Carter's Lagoon
DP World London Gateway Logistics Park Stanford-le-Hope Essex

Trench Investigation Report

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Carter's Lagoon, London Gateway Logistics Park,

Stanford le Hope, Essex,

Archaeological Trench Investigation

Written by Ashley Strutt and Stuart Foreman

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Summary

Oxford Archaeology South (OAS) was commissioned by DP World London Gateway Park Development Ltd to undertake an archaeological evaluation of the site of a drainage lagoon at the London Gateway Logistics Park (LGLP), adjacent to the DP World London Gateway Port alongside the River Thames near Stanford-le-Hope, Essex (NGR 570900E, 181900N). The trenching was undertaken in two phases, in January 2013 and May 2014. The lagoon is located within an area of the DP World London Gateway (DPWLG) site historically referred to as 'The Tongue Land'.

No significant archaeological remains were present within the evaluation trenches. All structures and artefacts encountered were of modern date and demonstrably associated with the former Shell Haven Oil Refinery. The truncation of the site by previous construction works and the landscape context (in reclaimed former marshland) limit both the potential for encountering terrestrial archaeological remains and the likelihood that remains would survive close to the present ground surface.

The evaluation trenching has only investigated the upper part of the alluvial sediment sequence. An impact assessment has concluded that the development as proposed would have no effect on any archaeological remains that may be deeply buried within the 10m thick Holocene alluvial sequence underlying the modern made ground within the site. The area surrounding the lagoon would be subject to ground-raising as part of the development to address flood risk potential, to the same level as the rest of the LGLP, which will protect any deeply buried archaeology from disturbance, except in the deepest part of the lagoon footprint. The trenching has shown that the upper alluvium in this area has low archaeological potential and has been heavily disturbed by previous development.

1 INTRODUCTION

1.1 Location and scope of work (Fig.1)

1.1.1 DP World London Gateway Park Development Ltd (LGPL) constructed a large drainage lagoon in an area of the DP World London Gateway site known as the 'Tongue Land', adjacent to the London Gateway Port, alongside the River Thames near Stanford-le-Hope, Essex (NGR 570900E, 181900N, Fig. 1). The first phase (Trenches 1-4) were completed in January 2013. The second phase (Trenches 5-8) were covered by a temporary construction compound at that time and had to be delayed until the compound was removed in May 2014. This report describes the results of both phases.

1.1.2 The site is bounded by the DP World London Gateway Logistics Park (LGLP) Admin Building to the west, the LGLP development plots to the east, the London Gateway Port (LGP) Access Road (to the south-west) and the LGLP east-west access road (to the north). The Thameshaven Branch of the London to Southend Railway lies to the south. All of these have been developed or redeveloped in recent years as part of the DPWLG development. The River Thames is *c* 400m south of the site. The nearest historic settlement is Great Garlands Farm, which was formerly visible on the rising ground to the west of the site, although now largely screened from view by the Port and Park Access Road. The nearest urban area is Stanford-le-Hope, situated *c.*1.5km to the north-west of the site. The Corringham/Fobbing Marshes local wildlife site lies 100m to the north.

1.1.3 Planning background

1.1.4 The DP World LGLP development is permitted pursuant to a Local Development Order which was made by Thurrock Council on the 7th November 2013. The resulting London Gateway Logistics Park Local Development Order (LGLP LDO, hereafter 'the LDO') supplants the previous outline planning consent and provides planning consent for the proposed commercial buildings, associated infrastructure and site preparation works, including Carter's Lagoon. An Environmental Impact Assessment (EIA) was prepared to inform the LDO, which included a chapter on cultural heritage and updated baseline studies (Thurrock Council/ DP World London Gateway, 2013b).

1.1.5 For development to benefit from the planning consent provided by the LDO it must accord with a number of compliance documents, in particular a Design Code (DC) and Code of Construction Practice (CoCP) (Thurrock Council/ DP World London Gateway, 2013b). In relation to archaeology, Section J of the CoCP requires that the archaeological impact arising from a construction design has to be assessed by a suitably qualified and experienced archaeologist. The resulting 'Archaeological Project Design' (APD) comprises an assessment of the archaeological impact of the proposed construction works, and proposals for any mitigation measures that may be required. An APD was prepared for Carter's Lagoon works by DP World London Gateway's Archaeological Contractor (Oxford Archaeology) in accordance with Section J of the CoCP (Thurrock Council/ DP World London Gateway, 2013b). It was validated by the LG Archaeological Liaison Officer (Gill Andrews) and the archaeological statutory consultee for the LGLP, Richard Havis (Senior Historic Environment Consultant, Essex County Council).

1.1.6 The archaeological potential of the lagoon site was considered to be uncertain. OA was commissioned by LGLP to conduct a trench investigation to establish the potential for significant archaeology within the site to be affected by construction of the lagoon.

1.2 Geoarchaeological background

1.2.1 The lagoon site lies entirely within geological deposits mapped by the British Geological Survey as 'Tidal Flat' deposits (inter-tidal alluvium). The development of these deposits is complex and has a direct bearing on the archaeological potential of the site. An extensive geoarchaeological deposit model covering the floodplain areas of the LG Port and LG Park, and incorporating the results from borehole surveys, an electrical resistivity survey, radiocarbon dating and palaeoenvironmental analysis was completed (OA 2012). The model does not detect archaeological sites directly; rather it provides a framework for predicting the most likely locations for significant sites, and for assessing past and future construction impacts within the floodplain. It allows the depth and potential location of archaeological sites to be predicted and compared against specific construction impacts.

1.2.2 At the end of the Devensian and during the early Holocene the Thames floodplain is likely to have been an extensive gravel braidplain. The deposit model indicates that the development area began to accumulate inter-tidal sediments from the late Mesolithic, from both marine and riverine influences, the channel network probably becoming more constrained and less braided as a result. The process of sedimentation continued throughout the Holocene, producing the current depth of alluvium.

1.2.3 The alluvial sequence in the vicinity of the lagoon site was examined in detail in Borehole OA06, which was subject to radiocarbon dating and palaeoenvironmental analysis as part of the geoarchaeological deposit model (OA 2012). The present ground surface lies at *c* 2.0mAOD and the alluvium is covered by *c* 1.2m of made ground formed during the development of the Shell Haven Oil Refinery. The Holocene sediment sequence, as recorded in Borehole OA06, consists of *c* 10.78m of silty clay alluvial deposits overlying Pleistocene gravels. The latter continued beyond the base of the borehole at -16.7mAOD. British Geological Survey mapping indicates that the Pleistocene sand and gravel deposits in the site area are probably the downstream equivalent of the East Tilbury Marsh Member or Shepperton Member of the Lower and Middle Thames.

