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**PLOT2 CENTRAL PARK,  
SEVERN BEACH,  
GLOUCESTERSHIRE:  
GEOARCHAEOLOGY  
BOREHOLE REPORT**

Prepared for Euro Garages  
Ltd

By  
Nick Watson

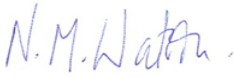
**ARCA**

Department of Archaeology and  
Anthropology  
University of Winchester  
Winchester  
SO22 4NR

<http://www.arcauk.com>

*Plot 2 Central Park, Severn Beach, Gloucestershire:  
Geoarchaeology Borehole Report*

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## SUMMARY

*This document reports on five geoarchaeological boreholes drilled on the Plot 2 Central Park site, Goldcrest Way, Severn Beach, Gloucestershire. The work was carried out by ARCA on behalf of Euro Garages Ltd in November 2020. The results from earlier geotechnical boreholes are included.*

*The Mercia Mudstone Group bedrock lies between -2.09m OD (9.62m bgl) and +0.90m OD (6.75m bgl). The top fraction is heavily weathered with evidence for solifluction. The bedrock is overlain by fine grained intertidal/fluviol deposits of the Wentlooge Formation that has intercalated thin peat units. These units have been correlated with dated peat units on the neighbouring Sevenside Hotel site. On this basis the basal peat dates to c. 2470 – 2286 cal BC in the Late Neolithic. The succeeding peat commences growth at c. 2140 – 1957 cal BC in the Early Bronze Age and is overwhelmed by intertidal sedimentation at c. 830 – 775 cal BC in the Late Bronze Age.*

*Lithological evidence demonstrates that there was a cyclical change in the environment represented by fresh and brackish water peats, and intertidal mudflats evolving within a very low energy regime. The vegetational history of the site has not been assessed, however, palynological work at the Sevenside Hotel site suggests that a similar picture would apply, namely that: there is no significant change throughout the sequence; the floral environment on the site consists of saltmarsh and fen/reed swamp with stands of alder and willow on the floodplain margin; and mixed deciduous forest grows on the higher land. These results are very similar to the sites of Willow Farm and Severn Road, 1.7km south southwest on the floodplain. No evidence of human activity was found.*

*The marked similarity in lithostratigraphy between the two sites leads to a recommendation that no further work be undertaken on the Plot 2 Central Park site.*

## **1. INTRODUCTION**

- 1.1 This report presents the results of a geoarchaeological investigation of five boreholes drilled at the site of the proposed road side services at Plot 2 Central Park, Goldcrest Way, Severn Beach, Gloucestershire, BS35 4GH (henceforth 'the site'). The work was carried out by ARCA on behalf of Euro Garages Ltd in November 2020. The work presented here is in accordance with a Written Scheme of Investigation (WSI) designed after consultation with Dr Paul Driscoll (Archaeology and Historic Environment Record Officer for South Gloucestershire County Council), and conforms to Historic England (2015) guidance on geoarchaeology (Watson 2020). The geoarchaeological study was requested by South Gloucestershire County Council as a condition for the granting of planning consent for road side services, a car park and associated landscaping.
- 1.2 The sections of the report are arranged as follows: Section 1 provides essential background to the project, i.e. the geographical and geological situation of the site, past work, and the aims of the present work. Section 2 outlines the methodology employed in collecting and utilising the geological data. The lithostratigraphy is presented in Section 3; Sections 4 discusses the significance of the data recovered in relation to the aims that have been set and gives recommendations for future work; conclusions are presented in Section 5. A bibliography, figures and appendices providing the locations and lithostratigraphy of the borehole logs complete the report.
- 1.3 The site is centred on NGR ST 55736 83137, and comprises an area of 4.5 ha, all of which has been covered by c. 2m of coarse Made Ground (Figure 1). It has a flat aspect and an elevation of c. +8m OD. The site lies on the east floodplain of the River Severn, c. 1.7km southeast of the town of Severn Beach. The spring tidal range of the Severn Estuary directly to the west (c. 2.1km) is c. 15m, indicating that without the sea defences and drainage channels the ground would be waterlogged, and periodically and frequently flooded by tidal surges of brackish water.
- 1.4 Construction of fuel tanks to serve the roadside services to a depth of 7m bgl will affect the geological strata and ARCA BH9 was positioned at this location. The four other boreholes (ARCA BH6 – ARCA BH8 and ARCA BH10) were located to provide a spread of data across the site. No other construction work will

affect *in situ* strata lying below the thick modern Made Ground deposits.

- 1.5 The British Geological Survey (1:50,000 1981, sheet 250) map the bedrock geology of the site as the Mercia Mudstone Group (MMG) that dates to the Early to Late Triassic (251.9 – 201.3 Ma). The bedrock is overlain by Tidal Flat Deposits that date to the Holocene Epoch (11.7ka to present day) (British Geological Survey 2020a; 2020b). The Tidal Flat Deposits have been subdivided by Allen and Rae (1987) into five formations that formed in intertidal and fresh water marsh environments, the most significant for the site is the Wentlooge Level Formation. This formation lies on the bedrock and usually comprises a basal gravel, basal peat and intercalated peats within silts and clays. The formation formed prior to the construction of coastal defences in the Roman period (c. 2nd century AD) (Allen and Rae 1987). The reclaimed former mudflats were used as pasture in the later Roman, medieval and post-medieval periods.
- 1.6 Work on the neighbouring Severnside Hotel site has shown that the Mercia Mudstone Group (MMG) bedrock lies between -1.05m OD (8.70m bgl) and -0.09m OD (7.80m bgl) (Figure 2, Figure 3 and Figure 4). It is overlain by Pleistocene diamicts and gravels that sub-crop between +0.51m OD (7.20m bgl) and +1.24m OD (6.45m bgl) and attain a maximum thickness of c. 1.5m. The succeeding deposits of the Wentlooge Formation are five, thin peat units [Peats (i) to (v)] intercalated in fine grained intertidal/fluvial deposits between +1.22m OD and +3.19m OD.
- 1.7 The basal peat [Peat (i)] dates to 2470 – 2286 cal BC in the Late Neolithic. The succeeding peat [Peat (ii)] commences growth at 2140 – 1957 cal BC in the Early Bronze Age and is overwhelmed by intertidal sedimentation at 830 – 775 cal BC in the Late Bronze Age.
- 1.8 Geotechnical work by Structural Soils (2018) involved the drilling five boreholes (BH501 – BH503, BH504A, BH505A and BH506) on the Plot 2 site and environs which indicate that deeper stratigraphy lies in the east and south east of the site where the bedrock sub-crop is c. -3.5m OD (11m bgl) in BH506 and lies at a greater, unknown depth in BH503 (Figure 4).
- 1.9 Palaeobotanical and lithological evidence from the Severnside Hotel cores demonstrate that there was a cyclical change in the environment represented by fresh and brackish water peats, and intertidal mudflats laid down under a very low energy

regime. The vegetational history of the site shows no significant change throughout the sequence. The floral environment consists of saltmarsh and fen/reed swamp with stands of alder and willow on the margin to the floodplain. Higher land supports a mixed deciduous forest. No evidence of human activity was found except for a single cereal pollen grain from the top of the sequence.

