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Tree-Ring Analysis of Timbers from Reigate Priory School, Bell Street, Reigate, Surrey

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Summary

The roof over the main range of this house was thought to have been constructed immediately pre-Reformation, but a dendrochronological date was requested in order to inform a conservation plan and subsequent management at the site. Seven timbers dated and gave an interpreted felling date range of AD 1553-64. Complete sapwood on several timbers could not be retained intact, but gave sufficient information to suggest that the actual date of felling is most likely to have been in the earliest few years of this date range. This roof is therefore post-Reformation, a fact which is significant for the interpretation of the development of the building.

Keywords

Dendrochronology
Standing Building

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Introduction

An Augustinian 'hospital' was founded on the site of the present Priory School (NGR TQ 253 500; Fig 1) in the early thirteenth century. By the end of that century it had been reordered as a priory, which was dissolved in AD 1536. Parts of the structure were retained and converted into a country house. An initial survey by Martin Higgins (Surrey County Council) highlighted this roof for investigation. An eight-bay roof of high quality occurs over the main range, which is thought to be immediately pre-reformation. English Heritage commissioned a dendrochronological study of this roof as its date is fundamental to the interpretation of the pre-reformation use of this building and the information was needed to inform a conservation plan being drawn up. A programme of below-ground archaeology is also planned, the location of which may be affected by a pre- or post-reformation date.

Methodology

The site was visited in July AD 2003. Oak timbers with more than 50 rings, traces of sapwood, and accessibility were the main considerations in the initial assessment. Those timbers judged to be potentially useful were cored using a 15mm auger attached to an electric drill. The cores were glued to wooden laths, labelled, and stored for subsequent analysis.

The cores were prepared for measuring by sanding using an electric belt-sander with progressively finer grit papers down to 400 grit. Any further preparation necessary, eg where bands of narrow rings occurred, was done manually. Suitable samples had their tree-ring sequences measured to an accuracy of 0.01 mm 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. The software used in measuring and subsequent analysis was written by Ian Tyers (1999).

Ring sequences were plotted to allow visual comparisons to be made between sequences on a light table. This activity also acts as a measure of quality control in identifying any errors in the measurements when the samples crossmatch. Statistical comparisons were made using Student's *t*-test (Baillie and Pilcher 1973; Munro 1984). The *t*-values quoted below were derived from the original CROS program (Baillie and Pilcher 1973). Those *t*-values in excess of 3.5 are taken to be indicative of acceptable matching positions provided that they are supported by satisfactory visual matches, and give consistent matching positions.

When crossmatching between samples is found, their ring-width sequences are meaned to form an internal 'working' site mean sequence. Other samples may then be incorporated after comparison with this 'working' master until a final site sequence is established, which is then compared with a number of reference chronologies (multi-site chronologies from a region) and dated individual site masters in an attempt to date it. Individual long series which are not included in the site mean(s) are also compared with the database to see if they can be dated.

The dates thus obtained represent the time of formation of the rings available on each sample. Interpretation of these dates then has to be undertaken to relate these findings to the construction date of the phase under investigation. An important aspect of this interpretation is the estimate of the number of sapwood rings missing. In this instance, the sapwood estimates are based on those proposed for this area by Miles (1997), in which 95% of samples are likely to have from 9 to 41 sapwood rings. Where bark is present on the sample the exact date of felling of the tree used may be determined.

The dates derived for the felling of the trees used in construction do not necessarily relate directly to the date of construction of the building. However, evidence suggests that, except in the re-use of timbers, construction in most historical periods took place within a very few years after felling (Salzman 1952; Hollstein 1965).

