Stainton West (Parcel 27) CNDR

Cumbria

Post-excavation Assessment

Oxford Archaeology North

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CONTENTS

List of Tables

SUMMARY

Cumbria County Council has constructed a new road, referred to as the Carlisle Northern Development Route (CNDR), around the western edge of Carlisle. The route extends for 8.5km around the western and northern sides of the city, from Greymoorhill North bridge (NY 3945 5990), in the north, to Newby West (NY 3731 5365), in the south, and covers an area of approximately 30ha. The construction of the road was let as a PFI Design and Build-type concession.

As there are significant archaeological remains along the route, including the World Heritage Site of Frontiers of the Roman Empire: Hadrian's Wall, which is statutorily protected as a Scheduled Monument (in this location, SM 26110), a brief (contained within Annex 14 Part 2B of Schedule 4 of the *Construction Contract*; Connect CNDR 2009) was prepared by Cumbria County Council's Historic Environment Service (CCCHES), acting in concert with English Heritage (EH), setting out the archaeological requirements for the main contractor (Birse Civils Ltd) in advance of and during construction works associated with the building of the road.

Birse Civils Ltd contracted Oxford Archaeology North (OA North) to undertake the archaeological investigations required by the brief. This work comprised archaeological trench evaluation, strip and record and open-area excavation, at several locations along the scheme, as well as a watching brief maintained during construction, where this resulted in a below-ground impact. This work was undertaken between May 2008 and April 2011.

This document focuses on one site in particular, where highly significant prehistoric discoveries were made. It presents the results of the fieldwork at Stainton West (Parcel 27 North), following the completion of a programme of archaeological post-excavation assessment. The results of the fieldwork programme from the CNDR scheme at large are reported elsewhere (OA North 2011a).

The Stainton West site comprised a complex sequence of deposits within a palaeochannel, perched on an early Holocene terrace, above the present floodplain of the River Eden. The deposits filling the channel contained a particularly well-preserved palaeoenvironmental assemblage, including deposits of waterlogged wood, some of which was worked. At various horizons within the channel, lithic, wooden and ceramic cultural material was recovered. Radiocarbon dating suggests that the earliest deposits in the channel formed in, at least, the Later Mesolithic period and the latest during the Late Bronze Age. Adjacent to the channel was an extremely rich assemblage of worked lithic material, seemingly of Early Mesolithic to Early Bronze Age date, although the vast majority of this material is representative of a Later Mesolithic or Early Neolithic technology. The lithic material was associated with features including tree throws, hearths and possible structures that probably indicate a contemporary settlement. Along the banks of the channel were several pits containing *in situ*, burnt material associated with spreads of fire-cracked stone. These features have been radiocarbon-dated to the Later Neolithic to Early Bronze Age and probably represent burnt mound activity. The date, size and good preservation of the Stainton West assemblage, as well as the extended sequence of activity it represents, make it one of the most important early prehistoric sites investigated within the North West to date. Given its rarity, it should be considered to be of international importance.

ACKNOWLEDGEMENTS

Oxford Archaeology North (OA North) would like to thank Birse Civils Ltd for commissioning the archaeological work. In particular, we wish to thank the following Birse Civils Ltd staff who worked closely with OA North throughout the project: Dave Curry, Steve Bullass, Andy Moore, Chris Smart, Wayne Foster, Bob Gibson, Dave Holding, Peter Barker, John Greensmith, Mark Wilkinson, Wendy Thompson, Chris Scurr, John Melia, (Father) John Melia, John Hart and Mike Holt-Bains. Connect Roads: CNDR administered the PFI concession, and Malcolm Findlay, Philip Bent and Nigel Blackbee provided advice and support for the archaeological programme. Martin Hardman, Kevin Walsh and Yvonne Craig of Capita Symonds have helped to integrate archaeological works with the rest of the project, solve problems as they arose, and ensured that there were no impediments to the archaeological programme. Geoff Holden of Cumbria County Council is thanked for his interest in the archaeological process and tolerance of the complications that occasionally arose from it. Mark Brennand and Richard Newman (Cumbria County Council Historic Environment Service) monitored the work and provided archaeological advice, and their ‘hands-on' approach was much valued. Sue Stallibrass and Jacqui Huntley, as Regional Science Advisors of English Heritage, provided support to the project and have enhanced the results with their insights. Story Construction Ltd are thanked for the provision of plant and for their skilled and helpful operators.

ADC ArcheoProjecten are especially thanked for their generosity in providing the sieving apparatus and knowledge, without which the retrieval of the lithic assemblage would not have been possible; in particular, Peter Kuster, Henk van der Velde, Leo Kuit, Jan Willem Beestman and Marieke Opbroek provided their time, advice and support. Many people have contributed their ideas to the project, and the valuable input of Mark Edmonds, Caroline Wickham-Jones, Chantal Conneller, Dave Coward, Helen Evans, Andy Myers, Ian Paterson, Rosemary Stewart and Tam Ward is gratefully acknowledged. The generous assistance of Gill Varndell of the British Museum in allowing access to the Ehenside Tarn artefacts is also gratefully recognised.

The fieldwork was undertaken by Fraser Brown, Paul Clark, Chris Wild, Caroline Raynor, Carl Champness, Caroline Bulcock, Andrew Frudd, Antony Haskins, Anna Hodgkinson, Ailsa Westgarth, Peter Aherne, Paul Beers, Steve Black, Dave Bonner, Bradley Brooker, Ged Callaghan, Sarah Cattell, Katy Chalmers, Mark Chesterman, Steve Clarke, Liz Collison, Steve Collison, Phil Cooke, Alistair Cross, Paul Dunn, Claire Dunscombe, Catherine Edwards, Christina Elcok, Vicky Fackrell, Diane Gorman, Sam Grimmer, Katherine Hamilton, Dan Heale, Yvonne Heath, Vickie Jamieson, Nate Jepson, Sean Johnson, Gemma Jones, Mathilde Jourdan, Lindsey Kemp, Michal Kempski, Nadia Khalaf, Rupert Lotherington, Sarah Lynchehaun, Michelle Maguire, Lisa McCaig, Clionadh Mcgarry, Iain Mcintyre, David Molnar, Dennis Morgan, Desmond O'Donoghue, Jon Onraet, Ken Owen, Aidan Parker, Kevin Paton, Dan Sausins, Carl Savage, Luke Severn, Katie Sludden, Fraser Stewart, Lewis Stitt, Toni Walford, Samantha Walsh, Liann Waring, Matt Weightman, and Berber Wouda.

The translation of the fieldwork archive into a digital record was undertaken by Paul Clark, Caroline Bulcock, Andrew Frudd, Antony Haskins, Anna Hodgkinson and Gemma Jones. These people also undertook the stratigraphic assessment. Lindsey Kemp compiled the composite photographic plans.

The palaeoenvironmental samples from the archaeological work were processed by Rachel Fosberry, Ross Lilley, Graeme Clarke, James Fairbairn, Stephen Morgan and Helen Stocks at OA East. The struck lithics were assessed by the team of David Bonner, Pascal Eloy, Anthony Haskins, and Aidan Parker, supervised by Antony Dickson and Ann Clarke. The identification of waterlogged wood species was undertaken by Denise Druce and Sandra Bonsall, who also prepared the pollen slides. In all other cases, the contributors listed below undertook the relevant assessment. This report was illustrated by Mark Tidmarsh; it was written, compiled and edited by Paul Clark and Fraser Brown (who managed the project); and Rachel Newman provided quality assurance.

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1 INTRODUCTION

1.1 STRUCTURE OF THIS REPORT

1.1.1 This report details the results from the archaeological investigations at Stainton West (Parcel 27 North), located at NY 337594 557137, on the floodplain north of Hadrian's Wall and the River Eden, south of Holme Lane and to the west of the village of Stainton (Fig 1). Stainton West was subject to strip and record, trench evaluation, borehole survey and open-area excavation by Oxford Archaeology North (OA North) as part of the Carlisle Northern Development Route (CNDR) scheme. During the course of these works, important archaeological remains, principally dating to the Mesolithic, Neolithic and Bronze Age were discovered. Due to the depth of impact of the development at this part of the scheme, which involved the installation of substantial culverts under the road embankment, it was not possible to preserve the archaeological remains *in situ* and full excavation was required. The results from the post-excavation assessment of Stainton West have been reported separately from the other CNDR sites (OA North 2011a) because of the exceptional nature of the findings. The investigations took place in phases, between October 2008 and December 2009, and this report combines the results from all these phases.

1.1.2 Included below is a discussion of the stratigraphy, the finds and palaeoenvironmental assemblages, and recommendations for post-excavation analysis. It comprises an introductory section (*Section 1*); an account of the excavation methodology employed (*Section 2*); the results of the archaeological fieldwork (*Section 3*); the results of the assessment (*Section 4*); a statement on the significance of the archaeology and its potential for further research (*Section 5*); updated research aims and objectives (*Section 6*); and a method statement detailing how these aims will be delivered (*Section 7*).

1.2 CIRCUMSTANCES OF THE PROJECT

1.2.1 Cumbria County Council has constructed a new road, referred to as the CNDR, around the western edge of Carlisle. The route extends for 8.5km around the western and northern sides of the city, from Greymoorhill North bridge (NY 3945 5990), in the north, to Newby West (NY 3731 5365), in the south, and covers an area of approximately 30ha (Fig 1).

1.2.2 Cumbria County Council let the construction of the road as a PFI Design and Build-type concession. As there are significant archaeological remains along the proposed route, including the World Heritage Site of Frontiers of the Roman Empire: Hadrian's Wall, which is statutorily protected as a Scheduled Monument (in this location, SM 26110), a brief (contained within Annex 14 to Part 2B of Schedule 4 Archaeology of the *Construction Contract*; Connect CNDR 2009) was prepared by Cumbria County Council's Historic Environment Service (CCCHES), acting in concert with English Heritage (EH), setting out the archaeological requirements for the main contractor (Birse Civils Ltd) in advance of and during construction works associated with building the road.

1.2.3 The Stainton West site (Parcel 27 North) was originally identified by the project brief (CCCHES and EH 2009) as an area for strip and record (Design 10). This phase of works was duly undertaken by OA North and resulted in a major prehistoric find, the scale and significance of which was unforeseeable at the start of the project. Several phases of further archaeological works followed, which were also undertaken by OA North, and constituted a separately funded adjunct to the originally identified programme of archaeological works. At the completion of fieldwork, the decision was taken to report the results of the assessment of Stainton West in a separate document to the assessment results from the other CNDR investigations (OA North 2011a). This was because it was felt that a combined report would be unduly unbalanced; the results from Stainton West, being of international importance, would be better served by being reported separately; and to avoid any risk of delay to the scheme-wide assessment that might arise from combination with the much more complex, and potentially fraught, assessment of Stainton West. Not withstanding this, all the sites from the CNDR, including Stainton West, will be considered together at analysis and will be published in a single integrated volume (*Section 7.31*), as this makes most sense archaeologically.

1.3 Site Location, Topography and Geology

1.3.1 The River Eden bisects the proposed route to the north-west of Carlisle, flowing in a great meander south-west of its more usual north-westerly course (Fig 1). North of the river, the road crosses the low-lying floodplain and river terraces immediately west of Stainton, before rising steeply towards Kingmoor House. On both sides of the river, but particularly to the south, the topography consists of relatively uniform, undulating terrain, in use today predominantly as pasture and arable fields enclosed by substantial hedgerows.

1.3.2 The Stainton West site lies, at approximately 9m OD, towards the centre of the land encompassed by the meander. It extends, north-eastwards, from a step, followed by a small beck, that rises up from the present-day floodplain to a step (now followed by Holme Lane) between two ancient terraces. On the floodplain and the river terrace occupied by the site, occasionally waterlogged depressions denote relict channels (palaeochannels) of the formerly braided River Eden. A more detailed description of the geotopography of the site can be found in *Sections 4.22* and *5.4*.

1.3.3 The underlying drift geology consists of Stanwix shales overlain by drift deposits of boulder clay; adjacent to the River Eden, these deposits are also covered with alluvium (British Geological Survey 1982), the latter grading from gravel to sand and then silt. The local soils are attributed to the Wick Association, coarse well-drained brown earths, which extend westwards to Burgh-by-Sands and Kirkbampton (Countryside Commission 1998).

1.4 Archaeological Background

1.4.1 A more comprehensive archaeological background for the CNDR has been compiled elsewhere (OA North 2011a). The following aims to highlight those elements of this that are of particular pertinence to Stainton West.

1.4.2 Given the nature of much of the land in the vicinity of Stainton, few traces of archaeological earthworks or other above-ground remains survive today, except for those on the opposite side of the Eden, which relate to the Vallum of Hadrian's Wall (EH 2010), the dismantled Carlisle to Silloth railway line (Ramshaw 1997, 136-7) and the Carlisle Navigation Canal (*op cit*, 25, 136-7; Fig 2). However, aerial photographs of the river terraces west and north of Stainton have revealed cropmarks suggestive of potential prehistoric or later activity (EH 2010; OA North 2011a; Fig 2), indicating that these relatively undisturbed, 'greenfield' sections of the proposed route have significant potential for the survival of important archaeological remains, including elements of possible prehistoric monuments.

1.4.3 ***Prehistoric period***: the recolonisation by humans of the Cumbrian landscape, following the last deglaciation, is not presently archaeologically well attested or understood, although some evidence for activity dating to the Late Upper Palaeolithic/Early Mesolithic (Hodgson and Brennand 2006), Later Mesolithic (*eg* Bonsall *et al* 1994) and Neolithic (*eg* Darbishire 1873) periods is known from sites near to the western coast. During the Bronze Age and Iron Age, the evidence for prehistoric settlement in the Carlisle area has increased considerably in recent years (McCarthy 2002, 33-50), but remains fairly sparse. Whilst this may, to a degree, genuinely reflect a comparatively low density of settlement, it is probably due principally to the difficulties inherent in identifying prehistoric sites in a region that is largely under pasture (which is generally far less conducive to aerial photography than most types of arable agriculture), and where prehistoric cultures appear to have produced relatively few artefacts durable enough to have survived to the present day. In the Iron Age, for example, the region appears to have been almost entirely aceramic (Hodgson and Brennand 2006, 56), vessels and containers presumably being fashioned from perishable materials such as wood, leather and horn.

1.4.4 The presence of Grinsdale Camp (HER 399; Fig 1), a fairly large, multivallate enclosure of presumed prehistoric (most probably Iron Age) date at Cargo on the north bank of the Eden, to the north of the proposed road (McCarthy 2002, 46-7), provides a strong indication that this part of the route at least was settled in prehistory. Whilst no direct evidence for prehistoric occupation was known from the line of the road itself prior to this project, aerial photography of the area west and north of Stainton, on the north side of the River Eden, has revealed a quite extensive complex of rectilinear and curvilinear cropmarks, including a number of apparently circular and semi-circular features (EH 2010; Fig 2). These can neither be dated nor characterised with certainty on photographic evidence alone, but are likely to be of prehistoric date, and may represent the remains of ploughed-out burial mounds (barrows) or ceremonial monuments such as henges or henge-like (hengiform) enclosures; possible examples of the latter are known from aerial photography on the Cumbrian coast (Hodgson and Brennand 2006, 39), and discoveries elsewhere in the North West suggest this class of monument may be more widespread than previously believed (Hodgson and Brennand 2007, 42).

1.4.5 The precise significance of the linear and rectilinear features visible on the aerial photographs is not known; some have the appearance of rectangular ditched enclosures, whilst others may be the remains of trackways and field systems. Such remains would not be out of place in a prehistoric or Romano-British context, and are likely to have been associated with a small rural settlement or farmstead, although a later date for some or all of these features cannot be ruled out.

1.4.6 The likely presence of prehistoric remains in the Stainton area is consistent with evidence from other parts of Britain, where river terraces were often favoured for prehistoric settlement due to the presence of fertile, and relatively easily-cultivated, alluvial soils overlying well-drained river gravels (Evans 1975, 62). Burnt mounds are often found in waterside locations (EH 2011) and evidence for activity of this sort might be expected to survive near to the former channels of the Eden.

1.4.7 ***Roman period***: whilst some of the rectilinear features traced by aerial photography in the Stainton area could conceivably be of Roman date (*Section 1.4.3*), the archaeology of the Roman period within the study area is dominated by Hadrian's Wall (Symonds and Mason 2009), which at this point ran on a roughly north-west to south-east alignment, on the steep escarpment forming the south bank of the Eden. The Stainton site lies outside of the Wall's military zone, and, indeed, beyond the borders of the Roman Empire when the Wall defined this (*ibid*). Given the close proximity of the Wall, as well as the Roman fort and settlement at Carlisle (Zant 2009), some activity of this date would not be unexpected in the area of the site, and the terraces, being good agricultural land, probably continued to remain attractive for farming. As such, any archaeological remains are likely to be agricultural in nature and any settlements rural in character.

1.4.8 As the Wall between Davidson's Banks and Grinsdale apparently closely follows the meander in the Eden (EH 2010), it might be anticipated that the river was flowing further to the south-west, away from Stainton West, at this time. However, if this was the case, the land occupied by the site may still have been vulnerable to periodic flooding, and it cannot be assumed that the older channels were certainly inactive.

1.4.9 ***Post-Roman period***: in the early medieval, medieval and post-medieval periods, the terraces probably continued to be largely rural and agricultural in character. Some of the cropmark features visible from aerial photography (EH 2010; Fig 2) may date from this time, and evidence for the ridge and furrow (*ibid*), still visible in some fields, almost certainly does. It seems likely that it was during these periods that the cultural landscape largely achieved its present-day form, with the establishment of the fields, hedgerows, tracks, farms and settlements that still exist today.

1.5 Previous Work on the Route

1.5.1 An archaeological assessment of the CNDR, including Stainton West, was undertaken by OA North in 1996, in its former guise as the Lancaster University Archaeological Unit (LUAU), as part of a Stage 2 Environmental Impact Assessment (LUAU 1996); this work included a desk-based survey of available cartographic and documentary sources and a walk-over survey of the different route options. The report concluded that further field evaluation was necessary to determine the full potential of the archaeology along the route. Subsequently, between 1996 and 2005, the Carlisle Archaeological Unit (CAU) and CFA Archaeology undertook various evaluations of different parts of the scheme (these works have been summarised and referenced elsewhere; OA North 2011a), but it is worth noting that some evidence for prehistoric activity was detected at several places. It was not possible to gain access to Stainton West (then referred to as Parcel 27 North) until 2005, when it was subject to trench evaluation (CFA 2005). The evaluation retrieved eight worked lithics, provisionally dated to the Late Neolithic period (HER 41362) from the topsoil and, in one trench, a preserved root from an oak tree. Some of the naturally deposited sediments were interpreted as silting within a palaeochannel. Generally, the geology was shown to comprise deposits of alluvial sediment.

2 METHODOLOGY

2.1 Project Design

2.1.1 In accordance with Annex 14 to Part 2B of Schedule 4 Archaeology (CCCHES and EH 2009) of the *Construction Contract* (Connect CNDR 2009), a series of archaeological project designs was produced for the various phases of work at Stainton West (Parcel 27 North), outlining methodologies designed to mitigate the impact on archaeological remains arising from the construction of the road or ancillary works. These methodologies, in all instances, complied with the stipulations of the brief (*ibid*). *Design 001* (OA North 2008) comprised a generic design establishing an investigatory framework for the CNDR as a whole, which drew heavily on the existing *Regional Research Agenda* for the North West (Brennand 2007) and the then draft *Research Agenda* for Hadrian's Wall (Symonds and Mason 2009). The other site-specific designs were respectively produced in advance of each phase of archaeological investigation. These were ultimately submitted to CCCHES as part of the project certification process, and all works undertaken complied with the terms of the relevant design. The designs are not referenced in the bibliography at the end of this report, but will be referred to in the text, where appropriate, and are included in the site archive. They comprise:

- *Design 10 Parcel 27 North, Strip and Record*;
- *Design 26 Parcel 27 North, Phase 1 Further Archaeological Works*;
- *Design 29 Parcel 27 Borehole Survey*;
- *Design 30 Parcel 27 North, Phase 2 Further Archaeological Works*;
- *Design 31 Parcel 27 North, Uppermost Buried Land Surface*;
- *Design 31 Parcel 27 North, Lowermost Buried Land Surface*.

2.1.2 The overall aim of the mitigating works was to provide an appropriate, specialist response to known or newly discovered archaeological remains during the course of the construction of the road or ancillary works, in order to assist the client with its planning and construction. Specific objectives were as follows:

- to undertake all on-site archaeological works in accordance with current Health and Safety legislation and relevant guidelines;
- to gather sufficient information to establish the extent, condition, character and date, as far as circumstances permit, of any archaeological features and deposits within the areas of investigation;
- to locate, sample-excavate and record any archaeological remains revealed;
- to locate, recover, identify, and conserve, as appropriate, any archaeological artefacts revealed;
- to locate, recover, assess and analyse, as appropriate, any palaeoenvironmental, palaeoeconomic and organic remains revealed;

- to date scientifically such remains by optimal means, including artefact typology, radiocarbon assay, or other appropriate dating methods;
- to recommend measures for preservation *in situ* of archaeological, palaeoenvironmental, palaeoeconomic and organic remains, where revealed, wherever feasible and desirable;
- to test the results of the previous evaluations (*Section 1.5*);
- to compile an appropriate report/publication;
- and to produce a paper and digital archive to professional standards, for deposition in the appropriate repositories.

2.2 Fieldwork Methodology

2.2.1 The following describes the excavation methodologies employed to undertake the various phases of archaeological investigation in order to ensure that the project's objectives were met. These methodologies were, necessarily, devised in response to an evolving need as the project progressed and the nature of the archaeological resource was revealed.

2.2.2 In the case of each investigative phase, all artefacts were retained for processing and analysis. Samples for environmental analysis and scientific dating were taken where suitable material was encountered.

2.2.3 Recording took place according to the normal principles of stratigraphic excavation. The stratigraphy was always recorded, even when no archaeological deposits were identified.

2.2.4 Context sheets approved by CCCHES were used for written field records; these were in a format acceptable to the *Institute for Archaeologists* (IfA 2002). A unique alpha-numeric project code was applied to all records. All archaeological features were accurately located by instrument survey and recorded on an appropriately scaled site plan, also by photographs, scale drawings and written descriptions, sufficient to permit the preparation of a detailed archive and report on the material. The trench location, as excavated, was accurately surveyed, tied into the WGS84 GPS co-ordinates datum and located on an up-to-date 1:1250 Ordnance Survey (OS) map base.

2.2.5 Specialists, from a wide range of disciplines, were invited to make periodic visits to the excavations as they proceeded; the site was also regularly visited by representatives from CCCHES and EH. The specialists and representatives were consulted and several formal seminars were convened; the resulting recommendations were built into the project methodology as was applicable.

2.2.6 Due to the requirement to construct a retention pond and install a series of substantial culverts, beneath what would be an elevated embankment for the road, the impact of the development was as much as 3.5m over some parts of the site. The geology was largely alluvial in nature, with some colluviation occurring at the north-eastern end of the site, and deposits of sediment survived to various depths (*Section 4.22*). The site was under pasture at the time of investigation, and plough truncation had apparently been minimal. Thick deposits of sand and silt alluvium, which was thought to have accumulated in the Holocene epoch (R Chiverrell *pers comm*), had the potential to contain anthropogenic remains. Consequently, establishing the appropriate level for the machine strip was not straightforward, as this had the potential to be variable across the site and, necessarily, had to be achieved in increments.

2.2.7 ***Strip and Record:*** during the first phase of investigations (*Design 10 Parcel 27 North, Strip and Record*), the topsoil and some of the subsoil (a relict ploughsoil), with a combined thickness of 0.20m, were stripped from the site, under constant archaeological supervision, by a back-acting, tracked excavator fitted with a smooth-faced ditching bucket. After it was recognised that the undisturbed alluvial sediments, exposed at this level towards the eastern part of the site (Fig 3; Grid Square Area), contained lithic artefacts, mechanical excavation ceased.

2.2.8 Lithic artefacts were collected by hand from over the stripped surface and surveyed to locate them in three dimensions. A series of four 1m square test pits was then hand excavated, at various points within the area where the lithic artefacts had been collected from, in order to characterise the nature of the flint-bearing deposits (Fig 3; TP1 and TP 4-6). One of these (TP5) appeared to confirm the existence of a palaeochannel that had been revealed by the topsoil strip.

2.2.9 ***Trench Evaluation:*** due to uncertainty regarding the potential for the survival of archaeological remains within the palaeochannel, a trench evaluation was requested by CCCHES (*Design 26 Parcel 27 North, Phase 1 Further Archaeological Works*). Within a 3m corridor along the northern edge of the excavation area (Fig 3; Evaluation Trench Corridor), the sediment containing the lithics was hand-excavated, by context, in 1m square blocks (66 in total), with the materials being retained as distinct whole-earth samples. This cleared corridor enabled a mechanical excavator to gain access to the south-western part of the site without disturbing the deposits containing the flint.

2.2.10 Subsequently, a 2m-wide trench was excavated to a maximum depth of 3.2m along the southern edge of the site, starting at the eastern edge of the palaeochannel, and working towards the beck at the western edge of the site (Fig 3). It was not possible to enter the deeper part of the trench because of concerns over Health and Safety, but the sequence of alluvial deposits could be recorded from outside of the trench, and samples were gathered from the arisings. Excavation stopped when gravels, believed to date to the end of the Pleistocene and, therefore, of very limited archaeological potential, were reached. At the western end of the trench, where archaeological features and finds were recognised at a depth of approximately 1m below the level of the topsoil strip, a limited amount of hand-excavation was undertaken (*Section 2.2.7*). Additionally, several smaller evaluation trenches were mechanically excavated to characterise the deposits along the corresponding northern edge of the site.

2.2.11 ***Borehole Survey:*** this phase of work (*Design 29 Parcel 27, Borehole Survey*) took place following the completion of the trench evaluation. It was principally to characterise a series of palaeochannels, recognised from LiDAR data, within the floodplain to the west (Parcel 27 South; *Section 4.22.2*; OA North 2011a; Fig 4). However, the opportunity was also taken to retrieve core samples from nine points across the palaeochannel in the Stainton

West site (Fig 3). The survey was undertaken by Soil Mechanics using a Terrier Rigg to take windowless samples in capped plastic tubes.

2.2.12 ***Open-area Excavation***: this was commissioned by CCCHES once the full significance and extent of the archaeological remains at Stainton West had been determined by the strip and record (*Section 2.2.7*) and trench evaluation (*Section 2.2.9*). To ensure that the most appropriate and proportionate methodologies were employed, designs were produced as the excavations progressed and the various elements of the site were exposed and characterised. The first of these (*Design 30 Parcel 27 North, Phase 2 Further Archaeological Works*) set out a strategy for the excavation of the lithic scatter and archaeological features in the east of the site, and for the exposure of organic deposits within the palaeochannel and features adjacent to it (Fig 3). Subsequently, other designs (*Design 31 Parcel 27 North, Uppermost Buried Land Surface* and *Design 31 Parcel 27 North, Lowermost Buried Land Surface*) respectively defined how, firstly, the deposits constituting an uppermost organic horizon (actually *Later Neolithic organic deposit* (*Sections 2.4.3* and *3.3.13*) and *Earlier Neolithic organic deposit*; *Sections 2.4.3* and *3.3.9*) and, then, an earlier, lower organic horizon (actually *Mesolithic organic deposit*; *Section 2.4.3* and *3.3.5*) should be excavated. The former of these designs also outlined an excavation methodology for the burnt mounds and other features revealed adjacent to the palaeochannel (*Section 3.3.17*; Fig 3), including those in the area of a retention pond to the north of the main site (*Section 3.3.18*; Fig 3).

2.2.13 Within the eastern part of the site, the sediment containing the lithic scatter was subdivided into a grid of 1m squares (820 in total; *Section 3.3.20*; Fig 3). The deposit within each of these squares was hand-excavated, by context, with the arisings being retained as distinct whole-earth samples. These samples, along with those collected from the trench evaluation (*Section 2.2.9*; *c* 270,000 litres in total), were then wet-sieved to 2mm and the resulting coarse clast residue retained in order to retrieved the finds therein (*Section 4.3*). Where archaeological features were identified (*Section 3.3*), these were hand-excavated in their entirety, recorded, sampled for palaeoenvironmental remains and any finds were three-dimensionally located. The grid squares were excavated in such a manner as to leave standing baulks, at regular intervals, running on perpendicular alignments to each other. These baulks were recorded and used to help interpret the nature of the deposits, their stratigraphic sequence and overall extent within the area. Following recording, the baulks were also removed and sampled using the same methodology employed for the rest of the grid squares. Work ceased once all the features had been excavated and the grid squares had all been sampled and sieved.

2.2.14 From over the top of the palaeochannel, the alluvial sediment was mechanically excavated by a back-acting, tracked excavator fitted with a smooth-faced ditching bucket, until the uppermost organic horizon (*Later Neolithic organic deposit* and *Earlier Neolithic organic deposit*; *Sections 3.3.13* and *3.3.9*) was revealed. Thereafter, all excavation continued by hand until the organic deposits had been completely removed. Excavation took place in segments (bays) with standing baulks, 1m wide, being left between these (Fig 5). The cross-sections of the channel sequence formed by these were drawn and photographed. Any finds recovered from the channel were three-dimensionally recorded, including wood collected for species identification, dating purposes or because it had been altered.

Dendrochronological samples were either retrieved as complete pieces of wood or sawn segments, if the piece of wood was too large for it to be practicably curated. All wood recovered for these reasons was photographed *in situ* prior to being lifted. Bulk sediment and monolith samples (Fig 5), for palaeoenvironmental remains, were also retrieved and survey-located. Samples of 20 litres of deposit were collected from five locations across the width of the organic deposit within each bay (to a total of 100 litres per bay) and wet-sieved to 2mm for the purposes of finds retrieval. A full photographic record was maintained throughout the excavation, including geolocated, overhead photographs being taken at regular intervals, so that these could be rectified and combined to form a composite photograph, enabling a plan to be digitised.

2.2.15 Once the entirety of the deposits forming the uppermost organic horizon had been removed by hand-excavation, a back-acting, tracked excavator, fitted with a smooth-faced ditching bucket was employed under close archaeological supervision to help remove the baulks and the alluvial deposits that separated the uppermost organic deposits from those forming the lower organic horizon (*Mesolithic organic deposit*; *Section 3.3.5*). Mechanical excavation ceased once the organic deposits were exposed within the baulks and excavation then proceeded by hand, until all the deposits within the channel had been reduced to the level of the top of the lower organic horizon. After recording and excavation of the features adjacent to the palaeochannel (*Section 3.3.17*) had taken place, the machine was used to remove spoil heaps and to landscape the site to enable easy access and egress into the channel and permit the continued excavation of the palaeochannel sequence.

2.2.16 The burnt mounds and other features adjacent to the palaeochannel were cleaned, planned and photographed and then excavated by hand in their entirety. The burnt mounds were excavated in quadrants, with bulk samples (from each quadrant) and monoliths being retrieved for palaeoenvironmental remains. The sections through the burnt mounds were drawn and photographed. Where pits were found in association with the burnt mounds, these were excavated in their entirety and recorded in half-section; all other features were treated in the same way. All finds were three-dimensionally recorded.

2.2.17 Once exposed by mechanical excavation (*Section 2.2.15*), the lower organic horizon was excavated, sampled and recorded in precisely the same manner as the upper organic horizon (*Section 2.2.14*). Excavation continued until the Pleistocene gravels had been exposed across the entire palaeochannel and all archaeologically sensitive deposits had been removed.

2.3 REPORTING

2.3.1 The brief (CCCHES and EH 2009) has specified that the results of the archaeological fieldwork, following a *MAP 2* assessment (EH 1991, 2-3), should be presented within an interim report; this document constitutes such a report. As required, it includes, '...an initial finds and environmental assessment and review of site data. It will identify the scope of the post-archaeological fieldwork analysis and result in a revised project specification and detailed timetable for the analysis. An interim site narrative shall also be provided...' (*ibid*; *Section 3.3*). More specifically, it includes the following requisite elements:

- a site location plan, related to the national grid;
- a front cover/frontispiece which includes the national grid reference of the site;
- the dates on which the work was undertaken;
- a concise, non-technical summary of the results set in the context of the known development of the historic environment of the Carlisle district;
- an explanation of any agreed variations to the brief, including justification for any work not undertaken;
- a description of the methodology employed, work undertaken and the results obtained;
- maps and other illustrations at an appropriate scale;
- a list of, and spot dates for, any finds recovered;
- a description of any environmental or other specialist work undertaken and outline of the results obtained;
- revised project specification for post-archaeological fieldwork analysis justified against research priorities (reference will need to be made to both the research agendas for the North West).

2.3.2 The last item in the above list (*Section 2.3.1*) anticipates a subsequent phase of analysis and dissemination. A detailed methodology for delivering this is presented in *Section 7* below.

2.4 Stratigraphic Assessment

2.4.1 The stratigraphic sequence at Stainton West is relatively complex, and assessment has necessitated the integration of results from various different phases and types of investigation (*Section 2.1.1*). Despite these challenges, *Section 3* of this document draws all the stratigraphic evidence together into a coherent whole. To facilitate this, much work has been undertaken, both during the excavation and the assessment, to ensure that the archive is adequately ordered, cross-referenced and indexed, and that stratigraphic units are appropriately defined and arranged within a robust framework. This structure has been captured in the paper site archive and a digital database.

2.4.2 In order to enable the reader to understand easily and take an overview of the site, this report will concentrate only on the most salient stratigraphic units (*Section 2.4.3*; Fig 6). Individual features will be referred to by context number, but some of the more general stratigraphic units (principally those 'geological' deposits within the palaeochannel or the grid square area adjacent to it) have been descriptively named. These latter units are effectively interpretative sets, collecting together individual stratigraphic groups (groups of contexts) defined at assessment, but refraining from irreversibly combining them, until analysis has confirmed that this is should be the case.

2.4.3 Table 1, for ease of reference to the archive, provides concordance between the main stratigraphic units and the group numbers issued to their components. To ensure clarity, the main stratigraphic units will be italicised whenever they are referred to throughout the text. It should be noted that, at a coarse level, the main stratigraphic units correspond to the lithological units defined in the geoarchaeological assessment (*Section 4.22*), although, on occasion, lithological units have been subdivided or combined on stratigraphic grounds.

Stratigraphic Unit	**Group Number**s
Basal sands and gravels	***70098, 70146, 90039, 90183***
Mesolithic organic deposit	***70228, 71012, 71013, 71014, 71015, 71016, 71059, 71060, 71061, 71096, 71097, 71098, 71106, 71149, 71150, 71151, 71152, 71153 71157, 71158***
Mesolithic/Neolithic alluvium	***70097, 70303, 70268, 70505***
Earlier Neolithic organic deposit	***70301, 70302***
Earlier Neolithic alluvium	***70135***
Later Neolithic organic deposit	***70300***
Later Neolithic alluvium	***70191, 70192, 70193, 70194, 70299***
Overbank alluvium	***70095, 70102, 70465, 70466, 70484, 90211, 90212***
Stabilised land surface	***90003, 90206, 27109***
Backwater channel	***90181, 27111***
Colluvium	***90002, 90571, 27110***

Table 1: Summary of the main stratigraphic units defined during the assessment

2.4.4 One inevitable consequence of the inundated conditions within the palaeochannel during its excavation, and the homogeneity of some of the black-coloured organic deposits it contained, is that the boundaries between certain similar deposits were not always recognisable while excavation was taking place (this is particularly true of the *Earlier Neolithic organic deposits* and the *Later Neolithic organic deposits*, which were in some places directly superimposed). These horizons were, however, visible in the sections of the standing baulks left at regular intervals across the channel. As finds and samples were three-dimensionally recorded at the time of their retrieval, it has been possible to reassign these to the stratigraphic deposit they actually came from, on the basis of an extrapolation from the recorded section, rather than the more general context to which they were assigned at the time of excavation. If more than usual uncertainty remains as to the true provenance claimed for a find or sample, this will be noted in the discussion.

2.5 Geoarchaeological Assessment

2.5.1 The geoarchaeological assessment involved the combination of the results of two main stages of work, field investigation and desk-based study, into a sedimentary deposit model for the site. This involved the integration of a number of different data sources that include Environment Agency Light Detection Aperture Radar (LiDAR), NextMAP Interferometric Synthetic Aperture Radar (IFSAR) digital elevation models, excavation and trench records, survey data, borehole sampling and field observations. The results of the assessment are presented in *Section 4.22*.

2.5.2 The first phase of field investigation comprised trench evaluation (*Section 2.2.9*) across the channel sequences identified within the site. A preliminary interpretative cross-section of the site sedimentary sequence was recorded and the archaeological potential of the wetland zone was investigated. This was followed by borehole sampling (*Section 2.2.11*), targeting archaeological horizons on Terrace 3 and palaeochannels on Terraces 3 and 4 (*Section 4.22*).

2.5.3 Frequent site visits were undertaken during the course of the main excavations (*Section 2.2.12*) to oversee the recording of the sedimentary sequence and to test the preliminary assumptions developed during the earlier stages of the project. Key stratigraphic surfaces were carefully examined, surveyed and sampled for further assessment. The sediments were described according to Jones *et al* 1999, which included information about depth, texture, composition, colour, clast orientation, structure, inclusions and contacts between deposits. The sampling and descriptions of the sediments followed English Heritage guidelines (2004).

2.5.4 Following the completion of the fieldwork, the site data were correlated into a stratigraphical deposit model in order to provide an interpretative framework to the site's sedimentary sequence. The various lithological contexts were correlated with the help of computer modelling software into coherent units. The multiple data sources were used to generate an even distribution of data points across the site to provide a highly detailed sedimentary and topographical model. This model was developed into 3D computer visualisations of the site using 3D GIS packages to aid in the mapping of deposits across the site and establish the context of the archaeology. The geoarchaeological interpretation also took cognisance of the findings of the palaeoenvironmental assessments.

2.6 ARCHIVE

2.6.1 A full archive, produced to professional standards, is being prepared, in accordance with current English Heritage guidelines (EH 1991, 2–3; 2006) and the *Guidelines for the Preparation of Excavation Archives for Long Term Storage* (Walker 1990). The project archive represents the collation and indexing of all the data and material gathered during the course of the project. The deposition of a properly ordered and indexed project archive in an appropriate repository is considered an essential and integral element of all archaeological projects by the IfA in that organisation's code of conduct (IfA 2002). The archive for the archaeological work undertaken at the site will be deposited with the nearest museum (Tullie House Museum and Art Gallery, Carlisle), which meets the Museums and Galleries Commission's criteria for the long-term storage of archaeological material (MGC 1992). This archive can be provided in the format recommended by English Heritage's former Centre for Archaeology, both as a printed document and on computer disks as ASCII files (as appropriate). Except for items subject to the Treasure Act and to landowner consent, all artefacts found during the course of the project will be donated to the receiving museum.

2.6.2 A synthesis (in the form of the index to the archive and a copy of the publication report) will be deposited with the Cumbria County Council Historic Environment Record (CCCHER). A copy of the index to the archive will also be available for deposition in the

EH Archive in Swindon.

2.6.3 CCCHER is taking part in the pilot study for the Online Access to Index of Archaeological Investigations (OASIS) project. The online OASIS form, at http://ads.ahds.ac.uk/project/oasis, will, therefore, also be completed as part of the archaeological work.

3 SUMMARY OF RESULTS

3.1 INTRODUCTION

3.1.1 The following presents the results of the archaeological investigations at Stainton West (Parcel 27). Multiple phases of work were undertaken at this site (*Section 2.1*), and these are drawn together into a coherent stratigraphic narrative below.

3.1.2 During fieldwork, it was convenient to consider Stainton West as comprising two main areas: the palaeochannel and grid square area, although, to understand the site correctly, it is important that the articulation of these areas remains a central concern. The text below will discuss the two areas separately, partly because the site chronology is not yet refined enough to permit secure phasing across them; however, any stratigraphic links between the palaeochannel deposits and the features and deposits of the grid square area will be noted where present.

3.2 QUANTIFICATION

3.2.1 The archaeological investigations at Stainton West have generated a large and diverse material, paper and digital archive. A summary listing of the archive material appears in Table 2.

Contexts by Context Type	**Number**
Cut	257
Deposit	3919
Group	120
Total	4296
Contexts by Feature Type	
Ditch	9
Drain	24
Fill	448
Hearth	17
Hedgerow	1
Layer	3580
Linear feature	1
Modern disturbance	11
Natural feature	78
Pit	39

Contexts by Feature Type	**Number**
Posthole	18
Ring gully	4
Stakehole	62
Structure	3
Worked Timber	3
Finds	Struck lithics, coarse stone, stone axes, prehistoric pottery, Romano-British pottery, medieval pottery, post-medieval pottery, beads and worked wood
Samples	
Bulk palaeoenvironmental samples	702
Monolith samples	242
Dendrochronological samples	80
Wood species ID samples	1073
Finds samples	3262
Graphic Archive	
Digital photographs	9412 (36.4GB)
Number of colour slide films	63
Number of black-and-white films	63

Table 2: Quantification of the archive for Stainton West

3.3 ASSESSMENT

3.3.1 ***Palaeochannel:*** the excavation identified a complex sequence of sediment deposition, reactivation and out-scouring within a relict channel of the Eden. This flowed in a general south/north direction across the excavation area, and, at its earliest and most extensive phase, covered an area of approximately 366m² within the site (Fig 5). Where exposed, the channel was formed, at its southern end, by a confluence of two braiding streams flowing around a small island (or eyot). Further to the north, a spur branched off from the west of the main channel. The channel continued out of the site to both the north and the south, and was visible at the time of excavation as a depression in the pasture fields adjacent to Stainton West (Plate 1). The formation processes that led to the survival of the channel are discussed within *Section 4.22*.