1.2.4 The overall chronology of the Holocene sequence at London Gateway, and associated palaeoenvironmental evidence, is discussed in detail in the geoarchaeological deposit model report. In summary, three main organic-rich peat horizons were identified, each representing a phase of marine regression and landscape stability. These were the only phases that produced suitable organic samples for reliable radiocarbon dating. The earliest phase is not represented in Borehole OA06. The earliest radiocarbon date used in the Deposit Model (8290-7980 cal.BC) was from an organic horizon at 11.59mAOD in Borehole OA15, which is located 600m east of the lagoon site. In conjunction with several later dates from other boreholes, this shows that the earliest Holocene sediments at London Gateway date from the early Mesolithic and fit well with a postulated period of landscape stability between *c* 8000 and 10,000 BP. The next stage of peat formation is dated from samples taken at -9.43mAOD in borehole OA06, 300m south-east of the lagoon site, which gave a combined date of 5990-5830 cal. BC and charcoal from -9.37mAOD in the same core which dated to 5630-5510 cal. BC (late Mesolithic). A third stage of stability, represented by peat formation, is present at -5.22mAOD, also in Borehole OA06, which gave a date of 4500-4360 cal. BC (late Mesolithic). A waterlogged leaf fragment from -4.75mAOD in Borehole OA06 gave a date of 2870-2490 cal. BC (late Neolithic), although waterlogged plant remains from alluvial deposits are often later in date than the deposits they derive from. The layers of

alluvium above these lacked organic material suitable for radiocarbon dating but must have been laid down broadly between the late Neolithic and post-medieval periods.

1.2.5 During the historic period (according to documentary evidence from *c* 1620 onwards), large scale systematic marshland reclamation and the construction of sea walls greatly reduced marine influence into the alluvial floodplain and the vertical accretion of the sediment body slowed or stopped. The top of the alluvial sequence has subsequently undergone soil maturation and stabilisation, coupled with drainage and agricultural improvement.

1.2.6 The interface between geologically defined landscape zones often acts as a focus for human settlement. The high archaeological potential of this zone is borne out by the presence of known historic settlement activity in the vicinity. Nearby historic terrace edge settlements, such as the medieval farm complex at Old Garlands/Great Garland are typically located on areas of river terrace gravel (apparently avoiding the clayey head deposits) at around the 13m contour, presumably to avoid the effects of floods. However, prior to the construction of sea walls in the 17th century they were located close enough to the terrace edge to permit ready access to the river Thames via navigable creeks.

1.2.7 A surviving area of undeveloped grazing marsh, 100m to the north of the lagoon site, illustrates how the landscape of the lagoon site would have looked prior to the development of Shell Haven West in the late 20th century. It contains a well-preserved complex of historic earthworks which extend around the head of Carter's Creek (so-named on the 1898 OS map). These are associated with the marshlands of Old Garlands Farm, an estate with well-documented medieval origins and a deserted medieval and post-medieval wharf, known in the 16th and 17th century as Feake's Hithe. Within this area the pattern and extent of creeks and field boundaries has changed relatively little since the medieval period, although the natural saltmarsh environment has been modified by land reclamation and subsequent drainage and agricultural improvement, each phase of which has left its mark on the landscape. The land retains a flat, open aspect. The lagoon site historically had a very similar landscape to this, as attested on detailed historic maps going back to 1619. However the plot was buried in a westward expansion of the Shell Haven Oil Refinery in the latter half of the 20th century. Various landscape features recorded on historic maps in this plot, mainly comprising earthen sea walls and the historic line of Carter's Creek, were levelled and covered over when this part of the refinery was developed.

1.2.8 The lagoon site is located close to the edge of the floodplain but is not itself within the interface zone and lies several hundred metres south-east of Feake's Hithe. It was also separated from the river terrace edge by Carter's Creek. While there is little or no potential for settlement archaeology in this plot, the infilled channel of the creek has significant potential for maritime archaeological finds, as it formed a link between Feake's Hithe and the River Thames. The adjacent section of the Thames Estuary, Lower Hope Reach, has been a busy deep sea anchorage for hundreds of years. Any such finds are likely to be buried at a depth of several metres.

1.2.9 Salterns or other seasonal marshland sites of various dates could be encountered in this plot. There is no indication of medieval/post-medieval salterns or other seasonal sites in the lagoon site on the historic maps, but Iron Age and Roman saltern mounds, known as 'red hills' are a common feature of the Essex coast and would not be expected to be show up on historic maps (unless re-used as sheepfolds in the post-medieval period).

1.3 Archaeological and historical background

1.3.1 Old Garlands Farm, within whose lands the lagoon site was historically located, is one of a group of small estates in the south-east of Stanford-le-Hope parish. Each estate historically consisted of a farm complex located on the river terrace (e.g. Broadhope Farm OA41; Old Garlands Farm OA56) located among their respective 'upland' fields, which at the time of the 1840 Tithe Map (ERO D/C/T362B) lay broadly between High Road and the edge of the river terrace. In addition, each estate included extensive marshland pasture, comprising, 'fresh marsh' (enclosed by a sea wall) and unenclosed 'greenmarsh', 'saltings' or 'waste'. The Old Garlands estate is remarkably well-documented from the medieval period onwards. The records indicate periodic increases in the extent and quality of associated marshland pasture as a result of land reclamation. Old Garlands was held as a freehold estate by successive members of the Garland family in the late 14th and early 15th centuries, the earliest named being 'Richard Garland, painter, of London'. A legal dispute from 1425 provides details of the estate, referring to charters dating from the late 14th century or earlier, at which time the estate consisted of *"one messuage, 38 acres of land, five acres of pasture, 60 acres of marsh and 18s. rents with appurtenances in Corringham and Stanford-le-Hope, Essex, of which the close and house aforesaid are a parcel."*

1.3.2 In 1591 the Old Garlands estate (the western part of the DPWLG, including the lagoon site) was acquired by Sir John Hawkins (then *Comptroller* of the Royal Navy) to endow a hospital in Chatham for sick and elderly sailors in the aftermath of the defeat of the Spanish Armada. 'The Hospital of Sir John Hawkins, Knight', still exists today, although it sold the Old Garlands estate in 1920. The hospital owned the estate continuously from 1592-1920 and extensive records survive from that period, held in the Rochester-upon-Medway City Archives (Medway CityArk CH108). A conveyance dated 1599 (transferring the farm to ownership of the hospital, following Hawkins death in 1595) refers to the "*manor and capital messuage called Olde Garlandes, 30 acres pasture adjacent to 95 acres greenmarsh and saltmarsh [abuttals], pasture for 26 sheep in Church Marsh, all in Stanford-le-Hope, rent of 5 acres from a fresh marsh in Corringham, and right of passage to and from Mousehole Well to carry water*". The use of three terms to describe different types of marshland here is a practice adopted in the 17th century (Rippon and Wainwright, 2011).

