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**Tree-Ring Analysis of Timbers from Westenhanger Castle, Stone
Street, Westenhanger, near Folkestone, Kent**

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Tree-Ring Analysis of Timbers from Westenhanger Castle, Stone Street, Westenhanger, near Folkestone, Kent

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Summary

Thirteen samples from the rafters of the conical roof of a dovecote tower at Westenhanger Castle were analysed by tree-ring dating. All samples cross-matched with each other to produced a single site chronology of 213 rings spanning the period AD 1338 - AD 1550. Interpretation of the sapwood on the samples would suggest that the timbers represented have an estimated felling date in the range AD 1560 - 80.

Keywords

Dendrochronology
Standing Buildings

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Introduction

Westenhanger Castle has been described as a fragment of a large moated and fortified house of the fourteenth century. It lies about eight miles west of Folkestone and about three miles north west of Hythe (TR 123372, maps Fig 1 and 2). A licence to crenellate was granted in AD 1343 to John de Kiriell, but he may not have undertaken the work immediately. The surviving remains show that it was of similar appearance to Bodium Castle, which was not licensed until AD 1385, and the work at Westenhanger might be of similar date.

Parts of the remaining walls at Westenhanger still reach a considerable height and are almost complete towards the north-east corner. These walls and the remaining foundations clearly represent a rectangular structure of substantial proportions; the internal courtyard was about 130 feet across. At three corners stood external round towers, the fourth, at the south-east corner, was square. Midway along the north and east walls stood external square towers. There appear never to have been towers midway along the south and west walls, but it is in the west wall that the main entrance is found. A plan of the site is given in Figure 3.

The Castle underwent considerable alteration in the early sixteenth-century when it was converted into a mansion. This work was probably undertaken by Sir Edward Poynings who died in AD 1522, with the work still incomplete. His son, Sir Thomas continued with the programme of conversion but in AD 1540 the house was given to Henry VIII in exchange for other property. Documentary evidence suggests that Henry himself did very little work here and it was therefore probably largely complete by the time he came to own it. As far as is known Henry only stayed here twice.

In AD 1552 the property passed into the hands of Sir Richard Sackville of Buckhurst in Sussex, Chancellor of the Court of Augmentations. It is known that he was certainly in residence here in AD 1565. In AD 1585 the site was acquired by Thomas Smythe esq, farmer of the customs of the port of London. Between this date and his death in AD 1591 Smythe is said to have greatly increased the beauty of the mansion and to have made magnificent additions.

The ownership of Westenhanger changed several times during the later sixteenth and seventeenth centuries when it was much reduced in size, quantities of material being taken from the site for other building projects. It was much reduced in size and grandeur by the eighteenth century when it was converted again, this time into a modest, though fine, Georgian country house.

Sampling and analysis by tree-ring dating were commissioned by English Heritage who are currently funding a programme of repairs to the ruined portions of the site. The purpose of this analysis was to establish, if possible, a date for the north-east tower which has been used as a dovecote. One view is that that an existing tower was converted to this use in the sixteenth century and given a new roof. An alternative view is that the tower was built in the fifteenth century specifically as a dovecote and that the roof is of this date also. A cross-sectional drawing of the north-east tower is provided in Figure 4.

The sampling of some *in-situ* floor timbers from the sixteenth-century cross-wing, preserved within the eighteenth-century house was also requested.

The Laboratory would like to take this opportunity to thank the owner Graham Ford and his family for their great help, cooperation, and enthusiastic support for this project. We would also like to thank David and Barbara Martin, consulting site archaeologists, of the Institute of Archaeology, University College London for their help with this project. This help relates specifically to being on site at a time to suit sampling, but also for providing copious notes and helping with the above introduction and particularly, as ever, for providing excellent drawings upon which to plot sample locations.

Sampling

The conical roof of the dovecote in the north-east tower contains twelve sets of frames. Each frame set consists of a main rafter rising from the wall-plate to a ring near the apex. To either side of each main rafter there is a spur rafter rising from the wall plate and joining the main rafter about three-quarters of the way up.

Attached to the wall plate near the foot of each main and spur rafter are sole pieces from which ashlar pieces rise. Within the roof space there is also a tiebeam running roughly east-west from one side to the other. The remains of a second tie beam may be present, but it has been cut and only the two ends are in place. A plan of the roof is shown in Figure 5, with an illustration of a frame set being shown in Figure 6.

Archaeological examination of the roof timbers strongly suggests that many of them, particularly the ashlar, but also most of the sole pieces, and a number of the spur rafters are later insertions. A number of the main rafters appear to be more modern replacements. It is likely that the two tiebeams are also later insertions.

Thus, from those timbers available which appeared as certainly belonging to a single cohesive roof-building phase a total of thirteen core samples was taken. Each sample was given the code WHC-A (for Westenhangar Castle, site "A"), and numbered 01 – 13. The position of the timbers cored was recorded at the time of sampling on a drawing provided by English Heritage, reproduced here as Figure 7. In this drawing the timber context numbers assigned by the site archaeologists are also shown. Details of the samples are given in Table 1.

An assessment was also made of the possible sixteenth-century timbers remaining in the eighteenth-century house. Unfortunately all those seen had too few rings for satisfactory analysis and core samples were not obtained from them.

Analysis

Each of the thirteen samples was prepared by sanding and polishing and their growth ring-width measured. These measurements were then compared with each other by the Litton/Zainodin grouping procedure (see appendix). At a minimum *t*-value of 4.5 all thirteen samples cross-matched with each other at relative positions as shown in the bar diagram Figure 8. The growth-ring widths of these eight samples were combined at these relative off-set positions to form WHCASQ01, a site chronology of 213 rings. Site chronology WHCASQ01 was then compared with a series of relevant reference chronologies for oak, giving it a first ring date of AD 1338 and a last measured ring date of AD 1550. Evidence for this dating is given in the *t*-values of Table 2.

The average heartwood/sapwood boundary date on the samples is AD 1545. The usual 95% confidence limit for the number of sapwood rings on mature oaks from Kent is 15 – 35 rings. Using these figures would give the timbers represented by these samples an estimated felling in the range AD 1560 – 80.

