40 BERMONDSEYSTREET, 42–44 BERMONDSEYSTREET AND 1–7 SNOWSFIELDS London SE1

London Borough of Southwark

Geoarchaeological deposit model

January 2019

MOLA

REGISTERED ORGANISATION CIfA

Museum of London Archaeology
Mortimer Wheeler House
46 Eagle Wharf Road, London N1 7ED
tel 020 7410 2200 | fax 020 410 2201
https://www.mola.org.uk
general enquiries: enquiries@mola.org.uk

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Archaeological interpretation of
geotechnical ground condition data

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MUSEUM OF LONDON
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NGR 533122 179897

Sign-off history

issue no.	issue date	prepared by	reviewed by	approved by	reason for issue
1	03-01-2019	Phil Stastney (Geoarchaeology)		Derek Seeley Project Manager	First issue

www.mola.org.uk

Mortimer Wheeler House, 46 Eagle Wharf Road, London N1 7ED
tel 0207 410 2200 fax 0207 410 2201 email:generalenquiries@mola.org.uk
Museum of London Archaeology is a company limited by guarantee
Registered in England and Wales
Company registration number 07751831 Charity registration number 1143574
Registered office Mortimer Wheeler House, 46 Eagle Wharf Road, London N1 7ED

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Glossary

Alluvium	Sediment laid down by a river. Can range from sands and gravels deposited by fast flowing water to clays that settle out of suspension during overbank flooding. Other deposits found on a valley floor (e.g. peat) are usually included in the term alluvium.
Bronze Age	2,000 – 800 BC
Built heritage	Upstanding structure of historic interest.
Early medieval	AD 410 – 1066. Also referred to as the Saxon period.
Evaluation (archaeological)	A limited programme of non–intrusive and/or intrusive fieldwork which determines the presence or absence of archaeological features, structures, deposits, artefacts or ecofacts within a specified area.
Excavation (archaeological)	A programme of controlled, intrusive fieldwork with defined research objectives which examines, records and interprets archaeological remains, retrieves artefacts, ecofacts and other remains within a specified area. The records made and objects gathered are studied and the results published in detail appropriate to the project design.
Geotechnical	Ground investigation for engineering purposes, typically boreholes and/or trial/test pits, to determine the nature of the subsurface deposits. Archaeological monitoring of geotechnical works can be a cost-effective means of carrying out two required investigations at the same time.
Heritage asset	A building, monument, site, place, area or landscape positively identified as having a degree of significance meriting consideration in planning decisions. Heritage assets are the valued components of the historic environment. They include designated heritage assets and assets identified by the local planning authority (including local listing).
Historic environment assessment	A written document whose purpose is to determine, as far as is reasonably possible from existing records and site inspection, the nature and significance of heritage assets within a specified area. Also known as a 'heritage statement' or 'statement of significance'.
Historic Environment Record (HER)	Archaeological database held and maintained by the County authority. In some counties this is named the HER (Historic Environment Record), where the built heritage data has been incorporated.
Holocene	The current geological epoch (during which a warm interglacial climate has existed) which started *c* 11,650 years ago when the glaciers of the most recent ice age began to retreat, characterised initially by the spread of forests. Also referred to as the 'Postglacial' and (in Britain) as the 'Flandrian'.
Iron Age	800 BC – AD 43
Later medieval	AD 1066 – 1500
Made Ground	Artificial deposit. An archaeologist would differentiate between modern made ground, containing identifiably modern inclusion such as concrete (but not brick or tile), and undated made ground, which may potentially contain deposits of archaeological interest.
Mesolithic	10,000 – 4,000 BC
Neolithic	4,000 – 2,000 BC
Palaeolithic	1,000,000 – 10,000 BC
Palaeoenvironment	The environment at a particular time in the past. Palaeoenvironmental remains include visible organic material such as timber, wood or seeds, and microscopic fossils such as pollen which provide information on the nature of the landscape and climate, and the context for human activity.
Peat	A build-up of organic material in waterlogged areas, producing marshes, fens, mires, blanket and raised bogs. Accumulation is due to inhibited decay in anaerobic conditions.
Pleistocene	The geological epoch before the Holocene (the current geological epoch), including a series of ice ages punctuated by warmer periods, with the advance and retreat of ice sheets.
Post-medieval	AD 1500 – present
Preservation by record	Archaeological mitigation strategy where archaeological remains are fully excavated and recorded archaeologically and the results published. For remains of lesser significance, preservation by record might comprise an archaeological watching brief.
Preservation in situ	Archaeological mitigation strategy where nationally important (whether Scheduled or not) archaeological remains are preserved *in situ* for future generations, typically through modifications to design proposals to avoid damage or destruction of such remains.
Residual	When used to describe archaeological artefacts, this means not *in situ,* i.e. Found outside the context in which it was originally deposited.
Roman	AD 43 – 410
Site	The area of proposed development
Study area	Defined area surrounding the proposed development in which archaeological data is collected and analysed in order to set the site into its archaeological and historical context.
Stratigraphy	A term used to define a sequence of visually distinct horizontal layers (strata), one above another, which form the material remains of past cultures.
Truncate	Partially or wholly remove. In archaeological terms remains may have been truncated by previous construction activity.
Watching brief (archaeological)	An archaeological watching brief is '*a formal programme of observation and investigation conducted during any operation carried out for non–archaeological reasons.*'

