Geoarchaeology

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QUEEN SQUARE, BRISTOL: GEOARCHAEOLOGICAL EVALUATION

Prepared for Bristol and Region Archaeological Services

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SUMMARY

A geoarchaeological borehole survey was carried out by ARCA and Geotechnical Engineering Ltd on the site of Queen Square, Bristol in November 2013. The works were undertaken in order to establish the nature of the Holocene stratigraphy at the site. Strata in the borehole cores were described by ARCA geoarchaeologists and the resultant data incorporated within a lithological/stratigraphical database held by that organisation for the central Bristol area. This document reports on the stratigraphy of the two boreholes and assesses the archaeological and palaeoenvironmental potential of the sediments encountered.

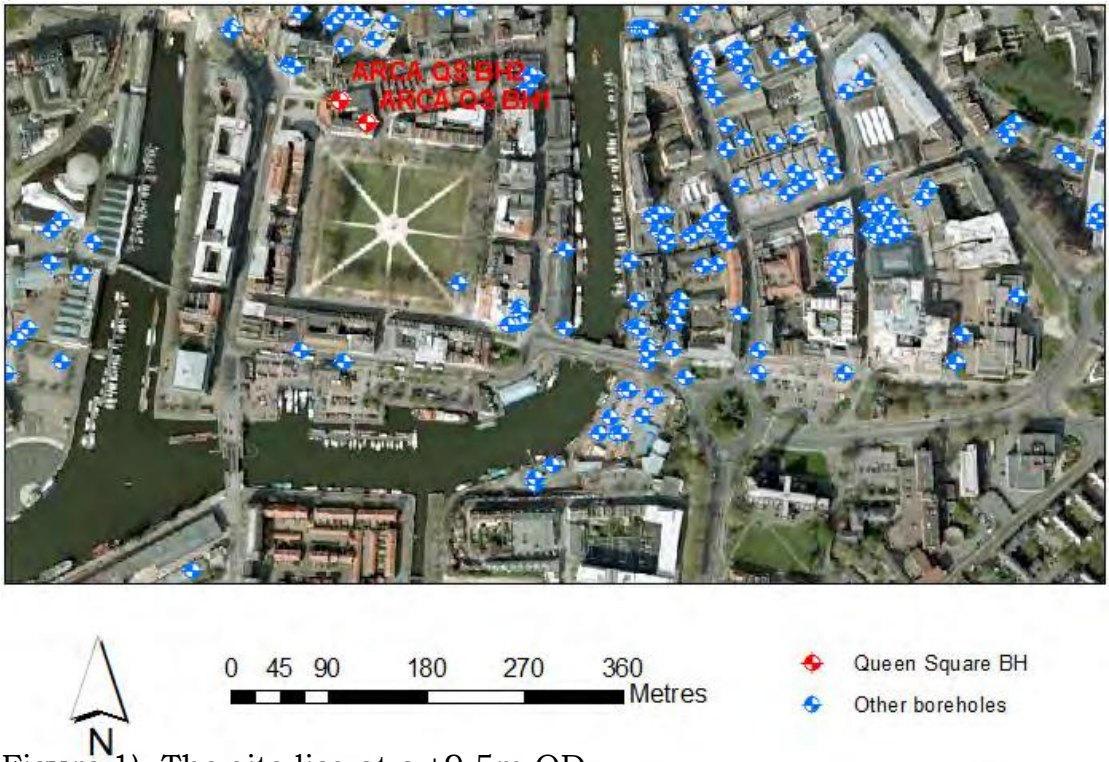
Bedrock of the Mercia Mudstone Group was encountered at the base of the Quaternary sedimentary sequence in BH1, outcropping below -5.85m OD at which point they were unconformably overlain by gravels of the Pleistocene Avon Formation. The majority of the sediments sampled in both boreholes belong to the Holocene Wentlooge Formation which outcrop between -2.46m OD and +6.65m OD in BH1, and between -1.95m OD and +6.95m OD in BH2. The Wentlooge Formation sediments at Queen Square were composed of two main stratigraphic units: 'Alluvium 3' and 'Alluvium 1', the former comprising silt/clay strata with fine sand laminae deposited on a point bar in the inner bend of the River Avon to the south of the site, whilst the latter were composed of silt/clay alluvial/intertidal deposits. The Holocene sequence at the site was capped by deposits of Made Ground, 3.05m thick in BH1 and 2.20m thick in BH2.

