



55 VASTERN ROAD, READING, BERKSHIRE

Geoarchaeological and Palaeoenvironmental Assessment Report

NGR: SU 71560 74130

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I. NON-TECHNICAL SUMMARY

Following a phase of previous fieldwork and deposit modelling, a geoarchaeological and palaeoenvironmental assessment exercise was undertaken on deposits obtained from the Vastern Road site. The results reveal that organic-rich alluvium began to accumulate close to the river from the late Neolithic / early Bronze Age period. With the exception of molluscs, palaeoenvironmental remains (pollen, diatoms and macrofossils) were limited, and no further geoarchaeological / palaeoenvironmental analysis is recommended. Nevertheless, the combined works have contributed to our understanding of the Holocene stratigraphic records for Reading and within this area of the Middle Thames Valley, providing a useful spatial and temporal comparison to local records from the River Thames and River Kennet valleys.

2. INTRODUCTION

2.1. Site context

This report summarises the findings of geoarchaeological and palaeoenvironmental assessment undertaken at the 55 Vastern Road, Reading (National Grid Reference: centred on SU 71560 74130; Figures 1 & 2). This work follows on from a previous geoarchaeological fieldwork and deposit modelling exercise (Simmonds & Batchelor, 2022). The site is approximately 1.2 hectares in size and is bordered by the River Thames and the Thames Cycle/Pedestrian Bridge to the north, Vastern Road to the south, residential properties and Lynmouth Road to the west, and offices to the east.

The British Geological Survey (BGS) shows the site is located on the edge of a west-east orientated spur of Devensian Langley Silt (Figure 1). Alluvial deposits of clay, silt, sand and gravel outcrop immediately to the north of the site. Gibbard (1985) records two boreholes in the area, to the east of the site, in which the alluvium comprised respectively '0.2m of brown sandy clay', close to the river on its north side, and '1.35m of blue grey clay with shells', at a point ca. 250m from the river on its south side. All the boreholes, including those recorded by Gibbard (1985 Fig.34) show the alluvium resting on gravel and sand between approximately 2-3m BGL, and is assigned by Gibbard to the Late Devensian Shepperton Gravel. Other outcrops of Langley Silt as well as older river terrace gravels of the of the Kempton Park Gravel and Taplow Gravel are recorded in the nearby vicinity of the site.

Geoarchaeological boreholes were recently put down at the site and combined with previous geotechnical records to produce a site-wide deposit model (Simmonds & Batchelor, 2022). In summary, the results of this exercise revealed Seaford Chalk Formation and Newhaven Chalk Formation (undifferentiated) bedrock overlain by a sequence of Late Devensian Lea Valley Gravel, Holocene alluvial deposits and variable thicknesses of Made Ground, which in places is likely to have truncated the alluvial sequence significantly. Interestingly, there appears to be no evidence for the Langley Silt as recorded at the site by the British Geological Survey (Figure 1), suggesting the alluvium outcrops further to the south than mapped. The alluvial sequences observed at the 55 Vastern Road site appear to be less organic than those observed elsewhere along this part of the Thames Valley. However, silty clay material was recorded that included numerous shells, and woody material in QBH3. Whilst not a peat, this alluvial unit was certainly more organic, and similar in composition to that recorded in neighboring borehole BH102 from the Thames Cycle/Pedestrian Bridge site (Batchelor, 2014).

Organic-rich alluvial deposits have also been recorded along the neighbouring Kennet Valley at Kenavon Drive in Reading (Young, 2013; Figure 1), and further afield at Ufton Nervet (Bell, pers. comm), Thatcham (e.g. Barnett, 2009) and Newbury (e.g. Ellis et al., 2003). Where recorded these

have been dated to the Mesolithic/Neolithic period and have often contained either archaeological or geoarchaeological evidence of human activity. In addition, whilst the precise OD heights were unknown when the fieldwork report was written, the organic-rich Alluvium within BH102 is at a similar elevation (35 to 34.5m OD) to the thick Late Glacial to present day Peat and Alluvial sequence recorded at Thames Valley Park (33 to 35m OD).

Elsewhere in Reading, investigations along Forbury Road indicate the presence of a palaeochannel that appears to have been a minor tributary of the River Kennet and is still recognisable as such in Rocque's map of 1746 (where it is named the 'Plummery Ditch') (Batchelor *et al.*, 2013). The palaeochannel is infilled by Peat (dating from the early Mesolithic to middle Neolithic) and Alluvium. Geotechnical borehole SU77SW44 is mapped as being on the northern margin of this former channel and also contained approximately 60cm of peat.

2.2. Geoarchaeological, palaeoenvironmental and archaeological significance

British Geological mapping, and previous archaeological, geoarchaeological and geotechnical investigations therefore indicate considerable variation in the type, thickness and age of the superficial deposits. Such variations are significant as they represent different environmental conditions that would have existed in a given location. For example: (1) the varying surface of the Gravel may represent the location of former channels and bars; (2) the presence of soil and peat represents former terrestrial or semi-terrestrial land-surfaces, and (3) the various alluvial units represent periods of changing hydrological conditions. Thus by studying the sub-surface stratigraphy across the site in greater detail, it will be possible to build an understanding of the former landscapes and environmental changes that took place across space and time.

Areas of high gravel topography, soils and peat represent potential areas that might have been utilised or even occupied by prehistoric people, evidence of which may be preserved in the archaeological (e.g. features and structures) and palaeoenvironmental record (e.g. changes in vegetation composition). The potential importance of the proposed site is enhanced by a large Prehistoric and Romano-British site excavated on the floodplain and terrace of the Thames at Thames Valley Park (Figure 1; Barnes *et al.*, 1997). Here, Mesolithic archaeological finds consisting of flint scatters including knapping waste and tools were recorded on the terrace edge and were interpreted as being indicative of an industrial base with limited evidence for domestic activity. During the Neolithic and Bronze Age, Beaker sherds and flint artefacts were recorded on the terrace, whilst Peterborough ware of Ebbsfleet/Mortlake was recorded on the floodplain. Middle Iron Age to Roman activity consisted of an enclosure which was interpreted as being indicative of agricultural production and small-scale industrial activity on the terrace, whilst various pits and postholes were recorded on the floodplain.

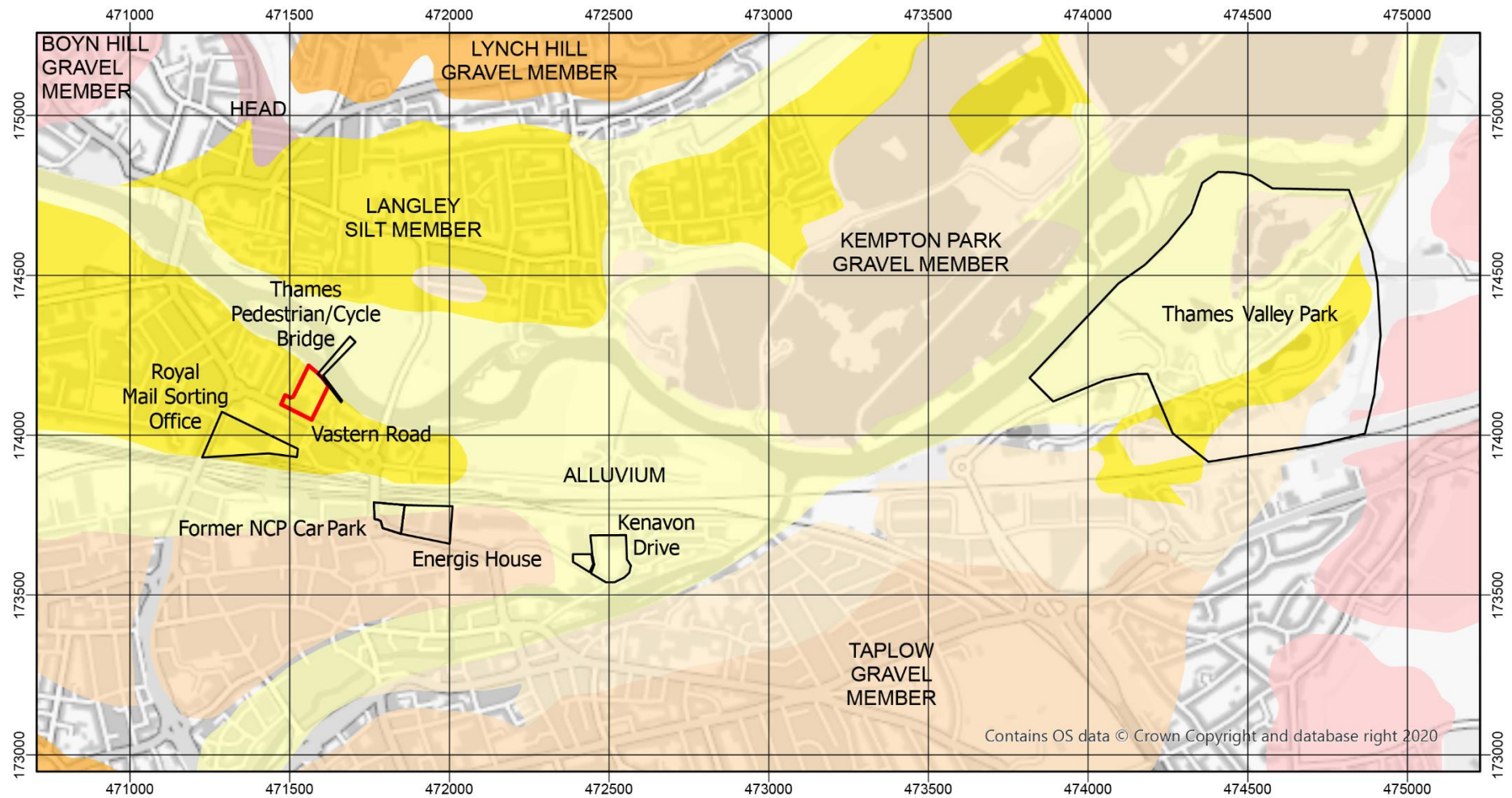
The alluvial and organic-rich sediments (in particular peat) have high potential to provide a detailed reconstruction of past environments on both the wetland and dryland. In particular, they provide the potential to increase knowledge and understanding of the interactions between hydrology, human activity, vegetation succession and climate. Such investigations are carried out through the assessment/analysis of palaeoecological remains (e.g. pollen, plant macrofossils & insects) and radiocarbon dating, and have been undertaken at the nearby sites such as Thames Valley Park which contained a significant quantity of animal bone (including probably Mesolithic aurochs), pollen and plant macrofossils.