1.3.3 Previous investigations for the London Gateway Access Road and Admin Building developments, and the adjacent section of the Coryton Gas Pipeline (Peachey and Dale 2005) have uncovered extensive evidence for medieval and post-medieval settlement, in a band along the river terrace edge *c* 300m north-west of the lagoon site, which can be identified as the remains of the deserted wharf known in the 16th and 17th centuries as as Feake's Hithe (Fig. 2). The archaeological and documentary evidence, taken together, suggests that this site was in use from *c* 1200 until *c* 1800. The earliest artefacts and features previously recovered date from the 12th-14th century. The most abundant archaeological evidence, however, dates from the 15th-16th centuries, including evidence for at least one substantial building, cobbled areas, kilns and occupation deposits (Peachey and Dale 2005).

1.3.4 A recent trench investigation on Great Garlands Farm, 430m north-west of the lagoon site, uncovered the well-preserved remains of a timber wharf, dated by radiocarbon and artefactual evidence to the late 15th or early 16th century (OA 2016) which confirmed the existence of Feake's Hithe' The wharf seems to have suffered a catastrophic collapse at the end of its life, as the articulated skeleton of a horse was found amongst the collapsed superstructure and the wharf revetment had collapsed inward towards the

bank as if under pressure from a high energy flood, such as a tidal storm surge (OA 2016). The records of Old Garlands indicate that floods were a perennial problem for the tenants.

1.3.5 The earliest detailed map, dated 1619, names the site Feake's Hithe but does not show any buildings at the wharf by that date, even though an individual Shepherd's hut in the marshes is depicted on the map. This suggests that the wharf was in decline by the early 17th century. One of the fields on the 1840 Tithe Map is named ‘Saw Pit Field’, indicating that boat- or ship-building may have taken place at Feake’s Hithe at an unknown date in the post-medieval period. The settlement is still named on the Chapman and André Map of Essex, published in 1777 ('Fox Hive') but seems to have fallen out of use entirely by the early 19th century, very likely as a result of Carter’s Creek silting up. Its wharf functions may have been taken over by an enclosure and wharf on Curry Marsh at the terminal of the Manor Way track (built as the result of a legal dispute in 1636-40).

1.3.6 The lagoon site coincides with the historic line of Carter’s Creek, but lies *c* 400m south-east (downstream) from the nearest known archaeology associated with Feake’s Hithe.

1.3.7 Earthen sea walls, probably originally built in the 1620s, are shown on a mid-17th century map of the marshlands of Old Garlands and neighbouring estates. Although undated this map is likely to have been drawn up in relation to a legal dispute involving the Hawkins Hospital marshlands in 1636-40. The sea wall is labelled ‘the Dutch wall against the Thames’, while Curry Marsh is annotated as ‘lately inned by the Dutchmen’, in reference to the immigrant Dutch engineers responsible for many English reclamation projects in the early 17th century.

1.3.8 In the late 19th and early 20th centuries large explosives factories and oil storage and refinery sites were developed some distance to the south-east of the lagoon site, attracted by the railway, the strategic location of the site in relation to London, the deep sea anchorage at Shell Haven, and the remoteness of the location from centres of habitation. These dramatically altered the visual character of the former marshland landscape. The refinery was subject to very extensive development and expansion during the 20th century and was identified as a key defence site during WW2. Wartime aerial photographs show several anti-glider landing ditches forming cross patterns, which extend into the Lagoon site (Figs. 2 and 3). These were mostly infilled in the immediate post-war period and little or no trace remains on the ground. The lagoon site formed part of the Shell Haven West development, which was one of the latest parts of the oil refinery to be constructed, starting in the late 1950s.

2 Evaluation Aims and Methodology

2.1 Aims

2.1.1 The aim of the investigation was to understand the likely impact of the development on any significant archaeology contained within the upper alluvial sequence in the lagoon site in order to inform the planning and design process for the lagoon.

2.1.2 The investigation aimed to determine the presence/absence, extent, date range, condition and complexity of any other archaeological remains which may survive, and assess the associations and implications of any remains encountered with reference to the historic landscape. It also aimed to determine the potential of the site to provide palaeoenvironmental evidence, and the implications of any remains with reference to economy, status, utility and social activity, including consideration of the likely range, quality and quantity of the artefactual evidence present.

2.2 Methodology

2.2.1 The potential archaeological impacts arising from construction of Carter's Lagoon were investigated by trial trenching, sufficient to inform the lagoon design process. Eight trenches were excavated, each 20m x 2m in plan. The typical depth of investigation was *c* 1.1m, the proposed maximum depth of the lagoon (-0.3mAOD). However, deep test pits were also excavated in seven out of eight of the trenches to investigate the potential of the underlying alluvium to contain organic horizons or marine archaeological sites. Test pits were excavated in each of the trenches to depths of *c* 3.5m. It is accepted that significant archaeological remains could be present at greater depth within the *c* 10m thick Holocene alluvial sequence underlying the site, but would be below the deepest impacts arising from construction of the lagoon.

2.2.2 Owing to the floodplain environment, the trenches were infilled in a rolling programme before they filled with water. Richard Havis (ECC), on behalf of the local planning authority, was kept informed of progress on a daily basis and thus had the opportunity to inspect trenches if significant archaeology was found. Record photographs of all of the trenches are included in this report.

3 RESULTS

3.1 Introduction and presentation of results

3.1.1 The results of the evaluation are presented below, and include a brief stratigraphic description of the trenches. The full details of all trenches with the dimensions and depths of all deposits are provided in Appendix A. Given that no significant deposits were encountered, no detailed trench plans or sections are shown. Record photographs of each trench are included as Plates 1 to 16.

