BEAR HOUSE, BEAR LANE, SOUTHWARK, LONDON SE1 (SITE CODE: BJH10): ENVIRONMENTAL ARCHAEOLOGICAL ASSESSMENT

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NON-TECHNICAL SUMMARY

CgMs Consulting Ltd commissioned Quaternary Scientific (QUEST) to carry out an environmental archaeological assessment of samples collected during a previous geoarchaeological borehole survey of land at Bear House, Bear Lane, Southwark, London (National Grid Reference: TQ 3185 8023; site code: BJH10). The following report aimed to assess the potential of two borehole samples for reconstructing the environmental history of the site and its environs. Boreholes Q.<BH1> and Q.<BH4> were located in the north-western and south-western corners of the site respectively.

The combined results of the borehole survey and environmental archaeological assessment have demonstrated that the sub-surface sediments at the site comprise basal Shepperton Gravel overlain by a sequence of Holocene alluvial sediments (including Peat), truncated by Made Ground. The underlying gravel surface decreases in elevation from north to south, and is overlain by Holocene alluvial sediments including very organic silts and peat. The alluvial sequence is generally thicker in the southern half of the site, both as a result of a lower gravel surface and thinner made ground. The assessment results (combined with previous work nearby) indicate that Peat initiation began earlier in the southern half of the site, towards the centre of the Bankside Channel. Towards the centre of the channel peat accumulation may have begun as early as the Middle Neolithic. During the period of peat accumulation the local environment consisted of wetland woodland, after which (probably during the Late Bronze Age) the local environment underwent a transition to open meadow-like conditions, during which time there is evidence for human activity in the local area. Archaeobotanical (plant) and zooarchaeological (animal) remains were poorly preserved in the organic horizons in both boreholes, but preservation was good in the alluvial deposits overlying these.

It has been recommended that environmental archaeological analysis is carried out on selected samples from boreholes Q.<BH1> and Q.<BH4>, together with detailed assessment of selected samples from the organic horizons. Further pollen counting is also recommended of existing samples from Bear Lane (Tan *et al*., 2008), where pollen preservation is sufficient to provide further information through the organic rich horizons, and which will contribute significantly to our understanding of the Bear House site and its environs.

INTRODUCTION

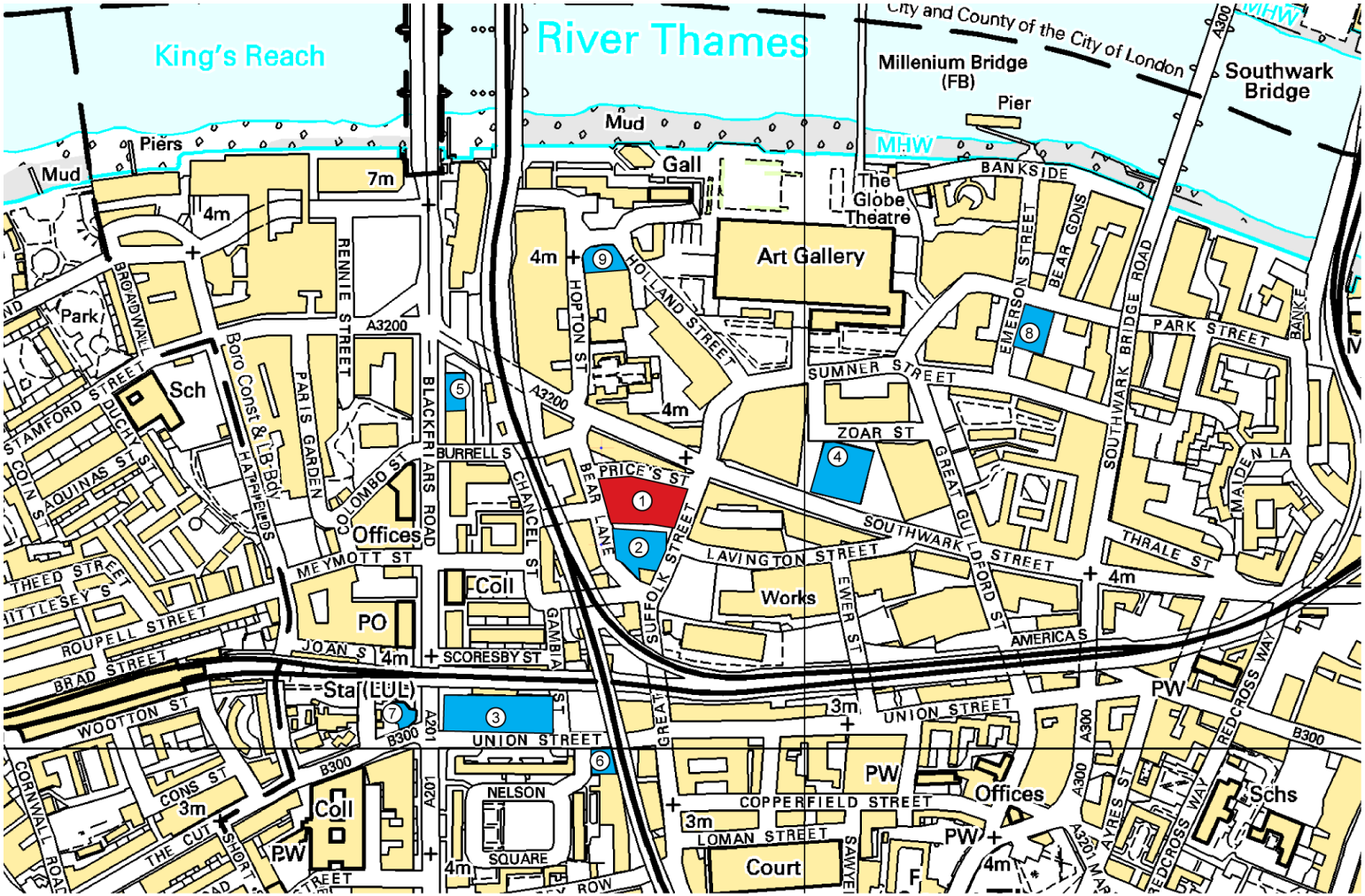
This report summarises the findings arising out of the environmental archaeological assessment undertaken by Quaternary Scientific (University of Reading) in connection with the proposed development at Bear House, Bear Lane, Southwark, London (National Grid Reference: TQ 3185 8023; Figures 1 and 2; site code: BJH10). The area of investigation is located on the floodplain of the estuarine Thames *ca*. 350m south of the modern waterfront, and *ca.* 150m south of the higher drier ground of the gravel terrace (NGR TQ 3185 8023; Figure 1; *ca*. 3.5m OD; Turner, 2009). The site is located within the Archaeological Priority Zone of Bankside, Bermondsey, Rotherhithe, as defined in the London Borough of Southwark's Unitary Development Plan (London Borough of Southwark, 1995).

A geoarchaeological borehole investigation was recently carried out, and the resultant sedimentary logs were integrated with previous geoarchaeological (Holden, 2007; Tan *et al.*, 2008) and geotechnical data (Ball, 2007) in order to produce a model of its depositional history (Young *et al.*, 2010; Figures 3 to 7; Tables 1 and 2; Appendix 1 and 2). The model indicated a sequence of Holocene alluvial sediment present across the whole site, resting on the surface of the Shepperton Gravel. The Holocene alluvial sequence consisted of a truncated Upper Silty Clay, generally underlain by a horizon of organic sediments, including Very Organic Silts and Peat. Where the Lower Alluvium is present, the Peat/Very Organic Silts and Gravel are separated by Silty Clay in which detrital plant material is common. The alluvial sequence is generally thicker in the southern half of the site, both as a result of a lower gravel surface and thinner Made Ground. The Shepperton Gravel surface itself slopes southward, confirming the expected presence of the Bankside Channel, a large and well documented palaeochannel alongside the River Thames (Dunwoodie, 2006). However, evidence from the addition of four new borehole records (Q.<BH1> to Q.<BH4>) and the development of a three-dimensional deposit model for the Bear House and Bear Lane sites indicate that the northern edge of the channel is located further south than previously suggested, and may be within the northern extent of the site itself; *ca.* 40m further south than indicated by Dunwoodie (2006).

Following the results of the deposit modelling exercise, a fuller investigation of the local and regional environments of the Holocene alluvial sediments was recommended to identify evidence of change or continuity through time at Bear House and to establish whether any significant spatial variability exists within the site. An assessment of two cores was recommended from Borehole Q.<BH1> and Q.<BH4>. The assessment of these core samples combined with the results of recent laboratory-based environmental archaeological investigations from Trench 7, Bear Lane (Figure 2; Tan *et al*., 2008) will represent a north-south transect across the projected course of the Bankside Channel.

The aim of this environmental archaeological assessment was to evaluate the potential of the sedimentary sequences for reconstructing the environmental history of the site and its environs, and specifically to address points made above. In order to achieve this aim, the environmental archaeological assessment consisted of the following techniques, as stated in the written scheme of investigation for this site (Batchelor, 2010):

1. Carrying out organic matter content determinations to enhance the results of the sedimentary descriptions
2. Radiocarbon dating of identified plant macrofossils to provide a provisional geochronological framework for the natural stratigraphic sequence
3. Assessment of the preservation and concentration of pollen grains and spores to provide a preliminary reconstruction of the vegetation history, and to detect evidence for human activities e.g. woodland clearance and cultivation
4. Assessment of the preservation and concentration of diatom frustules to provide a preliminary reconstruction of the hydrological history e.g. water quality and depth
5. Assessment of the preservation and concentration of macroscopic plant, insect and Mollusca remains from small bulk samples to provide a preliminary reconstruction of the vegetation history and general environmental context of the site.



① Bear House (BJH10)
② Bear Lane (BLZ07; Tan *et al.* 2008)
③ South Point (BKA02; Branch *et al.*, 2002)
④ St. Christopher's House (SCH03; London Archaeologist, 2004)
⑤ 231-241 Blackfriars Rd (BFX08; Batchelor *et al.*, 2008)
⑥ Jubillee Line, Union St (UNL08; Sidell *et al.*, 2000)
⑦ Joan St (JOA91; Sidell *et al.*, 2000)
⑧ 135 Park St (PKP09; Batchelor and Young, 2009)
⑨ 44-47 Hopton St (HNT94; London Archaeologist, 2001)

Figure 1: Location of Bear House, Bear Lane, Southwark, London SE1 and nearby past excavation sites

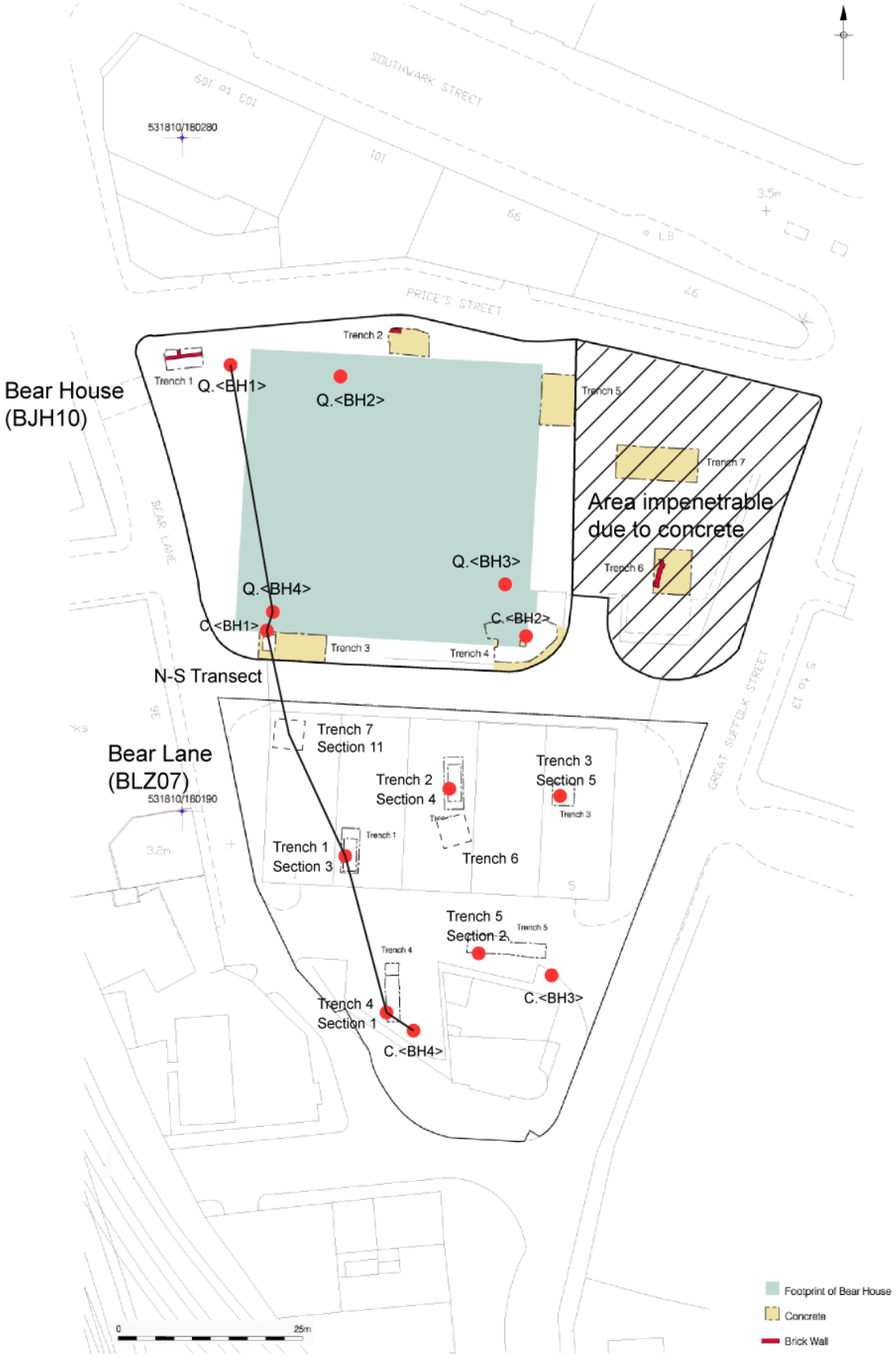


Figure 2: Bear House (this study) borehole locations and Bear Lane (previous study) column sample and borehole locations, Bear House, Bear Lane, Southwark, London SE1

