

# **A MIDDLE BRONZE AGE SETTLEMENT IN THE LEA VALLEY AT NAVIGATION PARK, PONDERS END, ENFIELD**

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## **SUMMARY**

A programme of trial trenching and excavation undertaken by Oxford Archaeology uncovered a Middle Bronze Age settlement of unusual form, situated between two parallel boundary ditches and enclosed on at least three sides by a fence. Evidence was found for a single probable roundhouse as well as a smaller post-built structure and numerous pits, some of which contained small quantities of domestic refuse. Ceramic evidence and radiocarbon dating indicate that the settlement was occupied between *c* 1440-1280 cal BC and 1030-840 cal BC. Sondages dug during the evaluation identified one or more palaeochannels at the western edge of the floodplain, infilled by a sequence of peat and alluvium, and a radiocarbon date of 2200-1950 cal BC was obtained for a piece of alder root from a channel-edge colluvial deposit.

## **INTRODUCTION**

A programme of archaeological evaluation and excavation was undertaken by Oxford Archaeology between 2010 and 2015 ahead of redevelopment of part of an existing industrial estate at Navigation Park, Ponders End, in the London Borough of Enfield. The work was commissioned by SEGRO Properties Ltd in accordance with a condition of planning permission for demolition of the existing structures and construction of industrial units. The fieldwork comprised two phases of evaluation, the second of which rolled directly into the mitigation stage in order to accommodate the demolition timetable.

## **LOCATION, GEOLOGY AND TOPOGRAPHY**

The site was situated on the western side of the Lea Valley at NGR TQ 362 952 (Fig 1). It was bordered by Morson Road to the west and south, the River Lee Navigation to the east and industrial areas to the north. It lay within the historic parish of Enfield, and the administrative authority of Enfield Borough Council and encompassed a total area of 4.7ha.

The underlying solid geology was mapped as London Clay, overlain by a drift geology of Kempton Park Gravels with Holocene alluvium on the lower, eastern part of the site (BGS Sheet 256, Solid and Drift 1:50,000). However, extensive geotechnical investigation that preceded the archaeological investigation demonstrated that alluvium was present throughout. A deposit model that was constructed from the geotechnical survey results indicated that the site had formerly sloped more steeply toward the River Lea than is apparent from the modern topography, which is the result of infilling of the lower-lying areas by the accumulation of alluvium and modern made ground. The alluvial sequence varied in depth from 0.3m in the west to 3.1m in the east. The Phase 2 evaluation established that the alluvium in fact represented two distinct elements, comprising a lower layer of 'brickearth' that was cut by the archaeological features, overlain by more recent clay alluvium. The made ground was laid down in order to raise the site above flood level and create a level platform on which to construct the industrial estate and varied in thickness from 0.4-2.8m, overlain throughout the site by surfaces of concrete and tarmac. As a consequence of the artificial levelling of the site, the ground surface was generally flat and lay at *c* 13m aOD with the archaeological horizon encountered at *c* 12.3m aOD.

## ARCHAEOLOGICAL BACKGROUND

The location of the site close to the edge of the interface between alluvial deposits and the river terrace gravels may have made it an attractive location for prehistoric populations. During the Holocene period the Lea Valley has experienced gradual sedimentation combined with channel migration across the width of the valley floor. An example of the resultant alluvial sequences is provided by a site at the former Delta Cables Works, Millmarsh Lane, c 1.8km north of Navigation Park, where peat and alluvial deposits were excavated within former river channels (Bowsher 1995). Peat towards the base of the sequence produced an early Mesolithic radiocarbon date of 7460-7080 cal BC and the excavation recovered an assemblage of 120 struck flints, dominated by flakes and blades. The peat deposits were overlain by alluvial clays and other organic-rich sediments that produced excellent palaeoenvironmental evidence and a late Mesolithic radiocarbon date of 6220-5880 cal BC. Archaeological work within the Lea floodplain in advance of the development of the Olympic Park, c 13km south of the site, has suggested that the upper alluvial deposits in the valley are likely to be of late Bronze Age to historic date (Corcoran *et al.* 2011).

Finds of Bronze Age date are particularly prevalent in the valley (Brown and Cotton 2000, 84) and several settlements have been excavated. These include a site at the Olympic Park (Powell 2012) and a settlement at Lower Edmonton that was closely associated with a field system (Bishop 2005). Field boundaries were also uncovered at Innova Park, 4.5km north of Navigation Park, and although the settlement form here was less certain, midden deposits and riverside revetments were recorded (Ritchie *et al.* 2008).

There is little evidence from the surrounding area for occupation dating to the late prehistoric and historic periods, although the River Lea is believed to have marked the boundary between the territories of the Iron Age 'tribes' of the Catuvellauni to the west and the Trinovantes to the east (Robbins 2003, 12). The earliest maps of the parish show the eastern extent of the site as marshland, with the western part lying within common arable fields. Although these maps date to the post-medieval period, it is likely that the land usage was similar during the medieval period.

The landscape of the Lea Valley changed significantly over the course of the post-medieval period as measures were taken to improve management of the river, the most significant of which was the granting in 1767 of an Act for the construction of a new channel, the River Lee Navigation, which extends on a parallel course to the original river and forms the eastern boundary of the site. The valley floor has also been substantially quarried for gravel, resulting in the creation of a string of lakes and reservoirs along its length. Piecemeal industrial development of the site began toward the end of the 19th century with the construction of a white lead works beside the Lee Navigation in the northern part of the site and a linoleum works to the south. By the 1930s the entire site had been developed as a cabinet works and subsequently a car parts factory, which closed in 2009.

### *Evaluation*

Two phases of evaluation trenching were undertaken (Fig 2), an initial investigation that comprised seven trenches in the southern part of the development (OA 2010) being followed by a further 19 trenches that encompassed the rest of the site (OA 2017). Middle Bronze Age features, comprising postholes, pits and a substantial N-S aligned ditch, were identified in the central part of the site, where the underlying gravel rises in elevation away from the deeper parts of the floodplain. Phase 1 Evaluation Trenches 5 and 7 and Phase 2 Evaluation Trench 6 revealed deeper sediment sequences that represent the infilling of one or more palaeochannels at the western edge of the floodplain. In these trenches, the Pleistocene gravel, representing high-energy fluvial deposition within a braided river system resulting from the melting ice of the last glaciation, was overlain by peat followed by alluvium, above which was modern made ground. The peat was more than 1.5m thick in Trench 6, and yielded a single unworked fragment of burnt flint and occasional charcoal flecks in Trench 7. The peat was absent from Trench 5, where the bottom of the alluvial sequence was represented by a deposit of gravelly silt containing small fragments of organic inclusions, from which a fragment of alder root was dated by radiocarbon to 2200-1950 cal BC (Table 5). Sondages excavated into the

Pleistocene gravels in order to investigate the organic 'Arctic Bed' deposits, which are known to be preserved within the Lea Valley, failed to identify any evidence for them; this may indicate either that the deposits are absent from this area or that they are buried at too great a depth to be exposed in the sondages.

