



whitby wood

CARMOOR ROAD

REMIDATION STRATEGY

L074-WTW-11-XX.XX-T-G-000005

P452204

Client: GMI

Status: S3 - Suitable for review and comment

Revision: P04

Date: 31/03/2026

REVISION HISTORY

REVISION	DATE	DESCRIPTION OF CHANGE	PREPARED BY:	REVIEWED BY:	APPROVED BY:
P01	06/09/24	First Issue	JB	TW	TW
DRAFT	27/02/26	DRAFT Preliminary draft for Planning prior to further GI and Gas Monitoring results.	GP	SM	SM
P03	05/03/26	Revised as per Contractor Comments	GP	SM	SM
P04	31/03/26	Response to EHO comments and inclusion of final GI and Ground Monitoring Results.	GP	SM	SM

PREPARED BY:



George Powell

Design Engineer

REVIEWED BY:



Sofia Michelaki

Associate

APPROVED BY:



Sofia Michelaki

Associate

whitby wood

+44 (0)20 7442 2216 | info@whitbywood.com | www.whitbywood.com

WHITBY WOOD LIMITED IS REGISTERED IN ENGLAND AND WALES REG NO. 07786822

TABLE OF CONTENTS

1 Introduction4

2 Site Description.....6

3 Review of Existing Information.....8

4 Remediation Objectives..... 23

5 Working practice and watching brief 27

6 Verification Reporting 29

TABLE OF FIGURES

Figure 1: Plan image from Google Maps6

Figure 2: Ground Investigation Layout (Via Land Science Supplementary GI Report) with added approximate Monitoring Well Locations. 10

Figure 3: Characteristic Gas Screening Situation (via CIRIA C655)3.2.4 12

TABLES

Table 1: Geoenvironmental Testing carried out for soil samples 20249

Table 2: Geoenvironmental Testing carried out for soil samples 20269

Table 3: Geoenvironmental testing carried out for water samples9

Table 4: Revised conceptual site model..... 13

Table 5: Remedial Options for Permanent Works..... 23

Table 6: Examples of Significant Observations..... 28

Appendices

- Appendix A: 2024 Phase II Contamination Assessment (Land Science)
- Appendix B: 2026 Supplementary Phase II Contamination Assessment (Land Science)
- Appendix C: 2026 Ground Gas Assessment (Land Science)
- Appendix D: Composition Testing Results of Cover Layer Material

DISCLAIMER

Whitby Wood Limited (WW) is appointed by GMI to provide Structural, Civil and Geotechnical consultancy services for the development of Carmoor Road.

This report has been produced for the exclusive use of GMI for the purposes set out herein only and it should not be used in whole or in part by any third parties without the express permission of WW in writing. WW neither owes nor accepts any duty to any third party whether in contract, tort or otherwise and shall not be liable for any loss, damage or expense of whatsoever nature which is caused by their reliance on the information contained in this report.

SUMMARY OF UPDATES FROM THE PREVIOUS REVISION

For clarity, a summary has been prepared below detailing the changes between the 2024 and 2026 revisions of the remediation Strategy for the development of Carmoor Road. Individual detailed are presented below:

- The report now includes the data from the 2026 investigations (Trial Pits and Gas Monitoring). Findings were generally similar with the exception of more widespread PAH's..
- The 2026 strategy is now justified by gas monitoring and SVOC/VOC testing. The characteristic situation was classified as CS1, as per CIRIA C665, but with the identification a consistent VOC's in the 2026 investigation. Therefore, despite the excavation of the majority of the Made Ground prior to construction, a gas membrane still is required beneath structures.
 - An installation and verification specification for the Gas Membrane can be found as Appendix 6/5 in the associated Earthworks Specification (L074-WTW-11-XX.XX-T-G-000002_P03).
- The 2026 strategy provides more confident and refined risk ratings within the Conceptual Site Model based on greater data quantity and gas results.
- The 2026 strategy reduces the risk to end users on account of the sitewide excavation occurring to at least 600mm below ground level. While measures are still required in areas of soft landscaping, the risk of direct contact or ingestion pathway completion from soils beneath structures or hard cover is considered minimal.
- The 2026 report reduces controlled waters risk, due to limited groundwater connectivity between remaining Made Ground and the principal aquifer, largely due to the toe level of piles.
- Based on the strategy to excavate the majority of Made Ground, more rigorous Excavated Material Classification guidance included:
 - New 2026 WAC results (some confirming hazardous status)
 - Further guidance on segregation and stockpile management

1 INTRODUCTION

The aims and objectives of this report are to outline the remediation strategy required for the development of the site known as Carmoor Road. The remediation is required to minimise or eliminate risk to the construction workers, site personnel, end users and off-site neighbours of the site of exposure to contamination.