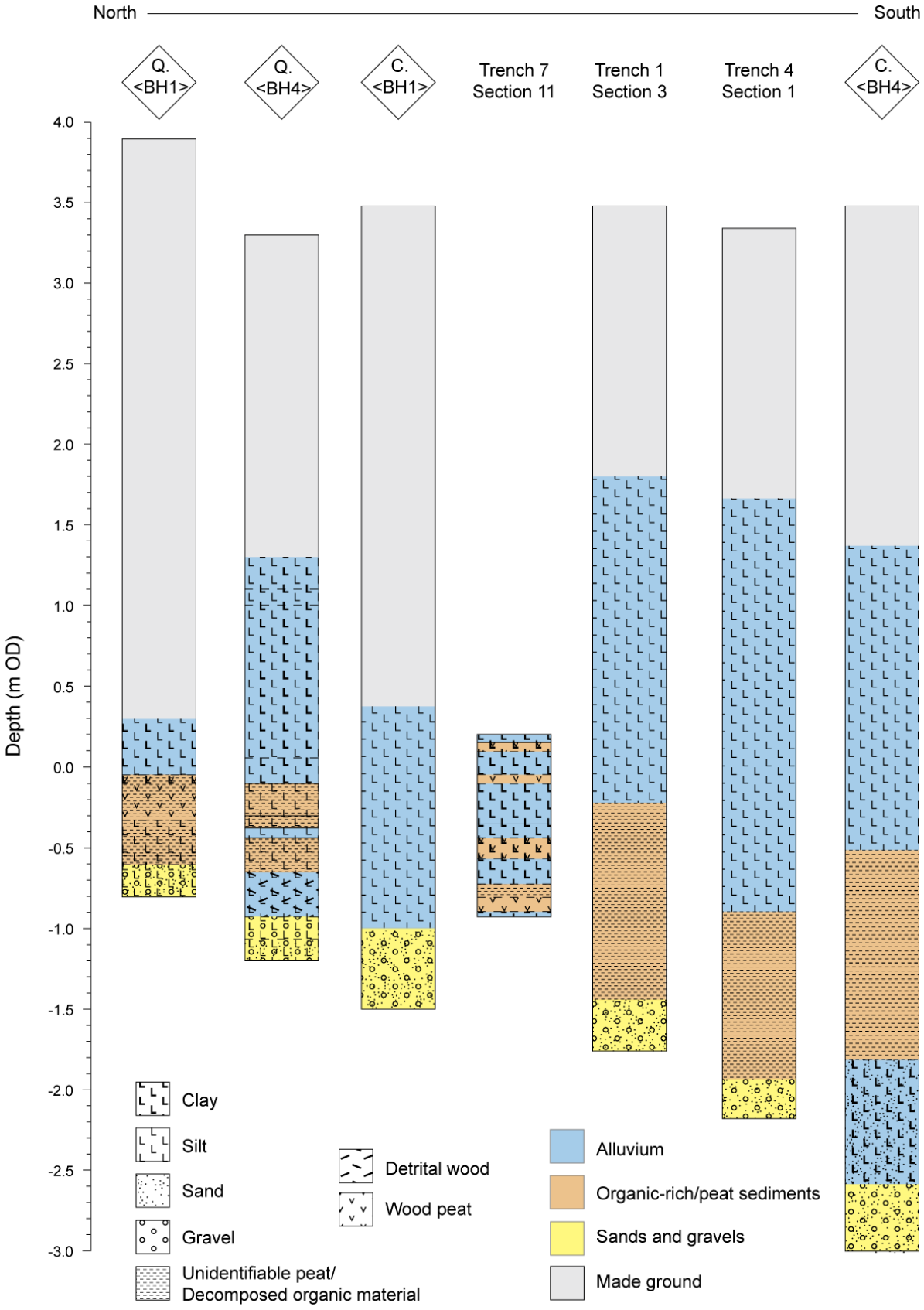


Figure 3: Lithostratigraphic diagram of a north-south transect of boreholes across Bear House (BJH10) and Bear Lane (BLZ07), Southwark, London SE1

