Waterman Infrastructure & Environment Limited
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The Former Stag Brewery, Mortlake

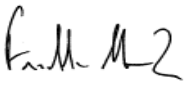
Basement Screening Assessment

Date: August 2022

Client Name: Reselton Properties Limited

Document Reference: WIE18671-100-BSA-16.1.4-RJM

This document has been prepared and checked in accordance with Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015 and BS EN ISO 45001:2018)

Issue	Prepared by	Checked by	Approved by
	Robbie J Moore Senior Consultant	Freddie Alcock Senior Associate	Carl Slater Technical Director Chartered Geologist
1.1.4			

Site and Assessment Verification Form

Site Details

Site Details	Applicant Information
Site Name	The Former Stag Brewery Mortlake
Planning Application reference	22/0900/OUT / 22/0902/FUL
Address and postcode	The Former Stag Brewery, Lower Richmond Road, Mortlake, London SW14 7ET
Brief description of works	Redevelopment of the former Stag Brewery for a residential lead mixed use
Geology type	Made Ground, over Kempton Park Gravel Member over London Clay Formation
Presence of Aquifer	Alluvium and Kempton Park Gravel Member Secondary A Aquifer
Total site area	9.25 ha
Is the site currently known to be at risk of flooding from any sources	The Site is within an area at between 50% and 75% risk of groundwater flooding

Chartered Professional Verification

Professional Details	Application Information
Name	Carl Slater
Profession / area of expertise	Technical Director in Geo-environmental Division, Waterman Infrastructure & Environment Ltd
Chartered institution and membership level	The Geological Society of London, FGS Chartered Geologist
Brief description of assessment involved	Review and signoff of Basement Impact Screening Assessment
Brief summary of assessment results	A Basement Impact Assessment is required to assess potential impact of 2 storey basement
Signature	

1. Introduction

Waterman Infrastructure & Environment Limited ("Waterman") was instructed by Reselton Properties Limited to prepare a Basement Screening Assessment to support two linked planning applications, Application A (22/0900/OUT) and Application B (22/0902/FUL) for the proposed redevelopment of the former Stag Brewery in Mortlake within the London Borough of Richmond upon Thames (LBRuT) (hereafter referred to as "the Site").

The purpose for this screening assessment is to

identify any potential matters that may have an adverse impact and determine if a Basement Impact Assessment is required. If the answer to any of the screening questions is "yes", or is currently unknown, matters relating to that question will need to be addressed as part of a Basement Impact Assessment, (London Borough of Richmond-upon-Thames Basement Assessment User guide, (2021)).

The findings of the Screening Assessment will inform requirement for and scope of the Basement Impact Assessment (BIA).

2. Report Context

Information Sources Relevant to the Site

This report has been completed in-line with Richmond-upon-Thames Basement Assessment User Guidance. The report is supported by a Preliminary Risk Assessment (PRA) for the Site prepared by Waterman in 2018 and last updated in 2022 (*report reference WIE18761-106-R-8.2.1-RJM, dated February 2022*); and a ground investigation report prepared in 2018 (*report reference WIE10667-101-R-4.2.1-RJM, dated February 2018*).

Intrusive ground investigation was undertaken on Site in 2016 by Soil Consultants Ltd and by AECOM in 2015. Groundwater levels and chemical quality data from these investigations have been included within this report.

Requirement for Basement Screening Assessment

Richmond-upon-Thames guidance outlines that a basement screening assessment is required where the Site falls in one of four throughflow catchment areas of Richmond-upon-Thames, or where a Site is in an area identified at greater than 25% susceptibility to groundwater flooding by Surface Flood Risk Assessment (SFRA) data.

An examination of SFRA mapping data for the Site (accessed online August 2022[1]) records the Site is not within a throughflow catchment area. However, the north of the Site is within an area at between 50% and 75% risk of groundwater flooding, with the south of the Site at 75% or greater risk. Therefore, a basement screening assessment is required.

Proposed Development and Planning Context

Planning permission for the development is sought in two parts; detailed planning permission for the eastern half of the Site (Application A) and outline planning permission for the western half of the Site (Application B). These applications seek planning permission for the following:

[1] London Borough of Richmond-upon-Thames Strategic Flood Risk Assessment (accessed online at https://www.richmond.gov.uk/flood_risk_assessment; 2 August 2022)

- **Application A (22/0900/OUT):** a hybrid planning application for the demolition of the majority of buildings (except for the Maltings, the façade of the Former Bottling building and the façade of the Former Hotel) and structures within the Site and the redevelopment of the majority of the former Stag Brewery. To the east of Ship Lane, planning permission is sought in detail for the construction of 549 residential units (as amended), flexible use floorspace, office, cinema, hotel / pub with rooms, and community use, flood defence works, towpath works, landscaping, amenity space, play space, public open space, car and cycle parking, installation of plant and energy equipment, new accesses, internal routes, and various associated works (Development Area 1). To the west of Ship Lane, planning permission is sought in outline (with all matters reserved) for up to 518 residential units (as amended), and various associated works (Development Area 2).
- **Application B (22/0902/FUL):** a detailed planning application for the construction of a six-form entry secondary school with associated sports pitch and play space, floodlighting, landscaping, car and cycle parking, new access routes and associated works to the west of Ship Lane in the area of the Site that is not covered by Application A.

The two Planning Applications are separate but will be linked through a S106 Agreement.

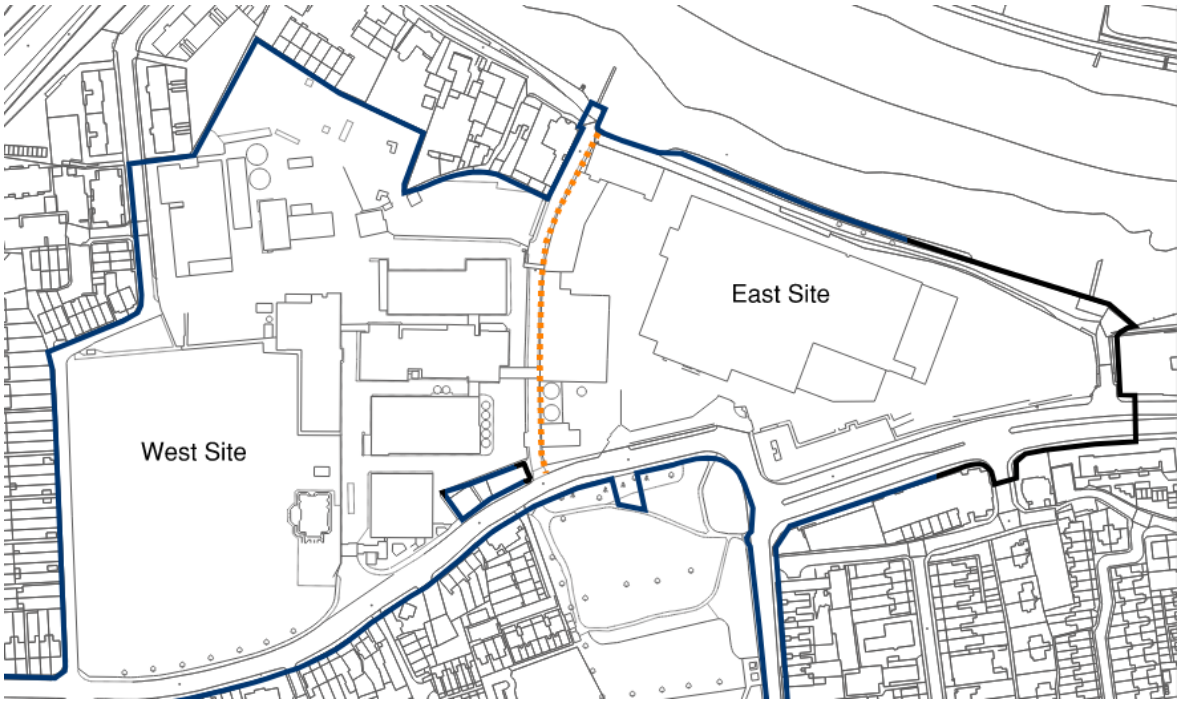
3. Site Details

Site Description

Stag Brewery is at National Grid Reference 520360, 175990, in Mortlake, south-west London. The brewery comprises two adjacent land plots bisected by Ship Lane. The eastern half of the Site is entirely occupied by brewery buildings, with the western half occupied by further brewery buildings in the north and east, and a playing field in the south-west. Thames Water sewers pass beneath the Site; however, these have been decommissioned by backfilling at the Site boundary.

Figure 1 sets out the main development area and shows the west and east parts of the Site. A full Site boundary plan is included in Appendix A.

Figure 1: Main Site Boundary showing east and west areas of the site



Brewing activities ceased in the Site in 2015. Subsequent works have been undertaken to strip out brewery infrastructure from the buildings and external areas such as tanks and electrical cabinets. Partial demolition of the external walls of some structures in the west of the Site has been completed to facilitate removal of larger tanks and other equipment.

Proposed Basement Details

A basement is proposed underlying much of the east site with a proposed development ground level of approximately 6.0m AOD, a smaller basement is proposed in west of the site where proposed ground level will be approximately 6.30m AOD.

The majority of the basement beneath the east of the site will have a formation level of +0.76m AOD. A section of this basement will be double level having a formation of approximately -2.635m OD.

A separate single-storey basement is proposed at the western half of the Site, in the north-east of this area. The formation level for this basement will be +1.45m AOD.

Proposed basement plans are in Appendix A.

Hydrogeology

The Environment Agency classifies the geological deposits underlying the Site as follows:

Table 1: Site Hydrogeology

Stratum	Depth to Top of Stratum (m bgl)	Thickness (m)	EA Classification
Made Ground	0.25 to 0.8	1.5 to 4.6	Not classified
Superficial Deposits (Alluvium and Kempton Park Gravel Member)	1.3 to 4.9	1.4 to 6	Secondary A Aquifer
London Clay Formation	3.7 to 7.6 (1.2 mAOD to -1.7 mAOD)	70m (approximate)	Unproductive Stratum

The Site is not in a groundwater Source Protection Zone. Based on available information, shallow groundwater in the Alluvium and Kempton Park Gravel Member is in hydraulic continuity with the tidal River Thames directly adjacent to the Site.

Recorded Groundwater Levels

The results of ground investigation by AECOM in 2015 recorded groundwater between 1.315 mAOD and 4.025 mAOD bgl. During the 2015 study tidal influence variation of 0.06m was measured over a monitoring period of 2.5 days.

The Soil Consultants 2016 ground investigation included installation of groundwater monitoring wells across the east of the site, targeting the shallow aquifer in the Kempton Park Gravel Member.

Details of groundwater level monitoring are set out in Tables 2 and 3. The AECOM 2015 and Soil Consultants 2016 reports, including the GI plans are included in Appendix B.

Table 2: Groundwater levels, AECOM 2015.

	Groundwater Levels Recorded				
Location	m bgl	m AOD	Location	m bgl	m AOD
BH2 (East)	4.121	1.569	BH9 (West)	1.75	4.025*
BH3 (West)	5.14	1.35	BH10 (West)	4.277	1.558
BH4 (West)	4.83	1.35	BH104B (East)	4.141	1.574
BH5 (West)	4.755	1.33	BH109 (West)	4507	1.633
BH7 (West)	5.11	1.315	BH110 (West)	4.805	1.435
BH8 (West)	4.8.15	1.34	BH111 (West)	5.097	1.313
BH112 (West)	Dry	Dry	BH201A (East)	3.59	1.90

*Likely anomaly and not representative of groundwater levels.

Table 3: Groundwater levels in the east of the Site, Soil Consultants 2016.

Location	Groundwater Levels Recorded	
	m bgl	m AOD
BH1	3.82	1.33
BH2b	3.51	1.45
WS1	4.48	1.64
WS4	4.10	1.75
WS5	3.09	2.67
WS7A (inside building)	4.42	0.81
WS10A	2.30	2.62

4. Screening Assessment

The following categories of information have been considered within the screening assessment:

- Subterranean characteristics
- Land stability (including ground levels and slope)
- Flood risk and drainage

Subterranean Characteristics

Interaction Between Groundwater and Basement Structures

The formation of the deepest basement in the east of the Site will extend to -2.635m OD. The large basement in the east of the site will have a formation of basement of +0.76. The formation of the proposed basement in the west of the Site will have a formation of +1.45m OD

Recorded groundwater information indicates water levels in 2015 and 2016 ranged from 0.81m OD to 2.67m (excluding the result from BH9 in the AECOM 2015 report) within the Alluvium and Kempton Park Gravel Member Secondary A Aquifer.

The London Clay Formation is generally present at between +1.2m and -1.7m OD,

The deeper two-storey basement will terminate in the London Clay Formation and below the site groundwater level. The large single storey basement in the east of the site may be formed below or close to the site groundwater level, whilst the shallower single-storey basement in the west of the Site may be formed below the groundwater level but is less likely to be formed on the London Clay Formation.

Nearby Watercourses, Flood Defence and Drainage Strategy

The Site is adjacent to the tidal River Thames. As part of the development works, the existing flood defence wall which sits at the northern boundary between the Site and the River Thames is to be augmented and raised through construction of a secondary wall. This new barrier will comprise a

sheet pile wall with an in-situ reinforced concrete capping beam behind the existing flood defence and will be set at a minimum of 6.70 m AOD.

Soakaways and other infiltration dissipation methods for surface water are not proposed as part of the development. Surface water drainage will be sent to eight new attenuation tanks to be installed across the Site, with total attenuation capacity of 2,669m^3. Surface water from these tanks would be pumped into the adjacent Thames Water sewers.

Land Stability

Ground Levels

Ground level across the Site is generally flat at around +5.0 to +6.0m OD. In the surrounding area, the ground level continues relatively consistent with the Site to the east, south and west. To the north, ground level trends downwards to the banks of the River Thames about 5m to 15m from the eastern Site boundary at closest point. However, the Thames Path running between the northern Site boundary and the Thames is an engineered structure and is not at risk of stability issues.

The proposed works will retain the area as flat at ground level and will not generate any new slopes at angles greater than 7^o. Where levels are to be built up access ramps of not greater than 1:20 equivalent to a 2.86^o slope are proposed.

Plan showing current ground level and proposed ground level are in Appendix C.

The Site is bounded by residences to the west, and the proposed western Site basement will not be excavated proximal to these dwellings. At the eastern Site, nearby buildings to the south and east are separated from the proposed excavation area by roadways which will provide a buffer between the new basement and these structures.

Trees and Infrastructure

There is no evidence or records of mineral workings or landfilling or raising on site. The Site has been built-up over various phases of redevelopment with associated reworking of ground taking place as is typical of urban industrial sites.

There are no below-ground tunnels or underground rail lines within the Site boundary. All existing sewer and water lines supplying the historical brewery have been cleaned and decommissioned.

Trees are in the northern area of the western Site and will be removed as part of the works to excavate the basement in this area.

Flood Risk and Drainage

Most of the existing Site is covered by hardstanding, with the exception of the playing fields in the west of the West Site. As the playing field is to be largely retained, (except for a small portion of its western extent where the proposed school will be built), excavation of the basement will not alter the impermeable area coverage across the Site.

Eight new attenuation tanks are proposed across the Site, with water discharged to Thames Water sewers. This will ensure additional infiltrations to groundwater from surface water does not occur as a result of the development thereby not increasing the risk of groundwater flooding. A copy of the Drainage Strategy is provided in Appendix D.

5. Conclusions

Guidance provided by the London Borough of Richmond-upon-Thames states that where the basement screening assessment identifies potential impacts from basement development at a Site, a full Basement Impact Assessment should be completed.

Following initial assessment through this report and according to the criteria set out by London Borough of Richmond-upon-Thames guidance, a Basement Impact Assessment will be required for the proposed development.

Basement Impact Assessment Scope

The scope of the Basement Impact Assessment will assess the potential impact for the presence of the basements to cause groundwater flooding due to the formation of the basements below groundwater level. It is assumed the requirement to undertake a BIA would be set as a pre-commencement condition.

APPENDICES

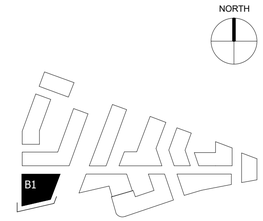
A. Plans

Site layout plans and proposed basement information

Mortlake Crematorium

Project Boundary

Project Details	WIE18671-100: Stag Brewery, Mortlake
Figure Title	Figure 1.4: Project Boundary
Figure Ref	WIE18671-100_GR_ES_1.4A
Date	2022
File Location	\\h-lncs\wiel\projects\wie18671\100\graphics\es\issued figures



KEY

01. BRICK WALLS
02. METAL CLAD ROOF
03. HORIZONTAL CONCRETE BAND
04. CLEAR GLAZING WITH GREY PPC ALUMINIUM FRAMES
05. CLEAR GLAZING WITH BRONZE ANODIZED ALUMINIUM FRAMES
06. GLASS BALUSTRADE
07. METAL BALUSTRADE
08. TEXTURED BRICK DETAIL
09. PROFILED METAL CLADDING
10. BRONZE ANODIZED ALUMINIUM PROFILE
11. COLOURED MOSAIC TILES
12. BRONZE ANODIZED ALUMINIUM CLADDING
13. PRE-CAST CONCRETE CLADDING
14. DECORATIVE FRIEZE
15. ANODIZED ALUMINIUM VENTILATION GRILLS
16. BRASS ANODIZED ALUMINIUM PROFILE
17. CURTAIN WALL
18. PRE-CAST FLUTED CONCRETE CLADDING
19. BILLBOARD

Revision description	Date	Check	Rev
HYBRID APPLICATION - DRAFT	26/02/22	BJ	E
REVISED B01 CINEMA DESIGN	28/09/20	BJ	D
GLA SUBMISSION	27/04/20	BJ	C
DRAFT GLA SUBMISSION	24/01/20	KH	B
FINAL DRAFT PLANNING APPLICATION	21/10/19	KH	A
LEGAL REVIEW	13/09/19	KH	-

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Project

Stag Brewery
Richmond

Drawing

BUILDING 01 - PROPOSED SOUTH ELEVATION

Drawn	Date	Scale
AJ	13/09/19	1 : 100 @ A1 1 : 200 @ A3

Job Number	Drawing number	Revision
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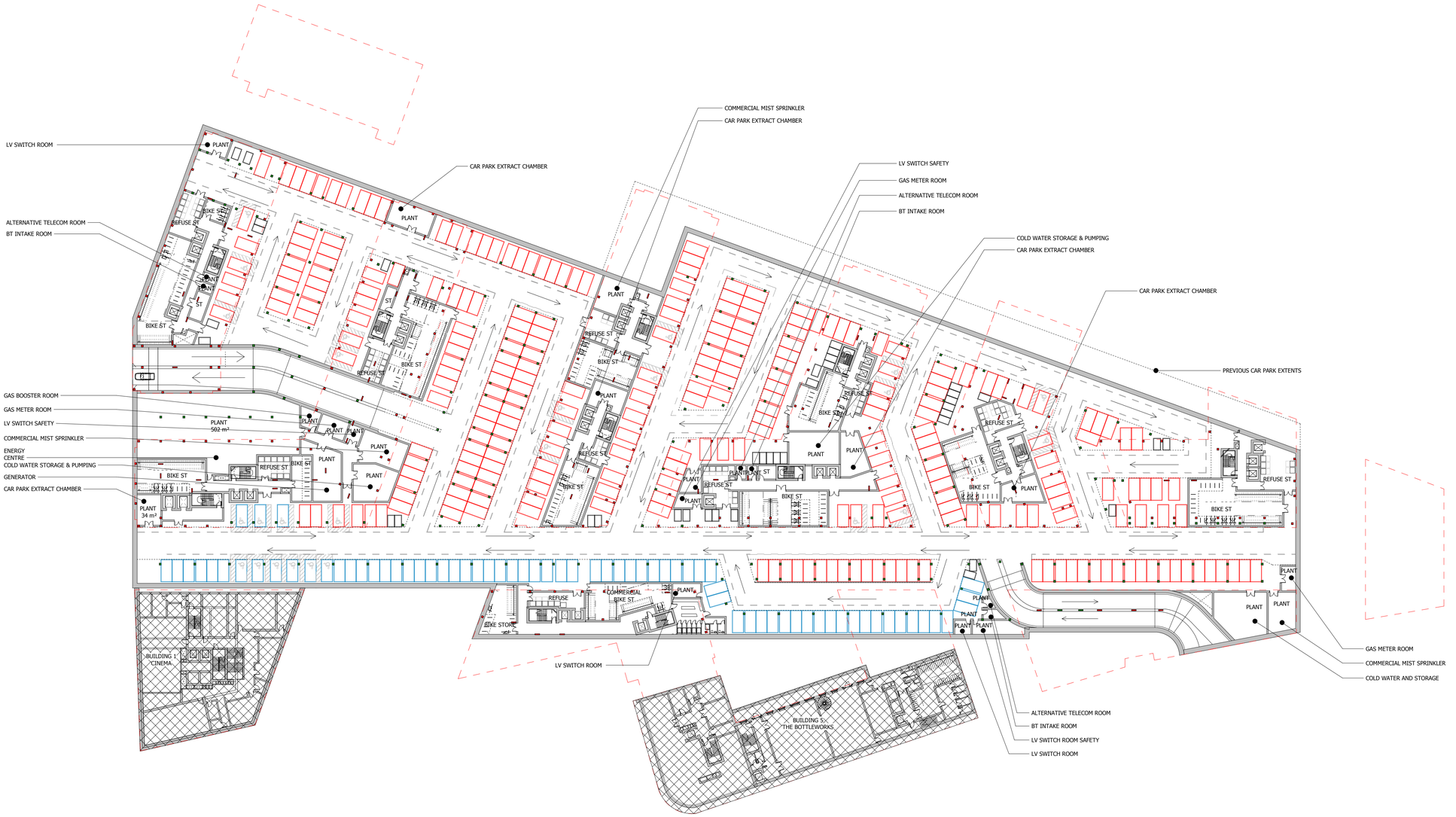


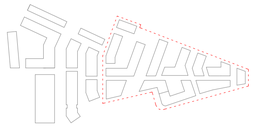
NORTH

0 5 10 25 50 m

NOTES:

DO NOT SCALE FROM THIS DRAWING. ALL DIMENSIONS TO BE CHECKED ON SITE. ALL OMISSIONS AND DISCREPANCIES TO BE REPORTED TO THE ARCHITECT IMMEDIATELY.

