1 TO 9 SANDYCOMBE ROAD

NORTH SHEEN, RICHMOND TW9 2EP

PHASE 2 ENVIRONMENTAL AND GEOTECHNICAL SITE INVESTIGATION REPORT

FOR

GOLDCREST LAND PLC

November 2016

Our Ref: HLEI34438/002R

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This report has been prepared in the RPS Group Quality Management System to British Standard EN ISO 9001:2008

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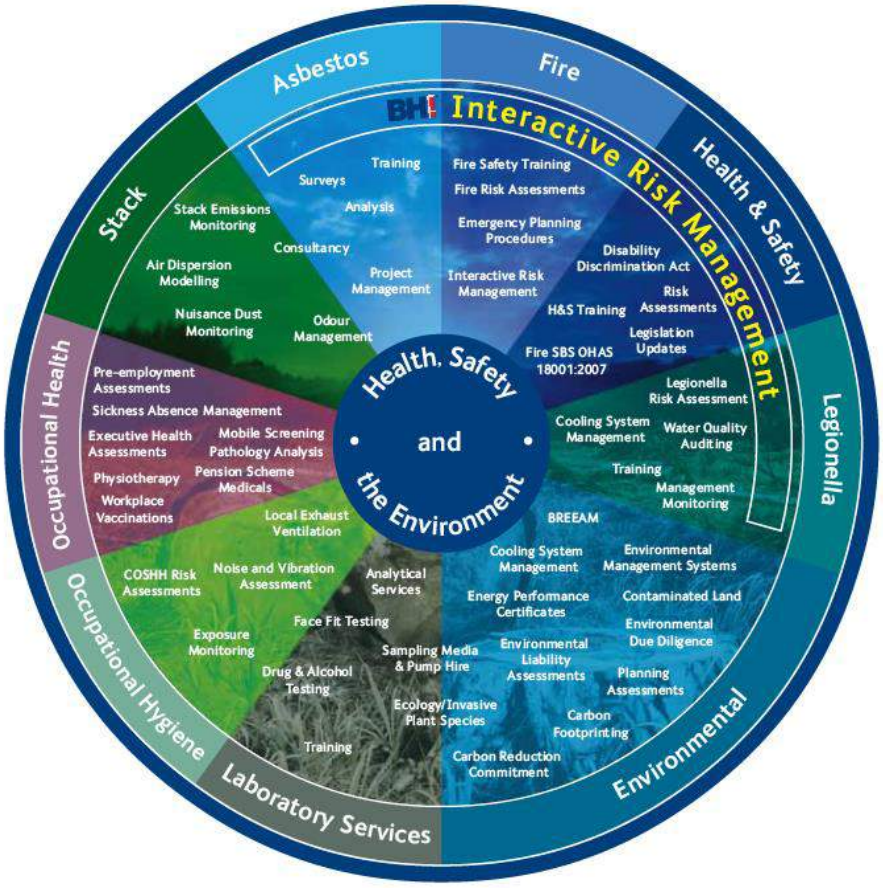

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EXECUTIVE SUMMARY

RPS Health, Safety & Environment (RPS) was commissioned by Goldcrest Land Plc to undertake a Phase 2 Environmental and Geotechnical Site Investigation at 1 to 9 Sandycombe Road, North Sheen, Richmond TW9 2EP. The report has been commissioned in relation to the proposed redevelopment of the site with a part four/part five-storey mixed use property, with associated car parking areas and some limited areas of soft landscaping.

The Phase 2 Site Investigation comprised two cable percussive boreholes advanced to 20.00m below ground level (bgl), three hand excavated inspection pits in areas of proposed and existing soft landscaping and five dynamic cone penetrometer (DCP) tests along the eastern boundary of the site targeting the periphery of the proposed building structure. Standard penetration testing (SPTs) was undertaken throughout the depth of each borehole and groundwater/gas monitoring wells were installed in each.

Tarmacadam was encountered at ground level in borehole BH1 and hand pit HP1 and brick paving was encountered at ground level in borehole BH2 underlain by Made Ground. Made Ground was encountered from ground level in hand pits HP2 and HP3. The Made Ground was directly underlain by the Kempton Park Gravel Formation, followed by the London Clay Formation.

Metals and polycyclic aromatic hydrocarbons (PAHs) were detected within soil samples collected from beneath the site at concentrations marginally in excess of their adopted Assessment Criteria (AC). Potential risks posed to both on and off-site human health receptors by these concentrations could be mitigated through the placement of a minimum 300mm validated clean soil layer in existing and proposed communal landscaped areas.

Based on the available information, and subject to the recommended mitigation measures being implemented, the potential risk posed to human health receptors from concentrations of contaminants of concern identified within soil sampled from beneath the site is considered to be ***LOW.***

Concentrations of contaminants of concern in excess of their relevant assessment criteria were not recorded within groundwater samples collected from beneath the site. The potential risk to Controlled Waters receptors from concentrations of contaminants of concern detected within groundwater sampled from beneath the site is therefore considered to be ***LOW.***

Based on the limited ground gas monitoring undertaken on site as part of the current investigation CIRIA Characteristic Situation 1 (CS1) is applicable to the site, whereby ground gas protection measures are not required. Therefore, the risk posed by ground gas to human health receptors and infrastructure is considered to be ***LOW.***

Due to the height and likely high loads imposed by the proposed development, a piled foundation solution is likely to be required in order to support the proposed development. Bored piles, terminating in the deeper layers of the London Clay Formation are likely to be suitable from a geotechnical perspective. Driven piles produce less spoil and can achieve higher end bearing capacities. However, their use may be precluded due to the presence of neighbouring residential properties and high pressure gas main crossing the site. Due to the inherent instability of Made Ground and the Kempton Park Gravel beneath the site and the possibility of borehole collapse due to running sands, continuous flight auger (CFA) piles may not be suitable for the proposed development.

It is understood that no basement is proposed beneath new development. In this case, it is likely that ground conditions immediately underlying the floor slab of this structure will comprise Made Ground overlying the Kempton Park Gravel. It is recommended that floor slabs are suspended to avoid excessive total and differential settlement. In this case, settlement of the proposed floor slabs will be controlled by the supporting foundations of the structure. This should be allowed for as part of detailed foundation design.

Given its approximately date of construction (pre 1999), it is possible that asbestos containing materials have been used in the construction and/or maintenance of the units on site. RPS have been informed that an asbestos survey has been undertaken for the site and no asbestos containing materials were encountered. It is recommended that a full asbestos demolition and refurbishment survey is undertaken prior to any demolition works on site.

1 INTRODUCTION

1.1 Preamble

RPS Health, Safety & Environment (RPS) was commissioned by *Goldcrest Land Plc* to undertake a Phase 2 Environmental and Geotechnical Site Investigation at 1 to 9 Sandycombe Road, North Sheen, Richmond TW9 2EP. The report has been commissioned in relation to the proposed redevelopment of the site with a part four/part five-storey mixed use property, with associated car parking areas and some limited areas of soft landscaping.

1.2 Objectives

The principal objectives of this assessment were as follows:

- To determine the contamination status of soil and groundwater beneath the site;
- To assess whether contamination is present within soil and/or groundwater beneath the site at concentrations that could impact future site users/occupiers and the wider environment;
- To assess the suitability of the site for its proposed use and to support the discharge of the planning conditions pertaining to the investigation of potentially contaminated land; and
- To determine the engineering properties of the underlying soils and to provide geotechnical parameters to assist preliminary foundation, ground slab and external hardstanding design.

1.3 Legislation and Guidance

This report has been produced in general accordance with:

- *Contaminated Land (England) Regulations 2006 (as amended);*
- *DEFRA Environmental Protection Act 1990: Part 2A - Contaminated Land Statutory Guidance (2012);*
- *Environment Agency (EA) Contaminated Land Report 11 (CLR 11): Model Procedures for the Management of Land Contamination;*
- *National Planning Policy Framework (2012)*;
- British Standard requirements for the *'Investigation of potentially contaminated sites - Code of practice' (ref. BS10175:2011)*;
- British Standard requirements for the *'Code of practice for ground investigations' (ref. BS5930:2015)*;
- CIRIA Document C665 - *Assessing risks posed by hazardous ground gases to buildings;*
- EN 1997-1 (2004): Eurocode 7: Geotechnical design - Part 1: General rules; and

- EN 1997-2 (2007): Eurocode 7: Geotechnical design - Part 2: Ground investigation and testing.

Where appropriate, consideration has also been given to the following:

- The potential for environmental liabilities to occur under other associated regimes, for example the *Water Resources Act (1991)* and the *Environmental Damage Regulations (2009)*;
- Key constraints on site redevelopment;
- General compliance issues for existing site activities / operations in the context of current legislation;

Details of the limitations of this type of assessment are described in Appendix A.

1.4 Site Location & Description

The site is located in North Sheen, Richmond at National Grid Coordinates 519010, 175770. A site location plan is provided as Figure 1. The site is roughly triangular in shape and occupies an area of approximately 0.15ha. At the time of the site works, the site comprised a vacant row of commercial units with an access road, associated parking areas and limited soft landscaping in the south of the site.

The site is located in an area of mixed residential and commercial land uses.

1.5 Proposed Development

The proposed development will comprise a part four/part five-storey property, with associated areas of car parking and some areas of soft landscaping. The ground floor of the property is proposed to be occupied by office accommodation, with the upper floors as residential apartments. It is understood that the trees present in the south of the site will be retained as part of the proposed development and planting in this area will be enhanced. New trees will be planted along the western boundary of the site and a planted buffer will be located along the eastern boundary. A proposed development plan is included as Figure 2.

1.6 Previous Reports

RPS has previously undertaken a Phase 1 Preliminary Risk Assessment of the site (Ref: HLEI34438/001R, dated December 2015). Information from this report is summarised below:

- A site walkover was undertaken on 15th December 2014, at the time of reporting, the site comprised a row of commercial units with an access road, associated parking areas and limited soft landscaping. On site tenants included a wood furnishers, a pet food company and a hardwood flooring company. However, it was understood that by December 2015 the units were

disused. Former on site uses and potential sources of contamination included buildings of unspecified use in the north of the site and the likely use of the site as railway land associated with the railway line located to the east;

- There was also considered potential for Made Ground to be present beneath the site as a result of past construction and demolition activity;
- Potentially contaminative off-site land uses at the time of the report included a railway line, a garage/petrol filling station, a car showroom and a gas valve compound. Historical off-site land uses included a timber yard and fuel depot, a pulp paper manufacturing works, a commercial printers and a gas works/gas holder depot;
- Following the proposed redevelopment of the site, it was considered that the risk to future human health receptors may be active via the pathways of dermal contact, ingestion of soil and the inhalation of soil/dust within the limited areas of soft landscaping. There was also the potential for ground gas and the inhalation of volatile contaminants of concern to impact future site users in indoor areas. Other potential pathways identified included the off-site migration of contaminants of concern via groundwater in granular horizons of the Kempton Park Gravel Formation. There was considered the potential for these contaminants of concern to impact neighbouring human health receptors via dermal contact, ingestion and vapour inhalation pathways; and
- It was recommended that the potential for the potential pollutant linkages detailed above to be active be assessed through a Phase 2 Environmental Site Investigation.

This report should be read in conjunction with that detailed above.

1.7 Geology and Hydrogeology

Based on British Geological Survey (BGS) mapping (1:50,000-scale) and the EA Groundwater Vulnerability mapping (1:100,000-scale), the stratigraphic sequence and aquifer classifications beneath the site are indicated to be as follows:

Table 1 – Descriptions of Geological Strata

Strata	Description & approximate thickness	Aquifer Classification
Kempton Park Gravel Formation	Sand and gravel. Likely to be a few metres in thickness in the vicinity of the site.	Secondary A Aquifer
London Clay Formation	Clay and silt. Likely to be up to 100 metres in thickness beneath the site.	Unproductive Stratum

Made Ground is likely to be present beneath the site as a result of previous construction and demolition activities.

EA mapping indicates that the site overlies a Secondary A Aquifer, relating to the Kempton Park Gravel Formation. These formations are formed of permeable layers capable of supporting water supplies at a local scale, in some cases forming an important source of base flow to rivers. The London Clay Formation is classified as an Unproductive Stratum. These formations have a low permeability and have negligible significance for water supply or base flow.

According to EA data, the site is not located in a designated groundwater Source Protection Zone (SPZ).

Information provided by the EA indicates that there are no active licensed groundwater abstractions within 1km of the site.

Groundwater chemical and quantitative quality beneath the site has not been classified under the EAôs local River Basin Management Plan.

1.8 Hydrology

There are no surface water features readily identifiable on Ordnance Survey (OS) mapping within 500m of the site.

Information provided by the EA indicates that there are no records of active licensed surface water abstractions within 1km of the site.

According to the EA flood map, the site is not located within an indicative fluvial flood plain.

2 PRELIMINARY CONCEPTUAL SITE MODEL

2.1 Background

An preliminary conceptual site model (CSM) consists of an appraisal of the *source-pathway-receptor* 'contaminant linkages' which is central to the approach used to determine the existence of 'contaminated land' according to the definition set out under Part 2A of the Environmental Protection Act 1990. For a risk to exist (under Part 2A), all three of the following components must be present to facilitate a potential 'pollutant linkage'.

- ***Source*** *referring to the source of contamination (Hazard).*
- ***Pathway*** *for the contaminant to move/migrate to receptor(s).*
- ***Receptor*** *(Target) that could be affected by the contaminant(s).*

Receptors include human beings, other living organisms, crops, controlled waters and buildings/ structures. The National Planning Policy Framework, used to address contaminated land through the planning process, follows the same principles as those set out under Part 2A. See Appendix B for further details on the Part 2A regime.

2.2 Potential Pollutant Linkages

Each stage of the potential pollutant linkages have been assessed individually on the basis of information obtained during the Phase 1 Preliminary Risk Assessment (ref: HLEI34438/001R) and is discussed in the following sections.

2.2.1 Potential Contaminant Sources

There is considered to be potential for contaminants of concern to be present beneath the site associated with the former buildings of unspecified use located in the north of the site (1896 to c.1913) and the likely use of the site as railway land (1913 to c.1991). In addition, it is understood that until recently the site has been used for light industrial / commercial purposes.

There is potential for Made Ground to be present beneath the site as a result of past construction and demolition activity, which may represent both a source of contamination and ground gas.

A number of historical and current potentially contaminative land uses have been identified in the immediate surrounding area including a railway line located adjacent to the east of the site (1871 to Present); a commercial printers located approximately 25m to the north of the site (1993 to 2003); a garage / petrol filling station located approximately 30m southwest (1960 to Present); a works of unspecified use (1960 to c.1991) located approximately 40m to the east, latterly a car showroom (c.1991 to Present); a timber yard located approximately 50m to the south (1896 to c.1934), latterly a

pulp and paper manufacturing works (from 1954 to 1958); and a gas works / gas holder depot approximately 60m to the southeast (1868 to c. 2006), latterly a gas valve compound (2006 to Present).

2.2.2 Potential Pathways

Following redevelopment, surface cover at the site will likely comprise mainly building cover and hardstanding with some areas of communal soft landscaping. In areas of the site covered by buildings or hardstanding, the risks to future on site human health receptors *via* the dermal contact and ingestion pathways will be mitigated. In areas of soft landscaping, the pathways of dermal contact, ingestion of soil and the inhalation of soil / dust could still be active. Furthermore, there would be potential for the airborne off-site migration of soil/dust from these areas.

There is the potential for ground gas and volatile contaminants of concern in soil and / or groundwater (if present) beneath the site to impact future site users *via* the inhalation pathway in indoor areas.

Groundwater within granular horizons of the Made Ground and the Kempton Park Gravel Formation may constitute a potential pathway for the off-site migration (*via* groundwater) of contaminants of concern. Pathways of dermal contact, ingestion and vapour inhalation to neighbouring human health receptors from potential contaminants of concern originating from the site may therefore be active.

Potential contaminants of concern associated with current and historical land uses in the vicinity of the site also have the potential to migrate onto site (via groundwater) and impact future site users *via* the pathways of dermal contact, ingestion and vapour inhalation.

2.2.3 Potential Receptors

Potential human health receptors include future site users and off-site residential and commercial occupants. Provided construction workers adopt appropriate levels of hygiene and personal protective equipment, they are not considered to be at significant risk from potential contaminants of concern and have not been considered further as part of this assessment.

The site is situated on a Secondary A Aquifer, relating to the Kempton Park Gravel Formation. The site is not located within a SPZ and there are no licensed groundwater abstractions within 1km of the site.

There are no surface water features within 500m of the site.

2.3 Outline Conceptual Site Model

An outline CSM has been developed based on each of the stages discussed above and the proposed use of the site. The CSM details the potentially active pollutant linkages identified between each of these components and is presented below.

Table 2 - Outline Conceptual Site Model

Potential Source	Contaminants of Concern	*Via*	Potential Pathways	Linkage Potentially Active?	Receptors
On site – historical: Buildings of an unspecified use in the north of the site, the likely use of the site as railway land and recent light industrial / commercial use of the site. **On site – current:** Made Ground.	Hydrocarbons, metals and asbestos	Soil	Direct contact/ingestion	✓	Future site users
			Inhalation of volatiles	✓	
			Airborne Migration of soil or dust	✓	Off-site users
			Leaching of mobile contaminants	✓	Secondary A Aquifer
		Groundwater	Direct contact/ingestion	✓ ✓	Future site users Off-site users
			Inhalation of volatiles	✓ ✓	Future site users Off-site users
			Vertical and lateral migration in permeable strata	✓	Secondary A Aquifer
Off-site – historical: A timber yard, a pulp paper manufacturing works, a commercial printers and a gas works / gas holder depot and works of unspecified use. **Off-site – current:** Railway line, garage / petrol filling station, car showroom and a gas valve compound.	Hydrocarbons, solvents and metals	Groundwater	Direct contact/ingestion	✓	Future site users
			Inhalation of volatiles	✓	Future site users
On and off-site – Made Ground / natural strata or bio-degradation of contamination.	CO_2, CH_4	Ground Gas	Inhalation of ground gas	✓ ✓	Future site users Off-site users
			Explosive risks	✓ ✓	Future site users Off-site users

3 INTRUSIVE SITE INVESTIGATION

3.1 Objectives

A number of potential pollutant linkages have been identified as associated with the site within the CSM presented as Table 2. An intrusive site investigation has been carried out in order to provide an assessment of whether pollutant linkages identified within the outline CSM are currently active or will be made active upon redevelopment of the site. The investigation also provided information on ground conditions and data for the assessment geotechnical properties of the strata underlying the site.

3.2 Description of Works

The site investigation was carried out between 21st and 23rd March and 8th April 2016 and comprised:

- Two cable percussion boreholes (BH1 and BH2) to depths of 20.00m below ground level (bgl);
- Installation of groundwater/gas monitoring wells in each borehole;
- Dynamic cone penetrometer (DCP) testing at five locations (DCP1 to DCP5) located along the eastern boundary of the site in order to derive California Bearing Ratio (CBR) values for shallow subgrade material; and
- Excavation of three hand dug inspection pits (HP1 to HP3) to depths of up to 1.10m bgl.

Borehole locations were restricted by the presence of multiple services beneath the site including a high pressure gas main, low pressure gas main, BT duct and foul water sewer. The approximate locations of services are indicated on Figure 3.

Boreholes BH1 and BH2 were positioned within the footprint of the proposed building in order to assess the contamination status of soil and groundwater beneath the site and to obtain geotechnical information on deep soils in order to facilitate preliminary foundation design. It was initially proposed to undertake an additional borehole to a depth of 20m bgl (or refusal) to the south of the existing commercial units, however a representative from National Grid stated that the proximity of this borehole was too close to the high pressure gas main given that vibration data for the cable percussive rig was not available.

Hand pits were undertaken in order to assess the contamination status of shallow soils in existing and proposed areas of landscaping. Hand pit HP1 was located in a proposed area of soft landscaping to the south of the existing commercial units (in the location of the proposed third borehole detailed above) and hand pits HP2 and HP3 were excavated in the existing area of soft landscaping in the south of the site.

DCP tests were undertaken along the eastern boundary of the site along the periphery of the proposed building footprint. These were undertaken in order to obtain CBR values for shallow subgrade material in relation to the erection of scaffolding during the construction of the proposed building.

An exploratory hole location plan is provided as Figure 3.

The soil arisings from each hole were carefully examined for visual and olfactory evidence of contamination. Headspace testing was undertaken on site for ionisable volatile organic compounds (iVOCs) using a portable Photo-Ionisation Detector (PID).

A return visit for groundwater sampling was carried out on 31st March 2016. The monitoring wells were inspected for the presence of free-phase hydrocarbon product using an oil/water interface probe and the depth to groundwater was recorded prior to sampling.

Ground gas monitoring was undertaken on three occasions, on 31st March and 8th and 15th April 2016. Installations were monitored for concentrations of methane, carbon dioxide, carbon monoxide, hydrogen sulphide, oxygen and iVOCs. In addition, the flow rate and barometric pressure were recorded.

3.3 Laboratory Testing

3.3.1 Environmental Laboratory Testing - Soil

Five samples of Made Ground and one sample of the Kempton Park Gravel Formation were submitted to a UKAS/MCERTS accredited laboratory and analysed for a number of determinands including:

Inorganic Determinands:
pH, arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, sulphide, total cyanide, sulphate, sulphur, selenium, zinc and asbestos.

Organic Determinands:
Polycyclic aromatic hydrocarbons (PAH), benzene, toluene, ethylbenzene and xylenes (BTEX), methyl tert-butyl ether (MTBE), speciated total petroleum hydrocarbons (TPH CWG) and monohydric phenol.

3.3.2 Environmental Laboratory Testing - Groundwater

Two groundwater samples were collected during the first monitoring visit from monitoring wells installed within borehole BH1 and BH2, screened in the Kempton Park Gravel Formation and analysed by a UKAS/MCERTS accredited laboratory for some or all of the following potential contaminants:

Inorganic Determinands:

pH, total organic carbon, arsenic, cadmium, chromium, hexavalent chromium, copper, lead, mercury, nickel, selenium, zinc, sulphate and total cyanide.

Organic Determinands:

PAH, TPH CWG including BTEX and MTBE, monohydric phenol and VOCs.

3.3.3 Geotechnical Laboratory Testing

Samples of Made Ground, the Kempton Park Gravel Formation and London Clay Formation were submitted to a UKAS accredited geotechnical testing laboratory and analysed for soil classification, total stress parameters, consolidation characteristics, pH and water soluble sulphate content.

4 SITE INVESTIGATION FINDINGS

4.1 Ground Conditions

4.1.1 Geology

The strata encountered during the intrusive investigation are summarised in the table below, and described in the following section.

