

HAWTHORN MEDICAL CENTRE

PHASE 2 GROUND INVESTIGATION REPORT

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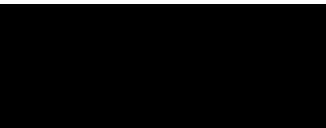
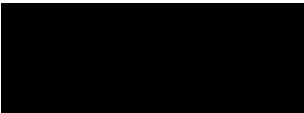
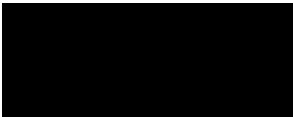
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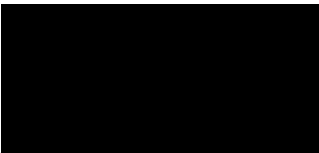
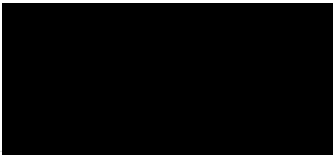
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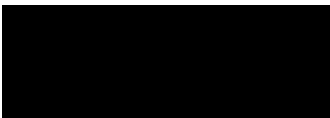
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EXECUTIVE SUMMARY

Appointment	Curtins were instructed by NHS Property Ltd to undertake a Preliminary Risk Assessment at a parcel of land located at the Manchester University Armitage Sports Centre, off Moseley Road, Fallowfield, Manchester M14 6PE. The site is centred on 386360, 393950 and covers an area of approximately 0.27 Ha. It is understood the development proposal is for a new 1 or 2 storey medical centre building with new access, hardstanding, and infrastructure.
Current Site Status	The site comprises of an area of soft landscaping, including several mature trees within the southeast of the site. The topography of the site is generally level.
Pre-Investigation Information	Earliest available mapping (1848) records the site as undeveloped agricultural land until 1920s where the site is recorded as part of the Owen's College Athletic Ground when is then renamed as Armitage Sports Centre between 2000 and 2017. The site remains as grassland to present day. Surrounding the site was mainly fields until 1893 where significant residential development has been recorded from 300m away. Further residential expansion is recorded south of the site from 1920s and then directly east of the site from 1930s. The area around the site currently broadly comprised of mainly residential development and sport pitches, including roads, a railway line and limited commercial development. BGS records show the site to be underlain by Glacial Till superficial deposits (Secondary Undifferentiated Aquifer) and Collyhurst Sandstone Formation bedrock (Principal Aquifer). There are no groundwater abstractions located within 250m of the site. The Envirocheck Report indicates the closest surface water feature is located 293m south-east of the site, unnamed water feature. 3 No. pollution incidents to controlled waters within 500m of the site. There are no surface water abstractions within 1km of the site. The site is not situated within a Coal Mining Reporting Area. There are no recorded BGS mineral sites within 1km of the site. There are no historical landfills, BGS recorded landfills or licensed waste management facilities located within 500m of the site.
Fieldworks Undertaken	Curtins ground investigation works were undertaken on 26th and 28th August 2025, comprising 3 No. Cable Percussive Boreholes, 2 No. Soakaway tests, 1 No. Trial Pits, and 5 No. California Bearing Ratio tests (CBRs). Groundwater monitoring standpipes were installed within all Cable Percussive Boreholes.
Encountered Ground Conditions	Surface cover was of topsoil which generally comprised of grass over a greyish brown slightly clayey occasionally gravelly sand with rootlets. Topsoil was encountered to a maximum depth of 0.23m bgl. Glacial Till deposits were encountered directly underlying the topsoil. Granular Glacial Till comprised of greyish brown slightly clayey slightly gravelly sand, and as reddish brown and brown clayey sand. Cohesive Glacial Till was encountered within CP01 and SA02 only, described as grey, brown and orange sandy slightly gravelly clay, and as firm to stiff reddish brown, grey and orange sandy slightly gravelly clay. Material indicative of weathered bedrock was encountered within 5 No. locations from depths of between 0.23m to 2.00m bgl (43.70m to 41.79m AOD), with thicknesses ranging between 0.30m to 1.80m, described as orangish brown/reddish brown clayey slightly gravelly sand, and as weathered, extremely weak reddish brown fine grained sandstone recovered as slightly clayey slightly gravelly sand. Bedrock was encountered under the Glacial Till and Weathered Bedrock from between 1.00m to 2.30m bgl (42.84m to 41.49m AOD). The bedrock was described as a very weak to weak reddish brown fine-grained sandstone which was recovered as a sandy cobbly gravel.

Environmental Laboratory Testing & Ground Gas Assessment	The proposed building is most analogous with a '<i>Commercial</i>' end use scenario. Results have been screened against '<i>Commercial</i>' GACs. No elevated concentrations of any of the contaminants of concern were recorded. All soil samples were screened for asbestos. No asbestos was identified. Concentrations of methane (CH₄), hydrogen sulphide (H₂S) and carbon monoxide (CO) were all below the detection limit of the gas monitor. Similarly ground gas flows have also been below the detection limit of the ground gas monitor. Concentrations of carbon dioxide (CO₂) across the three positions ranged from <0.1% (detection limit of gas monitor) up to 3.6%.
Ground Contamination and Groundwater Assessment	A Low risk rating is identified to site end-users and to construction workers, from contamination in soils from direct contact, dermal uptake, soil and dust ingestion and inhalation with the soils. No exceedances of '<i>Commercial</i>' GACs were recorded in any soil samples obtained during the ground investigation. A Low risk rating is identified to the site end-users from ground gases. This is due to a lack of viable sources recorded and low concentrations of ground gases present. Assessed as CS1, no ground gas protection measures required. Construction workers to be provided with appropriate PPE and sanitary facilities during ground works and construction works.
Geotechnical Assessment	An estimate of the presumed bearing capacity of square pad foundations bearing on competent sandstone, (below Glacial Till and completely weathered bedrock deposits) for settlements not exceeding 0.5% of the foundation width, of 250 kPa may be assigned. Based on the existing ground conditions encountered at the site and likely light loadings of the floor slab, it is possible that a ground bearing floor slab solution may be suitable where the sub-formation is specified as Weathered Bedrock. Where soft/loose or putrescible material is encountered, this should be removed and replaced a geotechnically suitable natural granular fill. Excavated material would need to be replaced with a geotechnically suitable natural granular fill material which should be engineered in layers properly to ensure that the material is compacted appropriately, preventing artificial soft spots being created and differential settlement occurring. Granular fill should be installed in accordance with an Earthworks Specification. Sub-formation level and construction level would need to be inspected by a geotechnical engineer prior to casting of the floor slab. Alternatively, a suspended floor slab via beam and block can be adopted if the above measures for installing a ground bearing floor slab are not viable practically or financially. Natural Till deposits for below ground concrete designs should be DS-1 and AC-2z due to relatively acidic pH levels. Whereas the bedrock of the Collyhurst Sandstone Formation is assessed as DS-1 and AC-1 to the depths investigated by Curtins would be suitable.
Recommendations	Reviewing all of the information to date there are limited recommendations to take the project forward with regards to contaminated land concerns. However, there are geotechnical items that need consideration for the project going forward: 1. Designers must account for the geotechnical recommendations made for the foundations, ground bearing floor slabs, hardstanding areas, and soakaways to ensure that the development can proceed efficiently. 2. Groundworkers and other trades to be provided with appropriate PPE and sanitary facilities with reference to environmental testing certificates appended herein. Potential for unrecorded contamination should also be considered.

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1 INTRODUCTION

1.1 Project Background

Curtins were instructed by NHS Property Ltd to undertake an intrusive ground investigation of a parcel of land located within the Manchester University Armitage Sports Centre, off Moseley Road, Fallowfield, Manchester M14 6PE.

It is understood that there are proposals to construct a new 1 or 2 storey medical centre building with new access, hardstanding, and infrastructure.

The site is situated on National Grid Reference 386360, 393950 and covers an area of approximately 0.27 Ha.

Proposed development plans are enclosed in Appendix A.

1.2 Scope of Services

This investigation aims to characterise the geo-environmental conditions for the proposed works.

Specifically, the Phase 2 report is intended to determine:

- a) If there is a risk of the proposed end user being adversely impacted upon by potential contamination in shallow site soils that may be present on the site due to its known current, recent and historical use;
- b) If there is a risk of groundwater and/or surface water being adversely impacted upon by potential contamination that may be present on the site due to its known current, recent and historical use;
- c) If there is a risk to the end user from soil gases including methane, carbon dioxide, carbon monoxide, and hydrogen sulphide; and,
- d) The likelihood of the proposed development being adversely impacted by geotechnical issues.

In addition, engineering recommendations for the proposed development are provided.

Detailed flood risk assessment, ecology, and archaeological studies are outside the scope of this report.

2 PHASE 1 PRELIMINARY RISK ASSESSMENT

This section presents a summary of the current site setting, history, geology, and hydrogeology/hydrology, previously detailed in the Curtins Phase 1 Preliminary Risk Assessment Report (PRA) (Ref. 1). As such, it is advised that this report is read in conjunction with the Curtins Phase 1 PRA (Ref. 1). A summary of the pertinent Curtins Phase 1 PRA Report information specifically for the proposed development site is presented in the following sub-sections.

This information will feed into the geotechnical assessment (refer to Section 11.0) and geo-environmental risk assessments (refer to Sections 7, 8 and 9).

2.1 Current Setting

The site comprises of an area of soft landscaping, including several mature trees within the southeast of the site. The topography of the site is generally level.

The site surrounding land use is summarised in *Table 1*.

Table 1 – Surrounding Area

Surrounding Area	N	Astroturf which forms part of the Armitage Sports Centre with playing fields and residential properties beyond.
	E	Car sales yard with A34 road/Kingsway road and railway line beyond.
	S	Moseley Road with residential properties beyond.
	W	Armitage Sports Centre pitches with a car park beyond.

2.2 Site History

A review of the available historical map information for the site, as presented within Curtins Phase 1 PRA (Ref. 1) has been undertaken with specific reference to potential sources of contamination and geohazards.

Earliest available mapping (1848) records the site as undeveloped agricultural land until 1920s where the site is recorded as part of the Owen's College Athletic Ground when is then renamed as Armitage Sports Centre between 2000 and 2017. The site remains as grassland to present day.

Surrounding the site was mainly fields until 1893 where significant residential development has been recorded from 300m away. Further residential expansion is recorded south of the site from 1920s and then directly east of the site from 1930s. Commercial development is recorded 70m east of the site from 1990s.

The area around the site currently broadly comprised of mainly residential development and sport pitches, including roads, a railway line and limited commercial development.

2.3 Published Geology and Hydrogeology

A review of British Geological Survey (BGS) map, 1:50,000 Scale, Bedrock and Superficial Editions, Stockport, Sheet 098, indicates the following geological sequence:

- Glacial Till overlying;
- Collyhurst Sandstone Formation.

2.3.1 Made Ground Deposits

The BGS maps do not indicate Made Ground on site, given the limited development both on-site and in the immediate surrounding area, limited Made Ground is anticipated.

2.3.2 Superficial Deposits

Superficial deposits are recorded as Glacial Till.

Glacial Till is typically described as a heterogenous mixture of clay, sand, gravel, and boulders varying widely in size and shape.

2.3.3 Bedrock Deposits

Bedrock deposits are indicated to be Collyhurst Sandstone Formation, which generally comprises of a soft red sandstone with interbedded grey sandstones locally.

2.3.4 Mining and Quarrying

The site is not located within a Coal Mining Reporting Area.

There are no BGS recorded mineral sites within 1km of the site boundary.

Based on the above, the likelihood of encountering relic mining features on-site is unlikely and therefore has not been considered further.

2.3.5 Other Pertinent Existing Geological Records

The Curtins Phase 1 PRA (Ref.1) confirms that there is 'no hazard to very low hazard potential' from the following ground stability hazards on and around the site: collapsible ground, compressible ground, running sands, landslides, shrinking or swelling clay, running sands and ground dissolution.

UK Radon Mapping (Ref. 2) confirms the site is situated in an area where <1% of homes are above the radon action level.

The Curtins Phase 1 PRA (Ref. 1) confirms that there is 1 No. geological fault line located approximately 20m west of the site boundary, striking approximately north northeast to south southwest.

2.4 Hydrogeology and Hydrology

The Collyhurst Sandstone Formation bedrock is classified as a Principal Aquifer, defined as:

"Principal and secondary aquifers provide significant quantities of drinking water, and water for business needs. They may also support rivers, lakes, and wetlands."

The Glacial Till deposits are classed as a Secondary Undifferentiated Aquifer, defined where:

"This is assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type."

The nearest surface water feature is located approximately 293m south-east of the site, which is recorded to be an unnamed water feature. 3 No. pollution incidents to controlled waters are recorded within 500m of the site boundary, the closest located 255m southeast of the site.

There are no licensed surface water or groundwater abstraction points within 1km of the site.

There are no active discharge consents within 1km of the site.

2.5 Landfill & Pollution

A review of existing report undertaken within Curtins Phase 1 PRA (Ref. 1) identified no currently operational or historical landfills within 1km of the site.

There are no licensed waste management facilities within 1km of the site.

2.6 Ground Gas Sources

The Envirocheck report identifies two records of potentially infilled land (water) within 250m of the site. The nearest is located approximately 11m north of the site dated 1848 which seems to be the historic Fallowfield Brook.

The Envirocheck and UK Radon mapping (Ref. 2) confirms the site is situated in an area of where less than 1% of homes are estimated to be at or above the Radon Action Level. On this basis, it is unlikely that radon protection measures will be required. However, where the new development incorporates a basement, advice of a specialist Radon assessor should be obtained to determine whether an elevated risk is present.

If this document is being referred to by an employer/prospective employer utilising space in the proposed development as workplaces, they are reminded of their responsibilities in respect of radon in the workplace under the Health and Safety at Work Act 1974. This is a reminder of legal requirements an employer should be aware of and comply with. This is not related to and does not impact upon the Local Authority Planning requirements and the discharge of conditions advised by a planning application decision notice.

2.7 Unexploded Ordnance (UXO) Risk Assessment

UXO Risk Mapping indicates that the risk posed by UXO associated with WW2 bombing to be **Moderate**-Risk within the site. Areas designated as Moderate-Risk are those where the bombing density of between 11 and 50 bombs per 1000 acres and that may contain potential WWII targets. Historical mapping does not indicate any ruins, or buildings that were no longer recorded in post-WWII mapping records, on or surrounding the site.

Based on the forgoing commentary, the likelihood of encountering UXO on site as part of the intrusive ground investigation works is **Low** and therefore has not been considered further.

The Principal Contractor should undertake their own risk assessments with respect to encountering UXO during construction.

If unexploded ordnance is discovered during any works, stop immediately, prevent access to the area, and inform the police. If the site boundary or location changes then the UXO risk should be reassessed.

2.8 Summary of Phase 1 Preliminary Conceptual Site Model (PCSM)

A summary of the potential pollutant linkages of the development site identified, from the Curtins Phase 1 PRA (Ref. 1) and Curtins analysis of online sources and other previous reports, are presented in *Table 2* below. Ground investigation was recommended to enable the safe redevelopment of the site.

Table 2 – Summary of Phase 1 PCSM

Source	Pathway	Receptor	Risk
Potential Made Ground of unknown composition associated with nearby construction of roads and houses.	Direct contact – Dermal contact, soil ingestion, and dust inhalation	Site End Users	Moderate/ Low
	Indirect contact – Vapour inhalation	Construction Workers	
	Plant uptake	Buried Structures – Aggressive Ground Conditions	
	Leaching and percolation into controlled waters	Controlled Waters - Groundwater	Low
	Groundwater migration and run-off to surface waters	Controlled Waters – Surface Water	Moderate/Low
Ground Gases – sources of unknown material that has the potential to contain	Permeation through ground and intrusion into buildings and structures.	Site end users	Moderate/Low

Source	Pathway	Receptor	Risk
organic / putrescible material.			
Radon	Permeation through ground floor.	Site end users	Low

Based on the findings of the PCSM, it is considered that the risks associated with ground contamination pertaining to the redevelopment of the site are **Low** and **Moderate/Low** for construction workers.

Ground conditions are expected to comprise a limited thickness of Made Ground deposits overlying cohesive and granular Glacial Till. Bedrock deposits are anticipated to comprise of Collyhurst Sandstone Formation.

Should any unexpected contamination be encountered during construction works should be stopped and a geo-environmental engineer contacted.

3 PHASE 2 INVESTIGATION SCOPE OF WORKS

Ground investigation works were undertaken on the 26th and 28th August 2025.

The scope of the ground investigation was designed in general accordance with current UK guidance including ICE UK Specification for Ground Investigation, Third Edition (2022) (Ref. 3) LCRM (Ref. 4), BS 10175 (Ref. 5), BS 5930:2015+A1:2020 (Ref. 6) BS EN 1997-1:2024 (Ref. 7) and BS EN 1997-2:2024 Eurocode 7 (Ref. 8).

The scope and rationale are summarised in *Table 3*.

Table 3 –Ground Investigation Scope of Works

Exploratory Hole Type	Exploratory Hole Reference	Exploratory Hole Depth m bgl (m AOD)	Rationale
Cable Percussive Boreholes	CP01	3.95 (38.84)	• Characterise ground and groundwater conditions. • Collect soil samples for geotechnical testing. • Undertake in-situ testing. • Install boreholes for groundwater level monitoring.
	CP02	2.45 (41.48)	
	CP03	2.45 (41.39)	
Soakaway Test Locations	SA01	1.70 (42.08)	• Confirm shallow ground conditions. • Where possible obtain Infiltration rates in general accordance with BRE 365
	SA02	1.10 (42.71)	
Machine Excavated Trial Pit	TP01	2.10 (41.70)	• Confirm shallow ground conditions.
California Bearing Ratio (CBR) using plunger and 4x4 as kentledge	CBR1	0.21 (43.57)	• Derive estimated CBR values.
	CBR2	0.19 (43.72)	
	CBR3	0.19 (43.62)	
	CBR4	0.16 (43.64)	
	CBR5	0.19 (43.76)	

3.1 Soil Logging and Sampling

Exploratory hole arisings were logged on site by a qualified Engineer. All exploratory holes were logged in accordance with the requirements of BS 5930:2015+A1:2020 (Ref. 6) including recording observed visual and olfactory indications of contamination. Exploratory hole logs are provided in *Appendix B*.

3.2 Monitoring Well Installations

Groundwater monitoring slotted 50 mm diameter pipes were installed within all three of the cable percussive boreholes.

A bentonite seal was placed above and below the screened section (response zone) of the borehole to minimise potential for downward migration of contaminants and the creation of a preferential migratory pathway. A gravel aggregate surround was installed in the annulus between the sides of the borehole in the response zone. The monitoring wells were primarily designed to assess the potential for ground gas and groundwater monitoring.

The installed response zones are summarised in *Table 4* below.

Table 4 – Monitoring Well Response Zones

Exploratory Hole Ref	Response Zone(s) m bgl (m AOD)	Strata Description
CP01	1.00 – 3.50 (42.79 – 40.29)	Glacial Till (Granular & Cohesive) & Bedrock
CP02	1.00 – 2.00 (42.93 – 41.93)	Glacial Till (Granular) & Bedrock
CP03	1.00 – 2.00 (42.84 – 41.84)	Bedrock

Copies of borehole logs can be referred to in *Appendix B* of this report.

3.3 Post Investigation Monitoring

3.3.1 Ground Gas & Groundwater Monitoring

Six ground gas and groundwater monitoring visits were undertaken between 3rd of September and 12th of November 2025. Groundwater results are presented in Section 5.6. Ground gas results are presented in *Section 8.1*.

4 LABORATORY ANALYSIS

Representative soil samples were selected for laboratory chemical and geotechnical testing, based on field observations and the development proposals.

Selected environmental soil samples were placed in laboratory provided containers and stored in cool boxes prior to being transported to the nominated laboratory under the laboratory's chain of custody documentation. The laboratory selected by Curtins for chemical analysis was Envirolab (UKAS and MCERTS accredited), and for geotechnical analysis was i2 Analytical (UKAS and MCERTS accredited).

Sampling positions were generally located in a non-targeted, systematic array to give adequate and representative coverage of the site's proposed end use and the immediate environmental setting.

4.1 Chemical Analysis

The PCSM carried out as part of the Curtins Phase 1 PRA summary has shown a Moderate/low and low risk to human health and controlled waters (groundwater and surface water) respectively. As no gross contamination was identified during the ground investigation, it was determined that there was no requirement to obtain groundwater samples.

The contaminants of concern potentially present on the site were considered to include, amongst others; organic matter, fill, hydrocarbons (e.g. fuel/oils) the extent of which is captured by the broad environmental testing suite listed in *Table 5*.

Table 5 – Environmental Chemistry Analysis Suite: Soils

Suite Ref	Analyte	LOD
Envirolab Soils Suite A	Asbestos Screen	-
	pH value	0.01 pH
	Soil Organic Matter (SOM)	0.14 % w/w
	Arsenic, Chromium, Chromium VI, Copper, Lead, Selenium, Zinc, Nickel	1 to 5 mg/kg
	Boron (water soluble)	1 mg/kg
	Cadmium	0.5 mg/kg
	Mercury	0.17 mg/kg
	Cyanide (total)	1 mg/kg
	Phenols (screen)	0.2 mg/kg
	PAHs (USEPA 16)	0.1 to 0.8 mg/kg
	TPH (Aro/Alk Split)	0.01 to 0.1 mg/kg
	Water Soluble 2:1 Sulphate	0.01 g/l

A total of 5 No. soil samples were obtained during the ground investigation, 2 No. from topsoil and 3 No. from natural soils and scheduled for chemical analysis as described in *Table 5*.

4.2 Geotechnical Analysis

Soil samples for laboratory testing were prepared in accordance with BS1377: Part 1:2016 (Ref. 6). The geotechnical testing undertaken is summarised in *Table 6*.

Table 6 – Geotechnical Testing Soils

Test Type.	Quantity	Standard
In Situ Testing		
Standard Penetration Test	2*	BS 5930:2015+A1:2020
Laboratory Testing		
pH	13	BS1377:1990, Part 3
Water Soluble Sulphate 2:1 SO ₄	13	BS1377:1990, Part 3
Water Content	1	BS1377:1990 Part 2
Atterberg 4 Point	1	BS1377:1990 Part 2
Particle Size Distribution (wet sieve)	4	BS1377:1990 Part 2

*Excluding SPT refusals >50.

5 GROUND CONDITIONS

The ground conditions generally comprise grass over topsoil underlain by a granular or cohesive Glacial Till, underlain by weathered bedrock and sandstone Bedrock of the Collyhurst Sandstone Formation.

5.1 General

A summary of the ground conditions encountered during the intrusive ground investigation works is presented in *Table 7*, with detailed information presented in the exploratory hole logs included in Appendix B.