A Phase 1 Desk Study (ref: 2554-A2S-XX-XX-RP-Y-0001-00) has been conducted by A-squared to develop an understanding of the ground conditions and any potential geo-environmental risk associated with the site. The report outlines a conceptual site model (CSM) and a Preliminary Risk Assessment (PRA) as well as proposals for intrusive investigation. Based on this report, the following contaminants were of concern:

- Heavy metals, in particular Lead, Mercury and Beryllium.
- PAH, in particular Naphthalene, Benzo(a) anthracene, Chrysene, Benzo(b) fluoranthene, Benzo(a)pyrene and Di-benzo(a,h) anthracene.
- Vapours related to the presence of hydrocarbons in the soil.

A Factual report (ref: LS7347) of the findings of said intrusive investigation was released by Land Science the report was issued in April 2024 and covers encountered ground conditions, geo-environmental laboratory testing and gas, vapour and water monitoring results.

A further Ground Investigation was conducted in early February 2026 including four Trial Pits and Window Samplers, to install Gas Monitoring wells only. A further Trial Pit has been undertaken beneath the nursery area of the site at the recommendation of the EHO.

This remediation strategy incorporates the full 2024 investigation, the early February 2026 investigation and the six rounds of Gas Monitoring installed in the 2026 wells.

A generic quantitative risk assessment (GQRA) and a revised CSM, based on the ground investigation, was completed as part of a technical note by Whitby Wood in May 2024 and updated in February 2026.

The evaluation of the above documents, including field results and data gathered by other parties, will lead directly to the conclusions made in this remediation strategy, therefore, no liability can be taken with the provided data.

2 SITE DESCRIPTION

2.1 SITE LOCATION

The development site is located at Carmoor Road, Manchester, M13 0FB. The site boundary and surrounding buildings is shown in Figures 1. The approximate National Grid reference for the site is 385519E, 395947N.

The development site falls within the central area of Manchester. It sits just outside of the defined city centre, just beyond the Corridor Manchester sub-area of the city centre. It is also just outside of and within easy walking distance of the defined Oxford Road Corridor Regeneration area. The site area is approximately 2100m². The site is bounded by Carmoor Road on the east, United Students – Brookhall student accommodation on the west, the West Indian Community Centre on the north and retail terraces on the south. Access to the site is from Carmoor Road from east and Autumn Street on the west.



Figure 1: Plan image from Google Maps

2.2 CURRENT SITE USE

Existing uses on the site include a garage workshop, an abandoned residential building, and a building used previously as a private day nursery which is now vacant. None of the buildings are of any architectural merit or are subject to statutory protection. The application site is not within a conservation area. It is situated 250 metres north of Victoria Park conservation area. It is understood that the existing buildings within site will be demolished to enable the new site development.

2.3 PROPOSED DEVELOPMENT

The development consists of the demolition of existing buildings and construction of purpose-built student accommodation with 172 beds in a mix of studio and cluster units alongside ancillary facilities and shared amenity space, site access and other associated works. The development consists of three to six storeys.

The proposed buildings are anticipated to be reinforced concrete structures with reinforced concrete slabs and columns, and core walls to provide lateral stability to the structure. Surrounding the site, permeable paving to support surface water drainage is proposed.

The structures are to be founded on piles terminating in the Till formation. Sitewide excavation, to at least 600mm below ground level, will occur to remove Made Ground and construct a working platform.

3 REVIEW OF EXISTING INFORMATION

3.1 PHASE 1 DESK STUDY

The phase 1 desk study provided by A2 in November 2022 (2554-A2S-XX-XX-RP-Y-0001-00) reviews the site setting based on a walkover survey and database searches. The walkover report provides insightful comments on modern day usage of the different areas of the site. The adjacent nursery is abandoned and one of the garage buildings is used for vehicle storage exclusively (no vehicle maintenance). A review of local planning records did not find any major works at the site location. Correspondence with Manchester City Council provided initial information on potential sources of contamination in the vicinity of the site. The only significant note provided related to a clinical waste transfer station and incinerator, located at Manchester Royal Infirmary.

A previous desk study had already been conducted for a wider site boundary including land to the North. It identified potential sources of contamination including Made Ground due to the historic and current use of the site as a garage, potential asbestos within the development, Made Ground associated with the infilling of former basements along the eastern boundary and contaminants in groundwater sourced from Made Ground. The contaminants identified consisted of heavy metals, PAHs and vapours associated to the presence of hydrocarbons.

The groundwater conditions on site were identified as comprising a potential perched water table above the impermeable Till deposits and a principal aquifer in the Collyhurst Sandstone Formation confined below the impermeable Till.

A review of geological hazards did not reveal any significant geotechnical risks associated with the information available on-site conditions. No historic mining activity was recorded at the site location, and no evidence of such activity was found to be likely based on a Consultants Coal Mining Report.

Site history showed the site to be developed with terraced buildings as of 1891, some of which are present to date, a row of residential garages was built in 1950 and replaced in 1965 by modern garage facilities. The garages are listed to date as the only contemporary trade directory on site.