Features dated to the later Bronze Age were identified in two trenches of the Phase 2 evaluation. Trench 3 of the Phase 1 evaluation encountered two ditches and a pit containing fired clay and burnt flint; alluvium sealing these features contained a flint-tempered pottery sherd of possible later Bronze Age date.

## **METHODOLOGY**

Two excavation areas were opened up, centred on trenches of the Phase 2 evaluation in which archaeological features had been identified. The smaller northern excavation area, which amounted to 0.02ha, failed to expose any archaeological remains and it is likely that the features that had been identified in Trench 11 were in fact tree-throw holes. The main excavation area, which encompassed an area of 0.21ha, uncovered a middle Bronze Age settlement and was progressively extended until the limits of the settlement had been exposed (Figs 3-4). The archaeological features were cut into a substrate of brickearth and were overlain by a buried ploughsoil 0.2m thick that survived intermittently where it had not been truncated by modern development. Above this were a layer of made ground and the concrete slab floor of the former car parts factory. The site was punctuated by areas of truncation associated with the factory, mostly comprising concrete ground beams and post pads. Many of these intrusions were quite small, but larger areas affected the southern part of the middle Bronze Age settlement and the area beyond the southern limit of the settlement had been almost completely truncated. The archaeological features were investigated and recorded in accordance with established OA practice (Wilkinson 1992). The archive will be deposited with the Museum of London under the accession code NVK15.

## **THE EXCAVATED SEQUENCE**

### ***Possible Late Neolithic/Early Bronze Age Pit [2212]***

A single small pit [2212] (Fig 3 and Fig 5 section 272) yielded two sherds that may derive from either a Neolithic Impressed Ware vessel or an early Bronze Age Food Vessel. Owing to the small size of the sherds, however, this identification is not certain and it is possible that the feature in fact forms part of the middle Bronze Age settlement. The feature also yielded one shattered blade-like flake in three pieces (likely to be a modern snap during excavation), an inner flake and a multiplatform flake core with thermal platform.

### ***Middle Bronze Age Settlement***

The settlement lay within a rectilinear fenced enclosure and was situated between two ditches, [2266] and [2340], that extended on parallel alignments. Two post-built buildings, [2211] and [2270], were identified, as well as numerous pits.

### ***Ditches [2266] and [2340]***

Ditches [2266] and [2340] extended on parallel NNE-SSW alignments and lay 28-30m apart (Fig 5 sections 227 and 312). Both ditches were V-shaped in profile, ditch [2266] measuring 2.4m wide and 0.85m deep and ditch [2340] measuring 1.2-1.5m wide and 0.55-0.7m deep. Each had a lower fill of bluish grey clay that may indicate deposition in standing water, overlain by upper fills that were more gravelly in character. Only a single sherd of middle Bronze Age pottery was recovered from these features, from the terminus on the north side of the entrance through ditch [2340], but their shared alignment with the fenced enclosure is strongly suggestive of a contemporary date. A continuation of ditch [2266] was exposed in Phase 2 Evaluation Trench 15, to the south of the excavation area [1504],

and it is possible that an undated ditch [3030] in Phase 1 Evaluation Trench 3, which lay on a similar alignment 50m further south, may also be part of this feature.

#### *Enclosure Fence*

The settlement between the ditches was enclosed by a fence line represented by an alignment of postholes on its north and east sides and part of the south side. The postholes were generally steep-sided, bowl-shaped features 0.3-0.7m in diameter and 0.1-0.4m deep and were mostly devoid of artefactual material, apart from three that each contained a single small sherd of pottery. No evidence was identified for the western side of the enclosure, either because the postholes here had been removed by modern truncation of the site or because ditch [2340] served as the boundary on this side. The area thus enclosed measured 23m north-south and a similar or slightly greater distance east-west. The posts were placed at intervals of 0.7-1.2m, with some larger gaps of up to 7.6m that probably represent areas where postholes have not survived truncation by later activities. The settlement was probably accessed through an entrance at the north-western corner, where a break in ditch [2340] coincided with an arrangement of postholes that is likely to represent a gateway or similar structure. The break in the ditch was 3.8m wide and comprised a simple causeway of unexcavated material, the ditch ending on either side in a rounded terminal. Parallel to the western, outer side of the causeway lay an alignment of four shallow postholes [2342] that may have supported a barrier that screened the entrance. A pair of larger postholes [2309] and [2313] lay on the inside. The southern posthole of this pair, [2313], had subsequently been replaced by posthole [2311]. It was uncertain whether the two parts of the arrangement represented separate elements of the entrance or whether they supported a structure that stood over the causeway, but it is clear that they were designed to control access across the ditch and into the settlement.

#### *Building [2211]*

The building was situated in the north-eastern quadrant of the enclosure and comprised a group of nine postholes in an oval arrangement. The postholes were extremely slight, none measuring more than 0.17m deep and several less than 0.1m deep, and defined a structure with dimensions of 3.6 x 3.0m. No artefactual material was associated with the structure.

#### *Building [2270]*

Building [2270] was rather more substantial than Building [2211] and may represent the principal domestic structure within the settlement (Fig 4). It was situated within the south-eastern part of the enclosure and comprised a group of 14 postholes that formed a horseshoe-shaped arrangement, open to the south/south-east apart from a further pair of postholes, [2201] and [2203]. It is uncertain whether the absence of further postholes on this side of the structure represented its original form or was a consequence of more recent truncation. The structure had overall dimensions of 6.5 x 6.0m. There were several instances of postholes arranged in closely-spaced or intercutting pairs, including postholes [2201] and [2203], but it was uncertain whether this represented a recurring construction technique or the replacement of posts as they wore out.

There were three instances of postholes that intersected with non-structural features. Posthole [2120] intersected slightly with a pit [2119] into which Bucket Urn <100> had been inserted (Fig 5 section 243 and Fig 6). The vessel stood upright on the base of the pit, which had presumably been dug specifically for this purpose, and appeared to have been complete when buried, although the upper part had subsequently suffered some truncation that resulted in the loss of part of the rim. In addition to this, posthole [2112] was dug into the fill of an undated pit [2110] and posthole [2116] intersected with pit [2114]. In the latter instance the stratigraphic relationship was not clear, but pit [2114] contained pottery of probable late Bronze Age date and is therefore likely to be the later feature.

