Chapter 3

The Mesolithic period to the Iron Age

INTRODUCTION

The period from the end of the Ice Age to the end of the prehistoric period saw fundamental transformations in the landscape of the DP World London Gateway area and the ways in which it was occupied and exploited. Evidence for activity at London Gateway preceding the middle Bronze Age is, however, provided only by a very sparse scatter of worked flint (Fig. 3.2). The paucity of evidence for activity in this earlier prehistoric period may be partly explained by the way in which the landscape was transformed. The evolution of the landscape is outlined in more detail below, but in simple terms, the gradual rise in sea level, the migration inland of the channel edge, and the accumulation of sediments are likely to have buried evidence for activity in this early prehistoric period at depths which were not generally reached by the excavations.

Much more extensive evidence was, however, found for activity in the middle and late Bronze Age (Fig. 3.3). This evidence was distributed predominantly on the higher ground of the gravel terraces and consisted of ditches which might represent the fragmentary remains of field systems, as well as pits associated with fired clay, briquetage and, in one case, a small group of charred flax seeds. Lying between 2km and 3km from Mucking, this evidence provides a picture of the wider context of the middle and late Bronze Age activity previously excavated there, notably for the late Bronze Age ringworks.

The most important middle and late Bronze Age finds were concentrated in the area covered by the Access Road and the surrounding trenches of the Pipeline Diversion. The trenches from the pipeline site lay on either side of the Access Road site, and it is useful to describe the two sites together (see Fig. 3.6). The dating of the ditches on these sites is, in some cases, uncertain, but the pottery recovered from them suggests that, if they did form field systems, they were initially laid out in the south during the middle Bronze Age but remained in use in the late Bronze Age, when they may have been extended to the north.

A small number of pits, either isolated or in small groups, were found scattered in and around the area covered by the field systems. The late Bronze Age pits and ditches often contained briquetage and fired clay derived from ovens or hearths, which indicates that the sites were related to salt production. One of the isolated middle Bronze Age pits also contained a group of fired clay pedestals, but there is no clear evidence that they were also related to salt-making.

A second small concentration of features consisting of ditches and a small number of pits were found on the Rail Corridor, some distance west of the Pipeline Diversion and Access Road sites (Fig. 3.4). All the features in this area were dated to the middle Bronze Age. The excavated area is too small to show whether or not the ditches formed part of a field system, and the most significant finds came from the pits, one of which contained a pot from which a group of charred flax seeds were recovered.

The only evidence for later activity was provided by five probable middle Iron Age sherds which were recovered from a ditch that also contained late Bronze Age and late Bronze Age–early Iron Age pottery on the Access Road site.

LANDSCAPE EVOLUTION DURING THE PREHISTORIC PERIOD

Evidence for the evolution of the landscape since the last Ice Age in the vicinity of DP World London Gateway predominantly derives from geoarchaeological deposit-modelling and palaeoenvironmental investigations of the reclaimed floodplain of the Thames at the main port site (Bates *et al.* 2012) and the floodplain/terrace edge at Stanford Wharf Nature Reserve (Biddulph *et al.* 2012a). This work is set within the context of an extensive body of quaternary and archaeological research for the wider area (summarised in Williams and Brown 1999 and Heppell 2010), not least the seminal work of Devoy (1979), whose study sites spanned the Thames at both Tilbury in Essex and the Cliffe Marshes in Kent.

Immediately following the last glacial maximum (after *c* 16,000 years BP; Ashton 2017, 241), the landscape around London Gateway would have been very different to what we see today. Regional research has shown that although the climate was gradually warming there was a series of dramatic oscillations where temperatures periodically dropped again to arctic conditions. Sea levels were still considerably lower than they are today, with much water still locked up in the northern icecaps. During this period, Britain was still joined to the Continent, forming a peninsular of northern Europe, and the Thames was a freshwater tributary of the River Rhine (Gibbard 2007, fig. 1). At London Gateway, the main Thames channel occupied the lower-lying ground beneath the now-reclaimed floodplain of the port site. Aggradation occurred in high-energy fast-flowing braided channels which formed a network of transient

streams with sand and gravel bars. On the higher ground overlooking the floodplain at Stanford Wharf Nature Reserve and beyond, erosion from harsh winds and seasonal meltwater under cold-climate periglacial conditions is likely to have occurred across a sparsely vegetated and unstable ground surface. Previous studies have demonstrated that in the harsher tundra-like conditions the vegetation is likely to have comprised dwarf birch, juniper and other low-growing arctic shrubs. 'Sub-arctic meadow' vegetation probably grew in moister areas, with sedges in cut-off channels on the floodplain. Scots pine and perhaps birch grew in stunted clumps in sheltered localities on the valley sides. Associated seasonal fauna may have included reindeer, wild horse, wolverine, and steppe pika. In contrast, warmer periods were characterised by the spread of alder, birch, willow and hazel woodland, with associated fauna including lynx, beaver and aurochs (Morigi *et al.* 2011, 140–3).

At the beginning of the Holocene (*c* 12,000 years BP), climatic conditions began to improve significantly. With a reduction in the flow of seasonal meltwaters, the Thames during this period transitioned into an anastomosing form with fewer active channels, eventually stabilising flow through a main channel. The area of the main port site was likely to be largely dry ground, with a varied relief formed by abandoned channels and sand bars of the relict braided stream system. The deposit-modelling and palaeoenvironmental work on borehole cores for the port site suggest that deposition of organic freshwater sediments occurred in lower-lying areas, which included a localised basin that may have formed an open body of water such as a small lake. Age estimates for the onset of organic sedimentation date from *c* 8000 cal BC at *c* -11.5m OD (Bates *et al.* 2012). The higher, drier ground would have provided additional landscape resources within different environments. Typically for the region an initial phase of birch and pine woodland seems to have been superseded by the mid-Holocene with the development of lime, oak, elm, hazel and alder (Scaife 2000, 111). Lime appears to have been of particular importance prior to the later prehistoric period and may have been growing in damp woodland as well as on the better-drained terraces (ibid.).

However, following a period of increased wetness and flooding owing to rising river levels, from *c* 6500 cal BC the basin was beginning to be influenced by brackish water incursion. The port site was gradually inundated, resulting in the deposition of a complex sequence of intercalated organic and minerogenic sediments. Dry ground areas were reduced first to a series of interconnected ridges and then islands, as tidal mudflats, creeks and salt marshes began to dominate the landscape. High-energy conditions associated with strong tidal regimes were present to the east, typified by the deposition of laminated clays, silts and sand. By the beginning of the Neolithic, almost all former dry ground is likely to have disappeared, buried beneath extensive deposits of intertidal sediment, in some places reaching up to 15m in thickness. These deposits continued to form until the area was reclaimed for agricultural use in the 17th century AD.

Pollen assemblages from the port site indicate the presence of woodland locally during the mid to late Holocene; this consisted principally of oak with elm and hazel, probably on the higher, drier areas, and lime and alder on wetter substrates. Significant diversity was suggested in the floodplain environments, consisting of shifting zones occupied by mudflats, salt marsh with tidal creeks, freshwater marsh and fen. Freshwater influence was noted in areas of higher ground, particularly along the inland edge between *c* 6000–2500 cal BC, and associated with short-lived episodes of peat accumulation. The plant remains assemblages included rhizomes of *Phragmites australis* (common reed) together with some seeds from plants which today grow in wet, freshwater habitats: lesser spearwort (*Ranunculus flammula*) and gipsywort (*Lycopus europaeus*). Although seeds from salt marsh goosefoot (*Chenopodium* cf. *chenopodioides*) suggest localised areas of brackish mudflats, seeds from plants such as sedges (*Carex* sp.), fennel pondweed (*Potamogeton* cf. *pectinatus*) and fat-hen (*Chenopodium album* L.) indicate wet meadows and marshy land.

The site of Stanford Wharf Nature Reserve straddles the edge of the floodplain and the higher terraces to the west of the main port development, adjacent to the current course of Mucking Creek (Biddulph *et al.* 2012a). The Holocene sequences here were much shallower. The area, though adjacent to a large palaeochannel that bisected the site from east to west, remained relatively dry land until the mid to late Holocene. The channel appears to have been active from at least *c* 5000 cal BC, providing a focus for human activity at the terrace edge. Although the majority of the archaeological evidence dated to the Roman period and was associated with salt production and other activities, evidence of prehistoric activity in the form of flint scatters was also recovered at the base of the sequence, associated with a possible buried land surface. Evidence from ostracod, foraminifera and diatom assemblages indicates that the channel was surrounded by extensive tidal mudflats backed by salt marsh. Initially it was prone to strong tidal influences and surges, but this influence diminished over time probably owing to silting. On the higher, drier ground the pollen assemblages suggested that deciduous woodland was present, with areas of grassland/pasture and heathland. However, OSL dating suggests that by *c* 700 cal BC deposition of salt marsh sediments had begun to encroach onto higher ground beyond the channel.

Very little significant environmental change was detected during the Roman and later periods and it appears that salt marsh and tidal creek environments prevailed until documentary and cartographic sources show that the land was reclaimed in the 17th century (Rippon 2012).

THE WIDER CONTEXT OF THE DP WORLD LONDON GATEWAY SITES

The area immediately around DP World London Gateway, and south Essex, north Kent and east London more broadly, are rich in prehistoric sites and finds

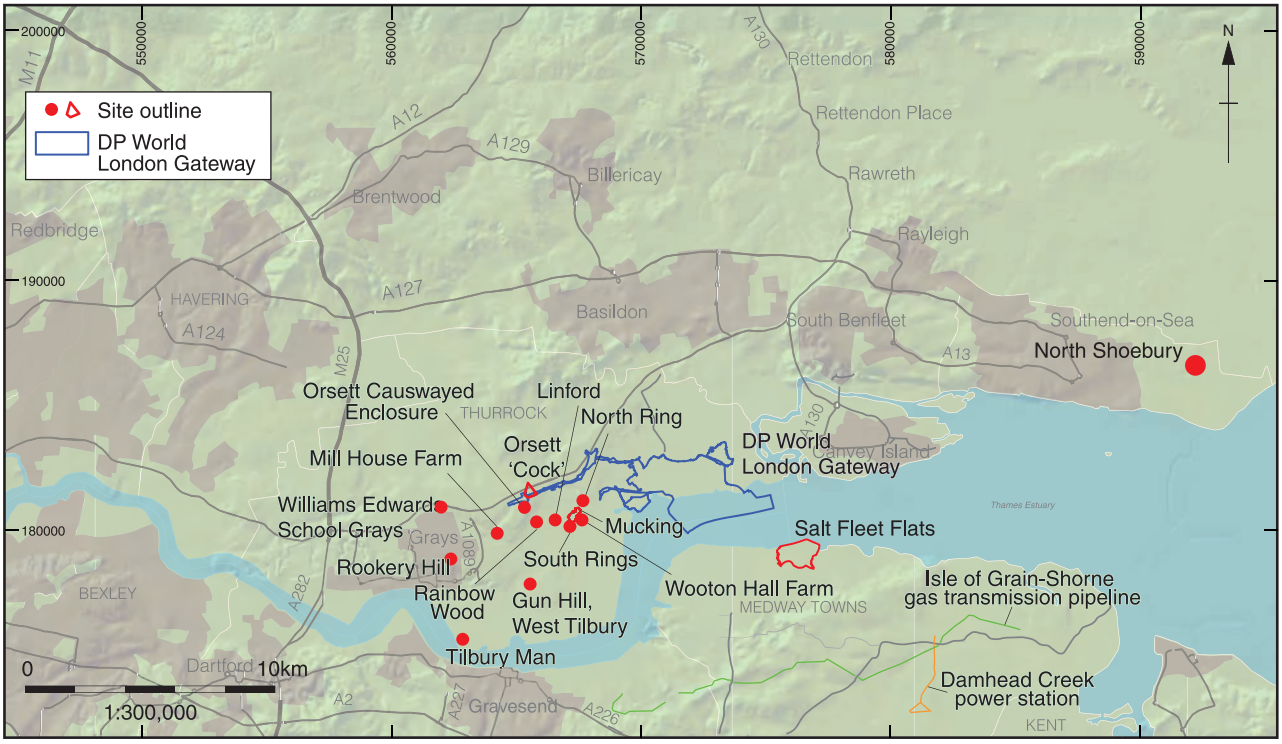

Figure 3.1 Location of prehistoric sites near to DP World London Gateway discussed in the text

(Glazebrook 1997; Medlycott 2011; Bedwin 1996; Williams and Brown 1999; Heppell 2010; Williams 2007; Ashbee 2005; Museum of London 2000). It would be impossible to mention all of them here and this section will, therefore, focus on the most significant prehistoric finds in and around Thurrock on the northern side of the estuary, which lie in the immediate surroundings of London Gateway.

Within this area (Fig. 3.1), the most significant archaeological investigations are those at Mucking, where intensive, large-scale excavations revealed a rich archaeological landscape with evidence from almost all of the conventional divisions of prehistory from the Mesolithic period onwards (Evans *et al.* 2015; Bond 1988; Clark 1993). Significant excavations have also recently taken place at Mill House Farm, to the east of Chadwell St Mary (Newton forthcoming). The investigations at Stanford Wharf Nature Reserve, although adjacent to the sites considered here, provided only limited evidence for prehistoric activity before the middle Iron Age (Biddulph *et al.* 2012a). A number of smaller excavations – at Orsett (Rodwell 1974; Hedges and Buckley 1978; Couchman 1979; Milton 1987), along the Grays Bypass (Wilkinson 1988) and at Linford, West Tilbury (Drury and Rodwell 1973), as well as more localised finds (eg Barford 1984; Turner 1998; Tripp 2018) and evidence from aerial photographs (eg Ingle and Saunders 2011), also enrich our picture of the local archaeology.

The Mesolithic period

The extensive excavations at Mucking found little evidence for Mesolithic activity. Two features which Evans *et al.* (2015, chap. 2) suggest may have been natural were assigned to the period, but otherwise activity in this period is evidenced only by a quite small assemblage of worked flint (including microliths and a tranchet axe). Even sparser evidence was recovered from Chadwell St Mary and Stanford Wharf Nature Reserve. Although small quantities of flint which might be Mesolithic were recovered at both sites, the only piece that can be dated to the Mesolithic with any confidence was a microburin from Chadwell St Mary. The other local excavations do not add much to this picture. The few finds include microliths from William Edwards School, Stifford Clay Road, Grays (Lavender 1998) and possibly Mesolithic flint from Gun Hill, Tilbury. A review of Sites and Monuments records in relation to the Grays Bypass excavations found only six potentially Mesolithic findspots (Wilkinson 1988, 115).

The paucity of Mesolithic material may well reflect the fact that, because of the rise in sea level, sites of this period lie either below the present-day estuary (from which Mesolithic finds have been recovered) or are covered by deep deposits of alluvium and peat. A striking demonstration of this is provided by the skeleton of Tilbury Man. This late Mesolithic skeleton, dated to 6070–5910 cal BC, was found during the construction of new docks in 1883 at a depth of 10.5m in a sand layer which lay below a sequence of peats and estuarine silts and clays (Schulting 2013).

Much denser scatters of Mesolithic flint have, nonetheless, been recovered from a number of sites not far away, such as Tank Hill, Purfleet (Leivers *et al.* 2007) and the Beam Washlands Reservoir, Dagenham (Champness *et al.* 2016), and these sites show that what is now the edge of the floodplain was occupied

throughout the Mesolithic. Similar finds have been made on the southern side of the Thames at Erith (Bennell 1998) and in the Ebbsfleet valley (Wenban Smith *et al*. 2020). The paucity of Mesolithic finds on higher ground (such as the gravel terraces), where they are more likely to have been found as a result of excavation, may, then, reflect the fact that occupation in the Mesolithic was focused on lower ground nearer to the developing estuary.

The Neolithic period

As some of the later Bronze Age finds from the London Gateway sites show, later sites may also remain hidden below alluvial deposits, but from the Neolithic onwards, the quantity of evidence increases. At Mucking two clusters of finds, including Decorated Bowl pottery (or Mildenhall Ware), were related to activity during the later part of the early Neolithic period and a cluster of 12 late Neolithic pits was associated with Grooved Ware. The Orsett causewayed enclosure (Hedges and Buckley 1978) was also associated with Decorated Bowl pottery and is likely to have been broadly contemporary with the early Neolithic pits at Mucking. Further probable Neolithic flint has been found at the Orsett Cock site (Carter 1998) and near an unusual 'cello-shaped' cropmark near Orsett (Couchman 1979). Apart from a rim which might be Grooved Ware found at Stifford Clays (Wilkinson 1988), the other evidence for activity in the Neolithic is limited to (often residual) worked flint which often cannot be precisely dated (eg Newton forthcoming). The most notable finds include leaf-shaped arrowheads found at Gun Hill (Drury and Rodwell 1973) and at Ardale School (Wilkinson 1988) which, although they can be later in date (Green 1980), suggest further early Neolithic activity. A transverse arrowhead, suggesting activity later in the Neolithic period, was also found at the latter site. These sites lie some distance to the west of London Gateway, but it is worth noting that Neolithic flint has also been found much closer at Rookery Hill, Stanford-le-Hope (Drury 1973).

The Beaker period and the early Bronze Age

Evidence for activity in the Beaker period and the early Bronze Age is not much more extensive than that for the Neolithic period. At Mucking, four clusters of finds representing late Neolithic/early Bronze Age activity were identified, two of them including burials associated with Beakers and barbed and tanged arrowheads (Evans *et al*. 2015, chap. 2). In both burials, traces of wooden coffins could be made out. A pit which contained three complete Beakers at the Orsett Cock site has also been interpreted as possibly having been a similar burial (Milton 1984–5). Early Bronze Age pottery was notably scarce at Mucking, but it is possible that some of the ring ditches there date from that period, although they were all small and it seems likely that many of them date from the middle Bronze Age (Garwood 2007). The same may well be true of the small ring ditches identified as cropmarks, distributed around the London Gateway sites (see Fig. 3.6). At Chadwell St Mary, a single pit containing Beaker pottery provided the only evidence for activity in this period.

The later Bronze Age

As at London Gateway, the first extensive evidence for occupation in Thurrock dates from the later Bronze Age. Alongside the ring ditches at Mucking (Evans *et al*. 2015, chap. 2), a small ring ditch at the Orsett Cock site (Milton 1987; Rodwell 1974) associated with cremated bone (which was recovered from both the ditch and two of the five small pits within it) provides an example of middle Bronze Age burial practices. As noted above, cropmarks in the area around the London Gateway sites reveal the presence of a number of further small ring ditches (Fig. 3.6). Without excavation, their date and original function is unknown, but it is plausible that many of them were middle Bronze Age funerary monuments.

Alongside this potentially extensive evidence for middle Bronze Age burial there is also widespread evidence similar to that at London Gateway for the setting out of field systems and for the cutting of pits in the middle and late Bronze Age. The most striking evidence, however, dating from the later part of the late Bronze Age, is the construction of ringworks, represented by the North Ring and the South Rings at Mucking, an example at Chadwell St Mary and also perhaps by cropmarks elsewhere.

The field system at Mucking has been broadly dated to the middle Bronze Age, although it may have been extended during the late Bronze Age (Evans *et al*. 2015, chap. 2). At Chadwell St Mary several phases of trackways and enclosures were found, all dating to the late Bronze Age (Newton forthcoming). Further evidence for field systems has been found at Linford (Yates 2001, fig. 7.5, table 7.4; Barton 1962, 61), Gun Hill, Tilbury (Drury and Rodwell 1973), and Baker Street, Orsett (Wilkinson 1988, 13–16; see also Yates 2007, chap. 3 and Evans *et al.* 2015, fig. 3.39 for the wider distribution of field systems in south Essex and north Kent).

At Mucking, a total of 46 pits and four postholes were also attributed to the middle Bronze Age (Evans *et al*. 2015, chap. 2) and a larger number of pits and post-built roundhouses, distributed mainly around the South Rings and in a separate area to the north, were dated to the late Bronze Age. Numerous clusters of late Bronze Age postholes and pits were found at Chadwell St Mary (Newton forthcoming). Few of these features could be related to clear structures, although a few four-post structures and possible roundhouses were identified. Pits associated with cylindrical pedestals (or loomweights) have also been found at Baker Street, Orsett (Wilkinson 1988). The context of the briquetage found at Hall Farm, Corringham, is unclear, but it may well have originally been deposited in pits comparable

to those at London Gateway (Barford 1984). At Gun Hill, postholes were found associated with a possible field boundary (Drury and Rodwell 1973).

The area west of London Gateway contained an exceptional concentration of late Bronze Age ringworks. Alongside the two examples at Mucking – the North Ring (Bond 1988) and the South Rings (Evans *et al.* 2015, chap. 3) – a further example has recently been excavated at Chadwell St Mary (Newton forthcoming). It has been suggested that two circular cropmarks of similar size in Thurrock might represent the locations of two further examples (Buckley *et al.* 1987, 53, nos 14 and 18; see also Ingle and Saunders 2011, 83). One of these examples (Buckley *et al.* 1987, 53, no. 14) may correspond to the ringwork at Chadwell St Mary, but the plot of the cropmark is rather larger than the excavated site and the published mapping is not sufficiently precise to be certain of the correspondence.

