LAND AT ENDERBY WHARF, CHRISTCHURCH WAY, LONDON BOROUGH OF GREENWICH SE10 0AG (NGR: TQ 3925 7873): ENVIRONMENTAL ARCHAEOLOGICAL ASSESSMENT REPORT

D.S. Young, C.R. Batchelor and C.P. Green
Quaternary Scientific (QUEST), School of Human and Environmental Sciences, University of Reading, Whiteknights, PO Box 227, Reading, RG6 6AB, UK

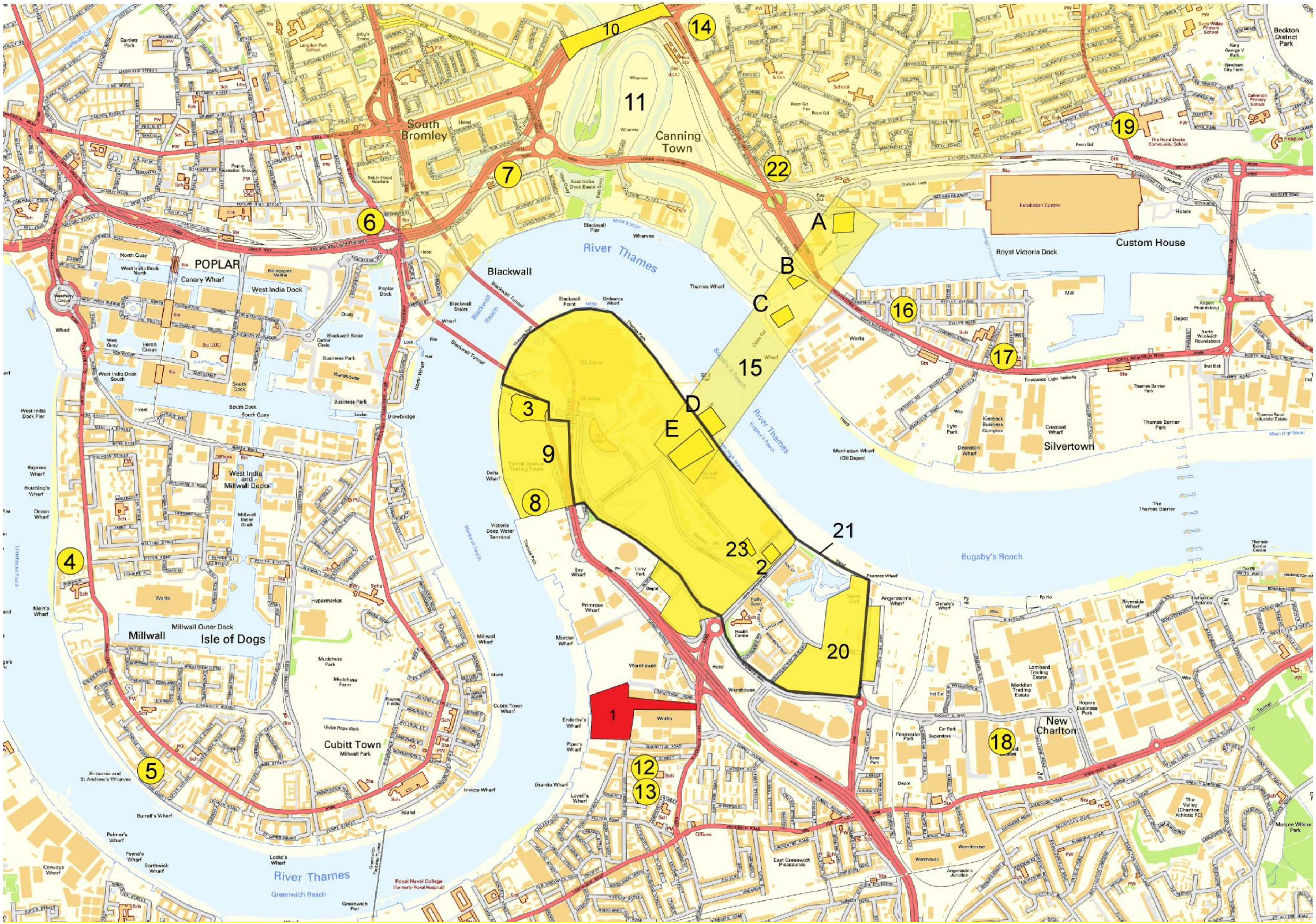
INTRODUCTION

This report summarises the findings arising out of the geoarchaeological assessment undertaken by Quaternary Scientific (University of Reading) in connection with the proposed development at Enderby Wharf, Christchurch Way, London Borough of Greenwich (National Grid Reference centred on: TQ 3925 7873; Figures 1 and 2). The site is approximately 4.0 hectares in size, and located towards the south-western corner of Greenwich Peninsula, bounded to the west by the River Thames and to the east by Blackwall Lane. Greenwich Peninsula is formed and bounded by a meander of the Thames to the west, east and north of the site, and lies opposite the confluence of the River Lea. The ground across the area originally formed part of the natural floodplain of the Thames and is underlain by river alluvium (British Geological Survey 1:50,000 sheets 256 North London 1993, 257 Romford 1996, 270 South London 1998, 271 Dartford 1998).

The Enderby Wharf site lies to the southwest of geoarchaeological investigations on the Greenwich Peninsula, carried out by Corcoran (2002) and since investigated in further detail (Batchelor, 2013; Young & Batchelor, 2013a; 2013b). In Corcoran's (2002) investigation, four landscape zones were identified as follows: Landscape Zones A and B represented areas of high (LZ-A = 2 to -2m OD) and moderately high (LZ-B = 2 to -4m OD) sand and gravel across the majority of the modelled area, but particularly in the areas of Tunnel Avenue, Victoria Deep Water Terminal, London Cable Car South Station, and the MO115 site (Figure 1). To the north-east of the Greenwich Peninsula area, the sand and gravel surface drops to below -4m OD in Landscape Zone C. In addition, smaller 'patches' of lower gravel surface (below -4m OD) were recorded towards the centre and south-western areas of the Millennium Festival Site (Figure 1; Landscape Zone D). These areas may have represented isolated hollows within the sand and gravel surface, or been interconnected to form a channel(s). During investigations at the MO115 and MO117 sites (Young & Batchelor, 2013a; 2013b) two depressions to the south-west and south-east of the Millennium Festival Site/Plot MO117 were recorded, lying *ca*. 200-500m northeast of the Enderby Wharf site. If the latter two are linked, they suggest that Corcoran's Landscape Zone D can be extended eastwards and may represent a former west-east palaeochannel. In addition, the new model provides some indication that a channel orientated approximately north-south may traverse the area between the Tunnel Avenue/Victoria Deep Water Terminal sites to the west, and the Cable Car South Station/MO115/MO117 sites towards the east (see Figure 1).

Boreholes were monitored during recent geotechnical investigations at the Enderby Wharf site. The resultant sedimentary logs were integrated with previous investigations (URS, 2003; Water and Earth Science Associated UK Ltd, 1993; Babtie, 2003), to produce a model of the sub-surface stratigraphy of the site (Young, 2013). The results of this investigation revealed a sequence of Shepperton Gravel overlain by Alluvium and Peat, overlain by Made Ground. The altitude and relief of the Gravel surface was relatively even, lying at between *ca*. -3.5 and -4.0m OD across the site. However, a depression in the Gravel surface is recorded southeast of the site at -4.9m OD (BGS borehole TQ37NE2157), indicative of a possible palaeochannel in this area. The margins of this channel appear to be recorded within the central and southern part of the site, where the Gravel surface falls to below *ca*. -4.0m OD in the area of borehole BH7. A Peat horizon was recorded at the site between *ca*. 0.0 and -2.5m OD, and generally between 1 and 2m thick. The accumulation of Peat represents a period of semi-terrestrial conditions that was thought to date to the Neolithic and Bronze Age periods, possibly contemporaneous with Bronze Age trackways recorded within *ca*. 150m at the 72-88 Bellot Street (Phil & Garrod, 1994; 3380 to 3500 cal BP) and Bellot Street (Branch *et al*., 2005; (3890-3680 to 3720-3570 cal BP) sites.

As a consequence of the above, the thickness and elevation of the Peat, and its potential to provide a record of environmental change and vegetation history, it was recommended that three geoarchaeological boreholes were collected from the site. These were collected in the area of (1) borehole BH5 (<QBH1>), towards the centre of the site and where the thickest Peat horizon was recorded; (2) BH7 (<QBH2>), on the margins of the possible palaeochannel towards the south of the site, and (3) towards the east of the site (<QBH3>), where no existing borehole records (with sufficient OD height data) were previously available for deposit modelling. An assessment of one of these boreholes (<QBH1>) was recommended in order to elucidate the age of the Peat, and to evaluate the potential for reconstructing the past environmental conditions of the site and its environs. The assessment incorporated: (1) radiocarbon dating of the base and top of the Peat in order to ascertain the age of peat accumulation and cessation; (2) organic matter determinations to aid identification of the sedimentary units; (3) assessment of the palaeobotanical remains (pollen, waterlogged wood and seeds) to provide a provisional reconstruction of the vegetation history; (4) assessment of the diatoms to provide an indication of the palaeohydrology (e.g. marine, brackish or freshwater), and (5) assessment of the zooarchaeological remains (insects and Mollusca) to provide information on the general environmental conditions, climatic change and hydrology of the site. The assessment aims to highlight any indications of nearby human activity, and provide recommendations for further analysis (if necessary).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14
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South Bromley
Canning Town
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A
Exhibition Centre
Custom House
Royal Victoria Dock
POPLAR
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West India Dock
B
Blackwall
River Thames
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Silvertown
West India and Millwall Docks
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2
4
Bugsby's Reach
20
Millwall Outer Dock
Millwall
Isle of Dogs
1
New Charlton
18
Cubitt Town
12
5
13
River Thames
Greenwich Reach

Figure 1: Location of (1) Enderby Wharf, Christchurch Way, London Borough of Greenwich and other geoarchaeological and archaeological sites nearby: (2) Plot MO117 (JHW13; Young & Batchelor, 2013b); (3) Tunnel Avenue (GPF12; Batchelor, 2013); (4) Atlas Wharf (AWF98; Lakin, 1998); (5) Mast House Terrace (MHT95; Bowsher & Wilkinson, 1995); (6) Preston Road (PPP06; Branch *et al*., 2007); (7) East India Docks (Pepys, 1665); (8) Victoria Deep Water Terminal (TUA02; Corcoran, 2002); (9) Greenwich Peninsula (Corcoran, 2002); (10) Canning Town (Stafford, 2012); (11) Lower Lea Valley Mapping Project (Corcoran *et al*., 2011); (12) Bellot Street (GLB05; Branch *et al*., 2005); (13) 72-88 Bellot Street (BSG93; McLean, 1993; Philp, 1993); (14) Canning Town Regeneration Area 7 & 1C (CTR12; Green & Young, 2012); (15) the Cable Car route (CAB11; Green *et al*., 2011) (A) North Station; (B) North Intermediate Tower; (C) North Tower; (D) South Tower; (E) South Station) (Batchelor *et al*., 2012); (16) Silvertown (BWC96; Wilkinson *et al*., 2000); (17) Fort Street (HW-FO94; Wessex Archaeology, 2000); (18) Greenwich Industrial Estate (GIE02; Morley, 2003); (19) Royal Docks Community School (PRG97; Holder, 1998); (20) Greenwich Millennium Village (Miller & Halsey, 2011); (21) Millennium Festival Site, Greenwich (BWP97; Bowsher & Corcoran, unknown); (22) 118 Victoria Dock Road (Barnett *et al*., 2012); (23) Plot MO115 (CHB13; Young & Batchelor, 2013a). *Contains Ordnance Survey data © Crown copyright and database right [2012]*