3.3.2 The many different context numbers issued to the deposits within the palaeochannel during fieldwork have been combined during the assessment to form several main stratigraphic units (*Section 2.4*), which provide headings for the descriptive text below. These will also be used (in italics) within subsequent sections of the report when making reference to the stratigraphy. A range of different artefact types was retrieved (*Sections 4.3-13*) and good assemblages of palaeoenvironmental remains survived and were extensively sampled (*Sections 4.14-21*).

3.3.3 The palaeochannel was excavated in two principal phases of directly consecutive work (*Section 2.2.14-7*). This was necessary for both archaeological reasons and other reasons revolving around practicality and safety. During each phase of work, the channel was subdivided into a series of cellular bays (Fig 5; Plate 2). This helped with water management; access and egress; spoil removal; and enabled cross-sections of the sequence to be recorded at regular intervals. The bays of the lower, later phase of work (Bay U-Z) do not directly correspond to and continue on from the upper phase (Bay O and Bays A-I; Fig 5), as these were repositioned to agree better with the morphology of the lower phase of the channel. The bays will be used throughout this section and subsequent sections of the report to provide a relative location within the channel. It should be noted that the intervening areas between the bays were also excavated, and are identified by reference to the bays flanking them *eg* the baulk between Bays X and Y is referred to as Bay X/Y.

3.3.4 **Basal Sands and Gravels:** these deposits, filling an earlier, larger phase of the River Eden (*Section 4.22.12*), formed the substrate through which the palaeochannel at Stainton West had eroded its course (Fig 6). Outside of the palaeochannel, they usually occurred at approximately 0.25m below the present-day ground surface, but at the deepest part of the excavated channel, they were seen at a depth of approximately 2.5m. These fluvial/alluvial deposits were probably deposited, at the end of the Pleistocene and start of the Holocene epochs, by the post-glacial River Eden (*Section 2.5*). Due to their age and high-energy nature, it is extremely unlikely that any anthropogenic material survives within them; certainly, no evidence for this was observed. The deposits were mostly sterile and devoid of palaeobotanical remains. Pollen did survive, but, where sampled, was very poorly preserved (*Section 4.19*). Excavation usually ceased once the *basal sands and gravels* were encountered.

3.3.5 **Mesolithic Organic Deposit:** the earliest major deposit in the channel sequence comprised thin layers of alluvial clay and sand interspersed with organic peaty deposits (Fig 6). This probably represents several different phases of lower- and higher-energy fluvial activity, which may have been taking place over a prolonged duration.

3.3.6 A significant quantity of wood was recovered, concentrated in two main groups. The northern group was located in Bays V to W and predominantly comprised long trunks (Fig 7). A, presently undated, dendrochronological cluster was identified within this group (*Section 4.24*). The southern group was largely contained within Bay Y and, except for one substantial trunk, was composed of much smaller pieces of wood. This also included a dendrochronological cluster, which is also not presently dated. Some of the wood pieces had been beaver-gnawed (Plate 3) and could represent the remains of zoogenic structures, possibly a dam in the north and a lodge in the south (Fig 7; Plate 2). A few anthropogenic artefacts were also recovered from this unit, mostly comprising struck lithics (*Section 4.3*), but also including coppice stools, burnt pieces of wood and tree-felling debris (*Section 4.13*).

3.3.7 Six samples from this unit were dated by radiocarbon assay (*Section 4.25*), returning Late Mesolithic dates. Two pieces of wood, one from Bay X and one from Bay Y, were also dated to the Late Mesolithic period by dendrochronology (Cluster 2; *Section 4.24.8*).

3.3.8 **Mesolithic/Neolithic Alluvium:** this unit overlay the *Mesolithic organic deposit*, and comprised thin deposits of grey alluvial clay, succeeded by a substantial deposit of pink sandy clay alluvium (Fig 6). The composition and thickness (up to 1m) of these deposits suggests a major phase of higher-energy flow and alluvial deposition. It is possible that during this active phase, earlier deposits were eroded and scoured out. The alluvial deposits predominantly occurred on the western side of the channel, although towards its southern end, they also survived on the eastern side. The lack of alluvium, at this point in the sequence, within the central part of the channel, probably indicates erosion by a subsequent phase of channel activity.

3.3.9 **Earlier Neolithic Organic Deposit:** this overlay the *Mesolithic/Neolithic alluvium* (Fig 6) and comprised a black organic peaty deposit, containing large quantities of wood (Fig 8). This probably represents a lower-energy phase within the channel, following the higher-energy phase that resulted in the erosion of the *Mesolithic/Neolithic alluvium* (*Section 3.3.8*). During this lower-energy phase, the watercourse was possibly little more than a stream flowing within only a small part of the channel. Nevertheless, the section of the channel within Stainton West was evidently a focus for human activity at the time. A collapsed hurdle fence, possibly a fish weir, was identified in the baulk between Bays A and B (Fig 8; Plate 4), and a line of pile-driven stakes, which may be the remains of a second weir, was found on a parallel alignment within the baulk between Bays B and C (Fig 8; Plate 5). Much of the other wood along the channel appears to have been deposited in a structured manner, possibly forming a crude platform along the eastern edge of the active watercourse (Fig 8). A significant proportion of the wood had been altered by human agency in a variety of ways (*Section 4.13*), best exemplified by two forked implements of uncertain function, presently termed *tridents* (*Section 4.13.4*; Plates 6 and 7), a hooked dowel (75826) and a possible paddle shaft (Plate 8) that had been deposited amongst the other wood within the platform.

3.3.10 In addition to the worked and unworked wood, many pieces of worked stone were deposited at this level within the channel. Of note, amongst this assemblage, were three polished stone axes, all made of stone originally from the English Lake District *(Section* 4.6; Plates 9-11). Other finds comprised struck lithics (*Sections* 4.3), including an arrowhead with glue still adhering to it (*Section 4.8*; Plate 12), and coarse stone tools (*Section 4.5*). The distribution of these finds seems to hold some structure, and two major clusters have been identified (Fig 8). One of these, comprising both worked stone and worked wood (including the tridents), was located on the eastern side of the channel, in Bays B to D. The other was located on the western side of the channel, in Bays E to G, and included only stone tools.

3.3.11 Six radiocarbon dates were obtained from the deposits forming this unit, yielding Neolithic dates (*Section 4.25*). Conversely, 13 pieces of wood from this deposit fit into a datable dendrochronological sequence, dating to the Late Mesolithic period (*Section 4.24*). Understanding the chronological discrepancy between these two datasets will be a priority for analysis (*Section 7.28.1*).

3.3.12 **Earlier Neolithic Alluvium:** this unit predominantly occurred along the western edge of the channel, where it overlay the *Earlier Neolithic organic deposit* (Fig 6). The composition of these sediments suggests a higher-energy phase of deposition within the channel, and it is conceivable that this may have also been associated with some erosion of the *Earlier Neolithic organic deposit.* A pit (***70129***; Fig 9) cut into this alluvium; it contained a *polissoir* (Plate 13; *Section 4.5.3*), and radiocarbon assay of a hazelnut from it produced an Earlier Neolithic date *(Section 4.25*).

3.3.13 **Later Neolithic Organic Deposit:** this comprised a black organic peaty sediment, which stratigraphically overlay the *Earlier Neolithic alluvium* (Fig 6) and filled the upper portion of pit ***70129*** (Fig 9). In places, it was physically directly superimposed on the *Earlier Neolithic organic deposit*, and, when this was the case, the boundary between these deposits was very hard to distinguish during excavation.

3.3.14 This deposit contained large amounts of wood (Fig 10), some of which was worked, and, particularly towards the top of the deposit, a significant proportion of this was seemingly *in situ* root wood from trees that once grew on the surface of a drier and largely infilled channel. Two Late Neolithic radiocarbon dates were obtained from this unit (*Section 4.25)* and a further Late Neolithic radiocarbon date was obtained from a residue on sherds from a Grooved Ware vessel (*Sections 4.9 and 4.25.6*; Plate 14). This vessel had originally been assigned to the *Earlier Neolithic organic deposit*, by reference to its depth and location within the channel; however, it seems more likely, considering all the other dating evidence, that the vessel was within a pit cut in from a higher level. A single polished stone axe (***70326***/4; Fig 10; Plate 15), made in a different type of stone from the others (*Section 4.6.2*), was also recovered from this unit.

3.3.15 Towards the southern limit of the site, in the western branch of the channel, a pit (***70250***; Fig 10), containing large amounts of burnt stone and the possible remnants of a hurdle basket, was cut into the top of this deposit. A nearby burnt mound (Burnt Mound 5; Fig 10; Plate 16), was morphologically different from all the other burnt mounds found at Stainton West (*Section 3.3.17*). It comprised a rectangular cut packed with fairly large burnt stones, amongst a wider spread of charcoal and much smaller burnt stones, possibly the seat of a large fire. This feature was dated by radiocarbon assay to the Late Neolithic period (*Section 4.25*) and may potentially be associated with the aforementioned pit in the channel.

3.3.16 **Later Neolithic Alluvium**: this deposit sealed the *Later Neolithic organic deposit* (Fig 6), and is thought to comprise overbank alluvium deriving from an active channel on a lower terrace (Terrace 4; *Section 4.22.6*) further to the west, the Stainton West channel now being no more than a backwater. Two radiocarbon samples were assayed from this alluvium, producing Later Neolithic dates (*Section 4.25*).

3.3.17 Several burnt mounds were identified on both banks of the palaeochannel (Fig 11). Eroded deposits from Burnt Mounds 1-4 directly overlay the *Later Neolithic alluvium*. The burnt mounds on the eastern bank of the channel (Burnt Mounds 1 and 2) comprised broadly circular, thin spreads of fire-cracked stones, with a single central pit, also containing burnt material (Plate 17). Sediment from the base of the pit in Burnt Mound 1 produced an Early Neolithic radiocarbon date (*Section 4.25*), although this material may have been redeposited clay used to line the pit, and, as such, the date may not relate to the use of this feature. Burnt Mound 2 produced a Later Neolithic radiocarbon date (*Section 4.25*), which may actually indicate its period of use. The burnt mounds on the western bank of the channel, recorded as Burnt Mounds 3 and 4 (Plate 18), were more difficult to define, as a single shallow spread of fire-cracked stone overlay at least four pits. Radiocarbon determinations from two of these pits dated them to the Early to Middle Bronze Age (*Section 4.25*). A further pit (***70155***; Fig 11), also possibly associated with the burnt mound activity, lay to the south of Burnt Mound 3.

3.3.18 To the north of the main channel sequence, in the footprint of a retention pond (Fig 11), several features were identified cutting the *Later Neolithic alluvium*. A penannular gully (***100031***), with a west-facing entrance flanked by a pair of postholes (***100033*** and ***100036***), had a central hearth (***100020***) and may have enclosed a small structure (Plate 19). Radiocarbon samples from one of the postholes and the hearth produced Early and Early to Middle Bronze Age dates. Residue on pottery, from a pit (***100026***) to the north of this structure and adjacent to another hearth (***100016***), was also dated, by radiocarbon assay, to the Middle Bronze Age.

3.3.19 **Overbank Alluvium**: this deposit sealed the palaeochannel sequence (Fig 6), and derived from flooding from active channels on a lower terrace (Terrace 4; *Section 4.22.6*) further to the west. A radiocarbon sample, dating to the Later Neolithic to Early Bronze Age, was obtained from this deposit (*Section 4.25*), although a second radiocarbon sample, dating to the Late Bronze Age (*Section 4.25*), was obtained from fairly high up in this deposit, suggesting that alluvium continued to be deposited at this later time. As such, it is possible that this unit actually represents very slow deposition over a prolonged period of time, whilst being stratigraphically equivalent to deposits described below within the grid square area (*Section 3.3.27*).

3.3.20 ***Grid Square Area:*** this part of the excavation comprised, in total, 886 1m² grid squares (Fig 3), targeting a populous and extensive scatter of worked lithics (*Section 4.3*), first identified during the strip and record (*Section 2.2.7*). This area stretched between the palaeochannel in the west and the rising gravel terrace to the east (Fig 12). During the excavation several features were identified in this zone, including, towards the eastern extent of the site, another shallow (*c* 0.40m in depth) palaeochannel (*backwater channel*) (Fig 12), a backwater at the time the main channel (*Section 3.3.1*) was active. The *backwater channel* flowed broadly north/south, parallel to the main palaeochannel.

3.3.21 **Basal Sands and Gravels:** these deposits were encountered across the excavation area, comprising sands in most of the grid square area (Fig 13), with sandy gravels exposed at the north-eastern edge of the site. They have previously been referred to with regard to the main palaeochannel (*Section 3.3.4*; Fig 6).

3.3.22 **Stabilised Land Surface:** this unit directly overlay the *basal sands and gravels* and appears to represent a stabilised surface (Figs 6 and 12), which allowed soil formation to occur. It is possible that this deposit is actually the upper fraction of the *basal sands and gravels*, altered by post-depositional processes, so that it appears to be of slightly different colour and consistency.

3.3.23 Several man-made and natural features, forming a palimpsest of activity, were either cut into the *basal sands and gravels* (Fig 13) or the *stabilised land surface*; in each case, determining this relationship will be a major priority for analysis. Radiocarbon dating evidence suggests that this activity may have taken place between the Later Mesolithic and Bronze Age (*Section 4.25*). A rich and extensive lithic scatter (*Section 4.3*) is probably associated with the Mesolithic and Neolithic features, and may either derive from the top of the *basal sands and gravels* or the *stabilised land surface*. Processes such as bioturbation, causing some upward and downward sorting and redeposition, have presently obfuscated this issue, and it is hoped that analysis will help resolve the precise stratigraphic context of the lithic assemblage, and thus the phasing of the activity.

3.3.24 The man-made features include hearths (Plate 20), pits, postholes and stakeholes (Fig 13). A large oval pit (***90262***; Plate 21), with a single posthole recorded in its base, is of uncertain function, and may either be the remains of a pit complex (*eg cf* Kinloch, Rhum; Wickham-Jones 1990), a pit house (*eg cf* Howick; Waddington 2007), a tank, or an enlarged tree throw. A radiocarbon sample from this feature *(Section 4.25*) has been dated to the Mesolithic period. A pit or tree throw (***90163***) has also produced a Mesolithic radiocarbon date, and cut the leached sediments beneath the *backwater channel* (*Section 3.3.25*), which have been assigned to the *basal sands and gravels*. Towards the southern extent of the site, a loose group of around 50 stakeholes (***90432***) was identified; as no obvious single structure could be inferred from this group, it seems likely that they represent different ephemeral structures, which may or may not have been contemporary. In addition to the man-made features, natural features may also have acted as foci for human activity; for example, a large tree throw (***90526***) contained a very rich assemblage of worked lithics (*Section 4.3*). A single Earlier Neolithic radiocarbon date was obtained from a sample of the deposits comprising the *stabilised land surface* (*Section 4.25*), and Bronze Age radiocarbon dates were retrieved from hearths ***90434*** and ***90217*** (*Section 4.25*).

3.3.25 **Backwater Channel:** this unit represents, principally, alluvial sediments that had accumulated in the *backwater channel* (Figs 6 and 14) and which sealed pit/tree throw ***90163*** (*Section 3.3.24*). Two tree throws (***90508*** and ***90522***), which cut into the deposit backfilling the channel, produced Early Neolithic radiocarbon dates (*Section 4.25*), suggesting that infilling occurred during the Late Mesolithic/Early Neolithic period.

3.3.26 **Colluvium:** this unit overlay the *backwater channel* (Fig 6), having accumulated at the base of the slope down from the gravel terrace at the eastern edge of the grid square area (Fig 14). It is probably redeposited material eroding from further up the slope.

3.3.27 **Overbank Alluvium:** this deposit probably formed as a result of flooding from the main palaeochannel (*Sections 3.3.1* and *3.3.19*) or others further to the west of the site. Within the grid square area, the alluvium directly sealed the s*tabilised land surface* (Figs 6 and 14) and contained quantities of struck lithics, which were very fresh looking, and exhibited a remarkable degree of preservation (*Section 4.4.7*). It is, however, possible that the lithic pieces had sorted upwards into the alluvium, and were actually deposited prior to its accumulation. On the other hand, although this unit is interpreted as being late in the sequence, it may have actually accumulated very slowly, at different rates over the area, and understanding its formation and chronology will be a priority for analysis (*Section*

7.6). Large sherds of Romano-British pottery (*Section 4.10*), lying in close association with each other and, seemingly, being *in situ*, were recovered from the top of this deposit, providing a *terminus ante quem* for the alluvial deposition.

4 ASSESSMENT

4.1 Stratigraphic Assessment

4.1.1 The stratigraphy of Stainton West is described in detail within the *Section 3*, which includes a quantification of the archive. The site was investigated and recorded during several phases of work (*Section 2.2*) and this assessment phase has drawn together the various elements into broad stratigraphic groupings. The assessment has found evidence for activity during four broad periods at the site, although there may be more than one phase of activity for each period. The periods, broad phases of activity and archaeological evidence is summarised in Table 3.

Period	**Phase**	**Date Range**	**Archaeological Evidence**
Mesolithic	Early Mesolithic	*c* 10,000 to *c* 7500 BC	Lithic tools
	Late Mesolithic	*c* 7500 to *c* 4000 cal BC	Lithic tools, worked wood, cut features including pits and tree throws, palaeochannel deposits (*Mesolithic organic deposit* and *Mesolithic/Neolithic alluvium*)
Neolithic	Earlier Neolithic	*c* 4000 to *c* 3000 BC	Lithic tools, pottery, worked wood, cut features including pits and tree throws, palaeochannel deposits (*Mesolithic/Neolithic alluvium*, *Earlier Neolithic organic deposit*, *Earlier Neolithic alluvium*)
	Later Neolithic	*c* 3000 to *c* 2000 BC	Lithic tools, pottery, worked wood, burnt mound, palaeochannel deposits (*Later Neolithic organic deposit* and *Later Neolithic alluvium*)
Bronze Age	Early Bronze Age	*c* 2000 to *c* 1500 BC	Lithic tools, burnt mounds, a roundhouse, hearths, palaeochannel deposits (o*verbank alluvium*)
	Middle Bronze Age	*c* 1500 to *c* 1200 BC	Pottery, a pit, hearths, palaeochannel deposits (o*verbank alluvium*)
	Later Bronze Age	*c* 1200 to *c* 800 BC	A hearth, palaeochannel deposits (o*verbank alluvium*)
Roman period and later	Romano-British	AD *c* 70 to *c* 410	Pottery
	Medieval and post-medieval	AD *c* 410 to *c* 1900	Pottery, extant field boundaries, field drains, a trackway

Table 3: Summary of the archaeological periods, phases and evidence at Stainton West

4.1.2 ***Assessment:*** the archaeology includes generalised scatters of lithic artefacts within buried sediments; waterlogged palaeochannel deposits; positive features such as hearths, burnt mounds and stone spreads; and cut features of man-made and natural origin, such as pits and tree throws. The site is remarkably well preserved, having been largely sealed under alluvium and colluvium, and only slightly affected by ploughing. However, field drains, which cut across the site, have truncated some deposits. In addition to the archaeological remains, there are well-preserved palaeoenvironmental assemblages (*Sections 4.14-21*).

4.1.3 In the Mesolithic period, the evidence is probably largely related to settlement and/or hunter/fisher-gathering activity. The Neolithic evidence is difficult to interpret, but might include some evidence for woodland clearance/husbandry, hunter/fisher-gathering activity, settlement and, possibly, other social/votive activity focusing on the channel or on the periphery of the monumental complex, nearby on the terrace (*Section 5.4.3*; Fig 2; OA North 20011a). The Bronze Age activity also focuses on the channel and may still be linked in some way to the monuments. It comprises features usually associated with settlement, as well as burnt mound activity, which may, in nature, be economic, social, religious or a combination of all of these. The Roman period is represented solely by beads and a few sherds of pottery, although some of these are fairly large fragments and must relate to activity in the vicinity of the site. The medieval and post-medieval features relate exclusively to the agricultural use of the site, which was still under pasture at the commencement of the project.

4.1.4 ***Potential:*** Stainton West is certainly of national, and probably international, importance. The extremely populous, largely *in situ* and well-recorded, lithic scatter (*Section 4.3*) has the potential to revolutionise our understanding of the Mesolithic and Neolithic periods, particularly in the North West. The excellent organic preservation within the palaeochannel affords a regionally unparalleled opportunity to study human activity in relation to the contemporary environment, whilst the survival of the wooden artefacts provides a rare insight into this aspect of prehistoric materiality. The possible association between the Neolithic activity within the palaeochannel and on its banks and the nearby hengiform monument and monumental complex (Fig 2; EH 2010; OA North 2011a) is highly significant and merits further investigation. The Bronze Age burnt mounds and structural remains have great potential to enhance present understandings of this period, particularly when considered in conjunction with the other Bronze Age sites excavated along the length of the CNDR (OA North 2011a). Perhaps what is most remarkable about Stainton West is that it comprises a palimpsest of, potentially, continuous activity from the Mesolithic period through to the start of the Roman period, and that human activity is particularly well represented and well preserved at several key horizons within this sequence. The principal potential of the site is explored in greater detail, and with regard to the artefactual and plaeoenvironmental assemblages, in *Section 5*, following an assessment of other elements of the data, presented in *Section 4*.

4.2 ARTEFACTS: INTRODUCTION

4.2.1 In total, 303,871 artefacts were recovered from Stainton West, the vast majority being struck lithics. Other material consisted of worked coarse stone (including stone axes), ochre, prehistoric, Romano-British, medieval and post-medieval pottery, and stone and glass beads (Table 4). In addition, 162 pieces of altered wood (explicitly modified by humans or animals), and a small and insignificant assemblage of animal bone, weighing 45g, and representing 28 individual specimens, was recovered. The overriding majority of the artefactual assemblage is prehistoric in date, reflecting the huge assemblage of worked lithics and predominance of prehistoric contexts at the site. The later material either came from land drains, or a relict ploughsoil sealing the site.

Type	***Total***
Struck lithics	***302,744***
Coarse stone	***405***
Stone axes	***4***
Ochre	***604***
Prehistoric pottery	***70***
Romano-British pottery	***22***
Medieval pottery	***3***
Post-medieval pottery	***12***
Beads	***7***
Altered wood	***162***
Total	***304,033***

Table 4: Artefact totals by type

4.3 Struck Lithics

4.3.1 ***Quantification:*** in total, 302,744 flaked lithics were recovered, largely by wet-sieving (to 2mm) *c* 270,000l of sediment from various different deposits at the Stainton West site. These were excavated, by context, within 1m grid squares – the grid covering an area of *c* 880m² within the site. A small proportion of this assemblage was recovered from the sieving of samples for palaeoenvironmental materials, and 7736 of the pieces were recovered by hand, from excavated features, and three-dimensionally recorded. These recovery methods were employed because it was hypothesised that the lithic assemblage was largely *in situ*, which seems to have been confirmed by the assessment. A full range of artefact types, including cores, knapping debris, flakes, blades and retouched tools, were collected (Table 5; Fig 16), indicating that tools were made and used at the site . A variety of raw materials had been chosen for knapping, including pebble flint, cherts, good-quality brown and grey flint, pitchstone, tuff and limestone (Table 5; Fig 16).

Category	B/Flint	CD	Chert	Grey flint	Lime-stone	Other	P/Flint	Pitch-stone	Quartz	Tuff	*Total*
Blade chip	262	913	4761	165	23	222	7665	13	13	3	***14,040***
Narrow blade	629	1245	5640	236	46	268	8555	50	9	9	***16,687***
Broad blade	820	622	2953	136	40	162	4619	18	5	15	***9390***
Regular flake	1313	2753	11,172	356	143	524	19,890	43	16	77	***36,287***
Irregular flake	310	1662	4873	142	58	216	6,431	15	9	25	***13,741***
Small flakes	1381	21,860	61,147	2176	166	2000	105,268	103	74	39	***194,214***
Core	113	113	1303	18	21	81	1456	4	9	5	***3123***
Pebble	2	7	67	1	3	19	157	1	0	2	***259***
Chunks	98	832	4153	60	34	152	2984	5	10	13	***8341***
Retouched	111	31	190	17	3	24	515	10	4	14	***919***
Microlith	131	434	1561	47	4	65	3497	1	3	0	***5743***
Total	***5170***	***30,472***	***97,820***	***3354***	***541***	***3733***	***161,037***	***263***	***152***	***202***	***302,744***

B/Flint = brown flint; CD = cannot determine; P/Flint = pebble flint

Table 5: Stainton West: lithic assemblage by type and raw material

4.3.2 ***Methodology:*** seven people were responsible for cataloguing the entire lithic assemblage, principally two experienced lithic specialists, who trained the remaining five people to recognise and record the various raw materials and basic artefact types. The cataloguing was completed over nine months of continuous working. The recording methodology was designed to maximise the amount and quality of information available for the lithic assessment, and it was based on the lithic recording system developed by Caroline Wickham-Jones for the analysis of a large assemblage (*c* 138,000) of flaked lithics from Kinloch, Rum (Wickham-Jones 1990). This recording method is well suited for the initial catalogue of a flaked lithic assemblage, as it is easily adaptable, by the inclusion of new terminology and metric data, for use at a more detailed research level. The lithics were recorded according to the fields of raw material, type, sub-type and classification (see *Appendix I* for details of each field). Regular flakes, irregular flakes, the various types of blades, small flakes and chunks (Fig 15) were recorded and bagged according to type and sub-type. The cores, core trimming and rejuvenation flakes, microliths and retouched pieces were also classified, and each of these was recorded individually by one of the lithic specialists, with additional description and measurements being recorded. All the results were entered into a PostgreSQL database, and made generally available on-line via the project website.

4.3.3 ***Assessment:*** Stainton West is a multi-period prehistoric site with lithic evidence indicating occupation from the Early Mesolithic period through to the Bronze Age. The Early Mesolithic presence is shown by a small group of retouched tools (shouldered/tanged points; Butler 2005, 94; Plate 22). Lithic assemblages of this date occur sporadically in the north-west of England and are nearly always associated with (apparently) later material (Hodgson and Brennand 2006, 2). Assessment suggests that the greater proportion of the lithic assemblage was probably produced as a result of activity at the site in the Late Mesolithic period, the earliest dates for which are around 5200 cal BC (*Section 4.25*). There is no evidence that the material has been disturbed since it was originally deposited, so its spatial distribution will be significant.

4.3.4 The surface condition of most of the lithics is good to excellent: there was evidence for patination on a few pieces and, in some cases, these had been reflaked over the patination, indicating that debitage from an earlier occupation of unknown date had been reused. The assessment of a small sample of lithics for the survival of use-polishes indicates that some contexts contained lithic assemblages with very good preservation and, therefore, information about how they were used can be productively explored by microwear studies (*Section 4.4*). The survival of residues is uncertain; however, if these exist, they can help determine precisely which plant or animal materials the tool has been in contact with, and can, therefore, provide important information regarding specific function.

4.3.5 As a consequence of retrieval by sieving, almost two-thirds of this assemblage is made up of debitage smaller than 10mm, which probably reflects its true composition. All elements in the knapping process are present, from unflaked nodules to cores, debitage and the finished and discarded tools (Plates 23-5). Backed blades, scalene triangles and fine points are the most numerous microlithic forms, and other common retouched pieces comprise edge-retouched pieces and some scrapers. Of great interest are the ‘knapping episodes’ that can be observed across the site. At least 82 of these have been identified within the original unit of analysis, the metre square, but further examination of material in neighbouring squares will discover the full extent of each spread. Knapping events can help in understanding processes of site formation; patterns of raw material exploitation; the production methods used in nodule reduction and tool manufacture; and they provide ‘snap shots’ into the past.

4.3.6 The assemblage (Table 5; Fig 15) is representative of a classic Late Mesolithic narrow-blade microlithic assemblage, with a strong emphasis on blade technology both in core-reduction techniques, knapping products and finished tools. An interesting feature is the number of core-trimming blades and flakes, which appear to be an integral part of the blade-production process at Stainton West. This does not feature to the same degree in other Mesolithic assemblages (*cf* Rum, Wickham-Jones 1990; Mount Sandel, Woodman 1985).

4.3.7 The microlithic component of the Mesolithic assemblage forms the dominant tool type: approximately 5600 microliths have been classified during assessment. The types of microlith forms present are comparable to those recorded at other Late Mesolithic sites, such as Rum (Wickham-Jones 1990) and Mount Sandel (Woodman 1985), although with relatively slightly higher numbers per form than at the two sites mentioned. Furthermore, there is much variation within the main classifications. For example, scalene triangles (numbering 1032) vary in their size, degree and positioning of retouch and form in plan across the group as a whole. Alongside the complete microliths, there is a significant number of microlith fragments (2034 in total). These fragments are important as they indicate that tools were being manufactured, used and discarded on the site.

4.3.8 In addition to the Mesolithic material, a proportion of the assemblage recovered probably results from Earlier Neolithic activity. Good evidence for this as been identified, associated with organic deposits in the palaeochannel (*Section 3.3.1*), and it seems reasonable to posit that this activity extends out from the channel and onto its banks, where the Mesolithic activity also focused. Indeed, leaf-shaped arrowheads (Plate 26) and axe-thinning flakes produced from Langdale tuff, both of which are usually associated with Neolithic activity, have a wide distribution across the site.

4.3.9 There does not appear to be any evidence that tools were produced in the Late Neolithic period at Stainton West, but technological analysis would discover if that were indeed the case. Some large round scrapers (Plate 27), dating to the Bronze Age, occur as isolated finds rather than as part of a larger lithic assemblage.

4.3.10 Flints and cherts from various sources were knapped and used on site (Fig 16), principally beach pebble flint, Carboniferous chert, probably from the north of England, and Radiolarian chert from the Southern Uplands of Scotland. A good-quality brown 'till flint', probably from the north-east of England, was also used, and pitchstone (almost certainly from the Isle of Arran in Scotland), tuff (from the English Lake District) and limestone (probably from sources close to the site) are present in smaller quantities.

4.3.11 Pebble flint from beach gravels is the most common raw material at Stainton West and is most likely to have been collected around the Cumbrian coast (D Coward *pers comm*). A good-quality brown flint was also used on site. This was recognised by its distinctive light cortex and is thought to be Scandinavian in origin, but deriving from the glacial tills of north-east England.

4.3.12 Radiolarian Cherts from the Southern Uplands occur as seams across that region and chert pebbles are also found in significant numbers in the drift geology north of the Southern Uplands Boundary Fault (Ward 2010). These cherts come in a range of colours from a distinctive blue/grey/green to red and black. It is considered very unlikely that this material was transported to the Carlisle area as glacial erratics, and its presence is likely to indicate access to a Scottish source by means of direct or indirect contact. Carboniferous cherts have a wide distribution across the north of England and specific sourcing can, therefore, be more problematic. Of particular concern at Stainton West is the separation of the black Radiolarian cherts from the black Carboniferous cherts, as this would enable a consideration of the extent to which these resources were exploited by or accessible to the communities at the site (*Section 7.7.30*).

4.3.13 Although every effort was taken to ensure the consistency, via an ongoing QA process by the two lithic specialists and by the project team undertaking the cataloguing at one location, some of the raw material types need to be reassessed and the identifications standardised, in light of experience gained over the last nine months. In particular, the material assigned to the limestone, tuff, grey flint, brown flint and other categories needs to be reassessed to confirm their identification. Further work will also be required to order the lithic material archive for use during analysis and prior to final deposition (*Section 7.7.2*).

4.3.14 ***Potential:*** the assemblage is one of the most important of its type and date to be recovered nationally, so far, and is certainly of unsurpassed regional significance, being the largest yet recovered in Cumbria by a factor of ten. The compilation of the catalogue has formed a record that will be a valuable resource for future researchers, and the assessment has highlighted the great potential of the assemblage for future research at analysis, aspects of this including:

- the 100% recovery of lithics over a continuous and extensive area, which allows work on a large and coherent group of artefacts;
- the use of a range of raw materials, the study of which can be used to answer questions on mobility, distance and contact in the Mesolithic period;
- the number of 'knapping episodes', which can be used to explore the finer detail of how the nodules were reduced, what was removed for use and how they were disposed of;
- there is potential for good survival of use polishes on at least part of the assemblage, indicating that a full programme of microwear analysis would be a viable means of understanding how the stone tools were used;
- in tandem with microwear analysis, the microlith assemblage has immense value in allowing questions relating to social organisation to be considered and should provide an excellent opportunity to understand elements of task organisation;
- there is also very good potential for studying the spatial distribution of the lithics in order to understand the formation of and relationships between the many different occupation deposits.

4.3.15 The further study of the lithic assemblage, if undertaken within the context of a wider and more in-depth analysis of the site stratigraphy, chronology and palaeoenvironment, would certainly enhance the understanding of the site. Work on all aspects of the site can draw on and inform recent archaeological research into the Mesolithic and Neolithic periods in the wider regional and national setting (*Section 5.2.3-12*), making a valuable contribution to the body of knowledge already provided by sites such as Kinloch, Rum (Wickham Jones 1990), Mount Sandel (Woodman 1985) and research within the Pennines (Howard-Davis 1996; Spikins 1998; 2000; 2003).

4.4 LITHIC MICROWEAR

4.4.1 ***Quantification:*** in order to determine whether lithic microwear would be an appropriate method for the analysis of the lithic assemblage from Stainton West (*Section 4.3*), a representative sample was sent to the Lithic Microwear Research Laboratory (LMRL) at Bradford University for assessment. The sample of 60 lithic pieces was selected from six key contexts and was representative of a range of different materials and lithic artefact types.

4.4.2 ***Methodology:*** lithic microwear analysis is the microscopic examination of surface wear and fracture scars that form along the edges of fine-grained siliceous stone artefacts such as those of flint and chert. Experimental studies demonstrate that microscopic wear and fracture-scar characteristics resulting from tool use vary systematically according to the worked material (*eg* hide, wood, meat, bone *etc*) and according to the applied forces and motions such as cutting, scraping, and wedging. Understanding these principles and relationships permits microwear analysts to suggest past uses of lithic artefacts with a greater degree of precision and accuracy than achieved through reliance on either macroscopic attribute analysis or ethnographic analogues of tool form. Following deposition, natural processes also produce systematic wear features that may make inferences about tool use more difficult (Levi-Sala 1986a; 1986b), but can aid in understanding site formation processes (Donahue 1994; 1998; Donahue and Burroni 2004; Burroni *et al* 2002).

4.4.3 As well as interpreting how individual tools were used, lithic microwear analysis can inform on the function of sites or areas at a site, thus enabling an understanding of social organisation. There are several processes that can reduce the capability of lithic microwear analysis. The primary processes causing issues are patination, thermal modification, and natural surface scratching and chemical erosion, known as post-depositional surface modification (PDSM).

4.4.4 Ridge-width measurement has been used as a general proxy for the degree of PDSM a lithic assemblage has undergone (Burroni *et al* 2002; Donahue and Burroni 2004; Donahue and Evans 2004; Shackley 1974). The analysis of archaeological and experimental material has led Donahue to define an arbitrary total preservation cut-off point of 4.5µm (Burroni *et al* 2002). Above this value, not all use-wear traces may be preserved (microwear traces preserve differentially, with ‘meat polish’ usually being the first to succumb to burial environment modification). Therefore, this measurement lends itself to use as a measure of functional analysis feasibility. Ten debitage flakes from each contextual unit of interest were studied to provide a suitably representative sample. Each of these flakes were selected to have dorsal ridges, as those without cannot be studied.

4.4.5 The flakes were cleaned using standard microwear cleaning procedures. The cleaning method involved soaking in water (ten minutes), brushing in running water with a soft bristle brush, soaking in HCl (10%, ten minutes) and soaking in water (ten minutes).

4.4.6 Ridge-width measurements were made by illuminating the dorsal ridges from an angle that is equally oblique to the ridges' mating surfaces. This illumination was provided using a metallurgical microscope, which also allows an observer to study the light, reflected back by this process, under magnification. The width of the light reflected from the ridge is directly proportional to the ridge width and this can be measured using a calibrated eyepiece graticule. Typically, the ridge on a British chalk flint flake, when freshly produced, is under 1µm. The microscope used was an Olympus BH2 reflected-light microscope, with a 20x (0.4NA) objective and 10x eyepieces. Ten measurements were taken from dorsal ridges on each flake to provide that artefact with a mean ridge width value.

4.4.7 ***Assessment:*** the patination observed on the pieces was minimal to absent, although thermal modification had occurred on some of the pieces. The results of the assessment of the debitage samples are presented in Table 6. Those samples where measurement of the dorsal ridge falls within the preservation limit of 4.5µm are highly likely to have total preservation of wear, and have been recorded as 'Good'. Those samples where preservation is likely to be variable were recorded as 'Moderate', and those which are likely to yield no useful data were recorded as 'Poor'.

Stratigraphic Unit	**Number of Stratigraphic Groups**	**Number of Lithic Pieces Assessed**	**State of preservation**
Stabilised land surface	1	10	Poor
Overbank alluvium	2	20	Good
Backwater channel	1	10	Good
Tree throw ***90526***	1	10	Moderate
Pit ***90262***	1	10	Moderate

Table 6: Stainton West: lithics assessed for microwear

4.4.8 ***Potential:*** the results (Table 6) suggest there is excellent potential for the use of lithic microwear analysis at this site. Furthermore, microwear, used in parallel with other methodologies (*Sections 4.4* and *7.7.22*), has great potential to enhance and maximise the interpretation of Stainton West. Indeed, not to undertake microwear could greatly limit this interpretation.

4.4.9 However, not all the samples submitted suggest suitability of their parent assemblages for analysis. The assessment has found that the lithics from two of the stratigraphic units (those where preservation was recorded as 'Good') have undergone minimal amounts of PDSM and thus microwear produced on these tools is likely to be well preserved.

4.4.10 The two samples from the *overbank alluvium* were particularly well preserved, which is fortunate, as this unit contains a very large percentage of the overall assemblage; is largely *in situ*; and covers an extensive part of the grid square area (Fig 14). This deposit has the greatest potential for analysis, for, although well preserved, the material in the *backwater channel* may not certainly be *in situ*.

4.4.11 Two samples (recorded as 'Moderate') from cut features include pieces that have rounded dorsal ridges, suggesting a degree of PDSM. For material in these units, the amount of information that can be gathered by lithic microwear analysis will be limited, although analysis may still prove useful for certain research questions.

4.4.12 The sample from the *stabilised land surface*, where preservation is 'Poor', has no potential for further analysis. This is, however, a less extensive continuation of the lithic scatter sampled in the *overbank alluvium* into an area where the host sediment composition changes. As such, the failure of this sample does not preclude or unduly constrain the analysis of the other sampled material.

4.5 Coarse Stone

4.5.1 ***Quantification:*** during the course of the excavation at Stainton West, an assemblage of worked stone was recovered. This comprised 405 pieces in total (Table 7).

Type	**Number**
Flaked cobbles/Regular flakes	72/24
Cobble tools	85
Anvils	6
Polissoirs and grinding slabs	5
Flaked Langdale tuff	202
Ground stone	11
Total	**405**

Table 7: Types of coarse stone artefacts

4.5.2 ***Assessment:*** most of the flaked cobbles and the regular, primary flakes from coarse stone cobbles were found in the palaeochannel. One or two of these cobbles are distinctive tools with chopper-like edges but, of the rest, most had just one or two flakes removed. Some of the tuff flakes retain a water-worn cortex, perhaps indicating a riverine source.

4.5.3 Also from the palaeochannel is a group of related tool types, such as the anvils, *polissoirs*, grinding slabs and axes. Their spatial relationship suggests they are intimately linked and possibly demonstrate that axes were produced or at least ground and polished around the edges of the channel, which presumably supplied water for grinding.

4.5.4 Some of the hammerstones and pieces of flaked tuff found around the site are also likely to be intricately associated with the processes of axe production, though tuff flakes were also scattered throughout the area of Mesolithic activity. The relationship between the flaked tuff around the Mesolithic site and that from around the palaeochannel bears further examination. The cobble tools are mainly only lightly worn and the majority are from the area of the Mesolithic site.

