Channel Tunnel Rail Link

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The radiocarbon dates from Saltwood Tunnel, Kent

by Michael J. Allen, Nancy Beavan Athfield, Mick Diack, Ian Riddler and Mike Trevathen

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1 INTRODUCTION

The radiocarbon programme was divided to address two separate, but overlapping subject areas. The first related to the chronology of the prehistoric settlement and funerary activity, whilst the second addressed a more detailed chronology of the Anglo-Saxon cemeteries, which involved defining their relationship with the Bronze Age barrow cemetery on which the burial grounds were focused.

The aims of the prehistoric settlement and funerary radiocarbon programme were to define the chronological relationship between the Early-Middle Bronze Age burials, Late Bronze Age settlement and Iron Age funeral activity, and to define whether inhumation and cremation burial practices were short-lived phases and were contemporary with, or succeeded, one another.

Within the Anglo-Saxon cemeteries a number of chronological and spatial groups were recognised, including several discrete groups of graves. Whilst some of the later prehistoric questions were also relevant to this activity, here the dating programme also attempted to define the start and end of the Anglo-Saxon burial phase, and whether there was a simple chronological progression between the three cemeteries, each of which was focussed around a Bronze Age barrow.

Strict selection and scrutiny of material was made in an attempt to ensure that all items dated specific events (cf. Allen and Bayliss 1995; Allen *et al.* 2004) and were not just datable items.

Material selected for dating was directly related to the burial event. Where skeletal material was not available or suitable, then short-lived, non-curated items which had a very limited offset between its date and the action of burial (cf. Allen and Bayliss 1995; Allen *et al.* 2004) were selected. Cremation burials and pyre-related deposits were dated by charcoal and charred plant remains from which short-lived and twiggy elements and sap wood elements likely to be tinder for the pyre were selected.

A total of 27 submissions was made. Three of these failed, providing 24 radiocarbon results (Tables 1 and 2 and figures 1-10); all have been calibrated with the atmospheric data presented by Stuiver *et al.* (1998) and performed on OxCal ver 3.9 (Bronk Ramsey 1995; 2001) and are expressed at the 95% confidence level with the end points rounded outwards to 10 years following the form recommended by Mook (1986).

2 RELIABILITY OF THE RADIOCARBON RESULTS AND REJECTED RESULTS

Michael J. Allen and Nancy Beavan Athfield

Due to the poor preservation of the bone and the low suspected collagen content nearly one quarter of the bone submissions from the Saxon cemetery failed (Table 2). In order to ascertain the preservation of bone protein and assure the reliability of radiocarbon ages a series of stable isotope analyses ($\delta^{13}C$, $\delta^{15}N$, and atomic C:N ratios) were obtained on selected samples.

2.1 Stable Isotope Analysis

by Nancy Beavan Athfield and Michael J. Allen

Six samples from the eight submitted in the R-38505 series were analysed for stable isotopes. Samples were analysed in duplicate by a Carlo Erba NA1500 coupled to a Europa 20/20 IRMS. Carbon and nitrogen isotopes were analysed simultaneously. The CO_2 and nitrogen gases were resolved using chromatographic separation on a GC column at 85°C for $\delta^{13}C$, $\delta^{15}N$ and atomic C:N ratios were calculated. The standards were EDTA ($\delta^{15}N$ -0.8, $\delta^{13}C$ -38.2) and cystine ($\delta^{15}N$ 8.1, $\delta^{13}C$ -17.1). The typical amount of sample analysed was 1mg and all analyses were performed in duplicate. All reference materials and internal standards were calibrated and traceable to the international standards V-PDB for C^{13} and Air for N^{15}. Typical precision for these analyses was ± 0.2‰

The results give below are the averages for the duplicate analysis.

Grave	***skeleton***		***lab no***	***result no***	***%N***	***$\delta^{15}N$ (Air)***	***%C***	***$\delta^{13}C$ (PDB)***	***C:N***
C190	sk 6420	foot frags	R-28505/1	NZA-19719	9.1	11.0	25.3	-19.0	2.8
C7	sk 1310	upper limb	R-28505/2	FAILED	1.8	9.0	8.4	-22.2	4.6
W185	sk 1329	long bone	R-28505/3	NZA-19638	12.6	9.3	34.9	-19.0	2.8
C176	sk 6407	Dentine	R-28505/4	FAILED	-	-	-	-	-
C181	sk 6636	lower limb	R-28505/5	NZA-19639	16.9	9.4	46.3	-18.2	2.7
C139	sk 4612	left limb	R-28505/6	FAILED	-	-	-	-	-
C174	sk 6230	femur/pelvis	R-28505/7	NZA-19640	12.5	8.6	33.2	-18.4	2.7
C4619	sk 4676	lower limb	R-28505/8	NZA-19641	13.3	9.8	35.0	-19.7	2.6

In the measured samples, the percentage carbon only fell outside the expected range for moderately preserved collagen in bone in sample R-28502/2, at only 8.4%; likewise, the lower percent value for nitrogen of 1.8 similarly indicates poorly preserved bone with little native protein remaining, resulting in a C:N ratio of 4.6, indicating a non-protein result. The δ13C for this sample was more than 10% higher than all other values, and it is likely that

some form of contaminate contributed to this value. This sample was determined to be unreliable for radiocarbon analysis and thus was failed.

Only one other sample produced percentage Nitrogen and Carbon levels that were low enough to give some concern. Sample R-28505/1 (grave C190), while the C:N ration of 2.8 is within the range for preserved protein, the low percentage of Nitrogen of 9.1, and percentage of Carbon of 25.3 indicates significant deterioration of available protein and its result (1415±35 BP) should be treated with some slight caution and is dealt with later. The C:N ratios and percentage carbon and nitrogen levels of the remaining measured samples indicate reasonable preservation of protein, and are likely to be secure. We can infer that the unmeasured samples that did not fail are also likely to be secure.

2.2 Rejected determinations

by Michael J. Allen

All bone samples with C:N ratios between 2.6 and 3.5 and which have carbon percentages of at least 30% were accepted as falling within the range expected for moderately well to well preserved archaeological bone, and that the AMS dates from these would be reliable. For this reason we are cautious on the result for Grave 6421 [C190].

