Stanford Wharf Nature Reserve
London Gateway
Stanford-le-Hope
Essex

Volume 1:
Post-excavation assessment

oxfordarchaeology
southsouthsouth

October 2010

Client: DP World

Issue No: 1
OA Job No: 4423
NGR: TQ 698 811

Post Excavation Assessment

Client Name: DP World

Document Title: Stanford Wharf Nature Reserve, London Gateway, Stanford-le-Hope, Essex

Document Type: Volume 1: Post-excavation assessment

Issue Number: 1

Grid Reference: NGR TQ 698 811
Planning Reference:

OA Job Number: JN 4423
Site Code: COMPA09
Invoice Code: COMPAPA
Receiving Museum: Thurrock Museum

Prepared by:	Chris Carey and Katrina Anker
Position:	Project Officers
Date:	21/10/10
Checked by:	Edward Biddulph
Position:	Senior Project Manager
Date:	21/10/10
Approved by:	Stuart Foreman
Position:	Senior Project Manager
Date:	26/10/10
Document File Location	W:\16 Post-excavation\2 Compensation Site A\PXA report\PXA_version2_201010\Report_v2\
Graphics File Location	Ditto
Illustrated by	Leo Heatley

Oxford Archaeology

Janus House
Osney Mead
Oxford OX2 0ES
t: (0044) 01865 263800 e: info@oxfordarch.co.uk
f: (0044) 01865 793496 w: www.oxfordarch.co.uk

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Stanford Wharf Nature Reserve, London Gateway, Stanford-le-Hope, Essex

Volume 1

Post-excavation assessment and updated project design

By Katrina Anker, Edward Biddulph, Chris Carey and Stuart Foreman

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Summary

Stanford Wharf Nature Reserve (previously known as Compensation Site A), was investigated as part of an ecological mitigation programme at the London Gateway Port development. The site lies at the southern end of Wharf Road, Stanford-le-Hope, on the north-east bank of Mucking Creek.

The excavations revealed a sedimentary sequence dating back to the Pleistocene (ice ages). Deposits of the early Holocene (c. 8,000 BC) contained worked flint and pottery, including Neolithic material. Later prehistoric artefacts indicated Iron Age activity at or near the site.

Two areas of early Roman salt extraction were uncovered. Key evidence included channels dug to catch salt water, clay briquetage coarsely formed into trays, containers and supports, evaporation hearths over which the briquetage vessels were placed, and traces of low mounds or 'red hills' , which formed a slight ridge along the north edge of the site in one area.

Salt extraction in the late Roman period appears to have been organised differently compared with the early Roman salterns. A large, robust hearth of this phase survives almost intact; it formed a low circular structure built from two courses of tile, with three raised pillars, perhaps to support lead tanks. The late Roman area included a very unusual building with a circular clay floor surrounded by a shallow gully. The building would have been supported by four massive posts built on post-pads of chalk and flint rubble, set in the base of square pits.

No evidence of Anglo-Saxon activity was identified. There is very limited artefactual or other evidence for medieval activity within Stanford Wharf, but some of the boundary ditches and channels that were open in the Roman period did appear to influence the arrangement of the later 19th century fields. The London Gateway Development area includes the former Thames Haven oil refinery and storage depot, which was identified as a key defence site during the Second World War.

This assessment and updated project design presents the preliminary findings of the fieldwork, specifies what further post-excavation recording and analysis is required, and assesses the potential of the results to address research questions and contribute to a better understanding particularly of the region's ancient landscape. A programme of analysis and publication is presented.

1 Description of the Project

1.1 Introduction

1.1.1 London Gateway is a major development on the Thames Estuary in south Essex, that will combine the UK's newest deep-sea container port with Europe's largest logistics park. The Port and Park received planning permission from Government on the 30th May 2007. The applications were in the form of an Outline Planning Application for the Park (OPA) and a Harbour Empowerment Order (HEO) for the Port. Archaeological planning conditions attached to the consents require adherence to the London Gateway Archaeological Mitigation Framework (AMF).

1.1.2 Stanford Wharf Nature Reserve is a 44-hectare site, bordered by Stanford-le-Hope industrial area to the north, Mucking Creek to the west, and the Thames Estuary to the south and east (Fig. 1; NGR TQ 6990 8110). A new inter-tidal mudflat has been created to provide a replacement ecological habitat, predominantly for wading birds. The site, which was formerly known as 'Compensation Site A', has been developed by DP World to satisfy planning conditions attached to development of the port. It is located to the west of the main development, in an area of former marshland, which documentary evidence suggests was reclaimed in the early 17th century (See 1.1.28 below). The creation of the new mudflat was accomplished by reducing the level of the site by c 500mm and breaching the existing sea wall to allow tidal inundation. Limited areas of deeper excavation, to c 1m depth, were required in the southern part of the site, and a new sea wall was constructed along the northern edge of the site.

1.1.3 DP World funded a series of field investigations at Stanford Wharf Nature Reserve to ensure that archaeological remains were preserved or investigated before the site was flooded. A desk-based assessment, gradiometer survey and trial trenching were all undertaken prior to the detailed investigation, and a site-specific archaeological project design was produced to guide the mitigation work (OA 2009a). The mitigation programme involved detailed excavation of the most significant archaeological remains, identified in Areas A and B (Plates 1 and 2), controlled archaeological stripping throughout the northern part of the site (Areas C and D), and monitoring during construction in the remainder (Areas A-K, Fig. 2). An archaeological team was also present during breaching of the existing sea wall (Area L) to record possible evidence for earlier phases of sea defence.

1.1.4 In accordance with the guidance contained within the AMF a project design was prepared in May 2009, describing the scope of proposed archaeological mitigation at the site. Project and geoarchaeological background information is presented in the design documents (Evaluation OA 2008b; Mitigation OA 2009c), and in the report on the site investigations (OA 2009b).

1.1.5 The AMF, site-specific project designs and archaeological fieldwork were approved by Essex County Council Historic Environment Branch and English Heritage, which provided archaeological advice to the local planning authorities. Site areas were released in stages to allow construction of the sea wall to proceed behind the archaeological excavation, the spoil from newly excavated areas being used as embankment fill. Each area was subject to a formal handover procedure requiring approval of ECC (R.Havis), DP World's Archaeological Liaison Officer (G.Andrews) and DP World's Environmental Manager (M.Pearson).

1.2 Geomorphological context

1.2.1 This section briefly outlines current models of landscape evolution for the development area as a whole, and Stanford Wharf Nature Reserve in particular.

1.2.2 The London Gateway development is located in the lower Thames estuary. The port, along with its associated access routes and ecological compensation sites, crosses a series of geomorphological zones, ranging from river terrace deposits, through the inter-tidal zone to the main Thames channel. The zones have widely varying archaeological potential.

1.2.3 The terrace sequence and landform models put forward for the Thames estuary in this report, follow Bridgland (1994) for Pleistocene lithologies and sequences. He identifies three inter-glacial phases since the Anglian glaciation (MIS 9, 7 and 5).

1.2.4 More recently, work by Bates and Whittaker (2004) has produced a cultural landscape model for the lower Thames, detailing the estuarine evolution throughout the Holocene. This builds on the classic framework put forward by Devoy (1979), who identified ten sequential phases of alternating minerogenic and organogenic deposits in the lower Thames (the Thames-Tilbury sequence). These alternating deposits represent an overall increase in the inter-tidal sediment stack throughout the Holocene, caused by a series of marine incursions/regressions in the early to mid Holocene. Much work has recently been undertaken in the upper estuary, particularly within London, where Siddell *et al.* (2000) have detailed the rise of cereal agriculture in the Neolithic and Bronze Ages within a shifting geomorphological environment. However, much of this work has generally been confined to the upper estuary (to the west), whereas the current development is located within the marine zone of the lower estuary, thereby offering valuable new and comparative data.

1.2.5 A key objective of the investigations at London Gateway is to develop a clear understanding of the chronological development of these alluvial deposit sequences, and how changes in sea level have affected land forms and human land-use since the end of the last cold stage (c. 10,000 before present).

1.2.6 The geomorphic units of the London Gateway project can be summarised as:

- a series of Terrace deposits (a compound group of Undifferentiated Head deposit, Terrace 2 deposits and Terrace 3 deposits);
- the inter-tidal zone (a compound group of a range of depositional environments on the inter-tidal floodplain);
- the tidal zone of the estuary;
- the interface zone between the dryland terrace and the inter-tidal floodplain.

1.2.7 An integrated deposit model for the London Gateway development area (OA 2008a) has been developed, based on a combination of extensive Electrical Resistivity Survey and borehole data. The interim results include a surface model of the Pleistocene topographic template, and a preliminary model for the evolution of the Holocene sediment body. This suggests an infilling of the estuarine zone, starting in the early Holocene (Mesolithic to Neolithic), with a significant alluvial wedge deposited across the study area (*c* 10 m thick, but up to 15 m in specific areas).

1.2.8 The Holocene alluvial sediments are expected to become rapidly deeper away from the terrace edge. A geoarchaeological assessment of the proposed London Gateway access road, just east of Stanford Wharf Nature Reserve (OA 2009b) has modelled the transition between the interface zone and terrace 2 deposits in detail, showing that it

shelves away rapidly over a very short distance (*c* 20 m). This results in a relatively narrow interface zone with high archaeological potential, due to proximity to areas of ancient settlement on the terrace edge, coupled with excellent conditions for archaeological preservation (waterlogged alluvial deposits). Archaeological potential is likely to be particularly high at locations where freshwater streams and tidal creeks provide lines of communication between the terrace edge and main Thames channel.

1.2.9 Stanford Wharf Nature Reserve lies to the west of the main development, adjacent to Mucking Creek, straddling the interface between the river terrace deposits and the intertidal zone. A geoarchaeological assessment has provided a detailed model of the Pleistocene topographic template, revealing a combination of dryland terrace environments, preserved under shallow alluvium at the inter-tidal edge (Carey *et al*. 2009). The underlying Pleistocene deposits are mapped as Terrace 2 or the Taplow/Mucking terrace, which consist of sediments formed in successive glacial and interglacial periods.

1.2.10 A series of resistivity survey and gouge auger transects at Stanford Wharf (OA September 2009) have demonstrated that the terrace was incised at the floodplain edge for a distance of *c* 200 m by a large palaeochannel. The incision, which probably formed in the Pleistocene, resulted in a shelf of raised ground at the terrace edge, an ideal environment for human exploitation and settlement during the Holocene, allowing access to wetland and dryland, saline and freshwater resources (Areas A-D, Fig. 2). This incised terrace was subsequently buried by alluvial deposits in the mid to late Holocene. There is a shallow gradient in the terrace from the north (top) to the south (bottom) of Areas A-D. The depth of the Holocene alluvial sediments above the terrace surface is *c* 1.5 m below ground level at the southern edge of the terrace, becoming shallower (*c* 0.3 m below ground level) at the northern edge. Extensive Roman saltern deposits were encountered immediately below the ploughsoil at the northern edge of the site, but at the southern edge of Areas A-D, were buried beneath alluvial deposits in excess of 1m thick. A series of boreholes indicate that the depth of the Holocene alluvium continues to increase to the south, in Areas E-K. The depth of alluvium is 3.85m in Borehole 3 (Fig. 4) and c 4.75m at the southern edge of the site, in Area I (OA September 2009, Fig. 8, Transect 2).

1.3 Sediment stratigraphy, preliminary landscape zonation and chronology

1.3.1 The description here will focus mainly on Area A, which had the best preserved archaeological sequence. As a result of more detailed and extensive investigation, this area is best understood in terms of both the sediment and archaeological stratigraphy.

1.3.2 Natural and anthropogenic sediments at the site are interleaved within complex sequences. Specialists in archaeological stratigraphy, soil science, artefacts, and biological remains will need to consider aspects of material culture, economy and the natural environment in an integrated manner, often within the same set of monolith samples. To assist in coordinating the analysis, this assessment includes details of the key sediment sequences that have been selected for analysis (Appendix D.2). These are a subset of the total samples collected from the site, which have been selected on the basis of the palaeoenvironmental assessment results, and the ability of the sequences to address the research aims stated in Section 1.6 below.

1.3.3 The major sediment bodies were recorded in a separate sequence from the context record, as the geological stratigraphic sequence does not correlate in a simple manner with the archaeological stratigraphy (geoarchaeological numbers are prefixed with a 'G'). For example the Roman saltern deposits all fall within a single major sediment unit,

yet the numerous episodes of deposition that make up that unit have resulted in superficially complex sequences of interleaved alluvium and anthropogenic saltern deposits. In addition, equivalent alluvial deposits may have been deposited considerably earlier in the southern part of the site than in the northern, which can introduce difficulties in comparing the geological and archaeological records. In an effort to integrate the archaeological and geological records, the geological sediment unit numbers have been noted on context records and matrices where relevant. Further integration is required in the early stages of the analysis.

1.3.4 The major sediment units show a striking similarity to the cultural landscape zones applied by Bates and Whitaker (2004) to the lower Thames estuary. This framework can therefore be adopted, in a modified form, as a model for the sediment bodies at Stanford Wharf Nature Reserve (Table 1). The number of major sediment units is relatively low, with a striking degree of lateral stratigraphy in a series of sediments deposited throughout the Holocene. They represent the transition from a freshwater environment on the terrace surface, through to full saline inundation within the inter-tidal zone.

Sediment unit	Description	Sediment number
Yellow grey silty sand	The early Holocene freshwater sand deposit, representing a depositional environment of glacial and early Holocene outwash braided channels	G3
Grey to brown sandy silt, locally often clayey	Bronze Age palaeosol	G4
Blue grey silty clay	Alluvium. Largely homogeneous deposit, deposited throughout the Holocene.	G5
Light grey to yellow silty clay, with a trace of sand	'Brickearth'. Undated, but potentially formed in MIS 7 or 5, ie deposited in a warm (inter-glacial) stage during the Pleistocene.	G42
Orange brown silty clay	Undifferentiated Head. No visible structure within the deposit. Matrix to clast supported gravel Head underneath the Holocene sequences in Area B.	G18
Immature, black to brown peaty clay	An immature peaty clay, heavily leached in places.	G39

Table 1: Key sediment units at Stanford Wharf Nature Reserve

1.3.5 The terrace 2 deposits are currently above the inter-tidal floodplain at a height of *c* 5 m OD at the floodplain edge. This terrace was formed during MIS 8 or 6 (glacial stages during the Pleistocene). During the subsequent periods, the Thames and its tributaries eroded and reworked much of this terrace away, downcutting into the estuary and its associated deposits. At the very northern extremity of the estuary, an active channel cut across the terrace 2 deposits, probably at the outward extremity of a lateral meander, producing the gentle shelf-like incision that formed Areas A, B, C and D. This palaeochannel has had its base gravels dated to 329 ka ± 36 ka (OA5, GL09091) by OSL dating, and this is consistent with a date in MIS8. Although this palaeochannel undoubtedly would have been reactivated throughout the Pleistocene, and also the Holocene. Only relatively minor localised erosion has occurred since the major episode of terrace incision.

Brickearth (G42)

1.3.6 Brickearth deposit (sediment unit G42) associated with the terrace 2 gravels - The age of formation of this deposit is unclear and may represent either an inter-glacial deposit

(MIS stages 7 or 5) or a silt deposit formed in the Devensian (MIS2). 'Brickearth' is a polygenetic term, representing a number of deposits that are difficult to date based on visual inspection. Superficially similar deposits derive from a number of Pleistocene stages. The sediment stratigraphy as exposed during excavation gave no further indication of its date. There is some indication that this deposit was being actively mined during the Roman period: It is likely that the large quantities of briquetage salt-making vessels and equipment recovered, were made on site using locally extracted brickearth (See Appendix A.4). Several features, eg pit 1249, can potentially be interpreted as quarry pits.

Freshwater early Holocene sand deposit (G3)

1.3.7 Above this brickearth deposit (G42) was a light grey to yellow silty sand, with localised clay pockets. This sediment unit (G3) is a freshwater sand deposit, representing a depositional environment of glacial and early Holocene outwash braided channels (landscape zone 2), unconstrained due to the lack of sediment on the terrace and in the lower estuary. While further work needs to be undertaken to fully establish the date of deposition, OSL dates this deposit to 9.8 ka ± 1.7 ka (GL09089), while radiocarbon offers a date of 3520-3340 cal BC (OxA-22432; 95.4%). Both place the deposition of this G3 unit broadly in the earlier Holocene. In assessing the radiocarbon result, the possibility that the dated material was intrusive cannot be discounted – The Neolithic flints were mostly found scattered on the surface of the sand, but some appeared to have worked their way into the top of the sand.

Bronze Age Palaeosol (G4)

1.3.8 A grey to brown sandy silt, locally often clayey (sediment unit G4, landscape zone 4), lies above unit G3. The higher clay content and generally more mixed grey brown colour of this deposit indicates that an increasing sediment load flowed into the estuary, eroded from the local argellic brown earths occupying the terrace tops. This deposit is also ubiquitous in Area A, and was formed in the Bronze Age (OSL date: 3.6 ka ± 0.2 ka, Gl09088; radiocarbon date 1120-920 cal BC (95.4%), OxA-22430). The lack of foraminifera and the associated pollen evidence suggest that this sediment was deposited in entirely freshwater conditions. In general, the lower Thames in the Bronze Age is well documented as a time of increasing deforestation and sediment erosion, coupled with increasing cereal cultivation, and this is reflected in the sedimentology of G4.

