APPENDIX 20: SCIENTIFIC DATING

An integral element of the CNDR project was the completion of an extensive programme of scientific dating, to provide a secure chronological framework for the excavated remains. This programme principally comprised radiocarbon dating, with organic materials being submitted from the majority of the sites examined, a total of 158 samples being subjected to radiocarbon assay. In addition to radiocarbon dating, the presence of large quantities of waterlogged wood within the *Principal palaeochannel* at Stainton West allowed for a fairly extensive programme of dendrochronological dating. This, in turn, was supplemented by radiocarbon wiggle-matching of 24 samples, as a means of dating several undated tree-ring clusters, identified during dendrochronological analysis. Following the acquisition of the radiocarbon and dendrochronological dates, where applicable, Bayesian chronological modelling was employed, which proved particularly useful for comprehending the complex sequence of events at Stainton West.

Details of the results of the radiocarbon and dendrochronological dating programmes are presented, and the various models are discussed that have been constructed to assist in the chronological interpretation of the evidence from specific sites. Additional details relating to individual radiocarbon and dendrochronological dates can be accessed via the CNDR Finds Database. In addition, detailed descriptions of the chronological development of individual sites are outlined in the period-based chapters (*Chs 3-14*).

Radiocarbon Dating of Deposits, Features, and Artefacts

R A Gregory and D Druce

Initially, during the course of the post-excavation assessment, 50 samples were submitted for radiocarbon assay (*cf* OA North 2011a; 2011b). At this stage, the principal aims of the radiocarbon programme were:

- to establish rudimentary chronological frameworks for the activity at the various sites;
- to assess the significance of the archaeological remains;
- to determine whether it would be possible to refine the rudimentary site chronologies through a more comprehensive radiocarbon-dating programme.

These samples had been obtained from seven of the sites investigated, 40 being from Stainton West (24 from the *Principal palaeochannel* and 16 from dryland areas), four from Parcel 42, two from Parcel 9, and one sample each from Parcels 21 North, 32, 41, and the watching-brief site at the henge monument. This material comprised 14 sediment samples, all from Stainton West, whilst the remainder, in line with the recommendations set out by Patrick Ashmore (1999), were all single-entity samples from sealed deposits. Single-entity charred plant remains or waterlogged plant remains, such as fruits or seeds, were prioritised, given that these represent a single year at age of death. In the absence of any macrofossils, or if the selection criteria necessitated it (*ie* unclear taphonomy of macrofossils), then charcoal or wood was selected. This comprised either diffuse porous taxa (*ie* short-lived wood, such as alder/hazel (*Alnus glutinosa/ Corylus avellana)* or hawthorn-type (Maloideae)), small roundwood/twigs, or sapwood (or, ideally, all three). The species/type of wood was identified where possible, but if the state of the material prevented this, then only inherently short-lived pieces were selected (*eg* indeterminate roundwood/twigs). Similarly, small roundwood/twigs or the sapwood of long-lived taxa (*eg* oak (*Quercus* sp), elm (*Ulmus* sp), or ash (*Fraxinus excelsior*)) were selected to avoid the 'old-wood effect'; an exception to this was oak-charcoal fragments from hearth ***90434***, from which a 'range-finder' date was considered acceptable (*Ch 4*). In addition to the dating of charred and waterlogged plant remains, materials derived from specific artefacts from Stainton West were radiocarbon dated. This included two samples of oak sapwood extracted from Tridents 1 and 2 (*Ch 8*;

Appendix 13), and a sample of the organic residue adhering to a later Neolithic Grooved-Ware vessel (*Ch 10*; *Appendix 11*).

The radiocarbon dates obtained during the post-excavation assessment clearly indicated that, together, the CNDR sites contained important prehistoric remains, dating to the Mesolithic, Neolithic, Chalcolithic periods, and the Bronze and Iron Ages, as well as significant remains relevant to the early medieval period. The assessment also indicated that the further acquisition of chronometric data would certainly enhance the interpretation of the sites. For instance, at Stainton West, it was concluded that additions to the existing radiocarbon data, along with dendrochronology, would allow for the construction of a robust chronology for both the deposits within the *Principal palaeochannel* and activity across the adjacent dryland areas (*Grid-square area*, burnt mounds, and retention pond area). Similarly, at the other CNDR sites, it was considered that radiocarbon assay represented the only effective means of establishing site chronologies, particularly as at these sites there was a general absence of other forms of material dating evidence.

A second extensive programme of radiocarbon dating was initiated based on these results, which formed a major element of the post-excavation analysis phase of work, with a principal aim of refining and strengthening several of the site chronologies. The programme entailed the dating of 108 additional organic samples, with 92 from Stainton West, seven from Parcel 42, two each from the henge monument, Knockupworth/Hadrian's Wall, and Parcels 32 and 21 North, and one from Parcel 9. The materials selected for dating overwhelmingly comprised single-entity charred and waterlogged plant remains, and short-lived wood and charcoal identified, where possible, to species, in line with the sampling strategy employed for dating during the assessment (*above*). In addition, from Stainton West, residue samples from a Late Neolithic Grooved-Ware vessel and a Bronze Age bucket-shaped vessel, and eight sediment samples were also submitted for radiocarbon assay.

Methodology

Laboratory procedures

G Cook

All of the 158 samples were assayed using the accelerator mass spectrometry (AMS) technique at the Scottish Universities Environmental Research Centre (SUERC), where they were assigned a 'SUERC-' laboratory code. Importantly, this laboratory maintains continual programmes of quality-assurance procedures, in addition to participating in international inter-comparisons (Scott 2003; Scott *et al* 2010), these tests indicating no significant offsets, and demonstrating the validity of the precision quoted.

The samples submitted to SUERC were pretreated following the techniques outlined by Stenhouse and Baxter (1983). Carbon dioxide (CO_2) obtained from the pretreated samples was then combusted in pre-cleaned sealed quartz tubes (Vandeputte *et al* 1996) and converted to graphite (Slota *et al* 1987). The AMS dating was as described by Freeman *et al* (2010).

Uncalibrated and calibrated dates

R A Gregory

The results derived from the programme of radiocarbon dating are presented as conventional radiocarbon ages (Stuiver and Polach 1977), and are quoted in accordance with the international standard known as the Trondheim convention (Stuiver and Kra 1986). The results have been calibrated using IntCal13 (Reimer *et al* 2013) and OxCal v4.3.2 (Bronk Ramsey 1995; 1998; 2001; 2009), and the date ranges have been calculated using the maximum intercept method (Stuiver and Reimer 1986). The calibrated date ranges have been rounded outwards to five years where the error measurement is less than ±25 BP and to ten years when it is greater than this (*cf* Mook 1986), using OxCal v4.3.2.

Statistical testing and comparison

R A Gregory

Following the completion of the radiocarbon-dating programme, those assays obtained from identical sample locations within the *Principal palaeochannel* at Stainton West, and also those from specific structures and features, were subjected to statistical testing. This was undertaken to establish their consistency and, in turn to assist in the formulation of chronological hypotheses which, in some instances, could be further explored through Bayesian modelling.

The statistical technique employed for this analysis was the non-Bayesian chi-square (χ^2) test of Ward and Wilson (1978), which can be used to determine whether duplicate dates are actually of the same age. Within the χ^2 test, the level of significance was set at 0.05 (T′(5%)), with *v* representing the degree of freedom; dates are considered statistically consistent when the T value (T′) is lower than the critical value (T′(5%)). All of the dates were derived from separate entities and hence were not from the same radiocarbon reservoir. As such, the χ^2 test was performed using the Combine function in OxCal v4.3.2, which merges the radiocarbon dates following calibration and provides an agreement index (A_{comb}). Within this index, good agreement between the combined dates is indicated by an A_{comb} value that is greater than the An value (*ie* the individual critical value).

Results

R A Gregory

The results of the 158 radiocarbon assays obtained from the sediment samples, plant macrofossils, charcoal, and artefacts are presented, though for ease of discussion these have been divided into three main groups. Two of these relate to Stainton West, with one specifically comprising those samples from the *Principal palaeochannel*, whilst the other consists of samples from the adjacent dryland area. The third group covers the remaining dated samples from several additional areas of prehistoric and historic activity excavated along the CNDR corridor, specifically those at Parcels 9, 21 North, 32, 41, and 42, Knockupworth/Hadrian's Wall, and the henge monument.

Stainton West: *Principal palaeochannel*

In total, 86 samples from sediments, waterlogged and charred plant remains, wooden artefacts, and organic residue were dated from the *Principal palaeochannel*. These samples were derived from the major stratigraphic units (*Ch 2*) in the channel and the results are arranged according to their stratigraphic position.

Stratigraphically, the earliest dated samples were associated with the *Mesolithic organic deposit* (*Ch 3*), which produced 14 radiocarbon dates spanning the mid-sixth to early fifth millennia cal BC (Table 383). The dated materials were derived from Bays B, V, X, and Y, with those from Bay V being from deposits ***71096*** and ***71097***, which were directly associated with a beaver dam (*Ch 3*). The samples from Bay B lay next to the beaver dam on the western side of the channel, and contained flaked lithics, whilst those from Bay X were from a deposit that lay between the dam and a beaver lodge, to the south (*Ch 3*). This deposit also contained flaked lithics. Finally, a single sample from Bay Y provides a date for a piece of timber forming an element of this lodge. All of the dates from Bays B and V also relate to one of the superzones, especially

Laboratory code	Material	Radiocarbon age (BP)	$\delta^{13}C$ (‰)	Calibrated date range (95% confidence)	Bay/sample/depth	Deposit
SUERC-47186	Immature hazelnut (*Corylus avellana*)	6346±39	-27.5	5470-5220 cal BC	Bay V; monolith 71158; 7.46 mOD	***71129***
SUERC-47187	Hazel (*Corylus avellana*) twig **77016**	6207±39	-29.7	5290-5050 cal BC		
SUERC-32826	Sediment	6655±35	-22.2	5640-5520 cal BC	Bay V; monolith 71158; 7.57 mOD	
SUERC-44754	Hazelnut (*Corylus avellana*)	6142±35	-30.3	5210-5000 cal BC	Bay V; monolith 71158; 7.61 mOD	***71089***
SUERC-44753	Alder/hazel (*Alnus*/*Corylus*) roundwood twig **77017**	6237±35	-29.1	5310-5060 cal BC	Bay V; monolith 71158; 7.64 mOD	
SUERC-44747	Hazelnut (*Corylus avellana*)	6065±35	-26.2	5060-4840 cal BC	Bay B; monolith 70225; 7.88 mOD	***70226***
SUERC-44748	Indeterminate twig 77006	5959±35	-26.0	4940-4720 cal BC		
SUERC-32694	Sediment	5600±35	-27.6	4500-4350 cal BC	Bay X; monolith 71169; 7.56 mOD	***71028***
SUERC-32705	Sediment	6330±40	-28.9	5470-5210 cal BC	Bay X; monolith 71175; 7.49 mOD	***71028***
SUERC-47195	Oak (*Quercus*) twig **77019**	5976±39	-27.1	5000-4790 cal BC		
SUERC-47196	Elm (*Ulmus* sp) twig **77020**	6002±39	-27.1	5000-4790 cal BC		
SUERC-44777	Indeterminate twig **77018**	6013±35	-29.5	5000-4800 cal BC	Bay X; monolith 71175; 7.70 mOD	***71026***
SUERC-44778	Indeterminate non-aquatic plant macrofossil	6013±35	-27.7	5000-4800 cal BC		
SUERC-32722	Elm (*Ulmus*) sapwood; timber **76298**	5970±35	-23.4	4950-4740 cal BC	Bay Y; 7.77 mOD	***71020***

Table 383: Radiocarbon dates from the Mesolithic organic deposit *in the* Principal palaeochannel*, Stainton West*

Laboratory code	Material	Radiocarbon age (BP)	δ^{13}C (‰)	Calibrated date range (95% confidence)	Bay/sample/depth	Deposit
SUERC-32696	Sediment	6150±40	-27.6	5220-4990 cal BC	Bay F; monolith 70254; 7.96 mOD	***70092***
SUERC-44764	Blackthorn-type (*Prunus* sp) seeds	5379±35	-27.4	4330-4040 cal BC	Bay F; monolith 70252; 8.17 mOD	***70345***
SUERC-44762	Hazelnut (*Corylus avellana*)	5093±35	-28.8	3970-3790 cal BC	Bay F; monolith 70252; 8.19 mOD	

Table 384: Radiocarbon dates from the Mesolithic alluvium *in the* Principal palaeochannel, *Stainton West*

CNDR 1, identified during pollen analysis, which is characterised by pollen associated with a mixed woodland (*Appendix 16*).

The next dated samples in the stratigraphic sequence came from the *Mesolithic alluvium* and *Mesolithic/Neolithic alluvium*, which probably relate to the same broad episode of channel alluviation, though the latter did seem to overlie the former (*Ch 6*). Three dated samples were from the *Mesolithic alluvium*, all from Bay F (Table 384). One, from sediment, produced a late sixth/early fifth millennia cal BC date, whilst the other two, from plant macrofossils, date to the late fifth/early fourth millennia cal BC and also provided dating evidence for pollen superzone CNDR 1 (*Appendix 16*).

The nine dated samples from the *Mesolithic/Neolithic alluvium* were from Bays B and D (Table 385). The Bay B samples have a wide date range, spanning the mid-sixth to late fourth millennia cal BC, and include three samples that were associated with a deposit (***70317***) containing flaked lithics, and three samples that were from a deposit (***70317***) that may have accumulated around timbers forming part of a dendrochronological cluster (Cluster 2). Together, the Bay D samples have more constricted date ranges, spanning the late sixth to early fifth millennia cal BC, and one sample was from a deposit (***70318***), which also produced flaked lithics.

The *Earlier Neolithic organic deposit* formed the next stratigraphic unit in the channel sequence (*Ch 8*), with a total of 27 samples being dated from this, the dates spanning the late fifth to early third millennia cal BC, though the majority date to the early part of the fourth millennium cal BC (Table 386).

Laboratory code	Material	Radiocarbon age (BP)	δ^{13}C (‰)	Calibrated date range (95% confidence)	Bay/sample/depth	Deposit
SUERC-32704	Sediment	6340±40	-28.3	5470-5220 cal BC	Bay B; monolith 70222; 8.14 mOD	***70317***
SUERC-47190	Hazelnut (*Corylus avellana*)	6005±39	-27.8	5000-4790 cal BC	Bay B; monolith 70222; 8.17/8.18 mOD	
SUERC-47191	Elm (*Ulmus* sp) twig **77001**	5802±39	-28.6	4770-4540 cal BC		
SUERC-44743	Hazelnut (*Corylus avellana*)	5301±35	-24.5	4250-4040 cal BC	Bay B; monolith 70222; 8.24 mOD	***70317***
SUERC-44744	Elm (*Ulmus* sp) twig **77005**	5443±35	-27.7	4360-4240 cal BC		
SUERC-32692	Hazelnut (*Corylus avellana*)	4425±35	-28.4	3330- 2920 cal BC	Bay B; bulk sample 70424	***70317***
SUERC-44787	Hazelnut (*Corylus avellana*)	5973±35	-29.1	4960-4740 cal BC	Bay D; monolith 70240; 7.85 mOD	***70318***
SUERC-44788	Elm (*Ulmus* sp) twig **77007**	5398±35	-25.2	4350-4070 cal BC	Bay D; monolith 70240; 7.78 mOD	***70318***
SUERC-32693	Sediment	6105±35	-28.4	5210-4930 cal BC	Bay D; monolith 70240; 7.80 mOD	

Table 385: Radiocarbon dates from the Mesolithic/Neolithic alluvium *in the* Principal palaeochannel, *Stainton West*

Laboratory code	Material	Radiocarbon age (BP)	δ13C (‰)	Calibrated date range (95% confidence)	Bay/sample/depth	Deposit/ structure
SUERC-42027	Hazel (*Corylus avellana*) roundwood **76011**	5037±26	-25.9	3950-3760 cal BC	Bay B; 8.38 mOD	***70308***: Structure ***75935***
SUERC-42018	Hazel (*Corylus avellana*) roundwood stake **76028**	4995±26	-29.5	3930-3700 cal BC	Bay A; 8.62 mOD	***70353***; Wooden Structure 1 (***70264***)
SUERC-42019	Hazel (*Corylus avellana*) trimmed roundwood **75913**	4963±26	-26.0	3800-3660 cal BC	Bay A; 8.85 mOD	
SUERC-42029	Hazel (*Corylus avellana*) roundwood stake **76034**	4901±26	-26.1	3720-3640 cal BC	Bay A; 8.65 mOD	
SUERC-44792	Hazel (*Corylus avellana*) roundwood stake **76238**	4930±35	-27.9	3780-3640 cal BC	Bay A/B; 8.34- 8.44 mOD	***70353***; Wooden Structure 2 (***70467***)
SUERC-42020	Hazel (*Corylus avellana*) roundwood stake **76226**	4935±26	-22.7	3770-3650 cal BC	Bay A/B; 8.52 mOD	
SUERC-42024	Hazel (*Corylus avellana*) roundwood stake **76228**	4928±23	-28.5	3770-3650 cal BC	Bay A/B; 8.44 mOD	
SUERC-42026	Elm (*Ulmus* sp) roundwood stake **76229**	4985±26	-25.8	3920-3690 cal BC	Bay A/B; 8.42 mOD	
SUERC-42028	Trimmed alder (*Alnus glutinosa*) roundwood **75778**	4928±23	-28.1	3790-3660 cal BC	Bay B; 8.53 mOD	***70308***
SUERC-42025	Alder (*Alnus glutinosa*) woodchip **76223**	4464±23	-28.1	3335-3025 cal BC	Bay A/B; 8.47 mOD	***70353***
SUERC-32633	Hazelnut (*Corylus avellana*)	4440±35	-27.4	3340-2920 cal BC	Bay A; bulk sample 70148; 8.53 mOD	***70353***
SUERC-44735	Hazelnut (*Corylus avellana*)	4976±35	-27.3	3930-3650 cal BC	Bay B; monolith 70222; 8.40 mOD	***70308***
SUERC-44736	Alder (*Alnus glutinosa*) twig **77002**	5036±35	-30.0	3950-3710 cal BC		
SUERC-44733	Hazelnut (*Corylus avellana*)	4973±35	-25.9	3920-3650 cal BC	Bay B; monolith 70222; 8.42 mOD	***70308***
SUERC-44734	Alder (*Alnus glutinosa*) twig **77000**	5028±35	-28.5	3950-3710 cal BC		
SUERC-26379	Trident 1; oak (*Quercus* sp) sapwood?	4965±35	-28.0	3910-3650 cal BC	Bay B; monolith 70222; 8.43 mOD	***70308***
SUERC-32946	Elm (*Ulmus* sp) roundwood **75639**	5000±35	-26.0	3950-3690 cal BC	Bay C; 8.42-8.53 mOD	***70403***
SUERC-47197	Hazelnut (*Corylus avellana*)	4801±39	-25.2	3660-3380 cal BC	Bay D; monolith 70296; 8.46 mOD	***70315*** (lower fraction)
SUERC-47198	Elm (*Ulmus* sp) roundwood **77015**	4909±39	-26.6	3770-3640 cal BC		
SUERC-44766	Hazelnut (*Corylus avellana*)	4973±35	-27.7	3920-3650 cal BC	Bay F; monolith 70252; 8.23 mOD	***70346***
SUERC-44765	Hazelnut (*Corylus avellana*)	4972±35	-25.5	3920-3650 cal BC	Bay F; monolith 70252; 8.25 mOD	

Table 386: Radiocarbon dates from the Earlier Neolithic organic deposit*, associated structures, and Trident 1 in the* Principal palaeochannel*, Stainton West*

Laboratory code	Material	Radiocarbon age (BP)	δ13C (‰)	Calibrated date range (95% confidence)	Bay/sample/depth	Deposit/ structure
SUERC-32634	Hazelnut (*Corylus avellana*)	4510±30	-30.7	3360-3090 cal BC	Bay F; Bulk sample 70124; 8.31-8.52 mOD	***70325***
SUERC-44782	Hawthorn (*Crataegus monogyna*) seeds	4384±35	-28.7	3100-2900 cal BC		
SUERC-32632	Hazelnut (*Corylus avellana*)	4990±35	-25.0	3940-3660 cal BC	Bay F; bulk sample 70115; 8.42 mOD	***70325***
SUERC-44775	Hazelnut (*Corylus avellana*)	5350±35	-26.7	4330-4050 cal BC	Bay F; monolith 70254; 8.25 mOD	***70325***
SUERC-44776	Elm (*Ulmus* sp) roundwood **77011**	5090±35	-26.2	3970-3790 cal BC		
SUERC-32718	Elm (*Ulmus* sp) roundwood **75718**	5070±40	-26.1	3970-3770 cal BC	Bay G; sample 75718; 8.46 mOD	***70424***

Table 386: Radiocarbon dates from the Earlier Neolithic organic deposit*, associated structures, and Trident 1 in the* Principal palaeochannel*, Stainton West (cont'd)*

These samples included items of wood forming elements of Structure ***75935***, Wooden Structures 1 and 2, and Trident 1 (*Appendix 13*). One sample, a plant macrofossil (SUERC-32633), was also extracted from adjacent to a polished-stone axehead (70353.30; *Ch 8*), whilst three samples, again plant macrofossils (SUERC-32634, SUERC-44782, and SUERC-32632), were from adjacent to wooden paddle **75706** (*Ch 8*). Some samples were also explicitly dated to assist with the pollen analysis and, of these, four from Bay B (SUERC-44735, SUERC-44736, SUERC-44733, and SUERC-44734) were selected to date a peak in elm, in pollen superzone CNDR 2, which occurred immediately prior to the initial Elm Decline (ED; *Appendix 16*). Two other samples (SUERC-44766 and SUERC-44765) were used to date a period immediately following this initial decline.

The *Earlier Neolithic alluvium* directly overlay the *Earlier Neolithic organic deposit*, and hence was stratigraphically later (*Ch 8*). Nine samples were dated from this, from Bays B, D, and O, with the resultant dates spanning the latter part of the fourth millennium cal BC (Table 387). One of these comprised a sample of wood from Trident 2 (*Appendix 13*), two were sediment samples, whilst the remainder consisted of hazelnuts and twigs, which were dated to assist in the analysis of pollen superzone CNDR 2, characterised by declining elm and an expansion in alder pollen (*Appendix 16*). Of these latter samples,

Laboratory code	Material	Radiocarbon age (BP)	δ13C (‰)	Calibrated date range (95% confidence)	Bay/sample/depth	Deposit
SUERC-44742	Alder (*Alnus glutinosa*) twig **77004**	4978±35	-31.7	3930-3660 cal BC	Bay B; monolith 70222; 8.52 mOD	***70187***
SUERC-44737	Hazelnut (*Corylus avellana*)	4526±35	-24.2	3370-3090 cal BC	Bay B; monolith 70222; 8.54 mOD	***70187***
SUERC-44738	Alder (*Alnus glutinosa*) twig **77003**	4688±35	-30.4	3630-3360 cal BC		
SUERC-48334	Hazelnut (*Corylus avellana*)	4730±34	-27.5	3640-3370 cal BC	Bay B; monolith 70222; 8.58 mOD	***70187***
SUERC-44784	Alder (*Alnus glutinosa*) twig **77012**	4775±35	-30.8	3650-3380 cal BC	Bay D; monolith 70296; 8.52 mOD	***70315*** (upper fraction)
SUERC-32635	Sediment	4585±35	-29.6	3510-3110 cal BC	Bay D; monolith 70296; 8.54 mOD	***70315*** (upper fraction)
SUERC-44783	Alder (*Alnus glutinosa*) twig **77014**	4769±35	-30.6	3650-3380 cal BC		
SUERC-26660	Trident 2; oak (*Quercus* sp) sapwood	4745±35	-27.5	3640-3370 cal BC	Bay D; 8.61-8.66 mOD	***70315*** (upper fraction)
SUERC-32702	Sediment	4380±35	-27.4	3100-2910 cal BC	Bay O; monolith 70507; 8.78 mOD	***70482***

Table 387: Radiocarbon dates from the Earlier Neolithic alluvium *and Trident 2 in the* Principal palaeochannel*, Stainton West*

Laboratory code	Material	Radiocarbon age (BP)	$\delta^{13}C$ (‰)	Calibrated date range (95% confidence)	Bay/sample/ depth	Feature/deposit
SUERC-32628	Hazelnut (*Corylus avellana*)	4675±35	-26.4	3630-3360 cal BC	Bay B; bulk sample 70063; 8.56-8.92 mOD	Tree-throw ***70129*** (fill ***70130***)
SUERC-44752	Alder (*Alnus glutinosa*) catkin axis	4380±35	-25.0	3100-2910 cal BC		
SUERC-44785	Hazelnut (*Corylus avellana*)	4534±35	-26.4	3370-3100 cal BC	Bay D; monolith 70296; 8.61 mOD	***70314***
SUERC-44786	Indeterminate twig 77013	4478±35	-29.1	3350-3020 cal BC		
SUERC-32626	Organic residue on Grooved Ware vessel	4145±35	-26.2	2880-2620 cal BC	Bay E; 8.68 mOD	Unidentified feature
SUERC-44772	Hazelnut (*Corylus avellana*)	4596±35	-26.1	3520-3120 cal BC	Bay F; monolith 70254; 8.48 mOD	***70326***
SUERC-44773	Indeterminate twig 77010	4423±35	-27.8	3330-2920 cal BC		
SUERC-32695	Sediment	4180±35	-29.1	2890-2630 cal BC	Bay F; monolith 70254; 8.66 mOD	***70326***

Table 388: Radiocarbon dates from the Later Neolithic organic deposit, *tree-throw* **70129**, *and the Grooved Ware vessel in the* Principal palaeochannel, *Stainton West*

six were used to bracket the Elm Decline Demise (EDD). This palynological event occurred after the initial Elm Decline (ED; *above*), when values for elm declined to absence, or presence only (*Appendix 16*). Of the six samples used to define its chronology, two (SUERC-44742 and SUERC-44784) bracketed its lower boundary, whilst the remaining four (SUERC-44737/8, SUERC-32635, and SUERC-44783) bracketed its upper boundary.

The *Later Neolithic organic deposit* sealed the *Earlier Neolithic alluvium* and was associated with increasing territorialisation of the channel (*Ch 10*), containing pollen relating to the establishment of alder carr in its immediate vicinity (pollen superzone CNDR 3; *Appendix 16*). Eight samples were dated, spanning the latter part of the fourth and earlier third millennia cal BC, of which four (SUERC-44785/6 and SUERC-44772/3) were from plant macrofossils directly associated with this deposit (Table 388). One sediment sample (SUERC-32695) was also extracted from the *Later Neolithic organic deposit*. Of the remaining samples, two were from a tree-throw (***70129***), within Bay B (*Ch 10*), whilst another was of organic residue from a Grooved Ware vessel that had been deposited in an unidentified feature, truncating the *Earlier Neolithic organic deposit* (*Ch 10*); this vessel is assumed to have been contemporary with the formation of the *Later Neolithic organic deposit*.

The *Chalcolithic alluvium* (*Ch 11*), the next stratigraphic unit in the channel, was directly dated by four samples from Bays B and D (SUERC-44745/6, SUERC-32703, and SUERC-32636; Table 389). In addition, two samples (SUERC-47188/9) came from the interface between the *Chalcolithic alluvium* (***70306***) and the underlying *Later Neolithic organic deposit* (***70307***). Two other features in the channel had a direct relationship with this layer. One was Burnt Mound 6 (*Ch 11*), which was sealed by the *Chalcolithic alluvium*, above the Neolithic deposits (*Ch 11*); this was dated by two samples (SUERC-42016/17). The other feature was natural in origin, creating a reactivation channel, which seems to have been related to the deposition of the *Chalcolithic alluvium* (*Ch 11*); this channel was also dated by two samples (SUERC-44767/8).

The *Bronze Age alluvium* formed one of the uppermost deposits in the *Principal palaeochannel*, sealing the *Chalcolithic alluvium* and reactivation channel (*Ch 11*). Six sediment samples from Bays F and O were used to date this deposit, though these produced a wide range of dates extending from the late fourth to the early first millennia cal BC (Table 390).

All of the duplicate assays from the major stratigraphic units in the *Principal palaeochannel* were also subjected to the χ^2 test, using the Combine function in OxCal, in order to test their consistency. This indicated that several of the duplicate assays from plant macrofossils and short-lived charcoal and wood, extracted from identical monolith sample locations, were statistically consistent, with good agreement indices, whilst others were found to be statistically inconsistent, or were in such poor agreement that they completely failed the test. In terms of the statistically inconsistent dates, and those that failed the Combine test, given the overall weight of the evidence, these presumably reflect the dating of an intrusive or

Laboratory code	Material	Radiocarbon age (BP)	δ13C (‰)	Calibrated date range (95% confidence)	Bay/sample/depth	Feature/deposit
SUERC-42016	Sediment	3935±26	-29.7	2560-2330 cal BC	Bay I; monolith 70303; 8.56 mOD	Burnt Mound 6; trough ***70250*** (fill ***70398***)
SUERC-42017	Charred hazelnut (*Corylus avellana*)	3891±26	-29.3	2470-2290 cal BC	Bay I; monolith 70303; 8.55 mOD	
SUERC-47188	Hazelnut (*Corylus avellana*)	3693±39	-24.3	2200-1960 cal BC	Bay B; monolith 70222; 8.70 mOD	***70307***/***70306*** interface
SUERC-47189	Hazel (*Corylus avellana*) roundwood charcoal	3758±39	-26.4	2300-2030 cal BC		
SUERC-44745	Hazelnut (*Corylus avellana*)	4530±35	-24.2	3370-3100 cal BC	Bay B; monolith 70222; 8.82 mOD	***70306***
SUERC-44746	Hazel (*Corylus avellana*) charcoal	3750±35	-25.9	2290-2030 cal BC		
SUERC-32703	Sediment	3915±35	-28.9	2490-2290 cal BC	Bay B; monolith 70222; 8.89 mOD	***70306***
SUERC-32636	Sediment	4150±35	-25.5	2880-2620 cal BC	Bay D; monolith 70240; 8.78 mOD	***70313***
SUERC-44768	Alder (*Alnus glutinosa*) twig 77009	3867±35	-29.5	2470-2200 cal BC	Bay F; monolith 70252; 8.39 mOD	Base of reactivation channel
SUERC-44767	Alder (*Alnus glutinosa*) twig 77008	3142±35	-28.2	1500-1300 cal BC	Bay F; monolith 70252; 8.41 mOD	

Table 389: Radiocarbon dates from the Chalcolithic alluvium*, Burnt Mound 6, and the reactivation channel in the* Principal palaeochannel*, Stainton West*

Laboratory code	Material	Radiocarbon age (BP)	δ13C (‰)	Calibrated date range (95% confidence)	Bay/sample/depth	Deposit
SUERC-32697	Sediment	3605±35	-29.0	2120-1880 cal BC	Bay F; monolith 70256; 8.73 mOD	***70468***
SUERC-44757	Sediment; humic acid	4149±35	-28.5	2880-2620 cal BC	Bay O; monolith 70507; 9.07 mOD	***70481***
SUERC-44758	Sediment; humin	4536±35	-29.2	3370-3100 cal BC		
SUERC-44755	Sediment; humic acid	4275±35	-29.1	3020-2760 cal BC		
SUERC-44756	Sediment; humin	4694±35	-29.8	3630-3370 cal BC		
SUERC-32698	Sediment	2725±35	-29.7	970-800 cal BC	Bay O; monolith 70507; 9.37 mOD	***70476***

Table 390: Radiocarbon dates from the Bronze Age alluvium *in the* Principal palaeochannel*, Stainton West*

residual item within a specific deposit, or might be a result of errors in the radiocarbon measurement of some of the samples (Table 391).

