Archaeological Watching Brief & Geoarchaeological Survey

at

ASDA SUPERSTORE PREMISES, CRANBOURNE INDUSTRIAL ESTATE, DOCK ROAD, GOSPORT.

for

ASDA Stores Ltd.

Report No. 2734/2012
OASIS No. 136333

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ASDA SUPERSTORE PREMISES, CRANBOURNE INDUSTRIAL ESTATE, DOCK ROAD, GOSPORT.

Centred on
N.G.R. SZ 6143 9950

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Abbreviations

AD	Anno Domini	EHA	English Heritage Archive
aOD	Above Ordnance Datum	Km	Kilometre
BaRAS	Bristol & Region Archaeological Services	m	Metre
BC	Before Christ	NGR	National Grid Reference
BHER	Bristol Historic Environment Record	OS	Ordnance Survey
c	Circa		
C	Century		

Adopted Chronology

Prehistoric	Before AD43
Roman	AD43-410
Anglo Saxon/Early Medieval	AD410-1066
Medieval	AD1066-1540
Post-medieval	AD1540-present

NOTE

Notwithstanding that Bristol and Region Archaeological Services have taken reasonable care to produce a comprehensive summary of the known and recorded archaeological evidence, no responsibility can be accepted for any omissions of fact or opinion, however caused.

November, 2012.

SUMMARY

An archaeological watching brief and geoarcharological survey were carried out during groundworks associated with the construction of an extension to the existing ASDA Gosport store. The site is centred on NGR SZ 6143 9950 and is located in land adjoining the superstore premises of ASDA (opened in 1977) within the Cranbourne Industrial Estate, roughly 1.5km west of the City of Portsmouth and to the south-west of Gosport's central area.

As anticipated the watching brief identified no archaeological remains within the area of the intrusive boreholes. Cores from the two boreholes were successfully retrieved and the stratigraphic units were identified. All deposits present on the site were assessed as having low archaeological and palaeoenvironmental potentials. No further archaeological or geoarchaeological works are recommended.

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1. INTRODUCTION

1.1 Bristol and Region Archaeological Services (BaRAS) were commissioned by ROSE Project Services on behalf of ASDA Stores Ltd to undertake an archaeological watching brief and geoarchaeological survey during groundworks associated with the construction of an extension to the existing ASDA Gosport store.

1.2 The watching brief was commissioned to comply with the condition of planning consent (planning application no. K.8520/33) and in accordance with a Written Scheme of Investigation prepared by Bristol and Region Archaeological Services (BaRAS 2012).

1.3 The fieldwork was undertaken between 13th and 15th August 2012 under the supervision of Simon Roper who also compiled this report.

1.4 The project archive will be deposited with Hampshire Museum Service under the Accession Number A2012.23 and a copy of the report will be made available to the English Heritage Archive. The project will be entered in the Archaeology and Historic Buildings Record for Hampshire (AHBR) on submission of the final report and in the Online Access to the Index of Archaeological Investigations (OASIS) as bristola1-136333.

2. THE SITE

2.1 The site comprises land adjoining the superstore premises of ASDA (opened in 1977) within the Cranbourne Industrial Estate, centred on NGR SZ 6143 9950, roughly 1.5km west of the City of Portsmouth and to the south-west of Gosport's central area. The industrial estate is bounded to the north by the B3333 known as South Street. In plan, the development area occupies a rectangular shape of approximately 750 square metres (**Fig.1**).

2.2 The site is not in a conservation area although it abuts a Coastal Zone Policy Area (GBLPR Policy R/CH1). There are no designated heritage assets or locally listed buildings on, or in close proximity to, the development site. The store extension is generally confined within, and surrounded by, modern development and will not impact any historical views (EH 2011).

2.3 The British Geological Survey (BGS) map the bedrock lying beneath the site as sands, silts and clays of the Wittering Formation (Bracklesham Group), a unit that accumulated in the Palaeogene (55-34my BP) (BGS 2012), which is overlain by sands and gravels of River Terrace 2 (a Late Pleistocene unit forming during the last cold stage) (BGS 2012). However both a previous and this borehole survey demonstrate that River Terrace 2 does not outcrop on the site. The previous geotechnical survey was carried out on the site to plan pile configurations and demonstrated that 3.5-5.1m of Made Ground overlies 'alluvium' (actually intertidal silt/clays) to 8.0-11.8m below ground level (BGL) at which point deposits of the Wittering Formation are encountered (Przewieslik 2011, 21). The same survey found contamination of the stratigraphy with hydrocarbons at 1.2-5.1m BGL in both boreholes, PID readings peaking at 1125ppm at 4.5m BGL in BH2. This survey concluded the hydrocarbons were a product of the gasworks previously located close to the site and that the main focus of contamination was the intertidal-Made Ground contact (see Section 5).

2.4 The significance of the submerged and intertidal prehistoric landscapes and associated occupation evidence of the Solent area are considered to be of national importance. There is an assumed potential for the archaeological and palaeo-environmental sediment resource from the bed of the former Haslar Lake to help understand the impact of sea level and climate change on the coastline.

3. ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

3.1 A summary history of the site is given in a previous desk-based assessment (Townsend 2011). Key points are summarised below.

3.2 The earliest reference to Gosport dates to 1241 when a 'Goseport' was recorded in the *Curia Regis Rolls*. Situated within the manor of Alverstoke, Gosport was probably intended as a new town and in 1284 it was described as 'Alverstoke cum Goseport et Uptune'. The successful settlement of Portsmouth may have provided some stimulus for the settlement of Gosport, which essentially comprised a small market town and port during the medieval period, and home to a number of fishermen. The large-scale expansion of Portsmouth, due primarily to naval activity, during the 17th and 18th centuries brought great economic benefits to Gosport which itself expanded as a result.

3.3 The ASDA store site and surrounding land appears to have comprised undeveloped land during the 18th century, and included a tidal creek of Haslar Lake. George Brown Irons constructed a gasworks in the 1830s, in what is now the northern portion of the store car park (**Fig. 2**). Initially, it was only the walled town that was supplied with gas but as Gosport's suburbs increased the service was extended to the new suburbs of Newtown and Stoke. The gasworks were expanded in 1926 and an artesian well was constructed there in 1933, the works survived until the 1960s.

3.4 The development portion of the site comprised part of Haslar Lake (formerly Stoke Lake), a coastal inlet on the north side of the Solent, until infilling operations took place between 1966 and 1970. While some disturbance is likely to have taken place during the infilling operations to Haslar Lake (mid-1960s) and the construction of the new superstore (mid-1970s), it is possible that areas of relatively undisturbed ground are present, possibly incorporating archaeological features and/or deposits, including the pre-existing bed of Haslar Lake.

4. AIMS AND METHODOLOGY

Fieldwork

4.1 The key objective of the watching brief was to monitor the drilling of two geoarchaeological boreholes located in the area of the store extension, with these boreholes providing datable palaeoenvironmental samples to address the following aims (Wilkinson 2012):

1. Determine the archaeological and palaeoenvironmental potential of Quaternary deposits outcropping on the site.
2. Provide a chronology for the Quaternary sediment sequence.
3. Determine the depositional environments and sub-environments in which deposition took place.
4. Determine the potential of key biostratigraphic proxies to provide useful palaeoenvironmental information of archaeological relevance.
5. Produce an assessment report detailing the results of the fieldwork and laboratory assessment.

