Geoarchaeology

ARCA

February 2014

Report Number: 1314-9

ST.ANNE'S WELL, NIGHTINGALE VALLEY, BRISTOL: GEOARCHAEOLOGICAL SURVEY

Prepared for Brislington Community Archaeology Project

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SUMMARY

In November and December 2013, one mechanical and four manual geoarchaeological boreholes were drilled by ARCA and The Brislington Community Archaeology Project (BCAP) on the site of St Anne's Well, Brislington, in the city of Bristol, in order to establish the nature of the Holocene stratigraphy. St Anne's Well is located on the narrow flood plain of the Brislington Brook, a tributary of the River Avon. Strata in the borehole cores were described by ARCA geoarchaeologists and members of BCAP. This document reports on the stratigraphy of the boreholes and discusses the archaeological and palaeoenvironmental significance of the sediments encountered.

Coarse grained alluvial sands and sandstone gravel was recovered below +6.6m OD in BH1 and below +7.5m OD in BHs 2 and 4. These deposits were derived from reworked colluvium eroded from the Magnotsfield Member which forms the sides of the gorge, through which the Brislington Brook has cut its course to the join the River Avon. Overlying silt/clay and fine sand laminae date to the Early Bronze Age (c.2350-2570 cal BC) and is the first indirect evidence of human activity in the watershed found on the site. After this date approximately 3m of silt/clays accreted on the floodplain. Topsoil has developed conformably within the alluvium in BHs 1, 2 and 5. In BHs 3 and 4 cultural deposits relating to Victorian landscaping were recorded.

No in situ organic strata were encountered nor is the alluvial sequence part of the contemporaneous Wentlooge Formation of the central Bristol area.

1. INTRODUCTION

1.1 Over the course of three days (29th November, 4th and 9th December 2013) five geoarchaeological boreholes were drilled at the site of St Anne's Well, Nightingale Valley, Brislington, Bristol (henceforth 'the site'). The works were divided between four hand drilled auger holes and one mechanically drilled borehole. Members of Brislington Community Archaeology Project (BCAP) assisted with the hand augering under the supervision of ARCA, with ARCA drilling the mechanical hole. BCAP had requested that ARCA assist them in the geoarchaeological survey of the valley of the Brislington Brooke in the environs of St Anne's Well. The purpose of this document is to assess the archaeological and palaeoenvironmental significance 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 and finally recommendations on further work are offered. A bibliography and appendices containing lithological descriptions of the borehole stratigraphy complete the document.

The site is located in the suburb of Brislington in the city of Bristol and is centred on NGR ST 62172 72514. The site is the northern most section of the Nightingale Valley in St Anne's Wood and extends *c.* 150m from the end of Chapel Way south to the footbridge over the Brislington Brook at Nature's Garden

(

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

1.3 The British Geological Survey (BGS) maps the site as lying on rock of the Mangotsfield Member, part of the Pennant Sandstone Formation a Carboniferous deposit dating from 306 to 311 my BP (BGS 2014) with the Redcliffe Sandstone Member rising immediately to the east. The Mangotsfield Member is a lithic arenite which weathers to a characteristic purple colour. It is interbedded with grey fissile mudstones and coal seams which outcrop north of the site. The BGS maps Holocene Alluvium deposits of clay, silt, sand and gravel as overlying the bedrock.

1.4 The Brislington Brook is a southern tributary of the River Avon. It occupies a steep sided north to south trending gorge which was probably cut into the Mangotsfield Member in the Pleistocene when ice blockage recast earlier drainage patterns. The gorge is several kilometres in length, approximately 20m in

depth and 50m wide at its base in the vicinity of the site. The slopes are wooded and there is a meadow/parkland floor; the brook is no more than 1.5m wide and meandering in habit.