Interpretation and conclusion

Tree-ring analysis has produced a single site chronology from the sampled timbers of the roof of the dovecote. It would appear that all those timbers that were sampled were felled in the mid to later part of the sixteenth century, estimated as being between AD 1560 - 80. The felling date proposed on the basis of dendrochronology would equate with the ownership of Westenhangar by Sir Richard Sackville. It would thus appear that while the tower itself may still be of fourteenth- or fifteenth-century date, the roof is certainly not that early.

Two observations might be made about the material from this site. Firstly some of the samples, particularly WHC-A01 and A07, and samples WHC-A02, 05, 11, and 13, represent a very coherent group of timbers in

that they cross-match very well with each other. Cross-matches with t -values of 10-plus are found between a number of these samples. This suggests that a single woodland source was used and that the felled trees were growing very close to each other. It might also be noted that samples WHC-A02, 05, 11, and 13 seem to come from the inner sections of trees that were much older when they were felled than those used for the rest of the rafters.

The second feature is that the site chronology created from the Westenhangar material cross-matches poorly with reference chronologies from Kent and the south, apart from Restoration House, Rochester, and how well it cross matches with reference chronologies from elsewhere in England. It cross-matches with t -values of only 4.1 against Kent-88, and with Southern England, despite its overlapping date-span but matches with higher t -values against material from Gloucestershire, Staffordshire, Nottinghamshire and Oxfordshire.

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Table 1: Details of samples from Westenhanger Castle, Near Folkestone, Kent

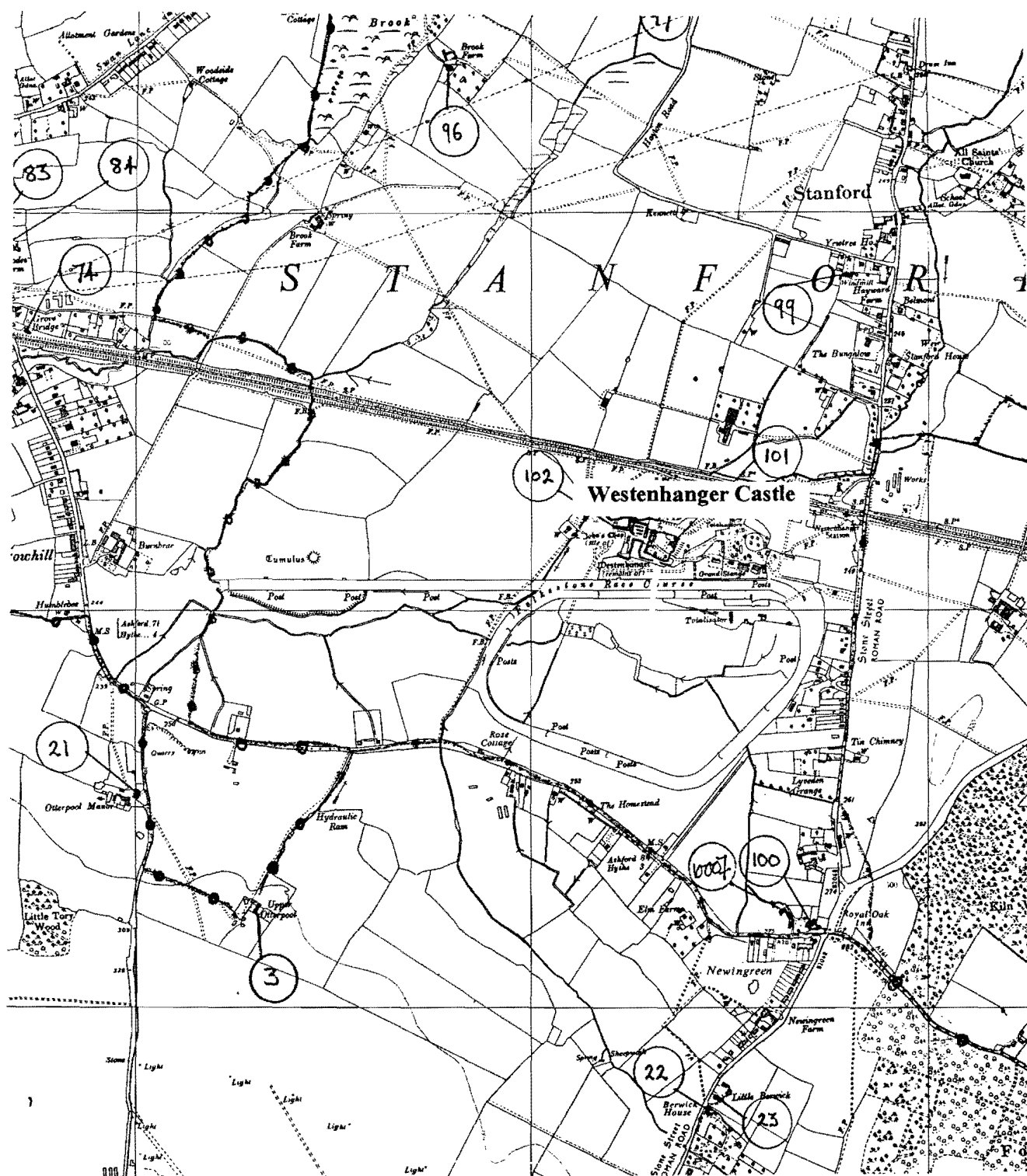
Sample no	Sample location and context number	Total rings	*Sapwood rings	First measured ring date	Last heartwood ring date	Last measured ring date
WHC-A01	Main rafter, 0307.1	71	h/s	AD 1470	AD 1540	AD 1540
WHC-A02	Spur rafter, 0307.4	122	no h/s	AD 1338	-----	AD 1459
WHC-A03	Spur rafter, 0308.7	77	h/s	AD 1469	AD 1545	AD 1545
WHC-A04	Main rafter, 0309.1	55	h/s	AD 1495	AD 1549	AD 1549
WHC-A05	Spur rafter, 0309.4	136	no h/s	AD 1346	-----	AD 1481
WHC-A06	Spur rafter, 0309.7	60	4	AD 1490	AD 1545	AD 1549
WHC-A07	Main rafter, 0310.1	78	h/s	AD 1473	AD 1550	AD 1550
WHC-A08	Spur rafter, 0311.7	120	h/s	AD 1426	AD 1545	AD 1545
WHC-A09	Spur rafter, 0312.7	95	h/s	AD 1451	AD 1545	AD 1545
WHC-A10	Spur rafter, 0314.4	97	h/s	AD 1442	AD 1538	AD 1538
WHC-A11	Spur rafter, 0314.7	135	no h/s	AD 1353	-----	AD 1487
WHC-A12	Main rafter, 0315.1	56	h/s	AD 1355	AD 1546	AD 1546
WHC-A13	Spur rafter, 0315.7	125	no h/s	AD 1355	-----	AD 1479

