DigVentures

Oak Tree Fields, Cerney Wick

Stage 5: Tasks 5.1 – 5.4

Final Technical Report

Co-authored by the Project Team

Oak Tree Fields, Cerney Wick

Stage 5: Tasks 5.1-5.4

Final Technical Report

Prepared on behalf of:

Historic England

Compiled by:

Joshua T. Hogue

With contributions from:

Enid Allison, Silvia Bello, Chris Casswell, Maggie Eno, Tom Hill, Indie Jago, Monika Knul, Nigel Larkin, Matt Law, Paul Lincoln, Marta Perez-Fernadez, Hannah Russ, Danielle Schreve, Kate Scott, Jenni Sherriff, Phil Toms, Daniel Young, Brendon Wilkins, Lisa Westcott Wilkins and Keith Wilkinson

DigVentures
5 Witham Studios
Hall Street
Barnard Castle
County Durham
DL12 8JB

hello@digventures.com
0333 011 3990
@thedigventurers

Purpose of document

This document has been prepared as a final technical report on targeted field investigations at Oak Tree Fields, Cerney Wick, in fulfilment of Stage 5, Tasks 5.1 – 5.4 for Historic England. The purpose of this document is to report on the results of specialist analyses arising from the recommendations outlined in the Stage 4 Stratigraphic and Specialist Report (Hogue et al. 2020a) and Updated Project Design (Hogue et al. 2020b).

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Project summary

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DigVentures is aiming to reduce its per capita carbon emissions.

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Executive summary

DigVentures were commissioned by Historic England to undertake a project evaluating the potential for in situ archaeology at Oak Tree Fields, Cerney Wick Gloucestershire, with funding allocated under the terms of NPPF Emergency Assistance.

The project has completed an assessment of previously collected materials recovered from the site (Russ et al. 2019; Stage 2a Review Point 3), a programme of fieldwalking and investigation of the lithostratigraphic sequence through geoarchaeological boreholes (Hogue et al. 2019, Stage 2b Review Point 4; and in Hogue et al. 2020 Appendix 1 and Appendix 2), and targeted field investigations (Stage 3 Review Point 5), including stratigraphic assessment; multiproxy palaeoenvironmental assessment of pollen, plant macrofossils, molluscs, insects and vertebrates and Optically Stimulated Luminescence (OSL) dating, as well as Updated Project Design (Hogue et al. 2020a, Stage 4 Review Points 6).

The document provides a final technical report on the results of subsequent analyses as recommended and in fulfilment of Stage 5, Tasks 5.1 – 5.4, Review Point of the Updated Project Design, Review Point 7 (Hogue et al. 2020b). The potential for these results to refine our understanding of the site's geological formation processes and aiding palaeoenvironmental and palaeoclimate reconstruction is discussed in the final section of this report.

Archive and publication

The physical archive will be deposited with Bristol Museum and the digital archive will be fully accessible via ADS, with details available via the site's OASIS record (digventur1-349815).

The project microsite is accessible here: https://ddt.digventures.com/cerney-wick/

The results of the project will form the basis of an open access format publication.

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1 INTRODUCTION

1.1 Project summary

1.1.1 The Oak Tree Fields project was formulated in response to the 2017 discovery of a Palaeolithic handaxe, found near well-preserved vertebrate remains, within a palaeochannel at Oak Tree Fields, Cerney Wick, Gloucestershire (hereafter 'the Site'; Figure 1) (NGR 406432 196105). A programme of non-intrusive and intrusive investigation was designed to assess the wider depositional context and taphonomy of this and other associated material, supported by Historic England under the terms of NPPF Emergency Assistance Funding (Wilkins et al. 2018).

1.1.2 The potential significance of a newly discovered site assigned to Marine Isotope Stages (MIS) 9-7 (~330-180 ka BP) was presented in detail in the Project Design (Wilkins et al. 2018, Section 2). Cerney Wick, with its combination of vertebrate and artefactual remains, and its attendant opportunities for the preservation of waterlogged material, was considered to provide a unique opportunity to investigate human- environment relations and concomitant impact of climate change. Furthermore, given its location at the headwaters of the River Thames, it provides potential for understanding connections and the movement of populations between well-known sites further downstream in the River Thames (e.g. Purfleet, Crayford, Stanton Harcourt) and sites at the northern extremities of occupation of Britain (e.g. Pontnewydd).

1.1.3 The project has completed an assessment of previously collected materials recovered from the site (Russ et al. 2019; Stage 2a Review Point 3), a programme of fieldwalking and investigation of the lithostratigraphic sequence through geoarchaeological boreholes (Hogue et al. 2019, Stage 2b Review Point 4; and in Hogue et al. 2020 Appendix 1 and Appendix 2), and targeted field investigations (Stage 3 Review Point 5), including stratigraphic assessment; multiproxy palaeoenvironmental assessment of pollen, plant macrofossils, molluscs, insects and vertebrates and Optically Stimulated Luminescence (OSL) dating, as well as Updated Project Design (Hogue et al. 2020a, Stage 4 Review Points 6).

1.1.4 This document provides a final technical report on the results of subsequent analyses as recommended and in fulfilment of Stage 5, Tasks 5.1 – 5.4, Updated Project Design, Review Point 7 (Hogue et al. 2020b). Its purpose is to provide the necessary information to refine our understanding of the site's geological formation processes and help better reconstruct the palaeoenvironmental and palaeoclimate conditions.

1.1.5 Excavations were led by the DigVentures team; lithostratigraphic recording, geoarchaeological interpretations, and subsequent laser granulometry and clast lithological analyses were undertaken by Dr Keith Wilkinson and colleagues at the University of Winchester; plant macrofossil analysis to understand the ecological setting of the palaeochannel was undertaken by Dr Daniel Young, Quaternary Scientific, University of Reading; insect sclerites to aid reconstruction of past environment were analysed by Dr Enid Allison at Canterbury Archaeological Trust; full quantification and analysis of the molluscs to better understand, contextualise and aid interpretation of the past ecological settings of the palaeochannel was undertaken by Dr Matt Law at Bath Spa University; and analysis of the vertebrate remains to establa ish minimum number of individuals, age, size and taxonomic status the mammoth remains. Taphonomic analysis to assess whether there has been faunal, including anthropogenic modification of the fossils, were led by Dr Hannah Russ with contributions from Dr Kate Scott, Prof Arian Lister, and Dr Silvia Bello at Natural History Museum (London), and Dr Mike Buckley at the University of Manchester. Specialist contributions are presented here, providing the basis for updated statements of potential and significance of the site.

1.2 Planning background

1.2.1 The following section has been reproduced from the 'Oak Tree Fields' NPPF Application (Section 1, Planning Background). Initial planning permission for mineral extraction on the Oak Tree Fields site dates to 1988. The initial permission is earlier than government planning policy guidance on archaeology contained in PPG16 (November 1990) and no archaeological conditions were attached to the original permission. The site was subject to Periodic Review of Mining Sites from June 2004. A desk-based assessment (DBA) was produced by Thames Valley Archaeological Services (dated August 2004, see Appendix 1) as an appendix to the Environmental Impact Statement which accompanied the submission. This recorded an earlier find of a hand-axe from a quarry 450m to the northwest of Oak Tree Fields, but, in line with then current thinking, indicated that the potential for in-situ deposits of Palaeolithic date was low (page 3). None was recorded at that time on the Gloucestershire Sites and Monuments Record in the search area. The DBA also reports on the results of geotechnical test pits and boreholes dug across the site, with no indication of significant deposits under the gravel being reported.

1.2.2 For reasons unknown the review was not further progressed until April 2009. Archaeological evaluation (geophysical survey and trial trenching) was recommended by the County Archaeologist's office but not carried out. The Review of Mineral Planning Permissions (ROMP) decision notice reference 04/5002/CWMRVW dated 19th April 2011 includes the following condition:

"23. The Mineral Operator will give the County Archaeologist not less than 21 days written notice prior to the commencement of soil / overburden stripping operations on site. The mineral operator shall afford at all reasonable times to any archaeologist 11 nominated by the Minerals Planning Authority and shall allow the archaeologist to observe the operations and record items of interests and finds.

Reason: To ensure that adequate archaeological investigation and recording is undertaken, in accordance with Policy NHE.6 of the Gloucestershire Structure Plan Second Review and Policy E8 of the Gloucestershire Minerals Local Plan."

1.2.3 The reason for the inclusion of an 'access' condition rather than the standard Model Condition 55 from App A Circular 11/95 was the Mineral Planning Authority's (MPA) concern over MPG14, para 174, which includes the following:

"….where MPAs determine conditions different from those submitted by the applicant; and the effect of those conditions, other than restoration or aftercare conditions, is to restrict working rights further than before the review, a liability for compensation will always arise." (As quoted, including highlighting, in email of 15/09/09 from Ben Gilpin, Principal Planning Officer to Charles Parry, Senior Archaeological Officer).

1.2.4 No archaeological work has subsequently been undertaken in the former fields where mammoth and other Palaeolithic material has recently been revealed under gravel deposits. Other planning applications have resulted in the archaeological excavation of features cut into the upper surface of the gravel nearby, the nearest being to the east of the former railway line that forms the boundary of the Oak Tree Fields site, but not on the site in question. 1

1.2.5 More recently, when asked for clarification of the extent to which the ROMP condition is enforceable, Kevin Philips, Team Manager Development Management and Minerals and Waste Planning, Gloucestershire County Council, replied via email on 2nd June 2017:

"You are correct that the condition is observational only so there is no tie-in with either funding or compliance measures at the disposal of the Minerals Planning Authority".

When asked verbally, on 11th July 2017, whether the condition had been discharged Kevin Phillips replied that it had not been but that as an access condition they (the MPA) wouldn't expect to receive a formal application to discharge the condition. The MPA considers that the condition has been complied with as Hills (the Operator) notified the MPA when they started work and the MPA could then have nominated an archaeologist

2 RESULTS OF PREVIOUS FIELDWORK

2.1.1 Over the spring of 2017 Neville and Sally Hollingworth (two local enthusiasts who regularly inspect adjacent quarry workings with the express permission of the Landowner) discovered a large number of vertebrate fossils and a flint handaxe at Oak Tree Fields. The material was collected from the surface and in machine excavated trenches during quarrying and drainage operations, and was removed to a purpose-built storage facility at their family home. Through subsequent enquiries other material came to light, including a further handaxe (found by Mark O'Dell) and two additional mammoth bones (recovered by Theo May and Ben Hinton) taking the total known assemblage from Cerney Wick at that time to 111 items. In total the assemblage comprised 2 handaxes, 108 bones, teeth and fragments thereof, and one fragment of preserved wood (H.001 to H.111). Neville and Sally Hollingworth produced a photographic catalogue of the 111 specimens (Hollingworth and Hollingworth nd), identifying vertebrate remains to genus and respective element wherever they were able.

2.1.2 An assessment of previously collected material (Stage 2a: Russ et al. 2019) indicated that the two handaxes were Lower Palaeolithic (Acheulean), typically associated with MIS 13–9, ~550-300 ka in Britain. They demonstrated some ridge rounding consistent with post-depositional movement in the burial environment, suggesting that they may have been redeposited at the site. The vertebrate remains included both steppe (*Mammuthus trogontherii*) and woolly mammoth (*Mammuthus primigenius*), which provide a preliminary date for the deposits to the end of the interglacial MIS 7 or beginning of the MIS 6 glacial

2.1.3 A review of the published geological information indicated the existence of gravels that outcrop across the study area, although the palaeochannel deposits known to exist at the site had not been previously mapped. No direct link between human presence, activity or interaction and the faunal remains could be shown on the limited basis of the initial review of the previously collected material.

2.1.4 In May 2019 on-site assessment through landscape survey and deposit modelling (Stage 2b: Hogue et al. 2019; also see further description in Hogue et al. 2020 Appendix 1 and Appendix 2) highlighted significant areas of modern disturbance caused by commercial quarrying. Furthermore, the Hollingworth's collection activities and the machine excavation this entailed in its final phase was attested both in a number of informal trenches in the quarry base and upcast from these latter. Most of the vertebrate remains identified during fieldwalking were located in areas adjacent to machine excavated trenches. However, it was considered likely that in situ deposits may have survived under substantial accumulations of up cast sediments and spoil heaps leftover from the earlier invasive extraction activities. Initial description of the lithostratigraphy indicated the survival of channel deposits up to 0.6m thick comprising multiple lithofacies and indicating a shifting fluvial environment from episodes of flood activity to times with slower moving water and marshy conditions. It appeared that the vertebrate remains were concentrated in facies reflecting a fast-moving large waterbody.

2.1.5 In July 2019 target field investigations were undertaken, comprising the excavation of four test pits across the base of the quarry to examine palaeoenvironmental remains and the potential for archaeological remains associated with the palaeochannel previously identified. These test pits targeted an area of the quarry where a Palaeolithic handaxe had been found in association with faunal remains and an area to the south where the palaeochannel survived to a greater depth, allowing its full stratigraphic sequence to be established. Once the sequence had been recorded, samples were taken for multi-proxy assessment – including pollen, plant macrofossils, Mollusca, insects and microvertebrates – faunal remains were lifted for conservation, and OSL samples taken from pertinent parts of the sequence. A full assessment of the remains was made and a chronology for the site and its depositional environment confirmed (Hogue et al. 2020a). Based on the assessment the palaeochannel was interpretated as having first formed over 200 ka in MIS7. Initially the river was a broad channel or series of channels (Phase 1) that likely downcut into a deeper channel (Phase 2), followed by faster flow in multiple channels (Phase 3a) with a subsequent period of aggradation (Phase 3b), and finally slower flow in more sinuous channels (Phases 4). Overlying the channel were Northmoor Member (Phase 5) gravels dating to MIS5. Recommendations for further analyses necessary to refine our understanding of the site' geological formation processes and help better reconstruct the palaeoenvironmental and palaeoclimate conditions were outlined in the accompanying Update Project Design (Hogue et al. 2020b) and following provides a final technical report on the results of these subsequent analyses. Further investigations were undertaken in August 2021 under the remit of the NHLF-funded project 'PalaeoPixels: Future Climate Pioneers' of which the results will be provided elsewhere.

3 RESEARCH AIMS AND OBJECTIVES

3.1 Aims and objectives

3.1.1 The project aims are articulated in full in the Project Design (Wilkins et al. 2018, Section 4.0, Aims 1-4, Q1-12). The project design was formulated according to the principles outlined in Historic England's *Curating the Palaeolithic* (forthcoming) and other relevant research frameworks, including Historic England's *Draft Research Strategy for Prehistory* (2010) and *Research and Conservation Framework for the British Palaeolithic* (Pettitt et al. 2008), and the *South West Archaeological Research Framework* (Grove and Croft 2012) (see Wilkins et al 2018, Section 5.0).

3.1.2 An Updated Project Design reflecting on the original aims of the project alongside the results of post-excavation assessment and recommendations for further work was completed in partial fulfilment of Stage 4 (Tasks 4.1-4.23) (Hogue et al. 2020b), resulting in formulation of the following objectives for further analysis and publication:

- Objective 1. Refine our understanding of the site's geological formation processes
- Objective 2. Palaeoenvironmental and palaeoclimate reconstruction

3.1.3 This report addresses the above objectives and requirements of further work in fulfilment of Stage 5 Analysis, Reporting & Conservation (Tasks 5.1-5.4) of the Updated Project Design (Hogue et al. 2020). It helps to address the overarching aim of the project to define and characterise the physical extent of the Site through a programme of non-intrusive investigations and intrusive excavation and obtains baseline data to facilitate the future management, research, presentation and enjoyment of the Site (Wilkins et al. 2018, Sections 4 and 5)

4 METHODOLOGY

4.1 Project model

4.1.1 The archaeological fieldwork, sampling, and laboratory work was carried out, unless otherwise stated, in accordance with the methodology defined in the Project Design (Wilkins et al. 2018) and is outlined in further detail the Landscape Survey and Deposit Modelling Interim Report (Hogue et al 2019) and the Stratigraphic and Specialist Assessment (Hogue et al. 2020a). Additional information is given below, regarding the methodological procedures adopted for further specialist analyses, in line with the suggestions outlined in Updated Project Design (Hogue et al. 2020b).

4.2 Geoarchaeology

<u>Monoliths</u>

4.2.1 Four monolith samples, each measuring 500 (height) x 100 (length across the section) x 100mm (depth into the section) were collected by Professor Keith Wilkinson. In the case of Monolith 4, a projecting blank matching the monolith dimensions was cut using a trowel, the tin hammered (using a rubber tiling mallet) onto the blank and the corners surveyed, and finally the blank cut from the section using a spade. A blank was not required in the case of Monolith 1–3 and rather the tins were simply hammered into the section, their corners surveyed and then they were removed by cutting behind them with a spade. The monolith tins were each labelled and wrapped in plastic film before being transported to the University of Winchester for description and sub-sampling.

4.2.2 The monolith samples were sub-sampled for palynological study during the post-excavation assessment (Hogue et al. 2020a, Section 7.2). They were then sub-sampled for a second time during the analytical stage of works in order to provide sediment for magnetic susceptibility, grain size and geochemical analysis (35 sub-samples in total). In this latter phase continuous 50mm-thick blocks of sediment spanning the entire width and half the depth of the monolith tin were removed, weighed, and then air dried at 40^{o}C for 72 hours. Samples were then re-weighed (to calculate moisture content), gently disaggregated using a pestle and mortar, placed in a nest of half phi interval sieves ranging between 16mm (-4.0 phi) and 2mm (-1.0 phi) and then agitated on a sieve shaker for 20 minutes. Residue retained on each sieve and in the basal catcher was then weighed to measure the grain size of the gravel fraction (Gale and Hoare 1991, 82–86), and the 16.0–11.2mm (-4.0 – -3.5 phi) and <2mm fraction separately bagged. The former was used for clast lithological analyses and the latter for all other sedimentary and geochemical tests as outlined below.

Grain size

4.2.3 A Malvern Mastersizer 2000 laser granulometer was used to measure the grain size of the <2mm (sand, silt and clay) fraction. The <2mm residue resulting from the process outlined in Section 4.2.1 was consecutively halved using a riffle box until its mass ranged between 0.4 and 1.0g, at which point the sub-sample was placed in a 14ml centrifuge tube. Chemical pre-treatment methods (10% HCl to remove carbonates and 30% H_2O_2 to oxidise organics), centrifuge and measurement protocols thereafter followed those outlined in Glauberman et al. (2020), while the resultant data were integrated were read into the Gradistat 9.1 template to calculate grain size parameters (Blott and Pye 2001).

Magnetic susceptibility

4.2.4 Magnetic susceptibility was determined using the procedures outlined by Gale and Hoare (1991, 221–226). Hence a pre-weighed 10ml Perspex pot was filled with <2mm sediment and reweighed, Separate measurements were then made at low (^{clf}) and high frequency (χ^{hf}) using a Bartington MS2 magnetic susceptibility meter attached to an MS2B sensor, and percentage frequency difference (χ^{fd}) calculated from the results. However, the latter parameter was found to vary only slightly (0–5%) and is therefore not considered further in the text below

Geochemistry

4.2.5 Geochemical data were determined by analysing sediment in the 10ml Perspex pots used for magnetic susceptibility. The pot lid was replaced with 6um Mylar film and then placed within a lead-lined test stand attached to a Niton XL3t GOLDD+ portable x-ray fluorescence (pXRF) sensor. The latter device was then used to make 180 second-long measurements of the sample using a copper-zinc priority 'Mining' mode (Glauberman et al. 2020).

4.3 Plant macrofossils

4.3.1 A total of seven bulk samples measuring between 0.65 and 0.80 litres from the site at Oak Tree Fields, Cerney Wick were processed for the recovery of plant macrofossil remains. The extraction process involved the following procedures: (1) measuring the sample volume by displacement; and (2) processing the sample by wet sieving using 125μm, 300μm and 1mm mesh sizes. Each sample was scanned under a stereozoom microscope at x7-45 magnification, with plant macrofossil remains picked and sorted into different categories based on their morphological characteristics. Identifications of the waterlogged seeds (Appendix 2 Table 4) were made using modern comparative material in the University of Reading reference collection, and reference atlases including Martin & Barkley (2000), NIAB (2004) and Cappers et al. (2006). Nomenclature used follows Stace (2010). The taxa are arranged into broad habitat classifications to aid the interpretation of the assemblage and reconstruction of past vegetation and palaeoenvironment. The 'unclassified' group contains taxa that are of too high a taxonomic level to allow classification into a habitat group, or taxa that can be found in a number of habitat types.

4.3.2 The analysis was undertaken following an assessment of the macrofossil remains in nine samples (see DigVentures, 2019). These samples measured 0.10 litres in volume and were processed in the same way. During the assessment, each sample was scanned to establish the quantity, quality and diversity of plant macrofossil remains; where preservation allowed, plant remains recovered were identified to genus and where applicable to species level. Data from the plant macrofossil assessment undertaken by Dr Marta Perez-Fernandez (see DigVentures, 2019) is included in the results below.

4.4 Insects

4.4.1 For the study of the insect remains, all dried material was re-hydrated (from those samples initially sorted for microvertebrates; see Hogue et al. 2020a, Section 4.3.8) and separate fractions re-combined. The samples were then gently wet-sieved to 0.3mm and the organic component was separated from mineral material by the 'washover' method. For two samples, the amount of organic material present was very small and the washover fraction was examined in its entirety. Paraffin flotation to extract insect remains was carried out on the remaining washovers. Methods used are based on those of Kenward et al. (1980).

4.4.2 Beetle (Coleoptera) and true bug (Hemiptera) sclerites were removed from the paraffin flots onto moist filter paper in a petri dish for identification using a low-power stereoscopic zoom microscope (x10 – x45). Identification was by comparison with modern insect specimens and by reference to standard published works. Minimum numbers of adult beetles and bugs were estimated from the major sclerites. Abundance of all other groups of insects was recorded semi-quantitatively on a four-point scale: + 1 - 3; ++ 4 - 10; +++ 11 – 25; ++++ 25 - 99 individuals. Other invertebrates were simply noted as present, common or abundant. Nomenclature for Coleoptera follows Duff (2018). Extracted insect material is currently stored in water in glass vials.

4.4.3 To aid interpretation, beetles and bugs were assigned to broad ecological groups (see Appendix 3 Table 6). Some taxa are included in one than one group, while others are uncoded, either because they occur in a wide variety of habitats and situations, or because it was not possible to identify the available sclerites closely enough. Ecological information was obtained mainly from Cox (2007); Duff (2012, 2016, 2020), Foster et al. (2014), Hansen (1987), Lane et al. (2020), Luff (1998, 2007), Morris (1997, 2002, 2008, 2012), and the UK Beetles website. Other sources are mentioned where relevant in text.

4.4.4 For the larger assemblages (>50 individuals), proportions for selected ecological groups were calculated based on the minimum number of individuals, with all percentages rounded to the nearest whole number. Aquatics were subtracted from the assemblages to provide percentages for terrestrial taxa. The proportion calculated for each group represents a minimum value since various generalist or uncoded taxa may have exploited similar habitats.

4.4.5 The Mutual Climatic Range (MCR) method (Atkinson et al. 1987) was used to indicate maximum and minimum temperatures represented by the assemblages from each phase, using the Bugs Coleopteran Entomology Package (BugsCEP; Buckland and Buckland 2006).

Table 1 GBA samples submitted for specialist analysis during Stage 5 (in chronological order)

Sample No.	Phase	Test Pit	Field Description	DV Unit	ARCA Unit	Stage 5 Analyses		
						Plant macros	Insects	Mollusca
12	1	1	Column I, 30-35cm	31006	v	Y		
11	1	1	Column I, 17-30cm	31006	v		Y	Y
10	1	1	Column I, 9-17cm	31002	iv		Y	Y
9	1	1	Column I, 0-9cm	31002	iv		Y	Y
26	1	1	Column I, 75-80cm	25008	B1		Y	
25	1	2	Column I, 70-75cm	25008	B1	Y		
22	3	2	Column I, 47-52cm	25005	K4		Y	Y
21	3	2	Column I, 45-47cm	25004	K3	Y		
18	3	2	Column I, 30-35cm	25003	K2		Y	Y
17	3	2	Column I, 25-30cm	25003	K2	Y		
15	3	2	Column I, 15-20cm	25002	K1	Y		
14	3	2	Column I, 10-15cm	25002	K1		Y	Y
74	4	3	Column II, 15-20cm	20005	F	Y		
72	4	3	Column II, 5-10cm	20005	F	Y		
69	4	3	Column I, 38-41cm	20003	C		Y	Y
67	4	3	Column I, 18-28cm	20003	C		Y	Y

4.5 Mollusca

4.5.1 Residues were weighed and air dried, then sorted into fractions using a nest of sieves (4mm, 2mm, 1mm, 500µm, 250µm) before Mollusca were extracted under a low power microscope. Mollusca were identified to species level using a reference collection. Ecological information is derived from Evans (1972), Kerney and Cameron (1979), Macan (1977), Kerney (1999), Davies (2008). and Killeen et al. (2004). *Pisidium clessini* was identified following criteria in Woodward (1913). Nomenclature follows Anderson and Rowson (2020).

4.5.2 Gastropod taxa were quantified by counting all intact shells and fragmentary non-repeating elements, such as the shell apex or body whorl with mouth. For each taxon, the element with the highest count was added to the number of intact shells to provide a Minimum Number of Individuals (MNI). For bivalve species, a determination was made for all intact valves and fragmentary hinge plates of whether they were left or right valves. The highest count for each taxon was then used as the MNI.

4.5.3 As an aid to interpretation, the Mollusca were organised into ecological groups based on their broad ecological tolerances. These groups are a combination of those of Evans (1972) for land snails, and Evans (1991) for freshwater Mollusca. *Euglesa supina*, and *Pisidium clessini*, which did not feature in Evans's groupings, have been assigned to Group 6d. These groups are:

- Group 3: Intermediate/ catholic species. Terrestrial taxa that are tolerant of a broad range of ecological conditions
- Group 4a: Common open country. Terrestrial taxa associated with open environments
- Group 5a: Amphibious/ freshwater. Species associated with marshy ground, and ground that periodically floods
- Group 6a: Freshwater slum. Species associated with poor quality, often temporary, freshwater bodies
- Group 6b: Freshwater catholic. Species associated with a wide range of freshwater bodies
- Group 6c: Ditch. Species associated with permanent lentic (still) to gently lotic (flowing) water bodies
- Group 6d: Moving water. Species found in lotic water bodies

4.5.4 Note that while useful for summarising the broad ecology implied by an assemblage, the use of ecological groups may mask fine details or occasions where a species is adapted to an ecological situation unlike its Ecological Group. Therefore, consideration has also been made of individual species ecologies.

4.5.5 Two diversity indices were calculated for the taxa within the samples (based on MNI): the Shannon and Brillouin indices using the statistical software package PAST (Hammer at al. 2001). Closeness of the two indices has been used to indicate 'completeness' of a sample, while larger differences reflect taxonomic depletion (Law 2017).

4.5.6 Detrended correspondence analysis was carried out on samples containing more than 40 shells. This method of statistical ordination organises the samples along two or more axes which account for the variation between samples. An eigenvalue between 0 and 1 quantifies how much of the variation each axis accounts for (Law 2017).

4.6 Fauna

4.6.1 This analysis has been undertaken according to published standards and guidelines (Baker and Worley 2019). The vertebrate remains collected by the Hollingworths and those from the archaeological excavations at Oak Tree Fields, Cerney Wick (CER19), were identified to element, and to as low a taxonomic level as possible. Quantification used the diagnostic zone method as presented by Dobney and Rielly (1988). Bone fusion was recorded as unfused, fusing or fused, with mammoth age estimated based on data for the African elephant (Loxodonta africana) presented by Haynes (1987; 1993). Mammoth teeth were measured and recorded according to Lister and Joysey (1992) and Lister and Sher (2015, supplement). A taphonomic assessment of each fragment was undertaken, recording the presence and absence of cut and chop marks, burning and calcination, any evidence for animal activity (canid or rodent gnawing), and surface preservation; any other surface modifications of note were also recorded.

4.6.2 One mammoth rib fragment was identified as having surface modification consistent on a macroscopic scale with stone-tool cut-marks (H.012). This specimen was initially examined using a hand lens and binocular microscope. The topography of surface modifications was further examined using a Focus Variation Microscope (FVM), the Alicona InfiniteFocus 5+ optical surface measurement system. This system was used to produce three-dimensional (3D) micro-morphological models of the scratches on the bone surface (recent damage and trampling) according to the methodology described by Bello and Soligo (2008).

5 STRATIGRAPHIC AND LITHOSTRATIGRAPHIC RESULTS

Keith Wilkinson (ARCA, University of Winchester) with contributions from Monika Knul, Paul Lincoln, Jenni Sheriff (ARCA, University of Winchester) and Josh Hogue (DigVentures)

5.1 Introduction

5.1.1 The following provides an updated stratigraphic and lithostratigraphic assessment of the site following subsequent geotechnical analyses in fulfilment of Stage 5 (Tasks 5.1) and helps to address Objective 1 of the Updated Project Design (Hogue et al. 2020b, see Section 2) by refining our understanding of the geological formation processes at Cerney Wick. Based on the results of the 2019 excavations, five phases of palaeochannel development were identified in the strata. Initially the river was a broad channel or series of channels (Phase 1) that likely downcut into a deeper channel (Phase 2), followed by faster flow in multiple channels (Phase 3) and finally slower flow in more sinuous channels (Phases 4 and 5). The lifecycle of the river was observed across all test pits and is outlined in detail in Section 5.6

5.1.2 Supplementary information is given in Hogue et al. (2020a); including, lithiostratigraphic descriptions of deposits identified in the Phase 2A and Phase 2B geoarchaeological work (see Appendix 1 and Appendix 2) and Phase 3 excavations (see Appendix 3); stratigraphic correlations for each DV Unit, ARCA Units, facies and interpretative phasing (Appendix 4); and monolith strata descriptions (Appendix 5).

