Foreshore-based Archaeological Evaluation report

Site 14: Heathwall Pumping Station (HEAPS)

TTP14

Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

Thames Tideway Tunnel

Foreshore-based Archaeological Evaluation Report Heathwall Pumping Station (HEAPS)

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Thames Tideway Tunnel

Foreshore-based Archaeological Evaluation Report Heathwall Pumping station (HEAPS)

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Executive summary

EX 1.1 This report was commissioned from Wessex Archaeology by Atkins on behalf of Thames Tideway Tunnel Ltd. It presents the results of a foreshore-based archaeological evaluation carried out by Wessex Archaeology at Heathwall Pumping Station, a Thames Tideway Tunnel project site.

EX 1.2 The evaluation included: parametric sonar (PS) survey, targeted walkover survey, geoarchaeological and palaeoenvironmental assessment of vibrocores, as well as radiocarbon dating of sub-samples taken during this evaluation, and the production of a foreshore deposit model. The report also takes account of data from previous investigations on the Site and its surroundings, including the results of gap analysis on bathymetric survey data (Wessex Archaeology 2013); geotechnical and historic borehole data (Appendix A.4); and information and drawings collated for the Environmental Statement (TTT 2013).

EX 1.3 The PS survey identified a depth of deposits (>0.5m) overlying the London Clay across most of the foreshore, although the survey alone was not able to identify the nature of these deposits. No specific sub-riverbed geophysical features of possible archaeological interest were identified within the Site, although disturbance and scour from outfall pipes was seen in this data and the bathymetric data in the north-east of the Site.

EX 1.4 The targeted walkover survey was successful in recording a number of *in situ* remains on the foreshore, including a double alignment of timber posts known from a previous foreshore survey to be an Early Saxon fish trap, the south-west end of which extends into the eastern foreshore of the Site. A patch of exposed peat, too thin to be sampled, and an undated timber were surveyed near the low water mark in the west of the Site. Post-medieval remains were also recorded including square-cut timbers of a jetty (since removed), part of a barge bed, and parts of two large millstones.

EX 1.5 The targeted walkover survey also retrieved a relatively small number of unstratified finds (66) of which all the dateable finds were mostly of post-medieval date, with the exception of a Romano-British tile fragment and a prehistoric flint core. This largely fits with the known artefacts previously recorded from the vicinity of the Site from the Greater London Historic Environment Record.

EX 1.6 Three vibrocores taken from centre of the intertidal zone were described and interpreted. Two vibrocores penetrated below the surface active beach deposits comprising episodes of varying energy and recorded an underlying deposit of redeposited chalk, interpreted as a probable barge bed. Underlying alluvium was recorded with a thin deposit of peat below this at *c*. 97.2m to 97.1m ATD. It is not certain if the full thickness of the peat was recorded in the cores as they were terminated at this depth, or if this apparently thin deposit is the surface of a thicker peat deposit, as displayed in boreholes records to the immediate west of the Site.

EX 1.7 Using available borehole data (Appendix A.4), a geoarchaeological deposit model has been prepared for the Site, and this has shown that the deposit sequence is variable across the foreshore Site. In the north-east (below the present river) the deposit sequence is limited to less than one metre of river gravels overlying London Clay, presumably as a result of erosion and/or dredging, which has removed the all of the previously overlying deposits; whilst across most of the inter-tidal area the sequence is predicted to be in the region of 4–5 metres in thickness. In this area, the deposit sequence comprises recent active beach deposits up to *c.*1.0m thick, overlying Holocene alluvium up to *c*.1.6m thick, overlying prehistoric organic deposits at least 0.11m thick (present in the centre and west of the Site only), above rivers gravels up to c.2m thick, above London Clay geology.

EX 1.8 Four landscape zones are predicted across the Site's foreshore (LZ1, LZ2, LZ3 and LZ4 see **Table 5.5**). Below the surface active beach deposits (LZ1), alluvium has been identified across a large area of the foreshore (LZ2), below this are organic deposits (LZ3) mapped only across the western and central foreshore, above river gravels (LZ4) present across most of the Site (**Figure 5**).

EX 1.9 Also of note is a depression seen in the modelling of the river gravels surface in the east of the Site (**Figure 7**). This is considered to be an inlet or probable minor tributary. This interpretation is consistent with recent geoarchaeological investigations in the surroundings that also suggested the presence of such channels (Branch et al 2010; Morley 2010). The alluvium on the upper foreshore, although of uncertain Holocene date, is likely related to this former channel.

EX 1.10 This evaluation has confirmed the presence of a previously known Early Saxon fish trap structure, which partly extends into the east of the Site, and recorded further remains that appear to have been exposed since the original survey in 2010. This suggests that more timbers of this highly significant structure could be buried below the foreshore surface. Additionally, the recording and radiocarbon dating of a Late Mesolithic peat surviving in the vibrocores, as well as a probable similarly dated exposed patch on the western foreshore surface is significant and suggests that further such remains are likely to survive, although perhaps limited in extent. Furthermore, these deposits could contain remains relating to prehistoric dry-land occupation/activity and information associate with environmental change. Although the buried alluvial sequence was not physically encountered during this evaluation and the precise date of the deposits is therefore uncertain, it is possible that the alluvium could contain buried remains (including organic preservation) dating between the prehistoric to medieval periods.

EX 1.11 Based on the foreshore evaluation results, the initial assessment of the archaeological potential of the Site set out in the Environmental Statement can be revised. The evaluation concludes that the Site has an overall **Moderate to High** potential for the survival of archaeological remains, and that these are likely to be of **Medium to High** significance to the identified research aims (OAWSI section 4).

EX 1.12 It is recommended that targeted archaeological survey, investigation and recording, including environmental sampling (advised by a geoarchaeologist), be undertaken within the area of the foreshore ground works.

EX 1.13 This evaluation has shown the potential significance of the Site to contribute towards the Route-wide Heritage Themes (RWHTs); and the themes which this Site has the potential to augment have been revised in the light of this evaluation. The nature of future interpretation is largely dependent on the results of future mitigation, although is perhaps likely to focus on evidence of Saxon exploitation of the Thames (in the form of fisheries).

1 Introduction

1.1 Purpose of this report

1.1.1 The purpose of this evaluation report for the Heathwall Pumping Station (HEAPS) Site is to:

a. Describe and assess the results of a foreshore-based evaluation, which included: parametric sonar survey, targeted walkover survey, and geoarchaeological and palaeoenvironmental assessment of vibrocores.

b. To provide information on the character, extent, quality, date, preservation and significance of archaeological deposits surviving at the Site likely to be affected by the TTT project through assessment of results of the above, and production of a foreshore deposit model.

c. To provide conclusions regarding predicted archaeological survival and significance across the Site.

d. To assess the significance of the evaluation results within the wider local and regional context and TTT Archaeological Research Framework.

e. To outline potentially suitable mitigation options.

1.1.2 The above is in accordance with the Site Specific Archaeological Written Scheme of Investigation (SSAWSI; ref. 100-RG-ENV-00000-000155).This SSAWSI was approved by the Historic Buildings and Monuments Commission for England (HBMCE) advisor to the project prior to the start of work on Site.

1.1.3 This document refers to archaeological approaches and definitions set out in the Overarching Archaeological Written Scheme of Investigation (OAWSI). The OAWSI forms part of the DCO, and is appended to the Environmental Statement. It sets out the overall mitigation strategy, procedures, standards and techniques to be followed across the Thames Tideway Tunnel project (the 'project').

1.1.4 This report is produced for Thames Tideway Tunnel Ltd. and will be submitted to the London Borough of Wandsworth. The results of this programme of evaluation works will inform the need for, design of, and programme of further mitigation to be undertaken by the Employer's Archaeological Contractor (EAC) during the Main Works phase of the project.

1.1.5 A field evaluation, and the reported results of that exercise, are defined in the most recent English Heritage guidelines (GLAAS April 2015 *Guidelines for Archaeological Projects in Greater London*) as:

a. To assess the presence or absence of archaeological remains; their extent, nature, quality, date and character in relation to the impact of the proposed development.

b. An exercise to enable the significance of the site's archaeological potential to be understood. This understanding, in turn, will allow for appropriate decisions to be made regarding change to the archaeological assets.

c. To provide a sufficient sample of the area of impact to confidently assess the principle aims and objectives of the fieldwork, as articulated in the Written Scheme of Investigation.

1.2 Site location

1.2.1 The Heathwall Pumping Station site, hereafter called 'the Site', lies along the southern bank of the River Thames in the London Borough of Wandsworth (**Figure 1**). The Site covers an approximate area of 1.3 hectares (centred on National Grid Reference 529530 177655). The Site is bounded to the north by the River Thames, to the east by open space with Elm Quay residential block beyond, to the south by Nine Elms Lane, and to the west by the Tideway Walk (Riverlight development, under construction). The Site lies less than 100m west of the TTT Kirtling Street site (KRST: TTT Site 14, **Figure 1**).

1.2.2 The Site comprises the Thames Water owned Heathwall Pumping Station (a modern 20th century building) and Middle Wharf, which is designated as a safeguarded wharf. Within the southern landward section of the Site there is mainly hardstanding, due to its current use as a Thames Water operational site and its former use as a concrete batching works. The northern half of the Site is located within the River Thames and its foreshore. In the western part of the Site, a barge is moored against a former wharf (**HEA 1C** ES Vol 15 Appendix E.1**; Figure 3**). A concrete and steel piled jetty, constructed in the 1950s, is located on the foreshore in the north-east part of the Site (**HEA 1H** ES Vol 15 Appendix E.1**; Figure 3**).

1.2.3 The ground level on the landward side of the Site is generally flat at *c.*104.5m ATD (above Tunnel Datum[i]), falling in the south-west corner by Nine Elms Lane to 103.5m ATD. On the foreshore, the ground slopes down towards the river from 101.7m ATD by the river wall to 96.8m ATD at the edge of the foreshore at low tide. At the northern boundary of the Site the river bed lies at c. 94.0m ATD.

1.2.4 This foreshore-based evaluation is focused on the intertidal area within the Site, to the north of the river wall.

1.2.5 The geology of the Site comprises alluvium from the historic floodplain of the River Thames, above Kempton Park Gravels. It lies at the intersection of two former tributary channels of the Thames, the Battersea Channel and the River Effra (Barton, 1992), located further to the east. These rivers eroded the (lower) Kempton Park gravels during the latter stages of the last Ice Age (Devensian), sculpting the subsurface topography of the

[i] ATD is equivalent to 100m above Ordnance Datum (aOD)

floodplain area (ES Vol 15, 7.4.9). Further details concerning the topography and geology of the Site are found in the ES Vol 15, Section 7.

1.3 Evaluation aims and objectives

1.3.1 All archaeological work on the project is considered within the context of the project specific Archaeological Research Framework, included in Appendix B of the OAWSI. The Framework groups together the potential types and classes of heritage assets that might be found at TTT Sites and draws on existing archaeological research frameworks and strategies for Greater London, e.g. *A Research Framework for London Archaeology* (MoLA & English Heritage, 2002) and *Greater Thames Estuary Historic Environment Research Framework* (Heppell 2010).

1.3.2 For evaluation at the Heathwall Pumping Station Site, the following Route-wide Heritage Themes (RWHTs) within the Archaeological Research Framework are relevant:

a. Palaeoenvironment and prehistory

b. Settlement patterns and boundaries

c. London's water systems and public health

1.3.3 For the evaluation the following questions were specified in the SSAWSI (Section 2.3):

a. *What is the topography of the foreshore at present, and how does this change over time (scour, sedimentation etc.)?*

b. *What is the depositional sequence at the Site?*

c. *Is there any evidence for the survival of deposits of palaeoenvironmental significance?*

d. Is there any evidence of prehistoric to post-medieval activity on the Site?

e. What is the character, date, condition and significance of deposits encountered?

f. What is the extent of archaeological survival across the Site?

g. What is the (seasonal) influence of tidal patterns and storm events on the archaeology of the foreshore?

1.4 Organisation of the report

1.4.1 The report is set out into the following sections:

Section 2: Historical and archaeological background; this provides a brief summary of the potential and significance of the archaeology likely to be encountered on the Site. This is summarised from Section 7, of Vol 15 of the Environmental Statement (ES).

Section 3: Methodology; this sets out the methods used in the evaluation (as defined in the SSAWSI), and quantifies the physical and drawn archive (i.e. numbers of plans and sections and boxes of finds).

Section 4: Fieldwork Results; this presents the results of the targeted walkover survey and parametric sonar survey undertaken as part of this evaluation.

Section 5: Geoarchaeological and Palaeoenvironmental Results; this describes the deposit sequence recorded in each vibrocore. Additional data is used to demonstrate the relationship between deposits located on the foreshore and those sequences landward of the river wall (i.e. a deposit model). Palaeoenvironmental assessment results and radiocarbon dating of samples taken during the evaluation is also described. This section also assesses the reliability of the results, noting any constraints encountered.

Section 6: Archaeological potential and significance; this responds to each of the Site specific questions identified to guide the evaluation, and how the results contribute to the project wide research themes. This section also discusses the predicted archaeological survival across the Site, and how the results refine the understanding of the significance of the archaeology as previously defined in the ES.

Section 7: Predicted impacts and recommendations; this assesses the impact of the development on the archaeological resource and provides recommendations as to an appropriate mitigation strategy.

2 Historical and archaeological background

2.1 Introduction

2.1.1 A desk-based assessment for this Site and its defined study area is reported within Volume 15 (Section 7, and detailed in Appendix E) of the Environmental Statement (ES). For detailed information on background and potential the ES should be referred to, however the relevant information is briefly summarised below.

2.1.2 Known historic environment assets (HEA references from the ES) are discussed where relevant in the text below; those indicated in bold (**HEA**) are shown on **Figure 3**.

2.2 Previous archaeological work

2.2.1 In 2010, the Thames Discovery Programme (TDP) surveyed the remains of a fish trap, first observed in 2009, and located partly within the Site (**HEA 66**). The remains recorded at the time (LAARC site code: FWW17, TDP feature no. A301) consisted of 28 posts set in two parallel rows, and three samples were retrieved and radiocarbon dated to cal AD550–670, the Early Saxon period (Cohen 2011, 135 and Fig 56).

2.2.2 A relevant foreshore survey undertaken in the 1990s by Thames Archaeological Survey (TAS) to the east of the Site uncovered post-medieval remains, including flood defences, barge beds, former dock entrances and foreshore consolidation deposits.

2.2.3 A number of recent geoarchaeological investigations have been undertaken within the wider area of the Site and these are summarised in the following section.

2.3 Historical and archaeological context

Palaeotopography and recent geoarchaeological investigations

2.3.1 A published study of the palaeotopography of the Battersea area (Morley 2010) is useful to understanding how the system of channels traversing the Thames floodplain in this area may have influenced people utilising the Site and its surroundings in the past. Other recent geoarchaeological investigations (Branch et al 2010; Green & Young 2011; Young et al 2013; Young 2015) particularly those undertaken in association with the Battersea Channel Project (Batchelor et al 2014) are also relevant, as the Site falls within the Battersea Channel Project area (**Figure 3**).

2.3.2 One of two areas of Kempton Park Gravel exist within the vicinity of the Site to the south of the present Thames, a remnant of a former gravel floodplain (higher and older than the modern Thames floodplain) deposited *c.* 30 000 – 150 000 years ago. These formed an island of higher land known as the Battersea Eyot, largely existing beneath the

present location of Battersea Park to the west of the Site. At the end of the last stage of cold climate (Late Devensian), a system of braided channels surrounded the eyot (Morley 2010, 176 and Fig. 5; ES Vol 14 Plate E.15).

2.3.3 In the Early Holocene, the network of channels gradually filled with fine-grained sediments and accumulations of peat as the Thames evolved to adopt a single-channel form. Two main channels lie within the vicinity of the Site at this time, the southernmost is referred to as the Battersea Channel (about 200m wide and over 5km long), now buried and evident from a swathe of alluvium along the south side and east of Battersea Eyot towards the present day Thames, although this may have been associated with other minor channels (Morley 2010, 176 and Fig.5; ES Vol 14 Plate E.15). A complex number of factors including changes in relative sea level, climatic fluctuations and human modification of the environment (certainly from the Neolithic onwards) drove this process of channel abandonment and relocation (*ibid*). This suggests that a complex sequence of deposits with archaeological and palaeoenvironmental potential may exist within the Site (Morley 2010 Fig 4; ES Vol 14 Plate E.16).

2.3.4 The Site is located on alluvium geology at the confluence of these former channels with the current line of the Thames, although the Kempton Park Gravel (Gibbard 1994) is located further to the south-west. Recent geoarchaeological investigations in the area show that sand and gravel of the Late Devensian Shepperton Gravel (Gibbard 1994) underlie the alluvium (Batchelor *et al* 2014, 5; Morley 2010 Fig 4; ES Vol 14 Plate E.16). Radiocarbon dating of peat deposits within a close range of elevations from recent investigations vary considerably (Mesolithic, Neolithic and Bronze Age) e.g. 7670–7510 cal BP[ii] at -1.25m to -1.75m OD (Morley 2010); 3980–3730 cal BP at -1.8m OD (Young *et al* 2012); 3460–3360 cal BP at -1.0m OD (Young *et al* 2013). This therefore shows that suitable conditions for peat formation were present at various times during the Holocene probably in abandoned channel remnants on an actively developing floodplain (Batchelor *et al* 2014, 5-6).

2.3.5 In the later Holocene, possibly as late as the Roman-British period, the Battersea Channel had near completely silted up and the Thames took the form of its present course (Morley 2010, 181 and Fig.5; ES Vol 14 Plate E.15). However, the depression of this infilled channel may have influenced the positioning of watercourses into the historic period. The Falconbrook's confluence with the present course of the Thames lies to the west of Battersea eyot and follows the western part of the former Battersea Channel, Morley suggests that a watercourse may have followed the line of the eastern part of the Battersea Channel, subsequently followed by the line of a sewer shown on Stanford's 1862 map, and later by the borough boundary between Wandsworth and Lambeth (Morley 2010, Fig. 3), along the current Wandsworth Road /A3036 approximately 150m south-east of the Site.

[ii] cal BP = calibrated years before present

Prehistoric (500,000BC - 43AD)

2.3.6 The location of the Site at this confluence area of channels, with the high drier gravel terrace further to the south-west of the Site is likely to have created a dynamic environment with rich resources. And whilst most of the Site was largely unsuitable for settlement, particularly as rising sea levels from the later prehistoric period resulted in tidal inundation, it may have been utilised for its resources in the early prehistoric period. Although no dated prehistoric remains are known within the Site, findspots known from the HER suggest limited activity and include: two Mesolithic axes found within the river *c.*100-200m to the north-west and north of the Site (HEA 13 and **HEA14**, ES Vol 15, Appendix E.1 and a Neolithic flint axe (HEA 12, ES Vol 15, Appendix E.1) was recovered near the foreshore *c.*195m north-west of the Site.

2.3.7 Prehistoric peat which built up on the edges of former channels is known from other geoarchaeological investigations within the wider surroundings of the Site (see 2.3.3-2.3.4 above; ES Vol 14 Plate E.16). Previous foreshore surveys *c.*30m to the east of the Site have identified small exposures of a peat and clay deposit on the foreshore (**HEA 67**).

Romano-British (AD 43 – 410)

2.3.8 The Site lay some distance from known Roman settlements and roads and the relative lack of known remains within the ES study area, combined with the likely flooded ground conditions at this time suggests there is very low potential for settlement.

2.3.9 The only known remains of this period within the Site relate to the chance find of two Roman coins on the foreshore recorded by the Portable Antiquities Scheme (**HEA 1G**).