Although organic strata of high palaeoenvironmental and archaeological potential have been encountered within Wentlooge Formation sediments at other sites in central Bristol, most notably in the Canon's Marsh area to the west of the site, no such strata were encountered at Queen Square. The Queen Square deposits are assessed as having low archaeological and palaeoenvironmental potentials and therefore no further geoarchaeological works are recommended.

1. INTRODUCTION

1.1 On 21 November 2013 Geotechnical Engineering Ltd., under the supervision of ARCA geoarchaeologists, drilled two geoarchaeological boreholes at Queen Square, Bristol (henceforth 'the site') at the request of Bristol and Region Archaeological Services (BaRAS) in advance of development of the site. The purpose of this document is to assess the archaeological and palaeoenvironmental potential of the stratigraphy recorded in the boreholes. The report is arranged as follows: first a brief account is provided of the geographic, geological and methodological background to the geoarchaeological project; secondly the borehole stratigraphy is discussed in detail; thirdly the archaeological and palaeoenvironmental potential of the sample resource in the boreholes is assessed and recommendations on further analytical work are offered. A bibliography and appendices containing lithological descriptions of the borehole stratigraphy complete the document.

The site is located c.350m east of Bristol Cathedral and is centred on centred on NGR ST 58751 72659. The area to be developed is bound by King Street to the north, King William Avenue to the east and Queen Square to the south and is 150m east of St Augustine's Reach (



1.2 Figure 1). The site lies at c.+9.5m OD.

1.3 The British Geological Survey (BGS) map the site as lying on rock of the Redcliffe Sandstone Member, part of the Mercia Mudstone Group (MMG), a Triassic deposit dating from 250-200 my BP (BGS 2014). The sandstone is unconformably overlain by Holocene tidal flat deposits of clay and silt, which is in turn sealed by Made Ground. The site is thought to occupy a former valley of the River Frome and coincides with that river's supposed confluence with the early River Avon.

1.4 A number of previous geoarchaeological borehole surveys have been carried out in the vicinity of the site. Existing records are predominantly concentrated to the north and to the west of the site (Figure 1). Investigations at Broad Quay, c.150m to the north west, encountered bedrock of the Mercia Mudstone Group (MMG) at the base of the Quaternary sequence with channels cut into the bedrock filled by Late Pleistocene fluvial gravels of the Avon Formation. These latter were in turn unconformably overlain by firstly laminated silt/clays and sands of the Holocene Wentlooge Formation between c.-3m OD and c.+6m OD and then deposits of Made Ground above +6m OD (Wilkinson 2007). A series of investigations in the Canon's Marsh area, c.500m to the west of the site, revealed more complex Holocene stratigraphy including organic strata, with peat formation dating to the Neolithic identified at the Cabot House, Deanery Road and Anchor Road sites (Cox *et al.* 2006, Stastney and Batchelor 2014, Wilkinson *et al.* 2002, 2009).

1.5 The objectives of the geoarchaeological borehole survey on the Queen Square site were to:

1.5.1 Determine the Holocene sedimentary sequence on the site.

1.5.2 Assess the archaeological, palaeoenvironmental and geoarchaeological potential of the Holocene sedimentary units encountered.