5.2 Test Pit 1

5.2.1 Unconformably (Miall 1996 6th order bounding surface) overlying the Oxford Clay Formation basement and filling localised hollows in that stratum were fossiliferous sediments of facies 6 (Unit 31006 [v]), which were in turn separated by a sharp boundary (Miall 1996 2nd order bounding surface) from the overlying gravel strata (Units 31002 and 31004–5 [iv-ii]) (Figure 3 and Figure 4). The extracted mammoth tusk and other vertebrate remains (see Section 8) rested either on Unit 31006 or the Oxford Clay (Unit 31003), and were banked up by gravels of Unit 31002 [iv]. The latter are of facies 3 and comprise sets of less than 0.05m thickness. Unit 31002 was conformably (Miall 1996 2nd order bounding surface) overlain by two further sand and gravel units, comprising firstly fine sands containing limestone pebbles and granules, and shells of the mollusc species, *Valvata piscinalis* (Unit 31005 [iii]. facies 6) and secondly a clast-supported pellet gravel (Unit 31004 [ii], facies 3). These latter and Unit 31002[iv] all pinched out to the south as a result of truncation, the latter presumably as a result of quarry activity given the presence of poorly sorted, unstructured matrix-supported gravels (Unit 31001[i]) overlying the unconformity.

5.2.2 Clast lithological analysis carried out on monolith sub-samples from Test Pit 1 demonstrates that all except for one (chert) particle is derived from crystalline limestone sources (see Section 5.5.2). Laser granulometry suggests similar <2mm grain size properties for Units 31005 and 31006 (Figure 15). Mean particle size of this fraction is in the very fine sand (76–63um) range, 63–77% of particles are of sand, while the grains are poorly sorted, and the distribution very fine skewed (i.e. focussed in the finer grain sizes). Clay makes <6% contribution, while 29–22% of particles are silt. The grain size distribution in Unit 31004 is distinct from the units below and is finer, having a mean in the coarse silt range (51um). The finer grain size is reflected in a higher silt (40%) and clay (8%) content, while the distribution is also very poorly sorted and fine skewed. Low frequency magnetic susceptibility measurements are low throughout Unit 31005 and the top of 31006 at 2–9 SI Units x 10^{-6} m^3 kg^{-1}, but a higher value was measured at the base of Unit 31006 (20 SI Units x 10^{-6} m^3 kg^{-1}), while the single measurement from Unit 31004 was 24 SI Units x 10^{-6} m^3 kg^{-1}.

5.2.3 Portable XRF measurements suggest that Units 31004–31006 have similar geochemical properties. ‘Balance’ (i.e. the sum concentration of elements with an atomic number <10) comprises 69–73% of the total composition, while silicon (11–16%) and calcium (6–13%) are significant secondary components. Other elements such as iron, aluminium, potassium and to a much lesser degree, titanium and zircon are present in lesser, but consistent concentrations. However, Unit 31004 is distinguished, not only from Units 31005 and 31006, but all other strata sampled in monolith samples by its phosphorus concentration. While Units 31005, 31006 and others sampled are 0.12–0.20% phosphorus, Unit 31004 is 0.47% comprised of this element. This latter feature, in combination with the comparatively fine grain size and relatively high magnetic susceptibility, suggests that Unit 31004 comprises strata of the Northmoor Formation and later that has been redeposited and contaminated during quarrying.

5.3 Test Pits 2 and 3

5.3.1 Test Pits 2 and 3 are treated together here as the units in the two pits were stratigraphically linked with the connection between the two supplied by Units 25001=20006. The earliest stratum unconformably (Miall 1996 6th order bounding surface) overlying the Oxford Clay Formation bedrock in the Test Pit 2 sequence was Unit 25009 (facies 7) (Figures 5, 6, 7 and 8). Indeed, this unit comprised weathered particles of the Oxford Clay, from which it could only be differentiated based on fossil inclusions (shells of freshwater Mollusca) and a lesser compaction. The former indicate that the silt/clay had been fluvially reworked and deposited either within an abandoned channel or on a floodplain. Unit 25009 was then unconformably overlain by bedded gravels of Units 25006 (facies 1) and 25007 (facies 4), indicating a transition to bedload flow in a high energy environment. These coarse-grained strata varied in structure and clast-support, (i.e. to coarse pebbles) while the latter in the west facing section (Unit 25006 [C]), suggested more rapid flow in this location. There were also some indications of flow direction, for example there was localised imbrication in the north-facing section suggesting flow from south-south-east to north-north-west (Figure 8). Similarly, fine, lenticular beds of silts to medium sands that climbed to the north and east [I1 and I2], had formed within Unit 25006 in the west and north facing sections, suggesting flow in the same direction. These lenticular beds were also (unlike the surrounding gravel facies) rich in mollusc shell and particularly *Bithynia* sp., suggesting accretion in a large body of water. The gravel strata of Unit 25006 were in turn unconformably overlain by gravel and fine-grained channel or scour hollow fills (Units 25006 [E], 25011 [G] and 25010 [H] – facies 2 and EE) in the south-facing section. The latter interpretation is more parsimonious given that the strata had accumulated in a cut immediately to the west (i.e. upstream according to the data outlined above) of two rounded, boulder-sized septarian nodules that sat on the surface of Unit 25009 (Figures 5 and 6). The lower of these boulders was of Kellaway Clay, but the upper was a conglomerate derived from Jurassic lithologies outcropping to the north and west of the site.

5.3.2 Grain size analysis of the <2mm fraction of Unit 25009 demonstrate that it is the finest of any stratum analysed, having a mean grain size of 14–21um (medium to coarse silt) and comprising 63–68% silt and 15–20% clay. There is a reverse bedded trend (coarsening mean grain size and decreasing clay content upwards), albeit those strata are poorly or very poorly sorted, while the distributions are near symmetrical (Figure 15). Unsurprisingly, given its gravel content Unit 25006, has very different grain size properties to Unit 25009, and which are similar to Units 31005–31006. Mean grain size is in Unit 25006 is 97um (the coarsest of any analysed stratum), while sand (60%) in much more prevalent that silt (34%) and clay (6%). As with the gravel strata, Units 31005–31006, the distribution is very poorly sorted and very fine skewed.

5.3.3 Low frequency magnetic susceptibility of Unit 25009 ranges between 7 and 14 SI Units x 10^{-6} m^3 kg^{-1} (Figure 15). However, while pXRF indicates that the same elements as in Units 31005–31006 are dominant (balance = 70–75%, silicon = 12–13%, calcium = 5–7%, this latter notably lower than in Units 31005 and 31006), there are important differences in some trace elements. Iron is found at twice the concentration of Units 31005–31006 (2–7%), as are titanium (0.4%), potassium (1.2–1.8%) and aluminium (2–3%). A finer grain size is likely to be at least part of the explanation for these differences as the overlying Unit 25006 has similar geochemical properties as Units 31005 and 31006. Nevertheless, magnetic susceptibility in the latter is high at 54 SI Units x 10^{-6}

$m^3\ kg^{-1}$, but only a tentative explanation is offered by the geochemistry data, i.e. the moderate correlation between that variable and calcium content (*r*=0.62), might suggest higher magnetic susceptibilities are associated with increased limestone content.

5.3.4 Fine-grained deposits unconformably (Miall 1996 2nd order bounding surface) overlaid the gravel strata of Unit 25006, collectively forming a 0.5m-thick lenticular bed in the west and eastern part of the south-facing sections between it and Unit 25001 [J]. As is described further below, the latter stratum was also found in Test Pit 3, thereby providing a link between the stratigraphies of Test Pit 2 and Test Pit 3. The 2.5m+ wide lenticular bed (Units 25005, 25004, 25003 and 25002, facies 8 and XX) was normally bedded as a whole - trending from predominantly sand- to silt-clay dominated strata - and was locally laminated, particularly within Unit 25003. It might have formed within either a channel through which moderate-low energy flow was directed or a large scour hollow. Whichever, the feature was succeeded by further clast- and matrix-supported gravels (Unit 25006, facies 1) that were indicative of higher velocity flow, again in a north-eastward direction given the pattern of imbrication in the west and south-facing sections. Although of different colours (a property of the matrix), the gravels from Test Pits 2 and 3 are all mostly comprised of the same crystalline limestone lithologies that characterise gravels in Test Pit 1, while as with Test Pit 1, the only exotic lithology is chert (Table 2)

5.3.5 As noted above, Unit 25001 [J] of Test Pit 2, was also encountered at the base of Test Pit 3 as Unit 20006 (facies 1) (Figures 9, 10 and 11). Overlying the latter and separated from it by an unconformable contact (Miall 1996 5th order bounding surface) was Unit 20013 (G), a massive, well-sorted brown silt (facies 10), forming the lowest fill of a 3m wide palaeochannel (here termed 'palaeochannel **a**'). However, following deposition of Unit 20013 (G), palaeochannel **a** was abandoned and/or moved to the east and fills of a second 2m wide palaeochannel ('palaeochannel **b**') were emplaced. Nevertheless, either at the same time as palaeochannel **b** was active or afterwards, palaeochannel **a** was reactivated and filled by an Oxford Clay-derived, massive silt/clay (Unit 20012, facies 7). The fills of palaeochannel **b** comprise Units 20005 (F), 20004, 20003, 20002 and possibly, 20001. Unit 20005 (F) was a thinly laminated silt/fine sand and organic mud (facies 8), which in turn was truncated, probably as a result of erosion of the channel sides by the passage of high energy flow, resulting in an unconformity (Miall 1996 2nd order bounding surface). Palaeochannel **b** was then infilled by initially laminated sands (Unit 20003, facies 5 and facies 8), then massively (Unit 20002, facies 6), and finally normally bedded silts to medium sands (Unit 20002, facies 9). The colour of the fine-grained particles in the last of these units suggest derivation from the Oxford Clay Formation. Units 20002 and 20003 were truncated and were separated from Unit 20001, a clast and matrix-supported gravel of similar properties to Unit 20006 (facies 1), by an unconformity (Miall 1996 5th order bounding surface). While Unit 20001 may have been a high energy fill of a rejuvenated palaeochannel **b**, it is more likely given its extent, that it was either the lowest part of the Northmoor Member or even Northmoor Member strata redeposited during quarry operations. Indeed, the truncation of Units 20002 and 20003 could have been caused by a mechanical excavator. The overall impression of the infilling of palaeochannel **b** was that it took place in moderate to low flow energies and that, initially at least, flow was punctuated. Later flow was of a more consistent and moderate energy.

5.3.6 Many of the facies differences outlined in Section 5.3.5 above are reflected in grain size distributions and low frequency magnetic susceptibility, and to a lesser extent in the geochemistry. Fills of palaeochannel **a**, i.e. units 25005 and 25013 have similar grain size properties i.e. mean grain sizes in the medium–coarse silt range (28–55um), is comprised almost equally of sand (28–55%) and silt (35–59%), and with a much lower proportion of clay (9–12%) (Figure 15). The stratum is very poorly sorted and very fine to fine-skewed, However, there are differences in magnetic susceptibility and grain size. The former reaches the highest levels in any stratum in the basal sample from Unit 25005, i.e. 74 SI Units x 10^{-6} m^3 kg^{-1}, before decreasing first to 10–13 SI Units x 10^{-6} m^3 kg^{-1}, and then to 3–5 SI Units x 10^{-6} m^3 kg^{-1} through most of the unit. The single sample from Unit 25013 has a low frequency magnetic susceptibility comparable with the lower part of Unit 25005 (i.e. 12 SI Units x 10^{-6} m^3 kg^{-1}). The geochemistry of Unit 25005 is as described for Unit 25009 above (Section 5.3.3) albeit that iron and aluminium are present in lower (1.2–2.2% and 1.5–2.4% respectively) and silicon in higher concentrations (11–15%). Indeed Unit 25013 shares the geochemical properties of Unit 25005, but the zircon concentration is the highest in any sample that was measured (0.36%).

5.3.7 The fills of palaeochannel **b** have a coarser grain size distribution than the primary fills of palaeochannel **a**, while skewness and kurtosis properties are also different (Figure 15). Mean grain size in Unit 20002–20004 is 47–63um (coarse silt), but the strata are dominated by sand-size particles (54–66%), with lesser quantities of silt (27–38%). and little clay (7–8%). All three units are poorly sorted, very fine skewed and mesokurtic (cf. polykurtic in Units 25005 and 25013). Portable XRF demonstrates that the geochemistry of Units 20002–20004 is indistinguishable from that of Unit 25005 (Section 5.3.6). However, there are magnetic susceptibility differences both with Units 20002–20004 and between those strata and Unit 25005. The base of Unit 20004 has very similar low frequency magnetic susceptibility properties as Unit 25013, i.e. measurements range from 12 to 13 SI Units x 10^{-6} m^3 kg^{-1}, but there is an increase in the middle part of the unit to 45–51 SI Units x 10^{-6} m^3 kg^{-1}, before a fall to 11–27 SI Units x 10^{-6} m^3 kg^{-1} in the top of the unit. As is implied above, it is notable that these variations do not coincide with changing grain size or geochemical properties. Units 20002 and 20003 also have elevated magnetic susceptibility measurements at 32 and 16 SI Units x 10^{-6} m^3 kg^{-1} respectively. Unit 20012 completes the palaeochannel sequence and as explained in Section 5.3.5 is a rejuvenation fill of palaeochannel **a**. However, its grain size, magnetic susceptibility and geochemical properties are within the range of the earlier fills (Units 20005 and 20013) of that channel (Figure 15).

5.3.8 Palaeochannel **b** extended eastwards as far as a cliff in the Kellaway Clay Member bedrock, against which it and its fills butted [Unit 20004 (E)] and onlapped (Units 20003 and 20002) (Figure 9, 10 and 11). Further to the east still, Test Pit 3 joined one to the Hollingworth's test pits which was recorded during the geoarchaeological borehole stage of works as 'ARCA BH38'. Here, vestigial Oxford Clay deposits (Unit 20015) overlaid the Kellaway Clay, while within involutions of the former were matrix-supported gravels of Unit 20008 (ARCA BH38 0.15-0.25m, facies 4) and also including a boulder-sized mammoth tusk in one such hollow. As Figure 9 and 10 demonstrates, Unit 20008 is stratigraphically earlier than the fills of palaeochannel **b**.

5.4 Test Pit 4

5.4.1 The basal gravels (Unit 14003, facies 1) were at least 0.5m thick, and were organised in c. 0.1m-thick sub-horizontal sets dipping slightly to the south and west, and differentiated by colour and the quantity of matrix (Figure 12). The gravels were unconformably (Miall 1996 5th order bounding surface) overlaid by further matrix-supported gravel (facies 4) and also silt-fine sand strata (facies 6), which were collectively designated as Unit 14002. Facies 4 was found both locally above and below facies 6, the contacts between the facies were diffuse and both facies were massively bedded and fossiliferous (they contain shell of the freshwater prosobranch mollusc, *Bithynia* sp.). The sequence was completed by further dense, matrix-supported gravels of Unit 14001 (facies 1), which were separated from Unit 14002 by an unconformable (Miall 1996 5th order bounding surface) boundary.

5.5 Quarry walls

5.5.1 Formal descriptions of the deposits exposed in the quarry walls are provided in Hogue et al. 2020a (Appendix 6), while only a brief summary is given here. The deposits were comprised of a variety of facies, consisting mostly of horizontally-bedded, clast- and matrix-supported sheet gravels. Occasionally beds were cross bedded (planar and trough cross bedding were both noted), but even these were arranged horizontally. Fine-grained beds were rare and where present comprised sand and granular sets within the cross bedded strata, and occasional lenticular beds of sand in the lea of gravel structures. Silt/clay beds were extremely rare and occurred only towards the base of the sequence (possibly indicating derivation from the Kellaway Clays). The predominantly coarse-grained sequence outlined above was overlain by massive silt/clay deposits that formed on the present Thames-Churn floodplain prior to quarrying. The present soil had developed within the latter.

5.5.2 Clast lithological analysis was carried out on the 16.0–11.2mm fraction of five 10l samples from the quarry walls (Section D) (Table 3). Over 96.8% of the clasts are of limestone lithologies derived from Jurassic rocks, of which the majority (crystalline and oolitic limestone) are from Cornbrash Formation, Forest Marble Formation and Athelstan Oolite Formation sources >3km west of the site (British Geological Survey 2019a). In contrast limestones ('Platy' grey limestone) derived from the local Kellaways Clay Member and Oxford Clay Formation make up <5% of the total. Other than the calcite, which has probably been sourced from caves in the limestone or travertine elsewhere upstream, all other lithologies are exotic to the catchment. The sandstone is likely derived from Triassic sources to the north or west, the chert is probably of Carboniferous age and also from rocks to the west and north, while given the westerly and northerly drainage, the single flint clast might be derived either from Cretaceous rocks in north-eastern England or might even be artefactual (it is too weathered to determine the latter). These exotics are all likely to have been transported to the catchment via Middle and Early Pleistocene glaciers and their outwash (Bridgland 1994, 35–41). The clast lithological composition recorded in the Oak Tree Field quarry wall accords with that of Northmoor Member deposits at Latton (94.5–99.5% limestone and with similar proportions of exotic content) and Ashton Keynes (99.5–100.0% limestone) as reported by Lewis et al. (2006).

5.6 Interpretation

5.6.1 The broad sequence of deposition in the Oak Tree Field quarry as witnessed by strata exposed in the test pit sections and the quarry walls can be divided into several phases.

Phase1

5.6.2 The earliest manifestation of the palaeochannel was likely as a broad channel or series of channels that ran through the site north and west of a cliff in the Kellaway Clay bedrock that stood at the south and east of the quarry. The diversity of grain sizes recorded suggest that during this phase a variety of flow regimes existed within the channel, ranging from low to high energy (facies 3, 6 and 7), while channel sinuosity also varied. Nonetheless, there appears to have been a broad trend for increasing energy levels through time. Almost all gravel particles are sourced from Middle Jurassic strata outcropping to the north and west of Oak Tree Field, while the Upper Jurassic rocks found on the site are not represented in the coarse particles. Indeed, the gravel-dominated strata are accompanied with relatively coarse (i.e. fine sand) mean grain size distributions <2mm and the association of the latter with calcium (r=0.61), would suggest that sand-sized particles are also derived from Middle Jurassic limestones. On the other hand, a source for the 24–37% silt and clay-particles is likely strata of the Oxford Clay Formation (Upper Jurassic) into which the channel was cut (see Section 5.6.6). Vertebrate bone was deposited in the channel during its early low energy cycle and these fossils were later banked up by gravels deposited under high flow energies. This phase of channel-deposition was witnessed in Test Pit 1 (Units 31006, 31002, 31005 and 31004, equivalent to ARCA Units v–ii), the base of Test Pit 2 (Unit 25009), and the easternmost margin to Test Pit 3 (Unit 20008).

Phase 2

5.6.3 The channel was then likely downcut, deepening the channel, and thereby truncating and removing the deposits that were laid down during its earliest manifestation. The downcutting left Unit 20008 perched >1m above the other residual channel deposits.

Phase 3

5.6.4 Following downcutting, renewed coarse-grained accretion took place in a high energy flow regime across the whole former channel area. However, in contrast to the broad channel that flowed during the earliest manifestation of the river, it ran as multiple shallow channels of low sinuosity and flowed in a SSW-NNE direction. As with Phase 1, the majority gravel source material was from limestone geologies to the north and west. Strata of Phase 2 were predominantly of facies 1, and were found in Test Pit 2 (Units 25007, 25006 and 25001) and Test Pit 3 (Unit 20006). At some stage during deposition of the gravels of Phase 3, either a channel became cut off from the main axial flow or a large scour hollow developed in the area of Test Pit 2. This depression (Phase 3a) was then infilled by sediments that were deposited in moderate to very low flow energies (Units 25004-25002, facies 8). The channel/scour hollow then once more became incorporated in the wider channel belt (Unit 25006).

5.6.5 Although the sub-samples examined for clast lithological analyses from Phases 1–3 are 1–2 orders of magnitude too small for the purpose, they hint that the relevant gravel strata are not sourced from oolitic limestone rocks. Further, the proportion of Carboniferous appears to be relatively high. Both properties are in contrast to the Northmoor Member discussed below and suggest subtlety different source material from the latter. The absence of oolitic limestone might indicate that the Athelstone Oolite Formation, which is presently only exposed west of Cirencester where Thames tributaries have downcut (British Geological Survey 2019a), was not present as a surface outcrop during Phases 1–3. On the other hand, there may have been more extensive outcrops of chert-bearing 'northern drift' within the stream catchment during Phase 1–3 than in Phase 5.

5.6.6 Nevertheless, initial channel infilling during Phase 3 was of predominantly silt and clay-sized particles that are likely derived from the Oxford Clay Formation (Unit 25005). This stratum has a distinctively fine grain size (c. half the mean of any other unit and 1.5 to 3 times the amount of clay), and a distinctive geochemical suite which includes relatively high concentrations of iron, titanium, potassium and aluminium. Indeed, the latter four elements are closely correlated with clay content (r=0.72 for iron, r=0.94 for titanium, r=0.88 for potassium and r=0.74 for aluminium).

Phase 4

5.6.7 During Phase 4, the bedform and flow of the channel altered once again, and multiple small (3–5m wide, <1m deep) channels developed. Flow passed down these sinuous features during alternating episodes of moderate to low energy, leading to their infilling, abandonment and rejuvenation. This phase was represented only in Test Pit 3 and by Units 20005–20002 and 20012 (facies 8, facies 5, facies 9 and facies 6).

5.6.8 Grain size analysis of the <2mm fraction and geochemical measurement suggests that the majority of the Phase 4 channel fills are intermediate between the Oxford Clay-derived basal channel fill of Phase 3 (Unit 25005) and gravel strata of both Phase 1 and Phase 3, i.e. derivation of <2mm particles was from both limestone and Oxford Clay sources.

Phase 5

5.6.9 Events between Phases 4 and 5 are unclear given that contacts between the Northmoor Member deposits and the palaeochannel fills were either not preserved within Oak Tree Fields quarry (i.e. they had been removed by quarrying), or they were buried beneath the battened slump which had formed against the quarry walls. Phase 5 deposition was of sheet gravels of a broadly similar character to those forming in Phase 3, although the thickness of the Phase 5 deposits suggested that the bedform of the latter was longer lasting.

5.6.10 Clast lithological analysis clearly demonstrates that the stream in which the Northmoor Member strata were deposited, passed through and sourced most of its sediment from Jurassic limestone deposits to the west and/or north. Rocks of local derivation are relatively rare.

6 BIOSTRATIGRAPHIC ANALYSES

6.1 Introduction

6.1.1 The following provides an updated biostratigraphic assessment of the site following subsequent analyses of plant macrofossil, molluscan, and insect remains in fulfilment of Stage 5 (Tasks 5.1) and serves to address Objective 2 of the Updated Project Design (Hogue et al. 2020b, see Section 2) by helping to reconstruct the ecological and climatic conditions at Cerney Wick.

6.1.2 Biostratigraphic analyses were undertaken in line with the methodological procedures defined in the Project Design (Wilkins et al. 2018), Stratigraphic and Specialist Assessment (Hogue et al. 2020a), Updated Project Design (Hogue et al. 2020b), and refined above (see Sections 4.4-4.6). Results for each proxy subjected to subsequent analysis is given below and further supporting information is given in Appendices 2-5.

6.2 Plant Macrofossils

Daniel Young (QUEST, University of Reading) and Marta Perez Fernandez (Royal Holloway University London)

6.2.1 Plant macrofossils counts in the samples are presented in Appendix 2 Table 4, a plot of frequencies is presented in Appendix 2 Figure 16 The results of the earlier assessment (see DigVentures, 2019) aforementioned appendices, including those samples for which no further analysis was undertaken.

6.2.2 Combined, the waterlogged seed assemblages recorded in the samples from Phases 1 and 3 represent a combination of aquatic, waterside and open, damp or disturbed ground growing in temperate conditions, with the macrofossil remains present from this range of environments most likely as a result of the fluvial redistribution of sediments from the wider area of the floodplain. However, on the basis of the preservation of the macrofossil remains, in particular in Units 25008 and 25004, there is little evidence to suggest that there has been substantial reworking of the sediments and the seeds are unlikely to have been transported far from their source. No major differences were identified in taxonomic diversity. Higher frequencies of Juncaceae (rushes) seeds were identified at assessment influencing the total numbers of specimens identified. Higher frequencies of small species, including those of Juncaeae, may be accounted for additional scanning of the sub-125 micron fraction at assessment. Additionally, frequencies can vary greatly due to subtle differences in locations. A description of the assemblage by phase is given below

Phase 1

6.2.3 Two samples were analysed from Phase 1, including sample <12> (31006) from Trench 1 and <25> (25008) from Trench 2. Plant macrofossil remains were poorly preserved in sample <25>, with only single fruits of *Carex* spp. (sedges) and undifferentiated Cyperaceae sp. (sedge family) recorded. However, preservation was good in sample <12>, the assemblage in this sample dominated by *Ranunculus repens/acris/bulbosus* (buttercup) and Juncaceae (rushes), and indicative of open, disturbed or damp grassland, consistent with the presence of *Picris* sp. (oxtongues) and *Rumex acetosella* (sorrel). Aquatic taxa were also present, including *Potamogeton* sp. (pondweed) and *Nuphar lutea* (yellow waterlily). *Potamogeton* is a broad genus found in a range of aquatic environments, but the floating yellow waterlily indicates slow moving or still water and can survive in water depths of up to 5m. Several taxa typical of waterside environments or damp ground were also present in this sample, including *Carex* cf. *rostrata* (beaked sedge), sedges, cf. *Scirpus* sp. (bulrush) and *Potentilla* sp. (cinquefoil). No woodland or scrubland taxa were recorded within the samples from Phase 1.

6.2.4 Four samples were assessed from Phase 1 during the previous phase of work (see DigVentures, 2019), including samples <9>, <10> (31002), <11> (31006) and <26> (25008). In context (31002) (samples <9> and <10>) the plant macrofossils were poorly preserved, but were indicative of either aquatic environments or damp and disturbed ground, dominated by rushes, sedge family, pondweed, Poaceae (grass family), cf. *Silene* sp. (e.g. campion) and cf. *Thalictrum* sp. (e.g. meadow rue). In context (31006) the results of the assessment of sample <11> were dominated by rushes and sedges, and were indicative of a damp, open environment, dominated by plants that occupy transition zones between open water and terrestrial habitats. Sample preservation was identified as poor during the assessment of sample <26>, context (25008), the samples containing few seeds of sedges and cf. *Silene* sp.

Phase 2

6.2.5 It is inferred that the channel was then likely downcut during this period, deepening the channel, and thereby truncating and removing the deposits that were laid down during its earliest manifestation. As such, no deposits survived from which to provide samples for environmental analyses (see Section 5.6)

Phase 3

6.2.6 Plant macrofossil preservation was poor in sample <15> (25002) from Phase 3, with only indeterminate sedges, rushes, and one achene of buttercup recorded, with only rushes found in sample <17> (25003). In contrast, a high concentration of macrofossil remains were identified in sample <21> (25004), this sample displaying a similar assemblage to that of sample <12> from Phase 1. Buttercup dominates the assemblage (25 of a total of 65 seeds/fruits), providing evidence for open, disturbed or damp grassland; a range of aquatic taxa were present including pondweed, *Ranunculus* subgenus *Batrachium* (water crowfoots), *Alisma plantago-aquatica* (common water-plantain) and *Zannichellia palustris* (horned pondweed). The water crowfoots are a large species that grow in still or flowing water; however, common water-plantain is found growing on exposed mud at the shallow edge of still or slow-flowing water, or in marshes and swamps, and is indicative of mesotrophic or eutrophic conditions. Horned pondweed grows in a range of shallow-water habitats, including eutrophic and brackish environments. Waterside and damp ground taxa were also recorded in sample <12>, including beaked sedge and other indeterminate sedges. Similar to Phase 1, No woodland or scrubland taxa were recorded within the samples from Phase 3.

6.2.7 Two samples were previously assessed from Phase 3, including sample <14> from context (25002) and <18> from context (25003). In context (25002) the sample was dominated by rushes, with few other taxa recorded, although meadow rue and campion were present, indicative of damp, open ground. In context (25003) the sample was dominated by rushes, sedges, *Epilobium* sp. (willowherb) and pondweed, again indicative of damp, open environments, probably on the margins of a water body; possible birch budscales and catkins (broken) and a possible Ericaceae leaf (fragment) were also recorded, likely derived from woodland or heathland in drier areas of the wider catchment.

