Historic England

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Nash's House (New Place Museum), 22 Chapel Street, Stratford-upon-Avon, Warwickshire

Tree-ring Analysis of Oak and Elm Timbers

Martin Bridge and Cathy Tyers

Scientific Dating

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Summary

The number of timbers available for sampling in the rear ranges was limited and none were dated. Four samples from timbers to the front range were cross-matched and dated, giving a felling date for this group of timbers of in, or around, winter AD1617/18. This suggests a construction date for the front range in AD 1618 or shortly thereafter.

Contributors

Martin Bridge and Cathy Tyers

Acknowledgements

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Front cover image

Nash's House, 22 Chapel Street, Stratford-upon-Avon, Warwickshire [photograph Martin Bridge]

Archive location

Historic England Archive, The Engine House, Fire Fly Avenue, Swindon SN2 2EH

Historic environment record

Warwickshire Historic Environment Record, Archaeological Information and Advice Communities, Warwickshire County Council, Barrack Street, Warwick CV34 4SX

Date of investigation

2022–24

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Introduction

This building was investigated as part of the *StratFire* project, a project proposed by the Stratford-upon-Avon Society and subsequently supported by Historic England.

The project focusses on the impact of two major fires in the late-sixteenth century in AD 1594 and AD 1595, as well as taking into account another major fire in AD 1614. Bearman (2000) investigated the two late sixteenth-century fires in detail using documentary sources. Subsequently the Stratford-upon-Avon Society have been highlighting the architectural heritage along the main thoroughfare through on-going volunteer-led research (Historic Spine (stratfordsociety.co.uk)) which has itself led to the development of the *StratFire* project (StratFire Project (stratfordsociety.co.uk)) which combines detailed archival research with comprehensive building recording and analysis, as well as dendrochronology. The project summary, as per the final agreed project design (Historic England Project number 8452) is as follows:

"The aim of this project, by means of high-level building recording and analysis, detailed archival research and dendrochronology, is to establish, following Stratford-upon-Avon's town fires of 1594 and 1595, the chronology, extent and nature of the reconstruction of buildings along High Street and Chapel Street, the epicentre of one or both of these fires. Post-fire documentary sources record damage to certain buildings, and architectural appraisal indicates that several timber-framed buildings surviving today date from the post-fire period. However, more needs to be established concerning the scale, nature and speed of this rebuilding, and the impact of the fires, both on the economic well-being of the town and the fortunes of the families most seriously affected. For many buildings there is simply no documentary evidence to draw on. Moreover, even when documentary evidence exists, it is either confusing or only establishes a date by which rebuilding had taken place. Conversely, it may record fire damage to properties that, from surviving architectural features, appear not to have been entirely rebuilt. High-level building analysis and dendrochronological investigation will resolve much of this uncertainty, provide a sound base for the interpretation of the documentary evidence, and throw definitive light on a crucial episode in the evolution of the architectural and cultural heritage of this internationally renowned town."

Nash's House

Nash's House, 22 Chapel Street, is a Grade I listed building (LEN 1204376), located on the east side of Chapel Street *c.* 23m north-east of its junction with Chapel Lane (Fig. 1). The building as recorded comprises four linked elements: a street frontage range (A) of three storeys and two bays, with a series of three attached rear ranges (B, C, and D), variously of two and one storey, along the southern plot boundary (Tyler 2022 unpubl). Bearman (2007) says of it, "No. 22 is a house of about 1600 (known now as Nash's House). Its front is Tudor replica built in 1912 to replace a brick and stucco front wall which in turn had replaced the original in the 1820s. Inside, however, many of the original timbers have survived and the ground floor is maintained as a typical Jacobean residence with a local history museum upstairs."

Figure 1: Maps to show the location of Nash's House, 22 Chapel Street. Scale: top-right 1:200,000; bottom 1:1000. © Crown Copyright and database right 2024. All rights reserved. Ordnance Survey Licence number 100024900.

