Prehistoric landscapes beneath the London Cable Car

Robert Batchelor, Christopher Green, Daniel Young, Philip Austin, Nigel Cameron and Scott Elias

Introduction and methods
Environmental archaeological investigations along the route of the London Cable Car (site code: CAB11) provided an opportunity to explore Holocene depositional environments and vegetation history on both sides of the river in this part of the Lower Thames Valley (Fig. 1). The Cable Car route spans Bugsby's Reach of the tidal River Thames between the North Greenwich 'peninsula' on the south bank and the Royal Victoria Dock on the north bank (National Grid References: from TQ 40111 80696 (north) to 39478 79745 (south)). Geotechnical investigations (including test pits and boreholes) were carried out in five main areas, as follows: North Station (NS); North Intermediate Tower (NIT); North Tower (NT); South Tower (ST), and South Station (SS) (Fig. 2).

The boreholes were monitored so that the sub-surface sediments could be mapped across the site, and significant sequences could be selected for detailed laboratory analysis. Two borehole core samples were retrieved from the North Tower (NT-BH03) and South Station (SS-BH1C) respectively. The sediment sequences were described in detail and sub-samples were extracted from organic-rich units for radiocarbon dating[1] (calibrated using OxCal v4.2 and the IntCal09 atmospheric curve).[2] Biostratigraphic remains (pollen, diatoms, seeds, wood and insects) were investigated in sub-samples from both boreholes using standard extraction and analysis procedures.[3]

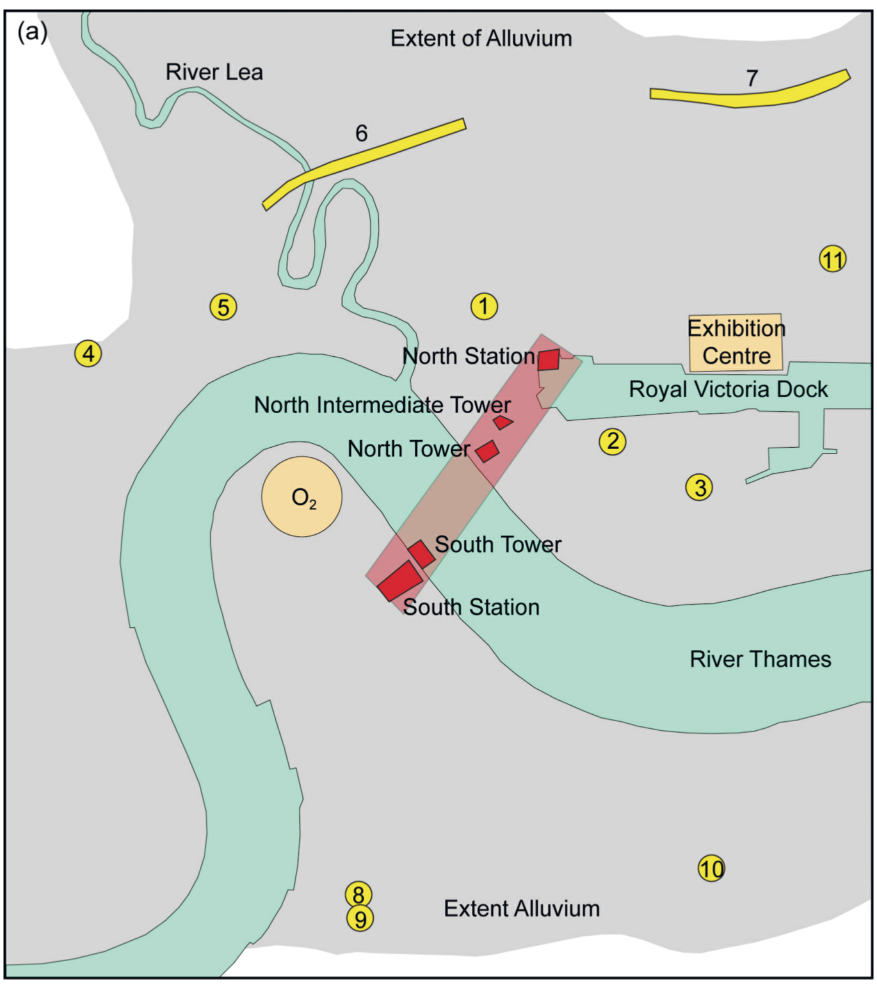


Fig. 1: location of the Cable Car route (North Station; North Intermediate Tower; North Tower; South Tower; South Station) and select other nearby sites of interest; (1) 118 Victoria Dock Road (fn. 13); (2) Silvertown (fn. 5); (3) Fort Street (fn. 8); (4) Preston Road (fn. 11); (5) East India Docks (Pepys' Diary, 22nd September 1665); (6) Canning Town (fn. 12); (7) Prince Regent Lane (fn. 12); (8) Bellot Street (fn. 9); (9) 72–88 Bellot Street (fn. 9); (10) Greenwich Industrial Estate (fn. 15)

Geology, sedimentary sequences and geochronology
On both the north and south bank of the river, the site is mapped by the British Geological Survey (BGS) as Alluvium overlain by Made Ground, and thus originally formed part of the natural floodplain of the Thames. Beneath the alluvium, up to *c.* 8m of sand and gravel (Shepperton Gravel) is recorded overlying London Clay.[4] The new sedimentary records along the route of the Cable Car largely confirm this general sequence, with Shepperton Gravel succeeded by various Holocene mineral- and organic-rich deposits (Fig. 3). However, in the area of the NIT, the sequence was entirely truncated during construction of the Western Dock Entrance. Here, records from the BGS borehole archive (NERC) have been used to reconstruct the sedimentary sequence.

