Historic England

Scientific Dating

# Greenham Barton
# Stawley
# Somerset

## Tree-ring Analysis of Oak Timbers

Martin Bridge and Cathy Tyers

Discovery, Innovation and Science in the Historic Environment

Research Report Series no. 190-2020

Front Cover: Greenham Barton from the south-west. Photograph © Stuart Blaylock November 2017

Research Report Series 190-2020

# GREENHAM BARTON
# STAWLEY
# SOMERSET

## Tree-Ring Analysis of Oak Timbers

Martin Bridge and Cathy Tyers

NGR: ST 08156 20047



ISSN 2059-4453 (Online)

SUMMARY
The building contains remnant medieval aisled trusses, one of which yielded samples producing a 75-year long sequence that dated to the period AD 1205–79. A single timber from this phase had complete sapwood, and was from a tree felled in the winter of AD 1279/80. The other timber had no sapwood but is broadly coeval.

The extant replacement hall roof and the roofs over the service range, the kitchen range, and the south roof over the solar appear to be broadly contemporaneous. All contain timber felled in the mid- to later-eighteenth century, and appear to represent a substantial re-ordering at this time.

CONTRIBUTORS
Martin Bridge and Cathy Tyers

ACKNOWLEDGEMENTS
We are grateful to Stuart Blaylock who carried out an archaeological investigation of the site, for kindly providing background information and the front cover image for our use. We are also grateful to Ellis and Co, the contractors on site who were very accommodating, and Jonathan Rhind Architects for the use of the adapted drawings by Levett Surveying in figures 4–7. Finally we would like to thank the owners who allowed the work to proceed. Shahina Farid (HE Scientific Dating Team) commissioned and facilitated the work.

ARCHIVE LOCATION
Somerset Historic Environment Record
Somerset Heritage Centre
Brunel Way
Norton Fitzwarren,
Taunton TA2 6SF

DATE OF INVESTIGATION
2019

CONTACT DETAILS

Martin Bridge
UCL Institute of Archaeology
31-34 Gordon Square
London WC1H 0PY
martin.bridge@ucl.ac.uk

Cathy Tyers
Historic England
Cannon Bridge House
25 Dowgate Hill
London EC4R 2YA
cathy.tyers@historicengland.org.uk

# CONTENTS

Introduction........................................................................................................ 1
Methodology........................................................................................................ 1
Ascribing felling dates and date ranges........................................................ 2
Results, Interpretation, and Discussion ............................................................ 2
Conclusions........................................................................................................ 4
References........................................................................................................ 5
Tables ............................................................................................................... 7
Figures............................................................................................................. 12
Appendix.......................................................................................................... 20

## INTRODUCTION

This manor house is listed at Grade I (LEN 1176225) and is situated in the far west of the county, north of the A38, about 5km west of Wellington and very close to the border with Devon (Fig 1). It is largely medieval and mid-sixteenth century in appearance, with later additions. The porch, screen passage, and kitchen are believed to survive from an earlier house, and recent work by the archaeologist Stuart Blaylock (2017; 2018) suggests that the shell of the great hall also dates to an earlier phase. Recent renovation work exposed elements suggesting the original house could be very early in date (Figs 2–3), and dendrochronological dating was requested by Rhiannon Rhys, HE Inspector of Historic Buildings and Areas, to enhance understanding of the early roof form exposed, and inform its significance, especially in comparison with a corpus of early structures in South Somerset identified by Penoyre (1998; 2005).

## METHODOLOGY

An assessment of the timbers for dendrochronological study sought accessible oak timbers with more than 50 rings and where possible traces of sapwood, although slightly shorter sequences are sometimes sampled if little other material is available. Those timbers judged to be potentially useful were cored using a 16mm auger attached to an electric drill. The cores were labelled, and stored for subsequent analysis.

The cores were polished on a belt sander using 80 to 400 grit abrasive paper to allow the ring boundaries to be clearly distinguished. The samples had their tree-ring sequences measured to an accuracy of 0.01mm, using a specially constructed system utilising a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to a PC, which recorded the ring widths into a dataset. The software used in measuring and subsequent analysis was written by Ian Tyers (2004). Cross-matching was attempted by a process of qualified statistical comparison by computer, supported by visual checks. The ring-width series were compared for statistical cross-matching, using a variant of the Belfast CROS program (Baillie and Pilcher 1973). Ring sequences were plotted on the computer monitor to allow visual comparisons to be made between sequences. This method provides a measure of quality control in identifying any potential errors in the measurements when the samples cross-match.

In comparing one sample or site master against other samples or chronologies, *t*-values over 3.5 are considered significant, although in reality it is common to find demonstrably spurious *t*-values of 4 and 5 because more than one matching position is indicated.  For this reason, dendrochronologists prefer to see some *t*-value ranges of 5, 6, and higher, and for these to be well replicated from different, independent chronologies with both local and regional chronologies well represented, except where imported timbers are identified. Where two individual samples match together with a *t*-value of 10 or above, and visually exhibit exceptionally similar ring patterns, they may have originated from the same parent tree. Same-tree matches can also be identified through the external characteristics of the timber itself, such as knots and shake patterns. Lower *t*-values however do not preclude same tree derivation.

*Ascribing felling dates and date ranges*

Once a tree-ring sequence has been firmly dated in time, a felling date, or date range, is ascribed where possible. With samples which have sapwood complete to the underside of, or including bark, this process is relatively straightforward. Depending on the completeness of the final ring (ie if it has only the spring vessels or early wood formed, or the latewood or summer growth) a precise felling date and season can be given. If the sapwood is partially missing, or if only a heartwood/sapwood transition boundary survives, then an estimated felling date range can be given for each sample. The number of sapwood rings can be estimated by using an empirically derived sapwood estimate with a given confidence limit. If no sapwood or heartwood/sapwood boundary survives then the minimum number of sapwood rings from the appropriate sapwood estimate is added to the last measured ring to give a *terminus post quem* (*tpq*) or felled-after date.

A review of the geographical distribution of dated sapwood data from historic timbers has shown that a sapwood estimate relevant to the region of origin should be used in interpretation, which in this area is 9–41 rings (Miles 1997). It must be emphasised that dendrochronology can only date when a tree has been felled, not when the timber was used to construct the structure or object under study.

## RESULTS, INTERPRETATION, AND DISCUSSION

A plan of the building, identifying the areas from which samples were obtained, is provided as Figure 4. Details of the samples are given in Table 1, with their locations shown in Figures 5–7. No plan is available to locate the positions of samples gmbt03 and gmbt04, which were obtained from the south roof (south of the Hall, but with an axis perpendicular to the Hall roof).

Six samples were taken from the remnant primary-phase timbers (see Figs 2–6). Unfortunately other timbers in this phase were not sampled because they were assessed as having too few rings, and of those sampled, three were found to have fewer than 40 rings and were not analysed further. A joist from the floor in the porch (gmbt22) showed a very rapid growth decline in the middle of its growth curve, and this did not match any other samples from the site, neither did it date on its own. The remaining two samples, both from the north aisled truss matched each other ($t$ = 5.3 with 30 years overlap) and were both dated independently as a means of checking this relatively short overlap. The combined series, gmbt1415, dated to the period AD 1205–79, some of the strongest matches being shown in Table 2 and the relative overlaps of the two series illustrated in Figure 8. One of these samples retained complete sapwood, indicating that the east arcade post was derived from a tree felled in the winter of AD 1279/80. The other dated sample, from the west arch brace, had no sapwood but is thought likely to be broadly contemporaneous.

Obviously dating a whole phase on the basis of a single timber would not be advised, although it probably gives a good indication of the date of this phase, and is in line with other similar dates for buildings of this type in the county (Penoyre 1998; 2005)

Elsewhere in the building, timbers were sampled from the extant hall roof, the south roof (over the solar), the service-range roof, and the kitchen-range roof (Fig 4), as well as some other timbers in the kitchen range and in the ground floor of the solar (Table 1). Samples from three timbers were found to have fewer than 40 rings and were not analysed further. Some samples had bands of very narrow rings where the ring boundaries could not be distinguished. These were measured in sections where the rings were reliably distinguishable (eg gmbt08 where a band of rings between gmbt08i and gmbt08ii could not be resolved, along with samples gmbt06 and gmbt20). Other series (gmbt29 and gmbt30) had complete sapwood, but this became detached during coring, although few rings (up to five rings) were thought to have been lost between the two sections of the core. Similarly, gmbt04 and gmbt16 both lost a few outer rings on coring, again it was thought that no more than five rings were lost. Sample gmbt32 had a band of very narrow rings at the outside, complete to the bark, but in this instance it was very difficult to even estimate how many rings were present. Two samples were taken from gmbt12 (gmbt12a and gmbt12b) to ensure recovery of the complete sapwood and these two series were combined for subsequent analysis.

The ring-width series from 23 timbers cross-matched (Table 3; Fig 9), including four pairs of series that cross-match with *t*-values of 10 or more which could therefore represent a pair of timbers derived from the same parent tree (gmbt12 and gmbt13; gmbt17 and gmbt19; gmbt26 and gmbt32; gmbt29 and gmbt30). Their series were therefore combined prior to being incorporated into a site chronology, GMBTt23. This was compared to an extensive series of reference chronologies and was securely dated to the period AD 1576–1770, some of the strongest matches being shown in Table 4. This site chronology included the three timbers from the roof over the solar (south roof), eight from the hall roof, five from the service-range roof, and seven from the kitchen-range roof. All of these roofs appear to be broadly contemporaneous (Fig 9) and appear to represent a substantial re-ordering of the house at this time.

The roof over the kitchen range has timbers derived from trees felled in the winter of AD 1755/56 and the spring of AD 1762 (Fig. 9). This, combined with the variable felling date ranges obtained for the other timbers from this roof, suggests that felling for this phase of building works was undertaken over a period of several years with short-term stockpiling of timber in advance of the commencement of building works.

The hall roof had one sample with complete sapwood, the timber being derived from a tree felled in the spring of AD 1767. The other dated timbers from this roof appear to form a coherent group, most likely felled at the same or a similar time, again with possible short-term stockpiling, with the re-roofing of the hall taking place shortly after felling.