Finally, the report reviews the contamination sources, potential pathways and potential receptors before summarising the potential contamination linkages. The findings of this report corroborate the findings of the previous desk study and established the main contamination risks to be associated with Made Ground and current and historical site use as garages. The conceptual site model is presented in Table 5.

3.2 TECHNICAL NOTE ON GENERIC QUALITATIVE RISK ASSESSMENT (GQRA)

3.2.1 Summary

Based on the recommendations of the desk study and the findings of the site-specific ground investigation undertaken by Land Science in April 2024 (ref: LS7347) and further additional investigation by Land Science (ref: LS9115) in February 2026, a GQRA has been carried out.

The following field works were carried out as part of the 2024 investigation:

- 5 no. dynamically sampler boreholes with follow-on rotary drilled boreholes with hand dug inspection pits.
- 4no. dynamic sampler boreholes with hand dug inspection pits.
- Groundwater monitoring standpipe installations within one borehole.
- Post-site work monitoring of groundwater levels, (3 no. monitoring visits)

The following field works were carried out as part of the 2026 investigation:

- 4 no. trial pits excavated, two samples taken from each (No interpretation of data yet available)
- Installation and monitoring of 4 No. Gas Monitoring Wells
- A further trial pit beneath the nursery area of the site for additional coverage, as requested by the Local Authority EHO (No results are available at the time of writing).

Each sample of Made Ground was tested for a general screen, speciated TPH and Volatile suites with one sample of Made Ground per pit. The other sample was tested for WAC.

Table 1 and Table 2 present the tests carried out on soil samples and Table 3 those for groundwater samples. It should be noted that groundwater was only encountered in one location, hence only one sample was tested as part of this investigation.

Table 1: Geoenvironmental Testing carried out for soil samples 2024

Test description	Number of tests
LS1-Soil (1)	9
TPH1	11
TPH7	9
Asbestos	9
LS2 (2)	15
(1) Screening suite: pH, fraction of organic carbon, Metals and Non-Metals, water soluble Sulphate, Sulphide, total Cyanide, total Phenols, speciated PAH's.	
(2) Waste Acceptance Criteria: Total Organic Carbon, Loss on Ignition, BTEX, speciated PCB's, Mineral Oil (EC10 – EC40), pH, Acid Neutralisation Capacity, speciated PAH's, 10:1 leachable Metals and Non-Metals.	

Table 2: Geoenvironmental Testing carried out for soil samples 2026

Test description	Number of tests
LS1-Soil (1)	10
TPH7	15
Asbestos	10
LS2 (2)	5
VOC's/SVOC's	15
(1) Screening suite: pH, fraction of organic carbon, Metals and Non-Metals, water soluble Sulphate, Sulphide, total Cyanide, total Phenols, speciated PAH's.	
(2) Waste Acceptance Criteria: Total Organic Carbon, Loss on Ignition, BTEX, speciated PCB's, Mineral Oil (EC10 – EC40), pH, Acid Neutralisation Capacity, speciated PAH's, 10:1 leachable Metals and Non-Metals.	

Table 3: Geoenvironmental testing carried out for water samples

Test description	Number of tests
LS1-Water (3)	1
(3) Screening suite: pH, Metals and Non-Metals, total Sulphate, Sulphide, total Cyanide, total Phenols, speciated PAH's.	

Further details of the design investigation works are presented in the investigation report.



Figure 2: Ground Investigation Layout (Via Land Science Supplementary GI Report) with added approximate Monitoring Well Locations.

3.2.2 Quantitative Risk Assessment Methodology

The GQRA's objective was to measure the results obtained in the laboratory tests from the site investigation against the generic acceptance criteria (GAC).

3.2.3 Results from the Generic Quantitative Risk Assessment

Based on the assessment, the following results are identified:

Soil Samples:

- Exceedance of heavy metal content is present in 18 samples, between 0.4 and 2.3 m below ground level. The detected heavy metals are **Lead**, **Mercury** and **Beryllium**.
- Exceedance for speciated PAH limits is present in 31 samples, between 0.2 and 0.6 m below ground level. Including all eight samples in the supplementary investigation. The detected PAH are **Naphthalene**, **Benzo(a) anthracene**, **Chrysene**, **Benzo(b) fluoranthene**, **Benzo(a)pyrene** and **Di-benzo(a,h) anthracene**.
- No asbestos was detected in the samples tested.
- One exceedance of **Total Petroleum Hydrocarbon (TPH)** limit in all of the tested samples at 0.3m depth.
- No exceedance for any **MTBE** and **BTEX** limit in all the tested samples.
- No exceedance for any PCB's in all the tested samples.
- Volatile organic compound (**VOC**) and semi volatile organic compound (**SVOC's**) were found in 14 of 15 samples in the supplementary investigation.

Groundwater Samples:

- Exceedance of copper content was found in one borehole (BH003).

Groundwater Monitoring

- Groundwater level was found to be 4.4m below ground level during the return visit undertaken to date, it was not encountered during the investigation works although water level measurements were made difficult due to the use of flush.

