TREE-RING ANALYSIS OF TIMBERS FROM THE GUILDHALL, HIGH STREET, WORCESTER

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Summary

Core samples were obtained from 16 different oak timbers, many of them probably reused, forming the frame of first-floor rooms of Worcester Guildhall. The analysis of 14 of these (two samples proving to be unsuitable) produced a single site chronology, WORGSQ01, comprising 11 samples, and having a combined overall length of 249 rings. This site chronology was dated as spanning the years AD 1361 to AD 1609.

Not unexpectedly, given the nature of the material, interpretation of the sapwood would suggest that timbers with different felling dates are present. Six timbers have estimated felling dates which cluster in the late-sixteenth to early-seventeenth centuries, and may represent a building thought to have been complete by AD 1617. Two other timbers may have been felled slightly later in the first quarter of the seventeenth century. One timber is unlikely to have been felled before AD 1624 and could have been felled as late as AD 1649. These may represent subsequent periods of building.

The felling date of two other dated timbers cannot be accurately determined because they do not have a heartwood/sapwood boundary, but both are unlikely to have been felled before the late sixteenth century. There is no indication of any fifteenth or early-sixteenth century material represented by the sampled timbers.

Introduction

The extant Guildhall is located in the High Street in the historic centre of Worcester (SO 850 548, Figs 1 and 2), and has been the seat of local government since at least the fourteenth century. The medieval Guildhall, which appears to have been established by the early- to mid-thirteenth century, was a long timber-framed building built parallel to, but set back from, the street, with its entrance towards the north end. In front of it was a range of shops and stalls. Circa AD 1417 – 18 part of the range of shops to the front was rebuilt to match existing jettied buildings. By the AD 1560s the Guildhall, which was already in use as a market place and a council chamber, held court sessions, and by the end of the century the building had inadequate space for these undertakings. Prior to AD 1599 a two-storied 'Tolsey' (or toll-house) was built adjacent to the main north entrance, and in AD 1601 land was acquired to the north of the Guildhall upon which an extension to the Tolsey was built, with a council chamber above and a 'walk' beneath. The construction date is slightly uncertain but this new building appears to have been complete by *c* AD 1615 – 17.

This new building apparently consisted of a covered walk along most of the Guildhall frontage, with the rebuilt and extended Tolsey at the north end, and four remaining medieval shops at the south end (possibly those rebuilt in AD 1417 – 18). There were at least two first-floor rooms in the Tolsey. In one, possibly that referred to as the 'treasury chamber', armour was stored. The other, the 'great chamber' was used as a magistrate's court and for smaller council meetings. Off the walk beneath were the freeman's prison and a storage chamber. This area was totally rebuilt in AD 1634.

There was then extensive work in the 'hall walk' in the AD 1690s, to the point where it became known as the '*new walke'*. Statues of Kings Charles I and II were erected here in AD 1695, these being joined by one of Queen Anne in AD 1709.

In April AD 1721 demolition of the medieval Guildhall began. The main building of the new Guildhall building, probably to the designs of AD 1718 – 21 by Thomas White, was then constructed in AD 1722, followed by the present North Wing in AD 1725, and the South Wing in AD 1727. The building is of brick with stone dressings. The centre range consists of nine bays and is two-storied. The wings at either end consist of three bays which although of the same overall height as the centre range, are two and a half storeys. There have been numerous additions and modifications to the North Wing, but the basement and upper floors remain in mutilated, but recognisable, form. The whole Guildhall was remodelled by Gilbert Scott and Thomas Rowe in the AD 1870s and AD 1880s, and the North Wing was drastically altered AD 1930 – 31. Despite these changes some earlier fabric survives on the upper floors and in the roof.

The timbers

The timbers to be sampled were exposed during alteration works to allow the insertion of a lift shaft in the northern wing. This involved the large-scale lifting of floorboards in one room to the front of the building on the first floor, and the lifting of floorboards and the temporary removal and repositioning of some timbers from an adjacent first-floor stair well. The timbers appear to comprise two distinct elements. The first are a series of larger, principal, beams forming the main frame of the first-floor. None of these main timbers, which are found in both the front room and stair-well area, show any decorative or architectural details by which they might be dated. Some of them do, however, show redundant mortices which might suggest they are reused in their present positions.

From the principal beams of the front room run a series of smaller common joists, forming the second timber element of the floor-frame. Some of these common joists also appear to

have had a former use, many of them having decorative moulding which cannot now be seen, given that they are hidden beneath the floorboards. Some of these common joists also have redundant joints. In addition to these moulded timbers, there was a series of smaller, plain or unmoulded, joists in the stairwell area. These smaller joists were removed during the alteration works. Photographs, provided by Michael Napthan Archaeology, Worcester, of some of these timbers are shown in Figure 3a/b.

On the basis of what could be seen of the decorative moulding, and by comparison to the very few other local examples, it was believed that some of the moulded timbers might be of fifteenth century date, having been reused from an earlier building on this site. It was also believed possible that some timbers might be of early-seventeenth century date, there being documentary evidence for alteration phases to the earlier Guildhall dating to AD 1615 – 17 and AD 1634. It was hoped that tree-ring dating would establish with greater certainty the date of these timbers and demonstrate a possible developmental sequence for this part of the Guildhall.

