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ALCHEMY PARK, CRABTREE MANORWAY NORTH, LONDON BOROUGH OF BEXLEY

Geoarchaeological Fieldwork and Deposit Modelling Report

NGR: TQ 500 801

Site Code: ALY16

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1. NON-TECHNICAL SUMMARY

A program of geoarchaeological fieldwork and deposit modelling was carried out by Quaternary Scientific (University of Reading) in connection with the proposed development of land at Alchemy Park, Crabtree Manorway North, London Borough of Bexley. The work was commissioned by Turley on behalf of Savills Investment Management. The aims of the investigation were: (1) to clarify the composition, nature and distribution of the sediments beneath the site; (2) to evaluate the potential of these sediments for providing information on the environmental history of the site, and evidence of human activity.

In order to address these aims, three geoarchaeological boreholes were put down across the site. The resultant records were combined with over 100 geotechnical logs which were inspected and evaluated, together with records from nearby archaeological/geoarchaeological investigations. The depth, thickness and nature of each major sedimentary unit was extracted and entered into geological modelling software, from which a series of topographic surface and thickness maps were produced.

The results of the deposit modelling demonstrate a sequence of River Terrace Gravels (the Shepperton Gravel), overlain by floodplain deposits of Lower Alluvium (sands, silts, peat and plant remains), Peat, and Upper Alluvium (silts and clays) beneath the site. However, the depth and thickness of these deposits changes from south (low gravel surface; thick floodplain deposits) to north (high gravel surface; thinner floodplain deposits) suggesting that the site is located towards the interface of two different environments: the floodplain valley of the Lower Thames Valley (to the north) and a deep west-east orientated palaeochannel (to the south).

Due to the depth of the sediments, the archaeological potential of the site is considered to be low. However, even in the absence of direct archaeological remains, the sediments recorded have the potential to contain a wealth of further information on the past landscape and evidence of human activities, through the assessment/analysis of palaeoenvironmental ecofact remains (e.g. pollen, plant macrofossils and insects) and radiocarbon dating. Not only will this work be of importance to understanding the history of the site, but it will contribute to our knowledge and understanding of the region as a whole. The findings of the exercise therefore indicate that the site has geoarchaeological and palaeoenvironmental potential, and thus it is recommended that an assessment of two sequences is carried out as outlined within the Written Scheme of Investigation for the site (Batchelor, 2015).

2. INTRODUCTION

2.1 Site context

This report summarises the findings arising out of the fieldwork and deposit modelling undertaken by Quaternary Scientific (University of Reading) in connection with the proposed development of land at Alchemy Park, Crabtree Manorway North, London Borough of Bexley (NGR centred on: TQ 500 801; site code: ALY16; Figures 1 & 2). Quaternary Scientific were commissioned by Turley to undertake the geoarchaeological investigations. The site is located on the floodplain of the Estuarine Thames, less than 300m from the modern waterfront and *ca.* 1km north of the floodplain edge and the rising ground of the valley side. The site lies on the south side of the Thames, forming part of the Erith Marshes which occupies the eastern end of the area of floodplain enclosed by the river where it makes a broad northward loop between Woolwich in the west and Erith in the east. The whole of this area of valley floor, which has its most northerly point at Crossness, is underlain by Holocene Alluvium. The British Geological Survey (BGS) 1:50,000 Sheets 257 Romford (1996) and 271 Dartford (1998) show the Alluvium overlying bedrock Lower Tertiary Lambeth Group sediments in much of the eastern part of the area; and overlying Taplow Gravel in the western part and in the south, adjacent to the higher ground that forms the southern edge of the floodplain.

Previous geotechnical investigations have been undertaken at the site by RSK Geotechnics Ltd (2004, 2005, 2006; Figure 2), comprising 10 boreholes, 13 window samples and 37 test-pits. In addition to these records, detailed geotechnical and geoarchaeological investigations were carried out on the neighbouring former NuFarm site (Young *et al.*, 2012a; Figure 2). The RSK Geotechnics records are very well distributed across the Alchemy Park site; as are the boreholes across the former NuFarm site (Figure 2). Combined, the results suggest a Shepperton Gravel surface that is higher across much of the former NuFarm site, and northern part of the Alchemy Park site, ranging between *ca.* -7.5 and -9.0m OD. On the southern part of the Alchemy Park site however, a large west-east deeper depression (possible palaeochannel) is indicated by a Gravel surface recorded between -10 and -10.6m OD.

Overlying the Shepperton Gravel on both the northern and southern parts of the Alchemy Park site is a sequence of Holocene floodplain deposits capped by Made Ground. The floodplain deposits can be collated into three major stratigraphic units: (1) Lower Alluvium, (2) Peat, and (3) Upper Alluvium, as described elsewhere in the Lower Thames Valley (see Green *et al.*, 2014).

1) The Lower Alluvium is predominantly described as a sandy silt containing organic-clay and traces of soft brown peat. It generally ranges between 3 and 5.5m in thickness, but in boreholes ALC-BH6 and ALC-BH10 where the Shepperton Gravel surface is lowest, it is considerably thicker (8-9m).
2) Peat overlies the Lower Alluvium and varies between 1.5 (ALC-BH2) and 4.1m (ALC-BH4) in thickness. It is thin however, in ALC-BH6 and absent in ALC-BH6.
3) The Upper Alluvium is described as predominantly clay, with occasional inclusions of silt, sand and plant remains. It generally ranges between 1.1 and 3.5m in thickness.

2.2 Palaeoenvironmental and archaeological significance

The existing records therefore indicate considerable variation in the height of the Shepperton Gravel surface, and the type, thickness and age of the subsequent Holocene deposits. Such variations are significant as they represent different environmental conditions that would have existed in a given location. For example: (1) the varying surface of the Shepperton Gravel may represent the location of former channels (towards the south of the site) and bars (towards the north); (2) the presence of peat represents former terrestrial or semi-terrestrial land-surfaces, and (3) the Lower and Upper Alluvium represent periods of inundation/flooding by estuarine or fluvial waters. Thus by studying the sub-surface stratigraphy across the site in greater detail, it will be possible to build an understanding of the former landscapes and environmental changes that took place across space and time.

Organic-rich sediments (in particular Peat) also have high potential to provide a detailed reconstruction of past environments on both the wetland and dryland from the Mesolithic to Late Bronze Age periods. In particular, there is the potential to increase knowledge and understanding of the interactions between relative sea level, human activity, vegetation succession and climate in this area of the Lower Thames Valley. Significant vegetation changes include the Mesolithic/Neolithic decline of elm woodland, the Neolithic colonisation and decline of yew woodland; the Late Neolithic/Early Bronze Age growth of elm on Peat, and the general decline of wetland and dryland woodland during the Bronze Age. Such investigations are carried out through the assessment/analysis of palaeoecological remains (e.g. pollen, plant macrofossils & insects) and radiocarbon dating. So called palaeoenvironmental reconstructions have been carried out on the sedimentary sequences from Crossness Sewage Works (Batchelor *et al.*, 2007a, b), Norman Road (Batchelor *et al.*, 2008a) and Imperial Gateway (Batchelor *et al.*, 2008b).

Finally, areas of high gravel topography, soils and peat represent potential areas that might have been utilised or even occupied by prehistoric people, evidence of which may be preserved in the archaeological (e.g. features and structure) and palaeoenvironmental record (e.g. changes in vegetation composition). Prehistoric structures have been located in the peat locally to the site at Erith Spine Road / Bronze Age Way (Sidell, 1996) and on the Erith Foreshore (Sidell pers. comm.)

2.3 Aims and objectives

Further borehole records are required to enhance our understanding of the sub-surface stratigraphy of the Alchemy Park site, and for any further assessment/analysis of the deposits (if necessary). Five significant research aims were thus proposed within the geoarchaeological Written Scheme of Investigation (WSI; Batchelor, 2015) for the site as follows:

1. To clarify the nature of the sub-surface stratigraphy across the site;
2. To clarify the nature, depth, extent and date of any alluvium and peat deposits
3. To investigate whether the sequences contain any artefact or ecofact evidence for prehistoric or historic human activity
4. To investigate whether the sequences contain any evidence for natural and/or anthropogenic changes to the landscape (wetland and dryland)
5. To integrate the new geoarchaeological record with other recent work in the local area for publication in an academic journal

The content of this report achieves the first two of these aims and considers the potential of addressing aims 3 to 5 through laboratory-based assessment and analysis. The following objectives were carried out in order to address aims 1 & 2:

1. To retrieve three geoarchaeological borehole sequences on a north - south transect across the site (Figure 2)

   AP-QBH1 will be put down in the region of AP-BH4 (where the Shepperton Gravel surface is higher and Peat is thickest),

   AP-QBH2 will be put down to fill a gap in the coverage of the site between AP-BH5, BH6 and BH7.

   AP-QBH3 will be put down on the southern edge of the site between AP-BH6 and AP-BH10 to complete coverage of the site in this area of the site, and clarify the presence/nature of the deeper sedimentary sequence that might be expected on this part of the site.

2. To utilise the stratigraphic data from the new and existing records to produce a deposit model of the major depositional units across the site.

   In addition to the three new geoarchaeological boreholes and existing data from both Alchemy Park and NuFarm, a programme of site investigation works was also undertaken in February 2016 by BWB Consulting, comprising 5 boreholes, 12 cone penetration tests and 26 test-pits. The results from these records form an important component to the following report.