The Shepperton Gravel, which was deposited within a high-energy braided river environment during the Late Devensian, has an undulating surface. At the SS on the south bank, this surface lies at around -3.0m OD; on the margins of the Thames at the ST, it falls to between *c.* -7.0 and -10.0m OD. On the opposite bank at the NT and NS, the Shepperton Gravel surface lies between *c.* -5.0 and -7.5m OD. However, in the

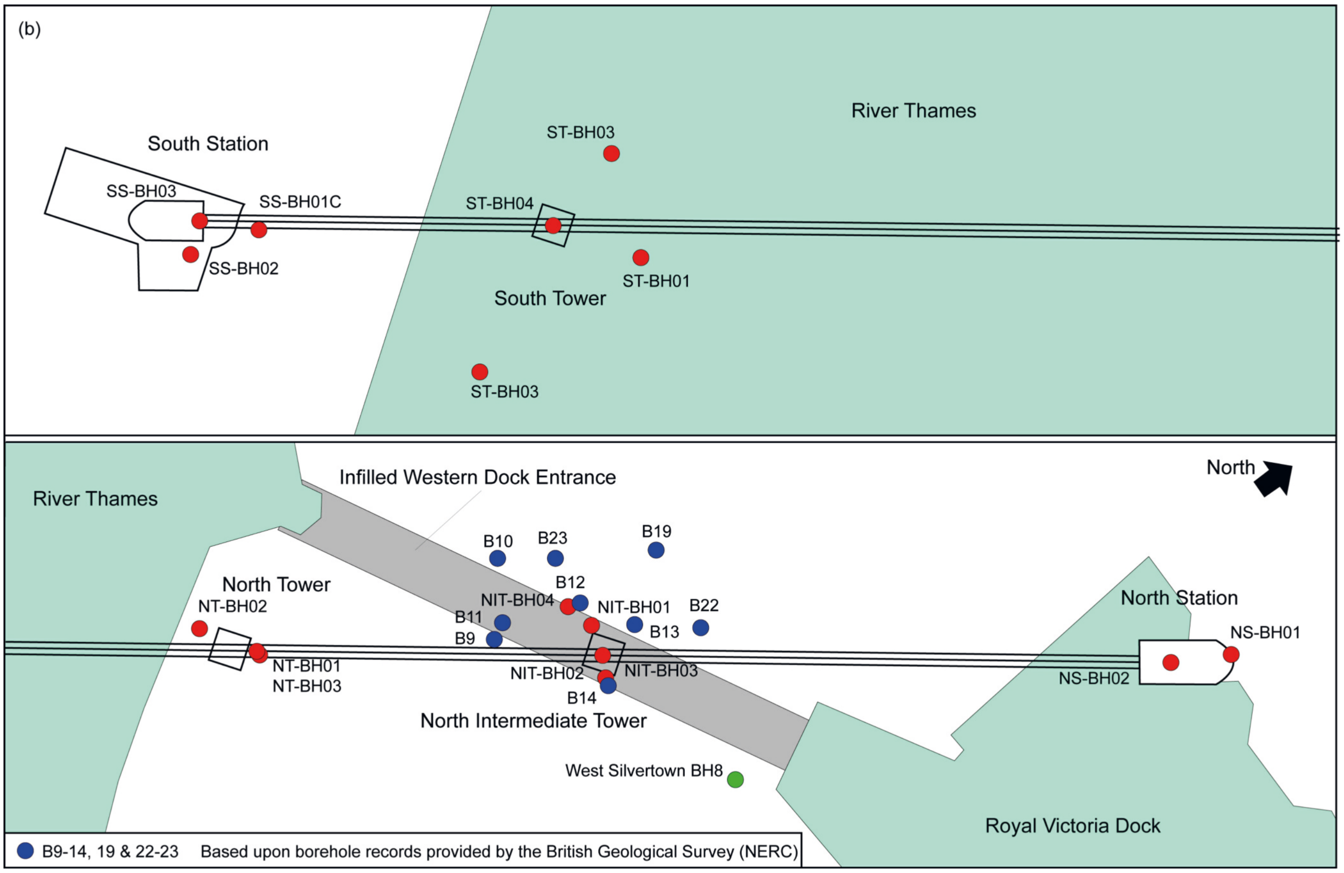


Fig. 2: location of boreholes at the North Station; North Intermediate Tower; North Tower; South Tower and South Station

area of the NIT a small number of sequences and boreholes from the adjacent site of West Silvertown[5] (Fig. 1, no. 2) indicate a higher gravel surface, between -3.3 and -1.6m OD. 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 Early Mesolithic), the surface of the Shepperton Gravel forming the valley floor of the River Thames was characterised by gravel bars aligned approximately parallel with the valley axis and separated by low-water channels. The gravel bars are significant archaeologically as they represent elevated points on the floodplain (eyots) where prehistoric activity may have taken place. The high points on the gravel surface at the Cable Car NIT site are not as high as those upstream on the Bermondsey and Horseleydown eyots in Southwark[6] (*c.* +1m OD) or those downstream in the area beneath the Royal Docks Community School[7] (*c.* +0.5m OD; Fig. 1, no. 11), where archaeological evidence for Mesolithic and Bronze Age activity has been recorded, probably indicative of seasonal exploitation. However, the gravel surface at Cable Car NIT site might have been located towards the margins of an eyot.

The borehole records on both the south and north bank indicate that a variable sequence of mineral- and organic-rich deposits, including peat, overlie the Shepperton Gravel. The mineral-rich sediments are generally fine-grained, representing the deposition of alluvium from standing or slow-moving water. In some places, e.g. towards the base of NT-BH03 (Fig. 4), this alluvium contained varying quantities of organic detritus resulting from either long-distance transportation or *in situ* deposition from plants growing in, or on the margins of, an open water-body. Periods of peat formation are representative of the development of a semi-terrestrial land-surface, most likely occupied by fen vegetation; while varying organic matter content values during peat formation indicate a dynamic landscape subject to frequent episodes of flooding. These semi-terrestrial land-surfaces have archaeological significance, representing areas that might have been used by human groups; for example, Neolithic and Bronze Age trackway structures have been recorded in the peat at Fort Street[8] (Fig. 1, no. 3) and Bellot Street[9] (Fig. 1, nos. 8 & 9). However, all the stratigraphic changes recorded in the sedimentary sequences represent evidence of significant spatial and temporal changes in the floodplain landscape, all of which would have impacted upon the potential activities of prehistoric people.

Sedimentation generally began in areas with a lower Shepperton Gravel surface, and migrated upwards and outwards. Thus, the earliest recorded Holocene sediment is in borehole NT-BH03 where accumulation began before 8000 cal BC (8800-8560 cal BC; Early Mesolithic) at a level slightly above -5.68m OD, and began later (sometime between 3940 and 3340 cal BC; Neolithic) in borehole SS-BH1C at the higher level of -3.01m OD. However, there are considerable local variations in the date and level at which Holocene sediment began to accumulate; for example in the nearby West Silvertown BH8[10] (Fig. 1, no. 2; Fig. 3), accumulation began around 10,570-9820 cal BC at an elevation of -2.5m OD.