*h/s = the heartwood/sapwood boundary is the last ring on the sample

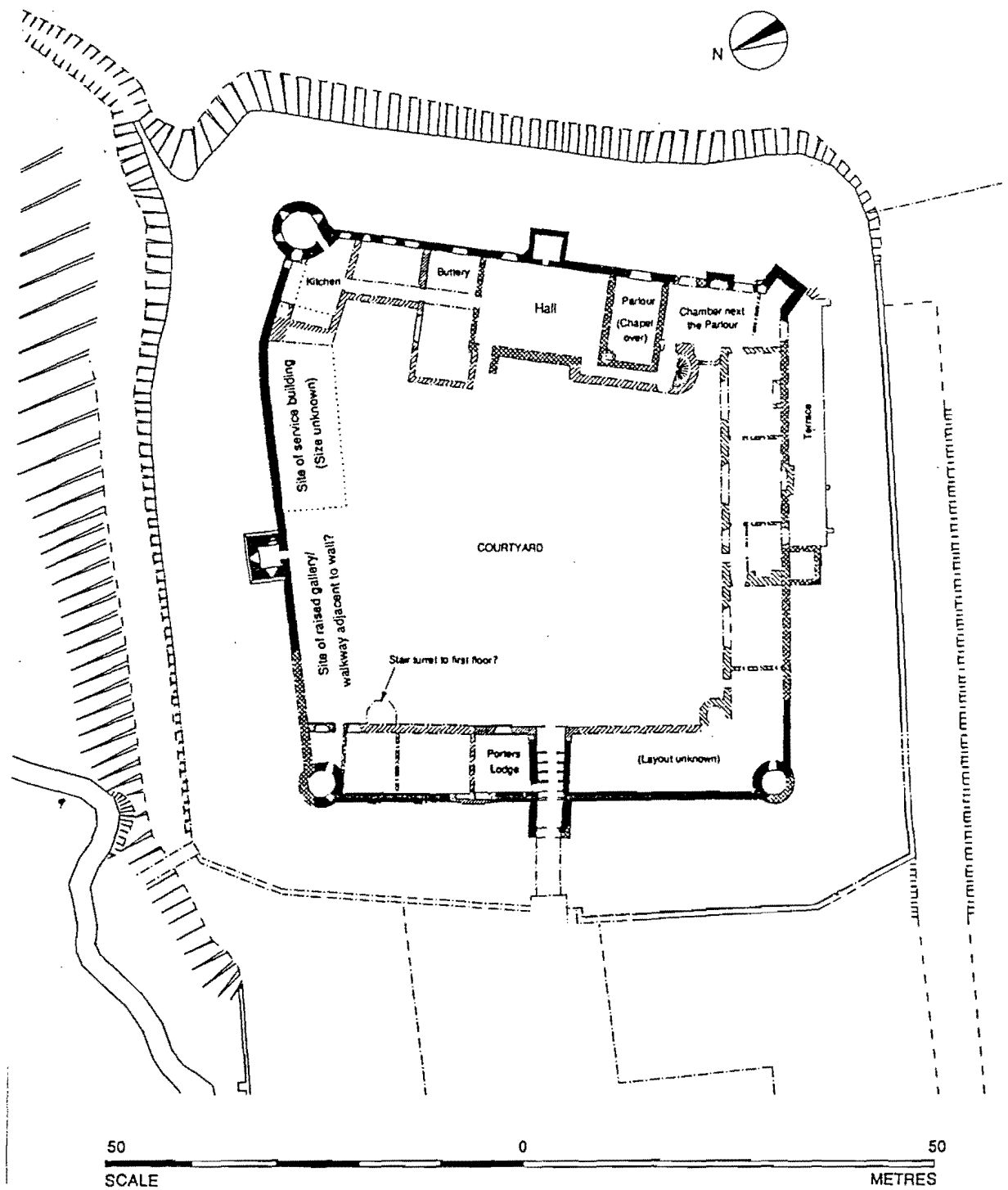
Table 2: Results of the cross-matching of site chronology WHCASQ01 with the reference chronologies when the first ring date is AD 1338 and last ring date is AD 1550

Reference chronology	Span of chronology	<i>t</i> -value	
MGB-E01	AD 401 – 1981	6.1	(Baillie and Pilcher 1982 unpubl)
East Midlands	AD 882 – 1981	6.9	(Laxton and Litton 1988)
England London	AD 413 – 1728	5.0	(Tyers and Groves 1999 unpub)
MC10---H	AD 1386 – 1585	6.2	(Fletcher 1978)
Restoration House, Rochester, Kent	AD 1378 – 1505	5.4	(Howard <i>et al</i> 1997)
High Street, Kinver, Staffs	AD 1431 – 1562	6.1	(Howard <i>et al</i> 1995)
26 Westgate St, Gloucester	AD 1399 – 1622	5.9	(Howard <i>et al</i> 1998)
Station St, Mansfield Woodhouse, Notts	AD 1432 – 1621	6.9	(Howard <i>et al</i> 1997)
Tusmore Park, Oxon	AD 1359 – 1545	5.4	(Howard <i>et al</i> 1992)
Southern England	AD 1083 – 1589	4.1	(Bridge 1988)
Kent-88	AD 1158 – 1540	4.1	(Laxton and Litton 1989)

