soils LIMITED

Basement Screening Assessment

at
Land at rear of 19-23 Friars Stile Road, Richmond, TW10 6NH

for
The Malins Group

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Control Document

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This is not a valid document for use in the design of the project unless it is titled Final in the document status box.

Current regulations and good practice were used in the preparation of this report. The recommendations given in this report must be reviewed by an appropriately qualified person at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Commission

Soils Limited was commissioned by The Malins Group to undertake a desktop scoping screening assessment to establish the impact and risk of the proposed basement construction, on land at Land at rear of 19-23 Friars Stile Road, Richmond, TW10 6NH. The scope of the investigation was outlined in the Soils Limited quotation reference Q27213, dated 05th January 2023.

This document comprises the basement screening assessment (BSA) and includes a scoping and screening assessment to identify any potential matters that may have an adverse impact and determined whether a full Basement Impact Assessment (BIA) is required.

Limitations and Disclaimers

This Basement Screening Assessment relates to the site located at Land at rear of 19-23 Friars Stile Road, Richmond, TW10 6NH and was prepared for the sole benefit of The Malins Group (The “Client”). The report was prepared solely for the brief described in Section 1.1 of this report.

The contents, recommendations and advice given in the report are subject to the Terms and Conditions given in Quotation Q27213, dated 05th January 2023 accepted by the client in their signed order form, dated 26th April 2023.

Soils Limited disclaims any responsibility to the Client and others in respect of any matters outside the scope of the above.

This report has been prepared by Soils Limited, with all reasonable skill, care and diligence within the terms of the Contract with the Client, incorporation of our General Conditions of Contract of Business and taking into account the resources devoted to us by agreement with the Client.

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The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief. As such these do not necessarily address all aspects of ground behaviour at the site.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

If the term “competent person” is used in this report or any Soils Limited document, it means an engineering geologist or civil engineer with a minimum of three years post graduate experience in the understanding and application of the appropriate codes of practice.

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Section 1 Introduction

1.1 Objective of Investigation

Soils Limited was commissioned by The Malins Group to undertake an intrusive ground investigation and to produce a BSA. The objective of this investigation was to establish the impact and risk of the proposed basement on land at rear of 19-23 Friars Stile Road, Richmond, TW10 6NH.

The report provides details on the ground and groundwater conditions on-site obtained from available desktop sources and provides a screening assessment on the potential impact of the proposed development on surrounding environs.

It is recognised that any Basement Screening Assessment is a live document and that further detailed assessments will be ongoing, if appropriate, as the design and construction progresses.

This document includes details of an intrusive ground investigation undertaken at the site by Soils Limited.

Section 2 Site Context

2.1 Location

The site was located at land at rear of 19-23 Friars Stile Road, Richmond, TW10 6NH and had an approximate O.S Land Ranger Grid Reference of TQ 18417 74348.

The site location plan is given in Figure 1.

2.2 Site Description

At the time of the investigation (May 2023) the site comprised a two storey stairwell structure connected to the rear of 23a Friars Stile Road and a single storey sloped roof storage garage along with access road associated with the 19-23a Friars Stile Road. The remaining site area was covered by hard standing comprising tarmacadam or concrete. The site was accessible from Onslow Road and was generally flat and level with a gentle (<1˚) slope down towards the north west. There was no evidence of soft landscaping or vegetation on the site. The site was bounded by residential properties in all directions.

An aerial photograph of the site and its close environs has been included in Figure 2.

2.3 Proposed Development

The proposed development was understood to comprise the demolition of the current on-site structures to allow for the construction of a three storey residential property with a basement beneath the entire footprint of the property and associated access, soft landscaping and infrastructure.

In compiling this report reliance was placed on drawings provided by the client ref 22.3349.100_P3 to 22.3349.112_P1, dated November 2022 to July 2023. The recommendations provided within this report are made exclusively in relation to the scheme outlined above, and must not be applied to any other scheme without further consultation with Soils Limited. Soils Limited must be notified about any change or deviation from the scheme outlined.

Development plans provided by the client are presented in Appendix E.

2.4 Site History

A review was undertaken of available historic OS mapping and aerial photography, using the following resources, National Library of Scotland online Map Finder and Google Earth.

The age of the property was determined to be post-1944. A summary of pertinent information from the available OS maps and aerial photography area provided in Table 2.1.

Table 2.1 Site History

Map	Description
OS 1892	Earliest available map shows plot was formally residential gardens as part of the terrace of houses on Friars Stile Road.
Up to 1944	No significant changes.
OS 1944-1972	Arrangement of terrace properties facing onto Friars Stile Road changed from previous maps. New arrangement is four properties with detached garages/storage structures to the rear. The end terrace property has a structure attached to the rear. On site garages and attached structure built pre 1944.
Aerial 2003	Google Earth Imagery shows no significant changes to the site structure or immediate neighbouring houses and confirms the change of structure identified in OS 1944-1972.
Aerial 2003 to 2022	No significant changes.

2.5 Neighbouring Properties / Structures

No.19-23a Friars Stile Road shared rear access onto the site and an attached stairwell structure was to the rear of 23a, this structure formed part of the development site. No. 1 Onslow Road located immediately north-west of the site was bounded by the rear wall of the garage structure on-site which included a semi-subterranean lower ground floor.

The nearest highway was Onslow Road, which was located <5m away from the proposed basement towards the east.

There were no noted granted planning applications for basements at properties immediately surrounding the site.

2.5.1 Listed Buildings/Structures

A number of locally listed buildings of townscape merit are present within the immediate vicinity of the site including 19 to 21 Friars Stile Road.

The nearest statutory listed structure was the Grade II Listed St Matthias's Church located ~100m north-east.

2.6 Topography

The site was generally flat and level at an elevation of approximately 8m AOD with a gentle (<1˚) slope down towards the north west. The wider area beyond the site generally sloped down away from the site in all directions at an angle of between 2˚ and 10˚ indicating the site to be on the top of a hill or mound. The steeper section of the slope are located approximately 200m to the west of the site past the B321 towards the River Thames. The elevation was taken from Google Earth data.

2.7 Published Geological Data

The 1:50,000 BGS map showed the site to be located upon the bedrock London Clay Formation with overlying superficial deposits of Boyn Hill Gravel Member.

2.7.1 Boyn Hill Gravel Member

The rivers of the south-east of England, including the River Thames and its tributaries, have been subject to at least three changes of level since Pleistocene times. One result has been the formation of a complex series of River Terrace Gravels. The Boyn Hill Gravel are found on higher ground than the existing flood plains and comprise sands and gravels of roughly bedded flint or chert gravels in a matrix of sand of varying degrees of coarseness.

2.7.2 London Clay Formation

The London Clay Formation comprises stiff grey fissured clay, weathering to brown near surface. Concretions of argillaceous limestone in nodular form (Claystones) occur throughout the formation. Crystals of gypsum (Selenite) are often found within the weathered part of the London Clay, and precautions against sulphate attack to concrete are sometimes required.

The upper boundary member of the London Clay Formation is known as the Claygate Member and marks the transition between the deep water, predominantly clay environment and succeeding shallow-water, sand environment of the Bagshot Formation.

The lower boundary is generally marked by a thin bed of well-rounded flint gravel and/or a glauconitic horizon. The formation overlies the Harwich Formation or where the Harwich Formation is absent the Lambeth Group.

2.8 Web Published Geology

A review of ground conditions using historic boreholes published on the BGS website within a 600m radius and up to a depth of 282m bgl, identified the following sequence and thickness of strata:

- Made Ground: 0.3m to 1.0m
- Boyn Hill Gravel Member: 3.0m to 6.4m
- London Clay Formation: 9.7m to 65.3m
- Lambeth Group: 69.9m to 85.3m
- Thanet Sand Formation: 70.83m to 88.39m
- Chalk: >143.0m to 282.0m

Due to the sites location at the top of a hill, the borehole records in the nearby area may not accurately reflect the thickness of strata beneath the site.

2.8.1 Groundwater

Historic boreholes published on the BGS website in the surrounding area recorded groundwater strikes at 4.5m bgl within the Boyn Hill Gravel Member, monitored circa 1960s. The relative elevation of the site compared to the historic borehole records may mean that the strike depth is not representative of that below the site.

2.9 Hydrology

The site was anticipated to be underlain by bedrock of the London Clay Formation, which would have overlying superficial deposits. The superficial deposits consisted of the granular Boyn Hill Gravel Member unconformably overlying the London Clay.

The Boyn Hill Gravel Member typically comprises sands and gravels and would therefore be permeable. Depending on the composition of any overlying Made Ground surface water would be expected to drain into the Boyn Hill Gravel Member.

The nearest permanent surface water feature was the River Thames ~470m west from the site.

Based on the Environmental Agency (EA) online catchment data explorer the site was within the London Management Catchment but not within any operational catchment area.

2.10 Hydrogeology

The Environment Agency has produced an aquifer designation system consistent with the requirements of the Water Framework Directive. The designations have been set for superficial and bedrock geology and are based on the importance of aquifers for potable water supply and their role in supporting water bodies and wetland ecosystems.

The London groundwater model was generally split into three aquifers, the Upper, Intermediate and Lower Aquifer.

- The Upper Aquifer confined to the superficial River Terrace Deposits, with the anticipated Boyn Hill Gravel Member being part of these deposits. The underlying London Clay Formation acts as an aquiclude to the underlying Intermediate and Lower Aquifers.

- The Intermediate Aquifer was generally associated with granular layers within the Lambeth Group.

- The Lower Aquifer was principally associated with the Chalk but can include the overlying Thanet Formation.