Gas Monitoring

Results from the six rounds of Gas Monitoring are presented in Table 4 below.

Table 4: Summary of Ground Gas Monitoring Results

Exploratory Hole Location	Max Flow Rate [l/hr]	Max CO ₂ [%]	Max CH ₄ [%]	Min O ₂ [%]	Max VOC's [ppm]
MW001	0.8	0.7	0.0	20.8	210.0
MW002	0.8	2.2	0.2	20.9	3.0
MW003	0.3	1.0	0.0	20.9	0.2
MW004	0.8	0.1	0.0	20.7	0.0
BH003	0.5	0.5	0.0	20.7	0.0

Utilising CIRIA C665 - Assessing risks posed by hazardous ground gases to buildings, a gas screening value can be derived for the site using the following equation:

$$\text{Gas screening value (litres of gas per hour)} = \text{max borehole flow rate (l/hr)} \times \text{max gas concentration (\%)}$$

The max flow rate on site was observed at 0.8 l/hr and the maximum gas concentration was found to be 2.2% CO₂ in BH003, hence the preliminary Gas Screening Value (GSV) for the site is 0.018. This figure will may change following the results of the remaining round of gas monitoring.

Figure 3 presents the Characters Situation values from CIRIA C655. Given the site has a GSV of 0.018, the site could be classified as Characteristic Situation 1, however given the concentrations of VOC's measured, **Characteristic Situation 2** shall be recommended. This conclusion is reflected in the Ground Gas Assessment completed by Land Science, included as Appendix 3.

	Characteristic situation (CIRIA R149)	Comparable classification in DETR et al (1999)	Risk classification	Gas screening value (GSV) (CH ₄ or CO ₂) (l/hr) ¹ Threshold	Additional factors	Typical source of generation
	1	A	Very low risk	<0.07	Typically methane £1 % and/or carbon dioxide £5 %. Otherwise consider increase to Situation 2	Natural soils with low organic content "Typical" made ground
	2	B	Low risk	<0.7	Borehole air flow rate not to exceed 70l/hr. Otherwise consider increase to characteristic Situation 3	Natural soil, high peat/organic content. "Typical" made ground
	3	C	Moderate risk	<3.5		Old landfill, inert waste, mineworking flooded
	4	D	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures.	Mineworking – susceptible to flooding, completed landfill (WMP 26B criteria)
	5	E	High risk	<70		Mineworking unflooded inactive with shallow workings near surface
	6	F	Very high risk	>70		Recent landfill site

Figure 3: Characteristic Gas Screening Situation (via CIRIA C655)

3.3 REVISED CONCEPTUAL SITE MODEL

The results from the ground investigation confirmed the results initially anticipated in the desk study. The following risks with rating low to moderate or higher associated with land contamination remain:

- Human health users of the proposed site via direct contact of on-site contamination
- Human health users off site via migration of on-site contamination
- Sulphate attack to proposed below ground structures due to on-site contamination
- Contamination of secondary aquifers via leaching of on-site contamination
- Human health users of the proposed site via migration from off-site contaminants

Risks to site workers and the environment (from potential land contamination) during the construction phase of the proposed development should be appropriately managed by successful implementation of construction phase risk assessments and method statements (RAMS). The associated construction phase risks from potential contamination are not considered further but should be appropriately considered and mitigated by the Principal Contractor in their preparation and implementation of construction phase RAMS and Construction Phase Plan (CPP).

As presented in Table 5, the impact of the contaminant sources listed above are most notably to the end users of the development, neighbours, proposed structure, and environment.

Table 5: Revised conceptual site model

Potential Contaminant Source	Potential Pathway	Receptor	Potential Contaminant Linkage	Risk Level	Justification based on Results from Investigation Report	Revised Risk Level
On-site Made Ground (Metals, PAHs)	Direct contact with soil, Inhalation of windblown soil, Ingestion of soil	Human health users of proposed site	Yes (However, only in areas of new proposed soft landscaping)	Low to moderate	Results from the ground investigation and monitoring indicated heavy metals and PAH contamination of Made Ground Magnitude: Medium Likelihood: Probable	Moderate
On-site Made Ground (PAHs)	Impact to water supply pipes followed by ingestion of contaminated water supply		Yes (New pipes may be laid in impacted soils)	Low to moderate	Results from the ground investigation and monitoring indicated heavy metals and PAH contamination of Made Ground Magnitude: Medium Likelihood: Probable	Moderate
On-site Made Ground (ground gas & vapours)	Ground gas generation and inhalation		Yes (Made Ground and any contamination on site represent a potential source of ground gas)	Low to moderate	Based on results from the ground investigation and monitoring, VOCs associated to hydrocarbon contamination are present. Ground Gas is characterised as CS1 within the GQRA. Magnitude: Medium Likelihood: Low Likelihood	Low to moderate