### *Pits*

A total of 43 pits were excavated, situated mostly within the fenced enclosure but including a few beyond it. The greatest concentrations of pits were situated in the vicinity of Building [2270] and in the north-west part of the settlement, south of the entrance. They were generally shallow features, only three measuring more than 0.4m deep. Most contained a single fill of sterile clay, but six were filled by deposits that were interpreted as domestic refuse, characterised by inclusions of charcoal, fired clay, burnt flint and pottery, albeit not in large quantities. Two of these pits, [2128] and [2184], were situated within Building [2270] and a further one, [2157], lay close to it, suggesting that the refuse may have been generated by occupation of the building. Two of the pits, [2224] and [2316], lay within the cluster of features in the north-west part of the enclosure and pit [1006] was immediately outside the north side of the enclosure.

The most notable pits were pit [2119], which was described above in relation to Building [2270], and pit [1006]. The latter feature was initially uncovered and sectioned during the evaluation stage of the investigation and was completely excavated during the excavation stage. In contrast to the generally circular shapes of the other pits on the site, it was sub-rectangular in plan, measuring 2.75 x 1.35m and 0.25m deep, and it also differed in having two distinct fills (Fig 5 section 1000). Lower fill [1005] comprised a dump of probable domestic refuse that included a deposit of sherds weighing more than 3.5kg that derived from a single Bucket Urn. Above this the pit had been backfilled with a deposit of redeposited clay [1004] that contained four flint flakes and nine chips.

### *Late Bronze Age Activity*

Three pits within the southern part of the settlement were attributed to the late Bronze Age. The largest of this group was pit [2154], a vertical-sided feature 0.43m deep with a single fill [2155] that contained more than 400g of pottery from at least four vessels, including part of a decorated bowl with a flaring rim, as well as flint flakes and a hammerstone. Pits [2077] and [2114] were smaller features and each produced a single sherd of pottery that was probably of late Bronze Age date.

### *Undated*

A shallow linear hollow, [2293], at the southern end of the excavation area was interpreted as a possible hollow-way. It was 4m wide with a maximum depth of 0.3m, but no artefactual material was recovered and its association with the settlement is uncertain

## **ARTEFACTUAL EVIDENCE**

### *Pottery*

#### *Lisa Brown*

A total of 673 sherds of prehistoric pottery weighing 9710g was recovered from the site. The evaluation stages produced 243 sherds (4385g) and the mitigation stage 430 sherds (5325g). The evaluation assemblage is entirely of middle Bronze Age date, but the mitigation group includes a late Bronze Age component.

### *Condition*

Generally, the condition of the assemblage is moderately good. An average sherd weight of 14g was registered for the combined assemblage. This is relatively high for a prehistoric assemblage, but reflects the large size and thick walls of some vessels. Two individual vessels are in unabraded condition, while the majority are moderately abraded and only 75 sherds heavily worn. One of the unabraded vessels, from pit [2119] associated with circular structure [2270], belongs to a Bucket Urn and is complete except for a partly truncated rim, presumably removed by ploughing. Two joining sherds in coarse flint-tempered ware from ditch [2345] are also unabraded.

### *Fabrics*

The fabric range is restricted to three grades of flint (coarse, medium and fine), all within a very finely sanded and slightly micaceous clay (Table 1). By far the predominant group is the coarse flint-tempered variety. A sub-variety of the coarse group, represented by only five sherds, additionally incorporates rare lumps of powdery red haematite. Two sherds with a distinctly soapy texture contain, in addition to medium grade flint and haematite, small inclusions of argillaceous matter, probably grog. These may be of Neolithic or early Bronze Age date. The flint used in all of the clay recipes could have been obtained from the Upper Chalk deposits to the north of the site.

The coarse variety is by far the largest, amounting to 67% by sherd count and 86% by weight of the total assemblage. The group containing slightly smaller (medium size) flint temper is much smaller (68 sherds), and the fine flint-tempered variety (22% by count, 7% by weight) correlates almost entirely with thin-walled sherds, reasonably well-sorted flint, and a superior surface treatment to the rest of the collection.

Table 1: Quantification of fabrics

Fabric	No. sherds	Weight (g)	% sherds	% weight
Coarse flint	451	8333	67	86
Coarse flint and haematite	5	56	1	1
Medium flint	68	543	9	5
Fine flint	147	772	22	7
Soapy with grog, rare flint and haematite	2	6	1	1

### *Forms*

Only a limited range of forms was identifiable because of the fragmentary state of the pottery, but both Bucket and Globular Urns were identified, as classified by Ellison (1975). Fragments of a large Middle Bronze Age 'urn' were recovered from the lower fill of pit [1006] (Fig 7.1) and sherds belonging to three other large vessels were present in pits [2119] (Fig 7.2) and [2123] (Fig 8.5) and stakehole [2079] (Fig 8.7). The example from pit [2119] was a near-complete Bucket Urn in 211 fragments weighing 3598g. The other two are represented only by two and three sherds and are less confidently classifiable to form, but their thick wall size suggests that they are either Bucket or Barrel Urns.

Five vessel parts with thinner walls are probably Globular Urns, also of middle Bronze Age date. Globular Urns are relatively fine vessels with bulbous bodies and constricted rims, often plain and slightly out-turned. These vessels appear to have no clear ancestry from earlier and contemporary Deverel-Rimbury vessels, but they share some characteristics with late Neolithic/early Bronze Age Beakers, especially in the bell-shaped profile and geometric decorative motifs, and may be survivors of that tradition. All except one of the Globular Urns incorporate medium or fine flint inclusions. The exception is unusually coarse for this vessel type, but overlap of form and fabric correlations are common with earlier prehistoric pottery. Fragments of Globular Urns were recovered from pit [2128], pit [2154] (Fig 8.8-9), pit [2184] (Fig 8.3 and 8.6), posthole [2136] of circular structure 2270 (Fig 8.4), and the northern entrance terminal of ditch [2340] (Fig 8.10). In some cases, the surfaces have been carefully smoothed and three examples are decorated. One vessel from pit [2184] (Fig 8.3) has fingernail impressions on the rim top, and the sherds from ditch [2340] are decorated with incised lines and impressed dots.

Body sherds in coarse and medium flint-tempered fabrics were recovered in small quantities from several other deposits, including ditches [2266] and [2340], several pits, a number of postholes of circular structure [2270], and a posthole of the enclosure fence. These are all probably fragments of standard Deverel-Rimbury forms, some possibly residual, but their small size precludes classification.

Pit [2154] produced fragment of a bowl with flaring rim, decorated just below the rim with impressed dots (Fig 8.9). The fabric, although flint-tempered, additionally incorporates lumps of powdery red haematite, unlike most of the middle Bronze Age group. This and a thin-walled carinated sherd in medium-grade flint-tempered ware from pit [2114] are probably late Bronze Age early bowl forms of a type currently thought to have emerged at around 1000-900 BC (Gibson 2011, 113; Barrett 1980). Undiagnostic sherds in fine flint-tempered fabrics with smoothed surfaces recovered from pits [2157] and [2278], posthole [2112] of circular structure 2270, and tree-throw hole [2077] could also be in this late Bronze Age tradition, but the material is too fragmentary to be certain, and some may belong to middle Bronze Age globular urns, which can be relatively small and well-made.