- 1.10 Detailed geoarchaeological studies have been made at the Willow Farm site and at the adjoining site of Severn Road at Hallen, c. 1.7km south southwest of the Severnside Hotel and Plot 2 Central Park sites (Wilkinson 2008; Wilkinson et al. 2012; 2013; Watson 2018). At Willow Farm these studies established a sequence of five intercalated peats dating from the Mesolithic (Peat 1, c. 7300 cal BC) at c. -8.7m OD to the Neolithic/Bronze Age (Peat 5, c. 2100 cal BC) at c. +4.4m OD. The MMG bedrock sub-crops at -10.18m OD (16.64m bgl). Evidence for possible human activity was recorded in the sequence: elm decline seen in the palynological record for Peat 4; and evidence from micromorphology for the presence of herd animals in the youngest peat, Peat 5.
- 1.11 The results of the Severn Road site showed a dated sequence of five peat units that correlated with Willow Farm although the basal peat dated to c. 8100 cal BC and began to grow almost a millennium earlier than its counterpart at Willow Farm (Watson 2018). Sedimentary deposition showed a cyclical sequence of deposits that were laid down as a result of relative sea level rise. Each cycle began with a flooding horizon across the top of a freshwater peat and included an intertidal mudflat and saltmarsh environment characterised by the gastropod *Hydrobia ulvae*, and channel sands. The most recent cycle was artificially interrupted with the initiation of drainage in the Roman period. Although some cold climate arboreal species are recorded in the basal peat, the floral communities in all the peats are broadly similar: sedge fen, reed swamp and salt-marsh type, with a more distant dryland deciduous woodland.
- 1.12 At Severnside Hotel the basal peat [Peat (i)] dates from 2470 – 2286 cal BC in the Late Neolithic. In comparison with Willow Farm and Severn Road the Severnside Hotel basal peat lies at +1.22m OD which is c. 10m higher. The consequence of this difference in elevation is that the much thicker peat and mud sequences found at Willow Farm and Severn Road (c. 16m compared to c. 2m on the Severnside Hotel site) began developing considerably earlier. At Severn Road this was at



8165 – 6371 cal BC, and at Willow Farm at 7310 – 6250 cal BC. The latest date for the uppermost peat at Severn Road is 4146 – 3264 cal BC in the Early Neolithic; and at Willow Farm it is a little later 3010 – 2700 cal BC. On the Severnside Hotel site, however, the sequence begins almost half a millennium later at 2470 – 2286 cal BC. There is therefore no overlap of the sequence at Severnside Hotel with those at Willow Farm and Severn Road.

1.13 The present site lies directly north and east of the Severnside Hotel site (Figure 1). The borehole survey has provided the opportunity to compare the strata found on the two sites, and in particular, deduce whether the five peat units found at the Severnside Hotel site are laterally extensive.

1.14 The aims of the work are to:

1.14.1 Determine the lithostratigraphic sequence of the site and the depositional environments in which the strata formed;

1.14.2 Provide a chronology for the Holocene sediment sequence;

1.14.3 Assess the potential of the deposits to provide new palaeoenvironmental information;

1.14.4 Correlate the litho- and biostratigraphic sequences with those investigated at the Severnside Hotel site, and by addressing 1.13.1 to 1.13.4;

1.14.5 Determine the geoarchaeological potential of strata sub-cropping on the site.

## **2. METHODOLOGY**

### **2.1 Borehole drilling**

2.1.1 Five geoarchaeological boreholes (ARCA BH6 – ARCA BH10) were positioned and marked on the site. The locations were surveyed to National Grid Reference and Ordnance Datum using a Leica System 1200 RTK GPS (Figure 1). The boreholes were drilled using a Pioneer 2 rig equipped with a dynamic sampler (i.e. capable of both pressure-based and rotary drilling) (see Geotechnical Engineering Ltd (2019) for technical details). Drilling commenced from the base of 1.2m deep inspection pits (dug by hand by the drilling crew to ensure the absence of

buried services) and continued until the top of the MMG bedrock was reached. Continuous cores were collected in 100mm diameter Perspex tubes from cased boreholes. The cores of the boreholes were boxed and transported to Geotechnical Engineering's facility at Centurion House, Olympus Park, Quedgeley, Gloucester, GL2 4NF for recording.

## 2.2 Core recording

2.2.1 The cores were cleaned with a scalpel, logged and photographed according to standard criteria (Jones *et al.* 1999; Munsell Color 2000; Tucker 2011).

2.2.2 Prior geotechnical investigation comprised six cable percussion boreholes (BH501 – BH503, BH504A, BH505A and BH506) and eight Trial Pits (Structural Soils (2018)). Data from selected boreholes have been included in this report; however, the Trial Pits were terminated at 3m below ground level (bgl) and did not provide useful information on the stratigraphy; they are not discussed further here. Two BGS boreholes (ST58SE82 and ST58SE68) are located relatively close to the site and reference is made to them.

2.2.2 Lithological and positional data collected during the fieldwork and the laboratory description of the five borehole cores were combined with selected geotechnical boreholes from the site in a RockWorks 15 database (RockWare 2013). The software was then used to plot lithostratigraphic cross-sections. Lithological data from the boreholes and their location and elevation are recorded in Appendices 1 and 2.

## 2.3 Archive

2.3.1 The material archive comprises the cores from the five boreholes and will remain in storage at the Geotechnical Engineering's facility at Quedgeley, Gloucester pending decisions on further work. *A cost may be incurred if storage exceeds 3 months from the time of drilling.*

2.3.2 The digital archive consists of the RockWorks database (in Microsoft Access format); lithostratigraphic cross-sections in JPG format; photographs of cores in JPG format and this report in PDF format. These digital archives are stored both on the University of Winchester server and on an external hard drive stored outside the University of Winchester. Copies of these data can be supplied on request.

2.3.3 OASIS records will be completed on approval of this report.

### **3. RESULTS: BOREHOLE STRATIGRAPHY**

3.0.1 The sedimentary sequence found on the site is divided into four main stratigraphic units. The units identified from youngest to oldest are:

1. Made Ground (Modern)
- 2a. Fine grained intertidal/fluvial deposits (Holocene Wentlooge Formation)<sup>1</sup>
- 2b. Organic deposits (Holocene Wentlooge Formation)
3. Diamict and fluvial gravels ((Late Devensian/early Holocene)
4. Mercia Mudstone Group bedrock (Triassic)

3.0.2 These units are described in stratigraphic order below.

#### **3.1 Mercia Mudstone Group bedrock**

3.1.1 The MMG bedrock sub-crops below the unconsolidated Quaternary strata in all the boreholes on the site. It lies between -2.09m OD (9.62m bgl) in ARCA BH6 and +0.90m OD (6.75m bgl) in ARCA BH10 (Figure 3). Geotechnical boreholes record the sub-crop at a maximum of -4.00m OD (11.6m bgl) in BH504A, on the eastern boundary of the site. At BH503 c. 120m north on the northeastern boundary, rockhead was not proven and lies below -4.00m OD (Figure 4). On the southern boundary the bedrock is also deep lying at -3.7m OD (11.50m bgl) in BH506. The bedrock would therefore appear to lie at c. 2m higher on the majority of the site than it does north to south along the eastern boundary.

3.1.2 The lithology of the bedrock is reddish brown (5YR 4/4), dry and stiff calcareous clayey-mudstone (marl) with reduction spots of light grey (10 YR 7/2) in the upper fraction. The upper part is weathered to a stiff clayey consistency, which diminishes with depth to where the indurate, fissile, dark reddish brown mudstone is retained. In ARCA BH6, ARCA BH7 and ARCA BH10 the top metre of weathered mudstone is coarsely mixed with grey silt/clay and may represent an ancient soliflucted regolith.

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<sup>1</sup> Rivers and streams produce freshwater fluvial deposits.

3.1.3 The MMG is unconformably overlain in all the ARCA boreholes on site by fine grained intertidal/fluviial deposits.

### **3.2 Diamict and gravel deposits**

3.2.1 Reworked periglacial deposits (diamicts) thought to be non-marine sediments and the products of local weathering seen in ARCA BH2 – ARCA BH5 on the Severnside Hotel site were not found (Watson 2019).

3.2.2 No evidence for fluviial sandy gravels was found in the ARCA boreholes, however they are recorded in three geotechnical boreholes: BH506 has a 4m thick unit sub-cropping at +0.30m OD; BH503 an unknown thickness at -3.50m OD and BH504A a 0.6m thick unit at -3.40m OD. These gravels lie over the deeper seated bedrock along the eastern boundary of the site (Figure 1 and Figure 4). ARCA BH2 on the Severnside Hotel site also records a gravel unit, 0.75m thick and lying at +0.65m OD.

