. Approximate depths to anomalies is added to the abstraction and interpretation plot.

2.5.2 The main form of data display prepared for this report are colour time slice plots derived from Reflex as a TIF graphic files. Time slices are plotted for 2.5ns (approx. 0.1m depth), 7.5ns (approx. 0.3m depth), 18.75ns (approx. 0.75m depth) and 37.5ns (approx. 1.5m depth). The time slices are chosen as an indication of change with depth and may not contain all of the anomalies highlighted within the abstraction plot; some anomalies are not adequately represented by time slices and have been interpreted by analysis of radar profiles. Colour radargrams are included in the report to highlight features within the radar profiles of selected traverses. Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing.

2.5.3 The raster images are combined with base mapping using ProgeCAD Professional 2016 creating DWG file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical quality. A digital archive, including raster images, is produced with this report, see Appendix D below.

3 RESULTS

3.1 *General overview*

- 3.1.1 The GPR survey located planar, hyperbolic and complex reflections within the survey areas. Several categories have been used in the abstraction and interpretation plots and these are listed within Table 1 followed by a list and description of the anomalies.
- 3.1.2 A velocity of 0.08m/ns was calculated using hyperbola matching although there were few suitable deep reflections for this type of analysis. The velocity is consistent with damp subsurface conditions although it is likely that higher velocities exist closer to the surface where soils are drier.

3.2 *Data quality and factors influencing the interpretation of anomalies*

- 3.2.1 The GPR data were collected with due consideration given to surface conditions, obstructions and area constraints. GPR signals appear to have achieved moderate penetration of up to approximately 1.5m – 2m. Data were collected along parallel traverses with 0.25m separation; however, the orientation of traverses was determined by the layout of the church and pews which were moved as the survey progressed across the nave and aisles. The west – east orientation of traverses in these areas is less than optimum when characterising graves and vaults that are similarly orientated; however, this is offset by using closely separated traverses in order to produce high resolution datasets.
- 3.2.2 Within the tower, north porch and chancel it was only possible to record a small number of traverses and as a consequence the interpretation of features within these areas has a lower level of confidence. The datasets also include multiple reflections from above ground structural elements within the church despite the use of a shielded antenna. However, these 'air waves' are characterised by long straight anomalies within the radargrams that generally arrive slightly later than subsurface features of interest and can, therefore, be ignored.
- 3.2.3 Metal grills and ledgerstone brasses have caused very high magnitude responses and these features are effectively opaque to GPR causing a series of multiple reflections. Deeper features may, therefore, not be present due to lack of penetration and high levels of noise. Grills within the southern aisle appear to have caused high level background noise that extends along the whole traverse and could not be adequately removed by processing.

3.3 *Data interpretation*

- 3.3.1 The list of sub-headings below attempts to define a number of separate categories that reflect the range and type of features located during the survey. A basic explanation of the characteristics of the radar anomalies is set

out for each category in order to justify interpretation, a basic key is indicated to allow cross referencing to the abstraction and interpretation plot. CAD layer names are included to aid reference to associated digital files (.dwg/.dxf). Sub-headings are then used to group anomalies with similar characteristics for each survey area.

Interpretation category and CAD layer names	Notes
<p><i>Planar and hyperbolic reflections associated with graves and/or vaults</i></p> <p>AS-ABST GPR GRAVE OR VAULT</p>	<p>Graves and vaults are often characterised by hyperbolic reflections but may also be associated with planar and complex reflections. The depth, size and orientation of the reflectors also provides a useful indication of their origin. Associated features such as memorials and ledgerstones may also be useful indicators. Strong responses may be caused by air voids and metal features.</p>
<p><i>Planar reflections associated with ledgerstones</i></p> <p>AS-ABST GPR LEDGERSTONE</p>	<p>Near surface planar GPR reflections caused by the interface between the ledgerstone and material below. Multiple planar reflections may be present.</p>
<p><i>Complex reflections associated with church structure</i></p> <p>AS-ABST GPR CHURCH STRUCTURE</p>	<p>Walling stone, rubble, mortar layers etc. forming masses of often short, irregularly shaped GPR reflections.</p>
<p><i>Planar and complex reflections of uncertain origin</i></p> <p>AS-ABST GPR UNCERTAIN</p>	<p>GPR anomalies that cannot be confidently interpreted. The morphology of the reflections is often amorphous. They may relate to subsurface disturbance, buried layers, structures or rubble and may be archaeologically significant.</p>
<p><i>Linear features of uncertain origin</i></p> <p>AS-ABST GPR UNCERTAIN</p>	<p>Narrow linear features that may represent services, drains, channels, ditches, etc.</p>
<p><i>Near surface reflections associated with shallow voids or metal objects</i></p> <p>AS-ABST GPR VOID OR METAL</p>	<p>Characterised by very high magnitude reflections caused by air gaps and conductive material.</p>
<p><i>Planar and complex reflections associated with modern ground disturbance/features</i></p> <p>AS-ABST GPR VOID OR MODERN</p>	<p>Visible surface features.</p>
<p><i>Planar reflections associated with buried path</i></p> <p>AS-ABST GPR PATH</p>	
<p><i>Reflections associated with services, ducts, ventilation etc.</i></p> <p>AS-ABST GPR SERVICES</p>	<p>Mapped or visible features.</p>

Table 1: List of GPR interpretation categories

3.4 List of ground penetrating radar anomalies

Planar and hyperbolic reflectors associated with graves and/or vaults

(1) - Planar surface reflections within the north western part of the nave relate to a ledgerstone set into the floor that has an inscription to Edward Bathurst who died in 1674, see Radargram 1 and Plate 2. The stone appears to overlie possibly two hyperbolic reflectors that probably represent graves; however, they appear offset to the north and are only partly covered by the survey due to cupboards set against the northern and western interior walls of the nave. The offset may imply that the ledgerstone has been moved and reset into its current location and any relationship with the graves is uncertain. The top of the response to main hyperbolic reflector is approximately 0.4m below the surface and its morphology may indicate a small barrel vault.

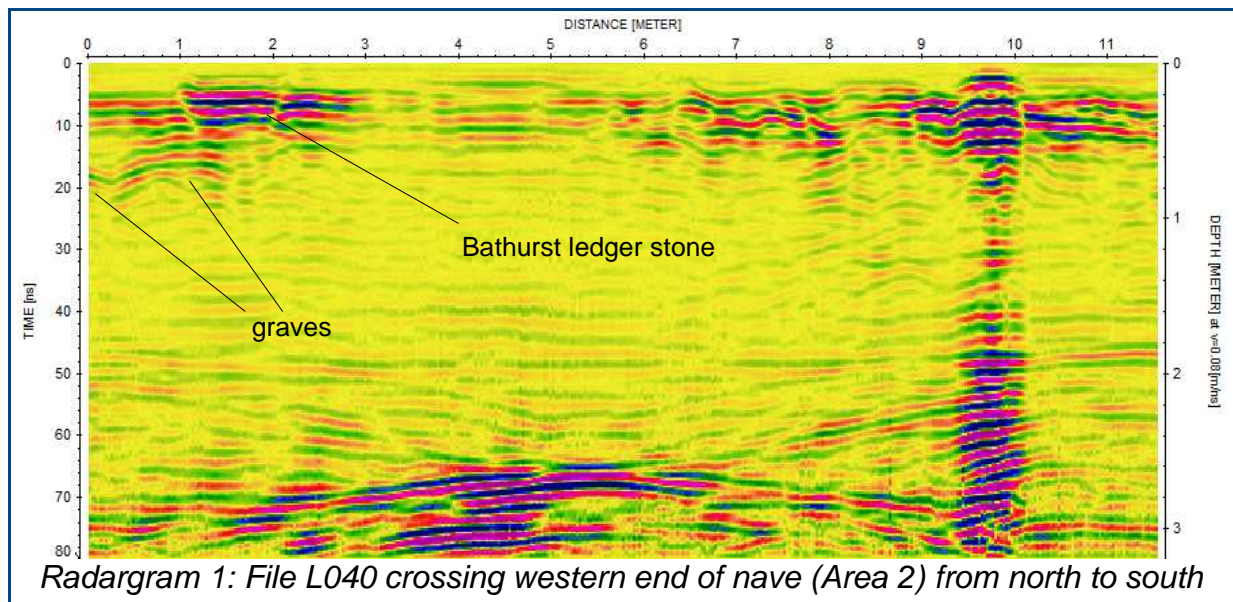
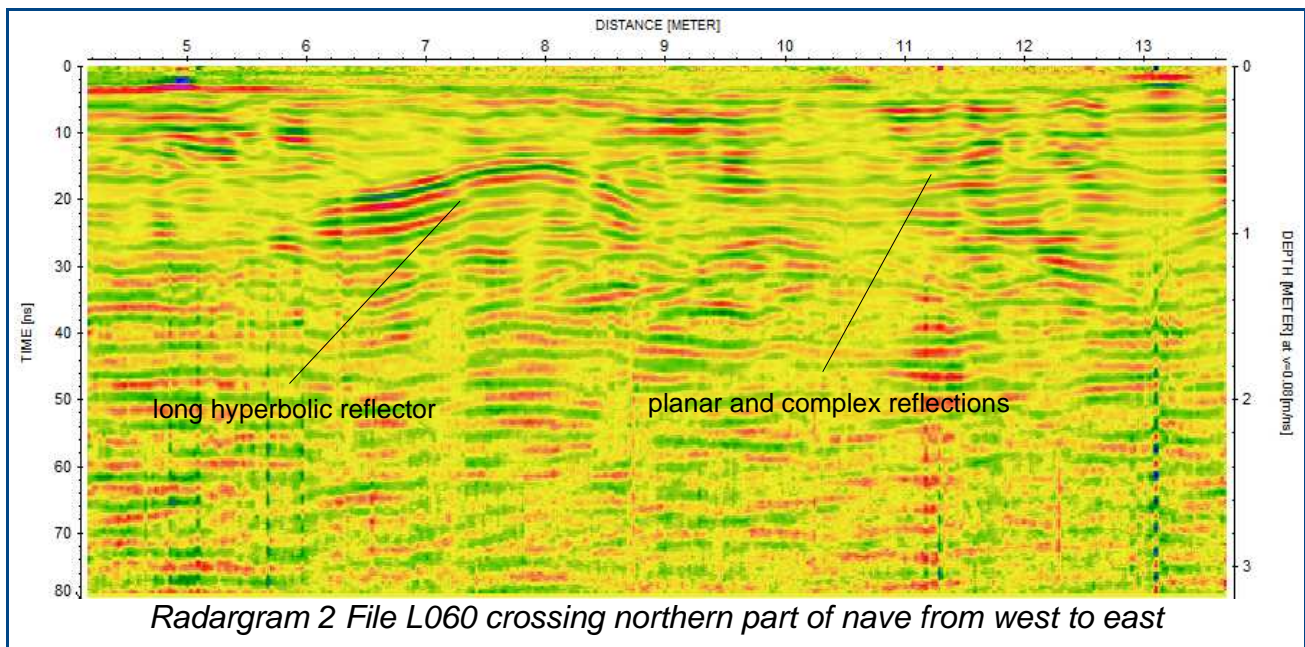
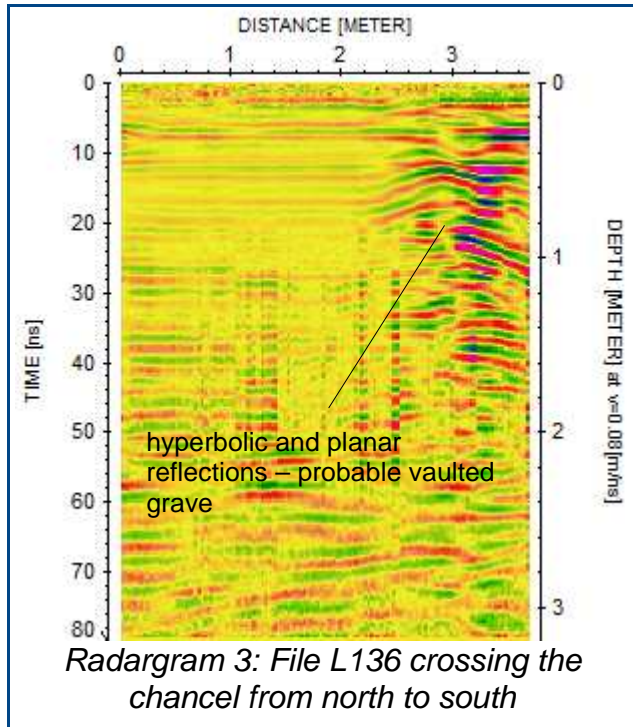