Sampling

Sampling and analysis by tree-ring dating of a particular group of timbers within the Guildhall was commissioned by English Heritage. The purpose of this was to establish the date of a series of floor timbers to inform the programme of alterations. From the timbers available a total of 16 samples was obtained, with samples being taken from the main beams in both the front room and the stairwell area, the moulded timbers reused as common joists in the main front room, and the plain common joists in the stairwell area. Each sample was given the code WOR-G (for Worcester Guildhall) and numbered 01 – 16. The positions of these samples are marked on plans made and provided by Michael Napthan Archaeology, these being reproduced here as Figure 4a/b. Details of the samples are given in Table 1. In this table the locations of all samples are identified following the system established on the drawings provided, where every timber is given a unique number.

Although there were other timbers available at this site, particularly from the main front room, it was seen that many of them appeared to be derived from fast grown trees. Given the relatively small sizes of most of these it was felt unlikely that such timbers would provide the required minimum of 54 rings required for satisfactory analysis, this applying to both moulded and undecorated timbers alike. Such timbers were not sampled.

The Laboratory would like to take this opportunity to thank James Dinn of Worcester City Council and Michael Napthan of Mike Napthan Archaeology, for their help in discussing the possible phasing of the timbers and for the provision of plans and photographs. We would also like to thank Thomas Vale Ltd, Builders, for allowing access to the site and for the help and cooperation of their staff during sampling.

Analysis

Each of the 16 samples obtained was prepared by sanding and polishing. It was seen at this point that two of the samples, WOR-G02 and G11, had too few rings for satisfactory analysis (ie less than 54) and these were rejected. The annual growth-ring widths of the remaining 14 samples were measured and then compared with each other. At a minimum value of t=4.5, a single group comprising 11 samples could be formed, the samples cross-matching with each other at relative off-set positions as shown in the bar diagram Figure 5.

The samples were combined at these off-set positions to form WORGSQ01, a site chronology of 249 rings. Site chronology WORGSQ01 was then satisfactorily dated by comparison to a number of relevant reference chronologies for oak as spanning the years

AD 1361 – 1609. The evidence for this dating is given in the *t*-values of Table 2.

Site chronology WORGSQ01 was then compared with the three remaining measured but ungrouped samples, WOR-G01, G10, and G16. There was, however, no further satisfactory cross-matching. Each of the ungrouped samples was then compared individually with the full range of reference chronologies. There was, again, no reliable cross-matching and these samples must remain undated.

Interpretation

Analysis by dendrochronology has produced a single site chronology, WORGSQ01, comprising 11 samples, its 249 rings dated as spanning the years AD 1361 – 1609. None of the samples has complete sapwood on it, and it is thus not possible to say precisely when any of the timbers represented was felled. Most of them, however, do have the heartwood/sapwood boundary and it is possible to provide an estimated felling date range for these timbers.

The relative position of the heartwood/sapwood boundary, on the nine samples where it exists, is varied and wide ranging, suggesting that the timbers were felled at different times. This makes the interpretation slightly more difficult. However, in broad terms, it appears that at least two, and possibly three, slightly different periods of felling may be represented.

The earlier period of felling is probably represented by samples WOR-G06, G08, G09, G12, G13, and G15. As is illustrated in bar diagram Figure 6, where the dated samples retaining the heartwood/sapwood boundary are sorted by last heartwood ring date, the relative position of the last heartwood ring on these six samples is similar, though not identical. On this group the last heartwood ring position varies by only 8 years, from relative position 207 (AD 1567), on sample WOR-G09, to relative position 215 (AD 1575) on samples WOR-G06 and G08, indicating that the earliest possible felling date for any of these six individual timbers is AD 1582 and the latest possible felling date is AD 1615.

However, such consistency is indicative of timbers having a similar felling date. The date of the average heartwood/sapwood transition of this group of six samples is AD 1572. Allowing a standard 95% confidence limit of 15 – 40 rings for the amount of sapwood the trees represented by these six samples might have had would give them an estimated felling date in the range AD 1587 – 1612.

The next period of felling might be represented by samples WOR-G03 and G07, which both have slightly later last heartwood ring dates, these being at AD 1593 and AD 1585 respectively, the average heartwood/sapwood boundary date being AD 1589. The estimated individual felling dates of the two timbers represented by these samples is AD 1608 – 33, and AD 1600 – 25 respectively, while the estimate of the two combined is AD 1604 – 29. Such ranges are again based on a 95% confidence limit of 15 – 40 rings for the amount of sapwood the trees represented by these two samples might have had.

It must be pointed out, however, that these two timbers do share a short time span with the group of six timbers discussed above when they could all have been felled together. This common felling period for the two groups lies between AD 1604 and AD 1612.

The latest felling date represented by any material analysed in this programme is represented by sample WOR-G04. This has the latest heartwood/sapwood boundary date of all, AD 1609. Using the same sapwood estimate as above, 15 – 40 rings, would give the timber represented an estimated felling date in the range AD 1624 – 49. This is certainly later than that found for most of the other samples.

Conclusion

Tree ring analysis of timbers from the frame of the first-floor at Worcester Guildhall appears to show that timbers with different felling dates have been used. Such an interpretation is perhaps not unexpected given that reclaimed timbers appear to be reused in their present locations. This variation in felling is illustrated, for example, by the fact that while the latest the timber represented by WOR-G09 could have been felled is AD 1607, the timber represented by WOR-G04 is very unlikely to have been felled before AD 1624 and could have been felled as late as AD 1649.

However, although it is not possible to be precise as to the felling date there does appear to be some indication of a clustering of felling dates in the late-sixteenth or very early-seventeenth centuries. This felling may be related to the documented construction/alteration to parts of the Guildhall complex *c* AD 1615 – 17, and *c* AD 1634. Tree-ring analysis indicates that no fifteenth or even early-sixteenth century material is represented, and that dating based on an interpretation of the moulding may now have a more firmly fixed time-frame.

