Chapter 2

Investigative framework and methodologies

THE ARCHAEOLOGICAL MITIGATION FRAMEWORK

From the start of the archaeological project, a commitment to a seamless and integrated approach to the archaeological resource, regardless of whether it was on dry land or beneath the Thames, underpinned the archaeological mitigation strategy. An assessment of cultural heritage (see below) demonstrated that the development had the potential to impact important archaeological remains. Guidance on how archaeological remains should be preserved or recorded within the framework of planning policy was originally set out in Planning Policy Guidance Note 16: Archaeology and Planning, known as PPG16 (the document and its successors were replaced by the National Planning Policy Framework in 2012). The guidance advocated the need to take account of known archaeology in development proposals and to ascertain the extent of further archaeological remains which may be affected by the proposed development. In the case of nationally important archaeological remains, the guidance stated that the presumption should be in favour of their preservation *in situ*. Where preservation *in situ* was not justified, it advised that it was reasonable for planning authorities to require the developer to make appropriate and satisfactory provision for excavation and recording of the remains. The Archaeological Mitigation Framework (AMF) was prepared in order to inform the decisions on the appropriate approach to mitigating the effects of the port development on the diverse archaeological resource (Fig. 2.1).

The general aim of the archaeological project was to move beyond simple recovery and description of remains and instead create a historical understanding of the dynamic relationship between human activity and the changing landscape in relation to its regional and wider context. This aim was guided by several principles: a single integrated approach; the formulation of research objectives; acceptance of the highly fragmentary nature and partial representation of archaeological materials in a complex matrix of sediments; and the requirement for procedures to reflect both the archaeological potential of the site and the physical conditions in which the archaeological remains were to be found. Research themes focused on Quaternary environments and Palaeolithic inhabitation, Holocene environments and inhabitation from the Mesolithic period to modern times, medieval and post-medieval reclamation of the Thames floodplain, industrialisation of the waterfront, maritime activity, and the archaeology of warfare.

Once the detail of the construction programme was finalised, site-specific project designs were prepared for each of the areas requiring archaeological investigation. Each reflected at a detailed level the archaeological strategy. Four environments were identified, within which different sampling strategies were to be employed, comprising the gravel terrace, the alluvial floodplain, the intertidal zone, and the Thames channel or seabed and existing fleets and creeks. The physical conditions that operated in those areas presented differing challenges in terms of accessibility to the archaeological resource and therefore demanded different methodological approaches. Appropriate strategies and methodologies were formulated with consideration to the physical environment, the depositional environment in which archaeological remains were likely to occur, and the principal research themes. These were underpinned by a commitment to a staged, iterative process of mitigation. A cycle of intervention, feedback and assessment over several years was anticipated as the scheme was implemented. A flexible and responsive approach to data collection and analysis was required in order to fully realise the potential of the archaeological deposits within the agreed constraints of the construction programme as it developed over time and in a manner that was cost effective and maximised archaeological value.

The implementation of the AMF required a range of archaeological techniques and strategies. All palaeoenvironmental, geomorphological and cultural data generated were to be georeferenced within a geographical information system (GIS) that acted as the primary data repository for the project, linking together datasets with differing units of measurement that operated on different spatial scales. This provided a powerful approach to integrate, query and correlate the diverse strands of investigations demanded by the AMF.

A range of investigative techniques were applied as part of the archaeological programme. Non-intrusive surveys were completed as part of an initial environmental statement and further non-intrusive survey were carried out where necessary. Surveys included topographical surveys, intertidal walkover surveys and geophysical surveys.

Mitigation sequence on the alluvial floodplain

The mitigation sequence for the floodplain was divided into three phases. Phase I comprised the refinement of the geoarchaeological deposit model using geotechnical data generated since the start of the archaeological

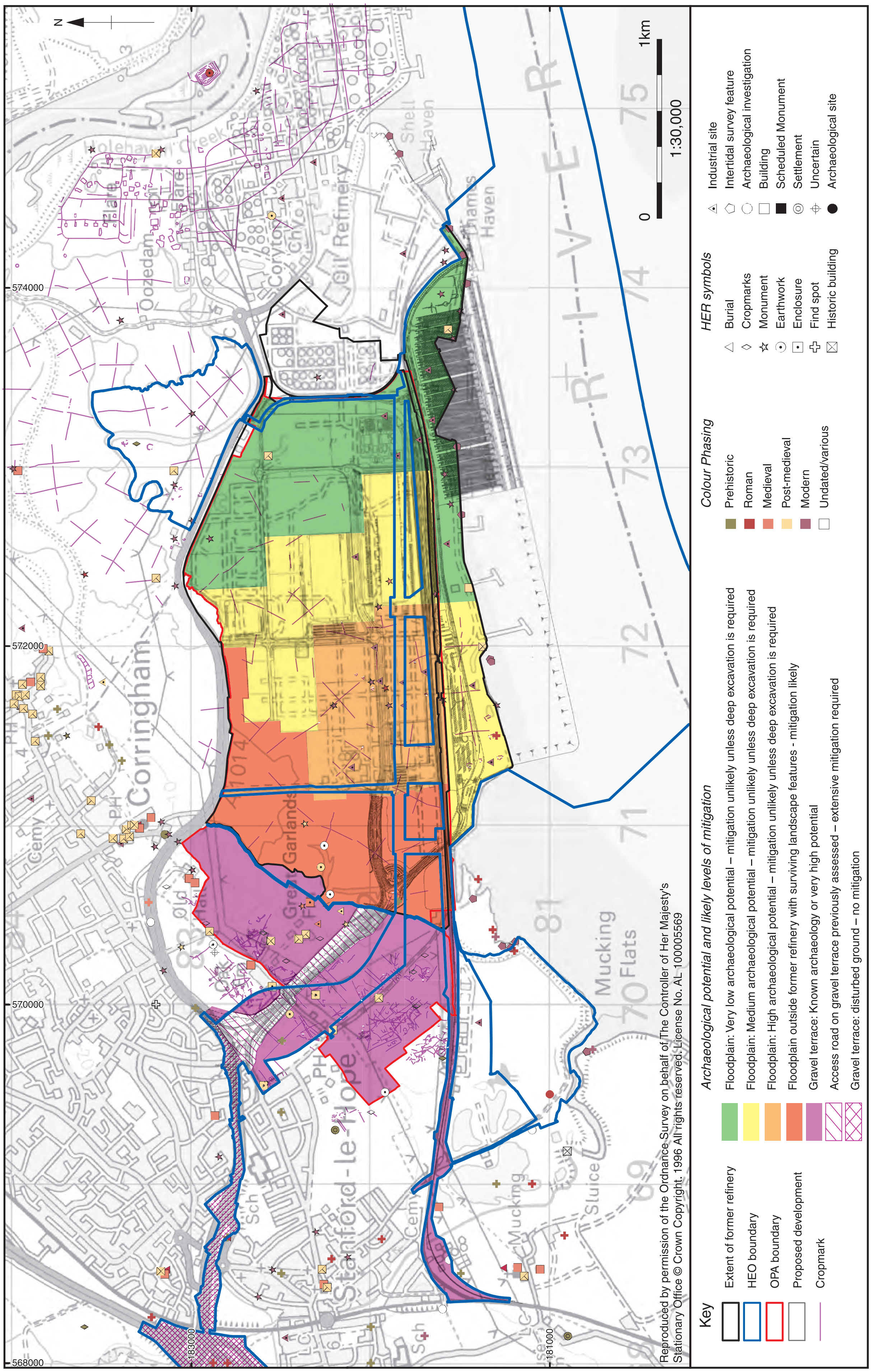

Figure 2.1 Overview of archaeological potential and likely levels of mitigation

programme in 2003. Borehole coverage across the site was extensive and the updating of the model continued as further geoarchaeological and geotechnical investigations were completed. The aim of the deposit modelling was to generate a three-dimensional map of the ancient topography of the floodplain deposits, defining the interface between the Holocene alluvium and the Pleistocene gravels and identifying geomorphological features such as early Holocene river channels and gravel islands. Additionally, sediment units of high palaeoenvironmental and archaeological preservation potential, such as peat beds, were identified.