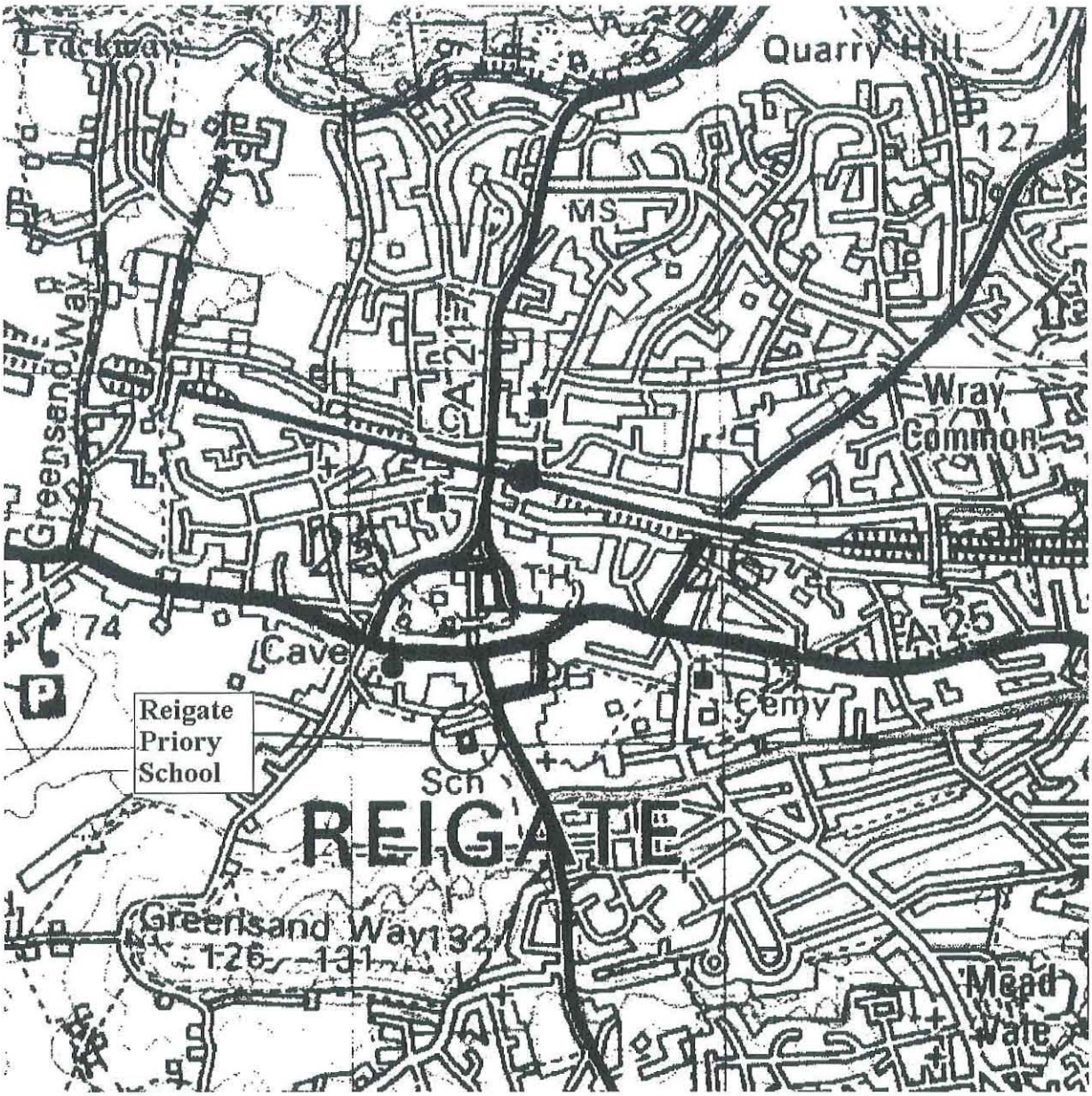

Figure 1: Map showing the general location of Reigate Priory School within Reigate