Selection of samples was rigorous and in all cases high levels of confidence were ascertained in the relationship between the material submitted and the event being dated. Careful scrutiny attempted to avoid any residual and intrusive elements, and in this the programme seems to have been a success. Two samples removed from grave goods were submitted after conservation. These were a bone gaming counter from grave 1048 [C5] (NZA-21511) and mineralised wood from a spearhead in grave 6653 [C200] (NZA-21688). Full conservation records enabled appropriate laboratory pre-treatment. Although both items were conserved and pre-treated in a similar fashion (see below). The result from mineralised wood within a spearhead confidently expected to fall with a date range of AD 560-680, gave a result of 4054±55 BP (2870-2460 cal BC). Even accepting that the wooden shaft could be earlier than the metal spear head if it was a curated staff, we cannot, however, conceive that it could be more than two millennia earlier. Rodger Sparks from the Rafter Radiocarbon Laboratory/ GNS Science confirmed that "this sample was pre-treated twice with a PEG removal regime. The first samples disintegrated. The second did hold up through chemical treatment but at combustion of the sample to CO_2, but there was only a 2% yield of carbon where one would expect at least 40% for wood. The laboratory commented that this yield is one expected more of soil, and indeed, the archived treated sample has the appearance of red dust. It is not know what the ^{14}C activity of PEG-like conservation materials are, nor their $\delta^{13}C$; but one might expect the δ13C would be more in the depleted and in the -30 to -28‰

range. The $\delta^{13}C$ of -28.95 ‰ is depleted for a wood, where about -27 to -25‰ would be the norm. A 2% yield of carbon is excessively low for wood, and it is hard to be confident that what was recovered was the native carbon from the wood".

On the basis that the low carbon yield (2%) is not acceptable for a wood sample, and the subsequent communication with the laboratory on chemical treatment and results, this determination is rejected and excluded from the dataset of reliable radiocarbon results.

2.3 Conservation

by Michelle Johns

Grave 1048 [C5] FN866 bone gaming counter- consolidated with 10% w/v Paraloid B72 (polymethylacrylate/ polyethyl methacrylate co-polymer) in toluene, to enable removal from soil block. Excess consolidant removed using acetone.

Grave 6653 [C200] FN 2457 + 2458 metal spear and mineralised wood - locally consolidated with 10% w/v Paraloid B72 (polymethyl acrylate/polyethyl methacrylate co-polymer) in toluene to retain evidence contained in corrosion products. Excess consolidant removed using acetone. Soil removed using airbrasive (53 microns aluminum oxide/1-3 bars pressure). Adjoined using cellulose nitrate (HMG) adhesive. (Numbers in square parenthesis are numbers ascribed during the fieldwork and are now revised. These are retained in this report to enable direct reference to the archive.)

3 PREHISTORIC OCCUPATION AND FUNERARY ACTIVITY

3.1 Mesolithic

Scarce earlier and later Mesolithic activity was noted across the site, in particular in pit 405. None of the Mesolithic material was securely associated with dateable items that could be used to define if it was contemporary with the Mesolithic activity at Sandway Road. After reviewing the data, even the radiocarbon determinations obtained from Sandway Road could not be used to define the date of Mesolithic activity there.

3.2 Neolithic

Initial aims relating to the prehistoric activity included elements ranging in date from the Neolithic to the Iron Age. The Neolithic period was represented by three pits containing Early Neolithic plain and carinated bowls. It was considered important to define if these were contemporary with each other (and thus related to a single phase of Neolithic activity) or were temporally discrete events. This event or events could then be chronologically related to

activity at, in particular, White Horse Stone. The ceramic evidence nationally tends to suggest that they are, in part, sequential, but the ceramic evidence in Kent is too poor to confirm this.

Two of the three pits were dated. Pit SG136 contained two vessels (an open globular bowl (P6) and a carinated bowl (P5)) whilst pit SG175 contained one small bowl with an applied cordon (P4). Clearly defined deposits of charred remains and charred hazelnuts were associated with these and produced Early Neolithic dates; pit SG136 (context 3371) gave a result of 3650-3380 cal BC (4775±30 BP, NZA-20599) and pit SG175 (context 3280) 3640-3370 cal BC (4742±30BP, NZA-20600). These are statistically indistinguishable results at the 95% confidence level (Ward and Wilson 1978) and indicate that pits SG136 and SG175 represent a single phase of activity. These fall within the phase of Early Neolithic plain bowls (*c.* 3700-3300 cal BC) and after carinated bowls (4100-3600 cal BC), but we cannot be more specific as to whether they are early or late in the Plain Bowl range.

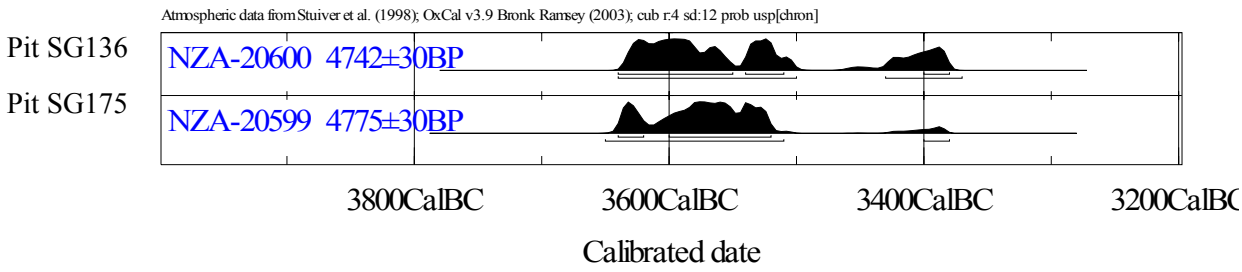


Figure 1. Radiocarbon distributions from Pit SG136 and Pit SG175

This Early Neolithic phase of activity (3650-3380 cal BC) is unparalleled on other CTRL sites in Kent. Results from the Long House at White Horse Stone and a pit at Tutt Hill are clearly earlier at about 3950-3700/3650 cal BC, while other dated Neolithic features at White Horse Stone are predominated nearly a millennia later (2900-2650 cal BC). Only one pit at Little Stock Farm (pit 2507) dating to 3350-3030 cal BC falls nearer the date of the Saltwood tunnel Neolithic events.

3.3 Bronze Age occupation and burial

The unenclosed settlement including pits, was defined as Late Bronze Age from their characteristic 'Post Deverel-Rimbury' (PDR) ceramic assemblages. The aims of the limited radiocarbon programme were to attempt to define if major settlement features (pits) were contemporary with any of the Bronze Age funerary remains and monuments (cremation burials and barrows). Although it was originally hoped that the programme would also define

whether the adjacent ditched field systems were initiated or in use during this period, no suitable material was present with which to date this event.

3.3.1 Beaker barrows and burials

Two burials were Early Bronze Age or Beaker and formed the earliest dated elements in the cemetery. These included the central (supine, but with legs flexed) inhumation 4676 [C4619] (grave 4619 in barrow 10082 in the Western cemetery), (3683±35 BP, NZA-19641), and the flexed inhumation in Beaker grave 4507 [C135] outside the Western cemetery (3722±45BP, NZA-19886). These calibrate to 2200-1940 and 2290-1970 cal BC respectively and can be seen to be contemporary within three generations. These burials fall about 300-500 years earlier than any other dated settlement or burial events (Figure 6). They are the earliest dates obtained for the cemetery, and may indicate the period of the instigation of the Bronze Age barrow cemetery.