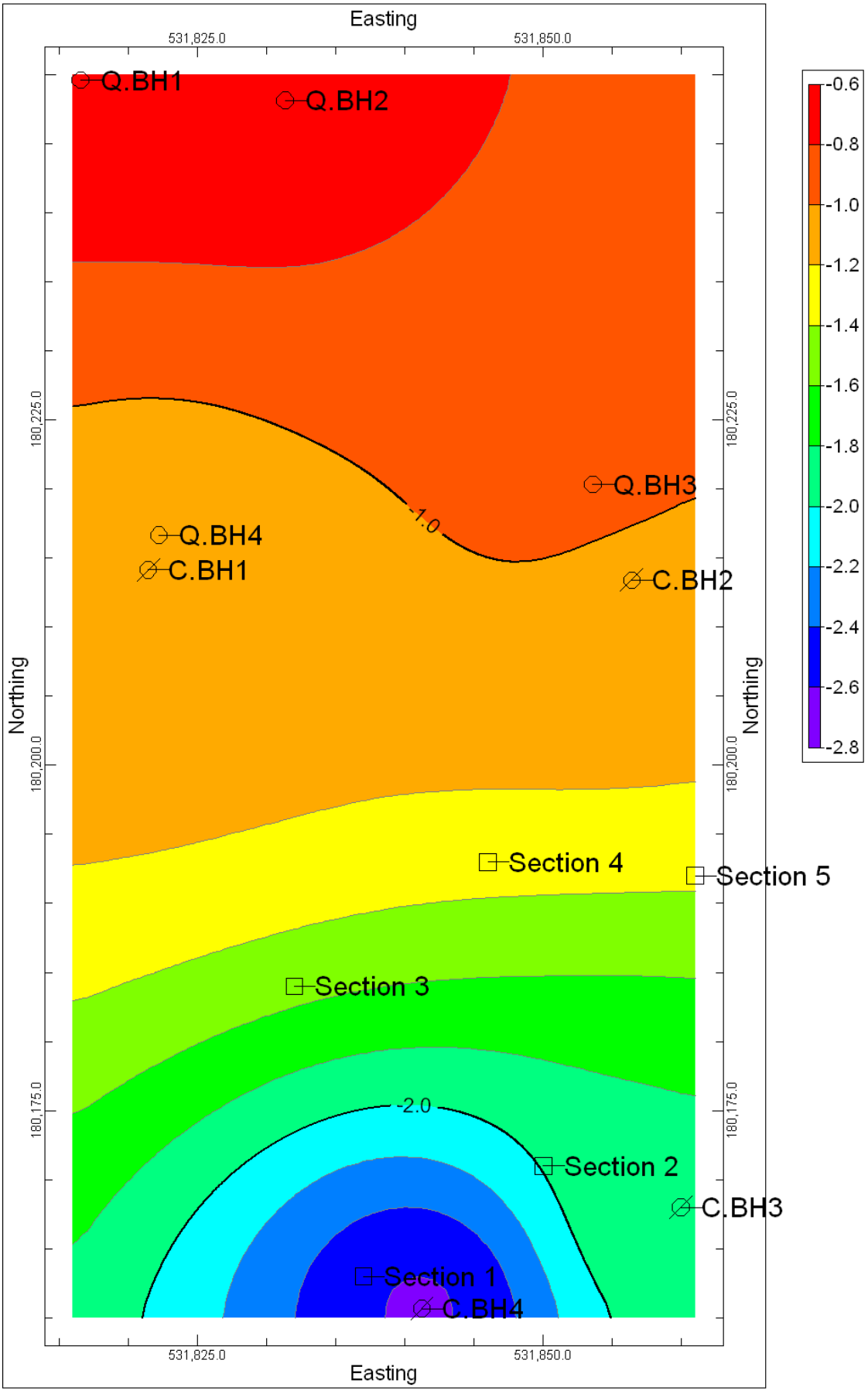


Figure 4: Modelled surface of the Shepperton Gravel (m OD); Unit 1

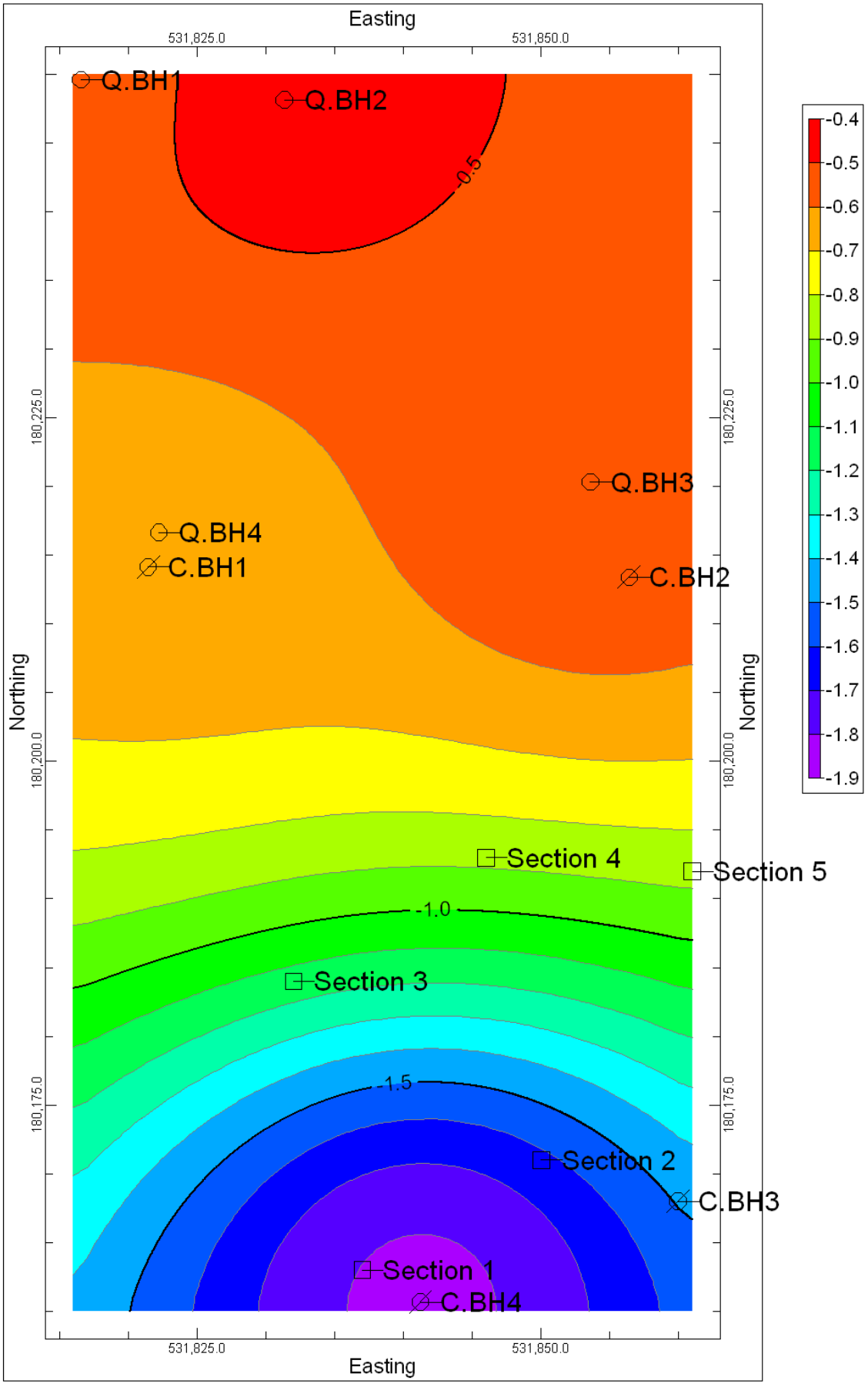


Figure 5: Modelled surface of the Lower Alluvium (m OD); Unit 2

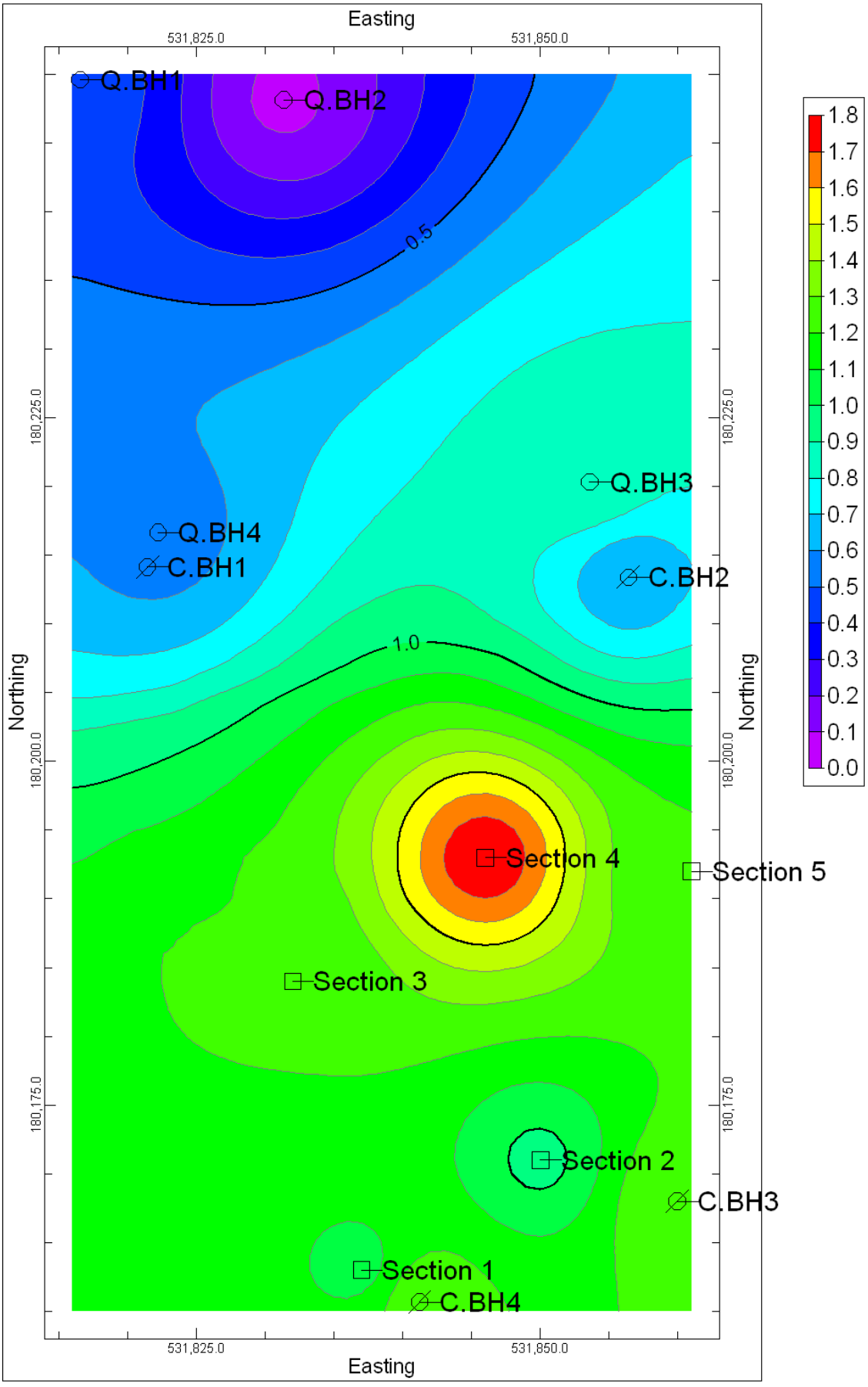


Figure 6: Modelled thickness of the Peat/Very Organic Horizons (m); Unit 3

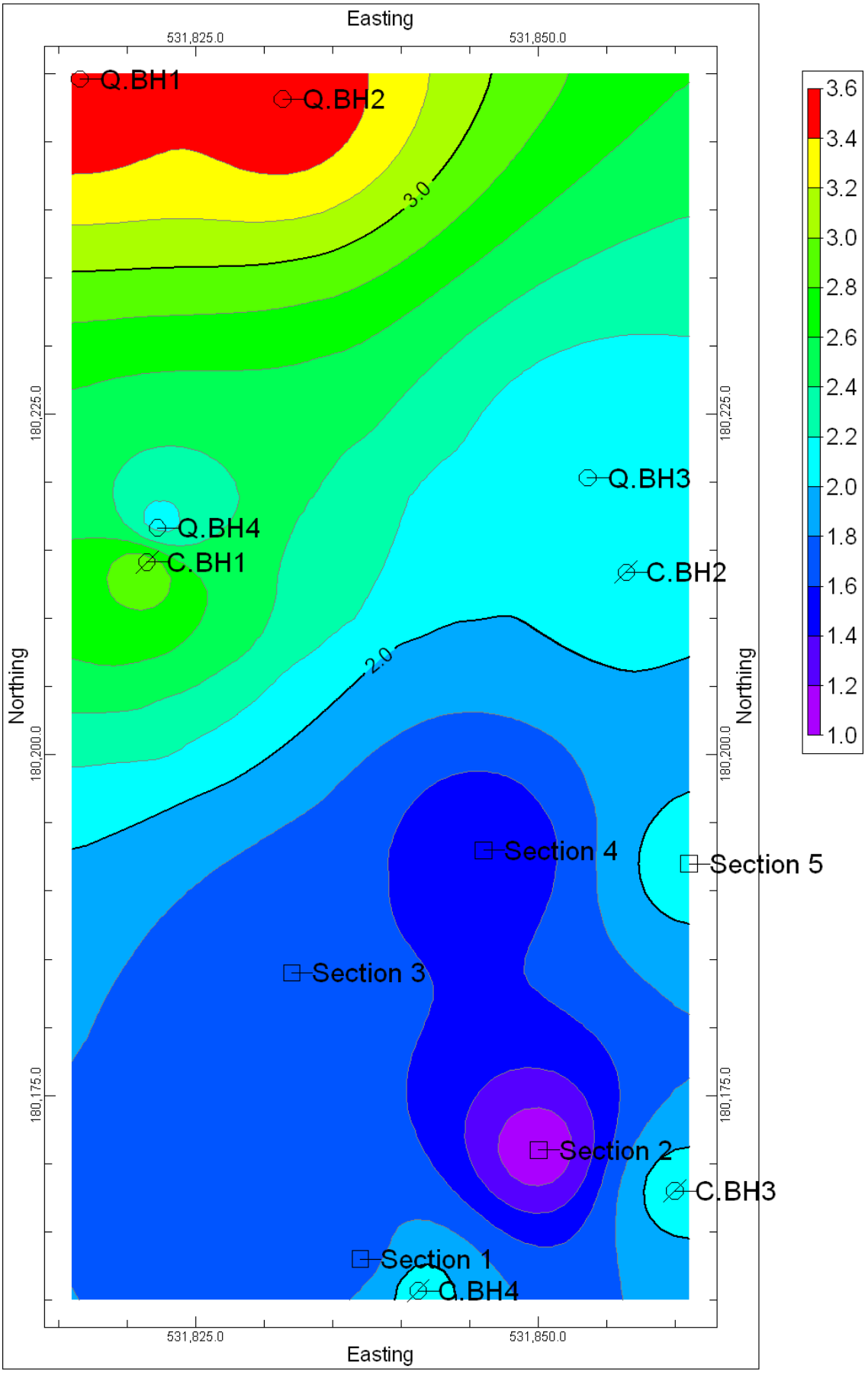


Figure 7: Modelled thickness of the Made Ground (m); Unit 5

METHODS

Previous investigations (field investigations; lithostratigraphic descriptions and deposit modelling)

Four boreholes (Q.<BH1> to Q.<BH4>) were put down at the site in May 2010 (Figure 2). Boreholes were recovered using cable percussion coring, carried out by Tony Bedford Drilling Services, and monitored by a member of Quaternary Scientific staff. The spatial attributes of each proposed borehole location were recorded in the field. These locations were adjusted following difficulties penetrating the made ground and relocated using GIS software (Appendix 1 and Figure 2).

The lithostratigraphy of boreholes Q.<BH1> to Q.<BH4> was described in the laboratory using standard procedures for recording unconsolidated sediment and organic sediments, noting the physical properties (colour), composition (gravel, sand, clay, silt and organic matter) and inclusions (e.g. artefacts) (Tröels-Smith, 1955). The procedure involved: (1) cleaning the samples with a spatula or scalpel blade and distilled water to remove surface contaminants; (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); (4) recording the degree of peat humification and (5) recording the unit boundaries e.g. sharp or diffuse. The results are illustrated in Figures 3 and 7, with the descriptions of selected boreholes Q.<BH1> and Q.<BH4> presented in Tables 1 and 2, and the remaining boreholes in Appendix 2.

The deposit model was based on a review of thirteen stratigraphic records incorporating the 4 new Quaternary Scientific geoarchaeological boreholes (Tables 1 and 2 and Appendix 2), 4 geotechnical boreholes from Bear Lane (Ball, 2007) and 5 descriptive records from archaeological sections (Holden, 2007). Sedimentary units from the boreholes were classified into the following five groupings: (1) Shepperton Gravel; (2) Lower Alluvium; (3) Peat/Organic horizons; (4) Upper Alluvium, and (5) Made Ground. The classified data for groups 1-5 were then input into a database with the RockWorks 2006 geological utilities software. Models of surface height (using a nearest neighbour routine) were generated for each of these stratigraphic groups; the surface height of the Shepperton Gravel and Lower Alluvium are displayed in Figures 4 and 5. Thickness of the Peat/Very Organic horizons (Unit 5; Figure 6) and Made Ground (Unit 3; Figures 7) were also modelled (also using a nearest neighbour routine). Because the boreholes are not uniformly distributed over the area of investigation, the reliability of the models generated using RockWorks is variable. In general, more records are available in the southern extent of the modelled area. Because of the

'smoothing' effect of the modelling procedure, the modelled levels of stratigraphic contacts may differ slightly from the levels recorded in borehole logs and section drawings.

It is also important to note that two sets of borehole records 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. The cores from the 4 new boreholes (Q.<BH1> to Q.<BH4>) represent the most detailed record of the sediment sequences, and follow the same descriptive techniques.

Organic matter determinations

Fourteen sub-samples from borehole Q.<BH1> and thirty-one sub-samples from borehole <Q.<BH4> were taken for determination of the organic matter content (Tables 3 and 4; Figure 8*)*. These records were important as they can identify increases in organic matter possibly associated with more terrestrial conditions. The organic matter content was determined by standard procedures involving: (1) drying the sub-sample at 110^0C for 12 hours to remove excess moisture; (2) placing the sub-sample in a muffle furnace at 550°C for 2 hours to remove organic matter (thermal oxidation), and (3) re-weighing the sub-sample obtain the 'loss-on-ignition' value (see Bengtsson and Enell, 1986).

Range-finder radiocarbon dating

Two sub-samples of wood extracted from near the top and base of the Peat in each borehole were submitted for AMS radiocarbon dating to Beta Analytic INC, Radiocarbon Dating Laboratory, Florida, USA. The results have been calibrated using OxCal v4.0.1 Bronk Ramsey (1995, 2001 and 2007) and IntCal04 atmospheric curve (Reimer *et al*., 2004). The results are displayed in Table 5.

Pollen assessment

Eight sub-samples from borehole Q.<BH1> and nineteen sub-samples from borehole Q.<BH4> were extracted for an assessment of pollen content. The pollen was extracted as follows: (1) sampling a standard volume of sediment (1ml); (2) adding two tablets 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 (>125µ); (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 on four transects (10% of the slide; Tables 6 and 7).

Diatom assessment

Six sub-samples from borehole Q.<BH1> and eight sub-samples from Q.<BH4> were extracted for the assessment of diatoms. The diatom extraction involved the following procedures (Battarbee *et al.,* 2001):

1. Treatment of the sub-sample (0.2g) with Hydrogen peroxide (30%) to remove organic material and Hydrochloric acid (50%) to remove remaining carbonates
2. Centrifuging the sub-sample at 1200 for 5 minutes and washing with distilled water (4 washes)
3. Removal of clay from the sub-samples in the last wash by adding a few drops of Ammonia (1%)
4. Two slides prepared, each of a different concentration of the cleaned solution, were fixed in mounting medium of suitable refractive index for diatoms (Naphrax)

Diatom floras and taxonomic publications were consulted to assist with diatom identification; these include Hendey (1964), Werff & Huls (1957-1974), Hartley *et al.* (1996) and Krammer & Lange-Bertalot (1986-1991). Diatom species' salinity preferences are discussed using the classification data in Denys (1992), Vos & de Wolf (1988, 1993) and the halobian groups of Hustedt (1953, 1957: 199), these salinity groups are summarised as follows (Tables 8 to 11):

1. Polyhalobian: >30 g l^{-1}
2. Mesohalobian: 0.2-30 g l^{-1}
3. Oligohalobian - Halophilous: optimum in slightly brackish water
4. Oligohalobian - Indifferent: optimum in freshwater but tolerant of slightly brackish water
5. Halophobous: exclusively freshwater
6. Unknown: taxa of unknown salinity preference.

