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STORETON HALL FARM STORETON, WIRRAL DENDROCHRONOLOGICAL ANALYSIS OF OAK TIMBERS

SCIENTIFIC DATING REPORT

Ian Tyers

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STORETON
WIRRAL

DENDROCHRONOLOGICAL ANALYSIS OF OAK TIMBERS

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SUMMARY

A tree-ring dating programme was commissioned on timbers from an outbuilding at Storeton Hall Farm. The results identified that timbers in both the floor and roof of one area of the building were datable by tree-ring dating techniques, with these areas using timbers felled during the late seventeenth century. This dating programme was commissioned to inform future planning decisions on this Building at Risk. This report archives the dendrochronological results.

CONTRIBUTORS

Ian Tyers

ACKNOWLEDGEMENTS

The sampling and analysis of timbers at Storeton Hall Farm was funded by English Heritage (EH). Practical help and valuable discussions were provided by Mark Fletcher of Matrix Archaeology, who also provided the descriptive text and the plans and elevations used here.

ARCHIVE LOCATION

Merseyside Historic Environment Record
Merseyside Archaeological Service
National Museums Liverpool
Dock Traffic Office
Albert Dock
Liverpool L3 4AX

DATE OF INVESTIGATION

2008–9

CONTACT DETAILS

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CONTENTS

INTRODUCTION

This document is a technical archive report on the tree-ring analysis of oak timbers from an outbuilding at Storeton Hall Farm, Wirral. It is beyond the dendrochronological brief to describe the building in detail or to undertake the production of detailed drawings. Elements of this report may be combined with detailed descriptions, drawings, and other technical reports at some point in the future to form either a comprehensive publication or an archive deposition on the building.

Storeton Hall Farm stands *c* 5km south-west of Birkenhead, and *c* 20km north-west of Chester (NGR SJ 3052 8442) within the Unitary Authority of Wirral Metropolitan Borough Council, formerly in the Metropolitan County of Merseyside, and traditionally in the County of Cheshire (Fig 1). The outbuilding contains the former solar block and one external wall of a former hall. The building is now L-shaped, using one wall of the hall as part of a later two-storey range. The analysis of timbers in areas within this Building at Risk was commissioned to inform future planning decisions.

METHODOLOGY

Tree-ring dating employs the patterns of tree-growth to determine the calendar dates for the period during which the sampled trees were alive. The amount of wood laid down in any one year by most trees is determined by the climate and other environmental factors. Trees over relatively wide geographical areas can exhibit similar patterns of growth, and this enables dendrochronologists to assign dates to some samples by matching the growth pattern with other ring-sequences that have already been linked together to form reference chronologies.

The building was visited in April 2008. An assessment of the dendrochronological potential of timbers in several areas of the structure had been requested by Jennie Stopford (EH IAM Manchester Office). This assessment aimed to identify whether oak timbers with sufficient numbers of rings for analysis existed in any part of the structure. This assessment concluded that the timbers in the roofs and floors all contained suitable material, whilst there were also some timbers of fairly marginal potential embedding in the former hall wall.

The sampling took place during October 2008. The selected timbers were sampled using a 15mm diameter corer attached to an electric drill. The cores were taken as closely as possible along the radius of the timbers so that the maximum number of rings could be obtained for subsequent analysis. The ring sequences in the cores were revealed by sanding.

This preparation revealed the width of each successive annual tree ring. Each prepared sample could then be accurately assessed for the number of rings it contained, and at this stage it was also possible to determine whether the sequence of ring widths within it could be reliably resolved. Dendrochronological samples need to be free of aberrant anatomical features, such as those caused by physical damage to the tree, which may prevent or significantly reduce the chances of successful dating.

Standard dendrochronological analysis methods (see eg English Heritage 1998) were applied to each suitable sample. The complete sequence of the annual growth rings in the suitable samples was measured to an accuracy of 0.01mm using a micro-computer based travelling stage. The sequences of ring widths were then plotted onto semi-log graph paper to enable visual comparisons to be made between sequences. In addition, cross-correlation algorithms (eg Baillie and Pilcher 1973) were employed to search for positions where the ring sequences were highly correlated. Highly correlated positions were checked using the graphs and, if any of these were satisfactory, new composite sequences were constructed from the synchronised sequences. Any *t*-values reported below were derived from the original CROS algorithm (Baillie and Pilcher 1973). A *t*-value of 3.5 or over is usually indicative of a good match, although this is with the proviso that high *t*-values at the same relative or absolute position need to have been obtained from a range of independent sequences, and that these positions were supported by satisfactory visual matching.