The service-range roof had one sample that lost a small number of rings out to the bark edge during coring, and was derived from a tree estimated therefore as felled in the period AD 1766–70. The other timbers from the service-range roof appear to form a coherent group most likely felled at the same, or similar, time with the roof being constructed shortly after felling.

The south roof (over the solar) looks to have been rebuilt with its long axis perpendicular to the original roof, and has timbers from trees felled in the period AD 1744–48 and in the winter of AD 1770/71. Thus construction may again have used stockpiled timbers, but it is of interest to note that some timbers in this roof look to be re-used and were not sampled. Further survey of this roof may be needed to clarify the dendrochronological evidence.

Timbers that were not subsequently dated were mostly embedded in walls or on the ground floor.

## CONCLUSIONS

This study has dated some remnants of the original house as constructed from timber felled in AD 1279/80. The combined site sequence, gmbt1415, shows the highest levels of similarity with reference chronologies from the south-west region (Table 2) suggesting that the timber is of relatively local origin.

The house was re-roofed in the latter half of the eighteenth century, using timbers that appear to have been felled in anticipation of the works and stockpiled for a short period before they were used in construction. Works appear to have proceeded from north–south, from the early AD 1760s (the kitchen-range roof) to the early AD 1770s (the south roof over the solar). Felling date ranges for timbers from the service-range roof and Hall roof are consistent with these areas of the house being re-roofed in the later AD 1760s. The combined site sequence, GMBTt23, shows the highest levels of similarity with reference chronologies from more varied regions suggesting the possibility that the timbers were derived from a source somewhat less local, although nevertheless most likely of southern English origin. It remains a possibility, bearing in mind the apparent short-term stockpiling, that the timbers were derived from several different woodland sources within an area.

## REFERENCES


Arnold, A J, Howard, R E, and Litton, C D 2004 *Tree-ring analysis of timbers from Kibworth Harcourt Post Mill, Kibworth Harcourt, Leicestershire*, Centre for Archaeol Rep, 76/2004

Arnold, A J, Howard, R E, and Tyers, C, forthcoming *Kirby Hall, Deene, Corby, Northamptonshire, Tree-ring Analysis of Timbers*, Historic England Res Rep Ser, 36/2015

Baillie, M G L, and Pilcher, J R, 1973 A simple cross-dating program for tree-ring research, *Tree Ring Bulletin*, 33, 7–14

Blaylock, S, 2017 *Historic buildings Survey of Greenham Barton, Wellington, Somerset,* unpubl report Nov 2017

Blaylock, S, 2018 *Archaeological watching brief on preliminary investigations at Greenham Barton, Wellington, Somerset,* unpubl report March 2018

Bridge, M C, 1996 List 69 Tree-ring dates,*Vernacular Architect*, 27, 91–2

Bridge, M C, 1998 List 86 Tree-ring dates,*Vernacular Architect*, 29, 105–6

Bridge, M C, 2001 *Tree-ring analysis of timbers from the Abbey Barn, Glastonbury, Somerset*, Centre for Archaeol Rep, 39/2001

Bridge, M C, 2012 *St Anne's Chapel, Paternoster Row, Barnstaple, Devon,Ttree-ring Analysis of Oak Timbers from the Roof and Crypt*, English Heritage Res Rep Ser, 41/2012

Bridge, M C, and Miles, D, 2016 Tree-Ring Date Lists, *Vernacular Architect*, 47, 87–92

Groves, C, and Hillam, J, 1994a *Dendrochronological analysis of the tithe barn, Englishcombe, near Bath, Avon, 1994*, Anc Mon Lab Rep, 64/94

Groves, C, and Hillam, J, 1994b *Tree-ring analysis of the medieval hall roof of Marwell Hall, Hampshire, 1993*, Anc Mon Lab Rep, 8/94

Hillam, J, 1991 *Tree-ring dating of oak cores from the Tithe Barn at Winterbourne near Bristol, Avon*, Anc Mon Lab Rep, 46/91

Howard, R E, Laxton, R R, and Litton, C D, 1999 *Tree-ring analysis of timbers from Bretby Hall, Bretby, Derbyshire*, Anc Mon Lab Rep, 43/1999

Miles, D H, 1997 The interpretation, presentation, and use of tree-ring dates, *Vernacular Architect*, **28**, 40–56

Miles, D, 2003 Dating Buildings and Dendrochronology in Hampshire, in *Hampshire Houses 1250 - 1700: Their Dating and Development* (ed E Roberts), 220–6, Southampton (Hampshire County Council)

Miles, D H, 2004 *Working compilation of reference chronologies centred around Somerset by various researchers*, unpubl computer file *SOMRST04*, Oxford Dendrochronology Laboratory

Miles, D H, and Haddon-Reece, D, 1995 Tree-ring dates, *Vernacular Architect*, **26**, 60–74

Miles, D H, and Worthington, M J, 1997 Tree-ring dates, *Vernacular Architect*, **28**, 159–81

Miles, D H, and Worthington, M J, 2000 Tree-ring dates, *Vernacular Architect*, **31**, 90–113

Miles, D H, Worthington, M J, and Bridge, M C, 2003 Tree-ring dates, *Vernacular Architect*, **34**, 109–13

Miles, D H, Worthington, M J, and Bridge, M C, 2005 Tree-ring dates, *Vernacular Architect*, **36**, 87–101

Mills, C M, 1988 *Dendrochronology of Exeter and its application*, unpubl PhD thesis, Sheffield Univ

Penoyre, J, 1998 Medieval Somerset Roofs, *PSANHS*, **141**, 78–81

Penoyre, J, 2005 *Traditional Houses of Somerset,* 93–5, Glastonbury (Somerset Books)

Tyers, C, Hurford, M, Arnold, A, Howard, R, and Thorp, J, forthcoming *Dendrochronological Research in Devon: Phase II,* Historic England Res Rep Ser

Tyers, I, 2004 *Dendro for Windows Program Guide* ,3rd edn, ARCUS Report, **500b**

Wilson, R, Miles, D, Loader, N J, Melvin, T, Cunningham, L, Cooper, R, and Briffa, K, 2012 A millennial long March-July precipitation reconstruction for southern-central England, *Climate Dynamics*, **40**, 997–1017

# TABLES

*Table 1: Details of tree-ring samples taken from Greenham Barton, Stawley, Somerset*

| Sample number | Location | Total number of rings | Date of sequence (AD) | Sapwood rings | Mean ring width (mm) | Mean sensitivity | Felling date range (AD) |
|---|---|---|---|---|---|---|---|
| *Remnant primary-phase timbers* | | | | | | | |
| gmbt01 | Tiebeam to south remnant base cruck truss | <40 | - | h/s | NM | - | - |
| gmbt02 | West vertical post above south tiebeam | <40 | - | h/s | NM | - | - |
| gmbt14 | East arcade post to north aisled truss | 60 | 1220–1279 | 17C | 3.42 | 0.18 | winter 1279/80 |
| gmbt15 | West arch brace to north aisled truss | 45 | 1205–1249 | - | 2.89 | 0.26 | after 1258 |
| gmbt21 | East-most joist in porch floor (first floor level) | <40 | - | h/s | NM | - | - |
| gmbt22 | 7th joist from east wall in porch floor (1st floor level) | 61 | - | h/s | 2.21 | 0.23 | - |
| *South roof (over solar)* | | | | | | | |
| gmbt03 | West upper purlin | 80 | 1691–1770 | 18C | 2.08 | 0.19 | winter 1770/71 |
| gmbt04 | East middle purlin | 157 | 1587–1743 | 8 (+≤5NMC) | 0.98 | 0.24 | 1744–48 |
| gmbt05 | East lower purlin | 70 | 1683–1752 | h/s | 2.89 | 0.22 | 1761–93 |
| *Hall roof (trusses numbered from south end)* | | | | | | | |
| gmbt06i | West principal rafter T1 (inner rings) | 70+11NM | 1576–1645 | - | 1.32 | 0.18 | - |
| gmbt06ii | *ditto* (middle rings) | 49+2NM | 1657–1705 | - | 0.89 | 0.22 | - |
| gmbt06iii | *ditto* (outer rings) | 32 | 1708–1739 | - | 1.51 | 0.18 | after 1748 |
| gmbt07 | West purlin, bay T1-T2 | 131 | 1604–1734 | h/s | 1.17 | 0.22 | 1743–75 |
| gmbt08i | East purlin, bay T1-T2 (inner rings) | 60+*c*15NM | - | - | 1.23 | 0.17 | - |
| gmbt08ii | *ditto* (outer rings) | 78 | 1644–1721 | h/s | 0.59 | 0.19 | 1730–62 |
| gmbt09 | East principal rafter T1 | 91 | 1658–1748 | h/s | 1.37 | 0.21 | 1757–89 |
| gmbt10 | West principal rafter T2 | 86 | 1658–1743 | h/s | 1.20 | 0.25 | 1752–84 |
| gmbt11 | East purlin, bay T2-T3 | 139 | 1610–1748 | 2 | 0.87 | 0.22 | 1755–87 |
| gmbt12 | West principal rafter T3 | 144 | 1623-1766 | 27¼C | 0.85 | 0.18 | spring 1767 |
| *gmbt12a* | *ditto* | *144* | *1623–1766* | *27¼C* | *0.83* | *0.18* | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *gmbt12b* | *ditto* | *72* | *1695–1766* | *27¼C* | *0.67* | *0.17* | - |
| gmbt13 | East principal rafter T3 | 126 | 1615–1740 | h/s | 1.08 | 0.21 | 1749–81 |
| *Service-range roof (trusses numbered from south end)* | | | | | | | |
| gmbt16 | West principal rafter T1 | 124 | 1642-1765 | 26 (+≤5NMC) | 0.98 | 0.27 | 1766–70 |
| gmbt17 | East principal rafter T2 | 142 | 1596–1737 | 8 | 1.05 | 0.31 | 1738–70 |
| gmbt18 | East principal rafter T4 | 130 | 1605–1734 | 2 | 1.17 | 0.28 | 1741–73 |
| gmbt19 | East principal rafter T3 | 115 | 1624–1738 | 2 | 0.92 | 0.29 | 1745–77 |
| gmbt20i | West principal rafter T2 (inner rings) | 75+*c*19NM | 1610–84 | - | 1.03 | 0.22 | *c* 1736–68 |
| gmbt20ii | *ditto* (outer rings) | 31 | - | 7 | 0.43 | 0.20 | - |
| *Kitchen range (roof trusses numbered from the west end)* | | | | | | | |
| gmbt23 | Post embedded in north wall of kitchen at first floor | <40 | - | - | NM | - | - |
| gmbt24 | Ground floor, east ceiling beam | <40 | - | - | NM | - | - |
| gmbt25 | Inner lintel to east window, ground floor north wall | 43 | - | h/s | 2.77 | 0.21 | - |
| gmbt26 | South principal rafter T1 | 96 | 1660–1755 | 34C | 1.18 | 0.26 | winter 1755/56 |
| gmbt27 | North principal rafter T1 | 89 | 1625–1713 | 2 (+14NM) | 1.46 | 0.26 | 1727–52 |
| gmbt28 | Upper north purlin, bay T1-T2 | 94 | 1668–1761 | 34¼C | 0.99 | 0.17 | spring 1762 |
| gmbt29 | North principal rafter T2 | 90 | 1651–1740 | h/s (+≤5NM+20NMC) | 1.47 | 0.22 | 1760–65 |
| gmbt30 | South principal rafter T2 | 72 | 1665–1736 | h/s (+≤5NM+21NMC) | 1.24 | 0.23 | 1757–62 |
| gmbt31 | South upper purlin, by T2-T3 | 63 | 1699–1761 | 10¼C | 1.75 | 0.16 | spring 1762 |
| gmbt32 | North principal rafter T3 | 71 | 1641–1711 | h/s (+*c* 35NMC) | 1.87 | 0.28 | *c* 1746–51 |
| *South ground floor (under solar)* | | | | | | | |
| gmbt33 | East-west beam north of screen | 117 | - | h/s | 1.63 | 0.18 | |
| gmbt34 | Half-beam at north end of room | <40 | - | - | NM | - | - |