Plate 2: Bathurst ledgerstone in north west part of nave

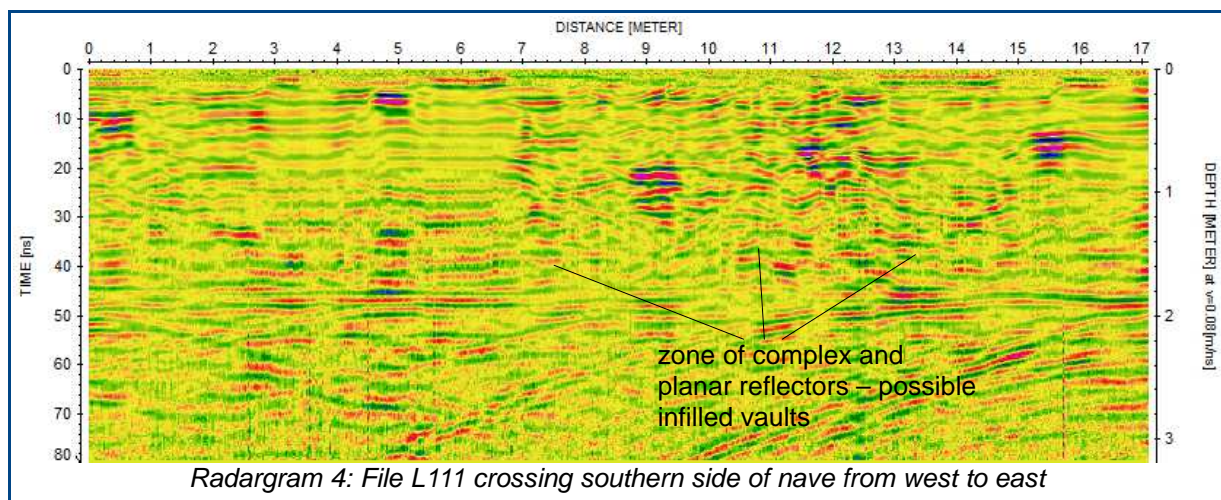
(2) - Planar, hyperbolic and complex reflections appear in two zones immediately to the south of the north wall of the nave to the east of the door to the north porch, see Radargram 2. It is likely that they represent vaults and graves. The western zone is characterised by a long hyperbolic reflector (approximately 3m long) that becomes more complex and fragmented from a distance of approximately 1m south of the nave wall. The eastern zone lacks hyperbola and is characterised by planar reflections representing horizontal layers just over 2m in length along the west to east extent. The upper part of hyperbolic reflector forming the western zone appears to be approximately 0.5m in depth with reflections extending to around 1.5m. Planar reflections forming the eastern zone appear at around 0.25m and may also extend to about 1.5m.



(3) - Planar and hyperbolic reflections close to the south wall of the chancel represent a vaulted grave, see Radargram 3. Due to the constraints to the survey area, it is likely that the full extent of the structure has not been covered. The initial response appears shallow at approximately 0.2m with reflections indicating a potential depth of approximately 1.8m. On the south chancel wall, immediately above the GPR anomalies, there is a memorial to Mrs Anne Simons (see Plate 3), and it is considered likely that the feature is her grave.

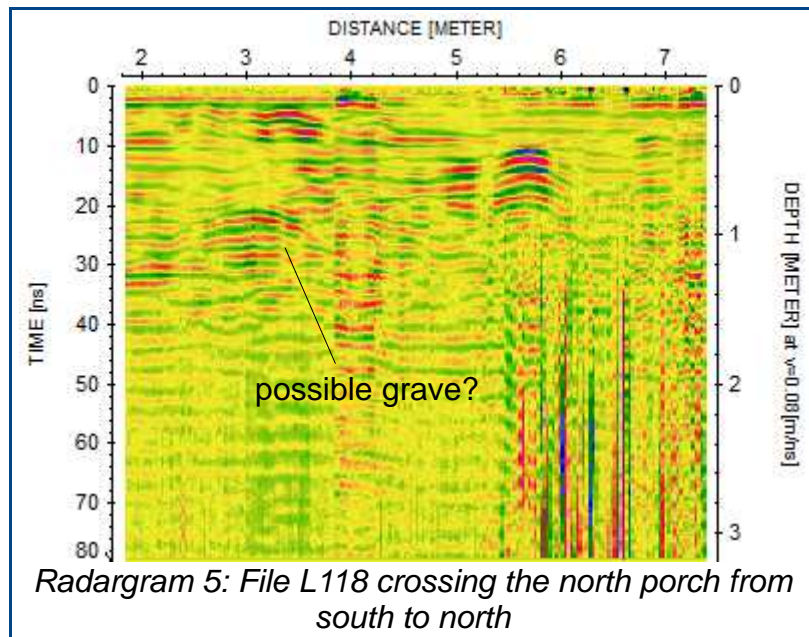


(4) - Planar and complex reflections covering a zone of approximately 2.2m by 7.8m along the southern side of the nave, see Radargram 4. The reflections extend from approximate depths of 0.2m to 1.5m and are considered likely to represent a series of vaults or graves. The anomalies cannot be clearly resolved possibly indicating infilling which may have been necessary to consolidate the floor during renovation.



(5) - Several hyperbolic reflections were recorded within the northern porch, see Radargram 5. They are located at a depth of approximately 0.8m and suggest a feature orientated east - west with similar dimensions to a grave.

The interpretation is somewhat tentative due to the constraints of the survey area and its location within the north porch.



Planar reflections associated with ledgerstones

(6) - The Bathurst ledgerstone is discussed above with anomaly (1). The stone may not be in its original position.

(7) - A large ledgerstone in the north eastern part of the nave, with two brasses, to John Townsend, Ellen, his wife and six children c1458 (Plate 4). The survey has recorded multiple planar reflections from the stone with very strong reflections from the brass. There is no convincing evidence for a grave beneath the stone.



Plate 4: Ledgerstone with two brasses - north eastern part of nave

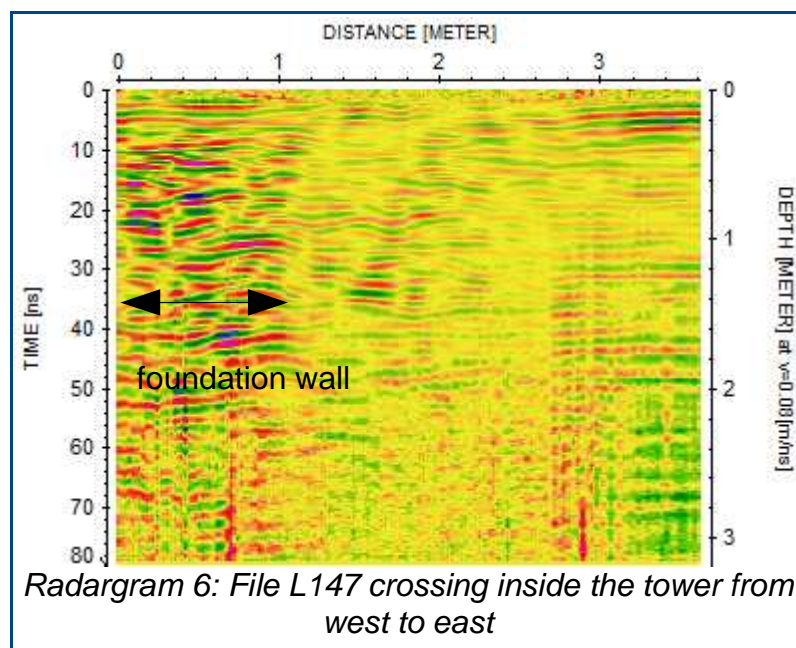


Plate 5: Ledgerstone with one brass - south eastern part of nave

(8) - A large ledgerstone, with two brasses, in the south eastern part of the nave to Robert Hitchman and wife c1510 (Plate 5). The survey has recorded multiple planar reflections from the stone with very strong reflections from the brass. There is no convincing evidence for a grave beneath the stone.

Complex reflections associated with church structure

(9) - A zone of complex reflections within the western side of the tower, see Radargram 6. The anomalies occur at approximately 0.1m to 2m in depth. They appear to be confined to a rectangular area that lies within the western entrance to the tower, their eastern limit appears to extend no further than the internal eastern side of the tower wall as indicated on the plan. It is considered likely that during the construction of the tower a substantial foundation wall was built up to just below the floor level and threshold of the western entrance.



Radargram 6: File L147 crossing inside the tower from west to east

Planar and complex reflections of uncertain origin

(10) - A zone of planar reflections at variable depths within the tower. The floor within this area appears to be made of ledgerstones presumably moved from elsewhere within the church. Shallow reflections are likely to be associated with these but the origin of short, deeper planar anomalies is unclear.

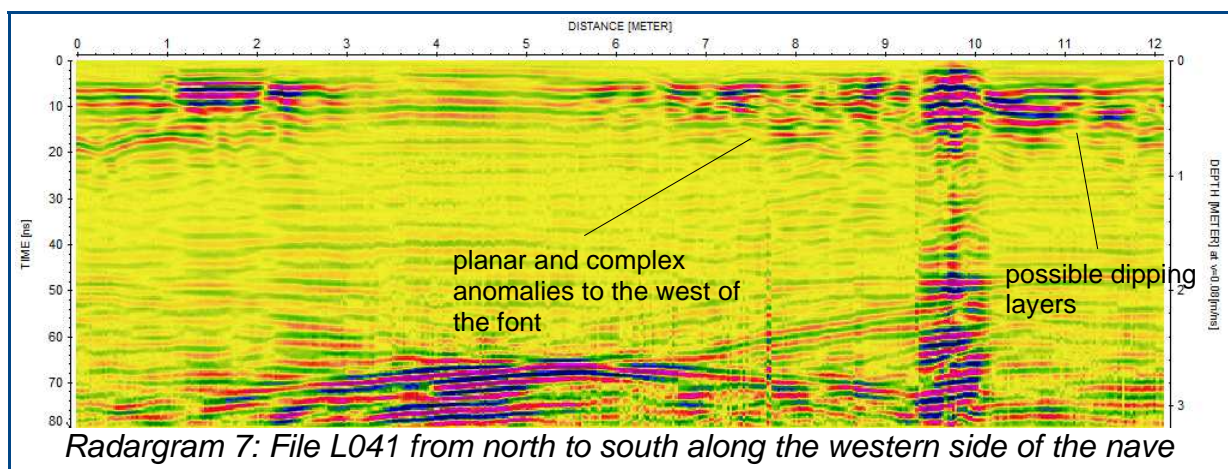
(11) - Planar and complex reflections to the south east of the most north westerly pillar within the nave visible between 0.25m and 0.7m in depth. It is unclear as to the origin of the anomalies but they may relate to structural remains or disturbance to the subsurface.

(12) - Similar to anomaly (11) but located to the north east of the most south westerly pillar in the nave and extending between approximately 0.2m and 0.8m in depth.

(13) - Amorphous areas containing planar and some hyperbolic anomalies in the southern and eastern parts of the nave. They have similar depths to anomalies (11) and (12) at between 0.2m and 0.8m but their origins cannot be determined. It is possible that they relate to former structural remains, ground disturbance or consolidation etc.

(14) - High magnitude, shallow planar and complex reflections to the west of the font possibly extending to approximately 1m in depth, see Radargram 8. The anomalies may indicate disturbance below the floor in this area. The potential for further graves should be considered as wall memorials are located nearby.

(15) - Planar, hyperbolic and complex reflections below the floor appear to infer a subsurface layer dipping slightly to the south. The anomalies may indicate disturbance down to approximately 1m, see Radargram 7.



(16) - In the southern part of the nave close to the southern door, and extending across the southern aisle with a roughly north - south orientation,

the survey recorded a zone of planar and hyperbolic reflections. The anomalies are mainly shallow at around 0.2m to 0.45m and they are likely to be associated with heating and ventilation.

(17) - The northern porch contains numerous planar, hyperbolic and complex reflections from near surface down to approximately 1.5m. Anomaly (5) within the porch has been tentatively interpreted as a possible grave but the GPR responses across most of the area suggest a very variable subsurface make-up.

(18) - Beneath the modern concrete slab path to the north of the church there are numerous planar, hyperbolic and complex reflections. A zone of more dense reflections has been highlighted and these may extend to approximately 1m deep; it is uncertain as to whether they relate to made ground beneath the current and earlier paths or whether there are remains of archaeological potential.

Linear features of uncertain origin

(19) - Two weak linear features appear to cross the central part of the nave with a north east to south west orientation. The more westerly appears very shallow whilst the easterly feature is approximately 0.5m deep. It is possible that the latter relates to a pipe or other service but the response is too weak to characterise confidently.

Near surface reflections associated with shallow voids or metal objects

(20) - High magnitude, near surface, planar reflections adjacent to the entrance to the northern porch probably indicate a very shallow thin void between the surface layers. It is likely to extend beyond the limit of the surveyed area.

(21) - A shallow linear feature associated with high magnitude reflections in the north eastern part of the nave. The anomaly may indicate a service or ventilation channel, and the high magnitude response may indicate a metal construction or surviving void. It is likely to pass immediately below the western end of the ledgerstone located in this part of the church.

(22) - Immediately to the north east of the southern door there are several shallow high magnitude anomalies that may represent voids. The anomalies may form a linear feature and may relate to the nearby subterranean boiler house.