Early medieval and later medieval (AD 410 - 1485)

2.3.10 The Site was located away from areas of known early medieval settlement centred on Vauxhall approximately 1km to the north-east, and Battersea approximately 2.5km to the south-west. The majority of the Site would have been liable to flooding and was probably marshland; therefore although unsuitable for settlement the locality could have been ideal for procuring resources such as fish. In the later medieval period, the marshes may have started to be reclaimed for pasture and cultivation between the medieval parishes of Battersea and Lambeth.

2.3.11 A recent foreshore survey by TDP in 2010 identified a series of 28 stakes set in two parallel lines on the foreshore which are interpreted as the remains of a fish trap (**HEA 66**), the western extent of which lies within the Site. Three samples of these timbers were radiocarbon dated to between AD550 and 670 – Early Saxon period (Cohen 2011,135 and Fig 56).

2.3.12 The site of a possible medieval manor house is known from the HER (**HEA 8**) and is marked *c.*40m to the south of the Site as recorded on the OS 1st edition map of 1874; however, there is no corroborating medieval documentary evidence (ES Vol 15 E.4.14).

Post-medieval (AD 1485 – present)

2.3.13 In the 16th and 17th centuries the Site lay in an area of cultivation, renowned for its rich soils. The site of a 17th century windmill or post mill (HEA 11, ES Vol 15 Appendix E.1) is recorded some 200m south-west of the Site; one of several mills known in the area. Rocque's map of 1746 shows the Site lay within the north-east corner of Battersea Common Field, a large area of drained and reclaimed open land (ES Vol 15 Plate E.2). Along Nine Elms Lane, riverside buildings, possible docks and landing areas are indicated and to the south land is subdivided into market gardens.

2.3.14 Historic maps examined for the ES show the increasing industrial development of the Site and its surroundings through the 19th and 20th centuries. Greenwood's map of 1824–1826 (ES Vol 15 Plate E.3) shows the southern part of the Site occupied by a number of buildings associated with a 'Stone Wharf and Factory', with the northern part lying on the undeveloped foreshore. The Site is located just to the east of a tidal mill on the riverfront and the inlet for the Nine Elms Mill Pond, constructed in the 1820s, with a water course indicated and a bridge.

2.3.15 During the 19th century the Site and the surrounding area became entirely industrial. The industrialisation culminated in the mid to late 19th century with the construction of the London Gas Works, the South Western Goods Depot and the Southwark and Vauxhall Water Works (HEA 17, ES Vol 15 Appendix E.1) including the Battersea Water Pumping Station (HEA 23, ES Vol 15 Appendix E.1), all located outside of the Site within the local environs. Bazalgette's Southern Low Level Sewer (**HEA 74**) was also constructed in 1865-68 beneath Nine Elms Lane outside the south-eastern edge of the Site. The Site itself was developed and redeveloped with various industrial works buildings and commercial wharves and docks, including the whiting and lime works, surrounding an open dock (labelled 'Middle Wharf' in OS map of 1894-1896), where the modern former pumping station now stands (ES Vol 15 Plate E.4 to Plate E.6).

2.3.16 Several remains related to 19th century commercial docks to the east of the Site were identified during previous foreshore surveys, including a dock entrance, opposite the former Newcastle Wharf, constructed between 1874 and 1894 (**HEA 65**). Two post-medieval riverfront defences, one of brick, and the other consisting of a line of vertical timber posts, were observed 155m to the east of the Site (HEA 62, ES Vol 15 Appendix E.1). Consolidation layers or possible barge beds (**HEA 68** and HEA 72, ES Vol 15 Appendix E.1) were also noted along the foreshore to the east of the Site.

2.3.17 In the early 20th century, OS maps show the Site continuing to be occupied by dockside warehouse buildings. The 'Middle Wharf' dock in the centre of the Site has 'Mill Pond Wharf' to the west and a jetty has been constructed on the foreshore to the north. The London County Council's Heathwall Sewage Pumping Station is shown located adjacent to the south-west edge of the dock with a culvert outfall (ES Vol 15 Plate E.7). By the mid-20th century, Middle Wharf dock had been infilled, the former dockside buildings of Mill Pond Wharf on its west side and goods-handling

structures were removed and a tank and three small buildings were constructed in the eastern part of the Site (ES Vol 15 Plate E.9). The former jetty has been removed and Middle Wharf, with a new jetty and crane, was relocated on the eastern foreshore (**HEA 1H**). The modern Heathwall Pumping Station was constructed over the in-filled Middle Wharf Dock in the early 1960s with an outfall sewer tunnel across the foreshore. A landing stage is also shown on the western foreshore (ES Vol 15 Plate E.9). There is a small public garden beside the riverfront in the eastern part of the Site (**HEA 1F**). It is separated from the Site by a high brick wall (ES Vol 15 Appendix E.5, Plate E.14), which is probably the western boundary wall of an area of 19th century industrial buildings.

2.4 Summary of potential from ES

2.4.1 A summary of the Site's archaeology potential and significance by period is given in **Table 2.1**; as identified in the ES (Vol. 15 Table 7.10.1).

Table 2.1: HEAPS archaeological potential and significance by period

Overall site potential: **moderate potential** for prehistoric land surfaces, evidence of Saxon activity and later industry. Site of overall **medium significance** (OAWSI, para 8.4.5).
High potential for palaeoenvironmental remains within the alluvium and on foreshore (**Low or Medium** asset significance)
Low potential for isolated prehistoric finds (**Low** asset significance)
Low potential for prehistoric riverside activity eg timber structures and boats (**High** asset significance)
Low potential for isolated Roman remains (**Low** asset significance)
Moderate potential for early medieval (Saxon) fish traps (**High** asset significance)
Known site of Saxon fish trap to east of Site (**High** asset significance)
Low potential for later medieval remains associated with land reclamation (**Low to medium** asset significance)
High potential for buried 18th and 19th century remains, including barge beds, wharves and jetties on the foreshore (**Low** asset significance)
High potential for buried 18th and 19th century remains, including the footings of industrial buildings and yards and an infilled dock on the landward side of the river wall (**Low** asset significance)

3 Evaluation Methodology

3.1 Introduction

3.1.1 The methods applied to the evaluation of the Site included:

a. Condition Monitoring (to track changes in the topography of the foreshore and riverbed of the Site over time, by comparison of data from successive bathymetry surveys);
b. Marine Geophysics (Parametric Sonar);
c. Targeted walkover survey;
d. Geoarchaeological and palaeoenvironmental recording and assessment of vibrocores, and radiocarbon dating of sub-samples taken during the evaluation; and
e. Deposit Modelling.

3.1.2 The Condition Monitoring programme is undertaken using third party bathymetry data, collected by Port of London Authority (PLA) for TTT, and is reported on separately at roughly quarterly intervals. The first Condition Monitoring report has been issued (Wessex Archaeology 2014; TTT document reference forthcoming). More detailed methodologies for the other techniques are set out below.

3.1.3 All archaeological investigations were carried out in accordance with the SSAWSI (ref.100-RG-ENV-00000-000155) for the evaluation works at this Site. All recording was carried out to the format and standards detailed with the *Archaeological Site Manual* (MOLAS 1994).

3.1.4 The site code was allocated by the Museum of London Archaeological Archive and Research Centre (LAARC) and is referenced: TTP14. This code was used on all records, retained artefacts and samples that form part of the Site archive.

Data and samples acquired prior to Evaluation

3.1.5 The scope of evaluation works as set out in the SSAWSI required the utilisation of data and samples acquired prior to the start of the evaluation. In addition to large numbers of geotechnical borehole data used in deposit modelling, these include:

Geoarchaeological vibrocores

3.1.6 A series of vibrocores have been retrieved from within the Site specifically for the purposes of geoarchaeological study (PLA 2013, **Appendix A.4**) at locations previously agreed with Historic Buildings and Monuments Commission for England (HBMCE) for the TTT project (**Figure 1**). These core samples were delivered to Wessex Archaeology, and have been assessed as part of this evaluation.

Non-archaeological marine geophysical data

3.1.7 TTT has gathered non-archaeological marine geophysical data over the course of the pre-consent phase of the project for engineering purposes, to inform understanding of ground conditions on the Site.

3.1.8 The data acquired prior to September 2013 comprises processed sidescan sonar and multibeam bathymetry datasets from multiple surveys. This data has been subjected to gap analysis in order to assess its suitability for use in identifying any unusual seabed structures that could be shipwrecks or other anthropogenic debris (Wessex Archaeology 2013; document ref. 1000-ENV-ZZZZZ-SGR-YE-RG-100001-P01).

3.1.9 The results of this gap analysis report show that the data were unsuitable for use in archaeological interpretation. Although not directly applicable to defining archaeological potential, this result has helped develop the methodology for this evaluation (SSAWSI; ref.100-RG-ENV-00000-000155).

3.2 Parametric sonar survey

3.2.1 The marine geophysical data were collected by Wessex Archaeology on board the Port of London Authority (PLA) vessel Galloper between the 9th and 14th June 2014. A gridded line system was set out for the survey in order to ensure maximum coverage of the Site (**Figure 1**). Due to the intertidal nature of the Site, the survey was planned around the tides in order to gain maximum information, with lines furthest out into the main Thames channel run at a lower tide and the closest lines (and cross lines) run around high tide.

3.2.2 The marine geophysical data were assessed for quality and their suitability for archaeological purposes using Wessex Archaeology's in-house criteria defined in **Table 3.1** below.

Table 3.1: Criteria for assigning geophysical data quality rating

Data Quality	Description
Good	Data which are clear and unaffected by weather conditions or sea state. The dataset is suitable for the interpretation of standing and partially buried metal wrecks and their character and associated debris field. These data also provide the highest chance of identifying wooden wrecks and debris.
Average	Data which are affected by weather conditions and sea state to a slight or moderate degree. The dataset is suitable for the identification and partial interpretation of standing and partially buried metal wrecks, and the larger elements of their debris fields. Wooden wrecks may be visible in the data, but their identification as such is likely to be difficult.
Variable	This category contains datasets with the quality of individual lines ranging from good to average to below average. The dataset is suitable for the identification of standing and some partially buried metal wrecks. Detailed interpretation of the wrecks and debris field is likely to be problematic. Wooden wrecks are unlikely to be identified.

3.2.3 The marine geophysical data have been rated as "**Average**" using the defined criteria. This is due to several survey limitations; i) equipment penetration was limited in places, likely due to the hard substrate (sands and gravels) identified during previous vibrocore surveys, and ii) the shallow depth of water meant data was obscured by seabed multiples. These represent site environmental limitations, which affect the quality of data in the same way, regardless of the equipment used.

3.2.4 PS data were acquired using an Innomar SES 2000 Compact Parametric Sub-bottom Profiler system, operated at a dual frequency of 10kHz/100kHz. Positioning data for the survey were provided by an Applanix PosMV Inertial navigation unit The data were logged by the PLA during the survey using HyPack, and recorded directly along with the PS data (recorded as both *.raw* and *.ses* files) in Innomar's SESwin software.

3.2.5 The PS data were initially viewed and processed using Innomar's ISE post-processing software. This program, along with the accompanying SES Convert software, was mainly used to convert the positioning data to British National Grid and the file formats to *.sgy* and *.xtf*. Images of the data acquired along each survey line were also taken. The converted PS data were processed by WA using Coda Seismic+ software. This software also allows the data to be visualised with user selected filters and gain settings in order to optimise the appearance of the data for interpretation. The shallow seismic data were interpreted with a two-way travel time (TWTT) along the z-axis. In order to convert from TWTT to depth, the velocity of the seismic waves was estimated to be 1,600ms-1. This is a standard estimate for the speed of sound through shallow unconsolidated sediments. The data were then interpreted using the lower frequency (10kHz) data within Seismic+, as this was found to produce better penetration, with comparisons back to the original dual frequency data set.

3.2.6 The PS data was interpreted and integrated with available archaeological and geotechnical borehole data across the Site (as detailed with the results). A discrimination flag was then added to all identified features in order to discriminate against those which are not thought to be of an archaeological interest. These flags are ascribed by type of non-archaeological and archaeological interest as set out in **Table 3.2** below.

3.2.7 The grouping and discrimination of information at this stage is based on all available information and is not definitive. It allows for all identified features of potential archaeological interest to be highlighted, while retaining all the information produced during the course of the geophysical interpretation for further evaluation should more information become available.

Table 3.2: Types of identified palaeogeographic features within the Site

Non-Archaeological	U2	Feature of non-archaeological interest
Archaeological	P1	Feature of probable archaeological interest, either because of its palaeogeography or likelihood for producing palaeoenvironmental material
	P2	Feature of possible archaeological interest

3.2.8 Occasionally, small possible mounds were also observed on the riverbed and recorded. For anomalies on the riverbed, the discrimination flags are ascribed as shown in **Table 3.3** below.

Table 3.3: Types of identified riverbed anomalies within the Site

Non-Archaeological	U1	Not of anthropogenic origin
	U2	Known non-archaeological feature
	U3	Non-archaeological hazard
Archaeological	A1	Anthropogenic origin of archaeological interest
	A2	Uncertain origin of possible archaeological interest
	A3	Historic record of possible archaeological interest with no corresponding geophysical anomaly

3.3 Targeted walkover survey

3.3.1 Existing available survey data, aerial photography and Greater London Historic Environment Record (HER) data was examined and plotted within a CAD GIS system and was used to generate a site briefing document in order to identify key features and survey data gaps and enable a degree of targeting for the walkover survey.

3.3.2 The walkover survey was undertaken on the 26th September 2014. Works on site consisted of the identification, examination and recording of features, layers and structures. Recording comprised allocation of a unique context-based record number to each feature, and a full written, drawn and photographic record was made, as appropriate, using the Wessex Archaeology *pro forma* recording system.

3.3.3 A survey-grade GPS was used on site to accurately plot all *in situ* remains and this data was incorporated into the CAD GIS model.

3.3.4 Object numbers (ON) were allocated at the time of the survey to artefacts, only when an artefact's position was considered potentially significant and/or the artefact was of intrinsic value.

3.3.5 In the context of the foreshore environment, and the relatively constrained tidal window within which the targeted walkover survey was undertaken, archaeological remains were not 'excavated' per se. However, limited hand-investigation was employed as necessary, particularly to obtain artefactual and/or palaeoenvironmental evidence where observed. Care was taken to preserve the integrity of any archaeological features or

complex deposits which may be better excavated under controlled archaeological mitigation.

3.3.6 The targeted walkover survey was not intended as a full condition survey of known assets (HEA from the ES) present on the foreshore. However, where further information could be gained to address the aims of the evaluation, appropriate recording and sampling of known assets was undertaken. The walkover survey aimed also to identify and record any assets previously not known and surface collect any artefacts present on the safely accessible foreshore at the time of the survey (i.e. to record new assets).

3.3.7 Where exposed areas of deposits with palaeoenvironmental potential were observed on the foreshore, bulk samples were taken for palaeoenvironmental assessment, where feasible. These were then labelled and returned to the Wessex Archaeology's laboratory for environmental processing and initial assessment.

3.3.8 Bulk samples were processed and assessed in accordance with the recommendations outlined in the HBCME *Guidelines for Environmental Archaeology and Geoarchaeology* (EH 2011).

3.3.9 Where bulk samples displayed good palaeoenvironmental potential, sub-sampling was undertaken in line with the procedures outlined in **Table 3.4** below. The methodology of processing these samples is presented in Section 3.5.

3.3.10 The recovery of finds on site and retention of artefacts/ecofacts and the archive was carried out in accordance with the methodology set out in the SSAWSI.

3.4 Geoarchaeological and palaeoenvironmental assessment of vibrocores

3.4.1 Three vibrocores had been previously retrieved within the Site for the TTT project (**Figure 1**). The following approach to the recording, assessment and analysis of the cores was employed. The work was also guided by the recommendations outlined in the HBCME *Guidelines for Environmental Archaeology and Geoarchaeology* (EH 2011).

3.4.2 A staged approach was utilised for the geoarchaeological and palaeoenvironmental investigations outlined in **Table 3.4** below.

Table 3.4: Staged approach to core assessment

Stage 1: Geoarchaeological assessment	The cores will be split and described by a geoarchaeologist, and interpretations made regarding formation processes and depositional environments, and their likely archaeological and palaeoenvironmental potential. This data will inform the development of a site-specific deposit model, which will also incorporate any other available data. Following geoarchaeological description and interpretation Stage 2 palaeoenvironmental assessment work would be scoped to assess the potential of the deposits, and to further characterise and interpret them.
Stage 2: Palaeoenvironmental assessment	Sub-sampling and assessment of samples agreed in Stage 2 will be undertaken (for a range of micro-and macro-fossil palaeoenvironmental indicators such as pollen, diatoms, plant macrofossils, molluscs, ostracods and foraminifera as appropriate, together with suitable plant macrofossils for radiocarbon dating). The relevant ecofacts will be identified to at least main Taxon, with quality of preservation and approximate quantification. This will enable the value of the palaeoenvironmental material surviving within the samples to be assessed. The Stage 2 findings will form part of the Evaluation Report, and set out the results of laboratory assessment, and summarise the results and their potential in the archaeological and palaeoenvironmental context of the local area. The results of deposit modelling will also be presented. Recommendations will be made as to whether any further analysis would be required as part of mitigation.

3.4.1 At Stage 1, existing core samples were opened, described and interpreted, as were any supplementary samples from additional mechanical coring and auger sampling works.

3.4.2 The cores were split and described by a geoarchaeologist, following Hodgson (1997). A wide range of characteristics were recorded including (but not limited to) texture, colour, structure, inclusions, nature of boundaries and evidence for depositional and post-depositional soil and sediment processes.

3.4.3 The results were used by the geoarchaeologist to interpret the likely formation processes represented, and to make initial judgements regarding the probable archaeological and palaeoenvironmental potential of the deposits.

3.4.4 Based on the results of Stage 1, three deposits within one vibrocore (**VB7013**) were identified as suitable for further work and Stage 2 laboratory assessment has been undertaken as a requirement to meet the HEAPS evaluation objectives.

Storage

3.4.5 The shelf life of the retained core samples is *c*. 3–4 years. The cores are retained at the Wessex Archaeology's geoarchaeology laboratory in controlled storage until such a time as they are no longer needed.

3.5 Palaeoenvironmental assessment

3.5.1 A series of two small bulk samples were taken from a peat layer in vibrocore **VB7013** at 2.92-2.94 m below ground level (bgl) and 2.96-2.98m bgl to assess preservation of waterlogged material and to select suitable material for radiocarbon dating.

3.5.2 In addition samples were taken for pollen assessment from the same peat layer at 2.92m and 2.97m bgl, and from the overlying alluvial deposits at 2.56-2.58m bgl and 2.67-2.69m bgl for both ostracods and foraminifera.

3.5.3 The following methods were used and the results are presented in section 5.2.

Macrofossils (plants, molluscs and insects)

3.5.1 Small bulk subsamples of 60 and 90ml respectively were processed in order to assess the presence/ absence and diversity of macrofossils, including molluscs, waterlogged plant material and insects.

3.5.2 Laboratory flotation was undertaken with the sample retained on a 0.25mm. The flot was visually inspected under a x10 to x40 stereo-binocular microscope to determine if waterlogged material occurred. Where waterlogged material was present, preliminary identifications of dominant taxa were recorded (see results section **Table 5.1**). The nomenclature used in this report follows Stace (1997).

Pollen

3.5.3 The two spot samples were prepared for pollen assessment from the stratigraphic sequence. Pollen preparation followed standard techniques including potassium hydroxide (KOH) digestion, hydrofluoric acid (HF) treatment and acetylation (Moore *et al*., 1991). A count of at least 200 total land pollen grains (TLP) excluding aquatics and spores were attempted for each sample. However, both of the samples were found to produce very low pollen concentrations and as a consequence a complete assessment count was only possible for the upper sample (2.92m bgl depth).