Table 3 – Encountered Strata

Strata	Depth to Top of Strata (m bgl)	Thickness (m)
Tarmac hardstanding	Ground level	0.08 to 0.15
Made Ground	Ground level	0.85 to 1.80
Kempton Park Gravel Formation	1.80	5.20 to 5.70
London Clay Formation	7.00 to 7.50	Not proven to a maximum depth of 20.00m bgl

A variable thickness of tarmacadam hardstanding was encountered at ground level at borehole BH1 and hand pit HP1, overlying Made Ground. Brick paving was encountered at ground level at borehole BH2, underlain by Made Ground and Made Ground was encountered from ground level at hand pits HP2 and HP3. The Made Ground across the site was directly underlain by the Kempton Park Gravel Formation, followed by the London Clay Formation.

General descriptions of the strata encountered during the intrusive investigation are summarised below. Reference should be made to the borehole logs within Appendix C of this report for full descriptions of ground conditions underlying the site.

Made Ground

Made Ground was encountered beneath hardstanding within boreholes BH1 and BH2 and hand pit HP1 and from ground level in hand pits HP2 and HP3. The base of the Made Ground was encountered at a depth of approximately 1.80m bgl in boreholes BH1 and BH2 and was unproven within the hand pits.

Made Ground was variable in nature, but generally comprised brown gravelly fine to medium sand with red and yellow brick, concrete and ceramic fragments.

Two standard penetration test (SPT) results obtained from within the Made Ground at depths of approximately 1.20m bgl were N = 2 and N = 8, which is indicative of a very loose, ranging to a loose material.

Particle Size Distribution (PSD) testing was undertaken on two samples collected from the Made Ground at depths ranging from approximately 0.70m to 1.20m bgl. The constituents of the samples are summarised below:

- Gravel: 20% to 46%;
- Sand: 38% to 60%; and
- Silt/Clay: 16% to 20%.

Geotechnical laboratory certificates are presented as Appendix D of this report.

Kempton Park Gravel Formation

The Kempton Park Gravel Formation was encountered beneath the Made Ground, where the thickness of this stratum was proven. The Kempton Park Gravel Formation ranged in thickness from approximately 5.20m to 5.70m, where proven and was encountered as orange-brown, sandy angular to rounded fine to medium flint gravel and orange-brown gravelly fine to coarse sand.

SPT results obtained from within the Kempton Park Gravel Formation at depths ranging from approximately 2.20m to 6.50m bgl gave results ranging from N = 10 to N = 39, which is indicative of a medium dense, ranging to a dense material.

PSD testing was undertaken on two samples collected from the Kempton Park Gravel Formation at depths ranging from approximately 2.20m to 3.65m bgl. The constituents of the samples are summarised below:

- Gravel: 44% to 68%;
- Sand: 30% to 48%; and
- Silt/Clay: 4%.

London Clay Formation

The London Clay Formation was encountered beneath the Kempton Park Gravel Formation at depths ranging from approximately 7.00m to 7.50m, where the thickness of this stratum was unproven. The London Clay Formation was generally encountered as grey, slightly silty or silty clay.

Atterberg Limit testing was undertaken on five soil samples collected from the London Clay Formation at depths ranging from approximately 8.00m to 18.95m bgl. This testing was undertaken to determine values for Liquid Limit (LL), Plastic Limit (PL) and Plasticity Index (PI). The results for LL ranged from 71% to 77%. The results for PL ranged from 29% to 31%. The results for PI ranged from 42% to 46%. This is indicative of a very high plasticity clay. Modified plasticity index values indicate that London

Clay Formation samples analysed have a moderate volume change potential. The natural moisture content for these samples ranged from 25% to 29%.

SPT results obtained from within the London Clay Formation at depths ranging from approximately 8.00m to 18.50m bgl gave results ranging from N = 19 to in excess of N = 50.

Approximate undrained shear strengths were calculated from SPT results using the correlation by Stroud:

$$C = f_1 \times N$$

Where, for high plasticity clays, $f_1 = 4.5$.

SPT results correspond approximately to undrained shear strength values ranging from 86kN/m^2 to in excess of 225kN/m^2, which is indicative of a high, ranging to a very high strength cohesive material.

Five quick undrained triaxial compression tests undertaken on samples collected from the London Clay Formation at depths ranging from approximately 9.50m to 18.95m bgl gave results ranging from 101kN/m^2 to 291kN/m^2. This is indicative of a high ranging to a very high strength material. The results of triaxial tests generally correlate well to results derived from SPTs and show increasing strength with depth. The natural moisture content of the samples ranged from 25% to 28%. Bulk density ranged from 1.91Mg/m^3 to 2.01Mg/m^3. Dry density ranged from 1.52Mg/m^3 to 1.59Mg/m^3.

One oedometer consolidation test was undertaken on a samples collected from the London Clay Formation at a depth of approximately 11.00m bgl from borehole BH1. Between a pressure range of 100kN/m^2 to 200kN/m^2, a coefficient of compression (m_v) value of 0.079m^2/MN was obtained. This is indicative of a low compressibility material.

4.2 Groundwater

The depth to groundwater could not be accurately determined during intrusive works, due to water added to assist drilling through granular strata. Groundwater levels recorded during subsequent monitoring visits to site are summarised in the table below:

Table 4 - Groundwater Data

Borehole ID	Well Screen Depth m bgl	Strata	Depth to Groundwater m bgl		
			31/03/2016	08/04/2016	15/04/2016
BH1	1.80 to 7.20	Kempton Park Gravel Formation	5.932	6.146	6.251
BH2	1.80 to 7.80	Kempton Park Gravel Formation	5.951	6.201	6.316

Free-phase hydrocarbon product was not observed within groundwater during monitoring visits.

The results of groundwater monitoring above appear to be representative of a continuous groundwater body within the Kempton Park Gravel Formation.

4.3 Field Evidence of Contamination

4.3.1 Visual and Olfactory Evidence of Contamination

Fragments of ash were recorded within Made Ground in borehole BH2. This may represent a source of elevated concentrations of organic and inorganic contaminants.

4.3.2 Photo-Ionisation Detector (PID) Readings

Soil arisings from each exploratory hole were screened for the presence of volatile contaminants using a PID. Elevated concentrations of volatile contaminants (>100 parts per million (ppm)) were not recorded in soil samples and were all less than the instrument detection limit of 1ppm.

Full PID records are presented within exploratory hole records in Appendix C of this report.

4.4 Ground Gas Monitoring

Ground gas monitoring has been undertaken on three occasions on 31st March and 8th and 15th April 2016. Installations were monitored for concentrations of methane, carbon dioxide and oxygen. In addition, the flow rate and barometric pressure were recorded. The results of the ground gas monitoring are presented in Appendix E.

Methane was not recorded at concentrations in excess of the instrument limit of detection (<0.1% by volume (v/v)). Carbon dioxide was recorded at concentrations of up to 2.3% v/v within monitoring wells BH1 and BH2, screened within the Kempton Park Gravel Formation, on 15th April 2016. A peak flow rate of 0.4 litres per hour was recorded within monitoring well BH2 on 31st March 2016 and monitoring well BH2 on 15th April 2016.

The lowest recorded oxygen concentration was 14.6% v/v within monitoring well BH2 on 31st March 2016. Atmospheric pressure ranged from 1012mb to 998mb during the monitoring visits.

The CIRIA Report C665 ó*Assessing risks posed by hazardous ground gases to buildings'* outlines indicative guideline concentrations for carbon dioxide and methane in association with gas flow rates for which gas protection measures may be required in new residential or commercial developments. The methodology is based on the Modified Wilson and Card approach that characterises the gas regime into a series of Characteristic Situations (1 to 5), with corresponding indicative gas protection

measures. Using this methodology, the ground gas regime at this site corresponds to Characteristic Situation 1 (CS1), whereby no gas protection measures are required.

5 CHEMICAL RESULTS AND ASSESSMENT

The field investigation findings indicate that pathways are present by which contaminants of concern can impact identified receptors. Chemical analysis has been carried out on soils sampled from beneath the site. The concentrations of contaminants of concern within soil can be compared to assessment criteria to determine whether these represent an unacceptable risk to identified receptors. The derivation of assessment criteria to be used and the comparison of these criteria to the results of the chemical analyses are presented below.

5.1 Human Health Assessment Criteria

In order to assess risks to future site users, concentrations of contaminants of concern have been compared to Suitable 4 Use Levels (S4UL) generic Assessment Criteria (AC) published by Land Quality Management: Chartered Institute of Environmental Health (LQM:CIEH) in 2015. In accordance with the copyright notice the Publication Number for RPS Group is S4UL3177.

The assessment has been based upon a residential land use without the potential for produce to be grown / consumed.

Soil Organic Matter (SOM) for samples of Made Ground collected on site ranged between 1.60% and 6.00% with an average SOM of 2.74% and the SOM within the one sample of Kempton Park Gravel Formation sampled from beneath the site was 0.1%. Concentrations of contaminants of concern within all soil samples have been compared to S4UL (1% SOM) values as a conservative approach.

A notable exclusion from the S4ULs is lead. In the absence of a S4UL for lead, the Category 4 Screening Level (C4SL) has been selected, published by DEFRA in 2014. It is noted that the C4SL are based on the acceptance of a low level of toxicological concern, rather than the more conservative standard adopted in the derivation of S4ULs, which are based on a tolerable or minimal level of risk.

The potential risk posed to controlled waters from contaminants of concern within soils beneath the site is not addressed by these screening criteria.

5.2 Comparison of Soil Analyses to Assessment Criteria

Chemical analysis was undertaken on five samples of Made Ground and one sample of the Kempton Park Gravel Formation. Analytical certificates for soils are presented in Appendix F. A comparison of soil analyses to the relevant assessment criteria is summarised below and presented as Appendix G.

5.2.1 Inorganic Determinands

Arsenic was detected at a concentration in excess of adopted AC (40mg/kg) in a sample of Made Ground collected from borehole BH2 at 1.40m bgl (51mg/kg).

Lead was detected at a concentration in excess of the adopted AC (310mg/kg) within a sample of Made Ground collected from borehole BH2 at 1.40m bgl (630mg/kg).

Inorganic contaminants were not recorded within any of the other soil samples analysed from beneath the site at concentrations in excess of adopted AC.

5.2.2 PAH

Benzo(b)fluoranthene was detected at concentrations in excess of adopted AC (3.9mg/kg) within samples of Made Ground collected from borehole BH1 at 0.50m bgl (9.1mg/kg) and hand pit HP1 at 0.60m bgl (7.6mg/kg).

Benzo(a)pyrene was detected at concentrations in excess of adopted AC (3.2mg/kg) within samples of Made Ground collected from borehole BH1 at 0.50m bgl (12mg/kg), hand pit HP1 at 0.60m bgl (10mg/kg) and hand pit HP2 at 0.60m bgl (6mg/kg).

Dibenzo(a,h)anthracene was detected at concentrations in excess of adopted AC (0.31mg/kg) within samples of Made Ground collected from borehole BH1 at 0.50m bgl (1.6mg/kg) and hand pits HP1 at 0.60mg/kg (1.3mg/kg), HP2 at 0.60m bgl (0.6mg/kg) and HP3 at 0.20m bgl (0.4mg/kg).

PAH contaminants were not recorded within other soil samples analysed from beneath the site at concentrations in excess of adopted AC.

5.2.3 TPH CWG (incl. BTEX/MTBE)

TPH contaminants were not recorded within soil samples analysed from beneath the site at concentrations in excess of adopted AC.

5.2.4 Other Organic Determinands

Monohydric phenol was not recorded within soil samples analysed from beneath the site at concentrations in excess of the laboratory limit of detection.

5.2.5 Asbestos

Asbestos containing materials (ACMs) were not identified in any of the five soil samples submitted for screening.

5.3 Groundwater Assessment Criteria

Two groundwater samples were collected from monitoring wells BH1 and BH2 installed on site on a single occasion and submitted to a UKAS accredited laboratory for chemical testing.

The preliminary conceptual site model identified a Secondary A Aquifer, relating to Kempton Park Gravel Formation, to be present beneath the site that would be sensitive to contaminants of concern (if present). However, the site does not lie within a groundwater SPZ and there are no licensed groundwater abstractions within 1km of the site. As such, the results of the groundwater analysis have been compared to the Environmental Quality Standards (EQS) for freshwater. Where such values are not available, the UK Drinking Water Standard (DWS) values have been used. Analytical certificates for groundwater samples are presented in Appendix F. A comparison of groundwater analyses to the relevant assessment criteria is summarised below and presented as Appendix G.

The potential risk to on site human health receptors from contaminants of concern in groundwater is not addressed by these screening values.

5.3.1 Inorganic Determinands

No inorganic contaminants were recorded at concentrations in excess of their relevant adopted AC.

5.3.2 PAH

No PAH contaminants were recorded at concentrations in excess of the laboratory limit of detection.

5.3.3 TPH CWG (incl. BTEX/MTBE)

No TPH CWG compounds including BTEX and MTBE were recorded at concentrations in excess of adopted AC.

5.3.4 VOCs

No VOCs were recorded at concentrations in excess of the laboratory limit of detection.

5.3.5 Other Organic Determinands

Monohydric phenol was not recorded at concentrations in excess of the laboratory limit of detection.

6 REVISED CONCEPTUAL SITE MODEL

The UK approach to the management of land contamination through the development process is risk-based, as was formerly implemented by Planning Policy Statement Number 23 (PPS23). PPS23 was formally withdrawn on the 27th March 2012 and replaced by the National Planning Policy Framework.

The Local Authority is likely to have based their strategy for the implementation of the National Planning Policy Framework on the withdrawn PPS23. Therefore, this risk assessment will be based primarily on the withdrawn PPS23, with broad consideration for the contents of the National Planning Policy Framework.

The risk assessment methods adopted by PPS23 reflected those adopted by Part 2A of the Environmental Protection Act (1990). Part 2A identifies that harm to human health and the environment arises not solely from the presence of contaminating substances or ósourcesô, but from their migration along a ópathwayôto where they can impact a ôreceptorô.

The potential pollutant linkages identified as part of the outline CSM have been assessed in light of the findings of the site investigation and are discussed below for each of the individual receptors identified.

6.1 Future Site Users

Concentrations of contaminants of concern, comprising lead, arsenic, benzo(b)fluroanthene, benzo(a)pyrene and dibenzo(a,h)anthracene were recorded within samples of Made Ground analysed from beneath the site at concentrations marginally in excess of adopted AC.

In areas proposed to be covered by hardstanding or the building footprint, the pathways of direct contact and ingestion to future site users will be broken. However, these contaminants may pose a potential risk to future site users within existing and proposed soft landscaped areas. As a minimum, a 300mm validated clean soil layer will be required to break the exposure pathways to future site users from these contaminants in communal landscaped areas.

Volatile contaminants of concern were not recorded within soils and groundwater analysed from beneath the site. Therefore, the vapour inhalation pathway to future site users is not considered to be active.

Elevated concentrations of contaminants of concern were not recorded within groundwater samples collected from beneath the site. Furthermore, groundwater was recorded beneath the site during subsequent monitoring visits at depths in excess of 5.00m bgl. It is therefore considered unlikely that future site users would come into direct contact with potential contaminants within groundwater.

Based on the available information and the recommended mitigation measures being implemented, the potential risk to future site users from concentrations of contaminants of concern detected within soils or groundwater sampled from beneath the site is considered to be **LOW.**

6.2 Off-site Human Health Receptors

Concentrations of contaminants of concern, comprising lead, arsenic, benzo(b)fluroanthene, benzo(a)pyrene and dibenzo(a,h)anthracene were recorded within samples of Made Ground analysed from beneath the site at concentrations marginally in excess of adopted AC. However, following redevelopment of the site, building cover, hardstanding and clean topsoil cover in existing and proposed areas of soft landscaping across the site will limit the potential for air-borne migration of soil or dust to impact neighbouring receptors.

Elevated concentrations of contaminants of concern were not recorded within groundwater samples collected from beneath the site. Furthermore, groundwater was recorded beneath the site during subsequent monitoring visits at depths in excess of 5.00m bgl. It is therefore considered unlikely that neighbouring site users would be at potential risk from contaminants of concern sourced from the site via the dermal contact, ingestion or volatilisation pathways.

Based on the available information, the potential risk to off-site human health receptors from concentrations of contaminants of concern detected within soils sampled from beneath the site is considered to be **LOW.**

6.3 Controlled Waters Receptors

Concentrations of contaminants of concern in excess of their relevant assessment criteria were not recorded within groundwater samples collected from beneath the site.

The potential risk to identified Controlled Waters receptors from concentrations of contaminants of concern detected within groundwater sampled from beneath the site is therefore considered to be **LOW.**

6.4 Structures and Infrastructure

6.4.1 Buildings (on site and off site)

Based on the limited ground gas monitoring undertaken on site as part of the current investigation CIRIA CS1 is applicable to the site, whereby ground gas protection measures are not required.

Therefore, the risk posed by ground gas to human health receptors and infrastructure is considered to be **LOW**.

6.4.2 *Polymeric Utility Pipes*

Elevated concentrations of hydrocarbon contaminants were not recorded within samples collected from soils and groundwater beneath the site. Standard polymeric utility pipes are therefore likely to be suitable for the proposed development. However, the requirements for buried utility pipes should be discussed with service providers before the development stage. The risk posed to buried services is considered to be **LOW**.

6.5 Conceptual Model

The potential source-pathway-receptor linkages and associated risks upon completion of the proposed development at the site, as identified following completion of the assessment, are summarised in the table below.

Table 5 - Revised Conceptual Site Model

Potential Source	Contaminants of Concern	*Via*	Potential Pathways	Linkage Potentially Active?	Receptors
On site – historical: Buildings of an unspecified use in the north of the site, the likely use of the site as railway land and recent light industrial / commercial use of the site. **On site – current:** Made Ground.	Hydrocarbons, metals and asbestos	Soil	Direct contact/ingestion	x	Future site users
			Inhalation of volatiles	x	
			Airborne Migration of soil or dust	x	Off-site users
			Leaching of mobile contaminants	x	Secondary A Aquifer
		Groundwater	Direct contact/ingestion	x x	Future site users Off-site users
			Inhalation of volatiles	x x	Future site users Off-site users
			Vertical and lateral migration in permeable strata	x	Secondary A Aquifer
Off-site – historical: A timber yard, a pulp paper manufacturing works, a commercial printers and a gas works / gas holder depot and works of unspecified use. **Off-site – current:** Railway line, garage / petrol filling station, car showroom and a gas valve compound.	Hydrocarbons, solvents and metals	Groundwater	Direct contact/ingestion	x	Future site users
			Inhalation of volatiles	x	Future site users
On and off-site – Made Ground / natural strata or bio-degradation of contamination.	CO_2, CH_4	Ground Gas	Inhalation of ground gas	x x	Future site users Off-site users
			Explosive risks	x x	Future site users Off-site users

The risk assessment is based upon the available information relating to the site and recommended mitigation measures being implemented. Should ground conditions inconsistent with those outlined in this report be encountered RPS should be contacted to enable further assessment.

7 GEOTECHNICAL ANALYSIS

7.1 Introduction

The proposed development will comprise a part four/part five-storey property, with associated areas of car parking and some areas of soft landscaping. It is understood that the ground floor of the property is proposed to be occupied by office accommodation, with the upper floors as residential apartments. It is understood that the trees present in the south of the site will be retained as part of the proposed development and planting in this area will be enhanced. New trees will be planted along the western boundary of the site and a planted buffer will be located along the eastern boundary. A proposed development plan is included as Figure 2.

This assessment is based on the proposed layout drawings. No preliminary structural loads have been received. Therefore, the preliminary recommendations below will need to be reviewed in light of subsequent detailed design.

7.2 Preliminary Geotechnical Risk Register

The table below summarises the potential geotechnical hazards associated with the development. The table provides an assessment of whether the site is likely to be affected by the hazard and the possible consequences and engineering considerations.

Table 6 – Geotechnical Risk Register

Hazard Description	Is hazard likely to be present / affect the site? (H / M / L / NA?)	Comments / possible engineering requirements where hazard present
Sudden lateral / vertical changes in ground conditions	M	The ground conditions from ground level are generally consistent with Made Ground overlying the Kempton Park Gravel Formation and the London Clay Formation. The main variations in ground conditions (if present) are likely to be associated with the depth and composition of the Made Ground. Running sand conditions are known to be common in the Kempton Park Gravel and may affect the chosen piling solution.
Highly compressible / low bearing capacity soils, (including peat and soft clay)	L/M	Due to the variability and low strength characteristics of the Made Ground, this is not considered to be a suitable bearing stratum for foundations or floor slabs. The Kempton Park Gravel Formation is likely to provide a suitable bearing stratum for traditional or trench fill foundations to support light to moderately loaded structures, up to three storeys in height. However, it is understood that the proposed development is to be up to five storeys in height and it is likely that piled foundations, terminating in the London Clay Formation will control settlement beneath the structure.

Hazard Description	Is hazard likely to be present / affect the site? (H / M / L / NA?)	Comments / possible engineering requirements where hazard present
Ground dissolution features / natural cavities	L	Ground conditions beneath the site are not consistent with this feature.
Shrinking and swelling clays	L	Made Ground and Kempton Park Gravel Formation, present to approximately 7.00m bgl are granular and non-plastic.
Slope stability issues	L	Whilst no significant slopes are present on site, any temporary or permanent slopes created as part of the development should be subject to appropriate geotechnical design based on site-specific site investigation information.
High groundwater table (including waterlogged ground)	L	Groundwater was encountered at depths of approximately 5.90m bgl during subsequent monitoring visits.
Filled and Made Ground (including embankments)	M	Made Ground was encountered to depths of up to approximately 1.80m bgl during intrusive works on site.
Obstructions (including foundations, services, basements, tunnels and adjacent sub-structures)	M/H	The site has been subject to development in the past. However, it is likely that relict foundation and services that may be present should be removed with standard construction plant. A high pressure gas main and fibre optic cables are known to cross the proposed development area. Foundations for the proposed development will need to be designed in order to avoid these and any easement zone specified by the service provider.
Underground mining	L/M	No evidence of gravel extraction was noted on the site as part of the previous desk study review, or subsequent intrusive works.
Concrete classification	L	Testing has indicated a Design Sulphate Class of DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) Classification of AC-1 would be appropriate for all buried concrete structures.
Seismic Activity	L	The Eurocode 8 seismic hazard zoning maps for the UK (Musson and Sargeant, 2007) indicate that horizontal Peak Ground Acceleration (PGA) values with 10% probability of being exceeded in 50 years (475 year return period) are between 0.00 and 0.02g, which is considered very low.

7.3 Foundation Solutions

7.3.1 Piled Foundations

Due to the height and likely high loads imposed by the proposed development, a piled foundation solution is likely to be required in order to support the proposed development. Bored piles, terminating in the deeper layers of the London Clay Formation are likely to be suitable from a geotechnical perspective. Driven piles produce less spoil and can achieve higher end bearing capacities. However, their use may be precluded due to the presence of neighbouring residential properties and high pressure gas main crossing the site. Due to the inherent instability of Made Ground and the Kempton Park Gravel Formation beneath the site and the possibility of borehole collapse due to running sands, continuous flight auger (CFA) piles may not be suitable for the proposed development.