Planar and complex reflections associated with modern ground disturbance/features

(23) - High magnitude reflections to the north of the church associated with drain grills, hollows and modern surface features.

Planar reflections associated with buried path

(24) - Planar reflections at approximately 0.4m may relate to a buried path adjacent to the north east corner of the church.

Reflectors associated with services, ducts, ventilation etc.

(25) - The survey located several surface and near surface anomalies related to services, ducts, heating and ventilation. Very high magnitude reflections caused by air spaces are associated with the extant floor grills within the nave. Several of the other linear anomalies are defined by low magnitude reflections possibly indicating that they are filled; however, high magnitude responses to the north of the southern door (22) probably indicate shallow voids as do moderately strong reflections from a linear feature in the north eastern part of the north aisle, anomaly (21).

4 DISCUSSION

- 4.1.1 The interpretation and abstraction of the GPR data indicates the presence of several unmarked graves or vaults. Anomalies (2) and (4) represent zones within the northern and southern aisles respectively that appear to represent subsurface disturbance to approximately 1.5m, and it is considered likely that these represent a series of graves or vaults. The reflections associated with the two zones do not clearly resolve the structure of these features which in part may be a consequence of the west to east traversing, but may also indicate backfilling of voids with rubble and soil.
- 4.1.2 A vaulted grave located in the chancel probably relates to the nearby wall memorial to Mrs Anne Simons, and probable graves in the north western part of the nave, in the north aisle, lie to the north of a ledgerstone to Edward Bathurst. As the graves only partly underlie the ledgerstone, it is unclear as to whether it has been repositioned from elsewhere or reset a short distance away from its original location. Characteristic hyperbolic reflections from beneath the northern porch floor have tentatively been interpreted as a possible grave. Early ledgerstones with brasses in the north eastern and south eastern parts of the nave do not appear to be associated with grave-like reflections. Similarly, ledgerstones set into the tower floor cannot be confidently associated with evidence for graves.
- 4.1.3 The survey located several small zones of mainly planar and complex reflections of uncertain origin. Interpretation was limited due to the amorphous extent of the zones and nature of the GPR reflectors. However, it is possible that further unmarked graves, structural remains or features of archaeological potential are represented.

- 4.1.4 High magnitude reflections caused by voids and metal are mainly associated with extant floor grills; however, several other potential near surface voids were located where no clear association with visible features is possible. Anomaly (20), close to the northern door in the north aisle of the church, relates to a zone of approximately 1m by 1m, but possibly extending further to the west, that contains very near surface high amplitude planar reflections likely to indicate a thin void near to the surface. Anomaly (21), in the eastern part of the north aisle, is defined by a shallow high magnitude linear feature that may be associated with a service, pipe or ventilation channel. The response may indicate an extant void but could also be associated with metal. It may pass immediately below the western end of the large ledgerstone located nearby. Anomalies (22) relate to several high magnitude shallow reflections located immediately north east of the southern doorway in the south aisle. The anomalies may indicate a linear feature, perhaps voids associated with the subterranean boiler house.
- 4.1.5 Survey to the north of the church was carried out to provide additional information on the archaeological potential of a small area of land and aid future management of the site. The data demonstrate the presence of numerous reflections below the current path running through this area and many of these are likely to be associated with previous tracks and ground consolidation. A zone of deeper and more dense reflections has been abstracted although the origin of these is uncertain.

5 CONCLUSION

- 5.1.1 The results of the survey demonstrate the presence of a number of subsurface features within the church. Several areas are likely to contain subsurface graves and vaults and these include zones within the northern and southern aisles and a small zone within the chancel. Several small zones of GPR reflectors have been classified as uncertain in origin but it is possible that some of these also represent graves; however, they may relate to other subsurface features and former disturbance.
- 5.1.2 Several small, shallow voids not associated with surface features have been abstracted but they do not appear to be extensive. In addition, several linear anomalies relating to former ventilation channels and heating pipes or channels were located.
- 5.1.3 Survey outside the northern side of the church revealed numerous reflections beneath the current path that probably relate to former tracks and ground consolidation. A zone of deeper and more dense reflections was located but its origin is uncertain.

6 REFERENCES

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7 ACKNOWLEDGEMENTS

Archaeological Surveys would like to thank Richard Bell, Churchwarden, for the commission and to Nigel Jones and Paul Cobb, fabric committee of the St Lawrence Church PCC for their help with the project and moving all the pews. Thanks also go to Mrs Helen Jones for the tea and Sylvia Dennish for supplying the St Lawrence Church Guide Book.

Appendix A – digital archive

Archaeological Surveys Ltd hold the primary digital archive at offices in Wiltshire (see inside cover for address). Data are backed-up onto an on-site data storage drive and at the earliest opportunity data are copied to CD ROM for storage on-site and off-site.

Surveys are reported on in hardcopy using A4 for text and A3 for plots (all plots are scaled for A3). The distribution of both hardcopy report and digital data is considered the responsibility of the Client unless explicitly stated in the survey Brief, Written Scheme of Investigation or other contractual agreement.

This report has been prepared using the following software on a Windows XP platform:

- Reflex v8 (GPR data analysis)
- ProgeCAD Professional 2016 (report plots),
- OpenOffice.org 4.1.1 Writer (document text),
- PDF Creator version 0.9 (PDF archive).



GPR Survey St Lawrence Church Lechlade-on-Thames Gloucestershire

Map of survey area

Reproduced from OS Explorer map no.170 1:25 000 by permission of Ordnance Survey on behalf of The Controller of Her Majesty's Stationery Office. © Crown copyright. All rights reserved. Licence number 100043739.



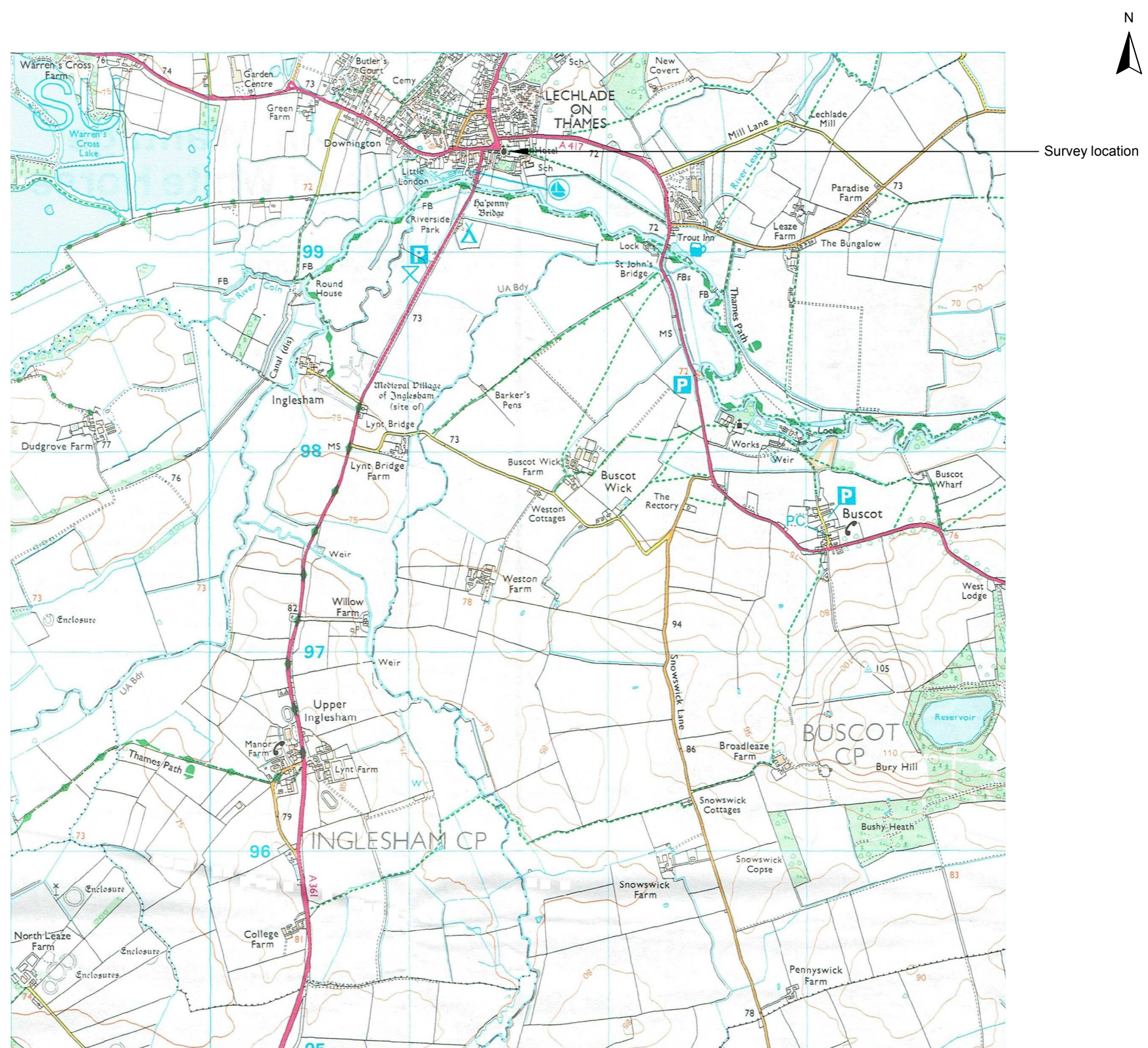
● Survey location

Site centred on OS NGR
SU 21495 99505

SCALE 1:25 000



SCALE TRUE AT A3





**GPR Survey
St Lawrence Church
Lechlade-on-Thames
Gloucestershire**

**Ground penetrating radar survey
referencing - Areas 1, 3, 5, 6 & 9**

Area 1 - nave
Baseline A - B parallel to west wall with 12.5m separation. A starts at 1m along baseline. Data collected in parallel traverses heading east. Eighty-one traverses separated by 0.25m with filenames L001 - L038, L060 - L080 & L093 - L116. Traverse L001 starts at 4m (3m from point A).

A - C = 1.66m A - D = 1.05m

Area 3 - nave and west tower

Same baseline as Area 1. Seventeen traverses separated by 0.25m with filenames L042 - L059. First traverse at 8.25m (7.25m from A) heading west.

A - I = 7.25m

Area 5 - north porch

Baselines J to K & L to M. Eight traverses separated by 0.25m with filenames L117 - L124. First traverse at J heading heading north.

J - K = 1.75m L - M = 1.75m
J - L = 1m J - N = 1.82m J - O = 0.35m

Area 6 - chancel

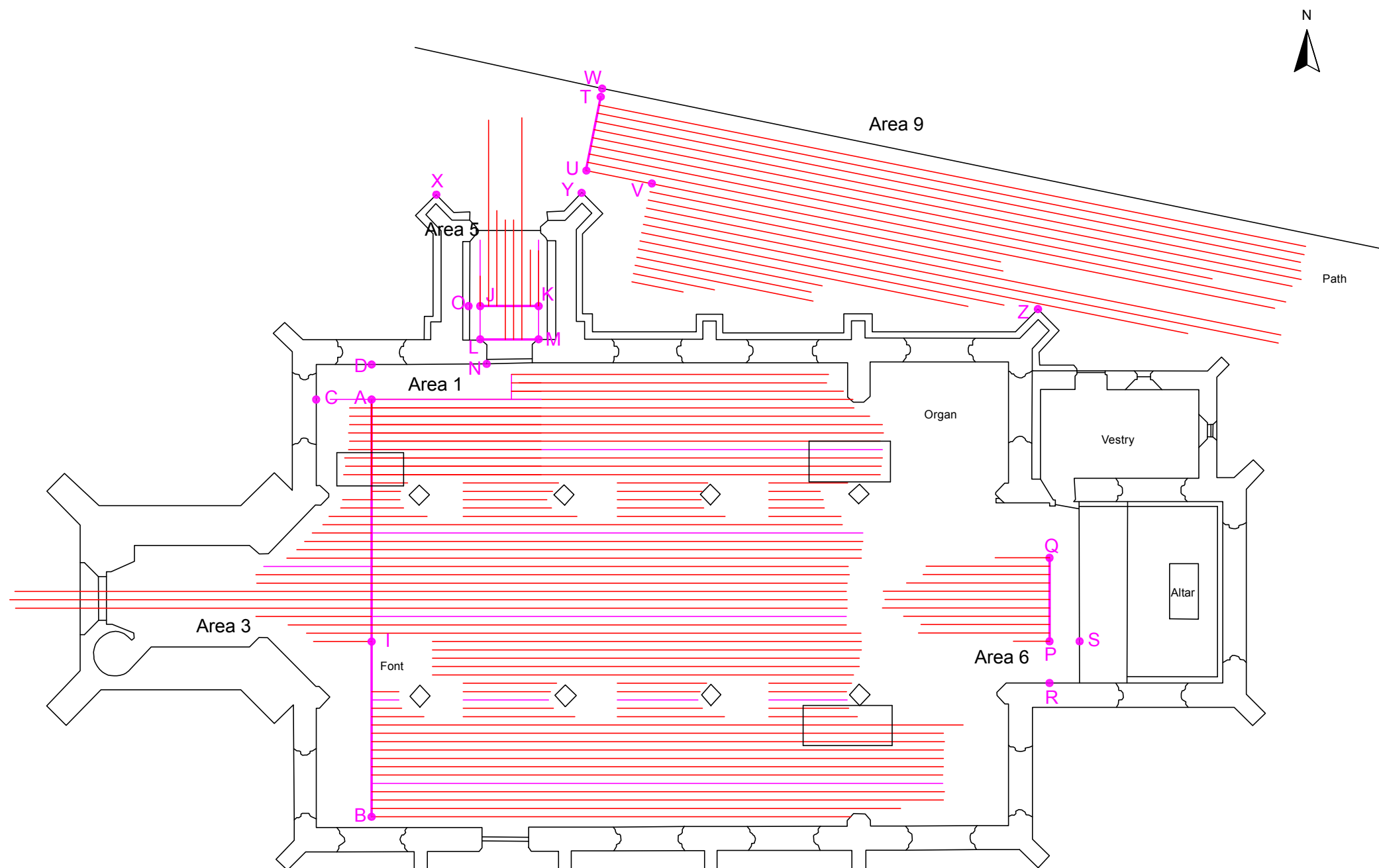
Baseline P to Q. Eleven traverses separated by 0.25m with filenames L125 - L135. First traverse at P heading heading west.