In addition, the χ^2 test was also used to ascertain the reliability of the sediment dates from the main stratigraphic units within the *Principal palaeochannel*. This test was therefore used to compare these with other radiocarbon assays made on short-lived plant macrofossils from identical sample locations or, in some cases, multiple sediment dates obtained from identical sample locations. In all instances, χ^2 testing of the duplicate dates containing one or more results derived from sediment samples produced statistically inconsistent results (Table 392); based on the weight of the evidence, it appears that the sediment assays produced unreliable dates. In addition, in one case, a dated sediment sample (SUERC-32705) came from a sample location that produced two dated fragments of short-lived wood (SUERC-47195 and SUERC-47196), which were themselves statistically consistent, providing further confirmation that the

Stratigraphic entity	Bay/context/monolith/ height (m OD)	Laboratory code	Radiocarbon age (BP)	Combine results	Combined calibrated date range (95% confidence)
Mesolithic organic deposit	Bay B; deposit ***70226***; monolith 70225; height 7.88	SUERC-44747	6065±35	Statistically inconsistent with poor agreement (T′=3.98; T′(5%)=3.8; *v*=1; A_{comb}=48.7% (An= 50.0%))	-
		SUERC-44748	5959±35		
	Bay V; deposit ***71129***; monolith 71158; height 7.46	SUERC-47186	6346±39	Statistically inconsistent with poor agreement (T′=5.04; T′(5%)=3.8; *v*=1; A_{comb}= 34.1% (An= 50.0%))	-
		SUERC-47187	6207±39		
	Bay X; deposit ***71028***; monolith 71175; height 7.49	SUERC-47195	5976±39	Statistically consistent with good agreement (T′=0.18; T′(5%)=3.8; *v*=1; A_{comb}= 115.3% (An= 50.0%))	4950-4790 cal BC
		SUERC-47196	6002±39		
	Bay X; deposit ***71026*** ; monolith 71175; height 7.70	SUERC-44777	6013±35	Statistically consistent with good agreement (T′=0.0; T′(5%)=3.8; *v*=1; A_{comb}=118.9% (An= 50.0%))	4990-4830 cal BC
		SUERC-44778	6013±35		
Mesolithic/ Neolithic alluvium	Bay B; deposit ***70317***; monolith 70222; height 8.17/8.18	SUERC-47190	6005±39	Statistically inconsistent with poor agreement (T′=11.41; T′(5%)=3.8; *v*=1; A_{comb}= 5.8% (An= 50.0%))	-
		SUERC-47191	5802±39		
Earlier Neolithic alluvium	Bay B; deposit ***70187***; monolith 70222; height 8.54	SUERC-44737	4526±35	Statistically inconsistent with poor agreement (T′=9.76; T′(5%)=3.8; *v*=1; A_{comb}=13% (An=50.0%))	-
		SUERC-44738	4688±35		
Later Neolithic organic deposit	Bay D; deposit ***70314***; monolith 70296; height 8.61	SUERC-44785	4534±35	Statistically consistent with good agreement (T′=1.18; T′(5%)=3.8; *v*=1; A_{comb}=92.8% (An=50.0%))	3350-3100 cal BC
		SUERC-44786	4478±35		
	Bay F; deposit ***70326***; monolith 70254; height 8.48	SUERC-44772	4596±35	Statistically inconsistent with poor agreement (T′=10.65; T′(5%)=3.8; *v*=1; A_{comb}=13% (An=50.0%))	-
		SUERC-44773	4423±35		
Later Neolithic organic deposit/ Chalcolithic alluvium	Bay B; deposit ***70307***; monolith 70222; height 8.70	SUERC-47188	3693±39	Statistically consistent with good agreement (T′=1.34; T′(5%)=3.8; *v*=1; A_{comb}=91.0% (An=50.0%))	2210-2030 cal BC
		SUERC-47189	3758±39		
Chalcolithic alluvium	Bay B; deposit ***70306***; monolith 70222; height 8.82	SUERC-44745	4530±35	Failed	-
		SUERC-44746	3750±35		
Earlier Neolithic organic deposit	Bay B; deposit ***70308***; monolith 70222; height 8.40	SUERC-44735	4976±35	Statistically consistent with good agreement (T′=1.35; T′(5%)=3.8; *v*=1; A_{comb}= 80.4% (An= 50.0%))	3940-3700 cal BC
		SUERC-44736	5036±35		

Table 391: χ^2 tests on the duplicate radiocarbon assays from plant macrofossils, charcoal, and short-lived wood, from identical sample locations within the Principal palaeochannel, *Stainton West*

Stratigraphic entity	Bay/context/monolith/ height (m OD)	Laboratory code	Radiocarbon age (BP)	Combine results	Combined calibrated date range (95% confidence)
Earlier Neolithic organic deposit	Bay B; deposit ***70308***; monolith 70222; height 8.42	SUERC-44733	4973±35	Statistically consistent with good agreement (T′=1.17; T′(5%)=3.8; *v*=1; A_{comb}=89.4% (An= 50.0%))	3930-3700 cal BC
		SUERC-44734	5028±35		
	Bay D; deposit ***70315*** (lower fraction); monolith 70296; height 8.46	SUERC-47197	4801±39	Statistically consistent with good agreement (T′=3.54; T′(5%)=3.8; *v*=1; A_{comb}=52.9% (An= 50.0%))	3700-3540 cal BC
		SUERC-47198	4909±39		
	Bay F; deposit ***70346***; monolith 70252; height 8.23	SUERC-44766	4973±35	Statistically consistent with good agreement (T′=0.0; T′(5%)=3.8; *v*=1; A_{comb}=126.3% (An=50.0%))	3800-3670 cal BC
		SUERC-44765	4972±35		
	Bay F; deposit ***70325***; monolith 70254; height 8.25	SUERC-44775	5350±35	Statistically inconsistent with poor agreement (T′=23.47; T′(5%)=3.8; *v*=1; A_{comb}=0.4% (An=50.0%))	-
		SUERC-44776	5090±35		

Note: Statistically consistent results are highlighted

Table 391: χ^2 tests on the duplicate radiocarbon assays from plant macrofossils, charcoal, and short-lived wood, from identical sample locations within the Principal palaeochannel, *Stainton West (cont'd)*

Stratigraphic unit	Context/height (m OD)	Laboratory code	Radiocarbon age (BP)	χ^2 test
Mesolithic organic deposit	Bay X; deposit ***71028***; monolith 71175; height 7.49	SUERC-32705	6330±40	Statistically inconsistent with poor agreement (T′=43.10; T′(5%)=6.0; v=2; A_{comb}=0.0% (An= 40.8%))
		SUERC-47195	5976±39	
		SUERC-47196	6002±39	
Earlier Neolithic alluvium	Bay D; deposit ***70315*** (upper fraction); monolith 70296; height 8.54	SUERC-44783	4769±35	Statistically inconsistent with poor agreement (T′=12.59; T′(5%)=3.8; v=1; A_{comb}=6.8% (An= 50%))
		SUERC-32635	4585±35	
Bronze Age alluvium	Bay O; deposit ***70481***; monolith 70507; height 9.07	SUERC-44757 (humic acid)	4149±35	Statistically inconsistent T′=61.1; T′(5%)=3.8; v=1
		SUERC-44758 (humin)	4536±35	
	Bay O; deposit ***70481***; monolith 70507; height 9.09	SUERC-44755 (humic acid)	4694±35	Statistically inconsistent T′=1543.8; T′(5%)=3.8; v=1
		SUERC-44756 (humin)	2725±35	

Table 392: χ^2 tests on the duplicate radiocarbon assays from plant macrofossils and sediment samples, from identical sample locations within the Principal palaeochannel, *Stainton West*

sediment dates were unreliable. The reasons for the unreliability of the sediment dates probably reflect the more general problems that are associated with dating sediment samples from alluvial deposits (*cf* Chiverrell *et al* 2009; 2010; Howard *et al* 2009; Chiverrell and Jakob 2012). Therefore, given their suspected unreliability, the sediment dates from Stainton West were omitted from the programme of chronological modelling.

Stainton West: dryland areas

Forty-six samples were dated from the dryland areas adjacent to the *Principal palaeochannel*. These came from the *Grid-square area*, burnt mounds, and across the western part of the site, which included the retention pond area (*Ch 1*).

The 31 samples from the *Grid-square area* dated a range of features and deposits associated with Mesolithic, Neolithic, and Bronze Age activity (Table 393). Dated Mesolithic features comprised hearth ***90452***, associated with Structure 1 (*Ch 3*), and hearth ***90593*** and pit ***90309*** (*Ch 3*), all elements of the Mesolithic Phase I encampment; two tree-throws (***90163*** and ***90208***) associated with Mesolithic Phase II activity (*Ch 3*); and several features associated the Mesolithic Phase III encampment, including hearths ***90434*** (*Ch 4*) and ***90263*** (*Ch 4*), stone-spread ***90396*** (*Ch 4*), and tree-throw ***90448*** (*Ch 4*). Other samples dating to the Mesolithic period (associated with Mesolithic Phases I and II, and the Hiatus Phase) were from the *Stabilised land surface* (*Ch 2*) and the *Mesolithic overbank alluvium* (*Ch 6*). The dated Neolithic and Bronze Age features from the *Grid-square area* were fewer in number: Early Neolithic tree-throws ***90531*** (*Ch 8*), ***90508*** (*Ch 8*), and ***90262*** (*Ch 8*). One Late Neolithic tree-throw (***90522***; *Ch 10*) was also dated, along with a Bronze Age hearth (***90217***; *Ch 11*).

CNDR Phase	Laboratory code	Material	Radiocarbon age (BP)	$\delta^{13}C$ (‰)	Calibrated date range (95% confidence)	Feature/deposit
Mesolithic Phase I	SUERC-43658	Charred hazelnut (*Corylus avellana*)	7055±29	-25.2	6010-5880 cal BC	*Stabilised land surface* ***90206*** (deposit ***81592***)
	SUERC-59308	Alder/hazel (*Alnus/ Corylus*) charcoal	7129±27	-27.5	6060-5920 cal BC	Hearth ***90452*** (fill ***90453***)
	SUERC-32642	Charred grass-family (Poaceae) seed	175±35	-25.8	cal AD 1650-1955	Hearth ***90593*** (fill ***90349***)
	SUERC-59306	Alder (*Alnus glutinosa*) charcoal	2543±26	-26.1	800-550 cal BC	Pit ***90309*** (fill ***90310***)
Mesolithic Phase II	SUERC-32706	Indeterminate short-lived charcoal fragments	6010±35	-25.6	5000-4800 cal BC	Tree-throw ***90163*** (fill ***90223***)
	SUERC-42000	Alder/hazel (*Alnus/ Corylus*) charcoal	5882±23	-29.1	4825-4705 cal BC	Tree-throw ***90208*** (fill ***90346***)
	SUERC-42004	Indeterminate short-lived charcoal	5919±26	-26.3	4850-4720 cal BC	
Mesolithic Phase III	SUERC-32638	Mineral encrusted oak (*Quercus*) charcoal	3120±30	-26.2	1460-1290 cal BC	Hearth ***90434*** (fill ***90445***)
	SUERC-41995	Alder/hazel (*Alnus/ Corylus*) charcoal	5757±23	-24.1	4690-4540 cal BC	
	SUERC-41996	Blackthorn-type (*Prunus* sp) charcoal	232±25	-25.5	cal AD 1640-1955	
	SUERC-59309	Willow/poplar (*Salix/Populus*) charcoal	183±26	-26.1	cal AD 1650-1955	Tree-throw ***90448*** (fill ***90459***)
	SUERC-59310	Indeterminate short-lived charcoal	5752±30	-25.3	4700-4510 cal BC	
	SUERC-43664	Hazel (*Corylus avellana*) charcoal	5727±29	-25.1	4690-4490 cal BC	*Stabilised land surface* ***90206*** (deposit ***90230***)
	SUERC-42610	Sediment	5211±28	-26.1	4060-3960 cal BC	Hearth ***90263*** (fill ***90264***)
	SUERC-41998	Charred barley (*Hordeum* sp) seed	368±26	-24.9	cal AD 1440-1640	Stone-spread ***90396*** (deposit ***90397***)
	SUERC-41999	Alder/hazel (*Alnus/ Corylus*) charcoal	5524±23	-24.6	4450-4335 cal BC	
	SUERC-43665	Alder/hazel (*Alnus/ Corylus*) charcoal	5567±27	-25.9	4460-4350 cal BC	
	SUERC-42005	Willow/poplar/ birch (*Salix/Populus/ Betula*) charcoal	122±26	-27.0	cal AD 1670-1940	Stone-spread ***90396*** (deposit ***83716***)

Table 393: Radiocarbon dates from the Grid-square area*, Stainton West*

CNDR Phase	Laboratory code	Material	Radiocarbon age (BP)	$\delta^{13}C$ (‰)	Calibrated date range (95% confidence)	Feature/deposit
Hiatus Phase	SUERC-43662	Charred hazelnut (*Corylus avellana*)	5323±29	-23.4	4250-4040 cal BC	*Stabilised land surface* ***90206*** (deposit ***84052***)
	SUERC-43663	Charred hazelnut (*Corylus avellana*)	5265±29	-25.1	4230-3980 cal BC	*Mesolithic overbank alluvium* ***90211*** (deposit ***87692***)
Early Neolithic Phase	SUERC-42591	Indeterminate short-lived charcoal fragment	6105±29	-25.6	5210-4940 cal BC	Tree-throw ***90262*** (fill ***90326***)
	SUERC-41994	Alder/hazel (*Alnus*/*Corylus*) charcoal	4917±23	-24.8	3765-3645 cal BC	
Early Neolithic Phase	SUERC-32637	Blackthorn-type (*Prunus* sp) charcoal	5720±35	-27.6	4690-4460 cal BC	Tree-throw ***90262*** (fill ***87675***)
	SUERC-59307	Alder/hazel (*Alnus*/*Corylus*) charcoal	4925±26	-26.2	3770-3640 cal BC	Tree-throw ***90262*** (fill ***87385***)
	SUERC-32643	Indeterminate short-lived charcoal (x15 fragments)	4940±35	-25.9	3790-3650 cal BC	*Stabilised land surface* ***90206*** (deposit ***83682***)
	SUERC-32708	Indeterminate short-lived charcoal	4930±40	-26.8	3790-3640 cal BC	Tree-throw ***90531*** (fill ***90527***)
	SUERC-32707	Alder/hazel (*Alnus*/*Corylus*) charcoal	4840±40	-25.3	3710-3520 cal BC	Tree-throw ***90508*** (fill ***90523***)
Late Neolithic Phase	SUERC-59311	Hazel (*Corylus avellana*) charcoal	4428±26	-25.6	3330-2920 cal BC	Tree-throw ***90522*** (fill ***90520***)
	SUERC-59312	Alder (*Alnus glutinosa*) charcoal	2930±29	-27.3	1220-1020 cal BC	Tree-throw ***90522*** (fill ***90521***)
Bronze Age Phase	SUERC-32644	Alder/hazel (*Alnus*/*Corylus*) charcoal	2915±35	-26.3	1220-1000 cal BC	Hearth ***90217*** (fill ***90237***)
	SUERC-41997	Alder/hazel (*Alnus*/*Corylus*) charcoal	2956±26	-26.2	1260-1050 cal BC	

Table 393: Radiocarbon dates from the Grid-square area*, Stainton West (cont'd)*

The duplicate assays from discrete features or deposits from the *Grid-square area* were also subjected to χ^2 testing (Table 394). Those features producing statistically consistent results were Late Mesolithic tree-throw ***90208*** and Bronze Age hearth ***90217***, whilst, of the four dates obtained from tree-throw ***90262***, two (SUERC-41994 and SUERC-59307) were statistically consistent, suggesting that this feature dates to 3710-3650 cal BC. If this is correct, the two other dates (SUERC-42591 and SUERC-32637) must come from residual material associated with Mesolithic activity. This hypothesis was confirmed by the character and position of the worked lithics within this tree-throw, which are consistent with being derived from a Late Mesolithic lithic scatter that was disturbed during the uprooting of a Neolithic tree (*Ch 4*). Two statistically consistent results (SUERC-41999 and SUERC-43665) were also obtained from Late Mesolithic stone-spread ***90396***, which suggests that it dates to 4450-4340 cal BC. The two other results (SUERC-41998 and SUERC-42005) from this spread relate to intrusive post-medieval material.

Aside from considering individual features, χ^2 testing was also used to examine possible links between results obtained from different features and deposits in the *Grid-square area* (Table 395). This indicated that a dated sample (SUERC-59308) from the *Stabilised land surface* and one (SUERC-43658) from hearth ***90452*** could relate to the same Late Mesolithic activity. Similarly, links could be made with materials dating to the Bronze Age from hearth ***90217*** (SUERC-41997 and SUERC-32644) and tree-throw ***90522*** (SUERC-59312), and materials dating to the second quarter of the fifth millennium cal BC from tree-throw ***90262*** (SUERC-32637), hearth ***90434*** (SUERC-41995), tree-throw ***90448*** (SUERC-59310), and the *Stabilised land surface* (SUERC-43664).

The dated from five burnt mounds on the eastern and western edges of the *Principal palaeochannel* (*Chs 10* and *11*) complemented the other burnt mound (Burnt Mound 6; *Ch 11*), which was within the channel. A series of related pits and hearths was also present to the west of the palaeochannel, associated with the

Deposit/feature	Laboratory code	Radiocarbon age (BP)	Combine results	Combined calibrated date range (95% confidence)
Stabilised land surface ***90206***	SUERC-43658	7055±29	Failed	-
	SUERC-32643	4940±35		
	SUERC-43662	5323±29		
	SUERC-43664	5727±29		
Tree-throw ***90208***	SUERC-42000	5882±23	Statistically consistent with good agreement (T′=0.91; T′(5%)=3.8; v=1; A_{comb}=99.9% (An=50.0%))	4800-4720 cal BC
	SUERC-42004	5919±26		
Hearth ***90217***	SUERC-32644	2915±35	Statistically consistent with good agreement (T′=0.76; T′(5%)=3.8; v=1; A_{comb}=97.7% (An=50.0%))	1220-1050 cal BC
	SUERC-41997	2956±26		
Tree-throw ***90262***	SUERC-59307	4925±26	Statistically consistent with good agreement (T′=0.02; T′(5%)=3.8; v=1; A_{comb}=122.7% (An=50.0%))	3710-3650 cal BC
	SUERC-41994	4917±23		
	SUERC-42591	6105±29	-	-
	SUERC-32637	5720±35	-	-
Tree-throw ***90522***	SUERC-59311	4428±26	Failed	-
	SUERC-59312	2930±29		
Stone-spread ***90396***	SUERC-41998	368±26	-	-
	SUERC-41999	5524±23	Statistically consistent with good agreement (T′=1.08; T′(5%)=3.8; v=1; A_{comb}=83.7% (An=50.0%))	4450-4340 cal BC
	SUERC-43665	5567±27		
	SUERC-42005	122±26	-	-
Cooking pit/hearth ***90434***	SUERC-32638	3120±30	Failed	-
	SUERC-41995	5757±23		
	SUERC-41996	232±25		

Note: Statistically consistent results are highlighted

Table 394: χ^2 tests on the duplicate radiocarbon assays from charcoal and charred plant samples, from identical contexts/features from the Grid-square area, *Stainton West*

burnt-mound activity, along with a structure (ring-gully **100031**; *Ch 11*), which has been interpreted as a possible sweat lodge/sauna (*Ch 12*).

All five dryland burnt mounds were subjected to radiocarbon dating. Most samples were of charred material contained in the troughs, though there was one sediment sample, again extracted from a trough (Table 396). Three were from Burnt Mound 1 (which included the sediment sample; *Ch 10*); two were from Burnt Mound 2 (*Ch 11*); four were from two separate troughs associated with Burnt Mound 3

Deposit/feature	Radiocarbon assay	Radiocarbon age (BP)	Combine results	Combined calibrated date range (95% confidence)
Stabilised land surface ***90206***	SUERC-59308	7129±27	Statistically consistent with good agreement (T′=2.62; T′(5%)=3.8; v=1; A_{comb}=68.3% (An=50.0%))	6020-5920 cal BC
Hearth ***90452***	SUERC-43658	7055±29		
Hearth ***90217***	SUERC-41997	2956±26	(T′=0.83; T′(5%)=6.0; v=2; A_{comb}=110.3% (An=40.8%))	1220-1050 cal BC
	SUERC-32644	2915±35		
Tree-throw ***90522***	SUERC-59312	2930±29		
Tree-throw ***90262***	SUERC-32637	5720±35	Statistically consistent with good agreement (T′=0.8; T′(5%)=7.8; v=3; A_{comb}=137.9% (An=35.4%))	4660-4540 cal BC
Hearth ***90434***	SUERC-41995	5757±23		
Tree-throw ***90448***	SUERC-59310	5752±30		
Stabilised land surface ***90206***	SUERC-43664	5727±29		

Table 395: Statistically consistent dates from select features/deposits from Grid-square area, *Stainton West*

Burnt Mound	Laboratory code	Material	Radiocarbon age (BP)	δ13C (‰)	Calibrated date range (95% confidence)	Feature/deposit
1	SUERC-42008	Alder/hazel (*Alnus*/ *Corylus*) charcoal	4178±26	-25.1	2890-2670 cal BC	Trough ***70456*** (fill ***70430***)
	SUERC-42009	Alder/hazel (*Alnus*/ *Corylus*) charcoal	4124±23	-26.6	2870-2580 cal BC	
	SUERC-32827	Sediment	4925±30	-25.6	3770-3640 cal BC	Trough ***70456*** (fill ***70439***)
2	SUERC-32714	Alder/hazel (*Alnus*/ *Corylus*) charcoal	3720±35	-27.1	2280-1980 cal BC	Trough ***70282*** (fill ***70284***)
	SUERC-42015	Blackthorn-type (*Prunus* sp) charcoal	3703±23	-24.1	2200-2025 cal BC	
3	SUERC-32715	Alder/hazel (*Alnus*/ *Corylus*) charcoal	3270±35	-26.8	1630-1450 cal BC	Trough ***70280*** (fill ***70289***)
	SUERC-42006	Alder/hazel (*Alnus*/ *Corylus*) charcoal	3324±26	-27.1	1690-1520 cal BC	
	SUERC-42010	Alder (*Alnus glutinosa*) charcoal	3297±26	-28.1	1640-1500 cal BC	Trough ***70028*** (fill ***70332***)
	SUERC-42014	Hawthorn-type (Maloideae) charcoal	3240±26	-25.6	1610-1440 cal BC	
4	SUERC-32716	Alder/hazel (*Alnus*/ *Corylus*) charcoal	3430±35	-28.1	1880-1640 cal BC	Trough ***70348*** (fill ***70377***)
5	SUERC-32717	Blackthorn-type (*Prunus* sp) charcoal	4110±35	-25.4	2870-2500 cal BC	Trough ***70350*** (fill ***70184***)
	SUERC-42007	Alder/hazel (*Alnus*/ *Corylus*) charcoal	4035±26	-27.5	2630-2470 cal BC	

Table 396: Radiocarbon dates from the dryland burnt mounds, Stainton West

Burnt Mound	Feature/context	Laboratory code	Radiocarbon age (BP)	Combine results	Combined calibrated date range (95% confidence)
1	Trough ***70456***; upper fill ***70430***	SUERC-42008	4178±26	Statistically consistent with good agreement (T′=2.01; T′(5%)=3.8; v=1; A_{comb}=71.5% (An= 50.0%))	2880-2630 cal BC
		SUERC-42009	4124±23		
2	Trough ***70282***; lower fill ***70284***	SUERC-32714	3720±35	Statistically consistent with good agreement (T′=0.15; T′(5%)=3.8; v=1; A_{comb}=114.7% (An=50.0%))	2200-2030 cal BC
		SUERC-42015	3703±23		
3	Trough ***70280***; lower fill ***70289***	SUERC-32715	3270±35	Statistically consistent with good agreement (T′=1.36; T′(5%)=3.8; v=1; A_{comb}=97.2% (An=50.0%))	1630-1520 cal BC
		SUERC-42006	3324±26		
	Trough ***70028***; lower fill ***70332***	SUERC-42010	3297±26	Statistically consistent with good agreement (T′=2.13; T′(5%)=3.8; v=1; A_{comb}=76.5% (An=50.0%))	1620-1500 cal BC
		SUERC-42014	3240±26		
	Troughs ***70280*** and ***70028*** combined	SUERC-32715	3270±35	Statistically consistent with good agreement (T′=4.89; T′(5%)=7.8; v=3; A_{comb}=66.3% (An=35.4%))	1620-1520 cal BC
		SUERC-42006	3324±26		
		SUERC-42010	3297±26		
		SUERC-42014	3240±26		
5	Pit ***70350***; fill ***70184***	SUERC-32717	4110±35	Statistically consistent with good agreement (T′=2.79; T′(5%)=3.8; v=1; A_{comb}=63.1% (An=50.0%))	2840-2490 cal BC
		SUERC-42007	4035±26		

Table 397: χ^2 tests on the duplicate radiocarbon assays from identical contexts/features associated with the dryland burnt mounds at Stainton West

(*Ch 11*); one was from Burnt Mound 4 (*Ch 11*); and two came from Burnt Mound 5 (*Ch 10*). Taken as a group, these radiocarbon dates reveal an extended chronology for burnt-mound activity at Stainton West, with Burnt Mounds 1 and 5 being a product of Late Neolithic activity, whilst the others were created in the earlier Bronze Age. Importantly, if the radiocarbon-dated samples from Chalcolithic-age Burnt Mound 6 are also considered, a near-continuous sequence of burnt-mound activity appears to be represented; based on the maximum calibrated date ranges, this possibly started in the twenty-eighth century cal BC and extended through to the fifteenth century cal BC.

All of the duplicate dates from the dryland burnt mounds were also subjected to χ^2 testing (Table 397). In all instances, the measurements of those from short-lived samples from Burnt Mounds 1-3 and 5 were found to be statistically consistent. Furthermore, in the case of Burnt Mound 3, the four assays from two separate troughs (***70280*** and ***70028***) were also statistically consistent. One sediment date (SUERC-42016) and one date (SUERC-42017) from a charred hazelnut were also obtained from a trough associated with Burnt Mound 6. Whilst both were statistically consistent, given the general unreliability of the sediment dates (*above*), this assay has been omitted from the chronological model.

Three other dryland samples were submitted for radiocarbon assay (Table 398), two from a hearth (***100020***) and posthole (***100033***) associated with the structure ***100031*** (*above*). These indicated that it dated to the middle centuries of the second millennium cal BC. Given that the activity was presumably all associated with the structure, these were also subjected to χ^2 testing, which indicated that they were statistically consistent, though with poor agreement. The other sample dated was of organic residue on a prehistoric bucket-shaped vessel (*Ch 11*), which indicated that the use of this pot dated to the latter part of the second millennium cal BC.

Parcels 9, 21 North, 32, 41, and 42, Knockupworth/ Hadrian's Wall, and the henge monument

Seven other sites on the CNDR produced material that was suitable for radiocarbon dating, and 26 samples were selected (Table 399). The majority comprised charcoal or charred plant remains from Parcels 9, 21 North, 32, 41, 42, and the henge monument, while two sediment samples were also dated from Knockupworth/Hadrian's Wall.

Three samples were from postholes associated with two roundhouses (Houses 1 and 2) at Parcel 9 (*Ch 11*), which indicated that House 1 dated to the early part of the second millennium cal BC, whilst House 2 was built in the middle centuries of that millennium. Two of the samples from a post-defined house (House 3) in Parcel 21 North produced disparate results, with one dating to the late third millennium cal BC date, whilst the other produced an early medieval date; however, it is thought that the later sample was from an intrusive plant macrofossil and that the house did indeed date to the Chalcolithic period (*Ch 11*). The third sample from this parcel was from an isolated pit (***21099***; *Ch 11*), which was dated to the earlier part of the second millennium cal BC. Two of the Parcel 32 samples were from a pit (***32004***; *Ch 11*), returning later Bronze Age dates, falling in the later centuries of the second millennium cal BC. The other was from a ditch (***32014***; *Ch 14*), which proved to be medieval in origin, dating to the end of the first millennium cal AD.

The single sample from Parcel 41 was from a ditch (***41003***). The resultant radiocarbon dates suggests that this was a feature of the earlier Bronze Age landscape, existing in the latter part of the second millennium cal BC (*Ch 11*).

Laboratory code	Material	Radiocarbon age (BP)	$\delta^{13}C$ (‰)	Calibrated date range (95% confidence)	Feature/deposit	χ^2 test
SUERC-32713	Alder/hazel (*Alnus/ Corylus*) charcoal	3395±35	-27.5	1870-1610 cal BC	Hearth ***100020*** (fill ***100019***); ring-gully ***100031***	Statistically consistent with a poor agreement (T'=3.72; T'(5%)=3.8; v=1; A_{comb}= 46.7% (An= 50.0%))
SUERC-32712	Charred grass-family (Poaceae) seed	3295±35	-26.4	1660-1490 cal BC	Posthole ***100033*** (fill ***100032***); ring-gully ***100031***	
SUERC-32627	Organic residue on bucket-shaped vessel	3075±35	-27.5	1430-1230 cal BC	Bucket-shaped vessel deposited in pit ***100026***	

Table 398: Radiocarbon dates from the ring-gully **100031** *and a prehistoric ceramic vessel, Stainton West*

Site	Structure	Context	Laboratory code	Material	Bulk sample	Radiocarbon age (BP)	$\delta^{13}C$ (‰)	Calibrated date range (95% confidence)
Parcel 9	House 1	Posthole ***9025*** (fill ***9026***)	SUERC-32724	Alder/hazel (*Alnus*/*Corylus*) and willow/poplar (*Salix*/*Populus*) charcoal	9029	3485±35	-25.9	1900-1690 cal BC
	House 2	Posthole ***9003*** (fill ***9004***)	SUERC-32723	Hawthorn-type (Maloideae) charcoal	9002	3205±35	-25.0	1610-1410 cal BC
			SUERC-42034	Charred barley (sp) grain	9002	3165±26	-26.3	1500-1400 cal BC
Parcel 21 North	House 3	Posthole ***21390*** (fill ***21392***)	SUERC-42035	Charred barley (sp) grain	21038	1186±25	-23.9	cal AD 760-940
			SUERC-42036	Alder/hazel (*Alnus*/*Corylus*) charcoal	21038	3765±26	-26.2	2290-2050 cal BC
	-	Pit ***21099*** (fill ***21158***)	SUERC-32828	Charred barley (sp) grain	21010	3455±30	-24.9	1880-1690 cal BC
Parcel 32	-	Pit ***32004*** (fill ***32003***)	SUERC-32726	Alder/hazel (*Alnus*/*Corylus*) charcoal	32005	2855±35	-27.7	1130-910 cal BC
			SUERC-42037	Charred wheat (sp) grain	32005	2861±23	-23.0	1115-935 cal BC
	-	Ditch ***32014*** (fill ***32032***)	SUERC-32725	Charred grass-family (Poaceae) seed	32008	995±35	-23.1	cal AD 980-1160
Parcel 41	-	Ditch ***41003*** (fill ***41005***)	SUERC-32727	Alder/hazel (*Alnus*/*Corylus*) charcoal	41000	3180±35	-26.1	1530-1390 cal BC
Parcel 42	House 4	Hearth ***42037*** (fill ***42038***)	SUERC-32728	Blackthorn-type (sp) charcoal	42000	3210±35	-25.2	1610-1410 cal BC
	House 6	Hearth ***42163*** (fill ***42164***)	SUERC-32732	Alder/hazel (*Alnus*/*Corylus*) charcoal	42067	3125±35	-26.0	1500-1280 cal BC
	Building 5	Posthole ***42502*** (fill ***42501***)	SUERC-32734	Indeterminate short-lived charcoal	42187	1240±35	-27.0	cal AD 680-890
			SUERC-42038	Charred grass-family (Poaceae) seed	42187	1227±23	-25.9	cal AD 690-885
	Building 2	Gully ***42274*** (fill ***42275***)	SUERC-42045	Charred barley (sp) grain	42096	1183±26	-24.7	cal AD 760-950
			SUERC-42046	Willow/poplar (*Salix*/*Populus*) charcoal	42096	1227±26	-26.5	cal AD 690-890
		Pit ***42260*** (fill ***42262***)	SUERC-42044	Charred oat (sp) grain	42090	1137±23	-26.2	cal AD 775-985
	Building 4	Posthole ***42410*** (fill ***42411***)	SUERC-32733	Indeterminate short-lived charcoal	42154	1190±35	-27.9	cal AD 710-970
			SUERC-42039	Alder/hazel (*Alnus*/*Corylus*) charcoal	42154	1178±25	-27.5	cal AD 770-950
	-	Posthole ***42444*** (fill ***42445***)	SUERC-42040	Charred wheat (sp) grain	42166	236±25	-26.9	cal AD 1635-1955
			SUERC-42595	Charred barley (sp) grain		1194±29	-24.3	cal AD 720-950

Table 399: Radiocarbon dates from Parcels 9, 21 North, 32, 41, and 42, Knockupworth/Hadrian's Wall, and the henge monument

Site	Structure	Context	Laboratory code	Material	Bulk sample	Radiocarbon age (BP)	$\delta^{13}C$ (‰)	Calibrated date range (95% confidence)
Knockupworth	Hadrian's Wall	Primary Vallum ditch ***51050*** (turf ***51026***)	SUERC-42030	Sediment	51023	2183±26	-28.6	360-170 cal BC
		Recut Vallum ditch ***51051*** (fill ***51039***)	SUERC-43037	Sediment	51015	2121±29	-29.8	350-50 cal BC
Henge monument	-	Ditch ***200108*** (fill ***200107***)	SUERC-33917	Blackthorn-type (sp) charcoal	250002	9320±40	-27.3	8720-8450 cal BC
		Ditch ***200108*** (fill ***200106***)	SUERC-37827	Charred wheat (sp) grain	250001	560±35	-22.5	cal AD 1300-1440
			SUERC-37828	Hazel (*Corylus avellana*) charcoal	250001	905±35	-27.6	cal AD 1030-1210

Note: Results ordered by site, period, entity, and/or radiocarbon age

Table 399: Radiocarbon dates from Parcels 9, 21 North, 32, 41, and 42, Knockupworth/Hadrian's Wall, and the henge monument (cont'd)

Site	Structure	Context	Laboratory code	Radiocarbon age (BP)	Combine results	Combined calibrated date range (95% confidence)
Parcel 9	House 2	Posthole ***9003*** (fill ***9004***)	SUERC-32723	3205±35	Statistically consistent with good agreement (T′=0.69; T′(5%)=3.8; v=1; A_{comb}=106.0% (An=50.0%))	1500-1420 cal BC
			SUERC-42034	3165±26		
21 North	House 3	Posthole ***21390*** (fill ***21392***)	SUERC-42035	1186±25	Failed	-
			SUERC-42036	3765±26		
Parcel 32	-	Pit ***32004*** (fill ***32003***)	SUERC-42037	2861±23	Statistically consistent with good agreement (T′=0.05; T′(5%)=3.8; v=1; A_{comb}=125.8% (An=50.0%))	1110-940 cal BC
			SUERC-32726	2855±35		
Parcel 42	Building 5	Posthole ***42502*** (fill ***42501***)	SUERC-32734	1240±35	Statistically consistent with good agreement (T′=0.01; T′(5%)=3.8; v=1; A_{comb}=116.4% (An=50.0%))	cal AD 690-880
			SUERC-42038	1227±23		
	Building 2	Gully ***42274*** (fill ***42275***)	SUERC-42045	1183±26	Statistically consistent with good agreement (T′=0.01; T′(5%)=3.8; v=1; A_{comb}=101.8% (An=50.0%))	cal AD 770-890
			SUERC-42046	1227±26		
	Building 4	Posthole ***42410*** (fill ***42411***)	SUERC-32733	1190±35	Statistically consistent with good agreement (T′=0.08; T′(5%)=3.8; v=1; A_{comb}=115.3% (An=50.0%))	cal AD 770-890
			SUERC-42039	1178±25		
	-	Posthole ***42444*** (fill ***42445***)	SUERC-42040	236±25	Failed	-
			SUERC-42595	1194±29		
Henge		Ditch ***200108*** (fill ***200106***)	SUERC-37827	560±35	Statistically inconsistent with poor agreement (T′=43.49; T′(5%)=3.8; v=1; A_{comb}=0.0% (An=50.0%))	-
			SUERC-37828	905±35		

Note: Statistically consistent results are highlighted

Table 400: χ^2 tests on the duplicate radiocarbon assays from charcoal and charred plant samples, from identical features from Parcels 9, 21 North, 32, and 42, and the henge monument

Eleven samples were submitted for dating from Parcel 42. Of these, two were from separate hearths, associated with adjacent roundhouses (Houses 4 and 6), the dates indicating that these were part of a settlement dating to the middle centuries of the second millennium cal BC (*Ch 11*). The other samples were from three post-defined rectangular buildings (Buildings 2, 4, and 5; *Ch 14*), defining a small settlement, and a posthole (***42444***; *Ch 14*) from an associated fenceline. The three samples from Building 2, and two each from Buildings 4 and 5, indicate that all date to a similar period in the second half of the first millennium cal AD. One of the two samples from fence posthole ***42444*** also produced a comparable early medieval date to the adjacent buildings, whilst the second was of post-medieval/modern date, suggesting it was intrusive.