Phase 4

6.2.8 Seed preservation was very poor in the samples analysed from Phase 4, with only indeterminate sedges *Sambucus nigra/racemosa* (elder) and rushes recorded in sample <74> (20005) and pondweed and horned pondweed in sample <72> (20005). The presence of elder in sample <74> represents the only definitive evidence for woodland or scrubland in the samples from Oak Tree Fields, whilst pondweed and horned pondweed grow in a range of aquatic settings, including eutrophic environments and standing or slow-moving water.

6.2.9 Three samples were assessed from Phase 4 during the earlier phase of work (see DigVentures, 2019), including those from contexts (20005) (sample <22>) and (20003) (<67> and <69>). The sample from context (20005) was dominated by rushes, grasses and cf. meadow rue, indicative of damp, open ground; the samples from context (20003) were dominated by rushes, sedges and Characeae (green algae), again indicative of damp, open environments on the wider floodplain.

6.3 Mollusca

Matthew Law (L-P Archaeology and Bath Spa University)

6.3.1 MNI for Mollusca present in the samples are presented in Appendix 3 Table 5. A plot of diversity indices is presented in Appendix 3 Figure 17, and the detrended correspondence analysis plot is presented in Appendix 3 Figure 18.

6.3.2 Shell was largely well preserved in the samples, with some brown staining and indications of decay on some shells in the form of small pits. No shell within the samples had the appearance of fresh, modern shell (proteinaceous periostracum intact or glossy, translucent appearance), suggesting that there has been no recent intrusion of material into the sediments.

Phase 1

6.3.3 Phase 1 was represented by four samples from Test Pit 1. Sample <11> reflected relatively low energy deposit Unit 31006 and samples <10> and <9> overlying gravel Unit 31002.

6.3.4 Numbers of molluscs were relatively low (n=49) in <11> Unit 31006. There was a relatively wide difference between the Shannon and Brillouin diversity indices for this sample, which is indicative of an incomplete sample, probably due to the impact of the current. More tangibly, this can be seen in the complete absence of *Bithynia* opercula from this sample, which is the result of winnowing of the lighter, flat, plate-like opercula by the current (O'Connor 2017, 134). Although on sedimentological grounds this deposit is described as low energy, the malacological interpretation would be of a riverine setting (dominance of Group 6d species), with some material washed in from a terrestrial setting (Group 3 and 4 taxa). A possible scenario then is that the sediment was laid down in a backwater setting periodically recharged and washed by higher energy floodwater throughput. Sample <11> also contained a single left valve of the freshwater bivalve *Pisidium clessini*. This is a globally extinct species, whose last appearance datum in Britain is during MIS 7 (Keen 2001).

6.3.5 Samples <10> and <9> from Unit 31002 were dominated by the Group 6d species *Valvata piscinalis*, and the 6b species *Ampullaceana balthica* (*Radix balthica* or *Lymnaea peregra* of earlier authors). *Ampullaceana* is tolerant of a wide range of situations, but *Valvata* is favoured by larger bodies of slower moving, well-oxygenated water bodies, usually on muddy substrates. Numbers of shells and of molluscan species were higher in these two samples than in the underlying deposit, and the Shannon and Brillouin indices are relatively close. Overall, it would appear that these samples derived from a relatively low-energy large river channel. This may imply intermittent stability which favoured these molluscs.

<u>Phase 2</u>

6.3.6 It is inferred that the channel was then likely downcut during this period, deepening the channel, and thereby truncating and removing the deposits that were laid down during its earliest manifestation. As such, no deposits survived from which to provide sample for environmental analyses (see Section 5.6)

<u>Phase 3</u>

6.3.7 Phase 3 was represented by three samples <22>, <18>, and <14> all collected from Test Pit 2.

6.3.8 Sample <22> from Unit 25005 contained a very low number of snails (n=12), again was dominated by *Valvata*, suggesting a relatively high-energy fluvial setting.

6.3.9 Sample <18>, from Unit 25003 contained both the highest number of molluscs (n=280) and the highest number of molluscan taxa (s = 17) of the assemblage. This was a fine grey sand with inclusions of organic mud and represents a period of stability within a topographical depression. The high numbers of *Valvata, Pisidium amnicum,* and *Bithynia tentaculata* would suggest that it is still within a lotic river system, however, rather than a stagnating oxbow. Interestingly, *Bithynia* opercula outnumber the shells of that species in this deposit. A possible scenario is that this deposit accumulated in a relatively quiet backwater. This sample also contains the extinct bivalve *Pisidium clessini*. One of the *Valvata* shells was stained black, most likely from deposition in highly organic mud. This sample, uniquely for this site, contained *Myxas glutinosa*, a snail restricted to slow moving, clean, calcareous waters, which avoids turbidity and weed-choked waters.

6.3.10 The overlying sample, <14>, contained few shells (n=21), and again appears to represent unstable conditions, most likely a return to conditions of increased energy. There is a relatively extreme difference between the Shannon and Brillouin indices for this sample, again potentially reflecting taphonomic winnowing of the shells, although in this case low numbers of shells may also affect the reliability of the indices.

Phase 4

6.3.11 Phase 4 was represented by <69> and <67> both recovered from Unit 20003 in Test Pit 3. The two samples from Unit 20003 contained relatively high numbers of shells and relatively high diversity. Again, *Bithynia* opercula outnumber shells of that species, these additional opercula may have been carried on relatively low energy waters. *Hippeutis complanatus* is present in <67>, this is a species associated with calcareous and well-vegetated still to slow-moving waters.

6.4 Insects

Enid Allison (Canterbury Archaeological Trust)

6.4.1 The concentration of insect remains was low to moderate throughout the sequence (a minimum of 5 – 31 individuals litre^{-1}). This may, at least some extent, be due to deposition being predominantly in an actively flowing channel with an unstable substrate, rather than in stationary or slowly flowing water where sediment and organic material would be more likely to accumulate. High fragmentation in all the samples has impacted on the identification of some of the material; this was particularly the case for larger taxa such as ground beetles (Carabidae), dung beetles (Scarabaeidae) and click beetles (Elateridae), and also for many weevils (Curculionidae). Levels of chemical erosion were generally moderate but in some cases cuticle had become significantly thinned resulting in crinkling or distortion of sclerites or fragments. With the exception of sample <69>, however, there were only limited degrees of colour loss or erosion of surface texture. A minority of the remains were encrusted with reddish-brown sediment. Heads of some taxa, notably dung beetles, were over-represented relative to other sclerites.

6.4.2 The species composition was very similar in all the assemblages, although numbers of identifiable beetles varied in individual samples. A full list of taxa recorded from each sample is provided in Table 1, and proportions of selected ecological groups in Table 2. The proportion of aquatic beetles was fairly consistent throughout most of the sequence (11 – 17% in assemblages with >50 individuals), while damp ground and waterside taxa, and decomposers, were proportionally well represented among the terrestrial beetle fauna. True bugs (Hemiptera), which often have rather restricted habitat and climate requirements and are therefore potentially of value for climatic reconstruction, were not closely identifiable on the available fragments.

Phase 1

6.4.3 The lithologies recorded suggest that a variety of flow regimes existed within the channel during phase 1, but there seems to have been a broad trend for increasing energy levels through time (Wilkinson *et al*. 2019). Samples from units 31006 (sample <11>) and 31002 (samples <10> and <9>) in test pit 1 produced moderate numbers of beetle remains (56 – 108 individuals). A single sample from unit 25008 in test pit 2 (sample <26>) produced only a few fragments of a water boatman (Hemiptera: Corixidae), and traces of indeterminate beetle cuticle. The largest assemblage was from the uppermost sample from unit 31002 (<9>).

6.4.4 Water beetles (11 – 17% of the assemblages) reflect a range of aquatic and marginal conditions. The predaceous diving beetles *Agabus bipustulatus* and *Colymbetes fuscus* are typical of still and slowly flowing water, while *Esolus parallelepipedus,* recorded only from sample <9>, is indicative of shallow, well-oxygenated, moderately swiftly running water. It appears to prefer channels with stony, often unstable substrates and little or no vegetation, but with abundant filamentous algae. Algae, moss and plant litter in marginal sediments were suggested by records of *Sphaerius acaroides* and *Georissus crenulatus*; the latter species usually occuring in sun-exposed places, often by running water. Several other species are typically found in soft waterside mud (*Ochthebius dilatatus*, *O*. cf *minimus*, *Laccobius* and *Cercyon ustulatus*).

6.4.5 Taxa from damp ground and waterside habitats accounted for 9 – 11% of the terrestrial fauna. Evidence for marginal vegetation came mainly from *Donacia dentata*, which feeds on the leaves of arrowhead (*Sagittaria sagittifolia*), *Donacia semicuprea* and ?*Notaris acridulus*, both found on sweet-grasses (*Glyceria*), and *Chaetocnema arida* group which occurs on various rushes (*Juncus*), sedges (*Carex*) and grasses (Poaceae). In places, ground close to the water was probably rather open or sparsely vegetated, and also permanently damp and muddy: the ground beetles *Dyschirius globulus* and *Clivina fossor* are typically found in such situations. Areas of relatively bare ground may have been colonised by ruderal plants and possibly waterside crucifers: *Chaetocnema concinna* or p*icipes* is associated with Polygonaceae such as knotweeds (*Polygonum*) and docks (*Rumex*), and *Meligethes* and *Ceutorhynchus* with crucifers (Brassiceae).

6.4.6 Grassland appears to have been present close to the channel, both on damp ground and more widely on drier terrain. *Pterostichus vernalis* is typical of damp grassland, whereas *Amara* species, *Calathus fuscipes*, and a smaller *Calathus,* are suggestive of relatively dry ground. *Helophorus nubilus* is found at plant roots, on sun-exposed, often rather dry grassland, and also on disturbed ground. The click beetles *Agrypnus murinus* and *Agriotes* are characteristic of grassland where their larvae predominantly feed on grass roots. *Orchestes hortorum*, specifically associated with oak (*Quercus*), and a scale insect found on a variety of woody vegetation (Coccoidea: Diaspididae), were both present in sample <9>, providing limited evidence for the presence of local trees and shrubs somewhere locally.

6.4.7 Beetles associated with foul decomposing matter, particularly herbivore dung, were notably common in all three samples, with the highest proportion recorded in sample <9> (unit 31002) where they made up over a third of the terrestrial beetle fauna (35%). Scarabaeoid dung beetles *(*Aphodiinae spp., Geotrupinae) formed a substantial part of this group, on their own accounting for a quarter of the terrestrial fauna. *Euheptaulacus sus* and ?*Melinopterus* sp(p). were present in all three samples, but other species were not identified closely.). *Anotylus gibbulus* group, which is no longer extant in Britain, appears to be associated with the dung of large mammals (Hammond *et al*. 1979). Other foul decomposer taxa recorded are especially characteristic of dung, although some species also occur in foul plant litter (*Sphaeridum*, *Cercyon impressus*, *C. pygmaeus*, *Playstethus arenarius*, *Oxytelus* ?*piceus, Hister bissexstriatus*). Various eurytopic decomposers may also have exploited available dung in addition to other forms of decomposing matter.

Phase 2

6.4.8 It is inferred that the channel was then likely downcut during this period, deepening the channel, and thereby truncating and removing the deposits that were laid down during its earliest manifestation. As such, no deposits survived from which to provide sample for environmental analyses (see Section 5.6)

Phase 3

6.4.9 Renewed accretion took place during phase 3, also thought to probably be attributable to the cooler phase MIS7d. Three samples from units 25005, 25003 and 25002 in test pit 2 produced assemblages consisting of 27 – 155 individuals (samples <22>, <18>, <14>). The assemblages were in many ways similar in composition and implication to those from phase 1 deposits, although a greater number of taxa was represented in the somewhat larger assemblage from sample <18> which appears to relate to a period of moderate to very low energy water flow (Wilkinson *et al*. 2019), which would have favoured the accumulation of organic material. Unless otherwise stated, the insect evidence detailed below is from sample <18>.

6.4.10 Aquatics accounted for 17% of the assemblage, again reflecting differing water regimes. The riffle beetle *Esolus parallelepipedus* is indicative of shallow, well-oxygenated, moderately fast running water, typically over a stony substrate, and *Ochthebius bicolon* is found in mud by running water. *Colymbetes fuscus* is typical of slowing flowing or still water and *Lophopus crystallinus*, a crystal moss animal (Bryozoa) represented by occasional statoblasts in sample <22>, occurs in water with only a slight current. Various taxa were indicative of relatively bare, exposed marginal sediments with algae and moss, and soft waterside mud (*Sphaerius acaroides* (sample <22>), *Georissus crenulatus*, *Dryops*, *Ochthebius dilatatus*, *O*. cf *minimus*, *Cercyon ustulatus*). *Byrrhus* and *Chaetarthria* species are specifically associated with moss, the latter usually in rafts of floating vegetation. *Tournotaris bimaculata* (sample <14>) lives on a variety of wetland monocotyledons (Typhaeceae, Cyperaceae, Poaceae), and *Chaetocnema arida* group on various rushes, sedges and grasses. Donaciine leaf beetles are associated with various marginal or emergent plants but their remains were too highly fragmented for close identification. *Rhinoncus perpendicularis* occurs on the terrestrial form of amphibious bistort (*Persicaria amphibia*) but in continental Europe it can also be found on other *Persicaria s*pecies and knotgrass (*Polygonum aviculare*). Taxa associated with damp ground and marginal terrestrial habitats were proportionally less common than in phase 1 (5% of the terrestrial fauna).

6.4.11 As with the earlier phase, areas of bare ground may have been colonised by ruderal plants: *Chaetocnema concinna* or *picipes* is associated with Polygonaceae such as knotweeds (*Polygonum*) and docks (*Rumex*), and *Phyllotreta* with crucifers (Brassicaceae). Ground beetles included species typical of both damp ground (*Bembidion biguttatum*, *Dyschirius globulus*, *Chlaenius*) and drier places (e.g. *Harpalus rufipes*, *Calathus fuscipes*, *C. melanocephalus*, *Amara*). Some of these taxa, together with *Helophorus nubilus*, suggest grassland habitats. The weevil *Graptus triguttatus* is found at the roots of plants in open grassy places, showing a marked preference for ribwort plantain (*Plantago lanceolata*) in the British Isles at the present day. *Sitona* species (sample <14>) are also typical of grassland where they are associated with leguminous plants (Fabaceae) such as clovers and trefoils. Hints of local trees and shrubs came from a record of *Crepidodera*, a small leaf beetle found on willows (*Salix*) and poplars (*Populus*).

6.4.12 Decomposers were again dominated by taxa associated with foul matter that predominantly consisted of scarabaeoid dung beetles. The foul component accounted for 23% of the terrestrial fauna in sample <18>, with similar proportions in the two smaller assemblages from this phase. Other taxa primarily associated with dung included *Sphaeridium bipustulatum*, *Cryptopleurum minutum*, *Platystethus arenarius*, *Hister bisexstriatus, Saprinus aeneus* (sample <22>), *Anotylus gibbulus* group and probably *A. complanatus*.

Phase 4

6.4.13 Phase 4 was represented by two samples from unit 20003 in test pit 3 (samples <69> and <67>) and might possibly be attributable to MIS7c and a warming climate. During this phase there were alterations in the bedform and flow of the channel, and multiple small channels 3 – 5 metres wide and less than a metre deep developed. Alternating episodes of moderate to low energy water flow led to episodes of infilling, abandonment, and rejuvenation (Wilkinson *et al.*, 2019).

6.4.14 Preservation of insect remains was particularly poor in the lower sample <69>, which might relate, at least in part, to fluctuations in water flow that allowed aeration of the deposit which would have been detrimental to insect preservation. A larger and significantly better preserved assemblage was recovered from sample <67> (149 individuals of 94 taxa), suggesting that conditions may have been more consistently wet by that stage.

6.4.15 Generally, the assemblages are suggestive of a running water channel, with swampy, well-vegetated backwaters or water margins, or perhaps periodically with a substantially reduced flow. There was clearly also an abundance of herbivore dung. Taxa associated with damp ground and marginal terrestrial habitats were proportionally more common than in Phase 3 (10% of the terrestrial fauna in sample <67>).

6.4.16 Water beetles (16% of the assemblage) indicated a range of aquatic conditions, with clearer evidence for swampy, richly-vegetated conditions compared to the earlier phases. Beetles from damp ground and marginal habitats made up 10% of the terrestrial assemblage. Three species of riffle beetles (*Elmis aenea*, *Limnius volkmari*, *Esolus parallelepipedus*) are indicative of clean, clear, well-oxygenated running channels, and *Ochthebius* ?*bicolon* of mud by running water. On the other hand, still or slowly flowing water and swampy or fen-like conditions were indicated by *Coelostoma orbiculare*, which usually occurs in moss in floating rafts of vegetation or at water margins. *Donacia crassipes*, found on the leaves of water lilies (*Nymphaea* and *Nuphar*), and *Hydrochus* species would also occur in still to slowly flowing water, and occasional statoblasts of *Lophopus crystallinus* suggest water with a slight current. *Georissus crenulatus* would have been associated with algae and moss in marginal sediments. The phytophages *Donacia dentata*, *Tournotaris bimaculata*, *Notaris acridulus*, and *Limnobaris* suggest a rich marginal vegetation where plants included arrowhead (*Saggitaria saggitifolia*), 'reeds' *sensu latu* (Typhaeceae, Cyperaceae, Poaceae), reed sweet-grass (*Glyceria maxima*), and sedges (*Carex*). The ground beetle *Pterostichus niger* is typical of rather damp shaded ground, with shade probably provided by tall waterside vegetation rather than trees or shrubs. No insects specifically associated with trees were recorded from this phase. Land away from the channel was probably significantly drier and predominantly grassland. *Calathus fuscipes*, a smaller *Calathus*, and *Amara* are typical of relatively dry ground, and *Agrypnus murinus*, *Serica brunnea* and a group of weevils (Curculionidae) of grassland. *Mecinus pascuorum* and *Mecinus pyraster* are both associated with ribwort plantain (*Plantago lanceolata*), and *Tychius* species and *Sitona* with leguminous grassland plants such as clovers and trefoils. The larvae of *Meligethes* feed on crucifers (Brassicaceae).

6.4.17 Decomposers associated with dung and possibly other forms of foul vegetable matter accounted for 34% of terrestrial insects in sample <67>, with scarabaeoid dung beetles making up the majority of this component (26% of the terrestrial fauna), similar proportions to those seen in phase 1 (sample <9>).

Climatic reconstruction

6.4.18 The Mutual Climatic Range (MCR) method (Atkinson *et al*. 1987) is based on the thermal range data of predatory or scavenging beetle species that are not dependent on plants for their distribution. It is emphasized that the method generates a range of temperatures between which the selected species could live, and not averages for summer and winter temperatures such as can be calculated from modern data based on actual climatic records. MCR data exists for 10 – 15 of the species identified from phases 1, 3 and 4 at Oak Tree Fields, and these indicate temperature ranges consistent with a temperate climate where summer temperatures at least may have been slightly lower than at the present day. The temperature ranges for all three phases almost completely overlap, the only difference being that winter temperatures might possibly have been cooler in phase 1 than in phases 3 and 4, but this is not clear based on the present data. Uncalibrated values for maximum and minimum temperatures calculated using BugsCEP (Buckland and Buckland 2006) are shown in Appendix 4 Figure 19, together with present day mean daily summer (July) and winter (January) temperatures for the Midlands region compiled by the Meteorological Office (Met Office, consulted 28.10.21).

7 FAUNAL REMAINS

Hannah Russ with contributions from Kate Scott, Adrian Lister, Silvia Bello, Chris Stringer, Louise Humphreys, and Mike Buckley

7.1 Introduction

7.1.1 In total, vertebrate remains exceeding 52.3kg in weight (219 specimens) were recovered from Cerney Wick in 2017 and 2019 (Appendix 5). In 2017 a flint handaxe was found alongside well-preserved vertebrate remains by amateur collectors Sally and Neville Hollingworth. In 2019 archaeological excavation of four test-pits at the site resulted in the recovery of vertebrate remains (n=77) from secure stratigraphic contexts. Both assemblages were assessed (Russ et al. 2019) in accordance with the Project Design (Wilkins et al. 2018), resulting in a number of recommendations for further work on the material. In 2021, 35 additional specimens collected in 2017 by the Hollingworth's, but not known to the Project Team at the time were made available for study and are included here. This report presents a combined catalogue and analysis of all the vertebrate remains recovered from the Site (apart from five mammoth teeth made available to Prof. Adrian Lister only in October 2021 by the Hollingworths and for which exact provenance remains unclear). The taphonomy of the vertebrates recovered from the Site is discussed below (Section 7.2) before separate discussion of the Hollingworth Collection (Section 7.3) and the excavated materials (Section 7.4).

7.2 Taphonomy

Condition

7.2.1 Two factors were considered in terms of determining the condition of each specimen: fragmentation and bone surface preservation. Fragmentation was recorded using the zonation system described by Dobney and Rielly (1988), while condition was graded from one to five, with one indicating excellent surface preservation, and five indicating extremely poor surface preservation/complete loss of bone surface (Lymann 1994).

7.2.2 The vertebrate remains recovered from Cerney Wick were preserved with variable levels of fragmentation and surface preservation. Near complete specimens included a *Mammuthus* sp. tarsal (Find 16) and thoracic vertebra (Find 6; two refitting fragments). All other specimens presented as fragments of elements, with Find 8, a mammoth tusk left in-situ, being the most fragmentary (n=60). Surface preservation ranged from 'good' (grade 2) to extremely poor (grade 5). Fifteen specimens, including those from 2017 and 2019 had 'good' surface preservation, including mammoth radius, tarsal, lumbar vertebra and rib, two bovine thoracic vertebrae, and a rib fragment from a large/very large mammal. The remainder of the assemblage displayed 'moderate' to 'very poor' preservation (92.7% by count, n=203). Overall, the condition of the material was variable.

Butchery

7.2.3 Possible evidence for butchery in the form of fine lines was initially identified on one specimen, a mammoth rib fragment (H.012) from the 2017 collection (Figure 20). Subsequent analyses show that evidence of trampling is manifested as short shallow scratches parallel or oblique to the main axis of the rib (Figure 20C and Figure 20F). Recent damage, which possibly occurred during recovery, is present across most of the upper-ventral side of the rib, in the form of striae and pitting that cut across the cortical surface (Figure 20B and Figure 20E). Modifications observed on the bone have been identified and classified as fresh damage and trampling marks based on established macro and micro-morphometric criteria (Shipman and Rose 1983; Pickering *et al.* 2013; Domínguez-Rodrigo *et al.* 2009). Hence, none of the modifications are consistent with butchery, only superficially resembling cutmarks.

Animal interaction

7.2.4 No evidence for carnivore activity was observed on any of the specimens, though several had surface pitting that appeared similar to that seen in carnivore gnawed remains. However, the location of the pitting on some specimens ruled out the possibility of carnivore gnawing. The cause of the pitting remains unknown.

Pathology

7.2.5 No skeletal abnormalities possibly resulting from disease, injury or age were recorded.

Burning and calcination

7.2.6 No evidence for burning was recorded.

Potential for measurements

7.2.7 Five steppe mammoth teeth and the cattle astragalus were suitably complete for either full or partial measurement. Further discussion of the mammoth teeth can be found below.

Ageing

7.2.8 Nineteen specimens provided some information that contributed to ageing mammoth and bovine remains from the Site. Five steppe mammoth teeth were suitably complete to allow analysis of plate numbers and wear to determine age at death (Appendix 5 Table 9), while a steppe mammoth left tibia and mammoth mandible fragment, humerus, radius, femur, left tibia, tusk and three vertebrae all provided age and/or bone fusion data, Appendix 5 Table 10. While some broad age categories could be estimated, the variation between the fusion ages for skeletal elements in males and females and the unknown sex of the remains from Cerney Wick prevented any precise ages to be estimated in most cases. The humerus from the 2017 collection was distally unfused and consistent in size with a neonate mammoth while most of the other remains represent immature mammoths. Only the tibia H.101 is that of a mature individual (c.18-32 years) and the radius H.105 could represent a mammoth of any age from mature to very old, Appendix 5 Table 10.

7.2.9 One bovine thoracic vertebra was caudally unfused while all other bovine vertebra were both cranially and caudally fused indicating 'adult' individuals.

Minimum Number of Individuals (MNI)

7.2.10 If taken as a single assemblage, a minimum of five mammoths, two over 18-19 years old at death, two 'juveniles' under 18-19 years at death, and a neonate, as well as two bovid and one brown bear are represented at the site.

7.3 Hollingworth Collection

7.3.1 This formal analysis complements the information gathered by Sally and Neville Hollingworth when they discovered the site in 2017.

7.3.2 In total, 110 bones, teeth and fragments thereof were assessed during Stage 2a of the project (Scott 2019). However, this report includes an additional 35 specimens that were made available during analysis that were not previously known to the Project Team. Two specimens included in the Stage 2a assessment have been removed from the project data and not included in this report due to new information that suggests that these may not have been found at the Cerney Wick site.

7.3.3 Including the additional material, and after the removal of the two specimens of questioned provenance, the 2017 vertebrate assemblage comprised 143 bones, teeth and fragments thereof, weighing in total 50.5kg.

7.3.4 Full details of the vertebrates can be found in Appendix 5. The vertebrate material included the remains of mammals from three identified families; Elephantidae (elephants and mammoths), Bovidae (cloven-hoofed, ruminant mammals) and Ursidae (bears). Unidentified fragments of medium- to very large-sized mammal bone formed 33.6% (n = 48) of the 2017 assemblage by count.

7.3.5 Preservation of the material was variable throughout the assemblage. Mammoth teeth were in excellent condition with good surface preservation and root retention. Some material was moderately fragmented, though almost complete elements were also recorded. No evidence for butchery in the form of cut- or chop-marks was observed, and no tooth-marks or evidence for gnawing or carnivore interaction was recorded.

7.3.6 Elephantidae remains comprised the largest part of the assemblage with 85 bones, teeth and fragments identified as certainly or likely mammoth (*Mammuthus* sp.) remains (Table 1, 59.4% by count). From these 85 mammoth specimens, it was possible to identify nine teeth and bones more precisely as *Mammuthus trogontherii* (steppe mammoth); this material included seven molar teeth, a near complete left pelvis and a left tibia shaft. Within the 35 new specimens included in this reporting was a humerus from a cf. neonate mammoth (H.146), based on the size and unfused distal epiphysis. A mammoth lumbar vertebra (H.116) had cranially and caudally fused epiphyses indicating an adult individual.

7.3.7 The Stage 2a assessment report and data included a molar tooth (assigned H.112) and a humerus (H.113), both identified as woolly mammoth (*Mammuthus primigenius*); however, these two specimens are no longer considered to form part of the Cerney Wick assemblage. These numbers have been re-allocated to specimens definitively from the site. The removal of these specimens leaves the steppe mammoth as the only identified mammoth species at the Site.

7.3.8 Bovid remains included two lumbar vertebrae of steppe bison (*Bison priscus*), four thoracic vertebrae, and fragments of right femur and mandible that could belong to steppe bison, aurochs (*Bos primigenius*) or cattle (*Bos taurus*), and an astragalus consistent with domestic cattle (Appendix 5 Table 8). The surface preservation of the possible cattle astragalus differed from the rest of the assemblage in both texture and colour. It is proposed that this bone is much more recent than the other material and is potentially intrusive in this context.

7.3.9 A left mandible fragment from a brown bear (*Ursus arctos*) is the only evidence for the presence of carnivores at the site (H.091).

7.4 2019 Excavations

7.4.1 The test-pit excavations in 2019 (CER19) recovered, in total, 76 bone, tusk and tooth fragments weighing in excess of 3.3kg.

Test Pit 1

7.4.2 Vertebrate remains were recovered from two contexts in Test Pit 1; Unit 31001 and 31002. The remains from Unit 31001 comprised two fragments of bone, one a near complete tarsal (hind foot bone) of a mammoth (Find #16), and the other a portion of vertebra (Find #15), also likely mammoth (Mammalia cf. *Mammuthus*). This context represents the spoil from previous interventions at the site in 2017, and therefore do not represent in situ remains. Unit 31002, palaeochannel deposits, contained eight fragments of bone and three tooth fragments, as well as the mammoth tusk (Find #3). The remains recovered from Unit 31002 included three rib fragments, one identified as mammoth (Find #9), and the other two as probable mammoth (Finds #2 and #5). Three tooth fragments representing a single lamella tooth plate (Find #10), a fragment of mandible ramus (Find #1; zones 3 and 6 according to Dobney and Rielly 1988) and two fragments of a near complete thoracic vertebra (Find #6) were all identified as mammoth, with the mandible fragment and tusk thought to represent juvenile individual(s). Two further bone fragments (Find #4) could not be identified to any particular element or species but were consistent with very large mammal.

Test Pit 2

7.4.3 A single fragment of bone consistent with *Mammuthus* sp. was recovered from Unit 25002 in Test Pit 2. The fragment could not be identified to any particular element of species.