4.2 The results are intended to provide information that will enable a reasonable, informed, planning decision to be made relating to the impact of the present and future developments on the buried historic environment of the application area.

4.3 The watching brief was carried out in accordance with the methodology outlined in the WSI, the Institute for Archaeologist's *Standards and Guidance for Archaeological Watching Briefs* (IfA 2008), the *Management of Archaeological Projects* 2 (HBMCE 1991) and the *Management of Research Projects in the Historic Environment* (MORPHE): *Project Manager's Guide* (EH 2006). A suitably qualified archaeologist was present during the borehole investigation.

4.4 The locations of the boreholes was recorded digitally using Leica System 1200 dGPS (accuracy 10-20mm) and in relation to the Ordnance Datum, and a plan produced in a suitable CAD format. Site photographs were taken in digital format. A site diary was kept recording the progress of the work and other relevant information.

Post-Fieldwork (By Keith Wilkinson)

4.5 The cores taken by the Pioneer drilling rig were transported to ARCA's laboratories at the University of Winchester where they were described using standard geological criteria (Tucker 1982, Jones *et al*. 1999, Munsell Color 2000), photographed and sub-sampled for biostratigraphic assessment and AMS ^{14}C dating.

4.6 Lithological descriptions from each borehole were uploaded to the RockWorks 15 geological utility software together with the GPS-derived locational data (Rockware 2012). That software was then used to plot composite cross section (**Fig. 3**).

4.7 The palynology of eight sub-samples taken from organic strata was assessed in Quest's Reading laboratories. The pollen was extracted as follows: (1) sampling a standard volume of sediment (1ml); (2) adding two tablets of the exotic clubmoss *Lycopodium clavatum* to provide a measure of pollen concentration in each sample; (3) deflocculation of the sample in 1% Sodium pyrophosphate; (4) sieving of the sample to remove coarse mineral and organic fractions (>125µ); (5) acetolysis; (6) removal of finer minerogenic fraction using Sodium polytungstate (specific gravity of 2.0g/cm^3); (7) mounting of the sample in glycerol jelly. Each stage of the procedure was preceded and followed by thorough sample cleaning in filtered distilled water. Quality control was maintained by periodic checking of residues, and assembling sample batches from various depths to test for systematic laboratory effects. Pollen grains and spores were identified using the University of Reading pollen type collection and the following sources of keys and photographs: Moore *et al.* (1991); Reille (1992). The assessment procedure consisted of scanning the prepared slides, and recording the concentration and preservation of pollen grains and spores, and the principal taxa on four transects (10% of the slide) (Appendix 2).

4.8 Eight sub-samples were extracted for the assessment of diatoms. The samples were extracted across contacts between mineral and organic units. The diatom extraction involved the following procedures (Battarbee *et al.* 2001):

1. Treatment of the sub-sample (0.2g) with Hydrogen peroxide (30%) to remove organic material and Hydrochloric acid (50%) to remove remaining carbonates
2. Centrifuging the sub-sample at 1200rpm for 5 minutes and washing with distilled water (4 washes)
3. Removal of clay from the sub-samples in the last wash by adding a few drops of Ammonia (1%)
4. Two slides prepared, each of a different concentration of the cleaned solution, were fixed in mounting medium of suitable refractive index for diatoms (Naphrax).

The assessment procedure consisted of scanning a large area of a coverslip on each slide for diatoms at magnifications of x400 and x1000 under phase contrast illumination. Diatom floras and taxonomic publications were consulted to assist with diatom identification; these include Hendey (1964), Werff and Huls (1957-1974), Hartley *et al.* (1996) and Krammer and Lange-Bertalot (1986-1991). Diatom species' salinity preferences are discussed using the classification data in Denys (1992), Vos and de Wolf (1988, 1993) and the halobian groups of Hustedt (1953, 1957: 199), these salinity groups are summarised as follows:

1. Polyhalobian: >30 g l^{-1}
2. Mesohalobian: 0.2-30 g l^{-1}
3. Oligohalobian - Halophilous: optimum in slightly brackish water
4. Oligohalobian - Indifferent: optimum in freshwater but tolerant of slightly brackish water
5. Halophobous: exclusively freshwater

Unknown: taxa of unknown salinity preference.

4.9 Four small bulk samples from BH1 were extracted for the recovery of Ostracoda and Foraminifera remains. The samples were wet sieved through 300 and 125µm mesh sizes and the resultant residues scanned under a stereozoom microscope at x7-45 magnifications. Those samples containing sufficiently preserved remains were analysed for Ostracoda and Foraminifera. Ostracods (Ostracoda) are Crustacea (aquatic invertebrates) and comprise a shell (carapace) with two valves (chitinous or calcareous). Species are divided into two groups, those occupying the benthic zone (the bottom of a water body) and those within the pelagic zone (the open water body). The benthic ostracods are found in freshwater and seawater, while the pelagic species are almost exclusively marine. They are highly sensitive to changes in salinity with three main assemblages identifiable: freshwater (<0.5‰ NaCl; lakes, rivers and ponds), brackish water (0.5-30‰ NaCl; lagoons and salt marshes) and marine (30-40‰ NaCl; oceans and seas), as well as rainfall, temperature and alkalinity. They are valuable to this analysis because they are indicators of changing influence of aquatic, in contrast to terrestrial, environments. Forams (Foraminiferida) are unicellular organisms and comprise a shell (test) composed either of secreted organic matter (tectin) and secreted minerals (calcite, aragonite or silica), or of agglutinated particles from the environment. Foraminifera are useful indicators of changes in water depth, salinity and climate. Identifications were made by reference to Athersuch *et al.* (1989).

5. RESULTS (By Keith Wilkinson)

Chronology

5.1

Table **1** presents the results of the AMS ^{14}C dating of two samples from silt/clay and organic strata. The two bulk organic samples from BH1, each of 1–2g weight, were submitted to the Scottish Universities Environmental Research Centre (SUERC) for AMS ^{14}C measurement.

Table 1. AMS ^{14}C dates on sub-samples from BH1

Lab. No.	Depth	^{14}C Age	2σ (95.4%) calibration
GU 28425	4.39-4.40m	18199±38 BP	22070-21450 cal. BP
GU 28426	6.62-6.63m	14108±30 BP	17490-16900 cal. BP

Calibration has been carried out using the IntCal09 curve (Reimer *et al.* 2009) and OxCAL 4 software (Bronk Ramsay 2009)

5.2 There are clear problems with the AMS ^{14}C chronology. Most significant is the Late Pleistocene age of both samples, which is inconsistent with both the stratigraphy (i.e. in intertidal sediments) and the biostratigraphic evidence, both of which suggest that a Holocene age should have been returned. A second problem is age inversion as GU 28425 produced a result 4000 years earlier than GU 28426, despite the fact that the latter is 2.23m further down the sequence. However, the hydrocarbon contamination that is discussed in Section 2.3 above, most likely explains both problems. As RSK's (2011) geotechnical report makes clear, peak hydrocarbon contamination is at 4.5m BGL, i.e. at the interface of the Made Ground and intertidal deposits, but it has clearly percolated down sequence to affect the entire intertidal sequence. Fossil fuels comprise geological carbon of extremely low ^{14}C content. Therefore hydrocarbon percolation will have diluted the ^{14}C concentration of organic remains in the sequence by a variable amount depending on the distance from the hydrocarbon source. Such dilution means that ^{14}C dating will not date the death of the sampled organism, but will rather produce an older age of a magnitude depending on the dilution factor.

