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CENTRAL WINCHESTER REGENERATION PROJECT: GEOARCHAEOLOGICAL AND HYDROGEOLOGICAL DESK-BASED ASSESSMENT

Prepared for Winchester City Council

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1. INTRODUCTION

1.1 This document is an interim geoarchaeological report on stratigraphy revealed in 13 boreholes drilled on the Central Winchester Regeneration (CWR) site (Figure 1). As such the document is the second report to be produced as part of the geoarchaeological investigation of the CWR site. The report thus follows from a desk-based assessment (DBA) of existing stratigraphic records from the CWR site and its immediate surrounding (Wilkinson 2020). The overarching strategy for geoarchaeological works on the CWR site, of which this document reports on the first phase of original data acquisition, were set out by Winchester City Council (2020) in their brief for the project.

1.2 The purpose of this interim stratigraphic report was articulated in ARCA's tender and interim written scheme of investigation (WSI) for the CWR geoarchaeological borehole survey and hydrogeological assessment. As such the primary aim is to provide a commentary on the stratigraphy revealed in boreholes drilled as part of the project and compare that with existing records from the site (Wilkinson et al. 2020, section 4.2.10, 26). In addition, a secondary aim is to propose a selection of sub-samples taken from the borehole cores that will subject to biostratigraphic assessment[1].

1.3 The intended audience for the report is officers of Winchester City Council, the Historic England Science Advisor for South-east England and specialists conducting biostratigraphic assessments of sub-samples recovered from the borehole cores (Wilkinson et al. 2020, section 4.2.10, 26).

1.4 The background of the CWR project and the state of knowledge with regards the stratigraphy of the CWR site prior to the drilling of the present boreholes is not discussed in this report. Rather, readers are referred to the geoarchaeological DBA for such information (Wilkinson 2020).

2. METHODOLOGY

2.1 The methodology adopted, for both investigations in the field (test pits and boreholes) and in describing core retrieved from the boreholes, largely followed that outlined in ARCA's tender and interim WSI for the CWR site. That methodology is described in outline below, while readers are referred to the tender and interim WSI for greater detail (Wilkinson et al. 2020, section 4.2-4.3.1, 20-24).

2.2 Borehole positions were agreed with Winchester City Council's Archaeologist and Project Manager for the CWR project and were then formally proposed in the DBA (Wilkinson 2020, section 6, 26-27). The locations were then subject to CAT scan and a position free of buried services selected for test pitting/borehole drilling. The latter position was then surveyed using a Leica CG16 (antenna) / CS20 (controller) RTK GPS (Figure 1 shows the locations).

2.3 In all locations other than ARCA BH05, ARCA BH05a, ARCA BH07, ARCA BH08 and ARCA BH14, test pits were excavated by Pre-Construct Archaeology to a depth of 1.2m below ground level (bgl) and using the methods articulated by Wilkinson et al (2020, section 4.2.3, 20). A test pit could not be dug at BH05 as the location rests on

[1] This secondary aim was added to the original remit for the interim report during a meeting between Tracy Matthews (Winchester City Council's Archaeologist), Rachel Robinson (Winchester City Council's Project Manager for the CWR project) and Keith Wilkinson (Director of ARCA) on 1 October 2020.

a c. 0.5m thickness of reinforced concrete, while in the case of ARCA BH07 and ARCA BH08, shallower test pits were excavated to the top of (non-reinforced) concrete layers which could not be penetrated using hand tools. In the case of ARCA BH5a and ARCA BH14, it was agreed that these sample locations would not be test pitted given the absence of archaeological strata in adjacent locations[2].

Figure 1. Location of ARCA and other boreholes, and borehole transects discussed in this report within the CWR site

[2] As confirmed in email conversations with Tracy Matthews on 2 and 9 September 2020

2.4 A Pioneer 2 dynamic probe drilling rig operated by Geotechnical Engineering was used to advance boreholes through the backfilled test pits, recover continuous cores to the top of the Chalk bedrock and install piezometer tubing for later groundwater monitoring as described by Wilkinson et al. (2020, sections 4.2.4-4.2.7, 22-23). Several attempts were made to use a concrete cutting shoe and a rotary drilling technique to advance ARCA BH5 through the reinforced concrete at that location. However, none were successful, the borehole was abandoned and replaced with ARCA BH5a[3],[4]. Rotary drilling was employed at ARCA BH5a to penetrate through the present concrete surface of the bus station car park and then 'pincers' were used to excavate a 0.2m diameter inspection pit to 1.2m bgl. The borehole was then advanced through the base of the inspection pit. ARCA BH14 was moved from its intended location in the north-eastern part of the former Friarsgate medical centre compound to a location in an informal car park c. 20m to the east. The reason for such removal was the presence of numerous services (not marked on any mapping) in the relevant part of the former Friarsgate medical centre. However, despite detailed and extensive CAT scanning in the car park location, a position free of services (including a water main) could not be found. The decision was therefore made not to drill ARCA BH14[3].

2.5 Cores retrieved from the boreholes were transported to the University of Winchester where they were described and sub-sampled by the authors exactly as set out by Wilkinson et al. (2020, sections 4.3.1, 4.3.3, 4.3.5, 4.3.7-4.3.8, 24-25). The lithological data so retrieved were then transferred to a database within the RockWorks 17 geological utilities package and that software used to generate the figures shown in Section 3 below (Wilkinson et al. 2020, section 4.3.9, 25-26).

3. RESULTS

3.0.1 Deposits sampled in the borehole cores are described in reverse stratigraphic order and using the stratigraphic framework set out in ARCA's tender and iWSI and repeated in the DBA (Wilkinson 2020, section 2.1.2, 8; Wilkinson et al. 2020 section 4.1.1, 18).

3.0.2 The descriptions are on the basis of two composite cross sections (Figure 3 and Figure 2), plotting ARCA's CWR boreholes. In the cross sections the stratigraphic correlations (i.e. attribution to Straigraphic Unit [SU], e.g. 'LF-4b Peat) have been made simply by projecting lines between the relevant subcrop contacts in each borehole.