Not every tree can be correlated by the statistical tools or the visual examination of the graphs. There are thought to be a number of reasons for this: genetic variations; site-specific issues (for example, a tree growing in a stream bed will be less responsive to rainfall); or some traumatic experience in the tree's lifetime, such as injury by pollarding, defoliation events by caterpillars, or similar. These could each produce a sequence dominated by a non-climatic signal. Experimental work with modern trees shows that 5–20% of all oak trees cannot be reliably cross-matched, even when enough rings are obtained.

Converting the date obtained for a tree-ring sequence into a date useful to the interpretation of the building requires a record of the nature of the outermost rings of the sample. If bark or bark-edge survives, a felling date precise to the year or season can be obtained. If no sapwood survives, the date obtained from the sample gives a *terminus post quem* for its use. If some sapwood survives, an estimate for the number of missing rings can be applied to the end-date of the heartwood. This estimate is quite broad and varies by region. This report uses a minimum of 10 rings and a maximum of 46 rings as a sapwood estimate (see eg English Heritage 1998, 10–11).

Where bark-edge or bark survives, the season of felling can be determined by examining the completeness or otherwise of the terminal ring lying directly under the bark. Complete material can be divided into three major categories:

- 'early spring', where only the initial cells of the new growth have begun – this is equivalent to a period in March/April, when the oaks begin leaf-bud formation;

- 'later spring/summer' where the early wood is evidently complete but the late wood is evidently incomplete, which is equivalent to May-through-September of a normal year, and
- 'winter' where the latewood is evidently complete and this is roughly equivalent to September-to-March (of the following year) since the tree is dormant throughout this period and there is no additional growth put on the trunk.

These categories can overlap as, for example, not all oaks simultaneously initiate leaf-bud formation. It should also be noted that slow growing or compressed material cannot always be safely categorised.

Timber technology studies demonstrate that many of the tool marks recorded on ancient timbers can only have been done on green timber. There is little evidence for long-term storage of timber or of widespread use of seasoned, rather than green, timber in the medieval period (see eg English Heritage 1998, 11–12).

Reused timbers can only provide tree-ring dates for the original usage date, not their reuse. Identifying reused timbers requires careful timber recording which notes the presence of features which are not functional in the structure. It is always possible that some timbers exhibit no evidence of earlier usage, and are thus 'hidden reused' timbers. The dendrochronological impact of this problem is particularly acute where only single timbers have been dated from a structure.

The analysis may highlight potential same-tree identifications if two or more tree-ring sequences are obtained that are exceptionally highly correlated. Such pairs, or sometimes more, are then used as a same-tree group and each can be given the interpreted date of the most complete of the samples. They are most useful where several timbers date but only one has any sapwood or where same-tree identifications yield linkages between different areas of a building.

RESULTS

In October 2008 17 timbers of four separate areas of the building were cored; these cores were labelled 1–17 inclusive. Four timbers were sampled in the south-east farm building roof, four from the north-west farm building roof, five from the north-west farm building floor, and four from the solar wing roof (Figs 2–4). Each sample was assessed for the wood type, the number of rings it contained, and whether the sequence of ring widths could be reliably resolved. This assessment confirmed that all the sampled timbers were oak (*Quercus* spp.) and that 13 were suitable for dendrochronological analysis. The four exceptions were samples 5, 9, 14, and 15, which all had either too few rings for analysis or had fragmented badly during sampling. There was some survival of sapwood in all of the targeted areas. The details of these samples are provided in Table 1.

The samples were prepared for analysis, measured, and the resultant ring series were compared with each other. Six of the 13 suitable samples were found to cross-match each other well (Table 2). These were then combined into a composite data set of 111 years' length, which was then compared with medieval and later tree-ring data from throughout the British Isles. The composite sequence was found to cross-match strongly against data from sites mostly on the western side of England, with consistent matching into northern England, Wales, and Northern Ireland (Table 3). This cross-matching provided calendar dates for the sequence of AD1572–1682. A summary of the results for the component samples of this chronology are provided in Table 1 and Figure 5.

The remaining individual series were not found to form any consistent groups. These individual series were compared with English, European, and other reference data, as well as the other undated sequences. These series have failed to provide any consistent dating evidence.

The measurement data for all the measured samples are listed in Appendix 1.