Table 7 – Summary of Ground Conditions Encountered

Strata	Depth to Top of Strata m bgl (m AOD)		Recorded Thickness (m)		Description
			Min	Max	
Topsoil	0.00 (Ground Level)		0.12	0.23	Grass over: Greyish brown slightly clayey, occasionally gravelly, sand with frequent rootlets. Gravel of sandstone, mudstone, slate, and rare brick.
Glacial Till	0.12 (43.81)	0.23 (43.58)	0.16 ⁽¹⁾	1.88	Greyish brown slightly clayey slightly gravelly SAND. Gravel of sandstone and mudstone. Or Orangish or reddish brown slightly clayey gravelly SAND. Gravel of sandstone, mudstone, and siltstone. Or Firm to stiff reddish brown, grey and orange sandy slightly gravelly CLAY. Gravel of sandstone.
Weathered Bedrock	0.23 (43.70)	2.00 (41.79)	0.30	1.80	Reddish brown clayey slightly gravelly SAND. Or Weathered, extremely weak, reddish brown fine grained SANDSTONE recovered as slightly clayey slightly gravelly sand.
Bedrock	1.00 (42.84)	2.30 (42.69)	>0.30 ⁽¹⁾	>1.65 ⁽¹⁾	Very weak to weak reddish brown fine-grained SANDSTONE. Recovered as sandy cobbly gravel or sandy gravel.

(1) Unproven thickness.

5.2 Topsoil

Topsoil deposits were encountered from surface in every location to a depth of 0.12 to 0.23m bgl (43.81-43.58m AOD) and comprised of grass over greyish brown slightly clayey, occasionally gravelly, sand with frequent rootlets.

5.3 Glacial Till Deposits

Deposits indicative of Glacial Till deposits were encountered underlying topsoil to a maximum depth of 2.00m bgl (41.79m AOD). The Glacial Till comprised of both granular and cohesive material.

Material indicative of granular Glacial Till was encountered underlying Topsoil within the majority of exploratory hole locations, described as greyish brown slightly clayey slightly gravelly sand, and as reddish brown and brown clayey sand. Gravel comprised of subrounded sandstone and mudstone.

Material indicative of cohesive Glacial Till was encountered within CP01 and SA02 only, between 1.10m and 2.00m bgl (42.69m to 41.79m AOD) and 0.23m to 1.10m bgl (43.58m to 42.71m AOD) respectively. This material was described as grey, brown and orange sandy slightly gravelly clay, and as firm to stiff reddish brown, grey and orange sandy slightly gravelly clay. Gravel comprised of subrounded sandstone and mudstone.

These deposits appear distinct in colour and strength from underlying weathered bedrock.

5.4 Weathered Bedrock – Collyhurst Sandstone Formation

Material indicative of weathered bedrock was encountered within CP01, CP02, CP03, SA01 and TP01 from depths of between 0.23m to 2.00m bgl (43.70m – 41.79m AOD), with thicknesses ranging between 0.30m to 1.80m.

Weathered bedrock was described as orangish brown/reddish brown clayey slightly gravelly sand within the Cable Percussive Boreholes (CP01, CP02 and CP03) and as weathered, extremely weak, reddish brown fine grained sandstone recovered as slightly clayey slightly gravelly sand within the Trial Pits (SA01 and TP01).

5.5 Collyhurst Sandstone Formation

Collyhurst Sandstone Formation bedrock was encountered within all Cable Percussive (CP) boreholes and TP01. Bedrock was encountered from 1.00m to 2.30m bgl (42.84m to 41.49m AOD) to a maximum depth of 3.95m bgl (39.84m AOD). The material was described as a very weak to weak reddish brown fine-grained sandstone. Recovered as a sandy cobbly gravel.

5.6 Obstructions Encountered

No obstructions were encountered during the ground investigation works.

5.7 Groundwater

No groundwater strikes were encountered during the ground investigation.

Six groundwater monitoring visits have been undertaken between the 3rd of September and the 12th of November 2025 as part of Curtins monitoring period, the results of which are presented in Table 8.

Table 8 – Groundwater Monitoring Results

Borehole Location	Response Zone m bgl (m AOD)	Installation Strata	Depth m bgl (m AOD)					
			03/09/2025	16/09/2025	30/09/2025	13/10/2025	28/10/2025	12/11/2025
CP01	1.00 – 3.50 (42.79 – 40.29)	Glacial Till (Granular & Cohesive) Bedrock (Sandstone)	Dry	Dry	3.55 (40.24)	Dry	Dry	Dry
CP02	1.00 – 2.00 (42.93 – 41.93)	Glacial Till (Granular) Bedrock (Sandstone)	Dry	Dry	2.08 (41.85)	2.04 (41.89)	1.67 (42.26)	1.97 (41.96)
CP03	1.00 – 2.00	Bedrock (Sandstone)	Dry	2.14 (41.70)	2.15 (41.69)	2.14 (41.70)	Dry	2.15 (41.69)

	(42.84 – 41.84)							
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5.8 Observed Potential Contamination

No visual or olfactory contamination was noted during the intrusive ground investigation works.

6 GROUND MODEL

A summary of the field and laboratory test results from samples of Topsoil, Glacial Till and Bedrock are summarised below. Results to date are enclosed within Appendix D.

6.1 Topsoil

Due to the limited volume of topsoil encountered and its variability in terms of composition, density and strength and typically poor geotechnical properties, the topsoil is not considered a suitable founding stratum for any geotechnical design. Therefore geotechnical testing of this material was limited. Results to date are included within *Table 9* below.

Table 9 – Summary of Geotechnical Test Results – Topsoil

Parameter	No. of Tests	Results	
		Min	Max
Laboratory Tests – General			
pH	2	4.54	5.88
Water Soluble Sulphate (mg/l)	2	10	

6.2 Glacial Till

A summary of the field and laboratory test results from samples of Glacial Till are summarised in *Table 10*. Results to date are included within *Table 10* below.

Table 10 – Summary of Geotechnical Test Results – Glacial Till

Parameter	No. of Tests	Results	
		Min	Max
Field Tests			
SPT 'N' Value (uncorrected)	1	5	
Laboratory Tests – General			
pH	3	4.81	6.10
Water Soluble Sulphate (mg/l)	3	<10	56
Total Sulphate (SO ₄ %)	1	0.04	
Total Sulphur (%)	1	0.011	
Liquid Limit (%)	1	31	
Plastic Limit (%)	1	17	
Plasticity Index (%)	1	14	

One SPT 'N' (uncorrected) result for the cohesive Glacial Till was 5.

A single Atterberg four point limit test was undertaken on cohesive material from location CP01 at depths of 1.20m – 1.65m bgl. This has returned results estimating that the cohesive material is of low strength with a low volume change potential material in accordance with NHBC Technical Standards (2025, Chapter 4.2).

6.3 Weathered Bedrock – Collyhurst Sandstone Formation

A summary of the field and laboratory test results from samples of the weathered bedrock are summarised in Table 11.

Table 11 – Summary of Geotechnical Test Results – Weathered Bedrock

Parameter	No. of Tests	Results	
		Min	Max
Field Tests			
SPT 'N' Value (uncorrected)	1	19	
Laboratory Tests – General			
pH	1	6.8	
Water Soluble Sulphate (mg/l)	1	75	
Total Sulphate (SO ₄ %)	1	0.035	
Total Sulphur (%)	1	0.01	
Particle Size Distribution Tests	1	See Appendix D	

One particle size distribution (PSD) test has been undertaken on the weathered bedrock material from location CP01 at depths ranging between 2.00 – 2.45m bgl. The results indicate that the sample is 59% sand, followed by 39% fines <0.063mm in size (silt & clays).

6.4 Bedrock Collyhurst Sandstone Formation

A summary of the field and laboratory test results from samples of the bedrock are summarised in Table 12.

Table 12 – Summary of Geotechnical Test Results – Bedrock

Parameter	No. of Tests	Results	
		Min	Max
Field Tests			
SPT 'N' Value (uncorrected)	6	>50	
Laboratory Tests – General			
pH	6	6.7	8.0
Water Soluble Sulphate (mg/l)	6	39	220
Total Sulphate (SO ₄ %)	6	0.024	0.053
Total Sulphur (%)	6	<0.005	0.011
Particle Size Distribution Tests	3	See Appendix D	

Three Particle Size Distribution (PSD) tests were undertaken on bedrock materials. The results of these analyses show that the material is predominantly sand followed by fines <0.063mm (silty & clays). Samples were disturbed during drilling and are unlikely to be representative of in-situ bedrock materials.

6.5 CBR Tests

5 No. of CBR tests using the plunger and 4x4 as kentledge method were progressed on the greyish brown slightly clayey slightly gravelly sand, underlying the topsoil (0.19-0.20m bgl). The full results are enclosed within *Appendix D*.

6.6 Soakaway Test

Two soakaway tests in general accordance with BRE 365 were undertaken during the ground investigation. SA01 was undertaken at 1.70m bgl (42.08m AOD) within weathered Collyhurst Sandstone Formation bedrock and SA02 was undertaken at 1.10m bgl (42.71m AOD) within Glacial Till. Results are enclosed within *Appendix D*.

6.7 Aggressive Ground Conditions

The classification of the site in terms of concrete in aggressive ground is based on the guidance provided in Table C1 of the Building Research Establishment (BRE) Special Digest 1, 3rd edition of 2005 (Ref. 11). Results obtained from the site are summarised within *Table 13*, and *Table 14* details the classification.

Table 13 – Summary of BRE Suite Results

Stratum	Quantity	Range
Glacial Till	pH	4.81 – 6.10
	Water Soluble Sulphate (mg/l)	<10 – 56
Weathered Bedrock	pH	6.8
	Water Soluble Sulphate (mg/l)	75
Bedrock	pH	6.7 – 8.0
	Water Soluble Sulphate (mg/l)	39 - 220

Table 14 – Aggressive Chemical Environment for Concrete (ACEC) Site Classification

Stratum	Design Sulphate Class	ACEC Class ⁽¹⁾
Glacial Till	DS-1	AC-2z
Weathered Bedrock	DS-1	AC-1
Bedrock	DS-1	AC-1

(1) ACEC assessment was based on the mobile groundwater condition in a greenfield scheme area.

7 GROUND CONTAMINATION ASSESSMENT

This section of the report includes the assessment of the potential contamination, solid, liquid and gas, identified on the subject site which may present a risk to the proposed end users, associated utilities, and the wider environment.

In LCRM guidance published by the Environment Agency (Ref. 4), the risk to human health or controlled waters is determined through an assessment of pollutant linkages between a source of contamination (within the ground or groundwater either on or off site) and a sensitive receptor such as end users of the site, building materials, edible plants grown in gardens or groundwater abstracted for drinking. This is termed a source-pathway-receptor relationship.

These models have a common approach, which is one of a tiered assessment. At each stage of the assessment further detail can be applied to the conceptual site model (CSM) to provide a detailed interpretation on a site by site basis. As part of the planning process this approach is adopted to establish either if the site is 'suitable for use' or whether additional work or else remedial work is required for the site to be deemed so.

The sub-sections hereafter therefore incorporate the second Tier (Tier 2) of the approach described in EA guidance, otherwise referred to as the Generic Quantitative Risk Assessment (GQRA). The GQRA builds on the qualitative risk assessment (Tier 1) presented in the Phase 1 PRA (Ref. 1), in conjunction with observations made during the ground investigation and is based solely on the results of the chemical and other testing data obtained as part of Curtins ground investigation. The GQRA is used to build/refine the CSM for the site as detailed and presented in Section 9.0 of this report.

More detail on Curtins risk assessment methodology, rationale and hierarchy for human health risk assessment is enclosed in Appendix H.

7.1 Human Health GQRA

7.1.1 Adopted Soil Human Health GACs Screening Methodology

The ground investigation was undertaken to assess the nature of the ground conditions. Building footprints will occupy the ground in the immediate vicinity of the soil samples obtained during this investigation, and consideration is given to the risk presented to the end users of the building, including staff, patients, and visitors. The proposed land use in these areas is most analogous with a '*Commercial*' end use scenario.

The soil organic matter (SOM) content has an influence on the volatilisation of organic contaminants (i.e., the higher the SOM, the lower the volatilisation rate and therefore inhalation exposure risk). Soil organic matter (SOM) values for the site ranged from 0.22% to 4.91%. Consideration of the geometric mean results in calculated values of 1.61% for the soil samples.

As such, a comparison against Tier 1 thresholds for an SOM of 1% for all the samples has been adopted for the *Commercial* end-use. The adopted GAC's are listed in *Appendix F*.

7.1.2 Generic Assessment Criteria Screening of Soil Laboratory Results

The results of the environmental testing can be referred to in *Appendix C*, with testing undertaken on a total of five soil samples across the site.

With respect to the '*Commercial*' end use, soil chemical analysis results did not record any exceedances when compared against GAC screening thresholds. Furthermore, no exceedances of '*residential with home grown produce*' thresholds were recorded.

All soil samples were screened for asbestos. No asbestos was identified.

8 GROUND GAS ASSESSMENT

The assessment of risk presented by ground gases is assessed with reference to guidance published by:

- CIRIA (2007) Assessing Risks Posed by Hazardous Ground Gases to Buildings, C665 (Ref. 12)
- Ground Gas Handbook (2009 (Ref. 13))
- CL: AIRE (2012) RB17: A pragmatic approach to Ground Gas Risk Assessment (Ref. 14)
- BSI Publication Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings BS8485:2015 (Ref. 15)
- NHBC NF94 (2023) Hazardous Ground Gas – an essential guide for housebuilders (Ref. 16)
- BRE 211 (2023) Radon – Guidance on protective measures for new buildings (Ref. 17)

The ground gas risk assessment adopts a tiered approach. In the first instance this involves a re-evaluation of the Conceptual Site Model described within the Phase 1 PRA Report (Ref. 1) and thereafter validating this conceptual model with the ground gas data, the semi-quantitative risk assessment.

8.1 Ground Gas Monitoring Results

To characterise the site's ground gas regime and validate the qualitative assessment of ground gas risk standpipe installations were incorporated within 3 No. cable percussive boreholes as detailed in *Section 3.2*.

The ground gas monitoring visits are now complete with visits undertaken between September 2025 and November 2025. Barometric pressures have ranged from 985mb up to 1025mb. The results log sheets are included in *Appendix E*. The results are summarised in Table 15.

Table 15 – Summary of Ground Gas Monitoring Results

Exploratory Hole ID	Maximum Gas Flow (l/hr)		Maximum Methane Concentration (%)	Maximum Carbon Dioxide Concentration (%)	Minimum Steady Oxygen Concentration (%)
	Maximum	Steady State			
CP01	<0.1	<0.1	<0.1	3.6	16.3
CP02	<0.1	<0.1	<0.1	2.1	17.9
CP03	<0.1	<0.1	<0.1	2.3	17.3

Concentrations of methane (CH₄), hydrogen sulphide (H₂S) and carbon monoxide (CO) were all below the detection limit of the gas monitor. Similarly ground gas flows have also been below the detection limit of the ground gas monitor.

Concentrations of carbon dioxide (CO₂) across the three positions ranged from <0.1% (detection limit of gas monitor) up to 3.6%.

8.2 Ground Gas Assessment

The Preliminary Conceptual Site Model (PCSM) presented within the Phase 1 PRA (Ref. 1) identified potential Made Ground and off-site infilled land (previously water) as potential sources of ground gas generation. Noxious and asphyxiate gases were attributed to include, but not limited to, carbon dioxide, carbon monoxide, methane, and hydrogen sulphide. The PCSM identified a **Moderate/Low Risk**.

The ground investigation undertaken by Curtins has not recorded Made Ground soils to be present at the advanced exploratory hole positions. This will remove the potential Made Ground source from the assessment as no deposits have been recorded to be present.

The underlying Till deposits have not recorded any organic or putrescible material. Based on the lack of potential sources the Superficial Till Deposits can also be removed from the assessment.

The results of the ground gas monitoring have recorded largely low concentrations with a maximum of 3.6% recorded for carbon dioxide at the location of CP01. Based on the results obtained and the lack of a viable source for these concentrations it is likely that biological respiration will be the originator of these low concentrations. In accordance with NHBC NF94.

Consideration on the quantity of monitoring data, range of barometric states, and weather conditions, it is deemed that the available dataset is representative of the gas regime pertaining to the development site. As such, the steady state flow rates (utilising flow rates and concentrations from the same borehole and visit undertaken) are deemed suitable for use when deriving the Q_{hg} and Gas Screening Value (GSV) for the site.

A calculation for methane cannot be made due to no positive flow rates and concentrations of methane being below detection limits.

Evaluation of the steady state borehole scenario records a calculated maximum Q_{hg} resulting in a GSV of 0.0036 l/hr for a carbon dioxide concentration of 3.6% and a flow of <0.1l/hr.

Based on the site conditions encountered a worst-case scenario check utilising flow rates and concentrations from different boreholes and visits is not deemed suitable for this assessment. As a result, the Q_{hg} results in a GSV returning a Characteristic Situation 1 (CS1) for the ground investigation area. This is a very low hazard potential, and the risk is assessed as Low based on the information obtained.

As highlighted in Section 2.6 the radon ground gas potential confirms the site is situated in an area where <1% of properties are above the radon action level. On this basis no radon protection measures are necessary in the construction of new dwellings or extensions.

The potential risks from ground gases and vapours at excavations are to be dealt with by the Contractor, in accordance with the Confined Space Regulations, during construction. Appropriate ground gas monitoring and safety measures should be in place during the works, as the potential presence of ground gases / vapours could pose a risk in any confined spaces of deep excavations.

9 REVISED CONCEPTUAL SITE MODEL

The Preliminary Conceptual Site Model (PCSM) presented in the Curtins Phase 1 Report (Ref.1) and discussed in *Section 2.0* of this report has been revised following the GQRA in *Section 7.0 and 8.0* above. The Revised Conceptual Site Model (CSM) is summarised in the table overleaf.

The CSM details the source-pathway-receptor linkages or potential pollutant linkages (PPL) that have been identified as relevant for the site. The GQRA details the associated level of risk relating to these potential pollutant linkages.

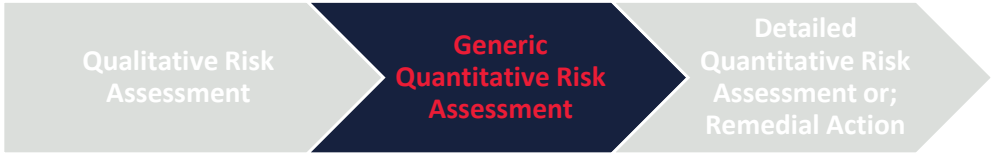
The CSM follows the framework outlined within CIRIA C552 (Ref. 18) which is summarised within *Appendix G*.

The 'risk rating' within the CSM refers to the risk that the source, pathway, receptor linkage, or PPL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation.

Risks presented by Mining are discussed and assessed within *Section 2.3.4*.

Risks presented by Unexploded Ordnance are discussed and assessed in *Section 2.7*.

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors, and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations, 2015 (Ref. 19) which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate / manage that risk. It has been assumed that any future construction works on site will be undertaken in compliance with these requirements. Reference should be given to the environmental testing results discussed within *Section 7.0* and presented within *Appendix C*.



- The table below represents the Second stage in the land quality risk assessment process; the Revised Conceptual Site Model following the Quantitative Risk Assessment.
- For a development site to be deemed 'suitable for use' the level of risk needs to be brought down to acceptable levels, i.e. low to very low risk. The purpose of each stage of risk assessment is ultimately to establish if there is a requirement for additional levels of assessment to be made to have sufficient confidence to support a risk characterisation or management decision, e.g., remedial action.

Conceptual Site Model			Qualitative Risk Assessment			Recommended Actions	Actions
Source	Pathway(s)	Receptor(s)	Consequence	Likelihood of Occurrence	Risk Rating		
No significant sources of potential contamination within site soils. Notwithstanding, no Made Ground soils were recorded onsite.	Direct contact and dermal uptake, soil and dust ingestion, dust & migration inhalation	End user of site Medical Centre staff and patients.	Medium Chronic health risk.	Unlikely	Low	No exceedances above Commercial General Assessment Criteria were identified. No asbestos containing materials identified during the ground investigation.	Construction workers to be provided with appropriate PPE and sanitary facilities.
	Vertical and horizontal migration through the superficial deposits (soils).	Construction Workers		Unlikely	Low		
	Horizontal migration over and through the superficial deposits (soils).	Controlled Waters (groundwater) Secondary Undifferentiated Aquifer associated with the superficial deposits and a Principal aquifer within the bedrock deposits. No licensed potable groundwater abstractions within 250m.	Medium Pollution of sensitive groundwater resources.	Unlikely	Low	No gross contamination encountered during ground investigation. In absence of a contamination source, the risk is low.	No further action required.
	Direct contact and dermal uptake, soil and dust ingestion, dust & migration inhalation.	Controlled Waters (surface water) Nearest surface water feature is approximately 293m south-east of the site. No surface water abstraction points within 1km.	Mild Pollution of non-sensitive water resources.	Low Likelihood	Low		
Ground gas: No Made Ground proven. Low putrescible content in Superficial Deposits.	Vertical and horizontal migration through existing service corridors and Made Ground.	End users of site	Medium Chronic health risk.	Unlikely	Low	Based on the encountered materials there is no viable source to generate ground gases of carbon dioxide or methane in sizeable quantities. The results assess a CS1 classification for the site.	No further action required.

10 SUMMARY OF POTENTIAL POLLUTANT LINKAGES

A **Low-risk** rating is identified to site end-users and to construction workers, from contamination in soils from direct contact, dermal uptake, soil and dust ingestion and inhalation with soils. No exceedances of Commercial General Assessment Criteria were identified within soil and no asbestos containing materials were identified during the ground investigation. Construction workers should be provided with appropriate PPE and sanitary facilities with respect to the environmental testing results enclosed herein.

A **Low-risk** rating is identified to controlled waters (Groundwater and Surface Waters) following the ground investigation accounting for no major sources of contamination identified at the site, limiting the migration pathway into the Principal Aquifer contained within Bedrock deposits.

A **Low-risk** rating is identified to site end users from ground gases. Assessed that due to no Made Ground soils recorded to be present and no putrescible or organic materials in the Till deposits no viable source. CS1 has been assessed for the site. No ground gas protection measures required.

11 ENGINEERING ASSESSMENT AND RECOMMENDATIONS

11.1 Introduction

This section will assess the relevant geotechnical issues for the proposed single storey medical centre.

The proposed development plans are contained within *Appendix A*. Structural details and loadings have not yet been provided.

It should be noted that detail may change in the development of designs beyond the issue of this Curtins Phase 2 Ground Investigation Report and the Construction Designer should satisfy themselves regarding the adequacy of their design and proposed approach to construction by reference to the on-going project design proposals, the ground investigation information, and their own examination of the site.

11.2 Geotechnical & Engineering Constraints

Geotechnical considerations inferred from the Curtins Ground Investigation are presented below, these must be reviewed to ensure that the development can progress in a cost effective and efficient manner.

11.2.1 Access & Construction Constraints

The only vehicle accessible points for the site are from Moseley Road via Chancellors Way approximately 200m to 300m west of the proposed site. The proposed development plan indicates that a new entrance will be created through the existing brick wall of Moseley Road to ensure equipment, machinery, and materials can be able to access this soft landscaped area of the site.

11.2.2 Known & Unknown Utility Lines

Based on the information provided by the client and associated consultants / contractors there is a known culvert located to the north outside of the proposed development boundary. This is located approximately 2.00m below ground level and is estimated to have a diameter of 1.20m.

The utility plans provided also indicate the presence of a potential electric utility line close to where the proposed building is to be situated.

For the proposed development, the principal contractor undertaking the development works should ensure that all available plans are obtained and reviewed. Where necessary known utilities should be identified and where clashing with potential structures should be disconnected and re-routed.