3.2 General soils and ground conditions

3.2.1 The ground conditions generally permitted adequate archaeological visibility. Groundwater flooding was not a significant problem during the Phase 1 trenching, which was carried out in May 2013. During Phase 2, which was completed in January 2014, the higher winter groundwater levels meant that the deep test pits flooded almost as soon they were excavated, resulting in a short window of opportunity to record the findings. Spoil arisings were inspected for traces of wood and artefacts in the alluvium. The deeper trenches and test pits were not suitable for manual access because of the unstable nature of the deposits and were recorded from ground level.

3.3 Trench 1 (Figs. 2 and 3, Plates 1 and 2)

3.3.1 This north-west to south-east aligned trench was located in the south-western part of the lagoon footprint. The stratigraphy consisted of an upper layer of sand, 0.4m thick (100), above a mixed made ground layer including concrete and brick rubble, 1.0m thick (102).

3.3.2 A test pit was dug to a depth of 3.5m, revealing the upper alluvium (103), a mottled orange brown alluvial silty clay layer 1.8m thick, which merged into blue-grey silty clay alluvium (101) 0.3m from the base of the pit. The total depth investigated was 3.5m, of which 1.4m was modern made ground.

3.4 Trench 2 (Figs. 2 and 3, Plates 3 and 4)

3.4.1 This east-west aligned trench was located in the south-western part of the lagoon footprint. An abandoned utility trench (cut 202, fill 203) of uncertain type was present crossing the middle of the trench. The stratigraphy consisted of an upper layer of sand, 1.2m thick (200).

3.4.2 A test pit was dug to a depth of 3.5m, revealing the upper alluvium (204), a mottled orange brown alluvial silty clay layer 2.0m thick, which merged into blue-grey silty clay alluvium (201) 0.3m from the base of the pit. The total depth investigated was 3.5m, of which 1.20m was modern made ground.

3.5 Trench 3 (Figs. 2 and 3, Plates 5 and 6)

3.5.1 This east-west aligned trench was located in the central part of the lagoon footprint. A modern drain was present crossing the middle section. The stratigraphy consisted of an upper layer of sand and gravel, 0.4m thick (300), and a mixed made ground layer including concrete and brick rubble, 0.8m thick (302).

3.5.2 A test pit was dug to a depth of 3.5m, revealing the upper alluvium (303), a mottled orange brown alluvial silty clay layer 1.9m thick, which merged into blue-grey silty clay

alluvium (301) 0.4m from the base of the pit. The total depth investigated was 3.5m, of which 1.20m was modern made ground.

3.6 Trench 4 (Figs. 2 and 3, Plates 7 and 8)

3.6.1 Trench 4 was aligned north-east to south-west and located at the western edge of the lagoon site. The stratigraphy consisted of an upper layer of sand and gravel, 0.5m thick (400), and a mixed made ground layer including concrete and brick rubble, 0.7m thick (402).

3.6.2 A test pit was dug to a depth of 3.5m, revealing the upper alluvium (403), a mottled orange brown alluvial silty clay layer 1.6m thick, which merged into blue-grey silty clay alluvium (401) 0.7m from the base of the pit. The total depth investigated was 3.5m, of which 1.20m was modern made ground.

3.7 Trench 5 (Figs. 2 and 3, Plates 9 and 10)

3.7.1 This north-east to south-west aligned trench was located in the central part of the lagoon footprint. It was heavily disturbed by modern construction. A concrete slab was encountered in two sections at the south-west section of the trench, at a depth of 0.9m. A brick rubble layer occupied the north-east end of the trench and was still present at 1.5m depth.

3.7.2 A deep test pit was excavated in a gap between the concrete slab sections, which provided a relatively undisturbed sequence. The top of the sequence was a hardcore layer 0.25m thick (500). Below that was a layer of sand, 0.65m thick (501). Underlying that was the upper alluvium (502), a mottled orange brown alluvial silty clay layer 1.6m thick, which merged into blue-grey silty clay alluvium (503) 1.0m from the base of the pit. Within the test sequence, the total depth investigated was 3.5m, of which 0.90m was modern made ground.

3.8 Trench 6 (Figs. 2 and 3, Plates 11 and 12)

3.8.1 This east-west aligned trench was located in the northern part of the lagoon footprint. A large metal tank in a pit was cut deeply into the alluvium at the east end of the trench. The top of the sequence was a thin mixed stoney made ground layer, 0.18m thick (600). Below that was a layer of sand, 0.32m thick (601). Below that was a 0.15m thick stoney layer, possibly a former surface. Underlying that was the upper alluvium (603), a mottled orange brown alluvial silty clay layer 2.5m thick, which merged into blue-grey silty clay alluvium (604) 0.35m from the base of the pit. The total depth investigated was 3.5m, of which 0.65m was modern made ground.

3.9 Trench 7 (Figs. 2 and 3, Plates 13 and 14)

3.9.1 This east-west aligned trench was located in the north-east area of the lagoon footprint. The cut for a large metal pipe cut through the trench on an east-west alignment. The top of the sequence was a 0.31m thick layer of sand (700). Below that was a 0.75m thick layer of mixed made ground (701) containing frequent brick, concrete and tarmac fragments. Underlying that was the upper alluvium (702), a mottled orange brown alluvial silty clay layer 1.2m thick, which merged into blue-grey silty clay alluvium (703) 1.24m from the base of the pit. The total depth investigated was 3.5m, of which 1.06m was modern made ground.

3.10 Trench 8 (Figs. 2 and 3, Plates 15 and 16)

3.10.1 This east-west aligned trench was located in the north-east area of the lagoon. Trench 8 was relatively undisturbed by structural features and seems to be a fairly typical sequence for the lagoon site in areas with limited modern ground disturbance. The top of the sequence was a 0.6m thick layer of sand (800). Below that was a 0.55m thick mixed made ground layer (801) containing frequent brick, concrete and tarmac fragments. Underlying that was the upper alluvium, a mottled yellow brown alluvial silty clay layer 2.1m thick, which merged into blue-grey silty clay alluvium 0.25m from the base of the test pit. The total depth investigated was 3.5m, of which 1.15m was modern made ground.

3.11 Finds summary

3.11.1 No archaeologically significant artefacts were recovered.

3.12 Acknowledgements

3.12.1 Oxford Archaeology was appointed to undertake the evaluation by LGPL, who funded the project. Richard Havis, the Senior Historic Environment Advisor for Essex County Council, monitored the work. The fieldwork was supervised by Ashley Strutt (Oxford Archaeology) in both phases. The project was managed for Oxford Archaeology by Stuart Foreman. Gill Andrews (Consultant Archaeologist) monitored the work on behalf of LGPL.

