NHS Property Services

Northwood and Pinner Cottage Hospital, Pinner Road, HA6 1DE

Phase 2 Geo-environmental and Geotechnical Site Investigation

1921134 01 (01)

MARCH 2021

RSK

RSK GENERAL NOTES

Project No.: 1921134 01 (01)

Title: Phase 2 Geo-environmental and Geotechnical Site Investigation : Northwood and Pinner Cottage Hospital, Pinner Road, HA6 1DE

Client: NHS Property Services

Date: March 2021

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Status: Rev 00

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Date:	March 2021	Date:	March 2021

Revision control sheet

Revision reference	Date	Reason for revision
Rev 00	August 2020	First issue
Rev01	March 2021	Second issue

Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK Environment Ltd.

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1 INTRODUCTION

1.1 Commissioning

RSK Environment Limited (RSK) was commissioned by NHS Property Services, the 'Client', to carry out a Geoenvironmental and Geotechnical Site Investigation of the land at Northwood and Pinner Cottage Hospital hereafter referred to as the 'site', located off Pinner Road in Northwood, HA6 1DE. The project was carried out to an agreed brief as set out in RSK's proposal (Ref. 1921134-01, January 2020).

This report is subject to the RSK service constraints given in **Appendix A** and limitations that may be described through this document.

1.2 Proposed development

It is understood the site is being considered for the construction of a new health care centre and two residential apartment blocks. The planned layout of the site is shown in **Appendix B**.

1.3 Objectives

The objectives of the work are:

- to identify any land contamination and geotechnical constraints to the proposed development; and
- to identify the need for any additional investigation or remediation works to demonstrate that the site is suitable for its proposed use.

1.4 Scope of works

The scope of this assessment has been developed in accordance with relevant British Standards and authoritative technical guidance as referenced through the report. The assessment of the contamination status of the site is in line with the technical approach presented in CLR 11 Model Procedures for the Management of Land Contamination (Environment Agency, 2004) and in general accordance with BS 10175: 2011 + A2 2017 (BSI, 2017). It is also compliant with relevant planning policy and guidance.

The scope of the intrusive investigation has been designed in line with the recommendations of BS5930: 2015 Code of practice for ground investigations (BSi, 2016), which maintains compliance with BS EN 1997-1 and 1997-2 and their related standards. It has also been developed in general accordance with BS 10175: 2011 + A2 2017. Ground gas assessment has been undertaken in general accordance with BS8756: 2013 and BS 8485:2015+A1:2019.

A brief summary of relevant legislation and policy relating to contaminated land is given in **Appendix C**.

The scope of works for the assessment has included the following:

- summary of previous phase 1 site investigation report;
- implementation of an intrusive investigation, in situ testing, soil sampling, laboratory geo-environmental and geotechnical testing;
- interpretation of data to develop a refined conceptual site model (CSM);
- generic quantitative risk assessment (GQRA) to evaluate potentially complete contaminant linkages identified in the refined CSM;
- identification of the need for further action, e.g. supplementary intrusive investigations/ monitoring, remediation works or other mitigation, if any;
- interpretation of ground conditions and geotechnical data to provide preliminary recommendations with respect to foundations and infrastructure design;
- preliminary assessment of the potential waste classification (hazardous / non-hazardous) implications of soil arisings; and
- preparation of this factual and interpretative report with recommendations for further works (i.e. undertake a remedial options appraisal to identify appropriate mitigation measures/produce a remedial implementation and verification plan) and/or remediation as necessary.

1.5 Existing reports

The following report detailing previous works at the site were made available for review:

- Phase 1 Ground Condition Assessment, Peter Brett Associates, report ref 35554/3501 Issue 01, dated September 2015.

Pertinent information from these reports has been summarised in **Section 2**.

1.6 Limitations

The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows may vary from those reported due to seasonal, or other, effects and the limitations stated in the data should be recognised.

Asbestos is often present in soils in discrete areas. Whilst asbestos-containing materials may have been locally encountered during the fieldworks or supporting laboratory analysis, the history of the site indicates that asbestos may be present in soils and could be encountered during more extensive ground works.

2 SITE DETAILS

2.1 Site location

Site location details are presented in **Table 1** and a site location plan is provided as **Figure 1**.

Table 1 Site location details

Site name	Northwood and Pinner Cottage Hospital
Full site address and postcode	Located off Pinner Road, Nothwood, HA6 1BT
National Grid reference (centre of site)	TQ100,906.

2.2 Site description

The site boundary and current layout is shown as **Figure 2**.

The site, of approximately 1 ha, is spilt into two separate areas referred to as plot 1 and 2. Plot 1 fronts Pinner Road and consists of the former Northwood and Pinner Cottage Hospital. The hospital is disused apart from a small section of the building which is currently occupied by the London Ambulance Service. The main hospital building is located in the western portion of this area and is a two-storey brick structure with single storey ancillary buildings to the west. Car parking is located to the north and south of the main building, with soft landscaping including a number of mature trees situated to the east.

Plot 2 is accessed off Neal Close, and consists of single store brick building currently used as Northwood Health Centre. Car parking is situated to the west and south of the health centre, and soft landscaping to the north and east.

The site is surrounded by residential properties.

2.3 Development plans

The proposed layout of the site, at the time of reporting, is shown in **Appendix B**. The development will comprise:

- Refurbishment of the existing cottage hospital on Plot 1, including demolion of existing extensions; and
- Demolition of existing health care centre on Plot 2 and construction of two four-storey residential apartment blocks to provide 70 units.

2.4 Preliminary risk assessment

The following sections summarise relevant information on the sites history and environmental setting based on the findings an existing Phase 1 assessment undertaken by Peter Brett Associates, and freely available information published by the British Geological Survey and the Environment Agency.

2.4.1 Site walkover

A site walkover was undertaken by Peter Brett Associates during August 2015, and more recently by RSK on the 24th June 2020. The following observations were made,

- The former hospital is disused apart from the southern section of the building and car park which is currently used by the London Ambulance service for resting crews and ambulance parking. The remainder of the building is in a state of disrepair and surrounded by wooden hoarding;
- The hospital contains a partial basement level that contains a boiler room. This could not be accessed during either of the walkovers surveys;
- A small electrical substation is located in the south eastern corner of the site;
- Potential sources of contamination identified associated with the hospital include the electrical substation (possible leakage of coolant oil containing polychlorinated bisphenols), and parking of vehicles on hard standing. (possible leak of oil for vehicles);
- It was stated in the Phase 1 report that there was the possibility that the boiler room could have been oil fired in the past. However, RSK found no evidence of fill points or pipe works during an external walkover of the site that would indicate the presence of an oil tank, and therefore this potential source has been excluded from further assessment. However, it would be prudent to check the condition of the boiler room prior to the refurbishment of the site; and
- No potential sources of significant contamination were identified associated with the existing health care centre with the exception of vehicle parking.

2.4.2 Historical development

The site was undeveloped agricultural land until the construction of the existing Northwood and Pinner War Memorial Hospital in 1924. The site was first used as general hospital with an operating theatre and x ray room and was subsequently converted for use as a respite and rehabilitation centre for elderly patients. A number of extensions and modifications were made to the building until the hospitals closure in 2008.

The health care centre was constructed on undeveloped land to the northeast of the hospital during the early 1970s.

2.4.3 Environmental setting

The published geological records from the British Geological Survey (BGS) indicates that the site is directly underlain by the London Clay Formation, which is anticipated to be approximately 12 m in thickness. This formation is further underlain by the Lambeth Group

(~15 m in thickness) with the Seaford and Newhaven Chalk Formations at depth (~27 m top of the chalk).

Associated with historical development of the site, made ground is likely to overlie these natural deposits.

With respect to groundwater resources, the London Clay Formation is classified by the Environment Agency as an unproduction stratum, and the underlying Chalk as a Principal Aquifer.

It is considered that the London Clay would prevent the vertical migration of any contamination from the site (if any) into the underlying chalk aquifer.

The site is located within Zone II of a Source Protection Zone (SPZ) for a public drinking water abstraction borehole located ~1.3 km to the south west. The abstraction is likely to take groundwater from the underlying chalk aquifer.

2.4.4 Environmental searches

The environmental database report contained within the Phase I desk study has been reviewed for relevant information that may impact on the development, a summary of the findings is provided below.

- There are records of active or historical landfills located within 2 km of the site;
- Radon protection measures are not required for the proposed development;
- There are three records of Local Authority Pollution Prevention and Control authorisations within 1 km radius of the site. The closest is for a dry cleaner located 240 m to the south east; and
- There are no records of pollutions incidents on or within 250 m radius of the site.

2.4.5 UXO threat Assessment

A preliminary unexploded ordnance (UXO) risk assessment has been carried out by 1st Line Defence Limited, which is presented in **Appendix C**. The report concluded that there is a low / minimal risk of encountering UXO on the risk and no further mitigation measures are required.

2.5 Initial conceptual site model

2.5.1 Potential sources of contamination

Potential sources of contamination identified from current activities and the history of the site and surrounding area are presented in **Table 2**.

Table 2 Potential sources of soil and groundwater contamination

Potential sources	Contaminants of concern	Current or historical?
On-site Hospital		
Made ground (i.e. fill material)	Unknown fill material but potentially including brick, ash and clinker and containing toxic and phytotoxic metals, inorganics, polycyclic aromatic hydrocarbons (PAHs), asbestos Ground gas.	Historical
Electrical substation	Coolant oil (Petroleum hydrocarbons and PCB's)	Historical
Vehicle parking	Petroleum hydrocarbons	Current
On-site health care centre		
Vehicle parking	Petroleum hydrocarbons	Current
Off-site		
None identified that are likely to impact the development.		

In relation to the vehicle parking, it was noted that hard standing across the car park was in good condition and therefore any minor leaks of oil / fuel are likely to be washed into surface water drainage rather than infiltration to the ground. The potential for any leaks from modern vehicles is also considered to be very low. This source is therefore considered unlikely to pose a significant risk to the development.

There is the potential of minor leaks of coolant oil from the existing electrical substation situated within the south eastern corner of the site. However, any contamination is expected to be localised as the underlying London Clay would restrict lateral migration. The proposed development plans indicate that this area of the site will be used as a car park, and therefore any contamination would be encapsulated beneath hard standing. It is therefore considered that there is no pollutant linkages between any potential contamination and future site users based upon the current proposed development plans.

2.5.2 Sensitive receptors and linking exposure/ migration pathways

Sensitive receptors identified at or in the vicinity of the site that could be affected by the potential sources identified above comprise:

- future site users – residential users of apartment blocks [oral, dermal and inhalation exposure with impacted soil, soil vapour and dust/fibres];
- future site users – workers and public accessing health care centre [oral, dermal and inhalation exposure with impacted soil, soil vapour and dust/fibres];
- future buildings and services [direct contact with contaminated soils or and chemical attack];
- future vegetation [direct contact with contaminated soils or groundwater and root uptake leading to phytotoxicity]; and

- Groundwater within the principal aquifer [piled foundation creating a vertical pathway for contamination to migrate into the aquifer].

Potential linking pathways are show in brackets for each item above.

Please note that construction workers and future maintenance workers have not been identified in the conceptual site model as receptors because risks are considered to be managed through health and safety procedures in accordance with CDM Regulations.

2.6 Initial conceptual risk assessment

The preliminary risk assessment findings and potentially complete contaminant linkages are shown in **Table 3**. The risk classification based on the combination of hazard consequence and probability using a risk matrix from CIRIA C552 (Rudland et al., 2001), a summary of which is included in **Appendix H**.

Table 3 Risk estimation for potentially complete contaminant linkages

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
Former Hospital						
Made ground	Future site users	Direct contact	Low	Medium	Moderate / Low	Made ground is likely to comprise construction debris such as brick and concrete, that poses a low risk to human health, risk may increase if asbestos is present. Unless degradable materials are encountered in the made ground the risk from ground gas is considered to be very low.
	Building services (water supply pipes) Vegetation	Direct contact	Low	Minor	Very low	There is no sign of any vegetation stress within the existing areas of soft landscaping. A suitable thickness of topsoil will be required in proposed areas of soft landscaping. Made ground is not expected to pose any issue to water supply pipes.
	Groundwater	Vertical migration via piled foundations	Unlikely	Medium	Low	It is not certain whether piled foundations will be adopted that would penetrate into the underlying chalk. Made ground is unlikely to contain contaminates that a leachable in significant concentrations that would pose a risk to the underlying groundwater
Boiler room / electrical substation and car park	Groundwater	Vertical migration via piled foundations	No linkage – proposed building will be constructed in eastern portion of the site, and so there will be no piled foundations in these areas.			
Existing health care centre						

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
Made ground	Future site users	Direct contact	Low	Medium	Moderate to Low	The majority of this area will be covered by the proposed new building and car parking and therefore there is a limited potential for exposure. Unless degradable materials are encountered in the made ground the risk from ground gas is considered to be very low.
	Building services (water supply pipes) Vegetation	Direct contact	Low	Minor	Very low	There is no sign of any vegetation stress within the existing areas of soft landscaping. Very limited areas of soft landscaping are shown on the proposed development plan. Made ground is not expected to pose any issue to water supply pipes.
	Groundwater	Vertical migration via piled foundations	Unlikely	Medium	Low	It is not certain whether piled foundations will be adopted that would penetrate into the underlying chalk.
Car park	Groundwater	Vertical migration via piled foundations	No linkage – footprint of proposed building is situated over the existing building and therefore no foundations will be constructed in the car park.			

Risk matrix		Consequences			
		Severe	Medium	Mild	Minor
Probability	Highly likely	Very high	High	Moderate	Moderate/low
	Likely	High	Moderate	Moderate/low	Low
	Low likelihood	Moderate	Moderate/low	Low	Very low
	Unlikely	Moderate/low	Low	Very low	Very low

The initial conceptual site model has identified potentially complete pollutant linkages that require further targeted intrusive investigation to assess the risk. Based on the available information, the highest risk (moderate to low) is considered to be from the potential for future site users to come into direct contact with made ground. All other linkages were assessed a low to very low to the identified receptors.

3 SITE INVESTIGATION STRATEGY & METHODOLOGY

3.1 Introduction

RSK carried out intrusive investigation works during the period 24th to 29th June 2020.

3.2 Objectives

The specific objectives of the investigation were as follows:

- to establish the ground conditions underlying the site including the extent and thickness of any made ground;
- to investigate potential sources of contamination identified in initial CSM;
- to assess geotechnical properties of soils; and
- to establish make-up of the existing foundations beneath parts of the hospital that are to be retained.

3.3 Investigation strategy

The techniques adopted for the investigation were chosen with consideration of the objectives and site constraints.

The ground investigation was carried out using intrusive ground investigation techniques in general accordance with the recommendations of BS5930: 2015 Code of practice for ground investigations, which maintains compliance with BS EN 1997-1 and 1997-2 and their related standards. Whilst every attempt was made to record full details of the strata encountered in the boreholes, techniques of hole formation and sampling will inevitably lead to disturbance, mixing or loss of material in some soils and rocks.

The investigation strategy involved both targeted and non-targeted boreholes and trial pits. The positions of the exploratory points were agreed with the Structural Engineers (Evolve) prior to commencing the site works.

The constraints to the investigation were as follows:

- Where possible exploratory points were moved off trafficked areas of the site to avoid disruption to the current site users;
- Access around the former hospital was limited for a cable percussive rig;
- Due to the presence of buried services, borehole WS1 was relocated approximately 5m northeast of its proposed position; and
- Hand pit 5 was moved in agreement with the structural engineers as the proposed position could not be accessed during the investigation.

Details of the investigation locations, installations and rationale are presented in **Table 4**.

Table 4 Exploratory hole and monitoring well location rationale

Investigation Type	Number	Designation	Monitoring well installation	Rationale Examples below
Boreholes by cable percussive methods	4	BH1 to BH4	None – backfilled upon completion	To prove the geological succession beneath the site and obtain geotechnical data for foundation design. The boreholes were positioned to provide good spatial coverage of the site. Three of the boreholes were drilled to 15 m bgl (BH1 to BH3), and one (BH4) to 20m depth).
Boreholes by windowless sampling methods	6	WS1 to WS6	None – backfilled upon completion	To determine the contamination status of the underlying ground and supplement geotechnical information on the shallow ground conditions. All of the window samples were positioned to provide spatial coverage of the site, also WS1, WS4 and WS6 were located in areas of possible tree root influence.
Trial-pits excavated by hand.	5	HP1 to HP5	n/a	To determine the make-up of the existing foundations on the former hospital. Positions were specified by the structural engineers.
Trial-pits excavated by hand.	3	CBR1 to CBR 3	n/a	In order to obtain CBR values using a clegg hammer for the design of the proposed car park. CBR3 was carried out in the hand pit for BH2.

The locations of the exploratory points are shown on **Figure 2**.

3.3.1 Implementation of investigation works

The exploratory holes were logged by an engineer in general accordance with the recommendations of BS 5930:2015 (which incorporates the requirements of BS EN ISO 14688-1, 14688-2 and 14689-1).

The soil sampling and analysis strategy was designed to characterise each encountered soil strata, permit an assessment of the potential contaminant linkages identified and investigate geotechnical characteristics. In addition, samples were taken to allow for geo-environmental and geotechnical testing to be undertaken.

Soils collected for laboratory analysis were placed in a variety of containers appropriate to the anticipated testing suite required. They were dispatched to the laboratory in cool boxes under chain of custody documentation. Samples were stored in accordance with the RSK quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination.

Selected samples were placed in polythene bags for headspace screening with a photo-ionisation detector (PID) fitted with a 10.6 eV bulb. The PID screening results are presented on the exploratory hole records.

3.4 Laboratory testing

Laboratory testing was undertaken at a UKAS accredited laboratory with ISO17025 and MCERTS accredited test methods were specified where applicable for contamination testing and as shown in the laboratory test certificates appended.

3.4.1 Chemical analysis of soil samples

The soil sampling strategy was designed to characterise made ground and natural soils typically within the upper 1.0 m.

The programme of chemical tests undertaken on soil samples obtained from the intrusive investigation is presented in **Table 5** with the laboratory testing results contained in **Appendix D**.

Table 5 Summary of chemical testing of soil samples

Stratum	Tests undertaken	No. of tests	Rationale
Made ground / Topsoil	Heavy metals and Polycyclic aromatic hydrocarbons (PAHs)	9	Contaminants associated with made ground.
	Asbestos screen	13	
	Speciated petroleum hydrocarbon split into criteria working group	6	Assess risk from leaks and spills of petroleum hydrocarbons.
	Polychlorinated bisphenols (PCB's)	1	Target soils within vicinity of the electrical substation.
	Total organic carbon	6	Confirm ground gas potential of made ground.

3.4.2 Geotechnical analysis of soils

Where appropriate disturbed, bulk and undisturbed soil samples were taken for geotechnical classification testing with the depth and nature of samples detailed within the exploratory hole records.

Where appropriate, testing was undertaken in accordance with BS 1377:1990 Method of Tests for Soils for Civil Engineering Purposes or, where superseded, by the relevant part of BS EN ISO 17892:2014 Geotechnical investigation and testing - Laboratory Testing of

Soil. Tests carried out in order to classify the concrete class required on-site have been undertaken following the procedures within BRE SD1:2005.

The programme of geotechnical tests undertaken on samples obtained from the intrusive investigation is presented in **Table 6**. The results and UKAS accreditation of tests methods are shown in **Appendix E**.

Table 6 Summary of geotechnical testing undertaken

Strata	Tests undertaken	No. of tests
London Clay	Moisture content %	19
	Liquid/ plastic limits	
	Triaxial	9
	pH, ws Sulphate, total Sulphate, total Sulphur	11
	pH, ws sulphate	5
Lambeth Group	Moisture content	1
	Liquid/ plastic limits	1
	pH, ws Sulphate, total Sulphate, total Sulphur	2

3.4.3 Infiltration testing

An infiltration test was carried out in borehole BH2. The borehole was drilled to 3 m depth and the casing pulled back to 2 m before filling the borehole with water to 2 m depth. The water level was monitored for 1 hour using a dip metre. The water level did not alter over the monitoring period indicating little or no significant infiltration.

4 SITE INVESTIGATION FACTUAL FINDINGS

The results of the intrusive investigation and subsequent geo-environmental and geotechnical laboratory analysis undertaken are detailed below.

4.1 Ground conditions encountered

The descriptions of the strata encountered, notes regarding visual or olfactory evidence of contamination, list of samples taken, field observations of soil and groundwater, and in-situ testing are included on the exploratory hole records presented in **Appendix F**.

The exploratory holes revealed that the site is underlain by a variable thickness of made ground over London Clay with the Lambeth Group encountered at depth. This appears to confirm the stratigraphical succession described within the preliminary CSM.

For the purpose of discussion, the ground conditions encountered during the fieldworks are summarised in **Table 7** with the strata discussed in subsequent subsections.

Table 7 General succession of strata encountered

Stratum	Exploratory holes encountered	Depth to top of stratum m bgl	Proven thickness (m)
Made ground / reworked topsoil	All	GL	0.20 to 1.2
London Clay Formation	All	0.20 to 1.2	7.3-11.6
Lambeth Group	BH1 to BH4	8.5-12.0	11 m+

4.1.1 Made ground / reworked topsoil

The presence of made ground was encountered across the site to a maximum depth of 1.2 m. It generally comprises a slightly gravelly to gravelly clay with varying proportions of flint, brick, and concrete. In areas of soft landscaping at BH1, WS02, WS04, and WS5, there was little evidence of anthropogenically derived materials and therefore, it is considered that this stratum represents a reworked topsoil.

With regards to visual and olfactory evidence of contamination, a fragment of cement sheeting was recorded in the made ground at BH2, consistent with asbestos containing material. No other evidence of significant contamination was noted.

4.1.2 London Clay Formation

This stratum was encountered beneath the made ground / reworked topsoil to the full depth of investigation of 15 m bgl. It comprises an initial layer of firm brown slightly sandy, slightly silty CLAY with occasional selenite crystals with the sand content increasing with depth. Between 5 m and 7 m depth, the formation became stiff dark brown thinly laminated silty clay with selenite crystals, which transitioned into a stiff dark grey clay with fine selenite crystals and shell fragments. A bed of black rounded pebbled was noted at 9 m

and 11 m depth in BH1 and BH2 but was not recorded in BH3 and BH4. The black pebble bed is commonly found at the base of the London Clay Formation.

A summary of the in-situ and laboratory test results recorded in the stratum are presented in **Table 8**.

Table 8 Summary of in-situ and laboratory test results for London Clay Formation

Soil parameters	Min. Value	Max. Value	Reference
Moisture content (%)	18.7	33.1	**Appendix E**
Modified moisture content (%)	20	37	
Liquid limit (%)	45	78	
Plastic limit (%)	18	31	
Plasticity index (%)	27	54	
Modified plasticity index (%)	27	54	
Plasticity term	Intermediate	Very high	
Volume change potential	Medium	High	NHBC Chapter 4.2
SPT 'N' values	8	30	**Appendix F**
SPT 'N_{60}' values	10	39	**Figure 3**
Undrained shear strength inferred from SPT 'N' values (kN/m^2)*	46	171	**Figure 4**
Undrained shear strength measured by shear vane testing (kN/m^2)	60	120	**Appendix F**
Undrained shear strength measured by triaxial testing (kN/m^2)	(34) 51	277	**Appendix E**
Consistency term from field description	Firm	Stiff	**Appendix F**
Strength term (inferred from Triaxial testing)	Medium (locally low)	Very high	
Notes: *derived using a Stroud Factor of 5.7 based upon PI 50%			

4.1.3 Lambeth Group

The top of the Lambeth Group (Reading Formation) was recorded between 8.5 m and 12 m bgl and consisted of an initial layer of very stiff grey to greenish grey slightly sandy silt CLAY with fine shell fragments. This was underlain by a very stiff multi-coloured slightly sandy CLAY. A dense brown SAND with clay bands was recorded in BH4 from 17 m to the base of the full extent of the investigation at 20 m bgl.

A summary of the in-situ and laboratory test results recorded in the stratum are presented in **Table 9**.

Table 9 Summary of in-situ and laboratory test results for cohesive soil and granular soils

Soil parameters	Min. Value	Max. Value	Reference
Cohesive			
Moisture content (%)	20	22.2	**Appendix E**
Modified moisture content (%)	20	22.2	
Liquid limit (%)	45	66	
Plastic limit (%)	19	24	
Plasticity index (%)	18	42	
Modified plasticity index (%)	18	42	
Plasticity term	Intermediate	High	
Volume change potential	Low	High	NHBC Chapter 4.2
SPT 'N' values	40	50	**Appendix F**
SPT 'N_{60}' values	52	65	**Figure 3**
Undrained shear strength inferred from SPT 'N' values (kN/m^2)*	168	210	**Figure 4**
Consistency term from field description	Stiff	Very stiff	**Appendix F**
Strength term (inferred from SPT testing)	Very high		
Granular			
SPT 'N' values	-	≥50 (refusal)	**Appendix F**
Density term	Very dense		
Notes: *derived using a Stroud Factor of 4.2			

4.2 Groundwater

The following groundwater observations were made during the investigation,

- BH1 was drilled to 15 m and left open overnight, water level was recorded at 9.5 m bgl the next day;
- Groundwater was recorded at 15 m in BH2 which rose to 13.7 m after 30min; and
- Slight water seepages were recorded at 8.5 m and 7.5 m in BH3 and BH4, respectively.

The groundwater observations are considered to represent perched water London Clay Formation and Lambeth Group.

4.3 Chemical laboratory results

The soil results are presented in **Appendix D**.

4.4 Geotechnical laboratory results

The results of the geotechnical testing are discussed in **Section 7** and presented in **Appendix E**.

5 GEO-ENVIRONMENTAL ASSESSMENT

5.1 Refinement of initial CSM

The ground conditions are in line with those anticipated within the CSM, and therefore there are no changes to the model.

5.1.1 Linkages added after refinement of the initial CSM

- Potential for future site users, vegetation and building services to come into direct contact with made ground; and
- Potential for contamination to migrate into the underlying principal aquifer via piled foundations.

5.2 Linkages for assessment

In line with CLR11 (Environment Agency, 2004), there are two stages of quantitative risk assessment, generic (GQRA) and detailed (DQRA). The GQRA comprises the comparison of soil, groundwater, soil gas and ground gas results with generic assessment criteria (GAC) that are appropriate to the linkage being assessed. This comparison can be undertaken directly against the laboratory results or following statistical analysis depending upon the sampling procedure that was adopted.

Following the refinement of the initial CSM, the potentially complete contaminant linkages that require further assessment and the methodology of assessment are presented in **Table 10**.

Table 10 Linkages for GQRA

Potentially relevant contaminant linkage	Assessment method
Soil	
1. Oral, dermal and inhalation exposure with impacted soil, soil vapour and dust by future residents	Human health GAC in **Appendix G** for a proposed residential end use without home grown produce. This assessment criteria have been selected as the site will be redeveloped with residential apartment blocks with communal soft landscaping.
2. Inhalation exposure of future residents to asbestos fibres	Qualitative assessment based on the asbestos minerals present, their form, concentration, location and the nature of the proposed development.
3. Uptake of contaminants by vegetation potentially impacting plant growth (phytotoxicity)	Comparison of soil data to GAC in **Appendix H** for phytotoxicity.
4. Contaminants permeating potable water supply pipes	Comparison of soil data to GAC in Appendix I for plastic water supply pipes using UKWIR (2010) guidance.

Potentially relevant contaminant linkage	Assessment method
Water	
5. Migration of contaminates into the underlying aquifer via piled foundations	Qualitative assessment using soil data.
Ground Gas	
6. Concentrations of methane and carbon dioxide in ground gas entering and accumulating in enclosed spaces or small rooms in new buildings, which could affect future site users.	Assessment based on visual observation of the ground conditions and testing of soils for organic material to classify the ground gas regime.

5.3 Methodology and assessment of soil results

The analysis of laboratory results relating to soil samples submitted for testing, including leachate analysis, is included in the following sections.

5.3.1 Oral, dermal and inhalation exposure with impacted soil by future occupants/site users

The assessment of the soil results shows that a single elevated concentration of lead (5560 mg/kg) was recorded in excess of the generic assessment criteria of 310 mg/kg in the made ground at WS3. No other samples recorded elevated concentrations of lead elsewhere on the site indicating that the impacted soils are localised. The proposed development plans show that the area around WS3 will be retained as an area of the soft landscaping, and therefore it is considered that the lead impacted soil poses a potential risk to future site users. The risk may be mitigated by the adoption of a capping layer involving partial or complete removal the impacted soils and placement of clean topsoil.

No other elevated concentrations of metals, PAH's or petroleum hydrocarbons were recorded above the assessment criteria. Furthermore, no PCB were recorded above the analytical detection limit in the sample taken from WS4.

5.3.2 Inhalation exposure of future occupants/site users to asbestos fibres

A single cement fragment possibly containing asbestos was identified in the made ground at BH2 during the site works. The results of the laboratory testing confirmed that the fragment of cement contained chrysotile asbestos. Furthermore, low concentrations (below 0.01% volume by weight) of amosite and chrysotile fibres were also recorded in the made ground at this position. No other samples tested recorded the presence of asbestos, however it is considered that due to the abundant use of this material during the period that the health care centre was construction and parts of the hospital (1930-1980s), there is the potential it could be found elsewhere on the site. As a precautionary measure it is recommended that a minimum 300 mm of clean topsoil is placed in all new communal soft landscaped areas to prevent future site users coming into direct contact with the any underlying impacted soils.

5.3.3 Uptake of contaminants by vegetation potentially inhibiting plant growth (phytotoxicity)

The results have been compared with the GAC presented in **Appendix H** for this linkage. The concentration of 5560 mg/kg recorded in the made ground at WS3 exceeds the GAC of 300 mg/kg for this linkage. No other exceedances were recorded.

There was no sign of any vegetation stress within the vicinity of WS3. However, it is considered that the risk may be mitigated by the adoption of a clean cover system in this area.

5.3.4 Impact of organic contaminants on potable water supply pipes

For initial assessment purposes, the results of the investigation have been compared with the GAC presented in Appendix I for this linkage, which are reproduced from *UKWIR Report 10/WM/03/21. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (UKWIR, 2010).

The results indicate that a relevant linkage is unlikely to exist associated with organic contaminants and therefore pollutant polyethylene (PE) and/or polyvinyl chloride (PVC) water supply pipes are expected to be suitable for use on the development.