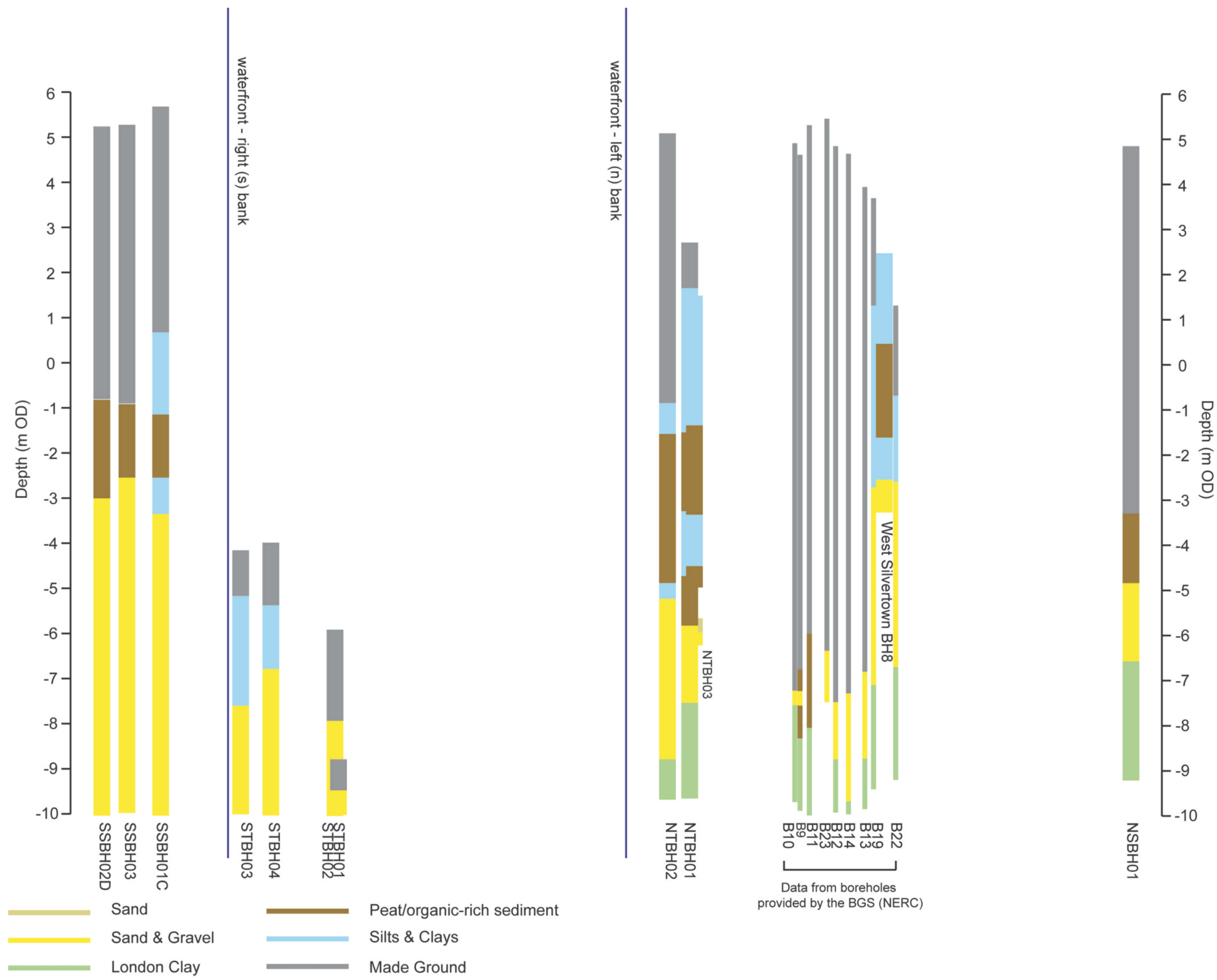


Fig. 3: transect of selected sedimentary logs across the Cable Car route

In borehole NT-BH03, two phases of peat formation took place; the first was short-lived, spanning 4900-4720 to 4830-4620 cal BC (Late Mesolithic), the second was longer spanning from 4340-4080 to 1110-920 cal BC (Early Neolithic to Late Bronze Age). This latter period of peat accumulation is comparable with SS-BH1C and other sites nearby such as Preston Road,[11] Canning Town,[12] 118 Victoria Dock Road,[13] Prince Regent Lane[14] and Greenwich Industrial Estate[15] (Fig. 1, nos 4, 6, 7 & 10).

Overlying the peat in all sequences (where not truncated) was another unit of alluvium, consisting of 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.

Biostratigraphy

The majority of both NT-BH03 and SS-BH1C contained a high concentration of sub-fossil remains in a good state of preservation. These data, together with the sedimentary and geochronological records have permitted reconstruction of the environmental history (Figs 5 & 6) which is comparable to other investigations from this part of the Lower Thames Valley.

Mesolithic

Reconstruction of the environmental history during the Mesolithic is based on the record from NT-BH03 only, as sedimentation did not commence until the Neolithic in SS-BH1C. The results indicate three significant changes in vegetation during this time (NT1-NT3; Fig. 5). During NT1 (Early Mesolithic), sedge (Cyperaceae) and reed (Poaceae) swamp occupied the wetland area with lesser quantities of other herbaceous/aquatic plants (e.g. *Ranunculus* and *Sparganium*). Willow (*Salix*) increased over this period, followed by alder (*Alnus*) indicating their colonisation within the wetland habitat. Pine (*Pinus*) and birch (*Betula*) occupied the surrounding dryland forming woodland typical of cold climatic conditions. This was later invaded by oak (*Quercus*), lime (*Tilia*), elm (*Ulmus*), ash (*Fraxinus*) and hazel (*Corylus*) reflective of a transition towards warmer conditions.

The transition to NT2 is characterised by a large expansion of pine woodland, reaching its peak sometime before 4900-4720 cal BC (Middle-Late Mesolithic). Oak, hazel, elm, lime and ash rapidly expanded within this pine woodland to form a mixed deciduous-coniferous community that continued until 4340-4080 cal BC (Late Mesolithic). This new forest ecosystem developed on the dryland all along the Lower Thames Valley, forming excellent areas for human occupation during the Mesolithic/Neolithic cultural periods, with rich plant and animal resources, including hazel nuts and acorns, and probably *Cervus elaphus* (red deer) and *Bos primigenius* (aurochs).[16]

During this period (NT2) peat temporarily formed on the wetland in the area of NT-BH03 and was colonised by sedge and reed swamp, and alder-willow carr woodland. After 4830-4620 cal BC (during NT3) this peat surface was flooded; the combined occurrence of herbs such as thrift (*Armeria maritima* types A & B) and Chenopodiaceae (e.g. *Suaeda maritima* – annual seablite) together with high numbers of polyhalobous and mesohalobous diatom taxa, suggest an estuarine influence during this period of inundation. Alder carr continued to expand on the wetland during this time, perhaps on the margins of the river and in back swamps.