Phase II, ancient landscape features mapping, comprised an extensive electrical resistivity imaging survey, a series of boreholes used to calibrate and ground-truth the resistivity survey results, and a site-wide palaeoenvironmental and radiocarbon dating programme. The resistivity survey results greatly enhanced the resolution of the preliminary deposit model, which together allowed a detailed map of the sub-surface topography and major geomorphological units across the development area to be developed. A pilot study, carried out in 2007, demonstrated that the resistivity survey was capable of detecting major buried topographical features (such as river channels) at sufficient resolution for mapping purposes (OA 2008a). It was also a rapid, non-intrusive method that provided an effective means of surveying the whole of the floodplain, rather than being limited to key transects. Geoarchaeological boreholes were used to calibrate and ground-truth the resistivity survey and the data were also fed into the deposit model.

Phase III comprised detailed mitigation. Construction design details for each area were reviewed and compared against the ancient landscape features mapping generated in Phase II. Where construction impacts coincided with areas of high archaeological potential, a range of mitigation options, from preservation *in situ* to open-area excavation, were considered. Wherever possible, construction impacts were avoided in areas of high archaeological potential, and in practice the depth of alluvial deposits within the floodplain and the intention to build up the ground level meant that preservation *in situ* was frequently achievable. Trenches or test pits were used to establish archaeological potential in areas of shallow construction impact. Open-area excavation within the floodplain was only anticipated under exceptional circumstances, for example if significant archaeology was identified at comparatively shallow depth or in an area of unavoidable and substantial construction impact.

Mitigation sequence on the gravel terrace

Excavation was the principal mitigation method on or close to the gravel terrace, where desk-based studies, non-intrusive survey or borehole work had identified potentially significant archaeological deposits, but where preservation *in situ* was not appropriate. A phased approach was normally taken. Phase I comprised preliminary trenching or test-pitting, which allowed deposits to be characterised. The layout of interventions and their density and depth varied according to sampling strategies appropriate to the nature of archaeological deposits being investigated and the physical and depositional environments within which they were found. Phase II was 'strip, map and sample' (SMS), which was applicable to shallow and surface deposits on the gravel terrace. The technique was particularly useful in response to proposed impacts such as topsoil stripping along infrastructure corridors and across building footprints and could be fully integrated into the early stages of the construction programme. The technique involves removal of non-archaeological surface deposits (topsoil or made ground) under archaeological supervision and the rapid mapping and sample excavation and recording of any archaeological remains identified. The level of sampling was dependent on the nature of the archaeological remains and their significance with reference to the project aims. Detailed excavation (Phase III) was considered where significant remains could not be adequately recorded or protected during Phases I and II. Site-specific methodologies for all techniques were provided in project designs and agreed with curatorial archaeologists, as specified in the AMF.

Monitoring and recording

Archaeological monitoring was undertaken throughout the construction phases of the project. This was considered the appropriate mitigation response where there was a low potential for archaeological remains to survive, where previous phases of mitigation had already been undertaken but there remained some potential for further archaeology evidence, and where it was evident from the nature of the impact and the accessibility of archaeological remains that monitoring was the most appropriate technique.

BUILDING KNOWLEDGE TO INFORM INVESTIGATIVE STRATEGIES

Establishing an appropriate programme of archaeological mitigation was dependent on a thorough understanding of the nature and survival of the archaeological resource and its geological and stratigraphic context. The assessment of cultural heritage within and around the DP World London Gateway development and the production of a geoarchaeological deposit model were therefore fundamental requirements in the earliest stages of the archaeological programme.

Cultural heritage assessment

The assessment of cultural heritage drew on primary and secondary archaeological records, historic environment records held by Essex and Kent county councils, site

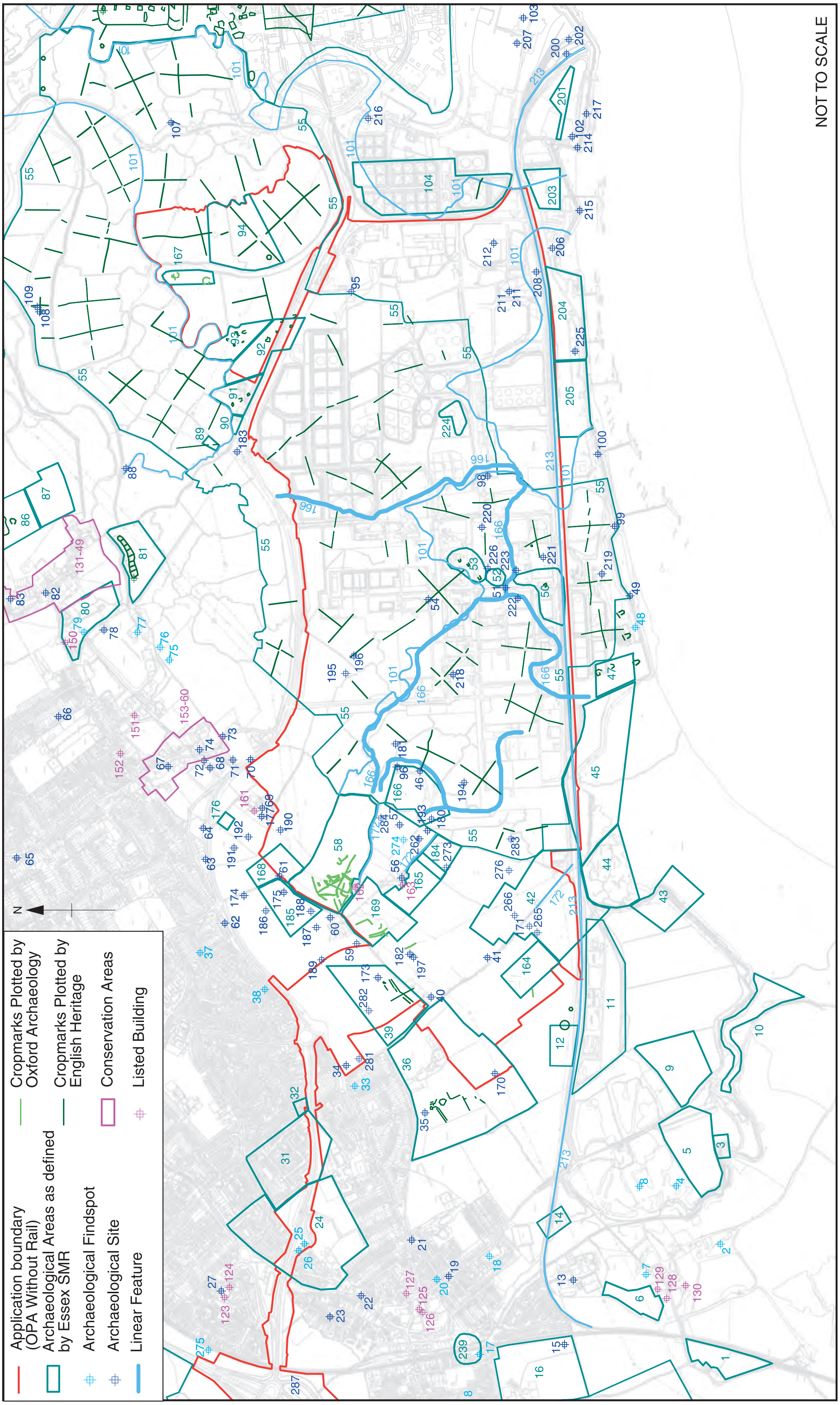

Figure 2.2 Mapping the location of cultural heritage within the DP World London Gateway development area in 2003

inspection, geotechnical and geophysical investigation and a survey of the industrial archaeology of the site. Additional, site-specific, desk-based assessments were prepared for three amelioration schemes: Site A, later known as Stanford Wharf Nature Reserve and subject to detailed excavation (Biddulph *et al.* 2012a); the Northern Triangle area; and Site X, now known as Salt Fleet Flats, in the Cooling Marshes in Kent. All three sites, farmland at the time of assessment, were earmarked for development as wildlife habitats.