Two small sherds are in a distinctive soapy fabric that includes argillaceous matter (possibly grog). There are faint traces of tooled decoration visible. These sherds, the only pottery from pit [2212], may belong to a Neolithic Impressed Ware vessel or an early Bronze Age Food Vessel, but it is impossible to say on the basis of 6g total of material. They were found associated with struck flint and burnt stone.

### ***Worked Flint***

*Michael Donnelly*

The investigations yielded just 47 pieces of flint (Table 2). The struck flint originated from a range of contexts and were usually found as single finds but a few pits contained small concentrations of flint. Period-specific tools were absent but the flint does include a range of typically early and later prehistoric debitage.

Table 2: The flint assemblage

Category type	
Flake	15
Blade	5
Blade-like	4
Blade index	37.5% (9/24)
Irregular waste	6
Sieved Chips10-2mm	12
Core multi platform flake	2
Scraper other	1
Retouch blade	1
Retouched flake	1
Total	47
Burnt unworked flint No./g	256/1506g
No. burnt (%)	11/47(23.40%)
No. broken (exc. chips) (%)	12/35 (34.29%)
No. retouched (exc. chips) (%)	3/35 (8.57%)

The assemblage includes a significant amount of blade forms. These include very well made blades with parallel sides, although none display signs of platform abrasion and soft-hammer bulbs are rare. These pieces most likely date to the Mesolithic-earlier Neolithic period. The assemblage also contains moderate amounts of squat, hard-hammer flakes with little platform preparation and broad, spurred platforms. These flakes typify later prehistoric assemblages of middle Bronze Age-Iron Age

date. Two cores were recovered, both flake-orientated, multi-platformed examples, neither of which is diagnostic.

Only three tools were recovered, none of which is chronologically diagnostic. One hard-hammer struck blade recovered from the subsoil displays backing along its left lateral margin and has irregular denticulations along its right side. This piece is most likely to be early prehistoric in date. One scraper fragment was also recovered from the same context, but very little can be said about its original form. Finally, a retouched flake was recovered from ditch [2266]. This piece was formed on a hard-hammer struck preparation flake and represents a highly expedient informal tool, quite typical of later prehistoric assemblages.

The assemblage is difficult to date with any degree of certainty. Some pieces are clearly early, mostly stray finds and flints from the subsoil. These pieces probably represent a background scatter related to sporadic early prehistoric activity along the Lea Valley. Very little evidence of early prehistoric activity was recovered during the preparatory works for the Olympic Park (Corcoran *et al.* 2011; Powell 2012). Closer to the site, excavations at Innova Park (Ritchie *et al.* 2008) and Lower Edmonton (Bishop 2005) brought to light assemblages of mixed date that included limited amounts of early prehistoric flintwork.

The bulk of the material recovered from Navigation Park represented contemporary middle-late Bronze Age flintwork, typified by a general lack of concern over the regularity of the blank, unprepared platforms with obvious spurs, usually on thick hard-hammer struck flakes and quite irregular blade-like flakes. The freshness of the assemblage strongly suggests that these pieces are contemporary with the pit fills that they were recovered from and these represent very low-level flint use as part of a middle-late Bronze Age domestic setting. Similar expedient assemblages are known from many Bronze Age sites in and around the London area, including from the nearby excavations discussed above. As at Innova Park and Lower Edmonton, flakes and cores dominated these assemblages and formal tools were rare.

### ***Fired Clay***

*Cynthia Poole*

A small assemblage of fired clay amounting to 421 fragments (2217g) was recovered. The fired clay can be divided into oven/hearth structure and portable objects, which are probably oven/hearth furniture. The material classed as oven or hearth structure retained only a single moulded flat surface varying from fairly smooth and even to a quite rough finish. The pieces were up to 27mm thick and a few possibly had a bonding surface on the back suggesting they formed an inner lining to the structure or had been daubed over the sides of a subsurface cut hollow. One piece appears to form the squared end of a flat slab with straight flat edge 26mm wide and may be part of a perforated clay plate of a type commonly found on late Bronze Age sites, though the edge did not take the typical form of these objects. All the material classified as oven or hearth furniture took the form of cylindrical drum- or barrel-shaped perforated blocks with flat or slightly convex ends. Those with convex ends are generally indicative of a middle Bronze Age date, whilst those with flat ends are normally considered to be late Bronze Age. All examples were fragmentary and no complete dimensions survived. One of the pieces from pit [2189] may have been of a more tapered pyramidal form. This could have been part of a standard late Bronze Age pyramidal block with horizontal perforation close to the top, but without a perforation surviving this must remain uncertain and the character of the piece did not appear typical of this form. A better parallel might be the unperforated slightly tapered block from Innova Park (Ritchie *et al.* 2008, fig 8.9).

The fired clay assemblage probably derives from domestic activity from ovens or hearths related to cooking or processing of crops. The structural material is most likely to come from simple ovens or hearths, possibly semi-enclosed structures utilising a shallow hollow as a base with a kerb or low walls and open at the top, although a fully enclosed dome would also be possible. The perforated



cylindrical blocks may be envisaged as pedestals used in conjunction with an open structure to support pots over the fire for cooking or baking.

The perforated blocks have traditionally been regarded as loomweights based on their occurrence and groupings in domestic structures. One of the best examples was a group of ten in house platform 4 (Hut 3) at Black Patch, Sussex (Drewett 1982, fig 10), where their linear arrangement was interpreted as evidence of a loom, though storage of the group against the back wall of the structure is an equally valid interpretation. More recently evidence to associate such artefacts with pottery production in middle and late Bronze Age contexts has been found at Bestwall Quarry (Woodward 2009, 291-9) and Tinney's Lane, Sherborne, Dorset (Best and Woodward 2012, 231-4), suggesting that these objects may have served more generally elsewhere as oven or hearth furniture. The consistent association of the blocks at the Navigation Park with other fired clay and burnt material including charcoal, carbonized seeds and burnt flint makes the identification of the perforated blocks as loomweights increasingly unlikely and here they are regarded as an accessory used in conjunction with domestic hearths or ovens.

There is some hint amongst the fired clay of late Bronze Age activity, but none of the items can be designated as such with any degree of certainty. None of the distinctive late Bronze Age forms of small perforated plates, perforated pyramidal and rectangular blocks can be positively identified, though a few fragmentary pieces are suggestive of such objects.

### ***Worked Stone***

*Ruth Shaffrey*

Two fragments of a quartzite hammerstone weighing 67g from pit [2154] are the only pieces of worked stone from the site. These stem from a flat rounded pebble that has shattered through exposure to heat but which also has percussion damage at the one surviving end. It has been used as a hammerstone, though it is not possible to determine if this is a result of flint working or from the pounding of other substances.