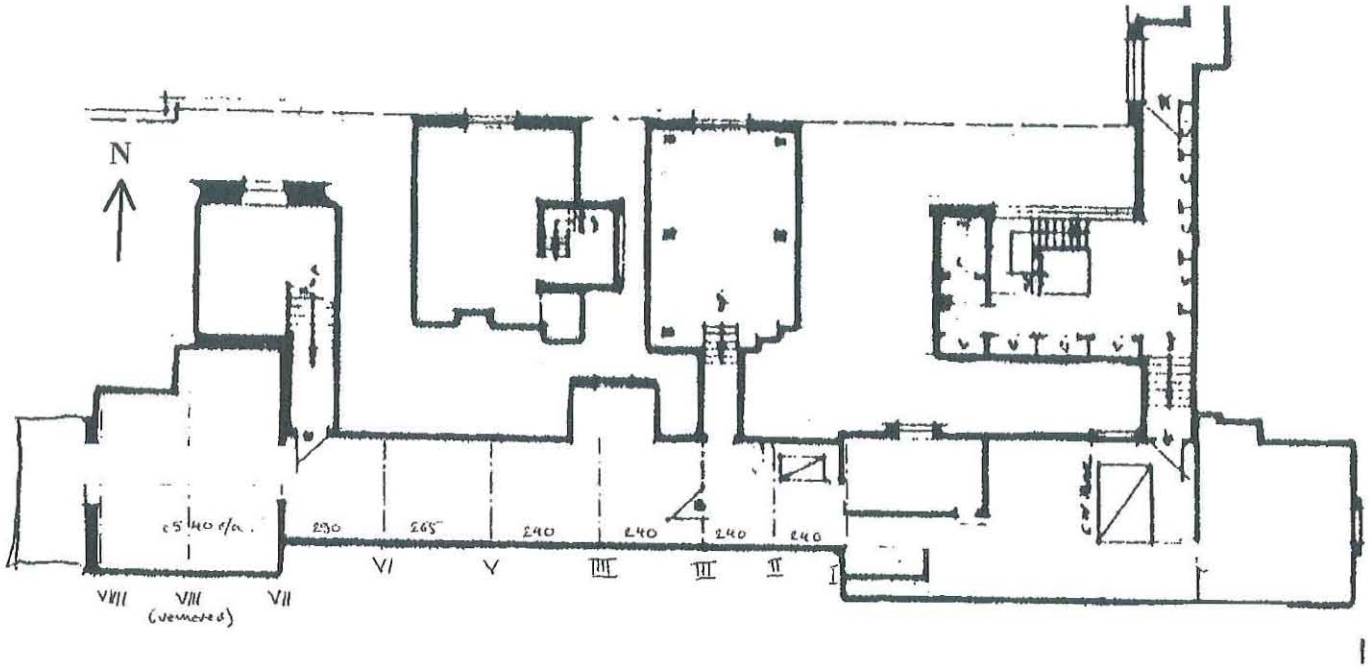

Figure 2: Plan of the south range of the Priory School, Reigate, showing the positions and numbering of the trusses discussed in the text, adapted from an original drawing by Martin Higgins