Preliminary anticipated bored pile bearing capacities are detailed in the table, below:

Table 7 - Anticipated Preliminary Bored Pile Capacities (kN)

Pile length (m)	Pile Diameter				
	300mm	450mm	600mm	750mm	900mm
12	240	395	565	755	965
14	320	515	735	975	1240
16	410	655	925	1220	1540
18	510	805	1135	1490	1875
20	620	975	1365	1790	2245

Partial safety factors have been applied to the calculated pile capacities above in accordance with Design Approach 1: Combination 2, as detailed within Tables A.6, A.7 and A.8 of Annex A in BS EN 1997-1. A model factor of 1.4 has also been applied to soil strength properties. This was found to be the most conservative design approach.

Loads are based on single piles only and do not take into account the action of groups of piles. This should be considered at the detailed design stage.

The pile capacity estimates presented above are preliminary and are based on a conservative soil profile derived from exploratory holes undertaken on site. The adopted pile profile is summarised as follows:

Table 8 - Adopted Soil Profile

Stratum	Depth (m bgl)	Bulk Density (kN/m^3)	Shear Strength (kN/m^2)	N_c	Soil/Pile Friction Angle (º)	N_q
Made Ground	Existing ground level to 2.00	18	Not considered			
Kempton Park Gravel	2.00 to 7.00	20	-	-	32	30
London Clay Formation	7.00 to a maximum proven depth of 20.00	20	75 at 7.00, increasing linearly to 225 at 20.00	9	-	-

Due to the variability of the Made Ground, the strength contribution offered by this stratum has been ignored in the pile capacity calculation.

A piling contractor should be consulted with regard to detailed pile design, since the type of pile adopted will affect capacity. An appropriate piling platform should be designed and constructed in accordance with BRE Digest 470 (Working platforms for tracked plant).

7.4 Floor Slabs

It is understood that no basement is proposed beneath new development. In this case, it is likely that ground conditions immediately underlying the floor slab of this structure will comprise Made Ground overlying the Kempton Park Gravel. It is recommended that floor slabs are suspended to avoid excessive total and differential settlement. In this case, settlement of the proposed floor slabs will be controlled by the supporting foundations of the structure. This should be allowed for as part of detailed foundation design.

7.5 Chemical Attack on Buried Concrete

Seven samples of Made Ground, three samples of Kempton Park Gravel Formation and two samples of the London Clay Formation were tested for pH and for sulphate content. The results are presented below:

Table 9 - Results of pH and sulphate testing

Sample Location and Depth (m bgl)	Sample Type	pH	Water Soluble (2:1 extract) sulphate (mg/l)	Design Sulphate Class	ACEC Class
BH1 at 0.50	Made Ground	9.4	39	DS1	AC1
BH1 at 1.00 to 1.20	Made Ground	8.3	30	DS1	AC1
BH1 at 2.00	Kempton Park Gravel	8.6	12	DS1	AC1
BH1 at 2.20 to 2.65	Kempton Park Gravel	8.1	30	DS1	AC1
BH1 at 14.00 to 14.45	London Clay Formation	8.6	38	DS1	AC1
BH2 at 0.70	Made Ground	10.4	63	DS1	AC1
BH2 at 1.40	Made Ground	8.0	39	DS1	AC1
BH2 at 3.20 to 3.65	Kempton Park Gravel	8.5	15	DS1	AC1
BH2 at 9.50 to 9.95	London Clay Formation	8.6	53	DS1	AC1
HP1 at 0.60	Made Ground	8.8	57	DS1	AC1
HP2 at 0.60	Made Ground	8.4	25	DS1	AC1
HP3 at 0.20	Made Ground	7.9	15	DS1	AC1

The data was used to assess appropriate concrete classification for buried concrete in accordance with BRE Special Digest 1, based on the following assumptions:

- Brownfield ground conditions;
- Mobile groundwater conditions; and
- The characteristic value for soluble sulphate has been calculated from the highest 20% of the results, while the characteristic value for pH is taken as the lowest 20% of pH results. The characteristic values are therefore taken as 59mg/l for soluble sulphate and 7.96 for pH value.

Based on the above, it is considered that a Design Sulphate Class of DS-1 and an Aggressive Chemical Environment for Concrete (ACEC) Classification of AC-1 would be appropriate for all buried concrete structures.

7.6 Pavements

At the request of Network Rail, five dynamic cone penetrometer tests were undertaken at locations between existing commercial units on site and the site boundary formed by the railway line (DCP1 to DCP5), prior to the erection of scaffolding in this location (as indicated in Figure 3). Calculated CBR values in the upper 600mm of the Made Ground generally ranged from approximately 2% to 5%.

CBR values obtained are considered to be low and it is recommended that soils are proof rolled and compacted prior to the erection of any temporary structures in this area of the site. Expanded base plates should be adopted for the proposed scaffolding in order to reduce bearing pressures.

7.7 Drainage Infiltration Testing

Falling head tests were undertaken within the monitoring wells installed within boreholes BH1 and BH2, screened within the Kempton Park Gravel Formation. Borehole logs are included within Appendix C.

The falling head tests were proposed to comply fully with the methodology detailed within BS5930:2015. The methodology recommends that the test is repeated three times, with the most conservative result selected as the design infiltration value. An equipment malfunction meant that the second test in borehole BH1 could not be completed.

Test calculations are included within Appendix H and summarised in the table below:

Table 10 – Results of Falling Head Tests

Test Location	Screened Stratum	Response Zone (m bgl)	Test Result 1 (m/s)	Test Result 2 (m/s)	Test Result 3 (m/s)
BH1	Kempton Park Gravel Formation	1.80 to 7.20	7.06×10^{-6}	-	6.52×10^{-6}
BH2	Kempton Park Gravel Formation	1.80 to 7.80	2.56×10^{-6}	2.93×10^{-6}	2.10×10^{-6}

It is recommended that the feasibility of soakaway drainage be confirmed by a specialist drainage engineer.

7.8 Temporary Works and Excavations

The site has been subject to development in the past. However, it is likely that relict foundation and services that may be present should be removed with standard construction plant.

An active high pressure gas main and fibre optic cables are known to cross the proposed development area. Foundations and associated excavations for the proposed development will need to be designed in order to avoid these and any easement zone specified by the service providers.

Groundwater was encountered from depths from 5.90m bgl within the Kempton Park Gravel Formation during monitoring visits. Significant groundwater exclusion/control measures are therefore unlikely to be required during any proposed excavations on site. If perched water is encountered within excavations on site, this may be controlled via pumping from a localised sump.

If perched water is encountered during excavation, degradation of the formation may occur. The formation should therefore be adequately protected from seepages and protected from adverse weather conditions. If the formation layer becomes wet resulting in softening or loosening of the surface materials, then excavation may have to be taken deeper in order to find a suitable bearing layer. Instability of excavations in granular material should be expected, especially during periods of adverse weather. Suitable shoring measures or battering back of slopes may be required for any excavations greater than 1.20m bgl. All temporary excavations should be undertaken in accordance with CIRIA Report 97 ï Trenching Practice.

Groundwater levels are likely to vary seasonally. Additional groundwater monitoring is recommended prior to construction.

8 CONCLUSIONS AND RECOMMENDATIONS

Environmental

The Phase 1 Preliminary Risk Assessment for the site (undertaken by RPS in December 2015) identified a number of potential pollutant linkages to human health receptors associated with the site. A Phase 2 Site Investigation was therefore undertaken to determine whether these linkages were active.

Metals and PAHs were detected within samples of Made Ground collected from beneath the site at concentrations marginally in excess of their adopted AC. Potential risks posed to both on and off-site human health receptors by these concentrations could be mitigated through the placement of a minimum 300mm validated clean soil layer in existing and proposed communal landscaped areas.

Based on the available information, and subject to the recommended mitigation measures being implemented, the potential risk posed to human health receptors from concentrations of contaminants of concern identified within soil sampled from beneath the site is therefore considered to be **LOW**.

Concentrations of contaminants of concern in excess of their relevant assessment criteria were not recorded within groundwater samples collected from beneath the site. The potential risk to Controlled Waters receptors from concentrations of contaminants of concern detected within groundwater sampled from beneath the site is therefore considered to be **LOW.**

Based on the limited ground gas monitoring undertaken on site as part of the current investigation CIRIA CS1 is applicable to the site, whereby ground gas protection measures are not required. Therefore, the risk posed by ground gas to human health receptors and infrastructure is considered to be **LOW**.

Geotechnical

Due to the height and likely high loads imposed by the proposed development, a piled foundation solution is likely to be required in order to support the proposed development. Bored piles, terminating in the deeper layers of the London Clay Formation are likely to be suitable from a geotechnical perspective. Driven piles produce less spoil and can achieve higher end bearing capacities. However, their use may be precluded due to the presence of neighbouring residential properties and high pressure gas main crossing the site. Due to the inherent instability of Made Ground and the Kempton Park Gravel beneath the site and the possibility of borehole collapse due to running sands, CFA piles may not be suitable for the proposed development.

It is understood that no basement is proposed beneath new development. In this case, it is likely that ground conditions immediately underlying the floor slab of this structure will comprise Made Ground

overlying the Kempton Park Gravel. It is recommended that floor slabs are suspended to avoid excessive total and differential settlement. In this case, settlement of the proposed floor slabs will be controlled by the supporting foundations of the structure. This should be allowed for as part of detailed foundation design.

Other Issues

Given its approximately date of construction (pre 1999), it is possible that asbestos containing materials have been used in the construction and/or maintenance of the units located on site. RPS have been informed that an asbestos survey has been undertaken for the site and no asbestos containing materials were encountered. It is recommended that a full asbestos demolition and refurbishment survey is undertaken prior to any demolition works on site.

FIGURES

N

Legend

Site boundary

RPS

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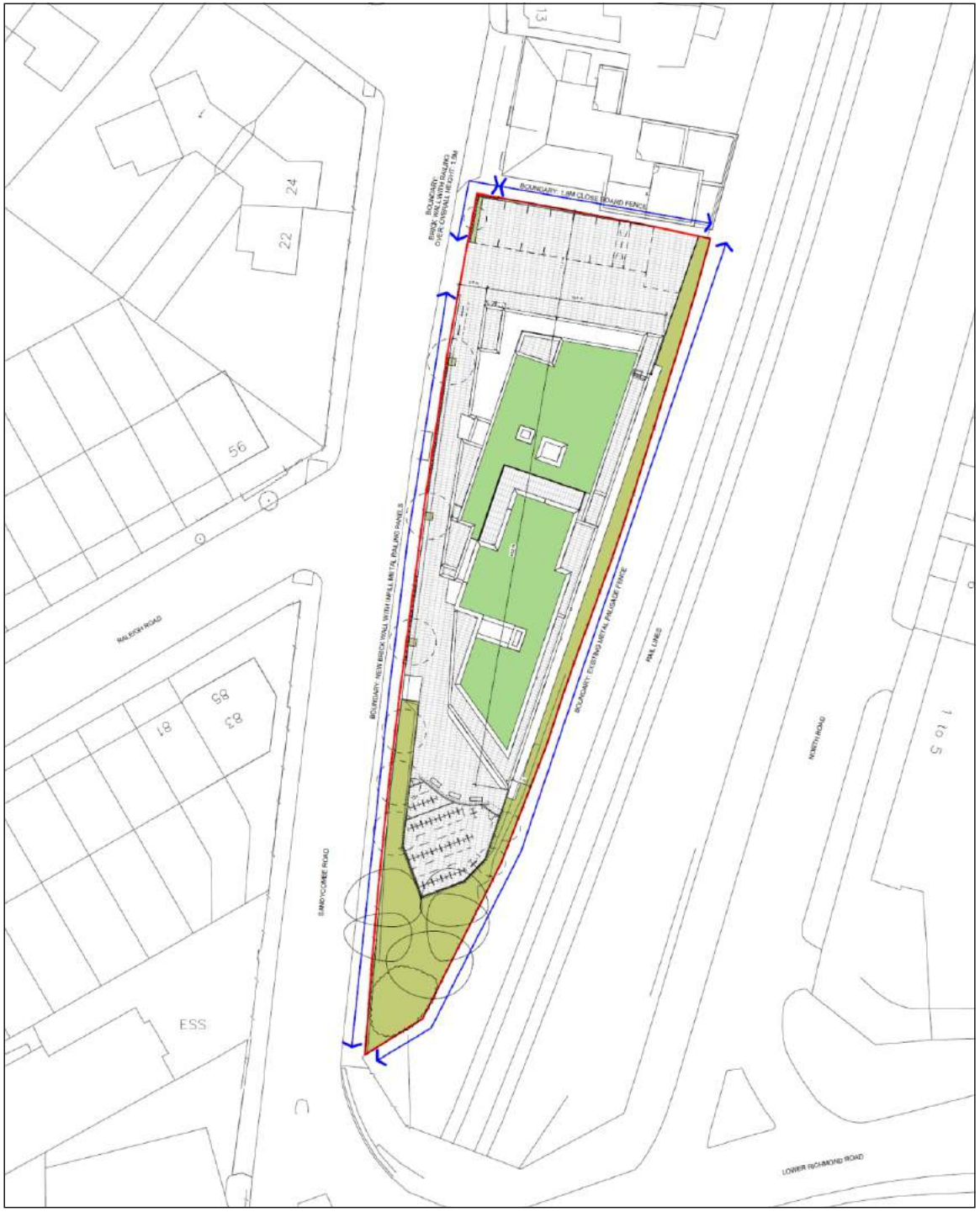
Client: GOLDCREST LAND PLC

Project: 1 TO 9 SANDYCOMBE ROAD

Title: SITE LOCATION PLAN

Job Ref:	Scale:	Date:
HLEI39505	NTS	APR 2016

Figure Number: 1 Rev: 0



Source: Goldcrest Architects (November 2016). *Block Plan - Proposed* (Drawing number P03 050)

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Client: GOLDCREST LAND PLC

Project: 1 TO 9 SANDYCOMBE ROAD

Title: PROPOSED DEVELOPMENT PLAN

Job Ref:	Scale:	Date:
HLEI39505	NTS	NOV 2016

Figure Number: 2 Rev: 2

Legend

- Site boundary
- 20m Borehole Locations
- Hand Pit Location
- High Pressure Gas Main Crossing Site
- BT Duct Crossing Site
- Foul Water Sewer Crossing Site
- Low Pressure Gas Main Entering Site

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Client: GOLDCREST LAND PLC

Project: 1-9 SANDYCOMBE ROAD

Title: EXPLORATORY HOLE LOCATION PLAN

Job Ref:	Scale:	Date:
HLEI34438	NTS	APR 2016

Figure Number: 3 Rev: 1

APPENDIX A

General Notes

RPS HEALTH, SAFETY & ENVIRONMENT

Phase 1 - Environmental Risk Assessment / Desk Study Environmental Review

General Notes

1. A "desk study" means that no site visits have been carried out as any part thereof, unless otherwise specified.
2. This report provides available factual data for the site obtained only from the sources described in the text and related to the site on the basis of the location information provided by the Client.
3. The desk study information is not necessarily exhaustive and further information relevant to the site may be available from other sources.
4. The accuracy of maps cannot be guaranteed and it should be recognised that different conditions on site may have existed between and subsequent to the various map surveys.
5. No sampling or analysis has been undertaken in relation to this desk study.
6. Any borehole data from British Geological Survey sources is included on the basis that: "The British Geological Survey accept no responsibility for omissions or misinterpretation of the data from their Data Bank as this may be old or obtained from non-BGS sources and may not represent current interpretation".
7. Where any data supplied by the Client or from other sources, including that from previous site investigations, have been used it has been assumed that the information is correct. No responsibility can be accepted by RPS for inaccuracies in the data supplied by any other party.
8. This report is prepared and written in the context of an agreed scope of work and should not be used in a different context. Furthermore, new information, improved practices and changes in legislation may necessitate a re-interpretation of the report in whole or in part after its original submission.
9. The copyright in the written materials shall remain the property of the RPS Company but with a royalty-free perpetual licence to the Client deemed to be granted on payment in full to the RPS Company by the Client of the outstanding amounts.
10. The report is provided for sole use by the Client and is confidential to them, their professional advisors, no responsibility whatsoever for the contents of the report will be accepted to any person other than the Client. [Unless otherwise agreed]
11. These terms apply in addition to the RPS HSED "Standard Terms & Conditions" (or in addition to another written contract which may be in place instead thereof) unless specifically agreed in writing. (In the event of a conflict between these terms and the said Standard Terms & Conditions the said Standard Terms & Conditions shall prevail.) In the absence of such a written contract the Standard Terms & Conditions will apply.

RPS HEALTH, SAFETY & ENVIRONMENT

Phase 2 – Site Investigations

General Notes

1. The assessments made in this report are based on the ground conditions as revealed by intrusive investigations, together with the results of any field or laboratory testing or chemical analysis undertaken and other relevant data which may have been obtained including previous site investigations. In any event, ground contamination often exists as small discrete areas of contamination ("hot spots") and there can be no certainty that any or all such areas have been located and/or sampled.

2. There may be special conditions appertaining to the site which have not been taken into account in the report. The assessment may be subject to amendment in the light of additional information becoming available.

3. Where any data supplied by the Client or from other sources, including that from previous site investigations, have been used it has been assumed that the information is correct. No responsibility can be accepted by RPS Companies for inaccuracies within the data supplied by other parties.

4. Whilst the report may express an opinion on possible ground conditions between or beyond trial pit or borehole locations, or on the possible presence of features based on either visual, verbal or published evidence this is for guidance only and no liability can be accepted for the accuracy thereof.

5. Comments on groundwater conditions are based on observations made at the time of the investigation unless otherwise stated. Groundwater conditions may vary due to seasonal or other effects.

6. This report is prepared and written in the context of the agreed scope of work and should not be used in a different context. Furthermore, new information, improved practices and changes in legislation may necessitate a re-interpretation of the report in whole or part after its original submission.

7. The copyright in the written materials shall remain the property of the RPS Company but with a royalty-free perpetual licence to the client deemed to be granted on payment in full to the RPS Company by the client of the outstanding amounts.

8. The report is provided for sole use by the Client and is confidential to them and their professional advisors. No responsibility whatsoever for the contents of the report will be accepted to any person other than the Client.

9. These terms apply in addition to the RPS Group "Standard Terms of Business" (or in addition to another written contract which may be in place instead thereof) unless specifically agreed in writing. (In the event of a conflict between these terms and the said Standard Terms of Business the said Standard Terms of Business shall prevail). In the absence of such a written contract the Standard Terms of Business will apply.

APPENDIX B

Part 2A (The Contaminated Land Regime)

Contaminated Land Definition

Under Section 57 of the Environmental Act 1995, Part 2A was inserted into the Environmental Protection Act 1990 to include provisions for the management of contaminated land.

Subsequent regulations were first implemented in England in April 2000, Scotland in July 2000 and Wales in July 2001[1], providing a definition of "contaminated land" and setting out the nature of liabilities that can be incurred by owners of contaminated land and groundwater.

According to the Act, contaminated land is defined as "any land which appears to the local authority in whose area the land is situated to be in such a condition, by reason of substances in, on or under the land that:

a) *significant harm* is being caused or there is a *significant possibility* of such harm being caused; or
b) *significant pollution* of controlled waters[2] is being caused or there is a significant possibility of such pollution being caused[3]".

The guidance on determining whether a particular possibility is significant is based on the principles of risk assessment and in particular on considerations of the magnitude or consequences of the different types of significant harm caused. The term "possibility of significant harm being caused" should be taken, as referring to a measure of the probability, or frequency, of the occurrence of circumstances that could lead to significant harm being caused.

The following situations are defined where harm is to be regarded as significant:

i. Chronic or acute toxic effect, serious injury or death to humans
ii. Irreversible or other adverse harm to the ecological system
iii. Substantial damage to, or failure of, buildings
iv. Disease, other physical damage or death of livestock or crops
v. The pollution of controlled waters[4].

[1] In England by The Contaminated Land (England) Regulations 2000, updated by The Contaminated Land (England) (Amendment) Regulations 2012; in Scotland by The Contaminated Land (Scotland) Regulations 2000, updated by the Contaminated Land (Scotland) Regulations 2005; and in Wales by The Contaminated Land (Wales) Regulations 2001, updated by the Contaminated Land (Wales) Regulations 2006.

[2] In Scotland the term "controlled waters" has been updated to "water environment" under the Contaminated Land (Scotland) Regulations 2005 in line with the Water Environment and Water Services (Scotland) Act 2003.

[3] The definition was amended in 2012 by implementation of the Water Act 2003.

[4] Groundwater in this context does not include waters within underground strata but above the saturated zone.

With regard to radioactivity, contaminated land is defined as ãany land which appears to be in such a condition, by reason of substances in, on or under the land that harm is being caused, or there is a *significant possibility of such harm being caused*[5]ô

The Risk Assessment Methodology

Risk assessment is the process of collating known information on a hazard or set of hazards in order to estimate actual or potential risks to receptors. The receptor may be humans, a water resource, a sensitive local ecosystem or future construction materials. Receptors can be connected with the hazard via one or several exposure pathways (e.g. the pathway of direct contact). Risks are generally managed by isolating or removing the hazard, isolating the receptor, or by intercepting the exposure pathway. Without the three essential components of a source (hazard), pathway and receptor, there can be no risk. Thus, the mere presence of a hazard at a site does not mean that there will necessarily be attendant risks.

The Risk Assessment

By considering where a viable pathway exists which connects a source with a receptor, this assessment will identify where pollutant linkages may exist. A pollutant linkage is the term used by the DEFRA in their standard procedure on risk assessment. If there is no pollutant linkage, then there is no risk. Therefore, only where a viable pollutant linkage is established does this assessment go on to consider the level of risk. Risk should be based on a consideration of both:

- The likelihood of an event (probability) - takes into account both the presence of the hazard and receptor and the integrity of the pathway.
- The severity of the potential consequence - takes into account both the potential severity of the hazard and the sensitivity of the receptor.

For further information please see the Contaminated Land section on the DEFRA website (www.defra.gov.uk).

[5] The Radioactive Contaminated Land (Modification of Enactments) (England) Regulations 2006 and Contaminated Land (Wales) Regulations 2006.

