A REPORT ON THE ENVIRONMENTAL ARCHAEOLOGICAL ASSESSMENT OF BOREHOLES COLLECTED FROM THE LONDON CABLE CAR ROUTE, LONDON BOROUGHS OF NEWHAM AND GREENWICH (site code: CAB11)

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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 Cable Car development in the London Boroughs of Newham and Greenwich (National Grid Reference: spanning TQ 40111 80696 (north) to 39478 79745 (south); site code: CAB11). The site spans Bugsby's Reach of the tidal River Thames between the North Greenwich 'peninsula' (meander core) on the right (south) bank and the Royal Victoria Dock on the left (north) bank. The site itself is divided into five main areas in which geotechnical investigations (test pits, window samples, cable percussion boreholes and rotary boreholes) were recently carried out by Soil Mechanics on behalf of Mott MacDonald, as follows: (1) the North Station (NS); (2) the North Intermediate Tower (NIT); (3) the North Tower (NT); (4) the South Tower (ST), and (5) the South Station (SS) (Figure 2). In addition two overwater boreholes were put down as part of a future potential tunnel project within the course of the River Thames (TU). These geotechnical works were monitored by Quaternary Scientific and integrated with existing records as part of a geoarchaeological investigation carried out to create a model of the depositional history of the site (Green *et al*., 2011; Figures 3 to 5; Tables 1 & 2; Appendices 1 & 2) and to collect samples suitable for environmental archaeological assessment and analysis (if necessary).

The resultant model included 36 borehole records and revealed London Clay bedrock (Unit 1) overlain by the Shepperton Gravel. The gravel surface formed a relatively level surface on the south bank of the Thames (-2.25m to -3.45m OD), but was deeper and more undulating to the north (between -2.50m and -5.88m OD), and with one borehole indicating a much higher surface of +1.55m OD. Resting on the Shepperton Gravel was an alternating sequence of Alluvium (Units 3a and 3b) and Peat (Unit 4); in some cases, multiple units of Peat were recorded. Each sequence were truncated to various depths by a Made Ground, sometimes >10m thick and cutting into the Shepperton Gravel. The geoarchaeological investigation also highlighted sequences at the North Tower (<NTBH03>) and South Station (<SSBH1C>) that contained thick sequences of Peat and Alluvium with potential to

reconstruct the environmental history of the site and its environs, and for identifying evidence of human activity (Figures 2, 3 and 6). These boreholes core samples were therefore retained for an environmental archaeological assessment, with the following objectives:

1. To carry out organic matter content determinations to enhance the results of the sedimentary descriptions
2. To radiocarbon date identified plant macrofossils to provide a provisional geochronological framework for the natural stratigraphic sequences
3. To assess 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. To assess the preservation and concentration of diatom frustules to provide a preliminary reconstruction of the hydrological history e.g. water quality and depth
5. To assess 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.


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Plaistow
TOWER HAMLETS
Mile End
Devons Road Station
Bow Common
River Lea
Canning Town
South Bromley
Limehouse
POPLAR
Blackwall
Custom House
Exhibition Centre
Royal Victoria Dock
Beckton
New Beckton Park
Cyprus
Albert Dock
London City Airport
King George V Dock
Canary Wharf
Hilton Docklands Pier
South Dock Marina
West India & Millwall Docks
Millwall
Cubitt Town
ISLE OF DOGS
River Thames
Limehouse Reach
Blackwall Reach
Bugsby's Reach
Woolwich Reach
Silvertown
The Thames Flood Barrier
North Woolwich
New Charlton
Charlton
GREENWICH
Old Royal Naval College
Greenwich Pier
BOAT TRIPS
Thames Path
Mean High Water
Euro Const. Boro Const & LB Bdy
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Figure 1: Location of (1) the Cable Car route ((A) North Station; (B) North Intermediate Tower; (C) North Tower; (D) South Tower; (E) South Station), London Boroughs of Newham and Greenwich and other nearby locations: (2) Bryan Road (Tucker, 1993); (3) Atlas Wharf (Lakin, 1998); (4) Preston Road (Branch *et al*., 2007); (5) East India Docks (Pepys, 1665); (6) Bellot Street (Branch *et al*., 2005); (7) 72-88 Bellot Street (McLean, 1993; Philp, 1993); (8) Silvertown (Wilkinson et al., 2000); (9) Fort Street (Wessex Archaeology, 2000); (10) Greenwich Industrial Estate (Morley, 2003); (11) Royal Docks Community School (Holder, 1998); (12) Beckton Nursery (Divers, 1995); (13) Beckton 3D (Meddens, 1996; Truckle, 1996); (14) A13 Woolwich Manor Way (Gifford and Partners, 2001); (15) Beckton Alp (Truckle and Sabel, 1994); (16) Golfers' Driving Range (Batchelor, 2009; Carew *et al*., 2009); (17) Beckton Tollgate (Tamblyn, 1994); (18) East Beckton District Centre (Jarrett, 1996); (19) East Ham FC (Scaife, 2001); (20) Albert Dock (Spurrell, 1889); (21) Royal Albert Dock (Batchelor, 2009); (22) Albert Road (Spurr *et al*., 2001); (23) North Woolwich Pumping Station (Sidell, 2003)

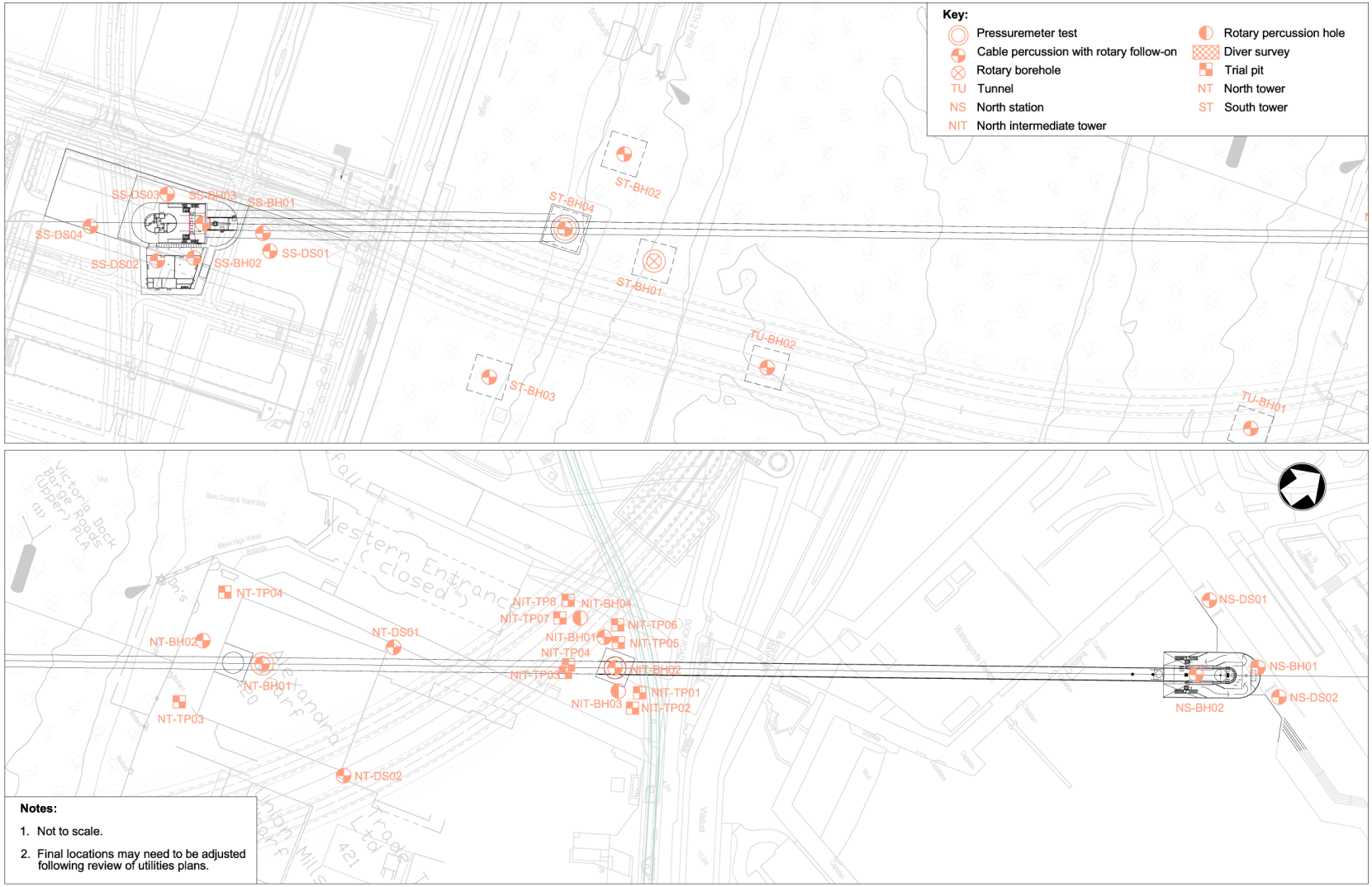

Figure 2: Detailed plan of the Cable Car route, London Boroughs of Newham and Greenwich (site code: CAB11).

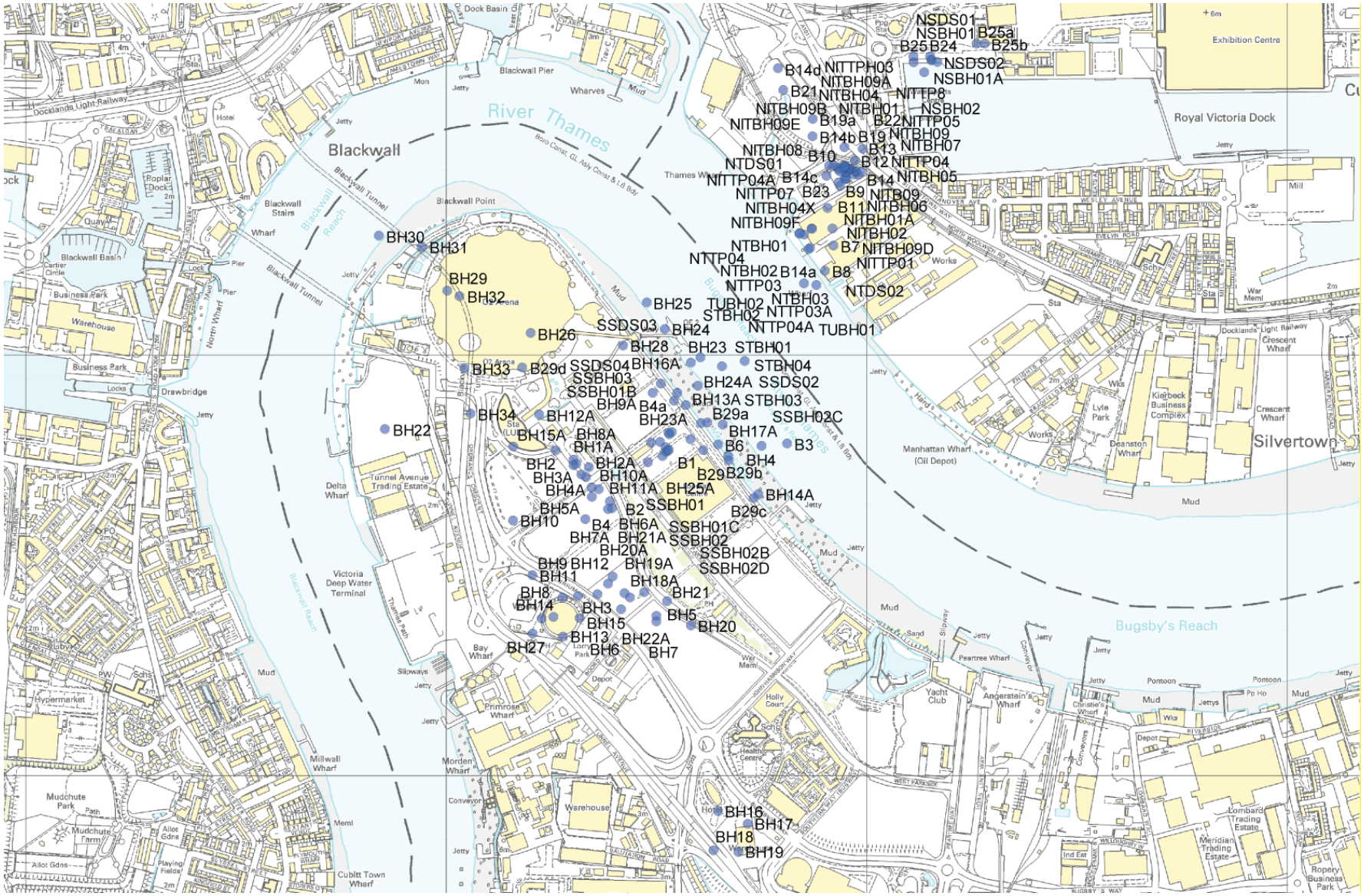

Figure 3: All geotechnical and BGS borehole locations from the Cable Car route and surrounding areas