Two sediment samples from Knockupworth/Hadrian's Wall, from the Vallum ditch, both returned Late Iron Age dates, spanning the last four centuries of the first millennium cal BC. One dated the formation of a laminated turf block, probably cut in the early AD 120s to be used in the construction of the Turf Wall element of Hadrian's Wall (*Ch 13*); this had subsequently been dumped into the primary Vallum ditch, most probably during the early AD 140s, when the Turf Wall was slighted (*Ch 13*). The second sample was from the recut Vallum ditch, and thus seems to date residual Late Iron Age organic material that had become incorporated into this (*Ch 13*).

One of the three samples from the ditch of the henge monument, partially excavated during a watching brief (*Ch 10*), returned a Mesolithic date, spanning the middle centuries of the ninth millennium cal BC, making it the earliest dated material from CNDR (*Ch 3*). The other samples returned later medieval dates. On the strength of these, it appears that the ditch of the prehistoric monument gradually filled with soil during this period, probably as a consequence of nearby ploughing/cultivation (*Ch 14*).

Specific radiocarbon assays from Parcels 9, 21 North, 32, and 42, and the henge monument were also subjected to χ^2 testing (Table 400). This initially focused on the duplicate assays obtained from identical features from these sites, but χ^2 testing was then used to consider those assays from different structures at Parcel 42, to determine if any were potentially contemporary.

The duplicate assays which were statistically consistent comprised the two (SUERC-32723 and SUERC-42034) from material contained in a posthole (***9003***) in House 2 in Parcel 9 (*Ch 11*). When combined, these suggest that this house might date to 1500-1420 cal BC. At Parcel 32, the two assays (SUERC-42037 and SUERC-32726) from pit ***32004*** (*Ch 11*) are also statistically consistent, providing a combined date of 1110-940 cal BC for the filling of this feature. Similarly, at Parcel 42, the duplicate dates from posthole ***42502*** (Building 5; SUERC-32734 and SUERC-42038; *Ch 14*), gully ***42274*** (Building 2; SUERC-42045 and SUERC-42046; *Ch 14*), and posthole ***42410*** (Building 4; SUERC-32733 and SUERC-42039; *Ch 14*) are all statistically consistent.

It is evident that the two radiocarbon assays from Bronze Age Houses 4 and 6 in Parcel 42, were statistically consistent (Table 401). This suggests that the houses could be of the same actual age (1500-1410 cal BC) and thus were contemporary structures (*Ch 11*).

When the intrusive date (SUERC-42040; *above*) is omitted, all of the dates from the early medieval settlement are statistically consistent. Indeed, the consistency of the results indicates that all of the dated buildings (2, 4, and 5), and also the fenceline (incorporating posthole ***42444***), could be of the same actual age (cal AD 770-880), or represent an

Site	Structure/ feature	Radiocarbon assay	Radiocarbon age (BP)	Combined results	Combined calibrated date range (95% confidence)
Parcel 42 (Bronze Age settlement)	House 4	SUERC-32728	3210±35	Statistically consistent with good agreement (T'=2.64; T'(5%)=3.8; =1; Acomb=70.7% (An=50.0%))	1500-1410 cal BC
	House 6	SUERC-32732	3125±35		
Parcel 42 (early medieval settlement)	Building 5	SUERC-32734	1240±35	Statistically consistent with good agreement (T'=9.36; T'(5%)=14.1; =7; Acomb=51.8% (An=25.0%))	cal AD 770-880
		SUERC-42038	1227±23		
	Building 2	SUERC-42046	1227±26		
		SUERC-42045	1183±26		
		SUERC-42044	1137±23		
	Building 4	SUERC-32733	1190±35		
		SUERC-42039	1178±25		
	Posthole ***42444***	SUERC-42595	1194±29		

Table 401: Statistically consistent dates from the Bronze Age and early medieval settlements in Parcel 42

archaeological phase that occurred over a relatively limited time.

Dendrochronology and Radiocarbon Wiggle-matching

Dendrochronology

I Tyers

Large quantities of waterlogged wood were uncovered by the open-area excavation of the *Principal palaeochannel* at Stainton West, in the organic deposits and also in some of the alluvium that had accumulated within this feature (*Appendix 13*). Given the presence of this material and its significance for dating the site's stratigraphy, a programme of dendrochronological dating was instigated.

Methodology

During the fieldwork, 72 timbers were sampled for dendrochronology, which were subsequently taken to OA's office in Lancaster for initial examination. The dendrochronological material was stored as complete cross-sections, wrapped in plastic. It is assumed, in the absence of other information, that these sections were obtained from the optimum location for sapwood and bark survival from the timber. Although the material included some circular discs, most of the sections were more or less sub-circular, depending on the amount of the trunk that had been lost through exposure, or poor waterlogging. The slices also included some fairly asymmetric material. Where possible, each of these timbers was assessed for the wood type, the number of rings it contained, and whether the sequence of ring widths could be reliably resolved. For dendrochronological analysis, samples usually need to be oak (*Quercus* sp; Table 402), to contain 50 or more annual rings, and the sequence needs to be free of aberrant anatomical features, such as those caused by physical damage to the tree whilst it was still alive (English Heritage 1998). Each slice was then sub-sampled to recover a single sample containing the maximum surviving radius of the parent tree.

Following the initial examination, 53 oaks were selected that were deemed suitable for dendrochronological analysis. These samples were brought to the laboratory and were then frozen to consolidate the timbers. The sequence of ring widths in each sample was revealed by preparing a surface equivalent to the original horizontal plane of the parent tree, with a variety of bladed tools, the width of each successive annual-growth ring being revealed. Standard dendrochronological analysis methods were applied to each suitable sample (*cf* English Heritage 1998). After thawing, the complete sequences of growth rings in the samples containing resolvable sequences were measured to an accuracy of 0.01 mm, using a micro-computer-based travelling stage (Tyers 2004). The sequence of ring widths was then plotted onto semi-log graph paper to enable visual comparisons to be made between sequences. In addition, cross-correlation algorithms (*cf* Baillie and Pilcher 1973) were employed to search for positions where the ring sequences were highly correlated (Tyers 2004). Highly correlated positions were checked using the graphs and, if any of these were satisfactory, new composite sequences were constructed from the synchronised sequences.

The *t*-values (a measure of the strength of the correlations) 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.

The sequences obtained from the suitable slices were compared with each other and any found to cross-match were combined to form a composite sequence. These, and any remaining unmatched sample sequences, were tested against a range of reference chronologies, using the same matching criteria: high *t*-values; replicated values against a range of chronologies at the same position; and satisfactory visual matching. Where such positions are found, these provide calendar dates for the ring-sequence.

The tree-ring dates produced by this process initially only date the rings present in the timber, the interpretation of these dates relying upon the nature of the final rings in the sequence. If the sample ends in the heartwood of the original tree, a *terminus post quem* for the death of the tree is indicated by the date of the last ring, plus the addition of the minimum expected number of missing sapwood rings. This *terminus post quem* may be many decades prior to the actual date that the tree died. Where some of the outer sapwood or the heartwood/sapwood boundary survives on the sample, a date range for the death of the tree could theoretically be calculated by using the maximum and minimum number of sapwood rings likely to have been present. For prehistoric material, the sapwood estimates used are a minimum of ten and maximum of 55 annual rings, where these figures indicate the 95% confidence limits of the range (Tyers 1998). Prehistoric bog-oaks often include samples with unusually large numbers of sapwood rings; potentially this is an oak physiological response to either rising water levels, or perhaps to saltwater egress, and given this, some caution is necessary when applying standard sapwood estimates to this material. For the dated samples

Stratigraphic unit	Bay/context	Wood number	Sample number	Rings	Sapwood	Average growth rate (mm)	Date of measured sequence	Interpreted result
Mesolithic organic deposit	Bay V; deposit ***71092***	**76465**	71134	53+? *+61*	-	1.67+0.82	Undated	-
	Bay W; deposit ***71134***	**76426**	71153	207	-	1.06	Undated	Matched to Cluster 1
		76430	71112	84	20+Bw	1.85	Undated	-
		76436	71113	71	H/S?	1.84	Undated	-
		76437	71114	80	-	2.01	Undated	Matched to Cluster 1
		76438	71115	56+? *+80*	-	2.04+ 0.71	Undated	-
		76441	71117	112	-	1.01	Undated	-
		76443	71119	70	-	0.85	Undated	-
		76448	71123	97+*10*	-	0.73	Undated	Matched to Cluster 1
		76454	71154	63	H/S?	2.27	Undated	Matched to Cluster 1
	Bay X; deposit ***71017***	**75869**	70147	73	-	0.94	Undated	Matched to Cluster 5
		76059	70183	64	-	1.37	Undated	Matched to Cluster 5
	Bay Y; deposit ***71020***	**76271**	71184	119	29+Bw	2.14	Undated	-
	Bay X/Y; deposit ***71020***	**76292**	71030	114	-	0.69	Undated	-
	Bay X; deposit ***71017***	**76422**	71086	90	H/S?	1.17	Undated	Matched to Cluster 5
	Bay X; deposit ***71028***	**76424**	71085	65	21+Bw	1.26	Undated	-
	Bay X; deposit ***71026***	**76425**	-	95	-	0.94	Undated	-
Mesolithic/Neolithic alluvium (Cluster 2)	Bay A; deposit ***70335***	**76065**	70479	298	21+Bw	0.83	4441-4144 BC	4144 BC winter
		76065	70480	295	28+Bw	0.74	4438-4144 BC	4144 BC winter
		76154	70481	137+*40*	-	0.67	4403-4267 BC	after 4217 BC
	Bay C; deposit ***70404***	**75648**	70113	245	H/S?	1.58	4466-4222 BC	4212-4167 BC?
	Bay D; deposit ***70318***	**76084**	70194	61	H/S?	1.71	4429-4369 BC	4359-14 BC?
	Bay E; deposit ***70410***	**75867**	70151	129	-	1.58	4459-4331 BC	after 4321 BC
		75868	70159	99+*20*	H/S	0.79	4452-4354 BC	4324-4279 BC
		75883	70155	99+*30*	-	1.13	4385-4287 BC	after 4247 BC
	Bay F; deposit ***70324***	**76014**	70171	183	-	1.21	4466-4284 BC	after 4274 BC
	Bay F/G; deposit ***70324***	**76220**	70458	135	32+B	0.72	4421-4287 BC	4287 BC

*Table 402: The 47 measurable oak (*Quercus *sp) dendrochronological samples from Stainton West*

Stratigraphic unit	Bay/context	Wood number	Sample number	Rings	Sapwood	Average growth rate (mm)	Date of measured sequence	Interpreted result
Mesolithic/Neolithic alluvium (Cluster 2)	Bay H; deposit ***70384***	**75729**	70132	134	-	1.30	4393-4260 BC	after 4250 BC
	Bay O; deposit ***70504***	**76508**	70517	74+*40*	-	0.82	4349-4276 BC	after 4226 BC
		76509	70518	125	H/S?	1.30	4416-4292 BC	4282-37 BC?
		76514	70523	135	H/S?	0.73	4427-4293 BC	4283-38 BC?
	Bay Y; deposit ***70384***	**76380**	71035	176	6	0.71	4409-4234 BC	4230–4185 BC
	Bay X; deposit ***70410***	**76237**	71084	83	H/S	0.70	4447-4365 BC	4355-10 BC
Earlier Neolithic organic deposit	Bay A; deposit ***70353***	**76118**	-	159	-	0.75	Undated	Matched to Cluster 3
		76155	70482	104	28+B	0.45	Undated	-
	Bay B; deposit ***70308***	**75931**	70160	61	-	2.50	Undated	-
	Bay C; deposit ***70403***	**75544**	-	140	H/S?	0.79	Undated	-
	Bay D; deposit ***70315***	**75889**	70195	70	10	1.44	Undated	-
	Bay E; deposit ***70409***	**76047**	70176	72	H/S?	1.40	Undated	-
	Bay O; deposit ***70498***	**76511**	70520	59	8	1.61	Undated	-
		76503	-	184	-	0.62	Undated	Matched to Cluster 3
Earlier Neolithic organic deposit; these samples are from stakes driven into this unit from a higher level	Bay G; deposit ***70424***	**75854**	70144	150	H/S+*30s*	0.83	Undated	Matched to Cluster 4
		76239	-	149	-	0.58	Undated	Matched to Cluster 4
Later Neolithic organic deposit	Bay B; deposit ***70307***	**75290**	70080	95	20+Bw	2.51	Undated	-
		75300	70081	104	21	0.71	Undated	-
	Bay D; deposit ***70314***	**75527**	70108	59	H/S?	1.22	Undated	-
		75853	-	60	6	1.62	Undated	-

Key: +Bw complete outermost ring, winter/early spring felled/died; +B bark-edge season felling/death indistinguishable; H/S heartwood/sapwood boundary; H/S? possible heartwood/sapwood boundary. Figures italicised in the Rings column (*eg +40*) indicate estimated minimum additional unmeasured heartwood rings. Figures italicised in the sapwood column (*eg +30s*) indicate additional unmeasured sapwood rings (Wood numbers **76438** and **76465** were measured in two sections, with an unknown number of rings between)

*Table 402: The 47 measurable oak (*Quercus *sp) dendrochronological samples from Stainton West (cont'd)*

where the bark edge survived intact, a precise date for the demise of the tree can be directly identified from the date of the last surviving ring. The tree-ring sequences often showed exceptional and unusual variations of growth rate; as a result, little attempt has been made to classify the last ring under the bark to a specific season, particularly amongst the slowest-growing material, as this was considered unsound with these samples.

Results

After the preparation of the 53 selected samples, it was determined that 47 contained measurable sequences (Table 402). Compared with most archaeological assemblages, the material was unusually slow grown and clearly from a relatively stressed environment. For example, many samples contained sections with aberrantly narrow growth, several contained repeated series of narrow-growth bands, and two contained two measurable sections separated by an unmeasurable band. The 47 samples were each measured successfully, yielding 49 separate tree-ring series.

The analysis of the samples indicated that 27 of the samples formed five separate groups, or clusters (Clusters 1-5), that cross-matched each other. One of these (Cluster 2) could be matched with existing prehistoric tree-ring data, whilst the others, although initially undated, were later subjected to radiocarbon wiggle-matching. In contrast, the remaining 20 samples produced tree-ring sequences that do not match the cluster groups, each other, or reference data, and are currently undated.

Wood number	76437	76448	76454
76426	6.12	5.68	4.75
76437		4.06	7.65
76448			4.01

Table 403: The t-values (Baillie and Pilcher 1973) between the four matched samples forming Cluster 1

Cluster 1 comprised four samples (Table 403; Fig 668) derived from wood at the base of the *Principal palaeochannel*. These were contained within the *Mesolithic organic deposit* (*'Mesolithic organic deposit I'* phase), and included one timber (**76437**) that had evidence for beaver modification (*Appendix 13*), perhaps forming an element of the beaver dam (*Ch 3*).

Cluster 2 formed the largest of the clusters (Table 404), comprising 16 samples, including those from the longest-lived trees at the site, and came from timbers within the *Mesolithic/Neolithic alluvium* (*'Mesolithic/Neolithic alluvium II'* phase; Table 402; *Ch 6*). Importantly, this cluster was matched with prehistoric tree-ring data, from the North West and elsewhere in the British Isles, at 4466-4144 BC inclusive (Table 405; Fig 669). Although most of these timbers did not exhibit evidence for cultural modification, two tapered examples were identified (**76065** and **76237**) that might be tentatively associated with intentional tree felling (*Appendix 13*). However, neither exhibited toolmarks and it is likely that their tapered form was a result of natural degradation.

The two Cluster 3 samples were associated with the *Earlier Neolithic organic deposit* (*'Early Neolithic I'* phase; Table 406; Fig 670; *Ch 8*). Both represented modified wood, in the form of a fragment of timber debris (**76503**) and a finished timber (**76118**; *Appendix 13*), which were probably derived from two contemporaneous trees.

Although the two Cluster 4 samples (**76239** and **75854**; Table 407; Fig 671) were recovered from the *Earlier Neolithic organic deposit*, they were two vertical timbers which had been driven into this deposit from a higher level. As such, they were associated with later activity within the channel (*'Late Neolithic'* phase; *Ch 10*). These timbers may have been derived from a pair of contemporaneous trees, and one (**76239**) had been modified at one end (*Appendix 13*).

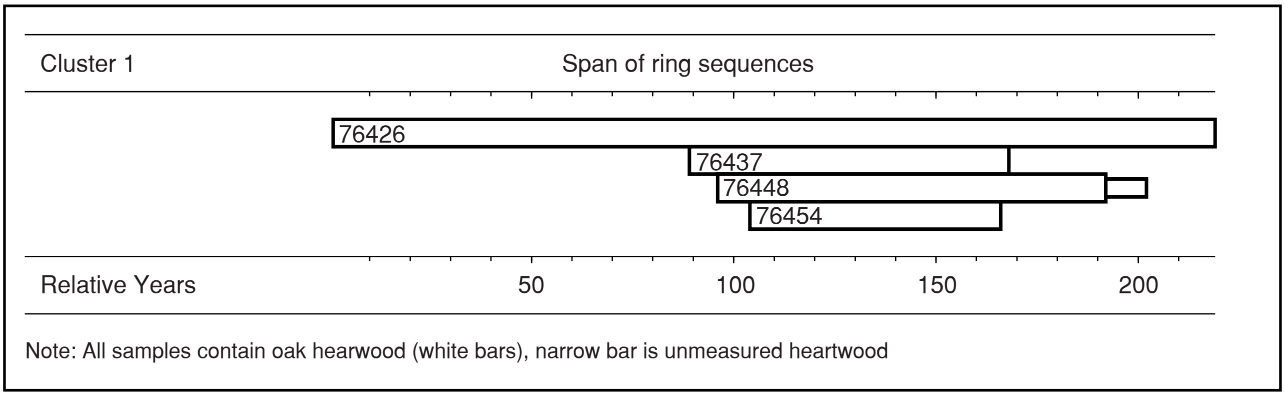


Figure 668: The dating positions of the four tree-ring samples from Cluster 1

Wood number	**75729**	**75867**	**75868**	**75883**	**76014**	**76065 (Sample 70479)**	**76065 (Sample 70480)**	**76084**	**76154**	**76220**	**76237**	**76380**	**76508**	**76509**	**76514**
75648	-	5.90	4.90	3.38	3.84	6.74	5.45	3.82	6.06	6.43	3.34	4.03	4.47	7.97	3.41
75729		4.53	4.64	4.48	4.26	5.98	5.50	-	4.19	4.44	-	7.58	6.18	5.59	3.44
75867			7.92	4.52	5.26	7.14	8.00	7.43	4.55	7.35	6.23	3.26	-	8.86	5.07
75868				-	3.42	5.30	6.52	7.43	3.57	6.13	8.08	-	\	5.39	3.83
75883					9.16	5.28	5.87	-	5.79	3.90	-	3.32	5.25	4.94	3.51
76014						5.88	4.68	5.77	3.33	4.98	-	-	4.17	6.38	-
76065 (Sample 70479)							*11.20*	5.43	6.88	5.66	4.19	4.54	3.28	6.08	4.85
76065 (Sample 70480)								5.55	6.53	4.69	4.69	4.47	4.40	6.07	4.41
76084									3.04	9.22	6.08	-	\	4.78	4.76
76154										5.42	-	4.18	4.99	7.41	3.86
76220											6.54	5.25	3.58	7.27	5.96
76237												-	\	4.32	3.60
76380													4.15	5.57	-
76508														4.74	-
76509															3.30

Note: These were combined for use in Table 405. Italicised value indicates the same tree

Table 404: The t-values between the 16 matched and dated samples forming Cluster 2

	Cluster 2 (16 samples) 4466-4144 BC
England prehistoric composite (J Hillam *pers comm*)	6.26
Lancashire, Ashton Lane (Brown and Baillie 1992)	6.67
Lancashire, Balls Farm (Brown and Baillie 1992)	4.38
Somerset, Meare heath bog-oak 4 (R A Morgan *pers comm*)	4.26
Belfast Long Chronology (Brown *et al* 1986)	5.91
Antrim, Garry Bog 3 (Baillie and Brown 1988)	5.61

Note: These are not fully independent series as the England composite includes the Lancashire and Somerset material, as well as other series, and the Belfast composite includes Garry Bog as well as other series

Table 405: Example of t-values between the composite sequence constructed from Cluster 2 and oak-reference data

Wood number	**76503**
76118	7.21

Table 406: The t-value between the two matched samples forming Cluster 3

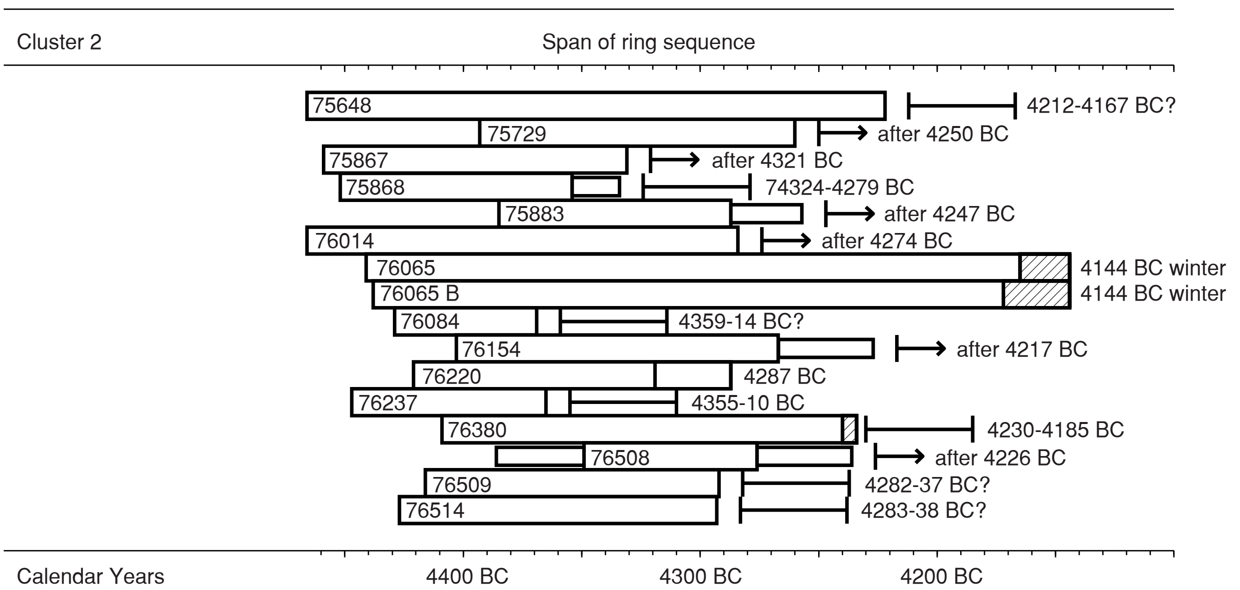
Cluster 5 comprised three samples (Fig 672), recovered from timbers associated with the *Mesolithic organic deposit*. However, in contrast to Cluster 1 (*above*), these timbers were not from the base of the channel, but instead were at a higher level within this stratigraphic unit (*'Mesolithic organic deposit II'* phase; *Ch 3*). The samples were derived from two unmodified pieces of timber (**76059** and **75869**), and a third piece (**76422**) that exhibited evidence of possible woodworking (*Appendix 13*). It appears that two of these timbers (**75869** and **76422**) were from the same tree (Table 408).

Radiocarbon wiggle-matching

C Tyers, G Cook, P Reimer, P Marshall, and S Griffiths

Dendrochronological analysis identified four undated tree-ring clusters (Clusters 1 and 3-5), which were associated with both Mesolithic and Neolithic stratigraphic units (*above*). Given their context, it was anticipated that, if dated, they would form valuable additions to the English dendrochronological sequence. In addition, as prior to the dating of these clusters the end of the English tree-ring chronology lay at 4989 BC (*cf* Hillam *et al* 1990), it was also felt that they might help to extend this chronology back into the sixth millennium BC.

Because of the potential of the undated clusters, English Heritage (now Historic England) funded a programme of radiocarbon wiggle-matching, to provide an indication of their age, and a clear framework for future dendrochronological work. More generally, this technique involves matching a series of radiocarbon determinations, which are separated by a known number of years, to the shape of the radiocarbon calibration curve. At its simplest, this can be done visually, although statistical methods



Note: Hatched bars are sapwood, narrow bars are unmeasured rings, interpretation of death of trees based on 10-55 year sapwood estimate

Figure 669: The dating positions of the 16 dated tree-ring samples from Cluster 2, and their interpretations

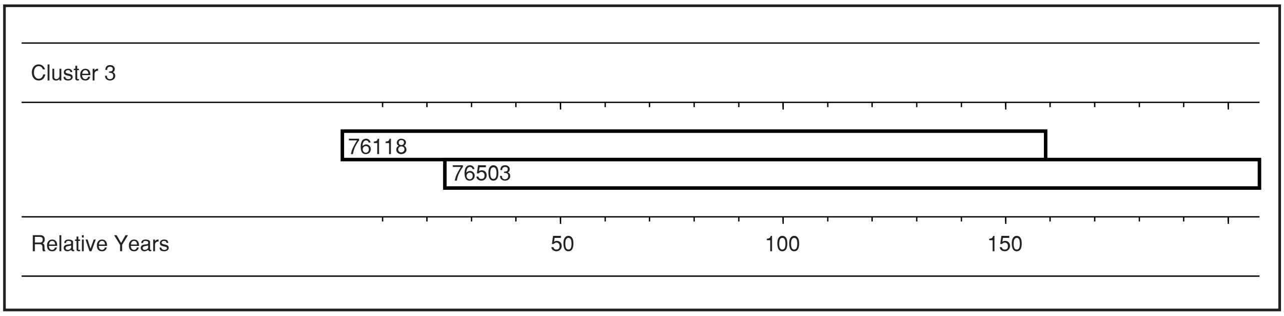


Figure 670: The dating positions of the two tree-ring samples from Cluster 3

Wood number	76239
75854	6.66

Table 407: The t-value between the two matched samples forming Cluster 4

are usually employed. Floating tree-ring sequences are particularly suited to this approach, as the calendar age separation of different blocks of wood submitted for dating is known precisely by counting the rings in the timber. An excellent summary of the history and variety of approaches employed for wiggle-matching is provided by Galimberti *et al* (2004).

Methodology and calibration

In total, 24 samples were extracted from the four, floating, tree-ring sequences, with six deriving from an unmodified timber (**76426**) in Cluster 1, which was originally discovered propping the beaver dam (*Ch 3*); six from a fragment of timber debris (**76503**) from Cluster 3; seven from a vertically driven timber (**75854**) in Cluster 4; and five from a modified timber (**76422**) in

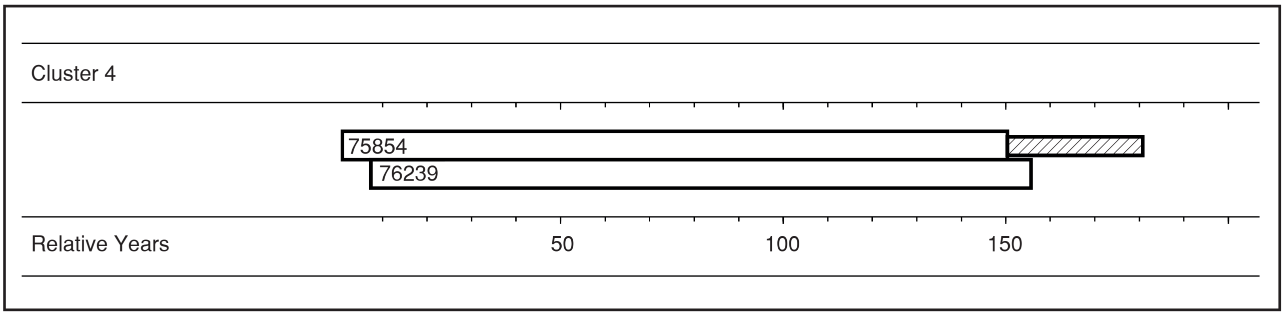


Figure 671: The dating positions of the two tree-ring samples from Cluster 4

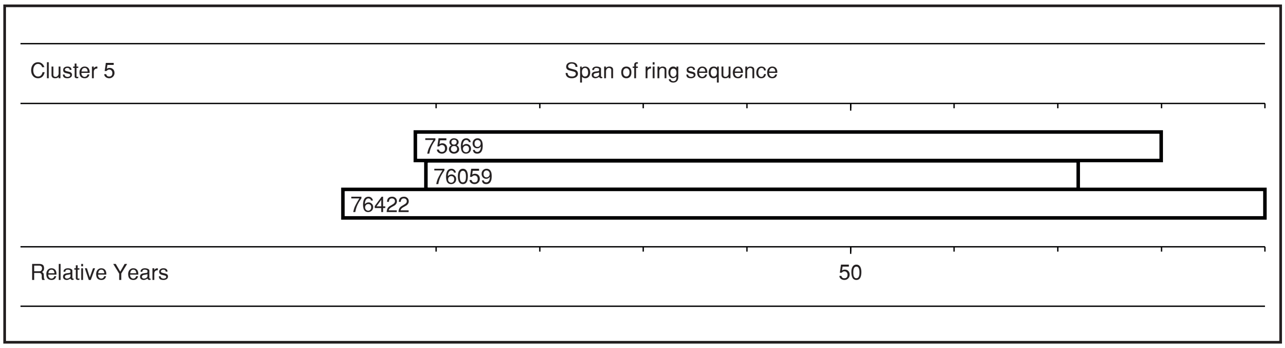


Figure 672: The dating positions of the three tree-ring samples from Cluster 5

Wood number	76059	76422
75869	6.83	*11.32*
76059		7.99

Note: Italicised value indicates the same tree

Table 408: The t-values between the three matched samples forming Cluster 5

Cluster 5. The majority of these samples represented decadal blocks of tree-rings, separated by at least ten rings, although the outermost part of an unmeasurable band of sapwood was also sampled from timber **75854**. Following extraction, the samples were subjected to radiocarbon dating, with 12 being dated at SUERC, following the methodology previously outlined for the dating of the organic remains and sediments.

The 12 other samples were, however, dated at Queen's University Belfast (QUB), and were accordingly assigned a 'UBA-' laboratory code. These samples were processed using an acid-alkali-acid pretreatment, as outlined in De Vries and Barendsen (1952). The pretreated and dried samples were placed in quartz tubes with a strip of silver ribbon to remove nitrates, chlorides, and copper oxide (CuO), and were then sealed under vacuum and combusted to CO_2 overnight at 850°C. The CO_2 was converted to graphite on an iron catalyst using the zinc reduction method (Vogel *et al* 1984). The graphite samples were analysed with a 0.5MeV NEC pelletron compact accelerator, with the $^{14}C/^{12}C$ ratios corrected for fractionation using the online measured $^{13}C/^{12}C$ ratio and in accordance with Stuiver and Polach (1977).

The QUB laboratory participates in international inter-comparisons (Scott 2003; Scott *et al* 2010), as do SUERC, and maintains quality-assurance procedures, which provide assurances on the precision of the assays. Following dating at both SUERC and QUB the results were then calibrated (Table 409), in line with the methodology and procedures previously detailed.

Laboratory code	Sample	Material	Radiocarbon age (BP)	$d^{13}C$ (‰)	Calibrated date range (95% confidence)
Cluster 1 – 76426 (unmodified timber)					
SUERC-44835	Block A	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 1-10	6936±33	-26.0	5900-5730 cal BC
UBA-22275	Block B	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 41-50	6849±42	-26.5	5840-5650 cal BC
SUERC-44836	Block C	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 91-100	6767±33	-26.6	5720-5620 cal BC
UBA-22276	Block D	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 131-40	6832±45	-26.3	5810-5630 cal BC
SUERC-44837	Block E	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 171-80	6624±33	-26.8	5630-5490 cal BC
UBA-22277	Block F	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 210-19	6593±44	-26.6	5620-5480 cal BC
Cluster 3 – 76503 (timber debris)					
SUERC-44844	Block M	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 1-10	5000±33	-28.7	3950-3690 cal BC
UBA-22280	Block N	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 31-40	5064±38	-28.6	3970-3770 cal BC
SUERC-44845	Block O	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 71-80	5078±33	-28.1	3960-3790 cal BC
UBA-22281	Block P	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 101-10	5040±47	-27.3	3960-3710 cal BC
SUERC-44846	Block Q	Waterlogged wood, oak (*Quercus* sp) heartwood rings 141-50	4927±33	-26.5	3780-3640 cal BC
UBA-22282	Block R	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 171-80	4957±44	-26.9	3930-3640 cal BC
Cluster 4 – 75854 (vertically driven timber)					
SUERC-44847	Block S	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 1-10	4301±33	-28.0	3020-2880 cal BC
UBA-22283	Block T	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 31-40	4373±49	-28.3	3320-2890 cal BC
SUERC-44848	Block U	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 61-70	4314±33	-26.3	3020-2880 cal BC
UBA-22284	Block V	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 91-100	4306±36	-27.2	3020-2880 cal BC
SUERC-44849	Block W	Waterlogged wood, oak (*Quercus* sp) heartwood, 116-25	4253±33	-27.0	2920-2700 cal BC

*Table 409: Radiocarbon results from timbers **76426**, **76503**, **75854**, and **76422**, obtained during the programme of wiggle-matching*

Laboratory code	Sample	Material	Radiocarbon age (BP)	d13C (‰)	Calibrated date range (95% confidence)
UBA-22285	Block X	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 141-50	4112±37	-27.5	2880-2570 cal BC
UBA-22286	Outermost part of the unmeasurable band of sapwood	Waterlogged wood, oak (*Quercus* sp) sapwood	4119±37	-27.4	2880-2570 cal BC
Cluster 5 – 76422 (modified timber)					
SUERC-44838	Block G	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 1-10	5959±33	-25.6	4940-4730 cal BC
UBA-22278	Block H	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 21-30	6029±38	-25.3	5030-4800 cal BC
SUERC-44839	Block I	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 41-50	5975±33	-25.0	4960-4770 cal BC
UBA-22279	Block J	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 61-70	5993±41	-25.6	5000-4780 cal BC
SUERC-44840	Block K	Waterlogged wood, oak (*Quercus* sp) heartwood, rings 81-90	5999±33	-25.5	4990-4790 cal BC

*Table 409: Radiocarbon results from timbers **76426**, **76503**, **75854**, and **76422**, obtained during the programme of wiggle-matching (cont'd)*

Radiocarbon wiggle-matching
Wiggle-matching the radiocarbon measurements from each sequence was undertaken by combining the radiocarbon dates with the calendar interval between the dated tree-rings known from dendrochronology. This was undertaken using the Bayesian approach to wiggle-matching first described by Christen and Litton (1995), implemented using OxCal v4.3.2 (Bronk Ramsey 2009) and the IntCal13 atmospheric calibration data for the northern hemisphere (Reimer *et al* 2013). The posterior-density estimates derived from this Bayesian modelling are, by convention, quoted in italics, and the results are depicted graphically, each distribution representing the relative probability that an event occurred at a particular time. For each of the dates, two distributions have been plotted: one in outline, which is the result of simple radiocarbon calibration, and one solid, based on the wiggle-match sequence. Distributions other than those relating to particular samples correspond to aspects of the model. For example, the distribution 'ring_219' is the estimated date of the final ring of this timber. The large square brackets down the left-hand side of the figures, along with the CQL2 keywords (Bronk Ramsey 2009), define the model exactly.