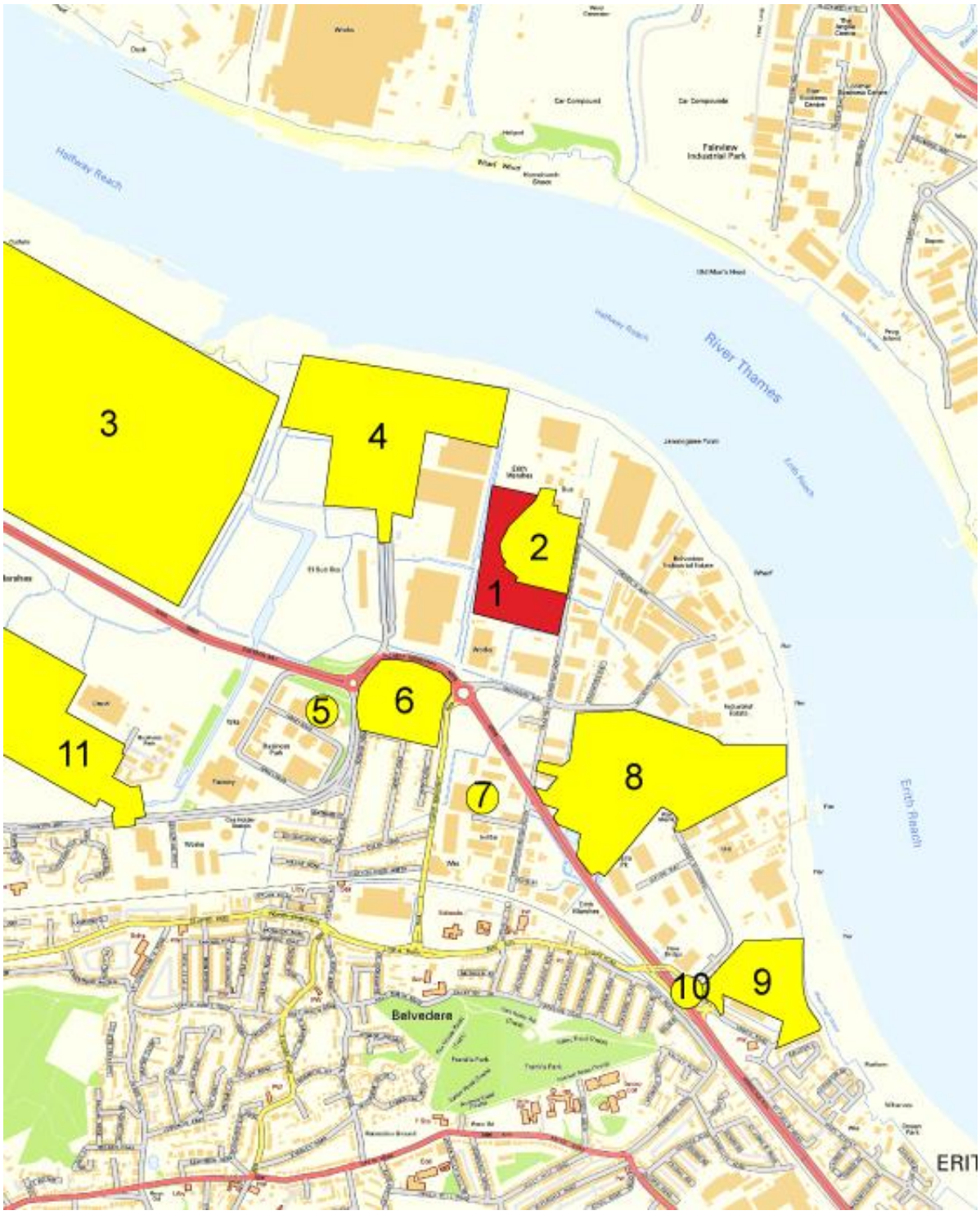

Figure 1: Location of (1) the Alchemy Park site (1) and other selected local sites: (2) Former NuFarm Site (Young *et al.*, 2008a); (3) Crossness (Devoy, 1979) / Crossness Sewage Works (EAW06 - Batchelor *et al.*, 2007a; CXS07 - Batchelor *et al.*, 2007b; CRO11 - Green *et al.*, 2011); (4) Norman Road (NNB06; Batchelor *et al.*, 2008a); (5) North Bexley Drainage Improvements (EWY01; Branch *et al.*, 2004); (6) Imperial Gateway (Batchelor *et al.*, 2008b); (7) Crabtree Manorway South (CXN05; Askew and Spurr, 2006); (8) Pirelli Works (PWR12; Young et al., 2012); (9) Erith Spine Road / Bronze Age Way (Sidell *et al.*, 1996); (10) Corinthian Quay (Corcoran & Lam, 2002); (11) Veridion Park (Green & Batchelor, 2013) *Contains Ordnance Survey data © Crown copyright and database right [2015]*

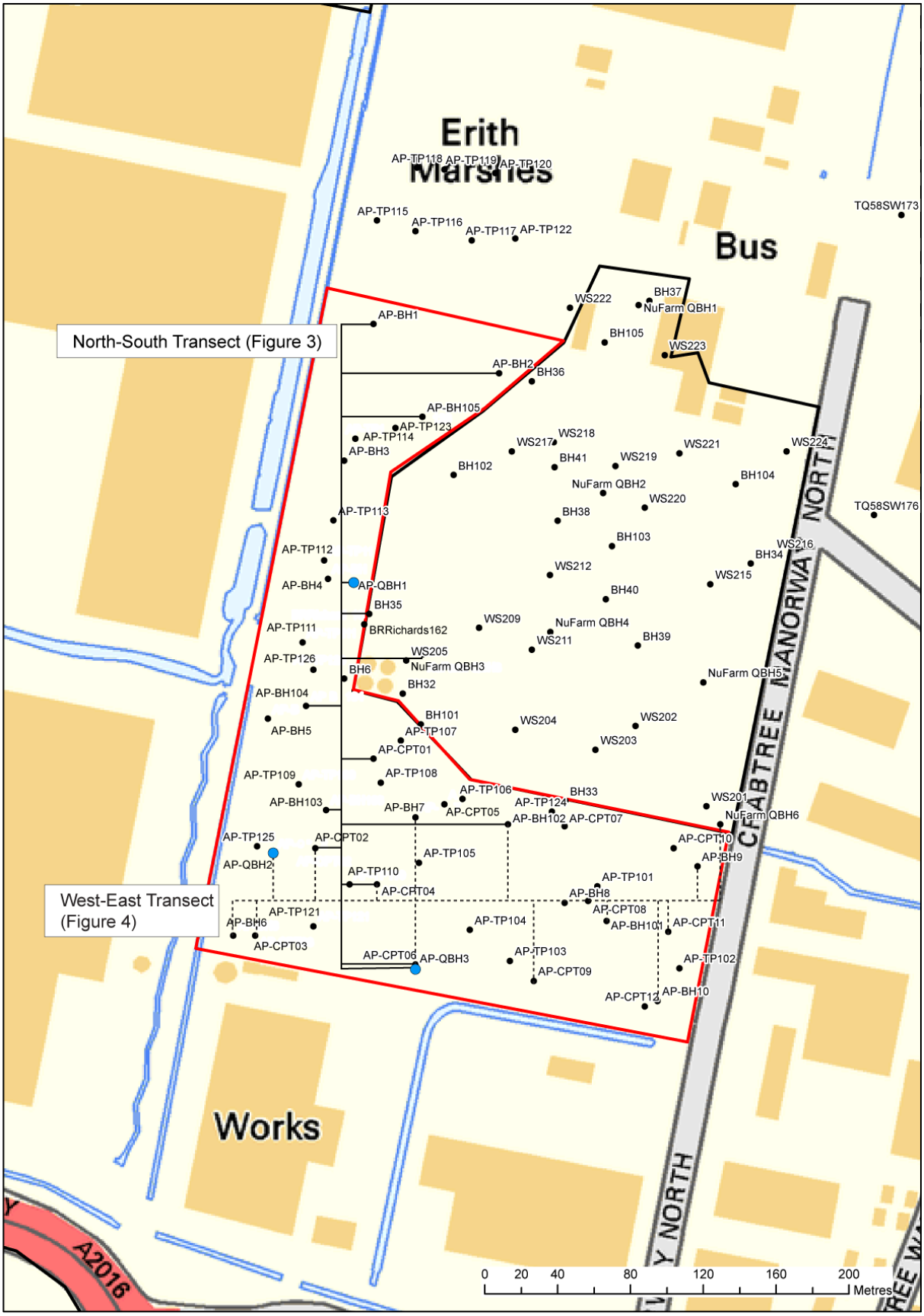

Figure 2: Location of the geoarchaeological boreholes and select recent/historical geotechnical boreholes and test-pits across the Alchemy Park and NuFarm sites, London Borough of Bexley

3. METHODS

3.1 Field investigations and lithostratigraphic descriptions

Three geoarchaeological boreholes (boreholes AP-QBH1 to QBH3) were put down at the site in February 2016 (Figure 2) by Quaternary Scientific. The borehole core samples were recovered using an Eijkelkamp window sampler and gouge set using an Atlas Copco TT 2-stroke percussion engine. This coring technique is a suitable method for the recovery of continuous, undisturbed core samples and provides sub-samples suitable for not only sedimentary and microfossil assessment and analysis, but also macrofossil analysis. The new and historic borehole locations were obtained with reference to site maps and recent topographic surveys (Table 1).

3.2 Deposit modelling

The deposit model was based on a review of 105 borehole and test-pit records, incorporating those from both Alchemy Park, NuFarm, and historical records from around the site (Figure 2; Table 1). West-east and north-south borehole transects were compiled (Figures 3 & 4). Sedimentary units from the boreholes were classified into three groupings: (1) Gravel, (2) Lower Alluvium; (3) Peat; (4) Upper Alluvium and (5) Made Ground. The classified data for groups 1-5 were then input into a database with the RockWorks geological utilities software. Models of surface height were generated for the Gravel, Lower Alluvium, Peat and Upper Alluvium (Figures 5, 6, 8 & 10). Thickness of the Lower Alluvium, Peat, Upper Alluvium, Total Alluvium and Made Ground (Figures 7, 9, 11, 12 & 13) was also modelled (also using a nearest neighbour routine). Because the boreholes are not uniformly distributed over the area of investigation, the reliability of the models generated using RockWorks is variable. In general, reliability improves from outlying areas where the models are largely supported by scattered archival records towards the core area of commissioned boreholes. Because of the 'smoothing' effect of the modelling procedure, the modelled levels of stratigraphic contacts may differ slightly from the levels recorded in borehole logs and section drawings.

As a consequence of this the modelling procedure has been manually adjusted so that only those areas for which sufficient stratigraphic data is present will be modelled. In order to achieve this, a maximum distance cut-off filter equivalent to a 50m radius around each record is applied to all deposit models. In addition, it is important to recognise that multiple sets of boreholes are represented, put down at different times and recorded using different descriptive terms and subject to differing technical constraints in terms of recorded detail including the exact levels of the stratigraphic boundaries. Of the records used in the deposit model, the cores from the boreholes monitored and recorded by Archaeology South East (Turnberry-BH1) and Quaternary Scientific (Lime-QBH2 and QBH3) represent the most detailed record of the sediment sequences.