Methodology

An initial assessment of the timbers for dendrochronological study sought accessible 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 in October 2022 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 series. 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*-values in the range 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 (i.e. if it has only the spring vessels or earlywood 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* 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

Thirteen oak (*Quercus* spp) timbers and one elm (*Ulmus* spp) timber in various parts of the complex were sampled, mostly from the front ranges, where more timbers are exposed and accessible (Table 1; Figs 2 and 3). Several sequences proved quite short and not useful for secure dating through conventional dendrochronology. The longer sequences mostly showed very variable growth rates, with multiple bands of very narrow rings (Fig. 4), likely to be caused by either localised environmental or anthropogenic effects, making reliable measurement challenging. Cores nash05 and nash12 both broke into two pieces, the break not necessarily being clean and rings therefore potentially having been lost between the inner and outer section. The ring-width measurements of each individual series are given in the Appendix.

Four of the longer sequences clearly matched each other (Table 2) once the issues with reliable measurement of the bands of narrow rings were resolved. The strong matches achieved ($t \geq 10.0$) may be interpreted as representing timbers potentially derived from the same parent tree, but in this instance this seems a little unlikely, given the size of the timbers and their positions within the building, so they maybe simply derived from trees located in a small discrete woodland area. A fifth timber (sample nash07; Fig. 5) had a very similar visual pattern of rings to the dated sequences, and is almost certainly of the same date, but it was not possible to reliably identify the ring boundaries in some of the bands of narrow rings and thus this core remains undated.

The four matched sequences were combined into a 186-year long sequence (NASH) which was subsequently dated to the period AD 1432–1617, the strongest matches being shown in Table 3.

Table 1. Details of samples taken from Nash's House, 22 Chapel Street, Stratford-upon-Avon.

Sample No	Location	Number of rings	Date of sequence (AD)	Sapwood	Mean ring width (mm)	Mean sensitivity	Felling date range (AD)
First-floor samples							
nash01	Partition wall headbeam, front range	140	1478–1617	31C	0.90	0.24	winter 1617/18
nash02	Rear post to partition wall, front range	186	1432–1617	26C	1.09	0.20	winter 1617/18
nash03	South post, truss 5, second rear range	70	-	-	2.04	0.36	-
Second-Floor samples							
nash04	North stud, east wall, front range	91	-	h/s	0.99	0.25	-
nash05i	East door jamb, partition wall (inner rings), front range	82	-	-	1.35	0.25	-
nash05ii	East door jamb, partition wall (outer rings), front range	42	-	10 (+8NM)	1.12	0.29	-
nash06	North tiebeam truss 1, front range	130	1486–1615	12 (+1NM)*	0.98	0.23	*c.* 1616–21
nash07	Rear wallplate at north end, front range	*c.* 120	-	*c.* 17	*c.* 1.5	*c.* 0.22	-
nash08	Mid-rail, partition wall, front range	38	-	5	1.30	0.20	-
nash09	South tiebeam, truss 3, front range	124	1491–1614	17	0.96	0.29	1614–38
nash10	North-east corner post, first rear range (elm)	34	-	-	4.34	0.33	-
nash11	North purlin, first rear range (re-used timber)	32	-	h/s	2.48	0.13	-

nash12i	South-east post (inner rings), second rear range	47	-	-	2.82	0.40	-
nash12ii	South-east post (outer rings), second rear range	27	-	14C	0.96	0.36	-
nash13	Rear (east) tiebeam, truss 6, second rear range	34	-	h/s	2.71	0.21	-
nash14	South wallplate, second rear range	59	-	10	1.60	0.18	-

*Key: h/s = heartwood/sapwood boundary; NM = not measured; C = complete sapwood, winter felled; * - timber retained complete sapwood but the outermost rings disintegrated on coring*