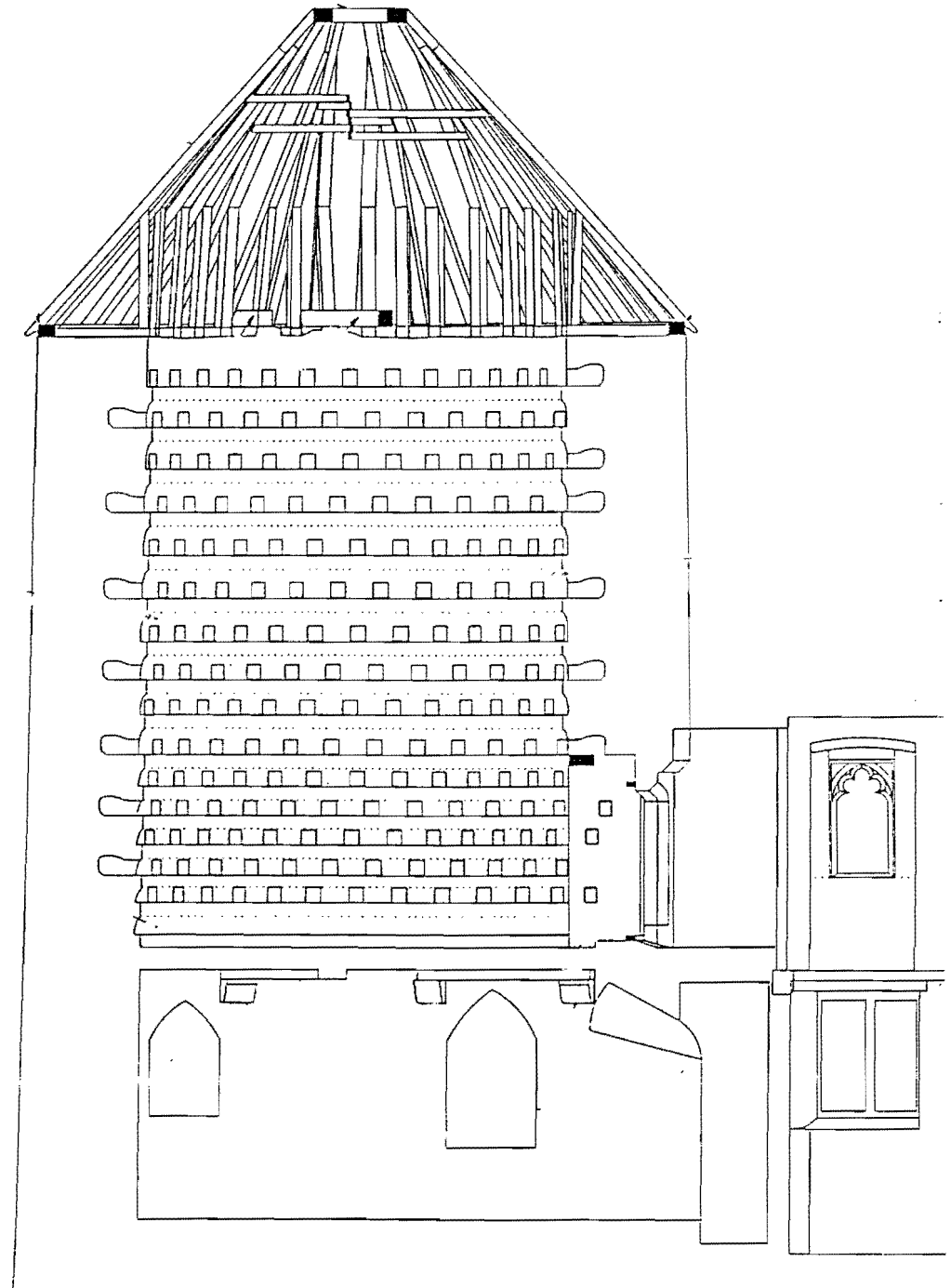
Figure 2: Map to show specific location of Westenhanger Castle



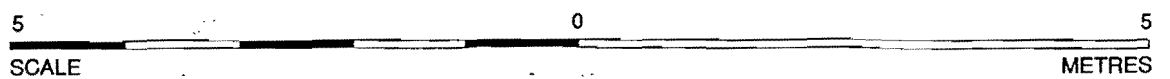
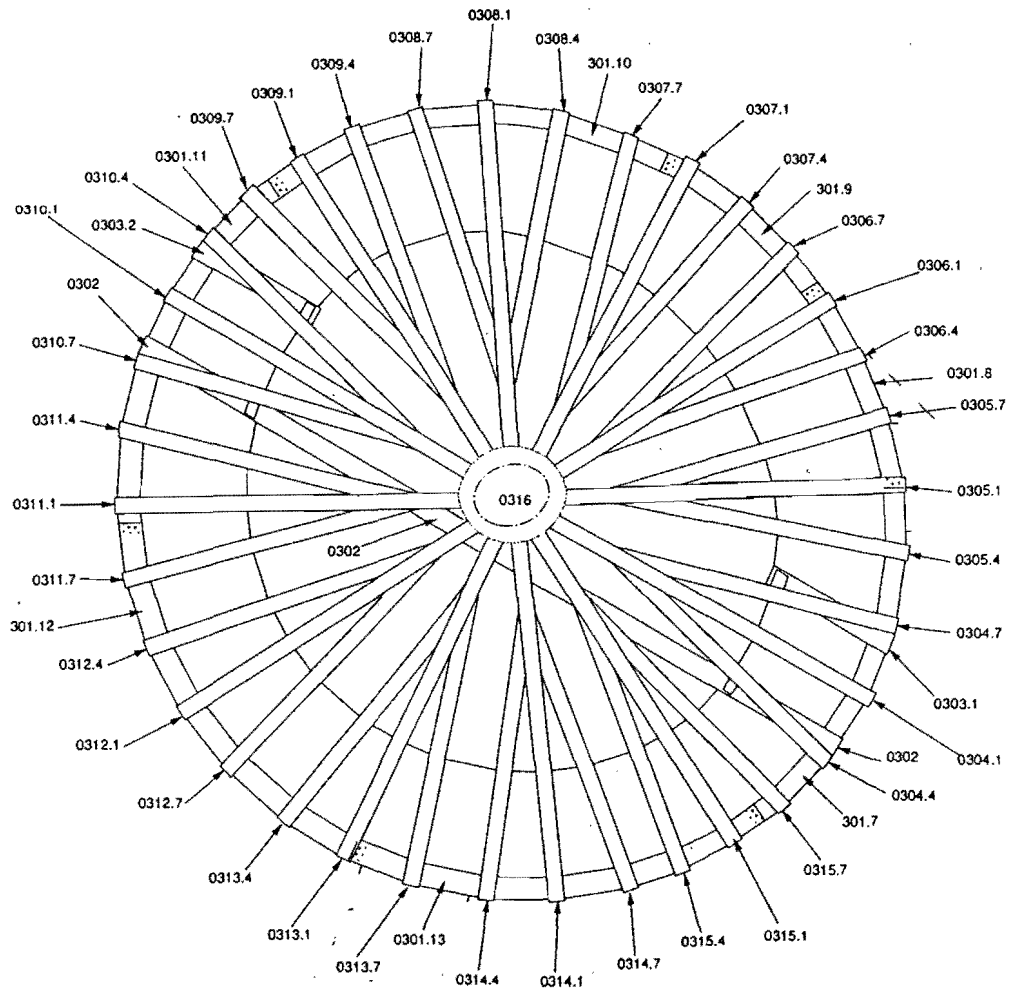
**Figure 3: General plan of Westenhanger Castle
(after David Martin)**