## **ENVIRONMENTAL EVIDENCE**

### ***Charred Plant Remains and Wood Charcoal***

*Sheila Boardman*

#### *Introduction*

Sixteen bulk soil samples collected during the excavations were assessed for plant material, of which six samples contained sufficient material for analysis for wood charcoal and five for charred plant remains. Three samples were investigated for both material types.

#### *Wood Charcoal (Table 3)*

Most numerous in all samples were fragments of oak (*Quercus*), which included a mixture of sapwood and heartwood, with occasional roundwood fragments. The dominance of oak sapwood may indicate preferential selection of immature trees and branches, with mature timbers and trees perhaps reserved for buildings or for other uses. The single late Bronze Age sample, from pit [2157], comprised entirely oak charcoal, suggesting that it was probably a discrete dump of fuel debris. Five samples, all from middle Bronze Age contexts, had a wider range of taxa and may represent mixed dumps of fuel debris. The taxa included hawthorn group (Pomoideae), field maple (*Acer campestre*), ash (*Fraxinus excelsior*), hazel (*Corylus avellana*), willow/poplar (*Salix/Populus*), alder (*Alnus glutinosa*), alder/hazel (*Alnus glutinosa/Corylus avellana*), holly (*Ilex aquifolium*) and blackthorn/cherry (*Prunus*). In addition to hawthorn (*Crataegus*), Pomoideae charcoal may include apple (*Malus*), pear (*Pyrus*) and rowan/whitebeam/service (*Sorbus*) species. The very mixed samples

include the contents of pot <100> in pit [2119], which may have contained general refuse that was dumped in the pit.

Table 3: Summary of wood charcoal

Sample No.		101	104	105	107	108	113
Context No.		1004	1018	2113	2117	2118	2156
Feature No.		1006	1017	2112	2116	2119	2157
Description		Pit fill	Fill of posthole	Fill of posthole	Fill of posthole	Fill of pot (SF100) in pit (2119)	Pit fill
Phase/Period		MBA	MBA	MBA	MBA	MBA	LBA
Litres of soil processed		40	20	13	12	25	32
Indet. softwood			1				
<b>Rosaceae</b>							
<i>Prunus</i>	blackthorn/cherry		1	1		1r	
Pomoideae	hawthorn group		6	18	12	3r	
cf. Pomoideae	cf. hawthorn group			1			
<b>Fagaceae</b>							
<i>Quercus</i>	oak	63shr	59shr	59shr	31sh	58shr	70sh
<b>Betulaceae</b>							
<i>Alnus glutinosa</i>	alder	2			1		
<i>Corylus avellana</i>	hazel	5r		4r	2	5	
<i>Alnus/Corylus</i>	alder/hazel	1	1			1	
<b>Salicaceae</b>							
<i>Salix/Populus</i>	willow/poplar			5	2		
<b>Sapindaceae</b>							
<i>Acer campestre</i>	field maple		1	9	12	2	
<b>Oleaceae</b>							
<i>Fraxinus excelsior</i>	ash			4	14	1	
<b>Aquifoliaceae</b>							
<i>Ilex aquifolium</i>	holly			3			
cf. <i>Ilex aquifolium</i>	cf. holly	1					
Indet. charcoal fragments		1	3	10b	3	2	
<b>Total charcoal fragments</b>		73	72	114	77	73	70

Key: h - heartwood; s - sapwood; r - roundwood; b - bark. F - frags. Pomoideae includes: *Pyrus* (pear), *Malus* (apple), *Crataegus* (hawthorn) and *Sorbus* (rowan, service, whitebeam).

Overall, the charcoal remains point to the availability and exploitation of a range of mixed deciduous woodland taxa, including oak, ash, field maple, hawthorn-group species, hazel and holly. Some damper areas are indicated by willow/poplar and alder. There was little *Prunus* charcoal, and the limited remains present may be from wild cherries (*Prunus avium* and/or *P. padus*) rather than blackthorn (*P. spinosa*). There were very few narrow roundwood fragments of blackthorn or hawthorn group in these samples, which may indicate that scrubby vegetation (or hedgerows) was not a major component of the local landscape, or that such areas were not routinely exploited for fuel.

#### Charred Plant Remains (Table 4)

The samples had limited charred remains but these include grains and chaff of emmer (*Triticum* (cf.) *dicoccum*), spelt (*T. spelta*) glume bases, plus a range of probable weeds of cultivation. The transition from emmer to spelt as the main staple crop is believed to have taken place during the Bronze Age, so all suitable samples (with cereal grains and/or chaff, plus a range of wild species) were analysed, in line with recommendations in the draft regional review (Campbell forthcoming).

Table 4: Summary of charred plant remains

Sample No.		101	104	107	114	109
<b>Context No.</b>		1004	1018	2117	2190	2155
<b>Feature No.</b>		1006	1017	2116	2189	2154
<b>Description</b>		Pit fill	Fill of posthole	Fill of posthole	Pit fill	Pit fill
<b>Period</b>		MBA	MBA	MBA	MBA	LBA
<b>Litres of soil processed</b>		40	20	12	12	25
<b>Cereal grain</b>						
<i>Triticum</i> cf. <i>dicoccum</i>	cf. emmer wheat	10				1
<i>Triticum</i> spp.	wheat	10.5	2			3
<i>Hordeum vulgare</i> L.	barley, hulled cf. twisted grain	3	2			
<i>Hordeum vulgare</i> L.	barley, hulled cf. straight grain	1				
<i>Hordeum vulgare</i> L.	hulled barley	7	5+Fs			
<i>Hordeum vulgare</i> L.	barley	2				
<i>Avena</i> sp.	oat	1	2+F			
cf. <i>Avena</i> sp.	cf. oat			2	1	
<i>Avena/Bromus</i> spp.	oat/brome		1	0.5		
Cereal indet.	indet. cereal	10	3+Fs	1+2F	2.5	1+Fs
Cereal indet.	coleoptile (detached sprouted embryo)		2F			
Cereal indet./large grass	cereal/large grass, grain					4F
<b>Cereal chaff and straw</b>						
<i>Triticum dicoccum</i> Schubl.	emmer wheat, glume base		2			
<i>Triticum</i> cf. <i>dicoccum</i>	cf. emmer wheat, glume base		4		1	1
<i>Triticum spelta</i> L.	spelt wheat, glume base		2	1		