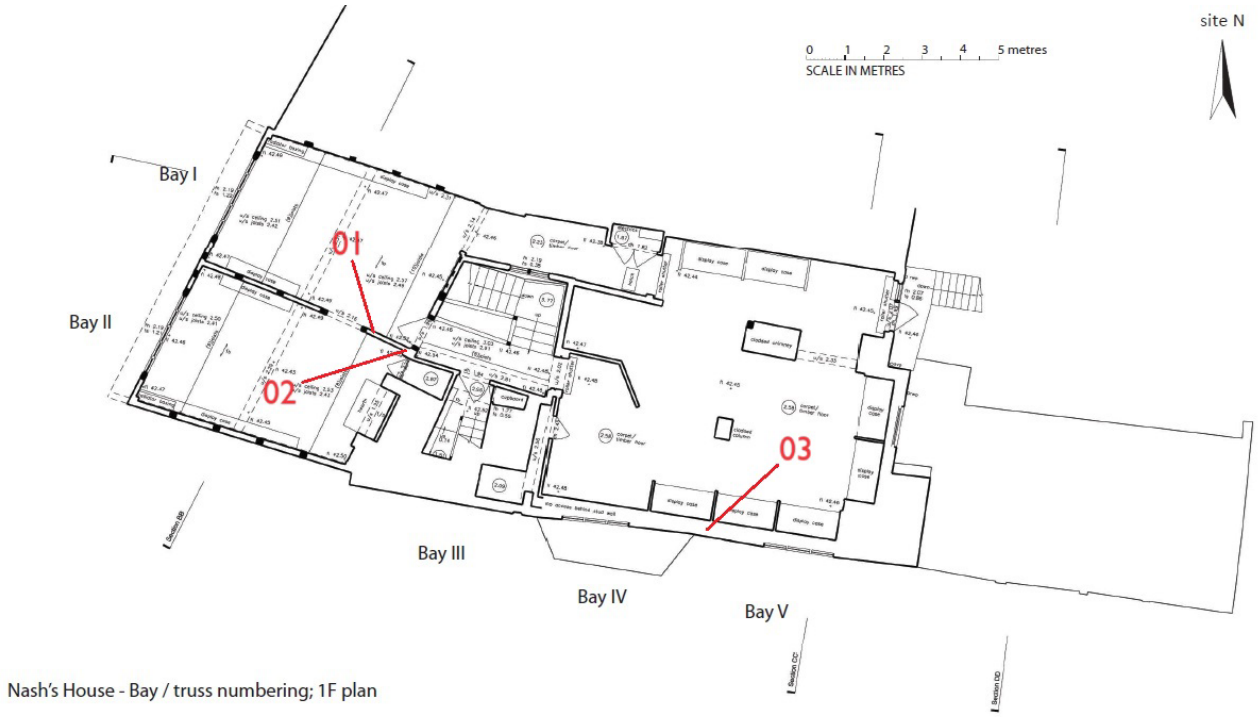

Figure 2: Plan of the first floor, showing the locations of timbers sampled for dendrochronology. [adapted from an original drawing by Ric Tyler]