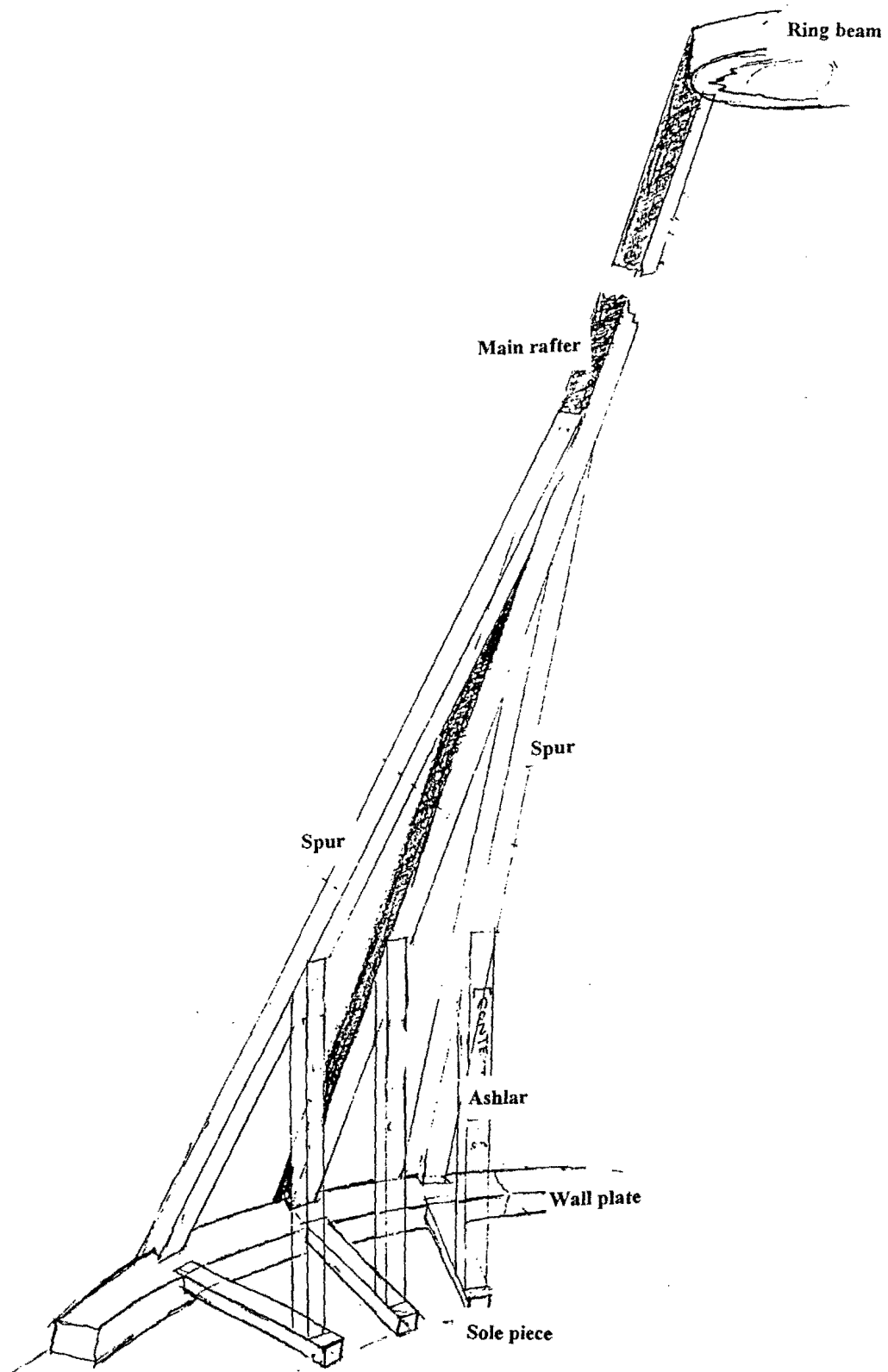
**Figure 4: Cross-section of the north-east tower
(after David Martin)**