3.1 SU-1 Lewes Nodular Chalk Formation

3.1.1 Chalk of the Lewes Nodular Chalk Formation was found in all ARCA's CWR boreholes at depths of between 7.63m bgl (+29.22m OD) in ARCA CWR BH06 and 10.80m bgl (+25.98m OD) in ARCA CWR BH13. Except for an area of relatively high subcrop (+28.17 to +27.49m OD) in the central part of the site in the area of ARCA CWR BH03, ARCA CWR BH04 and ARCA CWR BH06, there are no obvious trends in the surface elevation of the Lewes Nodular Chalk Formation (Figure 2 and Figure 3).

3.1.2 Deposits of the Lewes Nodular Chalk Formation exposed in the borehole cores comprised weathered detritus, while solid Chalk bedrock was not encountered in any of the boreholes.

[3] See footnote 2 on previous page.
[4] These attempts to drill ARCA BH5a lasted half a day and resulted in the destruction of three concrete cutting shoes. The drilling crew reported (verbally) that they had never witnessed such a failure before – such cutting shoes are used to drill through rocks as hard as granites where required.

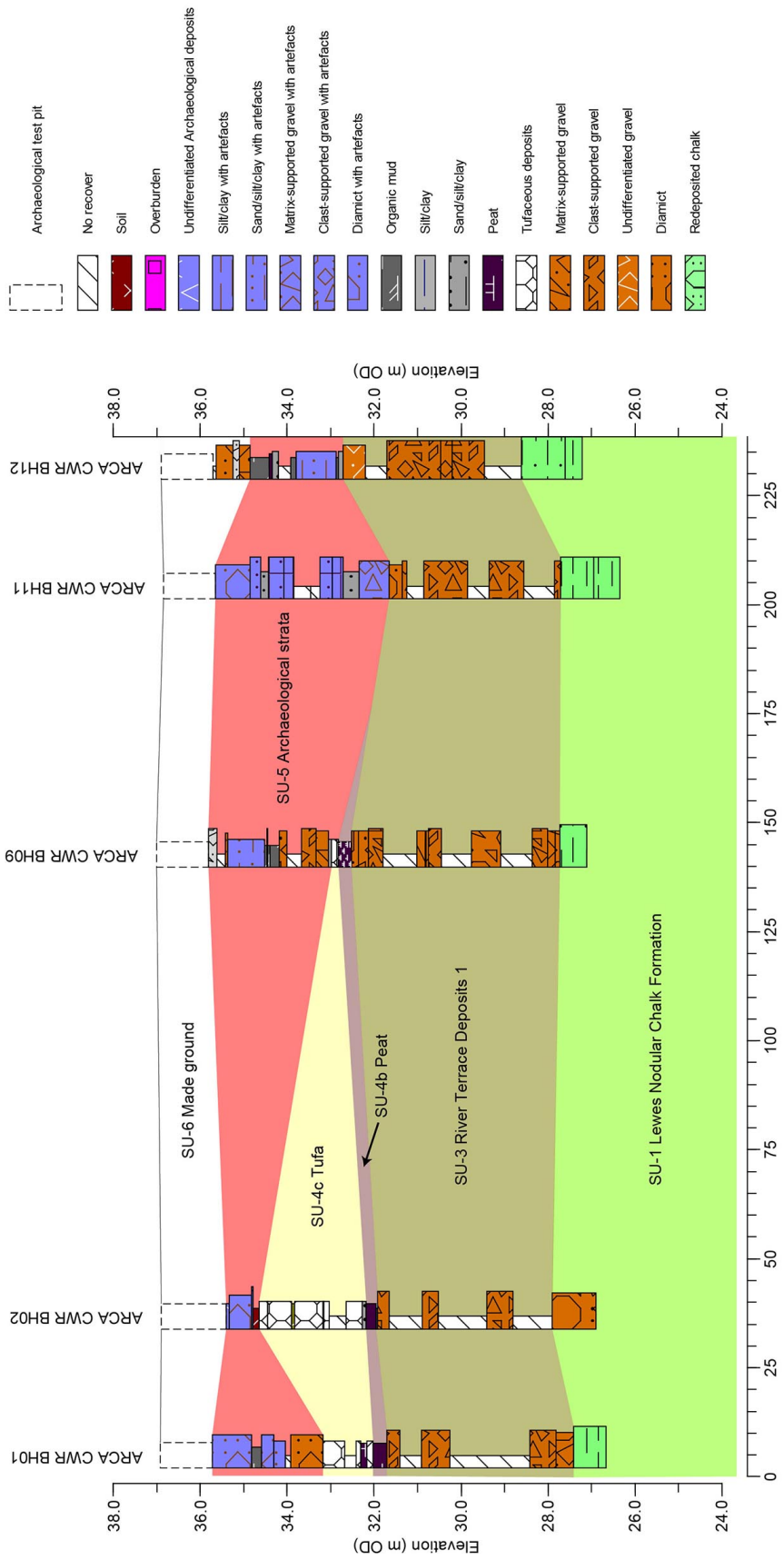

Figure 2. West-north-west to east-south-east composite cross section through ARCA's CWR boreholes in the northern part of the site