NORTH



KEY

- 286 Residential Spaces
- 71 Commercial Spaces
- 39 Motorbike Spaces
- 1,098 Cycle Spaces

Revision description	Date	Check	Rev
BASEMENT REDUCTION EXERCISE	25/05/22	RKB	F
LBRUT 2 APPLICATION	04/02/22	BJ	E
DRAFT FINAL HYBRID SUBMISSION	19/01/22	RKB	D
GLA SUBMISSION	27/04/20	BJ	C
DRAFT GLA SUBMISSION	24/01/20	KH	B
FINAL DRAFT PLANNING APPLICATION	21/10/19	KH	A
LEGAL REVIEW	13/09/19	KH	-

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Project

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Richmond

Drawing

PROPOSED DEVELOPMENT AREA 01
BASEMENT PLAN

Drawn	Date	Scale
RKB	06/09/19	1 : 500 @ A1 1 : 1000 @ A3

Job Number	Drawing number	Revision
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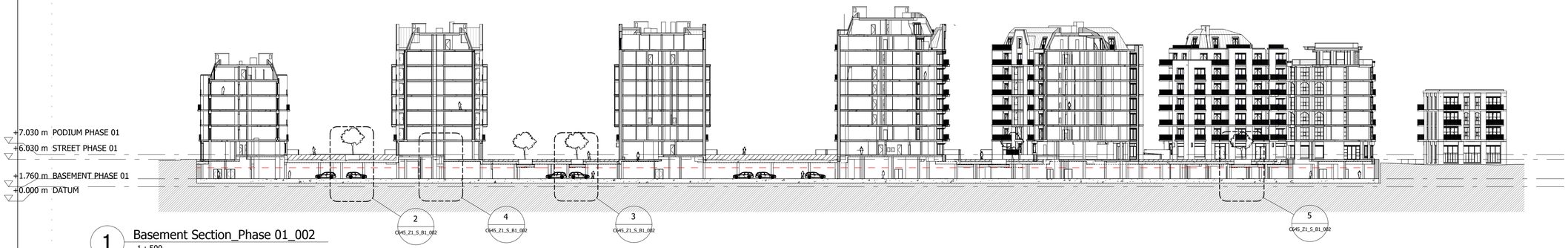
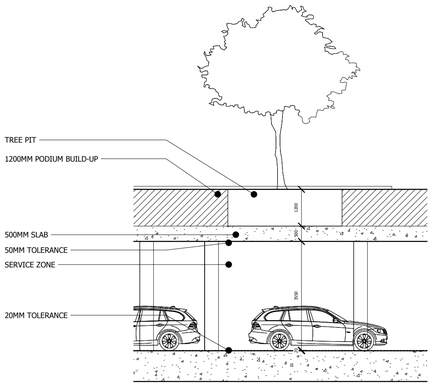
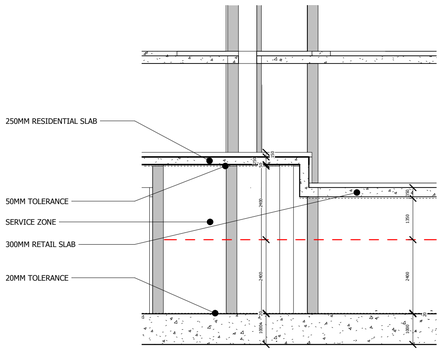


1 Basement Section_Phase 01_002
1 : 500



2 Basement Section_Development Area 01_Podium
1 : 100



4 Basement Section_Development Area 01_Slab Step
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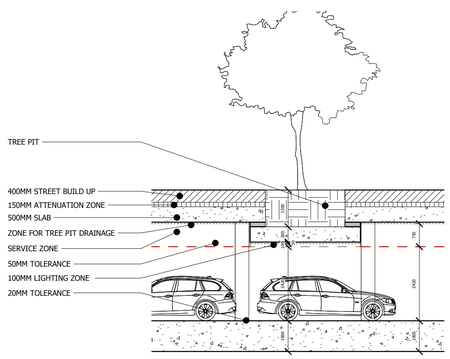

3 Basement Section_Development Area 01_Boulevard
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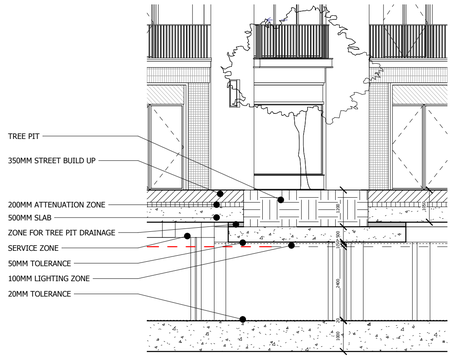

5 Basement Section_Development Area 01_Main Street
1 : 100

0 5 10 25 50 m

NOTES:

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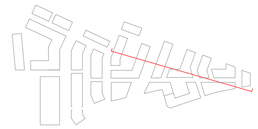
NORTH



Revision description	Date	Check	Rev
DRAFT FINAL HYBRID SUBMISSION	19/01/22	RKB	B
GLA SUBMISSION	27/04/20	BJ	A
PLANNING APPLICATION	29/03/18	BJ	-

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Project
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Drawing
PROPOSED DEVELOPMENT AREA 01
BASEMENT SECTION BB

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KHO	29/03/18	As indicated@ A1 @ A3

Job Number	Drawing number	Revision
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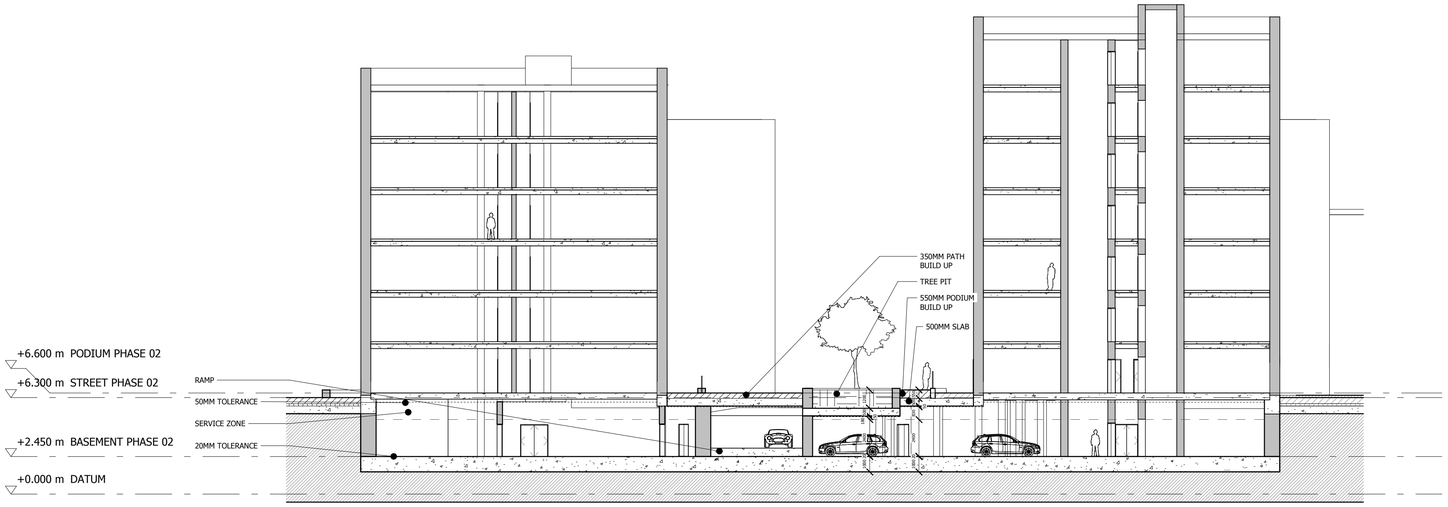

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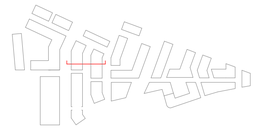

Revision description	Date	Check	Rev
DRAFT FINAL HYBRID SUBMISSION	19/01/22	RKB	B
GLA SUBMISSION	27/04/20	BJ	A
PLANNING APPLICATION	29/03/18	BJ	-

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Drawing

PROPOSED DEVELOPMENT AREA 02
BASEMENT SECTION CC

Drawn	Date	Scale
KHO	29/03/18	1 : 200 @ A1 1 : 400 @ A3

Job Number	Drawing number	Revision
18125	C645_Z2_S_B1_001	B

B. Ground Investigation Reports

AECOM 2015

Soil Consultants Report 2016

Soil Consultants
Ground Investigation
Geotechnical Analysis
Contamination Assessment

REPORT ON PRELIMINARY GROUND INVESTIGATION

PROPOSED REDEVELOPMENT:

STAG BREWERY, LOWER RICHMOND ROAD, MORTLAKE, LONDON SW14 7ET

Client:	**RESELTON PROPERTIES LIMITED**
Agent:	**DARTMOUTH CAPITAL ADVISORS LIMITED**
Engineers:	**WATERMAN STRUCTURES LIMITED** **Pickfords Wharf, Clink Street** **London SE1 9DG**
Report reference:	**10022/OT/JRCB**
Date:	**08 November 2016 (Rev.0)**

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REPORT ON PRELIMINARY GROUND INVESTIGATION

PROPOSED REDEVELOPMENT:

STAG BREWERY, LOWER RICHMOND ROAD, MORTLAKE, LONDON SW14 7ET

DOCUMENT ISSUE STATUS:

Issue	Date	Description	Author	Checked/approved
Rev 0	**08 November 2016**	**First issue**	**Opher Tolkovsky** BSc, MSc, DIC, CGeol, FGS	**John Bartley** BSc, MSc, FGS, CGeol

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APPENDIX

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- Dynamic sample borehole records
- Standard Penetration Test (SPT) results
- SPT hammer energy certificates

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- Plasticity charts
- Particle size distribution results
- Summary of undrained shear strength test results
- Soluble Sulphate/pH results (QTS Environmental)

Ground model/summary plots

- SPT and c_u vs depth
- Depth to top – River Terrace Deposits
- Depth to top – London Clay Formation
- Schematic geological cross sections

Plans & drawings

- Architectural drawings
- Topographical survey drawings
- Site Plan
- Location Maps

1.0 INTRODUCTION

Consideration is being given to the redevelopment of the former Stag Brewery site, Mortlake, which is to be demolished and replaced with educational, commercial, retail, leisure and residential apartment blocks (3-8 storeys) with a single storey basement to provide car parking facilities and plant rooms.

The redevelopment is to be carried out in three phases. The current preliminary exploratory work was restricted to Phases 1 and 2 (east of Ship lane) and this report specifically relates to those areas. However the review of available data does include some historical information within the Phase 3 area which we also comment on for completeness.

In connection with the proposed works, Soil Consultants Ltd (SCL) were commissioned by Dartmouth Capital Advisors Ltd, on behalf of Reselton Properties Ltd (the Client) to carry out a ground investigation to include the following elements:

- Review of existing geological/geotechnical information
- Limited intrusive work (eastern part of the site only) to identify the ground sequence
- Geotechnical and contamination sampling
- Geotechnical laboratory testing
- Factual and interpretative reporting of geotechnical results

This report reviews the existing information available, describes the investigation undertaken and then provides the exploratory and field/laboratory testing records together with preliminary geotechnical recommendations. Contamination/environmental assessment is being undertaken separately by Waterman Infrastructure & Environment (WIE), who have also undertaken the Desk Study of the site.

2.0 SITE DESCRIPTION

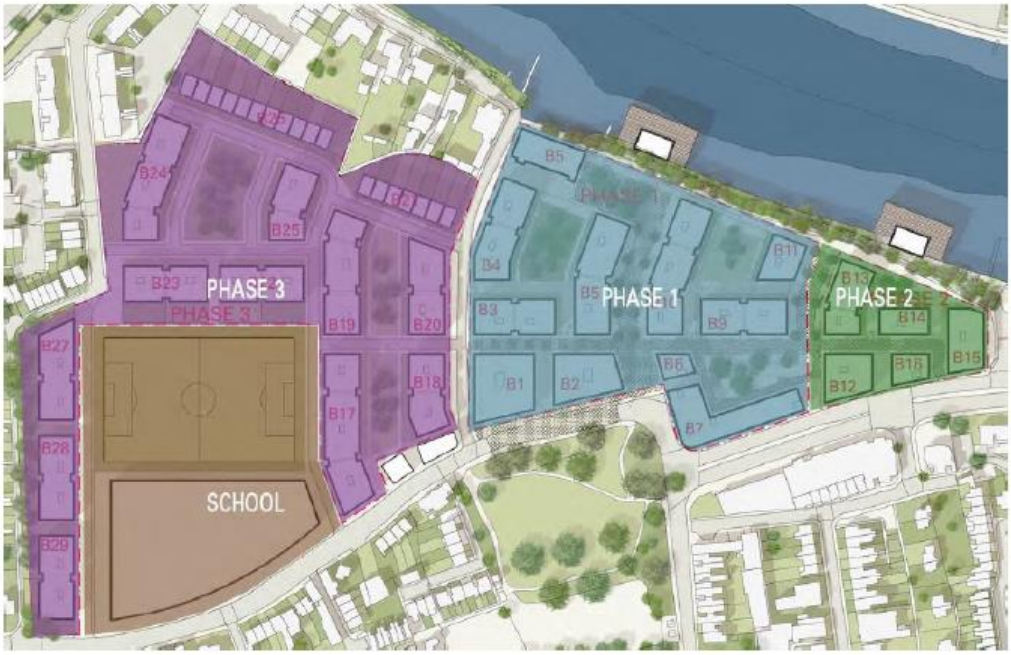
The site is located in Mortlake in the London Borough of Richmond upon Thames and is centred at approximate National Grid reference of 520410E, 176030N. The overall site is bound to the north by River Thames, to the south by Lower Richmond Road/Mortlake High Street, to the west by Williams Lane and to the east by Bulls Alley. The overall site is divided into two by Ship Lane.

The site is a triangular-shaped plot of land which covers an area of approximately 9 hectares (22 acres). The existing site level (shown on APR Services, 'Land Survey', Drawing No. 915213-7, July 2015 - see copy in the Appendix), lies at approximately +4.5m to +6.5mOD with the highest ground to the west falling down to the east. We understand that the proposed site levels will be similar to the existing.

The site contains many disused building with the majority of the remaining areas comprising access roads, loading bays and hardstanding. The bottling plant dominates the eastern half of the site whilst the south-western corner of the site comprises a grassed sports ground. The site is almost totally devoid of vegetation with the exception of a row of large trees (Sycamore or London Plane?) along the western side of Ship Lane, and on the periphery of the sports ground.

The current proposal is to carry out the majority of the development in three phases (Phases 1 to 3) as shown below. Phases 1 and 2 comprise the eastern half of the site, east of Ship Lane and Phase 3 comprises the western half of the site.

Whilst we discuss some elements of previous investigations and historical borehole information which fall into the Phase 3 area, at this stage the exploratory work carried out for this preliminary investigation was restricted to Phases 1 and 2.



3.0 PREVIOUS INVESTIGATIONS

Three previous investigation reports (within the site) have been obtained, which are summarised below.

1. *Soil Consultants Ltd - Project Stabilise, Budweiser Stag Brewing Company Ltd, Ref. 3665/JAD/TSR, January 2004*

    - This investigation comprised 3no boreholes, up to 12.5m deep located in the western site area between the sports ground and Ship Lane.

    - The boreholes proved a succession of made ground followed by localised superficial soils, River Terrace Deposits and the London Clay Formation

    - The made ground was highly variable, including soft clay, attaining a thickness of between 0.8m to 1.7m. At one location this overlay soft sandy clay with scattered gravel extending to about 2.2m depth. Generally dense sand and gravel to between about 5.5m and 6m depth was present in all boreholes. The London Clay Formation was then met, described as firm to stiff becoming stiff grey fissured clay, slightly silty in part and with local brown staining at top, which continued

to the base of the boreholes. Groundwater was recorded within the sand and gravel layer, at between 5.1m and 5.6m depth.

2. *Ground Explorations Ltd – Report on Exploration of ground conditions, Report No. 8320/RSW/vw, June 1980*

   - This investigation comprised 3no boreholes, up to 15.0m deep, located in the eastern part of the site

   - The boreholes proved a succession of made ground followed by River Terrace Deposits (two boreholes) and the London Clay Formation (all three boreholes)

   - The made ground was variable, including granular and cohesive deposits, attaining a thickness of between 1.5m to 4.6m. Generally dense or very dense sand and gravel was present in two of the boreholes to about 5.5m depth. The London Clay Formation was then present, directly beneath the made ground in one borehole, comprising stiff brown fissured clay becoming stiff to very stiff grey fissured silty clay with depth. Groundwater was recorded within the boreholes at between 3.0m and 4.0m depth, with standing water level recorded at 2.6m bgl in BH2

   - The eastern side of the site is indicated in the report to contain infilled basements

3. *AECOM – Phase 2 Environmental Site Assessment Report – Report Ref. 47075502, September 2015*

   - 31no shallow boreholes were drilled to a maximum depth of 6.0m

   - Where penetrated made ground was generally proven across the site to between 1.2m and 2.6m depth; buried obstructions (relict concrete slabs) were encountered at eleven locations, at a maximum depth of 3.6m in one of the boreholes (where the base of the made ground was not proven)

   - Superficial deposits were present beneath the made ground (where penetrated) comprising both soft cohesive soils, extending to a maximum of 2.6m bgl, followed by sands and gravels. The full thickness of the gravel was only recorded in one borehole at about 5m depth

   - The top of London Clay Formation was only proven in one borehole at about 5m depth. AECOM refer to an earlier investigation (2003) which investigated the western half of the site plus the south-western corner of the eastern site area, and this recorded the top of the London Clay at between 6.5m and 6.9m bgl, and at one position it was not present to the base of the BH at 7.2m depth. The report notes, however, that the use of auger drilling techniques means that the depths recorded may not be very accurate.

- Groundwater monitoring indicated water depths range between 3.57m and 5.14m bgl. A small tidal influence of 60mm was measured over a short period of 2.5 days – although it is not stated whether this reflects a spring tide condition where the water range differences between low and high tide are at their highest

4. In addition to the above investigations, several historical BGS borehole records are also available, the most recent and detailed of which are summarised below:

   - TQ27NW/393 – Cementation Ground Engineering borehole from 1972: located in the western part of the site, close to the SCL boreholes described above. Encountered made ground to 1.2m depth followed by soft to firm sandy clay to 1.5m, sand and gravel to 6.4m and stiff London Clay to the base of the borehole at 10.05m. Water strike at 6.1m

   - TQ27NW/394 – Cementation Ground Engineering borehole from 1972: located in the central area of the western part of the site. Encountered made ground to 0.9m depth followed by sand and gravel to 6.85m and stiff London Clay to the base of the borehole at 20.0m. Water strike at 6.1m

   - TQ27NW/398 – Cementation Ground Engineering borehole from 1972: located near Ship Lane in the western part of the site. Encountered made ground to 1.5m depth followed by firm silty clay to 1.85m, sand and gravel to 7.6m and stiff London Clay to the base of the borehole at 15.0m. Water at 4.9m and seepage at 4.55m

   - TQ27NW/924 – Exploration Associates borehole from 1995: located beneath the current bottling plant in the eastern part of the site. Encountered made ground to 1.4m depth followed by sand and gravel to 4.8m and very stiff London Clay to the base of the borehole at 15.0m. Groundwater not encountered during drilling

4.0 CURRENT SCL EXPLORATORY WORK

The SCL fieldwork was carried out in October 2016 and comprised the elements detailed below. The exploratory positions were determined following discussions with Waterman Structures Ltd. Sampling procedure for the environmental samples was in accordance with BS10175 and WI&E requirements. UXO specialist site attendance provided detection/clearance during the works.

Cable percussion boreholes

4no cable percussion boreholes (BH1 and BH2, 2A, 2B) were constructed using a cable percussion drilling rig. A summary of depths and inferred ground levels is given in the table below.

BH	Ground Elevation*	BH depth (below ground level)
1	+5.15m OD	30.00m
2	+4.81m OD	3.60m
2A*	+4.80m OD	3.50m
2B	+4.96m OD	30.00m

(Levels from GPS survey except for 2A whose level was inferred from the site survey drawing)

BH2 and BH2A were terminated due to encountering impenetrable concrete obstructions.

In situ Standard Penetration Tests (SPTs) were undertaken at regular intervals and representative soil samples, both disturbed and relatively undisturbed, collected for description and for testing.

The calibration certificate for the cable percussive drilling rig SPT equipment used indicates that Energy Ratio, Er, of 66% should be used to provide corrected N_{60} values in line with the recommendations given in BS EN 22476-3, 2005, National Annex A.

Dynamic sampler boreholes and dynamic probe tests

15no dynamic (windowless) sampler boreholes (WS1 to WS7, WS7A, WS8, WS8A, WS9, WS9A, WS10. WS10A and WS11) were completed using a small tracked rig, under the supervision of SCL, to depths of up to 5.5m bgl. SPTs were carried out in the natural strata and disturbed samples were taken for subsequent laboratory testing. Several of the boreholes were refused on obstructions within the made ground – WS6 at 0.5m, WS7 at 0.8m, WS7A at 1.4m, WS8 at 1.0m, BH10 at 1.6m, and WS11 at 0.7m depth.

The calibration certificate for the dynamic sampler drilling rig SPT equipment used indicates that Energy Ratio, Er, of 79% should be used to provide corrected N_{60} values in line with the recommendations given in BS EN 22476-3, 2005, National Annex A.

PID testing

PID (photo-ionisation detector) headspace testing was undertaken during the fieldwork on all made ground and shallow natural soil samples, and the results are shown on the relevant exploratory records in the Appendix.

Groundwater and gas installations

50mm ID HDPE monitoring standpipes were installed in most of the boreholes (with the exception of WS3, 6 & 11) into the London Clay Formation, with a filter/response zone generally within the Made Ground, to facilitate water/gas monitoring by Waterman Infrastructure & Environment.

A summary of the borehole installations is provided below:

Summary of pipe installation			
Installation reference (and nominal internal pipe diameter)	***Pipe tip***		***Response zone***
	Depth (m bgl)	***Approx. elevation (m OD)***	***Depth (m bgl)***
BH1	6.00	-0.85	1.00 to 6.00
BH2B	5.00	-0.05	1.00 to 5.00
WS1	5.00	+1.12	1.00 to 5.00
WS2	2.00	+4.10	1.00 to 2.00
WS4	5.00	+0.85	2.00 to 5.00
WS5	5.00	+0.76	2.00 to 5.00
WS7A	1.40	+3.83	0.50 to 1.40
WS8A	2.50	+2.65	1.00 to 2.50
WS9A	3.70	+1.20	1.00 to 3.70
WS10A	4.00	+0.90	1.00 to 4.00

Geotechnical laboratory testing

The following geotechnical laboratory testing was completed:

- Natural moisture content and index properties tests (Atterberg Limits)
- Undrained triaxial testing
- Particle size distribution
- Soluble sulphate/pH analyses (tested by QTS Environmental Ltd)

The borehole records are included in the Appendix, together with a Site Plan which shows the exploratory locations.

5.0 GEOLOGY AND GROUND CONDITIONS

Reference to published 1:50,000 scale BGS map indicates that the site is underlain by Kempton Park Gravel Formation, overlying the London Clay Formation, shown to extend to at least 45m depth in nearby historical boreholes. Alluvium, associated with The River Thames, is shown along the southern bank of The Thames, immediately to the north of the site. Historical BGS borehole from the 19th and early 20th centuries at the brewery site indicate that the London Clay Formation is about 60m thick and the chalk is present (below the Lambeth Group and Thanet Beds) at about 81m to 83m depth below ground level.

The various ground investigations (as discussed in Section 3.0) at the site confirmed the anticipated upper sequence as summarised below. The appended strength/depth graph and cross sections through boreholes should also be referred to as they readily illustrate the sequence.

It must be understood that the following summary is based on generally widely spaced boreholes (up to about 100m) and hence there can be expected to be further variation between these positions.

5.1 Made ground

Hard surfacing across the site comprised concrete (some reinforced) and/or asphalt. The underlying made ground typically ranged in thickness between about 1.0m and 3.0m, but locally, at the west of the site was <1.0m thick. In the extreme east, thicknesses of up to 4.6m of made ground were recorded.

The made ground varied in composition both laterally and vertically over short distances. It generally comprised variable, non-engineered mixtures of grey or brown silty sand, locally clay, and gravel size pieces of mostly concrete, flint and brick but also stone, asphalt, clinker, glass, metal, wood and occasional cobble to boulder size concrete and brick pieces. Obstructions from former structures were commonplace in the eastern part of the site, where made ground thicknesses were the greatest, with likely buried/infilled basements being present. The backfill to numerous service runs can also be expected. Several of the boreholes were terminated within concrete obstructions at this part of the site, between about 3.0m and 3.6m depth bgl.

5.2 Alluvium

Alluvium was recorded beneath the made ground in fourteen of the fifty one borehole records we have reviewed, which includes the current boreholes. Where present, the stratum was 0.35m to 1.5m thick (averaging about 0.9m), reaching depths of between 1.5m and 2.8m bgl, and approximate levels ranging between +3.0mOD and +4.9mOD. The stratum generally comprised brown/dark brown, locally grey/orange mottled clay/sandy clay, with occasional to some flint gravel. Occasional roots were also noted. The consistency of the clay was assessed as generally being soft, locally firm.

The distribution of the alluvium across the site has no discernible trend, being recorded in several boreholes in the southern area of the eastern part of the site, and, more frequently, at various locations across the western half. It is thus likely that this natural stratum has been removed from much of the site by the previous development and is now replaced by made ground.

Plasticity Indices (PI) of 14% and 19% and Liquid Limits of <40% were measured on two samples, indicating the alluvium to be low to intermediate plasticity (BS classification) and a low volume change potential (NHBC classification).

5.3 Kempton Park Gravel

The Kempton Park Gravel was present in almost all boreholes where the made ground was fully penetrated and described as brown or light brown, locally greyish or orange brown mixture of slightly silty/silty sand and gravel, locally clayey or very clayey. The gravel comprised fine to coarse flint.

The stratum attained a thickness of between 1.2m and 5.95m (averaging 3.67m), and where proven, extended to depths of between 3.7m and 7.6m bgl (average of 5.3m). We do not have information on the ground levels at the time of the historical investigations, however, assuming these were similar to the current ground levels these depths correspond to an elevation of approximately +1.2mOD to -0.65mOD across the site, generally rising from west to east. A single borehole record (BGS borehole 398), constructed in the southern central area of the site, identified that the base of the gravel possibly occurs

at about -1.7mOD. This is greater localised depth than recorded elsewhere may be due to either a) a higher ground level being present when the borehole was drilled or b) deeper geological scouring by the gravel.

An indicative plan in the Appendix gives approximate depth zones to the top of the stratum, based on all available boreholes. The top of the gravel stratum beneath the vast majority of the western site, and the central area of the eastern half of the site, are indicated to be in the range of 1m to 2m depth bgl, whilst the western and south-eastern corner of the western half of the site, and both the northern and southern zones of the eastern half are indicated to have a thicker made ground/alluvium, with the top of the gravel stratum occurring at 2m to 3m bgl. Local areas of either shallower or deeper occurrences are also recorded in part of the west and the extreme east of the overall site. In the east (BH GE03) the gravel was absent with the made ground resting upon the London Clay at 4.6m depth.