Macrofossil assessment

A total of thirteen small bulk samples (6 from borehole Q.<BH1> and 7 from borehole Q.<BH4>) were extracted for the recovery of macrofossil remains including waterlogged plant macrofossils, waterlogged wood, insects and Mollusca. The extraction process involved

the following procedures: (1) removing a sample up to 10cm in thickness; (2) measuring the sample volume by water displacement, and (3) 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 (Tables 12 and 13).

Preliminary identifications of the archaeobotanical remains (waterlogged plant macrofossils and wood), have been made using modern comparative material and reference atlases (Cappers *et al.* 2006, Hather 2000, Schweingruber 1990, Schoch *et al*. 2004). Nomenclature used follows Stace (2005). The quantities of waterlogged seeds and wood were recorded for each sample, with identifications of the main taxa (Tables 14 to 17). Preliminary identifications of the insects were made under a low powered stereo-microscope, and the concentration and state of preservation noted (Table 18 and 19). Identification and interpretation was based on modern comparative material and reference atlases (e.g. Kloet and Hincks, 1964-77; Kenward *et al.* 1986; Duff, 2008).

RESULTS AND INTERPRETATION OF THE LITHOSTRATIGRAPHIC DESCRIPTIONS AND ORGANIC MATTER CONTENT DETERMINATIONS

The results of the lithostratigraphic descriptions for boreholes Q.<BH1> and Q.<BH4> (Tables 1 and 2, and Figure 8) have been reported previously (Young *et al*., 2010), and as stated above indicate a sequence of Shepperton Gravel (Unit 1) overlain by Holocene Alluvium incorporating a silty Lower Alluvium (Unit 2), Peat or very organic silt (Unit 3), and Upper Silty Clay Alluvium (Unit 4). The sequences were truncated by Made Ground (Unit 5). Borehole Q.<BH1> contained 0.23m of Peat overlying 0.22m of Very Organic Silt, while Q.<BH4> contained 0.08m of Peat overlain by 0.20m of Very Organic Silt. The organic units in both boreholes were present between ca. -0.10 and -0.40m OD.

Quantification of the organic matter content by Loss-on-Ignition allowed further detail to be added to the lithostratigraphic descriptions (Tables 3 and 4 and Figure 8). The results revealed that organic matter values were consistently low within Units 1, 2, and 5 in both boreholes (generally <20%). As expected, the highest values were recorded within the Peat and Very Organic Units (generally >40% in both boreholes). These results largely confirm the records from the sedimentary descriptions, but indicate that frequent influxes of mineral-rich sediment took place during the period of peat formation.

Table 1: Lithostratigraphic description, borehole <BH1>, Bear House, Bear Lane, Southwark, London SE1

Depth (m OD)	Unit number	Composition
3.90 to 0.30	5	Made ground.
0.30 to -0.05	4	Gley 1 3/10Y; Ag2 As2; very dark greenish grey silt and clay. Diffuse contact into:
-0.05 to -0.10	3	10YR 3/2; Ag2 As1 Sh1 Dh+; very dark greyish brown clayey silt with disintegrated organic matter and traces of detrital herbaceous material.
-0.10 to -0.33	3	2.5YR 2.5/1; Sh3 Tl[1]1 Ag+; Humo. 3; well humified reddish black woody peat with traces of silt. Diffuse contact into:
-0.33 to -0.55	3	10YR 3/2; Ag2 Sh2 Dh+ Dl+; very dark greyish brown very organic silt with traces of detrital herbaceous material and detrital wood.
-0.55 to -0.60	3	Gley 1 4/10Y; Ag2 As1 Sh1 Gg+; dark greenish grey clayey silt with disintegrated organic matter. Occasional gravel clasts 3-4mm. Diffuse contact into:
-0.60 to -0.80	1	Gley 1 3/10Y; Gg2 Ag1 Ga1 Dl+; very dark greenish grey silty sandy gravel with traces of detrital wood. Gravel clasts 4-40mm.

Table 2: Lithostratigraphic description, borehole <BH4>, Bear House, Bear Lane, Southwark, London SE1

Depth (m OD)	Unit number	Composition
3.30 to 1.30	5	Made ground.
1.30 to 1.10	4	2.5Y 4/4; As3 Ag1; olive brown mottled orangey brown silty clay with iron nodules. Diffuse contact into:
1.10 to 1.00	4	2.5Y 3/2; As3 Ag1; very dark greyish brown silty clay. Diffuse contact in to:
1.00 to 0.05	4	2.5Y 2.5/1; As3 Ag1 Sh+; black silty clay with traces of disintegrated organic matter. Mollusc fragments common. Diffuse contact into:
0.05 to -0.10	4	2.5Y 2.5/1; As3 Ag1 Sh+ Dl+; black silty clay with traces of disintegrated organic matter and detrital wood. Mollusc fragments common. Sharp contact into:
-0.10 to -0.30	3	10YR 2/1; Ag2 Sh2 Dl+ As+; black very organic silt with traces of detrital wood and clay. Sharp contact into:
-0.30 to -0.38	3	2.5YR 2.5/1; Sh3 Ag1 Tl[2]+; Humo. 3/4; well humified reddish black silty peat with traces of wood. Sharp contact into:
-0.38 to -0.43	3	5Y 2.5/1; Ag4 Sh+; black silt with traces of disintegrated organic matter. Sharp contact into:
-0.43 to -0.65	3	2.5YR 2.5/1; Sh3 Ag1 Tl[2]+ Th[3]+; Humo. 3; well humified silty peat with traces of wood and herbaceous material.
-0.65 to -0.92	2	5Y 2.5/2; Ag3 Dl1; black silt with detrital wood. Diffuse contact into:
-0.92 to -1.08	1	Gley 1 4/10Y; Ag3 Gg1; dark greenish grey silt with gravel. Clasts flint, 5-40mm. Diffuse contact into:
-1.08 to -1.20	1	5Y 4/2; Gg2 Ga1 Ag1; olive grey silty sandy gravel.

Table 3: Results of the organic matter determinations of Borehole Q.<BH1>, Bear House, Bear Lane, Southwark, London SE1

Depth (m OD)		Organic matter (%)
From	To	
0.25	0.24	14.30
0.17	0.16	16.43
0.09	0.08	19.26
0.01	0	20.83
-0.07	-0.08	20.54
-0.15	-0.16	25.94
-0.23	-0.24	45.54
-0.31	-0.32	57.75
-0.39	-0.4	33.11
-0.47	-0.48	34.68
-0.55	-0.56	24.24
-0.63	-0.64	28.12
-0.71	-0.72	7.45
-0.79	-0.8	4.13

Table 4: Results of the organic matter determinations of Borehole Q.<BH4>, Bear House, Bear Lane, Southwark, London SE1

Depth (m OD)		% Organic matter
From	To	
1.29	1.28	15.18
1.21	1.20	14.30
1.13	1.12	10.51
1.05	1.04	7.59
0.97	0.96	6.75
0.89	0.88	6.46
0.81	0.80	11.39
0.73	0.72	12.73
0.65	0.64	10.78
0.57	0.56	13.19
0.49	0.48	15.97
0.41	0.40	9.59
0.33	0.32	14.09
0.25	0.24	12.53
0.17	0.16	11.84
0.09	0.08	20.73

Depth (m OD)		% Organic matter
From	To	
0.01	0.00	18.58
-0.07	-0.08	18.31
-0.15	-0.16	43.46
-0.23	-0.24	17.11
-0.31	-0.32	21.08
-0.39	-0.4	19.52
-0.47	-0.48	45.51
-0.55	-0.56	44.42
-0.63	-0.64	41.51
-0.71	-0.72	33.96
-0.79	-0.80	34.65
-0.87	-0.88	24.85
-0.95	-0.96	7.89
-1.03	-1.04	3.19
-1.11	-1.12	24.04

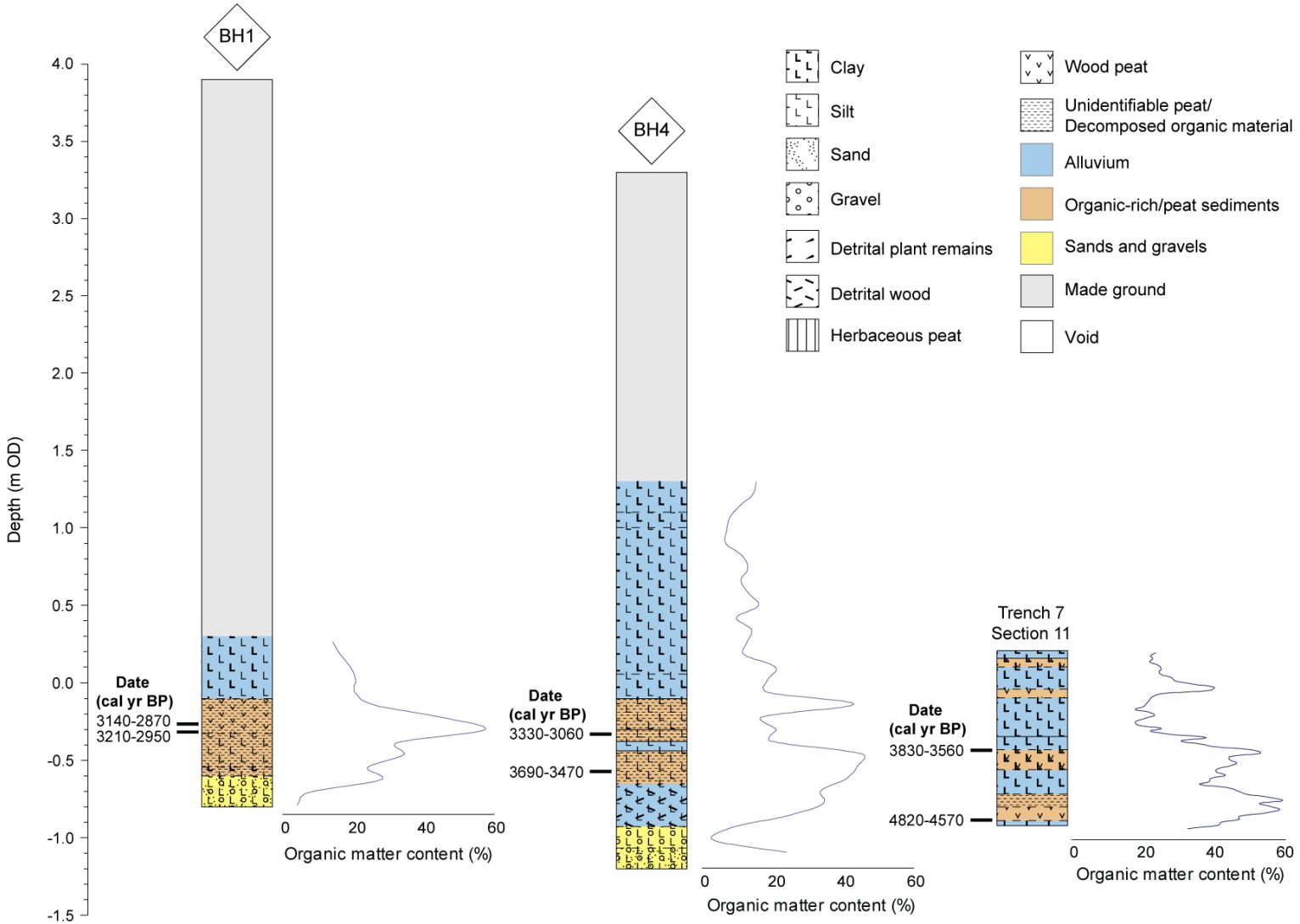


Figure 8: Results of the borehole Q.<BH1> and Q.<BH4>, Bear House, Bear Lane, Southwark, London SE1 lithostratigraphic analysis, incorporating lithostratigraphic descriptions and organic matter content, plotted with associated radiocarbon dates. The results of the Bear Lane lithostratigraphic and chronological analysis are also integrated

RESULTS AND INTERPRETATION OF THE RADIOCARBON DATING

A very small piece of *Corylus avellana*/*Alnus glutinosa* roundwood from the near base of the Peat (-0.31 to -0.32m OD; Unit 3) in borehole Q.<BH1> has been radiocarbon dated to 3210-2950 cal yr BP, and a fragment of *Corylus avellana*/*Alnus glutinosa*, cf *Alnus glutinosa* from the near top of the Peat (-0.23 to -0.24m OD; Unit 3) has been dated to 3140-2870 cal yr BP. Both samples were extracted either side of a 60% peak in organic matter content.