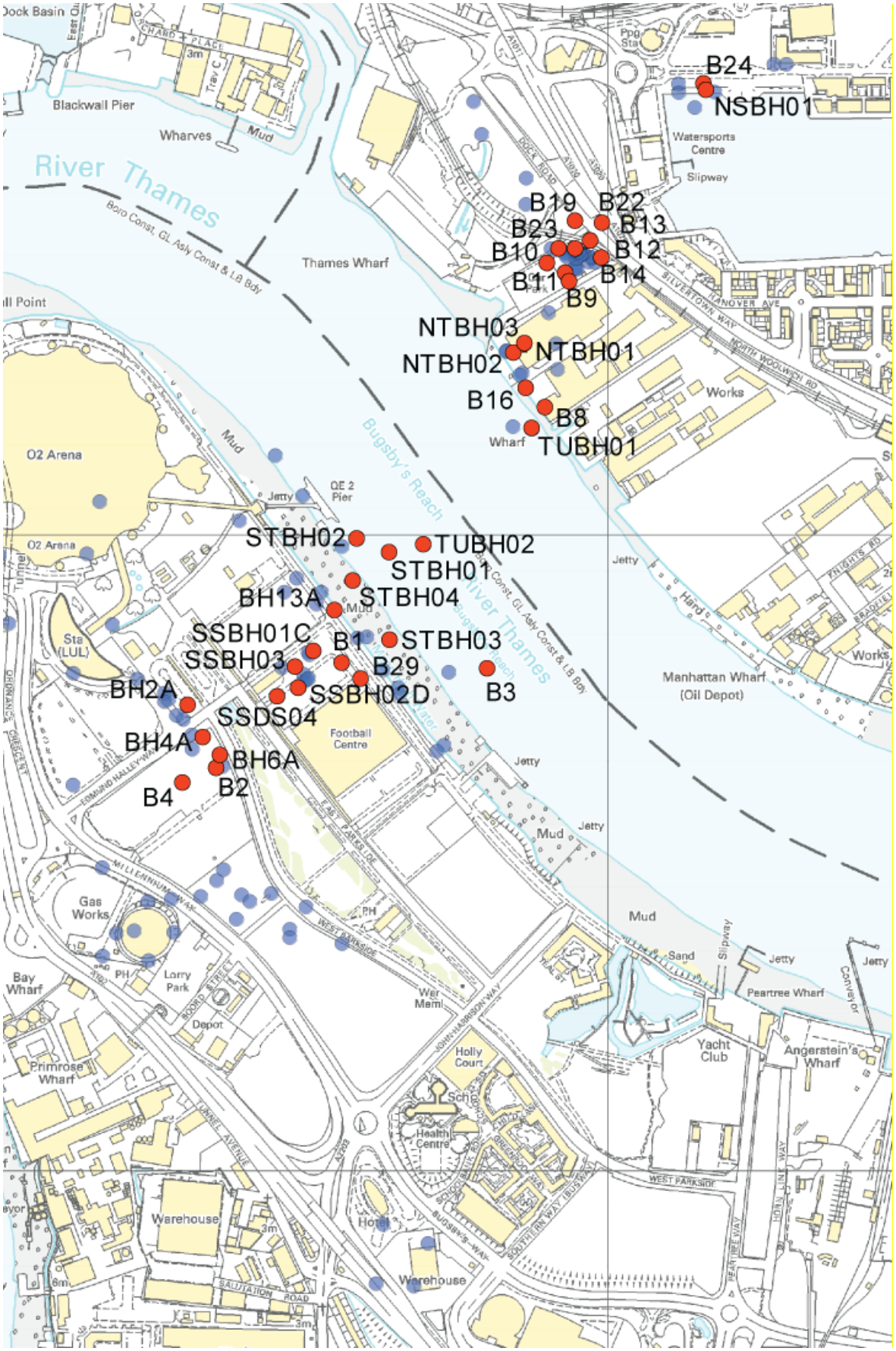

Figure 4: Transect map of selected boreholes along the Cable Car route, London Boroughs of Newham and Greenwich (site code: CAB11; see Figure 5)

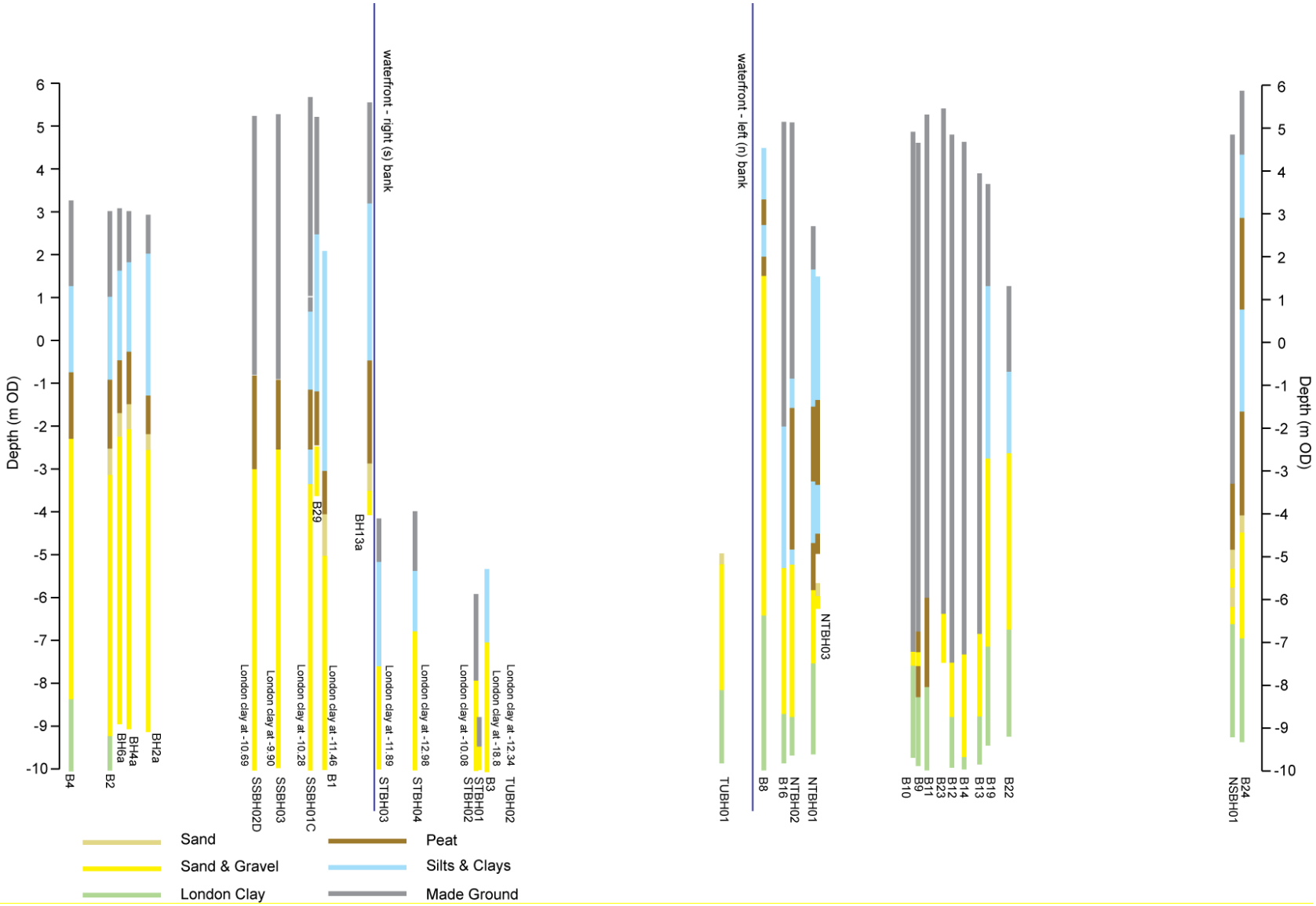

Figure 5: Transect of selected sedimentary logs across the Cable Car route

METHODS

Field investigations

Geotechnical borehole monitoring

Sub-surface investigations of the North Station (NS), North Intermediate Tower (NIT), North Tower, South Tower (ST), and South Station (SS) areas of the site by Soil Mechanics between February and April 2011 provided the opportunity to monitor and record the sediments from fifty-six geotechnical boreholes and test-pits (Figure 2, Appendix 1) which were obtained to various specified depths below surface. Quaternary Scientific visited the site to monitor and record the Holocene deposits from select geotechnical boreholes only (NSBH01, NITBH02, NTBH01, SSBH03). The remaining boreholes/test-pits were not recorded as they were either too closely located to other monitored geotechnical boreholes or were unlikely to penetrate deep enough to reach the Holocene alluvium. However, the geotechnical logs were retrieved for subsequent use in the deposit modelling process.

Each of the selected boreholes was recorded in the field using standard procedures for recording unconsolidated sediment and peat, noting the physical properties (colour), composition (gravel, sand, clay, silt and organic matter), peat humification and inclusions (e.g. artefacts) (Troels-Smith, 1955). The procedure involved: (1) recording the physical properties, most notably colour using a Munsell Soil Colour Chart, but occasionally dryness; (2) recording the composition, including moss peat (Turfa bryophytica; Tb), wood peat (Turfa lignosa; Tl), herbaceous peat (Turfa herbacea; Th), completely disintegrated organic matter (Substantia humosa; Sh), gravel (Grana glareosa; Gg), fine sand (Grana arenosa; Ga), silt (Argilla granosa; Ag) and clay (Argilla steatoides); (3) recording the degree of peat humification, and (4) recording the boundary changes e.g. sharp or diffuse. The results of the field based descriptions are provided in Appendix 2.

Geoarchaeological borehole retrieval

Following completion of the geotechnical borehole monitoring, two boreholes from the north and south bank of the River Thames were selected for further laboratory-based palaeoenvironmental investigations adjacent to boreholes NTBH01 and SSBH03 (<NTBH03> and <SSBH1C>). These boreholes were specifically chosen as they contained significant thicknesses of Holocene alluvium and peat. This transect provides the potential to identify evidence of change or continuity through time and to establish whether any significant spatial variability exists on either side of the River in this area of the floodplain. U100 core samples were retrieved by Soil Mechanics Limited with a cable percussion rig. At each location, the boreholes extended down to the Gravel. All samples were wrapped and labelled with the depth and orientation, and returned to the University of Reading for cold storage.