Shallow groundwater forming the Upper Aquifer was anticipated to be confined within the Boyn Hill Gravel Member. Historic BGS boreholes recorded groundwater at 4.50m bgl within the Boyn Hill Gravel Member. Groundwater within the Boyn Hill Gravel Member would effectively be perched on the underlying London Clay Formation. The perched groundwater flow direction will be in alignment with the topography of the London Clay Formation, anticipated to be in a westerly direction.

Any water that does infiltrate the London Clay Formation will generally tend to flow either with the topography or vertically downwards at a very slow rate towards the Intermediate and subsequently Lower Aquifer. Data for the London Clay Formation indicates horizontal permeability of between 10^{-7} m/s close to the surface increasing to 10^{-10} m/s at depth.

2.11 Flood Risk

The risk of flooding was assessed taking account of the information available from the EA flood maps, Strategic Flood Risk Assessment (SFRA) and Surface Water Management Plan (SWMP), both prepared for the London Borough of Richmond upon Thames.

The following were noted in relation to flood risk:

- The site was situated in Flood Zone 1, an area with low probability of flooding.
- No risk noted from fluvial or tidal flooding or surface water flooding.
- There was low potential for groundwater flooding to occur at surface, with a <25% risk of susceptibility of groundwater flooding.
- Low risk of flooding from reservoirs when there is also flooding from rivers.
- Within the Richmond Town Centre and Mortlake critical drainage area (CDA).
- In an area with 1 recorded internal and 1 external flood incidents, recorded by Thames Water.

Extracts from the EA flood maps, SFRA for fluvial or tidal, surface water and groundwater flooding are presented in Figure 4 to Figure 7.

In summary, the site of interest lies within Flood Zone 1, and has an area of less than 1 hectare and did not fall into an area at risk from fluvial or tidal flooding or surface water flooding. There was a low susceptibility and potential for groundwater flooding to occur at the surface and low risk of flooding from reservoirs.

2.12 Underground Infrastructure

No underground infrastructure was anticipated within the area of influence for the proposed development. The Property Asset Register Public Web Map prepared by Transport for London showed no underground tunnels nearby the site.

2.13 UXO Risk

Online bomb risk maps from ZeticaUXO indicated the area to have a moderate bomb risk.

Considering the results of the preliminary appraisal, it is recommended that a UXO specialist is contacted for a Preliminary UXO risk assessment.

Section 3 Screening Assessment

3.1 Introduction

Soils Limited has adopted a screening process to identify potential risks to the ground, groundwater/surface water, land stability, adjacent properties, and infrastructure to determine whether a full Basement Impact Assessment (BIA) was required.

The assessment is undertaken in the form of tabulated questions, based upon the Basement Assessment User Guide prepared for the London Borough of Richmond upon Thames.

3.2 Subterranean Characteristics Screening Assessment

The response to the Subterranean Characteristics Screening Assessment is given in Table 3.1.

Table 3.1 – Subterranean Characteristics Screening Assessment

Question	Response
1. Does the recorded water table extend above the base of the proposed subsurface structure?	**Unknown** – Historic boreholes from the surrounding area recorded groundwater strikes at 4.5m.
2. Is the proposed subsurface development structure within 100m of a watercourse or spring line?	No – Nearest watercourse the River Thames ~450m East.
3. Are infiltration methods proposed as part of the site's drainage strategy?	**Unknown** – No details on the proposed drainage strategy available at the time of reporting.
4. Does the proposed excavation during the construction phase extend below the local water table level or spring line (if applicable)?	**Unknown** – Historic boreholes from the surrounding area recorded groundwater strikes at 4.50m bgl.
5. Is the most shallow geological strata at the site London Clay?	No – Anticipated geology Boyn Hill Gravel Member overlying the London Clay Formation
6. Is the site underlain by an aquifer and/or permeable geology?	**Yes** – The Boyn Hill Gravel Member forms part of the River Terrace Deposits and Upper Aquifer (shallow groundwater).

3.3 Land Stability Screening Assessment

The response to the Land Stability Screening Assessment is given in Table 3.2.

Table 3.2 – Stability Screening

Question	Response
1. Does the site, or neighbouring area, topography include slopes that are greater than 7°?	No – Immediate surrounding topography was of low relief with slope <1°.
2. Will changes to site's topography result in slopes that are greater than 7°?	No – The proposed development will not result in slopes greater than 7°.

Question	Response
3. Will the proposed subsurface structure extend significantly deeper underground compared to the foundations of the neighbouring properties?	**Yes** – The development would be at a greater depth than neighbouring properties as there are no identifiable basements in the immediate vicinity.
4. Will the implementation of the proposed subsurface structure require any trees to be felled or uprooted?	No – No trees will be felled or uprooted as part of the development.
5. Has the ground at the site been previously worked?	**Unknown** – worked ground may be present due to previous site development
6. Is the site within the vicinity of any tunnels or railway lines?	No – No known tunnels or railway lines in close proximity.

3.4 Flood Risk and Drainage Screening Assessment

The response to the Flood Risk and Drainage Screening Assessment is given in Table 3.3.

Table 3.3 – Surface Flow and Flooding Screening

Question	Response
1. Will the proposed subsurface development result in a change in impermeable area coverage on the site?	No – The proposed development will maintain the current impermeable coverage on site
2. Will the proposed subsurface development impact the flow profile of throughflow, surface water or groundwater to downstream areas?	**Unknown** – potential impacts of changing groundwater flow.
3. Will the proposed subsurface development increase throughflow or groundwater flood risk to neighbouring properties?	No – Alterations to throughflow or groundwater flood risk are expected to be minimal due to the high permeability of the soils at the site an the unchanged impermeable surface covereing.
4. Will the proposed works take place under or adjacent to listed buildings or buildings of townscape merit?	**Yes** – the proposed works will be undertaken adjacent to locally listed buildings of townscape merit.

Section 4 Scoping

4.1 Introduction

The purpose of the scoping stage is to assess in more detail and determine the extent of the potential impacted identified as part of the screening assessment (where the answer is “yes” or “unknown” to any of the questions posed). The scoping stage is used to assist in defining the nature of investigation required and set the boundaries of the Basement Impact Assessment.

4.2 Potential Impacts

The following potential impacts were identified in Table 4.1 to Table 4.3.

Table 4.1 – Potential Impacts (Subterranean Characteristics)

Screening Question	Potential Impacts	Discussion
1. Does the recorded water table extend above the base of the proposed subsurface structure?	Basement construction could adversely affect the groundwater flow regime. Potential for flooding of the basement during construction. Potential change groundwater level surrounding the basement.	Historic groundwater data recorded the groundwater level between 4.5m bgl, although the data is not within the last 20 years. The proposed basement extension had a depth of ~3.5m. Based on the historic groundwater data the basement would not extend below the groundwater and unlikely to impact the groundwater flow regime. An on-site monitoring well would be required to confirm the local groundwater level. If groundwater levels were found to be above the level of the proposed basement extension the effect on the groundwater flow regime would be limited/negligible.
3. Are infiltration methods proposed as part of the site’s drainage strategy?	Impact upon the groundwater flow and levels.	The existing flow regime is unlikely to materially change the flow regime. The impermeable area on site will remain unchanged. A surface water management strategy will be required.
4. Does the proposed excavation during the construction phase extend below the local water table level or spring line (if applicable)?	Basement construction could adversely affect the groundwater flow regime. Excavations taken below the groundwater level could cause instability and flooding of the excavation.	In addition to the discussion for question 2; water ingress must be prevented by dewatering during construction, either by exclusion, extraction, or combination. The basement must be constructed using best practice with suitable temporary and permeant support, to prevent undue movements during construction affecting neighbouring properties/structures.

Screening Question	Potential Impacts	Discussion
6. Is the site underlain by an aquifer and/or permeable geology?	Removal of permeable soil that could be used for storage of rainfall, and adversely affecting surface water flood risk to neighbouring properties. Removal of permeable soil which was used for groundwater storage could adversely affect the groundwater flood risk.	The proposed basement extension was to extend into the ground by ~3.50m bgl and would remove a limited volume of the Boyn Hill Gravel Member. Any effect on rainfall storage, given the groundwater was likely (based on historic data) below this depth was considered minimal. The use of rainfall harvesting could be used to mitigate loss of rainfall storage.

Table 4.2 – Potential Impacts (Land Stability)

Screening Question	Potential Impacts	Discussion
3.Will the proposed subsurface structure extend significantly deeper underground compared to the foundations of the neighbouring properties?	Basement construction can result in undermining of foundations of neighbouring properties and cause excessive ground movements resulting in structural instability.	The neighbouring properties at 1 Friars Stile Road and 1 Onslow Road had sub-terranean ground floors as part of the construction. The proposed development is likely to extend to a depth of ~3.50m bgl which will be significantly deeper than the neighbouring structures on site. Ground investigation is recommended in order to establish the ground conditions beneath the site with the effects to be mitigated at the design stage. A ground movement assessment may be required.
5. Has the ground at the site been previously worked?	Worked ground may be present due to previous site development. Worked ground can be variable both laterally and vertically and foundations should not be placed within worked material.	The site has previously redeveloped and the building arrangement has changed. Ground investigation is recommended in order to establish the ground conditions beneath the site with the effects to be mitigated at the design stage. A ground movement assessment may be required.