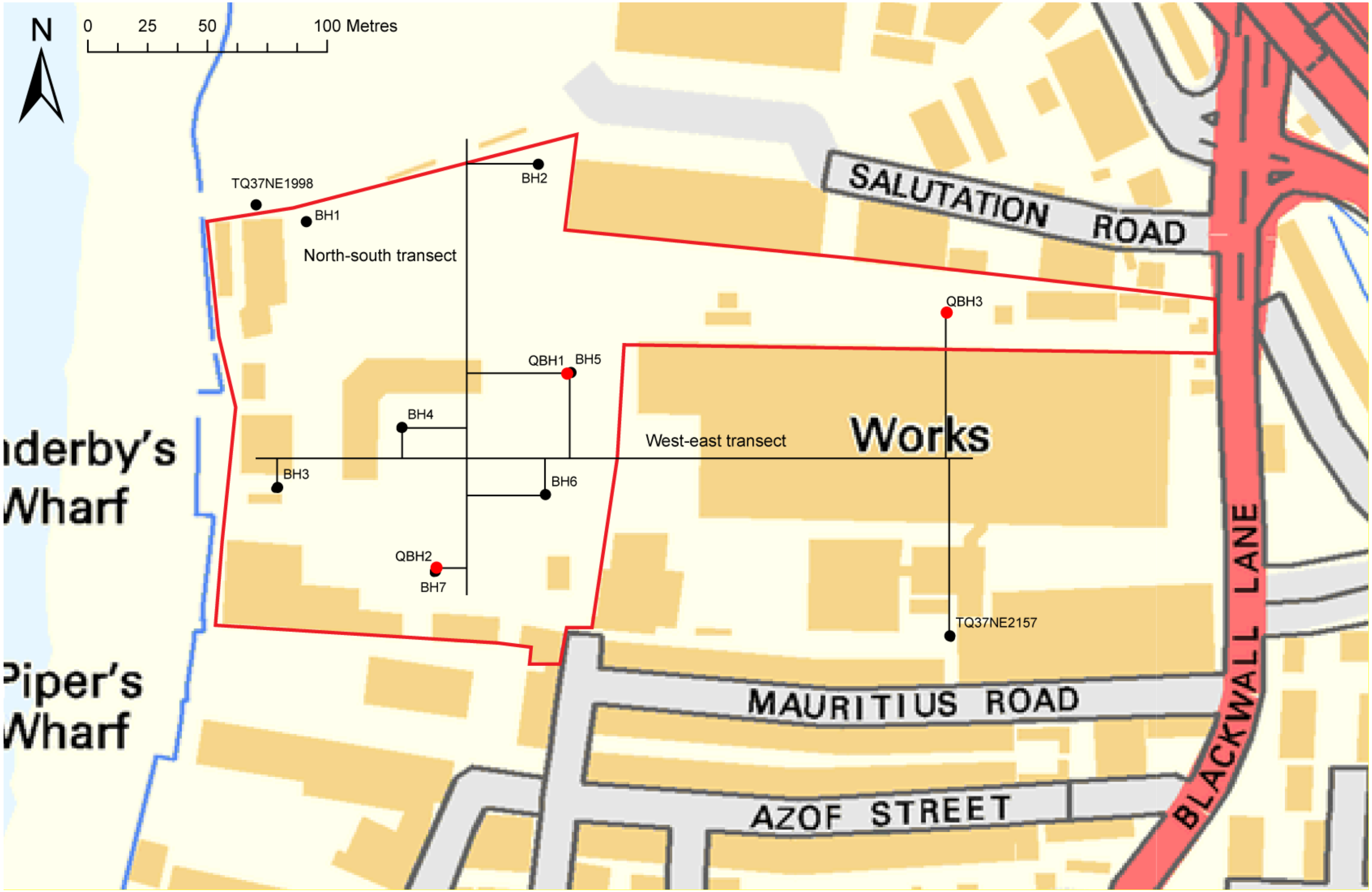

Figure 2: New geoarchaeological and existing geotechnical borehole locations at Enderby Wharf, Christchurch Way, London Borough of Greenwich. ***Contains Ordnance Survey data © Crown copyright and database right [2012]***

METHODS

Previous investigations (field investigations and deposit modelling)

Seven geotechnical boreholes were put down at the site by URS by cable percussion (BH1 to BH7). Selected boreholes (BH2, BH3, BH5 and BH7) were monitored and described in the field by Quaternary Scientific, and compared with the geotechnical descriptions provided by the drilling team. The resulting sedimentary logs were combined with those of the geotechnical boreholes and used to produce a deposit model for the site, in combination with boreholes put down nearby to the site, provided by the British Geological Society (NERC). Co-ordinates and OD height data was not available for the previous geotechnical boreholes put down at the site by WESA (2003), Babtie (2003) and URS (2003); these boreholes were thus not included in the deposit model.

An additional three boreholes (boreholes <QBH1> to <QBH3>) were put down at the site in January 2014 following the results of the deposit modelling exercise (Young, 2013; Figure 2). Borehole core samples were recovered using an Eijkelkamp window sampler and gouge set using an Atlas Copco TT 2-stroke percussion engine. This coring technique is a suitable method for the recovery of continuous, undisturbed core samples and provides sub-samples suitable for not only sedimentary and microfossil assessment and analysis, but also macrofossil analysis. The recovered core samples were wrapped in clear plastic to prevent moisture loss, labelled with the depth (metres from ground surface) and orientation (top and base) and returned to Quaternary Scientific for storage in a purpose built facility at 2^{o}C. This temperature prevents fungal growth on the core surface, which may lead to anomalous radiocarbon dates, and moisture loss. The spatial attributes of each borehole were recorded (Table 1 and Figure 2).

The sedimentary logs from these boreholes were combined with those of the previous deposit model, resulting in a total of 11 sediment logs for the deposit modelling process. Sedimentary units from the boreholes were classified into the following groupings: (1) Shepperton Gravel; (2) Lower Alluvium, (3) Peat, (4) Upper Alluvium and (5) Made Ground. The Lower Alluvium and Peat were not recorded in all boreholes; and where only alluvium was recorded, this was designated as the Upper Alluvium. The classified data for groups 1-5 were input into a database with the RockWorks 2006 geological utilities software. Models of surface height (using a nearest neighbour routine) were generated for the Shepperton Gravel, Lower Alluvium, Peat and Upper Alluvium (Figures 5, 6, 7 and 9). The thickness of the Peat, combined Alluvium and Made Ground was also modelled (also using a nearest neighbour routine) (Figures 8, 10 and 11). In addition, north-south and west-east 3-

Dimensional interpolated transects are provided for the site; these include selected borehole records for comparative purposes (Figures 3 and 4).

Table 1: Borehole attributes, Enderby Wharf, Christchurch Way, London Borough of Greenwich

Borehole number	Easting	Northing	Elevation (m OD)
<QBH1>	539270.39	178739.98	1.84
<QBH2>	539215.97	178659.37	2.32
<QBH3>	539428.27	178765.33	1.59

Lithostratigraphic descriptions

The lithostratigraphy of boreholes <QBH1> to <QBH3> 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 displayed in Figures 3, 4 and 12 and in Tables 2 to 4.

Organic matter determinations

47 sub-samples from borehole <QBH1> were taken for determination of the organic matter content (Table 5; Figure 12). 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^{0}C 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).

Radiocarbon dating

Sub-samples of unidentified twig wood (<2-3 years old) were extracted from the base of the middle and upper Peat horizons in borehole <QBH1> for radiocarbon dating. Both samples were submitted for AMS radiocarbon dating to the Scottish Universities Environmental Research Centre (SUERC), East Kilbride, Glasgow. The results have been calibrated using OxCal v4.0.1 (Bronk Ramsey, 1995; 2001 and 2007) and the IntCal13 atmospheric curve (Reimer *et al*., 2013). The results are displayed in Figure 12 and in Table 6.

Pollen assessment

Twelve sub-samples from borehole <QBH1> 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) (Table 7).

Diatom assessment

Four sub-samples from borehole <QBH1> 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)

Duplicate slides each having two coverslips were made from each sample and fixed in Naphrax for diatom microscopy. The coverslip with the most suitable concentration of the sample preparation was selected for diatom evaluation. A large area of this coverslip was scanned for diatoms at magnifications of x400 and x1000 under phase contrast illumination using a Leica microscope. The results are displayed in Table 8.

Macrofossil assessment

A total of seven small bulk samples from borehole <QBH1> 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 (Table 9).

Preliminary identifications of the waterlogged seeds have been made using modern comparative material and reference atlases (Cappers *et al.* 2006, Schoch *et al*. 2004). Nomenclature used follows Stace (2005) (Table 10).

RESULTS AND INTERPRETATION OF THE LITHOSTRATIGRAPHIC DESCRIPTIONS, DEPOSIT MODELLING, ORGANIC MATTER CONTENT AND RADIOCARBON DATING

The results of the deposit modelling for the site have been reported previously (Young, 2013; Appendix 1). The deposit model has been updated with the records from the three new geoarchaeological boreholes (Figures 5 to 11), and the lithostratigraphic description of these boreholes (<QBH1> to <QBH3>) and quantification of the organic matter content by Loss-on-Ignition (<QBH1>) has allowed further detail to be added to the lithostratigraphic descriptions (Figure 12; Tables 2 to 5).

The results of the deposit modelling are displayed in Figures 3 to 10. Figures 3 to 8 provide surface elevation and thickness models for each of the main stratigraphic units, whilst Figures 9 and 10 provide 2-Dimensional west-east and north-south transects across the site respectively. The results of the deposit modelling indicate that a sufficient number and spread of boreholes (including the new record for the eastern part of the site, <QBH3>) have been put down to permit modelling across the majority of the site.

The basal unit recorded in the deposit model for the site is a horizon of sand and gravel (the Shepperton Gravel). These sediments were deposited during the Late Devensian (Marine Isotope Stage 2, *ca*. 16,000-11,500 cal BP), within a high energy braided river system. The surface of this unit is relatively even across the site, recorded at between *ca*. -3.5 and -4.0m OD in the majority of boreholes (Figure 3). The Gravel surface rises in the northern part of the site however towards borehole BH2, where it was recorded at -2.8m OD, and to the east to -3.21m OD in the area of <QBH3>. Southeast of the site the Gravel surface falls in the area of BGS borehole TQ37NE2157 to -4.9m OD. Where the Shepperton Gravel is recorded at its lowest in boreholes BH7 and TQ37NE2157, and in two of the new geoarchaeological boreholes (<QBH1> and <QBH2>) it is overlain by a horizon of sand, between -4.01 and -4.08m OD in <QBH1> (less than 1% organic content; Table 5), -3.85 and -4.47m OD in <QBH2>, -3.86 and -4.06 in BH7 and -4.4 and -4.9m OD in TQ37NE2157. Where this unit is recorded, it is indicative of a gradual reduction in flow rate from that which deposited the coarser Shepperton Gravel, and was most likely deposited within depressions in the Gravel surface during the Early Holocene. Elsewhere, the Shepperton Gravel is overlain by sandy or clayey silt with frequent detrital organic inclusions of wood or herbaceous material, which in borehole <QBH1> contains generally less than 5% organic content (Table 5; Figure 12). This unit is considered to represent the Lower Alluvium, and is indicative of the former presence of low energy fluvial or estuarine conditions during the Early to Middle Holocene. The surface of this unit across the site lies at between -0.5 and -2.5m OD (Figure 4), generally sloping down towards the east of the site, falling from -0.5m OD in borehole BH3 in the west to -2.8 (BH2) and -2.45m OD (BH5) in the east. Beyond the southeastern margin of the site the surface of the Lower Alluvium lies at -3.7m OD in borehole TQ37NE2157.

In borehole <QBH1> a Peat horizon is recorded within the Lower Alluvium between -2.61 and -2.77m OD (up to 80% organic content), generally lower than that the Peat horizons recorded elsewhere and perhaps indicative of a localised transition to semi-terrestrial conditions that occurred earlier at this location. This horizon is overlain by silty clay Alluvium (indicative of flooding of the Peat surface). Elsewhere, and in all boreholes except BH6 (where Peat is absent), the Lower Alluvium is overlain by a generally woody or herbaceous Peat horizon which lies at between 0.0 and -2.5m OD, and is generally between 0.5 and 2m thick (Figures 5 and 6). In boreholes <QBH1>, <QBH2> and <QBH3> the Peat horizon is woody, and is recorded between -0.84 and -2.11m OD (<QBH1>; up to 80% organic content), -0.60 and -2.36m OD (<QBH2>) and -0.41 and -2.41m OD (<QBH3>). Beyond the southeastern margin of the site, the Peat was recorded as 3.3m thick in borehole TQ37N2157, between -0.4 and -3.7m OD. The Peat formation is indicative of a transition to semi-terrestrial conditions across the site, supporting the growth of wetland vegetation including herbaceous and woody taxa. Radiocarbon dating of borehole <QBH1> (-2.06 to -2.11m OD) indicates that this transition occurred during the Middle Neolithic (5290-4980 cal BP; Table 6).

Notably, in almost all boreholes the Peat is separated by a horizon of organic clayey silt (up to 35% organic in borehole <QBH1>), of variable thicknesses between *ca*. 0.5 and 1.0m but generally recorded between *ca*. -1.0 and -2.0m OD. Although not recorded at exactly the same elevation in all boreholes, this horizon may represent a broadly contemporaneous episode of flood events which brought an influx of mineral-rich material across the Peat surface. In borehole <QBH1> Peat formation had re-commenced by the Late Neolithic/Early

Bronze Age (4420-4240 cal BP; -1.48 to -1.53m OD).

The Peat is overlain across the site at between -0.5 and 0.0m OD by a horizon of silty clay, with occasional detrital organic matter and Mollusca fragments (generally <10% organic content), referred to here as the Upper Alluvium. This unit is representative of flooding of the Peat surface by low energy fluvial conditions. The surface of the Upper Alluvium is relatively even across the site, generally lying at between 1.0 and 0.5m OD (Figure 7). The Upper Alluvium is overlain by variable thicknesses of Made Ground (1-3m; Figure 9); the Made Ground is thickest towards the west, where it is recorded in borehole BH3 at 2.45m thick, and in BGS borehole TQ37NE1998 (just beyond the northwest margin of the site) at 4.0m thick. The modern surface of the site generally lies at between 2.5 and 2.0m OD.