Results

***Scope**: this report presents the results of a geoarchaeological deposit model exercise carried out by Museum of London Archaeology (MOLA) on the site of 40 Bermondsey Street, 42 Bermondsey Street and 1-7 Snowsfields, Southwark, London SE1. The site comprises two irregularly shaped areas: one on part of the northern side of Snowsfields ('Snowsfields site'), the other on the south side of Snowsfields and east of Bermondsey Street ('Bermondsey Street site'). The report summarises the archaeological potential of the sediments revealed in boreholes taken across the site and its vicinity. By modelling the buried stratigraphy and preliminarily reconstructing the evolving landscape of the site, four groups of deposits or 'facies' of varying archaeological and palaeoenvironmental potential are identified and described.*

***Results**:*

The underlying London Clay bedrock is overlain by Late Pleistocene floodplain gravels (facies 1). Within the site the gravels are overlain by Holocene in-channel fine sands and silty sands ('the lower alluvium' – facies 2) which are in turn sealed by fine-grained and occasionally organic floodplain deposits ('upper alluvium' – facies 3). Finally the site and the surrounding area is sealed by deposits of both historic and modern made ground (facies 4).

Modelling of the Early Holocene surface shows that the area around the site comprises a series of former gravel eyots separated by deeper former channels; boreholes drilled within the site demonstrate that it is positioned within a deep former river channel, partly filled by in-channel sands and silty sands that are probably Early to Middle Holocene in date.

Based on the archaeological interpretation of available geotechnical data, the archaeological potential of the site is as follows:

- *LZ1 defines an area covering the whole of the site and extending approximately 25m north west and east of the site. This zone represents areas of low-lying river gravels (below -15m OD) overlain by thick Holocene alluvial deposits, including both in-channel sands (the lower alluvium, facies 2) and floodplain alluvium (upper alluvium, facies 3). This zone may be of of high palaeoenvironmental potential, since organic alluvial deposits are likely to preserve indicators of past environmental conditions. Since this zone is likely to have been wetland throughout much of the Holocene, archaeological potential is generally lower, although there may be potential for isolated waterlogged archaeological finds.*
- *LZ2 defines a broad area beyond the north, west and eastern edges of the site. The surface of the floodplain gravel is between -1.5m and +0.5m OD in this zone and, consequently the alluvium(facies 2 and 3) is thinner in this zone. Much of the alluvium in this zone is likely to date to the historic era (Roman period onwards) and, where it survives, may seal earlier archaeological remains.*
- *LZ3 defines a number of areas where the gravel surface lies above +0.5m OD indicating the location of former eyots; the lower alluvium (facies 2) is typically absent in this zone, whilst the upper alluvium (facies 3) is relatively thin. Where the gravel surface has not been truncated, archaeological potential is high in LZ3, since the eyots in the Southwark area are likely to have been the focus of occupation from the prehistoric period onwards.*

This geoarchaeological deposit model has indicated that sediments of high palaeoenvironmental potential are likely to be preserved across the majority of the site. Archaeological potential is likely to be generally lower.

1 Introduction

1.1 Origin and scope of the report

1.1.1 This report has been commissioned from by MOLA (Museum of London Archaeology) by Arup Group on behalf of the client, Three Ten Bermondsey Limited, in advance of the preparation of a planning application to redevelop the site of 40 Bermondsey Street, 42-44 Bermondsey Street and 1-7 Snowsfields ('the site') – see Fig 1. It provides an archaeological interpretation of geotechnical borehole and trial pit data obtained for engineering purposes to establish ground conditions on the client property ('the site'). Using this data, zones of archaeological potential have been mapped and the likely nature and depth of archaeological deposits characterised across the site. Statutory provision for the safeguarding of heritage assets[1] – including archaeological remains – has been made at a national and local level. For this reason, the potential presence of such remains can constitute a risk. The archaeological interpretation of geotechnical data as part of an assessment of the archaeological potential of a site helps to identify potential cost and programming risks to future development that might result from a Local Planning Authority (LPA) planning condition for archaeological mitigation prior to construction (e.g. trial evaluation trenches, archaeological excavation and/or a watching brief). Identifying these issues at an early stage allows them to be anticipated and planned for, and any risks to be contained.