The search of the Historic Environment Record held by Essex County Council, heritage records held by Historic England (then English Heritage) and other sources returned some 350 entries relating to the Essex side of the development. These included findspots of prehistoric flint tools, prehistoric to Anglo-Saxon pottery and miscellaneous metalwork, chance discoveries of archaeological features, sites identified by cropmarks, earthworks, historical mapping and physical remains, and almost 100 listed buildings (Fig. 2.2). The cultural heritage assessment of Salt Fleet Flats, produced in 2002 and updated in 2012 as a result of changes to the site's configuration and to bring in new information since the original survey was completed, identified 30 heritage assets within the site itself and a further 153 sites within the wider study area (Fig. 2.3). The heritage assets within the site included potential salt manufacture sites, possibly of later medieval or post-medieval date, the sites of two farmsteads first shown in 1842, the line of sea walls first shown in 1898, and agricultural structures shown in 1842 and 1872. Kent County Council, Kent Record Office, English Heritage and others were consulted. Together, these baseline data provided a good indication of the past use of the area and helped to inform subsequent archaeological work.

The assessment indicated that there was a high potential for archaeological deposits to be encountered within the development area. Except for areas of the former refinery on the floodplain, the impact of previous development did not appear to have been substantial. Consequently it was recommended in the assessment that any adverse effects resulting from the development should be mitigated by further survey and evaluation.

Deposit model

From the outset of the project it was recognised that a

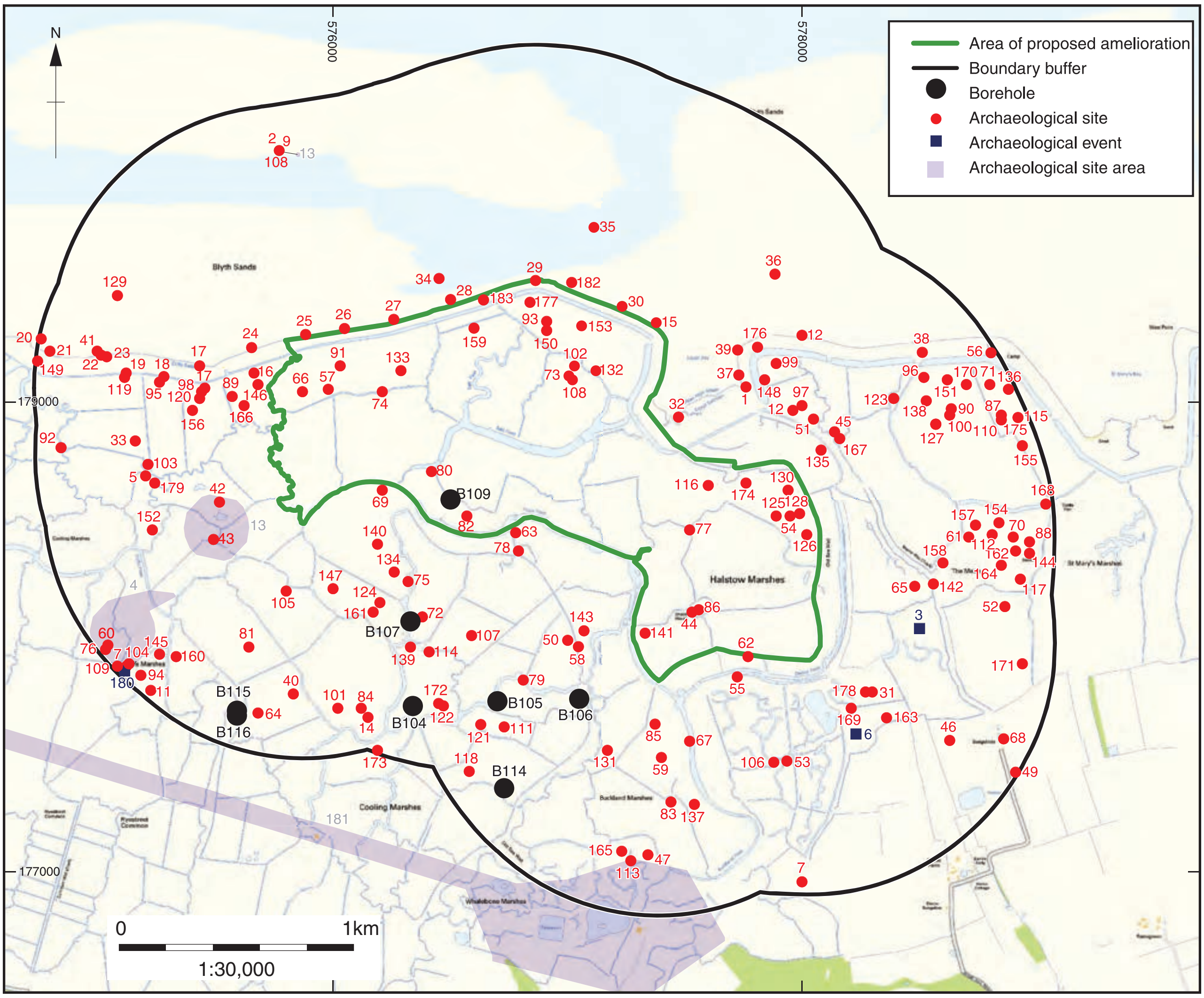

Figure 2.3 Mapping the location of cultural heritage within Salt Fleet Flats on the Cooling Marshes

geoarchaeological approach was required in order to investigate the deep alluvial sequences, since conventional methods of evaluation such as trial-trenching would only be effective in assessing the most recent phases of activity at the site. Initial work involved providing advice and services related to the preparation of the cultural heritage aspects of the Environmental Impact Assessment and its passage through Public Inquiry. As part of this, OA co-ordinated, in conjunction with Dr Martin Bates (formerly of the University of Wales, Trinity St David), the production of a site-wide deposit model spanning both land and marine environments, largely based on historic borehole data but ground-tested with archaeological boreholes and geophysical survey. It was intended that by characterising the various depositional environments this model would be a tool for assessing the archaeological potential of the floodplain and provide a basis for modelling development impacts and mitigation strategies.

During the lifetime of the project the site-wide deposit model has been updated several times with additional data from field survey, which included electromagnetic techniques, electrical profiling and Lidar. Targeted palaeoenvironmental analysis coupled with a programme of radiocarbon dating enabled a detailed integrated model of landscape change to be developed. The deposit model proved a valuable tool for predicting landscapes and areas of high potential for past human habitation within the development area, and for guiding the development process. The study built on previous models of the Thames Estuary and represents a significant advance in our understanding of archaeological landscapes within the floodplain.

Work on the deposit model began in 2002. A geophysical survey was conducted across selected blocks of land in order to investigate the sub-surface electrical properties of the buried deposits; individual sediment types vary in their resistance to an electrical current and therefore a knowledge of the spatial distribution of the sub-surface geoelectric units would provide a proxy record for sedimentary architecture. A ground investigation to recover sediment samples and characterise sedimentary properties of the deposits involved the use of different geotechnical sampling

Figure 2.4 The shell-and-auger drill rig in operation

devices. A shell-and-auger drill rig was used to recover 0.45m cores through the soft sediments and bulk samples from the underlying gravels. Electric static cone penetration tests (or CPTs) were used to examine additional data points (Fig. 2.4).