1.5.3 Make recommendations for further investigation of high potential strata for any future project that may arise.

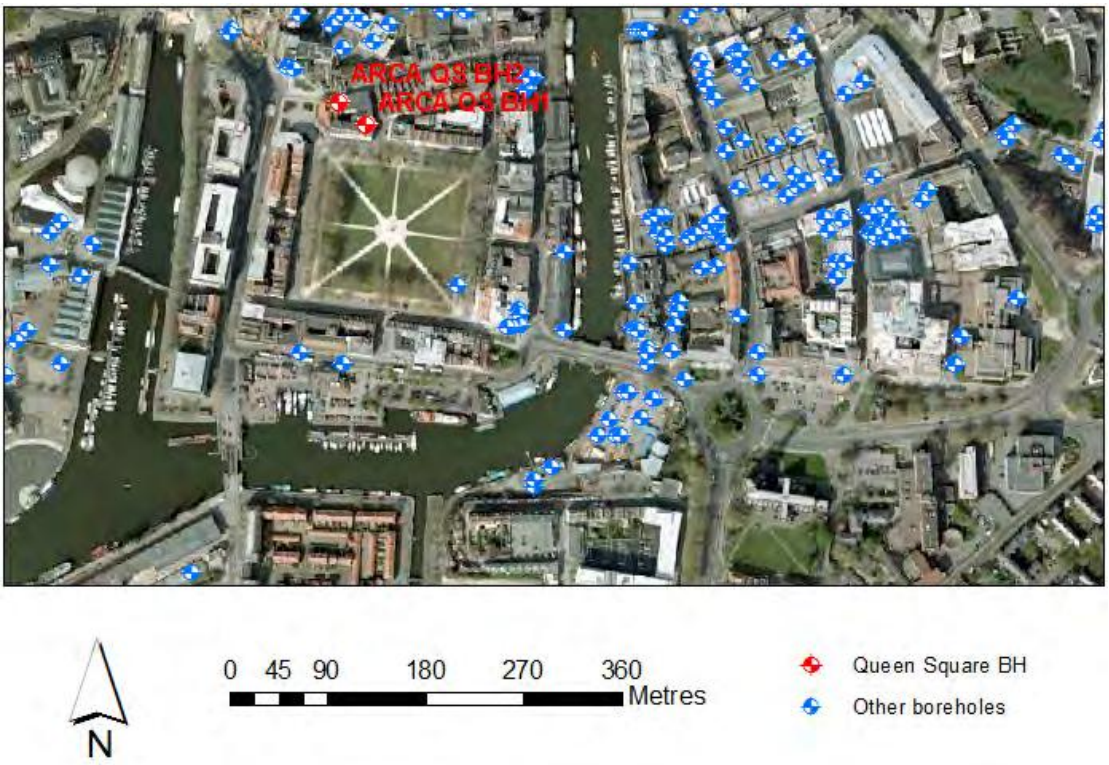


Figure 1. Location of boreholes on the Queen Square site.

2. METHODOLOGY

2.1 Boreholes were drilled using a Pioneer combined percussion and rotary rig by technicians from Geotechnical Engineering Ltd under the supervision of ARCA geoarchaeologists. The latter also used a Leica System 1200 RTK GPS to record the positions of the boreholes. The Pioneer rig provided dynamic and continuous core samples of the sedimentary sequence. The core samples were 112mm in diameter and were retained in plastic liners. The core samples were photographed and described on site by the ARCA geoarchaeologists using standard geological criteria (Tucker 1982, Jones *et al.* 1999, Munsell Color 2000). Full stratigraphic descriptions are presented in Appendix 1.

2.2 Lithological descriptions and positional data from the site were combined with lithological data from previous geotechnical and geoarchaeological boreholes in the vicinity of the site within a RockWorks database (RockWare 2012). The RockWorks software package was then used to plot lithological and stratigraphic cross sections (Figure 2, Figure 3 and Figure 4).

2.3 The geoarchaeological archive from the site consists of digital records (photographs of the cores, lithological descriptions and

RockWorks database entries) retained on the University of Winchester server.

3. BOREHOLE STRATIGRAPHY

3.0.1 Five major stratigraphic units (formal and informal formations and members) present at the site were revealed in the borehole stratigraphy. These are reviewed below in chronological order.

3.0.2 The two stratigraphic units which together comprise the bulk of the sedimentary sequences at Queen Square [Alluvium 3 and Alluvium 1 (*sensu* Wilkinson *et al.* 2013)] may both be referred to the Wentlooge Formation (*sensu* Allen and Rae 1987), but are discussed separately below.

3.0.3 The lithological data are plotted graphically in Figure 2, Figure 3 and Figure 4, while full descriptions are included as Appendix 1.