5.3 The AMS ^{14}C measurements carried out on stratigraphy below the ASDA extension, Gosport demonstrates that the entire intertidal sequence has been contaminated with hydrocarbons and that the technique cannot be used to date deposits on the site.

Stratigraphy

5.4 In the text below the stratigraphy revealed in the boreholes is reviewed in stratigraphic order. The lithological data are plotted graphically in (**Fig 3**), while full descriptions are included as Appendix 2.

Wittering Formation

5.5 Deposits of the Wittering Formation were encountered at 6.67m BGL in BH1 and 6.50m BGL in BH2. They comprise heterogeneous beds of black (10 YR 2/1) and very dark greyish brown (10 YR 3/2) compact silts and clays, finely laminated with grey (5 Y 5/1) fine sands. The Wittering Formation is part of the Bracklesham Group and was deposited in tropical, shallow marine environments of the Early Tertiary (Palaeogene, 55-34my BP).

5.6 Wittering Formation deposits were found in the geotechnical boreholes between 8.00 (RSK BH1) and 11.8m BGL (RSK BH2).

Marine and intertidal deposits

5.7 A shallow marine/intertidal sequence unconformably overlies deposits of the Wittering Formation between 5.41 and 6.63m BGL in BH1 and 5.74 and 6.50m BGL in BH2. The sequence initially comprises a 0.26-0.40m thick deposit of normally-bedded, laminated silts and fine sands, which is in turn overlain by 0.36-0.97m of matrix- and clast-supported flint gravels. The former is likely to have formed as a result of changing tidal energies and within a channel containing a relatively low suspended sediment load, while the latter is probably bedload forming at the base of the tidal channel (Reineck and Singh 1980, 315-319). Moderate quantities of organic particles are found within the laminated sequence, but these are reworked from areas surrounding the channel and therefore have a complex taphonomic history.

5.8 The intertidal channel sequence described above is unconformably overlain by a sequence of dark grey (5 Y 4/1) homogeneous silts and clays. The latter sequence extends from 5.13 to 5.41m BGL in BH1 and 5.22-5.74m BGL in BH2, and is likely to be the product of the fall from suspension of particles during ebb tide. It is notable that shells noted in the relevant layers in BH1 suggest a marine origin for the sediment.

5.9 The subtleties of the intertidal sequence as outlined in Sections 5.7-5.8 is not seen in the geotechnical borehole logs, which rather describe a sequence of homogenous sandy clays extending from 3.50-8.00m BGL in RSK BH1 and 5.10-11.80m in RSK BH2. Given the descriptions in the geotechnical borehole logs it is likely that the laminated fine sand/silt sequence is present below 6.50m BGL in RSK BH1 and 6.70m BGL in RSK BH2, but there is no indication that bedload gravels were encountered. These data might indicate that the geoarchaeological boreholes were drilled in the former channel centre while the geotechnical boreholes are located to the side.

5.10 A series of 0.16-0.25m thick layers of black (5 Y 2.5/1) organic muds unconformably overlie the intertidal channel sequence in BH1 between 4.25 and 5.13m BGL. The uppermost of these beds contains a brick fragment, although this might have been worked downwards from the overlying Made Ground during the borehole the drilling. The organic mud beds are also all associated with a very strong hydrocarbon odour. Shell fragments found in the lowest organic mud bed suggest an intertidal origin and therefore the most likely explanation for the deposit is that it formed as suspended load fallout at ebb tide, and that the dark colour has been produced by hydrocarbon contamination.

5.11 It is highly likely that the intertidal sequence outlined in Section 5.7-5.10 is of Holocene date. The previous occasion prior to the Holocene when intertidal sediments had the opportunity to form on the South coast was the sea-level high stand associated with the Ipswichian interglacial (Marine Isotope Stage 5e) at 120-128ky BP. The ^{14}C dates obtained from the present deposits are clearly much younger, while as explained in Section 5.2, contamination has produced older ages than is suggested by the biostratigraphy.

Made Ground

5.12 Deliberately deposited strata overlie the intertidal sequence from 4.25m BGL to the ground surface in BH1 and 5.22m BGL to the ground surface in BH2. In BH1 and the uppermost 1.84m of BH2, these deposits are diamicts comprised of sands, flint and brick gravels in a silt/clay matrix, while a reinforced concrete layer is found at 2.20-2.35m BGL in BH1. The sequence between 1.84 and 5.22m BGL in BH2 is similar, but also contains organic remains and porcelain, and which are likely to comprise reworked occupation debris.

5.13 Made Ground deposits are recorded as being 3.50m thick in geotechnical borehole RSK BH1 and 5.10m thick in RSK BH2.

5.14 The Made Ground deposits are most likely to have been deliberately placed in the former channel of the Haslar Lake to raise the ground above tidal level. Cartographic evidence suggests that infilling took place between 1966 and 1970.

Palynology

5.15 Eight sub-samples were extracted for the assessment of pollen. The results of this assessment (Appendix 3) indicate that pollen was present in very high concentrations and a moderate to good state of preservation in the majority of the samples assessed. The exception to this was sample -5.07 to -5.08m BGL in which pollen was recorded in low concentrations.

5.16 The results of the assessment indicate that a mixture of tree, shrub and herb pollen together with spores was present in each sample. Poaceae (grass family) most commonly dominates each assemblage, with *Pinus* (pine) and *Quercus* (oak). *Alnus* (alder), *Corylus* type (e.g. hazel), Lactuceae (dandelion family), *Chenopodium* type (e.g. *Suaeda maritima* – seablite), Cyperaceae (sedge family), *Plantago* type (plantain) and Asteraceae (daisy family) also commonly present. Less commonly recorded taxa include *Tilia* (lime), *Betula* (birch), *Ulmus* (elm), *Fagus* (beech), *Calluna vulgaris* (heather), *Rumex acetosa*/*acetosella* (sorrel), *Ranunculus* type (buttercup) and *Trifolium* type (clover). Spore taxa include most commonly *Pteridium aquilnum* (bracken) with *Polypodium vulgare* (polypody fern) and *Dryopteris* type (buckler fern). Dinoflagellate cysts were recorded in the majority of samples. Microscopic charred particles were present in every sample, sometimes in high concentrations.

5.17 Prior to interpreting the results of the pollen analysis, there are some important theoretical issues specific to pollen data from coastal lowland systems that require consideration. Firstly, due to the nature of the depositional environment recorded at the site (i.e. estuarine/marine), whilst the assemblage will incorporate pollen from the local vegetation, a large proportion is likely to originate from the region as a whole. This is due to the large pollen source area (PSA) which results from a large sedimentary basin. In such a large basin, both an increased quantity of wind-blown and fluvially derived pollen will occur (e.g. Sugita, 1994, 2007; Chumra *et al*., 1999). However, should the environment of deposition alter (e.g. to a terrestrial environment supporting an enclosed forest), the pollen source area would decrease accordingly, and the majority of the pollen reflect a local source.