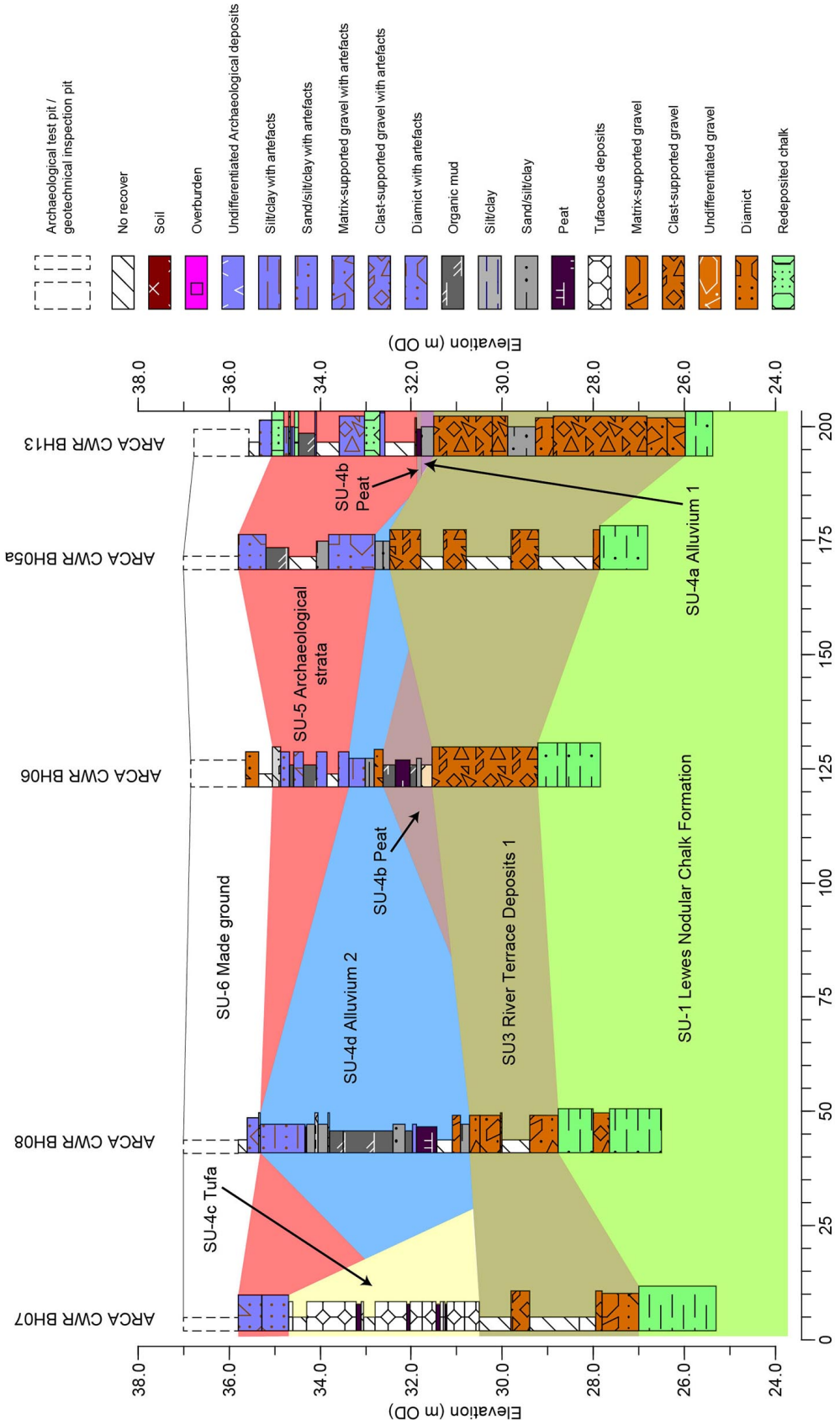

Figure 3. West-north-west to east-south-east composite cross section through ARCA's CWR boreholes in the southern part of the site

3.2 SU-3 River Terrace Deposits 1

3.2.1 Sand and gravel strata of River Terrace Deposits 1 was found unconformably overlying deposits of the Lewes Nodular Chalk Formation in all boreholes at depths of between 4.20m bgl (+32.71m OD) in ARCA CWR BH12 and 6.85m bgl (+30.15m OD) in ARCA CWR BH07. Thickness of the sands and gravels varied between 5.54m in ARCA CWR BH13 and 1.95m in ARCA CWR BH08. There are broad trends in the subcrop distribution, namely for thinning of the stratum in a westerly direction (Figure 3), and a higher surface in the central and western part of the site (but see Section 4.2 below) (Figure 2). Indeed, the thinnest subcrop of River Terrace Deposits 1 broadly coincides with the elevated Chalk subcrop described above in the ARCA CWR BH3 (2.72m), ARCA CWR BH04 (2.71m), ARCA CWR BH06 (2.33m) and ARCA CWR BH08 (1.95m) area.

3.2.2 River Terrace Deposits 1 strata encountered in the ARCA CWR boreholes comprised matrix- and clast-supported gravels of flint within a coarse to medium, flint-derived sand matrix. Much of the latter had been flushed out of the cores by water used for lubrication during the drilling operations, while only a single fine-grained bed was found, in ARCA CWR BH08 at 6.08–6.28m bgl (+30.92–+30.72m OD).

3.3 SU-4 Alluvium

3.3.1 As was described in the tender and iWSI (Wilkinson et al. 2020, section 4.1.1, 18), and the DBA (Wilkinson 2020, section 3.5, 14–18), SU-4 subcrops across the CWR site as four sub-units. Where there is a contact between SU-4 and SU-3 River Terrace Deposits 1, that boundary is always unconformable. SU-4a Sand, silt, clay and matrix-supported gravel (Alluvium 1) by definition only occurs where either or both SU-4c Peat and SU-4b Tufaceous deposits also subcrop. Further, SU-4d Sand, silt and clay (Alluvium 2) often incorporates archaeological artefacts and where this latter property is noted it implies co-deposition of SU-4d with SU-5 Archaeological strata.

3.3.2 The upper surface of the SU-4 subcrop varies between 1.69m bgl (+35.31m OD) in ARCA CWR BH08 and 4.50m bgl (+32.56m OD) in ARCA CWR BH10, while the overall thickness of the alluvium is between 4.59m in ARCA CWR BH08 and 0m in ARCA CWR BH11 and ARCA CWR BH12. In general, SU-4 Alluvium thickens towards the west of the CWR site and is either very thin or absent in the east (Figure 2 and Figure 3).