1.1.2 This report forms a supplement to a separate MOLA Evaluation report. The main assessment report draws on a broad range of standard historic environment data sources, including statutory designations.

1.1.3 This report can also be used to inform pre-planning application discussions with the LPA when submitted as part of a planning application. The report is not intended to substitute for an archaeological mitigation requirement, but instead provides a preliminary appraisal of the nature, extent, and possible archaeological significance of any deposits on the site, based on geotechnical data. Note: within the limitations imposed by dealing with historical material and maps, the information in this document is, to the best knowledge of the author and MOLA, correct at the time of writing. Further archaeological investigation, more information about the nature of the present buildings, and/or more detailed proposals for redevelopment may require changes to all or parts of the document.

1.2 Aims and objectives

1.2.1 The aim of the document is to:

- identify, using geotechnical borehole log and trial pit descriptions, the different depositional units within the site and map their location, extent and thickness;
- map zones of likely archaeological/palaeoenvironmental potential across the site based on the depositional units;
- provide an indication of the likely nature, depth and significance of buried archaeological deposits within each zone, based on the geotechnical data;
- provide recommendations for further investigation.

[1] Heritage assets are those parts of the historic environment which are considered to be significant because of their historic, evidential, aesthetic and/or communal interest. These might comprise below and above ground archaeological remains, buildings, structures, monuments or heritage landscape within or immediately around the site.

2 The deposit model

2.1 Introduction

2.1.1 Information about past environments is often required by LPA archaeological advisors, in order to better understand the nature and distribution of past human activity. On floodplains in particular the deposit sequence can be deep and complex, with ancient landsurfaces buried within and beneath alluvium (material deposited by water) or peat.

2.1.2 The solid geology and overlying deposits such as Brickearth and Gravels are a useful indicator of the land surface in the early Holocene, the current geological epoch which started *c* 11,650 years ago when the glaciers of the most recent ice age began to retreat, referred to in archaeological terms as the early Mesolithic (*c* 10,000 BC). Alluvium may preserve 'palaeoenvironmental' remains, i.e. evidence of ancient landscapes and environmental conditions such as fluctuating water levels, which together with data on the depths of the underlying deposits such as gravels or clays, gives a framework for an assessment of archaeological potential. Peat represents marshland which developed, in general, during fluctuations in a trend of rising sea level within the last 10,000 years. The acidic nature of peat preserves ancient organic palaeoenvironmental remains extremely well. Palaeoenvironmental remains provide information on the nature of the environment at a particular time in the past, giving a context for human activity. They can include visible organic remains (timber, wood, seeds), and microscopic fossils such as pollen, diatoms and ostracods.

2.1.3 Modelling software (Rockworks & ArcGIS) creates two and three-dimensional deposit models of the buried topography and overlying strata on the site. The depth and distribution of the various deposits is mapped by means of schematic cross-sections showing the thickness of each deposit and the level of the top of each deposit in metres Ordnance Datum (OD), where this is possible.

2.1.4 The modelling software has been used with readily available topographical and British Geological Survey (BGS) geological information, along with the client data obtained from geotechnical investigations on the site to map and characterise sub-surface deposits and former landsurfaces within the site and to provide an assessment of whether they are of potential archaeological/palaeoenvironmental interest

2.1.5 Borehole logs and trial pit descriptions were analysed by a MOLA Geoarchaeologist and the nature, character and thickness of each deposit entered into the modelling software. This includes the depth of the top of each deposit in relation to current ground level (and OD levels where known).

2.1.6 The resulting deposit model has been used to analyse the sequence and distribution of deposits and the landscape position and geological setting of the site. From this zones of higher and lower archaeological/palaeoenvironmental potential have been identified.

2.2 Sources and scope

2.2.1 Table 1 shows the sources consulted. As stated in the introduction, this report presents an analysis of geotechnical data only. It does not include a site walkover inspection. It is outside the scope of the present report to provide a broader assessment of the historic environment. The reader is referred to the main assessment report for this information.

Table 1: Data sources consulted

Source	Description	Number of datapoints	Comments
Previous work at the site	MOLA 2018 archaeological evaluation	4	Power auger boreoholes drilled at ERO18 by MOLA geoarchaeologists.
Previous MOLA boreholes	Recent MOLA works at Guy's Hospital (GUH17)	3	Three power auger boreholes drilled by MOLA geoarchaeologists.
MOLA borehole database	n/a	400	Data held on the MOLA geoarchaeological borehole database, including both previous MOLA investigations and BGS data collected during previous projects.
British Geological Survey (BGS)	Borehole scans available online at: http://www.bgs.ac.uk	51	Historical borehole records, mostly dating to the later 20th century onwards, but some records date back to the 19th century. Quality/resolution of data is variable. Only records that included elevation data and lithological descriptions were included.
TOTAL		458	

2.3 Methodology

2.3.1 In order to create the deposit model the geotechnical data was entered into a digital (Rockworks 15) database.

2.3.2 Each type of deposit was given a unique reference number. By examining the horizontal and vertical relationships of each deposit, correlations were made across the site and the deposits mapped laterally. Where possible, significant ancient landscape features, such as palaeochannels (ancient watercourses) and 'islands' of higher gravels beneath flood alluvium have been identified.