It should be noted that at the time of this investigation the future routes of water supply pipes had not been established, hence the investigation and sampling strategy may not be fully compliant with UKWIR recommendations. Consequently, a targeted investigation and specific sampling/analytical strategy may be required at a later date once the route(s) of the supply pipe(s) is/are known. In addition, it is recommended that the relevant water supply company be contacted at an early stage to confirm its requirements for assessment, which may not necessarily be the same as those recommended by UKWIR.

5.3.5 Vertical migration of contaminants into principal aquifer via piled foundations

It is proposed that piled foundations will be adopted for the development that will extend to approximately 18 m depth into the granular portion of the underlying Lambeth Group. Groundwater was encountered at ~15 m depth in this stratum which is located in zone II of source protection zone of abstraction well. It is considered that the risk that the piled foundations could create a pathway for contamination to migrate into the groundwater is low given the low levels of contamination recorded on the site. However, a foundation works risk assessment in line with Environment Agency guidance should be carried out to confirm the selected piling technique is not introducing new pathways.

5.3.6 Risk from ground gas

The only source of ground gas identified on-site was the presence of made ground. The intrusive works confirmed that made ground comprised of construction type debris, and chemical testing also showed that it contained low concentrations (below 5%) of organic matter, which would not generate significant volume of ground gas. There is therefore no risk to the proposed development from ground gas and no monitoring is considered to be necessary due to the absence of a viable source.

6 PRELIMINARY WASTE ASSESSMENT

In accordance with the definition provided in the Waste Framework Directive (WFD), materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded, by the holder'. Naturally occurring soils are not considered waste if reused on the site of origin for the purposes of development. Soils such as made ground that are not of clean and natural origin (irrespective of whether they are contaminated or not) and other materials such as recycled aggregate, do not become waste until the criteria above are met. Further background information is provided in **Appendix H**.

Excavation arisings from the development may therefore be classified as waste if surplus to requirements or unsuitable for reuse. The following assessments assume the material tested is classified subsequently as waste.

RSK recommends that a Sampling Plan be prepared to support any waste classifications and hazardous waste assessments, prior to any material being excavated. Given the level of data obtained, scale of the development and heterogeneity of the site soils, the following assessment should be considered indicative and further assessment should be undertaken following the preparation of a waste sampling plan.

6.1 Hazardous waste assessment

Technical Guidance WM3 (EA, 2018) sets out in Appendix D requirements for waste sampling. It is a legal requirement to correctly assess and classify waste. The level of sampling should be proportionate to the volume of waste and its heterogeneity. The preliminary assessment provided below is based only upon the available sample results and may not be sufficient to adequately classify the waste.

6.1.1 Chemical contaminants

Envirolab, an RSK company, has developed a waste soils characterisation assessment tool (HASWASTE), which follows the guidance within Technical Guidance WM3. The analytical results have been assessed using this tool to assess the hazardous properties to support potential off-site disposal of materials in the future. Note that it is ultimately for landfills to confirm what wastes they are able to accept within the constraints of their permit.

The results of the assessment show that the made ground at WS3 would be classified as a hazardous waste due to the concentration of the lead (5560 mg/kg). Further WAC testing is likely to be required to ensure that the material does not leachate limits for a hazardous landfill.

No other samples recorded heavy metals, PAHs or petroleum hydrocarbons recorded concentrations above the hazardous waste limits and therefore may be classified as non-hazardous waste.

6.1.2 Asbestos within waste soils

Technical Guidance WM3 requires that within a mixed waste the separately identifiable wastes be assessed separately.

For instance, where waste soil contains identifiable pieces of asbestos (visible to the naked eye) the asbestos should, where feasible, be separated from the soil and classified separately. This should be disposed of within a hazardous, stable non-reactive hazardous waste landfill or a special cell in a non-hazardous waste landfill.

Samples of potential asbestos containing material were collected from site and analysed for the presence of asbestos, the results of which are presented in **Appendix D**. Analysis confirmed that visible fragment of asbestos was recorded in the made ground at BH2. The made ground may therefore be classified as hazardous waste unless the fragments of asbestos are removed and disposed of separately. Fibrous asbestos was also detected but below the hazardous waste threshold of 0.1%.

6.2 WAC assessment

No samples were submitted for waste acceptance criteria (WAC) testing. Additional testing is likely to be required if soils are to be removed off-site to landfill. It is recommended that the results of the testing are discussed with prospective landfill operators at an early stage to confirm the classification of the material destined for off-site disposal and the requirements for further testing.

7 GEOTECHNICAL ASSESSMENT

7.1 Proposed development

The proposal is for partial demolition of existing structures and redevelopment with two residential blocks designated Block A and B and a Healthcare Centre extension. Construction and structural loads are as follows:

7.1.1 Block A

- RC Frame SLS Column Load = 3200 kN; and
- SFS Frame SLS Wall Load = 200 kN/m.

7.1.2 Block B

- RC Frame SLS Column Load = 3900 kN; and
- SFS Frame SLS Wall Load = 200 kN/m.

7.1.3 Healthcare centre extension

- Small 2 storey extension (brick clad) formed of load bearing masonry walls with line load of 120 kN/m.

Proposed development drawings and proposed layout plan are provided in **Appendix B** and **Figure 2**, respectively.

7.2 Key geotechnical hazards / development constraints

- Sudden lateral changes in ground conditions including made ground/ London Clay interface;
- Silt-rich soils susceptible to rapid loss of strength in wet conditions;
- Whilst not encountered during the assessment, existing sub-structures (existing piled foundations, basements and adjacent sub-structures, including below ground infrastructure) should be considered;
- Filled and made ground; and
- Adverse ground chemistry due to elevated sulphates in the London Clay Formation.

7.3 Ground model and characteristic values

The preliminary ground model summarised in **Table 11** has been adopted for the purpose of the preliminary foundation design recommendations. A single ground model has been adopted based on the findings of Borehole BH04 (20.00 m), where an upper horizon of made ground was encountered overlying a weathered profile of London Clay Formation before grading into the unweathered strata. A variably cohesive and granular sequence of the Lambeth Group was encountered beneath at depth.

Table 11 Ground model derived from ground investigation

Stratum		Elevation at top of stratum	Thickness (m)
BH01			
Made Ground		71.95	0.50
London Clay Formation		71.45	8.50
Lambeth Group	Cohesive	62.95	8.00
	Granular	54.95	Not proven (≥ 3.00)

Groundwater seepages were encountered both within the London Clay Formation and the Lambeth Group, ranging between 64.45 and 59.71 m AOD.

The geotechnical design parameters presented in **Table 12** are based on the results of the fieldwork, in-situ and laboratory testing, and reflect RSK's understanding of the proposed construction at the time this report was written. The designer should assess the applicability of the characteristic values provided below for the design situation under consideration and to ensure that it is a cautious estimate of the value affecting the occurrence of the relevant limit state(s).

Table 12 Summary of characteristic geotechnical design parameters

Design parameter	Stratum			
	Made Ground	London Clay Formation	Lambeth Group	
			Cohesive	Granular
Unit weight - $\gamma_{,k}$ (kN/m^3)	18.0[1]	20.0[4]	20.0[1]	21[1]
Undrained shear strength – $c_{u,}$ (kN/m^2)	-	50 + 8.752z[4]	120+16.25z[4]	-
Peak Effective Angle of Friction - $\varphi'_{pk,k}$ (°)	27[2]	26[2]	27[2]	37[2]
Critical State Angle of Friction - $\varphi'_{cv,k}$ (°)	25[2]	24[3]	25[3]	34[2]
Effective cohesion - $c'_{,k}$ (kN/m^2)	0[2]	2[2]	2[2]	0[2]

Notes 1 Estimated from soil descriptions using Figure 1 & 2 of BS 8002:2015

2 Assumed empirical values in the absence of testing

3 Estimated using Table 2 for fine soils and equations 3 & 4 for coarse soils from BS 8002:2015

4 Based on geotechnical laboratory testing carried out on site derived soil samples

7.4 Foundations

7.4.1 Foundation options

Based on the desk study information and completed intrusive works to date, the ground profile beneath the site comprises a variable thickness of made ground/ reworked topsoil ranging between 0.20 m and 1.20 m which was underlain by a natural geological succession comprising cohesive strata of the London Clay Formation, underlain at depth by variably cohesive and granular units of the Lambeth Group.

The design proposals at the site comprise a two storey extension to the existing health care centre and the construction of two new residential blocks of four-storeys high, designated Blocks A and B.

Given the presence of competent natural soils at relatively shallow depths comprising medium to high strength London Clay Formation, the clay is considered a suitable bearing stratum for the adoption of spread foundations for lightly to moderately loaded structures.

Notwithstanding the above, the site includes a series of semi-mature to mature trees which will be retained during redevelopment such that there is a potential for desiccated soils to be present throughout the site. Foundation depths in line with NHBC Standards will be required to extend beyond the depth of any potential tree influence (desiccation), from both existing and proposed planting. The zone of tree influence may therefore in this instance dictate the localised deepening of spread foundations. Raft foundations are unlikely to be an economical option as a result of deepening requirements and constructing spread foundations at depth may also prove problematic.

As such, and in addition to the high column loads associated with the larger residential apartment blocks, recourse to piled foundations is likely to provide the more economical design to support the proposed development. Recommendations for both foundation options are provided below.

7.4.2 Spread foundations

The recommendations for the design and construction of spread foundations in relation to the ground conditions are set out in **Table 13**.

Table 13 Design and construction of spread foundations

Design/construction considerations	Design/construction recommendations
Founding stratum	Medium to high strength London Clay Formation
Depth	Foundations should be taken to a minimum depth of 1.0 m below the final or existing ground level, whichever is lower, and at least 0.2 m into the founding stratum below any overlying made ground or to any greater depth required in respect of the special design considerations given below.
Special design considerations	

Design/construction considerations	Design/construction recommendations
Shrinkable soils	Owing to the presence of shrinkable clay soils, foundations should be designed taking into account all the normal precautions, including minimum founding depths, to minimise the risk of future foundation movements in accordance with NHBC Standards, Chapter 4.2, 'Building near trees' or similar. The findings of the ground investigation indicate that foundations must be designed for shrinkable soils of **high** volume change potential.
Stability of excavations	Exploratory locations remained stable during excavation which indicates that foundation excavations should also remain stable in the short term. In the event that excavations are to remain open for longer periods, consideration should be given to the use of trench support systems.
Construction considerations	All foundation excavations should be inspected, and any made ground and soft, organic or otherwise unsuitable materials removed and replaced with mass concrete. The proposed founding stratum is a relatively silt-rich soil, hence susceptible to rapid softening once exposed. Hence all foundation excavations should immediately be blinded with concrete or the full foundation constructed.

For illustrative purposes **Table 14** gives typical design resistances for spread foundations, based on the design parameters given in **Table 12**.

Table 14 Illustration of typical design resistances (R_d) for spread foundations

Typical Design Resistance for DA1 – Combinations C1 & C2 & SLS (kN/m2)				
Foundation Width	**Combination 1 - ULS**	**Combination 2 - ULS**	**SLS**	**Adopted Design Resistance**
Strip Footings				
0.50	280	185	153	153
0.75	261	186	111	111
1.00	282	187	90	90
1.25	283	188	76	76
1.50	285	189	66	66
Notes: All bearing resistances above are gross values				

With respect to Serviceability Limit State (SLS), total settlements are anticipated to be < 25 mm with differential settlements of half this amount.

7.4.3 Piled foundations

Recommendations for the design and construction of pile foundations in relation to the ground conditions are set out in **Table 15**.

Table 15 Design and construction of piled foundations

Design/construction considerations	Design/construction recommendations	
Pile type	The construction of both bored/CFA piles is considered technically feasible at this site.	
Possible constraints on choice of pile type	Given the close proximity of the site to nearby residential neighbourhoods, it is likely that the vibration/noise associated with pile driving will not be acceptable.	
Temporary casing	The presence of groundwater strikes has been recorded within the London Clay Formation and underlying Lambeth Group and therefore bored piles may require temporary casing. Alternatively, the use of continuous-flight-auger (CFA) injected bored piles or driven piles usually overcomes this issue. It is recommended that a specialist piling contractor be consulted with respect to the most suitable piling technique for the prevailing ground conditions.	
Made ground and upper cohesive strata	The thickness of made ground encountered at surfaced should be ignored for the purposes of this preliminary pile design. Due to the potential for shrinkable soils at shallow depth to be desiccated in areas of tree influence, no support should be assumed from the top 3.0 m of the London Clay Formation for piles located within areas of tree influence. Additionally, the upper 3.0 m of the piles should be sleeved or designed in tension to resist any associated uplift forces associated with hydrating desiccated clay.	
Man-made obstructions	The proposals include the demolition of existing buildings to permit construction of new residential apartment blocks and therefore, whilst not encountered during the investigation, sub-structures or other obstructions within made ground cannot be discounted. Buried obstructions may lead to some difficulty during piling and so it is recommended that once the proposed pile layout has been determined, pre-pile probing be carried out at each of the pile positions. Where buried obstructions are encountered, it will be necessary to either relocate the pile(s) or make allowance for removing the obstruction.	
Hard strata	An allowance should be made for chiselling thin 'rock' bands (claystone/ mudstone) within the London Clay Formation and within the Lambeth Group (calcrete).	
Pile design parameter		Bored
Pile design parameters for cohesive deposits – London Clay Formation	Undrained shear strength c_u (kN/m^2)	Cu = 50 kN/m^2 + 8.752z kN/m^2 where z = depth into clay (**Figure 4)**
	Adhesion factor α	0.5
	Bearing capacity factor, N_c	9
Lambeth Group - cohesive	Undrained shear strength c_u (kN/m^2)	Cu = 120 kN/m^2 + 16.25 z kN/m^2 where z = depth into clay (**Figure 4**)

Design/construction considerations	Design/construction recommendations	
	Adhesion factor α	0.5
	Bearing capacity factor, N_c	9
Lambeth Group - Granular	Shaft friction factor (k_s.tan δ)	0.36
	End bearing factor N_q	110
General parameters	Limiting concrete stress (kN/m^2)	7.5 N/mm^2
	Limiting shaft friction (kN/m^2)	110
	Limiting End bearing pressure (kN/m^2)	11,000
SLS Check	Factor of 1.2 on ultimate shaft friction	
Special precautions relating to bored pile shafts and bases	Bored pile concrete should be cast as soon after completion of boring as possible and in any event the same day as boring. Prior to casting the base of the pile bore should be clean, otherwise a reduced safe working load will be required. Similarly, if the pile bore is left open the shaft walls may relax/soften, leading to a reduced safe working load.	

The design resistance has been calculated in accordance with BS EN 1997-1 and the UK National Annex, using partial resistance factors for bored piles, given in **Table 16**.

Table 16 Partial resistance factors (γ_R)

Resistance	Set	
	DA1 C1	DA1 C2
Base - γ_b	1.0	2.0
Shaft (compression) - γ_s	1.0	1.6
Total (compression) - γ_t	1.0	2.0

The design procedure for piles varies considerably, depending on the proposed type of pile. However, for illustrative purposes **Table 17** gives indicative factored pile resistances in accordance with EC7 for traditional bored, cast-in-situ concrete piles of various diameters and lengths based upon the characteristic design parameters given in **Table 11** and **12**.

Table 17 Typical pile design resistances for bored/CFA cast-in-situ piles

Typical Design resistance for DA1 – Combinations C1 & C2 & SLS (kN)										
Pile toe depth		Pile diameter								
M bgl	M AOD	300 mm			400 mm			450 mm		
		C1	C2	SLS	C1	C2	SLS	C1	C2	SLS
14	57.95	543	328	527	765	458	703	883	526	791
15	56.95	621	376	609	872	523	812	1006	601	914
16	55.95	702	425	695	984	591	927	1133	678	1044
17	54.95	1226	696	782	1881	1052	1043	2255	1253	1173
18	53.95	1300	743	868	1980	1114	1158	2366	1322	1303

Consideration should be given to a comparison between the Combination 2 derived geotechnical capacities and the empirically calculated SLS capacities. The lower bound of the two calculated values should be adopted.

It should be stressed that the above capacities do not take into consideration limiting concrete stress nor pile group effects, the latter of which is more pronounced for a large number of closely spaced piles.

Settlement of new piles designed on the basis of the working loads outlined above would typically be anticipated to be in the range of 0.5% to 1.0% of the pile diameter. It should be noted, however, that this range is for individual piles and could increase significantly if piles are installed in closely spaced groups. As such, it may be necessary to determine the overall settlement of the foundation system once the final pile layout is known.

7.4.4 Foundation works risk assessment

The site lies within a source protection zone II for groundwater protection on account of its location in proximity to a groundwater abstraction well. It is anticipated that a foundation works risk assessment report will not be required however, due to the following:

- a considerable thickness of cohesive London Clay Formation/Lambeth Group has been encountered beneath the site and is likely to significantly retard any potential migration pathways to any sensitive receptors at depth (i.e. deep chalk aquifer);
- piled foundations may extend beyond the base of the cohesive soils to be founded within the granular portion of the Lambeth Group. However, no elevated concentrations of potentially mobile contamination were recoded within overlying soils and so the risks posed to the deeper aquifer are considered to be negligible;
- there are no identified ground gas sources present at depth that could become active through the adoption of the proposed foundations; and
- the site history and the findings of the site investigation have not revealed any evidence to suggest the presence of significant contamination (particularly free phase contaminants) within the ground profile.

7.4.5 Floor slabs

Within the footprint of the proposed new buildings, the site is generally underlain by circa. 600 mm of existing made ground/ topsoil. Also, there is the potential for desiccated clay soils. On this basis, it is recommended that ground floors be suspended to protect against the risks from damaging ground heave and designed in accordance with NHBC Standards, Chapter 5.2, 'Suspended ground floors'.

7.5 Roads and hardstanding

In the 1 m to 1.5 m below the proposed finished ground level the exploratory holes have revealed a soil profile comprising predominantly cohesive made ground/ reworked topsoil overlying natural cohesive soils of the London Clay Formation. The potentially poorest sub-grade materials within this profile comprise cohesive made ground and the underlying natural strata of the London Clay Formation.

Laboratory testing has revealed modified plasticity indices within the upper profile of the London Clay Formation ranged between 29% and 54%.

In view of the variable made ground encountered on site and the silt rich and high plasticity nature of the underlying natural strata, the estimated minimum, equilibrium soil-suction, California bearing ratio (CBR) value for the soils and groundwater conditions described above under a completed pavement is 2.0%, based upon Table C1 in TRRL (1984) Report LR1132. This value assumes that during construction the formation level will be carefully compacted, and any soft spots removed and replaced with well-compacted granular fill.

The results of in-situ CBR testing carried out using Clegg Hammer apparatus are summarised in **Table 18**.

Table 18 Summary of CBR values derived from in-situ Clegg Hammer tests

Test location	Material type	Minimum CBR value determined at or just below anticipated formation level
CBR 1	London Clay Formation	3.0%
CBR 2		4.8%
BH3 (CBR 3)	Made Ground (cohesive)	13.0%

The recommended sub-grade soil CBR value for road pavement design is therefore 2%. This value assumes that during construction the formation level will be carefully compacted, and any soft spots removed and replaced with well-compacted granular fill.

The sub-grade condition at the time of construction should be confirmed by testing at the final formation level by in situ CBR testing.

Due to the variability observed within the made ground, the sub-grade soils should be regarded as frost-susceptible, based upon the criteria given in Appendix 1 of TRRL (1970) Report Road Note 29. When the sub-grade is frost-susceptible the thickness of sub-base must be sufficient to give a total thickness of non-frost-susceptible pavement construction over the soil of not less than 450 mm.

7.6 Excavations for foundations and services

The exploratory boreholes and trial pits remained stable during progression which indicates that foundation excavations should also remain stable in the short term. In the event that excavations are to remain open for longer periods, consideration should be given to the use of trench support systems.

Manned entry into any excavations should not be undertaken without provision of suitable shoring and support and dewatering or suitable regrading and battering of side slopes to safe angles. Confined spaces protocols for the Health and Safety of personnel should always be used where man entry into excavations is to be undertaken as low oxygen conditions may be present.

The cohesive nature of the soils encountered suggests that pumping from open sumps should be sufficient to keep the excavations reasonably dry.

Excavation should be possible using conventional site plant. Breakers may be necessary to remove any concrete obstructions within the made ground.

7.7 Chemical attack on buried concrete

This assessment of the potential for chemical attack on buried concrete at the site is based on BRE Special Digest 1: Concrete in aggressive ground, which represents the most up-to-date guidance on this topic currently available in the UK.

The desk study and site reconnaissance survey indicated that, for the purposes of assessing the aggressive chemical environment of the site, the site should be considered as comprising as natural ground likely to contain pyrite.

Based on testing results, **Table 19** gives the characteristic pH, water-soluble and total sulphate content values for soils from each of the geological units encountered on-site.

Table 19 Characteristic pH, water soluble sulphate and total sulphate values

Stratum	pH	Water Soluble Sulphate (mg/l)	Total Potential Sulphate (mg/l)
Made Ground	6.40	97	-
London Clay Formation	5.50	3000	5.94
Lambeth Group (cohesive)	7.84	1040	0.57

Based on the results above and following the steps outlined in the BRE guidance, the Design Sulphate Classes and Aggressive Chemical Environment for Concrete classifications are summarised in **Table 20**, on the basis of water soluble sulphate and total potential sulphate, respectively.

Table 20 Concrete design class

Stratum	Ground water	Water Soluble Sulphate		Total Potential Sulphate	
		DS Class	AC Class	DS Class	AC Class
Made Ground	Static	DS1	AC1s	-	-
London Clay Formation	Mobile	DS3	AC2s	DS5	AC5
Lambeth Group	Mobile	DS2	AC2	DS2	AC2

On the basis of the above assessment and assuming mobile groundwater conditions beneath the site, it is recommended that buried concrete (spread/piled foundations) is designed in accordance with Design Sulphate Class DS-3 and Aggressive Chemical Environment for Concrete Class AC-2s (ACEC-AC). This assumes nominally mobile groundwater conditions and that no significantly disturbed clay comes into contact with concrete foundations.

7.8 Existing foundations

Five trial pits were excavated next to the existing hospital building to be retained as part of the development to determine the construction of the foundations. Trial pit records are presented in **Appendix F**.

The trial pits indicate that the building is founded on strip foundations which are between 600 mm and 880 mm below the existing ground levels. The foundation thickness was recorded between 200 mm and 300 mm.

7.9 Infiltration drainage

The results of the preliminary soakage test carried out within the London Clay Formation at BH2 indicate low rates of infiltration which are typical of the formation. It is therefore considered that shallow soakaways are unlikely to be feasible.

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 Geo-environmental assessment

The results of the site investigation showed that site was undeveloped agricultural land until the construction of the existing hospital in 1924 which was subsequently modified and extended before closure in 2008. The health care centre located in the northeaster portion of the site was constructed during the 1970s.

The ground investigation recorded a variable thickness (0.45 m to 1.2 m) of made ground comprising a gravelly clay with varying proportions of brick and concrete. The made ground is underlain by the London Clay Formation consisting of firm brown slightly sandy, slightly silty CLAY becoming stiff grey thinly laminated silty CLAY with selenite crystals. Shell fragment and a black pebble bed was noted at the base of this formation. The top of the Lambeth Group was encountered between 8.5 m and 12 m depth and comprised an initial layer of very stiff grey to greenish grey silty CLAY with shell fragments over multi-coloured slightly sandy CLAY. A brown sand with clay bands was record from 17 m to the full extent of the investigation at 20 m bgl. Groundwater was encountered at varying depths with the base of the London Clay Formation and within the Lambeth Group, which is considered to represent perched water.

The results of the soil testing recorded the limited evidence of contamination that poses a potential risk to future site users. A single elevated concentration of lead in the made ground at WS3 (next to the former hospital), and asbestos (fragment of cement and fibres) at BH2 (next to the existing health care centre). However, not all areas of proposed landscaping could be investigated due to the existing buildings. Therefore, as a precautionary measure it is considered that a clean capping layer should be adopted for all the future soft landscaped areas to prevent site users coming into direct contact with any impacted made ground. In view of the relatively small areas of planting it is considered that a 300 mm capping layer comprising clean (certified suitable for use) topsoil would be sufficient for all communal soft landscaping.

It is recommended that a remediation strategy should be developed for the site outlining the proposed mitigation measures, which would render the site suitable for the proposed development.

Piled foundations are to be adopted for the proposed development which are to extend ~18 m depth into the underlying Lambeth Group. This formation is located in zone II of source protection zone of a groundwater abstraction well. It is recommended that a foundation works risk assessment in line with Environment Agency guidance should be carried out to confirm the selected piling technique is not introducing new pathways into this aquifer. However, the risk is considered to be low given the limited presence of contamination identified.

No viable sources of ground gas were identified requiring further assessment or gas protection measures. Furthermore, no elevated concentrations of contaminants were identified that would pose a risk to water supply pipes.

The results of the preliminary waste assessment show that the made ground impacted with lead at WS3, and visible fragments of asbestos at BH2 would be classified as

hazardous waste. The waste classification may be reduced for BH2 if the fragments could be segregated from the remaining soils. Elsewhere on the site the samples tested show that the made ground would be classified as a non-hazardous waste. Further testing is likely to be required to fully classify any material destined for off-site disposal. Landfill operators should be consulted to confirm the waste classification and requirements for additional testing.

The findings of this assessment should be issued to the local authority environmental health officer for approval.

8.2 Geotechnical assessment

The key risks identified from the available ground investigation data are discussed below:

- Silt-rich soils susceptible to rapid loss of strength in wet conditions;
- Desiccated clay soils persist in areas of tree root influence;
- Whilst not encountered during the assessment, existing sub-structures (existing piled foundations, basements and adjacent sub-structures, including below ground infrastructure) should be considered;
- Filled and made ground; and
- The potential for adverse ground chemistry exists, which may affect the design of buried concrete and other building materials.

The medium to high strength cohesive soils of the London Clay Formation are considered suitable to provide sufficient bearing resistance for the adoption of traditional spread foundations to support the light to moderate loads within the redevelopment. However, the site is populated by existing vegetation/ trees such that there is the potential for desiccated soils to be present within the footprint of the proposed structures. Foundations depths in cohesive soils will be required to extend beyond the depths of tree influence, and this may not be practicable or economically viable. In this circumstance, and in consideration of the high column loads associated with the larger residential apartment blocks, recourse to a piled foundation solution may prove to be the more favourable option.

In view of variable made ground and the silt rich and highly plastic nature of the underlying natural strata, the recommended sub-grade soil CBR value for preliminary road pavement design is 2.0%. Due to the variability within the subgrade soils, the materials should be regarded as being frost susceptible.

With respect to concrete design, based upon the results of the assessment and assuming mobile groundwater conditions beneath the site, it is recommended that buried concrete (spread/piled foundations) be designed in accordance with Design Sulphate Class DS-3 and Aggressive Chemical Environment for Concrete Class AC-2s (ACEC-AC).

Given the impermeable nature of the natural soils beneath the site, the ground conditions do not appear suitable for the use of pit soakaways.

REFERENCES

British Standards Institution (BSI) (1990), 'BS 1377:1990. Methods of test for soils for civil engineering purposes'.

British Standards Institution (2015), 'BS 5930:2015. Code of practice for ground investigations'.

British Standard Institution (BSI) (2019), 'BS 8485:2015+A1:2019. Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.

British Standards Institution (2011), 'BS 10175:2011 + A2:2017. Investigation of potentially contaminated sites: Code of practice'.

British Standards Institution (2013), BS8576:2013. Guidance on investigations for ground gas – permanent gases and volatile organic compounds (VOCs).

Building Research Establishment (2005), BRE Special Digest 1: Concrete in aggressive ground.

Environment Agency (2018), 'Technical Guidance WM3. Guidance on the classification of and assessment of waste, 1st Edition, v.1.1, May 2018.

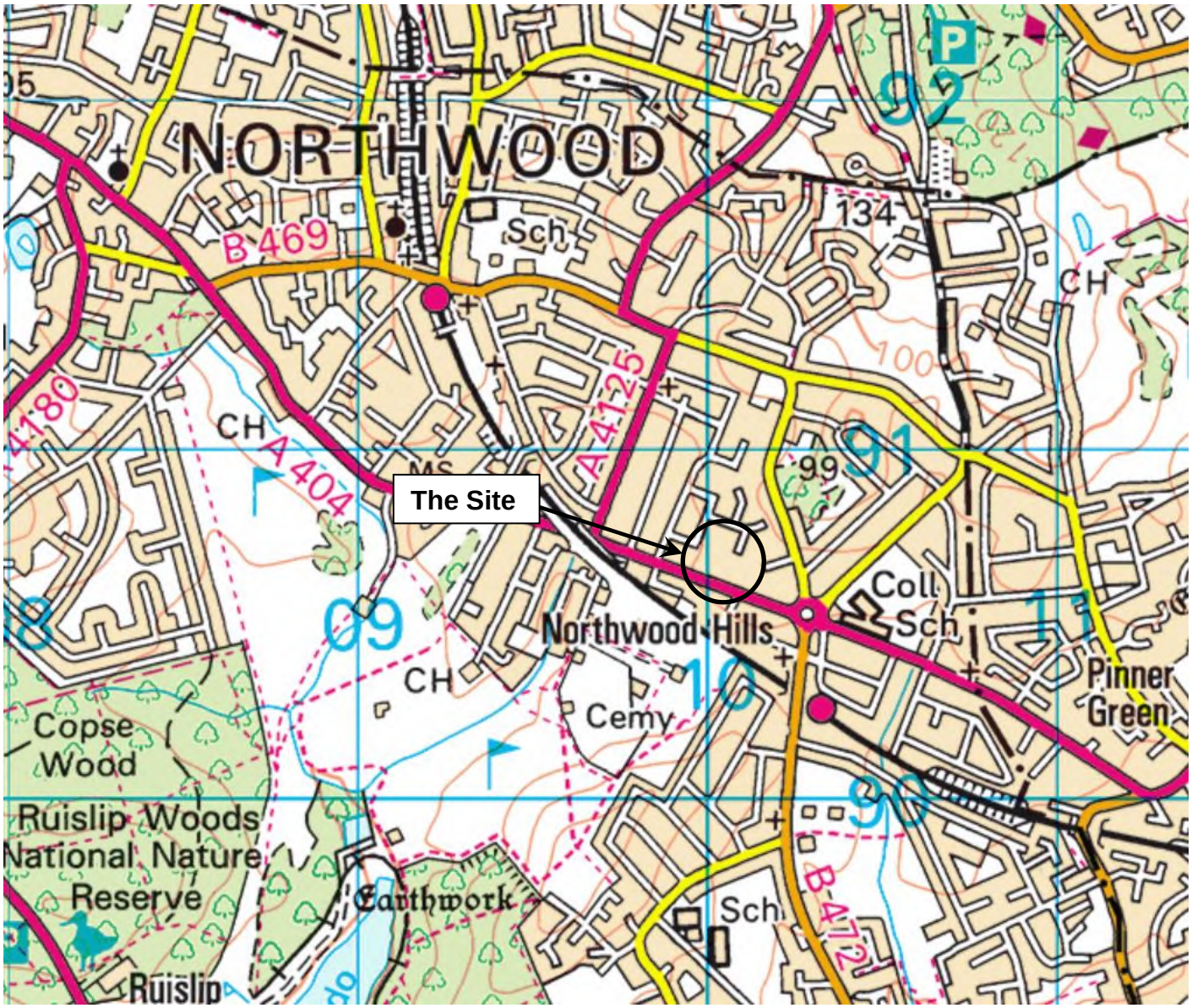
Environment Agency (2004), Model Procedures for the Management of Contaminated Land. Contaminated Land Report Number 11 (CLR11), September (Bristol: Environment Agency).