3.2.3 The gravel deposits are overlain by fine grained intertidal/fluviial deposits of the Wentlooge Formation.

### **3.3 Fine grained intertidal/fluviial deposits (Wentlooge Formation)**

3.3.1 On the site the fine grained deposits lie between +4.91m OD (2.62m bgl) in ARCA BH6 and +5.40m OD (2.25m bgl) in ARCA BH8. Where the bedrock is lower in ARCA BH6 the deposit is thickest, 7m; and where it is highest the deposit is least thick, 4.45m in ARCA 10 (Figure 3). Slightly higher elevations are found in BH505A and BH506, +6.1m OD in and +5.58m OD respectively (Figure 1 and Figure 4). In the BGS geotechnical borehole ST58SE68 c. 250m to the southeast a similar elevation is found: +5.65m OD. In general, the top of the fine grained deposits across the site and its environs is gently undulating to almost flat.

3.3.2 The lithology of the deposits is dark grey (Gley1 4/N), generally firm and moist, reduced silt/clay. No structure above c. 7m bgl was evident and the deposits were homogenous with occasional black humic spotting and allochthonous peat grains and granules. Below 7m faint, parallel and horizontal silt/clay/silt sets are seen in ARCA BH6 and ARCA BH7. The lowest fraction of deposit (c. 1.0m), which lies directly on the weathered mudstone, tends to be mottled (Gley 1 4/5GY dark greenish grey) and stiff. Rooting from overlying basal peat is seen in ARCA BH6. The uppermost fraction (on average 1.73m) of the

ARCA boreholes is oxidised to a dark greyish brown (10YR 4/2) and is a firm and moist silt/clay with orange iron oxide mottles (50%) throughout.

3.3.3 Units of peat are intercalated in the reduced fine grained deposits and are discussed in Section 3.4. On the site, the fine grained deposits are overlain by modern Made Ground in all the boreholes.

### 3.4 Organic deposits

3.4.1 A total of 17 peat units were recovered in the ARCA boreholes. This compares to the same number found in the five ARCA boreholes on the Severnside Hotel site where they have been grouped into five 'members' based on their elevations and are designated Peat (v) (the youngest) to Peat (i) the oldest (Watson 2019, table 1). This peat stratigraphy is depicted in ARCA BH2 in Figure 3.

3.4.2 The peat sequence on site lies between +3.37m OD (4.16m bgl) in ARCA BH6 and -0.86m OD (8.42m bgl) in the same borehole, a total maximum thickness of 4.26m of interbedded deposits (Figure 3). The thickest intact unit (230mm) is found in ARCA BH9 at + 1.46m OD. The average thickness of the intact peat units is 94mm and the minimum is 10mm.

3.4.3 The lithology of the peat units is very similar. They are black (7.5YR 2.5/1), firm, dryish and well humified with an unstructured, poorly fibrous texture. There is evidence for horizontal lamination with occasional granular-sized reed fragments horizontally laid towards the base. A single granular – sized fragment of wood was noted, otherwise macrofossils were absent. The top boundary is often sharp implying a rapid burial or some truncation. In ARCA BH9 where a diffuse top boundary is preserved to a thin peat, frequent examples of the minute (2mm) gastropod *Hydrobia ulvae* are present (Figure 5). This species is typical of mudflat environments (Kerney 1999).

3.4.4 In two geotechnical boreholes on the eastern boundary of the site (BH505A and BH506) occasional thin bands (c. 20mm) of peat are found, however, their elevations are not known and no correlation with the peat units in the ARCA boreholes can be made. More substantial units are found in: BH501 at +3.70m OD (400mm); BH503 at -0.5 m OD (450mm); ST58SE82 at +2.38m OD (150mm); and ST58SE68 at -0.5m OD (350mm). Of these two units lie at an elevation that corresponds to a peat

member found on the Severnside Hotel site: BH503 equivalent to Peat (i) (Figure 4); and borehole ST58SE82 equivalent to Peat (iv). This latter borehole is located c. 50m east of the Plot 2 site (Figure 1).

3.4.5 Insubstantial organic remains are reported in the geotechnical boreholes within the fine grained deposits, for example, 'Occasional dark brown to black spongy pseudo-fibrous peat and plant remains' in BH502. Such material is believed to be allochthonous, that is to say fluviially reworked across the flood plain. It is also seen in the ARCA boreholes and is recorded as rare to occasional grains and granules of peat.

### **3.5 Made Ground**

3.5.1 Made Ground is recorded in all the boreholes on the site. It has a thickness of between 2.25m in ARCA BH8 and 2.62m ARCA BH6. The lithology is dark brown (7.5YR 3/3) mixed with very dark grey (10YR 3/1) and dark greyish brown (2.5Y 4/2) diamict. The clastic content is primarily granular to cobble-sized clasts of angular concrete, brick and sandstone. Oxidation mottles are present throughout the unit. A sharp and unconformable boundary exists with underlying fine grained deposits. The Made Ground caps the stratigraphic sequence.

## **4. ASSESSMENT**

4.0.1 The sub-sections below review the lithostratigraphic evidence against the relevant aims of Section 1.14.

### **4.1 The Quaternary sequence**

4.1.1 The Mercia Mudstone Group bedrock forms an irregular incised basement to the later Quaternary sediments of the Severn Valley basin. The site lies on the eastern edge of the present day floodplain and estuary of the River Severn (Figure 1). The line of pinch out of these sediments – the Wentlooge Level Formation – lies c. 1.4km southwest of the site where they on lap against the rising bedrock at the base of Spanorium Hill.

4.1.2 With the amelioration of the climate at the end of the Pleistocene (11.7ka) fine grained sands, silts and clays were laid down by the meandering river. Peats developed in meander cut-offs and backswamp areas. On a regional scale the River Severn was, and still is, constantly adjusting to glacial eustacy (rapid rising

of true sea levels as ice sheets melt) and gradual isostatic readjustment as the weight of ice is released, with the result that a complex vertical and lateral sedimentary architecture forms and reforms, influenced by first fluvial, and then both fluvial and estuarine/marine processes. The meandering/anastomosing river, also continuously reworks earlier deposits. Organic strata are intercalated in these sediments. Peat growth occurs in response to almost zero detrital deposition and rising water tables. It marks a phase in time when vegetation growth exceeds or keeps pace with a rising tidal frame, or there is a decline in the rate of relative sea level rise.

4.1.3 The basal sediments of the Wentlooge Level Formation covering the bedrock erosion surface form a sequence of terrestrial and freshwater deposits laid down under periglacial conditions that were slowly ameliorating at the end of the late Glacial and beginning of the Holocene. These deposits are seen in ARCA BH6, ARCA BH7 and ARCA BH10 and consist of reworked mudstone bedrock and grey silt/clays that form a melange of soliflucted sediment. Sandy gravels with flint clasts that suggest a fluvio-glacial origin from a periglacial precursor of the River Avon are seen on the eastern boundary of the site. The heterogeneous lithology of these sediments reflects the topographical irregularities of the palaeo surface and gravels tend to fill deeper troughs or channels for example in BH506 (Figure 4). This is in contrast to the ubiquitous and homogenous nature of the overlying peat that marks the stabilisation, flooding and burial of the land surface at the end of the Pleistocene Epoch c. 11.7ka.

4.1.4 On the site, the peat sequence correlates well with the sequence found on the neighbouring Severnside Hotel site. This correlation is depicted in Figure 3 which shows three main peat horizons extending across the site. These horizons are composed of Peat (i); Peat (ii) and Peats (iv) and (v) combined. They are slightly undulating but maintain a roughly horizontal aspect: the elevation of Peat (i) – the horizon with greatest variation – deviates by less than 1% over a distance of 230m. As a consequence dating and palynological work on the Severnside Hotel site can be extrapolated with good confidence to the peat stratigraphy on the Plot 2 site.

4.1.4 Peat (i) is the basal peat and y extrapolation dates from c. 2470 – 2286 cal BC in the Late Neolithic. Palynological results from the Severnside Hotel work point to a sedge fen/reed swamp and

salt marsh environments occupying the floodplain surface. A carr woodland of alder and willow was probably growing on the margin of the floodplain with a mixed deciduous forest on the higher and dryer ground.