A fragment of *Corylus avellana*/*Alnus glutinosa*, cf *Alnus glutinosa* roundwood from the near base of the Peat (-0.58 to -0.59m OD; Unit 3) in borehole Q.<BH4> has been radiocarbon dated to 3690-3470 cal yr BP, and a fragment of unidentifiable bark from the near top of the Peat (-0.32 to -0.33m OD; Unit 3) has been dated to 3330-3060 cal yr BP.

The δ13C (‰) values are consistent with that expected for peat sediment, and there is no evidence for mineral or biogenic carbonate contamination. The results indicate that the Peat in borehole Q.<BH4> dates to the Early to Middle Bronze Age, and is slightly older than the Peat in Q.<BH1>, which dates to the Middle to Late Bronze Age.

Table 5: Results of the radiocarbon dating of boreholes Q.<BH1> and Q.<BH4>, Bear House, Bear Lane, Southwark, London SE1

Laboratory code / Method	Borehole number	Material and location	Depth (m OD)	Uncalibrated radiocarbon years before present (yr BP)	Calibrated age BC/AD (BP) (2-sigma, 95.4% probability)	δ13C (‰)
Beta-281885 AMS	Q.<BH1>	*Corylus avellana*/*Alnus glutinosa*, cf *Alnus glutinosa;* top of Peat (Unit 3)	-0.23 to -0.24	2870 ± 40	1190-1140 and 1140-920 cal BC (3140-3090 and 3090-2870 cal BP)	-28.0
Beta-281886 AMS	Q.<BH1>	*Corylus avellana*/*Alnus glutinosa*, cf *Alnus glutinosa* roundwood; base of Peat (Unit 3)	-0.31 to -0.32	2920 ± 40	1260-1000 cal BC (3210-2950 cal BP)	-29.6
Beta-281887 AMS	Q.<BH4>	Unidentifiable bark; top of Peat (Unit 3)	-0.32 to -0.33	2990 ± 40	1380-1330 and 1330-1120 cal BC (3330-3280 and 3280-3060 cal BP)	-29.2
Beta-281888 AMS	Q.<BH4>	*Corylus avellana*/*Alnus glutinosa*, cf *Alnus glutinosa* roundwood; base of Peat (Unit 3)	-0.58 to -0.59	3350 ± 40	1740-1520 cal BC (3690-3470 cal BP)	-29.5

RESULTS AND INTERPRETATION OF THE POLLEN ASSESSMENT

Eight sub-samples from borehole Q.<BH1> and nineteen sub-samples from borehole Q.<BH4> were extracted for an assessment of pollen content.

Borehole Q.<BH1>

The results of the pollen assessment indicate that a moderate amount of well-preserved pollen was present in the sample extracted from Unit 1 (Shepperton Gravels). The assemblage included tree and shrub taxa including *Alnus* (alder) and *Corylus* type (e.g. hazel); herbaceous taxa including *Plantago lanceolata* (ribwort plantain), *Cirsium* type (e.g. spear thistle) and Lactuceae (dandelion family); and aquatic and spore taxa including *Sparganium* type (bur-reed) and *Pteridium aquilinum* (bracken). This assemblage is indicative of a damp, open herb-dominated environment with some alder wetland woodland. Pollen is generally very poorly preserved in the Shepperton Gravel, and thus a moderate concentration of remains suggests that it could either be reworked, or towards the end of its deposition.

The pollen concentration and preservation of the five samples from Unit 3 (Peat or Very Organic units) was low to moderate, except in sample -0.31 to -0.32, in which no pollen grains were found. In general, the assemblage from Unit 3 was dominated by tree, shrub and herbaceous taxa including: *Quercus* (oak), *Alnus* (alder), *Ulmus (*elm*), Corylus* type (e.g. hazel), Lactuceae (dandelion family), Apiaceae (carrot family) and *Ranunculus* type (creeping buttercup). Aquatic and spore taxa were common including *Typha latifolia* (bulrush), *Pteridium aquilinum* (bracken) and *Dryopteris* type (buckler ferns). Due to the limited extent of the assemblage, only tentative reconstructions of the former environment can be made, but all taxa are typical of plants which grow in wetland environments. No definitive indicators of human activity or the nearby growth of saline taxa were recorded.

The pollen preservation and concentration of the two samples from Unit 4 (Upper Alluvium) was good to excellent. The assemblage from this Unit was dominated by herbaceous taxa including Poaceae (grass family), Lactuceae (dandelion family), *Chenopodium* type (e.g. fat hen), *Filipendula* (meadow sweet), Apiaceae (carrot family), *Cirsium* type (e.g. spear thistle) and Cyperaceae (sedge family). Tree and shrub taxa were limited, but included *Alnus* (alder), *Quercus* (oak), *Pinus* (pine) *Betula* (birch) and *Corylus* type (e.g. hazel). Aquatic and spore taxa were common including *Dryopteris* type (buckler ferns), *Pteridium aquilinum* (bracken) and *Sparganium* type (bur-reed). This assemblage is indicative of a damp, open environment dominated by herbaceous, fern and aquatic taxa. The provisional identification of *Cereale* and *Chenopodium* type may be indicative of nearby human activity, although pollen

taphonomic issues specifically associated with coastal lowland wetlands (e.g. determining the environment of origin) recommend caution in the interpretation of these taxa. No definitive indicators for the nearby growth of saline taxa were recorded during the course of the assessment. Micro-charcoal was present in both samples.

Borehole Q.<BH4>

The results of the pollen assessment indicate that a low concentration of well-preserved pollen was present in the sample extracted from Unit 2 (Lower Alluvium). The assemblage included tree and shrub taxa *Alnus* (alder) and *Corylus* type (e.g. hazel).

In general, although preservation was excellent, the pollen concentration of the seven samples extracted from Unit 3 (Peat and Very Organic units) was poor or very poor. The assemblage was dominated by aquatic and spore taxa including *Dryopteris* type (buckler ferns) and *Polypodium vulgare* (polypody). Herbaceous taxa were common, including Poaceae (grass family), Cyperaceae (sedge family), Lactuceae (dandelion family), *Aster* type (e.g. daisy) and *Chenopodium* type (e.g. fat hen). Tree and shrub taxa included *Alnus* (alder), *Quercus* (oak) and *Corylus* type (e.g. hazel). Similarly to Unit 3 in borehole Q.<BH4>, only tentative reconstructions of the former environment can be made due to the limited assemblage, but all preserved taxa are typical of plants which grow in wetland environments Micro-charcoal was present in low concentrations in four of the seven samples.

The pollen concentration and preservation of the nine samples taken from Unit 4 (Upper Alluvium) was generally good to excellent. The assemblage was dominated by herbaceous taxa including: Poaceae (grass family), Cyperaceae (sedge family), Lactuceae (dandelion family), *Chenopodium* type (e.g. fat hen), *Sinapis* type (e.g. white mustard), *Artemisia* (e.g. mugwort), *Anthemis* type (e.g. stinking chamomile) and cf. *Cereale* type (e.g. wheat). Aquatic and spore taxa were common, including *Dryopteris* type (buckler ferns), *Pteridium aquilinum* (bracken), *Polypodium vulgare* (polypody), *Sparganium* type (bur-reed), cf. *Typha latifolia* (bur-reed) and cf. *Lemna* (duckweed). Tree and shrub taxa were limited, but included *Alnus* (alder), *Pinus* (pine), *Tilia* (lime), *Quercus* (oak), and *Corylus* type (e.g. hazel). The assemblage is indicative of a wet, open environment dominated by herbaceous and aquatic vegetation. The provisional identification of *Cereale* and *Chenopodium* type maybe indicative of nearby human activity, although pollen taphonomic issues specifically associated with coastal lowland wetlands (e.g. determining the environment of origin) recommend caution in the interpretation of these taxa. The provisional identification of *Armeria maritima* (cf. thrift) may indicate the local growth of saline taxa. Micro-charcoal was present in all but one sample.

Table 6: Results of the pollen assessment of borehole Q.<BH1>, Bear House, Bear Lane, Southwark, London SE1

Depth (m OD)		Unit number	Main pollen taxa			Concentration 0 – 5	Preservation 0- 5	Microcharcoal 0 - 5
From	To		Latin name	Common name	Number			
0.17	0.16	4	*Alnus*	alder	8	5	4	2
			Pinus	pine	2			
			Quercus	oak	3			
			Corylus type	e.g. hazel	1			
			Cyperaceae	sedge family	6			
			Poaceae	grass family	18			
			Lactuceae	dandelion family	5			
			Chenopodium type	e.g. fat hen	2			
			cf. *Cereale* type	e.g. wheat	1			
			Apiaceae	carrot family	1			
			Sparganium type	bur-reed	1			
			Dryopteris type	buckler ferns	8			
			Polypodium vulgare	polypody	1			
			Lycopodium clavatum	clubmoss spike	29			
0.01	0.00	4	*Betula*	birch	1	3	3-4	2
			Quercus	oak	1			
			Alnus	alder	5			
			Corylus type	e.g. hazel	2			
			Chenopodium type	e.g. fat hen	1			
			Lactuceae	dandelion family	3			
			Caryophyllaceae	pink family	2			
			Cirsium type	e.g. spear thistle	1			
			Poaceae	grass family	2			
			Pteridium aquilinum	bracken	1			
			Dryopteris type	buckler ferns	8			
			Filipendula	meadowsweet	1			
			Lycopodium clavatum	clubmoss spike	17			
-0.15	-0.16	3	*Quercus*	oak	1	2	4	2
			Alnus	alder	2			
			cf. *Ulmus*	elm	1			
			Corylus type	e.g. hazel	2			

			Apiaceae *Aster* type *Polypodium vulgare* Lactuceae *Lycopodium clavatum*	carrot family daisy polypody dandelion family clubmoss spike	1 2 1 1 15			
-0.23	-0.24	3	*Quercus* *Alnus* *Corylus* type *Chenopodium* type Lactuceae *Ranunculus* type *Dryopteris* type *Pteridium aquilinum* *Lycopodium clavatum*	oak alder e.g. hazel e.g. fat hen dandelion family e.g. creeping buttercup buckler ferns bracken clubmoss spike	1 6 1 1 1 1 4 1 15	2-3	4	0
-0.31	-0.32	3	*Lycopodium clavatum*	clubmoss spike	3	0	-	0
-0.39	-0.40	3	*Quercus* *Alnus* *Dryopteris* type *Typha latifolia* Apiaceae Lactuceae *Lycopodium clavatum*	oak alder buckler ferns bulrush carrot family dandelion family clubmoss spike	2 1 2 1 1 2 20	1-2	4	2
-0.47	-0.48	3	Poaceae *Lycopodium clavatum*	grass family clubmoss spike	1 6	1	3	2
-0.63	-0.64	1	*Alnus* *Corylus* type *Cirsium* type *Plantago lanceolata* *Sparganium* type Lactuceae *Pteridium aquilinum* *Lycopodium clavatum*	alder e.g. hazel e.g. spear thistle ribwort plantain bur-reed dandelion family bracken clubmoss spike	2 2 1 1 3 1 1 4	2	3-4	2

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 = none, 1 = very poor , 2 = poor, 3 = moderate, 4 = good, 5 = excellent
Charcoal: 0 = none, 1= negligible, 2 = occasional, 3 = moderate, 4 = frequent, 5 = abundant

Table 7: Results of the pollen assessment of borehole Q.<BH4>, Bear House, Bear Lane, Southwark, London SE1

Depth (m OD)		Unit number	Main pollen taxa			Concentration 0 – 5	Preservation 0- 5	Microcharcoal 0 - 5
From	To		Latin name	Common name	Number			
1.29	1.28	4	*Alnus*	alder	2	5	3	3-4
			Pinus	pine	2			
			Tilia	lime	1			
			Corylus type	e.g. hazel	1			
			Poaceae	grass family	10			
			Dryopteris type	buckler ferns	2			
			Lactuceae	dandelion family	7			
			Cyperaceae	sedge family	1			
			Sinapis type	e.g. white mustard	1			
			Pteridium aquilinum	bracken	4			
			Caryophyllaceae	pink family	1			
			Chenopodium type	e.g. fat hen	2			
			cf. *Typha latifolia*	bulrush	1			
			Lycopodium clavatum	clubmoss spike	31			
1.13	1.12	4	*Alnus*	alder	3	2-3	3	2
			Pinus	pine	1			
			Quercus	oak	1			
			Corylus type	e.g. hazel	1			
			Poaceae	grass family	1			
			Cirsium type	e.g. spear thistle	1			
			Chenopodium type	e.g. fat hen	1			
			Cyperaceae	sedge family	2			
			Pteridium aquilinum	bracken	2			
			cf. *Armeria maritima*	thrift	1			
			cf. *Nuphar*/*Lemna*	water lily/duckweed	1			
			Lycopodium clavatum	clubmoss spike	2			
0.97	0.96	4	Lactuceae	dandelion family	1	0	1-2	0
0.81	0.80	4	*Alnus*	alder	1	3-4	3-4	2-3
			Quercus	oak	1			
			Chenopodium type	e.g. fat hen	4			
			Dryopteris type	buckler ferns	5			