Judging by the *t*-values of the cross-matching between some of the samples, it is very likely that the some of the sampled timbers represent trees growing close to each other, probably in the same stand of woodland. Samples WOR-G03 and G09, for example, cross-match with each other with a value of t=7.8, whilst samples WOR-G07 and G08 cross-match with a value of t=6.9. It is unlikely that any two timbers are derived from the same tree.

Also judging by the *t*-values of the cross-matches between site and reference chronologies it is possible that the location of the source woodland is to the south of Worcester. Table 2 shows that site chronology WORGSQ01 cross-matches very well with reference material from the West Midlands and Gloucestershire.

Although having sufficient rings for reliable analysis, three measured samples, WOR-G01, G10, and G16, remain ungrouped and undated. The rings of sample WOR-G01 displays a slightly complacent growth pattern with little annual variation in width, whilst the growth rings of sample WOR-G10 show two short bands of narrow rings. It is possibly these features which make cross-matching and dating difficult. There appears to be no problem with sample WOR-G16. It is also possible that all three samples represent timbers from different sources with different felling dates. This, in effect, makes them each single timbers which are often more difficult to date.

Finally, it is recommended that if any further work is undertaken on the Guildhall the timbers should be examined and assessed for dendrochronological potential. It is known, for example, that the roof of the northern end of the Guildhall, the date of which is unknown, contains a substantial amount of timber, much of it seemingly suitable for tree-ring analysis.

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Table 1: Details of samples from the Guildhall, High Street, Worcester

Sample number	Sample location	Total rings	*Sapwood rings	First measured ring date	Last heartwood ring date	Last measured ring date
	Main front room					
WOR-G01	Timber 102 - common joist	78	10	------	------	------
WOR-G02	Timber 110 - common joist	nm	---	------	------	------
WOR-G03	Timber 111 - common joist	122	h/s	AD 1472	AD 1593	AD 1593
WOR-G04	Timber 112 - common joist	128	h/s	AD 1482	AD 1609	AD 1609
WOR-G05	Timber 114 - common joist	150	no h/s	AD 1385	------	AD 1534
WOR-G06	Timber - common joist	54	4	AD 1526	AD 1575	AD 1579
WOR-G07	Timber 118 - main beam	175	10	AD 1421	AD 1585	AD 1595
WOR-G08	Timber 119 - main beam	136	h/s	AD 1440	AD 1575	AD 1575
	Stairwell area					
WOR-G09	Timber 115 - main beam	207	h/s	AD 1361	AD 1567	AD 1567
WOR-G10	Timber 116 - main beam	122	10	------	------	------
WOR-G11	Timber 117 - main beam	nm	h/s	------	------	------
WOR-G12	Timber 120 - common joist off-cut	95	10	AD 1489	AD 1573	AD 1583
WOR-G13	Timber 121 - common joist off-cut	101	h/s	AD 1471	AD 1571	AD 1571
WOR-G14	Timber 122 - common joist off-cut	107	no h/s	AD 1409	------	AD 1515
WOR-G15	Timber 123 - common joist off-cut	154	6	AD 1421	AD 1568	AD 1574
WOR-G16	Timber 124 - common joist off-cut	82	no h/s	------	------	------

* h/s = heartwood/sapwood boundary
nm = sample not measured

Table 2: Results of the cross-matching of site chronology WORGSQ01 and relevant reference chronologies when first ring date is AD 1361 and last ring date is AD 1609

Reference chronology	Span of chronology	*t*-value	
MC10---H	AD 1386 – 1585	12.5	(Fletcher 1978 unpubl)
26 Westgate St, Gloucester	AD 1399 – 1622	11.5	(Howard *et al* 1998b)
Wales and West Midlands	AD 1341 – 1636	10.6	(Siebenlist-Kerner 1978)
Naas House, Lydney, Glos	AD 1373 – 1568	9.3	(Howard *et al* 1998a)
South Central England	AD 1458 – 1681	7.6	(Howard 2002 unpubl)
Mercer's Hall, Gloucester	AD 1289 – 1541	7.5	(Howard *et al* 1996)
Worcester Cathedral	AD 1484 – 1772	6.8	(Arnold *et al* 2003)
19 – 20 High St, Kinver, Staffs	AD 1431 – 1562	6.8	(Howard *et al* 1995)