1.5 The Well of St. Anne is named after the saint whose thirteenth century chapel was once the pilgrimage site of Henry VII. The site of the chapel is at the confluence of the Brislington Brook and the River Avon, though its exact position is unclear. Coins and tokens dating to the reigns of Edward IV and Henry VII were recovered from the well in the late nineteenth century, however, the validity of these finds has recently been called into question by the author Ken Taylor in research for his forthcoming publication. The well is first indicated on the Ordnance Survey map of 1904. In the early twentieth century the well was cleaned and a spring discovered 6m below the ground surface (BCAP, 2014)

1.6 The objectives of the geoarchaeological borehole survey at St. Anne's Well as discussed between ARCA and representatives of BCAP, Rosie Tomlinson and Rowan Matthiessen, were as follows:

1.6.1 Instruct members of the BCAP in the use of the Edelman hand auger and the method of recording sedimentary strata.

1.6.2 Determine the Holocene sedimentary sequence on the site.

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

1.6.4 Recover a sample from sealed cores for AMS ^{14}C dating.

1.6.5 Make recommendations for further investigation for any future project that may arise.

2. METHODOLOGY

2.1 The methodology was to drill a single mechanical borehole (BH1) by ARCA using an Atlas Copco Cobra petrol-powered hammer and core samplers at a site previously investigated and deemed suitable by hand augering. The mechanical drilling device is capable of taking undisturbed cores 1m in length and 0.05m in diameter without significant compression to a depth of 10m, however it is not capable of penetrating thick (i.e. >0.5m) deposits of gravel or rubble. Hand augering at the site identified gravel deposits at *c.* 3.7m below ground surface (BGS).

Figure 1. Location of boreholes on the site.

2.2 A further four boreholes (BH2-5) were drilled using an Edelman hand auger along a north to south transect beside the Brislington Brook. The Ordnance Survey National Grid Reference and Ordnance Datum of the borehole positions were recorded using a Leica SmartNet GPS. The deposits recovered from the hand augering were described in the field while the core samples were taken to the ARCA laboratory at the University of Winchester where they were cleaned, photographed and described using standard geological criteria (Tucker 1982, Jones *et al.* 1999, Munsell Color 2000). Full stratigraphic descriptions are presented in Appendix 1.

2.3 Lithological descriptions and positional data from the site was entered into a RockWorks database (RockWare 2012). The RockWorks software package was then used to plot a lithological

and stratigraphic cross section (Figure 22). The British Geological Survey (BGS) Borehole Database was searched for records in the surrounding area of the site, and although some were found in the industrial park on Chapel Way, their content was deemed restricted and was unavailable for comparison.

2.4 A sample of humic sandy clay was taken at 2.95m BGL from the sealed cores from BH1 for AMS ^{14}C dating.

2.5 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.