Part IIA of the Environmental Protection Act (Contaminated Land Regulations (England) 2002 (London: HMSO).

Transport and Road Research Laboratory (1970), 'TRRL Road Note 29 (Appendix 1). Road pavement design'.

Transport and Road Research Laboratory (1984), 'TRRL Report LR1132 (Table C1)'.

FIGURES



Reproduced from the Ordnance Survey 1:50,000 Scale Landranger Map 176,
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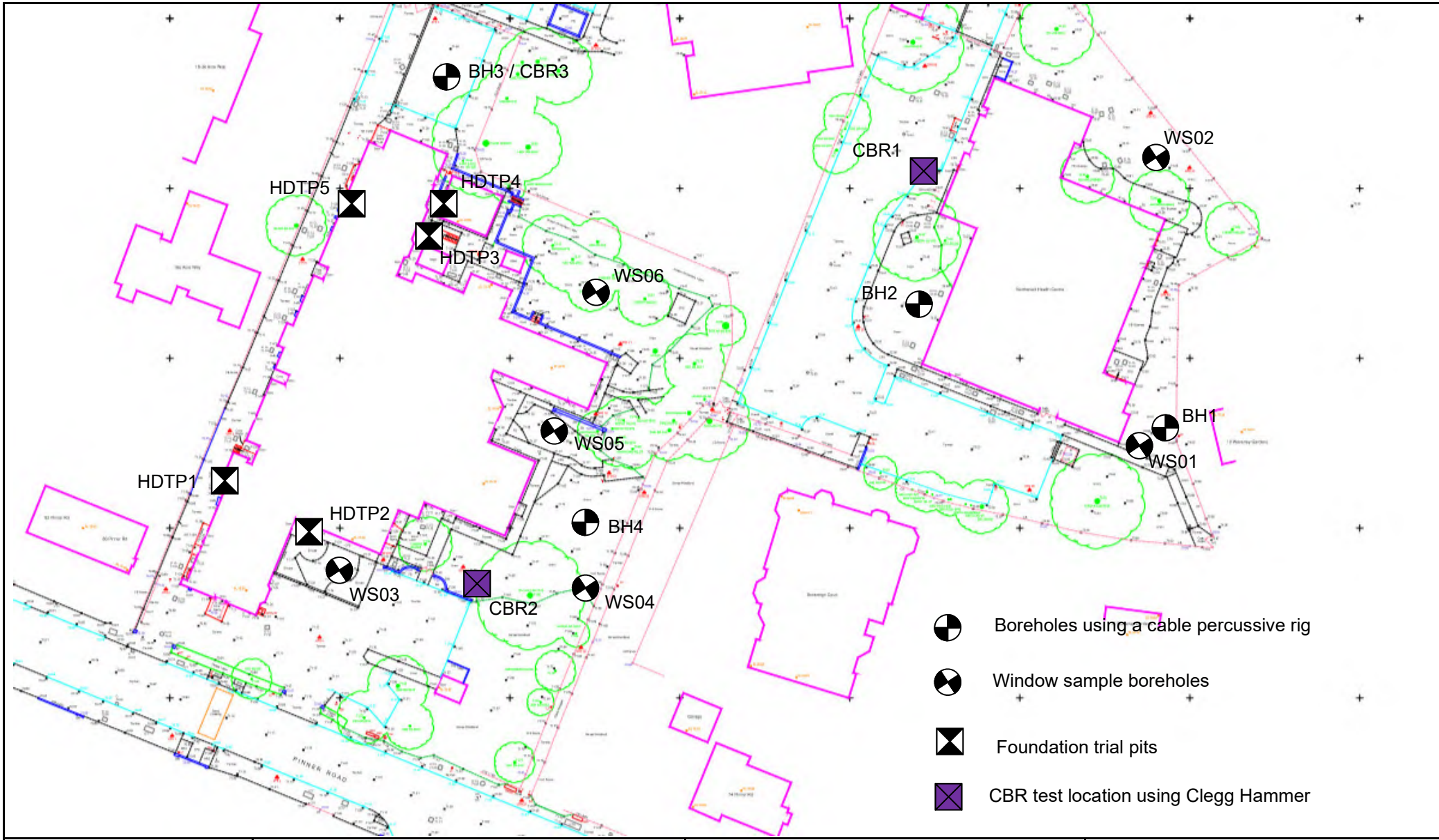
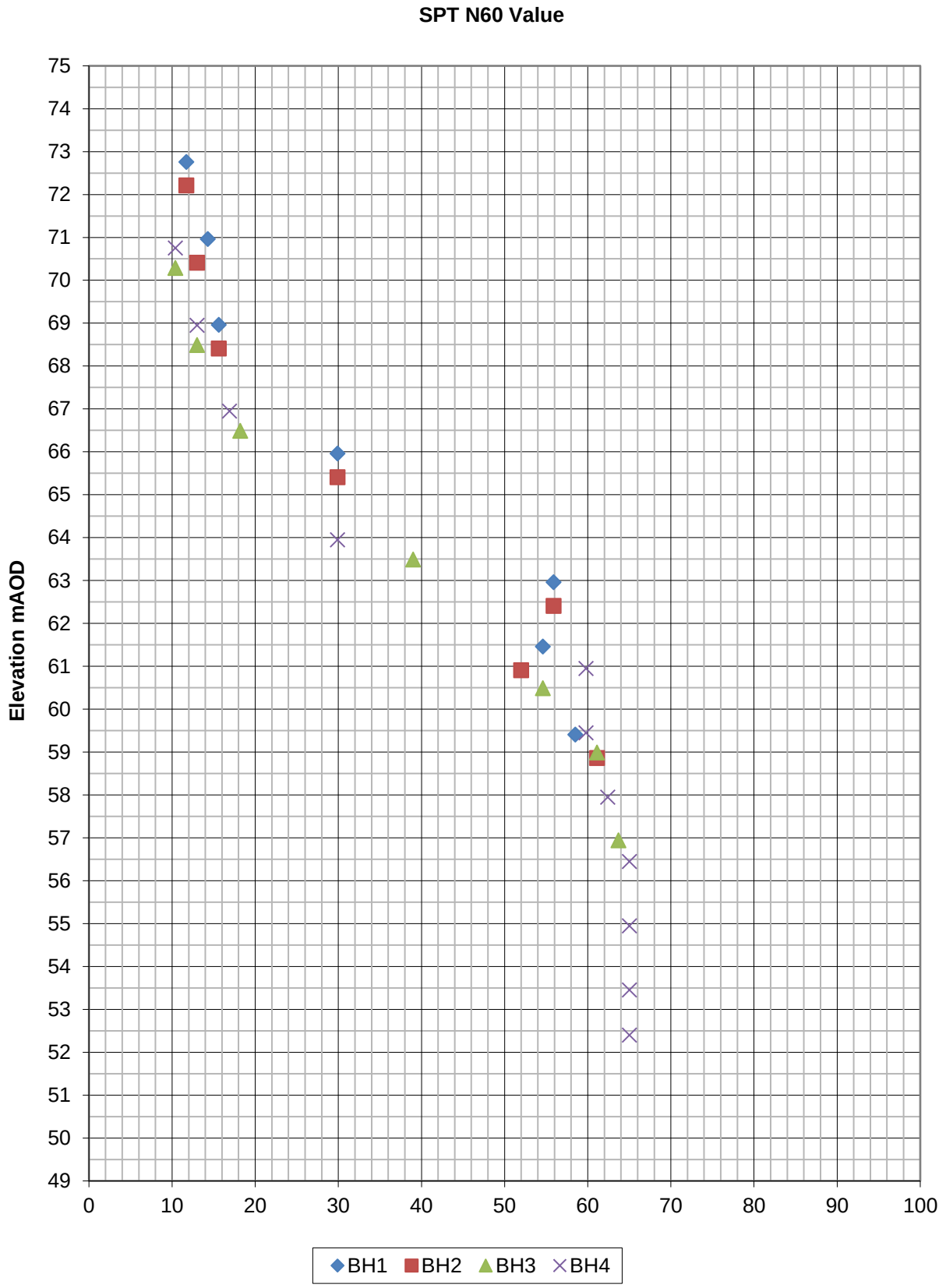
RSK Group Limited, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT.

RSK	**SITE LOCATION PLAN**	**Client:** NHS Property Services	**Figure No:** 1
		Site: North Pinner Cottage Hospital	**Job No:** 1921134
		Scale: N.T.S	**Source:** OS

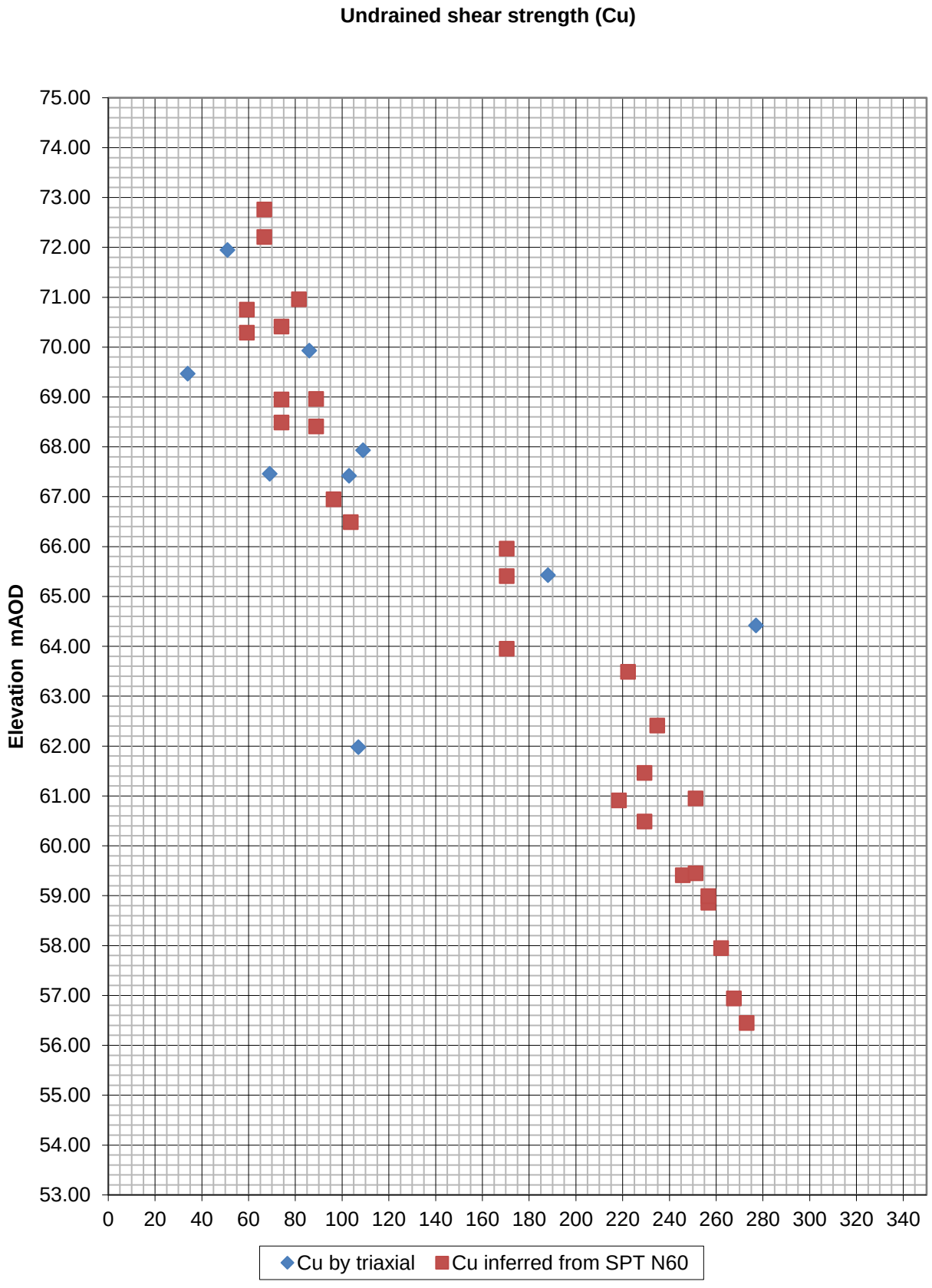


RSK	**Exploratory hole location plan**	**Client:** NHS Property Services Limited	**Figure No:** 2
		Site: Northwood and Pinner Cottage Hospital	**Job No:** 1921134
		Scale: N.T.S	**Source:** N/A

RSK	SPT N60 'N' Values vs Elevation		
Site: Northwood & Pinner Health Centre	**Client:** NHSPS	**Job Number:**	1921134
		Figure:	3



RSK	Undrained Shear Strength vs Elevation		
Site: Northwood & Pinner Health Centre	**Client:** NHSPS	**Job Number:**	1921134
		Figure:	4



APPENDIX A
SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for NHS Property Services (the "client") in accordance with the terms of a contract [RSK Group Standard Terms and Conditions] between RSK and the "client".. The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that, expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed in writing, the Services were performed by RSK exclusively for the purposes of the Client. RSK is not aware of any interest of or reliance by any party other than the Client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the Client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the Client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials, unless specifically identified in the Services.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a visual inspection of the site together with RSK's interpretation of information, including documentation, obtained from third parties and from the Client on the history and usage of the site, unless specifically identified in the Services or accreditation system (such as UKAS ISO 17020:2012 clause 7.1.6):

    a. The Services were based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely.

    b. The Services were limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the visual inspection.

    c. The Services did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services.

    RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the Client and RSK.

8. The intrusive environmental site investigation aspects of the Services are a limited sampling of the site at pre-determined locations based on the known historic / operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the properties of the materials adjacent and local conditions, together with the position of any current structures and underground utilities and facilities, and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters (as stipulated in the scope between the client and RSK, based on an understanding of the available operational and historical information) and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

10. The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows, may vary from those reported due to seasonal, or other, effects and the limitations stated in the data should be recognised.

11. Asbestos is often observed to be present in soils in discrete areas. Whilst asbestos-containing materials may have been locally encountered during the fieldworks or supporting laboratory analysis, the history of brownfield and demolition sites indicates that asbestos fibres may be present more widely in soils and aggregates, which could be encountered during more extensive ground works.

12. Unless stated otherwise, only preliminary geotechnical recommendations are presented in this report and these should be verified in a Geotechnical Design Report, once proposed construction and structural design proposals are confirmed.

APPENDIX B
DEVELOPMENT DRAWINGS

Camlins

New Zealand House, Abbey Foregate,
Shrewsbury, Shropshire, SY2 6FD
01743 290 779
www.camlins.com

Northwood & Pinner NHS Site
NHS Trust

General Arrangement - Landscape Plan

Status	Drawn by	Checked by
Planning	MSS	PSS

Drawing Number	Revision	Scale	Date
SY619-100-0001	-	1:250	25.02.2021

KEY

- Bitumen macadam with coloured wearing course - natural colour aggregate. Parking bays denoted by white line markings, to Engineer's detail.
- Natural stone flags to pedestrian routes and communal courtyards.30mm thick x 300mm coursed x random lengths Sandstone. Where subject to traffick overrun in Plot B, change to natural stone setts with suitable sub-base design to accommodate HGV loading.
- Visitor cycle stands. Sheffield style hoops, stainless steel.
- Proposed retaining wall and steps In situ concrete or timber sleeper or gabion. Heights to be retained vary from 0.5 to 1.5m
- Raised bed planter / allotment beds for residents.
- Roof terraces and extensive green roofs.
- Proposed specimen trees with hedge along Pinner Road.
- Proposed boxed pleached topiary hornbeam trees along site boundary.
- Boundary brickwork wall and railing 2.1m high and railing top to perimeter. Painted steel pedestrian gates, on secure fob access, 2.1m high. Instant hedge and / or climbing plants to private terraces perimeter.
- Existing tree to be retained and protected. Root protection area indicated.
- Mixed shrub and herbaceous planting with leaky pipe irrigation system (non-automated) to all planted areas, and bib taps for each courtyard and roof terrace.
- Timber pergola structure Hardwood timber 2.5m high. Seating beneath.

APPENDIX C
UXO THREAT ASSESSMENT

1st Line Defence Limited
Unit 3, Maple Park, Essex Road, Hoddesdon,
Herts, EN11 0EX
Tel: +44 (0)1992 245 020
E-mail: info@1stlinedefence.co.uk
Company No: 7717863
VAT No: 128 8833 79

www.1stlinedefence.co.uk

Express Preliminary UXO Risk Assessment

Client	RSK
Project	Northwood and Pinner Cottage Hospital
Site Address	Pinner Road, Norwood, HA6 1BT
Report Reference	EP11385-00
Date	12/06/20
Originator	OG

Assessment Objective

This preliminary risk assessment is a qualitative screening exercise to assess the likely potential of encountering unexploded ordnance (UXO) at the Northwood and Pinner Cottage Hospital site. The assessment involves the consideration of the basic factors that affect the potential for UXO to be present at a site as outlined in Stage One of the UXO risk management process.

Background

This assessment uses the sources of information available in-house to 1st Line Defence Ltd to enable the placement of a development site in context with events that may have led to the presence of German air-delivered or Allied military UXO. The report will identify any immediate necessity for risk mitigation or additional research in the form of a Detailed UXO Risk Assessment. It makes use of 1st Line Defence's extensive historical archives, library and unique geo-databases, as well as internet resources, and is researched and compiled by UXO specialists and graduate researchers.

The assessment directly follows CIRIA C681 guidelines "Unexploded Ordnance, a Guide for the Construction Industry". The document will therefore assess the following factors:

- Basic Site Data
- Previous Military Use
- Indicators of potential aerial delivered UXO threat
- Consideration of any Mitigating Factors
- Extent of Proposed Intrusive Works
- Any requirement for Further Work

It should be noted that the vast majority of construction sites in the UK will have a low or negligible risk of encountering UXO and should be able to be screened out at this preliminary stage. The report is meant as a common sense 'first step' in the UXO risk management process. The content of the report and conclusions drawn are based on basic, preliminary research using the information available to 1st Line Defence at the time this report was produced. It should be noted that the only way to entirely negate risk from UXO to a project would be to support the works proposed with appropriate UXO risk mitigation measures. It is rarely possible to state that there is absolutely 'no' risk from UXO to a project.

Risk Assessment Considerations	
Site location and description/current use	The site is located in Northwood, within the London Borough of Hillingdon. The site is currently occupied by Northwood & Pinner Cottage Hospital and Northwood Health Centre, as well as their associated grounds. Residential buildings facing Neal Close are to the north, Waverley Gardens is to the east, Pinner Road is to the south and additional residential dwellings adjoining Acre Way are to the west.  The site is approximately centred on the OS grid reference: **TQ 10058 90672**.
Are there any indicators of current/historical military activity on/close to the site?	In-house records do not indicate that the site footprint had any former military use. No features such as WWII defensive positions, encampments or firing ranges are recorded to have been located at or in the immediate vicinity of the site. In addition, no information of ordnance being stored, produced, or disposed of within the proposed site boundary could be found. The closest recorded Heavy Anti-Aircraft (HAA) battery was situated approximately 8.1km to the south of the site. The conditions in which unexploded anti-aircraft ordnance may have fallen unrecorded within the proposed site are analogous to that of aerially delivered Luftwaffe bombs.
What was the pre- and post-WWII history of the site?	According to pre-WWII OS mapping dated 1932, the site was occupied by *Northwood & Pinner War memorial Hospital* within its western area, with the eastern area defined by open ground. *Hundred Acres Farm* is evident to the immediate south-east of the site boundary. Pinner Road binds the site to the south, with residential dwellings and associated gardens facing Acre Way to the west. Post-WWII OS mapping dated 1959-65 indicates small changes within the site boundary. There are additional small structures within and bordering the north-west section of the site, along with the *Tennis Court* adjacent. Additional development is present to the east and south-east of the site, including new roadways and residential structures.
Was the area subject to bombing during WWII?	During WWII, the site was situated within the Ruislip-Northwood Urban District, which sustained an overall low-moderate density of bombing with an average of 39.1 items recorded per 1,000 acres according to official Home Office statistics. This included 228 high explosive bombs, 4 parachute mines, 20 oil bombs, 1 phosphorous bomb, 4 V-1 pilotless aircraft, and 1 V-2 long-range rocket, resulting in 258 incident across 6,583 acres. London Bomb Census mapping does not record any bombing incidents within the site boundary. An unexploded oil bomb is recorded to the immediate south-east of the site, with another to the north. Local bomb mapping for the area is held in-house and records a high explosive bomb to the south-west of the site across Pinner Road, and another to the north-west over Acre Way. These incidents are dated 21st November 1940, the same date range for the aforementioned unexploded oil bombs. Local incident records for this area are held in-house on this occasion and appear to note two unexploded bombs on the above-mentioned date. These are located at 149

	Pinner Road and 73 Addison Way respectively. Thus, they are not thought to have affected the site.
Is there any evidence of bomb damage on/close to the site?	Middlesex County Council (MCC) War Damage mapping does not record any damage within the site or in the surrounding area. There is no recorded damage in an area of a recorded V-1 strike to the far north-west. Anecdotal evidence suggests this caused significant damage and thus the accuracy of this map is unclear. It should be noted that this mapping does not note more minor levels of damage, however. No changes are evident within the site or vicinity between pre- and post-WWII OS mapping that may be indicative of bomb damage.
To what degree would the site have been subject to access?	Given the sites usage as a hospital, as well as its locality adjacent to roadways and residential properties, access in the area is anticipated to have been frequent. Therefore, it is thought probable that post-raid checks for evidence of UXO are likely to have been carried out.
To what degree has the site been developed post-WWII?	Significant development has occurred within the eastern area of the site, with the construction of the health centre. Additional structures are also evident within the western area. Further residential development has also occurred in the surrounds of the site, particularly to the north.
What is the nature and extent of the intrusive works proposed?	The proposed works are understood to comprise ground investigations including hand pits, window samples and cable percussive boreholes.

Summary and Conclusions

During WWII, the site was situated within the Ruislip-Northwood Rural District, which sustained an overall low-moderate density of bombing according to Home Office statistics, with an average of 39.1 items recorded per 1,000 acres. London Bomb Census mapping records two unexploded oil bombs in relative close proximity to the site, with the closest immediately to the south-east. Local mapping, however, indicates that these bombs were high explosive and the incident to the immediate south-east is now plotted to the south-west across Pinner Road. Local incident records are held in-house on this occasion and appear to indicate that two unexploded bombs fell on 149 Pinner Road and 73 Addison Way – both not located on site.

No changes between pre- and post-WWII OS mapping that may be indicative of bomb damage are notable. Similarly, MCC War Damage mapping does not record any damage within the site boundary or the immediate area. Given the lack of bombing/damage on site, and its usage as a hospital, post-raid checks for evidence of UXO within the area are anticipated to have been frequent.

Recommendations
Given the findings of this preliminary report, it is recommended that **no further research** be undertaken for this site. Whilst it would be possible to conduct a Detailed UXO Risk Assessment in order to acquire additional records such as high-resolution WWII-era aerial photography, it is not thought that the acquisition of such records would significantly alter findings of this report. If the client has any anecdotal or empirical evidence of UXO risk on site, please contact 1st Line Defence.

It should be noted that although the risk from unexploded ordnance on this site has been assessed as low/minimal, this does not mean there is 'no' risk of encountering UXO. This preliminary report has been undertaken with due diligence, and all reasonable care has been taken to access and analyse relevant historical information. By necessity, when dealing historical evidence, and when making assessments of UXO risk, various assumptions have to be made which we have discussed and justified within this report. Our reports take a common-sense and practical approach to the assessment of UXO risk, and we strive to be reasonable and pragmatic in our conclusions. As referenced, it would be possible to undertake further research into this site, but based on the evidence to hand, this is not deemed strictly necessary, and no reasonably justifiable requirement for proactive on-site mitigation has been identified.

It should however be stressed that if any suspect items are encountered during the proposed works, 1st Line Defence should be contacted for advice/assistance, and to re-assess the risk as necessary. Furthermore, we would recommend that ground personnel are always made aware of the potential for encountering UXO, what to look out for and what to do in the unlikely event that a suspect item is encountered, and that a UXO Risk Management Plan is put together for the proposed works. We would be happy to provide a template and guidance for this – contact us on 01992 245020. Should the scope of works change or additional works be proposed, 1st Line Defence should be contacted to re-evaluate the risk.