Deposit modelling

In the preparation of the deposit model, 153 borehole and test pit logs were examined from an area centred on NGR TQ 3975 8010. Logs were obtained from British Geological Survey archives (97) and from various drilling campaigns specifically associated with the investigation of the Cable Car site (56), including the two palaeoenvironmental boreholes (<NTBH03> and <SSBH1C>) (see Appendix 1 and Figure 3 for details). To develop the deposit model, 36 borehole logs were selected to form a transect extending from NGR TQ 39860 79560 on the south side of the river to NGR TQ 40170 80720 on the north side of the river (selected boreholes are displayed in Figure 4). Thirteen of the boreholes are located on the south side of the river, including palaeoenvironmental borehole <NTBH03>, 7 within the river channel and 16 on the north side of the river, including palaeoenvironmental borehole <SSBH1C>. The criteria for inclusion in the deposit model were (a) proximity to the transect line; and (b) borehole penetration through the full sequence of surviving Holocene alluvial deposits. In practice all but three of the selected boreholes extend down to the bedrock London Clay.

Despite the care taken in the evaluation and selection of the records incorporated in the deposit model, the reliability of the model is affected by the quality of the stratigraphic records which in turn is affected by the nature of the sediments and/or their post-depositional disturbance during previous stages of development on the site. In particular, it is important to recognise that several separate sets of boreholes are represented, put down at different times, by different companies 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 two palaeoenvironmental boreholes described below represent the most detailed record of the Holocene sediment sequence for which accurate height and lithostratigraphic information are available.

In general in the borehole logs it is possible to recognise consistently up to four Holocene sediment units forming Units 3-5 in the present account:

(Unit 6) Made Ground
(Unit 5) Upper Alluvial Silts & Clays
(Unit 4) Peat
(Unit 3) Lower Alluvial Deposits
(Unit 3b) Silts & Clays
(Unit 3a) Sands
(Unit 2) Sand & Gravel (Shepperton Gravel)

(Unit 1) London Clay

Detailed laboratory-based lithostratigraphic descriptions

The retrieved boreholes were recorded in the laboratory using standard procedures for recording unconsolidated sediment and peat, noting the physical properties (colour), composition (gravel, sand, clay, silt and organic matter), peat humification and inclusions (e.g. artefacts) (Troels-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, but occasionally dryness; (3) recording the composition, including moss peat (Turfa bryophytica; Tb), wood peat (Turfa lignosa; Tl), herbaceous peat (Turfa herbacea; Th), completely disintegrated organic matter (Substantia humosa; Sh), 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 boundary changes e.g. sharp or diffuse. The results of the laboratory-based descriptions are provided in Tables 1 and 2, Figure 6.

Organic matter determinations

Twenty sub-samples from borehole <NTBH03> and twenty-eight sub-samples from borehole <SSBH1C> were taken for determination of the organic matter content (Tables 3 and 4; Figure 6*)*. 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).

Radiocarbon dating

One sub-sample of waterlogged wood (*Alnus* sp.) was extracted from the top of peat, and one sub-sample of waterlogged seeds (*Rumex*/*Polygonum* sp.) from the base of the peat in borehole <NTBH03>. Two sub-samples of wood were extracted from the top (*Alnus* sp twig) and base (unidentified twig) of the peat in borehole <SSBH1C> for radiocarbon dating. All four samples 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 Figure 6 and Table 5.

Pollen assessment

Twelve sub-samples from each borehole 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 each borehole 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 Tables 8 and 9.

Macrofossil assessment

A total of twenty-one small bulk samples (11 from borehole <SSBH1C> and 10 from borehole <NTBH03>) 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 10 and 11).

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) (Tables 12 and 13).

A minimum of 10 waterlogged fragments per sample were assessed (Tables 12 and 13). The attributes and general quality of fragment preservation was noted. Preparation and examination of fragments follows standard practices as described in Hather (2000). Waterlogged wood fragments were thin sectioned using a hand held razor blade and mounted on a slide. Wood charcoal fragments were pressure fractured and supported in a sand bath. Following preparation both forms of wood remains were examined at magnifications of up to x400. Specific attributes and features recorded during examination were the diameter of any twig wood and, as a means of determining relative maturity, the number of growth rings. Nomenclature follows Stace (2005).

RESULTS AND INTERPRETATION OF THE GEOARCHAEOLOGICAL FIELD INVESTIGATIONS AND DEPOSIT MODELLING

The results of the fieldwork monitoring are displayed in Appendix 1. In the borehole monitored within the North Station (NSBH01), Made Ground was recorded down to a depth of -3.25m OD followed by blue-grey alluvium with dark brown pockets of peat and including fragments of wood. Sands and gravels commenced below -4.80m OD. The borehole within the North Intermediate Tower (NITBH02), was monitored down to a depth of 10m and was still within Made Ground. No further monitoring was carried out on this borehole, although the geotechnical borehole log, indicate that the Made Ground continued to a depth of 14.50m before reaching London Clay. The borehole from the North Tower (<NTBH01>) contained a very small amount of Made Ground (1.20m) overlying a thick sequence of alluvium including two substantial horizons of wood peat. Sands and gravels were encountered at -5.84m OD. This sequence was selected for further laboratory-based palaeoenvironmental investigations, and was re-cored as borehole <NTBH03> (a detailed description of which is provided in Table 1 and Figure 6). The borehole from the South Station (SSBH03) contained a thick horizon of contaminated Made Ground (5.20m) overlying alluvium from 0.14m OD and peat from -0.86 to -2.81m OD. Sands and Gravels were recorded below this. As a result of this *ca*. 2m thick horizon of peat, neighbouring borehole location <SSBH1C> was selected for laboratory based palaeoenvironmental investigations (displayed in Table 2 and Figure 6). As outlined within the introduction and methodology, these records were integrated with other geotechnical records to provide the following model of depositional history (Figure 5).

The London Clay bedrock (Unit 1) was recorded in 27 of the boreholes. It slopes down evenly on the south side of the river from -8.86m OD in borehole B4 to a maximum depth of -18.8m OD in the middle of the Thames channel in borehole B3, rising within the channel on its north side in borehole N11 to -8.39m OD. On the north side of the river the bedrock surface is uneven between -6.37m OD in borehole B8 and -8.72m OD in borehole B13.

The Shepperton Gravel (Unit 2) was recorded in all but one of the boreholes. On the south side of the river the surface of the gravel is rather uniformly between -2.25m OD (borehole 6a) and -3.45m (borehole 13a). It falls to -5.0m OD in borehole B1, but the gravel in borehole B1 is overlain by 3 feet (0.99m) of sand with a surface at -4.0m OD, and this sand may be part of the Shepperton Gravel rather than part of the overlying Holocene deposits. Within the river channel the gravel surface is at lower levels from *ca*. -5.0m OD (borehole N11) to just below -10.0m OD in the middle of the channel in borehole N12.

On the north side of the river the gravel has been heavily truncated in the seven boreholes in

the vicinity of the Royal Victoria Dock. In six of the remaining nine boreholes on the north side of the river, the surface of the gravel, between -4.4m OD (borehole B24) and -5.88m OD (borehole BH03), is generally lower than it is on the south side of the river by about 2m. This difference resembles the situation recorded by Gibbard (1994, Fig.41) in a transect extending from the Greenwich area across the Thames into the Isle of Dogs. This transect shows the surface of the Shepperton Gravel in the Isle of Dogs, on the north side of the river, at least 2m below the level on the Greenwich side of the river. However in the present area of investigation there are two boreholes on the north side of the river (boreholes B19 and B22) in which the surface of the Shepperton gravel is recorded at about the same level as it occurs on the south side of the river – between -2.5m OD and -3.0m OD, and in borehole B8 the surface of the gravel is recorded at +1.55m OD. This suggests the presence here of a gravel 'high', broadly comparable in terms of elevation to the Bermondsey and Horseleydown gravel 'highs' (eyots) upstream in the Southwark area. These variations in the level of the surface of the Shepperton Gravel are consistent with observations elsewhere in the Thames valley. They indicate that at the beginning of the Holocene, the surface of the Shepperton Gravel formed the valley floor of the River Thames and was characterised by gravel bars generally elongated approximately parallel with the valley axis and separated by channels in which finer-grained sediments are often preserved. The relief on this surface is generally from 2.0m to 4.0m and exceptionally up to 6m.

Overlying the Shepperton Gravel in all the boreholes is a sequence of Holocene alluvial deposits. In 18 of the boreholes this sequence includes a peat unit (Unit 4). In six cases (boreholes SSBH02D, SSBH03, B29a, B8, SSDS04, NSBH01) the peat rests directly on the underlying gravel. In the remaining twelve boreholes the peat rests on the Lower Alluvium (Unit 3), either on sand (Unit 3a) (8 boreholes) or on alluvial silts and clays (Unit 3b) (4 boreholes). The Lower Alluvium, whether sand or silts and clays, is generally less than a metre thick (median value 0.6m). In borehole <NTBH03> the Lower Alluvium was a well-bedded tufa-rich sand with common detrital plant and mollusc remains.

Where peat is present it usually forms a single horizon varying in thickness from 2.43m in borehole NTBH02 on the north side of the river to 0.92m in borehole B4 on the south side (average for 11 boreholes with a single untruncated peat horizon: 1.60m, median 1.53m). The upper surface of these untruncated single peat horizons is at levels between -0.66m OD and -3.0m OD (average 1.06m, median 0.98m). The lowest level at which these single peat units are recorded is -4.84m OD in borehole NTBH02. In four boreholes, all on the north side of the river (B8, NTBH01, <NTBH03>, B24) two peat horizons are present. Two of these boreholes (NTBH01 and <NTBH03>) were immediately adjacent to one another and

recorded closely similar alluvial sequences with a lower peat between -4.74m OD and -5.84m OD in Borehole NTBH01 and peat at a similar level in <NTBH03>. The greater part of this lower peat is therefore at a level below the lowest level at which the base of the single peat horizons was encountered. The upper surface of the upper peats in these two boreholes is close to -1.4m OD and therefore close to the level of the upper surface of the single peat horizons.

In borehole B24 a lower peat horizon occupies a level (-1.6 to -4.0m OD) similar to the single peat horizons recorded elsewhere in the transect, but the Holocene sequence in borehole B24 includes an upper peat at a higher level, between +2.9m OD and +0.8m OD. Peat is also recorded in borehole B8 at a similar level where two thin peat horizons are present between +3.37m OD and +1.55m OD.

In the 11 boreholes with untruncated peat horizons and in all four of the boreholes with two peat horizons, the uppermost peat is overlain by the Upper Alluvium (Unit 5). Where this unit has been examined in detail in boreholes <SSBH1C> and <NTBH03>, it is a grey to olive coloured well-sorted silt with some evidence of soil forming processes in its upper part and scattered finely-divided detrital plant remains generally present. It is everywhere overlain by Made Ground and has undoubtedly been truncated in some places. However in fourteen boreholes the contact with the Made Ground is at a level between 3.33m OD (Borehole 13a) and 0.57m OD (Borehole <SSBH1C>) (average 1.77m OD, median 1.70m OD). A natural floodplain level close to 1.75m OD therefore seems likely.

RESULTS AND INTERPRETATION OF THE ORGANIC MATTER CONTENT DETERMINATIONS

The results of the organic matter content determinations for <NTBH03> (Table 3; Figure 6) indicate low values within the basal sand and gravel (<10%), before increasing slightly within the overlying units of silty, sandy peat, peat and sand (up to 15%) that continue to -4.40m OD. High values of mineral content within an organic sediment such as peat suggest the surface at the time was subject to frequent flooding. Nevertheless, the organic matter content values are somewhat lower than expected, and are interpreted at least in part as a reflection of the coarse resolution at which the determinations were carried out during the assessment stage. Above these units was a thick sequence of alluvial silts and sands to -3.28m OD, which had a reflective low organic matter content (<6%). The overlying main peat unit spanned from -3.28m to -1.90m OD and contained values ranging between *ca*. 45% and 70% organic, with a peak at -2.70m OD. The final alluvial silts and clays were generally no more than 10% organic-rich.