SPT N_{60} values of between 13 and >50 blows were measured by SCL, indicating a variable medium dense to very dense state of compaction. A few results from the historical boreholes are also available giving a similar range of values, although there is no SPT hammer energy information available to produce a 'corrected' N_{60} values, thus direct comparison with the current results is not possible.

Particle size distribution tests from the SCL boreholes indicated a predominance of sand (between 32% and 93%) with gravel (generally between 5% and 68%), together with low fines (clay and silt) content ranging between 1% and 13%. It should be noted that the drilling through the granular strata necessitated the addition of water which may have washed out some of the fines from the samples with the results that fine particles may be under-represented in the tests.

5.4 London Clay Formation

The London Clay Formation was encountered beneath the Kempton Park Gravel (where penetrated), and at one of the historical boreholes in the east of the site, directly beneath made ground at 4.6m depth. It generally comprised brown/dark brown (weathered) with depth becoming dark greyish brown/grey fissured clay with occasional partings/pockets of silt/fine sand, occasional silty/slightly sandy zones, small infilled burrows, shell fragments and claystone nodules. It was necessary to undertake chiselling techniques to bypass these claystones.

The top of the London Clay was present at between 3.7m and 7.6m bgl (average of 5.3m) depth bgl (about +1.2mOD and -1.7mOD across the site) and a thin layer of reworked clay, up to 0.3m thick, containing flint gravel, was recorded locally. Whilst some of the boreholes recorded the upper zone of the clay to be brown, others did not, which indicates a variable weathered profile. The depth to the top of the London Clay across the site is shown in the indicative zone plan in the Appendix, indicating a deepening from 3m to 4m bgl in the south-east to a depth of 5m to 6m in the north-west across the eastern half of the site. Only limited data are available for the western half of the site (only covering the south-eastern corner), and these indicate depths to the top of the clay to from 5m to 6m range to 7m to 8m depth from south to north.

Plasticity Indices (PI) of >40% and Liquid Limits of >70% were measured, indicating the London Clay to be very high plasticity (BS classification) and a high volume change potential (NHBC classification).

In situ SPTs and triaxial testing indicate that the clay strength increases with depth, from an initially medium to high strength (minimum c_u of around 60kPa) at the top of the stratum, becoming very high strength below about 10m to 15m depth. The strength vs depth profile is shown in the Appendix.

The London Clay was present to the full depth investigated, maximum of 30m bgl in our boreholes at the eastern half of the site (about -25mOD minimum); historical BGS boreholes indicate a thickness of around 60m beneath the site.

5.5 Groundwater

Groundwater inflows were noted within the Kempton Park Gravel in SCL BH1 (at 4.3m sealed out by the casing at 5.0m) and in BH2B (at 3.20m sealed out at 4.15m). In the deeper dynamic sampler boreholes water was recorded at between about 2.9m and 4.5m depth, whilst several of the boreholes remained dry throughout.

The historical BGS boreholes recorded groundwater depths at about 4.5m and 6.1m bgl. The Ground Explorations 1980 investigation reported water at between about 2.6m and 4.0m, and the SCL boreholes of 2004 recorded groundwater within the superficial deposits at between 5.1m and 5.6m depth. More recently, groundwater monitoring by AECOM indicated water depths ranging between 3.57m and 5.14m bgl. A small tidal influence (of 60mm) was measured over a short period of 2.5 days – although it is not stated whether this reflects a Spring tide condition where the water range differences between low and high tide are at their highest.

Standpipe monitoring was undertaken by Waterman following the current investigation fieldwork and the results at the time of writing are summarised below:

Summary of available groundwater monitoring by WIE				
Installation reference	***Approximate pipe base***		***Water depth/level 27 October 2016***	
(all pipe 50mm ID)	***Depth (m bgl)***	***Elevation (m OD)***	***Depth (m bgl)***	***Elevation (m OD)***
BH1	5.87	-0.72	3.82	+1.33
BH2B	4.90	+0.06	3.51	+1.45
WS1	4.70	+1.42	4.48	+1.64
WS2	2.07	+4.01	Dry	N/A
WS4	4.49	+1.36	4.10	+1.75
WS5	3.18	+2.58	3.09	+2.67
WS7A	4.52	+0.71	4.42	+0.81
WS8A	2.42	+2.73	Dry	N/A
WS9A	0.85	+4.05	Dry	N/A
WS10A	3.90	+1.00	2.30	+2.62

Notes:

1) Ground levels from GPS survey
2) Pipe base shown is as measured during monitoring – reflecting some silting up of the installation

There is no current information available for the western half of the site, however, the recorded levels in the eastern half are similar to those recorded historically and we do not anticipate significant variations between the eastern and western halves of the site. Some variability should, however, be expected due

to former structures and geological variations. Seasonal variations and some tidal influence should also be anticipated.

5.6 Environmental observations

No visual or olfactory signs of gross contamination were observed in any of the strata and all PID headspace measurement indicated nil or very low concentrations of volatile hydrocarbons (all <5ppm with the exception of three results, maximum 16.3ppm) within the made ground and upper natural soils. Asbestos containing materials (ACMs) were not visually observed in our boreholes but these are common in made ground and in buildings constructed before 2000. Reference should be made to the WIE report in this regard.

6.0 PRELIMINARY GEOTECHNICAL ASSESSMENT

The overall scheme proposal (Phases 1, 2 and3) is to demolish the existing buildings and infrastructure, and redevelop the site with educational, commercial, retail, leisure and residential apartment blocks, with a single storey basement to provide car parking facilities and plant rooms to the development. A minimum headroom height in the proposed basement is to be approx. 4.0m to 4.5m and a raft thickness of approx. 850mm thick is proposed. The total excavation depth is expected to be up to about 7m, equating to an elevation of approximately -2.0mOD.

There will be a mix of building heights across the site of between 3-8 storeys. The residential blocks are likely to be concrete framed buildings utilising flat slab construction on in situ reinforced concrete columns. The proposed structure for the retail/leisure buildings is envisaged to be steel framed with composite beams and floors.

Available architectural drawings showing the proposed construction are appended.

6.1 Basement excavation and retaining wall

Based on the available borehole records, the excavation for the proposed basement, which is expected to be about 7.0m deep, will generally encounter a sequence of variable made ground, locally followed by alluvium, and then the Kempton Park Gravel. The available borehole records indicate that the London Clay Formation would be encountered at the lower part of the basement excavation, in some areas towards/at the base of the excavation, but at this stage we have insufficient deep borehole information to fully assess the geological sequence at the western half (Phase 3) of the overall site in particular.

Based on limited/partial available information depth to the London Clay Formation appears to deepen (and be at a lower elevation) from east to west within the Phase 1 and 2 area, and within the Phase 3 area it appears to be slightly deeper.

From the historical information and recent monitoring in 2016 (by Waterman), steady-state groundwater levels are expected to be around 1.5m to 3.5m above the formation level, within the superficial deposits and made ground, although this must be verified by further monitoring as levels may rise during wet periods. Limited information available at the time of writing, from a previous investigation by AECOM,

indicates that tidal influences are not thought to be significant, however, we would recommend additional monitoring work is undertake to verify these results, as the monitoring period undertaken previously was only for 2.5 days and it is not clear whether it coincided with the highest tidal range.

As a relatively high groundwater is present we consider that an embedded water-tight retaining wall construction will be required to permit basement excavation and stop any water ingress; a sheet pile or secant bored pile wall will probably be the optimum type. Where the excavation is likely to adversely affect any remaining structures/infrastructure, a robust arrangement of temporary internal bracings/props, including support elements near the top of the basement wall, will be required to maintain wall stability and assist in controlling ground movements. The presence of reported previous basements and deep concrete obstructions, particularly in the eastern half (Phase 1 and 2) of the site, must be considered in the choice of retaining wall and measures to remove the obstructions will have to be carefully considered to avoid installation difficulties.

Careful selection of the appropriate temporary design parameters will be needed, incorporating allowances for factors such as the presence of groundwater and the possibility of soil softening – CIRIA Report C580 provides more detail.

In the permanent case the lateral earth pressures will be supported directly by the piled retaining wall or by a reinforced concrete lining wall cast within the piles. In either case horizontal support to the wall will be provided by the new ground and basement floor slabs.

The following table of coefficients may be used for the preliminary design of the basement retaining wall:

Stratum	Bulk density (Mg/m^3)	Effective cohesion, c′ (kN/m^2)	Effective friction angle, ϕ' (degrees)
Made ground and alluvium	1.80	0	25
Kempton Park Gravel	2.00	0	36
London Clay:			
<5m below basement level	2.00	0	22
>5m below basement level	2.00	5	22

The wall designer should use these parameters to derive the active and passive earth pressure coefficients, Ka and Kp. The determination of appropriate earth pressure coefficients, together with factors such as the pattern of earth pressure distribution, will depend upon the type/geometry of the wall and the overall design approach. Piled walls may of course also be used to provide vertical load capacity if required subject to the necessary allowance being made for interaction effects.

A specialist contractor/structural engineer must be consulted to confirm the most appropriate type of wall and to provide the final wall design.

6.2 Basement raft design

The current proposals are for a very large basement extending beneath the vast majority of the site. We understand that current proposals envisage the use of a reinforced concrete basement raft and consider that this should provide an eminently suitable foundation solution. We recommend that a detailed ground movement analysis is undertaken in due course to provide the design/performance information based on the findings of the ground investigations; such an analysis is outside the scope of this current report.

The basement excavation will involve the removal of approximately 7m of soil, resulting in unloading of about 130kN/m^2. This stress reduction will theoretically result in an element of heave in the London Clay beneath the site. The potential long term effect of this heave in the London Clay as it recovers should be considered during raft design and the raft must clearly be designed to withstand potential forces/movements. The stresses within a large raft will be complex and will be highly dependent on the column spacing and the relative soil and structure stiffnesses. There may be areas of net unload where some heave would be expected, with other areas of net loading where downward settlements will occur. As discussed above, these raft movements should be analysed in due course by a specialist ground movement analysis.

It will also be necessary to consider uplift of the raft due to potential hydrostatic pressures and in this respect the guidelines incorporated in BS8102:2009 should be followed. The raft design will need to take account of potential seasonal fluctuations and/or accidental/tidal and flood conditions. At this stage, subject to further monitoring and detailed hydrogeological assessment (outside our current scope) we consider that a design water level of say 2m below ground level could be used for preliminary design. Based on this water level we consider that a theoretical hydrostatic uplift pressure of 50kN/m^2 should be used for raft design (for a 7m deep excavation). This preliminary value can be regarded as the minimum design uplift pressure for the basement raft. This design water level may need to be agreed with the local building control in due course.

We understand that the site is within Flood Zones 2 & 3 and the potential effects from flooding should also be carefully considered in the design.

6.3 Piled foundations

Piles are envisaged to form the basement retaining walls and may also be required to carry structural loads as part of the retaining wall structure or within other areas of the site. For the ground conditions encountered, with groundwater being present within the superficial soils, we consider that CFA piles are likely to present the optimum type for load-bearing. Obstructions must be expected, some at depth within the made ground and these will require removal prior to piling.

The following table of coefficients may be used for the design of CFA piles, based upon the measured strength/level profile included in the Appendix.

Shaft adhesion

Stratum	Depth/level	Undrained cohesion (from strength profile)	Ultimate unit shaft adhesion 'q_s'
All made ground and natural strata (above basement excavation)	Above 7.0m depth (about -2.0mOD)	Ignore	Ignore
London Clay Formation	Below 7.0 depth (about -2.0mOD)	Increases linearly from 90kN/m^2 at a rate of 9.44kN/m^2/m	Increases linearly from 45kN/m^2 at a rate of 4.72kN/m^2/m (incorporates α = 0.50)

Notes:

a) Unit shaft adhesion 'q_s' = α x c_u (where α = 0.50 and c_u is the undrained cohesion from the design line)

b) The α value of 0.5 is based upon 102mm diameter triaxial tests and this should not be varied

c) The average shaft adhesion over the pile length should be limited to 110kN/m^2

d) The maximum value for unit shaft adhesion should be limited to 140kN/m^2

End bearing

Stratum	Depth/level	Undrained cohesion (from strength profile)	Ultimate unit base resistance 'q_b'
London Clay	Below say 15m depth (-10.0m OD approx)	Increases linearly from 165.5kN/m^2 at a rate of 9.44kN/m^2/m	Increases linearly from 1,489.5kN/m^2 at a rate of 85kN/m^2/m (incorporates Nc = 9)

Notes:

a) Unit base resistance in clay 'q_b' = Nc x c_u (where Nc = 9 and c_u is the equivalent undrained cohesion from the design line)

Using the traditional UK approach, an overall Factor of Safety of 2.6 should be appropriate when applied to these ultimate parameters, in accordance with the LDSA guidelines. Example working loads are provided below:

Pile diameter (mm)	Pile toe depth (m bgl)	Ultimate load (kN)	Working load (kN)
450	15	960	370
	20	1695	650
	25	2600	1000
600	15	1385	530
	20	2395	920
	25	3630	1395
750	15	1860	715
	20	3165	1215
	25	4745	1825
900	15	2395	920
	20	4000	1540
	25	5940	2285

Notes:

a) Working load is calculated using F_{shaft} and F_{base} = 2.6

b) Concrete stress should be considered in the final design

c) Pile length assumes top of pile at 7m depth (approximately -2.0mOD)

d) Pile capacities are given as a guide and are not constituted as design recommendations

Although groundwater inflows were not observed within the London Clay, it is noted that groundwater seepages may occur within the stratum, especially in silty/sandy zones or where claystones are present. Some modification of the pile parameters or downgrading of the pile capacities may be warranted to mitigate the possible risk of clay softening, although this should be minimal with well-installed CFA piles.

Any piles within the heave zone may be subject to an element of uplift as the clay responds to the excavation unloading, with tensile forces being generated within the shaft. The maximum tensile forces will occur if the piles are installed prior to the excavation (for example single piles with plunge columns), but even if installed following the basement excavation they could still be subjected to some tension until the axial loads are applied by the new structure. The final pile design should address the potential tensile forces and appropriate reinforcement should be incorporated.

Eurocode 7 adopts a slightly different approach, applying partial factors to the ultimate pile capacity in accordance with EC7 (BS EN 1997-1:2004 and UK National Annex) for the ultimate limit state GEO Design Approach 1, Combinations 1 and 2. The following partial factors, as recommended in the UK National Annex, are applied:

a] Model Factor, γ_{Rd} = 1.4 (Combinations 1 and 2)

b] Factor on shaft resistance, γ_s = 1.6 (Combination 2)

c] Factor on base resistance, γ_b = 2.0 (Combination 2)

When designing to EC7, the engineer must ensure that the correct comparisons are made between the Design Actions and Design Resistances. Whilst the partial factors address ULS design, serviceability checks should also be carried out.

We recommend that a specialist piling contactor is consulted at an early stage to advise on the most appropriate pile type and to ultimately provide the final pile design. If pile testing is undertaken it is probable that a lower overall factor of safety could be adopted.

6.4 Foundation concrete

Concentrations of soluble sulphates were measured in selected soil and groundwater samples as follows:

- SCL (10no samples): water soluble sulphate range <10 to 251mg/kg and pH 7.4 to 9.3
- Waterman IE (5no samples): water soluble sulphate range 23 to 472mg/kg and pH 8.5 to 11.2
- AECOM (14no groundwater samples): soluble sulphate <2 to 457mg/kg and pH of 7.1 to 8.1

The older results from the previous investigations have not been included in this assessment as there is no reliance on these results.

The above values result in an overall Site Design Class DS-1/AC-1, as provided in BRE Special Digest 1 (2005), Table C2 for cases where soil oxidation is not anticipated (for example for piling). However, the results suggest that the London Clay is probably pyritic at this site, with many of the oxidisable sulphide levels significantly exceeding 0.3%. Our preliminary recommendation is that that buried concrete which is in contact with soils that have been disturbed/potentially oxidised is designed in accordance with ACEC Site Class AC-4.

Further testing (on both water and soil samples) is being undertaken by WIE as part of the environmental assessment which must be reviewed for final design.

6.5 Further geotechnical investigations

Further comprehensive ground investigations and monitoring of water levels will be required prior to final scheme design.

The current preliminary exploratory work was restricted to Phase 1 and 2 (the eastern half of the global site) and within this area there are significant distances of up to 100m between exploratory positions. In addition contractual reliance may not be available upon some information we have reviewed; particularly the Ground Explorations report of 1980; this information will certainly be outside any warranty period. The BGS Borehole data similarly is provided publicly for information purposes only. The majority of the dynamic sampler boreholes are also of insufficient depth to provide much useful geotechnical design information. Therefore, further investigations should comprise a series of deep boreholes to confirm the levels of the various strata and the groundwater regime, in order to provide sufficient pile and basement design information.

In the Phase 3 (western half of the global site) there are very little data which can be relied upon. Presumably the Client can obtain reliance on the data in the SCL 2004 report; we would have no objection to this but again the information will be outside any warranty period. The BGS information should be used for general background information only. Therefore, in this phase a comprehensive geotechnical investigation will be required, essentially across the whole of the area, again comprising a series of deep boreholes to confirm the levels of the various strata and groundwater regime to provide pile and basement construction design information.

Of course these additional investigations can be undertaken in tandem with WIE to efficiently provide the necessary environmental coverage.

As we have discussed above, a detailed ground movement analysis will be required to assess the performance of the proposed raft. In addition, a hydrogeological assessment is likely to be required for final scheme design.

GENERAL INFORMATION, LIMITATIONS AND EXCEPTIONS

Unless otherwise stated, our Report should be construed as being a Ground Investigation Report (GIR) as defined in BS EN1997-2. Our Report is not intended to be and should not be viewed or treated as a Geotechnical Design Report (GDR) as defined in EN1997-2. Any 'design' recommendations which are provided are for guidance only and are intended to allow the designer to assess the results and implications of our investigation/testing and to permit preliminary design of relevant elements of the proposed scheme.

The methods of investigation used have been chosen taking into account the constraints of the site including but not limited to access and space limitations. Where it has not been possible to reasonably use an EC7 compliant investigation technique we have adopted a practical technique to obtain indicative soil parameters and any interpretation is based upon our engineering experience and relevant published information.

The Report is issued on the condition that Soil Consultants Ltd will under no circumstances be liable for any loss arising directly or indirectly from ground conditions between the exploratory points which differ from those identified during our investigation. In addition Soil Consultants Ltd will not be liable for any loss arising directly or indirectly from any opinion given on the possible configuration of strata both between the exploratory points and/or below the maximum depth of the investigation; such opinions, where given, are for guidance only and no liability can be accepted as to their accuracy. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in using this Report.

Comments made relating to ground-water or ground-gas are based upon observations made during our investigation unless otherwise stated. Ground-water and ground-gas conditions may vary with time from those reported due to factors such as seasonal effects, atmospheric effects and and/or tidal conditions. We recommend that if monitoring installations have been included as part of our investigation, continued monitoring should be carried out to maximise the information gained.

Specific geotechnical features/hazards such as (but not limited to) areas of root-related desiccation and dissolution features in chalk/soluble rock can exist in discrete localised areas - there can be no certainty that any or all of such features/hazards have been located, sampled or identified. Where a risk is identified the designer should provide appropriate contingencies to mitigate the risk through additional exploratory work and/or an engineered solution.

Where a specific risk of ground dissolution features has been identified in our Report (anything above a 'low' risk rating), reference should be made to the local building control to establish whether there are any specific local requirements for foundation design and appropriate allowances should be incorporated into the design. If such a risk assessment was not within the scope of our investigation and where it is deemed that the ground sequence may give rise to such a risk (for example near-surface chalk strata) it is recommended that an appropriate assessment should be undertaken prior to design of foundations.

Where spread foundations are used, we recommend that all excavations are inspected and approved by suitably experienced personnel; appropriate inspection records should be kept. This should also apply to any structures which are in direct contact with the soil where the soil could have a detrimental effect on performance or integrity of the structure.

Ground contamination often exists in small discrete areas - there can be no certainty that any or all such areas have been located, sampled or identified.

The findings and opinions conveyed in this Report may be based on information from a variety of sources such as previous desk studies, investigations or chemical analyses. Soil Consultants Limited cannot and does not provide any guarantee as to the authenticity, accuracy or reliability of such information from third parties; such information has not been independently verified unless stated in our Report.

Our Report is written in the context of an agreed scope of work between Soil Consultants Ltd and the Client and should not be used in any different context. In light of additional information becoming available, improved practices and changes in legislation, amendment or re-interpretation of the assessment or the Report in part or in whole may be necessary after its original publication.

Unless otherwise stated our investigation does not include an arboricultural survey, asbestos survey, ecological survey or flood risk assessment and these should be deemed to be outside the scope of our investigation.

APPENDIX

Fieldwork, in-situ testing

- Cable percussion borehole records
- Dynamic sample borehole records
- Standard Penetration Test (SPT) results
- SPT hammer energy certificates

Laboratory testing and monitoring

- Summary of classification test results
- Plasticity charts
- Particle size distribution results
- Summary of undrained shear strength test results
- Soluble Sulphate/pH results (QTS Environmental)

Ground model/summary plots

- SPT and c_u vs depth
- Depth to top – River Terrace Deposits
- Depth to top – London Clay Formation
- Schematic geological cross sections

Plans & drawings

- Architectural drawings
- Topographical survey drawings
- Site Plan
- Location Maps

FOREWORD/GUIDANCE NOTES - CABLE PERCUSSION BORING

GENERAL

The Borehole Records are compiled from the driller's description of the strata encountered, an examination of the samples by our Geotechnical Engineer and the results of in-situ and laboratory tests. Based on this data, the report presents an opinion on the configuration of strata within the site. However, such reasonable assumptions are given for guidance only and no liability can be accepted for changes in conditions not revealed by the boreholes.

BORING METHODS

The Cable Percussion technique of boring is normally employed and allows the ground conditions to be reasonably well established. However, some disturbance of the ground is inevitable, particularly some "softening" of the upper zone of clay immediately beneath a granular soil. The presence of thin layers of different soils within a stratum may not always be detected.

GROUND WATER

The depth at which ground water was struck is entered on the Borehole Records. However, this observation may not indicate the true water level at that period. Due to the speed of boring and the relatively small diameter of the borehole, natural ground water may be present at a depth slightly higher than the water strike. Moreover, ground water levels are subject to variations caused by changes in the local drainage conditions and by seasonal effects. When a moderate inflow of water does take place, boring is suspended for at least 10 minutes to enable a more accurate short term water level to be achieved. An estimate of the rate of inflow is also given. This is a relative term and serves only as a guide to the probable flow of water into an excavation.

Further observations of the water level made during the progress of the borehole are shown including end of shift and overnight readings and the depth at which water was sealed off by the borehole casing, if applicable.

Whilst drilling through granular soils, it is usually necessary to introduce water into the borehole to permit their extraction. When additional water has been used a remark is made on the Borehole Record and the implications are discussed in the text.

SAMPLES

Undisturbed samples of the predominantly cohesive soils are obtained using a 100mm diameter open-drive sampler. In granular soils, disturbed bulk samples are taken and placed in polythene bags. Small jar samples are taken at frequent intervals in all soils for subsequent visual examination. Where ground water is encountered in sufficient quantity, a sample of the ground water is also taken.

IN-SITU STANDARD PENETRATION TESTS

This test is performed in accordance with the procedure given in B.S.1377: 1990. The individual blow count record for each test is given on a separate table. The 'N' value is normally the number of blows to achieve a penetration of 0.3m following a seating distance of 0.15m and is quoted at the mid-depth of the test zone. However if a change of stratum occurs within the test zone then a revised 'N' value is calculated to assess one layer in particular. In hard strata full penetration may not be obtained. In such cases the suffix + indicates that the result has been extrapolated from the limited penetration achieved. Where ground water has affected the measured values, the resultant 'N' value has been placed in brackets since it is unlikely to represent the true in-situ density of the soil.