Table 1: Borehole and select Test-Pit attributes for those records used in the deposit model, Alchemy Park, Crabtree Manorway North, London Borough of Bexley

Name	Easting	Northing	Elevation	Total depth	Top of Upper Alluvium	Top of Peat	Top of Lower Alluvium	Top of Shepperton Gravel	Top of Bedrock	Notes
AP-QBH1	549994	180223	0.9	8	2.37	2.41	5.00			SG not reached; Peat in LA
AP-QBH2	549950	180074	1.5	10	1.1	2.9	6.26			SG not reached
AP-QBH3	550028	180011	1.8	10	1.35	3.15	3.54			SG not reached
AP-BH1	550005	180365	1.6	15	1.6	4.4	6.5	10.3		UA organic rich/peaty 3.4-4.4; 50cm horizon of organic clay within peat (5.3-5.8); LA organic-rich & peaty throughout
AP-BH2	550074	180338	1.35	25	1.5	2.6	4.1	9.4	14.3	LA organic-rich and peaty throughout
AP-BH3	549989	180290	1.2	20	1.3	2.8	4.9	9.4	13.4	LA organic-rich and peaty throughout
AP-BH4	549980	180225	1	15		2.4	6.5	9.3	13.5	UA truncated; 50cm horizon of organic clay within peat (4.3-4.8); LA organic-rich and peaty throughout
AP-BH5	549947	180148	1.3	25	1.3	3.5	4.3	9.3	13.4	LA organic-rich and peaty throughout
AP-BH6	549928	180029	1.5	24	1.2	2.3	3.9	11.9	15.5	LA organic-rich and peaty throughout
AP-BH7	550028	180094	1.59	15	1.2	4.65	6.2	11.6		UA organic rich/peaty 4-4.65; LA organic-rich & peaty throughout; occasional gravel from 9.9m
AP-BH8	550110	180047	1.8	15	1.4	4.5	6.6	11.8		LA organic-rich & peaty throughout; occasional gravel from 9.9m
AP-BH9	550183	180067	1.4	25	0.7	3	5.4	10.8	14.5	UA organic rich/peaty 2.45-3; LA organic-rich & peaty throughout
AP-BH10	550161	179993	1.5	20	1.5		3	12.1		No peat; LA organic-rich/peaty throughout
AP-BH101	550133	180037	1.82	16.7	2.5	5.3	7	11		Peat within LA between 8.8 & 9.5m
AP-BH102	550079	180090	2.13	25	1.9	6.95	8.5	11	19	Peat within LA between 9.2 & 10.10m
AP-BH103	549979	180098	1.52	20	1.55	4.5	6.8	12	16.5	LA contains wood
AP-BH104	549968	180155	1.14	17	0.5	5.45	8.45	9.95	15	
AP-BH105	550032	180314	1.48	21.2	1.4	4	5.5	9.5	14.2	Peat within LA between 8.8 & 9.5m
AP-CPT01	550005	180126	1.15	13				9.8		Gravel surface only reliable height
AP-CPT02	549973	180077	1.5	13				12.7		Gravel surface only reliable height
AP-CPT03	549940	180029	1.3	13				11.6		Gravel surface only reliable height
AP-CPT04	550007	180057	1.6	13				11.9		Gravel surface only reliable height
AP-CPT05	550044	180101	1.4	13				9.8		Gravel surface only reliable height
AP-CPT06	550028	180013	1.8	13				13		Gravel surface only reliable height
AP-CPT07	550110	180089	1.7	13				11.1		Gravel surface only reliable height

AP-CPT08	550123	180048	1.7	13				11.2		Gravel surface only reliable height
AP-CPT09	550093	180004	1.7	13				12.6		Gravel surface only reliable height
AP-CPT10	550170	180077	1.7	13				10.5		Gravel surface only reliable height
AP-CPT11	550167	180031	1.6	13				12		Gravel surface only reliable height
AP-CPT12	550154	179990	1.66	13				12		Gravel surface only reliable height
AP-TP101	550128	180056	1.91	4	1.8	4				
AP-TP102	550173	180011	1.36	5	1	3.05	4.4			
AP-TP103	550080	180015	2.08	5	3.4					
AP-TP104	550058	180032	3.07	2						
AP-TP105	550030	180069	1.65	5	1.2					
AP-TP106	550054	180104	1.49	5	2.8					
AP-TP107	550020	180136	1.29	2.2	2					
AP-TP108	550009	180113	1.36	4.8		3.8				
AP-TP109	549964	180112	1.62	4.7	1.1	4.3				
AP-TP110	549992	180057	1.51	5	1.6	2.7	4.3			
AP-TP111	549966	180190	3.11	3.1						
AP-TP112	549978	180235	4.47	4.5						
AP-TP113	549983	180257	4.6	4.4						
AP-TP114	549995	180302	4.7	4.3						
AP-TP115	550007	180422	11.65	5						
AP-TP116	550028	180416	12.15	5						
AP-TP117	550059	180411	10.1	5						
AP-TP118	550029	180451	15.45	5						
AP-TP119	550044	180450	13.95	4						
AP-TP120	550072	180448	11.85	4.4						
AP-TP121	549972	180034	1.55	5.1		2.3	3.05			
AP-TP122	550083	180412	9.85	5						
AP-TP123	550017	180308	3.4	4	3.7					
AP-TP124	550103	180097	1.7	3.8	1.4					
AP-TP125	549941	180078	1.49	4	1.4	2.6				
AP-TP126	549972	180175	2.1	4	2.2					

4. RESULTS AND INTERPRETATION OF THE LITHOSTRATIGRAPHIC DESCRIPTIONS & DEPOSIT MODELLING

The results of the geoarchaeological borehole descriptions are shown in Tables 2-4. The results of the deposit modelling are displayed in Figures 3 to 11; Figures 3 and 4 are 2-dimensional transect through the two sites from north to south and west to east respectively. Figures 5 to 11 are surface elevation and thickness models for each of the main stratigraphic units. The results of the deposit modelling indicate that the number and spread of the logs is sufficient to permit modelling with a high level across the entire area under investigation

The full sequence of sediments recorded in the boreholes comprises:

Made Ground
Upper Alluvium – widely present
Peat – widely present
Lower Alluvium – widely present, frequently peaty
Gravel (Shepperton Gravel)

4.1 Shepperton Gravel

The Shepperton Gravel was present in all the boreholes that penetrated to the bottom of the Holocene sequence. It was deposited during the Late Glacial (15,000 to 10,000 years before present) and comprises the sands and gravels of a high-energy braided river system which, while it was active would have been characterised by longitudinal gravel bars and intervening low-water channels in which finer-grained sediments might have been deposited. Such a relief pattern would have been present on the valley floor at the beginning of the Holocene when a lower-energy fluvial regime was being established.

The surface of the Shepperton Gravel across the area (Figures 3-5) displays significantly variable relief between -7.5 (AP-BH6) and -11.2m OD (AP-CPT02; AP-CPT06). However, the results suggest a surface that is relatively even across much of the former NuFarm site, and northern part of the Alchemy Park site, ranging between *ca.* -7.5 and -9.0m OD. It is on the southern part of the Alchemy Park site that the gravel surface drops to below -10.5m OD (e.g. AP-BH103; AP-CPT09; AP-BH10) and reaches -11.2m in AP-CPT02 and AP-CPT06 (Figure 2). This is a pattern suggestive of a trough (possible palaeochannel) in this area of the site. The precise orientation and dimensions of this channel are unclear, but it appears to be aligned approximately west-east or northwest-southeast, and measured at least 100m in width and up to 2.2m in depth.

4.2 Lower Alluvium

The Lower Alluvium rests directly on the Shepperton Gravel and was recorded in all records both within and beyond the confines of the channel (Figures 3, 4 and 6). The deposits of the Lower Alluvium are described as a predominantly silty or clayey unit tending to become increasingly sandy downward in most sequences. The Lower Alluvium frequently contains detrital wood or plant

remains, and in many cases is described as organic rich, or peaty, or with traces of peat; in a few of the records (e.g. AP-QBH1, AP-BH7, AP-BH102, AP-103 and AP-105), distinct horizons of peat are recorded measuring up to 90cm in thickness. The surface of the Lower Alluvium (Figure 6) is highly variable, resting between -8m and -2m OD and ranges in thickness from 0m to 9m, but is mainly between 3m and 5m. The thicker occurrences of the Lower Alluvium are present where the surface of the Shepperton Gravel lies at a lower level; almost all the boreholes in which the Lower Alluvium exceeds 5.0m in thickness are situated within the former channel that crosses the southern part of the site. The surface of the Lower Alluvium is also higher within the confines of the channel.

The sediments of the Lower Alluvium are indicative of deposition during the Early to Mid-Holocene, when the main course of the Thames was probably confined to a single meandering channel. During this period, the surface of the Shepperton Gravel was progressively buried beneath the sandy and silty flood deposits of the river. The richly-organic nature of the Lower Alluvium, with evidence of localised and short-lived, probably episodic peat accumulation suggests that this was a period during which the valley floor was occupied by a network of actively migrating channels, with a drainage pattern on the floodplain that was still largely determined by the relief on the surface of the underlying Shepperton Gravel.

4.3 Peat

Overlying the Lower Alluvium across the whole site is a bed of peat, varying in thickness from 0.4m (AP-QBH3) to 5.6m (AP-BH6), but generally between 1.0m and 4.0m thick (Figure 8). The thickest horizons of peat (>2.5m) all occur beyond the confines of the former channel on the NuFarm and northern part of the Alchemy Park site; within the channel, the peat rarely exceeds 2.5m in thickness (AP-QBH2 being the only case- 3.4m of peat recorded). The surface of the peat (Figure 7) is fairly level between -1.0m and -3.0m OD; only in a couple of cases is it recorded at a lower elevation (>-4m OD in AP-BH102, AP-BH104 and NuFarm-QBH4).

The widespread occurrence of this peat indicates a general transition to a more stable valley floor, possibly associated with falling relative sea level and slight incision of the main channel of the Thames, encouraging the development of semi-terrestrial conditions across most of the floodplain. The peat is composed of wood and herbaceous remains indicating that during its accumulation the floodplain supported the growth of sedge fen/reed swamp and woodland communities. At the NuFarm site and on the northern part of the Alchemy Park site, the thicker peat horizons suggest accumulation may have continued for a period of 3000 to 4000 years (on the basis that 1m of peat is approximately equal to 1000 years). However, peat formation is considered to have commenced both later and for a shorter period of time within the confines of the channel. This is because of the higher surface elevation of the Lower Alluvium recorded here (Figure 6), indicating that the channel was still active at the time when peat began to accumulate beyond its margins. The thinner nature of the peat also suggests it accumulated for a much shorter period of time.

4.4 Upper Alluvium

The uppermost unit in the Holocene alluvial sequence is the Upper Alluvium, the deposits of which comprise largely sterile clays and silty clays. The Upper Alluvium generally ranges between 1 and 3m in thickness, but occasionally reaches up to 5m (e.g. AP-BH102 and AP-BH105). The deposition of the Upper Alluvium had the effect of infilling the remaining inequalities in the relief of the floodplain, so that the surface of the Upper Alluvium (Figure 9) is remarkably level between +0.5m and -0.1m OD.

The Upper Alluvium is typical of the mineral-rich sediments that are present as the uppermost element of the Holocene sequence beneath most floodplains in southern and south-east England. It is generally considered to reflect increased sediment loads resulting from intensification of agricultural land use from the later prehistoric period onward, combined with the effects of rising sea level.

4.5 Made Ground

Between 1 and 5m of Made Ground caps the Holocene alluvial sequence (Figure 11).