5.18 The second important issue to consider is that of the reworking of clastic sediments (e.g. Chumra *et al*., 1999). As outlined above, the ASDA, Gosport boreholes are composed entirely of fine-grained inorganic sediments of estuarine/marine origin. The pollen recorded may have been recently liberated, however much of it may be much older having been reworked from earlier sediments and shortly redeposited. The reworking of such grains maybe indicated by a high degree of poorly preserved pollen (Campbell, 1999), and indeed an elevated quantity of such grains were noted during the analysis. The presence of pre-Quaternary spores may also indicate the reworking of even older sediments, however none such palynomorphs were recorded within the two boreholes. Another consideration is that certain pollen grains may be over-represented in estuarine sediments due to their ability to float over long distances (e.g. *Pinus* and *Pteridium aquilinum*).

5.19 Finally, the identification of pollen grains (in particular herb taxa) is frequently limited by morphological similarities between grains from different species, and often only the genus can be established. Furthermore, some of the most diagnostic taxa found in saltmarsh environments are often palynologically indistinguishable from other members of their genera/family that may have originated from different environments. This is particularly the case for *Chenopodium* type which might represent either saltmarsh plants such as *Sueada maritima* or disturbed ground plants such as *Chenopodium album*. Similarly, Poaceae, Asteraceae and *Plantago* type might represent terrestrial species or their salt marsh equivalents.

5.20 Whilst there is no conclusive palynological evidence for an estuarine signal, the combined assemblage is highly suggestive of one. Many of the herbaceous taxa recorded within the samples might be representative of the growth of plants in a saltmarsh environment. These include *Chenopodium* type (e.g. seablite), Asteraceae (e.g. sea daisy), *Plantago* type (e.g. sea plantain) and probably various saline grasses. In addition, since pine pollen and bracken spores are frequently over-represented within clastic sediments, it is of note that high values of these taxa are frequently recorded in the samples. Finally, dinoflagellate cysts, which live in either fresh or marine waters are preserved in almost every sample.

5.21 There are however, indications of other, more distal vegetation communities, including the growth of mixed deciduous woodland dominated by oak on the dryland, and the wetland or river-edge growth of alder. Furthermore, and as highlighted above, some of the herbaceous taxa recorded may be representative of terrestrial habitats. As a consequence of this, and the nature of the assessment process it is not possible at this stage to quantify the spatial extent of woodland on the dryland. However, since many of the tree taxa recorded are thermophilous (warmth loving), the results of the pollen assessment do not correlate with that of the ^{14}C dating (5.1–5.3), which suggests accumulation during a cold stage. Instead, a Holocene age for the sediments is thought more likely.

5.22 The continual presence of microscopic charred particles may be indicative of anthropogenic activity. However, these particles may also have resulted from contamination which was noted during the coring and lithostratigraphic descriptions.

Diatoms

5.23 Eight sub-samples were extracted for the assessment of diatoms. The results of this assessment are displayed in Table 2. The results of the diatom assessment indicate an absence of diatoms in half of the samples. A number of factors influence diatom preservation, and it is probable that in the sediments examined here diatom concentrations were always low and that post-depositional destruction of the frustules has occurred due to drying-out, abrasion and possibly unfavourable chemical conditions. Dissolution of the diatom silica, for example, can occur as a response to the ambient dissolved silica concentration, the pH in open water, and the interstitial water in sediments. Using both fossil and modern diatoms, these and other environmental factors have been shown to affect the quality of preservation of assemblages (Flower, 1993; Ryves *et al.*, 2001).

Table 2 Results of the diatom assessment

Depth (m BGL)	Concentration	Quality of preservation	Diversity
4.39	2	2-3	Low
4.44	0	0	-
5.07	1-2	3	Low
5.21	2	2-3	Low
5.40	4	3-4	Moderate
6.37	0	0	-
6.58	0	0	-
6.78	0	0	-

Key:
Concentration: 0 = 0 frustules; 1 =1-75 frustules, 2 = 76-150 frustules, 3 =151-225 frustules, 4 = 226-300 frustules, 5 =300+ frustules per slide
Preservation: 0 = none, 1 = very poor, 2 = poor, 3 = moderate, 4 = good, 5 = excellent

5.24 However, in three samples a low diversity of diatoms are present in low concentrations and in a poor to moderate state of preservation. In one of the samples diatoms were moderately well preserved in high concentrations. A moderate diversity of taxa were recorded within this sample.

Foraminifera and ostracods

5.25 Four sub-samples were assessed for microfaunal remains. The results of this assessment are as follows:

5.26 4.39 to 4.41m BGL - This sample was characterised by abundant lignite. Foraminiferal assemblages were abundant but poorly diverse, comprising mainly *Ammonia beccarii* (no umbilical boss), *Haynesina germanicum* and *Elphidium williamsoni*. *Trochammina inflata* was also present. Ostracods were rare and represented by valves of a single species, *Leptocythere castanea*. Small unidentified gastropods also occurred commonly.

5.27 4.44 to 4.46m BGL - This sample yielded almost exactly the same microfaunal assemblage as the overlying sample. In addition, a single small bivalve, a single juvenile *Loxoconcha rhomboidea* and a few carapaces of a juvenile *Leptocythere* sp., probably *L. castanea* were seen.

5.28 5.07 to 5.09m BGL - This sample lacked the lignite seen in the overlying two samples but the faunal assemblage was nevertheless very similar. Some of the *Ammonia beccarii* appeared to have umbilical bosses and *Leptocythere castanea* was represented mainly by carapaces. In addition there were several large fragments of bivalve shells.

5.29 5.21 to 5.31m BGL - This sample residue was characterised by abundant fine sand and large bivalve and gastropod fragments. Foraminifera were the same as in all the overlying samples but appeared to be less common, their abundance being possibly diluted by the sand content. A single ostracod valve belonging to *Cyprideis torosa* (smooth form) was also observed.

5.30 All of microfaunal species recovered are broadly indicative of a brackish estuarine setting. The ostracod *Leptocythere castanea* is indicative of salt marshes and estuaries where it typically inhabits muddy substrates. The occurrence in the middle two samples of entire carapaces (both adult and juvenile) of this species does suggest that they have not been transported far or at all. *Trochammina inflata* is a high salt marsh indicator and has probably been washed in higher up the estuary. The occurrence of some specimens of *Ammonia beccarii* with a central umbilical plug does suggest greater marine influence at 5.07 – 5.09m BGL, but strictly marine forms are absent from all samples. The presence of sand and large shell fragments in the lowest sample indicates a higher energy environment than represented by the overlying samples. The absence of *L. castanea* from the lowest sample if probably due to the sandier nature of the sediment at this depth. The only ostracod found at this depth was a single valve of *Cyprideis torosa* which is found in a wide range of brackish environments.

6. ASSESSMENT (By Keith Wilkinson)

Archaeological and palaeoenvironmental potential

6.1 Deposits of the Wittering Formation have NO archaeological or palaeoenvironmental potential. These sediments accumulated >27 million years before the earliest human ancestors evolved.

6.2 The intertidal/marine sequence has a LOW archaeological potential. No evidence for either direct or indirect human impact was found in either the litho- or biostratigraphic record. Both lines of evidence also indicate that the sediments accumulated during twice-daily inundation by tidal water while there was no stable ground surface on which sustained human activity could take place. Despite the fact that biological preservation is good, the intertidal/marine sequence is also assessed as having a LOW palaeoenvironmental potential. This assessment is made because hydrocarbon contamination of the depositsrenders ^{14}C dating highly problematic, while the only other applicable absolute dating technique - optically stimulated luminescence – cannot be carried out on deposits that have been exposed to the light (the cores were cut open in order to describe the stratigraphy and sub-sample for biostratigraphic study and ^{14}C dating). The extreme difficulty in dating the strata means that even though detailed proxy palaeoenvironmental data might be recovered, they could not be related to an absolute timescale.