APPENDIX C

Exploratory Hole Logs

BOREHOLE LOG

Borehole No. **BH1**

Sheet 1 of 2

Project Name:	1 to 9 Sandycombe Road	Co-ordinates:	Date(s): 21/03/2016 - 22/03/2016			Hole Type:
Project No:	HLEI34438	Easting:	Drilling Method:			CP
Location:	North Sheen	Northing:	D150	Casing Diameter (mm) 150	Casing Depth (m) 7.80	Scale: 1:50
Client:	Goldcrest Land Plc	Ground Level (mAOD):	Logged By: RB			

Well	Water Strike(s)	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
					0.00	(0.15)			Tarmacadam.	
					0.15				(TARMACADAM)	
		0.50	ES						Very loose brown gravelly fine to medium sand. Gravel is angular to rounded fine flint with red and yellow brick and concrete fragments. (MADE GROUND)	
		0.50	PID1	0.0ppm						
		1.00	PID2	0.0ppm		(1.65)				1
		1.20	SPT(S)	N=2 (1,0/1,0,1,0)						
		1.20 - 1.65	B							
		1.50	PID3	0.0ppm						
					1.80				Medium dense orange brown/brown gravelly fine to medium SAND. Gravel is angular to rounded fine to medium flint. Becoming orange brown from 2.00m bgl. (KEMPTON PARK GRAVEL FORMATION)	
		2.00	ES							2
		2.00	PID4	0.0ppm						
		2.20	SPT(C)	N=28 (5,5/6,7,7,8)						
		2.20 - 2.65	B							
		3.00	PID5	0.0ppm		(2.20)				3
		3.20	SPT(C)	N=30 (3,3/5,8,8,9)						
		4.00	PID6	0.0ppm	4.00				Dense orange brown very sandy subangular to rounded fine to medium flint GRAVEL. Sand fraction is fine to medium. (KEMPTON PARK GRAVEL FORMATION)	4
		4.20	SPT(C)	N=39 (6,10/12,8,9,10)						
		5.00	PID7	0.0ppm		(1.20)				5
		5.20	SPT(C)	N=14 (4,5/4,3,3,4)	5.20				Medium dense orange brown gravelly fine to coarse SAND. Gravel is angular to rounded fine to medium flint. (KEMPTON PARK GRAVEL FORMATION)	
		5.20 - 5.65	B							
		6.00	PID8	0.0ppm		(1.80)				6
		6.50	SPT(C)	N=10 (1,2/2,3,2,3)						
		7.00	PID9	0.0ppm	7.00				High strength becoming very high strength grey slightly silty CLAY with rare rounded fine claystone gravel. (LONDON CLAY FORMATION)	7
		8.00	PID10	0.0ppm						8
		9.00	PID11	0.0ppm						9
		9.50	SPT(S)	N=21 (1,3/4,5,6,6)						
		10.00	PID12	0.0ppm					Continued on next sheet	10

Remarks

1. No groundwater encountered during drilling. 2. Standpipe installed to screen from 1.80m to 7.20m bgl. 3. Borehole finished with a traffic proof cover flush to ground level.

Groundwater			Chiselling		
Depth Strike (m)	Depth Casing (m)	Level After 20 Mins	Duration (hh:mm)	Top Depth (m)	Base Depth (m)

BOREHOLE LOG

Borehole No. **BH1**

Sheet 2 of 2

Project Name:	1 to 9 Sandycombe Road	Co-ordinates:	Date(s): 21/03/2016 - 22/03/2016		Hole Type:
Project No:	HLEI34438	Easting:	Drilling Method:		CP
Location:	North Sheen	Northing:	D150	Casing Diameter (mm): 150 / Casing Depth (m): 7.80	Scale: 1:50
Client:	Goldcrest Land Plc	Ground Level (mAOD):	Logged By: RB		

Well	Water Strike(s)	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
		10.50	ES							
		11.00	PID13	0.0ppm						11
		12.00	PID14	0.0ppm						12
		12.50	SPT(S)	N=30 (3,4/5,8,8,9)					*Band of claystone.*	
		13.00	PID15	0.0ppm						13
		14.00	PID16	0.0ppm						14
		15.00	PID17	0.0ppm		(13.00)				15
		15.50	SPT(S)	N=37 (4,6/6,9,10,12)						
		16.00	PID18	0.0ppm						16
		17.00	PID19	0.0ppm						17
		18.00	PID20	0.0ppm						18
		18.50	SPT(S)	50 (4,6/50 for 260mm)						
		19.00	PID21	0.0ppm						19
		20.00	PID22	0.0ppm					End of Borehole at 20.00m	20

Remarks

1. No groundwater encountered during drilling. 2. Standpipe installed to screen from 1.80m to 7.20m bgl. 3. Borehole finished with a traffic proof cover flush to ground level.

Groundwater			Chiselling		
Depth Strike (m)	Depth Casing (m)	Level After 20 Mins	Duration (hh:mm)	Top Depth (m)	Base Depth (m)

BOREHOLE LOG

Borehole No. **BH2**

Sheet 1 of 2

Project Name:	1 to 9 Sandycombe Road	Co-ordinates:	Date(s): 22/03/2016			Hole Type:
Project No:	HLEI34438	Easting:	Drilling Method:	Pipe Diameter: 50mm		CP
Location:	North Sheen	Northing:	D150	Casing Diameter (mm) 150	Casing Depth (m) 8.40	Scale: 1:50
Client:	Goldcrest Land Plc	Ground Level (mAOD):	Logged By: RB			

Well	Water Strike(s)	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
					0.00	(0.09) (0.05) (0.05)			Brick paviour. (MADE GROUND)	
		0.25	ES		0.09	(0.13)			Yellowish brown fine to medium sand. (MADE GROUND)	
		0.50	PID1	0.0ppm	0.14	(0.18)			Red brick fragments. (MADE GROUND)	
					0.19	(0.10)			Dark brown/brown/black gravelly fine to medium sand. Gravel is angular to subangular fine to medium flint with red brick and tarmacadam fragments. (MADE GROUND)	
		1.00	PID2	0.3ppm	0.32				Brown gravelly fine to medium sand. Gravel is angular to subrounded fine to medium flint with red and yellow brick fragments. (MADE GROUND)	
		1.20	SPT(S)	N=8 (1,1/2,2,2,2)	0.50				Concrete. (CONCRETE)	
		1.40	ES		0.60	(0.75)			Loose brown gravelly fine to medium sand. Gravel is angular to subrounded fine to medium flint with red and yellow brick fragments. (MADE GROUND)	
		1.50	PID3	0.2ppm	1.35	(0.25)			Loose black very ashy gravelly fine to medium sand. Gravel is angular to subrounded fine to medium flint with red and yellow brick fragments and rare slate fragments. (MADE GROUND)	
					1.60	(0.20)			Low strength brown/orange brown/black ashy gravelly very sandy clay. Gravel is angular to subangular fine to medium flint with red brick fragments. Sand fraction is fine to medium. (MADE GROUND)	
		2.00	PID4	0.0ppm	1.80				Dense becoming medium dense becoming dense orange brown very sandy angular to rounded fine to medium flint GRAVEL. Sand fraction is fine to medium. (KEMPTON PARK GRAVEL FORMATION)	
		2.20	SPT(C)	N=36 (4,6/8,9,9,10)						
		3.00	PID5	0.0ppm						
		3.20	SPT(C)	N=23 (2,3/5,5,6,7)						
		3.50	ES							
		4.00	PID6	0.0ppm		(4.20)				
		4.20	SPT(C)	N=33 (5,7/7,8,9,9)						
		5.00	PID7	0.0ppm						
		5.20	SPT(C)	N=36 (4,6/8,9,9,10)						
		6.00	PID8	0.0ppm	6.00				Medium dense orange brown gravelly fine to coarse SAND. Gravel is angular to rounded fine to medium flint. (KEMPTON PARK GRAVEL FORMATION)	
		6.50	SPT(C)	N=14 (2,2/3,5,4,2)		(1.40)				
		7.00	PID9	0.0ppm						
					7.40	(0.10)			Medium dense orange brown/grey slightly sandy silty CLAY. Sand fraction is fine. (KEMPTON PARK GRAVEL FORMATION)	
					7.50				High strength grey silty CLAY. (LONDON CLAY FORMATION)	
		8.00	PID10	0.0ppm						
		8.00	SPT(S)	N=19 (2,3/4,4,5,6)						
		8.80	ES							
		9.00	PID11	0.0ppm						
		10.00	PID12	0.0ppm					Continued on next sheet	

Remarks

1. No groundwater encountered during drilling. 2. Standpipe installed to screen from 1.80m to 7.0m bgl. 3. Borehole finished with a traffic proof cover flush to ground level.

Groundwater			Chiselling		
Depth Strike (m)	Depth Casing (m)	Level After 20 Mins	Duration (hh:mm)	Top Depth (m)	Base Depth (m)

BOREHOLE LOG

Borehole No. **BH2**

Sheet 2 of 2

Project Name:	1 to 9 Sandycombe Road	Co-ordinates:	Date(s): 22/03/2016			Hole Type:
Project No:	HLEI34438	Easting:	Drilling Method:	Pipe Diameter: 50mm		CP
Location:	North Sheen	Northing:	D150	Casing Diameter (mm)	Casing Depth (m)	Scale:
Client:	Goldcrest Land Plc	Ground Level (mAOD):	Logged By: RB	150	8.40	1:50

Well	Water Strike(s)	Samples & In Situ Testing			Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results						
		11.00	PID13	0.0ppm						11
		11.00	SPT(S)	N=28 (3,4/6,6,7,9)						
		12.00	PID14	0.0ppm						12
									Band of claystone recovered as grey angular to subangular fine to coarse gravel.	
		13.00	PID15	0.0ppm						13
		14.00	PID16	0.0ppm						14
		14.00	SPT(S)	N=32 (3,5/7,8,8,9)						
		15.00	PID17	0.0ppm		(12.50)				15
		16.00	PID18	0.0ppm						16
		17.00	PID19	0.0ppm						17
		17.00	SPT(S)	N=35 (4,6/8,8,9,10)						
		18.00	PID20	0.0ppm						18
		19.00	PID21	0.0ppm						19
		20.00	PID22	0.0ppm						20
									End of Borehole at 20.00m	

Remarks

1. No groundwater encountered during drilling. 2. Standpipe installed to screen from 1.80m to 7.0m bgl. 3. Borehole finished with a traffic proof cover flush to ground level.

Groundwater			Chiselling		
Depth Strike (m)	Depth Casing (m)	Level After 20 Mins	Duration (hh:mm)	Top Depth (m)	Base Depth (m)

HAND DUG PIT LOG

Pit No. **HP1**

Sheet 1 of 1

Project Name: 1 to 9 Sandycombe Road	Co-ordinates:	Date(s): 23/03/2016		Hole Type:
Project No: HLEI34438	Easting:	Equipment:		HDP
Location: North Sheen	Northing:	Hand dug pit	Pit Length: 0.42 m	Scale:
Client: Goldcrest Land Plc	Ground Level (mAOD):	Logged By: RB	Pit Width: 0.40 m	1:25

Backfill	Water Strike(s)	Samples & In Situ Testing			Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results						
					0.00	(0.08)			Tarmacadam. (TARMACADAM)	
					0.08	(0.04)				
		0.20	ES		0.12				Red brick fragments. (MADE GROUND)	
		0.20	PID1	0.0ppm		(0.23)				
					0.35				Light brown gravelly fine to medium sand. Gravel is angular to rounded fine to medium flint with red and yellow brick and concrete fragments. (MADE GROUND)	
		0.60	ES							
		0.60	PID2	0.0ppm		(0.58)			Brown gravelly fine to medium sand. Gravel is angular to subrounded fine to medium flint with abundant red and yellow brick, concrete and occasional tarmacadam fragments. (MADE GROUND)	
									End of Pit at 0.93m	

1
2
3
4
5

Remarks: 1. No groundwater encountered. 2. Hand pit backfilled with arisings.

Groundwater:

Stability:

AGS

HAND DUG PIT LOG

Pit No. **HP2**

Sheet 1 of 1

Project Name:	1 to 9 Sandycombe Road	Co-ordinates:	Date(s): 23/03/2016		Hole Type:
Project No:	HLEI34438	Easting:	Equipment:		HDP
Location:	North Sheen	Northing:	Hand dug pit	Pit Length: 0.35 m	Scale:
Client:	Goldcrest Land Plc	Ground Level (mAOD):	Logged By: RB	Pit Width: 0.50 m	1:25

Backfill	Water Strike(s)	Samples & In Situ Testing			Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results						
					0.00				Brown gravelly fine sand. Gravel is angular to rounded fine to medium flint with rare red brick and ceramic fragments and rootlets. (MADE GROUND)	
		0.20 0.20	ES PID1	0.0ppm		(0.40)				
					0.40				Brown slightly reddish brown gravelly fine sand. Gravel is angular to rounded fine to medium flint with red and yellow brick fragments, occasional slate and concrete fragments, rare barbed wire and rootlets. (MADE GROUND)	
		0.60 0.60	ES PID2	0.0ppm		(0.70)				
									End of Pit at 1.10m	

1
2
3
4
5

Remarks: 1. No groundwater encountered. 2. Hand pit backfilled with arisings.

Groundwater:

Stability:

HAND DUG PIT LOG

Pit No. **HP3**

Sheet 1 of 1

Project Name:	1 to 9 Sandycombe Road	Co-ordinates:	Date(s): 23/03/2016	Hole Type:
Project No:	HLEI34438	Easting:	Equipment:	HDP
Location:	North Sheen	Northing:		Scale:
Client:	Goldcrest Land Plc	Ground Level (mAOD):	Logged By:	1:25

Backfill	Water Strike(s)	Samples & In Situ Testing			Depth (mbGL)	Thickness (m)	Level (mAOD)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results						
					0.00				Dark brown gravelly fine sand. Gravel is subrounded to rounded fine to medium flint with concrete fragments and rootlets. (MADE GROUND)	
		0.20 0.20	ES PID1	0.0ppm		(0.30)				
					0.30				Brown/orange brown gravelly fine sand. Gravel is subrounded to rounded fine to medium flint with concrete fragments and rootlets. (MADE GROUND)	
		0.60 0.60	ES PID2	0.0ppm		(0.70)				
									End of Pit at 1.00m	1
										2
										3
										4
										5

Remarks: 1. No groundwater encountered. 2. Hand pit backfilled with arisings.

Groundwater:

Stability:

APPENDIX D

Geotechnical Laboratory Certificates

LABORATORY REPORT

4043

Contract Number: PSL16/1426

Report Date: 18 April 2016

Client's Reference:

Client Name: RPS Health, Safety and Environment
14 Cornhill
London
EC3V 3ND

For the attention of: Rob Philip

Contract Title: 1 to 9 Sandycombe Road, Richmond

Date Received: 30/03/2016
Date Commenced: 30/03/2016
Date Completed: 18/04/2016

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. 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 in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson (Director)
A Watkins (Director)
L Knight (Senior Technician)

D Lambe (Senior Technician)
S Royle (Senior Technician)

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SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH1		B	1.00	1.20	MADE GROUND brown very gravelly clayey silty sand.
BH1		B	2.20	2.65	Brown very sandy slightly silty GRAVEL.
BH1		B	8.00	8.45	Brown CLAY.
BH1		U	11.00		Stiff brown CLAY.
BH1		U	14.00	14.45	Very stiff brown CLAY.
BH2		B	0.70		MADE GROUND brown very sandy slightly clayey silty gravel.
BH2		B	3.20	3.65	Brown slightly silty SAND & GRAVEL.
BH2		U	9.50	9.95	Stiff brown CLAY.
BH2		U	12.50	12.95	Very stiff brown CLAY.
BH2		U	18.50	18.95	Very stiff brown CLAY.

UKAS TESTING
4043

PSL
Professional Soils Laboratory

Checked / Approved		Date	18/04/16	Contract No:
1 to 9 Sandycombe Road, Richmond				PSL16/1426
				Client Ref:

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
BH1		B	8.00	8.45	29			73	30	43	100	Very high plasticity CV.
BH1		U	14.00	14.45	27			77	31	46	100	Very high plasticity CV.
BH2		U	9.50	9.95	28			71	29	42	100	Very high plasticity CV.
BH2		U	12.50	12.95	25			74	30	44	100	Very high plasticity CV.
BH2		U	18.50	18.95	26			76	30	46	100	Very high plasticity CV.

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

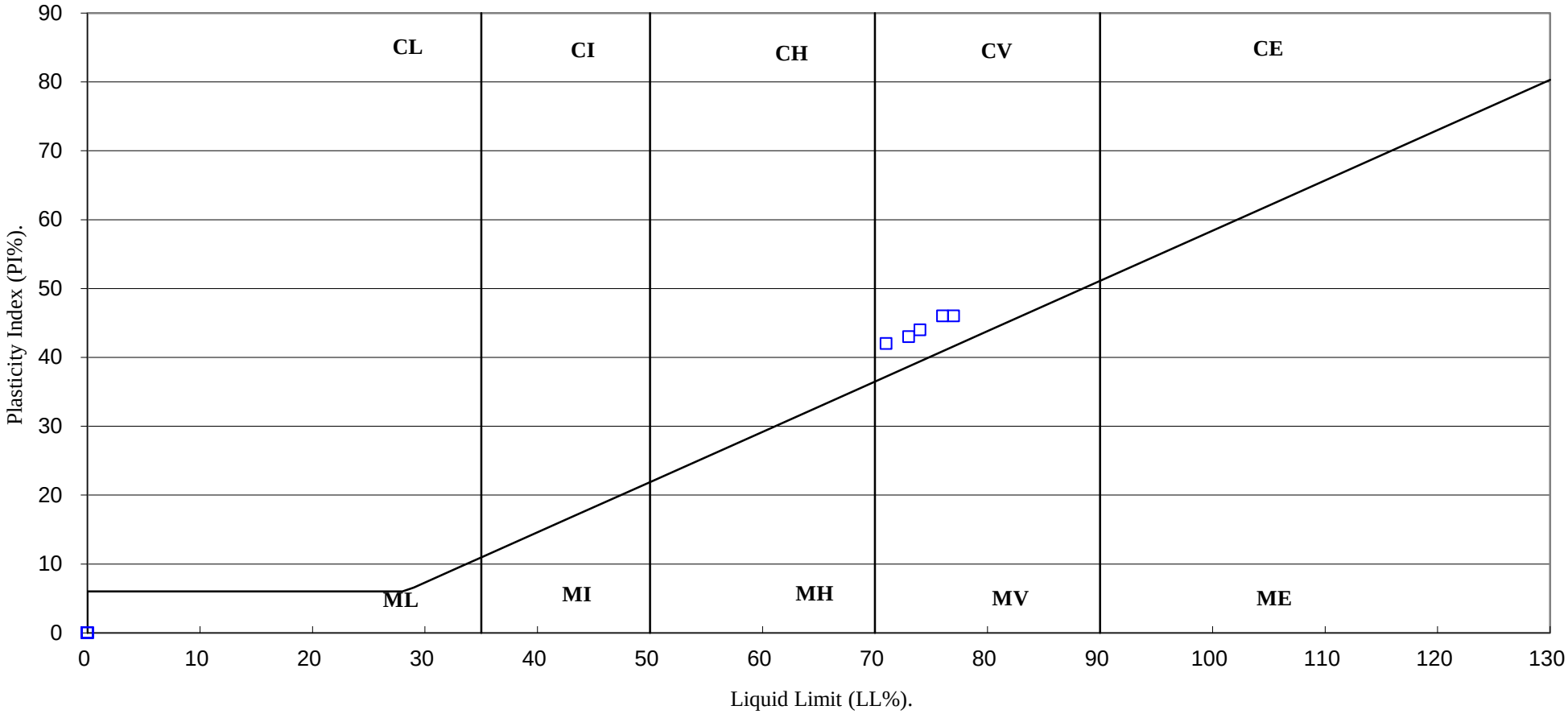
UKAS TESTING 4043

PSL Professional Soils Laboratory

Checked / Approved		Date	18/04/16	Contract No:
1 to 9 Sandycombe Road, Richmond				PSL16/1426
				Client Ref:

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.

(BS5930 :2015)



UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked /Approved**		**Date**	**18/04/16**	**Contract No:**
		1 to 9 Sandycombe Road, Richmond				**PSL16/1426**
						Client Ref:

PARTICLE SIZE DISTRIBUTION TEST

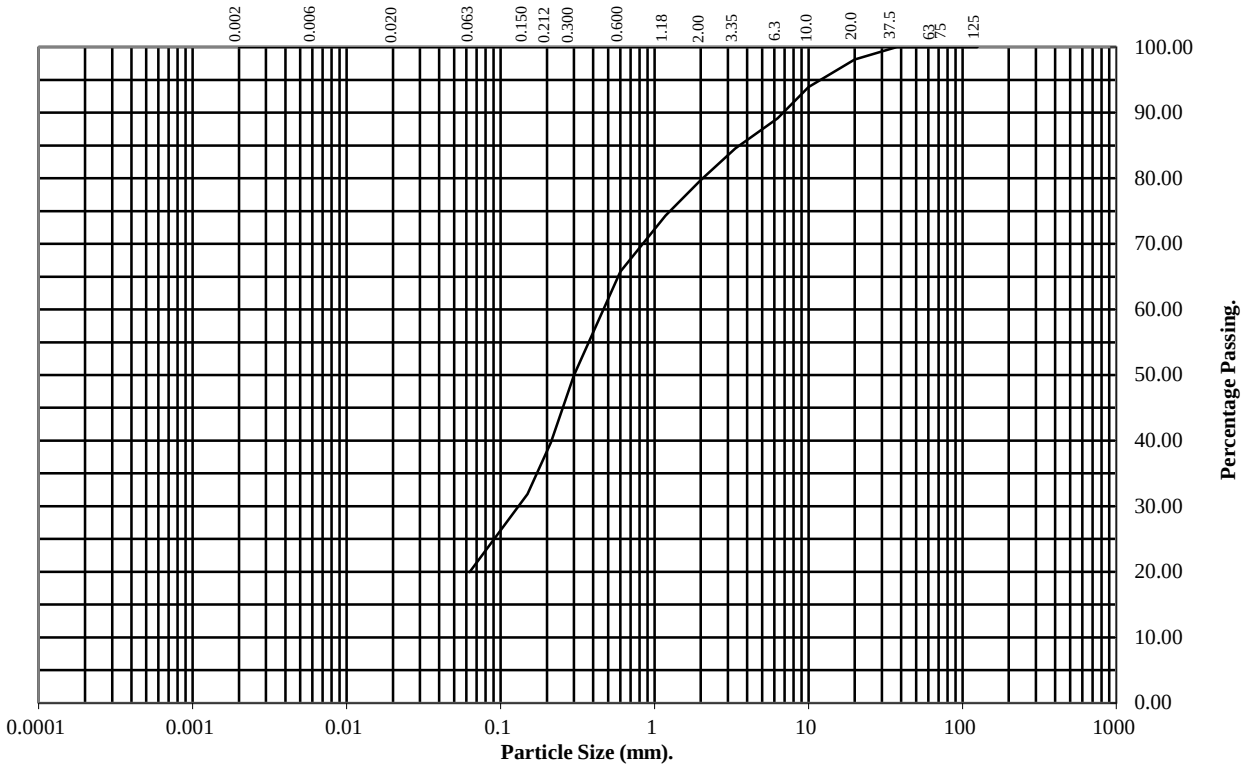
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH1** **Top Depth (m):** **1.00**

Sample Number: **Base Depth(m):** **1.20**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	98
10	94
6.3	89
3.35	85
2	80
1.18	74
0.6	66
0.3	50
0.212	40
0.15	32
0.063	20