<i>Triticum spelta</i> L.	spelt wheat, spikelet fork			1F		
<i>Triticum dicoccum/spelta</i>	emmer/ spelt, glume base		7		1+2F	6
<i>Triticum dicoccum/spelta</i>	emmer/spelt, spikelet fork		1F			
<i>Triticum</i> sp.	wheat, basal rachis internode	1				
<i>Triticum</i> spp.	glume wheat, rachis internode		1F			
<i>Avena</i> sp.	awn		1F			
<b>Wild, edible plants</b>						
<i>Corylus avellana</i> L.	hazel nutshell		1F			
<b>Wild plants</b>						
<i>Vicia/Lathyrus</i>	vetch/tare (> 2mm)	11		0.5		
<i>Vicia/Lathyrus</i>	vetch/tare (< 2mm)	4+Fs	1F		1+1F	
Fabaceae	small seeded legume	2F				
<i>Persicaria</i> sp.	persicaria			2.5		2
<i>Fallopia convolvulus</i> (L.) A. Love	black bindweed		1F			
cf. <i>Fallopia convolvulus</i>	cf. black bindweed	1F			1	
<i>Rumex</i> cf. <i>acetosella</i> L.	cf. sheep's sorrel	5				
<i>Rumex</i> spp.	dock	9	3+F	3	1F	
cf. <i>Rumex</i> sp.	cf. dock	1				
Polygonaceae	knotweed family		1			
<i>Stellaria</i> sp.	stitchwort					1
<i>Chenopodium album</i> L.	fat hen	3	4	5+Fs		1
<i>Chenopodium</i> sp.	goosefoot		1	1		2
<i>Galium aparine</i> L.	cleavers	2+F				
<i>Tripleurospermum inodorum</i> (L.) Sch. Bip.	scentless mayweed		1			
<i>Eleocharis paustris</i> (L.) Roem. and Schult.	spike-rush	1				
<i>Carex</i> sp.	sedge, three sided nutlet	1				
Poaceae	grass family medium caryopsis		1+Fs			3
Poaceae	grass family - small caryopsis		3+Fs		1+1F	1
<b>Indeterminate</b>	seed/fruit/nut	4+F	4	2+F	2+F	2+2F
<b>Quantifiable remains</b>		86.5	48	18.5	10.5	24

Whole cereal grains, diagnostic chaff fragments (glume bases and rachis internodes), plus individual seeds/fruits counted as one. Counts of fragmentary remains (e.g. of awns and nut shell) are suffixed by 'F' and are not included in the sample totals. Spikelet forks are normally counted as two (one fork normally holds two grains), but here they were too incomplete to count other than as fragments.

Pit [1006] produced the most quantifiable remains, largely comprising cereal grains and seeds/fruits of wild species. The grains were mostly wheat, and while grain characteristics in wheat are often very variable, many grains had high dorsal ridges and other characteristics typical of emmer. The other cereals were hulled barley, a single, small oat (*Avena* sp.) grain (presumably from a wild oat species) and indeterminate grains. The only chaff fragment present was a basal wheat (*T.* sp.) rachis fragment. Most of the other wild taxa are found today in a wide range of open and disturbed

habitats, but damper conditions are suggested by spike-rush (*Eleocharis palustris*) and sedge (*Carex* sp.). Sheep's sorrel (*Rumex acetosella*) is more typical of acid sandy soils and is found on open, heathy ground, in short grassland, and on cultivated land (Stace 2010).

Posthole [1017] produced a mixture of poorly preserved cereal grains/fragments, cereal chaff remains, a hazel (*Corylus avellana*) nut shell fragment and some largely fragmentary seeds and fruits of wild species. There was slightly more hulled barley (*Hordeum vulgare*) than wheat (*T. sp.*) grains, and oat (*Avena* sp.), plus oat/brome (*Avena/Bromus* spp.) and indeterminate grains. The cereal chaff remains indicate that both emmer (*T. dicoccum*) and spelt wheat (*T. spelta*) are present. There were more emmer glume bases than those of spelt, but indeterminate emmer/spelt glume bases were more numerous than either of these species. The wild species in this sample are again found in a wide range of conditions today.

The samples from posthole [2116], which formed part of roundhouse [2270], and pit [2189] both contained very few (<5) cereal grains/fragments but included probable oat (cf. *Avena* sp.), some wheat chaff (including spelt chaff in posthole [2116]), and seeds/fruits (and fragments) of wild species. A few seeds of persicaria (*Persicaria* sp.) from posthole [2116] may again point to damp conditions.

Late Bronze Age pit [2154] was almost identical to the last two samples but included one possible emmer wheat (*T. cf. dicoccum*) grain, which provides a very tentative hint that emmer wheat continued in cultivation in this area into the Late Bronze Age, assuming the highly ridged appearance does not reflect distortion on charring.

### *Summary and Conclusions*

All the samples investigated for wood charcoal were dominated by oak, and many other deciduous woodland species are present in the assemblage. The presence of this range of taxa, in both the Middle and late Bronze Age samples, suggests that fuel wood was not in short supply. Most of the samples were very mixed, with 6-8 charcoal taxa, so they most likely represent dumps of mixed fuel debris. As such, the wood charcoal sheds only limited light on the use of the various features as locations for refuse disposal.

The small size of charred plant assemblages and the mixing of cereal grains, chaff and probable weeds of cultivation indicate that the deposits represent debris from several crop-cleaning operations, which would typically have been carried out on a small-scale, day-to-day basis, as required (Stevens 2003). Two useful new radiocarbon dates were obtained from spelt chaff and probable emmer wheat grains. It seems likely that both wheats were cultivated locally in the middle and late Bronze Age, together with hulled barley.

### *Animal Bone*

#### *Lena Strid*

Only a few small, very poorly preserved fragments of animal bone survived, with largely only tooth enamel surviving the local soil conditions. None could be identified to species.

## **RADIOCARBON DATING**

Four samples were submitted to the Scottish Universities Environmental Research Centre (SUERC) AMS Facility, Glasgow, for radiocarbon dating. These comprised a piece of alder root from organic silt layer [5018] in evaluation Trench 5 that was submitted in order to establish whether it was of a suitable date to represent the Arctic Beds and samples of charred plant material from pits [1006] and [1017] and posthole [2119] (Table 5). The radiocarbon ages are quoted in conventional years BP (before AD 1950) and as calibrated calendrical dates at both 68.2% confidence and 95.4% confidence. The calibrated age ranges were determined using the University of Oxford Radiocarbon Accelerator

Unit calibration program OxCal 4.2.4 (Bronk Ramsey *et al.* 2013) and the IntCal13 curve (Reimer *et al.* 2013) and have been rounded out to the nearest 10 years following Mook (1986).