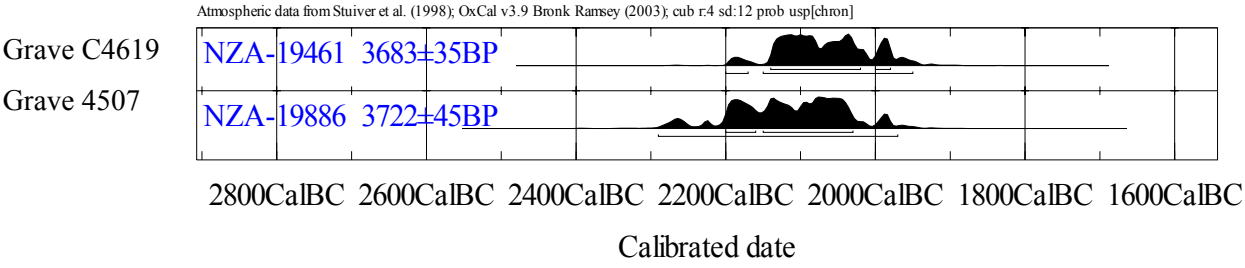


Figure 2. Radiocarbon distributions from Bronze Age inhumation grave 4507 [C135] (NZA-19886) and C4619 (NZA-18461).

3.3.2 Settlement

Charred crops and sooting on pottery were selected from four pits 5366 [W251], W207, 6658 [W369] and 3910 [C10166] to date the settlement events. The charred remains were considered to be disposed of and discarded burnt settlement and processing waste. All pits also contained diagnostic pottery forms.

Pit 5366 [W251]: contains a globular jar (R28, illustration 28) and forms that may be transitional and are considered to belong towards the end of the Deverel-Rimbury (*c.* 1500-1150 cal BC) tradition, (i.e.1100-1199 cal BC). The submitted sample is burnt residue on the transitional vessel (PRN 2474).

Pit W207: sealed layer with diagnostic pottery (context 5250), typically 1150-950 cal BC. This includes a thin-walled shoulder jar (R24, illustration no. 10) and thin-walled bowl R8 (illustration no. 11). Charred celtic (horse) bean (*Vicia faba*) dated.

Pit 6658 [W369]: This contains generally Deverel-Rimbury and post Deverel-Rimbury assemblages (with forms R31, R3, R30 and R38 – illustrations 29-34) (i.e. 1150-750 cal BC). This is specifically pottery that represents the later, decorated phase, of the Late Bronze Age (800-600 cal BC) *or* vessels that are the decorated component within the earlier part of the Late Bronze Age (*c*. 950-800 cal BC). Emmer/spelt grain from dump of grain and processing debris.

Pit 3910 [10166]: This pit is located at the opposite corner of the site to pit W207. Both features are in the same ceramic phase (1150-900 cal BC), but there is only a small overlap in the fabrics present and none in the vessel forms. Thin-walled vessels with burnished or wiped surfaces are common in these features; the pottery includes forms R38, R9, R11, and B2) which are typically Late Bronze Age (i.e. 1100-700 cal BC. Emmer/spelt grain from dump of grain and processing debris.

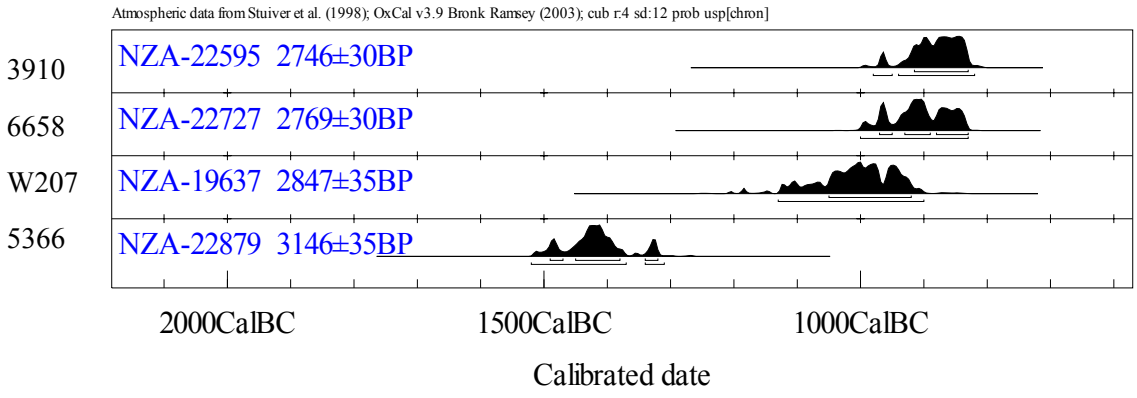


Figure 3. Radiocarbon distributions from Bronze Age pits.

The results (Table 1, Figure 3), clearly show Bronze Age activity, as expected, ranges from the Middle Bronze Age (1500-1400 cal BC) to the later Bronze Age (1000-800 cal BC). The results are, however, much more informative when examined with the expected ranges from the pottery vessels, and when examining dated events thought to be contemporaneous.

The Middle Bronze Age pit 5366 [251] was a non-domestic pit associated with the Bronze Age barrow cemetery and produced a typical date range (1520-1310 cal BC, 3146±35 BP). This is, however, more than 500 years later than the dated inhumations. The transitional vessel in this pit was dated directly by sooting on its surfaces (PRN 2474) and clearly falls not towards the end of the Deverel-Rimbury tradition (i.e. 1100-1199) as anticipated, but towards its beginning (1500-1150 cal BC). This feature is now considered to be an isolated Middle

Bronze Age pit, locate with more reference to the Early (and ?Middle) Bronze Age funerary monuments that to the late Bronze Age settlement phase.

The three Late Bronze Age domestic pits (207, 6658 [369], and 3910 [10166]) were amongst pit-clusters containing relatively large groups of pottery, some charred crop-processing waste and animal bone. They also fall within the general expected range giving an overall phase of dated occupation of about 1000-800 cal BC. Pit W207, expected to be 1150-950 cal BC, produced a date of 1130-900 cal BC (2847±35 BP, NZA-19637) precisely what was expected. This ceramic date estimate was, however, based on other dated examples elsewhere in the country. Pit 3910 [10166], which was ascribed to the same ceramic phase, produced a result of 2746±30 BP (NZA-22595) which calibrates to 980-820 cal BC. Pits 207 and 10166 are not clearly contemporary and their radiocarbon distributions only just overlap (Figure 3). The result from pit 10166 has greater parity with pit 369 (2769±30 BP, NZA-22727), which contained decorated vessels of the Late Bronze Age, and from which it is statistically indistinguishable at the 95% confidence limit (Ward and Wilson 1978). This latter result confirms that the decorated (PDR) wares in pit 369 represent the decorated component of the plainware PDR prevalent in the earlier part of the Late Bronze Age, and not a part of the later decorated phase of the latest Bronze Age.