Key: C = complete sapwood, felled winter; ¼C = complete sapwood, felled the following spring; *c* = estimated number of additional rings; h/s = heartwood/sapwood boundary; NM = not measured

*Table 2. Dating evidence for the site chronology gmbt1415, AD 1205–1279*

| Source region | Chronology | Publication reference | Filename | Span of chronology (AD) | Overlap (years) | *t*-value |
|---|---|---|---|---|---|---|
| *Regional chronologies* | | | | | | |
| Somerset | Somerset Master Chronology | Miles 2004 | SOMRST04 | 770–1979 | 75 | 6.0 |
| S Central England | South Central England | Wilson *et al* 2012 | SCENG | 663–2009 | 75 | 5.2 |
| *Site chronologies* | | | | | | |
| Somerset | Higher Broughton | Miles and Worthington 1997 | HIRBRWTN | 1173–1265 | 61 | 6.1 |
| Somerset | Crane Farm, Somerton | Miles and Worthington 2000 | crane12 | 1171–1337 | 75 | 6.0 |
| Somerset | Englishcombe Tithe Barn | Groves and Hillam 1994a | ENGCOMBE | 1157–1304 | 75 | 5.7 |
| Devon | Exeter Cathedral | Mills 1988 | EXCATH1 | 1137–1332 | 75 | 5.6 |
| Gloucestershire | Winterbourne Tithe Barn | Hillam 1991 | WNTERBR1 | 1187–1316 | 75 | 5.6 |
| Somerset | Abbey Barn, Glastonbury | Bridge 2001 | GLAST | 1095–1334 | 75 | 5.4 |
| Somerset | Castlebrook Farm, Compton Dundon | Miles *et al* 2003 | CMPTDNDN | 1109–1263 | 59 | 5.4 |
| Devon | St Anne's Chapel, Barnstaple | Bridge 2012 | BRNSTPL1 | 1344–1531 | 75 | 5.2 |
| Hampshire | Marwell Hall, Winchester | Groves and Hillam 1994b | MARWELL | 1138–1281 | 75 | 5.2 |
| Devon | Barton House, Otterton | Tyers *et al* forthcoming | OTBHT3F | 1161–1288 | 75 | 5.0 |

*Table 3. Cross-matching between the dated elements of site chronology gmbtT23. The figures are t-values, n/a being instances where there is no overlap, or there are less than 20 years overlap, values over 3.5 are significant. Sample labels are reduced to the number only. Those highlighted in grey represent same tree pairs.*

| | **04** | **05** | **06i** | **06ii** | **06iii** | **07** | **08ii** | **09** | **10** | **11** | **12** | **13** | **16** | **17** | **18** | **19** | **20i** | **26** | **27** | **28** | **29** | **30** | **31** | **32** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **03** | 4.8 | 9.2 | n/a | n/a | 5.4 | 2.2 | 2.8 | 7.5 | 5.3 | 7.4 | 4.2 | 2.2 | 5.2 | 2.6 | 2.8 | 4.5 | n/a | 1.3 | 5.0 | 2.2 | 6.5 | 6.0 | 3.7 | 1.8 |
| **04** | | 4.6 | 6.8 | 4.7 | 5.0 | 5.9 | 5.1 | 5.4 | 7.5 | 8.3 | 7.9 | 5.1 | 6.2 | 8.8 | 6.7 | 8.5 | 5.0 | 4.4 | 4.3 | 4.2 | 4.4 | 3.7 | 2.1 | 6.7 |
| **05** | | | n/a | 2.1 | 3.8 | 2.9 | 2.2 | 6.0 | 3.9 | 4.9 | 3.5 | 2.5 | 4.4 | 3.3 | 4.5 | 3.9 | n/a | 2.4 | 2.6 | 2.8 | 4.8 | 5.4 | 2.0 | 2.2 |
| **06i** | | | | n/a | n/a | 3.6 | n/a | n/a | n/a | 3.6 | 2.8 | 2.9 | n/a | 4.8 | 3.7 | 7.8 | 2.8 | n/a | 1.4 | n/a | n/a | n/a | n/a | n/a |
| **06ii** | | | | | n/a | 1.8 | n/a | 7.5 | 6.1 | 3.9 | 5.3 | 4.5 | 5.0 | 3.1 | 4.4 | 3.5 | 2.5 | 4.0 | 3.3 | 3.8 | 2.6 | 2.6 | n/a | 5.5 |
| **06iii** | | | | | | 2.1 | 2.5 | 6.3 | 6.3 | 4.1 | 2.7 | 1.6 | 3.6 | 0.7 | 4.7 | 2.5 | n/a | 0.5 | n/a | 1.1 | 2.0 | 1.3 | 3.1 | n/a |
| **07** | | | | | | | 5.0 | 2.7 | 2.9 | 6.2 | 4.6 | 2.8 | 5.2 | 6.5 | 5.9 | 5.1 | 3.0 | 2.8 | 2.4 | 1.2 | 2.6 | 1.4 | 2.5 | 2.4 |
| **08ii** | | | | | | | | 2.9 | 3.1 | 4.5 | 5.2 | 4.1 | 5.4 | 5.5 | 4.5 | 4.4 | 3.8 | 3.7 | 3.2 | 3.1 | 2.9 | 1.9 | 3.8 | 4.1 |
| **09** | | | | | | | | | 7.4 | 5.6 | 4.5 | 3.2 | 7.3 | 4.1 | 5.3 | 5.3 | 0.8 | 3.8 | 3.2 | 4.4 | 4.6 | 4.0 | 4.5 | 3.9 |
| **10** | | | | | | | | | | 7.3 | 7.2 | 4.8 | 8.0 | 4.9 | 4.3 | 8.8 | 3.3 | 5.0 | 4.1 | 3.1 | 4.7 | 4.4 | 3.0 | 5.4 |
| **11** | | | | | | | | | | | 8.1 | 6.9 | 9.6 | 6.1 | 6.9 | 7.9 | 5.5 | 2.3 | 3.6 | 2.9 | 4.5 | 3.9 | 2.9 | 3.1 |
| **12** | | | | | | | | | | | | 10.8 | 7.3 | 6.5 | 5.2 | 7.0 | 7.9 | 4.3 | 3.9 | 3.6 | 3.8 | 2.4 | 3.1 | 6.7 |
| **13** | | | | | | | | | | | | | 4.0 | 3.8 | 4.4 | 5.3 | 4.4 | 3.1 | 2.2 | 2.8 | 2.4 | 1.4 | 1.4 | 4.4 |
| **16** | | | | | | | | | | | | | | 5.9 | 6.0 | 7.6 | 6.7 | 5.2 | 5.2 | 3.8 | 6.6 | 4.9 | 3.4 | 6.0 |
| **17** | | | | | | | | | | | | | | | 5.4 | 11.6 | 6.2 | 6.1 | 4.3 | 2.0 | 3.9 | 2.5 | 3.9 | 4.4 |
| **18** | | | | | | | | | | | | | | | | 6.2 | 4.9 | 2.4 | 1.7 | 3.0 | 2.3 | 1.5 | 3.0 | 2.5 |
| **19** | | | | | | | | | | | | | | | | | 4.9 | 5.0 | 3.5 | 1.5 | 4.3 | 3.8 | 3.0 | 4.2 |
| **20i** | | | | | | | | | | | | | | | | | | 2.1 | 2.0 | n/a | 2.7 | 1.8 | n/a | 3.3 |
| **26** | | | | | | | | | | | | | | | | | | | 9.5 | 4.5 | 6.1 | 5.3 | 0.9 | 13.0 |
| **27** | | | | | | | | | | | | | | | | | | | | 4.3 | 6.4 | 4.8 | n/a | 7.4 |
| **28** | | | | | | | | | | | | | | | | | | | | | 4.3 | 4.6 | 4.2 | 6.6 |
| **29** | | | | | | | | | | | | | | | | | | | | | | 10.0 | 2.3 | 5.2 |
| **30** | | | | | | | | | | | | | | | | | | | | | | | 1.8 | 4.3 |
| **31** | | | | | | | | | | | | | | | | | | | | | | | | 0.3 |