			Artemisia Cyperaceae Poaceae *Sparganium* type Lactuceae *Polypodium vulgare* *Cereale* *Centaurea nigra* *Lycopodium clavatum* Obscured	e.g. mugwort sedge family grass family bur-reed dandelion family polypody e.g. wheat common knapweed clubmoss spike -	2 4 3 2 1 2 1 1 8 1			
0.65	0.64	4	*Quercus* *Pinus* *Corylus* type Lactuceae Cyperaceae Poaceae *Polypodium vulgare* cf. *Cereale* cf. *Lemna* *Lycopodium clavatum* Unknown (preservation)	oak pine e.g. hazel dandelion family sedge family grass family polypody e.g. wheat duckweed clubmoss spike -	1 1 1 1 2 5 1 1 2 6 5	2-3	3	2-3
0.49	0.48	4	*Alnus* *Pinus* Cyperaceae Poaceae *Chenopodium* type *Sparganium* type Lactuceae *Pteridium aquilinum* *Dryopteris* type *Lycopodium clavatum*	alder pine sedge family grass family e.g. fat hen bur-reed dandelion family bracken buckler ferns clubmoss spike	3 2 26 7 2 4 1 1 1 7	5	4	2-3
0.33	0.32	4	*Alnus* *Quercus* *Pinus* *Corylus* type	alder oak pine e.g. hazel	2 2 1 1	5	4	2-3

			Poaceae	grass family	10			
			Dryopteris *type*	buckler ferns	5			
			Pteridium aquilinum	bracken	2			
			Polypodium vulgare	polypody	2			
			Cyperaceae	sedge family	12			
			Chenopodium type	e.g. fat hen	3			
			Sparganium type	bur-reed	2			
			Lactuceae	dandelion family	1			
			Lycopodium clavatum	clubmoss spike	13			
0.17	0.16	4	*Pinus*	pine	3	2	3	3
			Quercus	oak	1			
			Lactuceae	dandelion family	2			
			Sparganium type	bur-reed	2			
			Dryopteris type	buckler ferns	1			
			Anthemis type	e.g. stinking chamomile	1			
			Poaceae	grass family	7			
			Cyperaceae	sedge family	4			
			Chenopodium type	e.g. fat hen	1			
			Lycopodium clavatum	clubmoss spike	17			
0.01	0.00	4	Quercus	oak	3	5	3-4	2
			Alnus	alder	2			
			cf. *Betula*	birch	1			
			Dryopteris type	buckler ferns	3			
			Sparganium type	bur-reed	4			
			Lactuceae	dandelion family	5			
			Cyperaceae	sedge family	9			
			cf. *Mentha*	mint	1			
			cf. *Cereale*	e.g. wheat	3			
			Polypodium vulgare	polypody	1			
			Artemisia	e.g. mugwort	2			
			Poaceae	grass family	2			
			Pteridium aquilinum	bracken	1			
			cf. *Lemna*	duckweed	1			
			cf. *Cirsium* type	e.g. spear thistle	1			
			Lycopodium clavatum	clubmoss spike	19			

-0.15	-0.16	3	*Alnus* *Corylus* type *Dryopteris* type *Lycopodium clavatum*	alder e.g. hazel buckler ferns clubmoss spike	7 1 2 5	2	4-5	0
-0.23	-0.24	3	*Quercus* *Dryopteris* type *Polypodium vulgare* *Lactuceae* *Aster* type *Lycopodium clavatum*	oak buckler ferns polypody dandelion family daisy clubmoss spike	1 5 2 2 1 47	1	4	1
-0.31	-0.32	3	*Alnus* Poaceae Cyperaceae *Dryopteris* type *Chenopodium* type *Lycopodium clavatum*	alder grass family sedge family buckler ferns e.g. fat hen clubmoss spike	3 1 1 1 1 16	1-2	4	1
-0.39	-0.40	3	cf. *Corylus* type *Dryopteris* type Lactuceae *Lycopodium clavatum*	e.g. hazel buckler ferns dandelion family clubmoss spike	1 3 2 7	1	4	0
-0.47	-0.48	3	Lactuceae *Lycopodium clavatum*	dandelion family clubmoss spike	1 3	1	4	1
-0.55	-0.56	3	*Alnus* cf. *Corylus* type *Polypodium vulgare* *Lycopodium clavatum*	alder e.g. hazel polypody clubmoss spike	1 1 3 15	1	4	1
-0.63	-0.64	3	*Alnus* *Quercus* *Dryopteris* type *Lycopodium clavatum*	alder oak buckler ferns clubmoss spike	2 1 1 37	1	3-4	0
-0.79	-0.80	2	*Alnus* *Corylus* type *Lycopodium clavatum*	alder e.g. hazel clubmoss spike	3 1 1	1	4	2
-0.95	-0.96	2	*Tilia* *Quercus*	lime oak	1 2	3	3-4	2

			Alnus	alder	2			
			Corylus type	e.g. hazel	1			
			Pteridium aquilinum	bracken	1			
			Cirsium type	e.g. spear thistle	1			
			Sparganium type	bur-reed	4			
			Cyperaceae	sedge family	8			
			Poaceae	grass family	1			
			cf. *Lemna*	duckweed	1			
			Polypodium vulgare	polypody	2			
			cf. *Cereale*	e.g. wheat	1			
			Lycopodium clavatum	clubmoss spike	6			
-1.11	-1.12	1	*Alnus*	alder	1	1	3	0
			Corylus type	e.g. hazel	1			
			Lycopodium clavatum	clubmoss spike	2			

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 = none, 1 = very poor , 2 = poor, 3 = moderate, 4 = good, 5 = excellent
Charcoal: 0 = none, 1= negligible, 2 = occasional, 3 = moderate, 4 = frequent, 5 = abundant

RESULTS AND INTERPRETATION OF THE DIATOM ASSESSMENT

Diatoms are present in three of the four samples from Q.<BH1>, and in five of the six samples from Q.<BH4> (Tables 8 and 9). Debris from higher plants was present in the two barren, basal samples from Q.<BH1> and Q.<BH4> respectively and a total of four small dissolved fragments, possibly of diatom origin, were tentatively identified in Q.<BH1> -0.55 to -0.56m OD and Q.<BH4> -0.63 to -0.64m OD (Tables 10 and 11). However, the species, or diatom origin, cannot be reliably confirmed. The results of the diatom species assessment for both sequences are shown in Tables 10 and 11. Summaries of the diatom assessments are shown in Tables 8 and 9 below.

Q.<BH1>

The diatom assemblages at -0.17 to -0.18m OD in Q.<BH1> have moderate numbers of diatoms and although the assemblages are poorly preserved the moderately high species diversity means that there is some potential for percentage diatom counting. In the sample from -0.15 to -0.16m OD in Q.<BH1> there are very low numbers of very poorly preserved diatoms; the assemblages have low to moderate species diversity but no further potential for analysis. As indicated above the basal sample from -0.55 to -0.56m OD has no further potential for analysis.

The marine planktonic diatom *Paralia sulcata* is present at -0.17 to -0.18m OD and -0.15 to -0.16m OD and another marine planktonic species *Podosira stelligera* is also present at -0.15 to -0.16m OD. All three diatom assemblages assessed from Q.<BH1> contain an estuarine diatom component. The estuarine planktonic species *Cyclotella striata* is relatively common in the top two samples. The mesohalobous benthic diatom *Nitzschia navicularis* is present in all three diatomaceous samples from Q.<BH1>, along with other benthic brackish-marine diatoms such as *Diploneis interrupta, Diploneis didyma* and *Nitzschia punctata*. The tidal nature of the habitat is reflected in the mixture of freshwater diatoms also present in these assemblages. In particular species such as *Fragilaria construens* var. *venter*, *Fragilaria brevistriata* and *Fragilaria pinnata* that are common at 0.01 to 0m OD or -0.17 to -0.16m OD. These taxa have freshwater salinity optima, but also have wide salinity tolerances. The freshwater diatom component is smaller at -0.15 to -0.16m OD.

Q.<BH4>

In the five diatomaceous samples from Q.<BH4> diatom numbers are low or very low and the quality of preservation (except at 0.65 to 0.64m OD and 0.01 to 0.00m OD) is generally poor or very poor. Species diversity varies from very low to moderate (Table 9). There is no

potential for diatom counting in the top and bottom samples, but there is either some potential or low potential (skeleton counts) to carry out percentage diatom counting and analysis on the remaining four samples.

The mesohalobous estuarine species, *Cyclotella striata* is common from 0.97 to 0.96m OD to -0.31 to -0.32m OD, and benthic marine brackish taxa such as *Nitzschia navicularis, Nitzschia granulata, Nitzschia punctata* and *Diploneis didyma* are also present in these samples. Marine diatoms, including *Paralia sulcata, Cymatosira belgica, Podosira stelligera, Rhaphoneis spp., Trachyneis aspera* and *Actinoptychus undulatus* are present in all five diatomaceous samples (0.97 to 0.96m OD to -0.31 to -0.32m OD). A component of freshwater diatoms is also present in all five samples. These oligohalobous indifferent taxa include *Fragilaria* spp., the aerophile *Ellerbeckia arenaria* and non-planktonic species *Amphora libyca* (0.01 to 0m OD)

In summary, the presence of marine or marine-brackish, estuarine taxa indicate the tidal nature of the environments, whilst the main freshwater components of the assemblages in Q.<BH1> and Q.<BH4> are of species with wide salinity tolerance or aerophiles.

Table 8: Summary diatom assessment results of borehole Q.<BH1>, Bear House, Bear Lane, Southwark, London SE1

Depth (m OD)		Unit number	Diatom concentration	Quality of preservation	Diversity	Assemblage Type	Potential for % count
From	To						
0.17	0.16	4	Moderate	Very poor	Moderate	bk mar fw aero	Some
0.01	0	4	Moderate	Poor	Moderate	bk fw	Some/ Modeate
-0.15	-0.16	3	Low	Ex poor	Low/ moderate	fw bk mar	None
-0.55	-0.56	3	None?	-	-	-	None

Key: Environment: fw – freshwater, aero- aerophilous, bk – brackish, mar – marine, hal – halophilous)

Table 9: Summary diatom assessment results of borehole Q.<BH4>, Bear House, Bear Lane, Southwark, London SE1

Depth (m OD)		Unit number	Diatom concentration	Quality of preservation	Diversity	Assemblage type	Potential for % count
From	To						
0.97	0.96	4	Extremely low	Very poor	Very low	bk mar fw	None
0.65	0.64	4	Low	Moderate to poor	Moderate/ low	bk mar fw	Some
0.33	0.32	4	Very low	Poor	Low	bk fw mar	Some/low
0.01	0	4	Low	Poor to moderate	Moderate	bk fw mar	Some
-0.31	-0.30	3	Low	Poor	Moderate/ low	bk mar fw	Some/low
-0.63	-0.64	1	None?	-	-	-	None

Key: Environment: fw – freshwater, aero- aerophilous, bk – brackish, mar – marine, hal – halophilous)

Table 10: Taxa identified during the diatom assessment, borehole Q.<BH1>, Bear House, Bear Lane, Southwark, London SE1

Diatom taxon	Depth (m OD)			
	0.17 to 0.16	**0.01 to 0**	**-0.15 to -0.16**	**-0.55 to -0.56**
Polyhalobous				
Paralia sulcata	1		1	
Podosira stelligera			1	
Mesohalobous				
Cyclotella striata	2	3	1	cf1
Diploneis interrupta	1			
Diploneis didyma	1		1	
Nitzschia compressa (=punctata)			1	
Nitzschia navicularis	1	1	1	
Oligohalobous Halophilous				
Navicula mutica		1		
Oligohalobous Indifferent				
Amphora libyca	1	2		
Cyclotella kuetzingiana	1			
Cymbella aspera	1			
Fragilaria brevistriata	1	2		
Fragilaria construens var.venter	1	2		
Fragilaria pinnata	2	2		
Pinnularia major	1			
Pinnularia pulchra		1	1	
Synedra ulna	1			
Unknown Salinity Group				
Aulacoseira sp.	1			
Chrysophyte cysts	1	1		
Diploneis sp.	1			
Fragilaria sp.	1	1		
Gomphonema sp.		1		
Navicula sp.		1		
Pinnularia sp.		1	1	
Unknown naviculaceae			1	

Table 11: Taxa identified during the diatom assessment, borehole Q.<BH4>, Bear House, Bear Lane, Southwark, London SE1