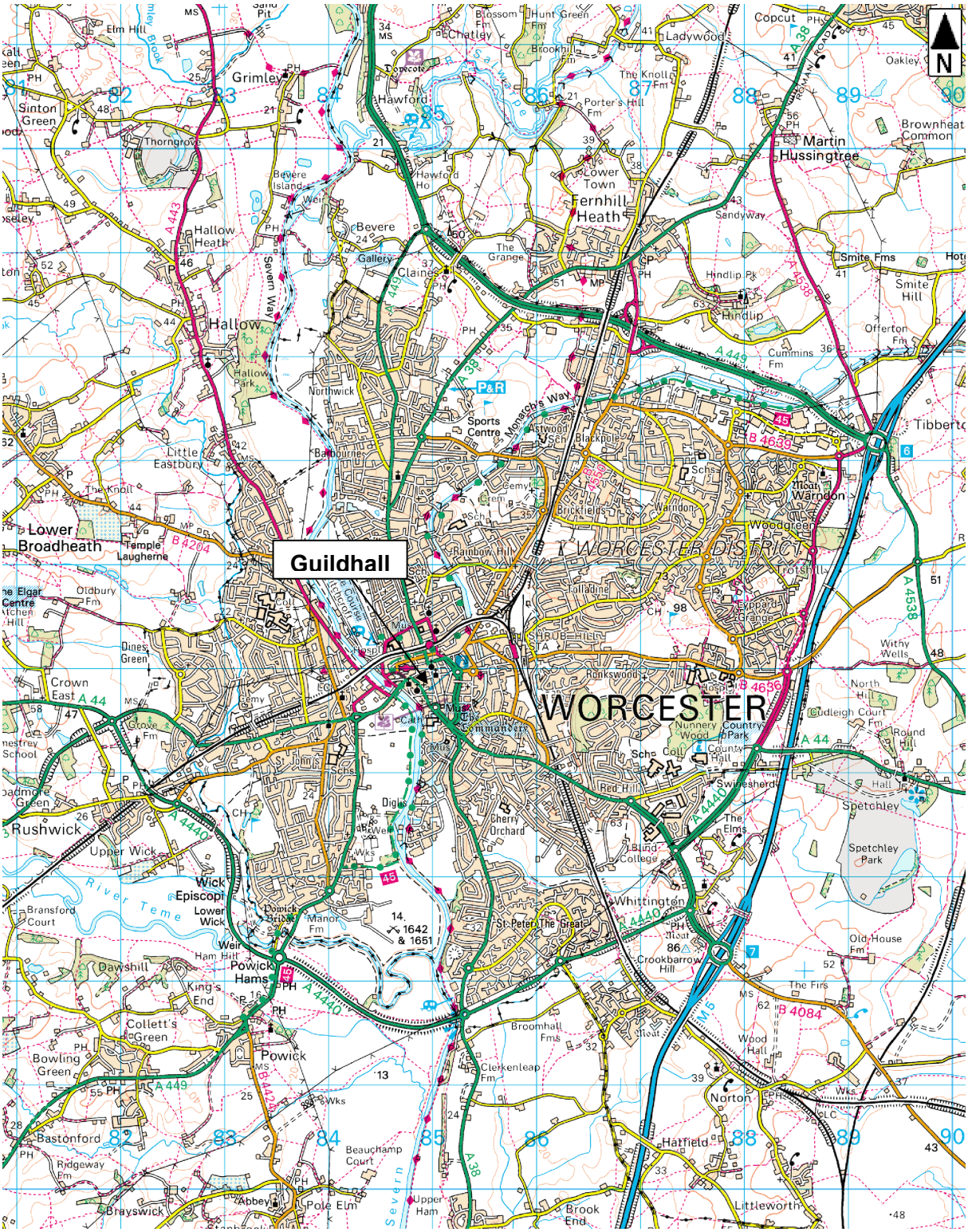

Figure 1: Map to show general location of the Guildhall

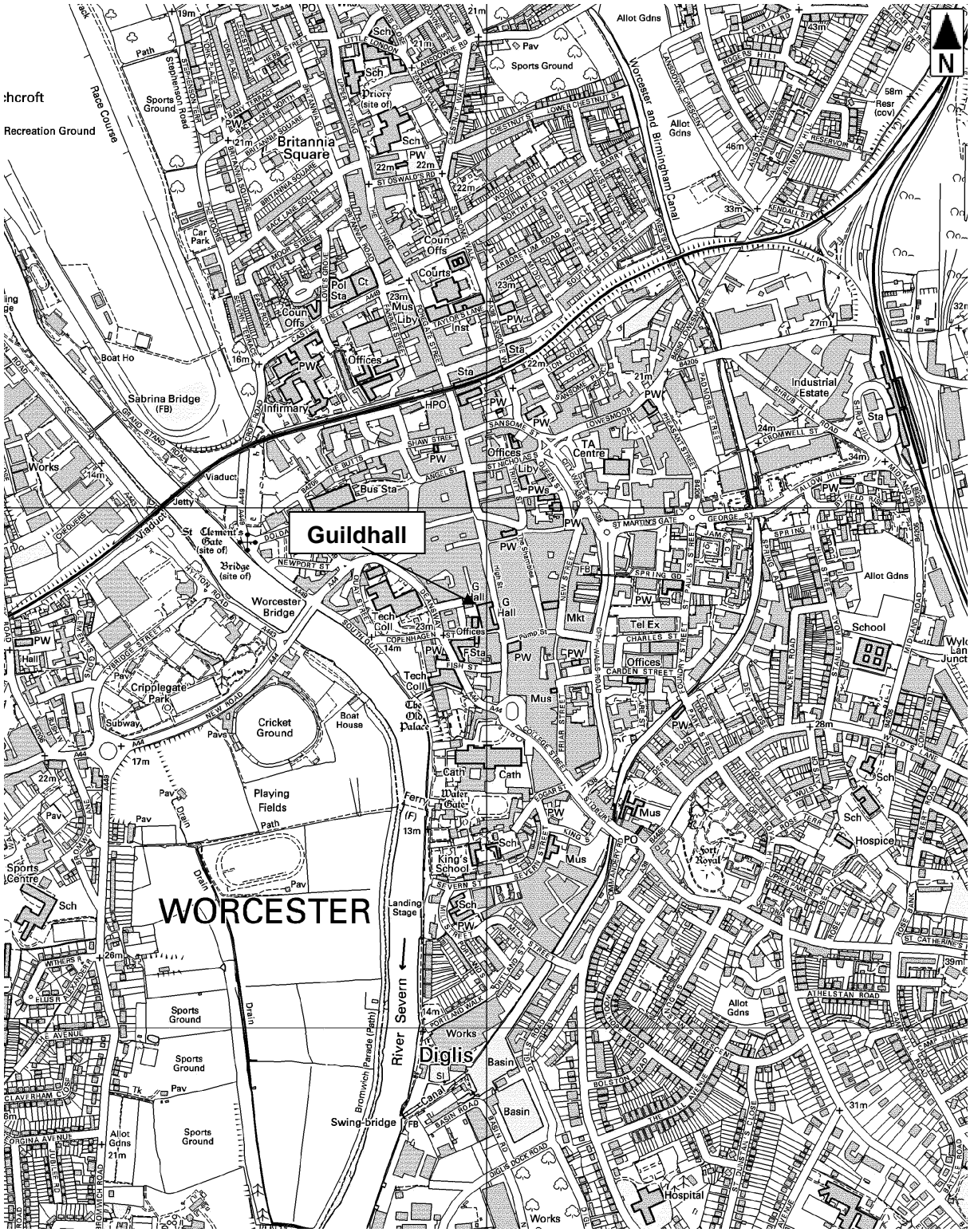

Figure 2: Map to show location of the Guildhall

