



**UK HOLOCAUST MEMORIAL
Victoria Tower Gardens
London SW1P**

City of Westminster

Report on geotechnical monitoring of geotechnical work

June 2019



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Victoria Tower Gardens
Westminster
SW1P**

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Site Code: VWG19

NGR 530260 179180

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Summary

This report on geoarchaeological monitoring of geotechnical work undertaken at UK Holocaust Memorial, Victoria Tower Gardens, Westminster, SW1P, has been commissioned from MOLA (Museum of London Archaeology) by Atkins on behalf of the client, the UK Holocaust Memorial Foundation. The site is bounded to the east by the River Thames, to the west by Millbank, to the north by Black Rod's Garden and to the south by the Millbank and Lambeth bridge junction. The site is generally level, ranging from 4.5m OD to 4.8m OD

The report summarises the geoarchaeological potential of the site, and the likely impact of this proposed redevelopment, the main component of which is to erect a memorial to the UK Holocaust Memorial involving deep excavations.

Five boreholes (VWG19_BH01 to VWG19_05) and one window sample (VWG19_WS05) were monitored. No artefacts were recorded. The underlying gravel deposits (floodplain gravels) were reached across the site and date to the Pleistocene period, reflecting the surface topography of the early Holocene /early Mesolithic. Within the site boundary, the surface of the Pleistocene gravel (and capping sands) lies at a maximum of -0.60m OD in VWG19_BH04 dipping off to the north at c -4m OD and the south at c -3m OD. Given the altitude, the high area of sands over gravels around VWG19_BH04 have low potential for Neolithic to Mesolithic remains and/or soils for palaeoenvironmental analysis. The Holocene alluvial deposits, which have high potential for reconstructing the ancient environmental context of the site through palaeoenvironmental analysis, range between 2m to 5m thickness. The alluvial deposits were in turn overlain by approximately 5m of made ground deposits, potentially associated with waterfront structures and land reclamation.

Detailed deposit modelling, including a transect through the site and modelling of the early Holocene surface and thicknesses of facies, has identified areas of higher and lower archaeological potential and concludes the proposed redevelopment is likely to impact on the underlying Holocene alluvial deposits.

In the light of revised understanding of the geoarchaeological potential of the site, a limited series of geoarchaeological terrier rig boreholes has been proposed to recover Holocene deposits for palaeoenvironmental assessment and potential future analysis. The boreholes have been placed within the proposed footprint of the building works to recover sediments that would be completely or partly removed during construction. Of particular interest are the areas where the sands overlying the Pleistocene deposits are highest and the lower, conjectured channel areas, where the palaeoenvironmentally rich Holocene alluvial deposits are thickest. In between these two boreholes a third borehole has been placed to recover material where data is minimal, on the slope between the high and low gravel areas.

Should trenches be dug prior to or as part of the construction phase, it is further recommended that a watching brief by a geoarchaeologist is undertaken on the works to record and, if possible, sample the deposits and underlying palaeo-topography to nuance the deposit models of this Tyburn/Thames confluence.

The overall decision if any further work is required rests with the Local Authority however.

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1 Introduction

1.1 Site background

- 1.1.1 The site comprises 0.25 ha, bounded to the east by the River Thames, to the west by Millbank, to the north by Black Rod's Garden and to the south by the Millbank and Lambeth bridge junction. At present, the site is an open public garden, with the Buxton Memorial located in the east of the park. The site is generally level, ranging from 4.5m OD to 4.8m OD. The centre of the site lies at National Grid reference (NGR) 530260 179180 (Fig 1).
- 1.1.2 A detailed description of the geology and geoarchaeological background of the site is provided in the earlier Desk-Based Assessment (DBA) (Atkins, 2018).

1.2 Planning and legislative framework

- 1.2.1 The planning and legislative background to the site is summarised in the previous Written Scheme of Investigation (WSI) (MOLA, 2019).
- 1.2.2 The watching brief was the first stage of evaluation undertaken in support of a planning application, with all work undertaken in accordance with the WSI (MOLA, 2019).

1.3 Origin and scope of the report

- 1.3.1 This geoarchaeological report on geotechnical works for the site has been commissioned from MOLA (Museum of London Archaeology) by Atkins on behalf of the client.
- 1.3.2 The report has been prepared within the terms of the relevant standard specified by the Chartered Institute for Archaeologists (CIFA, 2014).

1.4 Aims and objectives

- 1.4.1 As set out in the WSI (MOLA, 2019), this investigation has been designed to record sediments of geoarchaeological interest on the site in order to determine their extent, depth, nature and significance.
- 1.4.2 The following objectives and research questions have been identified for this evaluation:
- Confirm the depth of modern disturbance.
 - What is the nature and level of the natural topography?
 - What is the nature of palaeoenvironmental remains within alluvial deposits from the site?
 - Does any evidence for prehistoric or later activity exist within the alluvial sequence?
 - What evidence of early exploitation and management of the River Thames and River Tyburn survives on the site?

1.5 Proposed development summary

- 1.5.1 The proposed development for the Holocaust Memorial is located in an area in the southern two-thirds of the gardens and comprises the construction of a new ground level memorial, a learning centre, entrance pavilion, large courtyard area and café.

The development will contain a double basement level, covering c 0.4 hectare in area and is thought to require at least c 10m excavation below the present ground level. The insertion of new services and landscaping activities will also be required.

2 Topographical and historical background

- 2.1.1 A detailed description of the geology, archaeology and history of the site was provided in the earlier Historic Environment Desk Based Assessment (Atkins, 2018).
- 2.1.2 The importance of the site from a geoarchaeological perspective is that it lies at the confluence of the Thames and one of its tributaries, the Tyburn, flowing from the west. The Tyburn is considered to have bifurcated around a high sandy eyot (Thorney Island, where Westminster Abbey and the Palace of Westminster are now located). The southern branch of the Tyburn is postulated toward the south of the site along Horseferry Road (Barton and Myers 2016 see Fig 2).
- 2.1.3 British Geological Survey (BGS) mapping (<http://mapapps.bgs.ac.uk>) indicates the site and surrounding area lies under alluvial deposits typical of the wider Thames floodplain. However, the alluvial deposits here are particularly widespread, a result of the low lying nature of the ground and the confluence of the Thames and Tyburn river systems.
- 2.1.4 Historic boreholes within the Thames channel to the east of the site indicate the wider Thames floodplain (Shepperton) gravels are recorded at between approximately 10.5m and 9 below present ground level (Atkins, 2018), at c -3m OD (TQ37NW37). To the west of the site, the only landward borehole (TQ37NW53) indicates the gravels lie slightly higher at c -2.75m OD although, importantly, overlain by sands to c -2.25m OD and then peats/organic clays to -0.6m OD beneath thick made ground deposits. The sands are typical of late Pleistocene deposits capping the gravels (which in places form eyots such as Thorney Island) and organic alluvial material (peats / organic clays) are deposits of high palaeoenvironmental potential (Atkins, 2018).
- 2.1.5 Essentially, beyond the larger eyots such as Thorney Island, across the local area in the vicinity of the confluence of the Thames and Tyburn, the ancient environment (during the Holocene) was considered to be a mosaic of sandy channels, shallow pools and wetland, which probably existed here from the later prehistoric until subsumed beneath tidal mudflats during the medieval period (Nicholls et al 2018).
- 2.1.6 Although the site would not have been suitable for habitation at the time, it may have been used for early wetland exploitation as artefacts largely from the Bronze Age or possibly earlier have been found locally (Atkins, 2018). Only from the early Medieval period was the local area developed with the construction of Westminster Abbey (ibid, 2018).
- 2.1.7 By the 16th Century reclamation had expanded southwards, with early maps showing a water mill (Abbott's mill) and a slaughterhouse and yard in the north of the site. It is also likely that during this period some form of river wall existed.
- 2.1.8 Evidence of waterfront structures dating to the 17th Century have been recorded to the north of the site in Black Rod's Garden (PLW14) (MOLA, 2015). By the mid-18th Century, historic maps show the site being occupied by various wharves, comprising of large, irregularly planned warehouse buildings, interspersed by lanes and alleys to the river front.
- 2.1.9 Following the destruction of Westminster Palace by fire in 1834, the land south of Victoria Tower was developed into a public open space.
- 2.1.10 By the early 20th century, the full extent of the site had been reclaimed from the River Thames.