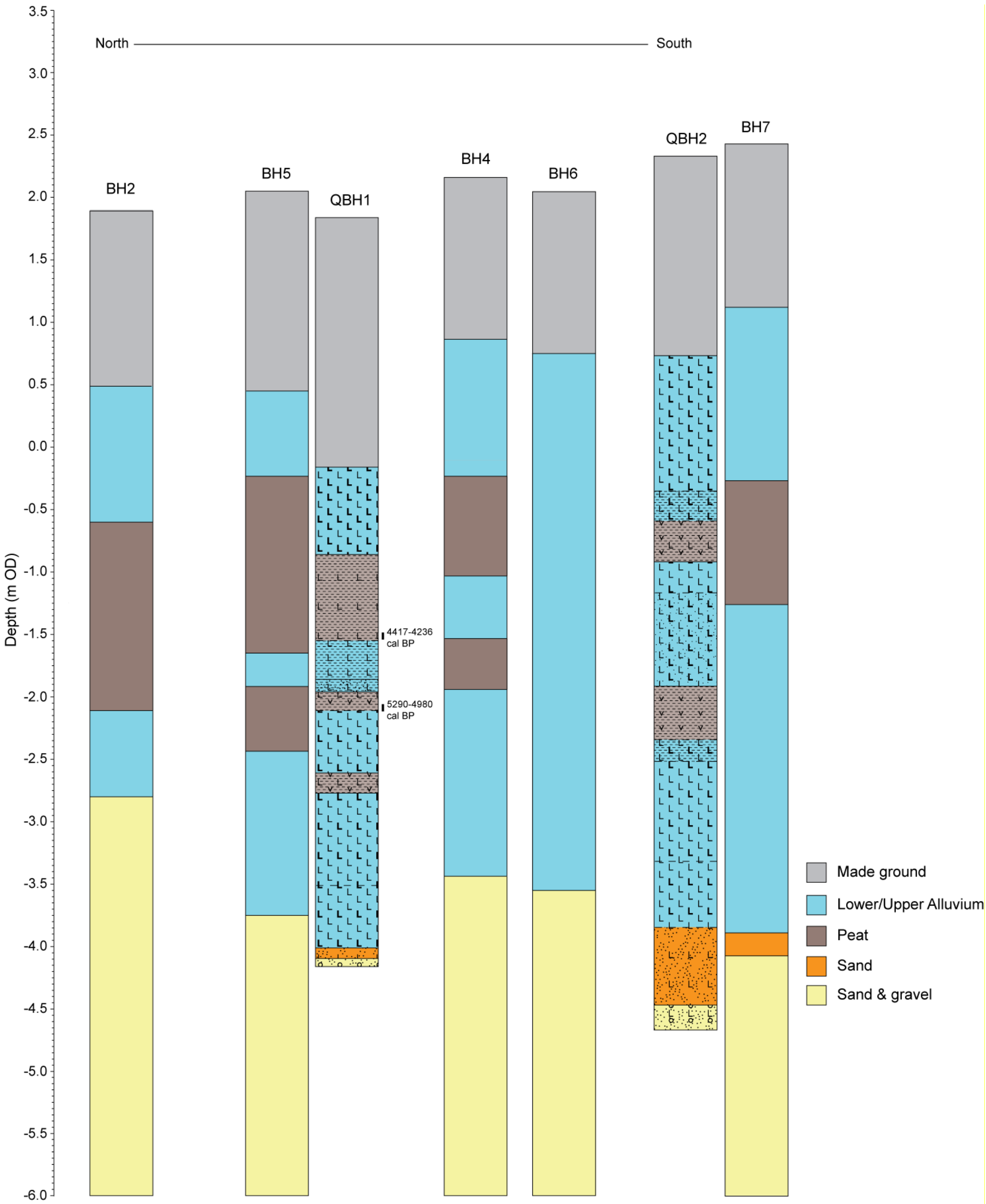

Figure 3: North-south transect of geoarchaeological and geotechnical boreholes across the site at Enderby Wharf, Christchurch Way, London Borough of Greenwich

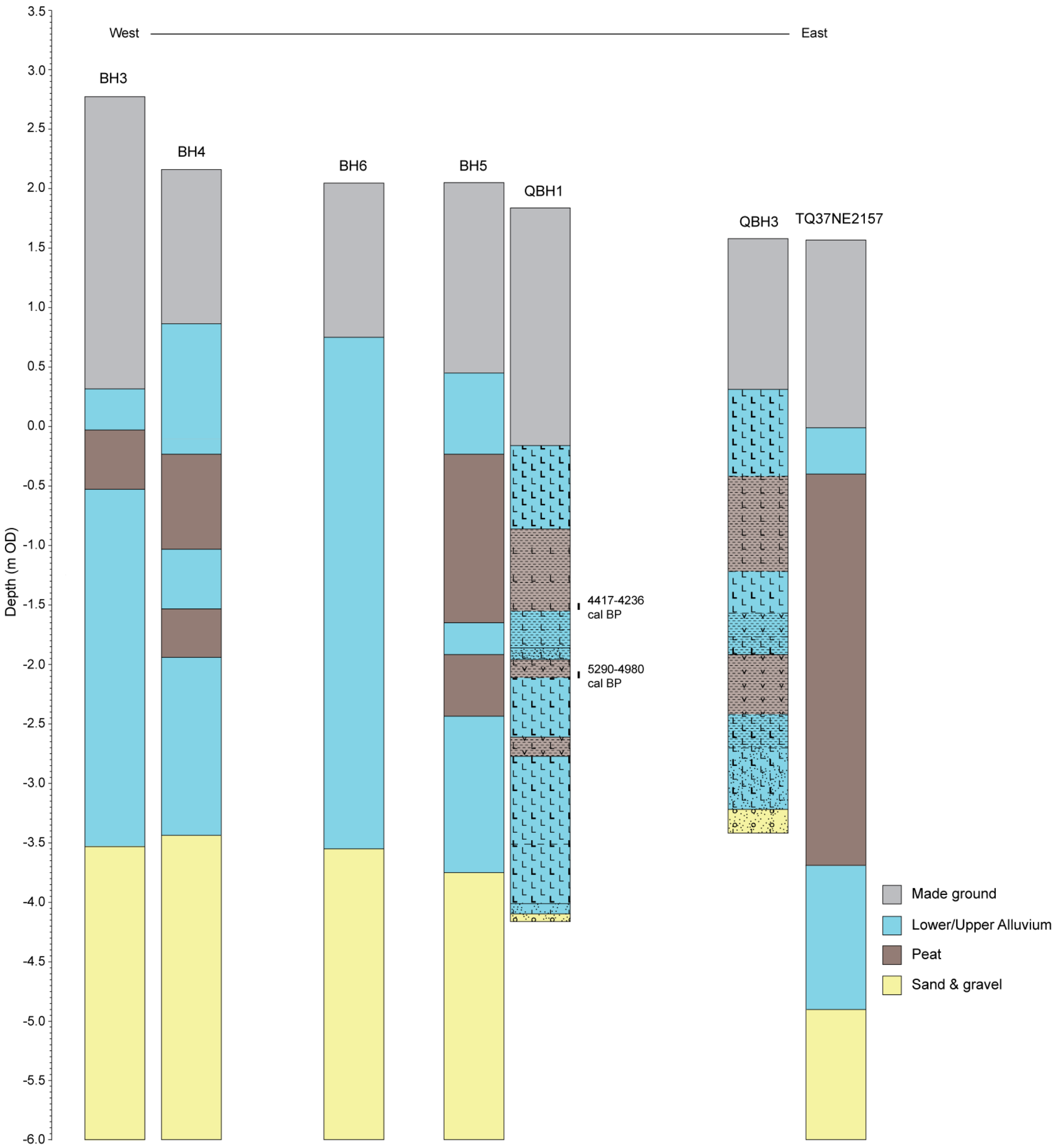

Figure 4: West-East transect of geoarchaeological and geotechnical boreholes across the site at Enderby Wharf, Christchurch Way, London Borough of Greenwich

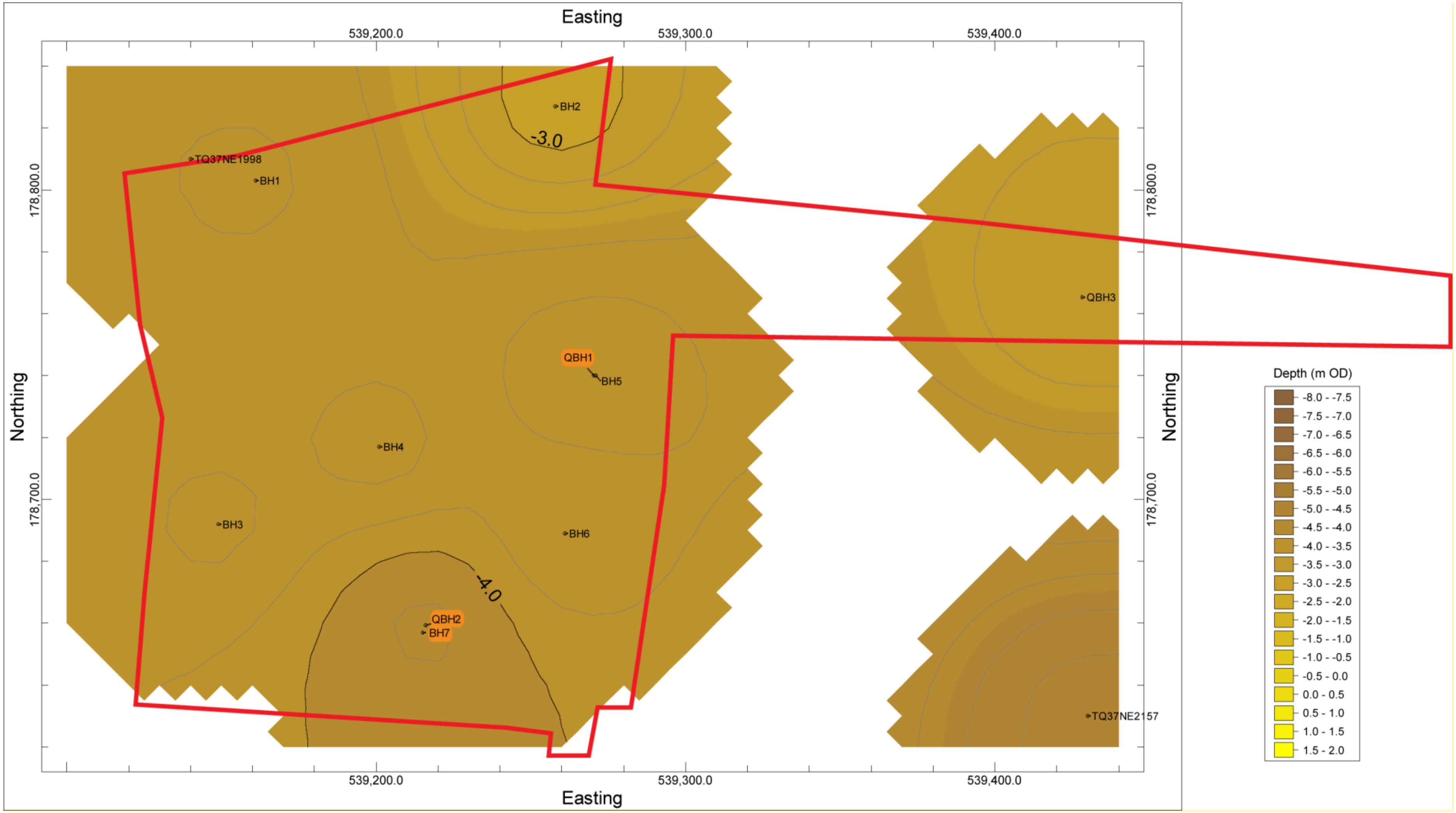

Figure 5: Modelled surface of the Shepperton Gravel (contour heights in metres OD). Where the Shepperton Gravel is overlain by sand these boreholes are highlighted in orange.