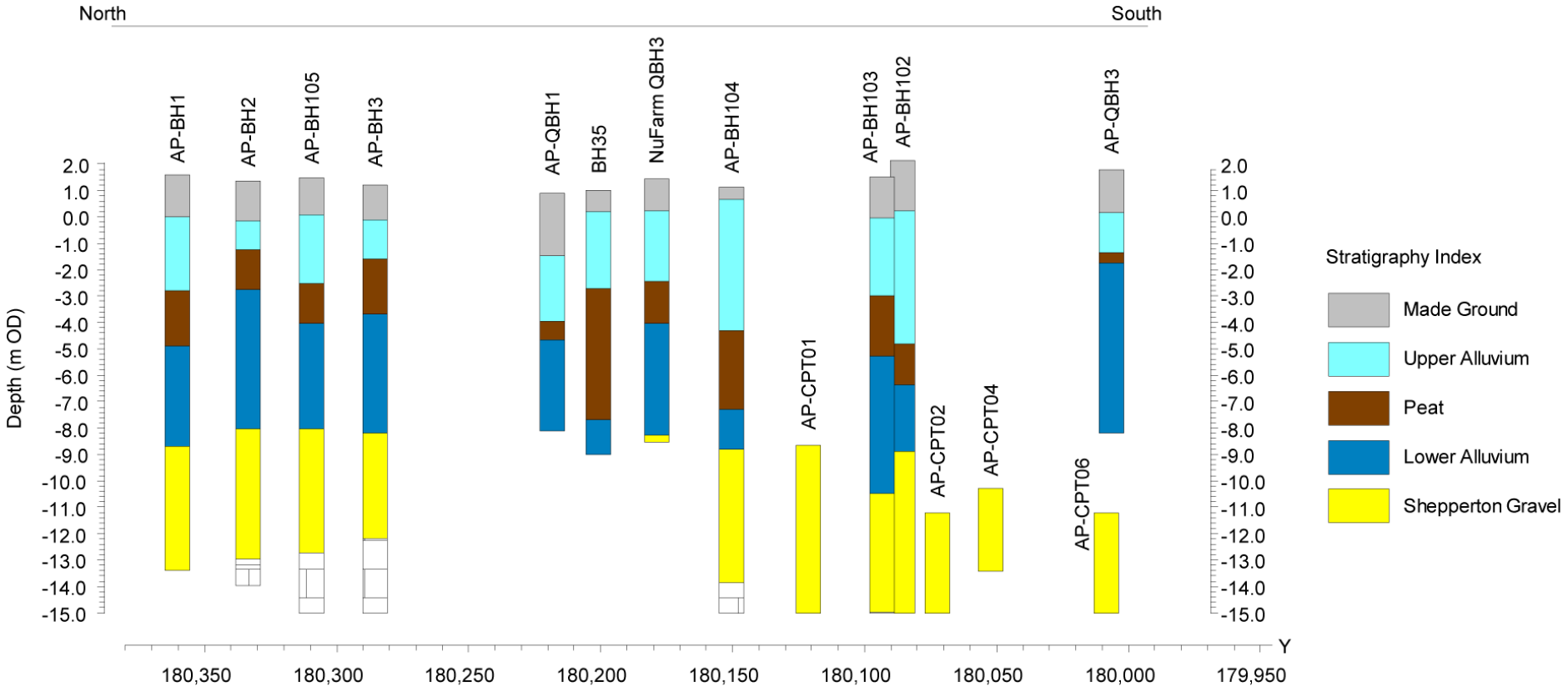

Figure 3: North-South transect of selected boreholes across Alchemy Park, Crabtree Manorway North, London Borough of Bexley

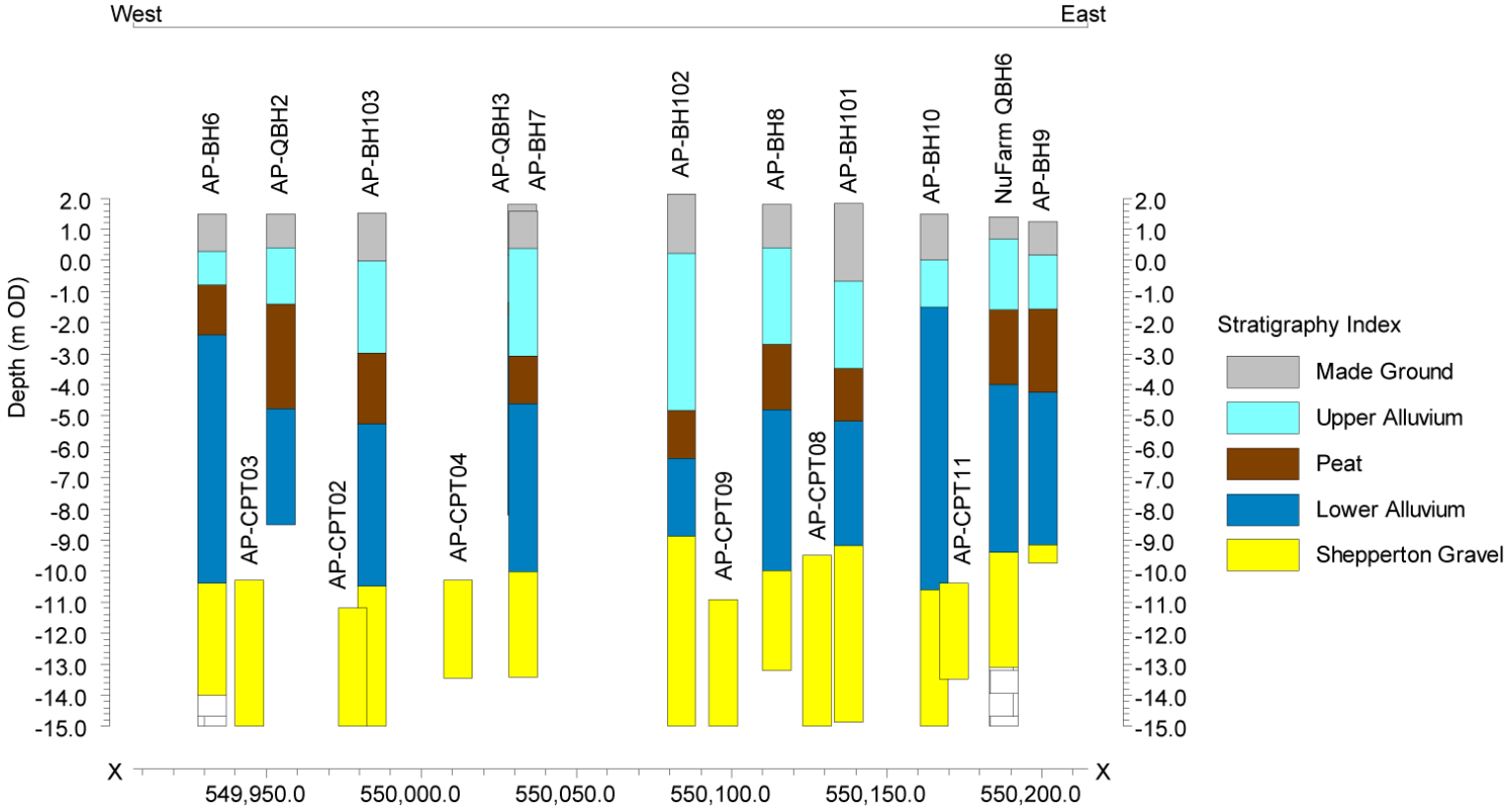

Figure 4: West-East transect of selected boreholes along the potential palaeochannel on the southern half of Alchemy Park, Crabtree Manorway North, London Borough of Bexley

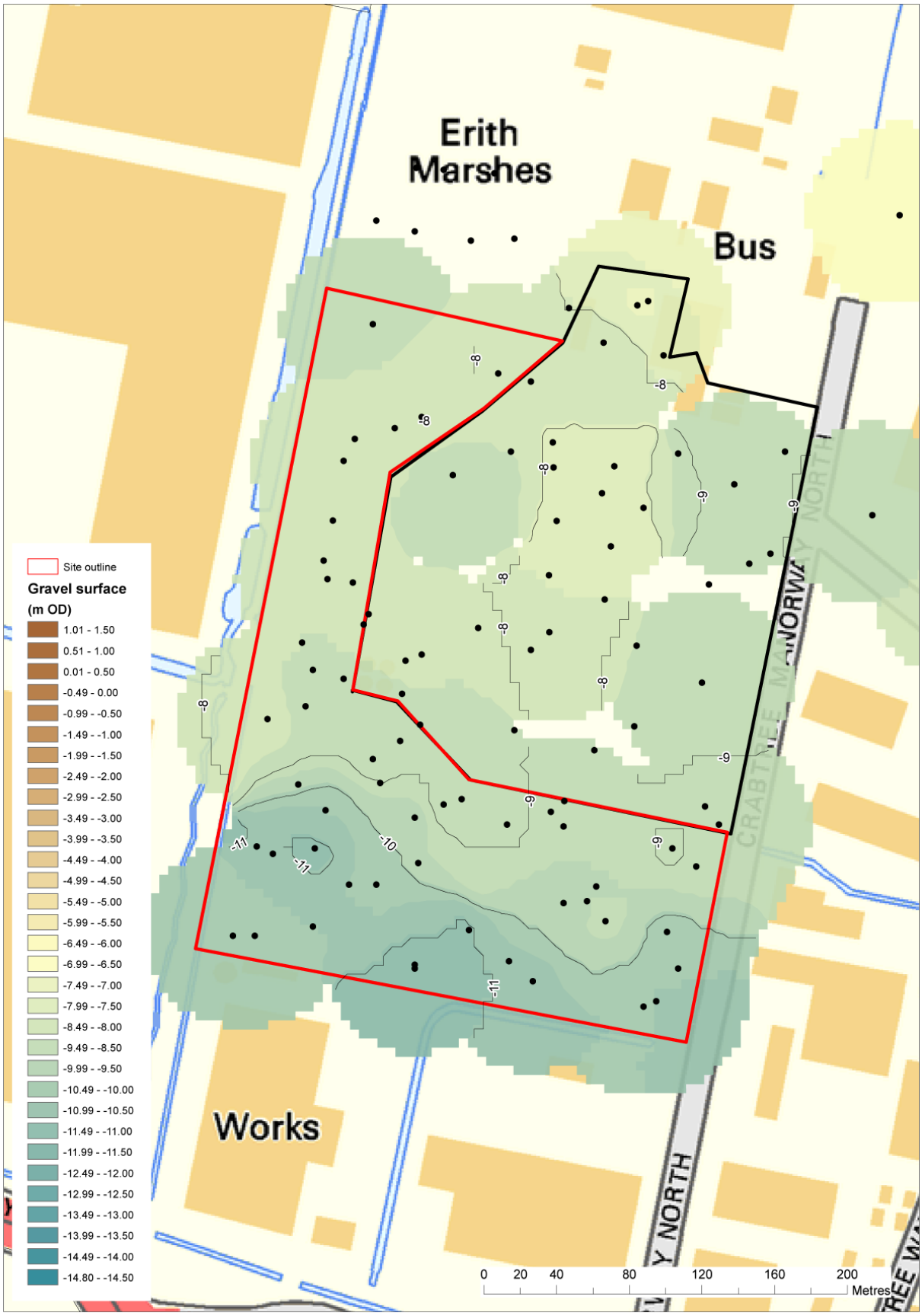

Figure 5: Top of the Shepperton Gravel (m OD) (site outline in red)