4.5.5 ***Potential:*** this material forms an important part of the lithic assemblage recovered from Stainton West, complementing the large assemblage of worked flint and chert. The coarse stone assemblage may have been used very differently from these other materials, and may relate to a different suite of activities or period of activity. Understanding how the coarse stone was used, and how its use was related to that of the flint and chert, will provide important information for understanding the site. At analysis, careful consideration will need to be given to the context of the coarse material, which will also require closer characterisation.

4.6 Stone Axes

4.6.1 ***Quantification:*** four stone axes (for a fuller description see Davis and Edmonds 2009) were recovered by the excavation at Stainton West, in addition to some fragments of Langdale tuff, which may have derived from axe maintenance or manufacture, and are included within the coarse stone assemblage (*Section 4.5.1*; Table 7). All of the axes came from the palaeochannel; three of them (***70325***/41, ***70413***/14 and ***70353***/30) were within the *Earlier Neolithic organic deposit* (*Section 3.3.9*), and one (***70326***/4) came from the *Later Neolithic organic deposit* (*Section 3.3.13*). Where alpha-numeric codes are quoted in brackets after the description of colour (*eg* olive grey (5Y4/1)), these refer to the widely used Munsell standard (*cf* Munsell Color 2009).

4.6.2 ***Assessment:*** **Axe *70326*/4:** this is a small and largely complete stone axe blade, measuring 93mm in length, 52mm in width and 29mm in thickness (Plate 15). Macroscopic inspection suggests that the raw material is some form of coarse quartzite, and in thin section the rock is olive grey (5Y4/1). The blade comprises a cutting edge, which is effectively symmetrical in both plan and section, with a pronounced curve down to each side. The butt of the piece is also curved and more or less rounded. There is no significant faceting on either lateral edge, and it is debatable whether the very slight flattening of the tip of the butt can be regarded as a deliberate facet. It may equally be a consequence of hammering/pecking. The axe may have been made from a small cobble or pebble obtained locally from the glacial drift and is more likely to have been made from a glacial erratic rather than a bespoke quarried block.

4.6.3 Microscopically, the rock is quartz dolerite, which falls within the description for Group XVIII (Bradley and Edmonds 1993, 41, fig 2.9). This fine-grained basic igneous rock is composed mainly of feldspar, augite and magnetite. The mainly colourless labradorite feldspar is fresh, and typically shows twinning, and parallel banding of white, grey or black, between crossed nicols. In unpolarised light, augite appears as colourless aggregates and small, well-formed crystals. Between crossed nicols, the augite, which occurs as broken patches, interstitial grains and long blades, is purplish-brown in colour, often with clear twinning. Magnetite forms the main opaque phase, with some ilmenite; both minerals are black and opaque. Although generally in very small quantities, quartz is widely distributed.

4.6.4 **Axe *70325*/41:** this broken stone axe blade measures 65mm in length, 48mm in width and is 24mm in thickness (Plate 11). Macroscopically, in thin section, the rock is dark greenish yellow (10Y6/6). The piece possesses effective symmetry in both section and plan, though there is a slightly more pronounced curve down and away from the cutting edge on one principal face. Though medium-grained, and thus not conducive to really fine flaking, the raw material does possess the property of conchoidal fracture, evidenced on both principal faces and on the cutting edge, where two small scars are consistent with the kinds of damage that blades often sustained during use. Flake scars can also be seen emanating from either lateral edge, some of them with partially smoothed edges consistent with their having been struck prior to the grinding of the blade surface. The simplest explanation for this is that the blade was roughed out by flaking before being ground down in the realisation of the final form.

4.6.5 Microscopically, this is a medium-grained, ungrouped volcaniclastic rock, which contains more silica and chlorite, and less epidote, than is normally found in rock from debitage and exposures adjacent to extraction sites around the Langdale Pikes (V Davis *pers obs*). Rosettes of chlorite needles are characteristic of this rock, a feature relatively uncommon, although not absent, in thin sections from the Group VI rock variants (*pers obs*), from around the Langdale Pikes (Edmonds 2004). Although the petrology does not match the published description for Group VI (*eg* Keiller *et al* 1941; Woolley 1989), it is very likely that, with further work, this rock can be matched to an outcrop or debitage within the geographical area of the axe-production sites.

4.6.6 **Axe *70403*/14:** this is a small and largely complete stone axe blade, which, on macroscopic grounds, is likely to be Group VI (Bradley and Edmonds 1993, 41, fig 2.9). It measures 126mm in length, 30mm in width and is 66mm in thickness (Plate 10). Macroscopically, in thin section, the rock is a pale olive (10Y6/2). The blade has a very distinctive form, the cutting edge being characterised by a very shallow curve, while the overall form of the blade is tapered down to a more or less pointed butt. Faceting is present to a very limited extent on the butt, and on both lateral edges. However, this is relatively irregular in character, and this, and other characteristics, may indicate that the blade has sustained a certain amount of reworking over the course of its active life. Indeed, the axe morphology suggests a resharpened butt-end of a larger axe.

4.6.7 Microscopically, the rock falls well within the range for Group VI (*eg* Keiller *et al* 1941; Woolley 1989), being a fine-grained epidotised tuff of andesitic composition. The matrix consists mainly of a turbid isotropic material, which contains epidote grains and microliths of feldspar. Random scatters of irregularly shaped grains of feldspar and cryptocrystalline silica, and more rarely sphene, may occur; they are most commonly associated with highly corroded feldspar fragments and pseudomorphs, possibly after pyroxene.

4.6.8 **Axe *70353*/30:** this is a complete stone axe blade, which, on macroscopic grounds, is likely to be Group VI (Bradley and Edmonds 1993, 41, fig 2.9). It measures 188mm in length, 63mm in width and is 34mm in thickness (Plate 9). Macroscopically, in thin section, the rock is a light olive grey (5Y6/1) with faint planar bedding/laminae, and randomly distributed, >0.5mm in diameter, opaque patches in a homogeneous matrix. The form of the blade places it within the category of 'Cumbrian Clubs' first defined by Clare Fell (Fell 1964). Like other examples, this highly distinctive blade has a profile characterised by almost parallel sides near the cutting edge and a pronounced 'waisting' towards the butt. The 'finish' on the blade is very fine; grinding and polishing is extensive enough to have removed almost all traces of the flaking that characterised the prior roughing-out of the blade. The cutting edge is ground to a very fine and shallow curve, and possesses a slight asymmetry in plan. The tapered end of the cutting edge appears to truncate the pronounced side facet on the blade and is also associated with at least two small flake scars, both or which have been ground down to varying degrees, and these patterns suggest a measure of reworking.

4.6.9 Microscopically, this is an epidotised tuff with typical Group VI characteristics (*eg* Keiller *et al* 1941; Woolley 1989). The fine-grained, intermediate matrix is composed of minerals with low interference colours, and consists mainly of angular to sub-angular clasts of rock fragments with some plagioclase microliths. Small patches of blue-green pleochroic amphibole are distributed randomly. Epidote rims are formed around some opaque mineral grains, and within larger aggregates; it also occurs as discrete crystals in the matrix or very thin veinlets. Some aggregates contain silica laths, especially those associated with pyrrhotite.

4.6.10 ***Potential:*** together, this is a small, but very significant, group of axes/axe fragments. In raw material terms, these axes reflect the working of stone from within the classic Group VI range, together with other stone, which also outcrops in the same general area, and one piece which may have been derived from a secondary deposit. If these four axes really do form a group, then this variety in the use of stone and sources may well be worth pursuing further. Certainly, part of the interest that has been shown in these axes stems from the fact that they have been recovered in secure and datable contexts and possess significant artefactual associations. Both of these factors are relatively rare in Cumbria. While they have been treated here as a group, this is something that would need to be demonstrated rather than assumed, particularly given the wide chronological range represented by other materials recovered from the site. Further comparative analysis can also be conducted, identifying specific parallels on both morphological and petrological grounds.

4.7 OCHRE

4.7.1 ***Quantification:*** in total, 604 pieces of ochre were recovered from a range of features and deposits at Stainton West. All of this material was retrieved from the gridded area adjacent to the palaeochannel, but within this area it had a wide distribution.

4.7.2 ***Assessment:*** the ochre mainly occurs as small, pea-sized, rounded lumps of soft red material and there are also chunks of harder haematite. A few larger lumps survive, and some of these retain visible striations from use. Intriguingly, in one instance, a narrow blade has been knapped from the ochre. Preliminary considerations of the distribution of the ochre suggest that there is some pattern to this, with the larger pieces of material seemingly clustering around the edges of the main worked lithic scatter.

4.7.3 ***Potential:*** taphonomic questions regarding the survival of ochre on wet sites (as indicated by the alluvium) need to be addressed before the assemblage can be interrogated. However, there is clear evidence that the prehistoric inhabitants were using ochre, and it should be possible to identify specific activity areas on site through closer analysis of wear traces and its spatial distribution.

4.8 RESIDUE ANALYSIS OF ARROWHEAD HAFTING MATERIAL

4.8.1 ***Quantification:*** a leaf-shaped arrowhead (***70403***/0015; Plate 12) was retrieved from the *Earlier Neolithic organic deposit* within the palaeochannel. Upon lifting, it was observed that a black organic material was still adhering to the proximal end of the arrowhead. It was therefore wrapped in aluminium foil and stored in a refrigerator. At the earliest opportunity, it was sent to Bradford University for analysis.

4.8.2 ***Methodology:*** a small (*c* 1-2 milligrams) sample of the organic material was removed from the arrowhead with a clean scalpel blade. The sample was transferred into a pre-cleaned glass vial and covered with 2ml of solvent (a 2/1 v/v ratio of analytical-grade dichloromethane and methanol) and left to stand for 48 hours. The sample was then ultrasonicated for 15 minutes and the solvent transferred using a Pasteur pipette to a clean vial. The solvent was then evaporated under a gentle stream of nitrogen.

4.8.3 Prior to Gas Chromatography-Mass Spectrometry (GC-MS), the sample was derivatised to improve chromatographic performance BSTFA (*N*,*O*-bis(trimethylsilyl)trifluoroacetamide); 1% TMCS (trimethylchlorosilane) was added to the sample and it was heated at 60°C for 15 minutes.

4.8.4 Analysis was carried out on an Agilent 7890A Series GC, connected to a 5975C Inert XL mass selective detector. The GC was fitted with a splitless injector and helium was used as the carrier gas. The column was inserted directly into the ion source of the mass spectrometer. The ionisation energy was 70eV and spectra were obtained by scanning between *m/*z 50 and 800. The column used was an Agilent DB5-ms 15m by 2.5mm by 2.5µm column. The oven temperature was programmed to be isothermal at 50°C for two minutes, followed by a rise of 10°C per minute up to 340°C, and an isothermal hold for ten minutes.

4.8.5 The organic material was also assayed for radiocarbon dating purposes, although it proved impossible to obtain a date. The sample has been archived lest dating should prove possible in the future.

4.8.6 ***Assessment:*** study of the total ion current (TIC) chromatogram of the trimethylsilylated solvent extract of the sample revealed the presence of betulin, betulone and lupeol, which confirms a birch bark origin. The remaining components are characteristic of thermal degradation, although these components can also form during burial. Betulin is converted into lupa-2,20(29)-dien-28-ol by dehydration and lupeol is converted into lupa-2,20(29)-diene. Long-chain dicarboxylic and hydroxy-fatty acids are present in low abundance, including ω-hydroxydocosanoic acid and α,ω-docosandioic acid. These derive from the thermal breakdown of suberin, a biopolyester present in birch bark.

4.8.7 The association of betulin, together with other related triterpenoids, is considered to be characteristic of birch bark. In addition to these, several other triterpenoids are often associated with birch bark tar following the heating of the bark to produce the tar, and any alteration caused by subsequent degradation mechanisms (Aveling and Heron 1998; Regert *et al* 1998; Urem-Kotsou *et al* 2002; Regert *et al* 2003). Birch bark is easily removed from the tree, and tar is produced when the bark is heated to more than 300ºC. Further work is needed to ascertain whether other sources of wood and bark can be used to produce effective adhesive substances. Pine resin and heated pinewood products (tar or pitch) are well known, but the chemistry of these substances is well understood and they are entirely different from the molecules identified here (Pollard and Heron 2008, 235-69).

4.8.8 The use of birch bark to produce a tar appears to have been known from at least the Middle Palaeolithic period onwards, with many occurrences now reported in the Mesolithic and Neolithic periods. Birch bark tar has been identified on a leaf-shaped arrowhead of Neolithic date from The Sweet Track (Aveling 1998). Further back in time, solidified pieces of birch bark tar bearing imprints of the stone tools and wooden hafts have been recovered from the Palaeolithic period in Germany (Grünberg 2002; Koller *et al* 2001). The key point of interest is the apparent preference for deliberate manufacture of birch bark tar, since such material cannot be collected or harvested directly from a tree (unlike, for example, pine resin). Rolls of birch bark must be collected and then subjected to heating in the absence of oxygen to temperatures of around 300°C or more. This apparently deliberate selection and preparation of certain resources over others (birch bark tar over pine products) is repeated throughout later European prehistory (*eg* Regert *et al* 2003). Whilst systematic comparative surveys are lacking of the physical properties of resin, heated wood and bark products, as well as of bitumen, choice and preference were being expressed. Yet, even if there were data of this nature, other factors are likely to have come into play. The ability to transform natural materials (such as wood or bark) into discrete organic substances, then subject to myriad uses (hafting of tools and weapons just happens to be the most visibly persistent context that survives today), would have had a dramatic impact on those who made these products in prehistory (Aveling and Heron 1999).

4.8.9 ***Potential:*** the results of the assessment are of interest for stone artefact studies and the interpretation of the Stainton West site. There is no potential for further analysis of the organic material, as the research aim – to identify the composition of this substance – has been achieved at assessment. The results will be included in the final report.

4.9 PREHISTORIC POTTERY

4.9.1 ***Quantification:*** a limited amount of prehistoric pottery was recovered. A few sherds might date to the Earlier Neolithic period, and there is Grooved Ware of Later Neolithic date, as well as Bronze Age-style pottery. The 66 sherds of Neolithic pottery represent a minimum of three to four vessels and include 53 sherds of Grooved Ware, and the four large sherds of Bronze Age pottery represent a minimum of two vessels.

4.9.2 ***Assessment:*** the Grooved Ware (Plate 14) came from the *Earlier Neolithic organic deposit* in the palaeochannel within Bay E. However, the lateness of the Later Neolithic radiocarbon date, retrieved from an organic accretion adhering to the pottery (*Section 4.25*), in relation to other, generally Earlier Neolithic, dates from this deposit, probably suggests that the pottery had been placed within a pit that had been cut down from a higher level within the channel (although such a pit was not detected during excavation). The other sherds of Neolithic pottery within the channel also came from the *Earlier Neolithic organic deposit*, with the exception of three sherds found in close association with an alluvial deposit (***70120***; not shown on plan) and a sherd from the *stabilised land surface* (Grid Square 129; Fig 12).

4.9.3 The putative Earlier Neolithic pottery is undecorated and often tempered with quartz grits, which were frequently highly calcined. The Grooved Ware ceramic is less intensively filled, using a range of softer grits, which may have derived from a stream bed, and some of the sherds have been decorated with incised horizontal lines. The Neolithic material comes from large open jars or tubs, whilst the Bronze Age pottery, the majority of which was from pit ***100026*** (*Section 3.3.18*), in the northern part of the site, derives from medium-sized jars. The Bronze Age pottery resembles the Neolithic pottery, being undecorated and characterised by numerous variously sized sedimentary quartz grits.

4.9.4 ***Potential:*** although the assemblage is small, it is of some significance, as well-dated Neolithic and Bronze Age pottery is generally rare in the region, and even more so from stratified deposits and settlement features (Hodgson and Brennand 2007, 49). The Stainton West material, therefore, offers a rare possibility to add significantly to the body of knowledge for the region. There is potential for lipid analysis of the material, which may establish what the vessels once contained. Most of the ceramic is stable, although somewhat friable. The lack of diagnostic or larger pieces suggests that conservation is not justified.

4.10 Romano-British Pottery

4.10.1 ***Quantification:*** the Romano-British pottery amounted to 22 sherds in total. It is possible that most of these sherds were the fragmented remains of a single vessel.

4.10.2 ***Assessment:*** the sherds were in a hard-fired slightly gritty reduced ware, and it was the only vessel of this type from the whole of the road scheme (OA North 2011a). The vessel imitated a Black-burnished ware jar form, with the base of the vessel burnished, and, above this, an irregular, lightly incised lattice. Nothing remains to indicate the rim form. The slightly obtuse lattice probably places the vessel in the second century AD or later (Gillam 1976).

4.10.3 The largest fragment of this jar (ten joining sherds) was from the *overbank alluvium* within Grid Square 314, with isolated sherds from the same deposit within adjacent Grid Squares 315 and 316 (Fig 14). If not part of the same vessel, most of the remainder of the fragments from the site are from an effectively identical vessel or vessels; these were distributed within a silty subsoil (***90182***), possibly a remnant agricultural soil sealed by the deposits making up a post-medieval trackway. Only two fragments from this latter scatter differ slightly, being a base and a body fragment in a fabric more reminiscent of Black-burnished ware category 1 (Farrar 1977).

4.10.4 ***Potential:*** the Romano-British pottery collected from Stainton West has very little potential for further analysis. The spot-dating undertaken for this assessment will contribute to the overall dating of various elements of the project, but no further refinement of this will be required. Perhaps the greatest contribution made by the pottery is the provision of a *terminus ante quem* for the formation of the deposits within the grid square area.

4.11 Medieval and Post-medieval Pottery

4.11.1 ***Quantification:*** in total, three fragments of medieval pottery and twelve fragments of post-medieval or recent pottery were recovered. None of these latter are earlier than the nineteenth century in date.

4.11.2 ***Assessment:*** two of the medieval sherds, both from ditch/drain ***90472*** (not shown on plan), within the grid square area, were in a White gritty ware. One retains a thin yellow-green glaze, perhaps suggesting that it was from a jug. Both are small and abraded, and may have derived from an agricultural soil before inclusion in the ditch. A white rim sherd was also retrieved from the *colluvium* (Grid Square 809; Fig 14).

4.11.3 All the sherds of post-medieval or recent pottery are relatively small, abraded, and on occasion frost-spalled, suggesting that they reached their final place of deposition as a result of midden spreading or night-soiling. Three of the fragments (from the *stabilised land surface* and the *overbank alluvium*) are extremely small (*c* 3mm in maximum dimension). The remainder of the group either came from land drains or a silty subsoil

(***90182***; not shown on plan) and comprised black-glazed redwares, brown stoneware, creamware, and white earthenwares, none of which is likely to be earlier than the very late eighteenth century in date. One land drain also produced a single fragment of unglazed white porcelain (perhaps Parian ware, developed in 1846 (Savage 1963, 217)) from a cast sculpture. All that remains is a single well-modelled finger at a scale of about half life-size. Undoubtedly a relatively expensive object when produced, it gives a brief glimpse of the type of household from which the material originated.

4.11.4 ***Potential:*** the medieval, post-medieval and recent pottery has no potential for further analysis. The spot-dating undertaken for this assessment will contribute to the overall dating of various elements of the site, but no further refinement of this will be required.

4.12 BEADS

4.12.1 ***Quantification:*** seven beads were recovered from the sieved samples. All are in fair to good condition, and, with the exception of one stone example, are complete.

4.12.2 ***Assessment:*** it seems quite likely that an irregular stone bead, effectively a perforated pebble, from the s*tabilised land surface* (Grid Square 360; Fig 12), is of Mesolithic date. It can be broadly paralleled amongst Early Mesolithic examples from Nab Head, Pembrokeshire (Tolan-Smith 2008, 146), but is not identical. Shale beads of Early Mesolithic date are known from elsewhere in the North West (see, for instance, Howard-Davis 1996), but early stone beads are rare. A second stone bead, apparently much more finely manufactured, is from the *colluvium* (Grid Square 979; Fig 14), and appears to be a small perforated cylinder in a highly crystalline pink stone. Crinoidal limestones are known in the locality, and it is not impossible that the bead has been made from a single disc-shaped segment of such a fossil. The use of crinoid discs as beads can be traced back to the Pleistocene (Bednarik 2005) and would thus not be out of place in a Mesolithic or later context.

4.12.3 There were, in addition, two small and irregular glass annular beads in brownish-yellow and greenish glass (from, respectively, the *overbank alluvium* (Grid Square 371; Fig 14) and the *backwater channel* (Grid Square 363; Fig 12). Both are listed by Guido (1978, 66; types iiib and iib) and are long-lived types, originating in the late Iron Age (first century BC), but persisting throughout the Roman period and beyond, into the sixth century AD (*ibid*).

4.12.4 It is likely that the remaining three beads (small black cylindrical 'seed' beads from tree throw ***90522*** (*Section 3.3.25*) and the *basal sands and gravels* (Grid Square 100; Fig 13), and a small red globular bead with an opaque white centre from the *stabilised land surface* (Grid Square 336; Fig 12)) are all of recent date. The small black examples can still be seen in use today, and the distinctive red bead can be identified as a 'white-heart' or 'Cournaline d'Aleppo'-type trade bead, often made on Murano (Venice) and probably developed in the second quarter of the nineteenth century (Blair *et al* 2009). Although such beads were widely used as trade beads in Africa and North America, they are also present in Britain, and, in this case, can be closely paralleled, for example, with beads from necklaces seen in nineteenth-century burials excavated at Redearth Primitive Methodist

Church, Darwen, in Lancashire (OA North 2011b).

4.12.5 ***Potential:*** there is little further potential for analysis of the beads of recent date. The Iron Age/Romano-British beads are of some general interest and are further indicators of activity in this area at the time. The stone beads are probably of earlier prehistoric origin and, therefore, comprise rare finds providing an important insight into this aspect of the materiality of the period; they will thus merit further study.

4.13 ALTERED WOOD

4.13.1 ***Quantification:*** 162 pieces of worked wood were recorded in detail, and the catalogue stored in the project archive. These include artefacts, woodworking debris, timber and trimmed roundwood (Table 8). The artefacts are few (five), but are very sophisticated, exhibiting advanced woodworking techniques. There were also 40 pieces of debris from woodworking and 11 pieces of timber and timber debris. The bulk of the material, however, is roundwood, much of it coppiced. Some of the material exhibits classic stone-axe cutting techniques and characteristics recorded elsewhere from Neolithic assemblages (*eg* Etton, Cambridgeshire (Taylor 1998a)). A few have been gnawed by beavers, one of which also exhibits scratch marks, possibly produced by brown bear (*Ursus arctos*) or Eurasian lynx (*Lynx lynx*).

Artefacts	Debris	Roundwood	Worked roundwood	Timber and timber debris	Beaver	Other
5	40	16	79	11	8	3

Table 8: Altered wood by category

4.13.2 ***Assessment:*** the scoring scale developed by the Humber Wetlands Project (Van de Noort *et al* 1995, table 15.1) has been used to assess the assemblage. This condition scale is based primarily on examination of the surface of the wood and the information which was recorded from that examination. The condition score reflects whether each type of analysis might be profitably applied, but is not intended as a recommendation for various analyses or treatment. A score of 5 would mean that all or any of the processes detailed, from museum conservation to species identification, might be worth applying to the material. A score of 0, on the other hand, would mean that very little or no data survived. A score of 4-5, which much of this material scores (Table 9), means that the material would stand up to most forms of analysis but might not be suitable for museum conservation.

	Museum conservation	**Technological analysis**	**Woodland Management**	**Dendrochronology**	**Species identification**	**Number of specimens**
5	+	+	+	+	+	6
4	-	+	+	+	+	39
3	-	+/-	+	+	+	86
2	-	+/-	+/-	+/-	+	24
1	-	-	-	-	+/-	1
0	-	-	-	-	-	0

Table 9: Relative condition of the altered wood

4.13.3 A proportion of the material is poor (2-3), generally due to water erosion. Most of the material in category 3 is borderline 3-4, and some of it may already have been deteriorating when it became waterlogged. The condition of six specimens is not noted in the archive.

4.13.4 The most striking artefacts from the site are the two tridents. In general, their shape resembles that of a modern culinary fork, with three parallel, straight-sided tines, but above the tines there is a well-marked ‘step’, the purpose of which is not obvious. One of the tridents is almost complete, having all three tines, albeit now broken in two pieces (75498 and 75499; Plate 7). The other example (75482; Plate 6) is broken, with only one tine surviving. The almost complete example is over 2m long, with a ‘blade’ *c* 175mm wide; the length from the step to the blade is *c* 1m. Comparable objects have been found in Neolithic contexts elsewhere, with two from Ehenside Tarn, also in Cumbria (Darbishire 1873), and another two found in Co Armargh in Ireland (Wilde 1857).

4.13.5 The third object identified as an artefact is 75706 (Plate 8). This was made in a similar way to the tridents, by carving down a piece of split timber, but it is more likely to have been a paddle, although it has broken at the point where the handle begins to expand to form the flattened blade of the paddle.

4.13.6 The final artefact (75826) is also a carved dowel, but more slender, with a slot or nock in one end. There are no obvious parallels for the last two artefacts, but a literature search may be productive.

4.13.7 Following illustration and recording of key pieces, the artefacts and certain other pieces chosen as representative of the assemblage as a whole were submitted to the York Archaeological Trust, where they have been conserved. The conservation technique required a two-stage PEG (polyethylene glycol) wax impregnation process using wax at concentrations of 15% PEG 200 and 20% PEG 4000. The wood was then immersed in a 5% solution of PEG 200 and the concentration increased until the desired level was reached. PEG additions were made at three to four weekly intervals to avoid collapse of the wood structure. Biocide was added to the treatment tank to reduce microbial activity. After wax impregnation, the wood was freeze-dried to remove any remaining water. Once dry, the excess surface wax was removed using a hot air blower and absorbent paper towels.

4.13.8 ***Potential:*** as the wood is so well preserved, from the time it was excavated the potential for data retrieval was considered very high, and this has proved to be the case. Worked

Neolithic wood is not common, and a large assemblage such as this is even more uncommon. Wooden artefacts, although often very beautiful, may only produce little, or limited, data, though. If they are well finished, for example, there will be few clues as to tools used and methods of fabrication. The debris from woodworking, coppicing *etc*, on the other hand, will produce more information about raw materials, woodworking techniques, exploitation of resources and so on. The assemblage is, therefore, of both regional and national importance, and the tridents, being exceptionally rare and unique in terms of their preservation, are finds of extraordinary significance. Further consideration of the assemblage, situating it within its wider research context, is given in *Section 7.16*.

4.14 Animal Bone

4.14.1 ***Quantification:*** in total, 28 fragments of animal bone or NISP (Number of Individual Specimens), weighing in the region of 45g, were recovered. These bones came from the *Earlier Neolithic organic deposit* and the *Later Neolithic organic* deposit in the palaeochannel, and the *overbank alluvium* and *stabilised land surface* in the grid square area (*Sections 3.3*; Table 10).

Species	**Palaeochannel**	**Grid square area**	**Total**
Medium mammal	6		**6**
Unidentified mammal	19	3	**22**
Total NISP	**25**	**3**	**28**

Table 10: *Species by depositional group or feature*

4.14.2 ***Assessment:*** the animal bone was rapidly scanned to identify the species present, the condition of the bone, and to assess its potential for further analysis. All of this material is in a very poor condition, being highly fragmented; typically only 1g in weight; and calcined (burnt white). It is highly likely that any unburnt bone deposited at the site has been lost to the archaeological record due to diagenetic (post-burial) attritional processes. It is, however, perhaps surprising that, if significant quantities of animal bone had been disposed of in the palaeochannel or the alluvium, no loose teeth were recovered, these being more resistant to post-depositional degradation.

4.14.3 ***Potential***: the animal bone has no potential for further analysis beyond a brief mention of its presence in these deposits. Calcined bone can be suitable for radiocarbon dating, but there is unlikely to be sufficient quantities present here to achieve a date.

4.15 Insects

4.15.1 ***Quantification:*** the insect faunas came from a series of samples taken from the various sections in the bays within the palaeochannel, from six of the main stratigraphic units, as well as a range of other channel deposits (*Section 3.3*; Table 11). Careful consideration was given to this selection to ensure that it included deposits at the same location as samples assessed for waterlogged plant remains (WPR) (*Section 4.17*), pollen (*Section 4.19*), foraminifera/ostracods (*Section 4.20*) and diatoms (*Section 4.21*), and also where there was good association with cultural material. In total, 52 samples were assessed for insect remains. Of these, 11 produced none, 11 were poorly preserved and 30 contained well-preserved samples. In the main, this diverse and rich insect fauna is distributed fairly evenly across the various bays sampled. In terms of depth down the section, often the lowest samples, directly above the gravels in the lowest parts of the channels, produced rather eroded and poor samples. The same is often true of material from the very top of the various channels.

	Bays									
	A	**B**	**D**	**F**	**I**	**O**	**V**	**X/W**	**X/Y**	**Z**
Mesolithic organic deposit	-	P	A	A	-	-	P	P	P	P
Mesolithic/Neolithic alluvium	P	P	P	A	-	P	-	-	-	-
Earlier Neolithic organic deposit	-	P	P	P	-	P	-	-	-	-
Earlier Neolithic alluvium	-	P	P	P	-	P	-	-	-	-
Later Neolithic alluvium	-	P	P	P	-	A	-	-	-	-
Later Neolithic organic deposit	-	-	-	-	-	P	-	-	-	-
Polissoir pit ***70129***	-	P	-	-	-	-	-	-	-	-
Deposit ***70345***	-	-	-	P	-	-	-	-	-	-
Deposit ***70121***	P	-	-	-	-	-	-	-	-	-
Deposit ***70395***	-	-	-	-	P	-	-	-	-	-
Deposit ***70398***	-	-	-	-	P	-	-	-	-	-
Deposit ***70062***	A	-	-	-	-	-	-	-	-	-

Table 11: Presence (P) and absence (A) of insects in the samples assessed from the palaeochannel

4.15.2 ***Methodology:*** the samples were processed using the standard method of paraffin flotation outlined in Kenward *et al* (1980), and the system for 'scanning' faunas, as outlined by Kenward *et al* (1985), was followed. The detailed results of the assessment are stored within the project archive. The taxonomy follows that of Lucht (1987) for the Coleoptera (beetles). It was hoped that an assessment of the insect remains from these samples would provide information on whether insects were present, whether these were of interpretative value, and whether they could be used to suggest the nature of the material deposited in the palaeochannel. Regarding the assessment, identifications of the insects present are provisional. In addition, many of the taxa present would be identified down to species level during a full analysis, producing more detailed information. As a result, these faunas should be regarded as incomplete and possibly biased.

4.15.3 ***Assessment:*** the majority of the insect fauna recovered were Coleoptera (beetles) and Tricoptera (caddis flies). The majority were well preserved and produced faunas of moderate to large size. A few faunas were so rich that it was not possible to sort all of the material in the time allocated. The insect faunas recovered are generally similar across all of the sections and bays sampled.

4.15.4 There is strong evidence for slow-flowing or stagnant water. This is clearly represented by the *Hydraena*, *Ochthebius* and *Limnebius* species of water beetle, recovered in large numbers from all of the material sampled. These taxa are normally associated with a range of slow-flowing or still waters (Hansen 1987). The range of 'diving beetles' recovered, including various species of *Agabus* and *Hydroporus,* also represents similar conditions. Again, these taxa are normally associated with pools of slow-flowing or stagnant water (Nilsson and Holmen 1995).

4.15.5 Surprisingly, given the clear evidence for slow or stagnant water conditions, there are very few indicators for stands of waterside vegetation, such as reeds or rushes. These plants host a range of beetles that are directly associated with them, such as the chrysomelid 'reed beetles', which are usually a dominant part of the insect faunas associated with this type of water conditions, but this is not the case at Stainton West. This may suggest that the channel was relatively clear of such vegetation during the period of time when these deposits were accumulating. The only indications for the presence of waterside vegetation come from Bay I, where a few individuals of the *Notaris* weevil were recovered. Species from this genus are usually associated with *Glyceria* (reed sweet-grasses). There is also a suggestion from several samples that some areas of the channel may have contained stands of water-dropworts, water-parsley and cowbane (Apiaceae), which is the favoured food plant of certain *Hydrophassa* species and *Prasocuris phellandrii*. There also appear to have been patches of duckweed (*Lemna* spp), as this is the food plant of the small weevil, *Tanysphyrus lemnae*.

4.15.6 In terms of terrestrial taxa, the majority are directly associated with woodland and trees. This includes a diverse range of species that are associated with decaying timber and trees, which are common in all of the samples examined. Typical indicators for dead wood are several of the elaterid 'click beetles', such as *Cerylon* spp, *Melasis buprestoides*, and the various species of Anobibae, Tenebrionidae, Cerambychidae, and Scolytidae recovered. There is also clear evidence for the presence of considerable amounts of tree leaf, fruits and nuts. This is clearly suggested by the recovery of a number of weevils that are associated only with tree leaf. This includes various species of the 'leaf rollers' *Rhynchites*, and the 'leaf miners' *Rhynchaenus* and *Rhamphus*. Species from these genera, associated both with dead wood and tree leaf, are all particularly sensitive indicators for host plant(s), often being associated with a single species of tree (Koch 1992).

4.15.7 There is also a consistent presence of a range of beetles that are usually associated with grazing and grassland. This is most clearly suggested by the numbers of individuals of the *Aphodius* and *Geotrupes* 'dung beetles' recovered. Species of this genus are normally associated with dung lying in open pasture (Jessop 1986).

4.15.8 ***Potential:*** the assessment has shown that the palaeochannel deposits at Stainton West have produced relatively large, diverse and interpretable insect fauna. They clearly have the potential to aid an understanding of the water conditions and landscape associated with the channel both in the Mesolithic and the Neolithic periods. The water beetles (*Section 4.15.4*), if the range is fully identified, have the potential to produce considerable information on the exact nature of water conditions associated with the palaeochannel, since these taxa are all very sensitive indicators of such conditions. The terrestrial beetles (*Sections 4.15.6-7*) will be particularly informative as to the structure of the forest and its species composition at Stainton West, and will also establish whether or not domestic animals or wild animals, such as deer, grazed near the channel.

4.15.9 Nationally, there are few insect faunas that are Late Mesolithic in date, and there are no other Mesolithic or Neolithic insect faunas on the west side of the Pennines. There is, therefore, a particularly striking gap in our understanding of landscape and woodland development in both periods in this part of the country that the material from Stainton West can address, establishing this site's importance at both a regional and national level. Even though the insect faunas are essentially similar across the various bays, they are diverse enough to mean that more than one location merits study. In total, 30 samples have potential for further analysis (Table 12). The analysis of the insects will need to be carried out in conjunction with the pollen (*Section 4.19*) and plant macrofossil analysis (*Sections 4.16* and *4.17*).

Bay	Number of Samples for Analysis
A	1
B	5
D	4
F	2
I	2
O	4
V	2
X/W	4
X/Y	2
Z	4

Table 12: Insect samples recommended for analysis by bay

4.16 WATERLOGGED WOOD

4.16.1 ***Quantification:*** species identifications were carried out on some 726 wood samples taken from the palaeochannel. Of these, 157 came from the *Mesolithic organic deposit*, 294 came from the *Earlier Neolithic organic deposit* and 253 from the *Later Neolithic organic deposit*. The identifications were made, primarily, to identify the range of woodland taxa growing at the site and to identify any changes in the composition of the woodland over time. In addition, all altered/worked pieces were examined to identify any trends in species selection and utilisation. Species identifications were also provisionally correlated with wood type, *ie* whether the pieces were small roundwood, trunk wood or root wood, to assess the data’s potential for providing information on likely taphonomy.

4.16.2 ***Methodology:*** in accordance with the advice of the English Heritage Regional Science Advisor, an on-site programme of systematic sampling was carried out, which involved the random selection of a representative amount of wood from each bay in the palaeochannel. Suspected altered or worked pieces were retained, and sampled for species identification back at the OA North offices.

4.16.3 Initially, a transverse section of each piece of wood was observed using a Leica MZ6 binocular microscope at up to x40 magnification, in order to determine its cellular make-up (*ie* ring, semi-ring, or diffuse porous wood). Many of the better-preserved pieces of oak (*Quercus* sp), with its distinct auxiliary rays, could be identified at this stage. However, if the transverse section was not clear, or if the wood was not oak, then small radial and tangential sections were mounted on a slide in water, sealed with a cover slip, and observed under transmitted light using an Olympus BH-2 microscope at up to x400 magnification. Identifications were aided with the use of standard reference texts (Schweingruber 1990; Hather 2000), and comparison with reference slides held at OA North. The taxonomic level of identification varied according to taxa. Fragments identified as *Prunus* sp (blackthorn-type in text) include sloe/blackthorn, wild plum, wild cherry and bird cherry. Maloideae, which includes hawthorn, whitebeam, apple and pear, is referred to as hawthorn-type.

4.16.4 ***Assessment:*** **The Relative Abundance of Wood Taxa:** the relative abundance of different wood taxa varied in each of the three major stratigraphic units (Fig 17; *Section 2.4*) within the palaeochannel. In order to present a true representation of the 'natural' wood in the channel, and to minimise biases in sampling selection, proportions were calculated by excluding any altered pieces of wood or oak wood sampled solely for dendrochronological assessment (a percentage of the dendrochronological samples was also sampled for identification of species as part of the overall sampling method). On this basis, the relative abundance of wood taxa from the *Mesolithic organic deposit* was calculated using 131 species identifications (ignoring 15 altered pieces and 11 purely dendrochronological samples). The *Earlier Neolithic organic deposit* was calculated using 222 species identifications (ignoring 56 altered pieces and 16 dendrochronological samples), and the *Later Neolithic organic deposit* was calculated using 234 species identifications (ignoring 18 altered pieces and one dendrochronological sample). Eight wood species were identified, two of which, birch (*Betula*) and willow/poplar (*Salix/Populus*), were not present in the *Mesolithic organic deposit*. The remaining six, alder (*Alnus glutinosa*), hazel (*Corylus avellana*), hawthorn-type, blackthorn-type, oak and elm (*Ulmus*), were present in all the stratigraphic units, although a clear difference in relative percentages is apparent.

4.16.5 The *Mesolithic organic deposit* is clearly dominated by hazel wood, with abundant elm and oak (Fig 17). Alder is fairly poorly represented, although it is likely that this layer developed prior to the alder rise in Britain, since pollen evidence suggests a major northerly and westerly expansion of alder took place from about 5000 BC (Tallantire 1992), and the radiocarbon dates from the *Mesolithic organic deposit* are, on the whole, earlier than this (*Section 4.25*). The relatively high proportion of hawthorn/blackthorn-type in the *Mesolithic organic deposit* is quite surprising and suggests some of the woodland bordering the channel was open and scrubby.

4.16.6 The relative percentages of the wood taxa in the *Earlier Neolithic organic deposit* (Fig 17) show a shift to almost equal proportions of hazel, alder and elm, the increase in alder being mirrored by a decrease in oak. Birch and willow/poplar are recorded for the first time, and the relative abundance of scrubby taxa decreases, with these remaining at fairly low levels. The dominant wood type in the *Later Neolithic organic deposit* is clearly alder (Fig 17). Oak is still well represented, but the relative percentages of elm and hazel appear to have decreased. This apparent decline in elm is significant and may reflect trends recognised nationally, present evidence suggesting this happened widely in Britain between *c* 4300 BC and *c* 3300 BC (Parker *et al* 2002). Dutch Elm Disease is considered to be one of the most likely explanations for the decline of elm during this period, although both climatic change and human activities may have also played a part (*ibid*).

4.16.7 **The Altered/Worked Wood:** oak was the preferred wood for the altered (and burnt) pieces from all the stratigraphic units in the palaeochannel. Hazel was also well utilised during the development of the *Later Neolithic organic deposit*, but only two pieces (of 56) were identified as alder, which is surprising, given the high percentage of alder wood identified from this deposit.

4.16.8 **Wood Species and Wood Type:** preliminary evidence suggests that there may be some correlation between species and wood type, *ie* trunk wood, roundwood or root wood. It is possible that the trunk wood from the *Mesolithic organic deposit* consists largely of oak, which is slightly at odds with the relative percentages of taxa generally, as this deposit was dominated by hazel wood. In addition, it appears that root wood is mostly confined to the *Later Neolithic organic deposit*, and is dominated by alder.

4.16.9 ***Potential:*** the waterlogged wood recovered from the palaeochannel was extremely well preserved and preliminary analyses have identified changes in the composition of the wood over time. The deposits are likely to span two of the major woodland chronological zones in Britain, the alder rise and the elm decline. Therefore, important information, regarding these phenomena in north-west Britain, may potentially be retrieved through analysis, by studying the waterlogged wood, alongside the other available evidence – especially the pollen data. Additionally, the waterlogged wood from the site provides a unique opportunity for the study of prehistoric human interaction with this environment. The current data suggest that oak and hazel may have been deliberately selected for crafting, even though other woods were seemingly more plentiful.