2.3. Aims and objectives

This report summarises the findings arising from a geoarchaeological fieldwork and deposit modelling exercise. The aims of this exercise, as outlined in the Written Scheme of Investigation (Batchelor, 2022), are as follows:

- 1 To clarify the nature of the sub-surface stratigraphy across the site;
- 2 To enhance our understanding of the nature, depth and of any former land surfaces, alluvial and peat deposits;
- 3 To investigate whether the sequences contain any artefact or ecofact evidence for prehistoric or historic human activity;
- 4 To investigate whether the sequences contain any evidence for natural and/or anthropogenic changes to the landscape (wetland and dryland);

Aims 1 and 2 were fulfilled as part of the previous geoarchaeological fieldwork and deposit modelling exercise (see Simmonds & Batchelor, 2022). The following report aims to evaluate the potential of fulfilling the remaining aims of the project by undertaking a program of radiocarbon dating and palaeoenvironmental assessment (incorporating pollen, diatom, plant macrofossils and mollusca). Depending on the outcome of this work a final stage of palaeoenvironmental analysis may be required.



Key: Thames Pedestrian/Cycle Bridge (Batchelor, 2014); Royal Mail Sorting Office (Batchelor & Green, 2010); Former NCP Car Park, (Dinwiddy, 2008); Energis House (Batchelor et al., 2013); Kenavon Drive (Young, 2013), and Thames Valley Park (Barnes et al., 1997).

Figure 1: Location of Vastern Road in relation to other sites of note across Reading. Superimposed on both Ordnance Survey and British Geological mapping.

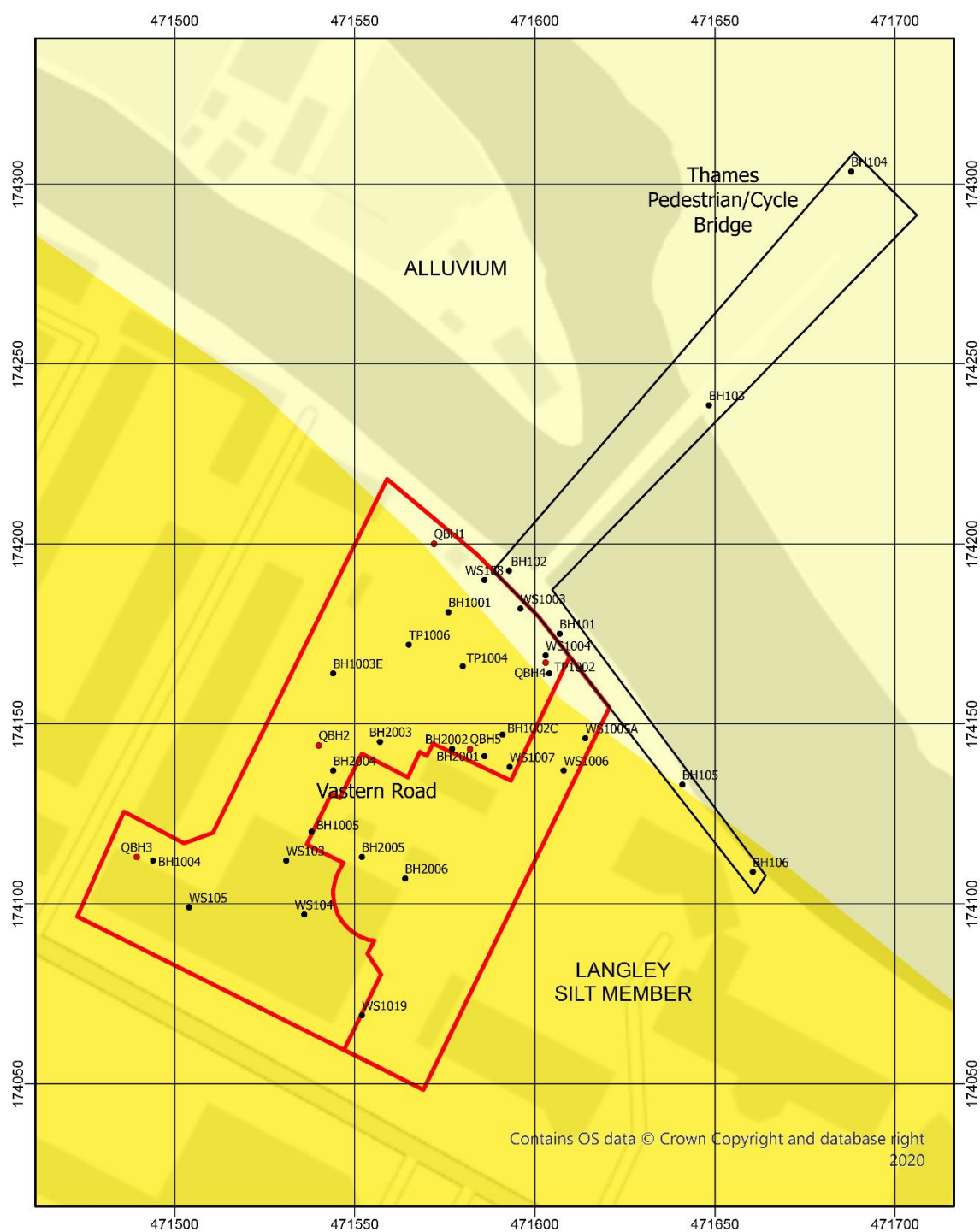


Figure 2: Location of previous geotechnical and QUEST geoarchaeological boreholes across the 55 Vastern Road site

3. METHODS

3.1. Fieldwork

Five boreholes (QBH1 to 5; Figure 2) were put down at the site for geoarchaeological purposes, alongside previous geotechnical boreholes. The geoarchaeological samples were retained intact for offsite geoarchaeological description. The boreholes were put down using a window sampling rig to the surface of the Gravel. The spatial attributes for each borehole are shown in Table 1. Due to the thickness and density of the Made Ground, only two boreholes (QBH1 and QBH3) were able to penetrate through to the underlying Holocene sediments.

Table 1: Spatial co-ordinates of the geoarchaeological boreholes

Name	Easting	Northing	Elevation (m OD)	Total Depth (m)
QBH01	471572	174200	38.25	5
QBH02	471540	174144	38.7	0.85
QBH03	471489.5	174113	38.12	3
QBH04	471603	174167	38.31	0.88
QBH05	471582	174143	38.4	0.3

3.2. Lithostratigraphic descriptions

The recovered samples were described off-site using standard procedures for recording unconsolidated sediments and organic remains, noting the physical properties (colour), composition (particle size, organic content and sorting), and any archaeological inclusions (Tröels-Smith, 1955). The procedure involved: (1) cleaning the sample using a scalpel; (2) recording the physical properties, most notably colour using a Munsell Soil Colour Chart; (3) recording the composition; gravel (*Grana glareosa*; Gg), fine sand (*Grana arenosa*; Ga), silt (*Argilla granosa*; Ag) and clay (*Argilla steatoides*; As); (4) recording the degree of peat humification and (5) recording the unit boundaries e.g. sharp or diffuse. The results of the lithostratigraphic descriptions are presented in Tables 2-6 and section 4.

3.3. Deposit Modelling

The deposit model for the site was based on a review of local stratigraphic records from the Quaternary Scientific Geoarchaeological Database, combining records from various geoarchaeological and geotechnical investigations across the site (Table 7) and wider area (see Figure 1) and the British Geological Survey (BGS) borehole archive (<https://www.bgs.ac.uk/geoindex/>). The geoarchaeological and geotechnical records from the site were also incorporated into the model.