Foraminifera

3.5.4 Two subsamples were assessed for the presence and environmental significance of foraminifera.

3.5.5 Sediment samples of *c*.25g were disaggregated in a weak solution of Hydrogen Peroxide and water, then wet sieved through a 63µm sieve. The sediment was dried and sieved through 500µm, 250µm, and 125µm sieves. The presence of foraminifera was assessed under 10-60x magnification and transmitted and incident light using a Vickers binocular microscope using standard techniques (Murray 1979, 1991).

Ostracods

3.5.6 Two subsamples were assessed for the presence and environmental significance of ostracods.

3.5.7 Sediment samples of *c*.25g were disaggregated in a weak solution of Hydrogen Peroxide and water, then wet sieved through a 63µm sieve. The sediment was dried and sieved through 500µm, 250µm, and 125µm sieves. Microfossils were assessed under 10-60x magnification and transmitted and incident light using a Vickers binocular microscope following methods detailed in Athersuch et al. (1989) and Meisch (2000).

Radiocarbon dating

3.5.8 Two samples of short-lived waterlogged plant remains from a vibrocore (**VB7013**) were submitted for radiocarbon dating to the Scottish Universities Environmental Research Centre (SUERC) (**Table 5.3**).

3.5.9 The radiocarbon dates have been calculated using the calibration curve of Reimer et al. (2013) and the computer program OxCal (v4.2.3) (Bronk Ramsey and Lee 2013) and cited in the text at 95% confidence and quoted in the form recommended by Mook (1986), with the end points rounded outwards to 10 years. The range in plain type in the radiocarbon tables has been calculated according to the maximum intercept method (Stuiver and Reimer 1986). All other ranges are derived from the probability method (Stuiver and Reimer 1993). The results are presented in Section 5.2.

3.6 Deposit model construction

3.6.1 In order to create the deposit model, available data points from the Site and vicinity were entered into a digital database (Rockworks 15). For this Site, these included: geoarchaeological vibrocores retrieved prior to the start of the evaluation (PLA 2013); historical borehole data (**Appendix A.4**); and 'pseudopoints' based upon marine geophysical data (**Appendix A.4**).

3.6.2 A total of 67 deposit records were entered into the database for this Site (due to the close proximity to the Kirtling Street TTT Site 14 many of the deposit records also form part of that dataset). The distribution of the data points most relevant to this analysis is illustrated in **Figure 5**.

3.6.3 During modelling, each identified lithological unit (gravel, sand, silt etc.) is given a unique colour and pattern allowing cross correlation of the different sediment and soil types across the Site. By examining the relationship of the lithological units (both horizontally and vertically) correlations can be made between soils and sediments, and associations grouped together on a site-wide basis. The grouping of these deposits is based on the lithological descriptions, which define distinct depositional environments.

3.6.4 Thus, where suitable contexts are present, a sequence of stratigraphic units[iii], representing certain depositional environments, and/or landforms can be reconstructed both laterally and through time for the Site. These

[iii] A geoarchaeological term defining a layer deposited under certain environmental conditions. For example, alluvial clays/silts deposited in intertidal salt marsh, or peats forming in wetland alder carr.

can then be displayed in the form of Digital Elevation Models (DEMs) and thickness plots.

3.6.5 In practice, the sequences recorded on most of the foreshore sites are limited in variability and depositional environments represented, and the number of stratigraphic units are therefore similarly limited.

3.6.6 The system of landscape zones and stratigraphic units has been retained nonetheless, in order to allow uniform approach between the Sites, and easier correlation with deposit modelling from evaluation of the land-based sites. These have been supplemented by transects across the Site to show the sequence of deposits and their relative levels.

3.7 Quantification of the archive

3.7.1 Three boxes of finds were recovered from the Site. The flots and residues from processed subsamples from one vibrocore (**VB7013**) have also been retained.

3.7.2 The Site finds, samples and records can be presently found under the site code TTP14 at the offices of Wessex Archaeology, but will be deposited in the Museum of London Archaeological Archive and Research Centre (LAARC) in due course.

4 Fieldwork results

4.1 Parametric sonar survey

Introduction

4.1.1 The approximate extents of deposits (>0.5m thick) overlying the London Clay have been mapped (**Figure 2**).

4.1.2 The Site contains a modern jetty associated with the former aggregate wharf, a significant deposit of aggregate on the seabed, and two large outfall pipes. The western edge of the Site is also obstructed by the eastern end of Nine Elms Pier and associated moored vessels, including the Battersea Barge. Despite this, good data coverage of the Site was obtained with the exception in the vicinity of the pier (**Figure 1**).

4.1.3 Two recent vibrocores (**VB7012A and VB7013**, **Appendix A.2**) and two historical BGS boreholes (TQ27NE633 and TQ27NE634, date uncertain on the records, but likely to be 1950s, **Appendix A.4**) located within the Site were used to aid interpretation of the PS data, albeit with a degree of caution due to the age of the records. This interpretation has also taken into consideration bathymetry data from the Site (**Appendix A.4**).

Results

4.1.4 The surface of London Clay is present beneath Pleistocene/Holocene (>0.5m thick) across the majority of the Site (**Figure 2**). However, due to the recent industrial use of the Site, the riverbed is disturbed by two outfall pipes and recent aggregate dumping. This disturbance and scour is observed in the PS data and the bathymetric data in both the northern and central parts of the Site.

4.1.5 No specific sub-riverbed geophysical features of possible archaeological interest were identified within the Site.

Summary

4.1.6 The parametric sonar survey has identified deposits of some depth across most of the foreshore Site overlying the surface of the London Clay.

4.1.7 It was impossible to determine the nature of these deposits overlying the London Clay from the survey alone. In light of the deposit modelling and vibrocore results, however, these are likely river gravels deep overlain by organic deposits and alluvium in the central and western part of the foreshore Site.

4.1.8 Two vibrocores (**VB 7012A** and **VB2013**, **Appendix A.2**) taken from the foreshore Site sampled organic deposits of peat at approximately 3m below the present surface of the foreshore/riverbed suggesting preserved terrestrial deposits may be present within the Site. No evidence of such deposits was identified within the PS data. However, this is possibly due to the buried depth of this material being beyond the PS equipment's

penetration and/or the dumping of aggregate creating a relatively harder seabed and reducing the penetration of the PS.

4.1.9 No specific geophysical sub-riverbed features were identified within the PS data. However, disturbance to the riverbed was seen in the form of two outfall pipes and dumped aggregate on the riverbed's surface, the erosional effect from the former is also seen in recent bathymetric data.

4.2 Targeted walkover survey

Introduction

4.2.1 The walkover survey was undertaken on the 26th September 2014. The majority of the foreshore was accessible at the time of the walkover except a small area in the south-west because of the presence of a moored barge (**Plate 1**).

4.2.2 The extant 19th century river wall (**HEA 1F**) along the south-east side of the foreshore and the extant concrete and steel jetty (**HEA 1H**) that extends onto the foreshore were photographed (**Plate 2**), but as they are part of the standing built heritage were not considered further within this archaeological evaluation.

4.2.3 The walkover survey was successful in recording a number of *in situ* timber remains on the foreshore including additional newly exposed timbers of an Early Saxon fish trap structure, some of which are located within the Site boundary (in comparison to the extent previously surveyed in 2010; **5011 Figures 3-4**); an area of exposed peaty organic clay of uncertain prehistoric date (**5010**) representing the eroded remains of a probable land surface; and a possibly associated undated roundwood timber **5009**. The survey also confirmed the presence of timber piles (**5001**, **5002**, **5006-5008**, **Figure 3**) relating to a post-medieval jetty that once crossed the foreshore and the remains of a post-medieval barge bed (**5012**, **Figure 3**).

4.2.4 A relatively small quantity (66 in number) of unstratified finds was recovered from the exposed foreshore (unstratified context **5000**) during the walkover survey (**Appendix A.1.1**). The finds were recovered as a sample of the material present on, and presumably eroding from the Site in this active foreshore environment. The finds are quantified by material type in **Table 4.1**, and detailed below. Most of the datable finds are post-medieval in date, with the exception of a Romano-British flat tile fragment and a prehistoric flint core.

Table 4.1: All finds by material type (number/weight (g))

Material	Number	Weight (g)
Pottery	38	1522
Clay Pipe	1	1
CBM	2	97
Flint	1	215

Material	Number	Weight (g)
Glass	9	416
Iron	2	154
Copper Alloy	1	12
Lead	1	28
Animal Bone	8	330
Ceramic	3	242

In situ remains

4.2.5 Five square-cut timber piles (**5001**, **5002**, **5006-5008 Figure 3**; **Plates 3-4**) were recorded in the central foreshore of the Site that likely relate to a 1950s jetty (since removed) that once extended riverwards on a north-south alignment across the foreshore in the early 20th century (para 2.3.17 above). All the timbers were eroded at their surface and each measured approximately 0.3m² and were exposed to a height of between *c.*0.1m and *c.*0.3m above the present foreshore surface. These remains appear to represent previously known assets (**HEA 1A**, **1B** and **1D**, **Figure 3**).

4.2.6 Two parts of iron and gritstone millstones (**5003** and **5004**, **Figure 3**; **Plates 5-6**) were identified on the foreshore at 98.58m ATD and 98.3m ATD respectively. These could not be lifted safely and so were left *in situ*.

4.2.7 A double alignment of timber posts known from a previous TDP investigation in 2010 (section 2.2 above) to be the remains of an Early Saxon fish trap partly extends into the eastern foreshore of the Site (**HEA 66** and **5011**, **Figure 3**; **Plates 7-8**). The full extent of the structure is approximately 23m; however it is only the south-western end of the structure that fall within the Site bounds, amounting to approximately 7m length of the structure consisting of 13 exposed timbers situated between 98.05m and 98.3m ATD (**5011**, **Figure 4, Plate 7**). Considering that this structure was previously recorded and as part of those investigations three samples of the timbers were lifted for radiocarbon-dating and returned dates of cal AD 550–670; the timbers were only surveyed and photographed during this walkover survey, and no further recording was undertaken at this evaluation stage.

4.2.8 It is significant that when recorded in 2010 the fish trap structure was then comprised of 28 posts (Cohen 2011, 135) whereas this evaluation has shown that more posts have been exposed since (presumably due to fluvial erosion). The total number is now 49 posts. When compared to the published figure from the TDP investigation (Fig 56, Cohn 2011), it is seen that the majority of these new additional posts are located on the north-eastern end of the alignment, outside of the Site; however it also apparent that one new post has been revealed on the south-western end of the alignment within the Site (**Figure 4**). It is therefore likely that further pairings of timbers related to this structure are potentially buried beneath the present surface of the foreshore within the Site.

4.2.9 To the immediate north of the south-western end of the Early Saxon fish trap, a small area (approximately 1.5m in diameter) comprising traces of small preserved pieces of wood was exposed at 97.88m ATD, surveyed and photographed (**5005**, **Figure 3**; **Plate 9**). Within the constraints of the survey, there was little time for further investigation, because of the incoming tide and therefore it is presently uncertain whether these represent exposed natural wood remains or worked timbers, such as small stakes or withies that could potentially be associated with the nearby fish trap.

4.2.10 An irregular area of exposed peaty organic clay (**5010**) measuring approximately 13m by 3.4m lying between 98.1m and 97.9m ATD was recorded at the low water mark in the west of the foreshore Site (**Figure 3; Plate 10**). It consisted of a very dark brown peaty clay with visible organic components of twigs as well as occasional gravel. On its edges the deposit was very thin, up to 0.04m thick, it overlay the river gravels and appeared to have been mostly eroded away as the river gravels were exposed over much of the surface and the remaining deposit appeared disturbed, leaving insufficient material for a bulk environmental sample to be taken. This layer is interpreted as the remains of an organic stabilisation horizon or probable land surface of uncertain prehistoric date.

4.2.11 A single roundwood timber **5009** was located within the area of exposed peat (**5010 Figure 3**; **Plate 10**), although the stratigraphic relationship with this deposit was not investigated. The timber measured *c.* 0.10m by 0.15m and was exposed to a height of 0.06m above the level of the present foreshore at 97.87m ATD. Bark was recorded to be intact on the southern side of the timber. It was not possible to sample this timber as it was only very briefly exposed and its base lay within the river water and therefore the possible post is presently undated, although it could be prehistoric were it to be contemporary with the surrounding peat deposit.

4.2.12 On the upper eastern foreshore, the eroded remains of a stone surface of a barge bed (**5012**, **Figure 3**) were surveyed to extend slightly into the Site at *c.*100.30m ATD, although the majority of this structure lay outside to the east of the Site.

Pottery

4.2.13 Thirty-eight sherds of pottery were recovered, all of which are post-medieval. All sherds are at least lightly abraded, and some have suffered considerable abrasion in the riverine environment, removing any surface treatments.

4.2.14 The assemblage is made up of stonewares, porcelain and refined wares. The stonewares, some with feldspathic glazes (ENGS, ENGS BRST, NOTS) are used primarily for containers for beverages, foodstuffs and other household goods; there is one Hartleys preserve jar. One unusual item is present: a probable beer tap surround, with a coloured feldspathic glaze and embossed lettering GING[ER BEER?]. The refined wares are used for tablewares (REFW, REFR, TPW), with some kitchen wares (YELL). There are two bone china sherds (BONE), probably also from tea wares, as is one sherd of Chinese porcelain (CHPO), while a second

fragment of porcelain, probably British, is from a decorative item, perhaps a figurine (ENPO).

4.2.15 None of the assemblage can be definitively dated to a period earlier than the 19th century.

Ceramic Building Material

4.2.16 Two fragments of tile weighing a total of 97g were recovered. One is a fragment of Romano-British tile, with a pattern of intersecting multiple-tooth comb marks, characteristic of box flue tile. A 20th century white-glazed tile fragment was also recovered.

Flint

4.2.17 One prehistoric flint core (**ON16**) was recovered.

Animal Bone

4.2.18 A total of eight fragments of animal bone weighing 330g was recovered. The assemblage was rapidly scanned to ascertain species, skeletal element, butchery and gnawing marks. The assemblage is composed of a mixture of butchery waste and bone from animals which are not commonly eaten.

4.2.19 Evidence for butchery is present in the form of a cattle metatarsal and bones from three unidentified large mammals, which had been split axially in order to remove the marrow inside.

4.2.20 Other animals represented in the assemblage are horse (two teeth) and red deer (antler). The red deer antler may represent craft-working waste.

Clay Pipe

4.2.21 One piece of undateable clay pipe stem, weighing 1g, was recovered.

Glass

4.2.22 Nine pieces of glass, weighing a total of 416g, were recovered. All of these are late 19th–20th century date. Most of the assemblage is composed of bottle and other vessel glass.

4.2.23 The bottle glass is all of late 19th to early 20th century date, and includes the base of a clear glass bottle, the neck of a clear blue glass bottle with a narrow neck, and the mouth of a clear glass bottle. A clear glass bottle stopper was also recovered.

4.2.24 The vessel glass consists of a base of a small clear glass vessel, a base of a drinking glass and a brown glass 2oz Marmite jar.

4.2.25 Two marbles, one in clear glass and the other blue, were also recovered.

Metal finds

4.2.26 Two iron items comprise a handle made from a curved iron strip and a small spanner. A copper alloy spoon was also recovered, with an elongated oval bowl, and stamped SILTONA on the underside of the handle.

A lead alloy spoked wheel, probably from a toy or model was also recovered.

5 Geoarchaeological and Palaeoenvironmental Results

5.1 Vibrocores

Introduction

5.1.1 Three vibrocore sequences were described and interpreted for the Site (**VB7012, VB7012A** and **VB7013**). The location of the vibrocores is shown in **Figure 1**. **VB 7012** and **VB7012A** were drilled approximately 5m apart due to **VB7012** refusing further penetration after 1m.

Results

5.1.2 The results are tabulated in **Appendix A.2** and summarised below.

Summary

5.1.3 All three vibrocores (**VB7012**, **VB7012A** and **VB7013**) from the Site returned deposits associated with the present depositional environment, although **VB7012** failed to penetrate below the surface active beach deposits.

5.1.4 The deposit sequence comprised: surface active beach deposits with episodes of varying energy (up to 1.03m deep) overlying chalk dumps possibly representing a buried barge bed structure (up to 0.4m thick, surface height at 99.68m to 99.95m ATD) overlying alluvial deposits (up to 1.62m thick, surface height at -99.58m and 98.98m ATD) above peat (at least 0.11m thick, surface height at 97.96m and 97.32m ATD) recorded at the base of two cores.

5.1.5 Vibrocores **VB7012A** and **VB7013** were terminated at *c.*3m depth - it is possible that gravel deposits were encountered at this level which caused the hole to be terminated there, but there is no direct evidence of this in the core itself (i.e. no gravelly peat initiation layer at the base).

5.1.6 **VB7012** (surface height of 100.22m ATD) reached a depth of 1.03m, **VB7012A** (surface height of 100.19m ATD) reached a depth of 3.03m and **VB7013** (surface height of 100.88m ATD) also reached a depth of 3.03m.

5.1.7 London Clay was not encountered in any of the vibrocores.

5.1.8 Material suitable for further palaeoenvironmental assessment and radiocarbon dating was present in **VB7013**, in the form of a peat which had been choked off by low-energy alluvium attributable to rising water levels. Sub-sampling was undertaken and assessed, as detailed in the following section.

5.2 Palaeoenvironmental assessment

Introduction

5.2.1 Although no deposits were bulk sampled during the walkover survey, material suitable for palaeoenvironmental investigation and dating was recovered from a vibrocore (**VB7013**) from the Site.

5.2.2 The peat layer at 2.92–3.03m bgl 97.96 to 97.85m ATD) was unfortunately not fully penetrated by the coring, so it is not known whether this is the full thickness of a thin peat deposit, or the top of a thicker deposit. The peat was overlain by a soft, buttery dark grey clay (see **Appendix A.2.3**) interpreted as representing the choking-off of wetland vegetation with alluvium deposited by rising water levels.

5.2.3 A series of two small bulk samples were taken from within and just above the peat layer in **VB7013** at 2.92–2.94 m bgl (97.27 to 97.25m ATD) and 2.96–2.98m bgl (97.23 to 97.21m ATD) to assess preservation of waterlogged material and to select suitable material for radiocarbon dating.

5.2.4 In addition samples were taken for pollen assessment from the same peat layer at 2.92m and 2.97m bgl (97.27 and 97.22m ATD), and from the overlying alluvial deposits at 2.56–2.58m bgl (97.65 to97.63m ATD) and 2.67–2.69m bgl (97.54 to 97.52m ATD) for both ostracods and foraminifera.

5.2.5 The methodology for the processing and assessment of macrofossils, pollen, foraminifera, ostracods and radiocarbon dating is outlined in Section 3.5 above.

Macrofossils (plants, molluscs and insects)

5.2.6 A series of two small samples (60ml and 90ml respectively) were taken from **VB7013** at 2.92–2.94 m bgl and 2.96–2.98 m bgl to evaluate for the preservation of waterlogged material and to select suitable material for radiocarbon dating.

Results

5.2.7 Small quantities of woody stem/twig/root fragments were recovered in both samples.

5.2.8 There were no molluscs or insect fragments observed in these samples.

Table 5.1: Macrofossil assessment results

Site	Heathwall Pumping Station	
Core	VB7013	VB7013
Depth (below ground level)	2.92-2.94	2.96-2.98
Volume (litres)	0.06	0.09
Waterlogged material		
woody stem/root frags > 2mm	+	+
woody stem/root frags < 2mm	+	+

Key: + = <50, ++ = 50-100, +++ = >100

Foraminifera

Introduction

5.2.9 Two sediment subsamples from the alluvial deposits within **VB7013** at 2.56–2.58m bgl (97.65 to 97.63m ATD) and 2.67–2.69m bgl (97.54 to 97.52m ATD) were assessed for the presence and environmental significance of foraminifera.