4.17 Waterlogged Plant Remains

4.17.1 ***Quantification:*** 73 bulk environmental samples were assessed for waterlogged plant remains (WPR) from deposits in the palaeochannel. Of these, 52 were also assessed for invertebrate remains (*Section 4.15*). Careful consideration was given to this selection to ensure that it included deposits at the same location as samples assessed for pollen (*Section 4.19*), ostracods/foraminifera (*Section 4.20*) and diatoms (*Section 4.21*), and also where there was good association with cultural material. This selection acted on the advice of the English Heritage Science Advisors for the North West (Sue Stallibrass) and Hadrian's Wall (Jacqui Huntley).

4.17.2 ***Methodology:*** in accordance with the advice of the English Heritage Science Advisors, an on-site programme of systematic sampling of all securely stratified contexts was implemented to eliminate the biases inherent in a strategy based on judgement alone, and to ensure that significant contexts were more reliably identified. Where dating by artefacts was insecure and/or where dating was likely to be a significant issue for the interpretation of the site, samples were also taken to allow the use of scientific methods, such as radiocarbon dating.

4.17.3 In accordance with accepted professional guidelines (EH 2002), bulk, 40-litre samples were taken, or the entire contents of contexts, when the volumes of these were less than this. However, because of the highly organic nature of the channel fills, only ten litres of each sample were processed. The flots were collected on a 300µm mesh, air-dried and examined under a binocular microscope. The contents of each flot and the residues, such as seeds, catkins, buds, wood, charcoal and amorphous plant remains, were quantified. The presence of modern contaminants, such as roots, insect eggs and modern seeds, was noted and a catalogue prepared and stored in the site database. The total number of seeds in each sample was quantified on a scale of 1–5, where 1 is rare and 5 is abundant (more than 100 items). All other remains were recorded on a scale of 1-3, where 1 is present and 3 is abundant. One litre sub-samples were wet sieved through a series of sieves (2mm, 500µm and 250µm mesh diameter) and the residues have been retained wet for future analysis. Following the initial assessment, the remaining part of all those samples in which some charcoal was recorded was processed. Plant nomenclature follows Stace (1997).

4.17.4 ***Assessment:*** WPR were recorded in all 73 samples assessed, with the levels of preservation being good in 28 samples and moderate in 14 samples. The results of the assessment are presented by major stratigraphic unit (*Section 2.4*; Table 13). The remaining 31 samples had poor survival, although two of these, from the *Mesolithic organic deposit* in Bay V, had good insect survival. No charred plant remains (CPR) were recorded in any of the samples, except for small amounts of charcoal (*Section 4.18*).

Stratigraphic Unit	**WPR**
Mesolithic organic deposit	Alder, apple/whitebeam, birch, blackthorn/cherry, dogwood, hazel, brambles, elderberry, herb seeds including dog's mercury, wood sorrel, wood-rush, chickweed, hemp-nettle, nettles, selfheal, spurge, grasses, plantain, sheep's bit sorrel and common sorrel, buttercups, speedwell, mint, gipsywort, marsh marigold, sedges, and water plantain. Matrix includes bark, buds, leaf fragments, moss fragments, roundwood, wood and wormcasts.
Mesolithic/Neolithic alluvium	Alder, blackthorn/cherry, catkins, hazel, herb seeds including wood sorrel, fumitory, hemp-nettle, nettles, heather, buttercups, and sedges. Matrix includes bark, buds, monocotyledon remains, moss fragments and roundwood.
Earlier Neolithic organic deposit	Alder, apple/whitebeam, blackthorn/cherry, dogwood, hazel, brambles, herb seeds including wood sorrel, nipplewort, stitchwort, buttercups, meadowsweet and sedges. Matrix includes bark, buds, moss fragments, roundwood and wood.
Earlier Neolithic alluvium	Alder, blackthorn/cherry, elder, hazel, brambles, herb seeds including spurge, buttercups and sedges. Matrix includes bark, buds, moss fragments, roundwood and wood fragments.
Later Neolithic organic deposit	Alder, apple/whitebeam, elder, blackthorn/cherry, hazel, brambles, herb seeds including wood sorrel, pale persicaria, spurge, hemp-nettle, nettles, selfheal, common sorrel, buttercups, gipsywort, rushes, and sedges, some with utricles. Matrix includes bark, buds, moss fragments, roundwood and wood.
Later Neolithic alluvium	Alder, brambles, elder, hazel, herb seeds including pale persicaria, nettles, buttercups, and violets. Matrix includes bark, buds, roundwood and wood.
Deposit ***70395***	Alder, brambles, blackthorn/cherry wood fragment, elder, hazel, herb seeds including spurge, nettle and buttercups. Matrix includes bark.
Deposit ***70398***	Alder, blackthorn/cherry, elder, hazel, brambles, herb seeds including hemp-nettle, grasses, buttercups and sedges. Matrix includes bark and wood fragments.
Deposit ***70345***	Hazel, brambles, but no alder, herb seeds including wood sorrel, nettles and sedges. Matrix includes bark, buds, moss fragments, and roundwood.
Deposit ***70121***	Hazel, brambles, herb seeds including pale persicaria, spurge, nettles, and sedges. Matrix includes bark, buds, moss fragments and roundwood.
Deposit ***70062***	A little hazel, brambles, herb seeds including spurge, buttercups, violets, and sedges. Matrix includes bark, earthworm egg cases, fungal sclerotia, and moss fragments.

Table 13: WPR identified during the assessment from the major stratigraphic units within the palaeochannel. Plants are ordered in broad ecological groupings

4.17.5 Seeds of woody plants were recorded in all samples assessed (Table 13), with hazel (*Corylus avellana)* nuts or nut fragments being the most common, recorded in 65 of the 73 samples. Alder (*Alnus glutinosa*) seeds were less frequent, occurring in 27 samples, and was more common in the uppermost deposits. Other woody taxa included blackthorn/cherry (*Prunus*), apple/whitebeam (*Malus*/*Sorbus*), elder (*Sambucus nigra*), brambles (*Rubus fruticosus* agg) and dogwood (*Cornus sanguinea*), but there was no elm (*Ulmus*), although both elm pollen and wood have been identified from the site. Several of the herbs recorded are also found in woodland situations, such as wood sorrel (*Oxalis acetosella*), which was identified in 20 samples, but was more common in the lower levels within the channel, and dog's mercury (*Mercurialis perennis*), that was only within the *Mesolithic organic deposit*.

4.17.6 Aquatics and plants of wet ground were not present in all the samples and were, perhaps surprisingly, absent from many of the samples from the channel. Sedges (*Carex*), often found on wet ground (Stace 1997), were identified in 37 samples. Other plants, for example, water plantain (*Alisma* sp) and gipsywort (*Lycopus europaeus*), found growing today on wet ground or in shallow water (*ibid*), were more frequent in the upper levels, especially within Bays D and F, although marsh marigold (*Caltha palustris*) and gipsywort were found in the *Mesolithic organic deposit* within Bay X. The matrices of many of the samples were very rich in buds from woody taxa, bark, wood fragments (including roundwood) and moss (bryophyte) remains.

4.17.7 The WPR assessment suggests that material often entered the channel from the surrounding land. The absence of large numbers of remains from plants that today are found growing in shallow water or on wet ground, except in the uppermost deposits, may mean that the palaeochannel was largely clear of vegetation, although future analysis of the moss remains could revise this interpretation.

4.17.8 ***Potential*****:** overall, the assemblage of WPR from the palaeochannel has good potential for further analysis. Six of the major stratigraphic units (*Section 2.4*) have produced material suitable for further analysis (Table 14), only the *basal sands and gravels* and the *overbank alluvium*, respectively at the earliest and latest part of the sequence, failing to produce viable material. Several other deposits from the channel also produced material worthy of further study, and the analysis of these vegetative remains will greatly contribute to an understanding of the local environment.

	Bays								
	A	**B**	**D**	**F**	**I**	**O**	**V**	**X**	**Z**
Mesolithic organic deposit	-	-	-	G	-	M	M	G	G
Mesolithic/Neolithic alluvium	-	G	M	G	-	G	-	-	-
Earlier Neolithic organic deposit	G	G	M	M	-	G	-	-	-
Earlier Neolithic alluvium	-	M	-	G	-	M	-	-	-
Later Neolithic organic deposit	-	G	G	M		G	-	-	-
Later Neolithic alluvium	-	-	G	-	-	-	-	-	-
Deposit ***70395***	-	-	-	-	G	-	-	-	-
Deposit ***70398***	-	-	-	-	G	-	-	-	-
Deposit ***70345***	-	-	-	G	-	-	-	-	-
Deposit ***70121***	G	-	-	-	-	-	-	-	-
Deposit ***70062***	G	-	-	-	-	-	-	-	-

Table 14: Relative potential of stratigraphic units within palaeochannel bays. G=good, M=moderate

4.17.9 The WPR from other Mesolithic and Early Neolithic sites, such as Star Carr, in Yorkshire, and Williamson's Moss, on the West Cumbrian coast, has largely been ignored or not widely publicised (Hall and Huntley 2007, 23). This makes the analysis of the WPR from Stainton West extremely important, both regionally and nationally. The integrated analysis of the WPR, CPR, charcoal, pollen, wood, insect remains and soil micromorphology has the potential to provide a very detailed picture of the local environment contemporary with the known Mesolithic and Neolithic activity.

4.18 Charred Plant Remains and Charcoal

4.18.1 ***Quantification:*** 271 bulk palaeoenvironmental samples were assessed for charred plant remains (CPR) and charcoal. Of these, 191 sampled features or deposits were in the grid square area (*Section 3.3.20*; Fig 3), the remainder (80) coming from the burnt mounds, layers and features adjacent to the palaeochannel (*Section 3.3.17-8*; Fig 3).

4.18.2 ***Methodology:*** in accordance with the advice of the English Heritage Science Advisors for the North West (Sue Stallibrass) and Hadrian's Wall (Jacqui Huntley), an on-site programme of systematic sampling of all securely stratified contexts was implemented to eliminate the biases inherent in a strategy based on judgement alone, and to ensure that significant contexts were more reliably identified. Where dating by artefacts was insecure and/or where dating was likely to be a significant issue for the interpretation of the site, samples were also taken to allow the use of scientific methods, such as radiocarbon dating.

4.18.3 To comply with accepted professional guidelines (EH 2002), bulk, 40-litre samples were taken, or the entirety of deposits, if these were less by volume than this, and were processed using a modified Siraf-type flotation tank. Given the importance of the Stainton West site, 100% of each sample was processed. The flots were collected on a 300µm mesh, air-dried and examined under a binocular microscope. Any material still retained in the residue was also extracted and assessed. The contents of each flot, such as cereal grains, cereal chaff, weed seeds and molluscs, were quantified, as was material such as coal, heat-affected vesicular material (HAVM), bone, mortar, and ceramic building material (CBM). The presence of modern contaminants, such as roots, insect eggs and modern seeds, was noted and a catalogue prepared. The charred remains were quantified on a scale of 1–4, where 1 is rare (one to five items); 2 is frequent (less than 50 items); 3 is common (51–100 items); and 4 is abundant (greater than 100 items). In addition, charcoal fragments larger than 2mm, hand-picked from the *c* 270,000 litres of deposit sieved for artefacts from the grid squares, were rapidly scanned for their suitability for further analyses or dating.

4.18.4 Any charcoal fragments within the bulk samples were quantified and provisionally identified where possible. In particular, for the purpose of providing suitable material for dating, the presence of any short-lived wood species, such as *Alnus glutinosa* (alder), *Corylus avellana* (hazel) or *Betula* sp (birch) (diffuse porous wood), was noted, as was the presence of other charred material, such as Poaceae (grass family) stems or tuber fragments. Charcoal fragments identified as *Prunus* sp (blackthorn-type in the text) include sloe/blackthorn, wild plum, wild cherry and bird cherry. Fragments identified as Maloideae, which includes hawthorn, whitebeam, apple and pear, is given as hawthorn-type in the text.

4.18.5 ***Assessment:*** **Grid Square Area:** 30 of the samples from the grid square area (*Section 3.3.20-6*; Figs 12-14) produced CPR, mostly in the form of the occasional charred bud and charred weed seeds. Several samples from the major layers in the area (*basal sands and gravels*, *overbank alluvium* and *colluvium*) did, however, contain one or two charred cereal grains of, mainly, *Hordeum vulgare* (barley) and/or *Avena* sp (oat).

4.18.6 A large oval pit (***90262***) and a smaller pit (***90163***) both contained a mixed assemblage of *Alnus*/*Corylus* and *Quercus* sp (oak) charcoal and were securely dated, by radiocarbon assay, to the Mesolithic period (*Section 4.25*). Several features were radiocarbon-dated to the Earlier Neolithic period, including two possible tree throws (***90508***) and (***90522***; Fig 12) and a sample from the *stabilised land surface* (*Sections 3.3.22* and *4.25*). Although none of these produced CPR, all three contained frequent charcoal fragments, dominated by *Alnus glutinosa*/*Corylus avellana* (alder/hazel). Two hearths (***90217*** and ***90434***; Fig 13) were radiocarbon-dated to the Middle to Late Bronze Age, and contained predominantly oak charcoal. Other features with rare to common charcoal include possible tree throws ***90526*** and ***90448*** (Fig 13), which were dominated by *Quercus* charcoal; a spread of burnt stones (***90396***; Fig 13), associated with *Alnus*/*Corylus* and other diffuse porous wood; a small pit (***90163***; Fig 13), which contained frequent *Alnus*/*Corylus* and *Quercus* sp fragments; and a possible tree throw (***90522***; Fig 12), which contained a mixed charcoal assemblage, including *Alnus*/*Corylus* and diffuse porous wood. Many samples sieved to >2mm for finds-retrieval purposes from the features on the terrace also contained charcoal fragments suitable for providing radiocarbon dates. Much of the charcoal appeared to be *Alnus*/*Corylus*, diffuse porous-type wood, or *Quercus* sp.

4.18.7 Of the major layers of deposit within the grid square area (*Section 3.3.20*; Fig 3), only the *overbank alluvium* contained appreciable amounts of CPR and charcoal together, the CPR comprising rare to frequent *Hordeum vulgare* grains, *Prunus* sp stone fragments and charred weed seeds, accompanied by common *Quercus* sp charcoal fragments. Bulk samples for palaeoenvironmental material taken from the s*tabilised land surface*, *colluvium* and *backwater channel* were assessed and, although devoid of CPR, contained abundant charcoal fragments, dominated by *Alnus*/*Corylus* wood, with smaller amounts of *Fraxinus excelsior* (ash) and *Prunus* sp. Many of the samples from these layers contained charcoal fragments suitable for providing radiocarbon dates, much of it being *Alnus glutinosa* or *Corylus avellana*. The >2mm sieved residue from the s*tabilised land surface*, *overbank alluvium*, and the *colluvium* contained common *Alnus*/*Corylus* and/or *Quercus* sp charcoal fragments, and the o*verbank alluvium* also contained rare possible Fabaceae (broom/gorse) wood charcoal. The presence of Fabaceae wood so early in date may be of interest, given its association with open ground or heathland (Stace 1997).

4.18.8 **The Burnt Mounds and Other Features Adjacent to the Palaeochannel:** 56 bulk samples, taken from the burnt mounds and features directly associated with them (*Section 3.3.17*; Fig 3), contained very few CPR. Abundant well-preserved charcoal, often fragments larger than 10mm in size, was, however, present. Most samples were dominated by *Alnus glutinosa*/*Corylus avellana*, with few *Prunus* sp, *Fraxinus exelsior* and *Quercus* sp fragments. However, the samples from Burnt Mound 1 appeared to be dominated by *Quercus* sp.

4.18.9 *Alnus glutinosa*/*Corylus avellana* charcoal from Burnt Mound 3 and its associated trough provided Early Bronze Age radiocarbon dates (*Section 4.25*). However, *Prunus* sp charcoal from Burnt Mound 5 (*Sections 3.3.15* and *4.25*; Fig 10) was dated by radiocarbon assay to approximately 1000 years earlier, demonstrating that similar activity had been taking place in this locality over a prolonged duration.

4.18.10 Four samples taken from ring gully ***100031*** (*Section 3.3.18*; Fig 11) were dominated by *Alnus glutinosa*/*Corylus avellana* roundwood. A hearth (***100020***) within the ring gully, and another (***100016***) nearby, contained mixed assemblages of diffuse porous wood, including *Alnus glutinosa*/*Corylus avellana* and Maloideae roundwood. In contrast to the other features from this area, nearby pit ***100048*** appeared to contain an assemblage dominated by *Quercus* sp.

4.18.11 **The Palaeochannel**: sediment sieved to >2mm for finds retrieval from the *Mesolithic organic deposit* contained frequent charcoal dominated by *Ulmus* sp (elm), *Quercus* sp and *Alnus glutinosa*/*Corylus avellana*, and, in addition, contained two semi-charred pieces. Sieved material greater than 2mm from the *Early Neolithic organic deposit* and *Late Neolithic organic deposit* contained abundant charcoal, dominated by *Fraxinus excelsior, Alnus glutinosa*/*Corylus avellana*, *Prunus* sp, Maloideae, and possible *Rhamnus catharticus* (common buckthorn). The differences in the assemblages may reflect a change in woody taxa growing at the site, the latter suggestive of much more open conditions with scrubby areas or hedgerow.

4.18.12 ***Potential:*** given the rarity of palaeobotanical assemblages of this date, both regionally and nationally (Hall and Huntley 2007), the material from Stainton West is very important, and has demonstrable potential for further CPR and/or charcoal analysis. One sample from the *overbank alluvium* contained cereal grains, blackthorn-type stone fragments, and weed seeds, which would be worthy of further analysis and dating. Cereal grains from two other samples from the *overbank alluvium*, one sample from the *basal sands and gravels*, and one sample from the *colluvium* could be dated by radiocarbon assay if required. Additionally, three samples from the *overbank alluvium*, four from the *stabilised land surface*, and one each from the *backwater channel* and *colluvium* contained charcoal worthy of further analysis, as did pits ***90262*** and ***90163***, tree throws ***90508***, ***90522*** and ***90526***, pit ***90448***, hearths ***90217*** and ***90434***, and a spread of burnt stones (***90396***). Radiocarbon assay of these layers/features would help to determine prehistoric woodland type and possible resource use.

4.18.13 Fifteen samples from the burnt mounds and associated features including Burnt Mounds 2 and 5, and tree throw ***70406*** (beneath Burnt Mound 1, as shown on Figure 11) would be worthy of charcoal analyses, in order to determine any differences in the woodland taxa growing and being utilised on site. Similarly, charcoal assemblages from ring gully ***100031***, hearths ***100016*** and ***100020***, and pit ***100047***, along with the three charcoal-rich samples from the palaeochannel (*Mesolithic organic deposit*), should be analysed to highlight any differences in the available woodland resource over time. It will be interesting to see if any changes in local wood types identified from the pollen, WPR and wood from Stainton West are also reflected in the charcoal assemblages.

4.18.14 In addition to the material retrieved from bulk palaeoenvironmental samples, many of the samples sieved for the retrieval of finds produced suitable material for radiocarbon dating. In some cases, this material provides additional information to that specifically sampled for palaeoenvironmental remains, and data from both sources have been combined and integrated in the project archive.

4.19 POLLEN

4.19.1 ***Quantification:*** in total, 174 sub-samples from 42 monolith samples were assessed for pollen and non-pollen palynomorphs. The samples were taken from a range of different locations across the site, principally focusing on, potentially, the most promising deposits, those within a palaeochannel, but also including archaeological features and deposits adjacent to the channel. Careful consideration was given to this selection to ensure that it included deposits at the same location as samples assessed for insects (*Section 4.15*), WPR (*Section 4.17*), foraminifera/ostracods (*Section 4.20*) and diatoms (*Section 4.21*), and also where there was good association with cultural material.

4.19.2 Within the channel, monoliths were selected from several different locations to ensure that a stratigraphically representative sample was retrieved, accounting for any lateral variation in the channel sequence and sampling the full sequence of deposits (Figs 18-21). This meant that certain key deposits were sampled in more than one location, and, consequentially, it was possible to determine any significant differences in the pollen assemblages and gauge the potential for correlation between locations. The ultimate aim of this was to identify a more closely targeted sample for analysis. As part of the sub-sampling process, the lithologies of all samples were described and recorded. These data and the raw pollen counts are stored within the CNDR site database.

4.19.3 ***Methodology:*** volumetric sub-samples were taken from the 174 samples, and two tablets containing a known number of *Lycopodium* spores were added so that pollen concentrations could be calculated (Stockmarr 1971). The samples were prepared using a standard chemical procedure (method B of Berglund and Ralska-Jasiewiczowa 1986), using HCl, NaOH, sieving, HF, and Erdtman's acetolysis, to remove carbonates, humic acids, particles >170µm, silicates, and cellulose, respectively. The samples were then stained with safranin, dehydrated in tertiary butyl alcohol, and the residues mounted in 2000cs silicone oil. Slides were examined at a magnification of x400 by ten equally spaced traverses across at least two slides to reduce the possible effects of differential dispersal on the slides (Brooks and Thomas 1967) or 100 total land pollen and spores. Pollen identification was made following the keys of Moore *et al* (1991), Faegri and Iversen (1989), and a small modern reference collection. Andersen (1979) was followed for the identification of cereal grains; plant nomenclature follows Stace (1997). The preservation of the pollen was noted and an assessment was made of the potential for further analysis. Charcoal particles greater than 5µm were recorded also (Peglar 1993). Fungal spore identification and interpretation followed van Geel (1978) and Blackford *et al* (2010).

4.19.4 ***Assessment:*** more than 60% of the sub-samples proved productive for pollen. The assessment of these demonstrates that the vegetation adjacent to the palaeochannel is likely to have largely comprised woodland, showing a tree pollen succession from hazel, oak, and elm-dominated communities to alder-dominated woodland. The upper part of the sequence in the palaeochannel suggests a potential transition from a wooded landscape to a more open, possibly cultivated environment.

4.19.5 Pollen assessment results are presented chronologically, according to the sequence of deposition, beginning with the bays at the northern end of the channel, progressing to those at its southern end, and thence to the burnt mounds and other features and deposits adjacent to it (Fig 5).

4.19.6 **Bay O**: 30 sub-samples were taken from five monoliths (Figs 5 and 18), of which 22 proved productive for pollen. Pollen assemblages appear to indicate a transition from a wooded environment to an open, cultivated landscape, since the oldest sediments are the *Earlier Neolithic organic deposit* and *Mesolithic/Neolithic alluvium*, present in sample 70526, where woodland assemblages are indicated. Hazel, elm and oak are the main tree components, although small amounts of alder are also present. In other samples, for example 70507, alder/hazel woodlands are initially dominant, but, then, potential openings within the woodlands may be interpreted from the pollen profile, gradually followed by wetter plant communities and finally, rich herb communities. In sample 70507, the transition from woodland to wetter plant communities has been radiocarbon-dated (*Section 4.25*): the woodland is of Neolithic age and the wetter open landscape is of the Bronze Age.

4.19.7 Small amounts of microcharcoal were found throughout all the samples assessed, although a greater amount was present in a moderate-poorly productive pollen sub-sample from the *overbank alluvium* in monolith 70512. The fungal spore *Kretzschmaria deusta* (*K deusta*) is present in sub-samples from Bay O, for example, from the *Earlier Neolithic organic deposit* and the *Neolithic/Mesolithic alluvium* in monolith 70526. The presence of *K deusta* is important, as this taxon is associated with dead or decaying wood, and has been recorded around the Mesolithic/Neolithic transition (Elm Decline; Innes *et al* 2006).

4.19.8 **Bays V and B**: Bay V underlay Bay B, and three of the monolith samples assessed in V continued up the profile into B: 71155 is continued as 70222; 71158 as 70225, and 71160 as 70227 (Figs 5 and 19). Within Bay V, 11 sub-samples from three monoliths were assessed for pollen and seven were found to be productive. The pollen assemblages in sample 71158 reveal a woodland flora (dominantly hazel, with oak and elm); radiocarbon dating of sediments at 0.32-0.33m (*Mesolithic organic deposit*) showed that they accumulated during the Late Mesolithic period (*Section 4.25*). The fungal spore *K deusta* is found sporadically, in small numbers, for example, in sample 71160, *Mesolithic organic deposit*.

4.19.9 From across the width of the channel in Bay B, samples 70219, 70222, 70225 and 70227 were assessed for pollen (Figs 5 and 19). Twenty-three pollen sub-samples yielded 16 sub-samples productive for pollen. The most productive samples were recovered from the centre of the Bay, from 70222 and 70225, where the greatest organic accumulation was found. Pollen assemblages are dominated by tree pollen, within which there is some evidence for change. Older forest communities were dominated by *Corylus* (hazel) and *Ulmus* (elm) pollen, which were replaced gradually by *Alnus* (alder) tree pollen. The transition within the tree pollen suggests a profile potentially spanning a Late Mesolithic to Neolithic time period. Radiocarbon dating (*Section 4.25*) of the top (*Later Neolithic alluvium*) and bottom (*Earlier Neolithic organic deposit*) of the deposit sequence in sample 70222 supports this interpretation (although the dating presently conflicts with the chronological ascription of the stratigraphy as it stands; *Section 4.25.6*).

4.19.10 Five further sub-samples from monolith 70228, also in Bay B, placed through deposits within a pit (***70129***) containing a *polissoir* (*Sections 3.3.12* and *4.5.3*; Figs 5 and 9), were assessed for pollen and three proved productive. All three samples yielded similar pollen assemblages, with tree pollen being dominant (especially alder, but hazel, oak, birch and elm were also present). Of interest is the presence of grasses (Cereal-type and/or *Glyceria*-type) and herbs associated with clearance, for example, *Plantago lanceolata*.

4.19.11 Types of fungal spores associated with woodland have been found in pollen samples from Bay B. Of particular importance is the identification of *K deusta*, which is present, for example, in the *Earlier Neolithic organic deposit*, where it occurs in samples 70222 and 70219. Microcharcoal has also been found in some samples, for example, 70227.

4.19.12 **Bays X/W and D**: Bay X/W underlay Bay D; monolith samples 71167 and 71169 in Bay X/W respectively continued as samples 70246 and 70240 in Bay D (Figs 5 and 20). Four pollen sub-samples were assessed from the Bay X/W monoliths and all proved productive for pollen. They yielded tree pollen assemblages dominated by hazel and elm, with some oak and alder, suggesting a possible Late Mesolithic age. Radiocarbon dating (*Section 4.25*) of the basal organic deposit (*Mesolithic organic deposit*) in sample 71169 confirms this interpretation.

4.19.13 Pollen assessment of 22 sub-samples from five monoliths (70230, 70240, 70246, 70258 and 70296) from Bay D (Figs 5 and 20) yielded 18 sub-samples productive for pollen. The samples at the bay margins, 70230 and 70258, indicate forest assemblages dominated by hazel and alder, potentially relatively younger assemblages than seen in monoliths from the middle of the bay. Evidence for the Mesolithic/Neolithic transition in the middle of the bay may be present in sample 70246, which contains changes in tree pollen composition, possibly indicative of the Elm Decline. Relatively frequent elm is present in the lower sub-samples but it has been replaced by dominantly alder and hazel pollen at the top of the section. This pattern is repeated in sample 70240, suggesting a probable Mesolithic pollen assemblage at the base of the sample and a Neolithic age at the top of this sample. Radiocarbon determinations (*Section 4.25*) from the upper and lower deposits in the sequence represented within sample 70240 (*Mesolithic organic deposit* and *Later Neolithic alluvium*) are consistent with this interpretation.

4.19.14 A wooden trident (74598/74599; *Sections 3.3.9* and *4.13.4*), found in this area, continued into the northern baulk of Bay D. Four productive pollen sub-samples were retrieved from monolith sample 70296, which was placed through the deposits in direct association with the trident. The two lower sub-samples, from the *Earlier Neolithic organic deposit*, reveal woodland assemblages, characterised by common elm pollen. The two upper sub-samples, from the *Later Neolithic organic deposit*, yielded rich mixed woodland assemblages, comprising, dominantly, alder and hazel with a little oak. This may suggest that the lower samples (beneath the position of the trident) are pre-Elm Decline in age and those above it are post-Elm Decline. Sapwood from the trident and a sediment sample (from the upper part of the *Earlier Neolithic organic deposit*), from as close to the position of the trident as can be determined, were both radiocarbon-dated to the Neolithic period (*Section 4.25*), which agrees with the post-Elm Decline interpretation.

4.19.15 The fungal spore *K deusta* is present in sub-samples from Bay D, for example, the *Mesolithic/Neolithic alluvium* and the *Earlier Neolithic organic deposit*, within sample 70230. Microcharcoal has also been found in the same sub-samples.

4.19.16 **Bays X/Y and F**: Bay X/Y underlay Bay F; monolith samples 71173, 71175 and 71176 in Bay X/Y respectively continued as 70250, 70252 and 70253 in Bay F (Figs 5 and 21). In Bay X/Y, 14 pollen sub-samples were assessed from five monoliths and seven proved productive for pollen. The recovery was best in sample 71175, which shows a tree assemblage dominated by hazel/oak and elm in the *Mesolithic organic deposit*. The character of the assemblage suggests a Late Mesolithic age, which is consistent with a radiocarbon date (*Section 4.25*) from the *Mesolithic organic deposit*. The fungal spore *K deusta* is present in the *Mesolithic organic deposit*, within sample 71173; microcharcoal is recorded sporadically throughout the samples assessed.

4.19.17 In Bay F, 20 sub-samples were assessed for pollen from four monoliths (70250, 70252, 70254 and 70256; Figs 5 and 21), of which 17 proved productive. The general trend is for the samples from the middle of the bay, for example 70254, to yield potentially older woodland assemblages than seen at the margins of the Bay. The pollen profiles suggest that, potentially, the Mesolithic/Neolithic transition may be represented in 70254. The deepest pollen sub-sample (from the *Mesolithic/Neolithic alluvium*) records hazel, oak and elm pollen, and the topmost sample (*Later Neolithic organic deposit*) records abundant alder pollen. Radiocarbon dates from samples 70254 and 70256 support this interpretation (*Section 4.25*). Monolith samples from the channel margins indicate a possible later woodland succession. Of particular interest is the *overbank alluvium* in samples 70252 and 70256, which show alder woods with a strong herb community, perhaps indicative of forest clearance or the development of fen carr by the palaeochannel. A radiocarbon date from this sediment shows it accumulated in the Early Bronze Age (*Section 4.25*).

4.19.18 Evidence for the presence of *K deusta* in Bay F is found in the *Mesolithic/Neolithic alluvium* in samples 70254 and 70256. Although generally present in small numbers throughout, charcoal values are also higher in this deposit.

4.19.19 Two sub-samples were assessed from monolith sample 70180, from a cooking pit (***70155***; Fig 11) on the western bank of the palaeochannel, adjacent to Bay F. One, from deposit ***70157***, proved productive for pollen, indicating alder/hazel woodland with significant open spaces and evidence for cultivation. Significant counts for microcharcoal were obtained from both samples assessed, suggesting some burning was taking place locally.

4.19.20 **Burnt Mounds**: these features were located adjacent to the palaeochannel, on both its east and west banks. Thirteen sub-samples were assessed for pollen from four monoliths (70235, 70329, 70348 and 70462), each taken through pits associated with the burnt mounds (*Section 3.3.17*; Fig 5). Pollen recovery was variable, with five productive sub-samples, one sub-sample showing moderate recovery and the rest poor. The best recovery, from samples 70329 and 70235 (both from Burnt Mound 4; *Section 3.3.17*), indicates alder woodland with open grassy areas and possible evidence for cultivation. Microcharcoal is present in small amounts within most of the assessed sub-samples. A single radiocarbon date from sample 70462 (*Section 4.25*) indicates a Neolithic age but probably does not date the use of the feature.

4.19.21 **Overbank Alluvium**: a single monolith sample, 70022 (Fig 5), was assessed from deposits of *overbank alluvium*, extending east from the palaeochannel, at its southernmost extent within the site. Although some pollen was recovered, none of the sub-samples contained sufficient pollen to provide other than a sketchy indication of vegetation. The most productive sub-sample contained occasional pollen of grasses and sedges, and a small variety of herbs. The poor assemblage suggests an open environment rather than a wooded one, which agrees with the evidence from the upper part of the channel deposits, in Bay O at the north end of the site.

4.19.22 **Grid Square Area**: the area to the east of the palaeochannel was sampled within a series of grid squares. The deposits there comprised a variety of alluvial sediments. Twenty-seven pollen sub-samples from seven monoliths (90080, 90093, 90159, 90204, 90285, 90361 and 90364; Fig 13) yielded 12 productive samples. The assemblages are similar to each other and show a change from older alder/hazel-dominated woodland to an upper assemblage with common grasses and herbs, indicative of possible cultivated open areas.

4.19.23 ***Potential:*** the Stainton West pollen sequence presents a rare opportunity to enhance significantly the understanding of the environment and how this changed through prehistory, as a result of climate change and, possibly, human agency. It will provide the evidence for detailed palaeoenvironmental reconstructions of the nature and composition of Mesolithic and Neolithic landscapes. Such a study will be entirely consistent with the stated aims of the *Regional Research Agenda* (Brennand 2007) and is, therefore, of regional importance.

4.19.24 More than 60% of the sub-samples are suitable for full analysis, including examples from early and later parts of the palaeochannel sequence; a pit associated with a burnt mound; and a pit containing a *polissoir*, cut into the edge of the channel within Bay B (Table 15). The assessment has confirmed the presence of organic sediments productive for palynomorphs, ranging in age from at least the Late Mesolithic to Neolithic and Bronze Age, and potentially later. There is potential to identify factors such as a demise in woodland vegetation and an increase in grasses and herbs associated with clearance and/or changing climatic conditions. Indications for the Elm Decline are potentially present in several of the samples assessed, and, importantly, it may be possible to connect this directly to evidence for human activity.

	Bay O	**Bays V and B**	***Polissoir* pit *70129***	**Bays X/W and D**	**Bays X/Y and F**	**Burnt Mound 4**
Basal sands and gravels	P	P	-	-	P	-
Mesolithic organic deposit	-	G	-	G	G	-
Mesolithic/Neolithic alluvium	P	M	-	G	G	-
Earlier Neolithic organic deposit	G	G	-	G	G	-
Earlier Neolithic alluvium	G	G	-	G	G	-
Later Neolithic organic deposit	G	G	-	-	G	-
Later Neolithic alluvium	G	G	-	G		-
Overbank alluvium	G	G	-	G	G	-
Other deposits	-	-	G	-	-	G

G=good, M=moderate and P=poor

Table 15: Location of the sampled deposits with potential for pollen analysis

4.19.25 Targeted pollen analysis, including counts for microscopic charcoal, a range of herb taxa and non-pollen palynomorphs (fungal spores), and accompanied by specific radiocarbon dating of sediments will greatly contribute to the interpretation of Stainton West and the environment of the River Eden valley. High-resolution pollen analysis will enable the identification of any breaks in sedimentation or any potential hiatus present within the sequences analysed. Specific recommendations for a targeted sample for pollen analysis are given in *Section 7.22*.

4.20 Foraminifera and Ostracods

4.20.1 ***Quantification:*** in total, 42 sub-samples from monolith samples were assessed for microfossils (foraminifera and ostracods). Of these, 29 samples came from the palaeochannel, and a further 13 samples from the adjacent grid square area. Careful consideration was given to this selection to ensure that it included deposits at the same location as samples assessed for insects (*Section 4.15*), WPR (*Section 4.17*), pollen (*Section 4.19*) and diatoms (*Section 4.21*).

4.20.2 ***Methodology:*** each sample, having been weighed, was broken up by hand into small pieces, put into a ceramic bowl and thoroughly dried. A spoonful of sodium carbonate was added (to help removal of the clay fraction), boiling water was poured over it and the sample was left to soak for several hours or over-night. After soaking, it was washed through a 75µm sieve with hot water, the residue being decanted back into the bowl to be dried again in the oven. After final drying, the samples were stored in small labelled plastic bags and later examined for their microfaunal content under a binocular microscope.

4.20.3 ***Assessment:*** the results of the microfossil survey were extremely disappointing. However, some ecological conclusions can be drawn, the evidence pointing to an exclusively freshwater environment. It is true, only seven of the 42 sub-samples contained cladocerans (freshwater water-fleas) and/or freshwater ostracods, but these relate to both the Mesolithic and Early Neolithic phases of the palaeochannel (*Section 3.3*; *Mesolithic organic deposit, Mesolithic/Neolithic alluvium, Earlier Neolithic organic deposit* and *Earlier Neolithic alluvium*).

4.20.4 There is clearly something about the environment of deposition (or through subsequent diagenesis) that has prejudiced the preservation of calcium carbonate. No calcareous ostracods, foraminifera, molluscs, or even earthworm granules were found. Even the few definite ostracods that did occur (belonging to one species, *Cypris ophtalmica*) were represented only by their organic templates. This is probably due in part to the organic-rich (and hence reducing) nature of much of the deposits, but it could also be due to the geology underlying the site (*Section 1.3.3*).

4.20.5 The ostracod *Cypris ophtalmica* adds a little to understanding the ecology and the palaeochannel regime at the time. It is extremely tolerant of a wide range of environmental factors (Meisch 2000). It lives in permanent and temporary, stagnant and flowing waters, both in small and large streams, and it seems particularly tolerant of waters containing much leaf and decaying plant litter. It also occurs in great numbers in waters enriched in iron and in acid water (pH <5).

4.20.6 Tidal rivers have distinctive and well-known foraminiferal and ostracod faunas (Meisch 2000). Allowing for a possible loss of ostracods due to decalcification (leaching and/or diagenesis), then agglutinating foraminifera, which make their shell from mineral grains which they cement to an organic template, would surely be present if the water had been brackish or salt-marsh occurred at any stage of the sedimentary sequence. In spite of a diligent search in every sample for these foraminiferal 'linings', a time-consuming and difficult task in often organic-rich samples, none was found. Foraminifera never inhabit freshwater, thus albeit on negative evidence, this again points to an exclusively non-marine environment throughout the life of the palaeochannel.

4.20.7 Whereas the sediments of both the earlier and later phases of the palaeochannel were represented by clean pinky-buff silty-sands or sands, which appear to indicate derivation from the local Triassic bedrock, the deposits found in the grid square excavations were rather different. There is much more iron mineral (probably limonite), as well as concretionary and tube-like masses formed around plant stems and rootlets (their impressions can easily be seen under the microscope). These are what Candy (Ashton *et al* 2005, 16) calls, respectively, rhizoconcretions and rhizoliths, and they reflect (when associated with a freshwater environment)…'the drying out of the environment and the formation of fully terrestrial conditions either as a result of the initiation of a drier climate…or because of sediment infilling/lateral migrations of the channel system. Rhizoliths, along with other calcrete types, are typically used to indicate the existence of a dry climate, either a semi-arid climate or a humid climate with pronounced dry months'...'As rhizoliths may form over relatively short periods of time *ie* the lifetime of the root, these features may not represent a long-lived period of land surface stability and soil development but could reflect a relatively short-lived land surface' (*ibid*). They also seem to be associated with weathering or near-surface groundwaters, formed prior to the onset of fully terrestrial conditions, or pedogenic activity.

4.20.8 ***Potential:*** in one respect, the results of the assessment of microfossils within the Stainton West samples were disappointing, and there is no potential for any further analysis. However, the assessment does help with the overall interpretation of the site, and is, as such, still of value. Freshwater cladocera and poorly preserved ostracods, albeit in only seven samples from the palaeochannel, indicate that a freshwater environment was prevalent. Tidal river ostracods and foraminifera are very well known, but none occurred. In particular, in spite of a diligent search, no agglutinating foraminifera were found which, because of their organic template, should have been preserved if the regime was brackish or salt-marsh, even in the most reducing of environments. The material from the grid square area is different from that from the palaeochannel, and suggests drying out and early pedogenesis.

4.21 Diatoms

4.21.1 ***Quantification:*** in total, 42 sub-samples from monolith samples were assessed for diatoms. Of these, 29 samples came from the palaeochannel, and a further 13 samples from the adjacent grid square area. Careful consideration was given to this selection to ensure that it included deposits at the same location as samples assessed for insects (*Section 4.15*), WPR (*Section 4.17*), pollen (*Section 4.19*) and foraminifera/ostracods (*Section 4.20*).

4.21.2 ***Methodology:*** the main objective was to confirm the presence of sediments relating to palaeochannels and to assess the nature of these water bodies. The samples were prepared using standard procedures. Approximately 1g of material was placed in a beaker with 50ml of hydrogen peroxide and heated for two hours to oxidise organic matter. The samples were then filled with deionised water and allowed to settle for 24 hours before replacing the water. This was repeated three times, effectively to dilute the residual hydrogen peroxide. Following the final wash, the samples were dispersed in 200ml of water, and the concentration of sediment in each beaker was assessed. In three cases, a 2x dilution was made to reduce the concentration. An aliquot of 0.2ml of the suspension was taken and pipetted onto a coverslip, which was dispersed in 0.2ml of deionised water. The coverslips were dried and permanent slides were made using Naphrax high-resolution diatom mountant. All the slides were scanned for diatoms, remains of which were found in 13 samples. Diatom concentrations were very low and enumeration was made of those occurring in three traverses of each coverslip, rather than setting a minimum count size. This method revealed 1-125 diatoms for each sample. Identifications were made from standard texts, mainly drawn from Krammer and Lange-Bertalot (1986-91) In addition to diatoms, the remains of Chrysophyte cysts, sponge spicules and phytoliths were also recorded. A separate aliquot of the sediment was dried to establish the water content and, from this, the dry weight equivalent of sediment used in the diatom analysis.