Soil Fraction	Total Percentage
Cobbles	0
Gravel	20
Sand	60
Silt/Clay	20

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 18/04/16	**Contract No:** PSL16/1426
		1 to 9 Sandycombe Road, Richmond		**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

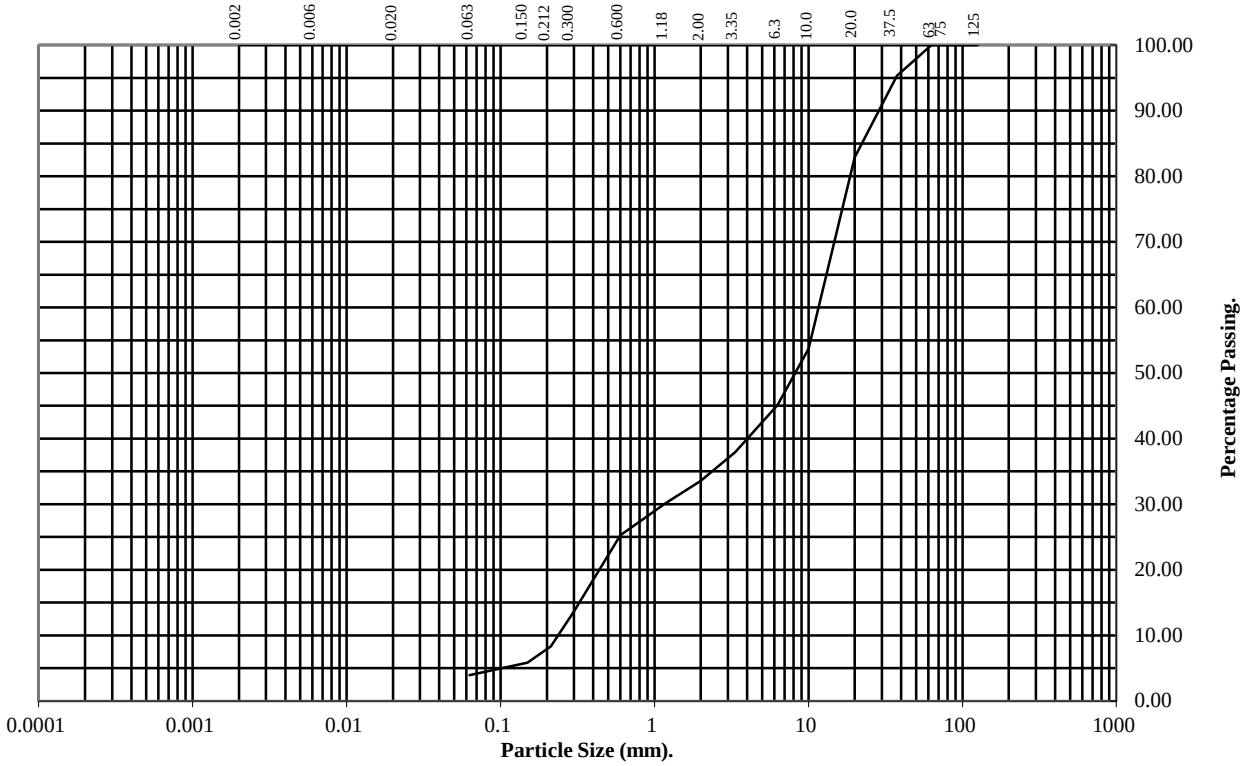
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH1** **Top Depth (m):** **2.20**

Sample Number: **Base Depth(m):** **2.65**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	95
20	83
10	54
6.3	45
3.35	38
2	34
1.18	30
0.6	25
0.3	14
0.212	8
0.15	6
0.063	4

Soil Fraction	Total Percentage
Cobbles	0
Gravel	66
Sand	30
Silt/Clay	4

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** **18/04/16**	**Contract No:** **PSL16/1426**
		1 to 9 Sandycombe Road, Richmond			**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

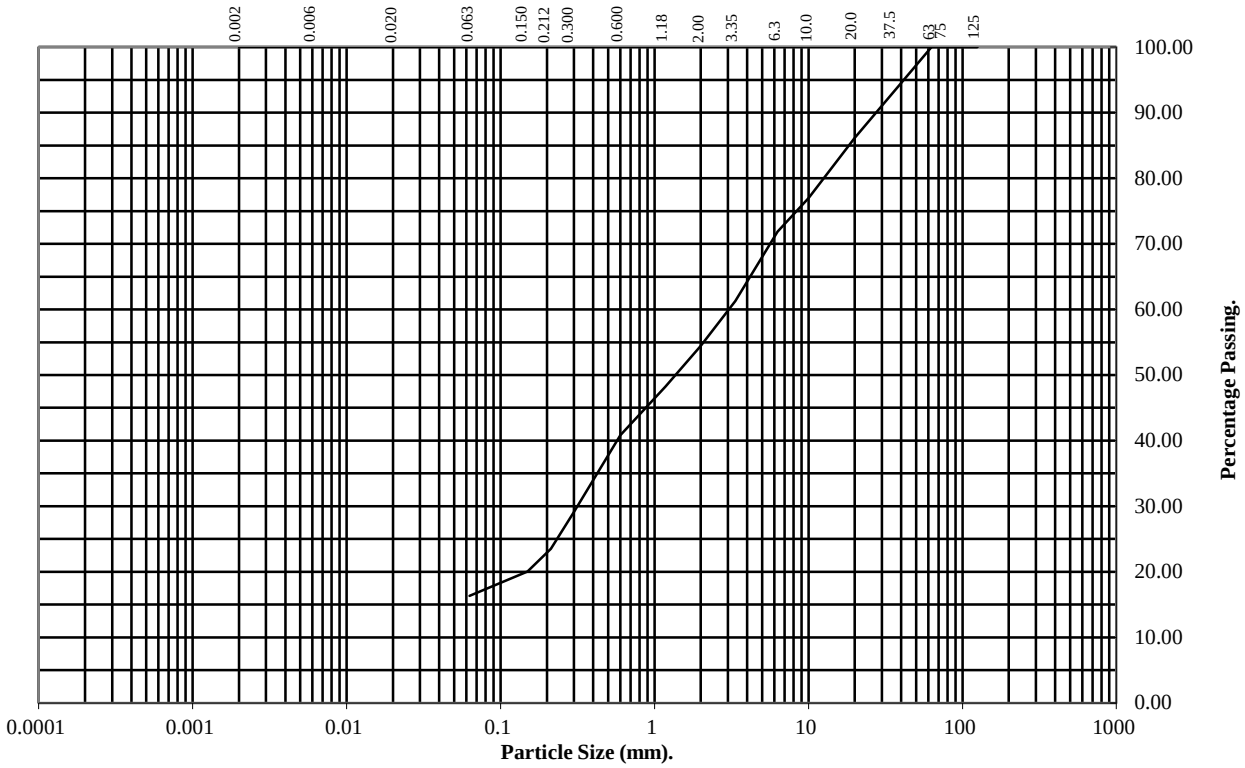
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH2** **Top Depth (m):** **0.70**

Sample Number: **Base Depth(m):**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	94
20	86
10	77
6.3	72
3.35	61
2	54
1.18	48
0.6	41
0.3	29
0.212	23
0.15	20
0.063	16

Soil Fraction	Total Percentage
Cobbles	0
Gravel	46
Sand	38
Silt/Clay	16

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date** 18/04/16	**Contract No:** PSL16/1426
		1 to 9 Sandycombe Road, Richmond		**Client Ref:**

PARTICLE SIZE DISTRIBUTION TEST

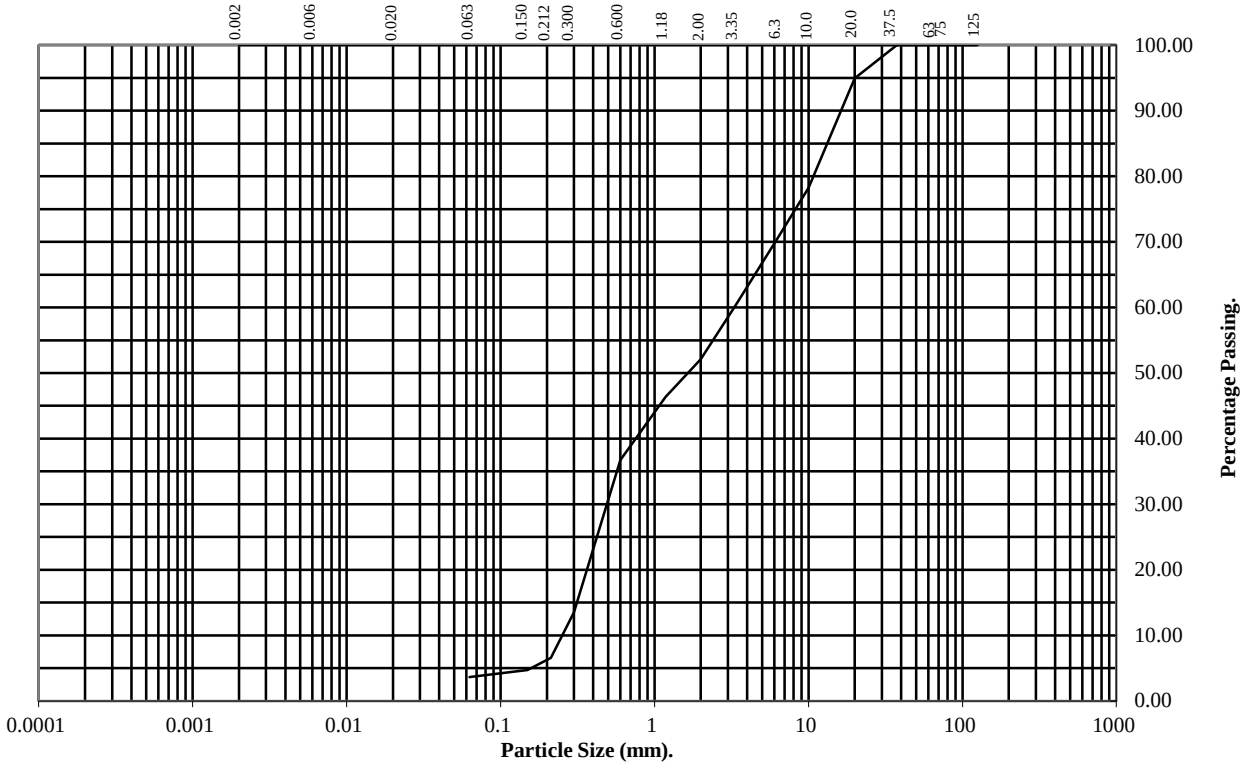
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: **BH2** **Top Depth (m):** **3.20**

Sample Number: **Base Depth(m):** **3.65**

Sample Type: **B**



BS Test Sieve	Percentage Passing
125	100
75	100
63	100
37.5	100
20	95
10	78
6.3	71
3.35	60
2	52
1.18	46
0.6	37
0.3	13
0.212	7
0.15	5
0.063	4

Soil Fraction	Total Percentage
Cobbles	0
Gravel	48
Sand	48
Silt/Clay	4

Remarks:

See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**		**Date** **18/04/16**	**Contract No:** **PSL16/1426**
		1 to 9 Sandycombe Road, Richmond			**Client Ref:**

ONE DIMENSIONAL CONSOLIDATION TEST

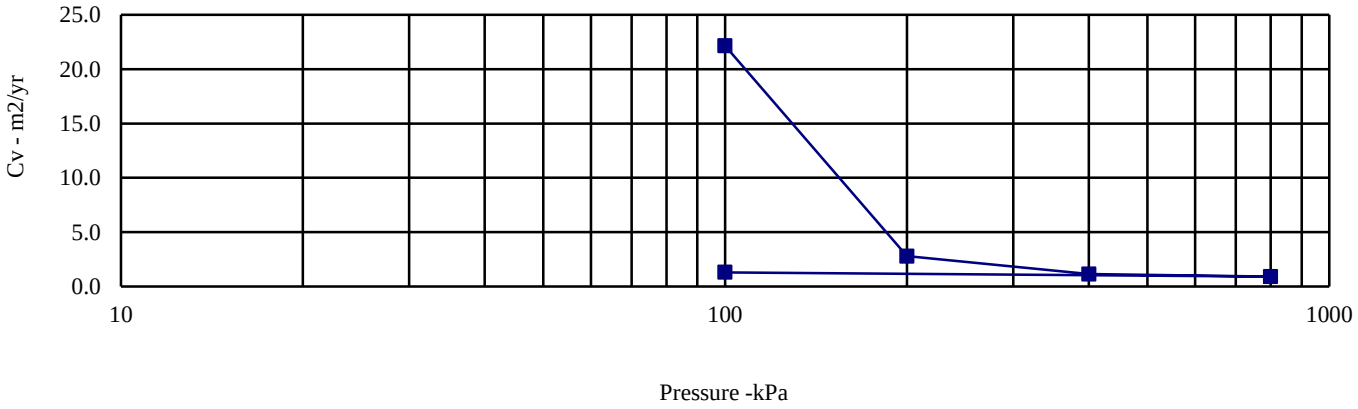
BS 1377: Part 5: 1990: Clause 3

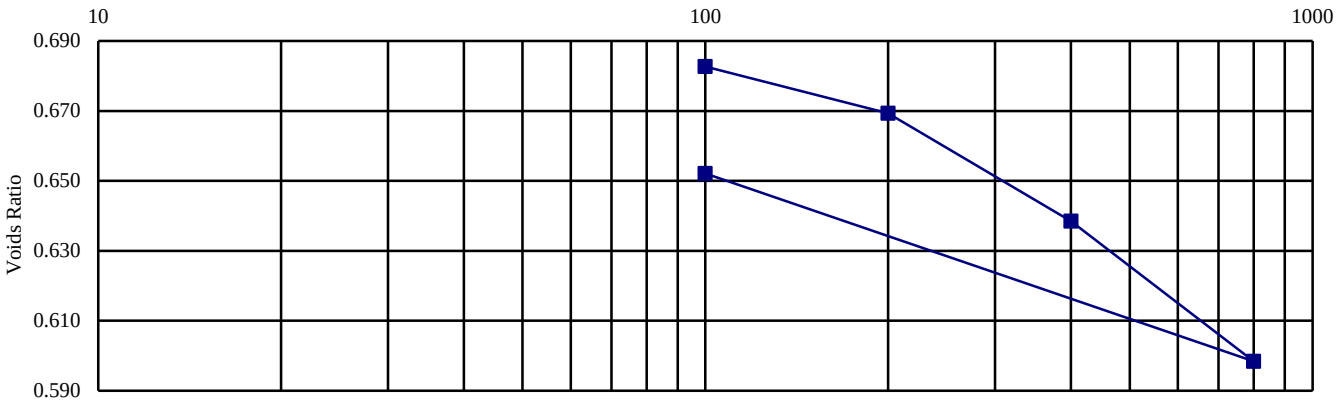
Hole Number: **BH1** **Top Depth (m):** **11.00**

Sample Number: **Base Depth (m) :**

Sample Type: **U**

Initial Conditions		Pressure Range kPa		Mv m2/MN	Cv m2/yr	Specimen location within tube:	Top
Moisture Content (%):	26						
Bulk Density (Mg/m3):	1.96	0	100	0.078	22.141	Method used to	
Dry Density (Mg/m3):	1.56	100	200	0.079	2.794	determine CV:	T90
Voids Ratio:	0.696	200	400	0.093	1.143	Nominal temperature	
Degree of saturation:	97.9	400	800	0.061	0.914	during test ' C:	20
Height (mm):	20.092	800	100	0.048	1.308	Remarks:	
Diameter (mm)	75.06					See summary of soils description.	
Particle Density (Mg/m3): Assumed	2.65						





UKAS TESTING 4043 / PSL Professional Soils Laboratory	Checked / Approved	Date	18/04/16	Contract No: PSL16/1426
	1 to 9 Sandycombe Road, Richmond			Client Ref:

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

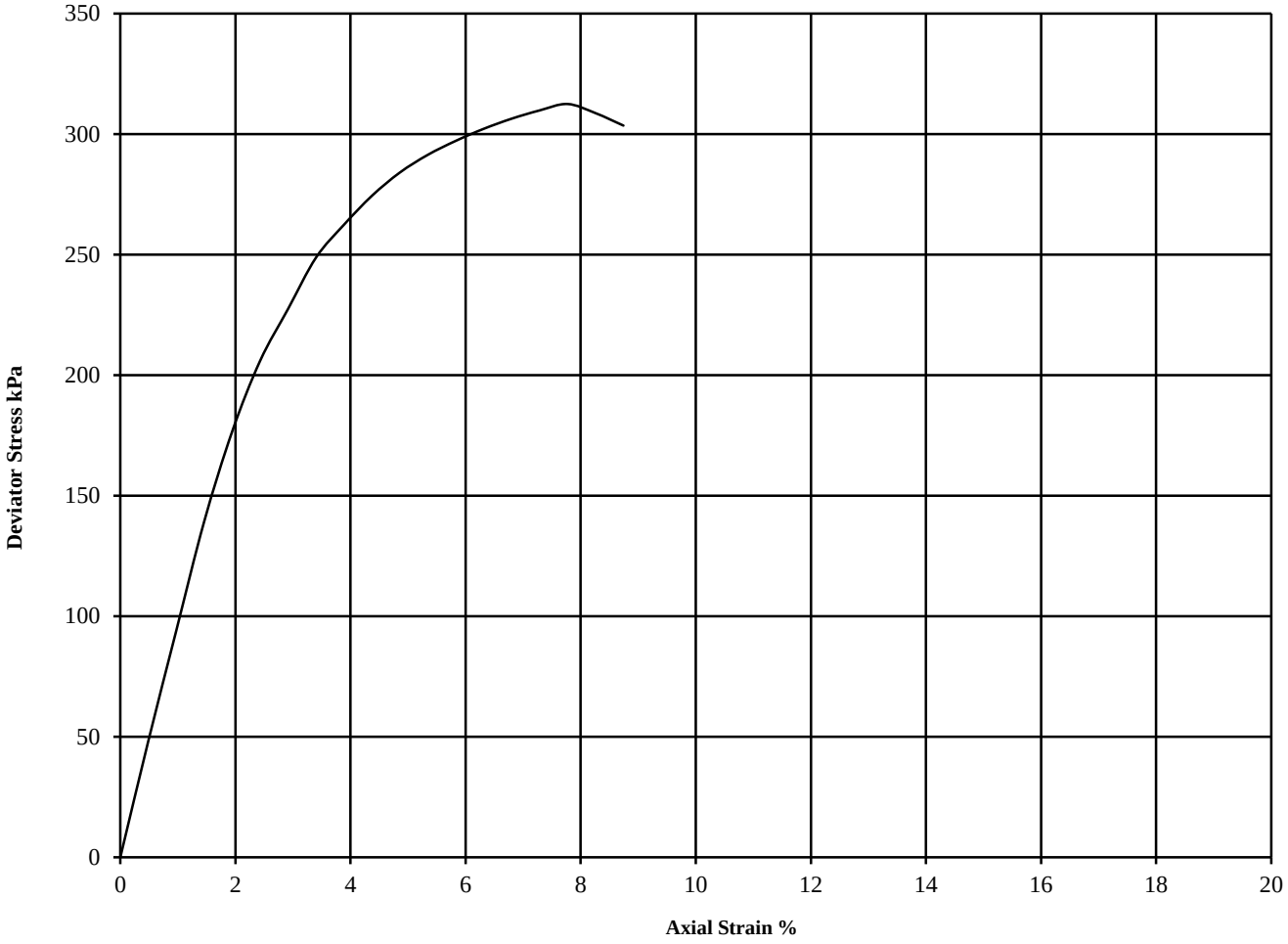
WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: **BH1** **Top Depth (m):** **11.00**

Sample Number: **Base Depth (m):**

Sample Type **U**



Diameter (mm):		102.0	Height (mm):		210.0	Test:	UU Single Stage		Remarks
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa) θ_3	Corr. Max. Deviator Stress (kPa) $(\theta_1-\theta_3)_f$	Shear Strength Cu (kPa) $^1/_2(\theta_1-\theta_3)_f$	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.36
1	27	2.01	1.59	220	312	156	7.8	Brittle	See summary of soil descriptions.