Test Pit 3

7.4.4 Vertebrate remains were recovered from two contexts in Test Pit 3; Unit 20007 and Unit 20008. A single specimen (Find #7) was recovered from Unit 20007. Find #7 could be identified only as the remains of a medium/large mammal. However, the cortex and trabecular bone has some characteristics consistent with hominin remains. It is unlike any of the other vertebrate remains from the site; it is less dense, a different colour and has a different cortical and trabecular bone structure. If hominin, it appeared to be a fragment from the proximal portion of a humerus shaft (without the epiphysis). The identification of species for this specimen was attempted using the protein fingerprinting technique known as ZooMS (zooarchaeology by mass spectrometry), but protein extraction proved unsuccessful (pers. comm Buckley). Subsequent morphological work on the specimen suggested that a Homo identification was unlikely (pers. comm Stringer and Humphreys)

7.4.5 Of the 74 fragments of tooth and bone recovered from the 2019 excavations, 60 were recovered from Test Pit 3, Unit 20008, dark grey gravel, and represented the extremely fragmentary remains of a mammoth tusk (Find #8). The specimen was in extremely poor condition – actively crumbling during the analysis work despite careful handling. The surfaces were powdery, and the larger fragments were cracked. This specimen was recorded as the most poorly preserved in the CER19 assemblage.

8 DISCUSSION

The Project Team

8.1.1 The following reflects on the project aims as articulated in the Project Design (Wilkins et al. 2018, Section 4.0, Aims 1-4, Q-12) drawing together findings from Stage 2a Desk-Based Assessment (Russ et al. 2019), Stage 2b Landscape Survey and Deposit Modelling (Hogue et al. 2019), Stage 3 Targeted Field Investigation, Stage 4 Specialist Assessment (Hogue et al. 2020a) and subsequent further analyses outlined in the Updated Project Design (Hogue et al. 2020b) and described above in fulfilment of Stage 5 Analysis & Reporting. It relates solely to the non-intrusive and intrusive investigations undertaken within the remit of the HE-funded project 7841 SURV and does not include the subsequent archaeological discoveries and results of investigations undertaken within the remit of the HLF-funded project OM-20-06286 PalaeoPixels: Future Climate Pioneers.

8.2 Chronology

8.2.1 Phase 1 deposits were dated by OSL from Unit 31006 [v] in Test Pit 1 to 225±23 ka (GL19030) and from Unit 25009 [A] in Test Pit 2 to 204±24 ka (GL19028) (Figure 13)(see Hogue et al. 2020a Sections 9 and Appendix 14 full OSL results and methodology), suggesting that the Phase 1 palaeochannel deposition occurred during the MIS6–8 interval (Figure 14). However, given that the Phase 1 deposits are likely to have formed in a temperate environment (see Section 8.3 below), while the vertebrate fauna from the channel is of interglacial character, it would seem most likely that the strata are of MIS7 (c. 240,000 to 190,000 BP).

8.2.2 The faunal remains recovered from the palaeochannel fills during the 2019 excavations (almost all from Phase 1 deposits given their distribution) and faunal remains collected previously by the Hollingworths further support an MIS7 age. The majority of faunal remains have been assigned to *Mammuthus sp.* and based on the size of the teeth suggest a small, late form of steppe mammoth (*Mammuthus cf. trogontherii),* a now well-known indicator for MIS 7. When excavations at Stanton Harcourt took place in the early 90s there was considerable opposition to the idea of a 'new' interglacial (MIS7) around 200,000 years ago (Buckingham *et al.* 1996). Now it is well established, and known not as a continuous period of warm episode, but as three warm peaks (MIS 7a, 7c and 7e) interrupted by two cooler intervals. The earliest peak (MIS 7e) appears to have been quite forested and the vertebrates varied; they included forest/straight-tusked elephant (*Palaeoloxodon antiquus*) and forest/Merck's rhinoceros (*Stephanorhinus kirchbergensis*), red deer, (*Cervus elaphus*) and aurochs (*Bos primigenius*) in addition to the small steppe mammoth. The two later phases (MIS 7a and 7c) are generally grouped together as no sites can be dated precisely enough to differentiate them, but the overall picture is of temperate climate, plenty of open grassland but also woodland. The species list for this period is more limited; steppe mammoth is usually the most abundant species followed by wild horse (*Equus ferus*) and steppe bison (all need ample grazing); forest elephant and red deer occurred in small numbers, but there were no rhinoceroses (Scott 2007; Scott and Buckingham 2021).The discovery of *Mammuthus cf. trogontherii* and steppe bison together, and in deposits characteristic of temperate environment, thus provides further support for an MIS7 age of depositional Phase 1 (Lister and Sher 2001). Indeed the Oak Tree Field vertebrate fauna from Phase 1 deposits is almost identical to that from Stanton

Harcourt (albeit without straight-tusked elephant, *Palaeoloxodon antiquus* at the former), and amino acid racemisation and OSL ages from that site also indicate an MIS7 age (Bowen et al. 1989, Zou et al. 1997), albeit that uranium series and electron spin resonance of mammoth tusks suggest later dates (Zhou et al. 1997). The assemblage from Cerney Wick is also very similar to that from the nearby of Latton. At the latter the environmental evidence for a cool climate and open landscape combined with the presence of the small steppe mammoth, suggested a late MIS 7 age (Lewis et al. 2006). The partial mandible of a brown bear (*Ursus arctos*), rare evidence for carnivores at an open air site, is further consistent with the MIS7 age for Cerney Wick, as a species that arrived in Europe around 250,000 BP (Herrero 1972).

8.2.3 Unfortunately, a major question remains regarding the provenance of material originally submitted by the collectors for assessment during Stage 2a (Russ et al. 2019), which included specimens of woolly mammoth (*Mammuthus primigenius*), and which was subsequently excluded due to inconsistencies in the collectors' descriptions of its provenance and concerns that it could not clearly be identified as forming part of the Cerney Wick assemblage. The removal of these specimens leaves the steppe mammoth as the only identified mammoth species at the Site. However, if the excluded woolly mammoth specimens did in fact originate from the Site (and more specifically from the Phase 1 deposits where the vast majority of vertebrate remains have subsequently been discovered during excavation), it would further help to refine the age of the Cerney Wick. Woolly mammoth (*Mammuthus primigenius*) first appeared in Britain at the very end of MIS 7 (e.g. Lister *et al.* 2005). The climate was cooling in advance of the next ice age (MIS 6) when the landscape became more open (grassland) and less wooded. At Marsworth, near Aylesbury, steppe and woolly mammoth, horse and bison are present, but no woodland species such as elephant and red deer remains were recovered. The site at Marsworth is seen as representing the transition of MIS 7/6 and is particularly interesting because woolly mammoth and steppe mammoth were living in the same landscape (Lister *et al.* 2005). If only tentatively then, it is interesting that there is some indication of a co-occurrence of steppe mammoth (*Mammuthus cf. trogontherii*) and woolly mammoth (*Mammuthus primigenius*) at Cerney Wick, albeit yet to be confirmed through controlled excavation.

8.2.4 Deposits from Phase 3a were OSL dated to 214±23 ka (GL19029) from Unit 25004 (K3) in Test Pit 2, thus demonstrating an apparent age inversion between GL19028 and GL19029 (Figure 13). However, given the overlap between the two ages at one standard deviation, and very significant overlap at two, the samples can be considered as providing indistinguishable ages (Figure 14). Nevertheless, there is less sedimentological and biostratigraphic grounds for suggesting an MIS7 age for Phase 3a and hence Phase 3 given that the deposits indicate formation in a broad, multichannel belt in high energy conditions. It is therefore possible that Phase 3/3a might be of MIS7 or MIS6 age (Figure 14). Further evidence is provided by a single OSL date of 187±19 ka (GL19031) from Phase 4 deposits in Unit 20003 (TP3), albeit that this sample suffered uranium disequilibrium problems (see Hogue et al 2020a). This latter age suggests that palaeochannel b was infilling in MIS6 or 7 but given that these channel infills were likely deposited in a temperate environment, an MIS7 age seems more likely. Taken together therefore, it is probable that Phases 1–4 are all of MIS7 age, while it is possible that the downcutting of Phase 2 and the coarse-grained deposition of Phase 3 might be attributable to one of the two cool phases in MIS7 (MIS7b or more likely, MIS7d) (Figure 14). If this scenario were correct, Phase 1 might be attributable to MIS7e (or possibly MIS7c). As noted above, the Stanton Harcourt channel deposits have also been attributed to MIS7 on the basis of multiple lines of evidence, while the channel fills of facies association A at Latton are also argued to be from the same interglacial on the basis of biostratigraphy (Mollusca, Coleoptera and vertebrates) and a U-series age on a horse tibia of >127 ka (Lewis et al. 2006).

8.2.5 Other biostratigraphic indicators were generally consistent with a MIS7 age for the palaeochannel deposits (Phases 1-4). The *Anotylus gibbulus* group of insects was recorded from five samples and is not present in Britain at the present day. It is widely recorded from Pleistocene deposits in Europe and also from Toronto (eastern Canada), but it underwent a profound contraction in range during MIS 5d-2, and currently appears to be restricted to the Caucasus mountains and eastern Siberia north of Vladivostok (Hammond *et al*. 1979; Elias 1994, 66). The earliest records of *A gibbulus* in Britain are from interglacial deposits attributable to MIS7, where it is often the most abundant rove beetle (Staphylinidae), e.g. Stanton Harcourt, Oxfordshire (Briggs *et al*. 1985); Marsworth, Buckinghamshire (Green *et al*. 1984). More than one species is referrable to the *A. gibbulus* group. Although a particular abundance of the group might be characteristic of MIS7, there are also records from later deposits including from interstadials within the last glacial cycle. The species appears to have an association with the dung of large herbivores and it has been suggested that its drastic contraction in range since the end of the Pleistocene may be in response to the extinction of many large mammal species (Morgan and Morgan 1980).

8.2.6 Other insect remains that are likely to represent species that are also no longer extant in the British Isles included a *Micropeplus* underside with shiny, mirror-like patches that was not comparable with any of the present day British species, and several taxa that were not identified closely, including some of the aphodiine dung beetles. Likewise, the palynological assessment provided broad evidence that the palaeochannel deposits date to a previous interglacial (Hogue et al. 2020a). *Abies* and *Picea* are not native to the UK during Holocene and hence their presence may indicate an earlier interglacial episode.

8.2.7 Two OSL dates provide indications of the chronology of Phase 5 (i.e. the Northmoor Member). Unit 48 in Section F was dated to 129±14 ka (GL19032), while Unit 28 in Section D has an OSL age of 112±11 ka (GL19037) (Figure 13) (see Hogue et al. 2020a, Section 9). These two ages overlap with one another at one standard deviation and significantly overlap at two but have only a minor coincidence with the dates from the palaeochannel (Figure 14). In other words, the OSL ages demonstrate a chronological discontinuity between the palaeochannel (Phase 1–4) and the Northmoor Member (Phase 5). Formation of the latter can in theory be attributable to MIS5 or MIS6 according to GL19032 and GL19037. However, assuming that the two samples date a similar period of deposition, there is a <10% chance that GL19037 is of MIS6 age, meaning that an MIS5 date is more likely. Furthermore, the sheet gravel strata of the Northmoor Member are very unlikely to derive from deposition in an interglacial climate (see Section 5.5), and it is therefore likely that accretion was in a post-MIS5e (Ipswichian) sub-stage (i.e. MIS5d or MIS5c). It should be emphasised, however, that both GL19032 and GL19037 were collected from the base of the Phase 5 accumulation at Oak Tree Field, and no attempt was made to date the upper strata of the Northmoor Member. In other words, strata higher in the Northmoor Member sequence at Oak Tree Field might post-date MIS5c.

8.3 Depositional environment

Lithofacies

8.3.1 Phase 1 palaeochannel sedimentation (facies 3, facies 6 and facies 4) are indicative of debris flows (gravel facies) and sediment gravity flows (sand facies) (Miall 1996, p. 79). The morphology of the deposits and their constraint within a relatively narrow area to the north and west of the Kellaway Clay bluff, would seem to suggest deposition within a single meandering channel. The interpretation of a single meandering channel is identical to that made for facies association A at the Latton site, 1.7 km to the north, while it is also the case that the latter is thought to have been confined within a fold of the Kellaway Clay bedrock (Lewis et al. 2006). Nonetheless, there is some evidence to suggest different climatic conditions between the sites with slightly warmer temperatures witnessed in association A at Latton than observed throughout the sequence at Oak Tree Fields, Cerney Wick (see Section 8.3.12 below)

8.3.2 Phase 2 at Oak Tree Fields is an inferred downcutting event that has been attributed to cooling conditions of MIS7d (possibly MIS7b), during which time base levels must have fallen [as is demonstrated by the benthic foraminiferal stack record (Figure 14), which shows (in part) global ice volume (Lisiecki and Raymo, 2005)] and the stream passing through the site would consequently readjust. Indeed, Bridgland's model of fluvial terrace formation suggests downcutting and scour at the transition from interglacial (MIS7e) to cold conditions (MIS7d) (e.g. Bridgland & Westaway 2008, 'phase 4'). Given the nature of the inferred downcutting event there is no biostratigraphic information available from Phase 2.

8.3.3 Phase 3 deposition is also likely to be from a cool episode in MIS7 (possibly MIS7d) during which deposition occurred as inertial bedflow in turbulent water flowing in a series of shallow, short-lived channels that developed across the palaeochannel area (Miall 1996, p. 79). The deposits of Phase 3a likely formed as waning flood deposits in the lea of a gravel barrier, while applying the Bridgland model to the Phase 3/3a accretion as a whole would place these events during the cooling of that author's phase 5 (Bridgland and Westaway 2008). Phase 3a, interpreted as either a channel became cut off from the main axial flow or a large scour hollow, was infilled by sediments that were deposited in moderate to very low flow energies (Units 25004-25002, facies 8), and this is further supported by evidence from the available environmental proxies (see Section 8.3.6)

8.3.4 Phase 4 sedimentation at Oak Tree Field might correspond to macro scale operation of Bridgland's phase 1 downcutting (to form the small palaeochannels), and phase 2 aggradation (i.e. infilling of the palaeochannels) in a warming climate that is possibly MIS7c. Facies within palaeochannels **a** and **b** are all fine-grained and suggest deposition by moderate energy sediment gravity flow while the channels were open, and during waning flood events and in backswamp environments following abandonment (Miall 1996, p. 79), and aggregation during relatively moderate-to-low depositional conditions is further suggested by available biostratigraphic information (see discussed in Section 8.3.6).

8.3.5 The Northmoor Member (Phase 5) deposition at Oak Tree Field is equivalent to facies association B from Latton (Lewis et al., 2006) and facies association B from Ashton Keynes (Lewis et al., 2001) (there are no equivalents at Oak Tree Field of the MIS2 facies association C and D fine-grained channel infills at Ashton Keynes or similar facies association C channel deposits at Latton). The predominantly sheet gravels that form Phase 5 deposition were deposited in multiple shallow channels in high energy flow and as inertial bedload (Miall 1996, 79). No biostratigraphic information was collected from these sheet gravels given that their study fell outside the focus of the project. As has previously been noted, the Northmoor Member is dated at the base of the sequence, with OSL taken from the earliest parts of the sequence exposed on the site, and which date firmly to MIS5.

Biostratigraphic Information

8.3.6 The depositional environment as inferred on basis of the lithofacies at Cerney Wick (see Section 8.3.1 above) is broadly supported by the various environmental proxies collected from deposits in the channel sequence. The assemblages provide a consistent picture of the local environment throughout the time the channel sequence accumulated. The caveat with any reconstructions associated with deposits that accumulated in running water, is that there may have been some degree of re-deposition, and samples recovered may represent a wider catchment than those obtained from an isolated water body. The samples examined here, however, appear to come generally from deposits associated with moderate to low energy flow, with limited evidence to suggest substantial reworking of the sediments. Most notably, analysis of the samples for insect remains provides a relatively comprehensive image of the surrounding landscape, especially as the range of taxa allow for reconstruction of winter/summer temperatures using the Mutual Climate Range (MCR) model (see Section 6). Conversely, species diversity and richness amongst samples obtained for both plant macrofossils and molluscs is less informative of the wider environment (beyond the channel itself), providing only general confirmation of the condition inferred from the other proxies.

8.3.7 Based on the insects two types of aquatic environment were identified. This may reflect either temporal changes in flow or the course of the channel, or diverse conditions in different parts of the channel at any one time. Small numbers of riffle beetles (Elmidae) throughout the sequence indicated a moderately fast flowing stream, probably with a stony unstable bed. *Esolus parallelepipedus* was present in all three phases, but *Limnius volkmari* and *Elmis aenea* were only recorded from Phase 4. *Georissus crenulatus*, recorded from all three phases, and *Oulimnius bicolon*, firmly identified only from Phase 3, are typically found in mud and sediments by running water. Both *E. parallelepipedus* and *G. crenulatus* favour substrates with abundant algae within the channel bed and in marginal sediments respectively. Water beetles associated with slowly flowing or still water were present throughout the sequence, also in small numbers. Occasional statoblasts of *Lophopus crystallinus*, indicative of water with only a slight current, were recorded from Phases 3 and 4.

8.3.8 Waterside mud and areas of bare or sparsely vegetated ground would have been present, at least in places. Moss among floating rafts of vegetation in still to slowly flowing water, or at the water margins, was specifically indicated in Phases 3 and 4. Some phytophages (herbivorous insects) are indicative of specific types of emergent and marginal vegetation, for which there was only limited evidence from plant macrofossils. This includes arrowhead (*Sagittaria sagittifolia*), reed sweet-grass (*Glyceria maxima*) and perhaps other *Glyceria* species, sedges (*Carex*), and various forms of tall waterside vegetation suggestive of 'reed-swamp' communities (as evidenced directly amongst the plant macrofossils in small numbers, see Section 6.2). Water lilies (*Nymphaea* or *Nuphar*) growing in still to slowly flowing water were indicated by *Donacia crassipes* in Phase 4 where swampy, richly vegetated conditions were particularly suggested.

8.3.9 A small group of phytophages associated with Polygonaceae, such as knotweeds (*Polygonum*), docks (*Rumex*), and crucifers (Brassicaceae) in Phases 1 and 3, suggest the colonization of areas of bare or sparsely vegetated ground by ruderal plants. Grassland appears to have been the dominant terrestrial habitat, mainly on rather dry, well-drained soils, but also in damper places probably lying close to the channel. Ribwort plantain (*Plantago lanceolata*), usually regarded as an indicator of disturbed grassland, is the host of the weevils *Mecinus pascuorum* and *M. pyraster* (Phase 4), and probably the main host of *Graptus triguttatus* (Phase 3). There was scant insect evidence for trees or shrubs growing close to the channel, with single individuals of *Orchestes hortorum*, found on oak (*Quercus*), and *Crepidodera,* found on willows (*Salix*) and poplars (*Populus*), providing the only hints of their nearby presence in Phases 1 and 3. No taxa suggesting dead wood habitats were recorded.

8.3.10 Substantial numbers of scarabaeoid dung beetles and other taxa primarily associated with dung provided abundant evidence that the area supported significant populations of grazing mammals that would have been attracted to the site by lush waterside vegetation and adjacent grassland, and where there was safe access to water. This foul decomposer component was a major element in all the samples, accounting for 16 – 35% of the terrestrial fauna in assemblages with >50 individuals. Scarabaeoid dung beetles dominated the foul decomposer group, on their own making up 16 – 26% of the terrestrial fauna. Most species are dependent on the dung of large mammalian herbivores, but some species will more rarely also exploit other forms of foul decaying vegetable matter or overwinter in flood debris (Jessop 1986, 19-25). The abundance of various Staphylinidae, Histeridae and Hydrophilidae that are also primarily associated with herbivore dung is significant, however, and it is clear that significant amounts of dung were present locally. Despite the fact that most dung beetles have very good dispersal abilities and, if necessary, will fly a fair distance to find new sources of fresh dung, modern analogue studies suggest that most of those recorded in samples from small water bodies will predominantly have arrived from within a 100 – 200 metre radius. The same studies indicate that their relative abundance appears to be strongly correlated with the density and proximity of locally grazing herbivores (Smith *et al*. 2010, 2014), although a fluvial environment would have a somewhat greater catchment than a small, still water body. *Euheptaulacus sus*, a scarabaeid beetle recorded from five samples, has very distinctive elytral markings and could be readily identified from small pieces of cuticle. It prefers dung in dry and sandy pasture on alluvial plains and the shores of water bodies (Jessop 1986, 19), and it appears to be dependent on continuity of dung availability and grazing to maintain open conditions. It is very rare in Britain at the present day and currently threatened with extinction (Hyman and Parsons 1992, 386-391).

8.3.11 The Mutual Climatic Range (MCR) method indicate temperature ranges consistent with a temperate climate where summer temperatures at least may have been slightly lower than at the present day for Phase 1, 3 and 4. The temperature ranges for all three phases almost completely overlap, the only difference being that winter temperatures might possibly have been cooler in Phase 1 than in Phases 3 and 4, but this is not clear based on the present data. Mean winter temperatures were between

-12°C and 6°C for Phase 1, -6°C to 6°C for Phase 3, and -7°C to 6°C for Phase 4, and mean summer temperatures between +15°C and +18 °C for all phases (Appendix 4 Figure 19).

8.3.12 It has been suggested elsewhere that Phase 1 at Oak Tree Fields may equate to the MIS7 fluvial deposits attributed to facies association A at Latton (see Section 8.3.1). However, a temperate environment with temperatures at least equivalent to the present day was indicated by the coleopteran data at Latton, suggesting a somewhat warmer climate than that indicated at Oak Tree Fields. The beetle fauna representing facies association A at Latton was very small, with only three species being used to obtain MCR data, but other beetles in the assemblage are also consistent with relatively warm climatic conditions (Lewis *et al*. 2006). The values obtained for the minimum temperature at Latton were very wide and they are therefore not particularly informative on winter temperatures. The range of taxa recorded suggest very similar habitats to those indicated for Phase 1 at Oak Tree Fields, with scarabaeoid dung beetles relatively well represented compared to other taxa. Association Ba and Bb at Latton are considered to have accumulated much later on from MIS4 onwards when different climatic regimes prevailed, however it is notable that temperatures estimate from Oak Tree Fields fit most consistency with Association Ba (albeit with much cooler winter temperatures at the latter).

8.3.13 At Latton (Lewis *et al*., 2006), a more substantial woodland component is recorded by the plant remains in facies association A, and perhaps interestingly facies association B has a relatively similar range and diversity of taxa compared to the assemblages to those at Oak Tree Fields, with aquatic taxa well-represented, along with grassland, disturbed and open ground taxa. Notably, only the presence/absence of plant species is given from Latton, and palaeobotanical analysis is overwhelming dominated by two samples from Oak Tree Fields (37.8% and 52.1% of the total specimens come from samples <12> and <21>, respectively). Plant macrofossil evidence dating from MIS7 at Stanton Harcourt (Buckingham *et al*. 2006), is not dissimilar to that at Oak Tree Fields, the assemblage dominated 'by those that live in or around water' (p. 405), and terrestrial flora indicate herb-rich grassland and disturbed ground, rather than woodland, which suggests some consistency with the results of the present investigation. Further upstream in the valley of the River Thames, the lower part of channel deposits at Marsworth, Buckinghamshire, considered most likely to be of MIS 7 date (see Murton *et al*., 2001) provide further plant remain evidence for relatively open conditions during this temperate phase. Here, grassland, open and disturbed ground taxa dominated the assemblage along with those of waterside, damp ground and shallow water. In the lower reaches of the Thames, MIS 7 deposits at Ponds Farm, Aveley, Essex (Allen *et al.,* 2011) provides further evidence for temperate conditions and shallow, still or slow-moving water, with several of the taxa indicative of base-rich water that was mesotrophic to eutrophic in nature. Woodland and scrubland taxa were well represented here, probably inhabiting better-drained areas close to the water body (Allen *et al.,* 2011).

8.3.14 Most of the molluscs identified at Oak Tree Fields were freshwater species, principally classified as species found in lotic water bodies (Group 6d, e.g. *Valvata piscinalis, Bithynia tentaculate, Pisidium amnicum*) and freshwater catholic taxa associated with a range of freshwater bodies (Group 6b, e.g. *Ampullaceana balthica, Euglesa nitida*). Even though species diversity was broadly similar throughout, increasingly numbers of *Bithynia* operculae, alongside *Myxas glutinosa* and *Hippeutis complanatus*, indicate periods of low energy, associated with Phases 3 and 4. Most notably, evidence of the freshwater bivalve *Pisidium clessini* was identified with Phase 1. This is now a globally extinct species, whose last appearance in Britain is during MIS 7 (Keen 2001). There were only very low numbers of terrestrial snail shells within the samples, which were likely to have been washed in from marginal sediments. Three taxa were most common, the ubiquitous species *Trochulus hispidus, Vallonia* cf. excentrica (snails of open habitats) and *Pupilla muscorum*, which is also associated with open habitats (although which was also common in marshy habitats in cold stages of the Pleistocene). Larger forms of *Pupilla* have been noted from cold stages, although the maximum shell height of *P. muscorum* at Oak Tree Fields (3.2mm) is within the modern range, and smaller than the maxima recorded by Kerney (1963), suggesting that the conditions may not necessarily have been dissimilar than today (as evidence by the MCR method).

8.4 Archaeology

8.4.1 Two handaxes have been recovered from the vicinity of Cerney Wick (Russ et al. 2019). One of these was found at the processing plant and might therefore originate from elsewhere within the quarry. The other was found in upcast produced during machine excavation of a sondage in 2017 (pers. comm. Sally Hollingworth) and in the vicinity of the Test Pit 1. Given that deposits of the Northmoor Member had been removed from this location prior to the excavation of Test Pit 1, it is highly likely that the handaxe originally sat in the palaeochannel sediments. However, based on the 2019 excavations it is unclear from which specific Units 31002, 31004, 31005, and 31006 [ii–v] the handaxe was removed and particularly whether it came from the same vertebrate fossil-bearing 31002 [iv]. Nevertheless, all the palaeochannel deposits exposed in Test Pit 1 were laid down in depositional Phase 1 and therefore date to MIS7. It is notable in this regard that Lower Palaeolithic artefacts (at least eight of them) were found in the MIS7 sediment gravity flows of facies association A at Latton (all by Neville Hollingworth, one of which was in situ) (Lewis et al. 2006), thus in a very similar stratigraphic position to that from Test Pit 1 at Oak Tree Field).

8.4.2 While at least one of the handaxes may have been present in the Phase 1 palaeochannel, the discovery of the finds complicates our ability to evaluate the depositional history of the artefact. Whilst the handaxes may both have been transported by fluvial processes from their place of discard, one seems likely to have ultimately derived from the Phase 1. Given that the gravels associated with aforementioned indicate deposition in a medium–high flow regime, the coarsest gravel particles in the beds are coarse pebbles (cf. the fine boulder-size of the handaxe), the flows that entrained the gravel and sand strata in Test Pit 1 (facies 3 and facies 6), may not have had sufficient traction to move the handaxe. Indeed, and despite their lower density, the same is probably true of the vertebrate fossils sitting at the contact between the Oxford Clay (Unit 31003 [v]) and Unit 31002 [iv]. Thus, it is possible that artefacts and vertebrate fossils are, together with the septarian nodules noted at the Oxford Clay–palaeochannel deposit interface, lags remaining from previous higher velocity flows and against which palaeochannel deposits have been emplaced. The condition of the handaxe may support this interpretation. Whilst it does show some slight signs of abrasion, it is perceivably more abraded on one face than the other and this same abraded face is also more heavily stained, lending itself to the interpretation that the artefact laid on a surface following discard. Given the lack of contextual information available during an initial assessment of the handaxe it was conservatively assumed principally on the basis of its typology that the artefact was likely derived from earlier deposits (Russ et al. 2019a), although it now seems highly probable that both the handaxe and the faunal remains are broadly contemporary with the channel deposits dating to MIS7. Such an interpretation the emplacement of the artefacts is rather different to that advanced for the 27 handaxes, cores and flakes (of which 4 were found in situ) and numerous vertebrate fossils from Dix's Pit, Stanton Harcourt, which are thought to have been deposited on emergent bars of a meandering river and then buried by subsequent gravel deposition. All nonetheless believed to date to similarly to MIS 7 (Buckingham 2007; Scott and Buckingham 2001).

8.4.3 On the basis of strata exposed in section in the test pit sections and quarry walls during 2019, there is very limited evidence for floodplain deposition and none at all for terrestrial processes (with the limited number of terrestrial specimens likely to have been washed in from marginal sediments). Rather, as has been discussed in Section 8.3 above, based on the exposures recorded during 2019 the deposits all formed within a fluvial environment. In other words, in locations where hominin activity is unlikely to have been either prolonged or intense. Nonetheless, if deposits in the floodplain at the margins of the river and/or terrestrial sediments survive, the site still holds potential for the discovery of in situ hominin activities residues/remains.

9 CONCLUSIONS

Josh Hogue (DigVentures) and Keith Wilkinson (ARCA, University of Winchester)

9.0 Following the 2019 excavations a programme of assessment was undertaken to evaluate the potential of the collections and provide recommendations for further work (Hogue et al. 2019). Research in line with the proposed recommendations, as provided here, has helped to provide clarification regarding the formation of the river channel and its associated environmental and climatic setting. Laboratory work investigation of the clast lithologies has provided further information regarding the likely source of the constituent sands and gravels within the river. Additional quantification and speciation of the various environmental proxies (molluscs, insects, and plant macrofossils) has provided greater resolution and perhaps most critically this can be seen in the presentation of Mutual Climatic Range (MCR) modelled temperatures which provide a rare insight into the climatic during MIS 7. Closer inspection of the vertebrate fossils has provided greater understanding of the taxonomic status of the species within the Hollingworth collection and has provided estimates of the minimum number of individuals (MNI) alongside an age profile for the population. Unfortunately, significant numbers of remains have yet to be recovered from in situ deposits during controlled excavations, and as such questions remain unanswered regarding the extent to which the previously collected material is genuinely representative of the fossil vertebrate remains associated with the palaeochannel. Major conclusions from the work conducted so far are given below.