4.1.5 The intercalated peat and mud deposits on site continued to be laid down into and beyond the Late Bronze Age (Peat (ii) is 830 – 775 cal BC) until, most probably, the early Roman period. The alternating lithology mud/peat/mud marks a cyclical change in the environment from estuarine mudflats crossed by tidal creeks to a reestablishment of brackish to freshwater alluvial deposition and the growth of peat on the new floodplain. On the Severnside Hotel site, each cycle begins with a humic mud lying immediately over the peat and is characterised by *Hydrobia ulvae*, a gastropod that is typical of mudflat/saltmarsh environments (Figure 5). This occurrence is seen in only one example on the Plot 2 site where more often slightly higher local energy conditions result in a truncation or rapid burial of the peat by intertidal mud. These transgressive mud deposits are the result of a rising mean sea level and tidal influence in response to relative changes in isostatic uplift from the release of the weight of the Pleistocene ice sheet and global eustatic sea level rises. A brackish environment of tidal mudflats, saltmarsh and tidal creeks is formed, the latter supplying fresh water from the River Severn watershed. As isostatic and eustatic adjustments take place, at times, slightly more freshwater enters the system and this favours the growth of peat. The diatom evidence from the Severnside Hotel site confirms this interpretation as it does not highlight either a fully marine or a fully freshwater environment at any point in the sequence but rather suggests mudflats and the intertidal realm with freshwater input varying over time (Watson 2019). The intimate relationship between the Severnside Hotel site and the Plot 2 Central Park site is such that the diatom evidence from the former can be applied to the later.

4.1.6 The mineralogenic sediment is mud with little or no evidence of sand deposits which reflects the very low energy environment that pertained over time on site. This may be seen as the result of a stabilisation of the sedimentary regime from the Late Neolithic onwards and has been noted at the Severn Road site where earlier cycles are of successively longer duration the older they are and have thick intercalated sand units (Watson 2018). Some dynamism is in evidence on the site though, and many peat units are truncated or missing all together, for example, in



ARCA BH0 only one unit is preserved. Meandering creeks are most likely responsible for this erosion.

4.1.7 There does not appear to be any significant change in the vegetational history of the Severnside Hotel site, that is to say, it alternates between tidal flat and saltmarsh, and fen/reed swamp and this is most probably the case on the Plot 2 site also. In the basal peat there is slight evidence for more lime and elm on the dry ground but this soon disappears. A solitary cereal pollen grain is posited as evidence for human activity at the top of the sequence. A similar pollen assemblage is found from Willow Farm and Severn Road at approximately the same elevation (c. +1.2m OD) although at an earlier date (3010 – 2700 cal BC) (Wilkinson *et al.* 2012; 2013; Batchelor and Young 2018).

4.1.8 The top fraction of the sequence has been oxidised brown by ferrous iron oxide compounds. This diagenetic process is post depositional and is driven by redox reactions as a result of a rising and falling water table. Anoxic conditions exist below the water table and the deposits are coloured shades of grey as a result of the presence of the mineral vivianite (hydrated iron phosphate) and any humic compounds that may be present. The water table has been artificially altered by drainage and land reclamation since the Roman period. The sequence is capped by modern Made Ground.

## **4.2 Archaeological and palaeoenvironmental potential of the strata and recommendations**

4.2.1 The soliflucted, weathered mudstone found in the ARCA boreholes and the gravels seen in the geotechnical boreholes on the site are deeply buried and were laid down in cold conditions inhospitable to the presence of man. Human groups were intermittently present during Devensian interstadials (White and Pettitt 2011) and the exploitation of river gravel is a possibility. Nonetheless, since the sampling of these deposits can only be achieved by borehole coring the potential to recover archaeological or palaeoenvironmental information must be low. *No further work is recommended on these deposits*

4.2.2 The fine grained intertidal/fluvial deposits of mineralogenic sediment on the site are laid down in an intertidal environment. Although this environment may have been subject to intermittent and localised human activity, it has a low potential for archaeology. The potential for palaeobotanical diatom

remains is moderate to high; however, it was noted in the Severnside Hotel work that the assessed flora confirmed the lithological interpretation of the strata. *Therefore, it is recommended that no sampling should take place for diatom assessment on the Plot 2 Central Park borehole cores.*

4.2.3 The organic strata in general have a low archaeological potential, however, the peat in particular has a high palaeobotanical potential. The peat stratigraphy on the site is believed to be an extrapolation of that seen on the Severnside Hotel site. As a result it is highly unlikely that sampling the Plot 2 peats for palynology would reveal any new information. Furthermore an analysis of pollen samples at a similar elevation and a Middle to Late Neolithic date at the Willow Farm site has been accomplished. *Therefore, it is recommended that no palynological sampling should take place on the Plot 2 Central Park borehole cores.*

## 5. CONCLUSIONS

- 5.1 On the Plot 2 Central Park site the MMG bedrock lies a slightly lower elevation by c. 1m in comparison to the adjoining Severnside Hotel site. The weathered bedrock is affected by periglacial conditions and gravels laid down on the ancient River Severn braid plain are found to the east and south. The succeeding deposits are associated with the warming Holocene climate and consist of intercalated peat and fine grained intertidal/fluvial deposits of the Wentlooge Formation.
- 5.2 The peat units are generally thin and are often truncated. They have been correlated with the dated peat stratigraphy found at the Severnside Hotel site and grouped into three horizons: Peat (i); Peat (ii) and Peats (iv) and (v) combined. Peat (i) is a basal peat that begins at c. 2470 – 2286 cal BC in the Late Neolithic. The succeeding Peat (ii) dates from c. 2140 – 1957 cal BC in the Early Bronze Age and is overwhelmed by estuarine sedimentation at c. 830 – 775 cal BC in the Late Bronze Age. The uppermost peat horizon is likely to predate Roman drainage of the region.
- 5.3 Lithological evidence demonstrates that there was a cyclical change in the environment represented by fresh and brackish water peats, and intertidal mudflats evolving within a very low energy regime. This change is driven by relative sea-level change. The vegetational history of the site is believed to be the

same as the adjoining Severnside Hotel site where no significant change is seen throughout the sequence. The floral environment consists of saltmarsh and fen/reed swamp with more distal stands of alder and willow on the floodplain margin. Mixed deciduous forest grows on the higher land. These results are very similar to the sites of Willow Farm and Severn Road, 1.7km south southwest. No evidence of human activity was found except for a single cereal pollen grain from the top of the sequence on the Severnside Hotel site.

- 5.4 The top of the fine grained sedimentary sequence is oxidised as a result of Roman drainage. The final depositional unit recorded is a c. 2.5m thick cap of Made Ground diamict.