UKAS TESTING 4043

PSL Professional Soils Laboratory

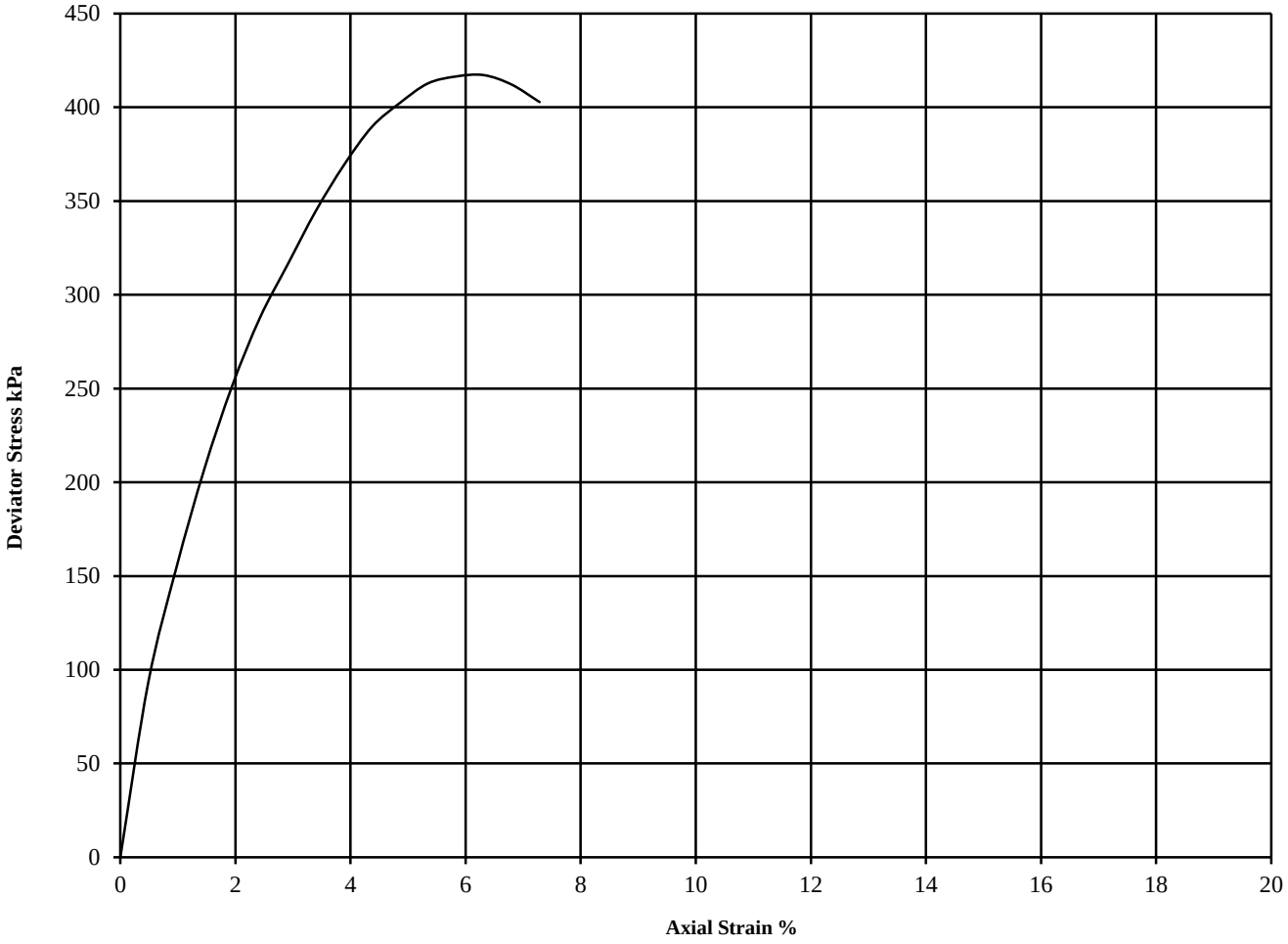
Checked / Approved		Date	18/04/16	Contract No:
1 to 9 Sandycombe Road, Richmond				PSL16/1426
				Client Ref:

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number:	**BH1**	**Top Depth (m):**	**14.00**
Sample Number:		**Base Depth (m):**	**14.45**
Sample Type	**U**		



Diameter (mm):		102.0	Height (mm):		210.0	Test:	UU Single Stage		Remarks
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa) θ_3	Corr. Max. Deviator Stress (kPa) $(\theta_1-\theta_3)_f$	Shear Strength Cu (kPa) $^1/_2(\theta_1-\theta_3)_f$	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.36
1	27	2.01	1.59	260	417	209	6.3	Brittle	See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date**	**18/04/16**	**Contract No:**
		1 to 9 Sandycombe Road, Richmond			**PSL16/1426**
					Client Ref:

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

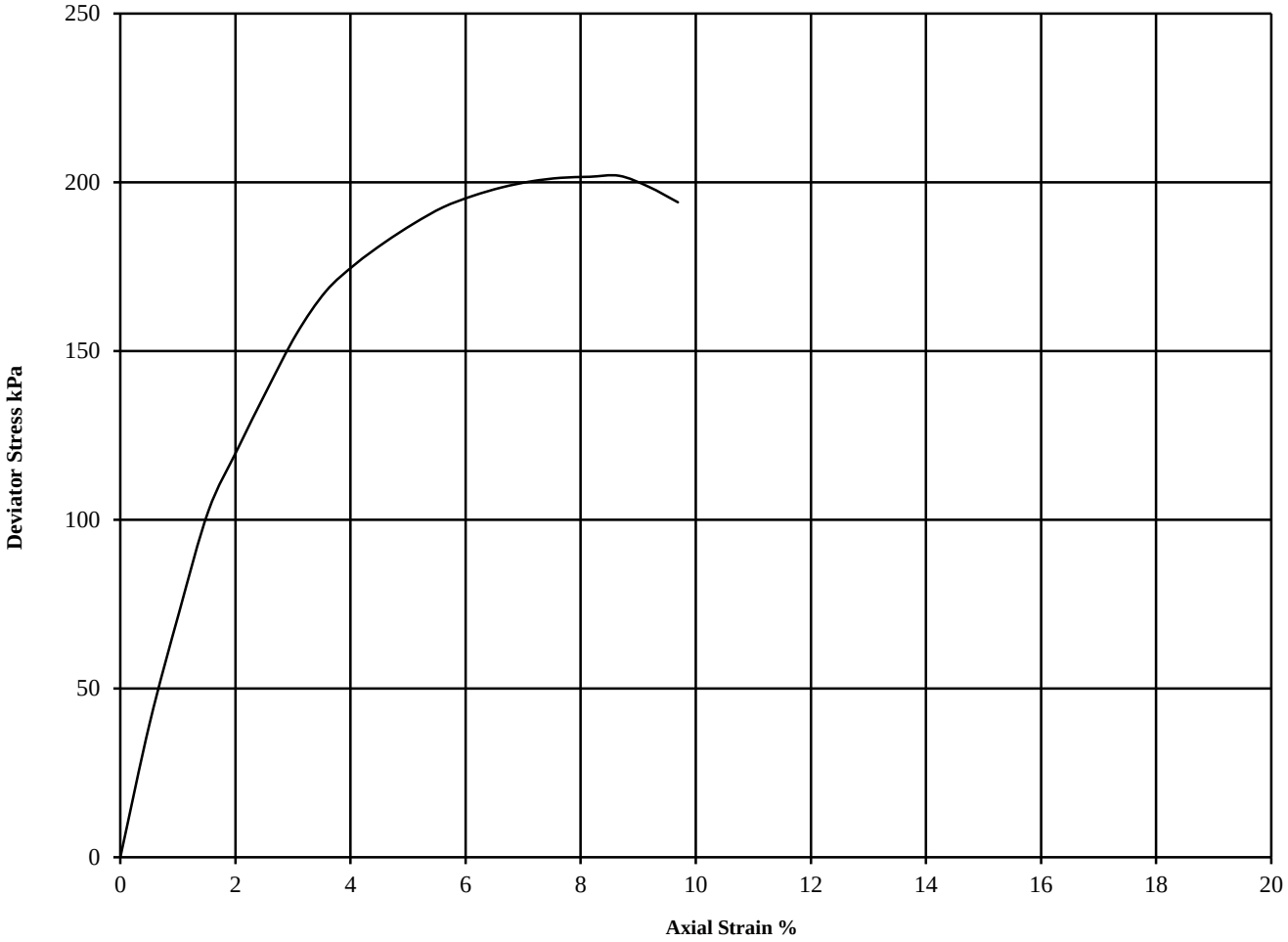
WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: **BH2** **Top Depth (m):** **9.50**

Sample Number: **Base Depth (m):** **9.95**

Sample Type **U**



Diameter (mm):		102.0	Height (mm):		200.0	Test:	UU Single Stage		Remarks
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa) θ_3	Corr. Max. Deviator Stress (kPa) $(\theta_1-\theta_3)_f$	Shear Strength Cu (kPa) $^1/_2(\theta_1-\theta_3)_f$	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.36
1	28	2.00	1.56	190	202	101	8.7	Brittle	See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date**	**18/04/16**	**Contract No:**
		1 to 9 Sandycombe Road, Richmond			**PSL16/1426**
					Client Ref:

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

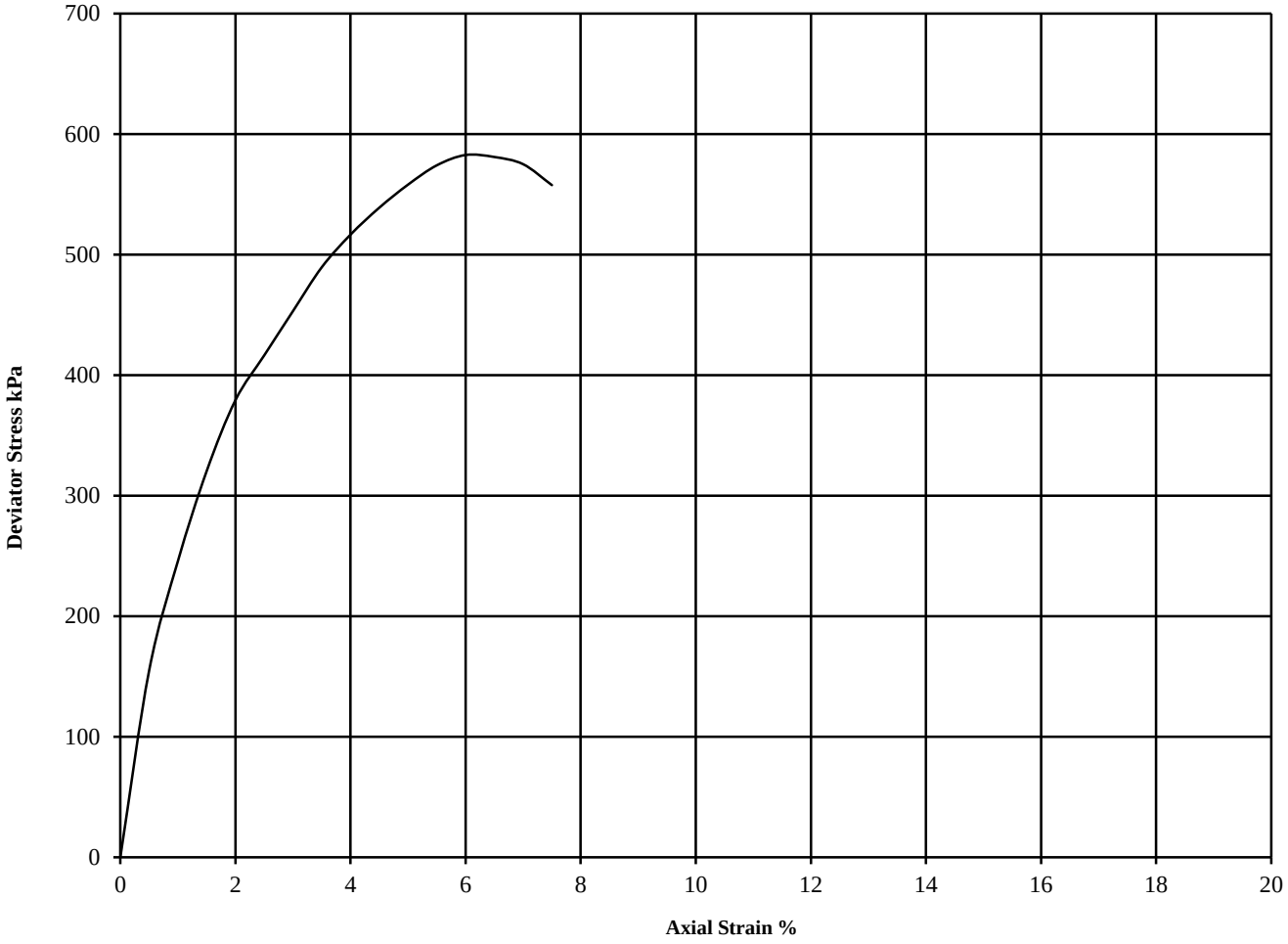
WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: **BH2** **Top Depth (m):** **12.50**

Sample Number: **Base Depth (m):** **12.95**

Sample Type **U**



Diameter (mm):		38.0	Height (mm):		76.0	Test:	UU Single Stage		Remarks
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa) θ_3	Corr. Max. Deviator Stress (kPa) $(\theta_1-\theta_3)_f$	Shear Strength Cu (kPa) $^1/_2(\theta_1-\theta_3)_f$	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.92
1	25	1.94	1.56	240	583	291	6.0	Brittle	See summary of soil descriptions.

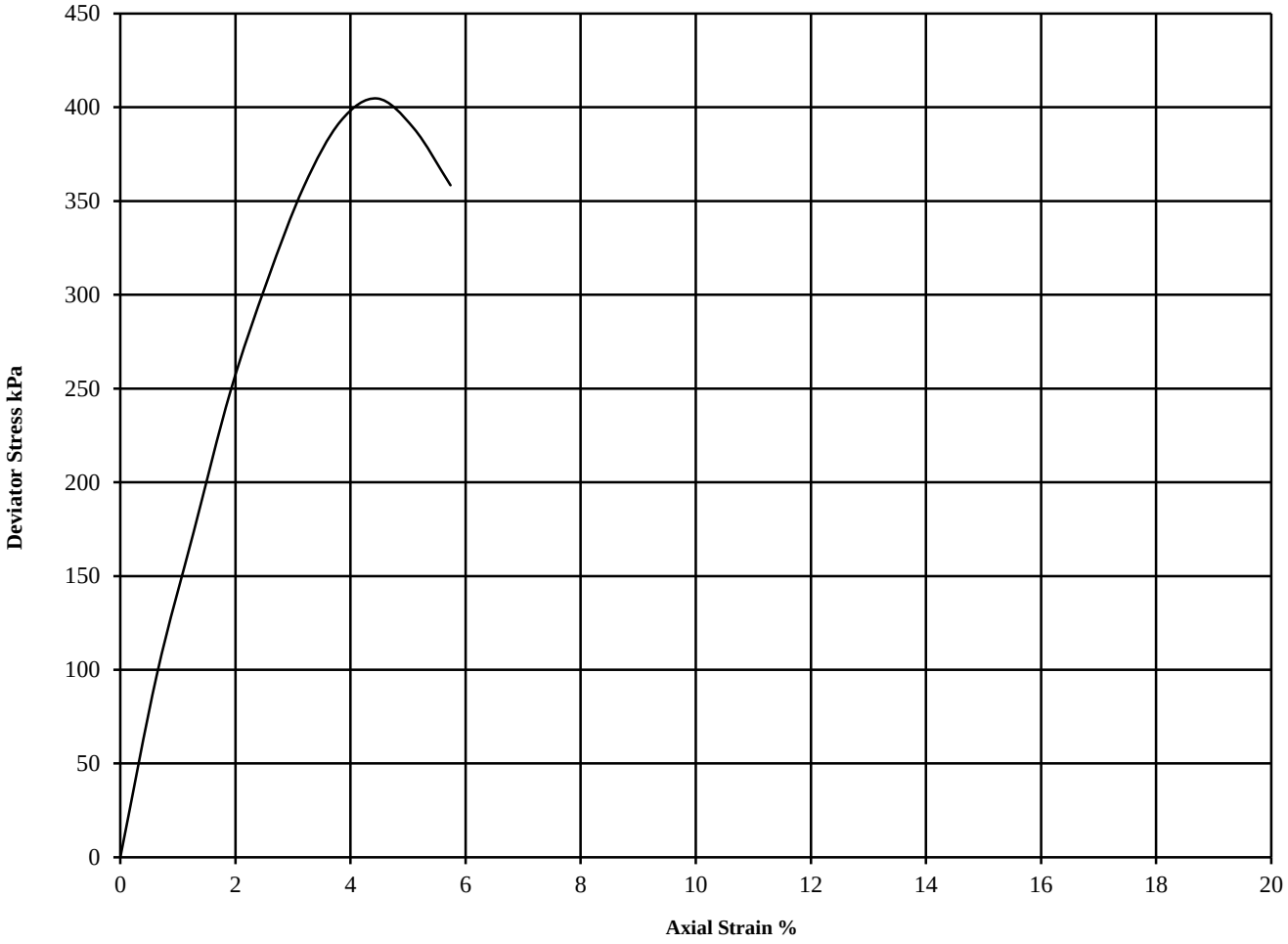
UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date**	**18/04/16**	**Contract No:**
		1 to 9 Sandycombe Road, Richmond			**PSL16/1426**
					Client Ref:

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number:	**BH2**	**Top Depth (m):**	**18.50**
Sample Number:		**Base Depth (m):**	**18.95**
Sample Type	**U**		



Diameter (mm):		102.0	Height (mm):		160.0	Test:	UU Single Stage		Remarks
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa) θ_3	Corr. Max. Deviator Stress (kPa) $(\theta_1-\theta_3)_f$	Shear Strength Cu (kPa) $^1/_2(\theta_1-\theta_3)_f$	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.36
1	26	1.91	1.52	350	405	202	4.5	Brittle	See summary of soil descriptions.

UKAS TESTING 4043	PSL Professional Soils Laboratory	**Checked / Approved**	**Date**	**18/04/16**	**Contract No:**
		1 to 9 Sandycombe Road, Richmond			**PSL16/1426**
					Client Ref:

Derwentside Environmental Testing Services

Certificate of Analysis

Certificate Number 16-62920

12-Apr-16

Client Professional Soils Laboratory Ltd
5/7 Hexthorpe Road
Hexthorpe
DN4 0AR

Our Reference	16-62920
Client Reference	PSL16/1426
Order No	(not supplied)
Contract Title	1-9 Sandycombew Road, Richmond
Description	6 Soil samples.
Date Received	06-Apr-16
Date Started	06-Apr-16
Date Completed	12-Apr-16
Test Procedures	Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the scope of UKAS 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. Observations and interpretations are outside the scope of ISO 17025. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Rob Brown
Business Manager

UKAS TESTING
2139

Summary of Chemical Analysis
Soil Samples

Our Ref 16-62920
Client Ref PSL16/1426
Contract Title 1-9 Sandycombew Road, Richmond

			Lab No	968435	968436	968437	968438	968439	968440
			Sample ID	BH1	BH1	BH1	BH2	BH2	BH2
			Depth	1.00-1.20	2.20-2.65	14.00-14.45	0.70	3.20-3.65	9.50-9.65
			Other ID						
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	n/s	n/s	n/s	n/s	n/s	n/s
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Inorganics									
pH	DETSC 2008#			8.3	8.1	8.6	10.4	8.5	8.6
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	30	30	38	63	15	53

Key: # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 16-62920
Client Ref PSL16/1426
Contract 1-9 Sandycombew Road, Richmond

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
968435	BH1 1.00-1.20 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
968436	BH1 2.20-2.65 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
968437	BH1 14.00-14.45 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
968438	BH2 0.70 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
968439	BH2 3.20-3.65 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	
968440	BH2 9.50-9.65 SOIL		PT 500ml	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	

Key: P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

APPENDIX E

Field Monitoring Data

Ground Gas Monitoring Results

Ground gas concentrations 31st March 2016

Borehole ID	Flow Rate (l/hr)		Methane (% vol)		Carbon Dioxide (% vol)		Oxygen (% vol)	iVOCs (ppm)
	Peak	Steady	Peak	Steady	Peak	Steady		
BH1	-0.4	<0.1	<0.1	<0.1	2.2	2.2	16.3	0.3
BH2	+0.4	<0.1	<0.1	<0.1	1.7	1.7	14.6	1.4

Atmospheric Pressure: 1012mb

Ground gas concentrations 8th April 2016

Borehole ID	Flow Rate (l/hr)		Methane (% vol)		Carbon Dioxide (% vol)		Oxygen (% vol)	iVOCs (ppm)
	Peak	Steady	Peak	Steady	Peak	Steady		
BH1	<0.1	<0.1	<0.1	<0.1	2.1	2.1	16.9	0.2
BH2	<0.1	<0.1	<0.1	<0.1	1.9	1.9	16.1	0.5

Atmospheric Pressure: 1010mb

Ground gas concentrations 15th April 2016

Borehole ID	Flow Rate (l/hr)		Methane (% vol)		Carbon Dioxide (% vol)		Oxygen (% vol)	iVOCs (ppm)
	Peak	Steady	Peak	Steady	Peak	Steady		
BH1	+0.4	<0.1	<0.1	<0.1	2.3	2.3	16.6	*
BH2	<0.1	<0.1	<0.1	<0.1	2.3	2.3	15.2	*

Atmospheric Pressure: 998mb

*iVOCs not recorded

Groundwater Monitoring Results

Borehole ID	Well Screen Depth m bgl	Strata	Depth to Groundwater m bgl		
			31/03/2016	08/04/2016	15/04/2016
BH1	1.80 to 7.20	Kempton Park Gravel Formation	5.932	6.146	6.251
BH2	1.80 to 7.80	Kempton Park Gravel Formation	5.951	6.201	6.316

APPENDIX F

Laboratory Analytical Certificates

Derwentside Environmental Testing Services

Certificate of Analysis

Certificate Number 16-62097

04-Apr-16

Client RPS Group
35 New Bridge Street
London
EC4V 6BW

Our Reference	16-62097
Client Reference	HLEI34438
Order No	(not supplied)
Contract Title	Sandycombe Road
Description	6 Soil samples.
Date Received	25-Mar-16
Date Started	25-Mar-16
Date Completed	04-Apr-16
Test Procedures	Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the scope of UKAS 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. Observations and interpretations are outside the scope of ISO 17025. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Rob Brown
Business Manager

UKAS TESTING
2139

Summary of Chemical Analysis
Soil Samples

Our Ref 16-62097
Client Ref HLEI34438
Contract Title Sandycombe Road

			Lab No	964177	964178	964179	964180	964181	964182
			Sample ID	BH1	BH1	BH2	HP1	HP2	HP3
			Depth	0.50	2.00	1.40	0.60	0.60	0.20
			Other ID						
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	21/03/16	21/03/16	22/03/16	23/03/16	23/03/16	23/03/16
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	20	14	51	12	17	19
Cadmium	DETSC 2301#	0.1	mg/kg	0.1	< 0.1	< 0.1	0.2	0.1	0.5
Chromium	DETSC 2301#	0.15	mg/kg	16	14	18	13	18	21
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	32	4.4	140	26	28	57
Lead	DETSC 2301#	0.3	mg/kg	110	7.5	630	180	160	200
Mercury	DETSC 2325#	0.05	mg/kg	0.22	< 0.05	0.98	0.22	0.31	1.7
Nickel	DETSC 2301#	1	mg/kg	15	14	29	13	16	16
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	DETSC 2301#	1	mg/kg	65	24	170	120	130	180
Inorganics									
pH	DETSC 2008#			9.4	8.6	8.0	8.8	8.4	7.9
Cyanide, Total	DETSC 2130#	0.1	mg/kg	< 0.1	< 0.1	0.3	0.5	0.6	0.7
Organic matter	DETSC 2002#	0.1	%	1.6	< 0.1	6.0	1.1	1.7	3.3
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	39	12	39	57	25	15
Sulphide	DETSC 2024#	10	mg/kg	24	20	40	130	32	28
Petroleum Hydrocarbons									
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	0.01	< 0.01	< 0.01	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4	< 3.4	24	< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	24	< 10	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	8.3	< 0.5	< 0.5	5.0	< 0.5	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	75	< 0.6	< 0.6	48	< 0.6	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	120	< 1.4	< 1.4	94	< 1.4	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	200	< 10	< 10	150	< 10	< 10
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	200	< 10	< 10	170	< 10	< 10
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
MTBE	DETSC 3321	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Chemical Analysis
Soil Samples

Our Ref 16-62097
Client Ref HLEI34438
Contract Title Sandycombe Road

			Lab No	964177	964178	964179	964180	964181	964182
			Sample ID	BH1	BH1	BH2	HP1	HP2	HP3
			Depth	0.50	2.00	1.40	0.60	0.60	0.20
			Other ID						
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	21/03/16	21/03/16	22/03/16	23/03/16	23/03/16	23/03/16
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
PAHs									
Naphthalene	DETSC 3301	0.1	mg/kg	0.2	< 0.1	< 0.1	0.1	0.1	< 0.1
Acenaphthylene	DETSC 3301	0.1	mg/kg	1.1	< 0.1	< 0.1	0.5	0.4	0.2
Acenaphthene	DETSC 3301	0.1	mg/kg	0.3	< 0.1	< 0.1	0.5	0.1	< 0.1
Fluorene	DETSC 3301	0.1	mg/kg	0.8	< 0.1	< 0.1	0.7	0.5	0.2
Phenanthrene	DETSC 3301	0.1	mg/kg	10	0.6	0.5	8.6	6.1	1.8
Anthracene	DETSC 3301	0.1	mg/kg	2.6	0.1	0.2	2.4	1.4	0.4
Fluoranthene	DETSC 3301	0.1	mg/kg	21	0.8	1.0	20	8.8	3.2
Pyrene	DETSC 3301	0.1	mg/kg	19	0.7	0.9	18	7.7	3.0
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	11	0.5	0.7	10	4.4	1.9
Chrysene	DETSC 3301	0.1	mg/kg	10	0.3	0.6	9.2	4.1	1.5
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	9.1	0.3	0.6	7.6	3.2	1.6
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	5.5	0.2	0.4	4.8	2.1	0.9
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	12	0.4	0.7	10	6.0	1.8
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	8.9	0.5	0.7	7.3	2.8	1.6
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	1.6	< 0.1	0.1	1.3	0.6	0.4
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	7.5	< 0.1	0.5	5.9	2.5	1.4
PAH Total	DETSC 3301	1.6	mg/kg	120	4.3	7.0	110	51	20
Phenols									
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Summary of Asbestos Analysis
Soil Samples