4 Discussion

4.1 Reliability of field investigation

4.1.1 The eight trenches represent a limited sample of the site area, but are sufficient to characterise the near-surface ground conditions and confirm the extent of ground disturbance associated with the former oil refinery. The absence of significant archaeological features is likely to be fair reflection of archaeological potential in the top 3.5m of the sediment sequence.

4.2 Archaeological impact assessment

4.2.1 **Baseline levels:** None of the eight trenches contained features or deposits of certain archaeological origin, other than modern deposits and made ground associated with the former Shell Haven oil refinery. These are not considered to be archaeologically significant and were not recorded in detail.

4.2.2 The ground level at the time of the trenching lay at *c* 2.1mAOD. The site is covered by a variable thickness of made ground, varying greatly in composition and appearance but typically including an upper layer of sand, similar to the dredged sand used in the recent London Gateway land raising, and a lower layer of mixed made ground with brick, concrete and tarmac inclusions. Late 20th century structural remains and service trenches were commonplace, including an *in situ* concrete slab in Trench 5 and a metal tank in Trench 6. The base level of the made ground was not always clearly defined owing to widespread disturbance caused by features and groundworks associated with the former oil refinery. The lower levels may be reworked or disturbed alluvium rather than made ground as such. The base of the made ground/top of the undisturbed alluvium represents the uppermost level at which significant archaeological remains could be encountered. This level was typically encountered at *c* 1.2m depth (0.8mAOD in Trench 1). The trenches were thus dug mostly through made ground deposits except where deep test pits were dug. However, the made ground was shallower in Trenches 6, 7 and 8, and the underlying alluvium lay at a slightly higher level. These trenches lay outside the infilled channel of Carter's Creek.

4.2.3 Deep test pits (up to 3.5m deep) were excavated in each of the trenches to investigate the underlying alluvium. The top layer of alluvium typically comprised orange brown silty clay, whose orange colour is the result of the oxidisation of organic content in the alluvium due to seasonal drying of the uppermost alluvial deposits. Below *c* 2.3m (-0.3mAOD) the alluvium typically comprised greyish blue silty clays of varying hue, typical of permanently waterlogged marine and intertidal alluvial deposits. No archaeological features, artefacts or traces of preserved wood were observed within the alluvium.

4.2.4 The maximum depth of investigation in all trenches was 3.5m (*c*-1.5mAOD) which only penetrated into the uppermost layers of the Holocene alluvium. For comparison, Borehole OA06, located 300m south-east of the lagoon site, recorded the top of the Holocene alluvium at 1.2mAOD (OA 2012) and recorded the total thickness as 10.78m, extending down to the surface of the underlying terrace gravel at -9.98mAOD. The last represents the lowest level at which archaeological remains are likely to be present in this part of the London Gateway site. There is potential at the base of the sequence for well-preserved Mesolithic land surfaces, inundated by rising sea levels in the early Holocene, demonstrated by radiocarbon dates and the presence of organic-rich peats near the base of the Holocene sequence in Borehole OA06 (see 1.2.4).

4.2.5 There was no indication of peat layers within the trenches. Peat was recorded at two levels in Borehole OA06 (see 1.2.4 above), but was too deeply buried to be encountered in the evaluation trenches (the uppermost peat, of late Mesolithic date, was recorded at -5.22mAOD in Borehole OA06). Peat layers indicate periods of marine regression and landscape stability within the floodplain. The latest radiocarbon date from Borehole OA06 derives from a waterlogged leaf fragment from -4.75mAOD, which gave a date of 2870-2490cal. BC (late Neolithic), although waterlogged plant remains from alluvial deposits are often later in date than the deposits they derive from. The level at which contemporary archaeological features occur within the alluvial sequence is likely to vary significantly within the lagoon site due to the presence of a substantial infilled former creek underlying the site (Carter's Creek).

4.2.6 The trench results indicate that the top 1–3m of the soil sequence (*c* 2.2mAOD to *c* -0.8mAOD) has little potential for significant archaeological discoveries. Marine and marshland archaeology of Mesolithic to post-medieval date could well survive at greater depths but will not be substantively affected by construction of the lagoon.

4.2.7 **Preparatory earthworks:** Land-raising was required to raise the lagoon banks to the level of the Logistics Park (the lagoon bank level lies at 3.2mAOD). This resulted in raised ground thickness around the edges of the lagoon of *c* 1.5m. The total thickness of modern made ground, including the former oil refinery made ground (1.2m thick), would thus be at least *c* 2.4m, which would provide a protective layer for any archaeology that may survive at greater depth.

4.2.8 **Drainage lagoon:** The drainage lagoon cut represents the most substantial potential archaeological impact. The surface area of the lagoon is *c* 3.1 ha. The bank level lies at 3.2m AOD. The base of the lagoon (invert level) is at 0 to -0.3m AOD (inlet to outlet). The permanent water level is designed to be at 1.0m AOD. The deepest parts of the lagoon thus cut into the uppermost layers of alluvium by up to *c* 1.1m. At this level the alluvium is heavily disturbed by former refinery features. The evaluation trenches were placed at the deepest part of the lagoon profile where the potential archaeological impact is greatest and were excavated to the base level of the lagoon. Localised deeper test pits were excavated to investigate the potential of the underlying alluvial deposits, but did not encounter any significant archaeological remains or organic horizons.

4.3 Conclusions

4.3.1 No significant archaeological remains were encountered within the evaluation trenches. Based on the results of the evaluation, no impact on archaeological remains was anticipated from construction of Carter's Lagoon.

4.3.2 There remains the possibility that significant remains are present at greater depth within the Holocene alluvial sequence, but any such remains lie below the level of construction impact arising from construction of the lagoon.