A subsequent geoarchaeological and palaeoenvironmental investigation was undertaken in 2003. This study enhanced the 2002 sub-surface deposit model and refined the understanding of the palaeoenvironmental potential of sediments and sequences preserved at the site. The opportunity was also taken to investigate historic borehole records from the British Geological Survey in order to place the information previously

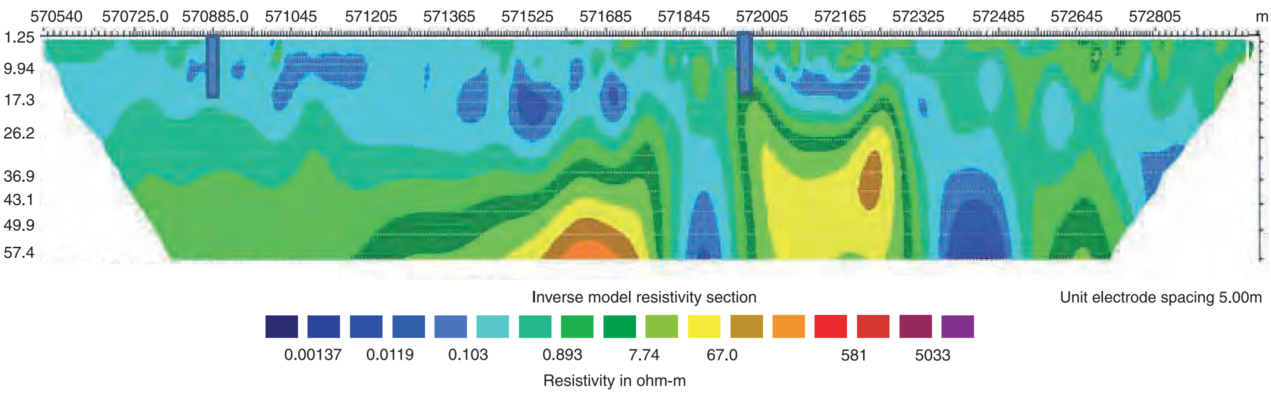

Figure 2.5 Deposit model: plot showing apparent pseudo–section and boreholes illustrating depth to base of Holocene alluvium

obtained from the detailed site investigation within a larger, sub-regional context. In addition, the study integrated the results of a sub-bottom profiling investigation undertaken by Emu Ltd on behalf of Wessex Archaeology with the data obtained from the core investigations and the additional boreholes (Emu 2003).

Further work to finalise the floodplain geoarchaeological deposit model was undertaken during 2011 (Bates *et al.* 2012). The aims of the study were to characterise key stratigraphic units and establish the vertical sequence of the sedimentary stack within the study area, link the geophysical data to the observed lithology and produce a definitive sub-surface model, define environments of deposition to key lithologies using a range of associated sub-fossil materials (foraminifera, ostracods, plant macrofossils and diatoms), and calibrate the lithological model with a series of radiocarbon dates from key stratigraphic units (Fig. 2.5). The results would allow an understanding of topographic change and associated sea-level fluctuations within the study area and links to broader patterns in the estuary to be developed. Other objectives of the study were to develop a local model for environmental change related to the evolution of the estuary's geometry and compile a series of palaeogeographic maps illustrating the physical evolution of the landscape in relation to sea level change.

The full report ('Deposit Model', Bates *et al.* 2012) is available in the digital volume.

Geophysical survey

An additional geophysical survey was undertaken in 2003 as part of a further stage of evaluation along the route of the access road and rail corridors, covering areas to the south-west of the 2002 survey (Andrews *et al.* 2003, appendix R). The fieldwork, carried out by Bartlett-Clarke Consultancy, confirmed that conditions on the gravel terrace were reasonably favourable for the magnetic detection of archaeological features. Among the more important findings was a ring ditch or barrow near to Corringham at the north-west corner of the survey area. The comparative lack of other findings from this part of the site, other than in the immediate vicinity of the ring ditch, suggested that there were unlikely to be further major concentrations of archaeological features in this area. Further to the south there are clusters of findings which could not be confirmed as archaeologically significant on the basis of the survey evidence alone, but which may have had archaeological potential.

Field artefact collection survey

In January and February 2003, OA carried out a field artefact collection or fieldwalking survey along the routes of the proposed access road and rail corridors within the development. The survey was carried out on both the gravel terrace and parts of the alluvial floodplain. The survey recovered a small quantity of worked and burnt flint, as well as one sherd of prehistoric pottery. The results suggested low potential for prehistoric settlement or activity in the vicinity. Six sherds of Roman pottery were also found, again indicating low potential in the area for Roman activity, but with no recognisable foci within the study area. The presence of medieval pottery also suggested potential for activity in that period, some of which is likely to be related to known medieval remains located during an Essex County Council Field Archaeological Unit watching brief carried out in 1999 close to Great Garlands Farm (Peachey and Dale 2005).

METHODS OF INVESTIGATION FOR PRINCIPAL MITIGATION

All methodologies were detailed in site-specific Archaeological Project Designs developed within the context of the London Gateway AMF. Investigation strategies were devised in consultation with Gill Andrews, the London Gateway Archaeological Liaison Officer and the local authority archaeological advisor, Richard Havis (Place Services, ECC) to ensure compliance with the aims and methods of the AMF.

Fieldwork was undertaken in accordance with standard OA practice (Wilkinson 1992). Archaeological trenches were excavated under the supervision of experienced archaeologists, using 360° mechanical excavators fitted with toothless ditching buckets. Topsoil, subsoil and alluvium were removed in spits of *c* 0.2m until undisturbed natural geology or the archaeological horizon was reached. The trenches were excavated to a typical depth of 1m and to a maximum depth of 3.5m, and their location recorded in relation to the site plan using a GPS. Archaeological deposits were excavated by hand. Where appropriate, environmental samples were retained for investigation. In addition, the sedimentology of the upper alluvial sequence was recorded. Standard recording sheets and registers were used. Digital photos and colour and black-and-white negative photographs were taken of archaeological features, deposits, trenches and evaluation work in general. Plans were drawn at an appropriate scale (1:50), with larger-scale plans (1:20) of features drawn as necessary. Section drawings of features were drawn at a scale of 1:10. All section drawings were located on the appropriate plans. The absolute heights (metres above OD) of all principal strata and features and the section datum lines were calculated and indicated on the drawings. Trenches were inspected by Richard Havis before being backfilled.

Northern Triangle East: habitat creation and enhancements (CONTE08)

In July 2008, a series of trial-trench excavations were carried out to the north-east of the development area at