The results of the <SSBH1C> organic matter determinations (Table 4; Figure 6) indicate low values within the basal sand and gravel (<4%) before gradually increasing from 15% to 33% through the overlying alternating units of peat and alluvium at -2.48m OD. As in borehole <NTBH1C>, it is possible that higher values were recorded within the individual peat units, but have not been picked up at the assessment stage due to the coarser resolution sampling at this stage of the investigations. Through the main peat (-2.48m to -0.93m OD) however, organic matter values varied between 40% and 70%, analogous to those recorded in <NTBH03>. The final units of alluvium and made ground contained generally limited organic matter content values of <10%.

RESULTS AND INTERPRETATION OF THE RADIOCARBON DATING

Identified waterlogged seeds of *Rumex*/*Polygonum* sp. from the silty sandy peat at the base of the <NTBH03> sequence (-5.63m to -5.68m OD) were radiocarbon dated to 10,740-10,510 cal BP (8790-8560 cal BC), and *Alnus* sp. waterlogged wood from the top of the peat (-1.95m to -2.00m OD) was radiocarbon dated to 3030-2870 cal BP (1080-920 cal BC). The δ13C (‰) values are consistent with that expected for Peat sediment, and there is no evidence for mineral or biogenic carbonate contamination. These results therefore indicate alluvial deposition and peat accumulation took place at the site between at least the Early Mesolithic and Late Bronze Age/Early Iron Age cultural periods.

Alnus waterlogged wood from the peat at the base of <SSBH1C> (-3.01 to -3.06m OD) was radiocarbon dated to 5580-5310 cal BP (3630-3360 cal BC), and the top of the peat at -0.98 to -1.03m OD was radiocarbon dated to 3380-3210 cal BP (1430-1260 cal BC). The δ13C (‰) values are consistent with that expected for Peat sediment, and there is no evidence for mineral or biogenic carbonate contamination. These results therefore indicate alluvial deposition and peat accumulation took place at the site between at least the Neolithic and Late Bronze Age cultural periods.

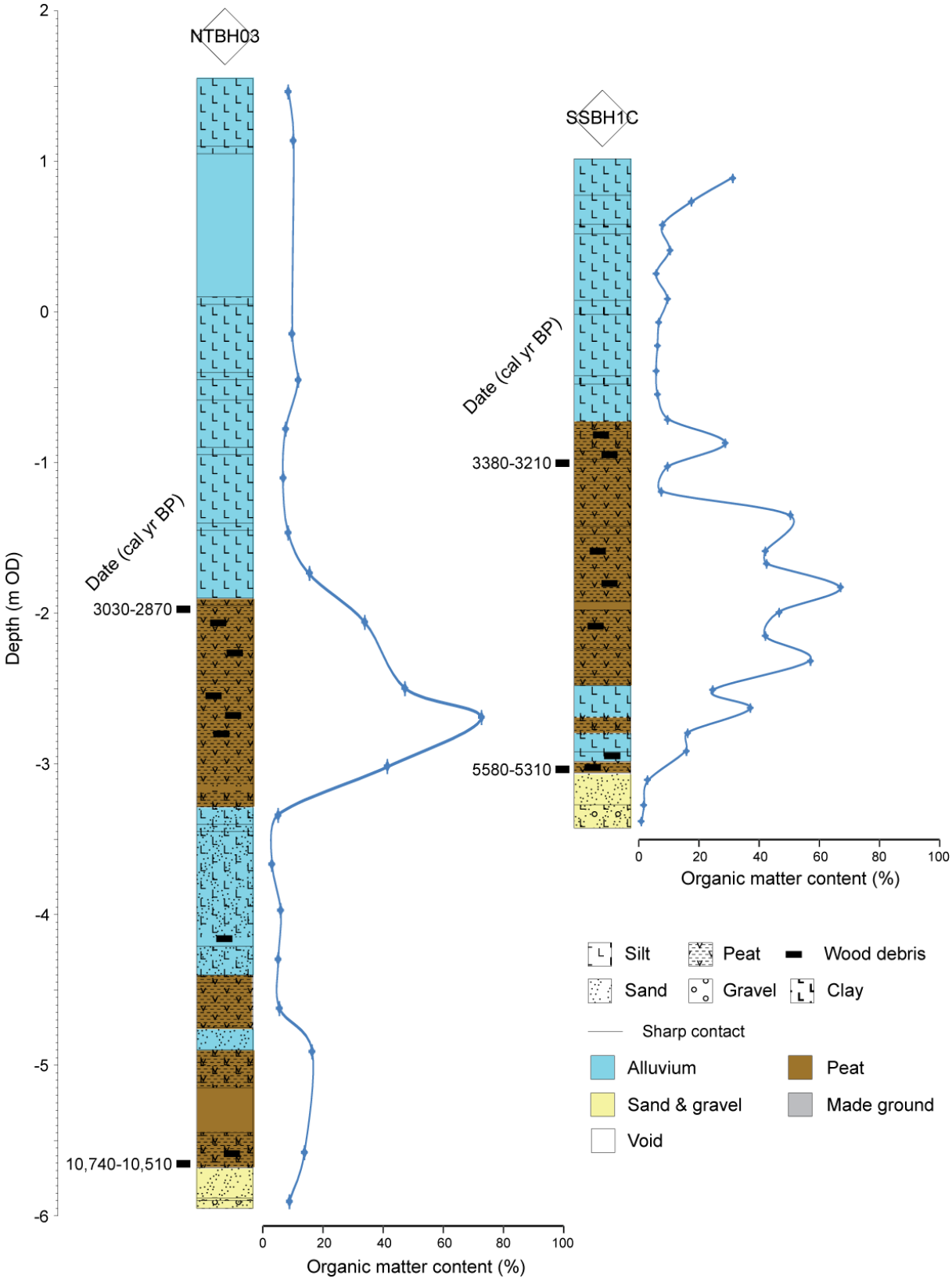

Figure 6: Results of the <NTBH03> and <SSBH1C> lithostratigraphic analysis, incorporating lithostratigraphy and organic matter content plotted with associated radiocarbon dates

Table 1: Results of the laboratory-based lithostratigraphic description of borehole NTBH03, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

Depth (m OD)	Sample type	Composition
2.75 to 1.55	-	Made Ground
1.55 to 1.10	U100	2.5Y4/1 dark grey with black flecks; very well sorted silt; massive; common detrital plant remains increasingly common downward; no acid reaction.
1.10 to 1.05	Shoe sample	olive brown silt; common detrital plant remains.
1.05 to 0.10	-	No retrieval
0.10 to 0.05	Shoe sample	Irregular mass of plant-rich silt.
0.05 to -0.40	U100	5Y3/1 very dark grey passing down gradually to 2.5Y4/4 olive brown, black flecks; very well sorted silt; massive passing down to blocky/crumby; root channels common in lower olive brown part; common root remains; vivianite as small (<1mm) white crystal clusters; strong acid reaction.
-0.40 to -0.45	Shoe sample	grey silt oxidising to olive brown with black flecks.
-0.45 to -0.58	U100	5Y4/1 dark grey and 2.5Y4/4 olive brown; very well sorted silt; blocky/crumby; scattered root channels and root remains; scattered detrital plant remains; moderate acid reaction; well-marked transition to:
-0.58 to -0.90	U100	Gley 1.4/1 dark grey; very well sorted silt; massive; scattered detrital plant remains; no acid reaction.
-0.90 to -0.95	Shoe sample	olive brown silt.
-0.95 to -1.40	U100	Gley 1.4/1 dark grey with Fe staining on structural surfaces; very well sorted silt; massive; scattered detrital plant remains; vivianite as small (<1mm) white crystal clusters and coating some structural surfaces.
-1.40 to -1.45	Shoe sample	grey silt with Fe stained structural surfaces.
-1.45 to -1.90	U100	5Y4/1 dark grey; very well sorted silt; massive; detrital plant remains increasingly common downward; wood debris increasingly common downward; no acid reaction.
-1.90 to -1.95	Shoe sample	Peat.
-1.95 to -2.40	U100	Peat with round wood (up to 40mm Ø).
-2.40 to -2.45	Shoe sample	Woody peat.
-2.45 to -2.90	U100	Peat with common wood debris.
-2.90 to -3.15	Shoe sample	Woody peat.
-2.95 to -3.17	U100	Peat with wood debris; well-marked transition to:
-3.17 to -3.28	U100	Mixture of wood-rich silt and peat in large (80mm) interpenetrating masses; very sharp contact with:
-3.28 to -3.40	U100	5Y4/1 dark grey; silt and silty fine sand; unevenly bedded – alternations of silt and silty fine sand with individual beds 2-3mm thick; root channels with scattered *in situ* vertical root remains; scattered detrital plant remains; moderate acid reaction.
-3.40 to -3.45	Shoe sample	Organic silty sand.
-3.45 to -3.90	U100	5Y4/1 dark grey; well sorted silt and fine sand; bedded – alternations of silt and silty fine sand with individual beds varying from 2-10mm thick; root channels with scattered in situ vertical roots; scattered detrital plant remains; small piece of round wood(10mm Ø); weak acid reaction.

-3.90 to -4.15	Shoe sample	organic silty sand.
-3.95 to -4.11	U100	5Y3/2 dark olive grey; well sorted slightly silty fine sand; massive; scattered broken mollusc shell; strong acid reaction; very sharp inclined contact with:
-4.11 to -4.21	U100	Mass of wood - ?root wood; very sharp horizontal contact with:
-4.21 to -4.40	U100	5Y4/1 dark grey; silt and silty fine sand; unevenly bedded - alternations of silt and silty fine sand with individual beds varying from 2-10mm thick; scattered detrital plant remains.
-4.40 to -4.45	Shoe sample	peat
-4.45 to -4.75	U100	Black with white vivianite flecks; well humified peat; lenses of blue vivianite; very sharp contact with:
-4.75 to -4.90	U100	5Y4/2 olive grey; fine to medium tufa-rich sand; massive; scattered detrital plant remains; scattered broken mollusc shell; strong acid reaction.
-4.90 to -5.15	Shoe sample	Peat
-5.20 to -5.65	-	No retrieval
-5.45 to -5.68	U100	Dark brown to black; wet mixture of peat, silt and wood debris becoming firmer and more sandy downward; gradual transition to:
-5.68 to -5.88	U100	5Y3/1 very dark grey to black; silty fine sand with bed of tufa-rich coarser sand at -5.81 to -5.83m OD; horizontally bedded; common detrital plant remains; scattered broken mollusc shell; strong acid reaction; well-marked transition to:
-5.88 to -5.90	U100	Silty sandy gravel
-5.90 to -5.95	Shoe sample	Sandy gravel/gravelly sand.