Palaeoenvironmental reconstructions in the Lower Thames Valley during the Mesolithic are fairly rare when compared to those from later

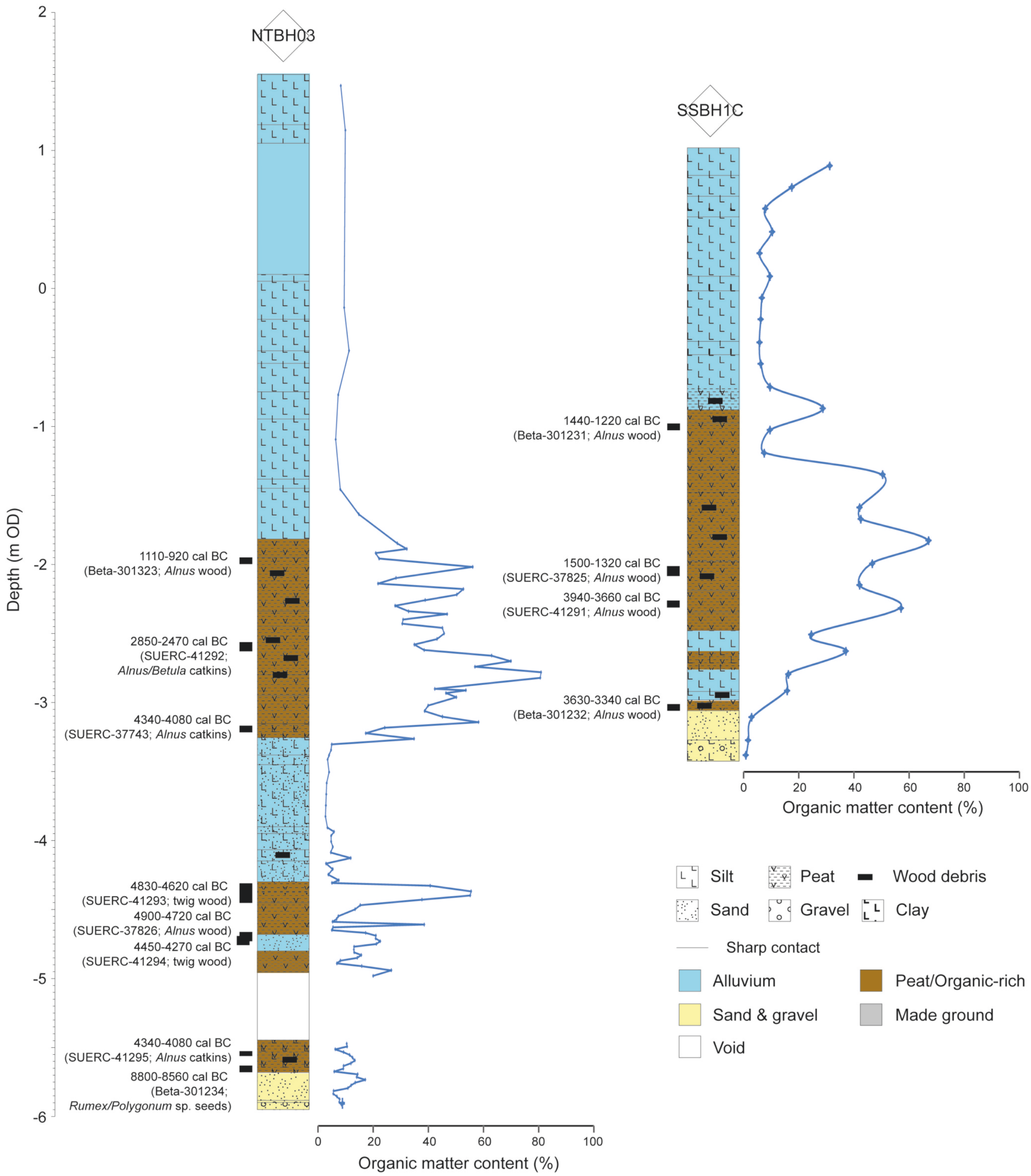


Fig. 4: North Tower and South Station detailed sedimentary records and radiocarbon dates

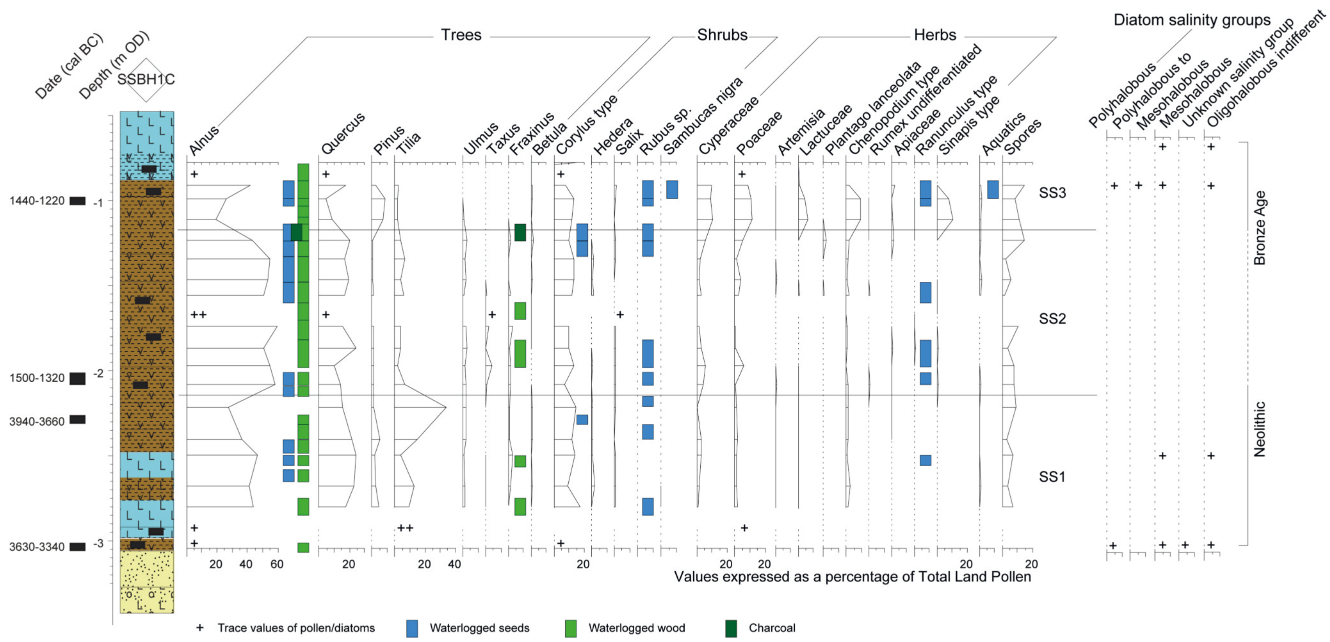


Fig. 5: South Station summary biostratigraphic diagram

cultural periods. This is due to the limited number of sites that accumulated alluvial/peat sediments over this time. The record from NT-BH03 is broadly consistent with these few records, but there are some significant differences in the chronology; most notably that of the peak in pine which is approximately 4000 years later than the Early Holocene age recorded at West Silvertown (between 10,570-9820 and 8810-8350 cal BC) and other sites such as Bramcote Green.[17]