Alluvium and peat deposits (G5 and G39)

1.3.9 The first of several homogeneous alluvial blocks, given the general number of G5 (minerogenic alluvium, landscape zone 5a), is above unit G4. This alluvial sediment is a blue to grey silty clay, with a trace of sand, and although locally variable it is not possible to date this sediment body based on its composition, other than to the Holocene. Thus the first G5 deposition at the southern end of Area A pre-dates the first alluvial deposition at the northern end of Area A by a considerable margin, potentially as much as 2000 years, although the exact chronology requires further refinement. The dating of alluvium G5 above the G3 sands, towards the southern end of Area A, has provided a date of 2.9 ka ± 0.3 ka (GL09086). This is a primary alluvial deposit, representing the first inter-tidal incursion onto the incised terrace at Area A at this location and provides evidence for the late Bronze Age marine incursion. The foraminifera from G5 represent species from the mid to high saltmarsh, showing this to be an inter-tidal deposit.

1.3.10 Post-dating this minerogenic wedge is a thin, immature, peaty clay deposit (organogenic sediment G39, landscape zone 5b), seen across the southern extent of Area A. Radiocarbon dating of this deposit required resubmission of the sample, suggesting a significant leaching of the organic material from this horizon caused by exposure of the deposit and weathering. The clay deposit was dated to 752 cal BC (OxA-22575), while the alluvium (G5) above the peaty clay was dated to 2.2 ka ± 0.2 ka (GL0908, Landscape zone 5c). The alluvium G5 above the peaty clay is deposited across the topographic gradient, and thus the date of deposition varies between the north and south of Area A. This deposit indicates a second significant inter-tidal incursion across Area A. It contains abundant foraminifera and pollen derived from a fully inter-tidal habitat. This is the marine transgression that interacts so significantly with the Roman-period occupation of the site.

1.3.11 This sequence comprises a three-fold series of deposits (minerogenic-organogenic-minerogenic) which reflects an initial marine incursion, followed by a phase of marine regression (the peaty clay), and a subsequent marine incursion. The first marine incursion was in the late Bronze Age (represented by G5 alluvium); the marine regression and formation of the peaty clay dated from the end of the Bronze Age to the early Iron Age. This peaty clay may represent the reversion to a freshwater habitat, or at the least one with a much decreased saline influence. The peaty clay was subsequently buried by further alluvium, deposited within the inter-tidal zone. This inundation is dated to the mid/late Iron Age, which suggests that the formation of the organogenic peaty clay sediment was a relatively short-lived reversal of the dominant trend of tidal encroachment in the lower Thames. This process of increasing saline influence across the incised terrace, correlates closely with the foraminifera, pollen and excavated archaeological evidence. Late Iron Age and Roman-period salt-making activity occurred in the face of an increasing tidal influence across the sloping terrace. By the late Roman/early post-Roman period, Area A was abandoned, as the whole terrace came under the influence of the inter-tidal zone (landscape zone 5c). A minerogenic alluvial deposit (G5) covers the terrace, which was deposited throughout the medieval period (landscape zone 6a). Alluvial deposition on the the site ended with documented systematic land reclamation, and consequent reversion to a freshwater habitat, in the early 17th century (landscape zone 6b).

Areas B, C and D

1.3.12 Area B revealed a similar transition in sediments to Area A, although it was located on top of a gravel head deposit and no alluvial peat deposits were revealed. Areas C and D were located on top of a silty clay Undifferentiated Head deposit, which formed a slightly lower topographic template than the adjacent areas of A and B.

1.4 Archaeological and historical background

1.4.1 The excellent archaeological potential of Stanford Wharf was realised from previous discoveries and pre-excavation investigations (Fig. 3). A desk-based assessment noted a number of sites and find-spots within Stanford Wharf Nature Reserve and the immediate area, including two groups of Roman pottery finds from the foreshore (Fig. 3, no. 43/44). Further pottery was recovered from the foreshore during walkover surveys in 2002 and 2009, indicating the presence of a Roman-period site in process of erosion (Fig. 3, no. 7002). A Roman well is recorded on the County Heritage Environment Record (HER) (Fig. 3, no. 9) within Area A, although the circumstances of discovery and precise location are unknown. In addition, a location next to Mucking Creek is

recorded in a gazetteer of the 'red hill' salt-extraction sites as a truncated or partly destroyed red hill (Fawn *et al.* 1990).

1.4.2 In January 2009, a gradiometer survey was conducted by South-West Archaeology over all available areas of the site, totalling approximately 38 hectares (OA 2009b). This showed numerous complex magnetic anomalies, although many were suspected to be inter-tidal features (Fig. 3). These anomalies were assessed using a combination of geotechnical data, archaeological hand-coring and electrical resistivity survey transects. A series of targeted trenches were excavated across the whole area in February 2009 which demonstrated the presence of complex, stratified archaeological and alluvial sediment sequences. The archaeological remains were concentrated mainly along the western boundary of the site, beside Mucking Creek, with a secondary focus along the eastern boundary of the site, beside another, unnamed, creek. The presence of briquetage, red hill deposits and pottery indicated that these were most likely saltern sites of Iron Age and/or Roman date. The archaeological features and deposits appeared to be concentrated in areas where the gravel terrace rises to the surface in the northern half of Stanford Wharf Nature Reserve, but were sparsely distributed or absent in the southern half where the alluvial deposits are deeper.

1.4.3 In addition to Roman salterns Stanford Wharf Nature Reserve has documentary evidence for post-medieval sea defences, land reclamation and agricultural improvement. Documents in the Essex Public Records office suggest that Fobbing and Stanford Marshes were reclaimed in c.1623: Late 19th century legal documents quote two royal commissions under Charles I (1633-4 and 1637-8), which were charged to 'find out what lots had been taken in and concealed from the King'. The commission jury stated that 1500 acres, comprising 'Fobbing Level Marshes', had been 'inned' ten years previously. In the late 16th and 17th centuries there was a widespread drive by landlords to reclaim areas of Essex marshland from the sea, the usual motivation being to create valuable pasturage for sheep and cattle.

1.4.4 The site was not included in the late 19th and 20th century industrial development that occurred at Shellhaven, but formed part of an agricultural buffer zone lying between the historic settlements (eg Stanford-le-Hope and Mucking) on the gravel terrace, and Shellhaven to the east. The marshland character of the area was gradually eroded between the early 17th century and the mid-20th century, as a result of post-medieval reclamation, and subsequent efforts to drain the land for agriculture. Drainage was intensified in the later 20th century with the introduction of mechanised methods (which seems to have had a detrimental affect on the preservation of organic archaeological remains materials in the upper part of the sequence). 19th century maps of the site show sinuous field boundaries, following the line of natural creeks, but these were replaced in the 20th century with straight boundaries, associated with the mechanical installation of land-drains. The gradiometer survey indicates several phases of land drainage, with considerably more intensive drainage in the southern half of the site (Areas E-K, Fig.1). Until the purchase of Stanford Wharf Nature Reserve by DP World (December 2008) the land was actively farmed and was under arable crop. Some areas of historic marshland landscape survive in the vicinity, notably in the remaining portion of Stanford-le-Hope marshes to the east.

1.4.5 During WW2 one of a series of 'Oil QF' bomb decoys was built in Stanford-le-Hope marshes, as far as possible from inhabited properties, in an attempt to divert German bombers away from the Thameshaven oil refinery by simulating bomb-damaged burning oil tanks (Essex Historic Environment Record).

1.4.6 In the mid-1970s the southern corner of the site (the same location as the reported bomb decoy control room) was used as a testing site for the Thames Flood Defence Project (S.Corbet, Carillion plc, pers.comm.). Remains of the testing facility were exposed during the evaluation and watching brief in Area J, and during the breaching of the sea wall in July 2010.

1.5 Archaeological description

Introduction

1.5.1 The excavations at Stanford Wharf Nature Reserve encompassed 13.5 hectares of formal excavation in the northern part of the site and a further 20.9 hectares in the southern part, which was stripped of topsoil and subsoil under watching brief conditions (Fig 4). Within the formal excavation area, 6.8 hectares was preserved *in situ* under the new sea wall, after investigation and recording of the surface deposits.

Neolithic (c 4000 BC-2400 BC)

1.5.2 Pre-Roman deposits predominantly survived below the level of construction impact and, as such, were largely preserved *in situ*. The earliest evidence for human activity comprises worked flint recovered from the interface between the sandy terrace and the early Holocene soil sediments in Area A. The sandy deposits were only extensively exposed along the North edge of Area A. The majority of the flint was recovered from the sandy G3 layer (1213). Various irregular shallow features cutting the top of G3 were interpreted as tree throw holes and/or animal burrows. A series of test pits was dug, and the spoil was sieved in spits, to examine the distribution of flint within the G3 deposit. The flints were mainly found scattered on or close to the surface of the sand, within the top 10cm spit, or within the irregular features. The deposit contained a number of blades, two end scrapers and side scrapers suggestive of an early Neolithic date. It is not clear at this stage whether this represents an in situ knapping site.

Bronze Age (c 2400 BC-700 BC)

1.5.3 As for the Neolithic, the Bronze Age levels were preserved in situ. A buried soil was preserved in patches across the site, variously affected by human activity, alluviation and marine inundation. This unit (G4) was seen in various localised deeper excavations, and is phased by OSL dating to the early to mid Bronze Age. Seven fragments of residual Neolithic pottery were recovered from a single intervention through this layer.

1.5.4 Residual late Bronze Age/Iron Age pottery was recovered in small quantities from ten further contexts, distributed widely across the main focus of activity in Area A.

1.5.5 In Area B, pit 4111 contained four fragments of pottery dating broadly from the Bronze or Iron Age. The pit was partially sealed by a thin spread of gravel, which had probably been affected by gentle tidal action. It was cut by late Roman ditch 8538, which surrounded the saltern mound.

1.5.6 The upper alluvial deposit (G5, context 2002) in Area D produced a small number of sherds dating to the late Bronze Age.

Middle-late Iron Age (c 400 BC-AD 43)

1.5.7 Four gullies, four pits, including a small possible brickearth quarry pit (6280), a ditch terminus and a single isolated post-hole, were all phased to the mid- to late- Iron Age period in Area A. All of these features are clustered on a slight topographic rise at the

interface of the early Holocene and sand/gravel terrace deposits, and lie close to the present ground surface. Middle Iron Age pottery was recovered from the features. In Area B, three sherds of residual middle Iron Age pottery were recovered from the surface of a Roman-period saltern, along with residual Iron Age fragments from two other deposits.

1.5.8 It is possible that the Area A red hills, features associated with salt production, were formed in the later Iron Age, though the dating evidence is equivocal. Each red hill formed a slight mound, with the majority concentrated together, some merging, in a slightly curving band extending beyond the northern boundary of the excavation area. The extent of further remains to the north is unknown, but the distinctive red soil was absent within the construction 'delft' ditch situated at the landward toe of the new sea wall some 40 m beyond the excavation boundary. Four of the nine mounds were examined in detail (9504, 9514, 9515 and 5644). All four comprised layers of red-brown material, likely to be derived from a combination of fuel material (possibly peat) and the weathered remains of fired clay and crudely made ceramic salt extraction equipment (briquetage; Kinnory, Appendix A.4). At Stanford Wharf Nature Reserve, these *in situ* dumps have been classified as Red Hill Type I. Material from these was redeposited in the Roman period, and these have been labelled types II, III and IV.

1.5.9 A tenth mound was observed away from the main cluster in the south-west of Area A (5808). Thin spreads of red soil recorded in the watching brief areas (Fig. 4, J and L) appeared to be too high in the stratigraphic sequence to be Iron Age or Roman, and they may instead represent cartloads of deposited red hill soil dumped in the marsh to create areas of hard-standing.

1.5.10 Red hills 9504, 9514, 9514 and 5644 contained mid to late Iron Age pottery, over 200 sherds in total, and a single OSL sample (2.0 ka ± 0.2 ka; GL09090) offered a date centred on the late Iron Age, with the possibility of a middle Iron Age or even early Roman date. However, there are some grounds for assigning the mounds to the Roman period. An assessment of the briquetage identified no certain Iron Age material, placing it almost exclusively in the early Roman period, although a highly fragmentary group of clay objects provisionally identified as an evaporation hearth pedestal and firebar could be Iron Age in date (Kinnory, Appendix A.4). The pottery from red hill 5808 was broadly dated to the Roman period.

1.5.11 Unfortunately, features stratigraphically earlier than the red hills were very limited and produced no dating evidence. Features within the mounds were also limited. There is some evidence of working surfaces or associated trample (context 5655, mound 5644; context 5513, mound 9504) and small, possible single use hearths within at least one mound, although the evidence for *in situ* burning is debatable (contexts 5475, 5671, 5196, mound 9504).

1.5.12 Some traces of reddened material were observed in Area B, particularly along the eastern baulk of the excavation, and potentially another red hill extends under the sea defences.

Late Iron Age – early Roman (c 50 BC-AD 120)

1.5.13 Group 8544, located in Area B, is tenuously assigned to the late Iron Age on the basis of three fragments of pottery. This slightly curving feature was only clearly visible after machine reduction of a saltern mound and may have been a pond or trough used for solar/wind concentration of salt water prior to evaporation over hearths. Features 8548 and 8549 contained similar fills and may also be of similar date and function, although it

is possible they are considerably earlier as late Bronze Age pottery was recovered from 8548.

1.5.14 A group of 12 oak piles in the southern part of Area A form a U-shaped structure (9500) on the edge of creek 8506. The waterlogged soils of this former marshland mean that timbers survive in fairly good condition, although the uppermost sections were usually found in an advanced state of decay, most likely a result of late 20th century land drainage. Apparently open at one end, this structure has been interpreted as a boathouse (Goodburn, Appendix A.13) and a radiocarbon date placed it in the early Roman period (20 cal BC-cal AD 130; GU-19628 (95.4%).

1.5.15 In Area C, grave 3052 contained remains of a cremation burial. The feature was truncated, and only the base of the feature survived. A ceramic vessel, identified as a cinerary urn, dated to the 1st century AD.

Early – mid Roman (c AD 43-250)

1.5.16 A few features in Area B have been dated by pottery to the early-mid Roman period (ditch 4208, pond/tank 4881 and 4566) (Fig. 5).

1.5.17 Remains of a possible footbridge or causeway were discovered in Area D (Plate 3). A pair of substantial wattlework revetments, 2027, were situated within channel 2148 near its intersection with channel 8519. The two rows of six upright posts measured approximately 3 m in length and were *c* 4 m apart. Radiocarbon dating indicated a date between AD 60 and 250 (GU-19379; 95.4%).

Mid Roman (c AD 120-250)

1.5.18 Spreads of redeposited red hill-type earth were laid across parts of Area A after *c* AD 120. Four areas of red earth were observed. These were classified into three types: Red Hill Type II, III and IV. Red Hill II was the reddest deposit, very similar in colour to Type I (*in situ* mound) and was spread in two areas, one (1384) surrounded by enclosure 9506 and ditch 8512, and a second, smaller area, surrounded by recut channel 8551. Type III, a reddish-brown colour, was located between ditches 8552 and 8551 and associated with saltern mound 5808. Type IV was a slightly red brown colour and more friable than the other two types. The boundaries between deposit types seem to coincide with major enclosures ditches and channels. However, variations between them may simply represent different conditions after deposition.

1.5.19 The spreads of red hill material are difficult to date with certainty, though a mid Roman date is preferred. Pottery recovered from 1384 suggested a date in the second quarter of the 2nd century AD for deposition.

1.5.20 Square enclosure 9506 cut both the *in situ* red hill deposits and the Red Hill Type II deposit, 1384. It was linked to channels 8550, 8506 and 8519 by a series of ditches (8513, 8552 and 8561), possibly to facilitate the supply of salt water to the working area. An entrance to enclosure 9506 was located in its south-western corner. Pottery from the enclosure and associated ditches suggest that features were filled with clay and occupation material during the late 2nd or first half of the 3rd century.

1.5.21 Roundhouse 9501 (Area A; Plate 4) was erected within the corner of enclosure 9506, probably before the mid 3rd century. A contemporary gravel track (8520) extended from the entrance of the roundhouse before turning south towards Mucking Creek. The roundhouse had two opposing entrances and traces of timber stakes survived within its ring gullies. It enclosed a working area consisting of a roughly central hearth (1484) and a rectangular row of three pits (1316), possibly settling tanks related to salt extraction

(Plates 5 and 6). An additional hearth (5918) was situated outside the NW entrance of the roundhouse. Intriguingly, quantities of slag and a smithing hearth bottom from the were recovered from the roundhouse gullies and settling tanks, suggesting that metalworking was carried out during this phase, and was perhaps even associated with the structure.

1.5.22 A fence-line (9502), defined by postholes and forming an enclosure that replaced 9506, may have been associated with the roundhouse. Pit 1249, located in the north-east corner of the enclosure 9502, was possibly dug to extract brickearth, but then utilised as a rubbish or cess pit. The lower fills were waterlogged, and notable finds included the sole of a leather shoe, and two near-complete beakers (Biddulph, Appendices A.2 and A.12). One of the beakers (Plate 7) contained an assemblage of plant remains that represents food contents, food waste or cess (Smith, Appendix B.3). Pottery from the pit and the postholes was consistent with a 3rd century date.

1.5.23 Ditch 8512, which incorporated several shallow troughs (9507) possibly to retain salt water within the ditch system at low tide, also appears to have been associated with 9502. It respected the outline of the enclosure 9506, but cut the ditch, indicating that it was the later feature. Interestingly, ditch 8512 contained a horse skull and a 2 m long wooden post.

1.5.24 Mound 5808 had several features cut into the top to create a working platform. Two small gullies (8507 and 8508) are possibly the remains of a wind-break surrounding an off-centre hearth (1581) and two settling tanks (1892 and 1894). Pottery was able only to give the features a broad mid to late Roman date. Channel 8550, to the west of Area A, also appears to be mid to late Roman in date and was recut in the late Roman period.

Late Roman (c AD 250-410)

1.5.25 Late Roman activity was concentrated along the western boundary of Stanford Wharf Nature Reserve, and was defined by a recut channel (8551) that formed an enclosure and may have connected to Mucking Creek. The ditch is on a different alignment to earlier enclosures, suggesting that the site was significantly reorganised. Pottery from the enclosure and this area generally dates the activity here to the late 3rd or 4th century.