Potential Contaminant Source	Potential Pathway	Receptor	Potential Contaminant Linkage	Risk Level	Justification based on Results from Investigation Report	Revised Risk Level
On-site Made Ground (ground gas & vapours)	Soil vapour generation and inhalation		Yes (Volatile contaminants are potentially present)	Low to moderate	Based on results from the ground investigation and monitoring, volatile contaminants are be present. Ground Gas is characterised as CS1 within the GQRA. Magnitude: Medium Likelihood: Probable	Moderate
On-site Made Ground (Metals, PAHs)	Inhalation of windblown soil from the site		Yes (Proposed site is predominantly sealed which prevent it acting as a viable source)	Very low	Yes (Site does not have a completely seal surface) Magnitude: Medium Likelihood: Unlikely	Very low
On-site Made Ground (ground gas & vapours)	Off-site migration and direct contact with impacted soil	Off-site human health	Yes (Open ground areas associated with student accommodation and the community centre present in the vicinity)	Low to moderate	Yes (Open ground areas associated with student accommodation and the community centre present in the vicinity)	Low to moderate
On-site Made Ground (ground gas & vapours)	Off-site migration and ingestion of impacted soil and dust			Low to moderate	Magnitude: Medium Likelihood: Low Likelihood	Low to moderate
On-site						

Potential Contaminant Source	Potential Pathway	Receptor	Potential Contaminant Linkage	Risk Level	Justification based on Results from Investigation Report	Revised Risk Level
Made Ground (PAHs, Metals)	Impact to water supply pipes followed by ingestion of contaminated water supply		Yes (Pipes may be laid in nearby soils impacted by potential contamination)	Low to moderate	(Pipes may be laid in nearby soils impacted by potential contamination) Magnitude: Medium Likelihood: Low Likelihood	Low to moderate †
On-site Made Ground (ground gas & vapours)	Ground gas generation, off-site migration and inhalation		Yes (Made Ground and current site use represents a potential source of ground gas)	Low to moderate	Based on results from the ground investigation and monitoring, ground gas associated to hydrocarbon contamination is present Magnitude: Medium Likelihood: Probable	Moderate
On-site Made Ground (PAHs, Metals)	Soil vapour generation, off-site migration and inhalation		Yes (Volatile contaminants are potentially present)	Low to moderate	Based on results from the ground investigation and monitoring, volatile contaminants are likely to be present Magnitude: Medium Likelihood: Probable	Moderate

Potential Contaminant Source	Potential Pathway	Receptor	Potential Contaminant Linkage	Risk Level	Justification based on Results from Investigation Report	Revised Risk Level
On-site Made Ground (PAHs, Metals)	Direct contact	On-site below ground structures	Yes (Structures may be constructed in impacted soils)	Low to moderate	Yes (Structures may be constructed in shallow, impacted soils) Magnitude: Medium Likelihood: Probable	Moderate
On-site Made Ground (ground gas & vapours)	Migration followed by ignition of ground gas		Yes (Made Ground and current site use represents a potential source of ground gas)	Low to moderate	Based on results from the ground investigation and monitoring, ground gas associated to hydrocarbon contamination is present Ground Gas is characterised as CS1 within the GQRA. Magnitude: Medium Likelihood: Probable	Moderate
On-site Made Ground (PAHs, Metals)	Migration followed by ignition of soil vapour		Yes (Volatile contaminants are potentially present)	Low to moderate	Based on results from the ground investigation and monitoring, ground gas associated to hydrocarbon contamination is present Magnitude: Medium Likelihood: Probable	Moderate

Potential Contaminant Source	Potential Pathway	Receptor	Potential Contaminant Linkage	Risk Level	Justification based on Results from Investigation Report	Revised Risk Level
On-site Made Ground (PAHs, Metals)	Off-site migration followed by direct contact		Yes (Onsite contamination unlikely to migrate off site and cause damage to adjacent foundations)	Low	Yes (On site contamination unlikely to migrate off site and affect neighbouring below-ground structures) Magnitude: Medium Likelihood: Unlikely	Low
On-site Made Ground (ground gas & vapours)	Off-site migration followed by ignition of ground gas		Yes (Made Ground and current site use represents a potential source of ground gas)	Low to moderate	Based on results from the ground investigation and monitoring, VOCs associated to hydrocarbon contamination is present but are unlikely to migrate so the fine soils present at surface level Magnitude: Medium Likelihood: Low	Low
On-site Made Ground (ground gas & vapours)	Off-site migration followed by ignition of soil vapour	Off-site below ground structures	Yes (Volatile contaminants are potentially present)	Low to moderate	Based on results from the ground investigation and monitoring, volatile contaminants are likely to be present but are unlikely to migrate so the fine soils present at surface level Magnitude: Medium Likelihood: Low	Low
On-site	Leaching and migration to groundwater via the unsaturated zone;		Yes (Limited shallow	Low to moderate	Yes	Low

