BASEMENT IMPACT ASSESSMENT

Ref: 24/38980-2 | Date: October 2024

10 Pembroke Villas
The Green
Richmond
TW9 1QF

Prepared for:
Michael Jones Architects

24/38980-2
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Site Analytical Services Ltd.

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1.0 INTRODUCTION

1.1 Project Objectives

The purpose of this assessment is to consider the effects of a proposed basement construction on the local slope stability, surface water and groundwater regime at the residential property at 10 Pembroke Villas, the Green, Richmond, TW9 1QF.

The recommendations and comments given in this report are based on the information contained from the sources cited and may include information provided by the Client and other parties, including anecdotal information. It must be noted that there may be special conditions prevailing at the site which have not been disclosed by the investigation and which have not been taken into account in the report. No liability can be accepted for any such conditions.

This report does not constitute a full environmental audit of either the site or its immediate environs.

1.2 Planning Policy Context

The London Borough of Richmond’s polices on future developments in the borough are set out in the Council’s Basement Assessment User Guide (2021) for basements.

This document requires proposed developments to mitigate against the effects of ground and surface water flooding and to include drainage systems that do not impact neighbouring property of the site or the water environment by way of changing the groundwater regime.

This report is intended to address the issues set out in the council’s basement policy. It will review existing site investigation data and provide a preliminary assessment of the issues identified by the Site Analytical Services Limited screening process.

This report also provides an impact assessment of the geo-environmental impacts on adjacent structures and the surrounding area based on available site investigation data.

As part of this guidance a subterranean (groundwater) flow screening chart is provided which follows current planning procedure for basements and lightwells adopted by other London Borough’s, including Camden, Westminster, Lambeth and Haringey. The completed chart in relation to this development is provided as Table 1, to this report.

1.3 Qualifications

The report has been prepared by Mr Thomas Murray, a Fellow of the Geological Society (FGS) with 10+ years’ experience.

2.0 SITE DETAILS

(National Grid Reference: TQ 176 751)

2.1 Site Location

The site is located on the north-west side of Pembroke Villas – approximately 80m to the south-east of the A136 (Twickenham Road). It is located in Richmond, London, at approximate postcode TW9 1QF and is immediately bound by similar residential properties to the north-east (11 Pembroke Villas) and south-west (9 Pembroke Villas). Railway tracks associated with Richmond Station border the north of the site. Richmond Green lies to the south-east, on the other side of Pembroke Villas.

The site is roughly rectangular in shape and covers an approximate area of 0.04 Hectares with the general area being under the authority of the London Borough of Richmond Upon Thames.

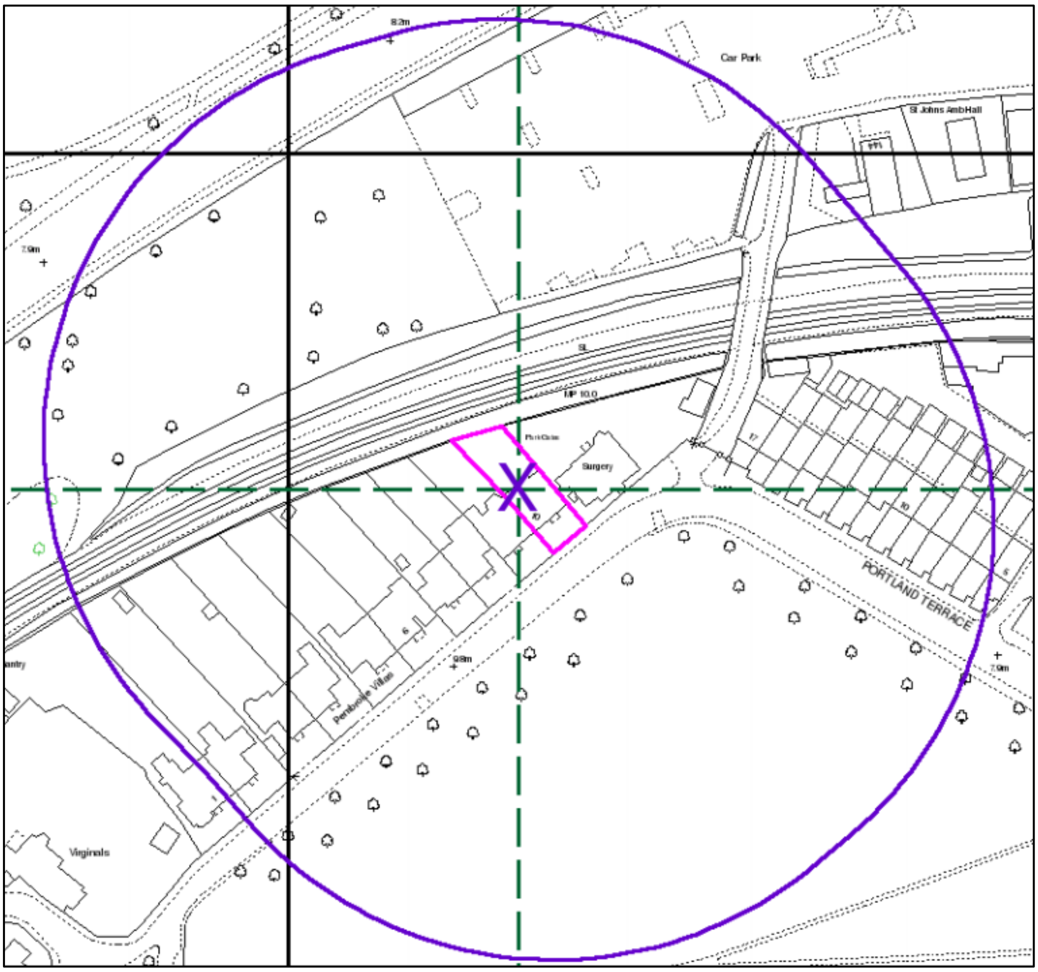

Figure 1. Site Location Plan

2.2 Site Layout and History

The site was attended on 8th October 2024 for the purposes of conducting the site walkover.

The site comprises a 2-storey residential semi-detached property with a basement level and associated private front and rear gardens.

The site is covered 60% in hardstanding and 40% in soft landscaping, predominantly within the rear garden.

Significant vegetation in the form of trees is located around the edge of the site, especially in the rear private garden. Minor vegetation exists throughout the rear garden area.

The site is essentially flat, with no sloping noticed.

From historical map evidence it would appear that the site was first built on prior to 1881, with no significant changes taking place to the property since its construction. A railway has been present within 250m.

2.3 Geology

The Geological Survey of Great Britain (England and Wales) covering the area indicates the site to be underlain superficially by the Kempton Park Gravel Member and then further underlain by the London Clay Formation bedrock at depth.

- 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 Kempton Park Gravels 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.

- The London Clay mainly comprises bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. It commonly contains thin courses of carbonate concretions (‘cementstone nodules’) and disseminated pyrite. It also includes a few thin beds of shells and fine sand partings or pockets of sand, which commonly increase towards the base and towards the top of the formation. At the base, and at some other levels, thin beds of black rounded flint gravel occur in places. Glauconite is present in some of the sands and in some clay beds, and white mica occurs at some levels.

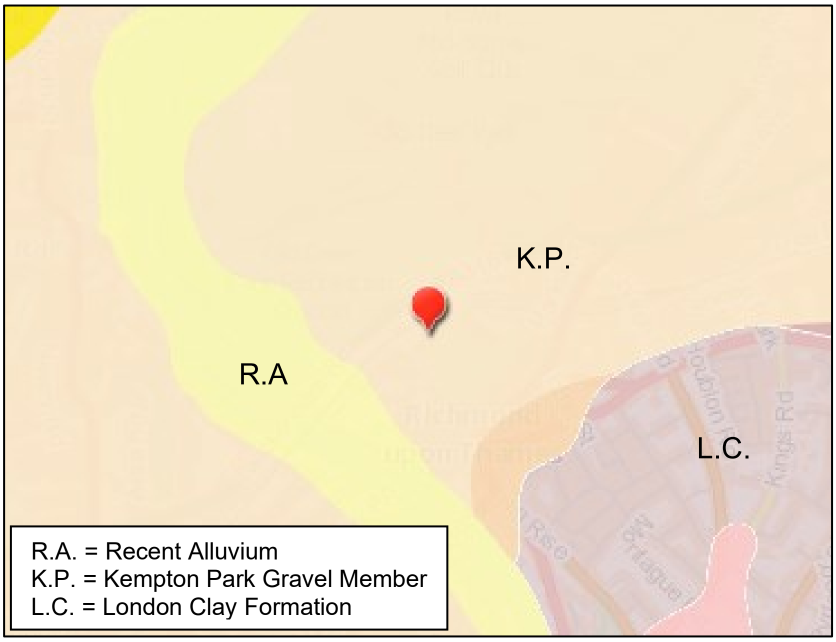

Figure 2. Superficial and Bedrock geology of the Site (Ref. BGS Geoindex)

2.4 Hydrology and drainage

2.4.1 Rainfall and run-off

According to Mayes (1997) rainfall in the local area averages around 610mm and is significantly less than the national average of around 900mm.

Evapotranspiration is typically 450mm/year resulting in about 160mm/year as 'hydrologically effective' rainfall which is available to infiltrate into the ground or run-off as surface water flow.

According to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011), the site is not within 100m of a former river or watercourse. The closest surface water feature is the River Thames, located 404m to the south-west of the site.

The area located immediately around the site is a residential area with approximately 65% of the surface covered with hardstanding. Some of the rainfall in the area will run-off hard surface areas and be collected by the local sewer network the rest will be absorbed through ground infiltration.

2.4.2 Drainage

Surface drainage from the site is assumed to be directed to drains along Pembroke Villas towards the south-west.

2.4.3 Flood Risk

River or Tidal flooding

The site is currently located 155m east of an area at risk of extreme flooding from rivers or sea without defence (Zone 2).

Surface water flooding

Further modelling of surface water flooding has been undertaken by the Environment Agency and was published on its website in January 2014; an extract from their model is presented within the Envirocheck Site Sensitivity maps. Whilst this map identifies three levels of risk (high, medium and low) it is understood that it is based at least in part on depths of flooding. The modelling shows very low of flooding across the site.