6.3 The Made Ground has a LOW archaeological and palaeoenvironmental potential. The age of the deposits (1966-1970) mean that they are not considered 'archaeological' according to many definitions. Even though older strata occur within the Made Ground in BH2, these have been removed from their original point of deposition and are therefore difficult to interpret.

Chronology

6.4 Deposits of the Wittering Formation date to the Palaeogene, i.e. the Early Tertiary (53 and 34my BP).

6.5 The sequence of laminated fine sands/silts, gravels and homogeneous silt/clays overlying the Wittering Formation is most likely to be of Holocene age despite the Late Glacial ^{14}C ages. There are no artefacts present in the relevant deposits, while biostratigraphic data do not allow a better discrimination of age. However, given the elevation of the strata with respect to OD, it is likely that they date from the Neolithic period and later.

6.6 The Made Ground was placed within the Haslar channel between 1966 and 1970. However, Made Ground sediments sampled in BH2 include artefacts that suggest an origin in occupation deposits pre-dating 1966.

Depositional environments

6.7 The Wittering Formation at the base of the accumulated in tropical shallow marine and marine-marginal environments.

6.8 Laminated fine sand/silt, clast- and matrix-supported gravels and homogenous silt/clays unconformably are likely to have been deposited in an intertidal channel. The channel waters are likely to have contained limited suspended sediment during deposition of the laminated fine sands/silts and gravels, but greater quantities at the time the silt/clays were deposited. The gravels are likely to have formed as a result of bedload traction processes and therefore mark the main axis of flow through the channel.

6.9 The Made Ground was deliberately placed within the channel to raise the area above the tidal frame.

Potential of biostratigraphic proxies

6.10 The results of the pollen assessment indicated that pollen concentration was high in the majority of samples. The combined assemblage is highly suggestive of an estuarine environment, with many of the herbaceous taxa recorded potentially representative of the growth of plants in a saltmarsh environment. In addition, there are indications of more distal vegetation communities, including the growth of mixed deciduous woodland dominated by oak on the dryland, and the wetland or river-edge growth of alder. However, it is not possible at this stage to quantify the spatial extent of woodland in these environments. However, since many of the tree taxa recorded are thermophilous (warmth loving), the results of the pollen assessment do not correlate with that of the ^{14}C dating, which suggests accumulation during a cold stage.

6.11 The results of the diatom assessment indicate that diatoms are intermittently present through the sequence. In some of the samples however, low to moderate concentrations of remains are recorded and the diversity is similarly low to moderate.

6.12 The results of the microfaunal assessment indicated that remains were recorded in each of the four samples assessed and were all broadly indicative of a brackish estuarine environment.

7. RECOMMENDATIONS

7.1 No further archaeological or geoarchaeological works are recommended on the sequence beneath the ASDA extension. Although microbiological remains are well preserved, they a. are unlikely to provide evidence (direct or indirect) of past human activity, and b. cannot be placed in a chronostratigraphic framework as hydrocarbon contamination emanating from the gas works that was formerly located close to the site prevents the use of ^{14}C dating.

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The fieldwork was undertaken by Simon Roper who also produced this report. The illustrations were prepared and the report compiled by Ann Linge. The archive was compiled and prepared for deposition by Simon Roper. The project was managed by Andy King.

APPENDIX 1: Policy Statement

This report is the result of work carried out in the light of national and local authority policies.

NATIONAL PLANNING POLICY (ENGLAND)

The *National Planning Policy Framework* (NPPF) for England published by the UK Government in March 2012 states that the historic environment, which includes designated and non-designated heritage assets, is an irreplaceable resource and, as such, should be taken into account by Local Planning Authorities when considering and determining planning applications. This is taken to form part of a positive strategy set out in the respective Local Plan to ensure the conservation and enjoyment of the historic environment. The assigned significance of heritage assets will be key factor in terms of their conservation.

Given their irreplaceable nature, any harm to, or loss of, a heritage asset, or heritage assets, should be clearly and convincingly justified as part of a planning application. As part of this, applicants are required to describe the significance of any heritage assets affected by a proposal, including any contribution made by their setting. Where a heritage asset, or assets, are to be harmed or lost as the result of a proposal, the applicant will be required to record and advance the understanding of the significance of that asset or assets, to include making the evidence arising publicly accessible, but this will be in proportion to the significance of the asset/assets in question.

While the NPPF takes into account the historic environment as a whole, additional protection is afforded to designated heritage assets under current English Law. Any proposal that would result in harm or loss of a designated heritage asset is also required to be justified by the applicant in meeting strict criteria set out in the NPPF.

LOCAL POLICY (see below)

Archaeology and Ancient Monuments

> Policy R/BH8
>
> Development will not be permitted which harms nationally important Archaeological Sites, whether scheduled or not, or their setting.
>
> Applications likely to affect Archaeological Sites should be accompanied by an assessment of their value, in each case considering the individual merits; and prepared by an appropriately qualified person and approved by the Borough Council in advance of any formal determination of the relevant application.
>
> Where preservation is not possible or feasible a planning condition may be imposed requiring a programme of investigation and recording to an acceptable standard prior to the commencement of the development.

10.34 The Local Plan area contains a number of important and distinctive archaeological sites, many reflecting the area's naval and military heritage over hundreds of years. As well as 'above ground' features, there are a number of 'below ground' remains which may be of local or national importance. However, only a small proportion of sites are protected as Scheduled Ancient Monuments (see Appendix N: Ancient Monuments) and some sites are listed in the Archaeology and Historic Buildings Record (AHBR) maintained by Hampshire County Council. Proposals which involve the carrying out of works to a Scheduled Ancient Monument require Scheduled Monument Consent from the relevant Government department.

10.35 There are likely to be many sites of archaeological significance which have not been identified. Development proposals which may affect archaeological sites and monuments that are not statutorily protected will be carefully assessed to ensure that the impact on such sites is minimised. Where there is evidence, for example from historic maps, that archaeological remains may exist, the Borough Council will require applicants to arrange for the carrying out of a field assessment prior to the application being determined in consultation with the County Archaeologist. Where the physical preservation of archaeological remains is not considered possible or feasible the Borough Council may require applicants to make provision for investigating and recording. Planning permission may be refused where applicants have not sought to accommodate archaeological requirements.

10.36 On occasion when the presence of archaeological remains only becomes apparent after development has commenced, the Borough Council will seek to negotiate with the applicant to preserve or excavate the remains as appropriate in consultation with the County Archaeologist or other appropriately qualified archaeologist.

10.37 Recent research on the historic town of Gosport has been presented in *An Extensive Urban Survey of Hampshire's and the Isle of Wight's Historic Towns; Gosport* (1999) and is also presented in *Hampshire Rural Settlements: Gosport* (2002). These Hampshire County Council studies provide extensive information on the potential archaeological interest of the immediate Town Centre and will be used to evaluate proposals within that part of the Local Plan area.