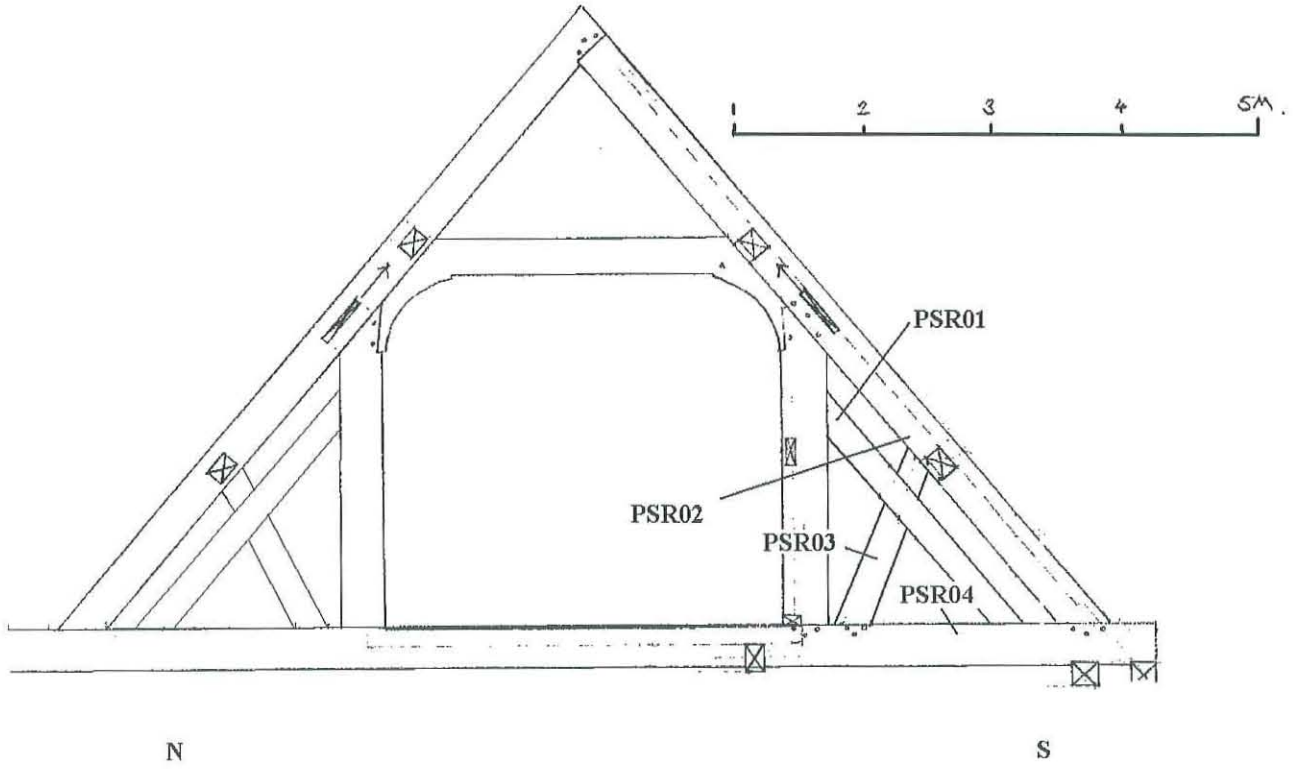

Figure 3: Truss V, showing the timbers sampled for dendrochronology, adapted from an original drawing by Martin Higgins

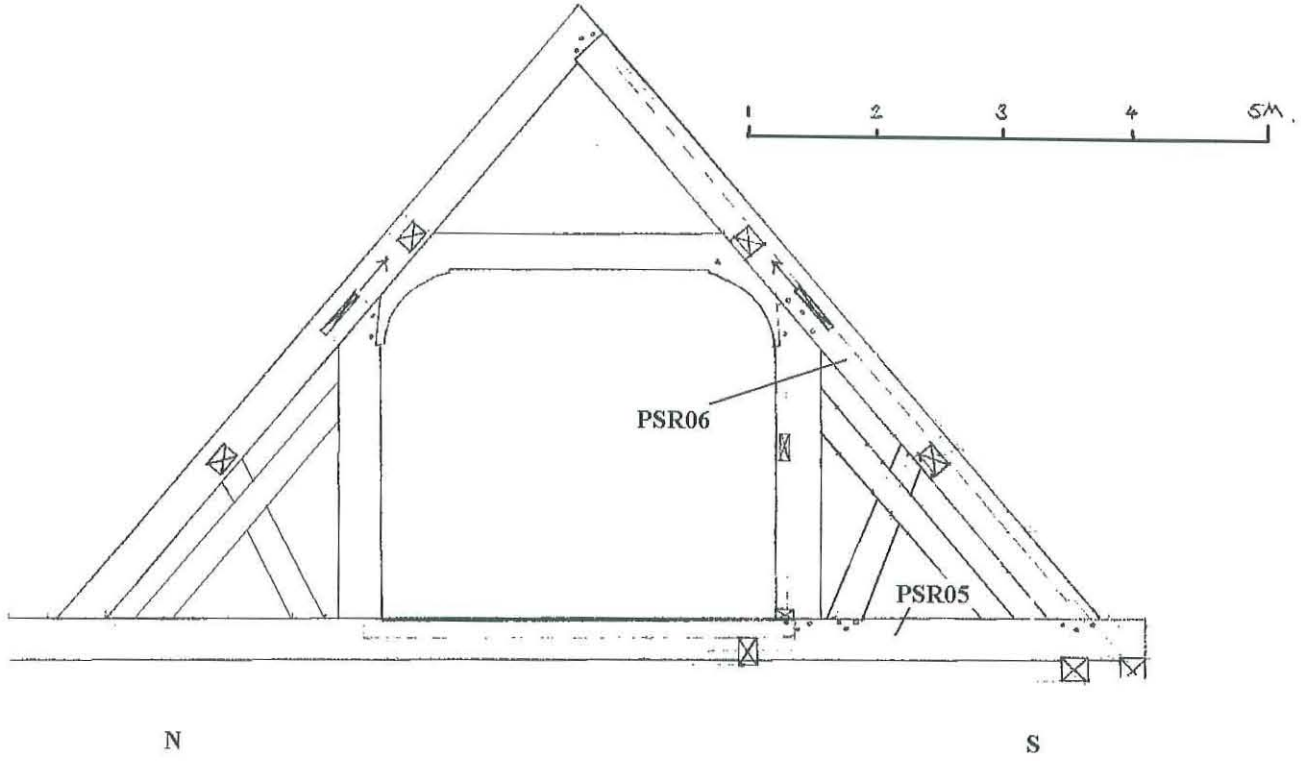

Figure 4: Truss VI, showing timbers sampled for dendrochronology, adapted from an original drawing by Martin Higgins