APPENDIX D
CHEMICAL TEST RESULTS

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 20/05246
Issue Number: 1 **Date:** 13 July, 2020

Client:
RSK Environment Ltd Hemel
18 Frogmore Road
Hemel Hempstead
Hertfordshire
UK
HP3 9RT

Project Manager: Andrew Tranter
Project Name: Northwood & Pinner Cottage Hospital
Project Ref: 1921134
Order No: N/A
Date Samples Received: 30/06/20
Date Instructions Received: 01/07/20
Date Analysis Completed: 13/07/20

Prepared by:

Sophie France
Client Service Manager

Approved by:

Holly Neary-King
Administration & Client Services Supervisor

Envirolab Job Number: 20/05246

Client Project Name: Northwood & Pinner Cottage Hospital

Client Project Ref: 1921134

Lab Sample ID	20/05246/1	20/05246/2	20/05246/3	20/05246/4	20/05246/6	20/05246/7	20/05246/8	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	HDTP1	HDTP1	HDTP2	HDTP3	HDPT5	CBR1	CBR2			
Depth to Top	0.20	0.60	0.45	0.60	0.30	0.50	0.40			
Depth To Bottom										
Date Sampled	24-Jun-20	24-Jun-20	24-Jun-20	24-Jun-20	26-Jun-20	26-Jun-20	26-Jun-20			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Sample Matrix Code	8	5A	5A	5A	6AB	5A	5AE			
% Stones >10mm$_A$	-	-	<0.1	-	40.9	-	3.3	% w/w	0.1	A-T-044
pH$_D$$^{M\#}$	-	-	8.50	-	11.06	-	7.81	pH	0.01	A-T-031s
pH BRE$_D$$^{M\#}$	-	-	-	-	11.06	-	-	pH	0.01	A-T-031s
Sulphate BRE (water sol 2:1)$_D$$^{M\#}$	-	-	-	-	37	-	-	mg/l	10	A-T-026s
Total Organic Carbon$_D$$^{M\#}$	-	-	0.39	-	1.03	-	1.28	% w/w	0.03	A-T-032s
Arsenic$_D$$^{M\#}$	-	-	<1	-	8	-	8	mg/kg	1	A-T-024s
Cadmium$_D$$^{M\#}$	-	-	1.1	-	0.6	-	1.2	mg/kg	0.5	A-T-024s
Copper$_D$$^{M\#}$	-	-	22	-	20	-	20	mg/kg	1	A-T-024s
Chromium$_D$$^{M\#}$	-	-	47	-	15	-	36	mg/kg	1	A-T-024s
Lead$_D$$^{M\#}$	-	-	31	-	236	-	45	mg/kg	1	A-T-024s
Mercury$_D$	-	-	<0.17	-	0.60	-	<0.17	mg/kg	0.17	A-T-024s
Nickel$_D$$^{M\#}$	-	-	27	-	12	-	15	mg/kg	1	A-T-024s
Selenium$_D$$^{M\#}$	-	-	2	-	<1	-	2	mg/kg	1	A-T-024s
Zinc$_D$$^{M\#}$	-	-	66	-	125	-	52	mg/kg	5	A-T-024s

Envirolab Job Number: 20/05246

Client Project Name: Northwood & Pinner Cottage Hospital

Client Project Ref: 1921134

Lab Sample ID	20/05246/1	20/05246/2	20/05246/3	20/05246/4	20/05246/6	20/05246/7	20/05246/8	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	HDTP1	HDTP1	HDTP2	HDTP3	HDPT5	CBR1	CBR2			
Depth to Top	0.20	0.60	0.45	0.60	0.30	0.50	0.40			
Depth To Bottom										
Date Sampled	24-Jun-20	24-Jun-20	24-Jun-20	24-Jun-20	26-Jun-20	26-Jun-20	26-Jun-20			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Sample Matrix Code	8	5A	5A	5A	6AB	5A	5AE			
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_D^{\#}$	NAD	NAD	-	NAD	NAD	NAD	-			A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_D$	N/A	N/A	-	N/A	N/A	N/A	-			A-T-045

Envirolab Job Number: 20/05246

Client Project Name: Northwood & Pinner Cottage Hospital

Client Project Ref: 1921134

Lab Sample ID	20/05246/1	20/05246/2	20/05246/3	20/05246/4	20/05246/6	20/05246/7	20/05246/8	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	HDTP1	HDTP1	HDTP2	HDTP3	HDPT5	CBR1	CBR2			
Depth to Top	0.20	0.60	0.45	0.60	0.30	0.50	0.40			
Depth To Bottom										
Date Sampled	24-Jun-20	24-Jun-20	24-Jun-20	24-Jun-20	26-Jun-20	26-Jun-20	26-Jun-20			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Sample Matrix Code	8	5A	5A	5A	6AB	5A	5AE			
PAH-16MS										
Acenaphthene$_A^{M\#}$	-	-	0.04	-	<0.01	-	<0.01	mg/kg	0.01	A-T-019s
Acenaphthylene$_A^{M\#}$	-	-	<0.01	-	0.01	-	0.01	mg/kg	0.01	A-T-019s
Anthracene$_A^{M\#}$	-	-	0.07	-	<0.02	-	<0.02	mg/kg	0.02	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	-	-	0.09	-	0.10	-	0.27	mg/kg	0.04	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	-	-	0.07	-	0.15	-	0.37	mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	-	-	0.08	-	0.15	-	0.41	mg/kg	0.05	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	-	-	<0.05	-	0.10	-	0.17	mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	-	-	<0.07	-	<0.07	-	0.15	mg/kg	0.07	A-T-019s
Chrysene$_A^{M\#}$	-	-	0.09	-	0.13	-	0.34	mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	-	-	<0.04	-	<0.04	-	<0.04	mg/kg	0.04	A-T-019s
Fluoranthene$_A^{M\#}$	-	-	0.15	-	0.20	-	0.50	mg/kg	0.08	A-T-019s
Fluorene$_A^{M\#}$	-	-	0.05	-	<0.01	-	<0.01	mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	-	-	<0.03	-	0.11	-	0.21	mg/kg	0.03	A-T-019s
Naphthalene $_A^{M\#}$	-	-	0.05	-	<0.03	-	<0.03	mg/kg	0.03	A-T-019s
Phenanthrene$_A^{M\#}$	-	-	0.28	-	0.06	-	0.14	mg/kg	0.03	A-T-019s
Pyrene$_A^{M\#}$	-	-	0.13	-	0.17	-	0.44	mg/kg	0.07	A-T-019s
Total PAH-16MS$_A^{M\#}$	-	-	1.10	-	1.18	-	3.01	mg/kg	0.01	A-T-019s

Envirolab Job Number: 20/05246

Client Project Name: Northwood & Pinner Cottage Hospital

Client Project Ref: 1921134

Lab Sample ID	20/05246/1	20/05246/2	20/05246/3	20/05246/4	20/05246/6	20/05246/7	20/05246/8	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	HDTP1	HDTP1	HDTP2	HDTP3	HDPT5	CBR1	CBR2			
Depth to Top	0.20	0.60	0.45	0.60	0.30	0.50	0.40			
Depth To Bottom										
Date Sampled	24-Jun-20	24-Jun-20	24-Jun-20	24-Jun-20	26-Jun-20	26-Jun-20	26-Jun-20			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Sample Matrix Code	8	5A	5A	5A	6AB	5A	5AE			
TPH CWG										
Ali >C5-C6$_A^{\#}$	-	-	<0.01	-	<0.01	-	<0.01	mg/kg	0.01	A-T-022s
Ali >C6-C8$_A^{\#}$	-	-	<0.01	-	<0.01	-	<0.01	mg/kg	0.01	A-T-022s
Ali >C8-C10$_A$	-	-	<1	-	<1	-	<1	mg/kg	1	A-T-055s
Ali >C10-C12$_A^{M\#}$	-	-	<1	-	<1	-	<1	mg/kg	1	A-T-055s
Ali >C12-C16$_A^{M\#}$	-	-	<1	-	<1	-	<1	mg/kg	1	A-T-055s
Ali >C16-C21$_A^{M\#}$	-	-	<1	-	<1	-	<1	mg/kg	1	A-T-055s
Ali >C21-C35$_A$	-	-	1	-	6	-	4	mg/kg	1	A-T-055s
Total Aliphatics$_A$	-	-	1	-	6	-	4	mg/kg	1	A-T-055s
Aro >C5-C7$_A^{\#}$	-	-	<0.01	-	<0.01	-	<0.01	mg/kg	0.01	A-T-022s
Aro >C7-C8$_A^{\#}$	-	-	<0.01	-	<0.01	-	<0.01	mg/kg	0.01	A-T-022s
Aro >C8-C10$_A$	-	-	<1	-	<1	-	<1	mg/kg	1	A-T-055s
Aro >C10-C12$_A^{M\#}$	-	-	<1	-	<1	-	<1	mg/kg	1	A-T-055s
Aro >C12-C16$_A$	-	-	<1	-	<1	-	<1	mg/kg	1	A-T-055s
Aro >C16-C21$_A^{M\#}$	-	-	<1	-	3	-	<1	mg/kg	1	A-T-055s
Aro >C21-C35$_A^{M\#}$	-	-	1	-	10	-	6	mg/kg	1	A-T-055s
Total Aromatics$_A$	-	-	1	-	13	-	6	mg/kg	1	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	-	-	3	-	19	-	10	mg/kg	1	A-T-055s
BTEX - Benzene$_A^{\#}$	-	-	<0.01	-	<0.01	-	<0.01	mg/kg	0.01	A-T-022s
BTEX - Toluene$_A^{\#}$	-	-	<0.01	-	<0.01	-	<0.01	mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	-	-	<0.01	-	<0.01	-	<0.01	mg/kg	0.01	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	-	-	<0.01	-	<0.01	-	<0.01	mg/kg	0.01	A-T-022s
BTEX - o Xylene$_A^{\#}$	-	-	<0.01	-	<0.01	-	<0.01	mg/kg	0.01	A-T-022s
MTBE$_A^{\#}$	-	-	<0.01	-	<0.01	-	<0.01	mg/kg	0.01	A-T-022s

Envirolab Job Number: 20/05246

Client Project Name: Northwood & Pinner Cottage Hospital

Client Project Ref: 1921134

Lab Sample ID	20/05246/9	20/05246/10	20/05246/11	20/05246/12	20/05246/13	20/05246/14	20/05246/15	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS1	WS2	WS3	WS4	WS5	WS6	BH2			
Depth to Top	0.40	0.20	0.30	0.30	0.30	0.30	0.50			
Depth To Bottom										
Date Sampled	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Sample Matrix Code	6AE	6AE	6ABE	6AE	6ABE	6ABE	6AB			
% Stones >10mm$_A$	1.3	12.2	13.9	<0.1	11.6	8.5	<0.1	% w/w	0.1	A-T-044
pH$_D$$^{M\#}$	7.36	6.40	7.94	7.13	7.63	7.24	-	pH	0.01	A-T-031s
pH BRE$_D$$^{M\#}$	7.36	6.40	-	-	7.63	-	8.51	pH	0.01	A-T-031s
Sulphate BRE (water sol 2:1)$_D$$^{M\#}$	<10	97	-	-	<10	-	16	mg/l	10	A-T-026s
Total Organic Carbon$_D$$^{M\#}$	-	-	3.13	-	3.02	2.77	-	% w/w	0.03	A-T-032s
Arsenic$_D$$^{M\#}$	12	7	7	3	5	8	-	mg/kg	1	A-T-024s
Cadmium$_D$$^{M\#}$	1.5	1.3	1.1	1.0	1.1	1.3	-	mg/kg	0.5	A-T-024s
Copper$_D$$^{M\#}$	27	15	33	23	22	52	-	mg/kg	1	A-T-024s
Chromium$_D$$^{M\#}$	29	33	28	41	32	39	-	mg/kg	1	A-T-024s
Lead$_D$$^{M\#}$	60	53	5560	108	92	146	-	mg/kg	1	A-T-024s
Mercury$_D$	<0.17	<0.17	0.28	<0.17	<0.17	<0.17	-	mg/kg	0.17	A-T-024s
Nickel$_D$$^{M\#}$	16	14	22	18	17	18	-	mg/kg	1	A-T-024s
Selenium$_D$$^{M\#}$	<1	2	3	2	3	2	-	mg/kg	1	A-T-024s
Zinc$_D$$^{M\#}$	89	55	108	74	72	136	-	mg/kg	5	A-T-024s

Envirolab Job Number: 20/05246

Client Project Name: Northwood & Pinner Cottage Hospital

Client Project Ref: 1921134

Lab Sample ID	20/05246/9	20/05246/10	20/05246/11	20/05246/12	20/05246/13	20/05246/14	20/05246/15	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS1	WS2	WS3	WS4	WS5	WS6	BH2			
Depth to Top	0.40	0.20	0.30	0.30	0.30	0.30	0.50			
Depth To Bottom										
Date Sampled	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Sample Matrix Code	6AE	6AE	6ABE	6AE	6ABE	6ABE	6AB			
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{D}^{\#}$	NAD	NAD	NAD	NAD	NAD	NAD	Amosite & Chrysotile			A-T-045
Asbestos Matrix (microscope)$_{D}$	-	-	-	-	-	-	Loose Fibres & Cement			A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_{D}$	N/A	N/A	N/A	N/A	N/A	N/A	No			A-T-045
Asbestos in Soil Quantification % (Hand Picking & Weighing)										
Asbestos in soil % composition (hand picking and weighing)$_{D}$	-	-	-	-	-	-	0.010	% w/w	0.001	A-T-054

Envirolab Job Number: 20/05246

Client Project Name: Northwood & Pinner Cottage Hospital

Client Project Ref: 1921134

Lab Sample ID	20/05246/9	20/05246/10	20/05246/11	20/05246/12	20/05246/13	20/05246/14	20/05246/15	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS1	WS2	WS3	WS4	WS5	WS6	BH2			
Depth to Top	0.40	0.20	0.30	0.30	0.30	0.30	0.50			
Depth To Bottom										
Date Sampled	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Sample Matrix Code	6AE	6AE	6ABE	6AE	6ABE	6ABE	6AB			
PAH-16MS										
Acenaphthene$_A^{M\#}$	0.01	<0.01	0.02	<0.01	0.01	0.01	-	mg/kg	0.01	A-T-019s
Acenaphthylene$_A^{M\#}$	0.02	<0.01	0.02	<0.01	<0.01	0.01	-	mg/kg	0.01	A-T-019s
Anthracene$_A^{M\#}$	0.05	<0.02	0.05	<0.02	0.03	0.05	-	mg/kg	0.02	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	0.35	<0.04	0.45	0.17	0.29	0.38	-	mg/kg	0.04	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.44	0.05	0.58	0.25	0.37	0.46	-	mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	0.47	0.05	0.64	0.29	0.39	0.52	-	mg/kg	0.05	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	0.25	<0.05	0.30	0.13	0.18	0.25	-	mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	0.17	<0.07	0.23	0.10	0.15	0.19	-	mg/kg	0.07	A-T-019s
Chrysene$_A^{M\#}$	0.39	<0.06	0.51	0.24	0.33	0.43	-	mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	0.05	<0.04	0.07	<0.04	0.04	0.05	-	mg/kg	0.04	A-T-019s
Fluoranthene$_A^{M\#}$	0.65	<0.08	0.86	0.34	0.51	0.66	-	mg/kg	0.08	A-T-019s
Fluorene$_A^{M\#}$	0.01	<0.01	0.02	<0.01	<0.01	0.01	-	mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.28	<0.03	0.34	0.15	0.22	0.31	-	mg/kg	0.03	A-T-019s
Naphthalene $_A^{M\#}$	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	mg/kg	0.03	A-T-019s
Phenanthrene$_A^{M\#}$	0.24	0.03	0.34	0.11	0.19	0.25	-	mg/kg	0.03	A-T-019s
Pyrene$_A^{M\#}$	0.56	<0.07	0.74	0.30	0.44	0.56	-	mg/kg	0.07	A-T-019s
Total PAH-16MS$_A^{M\#}$	3.94	0.13	5.17	2.08	3.15	4.14	-	mg/kg	0.01	A-T-019s

Envirolab Job Number: 20/05246

Client Project Name: Northwood & Pinner Cottage Hospital

Client Project Ref: 1921134

Lab Sample ID	20/05246/9	20/05246/10	20/05246/11	20/05246/12	20/05246/13	20/05246/14	20/05246/15	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS1	WS2	WS3	WS4	WS5	WS6	BH2			
Depth to Top	0.40	0.20	0.30	0.30	0.30	0.30	0.50			
Depth To Bottom										
Date Sampled	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Sample Matrix Code	6AE	6AE	6ABE	6AE	6ABE	6ABE	6AB			
Speciated PCB-WHO12										
PCB BZ 81$_A$	-	-	-	<0.005	-	-	-	mg/kg	0.005	A-T-004s
PCB BZ 105$_A$	-	-	-	<0.005	-	-	-	mg/kg	0.005	A-T-004s
PCB BZ 114$_A$	-	-	-	<0.005	-	-	-	mg/kg	0.005	A-T-004s
PCB BZ 118$_A^{M\#}$	-	-	-	<0.007	-	-	-	mg/kg	0.007	A-T-004s
PCB BZ 123$_A$	-	-	-	<0.005	-	-	-	mg/kg	0.005	A-T-004s
PCB BZ 126$_A$	-	-	-	<0.005	-	-	-	mg/kg	0.005	A-T-004s
PCB BZ 156$_A$	-	-	-	<0.005	-	-	-	mg/kg	0.005	A-T-004s
PCB BZ 157$_A$	-	-	-	<0.005	-	-	-	mg/kg	0.005	A-T-004s
PCB BZ 167$_A$	-	-	-	<0.005	-	-	-	mg/kg	0.005	A-T-004s
PCB BZ 169$_A$	-	-	-	<0.005	-	-	-	mg/kg	0.005	A-T-004s
PCB BZ 189$_A$	-	-	-	<0.005	-	-	-	mg/kg	0.005	A-T-004s
PCB BZ 77$_A$	-	-	-	<0.005	-	-	-	mg/kg	0.005	A-T-004s
Total Speciated PCB-WHO12$_A$	-	-	-	<0.007	-	-	-	mg/kg	0.005	A-T-004s

Envirolab Job Number: 20/05246

Client Project Name: Northwood & Pinner Cottage Hospital

Client Project Ref: 1921134

Lab Sample ID	20/05246/9	20/05246/10	20/05246/11	20/05246/12	20/05246/13	20/05246/14	20/05246/15	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS1	WS2	WS3	WS4	WS5	WS6	BH2			
Depth to Top	0.40	0.20	0.30	0.30	0.30	0.30	0.50			
Depth To Bottom										
Date Sampled	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20	25-Jun-20			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Sample Matrix Code	6AE	6AE	6ABE	6AE	6ABE	6ABE	6AB			
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	-	-	-	<0.01	<0.01	-	mg/kg	0.01	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	-	-	-	<0.01	<0.01	-	mg/kg	0.01	A-T-022s
Ali >C8-C10$_A$	<1	-	-	-	<1	<1	-	mg/kg	1	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	-	-	-	<1	<1	-	mg/kg	1	A-T-055s
Ali >C12-C16$_A^{M\#}$	<1	-	-	-	1	<1	-	mg/kg	1	A-T-055s
Ali >C16-C21$_A^{M\#}$	<1	-	-	-	6	<1	-	mg/kg	1	A-T-055s
Ali >C21-C35$_A$	14	-	-	-	79	9	-	mg/kg	1	A-T-055s
Total Aliphatics$_A$	14	-	-	-	86	9	-	mg/kg	1	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	-	-	-	<0.01	<0.01	-	mg/kg	0.01	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	-	-	-	<0.01	<0.01	-	mg/kg	0.01	A-T-022s
Aro >C8-C10$_A$	<1	-	-	-	<1	1	-	mg/kg	1	A-T-055s
Aro >C10-C12$_A^{M\#}$	<1	-	-	-	1	<1	-	mg/kg	1	A-T-055s
Aro >C12-C16$_A$	2	-	-	-	22	3	-	mg/kg	1	A-T-055s
Aro >C16-C21$_A^{M\#}$	7	-	-	-	217	9	-	mg/kg	1	A-T-055s
Aro >C21-C35$_A^{M\#}$	28	-	-	-	459	47	-	mg/kg	1	A-T-055s
Total Aromatics$_A$	37	-	-	-	699	61	-	mg/kg	1	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	51	-	-	-	784	71	-	mg/kg	1	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	-	-	-	<0.01	<0.01	-	mg/kg	0.01	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	-	-	-	<0.01	<0.01	-	mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	-	-	-	<0.01	<0.01	-	mg/kg	0.01	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	-	-	-	<0.01	<0.01	-	mg/kg	0.01	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	-	-	-	<0.01	<0.01	-	mg/kg	0.01	A-T-022s
MTBE$_A^{\#}$	<0.01	-	-	-	<0.01	<0.01	-	mg/kg	0.01	A-T-022s

Envirolab Job Number: 20/05246

Client Project Name: Northwood & Pinner Cottage Hospital

Client Project Ref: 1921134

Lab Sample ID	20/05246/16							Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH2									
Depth to Top										
Depth To Bottom										
Date Sampled	24-Jun-20									
Sample Type	Solid - Fragment / Tile									
Sample Matrix Code	8									
Bulk Fibre ID (inc. matrix)										
Bulk Fibre Identification$_{D}^{\#}$	Chrysotile									A-T-045
Bulk Fibre Identification Matrix (visual)$_{D}$	Cement									A-T-045
Bulk Fibre Identification - Suitable for Water Absorption Test?$_{D}$	Yes									Gravimetry

REPORT NOTES

General
This report shall not be reproduced, except in full, without written approval from Envirolab.
The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.
The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: RSK Environment Ltd Hemel, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, UK, HP3 9RT

Project: Northwood & Pinner Cottage Hospital

Clients Project No: 1921134

Project No: 20/05246

Date Received: 01/07/2020 (am)

Cool Box Temperatures (°C): 14.2, 14.5

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

APPENDIX E
GEOTECHNICAL TEST RESULTS

STRUCTURAL SOILS LTD

TEST REPORT

Report No. 584297-01 (00) 1774

Date 21-July-2020 Contract Northwood and Pinner Cottage Hopsital

Client RSK
Address 18 Frogmore Rd
Apsley
Hemel Hempstead
Hertfordshire
HP3 9RT
For the Attention of Andrew Tranter

Samples submitted by client	02-July-2020	Client Reference	1921134
Testing Started	06-July-2020	Client Order No.	n/a
Testing Completed	21-July-2020	Instruction Type	Written

Tests marked 'Not UKAS Accredited' in this report are not included in the UKAS Accreditation Schedule for our Laboratory.

UKAS Accredited Tests

P105	Water Content BS EN ISO 17892-1
P114	Liquid and plastic limits BS EN ISO 17892-12
P112	UU Triaxial BS EN ISO 17892-8

Undertaken by a sub-contractor

2.06	Sulphate content (acid extract) in accordance with BRE Special Digest 1:2005
2.04	Sulphate content (water extract) in accordance with BRE Special Digest 1:2005
2.07	pH value in accordance with BRE Special Digest 1:2005
2.05	Total sulphur in accordance with BRE Special Digest 1:2005

Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of .
Test were undertaken on samples 'as received' unless otherwise stated.
Opinions and interpretations expressed in this report are outside the scope of accreditation for this laboratory.

Structural Soils Ltd 18 Frogmore Rd Hemel Hempstead HP3 9RT Tel.01442 416661 e-mail dimitris.xirouchakis@soils.co.uk

TESTING VERIFICATION CERTIFICATE

1774

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with the Structural Soils Ltd Laboratory Quality Management System, results sheets and summaries of results issued by the laboratory are checked by an approved signatory. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **21/07/2020 09:43:35**.

Testing reported after this date is not covered by this Verification Certificate.

Approved Signatory
Alan Frost (Data Quality Manager)

(Head Office)
Bristol Laboratory
Unit 1A, Princess Street
Bedminster
Bristol
BS3 4AG

Castleford Laboratory
The Potteries, Pottery Street
Castleford
West Yorkshire
WF10 1NJ

Hemel Laboratory
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Tonbridge Laboratory
Anerley Court, Half Moon Lane
Hildenborough
Tonbridge
TN11 9HU

STRUCTURAL SOILS LTD	Contract: **Northwood and Pinner Cottage Hospital**	Job No: **584297**

TESTING VERIFICATION CERTIFICATE

1774

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with the Structural Soils Ltd Laboratory Quality Management System, results sheets and summaries of results issued by the laboratory are checked by an approved signatory. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **21/07/2020 15:56:55**.

Testing reported after this date is not covered by this Verification Certificate.

Approved Signatory
Sharon Cairns (Laboratory Manager)

(Head Office)
Bristol Laboratory
Unit 1A, Princess Street
Bedminster
Bristol
BS3 4AG

Castleford Laboratory
The Potteries, Pottery Street
Castleford
West Yorkshire
WF10 1NJ

Hemel Laboratory
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Tonbridge Laboratory
Anerley Court, Half Moon Lane
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STRUCTURAL SOILS LTD	Contract: **Northwood and Pinner Cottage Hospital**	Job No: **584297**

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with Part 1,Part 12 of BS EN ISO 17892

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Water Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425um	Description of Sample
BH1		U	2.00	33.1	77	23	54	100	Brown mottled light grey CLAY
BH1		U	4.00	20.3	68	20	48	91	Brown CLAY with occasional gypsum
BH1		U	6.50	21.9	45	18	27	100	Brown CLAY with occasional gypsum
BH1		D	14.00	22.2	66	24	42	100	Brown mottled with blue and orangish brown CLAY
BH3		U	9.50	20.0	37	19	18	100	Greyish brown slightly sandy silty CLAY with occasional shell fragments
BH4		U	4.00	23.4	52	20	32	100	Brown slightly sandy CLAY with occasional gypsum
BH4		U	6.50	18.7	48	17	31	94	Greyish brown slightly sandy CLAY with occasional gypsum
HDTP1		D	0.65	30.4	53	22	31	92	Brown mottled with orangish brown and dark brown slightly gravelly CLAY

SYMBOLS: * denotes BS 1377

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with Part 1,Part 12 of BS EN ISO 17892

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Water Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425um	Description of Sample
HDTP2		D	1.00	33.5	66	23	43	90	Brown mottled orange CLAY
WS1		D	1.00	22.6	66	24	42	92	Brown mottled grey and orangish brown slightly gravelly CLAY
WS1		D	2.00	24.0	74	23	51	99	Brown mottled orangish brown and white slightly sandy CLAY with gypsum
WS1		D	3.50	25.7	69	25	44	99	Brown mottled orangsih brown CLAY with gypsum
WS2		D	1.00	29.0	68	27	41	100	Brown mottled orange CLAY
WS2		D	2.30	29.7	78	26	52	95	Brown mottled bluish grey CLAY
WS3		D	1.00	31.9	68	23	45	100	Brown mottled orange and light grey CLAY
WS3		D	2.50	27.0	65	26	39	99	Brown mottled orangish brown and white slightly sandy CLAY with gypsum

SYMBOLS: * denotes BS 1377

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with Part 1,Part 12 of BS EN ISO 17892

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Water Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	% <425um	Description of Sample
WS4		D	1.00	31.8	76	25	51	100	Brown mottled very dark brown CLAY with organics
WS4		D	2.40	27.2	66	24	42	99	Brown mottled orange CLAY with gypsum
WS6		D	1.00	27.3	71	25	46	100	Brown mottled light grey slightly gravelly CLAY
WS6		D	2.50	23.7	64	24	40	97	Brown mottled orange CLAY with gypsum

SYMBOLS: * denotes BS 1377

STRUCTURAL SOILS LTD

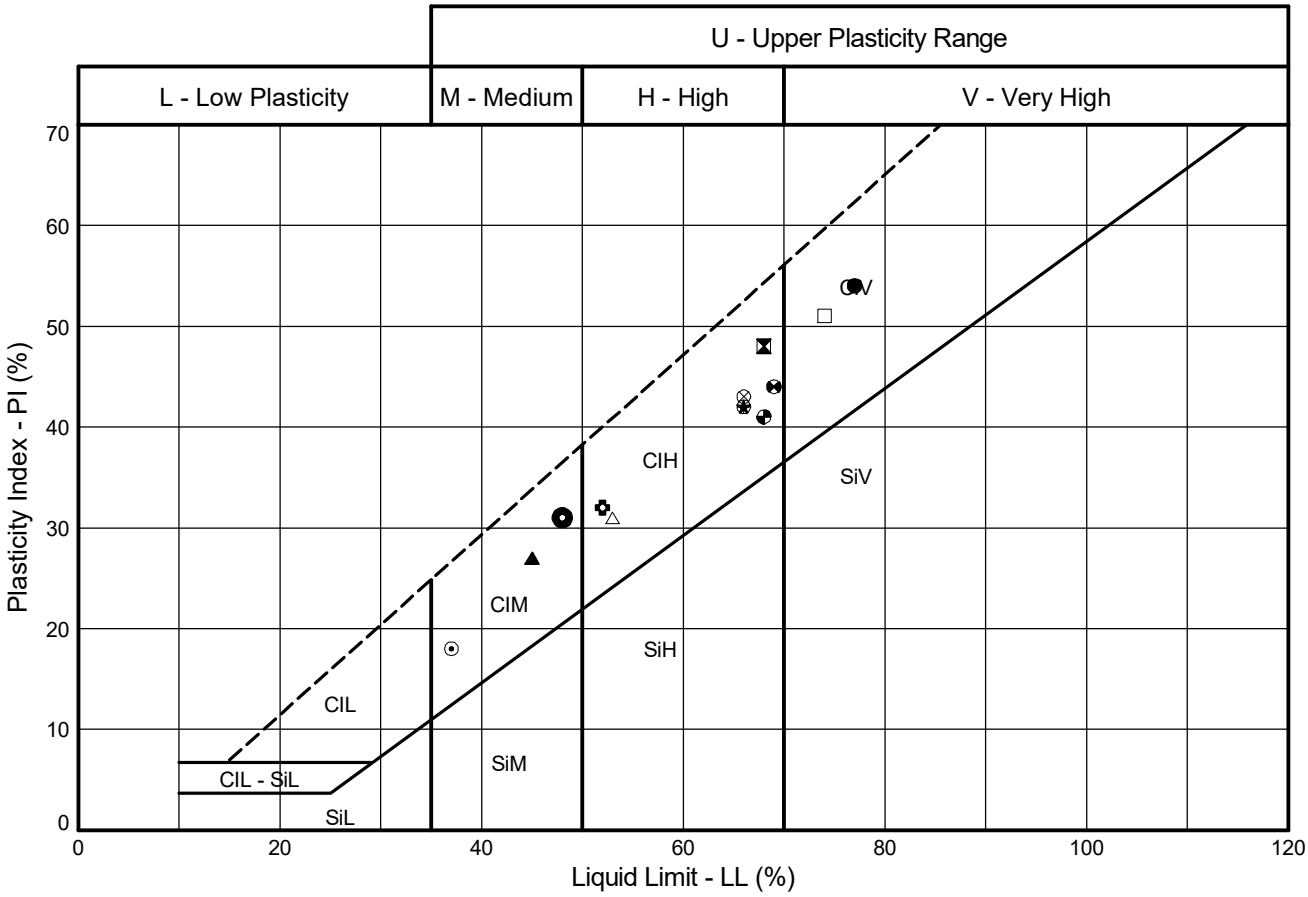
Contract: **Northwood and Pinner Cottage Hospital**

Contract Ref: **584297**

AGS

PI vs LL CHART

According to BS EN 14688-2:2018
Testing in accordance with BS EN ISO 17892-12:2018



Sample Identification				Test Method #	Preparation Method +	WC	LL	PL	PI	<425µm	Lab location	Notes
	Exploratory Position ID	Sample	Depth (m)			%	%	%	%	%		
●	BH1	U	2.00	5.3.14/5.5/6.5	5.2.1	33.1	77	23	54	100	B	
⊠	BH1	U	4.00	5.3.14/5.5/6.5	5.2.1	20.3	68	20	48	91	B	
▲	BH1	U	6.50	5.3.14/5.5/6.5	5.2.1	21.9	45	18	27	100	B	
★	BH1	D	14.00	5.3.14/5.5/6.5	5.2.7	22.2	66	24	42	100	H	
⊙	BH3	U	9.50	5.3.14/5.5/6.5	5.2.1	20.0	37	19	18	100	B	
✿	BH4	U	4.00	5.3.14/5.5/6.5	5.2.1	23.4	52	20	32	100	B	
◉	BH4	U	6.50	5.3.14/5.5/6.5	5.2.1	18.7	48	17	31	94	B	
△	HDTP1	D	0.65	5.3.14/5.5/6.5	5.2.7	30.4	53	22	31	92	H	
⊗	HDTP2	D	1.00	5.3.14/5.5/6.5	5.2.7	33.5	66	23	43	90	H	
⊕	WS1	D	1.00	5.3.14/5.5/6.5	5.2.7	22.6	66	24	42	92	H	
□	WS1	D	2.00	5.3.14/5.5/6.5	5.2.7	24.0	74	23	51	99	H	
⊠	WS1	D	3.50	5.3.14/5.5/6.5	5.2.7	25.7	69	25	44	99	H	
◒	WS2	D	1.00	5.3.14/5.5/6.5	5.2.7	29.0	68	27	41	100	H	

Tested in accordance with the following clauses of BS EN ISO 17892-12:2018.

5.3 - Cone Penetrometer Method
5.3.14 - One-Point Cone Penetrometer Method
5.4 - Casagrande Method
5.5 - Plastic Limit Method
6.5 - Plasticity Index

Water Content (WC) tested in accordance with BS EN ISO 17892-1:2014

+ Tested in accordance with the following clauses of BS EN ISO 17892-12:2018.

5.2.1 - Natural State
5.2.7 - Wet Sieved

Key: * = Non-standard test, NP = Non plastic.