P - Q = 2.5m P - R = 1.25m P - S = 0.9m

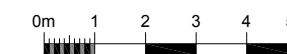
Area 9 - external to north along path and grass

Baseline T to U. Twenty one traverses separated by 0.25m with filenames L153 - L173. First traverse 0.25m along baseline from T heading heading east-south-east.

T - U = 2m U - V = 2m T - W = 0.25m
T - X = 5.55m T - Y = 2.57m T - Z = 14.8m



SCALE 1:150



SCALE TRUE AT A3



**GPR Survey
St Lawrence Church
Lechlade-on-Thames
Gloucestershire**

**Ground penetrating radar survey
referencing - Areas 2, 4, 7 & 8**

Area 2 - western part of nave

Baseline AA - BB parallel to north wall. A starts at 1m along baseline. Data collected in parallel traverses heading south. Three traverses separated by 0.25m with filenames L039 - L041. Traverse L039 starts at 0.25m west of AA.

A - AA = 0.59m AA - BB = 0.75m

Area 4 - nave in front of north door

Baseline G to F. Twelve traverses separated by 0.25m with filenames L081 - L092. First traverse at F heading heading west.

A - E = 2.25m E - F = 5.08m
F - G = 2.75m G - H = 0.89m

Area 7 - chancel

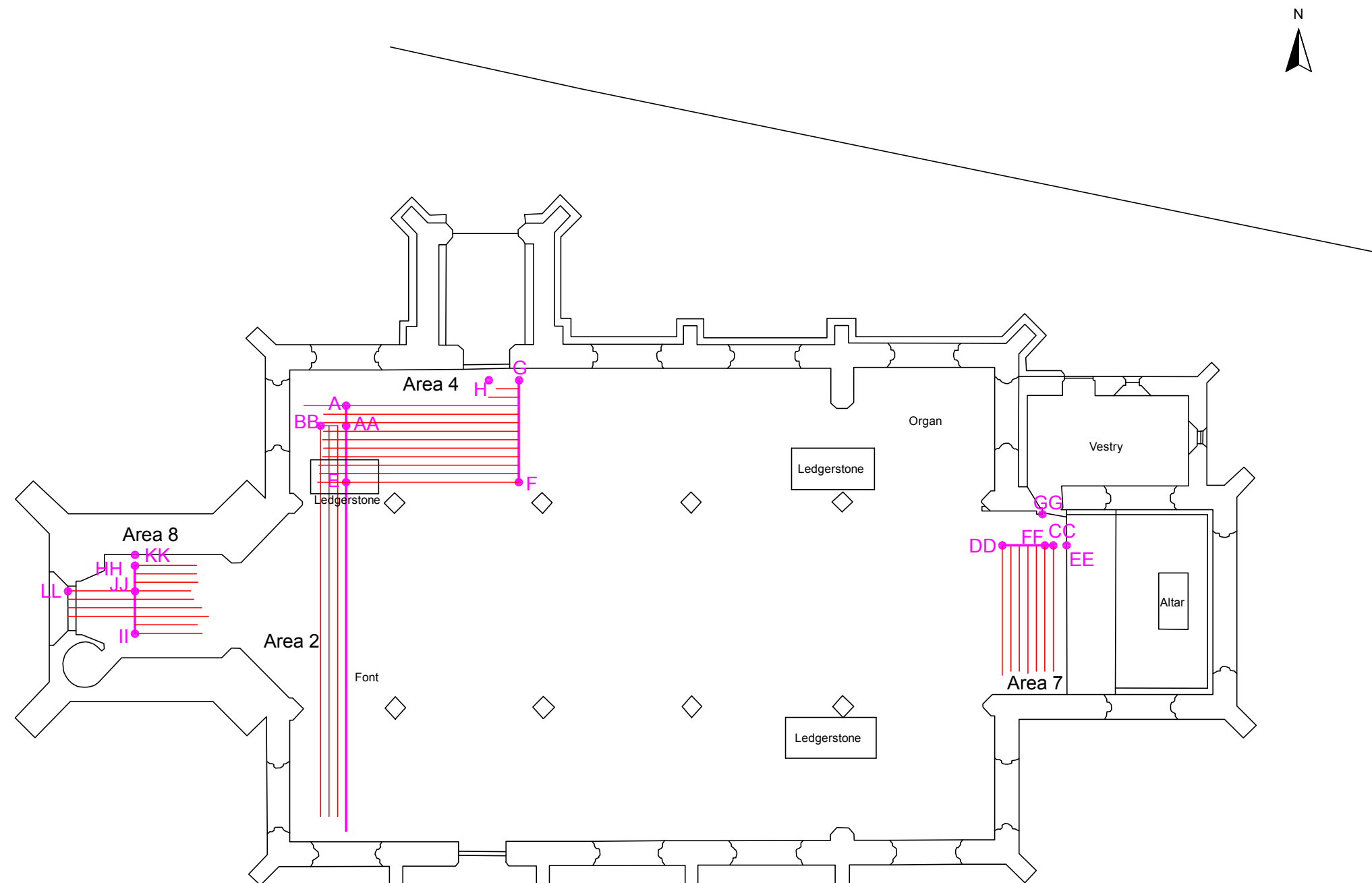
Baseline CC to DD. Seven traverses separated by 0.25m with filenames L136 - L137 & L139 - L143. First traverse from CC heading south.

CC - DD = 1.5m CC - FF = 0.25m
FF - GG = 0.93m CC - EE = 0.39m

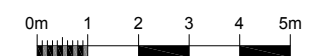
Area 8 - west tower

Baseline HH to II. Nine traverses separated by 0.25m with filenames L144 - L152. First traverse at HH heading heading east.

HH - II = 2m HH - JJ = 0.75m
JJ - LL = 1.97m HH - KK = 0.32m



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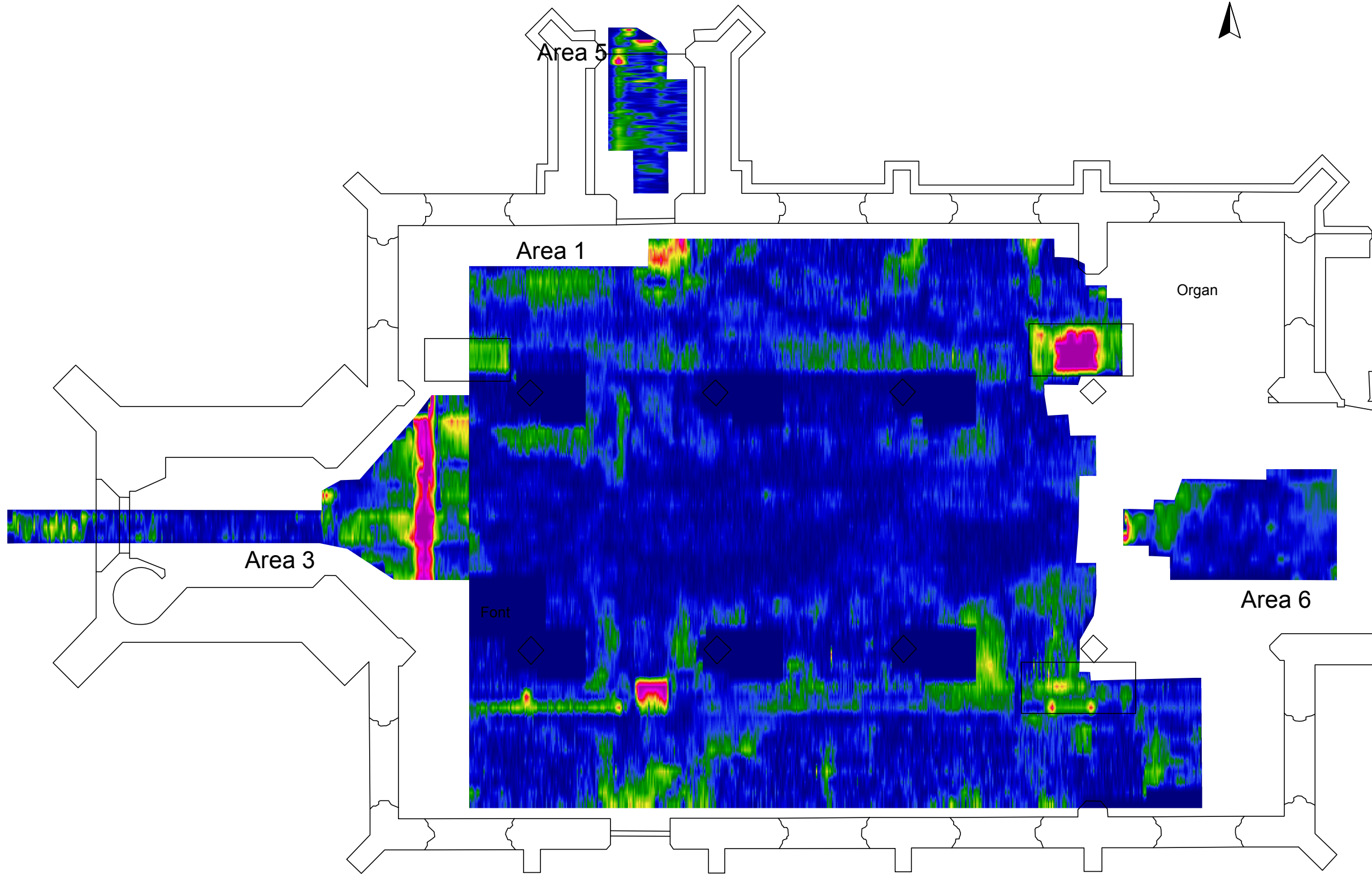


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**GPR Survey
St Lawrence Church
Lechlade-on-Thames
Gloucestershire**

**Ground penetrating radar
time slices at 2.5ns
Areas 1, 3, 5 & 6**



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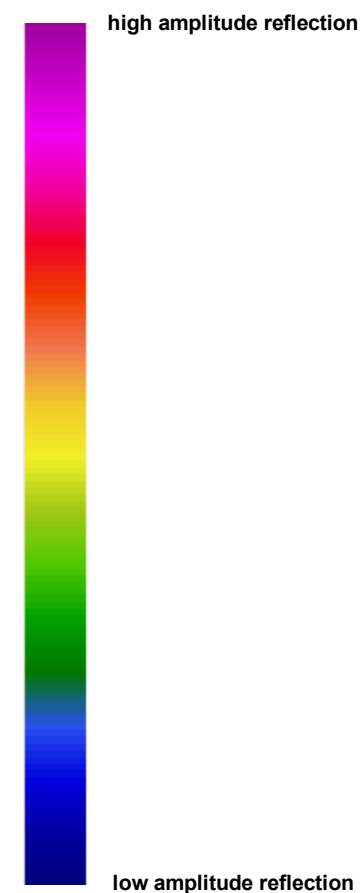