*Table 4. Dating evidence for the site chronology GMBTt23, AD 1576–1770*

| Source region | Chronology | Publication reference | Filename | Span of chronology (AD) | Overlap (years) | *t*-value |
|---|---|---|---|---|---|---|
| *Regional chronologies* | | | | | | |
| Hampshire | Hampshire Master Chronology | Miles 2003 | HANTS02 | 443–1972 | 189 | 8.5 |
| S Central England | South Central England | Wilson *et al* 2012 | SCENG | 663–2009 | 189 | 7.9 |
| Somerset | Somerset Master Chronology | Miles 2004 | SOMRST04 | 770–1979 | 189 | 5.7 |
| *Site chronologies* | | | | | | |
| Hampshire | Old Basing | Bridge 1996 | BASINGDF | 1684–1788 | 87 | 7.6 |
| Hampshire | Sydmonton Court, Kingsclere | Miles *et al* 2005 | SYDMNTN2 | 1667–1729 | 63 | 7.1 |
| Oxfordshire | Mapledurham Mill | Miles and Haddon-Reece 1995 | MDM17b | 1664–1776 | 107 | 6.9 |
| Kent | Wheelwrights' Shop, Chatham | Bridge 1998 | CHATHAM2 | 1615–1780 | 156 | 6.9 |
| Leicestershire | Kibworth Harcourt | Arnold *et al* 2004 | KIBASQ01 | 1582–1773 | 189 | 6.9 |
| Northamptonshire | Kirby Hall | Arnold *et al* forthcoming | KRBHSQ01 | 1378–1795 | 189 | 6.8 |
| Devon | Pound Farm, Luppit | Tyers et al forthcoming | LPPBT12A | 1557–1664 | 89 | 6.8 |
| Oxfordshire | Chastleton House, Chastleton | Miles *et al* 2005 | CHSTLTN2 | 1671–1788 | 100 | 6.5 |
| Gloucestershire | Dyrham Park | Bridge and Miles 2016 | DYRHAM | 1533–1698 | 123 | 6.3 |
| Derbyshire | Bretby Hall | Howard *et al* 1999 | BRTASQ01 | 1497–1718 | 143 | 6.1 |

## FIGURES


*Figure 1: Maps to show the location of Greenham Barton, Stawley in Somerset marked in red. Scale: top right 1:25000; bottom 1:2000. © Crown Copyright and database right 2020. All rights reserved. Ordnance Survey Licence number 100024900. © British Crown and SeaZone Solutions Ltd 2020. All rights reserved. Licence number 102006.006. © Historic England*

*Figure 2: View of the south remnant medieval truss in the south roof, looking north (photograph Martin Bridge)*

*Figure 3: The west arch-brace and tiebeam to the north remnant medieval truss, looking north (photograph Martin Bridge)*

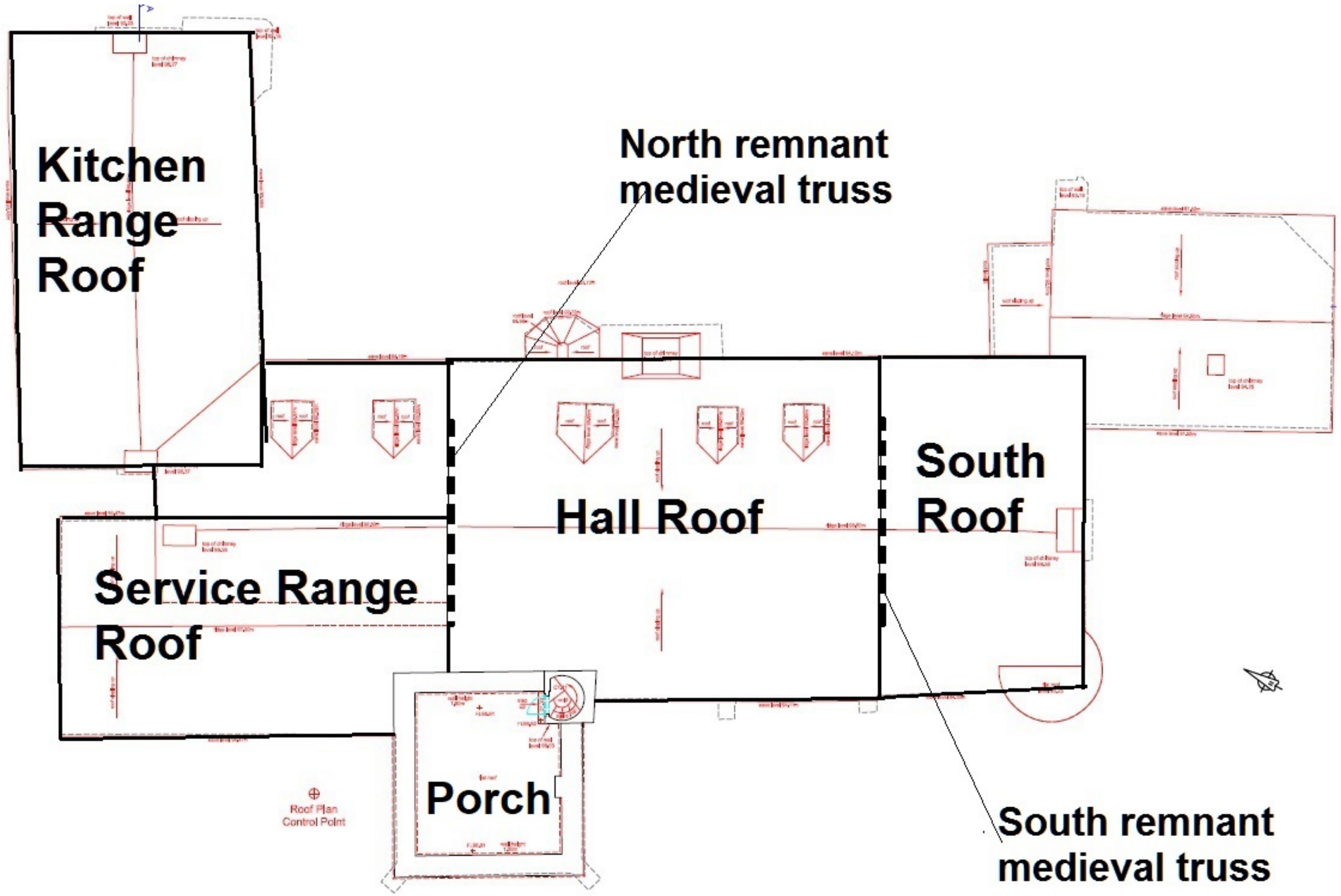



*Figure 4: Roof plan of Greenham Barton identifying the areas sampled (adapted from an original drawing by Levett Surveying, supplied by Jonathan Rhind Architects)*

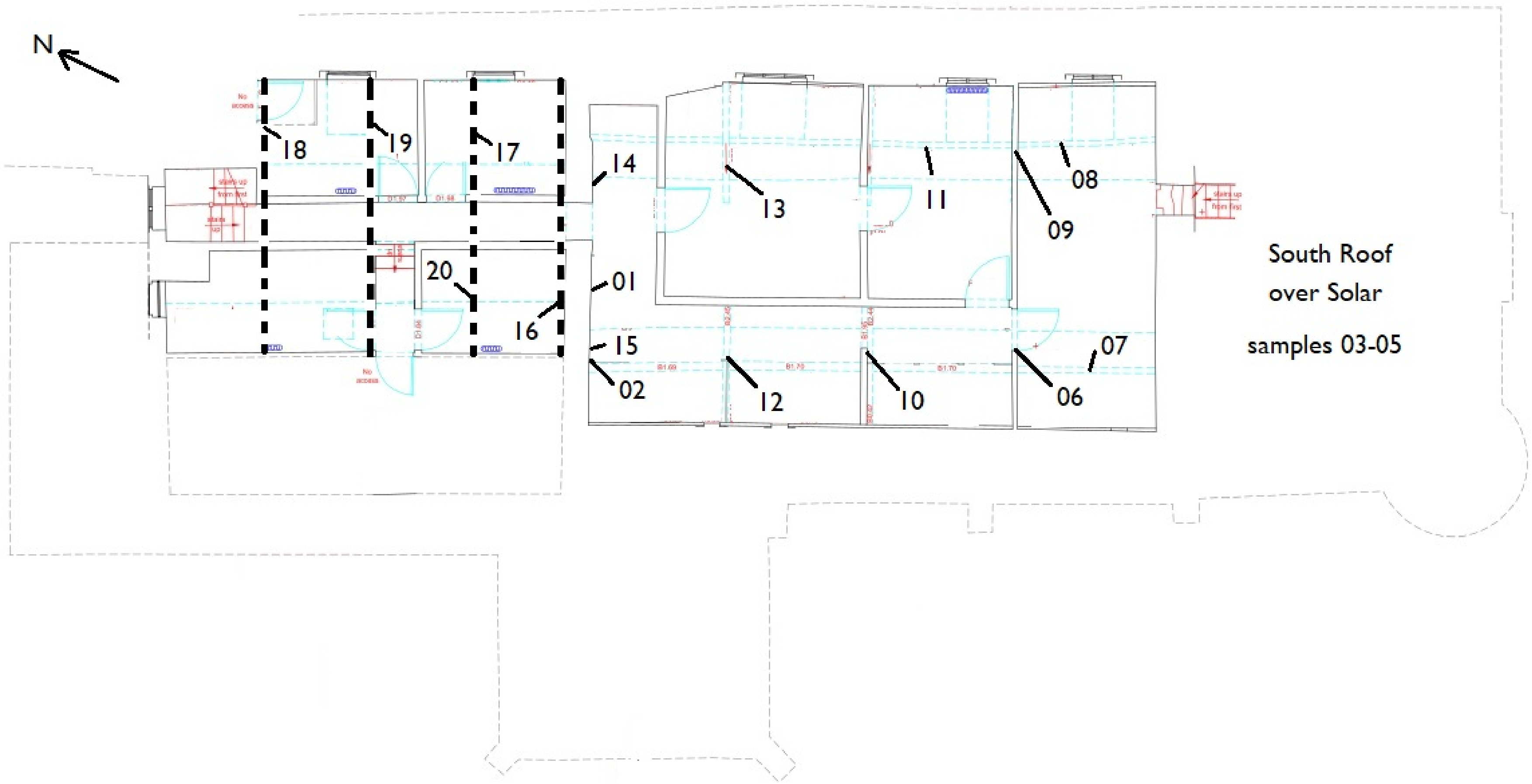



*Figure 5: Second-floor plan showing the locations of samples taken for dendrochronology (adapted from an original drawing by Levett Surveying, supplied by Jonathan Rhind Architects)*