DISCUSSION

The dated samples are derived from the floor and roof of a single part of the building, which are probably of the same date. These parts are discussed separately below.

NW Farm Building roof

This roof comprises two large trusses (T3 and T4, Figs 3 and 4a). The four samples from this area comprised two of the four principal rafters, a tie beam, and a purlin. All were suitable for analysis, but only two were found to cross-match the material from the floor below. This material comprised fairly slow-growing medium-aged oaks.

The tree-ring analysis dates the rings present in the cores. The correct interpretation of those dates relies upon the characteristics of the final rings in them. Bark-edge survived on neither of the datable timbers, but significant amounts of sapwood were recovered from one, and the heartwood/sapwood boundary was present on the other. Making allowances for minimum and maximum likely amounts of missing sapwood provides individual felling date ranges for both of the datable timbers. Figure 5 and Table 1 includes the interpreted felling date ranges for both of the datable samples.

The calculation of the common felling period for both dated timbers from this roof suggests a construction date between AD 1682 and *c* AD 1701. The mathematical combination of estimated sapwood distributions is statistically complex, and to achieve a tighter interpretation would require reliable sapwood data for the area, period, and the specific character of these oaks. Such data are not presently available. Until that point the use of robust combinatorial methods, or alternative statistical approaches might sacrifice a broad and indicative date for a narrower one of potentially spurious precision. It is clear, however, that this roof utilises timbers felled in the felled in the last two decades of the seventeenth century. There is no suggestion any of this material is either reused or secondary.

NW Farm Building floor

This floor comprises five large girts forming the ground-floor ceiling and floor above (Figs 2 and 4a). All five were sampled. Four were suitable for analysis and all four of these sequences were cross-matched and dated. There is no significant difference between this material and that found in the roof of the same area, with this material also comprising reasonably slow-growing medium-aged oaks.

Bark-edge survived on none of these timbers, but significant amounts of sapwood were recovered from two, and the heartwood/sapwood boundary was present on the remaining two. Figure 5 and Table 1 includes the interpreted felling date ranges for each of these datable samples.

The calculation of the common felling period for each dated timber from this floor suggests a construction date between AD 1682 and *c* AD 1699. This suggests the floor and roof of the NW Farm Building are contemporaneous.

SE Farm Building roof

This roof is of two trusses (labelled T1 and T2, Fig 3) of similar truss form to those in the roof of the NW Farm Building. Four samples were obtained from two principal rafters and two tie beams. Three were suitable for analysis, but none cross-matched each other, or other material from Storeton. This may suggest these timbers were of a different date, or obtained from a different source.

Solar

The solar contained three trusses, labelled T5–T7 (Figs 3 and 4b). One of these (T5) was in an unsafe condition and out of bounds for sampling purposes. The grain of the timbers in this area was more distorted than those in the other two areas of roof. Sampling the best of this material yielded four cores, two of which contained insufficient rings for analysis. The remaining two each yielded short sequences with some sapwood. However, there is no identifiable cross-matching between these series, or between them and the other material from Storeton. This may suggest these timbers were of a different date, or obtained from a different source.