Figure 3a/b: Photos of one of the moulded timbers used as a joist (top) and the timbers of the stairwell (bottom)

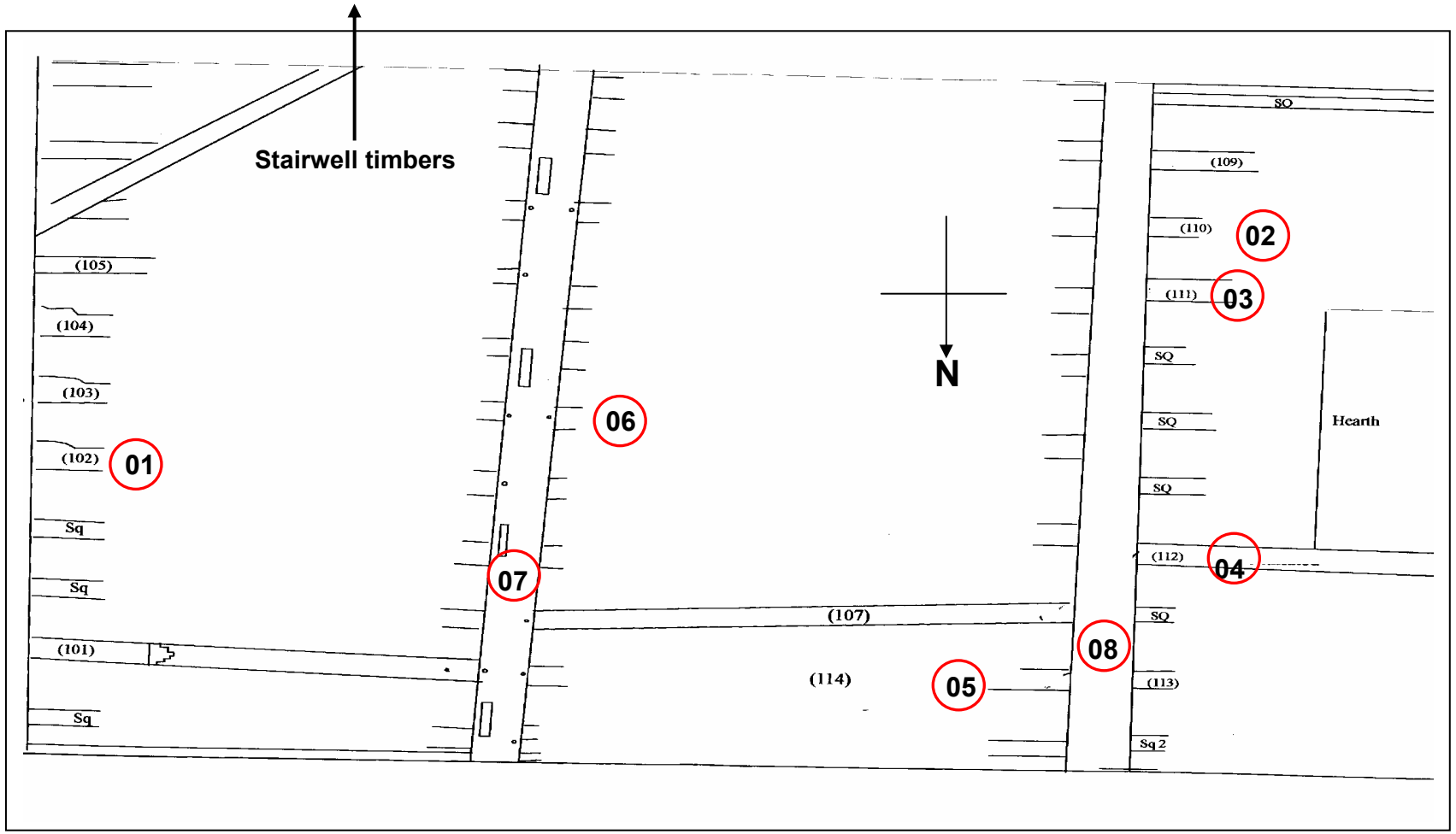

Figure 4a: General plan to show position of samples from the front room floor (after Mike Napthan)