2.3.3 The Rockworks data was transferred to ArcGIS v.10 where the Spatial Analyst Module was used to create maps showing the OD surface level and thickness of the key deposits.

3 The deposits

3.1 Nature of the deposits

3.1.1 Table 2 sets out the main depositional units identified, from ground level down to the base of the sequence.

3.2 Distribution and thickness of deposits

3.2.1 The distribution and thickness of the deposits on the site are shown in the west-east transect shown in Fig 2.

3.2.2 Fig 3 is a topographic plot of the early Holocene surface (i.e. showing the OD level of the top of the underlying solid and drift geology). This formed the ancient land surface at around 10,000 BC and is therefore close to the maximum potential depth of archaeological remains (discounting features cut into the surface, such as pits and ditches).

3.3 Data limitations

3.3.1 There are a total of 4 no. datapoints within the site. All of these reach pre-Holocene deposits allowing the early Holocene topography to be reconstructed. Further data from within the site and its immediate surroundings would improve the overall resolution of the deposit model.

Table 2: Main deposits identified and sequence

No.	Facies / surface	Lithology	Interpretation	Surface level (m OD)	Depth (m bgl)	Thickness (m)
4	Made ground	Variable - typically comprises a surface layer of concrete hardstanding overlying layers of gravel with brick and concrete rubble and disturbed clay.	Made ground deposited as a result of development of the site in the historic and modern eras. Roman and medieval deposits likely to be of high archaeological potential, although modern deposits are probably of little archaeological interest.	At ground surface c +3 to +5m OD		Varies from c.1m to 6m in thickness.
-	Base of truncation	-	Lower limit of modern truncation/disturbance	Highly variable, locally ranging between -2m OD and +3m OD.	Variable, locally ranging between 6m and 1m bgl.	n/a
3	Upper alluvium	Soft silt/clay, occasionally organic or, more rarely slightly sandy. Usually grey is colour, but may be brownish and/or mottled towards the top. Some peat beds present.	Alluvial/intertidal floodplain. Likely to date to later prehistory onwards historic era on the basis of its elevation (Bates and Whittaker 2004; Stafford et al 2012).	Variable depending on level of truncation, but up to +3m OD.	Variable depending on thickness of made ground and level of truncation, but often c.2-3m bgl.	Up to 4m, but variable.
2	Lower alluvium	Soft to firm greenish grey sandy silt/clay or silty fine sand.	Meandering river channel and channel margin environments (e.g. point bars, channel bars and levees). Probably Early to Middle Holocene (Mesolithic to Neolithic) in date.	Typically c.-1m OD.	Generally c.4m bgl.	Upt to 3-4m within the site.
-	Early Holocene surface		The undisturbed surface of the Pleistocene gravels, representing the former topography of the site at the beginning of the Holocene (early Mesolithic period).	Locally varies between -5m and +1m OD, typically at -4.5m OD within the site.	Generally at c.-7.5m bgl within the site, but may be shallower where the surface is higher.	n/a

No.	Facies / surface	Lithology	Interpretation	Surface level (m OD)	Depth (m bgl)	Thickness (m)
1	Pleistocene gravels	Dense, poorly sorted greyish sandy flint gravel.	Late Pleistocene (Palaeolithic) river braid plain under cold climatic conditions, typified by seasonal high-energy river flow as a result of Spring meltwater. Braid plain consists of multiple shifting river channels separated by unstable channel bars and gravel islands. Equivalent to the the Shepperton Gravel Member, although higher gravel deposits nearby may be part of the Kempton Park Gravel Member.	Locally varies between -5m and +1m OD, typically at -4.5m OD within the site.	Generally at c.-7.5m bgl	Not proven within the site, although locally the thickness varies from <2m to >6m.
-	London Clay Formation (bedrock)	Stiff clay	Bedrock geology dating to the early Eocene.	~-6m OD	Not proven within the site, but assumed to be below 9m bgl.	Not proven, although often >15m.

4 Zones of archaeological and palaeoenvironmental potential

4.1.1 On the basis of the location, extent and thickness of the various deposits identified in the deposit model and shown on the plan and transects, the site and its vicinity has been divided up into a number of zones. These are shown on Fig 4 and set out in Table 3, which provides a description of the character of each zone and also notes its likely archaeological and palaeoenvironmental potential.