Table 2: Results of the laboratory-based lithostratigraphic description of borehole <SSBH1C>, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

Depth (m OD)	Sample type	Composition
5.72 to 1.02	-	Made ground
1.02 to 0.77	U100	5Y4/2 olive grey to black with black flecks; well sorted gritty silt; massive; root channels; Charcoal; CBM; coal dust; piece of coke (50mm) at 0.84m OD; no acid reaction; well-marked transition to:
0.77 to 0.57	U100	5Y4/2 olive grey; well sorted silt; coarse bedding with horizontal partings marked by laminated plant material; scattered root channels and root remains; charcoal; CBM; no acid reaction.
0.57 to 0.52	Shoe sample	olive silty clay
0.52 to 0.07	U100	5Y4/2 olive grey with black patches and flecks; very well sorted silt; massive; common Fe-coated root channels and common root remains; faunal burrows; scattered detrital plant remains; moderate acid reaction.
-0.07 to -0.02	Shoe sample	nominal (220mm actual) olive silty clay
-0.02 to -0.43	U100	5Y4/3; very well sorted silt; massive; root channels; no acid reaction; tarry contamination coating structural and other surfaces.
-0.43 to -0.48	Shoe sample	olive silty clay with tarry contamination
-0.48 to -0.93	U100	5Y4/3 olive with black flecks; very well sorted silt

		becoming slightly peaty below -0.72m OD with wood debris; massive; root channels and scattered root remains; scattered detrital plant remains; no acid reaction; tarry contamination coating structural and other surfaces.
-0.93 to -0.98	Shoe sample	peat with branch wood
-0.98 to -1.43	U100	10YR2/2 very dark brown; peat with common wood debris
-1.43 to -1.48	Shoe sample	peat with branch wood
-1.48 to -1.93	U100	10YR2/2 very dark brown; peat with round wood (up to 35mm Ø).
-1.93 to -1.98	Shoe sample	*missing*
-1.98 to -2.24	U100	10YR2/2 very dark brown; incoherent mixture of peat and round wood (up to 40mm Ø) - ? drilling spoil; sharp contact with:
-2.24 to 2.43	U100	10YR2/2 very dark brown; peat; horizontal laminations.
-2.43 to -2.48	Shoe sample	woody peat with contorted partings of grey silt.
-2.48 to -2.93	U100	5Y3/2 dark olive grey; very well sorted silt with irregular inclusion of peat between -2.68m and -2.81m OD.
-2.93 to -2.98	Shoe sample	dark olive silt with scattered wood debris.
-2.98 to -3.06	U100	Peat with common wood debris; uneven sharp contact with:
-3.06 to -3.27	U100	5Y4/1 dark grey; very well sorted fine sand; no acid reaction; sharp contact with:
-3.27 to -3.43	U100	2.5Y4/4 olive brown; slightly silty sandy gravel of sub-angular and well-rounded flint clasts (up to 40mm).

Table 3: Results of the borehole <NTBH03> organic matter determinations, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

Depth (m OD)	Organic matter content (%)
1.47	8.09
1.15	9.80
-0.14	9.37
-0.46	11.20
-0.78	7.12
-1.10	6.19
-1.46	7.90
-1.74	14.87
-2.06	33.38
-2.50	46.92
-2.70	72.00
-3.02	40.92
-3.34	4.44
-3.66	2.64
-3.98	5.56
-4.30	4.71
-4.62	5.09
-4.90	15.96

-5.58	13.37
-5.90	8.36

Table 4: Results of the borehole <SSBH1C> organic matter determinations, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

Depth (m OD)	Organic matter content (%)
-3.38	1.07
-3.27	1.87
-3.11	3.08
-2.91	15.72
-2.79	16.26
-2.63	37.13
-2.51	24.53
-2.31	57.01
-2.15	42.10
-1.99	46.63
-1.83	67.04
-1.67	42.65
-1.59	42.12
-1.35	50.36
-1.19	7.65
-1.03	9.44
-0.87	28.84
-0.71	9.78
-0.55	6.37
-0.39	5.75
-0.23	6.31
-0.07	6.78
0.10	9.52
0.26	5.84
0.42	10.30
0.58	7.83
0.74	17.60
0.90	31.22

Table 5: Results of the borehole <NTBH03> and <SSBH1C> radiocarbon dating, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

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-301323	<NTBH03>	*Alnus* sp. waterlogged wood at top of highest Peat	-1.95 to -2.00	2840 ± 30	1080-920 BC 3030-2870 cal yr BP	-27.4
Beta-301234	<NTBH03>	*Alnus* sp. waterlogged wood at base of lowest Peat	-5.63 to -5.68	9400 ± 50	8790-8560 cal yr BC (10,740-10,510 cal yr BP)	-26.2
Beta-301231	<SSBH1C>	*Alnus* sp. waterlogged wood at top of highest Peat	-0.98 to -1.03	3080 ± 40	1430-1260 cal BC (3380-3210 cal BP)	-27.8
Beta-301232	<SSBH1C>	*Rumex*/*Polygonum* sp. seeds at base of lowest Peat	-3.01 to -3.06	4680 ± 40	3630-3360 cal BC (5580-5310 cal BP)	-29.4

RESULTS AND INTERPRETATION OF THE POLLEN ASSESSMENT

Twelve sub-samples from each borehole (<NTBH03> and <SSBH1C>) were extracted for an assessment of pollen content, the results are displayed in Tables 6 and 7 respectively.

Borehole <NTBH03>

The results of the pollen assessment indicate that the lowermost sample (-5.65 to -5.66m OD) comprises *Pinus* (pine), *Betula* (birch), Poaceae (grass family), Cyperaceae (sedge family), *Typha latifolia* (bulrush) and *Dryopteris* type (e.g. buckler ferns). In the next three samples the assemblages are dominated by tree and shrub taxa including *Pinus*, *Alnus* (alder), *Ulmus* (elm), *Tilia* (lime), *Quercus* (oak), Salix (willow) and *Corylus* type (e.g. hazel) with ground flora taxa including Poaceae, Cyperaceae, Asteraceae (daisy family) and *Dryopteris* type. The relative proportions of these taxa in each sample suggest that the environment was initially dominated by open herbaceous plants such as grasses and sedges, whilst pine and birch formed woodland. Whether the woodland was growing on the site or at a greater distance is more difficult to establish, since both trees produce a large quantity of pollen. Nevertheless, the assemblage is indicative of pioneer woodland, and suggests an early Holocene date. The following samples indicate the growth of alder (-5.56 to -5.57m OD), and later, the dominance of pine (-4.70 to -4.61m OD). The initial growth of alder could be somewhat unusual if the sequence is early Holocene, as it does not generally become widespread until after 9000 years ago, whilst the high values of pine suggests it is more likely to have been growing locally to the site.

The remaining samples between -3.02 and -1.89m OD are all somewhat similar in nature being dominated by *Alnus* with *Quercus*, *Tilia* (lime), *Pinus* and variable quantities of *Fraxinus* (ash), *Betula*, cf *Ulmus*, *Corylus* type and *Hedera* (ivy). Herb and fern taxa was limited comprising occasional grains of Poaceae, Cyperaceae, Asteraceae, Lactuceae (dandelion family), *Chenopodium* type (e.g. fat hen), *Polypodium vulgare* (polypody) and *Dryopteris* type. No aquatic pollen types were noted. This assemblage indicates the growth of fen woodland dominated by alder on the wetland, with a ground flora including grasses and sedges. Ash, birch, elm and hazel may also have occupied the wetland with alder, but are equally likely to have grown on the dryland forming mixed deciduous woodland dominated by oak and lime. Due to its entomophilous (insect pollinated) nature, lime is frequently under-represented in pollen-stratigraphic records. Therefore, the high values recorded in samples such as -2.85 to -2.86m OD suggest it was the most dominant component of the woodland, or, perhaps even that the dryland was relatively close to the site. No indications of anthropogenic activity were noted during the course of the assessment.

Borehole <SSBH1C>

The results of the pollen-stratigraphic assessment indicate that between -3.03 and -1.34m OD, the pollen taxa comprise a similar assemblage to that recorded between -3.02 and -1.89m OD in borehole <NTBH03>. Alder fen woodland dominated the wetland, whilst mixed lime-oak woodland occupied the dryland. The main differences appear to be that elm and possibly yew (*Taxus*) were more common in this sequence, indicating their greater occurrence within the local wetland and/or dryland woodland. Their occurrence is intriguing because, they may contribute to discussions on the Neolithic elm decline and colonisation and decline of yew woodland (see e.g. Batchelor, 2009). No anthropogenic indicators were noted during the course of the assessment.

Above -1.34m OD, the pollen assemblage changed to include a larger number diversity of herbaceous taxa, including Poaceae, Cyperaceae, *Sinapis* type (e.g. charlock), *Chenopodium* type (e.g. fat hen) and Lactuceae (dandelion family). This transition suggests the wetland and dryland woodland became more open. This may have been caused by an increase in surface wetness on the wetland (caused by relative sea level rise), or an increase in human activity on the dryland for example. However, no pollen taxa such as saline or anthropogenic indicators were recorded during the course of the assessment.

Table 6: Results of the pollen assessment of borehole <NTBH03>, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

Depth (m OD)		Main pollen taxa			Concentration 0 - 5	Preservation 0- 5	Microcharcoal 0 - 5
From	To	Latin name	Common name	Number			
-1.89	-1.90	*Alnus*	alder	5	3	3	1
		Quercus	oak	4			
		cf Tilia	lime	1			
		Pinus	pine	1			
		Betula	birch	1			
		Fraxinus	ash	1			
		Corylus type	e.g. hazel	2			
		Poaceae	grass family	1			
		Cyperaceae	sedge family	1			
		Asteraceae	daisy family	1			
-2.05	-2.06	*Alnus*	alder	1	1	3	1
		Quercus	oak	1			
		Tilia	lime	2			
		Dryopteris type	e.g. buckler fern	1			
		Unknown spore		1			
-2.21	-2.22	*Alnus*	alder	4	1-2	3-4	1
		Pinus	pine	1			
		Quercus	oak	1			
		Lactuceae	dandelion family	1			
-2.49	-2.50	*Alnus*	alder	8	3	3	1
		Quercus	oak	4			
		Pinus	pine	1			
		Tilia	lime	1			
		cf Ulmus	elm	3			
		Poaceae	grass family	1			
		Cyperaceae	sedge family	1			
		Dryopteris type	e.g. buckler fern	1			
-2.53	-2.54	*Alnus*	alder	4	3	3-4	1
		Quercus	oak	3			
		Tilia	lime	1			

		Fraxinus *Corylus* type *Hedera* *Chenopodium* type *Dryopteris* type	ash e.g. hazel ivy e.g. fat hen buckler fern	1 1 1 2 1			
-2.69	-2.70	*Alnus* *Pinus* *Corylus* type	alder pine e.g. hazel	11 1 2	2	4	0
-2.85	-2.86	*Alnus* *Tilia* *Quercus* *Corylus* type *Polypodium vulgare* Sphagnum	alder lime oak e.g. hazel polypody moss	25 7 8 3 2 1	5	4	1
-3.01	-3.02	*Alnus* *Quercus* *Pinus* *Corylus* type *Dryopteris* type	alder oak pine e.g. hazel e.g. buckler fern	18 6 2 7 1	5	4	0
-4.61	-4.62	*Alnus* *Pinus* *Salix* *Corylus* type Cyperaceae Poaceae	alder pine willow e.g. hazel sedge family grass family	1 6 1 1 1 1	2	3-4	1
-4.69	-4.70	*Alnus* *Quercus* *Pinus* *Ulmus* *Tilia* *Corylus* type *Salix* Poaceae Asteraceae *Dryopteris* type	alder oak pine elm lime e.g. hazel willow grass family daisy family e.g. buckler fern	1 4 14 1 2 1 1 1 1 1	4	3-4	3-4

-5.56	-5.57	*Alnus* *Pinus* *Betula* *Quercus* *Corylus* type *Salix* Cyperaceae *Dryopteris* type	alder pine birch oak e.g. hazel willow sedge family e.g. buckler fern	5 6 3 2 1 1 1 1	3-4	4	1
-5.65	-5.66	*Pinus* *Betula* Poaceae Cyperaceae *Typha latifolia* *Dryopteris* type	pine birch grass family sedge family bulrush e.g. buckler fern	6 2 6 2 1 1	5	4-5	0