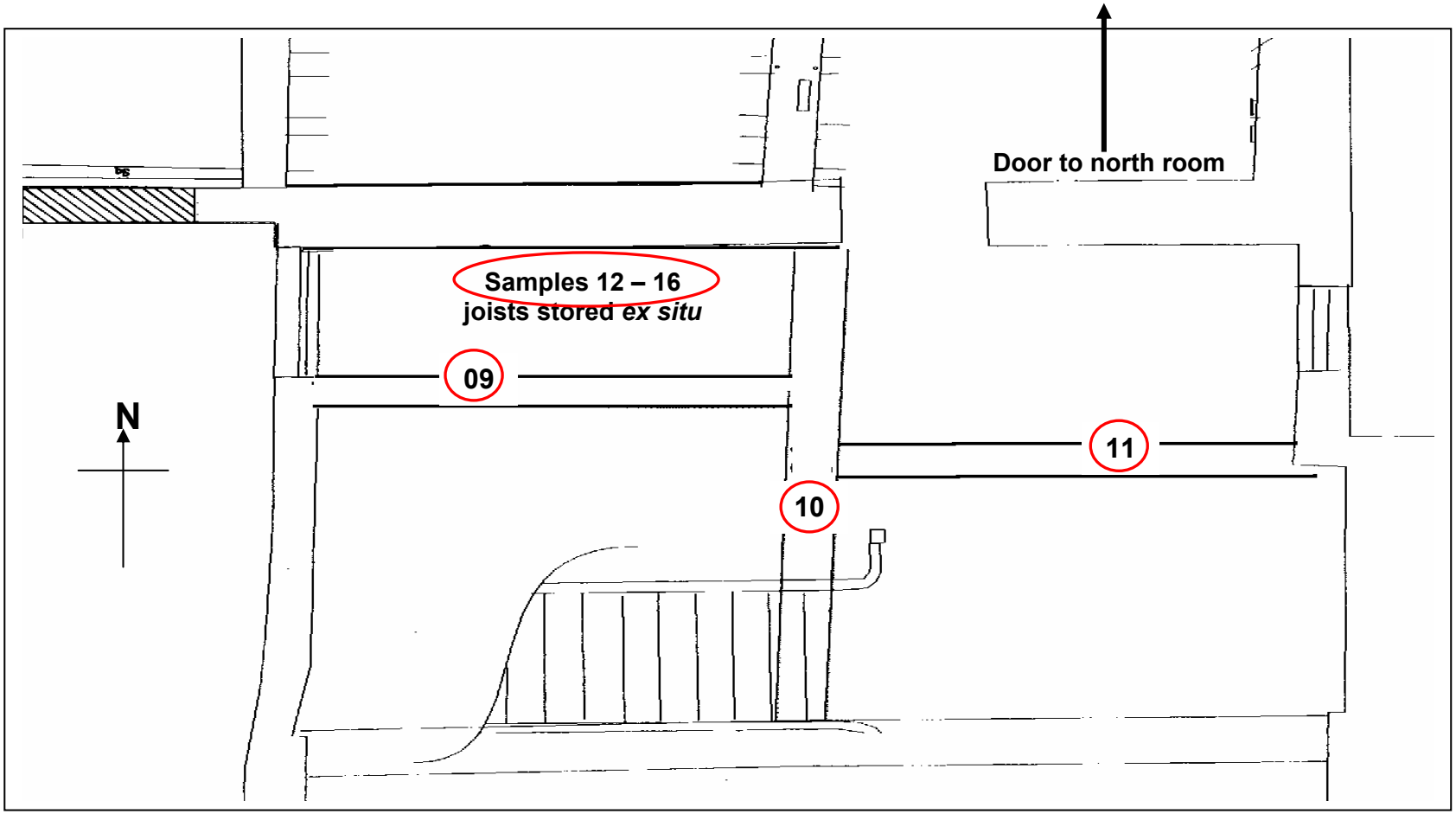

Figure 4b: Plan to show location of samples from the stairs timbers and removed joists (after Mike Napthan)