1.5.26 Traces of two structures survive within the enclosure. One is a rectangular structure (6090) that contains a large hearth (6061), and the other is a circular building (5760) with a clay floor and supported by four large posts represented by post-pads.

1.5.27 Structure 6090 is defined by postholes and gullies and measures 8 x 8 m. Although it appears to have been open on its eastern side, the presence of roof tile within the demolition/collapse layer suggests that it was roofed. The hearth measures 2.15 m x 2 m and comprises two courses of tile with three raised pillars surviving to three courses (Plate 8). White residue on lumps of fired clay suggests that the hearth was associated with salt evaporation. The hearth pillars may have supported lead evaporation pans. Gullies (8516, 8515 and 6513) to the west of building 6090 may be associated with the structure.

1.5.28 The circular clay floor of structure 5760 measured *c* 15m in diameter and was surrounded by a very shallow gully, possibly with a slight gravel bank (Plate 9). A central hearth (5202) was recorded. Four substantial postholes, *c* 4.3 m apart, were associated with the floor. Each square posthole was packed with chalk and flint rubble. The chalk post-pad 5754, within posthole 5903, sat on an additional layer of timber

(5755). The post that would have stood within this posthole was subsequently replaced or reinforced by two more posts (postholes 5907 and 5231). The size and scale of the post-pads suggests a two storey structure or one containing a heavy load. The structure may have functioned as a salt store, or possibly a watch or signal tower.

1.5.29 Artefactual and environmental evidence suggests that the late Roman phase saw activities other than salt extraction. Sample 1160 taken from enclosure 8551 consisted almost entirely of the bones of small fish (Plate 10), attesting to fish processing, perhaps even the manufacture of fish sauce or garum (Nicholson, Appendix B.2). In addition, several perforated cattle scapulae from the same ditch may be a product of meat preservation, presumably using the locally extracted salt (Strid, Appendix B.1).

1.5.30 The Area B saltern was of a broadly similar size to the enclosure in Area A and was surrounded by a combination of ditches and managed tidal channels. The tidal nature of the ditches is far more apparent here. Sections through the channel defining the southern side of the enclosure show eroded laminated deposits due to tidal erosion or flood events. Dating of the saltern is uncertain. Late Roman pottery was retrieved from the channels and linking ditches (8536, 8540, 8538) surrounding the saltern mound The saltern lacked the red earth deposits present in Area A, suggesting a production process consistent with a late Roman date.

1.5.31 Four hearths (4352, 4379, 4317 and 4813) and three clay-lined tanks (4274, 4717, 4336) were uncovered in the south east corner of the enclosure in Area B. Tank 4274 is a slightly unusual shape and may have initially contained two rows of three pits. A small probable beehive kiln (4224) was also recorded. The kiln was probably a single use structure and pottery recovered from the rake out deposit suggests a late Roman date for its use. Further isolated late Roman features include pit 4397, spreads 4261 and 4384 and ditch 8521.

Undated within the Roman period (AD 43-410)

1.5.32 Two rows of timber posts (9517) were present within the southernmost channel surrounding the saltern in Area B. Examination of the tool marks has shown that some of the timber was reused (Goodburn, Appendix A.13). It is possible that these two rows of timber posts, *c* 3 m apart, are a footbridge across the channel. A second wooden structure with traces of horizontal wattle was also identified to the far south of Area B (9518). This too may have been a footbridge or trackway across a boggier part of the site leading out into the marshes.

1.5.33 Two phases of gullies were recorded at the north-western side of Area B. Group 9508 respects an undated ditch to the north (8522) and a large Roman channel (4725) to the south, while group 9519 was cut by late Roman ditch 8521. The function of these gullies is currently unclear, but may be related to the extraction of peat for fuel. Similar features were found in Area A (9516)

1.5.34 Also in Area A, a cluster of eight posts to the north of the boathouse form no distinct structure. The posts are similar to those recovered from boathouse 9500.

Anglo-Saxon (c AD 410-1066)

1.5.35 Despite the proximity of the site to the Mucking excavations, and the fact that Mucking Creek is the closest large navigable creek to the Anglo-Saxon settlements there, no definite evidence of Anglo-Saxon activity has been identified at Stanford Wharf Nature Reserve. The archaeological landscape exposed by soil stripping in Areas A-D is essentially Roman in date, so Anglo-Saxon features should have been visible at this level, if present.

1.5.36 A pair of oak piles found in Area D (2058 and 2059) had unusually flat and broad axe marks characteristic of Saxon woodworking, though are known in Roman contexts (Goodburn, appendix A.13).

Medieval and post-medieval (1066-1800)

1.5.37 There is very limited artefactual or other evidence for medieval activity within Stanford Wharf, although a concentration of generally late medieval–early post-medieval finds and features was found in the extreme north-east corner of Area B (8564, 7039, 8546, 7034, and 7026). A few sherds of medieval pottery were found in gully 8532, also in Area B, and six fragments were recovered from channel 8540, perhaps indicating that this channel was active in the landscape from the the late Roman through to at least medieval period and possibly even into the 19th century. This supposition is supported by gully 8532, which appears to respect the shape of channel 8536. Similarly, a modern ditch follows the same alignment as 8521 in Area B, suggesting some degree of continuity in land use. However, this need not imply direct continuity, as the post-medieval field boundaries could have followed the line of long-abandoned earthworks.

1.5.38 No evidence for earlier sea defences were observed during the breach of the sea wall. A number of half-round wooden stakes approximately 1.6 m in length and 15 cm wide were observed extending parallel to the line of the original sea wall, and it seems likely that they were part of the initial construction. A sample has been taken for C14 dating.

World War II defences

1.5.39 During the Second World War, the southern part of Stanford Wharf Nature Reserve was the site of Stanford-le-Hope Oil QF (diversionary fire) bomb decoy. A concrete blockhouse comprising a night shelter, control room and oil storage bays, was located on the sea wall at the southern edge of Stanford Wharf Nature Reserve, but seems to have been demolished in the late 1940s (Essex Heritage Environment Record HER Number 20303). No remains had clearly been identified prior to breach of the sea wall. However, a series of concrete and brick remains found in Area B, group 9512, may be the remains of some of the oil fire installations.

Other modern remains

1.5.40 Several areas of sand with patches of modern brick and plastic tubing were recorded in Areas I and J (8001). These were the remains of an engineering testing area during the 1970s for the Thames tidal defences project (S Corbet, pers. comm.), which assessed the stability of earthen sea defences. Their locations correspond to a plan of the facility provided by a member of the project.

1.5.41 During the breach, a large concrete platform with steel reinforcing rods measuring approximately 21 m in length and 7 m wide was discovered within the existing sea wall. The platform was edged with steel corrugated sheet piling and was situated within an area of brick rubble on the estuary side. The structure appears to be associated with the flood prevention testing as identical plastic pressure tubing and other deposits were

visible beneath the structure. It is likely that this structure was observed in a site visit in 1999 and documented in the county HER.

1.6 Research aims and objectives

1.6.1 The investigations at Stanford Wharf Nature Reserve form one component of the London Gateway archaeological project, as set out in the AMF: 'The programme offers the opportunity to elucidate the history of the Thames Estuary, one of the great estuaries of Western Europe. The estuary has been a focus for human inhabitation from the Palaeolithic through to the 20th century and, throughout that period, changes in the environment and sea levels have profoundly affected patterns of settlement, exploitation of natural resources, and the use of the river for transport and trade' (OA 2003b). It is the history of this dynamic relationship between the changing environment and human inhabitation which the Stanford Wharf Nature Reserve post-excavation project seeks to address'.

1.6.2 The programme of archaeological analysis and dissemination at London Gateway is dependent upon the construction programme, which will extend over a number of years. It is important that results from each major phase of work are disseminated without undue delay. The general objective of the analysis and dissemination programme is to produce a series of accessible, academically rigorous and interesting products, aimed at a wide audience for the archaeology of South Essex and the Thames Estuary. The stimulation of that interest will contribute to the use of the archive for additional and future research.

1.6.3 The development of the AMF for the London Gateway development involved close consideration of the Archaeological Regional Research Framework (RRF) for the Greater Thames Estuary (Williams and Brown 1999) and the RRF for SE England (Glazebrook 1997; Brown and Glazebrook 2000). These documents have been produced by archaeological organisations responsible for managing and investigating the geoarchaeological resources of the estuary on local, regional, national and international levels. The Compensation Site A archaeological programme explicitly seeks to address the objectives of these frameworks, and is particularly relevant to the former. The RRF for the Greater Thames Estuary adopts a thematic rather than periodic approach, classifying land use zones within the estuary region. Relevant major themes include:

- 'Holocene palaeoenvironment',
- 'Estuary littoral archaeology'.

1.6.4 The following research aims were drawn up on completion of the fieldwork programme and presented in the post-excavation scoping report (OA 2009c). They represent a revision of aims presented in the Stanford Wharf Nature Reserve project design (OA 2009a), but include aims and objectives that emerged in the course of the excavation. Consequently, the revised and updated aims informed the assessment process. To what extent the aims have been addressed will be outlined below. Further revisions and additions to the objectives will then be proposed, followed by a statement of the work required to achieve them.

Regional palaeoenvironmental objectives

- **A.1.1** Characterise the inter-tidal deposits and geoarchaeological features at Stanford Wharf, and establish their chronological sequence

- **A.1.2** Establish a date for the incision and infilling of the palaeochannel to south of Areas A - D
- **A.1.3** Reconstruct local geomorphology, hydrology and vegetation through time
- **A.1.4** Investigate the pre-Roman alluvial landscape and factors responsible for the development of the Roman salterns at Stanford Wharf
- **A.1.5** Clarify the environments of deposition associated with the pre-red hill sequence, through the study of microfossils and sediment analysis
- **A.1.6** Investigate the methods and processes associated with the salt-making, and how this may have been influenced by palaeoenvironmental factors
- **A.1.7** Relate the site palaeoenvironmental sequences to current local and regional models

Prehistoric landscapes

- **B.1.1** Characterise the early prehistoric artefact-bearing deposit horizons and palaeosols

Late Iron Age and Roman-period salterns

- **B.2.1** 'Red hills and other saltern and pottery work-shops are the most common class of site intimately related to the coast. Work should be directed towards understanding the hierarchy and distribution of Roman settlement in relation to the estuary, communications, centres of administration and the utilisation of the rural landscape ' (Williams and Brown 1999, 33).
- **B.2.2** Establish the start and end dates for different types of activity at Stanford Wharf Nature Reserve
- **B.2.3** Investigate the formation processes associated with the *in situ* salt-making mounds in Areas A and B
- **B.2.4** Clarify the formation processes associated with extensive layers of reworked red hill material associated with the enclosures, and the Roman anthrosols, in Area A
- **B.2.5** Establish the character of economic activity at the site through examination of charred plant remains, animal bone, artefacts and microfossils
- **B.2.6** Is there evidence for domestic occupation?
- **B.2.7** Investigate the general exploitation of local natural resources and how this changed through time
- **B.2.8** Investigate the use of different fuel types in the salt-making process
- **B.2.9** If possible, establish a chronology for the blocks of strip gullies in Areas A, B and C
- **B.2.10** Examine artefacts associated with the saltern features
- **B.2.11** Identify evidence for a change from briquetage salt-pans in the early Roman period to lead pans in the late Roman through artefact studies, and chemical analysis of late Roman hearth deposits
- **B.2.12** Analyse and interpret the early Roman multi-ditched enclosures

- **B.2.13** Examine architectural forms present on the site, and how they change through time
- **B.2.14** Clarify the stratigraphic relationship of early Roman wattlework structures in Area D and the alluvial deposits it is buried within
- **B.2.15** Examine evidence for organisational changes at the site in the late Iron Age and within the Roman period by a combination of artefact studies, stratigraphy and scientific methods

Anglo-Saxon settlement patterns

- **C.3.1** Examine closely any possible evidence for continuity in settlement and land-use between the late Roman and Anglo-Saxon periods

Medieval and post-medieval settlement pattern

- **C.4.1** Establish a chronological sequence for medieval/post-medieval activity at Stanford Wharf Nature Reserve
- **C.4.2** Establish the character and extent of medieval activity within Stanford Wharf Nature Reserve
- **C.4.3** Compare archaeological evidence with documentary and cartographic evidence for land-use in the vicinity of Mucking Creek in the medieval and post-medieval periods
- **C.4.4** Identify the earliest evidence for Stanford-le-Hope Wharf.
- **C.4.5** Identify the mid-20th century structural remains within Area B

Sea walls and flood defences

- **D.1** 'Develop an holistic approach to the study of sea walls and flood defences in the estuary landscape, as evidence of climate change, reclamation, management and exploitation of the marshland resource'
- **D.1.1** Establish a chronological framework for the development of sea defences in the Stanford-le-Hope area
- **D.1.2** Understand the chronology and processes involved in the reclamation of Stanford Wharf
- **D.1.3** Develop an understanding of the historical context of sea defences in terms of land ownership and exploitation

Potential to address research aims

1.6.5 The stratigraphic, artefactual and palaeoenvironmental assessments have resulted in a robust baseline dataset. An overarching objective of the analysis will be to build on the baseline study to provide a detailed description of the stratigraphic sequence (accompanied by GIS maps and sections), chronology, the finds, sediments and palaeoenvironmental evidence. The description will allow most of the research aims to be addressed, but more generally, it will be at a level that supports the site interpretation and benefits future researchers. Some of the research aims, however, deserve particular attention. Much of the analysis will focus on the following themes.

Reconstructing the geomorphology, hydrology and vegetation (A.1.3)

1.6.6 Analysis of the structural wood is likely to shed light on local Roman-period woodlands and allow comparison with the evidence from Ebbsfleet and Roman London, amongst other sites. The nature of the wooden structures themselves, with their levels above Ordnance Datum, is crucial to one of the key potentials of the project as a whole, that of recording changing relative sea levels in the Roman period.

1.6.7 Analysis of palaeoenvironmental sequence 6 will give an insight into the formation of the anthrosols, as well as characterising the environment in the intervening periods, potentially representing periodic marine incursion. Sequence 8 at the southern edge of Area A will characterise the post Roman environment.

Investigating the pre-Roman alluvial sequence (A.1.4)

1.6.8 Palaeoenvironmental sequence 1 is a key sequence for the site, as it represents the transition of a terrace above the floodplain in the early Holocene to a tidally inundated land surface in the mid to later Holocene. This creates the context for the Roman saltmaking evidence.

Investigating salt-making methods and processes (A.1.6)

1.6.9 The analysis of the fills of the outer ring gully of roundhouse 9501 (sequence 14) will provide an environmental context for the immediate vicinity of the structure and potentially identify the nature of processes occurring in the roundhouse. Good evidence for the use of the structure is also likely to come from samples from sequence 16, taken from the settling tanks. Analysis of the sediments from the inner ditch may provide an insight into the processes occurring within the building. The aim of the analysis will be to look for variation in deposits, within and between tanks, such as microstratigraphy, in order to identify function.

1.6.10 Sediment analysis of sequence 22 (taken through the late Roman salt-extraction area of Area A) will help to characterise the changes in salt making detritus through time. The sequence from Area B (sequence 25) provides a comparison to Area A in of its evidence of salt production.

Dating the site (B.2.1, B.2.2)

1.6.11 Pottery, stratigraphy, radiocarbon dating and OSL have provided a good chronology for the phases of activity at the site. However, there are aspects of the site sequence that require clarification. It is generally held that the origin of the red hills in Essex lies in the late Iron Age, and there has been suggestions of a middle Iron Age origin (Barford 1989, 84). For the red hills of Stanford Wharf Nature Reserve, there is support for a middle Iron Age date, though given the paucity of contemporaneous activity elsewhere at Stanford Wharf, and the Roman character of the briquetage assemblage, the dating needs to be confirmed.

1.6.12 The early Roman period is poorly represented, and currently the timber boathouse is somewhat isolated. Whether more early Roman emerge through analysis remains to be seen.

1.6.13 Careful stratigraphic analysis, in conjunction with the ceramic dating, is required to disentangle the complex mid Roman sequence of archaeology in Area A and achieve a greater understanding of associations between features and organisation of activity. Area B appears to have been temporarily abandoned in the mid Roman period. This should be confirmed.

Understanding the red hills (B.2.3)

1.6.14 The nature and formation of red hills have long been a subject of debate, with little resolution of their character or composition. Red hills have traditionally been identified as the remains of spoil heaps and working areas of salt-making sites. The sampling of the red hills at Stanford Wharf have provided the opportunity for red hills to be characterised, perhaps for the first time, using a battery of analytical methods.

1.6.15 The excavation showed that the major components of the red earth material were weathered briquetage and fired clay, suggesting that briquetage manufacture, rather than salt-extraction waste, was responsible for the coloured soil. It may be significant that the briquetage assemblages from the areas A and B appear to be made from different fabric. In Area A where the red earth deposits are present, the briquetage fabric is predominantly shell and sand with some organic temper. In Area B, where the red earth deposits are absent, the fabric is almost exclusively organic temper. What plants were used to temper the briquetage can be addressed by analysis of the briquetage and plant remains.

1.6.16 Interestingly, initial characterisation of the palaeoenvironmental evidence from sample 1366 (context 6373A) revealed a large number of one species of foraminifera (*Trochammina inflata*), which resides within the inter-tidal zone, although no alluvium was located beneath the red hill in the area of sampling. This suggests that the foraminifera were derived from inter-tidal seawater, or that the seawater covered part of the red hill deposit before or during firing. The analysis of these proxies, in conjunction with the stratigraphic and artefactual record, will provide detailed information on the process of creation of these red hill deposits.