3 The geoarchaeological evaluation

3.1 Introduction

3.1.1 From the 29th April to 14th May 2019, five boreholes (VWG19_BH01-BH05) and one window sample (VWG19_WS05) were monitored by a MOLA geoarchaeologist at the site of the UK Holocaust Memorial, Victoria Tower Gardens.

3.2 Methodology

3.2.1 All the geoarchaeological recording of the boreholes and window sample was done in accordance with the WSI (MOLA 2019).

3.2.2 The locations and heights (x, y and z data) of the interventions were recorded by the sub-contractors (Ground Engineering Ltd.).

3.3 Results of geoarchaeological borehole survey

3.3.1 For the borehole /window sample locations (and line of transect), see Fig 2. For all the sedimentary logs of the interventions monitored, see below. Unmonitored window sample logs were provided by Ground Engineering Ltd. Five window samples in total (VWG19_WS1; VWG19_WS4 to 7) penetrated the made ground (at which point they terminated) and were therefore utilised in the deposit modelling. Those that did not penetrate made ground are not included in the results or modelling.

VWG19_BH01					
OS National Grid coordinates: 530258.6285 179076.581					
Depth below ground level (m)		Elevation (mOD)		Description	Interpretation
0.00	0.10	5.03	4.93	Turf	Made Ground
0.10	0.70	4.93	4.33	Very dark greyish brown loamy topsoil. Occasional brick fragments. Frequent gravel- up to 50mm, subrounded-subangular. Occasional rootlets.	
0.70	1.00	4.33	4.03	Very dark brown loamy topsoil. Occasional pottery, CBM. Frequent gravel- up to 30mm, subrounded-subangular. Occasional rootlets, oyster shell. One fragment of pipe.	
1.00	1.50	4.03	3.53	Light greyish brown silty clay. Large yellow brick fragments (greater than 50mm). Occasional tar and red brick.	
1.50	2.70	3.53	2.33	Mid Yellowish brown clayey coarse sand. Frequent yellow brick, occasional red brick. Quite dry- loose compaction.	
2.70	3.20	2.33	1.83	Light Grey slightly clayey gravelly coarse sand. Clasts up to 50mm, subangular-subrounded. Quite dry. Occasional orange brick flecks. Loose compaction. At 2.5m becomes more brownish and increase in orange brick fragments.	
3.20	4.00	1.83	1.03	Mid-Reddish grey silty clay. Frequent red brick-friable. Frequent gravel (up to 20mm-subrounded-subangular). Occasional tar.	
4.00	5.00	1.03	0.03	Black red sandy clay- ash layer? Frequent fragments of red brick, occasional tar/charcoal. Fine gravel.	

5.00	5.70	0.03	-0.67	Very dark bluish grey slightly silty wet clay. Occasional tar, red brick flecks, shell and gravel (less than 10mm).	
5.70	6.00	-0.67	-0.97	Mid bluish grey soft clay	Alluvium
6.00	6.50	-0.97	-1.47	Mid bluish grey silty soft clay. Occasional shell.	
6.50	8.10	-1.47	-3.07	Mid bluish grey silty firm clay. Occasional shell. Becoming slightly darker with increasing depth.	
8.10	8.70	-3.07	-3.67	Very dark grey organic firm clay- woody fragments.	
8.70	9.00	-3.67	-3.97	Light grey silty soft clay. Very wet. Some organic traces- woody.	
9.00	10.00	-3.97	-4.97	Mid brownish grey sandy gravel. Clasts up to 50mm. subangular-angular. Clasts becoming slightly larger with increasing depth (up to 70mm).	
10.00	11.50	-4.97	-6.47	Dark grey very wet coarse sandy gravel. Subangular-subrounded clasts- up to 30mm.	
11.50	11.70	-6.47	-6.67	Mid brownish grey clayey sandy gravel. Clasts up to 50mm, subrounded-subangular. Large fragment of grey rock.	
11.70	13.20	-6.67	-8.17	Light greyish brown firm/stiff silty clay.	London Clay

VWG19_BH02					
OS National Grid coordinates: 530259.7068 179148.41					
Depth below ground level (m)		Elevation (mOD)		Description	Interpretation
0.00	0.10	4.54	4.44	Turf	Topsoil
0.10	0.75	4.44	3.79	Light Brownish loamy topsoil. Occasional Pottery/Shell. Frequent CBM, Gravel (up to 30mm, subangular-subrounded). Frequent rootlets.	
0.75	1.00	3.79	3.54	Mid-Brown clayey sand. Yellow and red brick. Occasional rootlets. Frequent gravel (up to 50mm, subangular-subrounded).	Made Ground
1.00	1.50	3.54	3.04	Dark Greyish Brown sandy clay. Frequent red and yellow brick fragments.	
1.50	2.00	3.04	2.54	Very dark brownish grey silty clay. Slightly ashy. Occasional wood fragments. Frequent CBM, charcoal, mortar and tar.	
2.00	3.00	2.54	1.54	Black ash layer. Frequent rubble (red brick- very friable). Occasional pottery/oyster shell/animal bone. Occasional gravel (less than 30 mm). Between 2.5-3m, one piece of green glazed post-medieval pottery identified.	
3.00	3.50	1.54	1.04	Mid yellowish brown soft clayey sand. Frequent oyster shell. Occasional red brick.	
3.50	4.30	1.04	0.24	Mid grey silty clay. Occasional CBM fragments/oyster shell. Ashy pockets.	
4.30	5.40	0.24	-0.86	Mid bluish grey silty soft clay. Occasional oyster shell. Becoming slightly wetter with increasing depth.	Alluvium
5.40	6.90	-0.86	-2.36	Light grey silty soft clay with moderate gravel (subangular-subrounded, up to 50mm). Very wet.	

6.90	8.00	-2.36	-3.46	Mid grey coarse sandy gravel. Clasts 20-50mm, subrounded-rounded.	Pleistocene Gravels
8.00	10.50	-3.46	-5.96	Light brownish grey soft clayey sand and gravel. Clasts up to 40mm, subangular-subrounded. Occasional shell fragments. At 9m switch to coarse, very light brown sand and gravel.	
10.50	13.00	-5.96	-8.46	Light brown stiff silty clay.	London Clay

VWG19_BH03					
OS National Grid coordinates: 530256.2439 179187.728					
Depth below ground level (m)		Elevation (mOD)		Description	Interpretation
0.00	0.10	4.51	4.41	Turf	Made Ground
0.10	0.80	4.41	3.71	Dark brown loamy topsoil. Occasional rootlets/mortar. Frequent gravel (up to 50mm).	
0.80	0.90	3.71	3.61	Mid brown slightly sandy loamy topsoil. Occasional rootlets, gravel and CBM.	
0.90	1.00	3.61	3.51	Dark yellowish brown sandy clay. Moderate gravel- up to 30mm.	
1.00	1.30	3.51	3.21	Light brown firm silty clay. Occasional charcoal. Frequent yellow brick and red brick. Pockets of sand. Occasional mortar.	
1.30	1.80	3.21	2.71	Mid greyish brown sandy clay. Loose gravel - up to 50mm- subangular-subrounded. Occasional fragments of pink concrete, yellow and red brick.	
1.80	2.10	2.71	2.41	Light greyish yellowish brown sandy clay. Large fragments of pink mortar. Friable broken yellow brick. Frequent gravel - up to 30mm. Occasional tar fragments. Loose compaction.	
2.10	3.00	2.41	1.51	Very light greyish brown soft clayey coarse sand. Frequent gravel, up to 40mm, subangular-rounded. Moderate yellow/red brick. Borehole terminated at 3m.	