3.3.3 Within the overall subcrop distribution set out in 3.3.1–3.3.2 above are further trends. SU-4b Peat is found in the north-western part of the site, while it thins towards ARCA CWR BH09 in the central area and disappears east of the latter (Figure 2 and Figure 3). Further, SU-4c Tufaceous deposits are found in subcrops of 4.55m (ARCA CWR BH07), 1.79m (ARCA CWR BH03) and 0.66m (ARCA CWR BH04) in thickness in the western and north-central part of the site and the stratum then thins south and eastwards towards ARCA CWR BH09 where it subcrops as a 0.11m thick layer (Figure 2 and Figure 3). Tufa is not then found east of ARCA CWR BH09. It is of particular note that peat interdigitates with tufa in ARCA CWR BH07, the first time this phenomenon has been observed in Winchester (Figure 3).

3.3.4 SU-4d Alluvium 2 is found in variable thicknesses across the whole CWR site. However, as is implied in Section 3.3.1 it has not always been possible to separate that sub-stratum from the overlying SU-5 Archaeological deposits and in practice over parts of the study area, alluvial and archaeological deposition is likely to have occurred simultaneously. The thickest subcrop of SU-4d Alluvium 2 is in ARCA CWR BH08 in which 4.59m of such deposits were encountered, while in the north of the site 1.24 and

2.60m of similar fine-grained alluvium were sampled in ARCA CWR BH01 and ARCA CWR BH02 respectively. However, <1m of alluvial strata attributable to SU-4d subcrop elsewhere and it is notable that none of the boreholes drilled in the bus station contain the stratum.

3.4 SU-5 Archaeological deposits

3.4.1 Poorly sorted (diamicts) archaeological deposits (SU-5) unconformably overlie SU-3 River Terrace Deposits 1 in ARCA CWR BH11 and ARCA CWR BH12, while the archaeological deposits have a conformable contact with SU-4 Alluvium in all other boreholes. The archaeological deposits vary in their thickness between 4.00m in ARCA CWR BH11 to 0.00m in ARCA CWR BH08 (although see Section 3.3.4 on the latter). Indeed the thickest subcrop is in the area of the bus station (ARCA CWR 5a, 11–13) and the former Friarsgate medical centre (ARCA CWR BH10) (2.50–4.00 m), while the thinnest deposits are found in the southern part of the Middle Brook Street car park (ARCA CWR BH2–3) and the central part of the CWR site (ARCA CWR BH6–7, 9) (0.61–1.68m) (Figure 2).

3.4.2 Deposits of SU-5 are heterogeneous and vary from sediments dominated by clays and silts, but containing moderate gravel sized clasts and artefacts, to well-sorted organic-rich silts and structural materials. Examples of the latter are present in the form of two wooden, waterlogged stakes and multiple horizontal layers of mortar from 2.42–4.13m bgl (+34.43–+32.72m OD) in ARCA CWR BH11 and a wooden pile at 4.09–4.20m bgl (+32.69–+32.58m BGL) in ARCA CWR BH13.

3.4.3 Ceramics recovered from the SU-5 and SU-4d strata in the borehole cores have been scanned (but firm identifications not yet made) and post-medieval, medieval and Roman types all recognised (by David Ashby). These artefacts and others that will be recovered from the plant macrofossil and mollusc sub-samples recommended for assessment (see Section 5.1 below) will be passed to PCA specialists for more detailed study.

3.5 SU-6 Made ground

3.5.1 Made ground strata of SU-6 were encountered in the archaeological test pits through which the boreholes were advanced and the uppermost cores, and extends up to 2.05m bgl (+34.86m OD) in ARCA CWR BH12. Such strata are so defined based on inclusion of materials that were only manufactured and/or used in the 19th to 21st centuries. However, when such materials and indeed older artefacts, are absent, it is difficult to separate SU-6 Made ground from SU-5 Archaeological deposits. In other words, the inferred thickness of Made ground deposits is best considered a minimum estimate.

4. DISCUSSION

4.1 Figure 4 and Figure 5 plot both ARCA CWR boreholes and others from within the CWR site that reside within ARCA's lithostratigraphic database. In these cross sections, stratigraphic correlation has been carried out within RockWorks and achieved by vertically slicing the deposit model (the latter constructed using the algorithm and settings set out in the DBA [Wilkinson 2020, section 2.1.4, 8–9] along a straight line between the first and last boreholes). One change has, however, been made to the two models, i.e. curtailing the modelled extent of SU-4b Tufaceous deposits east of ARCA BH09 and replacing the modelled extension with SU-4d Alluvium.

4.2 The west-north-west to east-south-east transect shows that stratigraphic units are horizontally bedded (Figure 4). SU-1 Lewes Nodular Chalk Formation has an irregular surface subcrop, and as discussed in Section 3.2.2 above, SU-3 River Terrace Deposits 1, thickens to the east, while the elevation of its upper contact drops to the west. The latter feature is likely to be the result of new channel development in the western part of the CWR site and forms the basin in which SU-4a Sand, silt, clay and matrix-supported gravels, and SU-4b peat were later deposited. These initial sub-strata of SU-4 Alluvium are likely to be of Middle or Early Holocene date given ^{14}C dates on SU-4b elsewhere in central Winchester (see review in Wilkinson [2020, section 3.5.3, 15) and likely formed in first a channel and later a backswamp/abandoned channel environment. SU-4c Tufaceous deposits occur only in the west and the central part of the CWR site, but in the former they form a sub-crop of up to 4.55m in thickness in ARCA CWR BH07. Such deposits must have accreted within a shallow channel in which clean, carbonate-rich waters flowed, while the climate must also have been warm in order for precipitation to occur. Thin peat layers found within the tuffaceous deposits in ARCA CWR BH07 either represent reworking of stratigraphically earlier SU-4b Peat or episodes when the area was emergent from the channel and during which a floodplain margin marsh developed. If the latter, the peat layers provide an opportunity to date the central Winchester tufa for the first time (by ^{14}C). SU-4c is overlain by SU-4d Alluvium 2, which as noted in Section 3.3.4 above is relatively thick in the west of the CWR site, but which then thins to the east. In Figure 4, however, this pattern partly masks a particularly thick (4.55m) subcrop of SU-4d in ARCA CWR BH08. This latter borehole is within 25m of ARCA CWR BH07, yet no tufa (SU-4c) is present (cf. the 4.19m thickness in the ARCA CWR BH07), and it is thus likely that alluvium found in ARCA CWR BH08 is the fill of an artificial channel cut through SU-4a and SU-4b. it is unclear when such a channel developed or was cut, but it is notable that artefacts are found throughout SU-4d in ARCA CWR BH08). Archaeological deposits of SU-5 are present as a tabular layer, which as described in Section 3.4.1 above, thickens to the east, particularly within the present bus station.