Results

5.2.10 No foraminifera were present in the assessed sample.

5.2.11 A paucity of calcareous material was noted with this and other samples from similar contexts on other TTT sites, which is most likely due to acidification of organic sediments.

5.2.12 Most foraminifera have calcareous walls composed of calcium carbonate. Sediments with a low pH can cause the dissolution of foraminiferal tests, which may explain why these (and other) calcareous remains are largely absent from the assessed samples.

Ostracods

Introduction

5.2.13 Two sediment subsamples from the alluvial deposits within **VB7013** at 2.56–2.58m bgl (97.65 to 97.63m ATD) and 2.67–2.69m bgl (97.54 to 97.52m ATD) were assessed for the presence and environmental significance of ostracods.

Results

5.2.14 No ostracods were present in the sample.

5.2.15 A paucity of calcareous material was noted within these samples. Most ostracods have calcareous valves composed low magnesium calcite, and, as noted above, this is most likely due to acidification of organic sediments.

Pollen

5.2.16 Two samples were submitted for pollen assessment from a thin c. 0.05m peat unit encountered within **VB7013** at 2.92m and 2.97m bgl (97.27 and 97.22m ATD).

5.2.17 **Table 5.2** summarises the dominant species (>10% Total Land Pollen; TLP) for each sample depth. In addition, a selection of key subordinate species (<10%TLP) are also highlighted.

5.2.18 A qualitative assessment of pollen abundance and diversity is also provided. If abundance is stated to be low, this infers that it was not possible to count the 200 pollen grains during the assessment. Similarly, if diversity is high, over 20 taxa were encountered during assessment; medium = 10-20 taxa; low = <10 taxa. The pollen assemblages encountered were found to be broadly similar, and hence will be discussed together.

Table 5.2: Pollen assessment results

Sample depth	Dominant taxa	Other (minor) taxa	Abundance	Diversity
2.92m	*Pinus* *Corylus avellana type*	*Pteropsida* (monolete) indet. *Poaceae* *Ericaceae* undiff. *Quercus* *Ulmus*	Moderate	Low
2.97m	*Pinus*	*Poaceae* *Pteropsida* (monolete) indet. *Ericaceae* undiff. *Corylus avellana type*	Low	Low

2.92m and 2.97m depth

5.2.19 Pollen was found in moderate to low abundances within the prepared samples. Consequently, a count of 200 was achieved in the upper sample (2.92m) but not in the basal sample (2.97m). In both cases, the samples were dominated by *Pinus* (pine), contributing c. 80% TLP in the upper sample, increasing to *c.* >90% TLP in the basal sample. The other species that were encountered were therefore restricted in their abundance. Occasional grains of the arboreal taxa such as *Ulmus* (elm) and *Quercus* (oak) were encountered, as well as the shrub taxa *Corylus avellana* type (Hazel), and the herbs *Poaceae* (wild grasses) and *Ericaceae* (heather). The spore *Pteropsida* (monolete) indet. (ferns) was also often encountered (but spore taxa are not included within the TLP calculations). Occasional pre-Quaternary pollen were present in the basal sample, indicative of the potential reworking of material from elsewhere. Pollen diversity was therefore found to be low in both samples.

Discussion

5.2.20 The dominance of pine within both samples could be interpreted as indicating that dense pine woodland was located proximal to the sampling site at the time of peat deposition. This would fit within the timescale associated with the peat unit, with the south-east of the country likely to have featured pine woodlands during the early Holocene, prior to succession of the more ‘temperate’ vegetation in response to the climatic amelioration (and subsequent human exploitation of the landscape).

5.2.21 However, such interpretations should be treated with caution due to the overall dominance of pine. Isolated dense pine woodland may have been present in the locale, although mixed deciduous woodlands were more ‘typical’ by this time (Huntley & Birks, 1983). The absence of plant macrofossils to support this (Norcott, pers. comm.) in addition to the very low percentages of all other taxa in the sample, suggest that the assemblages may not be a fair representation of the vegetation present at the time of deposition.

5.2.22 Pine is a wind pollinated tree and hence produces very large quantities of pollen (Andersen, 1973). In addition, due to the high sporopollenin content

within its pollen grains pine grains are more resistant to oxidation (Havinga, 1967). Such factors mean that an abundance of pine grains within the samples has the potential to drastically skew interpretations. This, combined with the low overall pollen counts and low species diversity, point towards a modified pollen record (perhaps as a result of post-depositional pollen degradation). The dominance of pine and associated absence of other taxa therefore suggests that, whilst pine was undoubtedly present at the time of deposition, the extent of its overall contribution to the woodland canopy remains uncertain.

5.2.23 Due to the relatively poor preservation encountered within the two samples, it is suggested that no further analysis be undertaken on this peat unit.

Radiocarbon dating

Introduction

5.2.24 Two samples of short-lived waterlogged plant remains from a vibrocore (**VB7013**) were submitted for radiocarbon dating to the Scottish Universities Environmental Research Centre (SUERC) (**Table 5.3**).

Methods

5.2.25 The radiocarbon dates have been calculated using the calibration curve of Reimer et al. (2013) and the computer program OxCal (v4.2.3) (Bronk Ramsey and Lee 2013) and cited in the text at 95% confidence and quoted in the form recommended by Mook (1986), with the end points rounded outwards to 10 years. The range in plain type in the radiocarbon tables has been calculated according to the maximum intercept method (Stuiver and Reimer 1986).). All other ranges are derived from the probability method (Stuiver and Reimer 1993).

Results

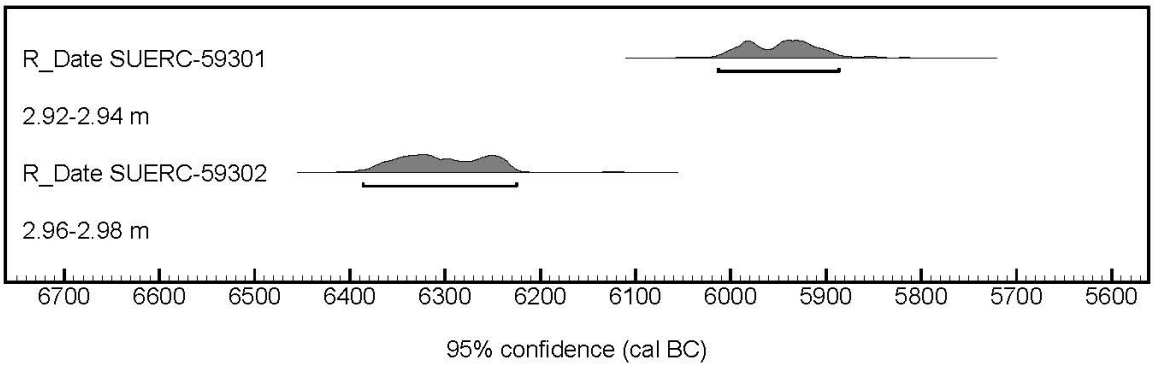
5.2.26 The aim of the radiocarbon dating programme was to determine the age of a peat deposit observed within vibrocore **VB7013**.

5.2.27 SUERC-59301 is on stem fragments from 2.92-2.94 m and SUERC-59302 is on stem fragments from 2.96-2.98 m within this vibrocore. The two dates provide a Late Mesolithic date for the peat deposit within this vibrocore (**Table 5.3** and **Figure 9**).

Table 5.3: Radiocarbon measurements on samples from VB7013

Laboratory Code	Context & sample	Radiocarbon age BP	$\delta^{13}C$ ‰	Calibrated date range (95% confidence)
SUERC-59301	VB7013 (2.92-2.94m) Waterlogged stem fragments	7065±34	-25	6020-5880 cal BC
SUERC-59302	VB7013 (2.96-2.98m) Waterlogged stem fragments	7414±30	-25	6390-6220 cal BC

Figure 9: Calibrated radiocarbon dates



Summary

5.2.28 The vibrocores from the Site returned deposits showing the deposit sequence to comprise active beach deposits with episodes of varying energy (up to 1.03m thick) with underlying chalk deposit possibly from a barge bed structure (up to 0.4m thick). This overlies alluvium (up to 1.62m thick) above a thin peat deposit (at least 0.06 –0.11m thick) at the base of two of the three vibrocores.

5.2.29 The results from samples taken from the peat unit and the overlying alluvium within **VB7013** indicate that there are at least some areas of the Site where probable prehistoric land surfaces are preserved – in this case a terrestrial wetland peat of late Mesolithic date – with demonstrable palaeoenvironmental evidence potential. The presence of contemporary cultural materials in this deposit currently remains an unproven possibility.

5.3 Geoarchaeological deposit model

Introduction

5.3.1 The following sections present sub-surface deposit models for the Site. These were constructed by extrapolating deposits identified within the data across the whole of the Site, including outlying points (**Appendix A.4**). Schematic cross sections were produced in the form of four transects

(located in **Figure 5** and shown in **Figure 6**, and described in **Appendix A.3**).

5.3.2 One Digital Elevation Model (DEM) and one thickness model of the river gravels were produced for the Site (**Figures 7** and **8**). From the results of the deposit modelling four Landscape Zones (LZs) were predicted (**Figure 5**).

Stratigraphic Units

5.3.3 Although not all recorded directly within the Site, six major stratigraphic units are known to exist in the area of the Site. These units are summarised in **Table 5.4** below, and listed in stratigraphic order from the oldest to the most recent.

5.3.4 For deposit modelling purposes the gravel units are recorded – with the exception of active beach deposits where possible – under the collective term of 'river gravels'. Where particular units are mapped locally this will be referred to; however, this evaluation is not designed to date or map gravel terrace deposits.

Table 5.4: Summary of stratigraphic units

Stratigraphic unit	Lithology/Description	Chronology	Environment of deposition
1. Lambeth Group	Clay, silt and sand.	Palaeogene, *c.* 56 to 66 million years ago	Swamps, estuaries and deltas
2. London Clay	Clay, silt and sand.	Palaeogene; 34 to 56 million years ago	Deep sea marine deposits
3. River gravels (including Terrace Gravels, e.g. Kempton Park)	Coarse grained sands and gravels	From Late Devensian, *c.*18–15,000 BP through to Holocene	High energy river regime (e.g. cold climate braided Kempton Park Gravels; (Gibbard 1994 & Bridgland 1994)
4. Organic deposits	Organic silts, clays and peats	Holocene	Temperate climate Stabilisation/channel edge deposits
5. Alluvium	Minerogenic silts, sands and clays	Holocene – ranging from prehistoric to post-medieval	Temperate climate Channel/Channel edge/waterlogged environment
6. Active beach deposits	Sands, sandy gravels and soft muds	Broadly early medieval to post-medieval: probably mostly post-medieval	Tidal foreshore environment

Results

River gravels DEM (Figure 7)

5.3.5 The elevation model was constructed using all 67 deposit records. The resulting DEM indicates that across the Site the surface of the river gravels varied in height from 100m ATD in the west of the Site to approximately 98.55m ATD in the centre of the Site in the vicinity of **VB7012** to 95.53m ATD at the east end of the Site.

5.3.6 The river gravels DEM shows the gravels as forming a terrace with an irregular upper surface in line with the modern course of the river. In the east end of the Site a depression within the gravels aligned approximately SSW–NNE likely indicates an inlet or the point at which a possible earlier tributary channel joined the main one. This 'depression' at the east end of the Site measured approximately 70m across with a base at around 95.5m ATD(at the top of the present foreshore).

River gravels thickness model (Figure 8)

5.3.7 A thickness model was produced in order to gauge the thickness of river gravels present between the active beach, alluvial and organic deposits that made up the surface of the foreshore, and the underlying London Clay.

5.3.8 The river gravels thickness model was constructed using all 67 deposit records, from the resulting model the thickness of the river gravels across the foreshore was mapped as ranging from approximately 2.0m in depth in the west of the Site to approximately 0.85m in depth within the base of the depression identified in the River gravels DEM, in the east of the Site.

Summary

5.3.9 From the deposit record transects, the river gravels DEM and thickness model, the sequence of deposits in the western part of the foreshore Site (the intertidal zone) consisted of London Clay overlain by river gravels, organic deposits, alluvium and surface active beach deposits, as seen in Transect A. The deposit sequence differed in the centre and east of the Site with no organic deposits and the alluvium and river gravels appearing to have been stripped away in the lower foreshore, presumably as a result of scour/dredging.

5.3.10 On the foreshore the river gravels were present in deposit records used in both transects and recorded at their greatest thickness of 3.29m in Transect B (**Appendix A.3**). The deposit records on the upper foreshore indicate the river gravels to be overlain by organic deposits then alluvium and active beach deposits in Transect A, but only alluvium and active beach deposits in Transect B; the eastward extent of the organic deposits on the foreshore is located somewhere between Transect A and B. The organic deposits, where recorded, were up to 0.11m deep with an upper surface at 97.22m ATD in **VB7012A** and 97.96m ATD in **VB7013** (**Appendix A.2**).

5.3.11 Organic deposits were also recorded in available borehole logs to the west of the Site, both on the foreshore (up to 2.13m at 98.48m ATD in

TQ27NE659 and on the landward side (up to 1.95m at 105.79m ATD in TQ27NE869 where the organic deposits were overlain by 2.75m of made ground (**Figure 5**).

5.3.12 The overlying alluvium recorded on the foreshore ranged in thickness from 1.62m (99.58m ATD) in **VB7013** located in Transect A at the top of the foreshore to 0.5m (95.32m ATD) in **SR5003** at the north-west end of Transect A.

5.3.13 The river gravels DEM (**Figure 7**) show the river gravels varying in height from -2.0m OD in the west of the Site to -4.47m OD in the east of the Site. This suggests the presence of a minor channel or inlet running north north-east to south south-west at the east end of the Site. This would appear to correlate with recent geoarchaeological investigations in the area that suggested the presence of such channels (Branch *et al* 2010; Morley 2010).

5.3.14 The river gravels thickness plot (**Figure 8**) modelled the river gravels as up to 2.0m at the western end of the Site decreasing to 0.85m in the base of the depression within the gravels in the eastern end of the Site. The thickness model shows the river gravels as extending across the Site though both Transect A and B (**Figure 6**) indicate the river gravels as having pinched before the northern extent of the Site boundary.

Landscape Zones (LZs)

5.3.15 Four major landscape zones (LZ1, LZ2, LZ3 and LZ4) are predicted across the Site as summarised in **Table 5.5**, and described below and shown in **Figure 5**.

Table 5.5: Summary of Landscape Zones

Landscape Zone	Description	Archaeological potential/ significance[iv]	Palaeoenvironmental potential/significance[v]
LZ1	Area characterised by the presence of sediments in the form of active beach deposits on the surface of the foreshore, comprised of silts, sands, and gravels, with some pockets of finer grained alluvium. Up to a maximum of 0.1.03m in thickness (at 100.22m ATD in VB7012).	Negligible potential for intact terrestrial strata. Probably mainly post-medieval in date. Evidence of post-medieval barge beds and former jetties, and potential for revetments (low significance). Potential for redeposited artefacts of other periods of likely low significance.	Moderate potential for remains of low significance within low-energy alluvial/ tidal muds
LZ2	Low/medium energy alluvial deposits occasionally with coarser inwashes. Up to maximum of 1.62m (99.58m ATD) in VB7013 located in Transect A. Underlying active beach deposits LZ1. Possible lateral extension of alluvium recorded on the landward side of the river wall.	Moderate to high potential for possible prehistoric to medieval river-associated activity within mouth of and adjacent to the identified tributary channel/inlet. Significance depends on date and type of any such remains: e.g. Early Saxon fish trap remains that extend into east of Site of high significance, as would be any potential prehistoric timber structures or boats.	Moderate to high potential for remains of medium or high significance

[iv] The significance level is determined using the criteria in Section 7 of ES Vol 2 Methodology

[v] Ibid.

Landscape Zone	Description	Archaeological potential/ significance[iv]	Palaeoenvironmental potential/significance[v]
LZ3	Area characterised by periods of stabilisation promoting peat formation together with periods of marine inundation. Organic peats, silts, and clays, of indeterminate date, where recorded up to 2.13m (at 98.48m ATD in TQ27NE659 outside to the west of the Site), Recorded to be at least 0.06 and 0.11m thick in Transect A within Site's foreshore during this evaluation Underlying LZ2.	Evidence of prehistoric terrestrial strata as evidenced by radiocarbon dated Late Mesolithic peat in VB7013 (at 97.96 to 97.85m ATD). Potential for evidence of occupation/ dry-land activity including timber structures and artefacts within such deposits (High significance).	High potential for remains of medium to high significance
LZ4	Undifferentiated river gravel units (Kempton Park gravels are mapped locally). This river gravel units may include silts and sands as well as gravel sediments. Where recorded, ranging from 0.50m to 2.29m in thickness (97.71m ATD in Transect B). Underlying LZ3. Possible lateral extension of river gravel deposits recorded on the landward side of the river wall.	Moderate potential for Holocene river gravels, low archaeological potential. Moderate to high potential for Pleistocene river gravel to be present, negligible potential for archaeological remains.	Low palaeoenvironmental potential

5.3.16 Based on the deposit modelling transects, active beach deposits (LZ1) are mapped over most of the Site, except the far north-east of the Site (**Figure 5**). The transects in **Figure 6** show a reduction in the river bed level since TQ27NE634 was drilled in the 1950's resulting in erosion of the river gravels, although as active beach deposits are by nature a result of the interaction between the active river system and the surface over which the river runs, active beach deposits may be present, but in an unknown form and depth.

5.3.17 Organic deposits (LZ3) underlie LZ2 and are mapped over the upper part of the foreshore in the west of the Site. The organic deposits, where recorded during this evaluation, were thin (0.06 and 0.11m in thickness), although their full thickness was not necessarily ascertained from the drilled vibrocores. No organic deposits were recorded within the landward deposit records indicating the organic deposits recorded here are not a demonstrable lateral extension of deposits recorded on the landward side of the Site, though organic deposits were recorded in boreholes (TQ27NE659 in a similar foreshore location and TQ27NE869 on the landward side of the river wall) to the west of the Site, where they were thicker (approximately 2m thick).

5.3.18 River gravels (LZ4) were mapped over the majority of the Site with the exception of an area approximately 60m by 20m in the northern end of the Site. Based on transects A and B the river gravels may survive at depth further down the foreshore into the River Thames due to their lower depth preventing their removal compared to the overlying alluvium and organic deposits of LZ2 and LZ3 whose higher elevation makes them more vulnerable to erosion. The transects also show that the river gravels recorded on the foreshore are a lateral extension of those recorded on the landward side of the river wall.

5.4 Overall reliability of the results

5.4.1 The data quality of the parametric sonar survey was defined as **Average**. Full planned data coverage was successfully achieved.

5.4.2 The walkover survey was completed successfully as the majority of the foreshore was accessible at the time of the survey except a small area in the south-west because of the presence of a moored barge.

5.4.3 The density of deposit records used in the deposit modelling was relatively sparse and distributed across the centre of the Site, with six data points falling within the Site bounds on the foreshore, with only four of these located on the inter-tidal area itself, one of which was a historic borehole; the other records were located on the lower foreshore beneath the present River Thames. Despite this, the accuracy of the predictive model is likely to be satisfactory regarding the distribution and thicknesses of the major units.