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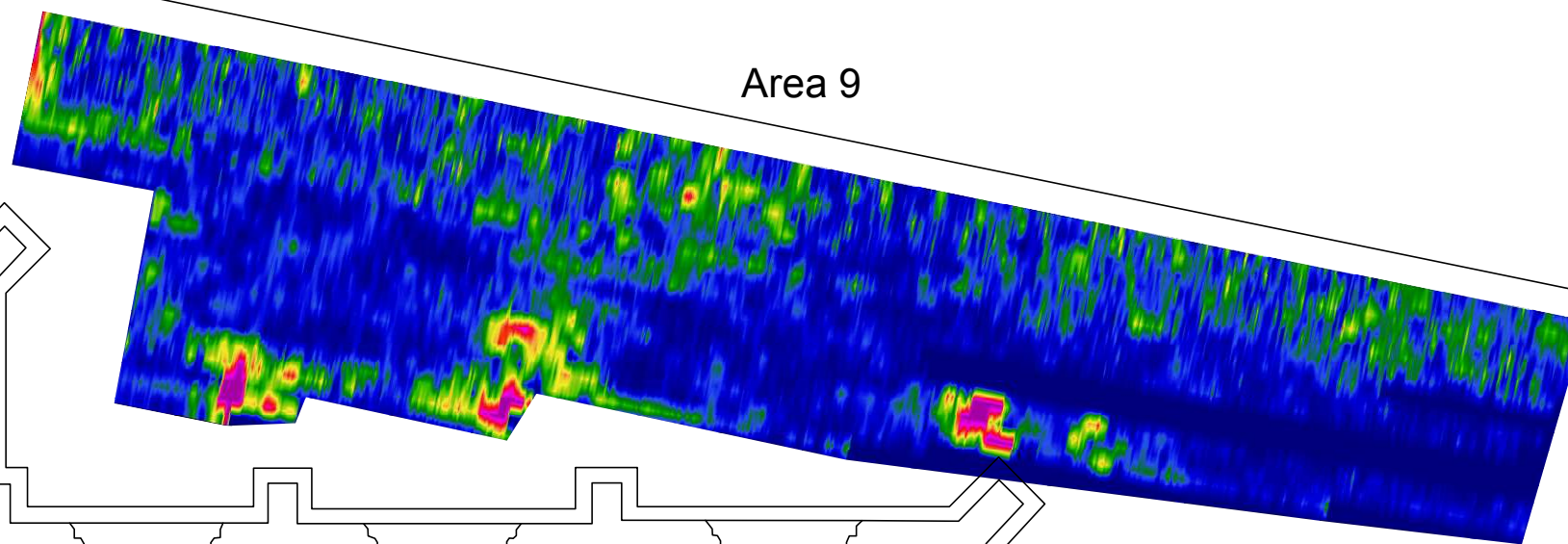


GPR Survey
St Lawrence Church
Lechlade-on-Thames
Gloucestershire

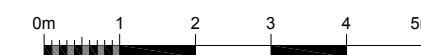
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Area 9



Area 9



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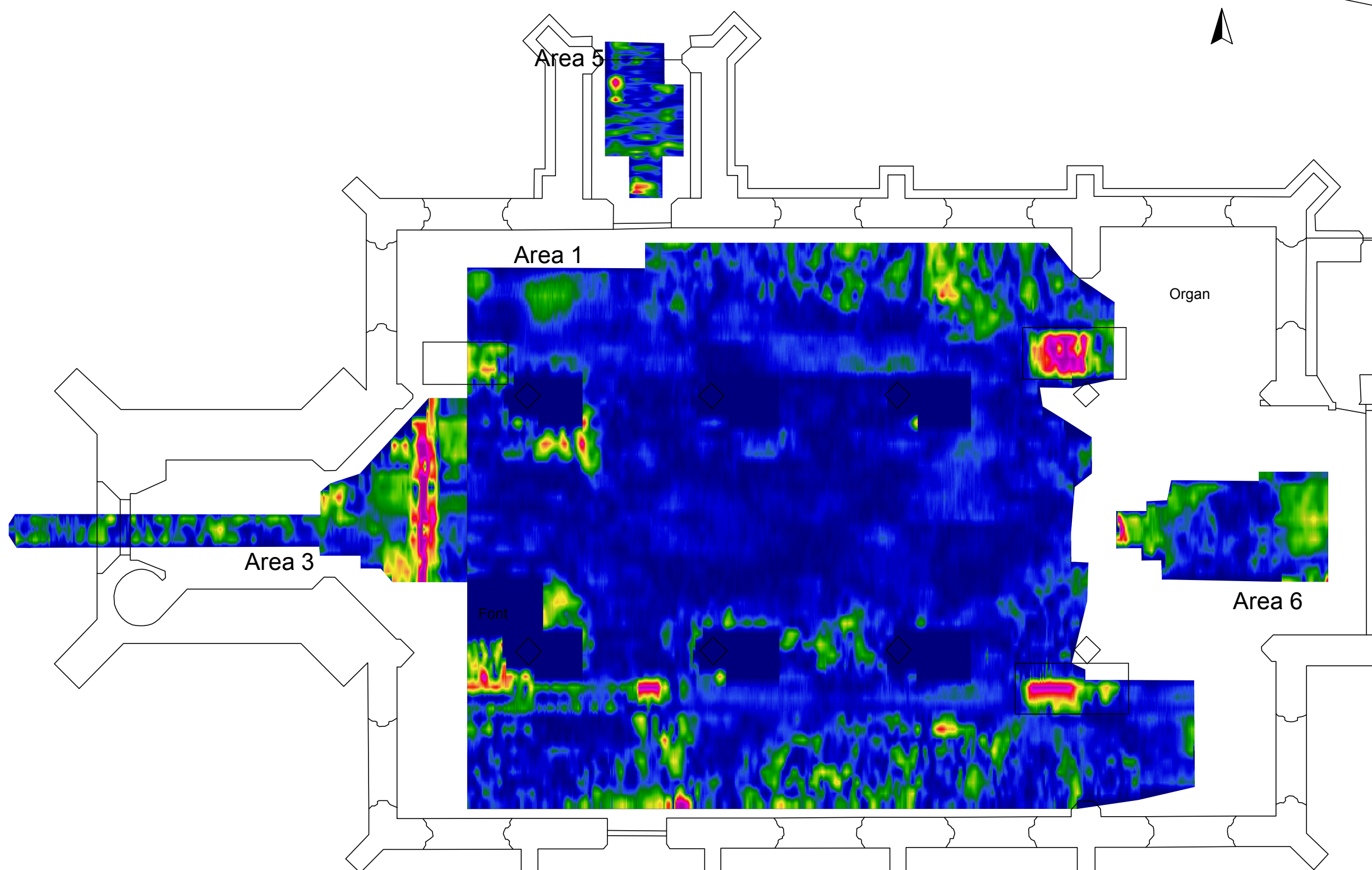
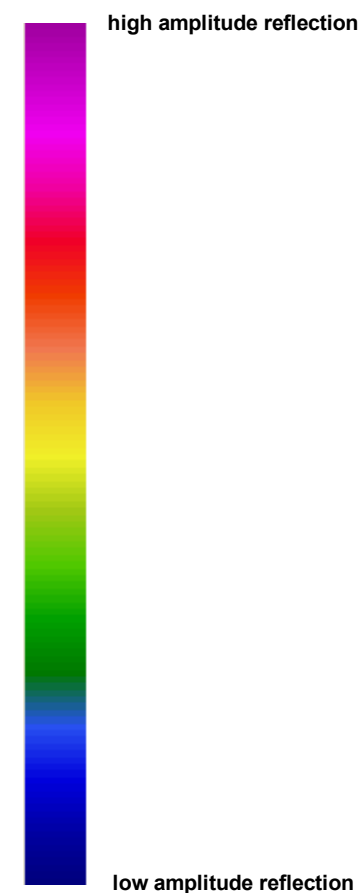


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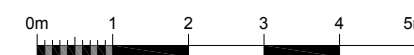


GPR Survey
St Lawrence Church
Lechlade-on-Thames
Gloucestershire

Ground penetrating radar
time slices at 7.5ns
Areas 1, 3, 5 & 6



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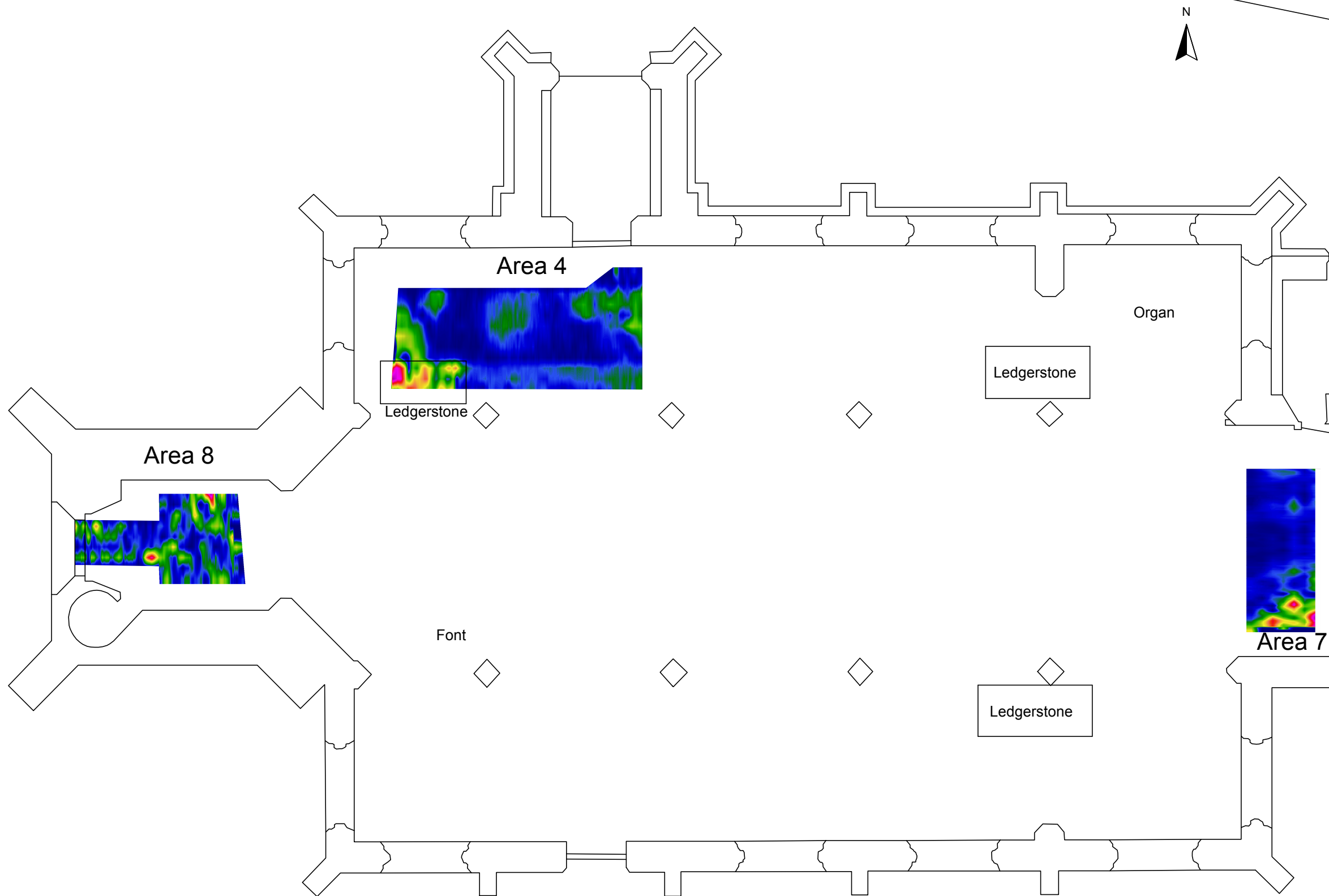
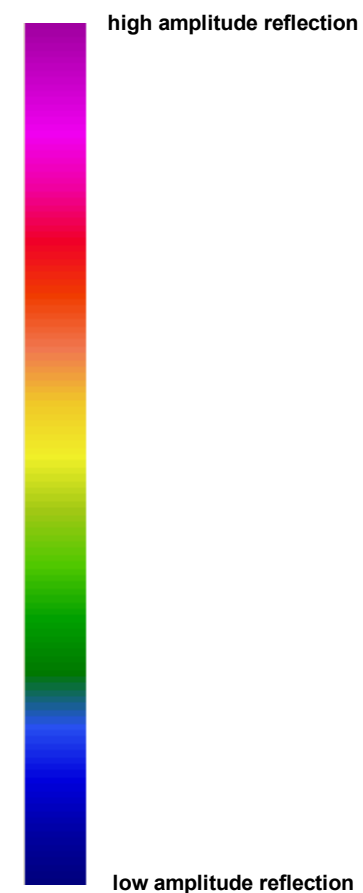


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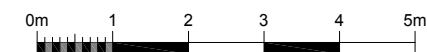


GPR Survey
St Lawrence Church
Lechlade-on-Thames
Gloucestershire

Ground penetrating radar
time slices at 7.5ns
Areas 4, 7 & 8



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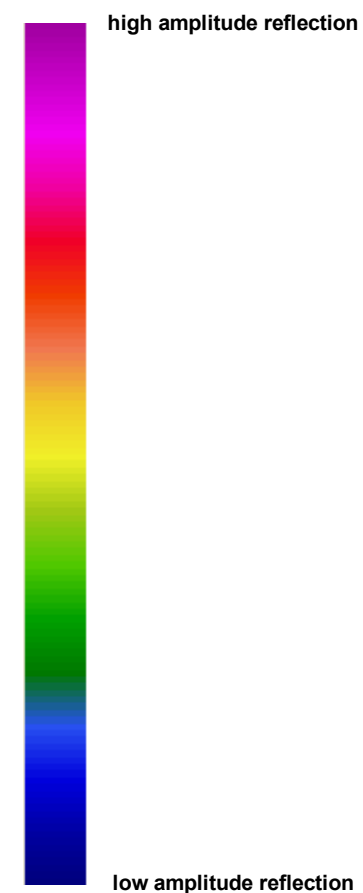