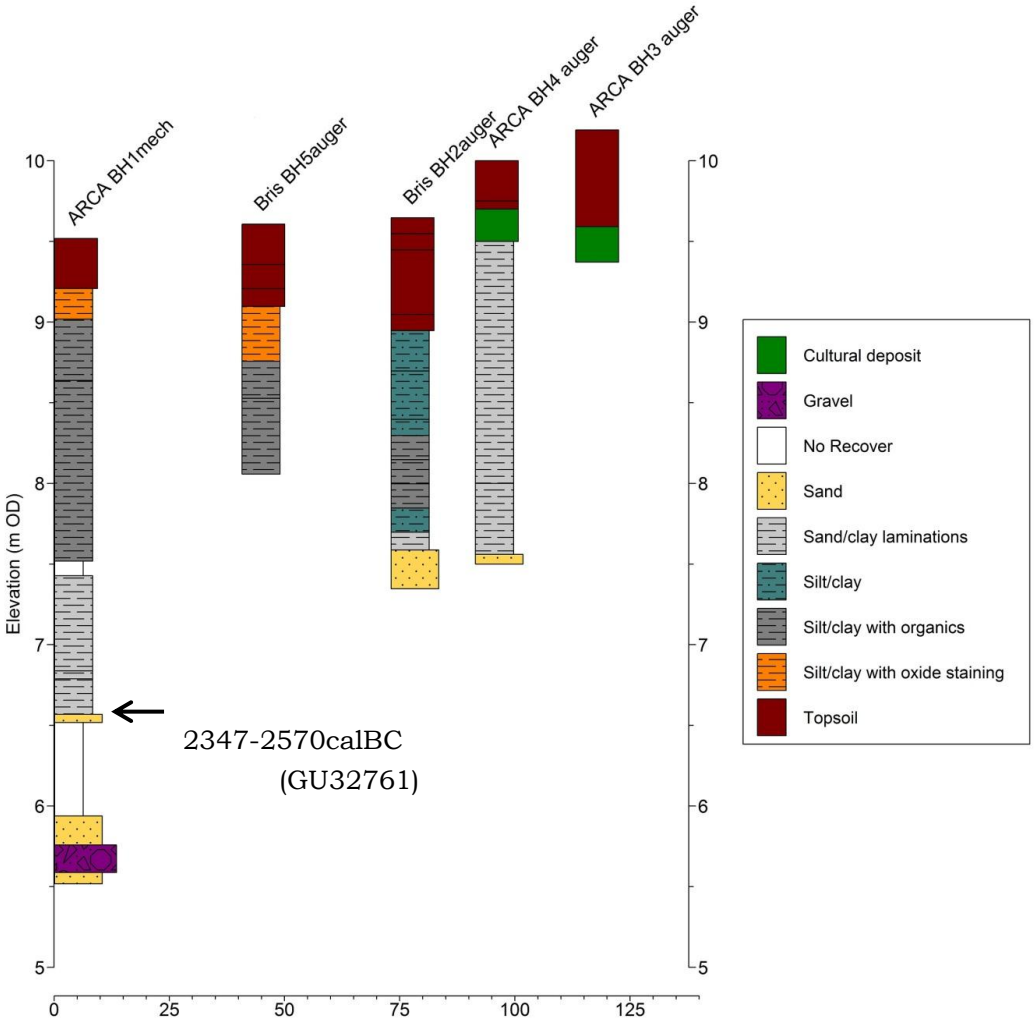

Figure 2. Lithology of boreholes at the site: North to South transect.

3. BOREHOLE STRATIGRAPHY

3.1 Two major stratigraphic units present at the site were revealed in the borehole stratigraphy. These are reviewed below in chronological order.

3.2 The lithological data are plotted graphically in Figure 22.

3.1 Alluvium

3.1.1 The Alluvium dates from the Holocene Epoch (11.5-0 ky BP) and consists of a fining upward sequence of gravel, sand and silt/clay. The coarse grained component recovered from BH1 below *c.* +6.6m OD, and BHs 2 and 4 below *c.* +7.5m OD, is typically a poorly sorted, sandy gravel of medium to coarse sand and angular, fine to medium, reddish purple sandstone clasts. The clasts are derived locally from the Magnotsfield Member which forms the sides of the gorge and their angular shape indicates that they have not travelled far. They may be a colluvial deposit eroded from the gorge walls and reworked by fluvial action in the river channel. The high energy environment under which these coarse clastic deposits were laid down probably took place during the first third of the Holocene by which time the amelioration of periglacial conditions in Southern England was complete and the climate was similar to the present day.

3.1.2 The overlying and finer grained deposits recovered in BH1 and BH4 are brown (10 YR 4/3) horizontal laminae of silt/clay interlaminated with very dark grey (2.5 Y 3/1) fine sand. In BH4 although the torsion resulting from hand augering badly disrupted the strata they remained recognisable. These are deposits that accumulate on a point bar or a levee and indicate that the early Brislington Brook had accommodated to its narrow floodplain and had assumed a meandering course which is the characteristic morphology of the lower courses of rivers in the Holocene. Sand laminae typically accrete on the inner bank of a river where the velocity falls. They also form levees along the top of river banks when flood waters laden with suspended sediment (fine sands, silts and clays) experience a fall in velocity upon leaving the channel and drop their load. Waterlogged, fine grained humic material settled out of suspension too, and became trapped within the interstices of the sand grains imparting a dark grey colour to the sediment. The base of the laminae (BH1, +6.57m OD) overlying the coarser grained alluvial strata are dated to *c.* 2350-2570 cal BC (see section 4), as seen in Figure 3.

3.1.3 Between +7.42m OD and +6.83m OD in BH1 the deposits develop from a cyclical stratigraphy of interlaminations on a 1-10mm scale to a cycle on a broader morphological scale: *c.*20-100mm thick beds of silt/clay are interbedded with medium sands. Although the time over which these deposits accreted is unknown- it may be over several centuries- the environment of deposition can be determined none the less. The silt/clay strata are overbank deposits typical of slack water whereas the coarser grained sands can be either a channel deposit or a levee deposit immediately adjacent to the channel and laid down under conditions of higher energy. The repeating sequence of strata is probably indicative of the meandering channel laterally reworking the narrow flood plain thereby creating a lithofacies of interbedded sands and clays: sands are deposited in/next to a channel; the channel migrates away and the old channel sands are overlain by silt/clays as it is now part of the flood plain; the channel migrates back and more sand is laid down and the cycle repeats. It should be borne in mind, that the sediments seen in the cores are the positive expression of deposition; the negative expression is that of erosion with the result that within this dynamic sedimentary regime strata are almost inevitably truncated to some extent.