It is also possible that unknown / unrecorded utility lines could be present in the proposed development area.

11.2.3 Removal of Existing Trees

The proposed development area has up to 12 No. trees that will require removal as part of the enabling works. It is assumed that there are no Tree Protection Orders (TPOs) are associated with these trees. When the trees are to be removed, this should include all below ground roots to ensure that no future issues are caused to ground floor slabs or surrounding hardstanding areas.

11.2.4 Weathering of the Rockhead Profile

Based on the geological knowledge available for the Collyhurst Sandstone Formation part of the overarching Appleby Group, this deposit is likely to be completely weathered at the near surface for sizeable depths to a soil. Based on the boreholes advanced to date this indicates a variable rockhead profile where sandstone was encountered. A summary of the rock profile is presented in Table 16.

Table 16 - Summary of Rock Weathering Profile

Exploratory Hole ID	Depth (m bgl)	Elevation (m AOD)	Description
CP01	2.00	41.79	Weathered bedrock
	2.30	41.49	Solid bedrock
CP02	0.23	43.70	Weathered bedrock
	1.20	42.73	Solid bedrock
CP03	0.33	43.51	Weathered bedrock
	1.00	42.84	Solid bedrock
SA01	0.39	43.39	Weathered bedrock
TP01	0.42	43.38	Weathered bedrock
	1.80	42.00	Solid bedrock

Therefore, the rockhead will vary laterally and vertically which will have an impact on proposed foundation design and loadings that can be transferred to the bedrock. With some foundation locations requiring to be sited deeper than others.

11.3 Foundation Design

Made Ground and Glacial Till are unlikely to be considered suitable for shallow foundations due to variability and low strength identified. Weathered bedrock is generally limited in nature and in parts difficult to distinguish from lower strength Glacial Till. It is therefore recommended that foundations are taken through any made ground, Glacial Till and completely weathered bedrock deposits to competent rock of the Collyhurst Sandstone Formation.

An estimate of the presumed bearing capacity of square pad foundations has been determined with reference to Eurocode 7, Annex G. A preliminary presumed bearing resistance, for square pad foundations bearing on competent sandstone, for settlements not exceeding 0.5% of the foundation width, of 250 kPa may be assigned. Appropriate mass concrete fill may be required to ensure building loads are transferred to the appropriate foundation formation strata.

Foundations must be constructed within the same strata type, to reduce the risk associated with differential settlement.

All foundation formations must be inspected by a geotechnical engineer prior to pouring of the concrete foundation.

11.4 Floor Slabs

Based on the existing ground conditions encountered at the site and likely light loadings of the floor slab, it is possible that a ground bearing floor slab solution may be suitable where the sub-formation is specified as Weathered Bedrock. Where soft/loose or putrescible material is encountered, this should be removed and replaced a geotechnically suitable natural granular fill.

Excavated material would need to be replaced with a geotechnically suitable natural granular fill material which should be engineered in layers properly to ensure that the material is compacted appropriately, preventing artificial soft spots being created and differential settlement occurring. Granular fill should be installed in accordance with an Earthworks Specification.

Sub-formation level and construction level would need to be inspected by a geotechnical engineer prior to casting of the floor slab.

Alternatively, a suspended floor slab via beam and block can be adopted if the above measures for installing a ground bearing floor slab are not viable practically or financially.

11.5 Excavations & Groundwater Levels

As per Table 8 in Section 5.6, shows a relatively dry borehole at the location of CP01. With minor levels of groundwater recorded to range between 41.69 in CP03 to 42.26m AOD in CP02.

On the basis of these results, it is considered that groundwater may be encountered in the excavations for proposed foundations, particularly at the locations of CP02 and CP03 in the sandstone bedrock. The main contractor should also provide details of how they intend to maintain the stability of excavations once building levels are finalised.

Groundwater may be encountered as seepages in shallow excavations for foundations or services as perched water. It is considered that perched water inflows, if encountered, may be controlled by pumping from sumps.

11.6 Chemical Attack on Buried Concrete

In *Section 6.7*, Table 14 this lists the assigned Design Sulphate (DS) and Aggressive Chemical Environment for Concrete (ACEC) classifications. The site has been classified in accordance with BRE Special Digest (Ref. 11) and laboratory testing undertaken accordingly. Based on the laboratory test results DS-1, and AC-2z for the development, due to relatively acidic pH levels within Glacial Till.

11.7 Hardstanding Assessment

Table 17 outlines the results of the in-situ CBR results which were obtained via the plunger method using a 4x4 as kentledge.

Table 17 – Summary of In-Situ CBR results

Exploratory Hole Location	Depth of Test (m bgl)	CBR Value (%)	Brief Soil Description
CBR01	0.20	6.6	Dark reddish brown gravelly SAND
CBR02	0.19	6.4	Dark brown slightly clayey SAND with rootlets
CBR03	0.19	4.9	Dark grey, brown very gravelly SAND
CBR04	0.19	11 *	Dark red gravelly SAND
CBR05	0.19	8.5 *	Dark reddish grey sandy GRAVEL

* Test stopped prematurely due to limits of equipment being reached. Comment by appointed subcontractor.

Based on the results of testing undertaken in this ground investigation a CBR value of 5% is likely to be suitable for preliminary pavement design.

Formation levels for access roads and road pavements once confirmed will require verification in the form of in situ and laboratory CBR testing and are likely to be within the underlying Till or Weathered Bedrock Deposits. Any depth of topsoil should be excavated and removed to ensure no soft materials are present.

The subgrade should be consistent and uniform to prevent differential settlement. Where any underlying natural soils are either very loose or very soft, or design CBRs are not achieved, materials should be excavated out and replaced with a suitable natural granular fill.

The hardstanding designer must satisfy themselves regarding the suitability of the chosen sub-formation for their design. Additional testing during construction may be required to confirm the suitability of the proposed sub-formation.

11.8 Soakaway Assessment

Soakaway tests in general accordance with BRE 365 was undertaken for the appointed scope undertaken by Curtins at two locations. Based on the ground investigation and results of the soakaways, this will not be a viable or recommended drainage option for the proposed development due to the following:

- Natural soils in SA01 are recorded as a slightly clayey gravelly sand (Weathered Collyhurst Sandstone Formation). In SA02 natural soils are recorded as a slightly gravelly sandy clay (Glacial Till). Even slightly clayey ground conditions can heavily impact soakaway tests.
- One test per location was run for approximately 3 hours with very little to no vertical movement of the water level over that time period.

- The effective drainage depths of 75% and 25% were not achieved which would make the site soils at the tested locations unsuitable for a soakaway drainage solution.

Therefore, it is advised that an alternative viable drainage solution is sought.

12 CONCLUSION AND RECOMMENDATIONS

12.1 Geotechnical

An estimate of the presumed bearing capacity of square pad foundations has been determined with reference to Eurocode 7, Annex G. A preliminary presumed bearing resistance, for square pad foundations bearing on competent sandstone, for settlements not exceeding 0.5% of the foundation width, of 250 kPa may be assigned. Appropriate mass concrete fill may be required to ensure building loads are transferred to the appropriate foundation formation strata.

Foundations must be constructed within the same strata type, to reduce the risk associated with differential settlement. All foundation formations must be inspected by a geotechnical engineer prior to pouring of the concrete foundation.

Based on the existing ground conditions encountered at the site and likely light loadings of the floor slab, it is possible that a ground bearing floor slab solution may be suitable where the sub-formation is specified as Weathered Bedrock. Where soft/loose or putrescible material is encountered, this should be removed and replaced a geotechnically suitable natural granular fill.

Excavated material would need to be replaced with a geotechnically suitable natural granular fill material which should be engineered in layers properly to ensure that the material is compacted appropriately, preventing artificial soft spots being created and differential settlement occurring. Granular fill should be installed in accordance with an Earthworks Specification.

Sub-formation level and construction level would need to be inspected by a geotechnical engineer prior to casting of the floor slab.

Alternatively, a suspended floor slab via beam and block can be adopted if the above measures for installing a ground bearing floor slab are not viable practically or financially.

Natural Till deposits for below ground concrete designs should be DS-1 and AC-2z due to relatively acidic pH levels. Whereas the weathered bedrock and competent bedrock of the Collyhurst Sandstone Formation is assessed as DS-1 and AC-1 to the depths investigated by Curtins would be suitable.

12.2 Ground Contamination

A revised tabulated revised CSM has derived the following findings on the Generic Quantitative Risk Assessment.

A **Low** risk rating is identified to site end-users, and to construction workers from contamination in soils from direct contact, dermal uptake, soil and dust ingestion and inhalation with Made Ground soils. No exceedances of 'Commercial' GACs were recorded furthermore no visual or olfactory evidence of contamination was recorded during the ground investigation. Asbestos was not identified onsite or during laboratory analysis. The proposed development building footprint and hardstanding will break the source-pathway-receptor linkage to site end users. Construction workers should be provided with appropriate PPE and sanitary facilities with respect to the environmental testing results enclosed herein.

A **Low** to **Very Low** risk rating is identified to controlled waters (Groundwater and Surface Waters) as no visual or olfactory evidence of contamination were identified in site soils.

A Low risk rating is identified for ground gases to the end users of the proposed development. Based on the lack of viable source and low ground gas concentrations recorded. Assessed as CS1, no ground gas protection measures required.

12.3 Recommendations

Reviewing all of the information to date there are limited recommendations to take the project forward with regards to contaminated land concerns. However, there are a few geotechnical items that need consideration for the project going forward:

1. Designers must account for the geotechnical recommendations made for the foundations, ground bearing floor slabs, hardstanding areas, and soakaways to ensure that the development can proceed efficiently.

2. Groundworkers and other trades to be provided with appropriate PPE and sanitary facilities with reference to environmental testing certificates appended herein. Potential for unrecorded contamination should also be considered.

13 REFERENCES

1. **Curtins** (2025) Hawthorn Medical Centre, Phase 1 Preliminary Risk Assessment, Ref. 087546-CUR-XX-XX-T-GE-00002-P01
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3. **ICE UK** (2022) Specification for Ground Investigation, Third Edition.
4. **Environmental Agency** (2020) Land Contamination Risk Management (LCRM)
5. **British Standards Institution** (2015+2020) Code of Practice for Site Investigations (report no. BS 5930).
6. **British Standards Institution** (2011+2017) Code of Practice for Site Investigations (report no. BS 10175).
7. **British Standards Institution** (2024) Eurocode 7: Geotechnical Design Part 1: General Rules (report no. BS EN 1997-1:2024
8.). **British Standards Institution** (2024) Eurocode 7: Geotechnical Design Part 2: Ground Properties (report no. BS EN 1997-2:2024
- 9.
10. **British Standard** (2016) Methods of test for soils for civil engineering purposes. General requirements and sample preparation (report no. BS1377-1 Incorporating corrigendum No.1).
11. **Building Research Establishment** (2005) Special Digest 1: Concrete in Aggressive Ground.
12. **CIRIA** (2007) Assessing Risks Posed by Hazardous Ground Gases to Buildings, C665
13. **Ground Gas Handbook** (2009)
14. **CL: AIRE** (2012) RB17: A pragmatic approach to Ground Gas Risk Assessment
15. **British Standard** (2015) Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings BS8485:2015
16. **NHBC NF94** (2023) Hazardous Ground Gas – an essential guide for housebuilders
17. **BRE 211** (2023) Radon – Guidance on protective measures for new buildings
18. **CIRIA C552** (2001) Contaminated Land Risk Assessment: A Guide to Good Practice.
19. **Health and Safety Executive** (2015) Construction (Design and Management) Regulations

14 APPENDICES

Appendix A – Drawings

Appendix B – Exploratory Hole Logs

Appendix C – Chemical Laboratory Test Results

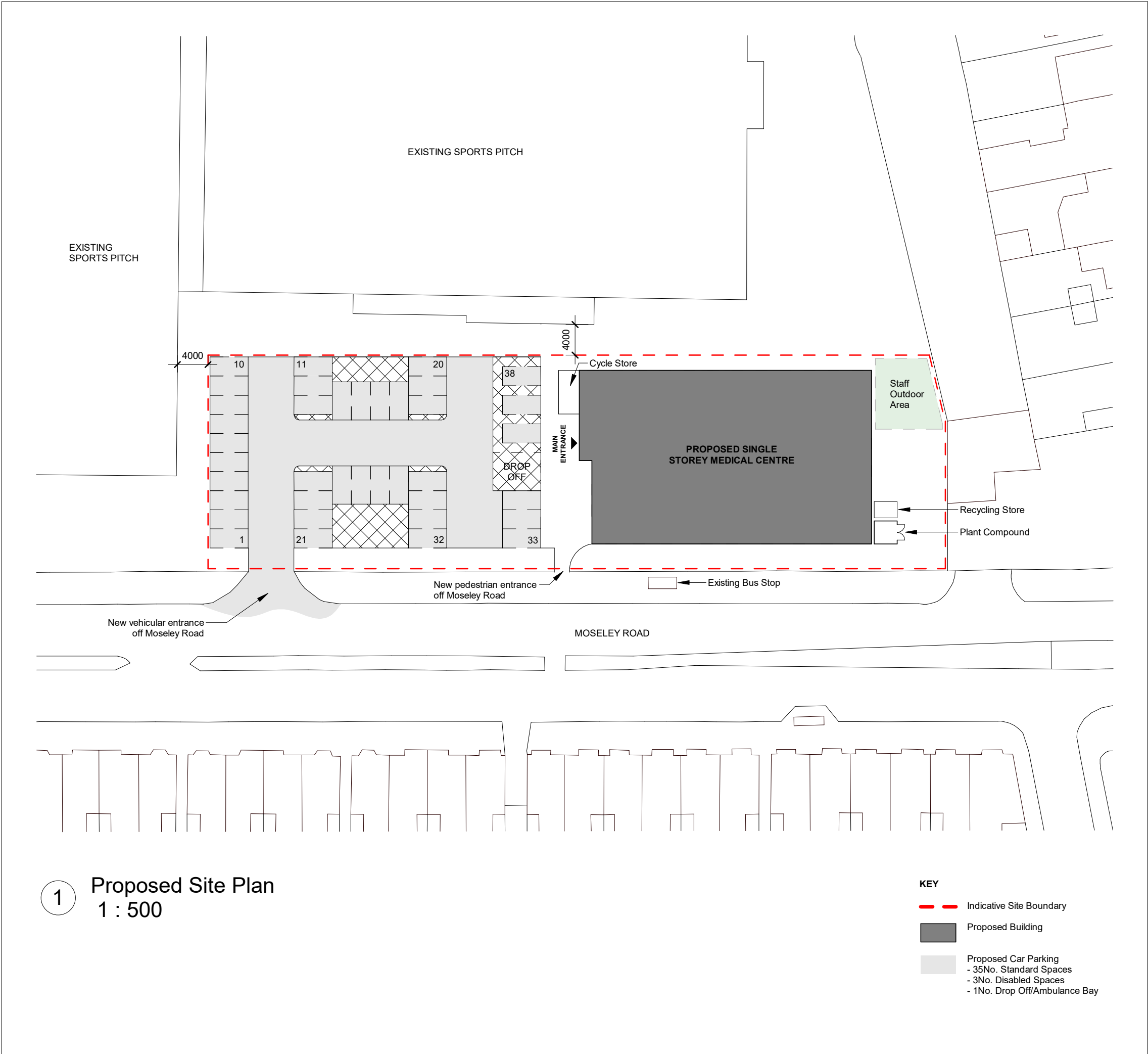
Appendix D – Geotechnical Laboratory Test Results, Soakaway and CBR Results

Appendix E – Groundwater Monitoring Results

Appendix F – GAC Screening Thresholds

Appendix G – Risk Assessment Methodology

Appendix A – Drawings



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Extents of site boundary shown are indicative and are to be confirmed.

P03	CR	6m buffer to University facilities reduced to 4m. Staff Outdoor Area, Plant Compound and Cycle Store added.	11/02/2025
P02	CR	Proposed building footprint and parking layout updated.	15/01/2025
P01	CLS	First Issue	06/12/2024
Rev	By	Description	Date



The Cruck Barn, Duxbury Park, Chorley, Lancashire, PR7 4AT
+44 1257 260070 | contact@gillingdod.com | gillingdod.com

Client Name:
NHS Property Services

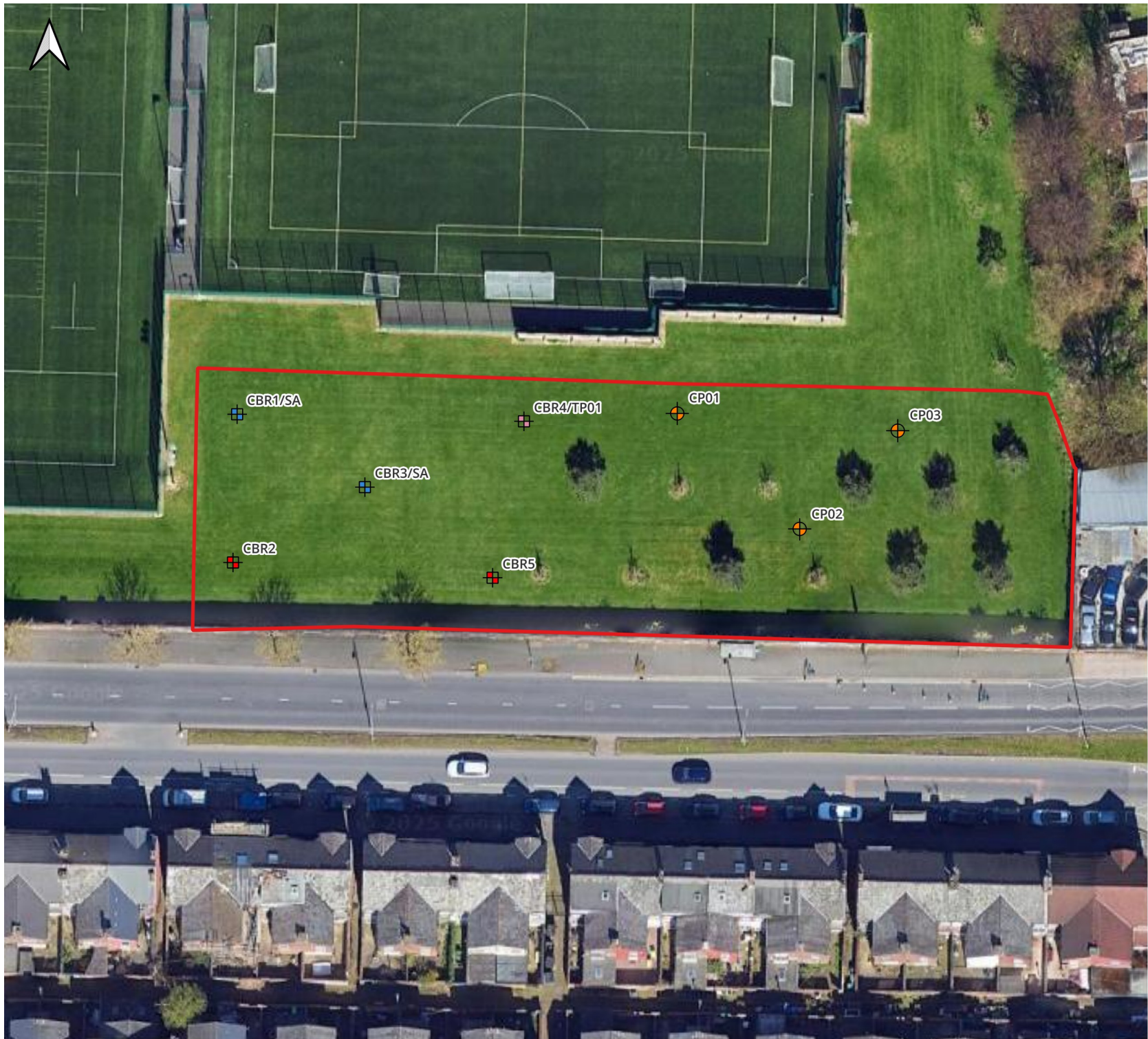
Site Name:
Hawthorn Medical Centre

Project Name:
Hawthorn Medical Centre

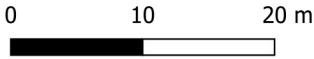
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Proposed Site Plan

Project No: 9114-001	Sheet Size: A3	Scale: As indicated	
Drawn by: CR	Checked by: CLS	Approved by: TGR	Revision: P03

Drawing Number:
Project Code / Originator / Volume / Level / Type / Discipline / System-Number
HMCNMC-GDA-V1-ZZ-DR-A-1002



- Approximate Site Boundary
- Exploratory Holes (depths detailed in CPP)
- CBR - California Bearing Ratio Test
 - CBR/SA - California Bearing Ratio and Soakaway Test
 - CP - Cable Percussive Borehole
 - CBR/TP - California Bearing Ratio and Trial Pit



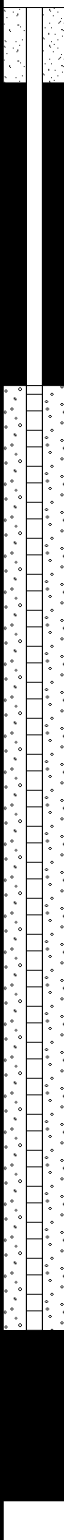
Curtins

Curtins Consulting Ltd
Merchant Exchange, 17-19 Whitworth Street West,
Manchester, M1 5WG
t: 0161 236 2394
e: manchester@curtins.com
www.curtins.com

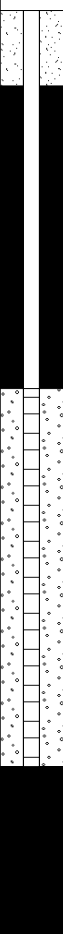
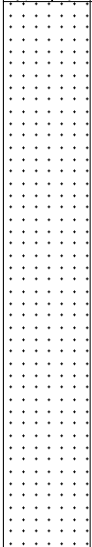
Structures - Civils - Environmental - Infrastructure - Transport Planning - Sustainability - Expert Advisory Services
Birmingham - Bristol - Cardiff - Douglas - Edinburgh - Kendal - Leeds - Liverpool - London - Manchester - Nottingham

Status				
INFORMATION				
Project:				
Hawthorn Medical Centre				
Drg Title:				
Exploratory Hole Location Plan				
Scale:	Size:	Issue Date:	Drawn:	Checked:
NTS	A3	22/09/2025	LW	RBJ
Drg No:				Rev:
087546-CUR-XX-XX-DR-GE-80002				P02

Appendix B – Exploratory Hole Logs

					Borehole Log			Borehole No. CP01 Sheet 1 of 1			
Project Name: Hawthorn Medical Centre					Project No. 087546		Co-ords: 386360.76 - 393959.51		Hole Type CP		
Location: Fallowfield, Manchester					Level: 43.79		Scale 1:20		Logged By LW		
Client: NHS Properties					Dates: 26/08/2025 - 26/08/2025						
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			
		Depth (m)	Type	Results							
		0.10	ES		0.12	43.67		Grass over TOPSOIL: Greyish brown slightly clayey slightly gravelly sand with frequent rootlets. Sand is fine to coarse. Gravel is fine to coarse subrounded to subangular of sandstone, mudstone, slate and rare brick. Greyish brown slightly clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded of sandstone and mudstone. Reddish brown and brown clayey SAND. Sand is fine to medium. [GLACIAL TILL]			
					0.25	43.54					
		0.50	ES					Grey, brown and orange sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to medium subrounded of sandstone. [GLACIAL TILL]			
											
		1.20		N=5 (1,1/1,1,1,2)	1.10	42.69		Reddish brown clayey slightly gravelly SAND. Sand is fine to medium. Gravel is fine to coarse, subrounded of sandstone, mudstone and siltstone. [WEATHERED COLLYHURST SANDSTONE FORMATION] Very weak - weak reddish brown SANDSTONE recovered as sandy gravel. [COLLYHURST SANDSTONE FORMATION]			
		1.20 - 1.65	B								
											
		2.00		N=19 (1,1/2,2,3,12)	2.00	41.79					
		2.00 - 2.45	B		2.30	41.49					
		3.00		50 (25 for 125mm/50 for 225mm)							
		3.00 - 3.45	B								
		3.50		50 (20,5/50 for 115mm)							
		3.50 - 3.95	D					End of borehole at 3.95 m			
					3.95	39.84					
Remarks Hand pit excavated from ground level to 1.20m bgl. Services and GPR clearance by Avoin Maa. No groundwater encountered. Borehole terminated at 3.50m bgl following SPT refusal, chiselling for 30 minutes and a further SPT refusal in sandstone.											