6 Archaeological potential and significance

6.1 Review of aims and objectives

Site specific questions

6.1.1 Drawing on the results presented in Sections 4 and 5, the following is concluded in relation to each of the objectives detailed in para 1.3.3:

a. What is the topography of the foreshore at present, and how does this change over time (scour, sedimentation etc.)?

6.1.2 Bathymetry data has been assessed as part of the ongoing condition monitoring programme of the foreshore Sites. This programme compares foreshore topographical data to evaluate the rate and significance of sediment erosion and deposition at each Site (ongoing alluvial processes) to show the effects on any buried archaeology that may be present. The results of the first monitoring report (Wessex Archaeology 2014; TTT document reference forthcoming) indicates a number of areas have experienced sediment accumulation of up to +0.4m between October 2013 and March 2014, this has occurred both in the deeper channel of the River Thames and close to the shore. The foreshore Site is dominated by two outfall pipes and the disturbance from these is seen in the bathymetry data (**Appendix A4**). Areas of significant accumulation appear to have been built up around these between October 2013 and March 2014; however, this is likely to be a data artefact (*ibid*). In conclusion, any buried archaeology that may be present at this Site is not currently being significantly affected by ongoing fluvial erosion.

b. What is the depositional sequence at the Site?

6.1.3 Assessment of three vibrocores located on the foreshore within the centre of the Site show active beach deposits of silt, sand and gravel up to approximately 1.0m thick directly overlying possible barge beds of re-deposited chalk, above alluvium in **VB7012A** and **VB7013**. The alluvium (up to 1.62m thick in **VB7013**) overlay a thin peat layer in **VB7012A** and **VB7013** (0.11m thick at 97.08m ATD in **VB7013**). It is not certain if the full extent of the peat was recorded in the cores as they were terminated at *c.*3m depth, or if this apparently thin deposit is the surface of a thicker peat deposit.

6.1.4 Deposit modelling indicated that the deposit sequence displayed in the vibrocores is not representative of the whole foreshore Site. Whereas the alluvium overlay peat, over river gravels in Transect A, the alluvium directly overlay river gravels in Transect B, above London Clay bedrock. Therefore the organic deposits are predicted to be confined to the central and west end of the foreshore Site. Although, where recorded in this evaluation, these organic deposits were thin and are not demonstrated to be a lateral extension from the landward side of the Site, thicker organic deposits (approximately 2m thick) were recorded in boreholes *c.*30m west

of the Site, both in a similar foreshore location and on the landward side of the river wall (**Figure 5**).

6.1.5 A difference in the surface height of the river gravels was seen in the digital elevation model produced for this evaluation (**Figure 7**) and is interpreted as evidence of a former channel or inlet joining the main river channel in the east of the Site. The preservation of organic peat deposits/probable land surfaces to the west of the Site therefore seems to fit with the predicted palaeotopography of the Site.

6.1.6 The river gravels deposits range from 0.50m to 2.29m in thickness.

c. Is there any evidence for the survival of deposits of palaeoenvironmental significance?

6.1.7 Evidence of deposits of palaeoenvironmental significance was recorded from a layer of peat at the base of two of the three assessed vibrocores (**VB7012A** and **VB7013**). Sub-samples taken from **VB7013** (height at approximately 97.96m ATD) and sent for radiocarbon dating have returned a late Mesolithic date for this probable land surface.

6.1.8 Assessment of very small sub-samples taken for palaeoenvironmental assessment from this peat layer in **VB7013**, and the overlying alluvium within the same core indicate some macrofossils, but little calcareous material such as foraminifera or ostracods. Both pollen sub-samples were dominated by pine. The evaluation proves that there is demonstrable survival of palaeoenvironmental evidence, and further potential may exist in similar probable land surfaces and alluvial deposits on the inter-tidal zone.

6.1.9 A thin layer of peaty clay (**5010**) was also identified during the walkover survey in the west of the Site only exposed at low tide (at98m ATD). It was not feasible to bulk sample this deposit, however the height of this deposit is comparable to the radiocarbon dated peat deposit in **VB7013**, and therefore it is too most likely of a late Mesolithic date.

d. Is there any evidence of prehistoric to post-medieval activity on the Site?

6.1.10 The peat in the vibrocore is radiocarbon dated as late Mesolithic and as explained above the exposed area of peaty organic clay **5010** in the west of the foreshore Site is likely to be of this date also. Timber **5009** located in this area, could have an association with the peaty deposit, but is presently undated.

6.1.11 A double alignment of timber posts of a fish trap, previously investigated by TDP in 2010 and radiocarbon dated to the Early Saxon period were surveyed. It has been shown that the western extent (approximately 7m) of the total exposed 23m alignment of the structure (**5011**) is located within the Site, and that further timbers have been exposed since it was previously surveyed in 2010, and so the likelihood that further remains of this structure are buried beneath the surface of the present foreshore within the Site is high (**Figure 4**). A small area with traces of preserved wood to the north of this (**5005**) wasn't fully investigated but could

represent small stakes or withies that could potentially be associated with the nearby fish trap.

6.1.12 Square-cut timbers recorded on the central foreshore (**5001**, **5002**, **5006**, **5007** and **5008**) are likely related to an early-mid 20th century jetty known from historic maps examined for the ES.

6.1.13 Most of the datable finds retrieved are post-medieval in date, with the exception of a Romano-British tile fragment and a prehistoric flint core.

e. What is the character, date, condition and significance of deposits encountered?

6.1.14 The active beach deposits are probably mainly post-medieval in date.

6.1.15 The foreshore alluvium is of uncertain Holocene date; however, the radiocarbon dated underlying peat deposit is late Mesolithic so the alluvium post-dates this; although there is the potential for different episodes of peat accumulation and alluvium formation within the deposit sequence on the foreshore. This is significant as such deposits have increased potential for the preservation of organic river-associated archaeological remains and palaeoenvironmental remains. The alluvium likely relates to a NNE–SSW aligned minor tributary or inlet. Deposit modelling indicates probable lateral continuity of alluvial deposits from the landward side of the river wall onto the foreshore of the Site.

f. What is the extent of archaeological survival across the Site?

6.1.16 Evidence from the deposit modelling, vibrocore assessment and comparison with the bathymetric plot of the present river bed (**Appendix A.5**) indicates that archaeological survival is affected in the north-east of the Site: the surface height of a borehole drilled in the 1950s at the north end of Transect B is higher than the surface of the present riverbed, indicating that the alluvium and upper part of the underlying river gravels have since been removed in this locality. This is largely confined to the north of the intertidal area (**Figures 5** and **6**) and most likely is a result of scour/dredging.

6.1.17 The bathymetric data and PS data also indicates disturbance to the river bed in this north-east part of the Site in the form of erosion related to two outfall pipes and accumulation from dumped aggregate on the riverbed's surface.

6.1.18 The extant 1950s jetty that extends onto the upper eastern foreshore will likely have had a minor local impact on archaeological survival on the foreshore within the footprint of its piles. Some shallow localised disturbance may also be present around the moored barge in the south-west of the Site. A narrow corridor of disturbance along the extant river wall from its construction is also likely, although the depth of impact is unknown for all of the above.

6.1.19 Archaeological survival is therefore generally considered to be best on the intertidal zone of the foreshore Site, away from the areas of previous impact outlined above, with organic deposits only expected to be preserved in the centre and west of the Site.

g. What is the (seasonal) influence of tidal patterns and storm events on the archaeology of the foreshore?

6.1.20 Ongoing conditioning monitoring of the Site will provide a detailed assessment of tidal and storm event influences on the archaeology. Results are scheduled to be provided on a quarterly basis over the 2014/2015 assessment period, dependant on the rate of third-party resurvey.

6.2 Predicted archaeological survival

6.2.1 The results of this evaluation indicate the following predicted archaeological survival:

- Surviving Late Devensian and Holocene deposits sequences may provide a record of environmental change and local palaeotopography;
- Areas of organic probable land surfaces of at least one period on central and western foreshore (one such deposit radiocarbon dated to late Mesolithic) containing palaeoenvironmental remains and potentially archaeological remains (one undated timber surveyed within the locality of an exposed peat deposit could be evidence of this, or of later riverfront activity);
- Other prehistoric and later remains may be buried within the alluvial sequence which could be associated with marginal wetland or riverfront activity (including timber structures such as the Early Saxon fish trap demonstrated to extend into the east of the foreshore Site); and
- Evidence of post-medieval remains relating to industrial use of foreshore including fragments of millstones, piles from previous jetty and barge beds, as well as potential for evidence of land reclamation (revetments, former river walls).

6.2.2 In summary, predicted archaeological survival previously described in the OAWSI and ES (as summarised in Section 2 above) can be revised and in light of the above overall archaeological survival is considered to be **Moderate to High**.

6.3 Significance

OAWSI assessment of significance

6.3.1 Based on the results of the survey techniques employed to evaluate the Site, the overall significance of the archaeological potential of the Site is deemed to be **Medium to High**, in relation to the identified research aims (OAWSI).

6.3.2 The main areas of significance are:

- Areas of organic probable land surface, one dated as late Mesolithic, may provide evidence of prehistoric occupation, as well as a record of environmental change;
- Buried alluvium across most of intertidal zone may contain buried archaeological river-associated remains, as well as a record of environmental change; and
- An Early Saxon fish trap timber structure located partly within the eastern foreshore of the Site.

Significance of the Site

6.3.3 With regard to *Conservation Principles, Policies and Guidance* (Historic England 2015), the results of the evaluation have been considered against the key criteria of Evidential, Historical, Aesthetic and Communal Value, to identify the significance of the Site's archaeology and to determine whether as undesignated assets the remains might be deemed of equal significance to designated assets.

6.3.4 Evidential Value: the Site has clear evidential value in the form of the remains of a radiocarbon dated Early Saxon timber fish trap structure that partly extends into the east of the foreshore Site as well as industrial post-medieval remains. The fish trap remains are of high significance as they are comparatively rare from the Thames with four or possibly five Early Saxon examples known and are also relatively rare from Great Britain (Cohen 2011, 136). The structure has the potential to provide evidence on Early Saxon activity, including the procurement of riverine food resources and, perhaps, to provide inferences on woodland management and settlement patterns during the period. Areas of peaty probable land surface in the west of the foreshore Site were also recorded, of which one has been radiocarbon dated to the late Mesolithic period. The deposit has a proven potential to provide palaeoenvironmental evidence, and may also contain contemporary cultural materials in relation to the exploitation of riverine resources and settlement. This asset should for this reason also be considered to be of medium to high value, depending on its state of preservation and extent, which is currently uncertain but is possibly likely to be patchy. Overall, Evidential Value therefore is considered to be of medium to high significance.

6.3.5 Historical Value: in the context of the use of the Thames foreshore over time, the development of the nation's capital, and reliance on sea-faring trade, could be considered of high value. Whilst the wider area around Heathwall Pumping Station has regional to national historical value in the form of the development of Battersea Power Station to the west, and in closer proximity, the Southwark and Vauxhall Water Works, the London Gas Works, the South Western Goods Depot and the Southwark and Vauxhall Water Works, by comparison the historical development of Middle Wharf and the Heathwall Sewage Pumping Station is considered of local to regional significance at most. Historical Value overall is therefore considered to be of local to regional significance.

6.3.6 Although Londoners, and the many millions of visitors to the city each year, draw great comfort and inspiration from the River Thames and the built heritage that defines its course, Heathwall Pumping Station foreshore might be considered of limited Aesthetic Value. As such, Aesthetic Value is deemed to be of local significance.

6.3.7 Communal Value: the social value of the foreshore with those that relied on the resource of the river, worked on it, interacted with it and lived alongside it (as, for instance, was the case with the London docks) was formerly high. In more recent times, many factors (not least technology, trade, economics etc.) have seen communities change, trades relocate, and traffic reduce, to a point that communal value must be considered relatively low (certainly by comparison). Communal Value is therefore considered of local significance only.

6.3.8 Although there are elements that may be considered of regional significance, particularly in relation to the Site's Evidential Value, as a whole, the heritage revealed during this foreshore evaluation at Heathwall Pumping Station foreshore is of local significance..

6.4 Discussion

6.4.1 This evaluation, whilst confirming the overall moderate to high potential and medium to high significance of the HEAPS Site, has also highlighted the likely nature of the deposit sequence that exists beneath the foreshore. This deposit sequence varies in depth and complexity across the foreshore Site. Preservation is likely to be best on the intertidal zone, where an alluvial sequence is predicted and in the central and western intertidal zone, where a radiocarbon dated late Mesolithic peat deposit was recorded from vibrocores. A pocket of peaty probable land surface was also exposed in this location on the present foreshore surface; although this could not be sampled and dated as part of the survey, a comparison of relative height with the dated land surface dated suggests this could be of a similar date.

6.4.2 Vibrocore assessment and deposit modelling has shown the deposit sequence to vary in thickness and complexity across the foreshore Site; in the north-east foreshore (below the present river) the deposit sequence is limited to less than one metre of river gravels overlying London Clay, presumably as a result of erosion and/or dredging having removed all of the previously overlying deposits. Across most of the intertidal area the overall deposit sequence is predicted to comprise around 4–5 metres in thickness; however, in this area the deposit sequence is thicker, comprises recent active beach deposits up to *c.*1.0m thickness overlying Holocene alluvium up to *c.*1.6m thickness, and, in places, overlying prehistoric organic deposits of at least 0.11m thickness in the centre and west of the Site., and Rivers gravels of up to *c.*2m thickness underlie this sequence above London Clay geology.

6.4.3 This deeper deposit sequence suggests a changeable environment through the Holocene, when the Thames was evolving from a braided channel system to a single-channel form. During dryer periods land

surfaces may have formed, perhaps only in localised areas, together with periods of alluvium formation, and likely in association with the infilling of an identified Late Pleistocene/Early Holocene channel. The identification of this channel is comparable to similar discoveries from recent geoarchaeological investigations in the area (Branch *et al* 2010; Morley 2010).

6.4.4 This site formation history is important for understanding known identified and as yet undiscovered buried archaeological remains within the Site. Whilst the foreshore Site itself is not situated on the Battersea eyot (and therefore Holocene settlement is perhaps unlikely), the presence of the peaty probable land surface dated to the late Mesolithic indicates that areas of the foreshore Site may have been suitable for occupation/dry-land activity at various times in prehistory. There is therefore potential for cultural material to exist within relation to such deposits. These may include wetland/riverfront archaeological structures of prehistoric and later dates buried within the alluvium.

6.4.5 This evaluation has shown the potential significance of the Site to contribute towards the Route-wide Heritage Themes (RWHTs). Dependent on the results of any proposed mitigation work, these themes can now be revised in the light of the evaluation to include :

- Theme 1: Palaeoenvironment and prehistory; and
- Theme 3: River management, transport, infrastructure and trade.

7 Predicted impacts and recommendations

7.1.1 The following predicted impacts of the proposed works have been identified:

- Construction on the foreshore of temporary and permanent cofferdams, outfall apron, and temporary campsheds for barge access to the north/north-east of the Site. The cofferdams will have a direct impact on any surviving archaeological and palaeoenvironmental remains, described in section 6.2 above, within their footprints. The main focus of construction activities is on the central and western foreshore, where archaeological preservation is likely to be best.
- Scour around foreshore structures, and any plant movement on the foreshore outside of the All Site Structure Zone, could affect fragile archaeological remains in the east of the Site, including the Early Saxon fish trap.
- Site enabling works and deep excavations associated with construction of CSO shaft, culverts and chambers would have an effect on any land-based remains present on the Site (not evaluated as part of this foreshore-based evaluation).

7.1.2 It is recommended that targeted archaeological survey and investigation, including environmental sampling (focused on the foreshore construction areas) should record surviving late Mesolithic probable land surfaces and buried alluvial deposits and any associated artefactual materials and structures they may contain. Post-medieval assets identified in this evaluation should also be recorded prior to their removal, thereby achieving the preservation by record of these remains. Detailed mitigation proposals should also focus on the Early Saxon fish trap in the eastern foreshore, which is of high archaeological significance and may be indirectly affected by the proposals.

7.1.3 Further to the recommendations set out above, mitigation options will be reviewed and developed in detail with the main works contractor, during the detailed design phase. The proposed mitigation strategy will then be set out in a SSAWSI, to be submitted to and approved by the HMBCE Advisor prior to the commencement of any on-site enabling and construction work.

Appendix A: Specialist reports

A.1 Targeted walkover survey

Table A.1.1: Targeted walkover survey: all finds

Site Code	Context	Object No	Material Type	Object Type	No.	Wt. (g)	Comments	Pot Fabric Code	Pot Form Code
TTP 14	5000		Pottery	base sherd	1	5		BONE	
TTP 14	5000		Pottery	base sherd	1	21		BONE	
TTP 14	5000		Pottery	body sherd	1	20	hand-painted dec	CHPO	
TTP 14	5000		Pottery	base sherd	1	27		ENGS	
TTP 14	5000		Pottery	body sherd	1	11		ENGS	
TTP 14	5000		Pottery	object	1	113	Beer tap surround? Embossed with GINGER…	ENGS	
TTP 14	5000		Pottery	rim sherd	1	52	rim of large bottle or flagon	ENGS	BOT GING,PPOT
TTP 14	5000		Pottery	rim sherd	1	42	Unusual form: bottle neck with applied pads/strips either side of neck	ENGS	BOT,PPOT
TTP 14	5000		Pottery	profile	1	113	small cylindrical inkwell	ENGS	INK,PPOT
TTP 14	5000		Pottery	base sherd	1	24	small cylindrical jar/bottle	ENGS	
TTP 14	5000		Pottery	body sherd	1	56		ENGS BRST	
TTP 14	5000		Pottery	body sherd	1	51	body/shoulder of medium cylindrical jar (ochre-dipped)	ENGS BRST	JAR CYL,PPOT

Site Code	Context	Object No	Material Type	Object Type	No.	Wt. (g)	Comments	Pot Fabric Code	Pot Form Code
TTP 14	5000		Pottery	rim sherd	1	83		ENGS BRST	BOT,PPOT
TTP 14	5000		Pottery	profile	1	115	small preserve jar; wide-spaced ribbing	ENGS BRST	JAR CYL,PPOT
TTP 14	5000		Pottery	handle	1	135		ENGS BRST	FLAG,PPOT
TTP 14	5000		Pottery	body sherd	1	29		ENGS BRST	
TTP 14	5000		Pottery	base sherd	2	4	back stamp GEN… / B… / W…	ENGS BRST	
TTP 14	5000		Pottery	base sherd	1	40	Hartley's jam jar; backstamp …EART… / HARTLEY'S / …BEL	ENGS BRST	JAR CYL,PPOT
TTP 14	5000		Pottery	base sherd	1	107	Decorative item	ENPO	
TTP 14	5000		Pottery	rim sherd	1	15	flat lid	NOTS	LID,PPOT
TTP 14	5000		Pottery	rim sherd	1	43		REFR	TPOT,PPOT
TTP 14	5000		Pottery	base sherd	1	13	probably teapot	REFR	
TTP 14	5000		Pottery	body sherd	1	46	possibly part of handle? Brown glaze	REFW	
TTP 14	5000		Pottery	rim sherd	1	17		REFW	PLAT,PPOT
TTP 14	5000		Pottery	body sherd	1	8		REFW	PLAT,PPOT
TTP 14	5000		Pottery	rim sherd	1	38		REFW	DISH,PPOT
TTP 14	5000		Pottery	rim sherd	1	44		REFW	PLAT,PPOT
TTP 14	5000		Pottery	rim sherd	1	25		REFW	PLAT,PPOT
TTP 14	5000		Pottery	rim sherd	1	3		REFW	PLAT,PPOT
TTP 14	5000		Pottery	body sherd	1	7		TPW	
TTP 14	5000		Pottery	rim sherd	1	15		TPW	PLAT,PPOT
TTP 14	5000		Pottery	rim sherd	1	15		TPW	PLAT,PPOT
TTP 14	5000		Pottery	base sherd	1	14	flatware	TPW3	