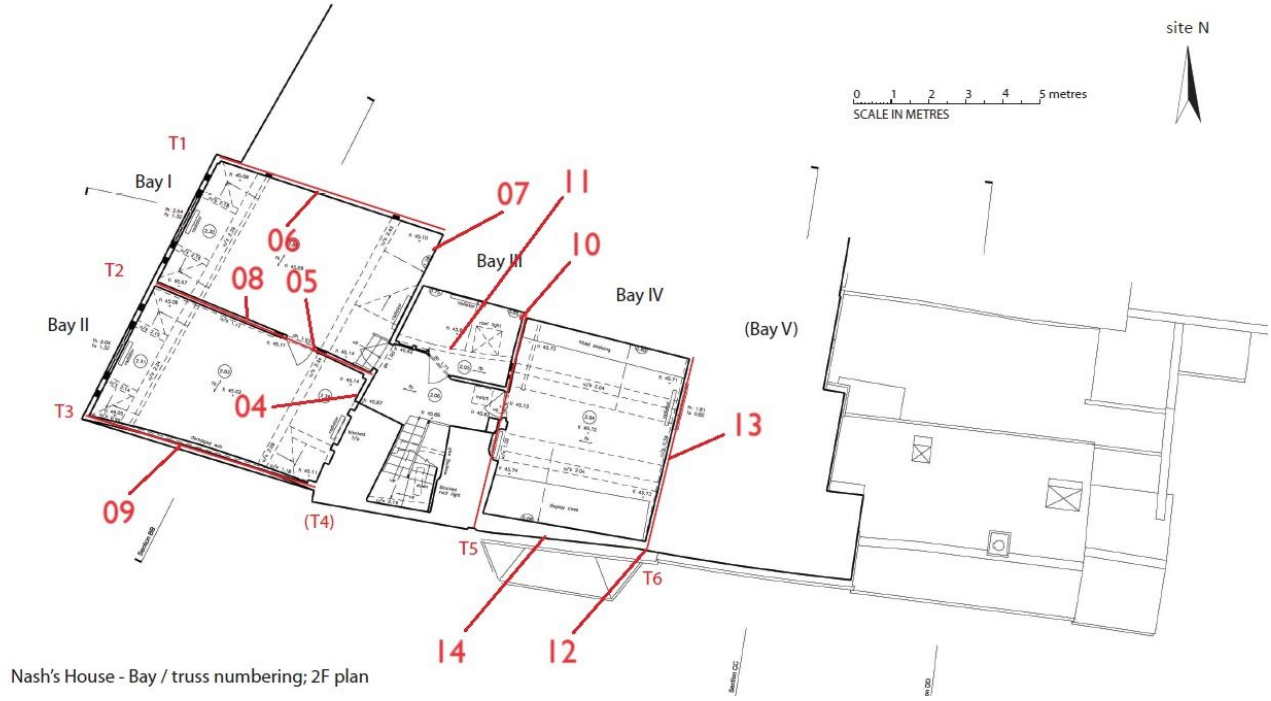

Figure 3: Plan of the second floor, showing the locations of timbers sampled for dendrochronology. [adapted from an original drawing by Ric Tyler]

Figure 4: Scan of sample nash01 showing the multiple bands of narrow rings.

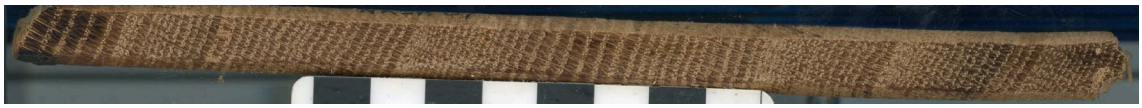

Figure 5: Scan of sample nash07 showing multiple bands of narrow rings, in which some of the ring boundaries could not be reliably distinguished.

Table 2: Cross-matching between the dated series from Nash's House.

		t-values	
Sample No	nash02	nash06	nash09
nash01	4.4	11.4	10.2
nash02		5.4	4.0
nash06			13.7

Table 3: Dating evidence for the site series NASH, AD 1432–1617.

Source region	Chronology:	Publication reference:	Filename:	Span of chronology (AD)	Overlap (years)	*t*-value
Hampshire	Shamblehurst Manor	Miles and Worthington 1999	shmbl4	1434–1575	142	8.5
Warwickshire	Stoneleigh Abbey	Howard et al. 2000	STOISQ01	1387–1658	186	7.2
Warwickshire	Kenilworth Castle	Howard et al. 2006	KNWESQ02	1482–1599	118	7.0
Oxfordshire	Western House, Warborough	Haddon-Reece et al. 1989	WAR	1473–1574	102	6.9
Buckinghamshire	No 4 High Street, West Wycombe	Miles et al. 2014	WWH	1470–1568	99	6.3
Oxfordshire	Harwell Church	Fletcher pers. comm.	HARCHRCH	1467–1557	91	6.3
Shropshire	New Hall, Eaton-under-Heywood	Miles and Worthington 2004	NEWHALL1	1390–1564	133	6.1
West Midlands	Manor House, West Bromwich	Arnold and Howard 2009	WBRASQ01	1318–1590	159	6.0
Shropshire	Gravenor House, Lydbury North	Miles et al. 2007	LYDBURY1	1492–1625	126	6.0
Kent	Deal Castle	Arnold and Howard 2015	DELCSQ01	1465–1601	137	6.0

Interpretation and Discussion

The four matched and dated ring series are clearly coeval (Fig 6). Two cores (nash01 and nash02), from a headbeam and post in a partition wall at first floor level, had retained complete sapwood, and were both from trees (or a tree) felled in winter AD 1617/18. A third timber, the north tiebeam (truss 1) in the front range, represented by core nash06 retained complete sapwood but a small number of the outermost rings immediately below the bark edge disintegrated on coring. The measured sequence from nash06 ended in AD 1615 with the trace of a ring after the last measured complete ring, and so has been assigned a limited 5-year likely felling date range of AD 1616–21 that incorporates the AD 1617/18 date of the two cores with complete sapwood. The fourth dated core, derived from the south tiebeam (truss 3) in the front range, retained 17 sapwood rings, ending in AD 1614, and again is most likely to have been felled at the same time in AD 1617/18.