3.1.4 Fine to coarse sand-sized mineral grains, in the main most probably quartz grains, are present throughout the deposits as are occasional angular sandstone clasts. This material is derived from the lithic arenite which outcrops on the gorge walls and on the site adjacent to the Well. It is incorporated into the stratigaphy via the reworking of colluvial deposits along the gorge by the Brislington Brook.

3.1.5 Approximately 2m of fine grained and unstructured alluvial silt/clays overly the laminae in BH1 and BH2. Sand to granular-sized organic fragments were present throughout although no *in situ* peat strata was recovered in any of the boreholes. The organic fragments were therefore allochthonous and derived from peat beds or other detrital organic residues further up or downstream. The River Avon is tidal and on high tides material could be transported from the peat beds around the confluence of the Rivers Avon and Frome at Canon's Marsh 6 km west.

3.1.6 The accretion of silt/clays on the floodplain comes about by flooding during periods of high discharge; on the retreat of the floodwaters the suspended load is deposited as the carrying capacity of the water rapidly falls. The source of the sediment is likely to be from upstream, though as noted above the lower reaches of the Brislington Brook also experience an intertidal regime. Deposits typical of such a regime have been identified in

central Bristol as 'Alluvium 1' (defined by Wilkinson *et al.* (2013)) of the Wentlooge Formation and are alluvial/intertidal strata that immediately underlie Made Ground. These deposits generally consist of very dark to dark grey (5 Y 3/1 to 5 Y 4/1) silt/clays with rare organic 'stains' but are unlike the greyish brown deposits recovered from the St Anne's Well site. The alluvial deposits from the site are, however, broadly contemporaneous with the intertidal Alluvium 1 deposits in the central Bristol area.

3.1.7 The dark greyish brown (2.5 Y 4/2) colour of strata between +8.76m OD and +9.21m OD in BH1 and BH5 is a mottled yellowish brown (10 YR 5/6) from iron oxide deposits. This is the result of post depositional oxidation of the upper part of the alluvial sequence due to fluctuations in the level of the water table.

Figure 3. Laminations within BH1, and AMS ^{14}C sample at 2.95-2.96m BGL.

3.2 Made Ground

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

3.2.2 Made Ground strata occur at the top of all five boreholes at the site and were between 0.3m and 0.82m in thickness. These strata are composed of silt/clay top soils with frequent bioturbation from roots and rare granular fragments of cultural material for example, charcoal and ceramic building material (CBM). In BH3 frequent pebble-sized sandstone clasts were encountered at +9.59m OD and the hole terminated at an obstruction at +9.37m OD. This stratum is recorded as a cultural deposit and may relate to Victorian landscaping. A

further cultural deposit was present in BH4 where granules of CBM and coal were noted.

4. CHRONOLOGY

4.1 A bulk sample of 1-2g was taken of the humic material and sand laminae (discussed above in 3.1.1) from BH1 at +6.57mOD and submitted to the Scottish Universities Environmental Research Centre (SUERC) for AMS ^{14}C measurement.

Table 1. Presents the results of the AMS ^{14}C dating.

Lab. No.	Depth	^{14}C Age	2σ (95.4%) calibration
GU 3271	6.57mOD	3957±28 BP	2570(29.0%)2515calBC 2501(57.7%)2399calBC 2382(8.6%)2347calBC

4.2 From *c.*2350-2570 cal BC to the present day approximately 3m of fine grained alluvium has accreted on the floodplain of the Brislington Brook. These deposits derive from the watershed where, over time, human activity has contributed greatly to the erosion of the land surface through forest clearance and agriculture. The sample dated was located at the base of the fine grained strata and overlying coarse grained sands and sandstone gravels. It may be tentatively concluded that this early Bronze Age date is evidence of human modification of the environment albeit circumstantial in nature. Earlier modification, if it took place, has either been eroded from the stratigraphic column or was too ephemeral to leave a record.

5. RECOMMENDATIONS

5.1 Further geoarchaeological work could be instigated between St Anne's Well and the confluence of the Brislington Brook with the River Avon to investigate the upper tidal frame deposits, that is to say, the possible intersection of the Wentlooge Formation and the Alluvial sequence described in this report. The recovery of datable and *in situ* strata would be key and complement the Holocene sequence of the central Bristol area.