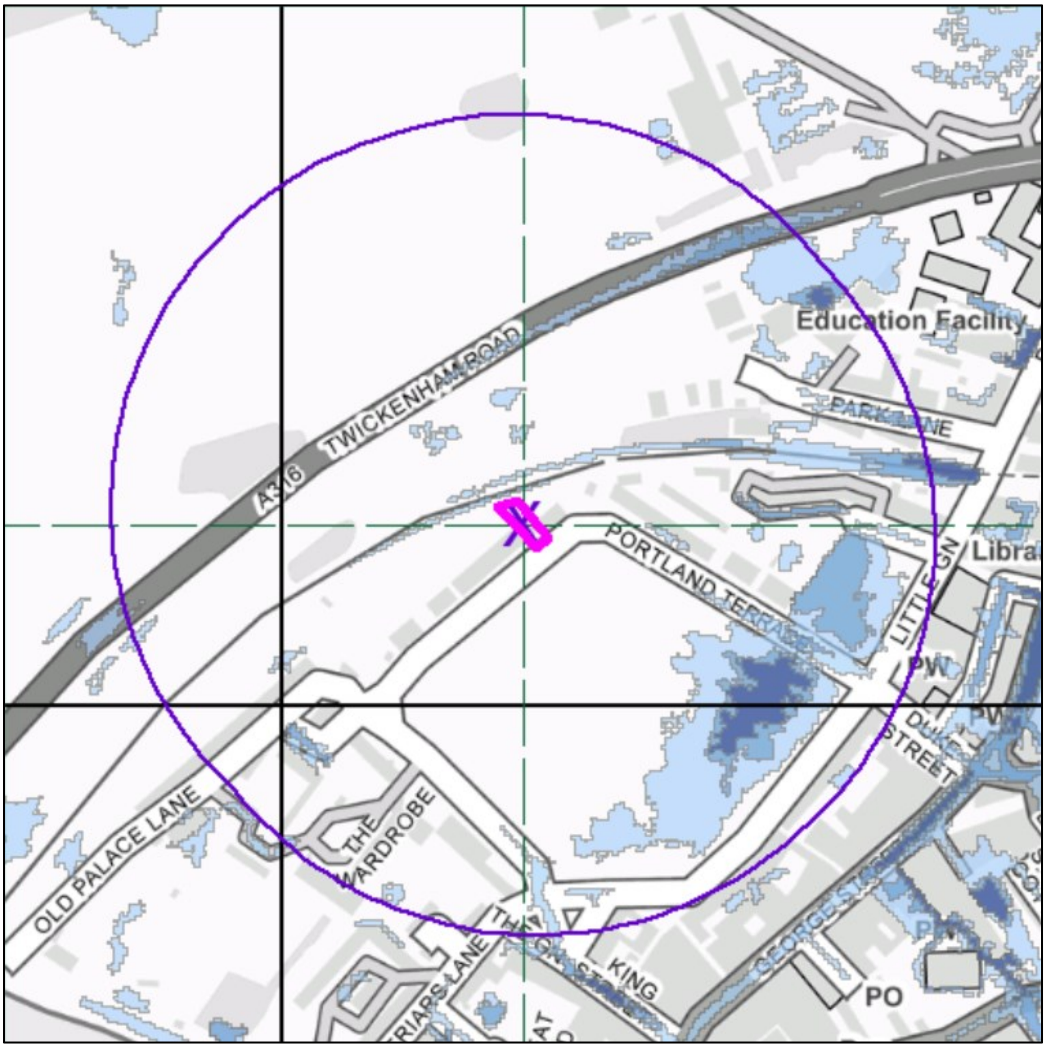

Figure 3. Extract from the Environment Agency's 'Risk of Flooding from Surface Water'. Ordnance Survey Crown copyright 2015. All rights reserved.

Sewer flooding

The London Regional Flood Risk Appraisal (2009) advises that foul sewer flooding is most likely to occur where properties are connected to the sewer system at a level below the hydraulic level of the sewage flow, which in general are often basement flats or premises in low lying areas. There is no record of sewer flooding having occurred at Pembroke Villas and therefore the risk of sewer flooding is considered low.

2.5 Hydrogeology

The Environment Agency Groundwater Protection Policy uses aquifer designations that are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) and also their role in supporting surface water flows and wetland ecosystems.

The superficial geology underlying the site (Kempton Park Gravel Member) has been classified as Secondary A Aquifer; permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

Groundwater levels within the Kempton Park Gravel Member has been monitored as part of this study and the results are described in Section 4.0 below.

Other hydrogeological data obtained from the Desktop Study (SAS Report Ref: 24/38021) for the site include:

- The site is not located within 1km of a source protection zone.
- There are 9 water abstraction licences within 1 kilometre of the site. The closest is located 538m to the north of the site at 'Richmond Athletics Assoc Ltd'. Due to the distance from the site it is not considered at risk.

2.6 Previous Reports

The results from a Desktop Study and Site Investigation are presented under separate cover in Site Analytical Services Limited reports (Project Nos. 24/38980 & 24/38980-1), dated October 2024. The findings from these reports are described in this basement impact assessment.

2.7 Proposed Development

At the time of reporting (October 2024), the proposed works include the extension of the existing basement level to the side of the currently property, on the eastern side of the site. It is proposed to construct the basement level to a maximum 3.00m bgl.

2.8 Results of Basement Impact Assessment Screening

A screening process has been undertaken for the site and the results are summarised in Table 1 below:

Table 1: Summary of screening results

Item	Description	Response	Comment
Sub-terranean (Ground water Flow)	1a. Is the site located directly above an aquifer.	Yes	The Kempton Park Gravel Member below the site has been designated as a Secondary A aquifer; permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
	1b. Will the proposed basement extend beneath the water table surface.	Unknown – to be confirmed by Ground Investigation	Given the presence of an aquifer below the site it is possible that groundwater will be encountered during any excavations for the proposed basement, however this will be confirmed by the ground investigation.
	2. Is the site within 100m of a watercourse, well (used / disused) or potential spring line.	No	According to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011), the site is not within 100m of a former river or. The closest surface water feature is the River Thames, located 404m to the south-west of the site.
	3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas.	No	The amount of hardstanding on-site is not expected to change.
	4. As part of site drainage, will more surface water (e.g. rainfall and run-off) than at present be discharged to the ground (e.g. via soakaways and/or SUDS).	No	Existing drainage paths are to be utilised where possible. Whether soakaways/SUDS are used on the proposed development is to be confirmed (beyond the scope of this report). An appropriately qualified engineer should be engaged to ensure mandatory requirements are met.
	5. Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to, or lower than, the mean water level in any local pond or spring line.	No	According to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011), the site is not within 100m of a former river or. The closest surface water feature is the River Thames, located 404m to the south-west of the site.
Slope Stability	1. Does the existing site include slopes, natural or man-made greater than 7 degrees (approximately 1 in 8).	No	The site is essentially flat.
	2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7 degrees (approximately 1 in 8).	No	Re-profiling of landscaping at the site is not proposed.

	3. Does the development neighbor land, including railway cuttings and the like, with a slope greater than 7 degrees (approximately 1 in 8).	No	The surrounding area is essentially flat.
	4. Is the site within a wider hillside setting in which the general slope is greater than 7 degrees (approximately 1 in 8).	No	There is a general slope across the surrounding area from north east to south west along Richmond Green, but this is less than 1 in 8.
	5. Is the London Clay the shallowest strata at the site.	No	With reference to available BGS records, the soil stratum below the site is the Kempton Park River Terrace Gravel. The boundary to the underlying London Clay Formation is over 550m to the south-east and therefore the site is not considered to be close to this stratigraphic boundary.
	6. Will any trees be felled as part of the development and/or are any works proposed within any tree protection zones where trees are to be retained.	No	It is understood that no trees are to be felled as part of the development.
	7. Is there a history of seasonal shrink-swell subsidence in the local area and/or evidence of such effects at the site.	No	The Kempton Park Gravel Member does not have potential for shrink-swell.
	8. Is the site within 100m of a watercourse or a potential spring line.	No	According to publications regarding Lost Rivers of London (Barton, 1992) and (Talling, 2011), the site is not within 100m of a former river or. The closest surface water feature is the River Thames, located 404m to the south-west of the site.
	9. Is the site within an area of previously worked ground.	No	According to the records held by the BGS the site is not underlain by any worked ground, Made Ground, infilled ground or landscaped ground.
	10. Is the site within an aquifer. If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction.	Unknown – to be confirmed by Ground Investigation	Given the presence of an aquifer below the site it is likely that groundwater will be encountered during any excavations for the proposed basement, however this will be confirmed by the ground investigation.
	11. Is the site within 5m of a highway or pedestrian right of way.	Yes	The site lies within 5m of Pembroke Villas.
	12. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties.	Yes	The development will increase the depths of foundation at the site, although the foundation depths of adjacent properties are not known.

	13. Is the site over (or within the exclusion zone of) any tunnels, e.g. railway lines.	No	The railway line to the rear of the property is over 15m from the proposed development.
Surface Water and Flooding	1. As part of the proposed site drainage, will surface water flows (e.g. volume of rainfall and peak run-off) be materially changed from the existing route.	No	The amount of hardstanding on-site is not expected to change.
	2. Will the proposed basement development result in a change in the proportion of hard surfaced / paved external areas.	No	The amount of hardstanding on-site is not expected to change.
	3. Will the proposed basement result in changes to the profile of the inflows (instantaneous and long-term) of surface water being received by adjacent properties or downstream watercourses.	No	All surface water for the site will be contained within the site boundaries and collected as described above; hence there will be no change from the development on the quantity or quality of surface water being received by adjoining sites.
	4. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses.	No	The surface water quality will not be affected by the development, as in the permanent condition collected surface water will generally be from roofs, or domestic hard landscaping.
	5. Is the site in an area known to be at risk from surface water flooding.	No	According to Figure 4 from Environment Agency's 'Risk of Flooding from Surface Water' the area at a very low risk from surface water flooding.

The Screening Exercise has identified the following potential issues which will be carried forward to the Scoping Phase

Subterranean Groundwater Flow

- Is the site located directly above an aquifer.

- Will the proposed basement extend beneath the water table surface.

Slope Stability

- Is the site within an aquifer. If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction.

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

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

3.0 SCOPING PHASE

The purpose of the scoping phase is to assess in more detail the factors to be investigated in the impact assessment. Potential impacts are assessed for each of the identified impact factors and recommendations are stated.

A conceptual ground model is usually complied at the scoping stage however, because the ground investigation has already been undertaken for this project, the conceptual ground model including the findings of the ground investigation is described under Chapter 4.

Subterranean (Groundwater Flow)

Potential Issue (Screening Question)		Potential impacts and actions
1a	Is the site located directly above an aquifer?	**Potential impact**: Infiltration could be reduced. **Action**: Ground Investigation required, then review.
1b	Will the proposed basement extend beneath the water table surface?	**Potential impact:** Local restriction of groundwater flows (perched groundwater or below groundwater table). **Action:** Ground investigation required, then review.

Slope Stability

10	Is the site within an aquifer? If so, will the proposed basement extend beneath the water table such that dewatering may be required during construction?	**Potential impact:** Inadequate provision of dewatering can lead to collapse of excavations. Inappropriate dewatering can cause removal of fines and/or unacceptable increases ineffective stress, both of which can cause ground structures to settle. **Action:** Ground investigation required in order to enable a proper assessment of the appropriate forms of groundwater control.
11	Is the site within 5m of a highway or a pedestrian right of way?	**Potential impact:** Excavation of basement causes loss of support to footway/highway and damage to the services beneath them. **Action:** Ensure adequate temporary and permanent support by use of best practice working methods.
12	Will the proposed basement substantially increase the differential depth of foundations relative to neighbouring properties?	**Potential impact:** Loss of support to the ground beneath the foundations of the surrounding properties if basement excavations are inadequately supported. **Action:** Ensure adequate temporary and permanent support by use of best practice methods.