Table 5: Summary of radiocarbon dates

Lab. ID	Context	Feature	Sample	$\delta^{13}\text{C}$ (0/00)	Radiocarbon age (BP)	Calibrated date (95.4% confidence)	Calibrated date (68.2% confidence)
SUERC-32559	5018	Peat layer	Waterlogged wood: <i>Alnus</i> sp.	-27.9	3690±40	2200-1950 cal BC	2140-2020 cal BC
SUERC-70773	1004	Pit 1006	<i>Triticum</i> cf <i>dicoccum</i> grain	-24.3	3110±30	1440-1280 cal BC	1430-1380 cal BC (39.0%) 1350-1300 cal BC (29.2%)
SUERC-70774	1018	Pit 1017	<i>Triticum spelta</i> glume base	-25.0	2943±30	1260-1240 cal BC (1.5%) 1240-1040 cal BC (93.9%)	1220-1110 cal BC
SUERC-70778	2118	Pit 2119	<i>Prunus</i> sp. charcoal	-25.1	2797±30	1030-880 cal BC (90.1%) 890-840 cal BC (5.3%)	1000-980 cal BC (6.0%) 990-910 cal BC (62.2%)

## DISCUSSION

The settlement at Navigation Park is typical of the middle Bronze Age, when such domestic sites and their associated field systems were coming to dominate the landscape in place of the ceremonial and funerary monuments that had characterised the Neolithic and early Bronze Age (MoLAS 2002, 23). Moreover, the choice of settlement location within the Lea Valley is consistent with increasing exploitation of the floodplain during this period (Brown and Cotton 2000, 91). Numerous finds of middle Bronze Age material have been made in the Lea Valley (Brown and Cotton 2000, 84), and several settlements have been excavated, including sites at the Olympic Park, Innova Park, Lower Edmonton and Leighton (Powell 2012; Ritchie *et al.* 2008; Bishop 2005; Bishop and Boyer 2014).

The settlement preserves the clearest settlement plan of the excavated sites in the Lea Valley and therefore contributes significantly to our understanding of settlement form. It is particularly significant that the limits of the settlement were clearly identified, comprising a roughly square enclosure set between a pair of boundary ditches and demarcated on at least three sides by a fence line. The use of fences to define the settlement boundary is unusual, since settlements of this period are more commonly either open or enclosed by a ditch circuit. A situation that may be analogous to the arrangement at Navigation Park has however been recorded at Heathrow Terminal 5, where Settlement 1 at Perry Oaks was similarly situated between a pair of ditches (in this instance defining parallel trackways) and was bounded to the south by a fence line (Lewis and Batt 2006, 116-122). The character of any northern boundary at Perry Oaks is unknown, since it lay beyond the limit of the excavation area. Also at Heathrow Terminal 5, the L-shaped 'post-built structure' at Farmstead 9 may represent two sides of a rectilinear enclosure that has otherwise been truncated (Leivers 2010, 185). No evidence for internal structures survived, but the structure lay close to a waterhole that contained domestic debris that may have derived from occupation within the putative enclosure. Other examples of the use of fences to define middle Bronze Age settlement boundaries can be seen elsewhere. At Stansted Airport, Essex, a group of roundhouses lay within a subrectangular enclosure that was defined by fence lines and ditches and was later enlarged and realigned (Cooke *et al.* 2008). Further afield, at Cotswold Community, Gloucestershire, two roundhouses lay in an area demarcated by an L-shaped fence line (Powell *et al.* 2010). Two particularly striking and unusual examples of fenced

enclosures have been excavated in Norfolk, at Hunstanton and at Norwich Northern Distributor Road (Healy *et al.* 1993; Moan 2017). The date of the trapezoidal enclosure at Hunstanton is problematic, since the ceramic evidence from the postholes comprised only a small number of sherds, most of them Neolithic but whose small size may indicate that they are residual, and three radiocarbon dates produced inconsistent ranges that varied from 2480-2030 to 1110-770 cal BC (Healy *et al.* 1993, table 46, recalibrated using the OxCal 4.3 calibration programme and the IntCal 13 curve). An adjacent roundhouse, Structure I, which may have been associated with the enclosure, produced five fairly large Collared Urn sherds and one from a possible Beaker, but the form, comprising a circular post-ring, is more characteristic of the Late Bronze Age or Iron Age, as noted by the excavators (Healy *et al.* 1993, 77) and so it is possible that the pottery from this building is also residual and the settlement of later date, more in line with the date of Navigation Park. The excavators noted that the small size of the Beaker sherd may indicate that it was residual, although the other sherds were in fresher condition (Healy *et al.* 1993, 71). More certainly of Middle-Late Bronze Age date is the site at Norwich Northern Distributor Road, where Site 3 at Bell Farm uncovered an entire landscape of fields, enclosures and trackways defined by postholes (Moan 2017, 32-51). At the time of writing, analysis of this site is still ongoing.

It is highly probable that fence lines were used more commonly in prehistory than is apparent from the surviving evidence, since shallow features such as postholes would be vulnerable to truncation by ploughing in the intervening centuries. Construction techniques may have varied according to the function of the barrier – in the case of the enclosure at Navigation Park, the spacing of the postholes is more appropriate to the use of inter-woven rods or wattle hurdles than post-and-rail construction, while not being close enough to indicate a palisade of contiguous timbers. Examples of the construction techniques that may have been used are provided by the series of Bronze Age timber structures preserved by waterlogging that have been recovered from locations along the Thames in east London. These include hurdles at Erith and Movers Lane (Bennell 1998; Stafford *et al.* 2012) that were laid as trackways to provide access across wet ground. Hurdles of broadly Bronze Age/Iron Age date were also preserved in a palaeochannel at Eton Rowing Lake, the only precisely dated piece being a panel that formed part of a bridge radiocarbon dated to the early Iron Age (Allen *et al.* forthcoming). No timber elements were preserved at Navigation Park, but the charcoal assemblage from pits within the settlement indicate that oak and other deciduous species that could be used as timber for building were not in short supply.

The range of features within the enclosure, comprising post-built structures and discrete pits and postholes, is typical of settlements of this period and bears comparison with the closely similar settlement in the lower part of the Lea Valley at Olympic Park Trench 9 (Powell 2012, 36-46). Occupation at this site was similarly situated between a pair of parallel ditches and although no certain building plans could be defined, the density of postholes clearly indicated that structures had been present. As at Navigation Park, the pits were invariably shallow. The ditches at the Olympic Park were interpreted as forming part of a co-axial field system and a similar interpretation may be appropriate at Navigation Park. The ditches recorded in Evaluation Trenches 3 and 5, south of the enclosure, may be part of such a wider arrangement of boundaries, although no ditches were identified in any of the other trenches. A similar pair of parallel ditches, but lacking any associated settlement evidence, was found at Lower Edmonton (Bishop 2005, 16 and fig 9), and field boundaries were also uncovered at Innova Park, where midden deposits clearly indicate the proximity of domestic occupation (Ritchie *et al.* 2008). Settlement 1 at Perry Oaks was considerably larger than the settlements at Navigation Park and Olympic Park Trench 9, measuring 70m east-west, but was nonetheless very similar in form. It presumably had a correspondingly larger resident population, as indicated by at least five posthole groups that are likely to represent buildings, although, as at the Olympic Park, none could be resolved into a definite plan. The enclosure at Hunstanton was interpreted as a stockade for livestock with domestic settlement situated beside rather than within it.