Table 3: Landscape zones and their archaeological / palaeoenvironmental potential

Zone	Character of zone	Archaeological / palaeoenvironmental potential
LZ1	LZ1 defines an area covering the whole of the site and extending approximately 25m north west and east of the site. This zone represents areas of low-lying river gravels (below -15m OD) overlain by thick Holocene alluvial deposits, including both in-channel sands (the lower alluvium, facies 2) and floodplain alluvium (upper alluvium, facies 3). This zone is likely to have been occupied by active river channels and/or riparian wetlands for most of the Holocene, from the Mesolithic until the historic period.	Since this zone is likely to have been wetland throughout much of the Holocene, archaeological potential is generally low, although there may be potential for isolated waterlogged archaeological finds. Furthermore, made ground dating to the historic period may be present at the site, and may relate to historic reclamation of the area. This zone is likely to be of of high palaeoenvironmental potential, since organic alluvial deposits are likely to preserve indicators of past environmental conditions including pollen, plant macrofossils, diatoms and ostracods, which may have the potential to elucidate past environmental changes, potentially spanning a large portion of the Holocene.
LZ2	LZ2 defines a broad area beyond the north, west and eastern edges of the site. The surface of the floodplain gravel is between -1.5m and +0.5m OD in this zone and, consequently the alluvium(facies 2 and 3) is thinner in this zone. Much of the alluvium in this zone is likely to date to the historic era (Roman period onwards) and, where it survives, may seal earlier archaeological remains.	Where the untruncated surface of the gravels survives, there may be some potential for archaeological remains to survive. Preservation of palaeoenvironmental remains of historic date is possible within the alluvium (facies 5) in this zone, and peat strata, which would be of high palaeoenvironmental potential, may exist along the margins of the former eyots in this zone.
LZ3	LZ3 defines a number of areas where the gravel surface lies above +0.5m OD indicating the location of former eyots; the lower alluvium (facies 2) is typically absent in this zone, whilst the upper alluvium (facies 3) is relatively thin.	Where the gravel surface has not been truncated, archaeological potential is high in LZ3, since the eyots in the Southwark area are likely to have been the focus of occupation from the prehistoric period onwards. Palaeoenvironmental potential is generally likely to be low in this zone, since although alluvium is likely to be present in some places in this zone, it is likely to have been disturbed or oxidised, and of limited vertical extent.

5 Conclusions

5.1.1 This geoarchaeological deposit model has indicated that sediments of palaeoenvironmental potential may be preserved across the site. Archaeological potential is likely to be generally lower, although there may be some potential for isolated waterlogged finds.

5.1.2 The monitoring of any future Site Investigation works, or having access to the records of bore holes and trial pits, would provide additional information on local deposits and their levels, enhance the deposit model and allow a more informed decision to be made by the Local Planning Authority on any requirement for future mitigation towards archaeology on the site.

6 References

Bates, M and Whittaker, K, 2004 *Landscape evolution in the Lower Thames Valley: implications for the archaeology of the earlier Holocene period*, in (J Cotton and D Field eds) *Towards a New Stone Age: aspects of the Neolithic in south-east England*, CBA research report. 50–70, York