4.21.3 ***Assessment:*** diatoms are single-celled algae with shell made from silica. The presence of diatoms in archaeological contexts is a strong indication of open water in the form of a stream channel, pond, estuary or marsh. Furthermore, the type of diatom found can be used to suggest the nature of the habitat, for example, whether it was subject to tidal inundation or freshwater. Of the 42 samples analysed, 13 (from seven different monolith samples) contained diatoms. Those samples containing diatoms were mainly from the northern part of the site and from the later stratigraphic units (*Section 3.3*), such as the *overbank alluvium* or the more recent deposits sealing it. Diatoms did, however, survive within the *Mesolithic/Neolithiic alluvium* and *Earlier Neolithic alluvium* in Bay O.

4.21.4 The diatoms present were mainly identified by fragments of valves. For the most part, these are from species such as *Cymbella cistula*, and also large *Pinnularia maior*, although precise identification is impossible from the fragments. Nevertheless, some 34 taxa were identified. The absolute numbers of diatom and chrysophyte cysts were calculated per gramme of dry sediment. Although the extrapolated numbers are large, reaching nearly 12 million per gramme of dry sediment, the concentration relative to silicate minerals was very low in most samples. The slides which did have diatom remains were examined in detail, and it was found that seven samples had remains of spines from freshwater sponges. All the slides in which the microfossils were found also had a large number of plant phytoliths. These are siliceous remains that have taken on the form of plant cells. They are especially common in grasses and sedges, where they offer structural rigidity, and the majority of the phytoliths present are from these groups.

4.21.5 The most obvious feature of the Stainton West samples is the absence and poor preservation of diatoms. Several reasons for this are possible. Firstly, the absence of diatoms could indeed be evidence that the samples were from essentially terrestrial contexts with little standing water. Secondly, the diatoms are present, but have been diluted by the large amount of siliceous minerals. Thirdly, the diatoms were once present, but have been dissolved and broken, leaving only traces of the former communities. All three of these factors have probably been at work here. The fragmentary state of some of the valves counted does imply dissolution and breakage. This is common in open-pored sediments, where concentrations of dissolved silica are kept low by water movement and therefore equilibrium is rarely reached. High alkalinities would add to this problem of preservation. In river sediments, a further issue is breakage caused by particle movement. It is impossible to identify categorically the reason for absence, although, conversely, the presence of diatoms in some samples does convey information.

4.21.6 Most of the taxa present are freshwater species, typical of vegetated channels and growing attached to plants or on rock surfaces. This would be consistent with the number of phytoliths. Some sites also have diatom species more typical of turbid environments with silty water or possibly muddy substrates. There are also a few species typical of relatively dry habitats, damp soils or ephemeral water bodies; these are labelled as aerophilous. The *Cyclotella* species found are largely shallow-water planktonic species, typical of relatively low-nutrient waters, but with water depths sufficient to support a plankton (>1m), although note the numbers found are very low. There is little evidence of salinity, except possibly the *Nitzschia* spp present. These could suggest some salt-water incursion or could have been transported by birds. There were no truly marine taxa found, implying no strong tidal connection, although the absence of diatoms in some samples could have been promoted by saline/alkaline waters. The chrysophytes are common in low-nutrient environments but can have broader distributions, so little can be deduced from these without further identification. The sponge spicules would also be typical in freshwater environments.

4.21.7 ***Potential:*** in one respect, the results of the assessment of microfossils of the Stainton West samples were disappointing, and there is no potential for any further analysis. However, 12 samples, of the 13 containing diatoms, had sufficient remains to make some inference regarding the past environment. These indicate, by virtue of their habitat preferences, shallow and well-vegetated channels. Some species may have been carried from higher up the catchment (for instance, some of the *Pinnularia* and *Eunotia* spp can have affinities with peat-rich soils), others (*eg Nitzschia frustulum*) may have been brought from the estuary. There is no strong evidence of salinity from the diatoms in these samples, indicating the sites containing diatoms were above the tidal limit. The water was of good quality, with few species typical of organic pollution.

4.22 Geoarchaeology

4.22.1 ***Introduction:*** the geoarchaeological assessment was undertaken, utilising the methodology summarised in *Section 2.5,* to develop a model of floodplain sedimentation and palaeohydrology, and to help establish how these processes may have directed human activity at the site and affected the archaeological record. The following describes the terrace sequence within the Stainton meander of the River Eden and proposes a deposit model for the site.

4.22.2 ***Assessment:*** five river terraces, ranging between 9m and 25m above OD, were identified within the Stainton meander. These terraces were uplifted, through isostatic rebound (Lloyd 2010), elevating former prehistoric floodplains above the level of the current River Eden. Using a combination of LiDAR and IFSAR digital elevation models, the extents of the river terraces and former channels have been mapped (Fig 4). Interrogation of the LiDAR data has also allowed the production of a height-range profile for the preserved fragments of river terrace. A chronological framework for the terrace sequence has been proposed (Table 16).

Terrace Sequence	**Probable date**	**Hydrology and sedimentation**
Terrace 1	Pleistocene	Sands.
Terrace 2	Late Glacial/Early Holocene	Unknown at present. Potentially similar sequences to Terrace 3.
Terrace 3	Mid-Holocene (Late Mesolithic to Bronze Age)	Laterally migrating channel sequences. Three channels; two containing peat deposits.
Terrace 4	Mid- to late Holocene (Bronze Age to Roman)	Meandering planform sequence, with at least three identifiable channels.
Terrace 5	Modern floodplain	Present-day River Eden.

Table 16: Chronological framework for terrace sequence in the Stainton meander

4.22.3 **Terrace 1:** at 13-20m above the current river, this is composed of coarse sands and gravels, and probably represents the earliest deglacial terrace lain down under glacial conditions, receiving outwash from glaciers in the Eden Valley. This terrace was probably associated with the initial incision of the Eden Valley through the glacial terrain of the Carlisle lowlands.

4.22.4 **Terrace 2:** this is an extensive topographical feature, located 6m above the current river, and, although undated at present, it is likely to be late glacial to early Holocene in age, given the early Holocene archaeology identified on Terrace 3.

4.22.5 **Terrace 3:** this terrace was the focus for the archaeological investigations and is constrained to the mid-Holocene on the basis of the archaeology. The terrace is located between 8m and 10m OD, consistent with a period of raised sea-level between *c* 6000 BC and *c* 2500 BC. The flat terrace surface is dissected by palaeochannels that display a multiple channel, but sinuous planform. Trench evaluation (*Section 2.2.9*) revealed organic-rich palaeochannels, and these were prime targets for securing a chronology for the fluvial development associated with Terrace 3. The archaeological evidence suggests a marked diminishing of activity on Terrace 3 after the Bronze Age.

4.22.6 **Terrace 4:** this is the most extensive Holocene surface, broadly located at 4m above the current river, and probably spans the late Iron Age and Roman periods. The geomorphology shows that the river, during this period, occupied multiple positions across the terrace, with the channels displaying a dominant meandering planform. The channel evolution on Terrace 4 was one of scrollbar, levees and chute channel meander migration (Nanson and Croke 1992), which differs from the more stable meandering channel form associated with Terrace 3. Typically, this type of planform change to greater lateral erosion and scroll-bar progression reflects a combination of increased sediment supply and reduced riverbank vegetation cover, probably from tree removal. This can cause positive feedback remobilising further sediments during lateral channel migration.

4.22.7 Eight cores were retrieved across Terrace 4, targeting the larger palaeomeander and the two further lateral scroll channels that traverse the terrace (Fig 4). The core profiles across this lateral accreting sequence typically comprised surface flood-laminate sands and silt, probably lain down in either backchannels or as overbank alluvium. Substantial pieces of charcoal were recorded throughout the cores, and their preservation suggests limited reworking through the river system, and perhaps a local floodplain origin for the burning.

4.22.8 **Terrace 5:** this is the modern floodplain next to the current River Eden, which post-dates the construction of the river embankment.

4.22.9 **Site Deposit Model:** the sedimentary sequence is discussed in terms of interpretative sediment groups that outline the main sedimentary environments present on the site. The model attempts to simplify a very complex floodplain system, and therefore many of the more localised deposits could not be represented within the model; these have instead been incorporated within the general sedimentary units. As noted in the stratigraphic assessment methodology (*Section 2.4*), the lithological units broadly agree with the stratigraphic units, Table 17 providing a concordance between the two sets (Fig 6).

Lithological Unit	**Stratigraphic Unit**
Sandy gravels	*Basal sands and gravels*
Basal sands	
Mesolithic organic deposit	*Mesolithic organic deposit*
Mesolithic/Neolithic alluvium	*Mesolithic/Neolithic alluvium*
Earlier Neolithic organic deposit	*Earlier Neolithic organic deposit*
	Earlier Neolithic alluvium
Later Neolithic organic deposit	*Later Neolithic organic deposit*
Later Neolithic alluvium	*Later Neolithic alluvium*
Overbank alluvium	*Overbank alluvium*
Stabilised land surface	*Stabilised land surface*
Backwater channel	*Backwater channel*
Colluvium	*Colluvium*
Topsoil	N/A

Table 17: Concordance of stratigraphical and lithological units

4.22.10 **Sandy Gravels:** this unit was encountered at the base of the excavations during the trench evaluation, borehole survey, excavation of the channels and at the edge of the site. The gravels represent material deposited through glacial outwash streams and rivers swollen by spring and summer melting. These rivers formed the deeply incised valleys of the area when most of the water was trapped in glacial ice and sea-level was much lower than the present day. During the winter months, the ground would have been frozen as permafrost and the valley edges would have been subject to solifluction processes. These deposits represent high-energy deposition that accumulated in a cold peri-glacial environment relating to the development of braided river systems that date from the late Pleistocene (*c* 20-10,000 BC). These deposits are typically found in lowland river valleys and consist of gravel bars that reflect shifting channel activity.

4.22.11 The surface of the sandy gravel deposits essentially defines the topography of the early Holocene landscape. With the notable exception of a few cave sites (Hodgson and Brennand 2006), the area is not known for its Palaeolithic industries. This could be in part due to the lack of gravel extraction or to the limited archaeological studies in the area. Had any finds been recovered from this period, they would be exceptionally rare and of regional importance.

4.22.12 **Basal Sands:** the basal sands were identified overlying the gravel and potentially represented an infilled palaeochannel. This channel extended across the entire length of Terrace 3, and covers just under 80m. These deposits are sand-dominated, but contained finer inter-bedded silt laminations near to their surface. The laminated nature of the deposit indicates variations in flow, perhaps representing seasonal or tidal fluctuations.

4.22.13 The sands represent a high-energy fluvial environment characteristic of the late glacial to early Holocene. The deposits accumulated at 7-9m OD, potentially within the range of the maximum marine transgression. Any artefacts identified within the deposits will have undergone a high level of reworking or modification. The surface of the basal sand (and gravel) deposits across the site defines the underlying palaeotopography, which would have been a significant influence on sedimentation patterns during the mid-Holocene.

4.22.14 **Mesolithic Organic Deposit:** the lowest part of this unit comprised finely inter-bedded sands and organic silts, indicating fluctuating flow regimes. There was a gradual transition into organic silts that represent a transition to a low-energy environment and drying out of the channel. The deposit became increasingly more organic in nature, eventually becoming wood-dominated near to the top of the unit. Occasional light yellowish sandy lenses were identified at the edge of the channel within the organic silt that may indicate possible erosion of the riverbanks, or a stabilised land surface.

4.22.15 These deposits would have accumulated within a shallow water environment, with slow-flowing or stagnant water conditions, that later allowed vegetation to encroach into areas of the channel. The accumulation of the main wood context within the unit may reflect a channel choked with vegetation and fallen trees (perhaps consistent with the evidence for beaver activity (*Sections 4.13.1* and *3.3.6*). The sharp undulating upper contact of this unit may also indicate erosions of the upper organic surface by the flow that deposited the overlying silty clay alluvium. The water-worn condition of much of the wood within the channel may also indicate some erosion and modification of its surface. Any artefacts or worked wood identified within the unit are likely to have undergone some minor modification, with only the large pieces of wood being found *in situ*.

4.22.16 **Mesolithic/Neolithic Alluvium:** this alluvial unit comprised both bluish-grey homogeneous silty-clay and pink sandy-clay, with a sharp erosional contact at its base that appeared to have accumulated after a fluvial event had truncated parts of the Mesolithic organic deposit. There was a gradual transition into more organic deposits near its upper surface.

4.22.17 These deposits represent a phase of increasing flow conditions and water-levels within the main channel. Although draining what was probably a predominantly forested landscape (*Section 4.19*), the minerogenic nature of the deposit would suggest that the channel was relatively free from vegetation. Any artefacts identified within these silty clay deposits are likely to have undergone a moderate degree of lateral transportation and possible size sorting. Any human activity associated with the channel at this time is likely to be found towards the channel edges or islands. The channel may have been deep enough to provide access into and river transportation through a densely forested landscape.

4.22.18 **Earlier Neolithic Organic Deposit:** this unit comprised a black organic-rich silty-clay, developing into a tightly packed unit of branches of differing sizes and small tree trunks. The nature of the deposits indicates the drying out of the channel during the Earlier Neolithic period. Sedimentation appears to have been significantly reduced within the channel and a natural wetland vegetation succession to alder carr seems to have been initiated. Localised silty clay deposits are recorded around the edges of the main deposits, possibly indicative of smaller drainage streams meandering across a larger channel clogged with vegetation. Any artefacts or worked wood identified within this low-energy environment are likely to have undergone only very minor modification and were probably *in situ*. Most of the wood appeared to be exceptionally well preserved (*Section 4.13.2*), especially the wooden artefacts, suggesting gently flowing or stagnant conditions.

4.22.19 There was a clear sedimentary contact between the Earlier Neolithic organic deposit and the overlying Later Neolithic organic deposit. This boundary was more distinct where it was divided by sandy-silt deposits (*Earlier Neolithic alluvium*, *Section 3.3.12*). These deposits appear to represent fluvial erosional material from the channel edges, which was not removed by later fluvial activity. This erosional activity, and the distinct difference in sedimentation between the two upper organic units, may suggest a period of stability and a significant slow-down or cessation of sedimentation in the channel during this period.

4.22.20 **Later Neolithic Organic Deposit:** this unit comprised organic silty-clay with frequent wood inclusions. The formation of these deposits indicates increasing groundwater levels within the channel and may also reflect changing vegetation conditions within the channel and surrounding floodplain. The nature of the deposit suggests a similar low-energy environment to that of the Earlier Neolithic organic deposit. Any artefacts are likely to be extremely well preserved and will be predominantly *in situ* and of considerable archaeological value.

4.22.21 **Later Neolithic Alluvium:** this alluvium marks a shift away from the deposition of organic sediments to minerogenic silty clays, representing a second phase of increasing flow conditions and deepening water-levels within the channel. This deposit consisted of soft light-grey/greyish-brown silty clays, with occasional organic lenses near to the base. Any artefacts recovered from these deposits are likely to have undergone a moderate degree of reworking and modification.

4.22.22 **Stabilised Land Surface:** this comprised a mid-brownish-grey silty/sandy-clay overlying the basal sands. Soil formation processes seem to have started to develop on this surface during the early to mid-Holocene. The upper surface of the deposit exhibited signs of stabilisation and weathering. The lithic scatter appears to have originated on this surface, subsequently sorting up and down the profile through processes of bioturbation and water displacement.

4.22.23 **Overbank Alluvium:** this deposit comprised a homogeneous soft light yellowish-grey silty-clay, accumulated over the southern extent of the stabilised land surface. The deposit represents low-energy overbank alluviation, and appears to have occurred between the Early Bronze Age and Iron Age.

4.22.24 **Backwater Channel:** a shallow linear undulation in the top of the basal sands was identified at the eastern edge of the terrace, filled with a slightly organic silt/sandy clay alluvium. This defined the extent of the stabilised land surface and was probably active during the Late Mesolithic/Earlier Neolithic period. This shallow undulation probably formed part of the drainage system of the terraces. Its organic nature would suggest that it was a low-energy environment, with vegetation growing within the channel, and perhaps only being seasonally active. Any artefacts identified within the backwater channel deposits are likely to have undergone minor to moderate modification.

4.22.25 **Colluvium:** the colluvium comprised dark blackish-brown sandy-silt that had accumulated at the base of Terrace 2. A number of colluvial episodes could be identified within the deposits, some associated with the lower sequence of inter-bedded organic alluvial silts in the backwater channel. The inter-digitation of these deposits may suggest that some of the colluviation occurred in antiquity. Any finds recovered from the colluvium are unlikely to be *in situ* and most probably have been eroded from upper terraces. Several worked lithic points of probable Early Mesolithic date (*Section 3.3.3*) were recovered from the colluvium and may have originally derived from the edge of Terrace 2.

4.22.26 **Topsoil:** the topsoil consists of a well-drained floodplain soil, possibly including a thin former ploughsoil. Part of the soil appears to have been colluvially derived from the edge of the adjoining upper terrace.

4.22.27 ***Potential:*** the geoarchaeological assessment has highlighted the importance of models of floodplain sedimentation and palaeohydrology to the understanding of the context of the archaeological remains at Stainton West. This assessment will continue to form the basis of the models used throughout the analysis phase, although there is potential for more work to refine these further. The detailed examination of key monolith samples (*Section 4.23*) from the palaeochannels and stabilised land surface will, hopefully, aid further interpretation of the sequence of sedimentary and hydrological change on the site; in particular, it should elucidate periods of stability and erosion that may have been associated with periods of archaeology activity.

4.22.28 The possible erosion deposits identified within the Mesolithic organic deposit may relate to localised clearance of the river-bank or surrounding area. Further analysis of the thin sand lenses identified within the lower sequence may help to correlate this with changes identified within the WPR (*Section 4.17*) and pollen (*Section 4.19*). A more detailed examination of the sedimentary contacts within the sequence may help to elucidate gaps within the sedimentation record, that may reflect changes in the archaeological record. The possible break in sedimentation in the channel sequence between the accumulation of the Earlier Neolithic organic deposit and the Later Neolithic organic deposit would benefit from more detailed study.

4.22.29 In order to test and confirm the current model of the terrace and channel sequence, it would be beneficial for a series of radiocarbon dates to be obtained from Terrace 4. Dates should be obtained from the top and bottom of the basal organic deposits identified at the base of the Bronze Age/Iron Age channel to confirm its date, which should clarify whether this channel was active at the time of the main activity on site. Dates from the sand-dominated charcoal-rich channel fills of Terrace 4 will also help to confirm the river terrace sequence. This should help to indicate when widespread woodland clearance occurred, which will help with the scheme-wide environmental discussion of the impact of later prehistoric and Roman activity on landscape and vegetation change.

4.22.30 The three-dimensional model of the site has the potential to provide a useful template on which further representations of the site could be based. The model should be updated following the results of the analysis and could be used to help create computer and artistic interpretations of the site during key periods of activity.

4.23 SOIL MICROMORPHOLOGY

4.23.1 ***Quantification:*** 32 monolith samples were assessed for soil micromorphology from Stainton West. The samples were taken from a range of different locations across the site (Figs 5 and 14), with 14 of them coming from the grid square area, and 18 from the palaeochannel and features adjacent to it, including four from burnt mounds. Due consideration was also given to the samples assessed to ensure that they included deposits at the same location as samples assessed for insects (*Section 4.15*), WPR (*Section 4.17*), pollen (*Section 4.19*), foraminifera/ostracods (*Section 4.20*) and diatoms (*Section 4.21*), and also where there was good association with cultural material.

4.23.2 ***Methodology:*** the samples were briefly characterised, with the thickness of contexts measured. Potential locations of sub-samples for soil micromorphology and bulk analyses were also noted (Goldberg and Macphail 2006). This identified which samples are suitable for further analysis, in terms of the methods to be used and the scale and the scope of the work, or, alternatively, which other of the samples would probably be suitable, should, in the course of analysis, they instead become preferable for study.

4.23.3 ***Assessment:*** the sediments examined within the monolith samples varied from coarse sands to silty clay loams and minerogenic to organic/peaty sediments. Only one of the 32 monoliths assessed showed no potential for soil micromorphology analysis. The 14 monoliths assessed from the grid square area (*Section 3.3.20*; Fig 13) sampled both layers and feature fills, and detected various soil and sediment boundaries, formation events and *in situ* vegetation effects/environments, including fine sediments carrying charcoal possibly resulting from activity associated with occupation. Significantly, the boundaries between anthropogenic features and land surfaces and alluvial deposits above and below them were visible. The sediments sampled ranged from dark humic silts, through clay silts to medium and coarse sands and fine gravel. These were variously characterised by mixing, mottling, gleying, leaching, panning and rooting, giving some indication of the wide range of processes in operation.

4.23.4 The four monolith samples assessed, from deposits forming the burnt mounds and pits associated with them (*Section 3.3.17*; Fig 5), detected the boundary between upper flood clays and the basal substrate/mound deposition, as well as the burnt materials within the pits. Unsurprisingly, the sampled deposits contained a great deal of evidence for burning in the area, including rubefied stones, calcined stones, burnt stones and sands, fire-cracked rock and charcoal flecks. The sampled alluvium included gleyed clay and sands, which were variously leached or red-tinged. Other processes evidenced, in addition to the burning, included mixing, mottling, gleying, leaching, panning and rooting.

4.23.5 Of those monoliths samples taken from the palaeochannel (*Section 3.3.1*; Fig 5), 14 were examined during the assessment. These included one which sampled a *polissoir* pit (***70129***; *Section 3.3.12*; Fig 9) and one placed through the sediments that accumulated both before and after a wooden trident (74598/74599) had been deposited (*Sections 3.3.9* and *4.13.4*). The channel deposits sampled varied widely in character, and charcoal fragments within them provided evidence for human activity, in addition to the deposition of the trident. The deposits ranged from humic soils and wood peats, containing fragments of wood; through silts, silty clays and clay silts; to fine, medium and coarse sands. They were of heterogeneous character over the channel, being indicative of the different conditions that prevailed and changed over time, and the complex processes at work. The visible effects these processes had on the sediments included lamination, mixing, mottling, gleying, leaching, staining and rooting.

4.23.6 ***Potential:*** soil micromorphological examination of the samples has excellent potential to provide information about many processes which affected the deposits encountered on site. The palaeochannel, the burnt mounds and the grid square area are all suitable for study. Studies might include the nature of the palaeosols and possible surfaces identified; the effects of erosion (human or naturally induced) on deposits; the conditions associated with inundation and associated sedimentation; the influence of anthropogenic activities, including background disturbance and burning; soil-sediment disturbance associated with artefacts such as the tridents; and possible disturbance associated with stock animal management, and natural animal activity.

4.23.7 **Palaeochannel Deposits:** the *polissoir* pit and the *Early Neolithic organic deposit* appear to hold the most potential of the samples in the palaeochannel sequence. The *polissoir* pit has all the characteristics of an infilled tree throw and associated soil formation, as judged from the monolith and section drawing. Previous studies of tree-throw hollows have been very rewarding (Barclay *et al* 2003; Goldberg and Macphail 2006; Macphail 1990; Macphail and Goldberg 1990), and, moreover, this monolith seems to show the presence of well-preserved Mor humus and charcoal, indicating development, possibly within an extant woodland. The monoliths (70296 and 70229) associated with the tridents show important sequences, including the mixing of deposits, which presumably is either of human or animal origin. Further monoliths will also be analysed to characterise fully the channel sequence, to provide information on the deposition processes.

4.23.8 **Burnt Mounds:** the analysis undertaken will allow these features to be both characterised and compared. Few such features have been studied from either inland or British coasts (Balaam *et al* 1987), although the CTRL and A13 projects in Kent and Essex have now increased the number of coastal burned rock midden sites (Macphail 2007; Macphail and Crowther 2007; 2009).

4.23.9 **Grid Square Area:** studies from this area should focus on the dryland/wetland interfaces and changing conditions, to see if there is evidence of a palaeosol, especially where traces of human activity were observed.

4.24 DENDROCHRONOLOGY

4.24.1 ***Quantification:*** of the 53 samples processed, 47 samples from oak timbers excavated from the palaeochannel were identified as suitable for dendrochronological assessment. Assessment of the timbers has demonstrated that 16 of these samples form a cluster dating from the fifth millennium BC. Four other clusters of between two and four timbers were identified, although these and a further 20 unmatched timbers are currently undated.

4.24.2 ***Methodology:*** following a site visit, each dendrochronological sample from Stainton West was initially examined at OA North's offices. The dendrochronological material was stored as complete cross-sections, wrapped in plastic. These sections were obtained from the optimum location for sapwood and bark survival from the timber. The material included some circular discs, but most of the sections were more or less sub-circular, depending on the amount of the trunk lost through exposure or poor waterlogging. The slices included some fairly asymmetric material. Each of these timbers was, where possible, 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 of oak (*Quercus* spp), 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. Each slice was sub-sampled to recover a single sample containing the maximum surviving radius of the parent tree.

4.24.3 A large quantity of the timbers was examined and rejected for analysis, as they contained too few rings, were too eroded, or contained unsuitable sequences for analysis. The original cross-section sizes of the complete samples had been recorded during the excavations and were not recorded again prior to sub-sampling. The selected samples comprised 53 oaks, which were brought to the laboratory for analysis. The samples 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 was revealed by this preparation method. Standard dendrochronological analysis methods (*eg* EH 1998) were applied to each suitable sample. After thawing, the complete sequences of growth rings in the samples containing resolvable sequences were measured to an accuracy of 0.01mm, using a microcomputer-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 (*eg* 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.

4.24.4 The *t*-values (held within the project archive) were derived from the original CROS algorithm (Baillie and Pilcher 1973), with a *t*-value of 3.5 or over being seen as 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).

4.24.5 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.

4.24.6 The tree-ring dates produced by this process initially only date the rings present in the timber. The interpretation of these dates relies 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* (*tpq*) for the death of the tree is indicated by the date of the last ring plus the addition of the minimum expected number of sapwood rings which are missing. This *tpq* may be many decades prior to the actual date these trees 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 10 and maximum of 55 annual rings, where these figures indicate the 95% confidence limits of the range (EH 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 salt-water egress. There is thus some caution necessary when applying standard sapwood estimates to this material. For the dated samples 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.

4.24.7 ***Assessment:*** the initially sub-sampled dendrochronological material comprised 53 oak (*Quercus* spp) samples. After their preparation, it was determined that 47 of these samples contained measurable sequences. 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 a non-measurable band. The 47 suitable samples were each measured successfully, yielding 49 separate tree-ring series.

4.24.8 Five groups of material were identified that cross-matched each other, randomly labelled Clusters 1-5 respectively. The largest of these (Cluster 2) matched with prehistoric tree-ring data from the North West and elsewhere in the British Isles (Table 18). This can be dated, on this basis, to 4466-4144 cal BC inclusive. These 16 samples include the longest-lived trees from the site, and were mostly not recorded as 'altered' (by anthropogenic or zoogenic agency). The next largest of the other clusters (Cluster 1), comprising four samples, included three recorded as 'altered', whilst the small numbers of matching samples in the other three clusters (containing two, two and three samples respectively) may represent either fragments of the same tree (*eg* Cluster 5) or pairs of contemporaneous trees (*eg* Clusters 3 and 4). The remaining 20 samples have produced tree-ring sequences that do not match the cluster groups, each other, or reference data, and are currently undated.

	***t*-value**
Stainton West, Cluster 2 (4466-4144 cal BC)	16
Oak reference data	
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 Morgan *pers comm*)	4.26
Belfast Long Chronology (Brown *et al* 1986)	5.91
Antrim, Garry Bog 3 (Baillie and Brown 1988)	5.61

(NB 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 18: Example t-values (Baillie and Pilcher 1973) between the composite sequence constructed from Cluster 2, and oak reference data

4.24.9 In an area like Stainton West, there were probably only certain conjunctions of conditions when oak trees could grow in locations where those trees might survive to the present by waterlogging. These events may be periodic, possibly environmentally driven, and this may be the reason for the apparent discontinuous clustering of the tree-ring data. It seems reasonable to make the assumption that the material is from an area of natural woodland that was in the River Eden floodplain, and thus subject to fluctuating watertables, and intermittent flooding events. Under this scenario, the anatomical features in the material could reflect the responses of the trees to this environment, and are not necessarily a reflection of anthropogenic interference. The dates for the sequences identify the period during which these trees occupied these areas, and the end of the sequences 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 material were probably caused by changes in drainage conditions creating increased stress on these trees. The frequency of such anomalies in the material is quite unlike the frequency seen for such features in timber derived from semi-natural or managed woodland.

4.24.10 The major result from the assessment is that about a third of the analysed assemblage (Cluster 2) is broadly coeval, and 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. The numbers of samples within this cluster drop steadily as the sequence progresses. Such a steady, rather than stepped, trend is more typical of natural assemblages than construction assemblages. It is not clear at this stage whether the end dates (4287 cal BC and 4144 cal BC) for the two trees (three samples) for which we have bark-edges are ‘felling dates’ in the traditional archaeological sense, or ‘dates of tree death’ relating to environmental events, for instance 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, some half a millennium before the currently available radiocarbon dates for the two tridents (*Section 4.25*). This at least implies the palaeochannel, in the lower part of the sequence, was accumulating organic remains for half a millennium, though possibly discontinuously. It remains possible that the four undated clusters represent quite different periods, and may include material of the same date as the tridents, and/or from before and/or after the dates of Cluster 2. Targeted radiocarbon wiggle-matching of key samples from these undated clusters may help to clarify their chronological relationships with each other, and with Cluster 2, and the tridents.

4.24.11 ***Potential:*** there is excellent potential for further analysis of the Stainton West material, and this should provide invaluable information which will help to refine the chronology and interpretation of the palaeochannel. The assessment has, however, produced a rather complex range of results, the interpretative value of which will take a little time to work through as other strands of post-excavation work proceed. This interpretative value can be enhanced, though, through a programme of radiocarbon dating and 'wiggle-matching' (*Sections 7.27.3* and *7.28.1*).

4.24.12 Nationally, there is a lack of contemporaneous site reference data with which to compare the Stainton West series, although there are discontinuous composite series from sites in the Belfast bogs, Lancashire mosses, East Anglian fens, Trent gravel pits, and Somerset levels (Table 18), and some material from west coast submerged forests. These series cover some or all of fifth-third millennia BC. If it is not excessively dominated by responses to the conditions on the site, the Stainton West material may provide a useful addition to these data series. It is to be hoped that the undated clusters may eventually provide additional chronological building blocks for some parts of this period. The Stainton West material, therefore, has the potential to be nationally important.

4.25 RADIOCARBON DATING

4.25.1 ***Quantification:*** in the course of the post-excavation assessment, several of the samples of organic remains retrieved during the fieldwork investigations were submitted to the Scottish Universities Environmental Research Centre (SUERC) laboratories for radiocarbon assay. This was not intended to provide a comprehensive chronology for the Stainton West site, but rather to enable the definition of a rudimentary chronological framework to help assess the significance of the archaeological remains and help determine their potential for further research, including the refinement of this chronology through a more comprehensive radiocarbon dating programme. To this end, 40 samples in total from Stainton West (Table 19) were subjected to initial radiocarbon assay.

Stratigraphic Unit	**Bay**	**Interpretation**	**Material**	**SUERC Code**	**Radiocarbon Age BP**	**Cal BC (95.4% Confidence)**	**δ^{13}C ‰**
Mesolithic organic deposit	V	Layer	Sediment	32826	6655±30	5640-5520	-22.2
	X/Y	Layer	Sediment	32705	6330±40	5470-5210	-28.9
	F	Layer	Sediment	32696	6150±40	5220-4990	-27.6
	D	Layer	Sediment	32693	6105±35	5210-4930	-28.4
	Y	Layer	Elm sapwood	32722	5970±35	4950-4720	-23.4
	X/W	Layer	Sediment	32694	5600±35	4500-4350	-27.6
Earlier Neolithic organic deposit	B	Layer	Sediment	32704	6340±40	5470-5210	-28.3
	G	Layer	Elm roundwood	32718	5070±40	3970-3770	-26.1
	C	Layer	Elm	32946	5000±35	3940-3660	-26.0
	F	Layer	Hazelnut	32632	4990±35	3940-3660	-25.0
	B	Layer	Trident	26379	4965±35	3905-3655	-28.0
	D	Layer	Trident	26660	4745±35	3635-3380	-27.5
	D	Layer	Sediment	32635	4585±35	3500-3100	-29.6
	F	Layer	Hazelnut	32634	4510±30	3360-3090	-30.7
	A	Layer	Hazelnut	32633	4440±35	3340-2920	-27.4
	B	Layer	Hazelnut	32692	4425±35	3330-2920	-28.4
	E	Layer	Residue on Grooved Ware pottery	32626	4145±35	2880-2610	-26.2
Polissoir pit ***70129***	B	Pit fill	Hazelnut	32628	4675±35	3630-3360	-26.4
Later Neolithic organic deposit	O	Layer	Sediment	32702	4380±35	3100-2910	-27.4
	F	Layer	Sediment	32695	4180±35	2890-2630	-29.1
Later Neolithic alluvium	D	Layer	Sediment	32636	4150±35	2880-2620	-25.5
	B	Layer	Sediment	32703	3915±35	2490-2290	-28.9
Overbank alluvium	F	Layer	Sediment	32697	3605±35	2120-1880	-29.0
	O	Layer	Sediment	32698	2725±35	970-800	-29.7
Burnt Mound 1	-	Pit fill	Sediment	32827	4925±30	3770-3640	-25.6
Burnt Mound 5	-	Pit fill	*Prunus* sp fragment	32717	4110±35	2870-2570	-25.4
Burnt Mound 2	-	Pit fill	Alder/hazel roundwood	32714	3720±35	2280-2020	-27.1

Stratigraphic Unit	**Bay**	**Interpretation**	**Material**	**SUERC Code**	**Radiocarbon Age BP**	**Cal BC (95.4% Confidence)**	**δ13 C ‰**
Burnt Mound 4		Pit fill	Alder/hazel fragment	32716	3430±35	1880-1630	-28.1
Burnt Mound 3	-	Pit fill	Alder/hazel roundwood	32715	3270±35	1630-1450	-26.8
Hearth ***100020***	-	Roundhouse	Alder/hazel roundwood	32712	3395±35	1870-1600	-27.5
Posthole ***100033***	-	Roundhouse	Charred grass seed	32713	3295±35	1680-1490	-26.4
Pit ***100026***	-	Pit fill	Residue on pottery vessel	32627	3075±35	1430-1260	-27.5
Pit ***90163***	-	Pit fill	Diffuse, porous wood	32706	6010±35	5000-4790	-25.6
Pit ***90262***	-	Pit fill	*Prunus* sp fragment	32637	5720±35	4690-4460	-27.6
Stabilised land surface	-	Layer	Diffuse, porous wood	32643	4940±35	3790-3650	-25.9
Tree throw ***90522***	-	Tree throw fill	Diffuse, porous wood	32708	4930±40	3790-3640	-26.8
Tree throw ***90508***	-	Tree throw fill	Alder/hazel fragment	32707	4840±40	3710-3520	-25.3
Hearth ***90434***	-	Layer	Oak fragments	32638	3120±30	1460-1310	-26.2
Hearth ***90217***	-	Layer	Alder/hazel roundwood	32644	2915±35	1260-1000	-26.3
Hearth ***90593***	-	Layer	Grass seed	32642	175±35	Modern	-25.8

NB – δ13C ‰ relative to Vienna Pee Dee Belemnite

Table 19: Results of initial programme of radiocarbon assay

4.25.2 ***Methodology:*** the calibrated results were produced using the Reimer *et al* (2004) curve and the computer programme Oxcal (v4.1; build 44; Bronk Ramsey 1995; 1998; 2001; 2009a; 2009b). Ranges have been obtained using the maximum intercept method (Stuiver and Reimer 1986) and are quoted in accordance with Stuiver and Polach (1977), but adapted for the increased precision available in later datasets (A Millard *pers comm*), rounded out by ten years when the error term is greater or equal to 25 years, and by five years when the error term is less than 25 years. When more than one result was produced on material from a single interpretative phase, the statistical consistency of results can be used to determine whether it is possible that they are of the same actual age (Ward and Wilson 1978).

4.25.3 ***Assessment:*** the results of the initial programme of radiocarbon assay (Table 19) are presented in the same order as the results of the stratigraphic assessment (*Section 3.3*). The samples have been variously dated to the Late Mesolithic, Neolithic and Bronze Age. Significantly, they have highlighted archaeological activity, throughout these periods, taking place both within and adjacent to a palaeochannel, which was accumulating sediment over this same timespan.

4.25.4 The principal aim of the radiocarbon programme of assessment was to establish, in broad terms and in tandem with the dendrochronology programme (*Section 4.24*), an absolute chronology for the activity at the Stainton West site. It was never the intention to derive a complete set of dates at this stage, but rather to obtain a range of dates, from both the palaeochannel and grid square area, in order to establish the duration of activity; help phase this; and date specific feature, deposit and artefact types. As the palaeochannel contains a prolonged sequence of well-stratified deposits and a wide variety of organic remains, it probably has the greatest chronometric potential. Structurally, the discussion follows the stratigraphy (*Section 3.3*), commencing with the radiocarbon results from the palaeochannel, referring to the various stratigraphic units (*Section 2.4*) in order of their sequence (earliest to latest), subsequently moving to the grid square area.

4.25.5 **Palaeochannel and Adjacent Features :** 24 measurements were made on material recovered from the palaeochannel (*Sections 3.3.1-19*), and eight further measurements were made on material sampled from burnt mounds, pits and a roundhouse adjacent to the channel. Six results from the *Mesolithic organic deposit* (although not from the lowest sediments forming this stratigraphic unit) produced exclusively Late Mesolithic dates (sixth- to fifth-millennium BC).

4.25.6 The 11 results from the *Earlier Neolithic organic deposit* sampled a variety of materials, including the sapwood of the two tridents (*Sections 3.3.9* and *4.13.4*), wood, hazelnuts, sediment and pottery residue. The vast majority of the results range widely within the fourth millennium BC, suggesting that the deposit formed during the Neolithic period. One sediment sample from Bay B has produced a result that dates to the sixth millennium BC, which seems at variance with the other chronometric data and the stratigraphic interpretation; further confirmation of the date of this deposit within Bay B is, therefore, required. The hazelnuts have produced results that are generally slightly later than the other materials, and the ranges extend slightly into the third millennium BC. A sample from a carbonised residue on a sherd of Grooved Ware pottery (*Section 4.9.2*), recorded as being from this deposit, produced a result dating firmly within the third millennium BC. The pottery was retrieved from close to the upper boundary between the *Earlier Neolithic organic deposit* and the *Later Neolithic organic deposit,* which were of very similar appearance and were not separated at the time of excavation. It is possible that the pottery has either wrongly been assigned to the earlier deposit or was in a shallow pit or scrape cut down from a higher level.

4.25.7 The two results from the tridents were not statistically consistent (T'=19.7; T'5%=3.8; n=1), with Bayesian modelling suggesting that the interval between the ages of these two artefacts was 60-390 years (95.4% probable). In an effort to establish if the younger trident was deposited in the palaeochannel 'fresh', a result was produced on the sediment surrounding the trident (SUERC-32635). These results are not statistically consistent

(T'=10.4; T'5%=3.8; n=1), however, since they measured material of different radiocarbon ages. The sediment sample had a high percentage of carbon (28.5% volume; 2.0g carbon in the sample submitted), and it is reasonable to expect that the sample accurately dates the sediment. If the sediment result is accurate, the older result on the trident might indicate that it was put into the deposit some time after it was made.

4.25.8 Additionally, a fourth millennium BC result was obtained from a hazelnut within a pit in Bay B that contained a *polissoir* (*Sections 3.3.12* and *4.5.3*). This pit cut the *Earlier Neolithic alluvium* and was sealed by the *Later Neolithic organic deposit* (*Section 4.25.9*). As such, the dated result seems rather early, perhaps implying that the hazelnut is residual.

4.25.9 Two results from samples of sediment within the *Later Neolithic organic deposit* produced late fourth to third millennium BC dates, which were slightly earlier than the third millennium dates from the stratigraphically later *Later Neolithic alluvium*. The results from two sediment samples from the latest stratigraphic unit – the *overbank alluvium* – variously date from the late third to early second millennium BC and the early tenth- to late ninth century BC, possibly suggesting that this unit accumulated over a prolonged period of time.