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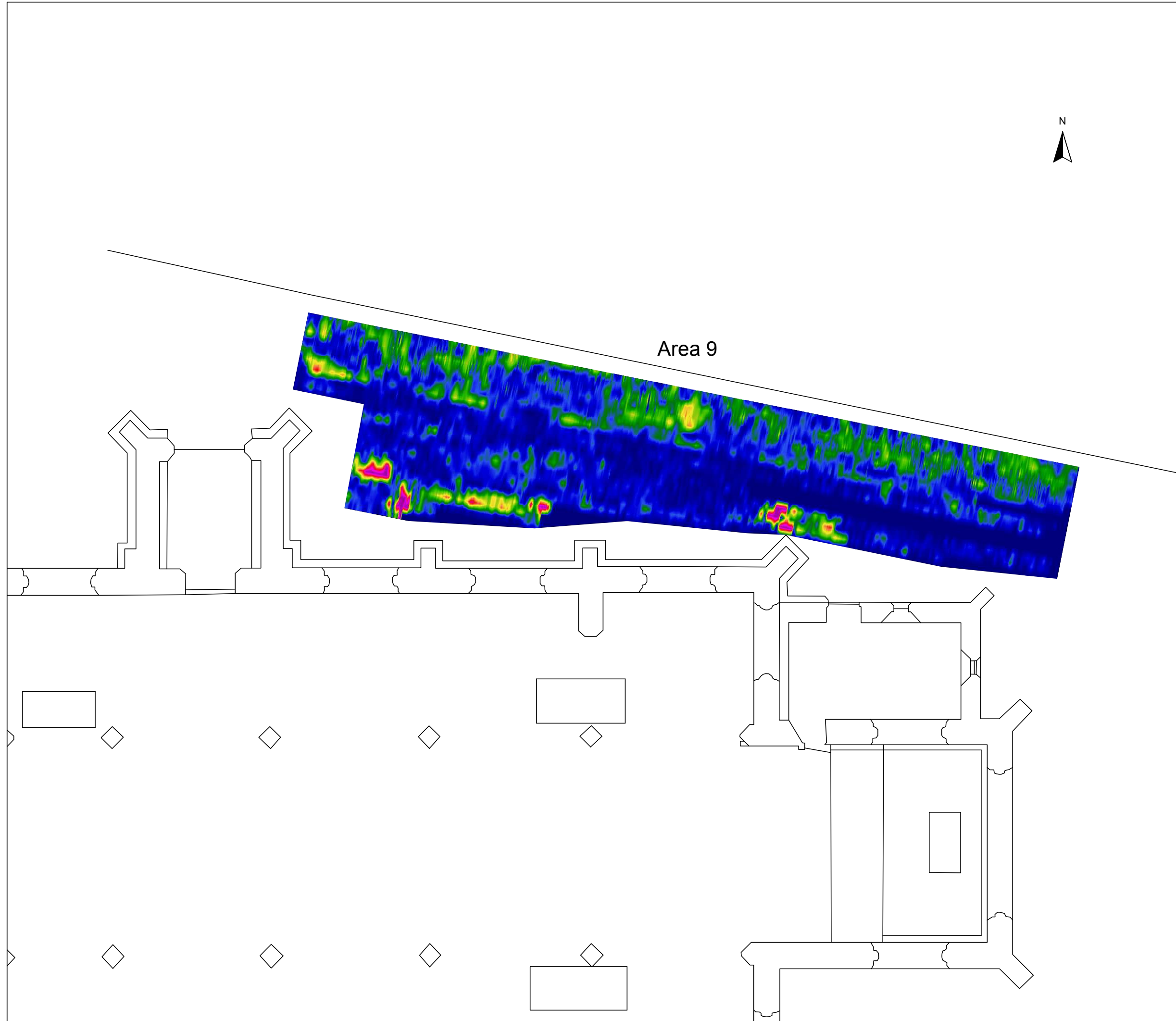


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Lechlade-on-Thames
Gloucestershire**

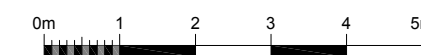
**Ground penetrating radar
time slices at 7.5ns
Area 9**



Area 9



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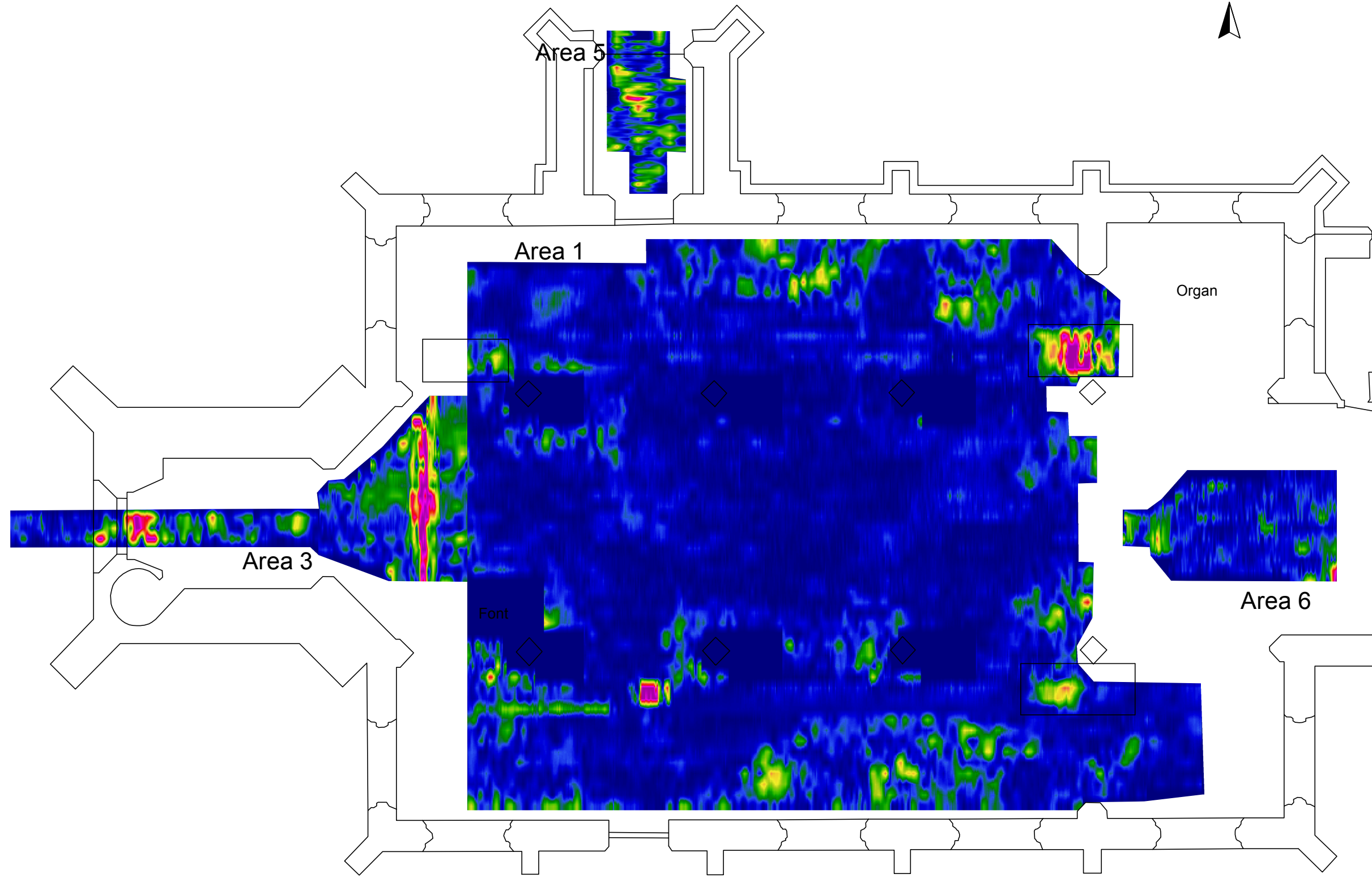
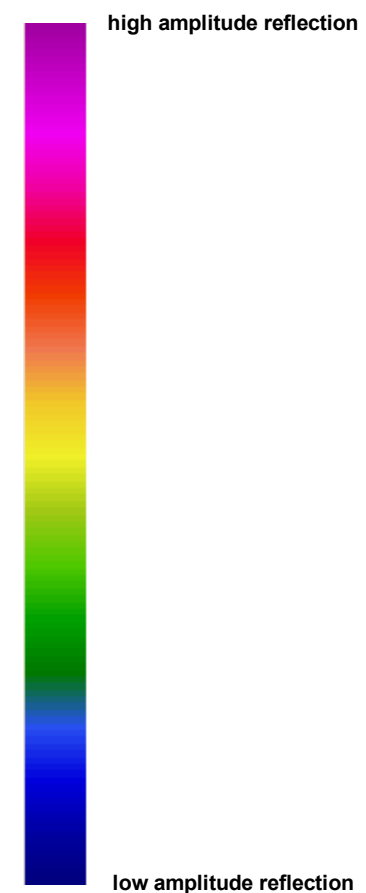


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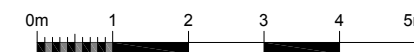


GPR Survey
St Lawrence Church
Lechlade-on-Thames
Gloucestershire

Ground penetrating radar
time slices at 18.75ns
Areas 1, 3, 5 & 6



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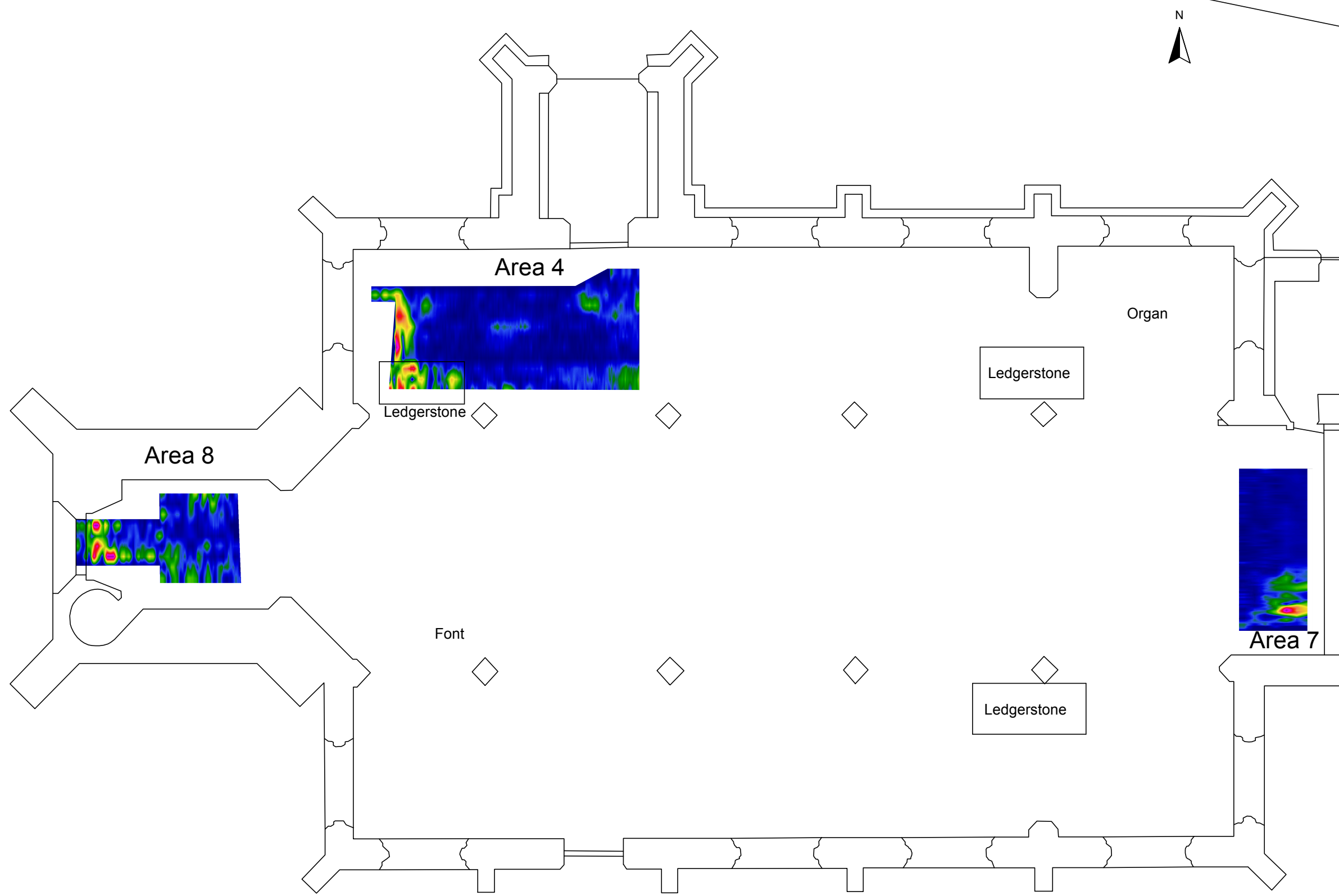