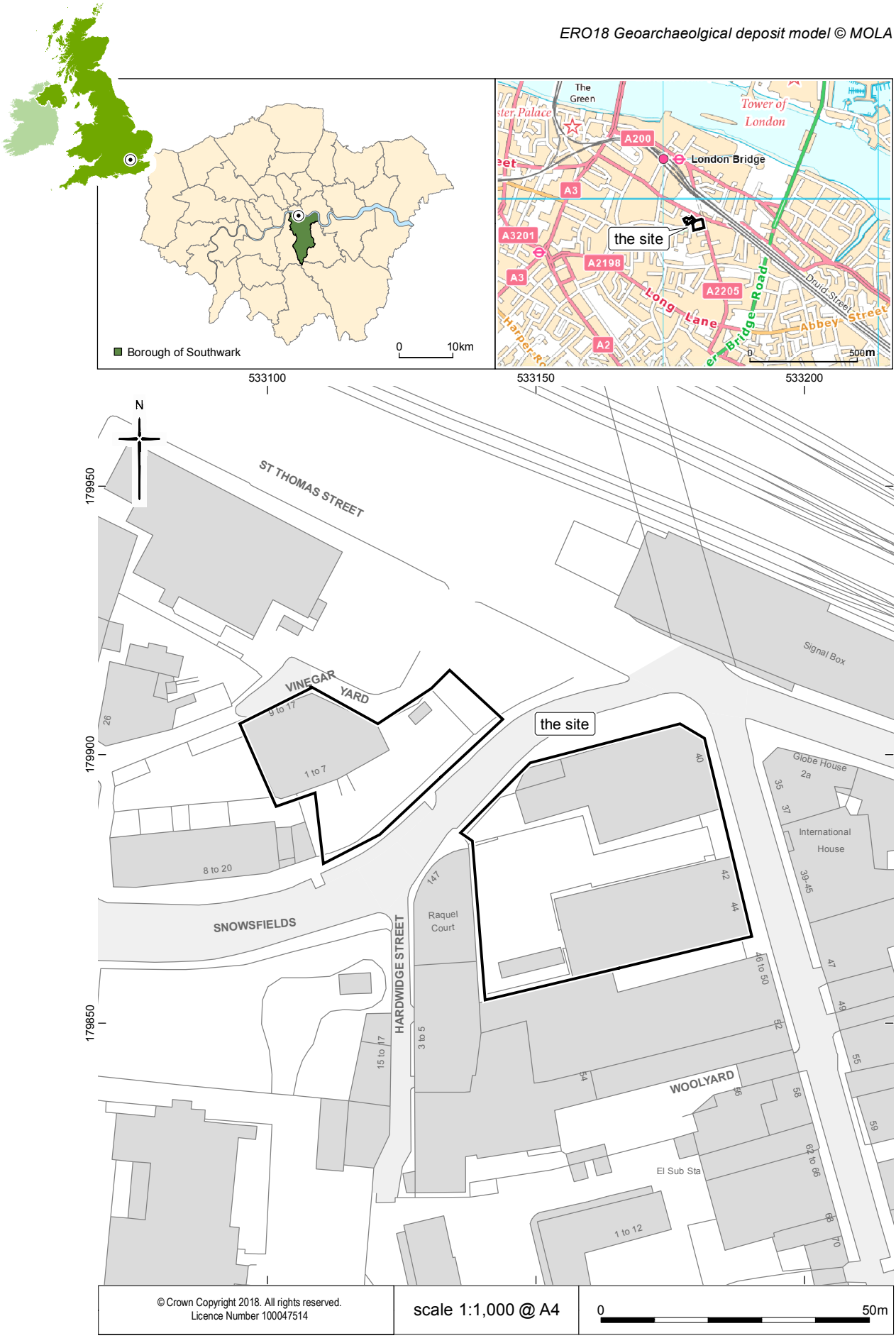

Fig 1 Site location

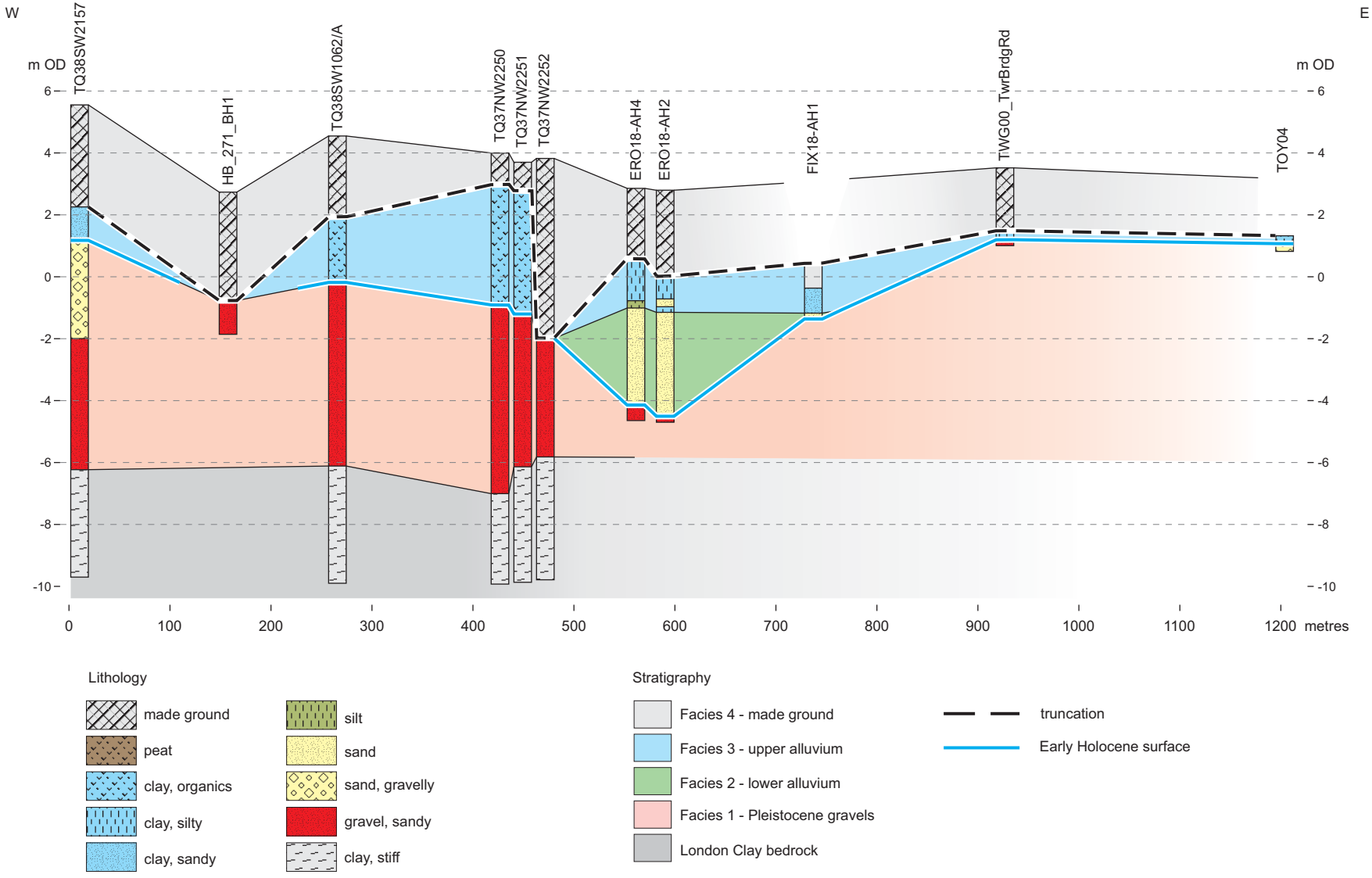