## 6. ACKNOWLEDGEMENTS

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## 8. FIGURES

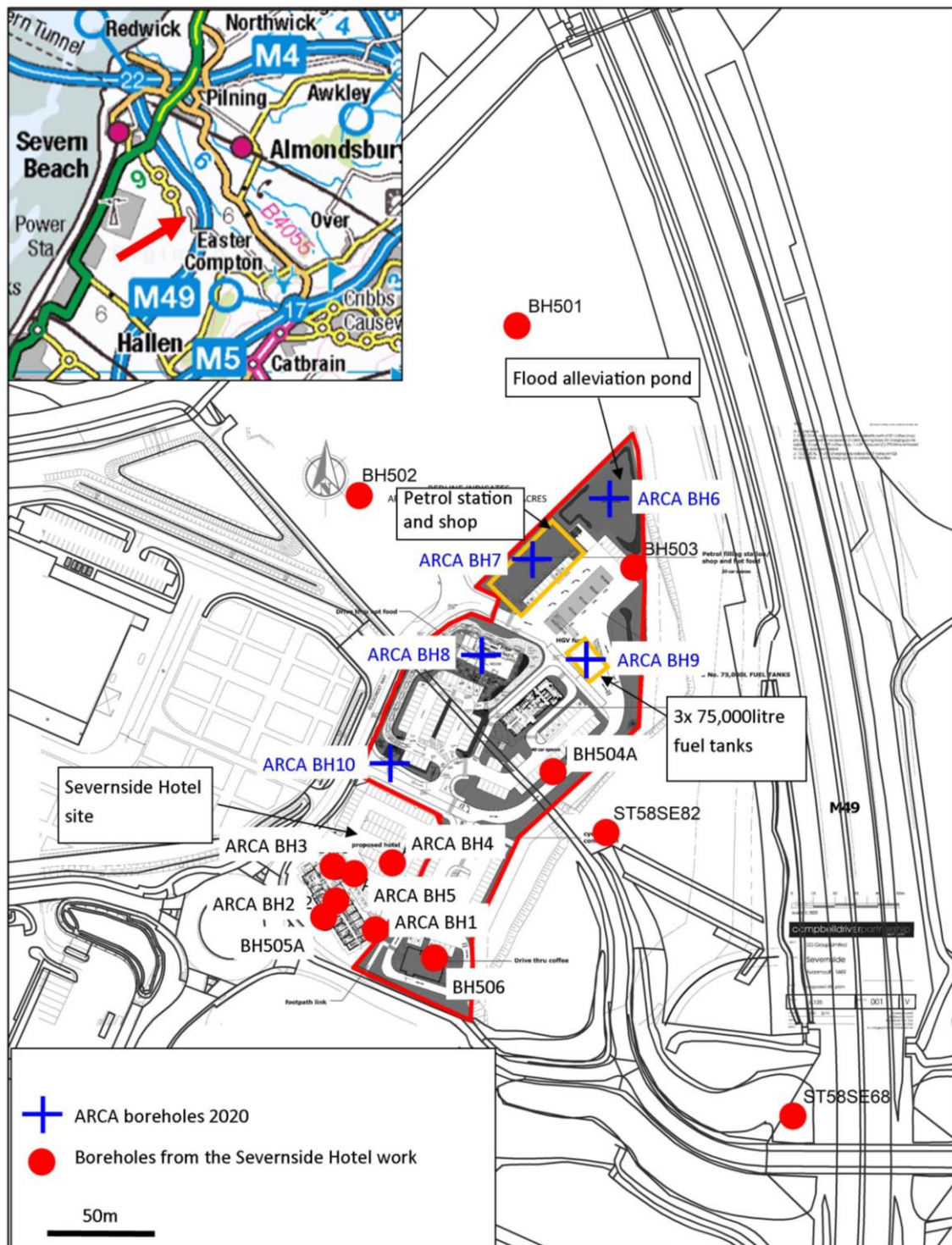


Figure 1. Plan of the Plot 2 Central Park site showing its geographical location and the boreholes discussed in the text. Site boundary is in red.

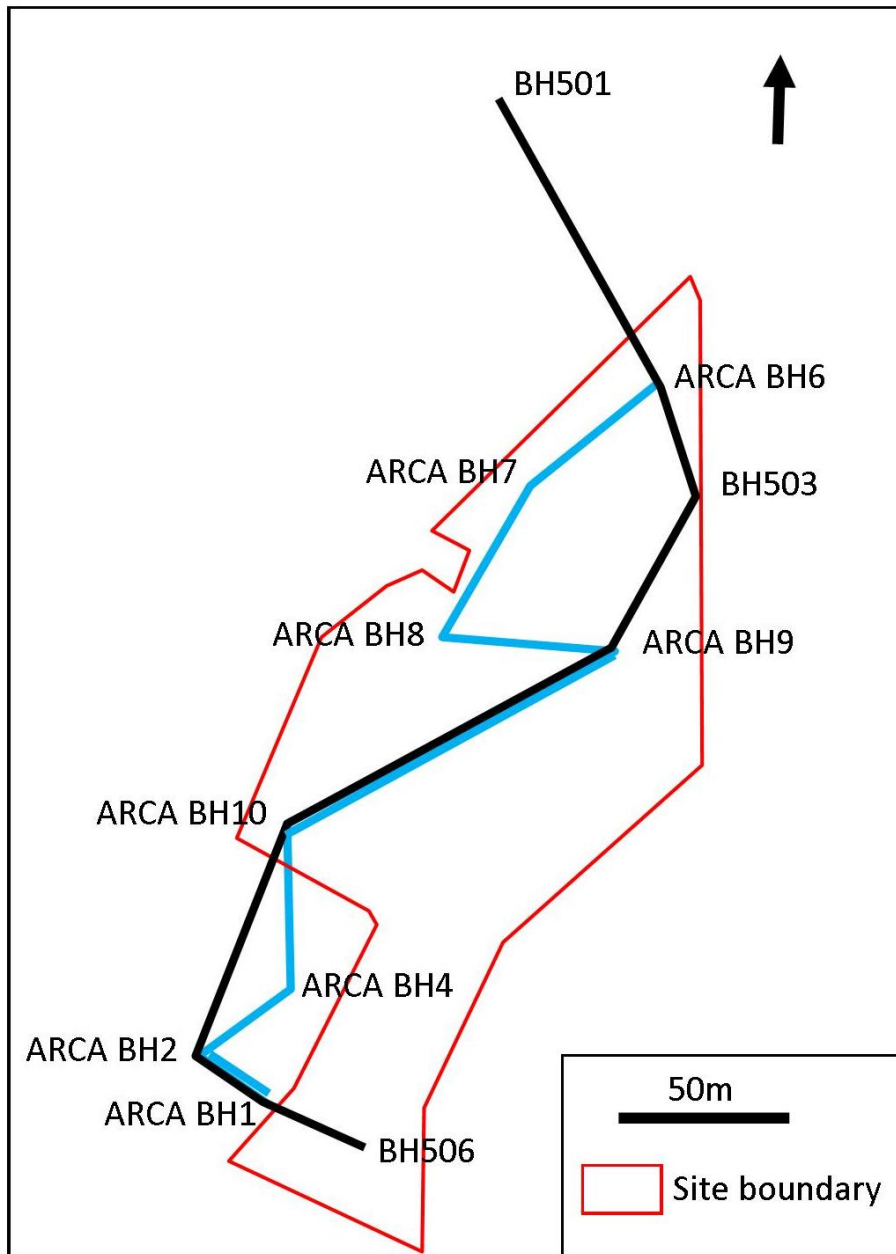


Figure 2. Plan of the site showing the two lithostratigraphic cross sections: in black the long section from BH501 in the north to BH506 in the south; and in blue from ARCA BH6 in the north to ARCA BH1 in the south.