The excavated ringworks present a set of similarities and contrasts. The Mucking examples both lay in areas where middle Bronze Age field systems had previously been set out. It is possible that the three cremation burials found at the North Ring – one of which was associated with two penannular gold rings – also belonged to this preceding phase of activity. At Chadwell St Mary, however, no clear indication of any preceding middle Bronze Age activity was found.

The three ringworks varied in size and in the number of entrances. The single circuit at Chadwell St Mary was the smallest, with a diameter of 35m and a ditch up to 1.5m wide and just 0.5m deep. It had only one entrance, facing south-east. Although the single circuit defining the North Ring at Mucking was only slightly larger (with a diameter of 38m), the ditch was larger, measuring up 4.7m wide and 1.55m deep. It had two diametrically opposed entrances, facing south-east and north-west but only one – the south-east-facing entrance – was retained in the second phase.

The South Rings, in contrast, was defined by two concentric circular ditches. Although the inner ditch had a diameter of around 46–7m, which was not much wider than that of the North Ring, the outer ditch, with a diameter of around 74–5m, was appreciably larger. The ditches themselves, however, were not correspondingly larger, measuring up to 4m wide and 1.3m deep. Like the North Ring it was associated with two opposed south-east and north-west entrances. The chronological relationship between the two ditches defining the South Rings is not clear, but it is possible that the outer ditch was a later addition.

There were also variations in the features associated with the ringworks. Although a quite high density of pits and postholes were found in and around the ringwork at Chadwell St Mary no clear structures were identified. Amongst the large number of postholes at the North Ring, in contrast, both N–S and E–W aligned rows divided the internal space (the E–W example being extended by a gully) and three post-built roundhouses were found. Bond (1988) suggested that these structure can be divided into two phases, the N–S aligned posthole row and two of the houses which lay behind it to the west belonging to the first phase, and the E–W aligned gully and postholes (extending from the south-east entrance) and the third roundhouse belonging to the second. The South Rings also contained, and was surrounded by, a large number of postholes and pits (which, unfortunately, were not well preserved on the north-western side), but in contrast to the North Rings it contained only a single central roundhouse, unusually defined, in one phase at least, by a continuous gully.

Despite the structural contrasts, the range of finds recovered from the two ringworks at Mucking was similar. Both contained moulds for casting copper alloy, and a crucible and a blob of copper spilt from a crucible at the North Ring and a fragment of copper alloy slag found at the South Rings also indicate metalworking. Both ringworks also contained small quantities of metalwork, large assemblages of pottery, briquetage, fired clay pedestals and perforated clay slabs as well as spindle whorls, worked flint and small quantities of animal bone. The Chadwell St Mary ringwork lacks evidence for metalworking (although some copper alloy wire and two pieces of lead were found) and for salt production, although it was associated with pottery and a large number of fired clay plates.

The presence of at least three, and possibly more late Bronze Age ringworks in such a small area does not, at first sight, fit well with the idea that they were elite residences which played a role as central places, controlling the surrounding area and trade through it (Yates 2007, chap. 12; Bradley 2007, 208–10; Evans *et al.* 2015, chap. 3), and raises the question of how the ringworks were related (cf Needham 1992; Evans *et al.* 2015, chap. 3). Although the more restricted range of finds from Chadwell St Mary suggests that there may have been differences in the status and roles of the ringworks, they also raise the possibility that there were differences in date, and that the sites may not all have been in use at the same time.

The chronological evidence is, unfortunately, not precise enough to define clearly the relationships between the three sites, but there is some indication that the Chadwell St Mary site was in use earlier than the ringworks at Mucking. The radiocarbon dates provide one source of evidence which, however, is complicated in several ways. Only a single radiocarbon date was obtained from the ringwork at Chadwell St Mary and the small number of dates from the Mucking sites have large errors. Evans *et al.* (2015, chap. 3) note also that the dates from the North Ring came from contexts likely to be late in the history of the site whilst those from the South Rings were from probably early contexts. Nonetheless, the single date from Chadwell St Mary falls in the period 1060–930 cal BC (68% confidence) and is probably earlier than those from the North Ring, which fall in the period 930–550 cal BC (68% confidence). The date ranges from the South Ring span the period 1060–810 cal BC (68% confidence) and are too wide to show how it was related to the other ringworks. The pottery, however, is also consistent with

the view that Chadwell St Mary may have been in use earlier than the Mucking sites (although it would allow for considerable chronological overlap). Peachey (in Newton forthcoming) suggests that most of the pottery from Chadwell St Mary spans the transition from the early to the mature phase of Plain Ware and that decorated material was scarce, whereas the presence of greater proportions of Decorated Ware and the association with Ewart Park metalwork in the Mucking ringworks suggest a later date. The chronological relationship of the Mucking ringworks is unclear, but Evans *et al.* (2015, chap. 3) suggest that the South Rings may have been constructed after the North Rings.

Whilst the detailed chronology remains uncertain, it is worth stressing that what evidence there is suggests that the ringworks at Mucking probably date from late in the late Bronze Age. Evans *et al.* (2015, chap. 3) suggest a date range of 900 to 700/650 cal BC for the South Rings, and the North Ring is unlikely to have been very much earlier. Whilst it is therefore possible that the Mucking ringworks post-date much of the other late Bronze Age evidence discussed above, some of the earlier evidence may well have been contemporary with the Chadwell St Mary ringwork.

Given the evidence for metalworking at the Mucking ringworks, it is worth adding that the area around London Gateway contains a notable number of late Bronze Age hoards (including the very large Grays Thurrock I hoard; Turner 2010) which Yates (2007, chap. 12) has related to the distribution of both field systems and ringworks.

The Iron Age

Despite the almost complete absence of evidence for activity in the Iron Age at London Gateway, extensive evidence has been found for occupation in that period in the surrounding area. Apart from extensive evidence for roundhouses (both post-built and possibly defined by gullies), pits and probably also four-posters at Mucking (Evans *et al.* 2015, chap. 4) and for a post-built roundhouse at Linford (Barton 1962), the evidence for the early Iron Age is limited to small numbers of features, such as the four-post structure at Rainbow Wood (Potter 1974) and small numbers of pits and a few other features at the Orsett Cock site (Milton 1987), Rectory Road, Orsett (Wilkinson 1988), the Neolithic causewayed enclosure site at Orsett (Hedges and Buckley 1978) and Gun Hill (Drury and Rodwell 1973), as well as by residual or stray finds at Stifford Clays and Primrose Island (Wilkinson 1988). Although often limited in extent, these excavations nonetheless provide evidence for the wide distribution of early Iron Age activity.

Evidence for middle Iron Age activity is equally widely distributed, often at the same locations, but includes a number of more clearly defined sites, often characterised by enclosures and by ring gullies which were probably related to roundhouses. The most extensive evidence was again found at Mucking, where a series of enclosures, usually rectilinear but also including curvilinear examples, was distributed across the excavated area (Evans *et al.* 2015, chap. 4). Many of the gully-defined roundhouses there also date from the middle Iron Age. Less extensive evidence of probably broadly similar enclosures has been found at the Orsett causewayed enclosure site (Hedges and Buckley 1978), Ardale School (Wilkinson 1988), Stifford Clays (Wilkinson 1988) and Gun Hill (Drury and Rodwell 1973). At Ardale School and Gun Hill the enclosures were again associated with ring gullies, an isolated example of which was also found at the Orsett Cock site (Carter 1998; Rodwell 1974).

Alongside this extensive settlement evidence, the excavations at Stanford Wharf Nature Reserve showed that salt extraction, which led to the formation of red hills, began there in the middle Iron Age (*c* 400–100 BC), most likely after *c* 250 BC (Biddulph *et al.* 2012b). Other evidence relating to salt production included pits, hearths and briquetage moulds, troughs, pedestals and firebars.

THE DP WORLD LONDON GATEWAY SITES

The Mesolithic and Neolithic periods

The only evidence for activity on any of the DP World London Gateway sites prior to the middle Bronze Age was provided by worked flint (Fig. 3.2) and even that was distributed remarkably sparsely, can only occasionally be dated with any precision and in most cases was probably residual. The worked flint does not, therefore, add much to our understanding of the area in the earlier prehistoric period beyond demonstrating that it was not entirely unpopulated.

The only concentrations of worked flint were found at Areas A and H of the Access Road. The largest group, consisting of just 57 pieces, was recovered from Area H at the southern end of the site, mostly from medieval features. Even this small group of flint probably derives from several periods. It includes the only piece that can be identified as probably Mesolithic – a microburin – but also flakes and blades that are more likely to derive from Neolithic and Bronze Age activity. Area A contained a total of 34 pieces, which again probably derived from activity during the Neolithic period and Bronze Age.

The remaining sites contained only very small assemblages and lack pieces which can be dated with any precision. The trenches excavated at the Pipeline Diversion, on either side of the Access Road, for example contained only 14 pieces of worked flint, most of which consisted of squat flakes which could have been later prehistoric in date, perhaps contemporary with the middle and late Bronze Age features (below). The remaining assemblages – 15 pieces, all from alluvial deposits, from the Proposed Development at Great Garlands Farm, eight pieces from the Rail Corridor and 25 pieces from Salt Fleet Flats in Kent – also contained similar possibly later prehistoric

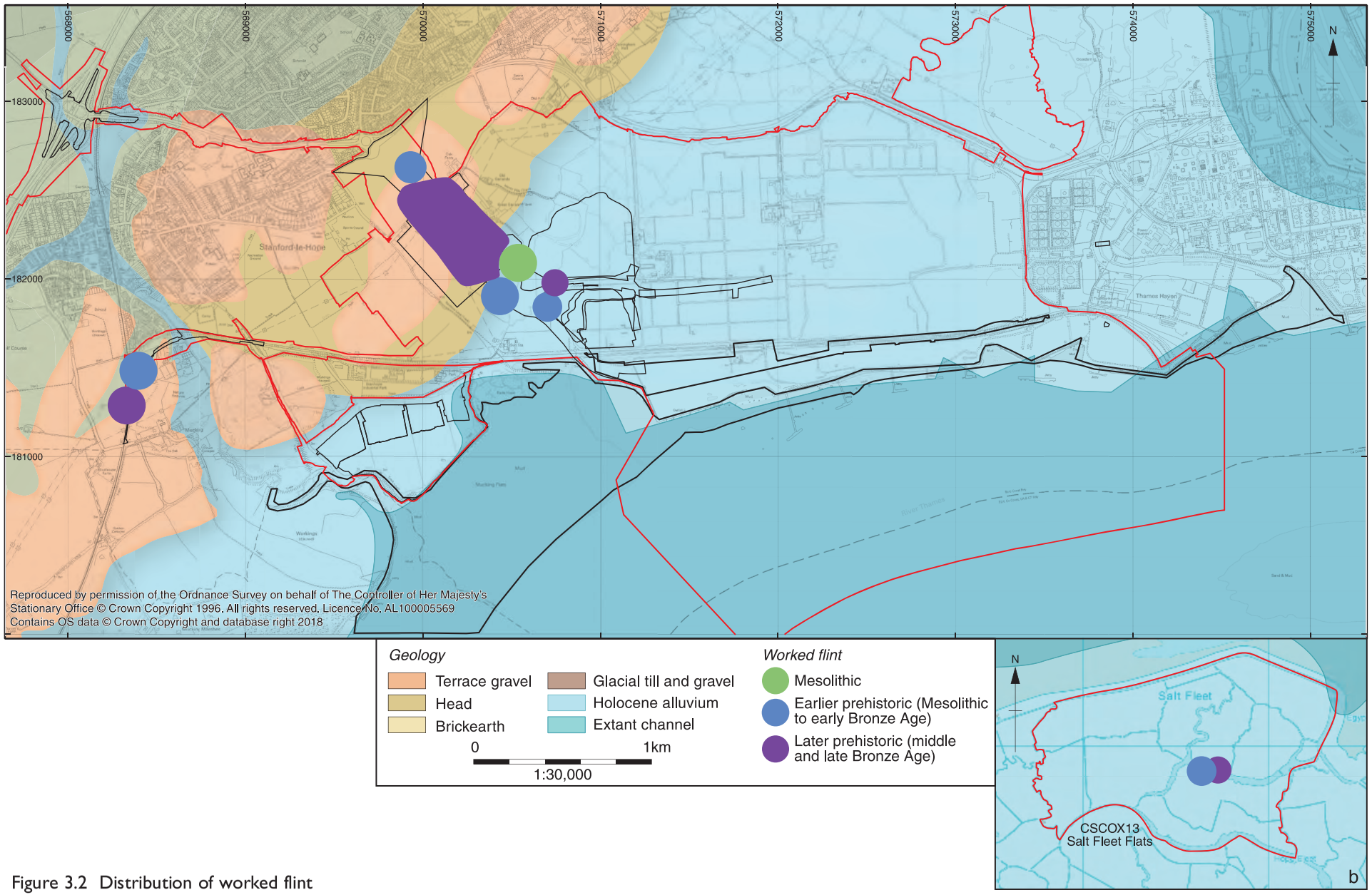

Figure 3.2 Distribution of worked flint

flint, but in each case a small number of blades and occasionally other types were present which could derive from earlier prehistoric activity.

Discussion: assessing levels of earlier prehistoric activity

It is very difficult to draw any useful conclusions from such small assemblages of poorly dated flint. Even the paucity of flint is not necessarily a straightforward indication of an absence of earlier prehistoric activity. Not only was the extent of the investigations limited, but, as the description of the development of the landscape above indicates, the landscape has changed significantly since the end of the Pleistocene and it is quite possible that traces of earlier prehistoric activity lie buried under the substantial alluvial deposits along the southern edge of the project area. Similar problems affected the excavations at Stanford Wharf Nature Reserve, but there a larger assemblage of 548 pieces of flint was recovered, including pieces dating from the Mesolithic and Neolithic periods and the Bronze Age.

The environmental evidence recovered from deposits grouped as G5a in a channel at Stanford Wharf Nature Reserve, dated to a period extending from the Mesolithic into the early Bronze Age, provides some indication of how the landscape was developing over this period (Biddulph *et al.* 2012b). Not surprisingly, a range of environments is represented, extending from tidal mudflats which developed near the channel into salt marsh during this period to deciduous woodland, the latter dominated by oak, hazel, alder, elm and lime but including also birch and pine on the higher ground with areas of grassland and heathland. The pollen included some cereal-type pollen similar to but larger than wild grasses, which might indicate that some arable crops were being grown in the area. A small quantity of charred grain was recovered from the surface (G3) which underlay the alluvial deposits. This surface, however, contained material with widely different dates extending up to the late Bronze Age – no doubt reflecting the fact that it was only gradually covered as the overlying alluvial deposits accumulated.

There is clear evidence for activity in what would have been broadly comparable contexts (albeit changing over time) in other areas adjacent to the Thames Estuary and its surroundings in the Mesolithic, Neolithic and early Bronze Age, both up-river (eg Meddens 1996; Champness *et al.* 2016; Bennell 1998; Leivers *et al.* 2007; Stafford *et al.* 2012; Coles *et al.* 2008; Crockett *et al.* 2002; Cotton 2000; Hart 2015; Barnett *et al.* 2011) and elsewhere along the Essex and Kent coasts (eg Wenban Smith *et al.* 2020; Wilkinson and Murphy 1995; Wilson *et al.* 1971).

The paucity of evidence for earlier prehistoric activity on the gravel terrace may initially appear more difficult to explain, but again the limited extent of the excavations at London Gateway makes it difficult to draw any significant conclusions. Evidence for earlier prehistoric activity on the gravel terrace has been found at a number of nearby sites. As has been noted above, at Mucking evidence for earlier prehistoric activity, especially in the later part of the early Neolithic (associated with Decorated Bowl pottery or Mildenhall Ware) and the late Neolithic (associated with Grooved Ware) was well represented, and there is evidence from other sites on the gravel terrace – notably the Orsett causewayed enclosure – for activity in the early Neolithic.

The difficulty of comparing the results from London Gateway with these nearby areas is, however, clearly exemplified by an attempt to compare the quantities of Mesolithic finds from London Gateway and Mucking. The extensive and very thorough excavations at Mucking recovered only 91 pieces of flint which could be attributed with some certainty to the Mesolithic (Evans *et al.* 2015, table 2.2) compared to just one piece – a microburin – from London Gateway (although there is a much larger group of material from both sites which might date from that period). Neither site provides evidence for intensive Mesolithic activity, but given the different scale of excavation it is impossible to determine whether the single piece from London Gateway represents a lesser level of activity than the larger assemblage from Mucking.

The difficulty in making comparisons also applies more generally to the earlier prehistoric period. Features from the Neolithic and early Bronze Age often consist, as at Mucking, of no more than small numbers of pits, scattered at a low density, which are less likely to be found in evaluation trenches than, for example, the extensive ditches of a field system (Hey and Lacey 2005).

It is, however, worth noting the possible presence of barrows on the gravel terrace. At Mucking, although two Beaker burials and some pits containing finds from that period were found, there was little ceramic evidence for activity in the early Bronze Age. Some of the barrows at Mucking could, however, date from that period, although others were middle Bronze Age (Evans *et al.* 2015, chap. 2). A small ring ditch associated with probably middle Bronze Age cremation burials was found at the Orsett Cock site (where a probable Beaker burial was also found; Milton 1987, 17–19). A number of cropmarks north-east and the south-west of the Access Road and Pipeline Diversion might mark the location of further round barrows (Fig. 3.6), although they could also reflect the presence of other types of features, and without excavation they remain undated. Many of the cropmarks potentially related to round barrows have diameters of around 10m to 15m, similar to the barrows excavated at Mucking, and this small size would fit most easily with a middle rather than an early Bronze Age date (Garwood 2007).

The middle and late Bronze Age

The most significant of the prehistoric discoveries at London Gateway date from the middle and late Bronze Age. The most extensive traces of activity in these periods were found at the Access Road and in trenches excavated on either side of it along the Pipeline

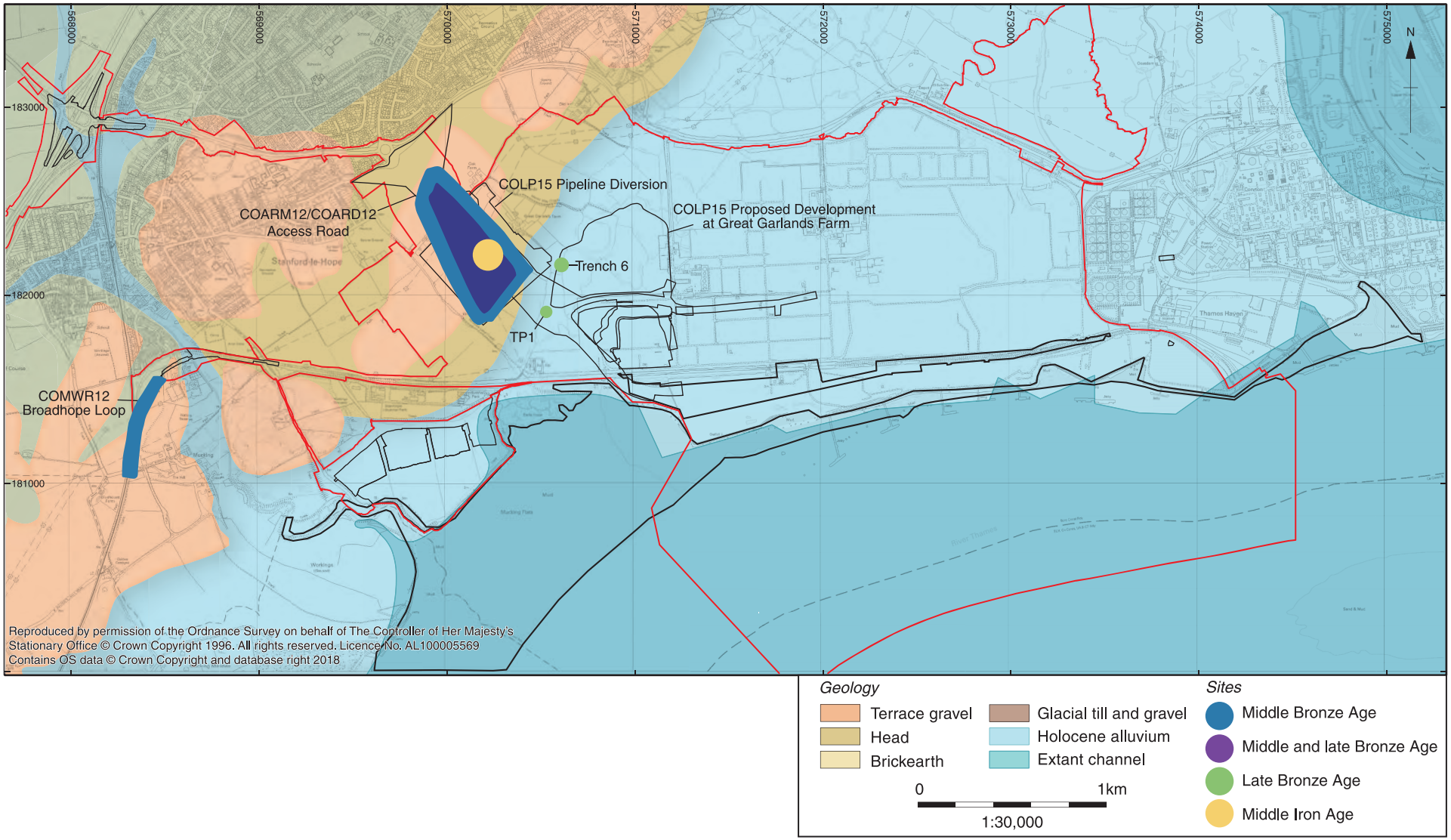

Figure 3.3 Distribution of sites with middle and late Bronze Age activity

Diversion (Fig. 3.3). Although the limits of the excavated areas mean that only a partial view is possible, together these excavations provide evidence for the existence of a field system centred on the gravel terrace but possibly extending some way onto the head deposits to the south-east. Further ditches were found to the west at the Rail Corridor which might also have formed part of a middle Bronze Age field system.