Diatom taxon	Depth (m OD)					
	0.97 to 0.96	0.65 to 0.64	0.33 to 0.32	0.01 to 0	-0.31 to -0.32	-0.63 to -0.64
Polyhalobous						
Cymatosira belgica		2				
Paralia sulcata		3	1	1	3	
Podosira stelligera			1			
Rhaphoneis minutissima		1				
Rhaphoneis sp.	1	1				
Rhaphoneis surirella		1				
Trachyneis aspera					1	
Polyhalobous to Mesohalobous						
Actinoptychus undulatus			1	1		
Mesohalobous						
Cyclotella striata	2	3	3	3	2	cf1
Diploneis didyma	1				1	
Nitzschia compressa (=punctata)	1		1			
Nitzschia granulata		1				
Nitzschia navicularis	1	1	1	1		
Mesohalobous to Oligohalobous Halophilous						
Cyclotella meneghiniana		1				
Oligohalobous Halophilous						
Navicula cincta		1				
Navicula mutica					1	
Oligohalobous Indifferent						
Amphora libyca				2		
Cymbella aspera					1	
Cymbella sinuata		1				
Ellerbeckia arenaria	1	1	1	1		
Fragilaria brevistriata		1		3		
Fragilaria construens var.venter				1		
Fragilaria pinnata		2		1	1	
Gomphonema angustatum var. productum					1	
Hantzschia amphioxys					1	
Navicula perpusilla				1		
Pinnularia major		1	1			
Synedra ulna	1	1		1		
Unknown Salinity Group						
Aulacoseira sp.				1		
Chrysophyte cysts	2	1	1	3	1	
Cymbella sp.		1				
Diatoma sp.						cf1
Diploneis sp.				1		
Gomphonema sp.		1				
Inderminate centric sp.	1					
Inderminate pennate sp.	1				1	
Navicula sp.				1		
Pinnularia sp.	1		1	1	1	
Unknown naviculaceae	1		1	1	1	cf1

RESULTS AND INTERPRETATION OF THE MACROFOSSIL ASSESSMENT

A total of thirteen small bulk samples (6 from borehole Q.<BH1> and 7 from borehole Q.<BH4>) were extracted for the recovery of macrofossil remains including waterlogged plant macrofossils, waterlogged wood, insects and Mollusca (Tables 12 and 13). The samples were focussed on the organic-rich sections of each borehole only.

Borehole Q.<BH1>

The results of an initial assessment indicated that borehole Q.<BH1> contained no charred plant remains (charcoal or wood), bone, magnetic particles, Mollusca or artefacts. Two of the six samples (samples -0.20 to -0.30 and -0.30 to -0.33m OD) contained moderate to high quantities of waterlogged wood; the remainder of the samples contained low amounts. Two of the samples (samples -0.33 to -0.40 and -0.40 to -0.50m OD) contained high quantities of waterlogged seeds, while the remainder of the samples contained low to moderate amounts. Insects were present in low quantities in five of the samples (samples -0.12 to -0.20, -0.20 to -0.30, -0.30 to -0.33, -0.33 to -0.40 and -0.40 to -0.50m OD).

Borehole Q.<BH4>

The results of an initial assessment indicated that borehole Q.<BH4> contained no bone, magnetic particles, Mollusca or artefacts. Charred wood was present in one of the samples (sample -0.43 to -0.53). Waterlogged wood was present in moderate to low quantities within all of the samples assessed. Waterlogged seeds were present in low to moderate quantities in all but one of the samples (sample -0.63 to -0.65m OD). Insects were recorded in low quantities in two of the samples (samples -0.10 to -0.20 and -0.30 to -0.38m OD).

Table 12: Results of the macrofossil assessment of borehole Q.<BH1>, Bear House, Bear Lane, Southwark, London SE1

							Charred					Waterlogged		Mollusca		Bone					
Depth (m OD) / Unit number	Borehole No.	Volume sampled (l)	Size of context sampled (%)	Volume processed (l)	Volume remaining	Fraction (e.g. flot, residue, >300µm)	Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Whole	Fragments	Large	Small	Fragments	Insects	Magnetic particles	Artefacts
-0.12 to -0.20 / 3	Q.<BH1>	0.4	90	0.4	0.0	>1mm	-	-	-	-	-	1/2	1	-	-	-	-	-	1	-	-
						>300µm	-	-	-	-	-	1	1/2	-	-	-	-	-	-	-	-
-0.20 to -0.30 / 3	Q.<BH1>	0.55	90	0.55	0.0	>1mm	-	-	-	-	-	5	1/2	-	-	-	-	-	-	-	-
						>300µm	-	-	-	-	-	-	1/2	-	-	-	-	-	1/2	-	-
-0.30 to -0.33 / 3	Q.<BH1>	0.2	90	0.2	0.0	>1mm	-	-	-	-	-	3	1/2	-	-	-	-	-	-	-	-
						>300µm	-	-	-	-	-	-	1/2	-	-	-	-	-	1	-	-
-0.33 to -0.40 / 3	Q.<BH1>	0.3	90	0.3	0.0	>1mm	-	-	-	-	-	1	4	-	-	-	-	-	-	-	-
						>300µm	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-
-0.40 to -0.50 / 3	Q.<BH1>	0.55	90	0.55	0.0	>1mm	-	-	-	-	-	1	5	-	-	-	-	-	-	-	-
						>300µm	-	-	-	-	-	-	1/2	-	-	-	-	-	1	-	-
-0.50 to -0.60 / 3	Q.<BH1>	0.45	90	0.45	0.0	>1mm	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
						>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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+

Table 13: Results of the macrofossil assessment of borehole Q.<BH4>, Bear House, Bear Lane, Southwark, London SE1

Charred												Waterlogged		Mollusca		Bone					
Depth (m OD) / Unit number	Borehole No.	Volume sampled (l)	Size of context sampled (%)	Volume processed (l)	Volume remaining	Size fraction	Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Whole	Fragments	Large	Small	Fragments	Insects	Magnetic particles	Artefacts
-0.10 to -0.20 / 3	Q.<BH4>	0.2	90	0.2	0	>1mm	-	-	-	-	-	2/3	2	-	-	-	-	-	-	-	-
						>300µm	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
-0.20 to -0.30 / 3	Q.<BH4>	0.4	90	0.4	0	>1mm	-	-	-	-	-	1/2	1	-	-	-	-	-	-	-	-
						>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-0.30 to -0.38 / 3	Q.<BH4>	0.3	90	0.3	0	>1mm	-	-	-	-	-	2	1/2	-	-	-	-	-	-	-	-
						>300µm	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-
-0.38 to -0.43 / 3	Q.<BH4>	0.2	90	0.2	0	>1mm	-	-	-	-	-	1/2	1	-	-	-	-	-	-	-	-
						>300µm	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
-0.43 to -0.53 / 3	Q.<BH4>	0.4	90	0.4	0	>1mm	-	1	1/2	-	-	1/2	1	-	-	-	-	-	-	-	-
						>300µm	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-
-0.53 to -0.63 / 3	Q.<BH4>	0.45	90	0.45	0	>1mm	-	-	-	-	-	2/3	1	-	-	-	-	-	-	-	-
						>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-0.63 to -0.65 / 3	Q.<BH4>	0.1	90	0.1	0	>1mm	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
						>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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+

RESULTS OF THE WATERLOGGED PLANT MACROFOSSIL ASSESSMENT (SEEDS AND WOOD)

The results of the macrofossil rapid assessment indicated that waterlogged plant macrofossils (seeds and wood) were present in all but one of the samples assessed, and these all underwent a more detailed assessment. The results of the borehole Q.<BH1> waterlogged plant macrofossil (seeds and wood) assessment are displayed in Tables 14 and 15; the Q.<BH4> results are displayed in Tables 16 and 17.

Borehole Q.<BH1>

One sample from Unit 2 (Lower Alluvium) contained low numbers of seeds, including *Sambucus* sp. (elder), *Ranunculus* sp. (e.g. creeping buttercup) and cf. *Carex pendula* (drooping sedge), indicating the growth of shrubs or small trees in a wet environment. Seeds were preserved in moderate to high concentrations throughout Unit 3 (Peat/Very Organic unit). The assemblage from this Unit was dominated by herbaceous taxa, including *Ranunculus* sp. (e.g. creeping buttercup), *Ranunculus* cf. *sceleratus* (cursed buttercup), *Chenopodium* sp. (e.g. fat hen), *Carex* sp. (sedge) and *Carex* cf. *pendula* (drooping sedge). Tree or shrub taxa are present in four of the five samples and include *Alnus* sp. (alder) and *Sambucus* sp. (elder). This assemblage is indicative of an open, wet environment dominated by herbaceous taxa including sedges. Seed taxa definitively indicative of human activity or saline conditions were not noted during the assessment of samples from borehole Q.<BH1>. The results of the waterlogged wood assessment indicate that all identifiable fragments were *Alnus* sp. (alder). This suggests that alder dominated wetland woodland was growing locally.

Borehole Q.<BH4>

The results of the waterlogged plant macrofossil assessment indicate that seeds were preserved in low concentrations through Unit 3 (Peat/Very Organic units) with the exception of the lowest sample (-0.63 to -0.65m OD). In the remainder of the samples, the assemblage is dominated by herbaceous taxa including *Ranunculus* sp. (e.g. creeping buttercup), *Carex* sp. (sedge) and *Carex* cf. *pendula* (drooping sedge), *Juncus* sp. (rush) and cf. *Stellaria* sp. (e.g. stitchwort). Tree and shrub taxa are common, and include *Alnus* sp. (alder), *Sambucus* sp. (elder) and *Rubus* sp. (bramble). This assemblage is indicative of a wet open environment, possibly representing alder carr woodland. Seed taxa definitively indicative of human activity or saline conditions were not noted during the assessment of samples from borehole Q.<BH4>. The results of the waterlogged wood assessment indicate that of the fragments that were identifiable, all were *Alnus* sp. (alder). The charcoal fragments found in sample -0.43 to -0.53m OD were identified as *Fraxinus* sp. (ash).

Table 14: Results of the waterlogged plant macrofossil (seeds) assessment of borehole Q.<BH1>, Bear House, Bear Lane, Southwark, London SE1

Sample depth (m OD)	Unit number	Latin name	Common name	Number
-0.12 to -0.20	3	*Sambucus* sp. cf. *Carex pendula* utricle *Chenopodium* sp. *Ranunculus* sp. *Carex* sp.	Elder drooping sedge e.g. fat hen e.g. creeping buttercup Sedge	2 2 1 2 12
-0.20 to -0.30	3	*Alnus* sp. catkin *Rubus* sp. *Ranunculus* sp. *Ranunculus* cf. *sceleratus* cf. *Carex pendula* utricle *Carex* sp.	alder bramble e.g. creeping buttercup cursed buttercup drooping sedge sedge	3 1 8 10 6 5
-0.30 to -0.33	3	*Alnus* sp. catkin cf. *Carex pendula* utricle *Ranunculus* sp.	alder drooping sedge e.g. creeping buttercup	6 5 5
-0.33 to -0.40	3	*Chenopodium* sp. *Ranunculus* sp. cf. *Carex pendula* utricle *Carex* sp.	e.g. fat hen e.g. creeping buttercup drooping sedge sedge	3 56 5 13
-0.40 to -0.50	3	*Sambucus* sp. *Carex* sp. cf. *Carex pendula* utricle *Ranunculus* sp.	elder sedge drooping sedge e.g. creeping buttercup	1 6 35 61
-0.50 to -0.60	3	*Sambucus* sp. cf. *Carex pendula* utricle *Ranunculus* sp.	elder drooping sedge e.g. creeping buttercup	1 1 1

Table 15: Results of the waterlogged plant macrofossil (wood) assessment of borehole Q.<BH1>, Bear House, Bear Lane, Southwark, London SE1

Sample depth (m OD)	Unit number	Latin name (Quantity)	Common name	C14 potential	Comments	Number
-0.12 to -0.20	3	*Alnus* sp. Indeterminate	alder -	Yes -	- Bark?	3 2
-0.20 to -0.30	3	*Alnus* sp.	alder	Yes	-	5
-0.30 to -0.33	3	*Alnus* sp.	alder	Yes	-	5
-0.33 to -0.40	3	*Alnus* sp.	alder	Yes	-	2
-0.40 to -0.50	3	Indeterminate	-	-	Bark?	2
-0.50 to -0.60	3	*Alnus* sp.	alder	Yes	-	5

Table 16: Results of the waterlogged plant macrofossil (seeds) assessment of borehole Q.<BH4>, Bear House, Bear Lane, Southwark, London SE1

Sample depth (m OD)	Unit number	Latin name	Common name	Number
-0.10 to -0.20	3	*Sambucus* sp. *Ranunculus* sp.	elder e.g. creeping buttercup	1 2
-0.20 to -0.30	3	*Sambucus* sp. *Alnus* sp. catkin *Ranunculus* sp. cf. *Stellaria* sp. *Carex* sp. cf. *Carex pendula* utricle	elder alder e.g. creeping buttercup e.g. stitchwort sedge drooping sedge	1 3 4 1 1 1
-0.30 to -0.38	3	*Alnus* sp. catkin *Rubus* sp. *Ranunculus* sp. *Juncus* sp.	alder bramble e.g. creeping buttercup rush	1 4 2 1
-0.38 to -0.43	3	*Sambucus* sp. *Ranunculus* sp. cf. *Carex pendula* utricle	elder e.g. creeping buttercup drooping sedge	2 2 1
-0.53 to -0.63	3	*Sambucus* sp. *Rubus* sp.	elder bramble	1 1

Table 17: Results of the waterlogged plant macrofossil (wood) assessment of borehole Q.<BH4>, Bear House, Bear Lane, Southwark, London SE1

Sample depth (m OD)	Unit number	Latin name (Quantity)	Common name	C14 potential	Comments	Number
-0.10 to -0.20	3	*Alnus* sp. Indeterminate	alder -	Yes -	includes twig wood bark?	4 1
-0.20 to -0.30	3	*Alnus* sp.	alder	Yes	-	2
-0.30 to -0.38	3	*Alnus* sp. Indeterminate	alder -	Yes -	- bark?	4 1
-0.38 to -0.43	3	*Alnus* sp. Indeterminate	-	Yes -	- bark?	3 2
-0.43 to -0.53	3	*Alnus* sp. *Fraxinus excelsior*	- ash	- No	- Charcoal; very slow grown	4 7
-0.53 to -0.63	3	*Alnus* sp. Indeterminate	-	Yes -	- bark?	3 2

RESULTS OF THE INSECT ASSESSMENT

The results of the macrofossil rapid assessment indicated that insects were recorded in low quantities in four of the six samples assessed from borehole Q.<BH1> and two of the seven samples assessed from Q.<BH4>. These samples underwent a more detailed assessment, the results of which are displayed in Tables 18 and 19.