These potential impacts have been further assessed through the ground investigation, as detailed in Section 4 below.

4.0 SITE INVESTIGATION DATA

4.1 Records of site investigations

The boreholes and soakage pit were completed at existing ground level and revealed ground conditions that were generally consistent with the geological records and known history of the area and comprised Made Ground up to 1.90m in thickness resting on the Kempton Park Gravel Member with the London Clay formation at depth.

These ground conditions are summarised in the following table. For detailed information on the ground conditions encountered in the boreholes and pit, reference should be made to the exploratory hole records presented in Appendix A.

Strata	Depth to top of strata (mbgl)	Depth to base of strata (mbgl)	Description
Made Ground	0.00	1.90 to 2.20	Stone Slab or grass over brown silty sand containing brick and concrete fragments.
Kempton Park Gravel Member	1.90 to 2.20	7.00 to 8.60	Loose through to very dense fine to coarse sand and fine to coarse gravel.
London Clay Formation	7.00 to 8.60	15.00 (max depth of BH1)	Stiff silty sandy clay containing partings of silty fine sand and gypsum crystals.

Summary of Ground Conditions in Exploratory Holes

4.2 Groundwater

Groundwater was encountered in both boreholes as detailed in the table below.

Exploratory Hole	Depth (m)	Notes	Stratum
BH1	7.80	Slight seepage	Kempton Park Gravel Member
BH2	7.00	Slight seepage	Kempton Park Gravel Member / London Clay Formation interface

Groundwater Strike Summary

It must be noted that the speed of excavation is such that there may well be insufficient time for further light seepages of groundwater to enter the boreholes and hence be detected, particularly within more cohesive soils.

Groundwater was encountered at a depth of 5.30m below ground level in Borehole 1 was not encountered within Borehole 2 during the two return monitoring visits. As the monitoring pipe in Borehole 1 is only 5cm below the monitored water level, it is likely this is trapped water and not a true representation of groundwater.

Isolated pockets of groundwater may also be present perched within any less permeable material found at shallower depth on other parts of the site especially within any Made Ground.

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (September and October 2024) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

5.0 FOUNDATION DESIGN

5.1 General

The proposed works include the extension of the existing basement level to the side of the currently property, on the eastern side of the site. It is proposed to construct the basement level to a maximum 3.00m bgl.

5.2 Site Preparation Works

The main contractor should be informed of the site conditions and risk assessments should be undertaken to comply with the Construction Design Management (CDM) regulations. Site personnel are to be made aware of the site conditions. It is recommended that extensive searches of existing man-made services are undertaken over the site prior to final design works.

5.3 Foundation Design

A result of the inherent variability of uncontrolled fill, (Made Ground) is that it is usually unpredictable in terms of bearing capacity and settlement characteristics. Foundations should, therefore, be taken through any Made Ground and either into, or onto a suitable underlying natural stratum of adequate bearing characteristics.

Based on the ground and groundwater conditions encountered in the boreholes and trial pits, it should be possible to support light loaded areas of the proposed new development on conventional strip or isolated pad foundations taken down below the Made Ground and any weak superficial soils and placed in the natural dense sand and gravel deposits which occur at a depth of approximately 2.20m below ground level at the site.

Using theory from Peck, Hanson and Thornburn (1974), square or rectangular foundations placed within these natural granular soils may be designed to allowable net bearing pressures of approximately 70kN/m^2 at 3.00m below ground level increasing to 300kN/m^2 at 4.00m below ground level in order to allow for a factor of safety of about three against general shear failure and should be sufficiently low to ensure that overstressing of the underlying soils does not occur. The quoted bearing capacity assumes a minimum foundation width of 1.00m, a worst case water level of sub 5.00m below ground level (as determined from groundwater monitoring) and is expected to limit settlement to less than 25mm.

The actual allowable bearing pressure applicable will depend on the form of foundation, its geometry and depth in accordance with classical analytical methods, details of which can be obtained from "Foundation Design and Construction", Seventh Edition, 2001 by M J Tomlinson (see references) or similar texts.

Any soft or loose pockets encountered within otherwise competent formations should be removed and replaced with well compacted granular fill.

5.4 Piled Foundations

In the event that the use of conventional spread foundations proves either impracticable or uneconomical due to the size and depth of foundation required, then a piled foundation may be required. In these ground conditions, it is considered that some form of bored and in-situ cast concrete piled foundation with reinforced concrete ground beams should prove satisfactory.

The construction of a piled foundation is a specialist activity and the advice of a reputable contractor, familiar with the type of soil and groundwater conditions encountered at this site should be sought prior to finalising the foundation design. The actual pile working load will depend on the particular type of pile chosen and method of installation adopted.

To achieve the full bearing value a pile should penetrate the bearing stratum by at least five times the pile diameter.

Piling methods should be capable of advancing pile bores through the surface Made Ground into the underlying natural soils.

Where piles are to be constructed in groups the bearing value of each individual pile should be reduced by a factor of about 0.8 and a calculation made to check the factor of safety against block failure.

Driven piles could also be used and would develop much higher working loads approximately 2.5 to 3 times higher than bored piles of a similar diameter at the same depth. However, the close proximity of adjacent buildings will in all probability preclude their use due to noise and vibration.

5.5 Retaining Walls

Several methods of retaining wall construction could be considered. These may include retaining structures cast in an underpinning sequence, or the use of temporary or sacrificial works to facilitate the retaining structure's construction. The excavation of the basement must not compromise the integrity of adjacent structures.

The full design of temporary and permanent retaining structures is beyond the scope of this report. However, the following design parameters for each element of soil recorded in the relevant exploratory holes are provided in the table below to assist the design of these structures.

Stratum	Depth to top	Bulk Density (Mg/m3) (ɣ)	Effective Angle of Internal Friction (Φ)
Lynch Hill Gravel Member	1.90 to 2.20	2.00	34

Retaining Wall Design Parameters

The 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 the earth pressure distribution, will depend upon the type/geometry of the wall and overall design factors.

5.5.1 Ground Movement

The upward movement of the base of an excavation occurs as a result of unloading and may be considered as consisting of two parts:

1. A short-term movement called heave which occurs as a result of elastic rebound and may typically occur during the construction period

2. A long-term movement called swell which occurs as a result of the absorption of water into the pores of the soils as the ground adjusts to new stress conditions.

The site lies above the London Clay Formation known to have a high susceptibility to shrinkage and swelling movements with changes in moisture content, as defined by the NHBC Standards, Chapter 4.2 (2010).

Excavations below 7.00m depth may encounter London Clay and the contractor should account for these upward ground movements such as providing heave protection measures to the floor slab.

The actual amount of movement will depend upon a number of factors including the construction timetable, ultimate loads and critically, the depth of the final excavation.

5.6 Basement Floor Slabs

The basement floor slab may be cast on the natural granular soils provided that the exposed formation is adequately compacted and protected from the elements.

5.7 Excavations

Shallow excavations for foundations and services are likely to require nominal side support in the short term and groundwater is unlikely to be encountered in significant quantities once any accumulated surface water has been removed. Deeper and longer excavations below approximately 1.50m below existing ground level will require close side support and some seepages of groundwater could be encountered.

No particular difficulties are envisaged in removing such water by conventional internal pumping methods from open sumps.

Normal safety precautions should be taken if excavations are to be entered.

5.8 Chemical Attack on Buried Concrete

Using the results contained in Appendix B, the following table provides the highest values encountered for the BRE SD1 Suite D specification and the equivalent DS and ACEC classes, based on mobile groundwater:

Strata	pH	2:1 Water Soluble SO_4 (mg/l)	2:1 Water Soluble Chloride (mg/l)	2:1 Water Soluble Nitrate (mg/l)	Total Sulphur (%)	Magnesium (mg/l)	DS Class	ACEC Class
Kempton Park Gravel Member	8.3-8.6	16	-	-	<0.02	-	DS-1	AC-1
London Clay formation	8.5-8.6	351	-	-	0.33	-	DS-1	AC-1

Worst case DS and ACEC classes based on the BRE SD1 Suite D results

In addition, segregations of gypsum were noted within the London Clay and scattered small gypsum crystals were also noted at depth. Consequently, it is considered that any buried concrete at depth may be attacked by such sulphates in solution and that it would be prudent to design any such deep buried concrete in accordance with full Class DS-2 and AC-2 conditions.

5.9 Soakaway Design

The results of the soakage tests carried out at the site indicate soil infiltration rates (f) of 1.30 x 10^{-5} m/sec and 1.28 x 10^{-5} m/sec. Due to time constraints, the third test had to be terminated early.

These soil infiltration rates lies within the range of clean sands and are classed as being of medium permeability material with good drainage characteristics.

The results of the tests indicated that the soil infiltration rate at the site is mostly relatively good and near surface conventional soakaways should prove satisfactory on-site . Where soakaways are proposed, it is recommended that the strata at the specific locations of soakaways be inspected, in compliance with good practice and guidance published in BRE 365 (1991).

Soakaway designs should include appropriate filter media to minimise risks of silt entering the chambers/drainage systems as such silt could reduce storage and percolation performance of the soakaway.

6.0 BASEMENT IMPACT ASSESSMENT

6.1 Summary

The screening identified a number of potential impacts. The table below summarises the previously identified potential impacts and the additional information that is now available from the site investigation in consideration of each impact.

Potential Impact	Site Investigation conclusions	Impact sufficiently addressed without further justification?
The site is directly above an aquifer.	The most recent soils investigation has proven that the site lies above the Kempton Park Gravel Member. These are generally aquifers formerly classified as minor aquifers.	No – see below for further details.
The proposed basement extends beneath the water table surface.	The maximum proposed dig level for the basement excavation (understood to be 3.00mbgl) lies above the minimum indicated groundwater level of 5.30mbgl and therefore the impact on groundwater from the development is likely to be minimal.	Yes.
The site is within 5m of a highway or pedestrian right of way.	The proposed basement is not to be extended below Pembroke Villas and therefore it is suggested that the impact on these access roads is likely to be minimal. There is nothing unusual in the proposed development that would give rise to any concerns with regard to the stability of public highways.	Yes.
The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties.	The development will result in the extension of the foundation depth of the basement relative to neighbouring properties.	No – see below for further details.

6.2 Outstanding Risks and Issues

The significant impacts which require further information have been described in detail below in order to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

The site is located directly above an aquifer.