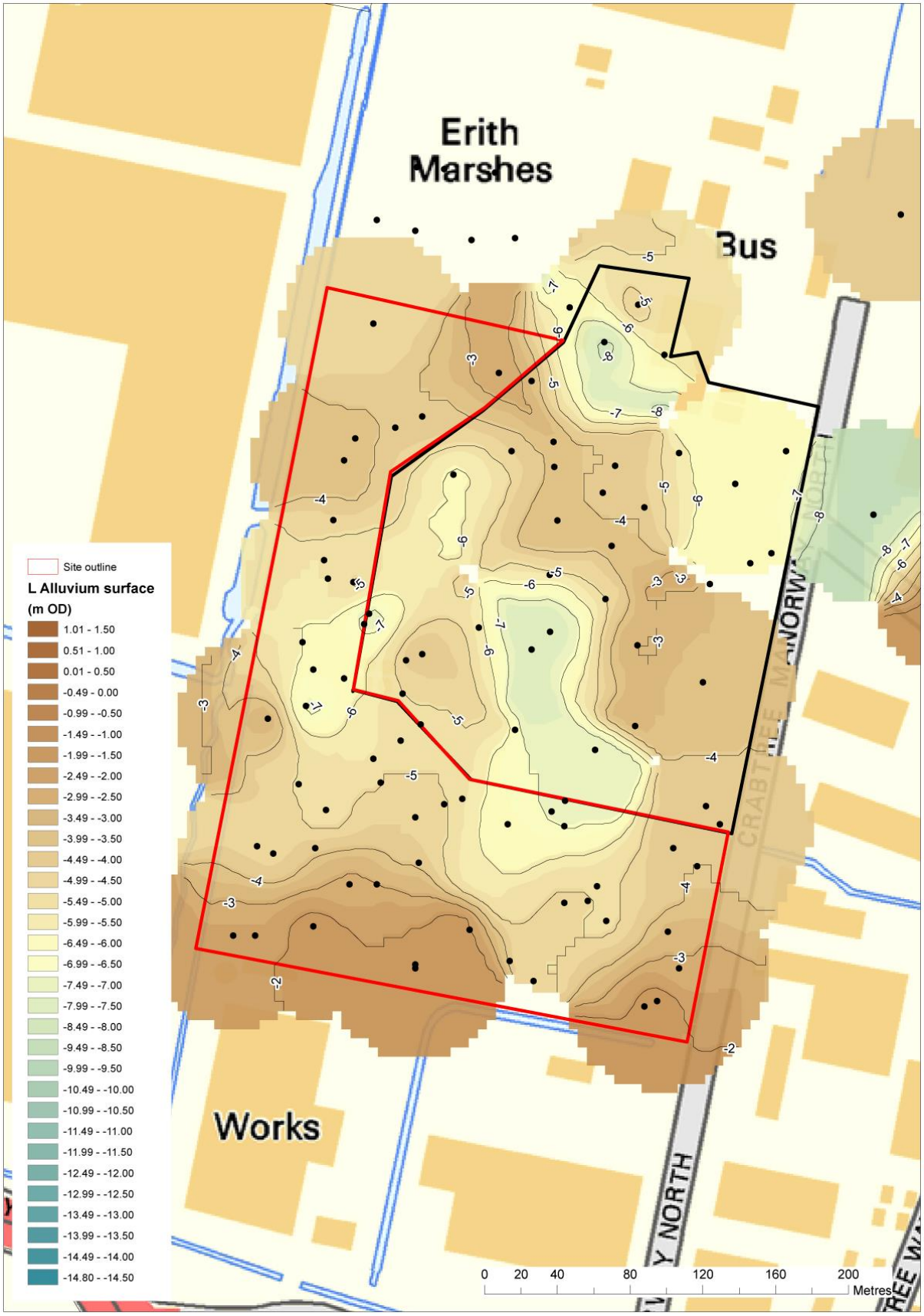

Figure 6: Top of the Lower Alluvium (m OD) (site outline in red)

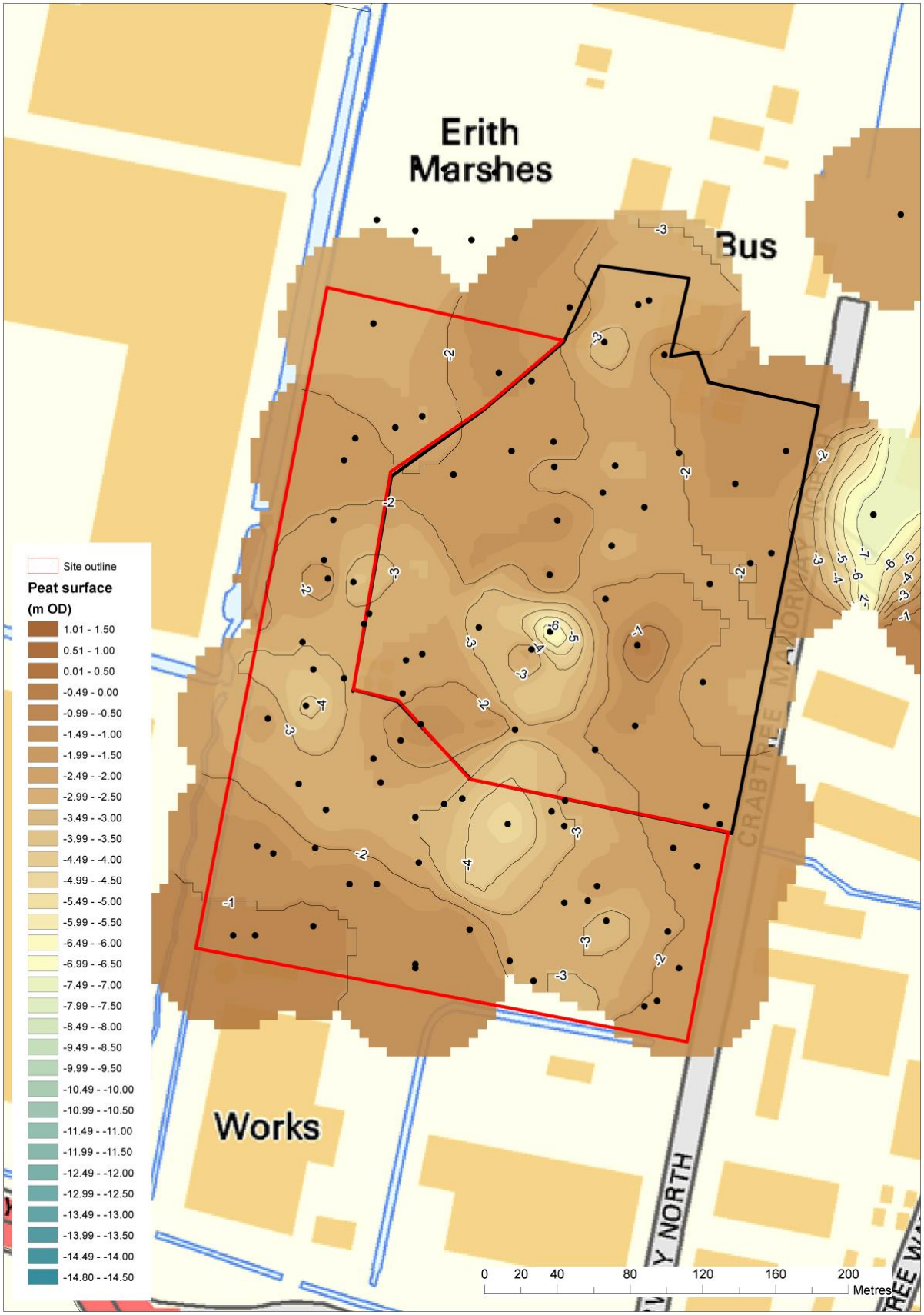

Figure 7: Top of Peat (m OD) (site outline in red)

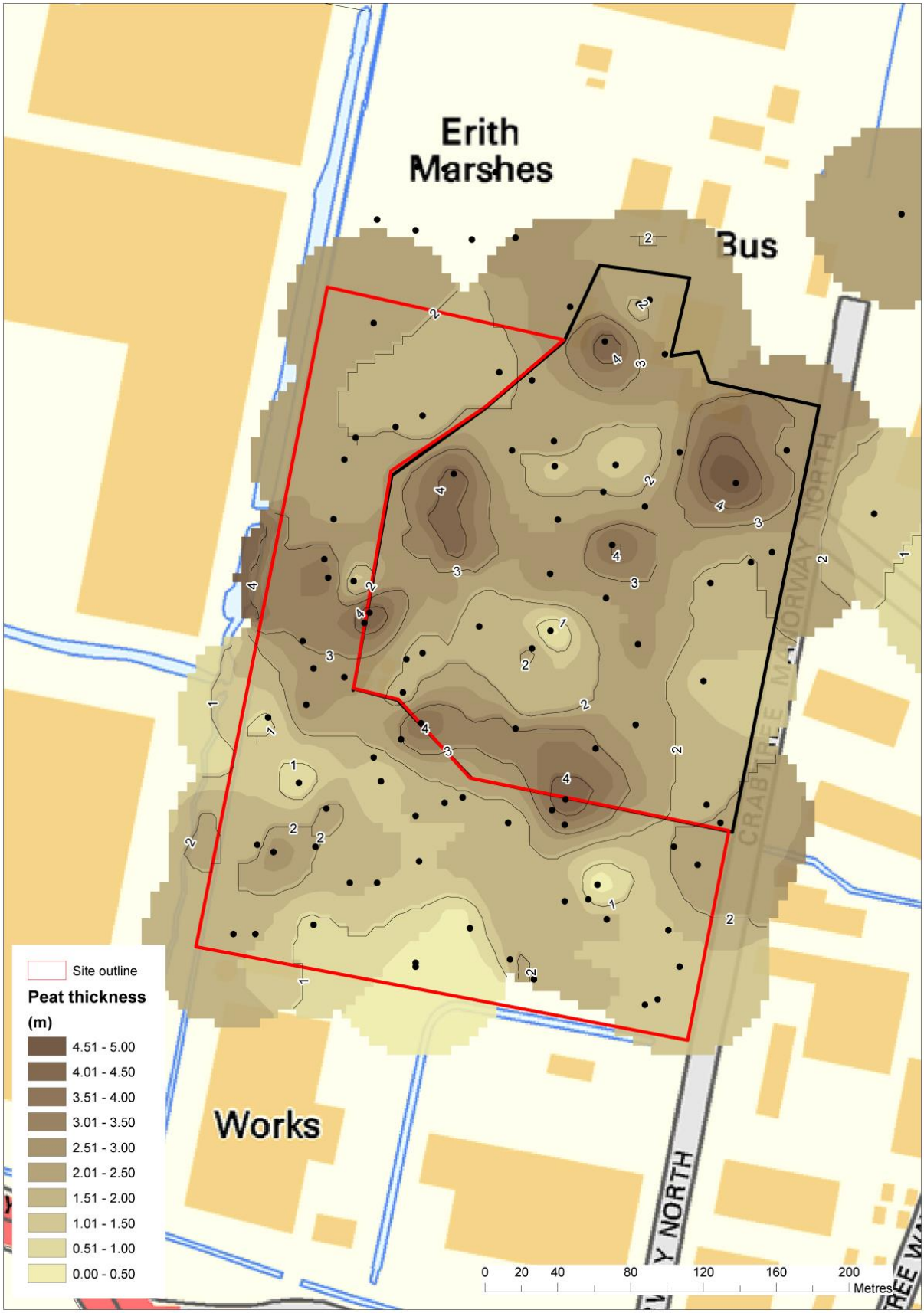

Figure 8: Thickness of Peat (m) (site outline in red)