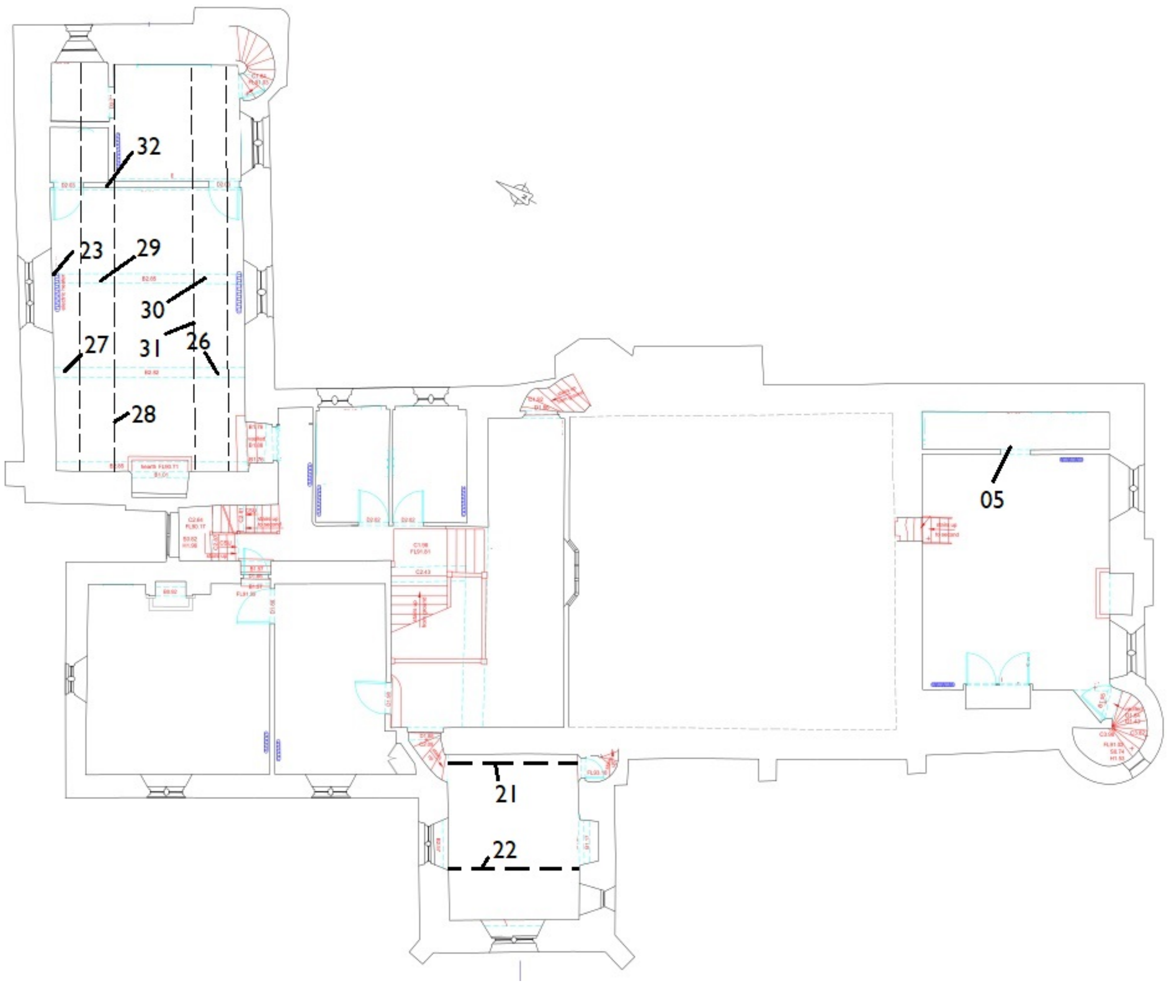



*Figure 6: First-floor plan showing the locations of samples taken for dendrochronology (adapted from an original drawing by Levett Surveying, supplied by Jonathan Rhind Architects)*

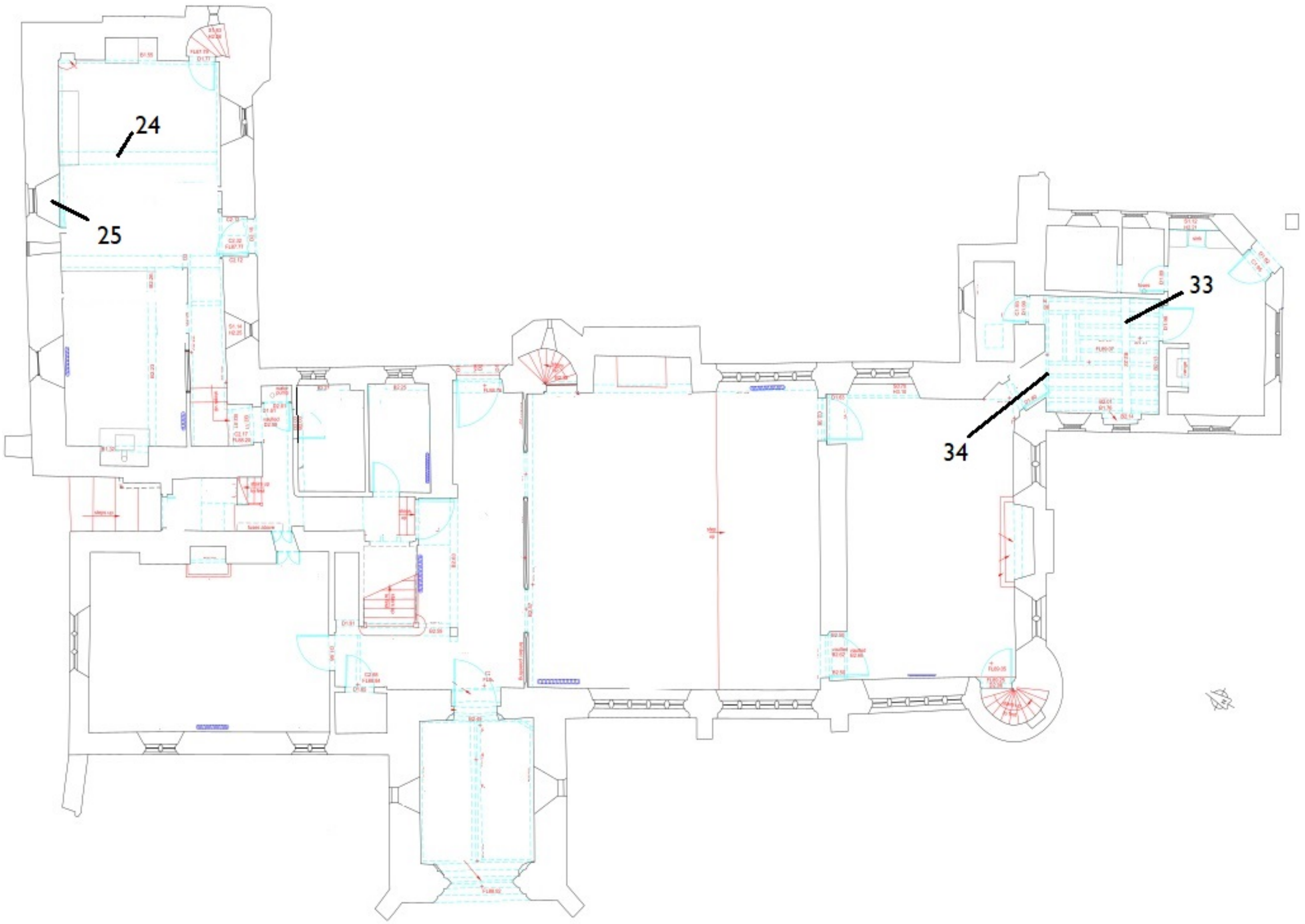



*Figure 7: Ground-floor plan showing the locations of samples taken for dendrochronology (adapted from an original drawing by Levett Surveying, supplied by Jonathan Rhind Architects)*

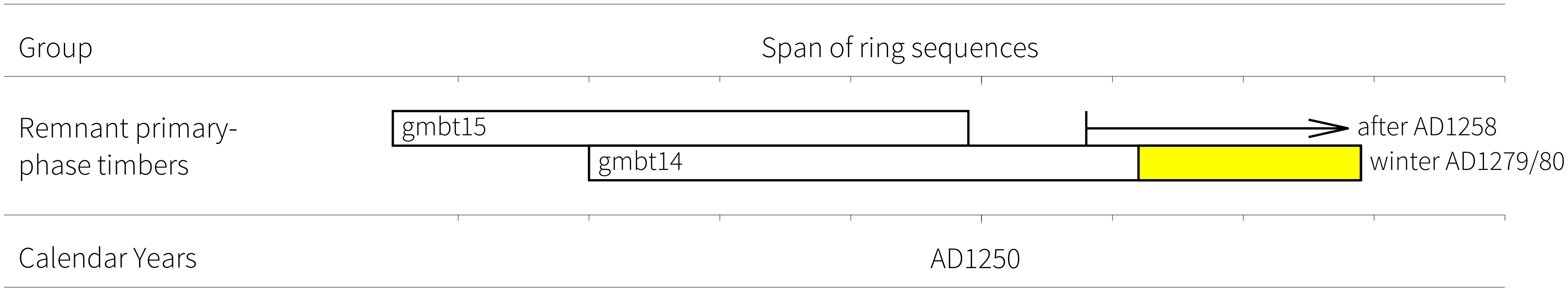



*Figure 8: Bar diagram showing the relative positions of overlap of the dated sequences from the remnant primary-phase timbers and their individual felling dates/date ranges: white bars represent heartwood; yellow bars represent sapwood rings*