Sedimentary units from the boreholes were classified into four main groups: (1) Bedrock, (2) Gravel, (3) Alluvium and (4) Made Ground. The classified data for groups 1-4 were then input into a database with the RockWorks 21 geological utilities software. Models of surface height were generated for the

Bedrock (Figure 3), Gravel (Figure 4), and the Alluvium (Figure 5). Thickness of the combined Holocene alluvial sequence (Figure 6), and the Made Ground (Figure 7) were also modelled (also using a nearest neighbour routine). A transect of borehole records across the site is shown in Figure 8.

Because of the 'smoothing' effect of the modelling procedure, it should be noted that the modelled levels of stratigraphic contacts may differ from levels recorded in borehole logs and section drawings (Carey et al. 2018). As a consequence, the modelling procedure has been manually adjusted so that only those areas for which sufficient stratigraphic data is present will be modelled. In order to achieve this, a maximum distance cut-off filter equivalent to a 50m radius around each record is applied. Finally, it is important to recognise that multiple sets of boreholes are represented, put down at different times and recorded using different descriptive terms and subject to differing technical constraints in terms of recorded detail including the exact levels of the stratigraphic boundaries.

3.4. Radiocarbon dating

One subsample was extracted from the base of the organic-rich alluvium in borehole SHO-QBHI for radiocarbon dating. In the absence of identified plant macrofossil material, a bulk sample of the material was submitted for dating of the humic acid and humin fractions. The sample was submitted for AMS radiocarbon dating to the BETA Analytic Radiocarbon Dating Facility, Miami, Florida. The results have been calibrated using OxCal v4.2 (Bronk Ramsey, 1995; 2001 and 2007) and the IntCal20 atmospheric curve (Reimer et al., 2020). Results are displayed in Table 8 and Figure 9.

3.5. Pollen assessment

Seven subsamples from borehole QBHI were extracted for an assessment of pollen content. The pollen was extracted as follows: (1) sampling a standard volume of sediment (1ml); (2) adding one tablet of the exotic clubmoss *Lycopodium clavatum* to provide a measure of pollen concentration in each sample; (3) deflocculation of the sample in 1% Sodium pyrophosphate; (4) sieving of the sample to remove coarse mineral and organic fractions ($>125\mu\text{m}$); (5) acetolysis; (6) removal of finer minerogenic fraction using Sodium polytungstate (specific gravity of 2.0g/cm^3); (7) mounting of the sample in glycerol jelly. Each stage of the procedure was preceded and followed by thorough sample cleaning in filtered distilled water. Quality control is maintained by periodic checking of residues and assembling sample batches from various depths to test for systematic laboratory effects. Pollen grains and spores were identified using the University of Reading pollen type collection and the following sources of keys and photographs: Moore et al (1991); Reille (1992). The assessment procedure consisted of scanning the prepared slides and recording the concentration and preservation of pollen grains and spores, and the principal taxa either on four transects (10% of the slide) or up to 100 total land pollen (Table 9).

3.6. Diatom assessment

A total of seven samples were submitted for an assessment of diatom presence from borehole QBH1 (Table 10). The samples under evaluation comprised a mixture of organic and minerogenic sediments. 0.5g of sediment was required for the diatom sample preparation. Samples were first treated with hydrogen peroxide to remove organic material. Samples were then sieved using a 10µm mesh to remove fine minerogenic sediments. The residue was transferred to a plastic vial, from which a slide was prepared for subsequent assessment. A minimum of four slide traverses were undertaken across each slide sample. When present, diatom species would be identified with reference to van der Werff and Huls (1958-74), Hendy (1964) and Krammer & Lange-Bertalot (1986-1991).

3.7. Macrofossil assessment

Two samples from QBH1 were extracted and processed for the recovery of macrofossil remains, including waterlogged plant macrofossils, wood and insects. The samples were focused on the most organic-rich part of the alluvium. The extraction process involved the following procedures: (1) measuring the sample volume by water displacement, and (2) processing the sample by wet sieving using 300µm and 1mm mesh sizes. Each sample was scanned under a stereozoom microscope at x7-45 magnifications and sorted into the different macrofossil classes. The concentration and preservation of remains was estimated for each class of macrofossil (Table 11).

3.8. Mollusca assessment

Nine samples were extracted at regular intervals through QBH1 for the recovery of mollusca. The samples were sieved into >1mm and >300µm. Molluscs were extracted using a low power stereo-microscope (x7-x40) from each of the samples, both intact specimens and apices together with the hinges of bivalves. Identifications and habitat preferences were made using standard guides (Evans 1972; Kerney and Cameron 1979; Cameron 2008; Rowson (Evans 1972; Kerney and Cameron 1979; Cameron 2008; Rowson *et al.* 2021) and a reference collection. The results are displayed in Table 12.

4. RESULTS & INTERPRETATION OF THE GEOARCHAEOLOGICAL DEPOSIT MODELLING AND RADIOCARBON DATING

The tabulated descriptions of VRR-QBH1 to VRR-QBH5 are displayed in Tables 2-6. The results of the deposit modelling are shown in Figures 3 to 8. Figures 3-7 are surface elevation and thickness models for the main stratigraphic units. Figure 8 is a two-dimensional transect of selected boreholes. The results of the deposit modelling indicate that the number and spread of the logs is sufficient to permit modelling across the site. The full sequence of sediments recorded in the boreholes comprises:

Made Ground – widely present

Alluvium – widely present

Gravel – widely present

Bedrock – widely present

4.1. Bedrock

The bedrock at the site is the Seaford Chalk Formation and Newhaven Chalk formation (undifferentiated). The depth across the site is variable, spanning from 26.21-30.20m OD. The surface is deepest in the north-western edge of the site, and rises to the north, east and south (Figure 3).

4.2. Gravel

Overlying the bedrock Chalk at the site is a horizon of gravel (Figure 4). This unit was reached in both of the successful geoarchaeological records from the site. It is considered to represent the Late Devensian Shepperton Gravel (Gibbard, 1985), deposited during the Devensian Late Glacial (15,000 to 10,000 years before present) and comprising the sands and gravels of a high-energy braided river system which, while it was active, would have been characterised by longitudinal gravel bars and intervening low-water channels in which finer-grained sediments might have been deposited. Such a relief pattern would have been present on the valley floor at the beginning of the Holocene (during the Mesolithic) when a lower-energy fluvial regime was being established. The surface of the Gravel within the area of the site is relatively uniform, recorded at levels between 34-35.7m OD (Figure 4 & 8), with the highest surface (35.7m OD) present in the south and south-east of the site, dipping towards the modern channel of the River Thames (34.0m OD).

4.3. Alluvium

Recorded overlying the Gravel in both geoarchaeological boreholes and many of the geotechnical records is a sandy clay deposit that is frequently described as containing decomposed organic matter,

having an organic odour and/or containing shell fragments (Figure 5). These characteristics are more akin to alluvium rather than Langley Silt, suggesting the alluvium extends further southward than the BGS records indicate. The Alluvium rests directly on the Gravel, with its surface fairly uniform, between 35.90-36.80m OD. Lower outcrop elevations are found closest to the modern river channel, with the alluvial surface across the rest of the site sitting at elevations above 36.41m OD although its natural level is likely to have been altered due to truncation by the overlying Made Ground).

The sediments of the Alluvium are variable, containing material ranging in particle size from fine clays through to gravel. Due to the depth and thickness of the overlying made ground (see section 4.4), only two of the geoarchaeological boreholes penetrated into the alluvial deposits: QBH1 and QBH3. QBH1 was heavily contaminated with hydrocarbons to a depth of 2.57m bgl (35.68m OD). Below this, silty clay material was recorded that included numerous shells, and woody material; this extended to a depth of 3.95m bgl (34.30m OD). Whilst not a peat, the 1m thick uncontaminated alluvial unit was certainly more organic with further palaeoenvironmental potential, and similar in composition to that recorded in neighboring borehole BH102 from the Thames Cycle/Pedestrian Bridge site (Batchelor, 2014).

Two radiocarbon determinations were made on the most organic-rich alluvium from the base of the sequence. The humic acid (alkali soluble) fraction provided an age of 4420-4240 cal BP (2470-2290 cal BC), whilst the humin (alkali insoluble fraction provided an age of 4230-3980 cal BP (2280-2030 cal BC) (Table 8; Figure 9). The two results barely overlap, but this is not uncommon when dating the two fractions (see Bayliss & Marshall, 2019). If the two dates are combined however, they provide a total range of 4420-3980 cal BP (2470-2030 cal BC), representing accumulation of the alluvial deposits on this part of the Vastern Road site, from the late Neolithic / early Bronze Age period.

By contrast, the 0.8m thick unit of alluvium recorded in QBH3 in the north-eastern corner of the site was almost entirely inorganic, comprising silts, clays and gravels; modern rootlets were the only organic remains noted. It was overlain however, by a thin 0.22m horizon of organic silty clay with woody remains; this was grouped as a peat unit. It could not be sampled for palaeoenvironmental work as it was encountered within the 1.2m inspection pit.