4.3.3 No archaeological mitigation was recommended in relation to the Carter's Lagoon construction.

Appendix A. Trench Descriptions and Context Inventory

Trench 1						
General description					**Orientation**	NW-SE
No significant archaeology identified within the limits of the trench. Test pit excavated, 3.5m deep.					**Avg. depth (m)**	1.05
					Width (m)	2.10
					Length (m)	30.00
Contexts						
Context no	**Type**	**Width (m)**	**Depth (m)**	**Comment**	**Finds**	**Date**
100	Layer	-	0 - 0.40	Sand levelling deposit	-	-
101	Layer	-	3.20-3.50+	Blue grey alluvial silty clay at base of test pit. Base of trench at 3.5m	-	-
102	Layer	-	0.40-1.40	Mixed made ground including concrete and brick rubble.	-	-
103	Layer		1.40-3.20	Orange brown upper alluvium	-	-

Trench 2						
General description					**Orientation**	E-W
No significant archaeology identified within the limits of the trench. Test pit excavated, 3.5m deep.					**Avg. depth (m)**	0.95
					Width (m)	2.10
					Length (m)	30.00
Contexts						
Context no	**Type**	**Width (m)**	**Depth (m)**	**Comment**	**Finds**	**Date**
200	Layer	-	0-1.20	Sand levelling deposit	-	-
201	Layer	-	3.20-3.50+	Blue grey alluvial silty clay at base of test pit. Base of trench at 3.5m	-	-
204	Layer	-	1.20-3.20	Orange brown upper alluvium		
202	Layer	-	0.45	Service trench cut	-	-
203	Layer	-	0.45	Fill of 202	-	-

Trench 3		
General description	**Orientation**	E-W

Trench 3						
No significant archaeology identified within the limits of the trench. Test pit excavated, 3.5m deep.					**Avg. depth (m)**	1.00
					Width (m)	2.10
					Length (m)	30.00
Contexts						
Context no	**Type**	**Width (m)**	**Depth (m)**	**Comment**	**Finds**	**Date**
300	Layer	-	0-0.40	Sand levelling deposit	-	-
301	Layer	-	3.10-3.50+	Blue grey alluvial silty clay at base of test pit. Base of trench at 3.5m	-	-
302	Layer	-	0.40-1.20	Made ground – Disturbed blue grey alluvial silty clay with concrete and brick inclusions	-	-
303	Layer		1.20-3.10	Orange brown alluvium	-	-

Trench 4						
General description					**Orientation**	E-W
No significant archaeology identified within the limits of the trench. Test pit excavated, 3.5m deep.					**Avg. depth (m)**	1.12
					Width (m)	2.10
					Length (m)	30.00
Contexts						
Context no	**Type**	**Width (m)**	**Depth (m)**	**Comment**	**Finds**	**Date**
400	Layer	-	0-0.50	Sand levelling deposit	-	-
401	Layer	-	2.80-3.50+	Blue grey alluvial silty clay at base of test pit. Base of trench at 3.5m	-	-
402	Layer	-	1.20-2.80	Brown silty clay alluvium	-	-
403	Layer		0.50-1.20	Mixed made ground including concrete and brick rubble		

Trench 5		
General description	**Orientation**	NNW-SSE
No significant archaeology identified within the limits of the trench	**Avg. depth (m)**	1.10m

Trench 5						
Test pit excavated, 3.5m deep.						
					Width (m)	2.10
					Length (m)	30.00
Contexts						
Context no	**Type**	**Width (m)**	**Depth (m)**	**Comment**	**Finds**	**Date**
500	Layer	-	0-0.25	Hardcore surface	-	-
501	Layer	-	0.25-0.90	Sand (made ground)		
502	Layer	-	0.90 - 2.50	Orange brown silty clay alluvium	-	-
503	Layer	-	2.50-3.50+	Blue grey alluvial silty clay at base of test pit. Base of trench at 3.5m	-	-
504	Layer	-	0.90+	Concrete slab		
505	Layer	-	0.90+	Building rubble at north end of trench		

Trench 6						
General description					**Orientation**	E-W
No significant archaeology identified within the limits of the trench. Test pit excavated, 3.5m deep.					**Avg. depth (m)**	1.10
					Width (m)	2.10
					Length (m)	30.00
Contexts						
Context no	**Type**	**Width (m)**	**Depth (m)**	**Comment**	**Finds**	**Date**
600	Layer	-	0-0.18	Redeposited silty clay mixed with building rubble	-	-
601	Layer	-	0.18-0.50	Sand (made ground)	-	-
602	Layer	-	0.50-0.65	Stony dark brown silty clay (buried surface?)	-	-
603	Layer	-	0.65-3.15	Orange brown alluvium	-	-
604	Layer	-	3.15-3.50+	Blue grey alluvial silty clay at base of test pit. Base of trench at 3.5m	-	-
605	Layer	-	-	Infilled tidal channel?	-	-
606	Layer	-	-	Loose, organic dark grey fill of 605	-	-

Trench 7						
General description					**Orientation**	E-W
No significant archaeology identified within the limits of the trench. Test pit excavated, 3.5m deep.					**Avg. depth (m)**	1.05
					Width (m)	2.10
					Length (m)	30.0
Contexts						
Context no	**Type**	**Width (m)**	**Depth (m)**	**Comment**	**Finds**	**Date**
700	Layer	-	0-0.31	Sand, made ground	-	-
701	Layer	-	0.31-1.06	Mixed made ground with brick, concrete and tarmac	-	-
702	Layer	-	1.06-2.26	Orange brown silty clay alluvium	-	-
703	Layer	-	2.26-3.50+	Blue grey alluvial silty clay at base of test pit. Base of trench at 3.5m		

Trench 8						
General description					**Orientation**	WNW-ESE
No significant archaeology identified within the limits of the trench. Test pit excavated, 3.5m deep.					**Avg. depth (m)**	1.12
					Width (m)	2.10
					Length (m)	30.00
Contexts						
Context no	**Type**	**Width (m)**	**Depth (m)**	**Comment**	**Finds**	**Date**
800	Layer	-	0-0.60	Sand, made ground	-	-
801	Layer	-	0.60-1.15	Mixed made ground with brick, concrete and tarmac	-	-
802	Layer	-	1.15-3.25	Orange brown silty clay alluvium	-	-
802	Layer	-	3.25-3.50+	Blue grey alluvial silty clay at base of test pit. Base of trench at 3.5m	-	-

Appendix B. Bibliography and References

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Rippon, S, and Wainwright, A, 2011 Our Wetland Heritage: An Integrated Approach Towards Managing Coastal Landscapes,

Saunders, A, Stanford-le-Hope, A History of the Church and Village

Stanford-le-Hope Tithe Map (1840) ERO D/C/T362B

Appendix C. Summary of Site Details

Site name: Carter's Lagoon, London Gateway Park Development Ltd, Stanford le Hope, Essex