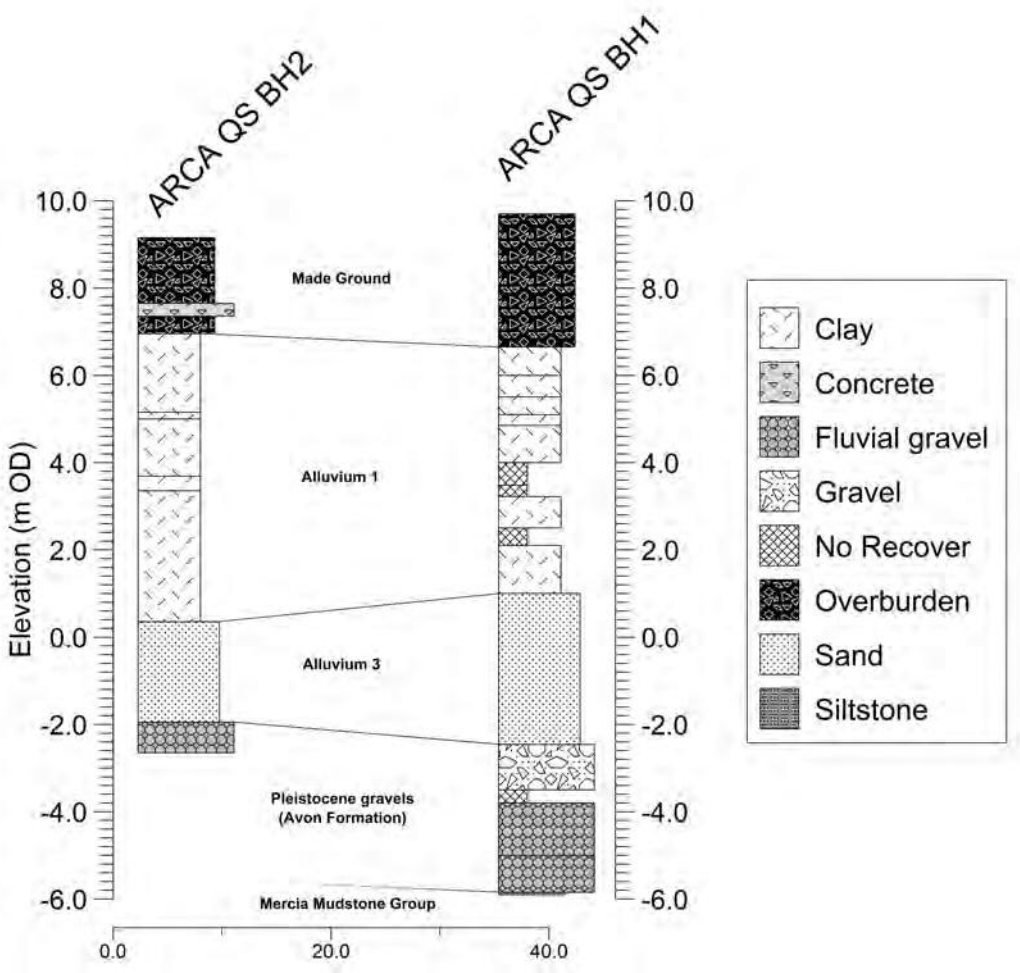


Figure 2. Lithology of boreholes at Queen Square

3.1 Mercia Mudstone Group

3.1.1 The Mercia Mudstone Group (MMG) dates from the Middle Triassic (c.230 my BP) and formed in a series of alluvial fans emanating from the Mendips and Bristol coalfields (Green 1992, 78). The MMG therefore comprises sand and conglomerate facies, but as the name suggests is primarily made up of silts and clays.

3.1.2 MMG is represented on the site by a reddish brown (5 YR 5/3) siltstone unit outcropping at -5.85m OD in BH1. As Figure 3 and Figure 4 demonstrate, the contact between MMG and the overlying Quaternary sediments is higher to the north and the west of the site. At Broad Quay, to the north of the site, the variable height of the upper surface of the MMG was demonstrated to be the result of the cutting of river channels during the Pleistocene (Wilkinson 2007, 8).