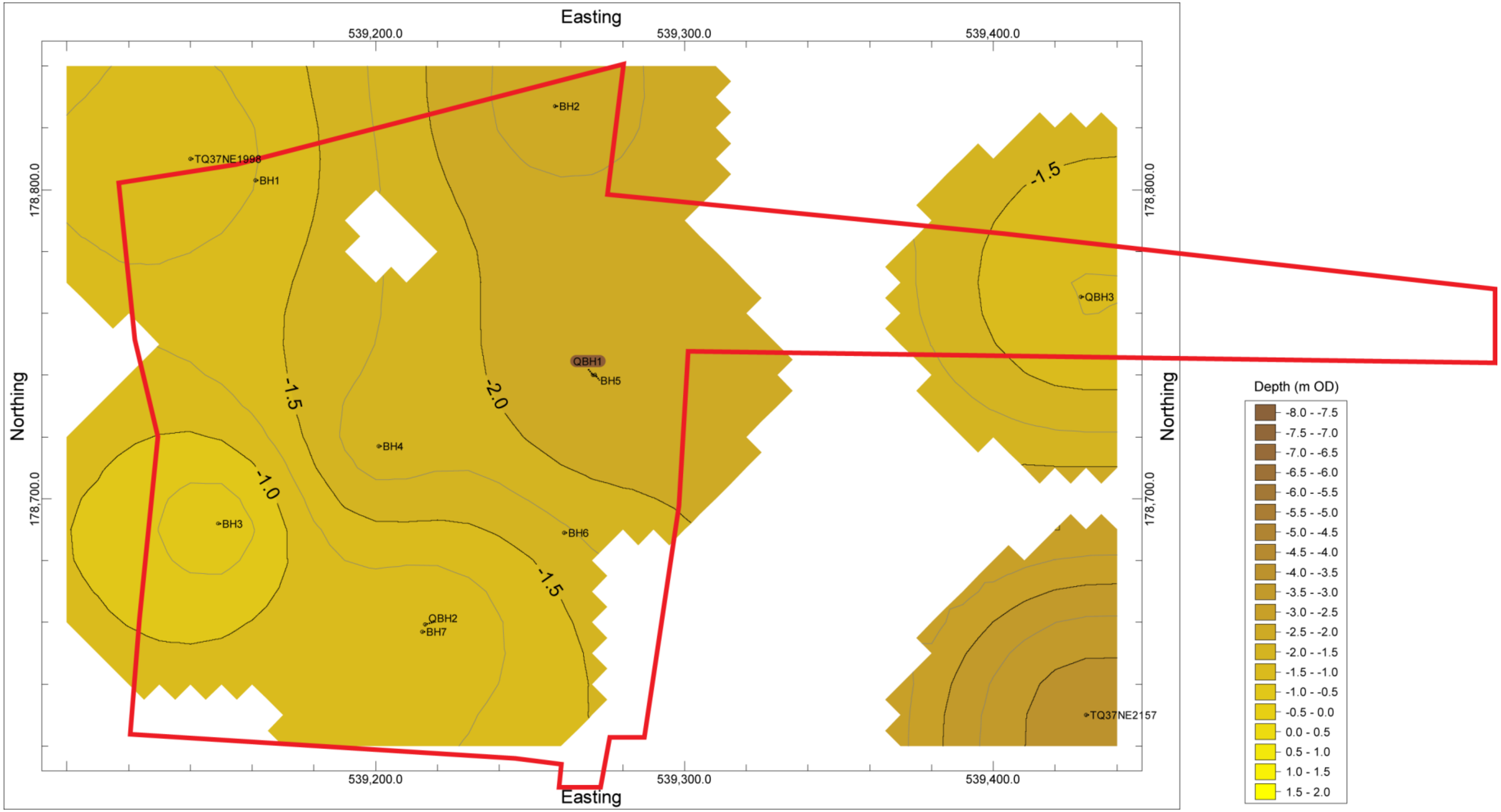

Figure 6: Modelled surface of the Lower Alluvium (contour heights in metres OD). The Lower Alluvium contains a silty Peat at the location of <QBH1> (highlighted in brown).

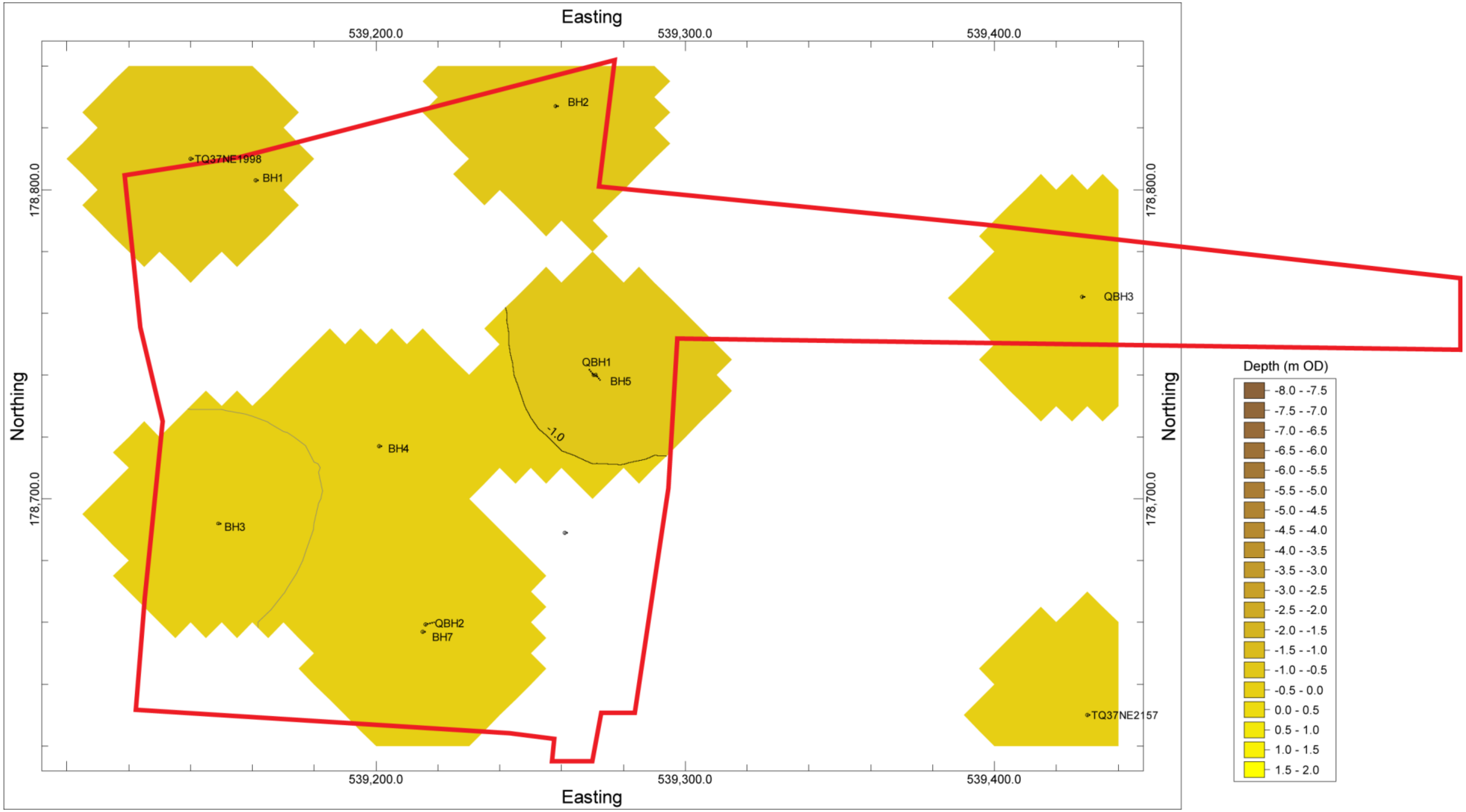

Figure 7: Modelled surface of the Peat horizon (contour heights in metres OD).

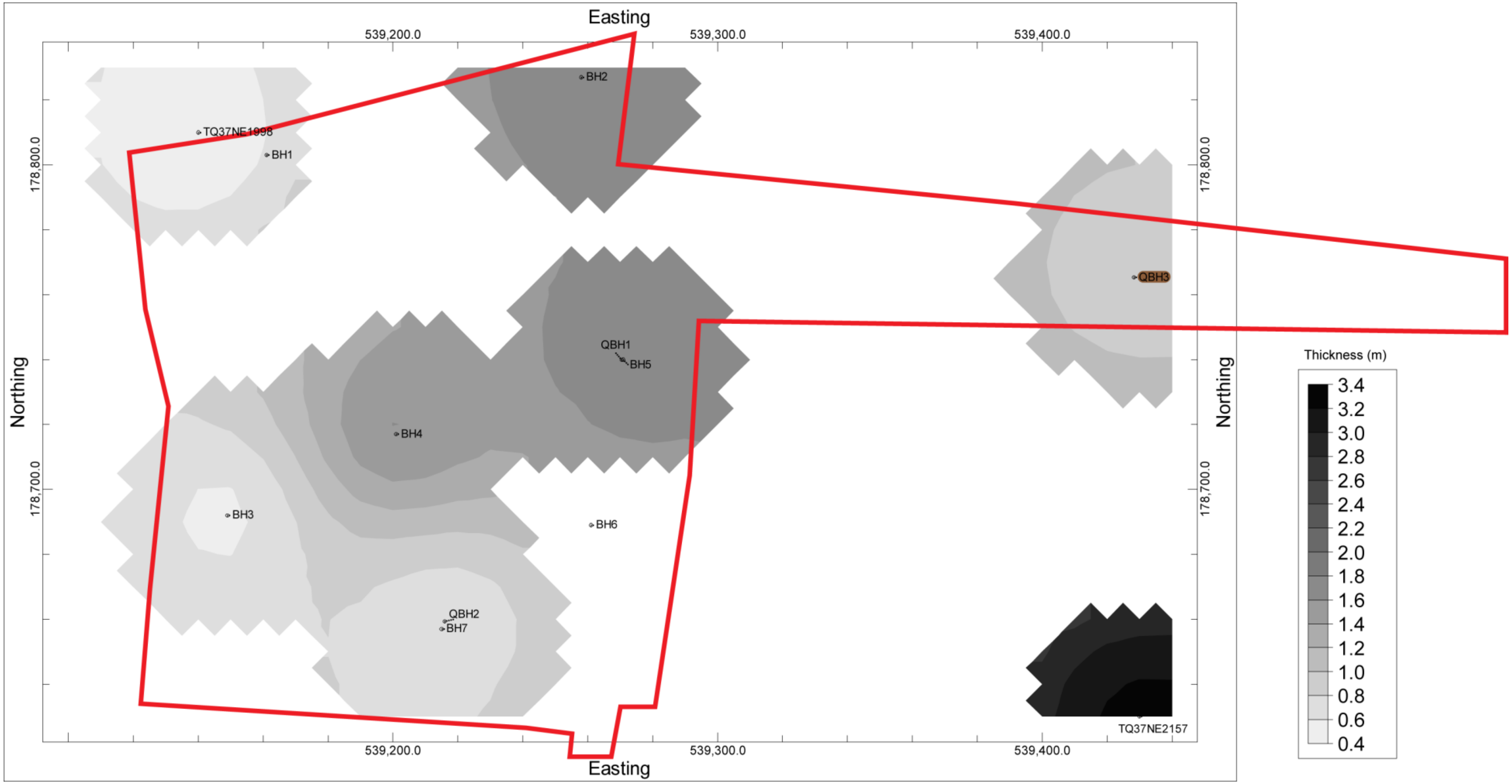

Figure 8: Modelled thickness of the Peat/organic sediment complex (metres).

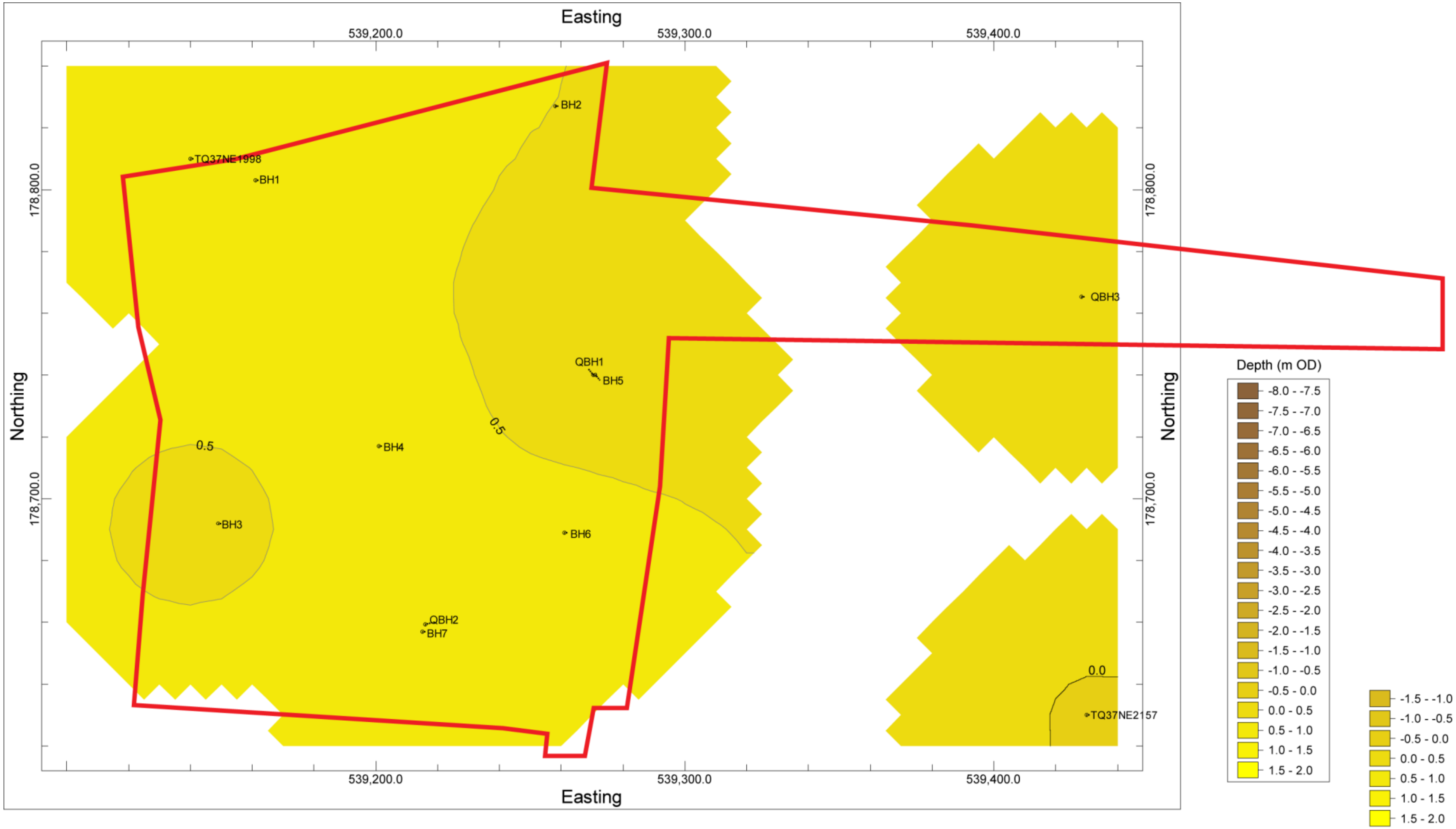

Figure 9: Modelled surface of the Upper Alluvium (contour heights in metres OD)