As proven from the site investigation, the site is underlain by aquifer sustaining Superficial (Drift) geology comprising permeable unconsolidated (loose) deposits. These deposits have been designated as Secondary A Class; permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

The Bedrock geology underlying the site (solid permeable formations) has been classified as Unproductive Strata; rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Due care and attention should be paid to ensure that no contamination incidents occur as a result of the development. No change to the existing drainage arrangements is proposed and therefore existing rates of rainfall infiltration and groundwater recharge will remain unchanged.

The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties.

The excavation and construction of the basement at the site has the potential to cause some movements in the surrounding ground if not properly managed. However, it is understood that ground movements and/or instability will be managed through the proper design and construction of mitigation measures during the works. This will require close collaboration with the appointed contractor’s temporary works coordinator.

The Party Wall Act (1996) will apply to this development because neighbouring houses lie within a defined space around the proposed building works. The party wall process should be followed and adhered to during this development.

A monitoring plan should be set out at design stage and should include a monitoring strategy, instrumentation and monitoring plans and action plans. Trigger levels on movements will need to be defined. Precise levelling or reflective survey targets should be installed at the garden walls and neighbouring buildings. Monitoring should take place in advance of the proposed works as a base-line survey, during the works and for a period following the completion of the works, to understand the long-term effects.

7.0 BIA CONCLUSIONS

1. The proposed works include the extension of the existing basement level to the side of the currently property, on the eastern side of the site. It is proposed to construct the basement level to a maximum 3.00m bgl.

2. Conditions at the site were investigated by Site Analytical Services Limited in September and October 2024 (SAS Report Reference 24/38980-1). The boreholes and soakage pits revealed ground conditions that were generally consistent with the geological records and known history of the area and comprised Made Ground up to 1.90m in thickness resting on the Kempton Park Gravel Member with the London Clay formation at depth.

3. As proven from the site investigation, the site is underlain by aquifer sustaining Superficial (Drift) geology comprising permeable unconsolidated (loose) deposits. The Bedrock geology underlying the site (solid permeable formations) has been classified as Unproductive Strata; rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

4. Water levels in the immediate vicinity of the property have been recorded below the level of the proposed basement.

5. A monitoring plan will be set out at design stage and will include a monitoring strategy, instrumentation and monitoring plans and action plans.

6. The proposed development will not increase flood risk at the site or the surrounding area. Also, since the development is on already developed land, it will not adversely impact the Council's sustainability objectives.

7. The excavation and construction of the basement at the site has the potential to cause some movements in the surrounding ground if not properly managed. However, it is understood that ground movements and/or instability will be managed through the proper design and construction of mitigation measures during the works.

8.0 REFERENCES

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2. Environment Agency, 2006. Groundwater levels in the Chalk-Basal Sands Aquifer in the London Basin

3. British Standards Institution, 1999+A2. Code of Practice for Site Investigations, BS5930, BSI, London

4. British Standards Institution, 1986. Code of practice for foundations, BS 8004, BSI, London.

5. British Standards Institution, 2009. Code of Practice for Protection of Below Ground Structures Against Water from the Ground. BS 8102, BSI, London

6. CIRIA, 2000. Sustainable Urban Drainage Systems: Design Manual for England and Wales. CIRIA C522, Construction Industry Research and Information Association, London

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8. NHBC Standards, Chapter 4.1, "Land Quality - managing ground conditions", September 1999.

9. Mayles, J. 1997. Regional climates of the British Isles, p74: Average precipitation for the period 1961-1990 St James Park, London = 611mm. Routledge

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9.0 APPENDIX A – GROUND INVESTIGATION FACTUAL REPORT

Factual Report on a

GEOTECHNICAL GROUND INVESTIGATION

Ref: 24/38980-1 | Date: October 2024

10 Pembroke Villas
The Green
Richmond
TW9 1QF

Prepared for:
Michael Jones Architects

DOCUMENT CONTROL

Project	10 Pembroke Villas, the Green, Richmond, TW9 1QF
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CONTENTS

1.0 Introduction

1.1 Outline and Limitations of Report

At the request of Michael Jones Architects, a ground investigation was carried out in connection with a proposed basement development at the above site. A Phase 1 Desk Study is presented under a separate cover in Site Analytical Services Limited Report Reference 24/38980, dated October 2024.

The information was required for the design and construction of foundations and infrastructure for the proposed development at the existing site, which includes the extension of a basement on-site.

The recommendations and comments given in this report are based on the ground conditions encountered in the exploratory holes made during the investigation and the results of the tests made in the field and the laboratory. It must be noted that there may be special conditions prevailing at the site remote from the exploratory hole locations which have not been disclosed by the investigation and which have not been taken into account in the report. No liability can be accepted for any such conditions.

2.0 Site Details

(National Grid Reference: TQ 176 751)

2.1 Site Location

The site is located on the north-west side of Pembroke Villas – approximately 80m to the south-east of the A136 (Twickenham Road). It is located in Richmond, London, at approximate postcode TW9 1QF and is immediately bound by similar residential properties to the north-east (11 Pembroke Villas) and south-west (9 Pembroke Villas). Railway tracks associated with Richmond Station border the north of the site. Richmond Green lies to the south-east, on the other side of Pembroke Villas.

The site is approximately rectangular in shape and covers an approximate area of 0.04 Hectares with the general area being under the authority of the London Borough of Richmond Upon Thames.

2.2 Published Geology

The Geological Survey of Great Britain (England and Wales) covering the area indicates the site to be underlain superficially by the Kempton Park Gravel Member and then further underlain by the London Clay Formation bedrock at depth.

3.0 Scope of Work

3.1 Site Works

The proposed scope of works was agreed by the client prior to the commencement of the investigations. To achieve this, the following works were undertaken:-

- The drilling of one rotary percussive borehole to a depth of 15.00m below ground level (Borehole 1).

- The drilling of one continuous flight auger borehole to a depth of 10.00m below ground level (Borehole 2).

- The installation of groundwater monitoring standpipes to an approximate depth of 5.00m in Borehole 1 and 4.00m in Borehole 2, together with a two return monitoring visits.

- The excavation by hand of one trial pit, to 1.40m maximum depth with soakage testing conducted to BRE: 365 standards (Soakage Pit 1).

- Sampling and in-situ testing as appropriate to the ground conditions encountered in the exploratory holes.

- Laboratory testing to determine the engineering properties of the soils encountered in the exploratory holes.

3.2 Ground Conditions

The approximate locations of the exploratory holes are illustrated on the site investigation plan, Figure 1 below.

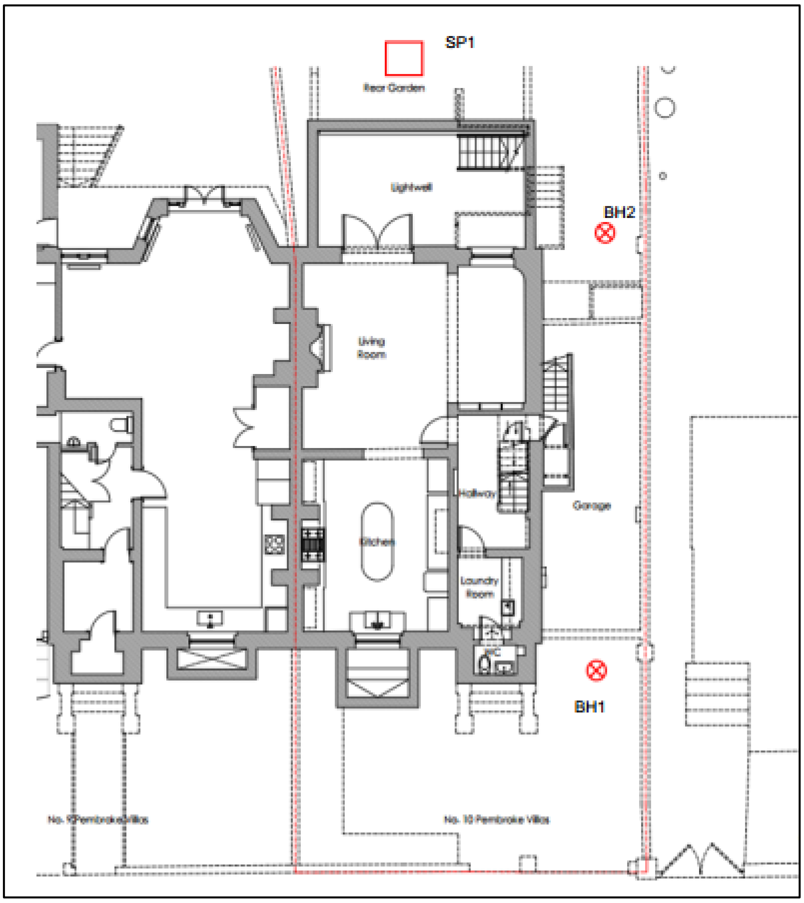

Figure 1. Site Investigation Plan

The boreholes and soakage pit were completed at existing ground level and revealed ground conditions that were generally consistent with the geological records and known history of the area and comprised Made Ground up to 1.90m in thickness resting on the Kempton Park Gravel Member with the London Clay formation at depth.

These ground conditions are summarised in the following table. For detailed information on the ground conditions encountered in the boreholes and pit, reference should be made to the exploratory hole records presented in Appendix A.

Strata	Depth to top of strata (mbgl)	Depth to base of strata (mbgl)	Description
Made Ground	0.00	1.90 to 2.20	Stone Slab or grass over brown silty sand containing brick and concrete fragments.
Kempton Park Gravel Member	1.90 to 2.20	7.00 to 8.60	Loose through to very dense fine to coarse sand and fine to coarse gravel.
London Clay Formation	7.00 to 8.60	15.00 (max depth of BH1)	Stiff silty sandy clay containing partings of silty fine sand and gypsum crystals.

Summary of Ground Conditions in Exploratory Holes

3.3 Groundwater

Groundwater was encountered in both boreholes as detailed in the table below.

Exploratory Hole	Depth (m)	Notes	Stratum
BH1	7.80	Slight seepage	Kempton Park Gravel Member
BH2	7.00	Slight seepage	Kempton Park Gravel Member / London Clay Formation interface

Groundwater Strike Summary

It must be noted that the speed of excavation is such that there may well be insufficient time for further light seepages of groundwater to enter the boreholes and hence be detected, particularly within more cohesive soils.

Groundwater was encountered at a depth of 5.30m below ground level in Borehole 1 was not encountered within Borehole 2 during the two return monitoring visits. As the monitoring pipe in Borehole 1 is only 5cm below the monitored water level, it is likely this is trapped water and not a trye representation of groundwater.

Isolated pockets of groundwater may also be present perched within any less permeable material found at shallower depth on other parts of the site especially within any Made Ground.

It should be noted that the comments on groundwater conditions are based on observations made at the time of the investigation (September and October 2024) and that changes in the groundwater level could occur due to seasonal effects and also changes in drainage conditions.

3.4 Soakage Testing

In order to assess the soil infiltration characteristics of the Made Ground and underlying natural soils, soakage tests were carried out in Soakage Pit 1 inclusive using the methods detailed in Building Research Establishment Digest 365: 1991.