While these results provide a useful contribution to regional ceramic studies they also confirm the cultivation of *Vicia faba* (pit 207) in the Late Bronze Age (1130-900 cal BC), which is an early dated record in Kent, although there are Early Bronze Age records on the Isle of Wight (Newbarn Down, biconical urn 2200-1500 cal BC; Scaife 1982), and elsewhere. The results also confirm the cultivation of cereals of emmer/spelt in the Late Bronze Age (990-820 cal BC) in Kent, which has been well documented previously.

3.3.3 Cremation burial

Three undated and unurned/unaccompanied cremation burials or pyre related deposits were selected to attempt to date this rite on site and in one case (1726) to enable us to infer the date of adjacent and grouped cremation burials (1703, 1722, 1724 and 1728). One unurned cremation burial (3602) and one possible pyre related deposit (1699) were cut by later features thus proving terminus *post quem* dates for these events. In each case charred remains were carefully selected which were assumed to be tinder (grasses, onion couch grass) and small wood (Maloidaea) of the pyre (Table 1).

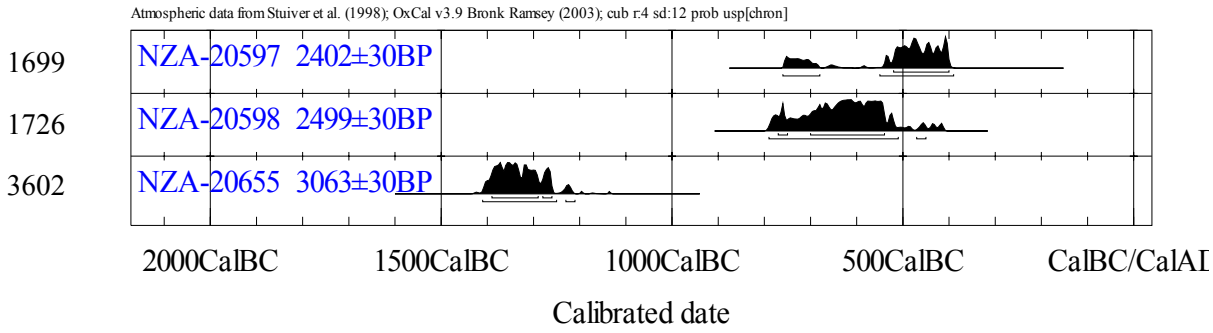
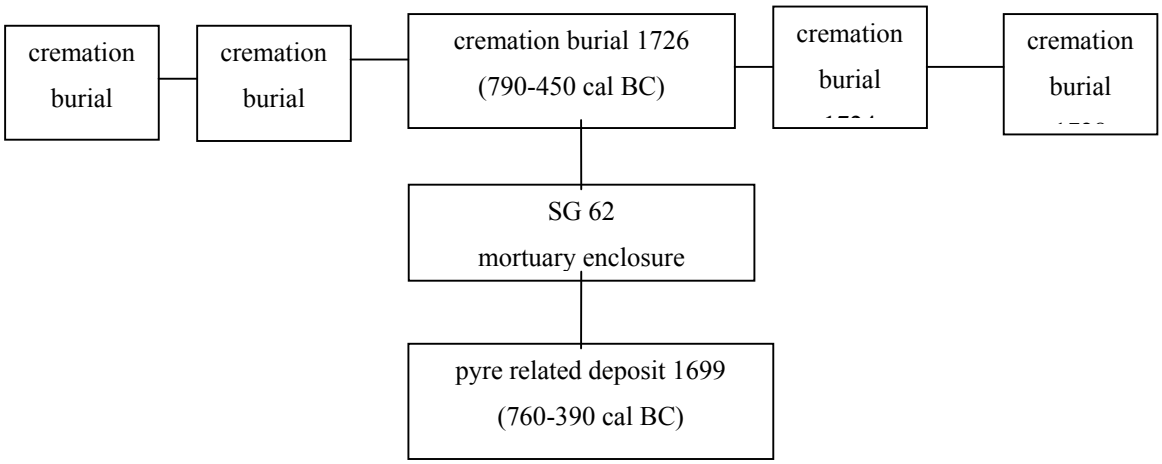


Figure 4. Radiocarbon distributions of cremation burials 3602, 1726 and 1699

Cremation burial 3602 was assumed to be Late Bronze Age/Early Iron Age and was cut by ditch SG 165 alongside the Early to Middle Iron Age droveway. The radiocarbon determination of 3063±30 BP (NZA-20655) indicates a Middle Bronze Age date (1410-1210 cal BC). The radiocarbon distribution of this result certainly overlaps in part with that from pit 5366, showing that both cremation (3602) and occupation events (pit 5366) are likely to be broadly contemporaneous.

The pyre related deposit 1699 adjacent to the easternmost barrow was cut by sub-square enclosure 'mortuary' SG62. A series of cremation burials (1703, 1722, 1724, 1726 and 1728) were aligned with enclosure and one (1726) cut the upper fills. Radiocarbon results, thus allow us to compare these cremation events and to constrain the date of construction of the 'mortuary' enclosure.



The precise nature of the pyre related deposit (pit 1699) was not determined with certainty, but the fact it contained 32 charred grass culms indicated some degree of integrity of the deposit. The result from this pyre deposit 1699 (2402±30 BP, NZA-20597) calibrates to 760-390 cal BC, and unfortunately lies clearly in the Early Iron Age radiocarbon plateau (*c.*

800/750-400 cal BC). Cremation burial 1726 gave a result of 2499±30 BP (NZA-20598) which calibrates to 790-360 cal BC) also falls within the radiocarbon plateau. Although they look similar, their radiocarbon distributions indicate that the date of burial 1726 is likely to be earlier than pyre debris 1699 (Figure 5); a reversal of the stratigraphy.

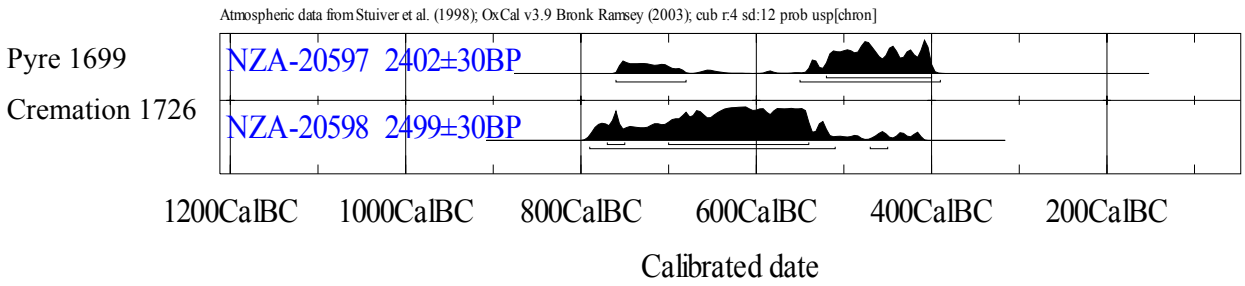


Figure 5. Radiocarbon distributions of pyre debris 1699 (NZA-20597) and cremation burial 1726 (NZA-20598).