Table 4.3 – Potential Impacts (Flood Risk and Drainage)

Screening Question	Potential Impacts	Discussion
2. Will the proposed subsurface development impact the flow profile of throughflow, surface water or groundwater to downstream areas?	Potential impacts of changing groundwater flow.	The neighbouring properties at 1 Friars Stile Road and 1 Onslow Road had sub-terranean ground floors as part of the construction. The proposed development is likely to extend to a depth of ~3.50m bgl which will be significantly deeper than the neighbouring structures on site

Screening Question	Potential Impacts	Discussion
		Ground investigation and further groundwater monitoring is recommended in order to establish the ground conditions beneath the site with the effects to be mitigated at the design stage.
4. Will the proposed works take place under or adjacent to listed buildings or buildings of townscape merit?	Basement construction can result in undermining of foundations of neighbouring properties and cause excessive ground movements resulting in structural instability.	The 2021 guidance from LB Richmond stated that "Guidance provided under 'Structural Impact Assessments' as part of the Good Practice Guide on Basement Developments (2015) should be followed to produce a Basement Impact Assessment. The 2015 Guide at paragraph 5, subparagraph 5.1 stated that: A Structural Impact Assessment (SIA) is required for basements under or adjacent to Listed Buildings, and it must be prepared and signed off by a Chartered Civil Engineer (MICE) or Structural Engineer (MI Struct.E). An SIA must include a Ground Movement Assessment (2015 Guide, par. 5.3, letter F) as well as engaging a Party Wall Surveyor (note to 2015 Guide, par 5, end of page 14). Listed buildings were intended as either Locally or Statutorily listed and must be within 20m from the excavation. A Ground Movement Assessment will be required.

Section 5 Intrusive Investigation

5.1 Proposed Project Works

The proposed intrusive investigation was designed to provide information on the ground conditions and to aid the design of foundations for the proposed residential development. The intended investigation, as outlined within the Soils Limited quotation (Q27213, dated 5th January 2023), was therefore to comprise the following items:

- CAT and Genny scan at exploratory hole locations
- 2No. up to 10m windowless sampler boreholes,
- 2No. up to 10m deep dynamic probes,
- Post site works monitoring (up to four occasions over four months),
- Laboratory geotechnical and contamination analysis.

5.1.1 Actual Project Works

The actual project works were undertaken on 16th February 2022, with subsequent laboratory testing and reporting, and comprised:

- CAT and Genny scan at exploratory hole locations,
- 2No. 5m windowless sampler boreholes (WS1 and WS2),
- 2No. 5m to 8m deep dynamic probes (DP1 and DP2),
- 4No. post site works monitoring (ongoing at time of reporting),
- Laboratory geotechnical and contamination analysis.

The two windowless sampler boreholes (WS1 and WS2) were backfilled with gravel and bentonite following the installation of monitoring wells.

All trial hole locations have been presented in Figure 3.

Following completion of site works, soil cores were logged, and sub sampled so that samples could be sent to the laboratory for both contamination and geotechnical testing.

5.2 Ground Conditions

On the 5th May 2023 the intrusive investigation was carried out and comprised:

- Two windowless sampler boreholes (WS1 and WS2) drilled to a depth of 5.00m below ground level (bgl) using a Dando Terrier. The depth of the exploratory holes was limited by the borehole sides collapsing and refusal on impenetrable strata.
- Two super heavy dynamic probes (DP1 and DP2) were driven to a depth of between 5.00m and 8.00m, prior and adjacent to their respective windowless sampler boreholes.
- A 5.00m deep monitoring well was installed into each borehole. The depth was limited by the borehole side collapsing to 5.00m bgl before installation. Each well comprised 1m of plain pipe with a bentonite surround and concrete cap, followed by 4m of slotted pipe and a gravel surround.

The maximum depths of exploratory holes have been included in Table 5.1.

All exploratory holes were scanned with a Cable Avoidance Tool (C.A.T.) and GENNY prior to excavation to ensure the health and safety of the operatives.

Table 5.1 Final Depth of Exploratory Holes

Exploratory Hole	Depth (m bgl)	Exploratory Hole	Depth (m bgl)
WS1	5.00^{W}	DP1	5.00
WS2	5.00^{W}	DP2	8.00

Note(s): ^{W} - well installation. The depths given in this table are taken from the ground level on-site at the time of investigation.

The soil conditions encountered were recorded and soil sampling commensurate with the purposes of the investigation was carried out. The depths given on the exploratory hole logs and quoted in this report were measured from ground level.

The soils encountered from immediately below ground surface have been described in the following manner. Where the soil incorporated an organic content such as either decomposing leaf litter or roots or has been identified as part of the in-situ weathering profile, it has been described as Topsoil both on the logs and within this report. Where man has clearly either placed the soil, or the composition altered, with say greater than an estimated 5% of a non-natural constituent, it has been referred to as Made Ground both on the log and within this report.

For more complete information about the soils encountered within the general area of the site reference must be made to the detailed records given within Appendix A, but for the purposes of discussion, the succession of conditions encountered in the exploratory holes in descending order can be summarised as:

Made Ground (MG)
Boyn Hill Gravel Member (BHT)
London Clay Formation (LC)

The ground conditions encountered in the exploratory holes are summarised in Table 5.2.

Table 5.2 Ground Conditions

Strata	Epoch	Depth Encountered (m bgl)		Typical Thickness (m)	Typical Description
		Top	Bottom		
MG	Anthropocene	G.L.	0.42 – 1.90	1.20	Concrete over brownish grey SAND AND GRAVEL with occasional concrete and brick fragments.
BHT	Pleistocene	0.42 – 1.90	2.70 – 3.40	1.90	Orangish brown mottled brown slightly gravelly sandy CLAY.
LC	Eocene	2.70 – 3.40	>8.00[2]	Not proven[3]	Brown mottled bluish grey CLAY.

Note(s): [1] Inferred to the base of the dynamic probes. [2] Base of strata not encountered. The depths given in this table are taken from the ground level on-site at the time of investigation.

5.3 Ground Conditions Encountered in Exploratory Holes

The ground conditions encountered in exploratory holes have been described below in descending order. The engineering logs are presented in Appendix B.1.

5.3.1 Made Ground

Soils described as Made Ground were encountered in both boreholes to a depth of 0.42m and 1.90m bgl.

The Made Ground comprised concrete over brownish grey SAND AND GRAVEL with occasional concrete and brick fragments.

The established depth of Made Ground found at each exploratory hole location have been included in Table 5.3.

Table 5.3 Established Depth of Made Ground

Exploratory Hole	Depth (m bgl)
WS1	1.90
WS2	0.42

5.3.2 Boyn Hill Gravel Member

Soils described as Boyn Hill Gravel Member were encountered in both exploratory hole locations underlying the Made Ground.

In location WS1 the Boyn Hill Gravel extended to a depth of 3.40m bgl and was inferred with DP1 to 3.40m bgl. The materials were generally cohesive and comprised orangish brown mottled brown slightly gravelly sandy CLAY.

In location WS2 the Boyn Hill Gravel extended to a depth of 2.70m bgl and was inferred within DP2 to 2.40m bgl. The materials were encountered as orangish brown slightly sandy slightly gravelly CLAY extending to 1.20m bgl; over orangish brown slightly gravelly clayey fine to medium SAND.

The established depth of Boyn Hill Gravel Member found at both exploratory hole locations have been included in Table 5.4.

Table 5.4 Established Depth of Boyn Hill Gravel Member

Exploratory Hole	Depth (m bgl)
WS1	3.40
WS2	2.70
DP1	3.40
DP2	2.40

5.3.3 London Clay Formation

The London Clay Formation was encountered underlying the Boyn Hill Gravel Member in both exploratory location to the maximum depth of 5.00m bgl. The formation was inferred to the full investigatory depth of up to 8.00m bgl in both dynamic probes.

The London Clay Formation comprised brown mottled bluish grey CLAY.

The established depth of London Clay Formation found at each exploratory hole location have been included in Table 5.5.

Table 5.5 Established Depth of London Clay Formation

Exploratory Hole	Depth (m bgl)
WS1	5.00[1]
WS2	5.00[1]
DP1	5.00[1]
DP2	8.00[1,2]

Note(s): [1] Final depth of exploratory hole. [2] Inferred below depth of the windowless sampler borehole

5.4 Roots

Roots and rootlets were not encountered during the investigation. However, this does not negate the presence of roots and rootlets in other areas of the site.

Roots may be found to greater depth at other locations on the site particularly close to trees and/or trees that have been removed both within the site and its close environs.

It must be emphasised that the probability of determining the maximum depth of roots from a narrow diameter borehole is low. A direct observation such as from within a trial pit is necessary to gain a better indication of the maximum root depth.

Some mature trees of small size were present within the neighbouring properties. The most relevant tree was within the rear garden of the neighbouring property at 1 Onslow Road, approximately 10m from the proposed basement development.

5.5 Groundwater

Groundwater was encountered at 3.40m bgl within WS1 and WS2 during drilling. A 5m deep monitoring well was installed into both boreholes and monitored on three out of four programmed occasions at the time of reporting (July 2023). At the time of reporting one further monitoring visit was to be undertaken. The post site works groundwater monitoring is presented in Table 5.6.

Table 5.6 Groundwater Monitoring

Exploratory Hole	Well Depth (m bgl)	Depth to Water (m bgl)		
		24/05/2023	13/06/2023	23/06/2023
WS1	4.75	-[1]	2.93	2.93
WS2	2.23	2.00	1.93	2.10

Note(s): Groundwater readings taken from ground level. [1] Location not monitored due to obstruction

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage, tidal effects. The investigation was conducted in May (2022), when groundwater levels should typically be falling from their annual maximum (highest) elevation, to their annual minimum (lowest) elevation around September.