On the basis of the orientation of the ditches, the Access Road/Pipeline Diversion field system can be divided into two parts – northern and southern – which were aligned slightly differently. It is possible that this difference in alignment reflects their relationship with the southern edge of the gravel terrace, but it might also reflect differences in chronology. The northern section was associated with only a single sherd of pottery which has been dated on the basis of its fabric to the late Bronze Age. It also, however, contained briquetage which suggests a late Bronze Age date. A larger quantity of pottery was recovered from the southern section. Most of this pottery has been dated to the middle Bronze Age, again on the basis of its fabric, but the ditches also contained smaller quantities of late Bronze Age and late Bronze Age–early Iron Age pottery as well as late Bronze Age briquetage. It is possible, then, that the southern section was laid out in the middle Bronze Age, before the northern section, but the presence of later finds suggests that the southern ditches remained open into the late Bronze Age and late Bronze Age–early Iron Age.

Scattered in and around these field systems were a number of pit groups and isolated pits which contained some of the most interesting Bronze Age finds. An isolated middle Bronze Age pit found at the Rail Corridor contained a large group of charred flax seeds within a partially intact barrel-shaped jar, whilst another isolated pit at the Access Road contained a group of fired clay pedestals, a large assemblage of middle Bronze Age pottery (including two partially intact burnt jars) and a small quantity of cremated bone (which could not be identified as human or animal). A group of late Bronze Age pits at the northern end of the Access Road contained briquetage, fired clay associated with ovens or hearths, and charcoal, suggesting that salt was being extracted. Fired clay was widely distributed, albeit often in small quantities, across the Access Road and Pipeline Diversion, but further notable groups of briquetage were recovered from late Bronze Age pits and field system ditches at the latter.

The features at the Access Road, Pipeline Diversion and Rail Corridor were situated either on the gravel terrace or the adjacent head deposits (Fig. 3.6). Three sites do, however, also provide evidence for activity on the tidal flats: unfortunately, this evidence is limited to small numbers of artefacts, often residual, and hence provides no more than an indication that the tidal flats were exploited in some way in the late Bronze Age.

Rail Corridor

The excavations along the Rail Corridor revealed a ditch, two groups of pits and two isolated pits which can be dated to the middle Bronze Age as well as two ditches of uncertain date (Fig. 3.4). The most interesting finds – an assemblage of charred flax seeds, partially intact pots and a ceramic fragment which may be briquetage – were recovered from pits, as was also the case for the Access Road and Pipeline Diversion (discussed below).

Field system ditches

Three ditches were identified at the Rail Corridor (Figs 3.4 and 3.5). Of these, only one (104) contained any dating evidence, amounting to no more than a single sherd of middle Bronze Age pottery. The other two ditches (121 and 139) contained no finds.

Clearly the excavations were too limited in extent to indicate whether the ditches formed part of a wider field system or an enclosure, and the presence of a single sherd is insufficient to be certain of their date. Whilst the evidence from the Rail Corridor does, nonetheless, raise the possibility that field systems existed in this area, it is worth adding that the site lies on head deposits. The middle Bronze Age field system at Mucking (Evans *et al.* 2015, chap. 2), in contrast, lies on gravel, and the possible field system at the Access Road and Pipeline Diversion (described below) seems also to have been largely confined to the gravel terrace, and extended only a short distance onto the head deposits. The interpretation of the Rail Corridor ditches is, therefore, open to debate. The ditches were, however, all quite slight features (measuring 0.59–1.00m wide and 0.09–0.40m deep) as is typical of field system ditches elsewhere. The ditches of the middle Bronze Age field system at Mucking, for example, measured 0.4m–1.0m wide and 0.2m–0.45m deep (Evans *et al.* 2015, chap. 2).

Pit 141

The charred flax seeds were found within a large barrel-shaped vessel with a diameter of *c* 0.32m which had been buried in a small oval pit (141) near the southern end of the excavation, in Area 2. The pit measured 0.4 x 0.3m and 0.14m deep and was thus just large enough to accommodate the pot (Fig. 3.5). Although other sherds were recovered from the pit, it is possible that they all derived from the partially intact vessel. The large size of the flax seeds suggests that they were from a cultivated variety. They were associated with a small number of charcoal fragments, a single charred cereal grain and a spelt wheat glume base.

Pit Group 1

A group of seven pits (109, 110–113, 127–8), one of which also contained a partially intact pot, were found towards the northern end of the excavation in Area 1. Another pit was represented by a second partially intact pot (106). This was recovered from the subsoil less than 10m from feature 113, but was upright, having remained *in situ* in a pit for which no cut could be observed. These features fell into two sizes: six (including 106) were small features, measuring just 0.22–0.31m across and 0.08–0.27m deep, whilst the remaining two (109 and 128) were wider but still

shallow features, measuring 0.70–0.76m across and 0.14–0.32m deep (Fig. 3.5).

Whilst the smaller features were of a size which might suggest that they were postholes rather than pits, two of them (106 and 113) contained the bases of truncated pots which had been placed upright within the pits. Given the similarity in size, it seems possible that the remaining small pits also originally contained pots which presumably were retrieved rather than being left in the pits. It is noticeable that the pottery recovered from one of the

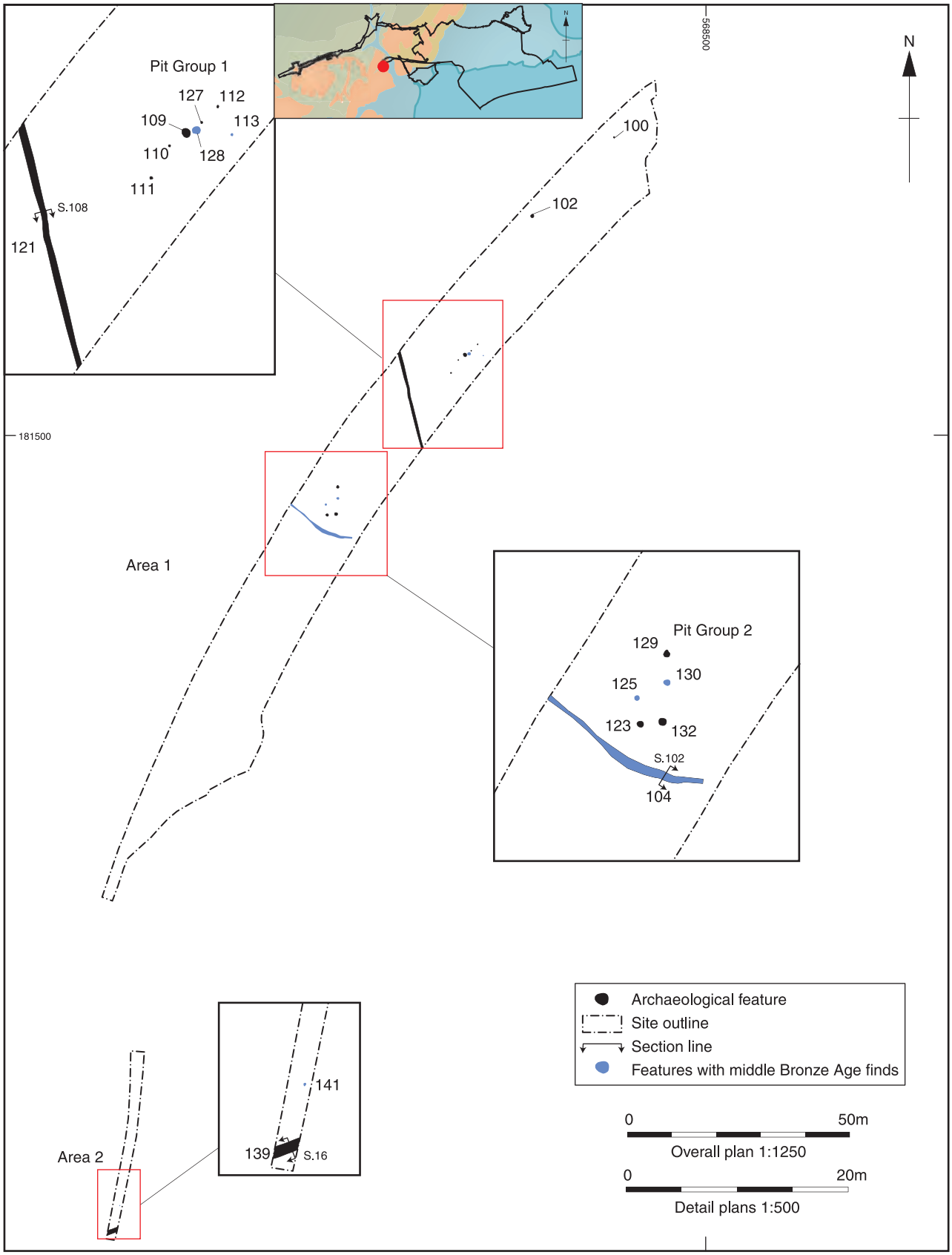

Figure 3.4 Plan of middle Bronze Age and undated features, Rail Corridor

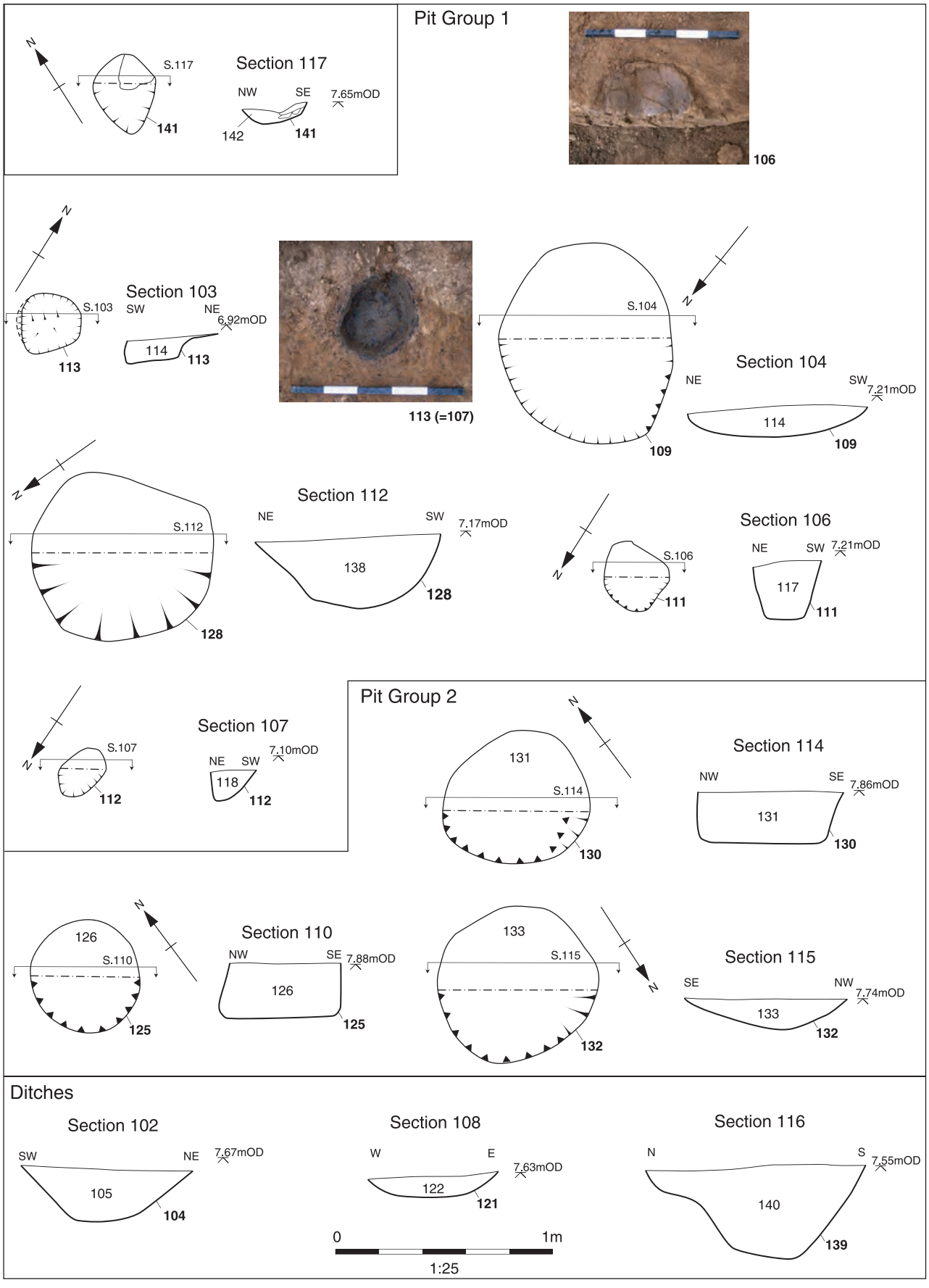

Figure 3.5 Sections of selected middle Bronze Age features, Rail Corridor

larger pits (128) consisted of large sherds, suggesting that although the pottery had been subject to some post-depositional damage before being buried it had not suffered as badly as pottery from other features and hence may have been deposited soon after it was broken.

The other large pit (109) was fire-reddened and contained a thin layer of charcoal on its base and sides. Whilst the use of this pit remains uncertain, this evidence for fire does suggest that the pits were not all used simply to contain vessels.

The only other finds recovered from the pits were five small fragments of fired clay from one of the small pits (113).

Pit Group 2

A second group of pits (123, 125, 129, 130, 132) was found further south. The five pits in this group were similar in size to the larger pits in Pit Group 1, measuring 0.50–0.70m wide and 0.29–0.25m deep (Fig. 3.5). They contained few finds: a few sherds of middle Bronze Age pottery in pits 130 and 125 and a few flint blades and flakes in pits 123 and 132. The most notable find, however, is a small fragment possibly of briquetage in pit 130. Unfortunately the fragment is too small for the identification to be certain.

Other pits

Two other small, isolated pits (102 and 100) were found, both of which lay near the northern end of the excavations. One of these (102) was comparable in size to the larger pits in Pit Group 1, measuring 0.78m wide and 0.16m deep, and contained a single sherd of middle Bronze Age pottery. The other (100) was comparable in size to the small features, measuring 0.36m across and 0.24m deep. It contained no finds but the similarity in size between these two features and those in Pit Group 1 suggests that they might all date from the middle Bronze Age.

Access Road and Pipeline Diversion

Ditches which might have formed parts of a field system, first set out in the south in the middle Bronze Age but possibly extended to the north in the late Bronze Age, were found in trenches excavated along both the Access Road and the Pipeline Diversion (Fig. 3.6).

Although the trenches excavated along the Access Road cover quite a high proportion of the area involved and allow some ditches to be traced for some distance, the trenches at the Pipeline Diversion provide only a very limited coverage of the land on either side of the Access Road in which only short stretches of ditch could be seen. Overall, the excavations provide only a limited view of the prehistoric landscape, and the suggestion that some of the ditches might have formed part of rectilinear field systems is, as a result, dependent upon projecting the alignment of the ditches beyond the excavated areas and assessing how they might have been related to ditches elsewhere. This exercise has been carried out based on the assumption that the field systems are likely to have been laid out in an at least approximately rectilinear fashion. This is often true of later Bronze Age field systems, including the middle Bronze Age field system excavated not far away at Mucking (Evans *et al*. 2015, fig. 2.35). As the late Bronze Age enclosures at Chadwell St Mary (Newton forthcoming) show, however, other forms are possible and later Bronze Age field systems elsewhere often not only include irregularities but can be laid out in much less regular, agglomerated ways (eg Framework Archaeology 2006; 2010). The layout of the middle and late Bronze Age ditches at the Access Road and Pipeline Diversion is consistent with the idea that they were arranged in a roughly rectilinear pattern, but it is important to stress that this interpretation is, at least in part, a product of the assumptions made at the beginning of the analysis. If the layout were, in fact, more irregular the arrangement would probably be impossible to reconstruct from the limited areas excavated.

The southern field system

Ditches found in the southern part (Areas H and C) of the Access Road and in Trenches 31 and 32 of the Pipeline Diversion could have formed part of a broadly rectilinear field system set out, probably in the middle Bronze Age, towards the southern edge of the gravel terrace, but also extending a short distance onto the head deposits to the south (Figs 3.6–3.8). Although the ditches forming the putative field system contained pottery which predominantly dates to the middle Bronze Age, pottery of late Bronze Age and late Bronze Age–early Iron Age date was also recovered from them. It appears likely that the ditches remained open during those periods and thus could have been contemporary with both the possibly later field system ditches to the north and the nearby pits described below which, in some cases, contained a similar range of finds.

The southernmost edge of the southern field system was represented by two ditches (8087 and 8033) set at right angles to each other, which were cut into the head deposits at Access Road Area H (Figs. 3.6 and 3.7). They would have intersected just outside the excavated area. A continuation of ditch 8033 was found *c* 70m away to the north-west in Area G, but the remaining trenches in Area H suggest that the field system did not extend any further to the north-east or south-east. The corner formed by the ditches may thus have represented the limit of the field system, which lay just beyond the southern edge of the gravel terrace.

A ditch (3101) which ran roughly at right angles to ditch 8087 was found in Trench 31 of the Pipeline Diversion. The northern end of this ditch lay within the trench, so whilst it is possible that it extended further to south to meet ditch 8087 (*c* 70m to the south), it is unclear whether it continued to the north.

Two further ditches (3206 and 3209), aligned roughly perpendicular to ditch 8087 were found at Pipeline Diversion Site B (Fig. 3.8). These two ditches lay directly adjacent but did not cut each other. The easternmost ditch (3209), however, contained only middle Bronze Age pottery, whilst the westernmost

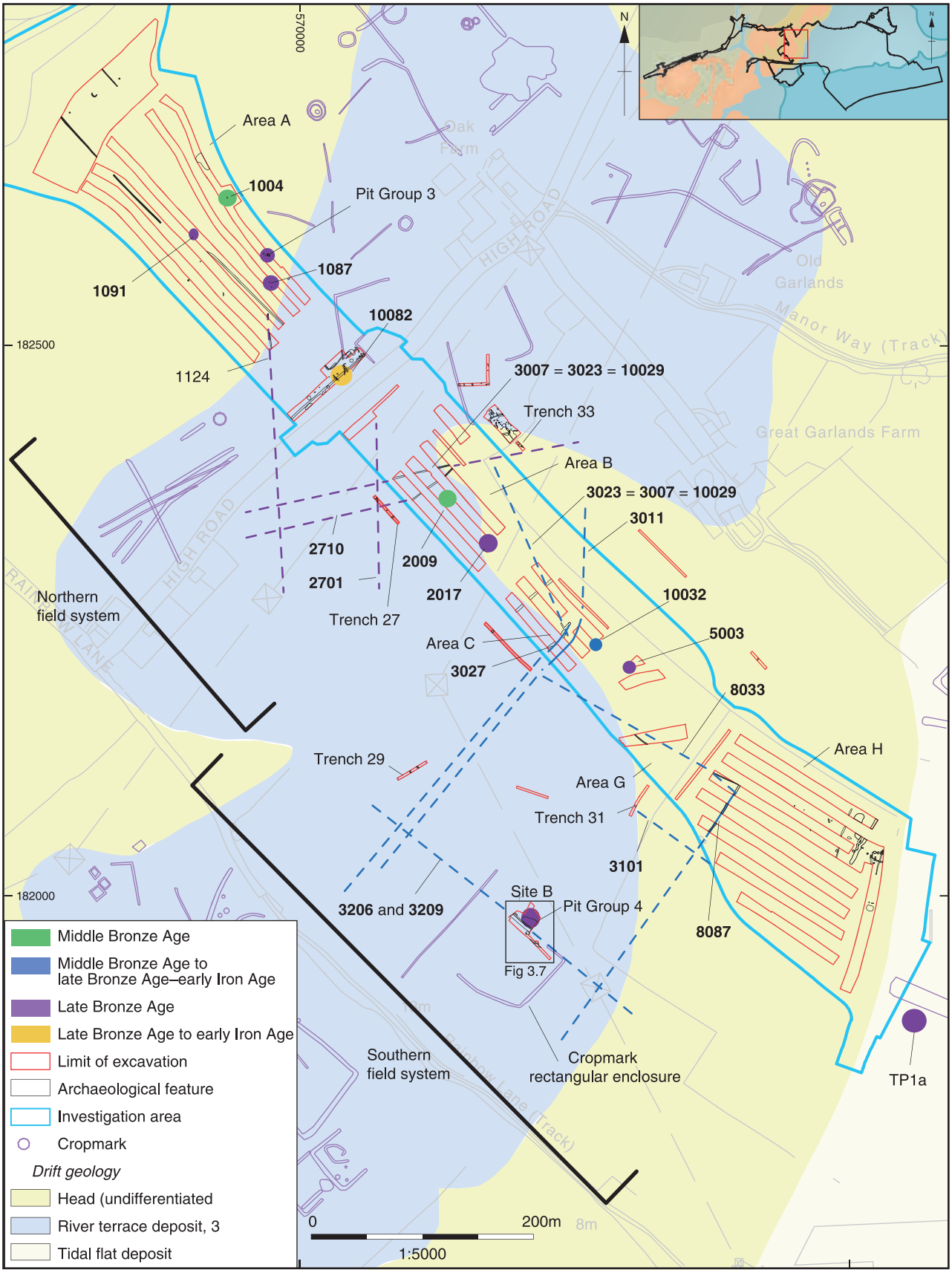

Figure 3.6 Plan of middle and late Bronze Age features, Access Road and Pipeline Diversion, with nearby cropmarks

(3206) contained both middle Bronze Age and late Bronze Age-early Iron Age sherds and cut one of the late Bronze Age pits (3201) in Pit Group 4 (below). It thus seems likely that the western ditch (3209) replaced the eastern (3206) and was cut in or after the late Bronze Age. The two ditches had the same alignment as what appears to have been a roughly rectangular enclosure revealed as a cropmark (Fig. 3.6). Another linear cropmark to the north-west of Site B was aligned roughly perpendicular to the excavated ditches. This alignment was also, however, followed by a number of cropmarks further to the west which may have been medieval in date. In the absence of excavation, the date of the cropmarks and their relationship with the excavated ditches is uncertain.