The trial pit was advanced to depths of 1.40m below ground level and trimmed to be as rectangular as possible to give a known test section. The pit was then filled as quickly as possible with water up to ground level and the water level monitored with time to assess the soil infiltration rate.

The infiltration rate was calculated using guidance from BRE Digest 365.

The results of the tests made and the calculations of apparent permeability or soil infiltration rates are presented on the appropriate worksheets, contained in Appendix B.

4.0 In-Situ and Laboratory Tests

4.1 Standard Penetration Tests

The results of the Standard Penetration Tests carried out in the natural soils are shown on the exploratory hole records in Appendix A. SPT 'N' values range between 1 and 69.

The results of the tests are shown on the appropriate borehole records and summary sheets presented in Appendix A.

4.2 In-Situ Tests

In the essentially cohesive natural soils encountered at the site, in-situ shear vane tests were made at regular depth increments in order to assess the undrained shear strength of the materials. The results indicate that the natural soils are of a generally high strength in accordance with BS 5930 (2015).

The results of the in-situ tests are shown on the appropriate exploratory hole records contained in Appendix A.

Mackintosh Probe tests were made at regular depth increments in order to assess the relative density of the soils encountered in Borehole 2. The results can be interpreted using the generally accepted correlation for Mackintosh Probe Tests which is as follows:

Mackintosh N75 X 0.38 = SPT 'N' Value

or

Mackintosh N300 X 0.1 = SPT 'N' Value

The results of the in-situ tests are shown on the appropriate exploratory hole records contained in Appendix A.

4.3 Classification Tests

Particle size distribution tests were conducted on five samples taken from the natural essentially granular soils present in Boreholes 1 and 2 using wet sieving methods.

The test results are given in both tabular and graphical formats in Appendix B.

4.4 Chemical Attack on Buried Concrete

Using the results contained in Appendix B, the following table provides the highest values encountered for the BRE SD1 Suite D specification and the equivalent DS and ACEC classes, based on mobile ground water:

Strata	pH	2:1 Water Soluble SO4 (mg/l)	2:1 Water Soluble Chloride (mg/l)	2:1 Water Soluble Nitrate (mg/l)	Total Sulphur (%)	Magnesium (mg/l)	DS Class	ACEC Class
Kempton Park Gravel Member	8.3-8.6	16	-	-	<0.02	-	DS-1	AC-1
London Clay formation	8.5-8.6	351	-	-	0.33	-	DS-1	AC-1

Worst case DS and ACEC classes based on the BRE SD1 Suite D results

In addition, segregations of gypsum were noted within the London Clay and scattered small gypsum crystals were also noted at depth. Consequently, it is considered that any buried concrete at depth may be attacked by such sulphates in solution and that it would be prudent to design any such deep buried concrete in accordance with full Class DS-2 and AC-2 conditions.

4.5 Soakaway Design

The results of the soakage test carried out at the site indicate a soil infiltration rate (f) of 1.30 x 10^{-5} m/sec and 1.28 x 10^{-5} m/sec. Due to time constraints, the third test had to be terminated early.

These soil infiltration rates lies within the range of clean sands and are classed as being of medium permeability material with good drainage characteristics.

The results of the tests indicated that the soil infiltration rate at the site is mostly relatively good and near surface conventional soakaways should prove satisfactory on-site . Where soakaways are proposed, it is recommended that the strata at the specific locations of soakaways be inspected, in compliance with good practice and guidance published in BRE 365 (1991).

Soakaway designs should include appropriate filter media to minimise risks of silt entering the chambers/drainage systems as such silt could reduce storage and percolation performance of the soakaway.

5.0 List of Appendices

Appendix A – Borehole and Soakage Pit Logs

Appendix B – In-Situ, Laboratory Test & Groundwater Monitoring Data

6.0 References

1. British Standards Institution, 2015. Code of practice for foundations, BS 8004, BSI, London.

2. British Standards Institution, 1990. Methods for test for soils for civil engineering purposes, BS1377, BSI, London

3. British Standards Institution, 1994. Code of practice for earth retaining structures, BS8002, BSI, London

4. British Standards Institution, Code of Practice for Site Investigations, BS5930: 2015, BSI, London

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6. NHBC Standards, Chapter 4.1, "Land Quality - managing ground conditions", September 1999.

APPENDIX A

Borehole & Soakage Pit Logs

Site Analytical Services Ltd.

Site	Borehole Number
10 PEMBROKE VILLAS, THE GREEN, RICHMOND, TW9 1QF	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
ROTARY PERCUSSIVE	128mm cased to 0.00m		MICHAEL JONES ARCHITECTS	2438980
	Location	**Dates**	**Engineer**	**Sheet**
	TQ176750	25/09/2024	STRUCTURAL DESIGN STUDIO	1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						0.04	MADE GROUND: Natural stone slab		
						0.15	MADE GROUND: Sand and cement		
						0.19	MADE GROUND: York stone slab		
							MADE GROUND: Loose becoming very loose, brown silty fine to coarse grained sand containing brick fragments		
0.25	D1								
0.50	D2								
0.75	D3								
1.00-1.45 1.00	SPT(C) N=6 D4		DRY	1,2/2,1,2,1		(2.01)			
1.50	D5								
2.00-2.45 2.00	SPT(C) N=1 D6		DRY	0,1/0,1,0,0					
						2.20	Loose, orange fine to coarse grained SAND		
2.50	D7								
						(1.20)			
3.00-3.45 3.00	SPT(C) N=7 D8		DRY	1,1/1,2,2,2					
						3.40	Very dense, orange yellow gravelly fine to coarse grained SAND		
3.50	D9								
4.00-4.45 4.00	SPT(C) N=43 D10		DRY	3,3/10,10,11,12					
4.50	D11								
5.00-5.45 5.00	SPT(C) N=52 D12		DRY	8,9/12,13,13,14					
6.00-6.45 6.00	SPT(C) N=63 D13		DRY	10,10/15,15,16,17		(5.20)			
7.00	D14								
7.50-7.95 7.50	SPT(C) N=61 D15		WET	9,9/14,15,16,16 Water Strike (1) at 7.80m.					∇1
8.00	D16								
						8.60	Firm becoming stiff, medium to dark grey silty CLAY		
9.00-9.45 9.00	SPT(C) N=16 D17		WET	2,3/3,4,4,5					

Remarks
Water level at 7.00m depth on completion
S= Standard Penetration Test
C= Dynmaic penetration Test - Cone
D= Disturbed Sample
Excavating from 0.00m to 1.00m for 1 hour.

Scale (approx)	Logged By
1:50	EW

Figure No. 2438980.BH1

Site Analytical Services Ltd.

Site	Borehole Number
10 PEMBROKE VILLAS, THE GREEN, RICHMOND, TW9 1QF	BH1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
ROTARY PERCUSSIVE	128mm cased to 0.00m		MICHAEL JONES ARCHITECTS	2438980
	Location	**Dates**	**Engineer**	**Sheet**
	TQ176750	25/09/2024	STRUCTURAL DESIGN STUDIO	2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
10.00	D18								
						(3.60)			
10.50-10.95 10.50	SPT N=22 D19		WET	3,4/5,5,6,6					
11.00	D20								
12.00-12.45 12.00	SPT N=69 D21		WET	4,5/10,36,18,5					
						12.20	Stiff, dark grey very silty CLAY containing shell fragments Claystone present at 12.40m depth		
13.00	D22								
						(2.80)			
13.50-13.95 13.50	SPT N=25 D23		WET	4,5/5,6,7,7					
14.00	D24								
						15.00	Complete at 15.00m		
15.00-15.45 15.00	SPT N=30 D25		WET	5,5/7,6,8,9					

Remarks
Water level at 7.00m depth on completion
S= Standard Penetration Test
C= Dynmaic penetration Test - Cone
D= Disturbed Sample

Scale (approx)	Logged By
1:50	EW

Figure No. 2438980.BH1

Site Analytical Services Ltd.

Standard Penetration Test Results

Site : 10 PEMBROKE VILLAS, THE GREEN, RICHMOND, TW9 1QF

Client : MICHAEL JONES ARCHITECTS

Engineer : STRUCTURAL DESIGN STUDIO

Job Number 2438980

Sheet 1 / 1

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
BH1	1.00	1.15	1.45	CPT	1	2	2	1	2	1	N=6	
BH1	2.00	2.15	2.45	CPT	0	1	0	1	0	0	N=1	
BH1	3.00	3.15	3.45	CPT	1	1	1	2	2	2	N=7	
BH1	4.00	4.15	4.45	CPT	3	3	10	10	11	12	N=43	
BH1	5.00	5.15	5.45	CPT	8	9	12	13	13	14	N=52	
BH1	6.00	6.15	6.45	CPT	10	10	15	15	16	17	N=63	
BH1	7.50	7.65	7.95	CPT	9	9	14	15	16	16	N=61	
BH1	9.00	9.15	9.45	CPT	2	3	3	4	4	5	N=16	
BH1	10.50	10.65	10.95	SPT	3	4	5	5	6	6	N=22	
BH1	12.00	12.15	12.45	SPT	4	5	10	36	18	5	N=69	
BH1	13.50	13.65	13.95	SPT	4	5	5	6	7	7	N=25	
BH1	15.00	15.15	15.45	SPT	5	5	7	6	8	9	N=30	

Site Analytical Services Ltd.

Site	Borehole Number
10 PEMBROKE VILLAS, THE GREEN, RICHMOND, TW9 1QF	BH1

Installation Type
Single Installation

Dimensions
Internal Diameter of Tube [A] = 50 mm
Diameter of Filter Zone = 128 mm

Client	Job Number
MICHAEL JONES ARCHITECTS	2438980

Location	Ground Level (mOD)	Engineer	Sheet
TQ176750		STRUCTURAL DESIGN STUDIO	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				1.00	Bentonite Seal
				5.00	Slotted Standpipe
				6.00	Bentonite Seal
	∇1			15.00	General Backfill

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	10 min	15 min	20 min	Depth Sealed (m)
25/09/24		7.80	0.00	Water Strike					

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks
Lockable cover set in cement

Site Analytical Services Ltd.