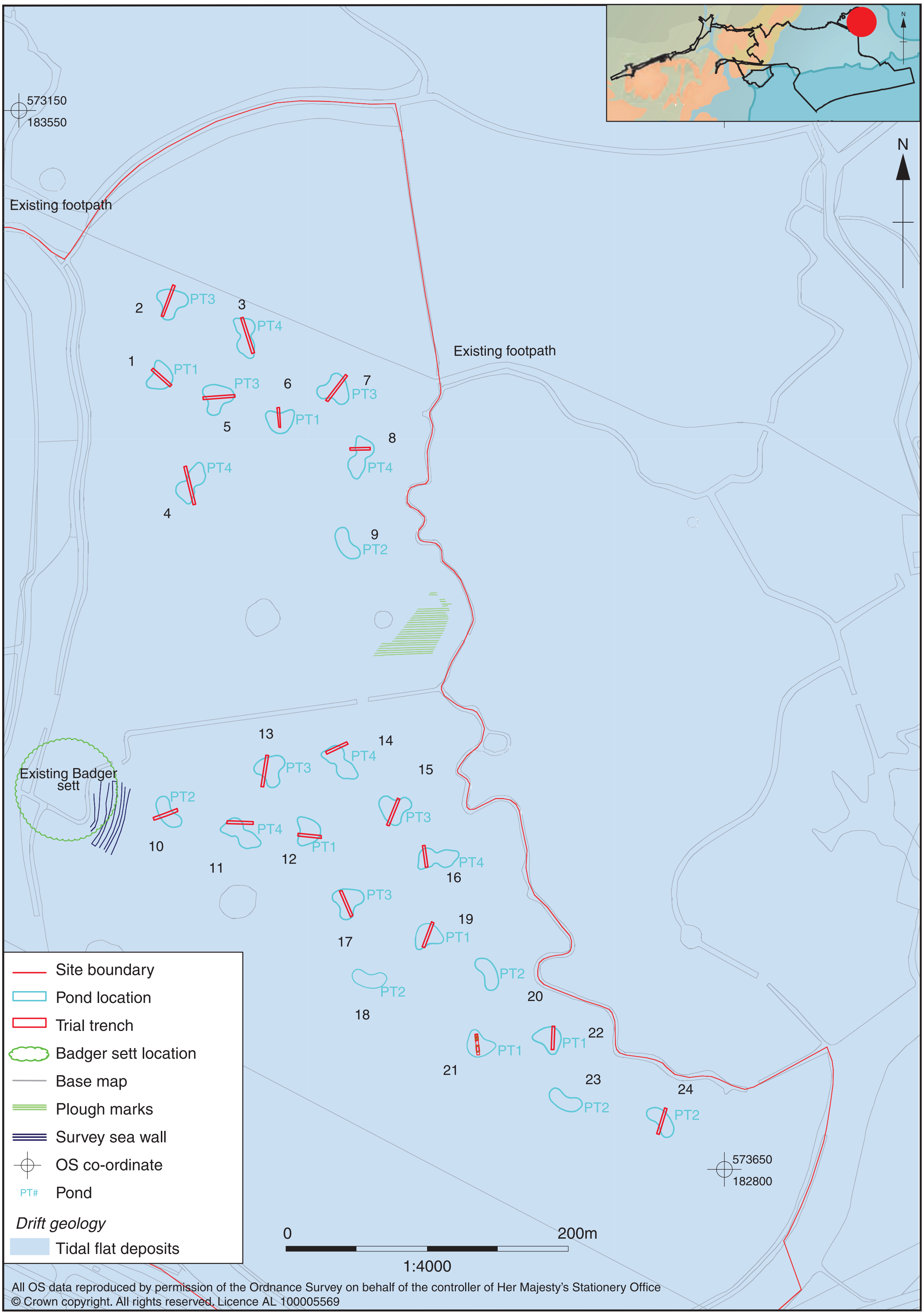

Figure 2.6 Trench location plan, Northern Triangle East

Figure 2.7 The modern sea wall constructed at Carter's Creek in the 20th century, adorned with graffiti

the Northern Triangle East site, an ecological habitat creation and enhancement area (Figs 1.2 and 2.6; TQ 733 831). The aim of the archaeological work was to assess the archaeological potential of the area and to mitigate the effects of constructing 24 ponds as well as other landscaping and planting work. Some 20 trenches were opened across an area of *c* 27ha. Prior to trenching, a rapid earthworks survey was conducted to record a representative sample of 'stetch' cultivation ridges, a type of cultivation practised in East Anglia during the 18th and 19th centuries, particularly on coastal marshes, and sea wall earthworks. The trenching revealed no below-ground archaeological remains, although two modern ditches, both extant features in the current landscape, were recorded.

Intertidal archaeological walkover survey (COMUD09)

The development involved extensive reclamation in front of the existing sea wall, using material dredged from the Thames channel to infill an area of current intertidal zone. A series of containment bunds were to be created and then infilled to the level required for the port construction. The existing sea wall was left in place and a retaining wall constructed along the seaward edge of the reclamation (Fig. 2.7). The reclamation had a very limited impact on the Holocene deposit sequence, these being confined to construction of the new wall. However, as surface finds and structures exposed along the foreshore were to be buried and potentially disturbed in the course of reclamation, surveys of the archaeological resource within the intertidal zone (TQ 730 830) were carried out. An initial survey was completed by Wessex Archaeology in 2001, with a follow-up survey, commissioned by DP World, carried out by OA in 2009.

A two-person team spent two days walking over the survey area between Mucking Creek and Vange Creek at low tide with a GPS surveying unit. Representative small finds were bagged and labelled and significant deposits surveyed. Photographic recording was undertaken throughout the survey area, including general record photographs of the foreshore at low tide. The survey was organised to make the best possible use of the spring tides within safety constraints. Consequently, areas such as Mucking Creek were investigated while the survey team waited for areas facing the sea wall and the glacis near the jetties at Thames Haven to become exposed by the lowest ebb of the spring tide. The survey identified several archaeological findspots of prehistoric, Roman and post-Roman date.

Rail Corridor (COMWR12)

The development of the DP World London Gateway Port and Logistics Park included the construction of a rail connection between the development and

Stanford-le-Hope and Mucking (Figs 1.2 and 2.8; TQ 684 816). The rail corridor for the most part follows the line of the existing Thames Haven Branch of the London, Tilbury and Southend Railway. As the ground within the existing rail corridor had been extensively disturbed by previous railway construction and ground levels were to be extensively built up within the floodplain areas of the development, few archaeological impacts were anticipated along most of the rail route. Two areas were, however, subject to archaeological mitigation: Broadhope Loop and Mucking Creek at the western end of the rail corridor, where the route was to be realigned. The Broadhope Loop (TQ 684 816) saw, in 2012, a strip, map and sample excavation, which revealed evidence of Bronze Age activity. A watching brief was maintained at Mucking Creek in the same year, with a final phase taking place in 2013 during the final stage of the realignment, during which no archaeological remains were encountered.

The largest area (Area 1, Fig. 2.8; *c* 4500m²) of the Broadhope Loop was in the central part of the site, located to the south-west of the Anglian Water Sewage Works. A smaller excavation (Area 2; *c* 157m²) took place to the south of Area 1, next to the existing railway line. The two areas were separated by the Coryton gas pipeline. Area 2 initially comprised the entire footprint of an Anglian Water access road but soil stripping was not carried out in the narrow southern strip of the strip as the density of archaeological features was very low and access along the strip had to be maintained. On the Mucking Creek section, six monitoring visits were made during groundworks, which included excavations to a depth of up to *c* 2m to install piling matts, and during a minor realignment of the banks of Mucking Creek.