The model for timber **76426** from Cluster 1 (Fig 673) has good overall agreement (A_{comb}: 79.2%; An=28.9; Bronk Ramsey *et al* 2001), and estimates the final ring of the sequence, ring 219, to have been formed

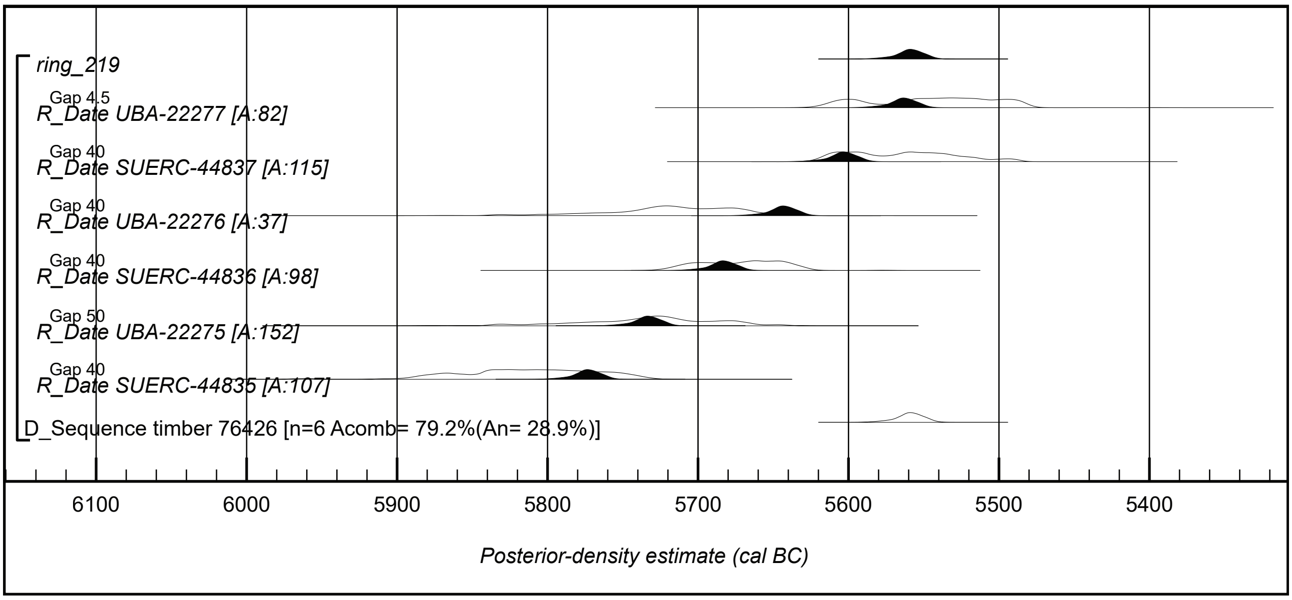


*Figure 673: Probability distributions of dates from timber **76426***

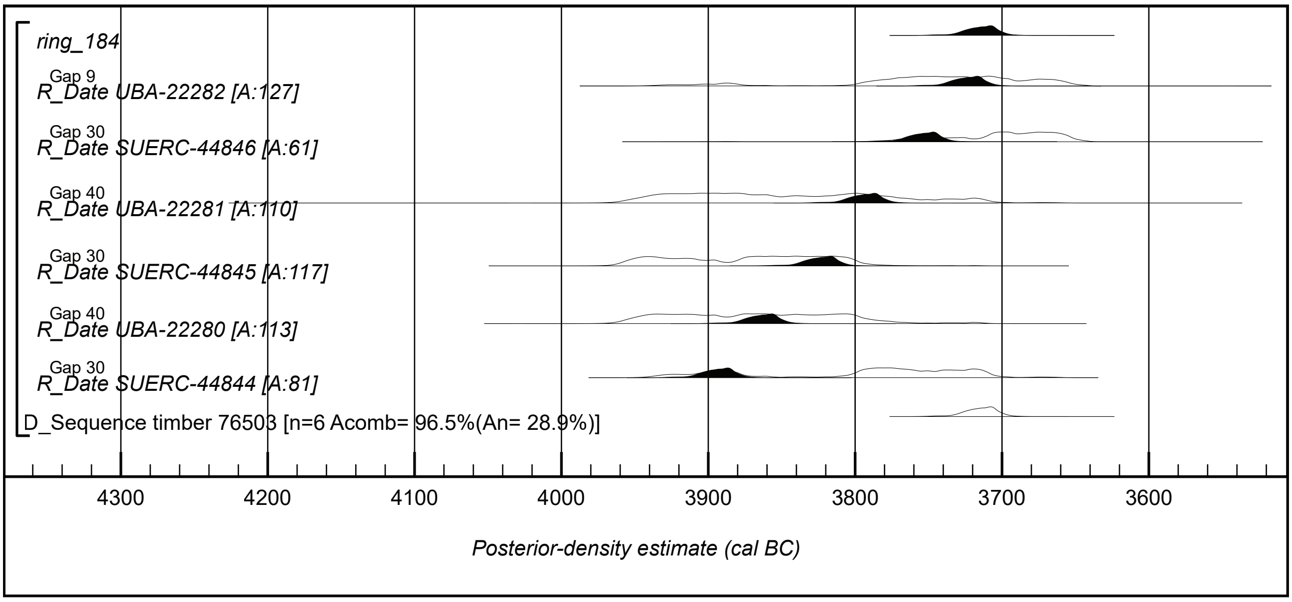


Figure 674: Probability distributions of dates from timber **76503**

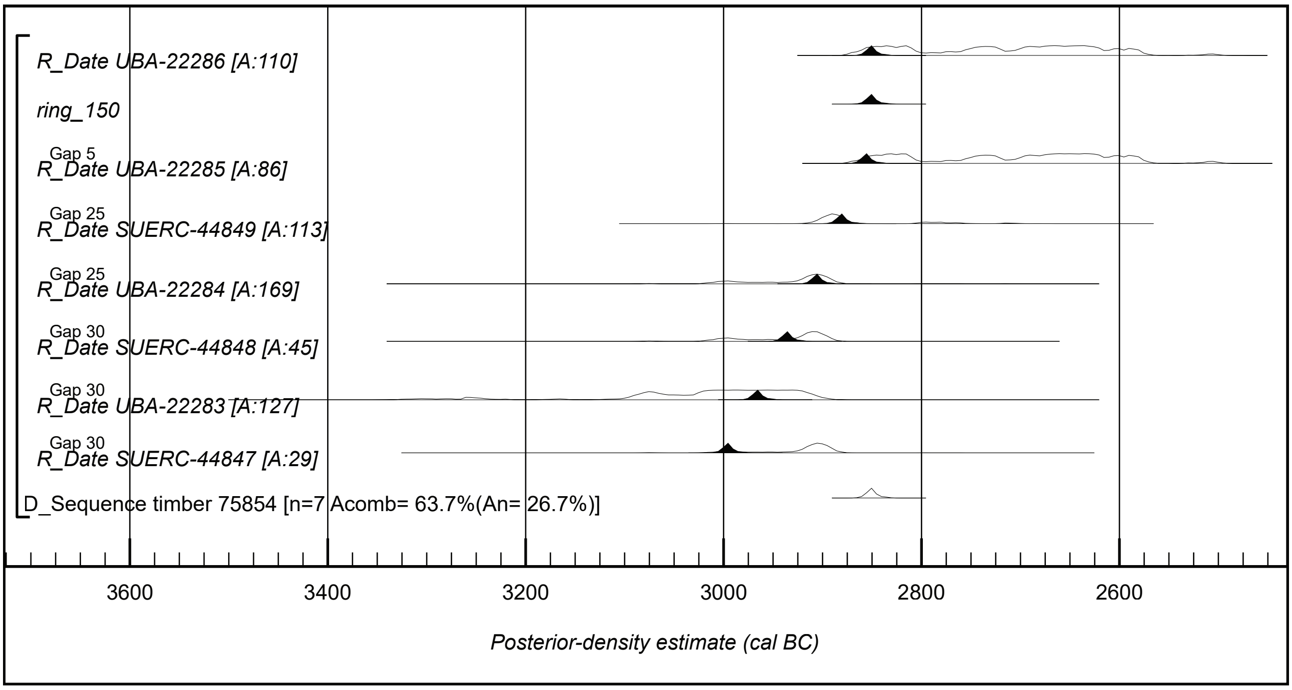


Figure 675: Probability distributions of dates from timber **75854**

in *5585-5540* cal *BC* (*95% probability*; *ring_219*). The model for timber **76503** from Cluster 3 (Fig 674), also has good overall agreement (A_{comb}: 96.5; An=28.9; *ibid*). It estimates the final ring of the sequence to have been formed in *3745-3690* cal *BC* (*95% probability*; *ring_184*).

The model for timber **75854** from Cluster 4 (Fig 675) again has good overall agreement (A_{comb}: 63.7; An=26.7; *ibid*), and estimates the final ring of the sequence (ring 150) to have been formed in *2865-2835* cal *BC* (*95% probability*; *ring_150*). Timber **75854** has also been tentatively matched with prehistoric tree-ring data and a last date for ring 150 of 2868 BC is suggested. The Highest Posterior-density interval for this distribution, at 99% probability, is *2870-2825* cal *BC* (Fig 676), compatible with the date suggested by the tree-ring analysis. Finally, the model for timber **76422** (Fig 677) from Cluster 5 also has good overall agreement (A_{comb}: 89.8; An=31.6; *ibid*), and estimates the final ring of the sequence to have been formed in *4865-4780* cal *BC* (*95% probability*; *ring_90*).

Discussion

I Tyers, C Tyers, and P Marshall

The stratigraphy and taphonomy of the assemblage are complex, and it was always possible that no useful

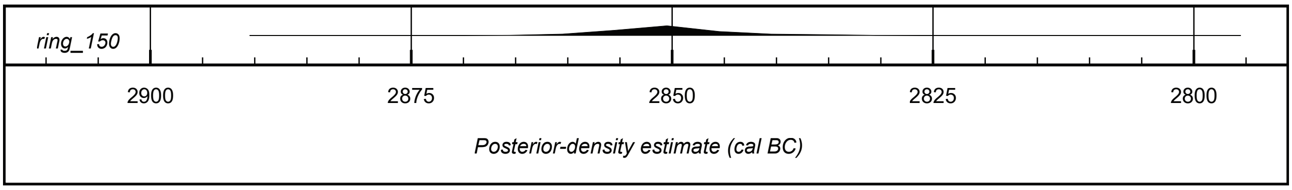


Figure 676: Probability distributions of the last measured ring (150) from timber **75854**

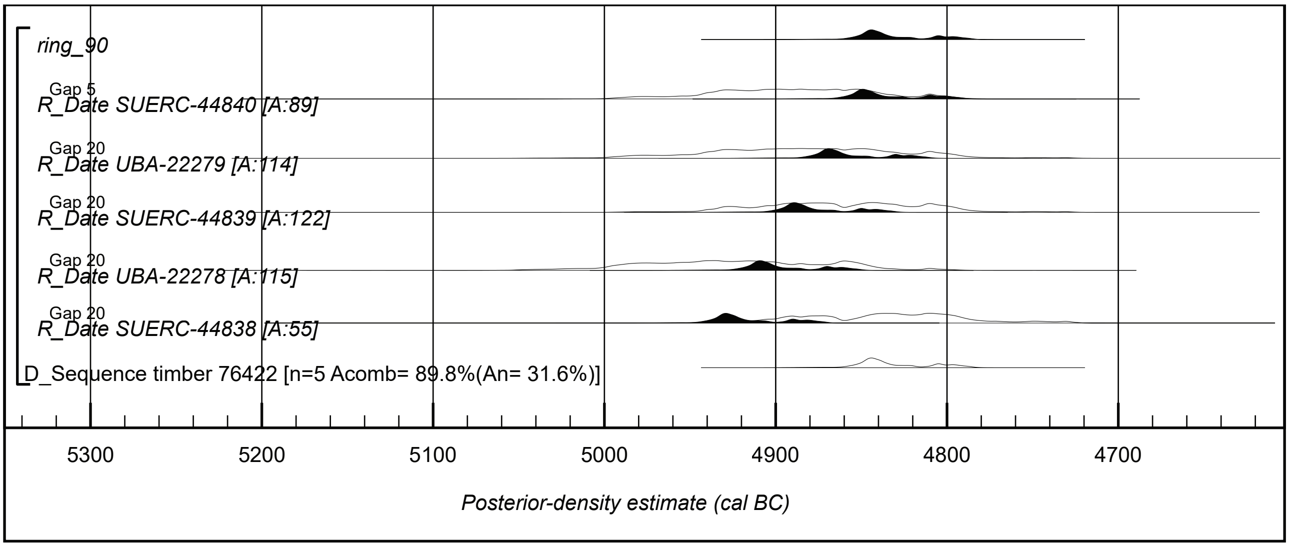


Figure 677: Probability distributions of dates from timber **76422**

data would have been generated through tree-ring analysis. For instance, the distance in time, the relative lack of available reference data from north-west England, and the relatively small numbers of timbers with more than 200 rings could all have resulted in a complete failure to produce useful information by tree-ring methods. On the other hand, it was also possible, if less likely, that the samples could have been derived from a single accumulation event, from a very small number of trees, and they might have all matched together and yielded a single group, that could have been dated.

At Stainton West, there were probably only certain conjunctions of conditions when oak trees could grow where those trees might survive to the present through waterlogging. These events could have been periodic, possibly environmentally driven, and this may be the reason for the apparent discontinuous clustering of the tree-ring data. It seems reasonable to assume that the timbers were from an area of natural woodland on the River Eden floodplain, which was thus subject to fluctuating watertables, and intermittent flooding events. In this scenario, the anatomical features in the material would reflect the trees' responses to this environment, and would not reflect anthropogenic interference.

The dates for the sequences identify the period during which these trees occupied these areas, and the end of the sequence identifies the date of death of some of the trees, and the earliest possible date of death of the rest of them. In woodlands where significant cultural modification is unlikely, such step-wise growth-rate changes, as are evident within some of the Stainton West timbers, were probably caused by changes in drainage conditions, creating increased stress on these trees. Moreover, the frequency of such anomalies in the timbers is quite unlike the frequency seen for such features in timber derived from semi-natural or managed woodland.

The major result from the analysis is that about a half of the analysed assemblage is broadly coeval (Cluster 2), and dates from the second half of the fifth millennium BC. Several different trees clearly died, or were felled by natural or unnatural events, during about 200 years of this period. This cluster is contemporaneous with periods of bog-oak growth and preservation from sites in Lancashire, East Anglia, Somerset, and Northern Ireland (Table 405). Bog-oaks of course have an equally complex taphonomy that may also be environmentally driven, since they also have to be able to have grown for long periods in an environment that was subsequently wet enough to preserve them.

Cluster 2 (Fig 669) shows a steady drop in the numbers of samples as the sequence progresses. Such a steady, not step-wise, pattern is more typical of bar diagrams derived from natural as opposed to construction assemblages (*cf* Baillie 1982). Hence, it is not clear whether the end dates (4287 BC and 4144 BC) for the two trees (three samples) which had bark-edges are 'felling dates' in the traditional archaeological sense, or dates of tree death relating to environmental events (such as trees falling into rivers, or flood accumulations). What is clear is that Cluster 2 represents a period of oak accumulation in the river channel, presumably from trees growing in the vicinity.

The trees in Cluster 3 were alive in the early part of the fourth millennium BC, those in Cluster 4 in the early part of the third millennium BC, whilst the trees in Cluster 5 are broadly contemporary with the earliest part of the English tree-ring chronology from Lancashire (4989-4165 BC; Brown and Baillie 1992; Hillam *et al* 1990) and are therefore important in bolstering the beginning of the sequence. The four timbers from Cluster 1 are also significant, in that they were alive in the first half of the sixth millennium BC and hence they may, in due course, contribute to the extension of the prehistoric English tree-ring chronology.

Chronological Modelling

S Griffiths, F Brown, and R A Gregory

Following the programme of scientific dating and stratigraphic analysis, chronological modelling was employed, which utilised the radiocarbon dates and, where pertinent, the chronometric data obtained from the dendrochronological analysis. The aim of this modelling was to produce more-robust chronologies for the Stainton West site, and also for those early medieval remains encountered at Parcel 42.

The modelling adopted a Bayesian approach (*cf* Buck *et al* 1996; Bayliss 2007; Bayliss *et al* 2007), which was performed using OxCal v4.3.2 (Bronk Ramsey 2009). As with the Bayesian modelling undertaken during the radiocarbon wiggle-matching, the outputs (posterior-density estimates) are quoted in italics, and modelled dates are at the 95% probability level, unless otherwise stated.

More specifically, Bayesian techniques were used in the construction of several chronological models. These included models that explored the chronology of the main stratigraphic units within the *Principal palaeochannel* at Stainton West; a model defining the overall site chronology at Stainton West; and a model defining the chronology of the Parcel 42 early medieval settlement.

In the output plots of these models, for each result two probability distributions were created. That in outline is the calibrated radiocarbon date, whilst the dark distribution represents the posterior-density estimate produced by the Bayesian statistical model. Within the plots, the brackets and OxCal Command Query Language keywords define the model exactly (*ibid*), whilst full details of the OxCal code are contained within the archive. Where appropriate, the agreement indices are also depicted on the respective model plots.

Stainton West: modelling prehistoric activity and palaeoenvironmental events

The Stainton West site produced several different chronological datasets, which could be used to date prehistoric anthropogenic activity and also the proxy record relating to environmental change. In addition, the scientific dates were from materials derived from both the *Principal palaeochannel* and the adjacent dryland areas; as such, it is possible to compare sequences from different parts of the site.

That said, the site did present several challenges for the establishment of robust chronological models. For example, in terms of the dryland areas, as a result of the absence of bone, and due to the fact that charred assemblages were not as numerous or rich as might have been expected, particularly given the evidence for repeated dense periods of occupation, it could be that anthropogenic activity at the site was not as precisely dated as one might wish. In addition, following the programme of dating, it was also clear that some of the dated charcoal and charred plant remains were intrusive or residual materials, which had been incorporated into tree-throws, hearths, and anthropogenic and natural surfaces. Fortunately, the stratigraphic associations of different features and associated assemblages of material culture have allowed many of these results to be archaeologically interpreted and situated with particular phases associated with the chronological model.

The same was true of some of the results from the *Principal palaeochannel*, which again, following dating, appeared to be intrusive or residual to particular parent units. Of course, this is not unique to Stainton West, as work on the taphonomy of radiocarbon samples in complex riverine or alluvial systems has demonstrated the issues associated with dating samples from alluvial deposits (*cf* Chiverrell *et al* 2009; 2010; Howard *et al* 2009; Chiverrell and Jakob 2012). However, these issues are normally associated with sites where relatively few scientific dating samples exist, and fortunately at Stainton West, the fairly extensive range of dated materials enabled the dates to be interpreted and a decision made as to whether they were included or excluded from the chronological model.

Sequences and phases

The *Principal palaeochannel* contained a sequence of well-defined organic and alluvial deposits that were initially grouped into distinct stratigraphic units. These were the *Mesolithic organic deposit*, Mesolithic-age alluvium (*Mesolithic alluvium* and *Mesolithic/Neolithic alluvium*), the *Earlier Neolithic organic deposit*, the *Earlier Neolithic alluvium*, the *Later Neolithic organic deposit*, the *Chalcolithic alluvium*, the *Bronze Age alluvium*, and the *Bronze Age/Iron Age alluvium* (*Ch 2*). During post-excavation analysis, these units/deposits were assigned to distinct OxCal phases, and some were also ordered into OxCal sequences (Fig 678). The construction of these sequences/phases was based on the consideration of formation processes, the stratigraphic sequence, and artefactual evidence (as outlined in the period-based chapters; *Chs 3, 4, 6, 8, 10,* and *11*, and the weight of the scientific-dating evidence. The sequences/phases comprise, in chronological and stratigraphical order, *'Mesolithic organic deposit I'*, *'Mesolithic organic deposit II'*, and *'Mesolithic/Neolithic alluvium I'*; these sub-phases were contained in the *'Lower palaeochannel'* phase and *'Early palaeochannel deposits'* sequence. Above these were the *'Mesolithic/Neolithic alluvium II'* phase; the *'Earliest Early Neolithic activity'*, *'Early Neolithic I'*, *'Early Neolithic II'*, *'Late Neolithic'*, and *'Burnt Mound 6'* sub-phases, nested in the *'Upper palaeochannel deposits'* phase and *'Late palaeochannel deposits'* sequence; and the *'Chalcolithic alluvium and reactivation channels'* phase. In addition, the *'Early Neolithic I'* phase also contained the *'Early Neolithic structures'* sequence, including the '*Wooden structures*' phase that also encompasses the *'Wooden Structure 1'* and *'Wooden Structure 2'* sub-phases. The direct dating evidence derived from the *Bronze Age alluvium* was insufficient to model (comprising only radiocarbon dates from sediment samples), whilst no scientific- dating evidence was obtained from the *Bronze Age/Iron Age alluvium* (*Ch 11*). Hence, no OxCal phases or sequences were created for these upper stratigraphic entities.

Significantly, the remains from the dryland areas adjacent to the palaeochannel could also be grouped into a series of distinct sequences/phases and sub-phases, based on artefactual and stratigraphical evidence, and the spatial patterning of lithic concentrations and associated features. Again, the full rationale which led to the construction of these sequences/phases is outlined in the period-based chapters (*Chs 3, 4, 6, 8, 10,* and *11*). Those dryland phases relevant to the Late Mesolithic occupation have been grouped under the *'Early activity'* sub-phase, which itself comprises the *'Earliest Mesolithic activity'* sub-phase; *'Mesolithic tree-throws/activity'* sub-phase; and the *'Mesolithic encampment I'* (and its sub-phases *'Hearth 90434'* and *'Tree-throw 90448'*) and *'Mesolithic encampment II'* sub-phases, associated with superimposed lithic scatters, which accordingly have been placed in the *'Mesolithic habitation'* sequence. All of these elements were sealed by a deposit that was

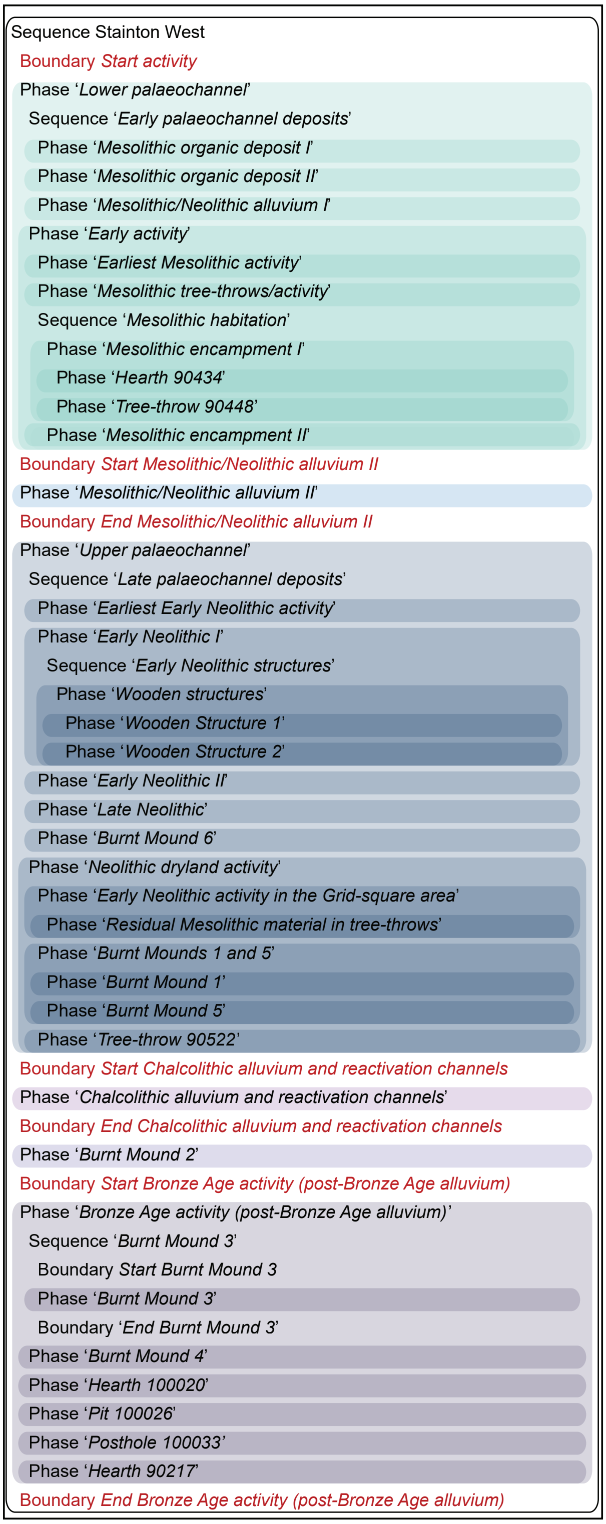


Figure 678: The structure of the OxCal chronological model for Stainton West

also found in the palaeochannel (associated with the *'Mesolithic/Neolithic alluvium II'*; *below*), and hence it was possible to nest these within the broader *'Lower palaeochannel'* phase (*above*).

Dates relevant to the earlier Neolithic activity at the site were placed in the *'Neolithic dryland activity'* phase, which itself comprised the sub-phases: *'Early Neolithic activity in the Grid-square area'* (including the sub-phase *'Residual Mesolithic material in tree-throws'*); *'Burnt Mounds 1 and 5'* (including the sub-phases *'Burnt Mound 1'* and *'Burnt Mound 5'*); and *'Tree-throw 90522'*. This was followed by the stratigraphically later *'Burnt Mound 2'* phase (*below*), which itself was followed by the stratigraphically later *'Bronze Age activity (post-Bronze Age alluvium)'* phase (*below*), which comprises the sub-phases: *'Burnt Mound 3'*; *'Burnt Mound 4'*; *'Hearth 100020'*; *'Pit 100026'*; *'Posthole 100033'*; and *'Hearth 90217'*.

Fortunately, in terms of relating the sequences and phases from the *Principal palaeochannel* and adjacent dryland areas, there are four identifiable deposits of alluvium that occurred both in the channel and across the dryland areas, which could be used to link the stratigraphy from these respective areas. The first of these were the contemporary deposits of *Mesolithic/Neolithic alluvium* in the *Principal palaeochannel*, and *Mesolithic overbank alluvium* beyond (in the *Grid-square area* and filling the *Backwater channe*l), which were all placed within the *'Mesolithic/Neolithic alluvium II'* phase. This phase could be seen to post-date the *'Mesolithic/Neolithic alluvium I'* phase in the *Principal palaeochannel*, and the *'Mesolithic encampment II'* phase in the *Grid-square area*, whilst it pre-dated the *'Earliest Early Neolithic activity'* phase in the palaeochannel and also the *'Early Neolithic activity in the grid-square area'* phase. Significantly, within the *Backwater channel*, this alluvial unit sealed tree-throws associated with the *'Mesolithic tree-throws/activity'* phase.

The *Chalcolithic alluvium* was another deposit which occurred in both the *Principal palaeochannel* and adjacent dryland areas. The *Chalcolithic alluvium* was probably contemporary with, or slightly preceded, a series of reactivation channels (grouped together as *'Chalcolithic alluvium and reactivation channels'* phase) and was stratigraphically later than the *'Burnt Mound 6'* phase, yet stratigraphically earlier than the *'Burnt Mound 2'* phase. It was also stratigraphically later than the *'Burnt Mounds 1 and 5'* phase.

The third 'linking' unit of alluvium, found in both the palaeochannel and dryland areas, was the *Bronze Age alluvium*. Within the channel, this sealed the *Chalcolithic alluvium* and was also stratigraphically later than *'Burnt Mound 2'*. Significantly, it was also stratigraphically earlier than *'Burnt Mound 3'* and *'Burnt Mound 4'*, as well as a series of Bronze Age features on either side of the channel. These comprised hearths ***100020*** and ***90217***, pit ***100026***, and posthole ***100033***, and, together with Burnt Mounds 3 and 4, formed elements of the *'Bronze Age activity (post-Bronze Age alluvium)'* phase (*above*).

The uppermost unit of alluvium present in both the *Principal palaeochannel* and adjacent dryland areas was the *Bronze Age/Iron Age alluvium*. In the channel, this sealed the *Bronze Age alluvium*, whilst it also covered all elements associated with the *'Bronze Age activity (post-Bronze Age alluvium)'* phase on the dry land.

The chronological data

The chronological data therefore derive from different stratigraphic units, of prehistoric date, within the *Principal palaeochannel* and from features and deposits associated with specific phases of prehistoric activity from the *Grid-square area*, and that to the west of the palaeochannel (*Ch 2*). It was compiled from dendrochronologically dated timbers; dendrochronological and radiocarbon wiggle-matched timbers; radiocarbon-dated ecofacts and sediments from bulk samples and from pollen monoliths; and radiocarbon-dated artefacts; however, because of the suspected unreliability, measurements made on sediments were not included in the models.

To be able to construct a robust chronology for Stainton West, two phases of modelling were undertaken. The first involved the production of a series of deposit models, each designed to provide a clearer chronology for the sequence of deposits, and their associated stratigraphic units contained within the *Principal palaeochannel*, and also key environmental events identified through pollen analysis (*Appendix 16*). These models used the radiocarbon dates that had been derived from the single-entity samples recovered from specific pollen monoliths. The second phase entailed the production of an overall site chronological model. This incorporated the modelled data derived from the deposit models (posterior-density estimates), along with the other chronometric data from the site.