Lab location: B = Bristol (BS3 4AG), C = Castleford (WF10 1NJ), H = Hemel Hempstead (HP3 9RT), T = Tonbridge (TN11 9HU)

STRUCTURAL SOILS LTD

Compiled By		Date
SC	**SHARON CAIRNS**	**21/07/20**

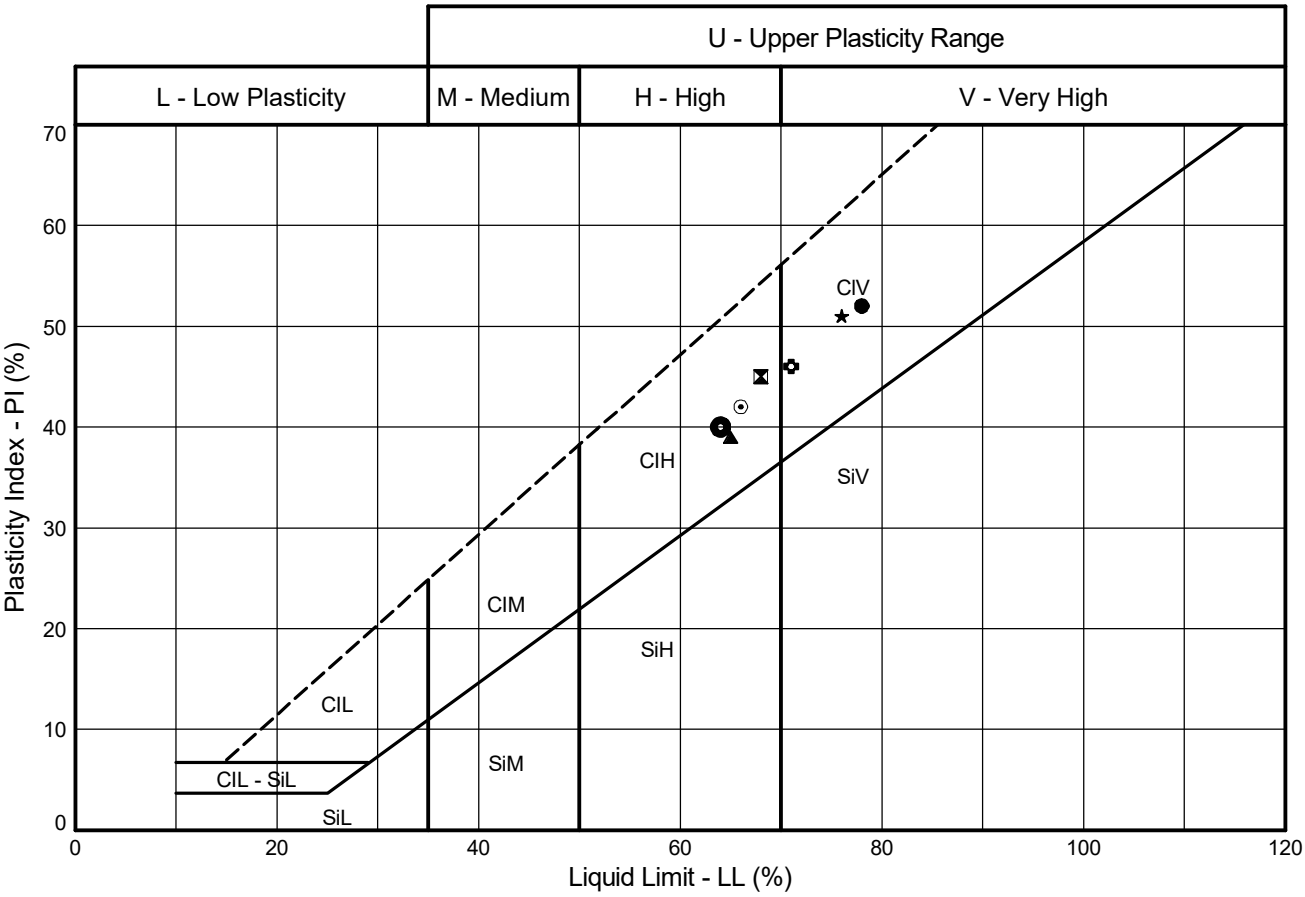
Contract: **Northwood and Pinner Cottage Hospital**

Contract Ref: **584297**

AGS

PI vs LL CHART

According to BS EN 14688-2:2018
Testing in accordance with BS EN ISO 17892-12:2018



Sample Identification				Test Method #	Preparation Method +	WC %	LL %	PL %	PI %	<425µm %	Lab location	Notes
	Exploratory Position ID	Sample	Depth (m)									
●	WS2	D	2.30	5.3.14/5.5/6.5	5.2.7	29.7	78	26	52	95	H	
⊠	WS3	D	1.00	5.3.14/5.5/6.5	5.2.1	31.9	68	23	45	100	H	
▲	WS3	D	2.50	5.3.14/5.5/6.5	5.2.7	27.0	65	26	39	99	H	
★	WS4	D	1.00	5.3.14/5.5/6.5	5.2.1	31.8	76	25	51	100	H	
⊙	WS4	D	2.40	5.3.14/5.5/6.5	5.2.7	27.2	66	24	42	99	H	
✿	WS6	D	1.00	5.3.14/5.5/6.5	5.2.7	27.3	71	25	46	100	H	
●	WS6	D	2.50	5.3.14/5.5/6.5	5.2.7	23.7	64	24	40	97	H	

Tested in accordance with the following clauses of BS EN ISO 17892-12:2018.

5.3 - Cone Penetrometer Method
5.3.14 - One-Point Cone Penetrometer Method
5.4 - Casagrande Method
5.5 - Plastic Limit Method
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5.2.1 - Natural State
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Key: * = Non-standard test, NP = Non plastic.

Lab location: B = Bristol (BS3 4AG), C = Castleford (WF10 1NJ), H = Hemel Hempstead (HP3 9RT), T = Tonbridge (TN11 9HU)

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Compiled By		Date
SC	**SHARON CAIRNS**	**21/07/20**

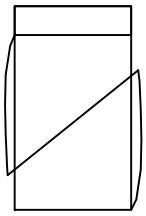
Contract	Contract Ref:
Northwood and Pinner Cottage Hospital	**584297**

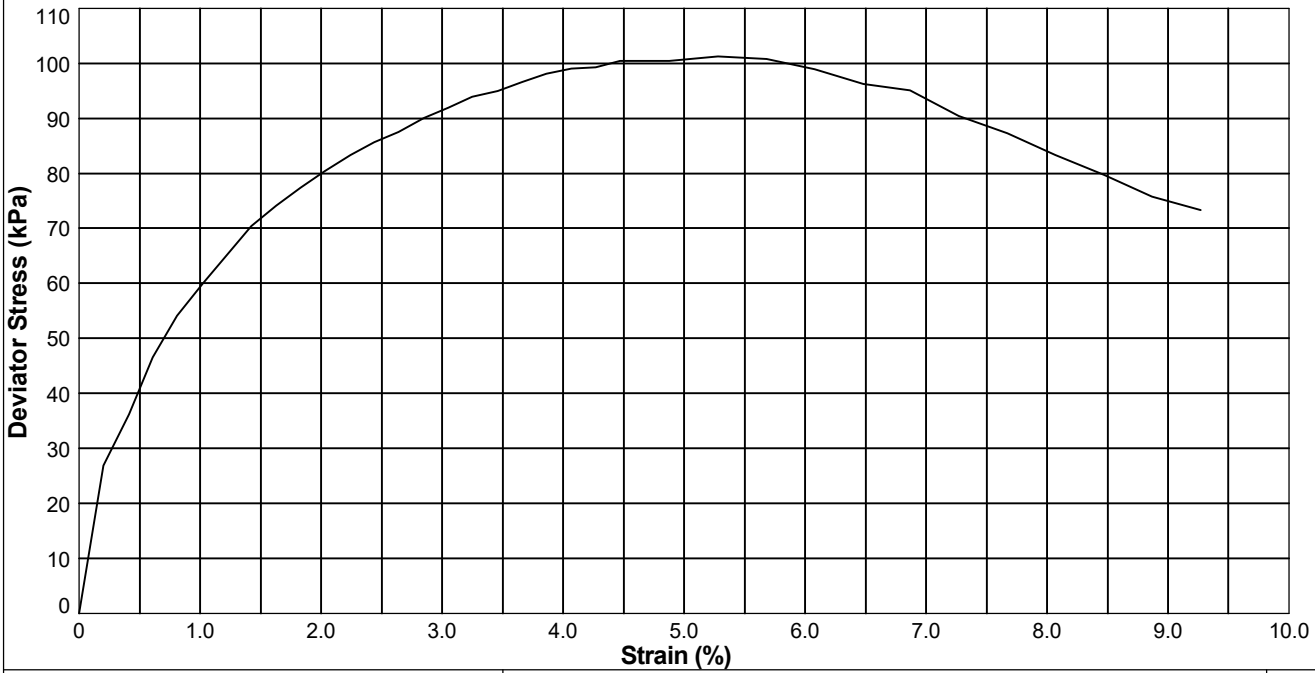
UNCONSOLIDATED QUICK UNDRAINED (SINGLE STAGE) TRIAXIAL COMPRESSION TEST

In accordance with BS EN ISO 17892 Part 8

Borehole: **BH1** Sample Ref: Sample Type: **U** Depth (m): **2.01**

Description : **Brown mottled light grey CLAY**

STAGE NUMBER			1	2	3
SAMPLE DETAILS	Sample Condition		Undisturbed		
	Orientation of sample		Vertical		
	Diameter	(mm)	105.23		
	Height	(mm)	201.79		
	Moisture Content	(%)	32		
	Bulk Density	(Mg/m^3)	1.91		
	Dry Density	(Mg/m^3)	1.44		
TEST DETAILS	Membrane Type		Rubber		
	Membrane Thickness	(mm)	0.29		
	Rate of Axial Displacement	(%/min)	1.34		
	Cell Pressure	(kPa)	40		
	Membrane Correction	(kPa)	0.39		
	Corrected Deviator Stress	(kPa)	101		
	Undrained Shear Strength	(kPa)	51		
FAILURE DETAILS	Strain at Failure	(%)	5.3		
	Mode of Failure 1 : **Brittle (shear plane)**				



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Bristol
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Compiled By		Date
	CONNEL MCLAUGHLIN	20/07/20

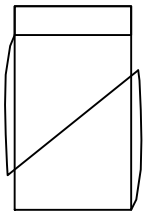
Contract	Contract Ref:
Northwood and Pinner Cottage Hospital	**584297**

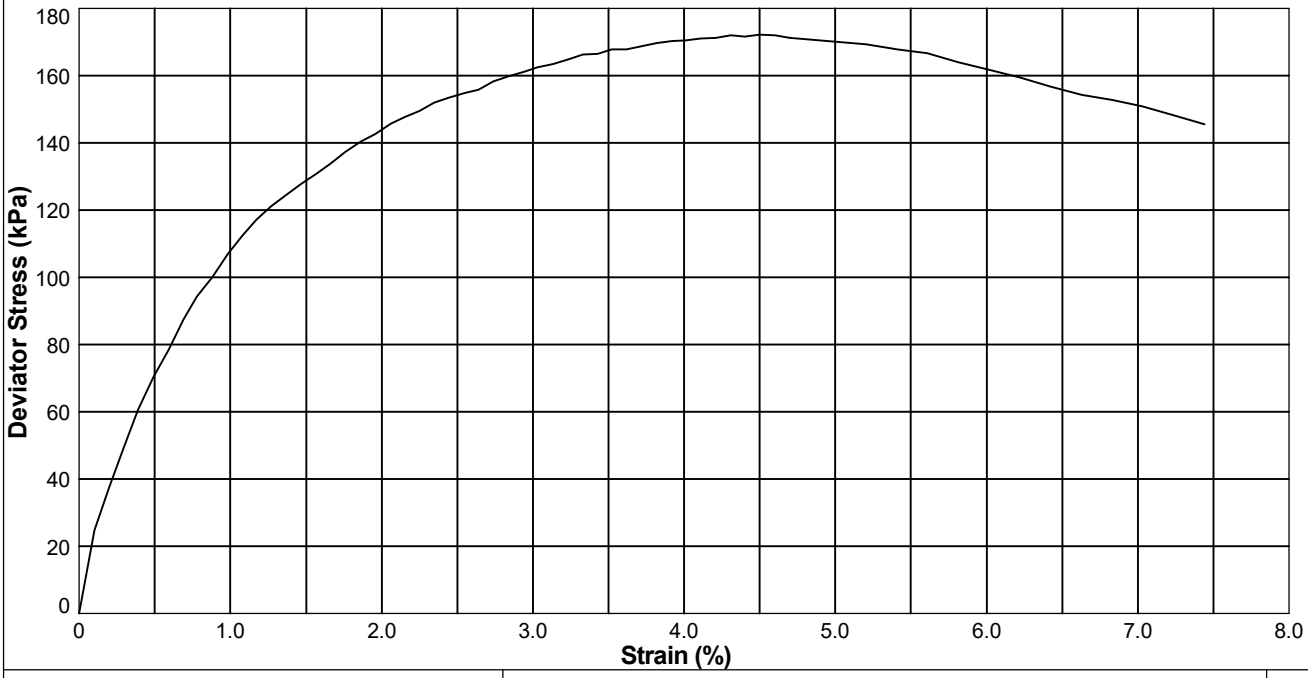
UNCONSOLIDATED QUICK UNDRAINED (SINGLE STAGE) TRIAXIAL COMPRESSION TEST

In accordance with BS EN ISO 17892 Part 8

Borehole: **BH1** Sample Ref: Sample Type: **U** Depth (m): **4.03**

Description : **Brown CLAY with occasional gypsum**

STAGE NUMBER			1	2	3
SAMPLE DETAILS	Sample Condition		Undisturbed		
	Orientation of sample		Vertical		
	Diameter	(mm)	105.34		
	Height	(mm)	201.81		
	Moisture Content	(%)	26		
	Bulk Density	(Mg/m^3)	1.92		
	Dry Density	(Mg/m^3)	1.53		
TEST DETAILS	Membrane Type		Rubber		
	Membrane Thickness	(mm)	0.25		
	Rate of Axial Displacement	(%/min)	0.99		
	Cell Pressure	(kPa)	80		
	Membrane Correction	(kPa)	0.29		
	Corrected Deviator Stress	(kPa)	172		
	Undrained Shear Strength	(kPa)	86		
FAILURE DETAILS	Strain at Failure	(%)	4.5		
	Mode of Failure 1 : **Brittle (shear plane)**				



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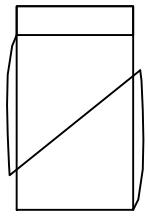
Northwood and Pinner Cottage Hospital	**584297**

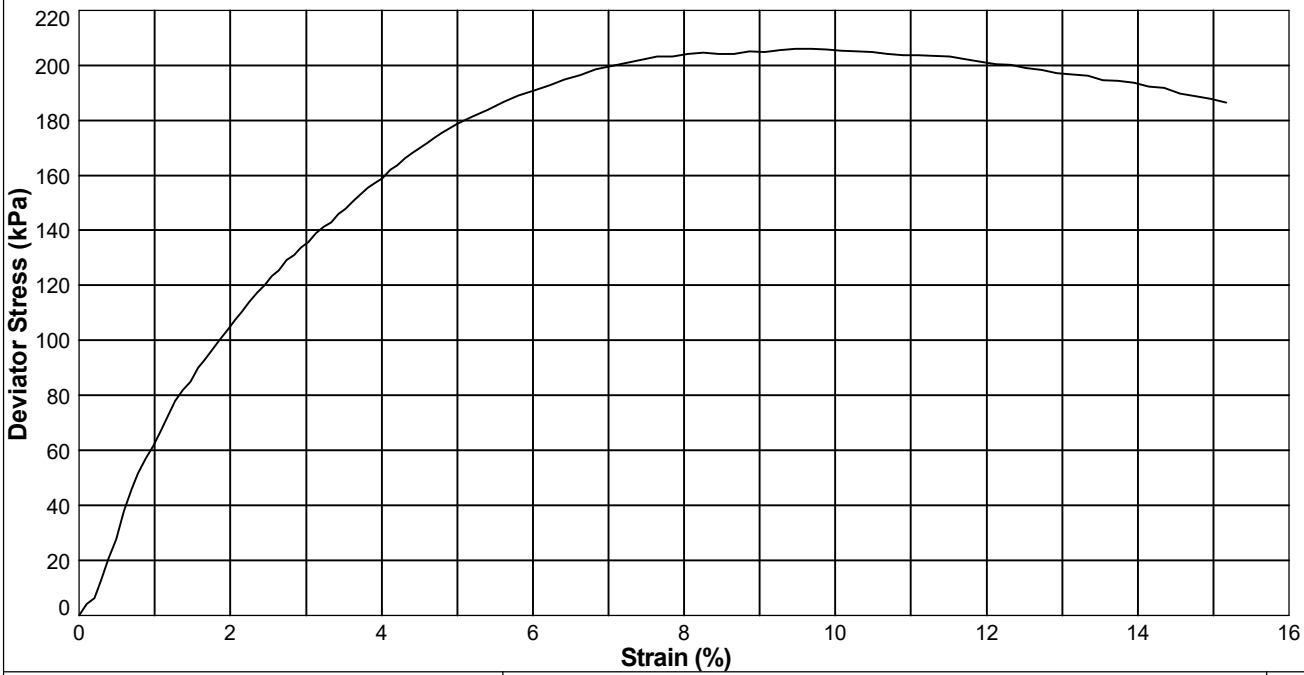
UNCONSOLIDATED QUICK UNDRAINED (SINGLE STAGE) TRIAXIAL COMPRESSION TEST

In accordance with BS EN ISO 17892 Part 8

Borehole: **BH1** Sample Ref: Sample Type: **U** Depth (m): **6.54**

Description : **Brown CLAY with occasional gypsum**

STAGE NUMBER			1	2	3
SAMPLE DETAILS	Sample Condition		Undisturbed		
	Orientation of sample		Vertical		
	Diameter	(mm)	105.43		
	Height	(mm)	201.77		
	Moisture Content	(%)	21		
	Bulk Density	(Mg/m^3)	1.96		
	Dry Density	(Mg/m^3)	1.62		
TEST DETAILS	Membrane Type		Rubber		
	Membrane Thickness	(mm)	0.24		
	Rate of Axial Displacement	(%/min)	0.99		
	Cell Pressure	(kPa)	130		
	Membrane Correction	(kPa)	0.51		
	Corrected Deviator Stress	(kPa)	206		
	Undrained Shear Strength	(kPa)	103		
FAILURE DETAILS	Strain at Failure	(%)	9.7		
	Mode of Failure 1 : **Brittle (shear plane)**				



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Compiled By		Date
	THOMAS DAVIES	21/07/20

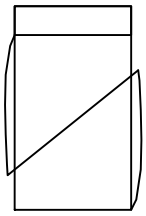
Contract	Contract Ref:
Northwood and Pinner Cottage Hospital	**584297**

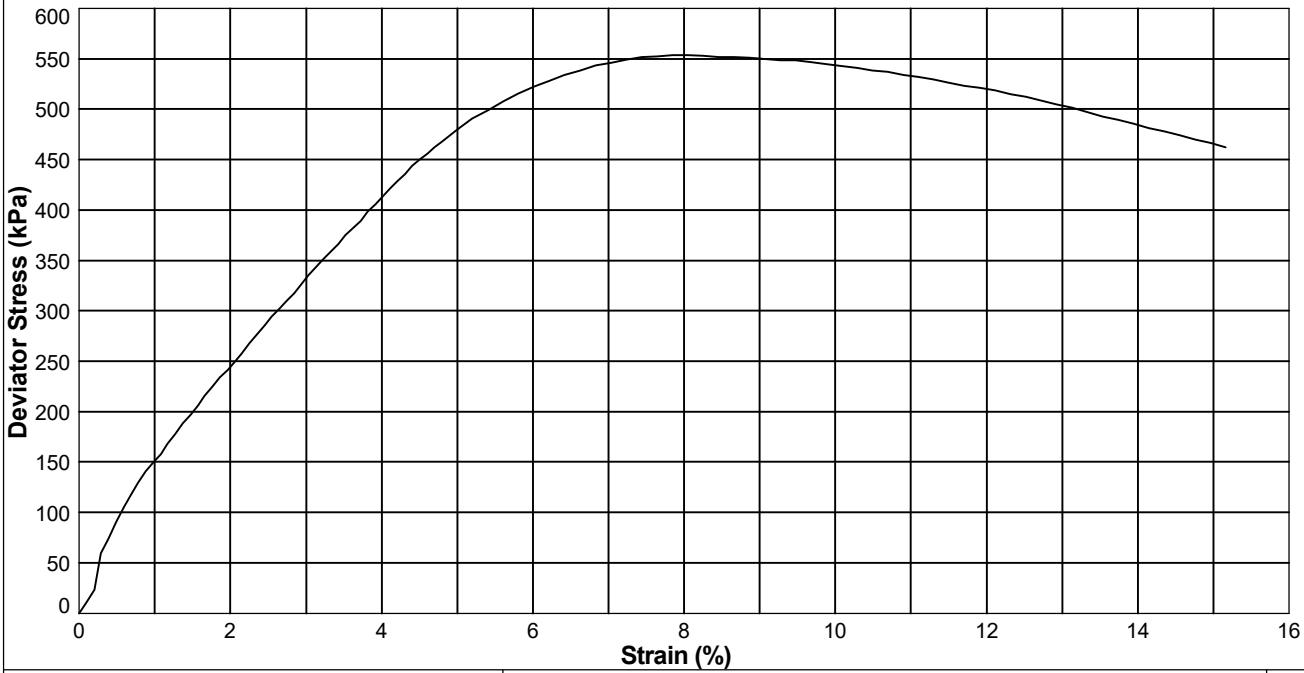
UNCONSOLIDATED QUICK UNDRAINED (SINGLE STAGE) TRIAXIAL COMPRESSION TEST

In accordance with BS EN ISO 17892 Part 8

Borehole: **BH1** Sample Ref: Sample Type: **U** Depth (m): **9.54**

Description : **Greyish brown slightly sandy CLAY with occasional shell fragments and gypsum**

STAGE NUMBER			1	2	3
SAMPLE DETAILS	Sample Condition		Undisturbed		
	Orientation of sample		Vertical		
	Diameter	(mm)	105.50		
	Height	(mm)	201.79		
	Moisture Content	(%)	18		
	Bulk Density	(Mg/m^3)	2.08		
	Dry Density	(Mg/m^3)	1.77		
TEST DETAILS	Membrane Type		Rubber		
	Membrane Thickness	(mm)	0.24		
	Rate of Axial Displacement	(%/min)	0.99		
	Cell Pressure	(kPa)	190		
	Membrane Correction	(kPa)	0.44		
	Corrected Deviator Stress	(kPa)	554		
	Undrained Shear Strength	(kPa)	277		
FAILURE DETAILS	Strain at Failure	(%)	8.0		
	Mode of Failure 1 : **Brittle (shear plane)**				



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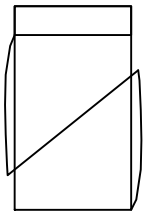
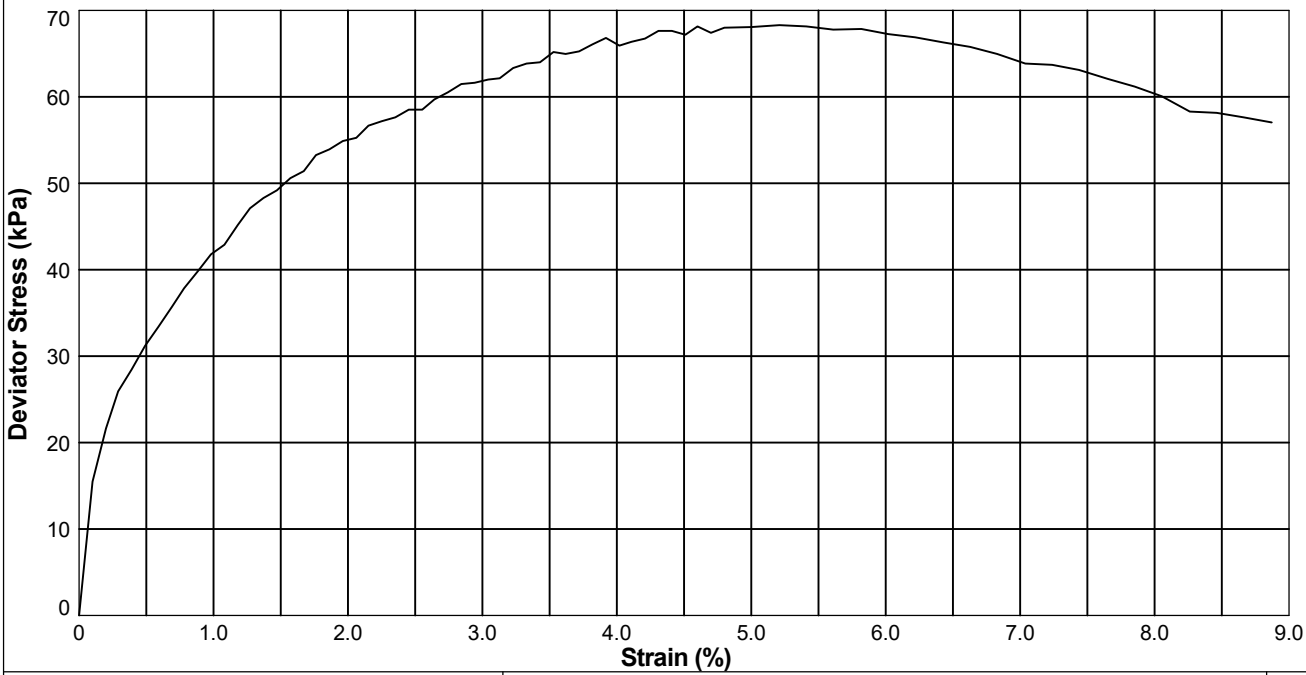
UNCONSOLIDATED QUICK UNDRAINED (SINGLE STAGE) TRIAXIAL COMPRESSION TEST

In accordance with BS EN ISO 17892 Part 8

Borehole: **BH3** Sample Ref: Sample Type: **U** Depth (m): **2.02**

Description : **Brown slightly gravelly slightly sandy CLAY**

STAGE NUMBER			1	2	3
SAMPLE DETAILS	Sample Condition		Undisturbed		
	Orientation of sample		Vertical		
	Diameter	(mm)	104.24		
	Height	(mm)	201.68		
	Moisture Content	(%)	28		
	Bulk Density	(Mg/m^3)	1.83		
	Dry Density	(Mg/m^3)	1.43		
TEST DETAILS	Membrane Type		Rubber		
	Membrane Thickness	(mm)	0.33		
	Rate of Axial Displacement	(%/min)	0.99		
	Cell Pressure	(kPa)	40		
	Membrane Correction	(kPa)	0.44		
	Corrected Deviator Stress	(kPa)	68		
	Undrained Shear Strength	(kPa)	34		
FAILURE DETAILS	Strain at Failure	(%)	5.2		
	Mode of Failure 1 : **Brittle (shear plane)**				



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Compiled By	Date
THOMAS DAVIES	21/07/20

Contract	Contract Ref:
Northwood and Pinner Cottage Hospital	**584297**

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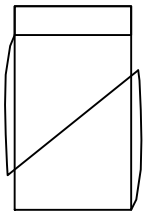
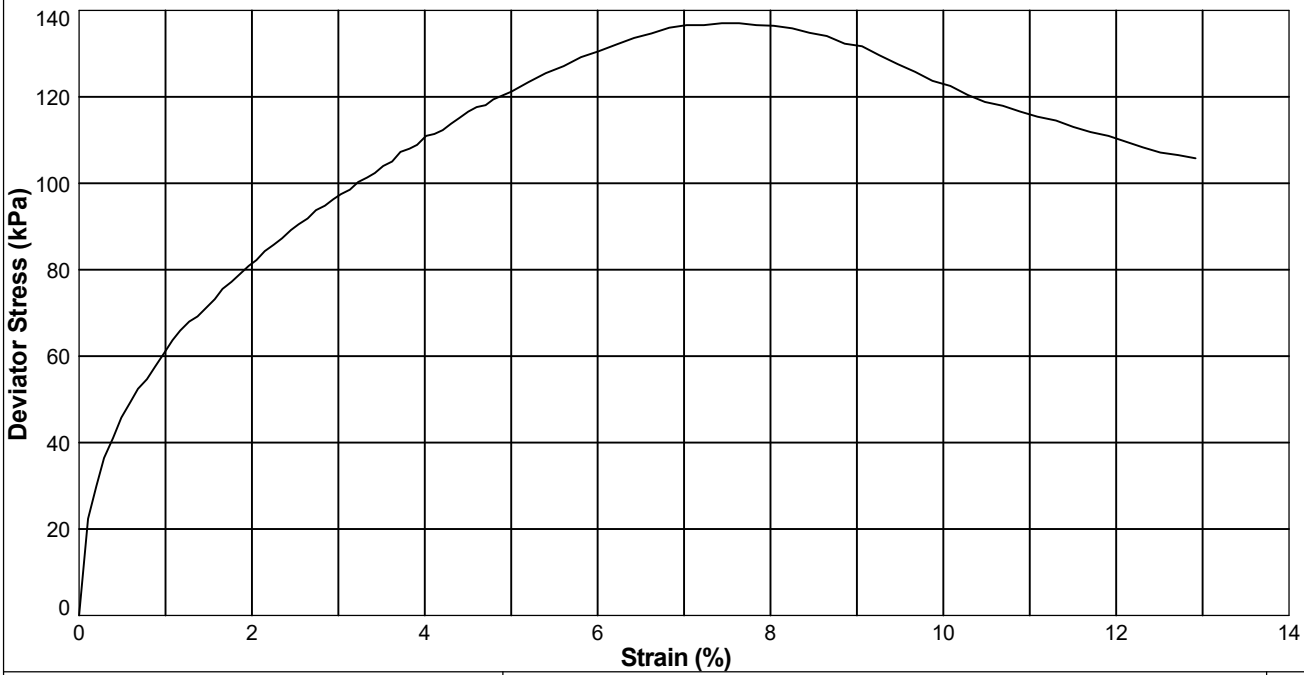
UNCONSOLIDATED QUICK UNDRAINED (SINGLE STAGE) TRIAXIAL COMPRESSION TEST

In accordance with BS EN ISO 17892 Part 8

Borehole: **BH3** Sample Ref: Sample Type: **U** Depth (m): **4.03**

Description : **Brown slightly sandy CLAY with occasional gypsum**

STAGE NUMBER			1	2	3
SAMPLE DETAILS	Sample Condition		Undisturbed		
	Orientation of sample		Vertical		
	Diameter	(mm)	105.27		
	Height	(mm)	201.90		
	Moisture Content	(%)	21		
	Bulk Density	(Mg/m^3)	1.98		
	Dry Density	(Mg/m^3)	1.64		
TEST DETAILS	Membrane Type		Rubber		
	Membrane Thickness	(mm)	0.38		
	Rate of Axial Displacement	(%/min)	0.99		
	Cell Pressure	(kPa)	80		
	Membrane Correction	(kPa)	0.66		
	Corrected Deviator Stress	(kPa)	137		
	Undrained Shear Strength	(kPa)	69		
FAILURE DETAILS	Strain at Failure	(%)	7.4		
	Mode of Failure 1 : **Brittle (shear plane)**				