APPENDIX 2: Lithological descriptions

Bore	Top (m)	Base (m)	Lithology	Comment
BH1	0.00	0.54	Overburden	2.5 Y 4/3 Olive brown matrix-supported, poorly sorted gravel. Granular to pebble sized angular flint and rare brick and concrete clasts in a sandy clay matrix. Diffuse boundary to:
	0.54	2.20	Overburden	5 Y 4/2 Olive grey compact silt/clay with frequent fine to coarse sand. Frequent granular- to pebble-sized fragments of red brick, charcoal, sub-angular flint pebbles and discrete lenses of grey, green and pink clays. Rare cobble-sized sub-angular flint. Sharp boundary to:
	2.20	2.35	Concrete	5 Y 7/1 Light grey concrete . Cobble-sized plate of steel. Sharp boundary to:
	2.35	3.00	No recover	Void
	3.00	3.20	Overburden	2.5 Y 4/2 Dark greyish brown loose matrix-supported, poorly sorted gravel of sub-angular granular to pebble-sized flint clasts. Sharp boundary to:
	3.20	3.87	Overburden	5 Y 3/2 Dark olive grey silt/clay with frequent coarse sand and occasional granular to pebble-sized flint and brick fragments. Occasional cobble-sized wood fragments. Poorly sorted. Sharp boundary to:
	3.87	4.25	Overburden	5 Y 3/1 Very dark grey silt/clay with frequent coarse sand. Occasional granular to pebble-sized sub-angular flint clasts. Moderately sorted. Sharp boundary to:
	4.25	4.44	Organic mud	5 Y 2.5/1 Black coarse sandy organic mud oxidising to 5 Y 3/1 Very dark grey. Very strong smell of hydrocarbon (petroleum). Single cobble-sized brick fragment. Moderately sorted. Sharp boundary to:

Bore	Top (m)	Base (m)	Lithology	Comment
BH1	4.44	4.50	Organic mud	5 Y 2.5/1 Black organic mud oxidising to 5 Y 5/3 Olive. Very strong smell of hydrocarbons (petroleum). Well sorted.
	4.50	4.88	No recover	Slump
	4.88	5.13	Organic mud	5 Y 2.5/1 Black organic mud oxidising to 5 Y 5/3 Olive. Occasional granular-sized shell fragments. Very strong smell of hydrocarbon (petroleum). Well sorted. Sharp boundary to:
	5.13	5.41	Silt	5 Y 4/1 Dark grey silt/clay with occasional to frequent granular shell fragments and whole shells. Diffuse boundary to:
	5.41	5.89	Matrix-supported gravel	5 Y 5/1 Grey very poorly sorted, clast-supported gravel of coarse sand to pebble-sized sub-angular flint clasts in a silt/clay matrix. Oxidising to 10 YR 5/4 Yellowish brown. Sharp boundary to:
	5.89	6.00	Silt	5 Y 5/1 Grey with oxidising to 10 YR 5/4 Yellowish brown silt/clay. Well sorted. Homogeneous.
	6.00	6.37	Clast-supported gravel	Loose gravel of granular to pebble-sized sub-rounded to rounded flint clasts. Well sorted. Sharp boundary to:
	6.37	6.63	Silt-fine sand	5 Y 5/1 Grey normally bedded silt/clay with rare granular-sized organic fragments. Very fine sandy, horizontal, continuous laminations towards the base. Well sorted. Gradual boundary to:

	6.63	7.50	Siltstone	10 YR 3/2 Very dark greyish brown silt/clay finely laminated with 5 Y 5/1 Grey silt/clay/very fine sand grains. Occasional iron oxide stains. Laminations are wavy, parallel and continuous towards base of core, but horizontal further down. Well sorted.
	7.50	7.88	No recover	Slump

Bore	Top (m)	Base (m)	Lithology	Comment
BH1	7.88	10.50	Siltstone	10 YR 2/1 Black compact silt/clay laminated with 5 Y 5/1 Grey fine sand. Laminae are fine, parallel and dip downwards sharply across the core. The clay laminae are themselves formed by finer laminae. Well sorted within laminae.
BH2	0.00	0.28	Overburden	10 YR 5/6 Yellowish brown, compact, poorly sorted, clast-supported gravel of granular to pebble-sized flint and concrete clasts. Sharp boundary to:
	0.28	1.72	Overburden	5 Y 3/2 Dark olive grey, compact silt/clay with frequent coarse sand and occasional to frequent granular to pebble-sized red brick fragments and flint clasts. Occasional granular-sized charcoal fragments. Poorly sorted. Sharp boundary to
	1.72	1.84	Overburden	10 YR 5/6 Yellowish brown loose, matrix-supported gravel of granular to fine pebble-sized angular flint clasts in a medium sand matrix. Poorly sorted. Sharp boundary to:
	1.84	3.00	Cultural deposit	5 Y 3/2 Dark olive grey changing to 5 Y 4/3 Olive by base, loose humic stained silt/clay with frequent coarse sand and occasional granular to pebble-sized red brick, flint fragments, organic fibres and wood (twigs). Single cobble-sized red brown soft amorphous fired? clay patch). At 2.56m fine pebble-sized porcelain sherd. Poorly sorted.
	3.00	3.66	No recover	Slump
	3.66	3.76	Cultural deposit	5 Y 4/3 Olive loose humic stained silt/clay with frequent coarse sand and occasional granular to pebble-sized red brick, flint fragments, organic fibres and wood (twigs). Poorly sorted. Diffuse boundary to:

Bore	Top (m)	Base (m)	Lithology	Comment
BH2	3.76	5.22	Cultural deposit	2.5 Y 3/2 Very dark greyish brown humic stained silt/clay with frequent coarse sand and occasional granular to pebble-sized red brick, flint fragments and organic fibres. At 4.28 t0 4.40m is a yellow silt/clay and coarse sand lens/layer. Diffuse boundary to:
	5.22	5.74	Silt	2.5 Y 4/1 Dark grey silt/clay with occasional to frequent granular-sized white shell fragments, rare pebble-sized whole bivalve shell and rare rounded flint pebbles. Rare granular-sized wood fragment (twig). Well sorted Sharp boundary to:
	5.74	5.83	Matrix-supported gravel	5 Y 4/1 Dark grey, loose, clast-suported, gravel of granular to fine pebble-sized sub-angular to sub-rounded flint clasts in a clay matrix. Poorly sorted. Sharp boundary to:

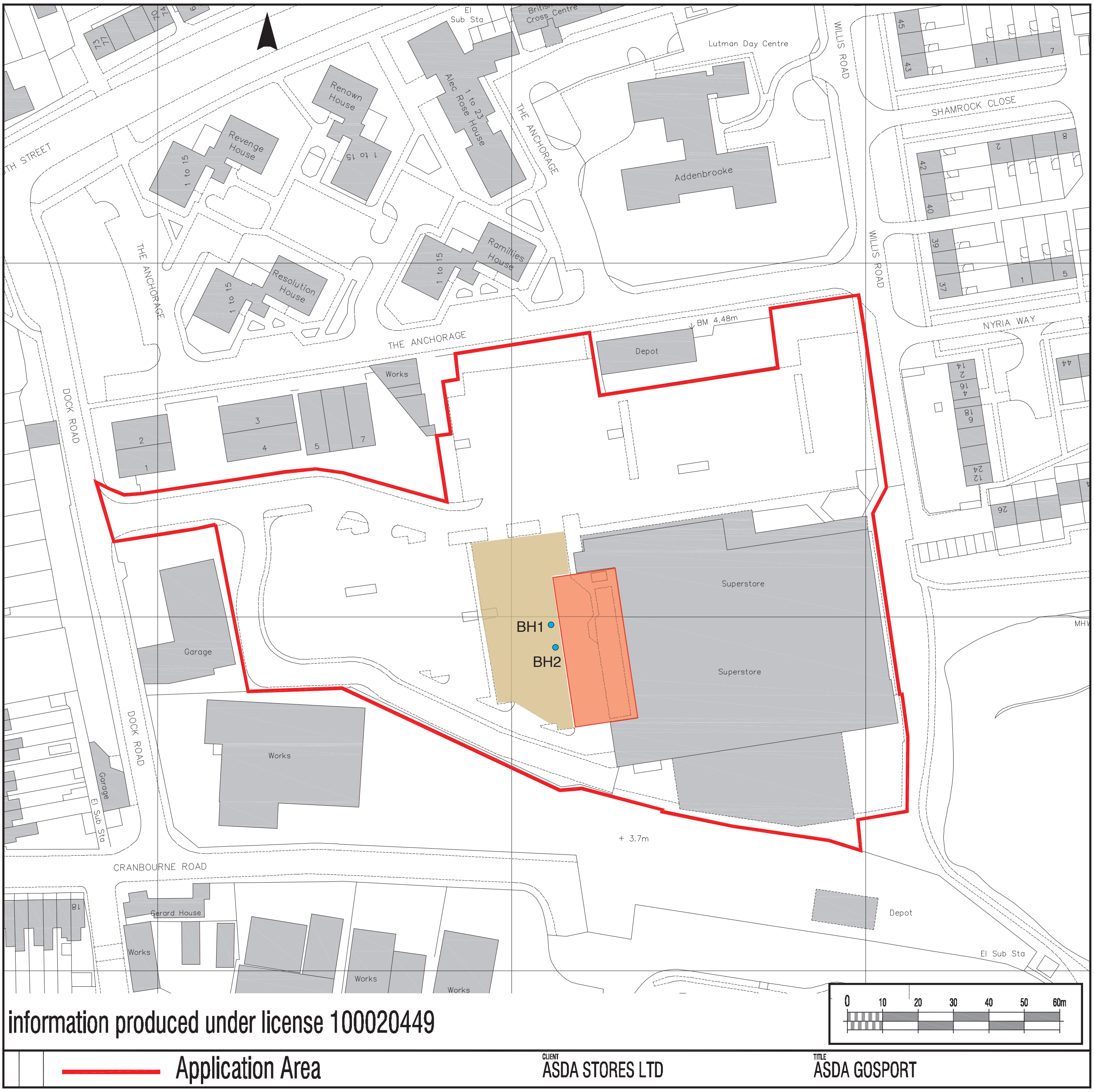
5.83	6.10	Matrix-supported gravel	5 Y 5/2 Olive grey, compact, matrix-supported gravel of granular to pebble-sized sub-angular to sub-rounded flint clasts in a clay matrix. Poorly sorted. Sharp boundary to:
6.10	7.50	Silt-fine sand	5 Y 5/1 Grey changing downward to 7.5 YR 2.5/1 Black compact silt/clay with frequent iron oxide staining. Frequent fine-medium, wavy, parallel fine sand laminae. Well sorted.
7.50	7.84	No recover	Slump
7.84	9.00	Siltstone	10 YR 2/1 Black compact silt/clay laminated with 5 Y 5/1 Grey fine sand. Laminae are fine, parallel and dip sharply across the core. The clay laminae are themselves formed by finer laminae.

Appendix 3: Palynological data

Depth (m BGL)	Main pollen taxa			Concentration 0 - 5	Total Pollen Concentration (grains/cm3)	Preservation 0- 5	Microcharcoal 0 - 5
	Latin name	Common name	Number				
4.39	*Alnus* *Quercus* *Pinus* *Tilia* *Corylus* type Poaceae Lactuceae *Chenopodium* type *Rumex acetosa/acetosella* *Trifolium* type *Ranunculus* type *Dryopteris* type *Polypodium vulgare* *Pteridium aquilinum* Dinoflagellate cyst	alder oak pine lime e.g. hazel grass family dandelion e.g. fat hen sorrel clover buttercup buckler fern polypody fern bracken	1 2 7 1 4 6 1 3 1 1 1 1 1 1 present	5	21,179	3	4
4.44	*Alnus* *Betula* *Pinus* *Quercus* *Corylus* type Poaceae Cyperaceae *Plantago* type Dinoflagellate cyst	alder birch pine oak e.g. hazel grass family sedge family plantain	1 1 6 4 4 11 1 3 present	5	1263	3-4	1
4.86	*Alnus* *Pinus* *Quercus* *Corylus* type Poaceae Cyperaceae *Chenopodium* type Lactuceae *Plantago* type Asteraceae	alder pine oak e.g. hazel grass family sedge family e.g. fat hen dandelion family plantain daisy family	2 4 5 3 6 1 2 3 3 1	5	8935	3-4	3-4
4.93	*Alnus* *Pinus* *Tilia* *Corylus* type *Salix* Poaceae Cyperaceae *Chenopodium* type Lactuceae Asteraceae *Pteridium aquilinum* *Dryopteris* type Dinoflagellate cyst	alder pine lime e.g. hazel willow grass family sedge family e.g. fat hen dandelion family daisy family bracken buckler fern	2 8 1 1 1 11 2 5 2 2 3 1 present	5	11,769	2-3	2-3
5.00	*Alnus* *Quercus* *Pinus* *Calluna vulgaris* Poaceae Lactuceae *Chenopodium* type *Artemisia* *Plantago* type *Pteridium aquilinum* Dinoflagellate cyst	alder oak pine heather grass family dandelion family e.g. fat hen mugwort plantain bracken	2 7 6 1 10 2 1 1 1 1 present	5	10,848	2-3	1-2
5.07	*Pinus* *Quercus* Poaceae Lactuceae *Chenopodium* type	pine oak grass family dandelion family e.g. fat hen	2 1 4 1 1	2	3992	3	1

5.14	*Quercus* *Betula* *Pinus* *Corylus* type Poaceae Cyperaceae *Plantago* type Lactuceae *Chenopodium* type *Pteridium aquilinum* *Polypodium vulgare* Dinoflagellate cyst	oak birch pine e.g. hazel grass family sedge family plantain dandelion family e.g. fat hen bracken polypody fern	13 2 2 8 8 1 2 1 1 2 1 present	5	21,411	4	1-2
5.21	*Alnus* *Quercus* *Betula* *Ulmus* *Fagus* *Pinus* *Corylus* type *Hedera* Poaceae Lactuceae Cyperaceae *Polypodium vulgare* Dinoflagellate cyst	alder oak birch elm beech pine e.g. hazel ivy grass family dandelion family sedge family polypody fern	2 10 3 1 1 4 5 1 7 1 1 2 present	5	27,797	4	1

Key:
Concentration: 0 = 0 grains; 1 =1-75 grains, 2 = 76-150 grains, 3 =151-225 grains, 4 = 226-300, 5 =300+ grains per slide
Preservation: 0 = none, 1 = very poor, 2 = poor, 3 = moderate, 4 = good, 5 = excellent
Charcoal: 0 = none, 1= negligible, 2 = occasional, 3 = moderate, 4 = frequent, 5 = abundant



Area of Proposed Extension

Area of Groundworks

Fig.1 Site location plan (courtesy of HGP Architects)