Site code: COOR12

Grid reference: 570900E, 181900N

Type: Evaluation trench investigation

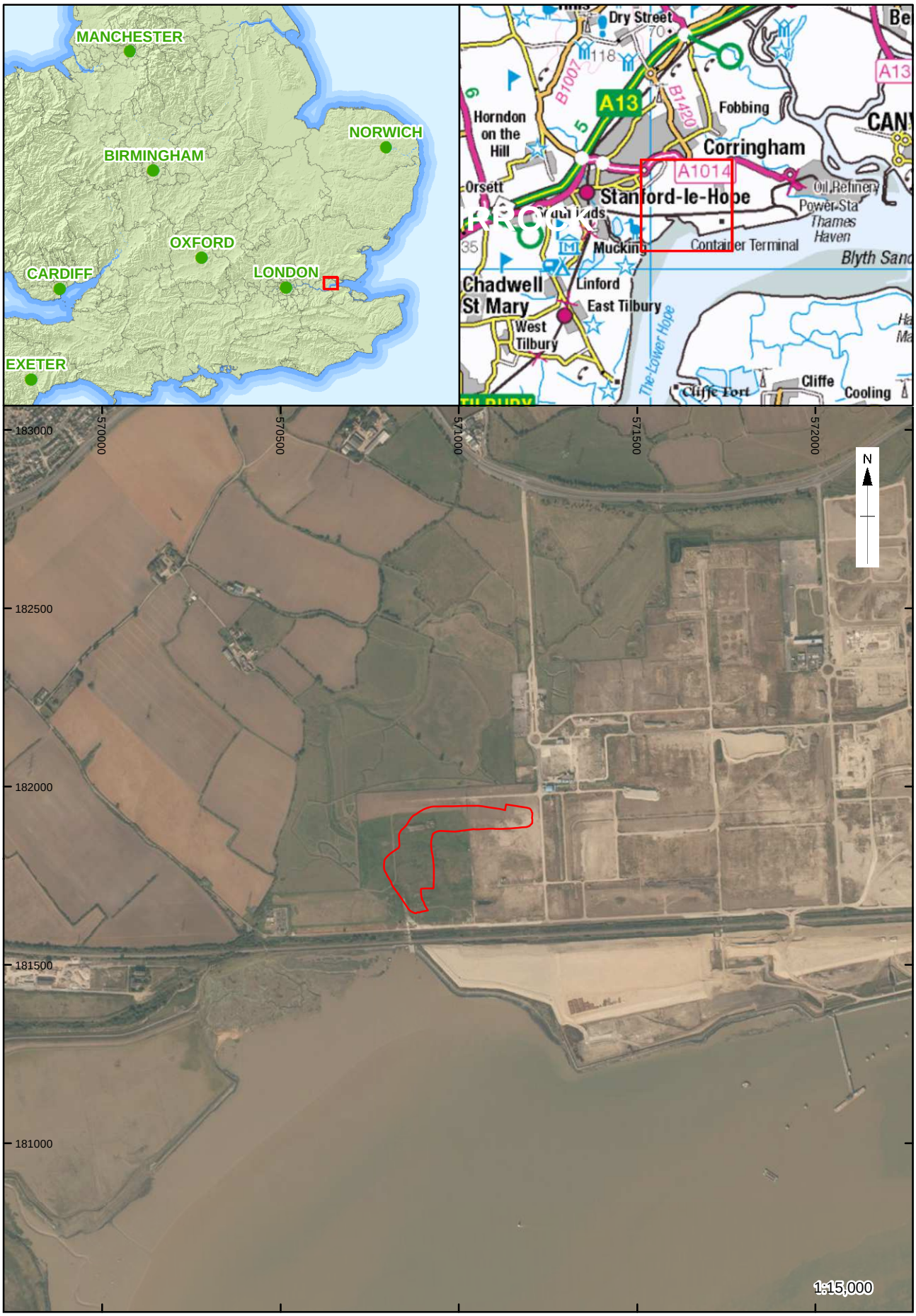
Date and duration: Phase 1: January 2013, Phase 2: May 2014 (4 days in total)

Area of site: 3.1 hectares

Summary of results: No significant archaeological remains were encountered within the eight evaluation trenches. Based on the results of the evaluation, and previous geoarchaeological investigations, no impact on archaeological remains is anticipated from the construction of Carter's Lagoon.

There remains the possibility that significant remains are present at greater depth within the 10m thick Holocene alluvial sequence, but any such remains will be below the proposed level of construction impact arising from the development and would be preserved *in situ* beneath a protective layer of made ground.

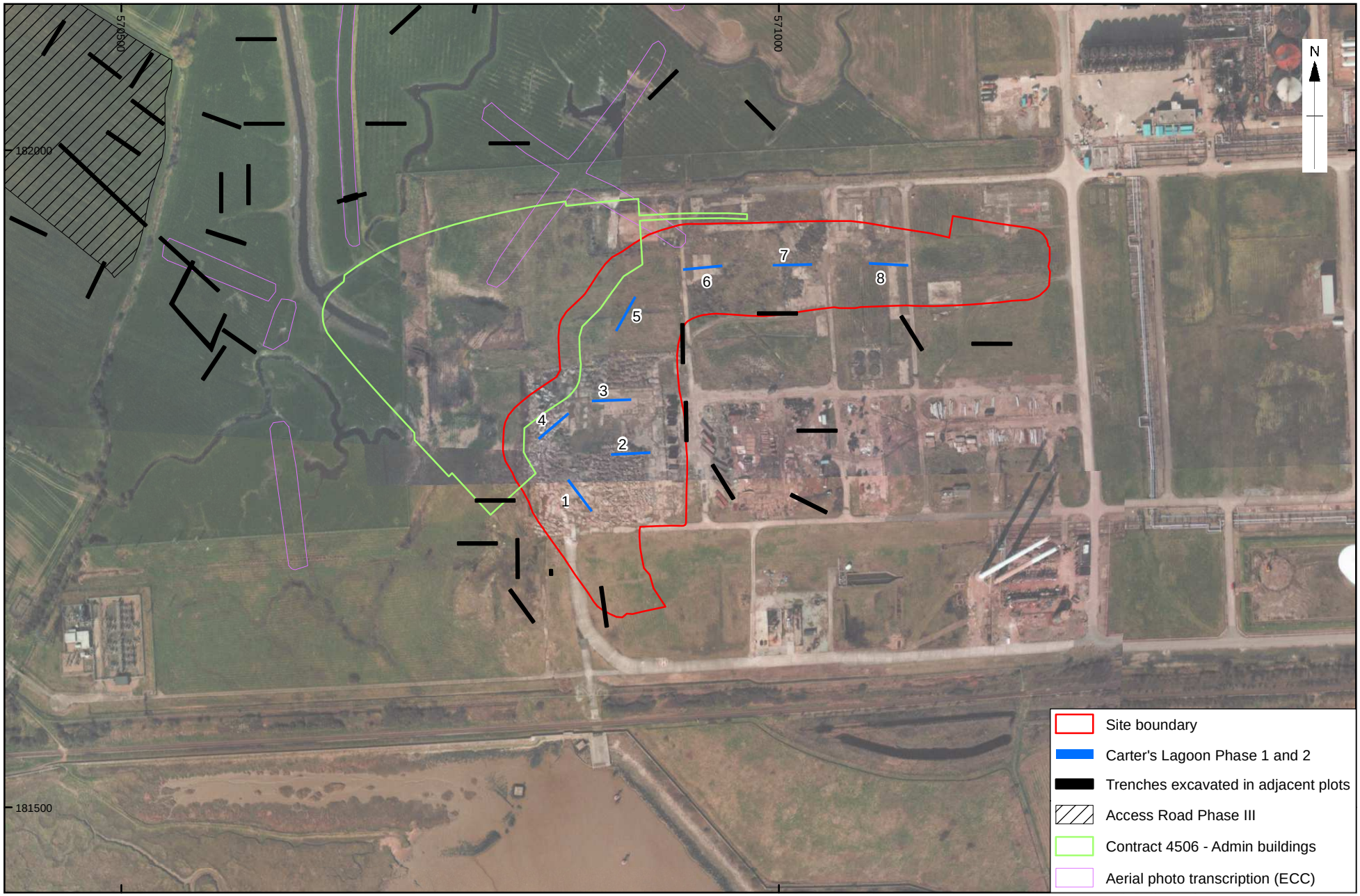
Location of archive: The archive is currently held at OA, Janus House, Osney Mead, Oxford, OX2 0ES, and will be deposited with Thurrock Museum in due course.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User