9.1 Preservation

9.1.1 While the 2019 investigations at Oak Tree Field reported here did not result in the discovery of archaeological artefacts beyond those found in 2017, they did provide some further information on the potential depositional and chronological setting of the handaxe previously found by Sally Hollingworth. The handaxe appeared most likely to be a lag recovered from the base of a MIS7 channel feature that passed through the quarry on a broadly south-west to north-east trajectory. As with the much more numerous vertebrate fossils found in a similar position (Test Pit 1), the artefact was likely banked up by and covered by coarse-grained deposits (Phase 1) that then protected them from subsequent erosion events (e.g. Phase 2, later MIS7 downcutting event, and later periglacial processes during MIS2, 4 and 6 glacial stages). All the vertebrates were notably in good condition. However, survival of associated multi-proxy environmental indicators (e.g. plant macrofossils, insects, coleoptera, molluscs and small vertebrates) is poor because of the high-energy fluvial environment in which handaxe and vertebrate remains are likely to have been deposits. Multi-proxy environmental indicators survived well and in greater abundance, however, in association with a later manifestation of the river which ran as multiple shallow channels of low sinuosity and flow (Phase 3), albeit with only a relatively limited number of associated vertebrate remains (Test Pit 2 and 3).

9.2 Significance

9.2.1 Given that no artefacts were found in situ within the MIS7 deposits at Oak Tree Fields during the 2019 excavations, it could not be determined whether there was any relationship between archaeological artefacts and the vertebrate remains. Indeed, the same situation pertains at Latton, where, although one artefact was extracted from the gravels of facies association A, its relationship with vertebrate fossils could not be established (Lewis et al. 2006). The lack of archaeological discoveries at Oak Tree Field and the equivocal nature of artefact-vertebrate fossil association, may have been taken to indicate that it simply was not an archaeological site. Conversely it may have been product of the small area subject to hand excavation. Even in the case of larger excavation areas artefact density is typically low. For instance, the Stanton Harcourt entire excavation area was approximately 150 x 100m (~150,000 m^2), yet yielded only 27 stone tools (Buckingham 2007). In contrast, only *c.* 13.5 x 4.25m (~58 m^2) of in situ deposits were excavated during the 2019 excavations at Cerney Wick. Nonetheless, Cerney Wick reflects a critical resource for understanding the nature and magnitude of climate change in the past and contextualising apparent shifts in hominin behaviour and adaption due to the survival of multi-proxy environmental indicators albeit beyond the area principally under investigation and associated with vertebrate remains - as highlighted in Historic England (2020) *Curating the Palaeolithic* draft guidance the importance and potential of Pleistocene deposits should still be considered even the absence of archaeological remains.

9.3 Dating framework

9.3.1 Stratigraphic and lithostratigraphic description of the sequence excavated at Cerney Wick in 2019, supported by OSL dating and multi-proxy analyses, has enabled a broad chronology for the palaeochannel to be established. The earliest manifestation of the river – in Phase 1 – likely occurred over 200 ka in MIS7, with Phases 2 – 4 representing changes to its flow regime occurring during the same Marine Isotope Stage. However, Phase 5 was represented by overlying gravels belonging to the Northmoor Member. The OSL ages for the unit place it firmly in MIS5, thereby confirming the ages of the unit at nearby Ashton Keynes (Lewis et al. 2001) and Cassington (Maddy et al. 1998), but contrary to the previous textbook view which suggested an MIS2–3 age (Bridgland 1994; Gibbard 1999, 1985). An MIS5 age for the Northmoor Member has implications for the archaeological potential of that unit, given that hominins are thought to have been absent from Britain during the MIS4–6 interval (e.g. Currant & Jacobi 2001). Indeed, only one site, near Dartford in Kent, has been suggested to be of MIS5b–d age on the basis of chronometric dating (Wenban-Smith et al. 2010), while none have been so claimed for MIS4–5a or MIS5e–6).

9.4 Early hominin presence?

9.4.1 No artefacts were identified during the 2019 investigations and as such no new inferences can be drawn regarding the range and spatial patterning of the artefacts on the site itself. However, the fieldwork has does offer some insights into the development of the River Chum and Thames confluence, and consequently highlights potential issues with future monitoring and protection of deposits in the region.

9.4.2 Lewis et al (2006) have suggested that the Northmoor Member gravels in the area of the present Cotswold Water Park formed within a low angle alluvial fan forming where the relatively steep River Churn (which drops by 5m km^{-1} from its source at Seven Springs near Cheltenham to Cirencester) meets the Thames floodplain (which has a slope of 0.7m km^{-1} between Somerford Keynes and Lechlade). Such a low angle fan setting in which channels might switch from one part of the fan to another might explain the MIS7–2 ages obtained from deposits within a narrow altitudinal range at Oak Tree Field, Latton and Ashton Keynes. Such a scenario, however, presents difficulties from a conservation point of view as the age of gravel deposits cannot be predicted on the basis of elevation or indeed present geological mapping. Indeed, each locality needs to be separately examined prior to and during aggregate removal in order to determine the depositional environment, chronology and hence Palaeolithic archaeological potential.

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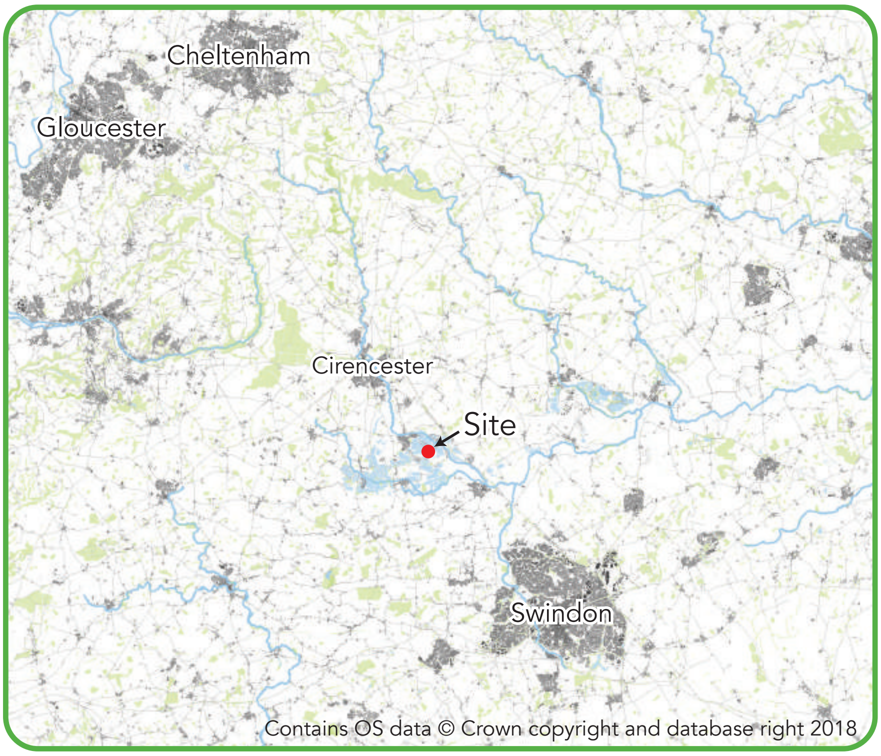

Figure 1 - Cerney Wick: Site location

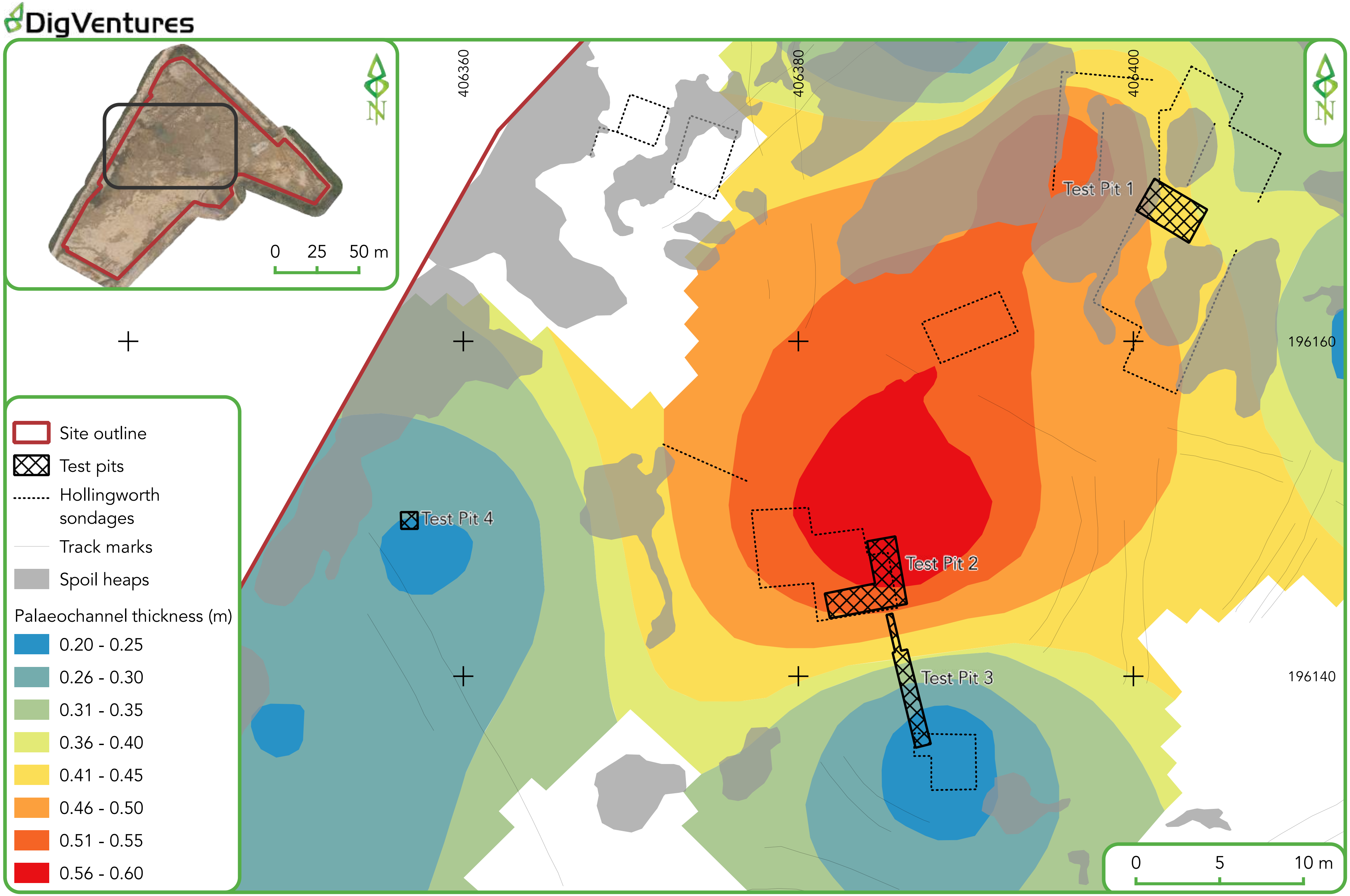

Figure 2 - Cerney Wick: Test pit locations

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Figure 3 - Cerney Wick: Test Pit 1 Plan

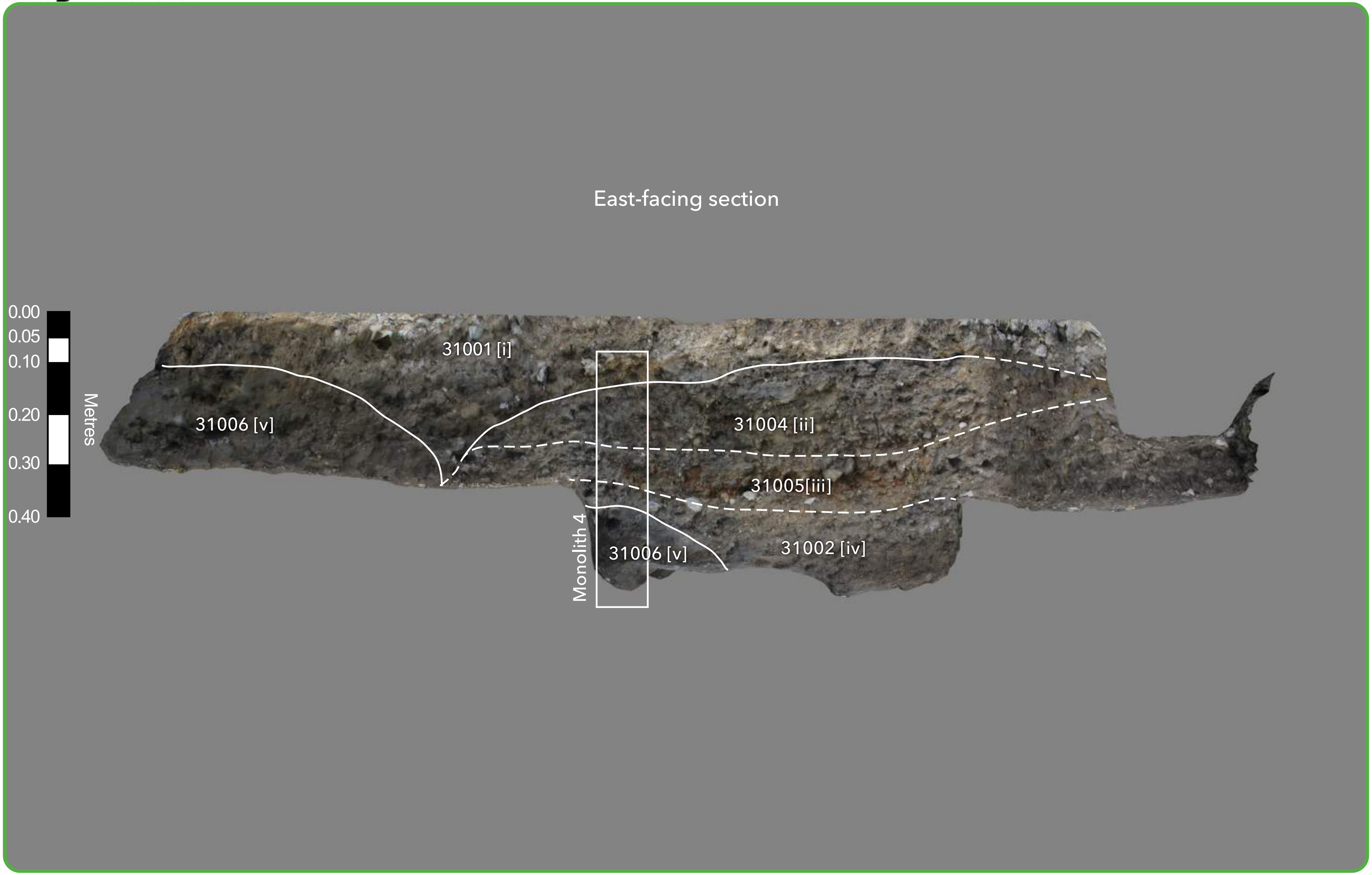

Figure 4 - Cerney Wick: East-facing section of Test Pit 1

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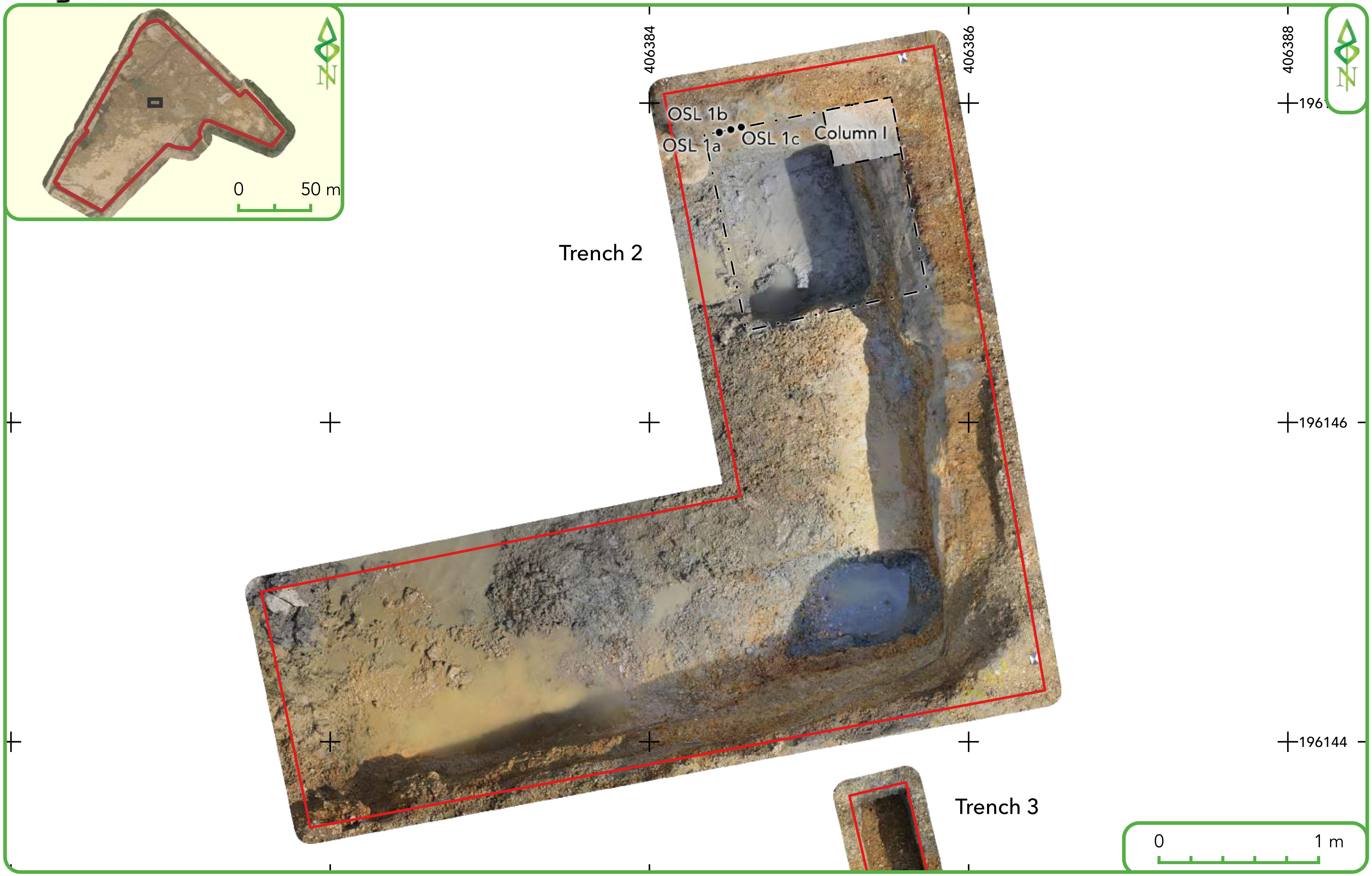

Figure 5 - Cerney Wick: Test Pit 2 Plan

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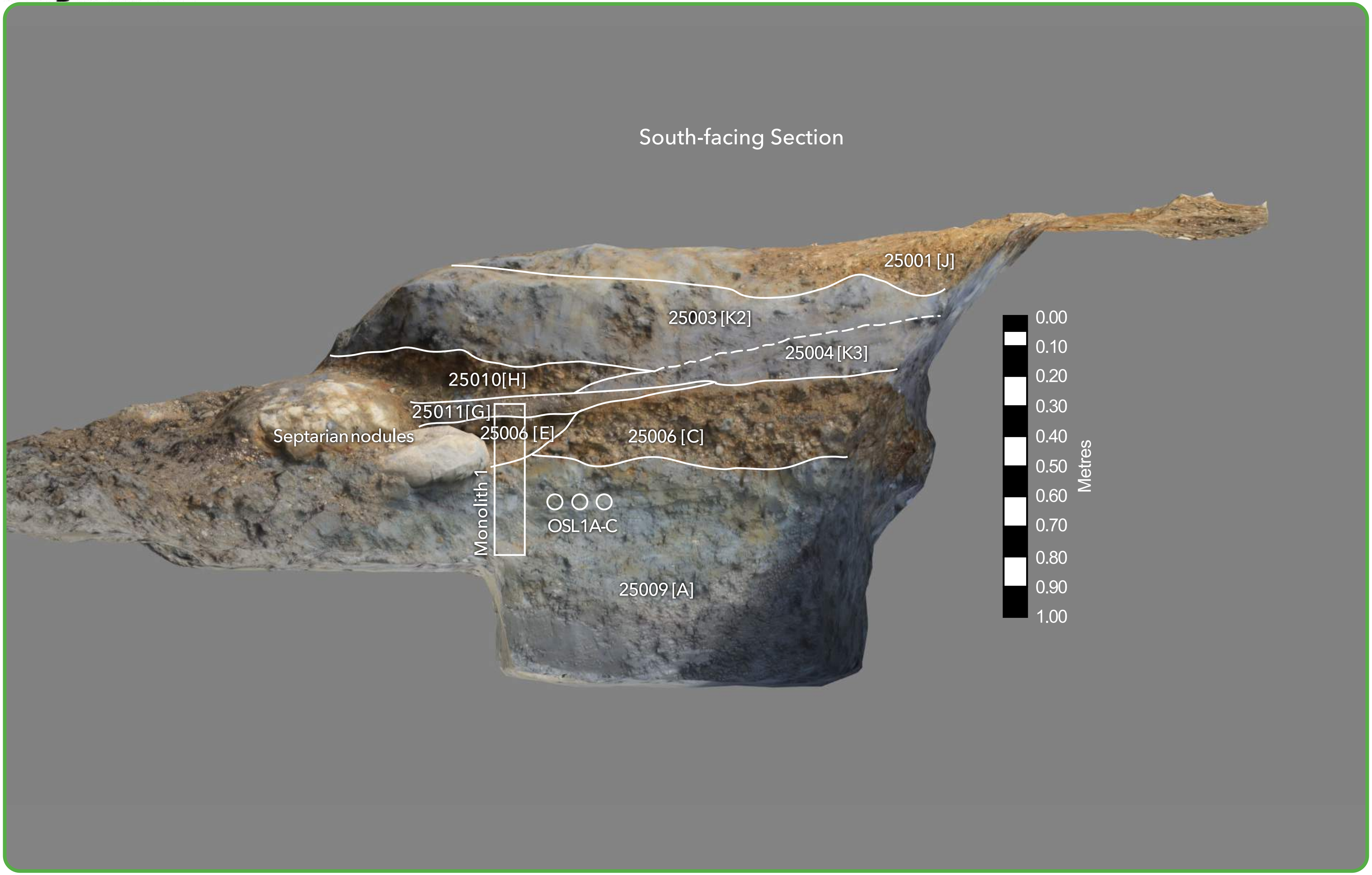

Figure 6 - Cerney Wick: South-facing section of Test Pit 2

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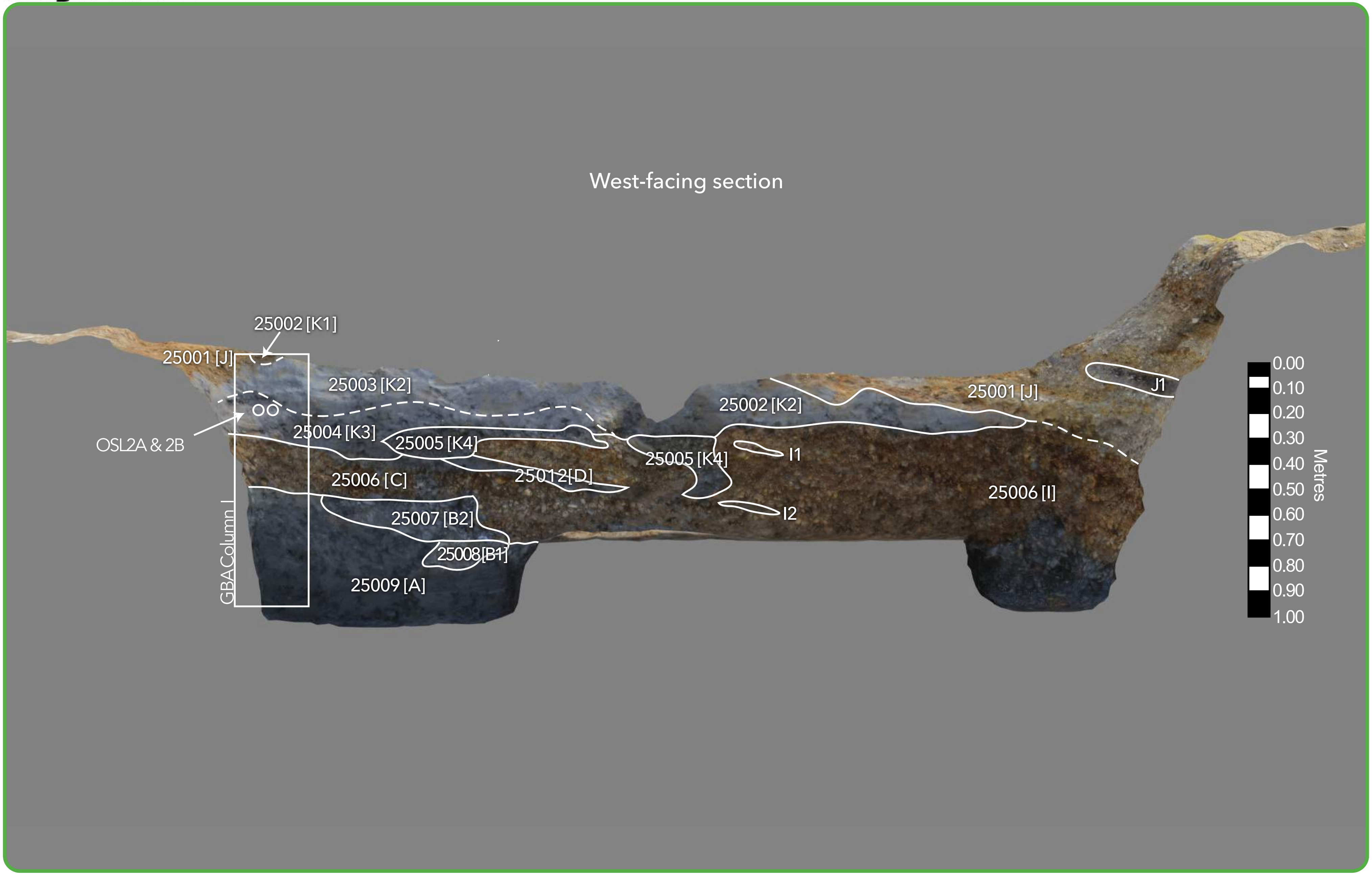