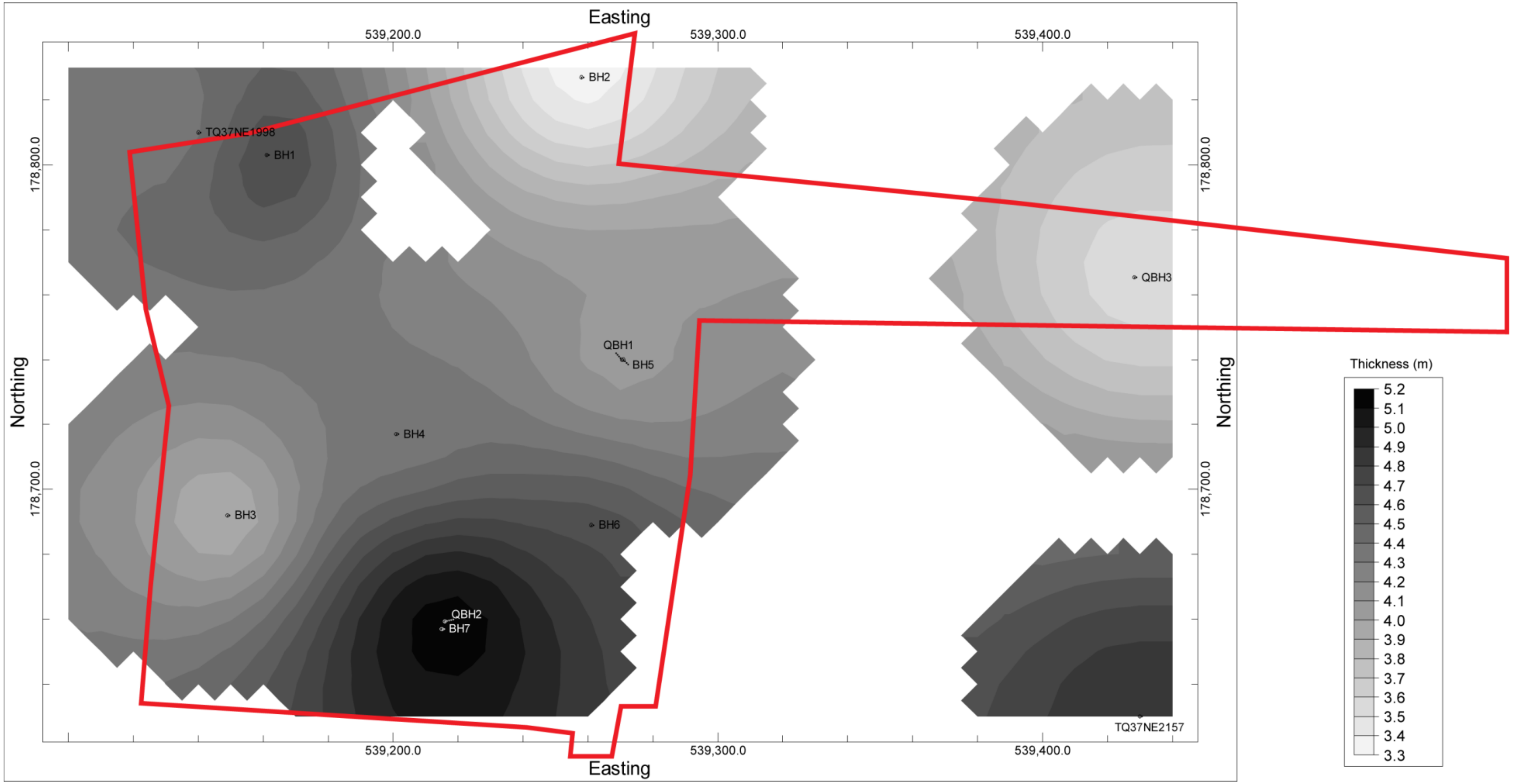

Figure 10: Modelled thickness of the combined Alluvium (incorporating the Lower Alluvium, Peat and Upper Alluvium) (metres)

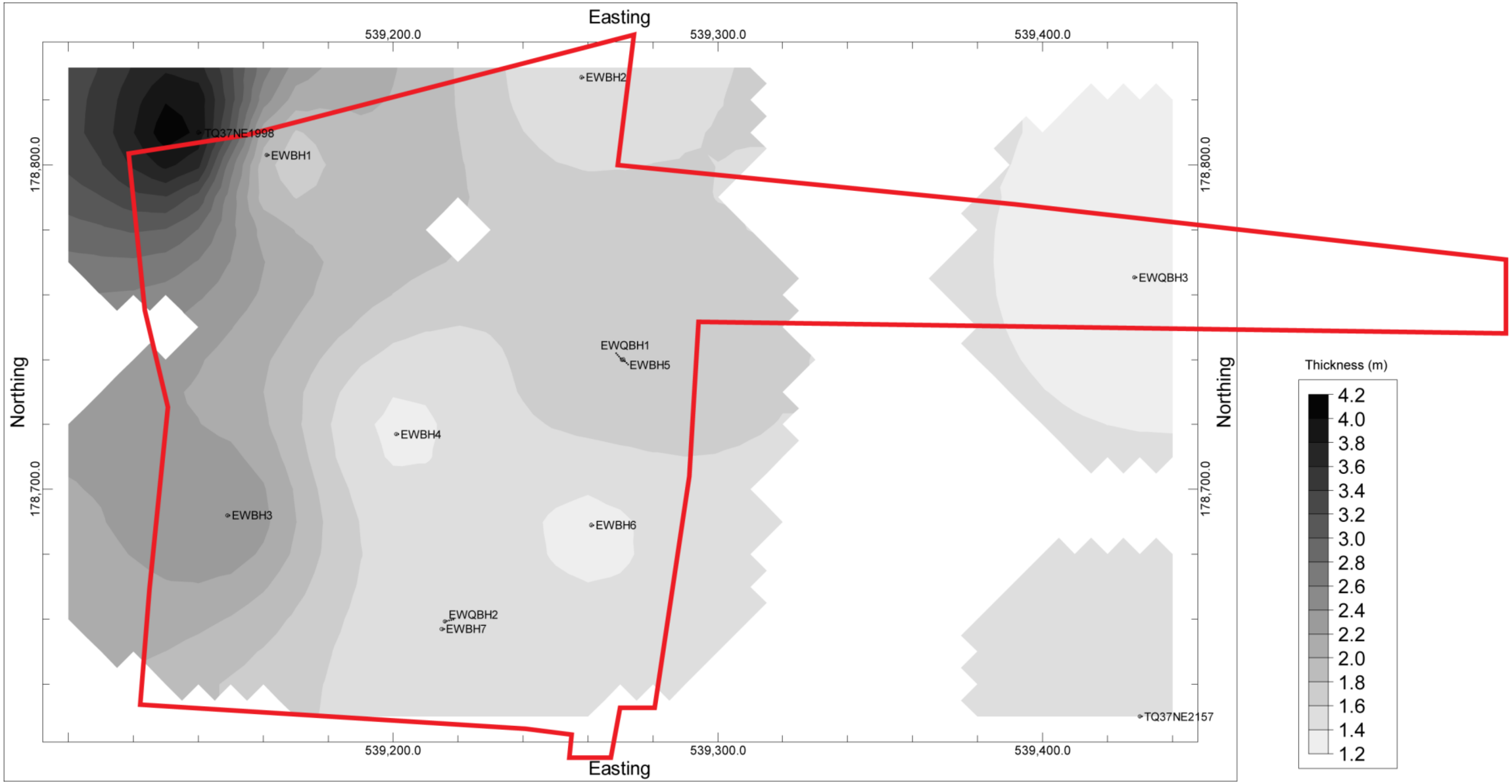

Figure 11: Modelled thickness of the Made Ground (metres)

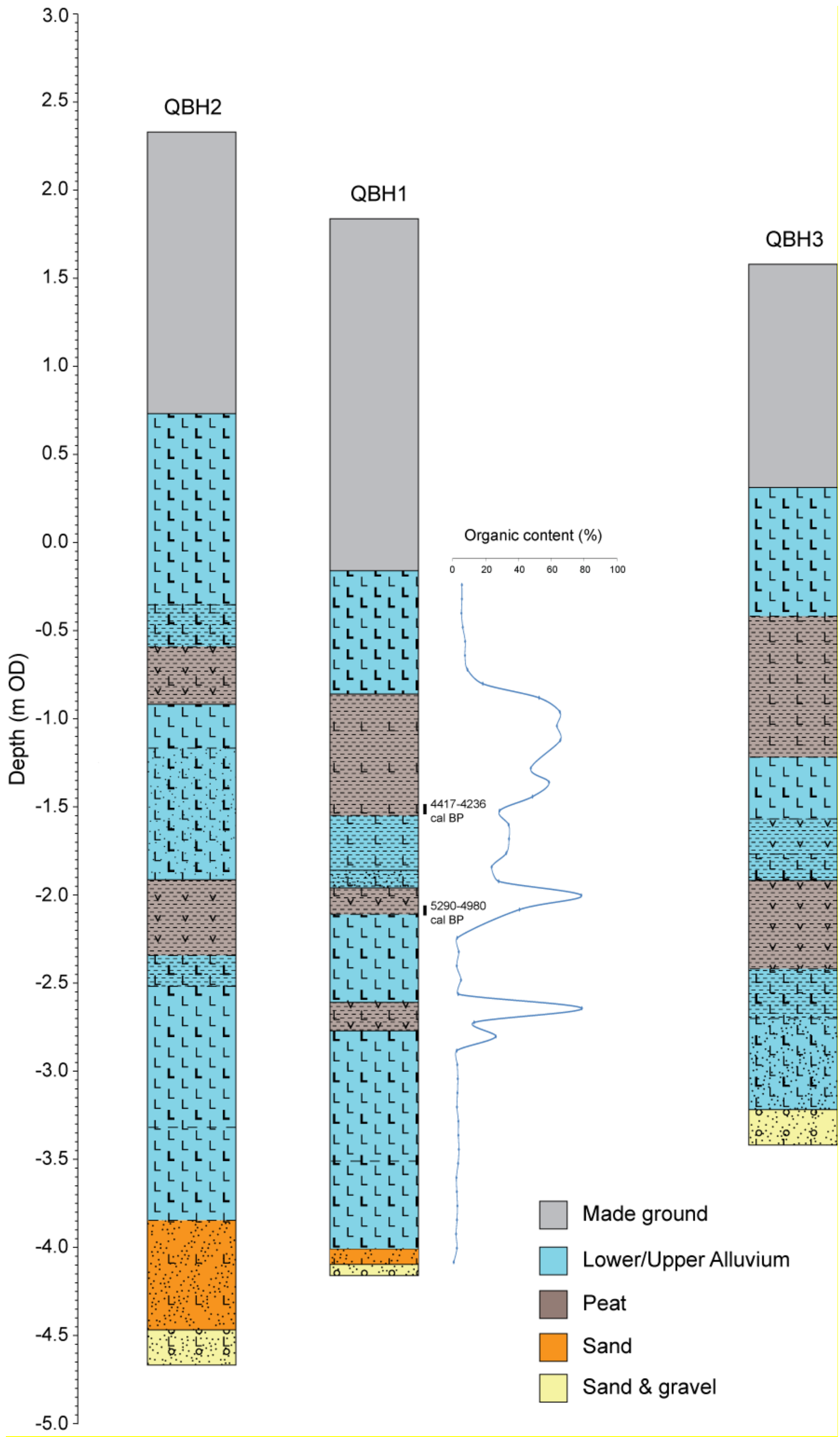

Figure 12: Results of the borehole <QBH1>, <QBH2> and <QBH3> lithostratigraphic analysis, incorporating lithostratigraphic descriptions and organic matter content, plotted with associated radiocarbon dates, Enderby Wharf, Christchurch Way, London Borough of Greenwich