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FIGURES

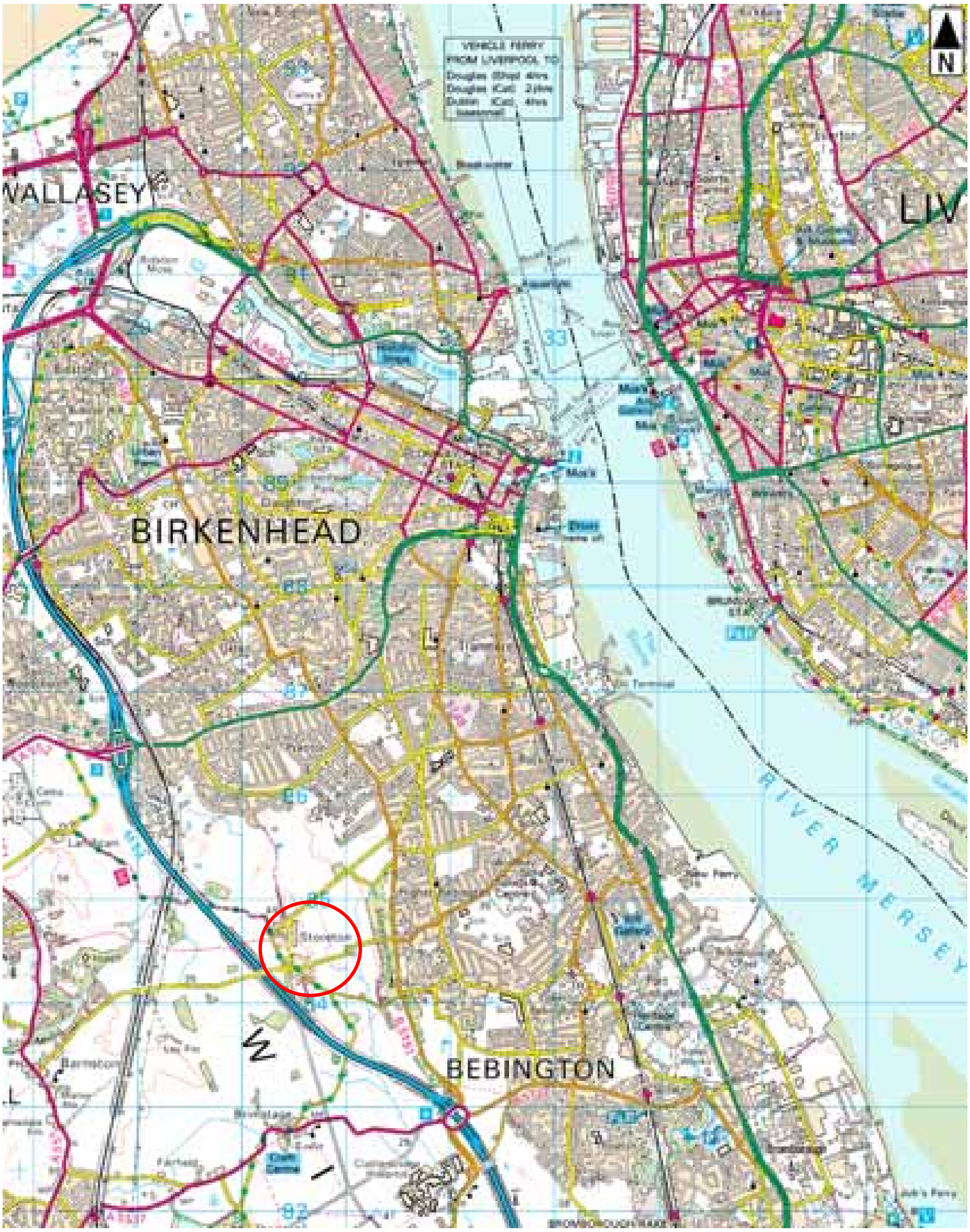


Figure 1. Location of Storeton Hall Farm (circled).