VWG19_BH04					
OS National Grid coordinates: 530240.3279 179212.966					
Depth below ground level (m)		Elevation (mOD)		Description	Interpretation
0.00	0.10	4.39	4.29	Turf	Topsoil
0.10	1.20	4.29	3.19	Mid-brown loamy topsoil. Occasional rootlets, CBM, chalk and gravel (up to 20mm)	
1.20	1.60	3.19	2.79	Firm silty clay. Light greyish brown. Occasional CBM and gravel	Made Ground
1.60	3.00	2.79	1.39	Loose yellowish brown sandy Clay. Frequent CBM. Friable red and yellow brick.	
3.00	4.00	1.39	0.39	Slightly light yellowish brown clayey sand. Frequent Gravel (up to 30mm). Occasional flecks of CBM.	
4.00	4.80	0.39	-0.41	Light grey silty gravelly firm Clay. Gravel (up to 20mm). Clasts are subangular.	Alluvium

4.80	5.00	-0.41	-0.61	Dark bluish grey firm silty clay.	
5.00	5.70	-0.61	-1.31	Mid-yellowish brown clayey coarse sand. Moderately compact. Occasional shells.	Pleistocene Gravels
5.70	6.20	-1.31	-1.81	Light yellowish brown gravelly coarse sand. Gravel up to 30mm, clasts predominantly subangular.	
6.20	10.00	-1.81	-5.61	Mid-yellowish brown coarse sandy gravel. Sediment very wet. Clasts up to 50mm and predominantly subangular. More variation in size of gravel as depth increases. Occasional shell.	
10.00	11.00	-5.61	-6.61	Light greyish brown Sandy Gravel. Gravel up to 50mm, clasts are subangular.	
11.00	12.50	-6.61	-8.11	Light greyish brown slightly silty stiff clay. Occasional gravel from 11-11.2m (less than 20mm). Possibly from above.	London Clay

VWG19_BH05					
OS National Grid coordinates: 530252.9481 179240.4					
Depth below ground level (m)		Elevation (mOD)		Description	Interpretation
0.00	0.10	4.54	4.44	Turf	Topsoil
0.10	1.20	4.44	3.34	Mid brown loamy Top soil. Occasional gravel (up to 30mm). Clasts are Subangular. Occasional CBM.	
1.20	1.50	3.34	3.04	Yellowish Brown clayey sand. Frequent chalk.	Made Ground (Demolition layer)
1.50	2.50	3.04	2.04	Dark brown sandy clay. Frequent friable orange brick.	
2.50	3.40	2.04	1.14	Black ash, very friable. Occasional tar/CBM/animal bone.	Made Ground
3.40	4.80	1.14	-0.26	Very dark brown/black silty clay. Frequent oyster shells, occasional brick, 'stable sweepings', and animal bone.	
4.80	6.50	-0.26	-1.96	Light bluish grey sandy firm clay. Occasional shell fragments and gravel (less than 30mm). Clasts are subrounded-rounded.	Alluvium
6.50	7.20	-1.96	-2.66	Mid-bluish grey sandy soft clay. Slightly wet. Occasional gravel (up to 30mm). Clasts are sub-angular.	
7.20	10.00	-2.66	-5.46	Light brownish grey Gravel. Clasts are subrounded-subangular. Up to 40mm.	Pleistocene Gravels
10.00	11.00	-5.46	-6.46	Light brownish grey coarse sandy Gravel. Clasts up to 20mm. Predominantly subrounded-subangular. Some light greyish brown silty Clay inclusions.	

VWG19_WS05					
OS National Grid coordinates: 530271.7346 179196.908					
Depth below ground level (m)		Elevation (mOD)		Description	Interpretation
0.00	0.10	4.35	4.25	Turf	Made Ground
0.10	0.38	4.25	3.97	Loamy Dark brown topsoil. Frequent gravel (up to 30mm), CBM. Moderate pottery. Occasional rootlets.	

0.38	1.20	3.97	3.15	Light Brown sandy clay. Topsoil. Frequent CBM, gravel. Occasional mortar.	
1.20	1.75	3.15	2.60	Light brown firm silty clay. With increasing depth, fragments of brick.	
1.75	3.00	2.60	1.35	Mid grey sandy clay. Frequent red and yellow brick. Gravel (up to 50mm). Loose material. Large voids when initially recovered in the middle.	
3.00	3.30	1.35	1.05	Light brownish grey silty clay.	
3.30	3.45	1.05	0.90	Light brownish grey silty clay. Frequent rubble fragments. At 3.46m pocket of yellow sand.	
3.45	3.80	0.90	0.55	Mid brown silty clay	
3.80	3.90	0.55	0.45	Black ash layer. Frequent tar.	
3.90	4.00	0.45	0.35	Grey silty clay. Fe and Mn staining.	
4.00	4.10	0.35	0.25	Light grey silty clay with CBM fragments. Most likely this is backfill.	
4.10	4.20	0.25	0.15	Crushed red brick- friable. Backfill.	
4.20	4.68	0.15	-0.33	Light greyish brown sand- slightly clayey. Friable CBM, gravel.	
4.68	5.00	-0.33	-0.65	Dark bluish grey firm silty clay. Small shells present. At 4.85m a piece of animal bone was recorded.	
5.00	5.20	-0.65	-0.75	No recovery	
5.20	5.55	-0.75	-1.20	Light brownish grey silty clay. Frequent CBM, gravel less than 20mm. Backfill	Alluvium
5.55	6.00	-1.20	-1.65	Soft light bluish grey sandy clay.	

Table 1: Sediments recorded in the geotechnical boreholes and window sample at Victoria Tower Gardens.

3.4 Discussion of the geoarchaeological borehole survey and deposit modelling

- 3.4.1 The deposits encountered in the monitored boreholes and window sample are illustrated (along with other historical borehole records) as a two dimensional cross-section or transect across the site (see Fig 2 & Fig 3) and in a series of thickness and surface (deposit model) plots (Figs 4 to 6). The site boreholes and window samples are prefixed VWG19 and to aid interpretation, deposits of similar characteristics in the transect and deposit models have been allocated facies (Facies 1 to 3).
- 3.4.2 The Shepperton gravel deposits (floodplain gravels, facies 1; Fig 3) are wide spread across the site and date to the Pleistocene period, reflecting the surface topography of the early Mesolithic. The level of the gravels varies across the site, as recorded in the transect (Fig 3), the early Holocene surface deposit model (Fig 4) and Table 2. Within the site boundary, the surface gravel lies at a maximum of -0.61mOD (where the gravels are capped by sands) in VWG19_BH04. The most southerly borehole (VWG19_BH01) records the deepest gravel at c -4m OD. The deposit model of the early Holocene surface (Fig 4) illustrates these deeper areas of gravel exist to the north and south of the site (at c -4m OD) with higher areas of gravel to c -2.4m OD in between (VWG19_BH02). The deeper areas align well with the conjectured routes of the Tyburn locally (Barton, 2016; see Fig 2). The gravels rise westward toward the river terrace (Fig 4) which can be taken to lie at above approximately 0m OD (*sensu* Stafford et al 2012).