Table 2: Lithostratigraphic description of borehole <QBH1>, Enderby Wharf, Christchurch Way, London Borough of Greenwich

Depth (m OD)	Depth (m bgs)	Composition
1.84 to -0.16	0.00 to 2.00	Made Ground
-0.16 to -0.84	2.00 to 2.68	Gley 1 5/10Y; As3 Ag1; greenish grey silty clay. Sharp contact in to:
-0.84 to -1.53	2.68 to 3.37	2.5YR 2.5/1; Sh3 Ag1 Tl+ Th+; Humo. 2; reddish black moderately humified silty peat with traces of herbaceous and woody material. Diffuse contact in to:
-1.53 to -1.88	3.37 to 3.72	7.5YR 4/1; Sh2 Ag2 Tl+ Th+; Humo. 3; dark grey well humified silt and peat with a trace of herbaceous and woody material. Sharp contact in to:
-1.88 to -1.95	3.72 to 3.79	Ag2 Ga1 Sh1 Dh+; horizontal beds of sandy silt or organic silt with traces of detrital herbaceous material. Beds are 8-4mm in thickness. Sharp contact in to:
-1.95 to -2.11	3.79 to 3.95	2.5YR 2.5/1; Sh2 Tl^{1}1 Ag1; Humo. 2; reddish black moderately humified silty herbaceous peat. Diffuse contact in to:
-2.11 to -2.61	3.95 to 4.45	Gley 1 5/10Y; Ag3 As1 Dl+ Sh+; greenish grey clayey silt with traces of detrital wood and organic matter. Sharp contact in to:
-2.61 to -2.77	4.45 to 4.61	10YR 2/1; Sh2 Ag1 Dl/Tl^{1}1; Humo. 2; black moderately humified silty peat with detrital or in situ woody material. Sharp contact in to:
-2.77 to -3.51	4.61 to 5.35	Gley 1 4/10Y; Ag2 As2; dark greenish grey silt and clay.
-3.51 to -4.01	5.35 to 5.85	Gley 1 4/10Y; Ag2 As2; dark greenish grey silt and clay. Sharp contact in to:
-4.01 to -4.08	5.85 to 5.92	Gley 1 4/10Y; Ga3 Ag1; dark greenish grey silty sand. Sharp contact in to:
-4.08 to -4.16	5.92 to 6.00	Gg3 Ga1; sandy gravel.

Table 3: Lithostratigraphic description of borehole <QBH2>, Enderby Wharf, Christchurch Way, London Borough of Greenwich

Depth (m OD)	Depth (m bgs)	Composition
2.32 to 0.72	0.00 to 1.60	Made Ground
0.72 to -0.37	1.60 to 2.69	Gley 1 5/10Y; Ag2 As2; greenish grey silt and clay with some calcareous nodules. Diffuse contact in to:
-0.37 to -0.60	2.69 to 2.92	10YR 3/2; Ag2 As1 Sh1; very dark greyish brown organic clayey silt. Diffuse contact in to:
-0.60 to -0.93	2.92 to 3.25	2.5YR 2.5/1; Sh2 Ag1 Tl^{2}1; Humo. 2; reddish black moderately humified silty woody peat. Sharp contact in to:
-0.93 to -1.18	3.25 to 3.50	Gley 1 4/N; Ag3 As1 Ga+; dark grey clayey silt with a trace of sand. Diffuse contact in to:
-1.18 to -1.93	3.50 to 4.25	Gley 1 4/N; Ag2 Ga1 As1 Dh+; dark grey sandy clay silt with some horizontal bedding. Sharp contact in to:
-1.93 to -2.36	4.25 to 4.68	2.5YR 2.5/1; Sh3 Tl^{2}1 Ag+; Humo. 2; reddish black moderately humified woody peat with a trace of silt. Diffuse contact in to:
-2.36 to -2.52	4.68 to 4.84	10YR 2/1; Ag2 As1 Sh1; black organic clayey silt. Diffuse contact in to:
-2.52 to -3.33	4.84 to 5.65	Gley 1 3/10Y; Ag3 As1 Dl+; very dark greenish grey clayey silt with a trace of detrital wood. Diffuse contact

		in to:
-3.33 to -3.85	5.65 to 6.17	Gley 1 6/10Y; Ag3 As1 Dl+; greenish grey clayey silt with a trace of detrital wood and some calcareous nodules. Diffuse contact in to:
-3.85 to -4.47	6.17 to 6.79	Gley 1 4/10Y; Ga3 Ag1; dark greenish grey silty sand. Sharp contact in to:
-4.47 to -4.68	6.79 to 7.00	Gley 1 4/10Y; Gg2 Ga1 Ag1; dark greenish grey silty sandy gravel.

Table 4: Lithostratigraphic description of borehole <QBH3>, Enderby Wharf, Christchurch Way, London Borough of Greenwich

Depth (m OD)	Depth (m bgs)	Composition
1.59 to 0.32	0.00 to 1.27	Made Ground
0.32 to -0.41	1.27 to 2.00	10YR 4/2; As2 Ag2; dark greyish brown silt and clay with some calcareous nodules. Some iron staining.
-0.41 to -1.21	2.00 to 2.80	10YR 2/1; Sh2 Ag2 Dl/Tl+; Humo. 3; black well humified silt and peat with a trace of detrital or in situ wood. Diffuse contact in to:
-1.21 to -1.54	2.80 to 3.13	Gley 1 4/10Y; Ag3 As1 Dh+; dark greenish grey clayey silt with a trace of detrital herbaceous material. Diffuse contact in to:
-1.54 to -1.76	3.13 to 3.35	10YR 4/1; Ag3 Sh1 Dh+; dark grey organic silt with a trace of detrital herbaceous material. Diffuse contact in to:
-1.76 to -1.89	3.35 to 3.48	Gley 1 4/10Y; Ag3 As1 Dh+; dark greenish grey clayey silt with a trace of detrital herbaceous material. Sharp contact in to:
-1.89 to -2.41	3.48 to 4.00	2.5YR 2.5/1; Sh3 $Tl^2$1 Th+ Ag+; Humo. 2/3; moderately to well humified woody peat with traces of herbaceous material and silt.
-2.41 to -2.68	4.00 to 4.27	10YR 2/1; Ag2 As1 Sh1 Dh+; black organic clayey silt with a trace of detrital herbaceous material. Diffuse contact in to:
-2.68 to -3.21	4.27 to 4.80	Gley 1 3/10Y; Ag2 As1 Ga1 Dh+; very dark greenish grey clayey sandy silt with a trace of detrital herbaceous material. Sharp contact in to:
-3.21 to -3.41	4.80 to 5.00	Gley 1 3/10Y; Gg2 Ga1 Ag1; very dark greenish grey sandy silty gravel.

Table 5: Results of the borehole <QBH1> organic matter determinations, Enderby Wharf, Christchurch Way, London Borough of Greenwich

Depth (m OD)		Organic matter content (%)
From	To	
-0.24	-0.25	5.59
-0.32	-0.33	5.60
-0.40	-0.41	5.33
-0.48	-0.49	6.13
-0.56	-0.57	7.61
-0.64	-0.65	7.48
-0.72	-0.73	8.97
-0.80	-0.81	18.31
-0.88	-0.89	52.64
-0.96	-0.97	65.30

-1.04	-1.05	63.50
-1.12	-1.13	65.59
-1.28	-1.29	47.57
-1.36	-1.37	58.71
-1.44	-1.45	48.62
-1.52	-1.53	28.56
-1.60	-1.61	34.09
-1.68	-1.69	34.33
-1.76	-1.77	32.66
-1.84	-1.85	23.70
-1.92	-1.93	27.99
-2.00	-2.01	78.38
-2.08	-2.09	40.71
-2.24	-2.25	2.79
-2.32	-2.33	3.71
-2.40	-2.41	2.48
-2.48	-2.49	5.04
-2.56	-2.57	3.38
-2.64	-2.65	78.70
-2.72	-2.73	13.09
-2.80	-2.81	26.25
-2.88	-2.89	2.47
-2.96	-2.97	2.79
-3.04	-3.05	3.10
-3.12	-3.13	2.87
-3.20	-3.21	2.60
-3.28	-3.29	3.44
-3.36	-3.37	3.42
-3.44	-3.45	3.75
-3.52	-3.53	3.28
-3.60	-3.61	2.25
-3.68	-3.69	2.50
-3.76	-3.77	2.87
-3.84	-3.85	2.61
-3.92	-3.93	2.06
-4.00	-4.01	2.56
-4.08	-4.09	0.64

Table 6: Results of the borehole <QBH1> radiocarbon dating, Enderby Wharf, Christchurch Way, London Borough of Greenwich

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)**	**δ13C (‰)**
SUERC-50522 (GU33051)	Twig wood; base of upper Peat	-1.48 to -1.53	3879 ± 27	2470-2290 cal BC (4420-4240 cal BP)	-28.6
SUERC-50523 (GU33052)	Twig wood; base of middle Peat	-2.06 to -2.11	4480 ± 29	3340-3030 cal BC (5290-4980 cal BP)	-28.5

RESULTS AND INTERPRETATION OF THE POLLEN ASSESSMENT

Twelve sub-samples from borehole <QBH1> were extracted for an assessment of pollen content (Table 7). These samples were targeted on the thin silty Peat within the Lower Alluvium (-2.77 to -2.61m OD) and the sequence of Peat and organic-rich sediments between -2.11 and -0.84m OD.

The results of the assessment indicate a high concentration and preservation of pollen within the two samples taken from the thin silty peat within the Lower Alluvium. These samples are dominated by *Alnus* (alder), *Quercus* (oak), Cyperaceae and *Filicales* (ferns) with lesser numbers of *Corylus* type (hazel), *Tilia* (lime), *Fraxinus* (ash), *Betula* (birch), *Hedera* (ivy), *Salix* (willow), Poaceae (grasses) and bur-reed (*Sparganium* type). This assemblage is indicative of a peat surface supporting the growth of alder and willow carr woodland; the high number of sedges and presence of the aquatic bur-reed is suggestive of a wet surface and areas of still or slow-moving water. Oak, ash, birch and hazel may also have occupied the peat surface, but are more likely to have occupied neighbouring areas of dryland forming mixed deciduous woodland with lime. The absence of elm (*Ulmus*) is also a chronological indicator; this tree formed an important component of the woodland across the British Isles until its decline around the Mesolithic/Neolithic transition. Within the Lower Thames Valley, this event has been dated between from 6400-6020 cal BP at Crossness Sewage Works (Batchelor *et al*., 2006), to 5590-5050 cal BP at Mar Dyke (Wilkinson, 1988), and corresponds with the range of the dates for the British Isles (6347-5281 cal BP) calculated by Parker *et al*. (2002).

The samples taken from the thicker sequence of Peat and organic-rich sediments also contains a high concentration and preservation of pollen, with the exception of samples -1.83 to -1.84m and -1.03 to -1.04m OD which contained a minimal number of remains. The main pollen taxa recorded within these samples is similar to those from the Peat within the Lower Alluvium, and thus are suggestive of similar vegetation communities growing on the wetland and dryland.

There are however important differences: between -2.00 and -1.91m OD, *Chenopodium* type pollen is recorded. This pollen type can be indicative of plants from either disturbed ground (e.g. *Chenopodium album* – fat hen) or saltmarsh (e.g. *Suaeda maritima* – annual seablite). Since its occurrence is contemporaneous with a transition from peat to organic-rich silt, it is considered likely in this case to be representative of a saline influence on the wetland environment.

From -1.68m to -0.87m OD, a drier peat surface is indicated by the absence of willow and aquatic taxa, and lower number of sedges. An increased number and diversity of tree and shrub taxa is also recorded within these samples including hazel, ivy, yew (*Taxus*) and elm. This is considered to be suggestive of a more diverse and mature wetland woodland dominated by alder.

The presence of yew is of particular note. The growth of yew on the peat surface during the Middle Holocene is now a well-documented occurrence, proven by multiple pollen, wood and plant macrofossil records (e.g. Seel, 2001; Batchelor, 2009; Branch et al., 2012; Batchelor *et al*., in prep.; Green *et al*., in prep). These records indicate that yew colonised a dry peat surface between approximately 5000 and 4000 cal BP; the occurrence of yew pollen at Enderby Wharf could therefore be both a chronological and hydrological indicator. Furthermore, there are very few records demonstrating the growth of yew in this area of the Lower Thames Valley; this stratigraphic sequence therefore has the potential to increase our knowledge and understanding of the spatial extent of yew growth across Lower Thames Valley floodplain.

The increased occurrence of elm pollen is also of potential interest, as recent records from various sites such as Barking Riverside (Green *et al*., in prep), Norman Road (Batchelor *et al*., 2009) and the Erith Foreshore (Seel, 2001), suggest elm formed a component of the wetland woodland during the Late Neolithic and Bronze Age after its decline from the dryland around the Mesolithic/Neolithic transition. The higher values of elm pollen therefore suggest that the Enderby Wharf sequence has the potential to enhance our knowledge and understanding of this occurrence. The continued occurrence of oak and lime pollen during the sequence of Peat and organic silt suggests that mixed deciduous woodland continued to occupy the dryland, probably with hazel, elm, yew, birch and ash. Towards the top of the Peat, a decline in dryland woodland is potentially indicated by a reduction in oak and lime values; an increased count is required to confirm this.