					Borehole Log			Borehole No. CP02 Sheet 1 of 1			
Project Name: Hawthorn Medical Centre					Project No. 087546		Co-ords: 386377.01 - 393949.18		Hole Type CP		
Location: Fallowfield, Manchester					Level: 43.93		Scale 1:20		Logged By LW		
Client: NHS Properties					Dates: 26/08/2025 - 26/08/2025						
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			
		Depth (m)	Type	Results							
		0.15	ES		0.12 0.23	43.81 43.70		Grass over TOPSOIL: Greyish brown slightly clayey slightly gravelly sand with frequent rootlets. Sand is fine to coarse. Gravel is fine to coarse subrounded to subangular of sandstone, mudstone and slate. Orangish brown slightly clayey SAND. Sand is fine to medium.		1	
								Orangish/reddish brown clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded of sandstone, mudstone and siltstone. [WEATHERED COLLYHURST SANDSTONE FORMATION]			
		1.20		N=50 (2,4/8,19,21,2)	1.20	42.73		Very weak - weak reddish brown SANDSTONE. [COLLYHURST SANDSTONE FORMATION]		2	
		1.20 - 1.65	B								
		2.00		50 (25 for 85mm/50 for 115mm)							
	2.00 - 2.45	D		2.45	41.48		End of borehole at 2.45 m		3		
									4		
Remarks Hand pit excavated from ground level to 1.20m bgl. Services and GPR clearance by Avoin Maa. No groundwater encountered. Borehole terminated at 2.00m bgl following SPT refusal, chiselling for 30 minutes and a further SPT refusal in sandstone.											

						Borehole Log			Borehole No. CP03 Sheet 1 of 1				
Project Name: Hawthorn Medical Centre						Project No. 087546		Co-ords: 386386.00 - 393959.92		Hole Type CP			
Location: Fallowfield, Manchester						Level: 43.84		Scale 1:20					
Client: NHS Properties						Dates: 27/08/2025 - 27/08/2025		Logged By LW					
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description					
		Depth (m)	Type	Results									
		0.05	ES		0.16	43.68		Grass over TOPSOIL: Greyish brown slightly clayey slightly gravelly sand with frequent rootlets. Sand is fine to coarse. Gravel is fine to coarse subrounded to subangular of sandstone, mudstone and rare slate. Orangish brown slightly clayey SAND. Sand is fine to medium. Orangish/reddish brown clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded of sandstone. [WEATHERED COLLYHURST SANDSTONE FORMATION]					
					0.33	43.51							
		0.75	ES	N=50 (4,7/50 for 245mm)	1.00	42.84		Very weak - weak reddish brown SANDSTONE. [COLLYHURST SANDSTONE FORMATION]					
		1.20											
		1.20 - 1.65	B										
		2.00		50 (6,13/50 for 125mm)	2.45	41.39	End of borehole at 2.45 m						
		2.00 - 2.45	D										

Remarks

Hand pit excavated from ground level to 1.20m bgl. Services and GPR clearance by Avoin Maa. No groundwater encountered. Borehole terminated at 2.00m bgl following SPT refusal, chiselling for 30 minutes and a further SPT refusal in sandstone.



				Trial Pit Log				Trialpit No SA01 Sheet 1 of 1			
Project Name: Hawthorn Medical Centre				Project No. 087546		Co-ords: 386316.37 - 393961.21 Level: 43.78		Date 27/08/2025			
Location: Fallowfield, Manchester						Dimensions (m): Depth 1.70		2.3 0.7		Scale 1:20 Logged LW	
Client: NHS Properties											
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description				
	Depth	Type	Results								
				0.19	43.59		Grass over TOPSOIL: Greyish brown slightly clayey slightly gravelly sand with frequent rootlets. Sand is fine to coarse. Gravel is fine to coarse subrounded to subangular of sandstone, mudstone and slate.				1
				0.39	43.39		Orangish brown slightly clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded of sandstone, mudstone and siltstone.				
							Weathered, extremely weak, reddish brown fine grained SANDSTONE recovered as slightly clayey slightly gravelly sand. Sand is fine to medium. Gravel is fine to coarse subrounded to subangular of sandstone. [WEATHERED COLLYHURST SANDSTONE FORMATION]				
				1.70	42.08		End of pit at 1.70 m				2
											3
											4
Remarks: Services and GPR clearance by Avoin Maa. Trial pit excavated to 1.70m bgl to facilitate soakaway testing.											
Stability: Stable											

				Trial Pit Log			Trialpit No TP01 Sheet 1 of 1		
Project Name: Hawthorn Medical Centre				Project No. 087546		Co-ords: 386346.24 - 393959.96 Level: 43.80		Date 27/08/2025	
Location: Fallowfield, Manchester				Dimensions (m): Depth 2.10		2 0.7		Scale 1:20 Logged LW	
Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
	Depth	Type	Results						
				0.18	43.62		Grass over TOPSOIL: Greyish brown slightly clayey slightly gravelly sand with frequent rootlets. Sand is fine to coarse. Gravel is fine to coarse subrounded to subangular of sandstone and mudstone.		
				0.42	43.38		Orangish brown clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded of sandstone, mudstone and siltstone.		
				1.80	42.00		Weathered, extremely weak, reddish brown fine grained SANDSTONE recovered as clayey slightly gravelly sand. Sand is fine to medium. Gravel is fine to coarse, subrounded of sandstone. [WEATHERED COLLYHURST SANDSTONE FORMATION]		
				2.10	41.70		Very weak - weak reddish brown fine grained SANDSTONE recovered as cobbly gravel. [COLLYHURST SANDSTONE FORMATION]		
				End of pit at 2.10 m					
Remarks: Services and GPR clearance by Avoin Maa. Trial pit excavated to 2.10m bgl to confirm shallow ground conditions.									
Stability: Stable									



Appendix C – Chemical Laboratory Test Results

FINAL ANALYTICAL TEST REPORT

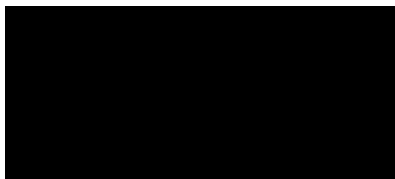
Envirolab Job Number: 25/09624
Issue Number: 1

Date: 05 September, 2025

Client: Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: Lucy Woods/Rebecca Baksh-Jones
Project Name: Hawthorn Medical Centre
Project Ref: B087546
Order No: 26078
Date Samples Received: 29/08/25
Date Instructions Received: 01/09/25
Date Analysis Completed: 05/09/25

Approved by:



Gemma Berrisford
Deputy Client Services Supervisor

Envirolab Job Number: 25/09624

Client Project Name: Hawthorn Medical Centre

Client Project Ref: B087546

Lab Sample ID	25/09624/1	25/09624/2	25/09624/3	25/09624/4	25/09624/5			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP01	CP01	CP02	CP03	CP03					
Depth to Top	0.10	0.50	0.15	0.05	0.75					
Depth To Bottom										
Date Sampled	26-Aug-25	26-Aug-25	26-Aug-25	27-Aug-25	27-Aug-25					
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES					
Sample Matrix Code	6AE	1A	4AE	6AE	1A					
% Moisture at <40C _A	8.3	13.3	6.9	6.8	8.7			% w/w	0.1	A-T-044
% Stones >10mm _A	<0.1	<0.1	<0.1	<0.1	11.3			% w/w	0.1	A-T-044
pH _D ^{M#}	5.88	5.33	4.81	4.54	5.62			pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	<0.01	<0.01	<0.01	<0.01	<0.01			g/l	0.01	A-T-026s
Cyanide (total) _A ^{M#}	<1	<1	<1	<1	<1			mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC _A	<0.2	<0.2	<0.2	<0.2	<0.2			mg/kg	0.2	A-T-050s
Organic Matter _D ^{M#}	4.73	1.09	1.95	4.91	0.22			% w/w	0.14	A-T-032s
Arsenic _D ^{M#}	10	1	3	9	<1			mg/kg	1	A-T-024s
Boron (water soluble) _D ^{M#}	<1.0	<1.0	<1.0	<1.0	<1.0			mg/kg	1	A-T-027s
Cadmium _D	<1.0	<1.0	<1.0	<1.0	<1.0			mg/kg	1	A-T-024s
Copper _D ^{M#}	36	11	14	28	4			mg/kg	1	A-T-024s
Chromium _D ^{M#}	10	7	9	10	7			mg/kg	1	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1	<1			mg/kg	1	A-T-040s
Lead _D ^{M#}	56	11	27	63	4			mg/kg	1	A-T-024s
Mercury _D	<0.17	<0.17	<0.17	0.34	<0.17			mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	8	5	8	7	6			mg/kg	1	A-T-024s
Selenium _D ^{M#}	<1	<1	<1	<1	<1			mg/kg	1	A-T-024s
Zinc _D ^{M#}	38	28	28	35	17			mg/kg	1	A-T-024s

Envirolab Job Number: 25/09624

Client Project Name: Hawthorn Medical Centre

Client Project Ref: B087546

Lab Sample ID	25/09624/1	25/09624/2	25/09624/3	25/09624/4	25/09624/5			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP01	CP01	CP02	CP03	CP03					
Depth to Top	0.10	0.50	0.15	0.05	0.75					
Depth To Bottom										
Date Sampled	26-Aug-25	26-Aug-25	26-Aug-25	27-Aug-25	27-Aug-25					
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES					
Sample Matrix Code	6AE	1A	4AE	6AE	1A					
Asbestos in Soil (inc. matrix)										
Asbestos in soil _D [#]	NAD	NAD	NAD	NAD	NAD					A-T-045
Asbestos Matrix (visual) _D	-	-	-	-	-					A-T-045
Asbestos Matrix (microscope) _D	-	-	-	-	-					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: 25/09624

Client Project Name: Hawthorn Medical Centre

Client Project Ref: B087546

Lab Sample ID	25/09624/1	25/09624/2	25/09624/3	25/09624/4	25/09624/5			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP01	CP01	CP02	CP03	CP03					
Depth to Top	0.10	0.50	0.15	0.05	0.75					
Depth To Bottom										
Date Sampled	26-Aug-25	26-Aug-25	26-Aug-25	27-Aug-25	27-Aug-25					
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES					
Sample Matrix Code	6AE	1A	4AE	6AE	1A					
PAH-16MS										
Acenaphthene _A ^{M#}	0.21	0.01	0.04	0.13	<0.01			mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	0.05	<0.01	0.01	0.04	<0.01			mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	0.36	<0.02	0.05	0.23	<0.02			mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	1.32	0.10	0.35	0.90	<0.04			mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	1.45	0.12	0.46	0.95	<0.04			mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	1.66	0.13	0.46	1.13	<0.05			mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	1.08	0.09	0.34	0.71	<0.05			mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	0.55	<0.07	0.14	0.36	<0.07			mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	1.78	0.16	0.48	1.21	<0.06			mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	0.26	<0.04	0.08	0.17	<0.04			mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	3.28	0.23	0.75	1.98	<0.08			mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	0.14	0.01	0.02	0.09	<0.01			mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	1.01	0.08	0.37	0.72	<0.03			mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	0.05	<0.03	<0.03	<0.03	<0.03			mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	1.92	0.16	0.35	1.22	<0.03			mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	3.23	0.24	0.74	2.04	<0.07			mg/kg	0.07	A-T-019s
Total PAH-16MS _A ^{M#}	18.4	1.33	4.64	11.9	<0.08			mg/kg	0.01	A-T-019s

Envirolab Job Number: 25/09624

Client Project Name: Hawthorn Medical Centre

Client Project Ref: B087546

Lab Sample ID	25/09624/1	25/09624/2	25/09624/3	25/09624/4	25/09624/5			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP01	CP01	CP02	CP03	CP03					
Depth to Top	0.10	0.50	0.15	0.05	0.75					
Depth To Bottom										
Date Sampled	26-Aug-25	26-Aug-25	26-Aug-25	27-Aug-25	27-Aug-25					
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES					
Sample Matrix Code	6AE	1A	4AE	6AE	1A					
TPH CWG with Clean Up										
Ali >C5-C6 _A	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	0.01	A-T-022s
Ali >C6-C8 _A	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	0.01	A-T-022s
Ali >C8-C10 _A	<1	<1	<1	<1	<1			mg/kg	1	A-T-055s
Ali >C10-C12 _A ^{M#}	<1	<1	<1	<1	<1			mg/kg	1	A-T-055s
Ali >C12-C16 _A ^{M#}	<1	<1	<1	<1	<1			mg/kg	1	A-T-055s
Ali >C16-C21 _A ^{M#}	2	<1	<1	1	<1			mg/kg	1	A-T-055s
Ali >C21-C35 _A ^{M#}	25	3	17	20	<1			mg/kg	1	A-T-055s
Total Aliphatics _A	27	3	17	21	<1			mg/kg	1	Calc-As Recd
Aro >C5-C7 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	0.01	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	0.01	A-T-022s
Aro >C8-C10 _A	2	1	1	2	<1			mg/kg	1	A-T-055s
Aro >C10-C12 _A	<1	<1	<1	<1	<1			mg/kg	1	A-T-055s
Aro >C12-C16 _A	4	1	1	4	<1			mg/kg	1	A-T-055s
Aro >C16-C21 _A ^{M#}	25	5	8	23	<1			mg/kg	1	A-T-055s
Aro >C21-C35 _A ^{M#}	99	13	30	90	<1			mg/kg	1	A-T-055s
Total Aromatics _A	131	20	40	119	<1			mg/kg	1	Calc-As Recd
TPH (Ali & Aro >C5-C35) _A	158	23	57	141	<1			mg/kg	1	Calc-As Recd
BTEX - Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	0.01	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	0.01	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	0.01	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	0.01	A-T-022s
MTBE _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01			mg/kg	0.01	A-T-022s

Report Notes

General

- This report shall not be reproduced, except in full, without written approval from Envirolab.
- The client Sample No, Client Sample ID, Depth to top, Depth to Bottom and Date Sampled are all provided by the client and can affect the validity of results.
- 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 within the same delivery, will be disposed of **four weeks** after the 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 our scope of accreditation.
- A deviating sample 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.
- If a sample is outside of the calibration range or affected by interferences then it may need diluting. This will result in the limit of detection (LOD) being raised.
- Subcontracted Analysis: Please see the appended report for any deviations, current LODs and accreditation status of the test.

Key

Superscript “#”	Accredited to ISO 17025
Superscript “M”	Accredited to MCertS
Superscript “U”	Individual result not accredited
None of the above symbols	Analysis unaccredited
Subscript “A”	Analysis performed on as-received Sample
Subscript “D”	Analysis performed on the dried sample, crushed to pass 2mm sieve.
Subscript “D” on Asbestos	Analysis performed on a dried aliquot of sample provided.
Subscript “A”	Analysis has dependant options against results. Details appear in the comments of your Sample receipt
IS	Insufficient Sample for analysis
US	Unsuitable Sample for analysis
NDP	No Determination Possible
NAD	No Asbestos Detected
Trace	Asbestos found not suitable for Gravimetric Quantification – not enough to accurately weigh.
N/A	Not applicable

Asbestos

Identification: 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

“Trace Asbestos Identified” will be reported if there is not enough present to verify the type.

Assigned Matrix Codes

1	SAND	6	CLAY/LOAM	A	Contains Stones
2	LOAM	7	OTHER	B	Contains Construction Rubble
3	CLAY	8	Asbestos Bulk (Only Asbestos ID accredited)	C	Contains visible hydrocarbons
4	LOAM/SAND	9	Incinerator Ash (some Metals accredited)	D	Contains glass / metal
5	SAND/CLAY			E	Contains roots / twigs

Note: 7,8,9 matrices are not covered by our ISO 17025 or MCertS accreditation, unless stated above.

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 by method A-T-007:

For waters, free and visible oils are excluded from the sample used for analysis, so the reported result represents the dissolved phase only.

Results “with Clean up” indicates samples cleaned up with Silica during extraction.

EPH CWG (method A-T-055) from TPH CWG:

EPH CWG results have humics mathematically subtracted through instrument calculation.

Where these humic substances have been identified in any IDs from “TPH CWG with clean up” please note that the concentration is **NOT** included in the quantified results but present in the ID for information.

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.

Please contact your client manager if you require any further information.

Envirolab Deviating Samples Report

Hattersley Science & Technology Park, Stockport Road, Hattersley, SK14 3QU
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client:	Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG	Project No:	25/09624
Project:	Hawthorn Medical Centre	Date Received:	01/09/2025 (am)
Clients Project No:	B087546	Cool Box Temperatures (°C):	18.0

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.

Envirolab Analysis Dates

Lab Sample ID	25/09624/1	25/09624/2	25/09624/3	25/09624/4	25/09624/5
Client Sample No					
Client Sample ID/Depth	CP01 0.10m	CP01 0.50m	CP02 0.15m	CP03 0.05m	CP03 0.75m
Date Sampled	26/08/25	26/08/25	26/08/25	27/08/25	27/08/25
A-T-019s	03/09/2025	03/09/2025	03/09/2025	03/09/2025	03/09/2025
A-T-022s	04/09/2025	04/09/2025	04/09/2025	04/09/2025	04/09/2025
A-T-024s	05/09/2025	05/09/2025	05/09/2025	05/09/2025	05/09/2025
A-T-026s	04/09/2025	04/09/2025	04/09/2025	04/09/2025	04/09/2025
A-T-027s	05/09/2025	05/09/2025	05/09/2025	05/09/2025	05/09/2025
A-T-031s	04/09/2025	04/09/2025	04/09/2025	04/09/2025	04/09/2025
A-T-032s	05/09/2025	05/09/2025	05/09/2025	05/09/2025	05/09/2025
A-T-040s	04/09/2025	04/09/2025	04/09/2025	04/09/2025	04/09/2025
A-T-042sTCN	04/09/2025	04/09/2025	04/09/2025	04/09/2025	04/09/2025
A-T-044	04/09/2025	04/09/2025	04/09/2025	04/09/2025	04/09/2025
A-T-045	02/09/2025	02/09/2025	02/09/2025	02/09/2025	02/09/2025
A-T-050s	05/09/2025	05/09/2025	05/09/2025	05/09/2025	05/09/2025
A-T-055s	04/09/2025	04/09/2025	04/09/2025	04/09/2025	04/09/2025
Calc-As Recd	04/09/2025	04/09/2025	04/09/2025	04/09/2025	04/09/2025

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

Appendix D – Geotechnical Laboratory Test Results, Soakaway and CBR Results

Curtins
17-19 Whitworth Street West
Manchester

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t:

t: 01923 225404

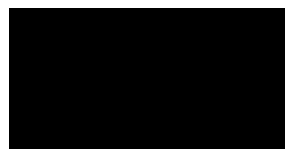
e: lucy.woods@curtins.com
Rebecca.Baksh-Jones@curtins.com
ebma.testing@curtins.com

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 25-046440

Project / Site name:	Hawthorn Medical Centre	Samples received on:	29/08/2025
Your job number:	B087546	Samples instructed on/ Analysis started on:	02/09/2025
Your order number:	26148	Analysis completed by:	08/09/2025
Report Issue Number:	1	Report issued on:	08/09/2025
Samples Analysed:	8 soil samples		



Signed: _____

Anna Goc
PL Head of Reporting Team
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting
air	- once the analysis is complete

Excel copies of reports are only valid when accompanied by this PDF certificate.