Deposit models

Three monolith sequences from Bays B/V, D, and F produced sufficient radiocarbon dates to allow deposit models to be produced, based on the Bayesian approaches outlined by Bronk Ramsey (2009) and Bronk Ramsey and Lee (2013). Therefore, for each of these sequences the results were modelled using the P_Sequence algorithm in OxCal:

```
P_Sequence("",1,1,U(-2,2))
{
…
}.
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The deposit models employed also allowed for flexibility in the estimation of the formation of the sediment over the depth of the core, in this case by averaging values of k (the rigidity of the model) between 0.1 mm^{-1} and 1000 mm^{-1}, which should provide a robust model for any sedimentary sequence (Bronk Ramsey and Lee 2013, 723). The interpolation rate was set to 1, which produced an output every 10 mm.

The modelling approach defines lithological units by Boundary parameters, and this, with the relatively limited data per unit, means in practice that the deposition rate within different units will appear fairly constant. As well as taking into account the depth of dated samples within different monoliths, and indications of changes in deposit formation at context interfaces, the deposition modelling also considered the relative, stratigraphic relationships between contexts sampled by the different monoliths.

Bays V/B

Twenty-three radiocarbon dates were produced from samples from the two monoliths (71158 and 70222) extracted from Bay V and the stratigraphically later Bay B (Fig 679). The relative stratigraphic ordering of the two monoliths was therefore included as prior information. Stratigraphically, monolith 71158 sampled the earliest deposits in the channel (*Mesolithic organic deposit*), and hence the dates from this were used to constrain those from monolith 70222, which sampled stratigraphically later channel deposits (running upwards from the *Mesolithic/Neolithic alluvium* to the *Chalcolithic alluvium*).

Monolith 71158 from Bay V was associated with five dated samples, all from the *Mesolithic organic deposit*. However, one of these, SUERC-32826, was produced on undefined sediment and has therefore not been included as an active likelihood in the model (Table 410). Two statistically inconsistent radiocarbon dates were produced at 7.46 m OD (SUERC-47187 and SUERC-47186), the older (SUERC-47186) perhaps representing residual material, therefore also being excluded. A result from 7.63 m OD (SUERC-44753) also appears to be too old for its position in the model in relation to SUERC-47187 and SUERC-44754 (from 7.60 m OD); therefore, this result has also been excluded as an active likelihood in the model.

The lower part of monolith 70222 (Bay B) sampled the *Mesolithic/Neolithic alluvium*, and produced five radiocarbon assays (Table 411). SUERC-32704 was not, however, included in the modelling as this measurement was made on undifferentiated sediment. The dates derived from a hazelnut and an elm twig at 8.17/8.18 m OD are statistically inconsistent (SUERC-47190 and SUERC-47191), the older (SUERC-47190) again perhaps representing redeposited or residual material; therefore, it has not been included in the model. Two statistically inconsistent results (SUERC-44743 and SUERC-44744) were also produced at 8.24 m OD; the earlier of these (SUERC-44744) may represent residual material and is therefore included as a *terminus post quem* (After).

The formation of deposits from further up this monolith may be more robustly estimated. From the *Earlier Neolithic organic deposit*, two statistically consistent sets of radiocarbon dates bracket a peak in elm pollen, at 8.40-8.42 m OD (CNDR 2: Zone 70222c; *Appendix 16*), which immediately preceded the start of the Elm Decline (ED). Of these, SUERC-44736 and SUERC-44735 pre-dated the elm-peak event, while SUERC-44734 and SUERC-44733 post-dated it. Weighted means of these pairs of results were taken prior to calibration and the deposit model estimates that this event occurred in *3940-3730 cal BC* (*Elm peak immediately prior to Elm Decline B*).

In addition, the pollen curves for ribwort plantain (*Plantago lanceolata*) and cereal-type pollen grains are more or less continuous from 8.44 m OD and 8.48 m OD respectively (CNDR 2: Zone 70222d; *Appendix 16*); these are indicative of Early Neolithic agricultural activity close to Stainton West. Moreover, the deposit model suggests that these indicators of clearance/agriculture first appeared in the first centuries of the fourth millennium cal BC, with the initial appearance of ribwort plantain estimated to date to *3930-3710 cal BC* (*Ribwort plantain B*) and the estimates for the first appearance of cereal pollen occurring slightly later at *3870-3670 cal BC* (*Cereal-type pollen B*).

In the Bay B pollen profile, another significant palaeoenvironmental event was recorded at 8.52-8.53 m OD, when elm declined to a presence only (Elm Decline Demise (EDD); *Appendix 16*). A constraining date is provided by SUERC-44742, at 8.52 m OD, whilst at 8.54 m OD, two statistically inconsistent radiocarbon measurements were produced on short-life samples (SUERC-44737 and SUERC-44738), SUERC-44737 appearing too young in comparison with the dates on either side of it, and hence it was excluded from the deposit model. When those dates selected as active likelihoods are used, the deposit model estimates that this palaeoenvironmental event occurred in *3780-3520 cal BC* (*Elm Decline Demise B*).

SUERC-48334 provided additional information on the formation of the *Earlier Neolithic alluvium* at 8.58 m OD, whilst, at 8.70 m OD, two statistically consistent radiocarbon measurements (SUERC-47188 and SUERC-47189) have been included in the model, and date the formation of the *'Chalcolithic alluvium and reactivation channels'*. Two statistically inconsistent measurements were also produced for the *Chalcolithic alluvium* on short-life macrofossils (SUERC-44746 and SUERC-44745) at 8.82 m OD. SUERC-44745 appeared

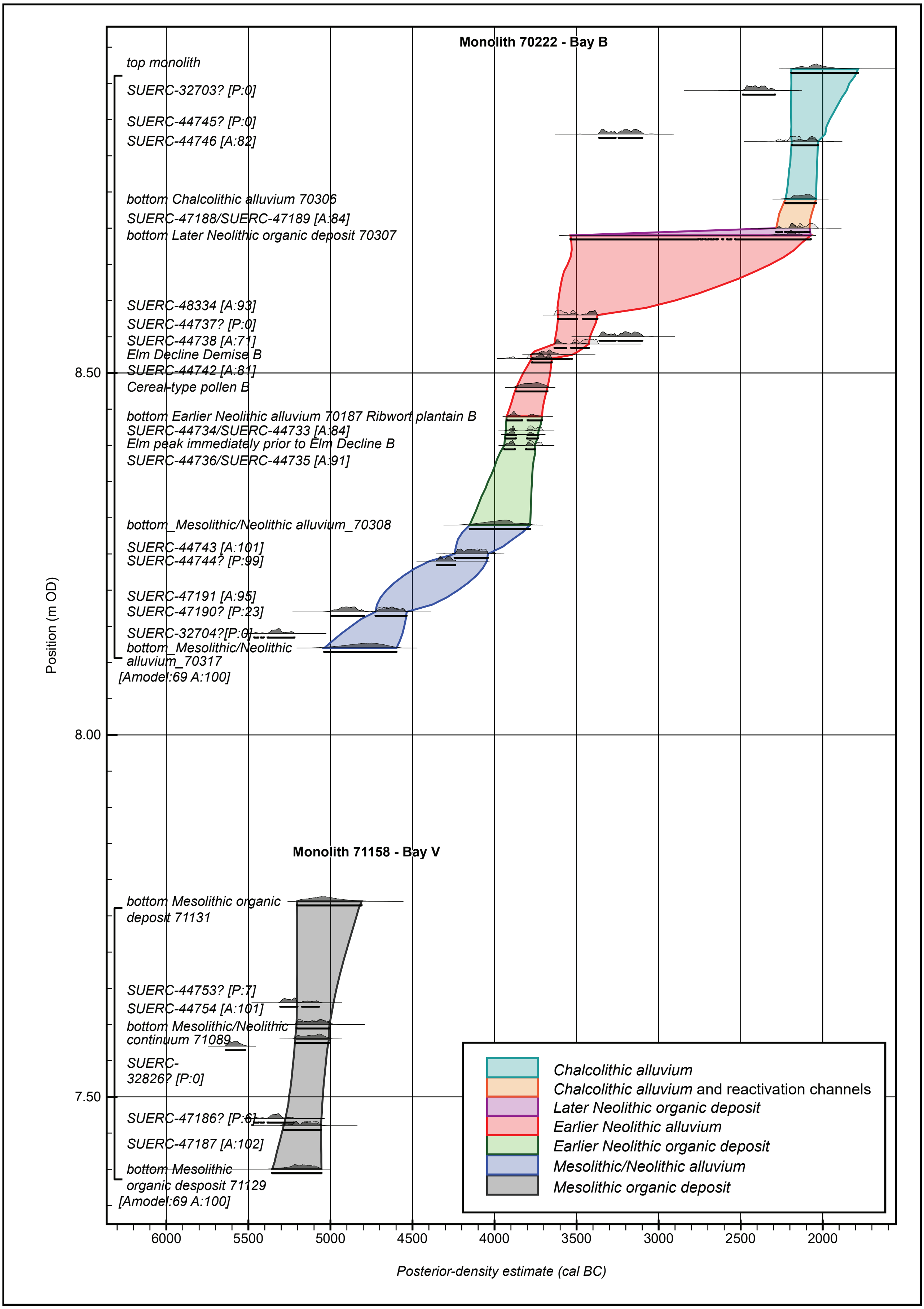

Figure 679: Bays V/B deposit models

OxCal Sequence	OxCal Phase	Sample depth (mOD)	Laboratory code	Radiocarbon age (BP)	Inclusion in Bayesian models	*Posterior density estimate (95% confidence) cal BC*
'Early palaeochannel deposits'	*'Lower palaeochannel'* phase; *'Mesolithic organic deposit I'* sub-phase	7.46	SUERC-47186	6346±39	Statistically inconsistent with duplicate date from same depth. *Terminus post quem* for deposit formation	*5470-5220*
			SUERC-47187	6207±39	Estimates date of deposit formation	*5290-5050*
		7.57	SUERC-32826	6655±35	Unreliable sediment date. Not included as an active likelihood	-
		7.61	SUERC-44754	6142±35	Estimates date of deposit formation	*5210-5000*
		7.63	SUERC-44753	6237±35	Appears too old in contrast to proximal results. *Terminus post quem* for deposit formation	*5310-5060*

Note: for details of the dated materials and deposits see Table 383. See Table 391 for the results of the χ^2 tests on duplicate dates

Table 410: Modelled radiocarbon dates in monolith 71158 from Bay V in the Principal palaeochannel*, Stainton West*

OxCal Sequence	OxCal Phase	Sample depth (mOD)	Laboratory code	Radiocarbon age (BP)	Inclusion in Bayesian models	*Posterior density estimate (95% confidence) cal BC*
'Early palaeochannel deposits'	*'Lower palaeochannel'* phase; *'Mesolithic/ Neolithic alluvium I'* sub-phase	8.14	SUERC-32704	6340±40	Unreliable sediment date. Not included as active likelihood	-
		8.17/8.18	SUERC-47190	6005±39	Statistically inconsistent with duplicate date from same depth. *Terminus post quem* for deposit formation	*5000-4790*
			SUERC-47191	5802±39	Estimates date of deposit formation	*4730-4530*
-	*'Mesolithic/ Neolithic alluvium II'* phase	8.24	SUERC-44743	5301±35	Statistically inconsistent with duplicate date from same depth. Estimates date of deposit formation	*4250-4040*
			SUERC-44744	5443±35	*Terminus post quem* for deposit formation	*4360-4240*
'Late palaeochannel deposits'	*'Upper palaeochannel'* phase; *'Early Neolithic I'* sub-phase	8.40	SUERC-44735	4976±35	Statistically consistent duplicate dates. Estimates date of deposit formation	*3930-3740*
			SUERC-44736	5036±35		
		8.42	SUERC-44733	4973±35	Statistically consistent duplicate dates. Estimates date of deposit formation	*3930-3720*
			SUERC-44734	5028±35		

Table 411: Modelled radiocarbon dates from monolith 70222 in Bay B in the Principal palaeochannel*, Stainton West*

'Late palaeochannel deposits'	*'Upper palaeochannel'* phase; *'Early Neolithic II'* sub-phase	8.52	SUERC-44742	4978±35	Estimates date of deposit formation	*3690-3640*
		8.54	SUERC-44737	4526±35	Statistically inconsistent with duplicate date from same depth. Not included as an active likelihood	-
			SUERC-44738	4688±35	Estimates date of deposit formation	*3640-3420*
		8.58	SUERC-48334	4730±34	Estimates date of deposit formation	*3620-3370*
-	*'Chalcolithic alluvium and reactivation channels'* phase	8.70	SUERC-47188	3693±39	Statistically consistent duplicate dates. Estimates date of deposit formation	*2290-2110*
			SUERC-47189	3758±39		
		8.82	SUERC-44745	4530±35	Statistically inconsistent with duplicate date from same depth. *Terminus post quem* for deposit formation	*3370-3100*
			SUERC-44746	3750±35	Estimates date of deposit formation	*2210-2060*
		8.89	SUERC-32703	3915±35	Unreliable sediment date. Not included as active likelihood	-

Note: for details of the dated materials and deposits see Tables 385-7, and 389. See Table 391 for the results of the χ^2 tests on duplicate dates

Table 411: Modelled radiocarbon dates from monolith 70222 in Bay B in the Principal palaeochannel, *Stainton West (cont'd)*

too old for its position in the model, and was therefore excluded. The other radiocarbon date from Bay B was SUERC-32703, at 8.89 m, again a sediment date, and, as such, was not included in the model. Apart from the direct dates, the deposition model for Bays V/B also used Boundary parameters, applied at context interfaces, to reflect potential changes in the deposit formation rate.

Bays X/D

The deposit models from these bays were based on the radiocarbon assays associated with three monoliths (Fig 680). The stratigraphically earliest of these was monolith 71175 from Bay X and the dates from this included two statistically consistent results at 7.49 m OD (SUERC-47196 and SUERC-47195), and two statistically consistent results at 7.70 m OD (SUERC-44778 and SUERC-44777; Table 412). Weighted means of these pairs of results were taken prior to calibration and were included in the deposit models, which were then used to produce posterior estimates for the formation of the *Mesolithic organic deposit*. Monolith 70240 was extracted from the overlying Bay D, which enabled the dating of deposits that lay stratigraphically above those examined by the monolith 71175, in Bay X. The most useful of these included two radiocarbon dates, SUERC-44787 at 7.85 m OD and SUERC-44788 at 7.92 m OD, that were used to produce posterior estimates for the formation of the *Mesolithic/Neolithic alluvium*.

The third monolith used in the deposit models for Bays X/D was 70296. This was from Bay D and, although it could not be related to the other two monoliths, it sampled a series of later stratigraphic units. Hence, the results from its deposit model were constrained by those from the two stratigraphically earlier monoliths (*above*). The dates from monolith 70296 included two statistically consistent results (SUERC-47198 and SUERC-47197) at 8.46 m OD, and two others (SUERC-44786 and SUERC-44785) at 8.61 m OD (Table 413). Weighted means of these pairs of results were taken prior to calibration and included in the model. Two other additional measurements (SUERC-44783 at 8.54 m OD and SUERC-44784 at 8.52 m OD) on short-life samples were also produced from the sequence. In line with policy, a single result (SUERC-32635) on undefined sediment was not included as an active likelihood in the deposit model.

As well as the estimates for the interfaces between different contexts, several significant pollen events have been identified in the Bay D sequence. Therefore, estimates have been made for the presence of clearance indicators in the form of ribwort plantain at 8.42 m OD, cereal-type pollen at 8.48 m OD, and the Elm Decline

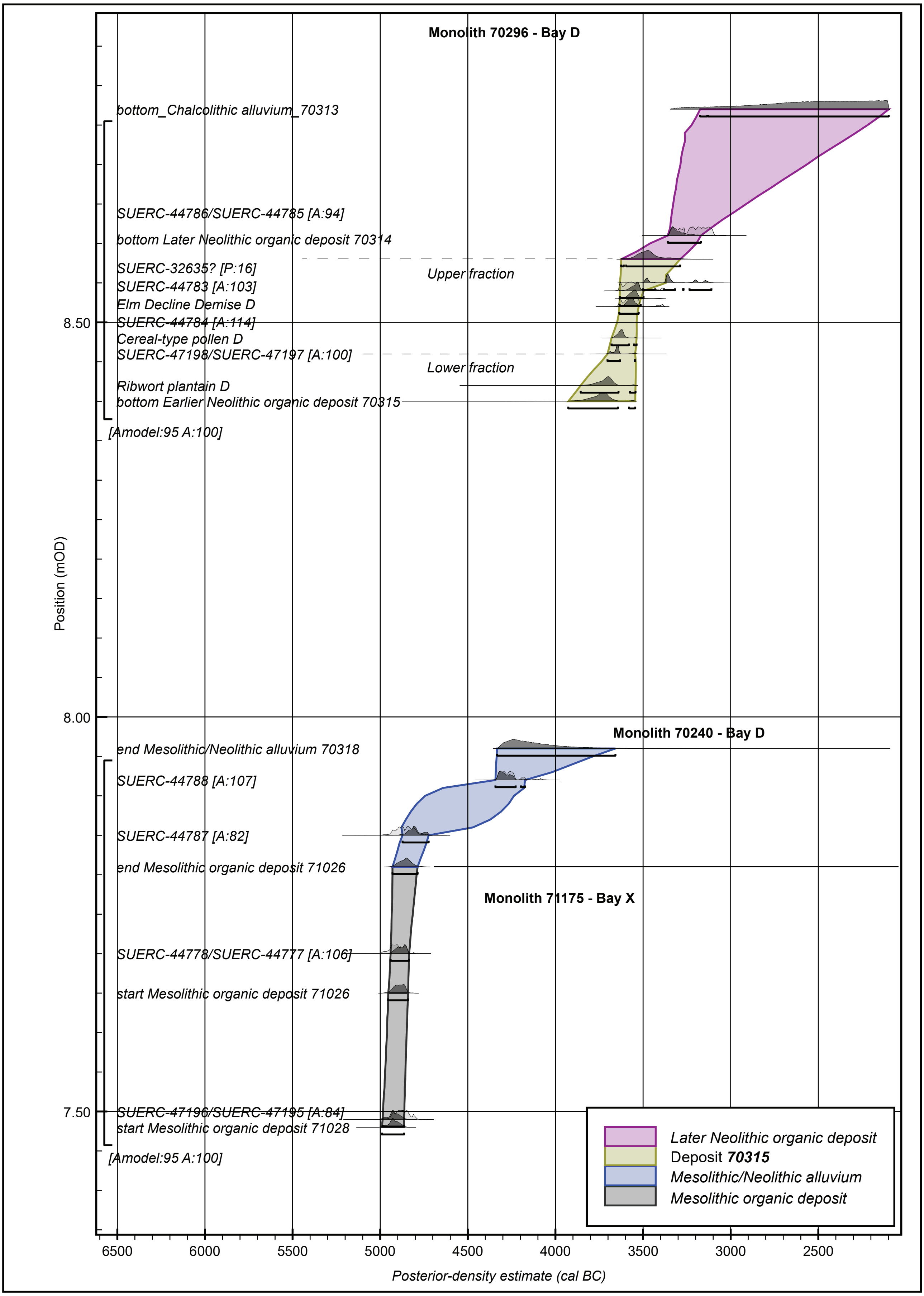

Figure 680: Bays X/D deposit models

OxCal Sequence	OxCal Phase	Monolith/ sample depth (mOD)	Laboratory code	Radiocarbon age (BP)	Inclusion in Bayesian models	*Posterior density estimate (95% confidence) cal BC*
'Early palaeochannel deposits'	*'Lower palaeochannel'* phase; *'Mesolithic organic deposit II'* sub-phase	71175; 7.56	SUERC-32694	5600±35	Unreliable sediment date. Not included as an active likelihood	-
		71175; 7.49	SUERC-32705	6330±40	Unreliable sediment date. Not included as an active likelihood	-
			SUERC-47195	5976±39	Statistically consistent duplicate dates. Estimates date of deposit formation	*4950-4850*
			SUERC-47196	6002±39		
		71175; 7.70	SUERC-44777	6013±35	Statistically consistent duplicate dates. Estimates date of deposit formation	*4930-4830*
			SUERC-44778	6013±35		
	'Lower palaeochannel' phase; *'Mesolithic/ Neolithic alluvium I'* sub-phase	70240; 7.85	SUERC-44787	5973±35	Estimates date of deposit formation	*4840-4720*
-	*'Mesolithic/ Neolithic alluvium II'* phase	70240; 7.78	SUERC-44788	5398±35	Estimates date of deposit formation	*4350-4170*
		70240; 7.80	SUERC-32693	6105±35	Unreliable sediment date. Not included as active likelihood	-
-	*'Chalcolithic alluvium and reactivation channels'* phase	70240; 8.78	SUERC-32636	3750±35	Unreliable sediment date. Not included as active likelihood	-

Note: for details of the dated materials and deposits see Tables 383, 385, and 389. See Table 391 for the results of the χ^2 tests on duplicate dates

Table 412: Modelled radiocarbon dates from monoliths 71175 from Bay X and 70240 from Bay D in the Principal palaeochannel, *Stainton West*

OxCal Sequence	OxCal Phase	Sample depth (mOD)	Laboratory code	Radiocarbon age (BP)	Inclusion in Bayesian models	*Posterior density estimate (95% confidence) cal BC*
'Late palaeochannel deposits'	*'Upper palaeochannel'* phase; *'Early Neolithic I'* sub-phase	8.46	SUERC-47197 SUERC-47198	4801±39 4909±39	Statistically consistent duplicate dates. Estimates date of deposit formation	*3710-3650*
	'Upper palaeochannel' phase; *'Early Neolithic II'* sub-phase	8.52	SUERC-44784	4775±35	Estimates deposit formation	*3640-3520*
		8.54	SUERC-32635	4585±35	Unreliable sediment date. Not included as active likelihood	-
			SUERC-44783	4769±35	Estimates date of deposit formation	*3640-3490*
	'Upper palaeochannel' phase; *'Late Neolithic'* sub-phase	8.61	SUERC-44785	4534±35	Statistically consistent duplicate dates. Estimates date of deposit formation	*3360-3170*
			SUERC-44786	4478±35		

Note: for details of the dated materials and deposits see Tables 386-8. See Table 391 for the results of the χ^2 tests on duplicate dates

Table 413: Modelled radiocarbon dates from monolith 70296 from Bay D in the Principal palaeochannel, *Stainton West*

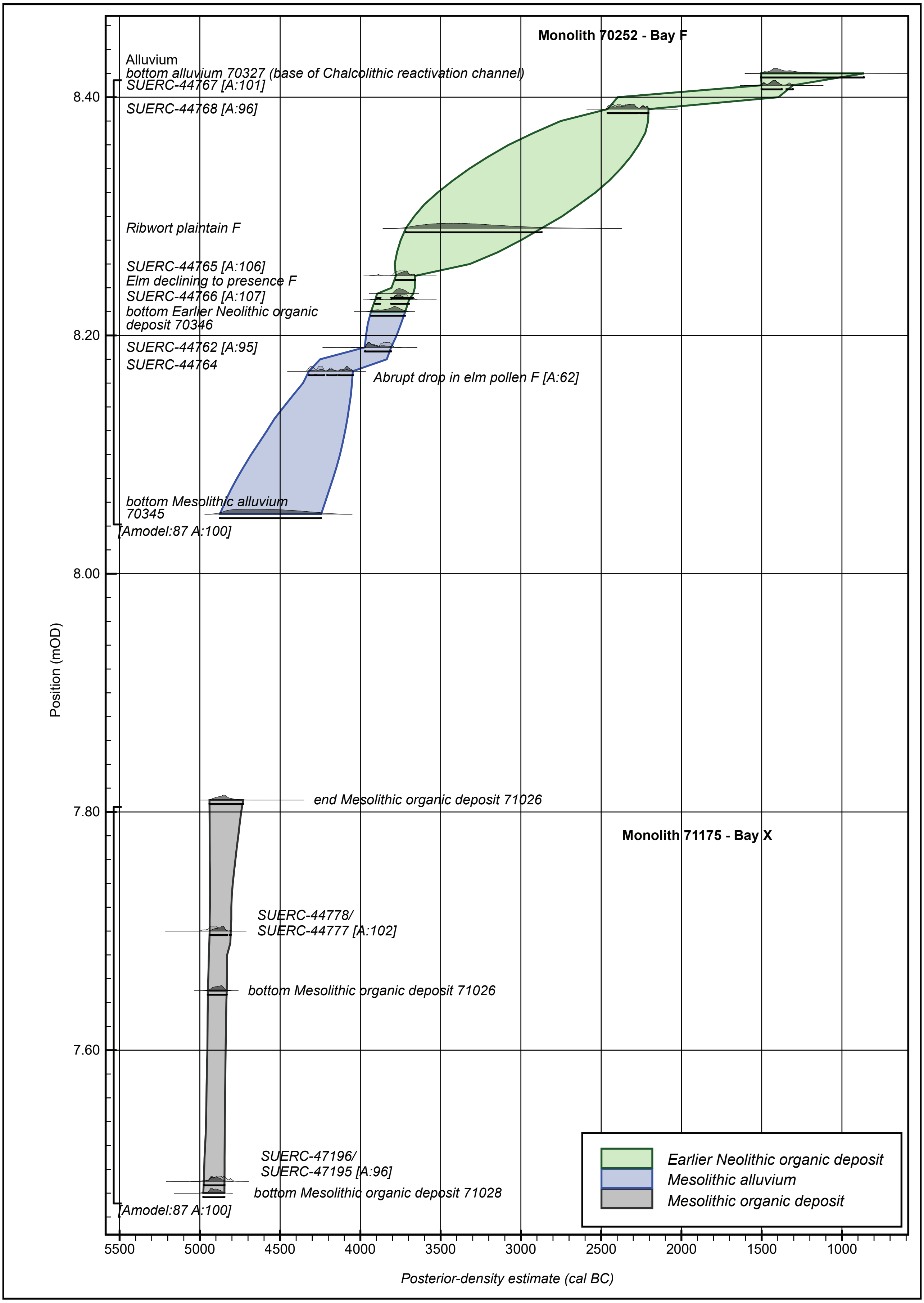

Figure 681: Bay X/F deposit models

Demise (EDD) at 8.53 m OD (*Appendix 16*). Accordingly, the model estimates that the clearance indicator, ribwort plantain, appears at *3860-3540 cal BC* (*Ribwort plantain D*), whilst the first appearance of cereal pollen occurs at an estimated date of 3690-3530 cal BC (Cereal-type pollen D). The Elm Decline Demise (EDD) is bracketed by two dates derived from alder twigs in monolith 70293, one of which (SUERC-44783), at 8.54 m OD, lay above this horizon, whilst the other (SUERC-44784), at 8.52 m OD, lay below it. Based on these dates, the deposit model estimates that this palaeoenvironmental event occurred in *3640-3510 cal BC* (*Elm Decline Demise D*). The other structure in the model takes the form of Boundary parameters applied at context interfaces, to reflect potential changes in the deposit formation rate.

Bay F

The data from monolith 70252 were used for the Bay F deposit model (Fig 681), constrained by being later than the estimates derived from the stratigraphically earlier monolith (71175) from Bay X. A series of results on short-life samples (SUERC-44764, SUERC-44762, SUERC-44766, SUERC-44765, SUERC-44768, and SUERC-44767) from monolith 70252 had good internal agreement in terms of the radiocarbon measurement and their depth (Table 414).

Several palynological events had also been identified in this monolith. An abrupt drop in elm pollen was noted at 8.17m OD, within the *Mesolithic alluvium*, though this was subsequently followed by a rise in elm pollen (CNDR 1: Zone 70252a; *Appendix 16*). The reasons for this abrupt drop are not clear, but it has been suggested that it may have been affected by the high percentage values for hazel-type pollen, or could be indicative of erosional events in the channel, which confused the pollen signatures. Perhaps significantly, this abrupt drop in elm was not coincident with consistent occurrences of ribwort plantain or cereal-type pollen (*Appendix 16*). It also appears unrelated to the later Elm Decline Demise (EDD) identified in Bays B and D, and the deposit model estimates that it dates to *4330-4040 cal BC* (*Abrupt drop in elm pollen F*).

Elm pollen was again at low levels at 8.23 m OD, and this event was bracketed by two dated samples (SUERC-44766 and SUERC-44765). Based on the wider pollen signatures from this section (CNDR 1: Zone 70252b), it is considered that this pollen event was consistent with a time after the Elm Decline (ED), but before the Elm Decline Demise (EDD; *Appendix 16*). The deposit model estimates that this event occurred in *3900-3670 cal BC* (*Elm declining to presence F*).

Another significant pollen event also occurred at 8.29 m OD, when ribwort plantain was present, suggestive of clearance/agriculture by Early Neolithic groups in the immediate area (*Appendix 16*). The deposit model estimates that this clearance indicator dates to *3720-2870 cal BC* (*Ribwort plantain F*). The other structure in the model takes the form of Boundary parameters applied at context interfaces, to reflect potential changes in the deposit formation rate.

The site chronological model

The site chronological model uses all the information about the relative stratigraphic development of the *Principal palaeochannel* and the adjacent dryland areas,

OxCal Sequence	OxCal Phase	Sample depth (mOD)	Laboratory code	Radiocarbon age (BP)	Inclusion in Bayesian models	*Posterior density estimate (95% confidence) cal BC*
-	*'Mesolithic/ Neolithic alluvium II'* phase	8.17	SUERC-44764	5379±35	Estimates date of deposit formation	*4320-4040*
		8.19	SUERC-44762	5093±35		*4040-3910*
'Late palaeochannel deposits'	*'Upper palaeochannel'* phase; *'Early Neolithic I'* sub-phase	8.23	SUERC-44766	4973±35	Estimates date of deposit formation	*3900-3690*
		8.25	SUERC-44765	4972±35		*3790-3660*
-	*'Chalcolithic alluvium and reactivation channels'* phase	8.39	SUERC-44768	3867±35	Estimates date of deposit formation	*2410-2200*
		8.41	SUERC-44767	3142±35	Too young for position in overall model. Not included as an active likelihood	

Note: for details of the dated materials and deposits see Tables 384, 386, and 389. See Table 391 for the results of the χ^2 tests on duplicate dates

Table 414: Modelled radiocarbon dates from monolith 70252 from Bay F in the Principal palaeochannel, *Stainton West*

alongside all pertinent chronometric dating evidence. These data have therefore been ordered and grouped into a series of OxCal sequences and phases, which define the structure of this chronological model. Within this, the posterior-density estimates for the Mesolithic deposits within the *Principal palaeochannel* and Mesolithic activity in the *Grid-square area* have been modelled. The posterior-density estimates for the Neolithic deposits and structures within the *Principal palaeochannel* have also been modelled, as have the posterior-density estimates for dryland Neolithic activity, and the Chalcolithic and Bronze Age activity at the site.

Mesolithic deposits in the Principal palaeochannel

The model incorporates all of the relevant chronometric data that enables the dates for the formation of the Mesolithic deposits in the *Principal palaeochannel* to be estimated. These data include the posterior-density estimates derived from deposit models for Bays X, B, and F, which are entered into the model as OxCal 'Priors'. However, dates from these models that interpreted as too old for their depths within the respective monoliths have not been included as active likelihoods and are therefore used as *termini post quos* (After) for their parent units, whilst those that are too late have been excluded from the model.