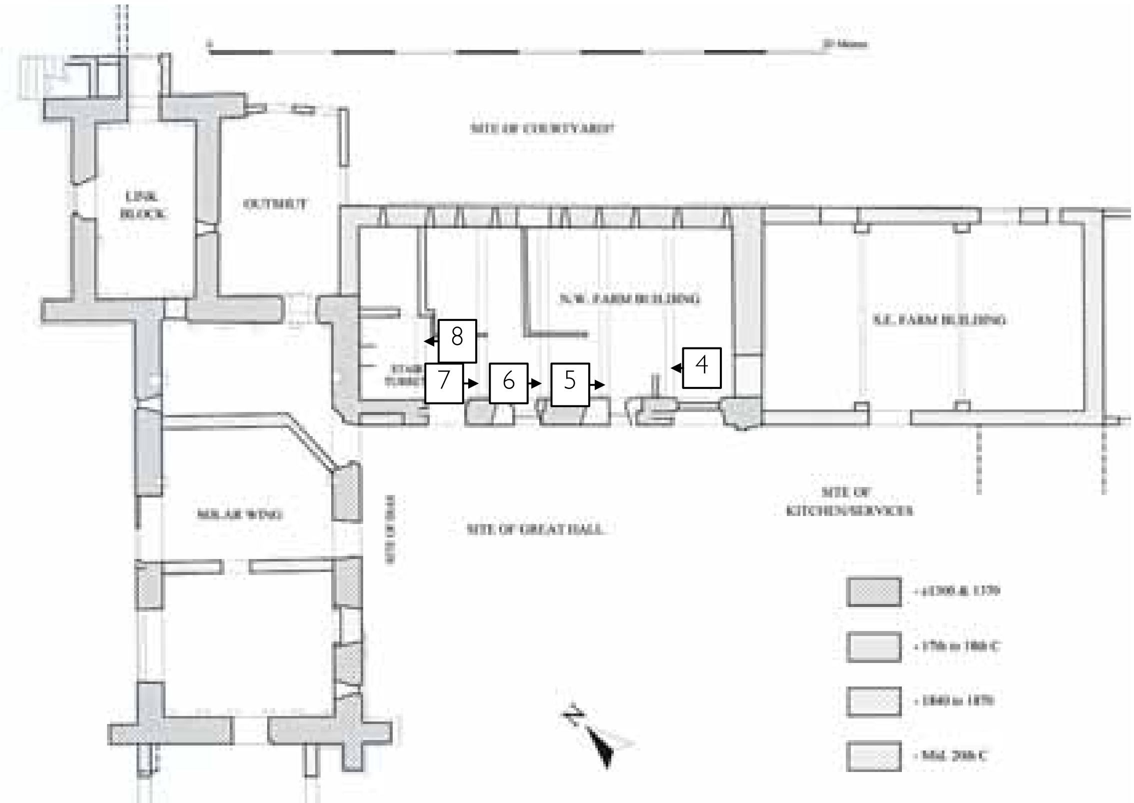


Figure 2. Ground Floor Plan of Storeton Hall Farm showing the location and naming of the areas discussed in this report, and the approximate location of the samples 4–8. Based on a plan supplied by Mark Fletcher, Matrix Archaeology

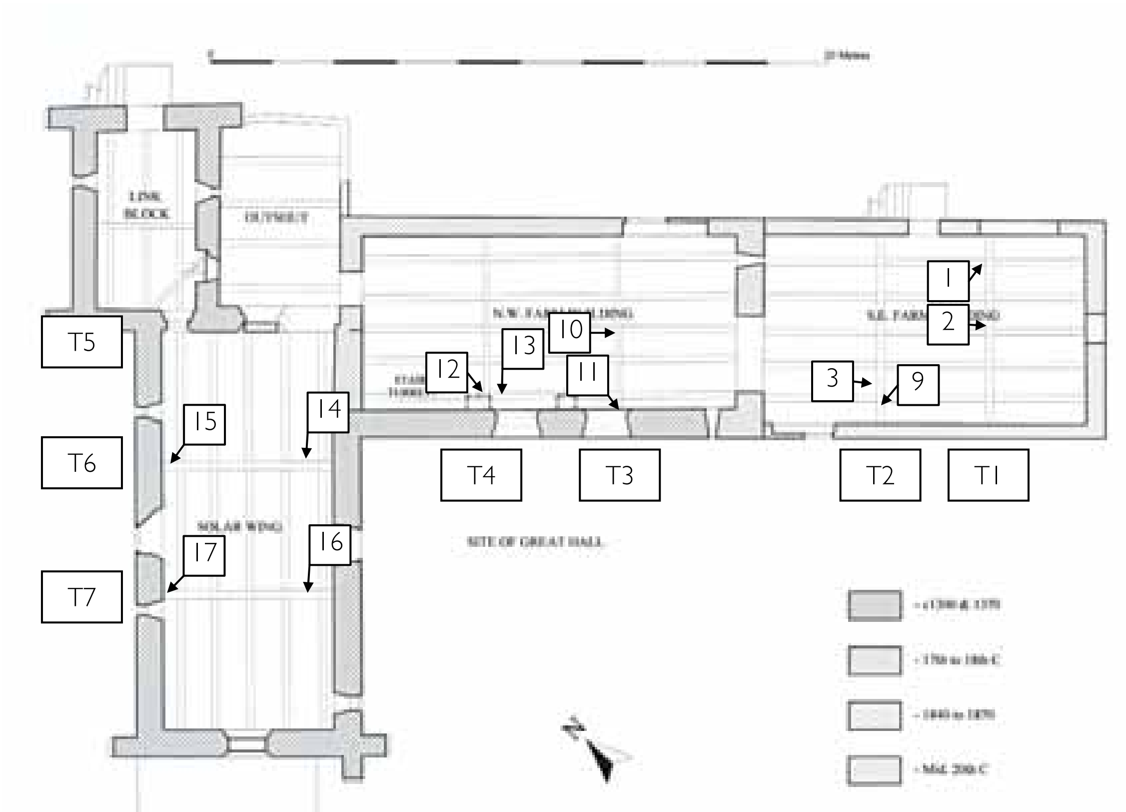


Figure 3. First Floor Plan of Storeton Hall Farm showing the location and naming of the areas discussed in this report, the truss numbering scheme followed (T1-T7), and the approximate location of samples 1–3 and 9–17. Based on a plan supplied by Mark Fletcher, Matrix Archaeology