Retention period for records and reports is minimum 6 years from the date of issue of the final report.
Some records may be kept for longer according to other legal/best practice requirements.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 25-046440
 Project / Site name: Hawthorn Medical Centre
 Your Order No: 26148

Lab Sample Number	665082	665083	665084	665085	665086
Sample Reference	CP01	CP01	CP01	CP01	CP02
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Water Matrix	N/A	N/A	N/A	N/A	N/A
Depth (m)	1.20-1.65	2.00-2.45	3.00-3.45	3.50-3.95	1.20-1.65
Date Sampled	26/08/2025	26/08/2025	26/08/2025	26/08/2025	26/08/2025
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status		

Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	15	11	9.5	8.1	7.4
Total mass of sample received	kg	0.1	NONE	1.3	1.4	1.3	1.4	1.3

General Inorganics

pH (L099)	pH Units	N/A	MCERTS	6.1	6.8	6.9	7.1	8
Total Sulphate as SO ₄	%	0.005	MCERTS	0.04	0.035	0.028	0.024	0.033
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	56	75	43	39	52
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	27.8	37.7	21.6	19.4	25.8
Total Sulphur	mg/kg	50	MCERTS	110	100	< 50	< 50	< 50
Total Sulphur	%	0.005	MCERTS	0.011	0.01	< 0.005	< 0.005	< 0.005

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number: 25-046440
 Project / Site name: Hawthorn Medical Centre
 Your Order No: 26148

Lab Sample Number	665087	665088	665089
Sample Reference	CP02	CP03	CP03
Sample Number	None Supplied	None Supplied	None Supplied
Water Matrix	N/A	N/A	N/A
Depth (m)	2.00-2.45	1.20-1.65	2.00-2.45
Date Sampled	26/08/2025	27/08/2025	27/08/2025
Time Taken	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status

Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	7	8.8	8.6
Total mass of sample received	kg	0.1	NONE	1.4	1.3	1.4

General Inorganics

pH (L099)	pH Units	N/A	MCERTS	8	7.7	6.7
Total Sulphate as SO ₄	%	0.005	MCERTS	0.033	0.04	0.053
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	120	170	220
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	59.8	87.1	112
Total Sulphur	mg/kg	50	MCERTS	64	74	110
Total Sulphur	%	0.005	MCERTS	0.006	0.007	0.011

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 25-046440
Project / Site name: Hawthorn Medical Centre

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
665082	CP01	None Supplied	1.20-1.65	Brown clay and loam
665083	CP01	None Supplied	2.00-2.45	Brown sand
665084	CP01	None Supplied	3.00-3.45	Brown sand
665085	CP01	None Supplied	3.50-3.95	Brown sand
665086	CP02	None Supplied	1.20-1.65	Brown sand
665087	CP02	None Supplied	2.00-2.45	Brown sand
665088	CP03	None Supplied	1.20-1.65	Brown clay and sand
665089	CP03	None Supplied	2.00-2.45	Brown sand

Analytical Report Number : 25-046440
Project / Site name: Hawthorn Medical Centre

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters Heating/Cooling (PrW) DI Process Water (DI PrW)
Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
Total sulphate (as SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES	In-house method	L038B	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Sulphate, water soluble, in soil (16hr extraction)	In-house method	L038B	D	MCERTS
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES	In-house method	L038B	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099-PL	D	MCERTS
Soil Descriptions	Textural classification	In-house method	L019B	W	NONE

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30°C.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Quality control parameter failure associated with individual result applies to calculated sum of individuals.
The result for sum should be interpreted with caution



TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022,
cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6



4041

Client: Curtins
Client Address: 17-19 Whitworth Street West, Manchester

Contact: Lucy Woods
Site Address: Hawthorn Medical Centre

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Client Reference: B087546
Job Number: 25-046442-1
Date Sampled: 26/08/2025
Date Received: 29/08/2025
Date Tested: 09/09/2025
Sampled By: Not Given

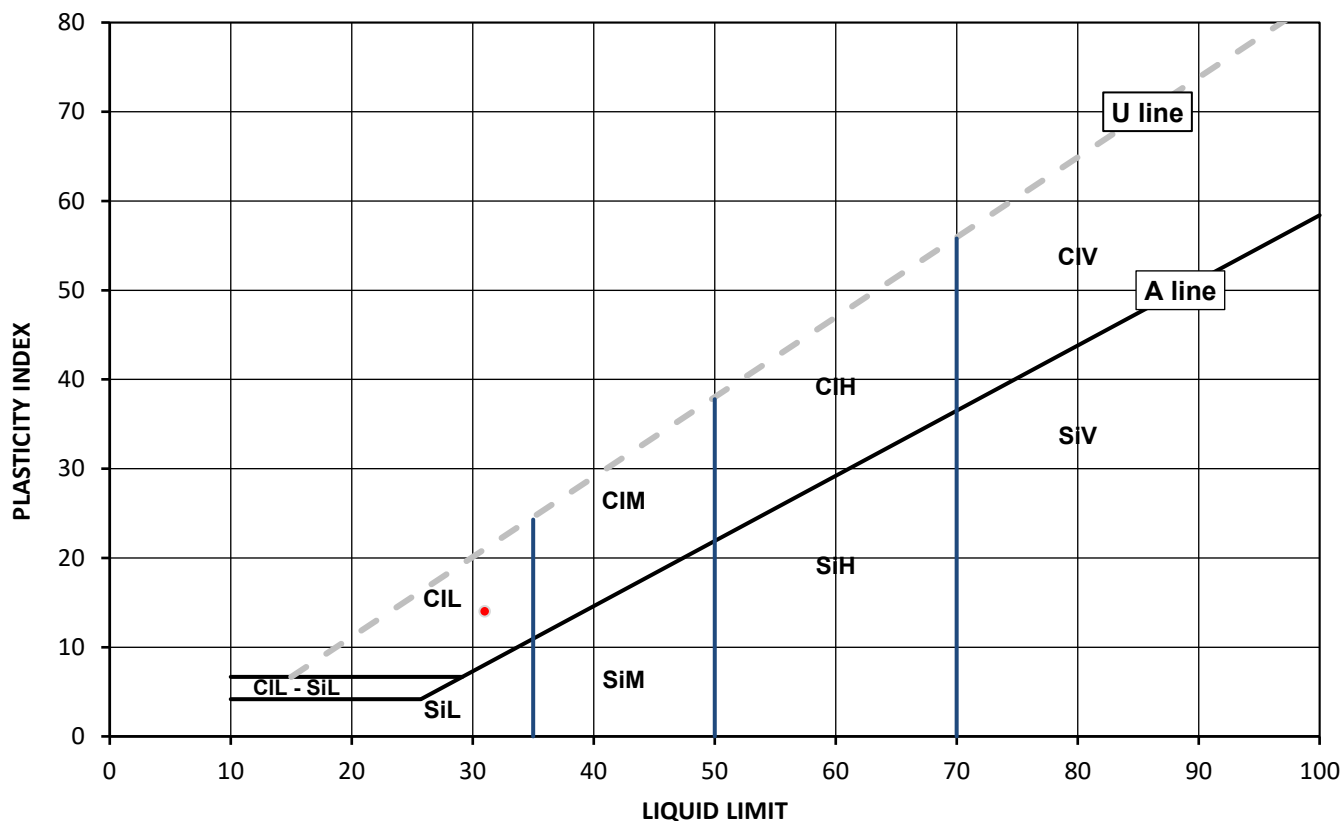
Test Results:

Laboratory Reference: 665099
Hole No.: CP01
Sample Reference: Not Given
Sample Description: Light brown slightly gravelly very sandy CLAY

Depth Top [m]: 1.20
Depth Base [m]: 1.65
Sample Type: B

Sample Preparation: Tested after >0.425mm removed by hand; The water content in the sample was increased
Cone Type: 80g/30deg

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
19.9	31	17	14	0.21	0.79	99



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

	Plasticity	Liquid Limit
Cl	Clay	below 35
Si	Silt	35 to 50
	L Low	50 to 70
	M Medium	exceeding 70
	H High	append to classification for organic material (eg ClHO)
	V Very high	
	O Organic	

Note: Water Content by BS EN ISO 17892-1:2014+A1:2022, BS 1377-2:2022; # Non accredited

Remarks:

Signed:

Monika Siewior
Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.



SUMMARY REPORT
DETERMINATION OF WATER CONTENT

Tested in Accordance with: BS EN ISO 17892-1:2014+A1:2022, BS 1377-2: 2022, clause 4.1



4041
Client: Curtins
Client Address: 17-19 Whitworth Street West, Manchester

Contact: Lucy Woods
Site Address: Hawthorn Medical Centre

Client Reference: B087546
Job Number: 25-046442-1
Date Sampled: 26/08/2025
Date Received: 29/08/2025
Date Tested: 09/09/2025
Sampled By: Not Given

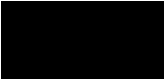
Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	WC											
		Reference	Depth Top m	Depth Base m	Type														
665099	CP01	Not Given	1.20	1.65	B	Light brown slightly gravelly very sandy CLAY		19.9											

Comments:

Signed:



Monika Siewior
Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd



4041



TEST CERTIFICATE

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Tested in Accordance with: BS EN ISO 17892-4:2016,
BS 1377-2:2022 cl. 10



Client: Curtins
Client Address: 17-19 Whitworth Street West, Manchester

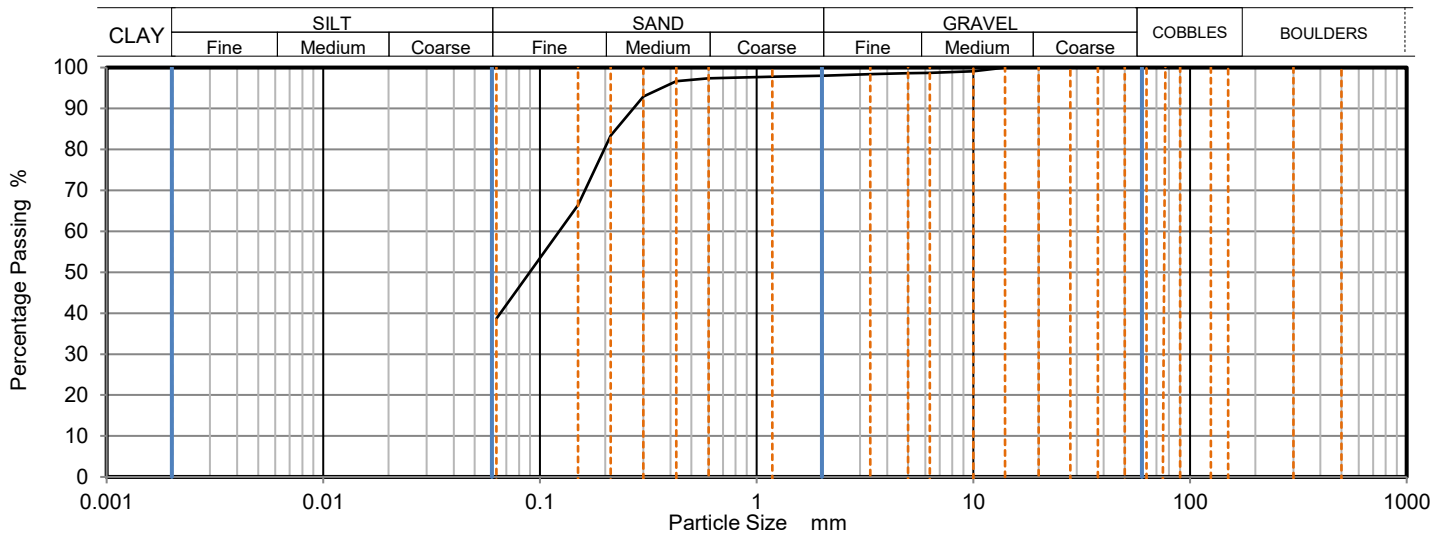
Client Reference: B087546
Job Number: 25-046442-1
Date Sampled: 26/08/2025
Date Received: 29/08/2025
Date Tested: 09/09/2025
Sampled By: Not Given

Contact: Lucy Woods
Site Address: Hawthorn Medical Centre
Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference: 665100
Hole No.: CP01
Sample Reference: Not Given
Sample Description: Light brown slightly gravelly sandy CLAY
Sample Preparation: Sample was quartered, oven dried at 106.0 °C and broken down by hand.

Depth Top [m]: 2.00
Depth Base [m]: 2.45
Sample Type: B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	99		
6.3	99		
5	99		
3.35	98		
2	98		
1.18	98		
0.6	97		
0.425	97		
0.3	93		
0.212	83		
0.15	66		
0.063	39		

Sample Proportions	% dry mass
Very coarse	0
Gravel	2
Sand	59
Fines <0.063 mm	39

Grading Analysis	
D100	mm 14
D60	mm 0.123
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with ISO 17892 -4, by sieving on as received or wet sample

Remarks:

Signed:

Monika Siewior
Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.



4041



TEST CERTIFICATE

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Tested in Accordance with: BS EN ISO 17892-4:2016,
BS 1377-2:2022 cl. 10



Client: Curtins
Client Address: 17-19 Whitworth Street West, Manchester

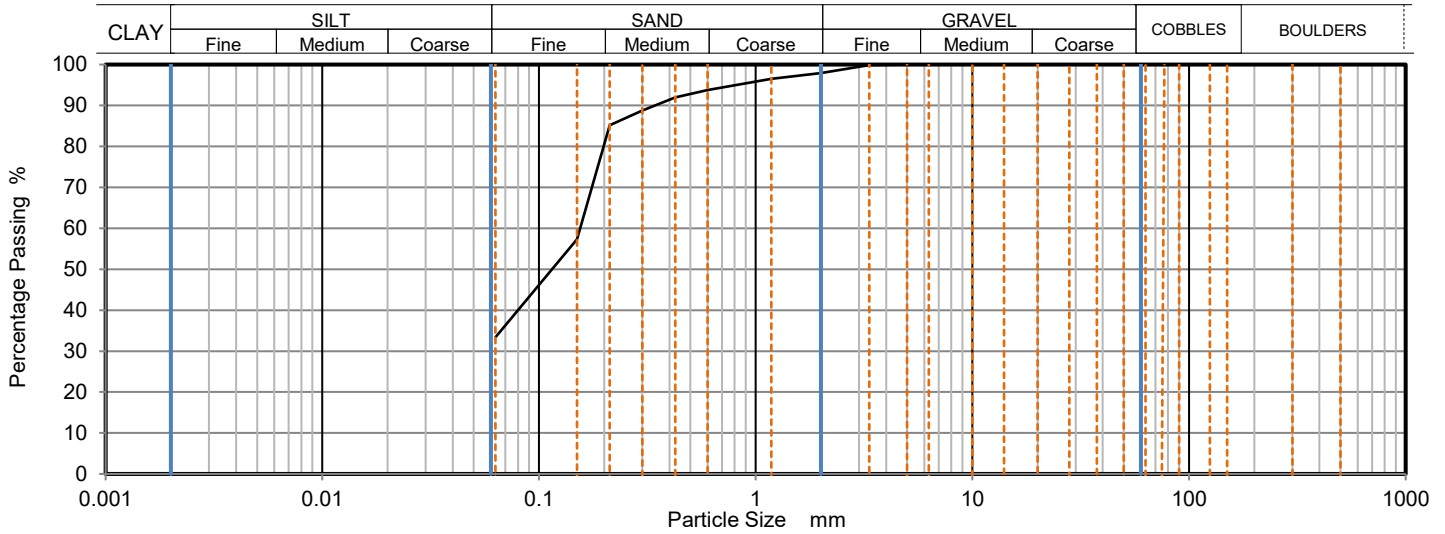
Client Reference: B087546
Job Number: 25-046442-1
Date Sampled: 26/08/2025
Date Received: 29/08/2025
Date Tested: 09/09/2025
Sampled By: Not Given

Contact: Lucy Woods
Site Address: Hawthorn Medical Centre
Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference: 665101
Hole No.: CP01
Sample Reference: Not Given
Sample Description: Orangish brown slightly gravelly very sandy CLAY
Sample Preparation: Sample was quartered, oven dried at 106.0 °C and broken down by hand.

Depth Top [m]: 3.00
Depth Base [m]: 3.45
Sample Type: B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	98		
1.18	97		
0.6	94		
0.425	92		
0.3	89		
0.212	85		
0.15	57		
0.063	33		

Sample Proportions	% dry mass
Very coarse	0
Gravel	2
Sand	65
Fines <0.063 mm	33

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with ISO 17892 -4, by sieving on as received or wet sample

Remarks:

Signed:

Monika Siewior
Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Tested in Accordance with: BS EN ISO 17892-4:2016,
BS 1377-2:2022 cl. 10



4041

Client: Curtins
Client Address: 17-19 Whitworth Street West, Manchester

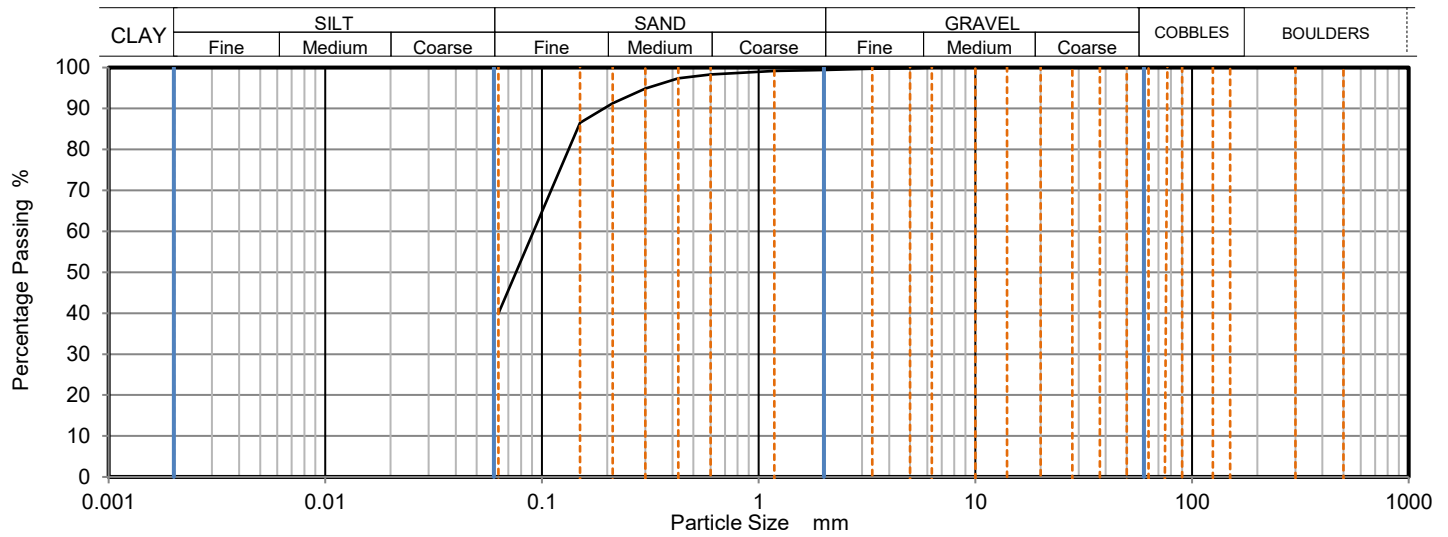
Client Reference: B087546
Job Number: 25-046442-1
Date Sampled: 26/08/2025
Date Received: 29/08/2025
Date Tested: 09/09/2025
Sampled By: Not Given

Contact: Lucy Woods
Site Address: Hawthorn Medical Centre
Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference: 665102
Hole No.: CP02
Sample Reference: Not Given
Sample Description: Orangish brown sandy CLAY
Sample Preparation: Sample was quartered, oven dried at 106.0 °C and broken down by hand.

Depth Top [m]: 1.20
Depth Base [m]: 1.65
Sample Type: B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	99		
1.18	99		
0.6	98		
0.425	97		
0.3	95		
0.212	91		
0.15	87		
0.063	40		

Sample Proportions	% dry mass
Very coarse	0
Gravel	1
Sand	59
Fines <0.063 mm	40

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

Note: Tested in Accordance with ISO 17892 -4, by sieving on as received or wet sample

Remarks:

Signed:

Monika Siewior
Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd

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4041



TEST CERTIFICATE

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Tested in Accordance with: BS EN ISO 17892-4:2016,
BS 1377-2:2022 cl. 10



Client: Curtins
Client Address: 17-19 Whitworth Street West, Manchester

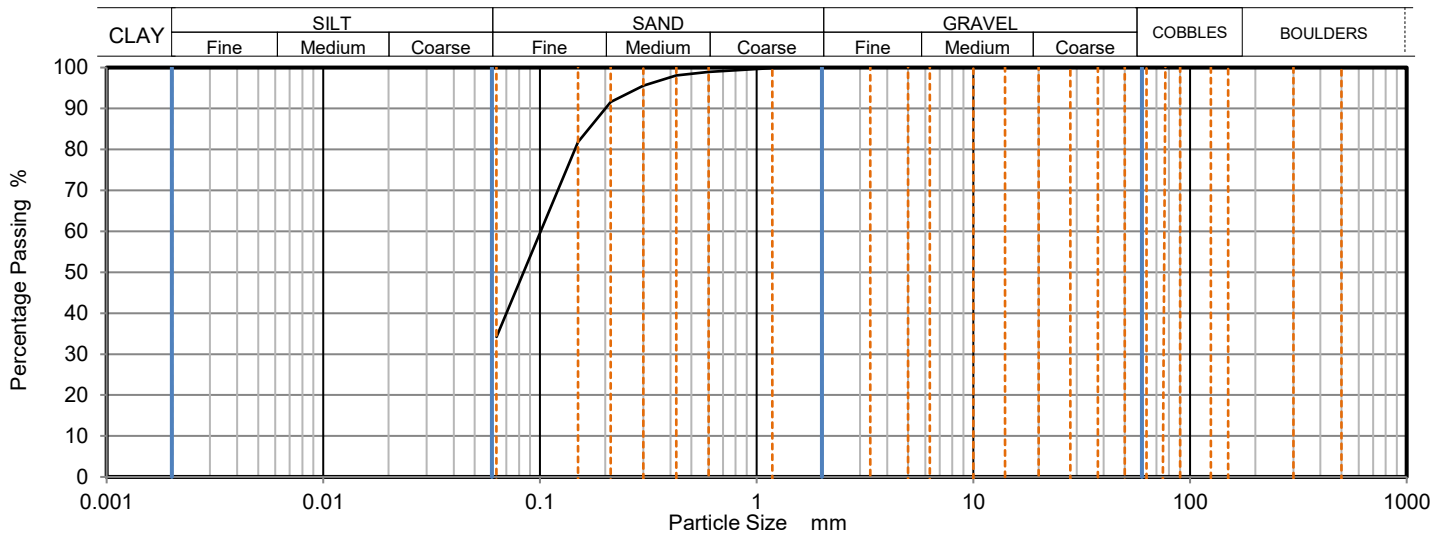
Client Reference: B087546
Job Number: 25-046442-1
Date Sampled: 27/08/2025
Date Received: 29/08/2025
Date Tested: 09/09/2025
Sampled By: Not Given

Contact: Lucy Woods
Site Address: Hawthorn Medical Centre
Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference: 665103
Hole No.: CP03
Sample Reference: Not Given
Sample Description: Orangish brown sandy CLAY
Sample Preparation: Sample was quartered, oven dried at 106.0 °C and broken down by hand.

Depth Top [m]: 1.20
Depth Base [m]: 1.65
Sample Type: B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
500	100		
300	100		
150	100		
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	99		
0.425	98		
0.3	96		
0.212	92		
0.15	82		
0.063	34		

Sample Proportions	% dry mass
Very coarse	0
Gravel	0
Sand	66
Fines <0.063 mm	34

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Uniformity and Curvature Coefficient calculated in accordance with BS EN ISO 14688-2:2018

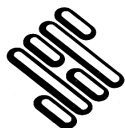
Note: Tested in Accordance with ISO 17892 -4, by sieving on as received or wet sample

Remarks:

Signed:

Monika Siewior
Senior Reporting Specialist
for and on behalf of i2 Analytical Ltd

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STRUCTURAL SOILS LTD

INSITU TESTING REPORT



1774

Report No. 785764R.01(00)

Office Location: Castleford

Date 01-September-2025 Contract: Hawthorn Medical Centre, Manchester

Client Curtins Consulting Limited
Address 51-55 Tithebarn Street,
Liverpool,
L2 2SB

For the Attention of: Rebecca Baksh-Jones

Order received	24-April-2025	Client Reference	None
Testing Started	27-August-2025	Client Order No.	None
Testing Completed	28-August-2025	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

* 5 no. Insitu CBR Test in accordance with BS1377:Part 9:1990, Clause 4.3

Not UKAS Accredited Tests

* 2 no. Soakaway Testing to BRE Digest 365
Please note that 3 fills in each pit was not achievable due to time constraints/ground conditions

The results represent the ground conditions at the specified locations and depths at the time of testing.

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.

Results relate only to items tested

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Structural Soils Ltd, The Potteries, Pottery Street, Castleford, WF10 1NJ Tel.01977552255, email Matthew Doran, matthew.doran@soils.co.uk

TESTING VERIFICATION CERTIFICATE



1774

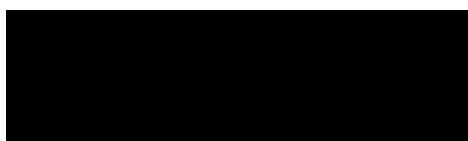
The test results included in this report are certified as:-

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: **01/09/2025 09:36:40**.