Potential Contaminant Source	Potential Pathway	Receptor	Potential Contaminant Linkage	Risk Level	Justification based on Results from Investigation Report	Revised Risk Level
Made Ground (PAHs, Metals)	Perched water percolation or lateral migration; Migration via advection and diffusion in the saturated zone; and Vertical and lateral migration of free-phase product in the unsaturated and saturated zones.	Controlled waters - Underlying Secondary A Aquifer (River Terrace Deposits)	groundwater likely to be present within the Till and groundwater likely to be present at depth within the Collyhurst Sandstone Formation)		(No groundwater was encountered during drilling and the use of flush in impermeable soil made return readings less credible) Magnitude: Medium Likelihood: Low Likelihood	
On-site Made Ground (PAHs, Metals)	On-site ingestion / dermal contact / inhalation / root uptake	Flora and fauna in proposed soft-landscaped areas at the site	Yes (Very limited soft-landscaping is proposed and it is of low sensitivity)	Low	Yes (Very limited soft-landscaping is proposed and it is of low sensitivity) Magnitude: Low Likelihood: Low Likelihood	Low
On-site Made Ground (PAHs, Metals)	Off-site migration at shallow depth followed by ingestion / dermal contact / inhalation / root uptake	Off-site flora and fauna in soft-landscaped areas nearby and Nature Conservation Area immediately south	Yes (Very limited soft-landscaping is in the immediately surrounding area and it is of low sensitivity)	Low	Yes (Very limited soft-landscaping is in the immediately surrounding area and it is of low sensitivity)	Low

Potential Contaminant Source	Potential Pathway	Receptor	Potential Contaminant Linkage	Risk Level	Justification based on Results from Investigation Report	Revised Risk Level
					Magnitude: Medium Likelihood: Low Likelihood	
Off-site Laundry, sub-station, garages (TPH, PAH, Metals)	On-site migration followed by direct contact or ingestion of soil	Human health users of proposed site	Yes (However, the site predominantly appears to have a completely sealed surface)	Very low	Yes (However, the site predominantly appears to have a completely sealed surface and the natural soil is impermeable) Magnitude: Medium Likelihood: Low Likelihood	Very low
Off-site Laundry, sub-station, garages (TPH, PAH, Metals)	Inhalation of windblown soil from off-site		No (Surrounding area predominantly sealed surfaces, therefore, a viable source of contaminated windblown soil is not present)	Not applicable	No (Surrounding area predominantly sealed surfaces, therefore, a viable source of contaminated windblown soil is not present)	Not applicable

Potential Contaminant Source	Potential Pathway	Receptor	Potential Contaminant Linkage	Risk Level	Justification based on Results from Investigation Report	Revised Risk Level
Off-site Laundry, garages (VOC, SVOC)	On-site migration followed by impact to water supply pipes and ingestion of the water supply		Yes (Pipes may be laid in soils impacted by potential off-site sources)	Low to moderate	Yes (Pipes may be laid in soils impacted by potential off-site sources) Magnitude: Medium Likelihood: Low Likelihood	Low to moderate
Off-site Laundry, garages (VOC, SVOC)	Ground gas generation, on-site migration and inhalation		No (No sources of off-site ground gas have been identified)	Not applicable	No (No sources of off-site ground gas have been identified)	Not applicable
Off-site Laundry, garages (VOC, SVOC)	Soil vapour generation, on-site migration and inhalation		Yes (Potential sources of volatile contamination have been identified in the vicinity of the site)	Low to moderate	Yes (Potential sources of volatile contamination have been identified on the site) Magnitude: Medium Likelihood: Medium	Moderate

Potential Contaminant Source	Potential Pathway	Receptor	Potential Contaminant Linkage	Risk Level	Justification based on Results from Investigation Report	Revised Risk Level
Off-site Laundry, sub-station, garages (TPH, PAH, Metals)	On-site migration followed by direct contact		Yes (Unlikely that gross contamination with potential to damage structures is migrating onto site)	Low	Yes (Unlikely that gross contamination with potential to damage structures is migrating onto site) Magnitude: Medium Likelihood: Low	Low
Off-site Laundry, garages (VOC, SVOC)	On-site migration followed by ignition of ground gas	On-site below ground structures	No (No sources of off-site ground gas have been identified)	Not applicable		Not applicable
Off-site Laundry, garages (VOC, SVOC)	On-site migration followed by ignition of soil vapour		Yes (Potential sources of volatile contamination have been identified)	Low to moderate	Yes (Sources of volatile contamination have been identified) Magnitude: Medium Likelihood: Medium	Moderate

Potential Contaminant Source	Potential Pathway	Receptor	Potential Contaminant Linkage	Risk Level	Justification based on Results from Investigation Report	Revised Risk Level
Off-site Laundry, sub-station, garages (TPH, PAH, Metals)	On-site ingestion / dermal contact / inhalation / root uptake	Flora and fauna in proposed soft-landscaped areas at the site	Yes (very limited soft-landscaping is proposed and it is of low sensitivity)	Very low	Yes (very limited soft-landscaping is proposed and it is of low sensitivity) Magnitude: Mild Likelihood: Low Likelihood	Very low

4 REMEDIATION OBJECTIVES

4.1 GENERAL

The proposed remediation strategy aims to break or remove the potential pollutant linkages identified in the above conceptual model. The aim of the remediation of the site is to provide a site that is suitable for its end land use and does not pose a risk to future site users or the surrounding environment.