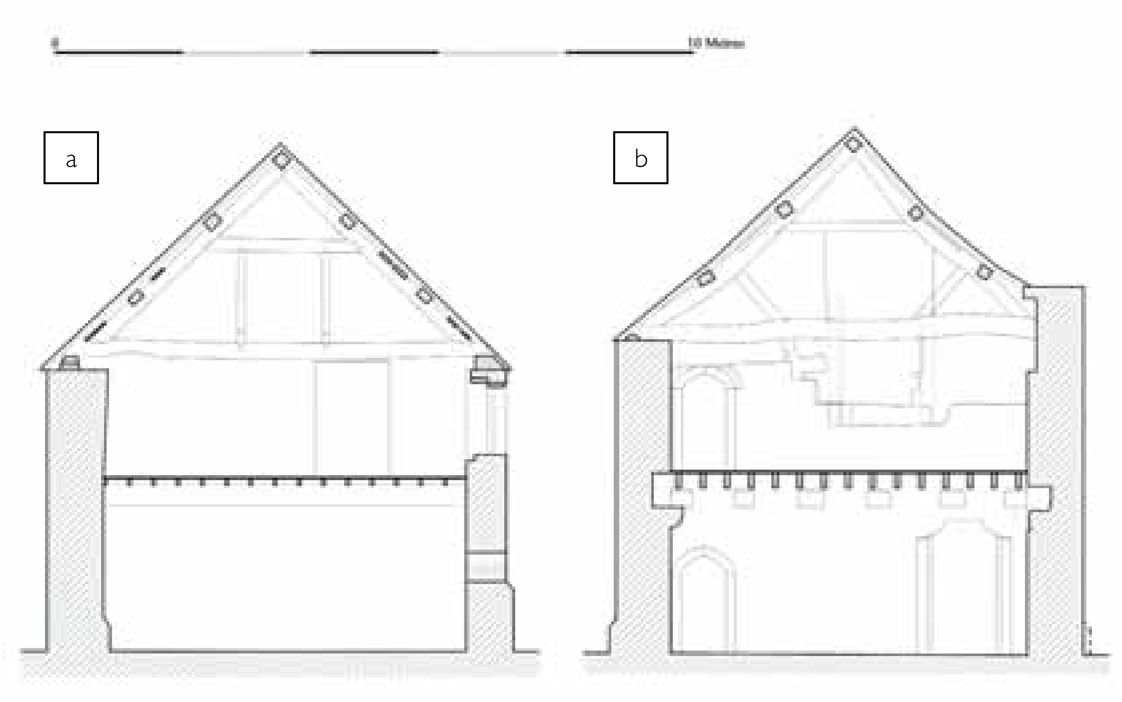


Figure 4. a) Truss T4, floor and section from NW Farm Building, and b) Truss T5, floor and section from Solar Wing, both of Storeton Hall Farm outbuilding. Based on a figure supplied by Mark Fletcher, Matrix Archaeology

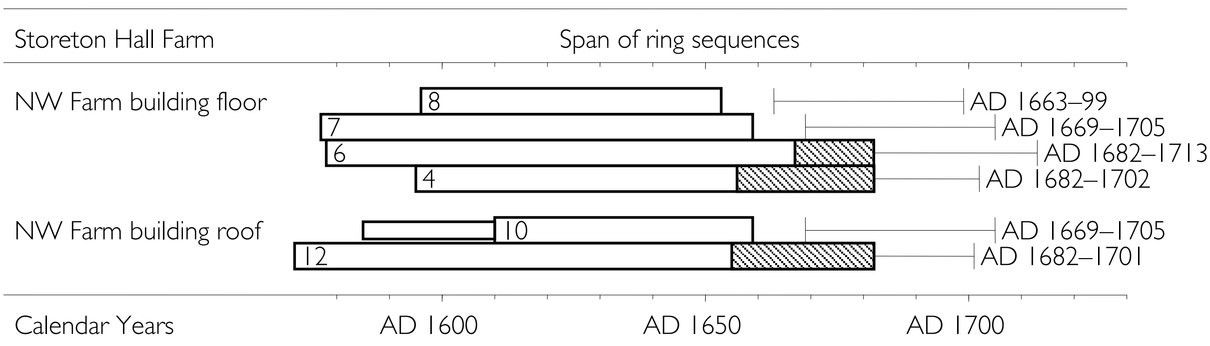


Figure 5. Bar diagram showing the absolute dating positions of the 6 dated tree-ring sequences for samples from Storeton Hall Farm. The interpreted felling dates are also shown for each sample.