The model also uses the radiocarbon-dating evidence from those monoliths extracted from Mesolithic deposits, which contained insufficient data to produce deposit models, and from individually selected items of wood/plant macrofossils extracted from these deposits. These included monoliths 70225 from Bay B and 70254 from Bay F, (Table 415), with the most useful data comprising two statistically inconsistent radiocarbon dates (SUERC-44747 and SUERC-44748) from monolith 70225. These could be associated with the '*Mesolithic organic deposit I*' phase, though the earlier (SUERC-44747) might have derived from residual material. This has therefore been included as a *terminus post quem* (After) in the overall model. A date from an elm timber from Bay Y, associated with the '*Mesolithic organic deposit I*' phase also provides a useful estimate. In contrast, a sediment date from *'Mesolithic/ Neolithic alluvium II'* phase has been excluded from the model, due to the general unreliability of the sediment dates, whilst a sample of hazelnut shell (SUERC-32692) was

OxCal Sequence	OxCal Phase	Monolith/bay/ sample depth (mOD)	Laboratory code	Radiocarbon age (BP)	Inclusion in Bayesian models	*Posterior density estimate (95% confidence) cal BC*
'Early palaeochannel deposits'	*'Lower palaeochannel'* phase; *'Mesolithic organic deposit I'* sub-phase	70225; Bay B; 7.88	SUERC-44747	6065±35	Statistically inconsistent with duplicate date from same depth. *Terminus post quem* for deposit formation	*5200-4890*
			SUERC-44748	5959±35	Estimates date of deposit formation	*4990-4870*
	'Lower palaeochannel' phase; *'Mesolithic organic deposit II'* sub-phase	Bay Y; 7.77	SUERC-32722	5970±35	Estimates date of deposit formation	*4930-4790*
-	*'Mesolithic/ Neolithic alluvium II'* phase	70254; Bay F; 7.96	SUERC-32696	6150±40	Unreliable sediment date. Not included as active likelihood	-
	'Mesolithic/ Neolithic alluvium II' phase	Bay B	SUERC-32692	4425±35	Too late in comparison with other material from the same stratigraphic unit. Not included as active likelihood	**-**

Note: for details of the dated materials and deposits see Tables 383 and 384. See Table 391 for the results of the χ^2 tests on duplicate dates

Table 415: Modelled radiocarbon dates from Mesolithic deposits in monoliths 70225 and 70254, and individually selected wood/plant macrofossils from Bays Y and B, in the Principal palaeochannel, *Stainton West*

too late when compared with the other results from its parent stratigraphic unit and has, therefore, not been included as an active parameter in the model.

The chronometric data from all 15 of the Cluster 2 timbers in the *Mesolithic/Neolithic alluvium* that were measured dendrochronologically and wiggle-matched form another important dataset that can be used to model the dates of the Mesolithic deposits in the channel. Within this, the precise felling dates were determined for three dendrochronological samples from two timbers (**76065** and **76220**) associated with the '*Mesolithic/Neolithic alluvium II*', these dates being included in the model to estimate this phase of channel infill (C_Date 76065 70479 4144 BC winter; C_Date 76065 70480 4144 BC winter; and C_Date 76220 70458 4287 BC; *Ch 6*). Timbers **75868**, **76237**, and **76380** were also associated with the *'Mesolithic/Neolithic alluvium II',* and these, in addition, have been included in the chronological model (C_Date 75868 70159 4324-4279 BC; C_Date 76237 71084 4355-10 BC; and C_Date 76380 71035 4230-4185 BC). However, because all of these timbers had sapwood rings, and because prehistoric bog-oaks often have unusually large numbers of such rings, potentially as a result of the oak's physiological response to either rising water-levels or, perhaps, to saltwater egress, the calendar estimate ranges for felling dates have been applied to these timbers, rather than using standard sapwood estimates within a Bayesian model (*cf* Bayliss and Tyers 2004).

Furthermore, in four timbers (**75648**, **76084**, **76509**, and **76514**) associated with the *'Mesolithic/Neolithic alluvium II',* the possible presence of the heartwood-sapwood transition has been noted, and provisional felling estimates have therefore been produced. These have been included as *termini post quos* (After) in the model (C_Date 75648 70113 4212-4167 BC?; C_Date 76084 70194 4359-14 BC?; C_Date 76509 70518 4282-37 BC?; and C_Date 76514 70523 4283-38 BC?). *Termini post quos* (After) felling dates were also estimated for several other timbers (**75729**, **75867**, **75883**, **76014**, **76154**, and **76508**) associated with the *'Mesolithic/Neolithic alluvium II',* based on the last counted heartwood rings (C_Date 75729 70132; C_Date 75867 70151; C_Date 75883 70155; C_Date 76014 70171; C_Date 76154 70481; and C_Date 76508 70517).

Samples from two other Mesolithic timbers from the *Principal palaeochannel* were also taken for radiocarbon dating, the results being wiggle-matched using Bayesian statistical modelling, and these have also been incorporated into the model. These were timber samples **76422** and **76426** and, in both cases, the last dated ring was of heartwood. Therefore, each of these estimates includes an unknown inbuilt 'old-wood' offset and thus timber **76426** (*Prior CNDR Cluster 1 ring_219*) provides a *terminus post quem* (After) for the *'Mesolithic organic deposit I'*, while timber **76422** (*Prior CNDR Cluster 5 ring_90*) provides a *terminus post quem* (After) for the *'Mesolithic organic deposit II'*.

Placing all of the radiocarbon and dendrochronological data within the site chronological model allows estimates to be made for the Mesolithic deposits that formed prior to the *'Mesolithic/Neolithic alluvium II'* (Fig 682). These form elements of the *'Mesolithic organic deposit I'*, *'Mesolithic organic deposit II'*, and *'Mesolithic/Neolithic alluvium I'* sub-phases, and the model also allows estimates to be made for several key parameters associated with these sub-phases. These create First and Last estimates, which indicate that the first dated event associated with the *'Mesolithic organic deposit I'* is *5290-5070 cal BC (First Mesolithic organic deposit I*), whilst the last estimate associated with this phase is *4990-4870 cal BC (Last Mesolithic organic deposit I*). The estimate for the first dated event associated with the *'Mesolithic organic deposit II'* is *4950-4860 cal BC (First Mesolithic organic deposit II*), and the estimate for the last dated event is *4910-4790 cal BC (Last Mesolithic organic deposit II*), whilst the first estimate associated with the formation of the *'Mesolithic/Neolithic alluvium I'* is *4840-4720 cal BC (First Mesolithic/Neolithic alluvium I*) and the last dated event associated with this phase is *4730-4530 cal BC (Last Mesolithic/Neolithic alluvium I*).

The model also enables a later phase of Mesolithic alluviation to be estimated, which can be associated with the *'Mesolithic/Neolithic alluvium II'* sub-phase (Fig 683). This estimates that this alluvium accumulated between *4400-4300 cal BC* (*Start Mesolithic/Neolithic alluvium II*) and *3990-3880 cal BC* (*End Mesolithic/Neolithic alluvium II*).

Mesolithic activity in the Grid-square area

The model incorporates all relevant chronometric data from Mesolithic features and deposits in the *Grid-square area* (Fig 684) and allows a series of estimates to be made relating to the dating of Mesolithic activity and habitation, prior to the *'Mesolithic/Neolithic alluvium II'* phase (*above*). This includes radiocarbon dates produced from charcoal and charred plant remains from several features and deposits (Table 416). The earliest of these dates came from a Mesolithic hearth (SUERC-59308) and a nearby burnt hazelnut shell (SUERC-43658), probably indicative of contemporary human activity, which together form elements of the *'Earliest Mesolithic activity'* sub-phase (*Ch 3*). Other Mesolithic dates (SUERC-32706, SUERC-42000, and SUERC-42004) derive from charred materials in tree-throws ***90163*** and ***90208***, and these form elements of the *'Mesolithic tree-throws/activity'* sub-phase (*Ch 3*). One of these (SUERC-32706) relates to tree-throw ***90163***, whilst the other two, statistically consistent, results (SUERC-42000 and SUERC-42004) date the filling of tree-throw ***90208***; all form active likelihoods in the model.

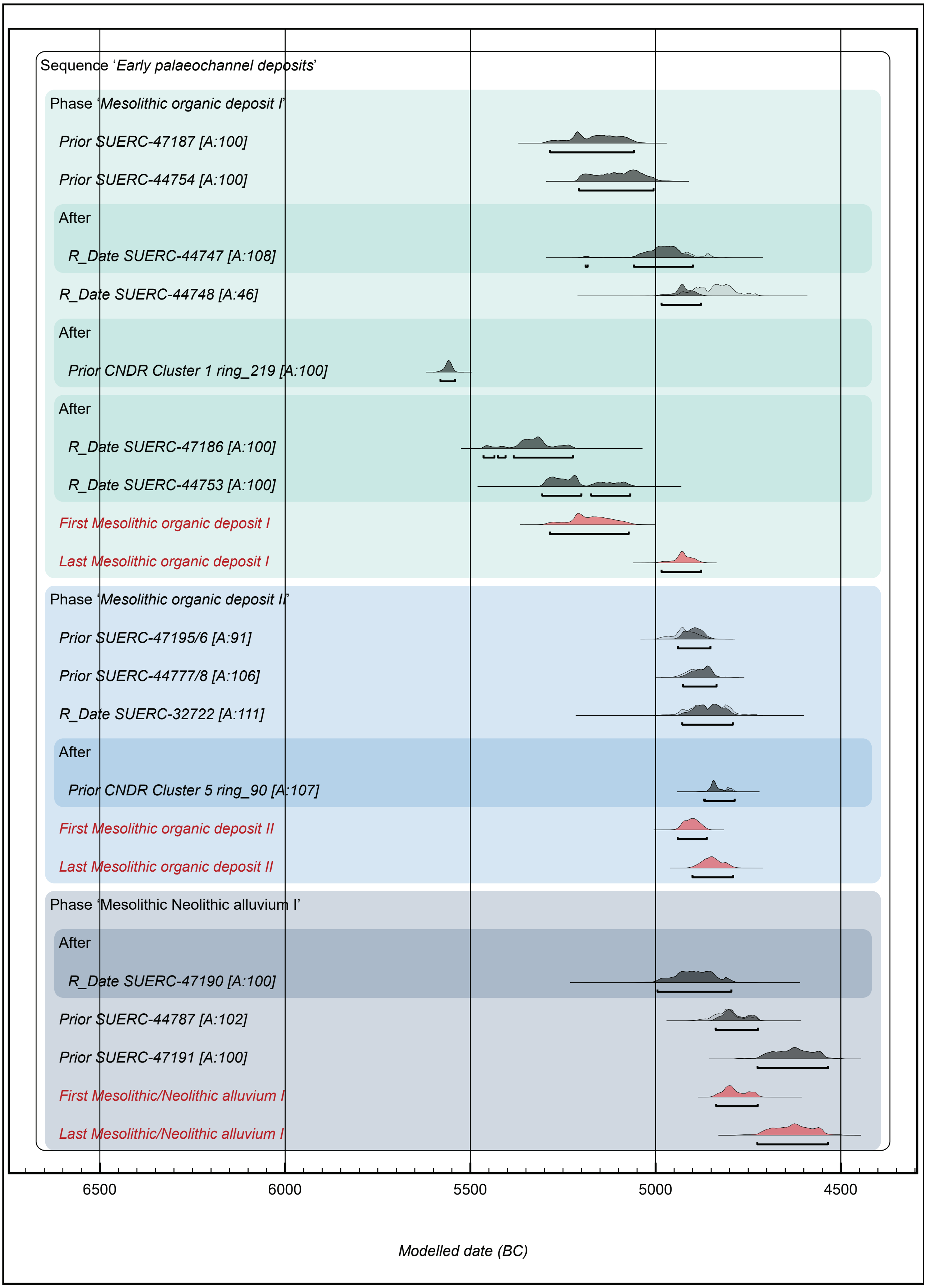

Figure 682: Posterior-density estimates for the Mesolithic deposits within the Principal palaeochannel, prior to the 'Mesolithic/Neolithic alluvium II' phase, at Stainton West

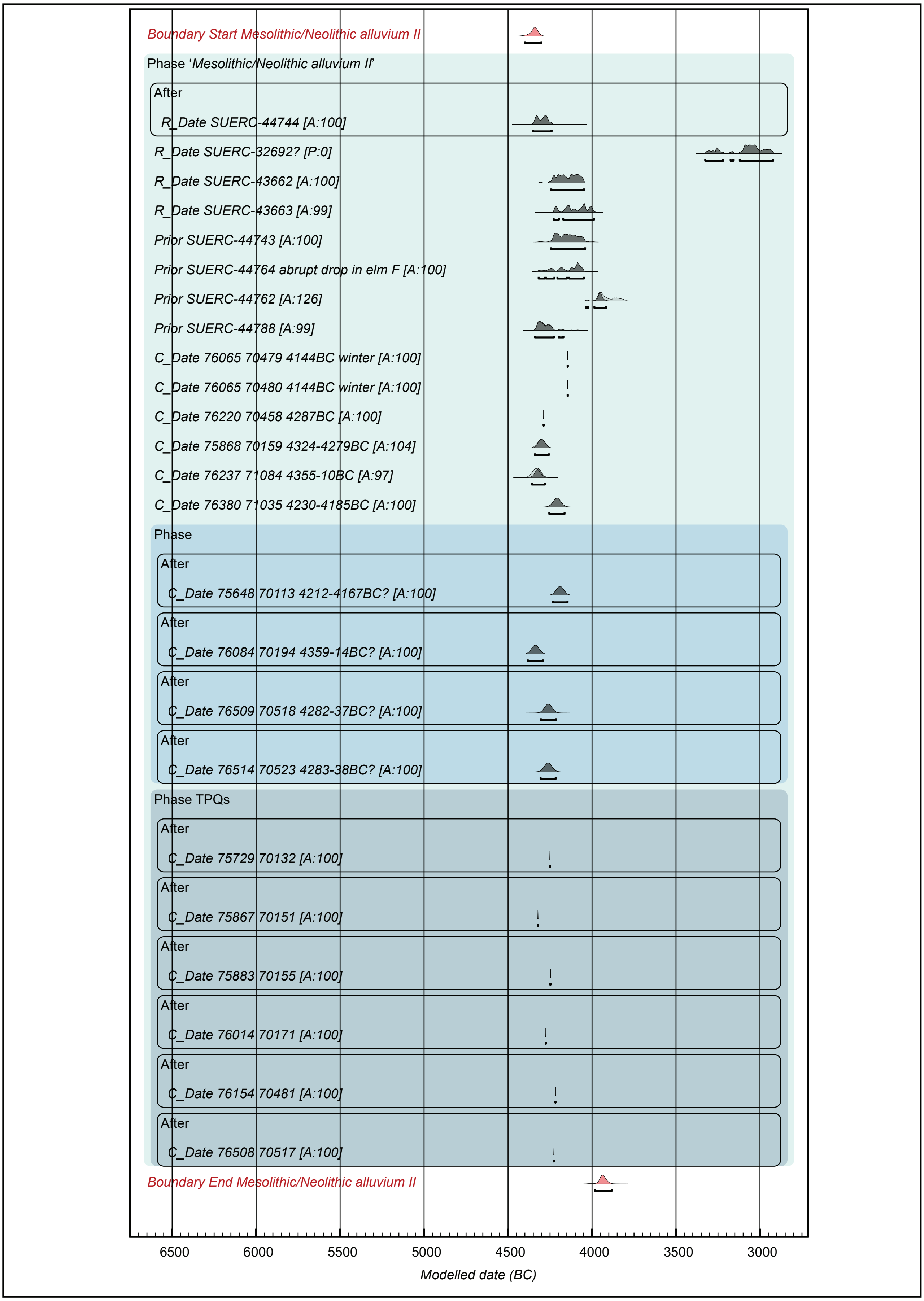

Figure 683: Posterior-density estimates and dendrochorological measurements for the 'Mesolithic/Neolithic alluvium II' phase, at Stainton West

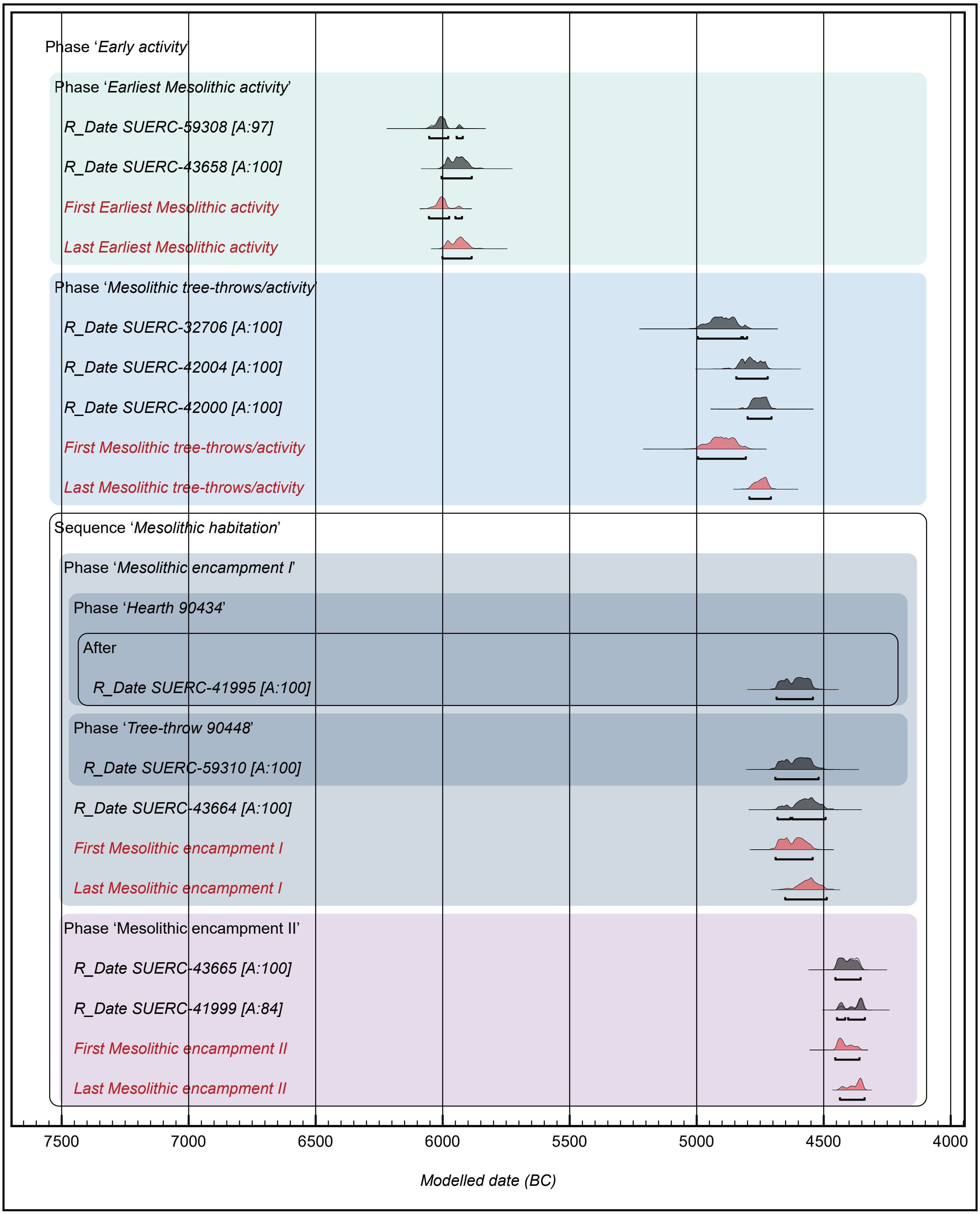

Figure 684: Posterior-density estimates for the Mesolithic deposits within the Grid-square area, prior to 'Mesolithic/Neolithic alluvium II' phase, at Stainton West

Dated material was also recovered from features and deposits associated with the *'Mesolithic encampment I'* and *'Mesolithic encampment II'* phases. The material associated with the *'Mesolithic encampment I'* phase include a charcoal fragment from the *Stabilised land surface* (SUERC-43664), which has been included as an active likelihood in the model, and charcoal fragments from hearth ***90434*** (*Ch* 4), assigned to the *'Hearth 90434'* sub-phase, and tree-throw ***90448*** (*Ch* 4), assigned to the *'Tree-throw 90448'* sub-phase.

OxCal Sequence	OxCal Phase	Feature/ deposit	Laboratory code	Radiocarbon age (BP)	Inclusion in Bayesian models	*Posterior density estimate (95% confidence) cal BC*
-	*'Lower palaeochannel'* phase; *'Early activity'* sub-phase; *'Earliest Mesolithic activity'* sub-phase	*Stabilised land surface*	SUERC-43658	7055±29	Probably relates to earliest Mesolithic dryland activity pre-dating *'Mesolithic-Neolithic alluvium II'*. Estimates date of deposit formation	*6010-5880*
		Hearth ***90452***	SUERC-59308	7129±27	Earliest Mesolithic dryland activity pre-dating *'Mesolithic/ Neolithic alluvium II'*. Estimates date of hearth	*6060-5920*
-	*'Lower palaeochannel'* phase; *'Early activity'* sub-phase; *'Mesolithic tree-throws/ activity'* sub-phase	Tree-throw ***90163***	SUERC-32706	6010±35	Estimates date of tree-throw	*5000-4800*
		Tree-throw ***90208***	SUERC-42000	5882±23	Estimates date of tree-throw	*4810-4700*
			SUERC-42004	5919±26		*4850-4720*
'Mesolithic habitation'	*'Lower palaeochannel'* phase; *'Early activity'* sub-phase; *'Mesolithic encampment I'* sub-phase; *'Hearth 90434'* sub-phase	Hearth ***90434***	SUERC-32638	3120±30	Intrusive material. Not included as an active likelihood	-
			SUERC-41995	5757±23	*Terminus post quem* for hearth	*4690-4540*
			SUERC-41996	232±25	Intrusive material. Not included as an active likelihood	-
	'Lower palaeochannel' phase; *'Early activity'* sub-phase; *'Mesolithic encampment I'* sub-phase; *'Tree-throw 90448'* sub-phase	Tree-throw ***90448***	SUERC-59309	183±26	Intrusive material. Not included as an active likelihood	-
			SUERC-59310	5752±30	Charcoal derived from activity associated with *'Mesolithic encampment I'*. *Terminus post quem* for tree-throw	*4700-4520*
	'Lower palaeochannel' phase; *'Early activity'* sub-phase; *'Mesolithic encampment I'* sub-phase	*Stabilised land surface*	SUERC-43664	5727±29	Charcoal derived from activity associated with *'Mesolithic encampment I'*. Estimates date of deposit formation	*4690-4490*
		Hearth ***90263***	SUERC-42610	5211±28	Unreliable sediment date. Not included as an active likelihood	-
		Pit ***90309***	SUERC-59306	2543±26	Intrusive material. Not included as an active likelihood	-
		Hearth ***90593***	SUERC-32642	175±35	Intrusive material. Not included as an active likelihood	-

Table 416: Modelled radiocarbon dates from Mesolithic dryland features and deposits, Stainton West

OxCal Sequence	OxCal Phase	Feature/ deposit	Laboratory code	Radiocarbon age (BP)	Inclusion in Bayesian models	*Posterior density estimate (95% confidence) cal BC*
'Mesolithic habitation'	*'Lower palaeochannel'* phase; *'Early activity'* sub-phase; *'Mesolithic encampment II'* sub-phase	Stone-spread ***90396***	SUERC-41998	368±26	Intrusive material. Not included as an active likelihood	-
			SUERC-41999	5524±23	Charcoal derived from activity associated with *'Mesolithic encampment II'*. The dates are statistically consistent and estimate the date of stone spread	*4450-4330*
			SUERC-43665	5567±27		*4460-4350*
			SUERC-42005	122±26	Intrusive material. Not included as an active likelihood	-
-	*'Mesolithic/ Neolithic alluvium II'* phase	*Stabilised land surface*	SUERC-43662	5323±29	Intrusive Mesolithic material from the dryland *Mesolithic/ Neolithic alluvium*. Estimates formation date of *Mesolithic overbank alluvium*	*4250-4040*
		Mesolithic overbank alluvium	SUERC-43663	5265±29	Radiocarbon date from the dryland *Mesolithic/ Neolithic alluvium*. Estimates date of deposit formation	*4230-3980*

Note: for details of the dated materials, deposits, and locations see Table 393. See Table 394 for the results of the χ^2 tests on duplicate dates

Table 416: Modelled radiocarbon dates from Mesolithic dryland features and deposits, Stainton West (cont'd)

It should be noted that hearth ***90434*** contained a mixed assemblage of dated charcoal (SUERC-32638, SUERC-41995, and SUERC-41996), so the earliest result (SUERC-41995) has been used as a *terminus post quem* (After) for the filling of this feature, whilst the other dates have not been included as active likelihoods in the model. Tree-throw ***90448*** contained Late Mesolithic charcoal (SUERC-59310) which, based on the stratigraphic and artefactual evidence, probably dates this feature, and therefore a later result (SUERC-59309) has not been included as an active likelihood in the model.

The dated material associated with the *'Mesolithic encampment II'* phase was derived from stone-spread ***90396***, a stone-working area above stone-working remains associated with the *'Mesolithic encampment I'* phase (*Ch 4*). Spread ***90396*** produced two statistically consistent results (SUERC-41999 and SUERC-43665), which have been used as active likelihoods within the model. This spread also produced two post-medieval results (SUERC-41998 and SUERC-42005), which came from clearly intrusive material and have therefore not been included as active likelihoods.

All of the modelled data from the *Grid-square area* allow the key parameters associated with Mesolithic activity and habitation to be estimated (Fig 685). Specifically, it seems that the earliest activity in this area dates to the late seventh/early sixth millennia cal BC, as the estimate for the first dated event associated with the *'Earliest Mesolithic activity'* is *6060-5920 cal BC* (*First Earliest Mesolithic activity*), while the last dated event is estimated as *6010-5880 cal BC* (*Last Earliest Mesolithic activity*). This was followed by a later phase of activity, the *'Mesolithic tree-throws/ activity'* sub-phase, and the model estimates that the first dated event associated with this is estimated as *5000-4800 cal BC* (*First Mesolithic tree-throws/ activity*), and the last dated event is estimated as *4800-4700 cal BC* (*Last Mesolithic tree-throws/activity*). The next phase of activity relates to the Mesolithic encampment, which encompasses the *'Mesolithic encampment I'* and *'Mesolithic encampment II'* sub-phases. The model estimates that the first dated event

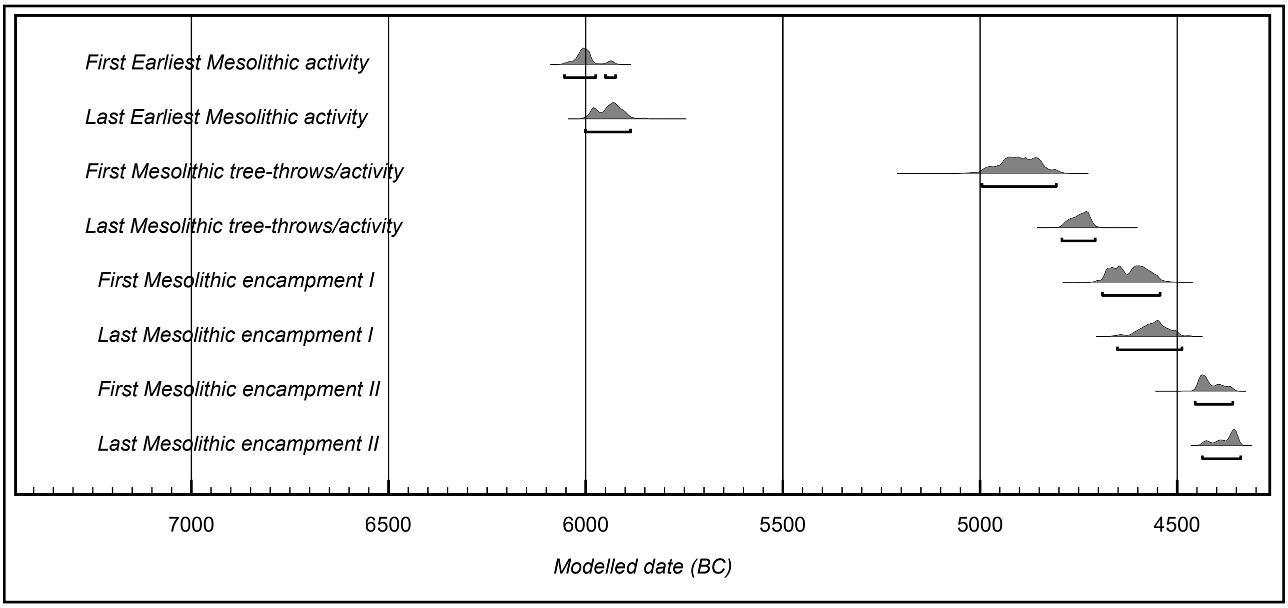

Figure 685: Posterior-density estimates for key Mesolithic parameters, at Stainton West

associated with the first phase of occupation occurred at *4690-4540 cal BC* (*First Mesolithic encampment I*), which may have lasted until *4660-4480 cal BC* (*Last Mesolithic encampment I*), whilst, in terms of the second Mesolithic encampment, the first dated event associated with its occupation is estimated as *4460-4350 cal BC* (*First Mesolithic encampment II*), with the last dated event being estimated at *4440-4330 cal BC* (*Last Mesolithic encampment II*).

The remains of the Mesolithic encampment were sealed by the *Mesolithic overbank alluvium*, an element of the *'Mesolithic/Neolithic alluvium II'* phase, and several results from the *Grid-square area* have been used to establish the date of this layer (Table 416). These derive from charred hazelnuts from the *Mesolithic overbank alluvium* (SUERC-43663), and the underlying *Stabilised land surface* (SUERC-43662), and the model indicates that it formed in the late fifth/early fourth millennia cal BC.

Neolithic deposits and structures in the Principal palaeochannel

That part of the site chronological model relevant to the Neolithic deposits in the *Principal palaeochannel* also uses the posterior-density estimates for deposit formation, as derived from the deposit models for Bays B, D, and F. Most of these estimates relate to earlier Neolithic deposits (Fig 686), and they also include estimates used to date specific pollen events associated with the Elm Decline and the first occurrence of indicators for clearance/agriculture. As with the modelled Mesolithic channel deposits, these dates are entered into the model as OxCal 'Priors'. Similarly, dates that have been interpreted as too old, seemingly reflecting residual materials, are also used as *termini post quos* (After) for their parent units, whilst those that are too late have been excluded.

Dates from another monolith (70254) in Bay B, together with several dates derived from bulk samples and individually selected plant macrofossils/wood from Neolithic deposits have also been integrated into this part of the model (Table 417). These included two statistically inconsistent radiocarbon dates from monolith 70254 (SUERC-44775 and SUERC-44776), which relate to the *'Early Neolithic I'* phase. The earlier of these (SUERC-44775) might represent residual material, and has thus been included as a *terminus post quem* (After) in the overall model. In addition, monolith 70254 produced two other statistically inconsistent radiocarbon dates (SUERC-44772 and SUERC-44773), associated with the *'Late Neolithic'* phase, and the earlier of these (SUERC-44772) has been included as a *terminus post quem* (After) in the model (Fig 687).

The other dates on individually selected items include SUERC-32633, which dated short-lived material from adjacent to axehead 70353.30 (*Ch 8*); however, this was too late in comparison with other material from its parent unit, and so it has been excluded from the model. Similarly, SUERC-32634 and SUERC-44782, which were produced on short-lived materials in the vicinity of wooden paddle 75706 (*Ch 8*), were also much later than others from their parent deposit, and therefore these have also been excluded as active likelihoods within the model. In addition, a sample of hazelnut shell (SUERC-32692) was too late when compared with the other results from its stratigraphic unit and has, therefore, not been included as an active

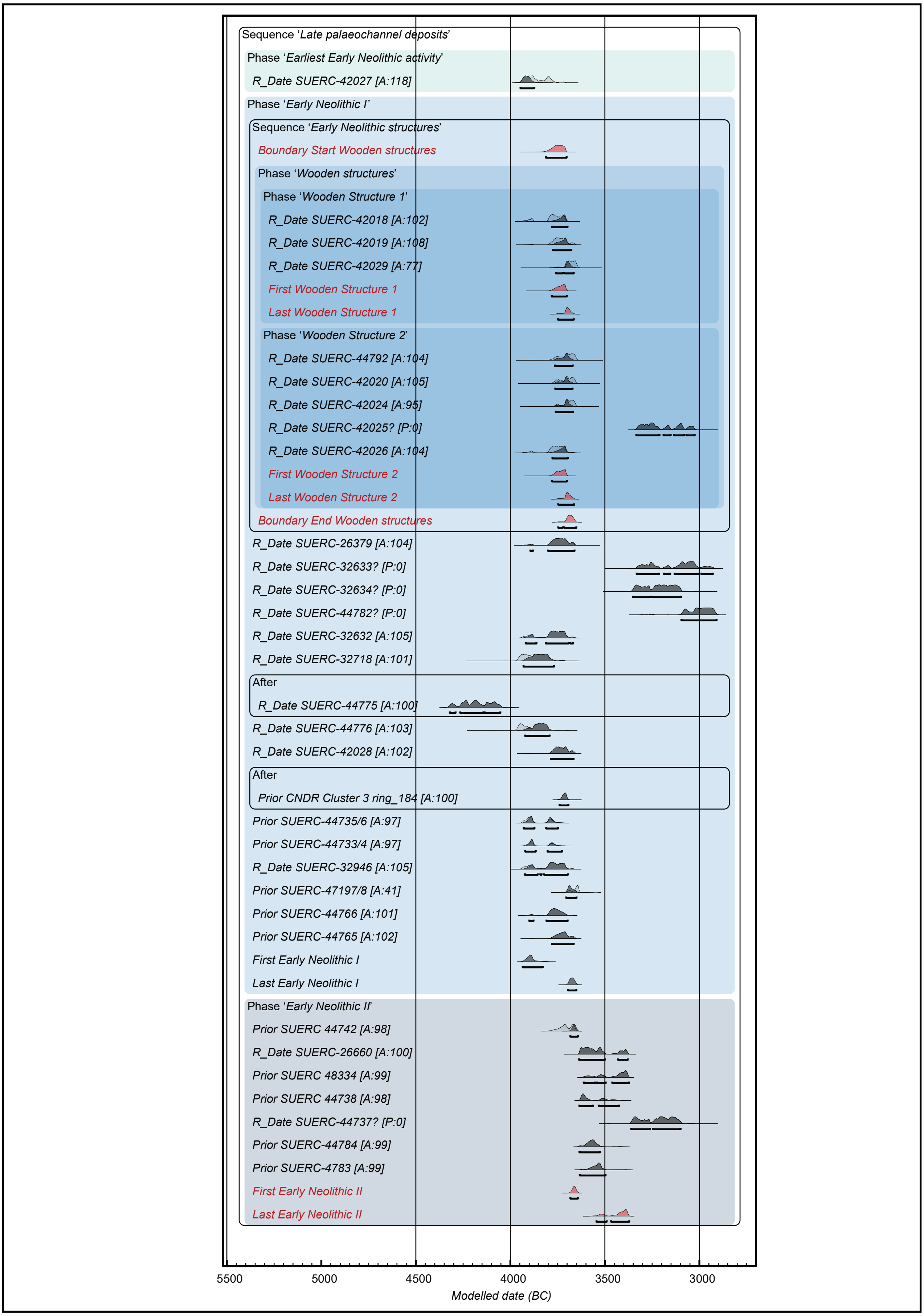

Figure 686: Posterior-density estimates for earlier Neolithic deposits/features within the Principal palaeochannel at Stainton West

OxCal Sequence	OxCal Phase	Monolith/ bay/ sample depth (mOD)	Laboratory code	Radiocarbon age (BP)	Inclusion in Bayesian models	*Posterior density estimate (95% confidence) cal BC*
'Late palaeochannel deposits'	*'Upper palaeochannel'* phase; *'Early Neolithic I'* sub-phase	70254; Bay F; 8.25	SUERC-44775	5350±35	Statistically inconsistent with duplicate date from same depth. *Terminus post quem* for deposit formation	*4330-4050*
			SUERC-44776	5090±35	Estimates date of deposit formation	*3930-3790*
		Bay A; 8.53	SUERC-32633	4440±35	Too late in comparison with other material from the same stratigraphic unit. Not included as active likelihood	-
		Bay C; 8.42-8.53	SUERC-32946	5000±35	Estimates date of deposit formation	*3930-3690*
		Bay F; 8.31-8.52	SUERC-32634	4510±30	Too late in comparison with other material from the same stratigraphic units. Not included as active likelihoods	-
			SUERC-44782	4384±35		
		Bay F; 8.42	SUERC-32632	4990±35	Estimates date of deposit formation	*3920-3660*
		Bay G; 8.46	SUERC-32718	5070±40	Estimates date of deposit formation	*3940-3760*
	'Upper palaeochannel' phase; *'Late Neolithic'* sub-phase	70254; 8.48	SUERC-44772	4596±35	Statistically inconsistent with duplicate date from same depth. *Terminus post quem* for deposit formation	*3520-3120*
			SUERC-44773	4423±35	Estimates date of deposit formation	*3330-2920*
		70254; 8.66	SUERC-32695	4180±35	Unreliable sediment date. Not included as active likelihood	-