6. ACKNOWLEDGEMENTS

6.1 ARCA would like to thank Rosie Tomlinson and Rowan Matthiessen for their help during the course of the project.

6.2 The project was managed for ARCA by Dr. Keith Wilkinson and the report was written by David Ashby and Nicholas Watson.

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APPENDIX 1: BOREHOLE LOCATIONS AND LITHOLOGICAL DESCRIPTIONS

Bore	Easting	Northing	Elevation	TD
ARCA BH1 mech	362144.228	172578.024	9.518	4.00
Bris BH2	362157.561	172508.478	9.647	2.30
ARCA BH3	362185.306	172485.252	10.191	0.82
ARCA BH4	362164.471	172491.526	10.978	2.50
Bris BH5	362160.422	172540.717	9.607	1.55

Position and elevation of boreholes at the site.

Bore	Top	Base	Lithology	Comments
ARCA BH1mech	0	0.31	Topsoil	2.5 Y 3/2 Very dark greyish brown silt/clay with rare granular-sized red CBM, coarse sand -sized shell and charcoal fragments. Occasional roots. Diffuse boundary to:
	0.31	0.5	Silt/clay with oxide staining	2.5 Y 4/2 Dark greyish brown silt/clay with occasional red iron oxide mottles. Occasional fine sand-sized mineral grains. Diffuse boundary to:
	0.5	0.88	Silt/clay with organics	2.5 Y 4/1 Dark grey silt/clay with occasional fine sand-sized mineral grains and rare coarse sand -sized black plant fragments and black humic acid staining. Diffuse boundary to:

	0.88	2	Silt/clay with organics	2.5 Y 4/2 Dark greyish brown silt/clay with rare to occasional fine sand-sized mineral grains, rare coarse sand-sized shell fragments and occasional sand to granular -sized black plant fragments and humic acid spots and staining. Rare pebble-sized wood fragment at base.
	2	2.09	No Recover	Slump
	2.09	2.68	Sand/clay laminations	2.5 Y 4/2 Dark greyish brown silt/clay interbedded with 2.5 Y 3/1 Very dark grey fine sand (20 to 100mm scale) Rare granular-sized organic fragments and humic staining particularly in sand beds. Sharp boundary to:
	2.68	2.73	Sand/clay laminations	5 YR 4/4 Reddish brown gravel of eroded angular pebble-sized red/ purple sandstone. Sharp boundary to:
	2.73	2.96	Sand/clay laminations	2.5 Y 4/2 Dark greyish brown to 10 YR 4/3 Brown fine horizontal laminae of silt/clay interlaminated with 2.5 Y 3/1 Very dark grey fine sand. *2.95-2.96m AMS C14 sample.* Sharp boundary to:
	2.96	3	Sand	2.5 Y 3/1 Very dark grey fine to medium sand with humic staining.
	3	3.58	No Recover	Slump
	3.58	3.76	Sand	2.5 Y 3/1 Very dark grey fine to medium sand with humic staining. Rare pebble-sized twig and shell. Sharp boundary to:
	3.76	3.93	Gravel	7.5 YR 4/4 Brown sandy gravel, poorly sorted with granular to pebble-sized sandstone clasts. Sharp boundary to:
	3.93	4	Sand	7.5 YR 4/1 Dark grey sandy clay with rare coarse sand-sized shell fragments: hole terminated.
Bris BH2auger	0	0.1	Topsoil	10 YR 3/4 Dark brown silt/clay with rare fine sand-sized mineral grains and frequent bioturbation (roots). Gradual boundary to:
	0.1	0.2	Topsoil	7.5YR 3/4 Dark brown silt /clay occasional pebble- sized angular clasts (red sandstone) occasional bioturbation. Gradual boundary to:

0.2	0.6	Topsoil	7.5 YR 4/3 Brown silt/clay with rare granular-sized angular clasts (red sandstone), rare granular-sized charcoal fragments, and rare granular-sized lenses of medium sand. Rare bioturbation. Gradual boundary to:
0.6	0.7	Topsoil	10 YR 3/3 Dark brown silt/clay with rare medium sand-sized mineral grains. At base rare fine pebble- sized angular clasts. Very gradual boundary to:
0.7	0.95	Silt/clay	10 YR 7.5 5/2 Brown silt/clay with rare granular-sized sandstone clasts. Occasional water snail shells & shell fragments occasional pebble-sized lenses of silt/clay with frequent medium sand-sized mineral grains. (Gradual change from topsoil to clay throughout). Diffuse boundary to :
0.95	1.25	Silt/clay	10 YR 7.5 5/4 Brown silt/clay occasional snail shells (water) and shell fragments. Gradual boundary to:
1.25	1.35	Silt/clay	5 YR 5/6 Olive silt/clay. Diffuse boundary to:
1.35	1.5	Silt/clay with organics	7.5YR 5/4 Brown silt/clay granule sized lenses of humic acid. Sharp boundary to:
1.5	1.65	Silt/clay with organics	7.5 YR 5/3 Brown silt/clay with frequent fine sand- sized mineral grains and frequent evenly distributed fibres of organic material (peat). Sharp boundary to:
1.65	1.8	Silt/clay with organics	7.5 YR 4/4 Brown silt/clay with frequent medium sand sized mineral grains occasional granular-sized fibres of organic matter (peat). Diffuse boundary to:
1.80	1.95	Silt/clay	7.5 YR 5/3 Brown silt/clay. Sharp boundary to:
1.95	2.06	Sand/clay laminations	2.5 Y 6/3 Light yellowish brown horizontal laminae of fine sand- sized mineral grains Occasional granular-sized lenses of peat & wood fragments. Sharp boundary to:

	2.06	2.30	Sand	7.5 YR 4/3 Brown granular-sized lenses of red fine sand- sized mineral grains Frequent medium sand sized mineral grains. Solid base: hole terminated.
ARCA BH3 auger	0.00	0.60	Topsoil	10 YR 3/3 Dark brown silt/clay with frequent roots. Diffuse boundary to:
	0.60	0.82	Cultural deposit	2.5 Y 3/2 Very dark greyish brown silt/clay with occasional to frequent granular to fine pebble-sized angular sandstone clasts (made ground, solid base: possible earlier path or pond?): hole terminated.
ARCA BH4 auger	0.00	0.25	Topsoil	10 YR 3/3 Dark brown silt/clay with angular sand to granular-sized sandstone clasts. Frequent roots. Diffuse boundary to:
	0.25	0.30	Topsoil	7.5 YR 3/2 Dark brown silt/clay with occasional medium sand-sized mineral grains. Diffuse boundary to:
	0.30	0.50	Cultural deposit	7.5 YR 3/4 Dark brown silt/clay with occasional medium sand-sized mineral grains and occasional to frequent granular-sized sandstone clasts, CBM and coal. Diffuse boundary to:
	0.50	2.00	Sand/clay laminations	5 Y 3/2 Dark olive grey silt/clay with mottles of 10 YR 3/2 Dark brown. Occasional medium sand-sized mineral grains and granular-sized sandstone clasts and rare horizontal (?) laminae. Diffuse boundary to:
	2.00	2.44	Silt/clay with organics	10 YR 3/2 Very dark greyish brown silt/clay with frequent coarse sand -sized mineral grains, occasional black humic staining and rare shell and waterlogged organic fragments. Diffuse boundary to:
	2.44	2.50	Sand	5 Y 4/1 Dark grey sandy clay with occasional angular granules of sandstone (solid base): hole terminated.
Bris BH5auger	0.00	0.25	Topsoil	10 YR 3/2 Very dark greyish brown silt/clay. Occasional bioturbation. (Topsoil) Diffuse boundary to:

0.25	0.40	Topsoil	10 YR 3/4 Dark yellowish brown silt/clay. Granular-sized lenses of black organic matter. Diffuse boundary to:
0.40	0.51	Topsoil	7.5 YR 4/4 Dark brown silt/clay with rare pebble-sized sub-angular clasts of sandstone and frequent medium sand -sized mineral grains. Sharp boundary to:
0.51	0.85	Silt/clay with oxide staining	2.5 Y 4/2 Dark greyish brown silt/clay with iron oxide staining. Gradual boundary to:
0.85	1.08	Silt/clay with organics	5 Y 4/2 Olive grey silt/clay with occasional evenly distributed fragments of black organic matter. Occasional granular to pebble-sized clasts of greyish green sandstone. Rare snail shell fragments. Gradual boundary to:
1.08	1.55	Silt/clay with organics	7.5 YR 5/3 Brown silt/clay with occasional evenly distributed fragments of black organic matter. Solid base: hole terminated.