3.1.3 The MMG is unconformably overlain by Pleistocene fluvial gravels of the Avon Formation.

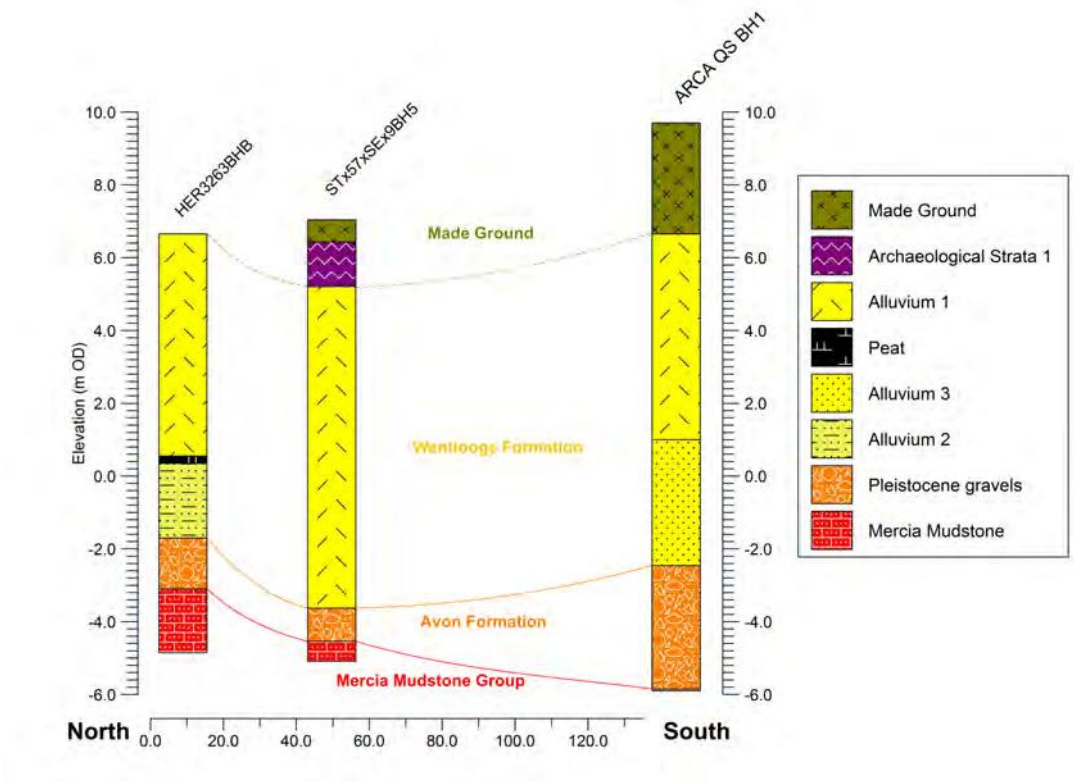


Figure 3. Composite stratigraphic section running from north to south through the Queen Square site and geotechnical boreholes from adjacent sites.

3.2 Avon Formation

3.2.1 Gravels of an as yet unnamed member of the Avon Formation (*sensu* Campbell *et al.* 1999) unconformably overlie the MMG in BH1 and were encountered in the base of BH2. The gravels comprise matrix and clast-supported poorly sorted sub-rounded to rounded gravels with some mudstone clasts. the latter derived from the MMG. The top surface of the Avon Formation is at -2.46m OD in BH1 and -1.95m OD in BH2.

3.2.2 Given the low elevation of their outcrop, the Avon Formation gravels encountered at Queen Square are likely to date from the latest part of the Late Pleistocene, i.e. the Devensian Late Glacial. Campbell *et al.* (1999) and Bates (2003) suggest that the Barhampton Member, which is at 3m above the present river level, is of Marine Isotope Stage (MIS) 6 date or earlier, and therefore as the gravels seen at Queen Square outcrop below river level, they must be later (MIS 5e-2, i.e. 130-14 kya). If this

hypothesis is correct it would suggest that undulations in the MMG observed at Queen Square and other sites in the vicinity had been filled by c.11,500 cal. BP and that Holocene sedimentation at Queen Square took place on a gravel surface at c.-2m OD. Avon Formation gravels have been found outcropping on a number of sites in central Bristol at similar elevations to those at Queen Square, including at Broad Quay (Wilkinson 2007), Harbourside (Wilkinson and Tinsley 2005) and Broadmead (Yendell and Stafford 2005, Wilkinson 2013).

3.3 Alluvium 3

3.3.1 The Wentlooge Formation is comprised of mineral silts, clays and occasional organic muds and peats deposited in intertidal/alluvial conditions. The Wentlooge Formation dates to the prehistoric period (from the Mesolithic to the Iron Age) (Allen and Rae 1987). Since other Holocene intertidal formations defined by Allen and Rae (1987) only outcrop in the immediate vicinity of the historic sea defences of the River Severn, all the Holocene intertidal/alluvial sediments encountered at the site are most likely referred to the Wentlooge Formation.

3.3.2 As mentioned previously in Section 3.0.2, both Alluvium 3 and Alluvium 1 are informal subdivisions of the Wentlooge Formation defined by Wilkinson *et al.* (2013) for alluvial/intertidal strata in central Bristol. Other units defined by Wilkinson *et al.* (2013) which were not encountered at Queen Square, but are shown on the composite stratigraphic sections in Figure 3 and Figure 4 include mid-Holocene Peat and Alluvium 2, the latter defined as alluvial/intertidal sediments found below the Peat.

3.3.3 Alluvium 3 is defined by Wilkinson *et al.* (2013) as alluvial sand strata encountered below Alluvium 1, and found predominantly in the Redcliffe area.