- 3.4.3 Notably, where the data is greatest, the more refined the detail of the early Holocene surface (as seen to the north of the site, see Fig 4). The recent geotechnical boreholes through the spine of the site provide detail but in fact, based on the work undertaken across the Tyburn / Thames confluence (e.g. Barton, 2016, Nicholls et al 2018, Yendell 2017) the site is probably a more nuanced mosaic of gravel highs and lows than appears on Fig 4, particularly across the central swathe of the site where data is minimal. Nevertheless, the data is a good indicator of the gross morphology of the site.

Table 2: Facies 1 depths and elevation within the site and immediate surrounds

Facies 1	Depth (m bgl)	Elevation at top (m OD)
AVGE	5.93	-2.26
MAX	9.40	2.21
MIN	3.22	-4.80

- 3.4.4 The deposit logs record up to c 5m thickness of alluvial deposits capping the floodplain gravel across the site (facies 2; Fig 3). The deposits varied in nature although were largely wet silty or sandy clays (sometimes organic) although no peat was recorded. These deposits relate to the Holocene flooding of the area and are of high palaeoenvironmental potential. The modelling of the thickness of this deposit (Fig 5) largely mirrors areas where the gravels are lowest and therefore again indicative of possible channel routes. Although suffering 'edge effects' where the data is minimal (particularly to the north west, off the site), the deposit model indicates in the north and to the south of the site, the alluvium reaches thicknesses of c 4.8m (Fig 5; Table 3) compared with 1m to 2.4m across the central northern part of the site (VWG19_BH04 & VWG19_BH05). The average thickness across the site is 2.45m thickness.

Table 3: Facies 2 thicknesses and elevation within the site and immediate surrounds

Facies 2	Thickness (m)	Elevation at top (m OD)
AVGE	2.45	0.19
MAX	4.80	2.41
MIN	1.00	-2.82

- 3.4.5 At an average of 3.73m in thickness across the site (although reaching nearly 6m thickness toward the north and south Fig 6, Table 4), units of modern ground-raising deposits (facies 3; Fig 3) are recorded across the site and local area. Some of these deposits may be post-medieval in date, with a fragment of green glazed post-medieval pottery found between c 1.5m OD and c 2.5m OD in VWG19_BH02. Further archaeological investigation of these deposits may indicate broad periods of anthropogenic ground-raising which could relate to the known construction of wharves at the site, their subsequent demolition and the development of the present gardens in the early 20th Century (Atkins, 2018). Made ground deposits were recorded in all geotechnical interventions undertaken across the site and, significantly, not penetrated in VWG19_BH03.

Table 4: Facies 1 thicknesses within the site and immediate surrounds

Facies 1	Thickness (m)
AVGE	3.73
MAX	5.70
MIN	0.91

4 Geoarchaeological potential

4.1 Original research questions

4.1.1 This section examines the extent to which the original research questions have been answered by the assessment.

- *Confirm the depth of modern disturbance.*

Between 0.91m and 4.68m thick made ground deposits were noted across the site and wider area. There appears little to no geoarchaeological or palaeoenvironmental potential in the made ground deposits. However, while nothing of specific archaeological interest identified in the boreholes, desk based assessment suggests significant archaeological remains may survive on the site.

- *What is the nature and level of the natural topography?*

Pleistocene floodplain gravels were reached in all interventions with the exception of VWG19_BH03 (terminated at 3m) and the window samples. Where logged, the floodplain gravels ranged in altitude from -4m OD (9m below ground level; bgl) in VWG19_BH01 to -1.31m OD (5.70m bgl) in VWG19_BH04. Importantly, late Pleistocene / early Holocene sand deposits were recorded in VWG19_BH04 overlying the gravels to -0.61m OD (5.00m bgl). The surface of the Pleistocene deposits dips toward the north and south away from the high point of VWG19_BH04 and represents the undulating nature of the early Holocene surface (Mesolithic topography) across the site.

- *What is the nature of palaeoenvironmental remains within alluvial deposits from the site?*

The alluvium at the site was significantly thick (between 2m and 5m). This deposit, due to the waterlogged conditions, has a high palaeoenvironmental potential. Through the analysis of microfossils (e.g. pollen, ostracods) and plant macrofossils the changing environment of the site can be tracked throughout the Holocene (from the later prehistoric through the historic period). Within these deposits it is also possible to find indirect evidence of anthropogenic activity such as woodland clearance and cereal production locally. Furthermore, organic material within the clays may prove suitable for radiocarbon dating, providing a timeframe for the stratigraphic column as a whole

- *Does any evidence for prehistoric or later activity exist within the alluvial sequence?*

No direct evidence (prehistoric or later artefacts) were recovered from the alluvial sequence (apart from a single piece of post-medieval green glazed pottery in VWG19_BH02) although future palaeoenvironmental work on the sequence could identify indirect evidence of anthropogenic activity on or in the locality of the site. The nature of the post-medieval/modern ground as a levelling layer suggests a certain amount of truncation and disturbance of the underlying alluvial deposits. Across the site there is the low potential for the preservation of Neolithic and Mesolithic artefacts in the surface of the sands around VWG19_BH04 given the altitude (-0.61m OD) which would have remained extant across the area until the late prehistoric (Bates and Whittaker, 2004) although no evidence of these periods was recovered.

- *What evidence of early exploitation and management of the River Thames and River Tyburn survives on the site?*

No evidence of early exploitation and management of the River Thames and River Tyburn was logged in the boreholes / window samples.

4.2 Overall potential

- 4.2.1 There is low potential for Mesolithic to Neolithic occupation horizons (e.g. spreads of worked flint, evidence of burning or indirect indicators of humans within ephemeral soil formation) in the surface of the sands around VWG19_ BH04, the highest area of the early Holocene topography, although none was seen in the geotechnical boreholes / window samples.
- 4.2.2 The overlying alluvial deposits however have high potential for indirect evidence of anthropogenic activity and environmental change preserved through surviving proxy environmental material (e.g. pollen and other botanical remains, diatoms, ostracods and insects). These remains are important for the reconstruction of the changing Mesolithic to post-medieval environmental context to the site.
- 4.2.3 Post-medieval to modern ground-raising deposits noted across the site are likely to have no palaeoenvironmental potential due to their nature and mode of deposition, although there remains a relatively high potential for post-medieval waterfront structures and associated archaeological remains.
- 4.2.4 Any geoarchaeological and palaeoenvironmental remains would be of considerable local importance, further adding to the current understanding of the River Tyburn and development of the local area.

5 Proposed development impact and recommendations

5.1 Impact of the development

- 5.1.1 The site is being developed to construct a UK Holocaust memorial in the southern two-thirds of the garden. Development will include the construction of a double basement excavating to at least c 10m bgl.
- 5.1.2 Due to the depth of excavation exceeding the depths of made ground across the site, it is expected that development would impacts on the preservation of the Holocene deposits, in places completely removing them.