Key:
Concentration: 0 = 0 grains; 1 =1-75 grains, 2 = 76-150 grains, 3 =151-225 grains, 4 = 226-300, 5 =300+ grains per slide
Preservation: 0 = 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 <SSBH1C>, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

Depth (m OD)		Main pollen taxa			Concentration 0 - 5	Preservation 0- 5	Microcharcoal 0 - 5
From	To	Latin name	Common name	Number			
-0.86	-0.87	*Quercus*	oak	1	1	3	1
		Corylus type	e.g. hazel	1			
		Poaceae	grass family	3			
		Lactuceae	daisy family	1			
-1.02	-1.03	*Alnus*	alder	2	3	3-4	2-3
		Pinus	pine	3			
		Corylus type	e.g. hazel	4			
		Cyperaceae	sedge family	4			
		Sinapis type	e.g. charlock	3			
		Asteraceae	aster family	1			
		Sparganium type	bur-reed	1			
		Pteridium aquilinum	bracken	1			
		Dryopteris type	e.g. buckler ferns	1			
-1.18	-1.19	*Alnus*	alder	9	4-5	4	4
		Pinus	pine	3			
		Quercus	oak	1			
		Corylus type	e.g. hazel	2			
		Poaceae	grass family	7			
		Cyperaceae	sedge family	1			
		Chenopodium type	e.g. goosefoot	3			
		Lactuceae	dandelion family	2			
		Dryopteris type	e.g. buckler ferns	1			
		Polypodium vulgare	polypody	1			
-1.34	-1.35	*Alnus*	alder	1	1	3	0
		Quercus	oak	1			
		Tilia	lime	1			
		Corylus type	e.g. hazel	1			
		Dryopteris type	e.g. buckler ferns	1			
		Pteridium aquilinum	bracken	1			
-1.58	-1.59	*Alnus*	alder	12	4	4	1

		Quercus	oak	3			
		Ulmus	elm	3			
		Pinus	pine	1			
		Corylus type	e.g. hazel	1			
		Poaceae	grass family	1			
		Sparganium type	bur-reed	1			
		Dryopteris type	e.g. buckler ferns	3			
		Polypodium vulgare	polypody	1			
-1.66	-1.67	*Alnus*	alder	9	3	4	1
		Quercus	oak	4			
		Fraxinus	ash	1			
		Tilia	lime	1			
		Corylus type	e.g. hazel	1			
		Dryopteris type	e.g. buckler ferns	1			
-1.82	-1.83	*Alnus*	alder	3	2	3	1
		Tilia	lime	4			
		Quercus	oak	1			
		Corylus type	e.g. hazel	4			
-1.98	-1.99	*Alnus*	alder	11	3	3-4	1
		Quercus	oak	1			
		Betula	birch	1			
		Tilia	lime	1			
		Corylus type	e.g. hazel	3			
		Lactuceae	dandelion family	1			
		Dryopteris type	e.g. buckler ferns	1			
		Polypodium vulgare	polypody	3			
-2.14	-2.15	*Alnus*	alder	9	3	4	1
		Ulmus	elm	1			
		Pinus	pine	1			
		Quercus	oak	1			
		Fraxinus	ash	1			
		cf *Taxus*	yew	1			
		Corylus type	e.g. hazel	3			
		Cyperaceae	sedge family	1			
		Dryopteris type	e.g. buckler ferns	1			

		Pteridium aquilinum	bracken	1			
-2.36	-2.37	*Alnus* *Ulmus* *Tilia* *Quercus* *Pinus* *Corylus* type *Chenopodium* type *Pteridium aquilinum* *Polypodium vulgare*	alder elm lime oak pine e.g. hazel e.g. fat hen bracken polypody	11 1 7 1 1 1 1 1 3	3-4	4	0
-2.50	-2.51	*Alnus* *Quercus* *Corylus* type *Dryopteris* type	alder oak e.g. hazel e.g. buckler ferns	18 7 3 1	4	3	0
-3.02	-3.03	*Alnus* *Corylus* type	alder e.g. hazel	6 2	1-2	3	1-2

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

Six sub-samples were processed for diatom assessment from each borehole. The results are displayed in Tables 8 and 9. The results of the diatom assessment indicate a very limited concentration or absence of diatoms in the majority of the samples from both boreholes. However, a high concentration of remains is recorded at -1.89 to -1.90m OD in borehole <NTBH03>, and two further samples indicate a low concentration. Borehole <SSBH1C> contains three samples with a low concentration of remains.

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 <SSBH1C>, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

Depth (m OD)		Diatom concentration	Quality of preservation	Diversity
From	To			
-0.70	-0.71	Low	Very poor	Low
-0.86	-0.87	Low	Very poor	Low
-2.50	-2.51	Low	Poor	Low
-2.62	-2.63	Extremely low	Very poor	Very low
-2.90	-2.91	None	-	-
-3.02	-3.03	Extremely low	Very poor	Very low

Table 9: Summary diatom assessment results of borehole <NTBH3>, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

Depth (m OD)		Diatom concentration	Quality of preservation	Diversity
From	To			
-1.73	-1.74	Low	Moderate	Very low
-1.89	-1.90	High	Moderate	High
-3.01	-3.02	Low	Poor	Moderate
-3.17	-3.18	Extremely low	Very poor	Very low
-4.77	-4.78	None	-	-
-5.65	-5.66	Extremely low	Very poor	Very low

RESULTS AND INTERPRETATION OF THE MACROFOSSIL ASSESSMENT

A total of twenty one small bulk samples (eleven from borehole <SSBH1C> and ten from <NTBH03> were extracted for the recovery of macrofossil remains including waterlogged plant macrofossils, waterlogged wood, insects, Mollusca and bone (Tables 10 and 11). The samples were focussed on the organic-rich sections of each borehole only.

Borehole <SSBH1C>

The results of an initial assessment indicated that the samples from borehole <SSBH1C> contained no Mollusca remains, charred seeds or bone. Fragments of charcoal between 2 and 4mm and less than 2mm in diameter were present in the lowest sample in the sequence (-3.01 to -3.06m OD). Fragments of insect remains were present in three samples (-2.50 to -2.56, -1.82 to -1.92 and -1.21 to -1.31m OD). Waterlogged wood was present in moderate to high quantities in all but two samples (-1.03 to -1.12 and -3.01 to -3.06m OD), in which low quantities were present. Waterlogged seed remains were absent in three samples (-0.82 to -0.92, -1.03 to -1.12 and -1.82 to -1.92m OD), the remaining eight samples containing low to moderate quantities of waterlogged seeds.

Borehole <NTBH03>

The ten samples from borehole <NTBH03> contained no charred seeds or bone. Charcoal between 2 and 4mm and less than 2mm in diameter was present in low quantities in one sample (-5.63 to -5.68m OD). Low quantities of fragments of Mollusca remains were present in four samples (-2.45 to -2.55, -4.65 to -4.75, -5.53 to -5.62 and -5.63 to -5.68m OD), two of these containing whole Mollusca remains (-4.65 to -4.75 and -5.53 to -5.62m OD). Fragments of insect remains were present in three samples (-2.45 to -2.55, -4.65 to -4.75 and -5.53 to -5.62m OD). Waterlogged wood was present in low quantities in two samples (-2.45 to -2.55 and -5.63 to -5.68m OD), the remaining eight samples containing moderate to high quantities. Waterlogged seeds were present in eight samples in generally moderate to high quantities, with only two samples not containing any seed remains (-2.45 to -2.55 and -2.78 to -2.88m OD).

Table 10: Results of the macrofossil assessment of borehole <SSBH1C>, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

				Charred					Waterlogged		Mollusca		Bone			
Depth (m OD)	Volume sampled (l)	Volume processed (l)	Fraction (e.g. flot, residue, >300µm)	Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Whole	Fragments	Large	Small	Fragments	Insects
-0.82 to -0.92	0.55	0.55	>1mm	-	-	-	-	-	4	-	-	-	-	-	-	-
			>300µm	-	-	-	-	-	1	-	-	-	-	-	-	-
-0.98 to -1.03	0.10	0.10	>1mm	-	-	-	-	-	2	2	-	-	-	-	-	-
			>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-
-1.03 to -1.12	0.30	0.30	>1mm	-	-	-	-	-	1	-	-	-	-	-	-	-
			>300µm	-	-	-	-	-	1	-	-	-	-	-	-	-
-1.21 to -1.31	0.50	0.50	>1mm	-	-	-	-	-	5	2	-	-	-	-	-	-
			>300µm	-	-	-	-	-	1	-	-	-	-	-	-	2
-1.62 to -1.72	0.45	0.45	>1mm	-	-	-	-	-	3	2	-	-	-	-	-	-
			>300µm	-	-	-	-	-	1	-	-	-	-	-	-	-
-1.82 to -1.92	0.60	0.60	>1mm	-	-	-	-	-	5	-	-	-	-	-	-	-
			>300µm	-	-	-	-	-	1	-	-	-	-	-	-	2
-2.02 to -2.12	0.50	0.50	>1mm	-	-	-	-	-	5	2	-	-	-	-	-	-
			>300µm	-	-	-	-	-	1	-	-	-	-	-	-	-
-2.22 to -2.32	0.55	0.55	>1mm	-	-	-	-	-	4	1	-	-	-	-	-	-

			>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-
-2.38 to -2.43	0.20	0.20	>1mm	-	-	-	-	-	3	1	-	-	-	-	-	-
			>300µm	-	-	-	-	-	-	-	-	-	-	-	-	-
-2.50 to -2.56	0.35	0.35	>1mm	-	-	-	-	-	4	2	-	-	-	-	-	-
			>300µm	-	-	-	-	-	1	-	-	-	-	-	-	1
-3.01 to -3.06	0.20	0.20	>1mm	-	1	-	-	-	1	-	-	-	-	-	-	-
			>300µm	-	-	1	-	-	-	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 11: Results of the macrofossil assessment of borehole <NTBH03>, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

				Charred					Waterlogged		Mollusca		Bone			
Depth (m OD)	Volume sampled (l)	Volume processed (l)	Fraction (e.g. flot, residue, >300µm)	Charcoal (>4mm)	Charcoal (2-4mm)	Charcoal (<2mm)	Seeds	Chaff	Wood	Seeds	Whole	Fragments	Large	Small	Fragments	Insects
-1.95 to -2.00	0.30	0.30	>1mm	-	-	-	-	-	2	1	-	-	-	-	-	-
			>300µm	-	-	-	-	-	1	-	-	-	-	-	-	-
-2.15 to -2.25	0.60	0.60	>1mm	-	-	-	-	-	3	1	-	-	-	-	-	-
			>300µm	-	-	-	-	-	1	-	-	-	-	-	-	-
-2.45 to -2.55	0.25	0.25	>1mm	-	-	-	-	-	1	-	-	-	-	-	-	-
			>300µm	-	-	-	-	-	-	-	-	1	-	-	-	1
-2.58 to -2.68	0.40	0.40	>1mm	-	-	-	-	-	5	2	-	-	-	-	-	-
			>300µm	-	-	-	-	-	1	-	-	-	-	-	-	-
-2.78 to -2.88	0.40	0.40	>1mm	-	-	-	-	-	5	-	-	-	-	-	-	-
			>300µm	-	-	-	-	-	1	-	-	-	-	-	-	-
-2.98 to -3.08	0.55	0.55	>1mm	-	-	-	-	-	5	5	-	-	-	-	-	-
			>300µm	-	-	-	-	-	1	2	-	-	-	-	-	-
-3.18 to -3.28	0.50	0.50	>1mm	-	-	-	-	-	5	3	-	-	-	-	-	-
			>300µm	-	-	-	-	-	1	1	-	-	-	-	-	-
-4.65 to -4.75	0.80	0.80	>1mm	-	-	-	-	-	3	-	-	1	-	-	-	-

			>300µm	-	-	-	-	-	-	1	1	1	-	-	-	1
-5.53 to -5.62	0.40	0.40	>1mm	-	-	-	-	-	2	3	1	1	-	-	-	-
			>300µm	-	-	-	-	-	-	2	-	1	-	-	-	2
-5.63 to -5.68	0.20	0.20	>1mm	-	1	1	-	-	1	2	-	-	-	-	-	-
			>300µm	-	-	-	-	-	-	1	-	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+

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

The results of the macrofossil rapid assessment indicated that waterlogged seeds were present in sixteen of the samples assessed, and that waterlogged wood was present in all 21 samples. In addition, two samples contained fragments of charcoal. These samples thus underwent a more detailed assessment. The results of the borehole <SSBH1C> and <NTBH3> waterlogged macrofossil (seeds and wood) and charcoal assessments are displayed in Tables 12 and 13.