4.3 The north to south transect displays broadly similar patterns to those set out in the previous paragraph (Figure 5). The composite cross section suggests that the surface subcrop of the Lewes Nodular Chalk Formation (SU-1) drops from north to south, while that of the River Terrace Deposits 1 (SU-3) is sub-horizontal. Sub-crops of the basal sub-units of SU-4 Alluvium (i.e. SU-4a–SU-4c) thin and disappear from north to south to be replaced by SU-4d, while archaeological deposits (SU-5) remain at a relatively constant thickness throughout the transect.

4.4 The subcrop patterns described in Sections 4.2 and 4.3 suggest several hypotheses that can be tested during further phases of geoarchaeological work:

1. The development and infilling of a broadly north-south orientated channel in the western and central area of the CWR site during the Early (i.e. 9700–6236 cal. BC) and/or Middle Holocene (6236–2250 cal. BC)[5];
2. A change in flow regime leading to the development of a shallow channel filled by clean, carbonate-charged water in the western part of the CWR during the Middle Holocene (6236–2250 cal. BC);
3. The development of a new 4m deep channel passing through the area in which ARCA CWR BH08 was drilled and its infilling by alluvial deposits during the historic period (AD 43 onwards);
4. Accretion of archaeological deposits from the Roman period (AD43–410) onwards across the entirety of the CWR site. The thickest of these deposits, those with the

[5] These sub-divisions referring to the Greenlandian (Early Holocene) and Northgrippian (Middle Holocene) (Subcommission on Quaternary Stratigraphy 2018)

greatest quantity of structural material and therefore the highest potential lie beneath the present bus station and its surrounds.

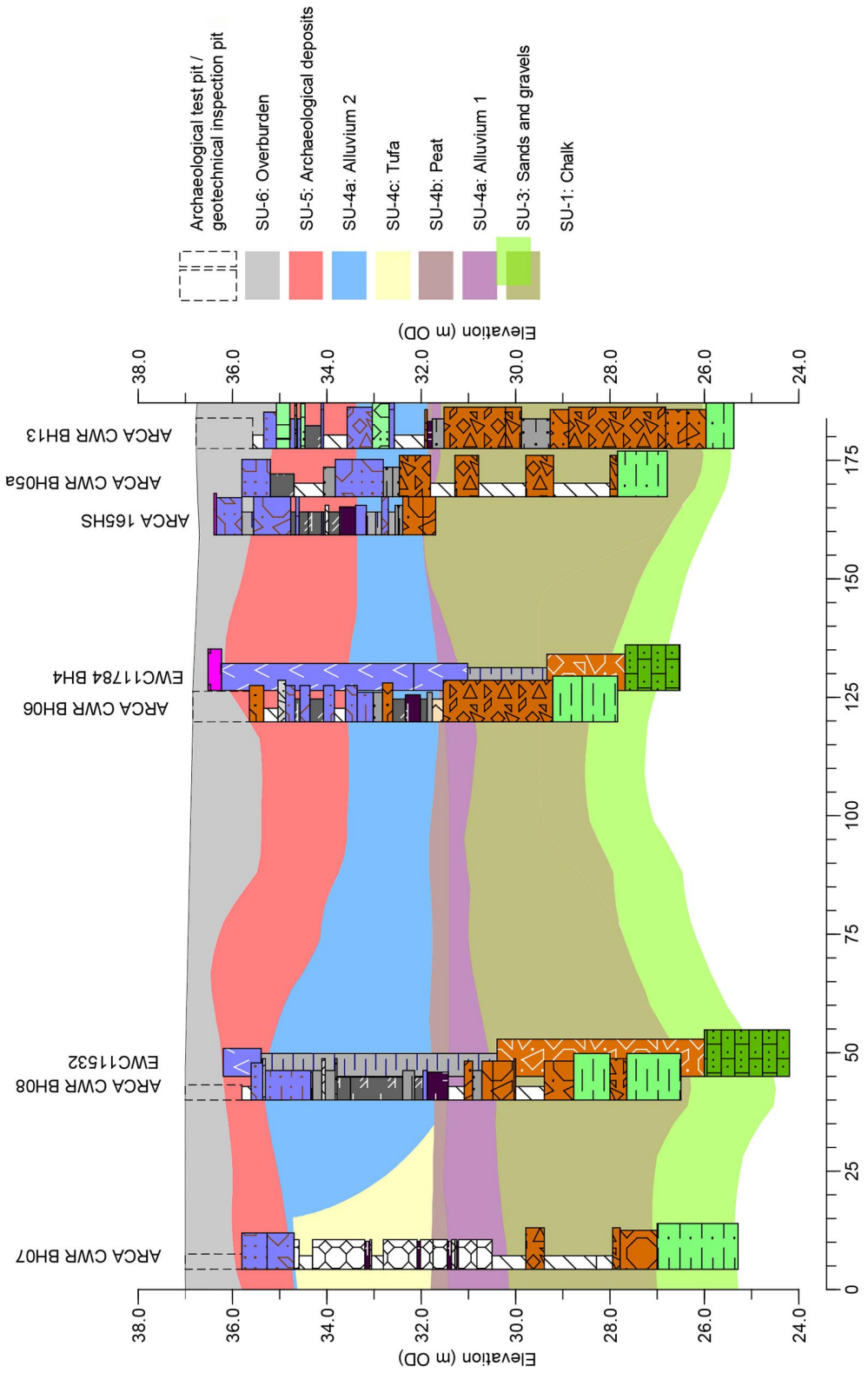

Figure 4. West-north-west to east-south-east composite cross section through the CWR site on the basis of ARCA CWR boreholes and other records in the ARCA stratigraphic database