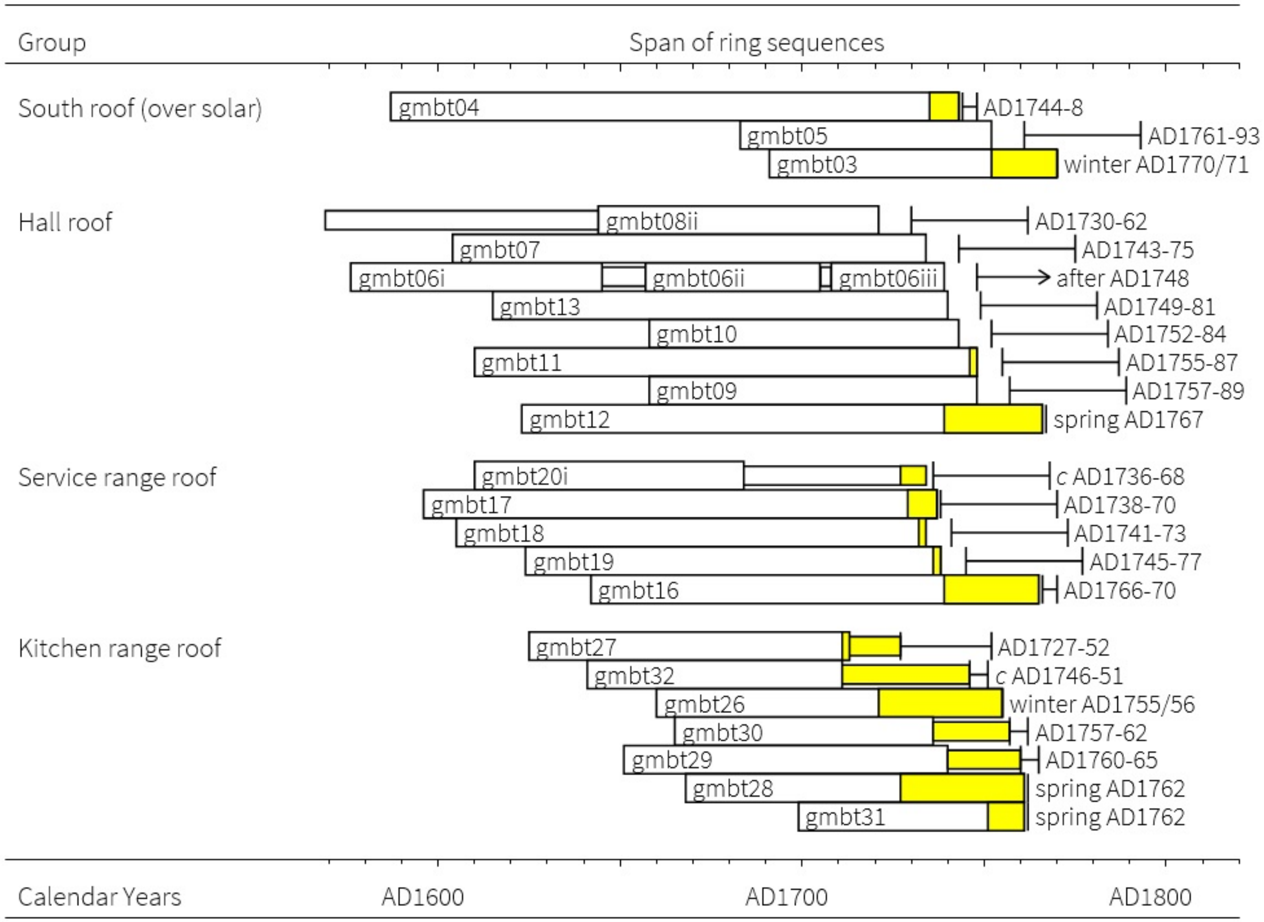



*Figure 9: Bar diagram showing the relative positions of overlap of the dated sequences from the re-ordering phase timbers and their individual felling dates/date ranges: white bars represent heartwood; yellow bars represent sapwood; narrow sections represent additional unmeasured rings*

## APPENDIX

Ring width values (0.01mm) for the sequences measured

gmbt03

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 513 | 376 | 368 | 225 | 316 | 427 | 351 | 307 | 250 | 297 |
| 282 | 322 | 312 | 260 | 163 | 221 | 229 | 233 | 262 | 208 |
| 252 | 428 | 420 | 287 | 341 | 270 | 200 | 280 | 309 | 221 |
| 295 | 334 | 245 | 311 | 311 | 349 | 308 | 212 | 222 | 268 |
| 158 | 160 | 139 | 177 | 182 | 154 | 90 | 83 | 99 | 91 |
| 84 | 106 | 129 | 105 | 117 | 142 | 106 | 99 | 91 | 80 |
| 85 | 82 | 93 | 132 | 100 | 112 | 115 | 143 | 103 | 122 |
| 71 | 74 | 97 | 142 | 126 | 135 | 169 | 223 | 167 | 180 |

gmbt04

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 140 | 132 | 175 | 144 | 199 | 199 | 107 | 156 | 178 | 209 |
| 207 | 247 | 213 | 215 | 132 | 125 | 153 | 96 | 66 | 114 |
| 117 | 111 | 109 | 146 | 156 | 84 | 116 | 109 | 114 | 87 |
| 76 | 117 | 96 | 114 | 89 | 96 | 101 | 71 | 63 | 86 |
| 73 | 79 | 70 | 78 | 66 | 82 | 81 | 63 | 72 | 44 |
| 59 | 101 | 56 | 55 | 89 | 51 | 74 | 51 | 74 | 57 |
| 50 | 52 | 69 | 82 | 101 | 64 | 77 | 131 | 147 | 77 |
| 82 | 142 | 103 | 143 | 127 | 93 | 85 | 119 | 198 | 124 |
| 86 | 120 | 79 | 55 | 63 | 83 | 59 | 62 | 63 | 35 |
| 67 | 48 | 63 | 112 | 107 | 125 | 104 | 119 | 50 | 91 |
| 116 | 119 | 117 | 52 | 121 | 91 | 97 | 73 | 69 | 103 |
| 113 | 93 | 82 | 99 | 86 | 122 | 151 | 183 | 97 | 104 |
| 116 | 120 | 119 | 82 | 92 | 96 | 108 | 91 | 98 | 104 |
| 66 | 100 | 85 | 75 | 78 | 101 | 99 | 88 | 60 | 71 |
| 51 | 52 | 59 | 66 | 66 | 60 | 66 | 63 | 74 | 51 |
| 55 | 58 | 73 | 98 | 79 | 66 | 107 | | | |

gmbt05

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 408 | 183 | 169 | 377 | 347 | 221 | 190 | 233 | 349 | 339 |
| 370 | 256 | 308 | 435 | 356 | 243 | 183 | 266 | 287 | 293 |
| 405 | 360 | 231 | 329 | 416 | 365 | 416 | 316 | 318 | 450 |
| 372 | 288 | 329 | 271 | 257 | 352 | 376 | 307 | 273 | 365 |
| 254 | 378 | 309 | 419 | 326 | 285 | 333 | 334 | 213 | 272 |
| 268 | 339 | 335 | 382 | 263 | 185 | 205 | 174 | 198 | 203 |
| 231 | 232 | 228 | 242 | 172 | 171 | 144 | 111 | 164 | 243 |

gmbt6i

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 168 | 216 | 270 | 248 | 320 | 245 | 293 | 273 | 226 | 214 |
| 151 | 213 | 213 | 194 | 127 | 211 | 174 | 122 | 159 | 168 |
| 190 | 171 | 199 | 198 | 147 | 164 | 140 | 168 | 144 | 106 |
| 167 | 144 | 156 | 196 | 173 | 173 | 95 | 146 | 86 | 115 |
| 82 | 86 | 103 | 101 | 113 | 89 | 92 | 88 | 80 | 70 |
| 75 | 71 | 75 | 82 | 74 | 58 | 65 | 60 | 44 | 45 |
| 41 | 47 | 52 | 36 | 40 | 42 | 34 | 29 | 25 | 34 |

gmbt6ii

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 33 | 50 | 41 | 48 | 46 | 36 | 40 | 50 | 63 | 75 |

58 51 50 48 54 108 132 77 75 69
82 62 92 113 87 107 116 90 57 57
78 89 86 76 142 164 155 93 105 142
164 133 99 98 90 113 122 234 126

gmbt06iii
179 134 126 140 153 173 141 136 136 127
163 221 135 176 188 165 186 126 201 148
129 160 162 159 143 133 167 193 150 97
85 101

gmbt07
118 130 257 282 266 310 309 328 243 318
281 246 244 263 294 282 310 226 250 230
185 136 159 184 183 169 201 178 161 144
84 115 87 93 88 62 71 77 54 74
68 47 47 61 57 68 49 28 32 32
43 38 31 49 152 91 109 55 40 60
51 78 87 76 103 124 100 143 99 71
87 64 47 51 60 80 111 97 147 87
70 51 58 73 58 59 54 75 60 58
41 34 42 68 68 55 58 57 52 77
121 110 94 93 60 62 42 55 66 108
87 88 98 61 96 97 138 125 161 158
230 142 165 126 121 121 211 114 119 148
193

gmbt08i
268 274 249 203 197 135 152 181 232 275
207 182 187 204 209 157 265 198 197 152
178 175 146 157 142 158 119 137 133 109
114 97 97 93 65 77 76 109 72 82
81 65 52 69 66 52 43 53 47 52
55 45 36 44 32 37 33 20 23 40

gmbt08ii
42 37 35 42 45 41 40 37 31 33
34 49 38 35 65 44 49 32 30 29
38 45 56 48 49 48 49 40 42 41
39 36 32 49 38 41 42 59 80 57
57 38 30 34 44 40 44 57 83 69
59 60 87 146 107 62 78 50 56 79
108 85 97 91 108 138 73 74 81 80
67 88 87 73 80 95 76 88

gmbt09
39 35 58 40 43 37 40 55 50 66
54 64 49 63 162 176 121 135 136 116
149 150 175 107 174 209 151 102 117 139
116 98 76 131 124 168 105 144 168 181
158 137 149 108 119 152 205 111 135 131
138 141 111 140 205 216 158 119 166 135
198 230 157 228 217 176 171 138 212 227