The remaining ditches that might have been related to the field system were found at Access Road Area C (Fig. 3.9). The three ditches in this area formed a slightly irregular arrangement. The largest of the ditches (3027) curved slightly as it ran off the gravel terrace and ended a short distance into the head deposits. A second ditch (3011) ran parallel to it, around 4m to the south, and extended beyond the edges of the excavation to both the north-east and south-west. A much smaller ditch (3007=3023=10029) ran just off right angles from ditch 3027, roughly along the edge of the gravel terrace. This ditch was traced for 30m to the north but for only 3m to the south where it ended just short of ditch 3011. The slightly off-rectilinear layout of these ditches may reflect their relationship with the edge of the gravel terrace. Whilst

Figure 3.7 Plan of middle and late Bronze Age features, Access Road Areas G and H and Trench 31, Pipeline Diversion

the ditches at Access Road Area H show that the field system continued in some areas onto the head deposits, the arrangement of the ditches at Pipeline Diversion Site B also suggests that in some areas they might have been laid out in relation to the underlying geology.

The ditches at the southern edge of the field system suggest the existence of NW–SE-aligned boundaries at intervals of *c* 55m (the distance from ditch 8033 to ditch 3101). Although the distance from ditch 8033 to ditches 3206 and 3209 was around 145m, there were no trenches in the intervening area which might have revealed more closely spaced divisions. There was also, however, no indication of NE–SW aligned boundaries between ditches 3027 and 8087, which lay *c* 200m

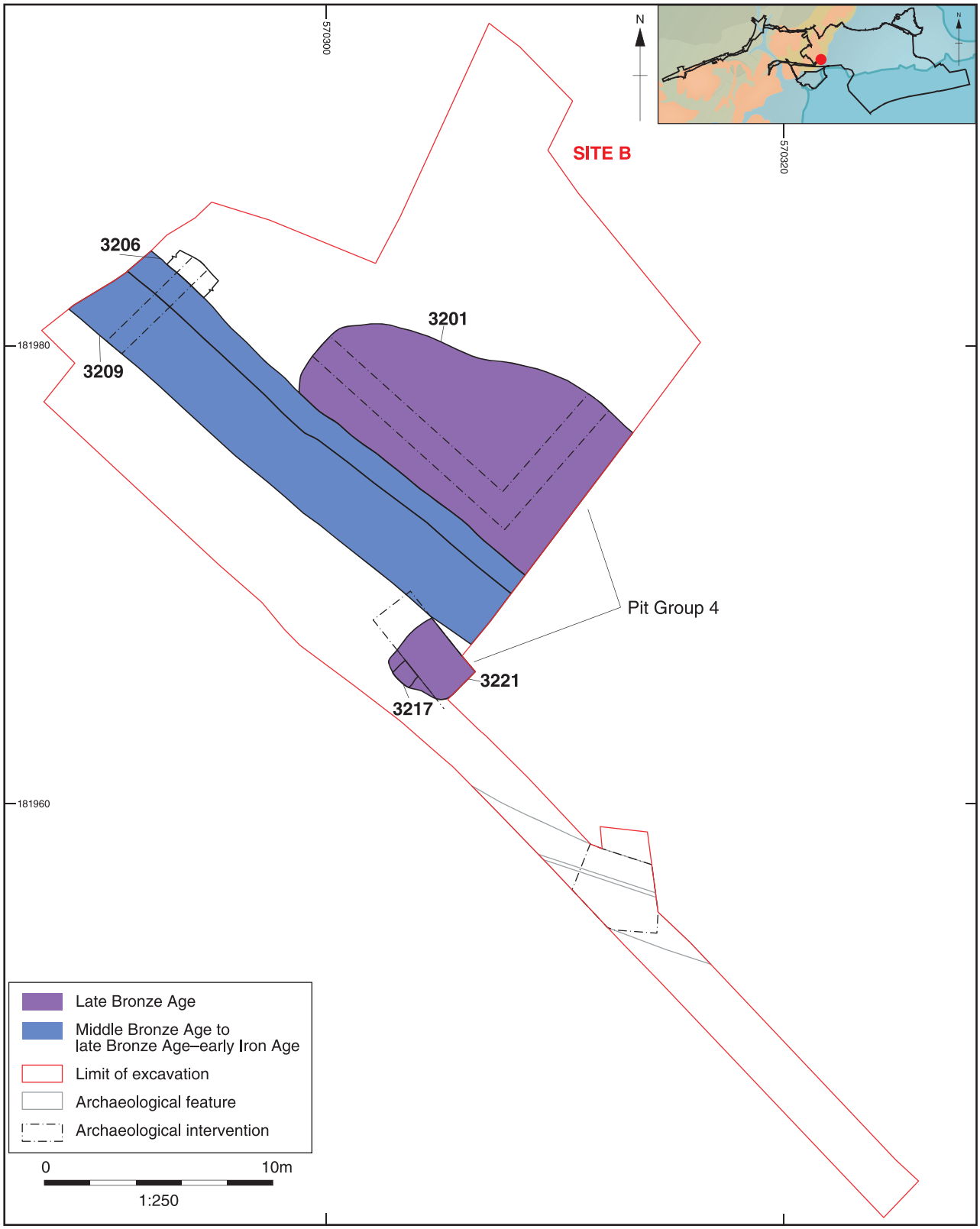

Figure 3.8 Plan of middle and late Bronze Age features, Pipeline Diversion Site B

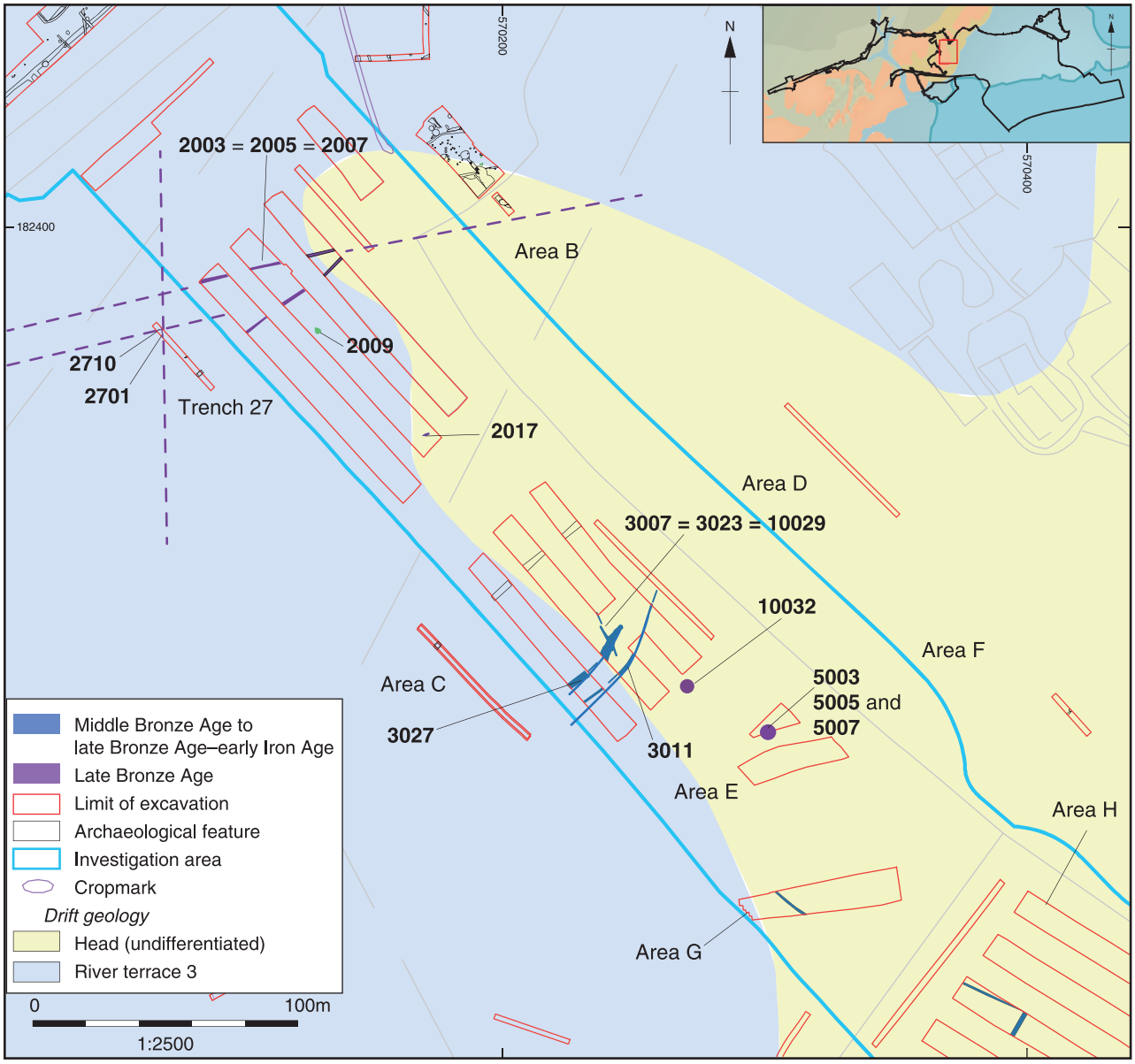

Figure 3.9 Plan of middle and late Bronze Age features, Access Road Areas B to G

apart, suggesting the possible existence of a large field, partially subdivided internally, but measuring around 200 x 200m.

The northern field system

Ditches found near the middle of the Access Road (in Area A) and in Trench 27 of the Pipeline Diversion hint at the possible existence of a second section of the field system towards the northern edge of the gravel terrace, perhaps dating to the late Bronze Age, and set out on a different alignment to the field system to the south (Fig. 3.10). The dating evidence for this part of the field system is, however, extremely meagre, and there is little indication from trenches in the same area to suggest that it formed an extensive, rectilinear pattern.

At Access Road Area A, a single ditch (1124) was traced over a distance of 32m. The ditch was aligned roughly parallel to a short stretch of ditch (2701) found in Trench 27 on the Pipeline Diversion. A third ditch (2710) found in Trench 27 ran at right angles to the west from ditch 2701. The only other excavated ditch which might have formed part of this field system was found in Area B of the Access Road. This ditch (2003=2005=2007) contained no finds and can be dated only on the basis that it ran parallel to ditch 2710, some 16m further north.

If these ditches had formed part of a single rectilinear field system, they would suggest the existence of a field measuring 75m wide E–W (between ditches 1124 and 2701). The only indication of the N–S size of the fields is given by the distance of 16m between ditches 2710 and 2003=2005=2007.

It is, however, worth noting that ditches were not found in some areas where they might have been expected if these ditches had formed part of an extensive rectilinear field system. This is most noticeably the case between Areas A and B where it might have been expected that a continuation of ditch 2701 would be found. However, the ditches were very shallow features and could have been wholly truncated in some areas of

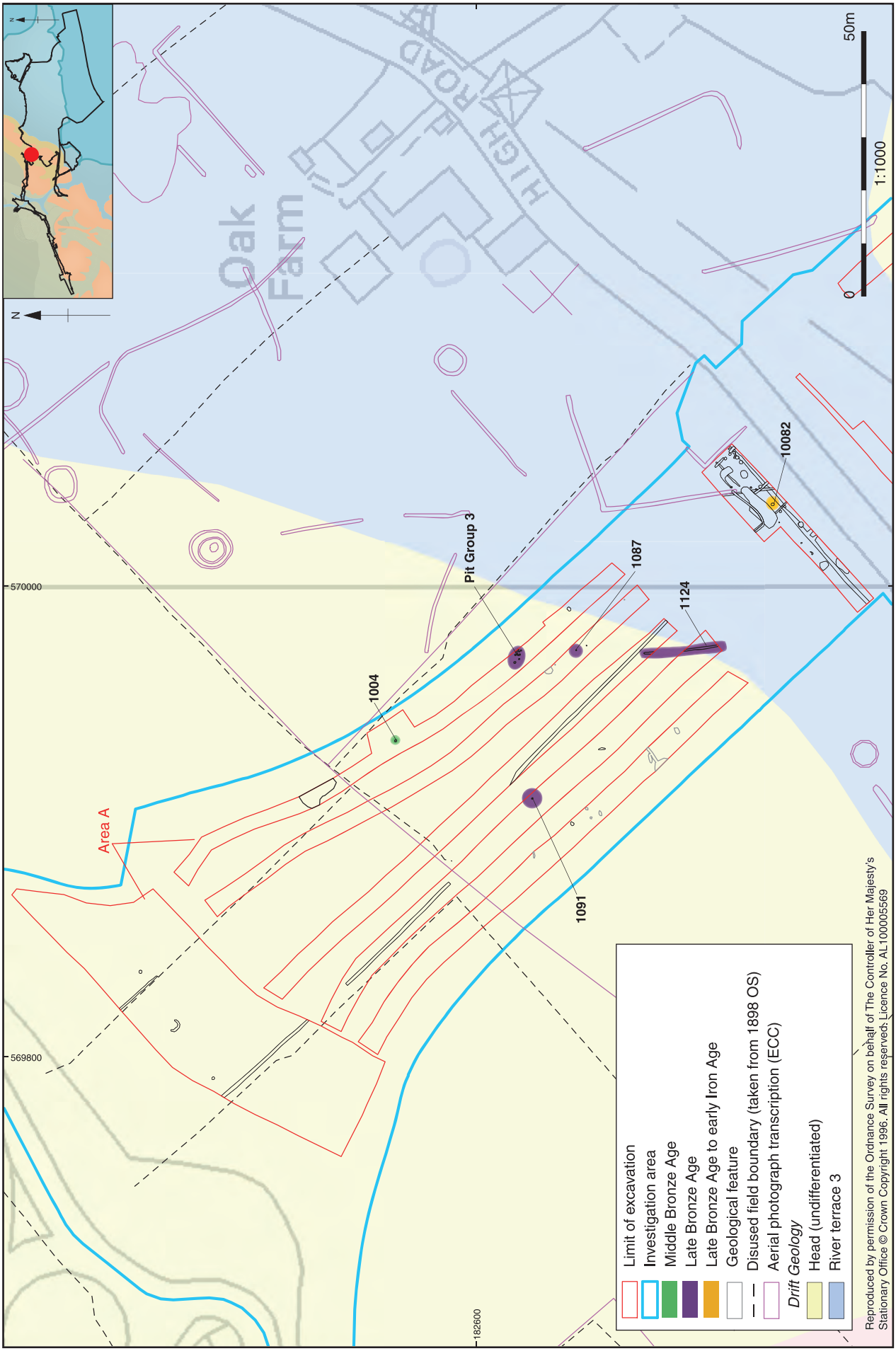

Figure 3.10 Plan of middle and late Bronze Age features, Access Road Area A

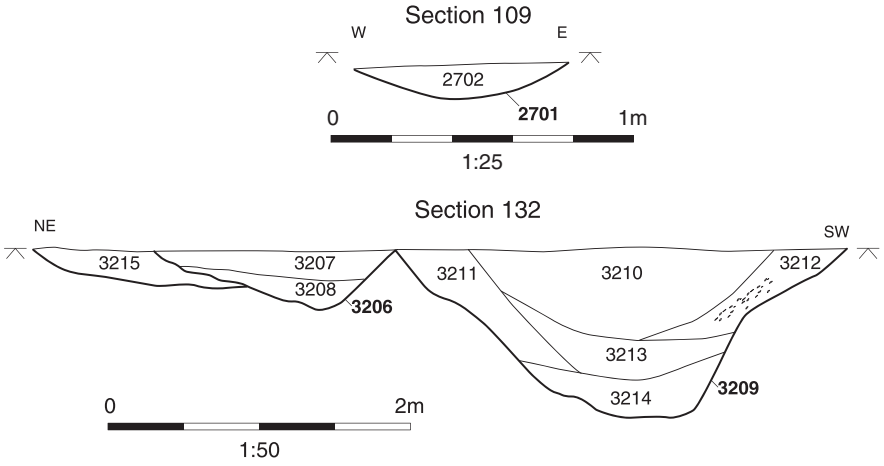

Figure 3.11 Sections of selected middle and late Bronze Age field system ditches, Pipeline Diversion

the site. Alternatively, the field system may have been more confined to the gravel terrace than the middle Bronze Age field system to the south. Both ditches 2710 and 2003=2005=2007 run only a short distance off the gravel into the head deposits and trenches dug into the head deposits where ditches might have been expected to occur did not uncover any trace of them. It is therefore possible that the apparently limited extent of the northern late Bronze Age field system is just a reflection of the narrow width of the gravel terrace in the area where the trenches were cut.

The size of the field system ditches

The ditches varied considerably in size (Fig. 3.11). Most of them were quite slight features with widths of around 0.5m and depths of around 0.3m or less. This size range is broadly typical of ditched field systems more widely.

There were also a small number of wider (but not deeper) ditches, some measuring around 1.5m to 2.0m wide, and, in a few cases, over 3.0m wide. These larger ditches all lay in the southern section of the field system. Ditches 3027 and 3209 fell into the largest class (over 3.0m wide) whilst ditches 8087 and 3206 fell into the middle range (between 1.5m and 2.0m). Aside from being concentrated in the southern field system, there is little other apparent order in the distribution of the larger ditches, although the larger size of ditches 3206 and 3209 at Pipeline Diversion Site B could be taken to support the idea that they were related to the rectangular enclosure identified from cropmarks rather than forming part of a wider field system.

Finds from the field system ditches

The finds from the field system ditches comprise limited quantities of pottery, briquetage, fired clay and worked flint. The single environmental sample taken from the ditches also revealed the presence of a limited range of charred plant remains. Overall, the range of material is similar to that recovered from the pits (discussed below). Whereas the pits occasionally contained quite large deposits of finds, often apparently related to specific activities, the ditches contain smaller quantities of more fragmentary material, as one might expect for features which would have been left open rather than backfilled (Fig. 3.21).

The pottery was largely concentrated in the southern section of the field system. The only pottery from the northern section was a single late Bronze Age sherd from ditch 1124. The dating of the northern section is not, however, entirely based on this single sherd since there is briquetage which also suggests a late Bronze Age date.

In contrast, pottery was recovered from nearly all the interventions in the southern field system. Only ditches 8033, 3101 and 3011 did not contain pottery. The quantities in the other ditches were, however, all small. Ditch 8087 contained the largest group (14 sherds/144g), but the other ditches often contained only one or two sherds. Most of this pottery was attributed to the middle Bronze Age, but small quantities of later pottery were also recovered: late Bronze Age sherds from ditches 8087 and 3007=3007=10029, and late Bronze Age–early Iron Age sherds from ditches 3206, 3027 and 3007=3023=10029.