4.25.10 Five results were produced on CPR and sediment recovered from pits associated with the burnt mounds (*Section 3.3.17*). These results are of significantly different ages (T'=1778.7; T'5%=9.5; n=4). If the (very limited) radiocarbon sample from the pits accurately date the use of the features, it is probable that the features were not in use at the same time, but were used sequentially; further radiocarbon dates would help to establish this more robustly. The sediment sampled from Burnt Mound 1 probably contains residual carbon, as it is thought that the date produced is too early for the feature's use. As such, from the dates available, it is probable that Burnt Mound 5 was the earliest feature in use. Burnt Mounds 2 and then 4 were sequentially the next in use, and Burnt Mound 3 was the last in use.

4.25.11 Two results were produced on different features from the roundhouse (*Section 3.3.18*). These results are statistically inconsistent (T'=4.1, T'5%=3.8; n=1), the measurements being made on samples of significantly different ages. The older sample, from a central hearth, ***100020*** (Fig 11), was produced on alder/hazel roundwood. The younger sample, from posthole ***100033***, was produced on a large grass seed. Both results could, however, derive from the use of the roundhouse. Further radiocarbon results on material which samples structural deposits and deposits associated with use could refine this chronology.

4.25.12 **Grid Square Area:** the earliest radiocarbon date for activity in the grid square area (*Sections 3.3.20-6*) was from an irregular pit or tree throw (***90163***; Fig 13) sealed by the deposits that infilled the *backwater channel*. This produced a radiocarbon result dating to the Later Mesolithic period. A second Later Mesolithic date was produced from *Prunus* sp charcoal within pit ***90262***, which may estimate the formation of the deposits within the pit. Further radiocarbon samples would establish whether these results are *in situ* and could refine evidence for occupation.

4.25.13 Material (alder/hazel charcoal) from tree throw ***90508*** (Fig 12) and diffuse porous charcoal from tree throw ***90522*** (Fig 12) both produced results dating to the Earlier Neolithic period. As these features cut the infill of the *backwater channel*, the results may suggest that the channel had silted before or during the Earlier Neolithic period. A radiocarbon result produced on diffuse porous charcoal from the *stabilised land surface* may also date activity at this horizon in the Early Neolithic period.

4.25.14 A result (on *Quercus* sp fragments) from hearth ***90434*** (Fig 13) provides a *terminus post quem* for its use in the Middle Bronze Age. A second hearth (***90217***; Fig 13) produced a Late Bronze Age date, demonstrating that activity continued within the grid square area at this relatively late time. Material sampled from a third hearth (***90593***; Fig 13), associated with a lithic working hollow (Fig 13), produced a modern result; the dated material has thus been interpreted as being intrusive.

4.25.15 ***Potential*****:** there is evidently good potential for the use of chronometric data to enhance the interpretation of the Stainton West site, and features, deposits and artefacts have been dated more closely than would otherwise have been the case. The lack of other forms of material dating evidence means that radiocarbon assay is an important method for establishing robust chronologies. Further radiocarbon determinations, as appropriate, from suitable samples containing single entity, short-lived materials in good association with their parent deposits would add substantially to the refinement of these chronologies. There is potential for further modelling using Bayesian statistics, which should incorporate the results of dendrochronological analysis, including radiocarbon dating of ring sequences and 'wiggle-matching' (*Section 7.27.3*).

4.26 Conservation

4.26.1 Most of the assemblage is well preserved and in good condition. Consequently, no further conservation is required. However, the tridents and certain pieces of worked wood, representative of the technology and character of the worked-wood assemblage at large, have been conserved (*Section 4.13.7*). The stone axes (*Section 4.6*) have been core-sampled, for petrological purposes, and the sampled plugs glued back into the cored-voids. Subject to the museum requirements, these sample points may require further finishing prior to display. This is, however, considered to be beyond the remit of this project.

4.27 Storage

4.27.1 Once the post-excavation analysis is complete, the whole project archive, which will include records, plans, both black and white and colour photographs, artefacts, ecofacts and sieved residues, will be prepared following the guidelines set out in *Environmental standards for the permanent storage of excavated material from archaeological sites* (UKIC 1984, Conservation Guidelines 3) and *Guidelines for the preparation of excavation archive for long-term storage* (Walker 1990).

4.28 Packaging

4.28.1 The general finds assemblage is currently largely well packed, and, excluding the lithic materials and conserved wood, will require no specialist packaging. Box lists are prepared and will be updated from the database when the identification and analysis of objects is complete. The conserved wood will need to be carefully packaged for transit – this will be undertaken by York Archaeological Trust. It is envisaged that the material will go directly to Tullie House Museum and Art Gallery, which will receive it and prepare the wood for long-term storage, as best it sees fit. In the case of the lithic artefacts, a large amount of reordering and repackaging will form one of the initial phases of analysis (*Section 7.7.2-3*). This will, primarily, be aimed at making the material accessible for future study. Box lists will be prepared and included in numbered and marked boxes, index-linked to the project database. All lithics will be stored in marked bags within the boxes, similarly corresponding to the database.

5 STATEMENT OF POTENTIAL

5.1 INTRODUCTION

5.1.1 The assessment of Stainton West has clearly demonstrated the local, regional, national, indeed international, potential of the site, and the material will certainly sustain further analysis. Indeed, such is the importance of the site that it is vital that it is understood as fully as is possible and that its interpretation is placed in the public domain. The Stainton West site derives additional value from being excavated as part of the CNDR roadscheme, the other archaeological investigations along the new road (OA North 2011a) providing a deeper temporal and a wider landscape context for the discoveries. The prehistoric remains find no parallel in any other site within Cumbria examined during modern times, and the site is, therefore, unique in benefiting from contemporary scientific analytical methods. Exceptionally well-preserved finds, environmental and stratigraphic evidence were recovered of Mesolithic, Neolithic and Bronze Age date. Furthermore, the various phases of activity from this extensive and formative period of history were superimposed, permitting long-term trends, transformations and transitions to be studied as part of a single coherent sequence. As such, rather than merely contributing to the existing body of knowledge (Brennand 2007), Stainton West will, in many ways, set the regional agenda.

5.1.2 The archaeology of Stainton West is all the more remarkable for not being predictable at the onset of the project. The, often experimental, methods employed during the excavation to meet the technical challenges posed by the archaeology have yielded a complete and highly varied dataset, and a wide range of different specialists were required to evaluate it. The clear potential of the site, and the quality of the preliminary results, entirely justifies the considerable resources deployed at the time of excavation and thereafter. In order to capitalise fully on this investment, further commitment will be required to ensure the successful delivery of a programme of analysis, research, and the publication of its results.

5.1.3 Prior to the commencement of fieldwork, a chronological review of the likely research potential of the CNDR study area was undertaken (OA North 2008), in order to establish research objectives for the project. Following the completion of the assessment programme, in accordance with MAP2 (EH 1991, 2-3) and MoRPHE (EH 2006), this has been reconsidered, and the principal areas of potential for further research are identified and summarised below. *Section 6* lists the updated research aims and objectives formulated to address this potential. These aims and objectives have been produced with reference to the regional (Brennand 2007) and national (EH 2003; 2005) research agendas.

5.2 POTENTIAL OF THE MATERIAL ASSEMBLAGE

5.2.1 The material assemblage from Stainton West is extremely rich, amounting to 304,033 individual finds comprising a range of material types (*Section 4.2.1*), but being predominantly lithic in nature. The finds show a wide date-range, from at least the Mesolithic period to the nineteenth century AD, although the vast majority are either

Mesolithic or Neolithic in date.

5.2.2 The principal interest in the overall assemblage lies with the lithic assemblage, which is described in detail within *Sections 4.3-8*. Also of note is the worked wood (*Section 4.13*), including two tridents and a paddle haft, and a small assemblage of prehistoric pottery (*Section 4.9*). Two small stone beads may also be prehistoric in date (*Section 4.12*) and, being rare archaeological finds, are of considerable interest. The finds from later periods have relatively little research potential, however, being from a relict ploughsoil or from field drains, and comprise several sherds of Romano-British pottery (*Section 4.10*), a few glass beads (*Section 4.12*) and a small assemblage of medieval and post-medieval pottery (*Section 4.11*).

5.2.3 ***Lithics:*** the lithic assemblage from Stainton West indicates occupation from the Early Mesolithic period through to the Bronze Age, although the majority of the assemblage seems to be characteristic of a Late Mesolithic technology. This is by far the largest assemblage of this date to be recovered from the north-west of England. In Cumbria, the only comparable site is Williamson's Moss (Bonsall *et al* 1994), near to the west coast, although there the lithic assemblage is only one-tenth of the size of that retrieved from Stainton West. More widely, the large lithic assemblages unearthed by excavations on the Hebridean island of Rum (Wickham-Jones 1990) and at Mount Sandel in Ireland (Woodman 1985) provide useful technological comparators, as do the upland Pennine assemblages (Howard-Davis 1996; Spikins 1998; 2000; 2003). Early Mesolithic lithics have seldom previously been identified in Cumbria, and are very rare within the North West generally. Finds of this date, which may provide some context for the Stainton West examples, are known from cave contexts in the Morecambe Bay area (Kents Bank Cavern; Salisbury 1997) and the Furness Peninsula (Bart's Shelter; Hodgson and Brennand 2006, 25) in Cumbria, and from Tatton Park, Cheshire (Higham and Cane 1999). The Stainton West lithic assemblage is, therefore, of inestimable importance regionally, and will be of interest to wider studies of the Mesolithic period and lithic materials at a national and north-western European level.

5.2.4 Although many lithic finds from the Neolithic period have been recovered across the region, evidence from excavations is rare and few of these assemblages can be directly related to occupation (Hodgson and Brennand 2006, 32). In addition to the Mesolithic material, a proportion of the Stainton West assemblage is probably Neolithic in date and may relate to occupation. Flakes of Langdale tuff, some of which look like axe-thinning flakes, possibly resulting from the final shaping or maintenance of stone axes, are spread throughout the whole lithic scatter. Together with the polished stone axes from the channel, and other diagnostic types, such as leaf-shaped arrowheads, these provide evidence for a poorly defined Neolithic component within the greater assemblage. However, Early Neolithic and Late Mesolithic flaking techniques were very similar to each other and it can be difficult for the modern-day researcher to identify chronological differences in a mixed assemblage (Edmonds 1990). There is also an equivocal suggestion that microlithic technology, traditionally considered Mesolithic in date, persisted in Cumbria into the Earlier Neolithic period (Cherry and Cherry 2002; Evans 2004), although the counterpoint to this is that traditional Neolithic forms, such as leaf-shaped points and polished stone axes, could have occurred at an early juncture. It is hoped that studies of tool combinations, blade size, blade and flake ratios, core reduction strategies, and possibly even observation of a change in raw material use *etc*, may all help to isolate the Neolithic material within the overall assemblage, and analysis has great potential to address many of the vexed chronological/typological issues, allowing a step change in our understanding of this transitional period.

5.2.5 The Stainton West lithic assemblage will lend itself to four major areas of research: raw material sourcing; technological study; functional study; and spatial analysis. Lithic raw materials can be used to ask questions about the nature of population mobility and range of influence of the hunter/gatherer societies (Barton and Roberts 2004; Wickham-Jones 2005). Principal questions of where the rock comes from and how it may have arrived on site (through technological analysis) have been investigated most recently on the west coast of Scotland, and a picture is being built up of how bloodstone, flint and baked mudstone were used around the coasts of the Inner Hebrides (Hardy and Wickham-Jones 2009; Mithen 2000; Wickham-Jones 1990). Similar work, looking at the use of flint and chert in the north of England, is summarised by Barton and Roberts (2004, 349-50), where raw material types have also been used to identify territorial boundaries (Donahue and Lovis 2006; Evans *et al* 2010). The wide variety of materials at Stainton West should permit a similar study, which will meet the need for the development of a programme of scientific analysis for characterising the sources of Mesolithic flint and chert implements, which has been established as an important research priority in the Regional Research Framework (Hodgson and Brennand 2007, 38).

5.2.6 A technological investigation of an assemblage is the foundation of all lithic analysis, since it provides a basis for asking further questions of the assemblage, and Warren (2006, 33) emphasises how it can be integrated into a study of Mesolithic social relations. For example, it can inform on how the material was brought on to site (whether as pebbles, pre-forms or quarried blocks); what tools were being made; whether some raw materials were knapped in a different way or preferred for specific tool forms; and whether the tools were made and used in different places *etc*. At Rum, it was used to differentiate specific knapping strategies and the use of different raw material between the Mesolithic and Neolithic phases (Zetterlund 1990). A thorough technological analysis of a selected proportion of the Stainton West assemblage should, similarly, be able to address those problems associated with interpreting the Mesolithic/Neolithic transition in the north-west of England.

5.2.7 A notable feature of the Stainton West assemblage was the number of potential ‘knapping episodes’, or at least significant concentrations of lithic debris, that were clearly or most likely derived from the same parent block. There, at least 82 of these have been identified within the original unit of analysis, the metre square, but further examination of material in neighbouring squares will discover the full extent of each spread. Knapping events can help in understanding processes of site formation; the production methods used in nodule reduction; and they are ‘snap shots’ into the past.

5.2.8 Microliths are the focus of much research on Mesolithic assemblages (Finlay *et al* 2000; Finlayson and Mithen 2000; Finlay 2009) and are seen as the signature tool of the Mesolithic period (Warren 2005, 103). At Stainton West, it is possible to be confident of the 100% recovery of microliths over a large area and, therefore, there is an ideal opportunity to explore, using computing techniques, the spatial combinations and groupings of the various microlithic forms and how they relate to, for instance, raw material, colour and context. In addition to microliths, there is also a wide variety of other retouched tools (scrapers, awls/borers, knives, *etc*) numbering *c* 850 in total. A full analysis of these will add to the understanding of the range of activities that would have occurred on the site.

5.2.9 Microwear and residue analysis are both scientific means of discovering the uses to which the stone tools were put. At most Mesolithic sites, the condition of the lithics is too poor to attempt useful evaluation by microwear (R Donahue *pers comm*). At Stainton West, however, an assessment on the condition of the lithic assemblage has highlighted several large contexts where preservation of wear traces is excellent (*Section 4.4.7*). The survival of residues is uncertain, but if these exist, they can help determine precisely which plant or animal materials the tool has been in contact with, and can, therefore, provide important information regarding specific function.

5.2.10 Microscopic studies of edge wear and breakage have been applied specifically to microliths by Bill Finlayson, with some interesting results which suggest that microliths of the same form have been used for different tasks across sites in the same region (Finlayson and Mithen 2000). During assessment of the Stainton West assemblage, the presence and patterns of edge damage were noted on the retouched tools and these observations could be used to identify, for example, spatial groups of similar wear patterns in their own right, or prior to selecting a sample for microwear study.

5.2.11 At Stainton West, an in-depth study of how the tools were used would be very productive to the interpretation of the site. It would also contribute greatly to a regional and national understanding of Mesolithic practices. However, its usefulness relies ultimately on the questions that are asked of the material, and it is imperative that any study is tied closely to the research questions of the site. For this reason, specific components of the assemblage should be targeted (within the contexts of good survival) to examine a whole range of issues, for instance the differences or similarities of uses within and between various microlithic types and other retouched tools; whether the large blades were used in a specific way; whether the other unretouched blades were used like microliths; what percentage of the ‘debitage’ was actually used; if task-specific areas could be identified; if the less available lithic material (such as good-quality brown flint and possibly some chert) was being used in a different way from tools made of the pebble flint.

5.2.12 Allied to aspects of raw material, technology and use is the big question of how the site was occupied over the millennia. At Stainton West, there is the material to look at the nature of the various occupations in close detail. Computing software and statistical analysis should be used to identify patterns in combinations and groupings of tools and debitage as a way of isolating specific activities. Limited refitting of some elements of the knapping events will allow study of the assemblage in relation to specific episodes of work and perhaps whether these were contemporary or not.

5.2.13 ***Wood:*** over the last few years, it has begun to be apparent that the techniques employed when using stone axes are probably quite different from those used with metal axes. It is, however, a difficult question to address because of the lack of suitable material in large enough assemblages. The quality of preservation at Stainton West is so good that even quite small details of technique may be preserved. The last sizeable assemblage of Neolithic wood to be examined in detail was the one from the causewayed enclosure at Etton (Taylor 1998a). Small quantities of material from other sites has subsequently been excavated and analysed (see, for example, Harding and Healy 2007), but there has not been another statistically significant assemblage. Research questions have been raised, but not answered, by this earlier work; Stainton West may provide an opportunity to address some of these questions.

5.2.14 Coppicing is an ancient technique which was already well established in the Neolithic period (Taylor 1998a, 127-9). There are hints in the material at Etton that different techniques were used to cut coppice with a stone axe rather than a metal one. This line of research was not recognised at the time, however, and thus not examined in detail. These techniques include a combination of cutting, tearing and cross-cutting to remove the stems. The initial examination of the Stainton West material indicates that all these techniques are present on the coppiced material.

5.2.15 There are several chunks of coppice stool in this assemblage, particularly from the *Mesolithic organic deposit*. It was suggested that the Neolithic bowls from Etton were manufactured by charring and scraping bulbous lumps taken from old coppice stools (Taylor 1998a, 152-5), but the bowls from Etton are fragmentary and in poor condition. There was also no real detritus from their shaping. There has subsequently been a small amount of experimental work carried out for a television film (http//www.channel4.com/history/microsites/T/timeteam/2005_north_bowl2.html), which showed that the technique works. No subsequent archaeological evidence for the use of it has been found, but examination of the coppice stool lumps from Stainton West will advance our knowledge of this technique.

5.2.16 Another previously unknown technique for shaping wood was recognised when wood from the Mesolithic site at Star Carr was examined (Taylor 1998b). This technique involved cutting grooves in wood and prising out the wood tangentially between them. This was used on material other than oak to get a similar effect to that later achieved on oak by splitting. There is also debris, within the *Mesolithic organic deposit*, *Earlier Neolithic organic deposit* and *Later Neolithic organic deposit*, which is diagnostic of a similar technique used for felling trees with stone axes. This technique has been explored by a group of Danish experimental archaeologists (Jørgensen 1985). Trees felled with metal tools rely on the fact that metal edges are efficient at cutting. The experiments in Denmark involved felling trees with polished stone axes, where a different approach was used, which did not rely on a sharp cutting edge. Trees were felled by cutting parallel grooves and splitting out the wood in between, producing stumps similar to ones which had come out of the North German peatlands. The debris produced by these experiments runs at a tangent to the grain and is parallel-sided, a small quantity of similar debris being found associated with the Neolithic long barrow at Stanwick, Northamptonshire (Harding and Healy 2007). Some of the evidence for tree felling at Stainton West looks likely to provide more data on this technique, and the first clear evidence that such a method was used in this country.

5.2.17 The tridents are remarkably fine objects, illustrating the sophistication of early woodwork. They are complex forms carved, with enormous skill, from split trunks. The quality of preservation of both tridents is first class, with edges and cut surfaces still sharp. The way in which they were fashioned is very clear, and the analysis of them will be very important in reassessing similar finds made in the nineteenth century (such as at Ehenside Tarn (Darbishire 1873); and Armagh (Wilde 1857)).

5.2.18 ***Pottery:*** the prehistoric pottery includes decorated sherds of Grooved Ware, other undecorated sherds of possible Earlier Neolithic date, and sherds of Bronze Age pottery. The Grooved Ware is a significant find, since few other vessels of this type are known from the region. The national gazetteer for Grooved Ware (Longworth and Cleal 1999) notes examples from Walney Island and Crosby Ravensworth, in Cumbria, Lockerbie, Dumfriesshire, and Luce Sands, Wigtonshire, and the distribution figure (*op cit*, 178) shows multiple findspots in the Carlisle area, although these are not itemised. Sherds of Grooved Ware pottery were also recovered from Scotby Road, Carlisle (McCarthy 2002, 37) and Blaise Vyner (*pers comm*) has assessed Grooved Ware recovered from the excavations at Carlisle Airport (Flynn 1998). During the course of their extensive fieldwalking activities in the Cumbrian limestone uplands, Cherry and Cherry (1987; 1992; 1995) recovered sherds of Grooved Ware from several sites.

5.2.19 An organic residue on the Stainton West Grooved Ware has produced a radiocarbon date of 2880-2610 cal BC (4145±35 BP; SUERC 32626; *Section 4.25*), which, despite some obfuscation caused by a plateau on this part of the calibration curve (Brindley 1999, 132-3), falls within the early part of the usual range for this type (Cleal 1999, 6). In terms of apparently being a deliberate deposit in close association with a river and a monumental complex, the pottery fits in well with the national and regional pattern of distribution and mode of deposition (*op cit*, 5-6; Manby 1999, 58-9). Analysis of the organic residue adhering to the pottery may help to elucidate its function. Others have suggested associations between Grooved Ware and feasting comestibles such as pork (Mukherjee *et al* 2008) and ale (Dineley 2004), which in turn may be related to its common selection for structured deposition and association with ceremonial monuments.

5.2.20 The other undecorated sherds of pottery recovered from Neolithic contexts at Stainton West probably belong to the Neolithic plain bowl tradition. Significantly, in the context of the lithic finds from the site, excavations at Holbeck Park, on the Furness Peninsula (OA North 2002), produced 106 sherds of Early Neolithic pottery, radiocarbon-dated to 4000-3700 cal BC by associated material (Hodgson and Brennand 2006, 32), accompanied by a rod microlith, charred wheat and two unpolished flakes of tuff. Also on the Furness Peninsula, Neolithic pottery was recovered from Roose Quarry (Jones 2001) and Trough Head (Barnes 1970, 5-6). Other sites in Cumbria where pottery of Early Neolithic type has been found include Ehenside Tarn (Darbishire 1873, 290-2), New Cowper Farm, Aspatria (Allen 2005) and Crosby Garrett (Higham 1986, 62; Manby 1970, 17). In the Carlisle area, Grimston Ware pottery has been retrieved from High Crosby (McCarthy 2002, 36; Vyner 1998) and Scotby Road (McCarthy 2002, 37; Vyner 1998). Cherry and Cherry (1987; 1992; 1995) have also recovered a wide range of different Neolithic pottery types from various sites in the Cumbrian limestone uplands. Pottery interpreted as Peterborough Ware was also recovered from a shallow pit at Old Grove, to the north-east of Carlisle (Lambert

1996, 11-2, fig 2:3).

5.2.21 The Bronze Age pottery at Stainton West was very similar to that found at the settlement sites excavated along the route of the CNDR (OA North 2011a), comprising undecorated jar sherds. It came from a pit in the vicinity of the roundhouse, which may have been related to the burnt mound activity along the river (*Section 3.3.17*) rather than being a settlement *per se*. Pottery of this date is regionally very rare, especially outside of a funerary context (Hodgson and Brennand 2006), so this addition is of considerable importance. Bronze Age-type pottery is, however, known from the east of Carlisle, at Botcherby (Barkle 1998), where it was associated with what was either a timber circle or a roundhouse.

5.3 POTENTIAL OF THE ENVIRONMENTAL ASSEMBLAGE

5.3.1 A comprehensive sampling programme for environmental remains, from a range of feature types, was undertaken along the length of CNDR, including from Stainton West. The environmental assemblage preserved at Stainton West is very diverse and, in many cases, extremely rich. On the advice of the English Heritage Regional Science Advisors for the North West (Sue Stallibrass) and Hadrian's Wall (Jacqui Huntley), samples were assessed for waterlogged plant remains (WPR), charcoal, charred plant remains (CPR), and faunal remains, including invertebrates, pollen, other palynomorphs, foraminifera, ostracods, and diatoms, and soil micromorphology. Sampling was either by bulk or monolith sample, the latter being, principally, for pollen, other palynomorphs, foraminifera, ostracods, diatoms and soil micromorphology. The quantification of samples for the various ecotypes and environmental indicators is to be found in *Sections 4.14* (Animal bone), *4.15* (Insects), *4.17* (WPR), *4.18* (CPR and charcoal), *4.19* (pollen), *4.20* (foraminifera and ostracods), *4.21* (diatoms) and *4.23* (soil micromorphology). In addition, of 1073 individual samples of wood (*Section 4.16*) taken from the palaeochannel, 726 were identified to species.

5.3.2 The principal interest of the overall environmental assemblage is its close association with archaeological features and artefacts of known date, both in the palaeochannel (*Section 3.3.5*) and the grid square area (*Section 3.3.20*). Stainton West is one of the few prehistoric wetland sites identified to the west of the Pennines in recent years, and Mesolithic, Neolithic and Bronze Age environmental assemblages in the North West are rare, with usually only a few plant macrofossils being recorded from each (Hall and Huntley 2007, 35). Indeed, the *Regional Research Agenda* (Hodgson and Brennand 2007), building on the work of the *North West Wetlands Survey* (in Cumbria, Hodgkinson *et al* 2000), has specifically highlighted the need to prioritise the investigation of prehistoric sites where good environmental assemblages survive.

5.3.3 There are no Mesolithic or Neolithic insect assemblages from the North West, making that from Stainton West of national importance. In contrast, Mesolithic, Neolithic and Bronze Age pollen and diatom studies are more frequent, but they are seldom associated with archaeological sites. Two notable exceptions are Ehenside Tarn (Walker 1966; 2001) and Eskmeals (Tipping 1994), both in west Cumbria, although neither of these are in inland river valley contexts like Stainton West, making it unique. Pollen assemblages from burnt mounds at Drigg (Pennington 1965; OA North 2010) and Sparrowmire (Heawood and

Huckerby 2002) are comparators for the burnt mound samples from Stainton West.

5.3.4 The WPR has a high potential for full analysis, and will complement the study of the insects and the pollen. Further interpretation of the wood data and the fungal spores will help reconstruct the conditions within the palaeochannel and the character of the local woodland. The assessment of the foraminifera, ostracods and diatoms has provided useful information regarding the environment within the channel, but their poor preservation (possibly a factor related to the nature of the environment during deposition) means that no further analysis is warranted. The very few scraps of animal bone, which were thinly distributed throughout the Neolithic channel deposits, came from either medium-sized mammals or unidentified mammals. They have no further research potential, but do hint tantalisingly that this material was once much more commonly present, but has not survived.

5.3.5 Whilst the assessment has been uniformly successful in assessing the relative potential of the various environmental assemblages, at this stage, the results permit different levels of interpretation. For example, the charcoal and CPR will allow the limited, but highly specific, interpretation of a wide range of features and deposits, whereas the insect data presently provide a much more generalised impression of the environment, and the pollen evidence is partial, but chronologically well constrained.

5.3.6 ***Stainton West in General:*** the insect fauna suggests a palaeochannel with slow-flowing or stagnant water and, in common with the WPR, there is little evidence of any stands of waterside vegetation. The terrestrial beetles recorded suggest woodland and trees with some taxa that are associated with decaying timbers, tree leaves, and fruits and nuts. Buds, decaying wood, leaf fragments and nuts are also prolific in the waterlogged plant remain samples. Further corroborative evidence for decaying wood comes from the pollen assessment, where the spores of *Kretzschmaria deusta*, a fungus associated with wood decay, were identified. This type of fungal spore has been recorded in a number of pollen studies at the time of the Elm Decline (Innes *et al* 2006). Beetles associated with grazing and grassland were recorded in all samples assessed for insects from the palaeochannel, along with a number of herbaceous seeds that suggest similar communities, which might indicate openings in the canopy (*Sections 4.15* and *4.16*).

5.3.7 One of the primary questions asked of the environmental material was whether the palaeochannel at Stainton West was directly influenced by changes in the relative sea-level during the life of the channel deposits. The assessment of the pollen, foraminifera, diatom and waterlogged plant remains has provided overwhelming evidence for a freshwater environment. However, the lack of any indicators of salinity does not preclude the possibility that rising sea-levels on the coast may have affected the Eden Valley, causing the backing up of freshwater. This evidence is consistent with the current understanding of relative sea-level over this period (*Section 5.4.9-10*).

5.3.8 ***Mesolithic Organic Deposit (Section 3.3.5):*** the pollen, WPR and wood samples all indicate a wooded environment in the Mesolithic period. The pollen and wood samples both suggest that hazel and elm were well represented in the woodland, with some oak and alder. Hazelnuts, seeds and catkins and, to a lesser extent, alder wood were identified during the assessment of the WPR, but no remains of elm or oak were observed. The woodland ground flora is represented by dog's mercury, wood-rush and wood sorrel; today, the three taxa are found growing in woods (often at the woodland edge), hedgerows/hedge banks and shady places (Stace 1997). The presence of other herbaceous plants and brambles, and the abundance of hazelnuts, suggests that the woodland may have been quite open in character or with some local clearances: hazel trees/bushes produce fewer flowers and subsequently fewer nuts in dense shade (Huntley 1993, 214), and these latter were abundant. Despite the excellent preservation of the pollen, plant, wood and insect remains, very few aquatic taxa were recorded during the assessment, suggesting that the vegetation was not encroaching from the banks of the Eden.

5.3.9 ***Mesolithic/Neolithic Alluvium (Section 3.3.8):*** the environmental evidence again suggests a woodland environment, but possibly quite open in character, or with local clearances. There is less variety in the WPR in this element of the site than in the *Mesolithic organic deposit* and, again, there is little or no evidence of any encroaching vegetation.

5.3.10 ***Earlier Neolithic Organic Deposit (Section 3.3.9):*** once again, a woodland environment of open character with local clearances is suggested. Elm remains well represented, but the pollen, wood samples and WPR all point to an increase in the representation of alder in the flora, and the wood suggests this may be at the expense of oak. Despite excellent preservation, very few remains from aquatic and wet ground plants were recorded during the assessment, so the channel seems to have remained clear of vegetation.

5.3.11 ***Earlier Neolithic Alluvium (Section 3.3.12):*** woodland continued to dominate the landscape, but elder seeds first appear in the WPR. The presence of elder suggests a well-manured soil and, together with the bramble seeds, is possibly indicative of scrub or waste and rough ground (Stace 1997).

5.3.12 ***Later Neolithic Organic Deposit (Section 3.3.15):*** by the Later Neolithic period, it appears that the channel was rapidly becoming infilled, with alder carr growing on the surface. Rushes, sedges, wood sorrel and gipsywort probably grew amongst the alder trees. The greater variety of herb seeds identified suggest that the dryland vegetation was possibly becoming more open.

5.3.13 ***Later Neolithic Alluvium (Section 3.3.16):*** woodland continued in the landscape but the pollen suggests that elm was no longer abundant. Bramble, elder and nettle seeds are again possibly indicative of scrub or waste and rough ground, and both the elder and the nettles indicate a nitrogen-rich soil, perhaps suggesting the presence of people or animals along the riverbank.

5.3.14 ***The Burnt Mounds and Other Features (Sections 3.3.17-18):*** CPR were absent from the burnt mound deposits but charcoal was frequent. The charcoal assemblage from Burnt Mound 1 differed from the other three, as it was dominated by oak, whereas Burnt Mounds 2, 3, 4 and 5 had a more mixed assemblage. The charcoal assemblage from ring gully ***100031*** (Fig 11) was also mixed. Pollen was recovered from monolith samples taken from the burnt mound troughs and a cooking pit, and preliminary findings suggest that the vegetation on the river banks during the Bronze Age was alder woodland with open areas.

5.3.15 ***Grid Square Area (Section 3.3.20):*** within the drier area adjacent to the channel, the environmental evidence mainly comprises CPR and charcoal, but the pollen assessed suggests the landscape became more open when the *overbank alluvium* (*Section 3.3.27*) was being deposited. Less than 16% of all the bulk samples taken from deposits in this area contained any charred remains and those recorded are mainly of charcoal, with a few weed seeds and charred cereal grains. Barley grains and *Prunus* fragments (sloe/blackthorn/cherry) were recovered from the *overbank alluvium*, but within the *colluvium*, *backwater channel* and *stabilised land surface*, the remains were exclusively of alder/hazel and oak charcoal. Fragments of alder/hazel and oak charcoal were identified in features radiocarbon-dated to the Mesolithic period (*Section 4.25*), and alder/hazel charcoal was predominant in features radiocarbon-dated to the Neolithic period (*ibid*), although by the Middle and Late Bronze Age, oak was the major fuel type (*Section 4.18*).

5.3.16 ***Principal Potential:*** **Insects:** there are very limited numbers of insect faunas that are Late Mesolithic in date. Furthermore, two of these (Goldcliff: Bell *et al* 2000; Bell 2007; Westwood Ho!: Girling and Robinson 1987) are from coastal peats and are probably not directly comparable with the material examined from Stainton West. Only a few inland riverine deposits have been studied to date, at sites such as Bole Ings, Nottinghamshire (Dinnin 1997), Mingies Ditches, Oxfordshire (Robinson 1993), and Runnymede Bridge, Oxfordshire (Robinson 1991). Similarly, Neolithic insect faunas are also limited, consisting mainly of a number of deposits from the sites mentioned above (*eg* Dinnin 1997), and also Croft, Leicestershire (Smith *et al* 2005), deposits associated with the Somerset Levels Trackways (Girling 1977; 1979; 1980; 1982; 1985), and with the pine woodlands of Thorne Moor Wastes (Whitehouse 1997; 2004). Of these, it is only the channel deposits at Bole Ings (Dinnin 1997) and Croft (Smith *et al* 2005) which are directly comparable with the Stainton West assemblage. This lack of comparable sites of a similar date alone suggests that the insect faunas from CNDR are of clear national importance. Similarly, the distribution of the sites in the UK also establishes that the insect faunas from CNDR are of national importance, since there are no other Mesolithic or Neolithic insect faunas from the western side of the Pennines. There is, therefore, a particularly striking gap in our understanding of landscape and woodland development in both periods in the North West, that the material from Stainton West will address.

5.3.17 The nature of woodland and insect communities in both the Mesolithic and the Neolithic periods is an aspect of the past that has become a wide area of debate (*ie* Vera 2000; Mitchell 2005; Whitehouse and Smith 2010). The insect fauna from Stainton West fits into this research and has the potential to change the understanding of how channel-side woodlands were structured and utilised by humans. In addition, we are still unsure of the composition in terms of forest structure and trees that are associated with this type of infilled channel (Dinnin 1997; Whitehouse and Smith 2005; Whitehouse and Smith 2010). There is also some continuing uncertainty over the nature and cause of clearings seen at this type of location from the Neolithic period, and the degree to which the cause of such clearings may be attributed to grazing of domesticated cattle and pigs in the woods, rather than wild animals (Robinson 2000; Smith *et al* 2010). The occurrence of both indicators for grassland and open ground seen in the insect faunas from Stainton West will be very informative in terms of this debate.

5.3.18 Lastly, valley woodlands usually contain an insect fauna which is no longer present in

Britain today (Buckland 1979; Buckland and Dinnin 1993; Whitehouse and Smith 2004). This is a range of species that are associated with deadwood and which have been described as '*urwaldrelikt*' (literally: old world relict) and, now, are certainly extinct in this country. During this assessment, several specimens were recovered which could not be readily identified to genus, suggesting the presence of such species.

5.3.19 **Other Evidence:** detailed analysis of the pollen, fungal spores and WPR from the monolith samples taken from the palaeochannel, combined with tight chronological dating, has the potential to distinguish very local changes in the environment during the Mesolithic period, the Mesolithic/Neolithic transition, the Neolithic period and Bronze Age, when the character of both the archaeology and environment were changing rapidly. The distinction between regional and local environments is often hard to make, and the accuracy of the relationship between the archaeology, chronology and environmental changes is difficult to determine (McCarthy 1995), but at Stanton West there is huge potential for this to be addressed. In the future, it may be possible to refine further the chronology of the archaeological and environmental changes, using the samples from Stainton West for very high-resolution pollen analysis. As such, the cores will be offered to Dr Jim Innes and his co-workers at Durham University for complementary academic research.

5.3.20 The analysis of WPR from other Mesolithic and Earlier Neolithic sites, such as Star Carr, in North Yorkshire, and Williamson's Moss, on the Cumbrian coast, has rarely been undertaken (Hall and Huntley 2007, 23). This makes the analysis of the WPR from the Stainton West channel deposits extremely important. The integrated analysis of the WPR, the pollen, wood, insect remains and the soil micromorphology has the potential to provide a very detailed picture of the local environment associated with the known Mesolithic and Neolithic archaeological activity.

5.3.21 If contemporary with the Mesolithic activity at Stainton West, the CPR or charcoal remains can potentially provide information on human activities and resource use from a period that is still poorly understood in Britain. Many of the earlier palaeoenvironmental investigations at Mesolithic sites have been limited to pollen analyses (Hall and Huntley 2007), although some later studies have addressed this extreme lack of palaeoenvironmental data. The recent investigation of the Mesolithic lakeside site at Star Carr produced evidence for the burning of reedswamp, which would have grown in and around the lake margins (Hather 1998; Law 1998). There are a few other sites, on the North York Moors and in the Pennines, which have produced Mesolithic charred material (Hall and Huntley 2007), but CPR are sparse and the evidence mainly comprises charcoal from the burning of vegetation. Such burning activity is typically associated with later Mesolithic, pre-elm decline, disturbances identified in many pollen records in the area (Hall and Huntley 2007).

5.3.22 Despite being unsuitable, in most cases, for further qualitative analysis, the CPR assemblages from Stainton West that have been radiocarbon-dated to the Neolithic period and the Bronze Age (*Section 4.25*) are also important, as charred material from sites of this date in northern England is surprisingly scarce (Hall and Huntley 2007). Any information will add significantly to our knowledge and understanding of earlier prehistoric activity and the environment in northern Britain. The main priority will be to establish a direct link between the charred material and human activity, although such sparse assemblages must be treated with caution, especially given the shallowness of the deposits, the palimpsest of activity, and the fact that modern roots are present in many of the samples. However, material, such as cereal grains, should not automatically be discounted on the assumption that it is intrusive. Some of the earliest examples of charred cereal grains in Britain, from Lismore Fields, near Buxton, and Billown on the Isle of Man, have been dated to 3950-3530 cal BC (4930±70 BP; OxA 2434) and 3930-3630 cal BC (4930±55 BP; OxA 10140) respectively (Jones and Rowley-Conwy 2007; Brown 2007). In Cumbria, a charred cereal grain from a tree throw at Holbeck Park (OA North in prep) has been radiocarbon-dated to 3960-3780 cal BC (5065±35 BP; SUERC 10772). These age ranges are certainly consistent with some of the dating evidence from the grid square area, and charred cereal grains should therefore be considered for radiocarbon dating.

5.3.23 The environmental assessment at Stainton West has demonstrated huge potential for environmental analysis in deposits dating to the Mesolithic period, the Mesolithic/Neolithic transition, the Earlier and Later Neolithic periods and the Bronze Age. Hall and Huntley (2007) suggest, in their review of the archaeobotanical record in Northern England, that the record of plant macrofossils needs to be extended for these periods, and the *Prehistoric Regional Research Agenda* (Hodgson and Brennand 2007, 36) has specifically highlighted the importance of environmental remains from sites of this date. As such, the palaeobotanical remains from Stainton West are regionally and nationally important, making further environmental analysis a very high priority, in the case of the CPR not withstanding the relatively small concentrations of the material. The material should, however, be studied in the context of the other environmental assemblages recovered from the CNDR scheme as a whole (OA North 2011a) to maximise our understanding of landscape development in the lower Eden Valley.

5.4 Potential of the Archaeological Stratigraphy and the Geoarchaeological Resource

5.4.1 At Stainton West, the channels and floodplain environment of the ancient River Eden provide a dynamic backdrop against which site formation and past human behaviour must be understood. The excavations have highlighted the importance that comprehending the landscape and geoarchaeological context of a site will have to its overall interpretation. Without this approach, it becomes almost impossible to examine the conditions that prevailed and the resources that were available in the past. Given the nature of the archaeological remains, any consideration of the cultural stratigraphy should necessarily take place alongside the natural stratigraphy, as, in many cases, there is no clear distinction between one and the other. Cultural materials were very often found within naturally accumulating deposits of fluvium, alluvium and colluvium, and archaeological features both truncated and were sealed by such deposits.

5.4.2 The principal stratigraphic potential at Stainton West is all of prehistoric date, the only features and deposits that date to later periods being the relict agricultural soils below the present-day pasture, the land drains that cross the site, and the hedges that enclose the field it lies in. The latter are probably of medieval or post-medieval date, although earlier origins are possible. The prehistoric stratigraphy comprises a range of natural and cultural deposits, cut features, stone spreads, hearths and wooden structural remains, all of which are either within or lie adjacent to a palaeochannel. The archaeological features and deposits have been described in detail within *Section 3.3*, and radiocarbon dating (*Section 4.25*) suggests that the earliest activity commenced in the sixth millennium BC and that the latest activity dates to the start of the first millennium BC, although lithic finds (*Section 4.3*) may suggest activity in the area several thousand years earlier on, and Iron Age or Romano-British beads (*Section 4.12*) and Romano-British pottery (*Section 4.10*) may point to a later human presence in the vicinity.