3.3.4 At Queen Square, Alluvium 3 is represented by dark grey to very dark grey (10 YR 4/1 to 10 YR 3/1) silt/clay with fine sand laminae and rare organic 'stains'. Alluvium 3 outcrops between -2.46m OD and +1.00m OD in BH1 and between -1.95m OD and +0.35m OD in BH2.

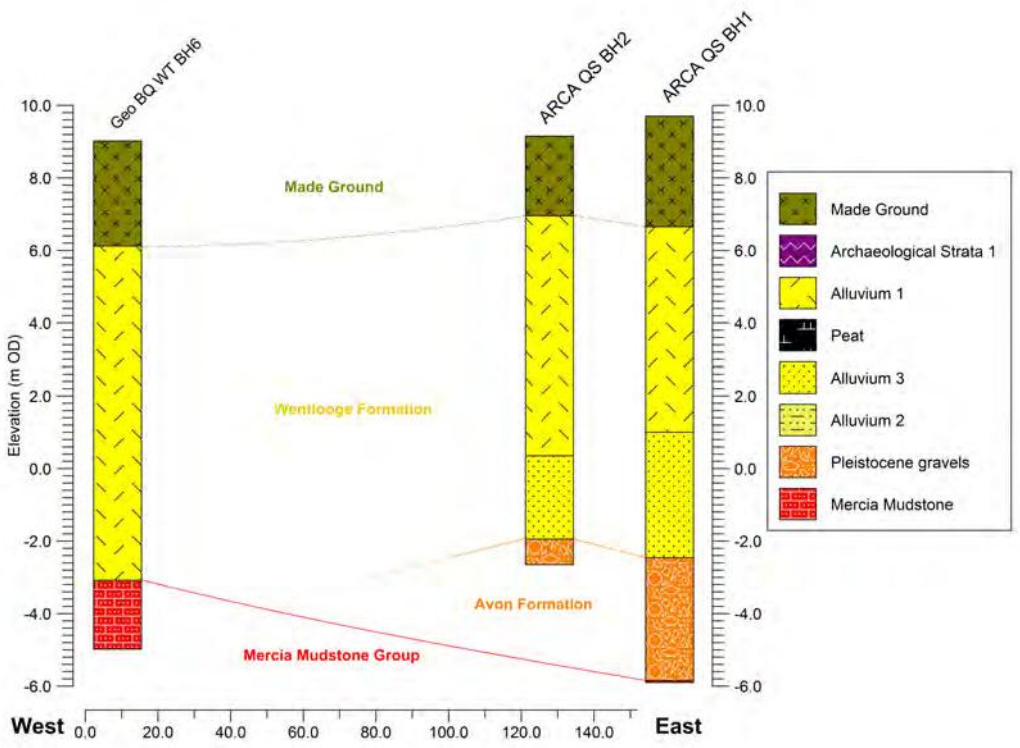


Figure 4. Composite stratigraphic section running from west to east through the Queen Square site and including geotechnical boreholes from adjacent sites.

3.3.5 Alluvium 3 deposits are likely to have formed on a point bar (i.e. sands and gravels forming on the inner bend of a meander as the Avon meander south of the site became more exaggerated (Miall 1996, 153-163).

3.3.6 Similar deposits of Alluvium 3 described by Wilkinson *et al.* (2013) were thickest in the north west of the Redcliffe area, and were interpreted as being deposited on a large point bar in a corresponding meander of the Avon around the north of Redcliffe. Radiocarbon dating of the base of these deposits

suggested that this point bar began to form after 3400 cal. BC and was still forming at 1450 cal. BC[1], but no chronological information has yet been obtained from the top of Alluvium 3 (Wilkinson 2008, 2009), although the overlying early 12th-century deposits provide a *terminus ante quem* for Alluvium 3 in Redcliffe (Wilkinson *et al.* 2013, 30).

3.4 Alluvium 1

3.4.1 Alluvium 1 is defined by Wilkinson *et al.* (2013) as alluvial/intertidal strata of the Wentlooge Formation that immediately underlie Made Ground. Whilst Alluvium 3 can be most probably referred to the Wentlooge Formation (*sensu* Allen and Rae 1987) it is unclear whether Alluvium 1 is part of the Wentlooge Formation (which dates to the prehistoric period) or the Northwick formation (*sensu* Allen and Rae 1987) (which dates to the historic period), or both. In the absence of chronometric dating evidence, it is impossible to distinguish between the two formations, since they cannot be differentiated lithologically (Allen and Rae 1987).