Fig 2 West to east transect across the site

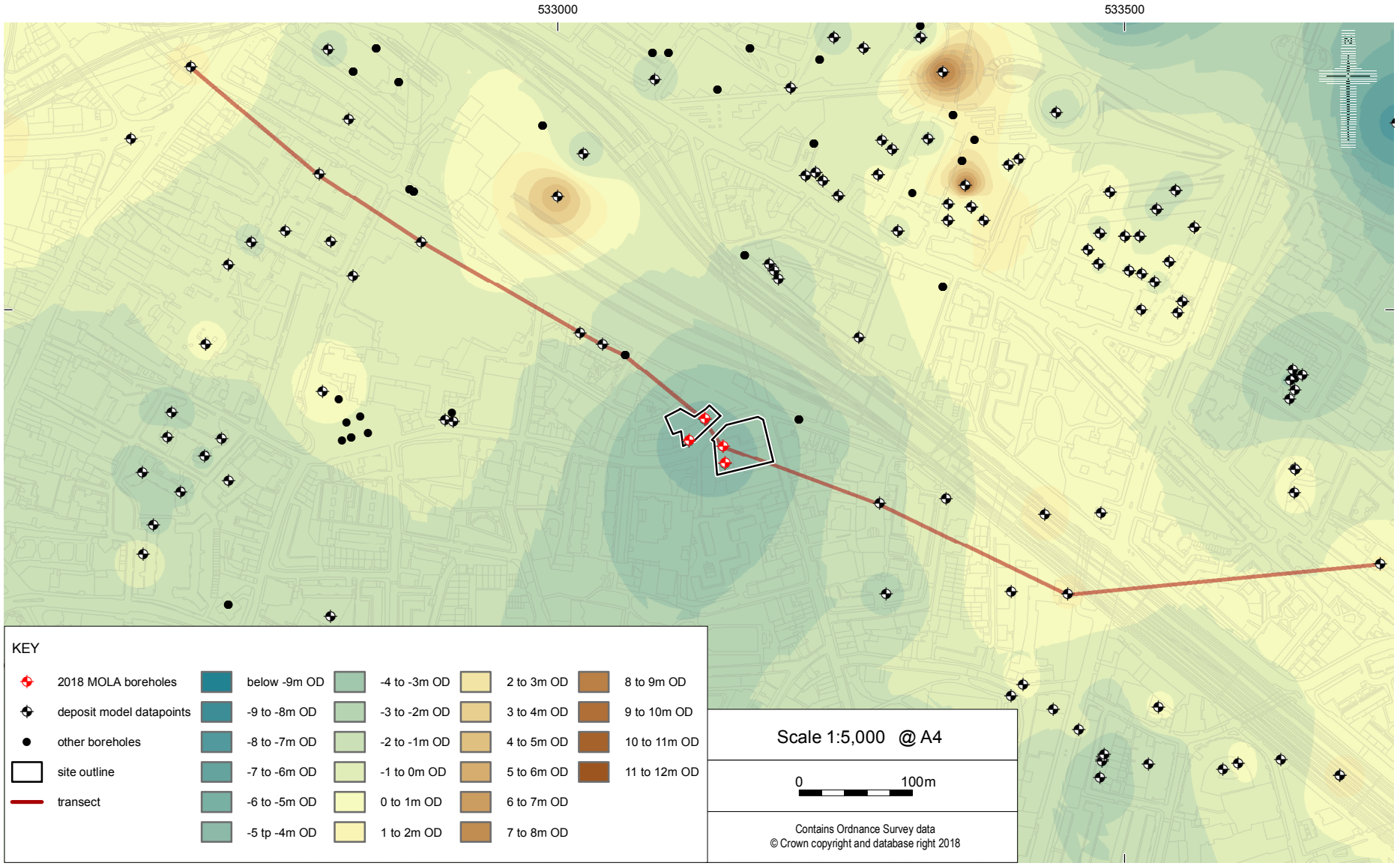