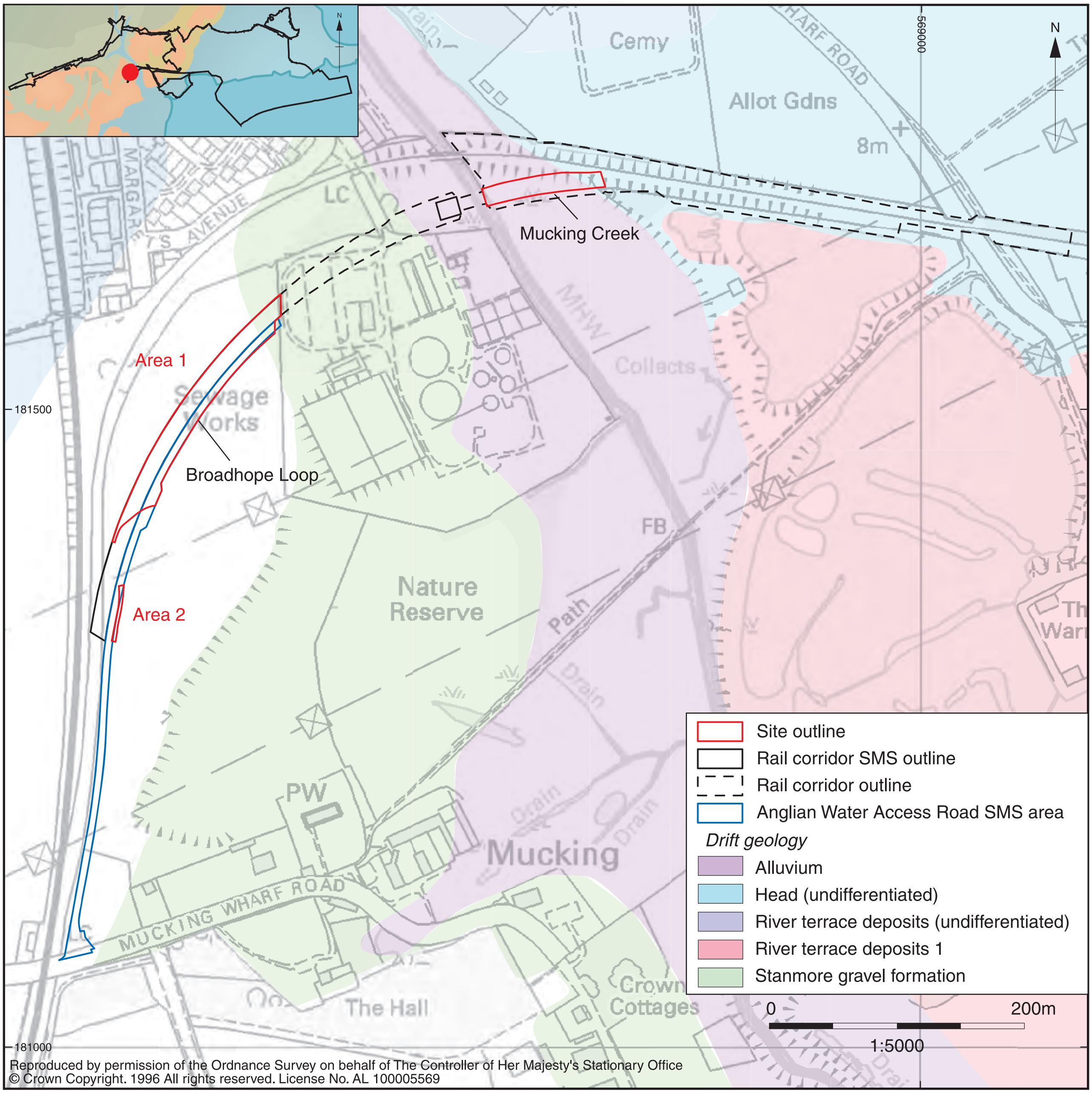

Figure 2.8 Areas of investigation, Rail Corridor

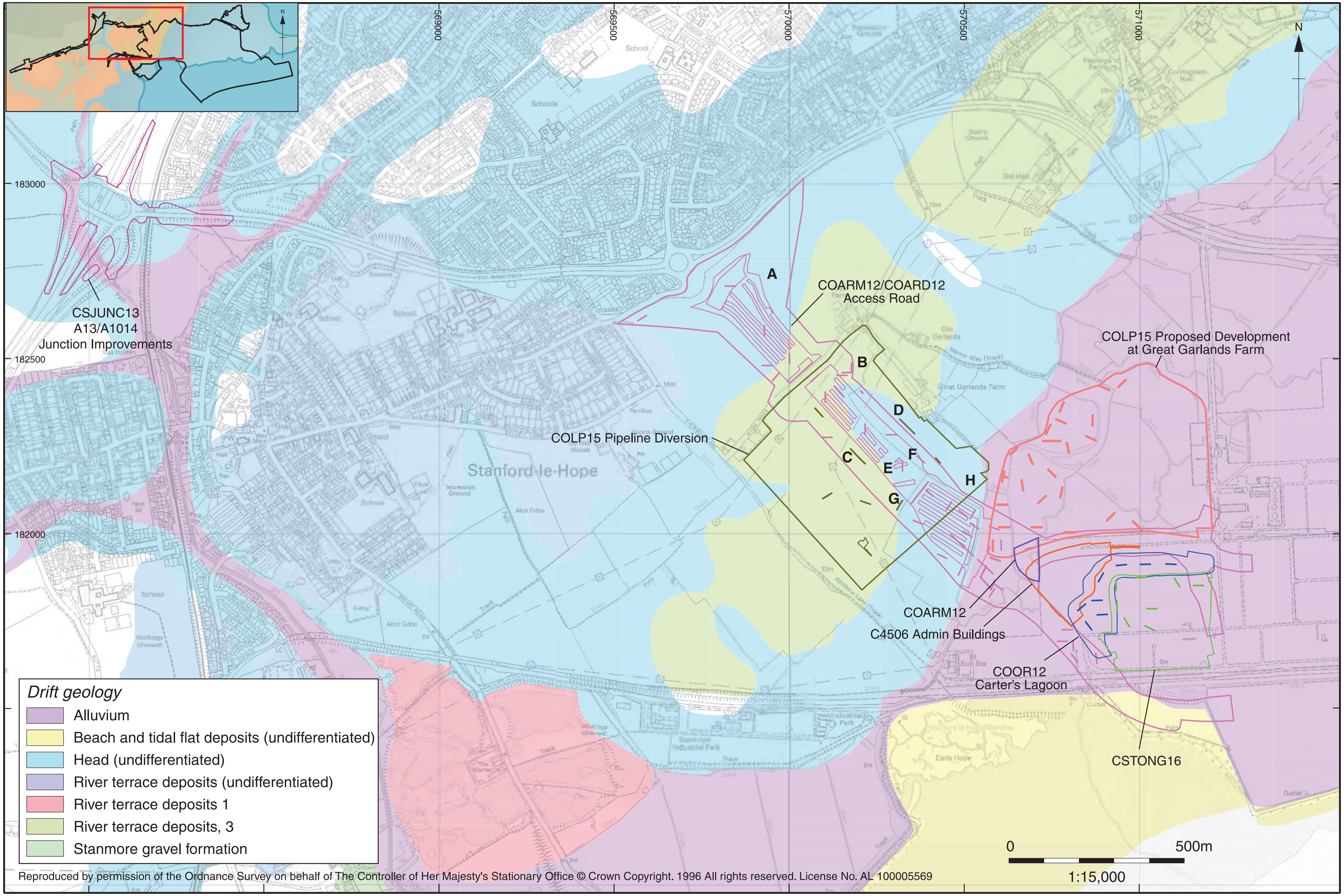

Figure 2.9 Areas of investigation, Access Road, Carter's Lagoon, A13/A1014 Junction Improvements, Logistics Park: Proposed Development at Great Garlands Farm and Pipeline Diversion, Logistics Park: Proposed Tongue Land HGV Lorry Park and Admin Building

Access Road (COARD12)

The development included the construction of an access road, a dual carriageway designed to link the container port and commercial park with Sorrell's Roundabout on the A1014 Manorway (TQ 7650 7850). Construction was completed in three stages, Phase 1 being the formation of a large embankment in the low-lying south-east section of the road which crossed the Thames floodplain, Phase 2 being the construction of the south-east section of the road on top of the Phase 1 embankment, and Phase 3 being the construction of the north-western section of the road across the higher ground from the Thames terrace edge to the A1014/Manorway road junction. Archaeological mitigation, carried out in 2012, was required for Phases 1 and 3 only. Phase 1 mitigation comprised the excavation of two trenches and five test pits. Phase 3 mitigation comprised a strip, map and sample excavation, with additional areas of targeted excavation (Fig. 2.9). No archaeological evidence was recovered during the Phase 1 work, but the Phase 3 stripping revealed evidence for prehistoric, medieval and post-medieval period activity.

Phase 1 mitigation was designed to investigate the archaeological potential of deep alluvial deposits and the interface zone between the river terrace and alluvial floodplain at the south-eastern end of the route. A continuous trench was excavated around the western end of the Access Road preliminary earthworks, with provision to expand the area if significant archaeology was found. In the event, this was reduced in scope once it was realised that the deposits had limited potential. Test pits were dug to assess the depth of the Holocene alluvial deposits as far as practicable and search for buried structures and land surfaces within the upper alluvium. A section of the historic sea wall, preserved as an earthwork, was surveyed and removed in an archaeologically controlled excavation. This involved excavating a 21.5m-long trench across the sea wall.

The Phase 3 strip, map and sample mitigation area was divided into Areas A–H, based on the divisions created by exclusion corridors around services and hedgerows; safety margins *c* 20m wide were left on either side of existing services, and 5m margins on either side of extant hedgerows for ecological reasons – most of these areas were subsequently monitored under watching brief conditions during the construction earthworks. Area A lay at the north-western end of the route and Area H at the south-eastern end (Fig. 2.10). Areas D and F were not in the event stripped and Area E contained no archaeological features. An amendment to the written scheme of investigation allowed the excavation to be limited to a series of 10m wide strips, leaving unexcavated strips for spoil storage in between. In addition to the strip, map and sample excavation, two areas of known archaeological interest were subject to targeted investigation and recording during construction works. These included sections through the High Road (following removal of the existing tarmac road surface) and through a hedgerow marking the boundary

Figure 2.10 Removing the topsoil across Area A on the Access Road

Figure 2.11 Separator pit under excavation, Welfare and Workshop Building drainage

between the Thames terrace edge and floodplain, following ecological mitigation.

Welfare and Workshop Building Drainage Works (COOR12)

In 2013, monitoring was carried out during the installation of drainage infrastructure associated with development of a welfare and workshop building (TQ 73800 81750). While it had been expected that the development would, for the most part, affect only recent made-ground deposits, monitoring was required during the excavation of a deeply buried separator tank which reached the Holocene alluvium underlying the modern layers (Fig. 2.11). The investigation recorded undisturbed alluvium at a depth of *c* 2.5m below ground level (*c* -0.5m OD). No archaeological remains were identified.