Neolithic

Reconstruction of the environmental history during the Neolithic comprises data from both NT-BH03 (NT4) and SS-BH1C (SS1 & SS2). In both sequences, this equates to the main period of peat accumulation which commenced from *c.* 4500 cal BC. During this cultural period, evidence from these two boreholes indicates that alder-dominated fen carr occupied the peat surface, whilst mixed deciduous woodland grew on the dryland. However, this period does feature three important changes in vegetation: (1) the decline of elm, (2) the colonisation and decline of yew (*Taxus*), and (3) an expansion of lime.

The elm decline

The NT-BH03 record indicates a decline in elm woodland on the dryland from *c.* 4340-4080 cal BC. This decline, which is well-documented across the British Isles between *c.* 4400 and 3350 cal BC,[18] was arguably the most significant change in woodland composition and structure around this time.

Causal hypotheses for the decline have included climate change to cooler conditions,[19] soil deterioration,[20] competitive exclusion,[21] and more frequently, human interference with natural vegetation,[22] anddisease.[23] The argument for a human-induced decline centres on the fact that the decline occurs around the transition from the Mesolithic to Neolithic and is often accompanied by pollen and/or insect evidence of temporary clearance for cultivation or animal husbandry.[24] The alternative argument for a disease-caused decline originates from the discovery of the bark beetle *Scolytus scolytus* (which carries the fungus *Ophiostoma* (*Ceratocystis*) *ulmi* that causes Dutch elm disease in modern populations) at or near to a decline in elm pollen in a small number of records.[25] However, on the basis that any single hypothesis is unlikely to explain the widespread and catastrophic nature of the decline, it seems likely that the Neolithic elm decline was caused by the interaction of multiple factors, and that the relative significance of each factor varied from site to site.[26]

In borehole NT-BH03, the timing of the elm decline coincides with the onset of peat formation. This suggests that environmental changes taking place on the floodplain and the expansion of fen carr woodland negatively impacted upon elm populations. A recent study suggests that this process was one of the more common influences on early Neolithic elm populations in the Lower Thames Valley.[27] However, it is not anticipated that this process operated in isolation, but that evidence of other factors (e.g. human activity) is masked as a consequence of the site's location towards the centre of the floodplain.

The colonisation and decline of yew

The pollen-stratigraphic records indicate that yew colonised the alder-dominated fen carr on the peat surface shortly after the decline of elm. Pollen values are low and no waterlogged wood was recorded, but several other sites have demonstrated the growth of this woodland community during the Neolithic along the Lower Thames Valley.[28] The growth of yew on floodplain peat during the Neolithic is of palaeoecological interest since the modern day ecology of yew indicates a preference for dry and basic conditions such as chalk downland and limestone geology.[29] Furthermore, the growth of yew may have had cultural significance, since its use in prehistory