Fig 3 Modelled elevation of the Early Holocene surface

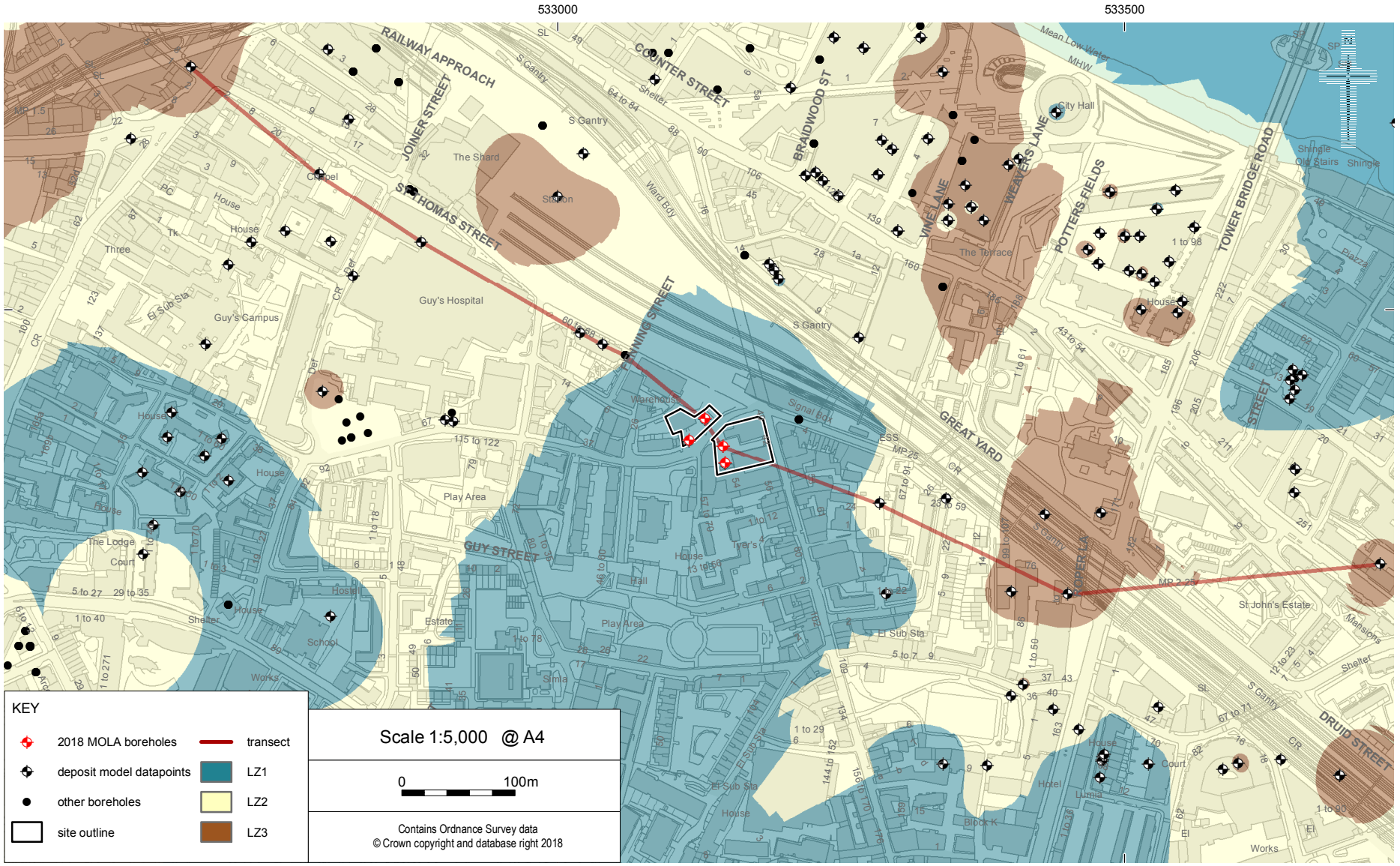

Fig 4 Landscape zones