Site	Borehole Number
10 PEMBROKE VILLAS, THE GREEN, RICHMOND, TW9 1QF	BH2

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
CONTINUOUS FLIGHT AUGER	128mm cased to 0.00m		MICHAEL JONES ARCHITECTS	2438980
	Location	**Dates**	**Engineer**	**Sheet**
	TQ176750	26/09/2024	STRUCTURAL DESIGN STUDIO	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						0.10	MADE GROUND: Stone slab over aggregate		
0.25	D1						MADE GROUND: Very loose, medium to dark brown silty fine to coarse grained sand containing brick and concrete fragments		
0.50	D2								
0.75	D3					(1.10)			
1.00 1.00-1.30	D4 M1 35/300					1.20	MADE GROUND: Loose, medium brown silty fine to coarse grained sand containing occasional brick fragments		
1.50 1.50-1.80	D5 M2 56/300					(0.70)			
						1.90	Loose brown orange silty fine to coarse grained SAND		
2.00 2.00-2.30	D6 M3 86/300					(0.90)			
						2.80	Medium dense, brown orange silty gravelly fine to coarse grained AND		
3.00 3.00-3.30	D7 M4 133/300								
3.50 3.50-3.70	D8 M5 145/200								
4.00 4.00-4.10	D9 M6 100/100								
4.50 4.50-4.60	D10 M7 100/100								
5.00 5.00-5.10	D11 M8 100/100					(4.20)			
6.00 6.00-6.10	D12 M9 100/100								
7.00 7.00	D13 V1 140+			Water Strike (1) at 7.00m.		7.00	Stiff, dark brown grey silty CLAY		∇1
8.00 8.00	D14 V2 140+					(3.00)			
9.00 9.00	D15 V3 140+								
10.00 10.00	D16 V4 140+					10.00			

Remarks
C= Dynmaic penetration Test - Cone
S= Standard Penetration Test
D= Disturbed Sample
Excavating from 0.00m to 1.00m for 1 hour.

Scale (approx)	Logged By
1:50	EW

Figure No. 2438980.BH2

Site Analytical Services Ltd.

Site	Borehole Number
10 PEMBROKE VILLAS, THE GREEN, RICHMOND, TW9 1QF	BH2

Installation Type	Dimensions		Client	Job Number
Single Installation	Internal Diameter of Tube [A] = 50 mm Diameter of Filter Zone = 100 mm		MICHAEL JONES ARCHITECTS	2438980
	Location	**Ground Level (mOD)**	**Engineer**	**Sheet**
	TQ176750		STRUCTURAL DESIGN STUDIO	1/1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
				1.00	Bentonite Seal
				4.00	Slotted Standpipe
				5.00	Bentonite Seal
	∇1			10.00	General Backfill

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	10 min	15 min	20 min	Depth Sealed (m)
26/09/24		7.00	0.00	Water Strike					

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks
Lockable cover set in cement

Site Analytical Services Ltd.

Site	Trial Pit Number
10 PEMBROKE VILLAS, THE GREEN, RICHMOND, TW9 1QF	SP1

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
SOAKAGE	0.50m(W) x 0.50m(L) x 1.40m(D)		MICHAEL JONES ARCHITECTS	2438980

Location	Dates	Engineer	Sheet
TQ176750	26/09/2024	STRUCTURAL DESIGN STUDIO	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40) 0.40	MADE GROUND: Grass over dark brown sandy topsoil		
					(0.80) 1.20	MADE GROUND: Medium brown silty fine to coarse grained sand containing brick fragments		
					(0.20) 1.40	MADE GROUND: Medium brown orange silty fine to coarse grained sand containing occasional brick fragments		
						Complete at 1.40m		

Plan

Remarks

Scale (approx)	Logged By	Figure No.
1:50	EW	2438980.SP1

APPENDIX B

In-Situ, Laboratory Test & Groundwater Monitoring Data

Site Analytical Services Ltd.

Soakaway Test (BRE Digest 365)

Site : 10 PEMBROKE VILLAS, THE GREEN, RICHMOND, TW9 1QF

Client : MICHAEL JONES ARCHITECTS

Engineer : STRUCTURAL DESIGN STUDIO

Job Number 2438980

Sheet 1 / 1

Location	Date	Level	Location
SP1	26/09/2024		

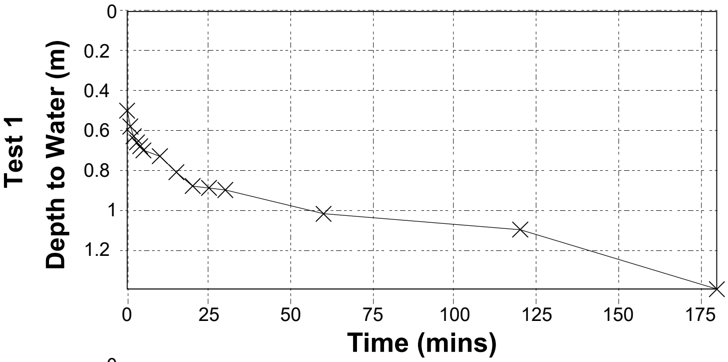
Pit Width (m)	0.50
Pit Depth (m)	1.40
Pit Length (m)	0.50

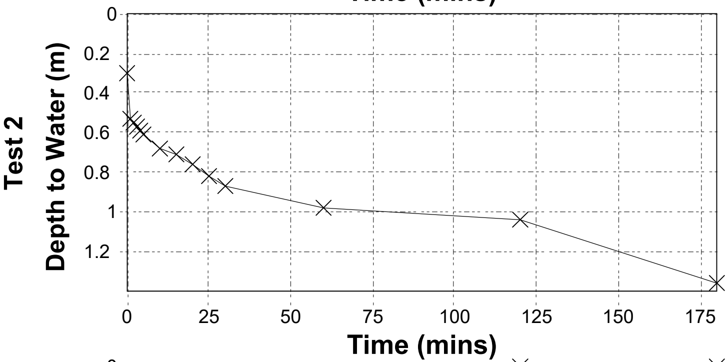
Soil type at test level	MADE GROUND: Medium brown silty fine to course grained sand
Groundwater	DRY
Drain discharge depth	
Sidewall stability	GOOD
Stone filled or open pit	Open pit

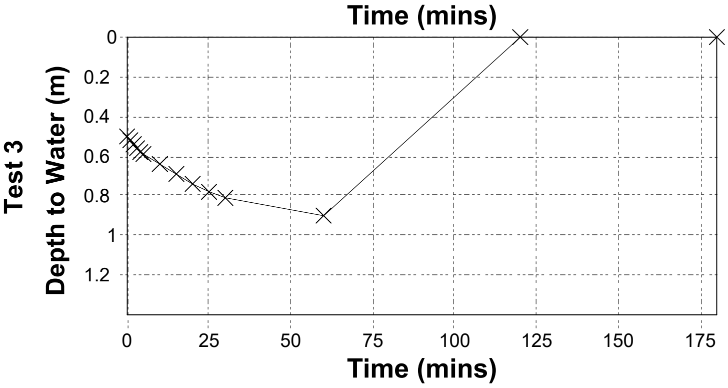
	1	2	3
Effective depth (m)	0.90	1.10	0.90
Volume outflowing between 75% & 25% (m3)	0.11	0.14	
Mean surface area through which outflow occurs (m2)	1.15	1.35	
Time for outflow between 75% & 25% (min)	125.83	132.69	
SOIL INFILTRATION RATE (ms-1), f	1.30E-5	1.28E-5	Test Failed

Remarks

Elapsed time (mins)	Depth to Water Test 1	Depth to Water Test 2	Depth to Water Test 3
0	0.50	0.30	0.50
1	0.58	0.53	0.52
2	0.63	0.55	0.54
3	0.66	0.57	0.56
4	0.68	0.59	0.58
5	0.70	0.61	0.59
10	0.73	0.68	0.64
15	0.81	0.71	0.69
20	0.88	0.76	0.74
25	0.89	0.82	0.78
30	0.90	0.87	0.81
60	1.02	0.98	0.90
120	1.10	1.04	
180	1.40	1.36	







GROUNDWATER MONITORING

GROUNDWATER MONITORING RECORD			
Date	**Weather Conditions**	**Ground Conditions**	**Temperature (°C)**
08/10/2024	Raining	Wet	16.0
Monitoring Point Location	**Depth to water (mBGL)**		**Depth to Base of well (mBGL)**
BH1	5.30		5.35
BH2	Dry		4.20

Table 1

GROUNDWATER MONITORING RECORD			
Date	**Weather Conditions**	**Ground Conditions**	**Temperature (°C)**
15/10/2024	Overcast	Dry	17.0
Monitoring Point Location	**Depth to water (mBGL)**		**Depth to Base of well (mBGL)**
BH1	5.30		5.35
BH2	Dry		4.20

Table 1a

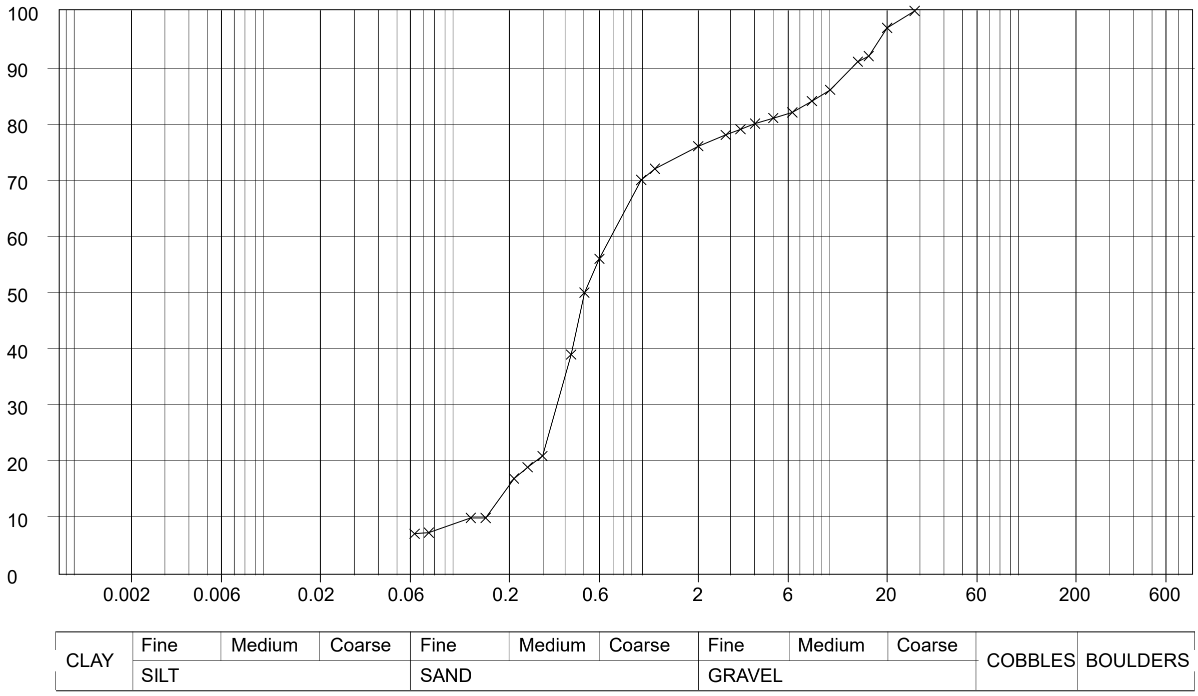
Site Analytical Services Ltd.