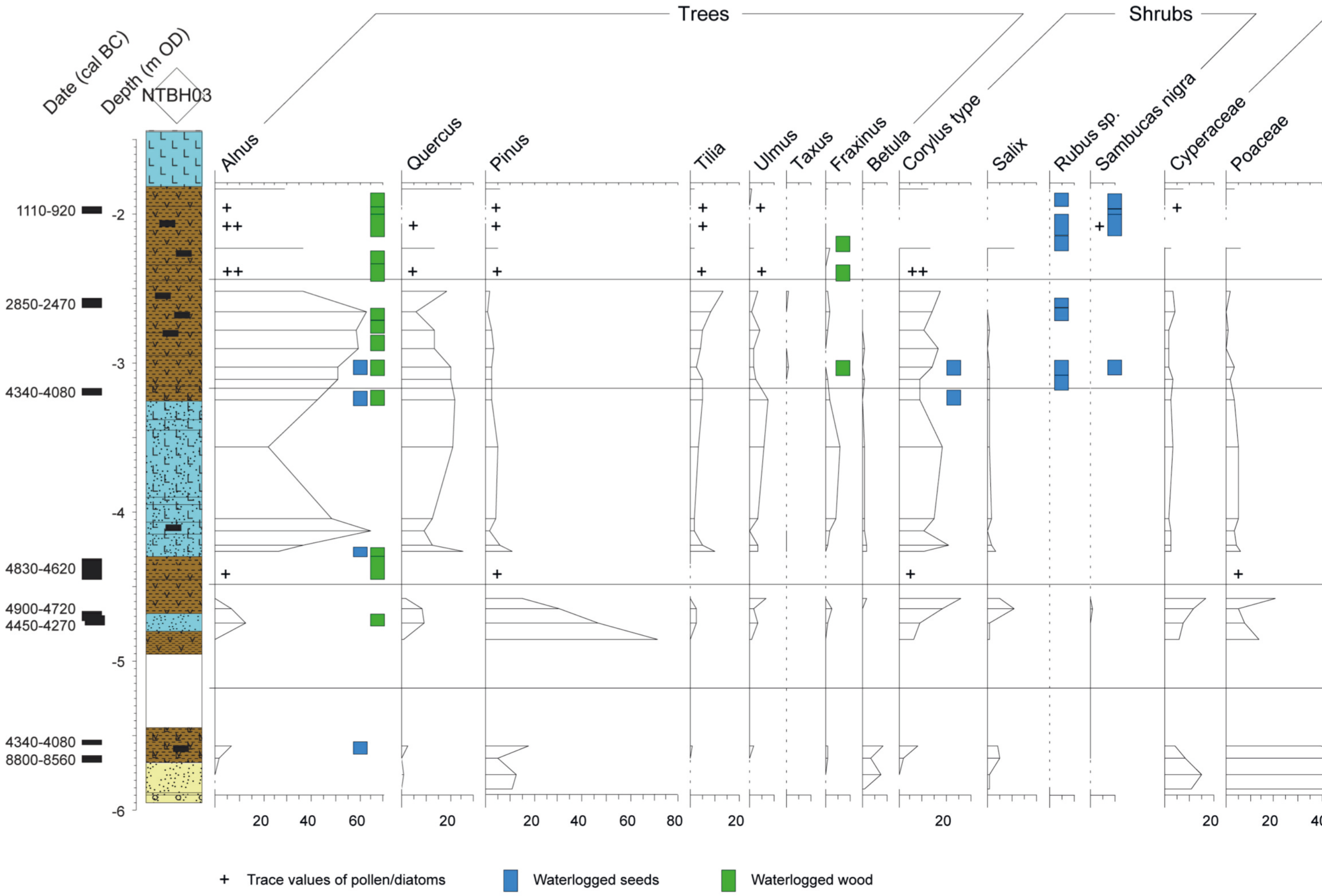


Fig. 6: North Tower summary biostratigraphic diagram

for the construction of weapons (e.g. the Neolithic yew bow), tools, trackways, platforms and boats is well-documented.[30]

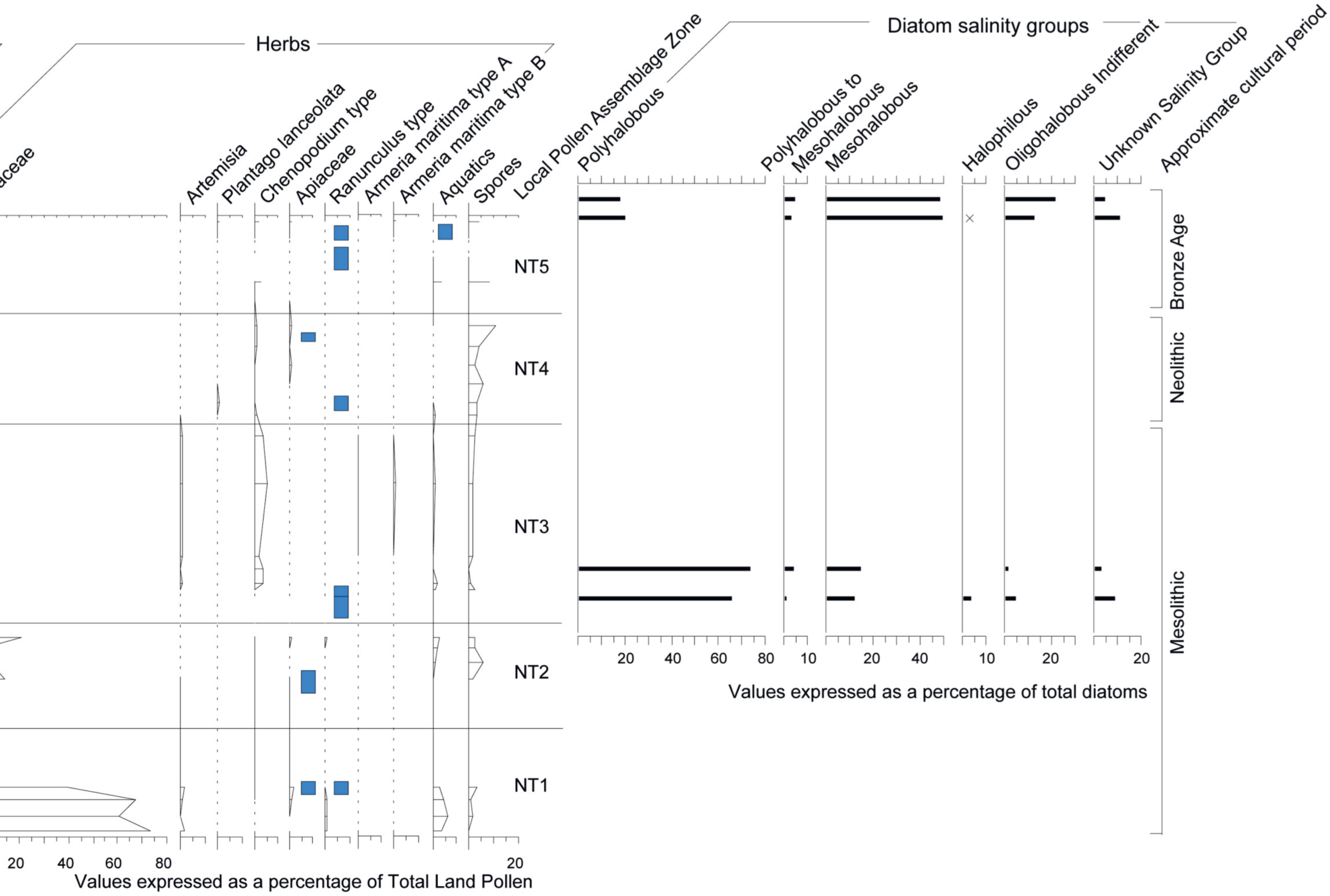
Recent investigations[31] indicate that yew colonised and declined from the peat surface during the Late Neolithic (this well-established sequence is another reason why radiocarbon date SUERC-41291 in SS-BH1C is considered to be incorrect). These same investigations indicate that a dry peat surface was almost certainly required to enable the growth of yew, although more favourable climatic conditions and human disturbance may also have had an influence. The decline of yew is most often related to wetter peat surface conditions, consequent of rising relative sea level. It is also considered likely that human activity had a far greater influence on the decline of yew, than on its expansion; it is notable that the decline occurs at the transition from the Neolithic to the Bronze Age. A return towards a more continental climate may also have contributed to the yew decline from the wetland. Both new records from the Cable Car support the developing model. The initial expansion of yew occurred at a time when the other lithostratigraphic and bioarchaeological records indicate drier surface conditions, and a more mature fen woodland community. Similarly, a decline in organic matter content contemporaneous with the fall in *Taxus* pollen values suggests increased inundation may have led to the disappearance of yew from the peat surface. There are no indicators to suggest that human activity caused the decline of yew at either site.

The expansion of lime

An unusual feature of both the new pollen-stratigraphic diagrams is the increase of *Tilia* (lime) percentage values towards the top of NT4 (2850-2470 cal BC) and SS1 (3940-3660 cal BC). Unlike most arboreal taxa, lime is insect-pollinated, so the pollen does not travel far from source. Therefore the high concentrations of lime pollen suggest that it was growing nearby on areas of dryland at these times.