Fired clay and briquetage from ditches 10029, 3206, 3209, and 3101 in the southern system also provide evidence which suggests that the ditches remained open in the late Bronze Age (see Table 3.1). They were also recovered from ditches 2701 and 2710 in the northern section of the field system. Most of the fired clay consisted of fragments of pedestals, but fragments from ovens or hearths, perforated plates and luting, and sherds from briquetage vessels were also recovered. Ditch 3206 contained a notably diverse assemblage of fired clay, but the largest group, consisting of 45 fragments (232g) came from ditch 2701.

The ditches also contained a small range of worked flint and burnt unworked flint. Only one sample was taken from the field system ditches – from ditch 8087. It contained a range of charred plant remains – indeterminate cereal grains, wheat glume bases and charcoal – that was similar to the material from the pits (described below).

Pits in and around the Access Road and Pipeline Diversion
A number of pits were distributed in and around the field system, occasionally in groups but more often as apparently isolated features. Almost all the pits date from the late Bronze Age, although there were two middle Bronze Age examples. The relationship of the pits to the field system may have varied. It is possible that the middle Bronze Age pits pre-dated the field system, at least in the northern part of the Access Road, and one may well have lain outside the area covered by the field system. In the case of some of the late Bronze Age pits, however, the similarities of the artefacts, and especially the fired clay, recovered from the pits and the ditches suggests that they were open contemporaneously.

As has been noted above, the pits contained some of the most interesting groups of prehistoric finds, including fired clay from oven or hearth structures, from oven or hearth furniture and from briquetage vessels. As the presence of briquetage vessels and discolouration associated with salt-making indicates, in the late Bronze Age much of this fired clay was associated with salt production. There is also, however, a group of fired clay pedestals from a middle Bronze Age pit which does not appear to have been related to salt production. Alongside this fired clay and briquetage, the pits also contained limited quantities of a small range of other material – pottery, worked flint and charred plant remains; whether these finds derive from nearby settlement or reflect more specialised activities related to the use of ovens or hearths is discussed further below.

One of the most striking assemblages of finds was a group of five perforated cylindrical drum-shaped fired clay pedestals (often interpreted as loomweights but more probably used as oven or hearth furniture) found with a conical fired clay pedestal in middle Bronze Age pit 1004 (see Figs 3.12 and 3.15). This pit lay on the head deposits, outside the area encompassed by the field system, near the northern end of the Access Road (in Area A; Figs 3.6 and 3.10). The pit also contained a large assemblage of Deverel-Rimbury pottery including two partially intact vessels. Both vessels were large barrel-shaped jars and had burnt surfaces discoloured by heat. The remaining finds consisted of a single flint flake, burnt unworked flint, five fragments of red deer antler, 34g of calcined bone fragments (which could not be identified to species), charcoal and a single charred cereal grain. The pit itself had a shallow bowl-shaped profile and measured 0.80m across and 0.13m deep.

Only one other pit (2009), which lay further south, in Access Road Area B, could be attributed to the middle Bronze Age (Fig. 3.9). Compared to pit 1004 it was a large feature, 2.10m across but only 0.10m deep, irregular in plan with gently sloping slides and a flat base. The only finds recovered from it were five small middle Bronze Age sherds (33g) and a small group of flint flakes, chips and a bladelet. A sample from the pit contained only highly fragmented charcoal.

A much larger number of late Bronze Age pits were found scattered more widely across both sites. Although most of the pits occurred as isolated features, two notable groups were found, both containing fired clay and briquetage associated with salt-making. The largest group (Pit Group 3) was found at the northern end of the Access Road (in Area A) to the north of the northern field system (Figs 3.10 and 3.13). All ten pits in this group were more-or-less circular or oval in plan, had

Figure 3.12 Middle Bronze Age fired clay pedestal pit 1004, Access Road Area A

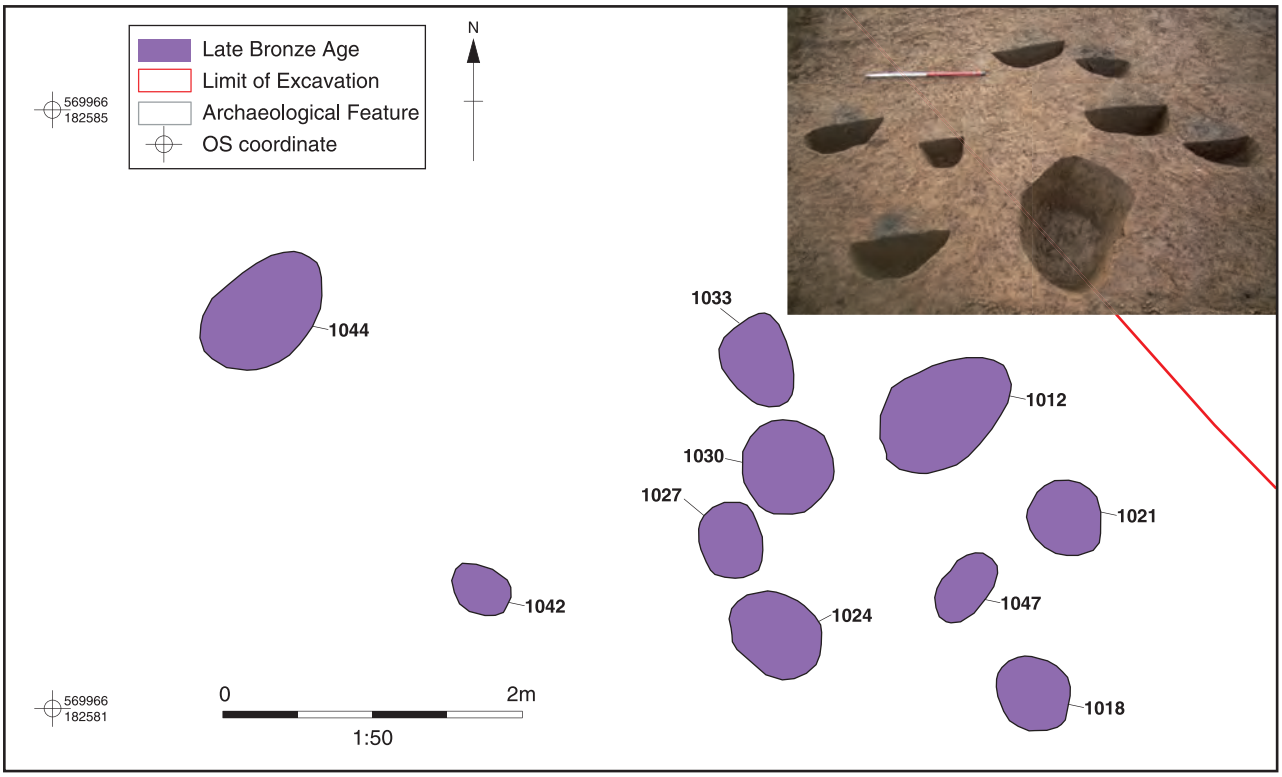

Figure 3.13 Plan of late Bronze Age Pit Group 3, Access Road Area A

steep or vertical sides and were shallow (between 0.22–0.38m deep). Their widths varied from 0.42–0.92m.

Many of the pits in this group contained small groups of late Bronze Age pottery and occasionally also flint flakes, burnt unworked flint and small quantities of charred plant remains (including charred grain, wheat glume bases, legumes, a small range of weed seeds and charcoal). The most striking finds, however, were a range of fragments of fired clay and briquetage, some of which were clearly associated with salt production. These finds were recovered from just four pits (1012, 1027, 1030 and 1033), with the bulk of the material coming from just two of them (1012 and 1027). Pit 1012 contained a large group of fired clay fragments, some with pink or lavender colouring associated with salt-working, which probably derived from an oven which may have had two chambers. Pit 1027 contained a range of fired clay hearth or oven furniture including two small props or pedestals, a hand-squeezed lump and fragments of flat plaques (perhaps oven lining), as well as a fragments of a briquetage vessel. Of the remaining two pits which contained fired clay, one (1033) contained a fragment of a briquetage vessel and the other (1030) an abraded lump of fired clay, the original form of which could not be inferred.

A second group of three pits (Pit Group 4) containing fired clay and briquetage associated with salt-making was found at Pipeline Diversion Area B (Fig. 3.8). One of these pits (3201) was a particularly large feature, rather irregular in plan, measuring 14.5m across and 0.29m deep. The other two (3217 and 3221) were much smaller features, one (3217) measuring 1.5m across and 0.45m deep whilst the other was not fully exposed in plan, but also measured 0.45m deep. The large pit (3201) was cut by one of the southern field system ditches (3206). All three pits contained small groups of late Bronze Age pottery as well as fragments of fired clay (some again displaying the white, pink or mauve discolouration associated with salt-working) and, in pit 3217, a briquetage vessel. Not surprisingly, the largest group of fired clay and briquetage came from the large pit 3201, which contained both a small quantity of fired clay probably from a hearth or oven and also fragments from pedestals, perforated plates, plaques and a bar or rod. One of the smaller pits (3221) lacked any structural fired clay but contained fragments of both pedestals and perforated plates. The other small pit (3217) contained two fragments of briquetage vessels. A similar range of fired clay and briquetage was recovered from the adjacent field system ditches (3206 and 3209), suggesting that the ditches and pits were open at the same time. The mean fragment size for the fired clay and briquetage from the pits and the ditches was similar – 8.9g for the pits and 8.0g for the ditches – suggesting that the ditches do not simply contain residual material from an earlier episode of activity associated with the pits. The pits also contained burnt unworked flint, a flint blade and a blade-like flake.

Fired clay and briquetage were recovered from two of the other late Bronze Age pits (1091 and 2017). Pit 1091 was a small, shallow pit with a bowl-shaped profile measuring 0.47m across and just 0.11m deep. It lay beyond the northern part of the field system, towards the northern end of Access Road Area A, *c* 60m from late Bronze Age Pit Group 3 (Fig. 3.10). It contained a small group of fired clay probably derived from a hearth or oven, some of which displayed salt discolouration.

The only other finds from this pit were a few charred cereal grains, some bedstraw (*Galium*) seeds and charcoal. The other pit (2017), in contrast, was a much wider feature, irregular in plan, again with a bowl-shaped profile, measuring 2.05m across but just 0.30m deep, which lay near the middle of the Access Road, in the area between the two sections of the field system (Fig. 3.9). It contained a larger group of highly fragmented fired clay (369 fragments, 620g) mixed with charcoal. The original form of the fired clay fragments could not be identified and there is no conclusive sign that it was related to salt-making. The pit also contained seven sherds of late Bronze Age pottery, including a partially intact jar and small quantities of charred grain (including wheat and possibly barley), wheat glume bases and a few charred weed seeds.

The date of a third pit (10032), also found near the middle of the Access Road, in Area D, is uncertain (Fig. 3.9). It contained a small group of pottery, most of which (6 sherds/72 g) was middle Bronze Age. The pottery also, however, included a single late Bronze Age–early Iron Age sherd (17g) and fragments probably from a briquetage vessel with a mauve–white colour typical of salt-working debris. The possible briquetage vessel suggests that the feature may have been similar in date to the late Bronze Age pits and ditches elsewhere along the Access Road and Pipeline Diversion, but the pottery could be taken to imply either earlier or later dates. Its fill also contained burnt material but was not sampled. It was a small circular feature, 0.32m wide and 0.17m deep, with steep sides and a flat base.

Other late Bronze Age features

Late Bronze Age pottery was recovered from a small number of other features scattered across the Access Road: two postholes or small pits (1087 and 5003) and an irregular features that may have been a tree-throw hole (10082). Pottery was also recovered from fill 8013 within post-medieval pond 8008. The two pits or postholes (1087 and 5003) were both small features, measuring 0.46m and 0.33m wide and 0.10m and 0.11m deep respectively. Pit 1087 contained just a single sherd of late Bronze Age pottery, a little charred grain, bedstraw (*Galium*) seeds and charcoal. It lay in the northern part of the Access Road (in Area A; Fig. 3.10), and, apart from another similar feature (1085) which contained charcoal but no other finds which lay 4.5m to the south, was an isolated feature. The other feature (5003) lay towards the southern end of the Access Road, just 0.2m from two similar small features, one of which (5005) cut the other (5007; Fig. 3.9). They were all small features, measuring 0.22–0.33m wide and 0.11–0.13m deep. Feature 5003 contained 27 small late Bronze Age sherds and charcoal. The other two features contained no finds. The remaining feature (10082) was irregular in plan and may have been a tree-throw hole (Fig. 3.6). It contained six late Bronze Age–early Iron Age sherds. Fill 8013 within pond 8008 (Fig. 5.8) contained a single sherd of late Bronze Age pottery.

Late Bronze Age evidence from other sites: beyond the gravel terrace

Evidence for prehistoric activity on the tidal flats is very limited, probably in large part because such evidence was buried at depths which were not generally reached by the excavations. At three sites, however, traces of middle or late Bronze Age activity were found in this area. In all three cases, however, the evidence is limited to small numbers of artefacts which, in two cases, were clearly residual.

Later Bronze Age or early Iron Age coarse flint-tempered sherds were recovered from a peat horizon at a depth of 2.3–2.4m below ground level from a test pit (TP1, Fig. 3.3) excavated in Trench 1A on the tidal flats at the Access Road. At the Proposed Development at Great Garlands Farm, which lies on the tidal flats to the south-east of the Access Road and Pipeline Diversion, late Bronze Age pottery and worked flint was found in a sondage in Trench 6, within redeposited alluvial deposits related to a historic dam (shown on a 17th-century map). Although probably redeposited, the pottery suggests that there was late Bronze Age activity in this area, close to the edge of the Head deposits, and, like the sherds from the Access Road test pit, raise the possibility that further evidence lies buried at greater depths in the alluvium. The walkover survey of the tidal flat also recovered a single prehistoric sherd.

It is also worth adding that the only prehistoric finds from Salt Fleet Flats, in Kent, consisted of probably later Bronze Age worked flint which was recovered from medieval contexts on alluvial deposits in Trench 30 (Fig. 2.16).

The Iron Age

The only evidence for activity between the late Bronze Age–early Iron Age and the late Iron Age is provided by five middle Iron Age sherds which were recovered from ditch 3007=3023=10029 in Area D of the Access Road (Figs 3.6 and 3.9). These sherds must be several centuries later in date than any other finds from the field system ditches and both late Bronze Age and late Bronze Age–early Iron Age pottery was recovered from the same context. Whilst it might, therefore, appear likely that the middle Iron Age pottery was intrusive, it is also possible that the ditch remained an open feature until the middle Iron Age and that the paucity of other early or middle Iron Age finds reflects a low level of activity on the site in those periods.

The paucity of evidence for early and middle Iron Age activity contrasts with the sequence at Mucking, Stanford Wharf Nature Reserve and other sites in Thurrock, and whilst it does suggest that the area was not occupied by any significant foci of settlement, it is quite possible that the area remained in use as agricultural land which, in these phases, does not appear to have been divided up by any form of archaeologically visible field system.

FINDS AND ENVIRONMENTAL EVIDENCE

The prehistoric finds from DP World London Gateway include worked flint, pottery, fired clay, briquetage, antler, burnt bone and charred plant remains. The small assemblage of worked flint has already been discussed above in relation to earlier prehistoric activity.

Although the assemblages of finds are, not surprisingly, quite small, they nonetheless contain some significant items. The briquetage and fired clay perhaps provides the most interesting evidence. It adds to a concentration of evidence for salt production and other activity involving fired clay and the use of ovens at Mucking and other sites in Thurrock. The pottery includes a number of partially intact middle and late Bronze Age vessels which provide evidence for the use of pots that were placed upright in small pits, presumably to serve as storage receptacles. The small quantities of charred plant remains recovered raise the question of whether the later Bronze Age pits were related to 'permanent' or temporary occupation. As a result of the acidic soil conditions, animal bone, apart from a small collection of burnt fragments is, unfortunately, absent.

Prehistoric pottery by Matt Brudenell

A combined total of 810 sherds (10,443g) of prehistoric pottery were recovered from the investigations (Brudenell, Specialist Report 1). With the exception of five probably middle Iron Age body sherds (14g) from ditch 10029 at the Access Road, all the material is of middle Bronze Age to early Iron Age date and belongs to the Deverel-Rimbury and Post-Deverel-Rimbury (PDR) ceramic traditions. All the pottery was recovered from just three sites. The largest group, spanning the later Bronze Age and the late Bronze Age–early Iron Age, came from the Access Road (377 sherds/6128g). The adjacent excavations along the Pipeline Diversion produced a much smaller assemblage (67 sherds/543g) which spans the same periods. The Rail Corridor also produced an assemblage of reasonable size (367 sherds/3772 g) but the pottery was all middle Bronze Age.

Fabrics with more-or-less coarse burnt flint temper were by far the most common, and dominate the middle Bronze Age assemblage in particular. The late Bronze Age and late Bronze Age–early Iron Age pottery also included a small proportion of flint- and grog-tempered material (especially in the late Bronze Age) and flint- and sand-tempered sherds (especially in the late Bronze Age–early Iron Age). A small proportion of sherds with

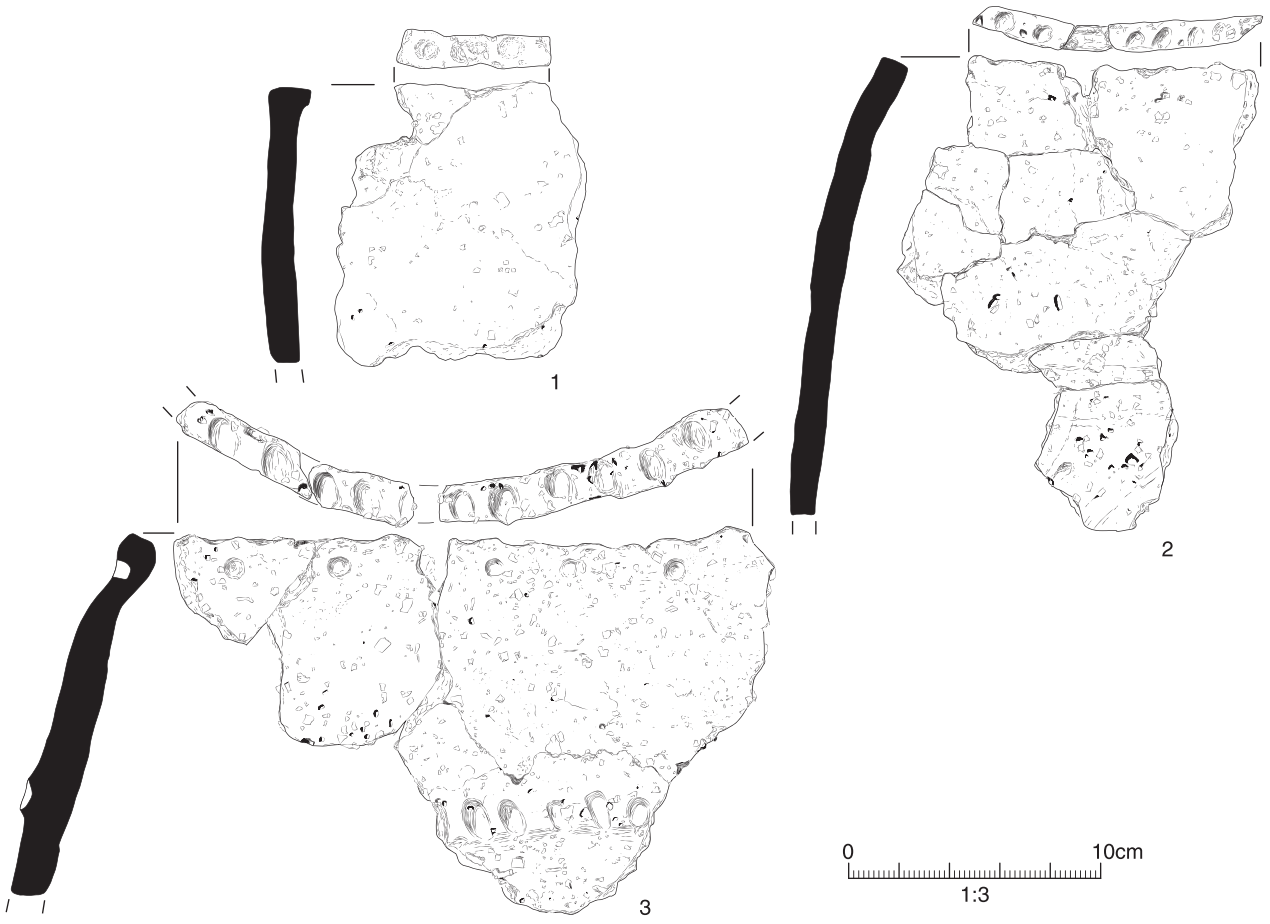

Figure 3.14 Selected middle Bronze Age pottery. 1: middle Bronze Age rim with fingertip impressions from pit 141, Rail Corridor; 2: middle Bronze Age rim with fingertip impressions and 3: middle Bronze Age decorated jar, both from pit 1004, Access Road

sand temper and voids from burnt out organic material also occurred throughout the periods represented. The fabrics of the late Bronze Age (PDR) assemblage are subtly different to those from the middle Bronze Age. The inclusion of crushed burnt flint remained ubiquitous, but the grade and density of flint tends to be smaller and lower in PDR groups and the vessel walls thinner.