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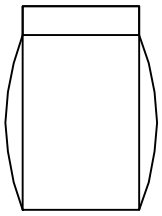
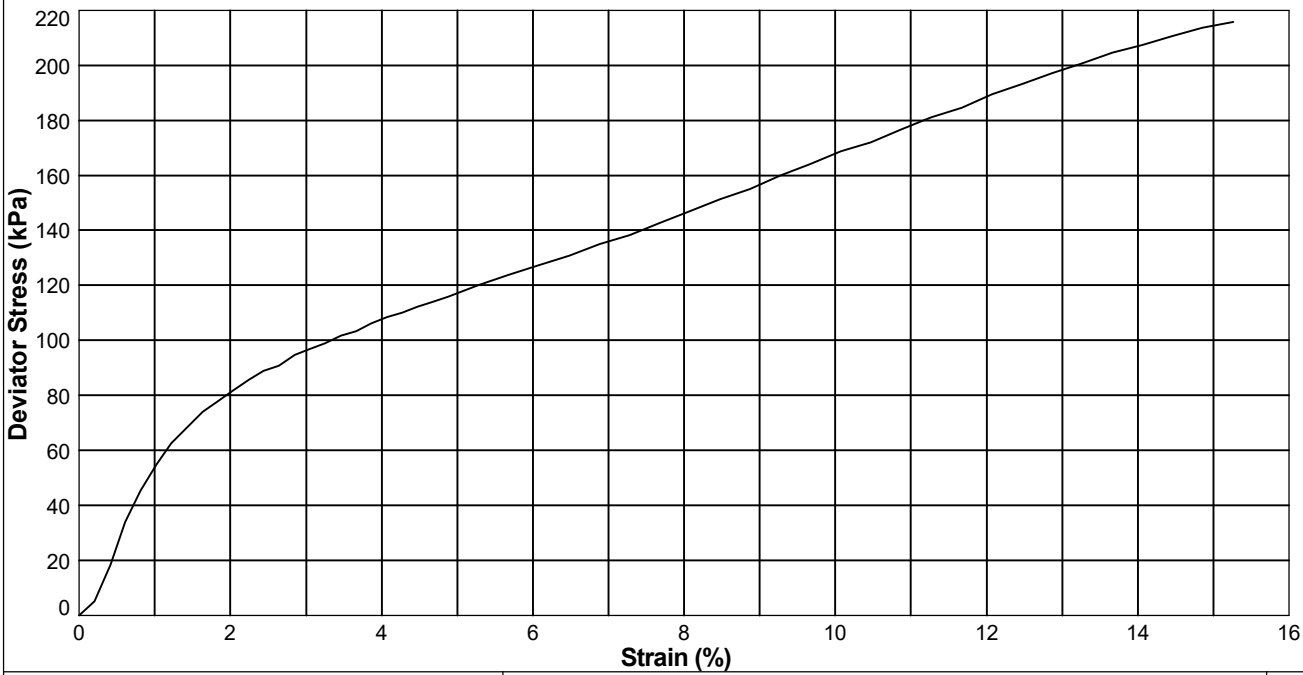
UNCONSOLIDATED QUICK UNDRAINED (SINGLE STAGE) TRIAXIAL COMPRESSION TEST

In accordance with BS EN ISO 17892 Part 8

Borehole: **BH3** Sample Ref: Sample Type: **U** Depth (m): **9.51**

Description : **Greyish brown slightly sandy silty CLAY with occasional shell fragments**

STAGE NUMBER			1	2	3
SAMPLE DETAILS	Sample Condition		Remoulded		
	Orientation of sample		Vertical		
	Diameter	(mm)	103.68		
	Height	(mm)	201.72		
	Moisture Content	(%)	21		
	Bulk Density	(Mg/m^3)	1.96		
	Dry Density	(Mg/m^3)	1.62		
TEST DETAILS	Membrane Type		Rubber		
	Membrane Thickness	(mm)	0.38		
	Rate of Axial Displacement	(%/min)	0.99		
	Cell Pressure	(kPa)	190		
	Membrane Correction	(kPa)	1.12		
	Corrected Deviator Stress	(kPa)	214		
	Undrained Shear Strength	(kPa)	107		
FAILURE DETAILS	Strain at Failure	(%)	15.0		
	Mode of Failure 1 : **Plastic (Barrelling)**				



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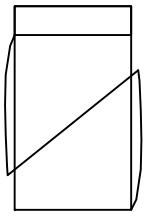
Contract	Contract Ref:
Northwood and Pinner Cottage Hospital	**584297**

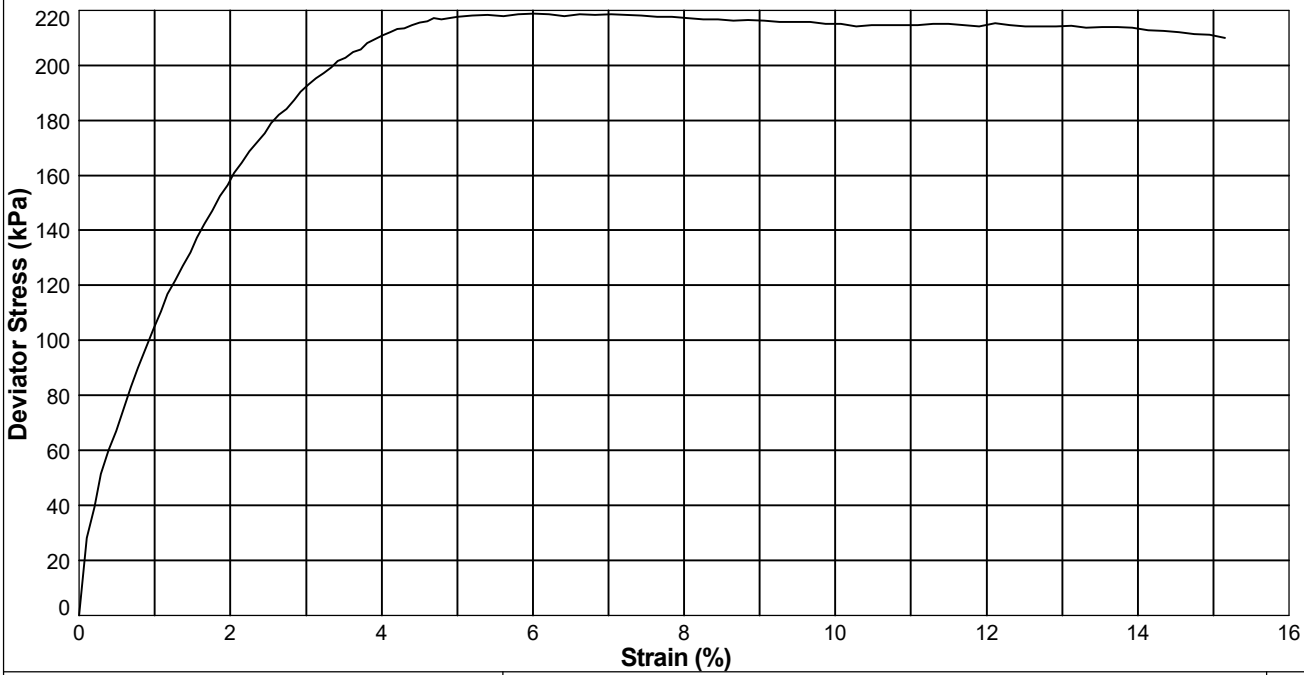
UNCONSOLIDATED QUICK UNDRAINED (SINGLE STAGE) TRIAXIAL COMPRESSION TEST

In accordance with BS EN ISO 17892 Part 8

Borehole: **BH4** Sample Ref: Sample Type: **U** Depth (m): **4.02**

Description : **Brown slightly sandy CLAY with occasional gypsum**

STAGE NUMBER			1	2	3
SAMPLE DETAILS	Sample Condition		Undisturbed		
	Orientation of sample		Vertical		
	Diameter	(mm)	103.56		
	Height	(mm)	201.96		
	Moisture Content	(%)	21		
	Bulk Density	(Mg/m^3)	2.00		
	Dry Density	(Mg/m^3)	1.66		
TEST DETAILS	Membrane Type		Rubber		
	Membrane Thickness	(mm)	0.29		
	Rate of Axial Displacement	(%/min)	0.99		
	Cell Pressure	(kPa)	80		
	Membrane Correction	(kPa)	0.43		
	Corrected Deviator Stress	(kPa)	219		
	Undrained Shear Strength	(kPa)	109		
FAILURE DETAILS	Strain at Failure	(%)	6.0		
	Mode of Failure 1 : **Brittle (shear plane)**				



STRUCTURAL SOILS
1a Princess Street
Bedminster
Bristol
BS3 4AG

Compiled By		Date
	THOMAS DAVIES	21/07/20

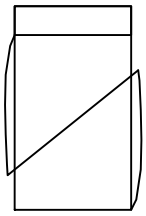
Contract	Contract Ref:
Northwood and Pinner Cottage Hospital	**584297**

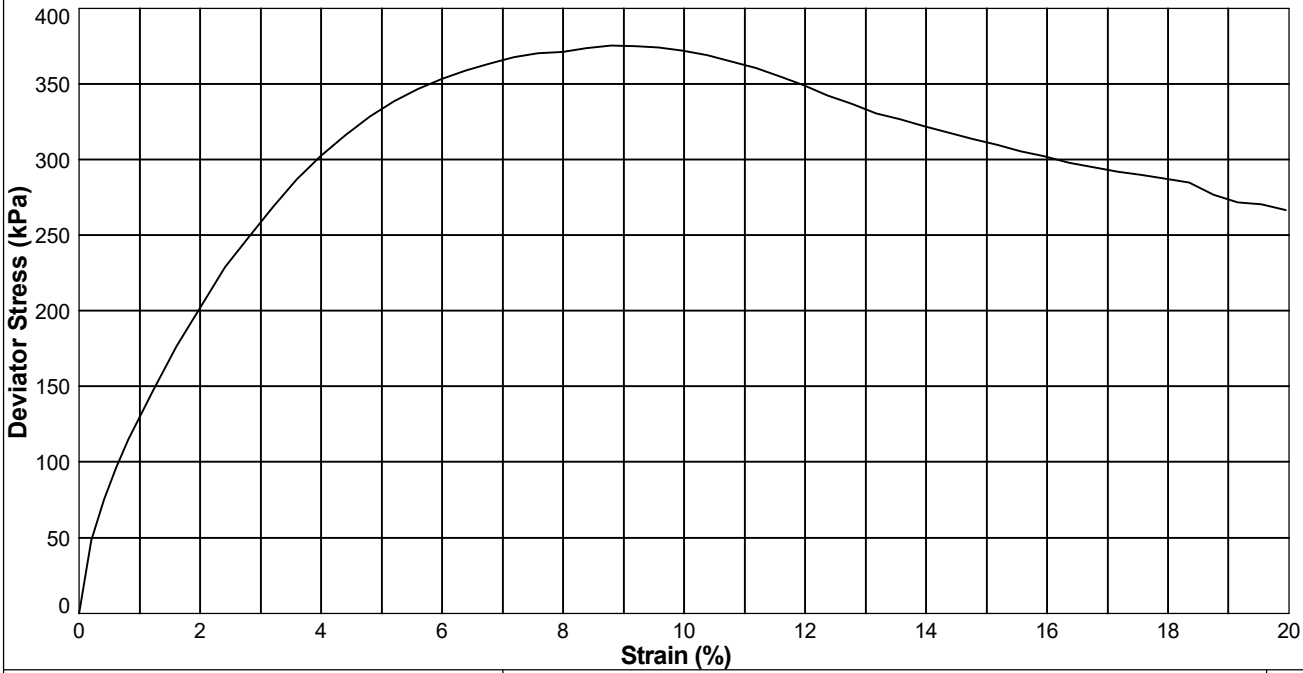
UNCONSOLIDATED QUICK UNDRAINED (SINGLE STAGE) TRIAXIAL COMPRESSION TEST

In accordance with BS EN ISO 17892 Part 8

Borehole: **BH4** Sample Ref: Sample Type: **U** Depth (m): **6.52**

Description : **Greyish brown slightly sandy CLAY with occasional gypsum**

STAGE NUMBER			1	2	3
SAMPLE DETAILS	Sample Condition		Undisturbed		
	Orientation of sample		Vertical		
	Diameter	(mm)	103.96		
	Height	(mm)	201.98		
	Moisture Content	(%)	17		
	Bulk Density	(Mg/m^3)	2.06		
	Dry Density	(Mg/m^3)	1.76		
TEST DETAILS	Membrane Type		Rubber		
	Membrane Thickness	(mm)	0.24		
	Rate of Axial Displacement	(%/min)	0.99		
	Cell Pressure	(kPa)	130		
	Membrane Correction	(kPa)	0.48		
	Corrected Deviator Stress	(kPa)	376		
	Undrained Shear Strength	(kPa)	188		
FAILURE DETAILS	Strain at Failure	(%)	8.8		
	Mode of Failure 1 : **Brittle (shear plane)**				



STRUCTURAL SOILS
1a Princess Street
Bedminster
Bristol
BS3 4AG

Compiled By		Date
	THOMAS DAVIES	21/07/20

Contract	Contract Ref:
Northwood and Pinner Cottage Hospital	**584297**

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 20/05502
Issue Number: 1 **Date:** 17 July, 2020

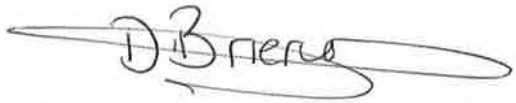
Client: Structural Soils Limited (Hemel Hempstead Lab)
18 Frogmore Road
Hemel Hempstead
UK
HP3 9RT

Project Manager: Hemel Lab/Sharon Cairns
Project Name: Northwood and Pinner Cottage Hospital
Project Ref: 1921134
Order No: N/A
Date Samples Received: 08/07/20
Date Instructions Received: 08/07/20
Date Analysis Completed: 16/07/20

Prepared by:

Holly Neary-King
Administration & Client Services Supervisor

Approved by:



Danielle Brierley
Client Manager

Envirolab Job Number: 20/05502

Client Project Name: Northwood and Pinner Cottage Hospital

Client Project Ref: 1921134

Lab Sample ID	20/05502/1	20/05502/2	20/05502/3	20/05502/4	20/05502/5	20/05502/6	20/05502/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH1	BH1	BH1	BH1	BH2	BH2	BH3			
Depth to Top	2.75	5.00	9.00	14.00	3.75	7.50	4.75			
Depth To Bottom		5.45								
Date Sampled										
Sample Type	Soil - D	Soil	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D			
Sample Matrix Code	5A	5A	5A	5A	5A	5A	5A			
% Stones >10mm$_A$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	% w/w	0.1	A-T-044
pH BRE$_D^{M\#}$	7.61	5.75	7.84	8.54	5.26	8.17	7.16	pH	0.01	A-T-031s
Sulphate BRE (water sol 2:1)$_D^{M\#}$	1230	3000	1510	746	1820	1220	2980	mg/l	10	A-T-026s
Sulphate BRE (acid sol)$_D^{M\#}$	0.49	1.36	0.36	0.09	0.63	0.34	2.21	% w/w	0.02	A-T-028s
Sulphur BRE (total)$_D$	0.18	0.52	1.84	0.11	0.22	0.23	0.85	% w/w	0.01	A-T-024s

Envirolab Job Number: 20/05502

Client Project Name: Northwood and Pinner Cottage Hospital

Client Project Ref: 1921134

Lab Sample ID	20/05502/8	20/05502/9	20/05502/10	20/05502/11	20/05502/12	20/05502/13		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH3	BH3	BH4	BH4	BH4	WS1				
Depth to Top	9.00	12.00	2.75	4.75	8.00	2.00				
Depth To Bottom					8.45	2.60				
Date Sampled						25-Jun-20				
Sample Type	Soil - D	Soil - D	Soil - D	Soil - D	Soil	Soil - D				
Sample Matrix Code	5AE	5A	5A	5A	5A	5AE				
% Stones >10mm$_A$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		% w/w	0.1	A-T-044
pH BRE$_D$$^{M\#}$	7.89	7.84	6.64	7.14	7.84	7.59		pH	0.01	A-T-031s
Sulphate BRE (water sol 2:1)$_D$$^{M\#}$	2560	1040	2810	2740	2690	1710		mg/l	10	A-T-026s
Sulphate BRE (acid sol)$_D$$^{M\#}$	2.46	0.21	0.93	1.41	2.22	3.16		% w/w	0.02	A-T-028s
Sulphur BRE (total)$_D$	1.98	0.19	0.28	0.53	1.86	1.29		% w/w	0.01	A-T-024s

REPORT NOTES

General
This report shall not be reproduced, except in full, without written approval from Envirolab.
The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.
The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed.
Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Structural Soils Limited (Hemel Hempstead Lab), 18 Frogmore Road, Hemel Hempstead, UK, HP3 9RT

Project: Northwood and Pinner Cottage Hospital

Clients Project No: 1921134

Project No: 20/05502

Date Received: 08/07/2020 (am)

Cool Box Temperatures (°C): 16.0

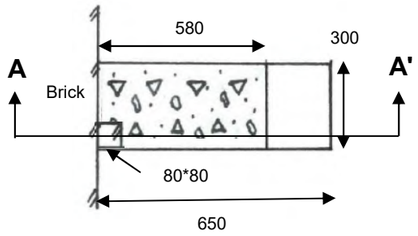
Lab Sample ID	20/05502/1	20/05502/2	20/05502/3	20/05502/4	20/05502/5	20/05502/6	20/05502/7	20/05502/8	20/05502/9	20/05502/10	20/05502/11	20/05502/12
Client Sample No												
Client Sample ID/Depth	BH1 2.75m	BH1 5.00-5.45m	BH1 9.00m	BH1 14.00m	BH2 3.75m	BH2 7.50m	BH3 4.75m	BH3 9.00m	BH3 12.00m	BH4 2.75m	BH4 4.75m	BH4 8.00-8.45m
Date Sampled												
Deviation Code												
E (no date)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Key
E (no date) *No sampling date provided (all results affected if not provided)*

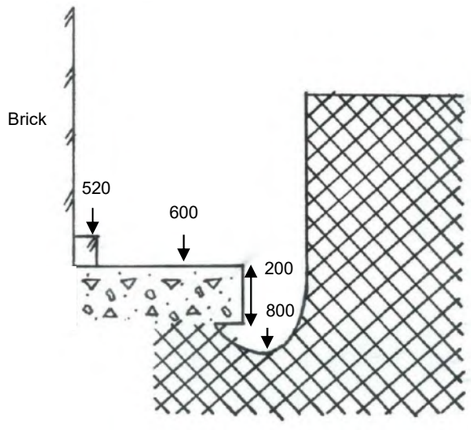
If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

APPENDIX F
EXPLORATORY HOLE LOGS

PLAN



SECTION A - A'



0.00m - Asphalt

0.05m - Concrete

0.15m - MADE GROUND: Dark brown slightly silty sandy subangular to subrounded fine to coarse GRAVEL of flint, brick and concrete. Medium cobble content of brick and concrete. Sand is fine to coarse.

0.45m - MADE GROUND: Orangish brown mottled grey slightly gravelly CLAY with occasional fragments of brick and concrete. Gravel is subangular to subrounded fine to medium flint.

PHOTO

General Remarks

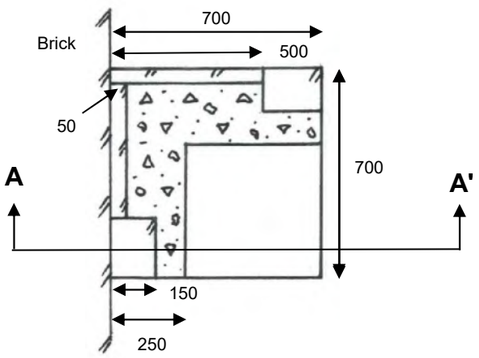
RSK Environment Ltd
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT
United Kingdom
Tel: +44 (0)1442 437500
Fax: +44 (0)1442 437550

Drawing Title: **FIGURE - HDTP1**

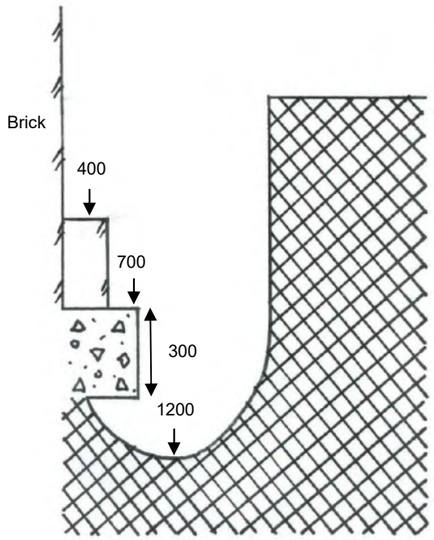
Project Title: **Northwood and Pinner Health Centre, HA6 2RN**

Dimensions	Level (mAOD)	Scale	Grid Ref	Client	Project Number
mm	-	1:20	-	Evolve UK	1921134 R01 (00)

PLAN



SECTION A - A'



0.00m - Tile

0.05m - Concrete

0.20m - MADE GROUND: Brown slightly slightly gravelly sandy CLAY with high cobble content of brick and concrete. Gravel is subangular to subrounded fine to coarse flint, brick and concrete. Sand is fine to coarse.

PHOTO

General Remarks

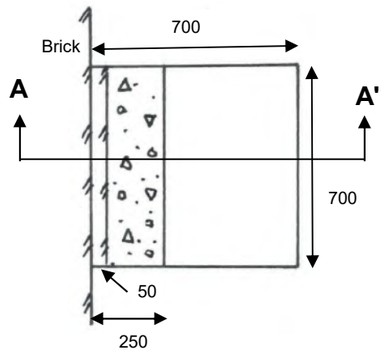
RSK Environment Ltd
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT
United Kingdom
Tel: +44 (0)1442 437500
Fax: +44 (0)1442 437550

Drawing Title: **FIGURE - HDTP2**

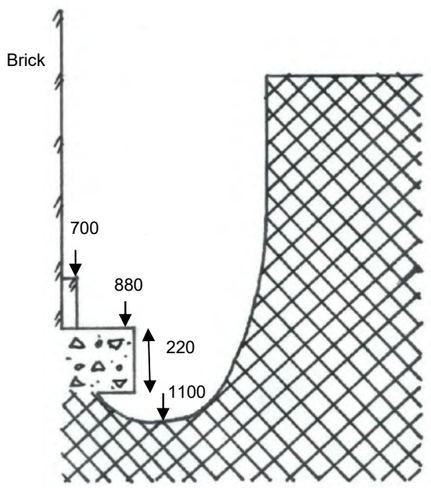
Project Title: **Northwood and Pinner Health Centre, HA6 2RN**

Dimensions	Level (mAOD)	Scale	Grid Ref	Client	Project Number
mm	-	1:20	-	Evolve UK	1921134 R01 (00)

PLAN



SECTION A - A'



0.00m - Concrete

0.05m - MADE GROUND: Brown slightly sandy subangular to subrounded fine to coarse GRAVEL of flint, brick and concrete. High cobble content of flint, brick and concrete. Sand is fine to coarse.

0.45m - MADE GROUND: Brown mottled grey slightly gravelly sandy CLAY with low cobble content of brick. Gravel is subangular to subrounded fine to medium flint, brick and concrete. Sand is fine to medium.

PHOTO

General Remarks

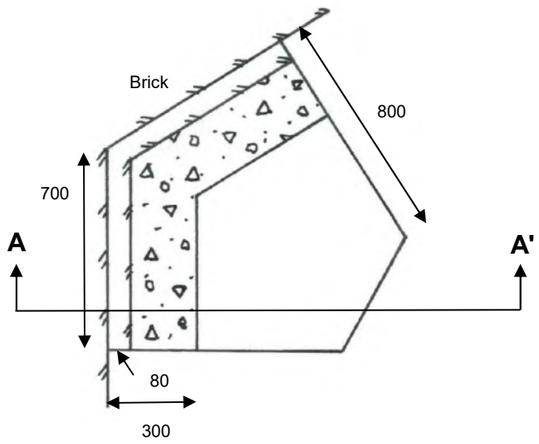
RSK Environment Ltd
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT
United Kingdom
Tel: +44 (0)1442 437500
Fax: +44 (0)1442 437550

Drawing Title: **FIGURE - HDTP3**

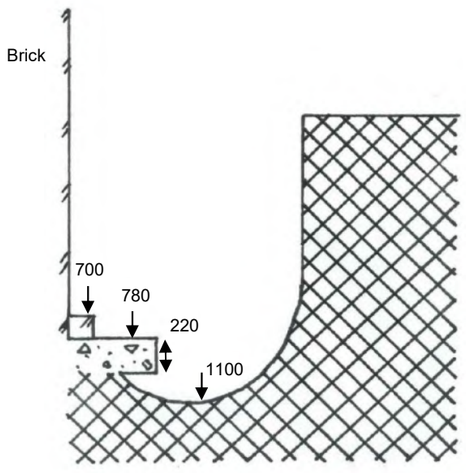
Project Title: **Northwood and Pinner Health Centre, HA6 2RN**

Dimensions	Level (mAOD)	Scale	Grid Ref	Client	Project Number
mm	-	1:20	-	Evolve UK	1921134 R01 (00)

PLAN



SECTION A - A'



0.00m - Concrete

0.05m - MADE GROUND: Brown slightly sandy subangular to subrounded fine to coarse GRAVEL of flint, brick and concrete. High cobble content of flint, brick and concrete. Sand is fine to coarse.

0.40m - MADE GROUND: Brown mottled grey slightly gravelly sandy CLAY with low cobble content of brick. Gravel is subangular to subrounded fine to medium flint, brick and concrete. Sand is fine to medium.

PHOTO

General Remarks

RSK Environment Ltd
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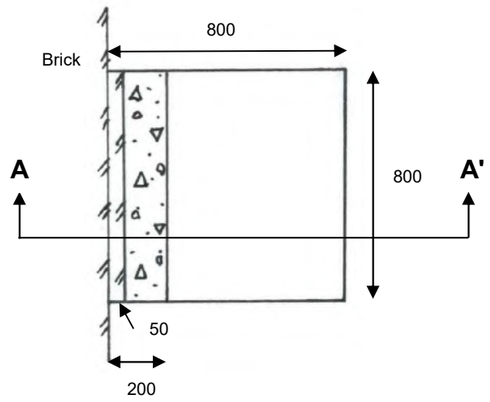
HP3 9RT
United Kingdom
Tel: +44 (0)1442 437500
Fax: +44 (0)1442 437550

Drawing Title: **FIGURE - HDTP4**

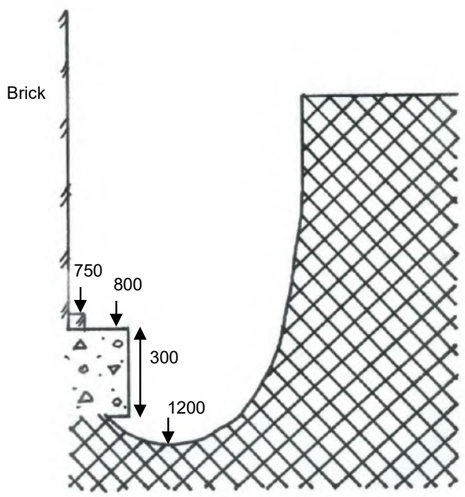
Project Title: **Northwood and Pinner Health Centre, HA6 2RN**

Dimensions	Level (mAOD)	Scale	Grid Ref	Client	Project Number
mm	-	1:20	-	Evolve UK	1921134 R01 (00)

PLAN



SECTION A - A'



0.00m - Asphalt

0.05m - Concrete

0.15m - MADE GROUND: Brown slightly silty sandy subangular to subrounded fine to coarse GRAVEL of flint, brick and concrete. High cobble content of brick. Sand is fine to coarse.

0.75m - MADE GROUND: Brown sandy gravelly CLAY with high cobble content of brick. Gravel is subangular to subrounded fine to coarse flint, brick and concrete.

PHOTO

General Remarks

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Hemel Hempstead
Hertfordshire
HP3 9RT
United Kingdom
Tel: +44 (0)1442 437500
Fax: +44 (0)1442 437550

Drawing Title: **FIGURE - HDTP5**

Project Title: **Northwood and Pinner Health Centre, HA6 2RN**

Dimensions	Level (mAOD)	Scale	Grid Ref	Client	Project Number
mm	-	1:20	-	Evolve UK	1921134 R01 (00)

BOREHOLE LOG

Contract:	Client:	Borehole:
Northwood & Pinner Health Centre	**NHSPS**	**BH1**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	**24.06.20** End: **24.06.20**	**73.96**	**E:510120.0 N:190668.5**	**1** of **2**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						MADE GROUND: Grass over firm orangish brown and brown mottled slightly gravelly silty CLAY with rootlets throughout. Gravel is angular to subrounded, fine to medium of flint and rare brick.	0.40	
0.50	1	D				Firm orange brown and brown mottled silty CLAY with black speckles and occasional roots. (LONDON CLAY FORMATION)		
1.00	2	D						
1.20-1.65	1	SPT	N=9			. . . at 1.2m becming firm to stiff orange brown mottled grey silty CLAY.		
1.20-1.65	3	D					(2.60)	
1.75	4	D						
2.00-2.45	1	U						
2.75	5	D					3.00	
3.00-3.45	2	SPT	N=11			Firm to stiff orangish brown sandy silty CLAY. Sand is in lenses of yellow fine sand. (LONDON CLAY FORMATION)		
3.00-3.45	6	D						
3.75	7	D				. . . fine angular gravel of selenite crystals below 3.75m bgl		
4.00-4.45	2	U						
4.75	8	D					(3.50)	
5.00-5.45	3	SPT	N=12					
5.00-5.45	9	D						
6.00	10	D					6.50	
6.50-6.95	3	U				Stiff brown grey thinly laminated silty CLAY with fine shell fragment and selenite crystals. (LONDON CLAY FORMATION)		
7.50	11	D					(1.50)	
8.00-8.45	4	SPT	N=23				8.00	
8.00-8.45	12	D				Stiff dark brown silty CLAY with sand lenses, fine shell fragments and selenite crystals. (LONDON CLAY FORMATION)		
							(1.20)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. Inspection pit excavated to 1.2m bgl
2. Borehole drilled to 15m and left overnight, groundwater water was recorded at 9.5m bgl.
3. Borehole backfilled with arisings upon completion.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**PJD**	**SMianowska**	

BOREHOLE LOG

Contract:	Client:	Borehole:
Northwood & Pinner Health Centre	**NHSPS**	**BH1**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	**24.06.20** End: **24.06.20**	**73.96**	**E:510120.0 N:190668.5**	**2** of **2**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
							9.20	
9.50-9.75 9.50	4 13	U D				Stiff to very still dark grey mottled grey sandy CLAY with fine shell fragments and selenite crystals. (LONDON CLAY FORMATION)	(2.80)	
10.50	14	D						
11.00-11.45 11.00-11.45	5 15	SPT D	N=43			. . . from 11m bgl rounded black pebbles.	12.00	
12.00	16	D				Very stiff dark grey and green grey very sand CLAY with shell fragments. (LAMBETH GROUP)	(0.50)	
							12.50	
12.50-12.95 12.50-12.95	6 17	SPT D	N=42			Very stiff greenish blue and white mottled silty CLAY with fine selenite crystals and shell fragments. (LAMBETH GROUP)	(0.50)	
							13.00	
13.50	18	D				Very stiff brown, light brown and grey slightly sandy CLAY. (LAMBETH GROUP)	(2.00)	
14.00	19	D				. . . at 14m becoming mottled red brown, brown and grey.		
14.55-15.00 14.55-15.00	7 20	SPT D	N=45				15.00	
						Cable percussion borehole terminated at 15.00m depth.		