Our Ref 16-62097
Client Ref HLEI34438
Contract Title Sandycombe Road

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
964177	BH1 0.50	SOIL	NAD	none	Michael Kay
964179	BH2 1.40	SOIL	NAD	none	Michael Kay
964180	HP1 0.60	SOIL	NAD	none	Michael Kay
964181	HP2 0.60	SOIL	NAD	none	Michael Kay
964182	HP3 0.20	SOIL	NAD	none	Michael Kay

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * - not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 16-62097
Client Ref HLEI34438
Contract Sandycombe Road

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
964177	BH1 0.50 SOIL	21/03/16	GJ 250ml, GJ 60ml x2, PT 1L x2		
964178	BH1 2.00 SOIL	21/03/16	GJ 250ml, GJ 60ml x2, PT 1L x2		
964179	BH2 1.40 SOIL	22/03/16	GJ 250ml, GJ 60ml x2, PT 1L x2		
964180	HP1 0.60 SOIL	23/03/16	GJ 250ml, GJ 60ml, PT 1L		
964181	HP2 0.60 SOIL	23/03/16	GJ 250ml, GJ 60ml, PT 1L		
964182	HP3 0.20 SOIL	23/03/16	GJ 250ml, GJ 60ml, PT 1L		

Key: G-Glass P-Plastic J-Jar T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

Derwentside Environmental Testing Services

Certificate of Analysis

Certificate Number 16-62439-1

12-Apr-16

Client RPS Group
35 New Bridge Street
London
EC4V 6BW

Our Reference	16-62439-1
Client Reference	HLEI34438
Order No	(not supplied)
Contract Title	1-9 Sandycombe Rd
Description	2 Water samples.
Date Received	01-Apr-16
Date Started	01-Apr-16
Date Completed	12-Apr-16
Test Procedures	Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the scope of UKAS 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. Observations and interpretations are outside the scope of ISO 17025. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Rob Brown
Business Manager

UKAS TESTING
2139

Summary of Chemical Analysis
Water Samples

Our Ref 16-62439-1
Client Ref HLEI34438
Contract Title 1-9 Sandycombe Rd

			Lab No	966227	966228
			Sample ID	BH1	BH2
			Depth		
			Other ID		
			Sample Type	WATER	WATER
			Sampling Date	n/s	n/s
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
Metals					
Arsenic, Dissolved	DETSC 2306	0.16	ug/l	0.97	1.0
Cadmium, Dissolved	DETSC 2306	0.03	ug/l	< 0.03	< 0.03
Chromium, Dissolved	DETSC 2306	0.25	ug/l	< 0.25	< 0.25
Chromium, Hexavalent	DETSC 2203	3	ug/l	< 3.0	< 3.0
Copper, Dissolved	DETSC 2306	0.4	ug/l	< 0.4	2.2
Lead, Dissolved	DETSC 2306	0.09	ug/l	< 0.09	0.23
Mercury, Dissolved	DETSC 2306	0.01	ug/l	< 0.01	< 0.01
Nickel, Dissolved	DETSC 2306	0.5	ug/l	0.6	2.8
Selenium, Dissolved	DETSC 2306	0.25	ug/l	2.6	1.6
Zinc, Dissolved	DETSC 2306	1.3	ug/l	< 1.3	9.3
Inorganics					
pH	DETSC 2008			7.6	7.4
Cyanide, Total	DETSC 2130	40	ug/l	< 40	< 40
Hardness	DETSC 2303	0.1	mg/l	334	447
Sulphate as SO4	DETSC 2055	0.1	mg/l	65	32
Sulphide	DETSC 2208	10	ug/l	< 10	< 10
Total Organic Carbon	DETSC 2085	1	mg/l	3.5	< 1.0
Petroleum Hydrocarbons					
Aliphatic C5-C6	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aliphatic C6-C8	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aliphatic C8-C10	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aliphatic C10-C12	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aliphatic C12-C16	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aliphatic C16-C21	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aliphatic C21-C35	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aliphatic C5-C35	DETSC 3072*	10	ug/l	< 10	< 10
Aromatic C5-C7	DETSC 3322	0.1	ug/l	0.8	1.7
Aromatic C7-C8	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aromatic C8-C10	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aromatic C10-C12	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aromatic C12-C16	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aromatic C16-C21	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aromatic C21-C35	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aromatic C5-C35	DETSC 3072*	10	ug/l	< 10	< 10
TPH Ali/Aro Total	DETSC 3072*	10	ug/l	< 10	< 10
Benzene	DETSC 3322	1	ug/l	< 1.0	1.7
Toluene	DETSC 3322	1	ug/l	< 1.0	< 1.0
Ethylbenzene	DETSC 3322	1	ug/l	< 1.0	< 1.0
Xylene	DETSC 3322	1	ug/l	< 1.0	< 1.0
MTBE	DETSC 3322	1	ug/l	< 1.0	< 1.0

Key: * -not accredited. n/s -not supplied.

Summary of Chemical Analysis
Water Samples

Our Ref 16-62439-1
Client Ref HLEI34438
Contract Title 1-9 Sandycombe Rd

			Lab No	966227	966228
			Sample ID	BH1	BH2
			Depth		
			Other ID		
			Sample Type	WATER	WATER
			Sampling Date	n/s	n/s
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
PAHs					
Naphthalene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Acenaphthylene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Acenaphthene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Fluorene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Phenanthrene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Anthracene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Fluoranthene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Pyrene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Benzo(a)anthracene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Chrysene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Benzo(b)fluoranthene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Benzo(k)fluoranthene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Benzo(a)pyrene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Indeno(1,2,3-c,d)pyrene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Dibenzo(a,h)anthracene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
Benzo(g,h,i)perylene	DETS 074*	0.01	ug/l	< 0.01	< 0.01
PAH Total	DETS 074*	0.2	ug/l	< 0.20	< 0.20
Phenols					
Phenol - Monohydric	DETSC 2130	100	ug/l	< 100	< 100

Key: * -not accredited. n/s -not supplied.

Summary of Chemical Analysis
Water VOC Samples

Our Ref 16-62439-1
Client Ref HLEI34438
Contract Title 1-9 Sandycombe Rd

Lab No	966228
Sample ID	BH2
Depth	
Other ID	
Sample Type	WATER
Sampling Date	n/s
Sampling Time	n/s

Test	Method	LOD	Units	
VOCs				
Dichlorodifluoromethane	DETSC 3432	1	ug/l	< 1
Chloromethane	DETSC 3432	1	ug/l	< 1
Vinyl Chloride	DETSC 3432	1	ug/l	< 1
Bromomethane	DETSC 3432	1	ug/l	< 1
Chloroethane	DETSC 3432	1	ug/l	< 1
Trichlorofluoromethane	DETSC 3432*	1	ug/l	< 1
1,1-dichloroethylene	DETSC 3432	1	ug/l	< 1
Trans-1,2-dichloroethylene	DETSC 3432	1	ug/l	< 1
1,1-dichloroethane	DETSC 3432	1	ug/l	< 1
Cis-1,2-dichloroethylene	DETSC 3432	1	ug/l	< 1
2,2-dichloropropane	DETSC 3432	2	ug/l	< 2
Bromochloromethane	DETSC 3432	4	ug/l	< 4
Chloroform	DETSC 3432	1	ug/l	< 1
1,1,1-trichloroethane	DETSC 3432	1	ug/l	< 1
1,1-dichloropropene	DETSC 3432	1	ug/l	< 1
Carbon tetrachloride	DETSC 3432	1	ug/l	< 1
Benzene	DETSC 3432	1	ug/l	< 1
1,2-dichloroethane	DETSC 3432	1	ug/l	< 1
Trichloroethylene	DETSC 3432*	1	ug/l	< 1
1,2-dichloropropane	DETSC 3432	1	ug/l	< 1
Dibromomethane	DETSC 3432	1	ug/l	< 1
Bromodichloromethane	DETSC 3432	4	ug/l	< 4
cis-1,3-dichloropropene	DETSC 3432	1	ug/l	< 1
Toluene	DETSC 3432	1	ug/l	< 1
trans-1,3-dichloropropene	DETSC 3432	1	ug/l	< 1
1,1,2-trichloroethane	DETSC 3432	1	ug/l	< 1
Tetrachloroethylene	DETSC 3432	1	ug/l	< 1
1,3-dichloropropane	DETSC 3432	1	ug/l	< 1
Dibromochloromethane	DETSC 3432	1	ug/l	< 1
1,2-dibromoethane	DETSC 3432	1	ug/l	< 1
Chlorobenzene	DETSC 3432	1	ug/l	< 1
1,1,1,2-tetrachloroethane	DETSC 3432	1	ug/l	< 1
Ethylbenzene	DETSC 3432	1	ug/l	< 1
m+p-Xylene	DETSC 3432	2	ug/l	< 2
o-Xylene	DETSC 3432	1	ug/l	< 1
Styrene	DETSC 3432	1	ug/l	< 1
Bromoform	DETSC 3432	1	ug/l	< 1
Isopropylbenzene	DETSC 3432	1	ug/l	< 1
1,1,2,2-tetrachloroethane	DETSC 3432	1	ug/l	< 1
Bromobenzene	DETSC 3432	1	ug/l	< 1
1,2,3-trichloropropane	DETSC 3432	1	ug/l	< 1

Key: * -not accredited. n/s -not supplied.

Summary of Chemical Analysis
Water VOC Samples

Our Ref 16-62439-1
Client Ref HLEI34438
Contract Title 1-9 Sandycombe Rd

Lab No	966228
Sample ID	BH2
Depth	
Other ID	
Sample Type	WATER
Sampling Date	n/s
Sampling Time	n/s

Test	Method	LOD	Units	
n-propylbenzene	DETSC 3432	1	ug/l	< 1
2-chlorotoluene	DETSC 3432	1	ug/l	< 1
1,3,5-trimethylbenzene	DETSC 3432	1	ug/l	< 1
4-chlorotoluene	DETSC 3432	1	ug/l	< 1
Tert-butylbenzene	DETSC 3432	1	ug/l	< 1
1,2,4-trimethylbenzene	DETSC 3432	1	ug/l	< 1
sec-butylbenzene	DETSC 3432	1	ug/l	< 1
p-isopropyltoluene	DETSC 3432	1	ug/l	< 1
1,3-dichlorobenzene	DETSC 3432	2	ug/l	< 2
1,4-dichlorobenzene	DETSC 3432	1	ug/l	< 1
n-butylbenzene	DETSC 3432	1	ug/l	< 1
1,2-dichlorobenzene	DETSC 3432	1	ug/l	< 1
1,2-dibromo-3-chloropropane	DETSC 3432	1	ug/l	< 1
1,2,4-trichlorobenzene	DETSC 3432	1	ug/l	< 1
Hexachlorobutadiene	DETSC 3432	1	ug/l	< 1
1,2,3-trichlorobenzene	DETSC 3432	1	ug/l	< 1

Key: * -not accredited. n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 16-62439-1
Client Ref HLEI34438
Contract 1-9 Sandycombe Rd

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
966227	BH1 WATER		GB 1L, GV x2, PB 1L		
966228	BH2 WATER		GB 1L, GV x2, PB 1L		

Key: G-Glass P-Plastic B-Bottle V-Vial

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

APPENDIX G

Comparison of Analytical Data to Assessment Criteria

Key:

10 Exceeds LOD

10 Exceeds S4UL

Analyte (by group)	Units	LOD	S4UL	BH1 0.50 21/03/16	BH1 2.00 21/03/16	BH2 1.40 22/03/16	HP1 0.60 23/03/16	HP2 0.60 23/03/16	HP3 0.20 23/03/16
				MG	KPG	MG	MG	MG	MG
General Inorganics									
Asbestos				NAD		NAD	NAD	NAD	NAD
Asbestos Comment				na		na	na	na	na
Asbestos Analyst				Michael Kay		Michael Kay	Michael Kay	Michael Kay	Michael Kay
Asbestos Checker				Jeff Cruddas		Jeff Cruddas	Jeff Cruddas	Jeff Cruddas	Michael Kay
Arsenic	mg/kg	0.2	40	**20**	**14**	**51**	**12**	**17**	**19**
Cadmium	mg/kg	0.1	85	0.1	0.1	0.1	**0.2**	0.1	**0.5**
Chromium	mg/kg	0.15	910	**16**	**14**	**18**	**13**	**18**	**21**
Chromium, Hexavalent	mg/kg	1	6	1	1	1	1	1	1
Copper	mg/kg	0.2	7100	**32**	**4.4**	**140**	**26**	**28**	**57**
Lead*	mg/kg	0.3	310	**110**	**7.5**	**630**	**180**	**160**	**200**
Mercury	mg/kg	0.05	56	**0.22**	0.05	**0.98**	**0.22**	**0.31**	**1.7**
Nickel	mg/kg	1	180	**15**	**14**	**29**	**13**	**16**	**16**
Selenium	mg/kg	0.5	430	0.5	0.5	0.5	0.5	0.5	0.5
Zinc	mg/kg	1	40000	**65**	**24**	**170**	**120**	**130**	**180**
pH			-	**9.4**	**8.6**	**8**	**8.8**	**8.4**	**7.9**
Cyanide, Total	mg/kg	0.1	-	0.1	0.1	**0.3**	**0.5**	**0.6**	**0.7**
Organic matter	%	0.1	-	**1.6**	0.1	**6**	**1.1**	**1.7**	**3.3**
Sulphate Aqueous Extract as SO4	mg/l	10	-	**39**	**12**	**39**	**57**	**25**	**15**
Sulphide	mg/kg	10	-	**24**	**20**	**40**	**130**	**32**	**28**
Petroleum Hydrocarbons									
Aliphatic C5-C6	mg/kg	0.01	42	0.01	0.01	0.01	0.01	0.01	0.01
Aliphatic C6-C8	mg/kg	0.01	100	0.01	0.01	0.01	0.01	0.01	0.01
Aliphatic C8-C10	mg/kg	0.01	27	0.01	0.01	0.01	0.01	0.01	0.01
Aliphatic C10-C12	mg/kg	1.5	130	1.5	1.5	1.5	1.5	1.5	1.5
Aliphatic C12-C16	mg/kg	1.2	1100	1.2	1.2	1.2	1.2	1.2	1.2
Aliphatic C16-C21	mg/kg	1.5	65000	1.5	1.5	1.5	1.5	1.5	1.5
Aliphatic C21-C35	mg/kg	3.4	65000	3.4	3.4	3.4	**24**	3.4	3.4
Aliphatic C5-C35	mg/kg	10	-	10	10	10	**24**	10	10
Aromatic C5-C7	mg/kg	0.01	370	0.01	0.01	0.01	0.01	0.01	0.01
Aromatic C7-C8	mg/kg	0.01	860	0.01	0.01	0.01	0.01	0.01	0.01
Aromatic C8-C10	mg/kg	0.01	47	0.01	0.01	0.01	0.01	0.01	0.01
Aromatic C10-C12	mg/kg	0.9	250	0.9	0.9	0.9	0.9	0.9	0.9
Aromatic C12-C16	mg/kg	0.5	1800	**8.3**	0.5	0.5	**5**	0.5	0.5

Analyte (by group)	Units	LOD	S4UL	BH1 0.50 21/03/16	BH1 2.00 21/03/16	BH2 1.40 22/03/16	HP1 0.60 23/03/16	HP2 0.60 23/03/16	HP3 0.20 23/03/16
Aromatic C16-C21	mg/kg	0.6	1900	**75**	0.6	0.6	**48**	0.6	0.6
Aromatic C21-C35	mg/kg	1.4	1900	**120**	1.4	1.4	**94**	1.4	1.4
Aromatic C5-C35	mg/kg	10	-	**200**	10	10	**150**	10	10
TPH Ali/Aro Total	mg/kg	10	-	**200**	10	10	**170**	10	10
Benzene	mg/kg	0.01	0.38	0.01	0.01	0.01	0.01	0.01	0.01
Ethylbenzene	mg/kg	0.01	83	0.01	0.01	0.01	0.01	0.01	0.01
Toluene	mg/kg	0.01	880	0.01	0.01	0.01	0.01	0.01	0.01
Xylene	mg/kg	0.01	79	0.01	0.01	0.01	0.01	0.01	0.01
MTBE	mg/kg	0.01	-	0.01	0.01	0.01	0.01	0.01	0.01
Polycyclic Aromatic Hydrocarbons (PAH)									
Naphthalene	mg/kg	0.1	2.6	**0.2**	0.1	0.1	0.1	0.1	0.1
Acenaphthylene	mg/kg	0.1	2900	**1.1**	0.1	0.1	**0.5**	**0.4**	**0.2**
Acenaphthene	mg/kg	0.1	3000	**0.3**	0.1	0.1	**0.5**	0.1	0.1
Fluorene	mg/kg	0.1	2800	**0.8**	0.1	0.1	**0.7**	**0.5**	**0.2**
Phenanthrene	mg/kg	0.1	1300	**10**	**0.6**	**0.5**	**8.6**	**6.1**	**1.8**
Anthracene	mg/kg	0.1	31000	**2.6**	0.1	**0.2**	**2.4**	**1.4**	**0.4**
Fluoranthene	mg/kg	0.1	1500	**21**	**0.8**	**1**	**20**	**8.8**	**3.2**
Pyrene	mg/kg	0.1	3700	**19**	**0.7**	**0.9**	**18**	**7.7**	**3**
Benzo(a)anthracene	mg/kg	0.1	11	**11**	**0.5**	**0.7**	**10**	**4.4**	**1.9**
Chrysene	mg/kg	0.1	30	**10**	**0.3**	**0.6**	**9.2**	**4.1**	**1.5**
Benzo(b)fluoranthene	mg/kg	0.1	3.9	**9.1**	**0.3**	**0.6**	**7.6**	**3.2**	**1.6**
Benzo(k)fluoranthene	mg/kg	0.1	110	**5.5**	**0.2**	**0.4**	**4.8**	**2.1**	**0.9**
Benzo(a)pyrene	mg/kg	0.1	3.2	**12**	**0.4**	**0.7**	**10**	**6**	**1.8**
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	45	**8.9**	**0.5**	**0.7**	**7.3**	**2.8**	**1.6**
Dibenzo(a,h)anthracene	mg/kg	0.1	0.31	**1.6**	0.1	0.1	**1.3**	**0.6**	**0.4**
Benzo(g,h,i)perylene	mg/kg	0.1	360	**7.5**	0.1	**0.5**	**5.9**	**2.5**	**1.4**
PAH Total	mg/kg	1.6	-	**120**	**4.3**	**7**	**110**	**51**	**20**
Phenol - Monohydric	mg/kg	0.3	440	0.3	0.3	0.3	0.3	0.3	0.3

* C4SL used in absence of S4UL

Key:

10	Exceeds LOD
10	Exceeds EQS/DWS

Analyte (by group)	Units	LOD	EQS/DWS	BH1 n/s	BH2 n/s
Metals					
Arsenic, Dissolved	µg/l	0.16	50	**0.97**	**1**
Cadmium, Dissolved	µg/l	0.03	0.25	0.03	0.03
Chromium, Dissolved	µg/l	0.25	4.7	0.25	0.25
General Inorganics					
Chromium, Hexavalent	µg/l	3	3.4	3	3
Copper, Dissolved	µg/l	0.4	10	0.4	**2.2**
Lead, Dissolved	µg/l	0.09	7.2	0.09	**0.23**
Mercury, Dissolved	µg/l	0.01	0.05	0.01	0.01
Nickel, Dissolved	µg/l	0.5	20	**0.6**	**2.8**
Selenium, Dissolved	µg/l	0.25	10	**2.6**	**1.6**
Zinc, Dissolved	µg/l	1.3	75	1.3	**9.3**
pH			-	**7.6**	**7.4**
Cyanide, Total	µg/l	40	-	40	40
Hardness	mg/l	0.1	-	**334**	**447**
Sulphide	µg/l	10	-	10	10
Total Organic Carbon	mg/l	1	-	**3.5**	1
Petroleum Hydrocarbons					
Aliphatic C5-C6	µg/l	0.1	10	0.1	0.1
Aliphatic C6-C8	µg/l	0.1	10	0.1	0.1
Aliphatic C8-C10	µg/l	0.1	10	0.1	0.1
Aliphatic C10-C12	µg/l	1	10	1	1
Aliphatic C12-C16	µg/l	1	10	1	1
Aliphatic C16-C21	µg/l	1	10	1	1

Analyte (by group)	Units	LOD	EQS/DWS	BH1	BH2
				n/s	n/s
Aliphatic C21-C35	µg/l	1	10	1	1
Aliphatic C5-C35	µg/l	10	-	10	10
Aromatic C5-C7	µg/l	0.1	10	**0.8**	**1.7**
Aromatic C7-C8	µg/l	0.1	10	0.1	0.1
Aromatic C8-C10	µg/l	0.1	10	0.1	0.1
Aromatic C10-C12	µg/l	1	10	1	1
Aromatic C12-C16	µg/l	1	10	1	1
Aromatic C16-C21	µg/l	1	10	1	1
Aromatic C21-C35	µg/l	1	10	1	1
Aromatic C5-C35	µg/l	10	-	10	10
TPH Ali/Aro Total	µg/l	10	-	10	10
Benzene	µg/l	1	10	1	**1.7**
Toluene	µg/l	1	50	1	1
Ethylbenzene	µg/l	1	20	1	1
Xylene	µg/l	1	30	1	1
MTBE	µg/l	1	-	1	1
Polycyclic Aromatic Hydrocarbons (PAH)					
Naphthalene	µg/l	0.01	2.4	0.01	0.01
Acenaphthylene	µg/l	0.01	-	0.01	0.01
Acenaphthene	µg/l	0.01	-	0.01	0.01
Fluorene	µg/l	0.01	-	0.01	0.01
Phenanthrene	µg/l	0.01	-	0.01	0.01
Anthracene	µg/l	0.01	0.1	0.01	0.01
Fluoranthene	µg/l	0.01	0.1	0.01	0.01
Pyrene	µg/l	0.01	-	0.01	0.01
Benzo(a)anthracene	µg/l	0.01	-	0.01	0.01
Chrysene	µg/l	0.01	-	0.01	0.01
Benzo(b)fluoranthene	µg/l	0.01	0.03	0.01	0.01
Benzo(k)fluoranthene	µg/l	0.01		0.01	0.01