Bronze Age

It is difficult to establish the precise environmental history during the Bronze Age, due to a combination of poor pollen concentration and chronological uncertainties. However, in both boreholes alder-dominated fen carr began to decline from the wetland, and in borehole SS-BH1C was replaced by vegetation indicative of wetter conditions and estuarine inundation. The transition to these conditions is also marked by a decrease in dryland woodland pollen taxa (e.g. *Quercus* and *Tilia*) and the occurrence of an array of herbaceous pollen taxa, probably (at least in part) indicative of Bronze Age land clearance for



settlement and/or farming purposes. The occurrence of alder and ash charcoal at the boundary into SS3 may also indicate an anthropogenic influence on the peat surface sometime before 1440-1220 cal BC. Definitive archaeological evidence for human activity on the peat surface during the Bronze Age is also recorded at a number of local sites in the form of wooden trackways.

The contemporaneous decline of woodland on both the wetland and dryland is striking and suggests a strong link between the two environments and with possible causes. Indeed, it is considered probable that the increased rate of relative sea level (RSL) rise that brought about environmental change on the floodplain, also contributed to the decline of mixed deciduous woodland on the dryland in two different ways. Firstly, RSL rise may have caused the expansion of wetland onto areas of former dryland, and/or the saturation of dryland soils. This would have caused the retreat of dryland woodland away from the sampling point. Secondly, the wetter conditions and estuarine inundation that caused the eventual abandonment of the wetland by Bronze Age people, most likely led to the concentration of anthropogenic activity (and thus clearance) on the neighbouring dryland edge. There seems little doubt that these RSL-driven processes could have influenced the rate of woodland decline on the dryland; however, the precise temporal and spatial relationships between RSL change, soil deterioration, human activity and dryland woodland decline remain very difficult to measure.

Conclusions

The investigations along the Cable Car route have revealed variation in the thickness of alluvial and peat deposits overlying an undulating gravel surface. However at both sample locations fine- and coarse-grained mineral-rich deposits and peat are recorded overlying sands and gravel (Shepperton Gravel). Transitions within this sequence of units represent significant changes in landscape from alluvial/estuarine to semi-terrestrial environments. Collectively, the sedimentary sequences from the two core sequences analysed represent deposition between the Early Mesolithic and Bronze Age cultural periods. During this time, the biostratigraphic records indicate the transition from birch and pine woodland growing under cool climatic conditions to the growth of mixed deciduous woodland on the dryland and alder fen carr on the floodplain during the later Mesolithic and Neolithic, before a decline of woodland during the Bronze Age in response to relative sea level change and woodland clearance for settlement and agricultural purposes.

Acknowledgements
The authors wish to acknowledge the kind assistance of Mace Ltd (clients), Annie Calder of URS Scott Wilson and Josh Williams at Mott MacDonald (archaeological consultants at different stages during the project), and Melissa Melikian and Paul Mason at AOC Archaeology (archaeological contractors).

Dr Rob Batchelor BSc PhD is Director, geoarchaeologist and pollen analyst of Quaternary Scientific (QUEST) at the University of Reading.
Dr Christopher Green BA is senior geoarchaeologist of Quaternary Scientific (QUEST) at the University of Reading. Daniel Young BSc MSc is projects manager and plant macrofossil specialist of Quaternary Scientific (QUEST) at the University of Reading.

Philip Austin BSc is an archaeobotanist specialising in wood and wood charcoal analysis. Dr Nigel Cameron BSc MSc PhD is Honorary Senior Research Fellow specialising in diatom analysis at the Environmental Change Research Centre, University College London. Professor Scott Elias PhD is Professor of Quaternary Science and Coleopteran specialist at Royal Holloway, University of London.

1. A note on the radiocarbon chronology: radiocarbon dates SUERC-41294 and 41295 (Fig. 3) are problematic, possibly resulting from difficulties in coring the lower horizons of borehole NT-BH03 where there was incomplete recovery between -4.95 and -5.45m OD. There are also chronological inconsistencies in the SS-BH1C sequence; in this case SUERC-37825 is considered incorrect, whilst it is unclear whether SUERC-41291 or Beta-301232 is the more reliable date from the base of the sequence.

2. C. Bronk Ramsey 'Radiocarbon calibration and analysis of stratigraphy: the OxCal program' *Radiocarbon* **37** (1995) 425–30; C. Bronk Ramsey 'Development of the radiocarbon program Oxcal' *Radiocarbon* **43** (2001) 355–63; P.J. Reimer, M.G.L. Baillie, E. Bard, A. Bayliss, J.W. Beck, P.G. Blackwell, C. Bronk Ramsey, C.E. Buck, G.S. Burr, R.L. Edwards, M. Friedrich, P.M. Grootes, T.P. Guilderson, I. Hajdas, T.J. Heaton, A.G. Hogg, K.A. Hughen, K.F. Kaiser, B. Kromer, F.G. McCormac, S.W. Manning, R.W. Reimer, D.A. Richards, J.R. Southon, S. Talamo, C.S.M. Turney, J. van der Plicht, & C.E. Weyhenmeyer (2009) 'IntCal09 and Marine09 radiocarbon age calibration curves, 0–50,000 years cal BP' *Radiocarbon* **51** (2009) 1111–50.

3. P.D. Moore, J.A. Webb & M.E. Collinson '*Pollen Analysis'* (2nd edn, 1991); B.E. Berglund '*Handbook of Holocene palaeoecology and palaeohydrology'* (1986); R.W. Battarbee, V.J. Jones, R.J. Flower, N.G. Cameron, H.B. Bennion, L. Carvalho & S. Juggins 'Diatoms' in J.P. Smol & H.J.B. Birks (eds), *Tracking Environmental Change Using Lake Sediments Volume 3: Terrestrial, Algal, and Siliceous Indicators* (2001); J.G. Hather *The Identification of the Northern European Woods: A Guide for archaeologists and conservators* (2000); R.T.J. Cappers, R.M. Bekker and J.E.A. Jans '*Digital Seed Atlas of the Netherlands*' (2006).

4. P.L. Gibbard '*Pleistocene History of the Lower Thames Valley'* (1994).

5. K.N. Wilkinson, R.J. Scaife & E.J. Sidell 'Environmental and sea-level changes in London from 10,500 BP to the present: a case study from Silvertown' *Proc Geol Assoc* **111** (2000) 41–54.

6. E.J. Sidell, J. Cotton, L. Rayner & L. Wheeler *The prehistory and topography of Southwark and Lambeth.* MoLAS Monogr **14** (2002); J. Leary, N. Branch & L. Rayner 'Prehistoric Southwark: Neolithic, Bronze Age and Iron Age activity on Horselydown Eyot' *London Archaeol* **13** (2011) 31–5.