DP World London Gateway Port Gate Complex (COOR12)

The excavation in 2013 by Murphy Group of a series of deep excavations during installation of drainage for the London Gateway Port Gate Complex (TQ 7140 8150)

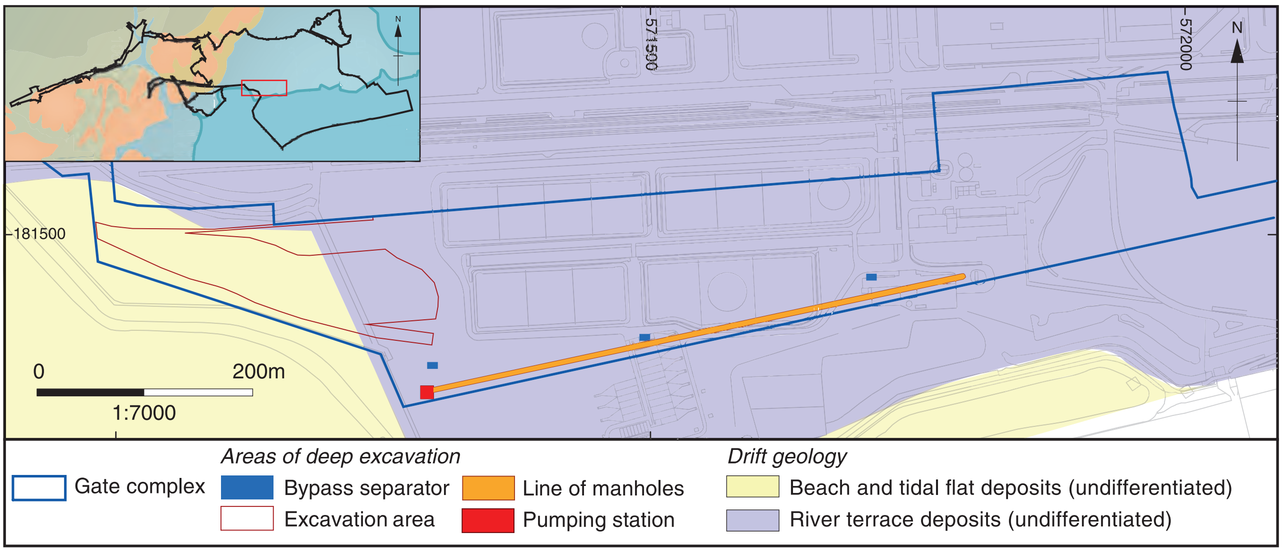

Figure 2.12 Area of archaeological monitoring, Port Gate Complex

Figure 2.13 Monitoring deep drainage excavations at DP World London Gateway Port Gate Complex

was subject to archaeological monitoring. This targeted drainage features – a pumping station, a series of separator pits and a deep pipe trench with manholes at intervals, all located at the western end of the Gate Complex – that would penetrate the alluvial deposits (Figs 2.12–14). No archaeological remains were discovered during the work, which recorded alluvium at variable depths and, in the case of the deepest separator pit, reached the (pre-refinery) marshland ground level below the alluvium at a depth of *c* -1.7m OD.

Carter's Lagoon, DP World London Gateway Logistics Park (COOR12)

An archaeological evaluation was carried out on the site of a drainage lagoon at the DP World London Gateway Logistics Park (Fig. 2.9; TQ 70900, 81900). The trenching was undertaken in two phases, during January 2013 and May 2014. The lagoon is located within an area historically known as 'the Tongue Land'. Eight evaluation trenches were opened, with deep test pits dug within seven of them. No significant archaeological remains were present within the evaluation trenches, all structures and artefacts encountered being of modern date and associated with the former Shell Haven oil refinery.

Cable Connection from DP World London Gateway to Coryton Power Station, Shellhaven Creek Crossing (COOR12)

In September 2012, archaeological monitoring was carried out during the installation of a 33kv electric cable connection between DP World London Gateway Logistics Park and Coryton Power Station, Corringham, Essex (TQ 73900 82200). An impact assessment had previously established that the cable trench and associated infrastructure would, for the most part, be excavated within the depth of modern made ground. Monitoring was required, however, where the cable trench crossed Shellhaven Creek. At this location the absence of made ground meant that the trench penetrated the uppermost layers of Thames floodplain alluvium infilling the channel of the creek, where there was some potential for encountering marine or marshland archaeological sites. Holocene alluvial deposits were observed to the limit of excavation, *c* 1.7m below ground level. No archaeological remains were identified during the works.

Salt Fleet Flats, Cooling Marshes, Kent (CSCOX13)

A trial-trench evaluation was carried out in 2013 on reclaimed marshland within the alluvial floodplain of

Figure 2.14 Deep drainage excavations in progress at DP World London Gateway Port Gate Complex

Figure 2.15 An evaluation trench exposing alluvial deposits at Salt Fleet Flats, Cooling Marshes