		Bay B; 8.56-8.92	SUERC-32628	4675±35	Statistically inconsistent with duplicate date from same depth. *Terminus post quem* for deposit formation	*3630-3360*
			SUERC-44752	4380±35	Estimates date of deposit formation	*3100-2910*

Note: for details of the dated materials and deposits see Tables 386 and 388. See Table 391 for the results of the χ^2 tests on duplicate dates

Table 417: Modelled radiocarbon dates from monolith 70254, and individually selected wood/plant macrofossils from Bays A-C, F, and G, in the Principal palaeochannel*, Stainton West*

parameter in the model. Finally, a hazelnut shell (SUERC-32628) from a tree-throw (***70129***; *Ch 10*) within the channel was too old in comparison to a dated alder catkin (SUERC-44752) from the same feature, and has been included as a *terminus post quem* (After) in the model.

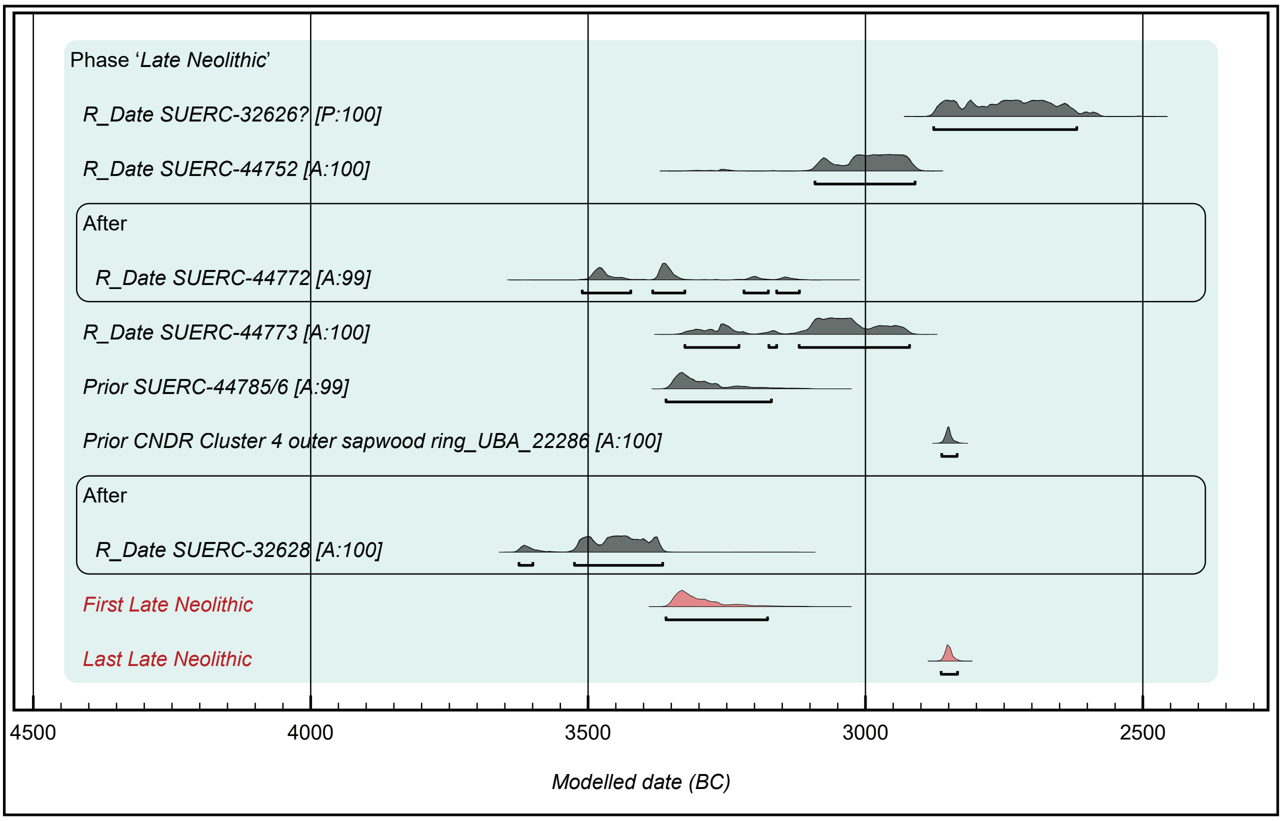

Figure 687: Posterior-density estimates for later Neolithic deposits/features within the Principal palaeochannel at Stainton West

Apart from the radiocarbon dates on short-lived materials from the monoliths and bulk samples, radiocarbon dates from anthropogenic material (structures and artefacts) within the *Principal palaeochannel* have also been employed in the model (Table 418). On stratigraphical grounds, Trident 1 (from the *Earlier Neolithic organic deposit*) has been assigned to the *'Early Neolithic I'* phase (*Ch 8*), whilst Trident 2 (from deposit ***70315*** (upper fraction), equivalent to the *Earlier Neolithic alluvium*) forms part of the *'Early Neolithic II'* phase (*Ch 8*). The other dated artefact from the *Principal palaeochannel* is the Grooved Ware vessel (SUERC-32626), which forms an element of the *'Late Neolithic'* phase (*Ch 10*). The wooden structures (***75935***; *Ch 8*; Wooden Structures 1 (***70264***) and 2 (***70467***; *Ch 8*) within the channel also produced radiocarbon measurements. Of these, ***75935*** was stratigraphically beneath Neolithic Trident 1 (*'Early Neolithic I'* phase) and on the strength of its radiocarbon date forms the only element of the *'Earliest Early Neolithic activity'* phase. Multiple measurements were obtained from Wooden Structures 1 and 2 (*'Wooden Structure 1'* and *'Wooden Structure 2'* sub-phases), and these measurements have been incorporated into an OxCal Sequence (*'Wooden structures'*), which allows estimates for the First and Last dated events from the structures to be calculated. A dated woodchip (SUERC-42025) was also recovered from Wooden Structure 2; however, this provided a date much later than the other results from the structure and its parent unit (*Earlier Neolithic organic deposit*). Therefore, it is probably an intrusive item and has been set as an outlier(?) within the model.

In addition, two Neolithic timbers (**75854** and **76503**) from the *Principal palaeochannel* were dated by dendrochronology and wiggle-matching, and these results have also been used in the model. Of these, the last dated ring (UBA-22286) from timber **75854**, from Cluster 4, provided a posterior-density estimate for its felling date. This vertically driven timber/stake has been included as an active likelihood in the model (*Prior CNDR Cluster 4 outer sapwood ring UBA-22286*) for dating the *'Late Neolithic'* phase within the channel. Timber **76503**, from Cluster 3 (*Prior CNDR Cluster 3 ring_184*), was a radially split oak plank (*Ch 8*), and the estimate includes an unknown inbuilt 'old-wood' offset, as the last dated ring from this was a heartwood ring. Accordingly, this provides a *terminus post quem* (After) for the *'Early Neolithic I'* phase.

The chronometric data derived from these sources provide a fairly comprehensive series of estimates for the dates of the earlier Neolithic deposits and structures in the *Principal palaeochannel*. From these, it seems that, initially, structure ***75953*** (perhaps a fish trap; *Ch 8*), associated with the *'Earliest Early Neolithic*

OxCal Sequence	OxCal Phase	Artefact/ structure	Laboratory code	Radiocarbon age (BP)	Inclusion in Bayesian models	*Posterior density estimate (95% confidence) cal BC*
'Late palaeochannel deposits'	*'Upper palaeochannel'* phase; *'Earliest Early Neolithic activity'* sub-phase	Structure ***75935***	SUERC-42027	5037±26	Stratigraphically underlies Trident 1. Estimates date of the structure	*3950-3870*
Late palaeochannel deposits'; *'Early Neolithic structures'*	*'Upper palaeochannel'* phase; *'Wooden Structures'* sub-phase; *'Wooden Structure 1'* sub-phase	Wooden Structure 1 (***70264***)	SUERC-42018	4995±26	Estimates date of the structure	*3780-3690*
			SUERC-42019	4963±26		*3780-3680*
			SUERC-42029	4901±26		*3770-3660*
	'Upper palaeochannel' phase; *'Wooden Structures'* sub-phase; *'Wooden Structure 2'* sub-phase	Wooden Structure 2 (***70467***)	SUERC-44792	4930±35		*3770-3670*
			SUERC-42020	4935±26		*3770-3670*
			SUERC-42024	4928±23		*3770-3670*
			SUERC-42026	4985±26		*3780-3690*
			SUERC-42028	4928±23	Relates to the use of Wooden Structure 2, and associated with alder woodworking	*3780-3680*
			SUERC-42025	4464±23	Woodchip recovered from Wooden Structure 2; too late in comparison with other results. Not included as an active likelihood	-
'Late palaeochannel deposits'	*'Upper palaeochannel'* phase; *'Early Neolithic I'* sub-phase	Trident 1	SUERC-26379	4965±35	Estimates date of Trident 1	*3900-3660*
	'Upper palaeochannel' phase; *'Early Neolithic II'* sub-phase	Trident 2	SUERC-26660	4745±35	Estimates date of Trident 2	*3640-3370*
	'Upper palaeochannel' phase; *'Late Neolithic'* sub-phase	Organic residue on Grooved Ware vessel	SUERC-32626	4145±35	Estimates use of Grooved ware vessel	*2880-2610*

Note: for details of the dated materials, deposits, and locations see Tables 386-8

Table 418: Modelled radiocarbon dates from Neolithic structures and artefacts from the Principal palaeochannel, *Stainton West*

activity', was constructed in the *3950-3870 cal BC* (SUERC-42027). This was closely followed by construction of Wooden Structures 1 and 2, the model estimating the first use of Wooden Structure 1 (***70264***) as *3790-3700 cal BC* (*First Wooden Structure 1*) and the last dated event at *3750-3660 cal BC* (*Last Wooden Structure 1*). Similarly, the first dated event associated with the use of Wooden Structure 2 (***70467***) is *3780-3700 cal BC* (*First Wooden Structure 2*), whilst the last dated event associated with the use of this structure is *3750-3660 cal BC* (*Last Wooden Structure 2*). It is highly probable, however, that both were elements of a single structure (*Ch 8*). Hence, an estimate for the start of use of both is *3820-3700 cal BC* (*Start Wooden structures*). The last dated event associated with the use of this structure is *3750-3650 cal BC* (*End Wooden structures*). The model also indicates that, together, these structures were in use for *0-100 years* (*Duration use structures*).

The model also provides estimates for the formation of the *'Early Neolithic I'* deposit, which was associated with Wooden Structures 1 and 2 (*above*), Trident 1, and plank **76503**. It suggests that this began to form in *3940-3820 cal BC* (*First Early Neolithic I*'), whilst the last dated event associated with its formation is *3700-3650 cal BC* (*Last Early Neolithic I*; Fig 688). In addition, the model also provides chronological estimates for the formation of the *'Early Neolithic II'* deposit, which was associated with Trident 2. An estimate for the start of the formation of this deposit is estimated as *3690-3640 cal BC* (*First Early Neolithic II*), and the last dated event associated with its formation is estimated as *3550-3370 cal BC* (*Last Early Neolithic II*).

Apart from estimating the dates of the earlier Neolithic structures and deposits, the model provides some, albeit lesser, chronological detail for the later Neolithic deposits in the channel. For instance, it suggests, based on the first dated estimate, that the '*Late Neolithic*' deposit began to form in *3360-3170 cal BC* (*First Late Neolithic*), whilst the last estimate dates to *2870-2830 cal BC* (*Last Late Neolithic*).

Neolithic dryland activity

The model uses a series of radiocarbon dates derived from Neolithic features and deposits adjacent to the *Principal palaeochannel* and within the *Grid-square area*, allowing the dates of Neolithic dryland activity to be estimated (Fig 689). The data incorporated into this part of the model comprise five radiocarbon dates, from the earlier Neolithic period, which can be associated with the *'Early Neolithic activity in the Grid-square area'* sub-phase (Table 419). Four of the dated samples (SUERC-32708, SUERC-59307, SUERC-41994, and SUERC-32707) came from three tree-throws (***90262***, ***90508***, and ***90531***), one of which (***90262***) also contained residual Late Mesolithic material that appears to have been introduced into the feature when the tree was felled (*Ch 4; Ch 8*). This material comprised lithics (*Appendix 9*) and two dated charcoal fragments (SUERC-32637 and SUERC-42591), one of which was probably associated with activity in the *'Mesolithic encampment I'* phase. In the model, these Late Mesolithic dates have been used as *termini post quos* (After) for the filling of tree-throw ***90262***, being assigned to the *'Residual Mesolithic material in tree-throws'* sub-phase. The remaining dated Neolithic sample (SUERC-32643) came from a Late Mesolithic *Stabilised land surface* and is therefore an intrusive item within this surface; in terms of dating earlier Neolithic activity at the site, this result has been used as an active likelihood in the model.

Other Neolithic features related to later Neolithic activity in the dryland areas, including Burnt Mound 1, Burnt Mound 5 (*'Burnt Mounds 1 and 5'* sub-phase; *Ch 10*), and tree-throw ***90522*** (*'Tree-throw 90522'* sub-phase; *Ch 10*). Burnt Mound 5 produced two statistically consistent results (SUERC-32717 and SUERC-42007), which are included as active likelihoods in the model, whilst Burnt

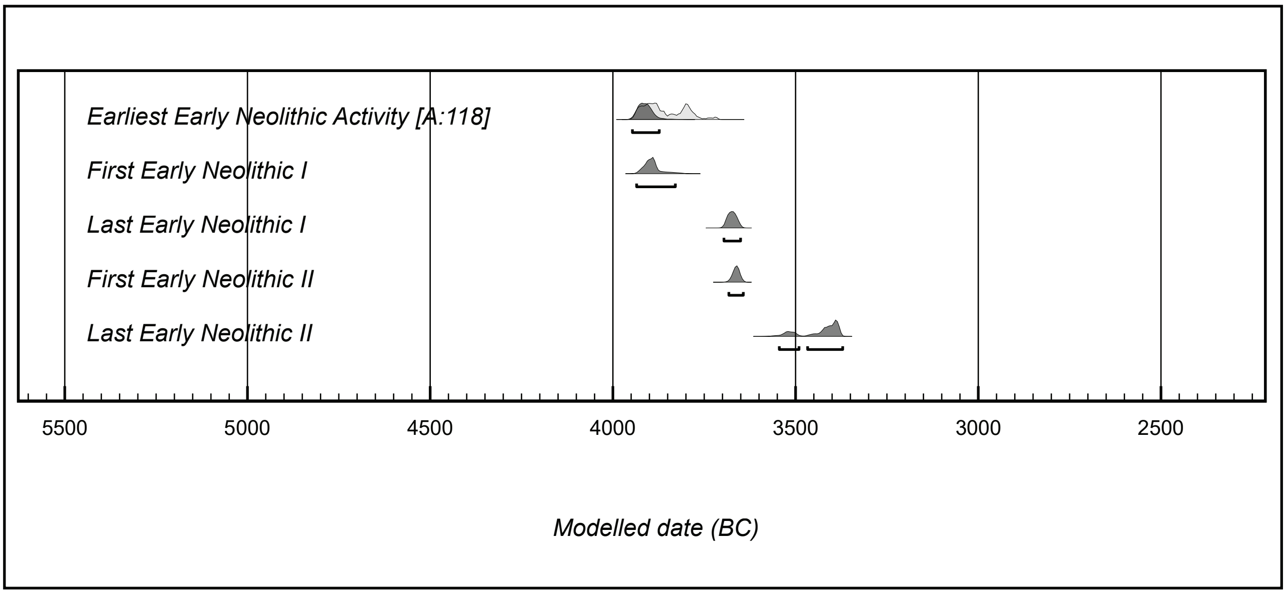

Figure 688: Posterior-density estimates for key earlier Neolithic parameters from the Principal palaeochannel, *at Stainton West*

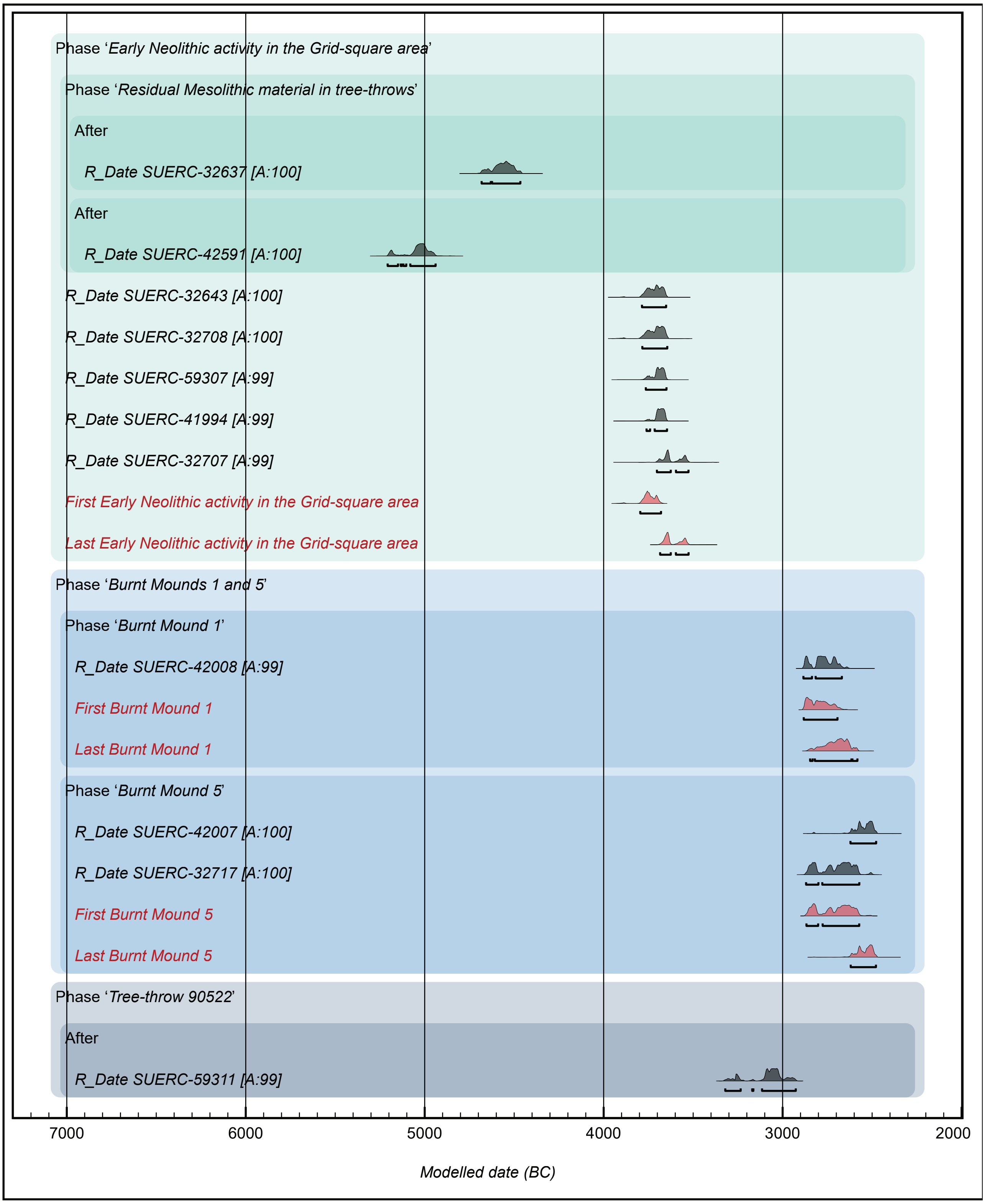

Figure 689: Posterior-density estimates for Neolithic dryland activity at Stainton West

Mound 1 produced three results (SUERC-32827, SUERC-42008, and SUERC-42009). One of these (SUERC-32827) was produced on undifferentiated sediment and has not, therefore, been included as an active likelihood in the model. The other two (SUERC-42008 and SUERC-42009), however, are statistically consistent and have been used as active likelihoods. Tree-throw ***90522*** produced two diverse results (SUERC-59311 and SUERC-59312). The earlier (SUERC-59311) has thus been used as a *terminus post quem* (After) for the filling of the feature, but the later result (SUERC-59312; *below*) has not been included as an active likelihood in the model.

OxCal Sequence	OxCal Phase	Feature/ deposit	Laboratory code	Radiocarbon age (BP)	Inclusion in Bayesian models	*Posterior density estimate (95% confidence) cal BC*
-	*'Upper palaeochannel'* phase; *'Neolithic dryland activity'* sub-phase; *'Early Neolithic activity in the Grid-square area'* sub-phase; *'Residual Mesolithic material in tree-throws'* sub-phase	Tree-throw ***90262***	SUERC-42591	6105±29	Charcoal derives from Mesolithic activity. *Terminus post quem* for tree-throw	*5210-4930*
			SUERC-32637	5720±35		*4690-4460*
-	*'Upper palaeochannel'* phase; *'Neolithic dryland activity'* sub-phase; *'Early Neolithic activity in the Grid-square area'* sub-phase	Tree-throw ***90262***	SUERC-41994	4917±23	Statistically consistent dates. Estimate date of tree-throw	*3770-3640*
			SUERC-59307	4925±26		
		Tree-throw ***90508***	SUERC-32707	4840±40	Estimates date of tree-throw	*3710-3520*
		Tree-throw ***90531***	SUERC-32708	4930±40	Estimates date of tree-throw	*3790-3640*
		Stabilised land surface	SUERC-32643	4940±35	Estimates date for early Neolithic activity	*3790-3650*
-	*'Upper palaeochannel'* phase; *'Neolithic dryland activity'* sub-phase; *'Burnt Mounds 1 and 5'* sub-phase; *'Burnt Mound 1'* sub-phase	Burnt Mound 1	SUERC-42008	4178±26	Statistically consistent duplicate dates. Estimate date of Burnt Mound 1	*2890-2660*
			SUERC-42009	4124±23		*2870-2580*
			SUERC-32827	4925±30	Unreliable sediment date. Not included as an active likelihood	-
-	*'Upper palaeochannel'* phase; *'Neolithic dryland activity'* sub-phase; *'Burnt Mounds 1 and 5'* sub-phase; *'Burnt Mound 5'* sub-phase	Burnt Mound 5	SUERC-32717	4110±35	Statistically consistent duplicate dates. Estimate date of Burnt Mound 5	*2880-2570*
			SUERC-42007	4035±26		*2630-2470*
-	*'Upper palaeochannel'* phase; *'Neolithic dryland activity'* sub-phase; *'Tree-throw 90522'* sub-phase	Tree-throw ***90522***	SUERC-59311	4428±26	*Terminus post quem* for tree-throw	*3330-2920*
			SUERC-59312	2930±29	Intrusive material. Not included as active likelihood	-

Note: for details of the dated materials, deposits, and locations see Tables 393 and 396. See Tables 394 and 397 for the results of the χ^2 tests on duplicate dates

Table 419: Modelled radiocarbon dates from Neolithic dryland features and deposits, Stainton West

Significantly, the modelled results provide estimates for several key parameters associated with Neolithic dryland activity (Fig 690). One relates to the period in which earlier Neolithic dryland activity occurred, estimated as beginning at *3800-3680 cal BC* (*First Early Neolithic activity in the Grid-square area*) and continuing until *3690-3520 cal BC* (*Last Early Neolithic activity in the Grid-square area*). In terms of later Neolithic activity, the first dated event associated with Burnt Mound 1 places this at *2890-2690 cal BC* (*First Burnt Mound 1*) and the last dated event estimates that this occurred in *2850-2580 cal BC* (*Last Burnt Mound 1*). The first dated event associated with the other later Neolithic burnt mound (Burnt Mound 5) estimates that this was first used in *2870-2570 cal BC* (*First Burnt Mound 5*); the last estimate

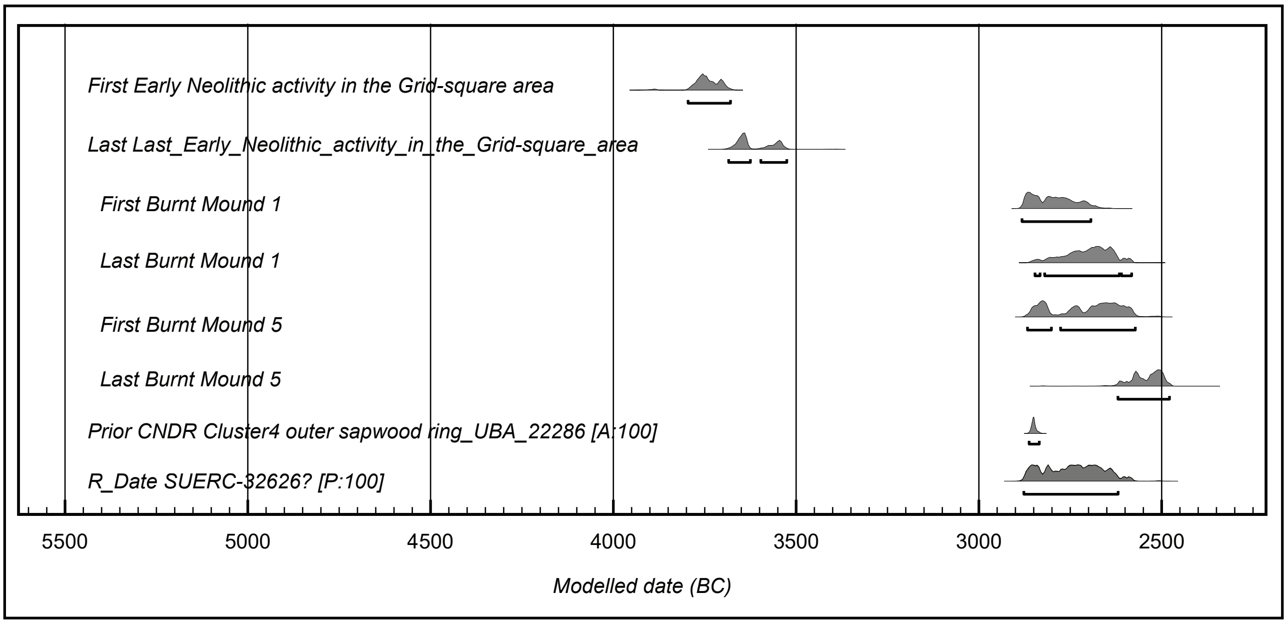

Figure 690: Posterior-density estimates for key Neolithic parameters from the dryland area at Stainton West

associated with its use suggests that this occurred in *2620-2470 cal BC* (*Last Burnt Mound 5*). Two results from tree-throw ***90522*** are not statistically consistent (*above*); the earlier has been used as a *terminus post quem* (After) and this may suggest that the activity associated with this feature occurred in *3330-2920 cal BC* (SUERC-59311).

Chalcolithic and Bronze Age activity
The chronological model has also been used to estimate the date of Chalcolithic deposits and features in the *Principal palaeochannel*, and Bronze Age activity in the adjacent dryland areas (Fig 691). For the part that relates to the channel, this incorporates the modelled dates from the deposit models for Bays D and F. These are entered as OxCal 'Priors', with one date (SUERC-44745) being set as a *terminus post quem* (After) for deposit formation. This part of the model also incorporates the radiocarbon-dating evidence from monolith 70303, which sampled Burnt Mound 6 (Table 420). Two samples were dated from this burnt mound, though only SUERC-42017 has been used as an active likelihood in the model, as SUERC-42016 was produced on sediment. Significantly, apart from dating the burnt mound to the Chalcolithic period, SUERC-42017 also provides a *terminus ante quem* for the underlying *Later Neolithic organic deposit* (part of the *'Late Neolithic'* phase).

In the dryland area, Earlier Bronze Age activity was initially represented by Burnt Mound 2 (*'Burnt Mound 2'* phase). This produced two statistically consistent radiocarbon dates (SUERC-32714 and SUERC-42015), allowing estimates to be made for the First and Last use of this burnt mound. The next phase of Bronze Age activity (*'Bronze Age activity (post-Bronze Age alluvium)'* sub-phase) comprises Burnt Mound 3 (*'Burnt Mound 3'* sub-phase), Burnt Mound 4 (*'Burnt Mound 4'* sub-phase), hearth ***100020*** (*'Hearth 100020'* sub-phase), pit ***100026*** (*'Pit 100026'* sub-phase), posthole ***100033*** (*'Posthole 100033'* sub-phase), and hearth ***90217*** (*'Hearth 90217'* sub-phase). Single radiocarbon assays were made on materials from Burnt Mound 4 (SUERC-32716), hearth ***100020*** (SUERC-32713), pit ***100026*** (SUERC-32627), and posthole ***100033*** (SUERC-32712).

Two samples from hearth ***90217*** produced statistically consistent results (SUERC-41997 and SUERC-32644), whilst Burnt Mound 3 produced four statistically consistent results (SUERC-32715, SUERC-42006, SUERC-42010, and SUERC-42014), which have been incorporated into a simple OxCal model (Sequence *'Burnt Mound 3'*), providing estimates for the Start and End use of this feature. Cooking pit/hearth ***90434*** also produced an earlier Bronze Age date (SUERC-32638; *Ch 4*); however, this feature relates to Late Mesolithic activity in the *Grid-square area*, and it also contained other fragments of charcoal, which have been dated to the Mesolithic (SUERC-41995) and post-medieval (SUERC-41996; *below*) periods. As such, the earlier Bronze Age result has not been included as an active likelihood in the model.

Two samples (SUERC-59312 and SUERC-59306), extracted from features in the *Grid-square area*, produced later Bronze Age dates; however, these date intrusive materials in Late Neolithic tree-throw ***90522*** and pit ***90309***, which, based on the lithic evidence, is probably Late Mesolithic in origin (*Ch 3*). Therefore, these results are not included as active likelihoods in the chronological model.

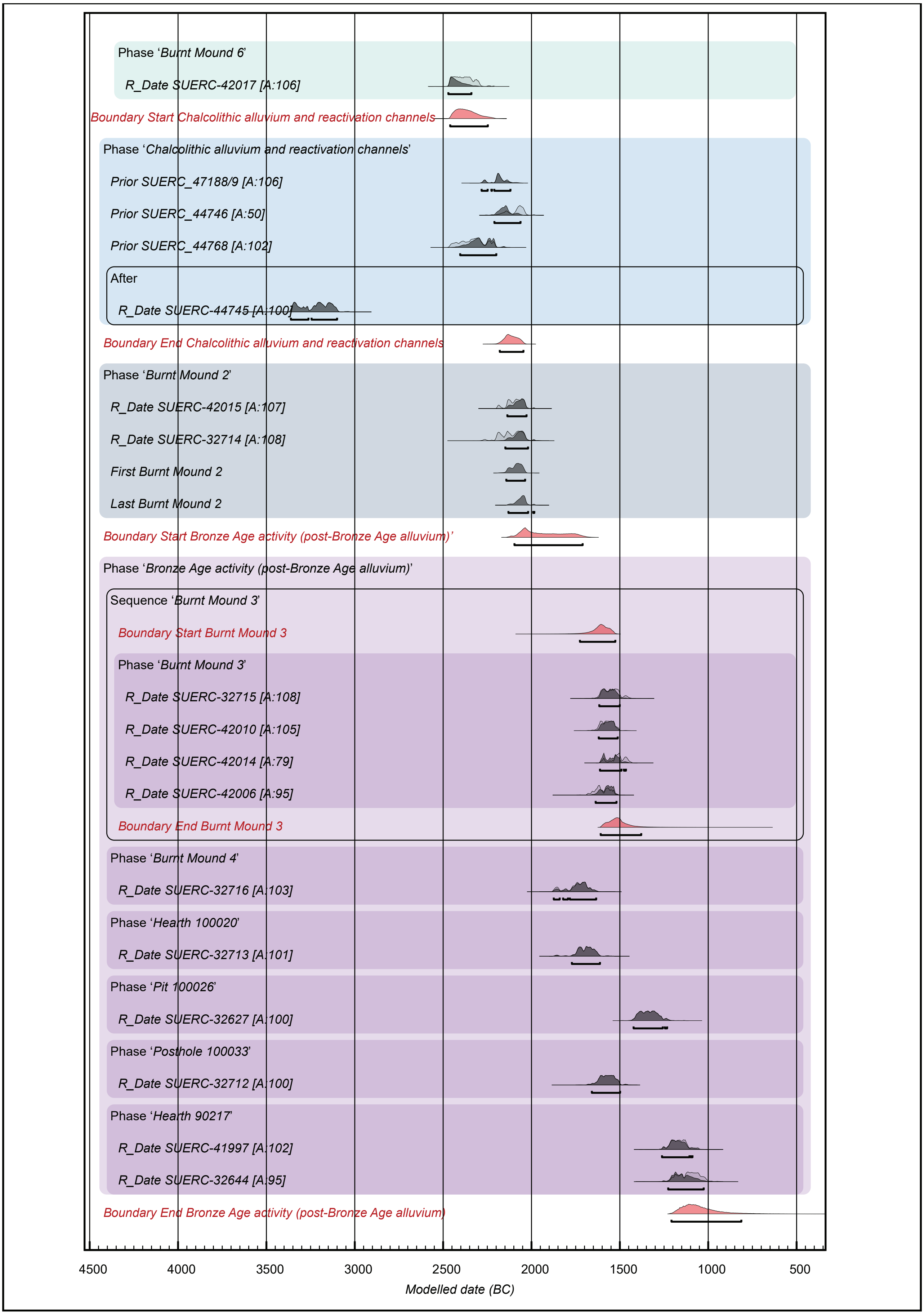

Figure 691: Posterior-density estimates for Chalcolithic and Bronze Age activity at Stainton West

OxCal Sequence	OxCal Phase	Feature/deposit	Laboratory code	Radiocarbon age (BP)	Inclusion in Bayesian models	*Posterior density estimate (95% confidence) cal BC*
'Late palaeochannel deposits'	*'Upper palaeochannel'* phase; *'Burnt Mound 6'* sub-phase	Burnt Mound 6 (monolith 70303; 8.56 mOD)	SUERC-42016	3935±26	Unreliable sediment date. Not included as active likelihood	-
		Burnt Mound 6 (monolith 70303; 8.55 mOD)	SUERC-42017	3891±26	Estimates date of deposit formation	*2480-2340*
-	*'Burnt Mound 2'* phase	Burnt Mound 2	SUERC-32714	3720±35	Statistically consistent dates. Estimate date of Burnt Mound 2	*2150-2020*
			SUERC-42015	3703±23		*2140-2020*
'Burnt Mound 3'	*'Bronze Age activity (post-Bronze Age alluvium)'* phase; *'Burnt Mound 3'* sub-phase	Burnt Mound 3	SUERC-32715	3270±35	Statistically consistent dates. Estimate date of Burnt Mound 3	*1620-1500*
			SUERC-42006	3324±26		*1640-1510*
			SUERC-42010	3297±26	Statistically consistent dates. Estimate date of Burnt Mound 3	*1630-1510*
			SUERC-42014	3240±26		*1620-1460*
-	*'Bronze Age activity (post-Bronze Age alluvium)'* phase; *'Burnt Mound 4'* sub-phase	Burnt Mound 4	SUERC-32716	3430±35	Estimates date of Burnt Mound 4	*1880-1630*
	'Bronze Age activity (post-Bronze Age alluvium)' phase; *'Hearth 100020'* sub-phase	Hearth ***100020***	SUERC-32713	3395±35	Estimates date of hearth ***100020***	*1780-1610*
	'Bronze Age activity (post-Bronze Age alluvium)' phase; *'Pit 100026'* sub-phase	Pit ***100026***	SUERC-32627	3075±35	Estimates use of bucket-shaped vessel	*1430-1230*
	'Bronze Age activity (post-Bronze Age alluvium)' phase; *'Posthole 100033'* sub-phase	Posthole ***100033***	SUERC-32712	3295±35	Estimates date of posthole ***100033***	*1660-1490*
	'Bronze Age activity (post-Bronze Age alluvium)' phase; *'Hearth 90217'* sub-phase	Hearth ***90217***	SUERC-32644	2915±35	Statistically consistent dates. Estimate date of hearth ***90217***	*1230-1020*
			SUERC-41997	2956±26		*1270-1080*

Note: for details of the dated materials, deposits, and locations see Tables 389, 393, 396, and 398. See Tables 394, 395, and 397 for the results of the χ^2 tests on duplicate dates

Table 420: Modelled radiocarbon dates from Chalcolithic and Bronze Age features and deposits, Stainton West

As with other periods, that part of the chronological model relevant to the Chalcolithic and Bronze Age radiocarbon dates also allows estimates to be made for several key parameters (Fig 692). One relates to the use of Burnt Mound 6, within the channel, being estimated to date to *2480-2340 cal BC* (SUERC-42017), whilst another relates to alluvial deposition, specifically that associated with the *Chalcolithic alluvium*. The model estimates that this began forming in *2470-2240 cal BC* (*Start Chalcolithic alluvium and reactivation channels*), while an estimate for the end of this formation is *2180-2040 cal BC* (*End Chalcolithic alluvium and reactivation channels*).