Results and interpretation of the waterlogged seed assessment

Borehole <SSBH1C>

Waterlogged seeds were preserved in low to moderate quantities in eight of the eleven samples from borehole <SSBH1C> (Table 12). The assemblage through the sequence is dominated by tree and shrub taxa including *Alnus glutinosa* (alder), *Corylus avellana* (hazel) and *Rubus* sp. (e.g. bramble). Herbaceous taxa were rare but included *Ranunculus* cf. *repens* (cf. creeping buttercup). This assemblage is indicative of a fen carr dominated by alder and hazel on the wetland surface, with an understorey of bramble and creeping buttercup.

Borehole <NTBH03>

Waterlogged seeds were preserved in generally moderate to high quantities in eight of the ten samples from borehole <BH3> (Table 13). The assemblage through the sequence is dominated by tree and shrub taxa including *Alnus glutinosa* (alder), *Corylus avellana* (hazel), *Rubus* sp. (e.g. bramble) and *Sambucus nigra*/*racemosa* (elder). Herbaceous taxa were present and included *Ranunculus* cf. *repens* (cf. creeping buttercup), *Rumex*/*Polygonum* sp. (dock/sorrel/knotweed) and *Lycopus* sp. (gypsywort). This assemblage is indicative of a fen carr dominated by alder and hazel on the wetland surface, with an understorey of bramble, elder, and herbaceous taxa including creeping buttercup, dock/sorrel/knotgrass and gypsywort.

Results and interpretation of the waterlogged wood assessment

Of the 123 fragments examined across both boreholes <SSBH1C> and <NTBH03>, 70 were identified as *Alnus glutinosa* (alder), 6 fragments were identified as *Fraxinus excelsior* (ash) and 1 fragment as *Salix*/*Poplus* sp. (willow/poplar). The majority of the wood identified derived from either twig wood or round wood from small branches. The remaining fragments, including bark fragments, could not be identified and were recorded as indeterminate.

The contents of the samples examined are suggestive of accumulated natural debris, comprising bark, twigs and small branches in the location of both boreholes. Alder was consistently the most abundant taxon identified which suggests that it was the principle source of woody debris throughout the period represented by the deposits. The abundance of alder suggests the presence of alder woodland, alongside other taxa tolerant of, or favouring wet soil; in this instance the occasional presence of ash and willow/poplar. The quality of preservation was generally good. Bark fragments were noticeably larger, and more robust, than twig and round wood fragments – most of which were small and more fragile. Almost all of the wood examined, and the 3 fragments of charcoal, contained fungal hyphae, in some instances in considerable quantities, suggesting prolonged decay at the time of burial.

Table 11: Results of the waterlogged plant macrofossil (seeds and wood) assessment of borehole <SSBH1C>, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

Depth (m OD)	Waterlogged seeds		Waterlogged wood			
	Latin name	**Common name**	**Latin name**	**Common name**	**Quantity**	**Comments**
-0.82 to -0.92	-	-	Alnus glutinosa	alder	10	Including x1 twig: *ca*. 2 years; *ca*. 3mm diameter
-0.98 to -1.03	*Rubus* sp. *Ranunculus* cf. *repens* *Alnus glutinosa*	e.g. bramble cf. creeping buttercup alder	*Alnus glutinosa* **(C14)** Indeterminate	alder -	3 2	- Bark
-1.03 to -1.12	-	-	*Alnus glutinosa*	alder	10	-
-1.21 to -1.31	*Rubus* sp. *Alnus glutinosa* *Corylus avellana*	e.g. bramble alder hazel	*Alnus glutinosa* Charcoal fragments *Alnus glutinosa* cf *Fraxinus excelsior*	alder alder ash	10 2 1	- -
-1.62 to -1.72	*Alnus glutinosa* *Ranunculus* cf. *repens* Unidentified	alder cf. creeping buttercup -	*Alnus glutinosa* cf *Salix*/*Populus* sp. Indeterminate	alder willow/poplar -	4 1 5	- - x5 bark fragments.
-1.82 to -1.92	-	-	*Alnus glutinosa* Indeterminate	alder -		x1 hardwood, x3 bark fragments.
-2.02 to -2.12	*Rubus* sp. *Alnus glutinosa* *Ranunculus* cf. *repens*	e.g. bramble alder cf. creeping buttercup	*Alnus glutinosa* Indeterminate	alder -	8 2	Including x4 twig wood. x2 bark fragments.
-2.22 to -2.32	*Rubus* sp.	e.g. bramble	Indeterminate	-	10	x10 bark fragments.
-2.38 to -2.43	*Corylus avellana*	hazel	*Alnus glutinosa*	alder	5	
-2.50 to -2.56	*Alnus glutinosa* *Ranunculus* cf. *repens*	alder cf. creeping buttercup	*Alnus glutinosa* *Fraxinus excelsior* Indeterminate	alder ash -	3 2 5	Including. x1 twig: *ca*. 3 years; *ca*. 8mm diameter. Very narrow growth rings (7+). x1 hardwood, x4 bark fragments.
-3.01 to -3.06	Unidentified	-	*Alnus glutinosa* **(C14)**	alder	5	

Table 12: Results of the waterlogged plant macrofossil (seeds) assessment of borehole <NTBH03>, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

Depth (m OD)	Waterlogged seeds		Waterlogged wood			
	Latin name	**Common name**	**Latin name**	**Common name**	**Quantity**	**Comments**
-1.95 to -2.00	*Sambucus nigra*/*racemosa*	elder	*Alnus glutinosa* **(C14)** Indeterminate	alder -	4 1 Bark	Including x1 & twigwood *ca*. 3 years old x4
-2.15 to -2.25	*Rubus* sp.	e.g. bramble	*Fraxinus excelsior* Indeterminate	ash -	2 8	- Hardwood, x4 bark fragments
-2.58 to -2.68	*Alnus glutinosa* *Rubus* sp. Apiaceae	alder e.g. bramble carrot family	-	-		
-2.78 to -2.88	-	-	*Alnus glutinosa* Indeterminate	alder -	5 5	- x10 bark fragments.
-2.98 to -3.08	*Lycopus* sp. *Alnus glutinosa* *Corylus avellana* *Sambucus nigra*/*racemosa* *Rubus* sp. *Rumex*/*Polygonum* sp.	gypsywort alder hazel elder e.g. bramble dock/sorrel/knotweed	*Alnus glutinosa* cf *Fraxinus excelsior*	alder ash	9 1	- -
-3.18 to -3.28	*Alnus glutinosa* *Corylus avellana* Unidentified	alder hazel -	*Alnus glutinosa* Indeterminate	alder	4 6	- x6 bark fragments.
-4.65 to -4.75	*Lycopus* sp. Unidentified	gypsywort -	*Alnus glutinosa* Indeterminate	alder -	2 3	 Bark
-5.53 to -5.62	*Alnus glutinosa* *Rumex*/*Polygonum* sp. *Ranunculus* cf. *repens* *Lycopus* sp.	alder dock/sorrel/knotweed cf. creeping buttercup gypsywort	-	-		

-5.63 to -5.68	*Rumex*/*Polygonum* sp. **(C14)**	dock/sorrel/knotweed	Indeterminate	-	5	

DISCUSSION

The aims of environmental archaeological assessment was to evaluate the potential of two borehole sequences (<NTBH03> and <SSBH1C>) identified during the course of the previous geoarchaeological field investigations for reconstructing the environmental history of the site and its environs.

The results of the assessment demonstrate that North Tower borehole <NTBH03>, on the north bank of the River Thames contains a thick sequence of intercalated Peat and Alluvial sediments measuring from -5.68 to +1.55m OD. The results of the range-finder radiocarbon determinations indicate that deposition commenced around 10,500 cal yr BP and continued until at least *ca*. 3000 cal yr BP, equating to deposition during the Mesolithic, Neolithic and Bronze Age cultural periods. The results of the archaeobotanical assessment (pollen, waterlogged wood and waterlogged seeds) indicate that during the deposition of the basal Peat, the local environment was first dominated by grasses and sedges with pine and birch woodland, prior to a transition towards alder dominated fen. The alder dominated fen remained dominant through the main Peat horizon at -3.28 to -1.95m OD. On the dryland (which may have been relatively near to the North Tower), the surface comprised mixed oak-lime dominated woodland throughout the majority of the sequence. No indications of anthropogenic activity were recorded, although this could be a reflection of the sampling strategy carried out during the assessment stage. The results of the diatom assessment show that frustules were present (generally in low concentrations) in certain samples, and these have the potential to reconstruct the hydrological history of the site. Insects and Mollusca were noted in limited concentrations during the bulk sample assessment which may also provide important information on the general environmental context of the site.

The chronology and provisional vegetation history indicated by the <NTBH03> sequence are analogous to those made at the nearby West Silvertown site located approximately 500m to the east (Figure 1; Wilkinson *et al*., 2000). One of the exceptions to this is that *Ulmus* (elm) and *Taxus* (yew) represent an important component of the West Silvertown pollen sequence but are not recorded at the new site. The decline of elm, and colonisation and decline of yew represent significant vegetation changes during the Neolithic cultural period that are recorded at a number of sites along the course of the Lower Thames Valley, but particularly on the north bank of the river and in the Newham area (Batchelor, 2009; Gifford and Partners, 2001; Scaife, 2001; Wilkinson *et al*., 2000; Jarrett, 1996; Divers, 1995; Tamblyn, 1994). The absence/limited concentration of pollen recorded at the new site is therefore significant to the mapping of ancient woodland along the course of the Thames.

Furthermore, the cultural periods represented in the <NTBH03> correlate with archaeological discoveries made in the nearby vicinity including: (1) a prehistoric structure (possible trackway) at Fort Street, Silvertown (Wessex Archaeology, 2000; Figure 1), and (2) Mesolithic and Bronze Age flints, pottery and debris at the Royal Docks Community School (Holder, 1998; Figure 1). Therefore, whilst no anthropogenic indicators were recorded during the assessment stage, the proximity of these sites, suggests there is potential to trace human activity during the environmental archaeological analysis stage. There is also probably a need to consider the potential for locating archaeological remains at the site.

The results of the assessment indicate that South Station borehole <SSBH1C>, on the south bank of the River Thames also contained a thick sequence of intercalated Peat and Alluvial sediments, this time measuring from -3.06 to +1.02m OD. The results of the range-finder radiocarbon determinations on the sequence indicate that deposition occurred between at least *ca*. 5500 and 3500 cal yr BP equating to the Neolithic and Bronze Age cultural periods. The results of the archaeobotanical assessment (pollen, waterlogged wood and waterlogged seeds) indicate that the local wetland environment comprised alder dominated fen, with a transition towards wetter, more open conditions towards the top of the Peat. On the dryland, the surface was occupied by mixed oak-lime dominated woodland, which also declined towards the top of the sequence, and more open conditions are indicated. The results of the diatom assessment show that frustules were present (generally in low concentrations) in certain samples, and these have the potential to reconstruct the hydrological history of the site. Insects were noted in limited concentrations during the bulk sample assessment which may also provide important information on the general environmental context of the site.