KEY White bars are oak heartwood, hatched bars are sapwood, the narrow bar represents unmeasured heartwood.

TABLES

Table 1. Details of the 17 samples from timbers from Storeton Hall Farm.

Sample	Location	Rings	Sap	Date of measured sequence	Interpreted result
1	SE T1north-east principal rafter	62	17+Bs	not dated	-
2	SE T1 tie beam	67	26+Bs	not dated	-
3	SE T2 tie beam	63	26+Bs	not dated	-
4	NW floor beam	88	26	AD 1595–AD 1682	AD 1682–1702
5	NW floor beam	-	-	not measured	-
6	NW floor beam	105	15	AD 1578–AD 1682	AD 1682–1713
7	NW floor beam	83	H/S	AD 1577–AD 1659	AD 1669–1705
8	NW floor beam	58	H/S	AD 1596–AD 1653	AD 1663–99
9	SE T2 south-west principal rafter	-	-	not measured	-
10	NW T3 tie beam	*25*+50	H/S	AD 1610–AD 1659	AD 1669–1705
11	NW T3 south-west principal rafter	49	-	not dated	-
12	NW T4 south-west principal rafter	111	27	AD 1572–AD 1682	AD 1682–1701
13	NW T3–T4 south-west lower purlin	*20*+67	-	not dated	-
14	Solar T6 tie beam	-	-	not measured	-
15	Solar T6 north-west principal rafter	-	-	not measured	-
16	Solar T7 tie beam	59	17	not dated	-
17	Solar T7 north-west principal rafter	51	14	not dated	-

KEY For locations see Figures 2 and 3. SE; south-east Farm Building, trusses T1 and T2 from south-east. NW; north-west Farm Building, trusses T3 and T4 from south-east. Solar; solar wing, trusses T5–T7 from north-east, H/S is heartwood/sapwood edge, Bs bark season early spring/summer, *italics* gives the estimated numbers of unmeasured rings.

Table 2. The t-values (Baillie and Pilcher 1973) between 6 sampled timbers from Storeton Hall Farm. - t-value less than 3.0.

	6	7	8	10	12
4	-	3.49	3.15	-	4.48
6		5.56	5.42	6.71	3.65
7			4.23	5.02	4.60
8				4.09	3.14
10					-

Table 3. Showing example t-values (Baillie and Pilcher 1973) between the composite sequence constructed from Storeton Hall Farm and oak reference data.

Reference chronology	Storeton AD 1572–1682
Anglesey, Hafoty Llansadwen (Hillam and Groves 1992)	5.52
Cheshire, Combermere Abbey (Howard *et al* 2003)	5.10
Herefordshire, Pembridge bell tower (Tyers 1999)	7.41
Lancashire, Turton Barn (Tyers 2008)	5.00
Northern Ireland regional sequence (Baillie 1977)	5.84
Northumberland, St Marys Chare Hexham (Arnold *et al* 2004)	5.56
Worcestershire, Wribbenhall (Tyers and Price 2007)	7.49
Yorkshire, Cookridge Moseley Wood Farm barn (Tyers 2006)	6.04

APPENDIX 1

sth1

316	431	315	218	318	384	319	387	349	311
288	296	325	289	342	392	250	281	264	101
50	59	83	125	295	240	133	197	256	77
279	348	299	286	87	70	50	48	46	47
55	75	100	73	97	169	92	159	106	126
334	201	261	276	139	150	212	231	146	212
294	398								

sth2

340	257	380	437	595	642	493	480	357	444
458	462	659	390	478	338	394	399	404	460
448	393	299	292	300	306	332	332	334	143
115	107	84	145	86	80	132	212	214	170
147	194	151	84	97	86	91	96	83	83
87	94	124	143	214	192	160	205	285	166
113	54	93	68	119	182	175			

sth3

614	565	526	644	516	378	490	605	820	657
530	473	623	441	352	454	331	496	333	245
349	282	222	241	341	166	203	89	158	131
212	234	159	217	153	173	114	93	154	174
218	175	197	181	168	155	135	155	149	118
171	144	183	139	86	84	95	128	141	159
177	179	143							