3.4.2 Alluvium 1 is present and exceeds 5.5m in thickness in both boreholes at the site. Alluvium 1 outcrops between +1.00m OD and +6.65m OD in BH1 and between +0.35m OD and +6.95m OD in BH2. The deposits generally consist of dark grey to brown (10 YR 3/1 to 10 YR 5/3) silts and clays with rare organic stains. Deposition was either in an alluvial floodplain or an intertidal mudflat.

3.4.3 The brown colour of strata of above +5.5m OD in BH1 and above +5.15m OD in BH2 may be indicative of oxidation of the upper part of Alluvium 1 at the site due to subsequent lowering of the water table.

3.4.4 Alluvium 1 is unconformably overlain by deposits of Made Ground in both boreholes at the site.

3.5 Made ground

3.5.1 'Made Ground' is a term used by the British Geological Survey to encompass deposits formed as a product of human action (BGS 2014). Made Ground at the site was the focus of

[1] AMS ^{14}C dates on unidentified charcoal from 1-2 Redcliffe Street (Beta 245645, 4720±40 BP) and 32-36 Victoria Street (Wk 25623, 3208±31 BP).

archaeological investigations carried out by BaRAS and is therefore not discussed in detail here.

3.5.2 Made Ground strata occur at the top of both boreholes on the site. They outcrop above +6.65m OD in BH1 and above +6.95m OD in BH2. The Made Ground deposits sampled in the top of BH1 comprise 3.05m of black diamict containing pebble to cobble-sized clasts of slate, iron, sandstone, plaster and glass. In BH2, Alluvium 1 is overlain by 0.40m of loose poorly-sorted angular gravel sealed by 0.30m of concrete, and capped with 1.5m of dark grey diamict with frequent concrete clasts.

4. ASSESSMENT

4.1 Archaeological significance

4.1.1 Deposits of MMG have NO archaeological significance given their Triassic age.

4.1.2 The Avon Formation gravels have a LOW archaeological potential. Whilst Palaeolithic artefacts have been found in Avon Formation gravels in other parts of the region, particularly at Shirehampton, these have mostly been recovered from gravels of the Ham Green Member (Bates and Wenban-Smith 2006, 161), which most likely are of MIS 10-12 date (Hunt 2006, 151), and therefore likely to be considerably older than the Avon Formation gravels encountered at Queen Square. As discussed in Section 3.2, the gravels encountered at the site are of an as yet unnamed member of the Avon Formation of probable MIS 5e-2 date, the archaeological potential of which is presently unknown. Nevertheless, any artefacts which are present in these gravels are likely to have been reworked and the depth of these deposits (>11m BGL) would present considerable logistical difficulties for any further archaeological investigation.

4.1.3 The sands and silt/clays of the Wentlooge Formation as a whole (including both Alluvium 3 and Alluvium 1) are assessed as having a LOW archaeological potential since these were deposited in an alluvial/intertidal setting, and there are no specific indicators of human activity.

4.1.7 The archaeological potential of the Made Ground has been tested by archaeological investigations carried out by BaRAS.

4.2 Palaeoenvironmental significance

4.2.1 The MMG has NO palaeoenvironmental potential.

4.2.2 The Avon Formation has a LOW palaeoenvironmental potential. Although freshwater mollusc and bivalve shells were noted in the upper 1.2m of the gravels in BH1 (between -5.00m OD and -3.80m OD) the absence of any chronological control for the sedimentary sequence restricts the value of any palaeoenvironmental data inferred from these.

4.2.4 The sands, silts and clays of Alluvium 3 and Alluvium 1 have a LOW palaeoenvironmental potential. Previous investigations of comparable deposits at Deanery Road and Harbourside suggest that pollen is variably preserved in such clastic strata (Wilkinson *et al.* 2002, Wilkinson and Tinsley 2005). Moreover, the source of the pollen in floodplain/mudflat deposits is difficult to determine. The lack of chronological control further restricts the potential of these strata.

4.2.5 The Made Ground has LOW palaeoenvironmental potential since it is composed of mixed deposits of unknown source and the water table lies below the made ground, meaning that biological remains are likely to have undergone oxidation

5. RECOMMENDATIONS

5.1 As discussed in Section 6, all strata encountered in the borehole cores are considered to be of low archaeological and palaeoenvironmental potential. Neither further fieldwork nor work on the existing cores is recommended.