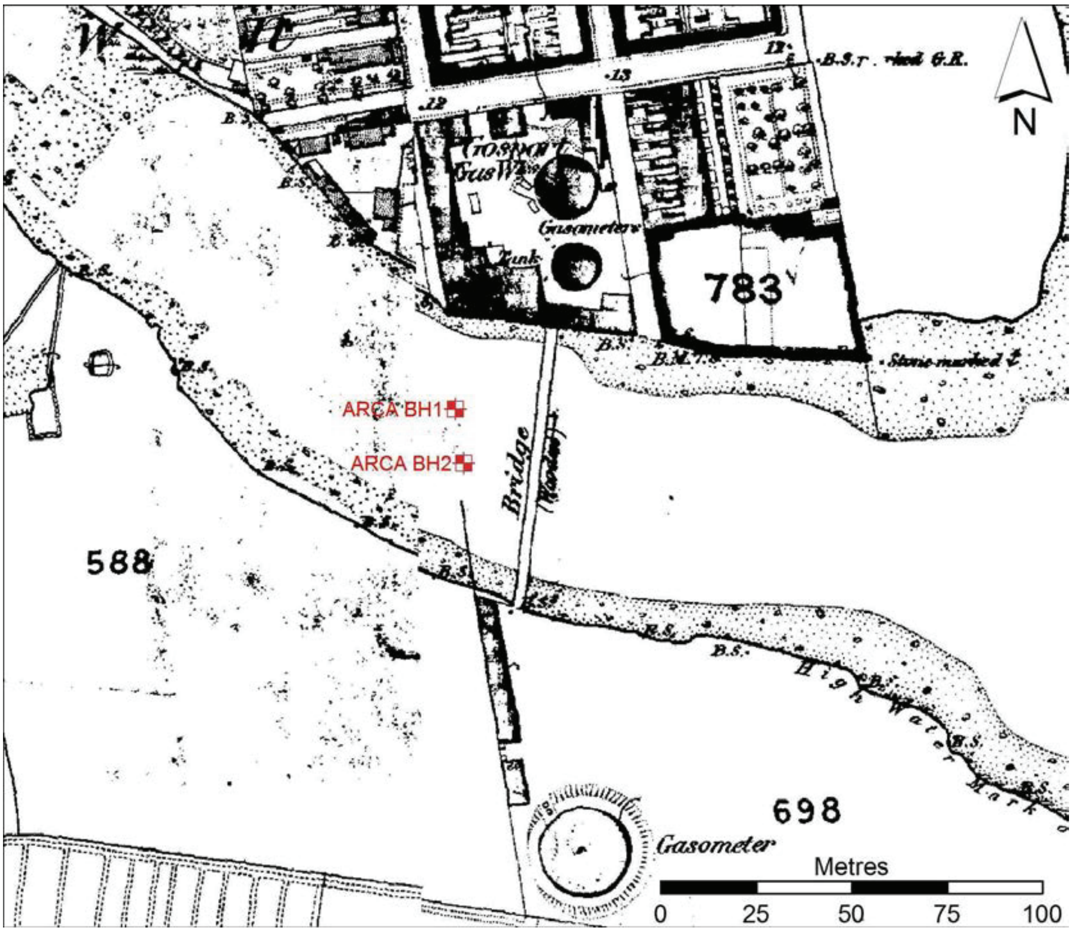


Fig.2 Locations of geoarchaeological and geotechnical boreholes plotted against the 1st Edition Ordnance Survey mapping

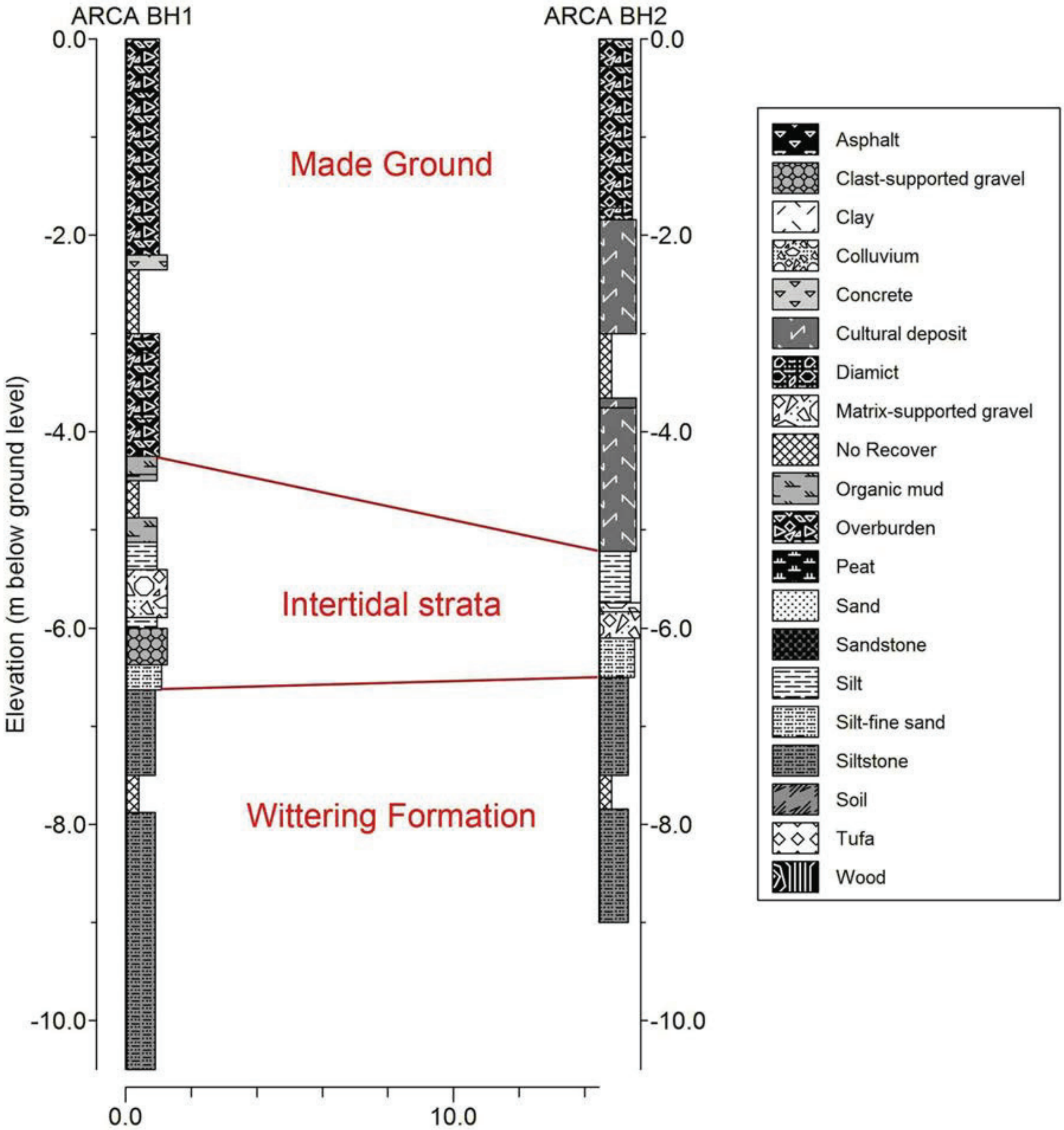


Fig.3 Composite cross section through the geoarchaeological boreholes

Plate 1 Core being removed from casing, looking north-east

Plate 2 Packed cores from the second borehole, looking east