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

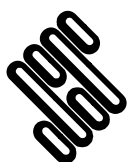


Approved Signatory
Matthew Doran (Site Testing Manager)

(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



**STRUCTURAL
SOILS LTD**

Contract:

**Hawthorn Medical Centre,
Manchester**

Job No:

785764



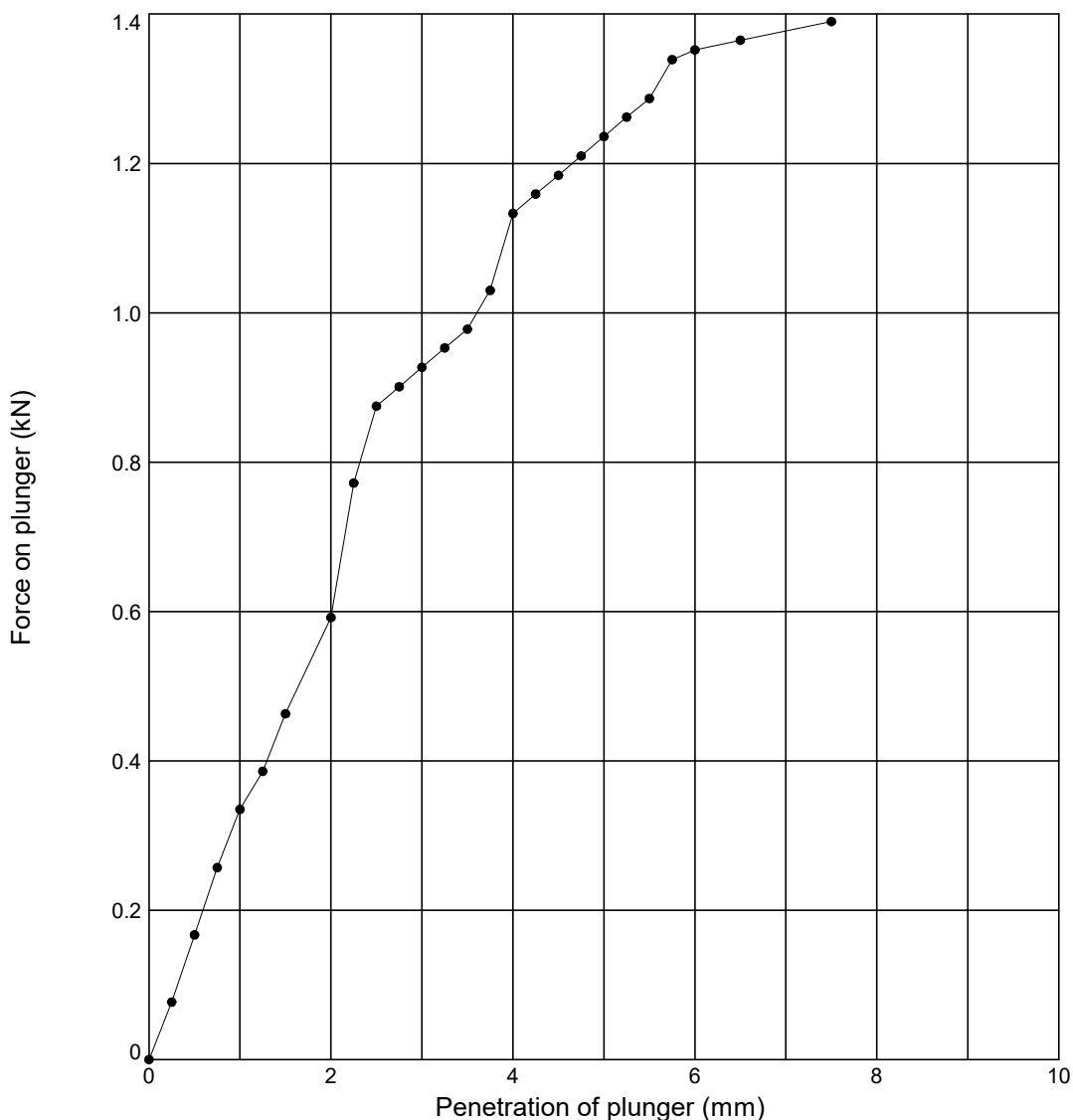
IN SITU CALIFORNIA BEARING RATIO TEST

In accordance with BS1377:Part 9:1990

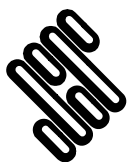
Position Ref: **CBR01**

Depth (m): **0.20**

Date: **28/08/25**



Test Details	Test Conditions	Test Results
Kentledge : Toyota Hilux Surcharge (kg) : 4.52 Surcharge Pressure (kPa) : 1	Weather : Fine Temperature (°C) : 16	CBR Value (%) : 6.6 Moisture Content (%) : 5.4
Sample Description	Test Notes	
Dark reddish brown gravelly SAND	Estimated particles >20 mm (%) : 5 Size and position of particles >20mm in relation to the plunger : Unknown	



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 Castleford
 W. Yorkshire WF10 1NJ

Compiled By		Date
[Redacted]		01/09/25
Contract	MATTHEW DORAN Hawthorn Medical Centre, Manchester	
Contract Ref:		785764



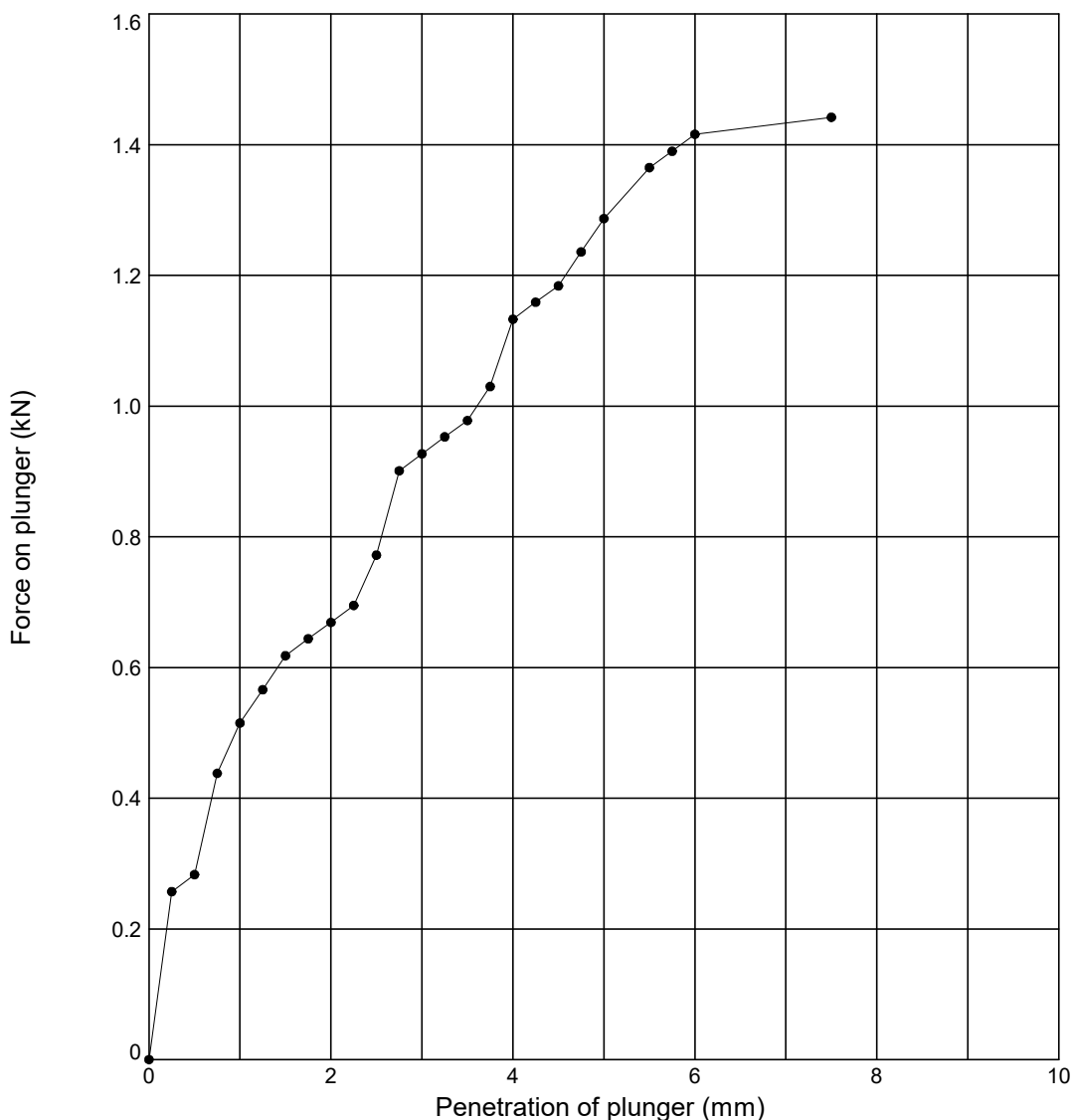
IN SITU CALIFORNIA BEARING RATIO TEST

In accordance with BS1377:Part 9:1990

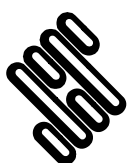
Position Ref: **CBR02**

Depth (m): **0.19**

Date: **28/08/25**



Test Details	Test Conditions	Test Results
Kentledge : Toyota Hilux Surcharge (kg) : 4.52 Surcharge Pressure (kPa) : 1	Weather : Temperature (°C) : 10	CBR Value (%) : 6.4 Moisture Content (%) : 11
Sample Description	Test Notes	
Dark brown slightly clayey SAND with rootlets	Estimated particles >20 mm (%) : 0 Size and position of particles >20mm in relation to the plunger : Unknown	



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Compiled By		Date
		01/09/25
Contract		Contract Ref:
Hawthorn Medical Centre, Manchester		785764
		

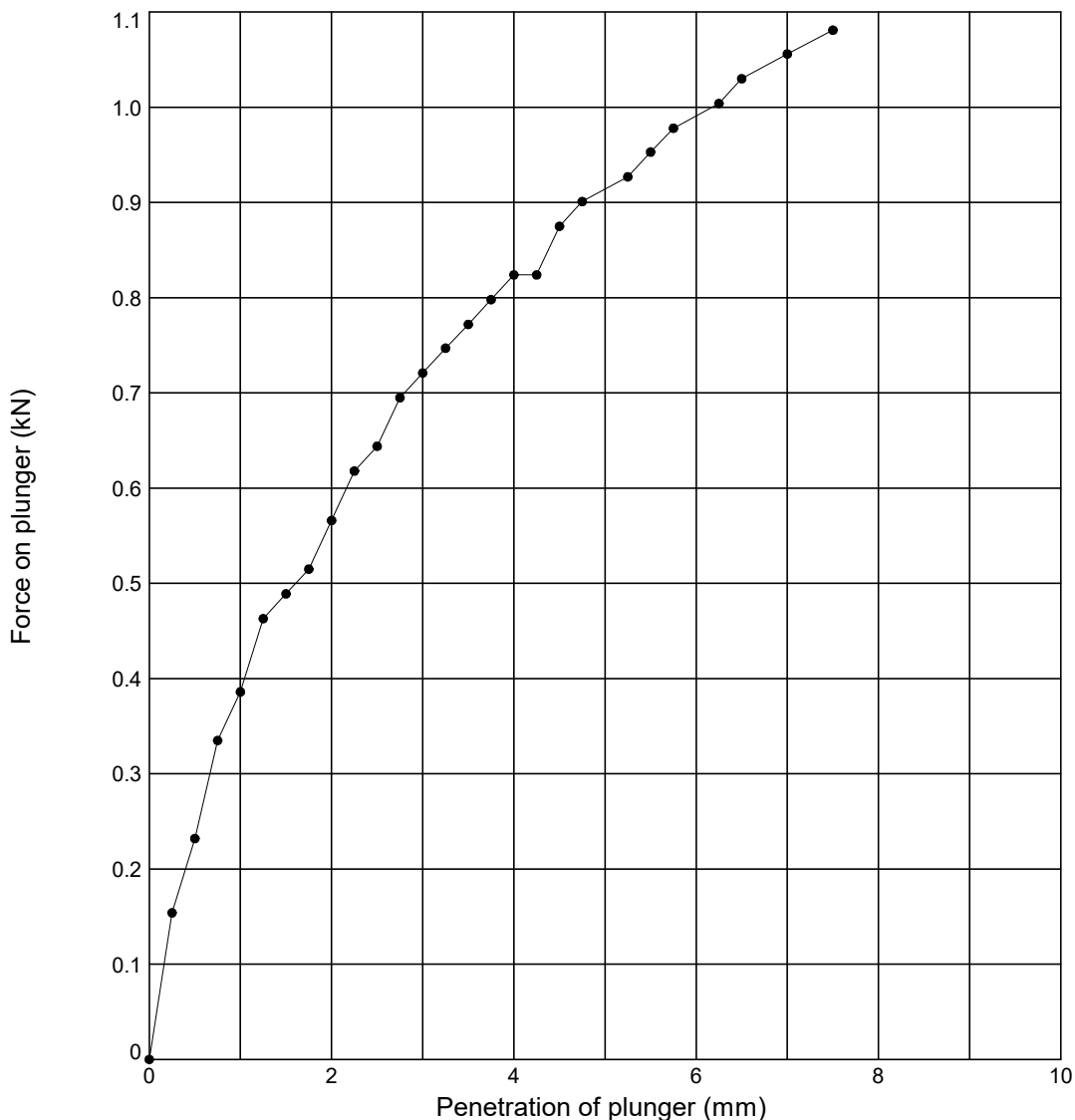
IN SITU CALIFORNIA BEARING RATIO TEST

In accordance with BS1377:Part 9:1990

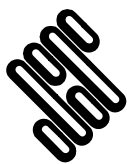
Position Ref: **CBR03**

Depth (m): **0.19**

Date: **28/08/25**



Test Details	Test Conditions	Test Results
Kentledge : Toyota Hilux Surcharge (kg) : 4.52 Surcharge Pressure (kPa) : 1	Weather : Fine Temperature (°C) : 18	CBR Value (%) : 4.9 Moisture Content (%) : 11
Sample Description	Test Notes	
Dark grey brown very gravelly SAND	Estimated particles >20 mm (%) : 0 Size and position of particles >20mm in relation to the plunger : Unknown	



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Compiled By			Date
		MATTHEW DORAN	01/09/25
Contract			Contract Ref:
Hawthorn Medical Centre, Manchester			785764
			

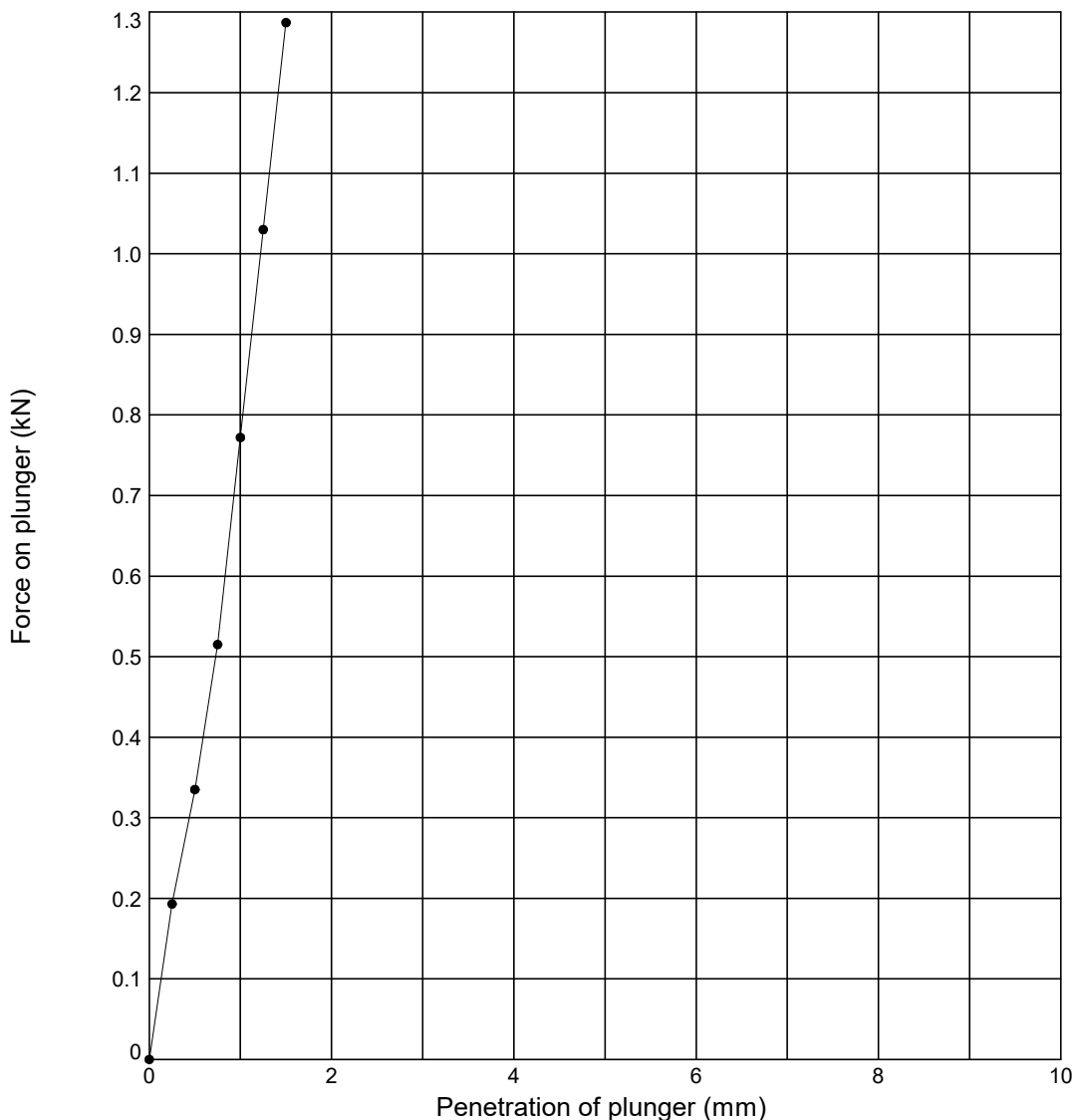
IN SITU CALIFORNIA BEARING RATIO TEST

In accordance with BS1377:Part 9:1990

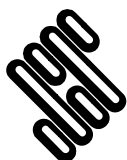
Position Ref: **CBR04**

Depth (m): **0.19**

Date: **28/08/25**



Test Details	Test Conditions	Test Results
Kentledge : Toyota Hilux Surcharge (kg) : 4.52 Surcharge Pressure (kPa) : 1	Weather : Fine Temperature (°C) : 18	CBR Value (%) : 11 Moisture Content (%) : 8.2
Sample Description	Test Notes	
Dark red gravelly SAND	Estimated particles >20 mm (%) : 5 Size and position of particles >20mm in relation to the plunger : Unknown Remarks : Test stopped prematurely due to limits of equipment being reached.	



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Compiled By		Date
[Redacted]		01/09/25
Contract	MATTHEW DORAN Hawthorn Medical Centre, Manchester	
Contract Ref:		785764



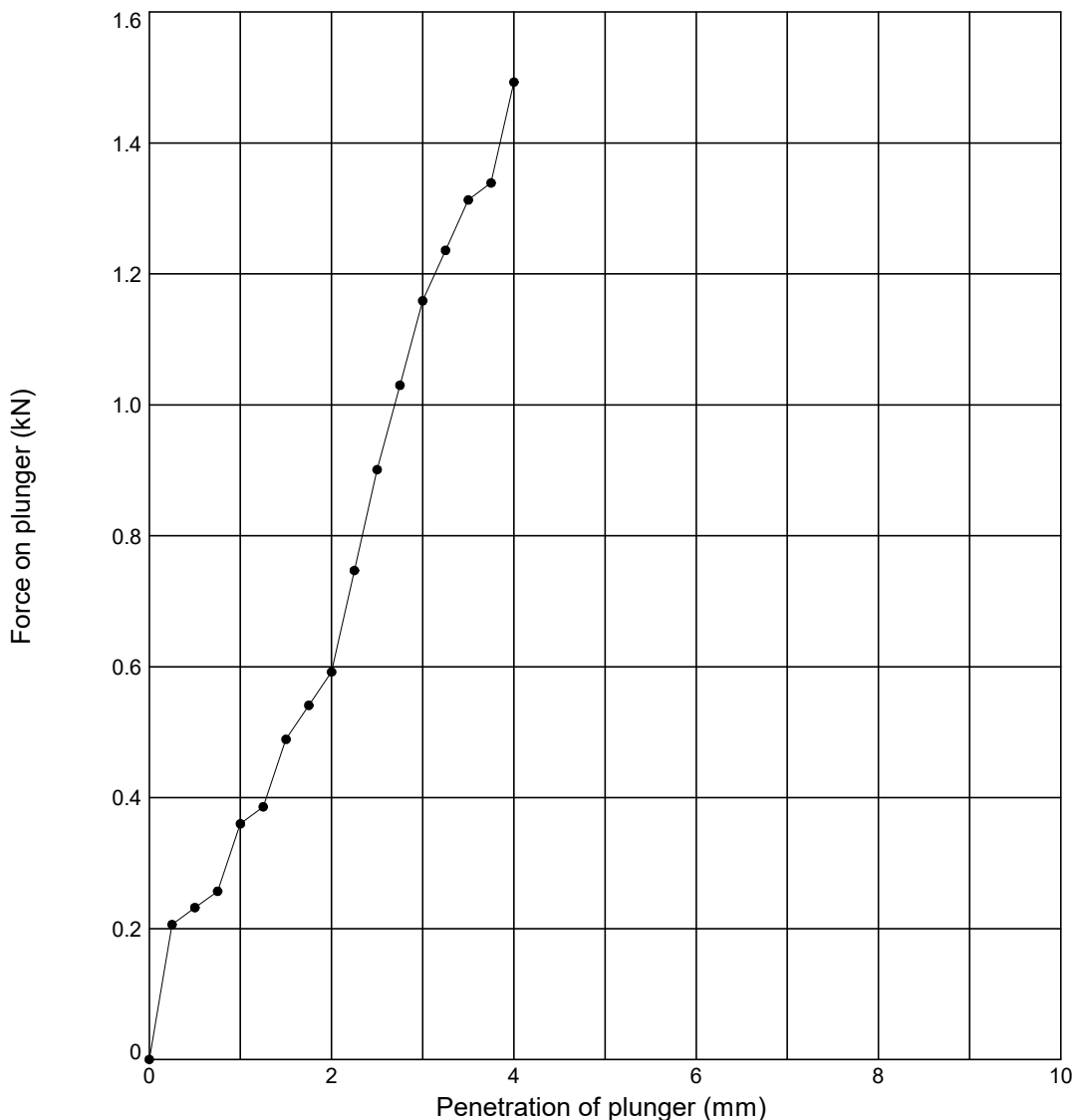
IN SITU CALIFORNIA BEARING RATIO TEST

In accordance with BS1377:Part 9:1990

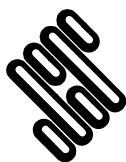
Position Ref: **CBR05**

Depth (m): **0.19**

Date: **28/08/25**



Test Details	Test Conditions	Test Results
Kentledge : Toyota Hilux Surcharge (kg) : 4.52 Surcharge Pressure (kPa) : 1	Weather : Fine Temperature (°C) : 18	CBR Value (%) : 8.5 Moisture Content (%) : 11
Sample Description	Test Notes	
Dark reddish grey sandy GRAVEL	Estimated particles >20 mm (%) : 0 Size and position of particles >20mm in relation to the plunger : Unknown Remarks : Test stopped prematurely due to limits of equipment being reached.	