**Figure 5: North-east tower plan of roof timbers
(after David Martin)**



**Figure 6: Sketch drawing of a frame set
(after David Martin)**



**Figure 7: North-east tower showing timbers sampled
(after David Martin)**

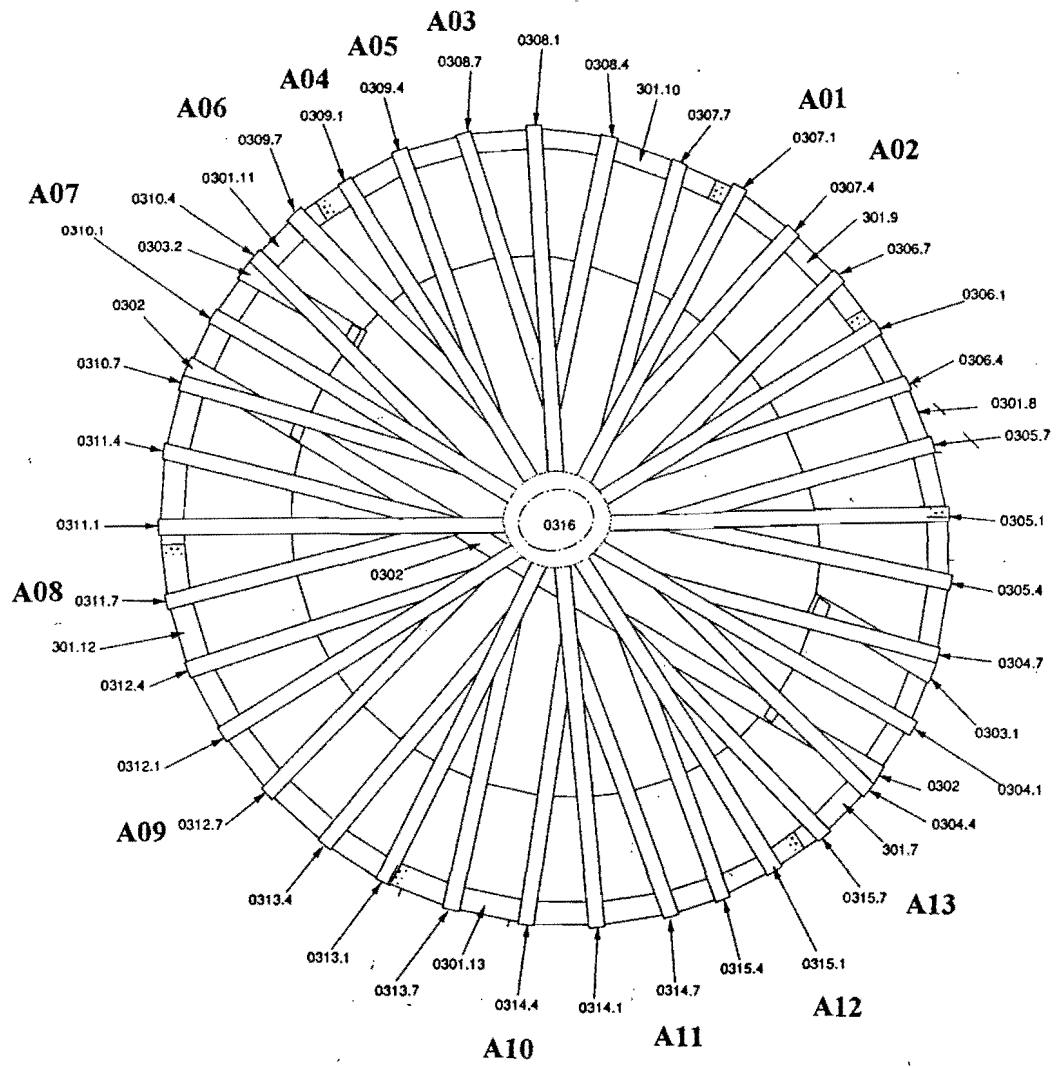
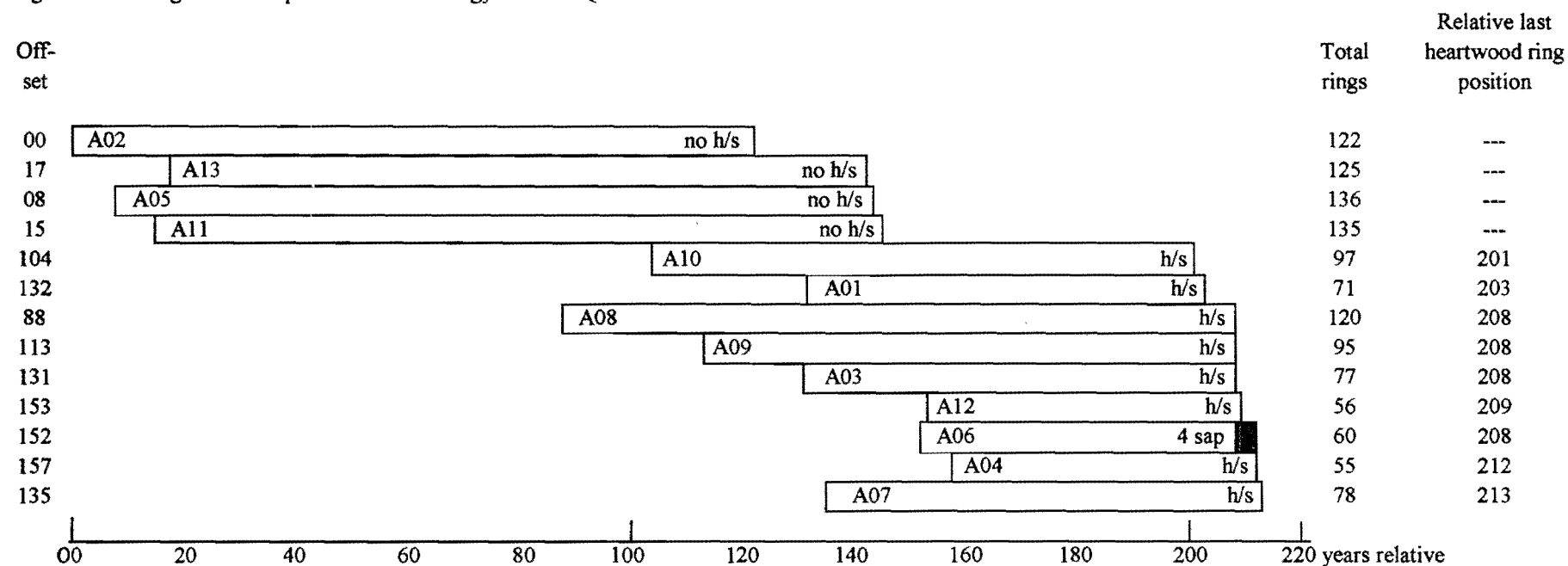


Figure 8: Bar diagram of samples in site chronology WHCASQ01



White bars = heartwood rings, shaded area = sapwood rings
h/s = heartwood/sapwood boundary is last ring on sample