Groundwater equilibrium conditions may only be conclusively established, if a series of observations are made via groundwater monitoring wells.

Section 6 Discussion of Geotechnical In-Situ and Laboratory Testing

6.1 Dynamic Probe Tests

Dynamic probing (DPSH) was undertaken at two locations (DP1 to DP2) adjacent and prior to the drilling of WS1 and WS2, to a depth of between 5.00m and 8.00m bgl. The results were converted to equivalent SPT “N60” values based on dynamic energy using commercial computer software (Geostru). The results were then interpreted based on the classifications outlined in Table C.1.1 and Table C.1.2.

The SPT “N60” values presented have been corrected in accordance with BS EN 22476 Part 3, to account for the rig’s trip hammer efficiency, borehole depth, overburden factors etc. Further correction of the ‘N’ values should therefore not be necessary. The energy ratio of the drilling rig was 81.34%. The energy ratio for each location is presented on the individual logs within Appendix B.1.

The Boyn Hill Gravel Member recorded equivalent SPT “N60” values between 9 and 22 within cohesive beds and 13 to 40 in granular beds.

The cohesive beds were classified as medium to high strength with an inferred undrained cohesive strength of 45 to 110kPa.

The relative densities of the granular beds were classified as medium dense to dense. There was no correlation with increase in depth and strength or relative density regarding the materials of the Boyn Hill Gravel Member.

The London Clay Formation recorded equivalent SPT “N60” values between 4 and 44. Classifying the cohesive beds as low to very high strength with an inferred undrained cohesive strength of between 20 to 220kPa. The soil strength was typically increasing with depth.

A full interpretation of the DPSH tests, are outlined in Appendix C.2Appendix C.2, Table C.2.1.

6.2 Atterberg Limit Tests

Atterberg Limit tests were performed on four samples, one obtained from the Made ground, two obtained from the cohesive Boyn Hill Gravel Member and the remaining sample from the London Clay Formation. The results were classified in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2.

The cohesive Boyn Hill Gravel Member was classified as medium volume change potential.

The London Clay Formation was classified as medium volume change potential.

A full interpretation of the Atterberg Limit tests are outlined in Table C.2.2, Appendix C.2 and the laboratory report in Appendix C.3.

6.3 Particle Size Distribution Tests

Particle Size Distribution (PSD) tests were performed on one sample from the granular Boyn Hill Gravel Member.

The PSD test classified the granular beds of the Boyn Hill Gravel Member as having no volume change potential in accordance BRE Digest 240 and NHBC Standards Chapter 4.2.

A full interpretation of the PSD tests, are outlined in Table C.2.3, Appendix C.2 and the laboratory report in Appendix C.3.

6.4 Sulphate and pH Tests

Two samples were taken, one from the Made Ground and one from the Boyn Hill Gravel Member and submitted for water soluble sulphate (2:1) and pH testing in accordance with Building Research Establishment Special Digest 1, 2005, 'Concrete in Aggressive Ground'.

The tests recorded water soluble sulphate for the Made Ground of 14mg/l, with pH values of 8.2.

The tests recorded water soluble sulphate for the Boyn Hill Gravel Member of <10mg/l, with pH values of 7.9.

The significance of the sulphate and pH Test results are discussed in Section 8.2 and the laboratory report in Appendix C.3.

Section 7 Engineering Appraisal

7.1 Established Ground Conditions

An engineering appraisal of the soil types encountered during the site investigation and likely to be encountered during the redevelopment of this site is presented. Soil descriptions are based on analysis of disturbed samples taken from the exploratory holes.

7.1.1 Made Ground

Foundations must not be placed on non-engineered fill unless such use can be justified on the basis of a thorough ground investigation and detailed design. Foundations must be taken through any Made Ground and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.

Soils described as Made Ground were encountered both boreholes to a depth of between 0.42m and 1.90m bgl.

7.1.2 Boyn Hill Gravel Member

Soils described as Boyn Hill Gravel Member were encountered in both exploratory hole locations underlying the Made Ground.

In location WS1 the Boyn Hill Gravel extended to a depth of 3.40m bgl and was inferred with DP1 to 3.40m bgl. The materials were generally cohesive and comprised orangish brown mottled brown slightly gravelly sandy CLAY.

In location WS2 the Boyn Hill Gravel extended to a depth of 2.70m bgl and was inferred within DP2 to 2.40m bgl. The materials were encountered as orangish brown slightly sandy slightly gravelly CLAY extending to 1.20m bgl; over orangish brown slightly gravelly clayey fine to medium SAND.

Results from DPSH testing inferred that the cohesive soils of the Boyn Hill Gravel Member were of a **medium to high strength,** with undrained cohesions of between **45kPa and 110kPa**.

The granular soils had relative densities between **medium dense and dense.**

The Atterberg Limits tests confirmed that the cohesive beds had **medium volume change potential** in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

The PSD tests confirmed that the granular beds had no volume change potential in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

Soils of the Boyn Hill Gravel Member varied between the two exploratory hole locations on site with cohesive strata encountered in WS1 and cohesive over granular strata encountered in WS2.

Due to the variability encountered on site and the proposed depth of the basement, the soils of the Boyn Hill Gravel were not considered a suitable bearing stratum.

7.1.3 London Clay Formation

The London Clay Formation was encountered underlying the Boyn Hill Gravel Member in both exploratory location to the maximum depth of 5.00m bgl. The formation was inferred to the full investigatory depth of between 5.00m and 8.00m bgl in both dynamic probes.

Results from DPSH testing inferred that the cohesive soils of the London Clay Formation were of a **low to very high strength,** with undrained cohesions of between **20kPa and 220kPa**.

The Atterberg Limits tests confirmed that the cohesive beds had **medium volume change potential** in accordance with both BRE Digest 240 and NHBC Standards Chapter 4.2.

Soils of the London Clay Formation are over-consolidated cohesive soils and as such are expected to display moderate bearing capacities with moderate settlement characteristics. The London Clay Formation was considered suitable as a bearing stratum.

7.1.4 Guidance on Shrinkable Soils

The ground conditions were established as Boyn Hill Gravel Member which was encountered as cohesive strata in WS1 to a depth of 3.40m bgl and cohesive over granular strata in WS2 to a depth of 2.70m bgl. Underlying the Boyn Hill Gravel Member was the cohesive London Clay Formation.

Atterberg Limit testing were classified in accordance with BRE Digest 240 and NHBC Standards Chapter 4.2. The cohesive Boyn Hill Gravel Member deposits had a medium volume change potential over the underlying granular soils of the Boyn Hill Gravel Member, that had no volume change potential. The London Clay Formation had a medium volume change potential.

The proposed development comprised a basement, which would extend to circa 3.50m bgl, passing through the cohesive beds and granular beds of the Boyn Hill Gravel Member and into the cohesive beds of the London Clay Formation. A medium volume change potential must be adopted for foundations passing through cohesive beds of the Boyn Hill Gravel Member.

7.1.5 Groundwater

Groundwater was encountered at 3.40m bgl during drilling of WS1 and WS2 and recorded between 1.93m and 2.93m bgl in subsequent monitoring of the installed wells, between May and July 2022. Vertical groundwater movement was likely to be limited / variable through the upper part of the Boyn Hill Gravel Member which included beds of cohesive clay. Groundwater seepages would be encountered within the interbedded granular beds. Underlying the cohesive beds, encountered to 2.50m bgl groundwater could be found migrating freely through the permeable sand and gravels.

Section 8 Foundation Scheme

8.1 Foundation Recommendations

Foundations **must not** be constructed within any Made Ground and Boyn Hill Gravel Member due to the likely variability and potential for large load induced settlements both total and differential.

Roots were not encountered during the investigation If roots are encountered during the construction phase foundations **must not be placed within any live root penetrated** or desiccated **cohesive soils or those with a volume change potential**. Should the foundation excavations reveal such materials, the excavations **must** be extended to greater depth in order to bypass these unsuitable soils. Excavations must be checked by a suitable person prior to concrete being poured.

The proposed basement had a depth of circa 3.50m deep, which would be taken into the cohesive London Clay Formation, which was classified as having medium volume change potential. Shallow foundations within the basement excavation were considered a potentially suitable foundation scheme for the proposed development.

8.1.1 Shallow Foundations within Basement Excavations

Foundations constructed within the basement excavation could be considered and the bearing capacity of such foundations is given below. If the foundation is to include lateral load from retained soil, then the distribution of loads on the foundation will be trapezoidal and the maximum pressure will be at the toe of the foundation. In such cases additional analyses must be requested by the client such that the appropriate analyse is undertaken.

If the wall is to have backfill placed on both sides, the backfill must be placed in shallow rises on both sides to maintain similar lateral forces on both sides of the wall.

A proposed basement excavation 3.50m deep would remove an overburden pressure of 63kPa, based on a unit weight of 18kN/m^3, for the overlying soil.

An “**net**” allowable bearing capacity of **100kPa** was calculated, founding at a depth of 3.50m bgl within the London Clay Formation, based on a 5m by 0.75m strip foundation.

Taking account of the removed overburden pressure the “**gross**” bearing value could be taken as **160kPa**.

For the allowable bearing value given above, settlements **should not be >15mm**, provided that excavation bases are carefully bottomed out and blinded or concreted as soon after excavation as is possible and kept dry. Settlements may be taken as proportional to the applied foundation pressure for the given size of the foundations. Based on the dynamic probes undertaken differential settlements of up to 10mm could occur across the foundation.

Anticipated settlements may be taken as proportional to the bearing capacity adopted (for the same configuration of foundation), therefore if the bearing value is halved the anticipated settlement will halve.