Investigating the reworked red hill material (B.2.2, B.2.4)

1.6.17 Questions remain over the composition and use of the redeposited red hill soil. In recent times, soil dug from the red hills was used as a soil enhancer by local farmers (Fawn *et al.* 1989, 5). The Roman occupants may have had similar motivations for laying down spreads of red earth, creating a drier working environment than the surrounding alluvial deposits in the process. Area B saltern lacks the red earth deposits present in Area A, despite having a near-identical range of industrial features (hearths, briquetage, settling tanks, drainage ditches and ponds). Analysis of the artefacts recovered may reveal differences in chronology, condition, assemblage composition and depositional histories, any of which could potentially shedding light on the nature of the red soil.

Establishing the character of economic activity (B.2.5)

1.6.18 Besides the predominant salt-extraction, the artefactual evidence revealed a range of other economic activities, all it seems taking advantage of the salt-related infrastructure and the extracted product. Iron working was carried out, and appears to have been associated with roundhouse 9501. With the evidence of perforated cattle scapulae, the potential identification of meat preservation in the late Roman period, presumably using home-extracted salt, is of particular interest. Similarly, the fish bones, from the same late Roman ditch as the scapulae, and tentatively interpreted as the waste from garum production, is very important. As a salt-producing site, the locality would have been well-suited to the production of salted fish and fish sauces, and if these remains do represent a locally manufactured product, it would be the first definite example of garum manufacture recovered from Britain.

1.6.19 This evidence has tremendous implications for the economic environment of the region, pointing to a level of specialisation that ensured regular and well-controlled supply of goods to various markets, such as flourishing villa estates (eg Great Holts Farm and Chignall), military installations (eg the Saxon Shore fort at Bradwell-on-Sea), and London. Quite what role the provincial government played in this economy is a matter of debate, though the possibility of state ownership or oversight will be examined.

1.6.20 A comparison with other salt-extraction sites will give an indication of the importance of the Wharf Road site – for example in terms of output, market reach, ownership and so on.

Tracing changes in site organisation and domestic occupation (B.2.6, B.2.15)

1.6.21 Confirming the stratigraphic sequence will be the principal means of achieving this aim. In addition, it is notable that much more pottery was deposited in the late Roman period compared with the earlier Roman phases. This has enormous relevance to understanding the changing nature of occupation at the site. The quantities of pottery may reflect the intensity of domestic occupation, with the salters preferring to reside in nearby settlements (chiefly Mucking) in the early and mid Roman period. The use of pottery in the late Roman salt industry, for instance as salt containers, should also be explored.

1.6.22 The briquetage may usefully be brought in here. There may be patterns of base or rim distribution which are suggestive of specific production activities or differences in organisation, for example between the salterns of areas A and B. The worked stone also has some potential to add to our understanding of the site. The rotary querns are usually indicative of general domestic activity. However, the presence of likely millstones suggests more intensive processing. It is possible they played a role in an industrial activity on site, but this will need further investigation. The paucity of personal and household metal and glass items and the comparatively small quantities of structural items both suggest that the site lacked any significant settlement element, and contributes to an understanding of the character of the occupation of the site.

1.6.23 Waterlogged deposits from rural sites of Roman date are considered relatively rare in Britain (eg van der Veen 2008; van der Veen et al. 2007) and, therefore, analysis of waterlogged food/waste debris from certain samples is of regional, if not national, significance, especially given the industrial character of the site. Whether the debris represents the remains of food, food waste or cess is not clear at this point, but will be specifically addressed during analysis.

Investigating fuel (B.2.3, B.2.8, B.2.9)

1.6.24 The absence of recognisable charcoal fragments in the hearth deposits suggests that peat or turf may have been used as fuel and that this was in part responsible for producing the distinctive red coloured earth spread across the area. Evidence for extraction of the peat or turf may be present as blocks of parallel strips in Area A (9516) and Area B (9508, 9519). These resemble medieval or post-medieval turbaries in the Lincolnshire fens and elsewhere (cf. Lane 2008). In the late Roman phase, a change in fuel type is suggested with larger quantities of charcoal present and less ash/burnt red silt.

1.6.25 Two related questions emerge from the assessment of the charred and waterlogged plant remains: what plants were used for fuel? Was this in combination with wood fuel/charcoal or was it occurring independently of wood fuels? The samples are highly suited to addressing these research questions in detail.

Examining the artefacts from saltern-related features (B.2.10)

1.6.26 The Roman-period pottery assemblage is one of the largest recently excavated in the region. Consequently, the potential for it to address research questions relevant to the saltworks and occupation at the site is very good. The pottery potentially allows us to relate this industrial site to the wider range of sites and settlements in the region in terms of site status and ranking (relevant also to B.2.1). The use of the pottery within an industrial and domestic context can be explored through analysis of types and deposition patterns, while trade and social connections across the estuary and along the lower Thames valley may be apparent from pottery supply patterns.

1.6.27 The assemblage of ceramic building material from this site is extremely important, as it relates to a specialised industry and much of it has been recovered either from *in situ* structures or from collapsed/demolished and subsequently dumped structures. Analysis of the tile can elucidate the construction and functioning of salt production in the later Roman period. There has been little study of wider aspects such as the inter-relationship of the tile industry and its products in relation to salt production. The analysis of the tile may provide information on sources: initial analysis suggests that much of the material may never have been previously used as roofing which has implications for resourcing of building material for the salt industry. The use of new as opposed to recycled tile has economic implications for the profitability of the later Roman salt production or connections with villa estates.

From briquetage to ?lead (B.2.11)

1.6.28 The absence of briquetage from the late Roman sequence across the site suggests that by the late 3rd century ceramic evaporation pans and other equipment were replaced by vessels and structures of other material. This is apparent with the construction of tile-built hearth 6061, but the discovery of a large lead 'rivet', possibly a repair or join, also points to the use of lead pans. Analysis of the possible metal flake on the kilnbar sherd from context 6064 may demonstrate the transition to metal brine heating pans during the Roman period, a process which is poorly documented due to the absence of metal pan finds in Essex.

1.6.29 In conjunction with the excavated evidence from the multiple hearths found at the site, the briquetage assemblage may allow for the development of a chronology of hearth structures and variation in salt-making techniques. Comparison of this assemblage with the artefacts from the Leigh Beck Roman saltern on Canvey Island (Essex County SMR 9659) would be useful. To this end, phasing of this pottery might present a significant clue to the dating for the end of the use of briquetage vessels in Essex salt production. Evidence from other red hill and salt extraction sites in Essex suggests that the use of briquetage ceased by the mid 2nd century (Fawn *et al.* 1989, 39). Site A, with good evidence for salt extraction using briquetage well into the 2nd century and possibly into the 3rd, brings this traditional dating into question.

Function of the multi-ditched enclosures (B.2.12)

1.6.30 The understanding of the environment in which enclosure 9506 was built and occupied can be gained through analysis of samples from palaeoenvironmental sequence 12 from a channel linked to the enclosure. It will also help elucidate the channel's function.

Architecture (B.2.13)

1.6.31 Structure 5760, the massive late Roman circular structure, is puzzling, and there are apparently no comparable circular structures at other saltworks. Its size and scale

suggests either a two-storey structure or one containing a heavy load. Late Roman roundhouses tend to be interpreted as agricultural buildings, such as at Shakenoak villa in Oxfordshire (Brodribb *et al.* 1971), but here a specialist function associated with salt-making is more plausible, and in any case, there are notable differences in architecture. Given that the 3rd century AD saw the construction of the Saxon Shore forts around the SE coast of Britain, the possibility that the structure functioned as a coastal watchtower or similar, perhaps relating to state interest in the site, should not be ruled out.

1.6.32 From detailed recording and analysis of the structural timbers, it should be possible to reconstruct some of the structures with more certainty, such as the possible boathouse, the large roundhouse and bridges. It should also be possible to tighten the dating of phases.

Sea defences (D.1.1)

1.6.33 No evidence for early sea defences was observed during the breach of the sea wall. A number of half-round wooden stakes approximately 1.6 m in length and 15 cm wide were observed extending parallel to the line of the original sea wall, and it seems likely that they were temporary works associated with construction or maintenance of the modern sea wall. A sample has been taken for C14 dating.

2 Resources and Programming

2.1 Project team

2.1.1 The project team is set out in the table below.

Name	Organisation	Position	Role
Leigh Allen	OA South	Finds manager	Find management and archiving
Edward Biddulph	OA South	Senior project manager	Post-excavation management; Roman pottery; report writing
Paul Booth	OA South	Senior project manager	Coins
Matt Bradley	OA South	Geomatics manager	Geomatics management
Lisa Brown	OA South	Senior project manager	Prehistoric pottery
Nigel Cameron	UCL	Environmental specialist	Diatoms
Chris Carey	OA South	Project officer	Sediment analysis; palaeoenvironmental reporting
Wendy Carruthers	Freelance	Environmental specialist	Charred and waterlogged plant remains
John Crowther	University of Wales	Soil scientist	Sediment characterisation and analysis
Dana Challinor	Freelance	Environmental specialist	Charcoal
Sharon Clough	OA South	Project officer	Human remains
Geraldine Crann	OA South	Supervisor	Finds administration
Stuart Foreman	OA South	Senior project manger	Post-excavation management
Damian Goodburn	Freelance	Wood specialist	Worked wood

Name	Organisation	Position	Role
Dana Goodburn-Brown	Freelance	Conservator	Metal object X-raying
Leo Heatley	OA South	Supervisor	GIS
Janice Kinnory	Freelance	Finds specialist	Briquetage
Steve Laurie-Lynch	OA South	Logistics and stores	Transport
Sarah Lucas	OA South	Senior illustrator	Graphics Office management
Richard Macphail	UCL	Environmental specialist	Micromorphology
Quita Mould	Freelance	Finds specialist	Leather
David Mullin	OA South	Project officer	Worked flint
Rebecca Nicholson	OA South	Environmental manager	Environmental management; fish bones
Sylvia Peglar	Freelance	Environmental specialist	Pollen
Susan Rawlings	OA South	Project officer	Archiving
Ian Scott	OA South	Project officer	Small finds
Nicola Scott	OA South	Archives manager	Archiving
Ruth Shaffrey	OA South	Project officer	Worked stone; ceramic building material
Alex Smith	OA South	Senior project manager	Post-excavation monitoring
Liz Stafford	OA South	Geoarchaeological manager	Geoarchaeological management
David Starley	Freelance	Metallurgist	Slag
Lena Strid	OA South	Project officer	Animal bone
John Whittaker	Natural History Museum	Environmental specialist	Foraminifera and ostracods

Table 2: Post-excavation project team

2.2 Methods statement

Prehistoric pottery (A.1)

2.2.1 Despite its small overall size, the assemblage merits publication. The assemblage can be placed in its local and regional context through comparison with published material, notably from Little Waltham (Drury 1978) and Mucking (Barrett and Bond 1988). Comparison with other sites along the Essex Thameside region that produced smaller proportions of prehistoric pottery (eg Brown 1998), as well as sites in north Kent, for instance the Channel Tunnel Rail Link sites (Booth 2006), will also be relevant.

Roman pottery (A.2)

2.2.2 In order to provide suitable data, the assemblage will be fully recorded by sherd count, weight and estimated vessel equivalents (EVE), following standard OA guidelines

(Booth nd). Fabrics will be assigned codes devised by the Essex County Council Field Archaeology Unit (eg Martin 2003, 98), while forms will be identified using Going's Chelmsford typology (1997), supplemented where necessary with the Colchester series (Symonds and Wade 1999) and regional corpora. This will ensure compatibility with other Essex sites. Ideally, forms should be also matched with the nascent Mucking typology (S Lucy pers. comm.); information on the typology will be sought from the Cambridge Archaeological Unit ahead of publication.

2.2.3 A range of analytical tools will be used to draw out information from the pottery. For example, simple proportions of forms and fabrics will allow the patterns of pottery supply to be charted. The mean sherd weight will be used to analyse patterns of deposition and pottery condition, while distribution plots generated from GIS will be used to demonstrate any spatial patterning. Correspondence analysis will highlight any associations between two variables, for example pottery types and site type.

2.2.4 A representative sample of pottery (around 100) will be selected for illustration. These will mainly be from large, well-dated groups, which will provide snapshots of pottery supply, but pottery of intrinsic interest, for example rare vessels or pottery that show aspects of use, such as trimming, burning, wear and graffiti, will also be selected.

Medieval and post-medieval pottery (A.3)

2.2.5 In general, the range of medieval wares present is what one would expect from a coastal site in south Essex and close to London. The assemblages dates within the period *c* 1200-1600 and includes a high proportion of 15th- to early 16th-century local red wares. No further work is recommended.

Briquetage (A.4)

2.2.6 Full recording of the briquetage assemblage is required to address the research aims. A more detailed study of vessel forms would be helpful, particularly with respect to the evidence for circular vessels which are thought to be rare in Essex but may not be within this assemblage. Differences in organisation and areas could emerge through detailed statistical analysis of the assemblage.

2.2.7 As organic temper impressions exist on many of the sherds in the assemblage, useful data on plants used as temper would be gained by further analysis of these features by an archaeobotanist.

2.2.8 During the scan of this material, a number of sherds of pottery with salt staining were removed from the fired clay assemblage. It would be useful to look for further evidence of the use of pottery (for example lid-seated jars) in the salt production process within the pottery assemblage. As the collected material includes fresh clay samples from six contexts at the site, the creation and firing of test pots for comparison with assemblage would be possible.

Ceramic building material (A.5)

2.2.9 The assemblage will need to be recorded in full with the following question in mind: How fresh are the breaks and can any pieces be refitted to give original dimensions? The results will then need to be analysed to look at:

- the distribution of different tile types in different features;
- how worn and/or burnt the tile is;

- the relative proportions of the different forms and how they compare with typical domestic assemblages and/or other salt working site assemblages; whether specific tile types were being selected for certain uses within kiln structures

2.2.10 Recording the assemblages with these aspects in mind may help answer questions about the source(s) of the CBM and whether it had been previously used.

2.2.11 There are a high number of signatures present in this assemblage including some types not identified by Brodribb (1987, fig. 47) or known to specialists at Oxford Archaeology. Signature marks are a poorly understood area of ceramic building material analysis and this assemblage provides an excellent opportunity to publish a detailed group of signature marks, a significant number of which are complete or near complete and which possibly relate to a single production area or workshop. These can be added to the growing type series of signature marks being established at Oxford Archaeology under the supervision of Cynthia Poole and would make a useful contribution to the wider study of ceramic building material manufacture.

2.2.12 The analysis of the ceramic building material should be fully integrated with the structural evidence from the site and the evidence of the fired clay/briquetage.

2.2.13 Prior to commencement of recording, a discard policy will need to be agreed between OA, DP World and the receiving museum. There are over 50 boxes of ceramic building material and it may not be possible for the museum to receive it in its entirety. If a discard policy is agreed, it is essential that all discarded material is fully recorded.

The lithics (A.6)

2.2.14 The flint assemblage should be placed in its wider context, both chronologically and regionally. There is high potential for refitting sequences of flakes and cores from context 1213. This analysis should be undertaken alongside a consideration of the spatial distribution of the material throughout the deposit from which it was recovered in order to identify possible knapping clusters and/or activity areas.

Worked stone (A.7)

2.2.15 The quernstones will be carefully examined for signs of wear in relation to their contexts of recovery. The question of whether they are associated with settlement or whether they could they have played a role in industrial processes on site will need to be investigated. The site will need to be examined for the location of a possible mill. Some fragments will be chosen for illustration. The quern/millstone assemblage will be analysed in the local and regional context.

Coins (A.8)

2.2.16 Five coins require cleaning. Identifications will then need to be revised and a short report prepared.

Metal objects (A.9)

2.2.17 The metalwork assemblage has been recorded. However, the assemblage, in particular the ironwork, requires x-ray. Following this, the database can be updated where necessary. The assemblage requires limited publication, with a discussion of the composition of the assemblage and its spatial and stratigraphic distribution, and illustrations and catalogue of selected items. The illustrations should include the spearhead, if the identification is confirmed after radiography, the two Colchester brooches and plate brooch, the possible tweezers and the hair pin. The Colchester

brooches and possibly the plate brooch fragments could be illustrated by photographs. The latter could also be illustrated by a line drawing showing its original form. The spear head might be best illustrated by reproduction of the X-ray plate with a simple line drawing reconstructing the complete head. It will probably not be possible to illustrate the tweezers which are very poorly preserved.

Iron slag (A.10)

2.2.18 The assemblage will be recorded in detail. It will be examined to identify the nature of the ironworking, for example smelting or smithing, while its distribution will show areas of metalworking activity.

Glass (A.11)

2.2.19 The assemblage has been recorded fully and little further work is required. None of the vessel glass requires detailed publication or illustration.

Leather (A.12)

2.2.20 The leather will be examined to confirm object identification. Using a low-powered microscope, it may be possible to identify species from the hair follicle pattern.

Structural wood (A.13)

2.2.21 Further work is required to complete the woodwork recording to basic standards set out in English Heritage guidelines (English Heritage 2010).

2.2.22 Following the completion of recording and sampling to the level suggested above, the assemblage will have the potential to address the research aims.

Human remains (A.14)

2.2.23 Examination of the human bone will potentially identify sex and age of the individual, if only broadly. A brief discussion will place the burial within its cultural context in terms of regional burial practices.

Animal bone (B.1)

2.2.24 The Bronze Age and medieval assemblages are very small and contain few bones identifiable to species. It is unlikely that future phasing will increase substantially the number of speciable bones, so further work is not required.

2.2.25 Until the final phasing of contexts has been completed it is not possible to establish exactly how many bones of Iron Age and Roman date will require recording; only securely phased bone should be recorded in full. The scope of further analysis is therefore based on the full recording of bones from securely dated features and a proportion of bones from currently unphased features.