5.4.3 Features of prehistoric date are rare in the region, relatively few having been positively identified during archaeological investigation (Hodgson and Brennand 2006). At Stainton West, they are associated with well-preserved and largely *in situ* artefactual (*Section 5.2*) and palaeoenvironmental (*Section 5.3*) assemblages, meaning that the potential for information retrieval is huge. However, as is often the case with prehistoric archaeology, the evidence is not clear cut and does not fit neatly into the categories that we use to describe human behaviour today or at other, perhaps more familiar, periods of history. This problem is compounded by the remains often being of an insubstantial nature; partial preservation; archaeological complexity; and that the site is a palimpsest, with one phase of activity being directly superimposed upon another, sometimes without any stratigraphic separation. On balance, it would appear from the assessment that this area had a variety of uses at different times in the past. It was variously, and sometimes simultaneously, a settlement; a source of resources; a place of production; the setting for votive or ceremonial and discursive practices; a possible crossing over the Eden; and a marginal area. The activity at Stainton West should be understood in terms of the gravel terrace to the east, where there is possible evidence for Early Mesolithic activity (OA North 2011a); a Neolithic ceremonial complex (EH 2010; OA North 2011a); and Bronze Age agriculture and settlement (OA North 2011a).

5.4.4 During the Late Mesolithic period, the archaeological activity is principally represented by an extensive and extremely populous lithic scatter (*Section 4.3*) in the grid square area, which is associated with at least two pits that have been radiocarbon-dated to the fifth millennium cal BC (*Section 4.25*). There are large numbers of other features, including a probable stakehole structure, pits, scoops and stone spreads, which may also be contemporary with the scatter. This is all probably part of a Mesolithic settlement that seems to extend beyond the boundary of the site. Whether this was short-lived, but intensive, occupation, of permanent or semi-permanent nature, or instead the result of repeated, ephemeral visitations to the same place, remains to be established. At broadly the same time, a possible beaver lodge and dam within the channel attests to activity by this species, which could have influenced the local environment, making it more attractive for the hunter/fisher-gatherers. Some worked and burnt wood (*Section 4.13*) and a few worked lithics, within the lowest levels in the channel, suggest humans were also active within it. Regionally, the Mesolithic remains at Stainton West are perhaps best paralleled by those at Williamson’s Moss (*Section 5.4.9*).

5.4.5 In the Neolithic period, tree throws within the grid square area, dated by radiocarbon assay (*Section 4.25*), and flint tools, such as leaf-shaped arrowheads (*Section 4.3.8*; Plate 26), and polished stone axe flakes (*Section 4.5.4*), may provide evidence for tree felling and hunting adjacent to the river. It is also possible that many of the other worked lithics and features in the area date to this time, and indicate more intensive occupation. Within the channel, possible fish weirs and a timber platform, on the eastern bank leading down from the grid square area, demonstrate that the watercourse acted as a focus for activity. Evidence that this was not entirely concerned with subsistence is provided by the structured deposition of pottery; felling debris; worked word, including two tridents and a paddle; polished stone axeheads, arrowheads, at least one *polissoir*, and other worked lithics (*Section 3.3*). On the far side of the channel, Burnt Mound 5 (*Section 3.3.15*), a linear stone setting and the base of at least one large fire, provides some indication that activity may have extended further into the floodplain. Although, regionally, there are no direct comparators for the remains at Stainton West known from modern excavations, those excavated at Ehenside Tarn (Darbishire 1873) in the nineteenth century seem tantalisingly similar in a number of ways, and may even hint at a distinctive regional *culture*.

5.4.6 Hearths in the grid square area, radiocarbon-dated to the Bronze Age (*Section 4.25*), show that this continued to be occupied to some extent, although perhaps not as intensively as during earlier periods, as lithic finds typologically diagnostic of this period do not occur in any quantity. Along the banks of the palaeochannel, on both sides, burnt spreads of stone associated with pits filled with fire-cracked stone and charcoal (Burnt Mounds 1-4; *Section 3.3.17*) demonstrate that this area was more intensively used. However, what precisely this activity was has yet to be established. A structure, comprising a ring gully and central hearth (*Section 3.3.18*), was possibly associated with the burnt mounds. It seems too small to be a dwelling, although this cannot be ruled out. A pit, containing pottery, near to the structure is equally equivocal, and can either be interpreted as evidence for domestic occupation or may instead have resulted from a symbolic practice of some kind. The channel at this time was probably still a wet environment, but the organic preservation was not anywhere near as good as lower down in the sequence, and organic evidence was not well represented. By the Late Bronze Age, the area may have been culturally marginal, and episodic flooding is indicated by accumulations of alluvium. Other examples of burnt mounds have been excavated at a number of sites in Cumbria (Hodgson and Brennand 2006, 44), although, to date, never have they been found in such frequency, concentrated into a single area.

5.4.7 Throughout this assessment, as the picture is not yet complete, the archaeology within the palaeochannel, and in the area of grid squares adjacent to it, has mainly been described separately, whereas the activity is seemingly contemporaneous and the areas were probably connected in use. One of the key aims of analysis must be to integrate these areas within the discussion and to demonstrate how they may have been articulated in practice. The waterlogged conditions within the palaeochannel mean that, in the past, different kinds of activities seem to have been undertaken in the two zones, and that there is better organic preservation within it than in the grid square area. Consequently, the nature of the evidence is very different. For example, there are far fewer lithic finds in the palaeochannel and no wooden finds from the grid square area; cut features and burnt deposits are much rarer in the channel, but wooden structures and other organic materials survive; tree felling and fire setting seem to have taken place within the grid square area, whereas stone axes and tree-felling debris seem to have been deliberately deposited in a structured manner within the channel. The challenge will be to develop robust chronologies, which operate across both areas, so that the complementary forms of evidence can be studied in combination.

5.4.8 The site at Stainton West offers an important new perspective on the Mesolithic period along the Solway Firth and will be highly significant for studies of this period. Elsewhere in western Cumbria, there is a concentration of settlement evidence in the Esk Estuary, and this is where most archaeological investigations have previously tended to focus. Fieldwork has identified activity at Skelda Hill, Williamson's Moss, Monk Moors, Eskmeals Pool III (Langley Park) and Eskmeals, near Newbiggin (Hodgkinson *et al* 2000, 63-7). Based on current evidence, it is difficult to assess whether the high density of Mesolithic activity identified at the edges of the Esk Estuary reflects a true concentration of activity; indeed, Stainton West raises the possibility that inland river valleys, as well as coastal settings, were attractive environments.

5.4.9 One of the most intensively studied sites of the Esk Valley is Williamson's Moss, where a large lithic assemblage, including a Late Mesolithic microlithic component, and potential wooden structures of fifth millennium BC date were found (Hodgson and Brennand 2006, 25). The site was located on a raised beach, which was subject to phases of marine sedimentation, but became isolated from the sea by the development of a single spit around 5000 BC, allowing a brackish backwater lake to develop (Huddart *et al* 1977, 142). It was the subsequent development of fen carr deposits at the edge of the backwater that appears to have first attracted Mesolithic groups to the area. Other Later Mesolithic sites in Cumbria also either tended to be located near to upland mires or slightly inland of the present coastline, on the shingle ridges that denote the perimarine fringe of maximum marine transgression (dated to 6400-5800 cal BC) when sea-levels reached a maximum of 7.1m OD (above present-day levels) on the southern Solway coastline (Lloyd 2010, 55).

5.4.10 Similarly, activity at Stainton West appears to have begun at around the start of the fifth millennium BC, which was near the end of the maximum marine transgression. However, apart from the lowest part of the sequence, the various phases of infilling and reactivation of the palaeochannel sequence at Stainton West relate to the main phase of subsequent marine regression. This regression was briefly interrupted by a slight rise in relative sea-level at around 600 BC, before continuing to the present (*ibid*).

5.4.11 The river terrace at Stainton West was sculpted by the glacial outwash channels that laid down the sandy gravel deposits that underlie the site. A sequence of high-energy braided channels formed an undulating topography, which would have created gravel bars between multiple shifting channels. The early deglacial topography would have affected the formation of later channels during the onset of warmer conditions during the mid-Holocene. Isostatic rebound, being far more rapid during this latter period (Lloyd 2010, 53), created a series of closely dated upper terrace formations.

5.4.12 The development of a sand-dominated channel on Terrace 3 (Fig 4), where most of the activity at Stainton West seems later to have focused, probably occurred in the early Holocene. The topography of this wide, relatively uniform channel sequence would have influenced the formation and sedimentation patterns of the early- to mid-Holocene. The incision of the main channel sequence on the site developed later during the mid-Holocene, and started to infill at the same time that the human activity was occurring on the site. The palaeochannel sequence appears to have accumulated in a predominantly freshwater system (*Section 4.21.6*) beyond the reach of the tidal range. The timing of the organic accumulations recorded within the sequence fits well with periods of sea-level fluctuations and the onset of peat formation in other terrestrial sequences from the region (Wimble *et al* 2000). Upstream, river systems are found to reflect the general signatures of sea-level fluctuations, mainly though the backing-up of freshwater systems. However, the channels exhibit a complex sequence of deposits that may also have been significantly affected by, variously, channel migration, as well as human and animal activity on the site. This sequence may, therefore, be very localised in origin and not necessarily representative of the wider floodplain sedimentary sequence.

5.4.13 The site appears to have occupied a significant topographical position in the floodplain, where the river potentially narrowed and was constrained by several floodplain islands, which would have possibly facilitated crossing over it at this point. These islands seem to have extended across Terrace 3, separated by a series of anatomising channels. High points or promontories at the edge of a wetland zone would have been very attractive locations for early prehistoric communities to exploit the rich wetland and river resources present. What is less clear is the role that wetland environments later held for early farming communities, although they no doubt continued to be an important resource. The use of wetlands is difficult to determine and the evidence is fragmentary at best for the late prehistoric period. It is, however, likely that wetland areas remained an integral and important part of a much more widely settled and exploited landscape. Nationally, evidence of activity from wetland zones has been identified in the form of artefacts recovered from alluvial and peat deposits as votive offerings (Prior 2003, 287-93).

5.4.14 In the context of the wider CNDR landscape (OA North 2011a), the wetland zone may have been contrasted and articulated with the adjacent terrace, through human movement and practice. Consequently, it may have been conceptualised as being *other* to it. During the Neolithic period, this is perhaps expressed archaeologically in the acts of deposition/construction within the channel, as opposed to the construction of monuments on the terrace, whereas, during the Bronze Age, the contrast is between the farming settlements on the terrace and the burnt mound activity adjacent to the channel (if the roundhouse at Stainton West can be discounted as a normal dwelling).

5.4.15 The sequence of deposits forming the *Mesolithic organic deposit* indicates a shallow channel, which was gradually drying out. The accumulation of the main wood unit indicates a significant reduction in the flow of the river and encroachment of vegetation into the channel. It is possible that some of the wood recorded could have fallen in from overhanging branches and the river banks, but it is just as likely that some of this wood was deliberately introduced into the channel. A number of gnawed tree trunks and branch ends (*Section 4.13*) within this unit may indicate beaver activity. Beaver dams provide natural fords across a river, and these create clearings, coppice and ponds. They can also produce very localised sedimentation regimes, as they stem the flow of the river and can cause it to migrate through alternative channels. Beavers also encourage tree growth by the coppicing of trees, which creates long thin stems that are dragged into the channel to create the dam and lodge (Coles 2006). At Star Carr, a collapsed beaver lodge was clearly used by people for a variety of activities (*ibid*).

5.4.16 Mesolithic communities may have been first drawn to the Stainton West site as a result of localised woodland disturbance caused by beaver clearance. These environments would have been attractive to hunter-gatherer groups, providing ready-made coppice stems that would be ideal for firewood, arrow shafts or harpoons. The new tree growth would also have encouraged foraging and hunting resources, and the ponding of the watercourse may have provided good fishing. These conditions could have been instrumental in the selection of this particular place for camps or more permanent settlement, resulting in the lithic scatter and features within the grid square area.

5.4.17 The accumulation of the *Mesolithic/Neolithic alluvium* clearly represents the onset of faster-flowing conditions within the channels between the Late Mesolithic and Earlier Neolithic periods. The strength of the flow may be partly seen in the water-worn tree trunks that were identified in parts of the Mesolithic organic sequence. This may have eroded and reworked parts of the upper deposits. The channel would have been deeper, possibly enough to allow water transport. Its minerogenic nature would also suggest that it was largely free from vegetation, and not so prone to seasonally drying out as the earlier deposits. Archaeological activity within the channel is likely to be less visible and unlikely to survive in this context.

5.4.18 The accumulation of the upper organic sequence marks the development of a prolonged drying out of the channel and a significant reduction in the flow of the river. The timings of the organic accumulation appear to correspond well to fluctuations in sea-level, and the back-up of an upstream freshwater system (*Sections 5.4.9-12*). The accumulation of the *Earlier Neolithic organic deposit* marks a gradual return to drier conditions and the encroachment of carr-type vegetation within the channels, activity apparently either continuing or being renewed on the land surface during this period. The possible wooden structures identified within the *Earlier Neolithic organic deposit* may have fulfilled multiple functions, including aiding communications, as ritual foci, and for fishing and they seem to have been associated with the ritual deposition of objects, such as polished stone axes (*Section 4.6*), pottery fragments (*Section 4.9*) and wooden artefacts (*Section 4.13*). These were deposited in a low-energy environment and are likely to have been found *in situ*.

5.4.19 There appears to have been a cessation or significant reduction in sedimentation within the channel between the deposition of the *Earlier Neolithic organic deposit* and the *Later Neolithic organic deposit*. The *Later Neolithic alluvium* identified at the edge of the channel appears to have accumulated during this period and indicates a prolonged period of more stable conditions on the floodplain, with little sedimentation occurring. This channel may have become cut off during this period.

5.4.20 The accumulation of the *Later Neolithic organic deposit* reflects a return to rising ground-water levels and organic sedimentation. This helped to bury the *Later Neolithic alluvium* preserved at the edge of the channels without removing it.

5.4.21 The overlying *overbank alluvium* suggests a rejuvenation of river flow within the channels during the later prehistoric period, possibly as a result of increased run-off and vegetation disturbance. The channel appears to have silted by the Early to Middle Iron Age, surviving as a topographical undulation that appears to have been seasonally waterlogged. By the time these channels were inactive, the terrace had been uplifted and the floodplain had moved down on to the fourth terrace (Fig 4).

5.4.22 All indications are that the flint scatters are predominantly *in situ* and are sealed within an early prehistoric land surface that also preserves buried features, such as possible structures and hearths. The excellent preservation of the land surface appears to be due to burial by later colluvium and alluvial deposits, and does not appear to have been disturbed by deep ploughing in recent times.

5.4.23 The deforestation of the landscape during the late Iron Age (McCarthy 1995; Huntley *et al* 2009, 113) could have given rise to the sand-dominated channels, identified within the fourth terrace, with the higher-energy river flow and increased sedimentation being attributable to greater run-off and erosion during this period. The charcoal-rich channel fills may also suggest that the floodplain was deliberately cleared and managed. Previous authors have argued that episodes of forest clearance were related to the construction of Hadrian's Wall, and the timber requirements of the Roman military infrastructure (Davies and Turner 1979; Barber 1981, 113). This argument has been subsequently challenged, as it rested on poor dating control (McCarthy 1995; Huntley 1999), and many sites appear to fit better with clearance being initiated in the late Iron Age for agrarian purposes. Site-specific work tends to support the idea of a patchwork of environments present before the construction of the Wall, and varying degrees of impact within different areas. The Stainton West site can help to provide colour to this picture and reveal whether the floodplain near Hadrian's Wall was actively managed by the Roman military.

5.5 Conclusions

5.5.1 The project has examined a rich palimpsest of activity at Stainton West as part of a much wider scheme of investigations along the CNDR (OA North 2011a). The true potential of the site can only be fully realised as part of this wider research programme. The landscape investigated owes its genesis to the end of the last Ice Age, *c* 10,000 BC, but has since then undergone a slow process of modification by both natural and man-made agents, including the River Eden, in order to become the landscape seen today. Inevitably, the evidence of such change has been localised and is inconsistent in its survival, and data gathered by this project do not represent the full series of chronological periods from the end of the last glaciation to the present day. Nonetheless, the material has the potential to elucidate many facets of the past use of the area, from shortly after its post-glacial recolonisation until fairly recent times. It is important to remember that the remains were created by rational, thinking human beings, who made a successful life within this evolving landscape. Their needs and aspirations must have governed the manner in which they interacted with and modified the world around them, and are thus revealed to some degree by a structured analysis of that landscape.

5.5.2 At Stainton West, the evidence is particularly good for the Mesolithic and Neolithic periods, and Bronze Age, and because of the quality of these remains, the site has been one of the most significant discoveries regionally in recent years. At the beginning of this section (*Section 5.1.1*), a bold statement was made that Stainton West will in many ways set the regional agenda for future research in these periods. Reference to the summaries of potential, advanced above, and the prehistoric period chapter of the *Regional Research*

Agenda (Hodgson and Brennand 2007) will, hopefully, bear this out. Stainton West clearly has the potential to contribute to many of the themes and initiatives set out in this latter document (Table 20), as well as others not specified therein.

Theme	**Initiatives**
Settlement and Land Use	2.4, 2.5 and 2.32
Fieldwork Techniques and Targeting	2.8, 2.10 and 2.11
Environment	2.15 and 1.16
Palaeolithic and Mesolithic	2.20, 2.21 and 2.23
Technology Production, [Trade] and Exchange	2.23, 2.24, 2.25, 2.262.54, 2.56, 2.57, 2.61, 2.62 and 2.63
Legacy	2.27
Burnt Mounds	2.49, 2.50 and 2.51

Table 20: Potential of Stainton West in relation to research themes and initiatives in the Regional Research Agenda (Hodgson and Brennand 2007)

5.5.3 In combination, the various sites of the CNDR (including Stainton West) have huge potential to improve the understanding of Carlisle's past and make a valuable contribution to regional and national research agendas. As is so often the case, the value of the whole is greater than the sum of its parts and, in this context, even negative evidence can be informative. As such, an holistic consideration of the archaeology of the CNDR has the greatest potential for historical research, and a coherent, chronologically ordered narrative account will thereby be achieved. The people of Cumbria have ultimately funded the archaeological programme, and it is they that, potentially, have the most to gain from the project. In the future, every effort should be made to ensure that the results reach the widest possible audience. Historical knowledge can make a significant contribution towards strengthening a sense of place and possession among modern communities, and it can help those who influence the growth and development of that landscape today to understand the importance of their ancestors' contribution to the past, and their own to the future (English Heritage 2000): the archaeology of the CNDR certainly has the potential to enable this.

6 UPDATED RESEARCH AIMS

6.1 Aims and Objectives of the Programme of Analysis

6.1.1 This section follows the guidance of English Heritage regarding the formulation of updated research aims (English Heritage 1991, 2–3). The original aims for the project remain valid, but can be updated, as follows, with new aims and objectives derived from the statement of potential set out in *Section 5*. Research Aim 4 has been elaborated in more detail than the others, as the analysis of the large and extensive *in situ* lithic assemblage is likely to be highly involved and require detailed spatial analysis (*Section 7.7.12*).

6.1.2 ***Updated Research Aim 1:*** What is the evidence for past human activity at Stainton West?

Objective 1: How is past activity characterised?

Objective 2: How was the site used during each phase of activity?

Objective 3: When did this activity take place?

Objective 4: Is there evidence for continuity in occupation or did this take place in discrete episodes?

Objective 5: What cultural, topographical or environmental factors may have governed the selection of Stainton West for the activities enacted there?

6.1.3 ***Updated Research Aim 2:*** How has the topography and geomorphology of the area served both to enable and constrain past action, and affected our understanding of the ancient landscape?

Objective 1: How does site visibility affect the understanding of landscape features through time?

Objective 2: What effect has the geomorphology of the area, particularly the River Eden, had upon human movement, settlement, society and subsistence through time?

Objective 3: Is there any evidence for change in relative sea-level at Stainton West?

Objective 4: What part has the topography of the area played in connecting it to other areas or isolating it from them?

Objective 5: Can study of mapping and documentary evidence assist with the analysis of the landscape through time?

Objective 6: Is there any persistence in landscape features in this area? How much continuity is apparent from ancient to modern times?

Objective 7: Has the solid and drift geology affected the survival of environmental evidence on these sites?

6.1.4 ***Updated Research Aim 3:*** How can the analysis of the palaeoenvironmental assemblages recovered from Stainton West be used to interpret human practice and past activity at the site, and contribute to an understanding of the past ecology and environment?

Objective 1: What evidence, if any, is there for climate change?

Objective 2: Is there any evidence that humans had a major effect on their environment at different times in the past?

Objective 3: What was the nature of the environment in the channel and how did this change over time?

Objective 4: What was the nature of the environment adjacent to the channel and how did this change over time?

Objective 5: What was the nature of the environment in the surrounding landscape and how did this change over time?

Objective 6: How might the past environment and ecology have constrained and enabled human activity?

6.1.5 ***Updated Research Aim 4:*** How can the analysis of the lithic assemblage recovered from Stainton West be used to understand human practice and past activity at the site?

Objective 1: What information can be gained from the study of the lithic raw materials, in terms of resource procurement strategies; connectivity to distant areas; the spatial distribution of the materials; and any evidence for their preferential use?

Objective 2: What information can be gained from the study of the relationship between burnt and unburnt lithic pieces and can hearth-side locations, middens or other activity sites be identified?

Objective 3: What information can be gained from the study of the lithic technology regarding the form in which the material was brought to the site; the activities undertaken; evidence for cultural or chronologically specific traits and changes over time; any spatial patterning in the distribution of the material?

Objective 4: What information can be gained from the study of the lithic tool types regarding the activities undertaken; evidence for cultural or chronologically specific traits and changes over time; any spatial patterning in the distribution of the material?

Objective 5: What information can be gained from the study of the coarse stone regarding the activities undertaken; any spatial patterning in the distribution of the *material; and any association with other early Neolithic cultural material Do the polished stone axes form a group and how do they contribute to an understanding of stone axe studies in Cumbria and at large?*

Objective 6: What information can be gained from the study of the ochre?

Objective 7: What information can be gained from the study of the microwear regarding the character of activities undertaken at the site; the use of particular resources; settlement organisation; seasonality; and site formation?

Objective 8: What information can be gained through the integration of the various lithic studies and integration with the other analyses undertaken at Stainton West?

6.1.6 ***Updated Research Aim 5:*** How can the analysis of the altered wood assemblage recovered from Stainton West be used to understand human practice and past activity at the site?

Objective 1: What is the evidence for prehistoric woodworking?

Objective 2: What is the evidence for prehistoric woodland husbandry?

Objective 3: Can any preferences be discerned in the selection of wood?

Objective 4: What is the evidence for structured deposition of wood within the channel, and what, if any, meaningful associations may be discerned?

Objective 5: Does the spatial analysis of the altered wood provide additional information?

Objective 6: What can be determined regarding the function of the tridents from a consideration of ethnographic, archaeological and technological comparanda?

Objective 7: What is the function of the apparent wooden structures within the channel?

Objective 8: How can the altered wood add to the interpretation of the site when combined with the study of the stratigraphy, other artefacts, dating evidence and palaeoenvironmental remains?

6.1.7 ***Updated Research Aim 6:*** How can the analysis of the prehistoric pottery assemblage recovered from Stainton West be used to understand human practice and past activity at the site?

Objective 1: What information will be provided by a detailed analysis of the prehistoric pottery?

Objective 2: Can the possible use of the Grooved Ware pottery be determined from lipid residue analysis?

Objective 3: How does the pottery compare to other assemblages regionally and nationally?

Objective 4: How can the pottery add to the interpretation of the site when combined with the study of the stratigraphy, other artefacts, dating evidence and palaeoenvironmental remains?

6.1.8 ***Updated Research Aim 7:*** What is the evidence for Bronze Age activity at Stainton West?

Objective 1: What evidence do the burnt mounds provide, and what might have been their function?

Objective 2: How do the other Bronze Age features relate to the burnt mounds and what is their function?

Objective 3: How do the burnt mounds relate to the river, the wider landscape and the other Bronze Age evidence from elsewhere on the scheme?

Objective 4: Is there any relationship between the Bronze Age activity and the activity from earlier periods, and why might this area still have been attractive?

Objective 5: What does analysis of the artefactual data contribute towards an understanding of the nature, chronology and trading links of this period?

Objective 6: What further information on farming practices and management of the landscape can be determined from the environmental analyses?

Objective 7: Can a precise chronology be determined for the Bronze Age activity? Is there any difference in the types of remains encountered over time? Is there a change in the way people used and related to the landscape over the course of this period?

6.1.9 ***Updated Research Aim 8:*** What can be learnt about activity at Stainton West during later periods?

Objective 1: Was the area marginalised in later periods and why might this have been?

Objective 2: What does the presence of Iron Age and Romano-British finds tell us about the site and its environs at this time?

Objective 3: What was the nature of post-Roman land use at Stainton West?

6.1.10 ***Updated Research Aim 9:*** How can the chronometric data from Stainton West be used to interpret human practice and past activity at the site, and contribute to an understanding of the past ecology and environment?

Objective 1: What is the date of the activity at Stainton West?

Objective 2: To what extent do the radiocarbon data and the dendrochronological data support each other, and how might any discrepancies be explained?

Objective 3: How can stratigraphic modelling and Bayesian statistics be used to refine the chronology of the site?

Objective 4: How does the site chronology contribute to typological studies regionally and nationally?

Objective 5: How does the site chronology help to interpret patterns of environmental change?

Objective 6: How does the site chronology help to interpret social, cultural and economic transition?

6.1.11 ***Updated Research Aim 10:*** How can the results be disseminated to the widest possible audience most appropriately and effectively?

Objective 1: Can various different levels of publication be employed in order to appeal to a wide audience?

Objective 2: How might new technologies and digital media be employed to help disseminate the results of analysis?

Objective 3: Can the local and national media help to generate interest in Stainton West?

Objective 4: Is there any possibility of a permanent exhibition at Tullie House Museum and Art Gallery? How might the project be best conducted to help facilitate this?

Objective 5: Is there any scope for employing experimental archaeology, eg artefact reconstruction, to help to interpret the assemblage and communicate any understanding that is thereby achieved?

7 METHOD STATEMENT

7.1 Programme Structure

7.1.1 The following methodology is necessary to fulfil the revised research aims outlined in *Section 6*. The post-excavation programme will be divided into the following stages:

- full cataloguing of any data representatively sampled
- further sequential investigation of material, particularly the lithics and palaeoenvironmental samples
- analysis
- synthesis
- preparation of draft text and illustrative material
- final report/publication
- archive deposition.

7.2 Management

7.2.1 Management and monitoring of the project will include advice and co-ordination, problem solving, and meetings with project staff and all interested external parties. The aim will be to ensure continued achievement of the research objectives, and intelligent adaptation of strategy in order to meet these. A full review of the project will be carried out at regular intervals during its lifetime. Certain elements of the analysis will be contingent on decisions undertaken at designated review phases.

7.3 Tasks

7.3.1 The tasks necessary to complete the archaeological work are listed below and, together with the updated research aims (*Section 6*), these constitute an Updated Project Design for Analysis. To summarise, these consist of a phase of stratigraphic analysis, in combination with the results now available from the finds and palaeoenvironmental assessments, and any other results that derive from the analysis of these assemblages; preparation of comprehensive digital catalogues of the finds and palaeoenvironmental remains; and preparation of a final report. In the course of these tasks, the interpretation of the chronological development of the site will be completed (augmented by the results of a programme of scientific dating), and the digital archive will be updated and enhanced. The paper and digital archive will be prepared for deposition at the Tullie House Museum and Art Gallery, Carlisle, in accordance with standard practices and protocols (see *Sections 4.27 and 7.32*), and in negotiation with the museum's curatorial staff, to meet their deposition policies.

7.3.2 CCCHES has been invited to review the proposed Updated Project Design for Analysis and comment on a) the ability of the available data to fulfil the stated aims and objectives of the project and, therefore, the analysis to be undertaken; b) the likely form of any publication or any other means of dissemination. In the interim, OA North proposes that the appropriate dissemination of the results of the archaeological analysis should, as a minimum, include the production of a full archaeological publication (see *Section 7.31*).

7.4 Processing and Transport of Artefact Assemblages

7.4.1 The finds will be marked, where appropriate, or stored in marked bags or containers, to allow complete integration into the site database. At an early stage in the analytical programme, where required, arrangements will be made to transport all relevant assemblages to the designated external specialists, if they are not already in possession, to facilitate analysis and reporting of the material. Conversely, on the completion of this work, material will need to be received from the specialists, sorted and checked against database records.

7.5 Digital Data in the Analysis Phase

7.5.1 During fieldwork and this assessment, databases were compiled containing the stratigraphic, finds and palaeoenvironmental information from the project; they also include indices to the digital photographs and primary graphical sources. These databases will be audited and augmented throughout the programme of analysis. Ultimately, the information in the databases, in addition to the digital photographs and scans of the textual and graphic archive, will be included in the permanent site archive deposited with the receiving museum (*Section 7.32*), and some or all of the data may be presented in a digital format to accompany the final publication.

7.5.2 The survey and graphical data have been digitised, cross-referenced with the stratigraphic databases and incorporated into a GIS (Geographical Information System). The GIS will be updated throughout the programme of analysis and it may be desirable to incorporate mapping data from previous phases of work (*Section 1.4*). Digital mapping data may be provided as an accompaniment to the final publication. On the completion of the analysis, metadata will be compiled on the digital mapping data and will be provided to the Cumbria HER, along with databases and GIS shapefiles. Consideration should be given to deposition of key elements of the digital archive with the Archaeological Data Service, and this contingent option can be pursued at the client's or CCCHES's request.

7.5.3 Ancillary data accompanying the final report will be produced in digital format. This might, for example, include specialist reports and data; stratigraphic data; mapping; additional photographs and images.

7.5.4 The integrated, web-based database that will be produced throughout the course of the analysis programme will, in the first instance, facilitate research by organising and collating the site archive in a way which enables information to be easily retrieved, queried and cross-referenced with other data. It will also enable each member of the project team to remain current with other members' research. The data will be constantly validated as it is used, which should result in a more consistent archive.

7.5.5 There will be textual, photographic, graphic and geospatial elements to the web-based digital archive, which will be ordered in a logical manner within the relational database, and will be accessible and internavigable, whether or not the user has any prior familiarity with the dataset. It will be possible for an end user to download information from the archive, in standard file formats for local use. It is hoped that there will be a geospatial element to how the data are accessed and displayed, although, as a minimum, the spatial data will be available for download.

7.5.6 In addition to the database, the publicly available website will host a series of blogs providing information about the project in an accessible manner. These blogs will mostly include textual, graphic and photographic elements, and possibly other media. The blogs will be hyperlinked to the site assessment reports, as is appropriate, to enable the user to 'quarry' into the site archive in more detail if they are so minded. It is possible that the website could ultimately act as a platform for disseminating digital versions of final reports and publications.

7.5.7 It is presently anticipated that OA will continue to host the website, in a static format, at the completion of the project. This should enable others to continue to access the site datasets. It may also be possible to incorporate this content (partially or in its entirety) in any resulting museum display.

7.6 Stratigraphic Analysis

7.6.1 The stratigraphic data recovered from the excavation (as indicated in *Section 3* above) will need to be analysed in greater detail in order to refine the provisional phasing and resolve problems highlighted by the assessment. A broad stratigraphic framework has been produced for the assessment, but it is clear from this work that there are some areas where further detailed worked is required. This broad stratigraphic framework will therefore be reviewed and refined, and it will also be essential to compile detailed sub-phasing, which will require careful analysis of the primary records, all contexts, and site plans and sections.

7.6.2 All contexts need to be attributed to these phases and sub-phases once established, and the site database will then require updating and amending. In the course of this analysis, the site matrix will require redrawing to conform to the amended periods and sub-phasing, and to include those contexts which could not be resolved at the assessment stage.

7.6.3 A detailed analytical document of the stratigraphic information, accompanied by phase drawings, sections and other relevant line illustrations, as required, will be drafted. This will provide detailed information on the periods and sub-phases for the site. The draft text and phase drawings will form the basis both of the summary information to be supplied to specialists and of the stratigraphic section of the synthetic report for the project.

7.6.4 The site will be considered together with the other evidence from the CNDR project as a whole (OA North 2011a) and in relation to other known archaeological sites in the surrounding area, and to their wider landscape and regional context. This will involve an element of library-based research and cartographic analysis.

7.7 STRUCK LITHICS

7.7.1 ***Structure of Analysis:*** the programme for the analysis of the lithic finds will broadly comprise: sub-selection (Phase 1); analysis (Phase 2); and publication (Phase 3).

7.7.2 **PHASE 1:** this will seek to validate and order the digital data, and organise the lithic materials, so that the archive is compatible with the site stratigraphy, following assessment, and remains compatible throughout analysis. This process of reorganisation will also ensure that the materials required for further study are made accessible, with like stored with like, so this can proceed in the most efficient manner; the archive will remain so ordered, so that it can easily be accessioned by any future analysts.

7.7.3 The reorganisation will result in an ordered and indexed material archive, accompanied by corresponding box record sheets, cross-referenced to the lithic database. Generally, lithics will be collated by contextual group, with each group being further separated by type (small flakes, regular flakes, irregular flakes, chunks, blades and retouched pieces) and then arranged within discrete boxes, according to context numeric order; the retouched pieces, including the microliths, will be further ordered by classification (*eg* scalene triangles, fine points, *etc*) within their box. However, the cores, knapping events and small finds will be stored in a slightly different manner. Cores will, firstly, be boxed by type (*eg* single platform core, multi-platform core, *etc*), and then according to contextual group, in context numeric order. Knapping events will be collated and stored together by context. Small finds will be stored by context number, in numeric order, along with any lithics from the same context that were retrieved by sieving rather than being three-dimensionally recorded. A document will be produced explaining the logic behind the archive and a box number will be added to the lithic database for each line of data.

7.7.4 There will need to be some limited revisiting of certain categories of lithic finds in order to undertake an overall QA exercise and resolve any potential inconsistency that has entered the catalogue during the initial assessment. It should be noted that this will only apply to certain material types (tuff/limestone; grey flint/brown flint; ‘other'; and anomalous cherts), which form only a small proportion of the assemblage; this requirement could not have been anticipated or avoided at the outset of the assessment.

7.7.5 The various knapping episodes will need to be better defined, by identifying further elements of these that might exist in spatially contiguous contexts (those in adjacent grid squares and in deposits that are above or below the deposit in which the knapping episode was initially identified). Some further detailed characterisation of the microliths will need to be undertaken to allow the definition of sub-types within the principal categories. The catalogue will be updated throughout this process, and a certain amount of database redesign and enhancement will be required to facilitate the capture of analytical data in the most appropriate structure and format.

7.7.6 Once the material has been recorded and characterised, in accordance with the above, the aim will be to identify targeted samples for Phase 2. This will require a detailed interrogation of the lithic dataset, investigating and characterising it with reference to its spatial context. By drawing out potentially significant patterns, contrasts and correlations, analysis will be targeted on significant areas of the site or components of the lithic assemblage (see *Section 7.7.12*).

7.7.7 A degree of liaison with external specialists and research by the project team is anticipated to be required during this phase. Once a sub-selection has been made and a dataset isolated for Phase 2, it is proposed to hold a review meeting to explain how the selection has been made and on what basis; to seek general consensus; and to invite comment from to the extended project team.

7.7.8 **Phase 2:** this will concentrate on undertaking various types of analysis on the sample identified during Phase 1. These analyses will be performed by both external specialists and the in-house project team. Coordinating the timetabling and integrating the analyses will be critical to the success of the project. Those analyses that will take the longest time to complete (microwear and technological analysis) will need to be started early within Phase 2. Detailed proposals for technological analysis and microwear are included below (respectively *Sections 7.7.16* and *7.7.22*). Other less time-consuming tasks will run concurrently with the microwear and technological analysis of the struck lithics. These will include the analysis of the retouched lithics (*Section 7.7.20*); raw material sourcing of some of the chert (*Section 7.7.30*); petrological characterisation of the pitchstone (*Section 7.7.38*); technological analysis of all of the coarse stone (including tuff; *Section 7.8*); and analysis of the ochre (*Section 7.10*).

7.7.9 Following the completion of analysis, during the latter part of Phase 2, a further detailed investigation and interrogation of the enhanced dataset will take place to look for meaningful patterns within the assemblage. A degree of research and specialist liaison is anticipated during Phase 2, and some illustrator time will be required to capture and present the results of the analysis. A project review meeting will be held at the end of the Phase 2 analysis to disseminate its findings to the extended project team and discuss how these results can be combined and presented within the publication arising out of Phase 3.

7.7.10 **Phase 3:** a text will be prepared to describe and present the results of analysis for publication. It is anticipated that a variety of levels and formats will be required. Technical reports, which will be targeted at a specialist audience, will be produced to discuss the assemblage by technological period and raw material type; reports will also be produced discussing the microwear, statistical analysis and spatial distribution of the assemblage. It is probably the case that these reports will be published via digital media, although overviews or abridged versions may appear in the over-arching hard copy publication. Additionally, salient information from the analysis of the lithic assemblage will be integrated within this text. Plates and illustrations, at an appropriate level of detail, will form part of any digital and paper reports.

7.7.11 Within both digital and paper reports, indexing will enable readers to query additional detail from the lithic catalogue on the website, the functionality of which will be enhanced to enable various levels of querying. The aim of the publication will be to make the results of the lithic analysis available, in an accessible format, to an interested, non-specialist readership, the focus being on what it has to tell us about past societies. However, a lithic specialist readership should also be able to obtain the information that they require from the publication without undue effort.

7.7.12 ***Spatial Analysis:*** during the lithic assessment, it became apparent that the worked stone assemblage was chiefly preserved *in situ* and had suffered lightly from the effects of taphonomic processes. Concomitantly, it has also become clear that there is spatial structure and patterning to certain components of the assemblage, principally diagnostic tool types and some raw material types. Building on the results of these observations, it is highly possible that meaningful spatial variability could exist in further components of the assemblage; however, in order to test for the survival of this, a more intensive level of data interrogation needs to be applied across the entire assemblage.

7.7.13 If the survival of further spatial configurations within the lithic assemblage are identified during Phase 1 of the analysis, they will provide a valuable data sub-set/s, which can be investigated, through detailed technological analysis (*Section 7.7.16*) and microwear studies (*Section 7.7.22*), in order to answer certain site-specific questions relating to the character, extent and chronology of occupation activity.

7.7.14 In order to test this hypothesis, it is proposed that a series of database queries should be run across the main dataset. The results of the queries will then be analysed spatially in a GIS software package. The queries will be constructed at varying levels of detail, depending on the questions being asked of the data, by utilising one or more of the main data fields used to create the lithic database during the assessment (raw material, burnt, type, sub-type, classification, *etc*).

7.7.15 Some of the themes and associated questions, which will guide the interrogation of the lithic assemblage in order to test for the survival of spatial structures and patterns, have been suggested within *Section 6*. While these themes and questions can be considered representative, this is not an exhaustive list, and analysis will be an iterative process, whereby initial results will be used to build more complex queries in order to test for spatial associations between data fields. Spatial analysis will form the matrix in which the other analyses are embedded, and will aim to engender an understanding of human practice at the site, whereby the relationships between people, place and landscape can be understood.

7.7.16 ***Technological Analysis:*** a 20% sample (*c* 20,000 pieces) of the chipped stone assemblage will be selected for detailed technological analysis. The sample will consider all parts of the assemblage except the small flakes, retouched pieces (formal tools and miscellaneous retouched blades and flakes) and the microliths. The retouched pieces will form the basis of a separate analytical study (*Section 7.7.20*). The microliths have already been subjected to metrical and technological analysis during the assessment, but, as this work progressed, it became clear that certain microlith forms will benefit from further classification to emphasise their variety in form and manufacture. This work will be undertaken during Phase 1 of the programme of analysis (*Section 7.7.2*).

7.7.17 The selection of the 20% sample will be based on the results of the spatial and stratigraphic analysis, and the quantification and characterisation of the potential knapping episodes undertaken in Phase 1 of the analysis. The resulting detailed technological analysis will involve the recording of the physical characteristics of the worked stone and the metrical recording of all complete pieces. The material will be characterised in technological terms, with the aim of identifying the range of stone working represented within the assemblage. This will involve recording a number of technological criteria, such as an assessment of the orientation of scars on the dorsal surfaces of complete flakes and blades, termination types, and the characterisation of platforms. Additionally, complete flakes and blades will be characterised and quantified in terms of their position within a generalised reduction sequence. Cores and core-maintenance pieces will also be characterised. A metrical analysis of flake/blade widths on core faces will be undertaken on certain cores in order to understand further blade and flake production and tool manufacture.

7.7.18 The results of the technological analysis should allow an understanding of a range of stone-working activities: how different raw materials were worked; how this changed over time; the types of blades and flakes being produced; how they were used in the production of tools and microliths; and so on. The technological analysis will also integrate the results of the microwear analysis, raw material sourcing and spatial analysis in order to understand the range and extent of stone working and utilisation across selected parts of the site.

7.7.19 A full report will be produced for the archive detailing the findings of the technological analysis, which will also consider the contextual and chronological significance of the assemblage across the wider region. The report will also use tables, charts and line drawings to illustrate the main points presented in the text. Finally, the results will be synthesised and integrated into the synthetic report for the project.