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**BH1**
Client:	**Reselton Properties Ltd**	Coordinates: 520384E, 175949N	Sheet 1 of 3
Engineer:	**Waterman Structures Ltd**	Ground Level: +5.15mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH commenced: 04/10/2016 BH/casing dia: 150mm BH casing depth: 5.0m							MADE GROUND: concrete [250mm] over compact concrete and brick - driller's decription	
	ES	0.50						
	PID	0.50	0.5					
	ES	1.00						
	PID	1.00	0.7					
Hand excavated inspection pit to 1.20m	D	1.30		1.20	3.95		Soft brown mottled sandy CLAY - driller's description	
	ES	1.50						
	PID	1.50	0.1					
	U	1.55						
				1.85	3.30		Light brown slightly silty gravelly fine to medium SAND. Gravel is subangular to rounded, fine to coarse flint	
Water added between 2.0m and 4.50m to assist drilling	ES	2.00						
	ES	2.50						
	PID	2.50	0.3				*at 2.55m; becoming dense*	
	B	2.55						
	SPT/C	2.55	N=39 N_{60}=43					
				3.15	2.00		Dense light brown slightly silty very sandy GRAVEL. Gravel is subangular to rounded, fine to coarse flint	
	ES	3.50						
	PID	3.50	0.3				*at 3.55m; becoming medium dense*	
	B	3.55						
	SPT/C	3.55	N=25 N_{60}=28					
Groundwater strike at 4.30m [fast flow]; sealed out at 5.0m								
	ES	4.50						
	PID	4.50	0.4					
	D	4.70		4.70	0.45			
	D	4.90		4.90	0.25		Firm dark brown, locally mottled dark grey and reddish brown, CLAY with rare subangular to rounded, fine to medium flint gravel	
	D	5.05		5.05	0.10			
	SPT/S	5.05	N=15 N_{60}=16				Firm dark brown, fissured, CLAY. Occasional light grey staining on fissured surfaces	
	PID	5.50	0.4				Stiff, fissured, dark greyish brown CLAY	
	D	6.00					*at 6.0m; with rare foram fossils*	
	U	6.55					*at 6.55m; locally firm*	
End of shift 04/10/2016 BH depth: 7.0m Groundwater depth: dry								
	D	7.50		7.50	-2.35		Stiff, fissured, dark greyish brown CLAY with frequent pockets and partings of dark grey fine sand and grey silt infilled burrows. Rare white foram fossils	
	D	8.05						
	SPT/S	8.05	N=24 N_{60}=26					
	D	9.00						
	U	9.55						
				10.00	-4.85		Continued on next sheet	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks: 50mm ID standpipe installed to 6.0m

Borehole No: **BH1**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**BH1**
Client:	**Reselton Properties Ltd**	Coordinates: 520384E, 175949N	Sheet 2 of 3
Engineer:	**Waterman Structures Ltd**	Ground Level: +5.15mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
	D	10.50					Very stiff, fissured, dark greyish brown CLAY with frequent pockets and partings of dark grey fine sand and grey silt infilled burrows. Rare white foram fossils	
	D SPT/S	11.05 11.05	N=34 N_{60}=37	11.05	-5.90		Very stiff, fissured, dark greyish brown CLAY	11
	D	12.00					*at 12.0m; with rare foram fossils and grey silt infilled burrows*	12
	U	12.55					*at 12.55m; locally stiff*	
	D	13.50		13.50	-8.35		Very stiff dark greyish brown slightly sandy silty CLAY. Occasional foram fossils and grey silt infilled burrows *between 13.70m and 13.80m; claystone*	13
	D SPT/S	14.05 14.05	N=35 N_{60}=38					14
	D	15.00						15
	U	15.55						
	D	16.50		16.50	-11.35		Very stiff dark greyish brown silty CLAY. Occasional foram fossils and grey silt infilled burrows	16
	D SPT/S	17.05 17.05	N=41 N_{60}=45					17
	D	18.00						18
	U	18.55						
	D	19.50		19.50	-14.35		Very stiff dark greyish brown slightly sandy silty CLAY. Occasional foram fossils and grey silt infilled burrows	19
				20.00	-14.85		Continued on next sheet	20

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks: 50mm ID standpipe installed to 6.0m

Borehole No: **BH1**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**BH1**
Client:	**Reselton Properties Ltd**	Coordinates: 520384E, 175949N	Sheet 3 of 3
Engineer:	**Waterman Structures Ltd**	Ground Level: +5.15mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
	D	20.05					Very stiff dark greyish brown slightly sandy silty CLAY. Occasional foram fossils and grey silt infilled burrows	
	SPT/S	20.05	N=46 N_{60}=51					
	D	21.00						21
	U	21.55						
End of shift 05/10/2016 BH depth: 22.0m Groundwater depth: dry								22
0.5hr chiselling between 22.20m and 22.35m [claystone]	D	22.55					*between 22.20m and 22.35m; claystone*	
	D	23.05						23
	SPT/S	23.05	N=46 N_{60}=51					
	D	24.00						24
	U	24.55						
	D	25.50						25
	D	26.05		26.00	-20.85			26
	SPT/S	26.05	N=51 N_{60}=56				Very stiff dark greyish brown CLAY with occasional white shell fragments	
	D	27.00						27
0.5hr chiselling between 27.40m and 27.60m [claystone]	U	27.55					*between 27.40m and 27.60m; claystone*	
								28
	D	28.75					*at 28.75m; locally silty clay with occasional grey silt infilled burrows*	29
	D	29.55						
BH completed: 06/10/2016 Groundwater depth on removal of casing: 3.90m	SPT/S	29.55	N=46 N_{60}=51	30.00	-24.85		End of hole at 30.00m	30

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks: 50mm ID standpipe installed to 6.0m

Borehole No: **BH1**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**BH2**
Client:	**Reselton Properties Ltd**	Coordinates: 520410E, 175962N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +4.81mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH commenced: 03/10/2016 BH/casing dia: 150mm BH casing depth: 3.45m							MADE GROUND: asphalt (300mm) over crushed concrete with brick, steel and concrete boulders - driller's description	
	ES	0.50						
	PID	0.50	0.7					
	ES	1.00						
	PID	1.00	0.9					
Hand excavated inspection pit to 1.20m	D	1.25						
	SPT/S	1.25	N=71					
	ES	1.50	N_{60}=78					
	PID	1.50	0.8					
1.5hr chiselling at 1.80m [possible concrete slab]								
	ES	2.00						
	PID	2.00	0.6					
1.5hr chiselling at 2.25m [concrete boulder]	D	2.25						
	SPT/C	2.25	N>50*					
Groundwater strike at 2.30m [fast inflow]; not sealed out	ES	2.50						
	PID	2.50	1.0					
	ES	3.00						
	PID	3.00	5.5					
2hr chiselling between 3.40m and 3.60m [possible concrete slab]				3.60	1.21		End of hole at 3.60m	
Borehole terminated on impenetrable concrete slab at 3.60m								

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks: BH backfilled upon completion

Borehole No: **BH2**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**BH2A**
Client:	**Reselton Properties Ltd**	Coordinates: 520651E, 176003N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +4.80mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH commenced 06/10/2016 BH/casing dia: 150mm BH casing depth: 2.0m							MADE GROUND: asphalt (250mm) over pea shingle, plastic pipe fragments and crushed concrete - driller's description	
Hand excavated inspection pit to 1.20m								
				2.00	2.80		MADE GROUND: pea shingle and crushed concrete - driller's description	
Groundwater strike at 2.30m [fast inflow]; not sealed out								
2hr chiselling between 3.45m and 3.50m [possible concrete slab]				3.45 3.50	1.35 1.30		MADE GROUND: concrete slab - driller's description End of hole at 3.50m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks: BH backfilled upon completion

Borehole No: **BH2A**

Soil Consultants

Site & Location:	**Stag Brewery, Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**BH2B**
Client:	**Reselton Properties Ltd**	Coordinates: 520598E, 175976N	Sheet 1 of 3
Engineer:	**Waterman Structures Ltd**	Ground Level: +4.96mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH commenced: 07/10/2016 BH/casing dia: 150mm BH casing depth: 4.15m							MADE GROUND: asphalt [200mm] over compact crushed concrete and brick	
Hand excavated inspection pit to 1.20m				1.25	3.71			
	ES	1.50					Firm orangish brown, mottled dark brown, sandy CLAY with frequent black flecks and rare rounded, fine to medium flint gravel	
	PID	1.50	0.1					
				1.80	3.16			
	B	2.00					Dense orangish brown slightly silty very gravelly SAND. Gravel is subangular to rounded, fine to coarse flint	
	ES	2.00						
	SPT/C	2.00	N=36 N_{60}=40					
	PID	2.00	0.1					
	B	3.00					*at 3.0m; becoming medium dense slightly silty very sandy gravel*	
	ES	3.00						
Groundwater strike at 3.20m [fast flow]; sealed out at 4.15m	SPT/C	3.00	N=14 N_{60}=15					
	PID	3.00	0.1					
				3.75	1.21			
	D	3.90					Soft to firm dark greyish brown CLAY with occasional subrounded, fine to medium gravel	
	D	4.05		4.05	0.91			
	SPT/S	4.05	N=15 N_{60}=16				Stiff, fissured, dark greyish brown CLAY. Rare grey silt infilled burrows	
End of shift 07/10/2016 BH depth: 4.50m Groundwater level: dry	D	4.75						
	U	5.05						
	D	6.00		6.00	-1.04		Stiff, fissured, dark greyish brown CLAY with occasional pockets and partings of dark grey fine sand. Rare foram fossils and grey silt infilled burrows	
	D	6.55						
	SPT/S	6.55	N=23 N_{60}=25					
	D	7.50						
	U	8.05						
0.5hr chiselling between 8.60m and 8.75m [claystone]							*between 8.60m and 8.75m; claystone*	
	D	9.00						
	D	9.55						
	SPT/S	9.55	N=25 N_{60}=28					
				10.00	-5.04		Continued on next sheet	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks: 50mm ID standpipe installed to 5.0m

Borehole No: **BH2B**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**BH2B**
Client:	**Reselton Properties Ltd**	Coordinates: 520598E, 175976N	Sheet 2 of 3
Engineer:	**Waterman Structures Ltd**	Ground Level: +4.96mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
				10.20	-5.24		Stiff, fissured, dark greyish brown CLAY with occasional pockets and partings of dark grey fine sand. Rare foram fossils and grey silt infilled burrows	
	D	10.50					Very stiff dark greyish brown slightly sandy silty CLAY with occasional to frequent foram fossils and grey silt infilled lenses. Occasional pockets and partings of fine dark grey sand	11
	U	11.50						
	D	12.00						12
	D SPT/S	12.55 12.55	N=34 N_{60}=37				*between 12.55m and 13.55m; locally silty clay*	
	D	13.50		13.50	-8.54		Very stiff dark greyish brown slightly sandy silty CLAY. Occasional foram fossils and grey silt infilled burrows	13
	U	14.05						14
	D	15.00					*at 15.0m; with rare fossil shell debris and frequent foram fossils*	15
	D SPT/S	15.55 15.55	N=35 N_{60}=38					16
	D	16.50		16.50	-11.54		Very stiff dark greyish brown silty CLAY. Occasional foram fossils and grey silt infilled burrows	
	U	17.05						17
	D	18.00					*at 18.0m; pocket of pyrite/pyritic sand*	18
0.5hr chiselling between 18.20m and 18.35m [claystone]							*between 18.20m and 18.35m; claystone*	
	D SPT/S	18.55 18.55	N=39 N_{60}=43					19
	D	19.50		19.50	-14.54		Very stiff dark greyish brown slightly sandy silty CLAY. Frequent foram fossils and grey silt infilled burrows	
				20.00	-15.04		Continued on next sheet	20

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks: 50mm ID standpipe installed to 5.0m

Borehole No: **BH2B**

Site & Location:	**Stag Brewery, Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**BH2B**
Client:	**Reselton Properties Ltd**	Coordinates: 520598E, 175976N	Sheet 3 of 3
Engineer:	**Waterman Structures Ltd**	Ground Level: +4.96mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation	
	U	20.05					Very stiff dark greyish brown slightly sandy silty CLAY. Frequent foram fossils and grey silt infilled burrows		
	D	21.00							21
	D	21.55							
	SPT/S	21.55	N=44 N_{60}=48						22
	D	22.50							
	U	23.05							23
	D	24.00							24
	D	24.55							
	SPT/S	24.55	N=47 N_{60}=52						
End of shift 10/10/2016 BH depth: 25.0m Groundwater depth: dry									25
	D	25.50							
	U	26.05		26.00	-21.04		Very stiff dark greyish brown CLAY with occasional white shell fragments		26
	D	27.00							27
	D	27.55							
	SPT/S	27.55	N=49 N_{60}=54						
0.5hr chiselling between 28.00m and 28.15m [claystone]							*between 28.0m and 28.15m; claystone*		28
	D	28.75					*at 28.75m; locally silty clay with occasional grey silt infilled burrows*		29
	U	29.55							
BH completed: 11/10/2016 Groundwater depth on removal of casing: 3.50m				30.00	-25.04		End of hole at 30.00m		30

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Cable Percussion

Remarks: 50mm ID standpipe installed to 5.0m

Borehole No: **BH2B**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**WS1**
Client:	**Reselton Properties Ltd**	Coordinates: 520396E, 176074N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +6.12mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions
BH constructed: 04/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth							MADE GROUND: reinforced concrete
	ES PID	0.50 0.50	0.3	0.50 0.60	5.62 5.52		MADE GROUND: orangish brown very clayey gravel. Gravel is fine to coarse flint
	ES PID	1.00 1.00	0.3				MADE GROUND: dark brown and reddish brown very clayey sandy gravel. Gravel is fine to coarse brick, flint, clinker. Rare pipe fragments
	ES PID	1.50 1.50	0.3				
				2.00	4.12		Orangish brown silty very gravelly SAND. Gravel is subangular to rounded, fine to coarse flint
	D	2.20					
	ES PID	2.50 2.50	0.3				
	D SPT/S	3.00 3.00	N=28 N_{60}=37				*at 3.0m; becoming dense fine to medium sand*
	ES PID	3.50 3.50	0.3				
	D	3.80		3.80	2.32		Dense dark brown, becoming orangish brown, very sandy GRAVEL. Gravel is subangular to rounded, fine to coarse flint
	SPT/S	4.00	N=35 N_{60}=46				
Groundwater strike at about 4.50m	ES PID D	4.50 4.50 4.70	0.2				*at 4.50m; becoming greyish brown slightly gravelly sand*
	SPT/S	5.00	N=21 N_{60}=28				*at 5.0m; becoming medium dense*
				5.50	0.62		End of hole at 5.50m

Backfill / Installation

1 2 3 4 5 6 7

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Dynamic Sampler

Remarks: 50mm ID standpipe installed to 5.0m

Borehole No: **WS1**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**WS2**
Client:	**Reselton Properties Ltd**	Coordinates: 520408E, 176037N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +6.08mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH constructed: 04/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth							MADE GROUND: asphalt (150mm) over reinforced concrete	
				0.40	5.68			
	ES PID	0.50 0.50	0.4				MADE GROUND: light greyish brown very gravelly sand. Gravel is fine to coarse concrete and flint	
				0.70	5.38			
							MADE GROUND: orangish brown slightly clayey sandy gravel. Gravel is fine to coarse flint and occasional concrete	
	ES PID	1.00 1.00	0.4					
							at 1.40m; concrete cobble	
	ES PID	1.50 1.50	0.3					
							between 1.65m and 1.80m; locally dark grey	
							at 1.80m; becoming dark greyish brown sand	
	D SPT/S	2.00 2.00	N=28 N_{60}=37	2.00	4.08		Dense orangish brown slightly to very sandy GRAVEL. Gravel is subangular to angular, fine to coarse flint. Locally clayey to very clayey	
	ES PID	2.50 2.50	0.2					
	SPT/S	3.00	N=34 N_{60}=45					
	ES PID	3.50 3.50	0.3				*at 3.50m; becoming very sandy gravel*	
	D SPT/S	4.00 4.00	N=44 N_{60}=58				*at 4.0m; becoming very dense*	
	ES PID	4.50 4.50	1.5					
							at 4.90m; becoming dark grey. Medium dense at 5.0m	
BH dry upon completion	ES SPT/S	5.00 5.00	N=22 N_{60}=29					
	PID	5.00	0.8					
				5.50	0.58		End of hole at 5.50m	

Backfill / Installation: 1 2 3 4 5 6 7

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Dynamic Sampler

Remarks: 50mm ID standpipe installed to 2.0m

Borehole No: **WS2**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**WS3**
Client:	**Reselton Properties Ltd**	Coordinates: 520447E, 176074N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +5.67mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH constructed: 04/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth							MADE GROUND: asphalt (150mm) over dark greyish brown slightly silty very gravelly sand. Gravel is fine to coarer limestone, flint and concrete	
	ES PID	0.50 0.50	0.4	0.50	5.17		MADE GROUND: dark brown gravelly clay. Gravel is fine to coarse brick, flint and chalk	
							at 0.80m; becoming orangish brown clayey gravelly sand. Gravel is brick and flint	
				1.00	4.67		Orangish brown silty slightly gravelly, locally gravelly to very gravelly, SAND. Gravel is subangular to rounded, fine to coarse flint	1
	ES PID D	1.50 1.50 1.60	0.3					
	SPT/S	2.00	N=23 N_{60}=30				*at 2.0m; becoming dense*	2
	ES PID D	2.50 2.50 2.70	1.8					
	SPT/S	3.00	N=32 N_{60}=42					3
	ES PID D	3.50 3.50 3.70	8.8					
	SPT/S	4.00	N=9 N_{60}=12	4.00	1.67		Medium dense dark brownish grey slightly gravelly SAND. Gravel is subangular to rounded, fine to medium flint	4
							at 4.20m; becoming dark grey with rare flint	
	ES PID D	4.50 4.50 4.70	1.3					
BH dry upon completion	SPT/S	5.00	N=35 N_{60}=46				*at 5.0m; becoming dense*	5
				5.50	0.17		End of hole at 5.50m	6 7

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Dynamic Sampler

Remarks: BH backfilled upon completion

Borehole No: **WS3**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**WS4**
Client:	**Reselton Properties Ltd**	Coordinates: 520431E, 176031N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +5.85mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH constructed: 04/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth							MADE GROUND: asphalt (200mm) over dark brown silty very sandy gravel. Gravel is limestone, brick and rare flint	
	ES PID	0.50 0.50	0.8					
				0.80	5.05		MADE GROUND: dark brown and black slightly sandy slightly gravelly clay. Gravel is fine to coarse clinker, brick and flint *at 0.90m; becoming light greyish brown*	
	ES PID	1.00 1.00	0.3					
	ES PID	1.50 1.50	0.3					
				1.70	4.15		MADE GROUND: dark brown grey slightly sandy slightly gravelly clay. Gravel is fine to medium clinker, brick and rare concrete fragments	
	ES PID	2.00 2.00	0.5	2.00	3.85		Light brown slightly, locally very, gravelly SAND. Gravel is subangular to angular, fine to coarse flint	
	D	2.30						
	ES PID	2.60 2.60	1.3				*at 2.60m; locally stained black*	
	D SPT/S	3.00 3.00	N=38 N_{60}=50				*at 3.0m; becoming very dense*	
	ES PID	3.50 3.50	4.2					
	SPT/S	4.00	N=17 N_{60}=22				*at 4.0m; becoming medium dense*	
	ES PID D	4.50 4.50 4.70	3.4					
	SPT/S	5.00	N=9 N_{60}=12	5.00	0.85		Firm dark brown CLAY	
BH dry upon completion	D	5.50		5.50	0.35		End of hole at 5.50m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Dynamic Sampler

Remarks: 50mm ID standpipe installed to 5.0m

Borehole No: **WS4**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**WS5**
Client:	**Reselton Properties Ltd**	Coordinates: 520429E, 175972N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +5.76mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH constructed: 03/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth							MADE GROUND: asphalt (100mm) over greyish brown sandy gravel of concrete	
	ES PID	0.50 0.50	2.0	0.50	5.26		MADE GROUND: light grey and pinkish grey clayey sandy gravel. Gravel is fine to coarse limestone and occasional brick	
	ES PID	1.00 1.00	0.4	1.20	4.56		MADE GROUND: dark brown slightly sandy slightly gravelly clay. Gravel is fine to coarse brick	
	ES PID	1.50 1.50	0.5					
	ES PID	2.00 2.00	0.5	2.20	3.56		Firm brownish grey slightly gravelly slightly sandy CLAY. Gravel is subangular to rounded, fine to coarse flint. Occasional root traces	
	D	2.30						
	ES PID	2.50 2.50	0.8	2.80	2.96		Medium dense orangish brown, becoming yellowish brown, slightly silty SAND with rare subangular to rounded, fine to coarse flint gravel	
	SPT/S D	3.00 3.10	N=16 N_{60}=21					
	ES PID	3.50 3.50	1.1					
	SPT/S	4.00	N=40 N_{60}=53				*at 4.0m; becoming very dense*	
Groundwater strike at about 4.50m	ES PID D	4.50 4.50 4.60	16.3				*at 4.50m; becoming slightly silty very gravelly sand*	
				5.00	0.76		End of hole at 5.00m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Dynamic Sampler

Remarks: 50mm ID standpipe installed to 5.0m

Borehole No: **WS5**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**WS6**
Client:	**Reselton Properties Ltd**	Coordinates: 520477E, 176066N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +5.22mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH constructed 05/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth							MADE GROUND: concrete	
BH refused at 0.50m				0.50	4.72		End of hole at 0.50m	

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Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Dynamic Sampler

Remarks: BH backfilled upon completion

Borehole No: **WS6**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**WS7**
Client:	**Reselton Properties Ltd**	Coordinates: 520486E, 176003N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +5.23mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH constructed 05/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth							MADE GROUND: reinforced concrete slab	
	ES	0.70		0.60	4.63		MADE GROUND: dark greyish brown very sandy gravel. Gravel is fine to coarse brick and flint. Locally clayey to very clayey	
BH refused at 0.80m	PID	0.70	0.1	0.80	4.43		End of hole at 0.80m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Dynamic Sampler

Remarks: BH backfilled upon completion

Borehole No: **WS7**

Soil Consultants

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**WS7A**
Client:	**Reselton Properties Ltd**	Coordinates: 520486E, 176003N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +5.23mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH constructed 05/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth				0.25	4.98		MADE GROUND: concrete	
	ES PID	1.00 1.00	0.3				MADE GROUND: dark grey clayey sandy gravel. Gravel is fine to coarse concrete, metal and clinker	
BH refused at 1.40m				1.40	3.83		End of hole at 1.40m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Dynamic Sampler

Remarks: 50mm ID standpipe installed to 1.40m

Borehole No: **WS7A**

Soil Consultants

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**WS8**
Client:	**Reselton Properties Ltd**	Coordinates: 520583E, 176026N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +5.15mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH constructed 03/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth							MADE GROUND: concrete	
				0.70	4.45		MADE GROUND: orangish brown slightly silty sandy gravel. Gravel is fine to coarse flint	
Bh refused at 1.0m	ES SPT/S PID	1.00 1.00 1.00	 N>50* 0.7	1.00	4.15		End of hole at 1.00m	

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Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Dynamic Sampler

Remarks: BH backfilled upon completion

Borehole No: **WS8**

Soil Consultants

Site & Location:	**Stag Brewery, Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**WS8A**
Client:	**Reselton Properties Ltd**	Coordinates: 520583E, 176026N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +5.15mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH constructed 12/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth							MADE GROUND: concrete	
				0.70	4.45		MADE GROUND: brown silty sandy gravel. Gravel is fine to coarse concrete and rare flint	
				1.00	4.15		MADE GROUND: brown and orangish brown sandy gravel. Gravel is fine to coarse flint and occasional concrete	
	ES PID	1.50 1.50	0.4					
	ES PID	2.00 2.00	0.2				*at 2.0m; becoming brownish grey very clayey sandy gravel*	
							at 2.30m: recovered as fine to coarse brick fragments - possible buried structure	
				2.40	2.75			
BH refused at 2.50m	ES PID	2.50 2.50	0.3	2.50	2.65		Orangish brown sandy GRAVEL. Gracvel is subangular to subrounded, fine to coarse flint End of hole at 2.50m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Dynamic Sampler

Remarks: 50mm ID standpipe installed to 2.50m

Borehole No: **WS8A**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**WS9**
Client:	**Reselton Properties Ltd**	Coordinates: 520517E, 175966N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +4.89mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH constructed 03/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth							MADE GROUND: asphalt (200mm) over concrete	
BH refused at 0.50m				0.50	4.39		End of hole at 0.50m	

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Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

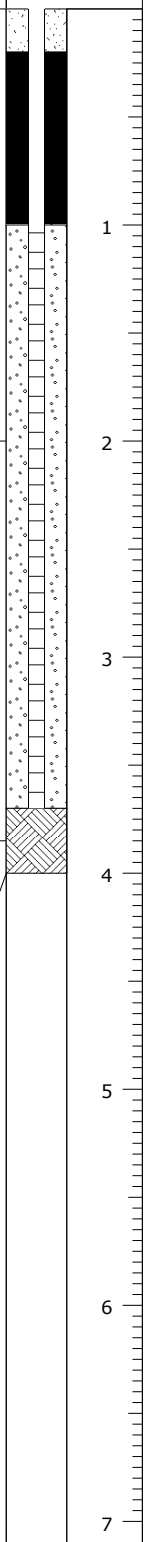
Borehole type: Dynamic Sampler

Remarks: BH backfilled upon completion

Borehole No: **WS9**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**WS9A**
Client:	**Reselton Properties Ltd**	Coordinates: 520517E, 175966N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +4.89mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests Type	Samples & Tests Depth (m)	Field Test Results	Strata Depth (m)	Strata Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH constructed 12/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth							MADE GROUND: dark brown clayey very sandy gravel. Gravel is fine to coarse flint, brick and clinker	
							at 1.60m; becoming orangish brown, grey, brown mottled slightly sandy slightly gravelly clay. Gravel is fine to coarse flint and rare brick	
	ES	2.00		2.00	2.89		Medium dense light brown silty slightly gravelly, locally very clayey, SAND. Gravel is subrounded to rounded, fine to coarse flint	
	SPT/S	2.00	N=10 N_{60}=13					
	PID	2.00	0.4					
	D	2.50						
Groundwater standing at about 2.90m upon completion							*at 2.90m; becoming orangish brown sandy gravel*	
	ES	3.00					*at 3.0m; becoming dense*	
	SPT/S	3.00	N=34 N_{60}=45					
	PID	3.00	2.9					
	D	3.50						
	HV	3.80	70	3.85	1.04		Firm dark grey, orangish grey and reddish grey mottled CLAY	
	D	3.90					*at 3.90m; becoming dark grey clay*	
	HV	3.90	60	4.00	0.89		End of hole at 4.00m	



Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Dynamic Sampler

Remarks: 50mm ID standpipe installed to 3.70m

Borehole No: **WS9A**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**WS10**
Client:	**Reselton Properties Ltd**	Coordinates: 520615E, 176024N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +4.92mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH constructed 03/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth				0.25	4.67		MADE GROUND: reinforced concrete	
	ES PID	0.50 0.50	1.1				MADE GROUND: dark grey sandy gravel. Gravel is fine to coarse concrete, brick and flint. Locally slightly clayey	
	ES PID	1.00 1.00	0.5					
BH refused at 1.60m	ES PID	1.50 1.50	0.5	1.60	3.32		End of hole at 1.60m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Dynamic Sampler

Remarks: BH backfilled upon completion

Borehole No: **WS10**

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**	Borehole No:	**WS10A**
Client:	**Reselton Properties Ltd**	Coordinates: 520615E, 176024N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +4.92mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH constructed 12/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth							MADE GROUND: grey sandy gravel. Gravel is fine to coarse concrete and rare brick	
	ES PID	2.50 2.50	 0.3	2.50	2.42		Light brown silty SAND and GRAVEL. Gravel is subangular to rounded, fine to coarse flint	
	D SPT/S	3.00 3.00	 N=37 N_{60}=49				*at 3.0m; becoming dense*	
	ES PID	3.50 3.50	 3.5	3.70	1.22		Stiff, locally firm, dark brownish grey CLAY	
	D HV HV	3.80 3.80 3.90	 75 70					
Groundwater standing at about 4.50m upon completion	D HV HV	4.50 4.50 4.70	 75 88					
	HV D	4.90 5.00	94 	5.00	-0.08		End of hole at 5.00m	

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Dynamic Sampler

Remarks: 50mm ID standpipe installed to 4.0m

Borehole No: **WS10A**

Soil Consultants

Site & Location:	**Stag Brewery,** **Lower Richmond Road, Mortlake, London SW14 7ET**		Borehole No: **WS11**
Client:	**Reselton Properties Ltd**	Coordinates: 520598E, 175976N	Sheet 1 of 1
Engineer:	**Waterman Structures Ltd**	Ground Level: +4.96mOD	Report No: 10022/OT

Progress & Observations	Samples & Tests: Type	Samples & Tests: Depth (m)	Field Test Results	Strata: Depth (m)	Strata: Level (m)	Legend	Strata Descriptions	Backfill / Installation
BH constructed 03/10/2016 BH dia: 100mm from GL to 1.0m, reducing with depth							MADE GROUND: asphalt (300mm) over dark greyish brown sandy gravel. Gravel is fine to coarse concrete, and rare brick and clinker	
	ES PID	0.50 0.50	0.3					
BH refused at 0.70m				0.70	4.26		End of hole at 0.70m	

1
2
3
4
5
6
7

Key: U = Undisturbed B = Bulk D = Small disturbed W = Water ES = glass jar & plastic tub E = glass jar SPT/S = split spoon SPT/C = solid cone PP = Pocket Penetrometer [kg/cm²] HV = Hand Vane [kPa] PID = Photo Ionisation Detector [ppm - Isobutylene Equivalent, PhoCheck Tiger, 10.6eV lamp] * = full SPT penetration not achieved - see summary sheet

Borehole type: Dynamic Sampler

Remarks: BH backfilled upon completion

Borehole No: **WS11**

SPT Calibration Report

EQUIPE GROUP
www.equipegroup.com

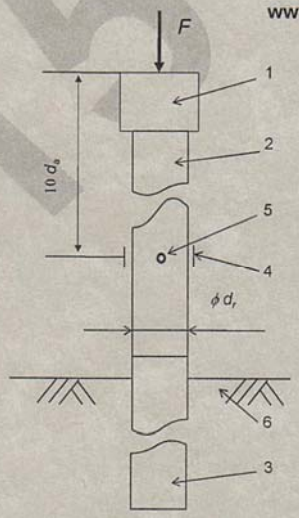
Hammer Energy Measurement Report

Type of Hammer	SPT HAMMER
Client	GEH GROUNDWORKS
Test No	EQU1367_5
Test Depth (m)	7.59
Date of Test	16 October 2015
Valid until	15 October 2016
Hammer ID	GEH2

Mass of the hammer m = 63.5kg
Falling height h = 0.76m
E_{theor} = $m \times g \times h$ = 473J

Characteristics of the instrumented rod

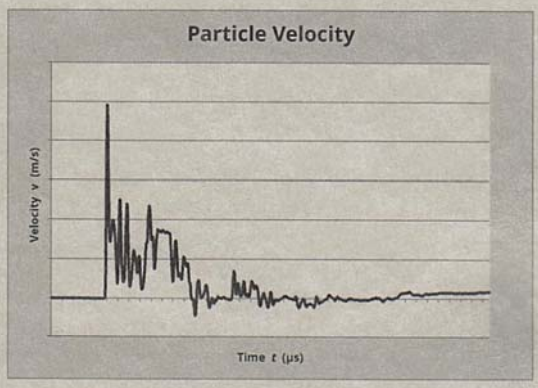
Diameter	d_r = 0.052 m
Length of the instrumented rod	0.558 m
Area	A = 11.61 cm^2
Modulus	E_a = 206843 MPa

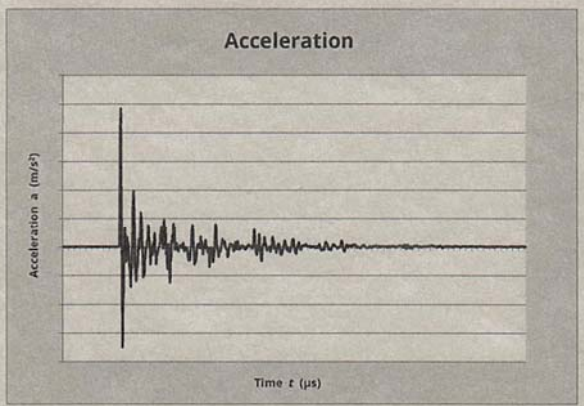


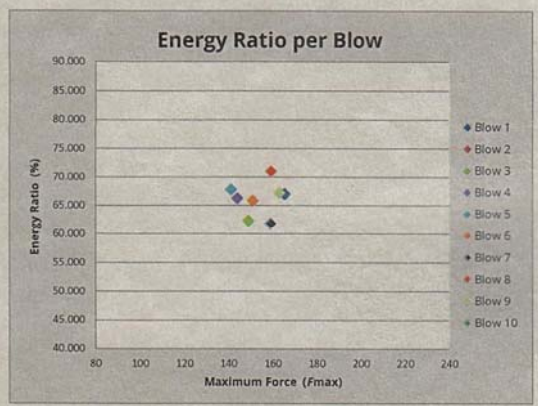
Key
1 Anvil
2 Part of instrumented rod
3 Drive Rod
4 Strain Gauge
5 Accelerometer
6 Ground

F Force
d_r Diameter of rod

Fig. B.1 and B.2 BS EN ISO 22476-3 : 2005 + A1 : 2011







Observations:
1.

E_{meas} = **0.312** kN-m

E_{theor} = **0.473** kN-m

Energy Ratio (E_r) = $\frac{E_{meas}}{E_{theor}}$ = **65.96%**

Equipe SPT Analyzer Operators: MH

Prepared by: **Checked by:** **Date** 21/10/2015

 Equipe Group, The Paddocks, Home Farm Offices, The Upton Estate, Banbury, Oxfordshire, OX15 6HU
Tel: +44 (0)1295 670990 Fax: +44 (0)1295 678232 Email: info@equipegroup.com

Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Dynamic sampling uk ltd
6-8 victory parkway
victory road
Derby
DE24 8ZF

Hammer Ref:	SS01
Test Date:	27/06/2016
Report Date:	
File Name:	SS01.spt
Test Operator:	TP

Instrumented Rod Data

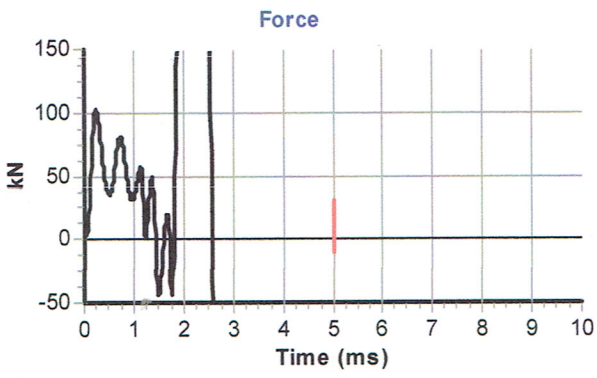
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.9
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	6455
Accelerometer No.2:	6457

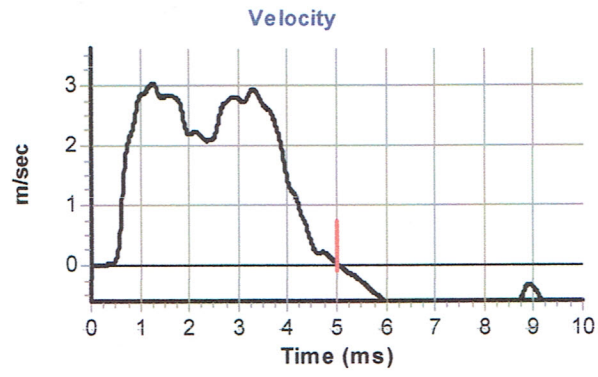
Hammer Information

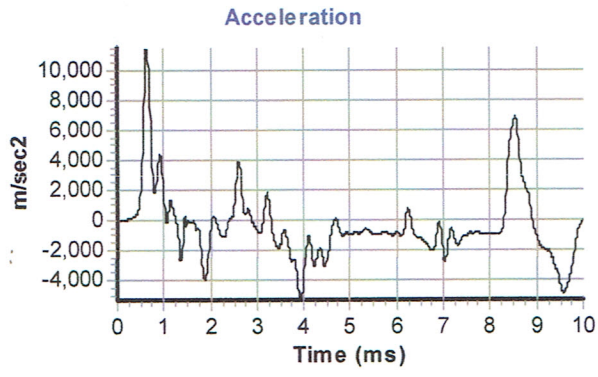
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
String Length L (m):	15.0

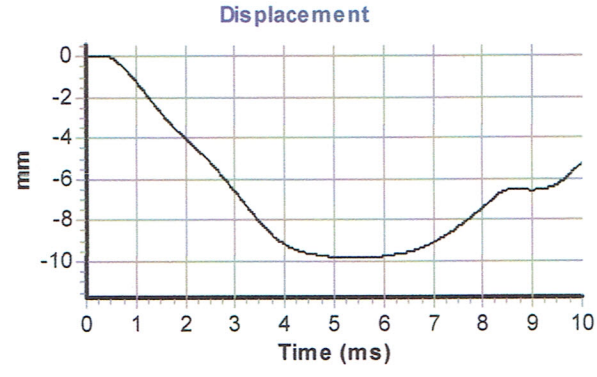
Comments / Location

Hammer tested at Dynamic samplins yard.









Calculations

Area of Rod A (mm2):	1021
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	374

Energy Ratio E_r (%): **79**

Signed: A.parker

Title: Manager

The recommended calibration interval is 12 months

Site & Location	**Stag Brewery, Lower Richmond Road, Mortlake, London SW14 7ET**	Report No:	**10022/OT**

STANDARD PENETRATION TEST SUMMARY

BH ID	Depth [m]	Test type	'N' value and blow-counts [Seating blows/Test blows]	N_{60}	Casing depth [m]	Water depth [m]	Remarks
BH1	2.55	C	N = 39 :5 5/ 8 10 10 11	44	2.55	DRY	
	3.55	C	N = 25 :4 4/ 6 6 6 7	28	3.55	DRY	
	5.05	S	N = 15 :2 3/ 3 4 4 4	17	5.00	DRY	
	8.05	S	N = 24 :3 3/ 5 6 6 7	27	5.00	DRY	
	11.05	S	N = 34 :4 4/ 7 9 9 9	38	5.00	DRY	
	14.05	S	N = 35 :3 4/ 7 8 10 10	39	5.00	DRY	
	17.05	S	N = 41 :4 4/ 8 10 11 12	46	5.00	DRY	
	20.05	S	N = 46 :5 5/ 9 11 13 13	51	5.00	DRY	
	23.05	S	N = 46 :5 5/ 9 12 12 13	51	5.00	DRY	
	26.05	S	N = 51 :5 6/ 10 13 13 15	57	5.00	DRY	
	29.55	S	N = 46 :5 5/ 8 11 13 14	51	5.00	DRY	
BH2	1.25	S	N = 71 :15 15/ 13 14 20 24	79	1.25	DRY	
	2.25	C	50 :50 /	>56*	0.00	DRY	Refusal
BH2B	2.00	C	N = 36 :4 5/ 7 9 10 10	40	2.00	DRY	
	3.00	C	N = 14 :3 3/ 3 3 4 4	16	3.00	DRY	
	4.05	S	N = 15 :2 3/ 3 4 4 4	17	4.05	DRY	
	6.55	S	N = 23 :3 3/ 5 6 6 6	26	4.15	DRY	
	9.55	S	N = 25 :3 3/ 5 6 7 7	28	4.15	DRY	
	12.55	S	N = 34 :4 4/ 8 8 9 9	38	4.15	DRY	
	15.55	S	N = 35 :5 5/ 7 9 9 10	39	4.15	DRY	
	18.55	S	N = 39 :5 5/ 8 10 10 11	44	4.15	DRY	
	21.55	S	N = 44 :5 5/ 9 10 12 13	49	4.15	DRY	
	24.55	S	N = 47 :5 5/ 9 12 13 13	52	4.15	DRY	
	27.55	S	N = 49 :6 7/ 11 12 13 13	55	4.15	DRY	
WS1	3.00	S	N = 28 :3 4/ 7 7 8 6	37	0.00	DRY	
	4.00	S	N = 35 :9 10/ 11 9 8 7	46	0.00	DRY	
	5.00	S	N = 21 :3 5/ 6 7 4 4	28	0.00	DRY	
WS10A	3.00	S	N = 37 :9 11/ 10 10 10 7	49	0.00	DRY	
WS2	2.00	S	N = 28 :7 6/ 7 7 7 7	37	0.00	DRY	
	3.00	S	N = 34 :8 8/ 7 9 8 10	45	0.00	DRY	
	4.00	S	N = 44 :9 12/ 12 11 11 10	58	0.00	DRY	
	5.00	S	N = 22 :2 3/ 4 6 7 5	29	0.00	DRY	
WS3	2.00	S	N = 23 :3 5/ 5 6 6 6	30	0.00	DRY	
	3.00	S	N = 32 :7 8/ 8 8 8 8	42	0.00	DRY	
	4.00	S	N = 9 :1 1/ 1 2 3 3	12	0.00	DRY	
	5.00	S	N = 35 :4 8/ 7 8 10 10	46	0.00	DRY	
WS4	3.00	S	N = 38 :10 9/ 8 10 10 10	50	0.00	DRY	
	4.00	S	N = 17 :7 6/ 5 5 3 4	22	0.00	DRY	
	5.00	S	N = 9 :3 2/ 2 2 2 3	12	0.00	DRY	
WS5	3.00	S	N = 16 :3 3/ 4 4 4 4	21	0.00	DRY	
	4.00	S	N = 40 :7 7/ 8 12 10 10	53	0.00	DRY	
WS8	1.00	S	50 :25 / 50	>66*	0.00	DRY	
WS9A	2.00	S	N = 10 :3 2/ 2 3 2 3	13	0.00	DRY	

Standard Penetration Test : BS EN ISO 22476:2005 Part 3 Hammer Energy Ratio, Er = 66% [CP boreholes] 79% [WS boreholes]

* where full penetration not achieved, the reported N_{60} is based on maximum uncorrected blow-counts of 50

** extrapolated N_{60} value where full penetration not achieved - this is indicative only and should be used with caution

Soil Consultants

Site & Location	**Stag Brewery, Lower Richmond Road, Mortlake, London SW14 7ET**	Report No:	**10022/OT**

STANDARD PENETRATION TEST SUMMARY

BH ID	Depth [m]	Test type	'N' value and blow-counts [Seating blows/Test blows]	N_{60}	Casing depth [m]	Water depth [m]	Remarks
WS9A	3.00	S	N = 34 :7 7/ 7 8 10 9	45	0.00	DRY	

Standard Penetration Test : BS EN ISO 22476:2005 Part 3 Hammer Energy Ratio, Er = 66% [CP boreholes] 79% [WS boreholes]

* where full penetration not achieved, the reported N_{60} is based on maximum uncorrected blow-counts of 50

** extrapolated N_{60} value where full penetration not achieved - this is indicative only and should be used with caution

Site & Location: **Stag Brewery, Lower Richmond Road, Mortlake, London SW14 7ET**

Report No: **10022/OT**

SUMMARY OF CLASSIFICATION TEST RESULTS

BH ID	Depth (m)	Type	w (%)	wL (%)	wP (%)	Pass 425 (%)	IP (%)	Mod IP (%)	IL (%)	LOI (%)	Description
BH1	1.55	U	10	38	19	>95	19		-0.48		Brown sandy CLAY
	4.90	D	33	79	32	>95	47		0.03		Dark brown CLAY
	6.55	U	27								Dark greyish brown CLAY
	9.55	U	26	73	31	>95	42		-0.14		Dark greyish brown CLAY
	12.55	U	26	78	30	>95	48		-0.09		Dark greyish brown CLAY
	15.55	U	20								Dark greyish brown slightly sandy silty CLAY
	18.55	U	26								Dark greyish brown silty CLAY
	21.55	U	25	77	33	>95	44		-0.18		Dark greyish brown slightly sandy silty CLAY
	24.55	U	25	81	33	>95	48		-0.18		Dark greyish brown slightly sandy silty CLAY
	27.55	U	20								CLAYSTONE
BH2B	5.05	U	28	76	32	>95	44		-0.09		Dark greyish brown CLAY
	8.05	U	26								Dark greyish brown CLAY
	11.50	U	25	79	30	>95	49		-0.11		Dark greyish brown slightly sandy silty CLAY
	14.05	U	27								Dark greyish brown slightly sandy silty CLAY
	17.05	U	26	82	31	>95	51		-0.10		Dark greyish brown silty CLAY
	20.05	U	25								Dark greyish brown slightly sandy silty CLAY
	23.05	U	23	79	33	>95	46		-0.23		Dark greyish brown slightly sandy silty CLAY
	26.05	U	25								Dark greyish brown CLAY
	29.55	U	25	78	32	>95	46		-0.16		Dark greyish brown CLAY

Testing in accordance with BS EN ISO 17892 unless specified otherwise

Date: 01 Nov 16

Modified Plasticity Index calculated in accordance with NHBC Standards Chapter 4.2 (reported if %passing 425mm <95%)

Percent passing 425μm: by estimation, by hand* or by sieving**

Soil Consultants

Site & Location: **Stag Brewery, Lower Richmond Road, Mortlake, London SW14 7ET**

Report No: **10022/OT**

SUMMARY OF CLASSIFICATION TEST RESULTS

BH ID	Depth (m)	Type	w (%)	wL (%)	wP (%)	Pass 425 (%)	IP (%)	Mod IP (%)	IL (%)	LOI (%)	Description
WS10A	3.80	D	31	75	32	>95	43		-0.03		Dark brownish grey CLAY
	5.00	D	28	77	32	>95	45		-0.09		Dark brownish grey CLAY
WS5	2.30	D	20	33	18	93	15	14	0.11		Brownish grey slightly gravelly slightly sandy CLAY
WS9A	3.90	D	32	75	33	>95	42		-0.02		Dark grey, orangish grey and reddish grey mottled CLAY

Testing in accordance with BS EN ISO 17892 unless specified otherwise

Date: 01 Nov 16

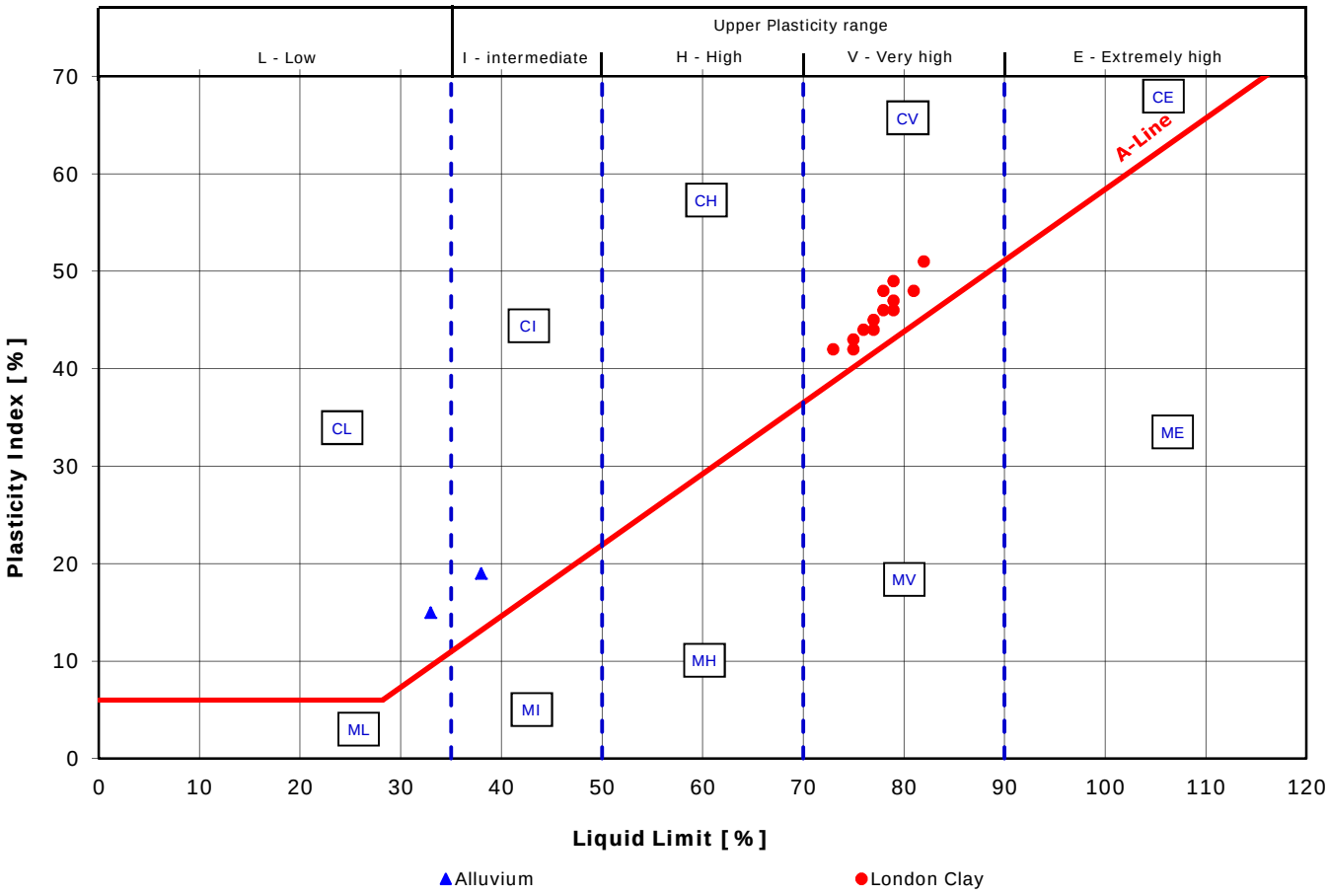
Modified Plasticity Index calculated in accordance with NHBC Standards Chapter 4.2 (reported if %passing 425mm <95%)

Percent passing 425μm: by estimation, by hand* or by sieving**

Soil Consultants

Site & Location	**Stag Brewery, Lower Richmond Road, Mortlake, London SW14 7ET**	Report No:	**10022/OT**

Plasticity Chart



M - SILT [plots below the A-Line]