All foundation formations must be examined, recorded, and signed off by a competent person.

Foundations must not be cast over foundations of former structures and other hard spots.

8.1.2 Basement and Stability Requirements

The following comments are of a very general non-specific nature. Should lateral and vertical ground movements and the damage category resulting works be required this can be undertaken by Soils Limited.

The excavation of the proposed basement was estimated at 3.50m bgl. Groundwater was encountered in between 1.93m and 3.40m bgl.

Groundwater levels could rise, particularly after prolonged periods of wet weather.

If the construction works take place during the winter months or during/after prolonged periods of wet weather perched water could accumulate or groundwater could be found migrating through the granular deposits of the Boyn Hill Gravel Member. If any water ingress is not prevented by dewatering, the basement slab could become “buoyant” whilst empty. This must be taken into account in the design. Support of excavation and dewatering with pumps from sumps introduced into the floor of the excavation must be considered.

Given the limited space between the proposed basement and site boundary it is recommended that a coffer dam type structure using a sheet piles, secant or contiguous concrete piled wall around the periphery of the structure.

Generally cantilevered piled walls have an open face to embedded ratio of about one to two ie. a supported face 3.50m in height would require a penetration into the ground, below the base of the excavation, of about 7.00m. Should the piled wall be purely an unsupported cantilever then it is likely that quite deep section sheet piles or large diameter bored piles would be required. Installing a braced waling to the wall could reduce the sheet section, or diameter of the piles.

In the absence of robust long-term groundwater monitoring data from the well installed, full hydrostatic pressure (worst credible case) must be taken into account for the design of the proposed basement slab/walls or the worst credible levels as defined by EC – 7.

8.2 Subsurface Concrete

The sulphate and pH tests carried out in accordance with BRE Special Digest 1, 2005, 'Concrete in Aggressive Ground', established the site concrete classifications for each stratum as presented in Table 8.1.

Table 8.1 Concrete Classification

Stratum	Design Sulphate Class	ACEC Class
MG	DS-1	AC-1
BHT	DS-1	AC-2[d]

Concrete to be placed in contact with soil or groundwater must be designed in accordance with the recommendations of Building Research Establishment Special Digest 1 2005, *'Concrete in Aggressive Ground'* taking into account any possible exposure of potentially pyrite bearing natural ground and the pH of the soils.

8.3 Excavations

Shallow excavations in the Made Ground/Topsoil and Boyn Hill Gravel Member are likely to be marginally stable in the short term at best.

Deeper excavations taken into the Boyn Hill Gravel Member and London Clay Formation are likely to be unstable and require support. Unsupported earth faces formed during excavation may be liable to collapse without warning and suitable safety precautions should therefore be taken to ensure that such earth faces are adequately supported or battered back to a safe angle of repose.

Excavations beneath the groundwater table are likely to be unstable and dewatering of foundation trenches may be necessary.

8.4 Soakaways

The granular soil of the Boyn Hill Gravel Member was considered potentially suitable for soakaways. The interbedded clay beds encountered up to 2.50m bgl would likely reduce the suitability of the shallow soils and full in-situ testing to BRE Digest 365 would be required to confirm viability.

Consultation with the Environment Agency must be sought regarding any use which may have an impact on groundwater resources.

Section 9 Chemical Analysis and Waste Disposal

9.1 Determination of Chemical Analysis

The driver for determination of the analysis suite was to allow an overview of the site for initial waste classification purposes and highlight any potential risks to site workers and end-users, based on the very limited analyses undertaken. This report does not include a full contaminated land risk assessment in line with current guidance and should be approached with the appropriate degree of caution. 1No. sample of Made Ground was submitted to the chemical analyses detailed in Table 9.1.

Table 9.1 Chemical Analyses Suites

No. of Tests	Determinants
1	Metal suites: Arsenic, Boron (Water Soluble), Cadmium, Chromium (total & hexavalent), Copper, Lead, Mercury, Nickel, Selenium, Zinc
1	Polycyclic aromatic hydrocarbons (PAH) – USEPA 16 suite
1	Extractable petroleum hydrocarbons (EPH) – Texas Banded
1	Phenols – total monohydric
1	pH values
1	Organic matter content
1	Moisture content
1	Asbestos screen
1	Waste Acceptance Criteria (WAC)

The soil testing was carried out in accordance with the MCERTS performance standard, and the results are shown in Appendix D.1, Test Report 23-06368

9.2 Assessment Criteria

The assessment criteria used to determine risks to human health are derived and explained within Appendix D.3.

9.3 Representative Contamination Criteria - Soil

Based on the proposed development, the results of the chemical analysis have been compared against a '***Residential without home grown produce***' end use, as presented in SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination December 2014 (C4SL), derived for the protection of human health, and adopted as the Generic Assessment Criteria (GAC). Where C4SL has not published screening values for determinants, generic screening values derived for the same end use have been adopted from the following published guidance; DEFRA Soil Guideline Values (SGV) and LQM/CIEH/Suitable 4 Use Level (S4UL). To assess the potential toxicity of organic determinants (Petroleum Hydrocarbons and Polyaromatic Hydrocarbons) to the human health, the soil sample was analysed for Soil Organic Matter (SOM). The selected sample analysed recorded, a SOM value of 1.2%.

9.4 Preliminary Risk Assessment – Soils

This report does not include a Generic Quantitative Risk Assessment (GQRA) and only comprised limited chemical analyses to provide a generic screening overview of potential risk to site workers and end-users. **None** of the substances analysed recorded concentrations in excess of the adopted guidance values.

9.5 Asbestos

The test certificate for the sample submitted for contamination analyses during this investigation includes the results of an Asbestos Screen, and 'Not detected' was reported. This finding does not obviate the risk of asbestos being present on the site and the client must seek advice from qualified and competent asbestos specialist during and prior to undertaking works to ensure compliance with appropriate legislation and guidance.

9.6 Duty of Care

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust is generated as a result of construction activities. The site should be securely fenced at all times to prevent unauthorised access. Washing facilities should be provided and eating restricted to mess huts.

9.7 Excavated Material

Excavated material as waste must be defined or classified prior to any disposal, transport, recycling or re-use at or by an appropriately licensed or exempt carrier and/or off-site disposal facility. The requirements inherent in both Duty of Care and Health and Safety must also be complied with. In order to determine what is to happen, what is suitable, appropriate and most effective in the disposal of wastes, especially those subject to CDM waste management plan requirements, several factors must be considered and competent advice should always be sought.

The amount, type and nature of the material to be removed will in part determine the amount and type of analysis that may be required to comply with current waste guidance, and thereby allow a competent person to suitably classify the material. Often this data is uncertain or unavailable, especially in the early stages of a project, and therefore further investigation, testing and analysis may be required as additional information regarding the development becomes available.

Wastes must be classified and defined by their solid characteristics to comply with current waste guidance. Existing information and analysis derived for environmental purposes may therefore be suitable for use in this context. WAC report the leachability of materials and therefore cannot be used to classify, characterise or define wastes. The only purpose of a WAC analysis is to determine the suitability of a given material for acceptance at one of the three different types of available licenced landfills (inert, stable non-reactive hazardous or hazardous).

Other options are available that may lead to significant savings against disposal to landfill and expert advice should always be sought from a competent person to advise on their relative costs or benefits and advise on any additional analysis, sampling or investigation that may be required to reduce remaining uncertainties and comply with current guidance.

9.7.1 WAC Testing

WAC analysis was undertaken on a single sample to provide a general indication for future waste removal. The WAC certificate is presented in Appendix D.2, within Test Report 23-06368.

9.8 Re-use of Excavated Material On-site

The re-use of on-site soils may be undertaken either under the Environmental Permitting Regulations 2007 (EPR), in which case soils other than uncontaminated soils are classed as waste, or under the CL:AIRE Voluntary Code of Practice (CoP) which was published in September 2008 and is accepted as an alternative regime to the EPR.

Under the EPR, material that is contaminated but otherwise suitable for re-use is also classified as waste and its re-use should be in accordance with the Environmental Permitting Regulations 2007 (EPR). Environmental Permit Exemptions (EPE) are for the re-use of non-hazardous or inert waste only; hazardous waste cannot be re-used under a permit exemption. EPE apply only to imported inert waste materials; inert material arising on site and recovered on site is not classified as waste and does not require an exemption. It is possible that materials arising on-site will be classified as inert and would not need an exemption.

Environmental Permit Exemptions are only allowed for certain activities, placing controls on the quantities that can be stored and re-used. The re-use of waste shall be within areas and levels defined in planning applications and permissions for the development. An EPE requires a site-specific risk assessment for the receptor site to demonstrate that the materials are suitable for use, i.e. that they will not give rise to harm to human health or pollution of the environment.

Under the CL:AIRE voluntary code of practice (CoP) materials excavated on-site are not deemed contaminated if suitable for re-use at specified locations or generally within the site.

Material that may have been classified as hazardous waste under the EPR may be re-used. The CoP regime requires that a ‘Qualified Person’ as defined under the CoP reviews the development of the Materials Management Plan, including review of Risk Assessments and Remediation Strategy/Design Statement together with documentation relating to Planning and Regulatory issues, and signs a Declaration which is forwarded to the Environment Agency and which confirms compliance with the CoP.

Should it be necessary to import materials from another site where materials are excavated and which is not material from a quarry or produced under a WRAP protocol, then an EPE would be necessary for the imported material whether the work was managed under the CoP or the EPR.

9.9 Imported Material

Any soil, which is to be imported onto the site, must undergo chemical analysis to permit classification prior to its importation and placement in order to ascertain its status with specific regard to contamination, i.e. to prove that it is suitable for the purpose for which it is intended.