At the time of writing, the foundation solution to be adopted is piled foundations. Therefore, the sequence of works for this scheme is:

- Demolition of the existing structures
- Excavation exercise and installation of working platform
- Installation of piles
- Excavation to cutoff level
- Formation of pile caps
- Main structural works
- Landscaping

The remedial works shall be inspected and verified by a suitably qualified and experienced environmental consultant.

The Contractor shall submit a method statement to Whitby Wood for approval in advance of the works. The method statement shall demonstrate that potential contamination issues have been considered and appropriate procedures and contingency measures will be implemented to mitigate against the possible release or spread of ground, liquid or airborne contaminants.

4.2 SUMMARY MITIGATION MEASURES

The measures employed on site are dependent on the type of works being undertaken. Table 6 describes the methods to be used for the areas to be developed with structures and the areas to be landscaped.

Table 6: Remedial Options for Permanent Works

No.	Proposed Remediation Measure	Linkage	Comments
Area of Proposed Structure			
1	Cover System / Capping	Pathway Interruption	Not a treatment but does contain the contaminant. Stops leaching and vertical movement. Concrete Structure acts as a capping layer for the existing ground on site
2	Excavation and Removal	Source Removal	Proposed works for the construction of the floor requires bulk excavation. Excavated soil should undergo proper testing prior to removal/reuse.
3	CFA Piles	Pathway Interruption	The proposed load bearing piles will penetrate through various strata and introduce a new pathway for contaminants present in the Made Ground to migrate to underlying strata and the existing groundwater. CFA piling minimises this risk as it is a method which causes minimal disturbance to the surrounding soil during installation. An appropriate piling method statement to control arisings/bleed is required from the Piling Contractor. Piling shall not be relied upon as a remediation measure for controlled waters unless specifically assessed.

No.	Proposed Remediation Measure	Linkage	Comments
4	Gas Vapour Membrane	Pathway Interruption	Not a treatment but contains the possibility of gasses to infiltrate closed spaces within the structure. As recommended by CIRIA C655 – Hazardous Gases.
5	Concrete Class Design as per BRE 465	Receptor Improvement	Concrete to be designed to the adequate Sulphate Class to ensure that it can withstand sulphate attacks
Area of Hard Landscaping			
1	Cover System / Capping	Pathway Interruption	Not a treatment but does contain the contaminant. Stops leaching and vertical movement. Pavement acts as a capping layer for the existing ground on site.
2	Excavation and Removal	Source Removal	The top 0.7m of Made Ground will be excavated and replaced with the cover system/capping layer in certain areas. Excavated soil should undergo proper testing prior to removal/reuse.
Buried tanks			
1	Removal and disposal	Source removal	Should any tanks be encountered, the contractor shall ensure that all buried tanks have been completely removed in the demolition phase of the works.

4.3 INFLUENCE OF REMEDIATION WORKS TO RECEPTORS

4.3.1 On-site Human Health

Four moderate risks associated with the presence of Made Ground were identified on site in the revised conceptual site model. These are associated with ingestion or inhalation of contaminants which construction staff will be directly exposed to. All groundworkers shall be issued appropriate PPE to work in close contact with contaminated materials including but not limited to: protective clothing, footwear, and gloves.

End users will be at a lower risk of exposure to ingestion or inhalation of the contaminants in the soil due to removal of Made Ground and hard covering, however some risk remains. Two options to mitigate this risk will be discussed here: removal and capping. The site is expected to feature hard cover over its entire surface area, therefore the contaminated deposits can either be confined below the new structures and surfaces or be entirely removed from site and replaced with appropriate fill. Both solutions offer advantages, while the solution of replacing the material present on site is a simple means to ensure that the source of contamination is removed, capping the material offers cost savings and ease of installation. Given the planned site wide excavation and significant coverage from building or hard cover, the risk to end users via direct contact ingestion is thought to be minimal.

In any areas of landscaping, the soft landscaping is expected to consist of a 600mm cover layer as per BRE 465 and will therefore replace the majority of Made Ground.

The majority of soft landscaping areas shall be beneath the construction pile mat, and hence the cover layer shall comprise at least 600mm of site won crushed concrete, with required soft landscaping build up above. The aim of the capping layer is to provide a clear barrier between the limited remaining Made Ground and site end users and hence prevent a the formation of a contamination pathway. Details of the test results of the material utilised are presented in Appendix D.