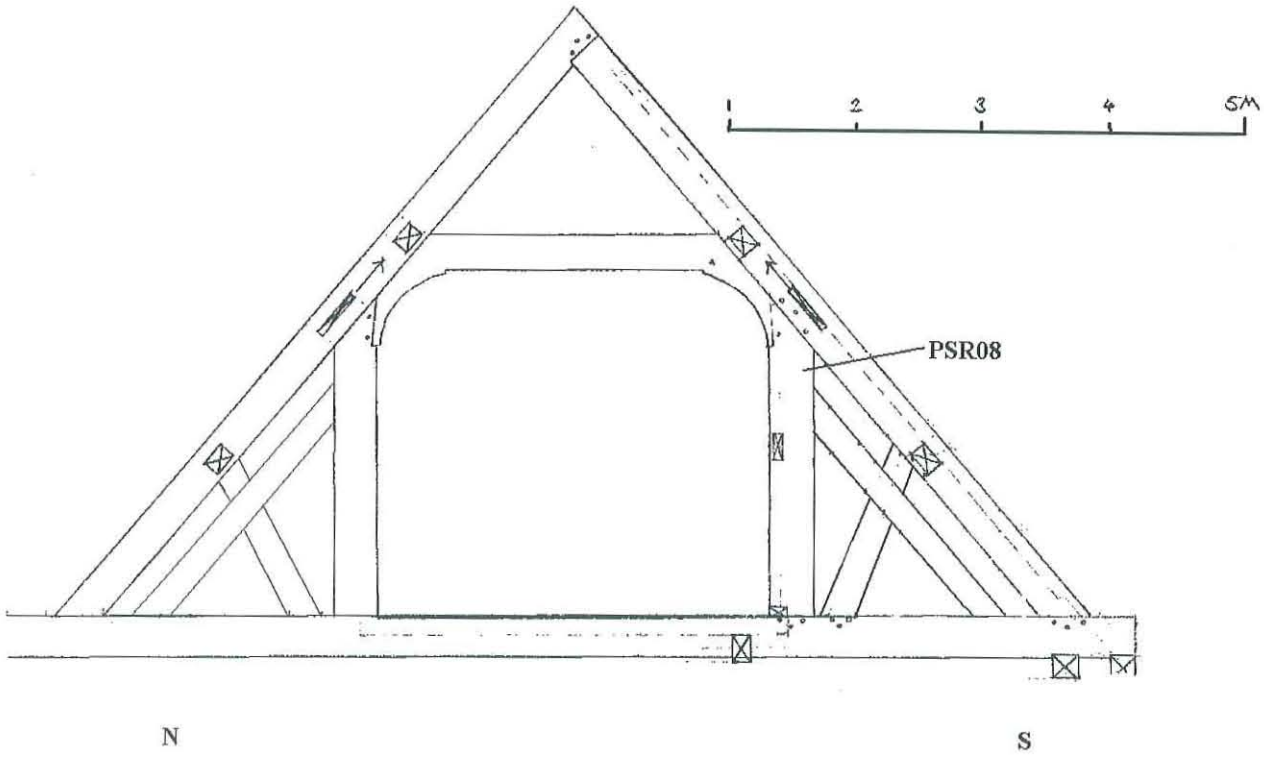

Figure 5: Truss VII, showing timbers sampled for dendrochronology, adapted from an original drawing by Martin Higgins

Results

All the timbers investigated were of oak (*Quercus* spp.). Access was only readily available to the southern side of the roof for the three western-most extant trusses, V, VI, and VII (Figure 2), the walls between the queen posts being lath and plastered, and a ceiling being in place below the collars. Thus sampling was restricted to a relatively small area. Several of the timbers retained complete sapwood, but this was friable and could not be retained intact on coring. Complete sapwood was extracted from PSR06, but it was detached from the rest of the core and one or two rings may have been lost between the heartwood on the core, and the start of the sapwood plug. Sample PSR08 lost the outer 10-15mm of sapwood. Information about the location of the individual cores is given along with other relevant information in Table 1, and illustrated in Figs 3-5. Sample PSR07 came from a stud in a partition wall immediately west of truss VII, and this has not been illustrated. Trusses have been numbered from the east end, adopting the numbers on the drawings supplied by Martin Higgins (Surrey County Council).