Borehole Q.<BH1>

The samples from borehole Q<BH1> (Table 18) generally contained too few insect remains to allow a detailed reconstruction of the local conditions. Combined, the assemblages from all samples simply indicate the presence of shallow, standing water with rich reed vegetation, bordered by a sandy riparian zone. All of the samples containing Trichoptera (caddisfly) larval remains are indicative of standing fresh water. The leaf beetle (Chrysomelidae) fauna includes the aquatic leaf beetle taxa *Plateumaris*, which lives on reeds in shallow fresh water.

Table 18: Results of the insect assessment of borehole Q.<BH1>, Bear House, Bear Lane, Southwark, London SE1

Taxon	**Depth (m OD)**				
	-0.12 to -0.20	**-0.20 to -0.30**	**-0.30 to -0.33**	**-0.33 to -0.40**	**-0.40 to -0.50**
COLEOPTERA					
Hydrophilidae					
Cercyon marinus Thoms.		1			
Staphylinidae					
Tachinus sp.		1			
Stenus sp.		1			
Aleocharinae sp. indet.	1				
Chrysomelidae					
Plateumaris sp.		1			
Curculionidae					
Genus et sp indet.		1		1	1
TRICHOPTERA					
Limnephilidae					
Genus et sp indet.	1		1		

Borehole Q.<BH4>

The two samples from borehole Q<BH4> (Table 19) contained too few insect remains to allow a reconstruction of the local conditions.

Table 19: Results of the insect assessment of borehole Q.<BH4>, Bear House, Bear Lane, Southwark, London SE1

Taxon	Depth (m OD)	
	-0.10 to -0.20	**-0.30 to -0.38**
COLEOPTERA		
Chrysomelidae		
Chrysomela sp.	1	
TRICHOPTERA		
Limnephilidae		
Genus et sp indet.	1	1

DISCUSSION AND CONCLUSIONS

The aim of the environmental archaeological assessment was to evaluate the potential of the sedimentary sequences for reconstructing the environmental history of the site and its environs, and specifically to: (1) identify evidence of change or continuity through time; (2) establish whether any significant spatial variability exists across the site, and (3) to detect evidence of human activity. An assessment of two cores was carried out from boreholes Q.<BH1> and Q.<BH4> as they contained significant alluvial and organic-rich horizons, and were located along a north-south transect across the site.

The results of the lithostratigraphic descriptions indicate that boreholes Q.<BH1> and Q.<BH4> contain the same sequence of deposits with Shepperton Gravel overlain by a sequence of Holocene alluvial sediments (including Peat), truncated by Made Ground. The Peat was thin in both boreholes (<35cm), but increased in thickness towards the centre of the Bankside Channel (-0.10 to -0.33m OD in borehole Q.<BH1>; -0.30 to -0.65m OD in borehole Q.<BH4>). The Peat was of similar organic composition in both boreholes (up to 60% organic-rich), indicating frequent influxes of mineral-rich sediment during its formation.

The results of the radiocarbon dating indicate that the Peat in borehole Q.<BH4> dates to the Early to Middle Bronze Age, and is slightly older than the Peat in Q.<BH1> (Middle to Late Bronze Age). In combination with previous data from the Bear Lane site (Tan *et al*., 2008; Figure 8), the new radiocarbon dates demonstrate that the Peat becomes older towards the centre of the Bankside Channel, where Peat accumulation may have begun as early as the Middle Neolithic. Given the age of the peat in the three sequences, it is likely that the

accumulation of Peat (>40% organic-rich) began in the southern half of the site, towards the centre of the Bankside Channel, gradually infilling the basin and accumulating towards the northern half of the site.

The archaeobotanical and zooarchaeological records demonstrate that the corresponding Units in boreholes Q.<BH1> and Q.<BH4> are analogous and are therefore summarised together below by Unit:

The pollen record from Unit 1 (Shepperton Gravel) is indicative of a damp, open woodland environment, but this interpretation is tentative, since it may be influenced by the detrital nature of the sediment within this unit. No diatoms were present in the sample extracted from this unit. The pollen and plant macrofossil records from Unit 2 (Lower Alluvium) indicate the growth of open woodland in a relatively wet environment, dominated by alder, elder, hazel, creeping buttercup and sedges.

During the accumulation of the Peat and Very Organic units (Unit 3), the pollen and waterlogged plant macrofossil records indicate generally continuous growth of a wet, open (possibly carr) woodland dominated by alder with some oak, elm, elder, hazel and bramble. The understory consisted of ferns, sedges and other herbaceous taxa. During this period the insect record indicates shallow, standing water with rich reed vegetation, bordered by a sandy riparian zone. Diatom concentration was generally low or poor in Unit 3, but the assemblages contain freshwater, brackish and marine taxa indicative of at least a partial tidal influence at the site.

Despite the presence of charred ash wood, evidence for human activity in the local area is scarce during the accumulation of Unit 3, but more common in Unit 4 (Upper Alluvium). During the deposition of Unit 4, the pollen record is indicative of a damp, open environment dominated by herbaceous, fern and aquatic taxa with anthropogenic indicators including *Cereale* (e.g. wheat) and possibly *Chenopodium type* (e.g. fat hen). The presence of marine or marine-brackish, estuarine taxa in the diatom records from boreholes Q.<BH1> and Q.<BH4> indicate the tidal nature of the environment during the accumulation of Unit 4. Where they were present, the freshwater components of the assemblages in Q.<BH1> and Q.<BH4> are of species with wide salinity tolerance or aerophiles.

The pollen records from Q.<BH1> and Q.<BH4> are consistent with those from Bear Lane (Tan *et al*., 2008), where detailed assessment of the pollen indicated wet, open woodland

dominated by alder (possibly alder carr) with anthropogenic indicators including cereal pollen.

RECOMMENDATIONS

The results of the environmental archaeological assessment have demonstrated that pollen concentration in Unit 3 (Peat/Very Organic Units) in boreholes Q.<BH1> and Q.<BH4> is generally poor or very poor. The waterlogged plant macrofossil remains (seeds and wood) are of low to moderate concentration throughout this Unit, but further work is unlikely to yield any further information than has been produced during the course of the assessment. The diatom samples extracted from the transitional boundaries in to Unit 3 are of low to very low concentration. The concentration of insect remains is very poor.

In contrast, the concentration of pollen in Unit 4 (Upper Alluvium) is generally moderate to excellent, while the diatom assessment indicates low to moderate concentrations. The archaeobotanical and zooarchaeological remains are sufficiently well preserved therefore to provide a reconstruction of the environmental conditions during the accumulation of this Unit.

In summary, it is recommended that the environmental archaeological analysis should consist of:

1) Full pollen analysis of selected samples from Unit 4 and detailed assessment of selected samples from Unit 3 (where concentration is sufficient)
2) Full diatom analysis of selected samples from Unit 4
3) Additional pollen counting of samples from Unit 3 from Bear Lane (Tan *et al.*, 2008) in order to provide 300 total land pollen (suitable for analysis) and to contribute to the pollen record from Bear House.

The environmental archaeological analysis will be prepared for publication in a relevant journal (e.g. London Archaeologist) and will draw on information from nearby sites including St. Christopher's House (London Archaeologist, 2004), 44-47 Hopton Street (London Archaeologist, 2001) and 245 Blackfriars Road (Thompson *et al.*, 1998).

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APPENDIX 1: BOREHOLE DETAILS

QUEST borehole details, Bear House, Bear Lane, Southwark, London SE1

Quest borehole number	Easting	Northing	Height at surface (m OD)
Q.<BH1>	531816.551	180249.594	3.90
Q.<BH2>	531831.342	180248.125	3.90
Q.<BH3>	531853.583	180220.325	3.40
Q.<BH4>	531822.216	180216.653	3.30

CARD Geotechnics boreholes and Pre-Construct Archaeology archaeological section details, Bear House and Bear Lane, Southwark, London SE1 (CARD Geotechnics, 2007; Holden, 2007)

Borehole/Section number	Trench Number	Easting	Northing	Height at surface (m OD)
C.<BH1>	N/A	531821.438	180214.155	3.47
C.<BH2>	N/A	531856.397	180213.397	3.47
C.<BH3>	N/A	531859.938	180167.999	3.47
C.<BH4>	N/A	531841.223	180160.666	3.47
Archaeological Section 1	4	531832	180184	3.47
Archaeological Section 2	5	531846	180193	3.47
Archaeological Section 3	1	531861	180192	3.46
Archaeological Section 4	2	531837	180163	3.36
Archaeological Section 5	3	531850	180171	3.27

APPENDIX 2: QUATERNARY SCIENTIFIC BOREHOLE RECORDS

Lithostratigraphic description, borehole <BH2>, Bear House, Bear Lane, Southwark, London SE1

Depth (m OD)	Depth (m bgs)	Composition
3.80 to 0.24	0.00 to 3.56	Made ground.
0.24 to 0.15	3.56 to 3.65	2.5Y 3/2; As3 Ag1 Sh+; very dark greyish brown silty clay with traces of disintegrated organic matter.
0.15 to 0.00	3.65 to 3.80	5Y 2.5/2; As3 Sh1 Ag+ Dl+; black clay with disintegrated organic matter and traces of silt and detrital wood. Diffuse contact in to:
0.00 to -0.25	3.80 to 4.05	10YR 3/2; Ag2 Sh1 Dl1 As+; very dark greyish brown organic silt with detrital wood and traces of clay. Diffuse contact in to:
-0.25 to -0.42	4.05 to 4.22	10YR 2/1; Sh2 Ag1 As1 Dl+; Humo. 3/4; well humified black disintegrated organic matter with silt and clay and traces of detrital wood. Diffuse contact in to:
-0.42 to -0.60	4.22 to 4.40	2.5Y 4/2; Ag3 As1 Dl+; dark greyish brown clayey silt with traces of detrital wood. Sharp contact in to:
-0.60 to -0.80	4.40 to 4.60	Gg3 Ga1. Clasts flint, 4-50mm.

Lithostratigraphic description, borehole <BH3>, Bear House, Bear Lane, Southwark, London SE1

Depth (m OD)	Depth (m bgs)	Composition
3.40 to 1.40	0.00 to 2.00	Made ground.
1.40 to 1.10	2.00 to 2.30	Gley 1 4/10Y; Ag2 As2 Dl+; dark greenish grey silt and clay with traces of detrital wood.
1.10 to -0.42	2.30 to 3.82	Borehole compromised- no sample retained
-0.42 to -0.50	3.82 to 3.90	2.5YR 2.5/1; Sh3 Ag1 Th^{3}+; Humo. 3/4; well humified reddish black silty peat with traces of herbaceous material. Diffuse contact in to:
-0.50 to -0.77	3.90 to 4.17	2.5Y 3/2; Ag2 Dl1 Sh1; very dark greyish brown silt with detrital wood and disintegrated organic matter. Sharp contact in to:
-0.77 to -0.85	4.17 to 4.25	Gley 1 4/10Y; Ag3 Gg1; dark greenish grey silt with gravel. Clasts flint 4-50mm. Diffuse contact in to:
-0.85 to -1.10	4.25 to 4.50	Gg4 Ga+ Ag+; gravel with traces of sand and silt. Clasts flint 4-50mm.