Site Code	Context	Object No	Material Type	Object Type	No.	Wt. (g)	Comments	Pot Fabric Code	Pot Form Code
TTP 14	5000		Pottery	rim sherd	1	10		TPW4	
TTP 14	5000		Pottery	rim sherd	1	7		TPW4	PLAT,PPOT
TTP 14	5000		Pottery	body sherd	1	50	Transfer-printed on inside	YELL	BOWL,PPOT
TTP 14	5000		Pottery	base sherd	1	98	Transfer-printed on inside	YELL	BOWL,PPOT
TTP 14	5000		Animal Bone	animal bone			3 x large mammal, split axially		
TTP 14	5000		Animal Bone	animal bone			1 x cow metatarsal, split axially		
TTP 14	5000		Animal Bone	animal bone			1 x red deer antler		
TTP 14	5000		Animal Bone	animal bone			1 x horse tooth, upper jaw		
TTP 14	5000		Animal Bone	animal bone			1 x horse tooth, lower jaw		
TTP 14	5000		Animal Bone	animal bone			1 x unidentifiable		
TTP 14	5000	16	Flint	Core	1	215			
TTP 14	5000		Clay Pipe	stem	1	1	Very thin stem. Unidentifiable.		
TTP 14	5000		CBM	tile	1	82	Roman; box flue tile, combed		
TTP 14	5000		CBM	tile	1	13	Modern white-glazed tile		
TTP 14	5000		CBM	drainpipe	1	61	Fragment of orange-brown-glazed drainpipe		
TTP 14	5000		Glass	bottle	1	83	19th - 20th century clear glass bottle base. Very worn.		
TTP 14	5000		Glass	drinking vessel	1	97	C20th base of heavy clear glass		

Site Code	Context	Object No	Material Type	Object Type	No.	Wt. (g)	Comments	Pot Fabric Code	Pot Form Code
							drinking vessel		
TTP 14	5000		Glass	vessel	1	42	Solid clear glass base of small vessel		
TTP 14	5000		Glass	bottle	1	19	Neck of clear blue glass bottle with narrow neck.		
TTP 14	5000		Glass	bottle	1	29	Mouth of clear glass bottle.		
TTP 14	5000		Glass	bottle	1	8	Small clear glass bottle stopper		
TTP 14	5000		Glass	jar	1	127	Brown glass 2oz Marmite jar		
TTP 14	5000		Glass	object	1	7	Clear glass marble with blue centre		
TTP 14	5000		Glass	object	1	4	Blue glass marble		
TTP 14	5000		Other ceramic	door knob	1	127	White ceramic door knob		
TTP 14	5000		Other ceramic	uncertain	1	54	C20th circular white ceramic item		
TTP 14	5000		Iron	strip	1	73	Handle made from curved iron strip. No decoration visible. Partially encrusted with stones.		
TTP 14	5000		Iron	spanner	1	81	Spanner with 15mm jaws, covered in corrosion products.		

Site Code	Context	Object No	Material Type	Object Type	No.	Wt. (g)	Comments	Pot Fabric Code	Pot Form Code
TTP 14	5000		Copper Alloy	spoon	1	12	Small spoon with elongated oval bowl. Stamped SILTONA on underside of handle.		
TTP 14	5000		Lead Alloy	toy	1	28	Cast 8-spoked wheel 1 3/4" diameter from a toy or model		

A.2 Geoarchaeological sediment descriptions

Table A.2.1: Vibrocore 7012 sediment description table

Location:	52952.75 177657.76	**Mono:**	VB7012	**Comments: TTT Heathwall Pumping Station** **Borehole 7012**		
Level (top):	0.22m OD	**Drg:**				
Depth		**Context**	**Samples**	**Sediment description**	**Interpretation**	
Mono	mOD					
0.00-0.65	0.22 – -0.43			GAP (compression)	GAP (compression)	Fluvial sandy gravels. Foreshore deposit.
0.65-1.03	-0.43 – -0.81			2.5Y 4/3 olive brown gravel with very wet sandy silt loam matrix. Clast supported. Poorly sorted, clast size <10cm. Patch of 10YR 2/1 black stained sandy matrix at 0.78-0.88 with a strong diesel smell.	Active beach deposits	

Table A.2.2: Vibrocore 7012A sediment description table

Location:	529525.2 177659.7	**Mono:**	VB7012A	**Comments: TTT Heathwall Pumping Station** **Borehole 7012A**		
Level (top):	0.19m OD	**Drg:**				
Depth		**Context**	**Samples**	**Sediment description**	**Interpretation**	
Mono	mOD					
0.00-0.28	0.19 – -0.09			GAP (compression)	GAP (compression)	
0.28-0.51	-0.09 – -0.32			10YR 4/2 dark greyish brown sandy gravel with some clay. Poorly sorted gravel, clast size <3cm. Slightly sandier at bottom 1cm. Sharp boundary	Active beach deposits	Fluvial sandy gravels and beach deposits, high and low energy events with a chalk dump.
0.51-0.84	-0.32 – -0.65			2.5Y 8/1 white chalk. Very compact with some large chunks <8cm. Sharp boundary.	Chalk dump (Barge bed?).	

Location:		529525.2 177659.7	**Mono:**	VB7012A	**Comments: TTT Heathwall Pumping Station** **Borehole 7012A**	
Level (top):		0.19m OD	**Drg:**			
Depth		**Context**	**Samples**	**Sediment description**	**Interpretation**	
Mono	mOD					
0.84-1.03	-0.65 – -0.84			7.5YR 3/1 very dark grey – 10YR 2/1 black sandy clay loam with gravel <3cm and small lumps of coal. Poorly sorted, fairly compact.	Foreshore/Beach deposits	
1.03-1.35	-0.84 – -1.16			GAP (compression)	GAP (compression)	
1.35-1.55	-1.16 – -1.36			10YR 3/1 very dark grey silty clay with small gravel and some sand. Becomes sandier with more gravel towards the bottom, size of gravel increases <3cm. Small frags of oyster shell.	Low energy alluvial deposit.	Low energy alluvial deposits
1.55-1.62	-1.36 – -1.43			GAP (compression)	GAP (compression)	
1.62-1.73	-1.43 – -1.54			10YR 3/1 very dark grey silty clay with some patches of sand, especially at the top where the gap is. Abundant freshwater molluscs, some identified: *Valvata piscinalis, Bithynia tentaculata* and *Radix balthica*, these species indicate flowing water. Abrupt boundary.	Low energy/area of flowing freshwater, likely channel edge.	Channel edge with flowing water.
1.73-2.03	-1.54 – -1.84			10YR 4/2 dark greyish brown sandy gravel. Poorly sorted gravel, clast size <5cm. Slightly sandier towards the bottom. Clear boundary.	High energy alluvial deposit	High energy alluvial sandy gravels and beach
2.03-2.62	-1.84 – -2.43			GAP (compression)	GAP (compression)	

Location:		529525.2 177659.7	**Mono:**	VB7012A	**Comments: TTT Heathwall Pumping Station** **Borehole 7012A**		
Level (top):		0.19m OD	**Drg:**				
Depth		**Context**	**Samples**	**Sediment description**	**Interpretation**		
Mono	mOD						
2.62-2.80	-2.43 – -2.61			10YR 4/2 dark greyish brown sandy gravel. Poorly sorted gravel, clast size <8cm. Clear boundary.	High energy alluvial deposit.	Alluvial/Fluvial sandy gravels and alluvial deposits, high and low energy events	
2.80-2.91	-2.61 – -2.72			10YR 3/1 sandy silt loam. Fairly compact with moderate poorly sorted gravel <3cm but mostly smaller <1cm. Some fragments of mollusc shell, too small to identify. Abrupt boundary.	Alluvial deposit, fairly low energy.		
2.91-2.97	-2.72 – -2.78			10YR 3/1 very dark grey – 10YR 2/1 black soft buttery clay. Massive, stone free. Abrupt boundary.	Low energy alluvial deposit, choking off peat.	Peat being choked off.	
2.97-3.03	-2.78 – -2.84			10YR 2/1 black fine peat. Soft with recognisable plant remains, bog beans and woody pieces. No apparent horizontality.	Peat.		

Table A.2.3: Vibrocore 7013 sediment description table

Location:	529526.18 177650.76	**Borehole:**	VB7013	**Comments: TTT Heathwall Pumping Station** **Borehole 7013**		
Level (top):	0.88m OD	**Drg:**				
Depth		**Context**	**Samples**	**Sediment description**	**Interpretation**	
Mono	mOD					
0.00-0.25	0.88 – 0.63			GAP (compression)	GAP (compression)	
0.25-0.45	0.63 – 0.43			10YR 3/2 very dark greyish brown sandy silt with gravel. Clast supported, moderately well sorted, clast size <3cm. Clear boundary.	Active beach deposit	Foreshore sandy gravels and beach deposits
0.45-0.93	0.43 – -0.05			10YR 2/1 black sand and gravel. Compact with a slight diesel smell. Pieces of brick, coal and metal observed. Sharp boundary	Active beach deposit.	
0.93-1.03	-0.05 – -0.15			2.5Y 8/1 white chalk. Fairly compact, large piece of metal present.	Chalk dump (barge bed)	Chalk dump
1.03-1.13	-0.15 – -0.25			GAP (compression)	GAP (compression)	
1.13-1.30	-0.25 – -0.42			2.5Y 8/1 white chalk. Fairly compact. Boundary sharp but a little mixed up with below.	Chalk dump (?barge bed)	
1.30-1.46	-0.42 – -0.58			10YR 3/1 very dark grey silty clay, some chalk from above mixed in at boundary. Sparse small gravel and small patches of sand. Clear boundary.	Low energy alluvial deposit	Fluctuating high and low energy alluvial deposits with

Location:	529526.18 177650.76	**Borehole:**	VB7013	**Comments: TTT Heathwall Pumping Station** **Borehole 7013**		
Level (top):	0.88m OD	**Drg:**				
Depth		**Context**	**Samples**	**Sediment description**	**Interpretation**	
Mono	mOD					
1.46-1.65	-0.58 – -0.77			2.5Y 3/3 dark olive brown sandy loam. Horizontal laminations of finer and coarser sand. Abundant freshwater molluscs throughout: *Valvata piscinalis* and *cristata, Bithynia tentaculata* (and opercula)*, Radix balthica, Planorbis planorbis, Theodoxus fluviatilis* and *Pisidium amnicium.* The mollusc assemblage indicates constant flowing water. Ostracods also observed. Concentrations of molluscs at 1.59-1.62. Sand grains become finer down profile. Sharp boundary	Possible channel edge with flowing water as indicated by the mollusc assemblage, alluvial deposits fluctuating between high and lower energy.	
1.65-2.03	-0.77 – -1.15			10YR 3/1 black silty clay oxidising to 2.5Y 3/3 dark olive brown. Fine horizontal laminations of 2.5Y 3/1 very dark grey. Fine sand layer at 1.70-1.72 and a coarse sand layer at 1.90-1.95. Rare small gravel <1.5cm and rare waterlogged roots.	Low energy alluvial deposits interspersed with higher energy events.	Fluctuating high and low energy alluvial deposits with fluvial sandy gravels.
2.03-2.41	-1.15 – -1.53			Core disturbed	Core disturbed	
2.41-2.54	-1.53 – -1.66			2.5Y 4/4 olive brown sandy gravel. Poorly sorted, clast size <4cm. Abrupt boundary.	High energy alluvial deposit.	
2.54-2.62	-1.66 – -1.74		F+O 2.56-2.58m	2.5Y 3/1 very dark grey soft buttery silty clay. Massive, stone free. Sharp boundary.	Low energy alluvial deposit.	

Location:	529526.18 177650.76	**Borehole:**	VB7013	**Comments: TTT Heathwall Pumping Station** **Borehole 7013**		
Level (top):	0.88m OD	**Drg:**				
Depth		**Context**	**Samples**	**Sediment description**	**Interpretation**	
Mono	mOD					
2.62-2.92	-1.74 – -2.04		F+O 2.67-2.69m F+O 2.77-2.79m F+O 2.84-2.86m	7.5YR 2.5/1 black very humic silty clay. Nearly a peat but not quite developed enough. Recognisable plant remains throughout and some waterlogged woody fragments increasing down profile. Abrupt boundary.	Low energy deposit. Alluviation choking off peat below.	Alluviation choking off peat below.
2.92-3.03	-2.04 – -2.15		P 2.92m P 2.97m M+C14 2.92-2.94 M+C14 2.96-2.98	10YR 2/1 black peat. Very soft with abundant plant remains and larger pieces of woody roots throughout.	Peat.	Peat

A.3 Deposit modelling: transect descriptions (Figure 6)

Transect A

Transect A ran from north-west to south-east across the west end of the Site, it measured approximately 94m long and contained five deposit records. Two deposit records (TQ27NE629 and TQ27NE630) were located on the landward side of the Site and three (VB7013, VB7012A and SR5003 were located on the foreshore.

The first deposit record (TQ27NE629) was located at the south-east end of the transect where the deposits were recorded as 3.35m of made ground over 3.22m of alluvium over 2.94m of river gravels over London Clay. The second deposit record (TQ27NE630) was located approximately 22m along the transect where the deposits were recorded as 4.21m of made ground over 1.82m of alluvium over 2.74m of river gravels over London Clay.

The third deposit record VB7013 was located on the foreshore approximately 43m along the transect and 5m out from the embankment where the deposits were recorded as 1.3m of active beach deposits, which included a layer of compact redeposited chalk from 0.93 – 1.3m (possibly evidence of a buried barge bed feature) over 1.62m of alluvium over peat (0.11m thick). The fourth deposit record (VB7012A) was located on the foreshore 51m along the transect and 13m out from the embankment where the deposits were recorded as 1.35m of active beach deposits within which a chalk dump was recorded form 0.51 – 0.84m (possibly evidence of a buried barge bed feature, associated with that found in VB7013) over 1.62m of alluvium over peat (0.06m + thick). The fifth deposit record (SR5003) was located on the foreshore approximately 91m along the transect and 53m out from the embankment where the deposits were recorded as 1.0m of active beach deposits over 0.5m of alluvium over London Clay.

As recently drilled boreholes the top of both VB7013 and VB7012A closely matched the plot of the profile of the present foreshore surface/river bed taken from bathymetric contour data (**Appendix A.4**). However the top of SR5005 drilled in 2005 was overlain by up to 0.8m of additional active beach deposits, indicating sediment accumulation in this locality.

Transect B

Transect B ran from north-west to south-east through the centre of the Site, measured approximately 136m in length and contained four deposit records, two (TQ27NE631 and TQ27NE627) were located on the landward side of the Site and two (TQ27NE633 and TQ27NE634) were located on the foreshore.

The first deposit record (TQ27NE631) was located at the south-east end of the transect where the deposits were recorded as 3.04m of made ground over 3.54m of alluvium over 2.3m of river gravels over London Clay. The second deposit record (TQ27N3627) was located approximately 14m along the transect where the deposits were recorded as 2.01m of made ground over 5.91m of alluvium over 0.31m of river gravels over London Clay.

The third deposit record (TQ27NE633) was located on the foreshore approximately 49m along the transect and 19m out from the embankment where the deposits were recorded as 0.76m of active beach deposits over 1.52m of alluvium over 3.29m of river gravels over London Clay. The fourth deposit record (TQ27NE634) was located on the foreshore 110m along the transect and 79m out from the embankment where the deposits were recorded as 0.6m of alluvium over 1.22m of river gravels over London Clay.

The top of borehole TQ27NE633 which was drilled in the 1950s closely matched the plot of the profile of the present foreshore surface/river bed taken from bathymetric contour data (**Appendix A.4**). At the north-west end of the transect the modern foreshore profile indicates that up to approximately 0.8m of the upper deposits of TQ27NE634 (which includes 0.6m of alluvium and up to 0.2m of the river gravels) have been removed since the core was drilled in the 1950s.

A.4 Data references

Borehole record	Source	Easting	Northing	Elevation mOD	Total depth Metres
MoLA-PW6060	MoLA	529570.8	177637.6	3.81	10
MoLA-SR6061	MoLA	529576.1	177644	3.9	10
MoLA-SR6062	MoLA	529584.6	177640.3	3.88	10
MoLA-SR6063	MoLA	529554.2	177611.2	3.89	10
SA2063	TTT	529606	177750	-4.7	5.5
SA2064	TTT	529351	177662	-6.08	8
SR5003	TTT	529494	177684	-3.68	7
TQ27NE1079	BGS	529600	177600	3.6	14.33
TQ27NE1122	BGS	529300	177600	0.01	6.88
TQ27NE156	BGS	529650	177620	3.66	15.54
TQ27NE1674	BGS	529190	177550	3	10.97
TQ27NE1856	BGS	529120	177570	5.1	15.24
TQ27NE1857	BGS	529140	177560	5.3	14.63
TQ27NE1858/9	BGS	529170	177560	5.33	5.3
TQ27NE1860	BGS	529160	177550	5.33	14.02
TQ27NE1861	BGS	529120	177600	5.18	15.54
TQ27NE1863	BGS	529150	177600	5.33	12.19
TQ27NE1864	BGS	529170	177590	2.59	15.54
TQ27NE1865	BGS	529120	177630	0.6	11.16
TQ27NE1866	BGS	529150	177630	0.6	0.6
TQ27NE1867	BGS	529150	177620	0.6	11.15
TQ27NE1868	BGS	529180	177620	0.6	10.67
TQ27NE1870	BGS	529120	177510	4.8	14.2
TQ27NE1871	BGS	529140	177510	5.2	15.24
TQ27NE220	BGS	529300	177400	3.96	16.76
TQ27NE531/B	BGS	529300	177500	5.18	8.53
TQ27NE535	BGS	529210	177620	1.34	9.75
TQ27NE536	BGS	529180	177530	1.09	9.75
TQ27NE537	BGS	529240	177590	1.06	10.36
TQ27NE538	BGS	529270	177460	2.25	8.83
TQ27NE626	BGS	529510	177570	4.62	10.97
TQ27NE627	BGS	529560	177630	4.63	17.07
TQ27NE629	BGS	529540	177610	4.96	15
TQ27NE630	BGS	529530	177630	4.81	15.33
TQ27NE631	BGS	529550	177620	5.02	15.73
TQ27NE632	BGS	529520	177610	0	0
TQ27NE633	BGS	529540	177660	-0.01	5.48
TQ27NE634	BGS	529530	177720	-3.65	2.43

Borehole record	Source	Easting	Northing	Elevation mOD	Total depth Metres
TQ27NE654	BGS	529420	177580	5.18	15.85
TQ27NE655	BGS	529420	177600	5.25	15.08
TQ27NE656	BGS	529420	177610	5.13	14.94
TQ27NE657	BGS	529370	177630	1.82	13.41
TQ27NE658	BGS	529420	177660	-2.13	5.48
TQ27NE659	BGS	529440	177660	-1.52	5.18
TQ27NE660	BGS	529370	177660	-0.91	5.48
TQ27NE661	BGS	529340	177660	-0.91	7.49
TQ27NE777	BGS	529160	177580	5.1	15.24
TQ27NE777 bh1	BGS	529130	177570	5.1	10.97
TQ27NE777/A	BGS	529180	177610	4	15.73
TQ27NE777/B	BGS	529140	177640	0.6	10.97
TQ27NE777/C	BGS	529160	177630	0.6	11.16
TQ27NE777/D	BGS	529190	177620	0.6	10.67
TQ27NE777/E	BGS	529150	177520	2.83	15.24
TQ27NE777/F	BGS	529170	177520	5.36	15.24
TQ27NE865	BGS	529403	177612	5.02	12.98
TQ27NE866	BGS	529384	177610	5.02	13.28
TQ27NE867	BGS	529363	177610	5.02	13.41
TQ27NE868	BGS	529344	177610	5.02	13.11
TQ27NE869	BGS	529429	177616	5.79	13.41
TR27NE658	BGS	529420	177660	-2.13	5.48
VB6032	WA/TTT	529245	177640	-1.04	2.4
VB7010	WA/TTT	529259.9	177674.6	-5	0.97
VB7010A	WA/TTT	529259.5	177676.5	-5	1.95
VB7011	WA/TTT	529300.7	177671.6	-5.5	1.8
VB7012	WA/TTT	529520.8	177657.8	0.22	1.03
VB7012A	WA/TTT	529525.2	177659.7	0.19	3.03
VB7013	WA/TTT	529526.2	177650.8	0.88	3.03