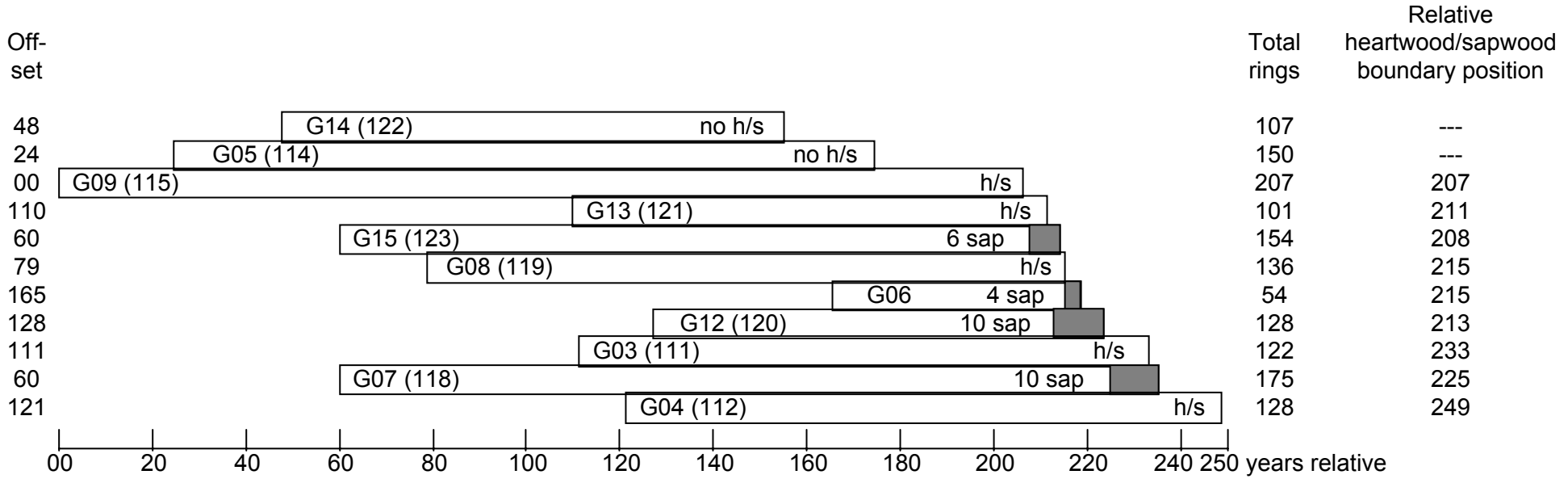

Figure 5: Bar diagram of the samples in site chronology WORGSQ01
white bars = heartwood rings, shaded area = sapwood rings
h/s = the heartwood/sapwood boundary is the last ring on the sample

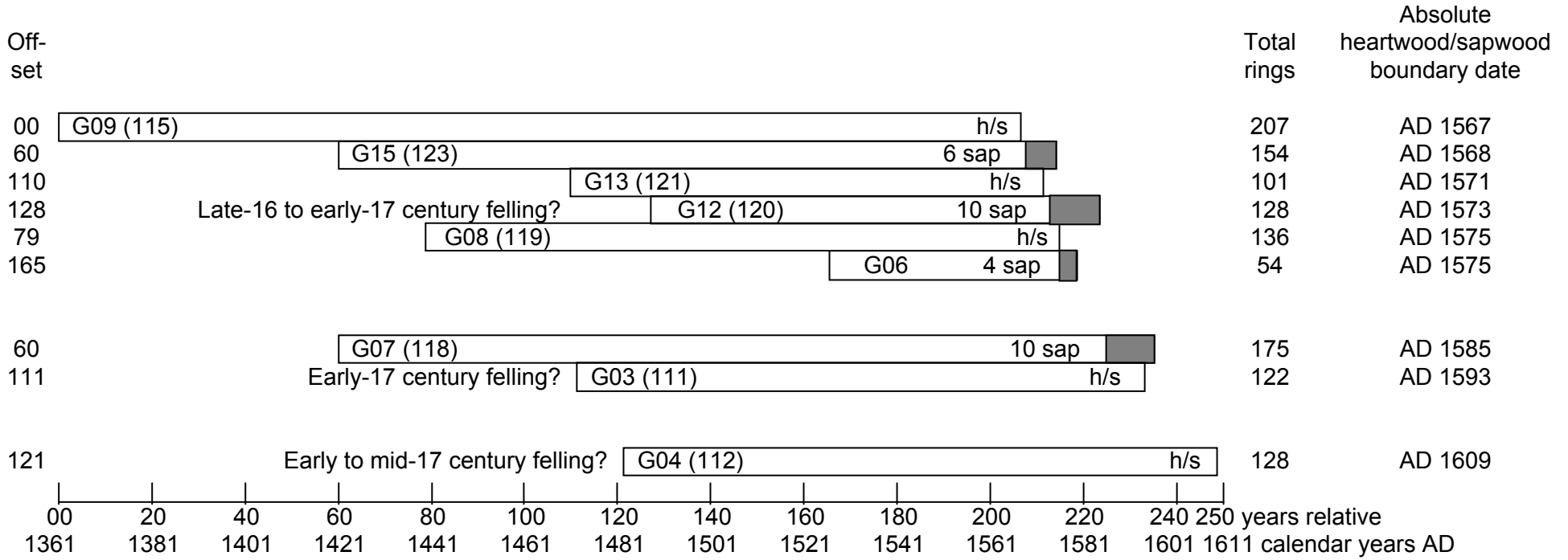

Figure 6: Bar diagram of the nine samples in site chronology WORGSQ01 with the heartwood/sapwood boundary in order of last heartwood ring and split in to possible felling phases
white bars = heartwood rings, shaded area = sapwood rings
h/s = the heartwood/sapwood boundary is the last ring on the sample