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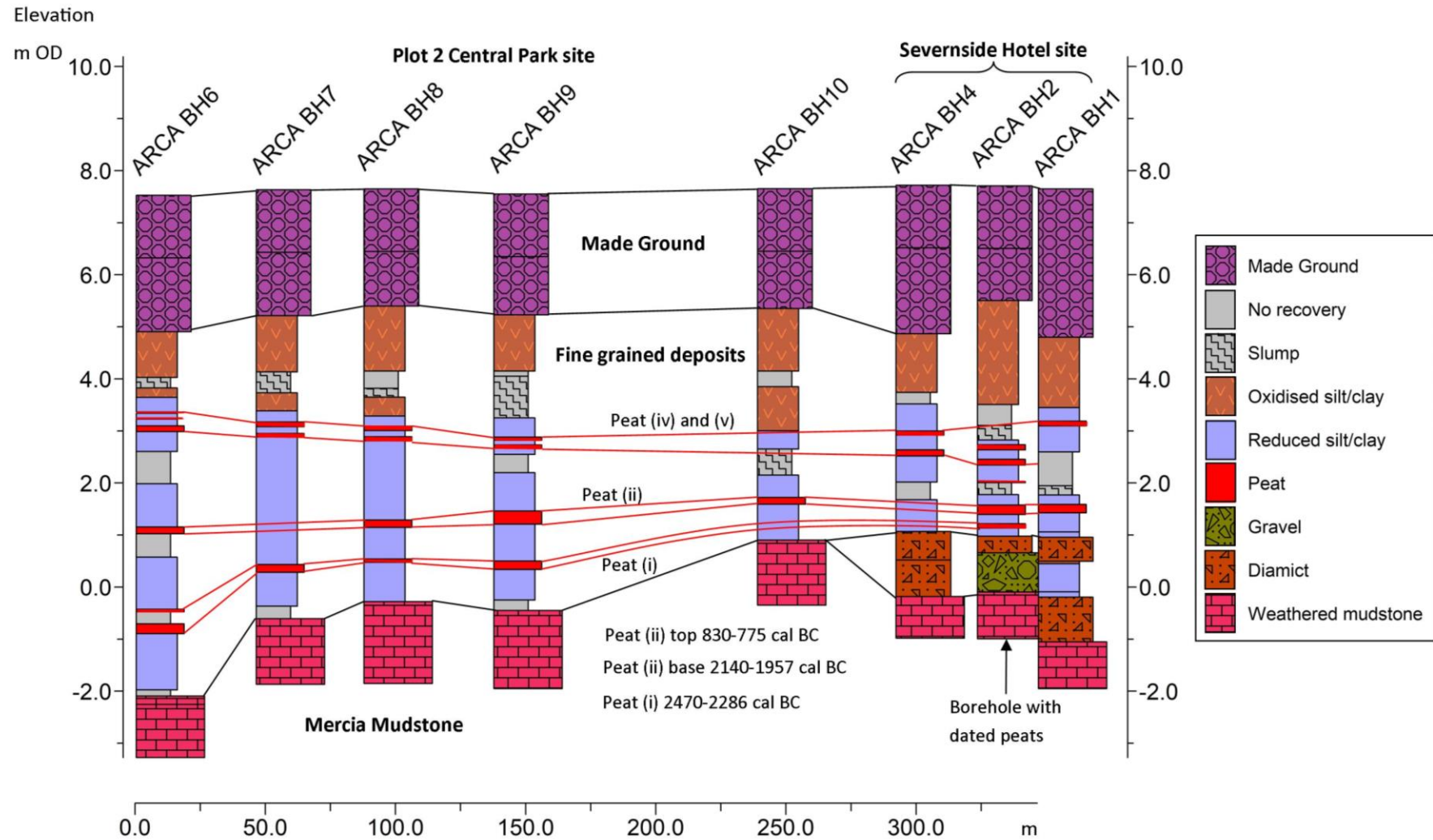


Figure 3. Lithostratigraphic cross section from north to south showing the coincidence of dated peat units in ARCA BH2 with those recorded on the Plot2 Central Park site. The vertical exaggeration is x20 and it therefore

emphasises the changes in elevation of the peat units which in the field are very minor (<1% in the most pronounced peat horizon, Peat (i)).

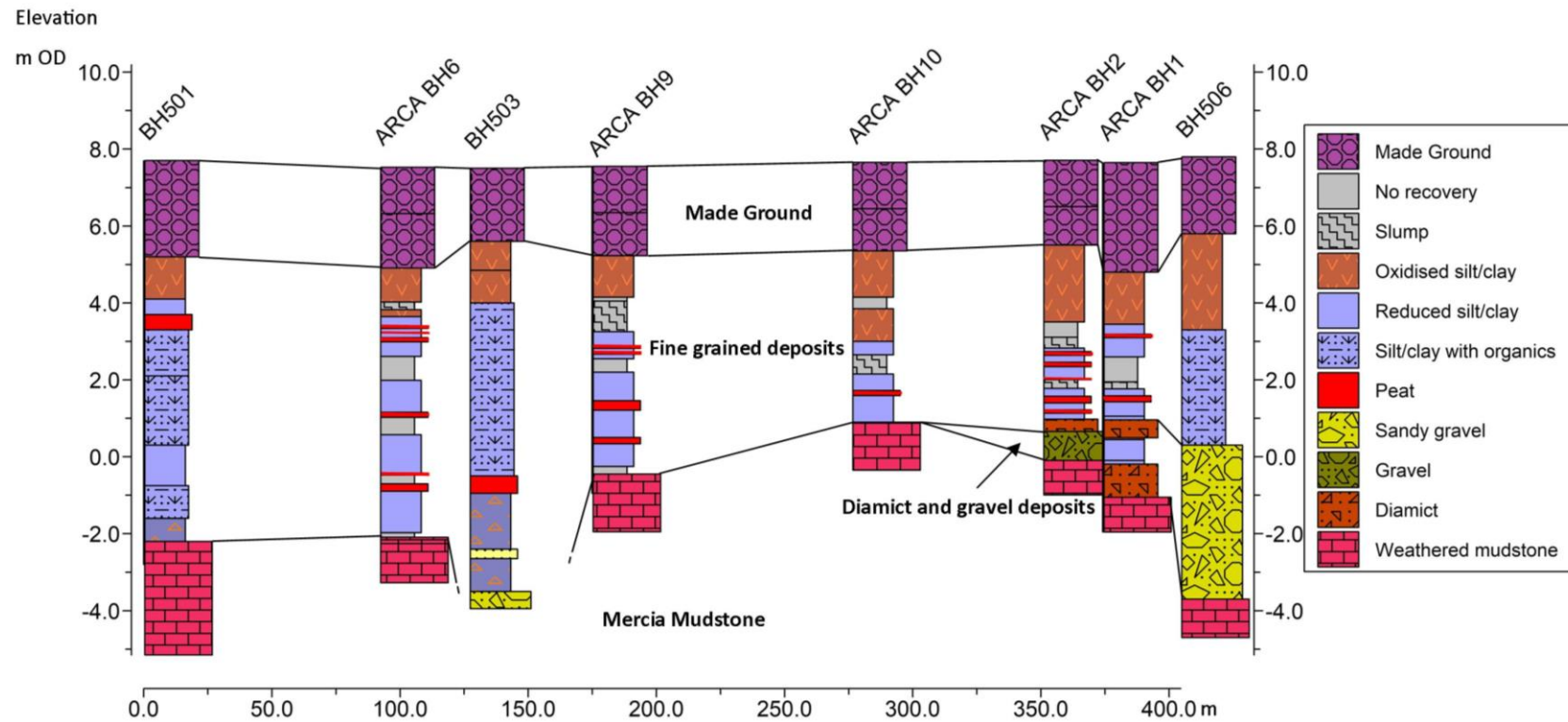


Figure 4. Lithostratigraphic cross section from north to south showing the relationship of the borehole strata on the site with borehole strata in the vicinity. Vertical exaggeration x15.