The various alluvial deposits recorded are indicative of deposition across a range of fluvial and/or semi-aquatic conditions on the floodplain during the Holocene. The predominantly high mineral content of the sediments may reflect increased sediment loads resulting from intensification of agricultural land use from the later prehistoric period onward, combined with the effects of rising sea level. The

deposits of the Alluvium are described as predominantly silty or clayey, with occasional organic lenses, mollusca and gravel clasts.

The thickness of the Holocene alluvium is displayed in Figure 6. The thickness of the alluvial sequence tends to reflect the topography of the Gravel surface, and in general appears to be around 0.5-2.0m thick across much of the site. Toward the river, greater thicknesses of up to 3m are observed (Figure 8).

4.4. Made Ground

Between 0.7m and 3.0m of Made Ground caps the alluvial sequence across the site (Figure 7) and is likely to have truncated the alluvial sequence. Concrete forms a substantial component of the Made Ground. Indeed, in QBH2, QBH4 and QBH5 drilling ceased whilst in concrete at depths of 0.85, 0.88 and 0.3m respectively.

Table 2: Geoarchaeological description of borehole QBH1

Depth (m OD)	Depth (m bgl)	Description	Stratigraphic Group
38.25 to 37.25	0.00-1.00	Brick, concrete & glass supported in a substrate of organic and inorganic materials	MADE GROUND
37.25 to 36.58	1.00-1.67	Brick fragments supported in a mottled brown silty-clay matrix. Diffuse contact into:	
36.58 to 36.51	1.67-1.74	7.5YR 4/2 Brown. Ag2 As2 Silty-clay. Sharp contact into:	ALLUVIUM
36.51 to 36.25	1.74-2.00	7.5YR 2.5/1 Black. Ag2 As2 Clay-silt contaminated with a petroleum product. Very odorous. Sharp contact into:	CONTAMINATED ALLUVIUM
36.25 to 36.21	2.00-2.04	Gley2 4/1 Dark bluish grey. As3 Ag1 Clay-silt contaminated with a petroleum product. Very odorous.	
36.21 to 36.10	2.04-2.15	2.5YR 5/3 Reddish brown. Gs2 Ga1 Gg1 Fine gravel & coarse sand supporting occasional sub-rounded cobbles. Unit is contaminated with a petroleum product. Slightly odorous. Sharp contact into:	
36.10 to 35.68	2.15-2.57	Gley2 4/1 Dark bluish grey. Ag2 As1 Gg1 Silt-clay with occasional sub-rounded cobbles. Unit contaminated with petroleum. Slightly odorous. Sharp contact into:	
35.68 to 35.25	2.57-3.00	Gley2 5/1 Bluish grey. As2 Ag2 Th+ Shells+ Clay-silt with few rootlets and mollusc shells throughout. Sharp contact into:	ALLUVIUM
35.25 to 35.15	3.00-3.10	Gley2 4/1 Dark bluish grey. As4 Clay.	
35.15 to 34.69	3.10-3.56	Gley2 4/1 Dark bluish grey. Ag2 As2 Shells+ Silty-clay with numerous rootlets and small broken mollusc fragments throughout. Diffuse contact into:	
34.69 to 34.30	3.56-3.95	10YR 5/3 Brown. Ag2 As2 Shells+ Th+ Silty-clay with numerous small broken mollusc fragments and decomposing wood material throughout. Notable wooden fragment (c. 0.5 x 3 cm) centred on 386 cm. Large broken bi-valve shell centred on 395cm. Diffuse contact into:	
34.30 to 34.25	3.95-4.00	10YR 6/3 Pale Brown. Gg(maj)4 Coarse rounded gravel supporting few small rounded cobbles. Sharp contact into:	SAND AND GRAVEL
34.25 to 34.03	4.00-4.22	10YR 4/3 Brown. Ag1 Ga1 Gs1 Gg1 Poorly sorted silty-sandy gravel. Gravels are sub-rounded and sub-angular. Larger cobbles also present. Varied geology but predominantly flints.	
34.03 to 33.25	4.22-5.00	7.5YR 5/1 Grey. Ag1 Ga1 Gs1 Gg1 Poorly sorted silty-sandy gravel. Gravels are sub-rounded and sub-angular. Larger cobbles also present. Varied geology but predominantly flints.	

Table 3: Geoarchaeological description of borehole QBH2

Depth (m OD)	Depth (m bgl)	Description	Stratigraphic Group
38.70 to 37.85	0.00-0.85	Concrete	MADE GROUND

Table 4: Geoarchaeological description of borehole QBH3

Depth (m OD)	Depth (m bgl)	Description	Stratigraphic Group
38.12 to 37.12	0.00-1.00	Brick, concrete & glass fragments supported in a mixed substrate of organic and inorganic materials	MADE GROUND
37.12 to 36.90	1.00-1.22	10YR 2/1 Black. Th3 Ag1 As+ Organic silty clay with a high quantity of wood fragments. Band of white carbonate material c. 0.5 cm thick.	PEAT
36.90 to 36.78	1.22-1.34	GLEYI 4/2 Grayish green. Ag2 As2 Gg(min)+ Silty-clay with trace quantities of fine gravel. Sharp contact into:	ALLUVIUM
36.78 to 36.62	1.34-1.50	GLEYI 3/1 Very dark greenish gray. Ag2 As2 Gg(maj)+ Silty-clay with some larger gravels. Sharp contact into:	
36.62 to 36.12	1.50-2.00	GLEYI 6/2 Pale green. As4 Th+ Clay with trace amounts of rootlets. Diffuse contact into:	
36.12 to 35.82	2.00-2.30	GLEYI 6/2 Pale green. As3 Gg(maj) Clay with few rounded gravels.	
35.82 to 35.72	2.30-2.40	GLEYI 3/1 Very dark greenish gray. Ag2 As1 Gg(maj) Silty-clay with few rounded gravels. Sharp contact into:	
35.72 to 35.12	2.40-3.00	5YR 5/8 Yellowish red. Gs2 Gg(min) Poorly sorted coarse sands and gravel. Gravels are sub-rounded and sub-angular. Mixed geology but predominantly flints. Diffuse contact into:	GRAVEL

Table 5: Geoarchaeological description of borehole QBH4

Depth (m OD)	Depth (m bgl)	Description	Stratigraphic Group
38.31 to 37.43	0.00-0.88	Concrete	MADE GROUND

Table 6: Geoarchaeological description of borehole QBH5

Depth (m OD)	Depth (m bgl)	Description	Stratigraphic Group
38.40 to 38.70	0.00-0.30	Concrete	MADE GROUND

Table 7: Summary of the previous geotechnical records from 55 Vastern Road

	m bgl	
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Name	Easting	Northing	Elevation	Total Depth (m)	Top of Made Ground	Top of Alluvium	Top of Gravel	Top of Bedrock	Alluvial description
BH1001	471576	174181	38.39	12	0	1.5	4	9	sandy clay with an organic odour
BH1002C	471591	174147	38.4	35	0	1.1	3.8	10.1	sandy clay with decomposed organic material between 1.1 and 2.3m bgl
BH1003E	471544	174164	38.71	35	0	1.96	3.3	12.5	silty clay with rare shell fragments
BH1004	471494	174112	38.31	35	0	1.7	2.4	8.1	silty clay with frequent pockets of partially decomposed organic material
BH1005	471538	174120	38.69	12	0	1.9	3	9.7	silty clay
BH2001	471586	174141	38.42	5	0	1.3	3.6		sandy clay with rare decomposed organic matter
BH2002	471577	174143	38.37	5	0	1.45	3.6		clay with occasional shell fragments above clay with silt lenses above sandy clay with decomposed organic matter
BH2003	471557	174145	38.56	4.5	0	2.2	3		clay with decomposed organic material and rare shell fragments
BH2004	471544	174137	38.76	5	0		3.5		No alluvium
BH2005	471552	174113	38.65	5	0	2.15	3.3		sandy clay with rare decomposed organic material and occasional gravel
BH2006	471564	174107	38.49	5	0	1.95	3		sandy clay with rare decomposed organic material and occasional gravel
WS1003	471596	174182	38.21	5.45	0	1.4	4.1		sandy clay with moderate organic odour
WS1004	471603	174169	38.37	5.45	0	1.5	3.7		sandy clay with organic odour
WS1005A	471614	174146	38.17	5.45	0	1.6	4		sandy clay with shell fragments
WS1006	471608	174137	38.19	5.45	0	1.6	3		sandy clay
WS1007	471593	174138	38.38	5.45	0	1.7	2.3		gravelly clay
WS1019	471552	174069	38.32	5.45	0	1.7	2.48		sandy clay
TPI002	471604	174164	38.36	4	0	1.6			sandy silty clay with organic odour and shell fragments into the same with decomposed organic material
TPI004	471580	174166	38.29	4.2	0	1.3			clay with shell fragments into silty clay with organic odour and decomposed organic material into silty clay with occasional shell fragments
TPI006	471565	174172	38.44	2.4	0	1.9			clay with organic odour
WS103	471531	174112		2	0	1.7			gravelly clay with shell fragments
WS104	471536	174097		2.4	0	1.75			gravelly clay with shell fragments
WS105	471504	174099		2.3	0	1.85			gravelly clay with shell fragments and organic matter
WS108	471586	174190		2.5	0	1.5			gravelly clay with organic material