These date ranges are similar, and despite the problems of determinations in the 4th-8th centuries BC, they indicate that all three events (pyre 1699, mortuary enclosure SG62 and cremation burial 1726) are Early Iron Age in date, and close in time to each other. We may assume that the adjacent cremation burials (1703, 1722, 1724 and 1728) all also fall into this Early Iron Age phase.

3.3.4 Grave 24

One unaccompanied inhumation was deemed to be unusual in that Grave 24 represents a singleton inhumation burial at the western edge of the site. It lies amongst a small Romano-British cremation cemetery and thus was considered to be the only potential Romano-British inhumation in the cemeteries. Other inhumation burials were either clearly Bronze Age or Saxon. Elements of the right lower limb were submitted for AMS dating and returned a result of 2185±35 BP (NZA-27734) which confirmed that this burial was unusual in that it was Middle Iron Age (370-110 cal BC) and remains the only dated burial of this phase.

3.4 Prehistoric Site chronology

The twelve results (Table 1; Figure 6) summarise some of the chronological development of the site. The Neolithic features are contemporary and remain the earliest dated features, occurring between six and eight centuries before the Early Bronze Age/Beaker barrows and burials.

The two dated inhumations (4507 [C135] (unenclosed burial) and C4619, in barrow 10082) suggest that the barrow cemetery commenced at least by *c.* 2200-1950 cal BC. No occupation or settlement activity was discerned to relation to this, but such activity is often archaeologically hard to recognise (Allen 2005; Gibson 2003; 2004).

The Bronze Age activity as represented by the pits spans the Middle and Late Bronze Age (*c.* 1500-800 cal BC), with the Middle Bronze Age being predominantly of funerary nature and the Late Bronze Age pits of domestic character. One cremation burial (3602), is broadly contemporary with the Middle Bronze Age activity, but other cremation related activity seems to post-date the Bronze Age occupation and certainly around mortuary enclosure SG62 is an Early Iron Age activity.

4 SAXON CEMETERY

Fifteen submissions were made to attempt to provide chronological relationships between, and development of the cemeteries. Due to poor bone and collagen survival three submissions failed and one was rejected (see Allen and Beavan Athfield, above). Thus eleven results (Table 2 and Figures 7-10) provide the basis for discussing the absolute chronology of the cemeteries. Specific chronological aims were to

- aid with establishing the start and duration of the cemetery
- examine if the three cemeteries represented a chronological development or were chronologically discrete
- define if the central ‘founder’ burials were the start of each Saxon cemetery
- to aid in defining the phases of the development of the cemeteries
- to examine if specific artefacts were contemporary with burial or are they curated heirlooms more than say 3 generations (75 years) older?
- to examine if specific objects were contemporary with the burial and related with their known artefact typology and chronology
- to examine if curation (beyond three generations) was present within the grave goods

define to which part of the Saxon cemeteries is the settlement (Sunken Featured Buildings) contemporary

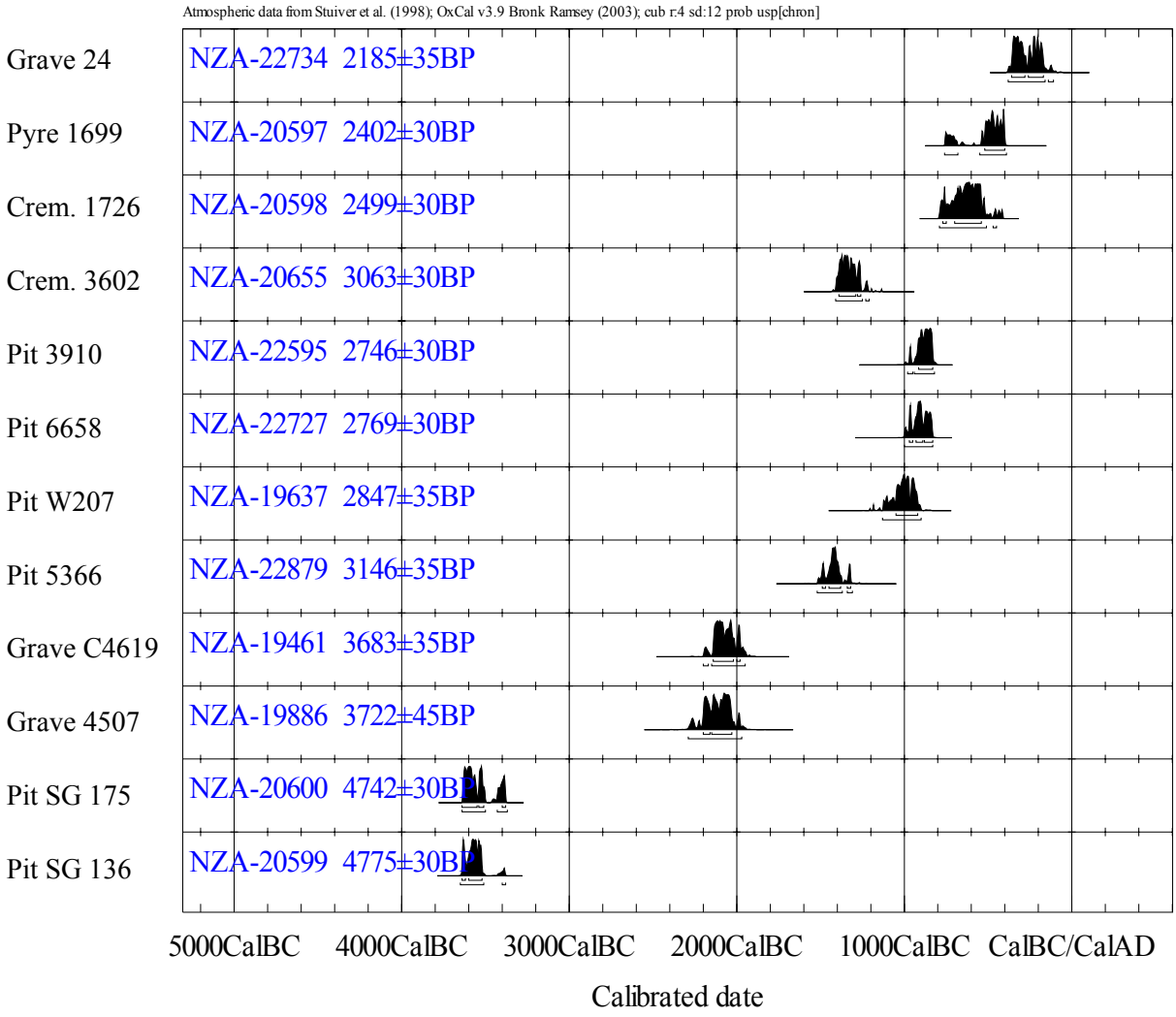


Figure 6. Radiocarbon distributions of the dated prehistoric events.