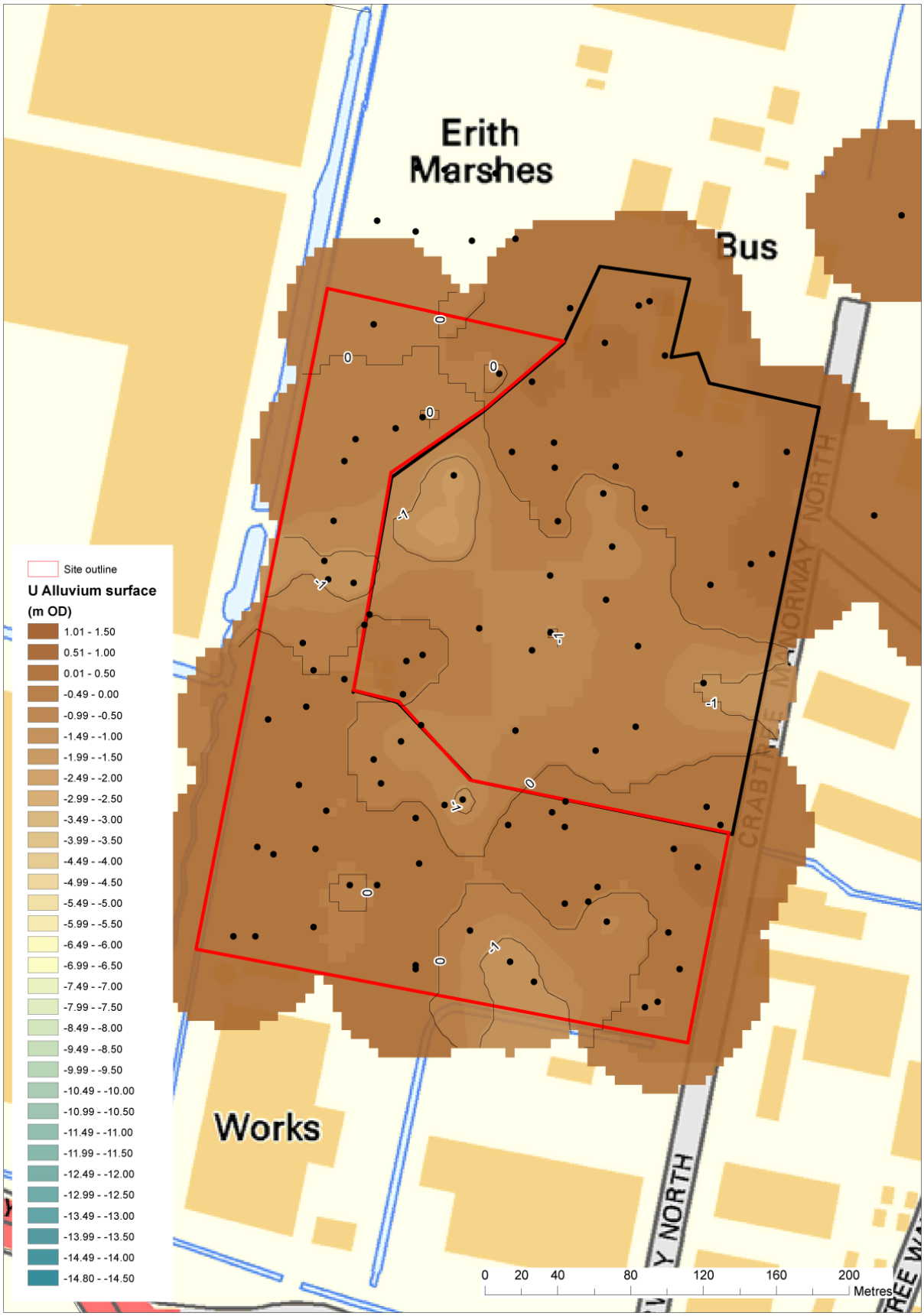

Figure 9: Top of the Upper Alluvium (m OD) (site outline in red)

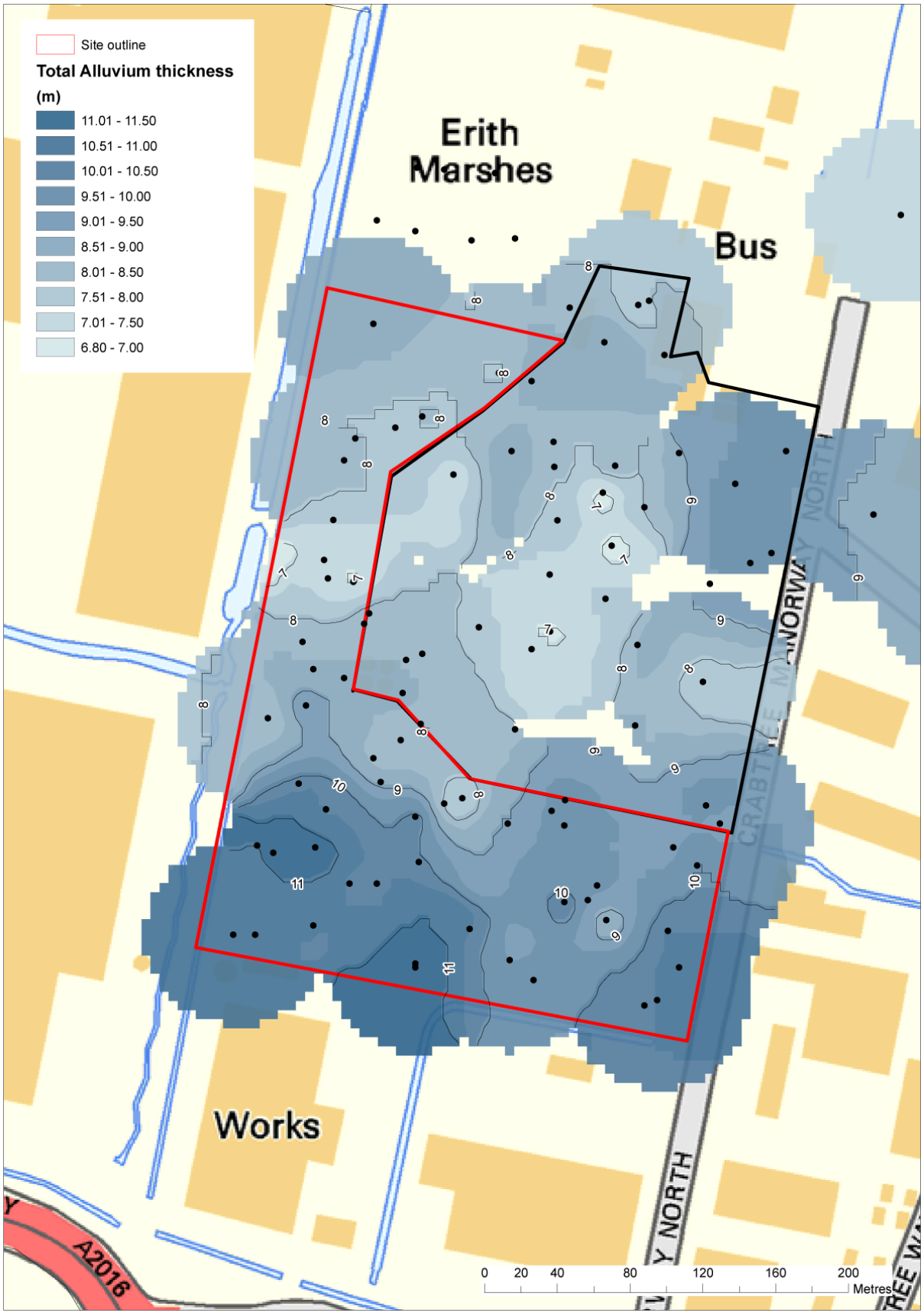

Figure 10: Thickness of Total Alluvium (m) (site outline in red)

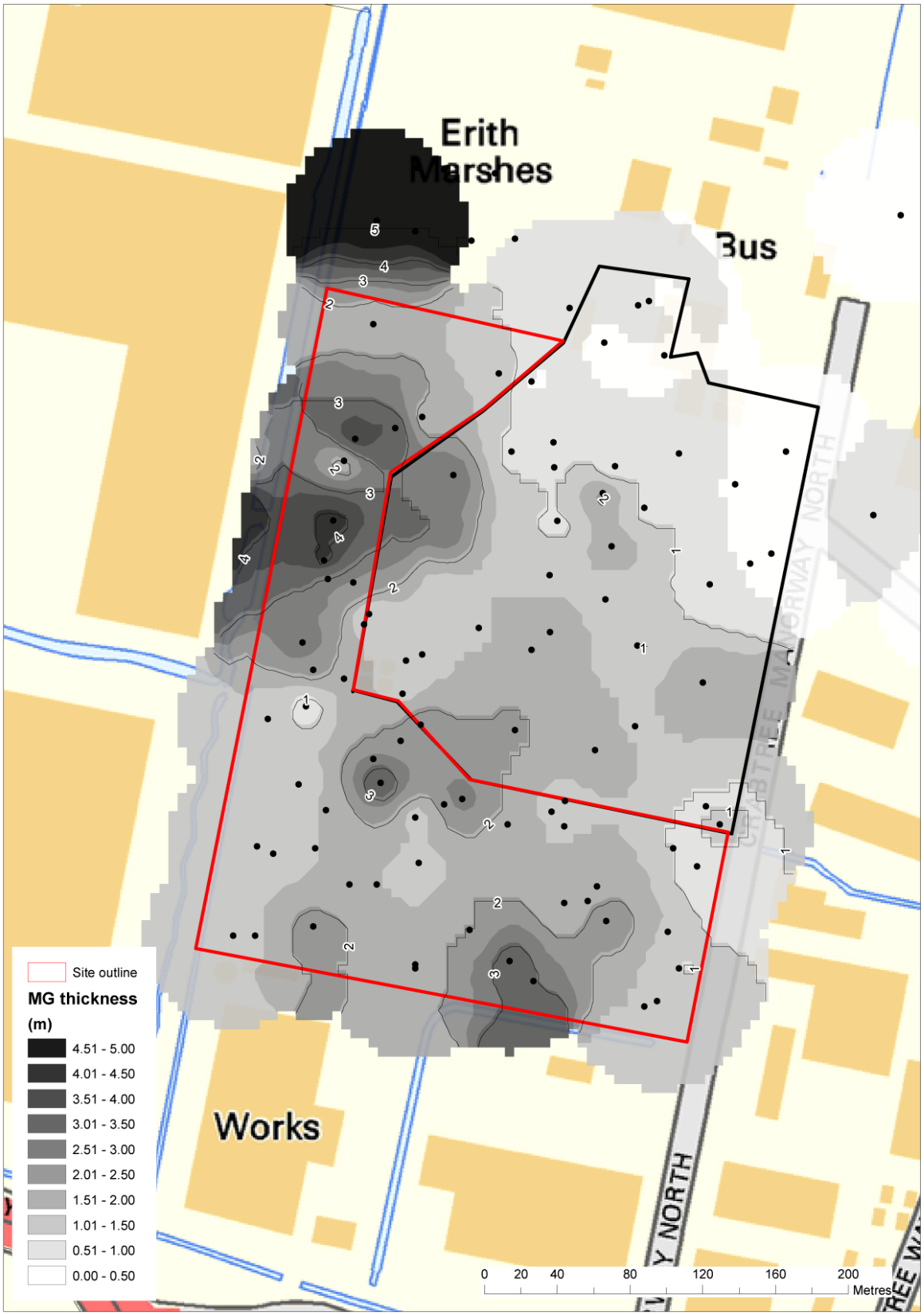

Figure 11: Thickness of Made Ground (m) (site outline in red)