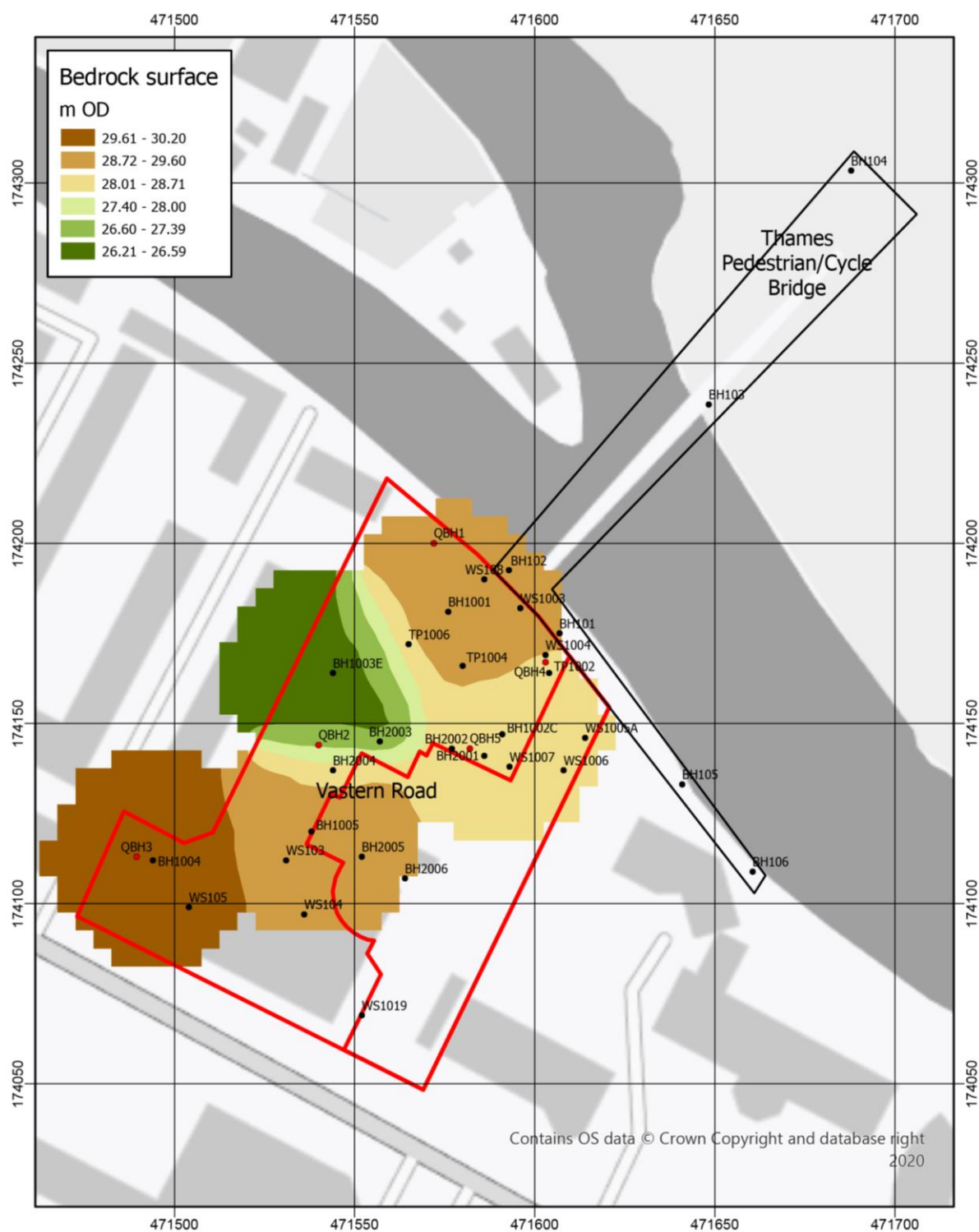


Figure 3: Top of the Bedrock (m OD) (site outline in red).



Figure 4: Top of the Gravel (m OD) (site outline in red).



Figure 5: Top of the Alluvium (m OD) (site outline in red).

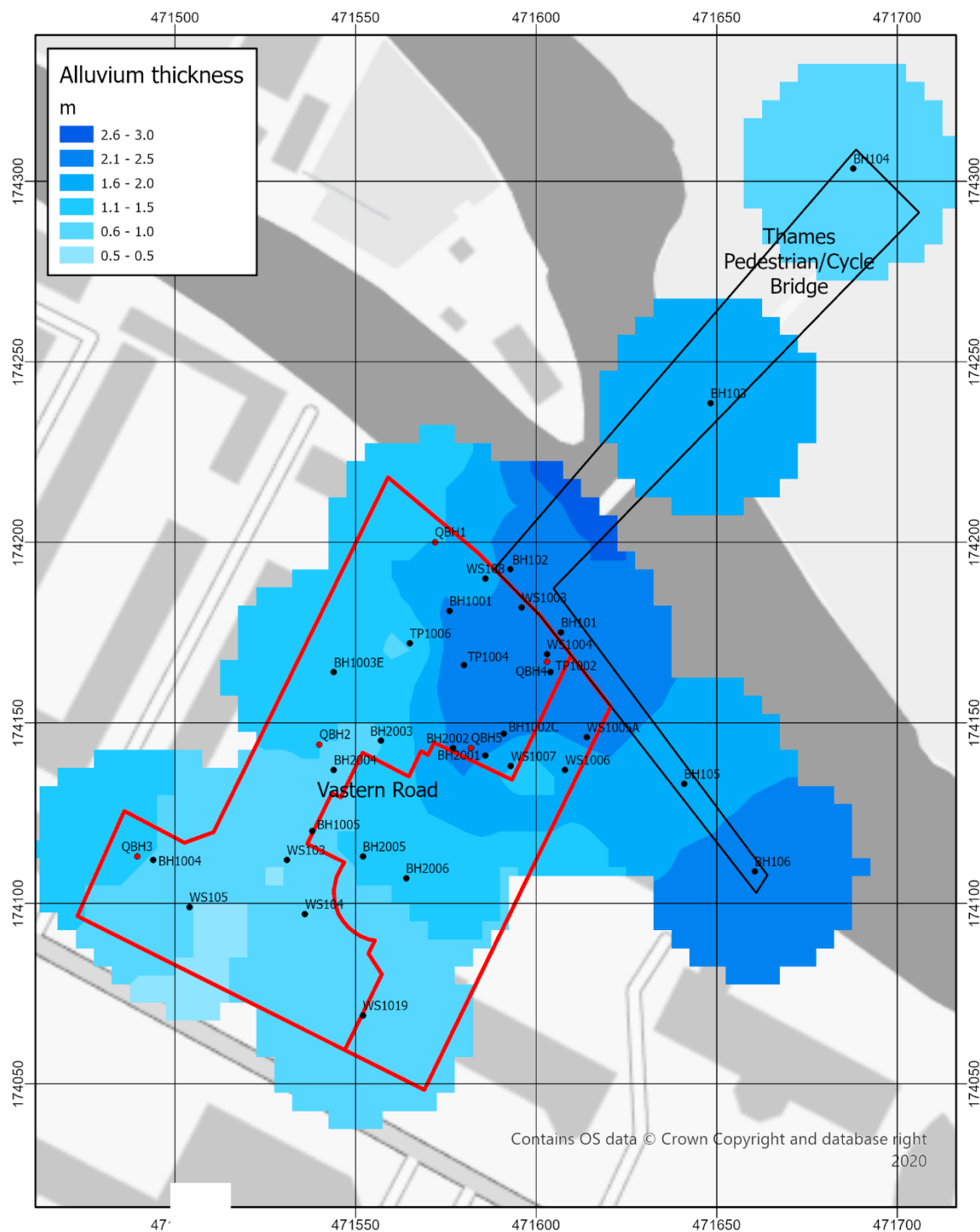


Figure 6: Thickness of the Holocene alluvial sequence (Lower Alluvium, Peat and Upper Alluvium) (m) (site outline in red).