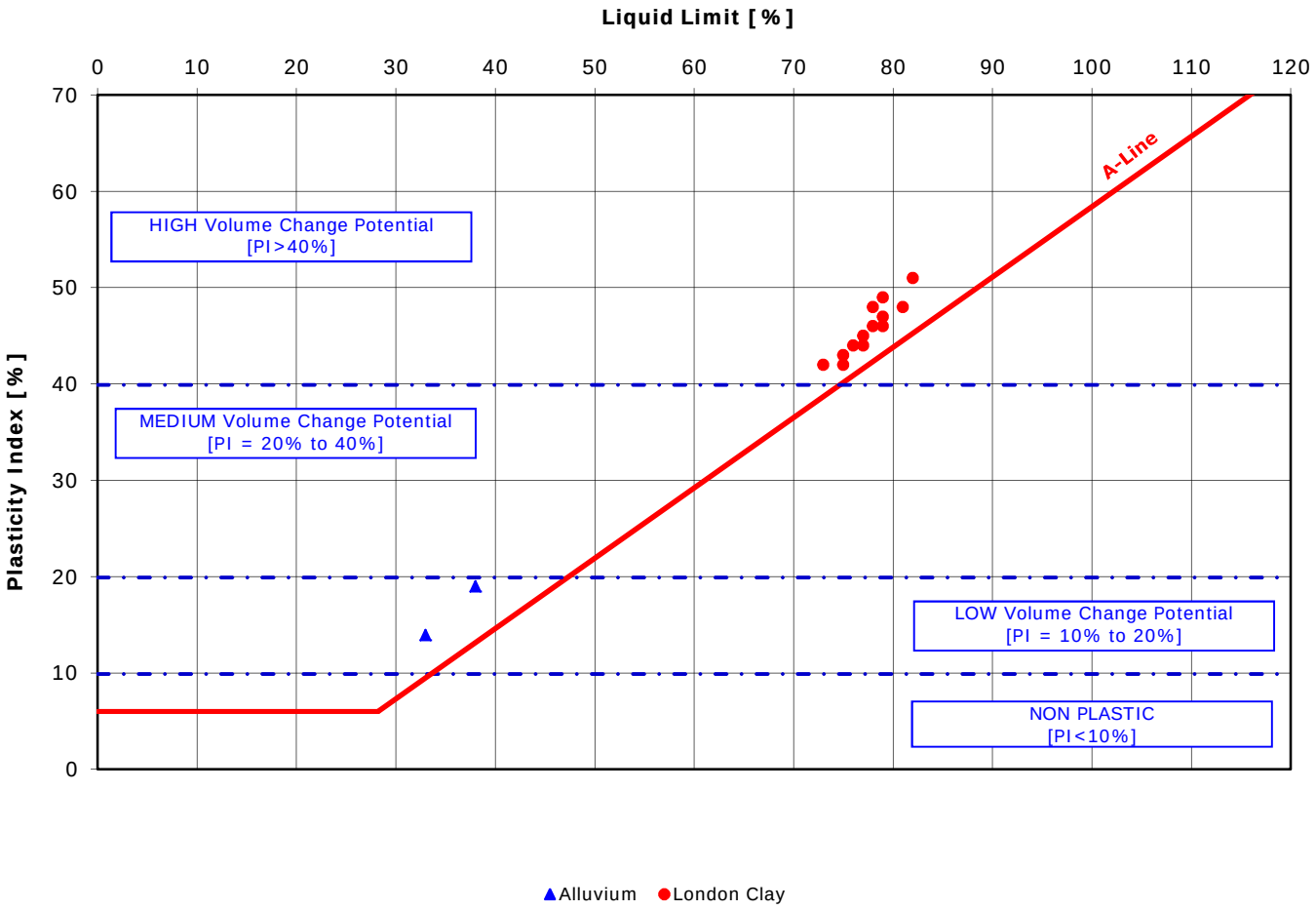
C - CLAY [plots above the A-Line]

Classification in accordance with BS5930:1999+A2:2010 "Code of practice for site investigations"

Soil Consultants

Site & Location	**Stag Brewery, Lower Richmond Road, Mortlake, London SW14 7ET**	Report No:	**10022/OT**

Plasticity Chart



Modified Plasticity Index, I'p:

$$I'p = \frac{Ip \times (\%\ \text{passing 425mm})}{100\%}$$

[where Ip = Plasticity Index]

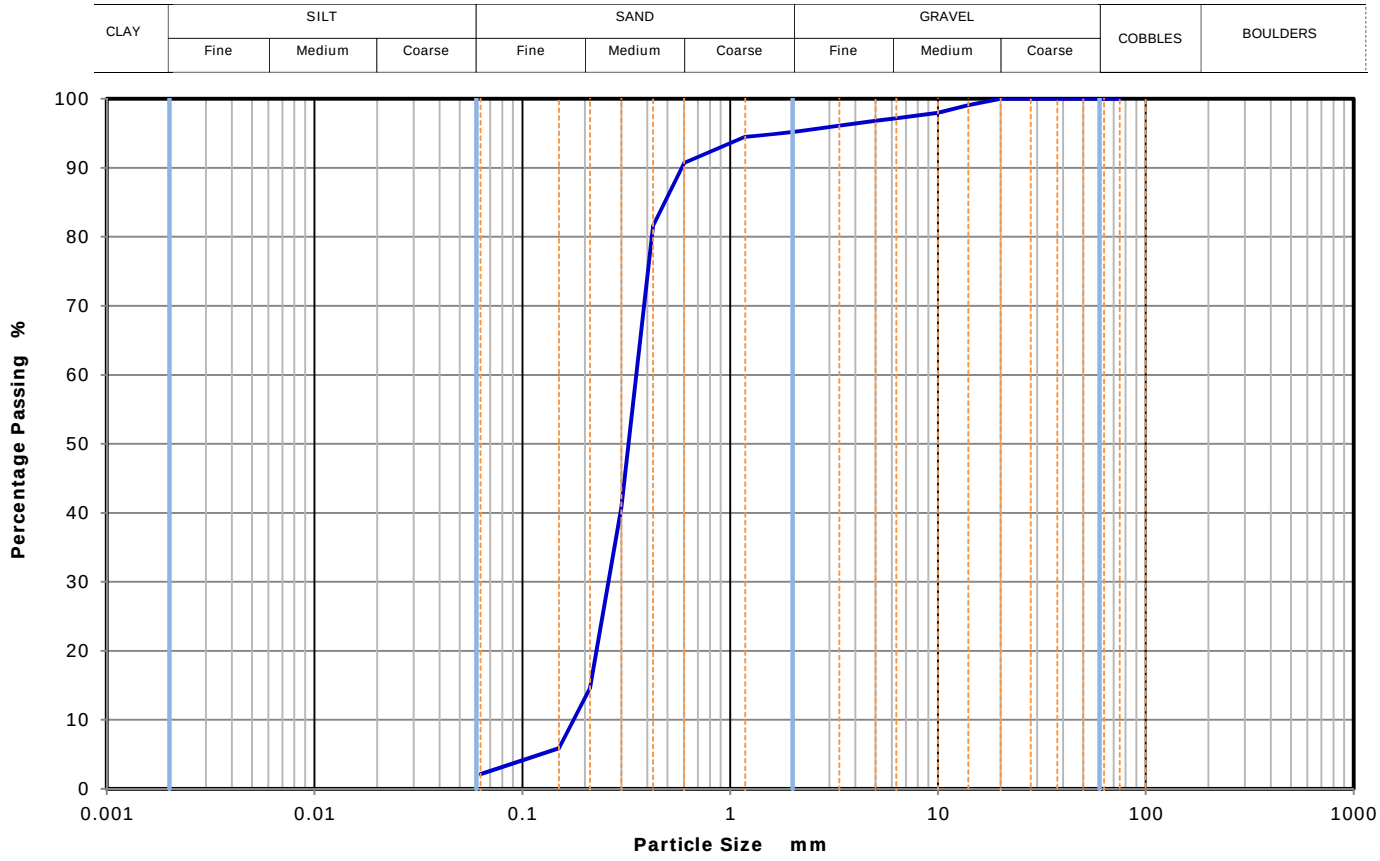
Classification in accordance with NHBC Standards, Part 4 'Foundations', Chapter 4.2 'Building near trees'

Soil Consultants

Site	**Stag Brewery,**	Report No:	**10022/OT**
Location	**Lower Richmond Road, Mortlake, London SW14 7ET**		

PARTICLE SIZE DISTRIBUTION

Hole ID: **BH1**	Description: **Light brown slightly silty gravelly SAND**
Depth [m]: **2.55**	



Sieving	
Size [mm]	% passing
75	100
63	100
50	100
37.5	100
28	100
20	100
14	99.1
10	98
6.3	97.2
5	96.8
3.35	96.1
2	95.2
1.18	94.5
0.6	90.7
0.425	81.6
0.3	40.8
0.212	14.6
0.15	5.9
0.063	2.1

Sample proportions	%
Cobbles	0
Gravel	5
Sand	93
Fines <0.063mm	2

Grading analysis		
D60	mm	0.4
D30	mm	0.3
D10	mm	0.2
Uniformity Coefficient		2.0
Curvature Coefficient		1.1

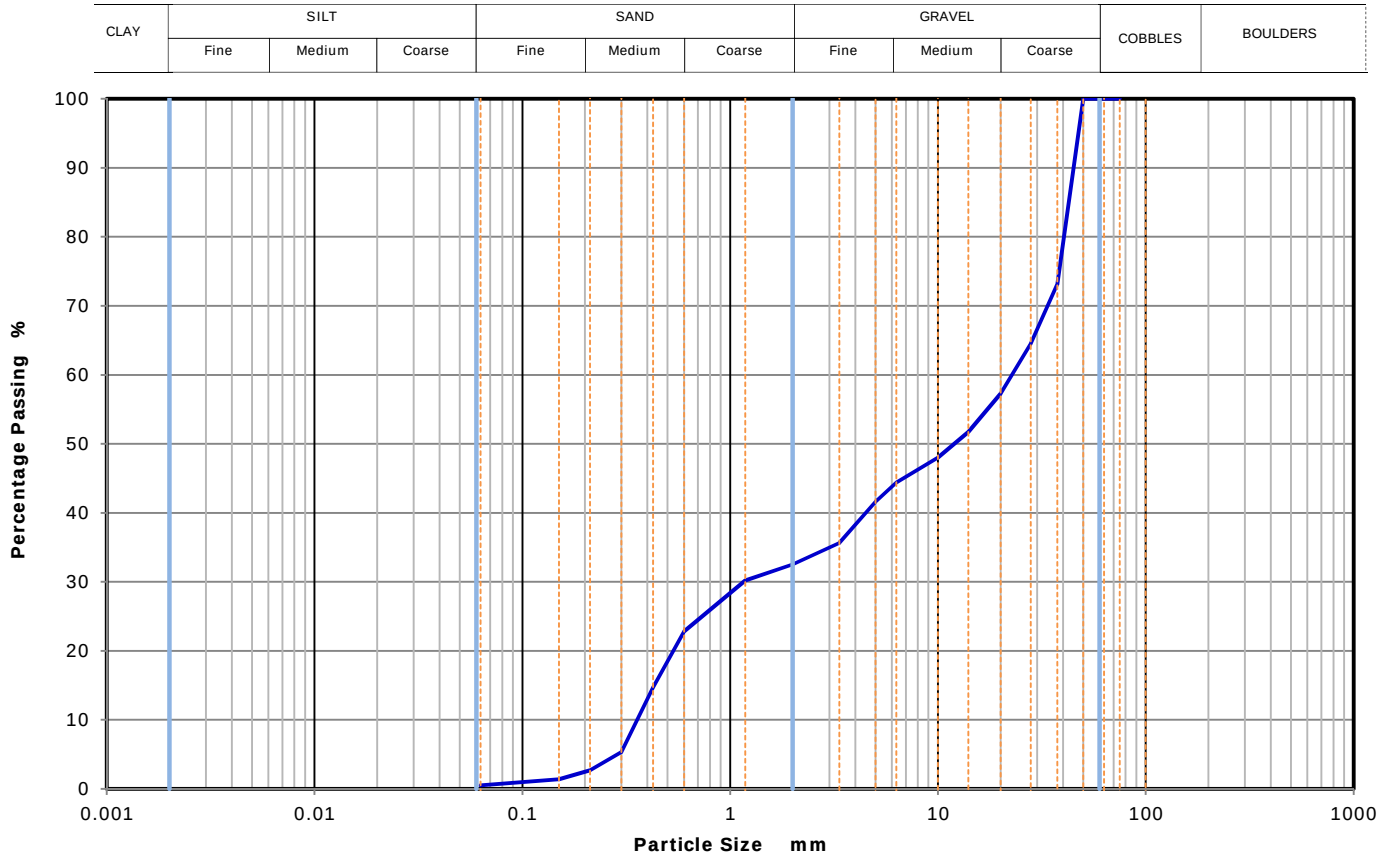
Test method and date	
Testing in accordance with BS EN ISO 17892:	
Wet sieving method	
Reporting date:	08 Nov 16

Soil Consultants

Site	**Stag Brewery,**	Report No:	**10022/OT**
Location	**Lower Richmond Road, Mortlake, London SW14 7ET**		

PARTICLE SIZE DISTRIBUTION

Hole ID: **BH1** Depth [m]: **3.55**	Description: **Light brown slightly silty very sandy GRAVEL**



Sieving	
Size [mm]	% passing
75	100
63	100
50	100
37.5	73.1
28	64.5
20	57.3
14	51.7
10	48
6.3	44.4
5	41.6
3.35	35.6
2	32.5
1.18	30.2
0.6	22.8
0.425	14.7
0.3	5.3
0.212	2.7
0.15	1.4
0.063	0.5

Sample proportions	%
Cobbles	0
Gravel	68
Sand	32
Fines <0.063mm	1

Grading analysis		
D60	mm	22.7
D30	mm	1.2
D10	mm	0.4
Uniformity Coefficient		63.5
Curvature Coefficient		0.2

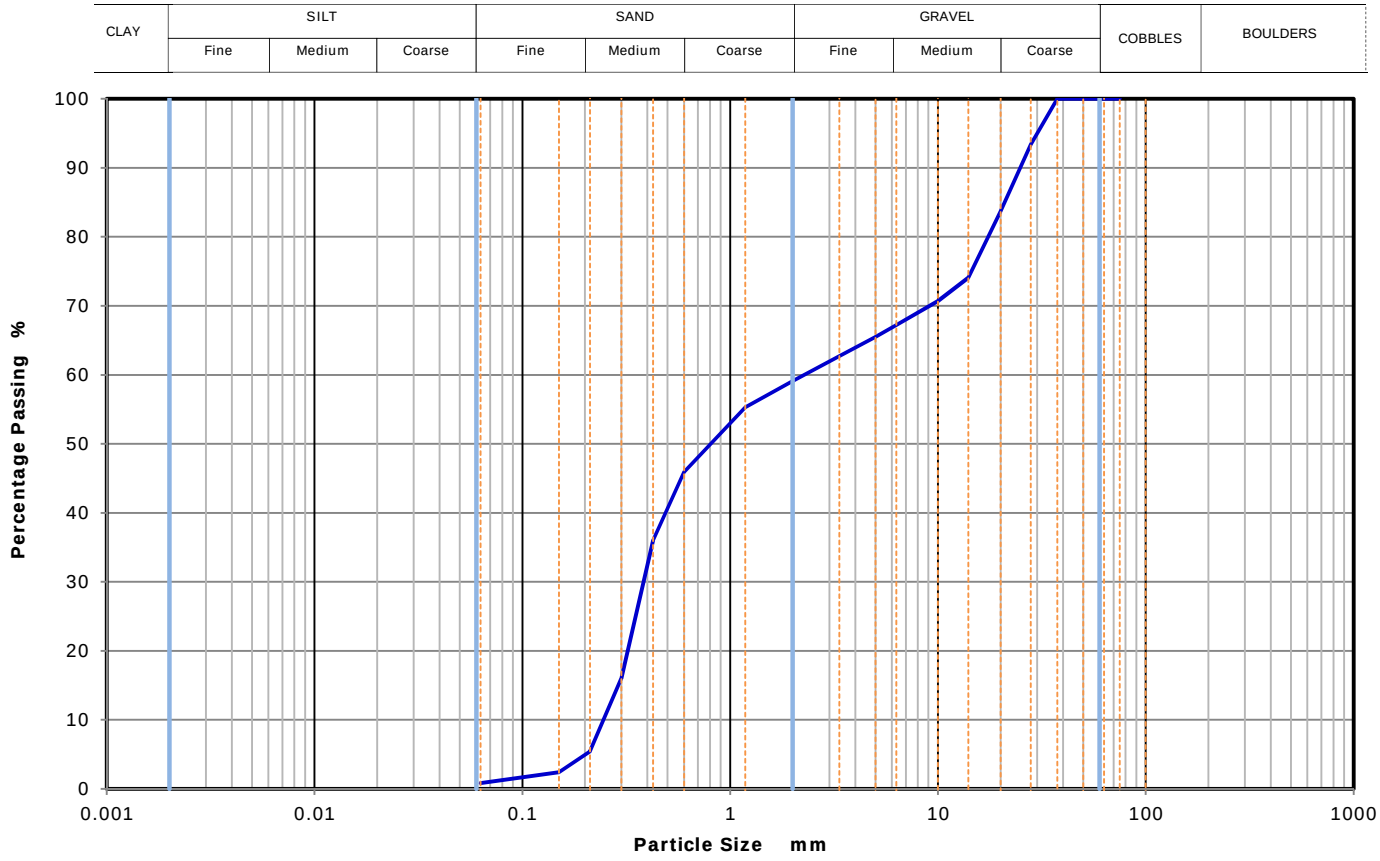
Test method and date	
Testing in accordance with BS EN ISO 17892:	
Wet sieving method	
Reporting date:	08 Nov 16

Soil Consultants

Site	**Stag Brewery,**	Report No:	**10022/OT**
Location	**Lower Richmond Road, Mortlake, London SW14 7ET**		

PARTICLE SIZE DISTRIBUTION

Hole ID: **BH2B** Depth [m]: **2.00**	Description: **Orangish brown slightly silty very gravelly SAND**



Sieving	
Size [mm]	% passing
75	100
63	100
50	100
37.5	100
28	93.4
20	83.7
14	74.1
10	70.7
6.3	67.2
5	65.5
3.35	62.7
2	59.1
1.18	55.3
0.6	45.9
0.425	36
0.3	16
0.212	5.4
0.15	2.4
0.063	0.8

Sample proportions	%
Cobbles	0
Gravel	41
Sand	58
Fines <0.063mm	1

Grading analysis		
D60	mm	2.3
D30	mm	0.4
D10	mm	0.2
Uniformity Coefficient		9.2
Curvature Coefficient		0.3

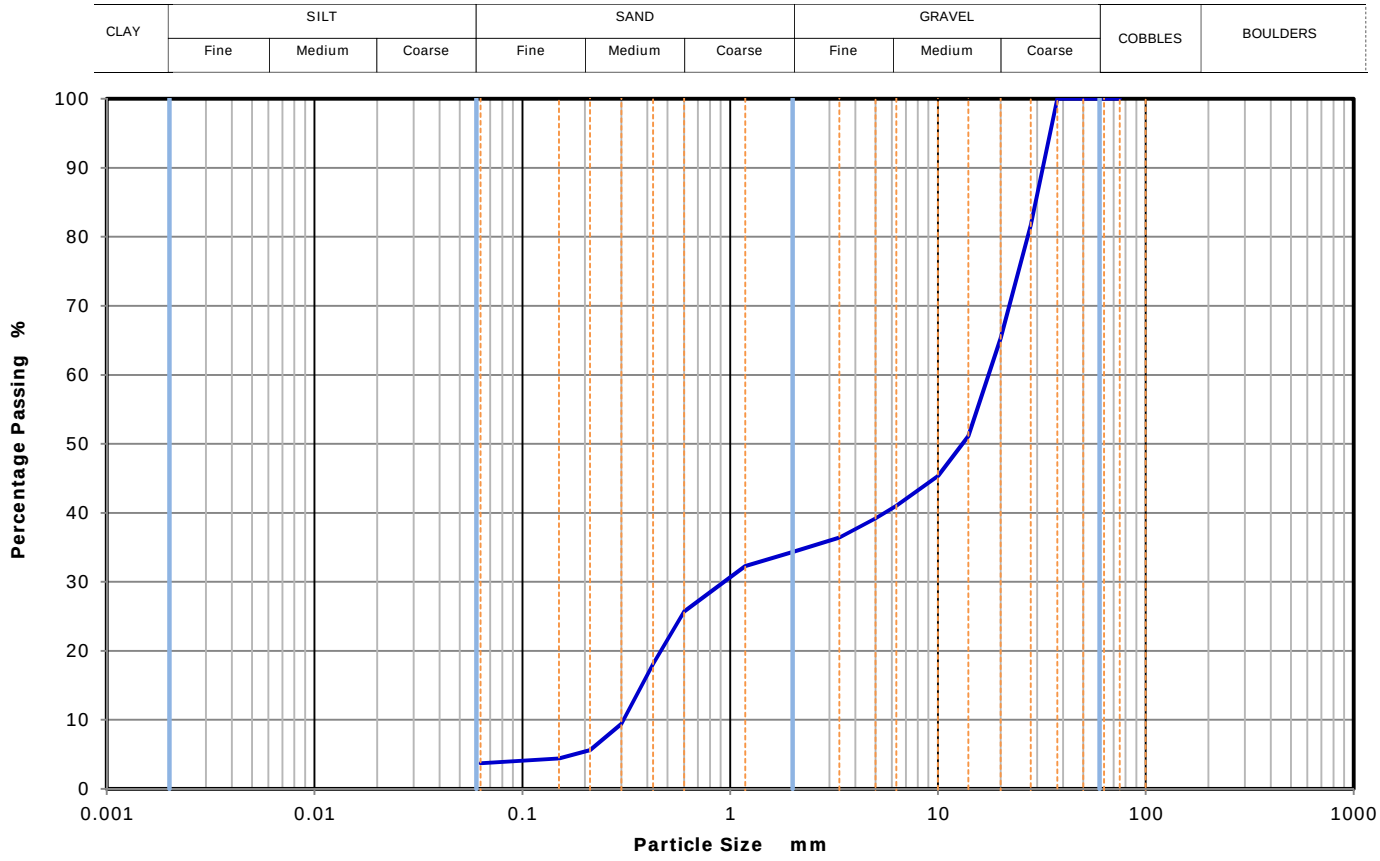
Test method and date	
Testing in accordance with BS EN ISO 17892:	
Wet sieving method	
Reporting date:	08 Nov 16

Soil Consultants

Site	**Stag Brewery,**	Report No:	**10022/OT**
Location	**Lower Richmond Road, Mortlake, London SW14 7ET**		

PARTICLE SIZE DISTRIBUTION

Hole ID: **BH2B**	Description: **Orangish brown slightly silty very sandy GRAVEL**
Depth [m]: **3.00**	



Sieving	
Size [mm]	% passing
75	100
63	100
50	100
37.5	100
28	81.7
20	65.3
14	51.1
10	45.3
6.3	41
5	39.2
3.35	36.4
2	34.3
1.18	32.3
0.6	25.7
0.425	18.1
0.3	9.4
0.212	5.6
0.15	4.4
0.063	3.7

Sample proportions	%
Cobbles	0
Gravel	66
Sand	31
Fines <0.063mm	4

Grading analysis		
D60	mm	17.5
D30	mm	0.9
D10	mm	0.3
Uniformity Coefficient		57.0
Curvature Coefficient		0.2