These laudable aims were severely restricted by the poor preservation of human bone and of collagen when bone survived. Further, the settlement features contained no reliably datable material, and so the full attention of the dating programme was based on the cemeteries.

It is clear (Figure 7) that the dated events from the cemeteries show that the Eastern and Western cemeteries seem to be co-eval both with earliest dated burials at about cal AD 400 to 550, and the latest dated burials of about cal AD 600-650. The dated events from the Central cemetery suggests it starts later (about cal AD 550-650) and ends later (about cal AD 650-750) than the two flanking cemeteries.

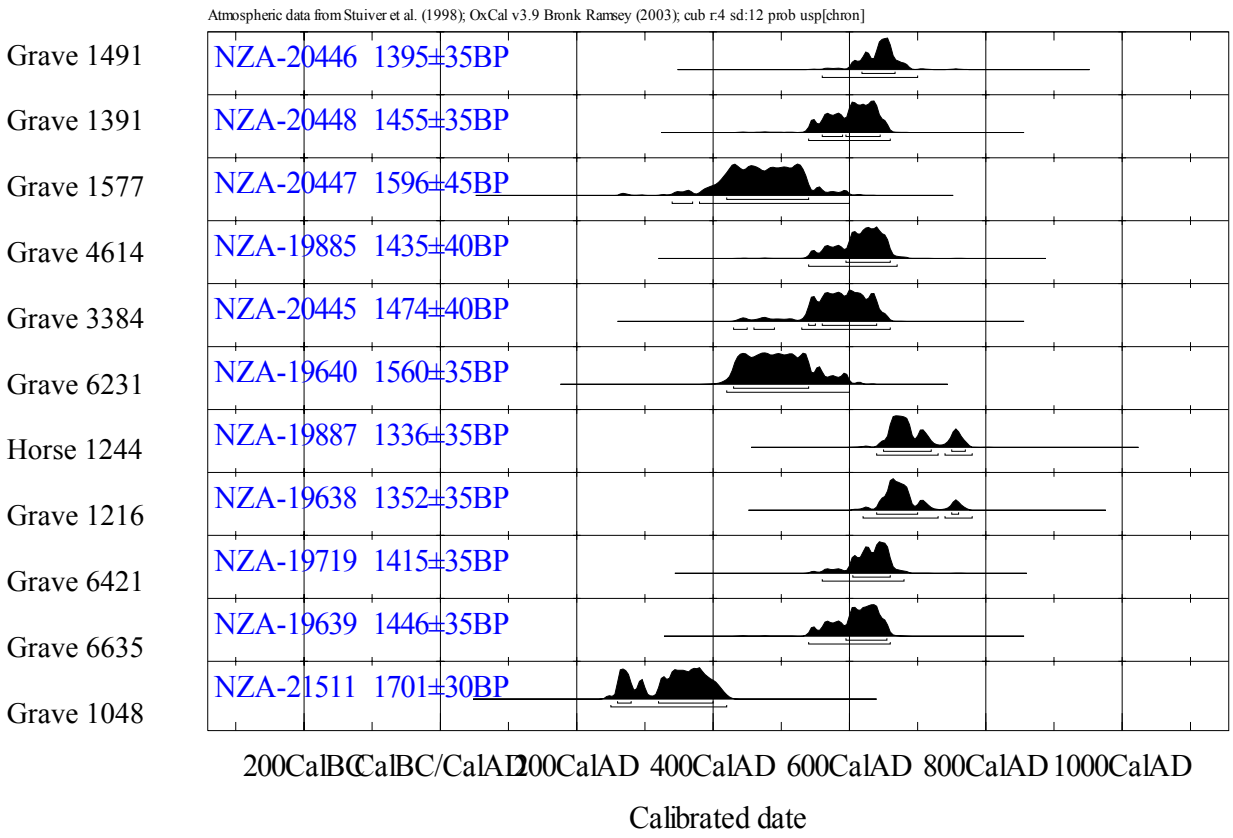


Figure 7. Radiocarbon distributions of the dated Saxon events.

We can see that the Saxon cemeteries commenced some 1400- 1700 years after the Early Bronze Age barrows. The dated evidence indicates that the cemetery was in use from about cal AD 400-550 to cal AD 650-750, spanning some 150-350 years. The nature of the calibrations gave ranges of between 200 and 120 years (i.e. spans covering 5-10 generations). Without any stratigrahic data with which to constrain the results the calibrated ranges were no improvement on the estimated ranges covering one century. Where, however, the results have been useful was in providing some relative chronology, and indicate the potential of some grave goods being ancient heirlooms.

4.1 Founder burials

A number of Saxon burials were considered to be 'founder burials' based on the fact they were often surrounded by ditches and seem to be encircled by other, presumably later, graves. Only one 'founder' grave was dated. This was from the Central cemetery 6421 [C190] (Table 2), and this result clearly shows that is contemporary with, or even slightly later than inhumation 6635 [C181].

4.2 Western Cemetery

Three Saxon graves were dated surrounding the Early Bronze Age barrow 10082 and central burial C4619 (2200-1940 cal BC) were dated. They included two lying outside the ditch on its south west and south eastern sides (4614 [C139] and 3885 [C129] respectively). A third was grave 6231 [C174], one of three in a line each surrounded by a shallow ditch.

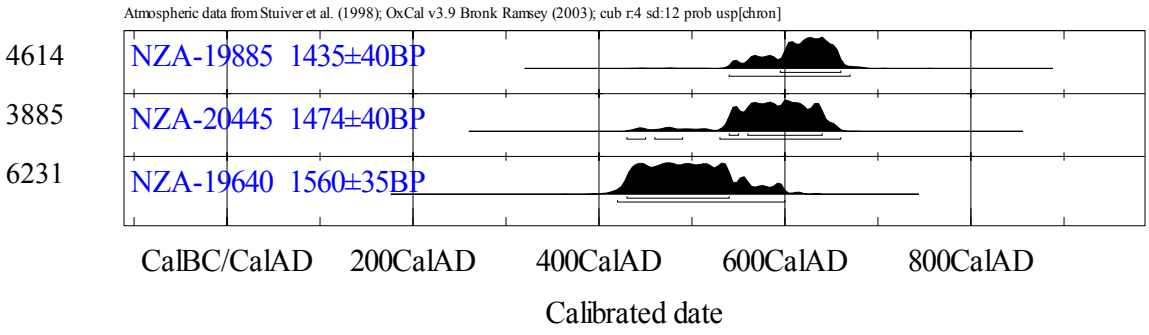


Figure 8. Radiocarbon distributions for graves in the Western Cemetery

The results indicate that the grave surrounded by a ditch (6231 [C174]; 1560±35 BP, NZA-19640) was the earliest (cal AD 430-660) and by inference thus graves 5650 [C143] and 6202 [C172] also belong to this early phase. These were superseded by other graves (3885 [C129], 1474±40 BP, NZA-20445 and 4614 [C139], 1435±40 BP, NZA-19885) around the fringes of the Early Bronze Age barrow which calibrate to AD 430-660 and 420-600 respectively. The dated elements of this cemetery range from cal AD 420 to 670, and the radiocarbon distributions (Figure 8) indicate the most likely range of cal AD 425-660 for the dated elements.