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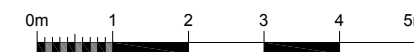


GPR Survey
St Lawrence Church
Lechlade-on-Thames
Gloucestershire

Ground penetrating radar
time slices at 18.75ns
Areas 4, 7 & 8



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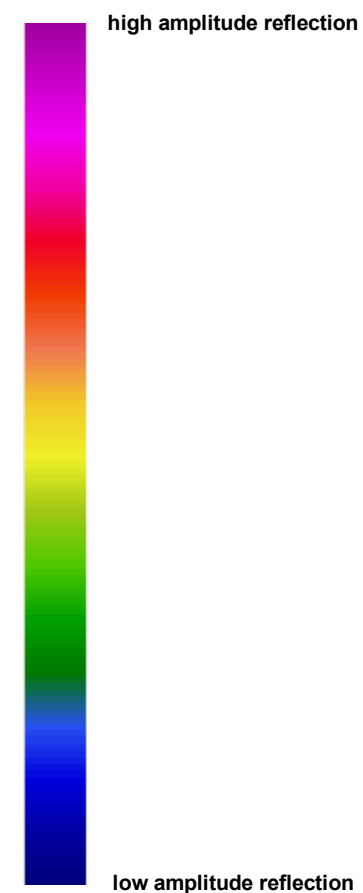


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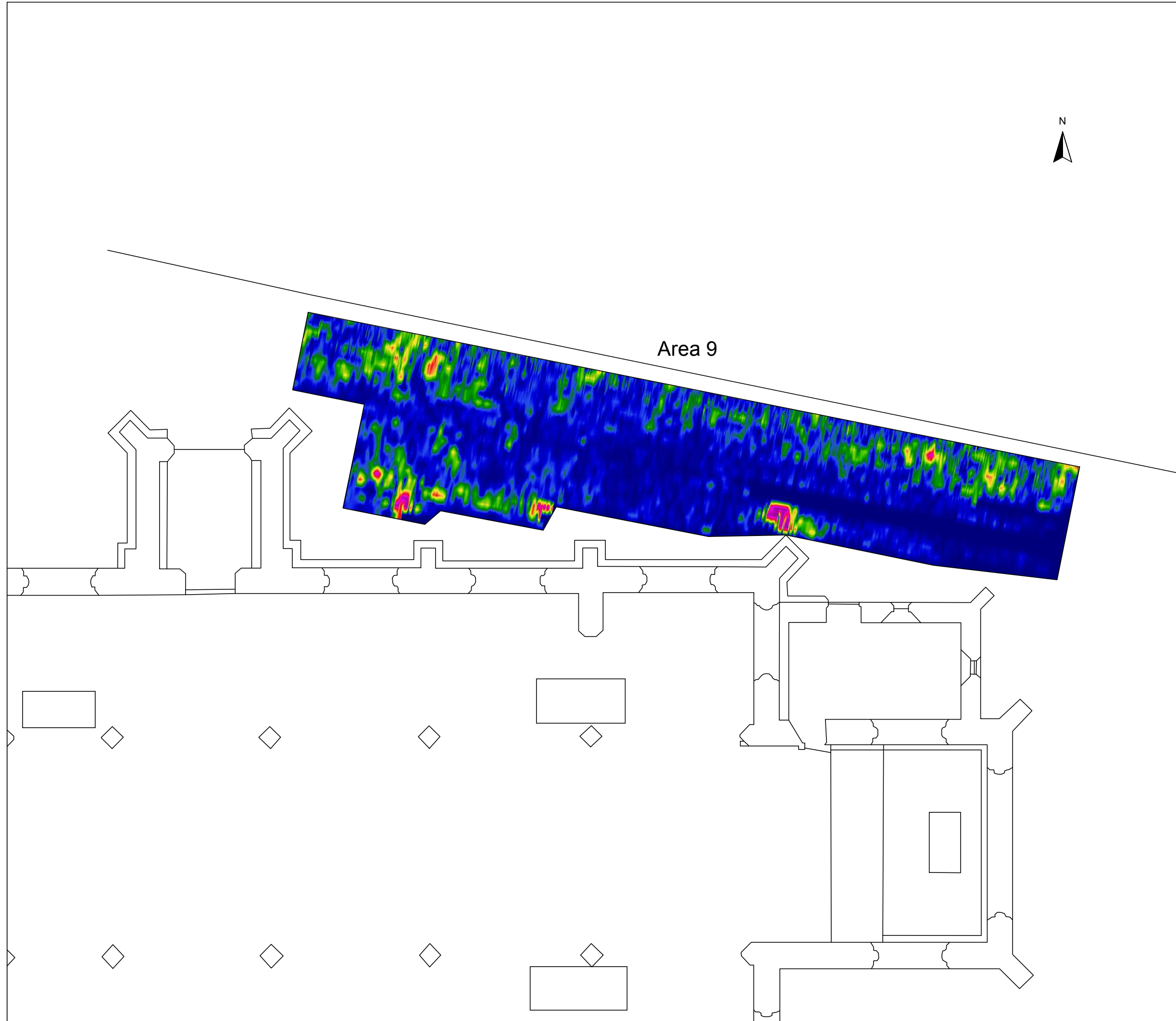


GPR Survey
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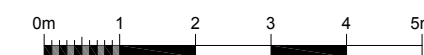
Ground penetrating radar
time slices at 18.75ns
Area 9



Area 9



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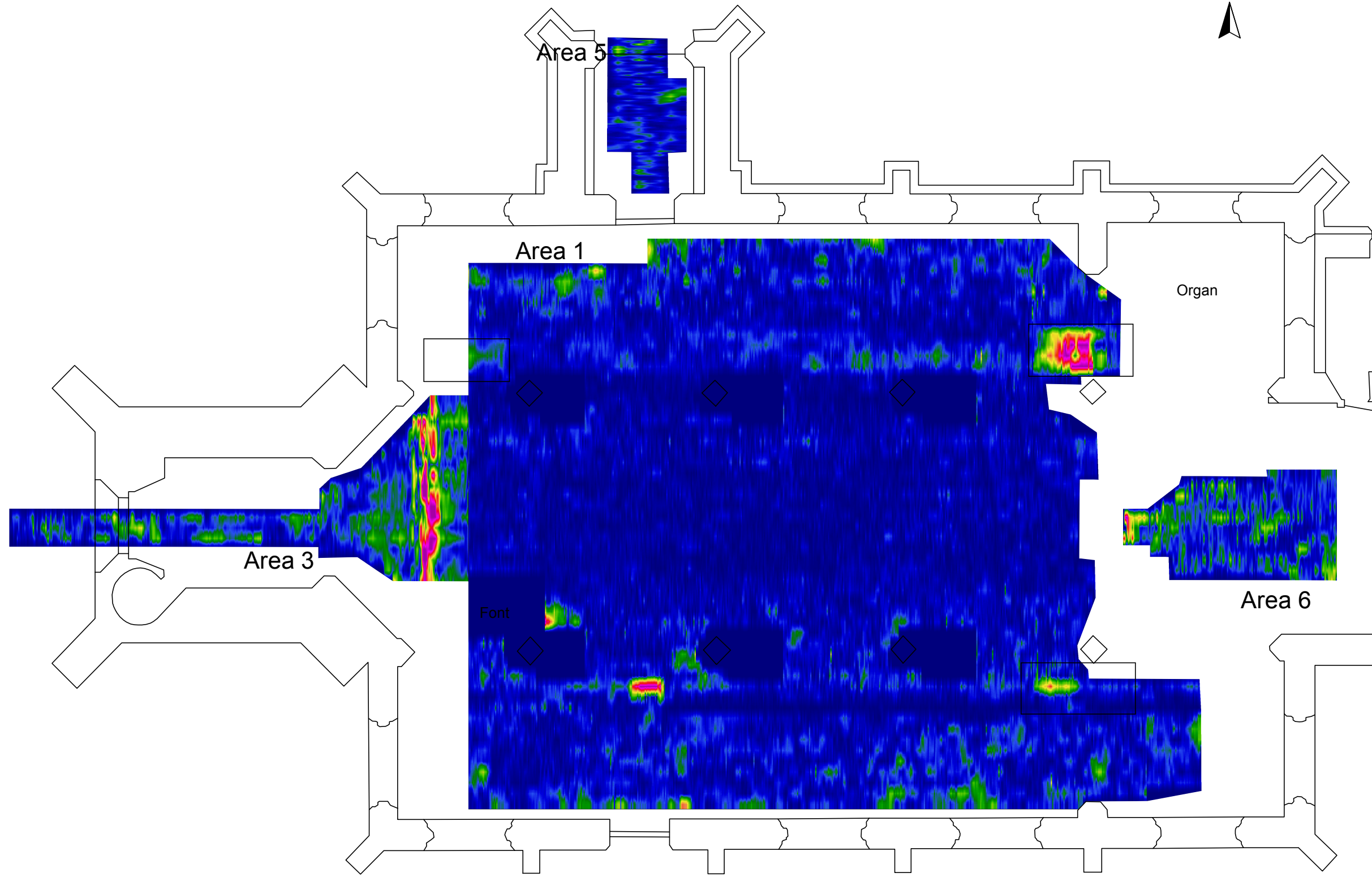
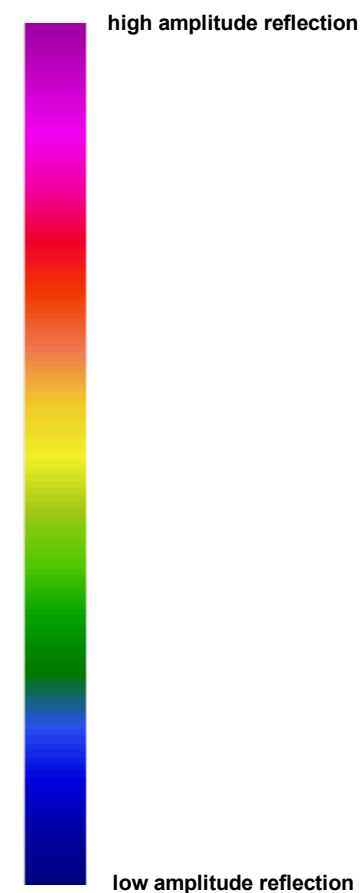
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FIG 12