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Compiled By		Date
[Redacted]		01/09/25
Contract	MATTHEW DORAN Hawthorn Medical Centre, Manchester	
Contract Ref:		785764

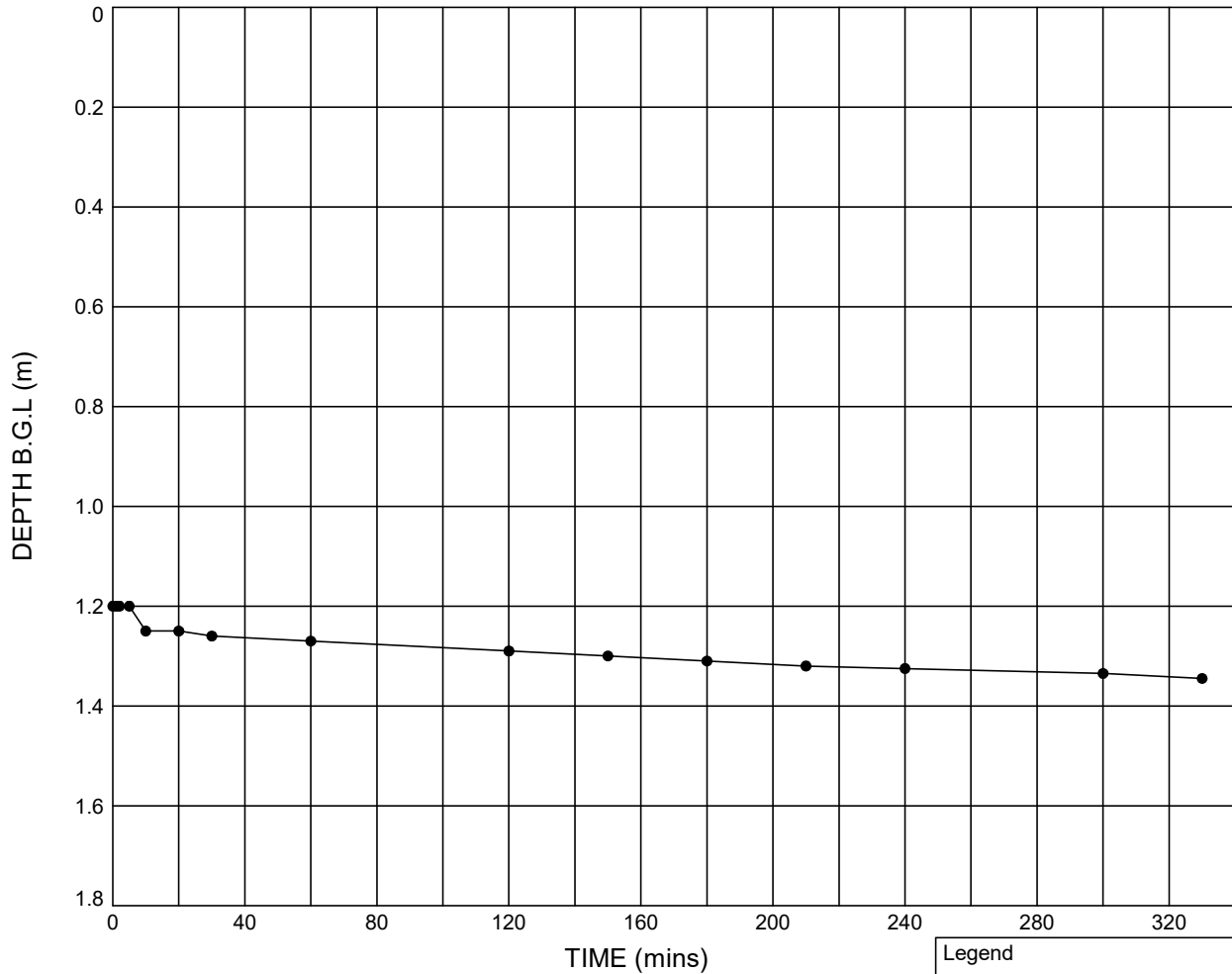


FULL SCALE SOAKAWAY TEST

Non-standard test

Soakaway Test - Position ID : **SA01**

Plot of Depth of Water Below Ground Level Against Time



Test 1

Pit start depth: = **1.70** m

Pit final depth: = **1.70** m

Effective depth, D_e = **0.50** m

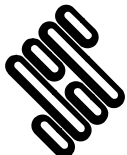
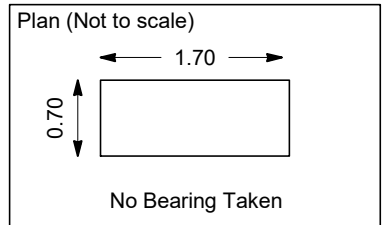
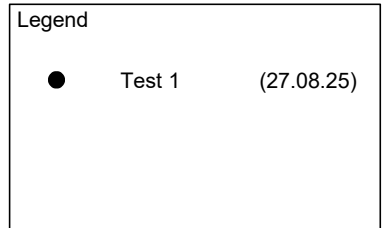
Effective storage volume, V_{p75-25} = **0.2975** m³

Surface area, a_{s50} = **2.3900** m²

Time, t_{p75-25} = **N/A** secs

Infiltration rate, f = **N/A** m/s

Notes: Test 1 - Unable to calculate infiltration rate due to insufficient drop in water level.



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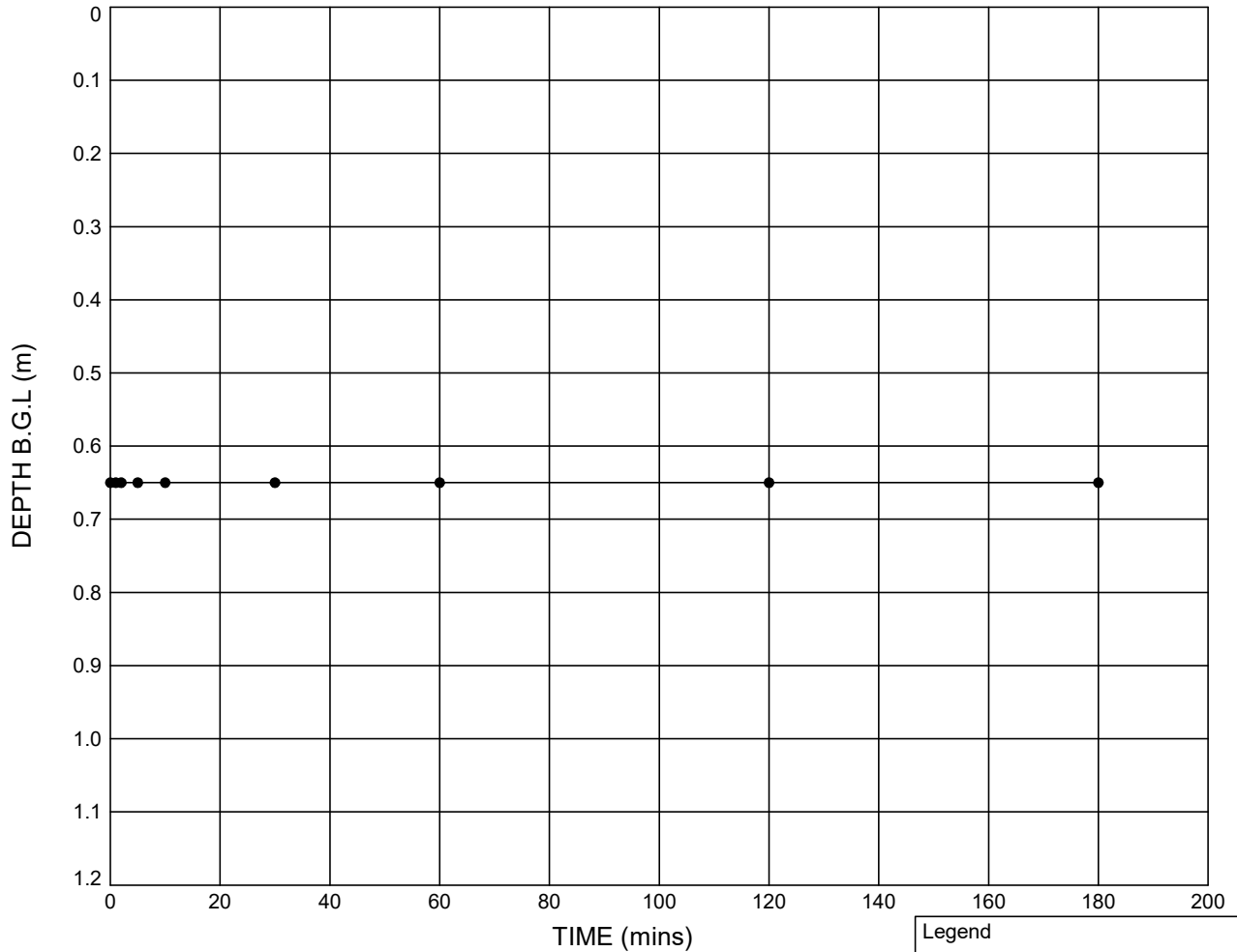
Compiled By	Date	Checked By	Date
[REDACTED]	27/08/25	[REDACTED]	
Contract		Contract Ref:	
Hawthorn Medical Centre, Manchester		785764	

FULL SCALE SOAKAWAY TEST

Non-standard test

Soakaway Test - Position ID : **SA02**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



Test 1

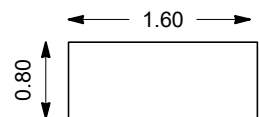
Pit start depth: = **1.10** m
 Pit final depth: = **1.10** m
 Effective depth, D_e = **0.45** m
 Effective storage volume, V_{p75-25} = **2.8800** m³
 Surface area, a_{s50} = **2.3600** m²
 Time, t_{p75-25} = **N/A** secs
 Infiltration rate, f = **N/A** m/s

Notes: Test 1 - Unable to calculate infiltration rate due to insufficient drop in water level.

Legend

● Test 1 (27.08.25)

Plan (Not to scale)



No Bearing Taken



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Compiled By

Date

Checked By

Date

27/08/25

Contract

**Hawthorn Medical Centre,
 Manchester**

Contract Ref:

785764

Appendix E – Ground Gas & Groundwater Monitoring Results



GAS MONITORING LOG SHEET

Project: Hawthorn Medical Centre **Date:** 03/09/2025
Job Number: B087546 **Visit:** 1
Client: NHS **Weather:** Rain
Barometric State: Steady **Ground Conditions:** Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
CP01	985	0.0	0.0	0.0	0.0	2.4	2.4	18.2	0	0	DRY	3.54	
CP02	986	0.0	0.0	0.0	0.0	1.4	1.4	19.6	0	0	DRY	2.04	
CP03	985	0.0	0.0	0.0	0.0	1.5	1.5	19.4	0	0	DRY	2.12	

Notes

Logged by

LW

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated



GAS MONITORING LOG SHEET

Project:

Hawthorn Medical Centre

Date:

16/09/2025

Job Number:

B087546

Visit:

2

Client:

NHS

Weather:

Sunny

Barometric State:

Rising

Ground Conditions:

Damp

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
CP01	1009	0.0	0.0	0.0	0.0	0.1	0.1	20.5	0	0	Dry	3.56	
CP02	1009	0.0	0.0	0.0	0.0	0.7	0.7	20.4	0	0	Dry	2.09	
CP03	1009	0.0	0.0	0.0	0.0	0.0	0.0	20.1	0	0	2.14	2.16	

Notes

Logged by

RBJ

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated



GAS MONITORING LOG SHEET

Project:

Hawthorn Medical Centre

Date:

30/09/2025

Job Number:

B087546

Visit:

3

Client:

NHS

Weather:

Sunny

Barometric State:

Steady

Ground Conditions:

Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
CP01	1020	0.0	0.0	0.0	0.0	0.9	0.9	19.5	0	0	3.55	3.56	
CP02	1021	0.0	0.0	0.0	0.0	1.5	1.5	19.1	0	0	2.08	2.09	
CP03	1021	0.0	0.0	0.0	0.0	0.5	0.3	20.2	0	0	2.15	2.16	

Notes

Logged by

RBJ

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated



GAS MONITORING LOG SHEET

Project:

Hawthorn Medical Centre

Date:

13/10/2025

Job Number:

B087546

Visit:

4

Client:

NHS

Weather:

Overcast

Barometric State:

Steady

Ground Conditions:

Damp

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
CP01	1024	0.0	0.0	0.0	0.0	3.3	3.2	17.5	0	0	Dry	3.54	
CP02	1025	0.0	0.0	0.0	0.0	1.9	1.8	18.9	0	0	2.04	2.06	
CP03	1025	0.0	0.0	0.0	0.0	0.8	0.5	19.9	0	0	2.14	2.16	

Notes

Logged by

RBJ

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated



GAS MONITORING LOG SHEET

Project:

Hawthorn Medical Centre

Date:

28/10/2025

Job Number:

B087546

Visit:

5

Client:

NHS

Weather:

Overcast

Barometric State:

Falling

Ground Conditions:

Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
CP01	998	0.0	0.0	0.0	0.0	3.4	3.4	16.3	0	0	Dry	3.55	
CP02	999	0.0	0.0	0.0	0.0	1.9	1.9	18.3	0	0	1.67	2.06	
CP03	999	0.0	0.0	0.0	0.0	0.0	0.0	20.4	0	0	Dry	2.14	

Notes

Logged by

JP

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated



GAS MONITORING LOG SHEET

Project:

Hawthorn Medical Centre

Date:

12/11/2025

Job Number:

B087546

Visit:

6

Client:

NHS

Weather:

Rain

Barometric State:

Steady

Ground Conditions:

Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
CP01	995	0.0	0.0	0.0	0.0	3.6	3.6	16.4	0	0	DRY	3.55	
CP02	996	0.0	0.0	0.0	0.0	2.1	2.1	17.9	0	0	1.97	2.05	
CP03	995	0.0	0.0	0.0	0.0	2.3	2.3	17.3	0	0	2.15	2.16	

Notes

Logged by
LW

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Appendix F – GAC Screening Thresholds

Human Health GQRA Rationale and Hierarchy

Background

Detailed guidance on human health risk assessment is available within several documents, published by both the Environment Agency, Defra, CL:AIRE, LQM/CIEH and Public Health England as referenced below (references a-h).

A Generic Quantitative Risk Assessment (GQRA) is carried out for the Potential Contaminant Linkages (PCLs) investigated by screening of soil contamination data against relevant Generic Assessment Criteria where available.

Generic Assessment Criteria are available for a range of different land use scenarios, soil organic matter (SOM) and soil types. Curtins have adopted available GACs for a sandy loam soil at 1%, 2.5% and 6% SOM using various sources.

GAC Hierarchy

A summary of and hierarchy for adopted GACs is identified below:

- i) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium, and lead as part of the 'Phase 1 Project'. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). In 2018 the 'Phase 2 Project' commenced which aims to develop C4SLs for a range of further contaminants. Currently available Phase 2 C4SLs include vinyl chloride, trichloroethene, tetrachloroethene, naphthalene, cis-1,2 dichloroethene, trans 1, 2 dichloroethene and per / polyfluoroalkyl substances (PFAS) . Where contaminant concentrations do not exceed C4SLs, there is no risk that the land poses a significant possibility of significant harm (SPoSH) or the level of risk is low, as such land can be demonstrated to be in Category 4 and cannot be determined as contaminated land. The C4SLs are proposed to be more pragmatic (whilst still strongly precautionary) in comparison with SGVs and S4UL's outlined below.
- ii) **Suitable for Use Levels (S4ULs):** In 2015 LQM and the Chartered Institute of Environmental Health published generic assessment criteria for 89 substances including metals, BTEX, TPH, polycyclic aromatic hydrocarbons, phenols, chlorinated solvents and other volatile organic compounds. The S4ULs represent a minimal risk to long term human health, derived using health criteria values. The methodology for deriving the S4ULs is based on the Environment Agency CLEA model with consideration of developments in UK human health exposure assessment, in particular the additional land uses and exposure assumptions.
- iii) **Other Supplementary Screening Criteria:** In addition to those developed by LQM/CIEH (outlined above), other third party organisations have derived SSVs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including those developed EIC/AGS/CL:AIRE and SoBRA published thresholds.

Alternative Assessment Approaches

PAH – Benzo(a)pyrene Surrogate Marker Assessment

In September 2017 Public Health England (PHE) (Ref. h) published guidance for the use of a surrogate marker approach to assess the risk posed by soil contamination with the genotoxic polycyclic aromatic hydrocarbons (PAHs). The guidance indicates that the use of a marker compound, such as Benzo(a)pyrene, provides a consistent indicator of the amount of 7 other genotoxic PAHs commonly tested for in soil including benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(123cd)pyrene and benzo(ghi)perylene.

Where PAH concentrations of these 8 no. PAHs are present within pre-determined ratios in soil, provided in the guidance, this approach is used, comparing soil concentrations of the marker compound with a Category 4 Screening Level, or site specific assessment criteria. An individual compound assessment is carried out for other PAH compounds not considered in the PHE guidance.

An individual compound assessment is carried out for all PAH compounds where pre-determined ratios are not met for the surrogate marker approach.

Notes

Curtins Generic Assessment Criteria provide further information and notes to be read in conjunction with this assessment rationale.

Human Health GQRA Rationale and Hierarchy



References

- a) Environmental Agency. (2009) Contaminated Land Exposure Assessment (CLEA) v1.071 model.
- b) Environment Agency. (2009) Human Health Toxicological Assessment of Contaminants in Soil (report no. SC050021/SR2).
- c) Environment Agency. (2009) Updated Technical Background to the CLEA Model (report no.SC050021/SR3).
- d) Environment Agency (2005) The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils Science Report P5-080/TR3.
- e) Department of Environment Food and Rural Affairs (DEFRA). (2012) Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (report no. PB13735).
- f) CL:AIRE (2014) Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, SP1010 Rev 2.
- g) LQM & CIEH (2015) S4ULs for Human Health Risk Assessment.
- h) Public Health England (2017) Contaminated Land Information Sheet: Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)

Contaminants	Residential with Home Grown Produce	Residential Without Home Grown Produce	Allotments	Commercial	Public open space (Residential)	Public park POS _{park}	Solubility Saturation Limit (mg/kg)	Vapour Satuation Limit (mg/kg)
Metals, Semi-Metals & non-metals								
Antimony	-	550	-	7500	-	-		
Arsenic	37	40	49	640	79	170		
Beryllium	1.7	1.7	35	12	2.2	63		
Boron	290	11000	45	240000	21000	46000		
Cadmium	22	150	3.9	410	220	880		
Chromium III	910	910	18000	8600	1500	33000		
Chromium VI	21	21	170	49	21	250		
Copper	2400	7100	520	68000	12000	44000		
Lead	200	310	80	2300	630	1300		
Mercury (elemental)	1.2	1.2	21	58	16	30		25.8
Mercury (inorganic)	40	56	19	1100	120	240		
Methylmercury	11	15	6	320	40	68		
Nickel	130	180	53	980	230	800		
Selenium	250	430	88	12000	1100	1800		
Vanadium	410	1200	91	9000	2000	5000		
Zinc	3700	40000	620	730000	81000	170000		
Inorganic Compounds								
Cyanide	24	24	24	1400	24	24		
Organic contaminants								
Aliphatic Risk Banded Hydrocarbons - TPH CWG method								
Aliphatic EC5 - EC6 TPHs	42	42	730	3200	570000	95000	304	
Aliphatic EC>6 - EC8 TPHs	100	100	2300	7800	600000	150000	144	
Aliphatic EC>8 - EC10 TPHs	27	27	320	2000	13000	14000	78	
Aliphatic EC>10-EC12 TPHs	130	130	2200	9700	13000	21000	48	
Aliphatic EC>12-EC16 TPHs	1100	1100	11000	59000	13000	25000	24	
Aliphatic EC>16 - EC35 TPHs	65000	65000	260000	1600000	250000	450000	8.48	
Aliphatic EC>35 - EC44 TPHs	65000	65000	260000	1600000	250000	450000	8.48	
Aromatic Risk Banded Hydrocarbons - TPH CWG method								
Aromatic EC5 - EC7 TPHs	70	370	13	26000	56000	76000	1220	
Aromatic EC>7 - EC8 TPHs	130	860	22	56000	56000	87000		869
Aromatic EC>8 - EC10 TPHs	34	47	8.6	3500	5000	7200		613
Aromatic EC10 - EC12 TPHs	74	250	13	16000	5000	9200	364	
Aromatic EC12 - EC16 TPHs	140	1800	23	36000	5100	10000	169	
Aromatic EC>16 - EC21 TPHs	260	1900	46	28000	3800	7600		
Aromatic EC>21 - EC35 TPHs	1100	1900	370	28000	3800	7800		
Aromatic EC>35 - EC44 TPHs	1100	1900	370	28000	3800	7800		
Long Chain Aliphatic and Aromatic Hydrocarbons								
Aliphatic and Aromatic EC >44-70	1600	1900	1200	28000	3800	7800		
Aromatic Hydrocarbons								
Benzene	0.2	0.89	0.039	27	140	190		
Ethyl benzene	47	83	16	5700	24000	17000		518
Toluene	130	880	22	56000	56000	87000		869
Xylene	56	79	28	5900	41000	17000	478 (o-xylene) 576 (p-xylene)	625 (m-xylene)
MTBE	49	73	23	7900			20400	
Phenol	280	750	66	760	760	760		
Polycyclic Aromatic Hydrocarbons (PAH) - Benzo(a)pyrene Surrogate Marker Approach, with reference to C4SL PAH Surrogate Marker Check Sheet where appropriate								
Benzo(a)Pyrene (C4SL Surrogate Marker Approach)	5	5.3	5.7	77	10	21		
Naphthalene	15	15	65	1600	11000	800	76.4	
Acenaphthylene	170	2900	28	83000	15000	29000	86.1	
Acenaphthene	210	3000	34	84000	15000	29000	57	
Fluorene	170	2800	27	63000	9900	20000	30.9	
Phenanthrene	95	1300	15	22000	3100	6200	36	
Anthracene	2400	31000	380	520000	74000	150000		1.17
Fluoranthene	280	1500	52	23000	3100	6300		
Pyrene	620	3700	110	54000	7400	15000		
Polycyclic Aromatic Hydrocarbons (PAH) - Individual Compound Assessment								
Naphthalene	15	15	65	1600	11000	800	76.4	
Acenaphthylene	170	2900	28	83000	15000	29000	86.1	
Acenaphthene	210	3000	34	84000	15000	29000	57	
Fluorene	170	2800	27	63000	9900	20000	30.9	
Phenanthrene	95	1300	15	22000	3100	6200	36	
Anthracene	2400	31000	380	520000	74000	150000		1.17
Fluoranthene	280	1500	52	23000	3100	6300		
Pyrene	620	3700	110	54000	7400	15000		
Benzo(a)anthracene	7.2	11	2.9	170	29	49		
Chrysene	15	30	4.1	350	57	93		
Benzo(b)fluoranthene	2.6	3.9	0.99	44	7.1	13		
Benzo(k)fluoranthene	77	110	37	1200	190	370		
Benzo(a)pyrene (only)	2.2	3.2	0.97	35	5.7	11		
Indeno(123cd)pyrene	27	45	9.5	500	82	150		
Dibenzo(ah)anthracene	0.24	0.31	0.14	3.5	0.57	1.1		
Benzo(ghi)perylene	320	360	290	3900	640	1400		
Chlorinated Aliphatic Hydrocarbons								
Chloroethene (Vinyl chloride)	0.0064	0.015	0.0017	1.1	7.8	18		
1,1-Dichloroethene (DCE)	0.23	0.23	2.8	26			2230	
Cis 1,2, Dichloroethene (DCE)	0.46	0.5	0.89	38	3800	2800	3940	
Trans 1,2, Dichloroethene (DCE)	0.9	0.93	3.7	69	13000	5600	3420	
Trichloroethene (TCE)	0.0093	0.0097	0.032	0.73	76	41		
Tetrachloroethene (PCE)	0.31	0.32	2	24	3200	1400		
1,1,1,2 Tetrachloroethane	1.2	1.5	0.79	110	1400	1500		
1,1,1 Trichloroethane	8.8	9	48	660	140000	57000		1425
1,2-Dichloroethane (Ethylene Dichloride)	0.11	0.16	0.054	12	300	300		
Tetrachloromethane	0.026	0.026	0.45	2.9	890	190		
Trichloromethane (Chloroform)	0.91	1.2	0.42	99	2500	2600		
Per- and Polyfluoroalkyl Substances (PFAS)								
Perfluorooctanoic Acid (PFOA)	0.0076	0.041	0.0014	0.6	0.079	0.17		
Perfluorononanoic Acid (PFNA)	0.013	0.041	0.0027	0.6	0.079	0.17		
Perfluorohexane Sulfonic Acid (PFHxS)	0.0081	0.041	0.0015	0.6	0.079	0.17		
Perfluorooctane Sulfonic Acid (PFOS)	0.0073	0.041	0.0013	0.6	0.079	0.17		