The dated timbers are all from the front range, and suggest a construction date of AD 1618, or within a year or two after this date and hence after the fires in the late-sixteenth century and that in the early-seventeenth century. It is of interest that a fireback in the property is also dated AD 1618, and this may be significant.

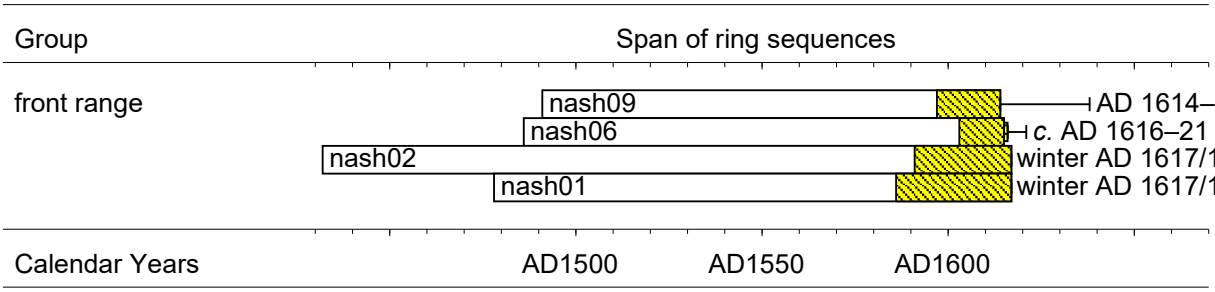

Figure 6: Bar diagram showing the relative positions of overlap of the dated samples and their individual likely felling date ranges. White sections represent heartwood rings, yellow hatched bars represent sapwood rings, with narrow sections representing additional unmeasured rings.

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Appendix

Ring width values (0.01mm) for the sequences measured

nash01

127	167	73	63	59	76	75	94	139	115
104	158	157	104	122	105	141	155	157	112
124	143	69	57	75	120	124	63	73	61
95	113	73	117	117	108	110	63	82	94
118	133	127	113	81	75	105	78	116	125
126	41	33	42	46	53	62	99	153	141
140	131	111	65	42	82	94	80	92	90
131	116	102	80	118	108	102	69	50	70
57	116	76	93	104	105	64	56	43	66
49	35	64	71	83	96	83	59	41	70
136	196	196	144	138	151	170	155	163	55
39	30	37	45	58	45	39	40	37	32
34	44	58	60	69	41	30	33	36	46
52	56	63	64	67	71	99	87	133	157

nash02

373	116	253	201	239	202	139	121	249	212
183	275	219	157	139	151	150	152	159	108
56	103	99	79	97	130	162	182	178	195
209	238	195	185	155	128	145	156	205	214
266	199	224	292	227	151	154	158	216	184
178	209	216	166	98	122	96	144	172	100
108	110	151	165	212	153	161	214	65	51
36	64	65	49	47	46	52	63	68	75
76	75	76	81	102	81	100	120	83	81
78	71	51	68	67	74	76	40	29	36
31	37	39	59	59	71	69	64	113	138
62	65	92	84	87	82	79	81	79	98
105	102	81	92	74	77	97	112	110	116
105	116	103	86	70	84	131	125	76	40
42	59	51	46	36	38	46	63	52	49
46	69	82	65	84	70	63	44	50	59
65	70	84	86	81	62	63	51	84	74
82	91	70	38	42	44	65	59	63	79
63	93	84	80	84	114				