7. N. Holder '*An Archaeological Excavation Assessment and Updated Project Design for Royal Docks Community School Site, Prince Regent Lane, Newham'* MoLAS unpublished report (1998).

8. Wessex Archaeology '*Fort Street (West) Silvertown, London, E16, Archaeological excavation assessment report'* Wessex Archaeology unpublished report (2000).

9. G. McLean '*An outline report on an archaeological evaluation at the land at the rear of 72-88 Bellot Street Greenwich London SE10'* SELAU unpublished report (1993); B. Philp '*An Outline Report on an Archaeological Evaluation Excavation at the Land at the Rear of 72-88 Bellot Street, Greenwich, London SE10*' SELAU unpublished report (1993); N. Hawkins '*Bellot Street, London SE10, London Borough of Greenwich: Evaluation*' Pre-Construct Archaeology unpublished report (2005).

10. *Op cit* fn 5.

11 N.P. Branch, C.R. Batchelor, S. Elias, C.P. Green & G.E. Swindle '*Preston Road, Poplar High Street, Poplar, London Borough of Hamlets (site code: PPP06): environmental archaeological analysis'* ArchaeoScape unpublished report (2007).

12. E. Stafford, D. Goodburn and M. Bates '*Landscape and Prehistory of the East London Wetlands. Investigations along the A13 DBFO Roadscheme, Tower Hamlets, Newham and Barking and Dagenham, 2000-2003'* Oxford Archaeology Monogr **17** (2012).

13. C. Barnett, M.J. Allen, G. Evans, J.M. Grimm, R. Scaife, C.J. Stevens & S.F. Wyles 'A submerged forest with evidence of Early Neolithic burning activity and the Tilbury alluvial sequence at Canning Town, East London' *Trans London Middlesex Archaeol Soc* **61** (2011) 1–15.

14. *Op cit* fn 12.

15. M. Morley '*Greenwich Industrial Estate, Bugsby's Way, Charlton, London SE7, a Geoarchaeological Investigation'* MoLAS unpublished report (2003).

16. C. Thomas & D.J. Rackham 'Bramcote Green, Bermondsey: a Bronze Age trackway and palaeoenvironmental assessment' *Proc Prehistoric Soc* **61** (1996) 221–53; *op cit* fn 11, Sidell *et al*.

17. *Op cit* fn 16, Thomas and Rackham.

18. A.G. Parker, A.S. Goudie, D.E. Anderson, M.A. Robinson & C. Bonsall 'A review of the mid-Holocene elm decline in the British Isles' *Prog Physical Geog* **26** (2002) 1–45.

19. A.G. Smith 'The Neolithic' in I.G. Simmonds & M.J. Tooley (eds) *The environment in British prehistory* (1981) 00–00.

20. S.M. Peglar & H.J.B. Birks 'The mid-Holocene Ulmus fall at Diss Mere, south-east England – disease and human impact?' *Veg History & Archaeobot* **2** (1993) 61–8.

21. B. Huntley & H.J.B Birks '*An atlas of past and present pollen maps of Europe: 0-13,000 years ago'* (1983).

22. R.G. Scaife 'The elm decline in the pollen record of South-east England and its relationship to early agriculture' in M. Jones (ed) *Archaeology and the flora of the British Isles* (1988) 00–00; H. Lamb & A. Thompson 'Unusual mid-Holocene abundance of *Ulmus* in western Ireland – human impact in the absence of a pathogen?' *The Holocene* **15** (2005) 447–52.

23. I. Perry and P.D. Moore 'Dutch elm disease as an analogue of Neolithic elm decline' *Nature* **326** (1987) 72–3; M.A. Girling & J. Grieg 'A first fossil record for *Scolytus scolytus* (F.) (elm bark beetle): its occurrence in elm decline deposits from London and implications for Neolithic elm disease' *Journ Arch Sci* **12** (1985) 347–51.

24. *Op cit* fn 23, Girling and Greig; *op cit* fn 22, Scaife.

25. *Op cit* fn 23, Girling and Greig; M.A. Girling 'The bark beetle *Scolytus scolytus* (Fabricius) and the possible role of elm disease in the early Neolithic' in M. Jones (ed) *Archaeology and the Flora of the British Isles* (1988) 34–8; C.R. Batchelor, N.P. Branch, E. Allison, P.A. Austin, B. Bishop, A. Brown, S.E. Elias, C.P. Green and D.S. Young 'The timing and causes of the Neolithic elm decline: New evidence from the Lower Thames Valley (London, UK)' *Env Archaeol* **19** (2014) 263–90.

26. *Op cit* fn 18; *op cit* 25, Batchelor *et al*.

27. *Op cit* fn 25, Batchelor *et al*.

28. S.P.S. Seel '*Late Prehistoric woodlands and wood use on the Lower Thames floodplain'* unpublished PhD thesis (2002); N.P. Branch, C.R. Batchelor, N.G. Cameron, G.R. Coope, R. Densem, R. Gale, C.P. Green and A.N. Williams 'Holocene environmental changes in the Lower Thames Valley, London, UK: implications for our understanding of the history of *Taxus* (L.) woodland' *The Holocene* **22** (2012) 1143–58.

29. P.A. Thomas & A. Polwart 'Taxus baccata L.' *J Ecology* **91** (2003) 489–524.

30. J.G.D. Clark 'Neolithic bows from Somerset, England, and the prehistory of archery in north-western Europe' *Proc Prehist Soc* **29** (1963) 50–98; J.M. Coles & F.A. Hibbert 'Prehistoric roads and tracks in Somerset, England: 1. Neolithic' *Proc Prehist Soc* **34** (1968) 238–58; J.M. Coles, S.V.E. Heal & B.J. Orme 'The use and character of wood in prehistoric Britain and Ireland' *Proc Prehist Soc* **44** (1978) 1–45; A. Sheridan 'Dating Scotland's past: The national museums of Scotland C14 dating programmes' *The Archaeol* **56** (2005) 38–9; E.V. Wright & D.M. Churchill 'The Boats from North Ferriby, Yorkshire, England, with a review of the origins of the sewn boats of the Bronze Age' *Proc Prehist Soc* **31** (1965) 1–24; E.V. Wright, R.E.M. Hedges, A. Bayliss & R. Van de Noort 'New AMS radiocarbon dates for the North Ferriby boats - a contribution to dating prehistoric seafaring in northwestern Europe' *Antiquity* **75** 726–34 (2001).

31. C.R. Batchelor '*Middle Holocene environmental changes and the history of yew (Taxus baccata L.) woodland in the Lower Thames Valley'* unpublished PhD thesis (2009); *op cit* fn 28, Branch *et al*.