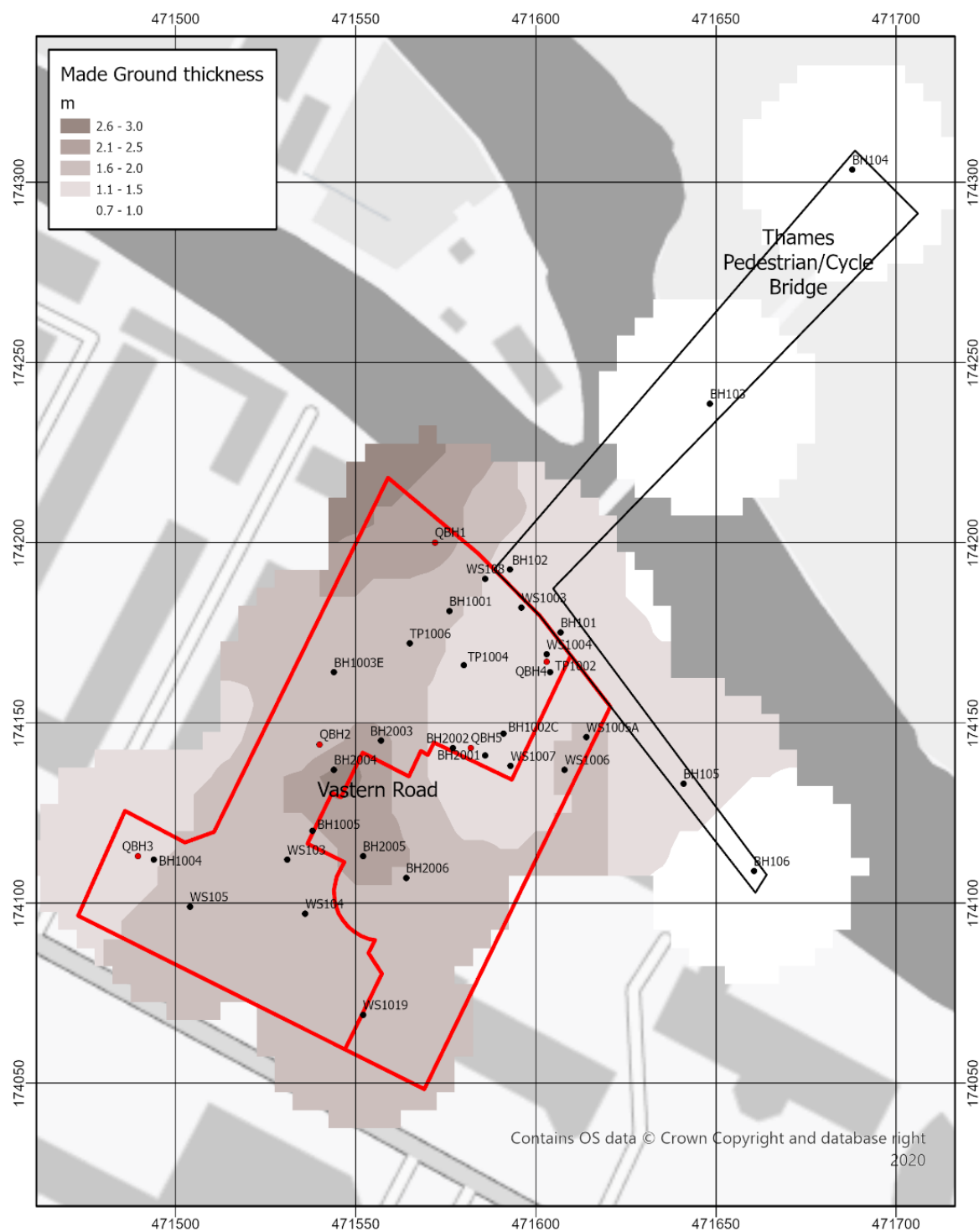


Figure 7: Thickness of Made Ground (m) (site outline in red).

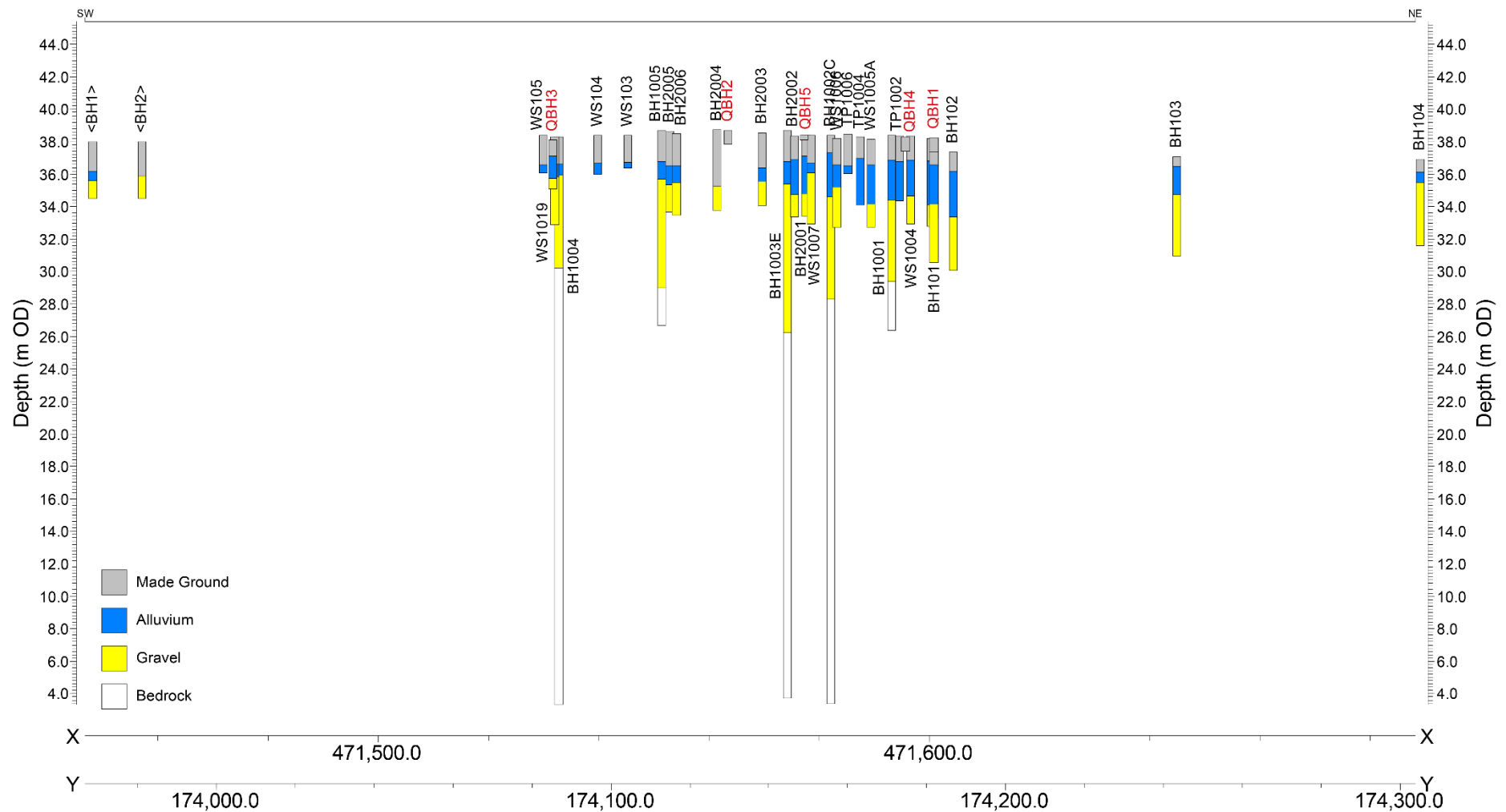
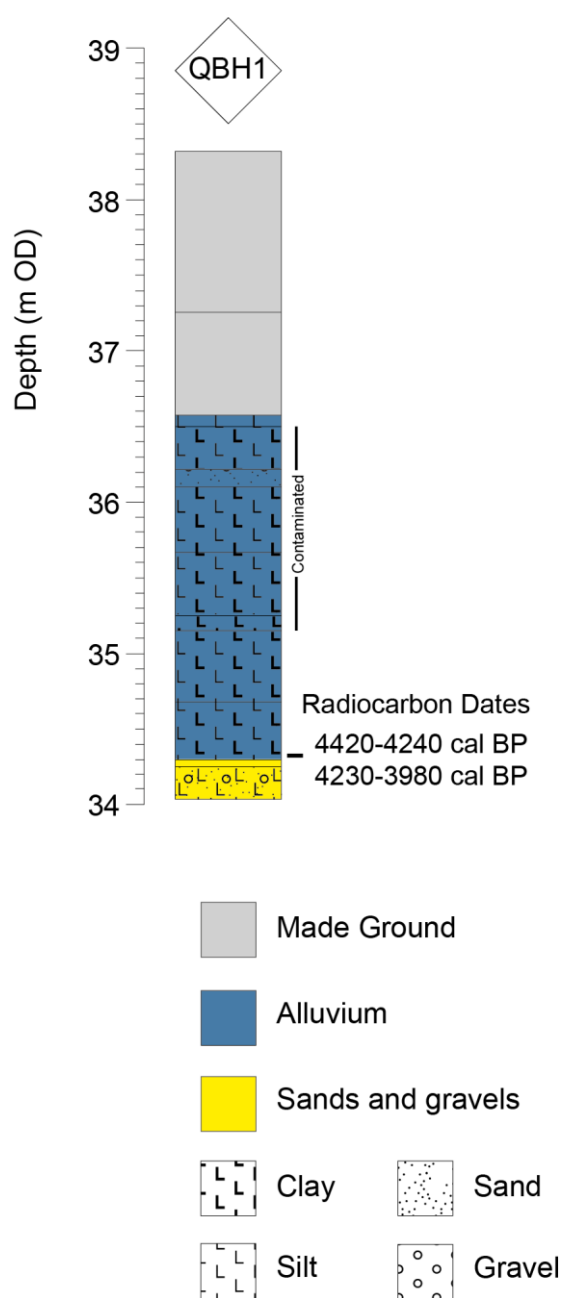


Figure 8: Transect of selected boreholes across the site (see Figure 2 for borehole locations).