Data of measured samples – measurements in 0.01 mm units

WHC-A01A 71

380 259 207 138 98 194 141 65 108 166 194 116 137 99 131 93 130 174 108 139
101 106 96 112 97 119 125 77 80 82 64 77 53 59 98 67 80 59 82 59
69 85 77 82 126 104 105 178 251 147 167 222 212 110 141 146 125 166 75 83
73 120 87 85 104 134 133 120 108 134 125

WHC-A01B 71

429 257 177 122 104 191 143 69 111 178 180 123 132 106 135 89 138 159 113 117
110 113 95 102 101 115 129 82 75 79 81 69 47 73 99 66 76 64 87 58
64 96 72 84 128 117 107 187 237 142 174 224 227 109 130 186 117 153 82 86
72 126 85 82 115 129 129 131 110 132 146

WHC-A02A 122

293 248 248 225 206 192 184 158 102 100 106 134 115 178 189 197 147 190 185 182
223 168 136 137 101 165 143 139 148 110 111 94 87 85 94 74 98 77 91 71
99 90 102 65 77 61 72 87 87 87 87 67 66 59 73 79 71 67 102 86
72 68 96 72 78 60 98 97 58 71 85 105 69 69 87 120 75 78 72 78
91 60 73 99 80 95 105 90 83 77 95 93 138 98 111 88 116 131 136 107
133 128 134 108 81 113 114 101 95 109 134 114 118 130 93 107 101 85 87 91
128 102

WHC-A02B 122

297 251 250 226 203 190 175 165 108 94 103 134 125 184 185 210 133 195 188 181
222 166 136 137 95 169 148 137 162 105 116 88 89 89 86 72 98 66 104 72
95 85 93 87 70 65 63 88 97 90 73 72 61 74 69 68 78 62 97 93
67 71 91 77 75 62 90 95 67 71 79 101 77 73 76 130 67 79 77 71
86 63 82 102 80 92 104 92 83 76 105 80 132 107 111 87 117 132 136 118
120 129 123 117 79 115 114 98 91 112 132 113 117 127 102 95 104 72 109 99
108 102

WHC-A03A 77

69 87 83 74 65 65 86 97 42 81 132 112 114 105 94 91 106 124 125 108
120 150 104 101 95 172 146 144 87 98 88 86 75 113 105 90 82 146 83 131
91 87 108 88 119 122 137 103 96 77 85 90 100 123 91 102 81 81 68 63
67 58 115 116 126 107 190 179 160 149 150 146 79 71 68 73 69

WHC-A03B 77

70 95 76 89 60 63 90 98 41 80 129 103 104 96 104 94 99 130 133 93
125 157 99 103 97 159 147 146 99 88 91 90 76 108 109 88 87 136 87 127
106 76 108 93 114 121 127 118 93 74 88 91 98 124 92 97 82 81 69 67
60 64 111 119 123 108 188 182 151 147 148 147 73 67 69 71 81

WHC-A04A 55

281 327 227 190 169 173 145 202 206 195 205 214 174 219 278 251 293 272 207 261
284 224 211 232 203 185 220 267 136 187 163 155 150 163 97 132 188 144 177 186
235 210 159 163 218 174 113 96 104 93 201 182 144 153 148

WHC-A04B 55

292 321 226 196 175 166 178 206 207 196 204 218 183 228 258 247 271 264 201 261
280 220 207 244 196 186 211 270 131 202 151 157 153 149 109 128 174 154 170 164
224 216 167 159 212 174 119 93 97 107 190 166 153 144 157

WHC-A05A 136

171 171 187 228 204 205 166 153 117 172 150 144 147 131 103 103 78 124 104 121
119 88 83 65 87 78 89 69 87 67 100 70 80 85 94 83 84 57 64 64
79 75 71 51 68 56 73 66 80 68 91 105 83 91 107 84 83 83 94 108
75 67 100 151 92 83 86 134 98 102 76 106 111 69 104 137 106 127 110 99
91 78 104 100 129 108 86 76 113 125 122 115 98 100 101 77 62 102 78 102
81 84 102 91 83 101 87 85 99 74 91 75 92 91 81 93 81 79 85 83
93 89 108 90 87 74 80 81 83 107 96 83 95 87 84 95

WHC-A05B 136

174 163 176 244 204 201 163 154 116 170 157 136 148 131 103 100 81 116 111 123
115 86 86 68 81 81 87 62 97 68 93 76 77 86 93 88 78 62 61 68
75 82 70 44 70 61 62 77 74 60 105 96 93 87 105 82 86 84 95 98
83 69 104 142 98 81 85 137 97 89 84 113 104 84 93 129 112 125 105 100
81 78 117 92 132 116 91 81 101 126 128 108 105 94 96 87 56 97 88 93
79 88 104 74 84 105 89 82 98 70 92 80 90 95 81 82 80 92 70 91
89 93 96 100 85 80 87 80 77 96 99 83 95 79 93 118

WHC-A06A 60

243 138 196 130 219 255 243 149 156 129 136 154 204 139 149 158 176 112 136 123
126 152 150 179 166 162 126 154 127 149 134 155 177 93 163 107 134 113 106 87
98 192 121 161 153 183 154 154 151 171 159 99 87 87 105 132 151 107 126 145

WHC-A06B 60

264 144 230 158 220 245 235 151 156 121 148 157 198 138 157 160 168 115 133 129
120 155 153 176 158 165 136 144 136 149 130 156 174 113 155 106 139 109 101 97
95 196 120 158 153 180 151 162 153 171 151 111 86 98 94 124 162 115 114 154

WHC-A07A 78

203 211 376 294 74 171 267 238 149 139 124 168 84 134 200 148 167 139 123 84
89 122 136 154 103 95 94 75 80 81 80 118 103 85 53 108 66 84 115 97
99 118 87 120 165 252 146 195 203 164 84 180 141 135 163 112 87 104 138 133
131 171 215 146 141 107 164 276 141 154 85 120 237 145 188 185 200 232

WHC-A07B 78

204 200 370 283 78 181 259 247 163 164 119 191 93 155 184 138 166 132 120 85
87 129 131 157 98 92 100 69 82 80 83 121 106 94 57 118 71 83 113 108
96 115 87 132 164 254 155 194 201 161 90 174 148 133 168 99 93 96 141 133
131 168 227 147 159 112 154 265 151 153 95 108 227 132 194 202 204 201