5.2 Recommendations

- 5.2.1 Detailed deposit modelling, including a transect through the site and modelling of the early Holocene surface and thicknesses of facies, has identified areas of higher and lower archaeological potential.
- 5.2.2 From this information a limited series of geoarchaeological terrier rig boreholes has been proposed to recover Holocene deposits for palaeoenvironmental assessment and potential future analysis (see proposed locations Fig 7). The boreholes have been placed within the proposed footprint of the building works to recover sediments that would be completely or partly removed during construction. Of particular interest are the areas where the sands overlying the Pleistocene deposits are highest (MOLA_BH1) and the lower, conjectured channel areas, where the palaeoenvironmentally rich Holocene alluvial deposits are thickest (MOLA_BH3). In between these two boreholes a third borehole (MOLA_BH2) has been placed to recover material in the vicinity of where VWG19_BH03 failed (but where VWG19_WS07 has proved access), on the slope between the high and low gravel areas.
- 5.2.3 Should trenches be dug prior to or as part of the construction phase, it is further recommended that a watching brief by a geoarchaeologist is undertaken on the works to record and, if possible, sample the deposits and underlying palaeo-topography to nuance the deposit models of this Tyburn/Thames confluence.
- 5.2.4 The overall decision if any further work is required rests with the Local Authority however.

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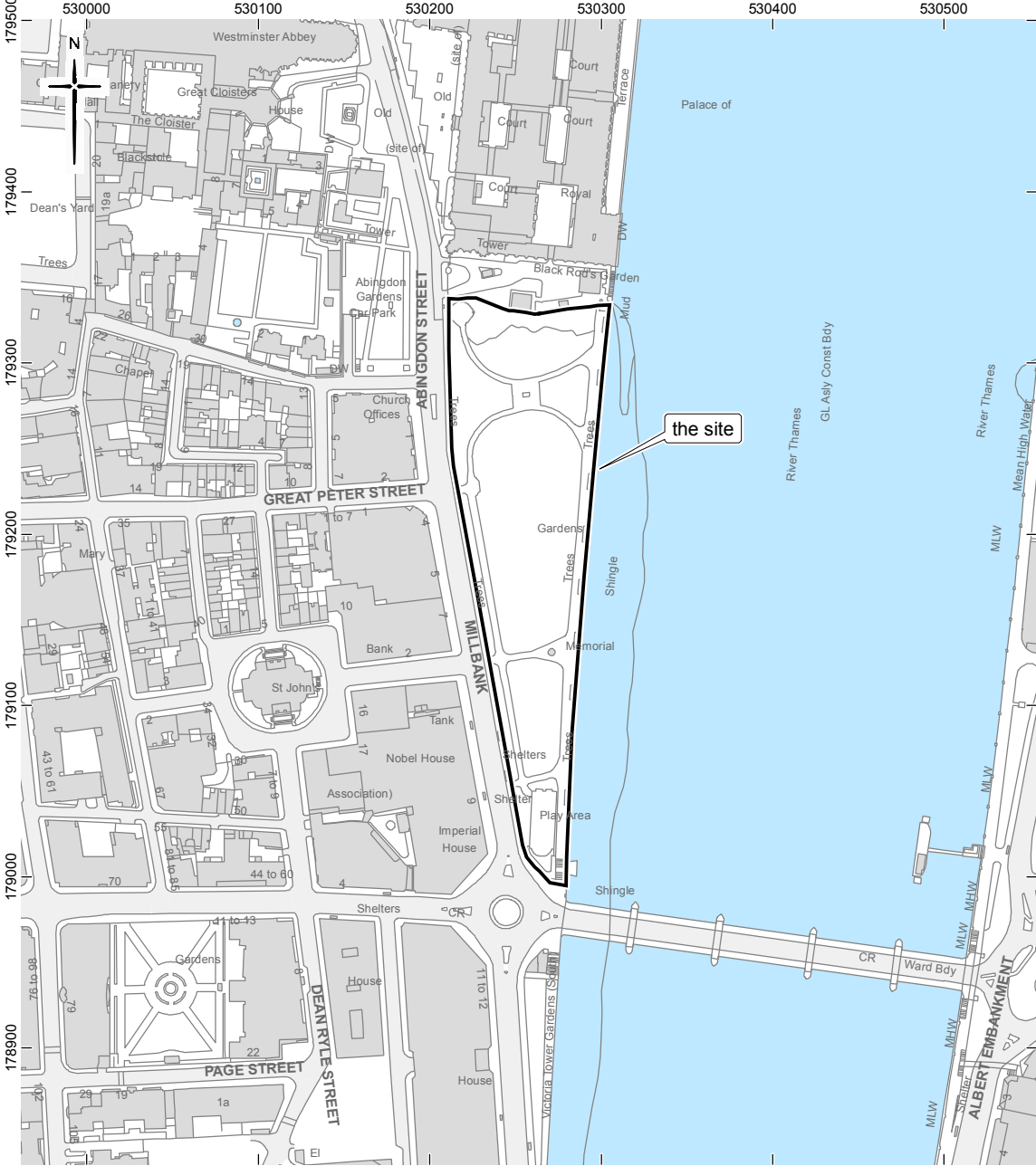
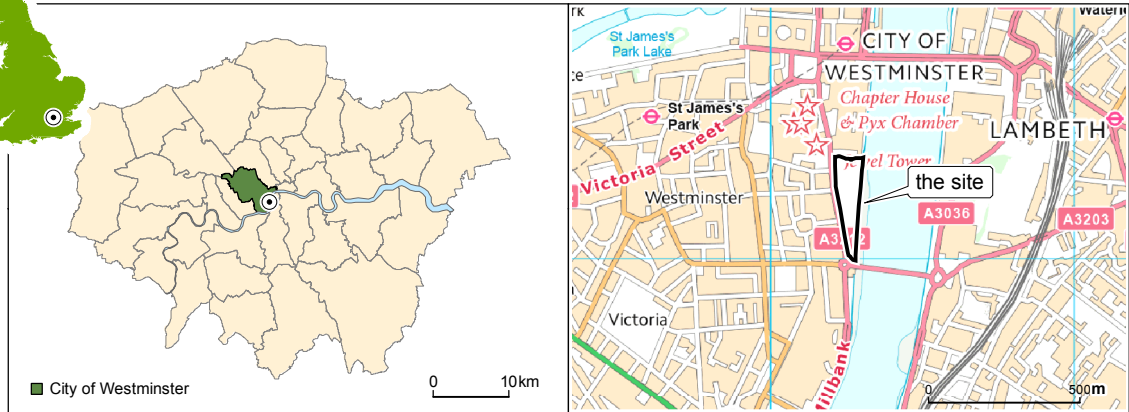
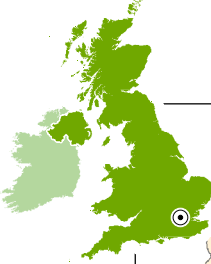
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scale 1:4,000 @ A4