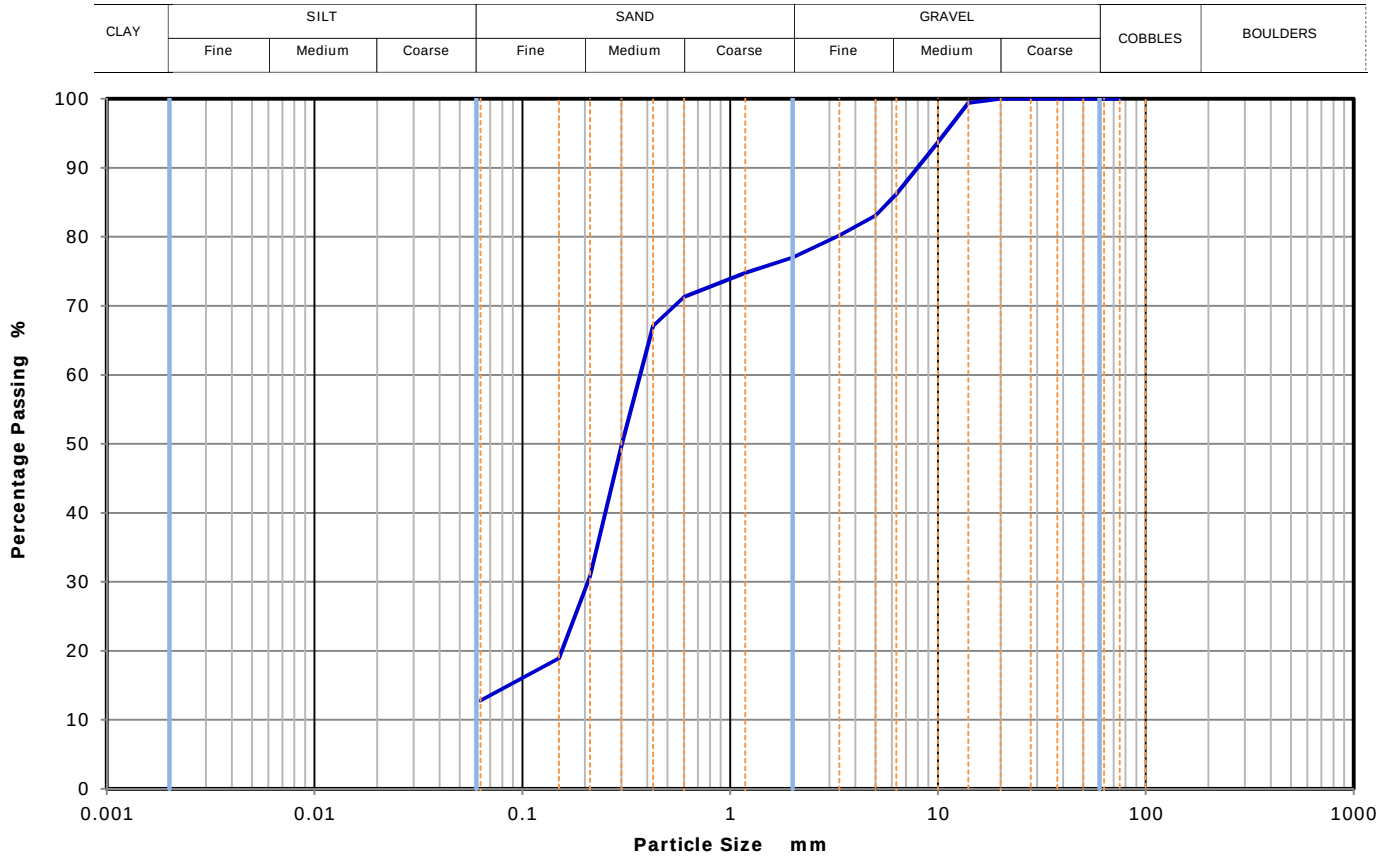
Test method and date	
Testing in accordance with BS EN ISO 17892:	
Wet sieving method	
Reporting date:	08 Nov 16

Soil Consultants

Site	**Stag Brewery,**	Report No:	**10022/OT**
Location	**Lower Richmond Road, Mortlake, London SW14 7ET**		

PARTICLE SIZE DISTRIBUTION

Hole ID: **WS1**	Description: **Orangish brown silty very gravelly SAND**
Depth [m]: **3.00**	



Sieving	
Size [mm]	% passing
75	100
63	100
50	100
37.5	100
28	100
20	100
14	99.4
10	93.7
6.3	86.2
5	83.1
3.35	80.2
2	77
1.18	74.8
0.6	71.3
0.425	67.1
0.3	49.7
0.212	30.8
0.15	18.9
0.063	12.8

Sample proportions	%
Cobbles	0
Gravel	23
Sand	64
Fines <0.063mm	13

Grading analysis		
D60	mm	0.4
D30	mm	0.2
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

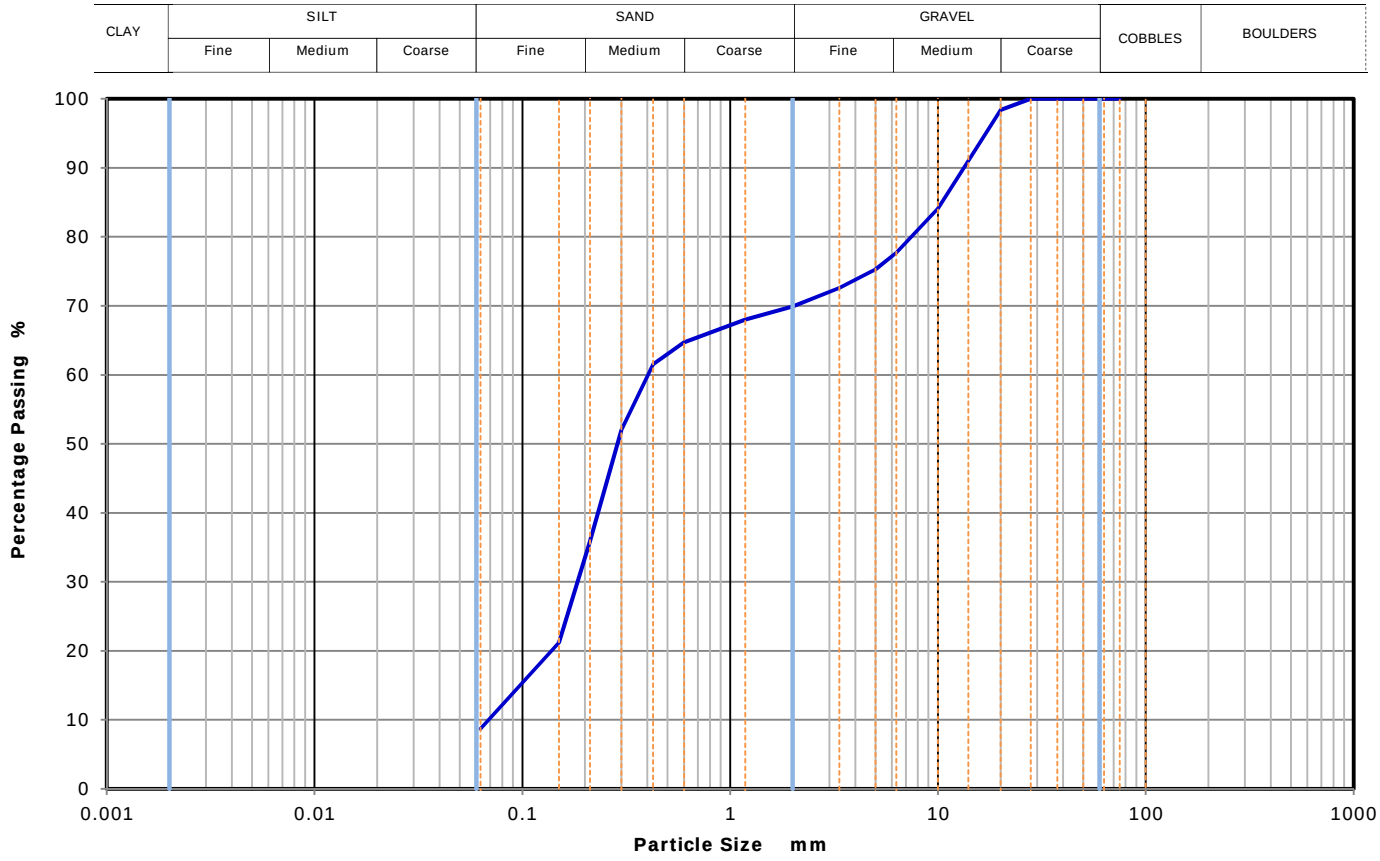
Test method and date	
Testing in accordance with BS EN ISO 17892:	
Wet sieving method	
Reporting date:	08 Nov 16

Soil Consultants

Site	**Stag Brewery,**	Report No:	**10022/OT**
Location	**Lower Richmond Road, Mortlake, London SW14 7ET**		

PARTICLE SIZE DISTRIBUTION

Hole ID: **WS3**	Description: **Orangish brown silty very gravelly SAND**
Depth [m]: **1.60**	



Sieving	
Size [mm]	% passing
75	100
63	100
50	100
37.5	100
28	100
20	98.4
14	91
10	84.1
6.3	77.7
5	75.3
3.35	72.6
2	69.9
1.18	68
0.6	64.7
0.425	61.5
0.3	52
0.212	35.9
0.15	21.2
0.063	8.7

Sample proportions	%
Cobbles	0
Gravel	30
Sand	61
Fines <0.063mm	9

Grading analysis		
D60	mm	0.4
D30	mm	0.2
D10	mm	0.1
Uniformity Coefficient		5.8
Curvature Coefficient		1.2

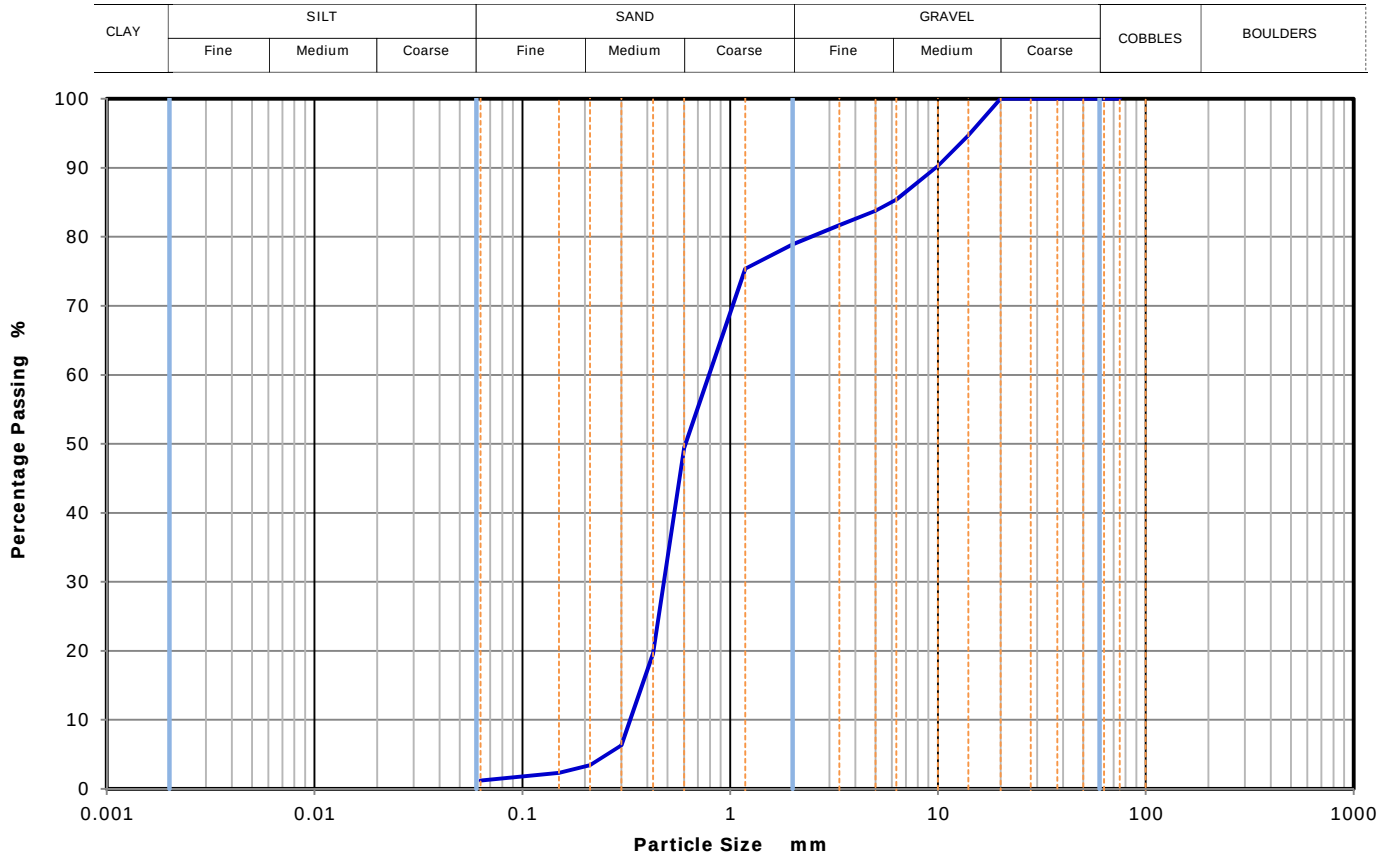
Test method and date	
Testing in accordance with BS EN ISO 17892:	
Wet sieving method	
Reporting date:	08 Nov 16

Soil Consultants

Site	**Stag Brewery,**	Report No:	**10022/OT**
Location	**Lower Richmond Road, Mortlake, London SW14 7ET**		

PARTICLE SIZE DISTRIBUTION

Hole ID: **WS5**	Description: **Orangish brown slightly silty very sandy GRAVEL**
Depth [m]: **4.60**	



Sieving	
Size [mm]	% passing
75	100
63	100
50	100
37.5	100
28	100
20	100
14	94.7
10	90.3
6.3	85.4
5	83.8
3.35	81.7
2	78.9
1.18	75.4
0.6	49.4
0.425	19.6
0.3	6.3
0.212	3.4
0.15	2.3
0.063	1.2

Sample proportions	%
Cobbles	0
Gravel	21
Sand	78
Fines <0.063mm	1

Grading analysis		
D60	mm	0.8
D30	mm	0.5
D10	mm	0.3
Uniformity Coefficient		2.4
Curvature Coefficient		0.9

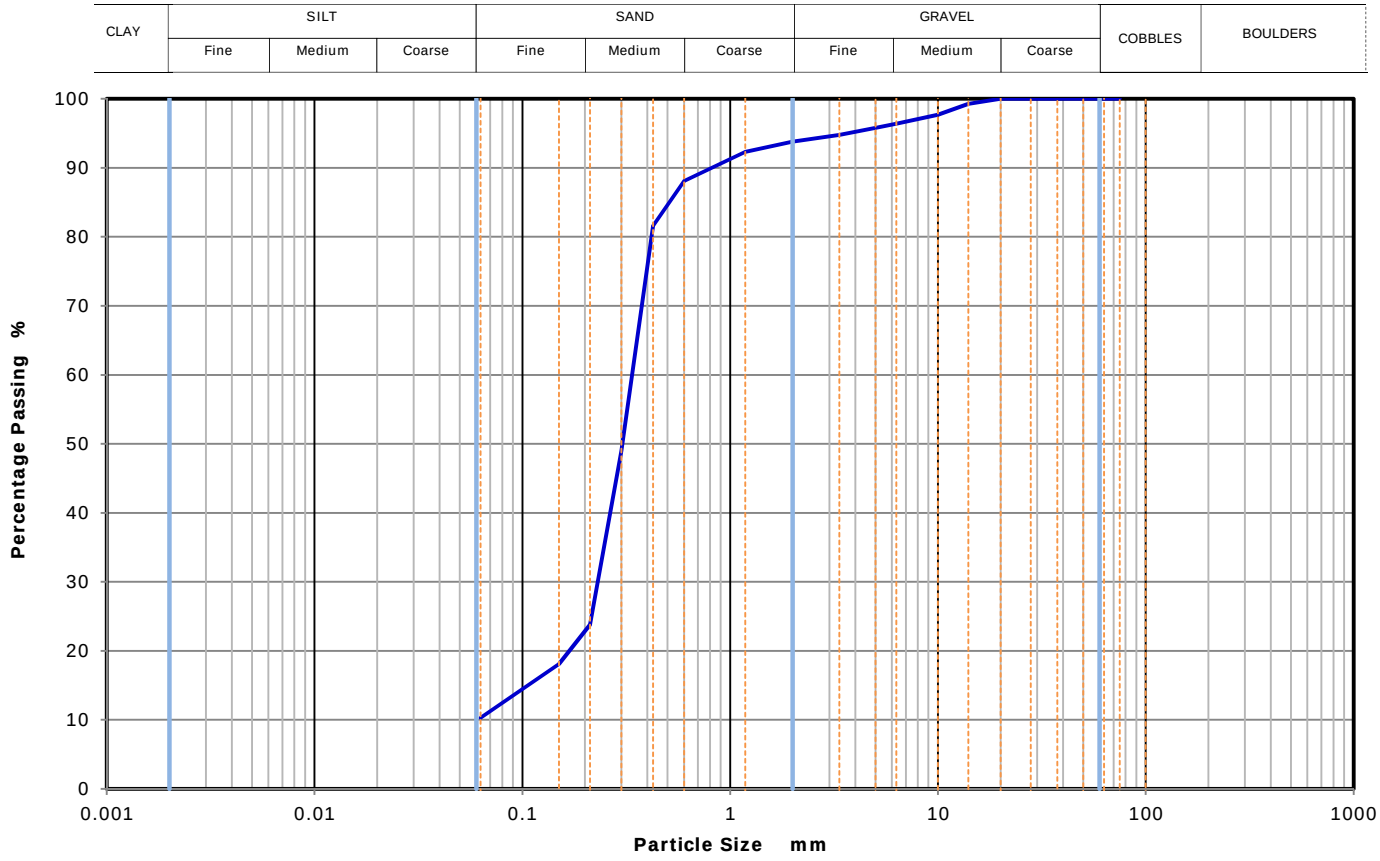
Test method and date	
Testing in accordance with BS EN ISO 17892:	
Wet sieving method	
Reporting date:	08 Nov 16

Soil Consultants

Site	**Stag Brewery,**	Report No:	**10022/OT**
Location	**Lower Richmond Road, Mortlake, London SW14 7ET**		

PARTICLE SIZE DISTRIBUTION

Hole ID: **WS9A**	Description: **Light brown silty gravelly SAND**
Depth [m]: **2.50**	



Sieving	
Size [mm]	% passing
75	100
63	100
50	100
37.5	100
28	100
20	100
14	99.3
10	97.7
6.3	96.4
5	95.8
3.35	94.8
2	93.8
1.18	92.3
0.6	88.1
0.425	81.6
0.3	49
0.212	23.8
0.15	18.1
0.063	10.3

Sample proportions	%
Cobbles	0
Gravel	6
Sand	84
Fines <0.063mm	10

Grading analysis		
D60	mm	0.3
D30	mm	0.2
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

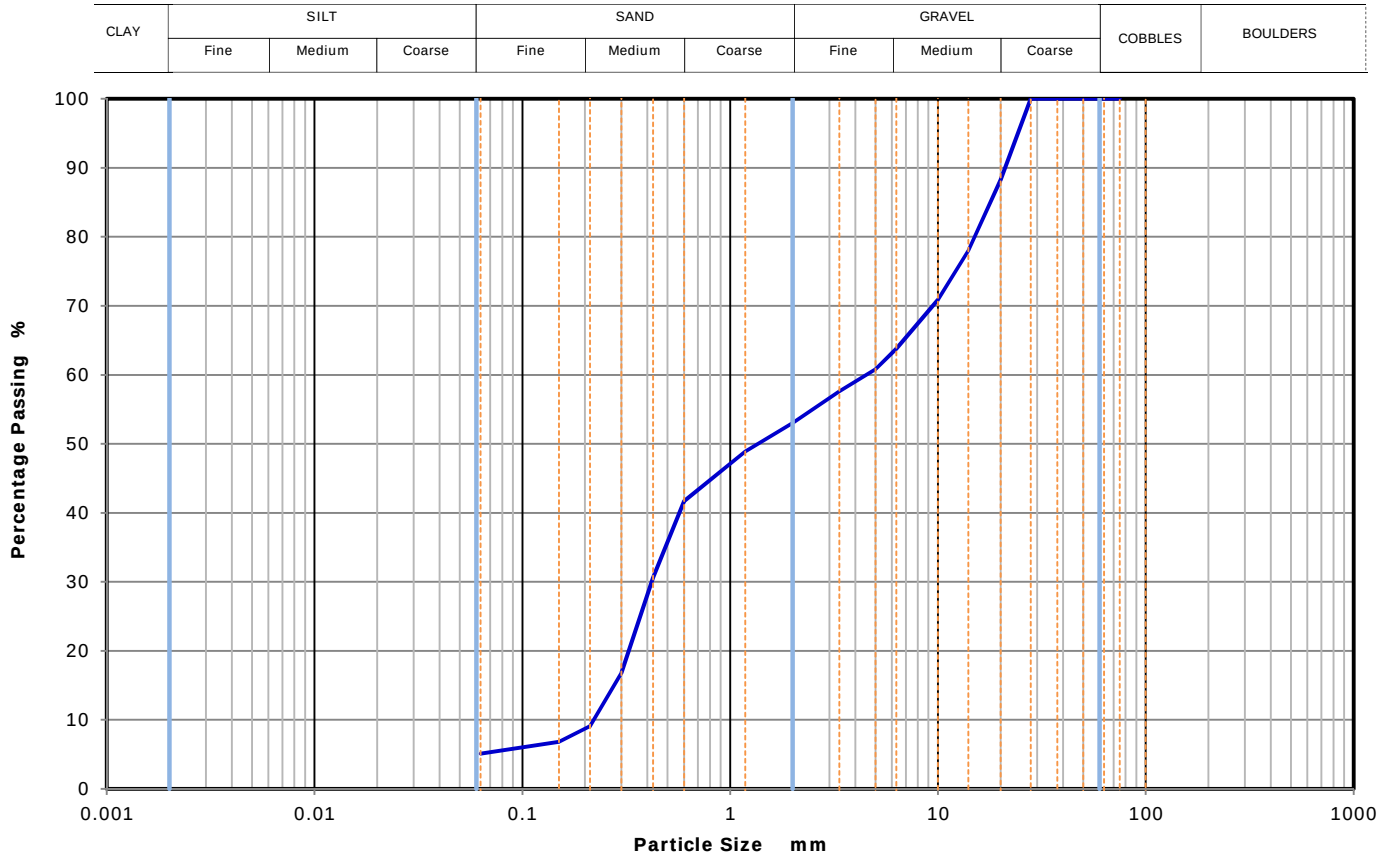
Test method and date	
Testing in accordance with BS EN ISO 17892:	
Wet sieving method	
Reporting date:	08 Nov 16

Soil Consultants

Site	**Stag Brewery,**	Report No:	**10022/OT**
Location	**Lower Richmond Road, Mortlake, London SW14 7ET**		

PARTICLE SIZE DISTRIBUTION

Hole ID: **WS10A**	Description: **Light brown silty SAND and GRAVEL**
Depth [m]: **3.00**	



Sieving	
Size [mm]	% passing
75	100
63	100
50	100
37.5	100
28	100
20	88.3
14	78
10	70.9
6.3	63.8
5	60.8
3.35	57.6
2	53
1.18	48.9
0.6	41.7
0.425	30.6
0.3	16.8
0.212	9.1
0.15	6.8
0.063	5.1

Sample proportions	%
Cobbles	0
Gravel	47
Sand	48
Fines <0.063mm	5

Grading analysis		
D60	mm	4.5
D30	mm	0.4
D10	mm	0.2
Uniformity Coefficient		20.5
Curvature Coefficient		0.2

Test method and date	
Testing in accordance with BS EN ISO 17892:	
Wet sieving method	
Reporting date:	08 Nov 16

Soil Consultants

Site	**Stag Brewery,**	Report	**10022/OT**
Location	**Lower Richmond Road, Mortlake, London SW14 7ET**	No:	

SUMMARY OF UNDRAINED SHEAR STRENGTH TEST RESULTS

BH ID	Depth [m]	Moisture content [%]	Bulk density [Mg/m^3]	Dry density [Mg/m^3]	Cell pressure [kPa]	$(\sigma_1-\sigma_3)_f$ [kPa]	Failure strain [%]	Failure mode	Undrained cohesion [kPa]	Remarks
BH1	1.55	10	1.98	1.80	70	94	7.00	B	47	
	6.55	27	1.91	1.50	130	142	4.00	B	71	
	9.55	26	2.00	1.59	190	427	5.00	B	214	
	12.55	26	1.97	1.56	250	295	5.00	P	148	
	15.55	20	2.05	1.71	310	429	5.00	B	215	
	18.55	26	2.00	1.58	370	445	4.00	P	223	
	21.55	25	1.98	1.58	430	576	8.00	B	288	
	24.55	25	2.01	1.61	490	421	7.00	B	211	
BH2B	5.05	28	1.95	1.52	100	151	5.00	P	76	
	8.05	26	1.97	1.56	160	187	5.00	P	94	
	11.50	25	1.99	1.59	220	386	8.00	B	193	
	14.05	27	1.95	1.54	280	377	7.00	P	189	
	17.05	26	1.96	1.55	340	349	4.00	B	175	
	20.05	25	1.96	1.57	400	423	4.00	B	212	
	23.05	23	2.04	1.66	460	706	8.00	B	353	
	26.05	25	2.03	1.62	520	459	6.00	B	230	
	29.55	25	2.07	1.66	590	825	6.00	B	413	

Testing in accordance with BS EN ISO 17892 UU = unconsolidated, undrained; MUU = multistage, unconsolidated, ur Date: 01 November 16

Unless stated otherwise: Rate of strain = 2mm/min, Standard latex membrame used with thickness = 0.5mm

Failure modes: B = brittle, I = intermediate, P = plastic

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QTS Environmental Ltd
Unit 1
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Lenham Heath
Kent
ME17 2JN
t: 01622 850410
russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 16-50918

Site Reference:	Stag Brewery, Lower Richmond Road, Mortlake, London
Project / Job Ref:	10022/JW
Order No:	None Supplied
Sample Receipt Date:	26/10/2016
Sample Scheduled Date:	26/10/2016
Report Issue Number:	1
Reporting Date:	01/11/2016