Key to source

WA = Wessex Archaeology
MoLA = Museum of London Archaeology
BGS = British Geological Survey
PLA = Port of London Authority
TTT – Thames Tunnel Tideway

Data references

MoLA = ‘MoLA monitored TTT core data supplied by client, ref. email from Suzanna Pembroke 31/3/14’

BGS = http://www.bgs.ac.uk/data/boreholescans/home.html

PLA vibrocores taken on behalf of TTT = 100-MD-GEO-00000-000091

DDS-000690-WXARC_Bathymetry (Transmittal: 100/WXARC/000009 Date: 13/8/14
Filename:100-MD-GIS-WXARC-000004)

Appendix B : NMR OASIS archaeological report form

OASIS DATA COLLECTION FORM: England

OASIS ID: wessexar1-216077

Project details

Project name	Foreshore-based Archaeological Evaluation, Heathwall Pumping Station
Short description of the project	Wessex Archaeology was commissioned to undertake a foreshore-based archaeological evaluation at Heathwall Pumping Foreshore, a Thames Tideway Tunnel project site. The evaluation included parametric sonar survey, geoarchaeological and palaeoenvironmental assessment of cores, a walkover survey and and the production of a foreshore deposit model.
Project dates	Start: 09-06-2014 End: 29-06-2015
Previous/future work	Yes / Yes
Any associated project reference codes	102510.33 - Contracting Unit No.
Type of project	Field evaluation
Site status	None
Current Land use	Coastland 1 - Marine
Current Land use	Coastland 2 - Inter-tidal
Monument type	POST ALIGNMENT Uncertain
Significant Finds	CERAMIC Roman
Methods & techniques	"Augering","Fieldwalking","Geophysical Survey","Vibro-core"
Development type	Tunnel
Prompt	Planning condition
Position in the planning process	After full determination (eg. As a condition)
Solid geology	LONDON CLAY
Drift geology	ALLUVIUM
Techniques	Other

Project location

Country	England
Site location	GREATER LONDON WANDSWORTH WANDSWORTH Heathwall Pumping Station
Study area	1.30 Hectares

Site coordinates	TQ 29594 77748 51.4833184387 -0.133421216775 51 28 59 N 000 08 00 W Polygon
Site coordinates	TQ 29459 77582 51.4818574547 -0.135425418621 51 28 54 N 000 08 07 W Polygon
Site coordinates	TQ 29459 77748 51.4833494218 -0.135364552881 51 29 00 N 000 08 07 W Polygon
Site coordinates	TQ 29594 77582 51.4818264732 -0.13348214586 51 28 54 N 000 08 00 W Polygon
Height OD / Depth	Min: -6.00m Max: 3.00m

Project creators

Name of Organisation	Wessex Archaeology
Project brief originator	Wessex Archaeology
Project design originator	Wessex Archaeology
Project director/manager	David Norcott
Project supervisor	David Howell
Project supervisor	Richard Payne
Project supervisor	Gail Wakeham
Type of sponsor/funding body	Developer

Project archives

Physical Archive Exists?	No
Digital Archive recipient	Wessex Archaeology
Digital Contents	"none"
Digital Media available	"Database","GIS","Geophysics","Images raster / digital photography","Text"
Paper Archive recipient	Wessex Archaeology
Paper Contents	"none"
Paper Media available	"Report"

Project bibliography 1

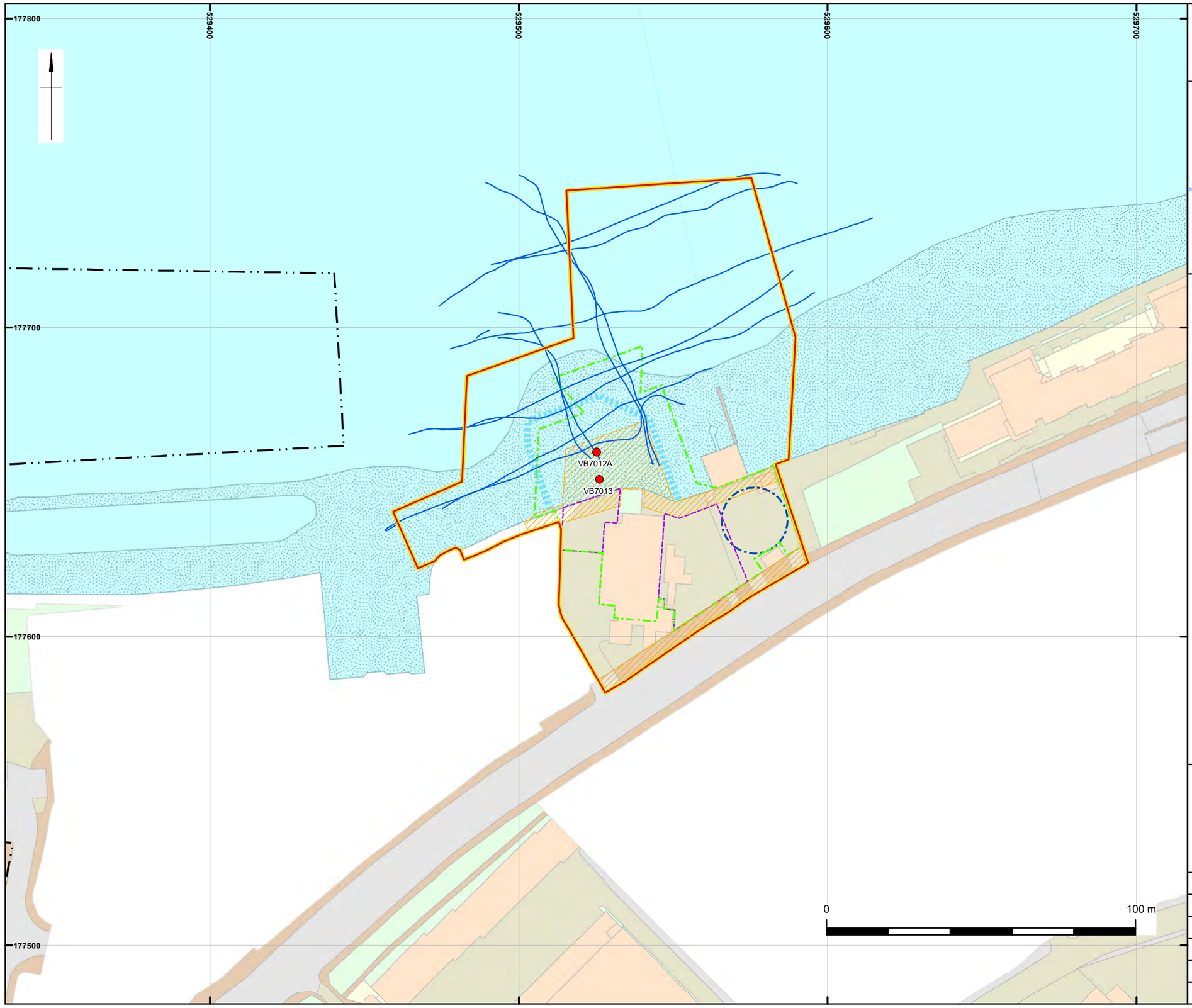
Publication type	Grey literature (unpublished document/manuscript)
Title	Foreshore-based Archaeological Evaluation Report Heathwall Pumping Station
Author(s)/Editor(s)	Howell, D., Norcott, D., Payne, R. and Wakeham, G.
Other bibliographic details	102510.33

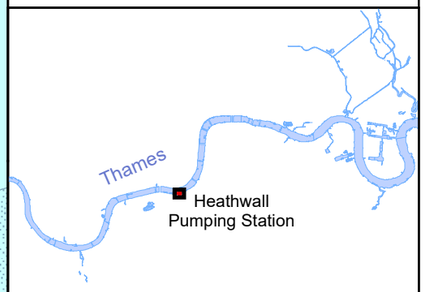
Date	2015
Issuer or publisher	Wessex Archaeology
Place of issue or publication	Salisbury
URL	http://oasis.ac.uk

Entered by	Richard Milwain (r.milwain@wessexarch.co.uk)
Entered on	29 June 2015

OASIS:

Figures





- Site
- TTT Site 14 - Kirtling Street
- Maximum extent of working area
- Vibrocores
- Parametric sonar survey lines
- Above-ground Structure Zone
- All Site Structure Zone
- Required Landscaping Area
- Shaft Zone
- Maximum extent of temporary works platform
- Intertidal Zone
- River Thames

Date:	16/06/2015
Revision Number:	0
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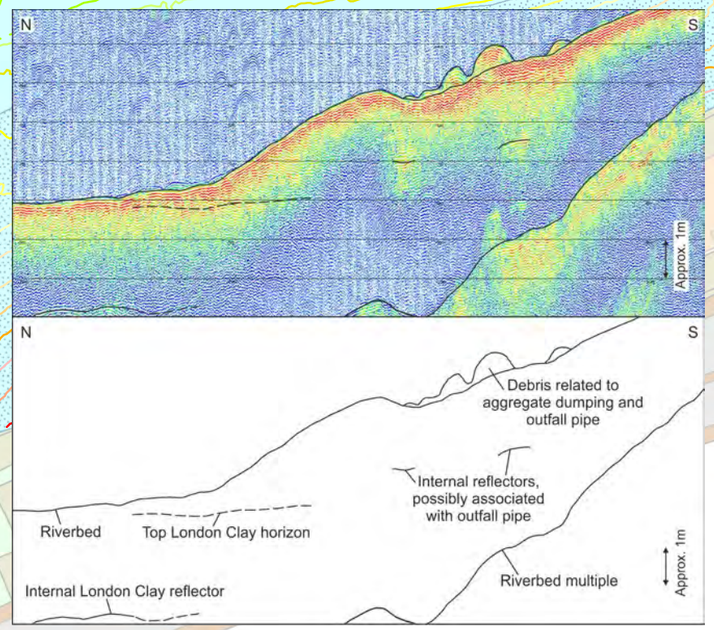
Heathwall Pumping Station evaluation location

Figure 1

529400
529500
529600
529700
177700
177600



Parametric sonar data example transect

Depth m OD
3
-6.5

0
50 m

Site
Intertidal Zone
Transect
Area with Pleistocene/Holocene deposits

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Scale:	1:1000 at A3	Illustrator:	KL
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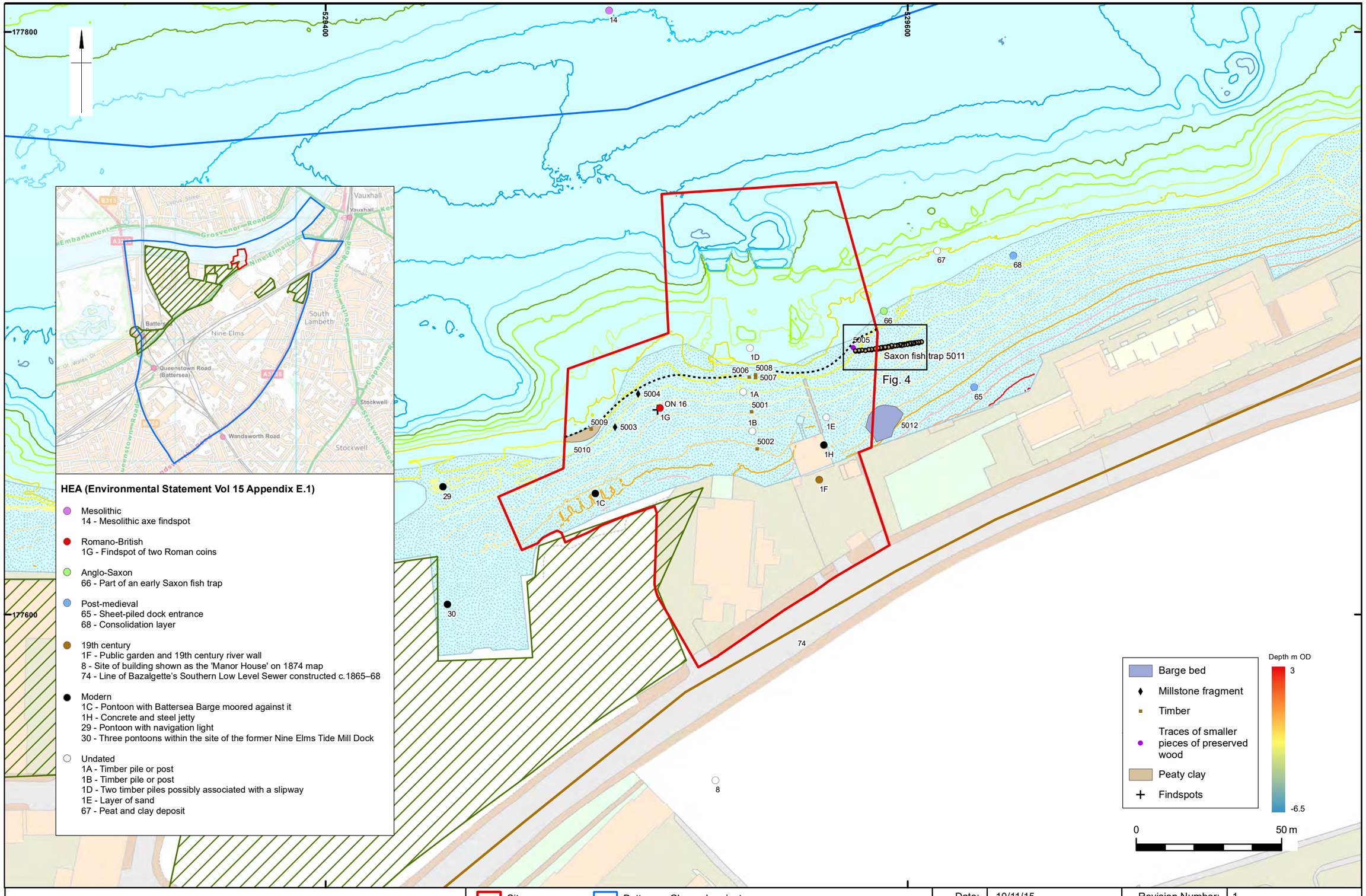
Heathwell Pumping Station Parametric Sonar Results

Figure 2



Site
Intertidal Zone
Bazalgette Sewer
Battersea Channel project
Previous geoarchaeological investigations
Extent of walkover survey

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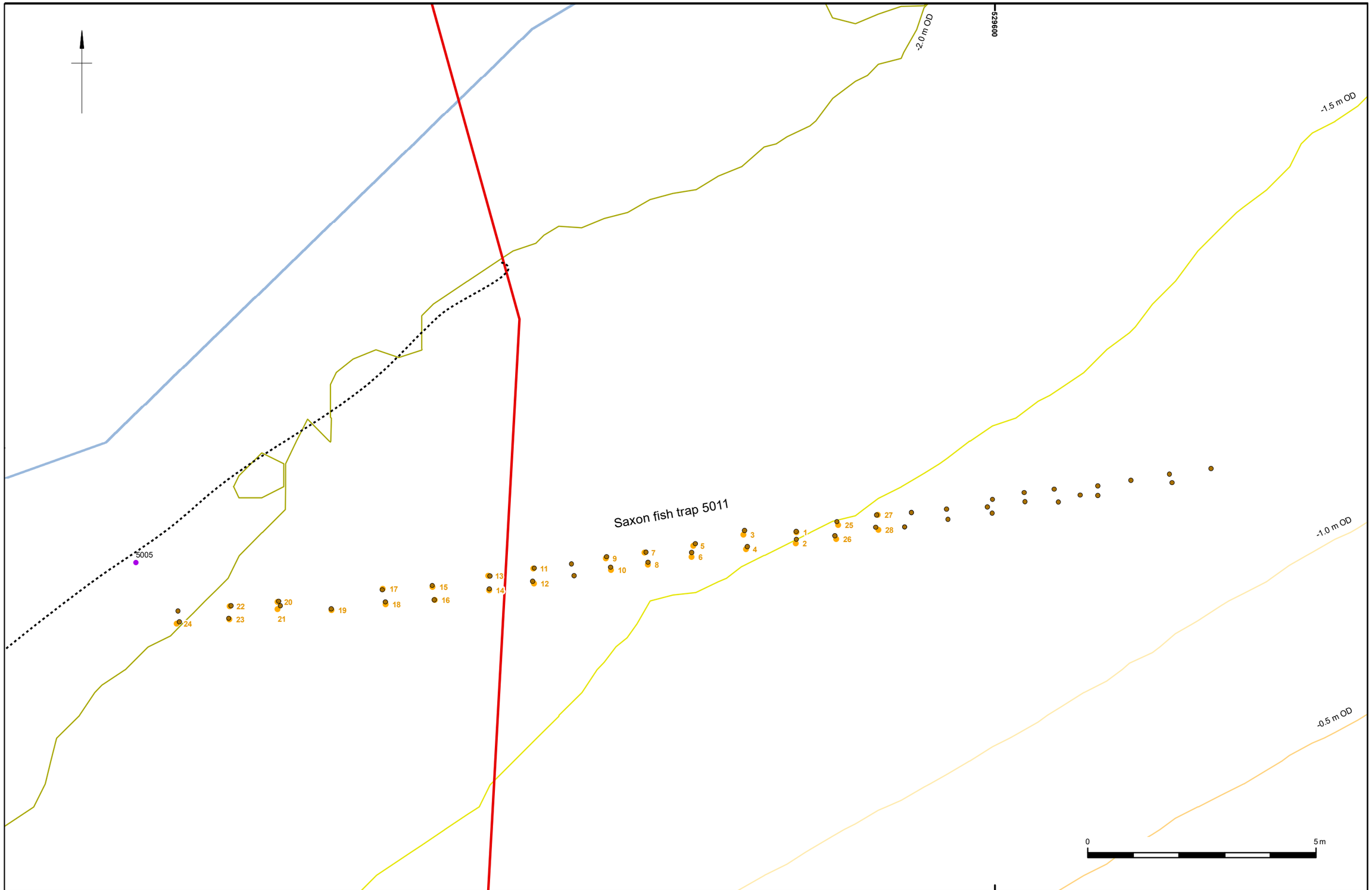
Heathwell Pumping Station: targeted walkover results with known historic environment assets (HEA) within Site

Figure 3



TDP survey data supplied by TDP/MoLA.