7.7.20 ***Retouched Lithics:*** the retouched pieces, edge retouched, scrapers, awls, *etc*, will be visually inspected by group to check for coherence, with a view to regrouping or sub-grouping similar artefacts contextually and by spatial association. This will be especially pertinent to the edge-retouched classifications in order to refine further this group of artefacts. The retouched pieces will also be considered in association with the microliths in order to check for any contextual or spatial arrangements between them. This latter phase of work will involve analysing spatial distributions rather than any further analysis of the microliths.

7.7.21 The results of this analysis will then be considered alongside published accounts of retouched pieces from sites of a similar date. This is expected to draw out a further understanding of the role of retouched pieces on Late Mesolithic sites, about which very little detailed work exists. A specialist report will be produced, which will be included within the project archive, and the project database will be enhanced as required. The salient results will be integrated into the synthetic report for the project.

7.7.22 ***Lithic Microwear:*** preliminary microwear assessment (*Section 4.4*) has demonstrated that some of the material from Stainton West is highly suitable for use-wear analysis. Additionally, the lithic material has undergone variable post-depositional modification that will contribute towards an understanding of the formation of the site over time. Of a potential sample of at least 35,225 pieces, identified at assessment, a representative (but not proportional) sample of 1733 flint artefacts will be examined during analysis for wear on edges, surfaces, and ridges that was caused by natural processes. Up to 1000 of these artefacts will be sampled for detailed analysis of wear from use and other processes; some of these will also be analysed for residues, if suitable.

7.7.23 The aims of the microwear study have been presented in *Section 6*. To enlarge on this, microwear will specifically look at the functional evidence on microliths from the site and assess whether there is any evidence for use, other than their long-held association with projectile armatures (*eg* Grace 1992, 53-63; Hardy 2004; Finlayson and Mithen 2000). Debitage, including cores, will be studied for functional evidence of their use as tools. Scrapers are rare on Later Mesolithic sites (Ellaby 1987, 65), and Spikins (2000, 115) cites evidence for the use of cores as scrapers on at least one site. Unretouched pieces have been found to be functionally as important, if not more so, than formal tool types (Hardy 2004, 41; Grace 1992, 62). Specific tool forms, such as truncations, the precise function of which is unknown (Reynier 2005, 134), will be analysed for any functional evidence of their use. Ellaby (2004, 20) has suggested that many of these pieces could be classed as piercing or boring tools, and Donahue (2002, 83) reports microwear evidence for piercing on the distal corners of a truncated blade from a site in Bermondsey. Consideration will be given to any evidence for microlith hafting or use in plant processing. Zvelebil (1994, 56) notes that, although microwear analysis of microliths in Britain has generally proved inconclusive, evidence of plant wear has been found on blades from the Late Mesolithic period in Denmark and Poland. Reynier (2005, fig 8.4) draws attention to a plant-harvesting knife from Africa which incorporates a hollow-based point and scalene triangle.

7.7.24 The microwear analysis will be performed by Dr Adrian Evans under the management of Dr Randolph Donahue, at the Lithic Microwear Research Laboratory of the School of Applied Sciences, University of Bradford. The sampled artefacts will be laid out in trays with labels and photographed to avoid any mixing up of material. They will then be gently washed in water with a soft nylon brush to remove adhering sediment. Artefacts will be soaked in 10% HCl for ten minutes, rinsed in water, then soaked in water for a further ten minutes. They will then be rinsed and patted dry with a clean, lint-free towel. Ethanol will be used to degrease artefacts during examination if necessary.

7.7.25 The artefacts will be examined principally at 200x magnification with an Olympus KL-BH2-UMA metallurgical microscope with incident-light and long working-distance objectives. Microscopic characteristics of edge-fracture scars, striations, pitting, and surface polishing will be recorded, classified, and interpreted (following Donahue 1988; 1994; 2002; Burroni *et al* 2002).

7.7.26 In addition to traditional microwear variables that are recorded for assessing the causal mechanism for wear phenomena, measurements quantifying the post-depositional modifications will also be collected. These data provide the means to evaluate use-wear interpretations further and to understand better the variation of post-depositional processes within and between contexts (Donahue 1998; 1999; 2002; Burroni *et al* 2002; Donahue and Burroni 2004). They also improve the comparability of use-wear results between sites. Major disturbance events and processes will produce various kinds and degrees of edge-fracture scarring, striations and other surface modification. Severe thermal alterations will produce microcracking, potlidding, and crazing of surfaces (Donahue 1999). A principal concern here is to identify and measure the effects of processes causing the gradual loss of material through abrasion or attrition. One technique for achieving this is by measuring the amount of dorsal-ridge rounding. Most kinds of use-wear will be obliterated on most surfaces when natural wear has rounded ridges to a value of 14.1µm. The preliminary study indicated that over half of the artefacts observed had ridge rounding less than 4.5µm.

7.7.27 The method of residue analysis is determined by the types of residues identified autoptically and the use questions surrounding individual tools. Starch, pollen, other plant remains, and fibrous residues can be identified using Pol microscopy by autoptic comparison. Protein residue analysis will be attempted, when appropriate, using SDS-Page for quantification and the ELISA immunological identification process.

7.7.28 The analysis will take place in stages, with each phase of work being contingent on the success of the previous phase (with regard to showing clear potential to satisfy the research aims of the project; *Section 6*), following review by OA North and CCCHES. It is anticipated that during Phase 1 (*Section 7.7.2*) *c* 20% of the microwear (in terms of the overall sample and value of the work) will be undertaken. This sample will be selected in order to answer specific research questions that arise out of further detailed characterisation of the assemblage; specifically, technological analysis (particularly of the knapping scatters; *Section 4.3.5*), spatial analysis and data interrogation (*Section 7.7.12*). The Phase 1 sample will be analysed to completion, resulting in a catalogue of results suitable for inclusion within a final specialist report, and a concise interim explanation of the significance of these results.

7.7.29 Further stages of work will follow throughout Phase 2 (*Section 7.7.8*), subject to the Phase 1 review finding that this is merited, analysing the remainder of the sample or a proportion of it. This work will continue to target research questions arising from analysis; will feed iteratively back into the analysis; and will deliver a catalogue of results and an explanation of this. The analysis will conclude with the production of an illustrated specialist report and a database of the results, both of which will form part of the project archive. The salient results will be integrated into the synthesis.

7.7.30 ***Raw Material Sourcing:*** there is a variety of different lithic materials represented within the Stainton West assemblage and, for many of these types, it is possible to form an hypothesis about the source (*Section 4.3.10*). A substantial proportion of the assemblage comprises chert, within which a range of types exist (*Section 4.3.12*). Of particular research interest is the good-quality black chert found at Stainton West. This either comes from the Southern Uplands of Scotland (Ward 2010) or from one or more sources in the north of England (Evans *et al* 2007; Evans *et al* 2010). Establishing the provenance(s) for this black chert, as well as the other lithic types at the site (see also *Sections 7.8.1* and *7.7.38*), will greatly enhance its interpretation, particularly in terms of how it may have been connected to distant places and communities.

7.7.31 The sourcing of the raw material will be performed by Dr Adrian Evans, under the management of Dr Randolph Donahue, at the Lithic Microwear Research Laboratory of the School of Applied Sciences, University of Bradford. The samples will be prepared by a technician.

7.7.32 The aim of the study will be to identify groups of artefacts made of the chert that display similar physical characteristics but are chemically distinct from each other. Chemical difference in physically similar chert types is an indicator of the exploitation of various sources. This project will be linked directly to an independently (AHRC) funded research programme (submitted by Dr Donahue and Dr Evans) to identify and characterise sources such that the two studies can be combined to provide provenance information regarding the chert recovered at Stainton West. The latter research programme will involve collecting field samples of chert from 60 locations (including bedrock formations, potential outcrops, glacial movements and river courses) that could have served as chert sources for Stainton West. Further research will be undertaken to identify the most suitable target areas for field collection, but likely candidates will almost certainly lie within southern Scotland, Yorkshire and Cumbria. These samples will be geochemically profiled, to augment baseline datasets, for comparison with the Stainton West cherts (*Section 7.7.36*). Additionally, analogue samples of radiolarian black chert collected from the Southern Uplands of Scotland will be tested to provide comparator baseline data. With regard to the latter, it is hoped to continue liaison with Rosemary Stewart, who is undertaking research on the geochemical profiling of these cherts as part of her PhD at Reading University.

7.7.33 Trace-element analysis, specifically laser ablation ICP-MS, is suggested as the most efficient and non-destructive method of profiling the geochemical signatures of the chert (Evans *et al* 2007; Evans *et al* 2010). The assemblage will be sampled in cooperation with OA North's lithic specialists to ensure that the collected sample is representative of the material at the site but also targeted to include several already identified knapping clusters (*Section 4.3.5*). In total, *c* 500 pieces will be sampled for analysis. Selection of the pieces will be limited to those that are under 30mm long/wide with flat surfaces, and may include some pieces that are larger, but the partial destruction of which has been agreed between OA North and the CCCHES. Destruction in these cases would be to reduce a piece, by snapping, down to a size that will fit the sampling chamber for laser analysis.

7.7.34 The sampled pieces will be cleaned using a cleaning solution without phosphates in an ultrasonic bath for ten minutes, before being dried and mounted in a temporary resin to facilitate consistent analysis. This is a non-destructive and reversible process.

7.7.35 The samples will be autoptically assessed using an Olympus BH2 reflected-light microscope to see if they can be grouped based on microscopic inclusions. Analysis by LA-ICP-MS will be performed with a PlasmaQuad III coupled with a VG MicroProbe II. Chemical concentration data will be collected on nine elements: lithium (7Li), magnesium (24Mg), vanadium (51V), manganese (55Mn), strontium (88Sr), barium (137Ba), lanthanum (139La), and dysprosium (163Dy), using a selection based on prior understanding of variable trace element chemistry in black cherts in Northern England. Data will be collected for 100 seconds of ablation (spot size: 125µm, scan speed: 40µm/s, lasing rate: 10Hz, dwell time: 10ms, laser energy: 0.5mJ) using time-resolved analysis. The results of the individual analyses of the artefactual and geological samples will be normalised and calibrated using the NIST standard reference material (SRM); 613 was used for this purpose. Analysis of this standard will be completed at the beginning and end of every session, and between every five samples. In the construction of the calibration curves, values, provided by Pearce *et al* (1996; table 9) for the standard glass, will be used.

7.7.36 Irrespective of the proposed parallel study (*Section 7.7.32*), which will certainly make an immense contribution to the interpretation and comprehension of the results from Stainton West, the analysis of the chert specimens, from the knapping scatters and from the other samples from the site, will have independent research value. At the site-specific scale, it will potentially enable superficially similar cherts from different provenances to be distinguished, on the basis of their distinct geochemical signatures. This characterisation could operate both within and between knapping events, contributing towards the technological interpretation of the lithic assemblage and the site more generally. It will provide a catalogue of geochemical signatures for the chert, upon which future research can draw, and will establish the foundations for a regional database. The baseline data that already exist because of similar studies undertaken in northern England (Evans *et al* 2007; Evans *et al* 2010), and which will be added to by profiling black radiolarian chert samples during this project, will enable preliminary hypotheses to be proposed regarding the likely articulation of Stainton West, Southern Scotland and areas east of the Pennines.

7.7.37 The analysis will conclude with the production of an illustrated report and a database of the results (the chemical signatures of the black cherts and variation between types), both of which will form part of the project archive. The salient results will be integrated into the synthetic report for the project.

7.7.38 ***Pitchstone:*** a significant amount of flaked pitchstone pieces has been recovered as part of the Stainton West lithic assemblage (*Section 4.3.10*). The source of this material is most probably the Scottish Isle of Arran (Williams Thorpe and Thorpe 1984; Ballin 2009; Ballin and Faithfull 2009). During the analysis phase of the project, the pitchstone will be non-destructively tested, using x-ray fluorescence spectrometry (XRF), to determine the geochemical constituents of the lithics. This analysis should establish whether they are from a single quarry or multiple sites on Arran, or from the surrounding islands. The exiguous assemblage of recently discovered Cumbrian examples will also be tested, in an attempt to establish a pattern of trade and movement in the Eden Valley and beyond, and to place Stainton West in its wider context.

7.7.39 The analysis will be undertaken at the University of Central Lancashire, a reference collection of pitchstone analogues being loaned by Torben Bjarke Ballin. In addition to the Stainton West assemblage, permission has been obtained to access lithics from Tullie House Museum and Art Gallery (Carlisle), Penrith and Eden Museum, Kendal Museum, and the Dales Countryside Museum (Yorkshire Dales National Park). Additionally, David Coward and Peter Cherry have both offered lithics from their research projects.

7.7.40 All specimens (analogues and lithics) will be tested on the same ‘Bruker Tracer IV-SD’ XRF machine, with a variety of filters and on a number of settings. The results of the chemical data for the analogues will be compared to those from the lithics, a match indicating probable provenance. The results of the analysis will be combined into a database and a report will be produced, both of which will form a part of the project archive. The salient results will be integrated into the synthetic report for the project.

7.8 Coarse Stone

7.8.1 The analysis of the coarse stone will involve a consideration of the spatial and stratigraphic context of the assemblage and its association with other materials and artefact types. The raw material will need to be identified by a geologist. Each artefact will be catalogued fully with regard to manufacture, wear traces and dimensions, and the information entered on the database. The tuff and stone tools from the palaeochannel may merit some refitting analysis. A full report will be produced for the archive, examining aspects of raw material selection; a review of the various types of artefact present; their context; distribution; function; chronological indicators; and comparisons with other sites of that period in the wider region. The salient details will be integrated into the synthetic report for the project.

7.9 Stone Axes

7.9.1 No further analysis of the stone axes will be required, beyond a reconsideration of their interpretation following the analysis of the other worked tuff (*Sections 4.5* and *7.8*) recovered from the site, and a closer study of the context of their recovery (*Section 4.6.10*). The assessment report will be included within the project archive and the results integrated into the synthetic report for the project.

7.10 Ochre

7.10.1 The analysis of the ochre will involve a consideration of the spatial and stratigraphic context of the assemblage and its association with other materials and artefact types. All of the ochre pieces will be weighed and measured and then examined with a hand lens for any striations, facets, *etc*, which demonstrate use. All additional information will need to be added to the project database. A full report will be produced for the archive, examining where the ochre may have derived from; taphonomic factors affecting the differential survival of ochre across the site; how and where the ochre was used on the site; any associations with other stone tools, *eg* scrapers or awls, or particular microwear traces which may indicate specific activities, such as hide preparation; and a background discussion of the use of ochre at Stainton West, compared with its presence at other early prehistoric sites. The salient details will be integrated into the synthetic report for the project.

7.11 Residue Analysis of Arrowhead Hafting Material

7.11.1 No further analysis of the material used to haft the arrowhead will be required. The assessment report will be included within the project archive and the results integrated into the synthetic report for the project.

7.12 Prehistoric Pottery

7.12.1 The assemblage is worth reporting in more detail in the final publication, and several sherds, particularly the Grooved Ware, may merit illustration. Radiocarbon dating and residue analysis should be considered, and thin-section and geochemical analysis may be justified on a representative selection of sherds. Most of the ceramic is stable, although somewhat friable. The paucity of diagnostic or larger pieces suggests that conservation is not justified, however. The analysis of the assemblage will result in the production of a specialist report, which will be included within the project archive. The results will be integrated into the synthetic report for the project.

7.13 Romano-British Pottery

7.13.1 An archive catalogue of this assemblage will be prepared, and its presence or absence noted in any stratigraphic discussion. Some sherds may require illustration in the report.

7.14 Medieval and Post-medieval Pottery

7.14.1 An archive catalogue of this assemblage will be prepared, and its presence or absence noted in any stratigraphic discussion. Following discussions with the receiving museum, at least some of the material may be discarded.

7.15 Beads

7.15.1 An archive catalogue of this assemblage will be prepared, and its presence or absence noted in any stratigraphic discussion. The early glass and stone beads will be fully recorded, including their illustration, and may bear further specialist analysis, regarding their composition and manufacture. The salient results from analysis of the assemblage will be included the synthetic report for the project. Following discussions with the receiving museum, at least some of the modern material may be discarded.

7.16 Altered Wood

7.16.1 There are very few assemblages of debris from working wood with stone tools, and even fewer have been examined or recorded in detail. The small amount of material which has been studied, however, clearly indicates that the techniques for using stone tools are distinctively different from those required for metal. The Stainton West material has quite clearly been worked using stone tool techniques and the assemblage from this site presents an excellent opportunity to examine these techniques in detail. Analysis of the altered wood will consider, amongst other things, the wider context of the assemblage; the evidence for woodland husbandry; the woodworking techniques employed; and the form and function of the artefacts.

7.16.2 The woodworking technology was recorded on a series of pre-printed wood sheets, which were designed for data catchment in the field and in the laboratory. In order that this data can be exploited to the maximum, it needs to be transferred to a computerised analytical database. The design for such a database has been developed over many years at Flag Fen, Peterborough. Analysis of the data will then be much more straightforward and compatible, for comparative purposes, with a number of other sites.

7.16.3 A detailed and complete analysis of all the material from the site is important because much of the wood is detritus from various forms of woodworking: coppicing, tree felling *etc*. The analysis of debris, plus the insight it gives into the selection of raw material, will be an important part of the research.

7.16.4 The method of manufacture of the tridents should be quite clear because of the quality of preservation. Fine wooden Neolithic artefacts are rare and generally take the form of axe hafts. The tridents have been made using some of the techniques for producing axe hafts, but the methods used for fabricating all parts of the artefacts are less clear. The analysis of how these artefacts were made is very important and can be used to reassess the similar finds from Ehenside Tarn (Darbishire 1873) and from Co Armagh (Wilde 1857), where the details of their manufacture are not clear. No modern reassessment of these artefacts has been made, and the data derived from the Stainton West examples will help to clarify some details of these other artefacts. The method of fabrication may also provide insight into the possible function of the objects.

7.16.5 Intensive analysis of individual pieces of wood, together with extensive examination of the different classes of debris, should help to clarify activities in different parts of the site. There is a general 'domestic' element to a great deal of the woodworking, as well as the specialised manufacture of remarkable and 'special' artefacts. It is interesting that the two exist side by side. The intensive and extensive analyses together should advance the study of prehistoric woodworking; the use and specialised techniques associated with the use of stone tools; the way that the environment was exploited to produce the raw materials; the nature of the raw materials required, and how these were sourced and harvested.

7.16.6 This analysis will result in the production of a report, which will be included within the project archive, the salient results of which will be integrated into the synthetic report for the project. The photographic archive will be rationalised and associated with the appropriate record in the wood index within the CNDR digital database, and images and illustrations will illuminate the report. The conserved pieces will be deposited with the Tullie House Museum and Art Gallery, and it is hoped that the tridents and other preserved pieces will be put on public display.

7.17 ANIMAL BONE

7.17.1 An archive catalogue of this assemblage will be prepared, and its presence or absence noted in any stratigraphic discussion. Following discussions with the receiving museum, some or all of the material may be discarded.

7.18 INSECTS

7.18.1 The insect faunas recovered form Stainton West should be fully analysed. Even though the insect faunas are essentially similar across the various bays, they are diverse enough to suggest that more than one location merits study. In total, 30 samples are recommended for further analysis, as shown in Table 21. The analysis of the insects will need to be carried out in conjunction with the pollen (*Section 4.19*) and plant macrofossil analysis (*Sections*

4.16 and *4.17*).

Bay	Number of Samples for Analysis
A	1
B	5
D	4
F	2
I	2
O	4
V	2
X/W	4
X/Y	2
Z	4

Table 21: Insect samples recommended for analysis by bay

7.18.2 The analysis of the assemblage will result in the production of a specialist report, which will be included within the project archive. The results will be integrated into the synthetic report for the project.

7.19 Waterlogged Wood

7.19.1 The assessment of the waterlogged wood shows that it has considerable potential to enhance the interpretation of the site by complementing the information provided by other palaeoenvironmental research. It will also provide a background to an understanding of the regimes of woodland husbandry and the cultural selection and modification of the wood. Fuller analysis of the existing data in relation to the other palaeoenvironmental evidence from the site will be required, as is further work on the correlation between wood species and wood type. Accompanied by additional dating evidence, this correlation may be key to understanding the taphonomy of the wood in relation to the immediate environment of the site. It will also be worth checking the elm wood for any evidence for the beetle believed to be responsible for spread of Dutch Elm Disease.

7.19.2 The information generated by the further research will be incorporated into the site database. A report will be produced and the salient points will be integrated into the synthetic report for the project.

7.20 Waterlogged Plant Remains

7.20.1 It is recommended that 23 of the assessed WPR samples are taken to full analysis. These come from a range of deposits within the palaeochannel sequence, and will account for variation over time and space. They will also provide good comparison with the results of other specialist analyses, including insects, pollen and soil micromorphology. The analysis of the assemblage will result in the production of a report, which will be included within the project archive. The results will be integrated into the synthetic report for the project.

7.21 Charcoal and Charred Plant Remains

7.21.1 Material will be selected and isolated for radiocarbon-dating purposes (*Section 7.28*). Those assemblages highlighted as worthy of analysis (*Sections 4.17.11-14)* will be characterised and considered in detail with regard to the information they can provide concerning their stratigraphic context and the wider interpretation of the site, as well as the environment and economy of the period they date to. The analysis of the assemblage will result in the production of a report, which will be included within the project archive. The results will be integrated into the synthetic report for the project.

7.22 Pollen

7.22.1 Targeted full pollen analysis, including counts for microscopic charcoal, a range of herb taxa and non-pollen palynomorphs (fungal spores), and accompanied by specific radiocarbon dating of sediments, will greatly contribute to the interpretation of Stainton West and the environment of the River Eden valley. High-resolution pollen analysis will enable the identification of any breaks in sedimentation or any potential hiatus present within the sequences analysed. Specific recommendations for a maximum of 315 sub-samples (to be taken at 20mm intervals) are given in Table 22. The radiocarbon dates are required in order to ensure that there is ample scope to correlate the results from cores analysed at different locations and accurately date all significant horizons.

Bay/Feature	Sample	Depth (m)	Total Depth (m)	Number of Radiocarbon Dates
B	70222	1	1	5
B	70219	0.10	0.10	1
B	70225	0.35-1.10	0.75	3
V	71158	0.5	0.5	2
V	71155	0.3	0.3	1
D (Trident)	70296	0.10-0.50	0.4	2
D	70246	0.40-0.90	0.5	3
F	70250	0.35-0.75	0.40	1
F	70252	0.05-0.70	0.65	3
O	70507	0.13-1.11	0.98	5
O	70513	0.23-0.46	0.23	2
Burnt Mound 4	70235	0.04-0.28	0.24	1
Polissoir pit ***70129***	70228	0.3-0.6	0.3	1
			6.29m	**30**

Table 22: Pollen samples recommended for analysis

7.22.2 This selection has been chosen in order to achieve a full sequence from deposits where pollen is well preserved, and to account for any lateral variation across the channel, as well as any specific complexity and disjunction between the lower and upper part of the sequence. Two of the samples (trident and *polissoir* pit) have been chosen, since they directly correspond to material instances of human intervention within the sequence, so they will potentially provide direct correlation between human activity and horizons within the pollen sequence. Where possible, and where this is likely to provide only replicate data, care has been taken to avoid duplicating the sequence sampled.

7.22.3 It is not necessarily the case that all the above samples will be analysed. CCCHES has indicated that it considers that certain samples (those from Bay D), to be, potentially, duplicate results, and should be considered of lower priority. Consequently, although these samples are included in this proposal, they shall be treated as contingent, and only analysed if the results from the analysis of the other samples suggest it is likely that they will contribute significantly to the research aims of the project (*Section 6*). This decision will be made through consultation between OA North and CCCHES.

7.22.4 There may well be potential for high-resolution analysis of pollen (for example at 1mm intervals), if significant horizons (such as an elm decline) are identified during the analysis. This will probably lie beyond the scope of this project, unless an academic partnership can be encouraged, which will yield results within the project timetable (*Section 5.3.19*). However, if this potential does become apparent, and such enhanced research is not for any reason practicable, viable samples will be preserved for a short period and offered to others for their own research.

7.23 Foraminifera and Ostracods

7.23.1 No further analysis of the foraminifera or ostracods will be undertaken. However, the assessment report and data will form part of the project archive, and the salient results will be integrated in the synthetic report for the project, as is appropriate.

7.24 Diatoms

7.24.1 No further analysis of the diatoms will be undertaken. However, the assessment report and data will form part of the project archive, and the salient results will be integrated into the synthetic report for the project, as is appropriate.

7.25 Geoarchaeology

7.25.1 No further geoarchaeological analysis is required *per se*. However, the interpretations deriving from this assessment will be integrated into the synthetic report for the project, after they have been validated against the results of other specialist analyses, when these become available. Some further enhancement and refining of the geoarchaeological model will take place, drawing from the available data. A limited amount of further research will be required to ensure that interpretations remain situated within the wider academic context. If required, the geoarchaeological model can form the basis for digital reconstructions of the site and the surrounding landscape.

7.26 Soil Micromorphology

7.26.1 At least 22 thin sections and 26 bulk analyses are recommended for analysis. In addition, six particle-size analyses are recommended and ten samples are recommended for magnetic susceptibility studies (with fractional conversion). Lastly, LOI, pH and P analyses are recommended for 15 representative natural and specially selected anthropogenic samples.

7.26.2 The soil micromorphology studies will be complemented by bulk analyses for LOI (organic matter estimates), pH, and, where appropriate, particle size, P and magnetic susceptibility. Such combined investigations have been employed previously at wetland-dryland/coastal/estuarine/intertidal sites (Crowther 2000; 2003; Crowther and Barker 1995; Cruise *et al* 2009; Macphail 1994; 2009; Macphail *et al* 2010; Macphail and Crowther 2004).

7.27 DENDROCHRONOLOGY

7.27.1 The principal aim of the dendrochronological analysis will be to refine the channel chronology by obtaining more precise dates for the undated clusters of wood identified during the assessment. This will be achieved by a programme of radiocarbon dating and ‘wiggle-matching'. Wiggle-matching is the process of 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 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).

7.27.2 A Bayesian approach to wiggle-matching will be applied, as described by Christen and Litton (1995) and Bronk Ramsey *et al* (2001). Specifically, this will take the form of numerical integration, using the program OxCal v4 (http://www.rlaha.ox.ac.uk/orau/). Details of the algorithms employed for this application are available from the on-line manual or in Bronk Ramsey (1995; 1998; 2001; 2009a). Simulation has suggested the likely accuracy of the radiocarbon results achieved by wiggle-matching currently undated wood from Stainton West, assuming sufficient samples are dated, will be ±30 years. This will significantly enhance the palaeochannel chronology.

7.27.3 Targeted radiocarbon wiggle-matching of key samples from the four undated clusters (*Section 4.24*) may help to clarify their chronological relationships with each other. Additionally, a large trunk (76271) on the interface between the *Mesolithic organic deposit* and the *Earlier Neolithic alluvium* will merit closer dating on stratigraphic grounds. In total, this will require an additional 30 radiocarbon dates.

7.28 RADIOCARBON DATING

7.28.1 Following analysis of the stratigraphy and a reconsideration of the material suitable for dating (*Section 4*), further samples will be selected for radiocarbon assay. Certificates will be prepared for these samples and submitted along with them to an appropriate laboratory. The aim will be to establish the robust association of the dated material with their parent deposits by secondary sampling of the same deposits, and to date deposits and features that have not yet been reliably dated. Primacy will be given to those deposits and features that have the greatest potential to enhance stratigraphic or specialist interpretations. It is anticipated that these samples will include *c* 75 samples from flots of CPR and charcoal from bulk samples, and CPR, charcoal or sediment samples extracted from monoliths (Table 23). In the case of the latter, consideration will be given to the presence of other significant data (such as pollen horizons) and to obtaining results in sequence (*Section 7.22*; Table 22). Additionally, the programme of radiocarbon dating will include a series (*c* 30) of samples that will seek to provide absolute dating, by 'wiggle-matching', for the currently undated dendrochronological clusters (*Section 7.27.3*). As the analysis progresses, the English Heritage Science Advisor for the North West and CCCHES will be consulted regarding the specific radiocarbon dating strategy, which will be undertaken in phases.

Provenance	**Number of Samples**
Pollen Cores	30
Dendrochronology	30
Features in grid square area	15
Burnt mounds and settlement features	10
Burnt mound deposit in the palaeochannel	2
Structures and altered wood *etc* in the palaeochannel	14
Artefacts	4

Table 23: Proposed radiocarbon dating programme

7.28.2 Wherever possible, Bayesian modelling will be undertaken (*Section 4.25.15*). The results will be incorporated within the stratigraphic narrative and an over-arching report prepared for the synthetic report for the project.

7.29 Integration of Datasets and Synthesis

7.29.1 The information gathered from analysis of the finds will be reviewed and integrated into the stratigraphic narrative. This will allow re-interpretation of the site using a thematic approach. The GIS will allow detailed interrogation of the data and the testing of hypotheses and phasing.

7.30 Illustrations

7.30.1 During each part of the analytical programme, a selection will be made of appropriate material for illustration. This will include general plans and sections, phase plans, photographs, and artefacts. Illustrations will be produced by experienced illustrators, using standard conventions.

7.31 Production of Text and Publication

7.31.1 Following the completion of the analysis of the stratigraphical and artefactual evidence, a comprehensive final report will be produced for publication as a monograph (*Lancaster Imprints* Series). All media placed within the public domain will integrate the results of work undertaken on all parts of the CNDR (OA North 2011a), including Stainton West. Prior to publication, the draft text will be submitted for internal revision, peer review, and review and comment by CCCHES and EH, and will be passed to all specialists after editing, for their comments. The exact word length cannot as yet be precisely estimated, although the main publication will comprise a single volume, which is unlikely to exceed 200,000 words. This will target both an academic and informed audience and will be written in an accessible style. The results of the project will be presented and situated within their wider archaeological context, locally, regionally and nationally, as is appropriate. It is possible that the publication will be accompanied by digital media, such as a website and/or CD containing digital plans, catalogues and specialist reports.

7.31.2 OA North suggests that serious consideration should also be given to more popular forms of dissemination, for instance a popular publication, schools' packs, websites, museum displays/exhibitions *etc*. The site is particularly important archaeologically and wider dissemination of the results will provide Cumbria with a valuable return on its research investment. The sites along the scheme lend themselves to interdisciplinary study, being relevant, for example, to such themes as technology, the natural environment and climate change, in addition to its obvious significance for prehistory, Hadrian's Wall studies and the early medieval period.

7.32 Archive Deposition

7.32.1 OA North undertakes to liaise throughout the project with the receiving museum (Tullie House Museum and Art Gallery, Carlisle) to meet its deposition policies (see also *Section 4.27*). On completion of the analysis, a discard policy will be implemented in agreement with the museum. On submission of the completed text for publication, the archive will be updated as necessary and the receiving museum will be contacted to obtain the latest information on its deposition arrangements. Material in files and boxes will be checked, and indices and box lists will be compiled and appended.

7.32.2 The digital archive will be checked and indexed, and hard copies made of the data if required by the recipient museum. The digital data will be accompanied by metadata, which will explain origin and accuracy.

7.33 Project Team

7.33.1 The key members of the Project Team are listed in Table 24 and a schedule of tasks that are anticipated as being required to deliver the analysis programme are given in *Appendix II*. Rachel Newman will provide academic oversight on both the analytical programme and the publication.

Archaeological Researcher		**Task**
Andrew Bates	OA North	Animal bone
Fraser Brown	OA North	Project management
Paul Clark	OA North	Stratigraphic analysis
Ann Clarke	External specialist	Struck lithics and coarse stone
Antony Dickson	OA North	Struck lithics
Randolph Donahue	External specialist	Lithic microwear and raw material sourcing
Denise Druce	OA North	CPR and charcoal
Adrian Evans	External specialist	Lithic microwear and raw material sourcing
Seren Griffiths	External specialist	Radiocarbon dating
Annie Hamilton-Gibney	External specialist	Pitchstone analysis
Christine Howard-Davis	OA North	Finds management
Elizabeth Huckerby	OA North	Environmental management and WPR
Richard Macphail	External specialist	Soil micromorphology
Lucian Pricop	OA South	Database management
Mairead Rutherford	OA North	Pollen
David Smith	External specialist	Insects
Maisie Taylor	External specialist	Altered wood
Ian Tyers	External specialist	Dendrochronology
Blaise Vyner	External specialist	Prehistoric pottery

Table 24: Key members of the Project Team

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APPENDIX I: LITHIC RECORDING SYSTEM

Field Headings

- Context no
- Group no
- Find no
- Number of pieces
- Raw material
- Burnt?
- Type
- Sub-type
- Classification
- Comments

Categories

RAW MATERIAL

- P/ flint - pebble flint
- B/ flint – good-quality grey/ brown flint
- G/ flint – grey flint
- Chert – all colours
- Tuff
- Pitchstone
- Quartz
- Other – specify in comments
- Cannot determine

BURNT

- Y/N Yes or no. Includes crazing, pitting and discolouration

SURVIVAL - just for retouched pieces

  - All
  - Distal
  - Proximal
  - Fragment

TYPE

- Pebble
- Core
- Blade chip - blade <5mm in width
- Narrow blade - blade 5mm-8mm in width
- Broad blade - blade >8mm in width
- Regular flake – flakes with a minimum of 10mm of regular acute edge
- Irregular flake – flakes with no regular edge
- Small flakes <10mm
- Chunks – any size
- Retouched core
- Retouched blade
- Retouched flake
- Retouched chunk
- Microlith

SUB-TYPE

- Whole – pebbles category
- Flaked – pebbles category
- With cortex – cores category
- Without cortex – cores category
- Primary – flakes, blades and chunks and retouched pieces
- Secondary – ditto
- Inner – ditto

CLASSIFICATION

- Multi-platform flake core
- Multi-platform blade core
- Multi-platform blade/ flake core
- Single platform flake core
- Single platform blade core
- Single platform blade/ flake core
- Opposed platform flake core

- Opposed platform blade core
- Opposed platform blade/ flake core
- Platforms at right-angles flake core
- Platforms at right-angles blade core
- Platforms at right-angles blade/ flake core
- Scalar core
- Disc core
- Amorphous core
- Core fragment
- Crested – blade category
- Plain – blade category
- Core rejuvenation – flake and blade categories
- Core trimming –flake and blade categories
- End scraper
- Side scraper
- Two sides scraper
- All round scraper
- Concave scraper
- Angled scraper
- Scraper resharpening flake
- Leaf point
- Barbed-and-tanged arrowhead
- Transverse arrowhead
- Invasive retouch indeterminate
- Notched
- Awl/ Borer
- Edge retouched
- Rod
- Backed bladelet
- Scalene triangle
- Crescent

- Fine point
- Broken microlithic fragment
- Obliquely blunted blade
- Lamelles a cran/ Microburin
- Burin spall

Maximum length (ML) – just for retouched pieces and cores

Maximum width (MW) – just for retouched pieces and cores

Maximum thickness (MTh) – just for retouched pieces and cores

APPENDIX II: POST-EXCAVATION ANALYSIS TASK LIST

TASK NUMBER	**TASK**
1	**MANAGEMENT**
1.1	Academic Management
1.2	Programme Management
1.3	Project Management
1.4	Project Administration
1.5	Environmental Management
1.6	Finds Management
2	**INITIALISATION**
2.1	Project Meeting
2.2	Environmental Meeting
2.3	Lithics Meeting
3	**IT SUPPORT**
3.1	Planning/Consultation Phase
3.2	Enhance/Update Database
3.3	Enhance/Update GIS Project
3.4	Create Web-viewer
3.5	Enhance/Update/Maintain Website
3.6	Integrate GIS/Web-viewer/Database
3.7	Software/Map Licensing
4	**STRATIGRAPHIC ANALYSIS**
4.1	Archive Review
4.2	Stratigraphic Analysis (Phase 1)
4.3	Stratigraphic Analysis (Re-phasing/Integration of Specialist Information – Phase 2)
4.4	Produce Stratigraphic Narrative
4.5	Illustration
4.6	Photography
4.7	Specialist Précis
5	**FINDS ANALYSIS (GENERAL)**
5.1	Prehistoric Pottery Analysis/Reporting

5.2	Lipid Analysis
5.3	Romano-British Pottery Analysis/Reporting
5.4	Beads Analysis/Reporting
5.5	Wooden Artefacts Analysis/Reporting
5.6	Logistics
5.7	Data Entry
5.8	Illustration
6	**FINDS ANALYSIS (LITHICS) – PHASE 1**
6.1	Review, Validate and Update Database
6.2	Correlate With Stratigraphic Groups
6.3	QA Limestone/Tuff
6.4	QA Brown/Grey Flint
6.5	QA Other
6.6	QA Anomalous Chert
6.7	Identify and Isolate Knapping Episodes
6.8	Data Entry
6.9	Interrogate Dataset (Identify and Isolate Sub-sample)
6.10	Microlith Analysis (Further Characterisation)
6.11	Research
6.12	Specialist Liaison
6.13	Logistics
6.14	Regrouping and Renumbering of Lithic Assemblage
6.15	Phase 1 Review Meeting
7	**FINDS ANALYSIS (LITHICS) – PHASE 2**
7.1	Metrical Analysis of Sub-sample
7.2	Retouched Pieces Analysis
7.3	Coarse Stone Tools Analysis
7.4	Pitchstone Analysis
7.5	Petrological Analysis (Tuff)
7.6	Ochre Analysis
7.7	Use Micro-wear Analysis
7.8	Chert Geochemical Provenancing
7.9	Consultation of Reference Collections (Raw Material Sourcing)

7.10	Spatial/Statistical Analysis of Enhanced Datasets
7.11	Review, Validate and Update Database
7.12	Specialist Liaison
7.13	Research
7.14	Photography
7.15	Illustration/Modelling *etc*
7.16	Phase 2 Review Meeting
8	**SPECIALIST REPORTING (LITHICS)**
8.1	Introduction/Quantification
8.2	Early Mesolithic Component
8.3	Late Mesolithic: Technology
8.4	Late Mesolithic: Retouched Pieces
8.5	Neolithic Component
8.6	Use Micro-wear
8.7	Spatial/Statistical Consideration
8.8	Raw Materials
8.9	Coarse Stone/Axes
8.10	Ochre
8.11	Pitchstone
8.12	Discussion
8.13	Methodological Review/Critique
8.14	Illustration/Photography
9	**PALAEOENVIRONMENTAL ANALYSIS/REPORTING**
9.1	Review Resource
9.2	Palynological Sample Selection
9.3	WPR/Insect Sample Selection
9.4	CPR Analysis
9.5	Charcoal Analysis
9.6	WPR Analysis
9.7	Wood Species Analysis
9.8	Insect Analysis
9.9	Pollen Analysis
9.10	Review Meeting

9.11	Review, Validate and Update Database
9.12	Logistics
9.13	Liaison
9.14	Research
9.15	Palaeoenvironmental Synthesis
10	**GEOARCHAEOLOGICAL ANALYSIS/REPORTING**
10.1	Monolith Selection
10.2	Soil Sedimentological Analysis
10.3	Data Entry
10.4	Enhance Lithological Model
10.5	Logistics
10.6	Research
10.7	Geoarchaeological Synthesis
11	**SCIENTIFIC DATING**
11.1	C14 Sample Selection
11.2	C14 Dating: Wiggle Matching and Modelling of Dendrochronological Sequences
11.3	C14 Dating: Pollen Samples
11.4	C14 Dating: Organic Materials from Artefacts, Deposits and Features
11.5	Chronological Modelling
11.6	Logistics
11.7	Synthesis
12	**DRAFT REPORT**
12.1	Compile Specialist Reports
12.2	Review Stratigraphic Narrative
12.3	Write/Compile Discussion and Conclusion
12.4	Compile Digital Reports/Data
12.5	Library Research
12.6	Illustrations
12.7	Photographs
12.8	Edit Draft Report
12.9	QA Draft Report
12.10	Edit Digital Reports/Data
12.11	QA Digital Reports/Data

12.12	Revise Draft Report: Text
12.13	Revise Draft Report: Illustrations
12.14	Revise Digital Reports/Data
12.15	Produce Draft Popular Publication
12.16	QA Draft Popular Publication
12.17	Revise Draft Popular Publication
12.18	Produce Draft Schools' Pack
12.19	QA Draft Schools' Pack
12.20	Revise Draft Schools'
12.21	Website: Final Review/Revision/QA
13	**ARCHIVE**
13.1	Archive Preparation
13.2	Ordering of Lithic Archive
13.3	Produce Metadata
13.4	Transport Archive
13.5	Deposition Fee
14	**FINAL PUBLICATION**
14.1	Incorporate/Address External Comments
14.2	Review Publication
14.3	Additional Illustrations/Photographs
14.4	Edit Report
14.5	QA
14.6	Revisions
14.7	Outreach (Schools *etc*)
14.8	Museum Liaison
14.9	Book Launch
15	**PRODUCTION**
15.1	Typesetting *etc*
15.2	Printing
15.3	Popular Publication
15.4	Schools' Pack