Fish bones (B.2)

2.2.26 Fish remains from prehistoric and Roman sites are still relatively rare, and hence all fish remains recovered from securely phased deposits of this age are worth recording and reporting. However, the assemblage from sample 1160 is of particular significance and further work is required in order to ascertain whether the remains represent garum or other fish product and to investigate whether the fish were likely to have been caught locally.

Charred and waterlogged plant remains (B.3)

2.2.27 In light of this assessment, it is clear that there are four main research issues for full analysis:

- What plants were used to temper briquetage? Was this restricted to a certain period or particular area on site?
- What plants were used for fuel? Was this in combination with wood fuel/charcoal or was it occurring independently of wood fuels?
- What food stuffs were consumed or disposed of by saltworkers on site?
- What was the nature of the surrounding environment?

2.2.28 All four of these research objectives require material that can be securely phased and/or directly related to specific activities or natural situations (eg water channel). A large number of samples have been identified in the CPR programme which have potential for analysis if combined with other samples or if securely phased. These will need review in order to establish their potential to add to our understanding of the activities carried out on site and/or the site's wider environment. As a result, it is recommended that time is allocated to provide archaeobotanical input in the final selection of samples for full analysis.

Phytoliths

2.2.29 The phytolith assessment was to be focused on the possible identification of different fuel types associated with the salt-making process, and a range of spot samples from monoliths were taken to test for phytolith preservation.

2.2.30 During the assessment, the value of recording the phytoliths in the face of the excellent CPR results was discussed. It was agreed that the phytoliths would add very little to our understanding of the palaeoenvironment, especially fuel, beyond information already gained from the CPR, and their assessment was consequently dropped from the programme.

Palaeoenvironmental proxies and sediment analyses (B.4 – B.8; Appendix D)

2.2.31 From the results of the assessment of the palaeoenvironmental proxies, the following is given as a guide to full analysis. As the assessment only sampled key contexts within the sequences, some further counts of diatoms, foraminifera and ostracods is required for qualitative information on depositional environments from contexts not investigated during the assessment.

Sequence 1: A Roman-period anthrosol located on the top of alluvium, with alluvium overlying a palaeosol G4 and early Holocene Sand G3

2.2.32 In total there are six monoliths, covering 1.0 m of sequence sample, with eight contexts. The sequence requires analysis for pollen, on a per context basis, above the G3 sands. It gives seven sample locations for pollen and one further context for analysis of foraminifera, ostracods and diatoms.

2.2.33 This is a key sequence for the early to mid Holocene environment, requiring analysis of particle size, organic and carbonate content (loss on ignition), combined with magnetic susceptibility and geochemical core scanning, for sediment characterisation. Soil micromorphology sections will be used to study the key interfaces for the transition between depositional environments, and also study the composition of specific

deposits, such as the anthrosol, to a maximum of seven thin sections. Suggested sample interval for organic and carbonate contents and particle size is 5 cm.

Sequence 6: Three sequential anthrosols separated by alluvial deposition towards the southern edge of Area A

2.2.34 The sequence contains two monoliths consisting of six contexts. Pollen can be analysed from five contexts and one further context can be analysed in terms of foraminifera, ostracods and diatoms.

2.2.35 This is a key sequence to address the formation processes of these anthrosols and their use. Full analysis of particle size, organic and carbonate content (loss on ignition) will be undertaken, combined with geochemical and magnetic susceptibility core scanning. Soil micromorphology sections will be used to study the key interfaces for the transition between deposits and also study the composition of specific deposits, such as the anthrosols, to a maximum of six thin sections. Three monoliths with a total length of 0.8 m, will have their sediment characterised using a sample interval of 5 cm.

Sequence 8: At the southern edge of Area A, potentially containing post Roman (medieval) alluvial sequence

2.2.36 It is suggested that two monoliths (1.0 m, five contexts) are analysed from this sequence for pollen, and three contexts for foraminifera, ostracods and diatoms.

2.2.37 In terms of sediment analyses, particle size, organic and carbonate content (loss on ignition), will be used in conjunction with magnetic susceptibility and geochemical core scanning. For the particle size, organic and carbonate contents a 5 cm sample interval will be used.

Sequence 9: Roman-period enclosure (9506), inner ditch

2.2.38 The inner enclosure ditch provided relatively poor results for the pollen. The understanding of the depositional environment is key for the inner enclosure ditch, with qualitative data already provided by the diatom and foraminifera assessment. As a result no further palaeoenvironmental work is envisioned on this sequence.

2.2.39 However, full analysis of sediment particle size, organic and carbonate content (loss on ignition) on a per context basis, combined with magnetic susceptibility core scanning, will be undertaken. Five contexts, from two monoliths (with a total length of 0.9 m) will be analysed.

Sequence 12: Roman-period enclosure (9506), outer ditch

2.2.40 This sequence has three sample groups, each of two monoliths, from a separate phase of the enclosure ditch, representing six monoliths in total, with a total length of 2.5 m and 14 contexts. There was generally good preservation of pollen and foraminifera. Further analysis should be undertaken of pollen from each six contexts, and diatom, foraminifera and ostracod counts on three contexts not investigated as part of the assessment.

2.2.41 Full analysis of sediment particle size, organic and carbonate content (loss on ignition) on a per context basis, combined with magnetic susceptibility core scanning, will compliment the palaeoenvironmental analysis.

Sequence 14: Roundhouse 9501, outer ditch

2.2.42 There are two monoliths which contain seven contexts and have a length of 1.0 m. These will be analysed for pollen for the characterisation of the immediate environment, An additional four contexts not included in the original assessment will be analysed for foraminifera, ostracods and diatoms.

2.2.43 Full analysis of sediment particle size, organic and carbonate content (loss on ignition) will occur on a per context basis, with magnetic susceptibility and geochemical core scanning. Deposits will be investigated via soil micromorphology to investigate debitage from salt-making processes (two thin sections).

Sequence 15: Roundhouse 9501, inner ditch

2.2.44 One monolith (0.5 m, three contexts) will be prepared for soil micromorphology thin-section analysis, combined with geochemical and magnetic susceptibility core scanning. From each context, one sub-sample will be analysed for particle size, organic and carbonate content (loss on ignition).

Sequence 16: Roundhouse 9501, set of three tanks

2.2.45 In total three samples are to be taken forward for analysis of their sedimentology. The CPR assemblage from these deposits was rich, although no microfossils were recorded. Thus, a sediment-based analysis combined with CPR will be the most productive analysis for these deposits, with no further analysis of pollen or foraminifera required.

2.2.46 Six sub-samples (two from each tank) will be analysed for particle size, organic and carbonate contents. Each monolith will be scanned for magnetic susceptibility. Two thin sections will be prepared for soil micromorphology.

Sequence 17: Roundhouse 9501, hearth

2.2.47 Soil micromorphology will be undertaken on two samples (four thin sections). This will be combined with geochemical and magnetic susceptibility core scanning, and a sample analysis from each context for organic and carbonate content (loss on ignition) and particle size.

Sequence 19: Red hill 5664, eastern side of Area A

2.2.48 No pollen was recovered from the one red hill deposit assessed, but the foraminifera results were substantial. The diatoms assemblage was poor, but qualitative data was still produced. Based on these results a series of contexts will be assessed for palaeoenvironmental analysis, to see if the pattern seen in assessment is repeated throughout. Eight contexts will be analysed for foraminifera, diatoms and pollen, in addition to the one assessed.

2.2.49 Six of the ten monoliths sample should have a full scan of their geochemistry and magnetic susceptibility. Particle size analysis, organic and carbonate contents (loss on ignition) will be used to characterise the sediments in the red hill. Soil micromorphology will be used to assess factors such as microstratigraphy and periodicity in deposition of the deposits. In total, there are 55 contexts, of which a maximum of 35 will be selected for analysis. Ten thin sections will be used for soil micromorphology.

Sequence 21: Floor samples from late Roman structure 5760

2.2.50 Two monoliths (0.45 m long total length, five contexts) will be analysed by soil micromorphology (two thin sections) and geochemical and magnetic susceptibility core scanning. In addition, a sample from each context will be analysed for particle size, organic and carbonate content (loss on ignition) and to aid characterisation.

Sequence 22: Late Roman deposit, Area A

2.2.51 Two monoliths will be analysed by soil micromorphology (two thin sections). Particle size analysis, organic and carbonate content (loss on ignition) will be undertaken on a per context basis. Magnetic susceptibility and geochemistry will be measured via core scanning.

Sequence 23: Fill of pit 1249

2.2.52 The waterlogged plant remains analysis of this deposit has proved extremely useful, with additional bulk samples provided for palaeoentomological analysis. Ostracoda and foraminifera were absent, potentially due to a freshwater input from groundwater, whilst diatoms revealed some marine and brackish species. Both pollen and diatom counts were low, revealing little further potential, consistent with a cess pit. As a result it is recommended that there is no further analysis of pollen, diatoms or foraminifera.

2.2.53 It is suggested that soil micromorphology analysis be undertaken to provide evidence of depositional environment using two thin sections, one from each of the two contexts.

Sequence 25: Salt making sequence at edge of platform, Area B; alluvium interleaved with salt making detritus

2.2.54 It is suggested this sequence is taken forward for full analysis as a comparison to the Area A. Although variable in the sequence, a full analysis of pollen should be undertaken on three monoliths, analysing one sub-sample from each of the 10 contexts suitable for analysis, plus seven contexts for foraminifera, ostracods and diatoms not included in the original assessment.

Sequence 26: Sequence of pre-Roman alluvium, with salt production deposits on top of the alluvium

2.2.55 This sequence will not be taken to full analysis. However, limited work can be undertaken on the pollen from context 4210, thus providing a context for the pre-Roman saltmaking environment.

Sequence OA3: Palaeochannel fill sequence

2.2.56 The length of sequence is 3.3 m for this borehole. Pollen, ostracods and foraminifera remains were shown to be diverse and abundant in the assessment and a full analysis of these proxies is necessary on specific parts of this sequence, combined with further radiocarbon dating, using a sample interval of 5 cm and making provision for the analysis of 20 sub-samples.

2.2.57 A full analysis of sediment geochemistry, particle size, organic and carbonate contents (loss on ignition) and magnetic susceptibility will be undertaken, based on the sample interval of 5 cm on a total core length of 3.3 m, giving 69 samples for sediment analysis. Each core will be scanned for geochemistry and magnetic susceptibility.

Additional analyses

2.2.58 Geochemical characterisation of the brickearth bulk sample is required for comparison with the geochemical core scanning. It is possible that the brickearth was being used for manufacture of clay infrastructure associated with the saltmaking. Geochemical fingerprinting can be used to establish whether this relationship exists.

2.2.59 GIS analysis of geomorphology and palaeoenvironmental landforms is required to complement the palaeoenvironmental and sediment analyses, providing a tool for integration, visualisation and archiving of the analyses.

Scientific dating (Appendix C)

2.2.60 The chronology of Site A can be broken down into three component parts: the relative dating of contexts, the radiocarbon dating of wooden structures (three dates) and the OSL and radiocarbon dating of the dominant sediment units (six radiocarbon dates and seven OSL dates). The dominant sediment units form a simple sequence, starting with the deposition of the G3 sands in the early Holocene. The wooden structures all fall within the Roman period. The development of the main sediment units has been linked into the cultural landscape model for the Thames, put forward by Bates and Whittaker (2004).

2.2.61 Owing to the small sample size of the dating pool, combined with the simplicity of the sediment sequence, it is suggested that Bayesian modelling is not warranted at this stage. Further dating of the sequence is proposed during the analysis. When the complete set of dates is available, it can be integrated with the broader chronostratigraphic framework being developed for the London Gateway site-wide palaeoenvironmental programme. At this level of analysis the dating evidence from Stanford Wharf can be linked to existing data from the wider Thames estuary, and Bayesian modelling may well be an appropriate tool for analysing the results.

2.2.62 While the OSL and radiocarbon dating has provided an overarching chronological framework, there is a requirement for further dates to be applied in order to provide greater resolution on specific sequences. No further OSL dates are required but provision is made for a further ten radiocarbon dates on samples from sedimentary sequences, to be distributed as follows:

- Sequence 1: Two dates on the lower alluvium and upper alluvium respectively.
- Sequence 8: Two dates on the organic rich deposit and alluvium beneath it
- OA3: Four dates on marker horizons throughout the borehole
- Pre-red hill alluvium: Two dates on the alluvium under the red hill, to confirm that this part of Area A was inundated by a Bronze Age marine incursion.

2.2.63 An additional six C14 determinations are required to clarify the dating of timber structures. These are:

- Area B footbridge 9517; timber 4388 had features that were more typical of medieval or later carpentry.
- Area B wattle 9518; the structure is currently of uncertain date.
- Possible Saxon timbers 2058 or 2059. Can a determination identify otherwise elusive Saxon activity?
- Timber 6505 from the possible litter or ladder; the object type is rare and so worth dating.

- A timber from the trench of roundhouse 9506, potentially dating construction.
- A wooden stake recorded during the breach of the sea wall can usefully be radiocarbon dated to determine whether it formed part of the original sea wall.

2.3 Stages, products and tasks

The overall programme

2.3.1 It is anticipated that, after a period of project design review, the analysis and publication programme will commence in October 2010 and be completed by July 2013 (see Gantt appended to end of volume)

2.3.2 The programme can be summarised as follows:

- November 2010-December 2011: Context and stratigraphic analysis and description; artefact analysis and reporting; scientific dating
- March 2011-October 2011: Context and stratigraphic analysis and description;
- March 2011-December 2012: Palaeoenvironmental analysis and reporting
- December 2012-June 2013: Preparing publication text and graphics; editing, typesetting, refereeing, printing; preparing digital publication
- May 2013-July 2013: Archiving

Publication

Essex Journal

2.3.3 The site description and interpretations presented in this assessment report and will form the basis for an interim report (*c* 5000 words) to be published in the *Essex Journal*. This is a twice-yearly journal published by Essex Congress, an umbrella body that coordinates and promotes the work of archaeological and historical groups across the county.

Monograph

2.3.4 The principal products of the analysis will be the final publication and detailed reports of the artefactual and environmental material, accompanied by supporting data. The archaeological report will comprise an illustrated hardback book of *c* 150 pages, with full colour illustrations, incorporating an integrated landscape narrative and a synthesis of the supporting specialists' reports. The text will be aimed primarily at an archaeologically informed, but non-specialist audience. Introductory and concluding chapters will present a detailed discussion of evidence for general landscape evolution at Stanford Wharf. The main focus of the book will be the history of Iron Age and Roman-period salt production, and its wider environmental and cultural context.

2.3.5 The anticipated print-run is expected to be *c* 500 copies, of which *c* 250 will be donated to local and academic libraries or retained by DP World for internal distribution. The remainder will be distributed on a semi-commercial basis by Oxbow Books or directly by OA. Further copies of the book will be supplied, if required, as 'print-on-demand' volumes.

2.3.6 The monograph text, graphics, and full specialists' reports and data will also be made freely available as a digital download from the OA Library

(http://library.thehumanjourney.net/), a website developed by Oxford Archaeology as a means of making reports and data accessible to all.

2.3.7 The working title for the publication is: *Roman salt production and marshland exploitation in south Essex: excavations at Stanford Wharf Nature Reserve, London Gateway, Stanford-le-Hope, Essex* (K Anker, E Biddulph, C Carey and S Foreman), Oxford Archaeology Thames Valley Monograph Series.

2.3.8 Its proposed contents are:

- Foreword, contents, abstract, and foreign language summaries in French, German, Spanish, acknowledgements
- **Chapter 1: Introduction** (*c* 10,000 words: The London Gateway archaeological project; planning background and the Archaeological Mitigation Framework; Stanford Wharf Nature Reserve; archaeological methods; archaeological and historical background)
- **Chapter 2: Landscape evolution from the late glacial period to the Roman period** (*c* 20,000 words: The late glacial landscape – formation of the Holocene topographic template; marine transgression – chronology and effects; the formation of channels, and changes in shoreline and tidal range; changing vegetation; prehistoric land-use and evidence for activity; chronology and effects on the landscape of intensive Roman-period marshland exploitation)
- **Chapter 3: Salt production from the Iron Age to the 3rd century AD** (*c* 30,000 words: Summary description and chronology; Summary of the salt production process; the Area A saltern in the early Roman period; the Area B saltern in the early Roman period; drainage and water management; fuel use; briquetage vessels and hearth furniture – production and distribution; red hills and red earth – formation, distribution, chemical analysis, significance; organisation of production; working in a wetland environment; transportation and trade; discussion of the wider context)
- **Chapter 4: Late Roman salt production** (*c* 30,000 words: Summary description and chronology; the Area A saltern in the late Roman period; the Area B saltern in the late Roman period; changes in site organisation; fuel use; discussion of the wider context – a late Roman industrial revolution?)
- **Chapter 5: Post-Roman land-use and marshland exploitation** (*c* 10,000 words: evolution of the post-Roman landscape; why no Anglo-Saxons?; medieval/post-medieval estate structure and historic land-use; land reclamation before and after the 17th century; modern drainage schemes and mechanised agriculture; WWII features)
- Bibliography, Index

2.3.9 Summaries of the artefactual and environmental evidence, accompanied by selected illustrations, will be interspersed through the monograph.

Current Archaeology

2.3.10 In order to reveal the definitive story of the site to a wider audience, and gain publicity for the monograph, an article (*c* 1500-2000 words) will be submitted to *Current Archaeology*, which is a popular archaeology magazine with a national reach. The monograph text and graphics, as well as images already produced for the London Gateway popular booklet, will form the basis of the magazine article.

The archive

2.3.11 The complete project archive will be prepared in accordance with current professional practice (Walker 1990). The archive, including the finds, will be deposited with Thurrock Museum (consent currently awaited) in accordance with their guidelines.