All the series matched each other (Table 2) except the shortest series of just 46 years from PSR05. The seven crossmatching series were combined into a site master chronology of 162 years, REIGPRY. This was dated by comparison with a range of regional multi-site, and individual site chronologies, the best results being shown in Table 3. The data for the site chronology are presented in Table 4. The relative positions of overlap are shown, along with the interpreted felling dates for each timber, in Fig 6.

Table 1: Oak (*Quercus* spp.) timbers sampled from . h/s represents the heartwood-sapwood boundary, figures in brackets represent additional unmeasured rings, and C represents complete sapwood. trusses are numbered from the west end of the roof

Sample number	Origin of core	Total no of years	Average growth rate (mm yr^{-1})	Sapwood details	Date of sequence AD	Felling date of timber AD
PSR01	Truss V, long brace on south side	109	1.07	h/s	1427 - 1535	1544 - 76
PSR02	Truss V, south principal rafter	116	2.00	9 (+3)	1428 - 1543	1546 - 75
PSR03	Truss V, south, short brace	67	1.69	5	1462 - 1528	1532 - 64
PSR04	Truss V, tie	120	1.67	-	1384 - 1503	after 1512
PSR05	Truss VI, tie	46	2.99	-	undated	unknown
PSR06	Truss VI, south principal rafter	96	2.18	h/s (+12 ?C)	1446- 1541	1553 – 82
PSR07	Stud in west end wall	51	1.43	h/s	1479 - 1529	1538 – 70
PSR08	Truss VII, queen post	93	1.79	13 +	1453 - 1545	1545 - 73

Table 2: Crossdating between the dated timbers from Priory School, Reigate. A (–) represents a *t*-value of less than 3.0

	t-values					
Sample no	**PSR02**	**PSR03**	**PSR04**	**PSR06**	**PSR07**	**PSR08**
PSR01	4.6	5.3	5.2	6.2	4.6	5.7
PSR02		3.4	6.2	4.9	3.9	-
PSR03			4.5	5.3	5.4	3.6
PSR04				5.8	5.1	5.7
PSR06					6.0	5.5
PSR07						3.9

Table 3: Dating evidence for the site chronology REIGPRY

		REIGPRY AD 1384 - 1545	
Dated reference or site master chronology	**Dates spanned (AD)**	***t*-value**	**Overlap (yrs)**
Hants02 (Miles pers comm)	443-1972	9.7	162
Oxon93 (Miles pers comm)	632-1987	6.3	162
Kent (Laxton and Litton 1989)	1158-1540	6.0	157
Southern England (Bridge 1988)	1083-1589	5.2	162
Chawton, Hampshire (Miles and Worthington 1998)	1289-1589	8.8	162
Vann, Surrey (Miles and Worthington 2000)	1404-1593	8.7	142
Norton St Philip, Somerset (Miles and Worthington 1998)	1290-1509	8.7	126
Reigate, Surrey (Tyers 1990)	1401-1590	8.5	145
East Barn, Newdigate, Surrey (Bridge 1998)	1312-1483	8.1	100
Mottisfont, Hampshire (Miles 1996)	1388-1538	8.0	151
Ford, West Sussex (Bridge 2000)	1286-1511	7.9	128
Cowfold, Sussex (Tyers 1990)	1377-1535	7.5	152
Headley, Hampshire (Miles, pers comm)	1313-1484	7.5	101
Bramley, Hampshire (Miles and Worthington 1999)	1364-1545	7.4	162
Crawley, Sussex (Miles and Worthington 1997)	1377-1472	7.3	89
Lyss Place, Hampshire (Miles and Worthington 2002)	1348-1541	7.2	158
Trees2, Hampshire (Miles and Haddon-Reece 1993)	1436-1549	7.1	110