Laboratory Test Results

Site : 10 PEMBROKE VILLAS, THE GREEN, RICHMOND, TW9 1QF	**Job Number** 2438980
Client : MICHAEL JONES ARCHITECTS	**Sheet** 1/5
Engineer : STRUCTURAL DESIGN STUDIO	

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Laboratory Description
BH1	2.50	D7	



Sieve / Particle Size	% Passing
28 mm	100.0
20 mm	97.0
16 mm	92.0
14 mm	91.0
10 mm	86.0
8 mm	84.0
6.3 mm	82.0
5 mm	81.0
4 mm	80.0
3.35 mm	79.0
2.8 mm	78.0
2 mm	76.0
1.18 mm	72.0
1 mm	70.0
600 µm	56.0
500 µm	50.0
425 µm	39.0
300 µm	21.0
250 µm	19.0
212 µm	17.0
150 µm	10.0
125 µm	10.0
75 µm	7.4
63 µm	7.2

Grading Analysis	
D85	9.0 mm
D60	714.3 µm
D10	150.0 µm
Uniformity Coefficient	4.8

Particle Proportions	
Cobbles + Boulders	-
Gravel	24.0%
Sand	68.8%
Silt	-
Clay	-

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

Site Analytical Services Ltd.

Laboratory Test Results

Site : 10 PEMBROKE VILLAS, THE GREEN, RICHMOND, TW9 1QF

Client : MICHAEL JONES ARCHITECTS

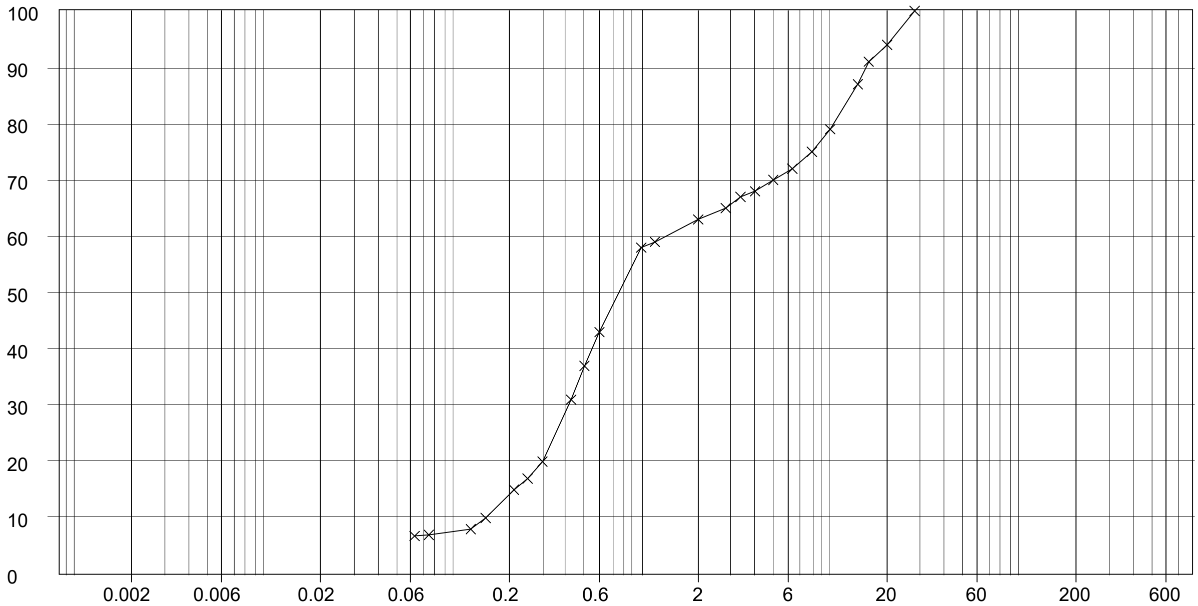
Engineer : STRUCTURAL DESIGN STUDIO

Job Number 2438980

Sheet 2/5

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Laboratory Description
BH1	4.50	D11	



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Sieve / Particle Size	% Passing
28 mm	100.0
20 mm	94.0
16 mm	91.0
14 mm	87.0
10 mm	79.0
8 mm	75.0
6.3 mm	72.0
5 mm	70.0
4 mm	68.0
3.35 mm	67.0
2.8 mm	65.0
2 mm	63.0
1.18 mm	59.0
1 mm	58.0
600 µm	43.0
500 µm	37.0
425 µm	31.0
300 µm	20.0
250 µm	17.0
212 µm	15.0
150 µm	10.0
125 µm	8.0
75 µm	7.0
63 µm	6.8

Grading Analysis	
D85	13.0 mm
D60	1.4 mm
D10	150.0 µm
Uniformity Coefficient	9.2

Particle Proportions	
Cobbles + Boulders	-
Gravel	37.0%
Sand	56.2%
Silt	-
Clay	-

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

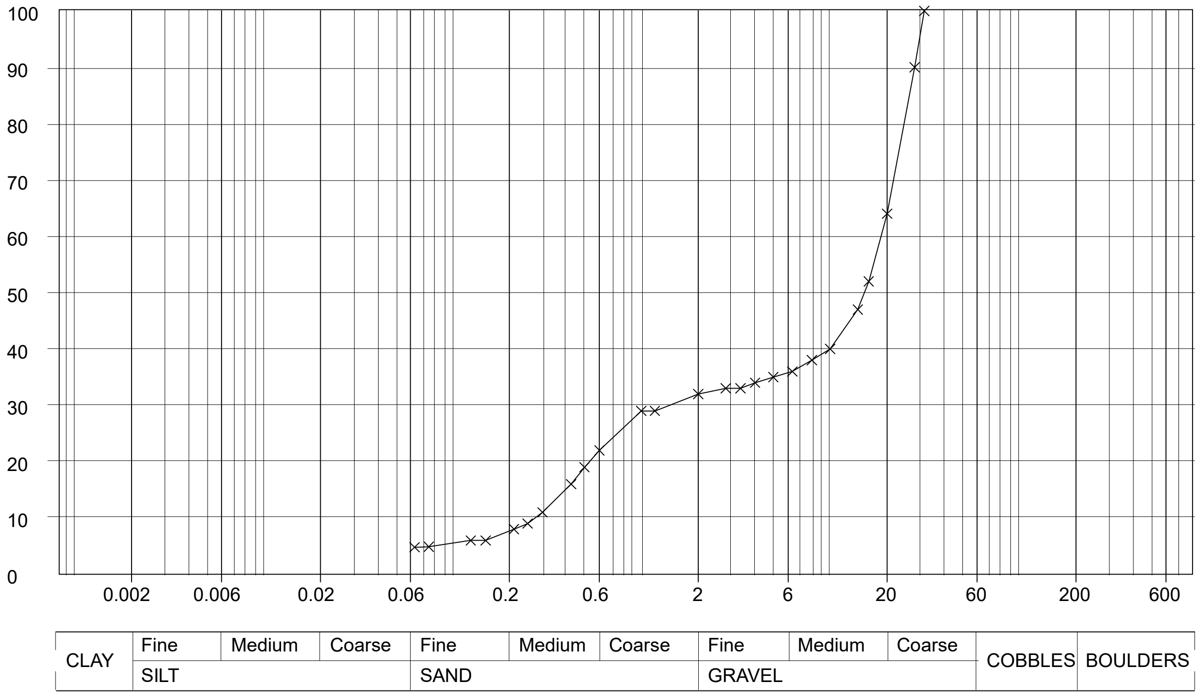
Site Analytical Services Ltd.

Laboratory Test Results

Site : 10 PEMBROKE VILLAS, THE GREEN, RICHMOND, TW9 1QF	**Job Number** 2438980
Client : MICHAEL JONES ARCHITECTS	
Engineer : STRUCTURAL DESIGN STUDIO	**Sheet** 3/5

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Laboratory Description
BH1	8.00	D16	



Sieve / Particle Size	% Passing
31.5 mm	100.0
28 mm	90.0
20 mm	64.0
16 mm	52.0
14 mm	47.0
10 mm	40.0
8 mm	38.0
6.3 mm	36.0
5 mm	35.0
4 mm	34.0
3.35 mm	33.0
2.8 mm	33.0
2 mm	32.0
1.18 mm	29.0
1 mm	29.0
600 µm	22.0
500 µm	19.0
425 µm	16.0
300 µm	11.0
250 µm	9.0
212 µm	8.0
150 µm	6.0
125 µm	6.0
75 µm	4.9
63 µm	4.8

Grading Analysis	
D85	26.5 mm
D60	18.7 mm
D10	275.0 µm
Uniformity Coefficient	67.9

Particle Proportions	
Cobbles + Boulders	-
Gravel	68.0%
Sand	27.2%
Silt	-
Clay	-

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

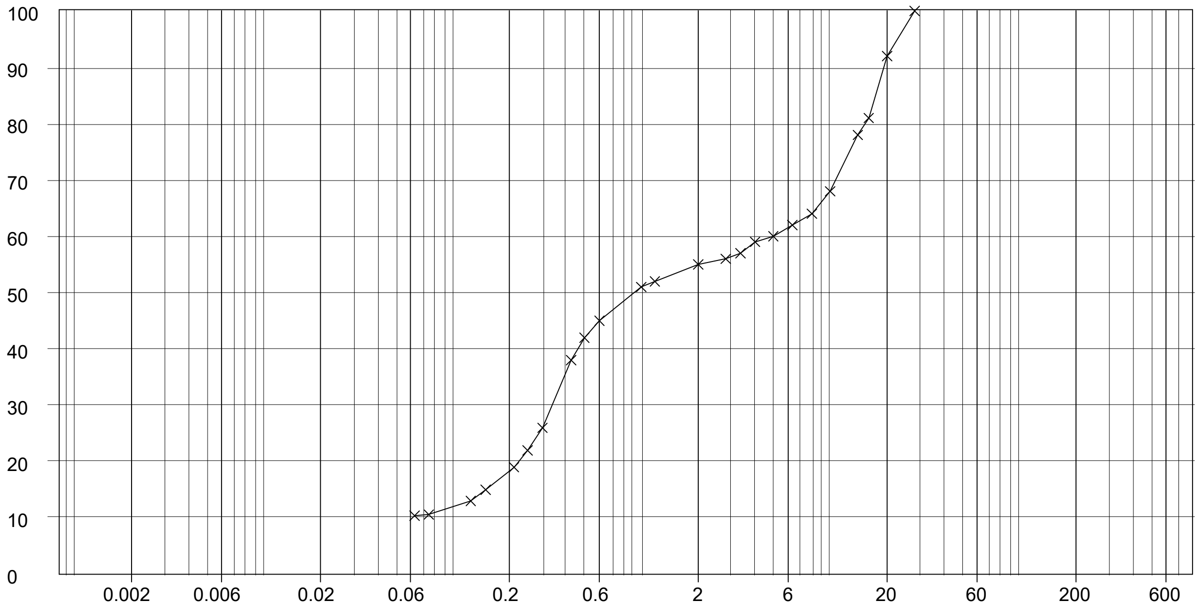
Site Analytical Services Ltd.