No definitive indicators of human activity (such as cereal pollen or enhanced values of microcharcoal) were recorded through the sequence. The various events outlined (i.e. the Mesolithic/Neolithic elm decline, the Late Neolithic/Bronze Age colonisation/decline of yew and elm from the peat surface and Bronze Age decline of dryland woodland) all have some association with anthropogenic disturbance.

Table 7: Results of the pollen assessment from borehole <QBH1> radiocarbon dating, Enderby Wharf, Christchurch Way, London Borough of Greenwich

	Depth (m OD)	**-0.87 to -0.88**	**-1.03 to -1.04**	**-1.19 to -1.20**	**-1.35 to -1.36**	**-1.51 to -1.52**	**-1.67 to -1.68**	**-1.83 to -1.84**	**-1.91 to -1.92**	**-1.99 to -2.00**	**-2.07 to -2.08**	**-2.63 to -2.64**	**-2.71 to -2.72**
Latin name	**Common name**												
Trees													
Alnus	alder	9		15	79	31	23	1	9	21	14	39	4
Quercus	oak	2	1	4	4	7	6		2	19	14	13	7
Pinus	pine			1		1					1		
Ulmus	elm				2	2	1		1				
Tilia	lime			2	3		3	1		2	7	2	1
Taxus	yew			1	1								
Betula	birch											1	
Fraxinus	ash					1						1	
Shrubs													
Corylus type	e.g. hazel			4	1	16	5	3		14	9	1	1
Hedera	ivy				2	8			1			1	
Salix	willow	1										4	
Herbs													
Cyperaceae	sedge family	2	1		1	1	2			7	6	11	4
Poaceae	grass family	2	1							1	2	1	
Plantago type	plantain										1		
Plantago lanceolata	ribwort plantain					1							
Chenopodium type	goosefoot family								1	1			
Apiaceae	carrot family										1		
Aquatics													
Sparganium type	bur-reed											1	
cf Menyanthes trifoliata	bulrush	1											

Spores													
Filicales	ferns		2	4		2	1		9	59	8	21	26
Pteridium aquilinum	bracken										3		
Polypodium vulgare	polypody			2		1	1						
Unidentifiable										1			1
Total Land Pollen (grains counted)		16	3	27	93	68	40		14	65	54	74	17
Concentration*		3	1	4	5	5	5		2	5	5	5	3
Preservation**		3	3	3	4	4	4		3	3-4	3	4	4
Microcharcoal Concentration***		0	0	0	0	0	0	0	1	0	0	0	2
Suitable for analysis		**YES**	**NO**	**YES**	**YES**	**YES**	**YES**	**NO**	**YES**	**YES**	**YES**	**YES**	**YES**

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*

RESULTS AND INTERPRETATION OF THE DIATOM ASSESSMENT

Four sub-samples from borehole <QBH1> were extracted for the assessment of diatoms. The results are displayed in Table 8. The results of the diatom assessment indicate that diatoms are absent in the two samples extracted at the base of the middle Peat (-2.07 to -2.08 and -2.15 to -2.16m OD). Diatoms were present in moderate quantities but in a relatively poor state of preservation in the two samples extracted from -1.83 to -1.84 and -1.91 to -1.92m OD.

A number of factors influence diatom preservation, and it is probable that in the sediments examined here diatom concentrations were always low and that post-depositional destruction of the frustules has occurred due to drying-out, abrasion and possibly unfavourable chemical conditions. Dissolution of the diatom silica, for example, can occur as a response to the ambient dissolved silica concentration, the pH in open water, and the interstitial water in sediments. Using both fossil and modern diatoms, these and other environmental factors have been shown to affect the quality of preservation of assemblages (Flower, 1993; Ryves *et al*., 2001).

Table 8: Summary diatom assessment results of borehole <QBH1>, Enderby Wharf, Christchurch Way, London Borough of Greenwich

Depth (m OD)		Diatom concentration	Quality of preservation	Diversity
From	**To**			
-1.83	-1.84	Moderate	Poor	Moderate
-1.91	-1.92	Moderate	Poor	Moderate
-2.07	-2.08	None	-	-
-2.15	-2.16	None	-	-

RESULTS AND INTERPRETATION OF THE MACROFOSSIL ASSESSMENT

A total of seven small bulk samples were extracted from borehole <QBH1> for the recovery of macrofossil remains including waterlogged plant macrofossils, waterlogged wood, insects and Mollusca (Table 9). The samples were focussed on the silty Peat within the Lower Alluvium (-2.77 to -2.61m OD) and the sequence of Peat and organic-rich sediments between -2.11 and -0.84m OD. The results of the macrofossil rapid assessment indicate that charcoal was present in low quantities in one sample (-1.66 to -1.76m OD); however, charred remains were absent in the remainder of the samples. Insects, the majority of which were preserved as fragments, were present in moderate quantities in two samples (-0.86 to -0.96 and -1.06 to -1.16m OD) and in low quantities in three samples (-1.26 to -1.36, -2.66 to -2.76 and -1.66 to -1.76m OD).

Waterlogged wood was present in low to moderate quantities in all seven samples, whilst waterlogged seeds were present in low quantities in four samples (-0.86 to -0.96, -1.66 to -1.76, -1.26 to -1.36 and -1.06 to -1.16m OD). No Mollusca or bone were recorded in the seven samples assessed.

RESULTS OF THE WATERLOGGED PLANT MACROFOSSIL ASSESSMENT (SEEDS)

The results of the macrofossil rapid assessment indicated that waterlogged seeds were present in four samples from the complex of Peat and organic-rich sediments; these samples thus underwent a more detailed assessment. Seeds were absent from the lower Peat horizon (-2.66 to -2.76m OD) and the lower part of the Peat/organic-rich sediments (-1.96 to -2.06m OD). The results are displayed in Table 10.

The combined seed assemblage comprised *Alnus glutinosa* (alder), *Ranunculus* cf. *repens* (cf. creeping buttercup), *Rumex*/*Polygonum* sp. (dock/sorrel/knotweed) and *Corylus avellana* (hazel). Whilst limited, the taxa recorded are typical of wetland fen environments; below -1.66m OD the assemblage is dominated by species indicative of wetland woodland (alder). The limited concentration of remains prevents any further interpretation of this assemblage.

Table 9: Results of the macrofossil assessment of borehole <QBH1>, Enderby Wharf, Christchurch Way, London Borough of Greenwich

				Charred					Waterlogged		Mollusca		Bone			
Depth (m OD)	**Volume sampled (l)**	**Volume processed (l)**	**Fraction**	**Charcoal (>4mm)**	**Charcoal (2-4mm)**	**Charcoal (<2mm)**	**Seeds**	**Chaff**	**Wood**	**Seeds**	**Whole**	**Fragments**	**Large**	**Small**	**Fragments**	**Insects**
-0.86 to -0.96	0.05	0.05	>300μm	-	-	-	-	-	2	1	-	-	-	-	-	2
-1.06 to -1.16	0.075	0.075	>300μm	-	-	-	-	-	2	1	-	-	-	-	-	2
-1.26 to -1.36	0.05	0.05	>300μm	-	-	-	-	-	2	1	-	-	-	-	-	1
-1.46 to -1.56	0.025	0.025	>300μm	-	-	-	-	-	1	-	-	-	-	-	-	-
-1.66 to -1.76	0.05	0.05	>300μm	1	1	-	-	-	1	1	-	-	-	-	-	1
-1.96 to -2.06	0.05	0.05	>300μm	-	-	-	-	-	3	-	-	-	-	-	-	-
-2.66 to -2.76	0.025	0.025	>300μm	-	-	-	-	-	2	-	-	-	-	-	-	1

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 10: Results of the waterlogged plant macrofossil (seeds) assessment of borehole <QBH1>,

Depth (m OD)	Waterlogged seeds		
	Latin name	**Common name**	**Number**
-0.86 to -0.96	*Ranunculus* cf. *repens*	cf. creeping buttercup	1
-1.06 to -1.16	Unidentified	-	1
-1.26 to -1.36	*Corylus avellana* nut shell *Rumex/Polygonum* sp. *Ranunculus* cf. *repens*	hazel dock/sorrel/knotweed cf. creeping buttercup	1 1 1
-1.46 to -1.56	-	-	-
-1.66 to -1.76	*Alnus glutinosa* catkin *Alnus glutinosa* fruit	alder alder	4 1
-1.96 to -2.06	-	-	-
-2.66 to -2.76	-	-	-

DISCUSSION AND CONCLUSIONS

The aim of the environmental archaeological assessment was to evaluate the potential of the borehole sequences for reconstructing the past environmental conditions of the site and its environs. Three new geoarchaeological boreholes were obtained from the site in order to achieve this aim: <QBH1>, located towards the centre of the site, where the Peat appeared to be thickest; <QBH2>, located on the margins of a possible channel towards the south of the site; and <QBH3>, located towards the east of the site where no borehole records (with sufficient OD height data) were previously available for deposit modelling.

Within the initial deposit modelling report, it was concluded that the deposits recorded at Enderby Wharf were analogous to those recorded across much of the Lower Thames Valley (Young, 2013), with a sequence of Shepperton Gravel overlain by Holocene Alluvium (including Peat), capped by Made Ground. The results of the deposit modelling revealed that the altitude and relief of the Gravel surface was relatively even, lying at between *ca*. -3.5 and -4.0m OD across the site, before falling south-eastwards towards a possible Late Pleistocene/Early Holocene palaeochannel where the Gravel surface is recorded at -4.9m OD in BGS borehole TQ37NE2157. As stated above, the Enderby Wharf site lies *ca*. 300m southwest of Corcoran's (2002) Landscape Zone B, where the Sand and Gravel surface is described as lying at between -4 and -2m OD, and 'probably not overlain by sand'. The deposit model for the site shows that the surface of the Shepperton Gravel lies within this range. However, in boreholes QBH1, QBH2, BH7, and BGS borehole TQ37NE2157 (generally where the Gravel surface is recorded below -4.0m OD in the central and southern parts of the site), it is overlain by a horizon of sand. These boreholes thus show similarities to Corcoran's (2002) landscape zone D, where Gravel surfaces below -4m OD are often overlain by a horizon of sand that accumulated within palaeochannels most likely of Late

Pleistocene/Early Holocene date. It is possible therefore that a palaeochannel is present in the area southeast of the Enderby Wharf site, and that the edge of this palaeochannel is recorded within the southeastern part of the site itself (in the area of boreholes QBH1, QBH2 and BH7). To the south of this possible palaeochannel, at the Bellot Street site (Branch *et al*., 2005) *ca*. 150m to the south of Enderby Wharf, the Shepperton Gravel surface rises to between -0.70 and -1.49m OD.

Elsewhere on Greenwich Peninsula, relatively high Shepperton Gravel surfaces (between *ca*. -1 and -1.7m OD) have been recorded at the Tunnel Avenue (Landscape Zone B; Batchelor, 2013) and Victoria Deep Water Terminal sites (Landscape Zone A; Corcoran, 2002). Towards the north-east of the Tunnel Avenue site however, the Shepperton Gravel surface drops to below -4m OD. It does the same towards the south-west and south-east of the MO115 (Landscape Zone B; Young & Batchelor, 2013a) and MO117 (Landscape Zones A and B; Young & Batchelor, 2013b) sites, and in the far south-eastern corner of Greenwich Millennium Village (Miller & Halsey, 2011). In addition, smaller 'patches' of lower gravel surface >-4m OD were recorded towards the centre and south-western areas of the Millennium Festival Site (Landscape Zone D; Bowsher & Corcoran, unknown). These areas of lower Gravel surface have been interpreted as either localised hollows, or part of interconnected palaeochannels. It is possible that the depression in the Gravel surface recorded to the southeast of the Enderby Wharf site represents a south-westwards extension of the possible channel recorded to the south of the MO117/Millenium Festival Sites (Young & Batchelor, 2013a; 2013b). However, it should be noted that additional borehole records are required for this area (outside of the Enderby Wharf site) in order to test this hypothesis.

The results of the lithostratigraphic description of the three new boreholes have revealed that a lower, silty Peat horizon is recorded within the Lower Alluvium in the area of borehole <QBH1> between -2.61 and -2.77m OD. Whilst no suitable macrofossils were available for radiocarbon dating of the lower Peat, assessment of the pollen assemblages in this horizon indicates that it post-dates the Mesolithic/Neolithic elm decline (*ca*. 6000-5500 cal BP; see above). This lower silty Peat horizon appears to be distinct to a thicker complex of generally woody or herbaceous Peat and organic sediment, which lies at between 0.0 and -2.5m OD across much of the site, and is generally between 0.5 and 2m thick. Radiocarbon dating of the base of this horizon has demonstrated that accumulation began during the Middle Neolithic (5290-4980 cal BP). In almost all boreholes Peat at the base and top of this horizon is separated by a horizon of variably organic clayey silt, of variable thicknesses between ca. 0.5 and 1.0m but generally recorded between ca. -1.0 and -2.0m OD. Although not recorded at exactly the same elevation in all boreholes, this horizon may represent a broadly contemporaneous episode of flood events which brought an influx of mineral-rich material across the Peat surface. Radiocarbon dating indicates that this event occurred prior to 4420-4240 cal BP (Late Neolithic/Early Bronze Age), by which time Peat formation had re-commenced. On the basis of the thickness of the Peat overlying this radiocarbon date, and assuming that 1.0m of Peat represents 1000 years of accumulation, Peat cessation may have occurred sometime during the Middle or Late Bronze Age.