2.3.12 All reports will in addition be lodged with the Essex County Council Heritage Conservation Record. Additional copies of the archive will be deposited with the National Monuments Record. The reports and data will also be submitted to the Archaeology Data Service (ADS) as part of the digital archive.

Outreach and education

2.3.13 Oxford Archaeology (principally through its Cambridge office, OA East) is one of the country's leading exponents of public archaeology and is keen to work with DP World to build relationships with local schools and communities.

2.3.14 The material generated through post-excavation, in particular the popular publication graphics and text, can potentially be used as a basis for public archaeology events and resources, such as web pages, educational packs, and exhibition display boards. In addition, a number of staff members are happy to provide talks to schools or community groups and can contribute to artefact display or similar events.

2.3.15 Staff time in the post-excavation programme has been allocated to meet the public archaeology needs of DP World.

2.4 Budget

2.4.1 A costed task list is set out in a separate table, along with a summary of proposed expenditure for each major category.

2.5 Project review and monitoring

2.5.1 Project progress will be monitored internally on a weekly basis by the post-excavation project manager (Edward Biddulph). This will be achieved through the checking of timesheet data and regular communication with project staff.

2.5.2 Each month, Edward Biddulph will review progress with overall project manager Stuart Foreman and OA's publications project manager, Alex Smith, and this review will form the basis of a monthly progress report, which will be submitted to Gill Andrews, consultant archaeologist for DP World.

2.5.3 The report will list completed tasks checked against budgetary and timetable milestones, highlight task outcomes (eg interesting information emerging from the analysis, revisions to the site chronology and narrative, and any risks to the timetable or budget), provide a general summary of progress, and outline the work due for completion the following month.

2.5.4 Oxford Archaeology will submit an invoice on a monthly basis to DP World. The estimated value of each invoice was given in the TCR 2 analysis and publication cost spread. However, the actual value of each invoice will be based on monthly expenditure.

Appendix A. References and Bibliography

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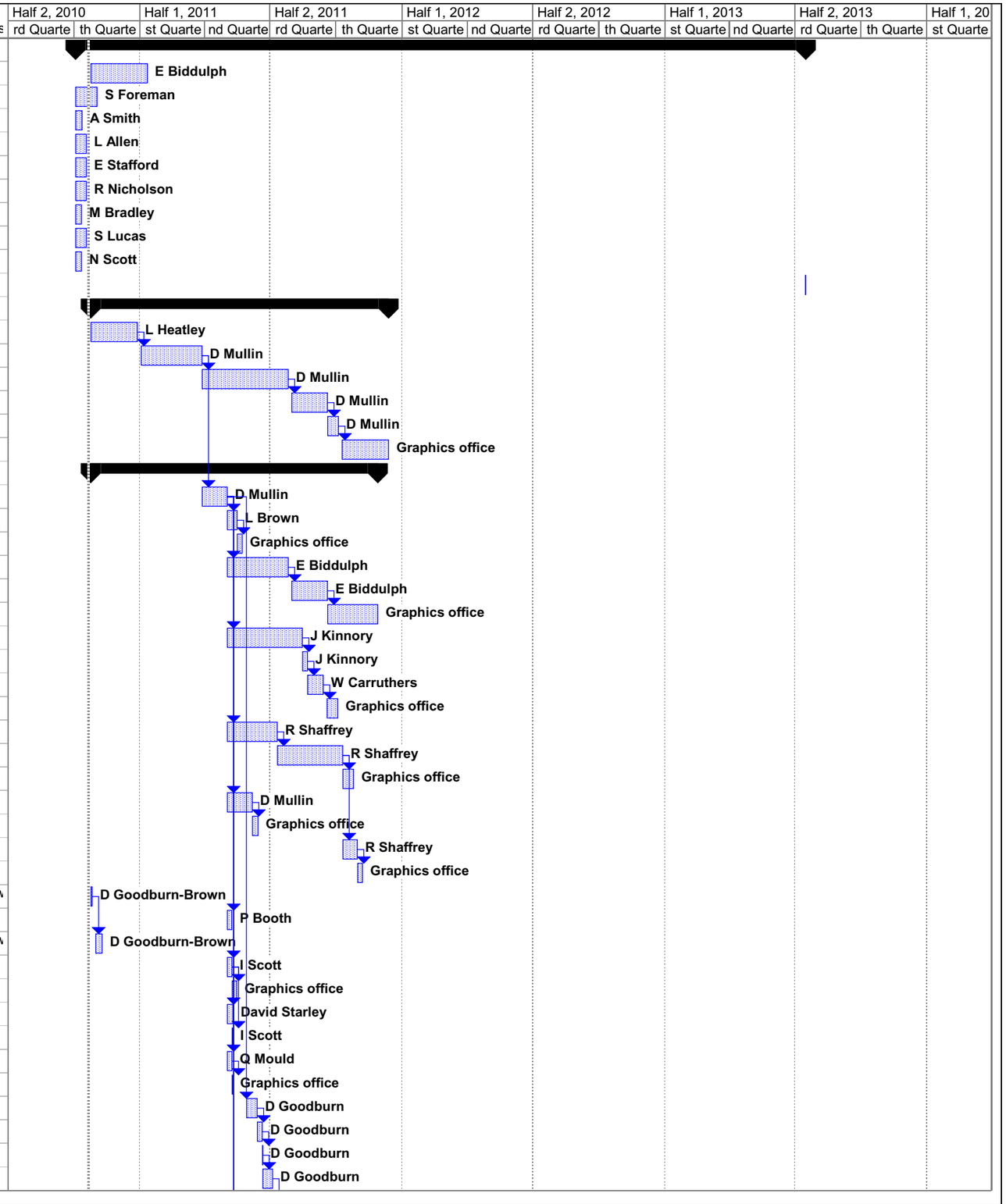
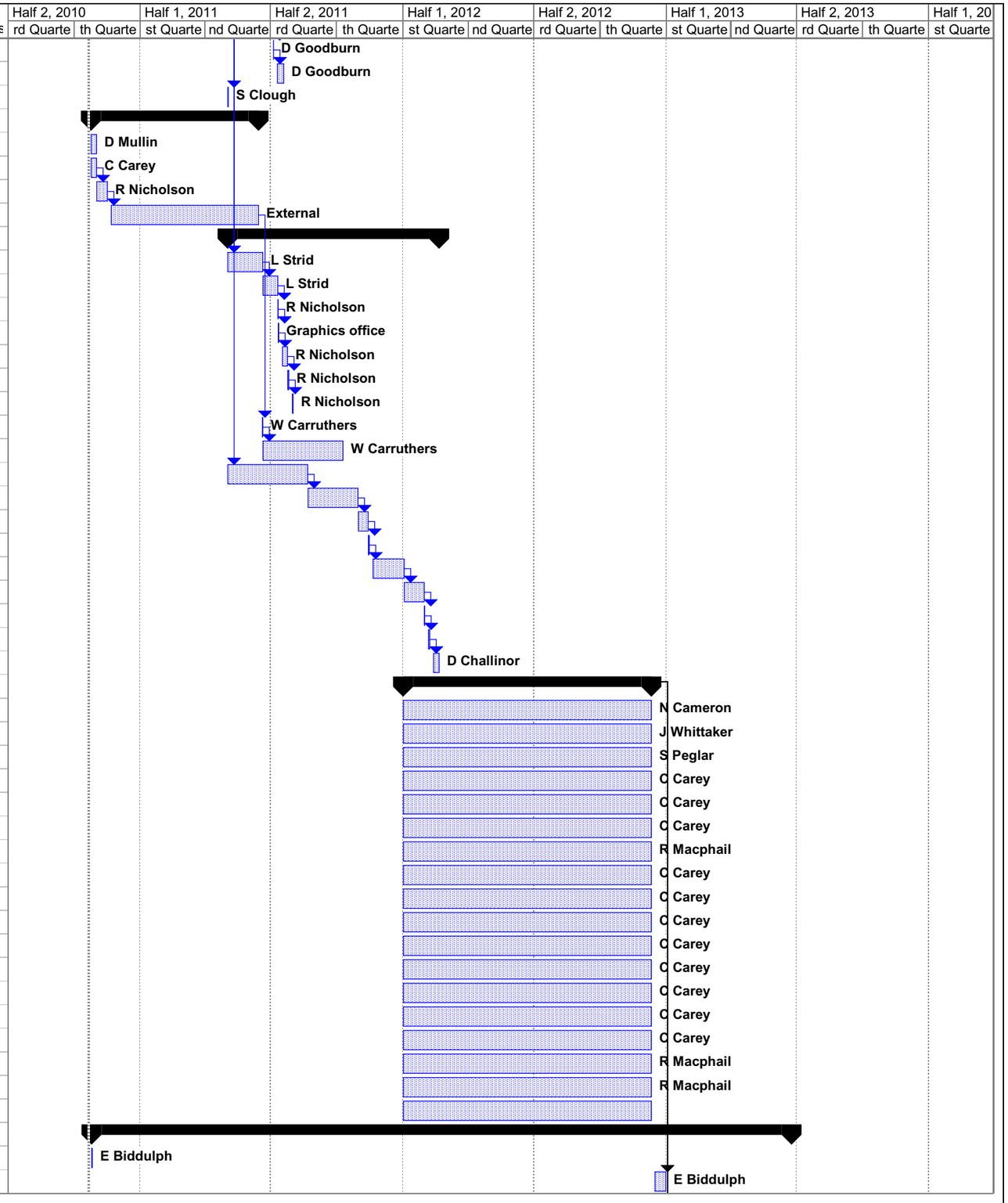
ID	Task Name	Duration	Start	Finish	Resource Names
1	**Management and administration**	**292 days**	**Mon 04/10/10**	**Tue 16/07/13**	
2	Post-excavation management	24 days	Mon 25/10/10	Tue 11/01/11	E Biddulph
3	Project management/external liaison	10 days	Mon 04/10/10	Tue 02/11/10	S Foreman
4	Project monitoring	4 days	Mon 04/10/10	Tue 12/10/10	A Smith
5	Finds management	5 days	Mon 04/10/10	Mon 18/10/10	L Allen
6	Geoarchaeology management	5 days	Mon 04/10/10	Mon 18/10/10	E Stafford
7	Environmental management	5 days	Mon 04/10/10	Mon 18/10/10	R Nicholson
8	Geomatics management	3 days	Mon 04/10/10	Mon 11/10/10	M Bradley
9	Graphics office management	5 days	Mon 04/10/10	Mon 18/10/10	S Lucas
10	Archives management	3 days	Mon 04/10/10	Mon 11/10/10	N Scott
11	Meetings	1 day	Tue 16/07/13	Tue 16/07/13	
12	**Stratigraphic analysis and reporting**	**120 days**	**Mon 25/10/10**	**Tue 13/12/11**	
13	Finalise GIS	20 days	Mon 25/10/10	Tue 28/12/10	L Heatley
14	Update phasing	25 days	Mon 03/01/11	Mon 28/03/11	D Mullin
15	Stratigraphic analysis	35 days	Tue 29/03/11	Tue 26/07/11	D Mullin
16	Stratigraphic narrative	15 days	Mon 01/08/11	Mon 19/09/11	D Mullin
17	Stratigraphic narrative figures – drawing brief	5 days	Tue 20/09/11	Tue 04/10/11	D Mullin
18	Stratigraphic narrative figures	20 days	Mon 10/10/11	Tue 13/12/11	Graphics office
19	**Artefact analysis and reporting**	**115 days**	**Mon 25/10/10**	**Mon 28/11/11**	
20	Specialist liaison	10 days	Tue 29/03/11	Mon 02/05/11	D Mullin
21	Prehistoric pottery: analysis and reporting	4 days	Tue 03/05/11	Mon 16/05/11	L Brown
22	Prehistoric pottery: illustration	2 days	Tue 17/05/11	Mon 23/05/11	Graphics office
23	Roman pottery: record pottery	25 days	Tue 03/05/11	Tue 26/07/11	E Biddulph
24	Roman pottery: analysis and report writing	15 days	Mon 01/08/11	Mon 19/09/11	E Biddulph
25	Roman pottery: illustration	20 days	Tue 20/09/11	Mon 28/11/11	Graphics office
26	Briquetage: recording and analysis	30 days	Tue 03/05/11	Mon 15/08/11	J Kinnory
27	Briquetage: dealing with overlap of ceramic material	2 days	Tue 16/08/11	Mon 22/08/11	J Kinnory
28	Briquetage: identification of plant impressions	7 days	Tue 23/08/11	Tue 13/09/11	W Carruthers
29	Briquetage: illustration	5 days	Mon 19/09/11	Mon 03/10/11	Graphics office
30	CBM: full recording	20 days	Tue 03/05/11	Mon 11/07/11	R Shaffrey
31	CBM: analysis, report writing and drawing briefs	26 days	Tue 12/07/11	Mon 10/10/11	R Shaffrey
32	CBM: Illustration	5 days	Tue 11/10/11	Tue 25/10/11	Graphics office
33	Lithics: recording and reporting	10 days	Tue 03/05/11	Mon 06/06/11	D Mullin
34	Lithics: illustration	3 days	Tue 07/06/11	Tue 14/06/11	Graphics office
35	Worked stone: analysis and reporting	5.5 days	Tue 11/10/11	Mon 31/10/11	R Shaffrey
36	Worked stone: Illustration	2 days	Mon 31/10/11	Mon 07/11/11	Graphics office
37	Coins: cleaning	2 days	Mon 25/10/10	Tue 26/10/10	D Goodburn-Brov
38	Coins: identification and reporting	1.5 days	Tue 03/05/11	Mon 09/05/11	P Booth
39	Metal objects: X-raying (596 objects)	4 days	Mon 01/11/10	Tue 09/11/10	D Goodburn-Brov
40	Metal objects: identification and report revisions	2 days	Tue 03/05/11	Mon 09/05/11	I Scott
41	Metal objects: illustration	1.5 days	Tue 10/05/11	Mon 16/05/11	Graphics office
42	Iron slag: recording and reporting	3 days	Tue 03/05/11	Tue 10/05/11	David Starley
43	Glass: additional discussion	0.5 days	Tue 10/05/11	Tue 10/05/11	I Scott
44	Leather: reporting	2 days	Tue 03/05/11	Mon 09/05/11	Q Mould
45	Leather: illustration	0.5 days	Tue 10/05/11	Tue 10/05/11	Graphics office
46	Wood: Clean, sample and record timbers	5 days	Mon 30/05/11	Mon 13/06/11	D Goodburn
47	Wood: identify species and update sample list	2 days	Tue 14/06/11	Mon 20/06/11	D Goodburn
48	Wood: select samples for dendrochronology	0.5 days	Tue 21/06/11	Tue 21/06/11	D Goodburn
49	Wood: update structural wood report	4 days	Tue 21/06/11	Tue 05/07/11	D Goodburn