Beyond the palaeochannel, Burnt Mound 2 is estimated to have been in use in *2150-2030 cal BC* (*First Burnt Mound 2*), and the last use of this feature is estimated to have occurred in *2140-1980 cal BC* (*Last Burnt Mound 2*). Following its use, the mound was sealed by a deposit of *Bronze Age alluvium* (*Ch 11*), after which Bronze Age activity resumed as part of the '*Bronze Age activity (post-Bronze Age Alluvium)*' phase, which is estimated to have begun in *2100-1710 cal BC* (*Start Bronze Age activity (post-Bronze Age Alluvium)*).

The use of Burnt Mound 3 is estimated to have begun in *1730-1520 cal BC* (*Start Burnt Mound 3*),

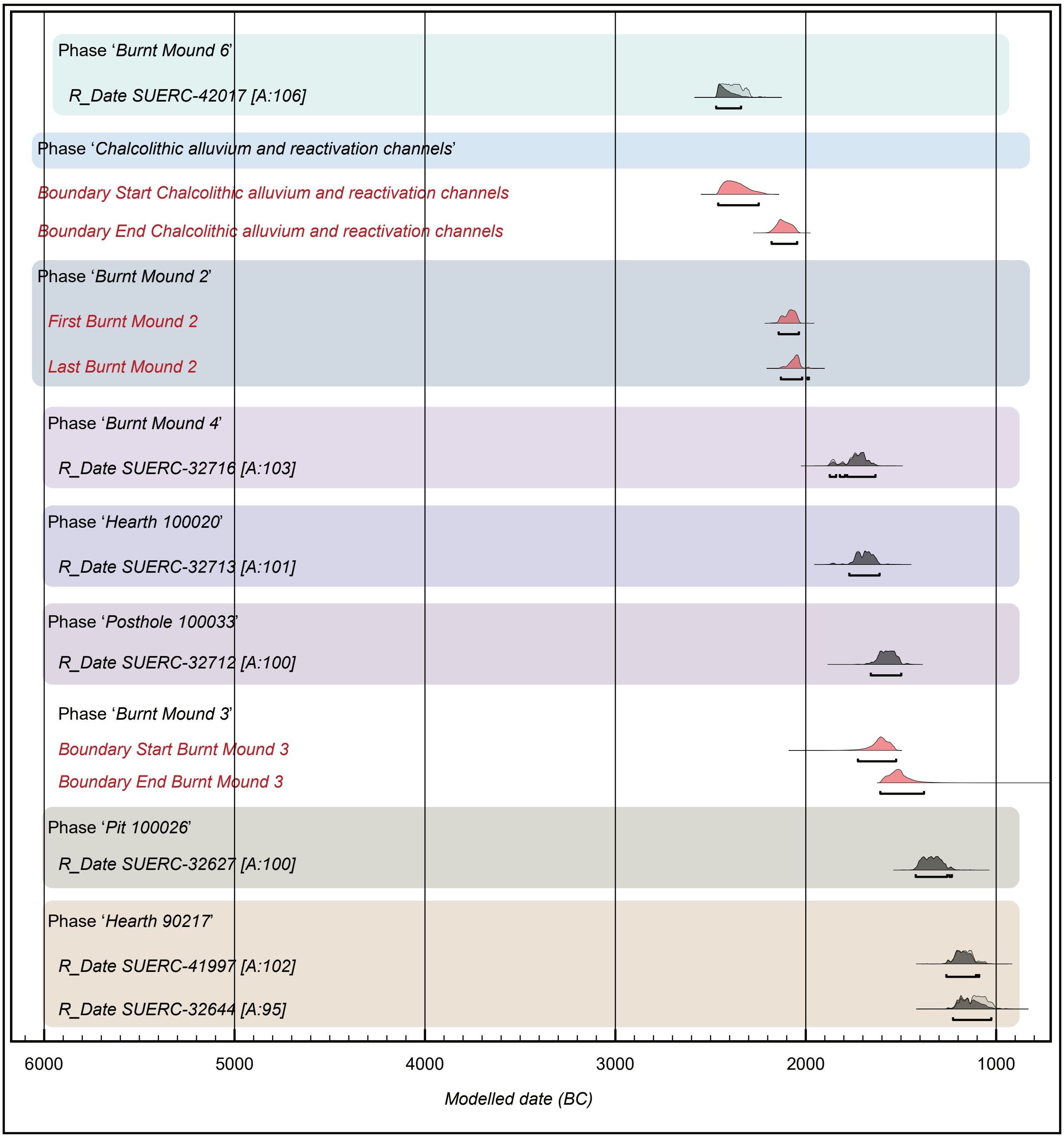

Figure 692: Posterior-density estimates for key Chalcolithic and Bronze Age parameters, at Stainton West

while its last use is estimated to have occurred in *1610-1370 cal BC* (*End Burnt Mound 3*). A measurement from Burnt Mound 4 places its use in *1880-1630 cal BC* (SUERC-32716). Hearth ***100020*** is estimated to have been in use in *1780-1610 cal BC* (SUERC-32713), activity associated with pit ***100026*** occurred in *1430-1230 cal BC* (SUERC-32627), whilst activity associated with posthole ***100033*** occurred in *1660-1490 cal BC* (SUERC-32712). Two radiocarbon dates estimate the use of hearth ***90217*** in *1270-1080 cal BC* (*SUERC-41997)* and *1230-1020 cal BC* (SUERC-32644). The end of Bronze Age dryland activity is estimated to have occurred in *1210-810 cal BC* (*End Bronze Age activity (post-Bronze Age Alluvium)*).

Later activity
Several post-medieval dates were obtained from charcoal fragments and charred plant remains from features that, on the basis of artefactual evidence and, in some instances, other dated samples, were probably extant in the Late Mesolithic period. Given this, these results have not been included as active likelihoods in the model. They were obtained from hearth ***90593***, which was associated with Mesolithic worked stone; hearth ***90434***, which was associated with Mesolithic worked stone and also produced a Late Mesolithic radiocarbon date; stone-spread ***90396***, which was associated with Mesolithic worked stone and produced Late Mesolithic dates; and tree-throw ***90448***, which was also associated with Mesolithic worked stone and produced a Late Mesolithic date.

Querying the model
Following the construction of the model, several additional queries were run to answer specific chronological questions:

What is the duration from the start of 'Earliest Mesolithic activity' *to the end of* 'Mesolithic encampment II'*?* The span of activity represented by the parameter *First Earliest Mesolithic activity* and the parameter *Last Mesolithic encampment II* is *1540-1700 years*.

What is the duration from the start of 'Mesolithic encampment I' *to the end of* 'Mesolithic encampment II'*?* The span of activity represented by the parameter *First Mesolithic encampment I* and the parameter *Last Mesolithic encampment II* is *90-320 years*.

What is the gap of time between the end of 'Mesolithic encampment II' *and the* 'Earliest Early Neolithic activity'*?* The difference between the *'Earliest Early Neolithic activity'* (represented by posterior-density estimate *SUERC-42027*) and the latest Mesolithic activity (represented by the posterior-density estimate *Last Mesolithic encampment II*) is *400-540 years*.

What is the gap of time between the end of 'Mesolithic encampment II' *and activity associated with* 'Early Neolithic I' *activity?* The difference between the *'Early Neolithic I'* activity (represented by the parameter *First Early Neolithic I*) and the latest Mesolithic activity (represented by the posterior-density estimate *Last Mesolithic encampment II*) is *420-560 years*.

What is the duration from the start of the 'Early Neolithic I' *activity to the end of* 'Early Neolithic II' *activity?* The span of activity represented by the parameter *First Early Neolithic I* and the parameter *Last Early Neolithic II* is *340-550 years*.

What is the gap of time between 'Early Neolithic I' *activity and* 'Early Neolithic II' *activity?* The difference between the parameter *First Early Neolithic I* and the parameter *First Early Neolithic II* is *160-280 years*.

What is the duration from the start of the 'Earliest Early Neolithic activity' *to the end of* 'Early Neolithic II' *activity?* The span of activity represented by the *'Earliest Early Neolithic activity'* (represented by posterior-density estimate SUERC-42027) and the end of the *'Early Neolithic II'* activity (*Last Early Neolithic II*) is *360-560 years*.

What is the gap of time between the age of Trident 1 and Trident 2? The difference between the relative ages of Trident 1 and Trident 2 is *30-350 years* (*95% probability*) or 70-210 years (*68% probability*).

Parcel 42: modelling the chronology of the early medieval settlement

For the chronology of the early medieval settlement at Parcel 42 to be examined, the radiocarbon results from this settlement were subjected to Bayesian modelling. The results were derived from charred plant remains and charcoal, those employed in the model being seven of the eight radiocarbon results obtained from the site. These results are statistically consistent, and they imply that the buildings, and other features forming the settlement, were broadly contemporaneous, which is also suggested by the spatial positioning of the buildings (*Ch 14*). The remaining date (SUERC-42040) from the site was excluded as an active likelihood, as this was clearly anomalous, and appears to derive from intrusive post-medieval material.

Results
Based on the statistically consistent dates, the model suggests that the structures at the site were first constructed in cal *AD 710-880* (*Boundary Start*; Fig 693). An estimate for the last use of these structures is cal *AD 780-950* (*Boundary End*). It is estimated that

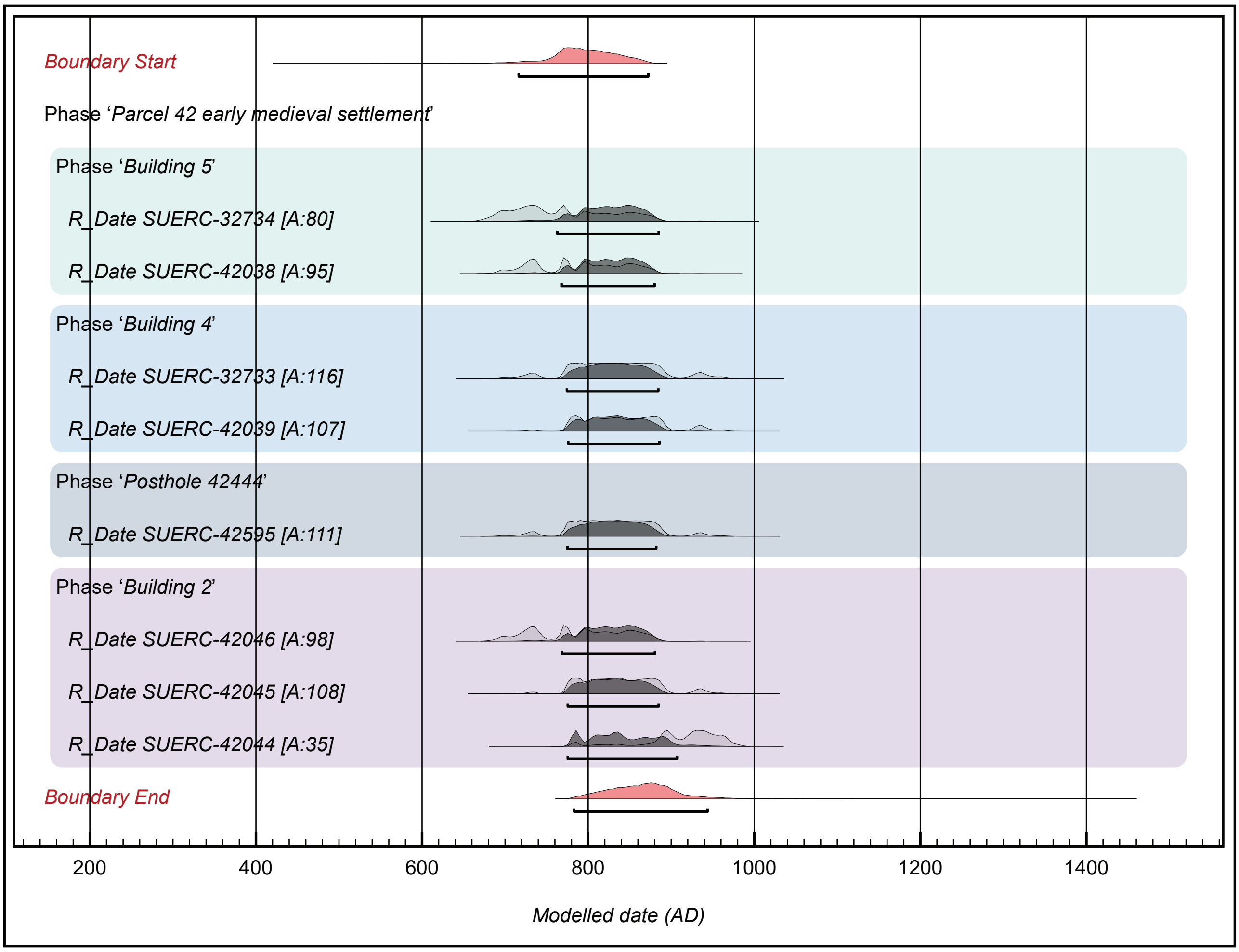

Figure 693: Posterior-density estimates for the Parcel 42 early medieval settlement

the activity sampled from the buildings went on for *1-150 years* (Fig 694).

Ordering prehistoric activity

Following the completion of the radiocarbon dating programme and modelling, order analysis was undertaken as a means of determining the chronological relationships between the dated deposits, features, structures, objects, and key palaeoenvironmental events. This analysis was performed using the 'Order' function in OxCal v4.3.2, which provides a probability (%) for a specific date being earlier (<) than another specific date. With this analysis, those probabilities which fall close to 50% have a greater chance of being contemporaneous. This analysis considered the key parameters from Stainton West and all of the Bronze Age dates derived from the CNDR scheme.

Results

Based on the results of the order analysis, several of the Mesolithic parameters, which fall within the 40-60% probability range, might be broadly contemporaneous (Table 421). These include *First Mesolithic organic deposit II*, which may have been contemporary with *First Mesolithic tree-throws/activity* and the *Last Mesolithic/Neolithic alluvium I*, which was seemingly contemporary with the *First Mesolithic encampment I*.

Of the earlier Neolithic parameters (Table 422), it is evident that much of the activity and many of the palaeoenvironmental events were possibly contemporaneous. For instance, the *First Early Neolithic activity in the Grid-square area* was probably contemporary with the construction of the wooden structures (*Start Wooden structures*) in the palaeochannel, and also the placement of Trident 1 into this feature, and *Elm declining to presence F*. It is also possible that *Cereal-type pollen B* was synchronous with this activity.

The *End Wooden structures* could be contemporary with the *Elm Decline Demise B*, which is an event that was possibly contemporary with *Last Early Neolithic I* and *First Early Neolithic II*. There seems a strong likelihood that the placement of Trident 2 in the palaeochannel was contemporary with *Elm Decline Demise D*, whilst, similarly, there is a strong possibility that *Last Early Neolithic activity in the Grid-square area*

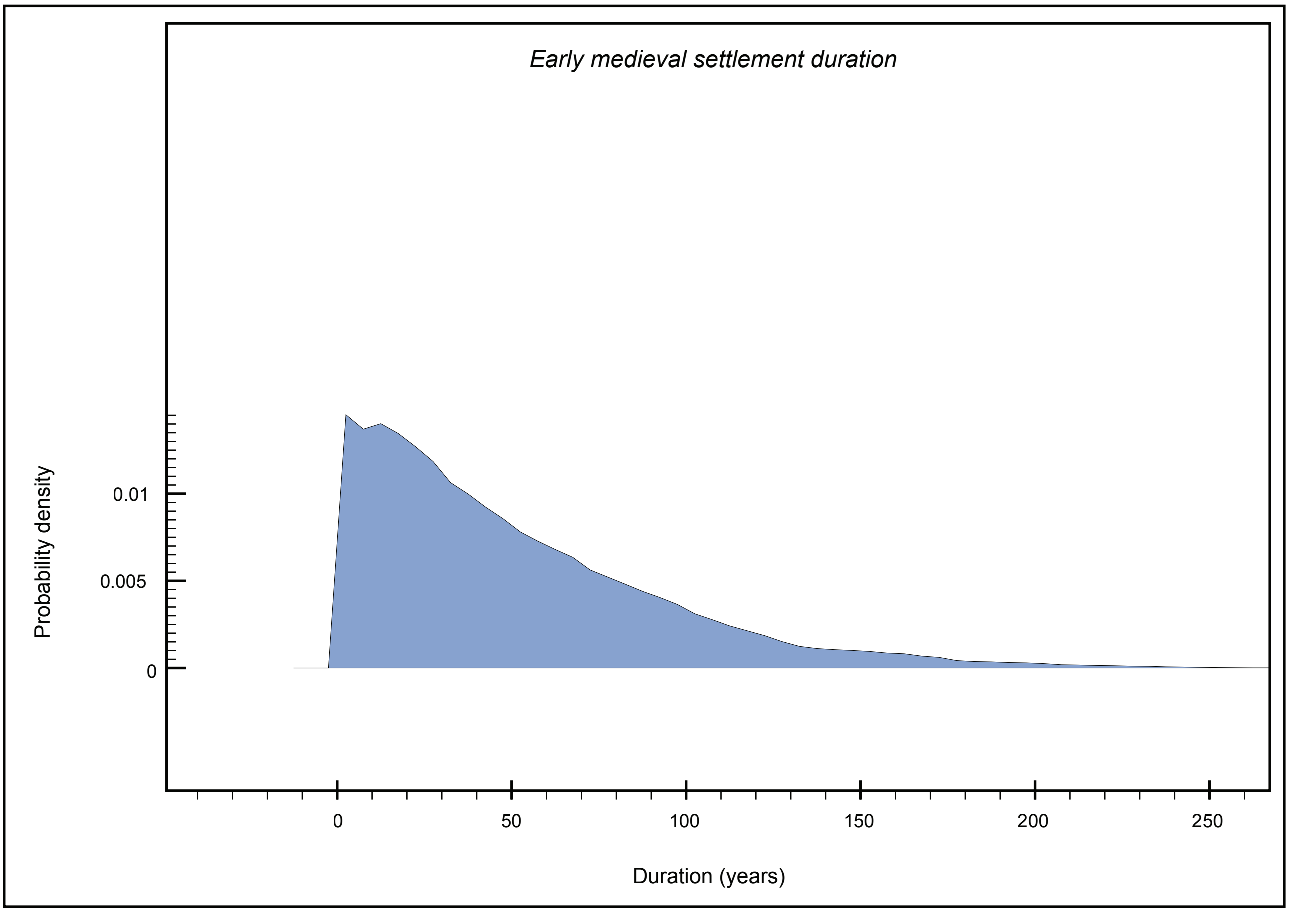

Figure 694: The duration of the Parcel 42 early medieval settlement

occurred at the same time as *Cereal-type pollen D*, and that *Ribwort plantain D* was contemporaneous with *Cluster 3 ring_184.*

With the later Neolithic parameters (Table 423), it appears that *Last Late Neolithic* was contemporary with *Cluster 4 outer sapwood ring UBA-22286*, whilst it is possible that the last use of Burnt Mound 1 was contemporary with the first use of Burnt Mound 5.

The only Bronze Age parameters that might have been contemporary (Table 424) were ditch ***41003*** (Parcel 41: *Ch 11*) and House 2 (Parcel 9; *Ch 11*). It is also possible that, when ditch ***41003*** (Parcel 41; *Ch 11*) was established, Houses 4 and 6 (Parcel 42; *Ch 11*) were occupied. By implication, Houses 2, 4, and 6 may also have been contemporary, particularly as these lay very close to the 40% probability level (*ie* there is a 35.48% that Houses 4 and 6 occurred before House 2).

	Probability (%) $t_1<t_2$																	
t_1	**t_2**																	
	First Earliest Mesolithic activity	*Last Earliest Mesolithic activity*	*Cluster 1 ring_219*	*First Mesolithic organic deposit I*	*Last Mesolithic organic deposit I*	*Cluster 5 ring_90*	*First Mesolithic organic deposit II*	*Last Mesolithic organic deposit II*	*First Mesolithic tree-throws/activity*	*Last Mesolithic tree-throws/activity*	*First Mesolithic/ Neolithic alluvium I*	*Last Mesolithic/ Neolithic alluvium I*	*First Mesolithic encampment I*	*Last Mesolithic encampment I*	*First Mesolithic encampment II*	*Last Mesolithic encampment II*	*Start Mesolithic/ Neolithic alluvium II*	*End Mesolithic/ Neolithic alluvium II*
First Earliest Mesolithic activity	-	92.55	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Last Earliest Mesolithic activity	7.45	-	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Cluster 1 ring_219	0	0	-	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
First Mesolithic organic deposit I	0	0	0	-	100	100	100	100	99	100	100	100	100	100	100	100	100	100
Last Mesolithic organic deposit I	0	0	0	0	-	99.86	75.59	99.11	67.24	100	100	100	100	100	100	100	100	100
Cluster 5 ring_90	0	0	0	0	0.14	-	0.7	39.38	10.09	99.76	91.96	100	100	100	100	100	100	100
First Mesolithic organic deposit II	0	0	0	0	24.41	99.3	-	96.36	52.05	100	100	100	100	100	100	100	100	100
Last Mesolithic organic deposit II	0	0	0	0	0.89	60.62	3.64	-	15.62	99.42	92.38	100	100	100	100	100	100	100
First Mesolithic tree-throws/activity	0	0	0	0	32.76	89.91	47.95	84.38	-	99.93	98.51	100	100	100	100	100	100	100
Last Mesolithic tree-throws/activity	0	0	0	0	0	0.24	0	0.58	0.07	-	17.84	98.47	99.94	100	100	100	100	100
First Mesolithic/Neolithic alluvium I	0	0	0	0	0	8.04	0	7.62	1.49	82.16	-	99.56	99.99	100	100	100	100	100
Last Mesolithic/Neolithic alluvium I	0	0	0	0	0	0	0	0	0	1.53	0.44	-	55.03	85.9	100	100	100	100
First Mesolithic encampment I	0	0	0	0	0	0	0	0	0	0	0	44.97	-	85.41	100	100	100	100
Last Mesolithic encampment I	0	0	0	0	0	0	0	0	0	0	0	14.1	14.59	-	100	100	100	100
First Mesolithic encampment II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	83.48	96.71	100
Last Mesolithic encampment II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16.52	-	82.64	100
Start Mesolithic/Neolithic alluvium II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.29	17.36	-	100
End Mesolithic/Neolithic alluvium II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-

Note: This table provides probabilities for the t_1 column parameters occurring before the t_2 row parameters (*ie* it is 92.55% probable that *First Earliest Mesolithic activity* occurred before *Last Earliest Mesolithic activity*). Highlighted values may relate to contemporaneous events

Table 421: Order analysis on the key Mesolithic parameters from Stainton West

t_1	Probability (%) $t_1<t_2$																			
	t_2																			
	Structure 75935	*Ribwort plantain B*	*First Early Neolithic I*	*Elm declining to presence F*	*Elm Decline Demise B*	*Start Wooden structures*	Cluster 3 Ring_184	Trident 1	*Cereal-type pollen B*	*First Early Neolithic activity in the Grid-square area*	*Ribwort plantain D*	*End Wooden structures*	*Last Early Neolithic I*	*First Early Neolithic II*	*Last Early Neolithic activity in the Grid-square area*	Trident 2	*Cereal-type pollen D*	*Elm Decline Demise D*	*Last Early Neolithic II*	*Ribwort plantain F*
Structure ***75935***	-	91.91	74.59	99.23	100	99.88	100	99.07	99.62	99.31	98.45	100	100	100	100	100	100	100	100	100
Ribwort plantain B	8.09	-	19.74	83.32	98.2	85.63	97.68	86.49	78.11	87.15	91.10	99.35	99.92	99.99	99.99	100	100	100	100	99.94
First Early Neolithic I	25.41	80.26	-	98.27	100	99.65	100	97.92	98.21	98.56	97.99	100	100	100	100	100	100	100	100	100
Elm declining to presence F	0.77	16.68	1.73	-	91.91	51.41	87.23	60.58	41.04	58.68	74.07	95.96	98.99	99.66	99.91	100	99.96	100	100	99.69
Elm Decline Demise B	0	1.80	0	8.09	-	7.35	20.69	13.66	8.25	11.10	25.85	40.96	50.14	59.92	79.66	94.08	81.15	94.49	99.34	95.62
Start Wooden structures	0.12	14.37	0.35	48.59	92.65	-	89.56	59.65	39.55	57.60	74.84	97.51	99.95	99.99	100	100	100	100	100	99.74
Cluster 3 Ring_184	0	2.32	0	12.77	79.31	10.44	-	26.94	16.01	22.39	52.49	91.18	99.57	99.93	99.98	100	99.97	100	100	99.17
Trident 1	0.93	13.51	2.08	39.42	86.34	40.35	73.06	-	33.74	47.46	65.54	89.71	95.54	98.39	99.57	100	99.81	100	100	99.36
Cereal-type pollen B	0.38	21.89	1.79	58.96	91.75	60.45	83.99	66.26	-	65.33	76.56	94.50	98.13	99.51	99.85	100	99.93	100	100	99.65
First Early Neolithic activity in the Grid-square area	0.69	12.85	1.44	41.32	88.9	42.40	77.61	52.54	34.67	-	68.71	94.01	98.84	99.79	99.92	100	99.95	100	100	99.54
Ribwort plantain D	1.55	8.90	2.01	25.93	74.15	25.16	47.51	34.46	23.44	31.29	-	75.22	85.24	91.27	95.71	98.32	95.62	98.50	99.97	98.34
End Wooden structures	0	0.65	0	4.04	59.04	2.49	8.82	10.29	5.50	5.99	24.78	-	70.48	88.44	96.92	100	98.43	100	100	97.74
Last Early Neolithic I	0	0.08	0	1.01	49.86	0.05	0.43	4.46	1.87	1.16	14.76	29.52	-	75.79	93.72	100	96.90	100	100	97.03

Table 422: Order analysis on the key earlier Neolithic parameters from Stainton West

	Probability (%) $t_1<t_2$																			
t_1	t_2																			
	Structure 75935	*Ribwort plantain B*	*First Early Neolithic I*	*Elm declining to presence F*	*Elm Decline Demise B*	*Start Wooden structures*	Cluster 3 Ring_184	Trident 1	*Cereal-type pollen B*	*First Early Neolithic activity in the Grid-square area*	*Ribwort plantain D*	*End Wooden structures*	*Last Early Neolithic I*	*First Early Neolithic II*	*Last Early Neolithic activity in the Grid-square area*	Trident 2	*Cereal-type pollen D*	*Elm Decline Demise D*	*Last Early Neolithic II*	*Ribwort plantain F*
First Early Neolithic II	0	0.01	0	0.34	40.08	0.01	0.07	1.61	0.49	0.21	8.73	11.56	24.21	-	87.18	99.99	93.38	100	100	96.21
Last Early Neolithic activity in the Grid-square are*a*	0	0.01	0	0.09	20.34	0	0.02	00.43	0.15	0.08	4.29	3.08	6.28	12.82	-	79.78	50.93	79.54	99.00	90.44
Trident 2	0	0	0	0	5.92	0	0	0	0	0	1.68	0	0	0.01	20.22	-	9.52	48.53	84.50	80.00
Cereal-type pollen D	0	0	0	0.04	18.85	0	0.03	0.19	0.07	0.05	4.38	1.57	3.10	6.66	49.07	90.48	-	94.89	99.80	92.42
Elm Decline Demise D	0	0	0	0	5.51	0	0	0	0	0	1.50	0	0	0	20.46	51.47	5.11	-	96.83	83.51
Last Early Neolithic II	0	0	0	0	0.66	0	0	0	0	0	0.03	0	0	0	0.10	15.50	0.20	3.17	-	63.76
Ribwort plantain F	0	0	0	0.31	4.38	0.26	0.83	0.64	0.35	0.46	1.66	2.26	2.97	3.79	9.56	20.00	7.58	16.49	36.24	-

Note: This table provides probabilities for the t_1 column parameters occurring before the t_2 row parameters (*ie* it is 91.91% probable that Structure ***75935*** occurred before *Ribwort plantain B*). Highlighted values may relate to contemporaneous events

Table 422: Order analysis on the key earlier Neolithic parameters from Stainton West (cont'd)

	Probability (%) $t_1<t_2$							
t_1	t_2							
	First Late Neolithic	*Last Late Neolithic*	*First Burnt Mound 1*	*First Burnt Mound 5*	*Cluster 4 outer sapwood ring_UBA-22286*	Grooved-Ware vessel	*Last Burnt Mound 1*	*Last Burnt Mound 5*
First Late Neolithic	-	100	100	100	100	100	100	100
Last Late Neolithic	0	-	77.41	94.97	50.06	89.66	98.88	100
First Burnt Mound 1	0	22.59	-	78.04	22.64	70.11	85.78	99.74
First Burnt Mound 5	0	5.03	29.95	-	5.06	37.75	49.8	96.9
Cluster 4 outer sapwood ring_UBA-22286	0	49.94	77.36	94.94	-	89.65	98.87	100
Grooved-Ware vessel	0	10.34	29.89	62.25	10.35	-	65.28	98.96
Last Burnt Mound 1	0	1.12	14.22	50.2	1.12	34.72	-	98.6
Last Burnt Mound 5	0	0	0.26	3.1	0	1.04	1.4	-

Note: This table provides probabilities for the t_1 column parameters occurring before the t_2 row parameters (*ie* it is 77.41% probable that *Last Late Neolithic* occurred before *First Burnt Mound 1*). Highlighted values may relate to contemporaneous events

Table 423: Order analysis on the key later Neolithic parameters from Stainton West

t_1 \ t_2 (Probability (%) $t_1<t_2$)	*Stainton West:* Burnt Mound 6	Parcel 21 North: House 3	*Stainton West: First Burnt Mound 2*	*Stainton West: Last Burnt Mound 2*	Parcel 9: House 1	Parcel 21 North: Pit ***21099***	*Stainton West: 'Burnt Mound 4'*	*Stainton West: 'Hearth 100020'*	*Stainton West: 'Posthole 100033'*	*Stainton West: Start Burnt Mound 3*	*Stainton West: End Burnt Mound 3*	Parcel 9: House 2 (SUERC-32723 and SUERC-42034 Combined)	Parcel 41: Ditch ***41003***	Parcel 42 Settlement (House 4 and 6 Combined)	*Stainton West: 'Pit 100026'*	*Stainton West: 'Hearth 90217' (SUERC-41997)*	*Stainton West: 'Hearth 90217' (SUERC-32644)*	Parcel 32: Pit ***32004*** (SUERC-42037 and SUERC-32726 Combined)
Stainton West: Burnt Mound 6	-	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Parcel 21 North: House 3	0	-	93.85	97.19	100	100	100	100	100	99.95	100	100	100	100	100	100	100	100
Stainton West: *First Burnt Mound 2*	0	6.15	-	74.40	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Stainton West: *Last Burnt Mound 2*	0	2.81	25.60	-	100	100	100	100	100	99.88	100	100	100	100	100	100	100	100
Parcel 9: House 1	0	0	0	0	-	65.67	84.29	95.47	99.98	98.77	100	100	100	100	100	100	100	100
Parcel 21 North: Pit ***21099***	0	0	0	0	34.33	¬-	72.46	89.04	99.93	98.07	100	100	100	100	100	100	100	100
Stainton West: *'Burnt Mound 4'*	0	0	0	0	15.71	27.54	-	72.45	99.48	96.05	99.98	100	100	100	100	100	100	100
Stainton West: *'Hearth 100020'*	0	0	0	0	4.53	10.96	27.55	-	97.67	91.40	99.62	100	100	100	100	100	100	100
Stainton West: *'Posthole 100033'*	0	0	0	0	0.02	0.07	0.52	2.33	-	28.14	71.88	99.25	98.48	99.49	100	100	100	100
Stainton West: *Start Burnt Mound 3*	0.02	0.05	0.10	0.12	1.23	1.93	3.95	8.60	71.86	-	89.33	100	99.73	100	100	100	100	100
Stainton West: *End Burnt Mound 3*	0	0	0	0	0	0	0.02	0.38	28.12	10.67	-	93.01	91.41	94.40	99.46	99.98	99.97	100
Parcel 9: House 2 (SUERC-32723 and SUERC-42034 Combined)	0	0	0	0	0	0	0	0	0.75	0	6.99	-	50.44	61.46	99.72	100	100	100
Parcel 41: Ditch ***41003***	0	0	0	0	0	0	0	0.01	1.52	0.27	8.59	49.56	-	59.32	98.20	100	100	100
Parcel 42 Settlement (House 4 and 6 Combined)	0	0	0	0	0	0	0	0	0.51	0	5.60	38.54	40.68	-	99.01	100	100	100
Stainton West: Pit ***100026***	0	0	0	0	0	0	0	0	0	0	0.54	0.28	1.80	0.99	-	99.76	99.44	100

Table 424: Order analysis on the Bronze Age dates from CNDR

t$_1$	Probability (%) $t_1<t_2$																	
	t$_2$																	
	Stainton West: Burnt Mound 6	Parcel 21 North: House 3	*Stainton West: First Burnt Mound 2*	*Stainton West: Last Burnt Mound 2*	Parcel 9: House 1	Parcel 21 North: Pit ***21099***	*Stainton West: 'Burnt Mound 4'*	*Stainton West: 'Hearth 100020'*	*Stainton West: 'Posthole 100033'*	*Stainton West: Start Burnt Mound 3*	*Stainton West: End Burnt Mound 3*	Parcel 9: House 2 (SUERC-32723 and SUERC-42034 Combined)	Parcel 41: Ditch ***41003***	Parcel 42 Settlement (House 4 and 6 Combined)	*Stainton West: 'Pit 100026'*	*Stainton West: 'Hearth 90217'* (SUERC-41997)	*Stainton West: 'Hearth 90217'* (SUERC-32644)	Parcel 32: Pit ***32004*** (SUERC-42037 and SUERC-32726 Combined)
Stainton West: *'Hearth 90217'* (SUERC-41997)	0	0	0	0	0	0	0	0	0	0	0.02	0	0	0.	0.24	-	32.56	96.25
Stainton West: *'Hearth 90217'* (SUERC-32644)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.56	67.44	-	99.58
Parcel 32: Pit 32004 (SUERC-42037 and SUERC-32726 Combined)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.75	0.42	-

Note: This table provides probabilities for the t_1 column parameters occurring before the t_2 row parameters (*ie* it is 100% probable that Stainton West: *Burnt Mound 6* occurred before Parcel 21 North: House 3). Highlighted values may relate to contemporaneous events

Table 424: Order analysis on the Bronze Age dates from CNDR (cont'd)