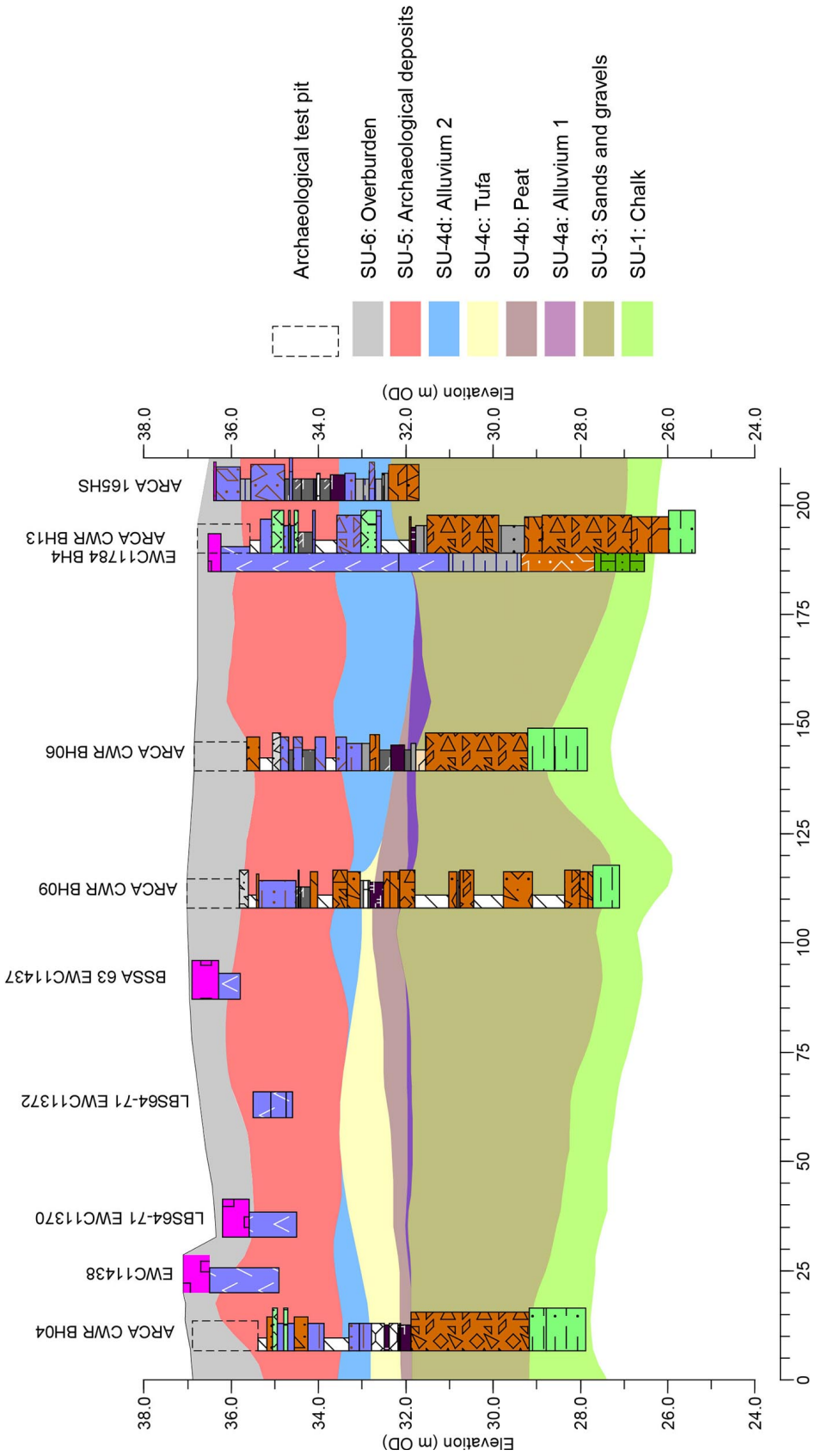

Figure 5. North to south composite cross section through the CWR site on the basis of ARCA CWR boreholes and other records in the ARCA stratigraphic database

5. BIOSTRATIGRAPHY AND SEDIMENTOLOGY STUDIES

5.1 Table 1 sets out the sub-samples proposed for biostratigraphic assessment. Given the purpose of the assessment, i.e. to focus on testing the preservation of organic remains in archaeological relevant deposits across the entirety of the CWR site, samples have been selected using the following criteria (in descending order of importance):

1. Archaeological (SU-5) or alluvial strata containing archaeological artefacts (SU-4d) in which waterlogged sub-fossil preservation of biological materials was noted during core description;
2. Representation from as many boreholes as possible;
3. Strata of particular biostratigraphic interest (SU-4c and SU-4b);
4. Alluvial strata (SU-4a and SU-4d) in which waterlogged sub-fossil preservation of biological materials was noted during core description;
5. Other alluvial strata

Table 1. Proposed sub-samples for assessment for palynology, plant macrofossils and Mollusca

SU (Stratigraphic Unit): SU-5 Archaeological strata; SU-4d Alluvium 2; SU-4c Tufaceous deposits; SU-4b Peat