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Site

Intertidal Zone

WA surveyed post

TDP previously surveyed posts

WA recorded traces of smaller pieces of preserved wood

Extent of walkover survey

Date:	07/07/15	Revision Number:	0
Scale:	1:80 at A3	Illustrator:	KL
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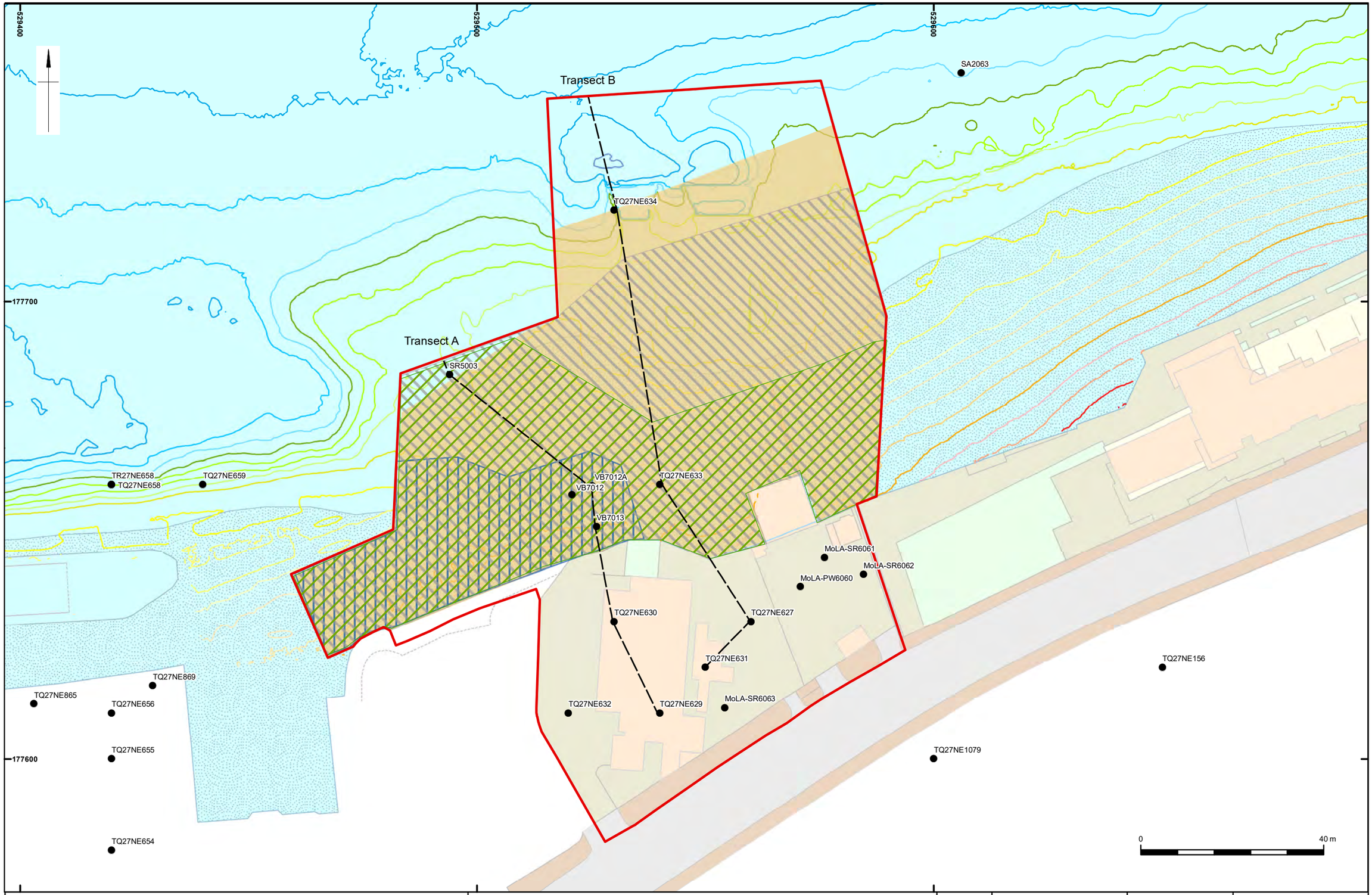
Heathwell Pumping Station: targeted walkover results inset of Early Saxon fish trap timber structure

Figure 4



Site
Intertidal Zone
Borehole records
Transect
LZ1
LZ2
LZ3
LZ4

Date:	01/07/15	Revision Number:	0
Scale:	1:800 at A3	Illustrator:	KL
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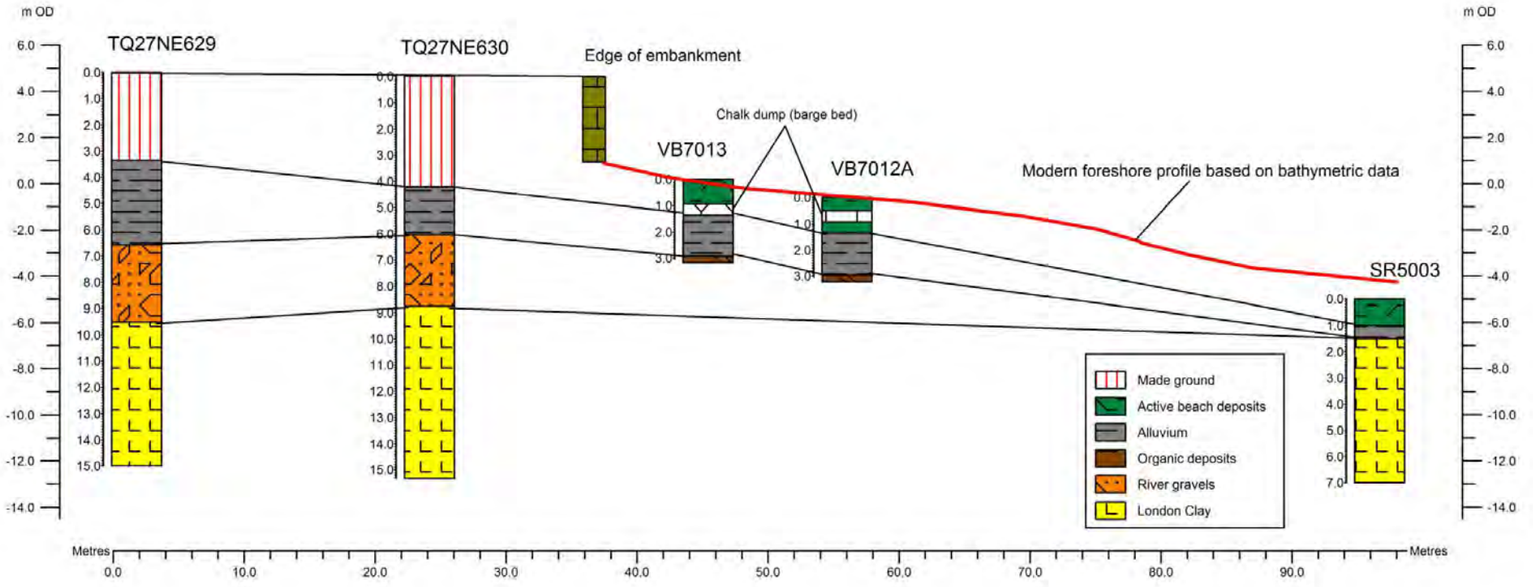
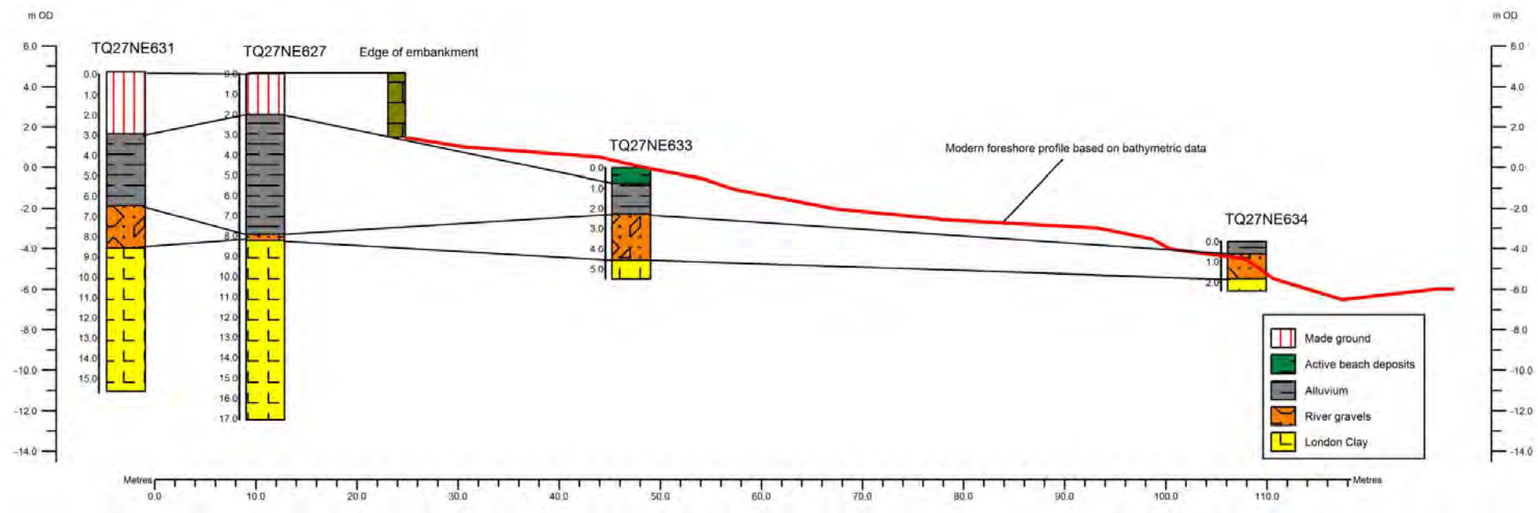
Heathwell Pumping Station Deposit Modelling: location of transects and predicted landscape zones

Figure 5



Transect A



Transect B

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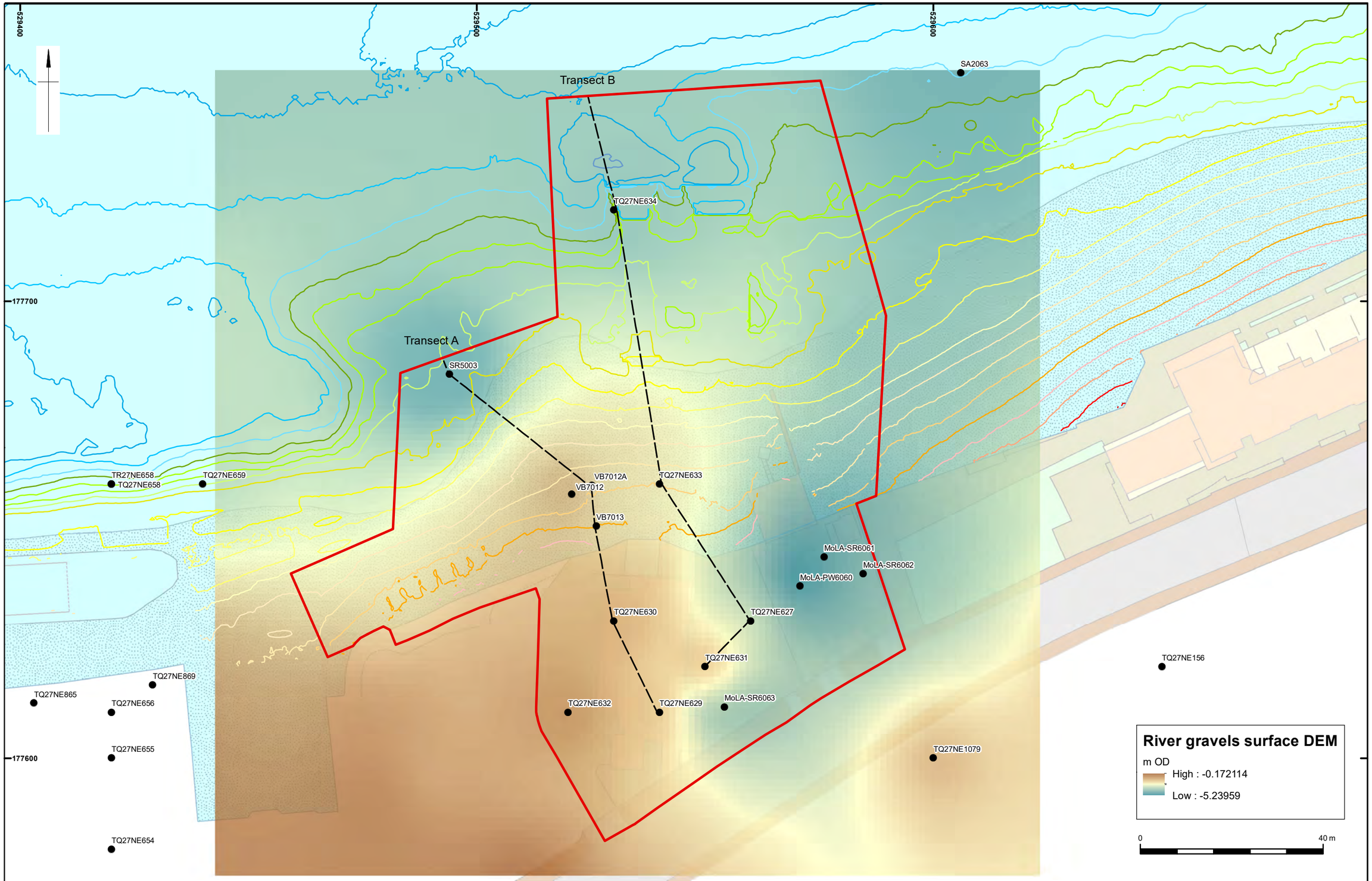
Heathwell Pumping Station Deposit modelling results (transects A to B)

Figure 6



Site
Transect
Intertidal Zone
Borehole records

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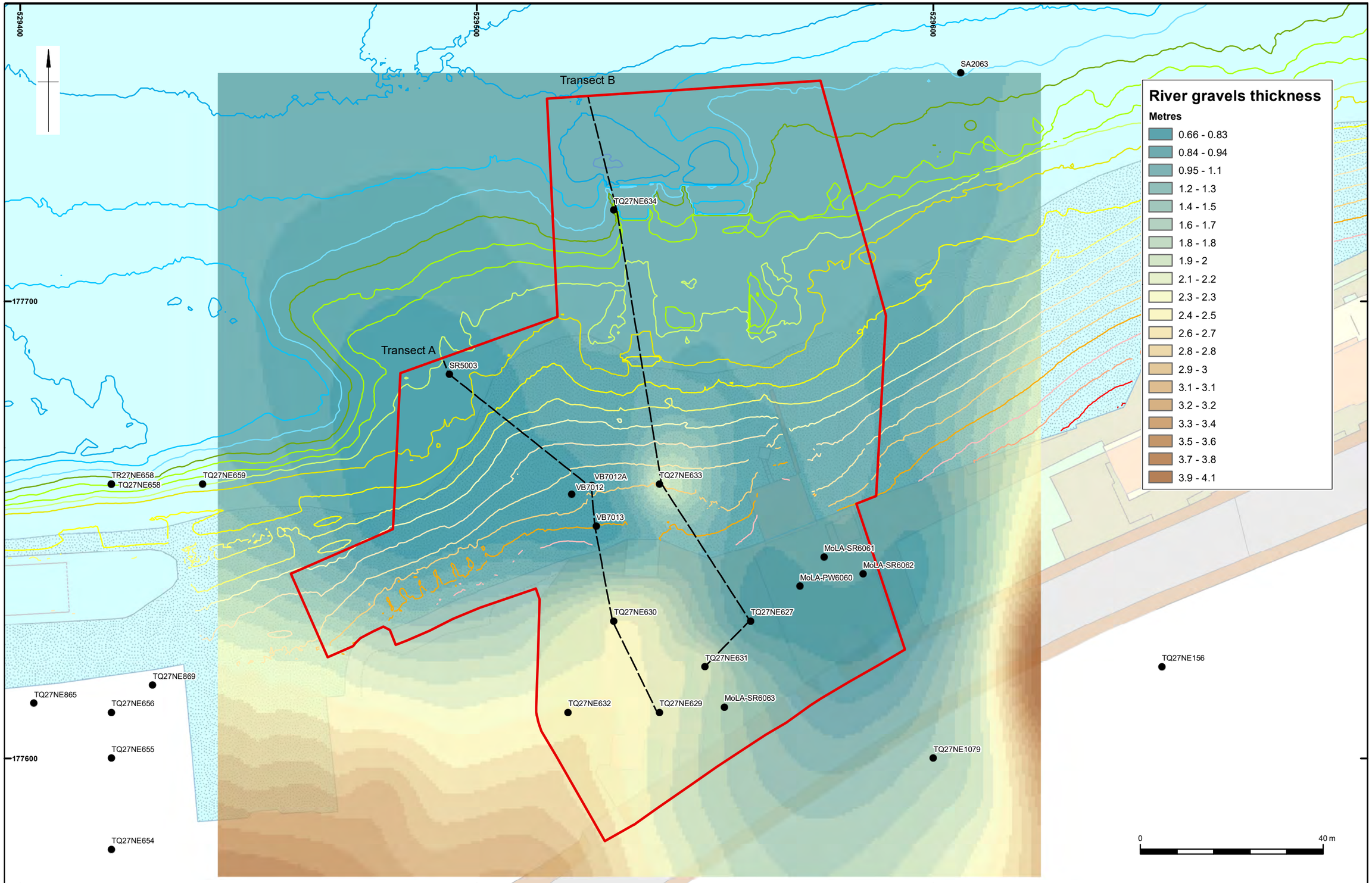
Heathwell Pumping Station river gravels DEM

Figure 7



Site
Transect
Intertidal Zone
Borehole records

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Heathwell Pumping Station river gravels thickness model

Figure 8

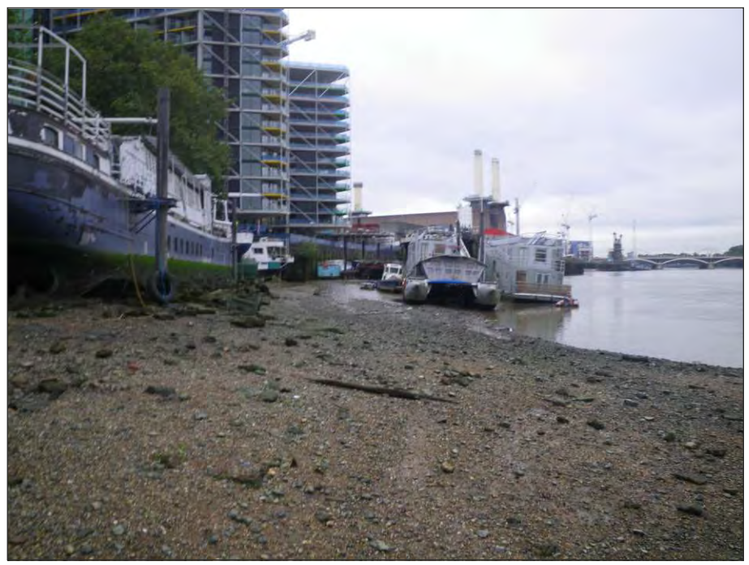

Plate 1: View of barge moored in south-west of Site, and foreshore beyond Site to west, with Battersea Power Station and bridge in distance

Plate 2: View to east across the Site showing river wall (HEA 1F) and extant concrete and steel jetty (HEA 1H)

Plate 3: Square-cut timber pile 5001

Plate 4: Surveying square-cut timbers 5006, 5007 and 5008 (view to west)

Plate 5: Detail of millstone 5003 embedded in surface beach deposits

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Plate 6: Detail of millstone 5004 lying on its reverse on surface of foreshore

Plate 7: Surveying Saxon fish trap timber alignment 5011 extending into Site

Plate 8: View from east of Site of Saxon fish trap timber alignment 5011

Plate 9: Detail of area with traces of small timbers (?stakes/withies or ?natural wood) 5005

Plate 10: Detail of timber 5009 and peaty deposit 5010

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