4.3 Central Cemetery

Four Saxon burials were dated in the Central cemetery including the 'founder' grave 6421 [C190] surrounded by an arc of burials (1366 [C46]) (not dated), grave 6635 [C181] surrounded by a small shallow ditch, and burial 1216 [W185]) at the northern end of a line of graves. In addition a horse burial (1244 [C27]) was also dated to determine if it belonged with the Saxon or Bronze Age cemetery. In addition 1391 within a small penannular enclosure immediately south of Bronze Age ring ditch 10052, and just east of Saxon barrow 10045 was dated.

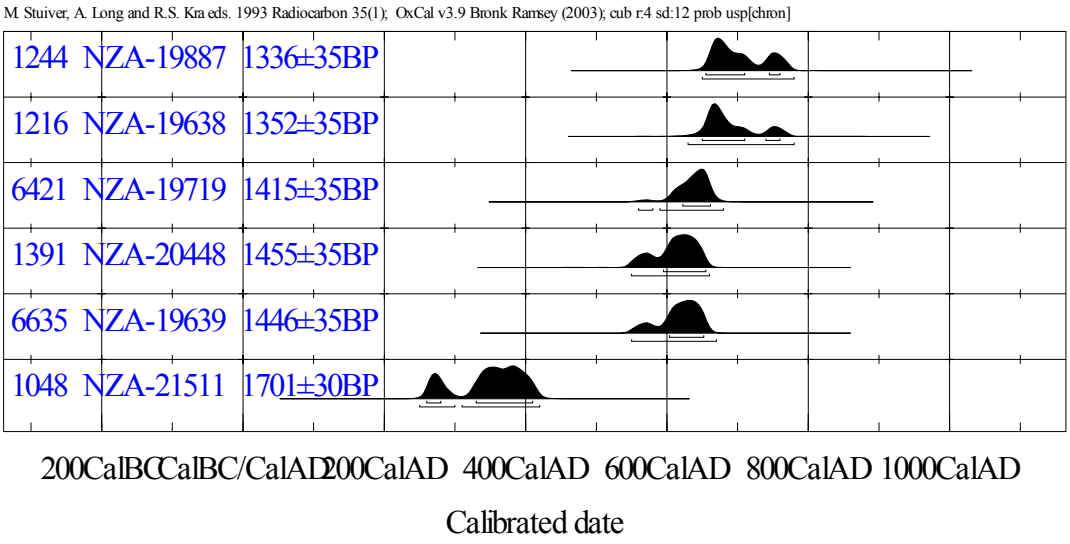


Figure 9. Radiocarbon distributions for graves, horse burial and gaming counter in the Central cemetery

The two graves surrounded by ditches or arcs of other graves (6635 [C181], 1446±35 BP, NZA-19639 and 6421 [C190], 1415±35 BP, NZA-19719) are statistically indistinguishable (cal AD 540-660 and 560-680 respectively) at the 95% confidence limit (Ward and Wilson 1978) and calibrate to about AD 550-650 (see Table 2). Their radiocarbon distributions (Figure 9) suggest that dates after cal AD 600 are more likely (i.e. AD 600-650). Grave 1216 [W185] at the end of a line of burials and grave 1391 within a pennanular ditch, are slightly later with a dates of cal AD 620-780 (1352±35 BP, NZA-19638) and AD 540-660

(1455±35BP, NZA-20448), and their radiocarbon distribution suggests dates in the earlier part of this range are more probable. The horse burial 1244 [C27] produced a result that was statistically indistinguishable (1336±35 BP, NZA19887) at the 95% confidence limit and clearly forms part of the Saxon cemetery.

The dated elements of the cemetery range from cal AD 540 to 780, but the radiocarbon distributions (Figure 9) indicate that a range of cal AD 600 to 700 is likely for the dated elements.

One radiocarbon result was obtained from one of a group of bone gaming counters from within 'founder' grave 1048 [C5] of the central cemetery. Its result (1701±30 BP, NZA-21511) calibrates to AD 250-420 giving it at a Romano-British date. On typological grounds it clearly is not Romano-British, so we must admit to there being a problem here. The difference of 230 to 300 years between the calibrated range of 250-420 with and the 'expected' date range of AD 550-650 (Riddler pers. comm.) cannot therefore be attributed to the fact that these items could be an heirloom. Even if this was the case, they would have had to been considerable antiques if the assumption that they were buried at AD 250-420 is correct. Unlike the rejected result from the conserved wooden shaft (see Allen and Bevean Athfield above) the conservation materials seem unlikely to have contributed 'old carbon' as the $\delta^{13}C$ would indicate extraneous carbon inclusion. Nancy Beavan Athfield from Rafter Radiocarbon laboratory reports that no acetone process was used prior to chemical demineralisation and gelatinisation when measuring, as this is not advisable to introduce these to proteins. The $\delta^{13}C$ of -20.54‰ agrees with the $\delta^{13}C$ values for other bone in this grouping (-19.62 to -20.89‰). At combustion, the counters yielded 20% carbon, and relative to a best expected for bone of between 35 and 45%C, this is more than acceptable.

There is, therefore, a problem with this result, and we tentatively suggest that it may be allied to contamination created by conservation materials which had not been wholly removed in pre-treatment.

4.4 Eastern Cemetery

Two further Saxon burials were dated in the Eastern cemetery. These were 1491 [W43] outside Bronze Age ring ditch 33, 1577 [W45] just within the Bronze Age ring ditch 33 and is part of a row of graves.

The grave (1577 [W45]) within the Bronze Age barrow was the earliest (1596±45 BP, NZA-20447) giving a calibrated date of AD 340-600. The other burial is more likely to fall after cal AD 600 (Figure 10), with grave 1491 outside the barrow (1395±35 BP, NZA-20446) calibrating to AD 560-700 (Table 2).