The periods of Peat formation, including the lower, silty Peat (on the basis of the pollen evidence) and the complex of Peat and organic sediments at the Enderby Wharf site therefore appear to be contemporaneous with a widespread period of accumulation recorded elsewhere across the Lower Thames Valley, between *ca*. 6500-3000 cal BP (equivalent to Devoy's (1979) Tilbury III Peat). They are also consistent with those recorded elsewhere on the Greenwich Peninsula. At the Victoria Deep Water Terminal site, Peat accumulation was radiocarbon dated to 5280-4660 cal BP (Neolithic), whilst at the Cable Car South Station in SSBH1C, the base of the Peat was recorded around 5580-5310/5890-5610 cal BP and continued until 3380-3210 cal BP (Neolithic through to Bronze Age). At the Bellot Street (Branch *et al*., 2005) site *ca*. 150m to the south, variable thicknesses of Peat were recorded between *ca*. -1.52 and -0.12m OD. Significantly, a Bronze Age trackway aligned north-south was found within Peat at -0.50m OD at the 72-88 Bellot Street site (Philp & Garrod, 1994), and a wooden structure was recorded within the Peat at another Bellot Street site (MLO98089, Branch *et al*., 2005; Hawkins, 2005) between -0.31m OD and -0.22m OD. Radiocarbon dating of the Peat above and below the structure at the Bellot Street site (Branch *et al.*, 2005) showed that wooden structure was of Middle Bronze Age date (3890-3680 to 3720-3570 cal BP).

Whilst the preservation of diatom remains within the sequence at Enderby Wharf was limited (except in two samples which are suitable for more detailed assessment), the combined results of the palaeobotanical assessments (pollen and seeds) indicate that during the formation of the lower, silty Peat, a relatively wet, alder-dominated fen environment dominated on the peatland surface, with deciduous woodland (including oak, ash, birch and hazel) on the dryland. As stated above, the absence of elm in this assemblage indicates that it post-dates the well-documented elm decline around the time of the Mesolithic/Neolithic transition (*ca*. 6000-5500 cal BP). During the formation of the upper complex of Peat and organic sediments, the palaeobotanical assessments are initially indicative of a relatively wet peat surface dominated by alder. The transition to organic Alluvium is coincident with the presence of *Chenopodium* type pollen, indicative of a potential saline influence at this location. During the accumulation of the upper part of the Peat/organic sediments there are indications of a drier, more mature woodland growing on the Peat surface, potentially including both elm and yew (both of which are significant from a palaeobotanical and potentially archaeological perspective). At Bellot Street (Branch *et al*., 2005), environmental archaeological assessment of the Peat horizon showed that the vegetation cover during its formation consisted of alder carr woodland on the wetland surface, with lime, oak, elm and birch woodland dominating the nearby dryland; during the period of Peat formation associated with the wooden structure, a general reduction in woodland cover on the dryland was recorded, with evidence for increasingly wet conditions on the wetland which may have led to the abandonment of the structure (Branch *et al*., 2005).

There is no definitive evidence in the lower, silty Peat or the upper complex of Peat/organic sediments for human activity. However, the vegetation history of the site records several important events, each of which has some association with anthropogenic disturbance: (1) the Mesolithic/Neolithic elm decline, (2) the Late Neolithic/Bronze Age colonisation/decline of yew and elm from the Peat surface, and (3) the Bronze Age decline of dryland woodland. Furthermore, utilisation of the local environment is known during (at least) the Bronze Age, in the form of structures recorded at the Bellot Street sites (Philp & Garrod, 1994; Branch *et al*., 2005). The sequences at the Enderby Wharf site are sufficiently close, and of correct age, to potentially contain evidence of human activity associated with the Bellot Street sites.

RECOMMENDATIONS

As stated above, the sequences at the Enderby Wharf site are sufficiently close, and of the correct age, to potentially contain evidence of human activity associated with the Bellot Street sites. In addition, palaeoenvironmental assessment of borehole <QBH1> has demonstrated that pollen grains are sufficiently well preserved to reconstruct the environmental and vegetation history of the site and its environs. Analysis of the sequence from borehole <QBH1> is therefore recommended, in order to provide a distal comparison to the sequences recorded at the Bellot Street sites. This analysis should consist of: (1) a minimum of two additional radiocarbon dates in order to confirm to age of the lower silty Peat and to confirm the age of Peat cessation; (2) analysis of the pollen assemblages from suitable samples; and (3) detailed assessment of diatom samples from the complex of Peat and organic sediments. The analysis of this sequence will quantify the changes in vegetation history identified during the assessment, including (1) the presence/absence of a Neolithic elm decline, (2) the presence/absence of yew on the Peat surface, and (3) the timing and nature of the environmental changes recorded within the complex of Peat/organic sediment (including a possible tidal influence).

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APPENDIX 1: ADDITIONAL QUEST BOREHOLE LOGS

Geotechnical description of borehole BH1 (not monitored)

Depth (m OD)	Depth (m bgs)	Geotechnical description	Geoarchaeological interpretation
2.25 to 1.05	0.00 to 1.20	Made Ground	Made Ground
1.05 to -0.25	1.20 to 2.50	Clay	Upper Alluvium
-0.25 to -1.15	2.50 to 3.40	Peaty clay	
-1.15 to -3.85	3.40 to 6.10	Sandy clay	
-3.85 to -5.45	6.10 to 7.70	Gravel	Shepperton Gravel
< -5.45	7.70+	Sandy gravel	

Lithostratigraphic description of borehole BH2

Depth (m OD)	Depth (m bgs)	Geotechnical description	Geoarchaeological description	Geoarchaeological interpretation
1.90 to 0.50	0.00 to 1.40	Made Ground	-	Made Ground
0.50 to -0.60	1.40 to 2.50	Clay	As3 Ag1; grey silty clay	Upper Alluvium
-0.60 to -1.60	2.50 to 3.50	Peaty clay		
-1.60 to -2.10	3.50 to 4.00		Sh3 $Tl^2$1 Th+ Ag+; humo. 2/3; brown moderately to well humified woody peat with a trace of herbaceous material and silt.	Peat
-2.10 to -2.40	4.00 to 4.30		Ag2 As2; grey silt and clay	Lower Alluvium
-2.40 to -2.80	4.30 to 4.70	Sandy clay	Ag2 As2 Dh+; grey silt and clay with a trace of detrital herbaceous material.	
-2.80 to -3.00	4.70 to 4.90	Sandy gravel	Gg3 Ga1; sandy gravel. Flint clasts 20-60mm in diameter; well-rounded to sub-angular.	Shepperton Gravel
-3.00 to -4.90	4.90 to 6.80	Gravel		
< -4.90	6.80+	Sandy gravel		

Lithostratigraphic description of borehole BH3

Depth (m OD)	Depth (m bgs)	Geotechnical description	Geoarchaeological description	Geoarchaeological interpretation
2.77 to 0.32	0.00 to 2.45	Made Ground	Made Ground	Made Ground
0.32 to -0.03	2.45 to 2.80	Peaty clay	Sh2 Ag1 Dl1; brown very organic silt with detrital herbaceous material.	Upper Alluvium
-0.03 to -0.53	2.80 to 3.30	Clay	Sh3 $Tl^1$1 Ag+; humo. 2/3; brown moderately to	Peat

			well humified woody peat with a trace of silt.	
-0.53 to -2.43	3.30 to 5.20		As2 Ag2 Ga+ Dh+; grey silt and clay with a trace of sand and detrital herbaceous material	Lower Alluvium
-2.43 to -3.53	5.20 to 6.30	Slightly clayey, slightly silty sand	Ga3 Ag1; greenish blue silty sand with occasional Mollusca fragments.	
-3.53 to -4.03	6.30 to 6.80	Gravel with sand	Gg3 Ga1 Ag+; sandy gravel with a trace of silt	Shepperton Gravel
< -4.03	6.80+	Sandy gravel		

Geotechnical description of borehole BH4 (not monitored)

Depth (m OD)	**Depth (m bgs)**	**Geotechnical description**	**Geoarchaeological interpretation**
2.16 to 0.86	0.00 to 1.30	Made Ground	Made Ground
0.86 to -0.24	1.30 to 2.40	Clay	Upper Alluvium
-0.24 to -1.04	2.40 to 3.20	Clayey peat with some woody remains and bands of clay	Peat
-1.04 to -1.54	3.20 to 3.70	Clayey silt	
-1.54 to -1.94	3.70 to 4.10	Slightly clayey peat with some plant remains	
-1.94 to -2.74	4.10 to 4.90	Silty clay	Lower Alluvium
-2.74 to -3.44	4.90 to 5.60	Sandy gravelly clay	
-3.44 to -4.64	5.60 to 6.80	Gravel	Shepperton Gravel
< -4.64	6.80+	Slightly sandy gravel	

Lithostratigraphic description of borehole BH5

Depth (m OD)	**Depth (m bgs)**	**Geotechnical description**	**Geoarchaeological description**	**Geoarchaeological interpretation**
2.05 to 0.45	0.00 to 1.60	Made Ground	Made Ground	Made Ground
0.45 to 0.25	1.60 to 1.80		As3 Ag1; blue grey silty clay with Mollusca fragments.	Upper Alluvium
0.25 to -0.15	1.80 to 2.20	Clay		
-0.15 to -0.25	2.20 to 2.30	Slightly clayey peat		
-0.25 to -0.85	2.30 to 2.90		Sh3 $Tl^2$1; humo. 2; reddish brown moderately humified woody peat	Peat

-0.85 to -1.65	2.90 to 3.70		Sh2 $Th^2$1 $Tl^2$1; humo. 2; moderately humified reddish brown herbaceous and wood peat	
-1.65 to -1.75	3.70 to 3.80		Ag2 Dl1 As1; blue grey clayey silt with detrital wood	
-1.75 to -1.95	3.80 to 4.00	Clay	Ag2 Dl1 As1; blue grey clayey silt with detrital wood	
-1.95 to -2.45	4.00 to 4.50		Sh2 $Th^2$1 $Tl^2$1; humo. 2; moderately humified reddish brown herbaceous and wood peat	
-2.45 to -3.05	4.50 to 5.10	Clay going in to slightly clayey sand	Ag2 Dl1 As1; blue grey clayey silt with detrital wood	Lower Alluvium
-3.05 to -3.75	5.10 to 5.80		Ag2 As1 Ga1 Dl+; grey clayey sandy silt with a trace of detrital wood material	
< -3.75	5.80+	Sandy gravel	Gg3 Ga1; sandy gravel. Flint clasts 40-60mm in diameter, rounded to sub-angular	Shepperton Gravel

Geotechnical description of borehole BH6

Depth (m OD)	**Depth (m bgs)**	**Geotechnical description**	**Geoarchaeological interpretation**
2.05 to 0.75	0.00 to 1.30	Made Ground	Made Ground
0.75 to -0.45	1.30 to 2.50	Clay with occasional gravel clasts	Upper Alluvium
-0.45 to -0.50	2.50 to 2.55	Clay with bands of organic clay	
-0.50 to -0.95	2.55 to 3.00	Peaty clay with rare fragments of plant remains	
-0.95 to -3.55	3.00 to 5.60	Clay with bands of peaty clay	
< -3.55	5.60+	Gravel	Gravel

Lithostratigraphic description of borehole BH7

Depth (m OD)	**Depth (m bgs)**	**Geotechnical description**	**Geoarchaeological description**	**Geoarchaeological interpretation**
2.44 to 1.14	0.00 to 1.30	Made Ground	Made Ground	Made Ground

1.14 to -0.26	1.30 to 2.70	Clay	As3 Ag1 Sh+ Dl+; grey silty clay with occasional pockets of organic matter and detrital wood.	Upper Alluvium
-0.26 to -1.26	2.70 to 3.70	Peat with plant remains including wood	-	Peat
-1.26 to -2.16	3.70 to 4.60	Clayey silt	As3 Ag1 Sh+ Dl+; grey silty clay with occasional pockets of organic matter and detrital wood.	Lower Alluvium
-2.16 to -3.56	4.60 to 6.00	Clay		
-3.56 to -3.86	6.00 to 6.30	Clay		
-3.86 to -4.06	6.30 to 6.50	Sand	-	
< -4.06	6.50+	Sandy gravel	Gg3 Ga1; sandy gravel. Flint clasts 20-60mm; rounded.	Shepperton Gravel