The Deverel-Rimbury assemblage includes a number of partially intact vessels. Pit 141 at the Rail Corridor included five refitting sherds which might all come from a large, slightly barrel-shaped vessel with a simple flat-topped rim with closely spaced fingertip impressions on the rim-top (Fig. 3.14, no. 1). Another two partially intact but heat-affected vessels were both recovered from the fired clay pedestal pit (1004) at the Access Road. Both were large slightly barrel-shaped jars, one with a fingertip impressed rim-top (Fig. 3.14, no. 2), the other, more elaborately decorated, with a flat-topped rim decorated with deep fingertip impressions, a slightly raised fingertip-decorated cordon and a row of circular tool-impressed holes located beneath the rim on the exterior which do not penetrate all the way through the vessel wall (Fig. 3.14, no. 3). The truncated bases of two large middle Bronze Age vessels were also found buried vertically in pits 106 and 113 at the Rail Corridor.

The late Bronze Age and late Bronze Age–early Iron Age PDR pottery includes only one partially intact vessel: a convex-walled coarseware jar with rounded rim from pit 2017 at the Access Road. The other pottery, however, included a number of sherds with distinctive features such an in-turned or 'hooked' rim, a tapered rim and an internally bevelled rim. Decoration was limited to just five sherds from two neck cordons, one cabled, the other with fingertip impressions, and a sherd with combing, a form of decoration which is restricted to late Bronze Age and late Bronze Age–early Iron Age assemblages in south-east Essex and parts of northern and eastern Kent (Brudenell 2012, 245–6).

Fired clay and briquetage by Cynthia Poole

Fired clay and briquetage were distributed widely across the Access Road and Pipeline Diversion in middle and late Bronze Age contexts (Table 3.1; Fig. 3.22; Poole, Specialist Report 5). The finds included a notable group of five perforated cylindrical drum-shaped pedestals and an unusual conical pedestal or support from middle Bronze Age pit 1004 (Fig. 3.15). The cylindrical pedestals are paralleled at Mucking and Baker Street, Orsett (Bond 1988, 37–8; Evans *et al.* 2015, chap. 2; Wilkinson 1988, 94). They have been found on other sites associated with evidence for pottery production and possibly metalworking, but are common on Bronze Age settlements and, although they have often been interpreted as loomweights, they are likely to have been used as oven or hearth furniture for a range of tasks. The conical example is more unusual. It shares some characteristics with some of the pedestals used for salt extraction but neither it nor any

Figure 3.15 Middle Bronze Age cylindrical (1 and 2) and conical (3) fired clay pedestals from pit 1004, Access Road

of the other fired clay in this pit show signs of salt discolouration.

A small number of fragments of small perforated plates (Fig. 3.19), recovered from the ditches of the southern field system and two of the pits in Pit Group 4 also provide evidence that not all of the fired clay was related to salt production. They have been found on a wide range of sites, concentrated in the Lower Thames Valley and the Thames Estuary (Champion 2014, table 1 and fig. 2). Champion has noted that although perforated plates have often been found associated with briquetage, they also occur at sites without briquetage, in some cases at some distance from sources of salt water. Furthermore, like the examples found at London Gateway, none show the discolouration typical of fired clay associated with salt production. He suggests that they were associated with cooking, and the baking of bread in particular. Such an association would fit well with the widespread occurrence of charred grain and chaff on the London Gateway sites, although the quantities of perforated plates were small compared to those associated with the ringworks at Chadwell St Mary (Newton forthcoming) and Mucking (Evans *et al.* 2015, chap. 3; Bond 1988, 39).

Figure 3.16 Late Bronze Age fired clay cup pedestals with splayed bases. 1–7 from ditch 2701; 8 from ditch 2710, Pipeline Diversion

Table 3.1 Summary of fired clay and briquetage from later Bronze Age contexts on the Access Road and Pipeline Diversion (* marks pieces with salt discolouration)

	MBA pit		*LBA pit group*							
	1004	*1012*	*1027*	*1030*	*1033*	*2017*	*1091*	*2701*	*2710*	*2510*
	Frags	*Wt (g)*	*Frags*	*Wt (g)*	*Frags*	*Wt (g)*	*Frags*	*Wt (g)*	*Frags*	*Wt (g)*
Oven/hearth structure			208*	6047				3	11	
Pedestal	26	2194								
Plaque					2	21				
Prop/support					9	139				
Hand-squeezed lump					1	58				
Briquetage vessel					1	2		1	11	
Other fired clay	50	156				1	22			368
Total	76	2350	208	6047	13	220	1	22	4	22

Figure 3.17 Late Bronze Age fired clay cup pedestals with tapered bases (9–12) and with a spatulate end (13). 9–10 from pit 3221; 11–13 from pit 3201, Pipeline Diversion

LBA pit		*Poss prehist pit*		*Northern field system*				*Poss prehist ditch*	
Frags	*Wt (g)*	*Frags*	*Wt (g)*	*Frags*	*Wt (g)*	*Frags*	*Wt (g)*	*Frags*	*Wt (g)*
	16*	167					1	3	
			20	124	5	25			
			25	108					
630									
368	630	16	167	45	232	5	25	1	3

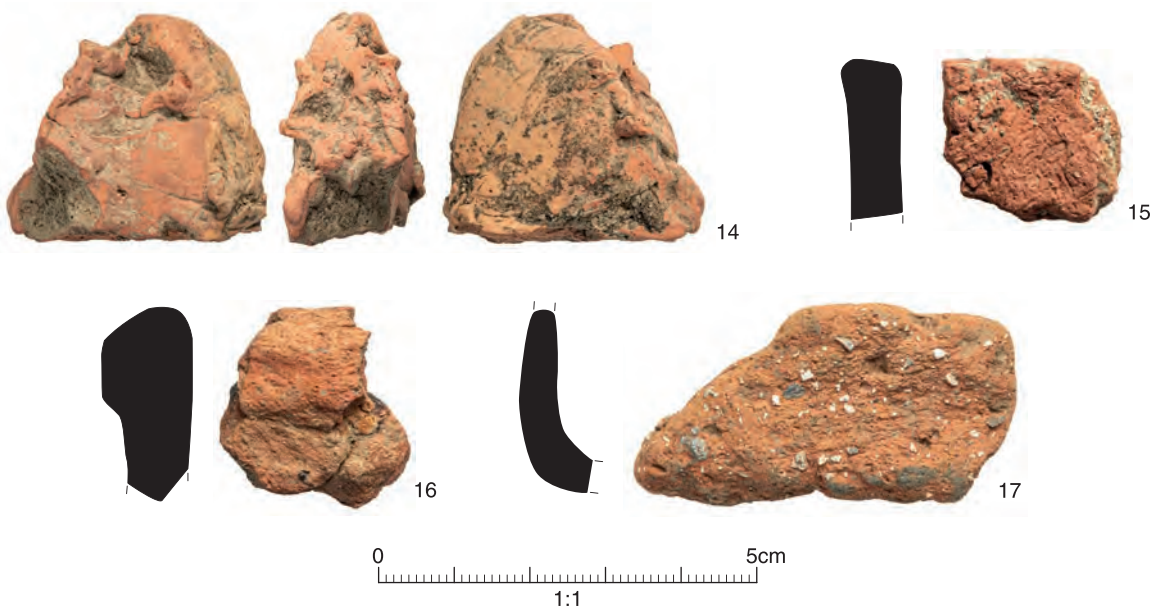

Figure 3.18 Late Bronze Age briquetage vessels (15–17) and luting (14). 14 from ditch 3206, 15 from pit 3217 and 16 from ditch 2701, Pipeline Diversion, 17 from pit 1033, Access Road

Many of the late Bronze Age features contained a range of briquetage forms which salt discolouration indicates had been used in salt extraction. The briquetage consisted predominantly of fragments from ovens or hearths and of pedestals but also included a range of vessels and other forms.

Cup pedestals with splayed bases were the type most commonly represented (Fig. 3.16), but there were also cup pedestals with tapered bases (Fig. 3.17, nos 9–12) and one example with a spatulate end (Fig. 3.17, no. 13). All these forms can be paralleled at Mucking. The cup end was probably used to hold briquetage evaporating cups rather than containing the brine itself. The examples found at London Gateway were fired to red, orange and reddish brown and only rarely exhibit salt-coloured mottles of lavender, pale pink or cream. It is clear from one example that the foot and stem were made as separate units which were luted together. The tapered examples must have been set into the clay floor of the salt-evaporating hearth to secure them in a vertical position.

The briquetage also included a range of fragments of props or supports, which, in some cases, appear to have been made by pressing soft, unfired clay into place in such a way as to stabilise containers during the evaporation or drying process.

The briquetage vessels (Figs 3.18 and 3.20) included flat-walled examples as well as a circular flared vessel which may have been used as a salt mould rather than an evaporation vessel.

The fragments from hearths or ovens included a large deposit in pit 1012 which probably all derived from a single structure which appears to have incorporated a built-in pedestal, suggesting that it may have formed part of a dual-chambered oven.

Animal bone by Lena Strid

Owing to the acidic soil conditions, the only bone recovered from prehistoric contexts was a deposit of 33.6g of small burnt bone fragments from pit 1004 (Strid,

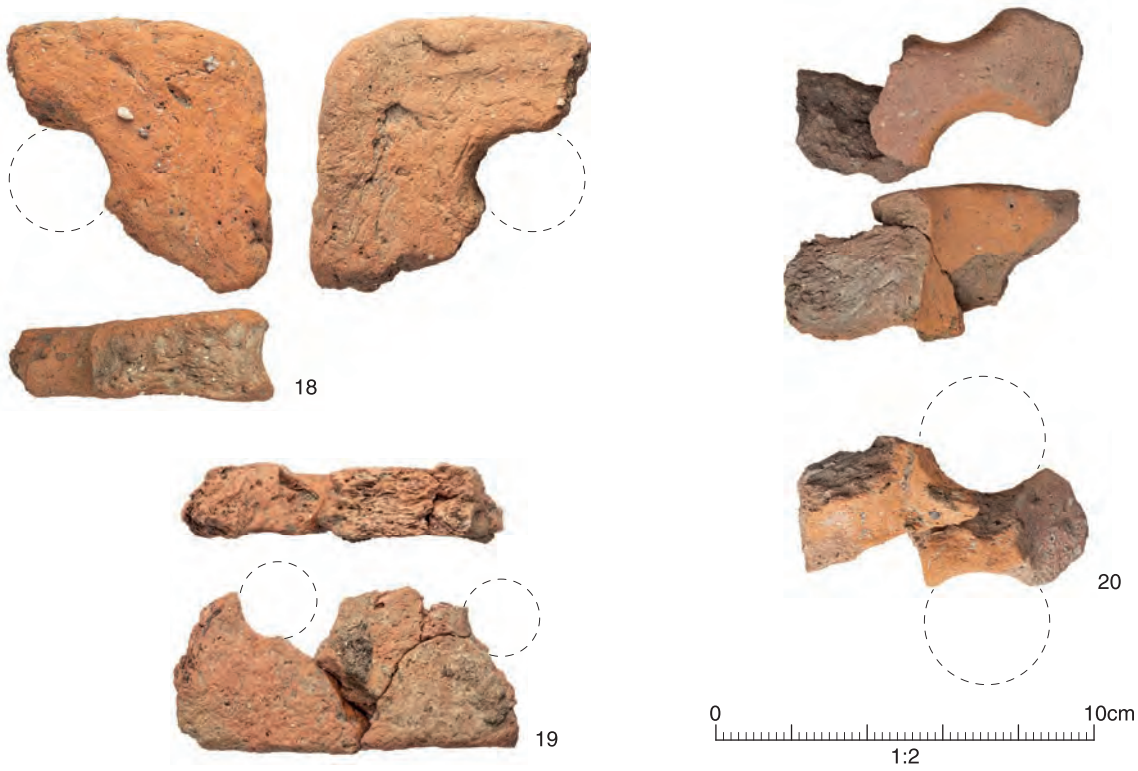

Figure 3.19 Late Bronze Age perforated fired clay plates. 18 and 20 from pit 3201; 19 from ditch 3206, Pipeline Diversion

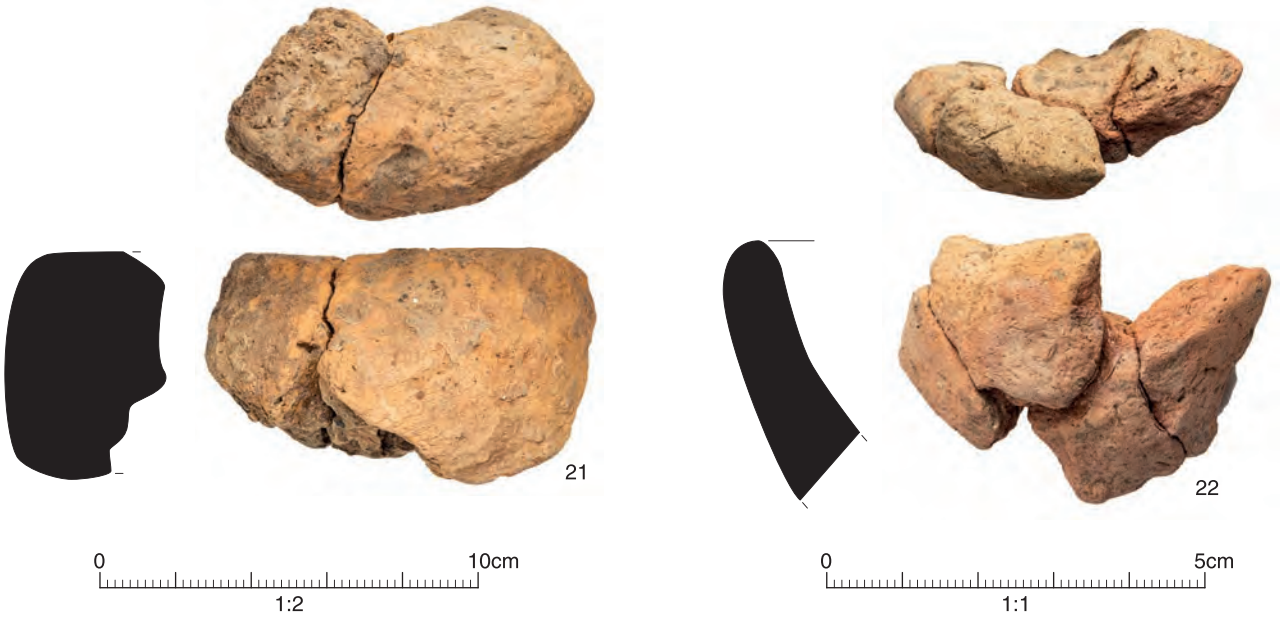

Figure 3.20 Late Bronze Age fired clay pedestal which probably formed part of an oven (21) and probably from a briquetage vessel (22). 21 from pit 1012; 22 from pit 10032

Specialist Report 14). The fragments were almost all buff white, indicating that they had been subject to intense heat, although a few black and blue-grey fragments were also present. Most of the fragments were less than 10mm across – many of them less than 4mm – and none could be identified to species. It is, therefore, unclear whether they derive from a (human) cremation or some other process. The same pit also contained five fragments of burnt antler.

Charred plant remains and charcoal by Julia Meen, Sharon Cook and Kath Hunter Dowse

Bulk samples for the recovery of charred plant remains and charcoal were taken from the fills of two of the middle Bronze Age pots – one of them the pot containing charred flax seeds in pit 141; the other one of the vessels set in a pit (113) in Pit Group 1 (Meen *et al.*, Specialist Report 16). The latter contained only a

single charred seed of *Lotus* type (as well as probably intrusive uncharred seeds) and a small amount of charcoal. The flax pit (141) contained a mixture of whole and fragmentary flax seeds, and the total of 105 is a minimum number of individual seeds based on a count of the distinctive 'beak' at the top of the seed. The large size of the flax seeds suggests that they are from a cultivated variety. The deposit was quite pure, but a single charred cereal grain and a spelt wheat glume base were also recovered.

A further middle Bronze Age sample was taken from pit 1004 at the Access Road. Alongside some charcoal, the only other charred material was a single, poorly preserved cereal grain.

Further samples were taken from late Bronze Age contexts at the Access Road and Pipeline Diversion – all from pits (including many of the pits in Pit Group 3) with the exception of one sample from a ditch. None of the samples contained large quantities of charred remains, but charred cereal grains, some of which could be identified as wheat and barley, and wheat glume bases were quite widely distributed. A small number of legumes and weeds seeds were also recovered.

THE MIDDLE AND LATE BRONZE AGE DISCUSSION

Although the extent of the excavations was limited, the middle and late Bronze Age evidence provides significant new information concerning the development of field systems and of the activities which occurred within them. Perhaps most significantly, since they were located just 2–3km from the late Bronze Age ringworks at Mucking, the discoveries provide new perspectives on the context in which the ringworks developed (Fig. 3.1). The recovery of charred plant remains provides one of the most important additions to the evidence from the excavations at Mucking itself and can be used to challenge the idea that pastoralism played a predominant role in local agriculture. The evidence for the growing of flax also adds a perhaps unexpected new dimension to the evidence in an area where previous interpretations have stressed the possible importance of sheep and wool (although it seems more likely that the flax seeds recovered at the Rail Corridor were intended for consumption rather than being directly related to textile production). In other respects, most noticeably the wide distribution of briquetage and fired clay related to salt production, the evidence from DP World London Gateway is similar to that recovered at Mucking.

Whilst the results thus provide new details of the wider context of the ringworks, it is important to note that the evidence is largely confined to the gravel terrace and head deposits. Interpretations of the evidence from Mucking have often speculated on the use of the marshes lying below the site towards the river. Whilst the London Gateway investigations have provided evidence for later Bronze Age activity on the tidal flats, this is limited to (often residual) artefacts and can, as a result, provide little extra detail of the way in which this area was used.

The environmental evidence recovered from a peat deposit (G39) and alluvial deposits (G5b) in a channel at Stanford Wharf Nature Reserve provide evidence for the character of the environment in the late Bronze Age and Iron Age (Biddulph *et al.* 2012b). The range of habitats represented by the evidence – salt marsh, alder and willow carr, open grassland possibly including pasture, and woodland dominated by oak and hazel but including also birch, pine, elm and lime – are similar to those which characterised the preceding periods, but the evidence suggests that there were changes in their distribution and extent. Most notable is the decline in oak and hazel, which suggests a decline in the extent of local woodland. This could be due to clearance associated with the expansion of field systems in the late Bronze Age but could also reflect the expansion of brackish conditions along the terrace edge, since sea levels were rising and the lower ground would probably have been periodically flooded. Middle and late Bronze Age radiocarbon dates obtained from samples from the palaeosol underlying the alluvial deposits show that alluviation continued into the late Bronze Age. Unfortunately none of the alluvial and peat deposits from which most of the environmental evidence was recovered can be dated to the middle Bronze Age and consequently the changes in the environment which may well have accompanied the original laying out of the field systems in that period are unclear.

Field systems

Although, as a result of the limited areas investigated, the picture is rather fragmented, the excavations provide evidence for the existence of possibly rectilinear ditched field systems which appear to have been first set out in the middle Bronze Age but which continued in use and may have been extended in the late Bronze Age (see Figs 3.3 and 3.6). As will be discussed further below, they thus suggest that the field systems were in use at the same time as the Chadwell St Mary and Mucking ringworks.

It is important, however, to understand the limitations of the evidence from the excavations. At the Rail Corridor, short sections of three ditches were found, but only one of these contained any finds, and that amounted to just a single sherd of middle Bronze Age pottery. Whilst the nearby pits can be dated with more certainty to the middle Bronze Age, the ditches cannot be regarded as being reliably dated. Although the Rail Corridor ditches do not clearly form a rectilinear pattern which might confirm that they were related to a field system, unless they formed some kind of enclosure the best parallels for such ditches in the middle Bronze Age are provided by field systems which, as has been noted above, are quite widely represented in south Essex.

The evidence for a field system at the Access Road and Pipeline Diversion is more extensive and, although

the view of it provided by the excavations is limited, it nonetheless provides stronger indications that the ditches may have been related to a rectilinear field system. Whilst the greater quantities of pottery and fired clay recovered from the excavations in these areas provides much stronger evidence that the field system dates from the later Bronze Age, it is difficult to define the chronology in more detail and to determine how the northern and southern sections of the field system were related. The two sections appear to have been aligned slightly differently. The extent of both sections appears, however, to have been almost entirely confined to the gravel terrace (although the southern section does extend some way onto head deposits), and rather than reflecting a difference in chronology, the difference in the alignment of the two sections could instead reflect the fact that they followed the irregular edge of the terrace.