Figure 7 - Cerney Wick: West-facing section of Test Pit 2

Figure 8 - Cerney Wick: North-facing section of Test Pit 2

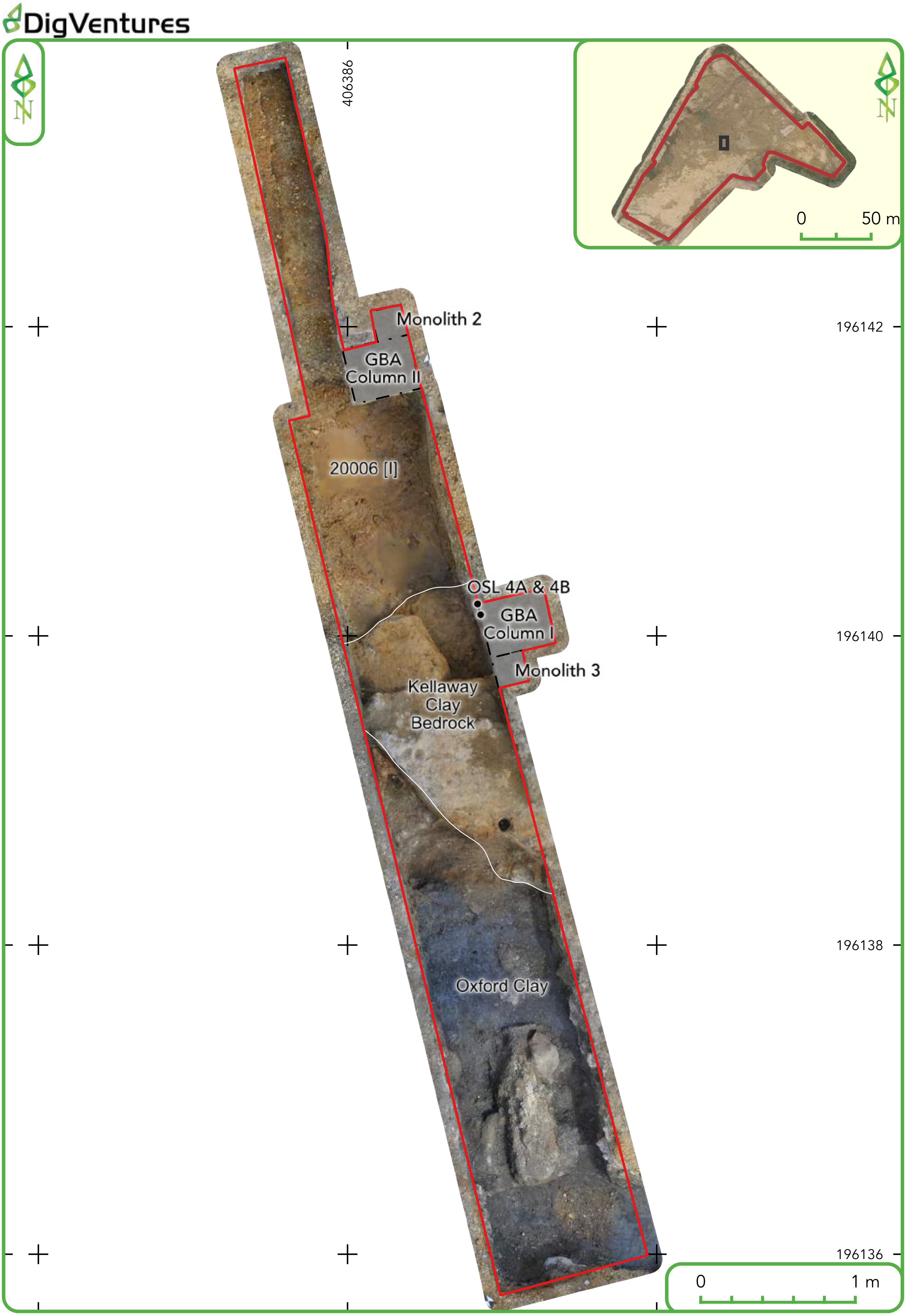

Figure 9 - Cerney Wick: Test Pit 3 Plan

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West-facing section

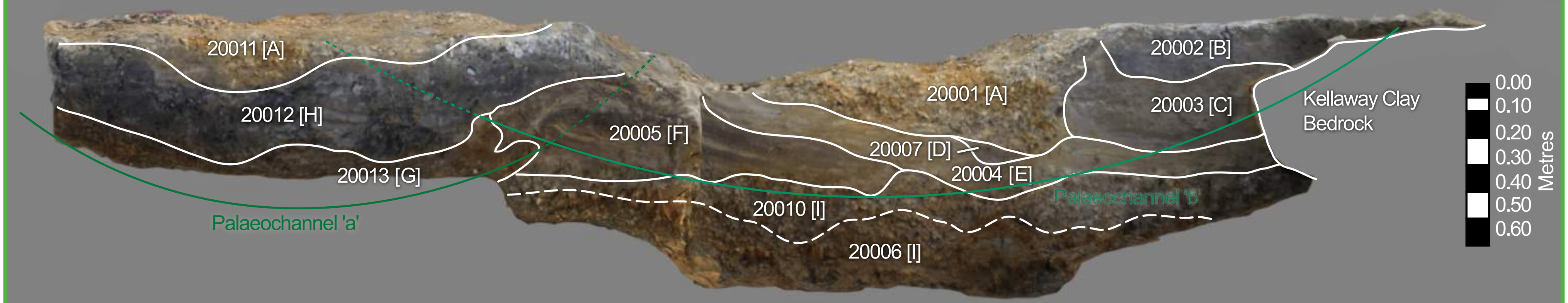

Figure 10 - Cerney Wick: West-facing section of Test Pit 3

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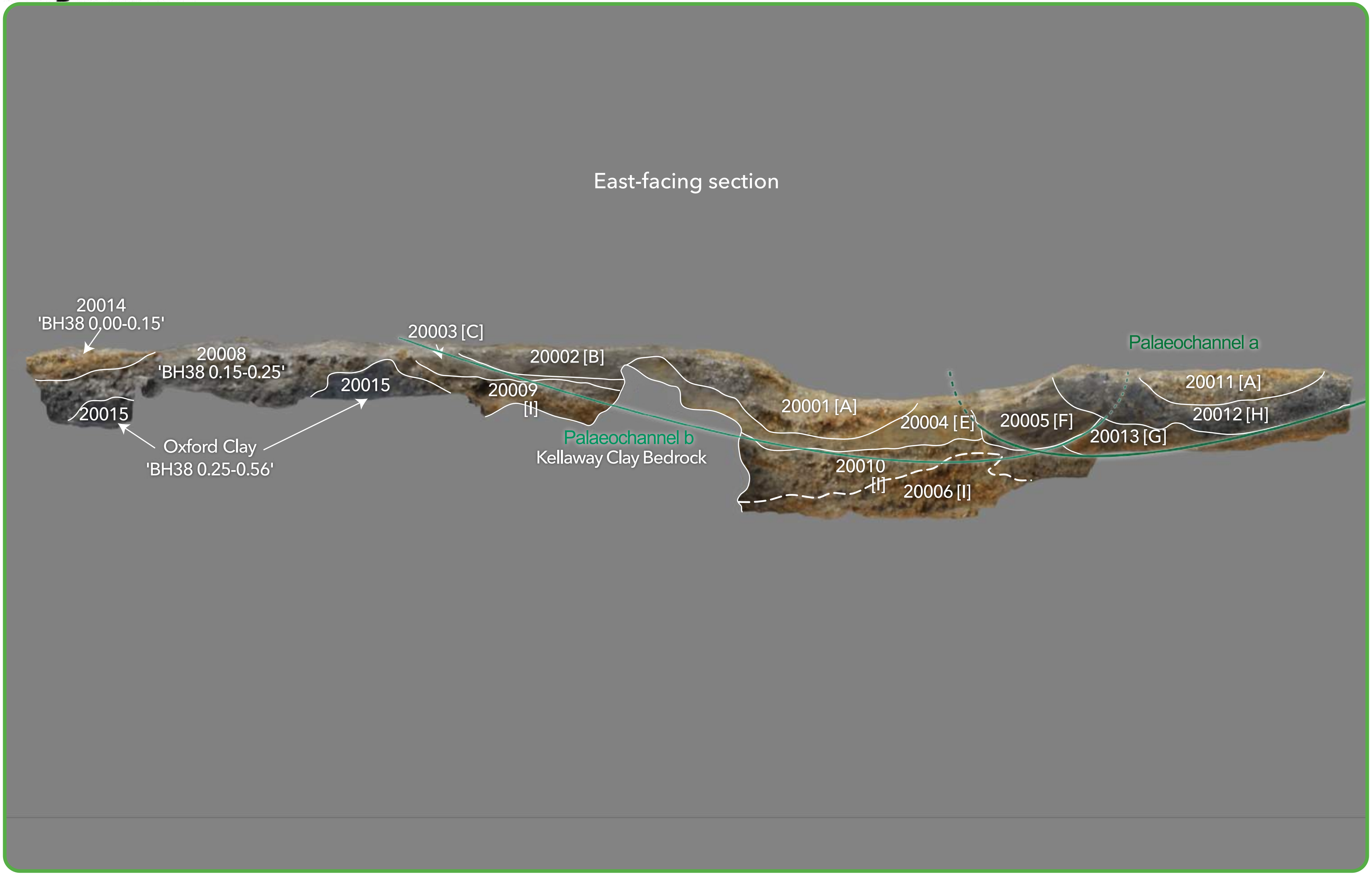


Figure 11 - Cerney Wick: East-facing section of Test Pit 3

Figure 12 - Cerney Wick: Test Pit 4 Plan (left) and east-facing section (right)

Figure 13 Logs of sampled test pit and quarry wall sections

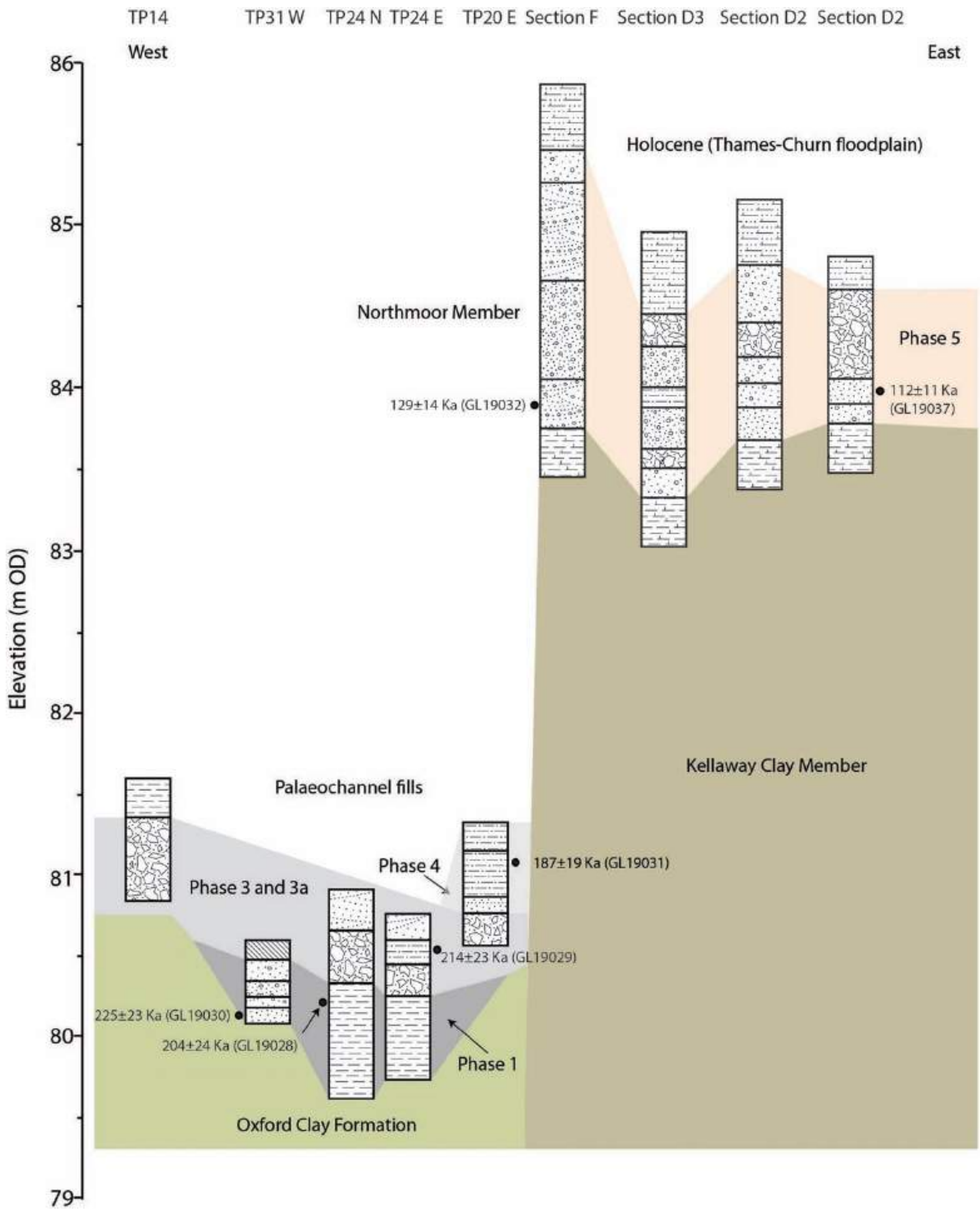
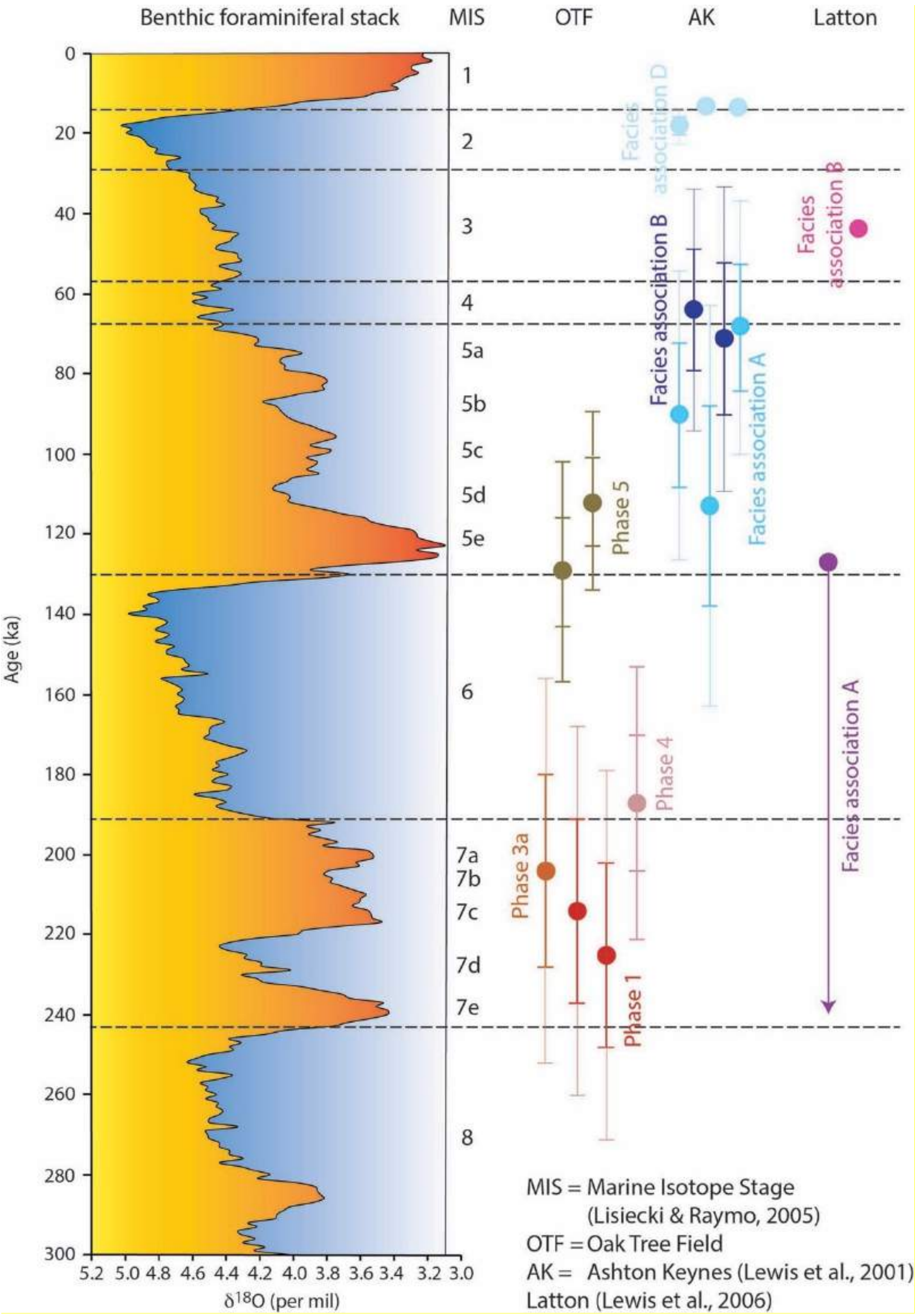


Figure 14 Ages, phases and facies associations from Oak Tree Field, Latton, Ashton Keynes, Cassington and Stanton Harcourt plotted again Lisiecki and Raymo's (2005) global stack of 18O from benthic foraminifera with MIS5 and MIS7 sub-division nomenclature follow



Appendices

APPENDIX 1. GEOLOGICAL DATA

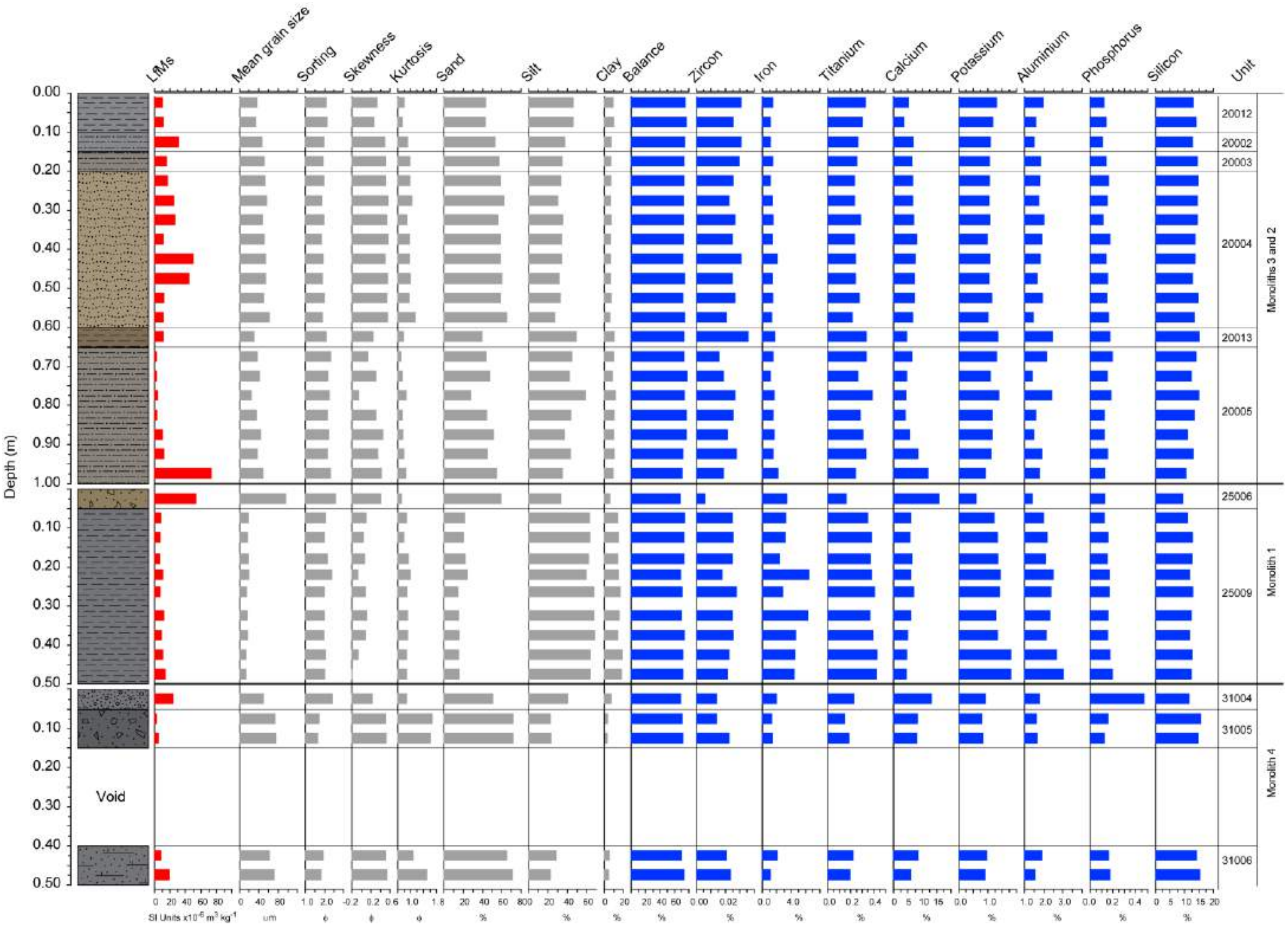
Table 2. Clast lithological analysis of monolith sub-samples from Test Pits 1–3

Monolith	1	2	2	3	3	4	4	4	4	4
Test Pit	2	3	3	3	3	1	1	1	1	1
Depth (cm)	0–5	0–5	45–50	0–5	45–50	0–5	5–10	10–15	40–45	45–50
Crystalline limestone	9	1	23	5	3	9	8	6	6	3
Grey 'platy' limestone			1							
Chert	1	1	1			1			1	
Total	10	2	25	5	3	10	8	6	7	3

Table 3. Clast lithological analysis results of samples from the quarry walls (figures in parenthesis are percentages)

Sample	1	2	3	4	5
Lithology Unit	19	32	5	2	2
Crystalline limestone	451 (81.7)	591 (79.1)	563 (83.7)	319 (63.0)	498 (89.6)
'Platy' grey limestone	8 (1.4)	22 (2.9)	2 (0.3)	22 (4.3)	3 (0.5)
Oolitic limestone	90 (16.3)	129 (17.3)	97 (14.4)	147 (29.1)	46 (8.3)
Jurassic fossils		2 (0.3)	2 (0.3)	6 (1.2)	3 (0.5
Brown sandstone	2 (0.4)		2 (0.3)	2 (0.4)	
Calcite		1 (0.1)	8 (1.2)	3 (0.6)	
Chert	1 (0.4)	1 (0.1)	1 (0.1)	7 (1.4)	6 (1.1)
Flint		1 (0.1)			
Total	552	747	673	506	556

Figure 15 Grain size, magnetic susceptibility and geochemistry data from sub-samples taken from Monoliths 1–4



APPENDIX 2. PLANT MACROFOSSILS

Table 4. Results of the plant macrofossil analysis, Oak Tree Fields, Cerney Wick.

		Phase 1						Phase 3					Phase 4				
	Sample number	9*	10*	11*	12	25	26*	14*	15	17	18*	21	22*	67*	69*	74	72
	DV Unit	31002	31002	31006	31006	25008	25008	25002	25002	25003	25003	25004	20005	20003	20003	20005	20005
	Trench	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3
Aquatic																	
Ranunculus subgenus *Batrachium*	fruit	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0
Nuphar lutea	seed	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Potamogeton sp.	fruit	0	2	0	5	0	1	0	0	0	2	8	0	0	2	0	3
Alisma plantago-aquatica	fruit	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Zannichellia palustris	fruitlet	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	1
cf. Nymphaea	seed	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Waterside and damp ground																	
Carex cf. *rostrata*	nutlet	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0
Carex spp.	fruit	1	1	5	3	1	6	0	2	0	2	4	4	15	5	1	0
cf. *Scirpus* sp.	nutlet	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Juncaceae	seed	59	0	71	12	0	0	24	6	9	33	3	48	212	37	2	0
Grassland/open, disturbed ground																	
Ranunculus repens/acris/bulbosus	achene	0	0	0	27	0	0	0	1	0	0	25	0	0	0	0	0
Picris sp.	fruit	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

		Phase 1						Phase 3					Phase 4				
	Sample number	9*	10*	11*	12	25	26*	14*	15	17	18*	21	22*	67*	69*	74	72
	DV Unit	31002	31002	31006	31006	25008	25008	25002	25002	25003	25003	25004	20005	20003	20003	20005	20005
	Trench	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3
Cirsium/Carduus sp.	fruit	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Allium sp.	seed	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
cf. *Luzula* sp.	seed	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Trifolium sp.	seed	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Rumex acetosella	nutlet	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Asteraceae	fruit	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Brassicaceae	seed	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Epilobium sp.	fruit	0	0	0	0	0	0	0	0	0	3	0	0	3	0	0	0
Silene sp.	seed	4	0	7	0	0	3	4	0	0	0	0	5	16	0	0	0
Thalictrum sp.	fruitlet	3	0	1	0	0	1	3	0	0	4	0	4	5	3	0	0
Woodland/Scrubland																	
Sambucus nigra/racemosa	seed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Betula	fruit	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Empetrum	fruit	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Unclassified		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potentilla sp.	achene	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Cyperaceae	fruit	0	4	0	0	1	2	0	0	0	0	0	0	0	0	0	0
Chenopodiaceae	seed	0	1	1	0	0	0	0	0	0	0	1	0	2	2	0	0
Polygonaceae	fruit	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Indet. seed casings	-	0	0	0	1	0	0	0	0	0	0	5	0	0	0	0	2
Unknown (corroded/broken)	-	0	0	0	5	2	0	0	2	1	0	2	0	0	0	0	3

		Phase 1						Phase 3					Phase 4				
	Sample number	9*	10*	11*	12	25	26*	14*	15	17	18*	21	22*	67*	69*	74	72
	DV Unit	31002	31002	31006	31006	25008	25008	25002	25002	25003	25003	25004	20005	20003	20003	20005	20005
	Trench	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3
Budscales	-	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Catkins	-	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Total seeds/fruits		67	9	86	61	4	13	32	11	10	47	65	61	254	51	4	9

* = assessment data only

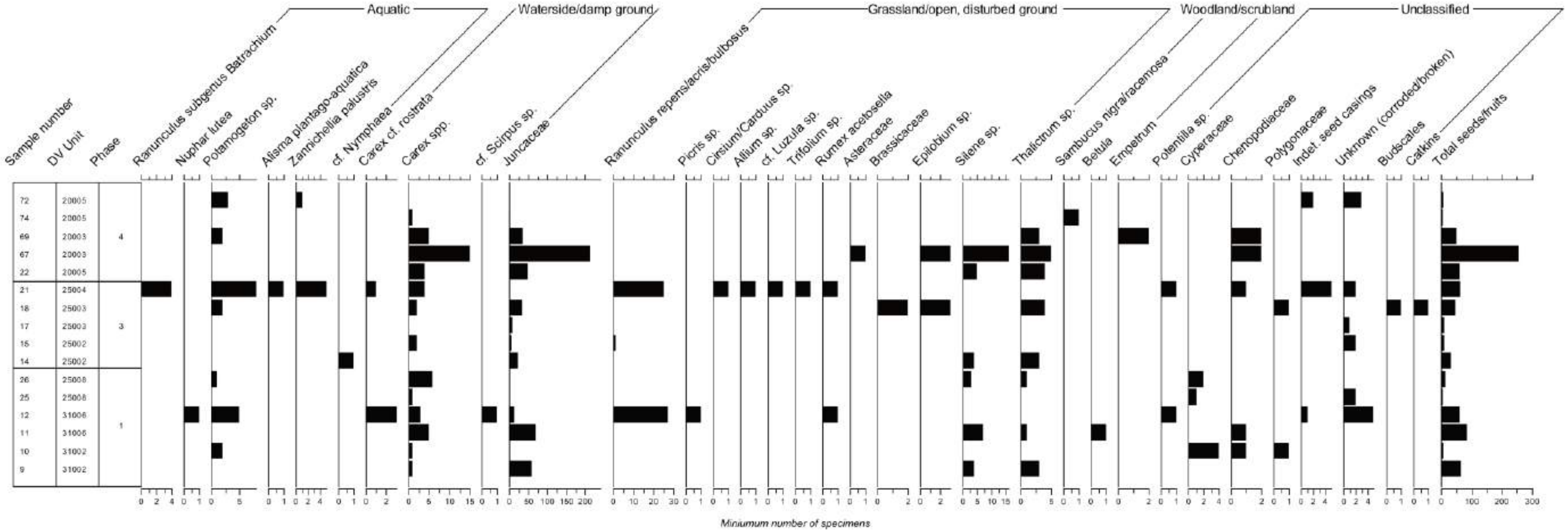


Figure 16. Results of the plant macrofossil analysis, Oak Tree Fields, Cerney Wick

APPENDIX 3. MOLLUSCA

Test Pit		1	1	1	2	2	2	3	3
Sample No.		9	10	11	14	18	22	67	69
DV Unit		31002	31002	31006	25002	25003	25005	20003	20003
Fraction (μm)		>500	>500	>500	>500	>500	>500	>500	>500
Proportion fresh: subfossil shell		0:1	0:1	0:1	0:1	0:1	0:1	0:1	0:1
MOLLUSCA	Ecological group								
Cochlicopa cf. *lubrica* (O. F. Müller, 1774)	3					1			
Limacidae sp.	3				1	1			1
Trochulus hispidus (Linnaeus, 1758)	3	3	11	3	3	3		2	2
Pupilla muscorum (Linnaeus, 1758)	4a	3	2		1	2			1
Vallonia cf. *excentrica* Sterki, 1893	4a	1	4	1	2				
Galba truncatula (O. F. Müller, 1774)	5a		2					3	1
Euglesa casertana (Poli, 1791)	6a			1	1	15		19	15
Left valve				*1*	*1*	*11*		*5*	*3*
Right valve						*15*		*19*	*15*
Ampullaceana balthica (Linnaeus, 1758)	6b	42	62	10	3	13	4	6	10
Euglesa nitida (Jenyns, 1832)	6b	2	6	1	3	6			
Left valve		*2*	*3*	*1*	*3*	*6*			
Right valve		*2*	*6*	*1*					
Gyraulus laevis (Alder, 1838)	6b					1		5	8
Hippeutis complanatus (Linnaeus, 1758)	6b							3	
Acroloxus lacustris (Linnaeus, 1758)	6c					1		1	1
Myxas glutinosa (O. F. Müller, 1774)	6c					1			
Ancylus fluviatilis O. F. Müller, 1774	6d	1						4	1
Bithynia tentaculata (Linnaeus, 1758)	6d	2	4	4		57	1	14	24

Test Pit		1	1	1	2	2	2	3	3
Sample No.		9	10	11	14	18	22	67	69
DV Unit		31002	31002	31006	25002	25003	25005	20003	20003
Shell		*1*	*1*	*4*		*36*		*10*	*4*
Opercula		*2*	*4*			*57*	*1*	*14*	*24*
Euglesa supina (A. Schmidt, 1851)	6d		1	1		1			
Left valve			1						
Right valve				1		1			
Euglesa henslowana (Sheppard, 1825)		4	9			1		1	
Left valve		*1*	*9*					*1*	
Right valve		*4*	*4*			*1*			
Pisidium amnicum (O. F. Müller, 1774)	6d		3	4	1	18	1	3	4
Left valve			*1*	*4*		*14*	*1*	*3*	*4*
Right valve			*3*	*1*	*1*	*18*		*2*	*2*
† *Pisidium clessini* Neumayr, 1875	6d			1		3			
Left valve				1		2			
Right valve						1			
Planorbarius corneus corneus (Linnaeus, 1758)	6d					1			
Valvata piscinalis (O. F. Müller, 1774)	6d	46	70	21	6	94	6	60	75
Total shells		108	183	49	21	280	12	138	152
Diversity Indices									
Taxa s		9	11	10	9	17	4	12	12
Shannon		1.3	1.55	1.69	2	1.73	1.13	1.7	1.56
Brillouin		1.2	1.46	1.45	1.56	1.62	0.85	1.56	1.44