WHC-A08A 120

129 87 90 99 125 91 116 78 118 136 118 113 92 92 110 116 75 102 99 82
69 78 129 95 103 92 100 93 88 62 94 85 65 65 71 65 60 55 59 64
67 57 77 70 60 67 61 63 66 75 72 42 58 48 42 64 55 58 82 72
81 74 64 64 68 64 56 86 58 75 115 105 85 95 86 90 92 85 110 111
96 108 87 59 96 83 75 64 73 67 64 95 118 93 59 81 89 71 86 65
84 67 68 46 48 61 55 64 71 81 67 74 80 74 73 78 60 74 74 81

WHC-A08B 120

116 98 91 103 122 106 98 78 113 135 121 110 95 84 115 107 75 104 102 79
66 79 130 87 102 90 94 94 77 62 112 73 78 64 76 70 53 56 58 64
58 61 65 69 69 57 67 52 67 78 72 43 55 54 48 51 50 57 75 84
75 72 63 69 62 64 60 75 61 79 109 89 81 95 99 82 101 85 116 118
93 110 85 80 93 76 84 66 77 77 52 93 115 87 54 65 84 64 84 57
78 60 64 44 41 64 47 65 76 87 65 72 91 71 80 91 64 62 77 78

WHC-A09A 95

65 69 87 78 70 97 101 112 88 78 76 71 59 74 78 75 81 103 85 93
75 81 83 78 120 103 67 102 74 77 105 100 119 127 142 129 120 123 129 101
119 109 140 161 126 126 97 86 112 96 94 86 89 98 171 181 144 161 103 104
76 91 90 118 83 81 82 112 81 55 74 105 66 80 65 112 109 86 65 61
99 68 83 114 153 112 110 89 124 141 120 95 63 56 97

WHC-A09B 95

63 73 81 80 58 100 98 109 84 88 80 68 72 74 82 76 82 96 81 87
78 87 76 88 114 99 77 97 80 77 112 107 107 135 143 127 114 105 137 100
130 90 116 136 127 141 113 76 115 93 95 108 76 104 180 142 152 168 116 88
70 101 87 124 112 67 83 122 65 70 77 92 78 69 74 113 110 95 75 58
88 68 102 107 156 95 106 98 130 137 131 90 62 67 114

WHC-A10A 94

75 105 85 80 68 70 92 78 102 98 70 58 89 60 61 72 85 65 64 71
58 51 64 65 77 73 101 84 104 66 87 73 92 118 120 91 84 73 96 101
92 125 146 99 101 133 115 117 95 102 91 90 104 109 122 105 85 80 83 95
88 63 85 136 130 99 103 94 85 89 139 137 129 115 88 121 141 110 84 126
131 69 91 81 91 79 100 82 72 100 111 100 114 108

WHC-A10B 97

87 103 87 71 71 65 100 76 100 92 56 70 74 69 65 70 91 58 65 77
50 48 61 62 72 64 107 78 84 63 98 79 89 119 122 82 92 86 61 119
85 119 144 98 104 118 118 118 92 100 103 83 106 100 126 108 93 78 78 91
86 78 83 142 134 99 102 80 86 91 130 121 131 100 104 138 145 125 84 122
129 80 99 65 101 85 84 79 71 101 96 121 93 90 98 96 127

WHC-A11A 135

119 129 192 168 154 180 117 95 126 78 117 101 113 105 103 126 94 103 114 89
79 111 89 127 104 119 128 100 101 109 99 87 95 91 89 100 73 89 72 80
93 96 87 127 109 130 95 105 107 97 84 98 110 98 87 115 102 97 73 105
100 100 69 71 82 98 93 84 113 87 104 93 96 83 87 107 73 110 112 120
76 93 117 115 113 112 112 82 89 71 89 70 67 73 89 109 102 103 107 85
78 78 61 90 86 78 88 101 97 90 77 81 100 84 86 100 94 105 83 92
64 87 122 133 94 90 86 128 98 94 94 145 117 114 152

WHC-A11B 135

98 117 203 175 150 180 127 95 122 77 123 112 112 99 105 125 99 102 116 87
100 112 87 122 108 116 143 99 115 102 99 91 99 93 94 90 76 78 79 73
94 107 81 126 117 127 89 109 101 90 90 96 107 111 84 103 114 88 76 105
110 87 75 66 76 109 81 88 108 80 96 90 99 94 86 106 72 125 106 104
87 98 111 109 111 106 112 89 91 54 79 68 73 71 86 112 103 103 99 88
78 72 58 93 79 92 88 98 95 86 85 86 95 83 88 105 96 111 78 92
81 89 125 138 91 90 89 110 98 97 108 144 124 119 129

WHC-A12A 56

186 182 133 217 227 242 163 145 123 117 115 185 111 148 134 180 120 146 182 145
211 202 172 193 211 190 148 158 155 166 185 228 148 190 145 170 150 115 110 109
193 147 168 171 256 188 193 174 218 213 144 125 150 123 172 228

WHC-A12B 56

233 167 158 228 243 235 162 150 128 105 118 129 128 119 141 154 121 166 164 152
193 209 170 179 225 182 158 147 159 159 196 215 158 186 160 181 131 120 108 102
199 150 163 180 255 201 183 181 217 216 147 124 153 109 179 223

WHC-A13A 125

165 132 137 161 132 108 108 72 114 102 129 105 88 113 100 101 96 92 80 101
82 115 81 95 101 87 76 73 82 73 102 84 92 83 70 70 71 66 65 68
66 104 71 84 72 94 74 81 72 99 105 89 66 95 132 82 74 100 113 81
67 66 84 113 94 77 133 65 117 100 84 64 64 100 83 120 112 110 83 87
107 116 122 118 85 71 70 54 81 78 80 73 68 87 90 72 92 71 77 82
62 87 72 69 66 70 72 67 67 68 71 76 63 106 112 92 84 88 80 94
106 104 72 98 120

WHC-A13B 125

164 137 133 159 128 107 108 70 116 111 107 97 96 113 91 107 94 99 62 104
80 115 73 102 99 92 71 76 80 68 81 89 85 94 59 77 75 69 79 75
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90 117 66 90 113