Table 2: Lithostratigraphic description of borehole AP-QBH1, Alchemy Park, Crabtree Manorway North, London Borough of Bexley

Depth (m OD)	Depth (m bgs)	Description	Stratigraphic group
0.90 to -0.70	0 to 1.60	Made ground	MADE GROUND
-0.70 to -1.10	1.60 to 2.00	Gley 2 6/1; As3, Ag1; Bluish grey silty clay	UPPER ALLUVIUM
-1.10 to -1.51	2.00 to 2.41	10YR 4/1; As3, Ag1; Dark grey silty clay with traces of organic matter; sharp contact into:	
-1.51 to -2.01	2.41 to 2.91	10YR 2/1; Sh2, Tl[1]1, Ag1; Humo 2-3; Black moderately humified silty wood peat; diffuse contact into:	PEAT
-2.01 to -2.81	2.91 to 3.71	UNRECOVERED	
-2.81 to -2.95	3.71 to 3.85	10YR 3/2; Ag2, Sh1, Tl[1]1; Humo 2; Very dark greyish brown moderately humified silty wood peat; sharp contact into:	
-2.95 to -3.86	3.85 to 4.76	10YR 2/1; Sh2, Tl[1]1, Ag1; Humo 2-3; Black moderately humified silty wood peat; diffuse contact into:	
-3.86 to -3.96	4.76 to 4.86	10YR 4/1; Ag3, Sh1; Dark grey organic-rich silt with traces of detrital plant remains; sharp contact into:	
-3.96 to -4.10	4.86 to 5.00	10YR 3/2; Sh2, Tl[2]1, Th[2]1; Humo 2; Dark grey moderately humified wood and herbaceous peat;	
-4.10 to -5.10	5.00 to 6.00	Gley 1 4/10Y; Ag2, As2; Dark greenish grey silty clay with traces of detrital plant remains and sand; diffuse contact into:	LOWER ALLUVIUM
-5.10 to -6.78	6.00 to 7.68	Gley 1 4/10Y; Ag2, As1, Dl1; Dark greenish grey silty clay with detrital wood and traces of Mollusca; large fragment of wood recorded between 7.25 and 7.36m bgl; diffuse contact into:	
-6.78 to -6.91	7.68 to 7.81	Gley 1 5/10Y; Ag2, Sh1, Dh1; Greenish grey organic-rich silt with detrital plant remains; sharp contact into:	
-6.91 to -7.10	7.81 to 8.00	10YR 2/1; Ag2, Sh2; Black organic-rich silt with traces of wood and herbaceous peat.	

Table 3: Lithostratigraphic description of borehole AP-QBH2, Alchemy Park, Crabtree Manorway North, London Borough of Bexley

Depth (m OD)	Depth (m bgs)	Description	Stratigraphic group
1.50 to 0.40	0 to 1.10	Made Ground	MADE GROUND
0.40 to -0.50	1.10 to 2.00	Gley 2 6/1; As3, Ag1; Bluish grey silty clay; diffuse contact into:	UPPER ALLUVIUM
-0.50 to -0.90	2.00 to 2.40	10YR 5/1; As3, Ag1; Grey silty clay; sharp contact into:	
-0.90 to -1.40	2.40 to 2.90	10YR 5/2; Ag2, As1, Sh1; Greyish brown organic-rich clayey silt; unknown contact into:	
-1.40 to -2.50	2.90 to 4.00	2.5YR 2.5/1; Sh3, $Th^2$1; Humo 2-3; Reddish black well humified herbaceous peat;	PEAT
-2.50 to -3.09	4.00 to 4.59	10YR 4/1; Ag2, As1, Ga1; Dark grey sandy clayey silt with detrital wood inclusions; diffuse contact into:	
-3.09 to -3.50	4.59 to 5.00	10YR 3/1; Sh2, Ag1, $Tl^2$1; Humo 2; very dark grey silty moderately humified wood peat, with silty peat between 4.85 and 5.00m bgl;	
-3.50 to -4.50	5.00 to 6.00	UNRECOVERED	
-4.50 to -4.76	6.00 to 6.26	10YR 3/1; Sh2, Ag1, $Tl^2$1; Humo 2; very dark grey silty moderately humified wood peat, with silty peat between 4.85 and 5.00m bgl;	
-4.76 to -5.01	6.26 to 6.51	Gley 1 4/10Y; Ag3, Dl1; Dark greenish grey silt and detrital wood with traces of clay; diffuse contact into:	LOWER ALLUVIUM
-5.01 to -5.31	6.51 to 6.81	Gley 1 4/10Y; Ag3, As1; Dark greenish grey clayey silt with traces of sand; finely bedded; diffuse contact into:	
-5.31 to -6.50	6.81 to 8.00	Gley 1 3/10Y; Ga2, Ag2; Very dark greenish grey silty sand with traces of detrital plant remains; finely bedded; diffuse contact into:	
-6.50 to -8.50	8.00 to 10.00	Gley 1 4/10Y; Ga3, Ag1; Dark greenish grey silty sand with traces of detrital plant remains; finely bedded	

Table 4: Lithostratigraphic description of borehole AP-QBH3, Alchemy Park, Crabtree Manorway North, London Borough of Bexley

Depth (m OD)	Depth (m bgs)	Description	Stratigraphic group
1.80 to 0.45	0 to 1.35	Made Ground	MADE GROUND
0.45 to 0.15	1.35 to 1.65	10YR 5/3; As3, Ag1; Brown silty clay with iron staining; sharp contact into:	UPPER ALLUVIUM
0.15 to -0.20	1.65 to 2.00	Gley 2 6/1; As3, Ag1; Bluish grey silty clay	
-0.20 to -1.20	2.00 to 3.00	UNRECOVERED	
-1.20 to -1.74	3.00 to 3.54	10YR 2/1 Sh3, $Th^2$2; Humo 2; Black well-humified herbaceous peat with traces of wood peat; sharp contact into:	PEAT
-1.74 to -2.20	3.54 to 4.00	Gley1 4/10Y; Ag3, As1; Dark greenish grey clayey silt with traces of detrital plant remains; diffuse contact into:	LOWER ALLUVIUM
-2.20 to -3.60	4.00 to 5.40	Gley 1 4/5GY; Ga2, Ag1, Dl1; Dark greenish grey silty sand and detrital wood with inclusions of detrital plant remains; sharp contact into:	
-3.60 to -5.54	5.40 to 7.34	Gley 1 3/10Y; Ga3, Ag1; Very dark greenish grey silty sand; diffuse contact into:	
-5.54 to -6.20	7.34 to 8.00	Gley1 4/10Y; Ga3. Dl1; sand with detrital wood and traces of silt; diffuse contact into:	
-6.20 to -7.20	8.00 to 9.00	UNRECOVERED	
-7.20 to -8.20	9.00 to 10.00	Gley1 4/10Y; Ga4; Dark greenish grey sand with traces of silt and detrital plant remains	

5. DISCUSSION

The results of the deposit modelling indicate that the sediments recorded at the Alchemy Park and NuFarm sites are similar to those recorded elsewhere in the Lower Thames Valley, with Late Devensian Shepperton Gravel overlain by a sequence of Holocene alluvial sediments, including two peat horizons, and buried beneath modern Made Ground. At the site and within its immediate vicinity, the principal relief feature of the Shepperton Gravel surface is a large linear depression extending west to east or north-west to south-east on the southern part of the site, with the Shepperton Gravel surface recorded at its lowest at a level of -11.2m OD.

In order to place the findings of this investigation in a wider regional context, the modelling procedures carried out have been extended to cover a larger area of the local Thames floodplain, including locations where previous similar geoarchaeological investigations have been undertaken (see Figure 1). The results of this wider-scale investigation are presented as a contour model of the Shepperton Gravel surface (Figure 12). The surface of the Shepperton Gravel is chosen as the basis for this wider regional evaluation because the relief features present on that surface are widely understood to have strongly influenced patterns of sedimentation on the Thames floodplain throughout the Holocene, and to have had a significant impact on the topography of prehistoric land surfaces. It is highlighted that the larger area has been modelled at a coarser resolution (100m as opposed to 50m radius from each borehole) and due to the absence of records in certain areas, the coverage of the model is incomplete.

Whilst the deep palaeochannel and its northern bank were identified on the Alchemy Park site, its southern bank lay beyond the margins of the site, and thus its width could not be established. Unfortunately the coverage of the wider model is incomplete immediately south of Alchemy Park, however, the channel would appear to be a maximum of 100-200m wide on the basis that the Shepperton Gravel surface is recorded at above -9m OD on the Imperial Gateway (Batchelor *et al.*, 2008b) and Pirelli Works (Young *et al.*, 2008b) sites. Extrapolating the orientation and origin of the channel is also restricted by the lack of coverage, however it would appear to be part of a wider pattern of probable drainage lines radiating from a more elevated part of the Shepperton Gravel surface identified during investigation of the Veridion Park site to the west (Batchelor and Green, 2013), whilst a deep embayment around Belvedere Industrial Estate suggest its confluence with the Thames at this point. Other deep depressions identified within the modelled area, include two which are orientated approximately north-south across the Pirelli Works site (Young et al., 2008b). The gravel surface at the base of these features however, is recorded at approximately -8m OD, indicating they are substantially less significant than that recorded at Alchemy Park (-11.2m OD).

Beyond the margins of the channels, the Shepperton Gravel surface generally lies around 7-8m OD, sloping downwards towards the Thames in a northern and eastern direction as might be expected. Two significantly high areas resting at -5m OD can be identified however, and such locations may have a greater potential to contain evidence of human activity. The first of these areas is located approximately 500m south of Imperial Gateway and most likely represents the edge of the Lower Thames Valley floodplain. The second is located approximately 400m north-

west of the Alchemy Park site. In this case, the elevated surface is questionable as it is represented by only a single borehole.

Following the deposition of the Shepperton Gravel, active fluvial processes dominated much of the Lower Thames Valley floodplain resulting in the deposition of the Lower Alluvium. In many places across the modelled area, peat formed either prior to, or during accumulation of the Lower Alluvium. When peat formed prior to the accumulation of the Lower Alluvium, it most frequently occurred in depressions in the Shepperton Gravel surface, but extended upward where gentle slopes afforded suitable conditions. The Lower Alluvium buries the Lower Peat and substantially infills the depressions in the surface of the Shepperton Gravel; but it also spreads, sometimes quite thickly, onto the higher areas of the gravel surface. It would appear therefore to have been an aggradational accumulation.