Project: COMPA PX gantt
Date: Thu 21/10/10

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

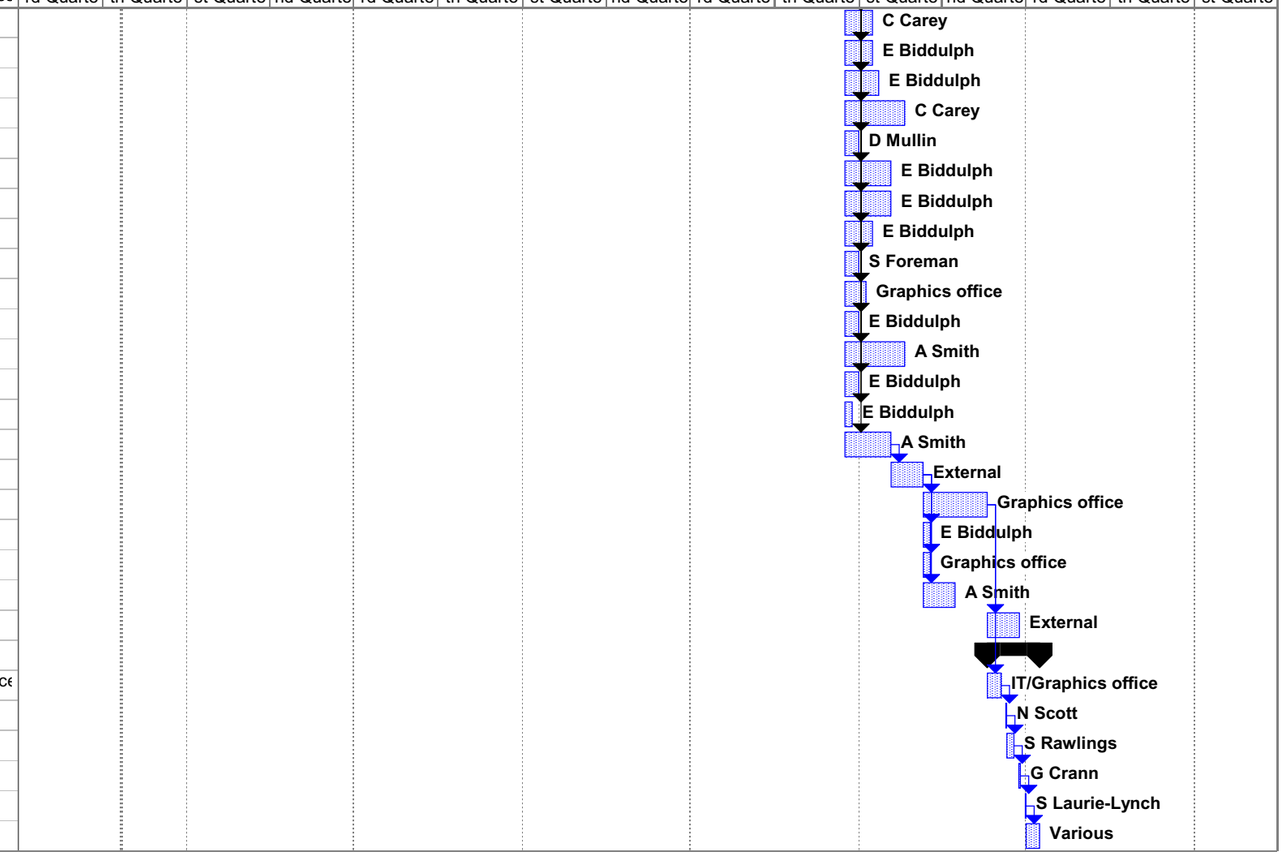
ID	Task Name	Duration	Start	Finish	Resource Names
50	Wood: prepare timbers for conservation/storage	0.5 days	Tue 05/07/11	Tue 05/07/11	D Goodburn
51	Wood: illustration	4 days	Mon 11/07/11	Tue 19/07/11	D Goodburn
52	Human remains: recording and reporting	1 day	Tue 03/05/11	Tue 03/05/11	S Clough
53	**Scientific dating**	**68 days**	**Mon 25/10/10**	**Tue 14/06/11**	
54	Identification of timbers for C14 dating	3 days	Mon 25/10/10	Mon 01/11/10	D Mullin
55	Preparation of palaeoenvironmental samples	3 days	Mon 25/10/10	Mon 01/11/10	C Carey
56	Administration and submission of C14 samples	5 days	Tue 02/11/10	Tue 16/11/10	R Nicholson
57	C14 Dating (16 samples @ £350 each)	60 days	Mon 22/11/10	Tue 14/06/11	External
58	**Palaeoenvironmental analysis/reporting (bulk samples)**	**84 days**	**Tue 03/05/11**	**Mon 20/02/12**	
59	Animal bones: recording	14 days	Tue 03/05/11	Mon 20/06/11	L Strid
60	Animal bones: analysis and reporting	6 days	Tue 21/06/11	Mon 11/07/11	L Strid
61	Animal bones: editing	0.5 days	Tue 12/07/11	Tue 12/07/11	R Nicholson
62	Animal bones: illustration	0.5 days	Tue 12/07/11	Tue 12/07/11	Graphics office
63	Fish bones: sorting	2.5 days	Mon 18/07/11	Mon 25/07/11	R Nicholson
64	Fish bones: identification and recording	1.5 days	Mon 25/07/11	Tue 26/07/11	R Nicholson
65	Fish bones: reporting	1 day	Mon 01/08/11	Mon 01/08/11	R Nicholson
66	CPR: finalise sample selection	1 day	Mon 20/06/11	Mon 20/06/11	W Carruthers
67	CPR: sorting	31.5 days	Tue 21/06/11	Mon 10/10/11	W Carruthers
68	CPR: identification and quantification	31.5 days	Tue 03/05/11	Mon 22/08/11	
69	CPR: sort and record red hills samples	20 days	Mon 22/08/11	Mon 31/10/11	
70	CPR: heavy residue sorting	4 days	Mon 31/10/11	Mon 14/11/11	
71	CPR: photography	1.5 days	Mon 14/11/11	Tue 15/11/11	
72	CPR: data presentation, research and reporting	13.5 days	Mon 21/11/11	Tue 03/01/12	
73	WPR: sorting and identification	8 days	Tue 03/01/12	Tue 31/01/12	
74	WPR: photography	0.5 days	Tue 31/01/12	Tue 31/01/12	
75	WPR: data preparation and reporting	2 days	Mon 06/02/12	Tue 07/02/12	
76	Charcoal	3 days	Mon 13/02/12	Mon 20/02/12	D Challinor
77	**Palaeoenvironmental analysis/reporting**	**100 days**	**Mon 02/01/12**	**Tue 11/12/12**	
78	Palaeoenvironment: diatoms	100 days	Mon 02/01/12	Tue 11/12/12	N Cameron
79	Palaeoenvironment: foraminifera and ostracods	100 days	Mon 02/01/12	Tue 11/12/12	J Whittaker
80	Palaeoenvironment: pollen	100 days	Mon 02/01/12	Tue 11/12/12	S Peglar
81	Sediment analysis:LOI/carb	100 days	Mon 02/01/12	Tue 11/12/12	C Carey
82	Sediment analysis: geochemistry	100 days	Mon 02/01/12	Tue 11/12/12	C Carey
83	Sediment analysis: magnetic susceptibility	100 days	Mon 02/01/12	Tue 11/12/12	C Carey
84	Sediment analysis: micromorphology	100 days	Mon 02/01/12	Tue 11/12/12	R Macphail
85	ICP-MS 1 sample analysis	100 days	Mon 02/01/12	Tue 11/12/12	C Carey
86	Phosphate analysis	100 days	Mon 02/01/12	Tue 11/12/12	C Carey
87	Magnetic susceptibility fractionation	100 days	Mon 02/01/12	Tue 11/12/12	C Carey
88	Particle size analysis	100 days	Mon 02/01/12	Tue 11/12/12	C Carey
89	Sub-sampling	100 days	Mon 02/01/12	Tue 11/12/12	C Carey
90	Sample preparation	100 days	Mon 02/01/12	Tue 11/12/12	C Carey
91	Sample management	100 days	Mon 02/01/12	Tue 11/12/12	C Carey
92	GIS analysis	100 days	Mon 02/01/12	Tue 11/12/12	C Carey
93	White nodules: identification, analysis, reporting	100 days	Mon 02/01/12	Tue 11/12/12	R Macphail
94	Micromorphology: green glaze analysis	100 days	Mon 02/01/12	Tue 11/12/12	R Macphail
95	Green glaze costs (thin sections/UCL overheads)	100 days	Mon 02/01/12	Tue 11/12/12	
96	**Publication**	**278 days?**	**Tue 26/10/10**	**Mon 24/06/13**	
97	Popular booklet	1 day	Tue 26/10/10	Tue 26/10/10	E Biddulph
98	Produce and submit article for Essex Journal	5 days	Mon 17/12/12	Mon 31/12/12	E Biddulph



Project: COMPA PX gantt
Date: Thu 21/10/10

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

ID	Task Name	Duration	Start	Finish	Resource Names
99	Research	10 days	Mon 17/12/12	Tue 15/01/13	C Carey
100	Research	10 days	Mon 17/12/12	Tue 15/01/13	E Biddulph
101	Integrated report: Chapter 1: Introduction	12 days	Mon 17/12/12	Tue 22/01/13	E Biddulph
102	Integrated report: Chapter 2: Landscape evolution	20 days	Mon 17/12/12	Tue 19/02/13	C Carey
103	Integrated report: Prehistoric discussion (chaps 2 and 3)	5 days	Mon 17/12/12	Mon 31/12/12	D Mullin
104	Integrated report: Chapter 3: Salt production from IA to 3rd C	15 days	Mon 17/12/12	Mon 04/02/13	E Biddulph
105	Integrated report: Chapter 4: Late Roman salt production	15 days	Mon 17/12/12	Mon 04/02/13	E Biddulph
106	Integrated report: Chapter 5: Post-Roman	10 days	Mon 17/12/12	Tue 15/01/13	E Biddulph
107	Overview	5 days	Mon 17/12/12	Mon 31/12/12	S Foreman
108	Additional figures	8 days	Mon 17/12/12	Tue 08/01/13	Graphics office
109	Bibliography and preliminaries	5 days	Mon 17/12/12	Mon 31/12/12	E Biddulph
110	Edit print report	20 days	Mon 17/12/12	Tue 19/02/13	A Smith
111	Edit specialists' reports for digital publication	5 days	Mon 17/12/12	Mon 31/12/12	E Biddulph
112	Produce and submit article for Current Archaeology	3 days	Mon 17/12/12	Mon 24/12/12	E Biddulph
113	Copy-edit	15 days	Mon 17/12/12	Mon 04/02/13	A Smith
114	Academic review	10 days	Tue 05/02/13	Mon 11/03/13	External
115	Typeset	20 days	Tue 12/03/13	Mon 20/05/13	Graphics office
116	Indexing	3 days	Tue 12/03/13	Tue 19/03/13	E Biddulph
117	Cover	3 days	Tue 12/03/13	Tue 19/03/13	Graphics office
118	Proof-read	10 days	Tue 12/03/13	Mon 15/04/13	A Smith
119	Printing and distribution	10 days?	Tue 21/05/13	Mon 24/06/13	External
120	**Archiving**	**17 days**	**Tue 21/05/13**	**Tue 16/07/13**	
121	Preparation of digital archive	5 days	Tue 21/05/13	Tue 04/06/13	IT/Graphics office
122	Microfilm research archive	1 day	Mon 10/06/13	Mon 10/06/13	N Scott
123	Assemble paper archive	3 days	Tue 11/06/13	Tue 18/06/13	S Rawlings
124	Finds deposition	2 days	Mon 24/06/13	Tue 25/06/13	G Crann
125	Finds deposition: transport	1 day	Mon 01/07/13	Mon 01/07/13	S Laurie-Lynch
126	Outreach/education liaison	5 days	Tue 02/07/13	Tue 16/07/13	Various



Project: COMPA PX gantt
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Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