sth4

353	221	232	226	122	123	253	343	473	483
431	482	492	414	345	355	242	254	287	211
172	228	231	301	192	217	166	163	77	78
132	217	268	182	172	155	102	88	62	42
87	70	132	220	111	125	121	61	113	62
68	136	123	144	137	142	121	70	57	70
97	120	38	30	22	34	25	36	40	48
35	26	28	36	55	66	72	60	57	51
62	139	129	140	149	137	128	85		

sth6

151	237	250	277	263	238	278	330	222	269
169	238	218	260	345	402	391	344	258	269
356	297	210	225	152	188	188	80	91	121
166	174	160	107	118	62	96	147	113	121
139	108	113	77	92	82	61	68	55	90
99	128	116	86	122	120	121	67	60	104
167	96	98	104	73	72	64	62	57	71
83	92	72	69	56	61	69	95	123	63
69	64	47	60	52	59	64	90	94	100
75	125	108	101	125	91	72	62	116	119
105	139	91	93	103					

sth7

415	573	471	497	358	292	293	285	269	286
228	219	253	264	291	265	313	360	416	343
378	391	381	239	273	228	254	255	129	170
140	149	120	191	223	170	177	223	180	189
105	186	154	137	79	89	63	75	55	79
87	88	140	101	77	121	122	113	100	64
127	193	99	136	120	100	98	79	66	102
87	100	120	106	82	77	88	130	154	174
131	117	103							

sth8

214	191	172	193	177	240	172	202	183	154
167	165	217	226	226	132	107	79	94	104
90	90	124	100	137	78	111	55	43	37
61	73	81	86	78	61	66	79	68	72
91	170	196	116	145	150	106	80	63	85
109	103	144	140	104	92	74	91		

sth10

549	563	439	392	360	406	274	201	256	172
184	136	168	131	123	121	93	116	105	167
142	107	143	120	81	67	62	83	119	70
105	86	96	76	90	93	88	106	123	117
111	116	87	67	73	113	143	104	95	85

sth11

387	495	471	313	307	237	222	219	261	226
275	183	223	366	362	390	369	201	307	257
152	151	100	127	158	166	151	139	84	127
135	111	131	154	82	77	70	77	44	58
43	43	79	85	80	76	55	77	87	

sth12

361	290	319	280	169	126	143	197	180	139
67	122	93	139	117	73	64	78	78	92
77	107	128	151	109	93	52	59	60	44
34	39	52	52	65	81	58	46	82	77
99	84	61	71	48	61	96	84	113	97
97	40	30	27	33	58	59	77	77	74
93	94	65	81	36	70	110	86	105	91
51	64	56	52	60	78	77	70	82	66
66	110	105	168	154	118	115	66	65	51
60	103	80	114	66	57	39	75	93	104
108	67	38	37	48	42	49	70	46	46
67									

sth13

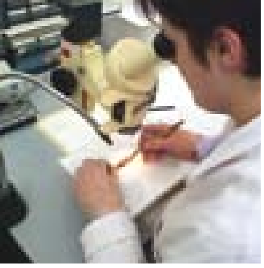
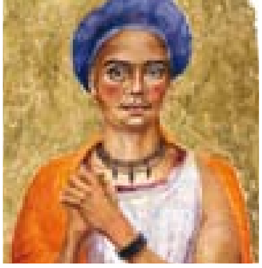
172	99	88	102	205	139	159	90	84	108
65	62	56	59	62	29	47	65	52	57
56	41	69	114	71	81	111	110	62	72
106	132	101	103	90	133	82	74	53	80
116	92	103	87	105	160	81	45	66	70
101	133	82	100	72	56	42	43	36	37
54	49	44	38	36	38	36			

sth16

197	166	167	322	277	296	380	398	407	464
445	539	476	465	484	318	264	323	373	302
491	429	417	392	389	262	280	339	372	108
88	70	73	86	120	162	183	203	180	185
152	200	192	137	103	125	170	218	216	221
132	76	71	117	172	130	199	206	220	

sth17

325	366	430	517	515	600	596	558	488	450
355	402	419	505	397	444	434	414	337	429
435	331	529	436	531	468	523	569	454	422
447	394	155	180	222	236	219	207	237	223
200	197	150	120	175	180	266	370	277	195
178									



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