Table 8: Results of the radiocarbon dating from QBH1

Laboratory code / Method	Material and location	Depth (m OD)	Uncalibrated radiocarbon years before present (yr BP)	Calibrated age BC/AD (BP) (2-sigma, 95.4% probability)	$\delta^{13}\text{C}$ (‰)
BETA-640978	Organic alluvium; humic acid (alkali soluble fraction)	34.33 to 34.31	3900 ± 30	2470-2290 cal BC 4420-4240 cal BP	-27.0
BETA-640977	Organic alluvium; humin (alkali insoluble fraction)	34.33 to 34.31	3730 ± 30	2280-2030 cal BC 4230-3980 cal BP	-24.9

**Figure 9: Lithostratigraphy and radiocarbon dating of QBH1**

5. RESULTS & INTERPRETATION OF THE POLLEN ASSESSMENT

The results of the assessment indicate an absence of pollen in almost all samples. Pollen preserves best in fine-grained organic deposits, so the lack of remains in the QBH I alluvium may be due to the predominantly inorganic and sometimes sandy nature of the sediment. The exception to this was at 34.43 to 34.42m OD however, where pollen was recorded in low concentrations. *Corylus* type (hazel) and Poaceae (grasses) were the most commonly recorded taxa, together with grains of *Quercus* (oak), *Alnus* (alder), *Prunus* type (blackthorn), Cyperaceae (sedges), Lactuceae (dandelions), Asteraceae (daisies), *Chenopodium* type (goosefoot family), *Plantago lanceolata* (ribwort plantain) and *Sparganium* type (bur-reed). Spores were also noted including Filicales (ferns) and *Polypodium* type (polypody).

Combined, the assemblage at 34.43 to 34.42m OD is suggestive of a relatively open semi-aquatic environment supporting grasses, reeds, sedges, bur-reed and isolated alder trees. Meadow type communities may be indicated by many of these taxa together with ribwort plantain, dandelions and daisies. Woodland incorporating at least oak appears to be very limited or growing at some distance from the site; although hazel shrubland does appear to have been growing in the nearby vicinity. There are no definitive indications of human activity, but the open nature of the vegetation could be suggestive of the deposits post-dating late prehistoric woodland clearance.

Table 9: Results of the pollen assessment on borehole QBH1

	Depth (m OD)	35.23 to 35.22	35.07 to 35.06	34.91 to 34.90	34.75 to 34.74	34.59 to 34.58	34.43 to 34.42	34.27 to 34.26
	Depth (m bgl)	3.02 to 3.03	3.18 to 3.19	3.34 to 3.35	3.50 to 3.51	3.66 to 3.67	3.82 to 3.83	3.98 to 3.99
Latin name	Common name							
Trees								
<i>Alnus</i>	alder						1	
<i>Pinus</i>	pine	1						
<i>Quercus</i>	oak						3	
<i>Ulmus</i>	elm							
<i>Tilia</i>	lime							
<i>Betula</i>	birch							
Shrubs								
<i>Corylus</i>	hazel						12	
<i>Prunus</i> type	e.g. blackthorn						1	
Herbs								
Cyperaceae	sedge family						3	
Poaceae	grass family						11	
Lactuceae	dandelion family						2	
Asteraceae	daisy family						2	
<i>Plantago lanceolata</i>	ribwort plantain						1	
<i>Chenopodium</i> type	e.g. fat hen						1	
Aquatics								
<i>Sparganium</i> type	bur-reed						1	
Spores								
<i>Sphagnum</i>	moss				1			
<i>Filicales</i>	ferns						3	
<i>Polypodium</i>	common polypody						1	
<i>Pteridium</i>	eagle fern						2	
Total Land Pollen (grains counted)		1	0	0	0	0	37	0
Concentration*		1	0	0	0	0	1	0
Preservation**		2	0	0	0	0	4	0
Microcharcoal Concentration***		0	0	0	0	0	0	0
Suitable for further analysis		NO	NO	NO	NO	NO	NO	NO

Key: *Concentration: 0 = 0 grains; 1 = 1-75 grains, 2 = 76-150 grains, 3 = 151-225 grains, 4 = 226-300, 5 = 300+ grains per slide; **Preservation: 0 = absent; 1 = very poor; 2 = poor; 3 = moderate; 4 = good; 5 = excellent; ***Microcharcoal Concentration: 0 = none, 1 = negligible, 2 = occasional, 3 = moderate, 4 = frequent, 5 = abundant

6. RESULTS & INTERPRETATION OF THE DIATOM ASSESSMENT

Diatoms were found to be absent in all samples under assessment, except for a very small assemblage encountered within sample 34.43 to 34.42m OD (Table 10). Here, corroded frustules of centric diatoms were relatively common, but the level of corrosion made it difficult to identify with confidence the genus, let alone species. It was tentatively concluded the corroded frustules were all of the same diatom, perhaps a diatom belonging to the genus *Ellerbeckia* or *Stephanodiscus*. Other occasional fragmented pieces of *Gyrosigma* sp and *Ulnaria* sp were observed. All other samples yielded no diatoms

During preparation it was noted that the samples all contained a relatively high sand content, in addition to there being an abundance of shell fragments. This may allude to relatively high depositional energy conditions, and/or some level of sediment reworking, which may account for the absence of diatoms within this sequence.

Table 10: Results of the diatom assessment

Depth (m OD)	Depth (m bgl)	Concentration	Preservation
35.23 to 35.22	3.02 to 3.03	0	0
35.07 to 35.06	3.18 to 3.19	0	0
34.91 to 34.90	3.34 to 3.35	0	0
34.75 to 34.74	3.50 to 3.51	0	0
34.59 to 34.58	3.66 to 3.67	0	0
34.43 to 34.42	3.82 to 3.83	1	1
34.27 to 34.26	3.98 to 3.99	0	0

Key: *Concentration: 0 = 0 grains; 1 = 1-75 grains, 2 = 76-150 grains, 3 = 151-225 grains, 4 = 226-300, 5 = 300+ grains per slide; **Preservation: 0 = absent; 1 = very poor; 2 = poor; 3 = moderate; 4 = good; 5 = excellent

7. RESULTS & INTERPRETATION OF THE MACROFOSSIL ASSESSMENT

The results of the assessment indicate a relatively low concentration of macrofossil remains within the samples (Table 11). Charcoal and wood fragments were recorded within both samples but were generally too small for identification. Waterlogged and charred seeds were also noted, but again these were in low concentrations and of low diversity. Complete mollusc shells were present in both samples, with abundant fragments noted. Such was the concentration of molluscs throughout the sequence, that a more detailed assessment of these remains was made (see section 8). No bone, insect, artefact or magnetic particles were recorded within the samples.

Table 11: Results of the macrofossil assessment

Depth (m OD)	Depth (m bgl)	Fraction (e.g. flot, residue, >300µm)	Description of matrix (%)	Charred					Waterlogged					Mollusca		Bone			Insects	Magnetic particles	Artefacts
				Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood (>4mm)	Wood (2-4mm)	Wood (< 2mm)	Chaff	Seeds	Whole	Fragments	Large	Small	Fragments			
34.60 to 34.55	3.65 to 3.70	>1mm	>95% organic		1	1	1+			1	1		1+	1	1						
		>300µm	~50% mollusc frag, ~50% organic			2	1+	1					1+	1	5						
34.35 to 34.30	3.90 to 3.95	>1mm	~100% organic			1	1+	1		1	1										
		>300µm	~100% organic			1	1+				5		2+		2						

Key: 0 = Estimated Minimum Number of Specimens (MNS) = 0; 1 = 1 to 25; 2 = 26 to 50; 3 = 51 to 75; 4 = 76 to 100; 5 = 101+

Diversity estimates: + = low diversity (1-5 types); ++ moderate diversity (5-15 types), +++ = high diversity (15+ types)

8. RESULTS & INTERPRETATION OF THE MOLLUSCAN ASSESSMENT

The results of the assessment record numerous opercula of *Bithynia* species in all samples. Not all were removed, and the numbers presented in Table 12 certainly under-represent this species. Similarly there were many very small valves of Pisids which were not removed. Most extracted specimens could be identified to species, but for some, especially *Vallonia* and the Pisids, species determination was not possible. The majority of the *Bithynia* opercula are from *B. tentaculata*, but *B. leachii* was also present. The great majority of the molluscs within the samples were extremely fragmented. Intact shells are infrequent, and it is clear that the figures given in the table grossly underestimate the total number of specimens in the original assemblages. However, the number of identifiable specimens permits a reasonable assessment of palaeo-environment during the period of deposition.