6. ACKNOWLEDGEMENTS

6.1 ARCA would like to thank John Bryant and Ian Greig (BaRAS) for their help during the course of the project.

6.2 Nick Watson and David Ashby monitored the drilling of boreholes and described the cores. The project was managed for ARCA by Dr Keith Wilkinson and the report was written by Phil Stastney.

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APPENDIX 1: BOREHOLE LOCATIONS AND LITHOLOGICAL DESCRIPTIONS

Borehole	Easting	Northing	Elevation (m OD)
ARCA QS BH1	358751.483	172659.027	9.701
ARCA QS BH2	358726.243	172680.394	9.153

Position and elevation of boreholes at Queen Square.

Bore	Top	Base	Lithology	Comments
ARCA QS BH1	0.00	3.05	Overburden	10 YR 2.5/1 Black diamict of pebble to cobble sized clasts of slate, iron, sandstone, plaster and glass. Sharp boundary to: to:
	3.05	3.70	Clay	10 YR 4/2 Greyish brown silt/clay. Rare organic stains. Sharp boundary to:
	3.70	4.20	Clay	10 YR 5/3 Brown silt/clay. Well sorted. Unknown boundary to:
	4.20	4.60	Clay	10 YR 3/1 Very dark grey. Occasional sand and organic stains. Sharp boundary to:
	4.60	4.85	Clay	10 YR 3/3 Brown silt/clay. Iron stained. Sharp boundary to:
	4.85	5.70	Clay	10 YR 5/1 Grey silt/clay. Unknown boundary to:
	5.70	6.22	No Recover	Void
	6.22	6.48	No Recover	Slump
	6.48	7.20	Clay	10 YR 3/1 Very dark grey silt/clay. Rare organic stains. Unknown boundary to:
	7.20	7.60	No Recover	Void

Bore	Top	Base	Lithology	Comments
ARCA QS BH1	7.60	8.70	Clay	10 YR 3/1 Very dark grey silt/clay. Rare organic stains. Sharp boundary to:
	8.70	12.16	Sand	10 YR 3/1 Very dark grey mottled 10 YR 5/1 Grey silt/clay. Rare organic stains and fine sand laminae. Sharp boundary to:
	12.16	13.20	Gravel	10 YR 3/1 Very dark grey poorly sorted, sub-rounded to rounded gravel. Granular to pebble sized clasts. Coarse clayey sand matrix. Unknown boundary to:
	13.20	13.50	No Recover	Slump
	13.50	14.70	Fluvial gravel	10 YR 3/1 Very dark grey poorly sorted, sub-rounded to rounded gravel. Granular to pebble sized clasts. Coarse clayey sand matrix. Wood cobble and freshwater shell at 14.10m. Sharp boundary to:
	14.70	15.55	Fluvial gravel	10 YR 5/6 Yellow brown poorly sorted, coarse sand to pebble sized gravel. Sharp boundary to:
	15.55	15.60	Siltstone	5 YR 5/3 Reddish brown mudstone.
ARCA QS BH2	0.00	1.50	Overburden	10 YR 3/1 Very dark grey diamict. Concrete clasts. Sharp boundary to:
	1.50	1.80	Concrete	Concrete. Sharp boundary to:
	1.80	2.20	Overburden	Loose angular gravel. Poorly sorted. Sharp boundary to:
	2.20	4.00	Clay	10 YR 4/2 Greyish brown silt/clay. Rare organic stains. Diffuse boundary to:
	4.00	4.15	Clay	10 YR 4/1 Dark grey silt/clay. Occasional coarse sand. Sharp boundary to:
	4.15	5.46	Clay	10 YR 4/2 Dark greyish brown silt/clay. Rare organic stains and reed fragments. Diffuse boundary to:
	5.46	5.80	Clay	10 YR 4/1 Dark grey silt/clay. Diffuse boundary to:

Bore	Top	Base	Lithology	Comments
ARCA QS BH2	5.80	8.80	Clay	10 YR 4/1 Dark grey silt/clay. Rare organic stains, and coarse sand to pebble sized wood fragments. Diffuse boundary to:
	8.80	11.10	Sand	10 YR 4/1Dark grey silt/clay. Occasional fine sand laminae. Sharp boundary to:
	11.10	11.80	Fluvial gravel	10 YR 3/1 Very dark greyish brown sandy gravel. Pebble to cobble sized clasts. Rare red mudstone clasts.