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**PJD**	**SMianowska**	

BOREHOLE LOG

Contract:	Client:	Borehole:
Northwood & Pinner Health Centre	**NHSPS**	**BH2**

Contract Ref:	Start: **25.06.20**	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	End: **25.06.20**	**73.41**	**E:510082.8 N:190683.2**	**1** of **2**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						MADE GROUND: Grass over reddish brown very sandy gravelly clay with a fragment of cement sheeting.	(0.60)	
0.50	1	D					0.60	
						Firm orange brown and mottle slightly sandy silty CLAY with occasional black speckles.# (LONDON CLAY FORMATION)		
1.00	2	D						
1.20-1.58	1	SPT	N=9					
1.20-1.65	3	D						
1.75	4	D				. . . rare fine selenite crystals throughout		
2.00-2.45	1	U					(3.15)	
2.75	5	D				. . . at 2.75m lenses of yellow sand.		
3.00-3.45	2	SPT	N=10					
3.00-3.45	6	D						
							3.75	
3.75	7	D				Firm brown, yellow and orangish brown motttled thinly laminated sandy silty CLAY with fine selenite crystals throughout. (LONDON CLAY FORMATION)		
4.00-4.45	2	U					(1.25)	
4.75	8	D						
							5.00	
5.00-5.45	3	SPT	N=12			Stiff dark brown thinly laminated silty CLAY with rare fine selenite crystals throughout. (LONDON CLAY FORMATION)		
5.00-5.45	9	D					(1.70)	
6.00	10	D				. . . rare lenses of orangish brown silty clay from 6.00m bgl		
6.50-6.95	3	U						
							6.70	
						Stiff dark grey thinly laminated sandy silty CLAY with fine selenite crystals. (LONDON CLAY FORMATION)		
7.50	11	D					(1.30)	
							8.00	
8.00-8.45	4	SPT	N=23			Stiff dark grey thinly laminated silty CLAY with fine selenite crytals and shells fragments. (LONDON CLAY FORMATION)		
8.00-8.45	12	D						

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. Inspection pit excavated to 1.2m bgl.
2. Groundwater stike recorded at 15m, level was recorded at 13.7m bgl after 30min.
3. Borehole backfilled with arisings upon completion.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**PJD**	**SMianowska**	

BOREHOLE LOG

Contract:	Client:	Borehole:
Northwood & Pinner Health Centre	**NHSPS**	**BH2**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	**25.06.20** End: **25.06.20**	**73.41**	**E:510082.8 N:190683.2**	**2** of **2**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
9.00	13	D				Stiff dark grey thinly laminated silty CLAY with fine selenite crytals and shells fragments. (LONDON CLAY FORMATION) *(stratum copied from 8.00m from previous sheet)* . . . at 9.0m black rounded pebbles.	(2.50)	
9.50-9.95	4	U						
10.50	14	D				Very stiff dark grey very sandy CLAY with shell fragments. (LAMBETH GROUP)	10.50 (0.50)	
11.00-11.45	5	SPT	N=43			Very stiff greenish blue and white mottled silty CLAY with fine selenite crystals and shell fragments. (LAMBETH GROUP)	11.00	
11.00-11.45	15	D						
12.00	16	D						
12.50-12.95	6	SPT	N=40					
12.50-12.95	17	D						
13.50	18	D		1		. . . at 13m bgl mottled red, grey and brown.	(4.00)	
14.00	19	D						
14.55-15.00	7	SPT	N=47					
14.55-15.00	20	D		1			15.00	
						Cable percussion borehole terminated at 15.00m depth.		

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**PJD**	**SMianowska**	

BOREHOLE LOG

Contract:	Client:	Borehole:
Northwood & Pinner Health Centre	**NHSPS**	**BH3**

Contract Ref:	Start: **26.06.20**	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	End: **26.06.20**	**71.49**	**E:510006.6 N:190716.6**	**1** of **2**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
0.50	1	D				MADE GROUND: Bitumen paving over orange brown occasionally mottled grey slightly sandy slghtly gravelly CLAY. Gravel is angular to subrounded, fine to coarse of flint, brick and rare concrete. . . . from 0.5m fine to medium size angular flint and rare brick fragments.	(1.20) 1.20	
1.20-1.65	1	SPT	N=8			Firm brown mottled grey slightly sandy CLAY with black speckles and fine selenite crystals. (LONDON CLAY FORMATION)		
1.20-1.65	2	D						
1.75	3	D						
2.00-2.45	1	U					(2.55)	
2.75	4	D				. . . from 2.75m thinly laminated.		
3.00-3.45	2	SPT	N=10					
3.00-3.45	5	D					3.75	
3.75	6	D				Firm orange brown and grey silty CLAY with very thin lenses of yellow sand. (LONDON CLAY FORMATION)		
4.00-4.45	2	U					(1.25)	
4.75	7	D					5.00	
5.00-5.45	3	SPT	N=14			Firm dark brown thinly laminated slightly sandy silty CLAY with fine selenite crystals. (LONDON CLAY FORMATION)		
5.00-5.45	8	D						
6.00	9	D				. . . becoming darker brown and laminated with depth	(2.70)	
6.50-6.95	3	U						
7.00	10	D					7.70	
8.00-8.45	4	SPT	N=30			Stiff very dark brown grey very sandy CLAY. Lenses of orangish brown fine sand throughout, and fine selenite crystals. (LONDON CLAY FORMATION)	(0.80)	
8.00-8.45	11	D		≈			8.50	
						Description on next sheet		

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. Inpsection pit excavated to 1.2m bgl.
2. Water stike at 8.5m very low inflow.
3. Borehole backfilled with arisings upon completion.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**PJD**	**SMianowska**	

BOREHOLE LOG

Contract:	Client:	Borehole:
Northwood & Pinner Health Centre	**NHSPS**	**BH3**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	**26.06.20** End: **26.06.20**	**71.49**	**E:510006.6 N:190716.6**	**2** of **2**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
9.00	12	D				Stiff very dark grey thinly laminated sandy silty CLAY with fine shell fragments. (LAMBETH GROUP) *(stratum copied from 8.50m from previous sheet)*	(1.40)	
9.50-9.95	4	U					9.90	
						Very stiff blue, dark greyish brown, red, yellowish brown and white mottled slightly sandy silty CLAY. (LAMBETH GROUP)		
10.50	13	D						
11.00-11.45	5	SPT	N=42					
11.00-11.45	14	D						
12.00	15	D					(5.10)	
12.50-12.95	6	SPT	N=47					
12.50-12.95	16	D						
13.50	17	D				. . . from 14m fine selenite crystals.		
14.55-15.00	7	SPT	N=49					
14.55-15.00	18	D					15.00	
						Cable percussion borehole terminated at 15.00m depth.		

Boring Progress and Water Observations						Chiselling / Slow Progress			General Remarks
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth	From	To	Duration (hh:mm)	

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**PJD**	**SMianowska**	

BOREHOLE LOG

Contract:	Client:	Borehole:
Northwood & Pinner Health Centre	**NHSPS**	**BH4**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	**29.06.20** End: **29.06.20**	**71.95**	**E:510034.4 N:190653.3**	**1** of **3**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						MADE GROUND: Grass over dark brown soft sandy gravelly silty CLAY. Gravel is fine to medium of flint, and rare brick. Roots and rootlets throughout.	(0.50) 0.50	
0.50	1	D				Firm orangish brown and brown mottled slightly sandy CLAY with black speckles and occasional rootlets. (LONDON CLAY FORMATION)		
1.20-1.65	1	SPT	N=8					
1.20-1.65	2	D						
1.25	3	D					(2.25)	
2.00-2.45	1	U						
							2.75	
2.75	4	D				Firm borwn mottled orange brown thinly laminated slightly sandy silty CLAY with fine selenite crystals. (LONDON CLAY FORMATION)		
3.00-3.45	2	SPT	N=10					
3.00-3.45	5	D						
3.75	6	D				. . . from 3.75m yellow sand lenses.	(2.25)	
4.00-4.45	2	U						
4.75	7	D					5.00	
5.00-5.45	3	SPT	N=13			Firm dark brownish grey thinly laminated silty CLAY with rare fine gravel of selenite. (LONDON CLAY FORMATION)		
5.00-5.45	8	D						
6.00	9	D					(2.50)	
6.50-6.95	3	U		▼1				
							7.50	
7.50	10	D				Firm to stiff dark grey very sandy CLAY with fine shell fragments. (LONDON CLAY FORMATION)		
8.00-8.45	4	SPT	N=23				(1.50)	
8.00-8.45	11	D						
							9.00	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. Inspection pit excavated to 1.2m bgl.
2. Groundwater strike at 7.5m, very low inflow.
3. Borehole backfilled with arisings upon completion.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**PJD**	**SMianowska**	

BOREHOLE LOG

Contract:	Client:	Borehole:
Northwood & Pinner Health Centre	**NHSPS**	**BH4**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	**29.06.20** End: **29.06.20**	**71.95**	**E:510034.4 N:190653.3**	**2** of **3**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
9.00	12	D				Stiff to very stiff greenish grey thinly laminted slightly sandy silty CLAY with fine shell fragments. (LAMBETH GROUP)		
9.50-9.95	13	D				. . . becoming mottled blueish grey and slightly gravelly below 9.00m bgl. Gravel is fine to medium, rounded of flint.	(1.50)	
10.50	14	D					10.50	
11.00-11.45	5	SPT	N=46			Very stiff grey, orange brown and red brown slightly sandy CLAY with selenite crystals. (LAMBETH GROUP)		
11.00-11.45	15	D				. . . coarse gravel of selenite (up to 7cm crystals) at 10.50m bgl		
12.00	16	D						
12.50-12.95	6	SPT	N=46					
12.50-12.95	17	D					(4.50)	
13.50	18	D						
14.00-14.45	7	SPT	N=48					
14.00-14.45	19	D					15.00	
15.00	20	D				Very stiff orangish brown and orange mottled sandy silty CLAY. (LAMBETH GROUP)		
15.50-15.95	8	SPT	N=50			. . . green mottling at 15.50m bgl		
15.50-15.95	21	D					(2.00)	
16.50	22	D				. . . reddish orange mottling at 16.50m bgl		
17.00-17.15	9	SPT	NP				17.00	
17.00-17.45	23	D				Dense orange brown SAND with clay lenses. (LAMBETH GROUP)		

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**PJD**	**SMianowska**	

BOREHOLE LOG

Contract:	Client:	Borehole:
Northwood & Pinner Health Centre	**NHSPS**	**BH4**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	**29.06.20** End: **29.06.20**	**71.95**	**E:510034.4 N:190653.3**	**3** of **3**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
18.00	24	D				Dense orange brown SAND with clay lenses. (LAMBETH GROUP) *(stratum copied from 17.00m from previous sheet)*	(3.00)	
18.50-18.58	10	SPT	NP					
18.50-18.95	25	D						
19.20	26	D						
19.55-19.63	11	SPT	NP					
19.55-20.00	27	D						
						Cable percussion borehole terminated at 20.00m depth.	20.00	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**PJD**	**SMianowska**	

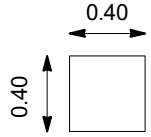
INSPECTION PIT LOG

Contract:	Client:	Trial Pit:
Northwood & Pinner Health Centre	**NHSPS**	**CBR1**

Contract Ref:	Date:	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	**26.06.20**	**73.49**	**E:510084.1 N:190701.6**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						MADE GROUND: Asphalt	0.02	
						MADE GROUND: Concrete	0.10	
						MADE GROUND: Dark brown and black slightly clayey sandy subangular to subrounded fine to medium GRAVEL of flint, concrete and brick with medium cobble content of brick. Sand is fine to coarse.	(0.30)	
							0.40	
0.50	1	ES				MADE GROUND: Soft dark brown and grey mottled green slightly gravelly CLAY with occasional fragments of brick. Gravel is subangular to subrounded fine to coarse flint and brick.	(0.20)	
0.60		CBR	3%			Inspection pit terminated at 0.60m depth.	0.60	

Plan (Not to Scale)



General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Borehole remained dry and stable throughout drilling.
3. Borehole terminated at 0.60m depth.
4. On completion, borehole backfilled with arisings.

All dimensions in metres | Scale: **1:10**

Method Used:	Plant Used:	Logged By:	Checked By:
Inspection pit	**Hand tools**	**HAbayatilaka**	

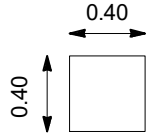
INSPECTION PIT LOG

Contract:	Client:	Trial Pit:
Northwood & Pinner Health Centre	**NHSPS**	**CBR2**

Contract Ref:	Date:	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	**26.06.20**	**71.59**	**E:510017.1 N:190642.4**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						Grass over dark brown slightly sandy gravelly SILT with rare brick fragments. Gravel is subangular to subrounded fine to coarse flint. Sand is fine to medium. (REWORKED TOPSOIL)	(0.30)	
							0.30	
0.40	1	ES				Brown and light brown mottled grey slightly silty CLAY.	(0.30)	
0.60		CBR	4.8%			Inspection pit terminated at 0.60m depth.	0.60	

Plan (Not to Scale)



General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Borehole remained dry and stable throughout drilling.
3. Borehole terminated at 0.60m depth.
4. On completion, borehole backfilled with arisings.

All dimensions in metres | Scale: **1:10**

Method Used:	Plant Used:	Logged By:	Checked By:
Inspection pit	**Hand tools**	**HAbayatilaka**	

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Northwood & Pinner Health Centre	**NHSPS**	**WS01**

Contract Ref:	Start: **25.06.20**	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	End: **25.06.20**	**73.69**	**E:510111.3 N:190661.2**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.40 0.40	1	ES PID	0.1ppm			Grass over dark brown slightly sandy gravelly CLAY with frequent rootlets. Gravel is subangular to subrounded fine to coarse flint. (MADE GROUND)	(0.60) 0.60	
	1.00-1.50	1	B				Firm grey mottled orangish brown slightly silty CLAY with occasional relic roots. (LONDON CLAY FORMATION)	(0.90) 1.50	
	2.00-2.60 2.00	2	B V	c_u=120/120/120			Stiff brown mottled grey CLAY with rare relic roots. (LONDON CLAY FORMATION) . . . yellow silty clay between 2.00 and 2.60m depth, and selenite crystals.	(2.50)	
	3.00		V	c_u=90/100/100			. . . Large relic root at 3.30m depth.		
	3.50-4.00	3	B						
	4.00		V	c_u=110/110/120			Borehole terminated at 4.00m depth.	4.00	

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. Borehole remained dry and stable throughout drilling.
4. Borehole terminated at 4.00m depth.
5. On completion, borehole backfilled with arisings.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window	**Dando Terrier**	**Simon Bolton**	**HAbayatilaka**	AT

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Northwood & Pinner Health Centre	**NHSPS**	**WS02**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	**25.06.20** End: **25.06.20**	**74.43**	**E:510118.3 N:190705.7**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.20 0.20	1	ES PID	0.0ppm			Grass over dark brown slightly gravelly CLAY with frequent rootlets. Gravel is subangular to subrounded fine flint. (MADE GROUND)	0.25	
							Stiff brown mottled grey slightly silty CLAY. (LONDON CLAY FORMATION)	(1.15)	
	1.00-1.80	1	B					1.40	
							Stiff orangish brown mottled brown silty CLAY. (LONDON CLAY FORMATION)	(0.40)	
								1.80	
	2.00		V	c_u=88/88/90			Firm brown mottled grey slightly silty CLAY. (LONDON CLAY FORMATION)		
	2.30-2.70	2	B				. . . selenite crystals from 2.3m bgl.	(2.20)	
	3.00		V	c_u=120/120					
	3.40-4.00	3	B				. . . Interbedded bands of yellow silty clay between 3.40 and 3.60m depth.		
	4.00		V	c_u=110/120			Borehole terminated at 4.00 depth.	4.00	

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. Borehole remained dry and stable throughout drilling.
4. Borehole terminated at 4.00m depth.
5. On completion, borehole backfilled with arisings.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window	**Dando Terrier**	**Simon Bolton**	**HAbayatilaka**	AT

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Northwood & Pinner Health Centre	**NHSPS**	**WS03**

Contract Ref:	Start: **25.06.20**	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	End: **25.06.20**	**71.24**	**E:509999.6 N:190645.3**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.30 0.30	1	ES PID	0.1ppm			MADE GROUND: Grass over dark brown slightly sandy gravelly SILT with high brick cobble content. Gravel is subangular to subrounded fine to medium flint. (MADE GROUND)	(0.60) 0.60	
	1.00-1.50	1	B				Stiff orangish brown mottled grey slightly silty CLAY with occasional relic roots. (LONDON CLAY FORMATION)		
	2.00		V	c_u=80/85/90			. . . Increase in silt content between 1.60 and 1.80m depth. . . . Decrease in silt content with depth below 1.80m.	(3.40)	
	2.50-3.00	2	B						
	3.00		V	c_u=85/86/85					
	3.50-4.00	3	B				. . . Band of yellow silty clay at 3.50m depth.		
	4.00		V	c_u=105/100/100			Borehole terminated at 4.00m depth.	4.00	

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. Borehole remained dry and stable throughout drilling.
4. Borehole terminated at 4.00m depth.
5. On completion, borehole backfilled with arisings.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window	**Dando Terrier**	**Simon Bolton**	**HAbayatilaka**	AT

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Northwood & Pinner Health Centre	**NHSPS**	**WS04**

Contract Ref:	Start: **25.06.20**	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	End: **25.06.20**	**71.69**	**E:510026.1 N:190641.3**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.30 0.30	1	ES PID	0.1ppm			Grass over dark brown slightly gravelly CLAY with frequent rootlets. Gravel is subangular to subrounded fine flint. (MADE GROUND)	0.20 (0.30)	
							Firm Brown slightly sandy silty CLAY with occasional rootlets. Sand is fine to coarse. (LONDON CLAY FORMATION)	0.50	
	1.00-1.50	1	B				Stiff grey mottled orang slightly silty CLAY with occasional relic roots. (LONDON CLAY FORMATION)		
	2.00		V	c_u=92/100/95					
	2.40-2.80	2	B				. . . from 2.4m selenite crystals.	(3.50)	
	3.00		V	c_u=95/95/98					
	3.50-4.00	3	B				. . . Interbedded yellow silty CLAY between 3.80 and 4.00m depth.	4.00	
	4.00		V	c_u=95			Borehole terminated at 4.00m depth.		

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. Borehole remained dry and stable throughout drilling.
4. Borehole terminated at 4.00m depth.
5. On completion, borehole backfilled with arisings.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window	**Dando Terrier**	**Simon Bolton**	**HAbayatilaka**	AT

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Northwood & Pinner Health Centre	**NHSPS**	**WS05**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134	**25.06.20** End: **25.06.20**	**71.60**	**E:510027.2 N:190665.4**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.30 0.30	1	ES PID	0.2ppm			MADE GROUND: Grass over dark brown slightly sandy gravelly CLAY with frequent rootlets and rare brick fragments. Gravel is subangular to subrounded fine to coarse flint. Sand is fine to coarse. (MADE GROUND)	(0.45) 0.45	
	1.00-1.50	1	B				Firm becoming stiff brown mottled orangish brown and grey slightly silty CLAY. (LONDON CLAY FORMATION)	(2.65)	
	2.00-2.50 2.00	2	B V	c_u=60/70/60			. . . Interbedded bands of white and cream crystalline carbonate calcretions between 2.00 and 2.50m depth.		
	3.00		V	c_u=75/70				3.10	
	3.50-4.00	3	B				Stiff brown mottled grey slightly silty CLAY. (LONDON CLAY FORMATION) . . . Pockets of yellow silty clay at 3.50m depth.	(0.90)	
	4.00		V	c_u=95/90				4.00	

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. Borehole remained dry and stable throughout drilling.
4. Borehole terminated at 4.00m depth.
5. On completion, borehole backfilled with arisings.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window	**Dando Terrier**	**Simon Bolton**	**HAbayatilaka**	AT

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Northwood & Pinner Health Centre	**NHSPS**	**WS06**

Contract Ref:	Start: **25.06.20** End: **25.06.20**	Ground Level:	National Grid Co-ordinate:	Sheet:
1921134		**72.06**	**E:510040.3 N:190681.0**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.30 0.30	1	ES PID	0.1ppm			Grass over dark brown slightly silty gravelly fine to coarse SAND with frequent rootlets. Gravel is subangular to subrounded fine to medium flint. (MADE GROUND)	(0.45) 0.45	
	1.00-1.50	1	B				Stiff brown mottled orange and grey slightly silty CLAY. (LONDON CLAY FORMATION)	(2.35) 2.80	
	2.00		V	c_u=100/110/100					
	2.50-3.00	2	B						
	3.00		V	c_u=85/95/95			Stiff brown mottled yellow CLAY with interbedded bands of yellow silty clay. (LONDON CLAY FORMATION)	(0.70) 3.50	
	3.50-4.00	3	B				Stiff brown mottled orangish brown CLAY. (LONDON CLAY FORMATION)	(0.50) 4.00	
	4.00		V	c_u=90/95/95			Borehole terminated at 4.00m depth.		

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. Borehole remained dry and stable throughout drilling.
4. Borehole terminated at 4.00m depth.
5. On completion, borehole backfilled with arisings.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window	**Dando Terrier**	**Simon Bolton**	**HAbayatilaka**	AT

APPENDIX G
GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH

Generic assessment criteria for human health: residential scenario without home-grown produce

Background

RSK's generic assessment criteria (GAC) were initially prepared following the publication by the Environment Agency (EA) of soil guideline value (SGV) and toxicological (TOX) reports, and associated publications in 2009[1]. RSK GAC were updated following the publication of GAC by LQM/CIEH in 2009[2]. RSK GAC are periodically revised when updated information on toxicological, land use or receptor parameters is published.

Updates to the RSK GAC

In 2014, the publication of Category 4 Screening Levels (C4SL)[3,4], as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3)[5] used in the generation of SGVs.

C4SL were published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010[3]). Where a C4SL has been published, the RSK GAC duplicates the C4SL published values using all input parameters within the SP1010 final project report[3] and associated appendices[6], and adopts them as GAC for these six substances.

For all other substances the C4SL exposure modifications relevant for residential without home-grown produce end use have been applied to the current RSK GAC. These include alterations to daily inhalation rates for residential and commercial scenarios, reducing soil adherence factors in children (age classes 1 to 12 only) and reducing exposure frequency for dermal contact outdoors.

The RSK GAC have also been revised with updated toxicology published by LQM/CIEH in 2015[7] or by the USEPA[14], where a C4SL has not been published.

RSK GAC derivation for metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using the Contaminated Land Exposure Assessment (CLEA) tool v1.071, supporting EA guidance[5,8,9] and revised exposure scenarios published for the C4SL[3]. The SAC are also termed GAC.

Conceptual model

In accordance with SR3[5], the residential without home-grown produce scenario considers risks to a female child between the ages of 0 and 6 years old as the highest risk scenario. In accordance with Box 3.1 of SR3[5], the pathways considered for production of the SAC in the residential without home-grown produce scenario are

- direct soil and dust ingestion in areas of soft landscaping
- dermal contact with soil and indoor dust

- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

In line with guidance in the EA SGV report for cadmium[1], the RSK GAC for cadmium has been derived based on estimates representative of lifetime exposure. Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium, and the derivation of the TDI_{oral} and TDI_{inh}, are based on considerations of the kidney burden accumulated over 50 years or so. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period.

With respect to volatilisation, the CLEA model assumes a simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase[9]. The upper boundaries of this partitioning are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA model estimates saturated soil concentrations where these limits are reached[9]. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous- or vapour-based soil saturation limits. Model output cells are flagged red where the saturated soil concentration has been exceeded and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10%. In this case, further consideration of the following is required[9]:

- Free phase contamination may be present.
- Exposure from the vapour pathways will be over-predicted by the model, as in reality the vapour phase concentration will not increase at concentrations above saturation limits
- Where the vapour pathway contribution is greater than 90%, it is unlikely the relevant health criteria value (HCV) will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Where the vapour pathway is the predominant pathway (contributes greater than 90% of exposure) or the only exposure route considered and the cell is highlighted red (SAC exceeds saturation limit), the risk based on the assumed conceptual model is likely to be negligible as the vapour risk is assumed to be tolerable at maximum possible soil concentrations. In such circumstances, the vapour pathway exposure should be considered based on the presence of free phase or non-aqueous phase liquid sources and the measured concentrations of volatile organic compounds (VOC) in the vapour phase. Screening could be considered based on setting the SAC as the modelled soil saturation limits. However, as stated within the CLEA handbook[9], this is likely to not be practical in many cases because of the very low saturation limits and, in any case, is highly conservative.

It should also be noted that for mixtures of compounds, free phase may be present where soil (or groundwater) concentrations are well below saturation limits for individual compounds.

Where the vapour pathway is only one of the exposure pathways considered, an additional approach can then be utilised as detailed within Section 4.12 of the CLEA model handbook[9], which explains how to calculate an effective assessment criterion manually.

SR3[5] states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase contamination by petroleum hydrocarbons are at least a factor of ten higher than those likely to be measured on-site. RSK has therefore applied an empirical subsurface to indoor air correction factor of 10 into the CLEA model chemical database for all petroleum hydrocarbon fractions (including BTEX, trimethylbenzenes and the

polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene) to reduce this conservatism.

Input selection

The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7[10], the EA TOX[1] reports, the C4SL SP1010 project report and associated appendices[3,6], the 2015 LQM/CIEH report[7] or the USEPA IRIS database[14]. Where a C4SL has been published, the RSK GAC have duplicated the C4SL published values using all input parameters within the SP1010 final project report[3] and associated appendices[6], and has adopted them as GAC for these six substances. Toxicological and specific chemical parameters for 1,2,4-trimethylbenzene, barium and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report[11].

For TPH, aromatic hydrocarbons C_5–C_8 were not modelled, as this range comprises benzene (>EC5-EC7) and toluene (>EC7-EC8), which are modelled separately.

Physical parameters

For the residential without home-grown produce scenario, the CLEA default building is a small, two-storey terrace house with a concrete ground-bearing slab. SR3[5] notes this residential building type to be the most conservative in terms of potential for vapour intrusion. The building parameters used in the production of the RSK GACs are the default CLEA v1.06 inputs presented in Table 3.3 of SR3[3], with a dust loading factor detailed in Section 9.3 of SR3[5]. The parameters for a sandy loam soil type were used in line with Table 4.4 of SR3[5]. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this SOM, RSK has produced an additional set of GAC for SOM of 1% and 2.5% for all substances using the CLEA tool.

Summary of modifications to the default CLEA SR3[5] input parameters for residential without home-grown produce

In summary, the RSK GAC were produced using the default input parameters for soil properties, the air dispersion model, building properties and the vapour model detailed in SR3[5]. Modifications to the default SR3[5] exposure scenarios based on the C4SL exposure scenarios[3] are presented in Table 2 below.

The final selected GAC are presented by pathway in Table 3 and the combined GAC in Table 4.