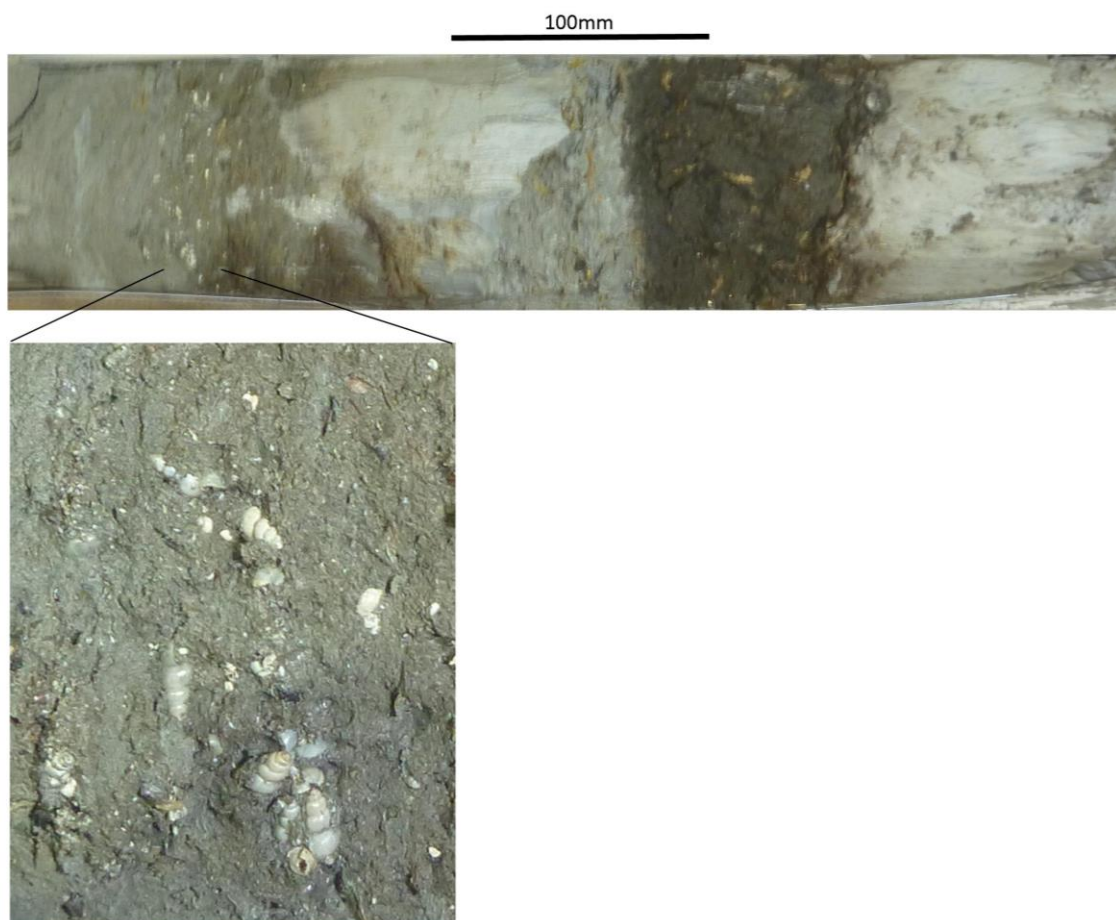


Figure 5. Section of core from ARCA BH9 showing a peat overlain by mud and a humic band (4.67m bgl) containing *Hydrobia ulvea*, a gastropod characteristic of a mudflat.

## APPENDIX 1: LOCATION OF BOREHOLES

<b>Bore</b>	<b>Easting</b>	<b>Northing</b>	<b>Elevation</b>
ARCA BH6	355775.068	183204.666	7.526
ARCA BH7	355739.253	183175.659	7.633
ARCA BH8	355716.115	183141.352	7.648
ARCA BH9	355764.500	183129.200	7.550
ARCA BH10	355672.665	183086.433	7.651

## APPENDIX 2: LITHOSTRATIGRAPHY OF BOREHOLES

<b>Borehole</b>	<b>Top m</b>	<b>Base m</b>	<b>Lithology</b>	<b>Description</b>
ARCA BH6	0.00	1.20	Made Ground	
ARCA BH6	1.20	2.62	Made Ground	
ARCA BH6	2.62	3.50	Oxidised silt/clay	10 YR 4/2 Dark greyish brown firm and moist silt/clay with orange iron oxide mottles (50%) throughout. Homogeneous unit.
ARCA BH6	3.50	3.70	Slump	
ARCA BH6	3.70	3.88	Oxidised silt/clay	10 YR 4/2 Dark greyish brown firm and moist silt/clay with orange iron oxide mottles (50%) throughout. Homogeneous unit.
ARCA BH6	3.88	4.16	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. Sharp boundary to:
ARCA BH6	4.16	4.19	Peat	7.5YR 2.5/1 Black, firm and dryish (not muddy), well humified peat. Unstructured with frequent fine fibres.

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				Diffuse boundary to:
ARCA BH6	4.19	4.29	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. 30mm top is 2.5Y 4/2 muddy appearance with diffuse parallel and horizontal banding and frequent grains and granules of peat. Sharp boundary to:
ARCA BH6	4.29	4.30	Peat	7.5YR 2.5/1 Black, firm and dryish (not muddy), well humified peat. Unstructured with frequent fine fibres. Diffuse boundary to:
ARCA BH6	4.30	4.43	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. 30mm top is 2.5Y 4/2 muddy appearance with diffuse parallel and horizontal banding and frequent grains and granules of peat. Sharp boundary to:
ARCA BH6	4.43	4.54	Peat	7.5YR 2.5/1 Black, firm and dryish (not muddy), well humified peat. Unstructured with frequent fine fibres grades into structured parallel laminae of granular-sized reed fragments pale yellow in colour. Diffuse boundary to:
ARCA BH6	4.54	4.92	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. 20mm top is 2.5Y 4/2 muddy appearance with diffuse parallel and horizontal banding and frequent grains and granules of peat.
ARCA BH6	4.92	5.54	No recovery	Void
ARCA BH6	5.54	6.37	Reduced silt/clay	Void
ARCA BH6	6.37	6.50	Peat	7.5YR 2.5/1 Black, firm and dryish (muddy top 10mm), well humified peat. Unstructured with frequent fine fibres grades into structured parallel laminae of granular-sized reed fragments pale yellow in colour. Base destroyed at end of core.

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ARCA BH6	6.50	6.95	No recovery	Void
ARCA BH6	6.95	7.95	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. Occasional grains and granules of peat and humic spots. Silt and clay sets 5mm/5mm/5mm parallel and horizontal. Sharp boundary to:
ARCA BH6	7.95	8.00	Peat	Peat: destroyed
ARCA BH6	8.00	8.23	No recovery	Void
ARCA BH6	8.23	8.42	Peat	7.5YR 2.5/1 Black, firm and dry, well humified peat. Unstructured with frequent fine fibres grades into structured parallel laminae of granular-sized reed fragments pale yellow in colour. Clean silt/clay irregular band with sharp lower contact c. 6mm thick at 8.37m.
ARCA BH6	8.42	9.50	Reduced silt/clay	Gley 1 4/5GY dark greenish grey, firm to stiff reduced silt/clay with rare vertical and sub vertical cracks (roots?) stained black (humic acid). Rare white fine pebble-sized spots.
ARCA BH6	9.50	9.62	No recovery	Void
ARCA BH6	9.62	9.78	Weathered mudstone	5YR 4/4 Reddish brown stiff weathered mudstone irregularly mixed with grey silt/clay. (Soilflucted top of mudstone)
ARCA BH6	9.78	10.80	Weathered mudstone	5YR 4/4 Reddish brown stiff weathered mudstone with rare reduction spots becoming very stiff/indurate towards base. Not brecciated. (MMG). End of BH.
ARCA BH7	0.00	1.20	Made Ground	

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ARCA BH7	1.20	2.42	Made Ground	
ARCA BH7	2.42	3.50	Oxidised silt/clay	10 YR 4/2 Dark greyish brown firm and moist silt/clay with orange iron oxide mottles (50%) throughout. Homogeneous unit.
ARCA BH7	3.50	3.90	Slump	
ARCA BH7	3.90	4.25	Oxidised silt/clay	10 YR 4/2 Dark greyish brown firm and moist silt/clay with orange iron oxide mottles (50%) throughout. Homogeneous unit. Diffuse boundary to:
ARCA BH7	4.25	4.46	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. Sharp boundary to:
ARCA BH7	4.46	4.55	Peat	7.5YR 2.5/1 Black, firm and dry, well humified peat. Unstructured with frequent fine fibres grades into structured, parallel laminae of granular-sized reed fragments pale yellow in colour. Diffuse boundary to:
ARCA BH7	4.55	4.68	Reduced silt/clay	Gley1 4/N Dark grey silt/clay. 20mm top is 2.5Y 4/2 muddy appearance with diffuse parallel and horizontal banding and frequent grains and granules of peat. Sharp boundary to:
ARCA BH7	4.68	4.75	Peat	7.5YR 2.5/1 Black, firm and dryish, well humified peat. Unstructured with frequent fine fibres grades into structured, parallel laminae of granular-sized reed fragments pale yellow in colour. Diffuse boundary to:
ARCA BH7	4.75	7.20	Reduced silt/clay	Gley1 4/N Dark grey silt/clay. Top 30mm is 2.5Y 4/2 muddy appearance with diffuse parallel and horizontal banding and frequent grains and granules of peat. Occasional grains and granules of peat and humic spots. Rare silt and clay sets 5mm/5mm/5mm parallel and horizontal, and irregularly spaced from