9.10 Discovery Strategy

There may be areas of contamination not identified during the course of the investigation. Such occurrences may also be discovered during the demolition and construction phases for the redevelopment of the site.

Care should be taken during excavation works especially to investigate any soils, which appear by eye (e.g. such as fibrous materials, large amounts of ash and unusual discolouration), odour (e.g. fuel, oil and chemical type odours or unusual odours such as sweet odours or fishy odours) or wellbeing (e.g. light headedness and/or nausea, burning of nasal passages and blistering or reddening of skin due to contact with soil) to be contaminated or of unusual and/or different character to standard soils or those analysed.

In the event of any discovery of potentially contaminated soils or materials, this discovery should be quarantined and reported to the most senior member of site staff or the designated responsible person at the site for action. The location, type and quantity must be recorded and the Local Authority, and a competent and appropriate third-party Engineer/Environmental consultant notified immediately. An approval from the Local authority must be sought prior to implementing any proposed mitigation action.

The discovery strategy must remain on site at all times and must demonstrate a clear allocation of responsibility for reporting and dealing with contamination. A copy of the strategy must be placed on the health and safety notice board and /or displayed in a prominent area where all site staff are able to take note of and consult the document at any time. Any member of the workforce entering the site to undertake any excavation must be made aware of the potential to discover contamination and the discovery strategy.

Section 10 Basement Impact Assessment

10.1 Mitigation of Adverse Effects

This section of the report addresses the potential impacts identified by the scoping study and the relevant findings of the ground investigation and mitigation measures, where required.

Is the site located directly above an aquifer?

And

Will the proposed basement extend beneath the water table surface?

Potential Impacts: Alteration of existing groundwater flow regime, which in turn could potentially cause local increase or decrease of groundwater levels.

Ground Investigation Findings: The ground investigation identified a Made Ground overlying the Boyn Hill Gravel Member and the London Clay Formation. The Made Ground and superficial deposits (Head and Hackney Gravel Member) contained granular material which could allow the migration of shallow groundwater. Groundwater was encountered between 1.93m and 3.40m bgl, which was approximately 0.10m to 1.50m above the basement founding level.

The basement would extend through the Made Ground and superficial deposits into the London Clay Formation. The London Clay Formation has a very low permeability. Basement walls and piles across the groundwater flow direction could act as a barrier to the shallow groundwater.

Mitigation: Groundwater was suspected to flow in a westerly direction based on the topography putting it in alignment with the narrow side of the basement. The basement was isolated and so the increase would probably be negligible, as GW could still flow around it without increasing the length of the flow path significantly

Will the proposed subsurface structure extend significantly deeper underground compared to the foundations of the neighbouring properties?

Potential Impacts: Basement construction can result in undermining of foundations of neighbouring properties and cause excessive ground movements resulting in structural instability.

Ground Investigation Findings: The ground investigation found Made Ground and Boyn Hill Gravel Member over the London Clay Formation. The granular soils of the Made Ground and Boyn Hill Gravel Member would be unstable in the short term as would be soils taken below the groundwater table.

Mitigation: The basement construction should include the design of permanent works to ensure ground movements are within tolerable limits and temporary works to prevent damage during construction.

Is the site within 5m of a highway or pedestrian right of way?

Potential Impacts: Excavation of a basement could result in structural damage to the roads/ footways or buried services.

Ground Investigation Findings: The basement would be constructed through the Made Ground and Boyn Hill Gravel Member which could be unstable. The London Clay Formation would be marginally stable in the short term.

Mitigation: Design of permanent works to ensure induced ground movements are within tolerable limits and temporary works to prevent damage during construction.

Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?

Potential Impacts: Basement construction can result in undermining of foundations of neighbouring properties and cause excessive ground movements resulting in structural instability.

Ground Investigation Findings: The basement would be constructed through the Made Ground and Boyn Hill Gravel Member which could be unstable. The London Clay Formation would be marginally stable in the short term.

Mitigation: Structural design and method statements will draw on established successful practices. Pre-start and completion surveys will be made of the adjoining properties.

Will the proposed works take place under or adjacent to listed buildings or buildings of townscape merit?

Potential Impacts: Basement construction can result in undermining of foundations of neighbouring properties and cause excessive ground movements resulting in structural instability.

Ground Investigation Findings: The basement would be constructed through the Made Ground and Boyn Hill Gravel Member which could be unstable. The London Clay Formation would be marginally stable in the short term.

Mitigation: GMA and SIA to be produced due to the neighbouring site being a locally listed building of townscape merit within 20m of the Structural design and method statements will draw on established successful practices. Pre-start and completion surveys will be made of the adjoining properties.

10.2 Surrounding Buildings

This section considers the potential effects of basement construction on nearby properties.

Detrimental effects would be manifested as cracking and more serious structural damage. Many old buildings in do exhibit signs of historic movement and repair. In practice, it is often difficult to attribute cracks visible in a structure to specific site construction activities unless a detailed survey of the affected structure and its founding strata had been undertaken before the construction works.

Any observed changes in the state of the building can then be causally linked to the works with more confidence and less debate than if no pre-works condition survey had been undertaken. Surveys require the cooperation of the property owners, as entry by surveyors into the property will be necessary. This would normally be undertaken in collaboration with the neighbour's party wall surveyors.

Close supervision will be made during the construction phase. Movement monitoring of neighbouring and nearby structures will be undertaken before construction starts and continued through the construction phase and for an appropriate period thereafter.

The data from the site investigation has established soil and groundwater conditions. The client's engineer can prepare working drawings and construction method statements that will mitigate adverse effects of nearby properties.

Section 11 Conclusion and Recommendations

11.1 General

The findings of this report are informed by site investigation data and information regarding construction methods, sequence, loading and allowable bearing capacity provided by the client. The analysis is undertaken on the assumption of high quality workmanship.

Groundwater levels were recorded between 1.93m and 3.40m bgl. The excavation depth of the proposed basement was at a ground level of approximately 3.50m bgl, therefore groundwater would pose a risk during excavation. Water ingress would have to be prevented during basement excavation. Given the cohesive nature of the London Clay Formation it would be recommend that dewatering with pumps from sumps introduced into the floor of the excavation must be considered.

An appropriate monitoring regime must be adopted to manage risk and potential damage to neighbouring structures, during construction onsite.

The basement construction would act as a barrier to the groundwater flow, due to extending through the shallow groundwater into the low permeability London Clay Formation. The composition of the Made Ground and superficial deposits supporting the shallow groundwater was variable. Determining a permeability for further analysis would be based on rough assumptions. Therefore, calculating accurately the local groundwater level increase around the basement would be difficult.

The cumulative effect of the proposed basement extension was considered limited. The proposed basement had a depth of ~3.50m bgl, which extended to a greater depth than the neighbouring buildings. The lower boundary of the Boyn Hill Gravel Member was recorded on site as being 2.70m and 3.40m bgl.

Groundwater seepages could be encountered during the basement excavation. Water ingress must be prevented by dewatering during construction, either by exclusion, extraction, or a combination.

The basement will require waterproofing. Positive pumped devices and/or anti-return valves must be applied to drainage systems in the basement to avoid flooding from sewers.

Given the limited space between the proposed basement and site boundary it is recommended that a coffer dam type structure using a sheet piles, secant or contiguous concrete piled wall around the periphery of the structure is adopted.

The permanent works must be designed to ensure induced ground movements surrounding the site are within tolerable limits and temporary works sufficiently design to prevent damage during construction. It was recommended monitoring of surrounding structure was undertaken during construction.

Overall it was considered the proposed development would have a limited impact on neighbouring properties provided a suitable basement construction was selected.

Any additional surface water and the removal of potential permeable soil used for rainfall storage, should be managed by the drainage scheme. The use of rainfall harvesting could be used to mitigate loss of rainfall storage.

Provided the basement is constructed using best practice and suitable temporary and permanent support, unacceptable movements to neighbouring properties were considered unlikely. Soils Limited can undertake ground movement assessment as required to support basement applications.

A Ground Movement Assessment (GMA) is required prior to the basement construction.

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Figure 1 – Site Location Map

Job Number 20904	**Project** Land at rear of 19-23 Friars Stile Road, Richmond, TW10 6NH
Client The Malins Group	**Date** July 2023