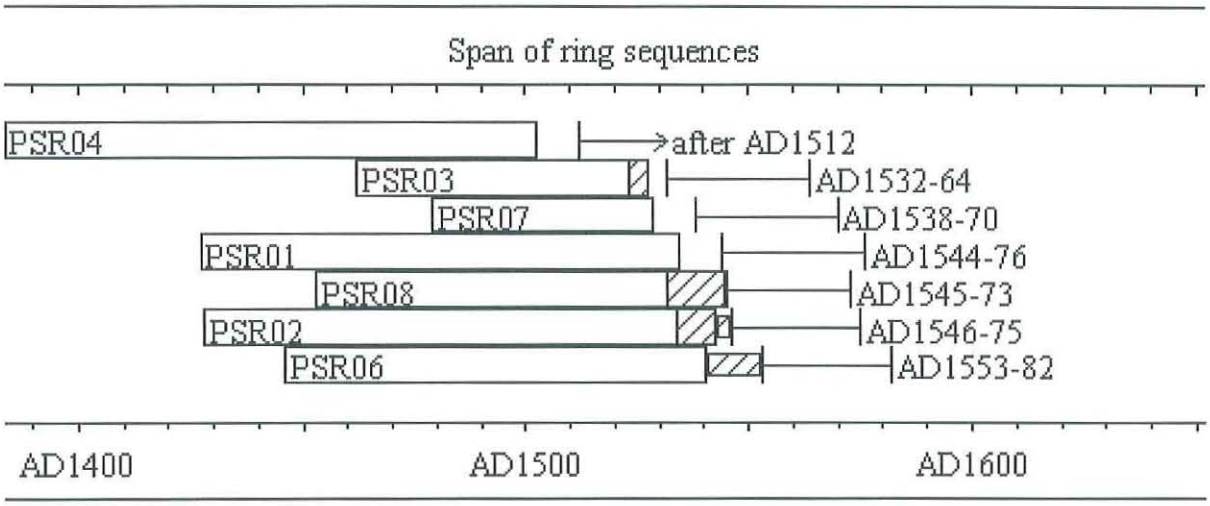

Figure 6: Bar diagram showing the relative positions of overlap of the dated samples from Priory School, Reigate, with their interpreted felling date ranges. Narrow bar sections represent additional unmeasured rings and hatched sections are sapwood rings

Interpretation and Discussion

All the dated timbers appear to belong to a single batch of timbers, probably felled at the same time. The combined felling date range for these timbers is AD 1553-64. Whilst this is a relatively narrow range it can reasonably be shortened when taking into account the information gained at the time of sampling from the timbers which retained complete sapwood. PSR06 had complete sapwood, but there was a break between the heartwood core and the sapwood section. The overall length of the core compared with the depth of the hole showed that the number of rings missing must have been very small, probably only of the order of one or two. Sample PSR08 lost in the region of 10-15 mm to the bark edge – representing less than 15 rings, assuming growth continued at a similar rate to the years before the end of the core. These timbers strongly suggest that felling, and therefore construction, was most likely to have taken place in the few years immediately after AD 1553. This puts construction of the roof to post-Dissolution, rather than immediately pre-Dissolution as had been thought, and is an important finding in the interpretation of the rest of the site.

The strong matching of the site chronology to sites around Surrey and neighbouring parts of Sussex and Hampshire suggests that the timber used was most likely of local origin.

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Table 4: Ring width data for the site chronology REIGPRY, AD 1384-1545

ring widths (0.01mm)										number of trees									
454	452	527	564	583	336	291	285	238	286	1	1	1	1	1	1	1	1	1	1
267	277	263	239	178	175	145	135	95	162	1	1	1	1	1	1	1	1	1	1
201	191	184	166	138	171	216	222	132	96	1	1	1	1	1	1	1	1	1	1
123	134	132	156	192	137	151	152	129	158	1	1	1	1	1	1	1	1	1	1
155	130	83	123	209	224	187	208	229	173	1	1	1	2	3	3	3	3	3	3
153	157	168	208	226	185	189	192	204	214	3	3	3	3	3	3	3	3	3	3
181	148	128	155	191	215	218	229	165	178	3	3	4	4	4	4	4	4	4	5
207	227	191	154	154	141	132	103	118	188	5	5	5	5	5	5	5	5	6	6
154	208	201	193	162	119	117	105	151	186	6	6	6	6	6	6	6	6	6	6
211	252	212	160	140	168	177	180	98	129	6	6	6	6	6	7	7	7	7	7
193	173	211	191	187	164	172	158	153	187	7	7	7	7	7	7	7	7	7	7
187	156	254	191	140	154	125	128	135	138	7	7	7	7	7	7	7	7	7	7
130	112	123	172	138	160	170	174	178	169	6	6	6	6	6	6	6	6	6	6
168	158	146	130	133	141	101	112	165	152	6	6	6	6	6	6	6	6	6	6
150	114	123	135	140	147	144	189	181	189	6	6	6	6	6	5	4	4	4	4
171	191	181	256	249	277	239	275	171	142	4	4	3	3	3	3	3	3	2	2
104	174									1	1								