0 200m

Fig 1 Site location

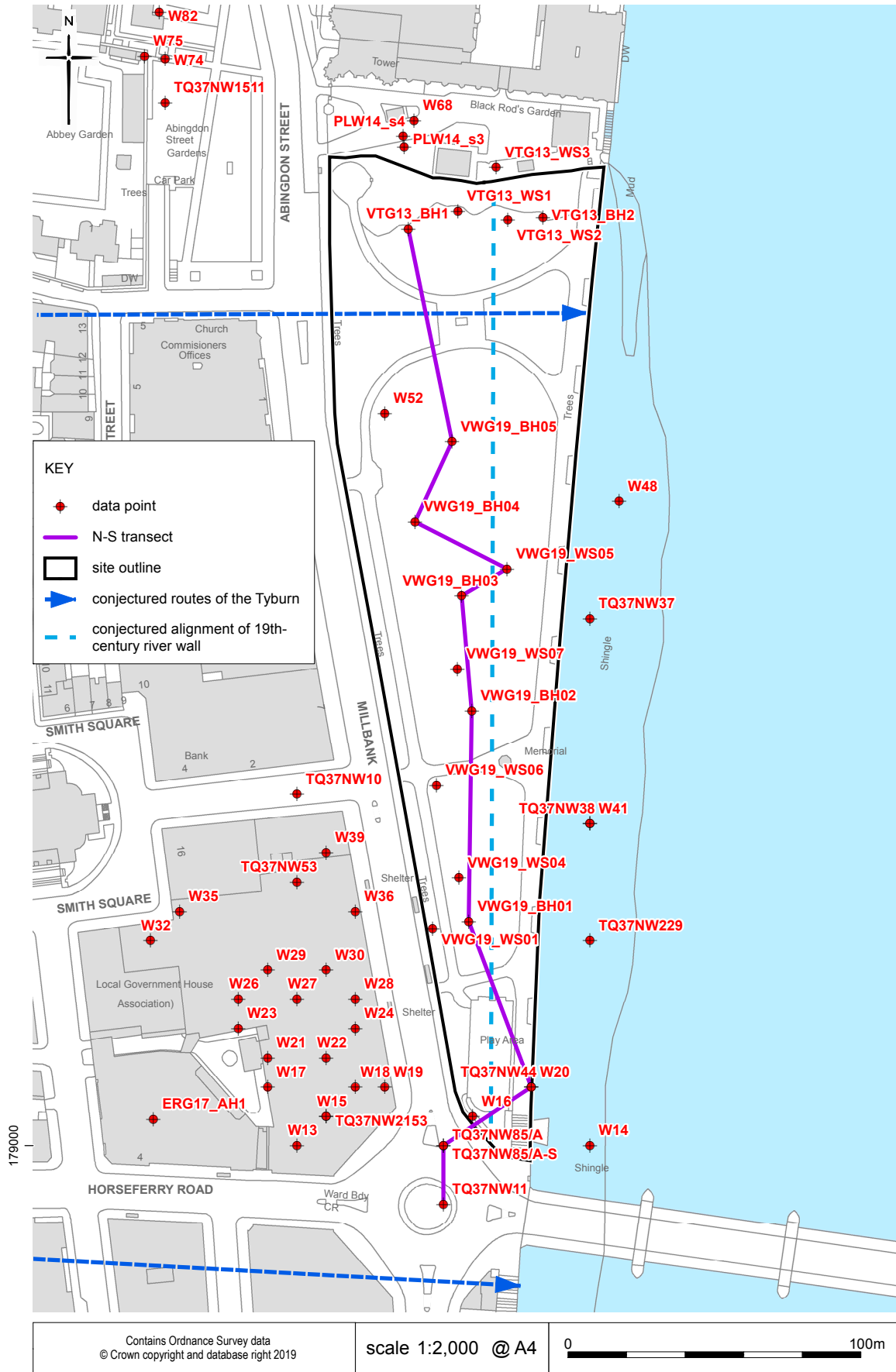


Fig 2 Utilised borehole and window sample locations and line of transect with conjectured routes of the Tyburn (Barton 2016)

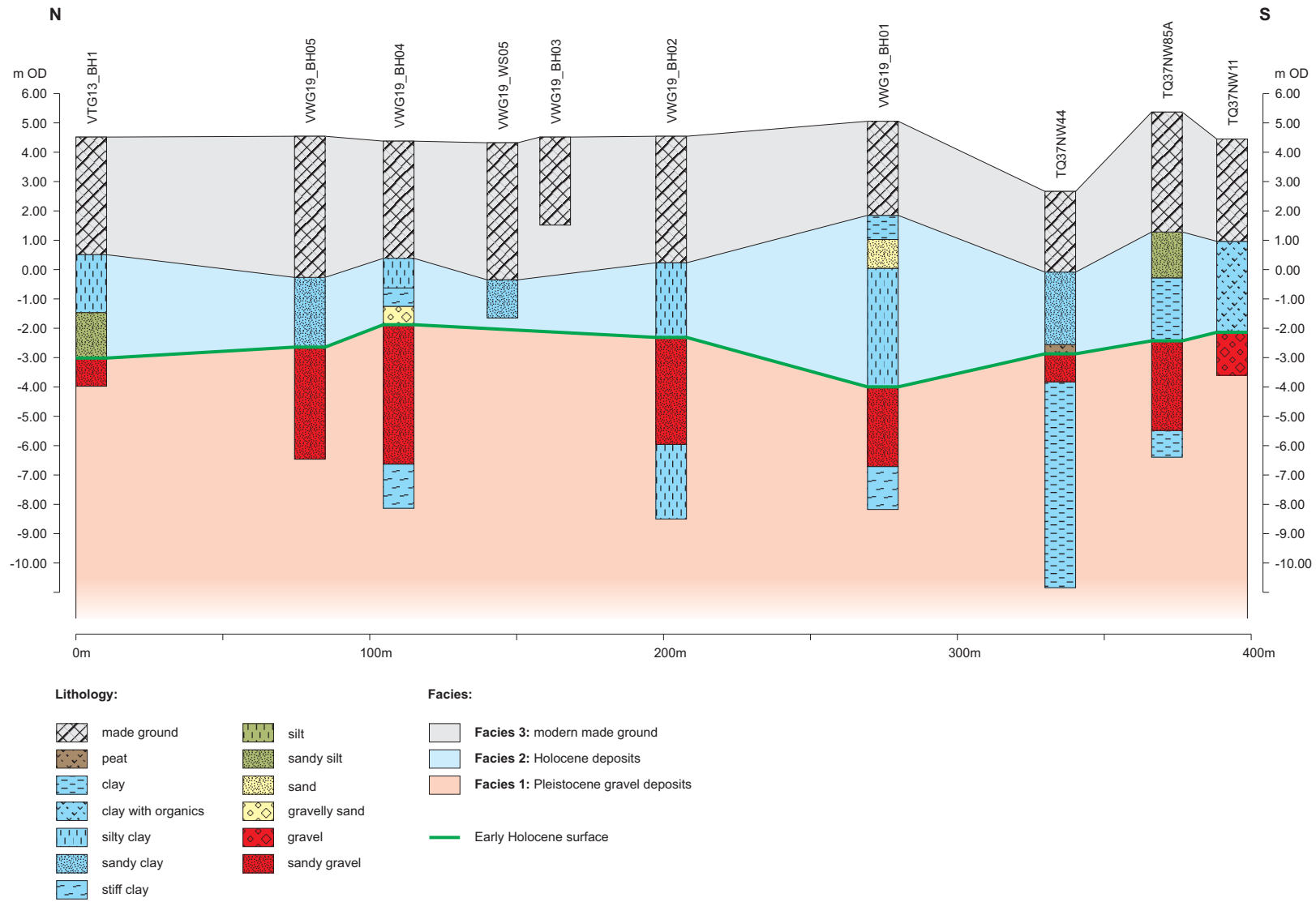


Fig 3 North-south transect across the site showing the levels and thickness of deposits, derived from geotechnical and geoarchaeological data