Elm pollen was recorded more frequently in the <SSBH1C> sequence, and a tentative identification of yew pollen was made at -2.14 to -2.15m OD. No strong *Taxus* pollen signal has been recorded within this area of the Thames (nor have any trees or macrofossil remains). The new record is therefore significant for mapping the former distribution of yew on the floodplain surface in this area of the Lower Thames Valley. Furthermore, there are few environmental archaeological records from this area, and thus analysis on the <SSBH1C> sequence would add to our knowledge and understanding of the general palaeoenvironmental conditions. Some of the nearest archaeological remains recorded on this side of the river were a Bronze Age wooden trackway(s) within the Peat at two sites on Bellot Street (Branch *et al*., 2005; McLean, 1993; Philp, 1993). However, the potential for finding archaeological remains at the new site within the Peat is probably limited due to the frequent truncation and contamination of sequences noted during the geoarchaeological fieldwork (Green *et al*., 2011).

CONCLUSIONS AND RECOMMENDATIONS

Following the results of the environmental archaeological assessment, both sequences (<NTBH03> and <SSBH1C>) are recommended for high resolution analysis, incorporating (1) further organic matter determinations; (2) further radiocarbon dating; (3) pollen; (4) diatoms; (5) waterlogged plant macrofossils (seeds and wood); (6) insects and (7) Mollusca. These investigations will provide a detailed reconstruction of the environmental history of each site, and elucidate evidence for human activity and sea level change. The investigations also provide the opportunity to increase knowledge and understanding of the distribution of ancient woodland across these areas of the Lower Thames Valley.

The sequence from <NTBH03> is of particular note. Whilst the absence of sample between -5.20 and -5.65m OD due to non-retrieval is an unfortunate loss, the new sequence from this record represents one of a limited number of sites from the Lower Thames Valley that contain deposits dating back to the Early Holocene (Early Mesolithic period). It is recommended however, that analysis on the sequence might wait until archaeological mitigation is completed on the site (if carried out). If archaeology is uncovered, it would be more beneficial to collect a sequence of environmental samples that can be directly associated with the remains. Furthermore, if an opportunity to collect further samples from the basal peats above *ca*. -5.80m OD arises, it is recommended that further column and bulks are collected as such opportunities are rare in the Lower Thames Valley, and would enable the retrieval of greater numbers of macrofossil remains.

A method statement for the analysis stage is provided in Appendix 3.

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APPENDIX 1: Details of the geotechnical boreholes from the North Station (NS), North Intermediate Tower (NIT), North Tower, South Tower (ST), and South Station (SS) areas of the Cable Car, London Boroughs of Newham and Greenwich (site code: CAB11) and additional previous borehole locations

Borehole number	Easting	Northing	Depth at surface (m OD)
NS			
NSDS01	540111.26	180696.07	5.32
NSBH01A	540152.83	180702.12	4.87
NSBH01*	540152.91	180700.09	4.85
NSDS02	540167.03	180696.54	4.54
NSBH02	540135.76	180672.33	-5.52
NIT			
NITBH06	539951.44	180418.42	5.43
NITTP04	539948.69	180419.02	5.38
NITTP04A	539946.91	180419.66	5.34
NITTPH03	539969.51	180429.48	5.39
NITBH05	539980.00	180428.72	5.46
NITTP01	539973.66	180435.92	5.33
NITBH02*	539972.81	180437.25	5.28
NITBH09	539961.27	180443.27	5.18
NITBH09A	539960.26	180442.76	5.21
NITBH09B	539957.29	180440.72	5.18
NITB09	539956.00	180439.73	5.15
NITBH09D	539954.54	180439.04	5.14
NITBH09E	539948.77	180434.30	5.22
NITBH09F	539949.18	180434.77	5.22
NITBH01A	539948.55	180443.13	5.29
NITBH01	539953.33	180444.87	5.28
NITTP05	539947.94	180448.23	5.41
NITBH07	539947.14	180449.86	5.43
NITBH04	539943.82	180446.50	5.39
NITBH04X	539943.82	180446.51	5.38
NITBH08	539931.78	180444.77	5.55
NITTP8	539932.22	180442.01	5.51
NITTP07	539935.04	180437.22	5.41
NT			
NTTP03A	539864.83	180255.08	5.09
NTTP03	539861.05	180252.00	5.10
NTBH02	539850.35	180286.36	5.16
NTTP04A	539839.75	180289.65	5.15
NTTP04	539838.85	180288.11	5.12
NTDS01	539906.01	180349.48	2.66
NTDS02	539918.06	180300.72	2.72
NTBH01*	539868.52	180300.77	2.76
NTBH03**	539869.01	180300.01	2.75
ST			
STBH01	539655.23	179973.19	-8.72
STBH04	539597.20	179927.28	-3.88
STBH02	539603.46	179994.39	-5.88
STBH03	539656.99	179834.86	-4.08
SS			
SSDS04	539478.67	179745.07	5.05
SSDS03	539486.27	179791.10	5.14
SSBH03*	539507.18	179793.44	5.34
SSBH01	539527.90	179815.24	5.56
SSBH01B	539530.52	179811.84	5.64
SSBH01C**	539535.75	179817.14	5.72

SSDS02	539521.13	179780.75	5.74
SSBH02D	539513.84	179759.81	5.31
SSBH02C	539522.27	179770.42	5.50
SSBH02	539526.13	179772.51	5.54
SSBH02B	539529.00	179774.72	5.55
TU			
TUBH01	539879.91	180166.61	-4.89
TUBH02	539709.58	179986.13	-10.04

** Boreholes monitored by Quarternary Scientific in the field*
*** Retrieved geoarchaeological boreholes*

Record name	**Origin**	**Easting**	**Northing**
BH2	SE Gas mains	539260	179773
BH3	SE Gas mains	539359	179432
BH4	SE Gas mains	539749	179784
BH5	SE Gas mains	539525	179415
BH6	SE Gas mains	539415	179396
BH7	SE Gas mains	539499	179380
BH8	SE Gas mains	539254	179378
BH9	SE Gas mains	539313	179428
BH10	SE Gas mains	539158	179607
BH11	SE Gas mains	539204	179477
BH12	SE Gas mains	539276	179424
BH13	SE Gas mains	539277	179331
BH14	SE Gas mains	539226	179374
BH15	SE Gas mains	539317	179375
BH16	SE Gas mains	539646	178916
BH17	SE Gas mains	539716	178886
BH18	SE Gas mains	539635	178823
BH19	SE Gas mains	539694	178819
BH20	SE Gas mains	539581	179357
BH21	SE Gas mains	539470	179436
BH22	SE Gas mains	538853	179824
BH23	SE Gas mains	539581	179982
BH24	SE Gas mains	539519	180062
BH25	SE Gas mains	539476	180125
BH26	SE Gas mains	539200	180052
BH27	SE Gas mains	539205	179338
BH28	SE Gas mains	539420	180023
BH29	SE Gas mains	539002	180153
BH30	SE Gas mains	538839	180284
BH31	SE Gas mains	538941	180257
BH32	SE Gas mains	539031	180140
BH33	SE Gas mains	539042	179969
BH34	SE Gas mains	539057	179861
BH1A	SE Gas mains	539309	179742
BH2A	SE Gas mains	539339	179733
BH3A	SE Gas mains	539332	179710
BH4A	SE Gas mains	539362	179681
BH5A	SE Gas mains	539346	179663
BH6A	SE Gas mains	539389	179652
BH7A	SE Gas mains	539393	179636
BH8A	SE Gas mains	539302	179751

BH9A	SE Gas mains	539302	179738
BH10A	SE Gas mains	539321	179716
BH11A	SE Gas mains	539345	179686
BH12A	SE Gas mains	539220	179859
BH13A	SE Gas mains	539569	179881
BH14A	SE Gas mains	539741	179669
BH15A	SE Gas mains	539159	179783
BH16A	SE Gas mains	539510	179932
BH17A	SE Gas mains	539671	179750
BH18A	SE Gas mains	539436	179424
BH19A	SE Gas mains	539423	179434
BH20A	SE Gas mains	539384	179457
BH21A	SE Gas mains	539395	179474
BH22A	SE Gas mains	539499	179367
BH23A	SE Gas mains	539541	179891
BH24A	SE Gas mains	539549	179910
BH25A	SE Gas mains	539605	179838
B1.	BGS	539580	179800
B29	BGS	539611	179774
B29a	BGS	539620	179840
B29b	BGS	539670	179760
B29c	BGS	539730	179660
B29d	BGS	539180	179970
B2	BGS	539384	179634
B3	BGS	539810	179790
B4	BGS	539330	179610
B4a	BGS	539490	179910
B6	BGS	539646	179787
B7	BGS	539920	180260
B8	BGS	539900	180200
B9	BGS	539936	180402
B10	BGS	539904	180426
B11	BGS	539932	180410
B12	BGS	539946	180448
B13	BGS	539971	180463
B14	BGS	539987	180436
B14a	BGS	539850	180170
B14b	BGS	539870	180520
B14c	BGS	539910	180450
B14d	BGS	539788	180682
B16	BGS	539870	180230
B19	BGS	539946	180494
B19a	BGS	539871	180561
B21	BGS	539801	180630
B22	BGS	539990	180490
B23	BGS	539920	180450
B24	BGS	540150	180710
B25	BGS	540110	180710
B25a	BGS	540260	180740
B25b	BGS	540280	180740

APPENDIX 2: RESULTS OF THE FIELD-BASED BOREHOLE DESCRIPTIONS

Results of the field-based lithostratigraphic description of borehole NSBH01, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

Depth (m OD)	Depth (m BGS)	Composition
4.85 to -3.25	0 to 8.10	Made Ground
-3.25 to -4.80	8.10 to 9.65	Blue-grey silty clay (alluvium) with dark brown pockets of peat and including fragments of wood (interrupted recovery)
>-4.80	>9.65	Sands and gravels

Results of the field-based lithostratigraphic description of borehole NITBH02, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

Depth (m OD)	Depth (m BGS)	Composition
5.28 to -4.72	0 to 10+	Made Ground

Results of the field-based lithostratigraphic description of borehole NTBH01, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

Depth (m OD)	Depth (m BGS)	Composition
2.76 to 1.56	0 to 1.20	Made Ground
1.56 to -1.44	1.20 to 4.20	Blue-grey silty clay (alluvium) with occasional inclusions of waterlogged wood and Mollusca
-1.44 to -3.34	4.20 to 6.10	Dark brown; Well humified wood peat with occasional clay inclusions
-3.34 to 4.74	6.10 to *ca*. 7.50	Blue-grey silty clay (alluvium) with occasional inclusions of waterlogged wood
-4.74 to -5.84	*ca*. 7.50 to 8.60	Dark brown moderately humified peat with wood and herbaceous inclusions, becoming more sandy with depth
>-5.84	>8.60	Sands and gravels

Results of the field-based lithostratigraphic description of borehole SSBH03, London Cable Car London Boroughs of Newham and Greenwich (site code: CAB11)

Depth (m OD)	Depth (m BGS)	Composition
5.34 to 0.14	0 to 5.20	Contaminated Made Ground
0.14 to -0.86	5.20 to 6.20	Blue-grey silty clay (alluvium) with occasional inclusions of waterlogged wood and Mollusca.
-0.86 to -2.81	6.20 to 8.15	Reddish brown well humified wood peat with inclusions of silt and clay
>-2.81	>8.15	Sands and gravels