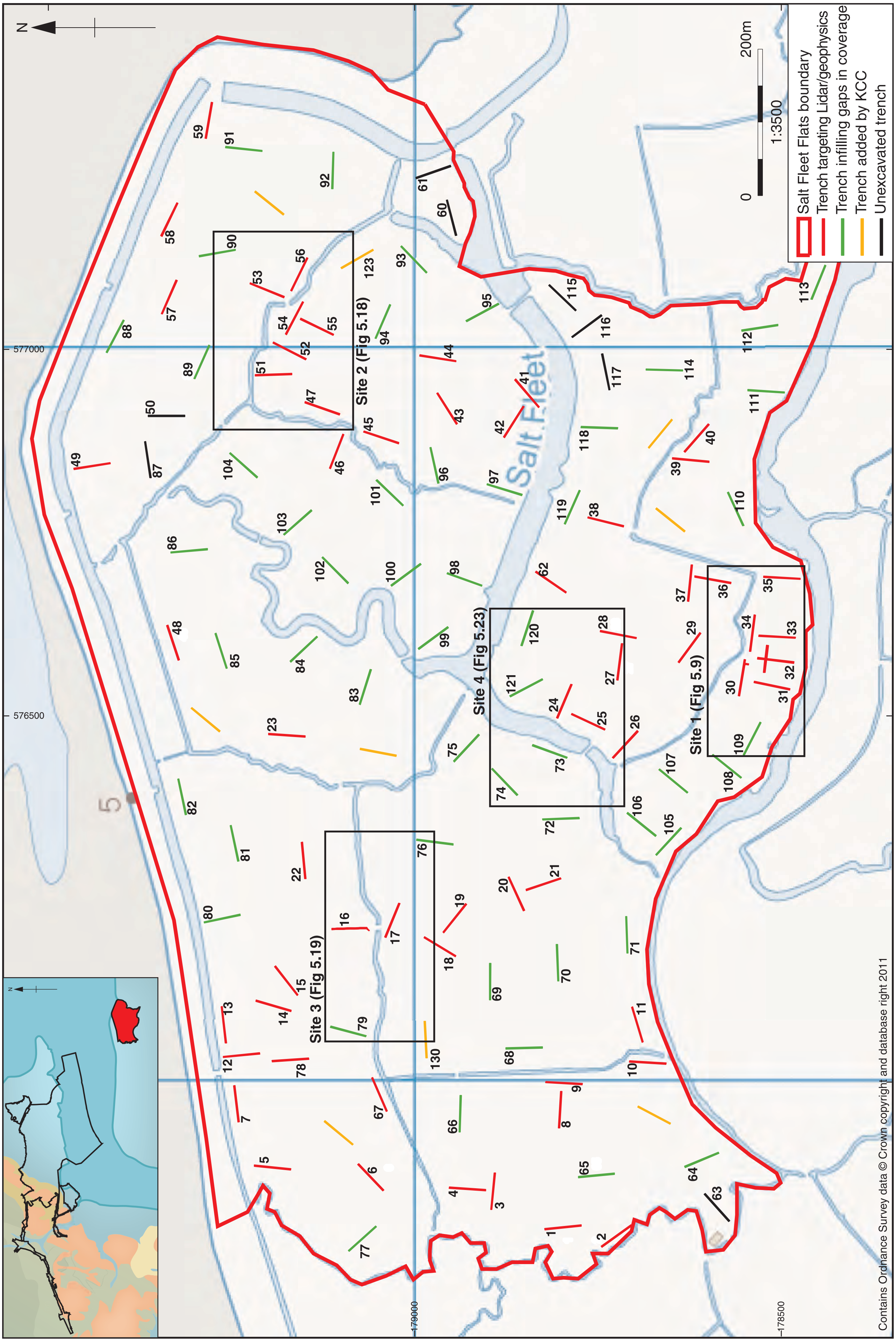

Figure 2.16 Trench location plan, Salt Fleet Flats, Cooling Marshes

the River Thames in the parishes of Cooling and High Halstow on the Hoo Peninsula in Kent (Fig. 2.15; TQ 7650 7850). The purpose of the fieldwork at Salt Fleet Flats (formerly known as Site X) was to assess the archaeological potential of the site and identify any constraints on the creation of a new mudflat, which was to be developed as a replacement habitat for wildlife. A 1% sample of the site by area (130 trenches, each 50m x 2m in plan) was proposed. In the event, 122 trenches were excavated, of which 61 were located to investigate specific targets (Fig. 2.16). These included magnetic anomalies identified by geophysical survey, possible earthwork features identified by Lidar survey and various features identified from aerial photographs or historic maps. The remaining 61 trenches were distributed to fill gaps in coverage. Eight trenches could not be excavated owing to various access constraints, including the presence of protected nesting birds, the placement of the temporary compound and difficulties in crossing a creek with the mechanical excavator. Four areas (sites 1-4) representing concentrations of archaeological features were identified.

The depth of investigation was limited to the depth of impact arising from the proposed development, which was generally expected to be *c* 0.5m, with the possibility of localised deeper excavations up to 1m deep. As flooding of trenches was expected to be a problem during excavation, trenches containing no archaeology were backfilled as soon as recording was complete.

A13/A1014 Junction Improvements (CSJUNC13)

In 2013, the excavation of a drainage pond was monitored (TQ 68050, 82750) during improvements to the existing A13/A1014 road junction (Fig. 2.9). The pond was located in the Hassenbrook stream valley in a relatively undisturbed area of ground between the main westbound carriageway of the A13 and the A1014 slip-road. Desk-based assessment had highlighted previous discoveries of significant Roman remains from the area in the mid-1930s and the early 1970s. As the works generally involved building up the ground levels within the existing road boundary, excavation of the 3m-deep pond was identified as the only construction activity with the potential to affect archaeological deposits. In the event, no archaeological remains were discovered during the monitoring work.

Logistics Park Infrastructure (COOR14)

A trial-trench investigation was undertaken in connection with the DP World London Gateway Logistics Park Infrastructure development (Figs 2.17 and 2.18; TQ 71800 81940), which involved the raising of ground levels by at least *c* 1.7m and the creation of an access road from the A1014 Manorway, associated drainage and services, and contractors' compounds and stockpile areas. The drainage works covered included

Figure 2.17 A trench exposing thick alluvial deposits during the evaluation at the Logistics Park Infrastructure site

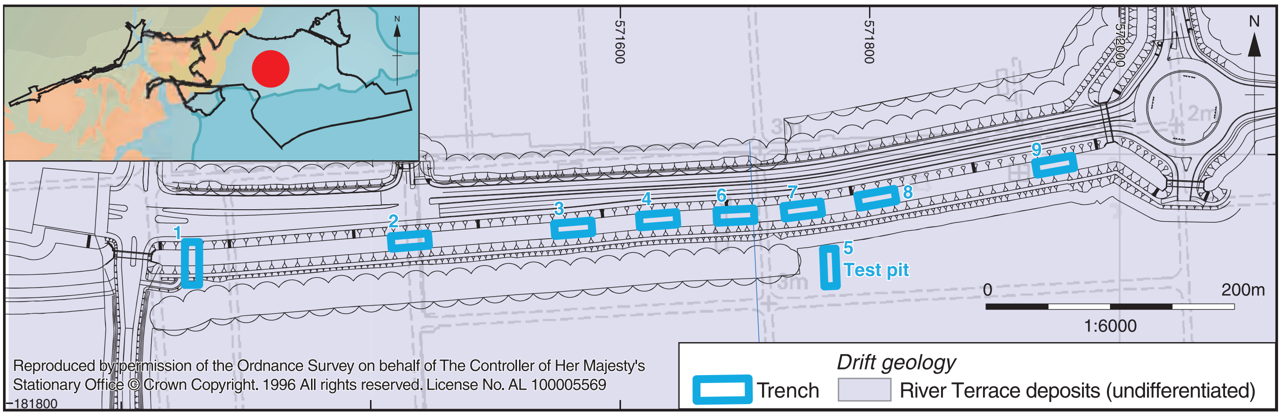

Figure 2.18 Trench location plan, Logistics Park Infrastructure

the excavation of large swales and ponds alongside the access road route. The trenches were focused predominantly along the line of a drainage swale, in the vicinity of a possible Roman salt-working site that was reportedly found during development of the former oil refinery in the 1960s. The investigation of nine trenches, excavated to a target depth of 0m OD, and one test pit, dug within Trench 5 to a depth of -3.9m aOD to investigate the potential saltern evidence, was completed in February 2014. The trenches encountered alluvial deposits but no evidence of any archaeological features or finds.

Pipeline Diversion (COLP15)

A trial-trench evaluation was undertaken in 2015 within the site of a gas pipeline diversion (operated by the Coryton Energy Company Ltd, CECL), which crossed the Port and Park Access Road and lay in an area of historic farmland at Great Garlands Farm to the west of the port (Fig. 2.9; TQ 70200, 82100). The investigation comprised 11 evaluation trenches, which revealed two concentrations of prehistoric and Roman-period archaeology. The relevant trenches were expanded to form small excavation areas in order to clarify the extent of the remains. The excavation areas were designated Sites A and B.

Logistics Park: Proposed Development at Great Garlands Farm (COLP15)

An archaeological evaluation was carried out at the site of a proposed development site adjacent to the port (Fig. 2.9; TQ 70887 82261). The site lies within historic farmland at Great Garlands. Twenty-one trenches were opened in 2015, of which two revealed archaeological evidence including the remains of a 16th/17th-century timber wharf structure. It should be noted that the upper part of the soil sequence only – that is, the top 1m – was investigated, as only this part would be affected by the development. However, there remains a potential for archaeological evidence to exist below this depth. The eastern areas of the site, subject to ground-raising, were not included in the trenching scope.

Logistics Park: Proposed Tongue Land HGV Lorry Park (CSTONG16)

This site was located within a *c* 7.7 hectare-area traditionally known as the Tongue Land (Fig. 2.9; TQ 7110 8190). It lay close to Great Garlands Farm, which was visible on the rising ground to the west of the site but is now largely screened from view by the Port and Park Access Road. The archaeological mitigation was carried out in 2016 and comprised the excavation of eight evaluation trenches. The only structures and artefacts encountered were of modern date and associated with the former Shell Haven oil refinery.

Admin Building Works, Contract C4506

A trial-trench investigation was carried out in March 2012 as part of the mitigation associated with ground-raising for the DP World London Gateway Admin Building and adjacent Access Road preliminary earthworks. Previous trenching and surveys had revealed very little in the floodplain section of the Access Road that adjoined the Admin Building plot. Nevertheless, the archaeological sensitivity of the interface zone between the terrace edge and the alluvial floodplain meant that further investigation was required. The trenching, designed to investigate the impacts from band drainage within the sensitive terrace edge zone, extended around the western end of the Access Road preliminary earthworks. A single trench was excavated to a typical depth of 1m, while a series of four deep inspection holes were excavated to a maximum depth of 3m (Fig. 2.9). The deposit sequence consisted of relatively homogeneous silty clay alluvium and the underlying terrace gravel was not encountered in any of the deep inspection pits. A localised peat horizon, representing a vegetated marsh surface buried by later alluvium, was identified at a depth of 2.50m in association with two sherds of flint-tempered, hand-made pottery of probable Bronze Age date.