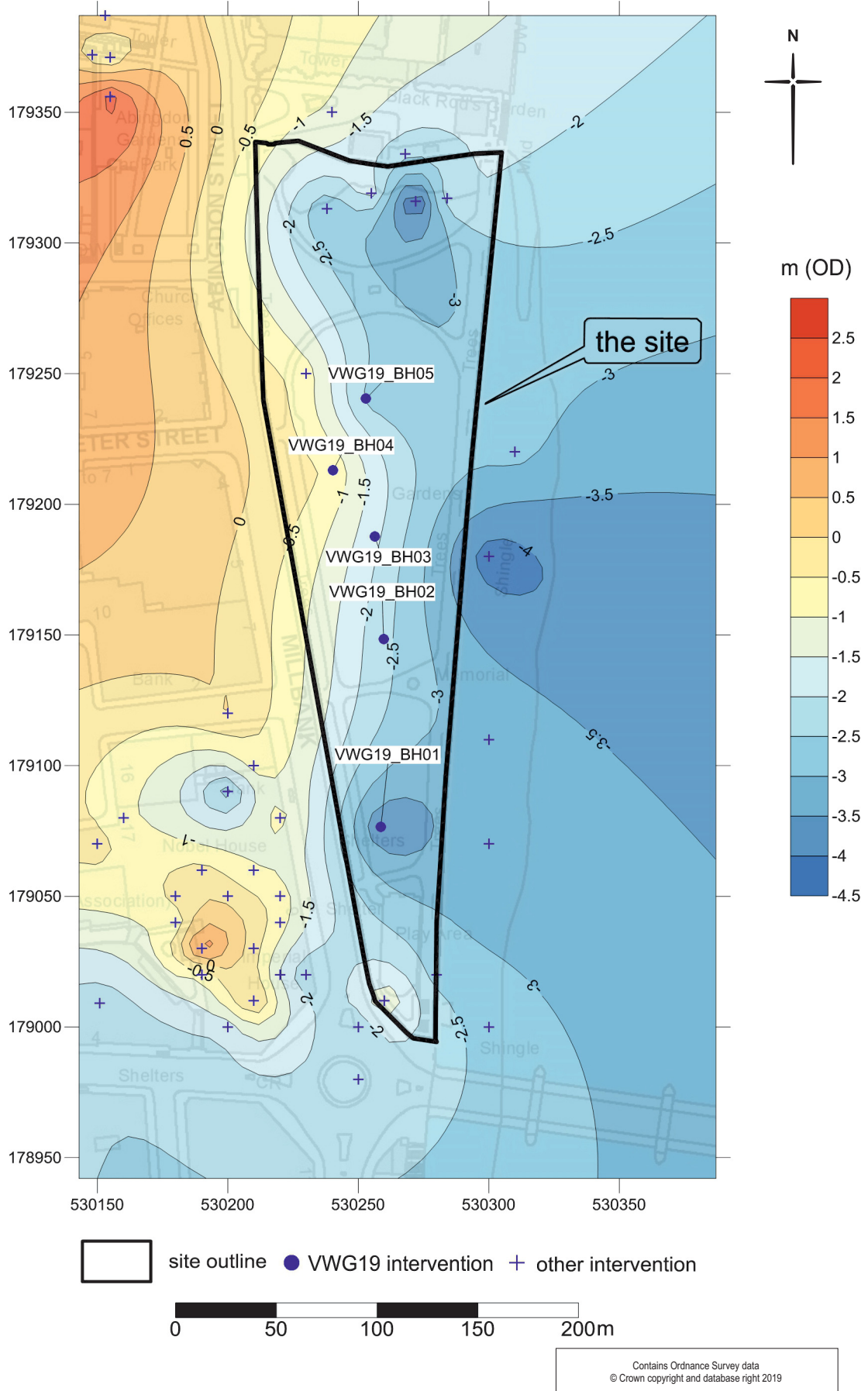


Fig 4 Early Holocene (facies 1) surface

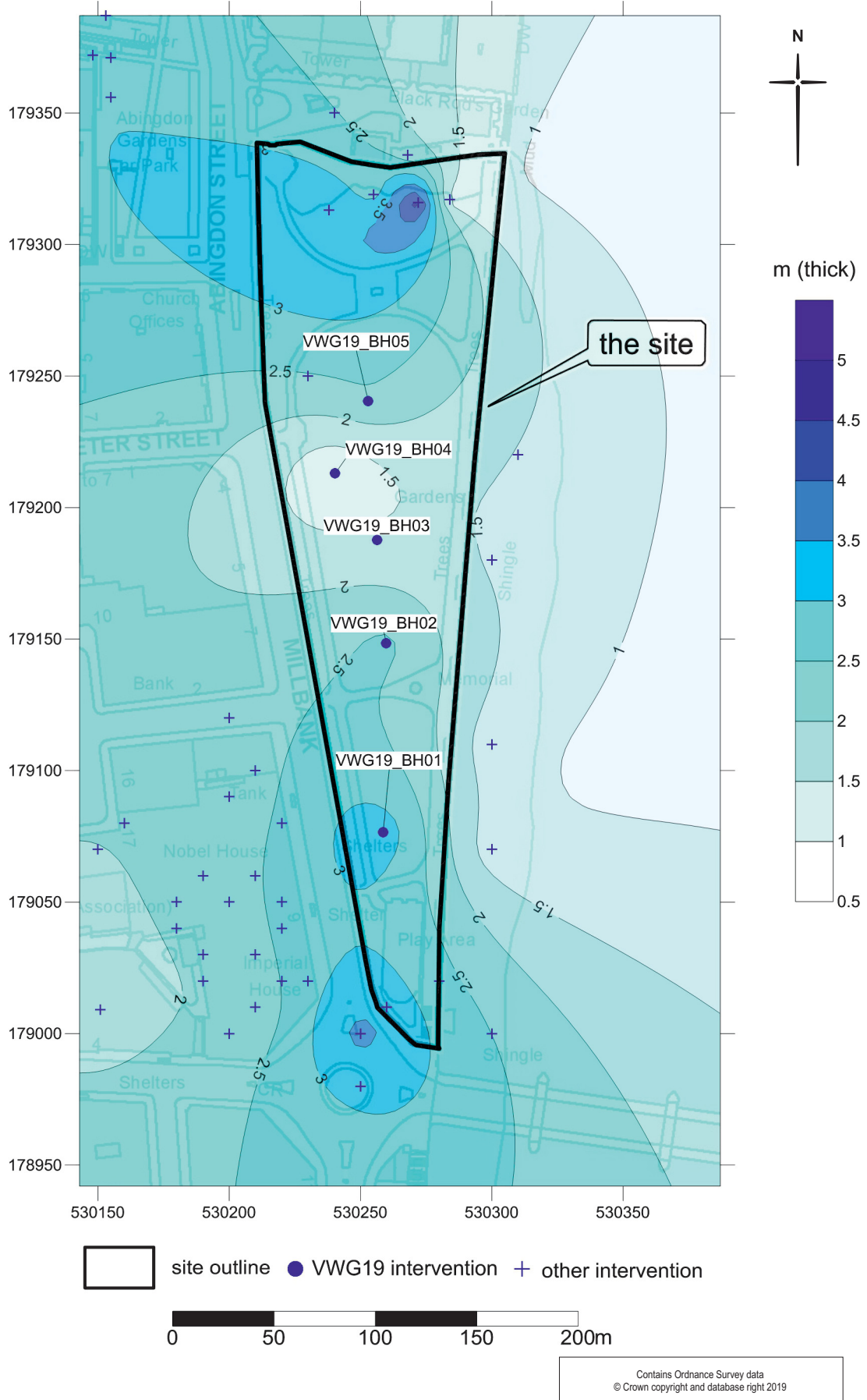


Fig 5 Thicknesses of the Holocene (facies 2) deposits across the site

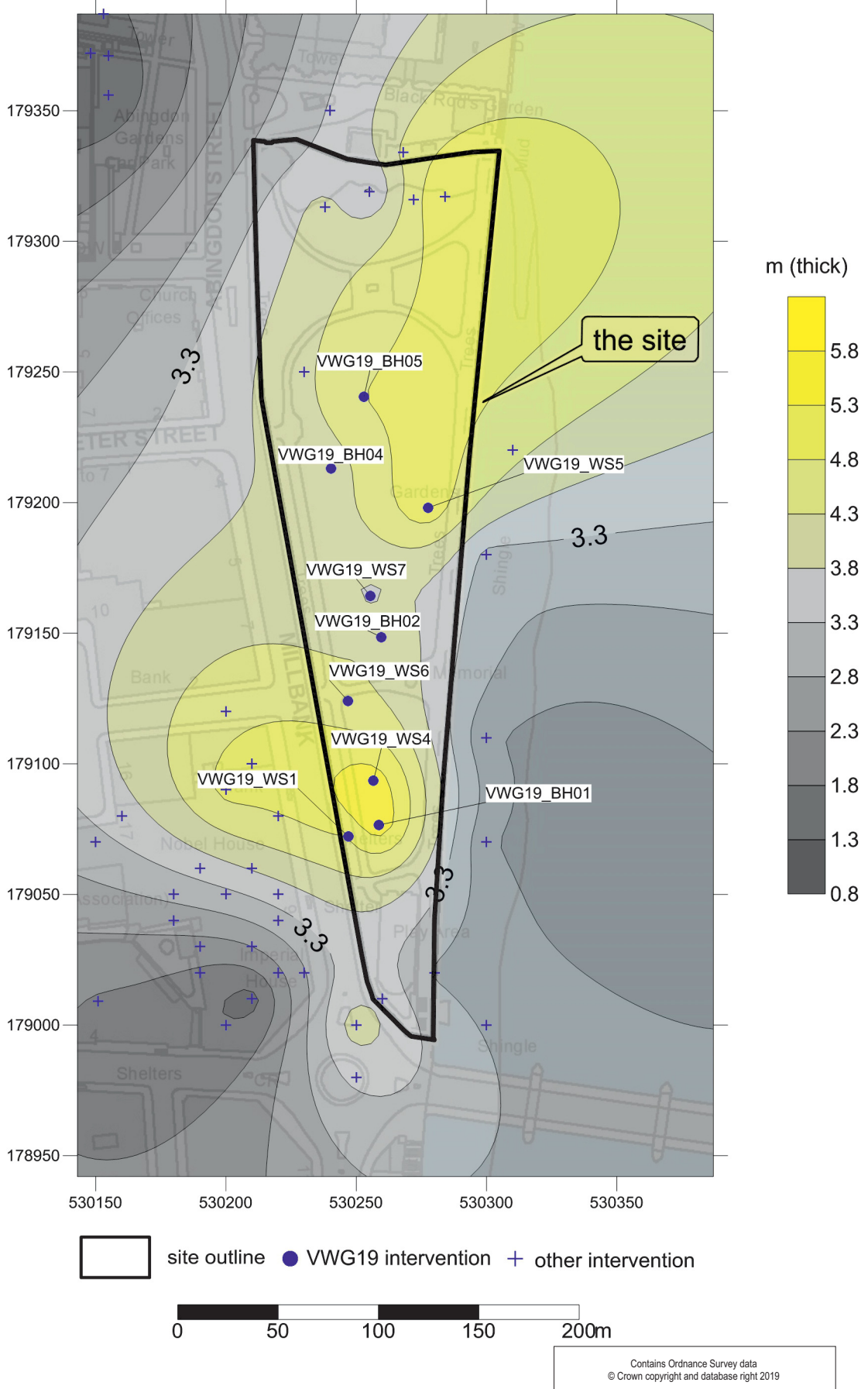