195 195 237 157 150 132 166 171 188 111
131 164 167 150 123 161 152 155 161 107
87

gmbt10
49 39 83 51 38 36 45 77 51 45
72 78 43 47 61 93 50 48 48 79
41 81 89 69 112 95 96 54 56 82
72 78 67 139 102 178 94 125 132 129
103 102 64 79 87 108 155 102 141 144
125 195 133 158 164 182 125 130 183 159
190 185 130 160 203 180 170 165 260 162
139 190 205 175 194 190 235 237 157 114
144 168 203 155 160 214

gmbt11
123 145 109 123 106 97 78 74 112 79
97 69 85 92 65 39 74 74 76 82
71 76 60 76 47 67 42 65 59 41
59 76 40 46 50 44 33 45 51 65
69 56 52 43 57 78 47 45 64 64
78 61 62 49 59 87 63 51 48 53
57 75 74 77 45 51 48 76 58 79
82 73 99 60 60 40 46 78 60 57
50 63 55 66 53 48 51 56 48 49
43 49 62 96 86 69 100 123 87 84
71 74 98 99 56 72 90 61 122 158
153 142 164 106 130 134 190 183 156 155
225 164 143 177 178 217 117 94 94 125
132 123 157 209 181 148 196 126 113

gmbt12a
163 157 106 122 176 166 160 129 113 134
113 90 99 57 110 111 84 99 111 50
70 76 63 92 74 69 97 96 82 54
50 97 117 99 88 137 105 131 92 99
60 90 119 114 83 100 97 85 89 105
162 141 102 105 134 109 110 145 126 155
146 146 80 108 117 120 114 98 135 117
146 99 84 110 122 115 47 38 32 28
23 42 47 50 47 54 66 50 56 60
59 55 60 65 40 60 62 53 59 62
59 50 56 50 49 49 55 64 54 45
59 51 56 58 49 56 56 57 54 50
83 67 61 73 56 52 46 48 62 65
70 71 60 58 56 56 56 57 42 52
65 69 69 68

gmbt12b
113 116 133 110 55 28 39 36 43 52
58 58 63 57 84 57 65 69 61 60
66 66 44 70 71 67 68 75 73 59
69 68 62 59 57 81 55 54 70 59

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 74 | 68 | 52 | 71 | 77 | 63 | 66 | 57 | 99 | 64 |
| 69 | 79 | 68 | 56 | 62 | 50 | 67 | 79 | 75 | 84 |
| 77 | 67 | 56 | 53 | 63 | 51 | 54 | 46 | 70 | 78 |
| 77 | 102 | | | | | | | | |

gmbt13

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 190 | 143 | 140 | 199 | 160 | 181 | 136 | 154 | 165 | 143 |
| 71 | 88 | 194 | 152 | 122 | 136 | 87 | 118 | 129 | 124 |
| 122 | 92 | 149 | 151 | 106 | 146 | 110 | 71 | 46 | 55 |
| 65 | 64 | 63 | 66 | 85 | 86 | 102 | 94 | 82 | 95 |
| 130 | 102 | 122 | 154 | 113 | 190 | 147 | 150 | 93 | 125 |
| 151 | 189 | 135 | 154 | 128 | 135 | 106 | 122 | 220 | 174 |
| 122 | 138 | 215 | 200 | 268 | 288 | 267 | 274 | 228 | 220 |
| 93 | 135 | 116 | 103 | 85 | 90 | 105 | 94 | 127 | 94 |
| 89 | 103 | 105 | 102 | 46 | 36 | 30 | 30 | 39 | 42 |
| 52 | 64 | 50 | 64 | 66 | 66 | 52 | 51 | 53 | 45 |
| 71 | 78 | 37 | 73 | 52 | 57 | 80 | 83 | 74 | 57 |
| 47 | 55 | 74 | 69 | 68 | 72 | 60 | 46 | 64 | 61 |
| 67 | 52 | 55 | 70 | 86 | 83 | | | | |

gmbt14

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 409 | 540 | 468 | 538 | 494 | 452 | 511 | 377 | 564 | 524 |
| 520 | 427 | 448 | 447 | 454 | 401 | 279 | 398 | 374 | 336 |
| 391 | 317 | 404 | 394 | 295 | 300 | 331 | 337 | 306 | 387 |
| 337 | 333 | 304 | 301 | 353 | 385 | 363 | 344 | 320 | 365 |
| 408 | 275 | 195 | 252 | 340 | 298 | 294 | 226 | 293 | 224 |
| 269 | 279 | 171 | 268 | 226 | 147 | 83 | 136 | 155 | 127 |

gmbt15

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 326 | 373 | 188 | 333 | 342 | 428 | 248 | 229 | 326 | 358 |
| 271 | 319 | 383 | 376 | 301 | 423 | 543 | 412 | 390 | 324 |
| 260 | 395 | 217 | 330 | 380 | 229 | 225 | 280 | 370 | 255 |
| 211 | 164 | 297 | 300 | 170 | 199 | 175 | 208 | 336 | 179 |
| 141 | 205 | 209 | 186 | 171 | | | | | |

gmbt16

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 35 | 46 | 50 | 31 | 42 | 39 | 64 | 64 | 55 | 40 |
| 32 | 35 | 50 | 55 | 43 | 38 | 91 | 57 | 121 | 65 |
| 59 | 38 | 69 | 112 | 102 | 65 | 72 | 98 | 70 | 102 |
| 119 | 138 | 69 | 53 | 60 | 98 | 78 | 87 | 122 | 84 |
| 138 | 71 | 71 | 53 | 58 | 106 | 77 | 88 | 69 | 97 |
| 90 | 116 | 82 | 78 | 92 | 120 | 91 | 74 | 92 | 137 |
| 123 | 195 | 231 | 102 | 124 | 171 | 166 | 207 | 159 | 179 |
| 252 | 261 | 163 | 139 | 125 | 154 | 234 | 189 | 138 | 163 |
| 175 | 114 | 132 | 119 | 164 | 136 | 104 | 91 | 223 | 130 |
| 123 | 119 | 109 | 125 | 157 | 80 | 97 | 164 | 120 | 87 |
| 97 | 139 | 121 | 97 | 101 | 52 | 56 | 55 | 99 | 74 |
| 71 | 65 | 55 | 43 | 54 | 30 | 54 | 58 | 31 | 39 |
| 40 | 59 | 53 | 39 | | | | | | |

gmbt17

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 148 | 134 | 222 | 238 | 183 | 192 | 239 | 208 | 244 | 182 |
| 389 | 293 | 233 | 192 | 187 | 152 | 87 | 178 | 125 | 119 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 91 | 140 | 157 | 99 | 105 | 132 | 221 | 217 | 124 | 120 |
| 131 | 140 | 171 | 144 | 162 | 99 | 135 | 112 | 60 | 79 |
| 46 | 70 | 82 | 70 | 111 | 122 | 84 | 88 | 50 | 72 |
| 77 | 58 | 129 | 101 | 120 | 84 | 48 | 40 | 91 | 171 |
| 111 | 57 | 90 | 57 | 93 | 59 | 31 | 39 | 75 | 83 |
| 51 | 60 | 77 | 102 | 50 | 73 | 81 | 55 | 80 | 63 |
| 39 | 78 | 99 | 90 | 164 | 175 | 197 | 111 | 87 | 41 |
| 66 | 105 | 109 | 96 | 87 | 125 | 109 | 132 | 48 | 39 |
| 71 | 111 | 127 | 78 | 64 | 54 | 66 | 121 | 165 | 101 |
| 100 | 103 | 50 | 94 | 42 | 56 | 92 | 138 | 101 | 69 |
| 95 | 64 | 78 | 60 | 76 | 86 | 83 | 53 | 57 | 61 |
| 78 | 70 | 71 | 69 | 68 | 42 | 31 | 35 | 32 | 31 |
| 35 | 94 | | | | | | | | |

gmbt18

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 117 | 161 | 190 | 173 | 160 | 189 | 161 | 112 | 179 | 131 |
| 134 | 117 | 110 | 159 | 168 | 172 | 117 | 178 | 239 | 195 |
| 121 | 71 | 104 | 102 | 137 | 143 | 101 | 115 | 147 | 90 |
| 57 | 33 | 52 | 44 | 28 | 56 | 54 | 41 | 54 | 50 |
| 34 | 37 | 39 | 53 | 78 | 40 | 38 | 47 | 60 | 86 |
| 120 | 78 | 51 | 136 | 91 | 133 | 80 | 48 | 56 | 93 |
| 240 | 296 | 303 | 188 | 203 | 125 | 147 | 157 | 123 | 125 |
| 84 | 48 | 80 | 78 | 74 | 95 | 90 | 127 | 140 | 111 |
| 78 | 148 | 211 | 129 | 93 | 59 | 104 | 137 | 117 | 94 |
| 80 | 104 | 117 | 115 | 104 | 121 | 105 | 102 | 109 | 167 |
| 120 | 256 | 282 | 194 | 131 | 89 | 111 | 114 | 124 | 88 |
| 94 | 105 | 105 | 107 | 221 | 102 | 83 | 176 | 141 | 101 |
| 69 | 145 | 157 | 96 | 118 | 118 | 134 | 129 | 158 | 82 |

gmbt19

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 188 | 146 | 174 | 190 | 169 | 179 | 155 | 112 | 144 | 166 |
| 114 | 129 | 104 | 161 | 166 | 104 | 137 | 196 | 171 | 113 |
| 116 | 121 | 126 | 71 | 96 | 168 | 109 | 110 | 84 | 55 |
| 115 | 110 | 76 | 46 | 88 | 58 | 104 | 49 | 42 | 45 |
| 109 | 104 | 70 | 70 | 74 | 96 | 53 | 83 | 66 | 69 |
| 63 | 54 | 31 | 77 | 56 | 95 | 130 | 88 | 175 | 123 |
| 89 | 58 | 68 | 107 | 93 | 93 | 87 | 123 | 109 | 154 |
| 67 | 64 | 78 | 77 | 79 | 70 | 45 | 48 | 56 | 104 |
| 114 | 60 | 69 | 74 | 46 | 70 | 33 | 47 | 48 | 70 |
| 50 | 67 | 99 | 53 | 89 | 59 | 52 | 74 | 101 | 59 |
| 44 | 53 | 79 | 52 | 59 | 51 | 76 | 51 | 58 | 56 |
| 67 | 83 | 94 | 137 | 101 | | | | | |