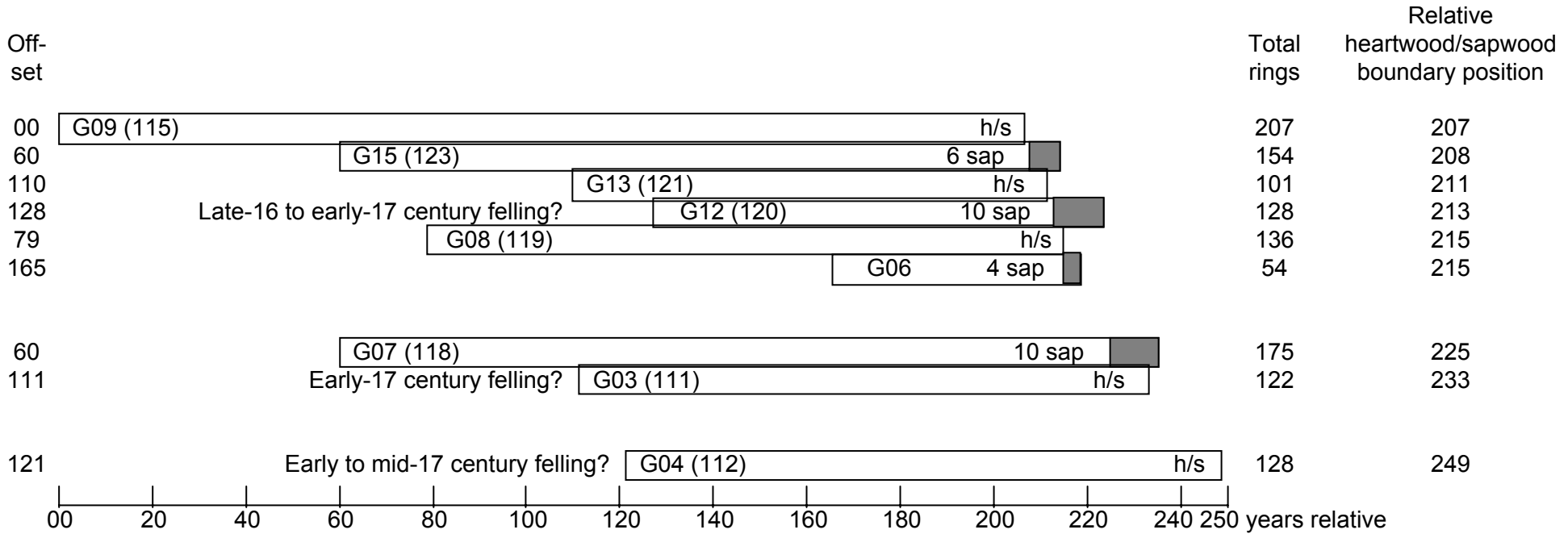

Figure 6: Bar diagram of the nine samples in site chronology WORGSQ01 with the heartwood/sapwood boundary in order of last heartwood ring and split in to possible felling phases
white bars = heartwood rings, shaded area = sapwood rings
h/s = the heartwood/sapwood boundary is the last ring on the sample

Data of measured samples – measurements in 0.01 mm units

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WOR-G01A 78
 289 336 199 269 241 258 310 305 231 236 197 241 322 256 240 309 272 252 226 206
 260 234 287 254 201 228 230 225 190 133 185 192 275 227 233 299 334 321 266 105
 132 167 228 206 332 263 225 216 197 186 239 197 306 351 325 341 349 231 272 291
 254 300 255 271 241 277 329 175 167 174 302 302 213 241 197 333 199 285
WOR-G01B 78
 278 367 222 257 235 246 291 304 231 237 202 242 355 267 252 297 275 257 228 206
 249 242 285 260 201 233 212 219 207 132 187 182 266 220 260 314 323 338 278 133
 144 191 197 199 317 277 220 205 214 186 229 199 321 348 305 358 337 251 269 291
 284 290 246 262 239 263 365 157 126 212 276 299 280 241 181 358 222 287
WOR-G03A 122
 102  91  90 160 116 123  84 105  89 109  98  88 132 130 107 137 105 103 139 132
 104 206 211 196 318 218 191 262 244 237 299 224 207 210 192 194 179 220 172 259
 251 288 243 197 172 197 164 242 188 186 225 179 193 128  97 112 171 192 124 133
 105 136 164 159 177 174 145 147 159 167  73 120 119 138 112  74 112 121 118 130
  72  92 105 134 100 103  72  98 119  97  88  97 112  76  57  60  66  76  83 124
 100  94  71  73  67  70  69  95 109  88  66  78 122 102 137 119 112 122  84  92
 120 108
WOR-G03B 122
 125  89  90 159 113 130 104  91  96 102 107 145 102 160 115 150  99 107 130 117
 117 189 218 196 307 225 185 269 262 223 303 225 204 211 194 195 188 220 171 259
 249 292 243 203 173 186 177 232 172 207 226 166 193 128  91 127 172 188 125 137
 108 142 153 158 188 163 152 138 170 149  93 115 115 139 116  87 107 117 121 108
  88 103  93 123  96 112  81 107 122  91 100  85 110  72  58  56  69  66 100 117
  86  93  64  67  74  89  63  94  98  88  70  80 124 114 128 118 108 126  77  88
 130 146
WOR-G04A 128
  79  88 121  92 105 106  83  86  89  71  77  75  82  82  96  66  72  51  75  71
  63  75  71  78  83  57  72  63  59  80  60  55  63  52  59  73  63  65  64  71
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 126 114 127 114  79  74 109 141 124 124 109 129 122 117  99 108  81 121 120 115
 105 105 119 137 122 145 124 142 101 148 132 113 201 219 239 230 169 131 140 191
 139 187 211 212 226 230 199 205
WOR-G04B 128
  71  98 107 101 110 103  91  83  88  82  71  69  76  87  90  73  65  70  56  69
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 154 185 202 214 222 234 195 206
WOR-G05A 150
  76  75  77  64  55  64  67  79  48  67  37  69  66  79  77  82  91  73 112  91
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WOR-G05B 150
  69  76  80  61  75  40  75  79  46  69  32  69  74  79  83  68 101  74 113  86
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WOR-G06A 54
  95 110 161 189 311 460 185 192 229 350 202 156 141 202 233 282 201 202 213 196
 145 152 166 226 172 205 166 179 204 281 152 162 170 158 180 137 161 111 152 139
  98 104 131 175 276 298 252 299 276 226 172 230 167 284
WOR-G06B 54
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 154 134 161 222 178 207 169 173 216 266 170 148 177 176 165 136 154 112 161 134
 109  83 163 157 259 313 242 307 287 194 210 209 185 228
WOR-G07A 175
 237 172 123 103  89 150 159 177 129 155 156 168  89 131 160  88  78  66  58  90
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WOR-G07B 175
 142 170 105 122  86 151 176 185 129 167 150 131 103 101 157  94 102  63  63  84
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