Roundhouse [2270] appears to have been the main domestic building, although the surviving evidence suggests that it was an unimpressive structure represented by a circuit of postholes with

rather irregular size and spacing. Its dimensions place it toward the lower end of the size range for prehistoric roundhouses; a survey of roundhouses in the Middle and Upper Thames Valley suggested a typical diameter of 7.5-10m, with some larger examples and smaller structures down to 5m (Lambrick 2009, 141) while Pope's dataset for England and Wales gives a range of 4-14m with an average of 8m (Pope 2008, 17). The building is similar, both in size and form, to a structure recorded at Olympic Park Trench 43 (Powell 2012, 57).

The distribution of the features provides some evidence for the arrangement of space within the settlement. The south-eastern part of the enclosure, diametrically opposite the entrance, was the main domestic focus, where the roundhouse was located, with the greatest concentration of the surviving pits were situated within and around it. The small quantities of charcoal, fired clay, burnt flint and pottery within these features presumably derived from domestic activities within the building. The most intriguing of these deposits was the Bucket Urn that had been placed upright on the base of pit [2119], although the stratigraphic relationship between this feature and posthole [2120] could not be established and so it is uncertain whether the vessel was contemporary with the building. The vessel may have been placed as an offering, perhaps as a foundation deposit associated with the construction of the house or as a rite of closure associated with its abandonment, but it may alternatively have had a more prosaic function as a storage vessel, sunk into the ground either for convenience or to assist in keeping the contents at a low temperature. Two similarly-placed vessels were associated with one of the possible post-built buildings at Settlement 1 at Perry Oaks (Lewis and Batt 2006, 119-21). A second activity area was represented by a group of pits situated north-west of Roundhouse [2270], toward the enclosure's entrance, while the north-western quadrant was occupied by Building [2211], which probably represented a small ancillary structure or animal pen.

The chronology of the settlement was provided by a combination of ceramic and radiocarbon dates. Much of the pottery could not be closely dated due to the fragmentary state of the sherds, but Middle Bronze Age Bucket and Globular Urns were identified, as well as Late Bronze Age sherds from a smaller number of features, including pieces that are probably an early bowl form of a type thought to have emerged around 1000-900 BC (Brown, above). These dates were confirmed by radiocarbon determinations that ranged from 1440-1280 cal BC to 1030-840 cal BC. If the features represent a continuous period of occupation, the settlement may therefore have been in use for more than two centuries and encompassed the boundary between the Middle and Late Bronze Age. This is considerably longer than the lifespan of a single roundhouse, and would require that the building was rebuilt during the occupation of the settlement – the closely-spaced and intercutting pairs of postholes might be evidence for this, but the irregular spacing of the posthole circuit makes certainty difficult. The dating evidence from ditches [2266] and [2340] was insufficient to ascertain whether they were constructed at the same time as the settlement or whether the boundaries pre-dated the insertion of the settlement, as was certainly the case at the Olympic Park Trench 9, where a radiocarbon date of 1430-1270 cal BC from one of the ditches contrasted with three identical dates of 1010-840 cal BC from settlement features (Powell 2012, 38 and 41). These dates suggest that the ditches at the Olympic Park were established at about the same time as the settlement at Navigation Park but that the domestic occupation that was subsequently situated between them was of short duration and coincided with the latter part of the occupation at Navigation Park. The main period of activity at Perry Oaks Settlement 1 was similar to Navigation Park, being dated to 1700-1150 BC by the presence of Deverel-Rimbury pottery with a final stage of occupation comprising a small number of features that produced Late Bronze Age pottery (Lewis and Batt 2006, 121-2).

The charred plant remains, although sparse, have produced evidence for the cultivation of both spelt and emmer wheat in proximity to the settlement, as well as hulled barley. It is generally accepted that spelt replaced emmer as the staple crop in southern Britain during the middle Bronze Age and the settlement at Navigation Park appears to date from this transitional period. The radiocarbon dating of spelt chaff from pit [1017] indicates that this species was being cultivated at the settlement by 1260-1040 cal BC, in contrast to the situation at Innova Park, where there was no evidence for spelt cultivation (Ritchie *et al.* 2008, 20). Emmer clearly continued to be grown



alongside spelt, since emmer chaff was also present in this deposit. Indeed, the single grain of emmer and small quantity of chaff recovered from Late Bronze Age pit [2154] may indicate that cultivation of emmer did not cease until at least the end of the 2nd millennium. Emmer was also identified in Late Bronze Age pits at Olympic Park Trench 9 (Wyles *et al.* 2012, 315). The poor preservation of skeletal material precludes any investigation of animal husbandry at the site or of the balance between pastoral and arable production. The topographic setting of the settlement is likely to be key to the subsistence strategy of the community; although the ground has been built up and levelled to accommodate modern development, and the original topography buried, modelling of the surface of the Pleistocene gravels from borehole data clearly shows that the settlement was situated at the limit of the slightly higher ground at the eastern edge of the floodplain (Fig. 2). Immediately east of the settlement boundary the terrain sloped down toward the river, and this location was presumably selected in order to allow ready access to the pasture and other resources of the river and floodplain without exposing the settlement to a risk of flooding.

A number of Bronze Age settlements are now known within the Lea Valley, representing a period of colonisation of a landscape that does not appear to have been previously settled. Although earlier activity has been identified, including the Mesolithic flints at Millmarsh Lane (Bowsher 1995) and Neolithic material including an axe at the Olympic Park (Leivers and Gittins 2012), this evidence appears to be associated with visits to the valley rather than longer-term occupation. The single unworked fragment of burnt flint and occasional charcoal flecks noted within the peat layer in Phase 1 evaluation Trench 7 may be associated with such an event. It is not until the Bronze Age that settlements and field systems become evident. This colonisation was made possible by the drying out of the valley bottom, as the alder carr and fen that had dominated during the early part of the Holocene was replaced by grassland environments. At Navigation Park this change in environment was represented by the end of peat formation within the infilled channel(s) encountered by Phase 1 evaluation Trench 7 and Phase 2 evaluation Trench 6 and the organic gravel layer [5018] in Phase 1 evaluation Trench 5. The radiocarbon date of 2200-1950 cal BC obtained for the latter layer places it several centuries before the settlement here, prior to the main episode of colonisation. Further evidence for the changing environment is provided by the reduction in tree pollen recorded at the Olympic Park and other sites, and a corresponding increase in grasses, among other species, which has been interpreted as evidence for the development of a patchwork of localised environments including grassland, marshland and standing water (Stevens *et al.* 2012, 404). This process of environmental change produced a landscape that facilitated the Bronze Age colonisation of the valley of which the site at Navigation Park formed a part.

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