Table 5 MNI for Mollusca present in samples

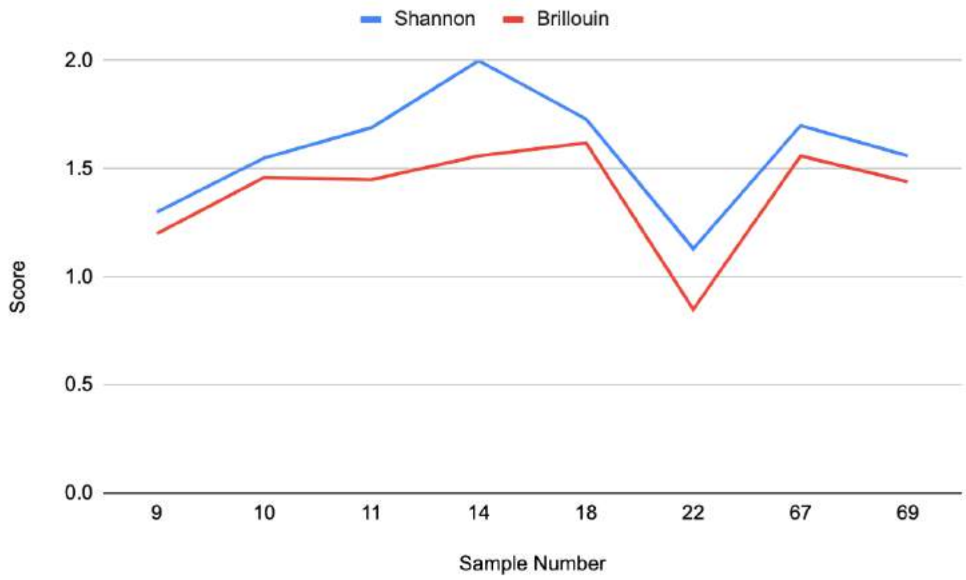


Figure 17 Mollusca – Diversity Indices

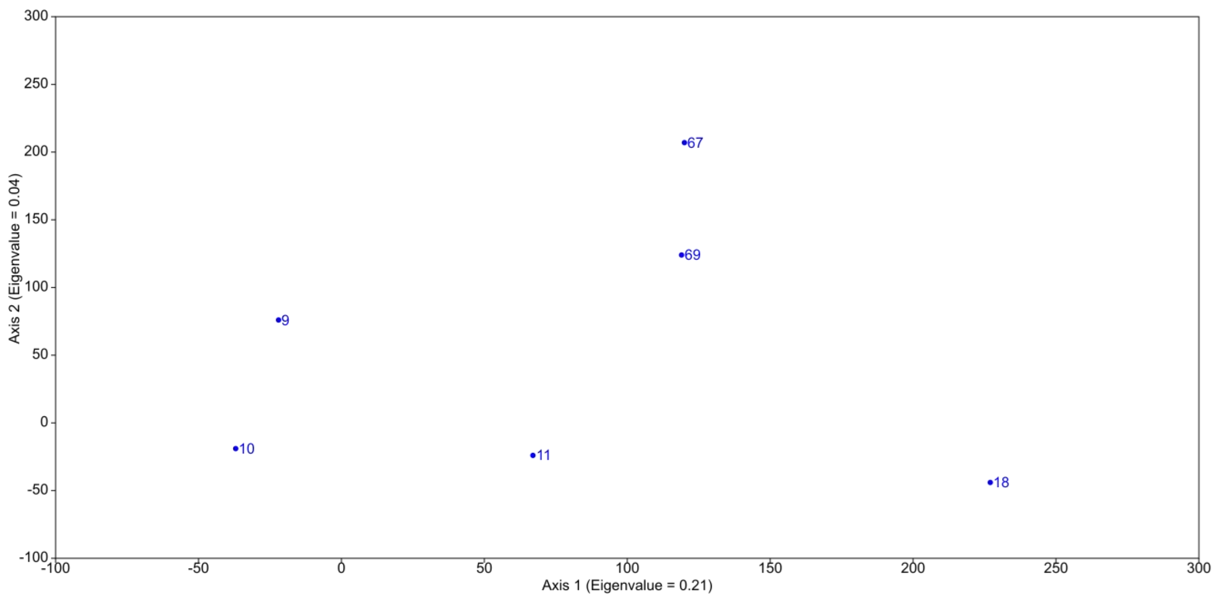


Figure 18 Mollusca – Detrended Correspondence Analysis

APPENDIX 4. INSECTS AND OTHER INVERTEBRATES

TEST PIT	TP1	TP1	TP1	TP2	TP2	TP2	TP3	TP3
DEPTH	17-25cm	9-17cm	0-9cm	47-52cm	30-35cm	10-15cm	38-41	18-28cm
SAMPLE	<11>	<10>	<9>	<22>	<18>	<14>	<69>	<67>
PHASE	1	1	1	3	3	3	4	4
DV Unit	31006	31002	31002	25005	25003	25002	20003	20003
ARCA unit	v	iv	iv	k4	k2	k1	C	C
Sample volume	5L	5L	5L	5L	5L	5L	5L	5L
CRUSTACEA								
Daphnia magna group ephippia	-	-	-	P	P	-	-	-
Daphnia sp(p). ephippia	P	-	P	-	-	-	-	-
Cladocera spp. ephippia	-	-	-	-	P	-	-	-
Ostracoda spp. carapaces	-	-	P	C	C	-	C	C
INSECTA								
DERMAPTERA (earwigs)								
Dermaptera sp. [u]	-	-	+	-	+	-	-	+
HEMIPTERA: HETEROPTERA (true bugs)								
Lygaeidae (ground bugs)								
Lygaeidae spp. [oa-p]	+	-	-	-	+	+	+	+
Corixidae (water boatmen)								
Corixidae spp. [oa-w]	+	+	+	+	+	+	-	-
Saldidae (shore bugs)								
Saldidae sp(p). [oa-d]	+	-	-	-	+	-	+	-
Heteroptera sp. [u]	-	+	-	-	-	-	-	-
HEMIPTERA: HOMOPTERA								
Auchenorhyncha spp. [oa-p]	+	-	-	-	+	-	-	-
Psylloidea (jumping plant lice)								
Trioza sp. nymph [oa-p]	+	-	-	-	-	-	-	-
Aphidoidea sp. (aphids)	+	-	-	+	+	-	-	-
Coccoidea sp. (scale insects)	-	-	+	-	-	-	-	-
COLEOPTERA (beetles)								
Sphaeriusidae								
Sphaerius acaroides Waltl [oa-w]	1	-	1	1	-	-	-	-
Dytiscidae (diving beetles)								
Agabus bipustulatus (Linnaeus) [oa-w]	-	-	1	-	-	-	-	-
Agabus or *Ilybius* spp. [oa-w]	-	-	-	-	1	-	-	2
Colymbetes fuscus (Linnaeus) [oa-w]	-	-	1	-	1	-	-	1
Hydroporinae spp. [oa-w]	1	1	-	-	3	-	-	-
Dytiscidae sp. [oa-w]	1	1	-	-	-	-	-	-
Carabidae (ground beetles)								
Loricera pilicornis (Fabricius) [oa]	-	-	1	-	-	-	-	-
Clivina fossor (Linnaeus) [oa]	-	-	1	-	-	-	-	-
Dyschirius globosus (Herbst) [oa]	-	1	-	1	2	-	-	-

TEST PIT	TP1	TP1	TP1	TP2	TP2	TP2	TP3	TP3
DEPTH	17-25cm	9-17cm	0-9cm	47-52cm	30-35cm	10-15cm	38-41	18-28cm
SAMPLE	<11>	<10>	<9>	<22>	<18>	<14>	<69 >	<67>
PHASE	1	1	1	3	3	3	4	4
DV Unit	31006	31002	31002	25005	25003	25002	20003	20003
ARCA unit	v	iv	iv	k4	k2	k1	C	C
Sample volume	5L	5L	5L	5L	5L	5L	5L	5L
Bembidion (*Metallina*) *lampros* or *properans* [oa]	-	-	1	-	-	-	-	-
Bembidion (*Ocydromus*) sp.	-	-	1	-	-	-	-	-
Bembidion (*Philochthus*) *biguttatum* (Fabricius) [oa-d]	-	-	-	-	1	-	-	-
Bembidion spp. [oa]	-	1	-	-	3	-	1	2
Pterostichus vernalis (Panzer) [oa-d]	-	1	-	-	-	-	-	-
Pterostichus niger (Schaller) [oa]	-	-	-	-	-	-	-	1
Pterostichus spp. [oa]	-	-	-	-	2	-	-	1
Amara spp. [oa]	-	1	1	-	1	-	-	1
Chlaenius sp. [oa-d]	-	-	-	-	1	-	-	-
Harpalus rufipes (De Geer) [oa]	-	-	-	-	1	-	-	-
Calathus fuscipes (Goeze) [oa]	-	-	2	1	1	-	-	1
Calathus melanocephalus (Linnaeus) [oa]	-	-	-	-	1	-	-	-
Calathus spp. indet. small species [oa]	-	1	2	-	-	-	-	2
Microlestes or *Syntomus* sp. [oa]	-	-	-	-	1	-	-	-
Carabidae spp. and sp. indet. [ob]	3	3	2	2	3	3	5	3
Helophoridae (grooved water scavengers)								
Helophorus nubilus Fabricius [oa]	-	3	-	-	3	-	-	-
Helophorus spp. and sp. indet. [oa-w]	6	3	7	2	12	3	2	10
Georissidae								
Georissus crenulatus (Rossi) [oa-w]	2	1	-	-	1	-	-	1
Hydrochidae								
Hydrochus sp. indet. [oa-w]	-	-	1	-	1	-	1	1
Hydrophilidae								
Berosus sp. [oa-w]	-	-	1	-	-	-	-	-
Laccobius sp. [oa-w]	-	-	1	-	-	-	-	-
Chaetarthria seminulum or *simillima* [oa-d]	-	-	-	-	1	-	-	-
Coelostoma orbiculare (Fabricius) [oa-w]	-	-	-	-	-	-	1	-
Sphaeridium bipustulatum Fabricius [rf]	-	-	-	-	2	-	-	-
Sphaeridium sp. indet. [rf]	1	-	-	-	-	-	-	2
Cercyon impressus (Sturm) [rf]	-	-	1	-	-	-	-	1

TEST PIT	TP1	TP1	TP1	TP2	TP2	TP2	TP3	TP3
DEPTH	17-25cm	9-17cm	0-9cm	47-52cm	30-35cm	10-15cm	38-41	18-28cm
SAMPLE	<11>	<10>	<9>	<22>	<18>	<14>	<69>	<67>
PHASE	1	1	1	3	3	3	4	4
DV Unit	31006	31002	31002	25005	25003	25002	20003	20003
ARCA unit	v	iv	iv	k4	k2	k1	C	C
Sample volume	5L	5L	5L	5L	5L	5L	5L	5L
Cercyon melanocephalus (Linnaeus) [rf]	-	-	-	-	-	-	-	4
Cercyon pygmaeus (Illiger) [rf]	1	-	1	-	-	-	-	-
Cercyon tristis group (Illiger) [oa-d]	-	-	1	-	-	-	-	-
Cercyon ustulatus (Preyssler) [oa-d]	1	-	-	-	1	-	-	2
Cercyon spp. and sp. indet. [u]	1	-	1	-	3	1	2	-
Cryptopleurum crenatum (Kugelann) [rf]	-	2	1	-	2	-	-	2
Cryptopleurum minutum (Fabricius) [rf]	-	-	-	-	1	-	-	-
Histeridae (clown beetles)								
Saprinus aeneus (Fabricius) [rt]	-	-	-	1	-	-	-	-
Hister bissexstriatus Fabricius [rt]	-	2	4	-	2	-	1	1
Histerinae spp. and sp. indet. [rt]	-	1	1	1	-	-	-	2
Histeridae sp. [u] isolated leg segments	1	-	-	-	-	1	-	-
Hydraenidae								
Hydraena spp. [oa-w]	-	-	1	-	1	-	-	2
Limnebius ?nitidus (Marsham) [oa-w]	-	-	-	-	2	-	-	-
Ochthebius bicolon Germar [oa-w]	-	-	-	-	2	-	-	-
Ochthebius bicolon or *dilatatus* [oa-w]	-	-	-	-	-	-	-	1
Ochthebius dilatatus Stephens [oa-w]	-	-	1	-	2	-	-	-
Ochthebius c.f. *minimus* [(Fabricius) oa-w]	-	-	1	-	2	-	-	1
Ochthebius sp. indet. [oa-w]	2	-	-	-	-	1	-	-
Ptiliidae (featherwing beetles)								
Ptenidium sp. [rt]	-	-	1	-	-	-	-	-
Acrotrichis sp. [rt]	1	-	-	-	1	-	-	-
Silphidae (sexton beetles)								
Silphidae spp. [u]	-	-	1	-	1	-	-	1
?Silphidae sp. [u]	1	-	-	-	-	-	1	-
Staphylinidae (rove beetles)								
Acrolocha sulcula (Stephens) [rt]	-	-	1	-	1	-	-	2
Micropeplus sp. [rt]	-	-	-	-	-	1	-	-
Pselaphinae spp. [u]	1	-	-	-	1	2	-	-
Tachyporus spp. [u]	2	-	-	-	2	1	-	-

TEST PIT	TP1	TP1	TP1	TP2	TP2	TP2	TP3	TP3
DEPTH	17-25cm	9-17cm	0-9cm	47-52cm	30-35cm	10-15cm	38-41	18-28cm
SAMPLE	<11>	<10>	<9>	<22>	<18>	<14>	<69>	<67>
PHASE	1	1	1	3	3	3	4	4
DV Unit	31006	31002	31002	25005	25003	25002	20003	20003
ARCA unit	v	iv	iv	k4	k2	k1	C	C
Sample volume	5L	5L	5L	5L	5L	5L	5L	5L
Tachinus ?rufipes (Linnaeus) [u]	-	1	-	-	-	-	-	-
Tachinus spp. and sp. indet. [u]	1	-	2	1	2	-	-	2
Aleochara sp. [rt]	-	-	-	-	1	-	-	-
Aleochariinae spp. [u]	1	3	2	-	7	3	-	1
Bledius sp. [oa]	1	-	-	-	1	-	-	-
Carpelimus spp. [u]	-	-	-	1	2	1	1	1
Platystethus cornutus group [oa-d]	-	1	-	-	-	-	-	-
Platystethus nitens (Sahlberg) [oa-d]	3	-	2	-	1	-	-	2
Platystethus nitens or *nodifrons* Mannerheim [oa-d]	-	-	-	-	-	-	-	1
Platystethus ?nodifrons Mannerheim [oa-d]	-	-	-	-	-	1	-	-
Platystethus (*Craetopycrus*) sp. [oa-d]	-	-	2	-	-	-	-	-
Platystethus arenarius (Geoffroy in Fourcroy) [rf]	-	-	1	-	1	-	-	1
Anotylus complanatus (Erichson) agg. [rt]	-	-	-	-	1	1	1	1
Anotylus gibbulus group [rt]	3	1	1	-	3	-	-	1
Anotylus nitidulus (Gravenhorst) [rt-d]	1	1	-	-	-	-	-	-
Anotylus rugosus (Fabricius) [rt]	-	-	2	-	-	-	-	-
Anotylus tetracarinatus (Block) [rt]	1	-	-	-	-	-	-	-
Oxytelus ?piceus (Linnaeus) [rf]	1	-	2	1	-	-	1	-
Scydmaeninae spp. [u]	1	1	-	-	1	-	-	-
Stenus spp. [u]	3	-	4	-	3	-	-	1
Lathrobium sp. [u]	-	-	1	-	1	-	-	1
Astenus sp. [rt]	-	-	-	-	1	-	-	-
Paederinae sp. [u]	-	-	-	-	-	-	-	1
Xantholinus gallicus or *linearis*[rt]	1	1	-	-	-	-	-	-
Neobisnius sp. [rt]	-	-	1	-	1	-	-	-
Gabrius sp. [rt]	-	-	1	-	-	-	-	-
Staphylininae spp. [u]	3	2	3	1	3	-	1	4
Geotrupidae (dor beetles)								
Geotrupini sp. [oa-rf]	1	-	-	-	1	-	-	1
Scarabaeidae (dung beetles and chafers)								
Euheptaulacus sus (Herbst) [oa-rf]	1	1	2	-	2	-	-	2
?Melinopterus sp. [ob-rf]	5	3	10	-	6	-	4	21

TEST PIT	TP1	TP1	TP1	TP2	TP2	TP2	TP3	TP3
DEPTH	17-25cm	9-17cm	0-9cm	47-52cm	30-35cm	10-15cm	38-41	18-28cm
SAMPLE	<11>	<10>	<9>	<22>	<18>	<14>	<69>	<67>
PHASE	1	1	1	3	3	3	4	4
DV Unit	31006	31002	31002	25005	25003	25002	20003	20003
ARCA unit	v	iv	iv	k4	k2	k1	C	C
Sample volume	5L	5L	5L	5L	5L	5L	5L	5L
Aphodiinae spp. [ob-rf]	2	4	11	4	13	3	1	8
Serica brunnea (Linnaeus) [oa-p]	-	-	-	-	-	-	1	-
Scirtidae (marsh beetles)								
Scirtidae sp. [oa-d]	-	-	-	-	-	-	-	1
Byrrhidae (pill beetles)								
Byrrhus sp. [oa]	-	-	-	-	1	-	-	-
Byrrhidae sp. [u]	-	-	-	-	-	-	-	1
Elmidae (riffle beetles)								
Elmis aenea (Müller) [oa-w]	-	-	-	-	-	-	1	-
Esolus parallelepipedus (Müller) [oa-w]	-	-	1	-	1	-	-	2
Limnius volckmari (Panzer) [oa-w]	-	-	-	-	-	-	1	1
Dryopidae (long-toed water beetles)								
Dryops sp. [oa-d]	-	-	-	-	1	-	-	-
Elateridae (click beetles)								
Agrypnus murinus (Linnaeus) [oa-p]	-	1	1	-	-	-	-	1
Agriotes sp. [oa-p]	-	2	1	-	-	-	-	-
Elateridae spp. and sp. indet. [ob]	1	-	1	1	3	-	1	4
Cantharidae (soldier beetles)								
Cantharidae spp. [ob]	-	-	-	-	1	-	1	-
Nitidulidae (sap and pollen beetles)								
Meligethes sp. [oa-p]	1	1	-	-	-	-	-	1
Coccinellidae (ladybirds)								
Propylea quattuordecimpunctata (Linnaeus) [oa]	-	-	-	-	-	-	-	1
Corylophidae								
Orthoperus sp. [rt]	1	-	-	-	-	-	-	-
Latridiidae (minute brown scavenger beetles)								
Enicmus sp. [rd]	-	-	1	-	1	-	-	-
Corticariinae spp. [rt]	-	1	1	-	1	-	-	-
Anthicidae (ant-like flower beetles)								
Anthicidae sp. [rt]	1	-	-	-	1	-	-	2
Chrysomelidae (seed and leaf beetles)								
Donacia crassipes Fabricius [oa-p-d]	-	-	-	-	-	-	-	2
Donacia dentata Hoppe [oa-p-d]	-	-	1	-	-	-	1	1
Donacia semicuprea Panzer [oa-p-d]	-	-	1	-	-	-	-	-
Donacia spp. and sp. indet. [oa-p-d]	-	1	-	1	2	1	-	-

TEST PIT	TP1	TP1	TP1	TP2	TP2	TP2	TP3	TP3
DEPTH	17-25cm	9-17cm	0-9cm	47-52cm	30-35cm	10-15cm	38-41	18-28cm
SAMPLE	<11>	<10>	<9>	<22>	<18>	<14>	<69>	<67>
PHASE	1	1	1	3	3	3	4	4
DV Unit	31006	31002	31002	25005	25003	25002	20003	20003
ARCA unit	v	iv	iv	k4	k2	k1	C	C
Sample volume	5L	5L	5L	5L	5L	5L	5L	5L
Donacia or *Plateumaris* sp. indet. [oa-p-d]	1	-	-	-	-	-	-	1
Lema or *Oulema* sp. [oa-p]	-	-	-	-	-	-	-	1
Crepidodera sp. (Fabricius) [oa-p-t]	-	-	-	-	1	-	-	-
Chaetocnema arida group [oa-p]	-	2	1	2	1	-	-	3
Chaetocnema concinna or *picipes* [oa-p]	-	-	1	-	1	-	-	1
Longitarsus sp. [oa-p]	1	-	-	-	-	-	-	-
?*Longitarsus* sp. [oa-p]	-	-	-	-	1	-	-	-
Phyllotreta sp. [oa-p]	-	-	-	-	2	-	-	-
Alticini spp. [oa-p]	1	-	-	-	3	1	1	3
Chrysomelidae sp. [oa-p]	1	-	-	-	-	-	-	-
Apionidae								
Apionidae spp. [oa-p]	1	2	2	-	4	2	1	-
Erirhinidae (wetland weevils)								
Notaris acridulus (Linnaeus) [oa-p-d]	-	-	-	-	-	-	-	2
?*Notaris acridulus* (Linnaeus) [oa-p-d]	-	1	-	-	-	-	-	-
Notaris sp. [oa-p-d]	-	-	-	-	-	-	1	-
Tournotaris bimaculata (Fabricius) [oa-p-d]	-	-	-	-	-	1	1	1
Curculionidae (weevils)								
Limnobaris sp. [oa-p-d]	-	-	-	-	-	-	-	1
Mecinus pascuorum (Gyllenhal) [oa-p]	-	-	-	-	-	-	-	1
Mecinus pyraster (Herbst) [oa-p]	-	-	-	-	-	-	-	1
Orchestes hortorum (Fabricius) [oa-p-t]	-	-	1	-	-	-	-	-
Tychius spp. [oa-p]	-	-	-	-	-	-	-	3
Ceutorhynchus spp. [oa-p]	1	1	-	-	-	-	-	1
Rhinoncus perpendicularis (Reich) [oa-p]	-	-	-	-	1	-	-	-
Ceutorhynchinae spp. [oa-p]	-	-	-	-	1	-	-	4
Graptus triguttatus (Fabricius) [oa-p]	-	-	-	-	1	-	-	-
Sitona sp. [oa-p]	-	-	-	-	-	1	1	-
Curculionidae spp. and sp. indet. [oa-p]	3	1	3	4	4	2	4	6
Coleoptera spp. and sp. indet. [u]	1	2	5	2	6	1	4	7
DIPTERA (flies)								

TEST PIT	TP1	TP1	TP1	TP2	TP2	TP2	TP3	TP3
DEPTH	17-25cm	9-17cm	0-9cm	47-52cm	30-35cm	10-15cm	38-41	18-28cm
SAMPLE	<11>	<10>	<9>	<22>	<18>	<14>	<69>	<67>
PHASE	1	1	1	3	3	3	4	4
DV Unit	31006	31002	31002	25005	25003	25002	20003	20003
ARCA unit	v	iv	iv	k4	k2	k1	C	C
Sample volume	5L	5L	5L	5L	5L	5L	5L	5L
Chironomidae spp. larval head capsules	-	-	+	-	-	-	-	-
Diptera spp. puparia	-	+	+	+	+	+	-	+
HYMENOPTERA (bees, wasps and ants)								
Hymenoptera Parasitica spp.	+	++	+	-	+	-	+	+
TRICHOPTERA (caddis flies)								
Trichoptera sp. larval fragments	+	-	-	-	+	-	-	+
ARACHNIDA								
Acarina spp. (mites)	P	P	C	P	P	P	P	P
Aranae sp. (spiders)	-	-	-	-	P	P	-	-
BRYOZOA								
Lophopus crystallinus (Pallas) statoblasts	-	-	-	P	-	P	P	-
MINIMUM NUMBER BEETLES	69	56	108	27	155	31	42	149
Concentration of beetle remains per litre sediment	14 litre-1	11 litre-1	22litre-1	5 litre-1	31 litre-1	6 litre-1	8 litre-1	30 litre-1

Ecological codes shown in square brackets are: d - damp ground/waterside, oa - taxa occurring in outdoor habitats and not usually in accumulations of decomposing matter, ob - probable outdoor taxa, p- plant-associated taxa, rd - dry decomposers, rf - foul decomposers, rt - eurytopic decomposers, t - tree, u - uncoded, w - aquatic.
A minimum number of individuals (MNI) has been estimated for Coleoptera. All other insects have been recorded semi-quantitively as + 1-3, ++ 4-10, +++ 11-50.
Other groups of invertebrates have been recorded as present (P) or common (C)

Table 6 Insects and other invertebrate taxa

Test Pit	TP1	TP1	TP1	TP2	TP3
Depth	17-25cm	9-17cm	0-9cm	30-35cm	18-28cm
Sample	<11>	<10>	<9>	<18>	<67>
Phase	1	1	1	3	4
DV Unit	31006	31002	31002	25003	20003
ARCA Unit	v	iv	iv	k2	C
Sample volume	5L	5L	5L	5L	5L
AQUATIC					
Minimum aquatic individuals	12	6	17	26	24
Minimum aquatic taxa	7	5	13	13	14
%Aquatics (of whole assemblage)	17%	11%	16%	17%	16%
TERRESTRIAL					
Minimum terrestrial beetle individuals	57	50	91	129	125
Minimum terrestrial beetle taxa	48	42	69	95	80
Decomposers					
% Dry decomposers [rd]	0%	0%	1%	1%	0%
% Foul decomposers [rf]	21%	16%	35%	23%	34%
% Eurytopic decomposers [rt]	16%	10%	10%	8%	6%
% Total decomposers [rd+rf+rt]	37%	26%	46%	32%	41%
Other groups					
% Damp ground/waterside [d]	11%	10%	9%	5%	10%
% Plant-associated [p]	18%	24%	13%	19%	26%
% Wood-associated [l]	0%	0	0%	0%	0%
% Tree foliage etc [t]	0%	0%	1%	1%	0%
% Scarabaeoid dung beetles	16%	16%	25%	17%	26%

Percentages are based on numbers of individuals and have been rounded to the nearest whole number.
Proportions of aquatic taxa have been calculated as percentages of the whole assemblage. Other groups have been calculated as a proportion of the terrestrial beetle fauna. Ecological codes shown in square brackets are explained in Table 6

Table 7 Proportions of selected groups of beetles (Coleoptera) in assemblages with >50 individuals

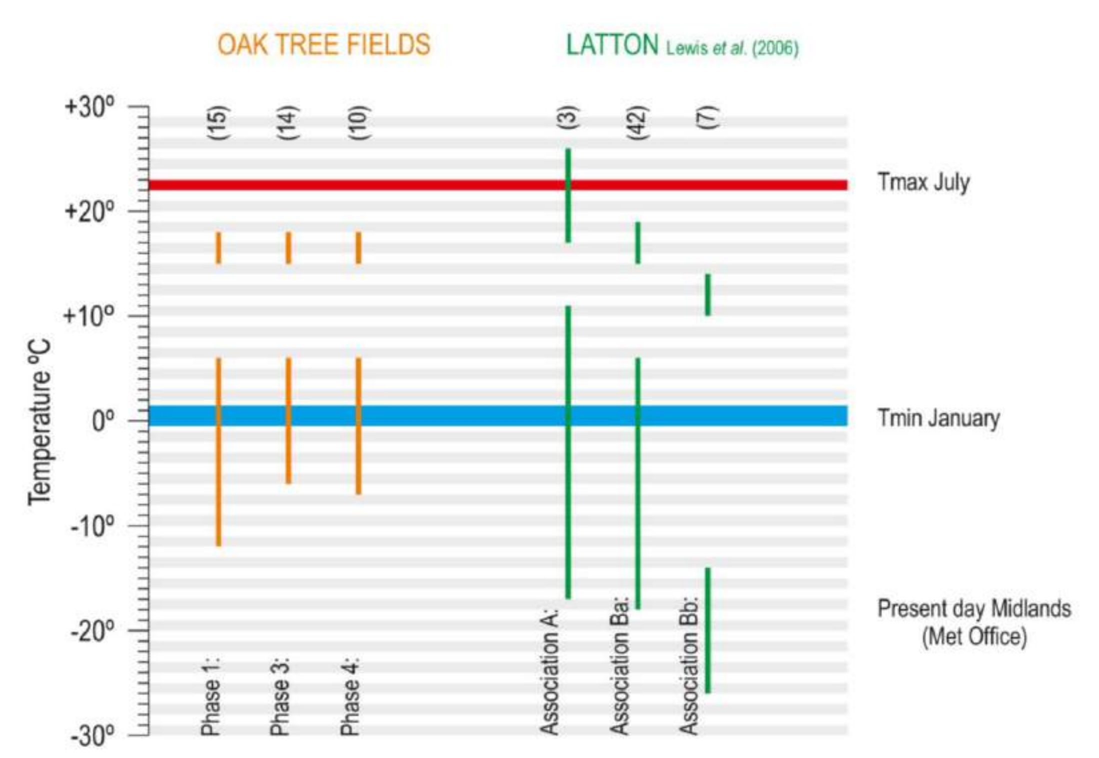


Figure 19 Palaeotemperature estimates from Coleoptera assemblages using the Mutual Climatic Range method (Atkinson et al 1987), calculated using BugsCEP (Buckland & Buckland 2006).