nash03

379	355	452	142	236	333	292	245	354	421
401	445	343	291	332	175	127	245	436	448
409	218	57	58	90	111	185	63	74	93
233	267	441	380	331	291	313	71	52	44
68	103	132	294	250	270	336	82	43	36
90	85	154	187	101	116	109	136	156	145
82	98	89	154	131	194	120	149	47	66

nash04

327 105 81 77 57 74 117 91 50 97
169 178 194 164 188 167 147 164 130 103
110 72 120 129 165 137 132 132 78 37
50 73 65 54 101 106 100 100 119 116
72 55 72 54 78 83 137 132 116 130
112 108 117 90 59 75 140 125 124 141
149 113 65 52 63 58 54 75 78 78
95 92 62 39 57 67 85 92 73 65
93 155 72 73 30 28 51 41 61 81
111

nash05i
164 220 164 108 70 54 74 80 92 111
135 178 169 177 189 114 173 175 163 518
350 285 310 242 233 126 80 86 60 67
46 51 63 66 80 130 146 175 138 146
185 157 203 106 69 91 102 102 140 148
86 94 106 74 57 47 60 63 77 90
116 129 143 215 150 61 87 72 50 82
122 168 180 168 177 148 213 197 127 116
105 200

nash05ii
184 244 231 236 175 112 54 67 55 60
54 75 69 110 90 102 87 91 117 105
123 140 97 44 58 141 255 60 58 74
77 67 102 81 125 127 80 131 151 117
105 193

nash06
119 145 144 216 211 126 125 104 140 169
205 180 152 172 99 86 97 129 143 97
91 65 103 135 131 160 196 148 114 72
93 101 108 93 74 67 55 55 65 63
74 82 59 31 31 53 38 63 59 108
125 131 144 118 132 76 47 74 74 70
93 114 178 157 112 97 93 87 87 59
51 46 48 59 65 68 61 57 44 34
29 45 36 34 59 55 57 72 67 47
44 67 97 154 182 125 146 137 165 127
138 72 31 36 48 84 105 103 122 124
88 95 133 150 110 139 110 167 63 44
44 36 78 116 107 131 103 124 125 133

nash08
109 131 83 128 128 143 128 126 100 79
78 99 186 146 148 128 171 182 96 48
56 59 76 101 142 167 150 123 129 118
126 160 170 173 202 184 218 132

nash09

136 167 139 156 192 175 122 62 86 28
53 53 108 124 79 91 59 117 143 103
130 141 122 94 57 59 64 79 66 57
46 42 32 63 51 68 44 27 27 30
81 102 79 127 155 164 132 145 134 126
94 42 68 74 64 83 70 115 122 76
85 59 72 81 57 28 32 31 55 49
53 44 51 24 19 23 23 42 25 98
125 106 133 99 65 40 86 146 190 231
161 198 190 230 163 193 89 44 38 42
82 99 114 127 144 86 80 116 141 118
133 131 163 72 40 45 55 105 148 165
182 161 182 161

nash10
631 348 371 359 617 720 262 164 189 538
292 508 684 363 324 450 510 596 444 648
588 623 962 249 253 364 405 247 301 419
357 393 285 278

nash11
215 364 354 361 319 277 328 377 374 315
300 300 302 303 280 263 254 179 191 158
201 185 142 190 213 158 180 186 171 151
179 153

nash12i
254 290 308 364 453 246 357 378 373 687
627 471 566 194 392 318 172 121 138 254
245 440 135 83 79 122 317 86 107 129
271 405 328 467 392 287 253 80 41 53
70 89 237 462 235 408 461

nash12ii
61 49 48 50 111 103 187 155 39 30
71 98 156 200 155 116 50 54 57 92
65 172 165 138 69 47 43

nash13
474 393 521 313 384 423 463 390 349 351
280 276 297 249 127 58 113 121 169 199
226 202 225 259 216 241 247 255 347 215
260 212 202 155

nash14
260 189 183 258 217 173 199 308 367 211
234 235 325 236 232 243 186 237 210 217
250 282 277 181 217 210 174 182 149 164
164 115 152 127 104 105 90 81 76 108

76	77	129	86	72	88	72	81	88	96
70	68	73	110	61	60	60	61	57	

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