Analyte (by group)	Units	LOD	EQS/DWS	BH1	BH2
				n/s	n/s
Benzo(a)pyrene	µg/l	0.01	0.05	0.01	0.01
Indeno(1,2,3-c,d)pyrene	µg/l	0.01	0.002	0.01	0.01
Benzo(g,h,i)perylene	µg/l	0.01		0.01	0.01
Dibenzo(a,h)anthracene	µg/l	0.01	-	0.01	0.01
PAH Total	µg/l	0.2	-	0.2	0.2
Phenol - Monohydric	µg/l	100	-	100	100

Key:

10	Exceeds LOD
10	Exceeds EQS/DWS

Analyte (by group)	Units	LOD	EQS/DWS	BH2 n/s
Volatile Organic Compounds (VOCs)				
Dichlorodifluoromethane	µg/l	1	-	1
Chloromethane	µg/l	1	-	1
Vinyl Chloride	µg/l	1	-	1
Bromomethane	µg/l	1	-	1
Chloroethane	µg/l	1	-	1
Trichlorofluoromethane	µg/l	1	-	1
1,1-dichloroethylene	µg/l	1	-	1
Trans-1,2-dichloroethylene	µg/l	1	-	1
1,1-dichloroethane	µg/l	1	-	1
Cis-1,2-dichloroethylene	µg/l	1	-	1
2,2-dichloropropane	µg/l	2	-	2
Bromochloromethane	µg/l	4	-	4
Chloroform	µg/l	1	-	1
1,1,1-trichloroethane	µg/l	1	-	1
1,1-dichloropropene	µg/l	1	-	1
Carbon tetrachloride	µg/l	1	-	1
Benzene	µg/l	1	-	1
1,2-dichloroethane	µg/l	1	-	1
Trichloroethylene	µg/l	1	-	1
1,2-dichloropropane	µg/l	1	-	1
Dibromomethane	µg/l	1	-	1
Bromodichloromethane	µg/l	4	-	4
cis-1,3-dichloropropene	µg/l	1	-	1

Analyte (by group)	Units	LOD	EQS/DWS	BH2 n/s
Toluene	µg/l	1	-	1
trans-1,3-dichloropropene	µg/l	1	-	1
1,1,2-trichloroethane	µg/l	1	-	1
Tetrachloroethylene	µg/l	1	-	1
1,3-dichloropropane	µg/l	1	-	1
Dibromochloromethane	µg/l	1	-	1
1,2-dibromoethane	µg/l	1	-	1
Chlorobenzene	µg/l	1	-	1
1,1,1,2-tetrachloroethane	µg/l	1	-	1
Ethylbenzene	µg/l	1	-	1
m+p-Xylene	µg/l	2	-	2
o-Xylene	µg/l	1	-	1
Styrene	µg/l	1	-	1
Bromoform	µg/l	1	-	1
Isopropylbenzene	µg/l	1	-	1
1,1,2,2-tetrachloroethane	µg/l	1	-	1
Bromobenzene	µg/l	1	-	1
1,2,3-trichloropropane	µg/l	1	-	1
n-propylbenzene	µg/l	1	-	1
2-chlorotoluene	µg/l	1	-	1
1,3,5-trimethylbenzene	µg/l	1	-	1
4-chlorotoluene	µg/l	1	-	1
Tert-butylbenzene	µg/l	1	-	1
1,2,4-trimethylbenzene	µg/l	1	-	1
sec-butylbenzene	µg/l	1	-	1
p-isopropyltoluene	µg/l	1	-	1
1,3-dichlorobenzene	µg/l	2	-	2
1,4-dichlorobenzene	µg/l	1	-	1
n-butylbenzene	µg/l	1	-	1

Analyte (by group)	Units	LOD	EQS/DWS	BH2 n/s
1,2-dichlorobenzene	µg/l	1	-	1
1,2-dibromo-3-chloropropane	µg/l	1	-	1
1,2,4-trichlorobenzene	µg/l	1	-	1
Hexachlorobutadiene	µg/l	1	-	1
Naphthalene	µg/l	1	-	
1,2,3-trichlorobenzene	µg/l	1	-	1

APPENDIX H

Falling Head Test Results

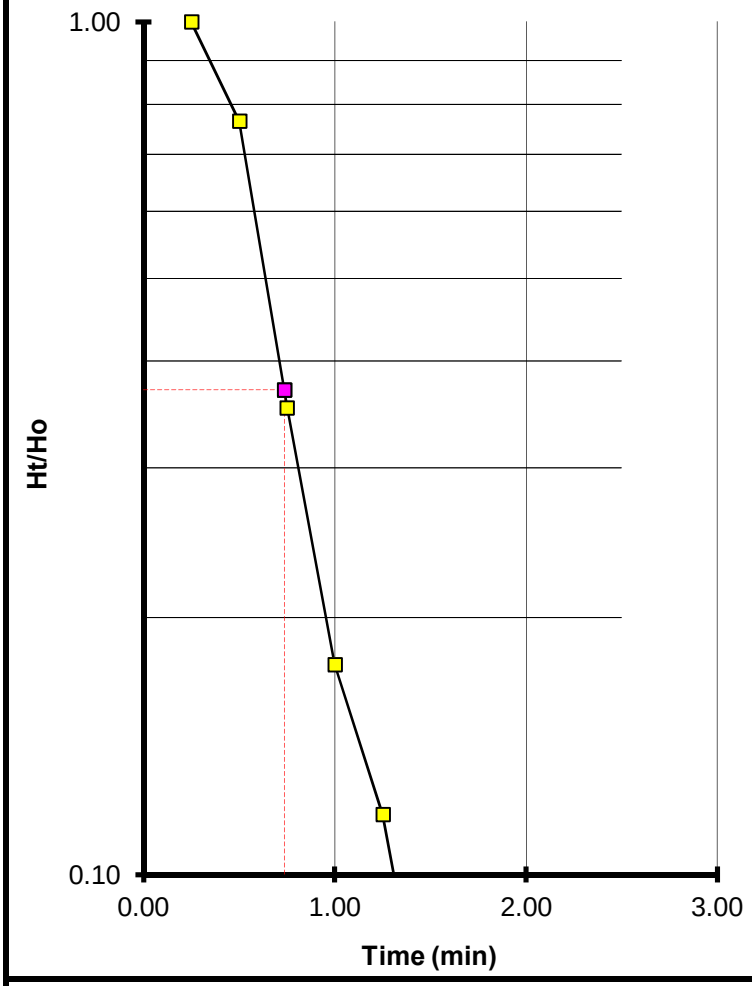
Variable Head Permeability Test

Project No.:	HLEI 34438
Project Name:	1 to 9 Sandycombe Road
Client:	Goldcrest Land Plc
Borehole No.:	BH1 - Test 1
Compiled By	LF
Date	15/04/2016
Checked By	RA
Date	15/04/2016

TEST RESPONSE ZONE DETAILS:

Top (mbgl):	1.80
Bottom (mbgl):	7.20
Length (m):	5.40
Diameter (m):	0.050
Initial Standing Water Level (m below top of casing):	6.248
Height of casing or standpipe : above ground level (m)	0.00
Falling or Rising Head Test?	Falling

Elapsed Time (mins)	Depth to Water* (m)	Ht/Ho
0.25	6.231	1.00
0.5	6.235	0.76
0.75	6.242	0.35
1	6.245	0.18
1.25	6.246	0.12
1.5	6.247	0.06
1.75	6.248	
2	6.248	
2.25	6.248	
2.5	6.248	



Cross Sectional Area of Test Zone	A=	0.00196
Shape Factor (Case C)	F=	6.30666
Time to reach Ht/Ho = 0.37 (sec)	T=	44
Permeability (m/s)	K=	7.06E-06

RPS

35 New Bridge Street
London
EC4V 6BW

Comments

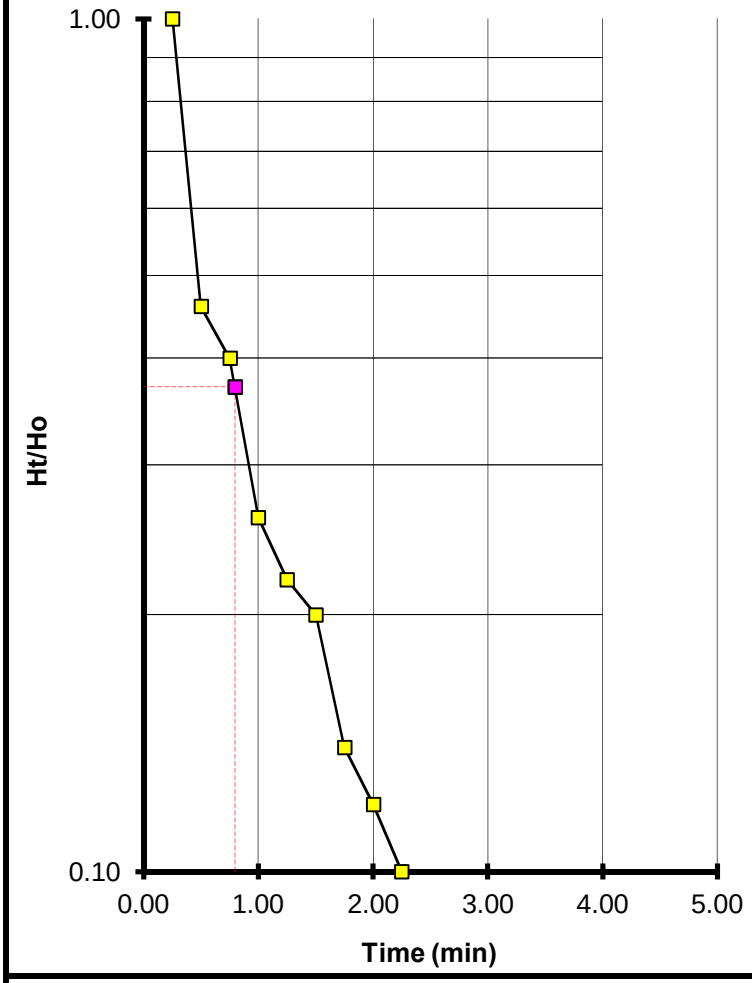
Variable Head Permeability Test

Project No.:	HLEI 34438
Project Name:	1 to 9 Sandycombe Road
Client:	Goldcrest Land Plc
Borehole No.:	BH1 - Test 3
Compiled By	LF
Date	15/04/2016
Checked By	RA
Date	15/04/2016

TEST RESPONSE ZONE DETAILS:

Top (mbgl):	1.80
Bottom (mbgl):	7.20
Length (m):	5.40
Diameter (m):	0.050
Initial Standing Water Level (m below top of casing):	6.24
Height of casing or standpipe : above ground level (m)	0.00
Falling or Rising Head Test?	Falling

Elapsed Time (mins)	Depth to Water* (m)	Ht/Ho
0.25	6.19	1.00
0.5	6.217	0.46
0.75	6.22	0.40
1	6.227	0.26
1.25	6.229	0.22
1.5	6.23	0.20
1.75	6.233	0.14
2	6.234	0.12
2.25	6.235	0.10
2.5	6.236	0.08
2.75	6.237	0.06
3	6.237	0.06
3.25	6.237	0.06
3.5	6.238	0.04
3.75	6.239	0.02
4	6.24	



Cross Sectional Area of Test Zone	A=	0.00196
Shape Factor (Case C)	F=	6.30666
Time to reach Ht/Ho = 0.37 (sec)	T=	48
Permeability (m/s)	K=	6.52E-06

RPS

35 New Bridge Street
London
EC4V 6BW

Comments

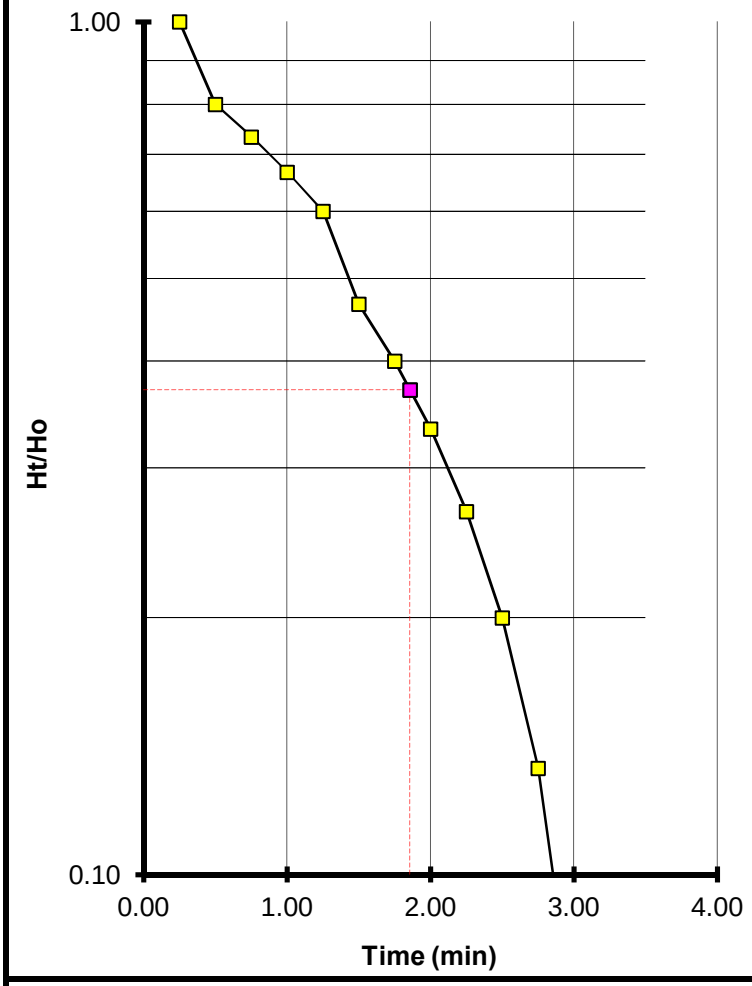
Variable Head Permeability Test

Project No.:	HLEI 34438
Project Name:	1 to 9 Sandycombe Road
Client:	Goldcrest Land Plc
Borehole No.:	BH2 - Test 1
Compiled By	LF
Date	15/04/2016
Checked By	RA
Date	15/04/2016

TEST RESPONSE ZONE DETAILS:

Top (mbgl):	1.80
Bottom (mbgl):	7.80
Length (m):	6.00
Diameter (m):	0.050
Initial Standing Water Level (m below top of casing):	6.32
Height of casing or standpipe : above ground level (m)	0.00
Falling or Rising Head Test?	Falling

Elapsed Time (mins)	Depth to Water* (m)	Ht/Ho
0.25	6.3	1.00
0.5	6.303	0.80
0.75	6.304	0.73
1	6.305	0.67
1.25	6.306	0.60
1.5	6.308	0.47
1.75	6.309	0.40
2	6.31	0.33
2.25	6.311	0.27
2.5	6.312	0.20
2.75	6.313	0.13
3	6.314	0.07
3.25	6.314	0.07
3.5	6.315	



Cross Sectional Area of Test Zone	A=	0.00196
Shape Factor (Case C)	F=	6.87338
Time to reach Ht/Ho = 0.37 (sec)	T=	111
Permeability (m/s)	K=	2.56E-06

RPS

35 New Bridge Street
London
EC4V 6BW

Comments

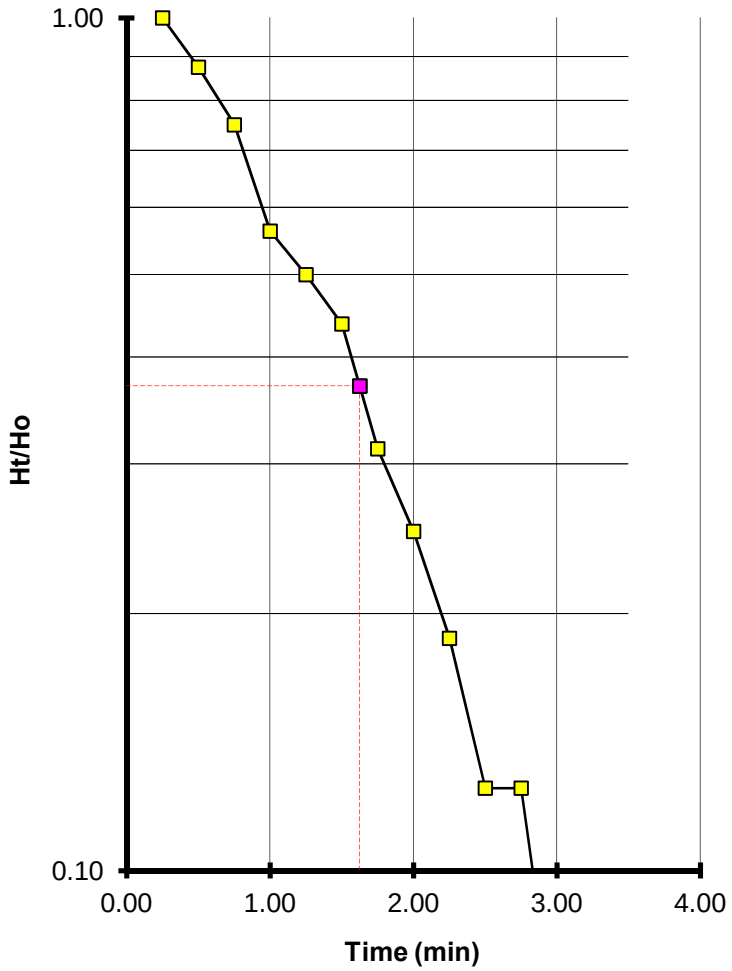
Variable Head Permeability Test

Project No.:	HLEI 34438
Project Name:	1 to 9 Sandycombe Road
Client:	Goldcrest Land Plc
Borehole No.:	BH2 - Test 2
Compiled By	LF
Date	15/04/2016
Checked By	RA
Date	15/04/2016

TEST RESPONSE ZONE DETAILS:

Top (mbgl):	1.80
Bottom (mbgl):	7.80
Length (m):	6.00
Diameter (m):	0.050
Initial Standing Water Level (m below top of casing):	6.32
Height of casing or standpipe : above ground level (m)	0.00
Falling or Rising Head Test?	Falling

Elapsed Time (mins)	Depth to Water* (m)	Ht/Ho
0.25	6.299	1.00
0.5	6.301	0.88
0.75	6.303	0.75
1	6.306	0.56
1.25	6.307	0.50
1.5	6.308	0.44
1.75	6.31	0.31
2	6.311	0.25
2.25	6.312	0.19
2.5	6.313	0.13
2.75	6.313	0.13
3	6.314	0.06
3.25	6.314	0.06
3.5	6.315	



Cross Sectional Area of Test Zone	A=	0.00196
Shape Factor (Case C)	F=	6.87338
Time to reach Ht/Ho = 0.37 (sec)	T=	97
Permeability (m/s)	K=	2.93E-06

RPS

35 New Bridge Street
London
EC4V 6BW

Comments

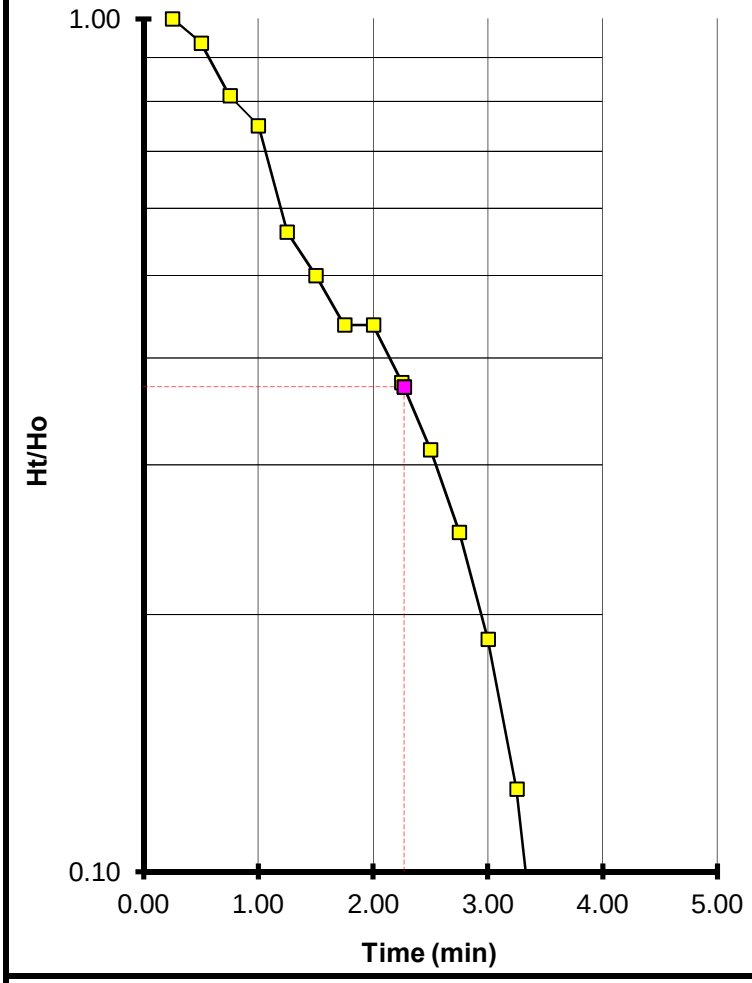
Variable Head Permeability Test

Project No.:	HLEI 34438
Project Name:	1 to 9 Sandycombe Road
Client:	Goldcrest Land Plc
Borehole No.:	BH2 - Test 3
Compiled By	LF
Date	15/04/2016
Checked By	RA
Date	15/04/2016

TEST RESPONSE ZONE DETAILS:

Top (mbgl):	1.80
Bottom (mbgl):	7.80
Length (m):	6.00
Diameter (m):	0.050
Initial Standing Water Level (m below top of casing):	6.32
Height of casing or standpipe : above ground level (m)	0.00
Falling or Rising Head Test?	Falling

Elapsed Time (mins)	Depth to Water* (m)	Ht/Ho
0.25	6.299	1.00
0.5	6.3	0.94
0.75	6.302	0.81
1	6.303	0.75
1.25	6.306	0.56
1.5	6.307	0.50
1.75	6.308	0.44
2	6.308	0.44
2.25	6.309	0.38
2.5	6.31	0.31
2.75	6.311	0.25
3	6.312	0.19
3.25	6.313	0.13
3.5	6.314	0.06
3.75	6.314	0.06
4	6.315	



Cross Sectional Area of Test Zone	A=	0.00196
Shape Factor (Case C)	F=	6.87338
Time to reach Ht/Ho = 0.37 (sec)	T=	136
Permeability (m/s)	K=	2.10E-06

RPS

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EC4V 6BW

Comments