There are relatively few localities where the Lower Alluvium is missing, and resting on it almost everywhere is a bed of peat which is recorded in the vast majority of boreholes evaluated in the mapped area. The presence of peat represents evidence of a transition to a semi-terrestrial environment, and the records of detrital wood and *in situ* tree remains (Spurrell 1889; Whitaker 1889; Batchelor *et al*., 2007b, 2008a) indicate that wetland woodland was present at least locally on the floodplain. The thickness of the peat recorded at Alchemy Park and elsewhere across most of the mapped area, mainly between 1.0m and 3.0m indicates that the process of peat accumulation was taking place over a period of at least 3000 years (assuming accumulation occurs at a rate of approximately 1000 years per 1m of Peat). At the Imperial Gateway site (Batchelor *et al* 2008b), towards the eastern edge of the mapped area, peat accumulation was radiocarbon dated to 7160-6900 cal BP (late Mesolithic) at the base of the peat at a level of -6.24m OD and to 3840-3640 cal BP (Bronze Age near the top of the peat at a level of -1.23m OD. A similar range of dates is recorded at the Crossness Sewage Works (Batchelor *et al*., 2007a), Norman Road (Batchelor *et al.*, 2008a) and Pirelli Works (Young *et al*., 2008b) sites and could be expected for accumulation of the main peat at the Alchemy Park site.

The Upper Alluvium which overlies the Peat across the whole of the mapped area represents a transition from semi-terrestrial to alluvial/estuarine conditions, and was most likely brought about by a regional increase in the rate of relative sea level rise (Sidell, 2003). Figure 11 represents the very low relief pattern of the Upper Alluvium across the Alchemy Park and NuFarm sites and by comparison with Figure 10 indicates the way in which Holocene alluviation has very effectively masked the inequalities that were present on the surface of the Shepperton Gravel at the beginning of the Holocene period.

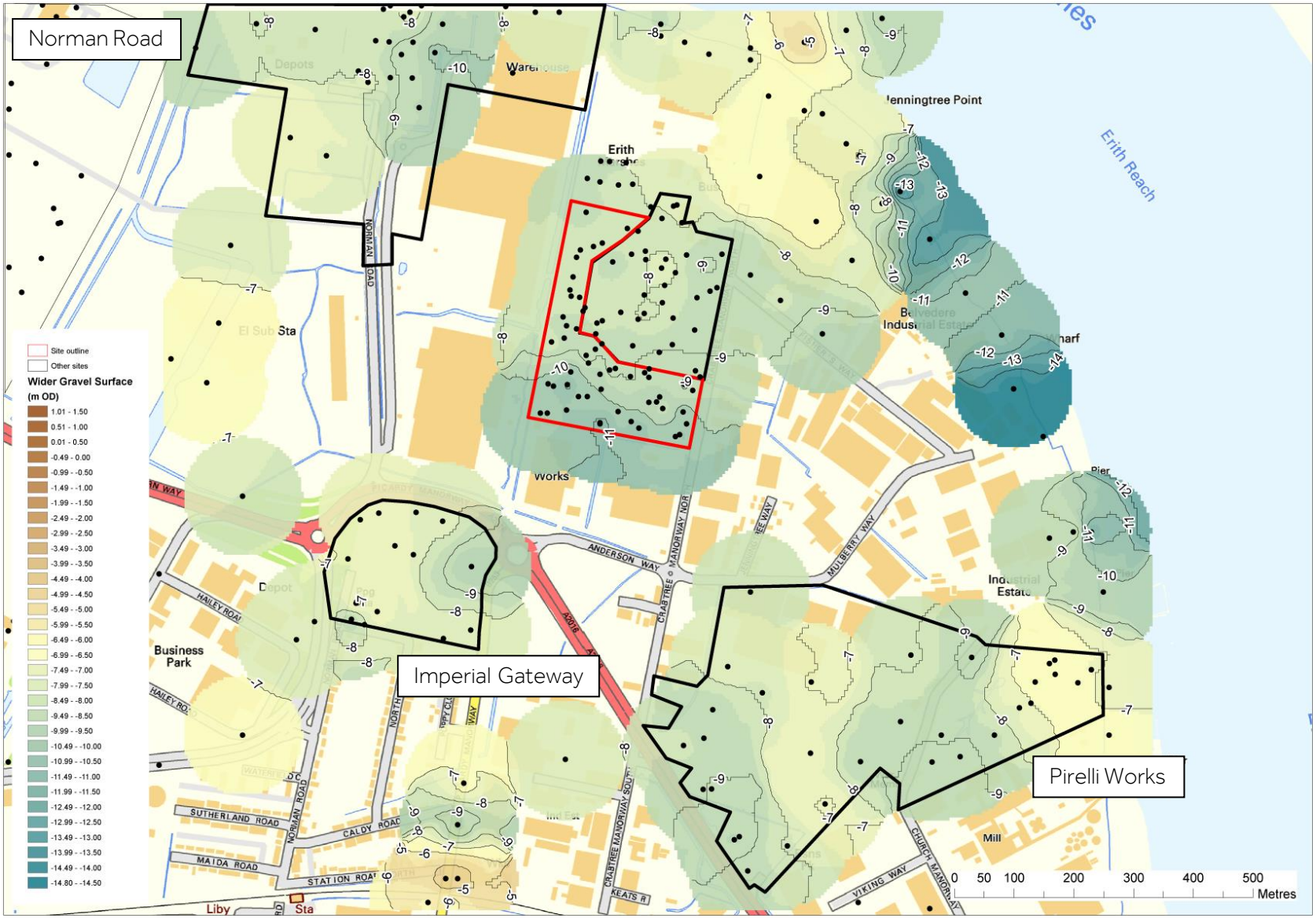

Figure 12: Surface of the Shepperton Gravel across the wider area surrounding the Alchemy Park and NuFarm sites

6. CONCLUSIONS AND RECOMMENDATIONS

The aims of the geoarchaeological investigations at the Alchemy Park site were: (1) to clarify the nature of the sub-surface stratigraphy across the site, (2) to clarify the nature, depth, extent and date of any alluvium and peat deposits, and (3) to evaluate the potential for reconstructing the environmental history of the site and its environs (aims 3 to 5 of the project). In order to achieve these aims, a programme of deposit modelling of the surface elevation and thickness of the major stratigraphic units at the site was carried out, incorporating previous geotechnical borehole descriptions and records from three new geoarchaeological boreholes.

The results have confirmed that the site is located on a Shepperton Gravel surface resting between -7.5 and -9m OD. On the southern part of the site however, a west-east or northwest-southeast orientated deep trough (probable palaeochannel) is recorded. The channel is cut into the Shepperton Gravel surface, estimated to measure between 100 and 200m in width and *ca*. 2.5 in depth. A tripartite sequence of Lower Alluvium, Peat and Upper Alluvium infills the potential palaeochannel, and surrounding higher gravel surface. The sequences represented in the Alchemy Park geoarchaeological boreholes have good potential to provide detailed reconstructions of landscape change, potentially including evidence of human activity. Currently, the date of these deposits is unknown, but on the basis of sequences recorded nearby, these are likely to have accumulated from the late Mesolithic to Bronze Age periods (spanning up to 4000 years).

The results of the investigation thus demonstrate considerable variation in the height of the Shepperton Gravel, and the type and thickness of the subsequent Holocene deposits. Such variations are significant as they represent different environmental conditions that would have existed in a given location. For example: (1) the substantial variations in the surface of the gravel recorded here appear to represent the edge of a palaeochannel; (2) the Peat recorded represents a former semi-terrestrial land surface, and (3) fine tomedium grained sediments such as sands, silts and clays represent periods of flooding and/or colluvial inwash. Thus studying the sub-surface deposits of the site has enabled us to start building our understanding of the former landscapes and environmental changes that took place over both space and time across the site.

Due to the depth of the sediments, the archaeological potential of the site is considered to be low. However, even in the absence of the archaeological remains, the sediments have the potential to contain a wealth of further information on the past landscape, through the assessment/analysis of palaeoenvironmental remains (e.g. pollen, plant macrofossils and insects) and radiocarbon dating. So called environmental archaeological or palaeoenvironmental investigations can identify the nature and timing of changes in the landscape, and the interaction of different processes (e.g. vegetation change, human activity, climate change, hydrological change) thereby increasing our knowledge and understanding of the site and nearby area. In the case of human activity, palaeoenvironmental evidence can include: (1) decreases in tree and shrub pollen suggestive of woodland clearance; (2) the presence of herbs indicative of disturbed ground, pastoral and/or arable agriculture; (3) charcoal/microcharcoal suggestive of anthropogenic or natural burning, and (4) insect taxa indicative of domesticated animals. Such investigations are routinely carried out

where required as part of planning conditions across the Lower Thames Valley and its tributaries, instructed by the LPA Archaeological Advisor. It is recommended that an assessment of two borehole sequences is carried out, with the main aim of establishing the varying dates of peat formation/cessation across the site and assessing the palaeoenvironmental potential of these sequences.

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8. APPENDIX 1: OASIS

OASIS ID: quaterna1-245451

Project details

Project name	Alchemy Park, Crabtree Manor Way North, Bexley
Short description of the project	Three geoarchaeological boreholes were put down across the site and combined with over 100 geotechnical records to provide a detailed deposit model for the site. The results reveal a deep west-east orientated palaeochannel on the southern part of the site cut into the river terrace gravels. A sequence of alluvial and peat sediments overlies the gravels, capped by made ground. The peat is likely to date from the late Mesolithic to Bronze Age period and has good potential for providing a reconstruction of the environmental history of the site and elucidating evidence for human activity.
Project dates	Start: 01-02-2016 End: 11-03-2016
Previous/future work	No / Yes
Any associated project reference codes	ALY16 - Sitecode
Type of project	Environmental assessment
Monument type	PEAT Late Prehistoric
Significant Finds	PEAT Late Prehistoric
Survey techniques	Landscape

Project location

Country	England
Site location	GREATER LONDON BEXLEY BEXLEY Alchemy Park
Postcode	DA17 1AX
Study area	4 Hectares
Site coordinates	TQ 550000 185010 50.944507274775 0.206628764437 50 56 40 N 000 12 23 E Point

Project creators

Name of Organisation	Quaternary Scientific (QUEST)
Project brief originator	Consultant
Project design originator	Dr C.R. Batchelor
Project director/manager	C.R. Batchelor
Project supervisor	C.R. Batchelor
Type of sponsor/funding body	Developer

Project archives

Physical Archive	No

Exists?	
Digital Archive Exists?	No
Paper Archive recipient	LAARC
Paper Media available	"Report"

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Alchemy Park, Crabtree Manorway North, London Borough of Bexley: Geoarchaeolgoical fieldwork and deposit model report
Author(s)/Editor(s)	Batchelor, C.R.
Author(s)/Editor(s)	Green, C.P.
Author(s)/Editor(s)	Young, D.S.
Other bibliographic details	Quaternary Scientific (QUEST) Unpublished Report March 2016; Project Number 201/15
Date	2016
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Entered by	Rob Batchelor (c.r.batchelor@reading.ac.uk)
Entered on	11 March 2016