Figure 2 – Aerial Photograph

Project
Land at rear of 19-23 Friars Stile Road, Richmond, TW10 6NH

Client
The Malins Group

Date
July 2023

Job Number
20904

Figure 3 - Trial Hole Location Plan

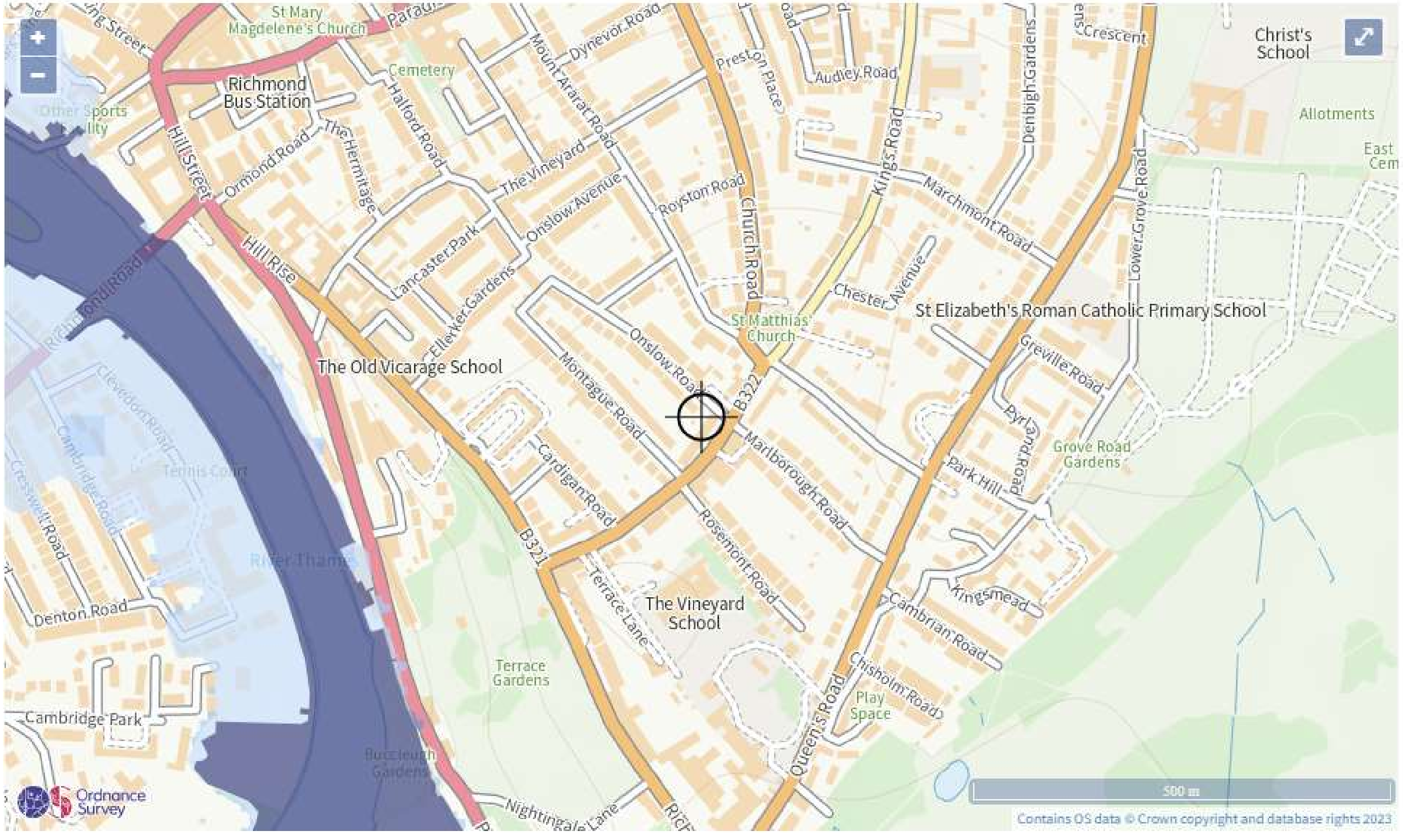
Project
Land at rear of 19-23 Friars Stile Road, Richmond, TW10 6NH

Client
The Malins Group

Date
July 2023

Job Number
20904

Figure 4 – Fluvial or Tidal Flooding



Extent of flooding from rivers or the sea

High Medium Low Very low Location you selected

Project
Land at rear of 19-23 Friars Stile Road, Richmond, TW10 6NH

Client
The Malins Group

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July 2023

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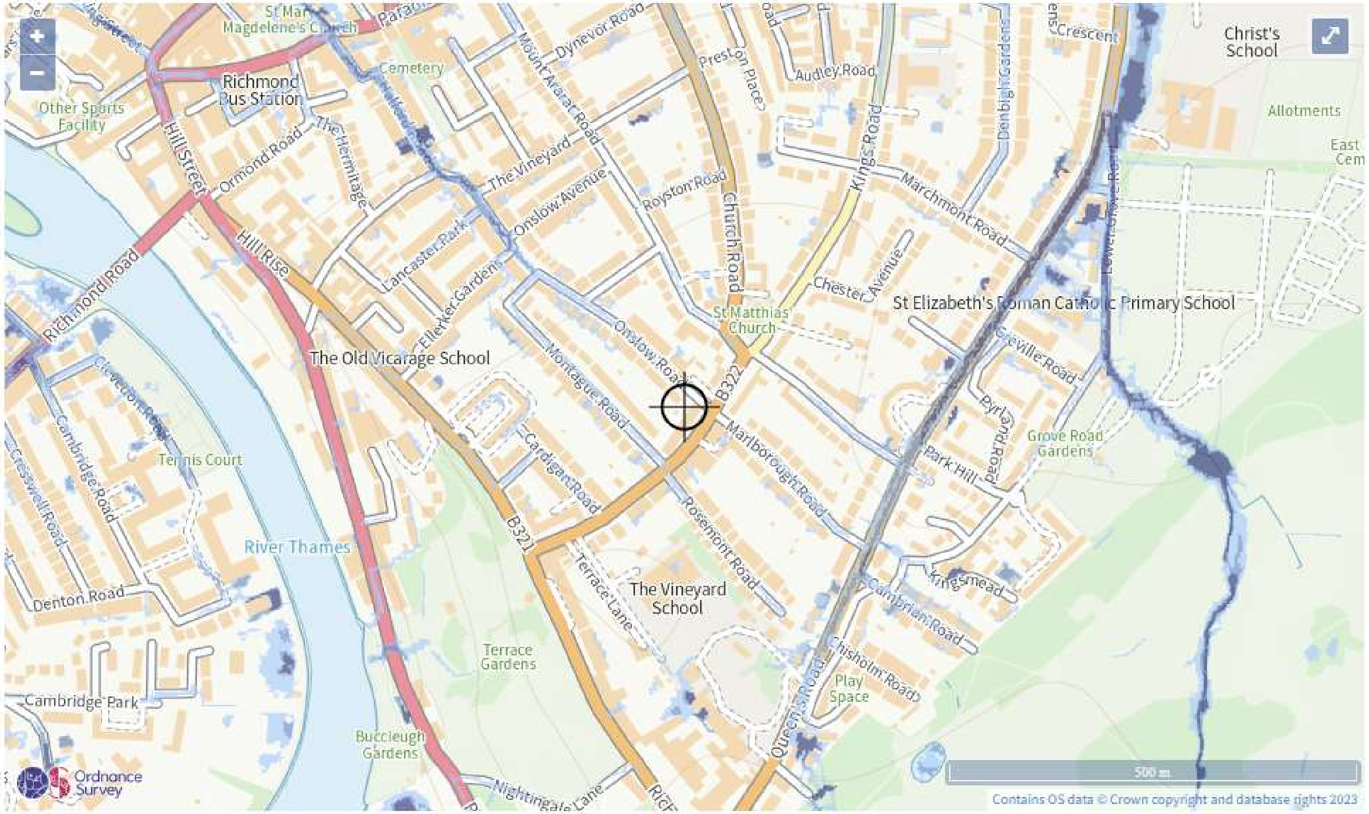