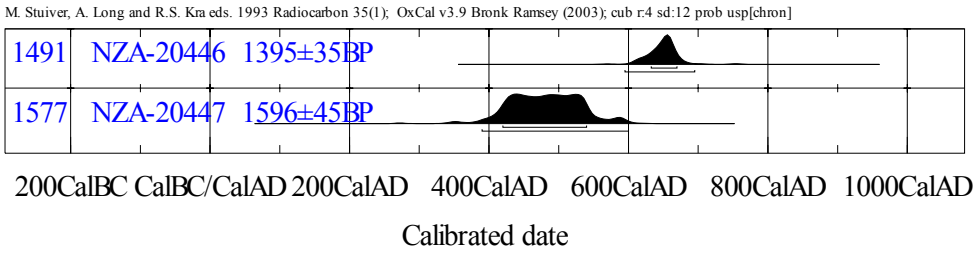


Figure 10. Radiocarbon distributions of graves in the Eastern cemetery

The dated ranges for this cemetery are cal AD 560-700, but the radiocarbon distributions (Figure 10) indicate that a phase of cal AD 400-650 is more likely within this range, for the dated elements.

4.5 Saxon Cemetery Chronology

The radiocarbon programme has been very useful, and has aided in informing and refining the establishment, chronology and longevity of the Saxon cemeteries. This success is due to the fact that these results emerged from definite research questions, and were not simply refining artefact chronologies. It has raised a number of further questions engendering further thought, refinement and consideration of the Saxon graves and grave goods here.

5 DISCUSSION AND CONCLUSIONS

The radiocarbon dating programme has provided some important chronological markers and information. It has not, however, dated every main event as some phases of activity (e.g. Romano-British cremation cemetery) were satisfactorily dated by pottery and grave goods. Combining both sets of information we can suggest a development of the cemetery as follows.

Site evidence	*Activity*	*C14 Date range*	*Phase range*
Saxon Central cemetery	Burial	AD 540-780	AD 550-700
Saxon Western cemetery	Burial	AD 420-660	AD 525-650/675
Saxon Eastern cemetery	Burial	AD 340-700	AD 525-600
RB cremation cemetery	Cremation	-	AD 1-150
IA burial	Burial	370-110	400-100
IA cremation cemetery	Cremation	790-390	800-400
LBA activity	Domestic activity & fields	990-820	1100-700
MBA	Pits and cremation	1520-1210	1500-1350
EBA + MBA barrows	Monumental and funerary activity	2290-1940	2200-1800/1500
Neolithic activity	Pits	3650-3370	3560-3500
Mesolithic pits	unknown	-	7th millennium BC

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Feature	*context*	*sample*	*context details*	*material*	*result no.*	*δ C^{13}*	*result BP*	*cal*	*estimate*
Neolithic pit SG136	3371	245		hazelnuts	NZA-20599	-24.12	4775±30	3650-3380	4000-3000 BC
Neolithic pit SG175	3280	239		hazelnuts	NZA-20600	-26.84	4742±30	3640-3370	4000-3000 BC
Grave 4507 [C135]	sk 4552		Western cemetery	r femur	NZA-19886	-21.13	3722±45	2290-1970	2000-1700 BC
BA Grave C4619	sk 4676		Barrow inhumation	lower limb	NZA-19641	-21	3683±35	2200-1940	2000-1700 BC
Pit 5366	5368	PRN 2747	single fill	PRN 2474	NZA-22879	-27.8	3146±35	1520-1310	1500-1150 BC
BA pit W207	5250	324	sealed layer, dumped diagnostic pottery	charred Vicia faba	NZA-19637	-25.8	2847±35	1130-900	1150-950 BC
Pit 6658	6662	652	dump of charred material on top fill	emmer/spelt grain	NZA-22727	-22.5	2769±30	990-820	1150-750 BC
Pit 3910	3975	842	basal fill	emmer/spelt grain	NZA-22595	-22.34	2746±30	980-820	1150-900 BC
Unurned cremation burial 3602	3611	280		Maloideae charcoal <50 yrs	NZA-20655	-25.77	3063±30	1410-1210	1100-400 BC
Unurned cremation burial 1726	1727	120		onion couch grass tubers	NZA-20598	-25.34	2499±30	790-450	700-400 BC
Pyre related deposit 1699	2700	112		32 grass bases	NZA-20597	-27.44	2402±30	760-390	700-400 BC
Grave 24	sk 211			Human bone	NZA-22734	-20.1	2185±35	370-110	AD 250-500

Table 1. Prehistoric radiocarbon results from Saltwood Tunnel

Feature	*context*	*sample*	*context details*	*material*	*result no.*	*δ C^{13}*	*result BP*	*cal*	*estimate*
Saxon Grave 1048 [C5]	1046	85	Central cemetery, founder grave	gaming counters FN823	NZA-21511	-20.54	1701±30	AD 250-420	AD 550-650
Saxon Grave 6635 [C181]	sk 6636		Central cemetery ring ditch inhumation	lower limb	NZA-19639	-19.73	1446±35	AD 540-660	AD 600-700
Saxon Grave 6421 [C190]	sk 6420		Central cemetery founder gave	foot frags	NZA-19719	-19.96	1415±35	AD 560-680	AD 550-650
Saxon Grave 1081 [C7]	sk 1310		Central cemetery founder grave	left upper limb frag	R-28505/2		FAILED		AD 550-650
Saxon Grave 1216 [W185]	sk 1329		Central cemetery, linear inhumation	long bone	NZA-19638	-20.41	1352±35	AD 620-780	AD 475-575
Saxon Grave 6406 [C176]	sk 6407		Central cemetery ring ditch inhumation	dentine	R-28505/4		FAILED		AD 600-700
Horse burial grave 1244 [C27]	1327		Central cemetery horse burial	horse r humerus	NZA-19887	-22.53	1336±35	AD 640-780	AD 550-650
Saxon Grave 6231 [C174]	sk 6230		Western cemetery ring ditch inhumation	femur/pelvis frag	NZA-19640	-19.62	1560±35	AD 420-600	AD 600-700
Saxon Grave 3385 [C129]	3884		Western cemetery	femur + other	NZA-20445	-19.77	1474±40	AD 430-660	AD 600-700
Saxon Grave 4614 [C139]	sk 4612		Western cemetery linear	Left limb	R-28505/6		FAILED		AD 475-575
Saxon Grave 4614 [C139]	sk 4612		Western cemetery linear	r femur+ l radius	NZA-19885	-20.24	1435±40	AD 540-670	AD 475-575
Saxon Grave 1577 [W45]	sk 1856		Row in E cemetery	long bone frags	NZA-20447	-19.36	1596±45	AD 340-600	
Saxon Grave 1491 [W43]	sk 1575		Row in E cemetery	femur + pelvis frags	NZA-20446	-19.9	1395±35	AD 560-700	AD 475-575
REJECTED RESULTS									
Saxon Grave 6653 [C200]	cut 6653		Central cemetery, founder grave	unident mineralised roundwood from spearhead	NZA-21688	-28.95	4054±55	2870-2460 BC	AD 560-680

Table 2. Saxon radiocarbon results from Saltwood Tunnel