Figure 1: Site location

X:\ILG2007\03_Geomatics\GIS\ArcGIS\current\001 projects\Arcview 3 projects\Carter's lagoon_2901131\2016-09-13\Figure1_130916.mxd*gary.jones*13/09/2016



X:\ILG2007\03_Geomatics\GIS\ArcGIS\current\001 projects\Arcview 3 projects\Carter's lagoon_290113\2016-09-13\Figure2_130916.mxd*gary.jones*14/09/2016

Figure 2: Trench layout overlaid over aerial photos taken in 2008

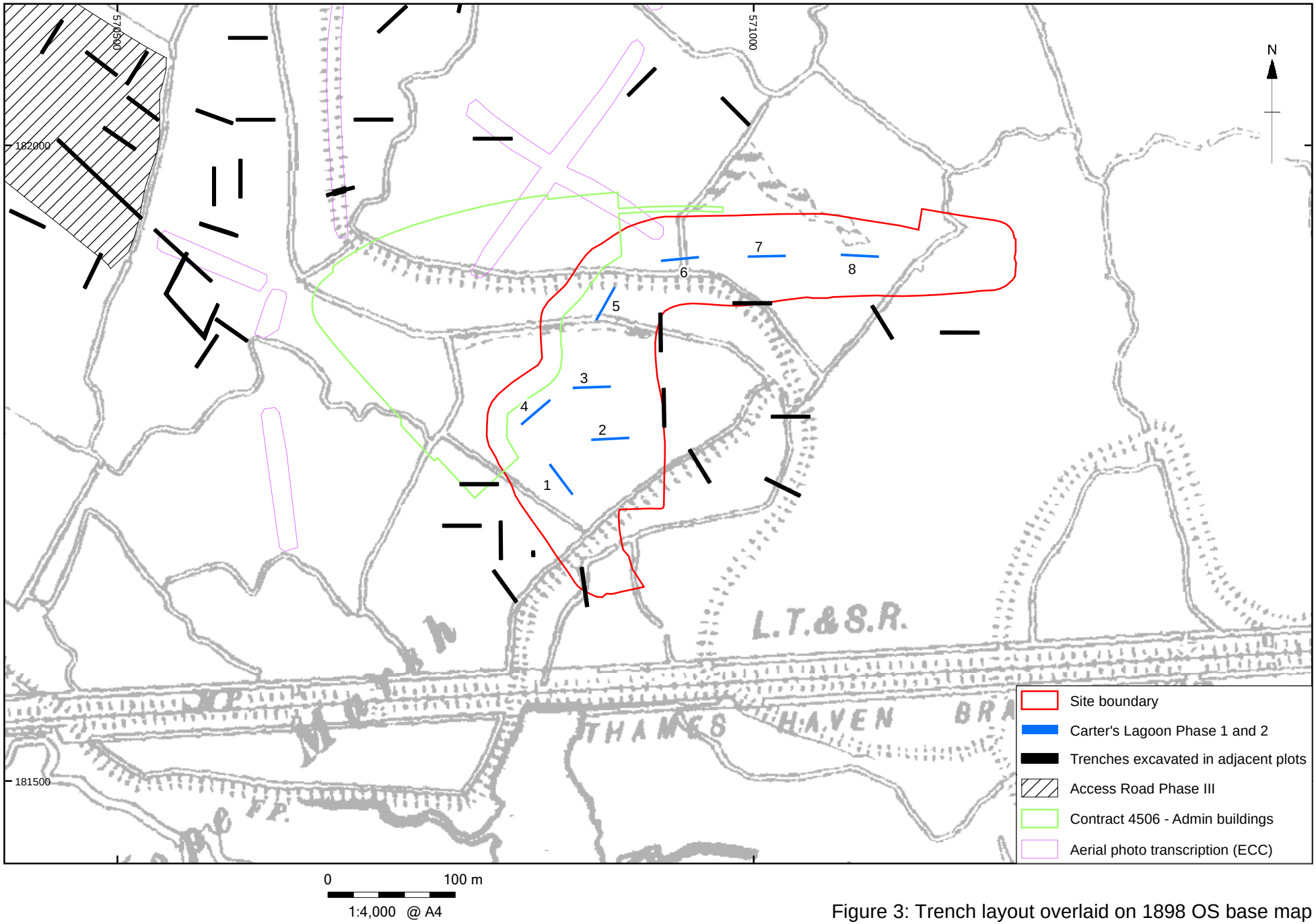


Figure 3: Trench layout overlaid on 1898 OS base map

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