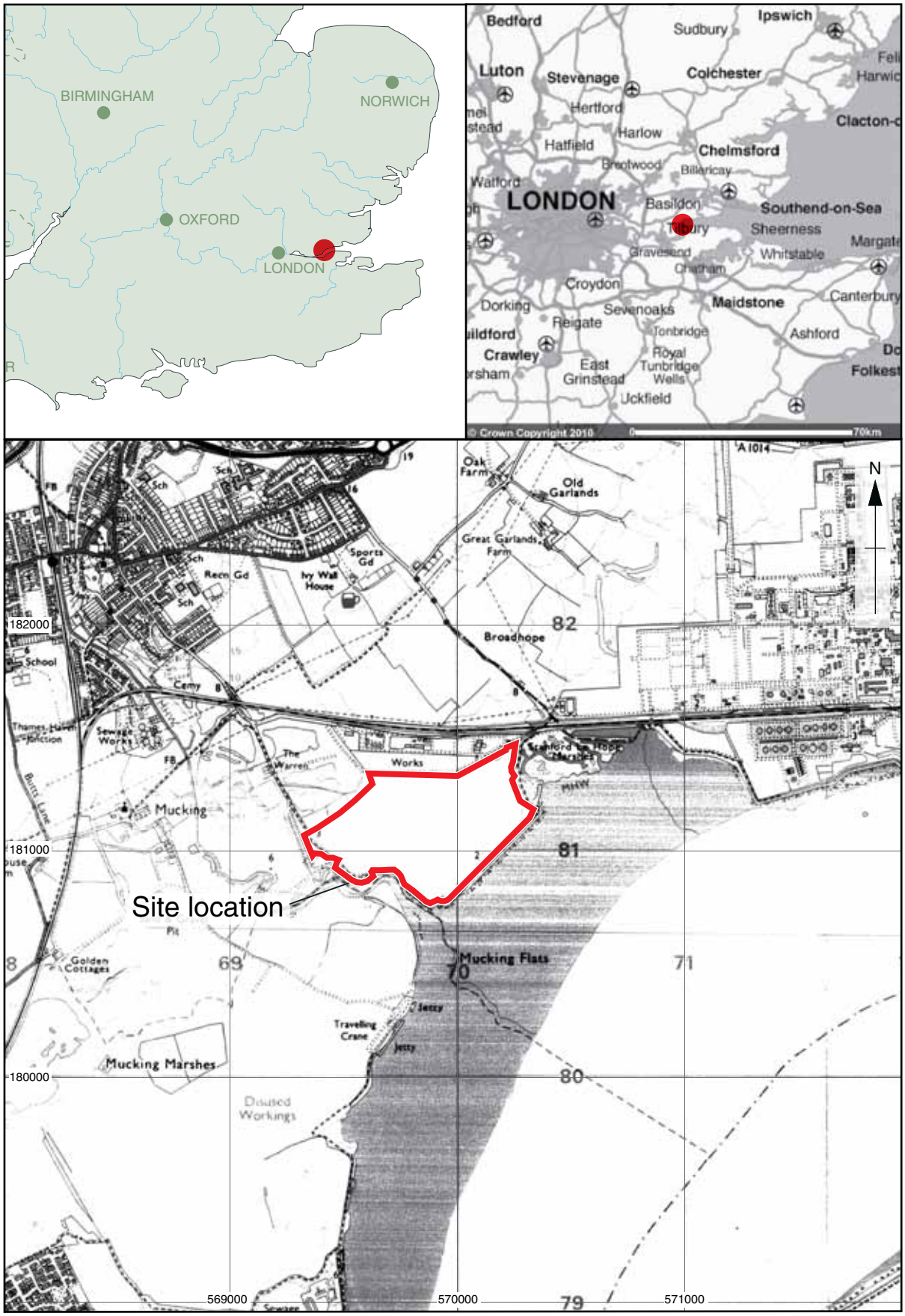


Figure 1: Site location

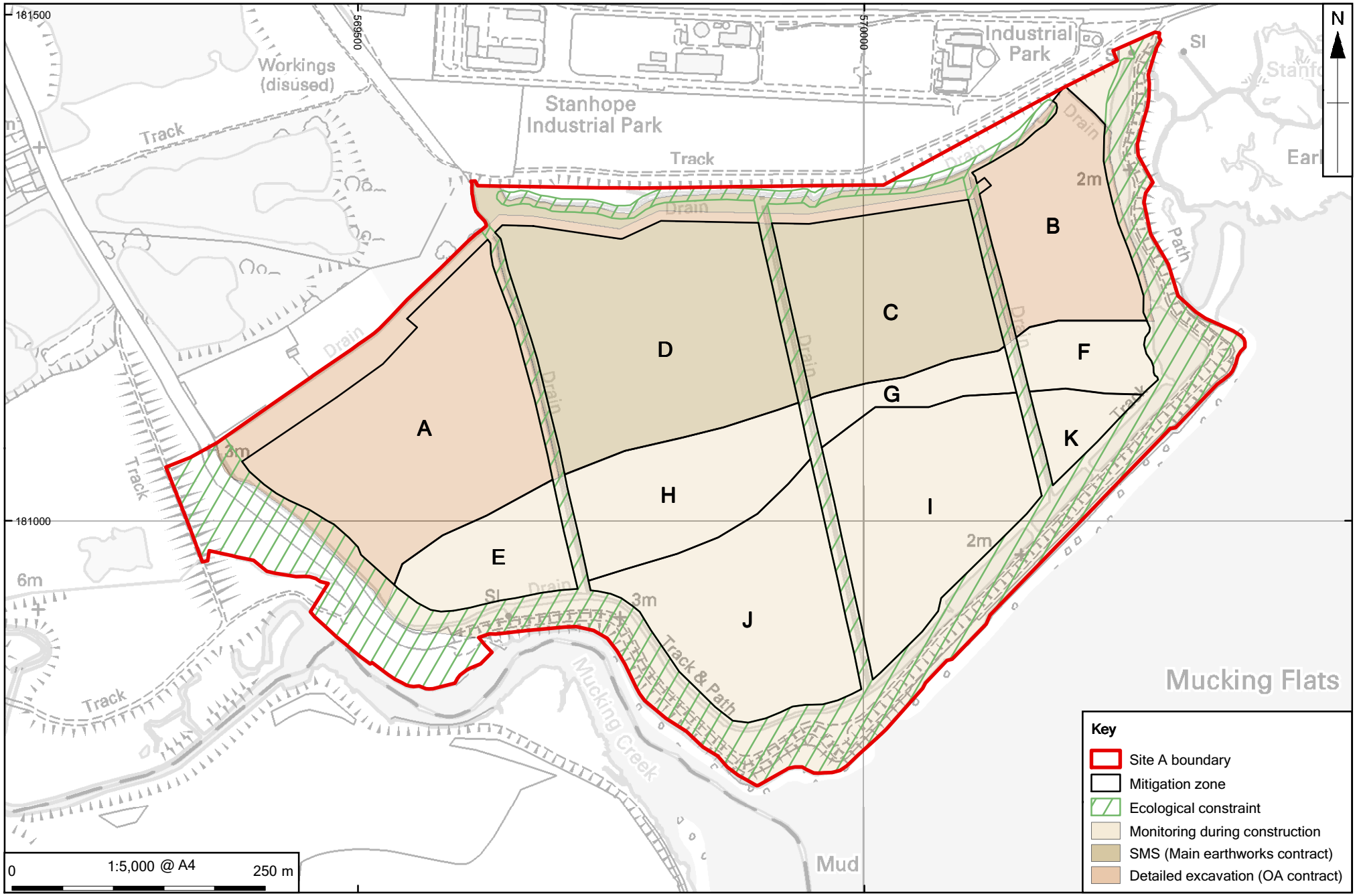
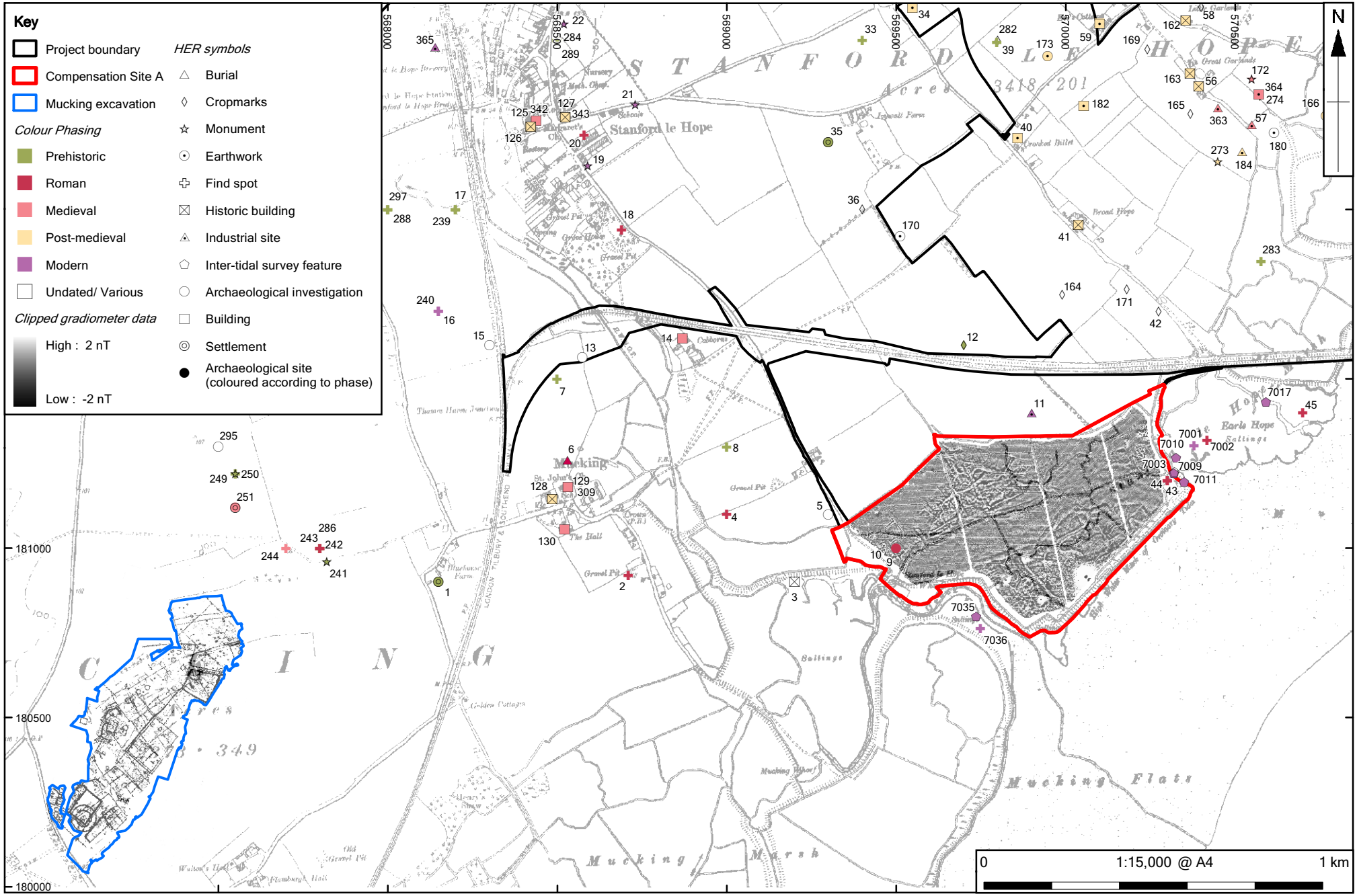
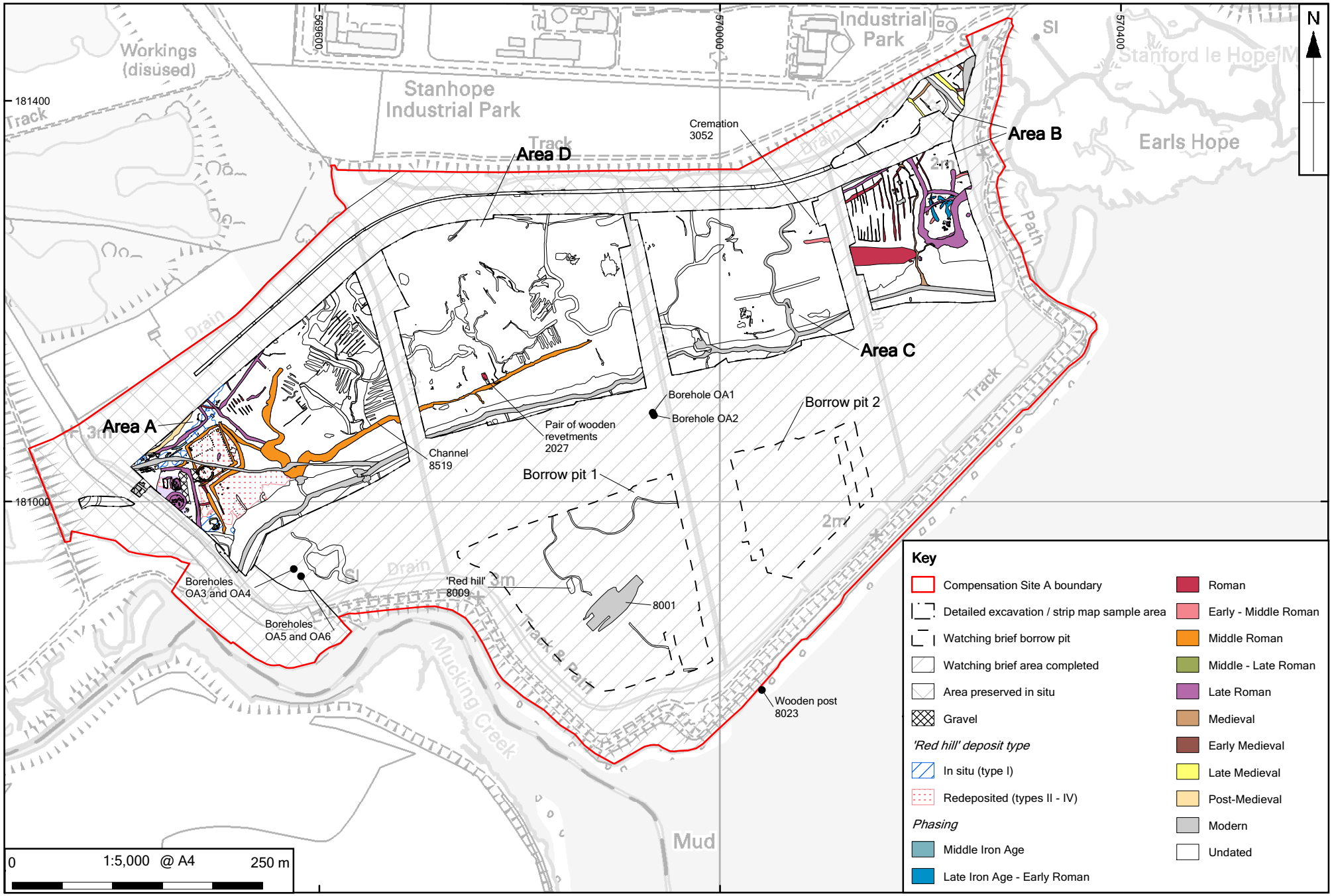


Figure 2: Areas of excavation



QA by: ACAKC & HK 22.07.2010

Figure 3: Site location in relation to Mucking excavations (Clark 1993) overlaid on an 1898 OS map



QA by: ACAKC & HK 22.07.2010

Figure 4: Overall plan of excavated features

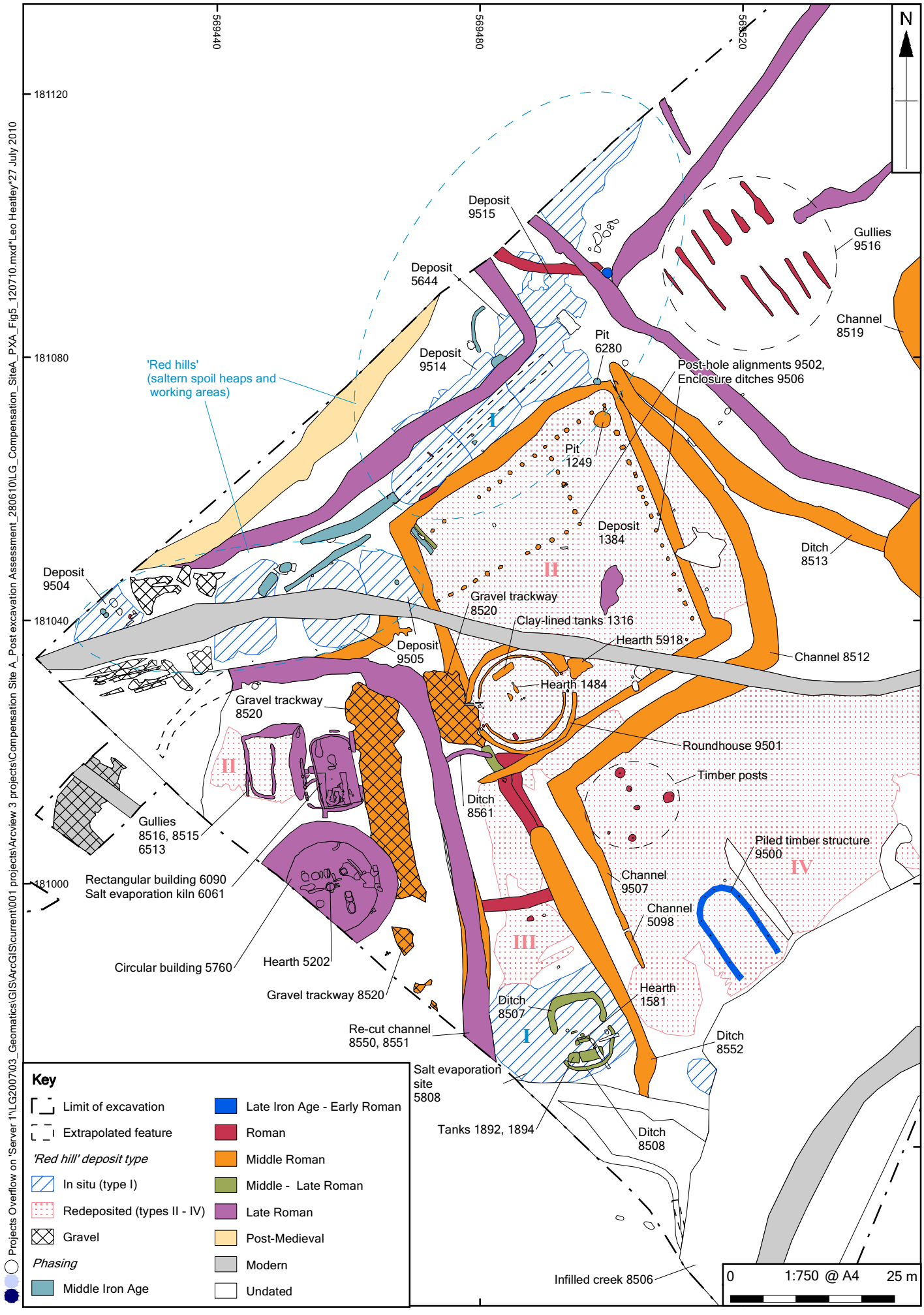


Figure 5: Plan of Area A

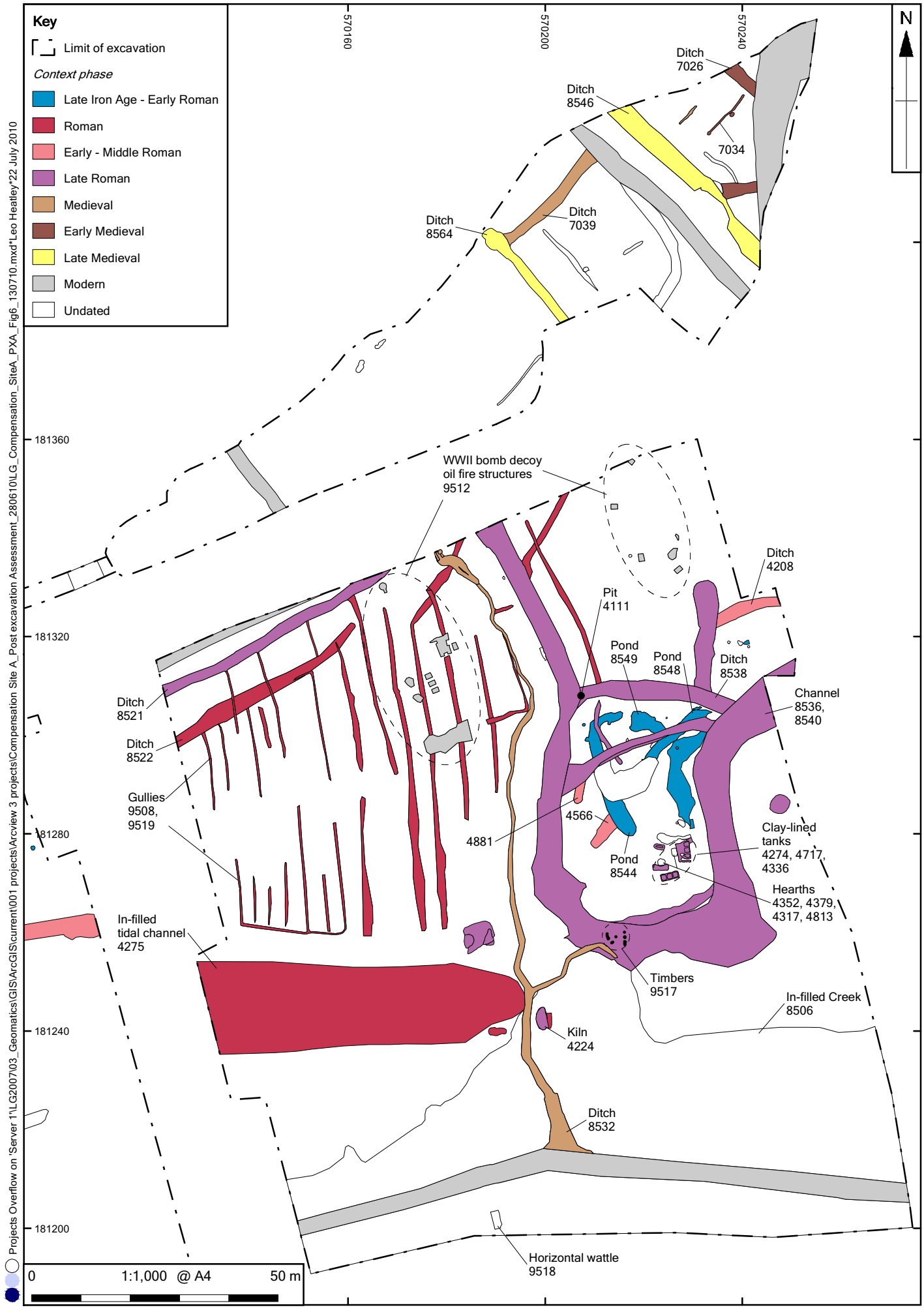


Figure 6: Plan of Area B

Plate 1: Aerial photograph, Area A (image courtesy of ECC Heritage Historic Environment Branch)

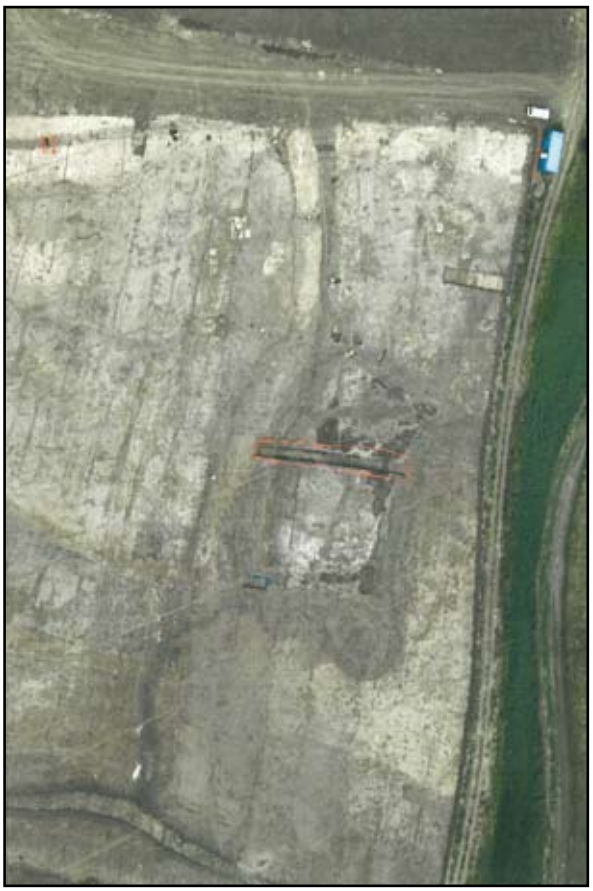


Plate 2: Aerial photograph, Area B
(image courtesy of ECC Heritage Historic Environment Branch)

Plate 3: Wattle revetment, Area D

Plate 4: Roundhouse, Area A

Plate 5: Settling tanks in roundhouse, Area A

Plate 6: Roundhouse hearth, Area A

Plate 7: Excavating a complete pot from pit 1249, Area A

Plate 8: Tile-built hearth, Area A

Plate 9: Circular structure 5760, Area A

Plate 10: Fish bones from ditch 8551, Area A

Head Office/Registered Office/ OA South

Janus House
Osney Mead
Oxford OX2 0ES

t: +44 (0) 1865 263 800
f: +44 (0) 1865 793 496
e: info@oxfordarch.co.uk
w:http://thehumanjourney.net

OA North

Mill 3
Moor Lane
Lancaster LA1 1GF

t: +44 (0) 1524 541 000
f: +44 (0) 1524 848 606
e: oanorth@thehumanjourney.net
w:http://thehumanjourney.net

OA East

15 Trafalgar Way
Bar Hill
Cambridgeshire
CB23 8SQ

t: +44 (0) 1223 850500
f: +44 (0) 1223 850599
e: oaeast@thehumanjourney.net
w:http://thehumanjourney.net

OA Méditerranée

115 Rue Merlot
ZAC La Louvade
34 130 Mauguio
France

t: +33 (0) 4.67.57.86.92
f: +33 (0) 4.67.42.65.93
e: oamed@thehumanjourney.net
w: http://oamed.fr/

OA Grand Ouest

7 Rue des Monderaines
ZI - Ouest
14650 Carpiquet
France

t: +33 (0) 2 49 88 01 01
f: +33 (0) 2 49 88 01 02
e: info@oago.fr
w: http://oago.fr