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				5m -6.50m then regular 20mm/10mm/20mm/10mm sets. But very fine and faint. Sharp boundary to:
ARCA BH7	7.20	7.35	Peat	7.5YR 2.5/1 Black, firm and dryish, well humified peat. Unstructured with frequent fine fibres grades into structured, parallel laminae of granular-sized reed fragments pale yellow in colour. Diffuse boundary to:
ARCA BH7	7.35	8.00	Reduced silt/clay	Gley1 4/N Dark grey grading into Gley 1 4/5GY dark greenish grey mottling, firm silt/clay with a reddish shade at base.
ARCA BH7	8.00	8.24	No recovery	Void
ARCA BH7	8.24	9.50	Weathered mudstone	5YR 4/4 Reddish brown stiff weathered mudstone irregularly mixed with grey silt/clay. (Soilflucted top of mudstone). End of BH.
ARCA BH8	0.00	1.20	Made Ground	
ARCA BH8	1.20	2.25	Made Ground	
ARCA BH8	2.25	3.50	Oxidised silt/clay	10 YR 4/2 Dark greyish brown firm and moist silt/clay with orange iron oxide mottles (50%) throughout. Homogeneous unit.
ARCA BH8	3.50	3.83	No recovery	
ARCA BH8	3.83	4.00	Slump	
ARCA BH8	4.00	4.36	Oxidised silt/clay	10 YR 4/2 Dark greyish brown firm and moist silt/clay with orange iron oxide mottles (50%) throughout. Homogeneous unit.
ARCA BH8	4.36	4.56	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. Sharp boundary to:
ARCA BH8	4.56	4.64	Peat	5Y 3/1 Very dark grey mixed with 2.5Y 3/3 Dark olive brown, moist and firm peat. Very well humified

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				(plastic) with rare granular fragments. Sharp boundary to:
ARCA BH8	4.64	4.76	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. 25mm top is 2.5Y 4/2 muddy appearance with diffuse parallel and horizontal banding and frequent grains and granules of peat. Sharp boundary to:
ARCA BH8	4.76	4.84	Peat	7.5YR 2.5/1 Black, firm and dryish, well humified peat. Unstructured with frequent fine fibres grades into structured, parallel laminae of granular-sized reed fragments pale yellow in colour. Diffuse boundary to:
ARCA BH8	4.84	6.36	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. 25mm top is 2.5Y 4/2 muddy appearance with diffuse parallel and horizontal banding and frequent grains and granules of peat. Occasional grains and granules and fine pebble-sized lenses of peat; humic streaks and spots. Sharp boundary to:
ARCA BH8	6.36	6.50	Peat	7.5YR 2.5/1 Black, firm and dry, well humified peat. Unstructured with frequent fine fibres. Disrupted towards base.
ARCA BH8	6.50	7.11	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. Occasional grains and granules peat; humic streaks and spots. Sharp boundary to:
ARCA BH8	7.11	7.17	Peat	7.5YR 2.5/1 Black, firm and dryish, well humified peat. Unstructured with frequent fine fibres grades into structured, parallel laminae of granular-sized reed fragments pale yellow in colour. Diffuse boundary to:
ARCA BH8	7.17	7.93	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. 20mm

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				top is 2.5Y 4/2 muddy appearance with diffuse parallel and horizontal banding and frequent grains and granules of peat. Grades into a firm to stiff Gley 2 5/10G Greenish grey and 4/5B Greyish blue silt/clay with occasional humic streaks. Rare granules of grey mudstone.
ARCA BH8	7.93	9.50	Weathered mudstone	5YR 4/4 Reddish brown stiff weathered mudstone with rare reduction spots becoming very stiff/indurate at 9.25m towards base. Not brecciated. (MMG). End of BH.
ARCA BH9	0.00	1.20	Made Ground	
ARCA BH9	1.20	2.32	Made Ground	
ARCA BH9	2.32	3.40	Oxidised silt/clay	10 YR 4/2 Dark greyish brown firm and moist silt/clay with orange iron oxide mottles (50%) throughout. Homogeneous unit.
ARCA BH9	3.40	3.50	No recovery	Void
ARCA BH9	3.50	4.30	Slump	
ARCA BH9	4.30	4.67	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. Sharp boundary to:
ARCA BH9	4.67	4.73	Silt/clay with organics/Peat	2.5Y 4/1 Dark grey humic silt/clay with frequent fine fibres (peat) and very fine parallel laminae. Frequent whole shell of <i>Hydrobia ulvae</i> . Diffuse boundary to:
ARCA BH9	4.73	4.82	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay and 2.5Y 4/2 Dark greyish brown muddy, diffuse, parallel and horizontal banding and frequent grains and granules of peat especially towards the top. Sharp boundary to:
ARCA BH9	4.82	4.88	Peat	7.5YR 2.5/1 Black, firm and dryish, well humified



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				peat. Unstructured with frequent fine fibres grades into structured, parallel laminae of granular-sized reed fragments pale yellow in colour. Diffuse boundary to:
ARCA BH9	4.88	5.00	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. Occasional grains and granules peat; humic streaks and spots. Sharp boundary to:
ARCA BH9	5.00	5.35	No recovery	Void
ARCA BH9	5.35	6.09	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. Occasional grains and granules peat; humic streaks and spots. Sharp boundary to:
ARCA BH9	6.09	6.34	Peat	7.5YR 2.5/1 Black, firm and dryish, well humified peat. Unstructured with frequent fine fibres grades into structured, parallel laminae of granular-sized reed fragments pale yellow in colour. Occasional fine roots. Very fine sandy silt/clay interlaminated towards base. Diffuse boundary to:
ARCA BH9	6.34	7.05	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm very fine sandy silt/clay to 6.8m. Sand lost towards base; occasional humic spots. Diffuse boundary to:
ARCA BH9	7.05	7.21	Peat	7.5YR 2.5/1 Black, firm and dryish, well humified peat. Unstructured with frequent fine fibres grades into structured, parallel laminae of granular-sized reed fragments pale yellow in colour. Rare wood granule at top. Gradual boundary to:
ARCA BH9	7.21	7.80	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. 50mm top is 2.5Y 4/2 muddy appearance with diffuse parallel and horizontal banding and frequent grains and granules of peat. Grades into a firm to stiff Gley 2

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				5/10G Greenish grey and 4/5B Greyish blue fine sandy silt/clay with rare peat granule and rock fragment.
ARCA BH9	7.80	8.00	No recovery	Void
ARCA BH9	8.00	9.50	Weathered mudstone	5YR 4/4 Reddish brown stiff weathered mudstone with rare reduction spots becoming very stiff/indurate at 9.25m towards base. Not brecciated. (MMG). End of BH.
ARCA BH10	0.00	1.20	Made Ground	
ARCA BH10	1.20	2.30	Made Ground	
ARCA BH10	2.30	3.50	Oxidised silt/clay	10 YR 4/2 Dark greyish brown firm and moist silt/clay with orange iron oxide mottles (50%) throughout. Homogeneous unit.
ARCA BH10	3.50	3.80	No recovery	
ARCA BH10	3.80	4.65	Oxidised silt/clay	10 YR 4/2 Dark greyish brown firm and moist silt/clay with orange iron oxide mottles (50%) throughout. Homogeneous unit. Gradual boundary to:
ARCA BH10	4.65	5.00	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. Sharp boundary to:
ARCA BH10	5.00	5.50	Slump	
ARCA BH10	5.50	5.93	Reduced silt/clay	Gley1 4/N Dark grey, moist and firm silt/clay. Occasional peat granule just above base (entrained as peats flood). Sharp boundary to:
ARCA BH10	5.93	6.06	Peat	7.5YR 2.5/1 Black, firm and dryish, well humified peat. Unstructured with frequent fine fibres grades into structured, parallel laminae of granular-sized reed fragments pale yellow in colour. Irregular and diffuse boundary to:

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ARCA BH10	6.06	6.75	Reduced silt/clay	Gley1 4/N Dark grey becomes mottled with Gley 1 4/5GY dark greenish grey firm to stiff silt/clay. No muddy top. Occasional roots, and grains and granules of peat.
ARCA BH10	6.75	8.00	Weathered mudstone	5YR 4/4 Reddish brown stiff weathered mudstone irregularly mixed with grey silt/clay. (Soilflucted top of mudstone). End of BH.