The molluscs within the nine samples are all consistent with overbank alluvium from the adjacent River Thames, there being a mixture of terrestrial and freshwater species in all samples. At the lower levels there is a predominance of freshwater molluscs, but in the upper levels there is an approximately even split between land and aquatic species.

Of the freshwater shells, *Bithynia* is strongly dominant, both *B. tentaculata* and *B. leachii*, species which are typical of large well-oxygenated water bodies consistent with deriving from the main river; *B. tentaculata* is not found in small stagnant pools (Boycott 1936: 140). In the entire assemblage only very few intact shells were found; these are relatively robust shells, and the degree of fragmentation suggests that this was a high-energy river during the entire period of deposition. Large numbers of *Bythinia* opercula were present, especially in the samples from 34.75 to 34.70 and 34.65 to 34.60m OD. Opercula are flat and 'two-dimensional,' so are easily transported by flowing water and are better able to survive than the 'three-dimensional' shells.

Valvata cristata is present in all but the uppermost sample, a species more associated with still or slow-flowing waters and in well-vegetated places with a muddy substrate such as clean backwaters. The implication is that the land adjacent to the river was wetland which regularly flooded. All the other aquatic species are consistent with the above, *Theodoxus fluviatilis*, *Ancylus fluviatilis* and *Pisidium amnicum* all being associated with moving water, while the other species in the assemblage are more catholic in their habitat preferences, being able to live in a wide variety of environments.

The terrestrial species support the freshwater findings. *Carychium minimum*, the Succineidae and *Zonitoides nitidus* all prefer wetland/marsh habitats. The Succineidae typically live in vegetation at the margins of water bodies, both flowing and stagnant. The dominant land molluscs are *Vallonia* spp.; it is

not possible to identify fragmented specimens of *V. excentrica* and *V. pulchella* to species, but it is likely that the majority of the fragments in these assemblages are more likely to be *V. pulchella*, a species favouring wetter ground than *V. excentrica* or *V. costata*, which are found in drier habitats (Evans 1972: 162).

Only in one sample (35.05 to 35.00m OD) were there any molluscs which require some shade (*Discus rotundatus*, *Vitrea crystallina* and *Aegopinella nitidula*) and these were only present as single specimens of each. Their presence implies that there was some shade-providing vegetation in the vicinity, but this is not necessarily woodland.

Other terrestrial species are few in number and are catholic in their environmental preferences, being able to live in habitats which are open or shady.

Table 12: Results of the molluscan assessment

Depth (m OD)	35.15 to 35.10	35.05 to 35.00	34.95 to 34.90	34.85 to 34.80	34.75 to 34.70	34.65 to 34.60	34.50 to 34.45	34.40 to 34.35	34.30 to 34.25
Depth (m bgl)	3.10 to 3.15	3.20 to 3.25	3.30 to 3.35	3.40 to 3.45	3.50 to 3.55	3.60 to 3.65	3.75 to 3.80	3.85 to 3.90	3.95 to 4.00
TERRESTRIAL									
<i>Carychium minimum</i>	4	3		4	1	9		1	
Succineidae			1				1		
<i>Cochlicopa</i> spp.		2		2	3				
<i>Vallonia costata</i>	1	1							
<i>Vallonia excentrica</i>			2	3					
<i>Vallonia pulchella</i>	1	2							
<i>Vallonia</i> spp.	12	20	3	13		10			7
<i>Discus rotundatus</i>		1		1					
<i>Vitrea crystallina</i>		1							
<i>Aegopinella nitidula</i>		3							
<i>Zonitoides nitidus</i>	1		1			2		1	
Slug plates	1	1							
<i>Trochulus hispidus</i>	2		2						
<i>Trochulus</i> spp.	4	3			1				
<i>Cepaea</i> spp.		frags		frags					frags
FRESHWATER									
<i>Theodoxus fluviatilis</i>						1			
<i>Valvata cristata</i>		9	1	8	9	19	13	4	23
<i>Bithynia opercula</i>	4	15	10	5	++++	++	4	5	6
<i>Galba truncatula</i>	4	2		1	1				
<i>Anisus leucostoma</i>						1			
<i>Gyraulus albus</i>		2		3	1	1	2	2	2
<i>Gyraulus crista</i>		6	1		4	5	4		1
<i>Hippeutis complanatus</i>	1								1
<i>Ancylus fluviatilis</i>		2						1	
<i>Pisidium amnicum</i>			1						
<i>Euglesa nitida</i>					1				
<i>Euglesa subtruncata</i>						2			
Unidentified pisids	1	4		6	2	7	6	6	3

9. DISCUSSION

The results of the original geoarchaeological deposit modelling (Simmonds & Batchelor, 2022) recorded a sequence of Seafood Chalk Formation and Newhaven Chalk Formation (undifferentiated) bedrock overlain by Late Devensian Shepperton Gravel, Holocene alluvial deposits and variable thicknesses of Made Ground, which in places is likely to have truncated the alluvial sequence significantly. Interestingly, there appears to be no evidence for the Langley Silt as recorded at the site by the British Geological Survey (Figure 1). This would imply that the alluvium extends further south than previously mapped.

The alluvial sequences observed at the 55 Vastern Road site appear to be less organic than those observed elsewhere along this part of the Thames Valley. However, silty clay material was recorded that included numerous shells, and woody material in QBH3. Whilst not a peat, this alluvial unit was certainly more organic, and similar in composition to that recorded in neighboring borehole BH102 from the Thames Cycle/Pedestrian Bridge site (Batchelor, 2014).

Subsequent radiocarbon dating of the organic-rich alluvium as part of this assessment report, demonstrates that it began forming from 4420-3980 cal BP (2470-2030 cal BC), representing accumulation from the late Neolithic / early Bronze Age period onwards. This is later than other sites within the neighbouring Kennet Valley, where similar organic, sandy deposits with plant remains and mollusca have been dated from the Mesolithic/Neolithic period at Kenavon Drive (Young, 2013; Figure 1), and further afield at Upton Nervet (Bell, pers. comm), Thatcham (e.g. Barnett, 2009) and Newbury (e.g. Ellis *et al.*, 2003). More recently, peat deposits from the Former Energis House site on Forbury Road have been dated from the beginning of the Mesolithic to middle of the Neolithic period as part of an undergraduate dissertation project. This is of note because the peat deposits at Forbury Road and organic-rich alluvium on the current site accumulated at almost identical elevations.

The molluscan assemblage from the Vastern Road sequence all indicate the deposits are representative of overbank alluvium. It is likely that the ground on which they were deposited remained wet throughout the period of deposition, but there were some islands of drier ground which could support terrestrial species, although these may have been washed in from surrounding areas. It is likely that the environment was a fen landscape providing islands of dry ground, but which was regularly flooded from the nearby river. The landscape is unlikely to have altered much over the whole period of deposition, but the presence of large numbers of *Bithynia* opercula at 34.75 to 34.60m OD may imply a wetter environment and the presence of a greater number of dry-land shells at 35.05 to 35.00m OD suggests a period when flooding may have been reduced. The diatoms provide no additional hydrological information as no identifiable remains were recorded.

The pollen evidence was also sparse, with remains only recorded in low concentrations within one sample at 34.43 to 34.42m OD. This limited assemblage was suggestive of a relatively open semi-aquatic environment supporting grasses, reeds, sedges, bur-reed and isolated alder trees. Meadow type communities may be indicated by many of these taxa together with ribwort plantain, dandelions and daisies. Woodland incorporating at least oak appears to be very limited or growing at some distance from the site; although hazel shrubland does appear to have been growing in the nearby vicinity. There are no definitive indications of human activity, but the open nature of the vegetation supports the results of the radiocarbon dating in suggesting a sequence likely to post-date late prehistoric woodland clearance.

Other earlier sequences from the Kennet Valley and further down river at Thames Valley Park (Barnes et al., 1997) do contain archaeological or geoarchaeological evidence of human activity. The lack of evidence within the Vastern Road sequence is not unsurprising however, given the thin nature of the organic-rich sediments and limited concentration of remains.

10. CONCLUSIONS & RECOMMENDATIONS

The combined results of the geoarchaeological and palaeoenvironmental fieldwork & assessment works have contributed to our understanding of the Holocene stratigraphic records for Reading and within this area of the Middle Thames Valley, providing a useful spatial and temporal comparison to records from sites such as Thames Valley Park (Barnes et al., 1997), Forbury Road (research in progress) and at various locations along the Kennet Valley. However, due to the lack of identifiable diatom taxa, and limited concentration of pollen and macrofossil remains, no further analysis of these proxies is possible. The mollusc assemblages provide a good indication of the palaeo-environment during deposition. Examination of the intervening samples would permit better understanding of the less obvious changes which have taken place and would give a clearer picture of fluctuations in the wetter/drier phases. However, it is unlikely to add much to the overall interpretation and so no further work is recommended. Similarly additional radiocarbon dating is unlikely to provide useful additional information as the organic-rich alluvium is thin (<40cm) and unlikely to represent a prolonged period of accumulation beyond the late Neolithic/early Bronze Age.

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