Borehole	Strata type	SU	Top (m)	Base (m)	Purpose
ARCA CWR BH03	Tufaceous deposits	4c	2.85	2.90	Mollusca
ARCA CWR BH03	Tufaceous deposits	4c	3.20	3.25	Mollusca
ARCA CWR BH03	Tufaceous deposits	4c	3.70	3.75	Mollusca
ARCA CWR BH03	Tufaceous deposits	4c	4.09	4.14	Mollusca
ARCA CWR BH03	Organic mud	4c	4.20	4.25	Mollusca
ARCA CWR BH03	Sand/silt/clay	4b	4.74	4.78	Mollusca
ARCA CWR BH04	Sand/silt/clay with artefacts	5	2.95	3.00	Mollusca
ARCA CWR BH04	Tufaceous deposits	4b	4.65	4.70	Mollusca
ARCA CWR BH06	Diamict with artefacts	5	2.28	2.33	Mollusca
ARCA CWR BH06	Diamict with artefacts	5	3.27	3.32	Mollusca
ARCA CWR BH06	Sand/silt/clay with artefacts	4d	3.52	3.57	Mollusca
ARCA CWR BH06	Organic mud	4d	4.40	4.45	Mollusca
ARCA CWR BH08	Organic mud	4d	3.65	3.70	Mollusca
ARCA CWR BH09	Tufaceous deposits	4c	4.01	4.06	Mollusca
ARCA CWR BH09	Tufaceous deposits	4c	4.09	4.14	Mollusca
ARCA CWR BH01	Organic mud	5	2.25	2.26	Plant macrofossils
ARCA CWR BH03	Diamict with artefacts	5	1.85	1.90	Plant macrofossils
ARCA CWR BH03	Sand/silt/clay with artefacts	5	2.45	2.50	Plant macrofossils
ARCA CWR BH03	Sand/silt/clay with artefacts	5	2.75	2.80	Plant macrofossils
ARCA CWR BH04	Sand/silt/clay with artefacts	5	2.70	2.75	Plant macrofossils
ARCA CWR BH04	Sand/silt/clay with artefacts	5	2.85	2.90	Plant macrofossils
ARCA CWR BH05A	Organic mud	5	2.07	2.12	Plant macrofossils

Borehole	Strata type	SU	Top (m)	Base (m)	Purpose
ARCA CWR BH06	Organic mud	5	2.20	2.25	Plant macrofossils
ARCA CWR BH06	Diamict with artefacts	5	2.47	2.52	Plant macrofossils
ARCA CWR BH06	Organic mud	5	2.67	2.72	Plant macrofossils
ARCA CWR BH06	Diamict with artefacts	5	2.79	2.84	Plant macrofossils
ARCA CWR BH06	Sand/silt/clay with artefacts	4d	3.52	3.57	Plant macrofossils
ARCA CWR BH08	Organic mud	4d	3.35	3.40	Plant macrofossils
ARCA CWR BH08	Organic mud	4d	3.65	3.70	Plant macrofossils
ARCA CWR BH08	Organic mud	4d	4.00	4.05	Plant macrofossils
ARCA CWR BH08	Organic mud	4d	4.50	4.55	Plant macrofossils
ARCA CWR BH08	Peat	4b	5.18	5.23	Plant macrofossils
ARCA CWR BH08	Peat	4b	5.35	5.40	Plant macrofossils
ARCA CWR BH08	Sand/silt/clay	4a	6.22	6.27	Plant macrofossils
ARCA CWR BH09	Sand/silt/clay with artefacts	5	1.80	1.85	Plant macrofossils
ARCA CWR BH09	Sand/silt/clay with artefacts	5	2.25	2.30	Plant macrofossils
ARCA CWR BH09	Organic mud	5	2.65	2.70	Plant macrofossils
ARCA CWR BH01	Diamict with artefacts	5	1.35	1.36	Pollen
ARCA CWR BH01	Diamict with artefacts	5	1.85	1.86	Pollen
ARCA CWR BH01	Organic mud	5	2.25	2.26	Pollen
ARCA CWR BH01	Sand/silt/clay with artefacts	5	2.65	2.66	Pollen
ARCA CWR BH01	Diamict	5	3.23	3.24	Pollen
ARCA CWR BH01	Diamict	4d	3.74	3.75	Pollen
ARCA CWR BH02	Soil	4d	2.12	2.13	Pollen
ARCA CWR BH03	Sand/silt/clay with artefacts	5	2.34	2.35	Pollen
ARCA CWR BH03	Sand/silt/clay with artefacts?	5	2.81	2.82	Pollen
ARCA CWR BH04	Sand/silt/clay with artefacts	5	2.68	2.69	Pollen
ARCA CWR BH04	Sand/silt/clay with artefacts	5	2.98	2.99	Pollen
ARCA CWR BH04	Peat	4b	4.78	4.79	Pollen
ARCA CWR BH05A	Organic mud	5	1.90	1.91	Pollen
ARCA CWR BH05A	Organic mud	5	2.29	2.30	Pollen
ARCA CWR BH05A	Sand/silt/clay	5	2.96	2.97	Pollen
ARCA CWR BH05A	Diamict with artefacts	5	3.70	3.71	Pollen
ARCA CWR BH05A	Sand/silt/clay	4d	4.26	4.27	Pollen
ARCA CWR BH06	Organic mud	5	2.21	2.22	Pollen
ARCA CWR BH06	Organic mud	5	2.72	2.73	Pollen