Figure 1: Conceptual model for CLEA residential scenario without home-grown produce

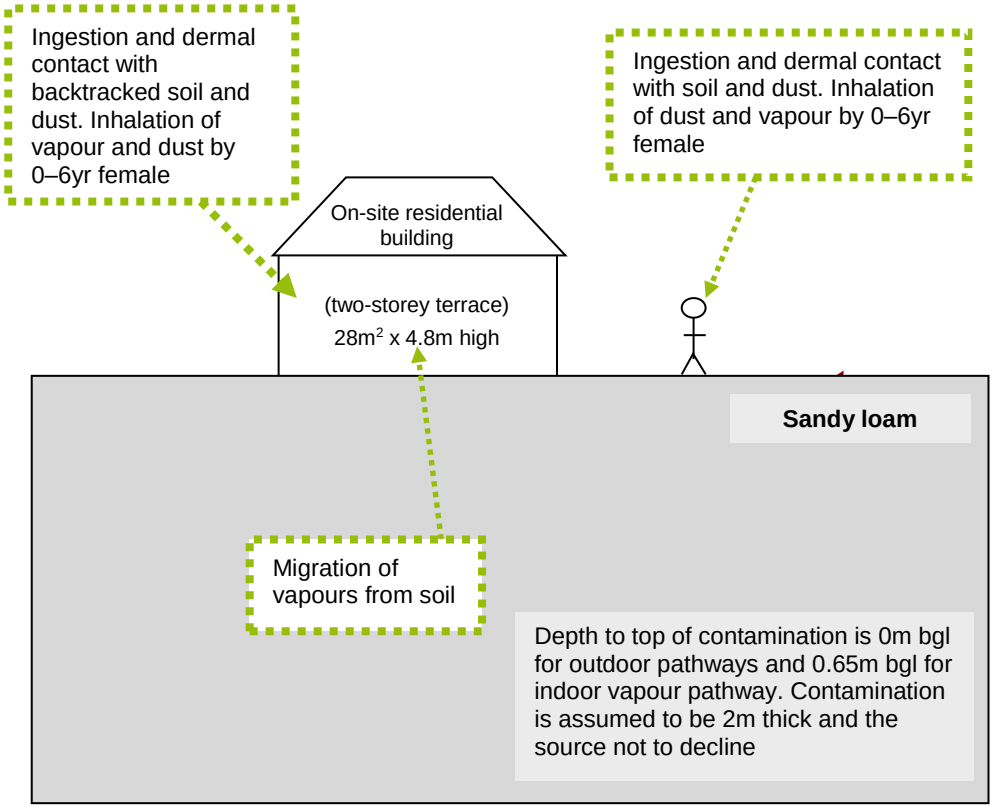


Table 1: Exposure assessment parameters for residential scenario without home-grown produce – inputs for CLEA model

Parameter	Value	Justification
Land use	Residential without home-grown produce	Chosen land use
Receptor	Female child	Key generic assumption given in Box 3.1, SR3[5]
Building	Small terraced house	Key generic assumption given in Box 3.1, SR3[5]. Small, two-storey terraced house chosen, as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, SR3)[5]
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, from Table 3.1, SR3)[5]
Start age class (AC)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged 0–6. From Box 3.1, SR3[5]
End AC	6	
SOM (%)	6	Representative of sandy loamy soil according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[13]
	1	To provide SAC for sites where SOM <6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Residential without home-grown produce – modified receptor data

Parameter	Unit	Age class					
		1	2	3	4	5	6
Soil to skin adherence factor – (outdoor)	mg soil/cm^2 skin	0.1	0.1	0.1	0.1	0.1	0.1
Justification		Table 3.5, SP1010[3]					
Inhalation rate	m^3 day^{-1}	5.4	8.0	8.9	10.1	10.1	10.1
Justification		Mean value USEPA, 2011[12]; Table 3.2, SP1010[3]					
Notes: For **cadmium**, the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1-18. This is because the TDI_{oral} and TDI_{inh} are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period. See the Environment Agency Science Report SC05002/ TOX 3[1], Science Report SC050021/Cadmium SGV[1] and the project report SP1010[3] for more information.							

References

1. Environment Agency (2009), 'Science Reports SC050021 - SGV and TOX reports for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs'; 'Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs', and 'Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs'. Available at: https://www.gov.uk/government/publications/contaminants-in-soil-updated-collation-of-toxicological-data-and-intake-values-for-humans and https://www.gov.uk/government/publications/land-contamination-soil-guideline-values-sgvs (accessed 4 February 2015)

2. Nathanial, C. P., McCaffrey, C., Ashmore, M., Cheng, Y., Gillet, A. G., Ogden, R. C. and Scott, D. (2009), *LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment*, second edition (Nottingham: Land Quality Press).

3. Contaminated Land: Applications in Real Environment (CL:AIRE) (2014). 'Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination', Revision 2, DEFRA research project SP1010.

4. Department for Environment, Food and Rural Affairs (Defra) (2014), 'SP1010: Development of Category 4 Screening Levels for assessment of land affected by contamination – Policy Companion Document', Revision 2.

5. Environment Agency (2009), *Science Report – SC050021/SR3. Updated technical background to the CLEA model* (Bristol: Environment Agency).

6. Contaminated Land: Applications in Real Environment (CL:AIRE) (2014). 'Appendices C to H). DEFRA research project SP1010'.

7. Nathanial, C. P., McCaffrey, C., Gillet, A. G., Ogden, R. C. and Nathanial, J. F. (2015), *The LQM/CIEH S4ULs for Human Health Risk Assessment* (Nottingham: Land Quality Press).

8. Environment Agency (2009), *Human health toxicological assessment of contaminants in soil. Science Report – Final SC050021/SR2* (Bristol: Environment Agency).

9. Environment Agency (2009), *Science Report – SC050021/SR4 CLEA Software (version 1.05) Handbook* (Bristol: Environment Agency).

10. Environment Agency (2008), *Science Report SC050021/SR7. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values* (Bristol: Environment Agency).

11. CL:AIRE (2010), *Soil Generic Assessment Criteria for Human Health Risk Assessment* (London: CL:AIRE).

12. USEPA (2011), *Exposure factors handbook*, EPA/600/R-090/052F (Washington, DC: Office of Research and Development).

13. Environment Agency (2009), 'Changes made to the CLEA framework documents after the three-month evaluation period in 2008', released January 2009.

14. USEPA (2010). Hydrogen cyanide and cyanide salts. Integrated Risk Information Systems (IRIS) Chemical Assessment Summary. September 2010. https://www.epa.gov/iris (accessed 9 December 2015)

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE

Table 3

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Home-Grown Produce

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals													
Arsenic	(a,b)	3.99E+01	5.26E+02	NR	NR	3.99E+01	5.26E+02	NR	NR	3.99E+01	5.26E+02	NR	NR
Barium	(b)	1.35E+03	NR	NR	NR	1.35E+03	NR	NR	NR	1.35E+03	NR	NR	NR
Beryllium		1.56E+02	1.72E+00	NR	NR	1.56E+02	1.72E+00	NR	NR	1.56E+02	1.72E+00	NR	NR
Boron		1.08E+04	5.20E+06	NR	NR	1.08E+04	5.20E+06	NR	NR	1.08E+04	5.20E+06	NR	NR
Cadmium	(a)	1.95E+02	4.88E+02	1.49E+02	NR	1.95E+02	4.88E+02	1.49E+02	NR	1.95E+02	4.88E+02	1.49E+02	NR
Chromium (III) - trivalent	(c)	1.98E+04	9.07E+02	NR	NR	1.98E+04	9.07E+02	NR	NR	1.98E+04	9.07E+02	NR	NR
Chromium (VI) - hexavalent	(a,d)	5.91E+01	2.06E+01	NR	NR	5.91E+01	2.06E+01	NR	NR	5.91E+01	2.06E+01	NR	NR
Copper		1.08E+04	1.41E+04	7.13E+03	NR	1.08E+04	1.41E+04	7.13E+03	NR	1.08E+04	1.41E+04	7.13E+03	NR
Lead	(a)	3.14E+02	NR	NR	NR	3.14E+02	NR	NR	NR	3.14E+02	NR	NR	NR
Elemental Mercury (Hg^0)	(d)	NR	2.41E-01	NR	4.31E+00	NR	5.74E-01	NR	1.07E+01	NR	1.25E+00	NR	2.58E+01
Inorganic Mercury (Hg^{2+})		5.71E+01	3.63E+03	5.62E+01	NR	5.71E+01	3.63E+03	5.62E+01	NR	5.71E+01	3.63E+03	5.62E+01	NR
Methyl Mercury (Hg^{4+})		1.80E+01	1.87E+01	9.16E+00	7.33E+01	1.80E+01	3.62E+01	1.20E+01	1.42E+02	1.80E+01	7.68E+01	1.46E+01	3.04E+02
Nickel	(d)	1.88E+02	1.81E+02	NR	NR	1.88E+02	1.81E+02	NR	NR	1.88E+02	1.81E+02	NR	NR
Selenium	(b)	4.31E+02	NR	NR	NR	4.31E+02	NR	NR	NR	4.31E+02	NR	NR	NR
Vanadium		1.17E+03	1.46E+03	NR	NR	1.17E+03	1.46E+03	NR	NR	1.17E+03	1.46E+03	NR	NR
Zinc	(b)	4.05E+04	3.63E+07	NR	NR	4.05E+04	3.63E+07	NR	NR	4.05E+04	3.63E+07	NR	NR
Cyanide (free)		4.03E+01	1.37E+04	4.02E+01	NR	4.03E+01	1.37E+04	4.02E+01	NR	4.03E+01	1.37E+04	4.02E+01	NR
Volatile Organic Compounds													
Benzene	(a)	7.36E+01	9.01E-01	8.90E-01	1.22E+03	7.36E+01	1.68E+00	1.64E+00	2.26E+03	7.36E+01	3.48E+00	3.33E+00	4.71E+03
Toluene		2.87E+04	9.08E+02	8.80E+02	8.69E+02	2.87E+04	2.00E+03	1.87E+03	1.92E+03	2.87E+04	4.55E+03	3.93E+03	4.36E+03
Ethylbenzene		1.29E+04	8.34E+01	8.29E+01	5.18E+02	1.29E+04	1.96E+02	1.93E+02	1.22E+03	1.29E+04	4.58E+02	4.42E+02	2.84E+03
Xylene - m		2.32E+04	8.25E+01	8.22E+01	6.25E+02	2.32E+04	1.95E+02	1.93E+02	1.47E+03	2.32E+04	4.56E+02	4.47E+02	3.46E+03
Xylene - o		2.32E+04	8.87E+01	8.83E+01	4.78E+02	2.32E+04	2.08E+02	2.06E+02	1.12E+03	2.32E+04	4.86E+02	4.76E+02	2.62E+03
Xylene - p		2.32E+04	7.93E+01	7.90E+01	5.76E+02	2.32E+04	1.86E+02	1.85E+02	1.35E+03	2.32E+04	4.36E+02	4.28E+02	3.17E+03
Total xylene		2.32E+04	7.93E+01	7.90E+01	6.25E+02	2.32E+04	1.86E+02	1.85E+02	1.47E+03	2.32E+04	4.36E+02	4.28E+02	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		3.87E+04	1.04E+02	1.04E+02	2.04E+04	3.87E+04	1.69E+02	1.69E+02	3.31E+04	3.87E+04	3.21E+02	3.19E+02	6.27E+04
Trichloroethene		6.45E+01	1.72E-02	1.72E-02	1.54E+03	6.45E+01	3.59E-02	3.59E-02	3.22E+03	6.45E+01	7.98E-02	7.97E-02	7.14E+03
Tetrachloroethene		7.13E+02	1.79E-01	1.79E-01	4.24E+02	7.13E+02	4.02E-01	4.02E-01	9.51E+02	7.13E+02	9.21E-01	9.20E-01	2.18E+03
1,1,1-Trichloroethane		7.74E+04	9.01E+00	9.01E+00	1.43E+03	7.74E+04	1.84E+01	1.84E+01	2.92E+03	7.74E+04	4.04E+01	4.04E+01	6.39E+03
1,1,1,2 Tetrachloroethane		7.34E+02	1.54E+00	1.53E+00	2.60E+03	7.34E+02	3.56E+00	3.55E+00	6.02E+03	7.34E+02	8.29E+00	8.20E+00	1.40E+04
1,1,2,2-Tetrachloroethane		7.34E+02	3.92E+00	3.90E+00	2.67E+03	7.34E+02	8.04E+00	7.95E+00	5.46E+03	7.34E+02	1.76E+01	1.72E+01	1.20E+04
Carbon Tetrachloride		5.15E+02	2.58E-02	2.58E-02	1.52E+03	5.15E+02	5.65E-02	5.64E-02	3.32E+03	5.15E+02	1.28E-01	1.28E-01	7.54E+03
1,2-Dichloroethane		1.55E+01	9.20E-03	9.20E-03	3.41E+03	1.55E+01	1.33E-02	1.33E-02	4.91E+03	1.55E+01	2.28E-02	2.27E-02	8.43E+03
Vinyl Chloride		1.81E+00	7.73E-04	7.73E-04	1.36E+03	1.81E+00	1.00E-03	9.99E-04	1.76E+03	1.81E+00	1.53E-03	1.53E-03	2.69E+03
1,2,4-Trimethylbenzene		NR	5.58E+00	NR	4.74E+02	NR	1.29E+01	NR	1.16E+03	NR	2.69E+01	NR	2.76E+03
1,3,5-Trimethylbenzene	(e)	NR	NR	NR	2.30E+02	NR	NR	NR	5.52E+02	NR	NR	NR	1.30E+03
Semi-Volatile Organic Compounds													
Acenaphthene		7.64E+03	4.86E+04	6.60E+03	5.70E+01	7.64E+03	1.18E+05	7.17E+03	1.41E+02	7.64E+03	2.68E+05	7.43E+03	3.36E+02
Acenaphthylene		7.65E+03	4.59E+04	6.55E+03	8.61E+01	7.65E+03	1.11E+05	7.15E+03	2.12E+02	7.65E+03	2.53E+05	7.42E+03	5.06E+02
Anthracene		3.82E+04	1.53E+05	3.06E+04	1.17E+00	3.82E+04	3.77E+05	3.47E+04	2.91E+00	3.82E+04	8.76E+05	3.66E+04	6.96E+00
Benzo(a)anthracene		1.98E+01	2.47E+01	1.10E+01	1.71E+00	1.98E+01	4.37E+01	1.36E+01	4.28E+00	1.98E+01	6.26E+01	1.50E+01	1.03E+01
Benzo(a)pyrene	(a)	5.34E+00	3.51E+01	NR	9.11E-01	5.34E+00	3.77E+01	NR	2.28E+00	5.34E+00	3.89E+01	NR	5.46E+00
Benzo(b)fluoranthene		4.97E+00	1.93E+01	3.95E+00	1.22E+00	4.97E+00	2.13E+01	4.03E+00	3.04E+00	4.97E+00	2.22E+01	4.06E+00	7.29E+00
Benzo(g,h,i)perylene		4.38E+02	1.87E+03	3.55E+02	1.54E-02	4.38E+02	1.94E+03	3.58E+02	3.85E-02	4.38E+02	1.97E+03	3.59E+02	9.23E-02
Benzo(k)fluoranthene		1.31E+02	5.41E+02	1.06E+02	6.87E-01	1.31E+02	5.76E+02	1.07E+02	1.72E+00	1.31E+02	5.91E+02	1.07E+02	4.12E+00
Chrysene		3.95E+01	1.19E+02	2.97E+01	4.40E-01	3.95E+01	1.49E+02	3.12E+01	1.10E+00	3.95E+01	1.66E+02	3.19E+01	2.64E+00
Dibenzo(a,h)anthracene		3.95E-01	1.45E+00	3.10E-01	3.93E-03	3.95E-01	1.64E+00	3.18E-01	9.82E-03	3.95E-01	1.74E+00	3.22E-01	2.36E-02
Fluoranthene		1.59E+03	3.83E+04	1.53E+03	1.89E+01	1.59E+03	8.87E+04	1.56E+03	4.73E+01	1.59E+03	1.83E+05	1.58E+03	1.13E+02

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE

Table 3

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Home-Grown Produce

Compound	Notes	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Fluorene		5.09E+03	6.20E+03	2.80E+03	3.09E+01	5.09E+03	1.53E+04	3.82E+03	7.65E+01	5.09E+03	3.62E+04	4.47E+03	1.83E+02
Indeno(1,2,3-cd)pyrene		5.65E+01	2.12E+02	4.46E+01	6.13E-02	5.65E+01	2.38E+02	4.56E+01	1.53E-01	5.65E+01	2.50E+02	4.60E+01	3.68E-01
Naphthalene		2.50E+03	2.33E+01	2.31E+01	7.64E+01	2.50E+03	5.58E+01	5.46E+01	1.83E+02	2.50E+03	1.31E+02	1.25E+02	4.32E+02
Phenanthrene		1.58E+03	7.17E+03	1.30E+03	3.60E+01	1.58E+03	1.76E+04	1.45E+03	8.96E+01	1.58E+03	4.07E+04	1.52E+03	2.14E+02
Pyrene		3.82E+03	8.79E+04	3.66E+03	2.20E+00	3.82E+03	2.04E+05	3.75E+03	5.49E+00	3.82E+03	4.23E+05	3.79E+03	1.32E+01
Phenol		6.48E+04	4.58E+02	4.55E+02	2.42E+04	6.48E+04	6.95E+02	6.88E+02	3.81E+04	6.48E+04	1.19E+03	1.17E+03	7.03E+04
Total Petroleum Hydrocarbons													
Aliphatic hydrocarbons EC_5-EC_6		3.23E+05	4.24E+01	4.24E+01	3.04E+02	3.23E+05	7.79E+01	7.79E+01	5.58E+02	3.23E+05	1.61E+02	1.61E+02	1.15E+03
Aliphatic hydrocarbons >EC_6-EC_8		3.23E+05	1.04E+02	1.04E+02	1.44E+02	3.23E+05	2.31E+02	2.31E+02	3.22E+02	3.23E+05	5.29E+02	5.29E+02	7.36E+02
Aliphatic hydrocarbons >EC_8-EC_{10}		6.45E+03	2.68E+01	2.68E+01	7.77E+01	6.45E+03	6.55E+01	6.53E+01	1.90E+02	6.45E+03	1.56E+02	1.55E+02	4.51E+02
Aliphatic hydrocarbons >EC_{10}-EC_{12}		6.45E+03	1.33E+02	1.32E+02	4.75E+01	6.45E+03	3.31E+02	3.27E+02	1.18E+02	6.45E+03	7.93E+02	7.67E+02	2.83E+02
Aliphatic hydrocarbons >EC_{12}-EC_{16}		6.45E+03	1.11E+03	1.06E+03	2.37E+01	6.45E+03	2.78E+03	2.42E+03	5.91E+01	6.45E+03	6.67E+03	4.37E+03	1.42E+02
Aliphatic hydrocarbons >EC_{16}-EC_{35}	(b)	6.50E+04	NR	NR	8.48E+00	9.25E+04	NR	NR	2.12E+01	1.11E+05	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC_{35}-EC_{44}	(b)	6.50E+04	NR	NR	8.48E+00	9.25E+04	NR	NR	2.12E+01	1.11E+05	NR	NR	5.09E+01
Aromatic hydrocarbons >EC_8-EC_{10}		2.58E+03	4.74E+01	4.72E+01	6.13E+02	2.58E+03	1.16E+02	1.15E+02	1.50E+03	2.58E+03	2.77E+02	2.69E+02	3.58E+03
Aromatic hydrocarbons >EC_{10}-EC_{12}		2.58E+03	2.58E+02	2.52E+02	3.64E+02	2.58E+03	6.39E+02	5.94E+02	8.99E+02	2.58E+03	1.52E+03	1.24E+03	2.15E+03
Aromatic hydrocarbons >EC_{12}-EC_{16}		2.58E+03	2.85E+03	1.80E+03	1.69E+02	2.58E+03	7.07E+03	2.30E+03	4.19E+02	2.58E+03	1.68E+04	2.48E+03	1.00E+03
Aromatic hydrocarbons >EC_{16}-EC_{21}	(b)	1.86E+03	NR	NR	5.37E+01	1.90E+03	NR	NR	1.34E+02	1.92E+03	NR	NR	3.21E+02
Aromatic hydrocarbons >EC_{21}-EC_{35}	(b)	1.93E+03	NR	NR	4.83E+00	1.93E+03	NR	NR	1.21E+01	1.93E+03	NR	NR	2.90E+01
Aromatic hydrocarbons >EC_{35}-EC_{44}	(b)	1.93E+03	NR	NR	4.83E+00	1.93E+03	NR	NR	1.21E+01	1.93E+03	NR	NR	2.90E+01

Notes:

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly affect the interpretation of any exceedances as the contribution of the indoor and outdoor vapour pathway to total exposure is >10%.

Calculated SAC exceeds soil saturation limit but the exceedance will not affect the SAC significantly as the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway (Section 10.1.1, SR3)

(a) SAC for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead are derived using the C4SL toxicology data.

(b) SAC for boron and selenium should not include the inhalation pathway as no expert group HCV has been derived; aliphatic and aromatic hydrocarbons >EC16 should not include inhalation pathway due to their non-volatile nature and inhalation exposure being minimal (oral, dermal and inhalation exposure is compared to the oral HCV); arsenic should only be based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The Oral SAC should be adopted for zinc and benzo(a)pyrene.

(c) SAC for CrIII should be based on the lower of the oral and inhalation SAC (see LQM/CIEH 2015 Section 6.8)

(d) SAC for elemental mercury, chromium VI and nickel should be based on the inhalation pathway only.

(e) SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used.

Table 4
Human health generic assessment criteria for residential without home-grown produce

Compound	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals			
Arsenic	40	40	40
Barium	1,300	1,300	1,300
Beryllium	1.7	1.7	1.7
Boron	11,000	11,000	11,000
Cadmium	149	149	149
Chromium (III) - trivalent	910	910	910
Chromium (VI) - hexavalent	21	21	21
Copper	7,100	7,100	7,100
Lead	310	310	310
Elemental Mercury (Hg^0)	0.2	0.6	1.2
Inorganic Mercury (Hg^{2+})	56	56	56
Methyl Mercury (Hg^{4+})	9	12	15
Nickel	180	180	180
Selenium	430	430	430
Vanadium	1,200	1,200	1,200
Zinc	40,000	40,000	40,000
Cyanide (free)	40	40	40
Volatile Organic Compounds			
Benzene	0.9	1.6	3.3
Toluene	900 (869)	1,900	3,900
Ethylbenzene	80	190	440
Xylene - m	80	190	450
Xylene - o	90	210	480
Xylene - p	80	180	430
Total xylene	80	180	430
Methyl tertiary-Butyl ether (MTBE)	100	170	320
Trichloroethene	0.02	0.04	0.08
Tetrachloroethene	0.2	0.4	0.9
1,1,1-Trichloroethane	9.0	18.4	40.4
1,1,1,2 Tetrachloroethane	1.5	3.5	8.2
1,1,2,2-Tetrachloroethane	3.9	8.0	17.2
Carbon Tetrachloride	0.026	0.056	0.128
1,2-Dichloroethane	0.009	0.013	0.023
Vinyl Chloride	0.0008	0.0010	0.0015
1,2,4-Trimethylbenzene	5.6	12.9	26.9
1,3,5-Trimethylbenzene	NR	NR	NR
Semi-Volatile Organic Compounds			
Acenaphthene	6,600 (57)	7,200	7,400
Acenaphthylene	6,600 (86)	7,200	7,400
Anthracene	31,000 (1.17)	35,000	37,000
Benzo(a)anthracene	11.0	13.6	15.0
Benzo(a)pyrene	5.3	5.3	5.3
Benzo(b)fluoranthene	4.0	4.0	4.1
Benzo(g,h,i)perylene	355	358	359
Benzo(k)fluoranthene	106	107	107
Chrysene	30	31	32
Dibenzo(a,h)anthracene	0.31	0.32	0.32
Fluoranthene	1,500	1,600	1,600
Fluorene	2,800 (31)	3,800 (77)	4,500 (183)
Indeno(1,2,3-cd)pyrene	45	46	46
Naphthalene	23	55	125
Phenanthrene	1,300 (36)	1,450	1,520
Pyrene	3,700	3,800	3,800
Phenol	440*	688	1,170
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC_5-EC_6	42	78	161
Aliphatic hydrocarbons >EC_6-EC_8	100	230	530
Aliphatic hydrocarbons >EC_8-EC_{10}	27	65	155
Aliphatic hydrocarbons >EC_{10}-EC_{12}	130 (48)	330 (118)	770 (283)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	1,100 (24)	2,400 (59)	4,400 (142)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	65,000 (8)	92,000 (21)	111,000
Aliphatic hydrocarbons >EC_{35}-EC_{44}	65,000 (8)	92,000 (21)	111,000
Aromatic hydrocarbons >EC_8-EC_{10}	47	115	269
Aromatic hydrocarbons >EC_{10}-EC_{12}	300	600	1,200
Aromatic hydrocarbons >EC_{12}-EC_{16}	1,800 (169)	2,300 (419)	2,500
Aromatic hydrocarbons >EC_{16}-EC_{21}	1,900	1,900	1,900
Aromatic hydrocarbons >EC_{21}-EC_{35}	1,900	1,900	1,900
Aromatic hydrocarbons >EC_{35}-EC_{44}	1,900	1,900	1,900
Minerals			
Asbestos	Stage 1 test – No asbestos detected with ID; Stage 2 test - <0.001% dry weight (exceedance of either equates to an exceedance of the GAC)[1]		

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

NR - SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used

EC - equivalent carbon. SAC - soil assessment criteria.

[1] LOD for weight of asbestos per unit weight of soil calculated on a dry weight basis using PLM, handpicking and gravimetry.

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58.
1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

(VALUE IN BRACKETS)

RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets.

APPENDIX H
GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS

GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS

Several compounds can inhibit plant growth; hence it is important to have generic assessment criteria (GAC) to promote healthy plant growth. In the absence of other published GAC, the GAC have been obtained from legislation (UK and European) and guidance related to the use of sewage sludge on agricultural fields.

The Council of European Communities Sewage Sludge Directive (86/278/EEC) dated 1986, has been transposed into UK law by Statutory Instrument No. 1263, The Sludge (use in Agriculture) Regulations 1989 (Public Health England, Wales and Scotland), as ammended in 1990 and The Sludge (use in Agriculture) Regulations (Northern Ireland) SR No, 245, 1990. In addition the Department of Environment (DoE) produced a Code of Practice (CoP) (Updated 2nd Edition) in 2006 which provided guidance on the application of sewage sludge on agricultural land (however the status of this document is unclear as it is on the archive section of the Defra website).

The directive seeks to encourage the use of sewage sludge in agriculture and to regulate its use in such a way as to "***prevent harmful effects on soil, vegetation, animals and man".*** To this end, it prohibits the use of untreated sludge on agricultural land unless it is injected or incorporated into the soil. Treated sludge is defined as having undergone "biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use". To provide protection against potential health risks from residual pathogens, sludge must not be applied to soil in which fruit and vegetable crops are growing, or less than ten months before fruit and vegetable crops are to be harvested. Grazing animals must not be allowed access to grassland or forage land less than three weeks after the application of sludge.

The specified limits of concentrations of selected elements in soil are presented in Table 4 of the updated 2nd Edition of the DoE Code of Practice and are designed to protect plant growth. It is noted that these values are more stringent than the values set in current UK regulations. However since they were ammended following recommendations from the Independent Scientific Committee in 1993. (MAFF/DOE 1993). The GAC are presented in Table 1.

Table 1: Generic assessment criteria

Determinant	Generic assessment criteria (mg/kg)			
	pH 5.0 < 5.5	pH 5.5 < 6.0	pH 6.0 < 7.0	pH >7.0
Zinc	200	200	200	300
Copper	80	100	135	200
Nickel	50	60	75	110
Lead	300	300	300	300
Cadmium	3	3	3	3
Mercury	1	1	1	1
Note: Only compounds with assessment criteria documented within the Directive 86/278/EEC have been included, although criteria for 5 additional compounds have been presented within the 2006 CoP.				

APPENDIX I
GENERIC ASSESSMENT CRITERIA FOR POTABLE WATER SUPPLY PIPES

A range of pipe materials is available and careful selection, design and installation is required to ensure that water supply pipes are satisfactorily installed and meet the requirements of the Water Supply (Water Fittings) Regulations 1999 in England and Wales, the Byelaws 2000 in Scotland and the Northern Ireland Water Regulations. The regulations include a requirement to use only suitable materials when laying water pipes and laying water pipes without protection is not permitted at contaminated sites. The water supply company has a statutory duty to enforce the regulations.

Contaminants in the ground can pose a risk to human health by permeating potable water supply pipes. To fulfil their statutory obligation, UK water supply companies require robust evidence from developers to demonstrate either that the ground in which new plastic supply pipes will be laid is free from specific contaminants, or that the proposed remedial strategy will mitigate any existing risk. If these requirements cannot be demonstrated to the satisfaction of the relevant water company, it becomes necessary to specify an alternative pipe material on the whole development or in specific zones.

In 2010, UK Water Industry Research (UKWIR) published *Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (Report Ref. No. 10/WM/03/21). This report reviewed previously published industry guidelines and threshold concentrations adopted by individual water supply companies.

The focus of the UKWIR research project was to develop clear and concise procedures, which provide consistency in the pipe selection decision process. It was intended to provide guidance that can be used to ensure compliance with current regulations and to prevent water supply pipe failing prematurely due to the presence of contamination.

The report concluded that in most circumstances only organic contaminants pose a potential risk to plastic pipe materials and Table 3.1 of the report provides threshold concentrations for polyethylene (PE) and polyvinyl chloride (PVC) pipes for the organic contaminants of concern. The report also makes recommendations for the procedures to be adopted in the design of site investigations and sampling strategies, and the assessment of data, to ensure that the ground through which water supply pipes will be laid is adequately characterised.

Risks to water supply pipes have therefore been assessed against the threshold concentrations for PE and PVC pipe specified in Table 3.1 of Report 10/WM/03/21, which have been adopted as the GAC for this linkage and are reproduced in Table A3 below.

Since water supply pipes are typically laid at a minimum depth of 0.75 m below finished ground levels, sample results from depths between 0.5 m and 1.5 m below finished level are generally considered suitable for assessing risks to water supply. Samples outside these depths can be used, providing the stratum is the same as that in which water supply pipes are likely to be located. The report specifies that sampling should characterise the ground conditions to a minimum of 0.5 m below the proposed depth of the pipe.

It should be noted that the assessment provided in this report is a guide and the method of assessment and recommendations should be checked with the relevant water supply company.

Table Q1: Generic assessment criteria for water supply pipes

		Pipe material	
		GAC (mg/kg)	
	Parameter group	**PE**	**PVC**
1	Extended VOC suite by purge and trap or head space and GC-MS with TIC (Not including compounds within group 1a)	0.5	0.125
1a	• BTEX + MTBE	0.1	0.03
2	SVOCs TIC by purge and trap or head space and GC-MS with TIC (aliphatic and aromatic C_5–C_{10}) (Not including compounds within group 2e and 2f)	2	1.4
2e	• Phenols	2	0.4
2f	• Cresols and chlorinated phenols	2	0.04
3	Mineral oil C_{11}–C_{20}	10	Suitable
4	Mineral oil C_{21}–C_{40}	500	Suitable
5	Corrosive (conductivity, redox and pH)	Suitable	Suitable
Specific suite identified as relevant following site investigation			
2a	Ethers	0.5	1
2b	Nitrobenzene	0.5	0.4
2c	Ketones	0.5	0.02
2d	Aldehydes	0.5	0.02
6	Amines	Not suitable	Suitable
Notes: where indicated as 'suitable', the material is considered resistant to permeation or degradation and no threshold concentration has been specified by UKWIR.			