Contaminants	Residential with Home Grown Produce	Residential Without Home Grown Produce	Allotments	Commercial	Public open space (Residential)	Public park POS _{park}	Solubility Saturation Limit (mg/kg)	Vapour Satuation Limit (mg/kg)
Metals, Semi-Metals & non-metals								
Antimony		550		7500				
Arsenic	37	40	49	640	79	170		
Beryllium	1.7	1.7	35	12	2.2	63		
Boron	290	11000	45	240000	21000	46000		
Cadmium	22	150	3.9	410	220	880		
Chromium III	910	910	18000	8600	1500	33000		
Chromium VI	21	21	170	49	21	250		
Copper	2400	7100	520	68000	12000	44000		
Lead	200	310	80	2300	630	1300		
Mercury (elemental)	1.2	1.2	21	58	16	30		25.8
Mercury (inorganic)	40	56	19	1100	120	240		
Methylmercury	11	15	6	320	40	68		
Nickel	130	180	53	980	230	800		
Selenium	250	430	88	12000	1100	1800		
Vanadium	410	1200	91	9000	2000	5000		
Zinc	3700	40000	620	730000	81000	170000		
Inorganic Compounds								
Cyanide	24	24	24	1400	24	24		
Organic contaminants								
Aliphatic Risk Banded Hydrocarbons - TPH CWG method								
Aliphatic EC5 - EC6 TPHs	78	78	1700	5900	590000	130000	558	
Aliphatic EC>6 - EC8 TPHs	230	230	5600	17000	610000	220000	322	
Aliphatic EC>8 - EC10 TPHs	65	65	770	4800	13000	18000		190
Aliphatic EC>10-EC12 TPHs	330	330	4400	23000	13000	23000		118
Aliphatic EC>12-EC16 TPHs	2400	2400	13000	82000	13000	25000	59	
Aliphatic EC>16 - EC35 TPHs	92000	92000	270000	1700000	250000	480000	21	
Aliphatic EC>35 - EC44 TPHs	92000	92000	270000	1700000	250000	480000	21	
Aromatic Risk Banded Hydrocarbons - TPH CWG method								
Aromatic EC5 - EC7 TPHs	140	690	27	46000	56000	84000	2260	
Aromatic EC>7 - EC8 TPHs	290	1800	51	110000	56000	95000	1920	
Aromatic EC>8 - EC10 TPHs	83	110	21	8100	5000	8500		1500
Aromatic EC10 - EC12 TPHs	180	590	31	28000	5000	9700	899	
Aromatic EC12 - EC16 TPHs	330	2300	57	37000	5100	10000	419	
Aromatic EC>16 - EC21 TPHs	540	1900	110	28000	3800	7700		
Aromatic EC>21 - EC35 TPHs	1500	1900	820	28000	3800	7800		
Aromatic EC>35 - EC44 TPHs	1500	1900	820	28000	3800	7800		
Long Chain Aliphatic and Aromatic Hydrocarbons								
Aliphatic and Aromatic EC >44-70	1800	1900	2100	28000	3800	7800		
Aromatic Hydrocarbons								
Benzene	0.17	0.7	0.034	47	72	100		
Ethyl benzene	110	190	39	13000	24000	22000		1220
Toluene	290	1900	51	110000	56000	95000		1920
Xylene	130	180	67	14000	42000	23000	1120	1470
MTBE	84	120	44	13000			33100	
Phenol	550	1300	140	1500	1500	1500		
Polycyclic Aromatic Hydrocarbons (PAH) - Benzo(a)pyrene Surrogate Marker Approach, with reference to C4SL PAH Surrogate Marker Check Sheet where appropriate								
Benzo(a)Pyrene (C4SL Surrogate Marker Approach)	5	5.3	5.7	77	10	21		
Naphthalene	36	36	130	3700	15000	1200	183	
Acenaphthylene	420	4600	69	97000	15000	30000	212	
Acenaphthene	510	4700	85	97000	15000	30000	141	
Fluorene	400	3800	67	68000	9900	20000	76.5	
Phenanthrene	220	1500	38	22000	3100	6200		
Anthracene	5400	35000	950	540000	74000	150000		
Fluoranthene	560	1600	130	23000	3100	6300		
Pyrene	1200	3800	270	54000	7400	15000		
Polycyclic Aromatic Hydrocarbons (PAH) - Individual Compound Assessment								
Naphthalene	36	36	130	3700	15000	1200	183	
Acenaphthylene	420	4600	69	97000	15000	30000	212	
Acenaphthene	510	4700	85	97000	15000	30000	141	
Fluorene	400	3800	67	68000	9900	20000	76.5	
Phenanthrene	220	1500	38	22000	3100	6200		
Anthracene	5400	35000	950	540000	74000	150000		
Fluoranthene	560	1600	130	23000	3100	6300		
Pyrene	1200	3800	270	54000	7400	15000		
Benzo(a)anthracene	11	14	6.5	170	29	56		
Chrysene	22	31	9.4	350	57	110		
Benzo(b)fluoranthene	3.3	4	2.1	44	7.2	15		
Benzo(k)fluoranthene	93	110	75	1200	190	410		
Benzo(a)pyrene (only)	2.7	3.2	2	35	5.7	12		
Indeno(123cd)pyrene	36	46	21	510	82	170		
Dibenzo(ah)anthracene	0.28	0.32	0.27	3.6	0.57	1.3		
Benzo(ghi)perylene	340	360	470	4000	640	1500		
Chlorinated Aliphatic Hydrocarbons								
Chloroethene (Vinyl chloride)	0.01	0.019	0.0031	1.4	7.8	19		
1,1-Dichloroethene (DCE)	0.4	0.41	5.6	46			3940	
Cis 1,2, Dichloroethene (DCE)	0.78	0.84	1.7	64	3800	2400	6610	
Trans 1,2, Dichloroethene (DCE)	1.6	1.7	0.75	120	13000	7000	6170	
Trichloroethene (TCE)	0.02	0.02	0.072	1.5	78	54		
Tetrachlorethene (PCE)	0.7	0.71	4.8	55	3300	1900		
1,1,1,2 Tetrachlorethane	2.8	3.5	1.9	250	1400	1800		
1,1,1 Trichlorethane	18	18	110	1300	140000	76000		2915
1,2-Dichloroethane (Ethylene Dichloride)	0.18	0.24	0.1	17	210	330		
Tetrachloromethane	0.056	0.056	1	6.3	920	270		
Trichloromethane	1.7	2.1	0.83	170	2500	2800		
PFAS								
Perfluorooctanoic Acid (PFOA)	0.0076	0.041	0.0014	0.6	0.079	0.17		
Perfluorononanoic Acid (PFNA)	0.013	0.041	0.0027	0.6	0.079	0.17		
Perfluorohexane Sulfonic Acid (PFHxS)	0.0081	0.041	0.0015	0.6	0.079	0.17		
Perfluorooctane Sulfonic Acid (PFOS)	0.0073	0.041	0.0013	0.6	0.079	0.17		

Contaminants	Residential with Home Grown Produce	Residential Without Home Grown Produce	Allotments	Commercial	Public open space (Residential)	Public park POS _{park}	Solubility Saturation Limit (mg/kg)	Vapour Satuation Limit (mg/kg)
Metals, Semi-Metals & non-metals								
Antimony		550		7500				
Arsenic	37	40	49	640	79	170		
Beryllium	1.7	1.7	35	12	2.2	63		
Boron	290	11000	45	240000	21000	46000		
Cadmium	22	150	3.9	410	220	880		
Chromium III	910	910	18000	8600	1500	33000		
Chromium VI	21	21	170	49	21	250		
Copper	2400	7100	520	68000	12000	44000		
Lead	200	310	80	2300	630	1300		
Mercury (elemental)	1.2	1.2	21	58	16	30		25.8
Mercury (inorganic)	40	56	19	1100	120	240		
Methylmercury	11	15	6	320	40	68		
Nickel	130	180	53	980	230	800		
Selenium	250	430	88	12000	1100	1800		
Vanadium	410	1200	91	9000	2000	5000		
Zinc	3700	40000	620	730000	81000	170000		
Inorganic Compounds								
Cyanide	24	24	24	1400	24	24		
Organic Compounds								
Aliphatic Risk Banded Hydrocarbons - TPH CWG method								
Aliphatic EC5 - EC6 TPHs	160	160	3900	12000	600000	180000	1150	
Aliphatic EC>6 - EC8 TPHs	530	530	13000	40000	620000	320000	736	
Aliphatic EC>8 - EC10 TPHs	150	150	1700	11000	13000	21000		451
Aliphatic EC>10-EC12 TPHs	760	770	7300	47000	13000	24000		283
Aliphatic EC>12-EC16 TPHs	4300	4400	13000	90000	13000	26000	142	
Aliphatic EC>16 - EC35 TPHs	110000	110000	270000	1800000	250000	490000		
Aliphatic EC>35 - EC44 TPHs	110000	110000	270000	1800000	250000	490000		
Aromatic Risk Banded Hydrocarbons - TPH CWG method								
Aromatic EC5 - EC7 TPHs	300	1400	57	86000	56000	92000	4710	
Aromatic EC>7 - EC8 TPHs	660	3900	120	180000	56000	100000		4360
Aromatic EC>8 - EC10 TPHs	190	270	51	17000	5000	9300		3590
Aromatic EC10 - EC12 TPHs	380	1200	74	34000	5000	10000	2150	
Aromatic EC12 - EC16 TPHs	660	2500	130	38000	5000	10000		
Aromatic EC>16 - EC21 TPHs	930	1900	260	28000	3800	7800		
Aromatic EC>21 - EC35 TPHs	1700	1900	1600	28000	3800	7900		
Aromatic EC>35 - EC44 TPHs	1700	1900	1600	28000	3800	7900		
Long Chain Aliphatic and Aromatic Hydrocarbons								
Aliphatic and Aromatic EC >44-70	1900	1900	3000	28000	3800	7900		
Aromatic Hydrocarbons								
Benzene	0.87	3.3	0.18	98	140	230		
Ethyl benzene	260	440	91	27000	25000	27000		2840
Toluene	690	3900	120	180000	56000	100000		4360
Xylene	310	430	160	30000	43000	31000	2620	
MTBE	160	220	90	24000			62700	
Phenol	420	2300	280	3200	3200	3200		
Polycyclic Aromatic Hydrocarbons (PAH) - Benzo(a)pyrene Surrogate Marker Approach, with reference to C4SL PAH Surrogate Marker Check Sheet where appropriate								
Benzo(a)Pyrene (C4SL Surrogate Marker Approach)	5	5.3	5.7	77	10	21		
Naphthalene	85	85	200	8400	17000	1900	432	
Acenaphthylene	920	6000	160	100000	15000	30000	506	
Acenaphthene	1100	6000	200	100000	15000	30000	336	
Fluorene	860	4500	160	71000	9900	20000	183	
Phenanthrene	440	1500	90	23000	3100	6300		
Anthracene	11000	37000	2200	540000	74000	150000		
Fluoranthene	890	1600	290	23000	3100	6400		
Pyrene	2000	3800	620	54000	7400	15000		
Polycyclic Aromatic Hydrocarbons (PAH) - Individual Compound Assessment								
Naphthalene	85	85	200	8400	17000	1900	432	
Acenaphthylene	920	6000	160	100000	15000	30000	506	
Acenaphthene	1100	6000	200	100000	15000	30000	336	
Fluorene	860	4500	160	71000	9900	20000	183	
Phenanthrene	440	1500	90	23000	3100	6300		
Anthracene	11000	37000	2200	540000	74000	150000		
Fluoranthene	890	1600	290	23000	3100	6400		
Pyrene	2000	3800	620	54000	7400	15000		
Benzo(a)anthracene	13	15	13	180	29	62		
Chrysene	27	32	19	350	57	120		
Benzo(b)fluoranthene	3.7	4	3.9	45	7.2	16		
Benzo(k)fluoranthene	100	110	130	1200	190	440		
Benzo(a)pyrene (only)	3	3.2	3.5	36	5.7	13		
Indeno(123cd)pyrene	41	46	39	510	82	180		
Dibenzo(ah)anthracene	0.3	0.32	0.43	3.6	0.58	1.4		
Benzo(ghi)perylene	350	360	640	4000	640	1600		
Chlorinated Aliphatic Hydrocarbons								
Chloroethene (Vinyl chloride)	0.017	0.029	0.0058	2.2	7.8	19		
1,1-Dichloroethene (DCE)	0.82	0.82	12	92			7940	
Cis 1,2, Dichloroethene (DCE)	1.5	1.6	3.6	120	3900	3100	12900	
Trans 1,2, Dichloroethene (DCE)	3.3	3.4	16	260	13000	9100	12600	
Trichloroethene (TCE)	0.043	0.045	0.16	3.4	79	69		
Tetrachloroethene (PCE)	1.6	1.6	11	130	3400	2500		
1,1,1,2 Tetrachloroethane	6.4	8.2	4.4	560	1400	2100		
1,1,1 Trichloroethane	39	40	240	3000	140000	100000		6392
1,2-Dichloroethane (Ethylene Dichloride)	0.31	0.41	0.19	29	310	380		
Tetrachloromethane	0.13	0.13	2.4	14	950	400		
Trichloromethane	3.4	4.2	1.7	350	2500	3100		
PFAS								
Perfluorooctanoic Acid (PFOA)	0.0076	0.041	0.0014	0.6	0.079	0.17		
Perfluorononanoic Acid (PFNA)	0.013	0.041	0.0027	0.6	0.079	0.17		
Perfluorohexane Sulfonic Acid (PFHxS)	0.0081	0.041	0.0015	0.6	0.079	0.17		
Perfluorooctane Sulfonic Acid (PFOS)	0.0073	0.041	0.0013	0.6	0.079	0.17		

- 1) All Values are in mg/kg, reported to 2 significant figures.
- 2) Numbers in bold are C4SLs, Numbers in italics are S4ULs, Numbers underlined are EIC/AGS/CL:AIRE GACs, Numbers in red are SoBRA Acute Generic Assessment Criteria.
- 3) Assumptions and key notes made when deriving the Generic Assessment Criteria are contained within the relevant guidance documents, references:
 - a) Contaminated Land: Applications in Real Environments (2014) SP1010 - Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, Final Project Report (Revision 2b)
 - b) Land Quality Management Ltd. (2015) The LQM/CIEH S4ULs for Human Health Risk Assessment.
 - c) CL:AIRE, EIC, AGS (2010) Soil Generic Assessment Criteria for Human Health Risk Assessment.
 - d) Society of Brownfield Risk Assessment (2020) Development of Acute Generic Assessment Criteria for Assessing Risks to Human Health from Contaminants in Soil.
 - e) Environment Agency (2009) Human Health Toxicological Assessment of Contaminants in Soil, Science Report - SC050021/SR2.
- 4) Generic Assessment Criteria listed in the following order of preference: C4SLs, S4ULs, CL:AIRE/AGS/EIC Generic Assessment Criteria, Other relevant Generic Assessment Criteria where GACS associated with the prioritised GACs are not available as outlined further in Curtins Rationale and Hierarchy notes.
- 5) To use Benzo(a)pyrene as a surrogate marker for PAH contamination, the assumptions set out in the relevant C4SL documentation must be met. A C4SL PAH surrogate marker checklist is appended.
- 6) Naphthalene is a volatile PAH. The C4SL values are derived on the basis of chronic exposure and risks to human health, and do not explicitly account for acute risks (e.g. a one off ingestion of a significant amount of soil by a young child) where the inhalation pathway is the main risk driver. Further consideration of the acute risk may be required in external settings (POS_{park} and POS_{resi}) where the GAC is substantially greater than the residential equivalent, to account for the possibility of acute exposure to the ingestion of naphthalene. The theoretical solubility saturation limit of naphthalene in soil is substantially lower than the GAC value, and therefore it is likely that free phase contamination would be present where the GAC is exceeded. In such a situation, it is unlikely that the product would remain in-situ untreated, and consideration of remediation / mitigation methods would be required.
- 7) Where the C4SL surrogate marker checklist indicates the PAH ratios are not suitable, individual PAH compounds must be assessed individually against the relevant contaminant specific assessment criteria.
- 8) Risk associated with additive effects of TPH contamination needs to be assessed in addition to the individual bandings, using the following equation:

$$HI = \sum HQ_i = \sum \frac{\text{Measured concentration, } Fi \text{ (mg/kg)}}{\text{Relevant GAC (mg/kg)}} Fi$$

Where:

HI = Hazard Index

HQ = Hazard Quotient

Fi = Fraction i

Where the HI > 1, there may be a risk to human health.

- 9) Exposure to all xylene isomers to be considered together. Values detailed in this table are the lowest (most conservative) of o-, m- and p- xylene isomers.
- 10) PFAS assessment also uses a hazard index approach to ensure the total exposure from all four PFAS compounds combined does not exceed the LLTC_{oral}. Where the hazard index exceeds 1, further consideration or assessment of the risk is required, even where none of the individual C4SL values are exceeded.
- 11) PFAS C4SL values are interim. The C4SL has been derived using the sum of the four PFAS compounds as the basis of the low level of toxicological concern. The term interim reflects concerns raised by the Committee on Toxicity (COT) and the fact that further work by the COT and others may result in the need for the LLTC to be updated.
- 12) Generic Assessment Criteria assume no free phase contamination is present. Where free phase contamination is present, further assessment may be required.
- 13) Solubility Saturation Limit and Vapour Saturation Limit are provided in accordance with relevant guidance documents. Where these values are exceeded, and the vapour pathway is an important contributing pathway to exposure, then the following should be considered:
 - Free phase contamination may be present
 - Exposure from vapour pathways will be over predicted.
 - Where the vapour pathway is >90% of exposure then it is unlikely that the relevant HCV will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Additional assessment should be undertaken where this is the case, with consideration that:

- Exposure is unlikely to reach the relevant HCV and the risk based on the assumed conceptual model is likely to be negligible.
- Vapour pathway exposure should be calculated using algorithms suitable for free phase or NAPL sources
- Screening could be considered using the lower saturation limit, which is the approach adopted by the USEPA. However, this may not be practical in many cases because of very low limits and is in any case highly conservative.

Where the vapour pathway is the only exposure pathway considered then effective assessment criteria should be derived manually in accordance with guidance outlined in CLEA Science Report SC050021/SR4

Appendix G – Risk Assessment Rationale

The site-specific risk assessment, presented in this report, follows the principle of establishing whether there is a viable linkage between a contaminant source to a potential receptor, via an exposure pathway.

The risk assessment corresponds with the total site area and incorporates both descriptive (qualitative) and, where available, numerical (quantitative) lines of evidence.

Risk assessment is the process of collating known information on a hazard or set of hazards to estimate actual or potential risk to receptors. The receptor may be humans, a water resource, a sensitive local ecosystem, or future construction materials. Receptors can be connected to the source by one or several exposure pathways such as direct contact for example. Risks are managed by isolating the receptor or intercepting the exposure pathway or by isolating or removing the hazard.

Without the three essential components of a source, pathway, and receptor there can be no risk. Therefore, the presence of contaminant source on a site does not necessarily mean there is a risk.

The risk assessment considers the likelihood of a particular event taking place (accounting for the presence of the source and receptor and the viability of the exposure pathway) in conjunction with the severity of the potential consequence (accounting for the potential severity of the hazard and the sensitivity of the receptor).

In the risk assessment the consequence of the hazard has been classified as severe, medium, mild, or minor and the probability (likelihood) of the circumstances occurring classified as high likelihood or low likelihood or unlikely.

The consequences and probabilities are subsequently cross correlated to give a qualitative estimation of the risk using Department of the Environment risk classifications as detailed in the table below and as referenced in CIRIA C552.

		Consequence			
		Severe	Medium	Mild	Minor
Probability (Likelihood)	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

In accordance with DoE guidance, the following categorisation of **consequence** has been developed.

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in “significant harm” as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to an ecosystem or organisation forming part of such ecosystem.	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health. Pollution of sensitive water resources. A significant change in an ecosystem or organism forming part of such ecosystem.	Concentration of a contaminant from site exceeds the generic or site-specific assessment criteria. Leaching of contaminants from a site to a Principal or Secondary A aquifer. Death of a species within a designated nature reserve. Lesser toxic and asphyxiate effects
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures, and services. Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater (Inc. Secondary B aquifers). Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily repairable effects of damage to buildings, structures, and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

In accordance with DoE guidance, the following categorisation of **probability** has been developed.

Classification	Definition
High Likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage, and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and over the long term.
Low Likelihood	There is a pollution linkage, and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place and is less likely in the shorter term.
Unlikely	There is a pollution linkage, but circumstances are such that it is improbable that an event would occur even in the very long term.

In accordance with DoE guidance, the following categorisation of **risk** has been developed.

Classification	Definition
Very High Risk	There is a <i>high probability</i> that <i>severe harm</i> could arise to a designated receptor from an identified hazard at the site without appropriate further action.
High Risk	<i>Harm is likely to arise</i> to a designated receptor from an identified hazard at the site without appropriate further action.
Moderate Risk	<i>It is possible</i> that without appropriate further action <i>harm could arise</i> to a designated receptor. It is relatively <i>unlikely</i> that any such harm would be <i>severe</i> , and if any harm were to occur it is <i>more likely</i> that such harm would be <i>relatively mild</i> .
Low Risk	<i>It is possible</i> that <i>harm could arise</i> to a designated receptor from an identified hazard. It is <i>likely</i> that, at worst, if any harm was realised any effects would be <i>mild</i> .
Negligible Risk	The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.

The term 'risk' in this instance refers to the risk that the source, pathway, receptor linkage for a given source of contamination is complete. It does not refer to immediate risk to individuals or features present on the site from potential contaminants and is intended to be used as a tool to assess the necessity of further investigation.