Borehole	Strata type	SU	Top (m)	Base (m)	Purpose
ARCA CWR BH06	Marl	4a	5.22	5.23	Pollen
ARCA CWR BH07	Peat	4c	3.80	3.81	Pollen
ARCA CWR BH07	Peat	4c	4.97	4.98	Pollen
ARCA CWR BH07	Peat	4c	5.54	5.55	Pollen
ARCA CWR BH07	Peat	4c	5.78	5.79	Pollen
ARCA CWR BH08	Sand/silt/clay with artefacts	5	1.82	1.83	Pollen
ARCA CWR BH08	Sand/silt/clay with artefacts	5	2.22	2.23	Pollen
ARCA CWR BH08	Sand/silt/clay with artefacts	5	2.62	2.63	Pollen
ARCA CWR BH08	Sand/silt/clay	5	2.98	2.99	Pollen
ARCA CWR BH08	Organic mud	5	3.26	3.27	Pollen
ARCA CWR BH08	Organic mud	5	3.98	3.99	Pollen
ARCA CWR BH08	Organic mud	5	4.58	4.59	Pollen
ARCA CWR BH08	Organic mud	5	4.88	4.89	Pollen
ARCA CWR BH08	Sand/silt/clay with artefacts	5	5.10	5.11	Pollen
ARCA CWR BH08	Peat	4b	5.14	5.15	Pollen
ARCA CWR BH08	Peat	4b	5.38	5.39	Pollen
ARCA CWR BH08	Sand/silt/clay	4a	6.24	6.25	Pollen
ARCA CWR BH09	Sand/silt/clay with artefacts	5	1.73	1.74	Pollen
ARCA CWR BH09	Sand/silt/clay with artefacts	5	2.45	2.46	Pollen
ARCA CWR BH09	Organic mud	5	2.58	2.59	Pollen
ARCA CWR BH09	Organic mud	5	2.77	2.78	Pollen
ARCA CWR BH10	Organic mud	5	2.15	2.16	Pollen
ARCA CWR BH10	Matrix-supported gravel with artefacts	5	2.65	2.66	Pollen
ARCA CWR BH10	Sand/silt/clay with artefacts	5	3.27	3.26	Pollen
ARCA CWR BH12	Organic mud	5	2.20	2.21	Pollen
ARCA CWR BH12	Peat	5	2.53	2.54	Pollen
ARCA CWR BH12	Organic mud	5	3.07	3.08	Pollen
ARCA CWR BH12	Sand/silt/clay with artefacts	5	4.03	4.04	Pollen
ARCA CWR BH13	Sand/silt/clay with artefacts	5	2.13	2.14	Pollen
ARCA CWR BH13	Organic mud	5	2.34	2.35	Pollen
ARCA CWR BH13	Organic mud	5	2.64	2.65	Pollen
ARCA CWR BH13	Sand/silt/clay	4a	5.16	5.17	Pollen

5.2 Table 2 cross references sub-samples recommended for biostratigraphic assessment with those suggested in ARCA's tender (Wilkinson et al 2020, section 4.3.5, 24–25). As will be obvious, an additional six (6) palynological samples are recommended for assessment beyond those costed in the tender, but these are compensated for by assessing eight (8) fewer plant macrofossil sub-samples. The reason for such a 're-deployment' is the quantity and thickness of organic mud strata lacking visible plant macroremains (i.e. where pollen is likely to be preserved, but plant macrofossils not) cf. strata containing visible plant macro remains. Mollusc shell was observed in both

the tufa (terrestrial/freshwater) and archaeological strata (marine), but waterlogging is unlikely to contribute to shell preservation. For these reasons, samples for molluscan assessment have been focussed on a mixture of tufaceous (mollusc shells have not previously been examined from equivalents of SU-4b in Winchester) and Archaeological strata (SU-5)

Table 2. Sub-samples proposed for biostratigraphic assessment in Table 1 compared to those costed in ARCA's tender and interim WSI (Wilkinson et al. 2020, section 4.3.5, 24–25)

Sample type	In tender	Proposed for assessment here
Mollusca	15	15
Plant macrofossils	30	22
Pollen	45	51

5.3 Following agreement with Winchester City Council's archaeologist and advice from the Historic England Science coordinator for South-east England, the relevant sub-samples will be submitted to the specialists listed in ARCA's tender and iWSI (Wilkinson et al. 2020, section 4.3.6, 25), namely Dr Rob Batchelor (pollen) and Dr Dan Young (plant macrofossils) of Quest, University of Reading, and Prof. Keith Wilkinson (Mollusca) of ARCA, University of Winchester.

5.4 Sub-samples submitted for assessment will be examined as set out in the tender and iWSI (Wilkinson et al. 2020, section 4.3.5–4.3.6, 24–25), and as stated in that document, in addition to taxonomic identifications, diversity, abundance and preservation will be reported against a five-point scale:

Score	Diversity	Abundance	Preservation
1	<5 taxa	<10 occurrences	Highly eroded/weathered fossils, only most robust taxa noted
2	6–10 taxa	11–25 occurrences	Highly eroded fossils and fragile taxa present as fragments
3	11–20 taxa	26–75 occurrences	Moderately eroded fossils and fragile taxa present
4	21–30 taxa	76–200 occurrences	Uneroded/weathered fossils and fragile taxa present
5	>30 taxa	>200 occurrences	Uneroded/weathered fossils, fossils are articulated, fragile taxa are present

5.5 ARCA's tender and iWSI stated that the sedimentological properties of 150 sub-samples would be examined (including 30 humification measurements of organic strata) (Wilkinson et al. 2020, section 4.3.2–4.3.4, 24), while 193 such sub-samples were taken during core description. ARCA propose to carry out magnetic susceptibility (low frequency), pXRF and loss-on-ignition (the latter at 550^{o}C to estimate organic carbon content) measurements on all the collected samples, and humification measurements on all sub-samples collected from peat and organic mud strata. No additional charge will be made for the extra sub-samples that are analysed.

5.6 Artefacts and vertebrate bone, both extracted from the cores during description and recovered from plant macrofossil and molluscan assessment will be examined by an ARCA geoarchaeology for rounding and abrasion properties, before being passed on to PCA and Dr Monika Knul (ARCA) to report on artefacts and vertebrate bone respectively. The relevant specialists will be asked to report on preservation in addition to providing identifications.

6 REFERENCES

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