Authorised by:

Russell Jarvis
Associate Director of Client Services

Authorised by:

Ela Mysiara
Inorganics & ICP Section Head

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Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate						
QTS Environmental Report No: 16-50918	**Date Sampled**	15/10/16	15/10/16	15/10/16	15/10/16	15/10/16
Soil Consultants Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Stag Brewery, Lower Richmond Road, Mortlake, London	**TP / BH No**	WS2	WS4	WS9A	WS10A	BH1
Project / Job Ref: 10022/JW	**Additional Refs**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	**Depth (m)**	2.00	4.70	3.90	4.50	1.55
Reporting Date: 01/11/2016	**QTSE Sample No**	235212	235213	235214	235215	235216

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	8.6	7.4	7.7	8.3	8.2
Total Sulphate as SO_4	mg/kg	< 200	NONE	< 200	< 200	1002	856	206
Total Sulphate as SO_4	%	< 0.02	NONE	< 0.02	< 0.02	0.10	0.09	0.02
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	23	< 10	166	161	26
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.02	< 0.01	0.17	0.16	0.03
Total Sulphur	%	< 0.02	NONE	< 0.02	< 0.02	1.19	0.42	0.02

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C
Analysis carried out on the dried sample is corrected for the stone content
Subcontracted analysis $^{(S)}$

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
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Tel : 01622 850410

4480

Soil Analysis Certificate						
QTS Environmental Report No: 16-50918	**Date Sampled**	15/10/16	15/10/16	15/10/16	15/10/16	15/10/16
Soil Consultants Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Stag Brewery, Lower Richmond Road, Mortlake, London	**TP / BH No**	BH1	BH1	BH2B	BH2B	BH2B
Project / Job Ref: 10022/JW	**Additional Refs**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: None Supplied	**Depth (m)**	6.55	12.55	17.05	23.05	29.55
Reporting Date: 01/11/2016	**QTSE Sample No**	235217	235218	235219	235220	235221

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	MCERTS	8.1	8.8	9.1	8.9	9.3
Total Sulphate as SO_4	mg/kg	< 200	NONE	971	1737	952	685	670
Total Sulphate as SO_4	%	< 0.02	NONE	0.10	0.17	0.10	0.07	0.07
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	197	251	178	105	90
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	0.20	0.25	0.18	0.11	0.09
Total Sulphur	%	< 0.02	NONE	0.57	2.56	0.63	0.72	0.61

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C
Analysis carried out on the dried sample is corrected for the stone content
Subcontracted analysis $^{(S)}$

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
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Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate - Sample Descriptions	
QTS Environmental Report No: 16-50918	
Soil Consultants Ltd	
Site Reference: Stag Brewery, Lower Richmond Road, Mortlake, London	
Project / Job Ref: 10022/JW	
Order No: None Supplied	
Reporting Date: 01/11/2016	

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
$ 235212	WS2	None Supplied	2.00	7.1	Light brown sand
$ 235213	WS4	None Supplied	4.70	12.4	Light brown sand
$ 235214	WS9A	None Supplied	3.90	21.9	Brown clay
$ 235215	WS10A	None Supplied	4.50	21.7	Brown clay
$ 235216	BH1	None Supplied	1.55	8.5	Light brown sandy clay with stones
$ 235217	BH1	None Supplied	6.55	19.1	Brown clay
$ 235218	BH1	None Supplied	12.55	16.1	Light grey clay
$ 235219	BH2B	None Supplied	17.05	17	Brown clay
$ 235220	BH2B	None Supplied	23.05	16.7	Brown clay
$ 235221	BH2B	None Supplied	29.55	16.9	Brown clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample I/S

Unsuitable Sample U/S

$ samples exceeded recommended holding times

QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
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Tel : 01622 850410

4480

Soil Analysis Certificate - Methodology & Miscellaneous Information

QTS Environmental Report No: 16-50918

Soil Consultants Ltd

Site Reference: Stag Brewery, Lower Richmond Road, Mortlake, London

Project / Job Ref: 10022/JW

Order No: None Supplied

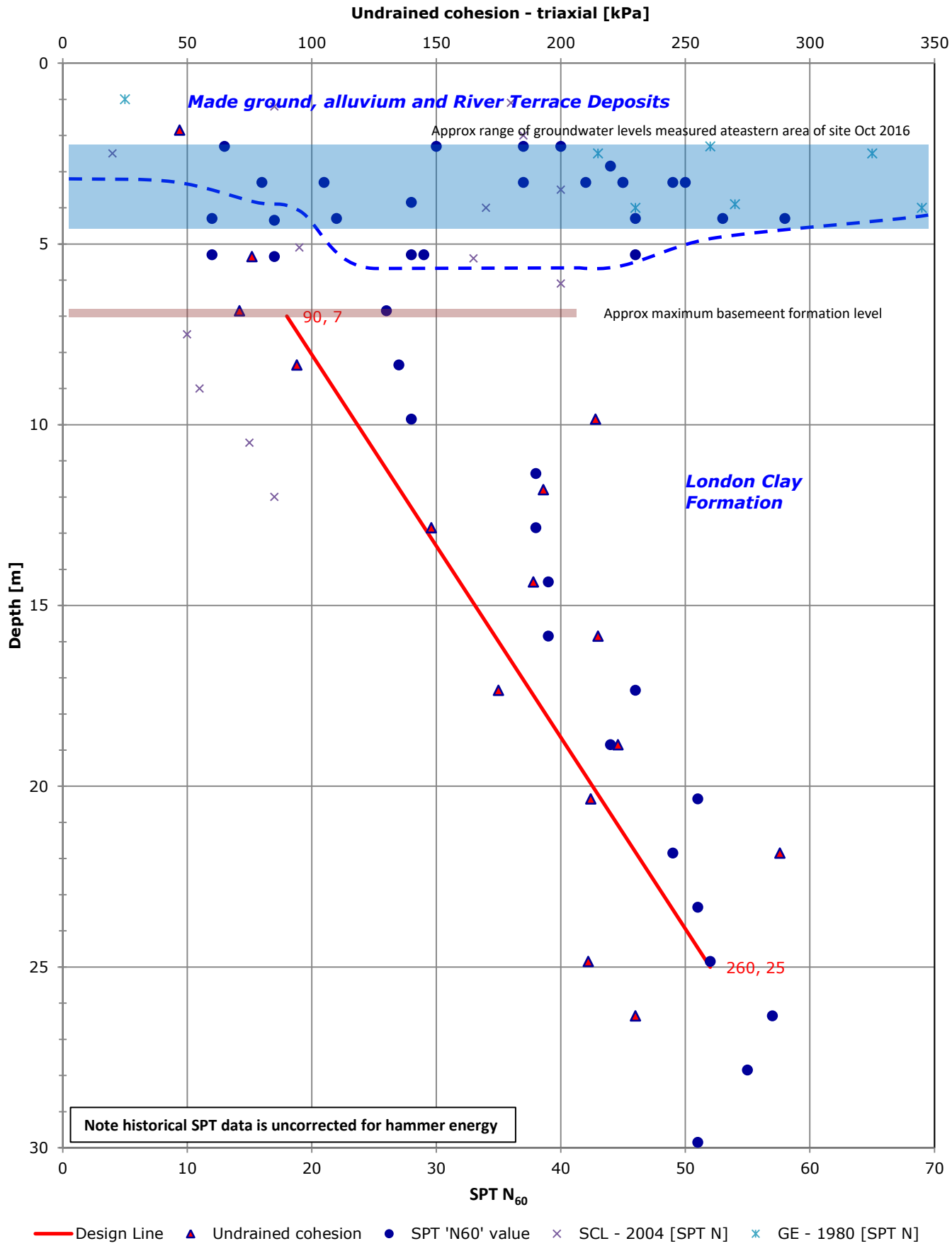
Reporting Date: 01/11/2016

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

Site & Location	**Stag Brewery, Lower Richmond Road, Mortlake, London SW14 7ET**	Report No:	**10022/OT**

Undrained cohesion and SPT [N60] vs depth



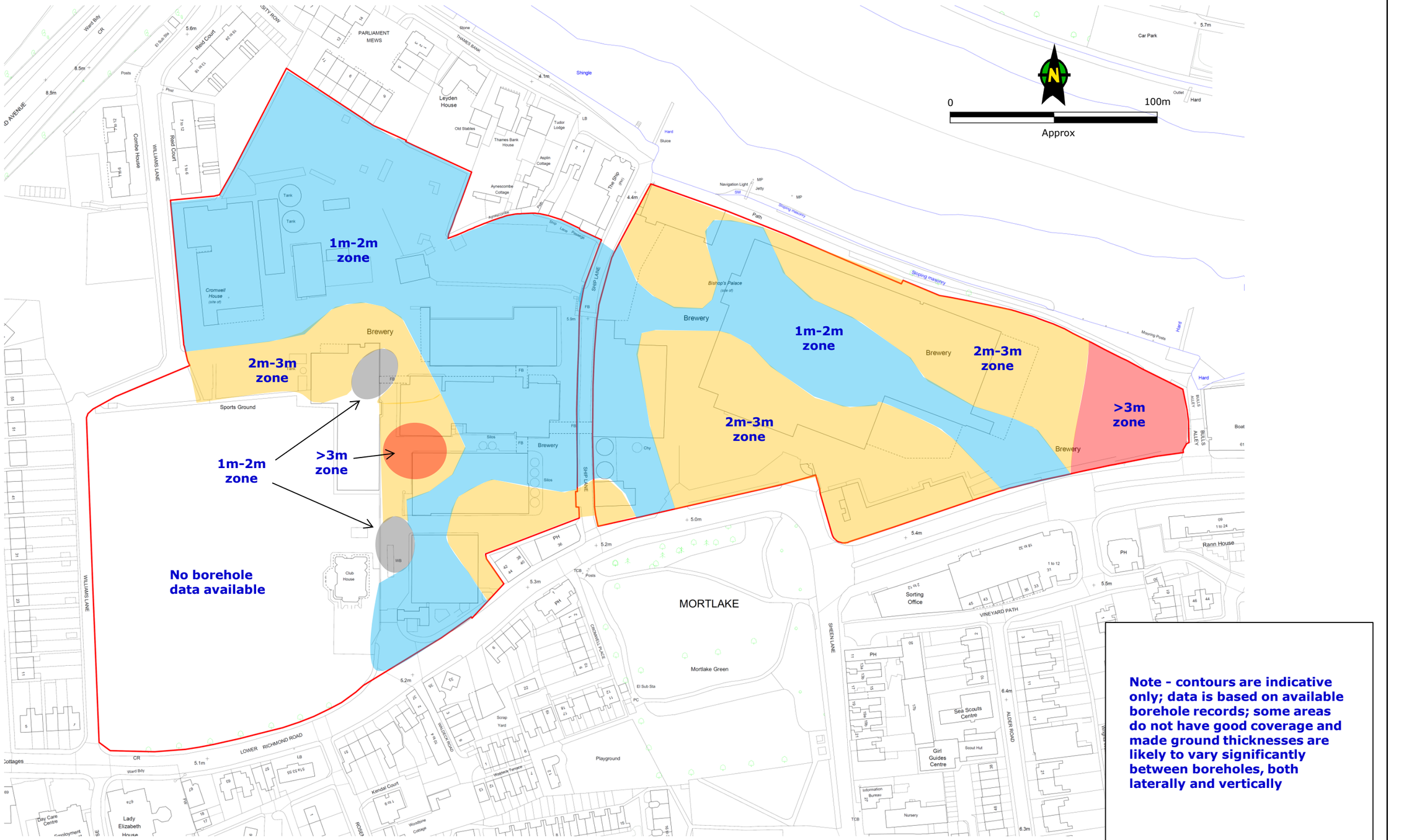
Design Line Δcu = 9.44kPa/m

Note: this plot may incorporate extrapolated results, generally where 'N' >50 - these are indicative only and should be used with caution

Soil Consultants

Site Location	Stag Brewery, Lower Richmond Road, Mortlake, London SW14 7ET	Report No: 10022/OT

Depth to top - River Terrace Deposits



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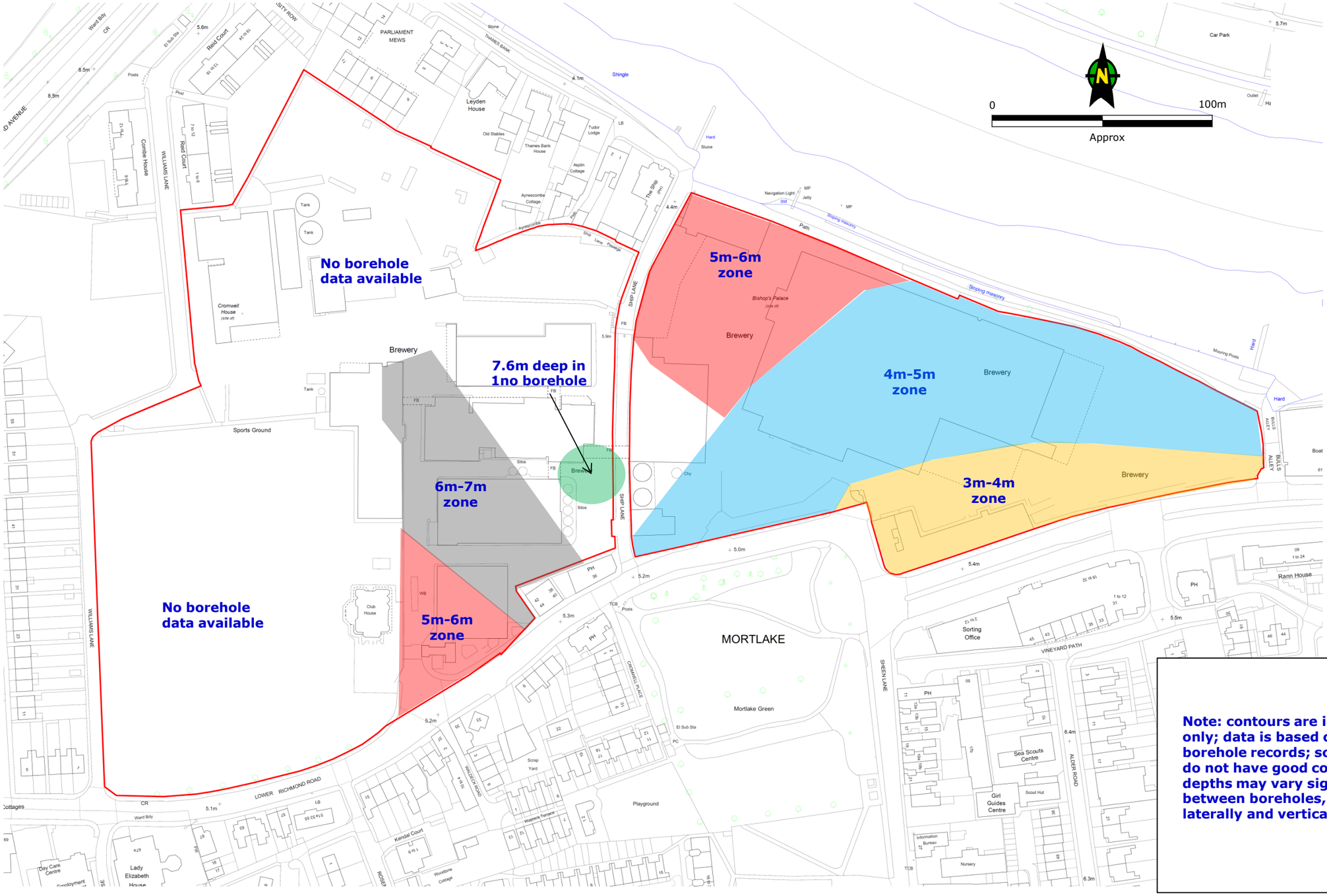
Site Location	Stag Brewery, Lower Richmond Road, Mortlake, London SW14 7ET	Report No: 10022/OT

Depth to top – London Clay Formation



Note: contours are indicative only; data is based on available borehole records; some areas do not have good coverage and depths may vary significantly between boreholes, both laterally and vertically

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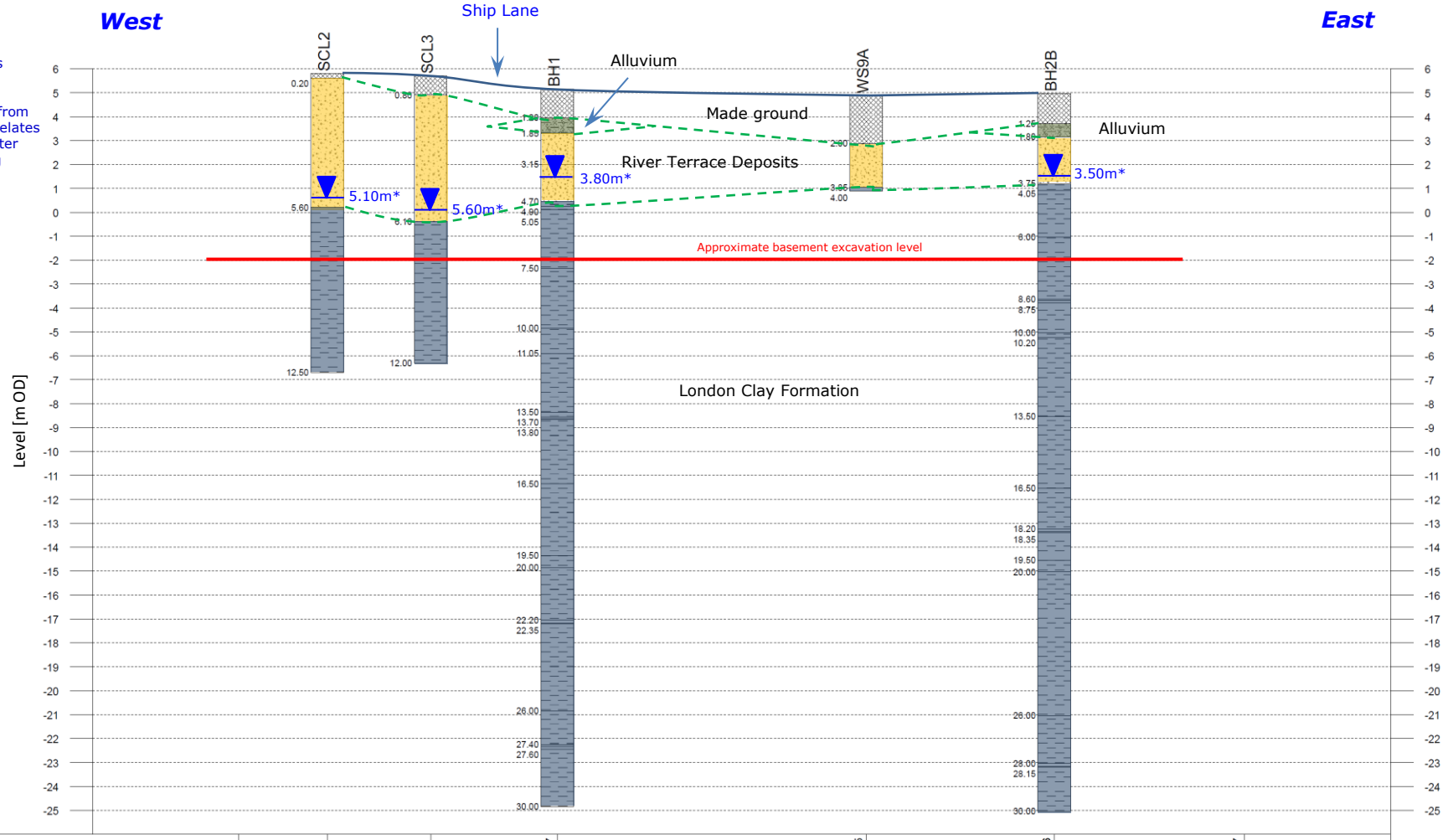
Project Id: 10022/OT
Project Title: Stag Brewery,
Location: Lower Richmond Road, Mortlake, London SW14 7ET
Client: Reselton Properties Ltd

Section AA

Soil Consultants

Notes:

* Groundwater levels shown are highest recorded at time of writing; information from historical boreholes relates to information on water strikes during drilling



Chainage (m)	0.00	38.42	83.28	138.27	272.35	353.96	436.57
Offset (m)	1.91	6.04	2.48	3.71	4.81		
Elevation (mAOD)	5.80	5.70	5.15	4.89	4.96		

STRATA BOUNDARIES BEETWEEN BOREHOLES INDICATIVE ONLY; VARIATIONS BETWEEN BOREHOLES SHOULD BE ANTICIPATED

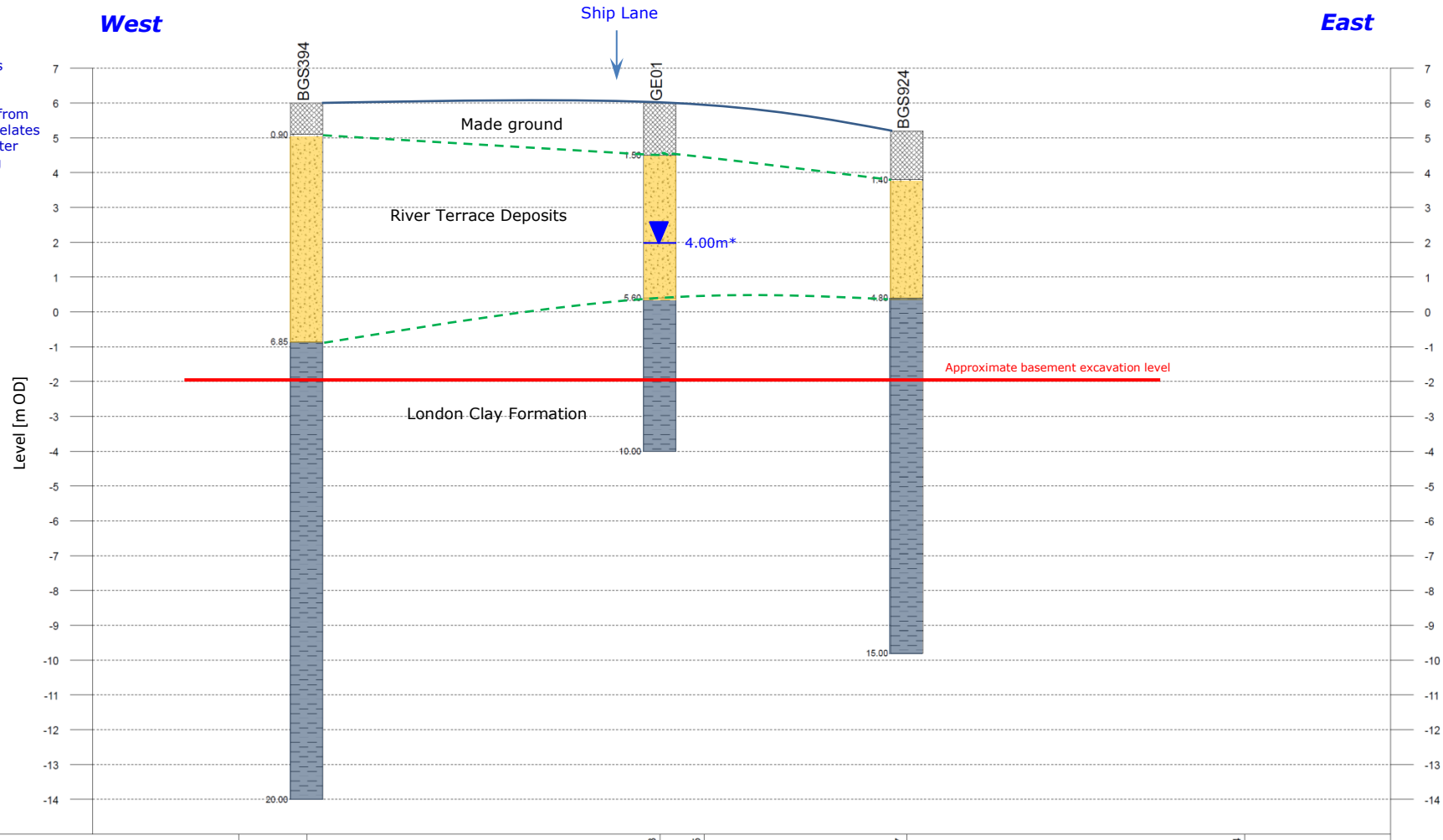
Project Id: 10022/OT
Project Title: Stag Brewery,
Location: Lower Richmond Road, Mortlake, London SW14 7ET
Client: Reselton Properties Ltd

Section BB

Soil Consultants

Notes:

* Groundwater levels shown are highest recorded at time of writing; information from historical boreholes relates to information on water strikes during drilling



Chainage (m)	0.00	23.46		145.63	161.05		231.07		347.94		
Offset (m)	3.63		12.41		4.39	10.13					
Elevation (mAOD)	6.00		6.00		6.08	5.20					