gmbt20i

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 237 | 256 | 158 | 221 | 192 | 150 | 125 | 151 | 202 | 194 |
| 200 | 213 | 228 | 267 | 186 | 187 | 156 | 173 | 200 | 228 |
| 114 | 102 | 140 | 105 | 100 | 150 | 83 | 121 | 114 | 111 |
| 135 | 110 | 65 | 56 | 56 | 52 | 57 | 53 | 61 | 73 |
| 73 | 63 | 47 | 33 | 84 | 74 | 69 | 50 | 74 | 62 |
| 101 | 51 | 39 | 36 | 45 | 83 | 77 | 56 | 48 | 56 |
| 56 | 59 | 58 | 62 | 50 | 25 | 28 | 38 | 33 | 35 |
| 60 | 57 | 66 | 37 | 51 | | | | | |

gmbt20ii

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 58 | 67 | 81 | 70 | 61 | 65 | 30 | 37 | 51 | 35 |
| 27 | 25 | 33 | 34 | 46 | 32 | 34 | 33 | 35 | 31 |
| 24 | 28 | 26 | 21 | 31 | 33 | 53 | 44 | 48 | 51 |
| 79 | | | | | | | | | |

gmbt22

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 255 | 326 | 410 | 357 | 342 | 386 | 365 | 421 | 306 | 275 |
| 295 | 348 | 297 | 355 | 328 | 403 | 373 | 418 | 481 | 380 |
| 265 | 398 | 451 | 429 | 353 | 291 | 335 | 370 | 368 | 397 |
| 82 | 59 | 65 | 49 | 82 | 59 | 53 | 49 | 33 | 46 |
| 55 | 37 | 42 | 50 | 53 | 65 | 81 | 102 | 112 | 85 |
| 164 | 128 | 170 | 137 | 166 | 172 | 193 | 77 | 50 | 89 |
| 108 | | | | | | | | | |

gmbt25

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 189 | 294 | 339 | 241 | 239 | 138 | 118 | 203 | 255 | 261 |
| 276 | 314 | 279 | 339 | 332 | 404 | 379 | 313 | 423 | 357 |
| 383 | 393 | 295 | 264 | 259 | 349 | 206 | 382 | 392 | 306 |
| 330 | 266 | 388 | 429 | 298 | 202 | 195 | 181 | 170 | 101 |
| 160 | 150 | 135 | | | | | | | |

gmbt26

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 114 | 118 | 103 | 85 | 243 | 195 | 243 | 132 | 171 | 392 |
| 116 | 126 | 205 | 254 | 222 | 211 | 280 | 383 | 305 | 227 |
| 254 | 226 | 256 | 147 | 163 | 135 | 185 | 230 | 236 | 184 |
| 167 | 260 | 161 | 188 | 88 | 76 | 129 | 156 | 92 | 73 |
| 82 | 103 | 132 | 148 | 206 | 123 | 115 | 132 | 152 | 148 |
| 95 | 117 | 96 | 128 | 85 | 53 | 80 | 61 | 88 | 67 |
| 71 | 76 | 71 | 64 | 51 | 52 | 51 | 49 | 48 | 47 |
| 69 | 58 | 44 | 56 | 39 | 35 | 39 | 40 | 41 | 31 |
| 24 | 31 | 35 | 29 | 45 | 48 | 29 | 57 | 19 | 31 |
| 26 | 26 | 33 | 41 | 30 | 35 | | | | |

gmbt27

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 47 | 41 | 48 | 60 | 51 | 60 | 41 | 46 | 44 | 43 |
| 165 | 210 | 253 | 219 | 195 | 223 | 289 | 177 | 222 | 225 |
| 182 | 160 | 151 | 172 | 164 | 151 | 128 | 83 | 134 | 140 |
| 116 | 90 | 123 | 128 | 78 | 95 | 107 | 140 | 112 | 249 |
| 227 | 229 | 114 | 135 | 219 | 112 | 76 | 156 | 176 | 212 |
| 237 | 267 | 379 | 320 | 195 | 251 | 230 | 197 | 138 | 184 |
| 133 | 139 | 216 | 253 | 198 | 143 | 160 | 122 | 220 | 75 |
| 108 | 199 | 151 | 127 | 96 | 79 | 89 | 116 | 156 | 138 |
| 82 | 72 | 105 | 79 | 79 | 41 | 56 | 52 | 73 | |

gmbt28

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 76 | 101 | 64 | 71 | 104 | 145 | 116 | 135 | 122 | 134 |
| 110 | 87 | 118 | 100 | 114 | 113 | 130 | 117 | 125 | 156 |
| 124 | 122 | 152 | 203 | 178 | 178 | 172 | 135 | 225 | 194 |
| 154 | 118 | 144 | 141 | 133 | 150 | 114 | 91 | 77 | 82 |
| 107 | 120 | 91 | 107 | 110 | 124 | 105 | 103 | 86 | 75 |
| 81 | 93 | 111 | 88 | 106 | 100 | 99 | 65 | 85 | 107 |
| 89 | 88 | 84 | 80 | 84 | 81 | 53 | 53 | 43 | 43 |

48 64 58 49 45 62 68 52 64 74
48 46 72 76 84 57 77 61 64 72
78 73 85 61

gmbt29
293 167 376 460 349 246 249 258 247 381
295 294 261 320 410 329 195 265 229 121
110 164 210 165 167 127 197 175 110 177
146 155 101 108 118 135 113 123 89 121
169 119 129 96 120 159 131 128 87 109
101 102 125 114 78 74 151 124 137 108
111 184 195 92 128 116 93 91 98 87
96 68 53 58 73 71 68 50 49 56
35 35 29 30 38 55 38 66 68 66

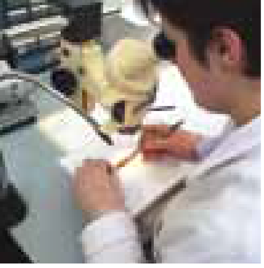
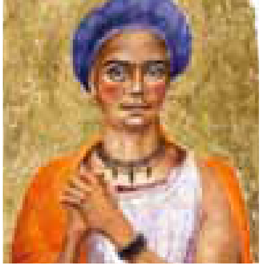
gmbt30
261 262 121 162 177 85 117 157 213 150
139 127 197 183 151 209 116 187 136 121
126 124 106 121 98 119 187 109 152 102
119 190 113 83 81 101 90 91 126 104
75 90 164 174 182 163 124 190 196 128
171 115 87 109 120 101 84 90 68 105
116 99 83 76 65 63 51 55 41 42
39 40

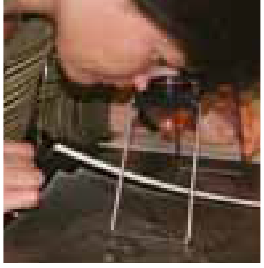
gmbt31
159 143 119 139 164 208 164 202 194 168
186 123 135 196 197 185 154 122 117 110
131 124 144 187 157 167 128 160 184 189
181 185 144 192 182 230 191 192 127 253
233 171 195 184 251 221 185 175 169 140
129 179 173 192 159 227 203 205 203 224
219 205 170

gmbt32
293 205 206 181 261 240 186 199 202 177
206 83 176 283 215 117 124 215 120 170
139 134 95 234 241 290 179 225 360 149
160 204 311 213 301 424 533 413 300 351
253 286 222 230 153 232 322 351 267 195
293 157 156 75 67 94 100 71 49 47
48 61 63 71 65 45 38 56 56 34
31

gmbt33
117 61 76 103 110 111 164 151 142 192
183 92 65 89 130 154 194 256 234 217
225 172 221 207 204 241 208 241 178 153
168 128 136 174 186 194 182 178 121 152
182 256 320 220 236 186 156 193 172 192
169 197 209 195 245 151 161 203 150 149
145 147 168 202 214 212 170 217 205 156
146 178 173 188 231 242 240 125 44 60

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 61 | 86 | 93 | 111 | 85 | 107 | 111 | 85 | 102 | 105 |
| 112 | 111 | 140 | 163 | 123 | 134 | 131 | 174 | 155 | 153 |
| 134 | 148 | 142 | 111 | 149 | 140 | 179 | 117 | 103 | 138 |
| 153 | 180 | 211 | 217 | 260 | 255 | 152 | | | |


# Historic England Research and the Historic Environment

We are the public body that looks after England's historic environment. We champion historic places, helping people understand, value and care for them.

A good understanding of the historic environment is fundamental to ensuring people appreciate and enjoy their heritage and provides the essential first step towards its effective protection.

Historic England works to improve care, understanding and public enjoyment of the historic environment. We undertake and sponsor authoritative research. We develop new approaches to interpreting and protecting heritage and provide high quality expert advice and training.

We make the results of our work available through the Historic England Research Report Series, and through journal publications and monographs. Our online magazine Historic England Research which appears twice a year, aims to keep our partners within and outside English Heritage up-to-date with our projects and activities.

A full list of Research Reports, with abstracts and information on how to obtain copies, may be found on www.HistoricEngland.org.uk/researchreports

Some of these reports are interim reports, making the results of specialist investigations available in advance of full publication. They are not usually subject to external refereeing, and their conclusions may sometimes have to be modified in the light of information not available at the time of the investigation.

Where no final project report is available, you should consult the author before citing these reports in any publication. Opinions expressed in these reports are those of the author(s) and are not necessarily those of Historic England.

The Research Reports' database replaces the former:

Ancient Monuments Laboratory (AML) Reports Series
The Centre for Archaeology (CfA) Reports Series
The Archaeological Investigation Report Series and
The Architectural Investigation Reports Series.

ISSN 2059-4453 (Online)