Laboratory Test Results

Site	: 10 PEMBROKE VILLAS, THE GREEN, RICHMOND, TW9 1QF	**Job Number** 2438980
Client	: MICHAEL JONES ARCHITECTS	**Sheet** 4/5
Engineer	: STRUCTURAL DESIGN STUDIO	

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Laboratory Description
BH2	3.00	D7	



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Sieve / Particle Size	% Passing
28 mm	100.0
20 mm	92.0
16 mm	81.0
14 mm	78.0
10 mm	68.0
8 mm	64.0
6.3 mm	62.0
5 mm	60.0
4 mm	59.0
3.35 mm	57.0
2.8 mm	56.0
2 mm	55.0
1.18 mm	52.0
1 mm	51.0
600 µm	45.0
500 µm	42.0
425 µm	38.0
300 µm	26.0
250 µm	22.0
212 µm	19.0
150 µm	15.0
125 µm	13.0
75 µm	10.6
63 µm	10.4

Grading Analysis	
D85	17.5 mm
D60	5.0 mm
D10	<63.0 µm
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	-
Gravel	45.0%
Sand	44.6%
Silt	-
Clay	-

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

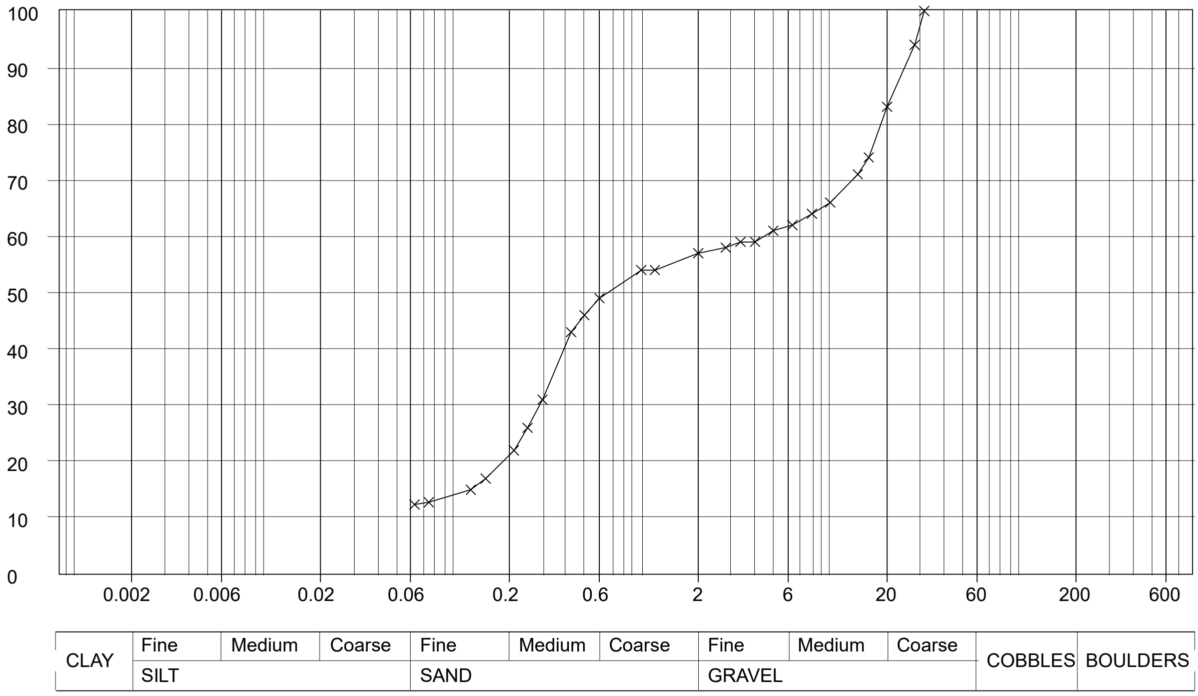
Site Analytical Services Ltd.

Laboratory Test Results

Site : 10 PEMBROKE VILLAS, THE GREEN, RICHMOND, TW9 1QF	**Job Number** 2438980
Client : MICHAEL JONES ARCHITECTS	
Engineer : STRUCTURAL DESIGN STUDIO	**Sheet** 5/5

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Trial Pit	Depth (m)	Sample	Laboratory Description
BH2	4.00	D9	



Sieve / Particle Size	% Passing
31.5 mm	100.0
28 mm	94.0
20 mm	83.0
16 mm	74.0
14 mm	71.0
10 mm	66.0
8 mm	64.0
6.3 mm	62.0
5 mm	61.0
4 mm	59.0
3.35 mm	59.0
2.8 mm	58.0
2 mm	57.0
1.18 mm	54.0
1 mm	54.0
600 µm	49.0
500 µm	46.0
425 µm	43.0
300 µm	31.0
250 µm	26.0
212 µm	22.0
150 µm	17.0
125 µm	15.0
75 µm	12.8
63 µm	12.4

Grading Analysis	
D85	21.5 mm
D60	4.5 mm
D10	<63.0 µm
Uniformity Coefficient	-

Particle Proportions	
Cobbles + Boulders	-
Gravel	43.0%
Sand	44.6%
Silt	-
Clay	-

Method of Preparation : BS 1377:PART 1:1990:7.3 Initial preparation 1990:7.4.5 Particle size tests

Method of Test : BS 1377:PART 2:1990:9 Determination of particle size distribution

Remarks :

Steve Barratt
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IG11 0EA

Normec DETS Limited
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Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 24-11682

Site Reference:	10 Pembrooke Villas. The Green. Richmond TW9 1OF
Project / Job Ref:	24/38980
Order No:	14775
Sample Receipt Date:	02/10/2024
Sample Scheduled Date:	02/10/2024
Report Issue Number:	1
Reporting Date:	09/10/2024

Authorised by:

Dave Ashworth
Technical Manager

Dates of laboratory activities for each tested analyte are available upon request.

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Normec DETS Limited
Unit 1, Rose Lane Industrial Estate
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Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410

Soil Analysis Certificate						
DETS Report No: 24-11682	**~Date Sampled**	26/09/24	26/09/24	26/09/24	26/09/24	26/09/24
Site Analytical Services Ltd	**~Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
~Site Reference: 10 Pembrooke Villas, The Green, Richmond TW9 1QF	**~TP / BH No**	BH1	BH1	BH1	BH1	BH2
~Project / Job Ref: 24/38980	**~Additional Refs**	D9	D14	D20	D24	D6
~Order No: 14775	**~Depth (m)**	3.50	7.00	11.00	14.00	2.00
Reporting Date: 09/10/2024	**DETS Sample No**	741475	741476	741477	741478	741479

Determinand	**Unit**	**RL**	**Accreditation**		(n)		(n)	
pH	pH Units	N/a	**MCERTS**	8.3	8.4	8.5	8.6	8.3
Total Sulphate as SO_4	mg/kg	< 200	**MCERTS**	291	< 200	890	516	< 200
Total Sulphate as SO_4	%	< 0.02	**MCERTS**	0.03	< 0.02	0.09	0.05	< 0.02
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	**MCERTS**	16	< 10	351	100	< 10
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	**MCERTS**	0.02	< 0.01	0.35	0.10	< 0.01
Total Sulphur	%	< 0.02	NONE	< 0.02	< 0.02	0.33	0.30	< 0.02

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Method Description page describes if the test is performed on the dried or as-received portion

Subcontracted analysis (S)

~Sample details provided by customer and can affect the validity of results

(n) Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation

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

Soil Analysis Certificate						
DETS Report No: 24-11682	**~Date Sampled**	26/09/24	26/09/24			
Site Analytical Services Ltd	**~Time Sampled**	None Supplied	None Supplied			
~Site Reference: 10 Pembrooke Villas, The Green, Richmond TW9 1QF	**~TP / BH No**	BH2	BH2			
~Project / Job Ref: 24/38980	**~Additional Refs**	D11	D14			
~Order No: 14775	**~Depth (m)**	5.00	8.00			
Reporting Date: 09/10/2024	**DETS Sample No**	741480	741481			

Determinand	**Unit**	**RL**	**Accreditation**					
pH	pH Units	N/a	**MCERTS**	8.6	8.5			
Total Sulphate as SO_4	mg/kg	< 200	**MCERTS**	< 200	514			
Total Sulphate as SO_4	%	< 0.02	**MCERTS**	< 0.02	0.05			
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	**MCERTS**	< 10	63			
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	**MCERTS**	< 0.01	0.06			
Total Sulphur	%	< 0.02	NONE	< 0.02	0.08			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Method Description page describes if the test is performed on the dried or as-received portion

Subcontracted analysis (S)

~Sample details provided by customer and can affect the validity of results

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Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 24-11682	
Site Analytical Services Ltd	
~Site Reference: 10 Pembrooke Villas, The Green, Richmond TW9 1QF	
~Project / Job Ref: 24/38980	
~Order No: 14775	
Reporting Date: 09/10/2024	

DETS Sample No	~TP / BH No	~Additional Refs	~Depth (m)	Moisture Content (%)	Sample Matrix Description
741475	BH1	D9	3.50	5.4	Light brown sandy clay with stones
741476	BH1	D14	7.00	2.1	Light brown sandy gravel with stones
741477	BH1	D20	11.00	21.9	Brown clay
741478	BH1	D24	14.00	13.2	Brown clay with stones
741479	BH2	D6	2.00	5.3	Light brown sandy clay
741480	BH2	D11	5.00	3.5	Light brown sand
741481	BH2	D14	8.00	11.6	Grey clay

Moisture content is part of procedure E003 & is not an accredited test
Insufficient Sample [I/S]
Unsuitable Sample [U/S]
~Sample details provided by customer and can affect the validity of results

Normec DETS Limited
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Maidstone
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Soil Analysis Certificate - Methodology & Miscellaneous Information
DETS Report No: 24-11682
Site Analytical Services Ltd
~Site Reference: 10 Pembrooke Villas, The Green, Richmond TW9 1QF
~Project / Job Ref: 24/38980
~Order No: 14775
Reporting Date: 09/10/2024

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	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
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

~Sample details provided by customer and can affect the validity of results

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Unit 1, Rose Lane Industrial Estate
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4480

List of HWOL Acronyms and Operators
DETS Report No: 24-11682
Site Analytical Services Ltd
~Site Reference: 10 Pembrooke Villas, The Green, Richmond TW9 1QF
~Project / Job Ref: 24/38980
~Order No: 14775
Reporting Date: 09/10/2024

Acronym	**Description**
HS	Headspace analysis
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent
CU	Clean-up - e.g. by florisil, silica gel
1D	GC - Single coil gas chromatography
2D	GC-GC - Double coil gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics only
AR	Aromatics only
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative eg. EH+HS_Total or EH_CU+HS_Total
~	Sample details provided by customer and can affect the validity of results

Det - Acronym