Fig 6 Thicknesses of the made ground (facies 3) deposits across the site

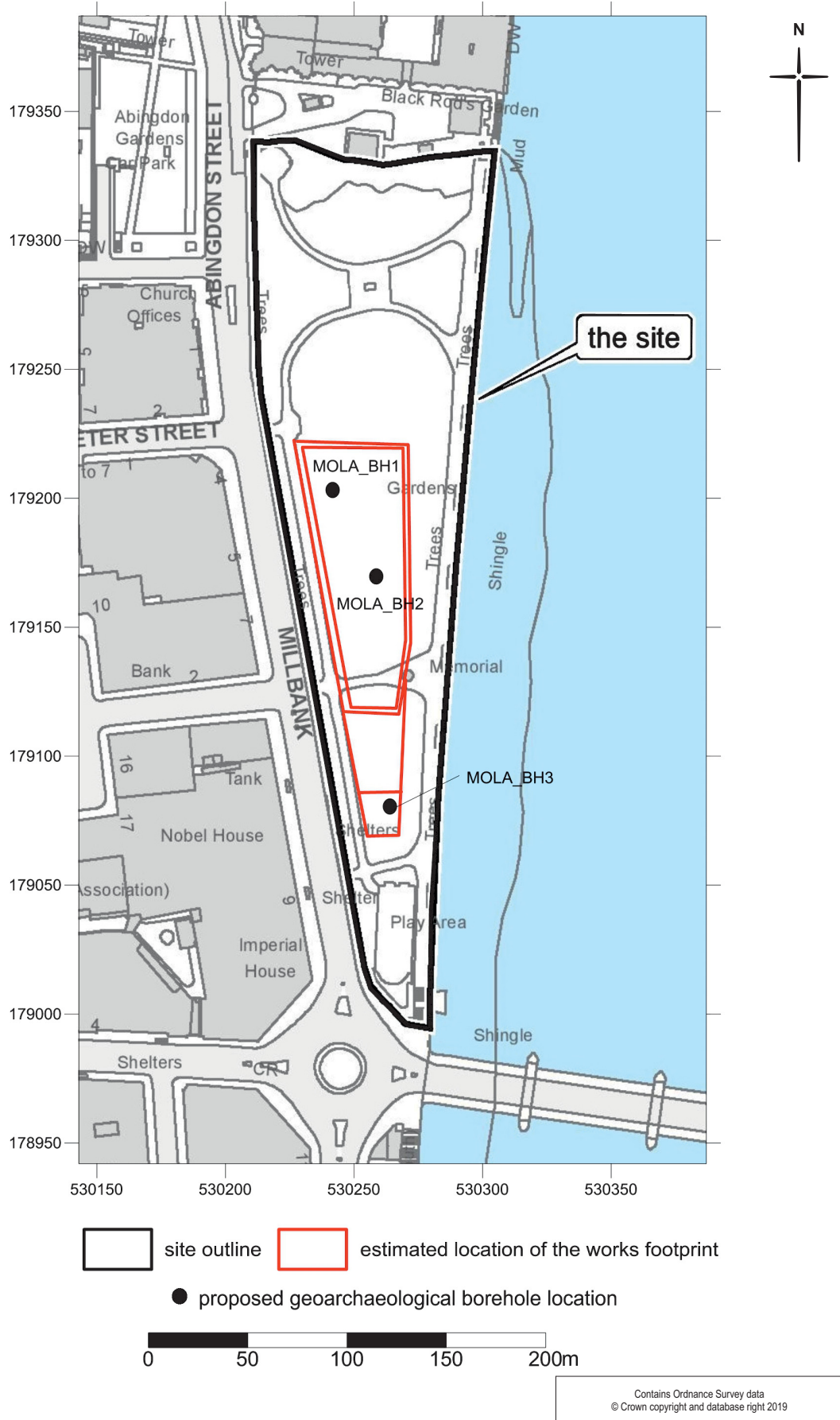


Fig 7 Projected works footprint and proposed positions of geoarchaeological boreholes