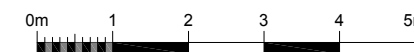


GPR Survey
St Lawrence Church
Lechlade-on-Thames
Gloucestershire

Ground penetrating radar
time slices at 37.5ns
Areas 1, 3, 5 & 6



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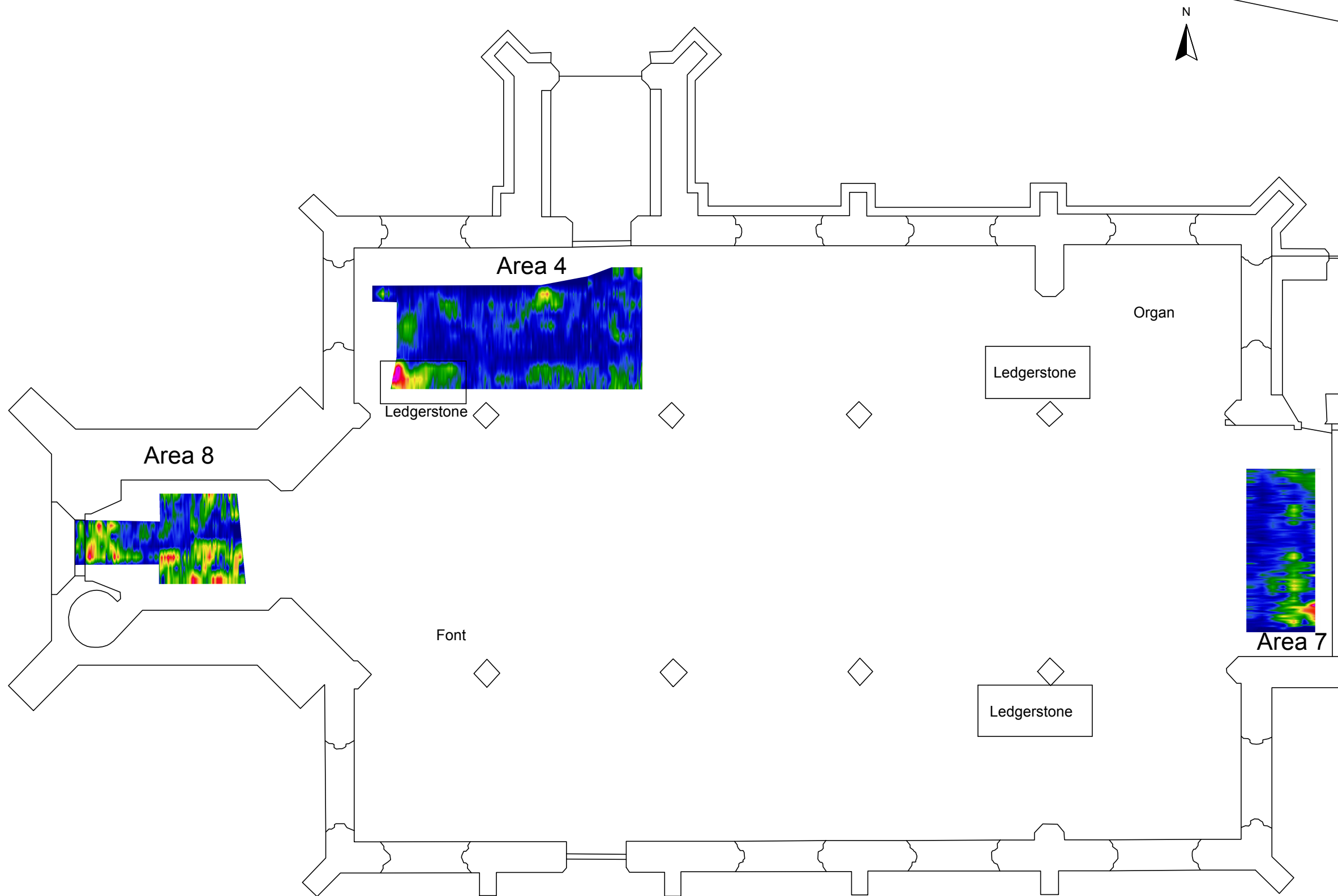
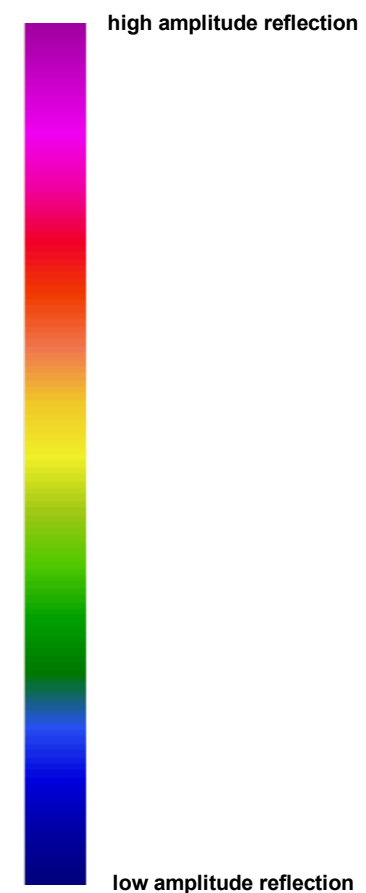


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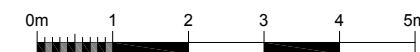


GPR Survey
St Lawrence Church
Lechlade-on-Thames
Gloucestershire

Ground penetrating radar
time slices at 37.5ns
Areas 4, 7 & 8



SCALE 1:100

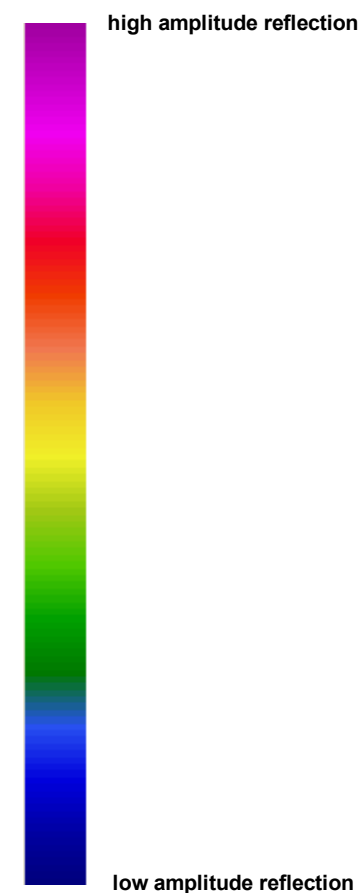


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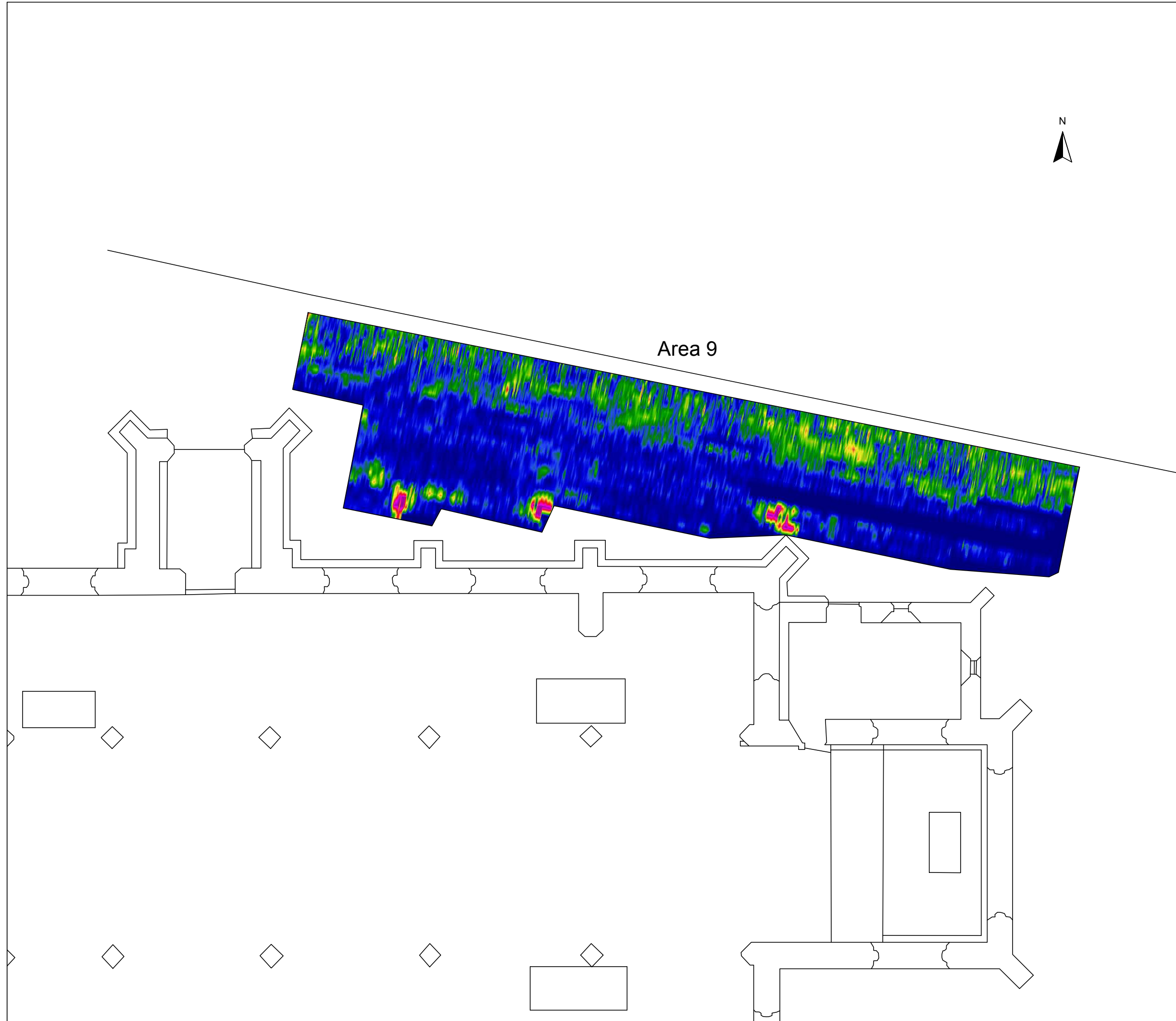


**GPR Survey
St Lawrence Church
Lechlade-on-Thames
Gloucestershire**

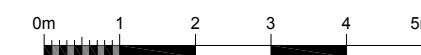
**Ground penetrating radar
time slices at 37.5ns
Area 9**



Area 9



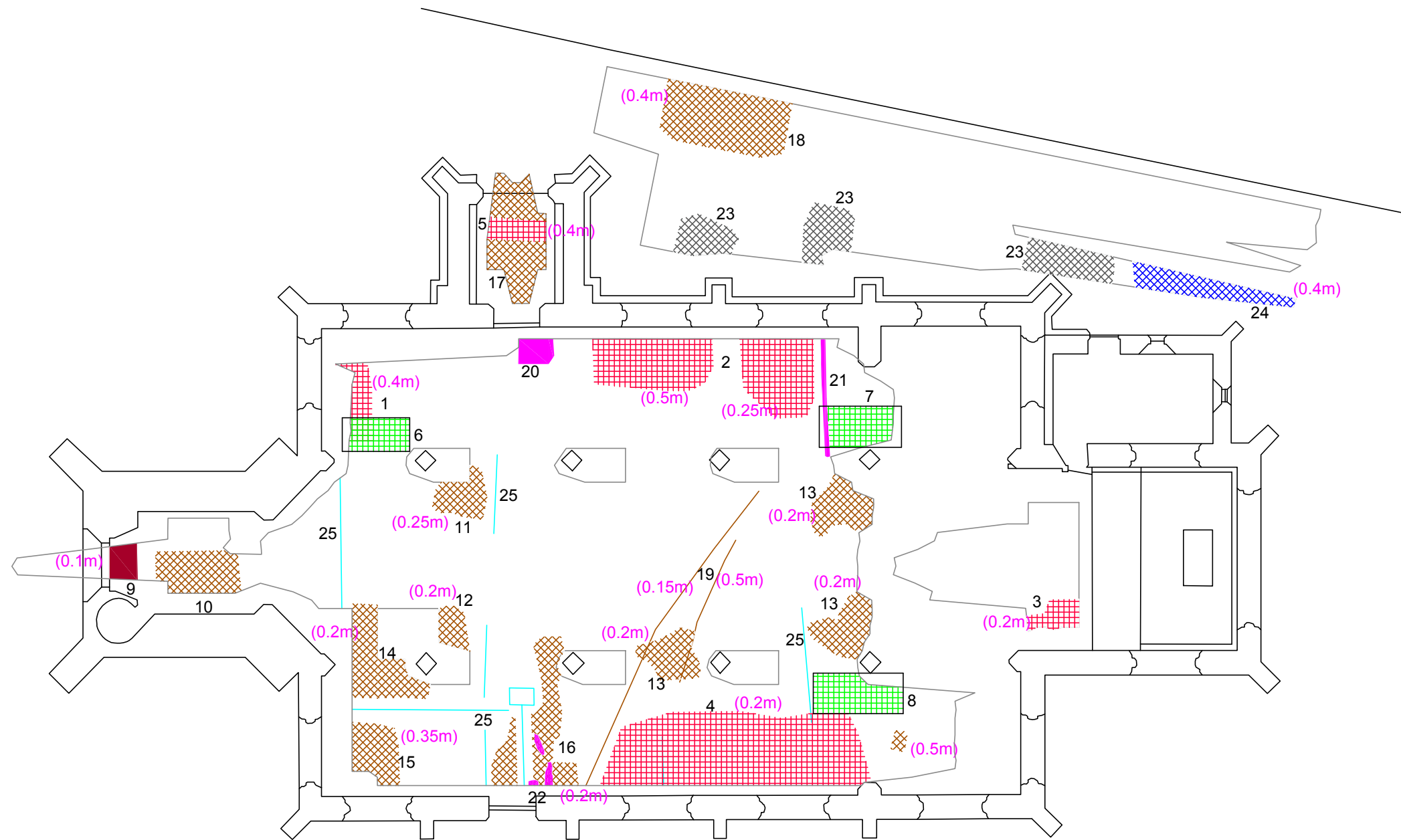
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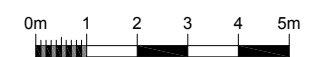
**GPR Survey
St Lawrence Church
Lechlade-on-Thames
Gloucestershire**



**Abstraction and interpretation of
GPR anomalies**

- Linear feature of uncertain origin - possible service.
- Linear feature - service/duct/ventilation
- Planar, hyperbolic and complex reflectors associated with grave or vault
- Planar reflectors associated with ledgerstones
- Planar and complex reflectors of uncertain origin
- Planar and complex reflectors associated with modern ground disturbance/features
- Planar reflectors associated with buried path
- Complex reflectors associated with church structure
- Near surface reflectors associated with shallow voids or metal objects
- 21 GPR anomaly label
- (0.5m) Approximate depth of GPR anomaly

SCALE 1:150



SCALE TRUE AT A3