The only evidence for the date of the northern section is provided by a single late Bronze Age sherd, although some of the fired clay and the briquetage also suggest a late Bronze Age date. In contrast, most of the pottery from the southern section was middle Bronze Age, but the presence of later pottery – both late Bronze Age and late Bronze Age–early Iron Age – and fired clay and briquetage suggest that the ditches remained open throughout those periods.

The sequence of development may have been slightly different to that at Mucking. The field system at Mucking has been broadly attributed to the middle Bronze Age, and part of it was cut by the construction of the South Rings, but Evans *et al.* (2015, chap. 2) also suggest that parts of it in the north of the site may have been extended in the late Bronze Age. The sequence was inverted at Chadwell St Mary, where the ringwork was cut through by a ditch which formed part of a system of late Bronze Age enclosures (Newton forthcoming). A more complex sequence of development was found at North Shoebury, where a set of middle Bronze Age rectilinear enclosures, perhaps part of a field system, were replaced by a late Bronze Age trackway and other ditches, again perhaps forming a field system, which was set out on an alignment which differed from that of the middle Bronze Age enclosures. Further boundaries were added to the late Bronze Age system in the early Iron Age (Wymer and Brown 1995). The sequence at London Gateway was perhaps most comparable to that at Mucking, with a northern extension in the late Bronze Age, set out on a different alignment to the middle Bronze Age southern field system. Although there was no early Iron Age development at the Access Road and Pipeline Diversion comparable to that at North Shoebury, the excavations do provide clearer evidence, paralleling that at Chadwell St Mary, for the continued used of field systems or enclosures in the late Bronze Age than was found at Mucking.

The date at which the field systems at London Gateway fell out of use is unclear. Sufficient late Bronze Age–early Iron Age pottery was recovered from the field system ditches to show that some of them survived at least as open features into that period. The recovery of five middle Iron Age sherds from one of them suggests that some of them might have remained open until much later, but it is also possible that the middle Iron Age pottery reflects local disturbance, and the paucity of Iron Age finds overall suggests that, as at Chadwell St Mary, the level of activity occurring in the area of the field system in that period was very much reduced compared to the Bronze Age.

The limited extent of the London Gateway excavations makes it difficult to estimate the likely size of the fields defined by the field system, but what evidence there is suggests that they may have been quite large, with widths in some cases of 55m and 75m, although there might also have been much larger plots measuring around 200m across, as well as smaller subdivisions. Ladle and Woodward (2009, table 120) have collated the dimensions of plots within field systems from southern England. The examples they list range in size from just 25m across up to 120m across, but measurements of around 40–70m are most common, and the likely size of the examples at London Gateway thus seem typical of such Bronze Age field systems more generally. Interestingly, the largest examples listed by Ladle and Woodward, with dimensions of 170 x 120m are at Mucking. It nonetheless seems likely that the apparently larger plots at London Gateway, measuring 200m across, were subdivided internally and that their large size reflects the limitations of the trenching.

The use of the field system: charred plant remains

The evidence from London Gateway includes one further element which has significant implications for our understanding of the field system. Previous interpretations of the ringworks at Mucking and of field systems in general have stressed their relationship with pastoralism. Bond (1998, 52; see also Evans *et al.* 2015, chap 2) suggested that the agricultural economy of the North Ring was primarily pastoral, perhaps involving transhumance between the terrace and the estuarine marshes, and Yates (2001; 2007) has drawn attention to the presence of droveways and waterholes and argued more generally that field systems were related to intensive livestock rearing. It is important to note that the scarcity of animal bone from Mucking and Chadwell St Mary and from London Gateway, other than calcined fragments, is almost certainly a reflection of poor preservation due to acidic soil conditions. Charred plant remains were not systematically recovered from Mucking, but the almost ubiquitous occurrence, albeit always in small quantities, of charred grain, wheat glume bases and occasionally also a small range of weed seeds where samples were taken from middle and late Bronze Age features at London Gateway and at Chadwell St Mary could be taken to suggest that arable agriculture might have played a more important role than has previously been suggested.

Rather than implying that arable was, in fact, more important than pastoral agriculture, it is, however, more

plausible to see this evidence as supporting Evans *et al.*'s (2015, chap. 2) suggestion that the agricultural regime was mixed. The field systems on the gravel terraces could, then, have been used to protect arable crops, to control the grazing of livestock on the stubble after the harvest, and to concentrate manure on the fields.

It is, however, important to note that however wide its distribution, the charred grain recovered from the Access Road and Pipeline Diversion does not definitively prove that the crops were grown there. The composition of richer assemblages of charred plant remains from the late Bronze Age enclosure at Lofts Farm, where glume bases were well-represented but evidence for the earlier stages of crop-processing was not found, was used to support the suggestion that pastoralism, again involving the use of estuarine marshes, was also predominant there (Brown 1988, 294–5). In the case of Lofts Farm, this argument is supported by the observation that because of the poor soil and high ground water levels in the winter, the surrounding land is not well suited to arable agriculture. Whilst such arguments do not apply to the gravel terraces in and around the London Gateway sites, given the potentially important role that the ringworks played in trade and exchange, it is possible that grain was 'traded' in rather than having been grown in the surrounding field systems. The charred plant remains from London Gateway are too limited to allow any detailed interpretation of the stages of crop processing represented, but the presence of a number of wheat glume bases could be taken to suggest that the last stages of crop processing took place nearby (Stevens 2003, 63–4, fig. 1).

It is also possible that chaff was deliberately taken to the London Gateway sites for use as temper in briquetage (Barclay *et al.* 2006, 107) or to provide fuel for salt extraction (which does not require high temperatures: Riehm 1961, 184; Kinory 2011, 33–4). The densest distribution of charred plant remains occurs in late Bronze Age Pit Group 3 on the Access Road, which also contained the largest group of briquetage, and where charred grain occurred in other pits they also tended to contain briquetage. This apparent association could, however, merely reflect the quite wide distribution of both briquetage and fired clay.

There is, however, one other form of evidence which suggests that grain may have been grown locally and was linked to the nearby ringworks. The ringworks at both Mucking and Chadwell St Mary were associated with large numbers of perforated fired clay plates. At Mucking, by far the largest concentrations of fired clay plaques were associated with the North Ring (where 16kg of fragments were recovered; Bond 1988, 39) and the South Rings (where 210 fragments weighing 12.5kg were found; Evans *et al.* 2015, chap 3, fig. 3.19). At Chadwell St Mary, the majority of the fired clay consisted of fired clay plates (370 fragments weighing 9.5kg), the largest concentrations of which were concentrated in features within the ringwork and just south of it (Newton forthcoming). If Champion's (2014, 289–92) suggestion that fired clay plaques were used for baking (and for baking bread in particular) is correct, then the ringworks would appear to have played a significant role in the production of bread or other forms of food. Such a role would fit well with the widespread occurrence of charred grain and chaff in the features at London Gateway and the field systems could be seen as having provided the grain which was baked in the ringworks.

The pits

Although limited in numbers, many of the pits contained deposits which provide significant evidence for activity in and around the field systems. A few of the middle Bronze Age pits contained partially intact vessels which may represent evidence for the primary use of the pits for storage. A number of them contained large deposits of fired clay and briquetage which suggest a quite direct link between the finds from the pits and a specific set of activities related to salt-making. There are also, however, a range of pits containing small quantities of mixed debris which were probably secondarily deposited in the pits after they had gone out of primary use. The quite widespread distribution of charred grain (albeit in small quantities) in these pits has already been noted in relation to the question of whether the field systems were used primarily for pastoral or mixed agriculture. The presence of both these mixed deposits and deposits apparently related to more specific activity also, however, raises a more general question concerning whether the pits were related to everyday occupation or to specific activities.

The primary use of the pits

As is common on prehistoric sites, there is little evidence for the primary use of the pits beyond their size and shape. At Mucking two groups of pits were identified (Evans *et al.* 2015, chap. 2) which appear to have had specific primary uses: clay pits (which were used to store clay) and pink pits (with characteristic reddish or pink layers of fill which may have been derived from salt extraction and were perhaps produced by a process similar to that which produced red hills: see Biddulph *et al.* 2012b, 13–14). No comparable features were identified at London Gateway (despite the general similarity of the features on the two sites in the middle and late Bronze Age).

Only one pit at London Gateway – pit 109 in Pit Group 1 at the Rail Corridor – showed evidence of having been affected by heat. A thin layer of charcoal was found on the base and sides of this pit but it contained no other finds and neither it nor the nearby pits provided any further indication of what its primary use may have been. No briquetage was recovered from the pit group and there is no indication that it was used to extract salt. Apart from the possible fragment of briquetage from pit 130 in Pit Group 2 at the Rail Corridor there is no evidence for salt-making prior to

the late Bronze Age at London Gateway or other sites in the surrounding area (Kinory 2011, appendices 1 and 5). Indeed, as will be discussed further below, although there is clear evidence for salt production in the middle Bronze Age (Kinory 2011, 30–3; Barclay *et al.* 2006, 106–8), such evidence is scarce, and it is only in the late Bronze Age that more extensive evidence is found. Despite the presence of occasionally significant quantities of briquetage and fired clay from hearths or ovens and from oven furniture, no *in situ* evidence for hearth or oven structures was found. A rectangular late Bronze Age feature which may have formed part of an oven was found at Chadwell St Mary but it was not associated with either briquetage or fired clay (Newton forthcoming) and the way in which it was used is unknown.

Some of the middle Bronze Age pits in Pit Group 1 do, however, provide evidence which suggests that some of the pits were used to store material in pots. Two of the middle Bronze Age pits (pits 106 and 113) contained the truncated bases of vessels. The charred flax seeds from pit 141 were also recovered from a partially complete vessel, again set in a small pit, measuring 0.4m by 0.14m deep, which was only just bigger than the pot. Two further pits (1004 and 2017) contained partially intact pots, but these were much wider (but not deeper) pits which also contained significant groups of fired clay and the processes involved in the deposition of the artefacts are discussed further below.

Unfortunately, although they contained partially intact pots, only the example in pit 141 provides much detail of the size of the pot. Pit 141 contained a large barrel-shaped vessel with a diameter at the rim of 0.32m. It would thus fall amongst the larger of the middle Bronze Age vessels at Mucking (Evans *et al.* 2015, fig. 2.42). The pot from pit 106, however, may have been smaller, since its base had a diameter of 0.15m.

The occurrence of the deposit of charred flax seeds in pit 141 could be taken to support the idea that these pots formed, in some sense, special deposits. It is, however, also possible that the partially intact vessels in the other pits reflect the use of the pits to store material inside the pots. Similar examples of intact pots in small pits were found at Mucking (Evans *et al.* 2015, chap. 2) and North Shoebury (Wymer and Brown, 1995, 21, 80, fig. 18). The pits are certainly too small to have been much use for grain storage in the way suggested by Reynolds' (1974, 126–7) experiments, but their use to store material inside pots could explain their small size.

Deposition in the pits: exceptional but not special deposits

Analysis of the patterns of deposition in the other pits suggests that a number of them contained what might be termed exceptional but not special deposits. That is, the deposits stand out from the more usual mixed debris retrieved from prehistoric pits, because of the presence of notable quantities of particular categories of finds – in this case fired clay and briquetage – but the material is, nonetheless, fragmentary and incomplete, and need not be regarded as having been specially placed or otherwise deposited as the result of any special treatment.

Based on their observations in Highland Mayan villages, Hayden and Cannon (1983) outlined a useful model of the ways in which rubbish may be disposed of. In their model, much of the rubbish generated by everyday life is initially discarded in provisional dumps in locations usually quite close to the locations in which it has been generated, and, when such accumulations become a nuisance, is then secondarily disposed of in more out of the way locations such as pits, streams or ravines. Such a pattern of behaviour can be used to explain the mixed assortments of broken artefacts and other material – typically largely consisting of pottery and animal bone but also occasionally including fired clay, charred plant remains and a few other stray items – which are often recovered from later prehistoric pits and ditches. A number of the pits at the Access Road and Pipeline Diversion did not conform very well to this characterisation. Even where a mixture of finds was found, it was sometimes the case that a particular category of material stands out, suggesting that rather than deriving from the mixed debris generated by everyday life, the contents of the pits in large part derive from a more specific set of activities.

The assemblage of finds – consisting of five fired clay pedestals which may have been used as supports for items in a hearth or oven, the heated-affected pots, burnt unworked flint, the cremated bone and the charcoal – recovered from middle Bronze Age pit 1004, for example, all suggest that the contents of the pits were largely derived from activities related to an oven or hearth and were deposited directly into the pit once that activity was over (rather than becoming mixed with other finds before being deposited). The exact character of this activity is unclear. There is no indication that it was related to salt extraction and if the cremated bone does not indicate a relationship with funerary rites some other process involving heat must be envisioned.

The concentrations of fired clay and briquetage in some of the pits in late Bronze Age Pit Group 3 provide another example where specific groups of material may have been deposited quite directly into pits. Only two of the pits in this group contained large groups of briquetage and fired clay, and each of the pits appears to have contained material from a specific source. Pit 1012 contained by far the largest group of fired clay, all of which could have derived from a hearth or oven, whereas pit 1027 contained briquetage, almost all of which derived from oven furniture (consisting of plaques, props and supports, and a hand-squeezed lump), although a single fragment from a briquetage vessel was also recovered. The only other fired clay or briquetage recovered from this pit group consisted of a single fragment from a briquetage vessel and three fragments possibly from a hearth or oven from pit 1033 and a single fragment of fired clay from pit 1030, the original form of which could not be identified. It is possible that the quite large quantity of fired clay in late Bronze Age pit 2017 also derived in a similarly direct manner from a specific

Figure 3.21 Summary of mean sherd weight and mean weight of fragments of fired clay and briquetage from middle and late Bronze Age features

episode of activity, but the fired clay is too fragmented for its original form to be identified.

Some support for the idea that the fired clay and briquetage in Pit Group 3 derived more directly from the activity which generated it than the other fired clay is provided by an analysis of the mean size of the fragments from specific contexts. The mean sizes of the fragments of fired clay and briquetage from both pit 1004 and Pit Group 3 were both much higher than those from other contexts (Fig. 3.21). When applied to the pottery, the same analysis picks out many of the pits which contained partially intact pots. The pots in pits 141, 106 and 1004 contained significantly larger sherds than almost all of the other features (although pits 130 and 10032, which did not contain partially intact vessels, also had larger mean sherd weights than most of the other features).

Other evidence from the pits

The more fragmentary character of the finds from the other pits and from the ditches suggests that the finds from them might have been deposited as a result of processes more similar to those envisaged by Hayden and Cannon (ie, that they were initially discarded elsewhere and only later became incorporated into the features). These finds consist of small quantities of small sherds of pottery, small fragments of fired clay, occasional pieces of worked and burnt unworked flint, and limited quantities of charred plant remains, including grain, and charcoal. The quite widespread distribution of these finds, although the quantities are small, raises the question of whether pits were related to specialised activity sites primarily involved in activities such as salt-making or to more general, everyday occupation, and if so, what form that occupation took – was it seasonal occupation related to agricultural activity in the field system or its surroundings, or a place of permanent occupation? Before looking in more detail at these questions it is worth considering the character of the more specialised activities.

The pits as evidence for activity in and around the field syste

The exceptional deposits from the pits (and the more fragmentary debris from the pits and ditches) suggest that a range of activities were carried out in and around the field systems. Of these, salt production is quite clearly identifiable from the remains of salt-discoloured briquetage (Fig. 3.22). The other activities, involving the use of fired clay pedestals not related to salt production, and the charred flax seeds, are less clearly defined but need not have been less significant (Fig. 3.22).

Flax

The discovery of a group of charred flax seeds deposited in a large pot in a small pit is an unusual find. Flax may well be under-represented in the archaeological record. It forms part of early Neolithic assemblages across Europe (Rast-Eichner 2005), and flax seeds and impressions of flax seeds in pottery have been found in early Neolithic contexts in Britain at The Stumble, Essex (Wilkinson and Murphy 2012, 84–7), Lismore Fields, Derbyshire (Wiltshire and Edwards 1993, cited in Wilkinson and Murphy 2012, 87) and Windmill Hill, Wilts (Helbæk 1952, 199), as well as in Beaker and early Bronze Age contexts at Belle Tout, Sussex (Bradley 1970, 361, 375) and Handley Barrow, Dorset, (Ashbee *et al.* 1989, 83–4). Seeds were also recovered from the early to middle Bronze Age site at West Row Fen, Suffolk (Martin and Murphy 1988, 355; Murphy and Jones 1983). Linen is commonly recovered from waterlogged Neolithic contexts around the Alps (Leuzinger and Rast-Eicher 2011; Herbig 2009; Maier and Schlichterle 2011), and prior to the adoption of wool in the Bronze Age (Serjeantson 2011, 29; Ryder 1987) flax could well have been a major source of textiles in Britain too (Henshall 1950; Cameron *et al.* 2016). The Alpine sites also provide evidence suggesting the consumption of flax (Maier and Schlichterle 2011, 568–9; Herbig and Maier 2011), and direct evidence is provided by the much later (Iron Age) bog bodies from Tollund and Kayhausen in Denmark and Germany (Helbæk 1950; Nielsen *et al.* 2018; Behre 2007, 67).

Although present in earlier contexts, flax remains have only been identified more widely in later Bronze Age contexts (Tomlinson and Hall 1996), at, for example, Must Farm, Cambs (Knight *et al.* 2019, 658), the Wilsford Shaft, Wilts (Ashbee *et al.* 1989, 83–4), Aldermaston Wharf, Reading Business Park and Weir Bank Stud Farm, Berks (Bradley *et al.* 1980, 246–7; Moore and Jennings 1992, 106–10, 122; Barnes and Cleal 1995, 35, 43), Runnymede Bridge, Surrey (Needham 1991), and Heathrow, Greater London (Framework Archaeology 2006, 155; 2010, 23–4, 183, 185). More locally, a single fragment of a flax capsule was found in a late Bronze Age pit at Chadwell St Mary (Newton forthcoming).

At West Row Fen, Reading Business Park and Heathrow the remains of flax have been linked to waterlogged pits and hence to retting and textile production. It seems more likely, however, that the charred seeds found on the Access Road site were intended for consumption, even if the surrounding area might well have provided a suitable location for retting (Hurcombe 2014, chap. 2). The presence of a deposit of charred seeds within a pot perhaps suggests an attempt to roast the seeds to make it easier to remove the capsule and grind the seeds, either to extract the oil or to consume as seeds. Although it is possible that the seeds were burnt during an attempt to dry them for storage, it seems unlikely that such a process would be best carried out by placing the seeds in a pot. Given the evidence provided by the later bog bodies mentioned above, a culinary use seems more likely. Although no parallels have been found for deposits in pots in Britain, similar deposits have been found in some of the Neolithic sites in the Alpine foreland (Maier and Schlichterle 2011, 569). Consumption of flax seeds or oil need not exclude the use of the plant stems to make textile, since the

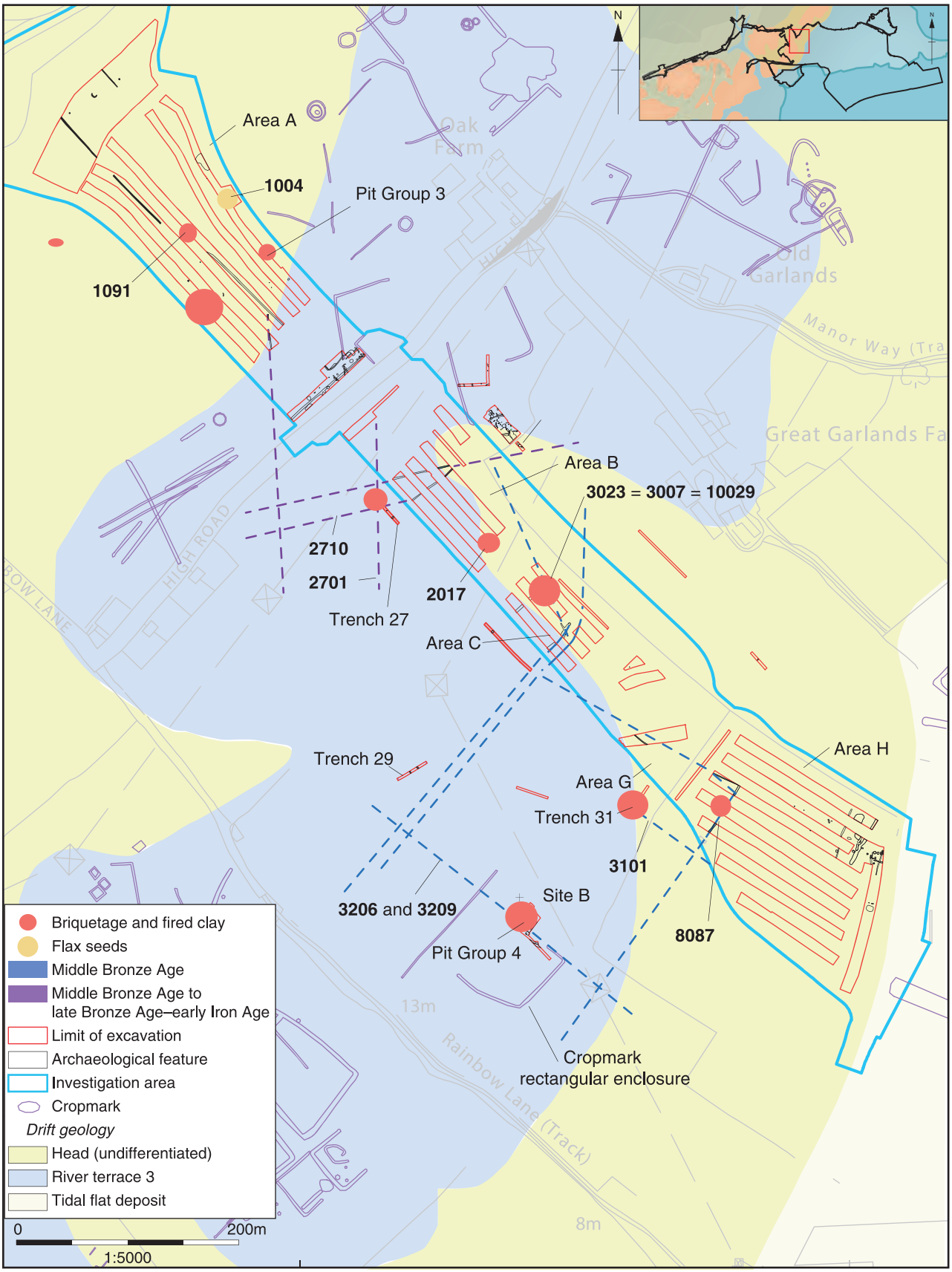

Figure 3.22 Distribution of briquetage, fired clay and the charred flax seed deposit, Access Road and Pipeline Diversion

seeds are likely to have been removed before the fibre was extracted (Hurcombe 2014, chap. 2).