Numbers of species the temperature ranges are based on shown in brackets

APPENDIX 5. FAUNAL REMAINS

		CER19					2017 Hollingworth Collection	
		Test Pit 1		Test Pit 2	Test Pit 3			
Common name	Taxonomic name	31001	31002	25002	20007	20008		Total
Steppe mammoth	*Mammuthus trogontherii*						7	7
cf. Steppe mammoth							2	2
Mammoth	*Mammuthus* sp.	1	8	1		60	61	131
cf. mammoth		1	2				15	18
Brown bear	*Ursus arctos*						1	1
Steppe bison	*Bison priscus*						2	2
Cattle?	*Bos taurus?*						1	1
Steppe bison/aurochs/cattle	Bovidae						6	6
Medium/large mammal					1			1
Large mammal							2	2
Large/very large mammal							12	12
Very large mammal			2				34	36
	Total	2	12	1	1	60	143	219

Table 8 Summary of vertebrate remains from Cerney Wick, count.

Specimen	Tooth type	Max. length (mm)	Max. width (mm)	Occlusal surface Max. length (mm)	Occlusal surface Max. width (mm)	LF/LL	ET	No. of plates in wear	Max. height (mm)	No. of plates	Plates in *M. trogontherii*	LAWS category	AEY++	Comments
H.105	Right mandibular M3	#	80.0	#	68.8	8.44/11.85	1.7 - 1.8 - 2.0	11-12	125.9	-18p	17-24	XXIII	43	P = 17 & 24 (steppe) and 19 & >26 (woolly) are very rare extremes
H.106	Right maxillary M3	162	70.0	125.7	68.8	11.75/8.51	1.8 - 2.0 - 2.2	1-13	(110)	x/18	17-22	XXIV	45	Exceptionally small M3
H.109	Right maxillary M3	195	82.5	167	78.2	10.19/9.81	1.8 - 1.9 - 2.0	1-15	120+	x/19p	17-22	XXVI	49	
H.110	Right mandibular M3	226	69.0	163	68.9	8.82/11.34	1.7 - 1.8 - 1.9	1-16	97.9	X20p	17-22	XXV	47	
H.111	Left maxillary cf. M2	145	70.0	141.2	68.5	11.37/8.80	Ommitted	1-12	#	x/14.5x	M1 9-12* M2 11-15*	XVIII/XIX	30/32	* UK MIS 7 *M. trogontherii*

Table 9 Metrical and laminar plate data for steppe mammoth teeth from Cerney Wick.

++ = African equivalent years after Laws (1966).

Specimen number	Context	Element	Side	Fusion data	Age
H.096	\	Radius	L	Fused proximal; unfused distal	18-50+
H.101	\	Tibia	L	Fused distal	18-32+
H.103	\	Tibia*	L	Unfused proximal and disal	Under 18 years
H.104	\	Femur	L	Unfused distal	Under 18 years
H.116	\	Vertebra	\	Cranially and caudally unfused	Under 18 years
H.146	\	Humerus	L	Unfused distal	Neonatal
1	31002	Mandible	R	\	Juvenile
3	31002	Tusk	\	\	Juvenile
6	31002	Thoracic vertebra	\	cranial and caudal plates in process of fusing	c. 18 years

Table 10 Mammoth remains providing ageing information.

*All are Mammuthus sp., with the exception of the tibia marked * Ages estimated based on data for the African elephant (Loxodonta africana) presented by Haynes 1987; 1993.*

Find No.	DV Unit	Element	Count	Side	Fragmentation (Dobney and Reilly 1988)	*ID*	Common name	Weight (g)	Condition	Burning	Butchery	Carnivore Interaction	Measurable	Ageable	Comments
1	31002	Mandible	1	R	3 6	*Mammuthus* sp.	Mammoth	419	3	0	0	0	0	1	
2	31002	Rib	1	\	2	Mammalia cf. *Mammuthus*	Very large mammal cf. mammoth	325	3	0	0	0	0	0	
3	31002	Tusk	1			Mammuthus sp.	Mammoth		4	0	0	0	0	Juvenile	
4	31002	Unidentified	2	\	\	Mammalia	Very large mammal	227	4	0	0	0	0	0	
5	31002	? Rib	1	\	\	Mammalia cf. *Mammuthus*	Very large mammal cf. mammoth	146	3	0	0	0	0	0	
6	31002	Thoracic vertebra	2	\	1 2 3 .	*Mammuthus* sp.	Mammoth	1338	2	0	0	0	0	cranial and caudal vertebral plates are in the process of fusing	
7	20007	Unidentified	1	\	\	Mammalia	Medium/large mammal	13	3	0	0	0	0	0	
8	20008	Tusk	60	\	\	*Mammuthus* sp.	Mammoth	168	5	0	0	0	0	0	
9	31002	Rib	1	\	partial 1	*Mammuthus* sp.	Mammoth	190	2	0	0	0	0	0	
10	31002	Single lamella - tooth plate	3	\	Fragments	*Mammuthus* sp.	Mammoth	58	4	0	0	0	0	0	
12	20008		Left in situ												
14	25002	Unidentified	1	\	Fragment	Mammuthus sp.	Mammoth	42	4	0	0	0	0	0	
15	31001	Vertebra - Atlas?	1	\	2	Mammalia cf. *Mammuthus*	Very large mammal cf. mammoth	95	3	0	0	0	0	0	
16	31001	Tarsal	1	\	85%	Mammuthus sp.	Mammoth	310	2	0	0	0	0	0	

Table 11 Archive data for faunal remains collected during 2019 excavations

H ref	Element	Count	Side	Fragmentation (Dobney and Reilly 1988)	ID	Common name	Weight (g)	Condition	Burning	Butchery	Carnivore interaction	Measurable	Ageable	Comments
H.002	Astragalus	1	L	1234	Bovidae cf. *Bos taurus*	Possibly domestic cattle	65	4	0	0	0	y	0	Original ID toe bone. Kate Scott comment: small for bison, in the size range for domestic cattle
H.003	Mandible	1		Mandibular symphysis	*Mammuthus* sp.	Mammoth	825	4	0	0	0	0	0	
H.004	Skull	1		Fragment	*Mammuthus* sp.	Mammoth	1090	3	0	0	0	0	0	
H.005	Skull	1		Fragment	*Mammuthus* sp.	Mammoth	426	4	0	0	0	0	0	
H.006	Scapula	1	L	1 . 0 . 0 0 0 0 0	Mammuthus sp.	Mammoth	486	3	0	0	0	0	0	
H.007	Mandible	1		Fragment	*Mammuthus* sp.	Mammoth	318	3	0	0	0	0	0	
H.008	Skull	1		Fragment	*Mammuthus* sp.	Mammoth	220	3	0	0	0	0	0	
H.009	Mandible	1		Fragment	*Mammuthus* sp.	Mammoth	178	4	0	0	0	0	0	
H.010	Skull	1		Fragment	*Mammuthus* sp.	mammoth	356	4	0	0	0	0	0	
H.011	Longbone shaft	1		Fragment	cf. *Mammuthus* sp.	cf. mammoth	497	3	0	0	0	0	0	
H.012	Rib	1		Fragment	*Mammuthus* sp.	Mammoth	219	2	0	0	0	0	0	
H.013	Unidentified	1		Fragment	Very large mammal	Very large mammal	197	3	0	0	0	0	0	
H.014	Skull fragment	1		Fragment	*Mammuthus* sp.	Mammoth	56	4	0	0	0	0	0	
H.015	Skull fragment	1		Fragment	*Mammuthus* sp.	mammoth	200	4	0	0	Lots of pitting on the bone surface	0	0	Thereis recent surface damage on this specimen
H.016	Femur	1		Fragment	*Mammuthus* sp.	Mammoth	259	4	0	0	0	0	0	I would have gone with longbone shaft fragment.
H.017	Mandible	1		Fragment	*Mammuthus* sp.	Mammoth	239	4	0	0	0	0	0	
H.018	Ulna	1	L	0 0 1 1 . 0 0 0 0 0 0 0	*Mammuthus* sp.	Mammoth	1251	3	0	0	0	0	0	
H.019	Mandible	1		Fragment	*Mammuthus* sp.	Mammoth	410	3	0	0	0	0	0	
H.020	Pelvis	1		Fragment	*Mammuthus* sp.	Mammoth	657	4	0	0	0	0	0	Pitting on bone surface
H.021	Pelvis	1	#	Fragment	*Mammuthus* sp.	Mammoth	583	4	0	0	0	0	0	Pitting on bone surface
H.022	Skull	1		Fragment	*Mammuthus* sp.	Mammoth	269	4	0	0	0	0	0	Pitting on bone surface
H.023	Mandible	1	#	Fragment	*Mammuthus* sp.	Mammoth	438	4	0	0	0	0	0	
H.024	Post-cranial	1		Fragment	cf. *Mammuthus* sp.	cf. mammoth	166	4	0	0	0	0	0	
H.025	Vertebra	1		4	*Mammuthus* sp.	Mammoth	132	3	0	0	0	0	0	Surface scrapes look recent. Pitting on the bone surface
H.026	Mandible	1		Fragment	cf. *Mammuthus* sp.	cf. mammoth	111	4	0	0	0	0	0	
H.027	Indeterminate	1		Fragment	Very large mammal	Very large mammal	100	4	0	0	0	0	0	
H.028	Mandible	1		Fragment	*Mammuthus* sp.	Mammoth	285	5	0	0	0	0	0	
H.029	Vertebra	1		1 (centrum, no epiphysis)	*Mammuthus* sp.	Mammoth	222	3	0	0	0	0	unfused centrum	Juvenile

H ref	Element	Count	Side	Fragmentation (Dobney and Reilly 1988)	ID	Common name	Weight (g)	Condition	Burning	Butchery	Carnivore interaction	Measurable	Ageable	Comments
H.030	Mandible	1		Fragment	*Mammuthus* sp.	Mammoth	294	4	0	0	0	0	0	
H.031	Mandible	1		Fragment	*Mammuthus* sp.	Mammoth	133	4	0	0	0	0	0	
H.032	Skull	1		Fragment	*Mammuthus* sp.	Mammoth	160	4	0	0	0	0	0	
H.033	Indeterminate	1		Fragment	cf. *Mammuthus* sp.	cf. mammoth	169	4	0	0	0	0	0	Pitting on bone surface
H.034	Skull	1		Fragment	*Mammuthus* sp.	Mammoth	73	5	0	0	0	0	0	
H.035	Indeterminate	1		Fragment	cf. *Mammuthus* sp.	cf. mammoth	133	4	0	0	0	0	0	
H.036	Indeterminate	1		Fragment	cf. *Mammuthus* sp.	cf. mammoth	77	3	0	0	0	0	0	
H.037	Indeterminate	1		Fragment	cf. *Mammuthus* sp.	cf. mammoth	88	4	0	0	0	0	0	
H.038	Tusk	1		Fragment	*Mammuthus* sp.	Mammoth	144	4	0	0	0	0	0	
H.039	Skull	1		Fragment	*Mammuthus* sp.	Mammoth	46	5	0	0	0	0	0	
H.040	Indeterminate	1		Fragment	cf. *Mammuthus* sp.	cf. mammoth	88	4	0	0	0	0	0	
H.041	Indeterminate	1		Fragment	cf. *Mammuthus* sp.	cf. mammoth	41	3	0	0	0	0	0	Pitting on bone surface
H.042	Tusk	1		Fragment	*Mammuthus* sp.	Mammoth	83	3	0	0	0	0	0	
H.043	Tusk	1		Fragment	*Mammuthus* sp.	Mammoth	84	4	0	0	0	0	0	
H.044	Tusk	1		Fragment	*Mammuthus* sp.	Mammoth	72	4	0	0	0	0	0	One area on the distal end is smoothed - water
H.045	Skull	1		Fragment	Mammalia	Very large mammal	57	3	0	0	0	0	0	
H.046	Indeterminate	1		Fragment	cf. *Mammuthus* sp.	cf. mammoth	70	3	0	0	0	0	0	Some Fe staining on bone surface and one breaks
H.047	Tusk	1		Distal tip	*Mammuthus* sp.	Mammoth	119	4	0	0	0	0	0	
H.048	Indeterminate	1		Fragment	cf. *Mammuthus* sp.	cf. mammoth	114	4	0	0	0	0	0	
H.049	Indeterminate	1		Fragment	Mammalia	Large/very large mammal	15	4	0	0	0	0	0	
H.050	Indeterminate	1		Fragment	cf. *Mammuthus* sp.	cf. mammoth	87	4	0	0	0	0	0	
H.051	Skull	1		Fragment	*Mammuthus* sp.	Mammoth	29	3	0	0	0	0	0	
H.052	Indeterminate	1		Fragment	cf. *Mammuthus* sp.	cf. mammoth	101	4	0	0	0	0	0	
H.053	Indeterminate	1		Fragment	Mammalia	Very large mammal	12	3	0	0	0	0	0	
H.054	Skull	1		Fragment	*Mammuthus* sp.	Mammoth	83	5	0	0	0	0	0	
H.055	Indeterminate	1		Fragment	Mammalia	Very large mammal	40	4	0	0	0	0	0	
H.056	Indeterminate	1		Fragment	Mammalia	Very large mammal	56	4	0	0	0	0	0	
H.057	?Rib	1		Fragment	cf. *Mammuthus* sp.	cf. mammoth	42	4	0	0	0	0	0	
H.058	Indeterminate	1		Fragment	Mammalia	Very large mammal	31	4	0	0	0	0	0	

H ref	Element	Count	Side	Fragmentation (Dobney and Reilly 1988)	ID	Common name	Weight (g)	Condition	Burning	Butchery	Carnivore interaction	Measurable	Ageable	Comments
H.059	Indeterminate	1		Fragment	Mammalia	Very large mammal	33	4	0	0	0	0	0	
H.060	Indeterminate	1		Fragment	Mammalia	Very large mammal	33	3	0	0	0	0	0	
H.061	Indeterminate	1		Fragment	Mammalia	Very large mammal	32	4	0	0	0	0	0	
H.062	Molar	1		Fragment	*?Mammuthus trogontherii*	cf. Steppe mammoth	141	4	0	0	0	0	0	
H.063	Skull	1		Fragment	Mammalia	Very large mammal	20	4	0	0	0	0	0	
H.065	Indeterminate	1		Fragment	Mammalia	Very large mammal	14	4	0	0	0	0	0	
H.066	Indeterminate	1		Fragment	Mammalia	Very large mammal	26	3	0	0	0	0	0	
H.067	Mandible	1	#	. 0 0 0 0 0 0	Mammalia	Large mammal	23	2	0	0	0	0	0	
H.068	Skull	1		Fragment	Mammalia	Very large mammal	22	3	0	0	0	0	0	
H.069	Skull	1		Fragment	Mammalia	Very large mammal	10	2	0	0	0	0	0	
H.070	Tusk	1		Fragment	*Mammuthus* sp.	Mammoth	8	2	0	0	0	0	0	
H.071	Indeterminate	1		Fragment	Mammalia	Very large mammal	20	4	0	0	0	0	0	
H.072	Indeterminate	1		Fragment	Mammalia	Very large mammal	14	4	0	0	0	0	0	
H.073	Indeterminate	1		Fragment	Mammalia	Large/very large mammal	5	4	0	0	0	0	0	
H.074	Indeterminate	1		Fragment	Mammalia	Large/very large mammal	10	4	0	0	0	0	0	
H.075	Indeterminate	1		Fragment	Mammalia	Large/very large mammal	4	4	0	0	0	0	0	
H.076	Skull	1		Fragment	Mammalia	Large/very large mammal	4	4	0	0	0	0	0	
H.077	Indeterminate	1		Fragment	Mammalia	Very large mammal	11	4	0	0	0	0	0	
H.078	Indeterminate	1		Fragment	Mammalia	Very large mammal	7	4	0	0	0	0	0	
H.079	Indeterminate	1		Fragment	Mammalia	Very large mammal	12	4	0	0	0	0	0	
H.080	Indeterminate	1		Fragment	Mammalia	Very large mammal	9	4	0	0	0	0	0	
H.081	Indeterminate	1		Fragment	Mammalia	Very large mammal	7	4	0	0	0	0	0	
H.082	Indeterminate	1		Fragment	Mammalia	Large/very large mammal	4	4	0	0	0	0	0	
H.083	Indeterminate	1		Fragment	Mammalia	Large/very large mammal	4	2	0	0	0	0	0	
H.084	Indeterminate	1		Fragment	Mammalia	Very large mammal	14	4	0	0	0	0	0	
H.085	Molar	1		Fragment	*?Mammuthus trogontherii*	cf. Steppe mammoth	526	2	0	0	0	0	0	
H.086	Tusk	1		Section	*Mammuthus* sp.	Mammoth	186	3	0	0	0	0	0	
H.087	Lumbar vertebra	1		123	*Bison priscus*	Steppe bison	267	2	0	0	0	0	Cranially and caudally fused	
H.088	Lumbar vertebra	1		14	*Bison priscus*	Steppe bison	669	2	0	0	0	0	Cranially and caudally fused	
H.089	Skull	1		Occipital condyles	*Mammuthus* sp.	Mammoth	827	4	0	0	0	0	0	

H ref	Element	Count	Side	Fragmentation (Dobney and Reilly 1988)	ID	Common name	Weight (g)	Condition	Burning	Butchery	Carnivore interaction	Measurable	Ageable	Comments
H.090	Mandible	1		Fragment	*Mammuthus* sp.	Mammoth	788	4	0	0	0	0	0	
H.091	Mandible	1	L	. 0 . 0 0 . 0	*Ursus arctos*	Brown bear	148	3	0	0	0	0	0	Original ID: Cave bear
H.092	Skull	1		Fragment	*Mammuthus* sp.	Mammoth	459	3	0	0	0	0	0	
H.093	Scapula	1	R	. 1 1 . . 0 0 0 0	*Mammuthus* sp.	Mammoth	1140	3	0	0	0	0	0	
H.094	Skull	1		Fragment	*Mammuthus* sp.	Mammoth	1247	3	0	0	0	0	0	
H.095	Scapula	1	R	0 0 0 1 1 0 0 0 0	*Mammuthus* sp.	Mammoth	932	3	0	0	0	0	0	
H.096	Radius	1	L	0 . 0 0 . 0 1 . 9 or 10	*Mammuthus* sp.	Mammoth	690	2	0	0	0	0	Fused proximal unfused distal	Non-adult individual
H.097	Longbone shaft	1		Fragment	*Mammuthus* sp.	Mammoth	753	4	0	0	0	0	0	
H.098	Rib	1		Fragment	*Mammuthus* sp.	Mammoth	640	4	0	0	0	0	0	
H.099	?Tibia	1		Diapysis section	*Mammuthus* sp.	Mammoth	458	5	0	0	0	0	0	
H.100	Rib	1		Fragment	*Mammuthus* sp.	Mammoth	286	5	0	0	0	0	0	
H.101	Tibia	1	L	0 0 0 0 . . . 1 1 1	*Mammuthus* sp.	Mammoth	1735	3	0	0	0	0	Fused distal	
H.102	Mandible	1		. . 0 0 0 0 0	*Mammuthus* sp.	Mammoth	2302	3	0	0	0	0		
H.103	Tibia	1	L	0 0 0 0 0 0 1 1 1 1	*Mammuthus trogontherii*	Steppe mammoth	1888	3	0	0	0	0	Unfused proximal and disal epiphyses	Non-adult individual
H.104	Femur	1	L	0 1 1 0 . 1 1 1 0 0 0	*Mammuthus* sp.	Mammoth	3720	4	0	0	0	0	unfused distal	
H.105	Mandibular M3	1	R	95	*Mammuthus trogontherii*	Steppe mammoth	2640	3	0	0	0	y?	y?	
H.106	Maxillary M3	1	R	Complete	*Mammuthus trogontherii*	Steppe mammoth	1312	3	0	0	0	y	y	
H.107	Pelvis	1	L	Almost complete	*Mammuthus trogontherii*	Steppe mammoth	1000	4	0	0	0	0	0	
H.109	Maxillary M3	1	R	Complete	*Mammuthus trogontherii*	Steppe mammoth	2317	3	0	0	0	y	y	
H.110	Mandibular M3	1	R	Complete	*Mammuthus trogontherii*	Steppe mammoth	1870	3	0	0	0	0	y	
H.111	cf. M2 in maxilla	1	L	Complete	*Mammuthus trogontherii*	Steppe mammoth	2812	3	0	0	0	y	y	
H.112	Femur	1	R	0 0 0 0 0 0 . . 0 0 0	*Bovine*	Steppe bison/aurochs/cattle	225	3	0	0	0	0	0	Fresh break
H.113	Longbone shaft	1	#	Fragment	Mammalia cf. *Mammuthus*	Very large mammal cf. mammoth	348	3	0	0	0	0	0	
H.114	Pelvis	1	#	Acetabulum fragment	*Mammuthus sp.*	Mammoth	385	3/4	0	0	0	0	0	
H.115	Skull	1	#	Fragment	*Very large mammal*	Very large mammal	116	3	0	0	0	0	0	

H ref	Element	Count	Side	Fragmentation (Dobney and Reilly 1988)	ID	Common name	Weight (g)	Condition	Burning	Butchery	Carnivore interaction	Measurable	Ageable	Comments
H.116	Vertebra	1	#	. 0 0 0	*Mammuthus sp.*	Mammoth	165	3	0	0	0	0	Cranially and caudally unfused	Cranially and caudally unfused
H.117	Unidentified	1	#	Fragment	*Very large mammal*	Very large mammal	148	4	0	0	0	0	0	Scratches on the surface of this bone look recentl?
H.118	Longbone shaft	1	#	Fragment	*Mammalia*	very large mammal	493	4	0	0	0	0	0	
H.119	Maxilla	1	R	Fragment	*Mammuthus sp.*	Mammoth	207	3	0	0	0	0	0	
H.120	Thoracic vertebra	1	#	1 0 0 0	*Bovine*	Steppe bison/aurochs/cattle	102	4	0	0	0	0	Cranially and caudally fused	
H.121	Thoracic vertebra	1	#	1 . . .	*Bovine*	Steppe bison/aurochs/cattle	294	3	0	0	0	0	Cranially and caudally fused	
H.122	Thoracic vertebra	1	#	. 0 0 0	*Bovine*	Steppe bison/aurochs/cattle	57	2	0	0	0	0	Caudally unfused	
H.123	Pelvis	1	#	Fragment	*Mammuthus*	Mammoth	170	3	0	0	0	0	0	
H.124	Pelvis	1	#	Fragment	*Mammuthus sp.*	Mammoth	392	4	0	0	0	0	0	Refits with H. 127
H.125	Atlas	1	L	20%	*Mammuthus sp.*	Mammoth	222	4	0	0	0	0	0	
H.126	Rib	1	#	Fragment	*Large/very large mammal*	*Large/very large mammal*	45	2	0	0	0	0	0	
H.127	Pelvis	1	#	Fragment	Mammuthus sp.	Mammoth	318	3	0	0	0	0	0	Refits with H. 124
H.128	Skull	1	#	Fragment	*Mammalia*	Very large mammal	74	3	0	0	0	0	0	
H.129	Thoracic vertebra	1	#	1 . 0 1	*Bovine*	Steppe bison/aurochs/cattle	146	2	0	0	0	0	Cranially and caudally fused	
H.130	skull	1	#	Fragment	*Very large mammal*	very large mammal	130	5	0	0	0	0	0	
H.131	Skull	1	#	Fragment	*Mammalia*	very large mammal	31	4	0	0	0	0	0	
H.132	Rib	1	#	Fragment	*Large/very large mammal*	*Large/very large mammal*	36	4	0	0	0	0	0	Weight include some adhering sediment
H.133	Unidentified	1	#	Fragment	*Large/very large mammal*	*Large/very large mammal*	31	4	0	0	0	0	0	
H.134	Mandible/maxilla	1	#	Fragment	*Mammalia*	Very large mammal	30	4	0	0	0	0	0	
H.135	Longbone shaft	1	#	Fragment	*Very large mammal*	Very large mammal	160	4	0	0	0	0	0	Fresh break
H.136	Longbone shaft	1	#	Fragment	*Mammalia*	Very large mammal	148	3	0	0	0	0	0	
H.137	Maxilla	1	#	Fragment	*Mammuthus sp.*	Mammoth	300	3	0	0	0	0	0	
H.138	Longbone shaft	1	#	Fragment	*Large/very large mammal*	*Large/very large mammal*	41	3	0	0	0	0	0	
H.139	Rib	1	#	Fragment	*Very large mammal*	*Large/very large mammal*	62	3	0	0	0	0	0	
H.140	Longbone shaft	1	#	Fragment	*Mammalia*	Very large mammal	19	3	0	0	0	0	0	

H ref	Element	Count	Side	Fragmentation (Dobney and Reilly 1988)	ID	Common name	Weight (g)	Condition	Burning	Butchery	Carnivore interaction	Measurable	Ageable	Comments
H.141	Rib	1	#	Fragment	*Large mammal*	Large mammal	16	3	0	0	0	0	0	
H.142	Unidentified	1	#	Fragment	*Very large mammal*	Very large mammal	33	3	0	0	0	0	0	
H.143	Mandible	1	#	. 0 0 0 0 0 0	*Bovine*	Steppe bison/aurochs/cattle	33	3	0	0	0	0	0	
H.144	Tusk	1	#	Fragment	*Mammuthus sp.*	Mammoth	200	3	0	0	0	0	0	
H.145	Tusk	1	#	Fragment	*Mammuthus sp.*	Mammoth	155	3	0	0	0	0	0	
H.146	Humerus	1	L	0 0 0 0 0 0 0 1 1 1 1 0	*Mammuthus sp.*	Mammoth	267	3	0	0	0	0	Distal unfused	Neonate?

Table 12 Archive data for faunal remains collected by the Hollingworths

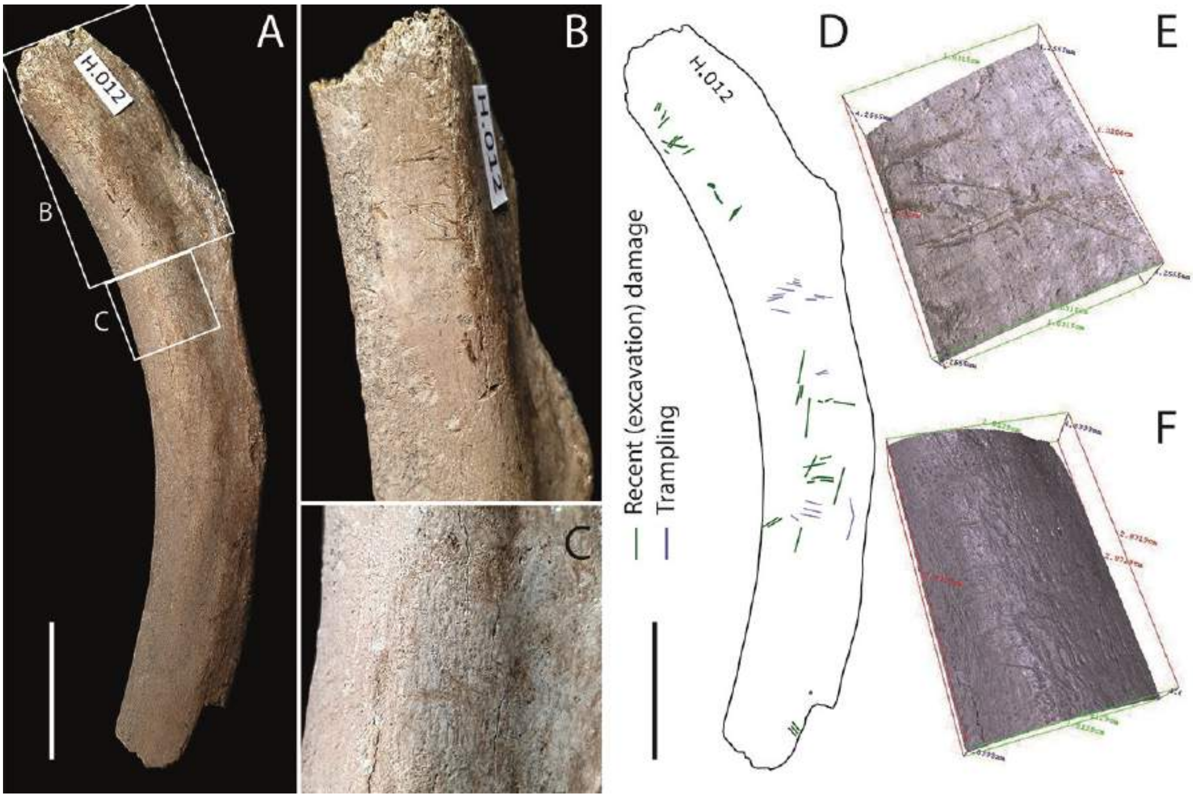


Figure 20. Bone fragment H.012

Photo (A) and drawing (D) of bone fragment H.012. Photo (B) and Alicona 3D image (E) detailing recent damage. Photo (C) and Alicona 3D image (F) detailing trampling marks.