Extent of flooding from surface water

High Medium Low Very low Location you selected

Figure 5 – Surface Water Flooding

Project
Land at rear of 19-23 Friars Stile Road, Richmond, TW10 6NH

Client
The Malins Group

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July 2023

Job Number
20904

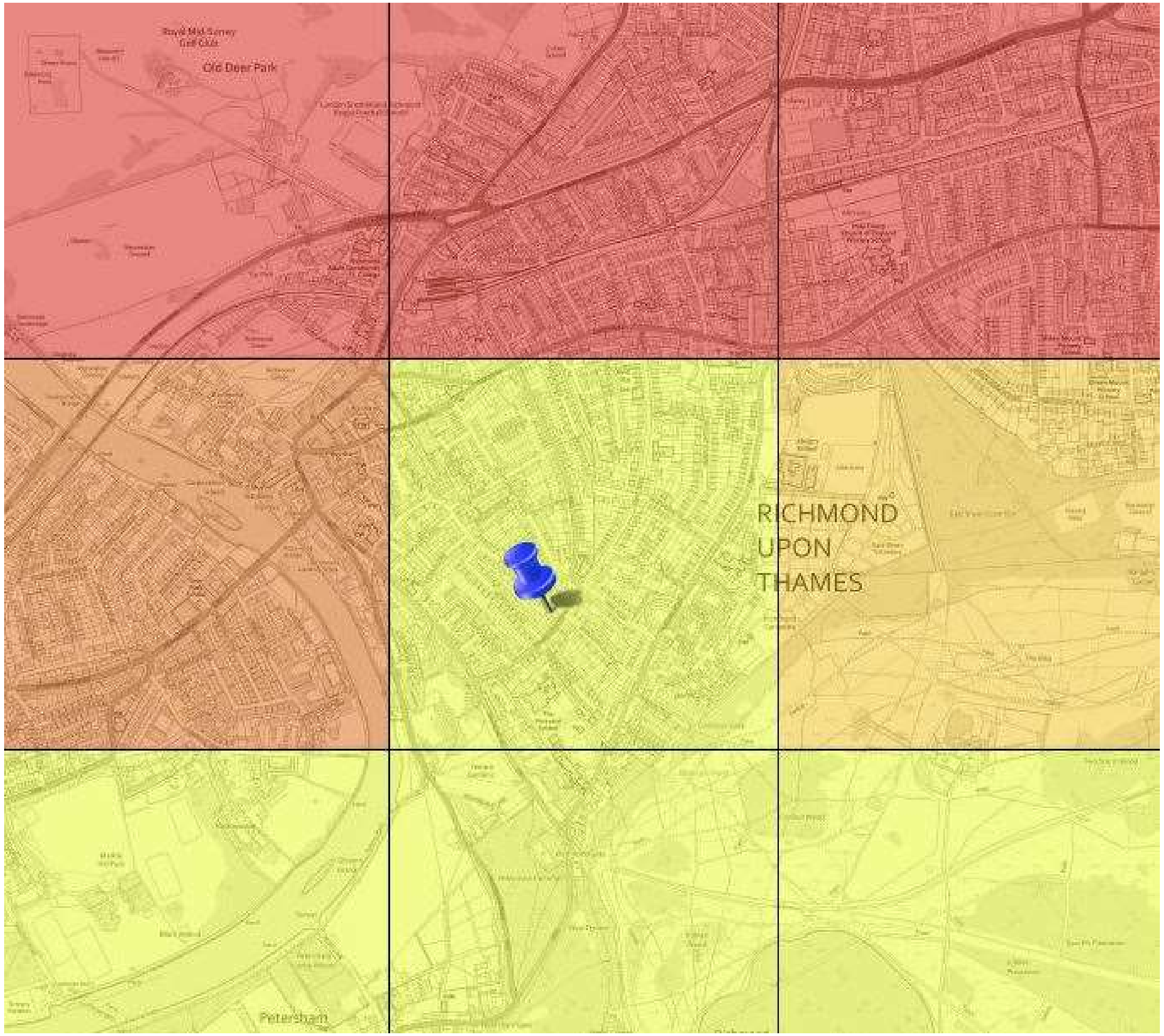

Figure 6 – Potential for Groundwater Flooding

Project
Land at rear of 19-23 Friars Stile Road, Richmond, TW10 6NH

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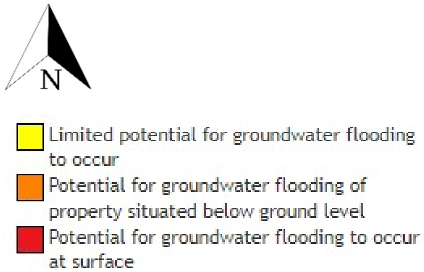

Figure 7 – Flooding from Reservoirs

Project
Land at rear of 19-23 Friars Stile Road, Richmond, TW10 6NH

Client
The Malins Group

Date
July 2023

Job Number
20904

Maximum extent of flooding from reservoirs:

when river levels are normal | when there is also flooding from rivers | Location you selected

Appendix A Standards and Resources

The site works, soil descriptions and geotechnical testing was undertaken in accordance with the following standards were applicable:

- Camden geological, hydrogeological, and hydrological study, Guidance for subterranean development, Issue01/November 2010,
- British Geological Survey Website
- EA Website
- Google Earth
- National Library of Scotland online Map Finder
- Planning Advice Note. Good Practice Guide on Basement Developments. The London Borough of Richmond upon Thames. (2015)
- Basement Assessment User Guide prepared for the London Borough of Richmond upon Thames
- Strategic Flood Risk Assessment, London Borough of Richmond upon Thames (2020)
- Surface Water Management Plan, London Borough of Richmond upon Thames (2011)
- Property Asset Register Public Web Map, Transport for London
- The Lost Rivers of London, Historical Publications Ltd, 1992, N Barton.

Appendix B Field Work

Appendix B.1 Engineers Logs

Appendix C Geotechnical In-Situ and Laboratory Testing

Appendix C.1 Classification

Classification based on SPT "N" values:

The inferred undrained strength of the cohesive soils was based on the SPT "N" blow counts, derived from the relationship suggested by Stroud (1974) and classified using Table C.1.1. (Ref: Stroud, M. A. 1974, "The Standard Penetration Test – its application and interpretation", Proc. ICE Conf. on Penetration Testing in the UK, Birmingham. Thomas Telford, London.).

Table C.1.1 SPT "N" Blow Count Cohesive Classification

Classification	Undrained Cohesive Strength C_u (kPa)
Extremely low	<10
Very low	10 – 20
Low	20 – 40
Medium	40 – 75
High	75 – 150
Very high	150 – 300
Extremely high	> 300

Note: (Ref: BS EN ISO 14688-2:2004+A1:2013 Clause 5.3.)

The relative density of granular soils was classified based of the relationship given in Table C.1.2.

The *UK National Annex to Eurocode 7: Geotechnical design – Part 2: Ground investigation and testing, NA 3.7 SPT test, BS EN 1997-2:2007, Annex F* states "Relative density descriptions on borehole records should also be based on uncorrected SPT N values, unless significantly disturbed, using the density classification in BS 5930:2015, Table 7.

Table C.1.2 SPT "N" Blow Count Granular Classification

Classification	SPT "N" blow count (blows/300mm)
Very loose	0 to 4
Loose	4 to 10
Medium dense	10 to 30
Dense	30 to 50
Very dense	Greater than 50

Note: (Ref: The Standard Penetration Test (SPT): Methods and Use, CIRIA Report 143, 1995)

Appendix C.2 Interpretation

Table C.2.1 Interpretation of DPSH Blow Counts

DP	Strata	Equivalent SPT N Blow Counts	Inferred Cohesive Strength/Granular Density
DP1	BHT 2.10 – 3.40 CLAY	9 – 22	Medium to High (C_u = 45 – 110kPa)
	LC[1] 3.40 – 5.00 CLAY	13 - 31	Medium to very High (C_u = 65 – 155kPa)
DP2	BHT 1.20 – 2.40 Gravelly clayey SAND	13 – 40	Medium Dense to Dense
	wLCF 2.40 – 5.10 CLAY	4 - 13	Low to Medium (Cu = 20 – 65kPa)
	LCF[1] 5.10 – 8.00 CLAY	22 – 44	High to Very High (C_u = 110 – 220kPa)

Note: [1] Ground conditions inferred past the base of windowless sampler boreholes. wLCF = Weathered London Clay Formation

Table C.2.2 Interpretation of Atterberg Limit Tests

Stratum	Moisture Content (%)	Plasticity Index (%)	Passing 425µm Sieve (%)	Modified Plasticity Index (%)	Soil Classification	Volume Change Potential	
						BRE	NHBC
MG	18	27	91	25	CI	Medium	Medium
BHT	10 – 16	29 – 30	89 – 90	26 – 27	CI	Medium	Medium
LC	26	25	100	25	CI	Medium	Medium

Note: BRE Volume Change Potential refers to BRE Digest 240 (based on Atterberg results)
NHBC Volume Change Potential refers to NHBC Standards Chapter 4.2
Soils Classification based on British Soil Classification System
The most common use of the term clay is to describe a soil that contains enough clay-sized material or clay minerals to exhibit cohesive properties. The fraction of clay-sized material required varies, but can be as low as 15%. Unless stated otherwise, this is the sense used in Digest 240. The term can be used to denote the clay minerals. These are specific, naturally occurring chemical compounds, predominately silicates. The term is often used as a particle size descriptor. Soil particles that have a nominal diameter of less than 2 µm are normally considered to be of clay size, but they are not necessarily clay minerals. Some clay minerals are larger than 2 µm and some particles, 'rock flour' for example, can be finer than 2 µm but are not clay minerals.
(The Atterberg Limit Tests were undertaken in accordance with BS 1377:Part 2:1990 Clauses 3.2, 4.3 and 5)

Table C.2.3 Interpretation of PSD Tests

Location	Depth (m bgl)	Soil Description	Volume Change Potential		Passing 63µm Sieve (%)
			BRE	NHBC	
WS2	2.30	Orange/ brown slightly gravelly silty/ clayey fine to coarse SAND	No	No	14

Note: BRE 240 states that a soil has a volume change potential when the clay fraction **exceeds 15%**. Only the silt and clay combined fraction are determined by sieving therefore the volume change potential is estimated from the percentage passing the 63µm sieve. NHBC Standards Chapter 4.2 states that a soil is shrinkable if the percentage of silt and clay passing the 63µm sieve is greater than 35% and the Plasticity Index is greater than 10%.
(The Particle Size Distribution Tests were undertaken in accordance with BS 1377: Part 2: 1990 Clause 9)

Appendix C.3 Geotechnical In-Situ and Laboratory Results

Appendix D Chemical Laboratory Testing

Appendix D.1 Chemical Laboratory Results

Appendix D.2 Determination of Hazardous Waste Classification

Software such as the HazWasteOnline produced Hazardous Waste Classification Tool, enables soils ‘total’ chemical testing data to be used to identify the classification of waste soils in accordance with Environment Agency guidance. The HazWasteOnline Hazardous Waste Classification Tool was designed primarily for the classification of soil wastes as identified by the European Waste Catalogue (EWC) Chapter 17 - Construction and demolition wastes (including contaminated soils).

The classification of waste as either hazardous or non-hazardous must be conducted in accordance with the 2003 Environment Agency publication Interpretation of the Definition and Classification of Hazardous Waste (Technical Guidance WM2). This establishes the regulatory framework and allows classification of wastes based on their various risk phrases. Additional guidance provided by the 2007 Environment Agency publication ‘How to Find Out if Waste Oil and Wastes that Contain Oil Are Hazardous’ (HWR08) provides further clarification on the classification methodology for hydrocarbon contamination.

As part of the Hazardous Waste Classification process, contaminant compounds are selected based on historical and contemporary land-use. The inclusion of such data on the input form enables the correct waste classification to be determined. For example, in cases of land associated with former gasworks, the classification of coal-tar contaminated soils can be partially determined using total PAH concentrations as opposed to TPH concentrations as coal-tar may be deemed a “substance”. Hazardous (HWR08) provides further clarification on the classification methodology for hydrocarbon contamination.

Appendix D.3 Assessment Criteria

Appendix E Information Provided by the Client

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