As has been noted above, the discovery of a deposit of charred flax seeds adds a new dimension to our understanding of the area and of the ringworks at Mucking. Previous interpretations (eg Bond 1998, 52; Jones and Bond 1980, 478, cited in Evans *et al.* 2015, chap 3) have often suggested that the pastoral economy of the area involved a pattern of local transhumance in which sheep grazed on the estuarine marshes in the winter. And this suggestion has been linked to the presence of spindle whorls and fired clay pedestals – interpreted as loomweights – which are taken to underline the significance of wool and the production of textiles from it (eg Barford 1992). The occurrence of the deposit of charred flax seeds at the Access Road suggests, however, that alongside (or perhaps even instead of) wool, flax might also have played a significant role in textile production. Analysis of late Bronze Age plant fibres from Must Farm in Cambridgeshire has shown that they were made using splicing rather than spinning (Gleba and Harris 2019). Whilst the spindle whorls found at both the South and North Rings (Evans *et al.* 2015, chap. 3, table 3.19; Bond 1988, 37) may not have been used to spin flax, their varied forms suggest they may have been used in various ways. As well as spinning wool they could have been used to ply spliced flax yarn together or to add twist to it (Gleba and Harris 2019, 2341; cf. Rast-Eicher 2005, 121).

Salt production

Alongside the use of flax, the pits also provide evidence for the production of salt. Evidence for salt extraction has been found at much earlier dates on the Continent than in Britain (Harding 2013, chap. 4). Although it is quite possible that salt was extracted at earlier dates in ways which have left no archaeological trace, the earliest evidence of salt production (Kinory 2011, 30–1; Morris 2007) using briquetage in Britain dates from the middle Bronze Age at Brean Down, Somerset (Bell 2014), and at a number of sites in the East Anglian Fens including Northey (Gurney 1980), Padholme Road, Fengate (Pryor 1980, 18, 181), Brigg's Farm, Thorney (Pickstone and Mortimer 2011), and Pode Hole Quarry (Daniel 2009, 74), all in Cambridgeshire, and Billingborough in Lincolnshire (Chowne *et al.* 2001, 58; Morris 2007). The small fragment from middle Bronze Age pit 130 in Pit Group 2 at the Rail Corridor could, then, be amongst the earliest briquetage in Britain. Unfortunately, it is too small be identified with any certainty and in the absence of other evidence from Essex the idea that salt was extracted using briquetage in the middle Bronze Age in the Thames Estuary remains unconfirmed. There is no evidence from the Kent side of the estuary for the use of briquetage before the late Bronze Age (Barclay *et al.* 2006, 61).

As elsewhere in Essex and Kent – and in particular at Mucking – definite evidence for the use of briquetage appears at London Gateway in the late Bronze Age (Kinory 2011, fig. 4; Barclay *et al.* 2006, 104–8; Evans *et al.* 2015, chap. 3). It has been suggested that because of the distance of the sites at Mucking from the estuary, the briquetage recovered there might reflect the production of briquetage (and perhaps also the use of salt) rather than the extraction of salt (Jones 1977; Evans *et al.* 2015, chap. 3). The same question has been raised in relation to the evidence from Kent (Barclay *et al.* 2006, 107), and given their distance from the water, also arises for the Access Road and Pipeline Diversion (and nearby sites such as that at Corringham; Barford 1984). As Evans *et al.* (2015, chap. 3) also note, however, the evidence that the briquetage at Mucking has been discoloured by use indicates that it had already been used before deposition. The same argument applies to the briquetage from London Gateway, which displays similar white and mauve discolouration.

It is important to remember that creeks probably brought salt water closer to both Mucking and London Gateway (see Chapter 5) than is at first apparent, and that the process of salt extraction would have involved bringing together clay and fuel as well as brine or wet salt. That may partly explain the distance of the salt extraction sites from the estuary. It is also possible that the process of extracting salt involved more than one stage. The initial stage, involving either solar evaporation or more likely heating of brine, may have taken place nearer to the water (and may be buried below alluvial deposits) and only the second stage, involving the final drying and shaping of the salt, may have used briquetage at locations further inland, such as those at London Gateway and at Mucking (Bell 2014, 171). Gouletquer (1988) has stressed the importance of concentrating the brine before it is finally crystallised and dried. Experiments by Tencariu *et al.* (2015, 127) suggest that reducing liquid brine to salt in briquetage is difficult (leading to the formation of only a soft salt cake and often cracking the briquetage vessel) and supports the idea that a two stage process, in which the brine is initially reduced to a paste before being dried in briquetage vessels, is most likely.

The differences in the quantities of different types of briquetage at different sites may provide further insight into the process involved in the extraction and distribution of salt. At London Gateway the concentration of particular types of briquetage in individual pits has been noted (such as the concentration within Pit Group 3 of fragments from a hearth or oven in pit 1012 but of oven or hearth furniture in pit 1027) and it has been suggested that this reflects debris being deposited quite directly into the pits when the corresponding activity was finished. There were also, however, gross differences in the proportions of different kinds of briquetage which occur at different sites. At London Gateway most of the briquetage derives from oven or hearth structures (6508g in total). There was also a quite high proportion of fragments from oven or hearth furniture (1055g) but fragments of briquetage vessels were scarce (141g; there was also 850g which could not be classified). The scarcity of briquetage vessels seems also to be characteristic of the northern area of the excavations at Mucking

(Evans *et al.* 2015, chap. 3) where just 210g were classified as coming from vessels compared to 16.9kg of fragments from pedestals. The briquetage recovered from the South Rings, in contrast, was dominated by vessel fragments (4384g), although it also contained an appreciable but smaller proportion of pedestals (3364g) as well as a small proportion of 'angles' (685g). Briquetage was also recovered from the North Ring, but the exact proportions are unclear.

Noting these differences in the proportions of vessels and pedestals, Evans *et al.* (2015, chap. 3) have suggested that the ringworks played a role as both consumers and as centres of redistribution. The contrasting scarcity of briquetage vessels and the dominance of fragments from ovens or hearths and oven and hearth furniture at London Gateway and the northern area of the Mucking excavations supports the idea that salt extraction (or its last stages) was carried out in the area surrounding the ringworks and that the products were taken to the ringworks for consumption or redistribution. Kinory (2011, 118–22) has noted that there is little evidence for the wider distribution of briquetage from sources in Essex and has suggested that the salt could have been removed from the briquetage and transported in organic containers. If that were the case, the predominance of briquetage vessels at the South Rings could indicate that salt was repackaged for distribution there and hence underline the site's role as a distribution centre.

Other fired clay

The middle Bronze Age fired clay pedestal pit (1004) at the Access Road contained fired clay pedestals which do not appear to have been related to salt extraction and thus provides evidence for activities other than salt-making. The five cylindrical fired clay pedestals are, like the finds of briquetage, not an isolated find. Barford (1992) noted a concentration of both cylindrical and pyramidal fired clay pedestals in Thurrock at sites including Mucking (Evans *et al.* 2015, chap. 3), Linford (Barton 1962), Orsett Cock (Rodwell 1974) and Baker Street (Wilkinson 1988). One of the pits at Mucking contained a matching group of five cylindrical pedestals (Evans *et al.* 2015, chap. 2).

Such objects have usually been interpreted as loomweights and have, as a result, been linked to textile production, and, as has been noted above, to grazing on the salt marshes. As Poole has suggested, however, the context of such finds elsewhere, and their association with a conical pedestal in the case of pit 1004, suggests that they are more likely to have been used as oven or hearth furniture, which are likely to have been used for a range of activities involving the use of hearths or ovens. In the case of pit 1004 they were associated with two large, heat-affected jars, a small group of calcined bone and some fragments of burnt antler. None of the burnt bone could be identified as human and the deposit cannot, therefore, be linked to cremation rites. Whilst the finds are thus linked by their relationships with fire and heat, the calcined bone must have been subjected to much higher temperatures than the pots and the finds probably, therefore, derive from several different sources.

Even though the character of the associated activity is unclear, the contents of the pit and the similar finds from elsewhere in Thurrock suggest that in addition to salt extraction other, perhaps specialised activities were carried out in and around the field system in both the middle and late Bronze Age.

Other finds: settlement or specialised activities?

Alongside the more striking deposits related to flax, salt extraction and whatever process was associated with the finds from pit 1004, the pits also contained small quantities of other finds – smaller pot sherds, occasional worked and burnt flint, and sparse but widely distributed charred plant remains. Whilst all this material could have been related to the more specialised activities associated with the pits, they could also be seen as being typical of domestic debris associated with everyday life. The widespread distribution of charred plant remains, for example, could reflect the use of chaff as temper or as fuel for salt extraction, but could equally derive from the later stages of crop-processing and thus reflect occupation. The perforated fired clay plates also provide evidence for activity, probably related to cooking, and perhaps bread-baking in particular, which suggests that some of the activity evidenced by finds from the pits could have been quotidian in character. The question arises, then, whether the pits were related primarily to specialised activities or were part of a more general occupation of the area.

There is no easy way of answering this question. The absence of structures, such as post-built roundhouses, even though they were found in the ringworks at Mucking, is not decisive evidence against the idea that the pits mark the location of settlement. At both Mucking outside the ringworks and other sites where the lack of roundhouses has been noted (such as Heathrow; Framework Archaeology 2010, 135), concentrations of debris have been used to identify centres of occupation, and the same argument could be applied to London Gateway (even though the quantities of finds are small).

Even the scale and duration of activity is difficult to assess. The quantities of finds are largely a reflection of the number of cut features present rather than a straightforward indication of the scale, duration or intensity of activity. The presence of fragmentary material indicates that not all the debris was deposited in pits or ditches, and surface material has either not survived or was not recovered (Evans *et al.* 2014). The number of features appears less dense than was the case at Mucking, but again this may be partly a product of the less extensive excavation at London Gateway.

The contrast with the evidence from the ringworks is, however, clear, and suggests a quite different form of occupation. The differences could be explained in a number of ways – by the status of the occupants or by the association of the ringworks with feasting or ritual

(Evans *et al.* 2015, chap. 3; Bradley 2007, 208–10) – but it is difficult to resist the idea that the pits were related to briefer, perhaps seasonal episodes of settlement, perhaps predominantly related to specialised activities. It has been suggested that salt extraction would have been a seasonal activity (Bradley 1975; Kinory 2011, 35–8) which could have been scheduled around other activities including the agriculture related to the field systems and the marshes. It is noticeable that unlike the red hills, which began to form in the middle Iron Age at Stanford Wharf Nature Reserve (Stansbie and Biddulph 2012), the locations at which salt was extracted in the late Bronze Age appear only to have been used for short periods – possibly for single episodes of extraction – rather than accumulating over long periods. Such a pattern of short episodes at different locations could reflect the integration of salt extraction with other shifting activities.

Activity on the tidal flats

The late Bronze Age sherds found on the tidal flats on the excavated sites provide no more than evidence that the lower ground, running down to the estuary, was exploited in the later prehistoric period, and thus do not contribute in any other significant way to our understanding of how this area may have been used. As has been noted above, it has been suggested that the marshes may have been used for grazing sheep (Bond 1998, 52; Jones and Bond 1980, 478, cited in Evans *et al.* 2015, chap 3) and for the primary stages of salt extraction. In east London a number of trackways, causeways and other features have been found which provide evidence for activity in the later Bronze Age, including grazing animals (although most date from the middle Bronze Age; Meddens 1996; Stafford *et al.* 2012, chap. 10).

The DP World London Gateway sites as a context for the Mucking ringworks

The Mucking ringworks lie just 2–3km from DP World London Gateway, and the fact that the London Gateway sites provide a wider context for the development of the ringworks at Mucking adds to their significance. It is important to stress that the ringworks at Mucking date from late in the Bronze Age. Evans *et al.* (2015, chap. 3) suggest a date range of 900 to 700/650 cal BC for the South Rings, and, whatever its precise chronological relationship with the South Rings, the North Ring must date from the same broad period. Much of the evidence found at London Gateway, even that from the late Bronze Age, could have pre-dated the Mucking ringworks, but the recovery of late Bronze Age–early Iron Age pottery from some of the pits and ditches suggests that the field system ditches remained open and activity continued during the period in which the ringworks (which also contained late Bronze Age–early Iron Age pottery) were occupied. As has been noted above, the ringwork at Chadwell St Mary (Newton forthcoming) may date from a slightly earlier period than the Mucking ringworks, but it lies a further 3km to the west and thus any relationship with London Gateway may have been less direct.

As has been noted above, exactly how the form of the ringworks should be interpreted is open to question (Evans *et al.* 2015, chap. 3; Bradley 2007, 208–10), and the discoveries at Chadwell St Mary ringwork, lacking some of the finds (such as evidence for metalworking and for salt production) which suggest a special status for the ringworks at Mucking, adds a new dimension to our picture of their development which it is impossible to pursued here. They may provide an indication of how the role of ringworks developed over time.

It is, however, clear that the ringworks stand out from other forms of settlement and it is easy to see them as having had a special status. Whatever their roles in ritual and feasting (Evans *et al.* 2015, chap. 3; Needham 1992, 52–6), it is impossible to ignore the evidence at Mucking for the possible social and economic aspects of their status. Interpretations have often stressed the strategic position of the ringworks, overlooking the Thames, and the role they are likely to have played controlling trade or exchange (Evans *et al.* 2015, chaps 4 and 6; Yates 2007, chap. 12; Fig. 3.1). At the same time, their association (and that of other ringworks, such as Springfield Lyons: Brown and Medlycott 2013, 47–74; and South Hornchurch: Guttman and Last 2000, 344) with the production of metalwork and weapons – swords in particular (although they are not restricted to ringworks: Brown and Medlycott 2013, table 3.7) – has also often been stressed. The evidence from London Gateway provides further evidence for the importance of a range of different forms of production in the emergence of the ringworks and suggests that as well as controlling trade into and along the river Thames, they may also have played an important role in distributing material produced nearby. It also raises the question of how the distribution of this variety of materials was organised.

London Gateway provides evidence for an uncommonly wide range of production – field systems for mixed farming, salt extraction, the use of flax, possibly for consumption but perhaps also related to textile production, and whatever other activities were related to the fired clay – to add to the metalworking evidenced at the ringworks. It is impossible to be certain that this production was directly related to the ringworks at Mucking but lying just a few kilometres away it is unlikely that there was no relationship.

Much of this evidence has been noted previously, notably in the excavations at Mucking itself, but also at other sites. Although Yates has observed an association between field systems and ringworks, he also notes that field systems have a much wider distribution. As has been stated above, evidence for flax cultivation is also widespread in the later Bronze Age, and, as Needham and Bridgford (2013) show, even evidence for metalworking occurs at a wide range of sites.

The evidence also, however, suggests a gradual intensification in production. It has been suggested that the creation of field systems reflects agricultural intensification, and Gouletquer (1988) has suggested that the elaboration of the process involved in extracting salt is dependent upon the scale of extraction. The adoption of briquetage, possibly from Continental sources (Barford 1984, 140; Jones 1977), could be seen as a means of intensifying production – not, as Kinory (2011, 35–8) stresses, to a full-time specialised occupation, but above the level implied by simpler techniques of extraction. Any such intensification implies the existence of some use for the products and thus either local changes in lifestyle or a widening population who could acquire the products through exchange. Whilst much of the production was not unique to Mucking and its environs, it is clearly the case that intensification and the wide range of products involved created a context which was conducive to the control of distribution. The contrasts between the ringworks at Chadwell St Mary and at Mucking, if they were of different dates, may provide an indication of the increasing control of distribution exercised by the occupants of ringworks.

The organisation of exchange

The wide range of evidence for production also raises the question of how the exchange of different things was organised. The inclusion of salt amongst the list of exchanged commodities adds a particular interest since it has been used in a currency-like manner (ie, as a medium of exchange) in various contexts (eg, Godelier 1969; Abir 1966), and it has been suggested that it might have been used in a similar way in prehistory (Riehm 1961, 184–5). A detailed consideration of this question is beyond the scope of this discussion, but it is perhaps worth making a few points.

The different items and commodities could have been organised into different spheres of exchange. Such spheres of exchange have been widely reported in ethnographic contexts from the recent past (Salisbury 1962, 199 203). Although such systems can involve very elaborate distinctions (such as the 22 varieties of Dap money on Rossel Island; Armstrong 1924), they often involved a basic distinction, such as that between *gimwali* and the *kula* in the Trobriand Islands (Malinowski 1920; 1922) and between trade and the potlatch in the Pacific North-West (Drucker 1965), between a sphere of exchange in quotidian items from a prestige sphere.

It is not easy to find archaeological evidence for such differentiation, but one indication may be provided by gross differences in patterns of deposition which could reflect differences in the significance of the material involved. One such distinction could be seen in the different ways in which the kinds of artefacts found in the London Gateway features (and at contemporary sites such as Mucking) and metalwork were deposited. Yates has described the general association between ringworks and the deposition of metalwork (Yates 2001, chap. 12), which is well exemplified in Thurrock. Despite this broad spatial association and the occurrence of metalworking debris at Mucking, it is striking that very little metalwork was recovered from the excavations there (both in the ringworks and their surroundings – and what little was recovered from Mucking consisted of fragments of pins, tweezers, a strap end and a bracelet, as well as unidentified pieces) and no metalwork was found at London Gateway. Although the Mucking finds include one fragment of a socketed axe, the numerous hoards found in the surroundings include a much richer and wider range of material (Turner 1998, 75–7) in which axeheads and ingot material predominate but which also include appreciable numbers of fragments of spearheads and swords (Turner 2010, figs 5a and 6).

However these hoards are interpreted (Bradley 1990; 2016) – as founders hoards, votive deposits or in some other way – their deposition in isolated contexts rather than in centres of occupation could be taken to indicate that they were valued in a different way from other material. It is certainly easy to imagine that the exchange of weaponry, for example, would have been socially constrained and thus have formed a distinct sphere of exchange. Furthermore, the limits on the sources of both bronze and salt might have helped maintain their role in particular forms of exchange (and the potential for that exchange to be controlled).

Douglas (1967, 122), however, has suggested that gift economies can be classified along a continuum from rigidly controlled economies in which there are strictly defined spheres of exchange, through mixed economies, to freely competitive economies in which no restrictions are placed on exchange. Although few examples at the free end of this spectrum have been found, there are cases, such as that of the Kapauku (Pospisil 1963) which Douglas suggests were 'dominated by production for exchange' and 'are as thoroughly commercial as any in Western Europe or the United States' (Douglas 1967, 26). It could be argued that the separate deposition of bronze hoards simply reflects the fact that working Bronze required specialist knowledge and technology. Furthermore, the size of the Dover boat (Clark 2004), if it was used for 'trade', could be taken to support the idea of a quite commercial form of exchange.

Further discussion of this issue is beyond the scope of this volume, but it is perhaps worth adding that the social contexts of exchange may have encompassed a very wide range, extending both spatially and socially from local kinship relations to relations across the Channel suggested both by metalwork and other aspects of material culture (eg Clark 2009) and by the presence of individuals from various locations on the Continent at Cliffs Farm, Thanet, Kent (McKinley *et al.* 2014). Different forms of exchange may have mirrored these differences in social relationships. It is possible that the occupants of the ringworks played a central role in mediating between these social spheres – between the local production exemplified by the London Gateway sites and wider social relations.