A further area of soft landscaping is proposed to present along the northern border of the site, in this area Made Ground is to be removed to at least 600mm and backfilled with clean imported fill comprising landscaping build up, subbase and topsoil. Details of the imported fill shall be included within the Verification Report following the works.

In areas of structural development, no direct pathway will remain between the site users and the contamination in the ground as discussed above, however, vapours can permeate the structure and present a risk to the users. Vapours can be contained by a gas membrane placed below foundations; this is not required in hard or soft landscaping areas as the vapours cannot accumulate in open air conditions. An installation and verification specification for the Gas Membrane is included within the associated Earthworks specification as Appendix 6/5 (L074-WTW-11-XX.XX-T-G-000002_P03).

The majority of the Made Ground is to be excavated and replaced during the construction of the working platform, significantly reducing the impact of the source and providing a barrier in the pathway. A gas membrane is still recommended to ensure the prevention of vapour build up.

The second pathway of concern is ingestion via impact to the water supply pipes. There are two possible solutions to this issue. Firstly, contain water supply pipes within any drainage or bedding layers free of contamination, which may be applicable if all Made Ground is removed from site. The other possibility is to alter the composition of the pipes to a material which would prevent contamination migration, cast iron for example, should they be laid in contaminated ground. No potable water pipes shall be placed within Made Ground without an altered pipe composition.

During earthworks, temporary stockpiles of excavated materials on site waiting for off-site removal shall be formed as discrete mounds and where possible, resting on hardstanding, or alternatively on impermeable membranes to prevent cross contamination of the site. A record shall be maintained of the location of temporary stockpiles, their chemical status, and from where the materials were originally excavated.

4.3.2 Off-site Human Health

Off-site human health could also be at risk via similar pathways to onsite human health explained above but will be addressed in a different manner. The significant difference between the two receptors is the migration of contamination sources required for the risk to be realised, a remediation strategy for this receptor will focus on this. The pathways of concern are again direct contact, ingestion of soil or dust and ingestion via water supply pipes, the latter are addressed in the same manner as in section 4.3.1. The direct contact with soil and ingestion of soil or dust are likely to be escalated by the measures required for section 4.3.1, specifically when concerning the removal or temporary storage of excavated contaminated material on or near site.

Temporary stockpiles shall be controlled as per section 4.3.1.

4.3.3 Off-Site Flora and Fauna

The same measures undertaken in section 4.3.1 should account for any potential issues to offsite flora and fauna. Any location chosen for offsite storage of any excavated material, temporary or otherwise, should be properly researched and approved.

4.3.4 Controlled Waters

As per the ground model discussed in section 3.1, the site is underlain by an impermeable stratum of Till which lies above a principle aquifer contained in the Collyhurst Sandstone Formation. The results of the site-specific site investigation, the Till extends from approximately 1m below ground level (bgl) to between 15 to 19.5m bgl.

Some perched groundwater may be present within Made Ground, however the majority of Made Ground shall be removed as part of enabling works. No significant dewatering is anticipated.

The works likely to impact the principal aquifer on this site are the piling works which may open vertical flow paths, linking the contamination of the Made Ground to the aquifer. To avoid this, the Contractor should consider this risk when selecting an appropriate method of installation, methods such as CFA piling present minimal risk for cross contamination as it causes minimal disturbance during installation and seals the pathway with grout without leaving an open excavation. Piles are currently scheduled to terminate in the Till Member, the risk to the principal aquifer is considered low.

4.3.5 Below Ground Structures

Buried structures may be exposed to aggressive soil or water conditions, the site-specific investigations collected samples to quantify the risk and determined from the results of the Sulphate and pH analyses that the appropriate concrete design class should be Class DS-1 and an ACEC class AC-1.

4.4 CLASSIFICATION OF EXCAVATED MATERIALS

Due to the concentrations of total PAH and TPH found in the samples tested for WAC, the material on site cannot be classified as inert sitewide. From the site use and historical use, the area of the site to the northeast has been less exposed to contamination than the rest of the site and could be classified as inert. The site investigation confirmed this and indicated the area of the courtyard behind the garages to be the most contaminated with WAC testing classifying it as Stabilised Non-Reactive Hazardous Waste. Made Ground in other areas were not found to be hazardous but did not meet the criteria to be classified as inert, it should therefore be treated as Non-Hazardous.

When undertaking the excavation works, the Contractor should take care to identify visual and olfactory signs of contamination to avoid cross contamination between different material stockpiles on site.

4.5 CONTRACTOR'S METHOD STATEMENT AND INSPECTION OF REMEDIATION WORKS

The Principal Contractor shall submit, in advance of the works, a method statement(s) to Whitby Wood for approval. The method statement(s) shall demonstrate that all relevant potential contamination issues have been considered and that appropriate procedures and contingency measures will be implemented to mitigate against the possible release of ground, liquid or airborne contaminants.

Responsibility for the correct implementation of the remediation strategy lies with the appointed Contractor. However, the remedial works shall be inspected and validated by a suitably qualified and experienced Environmental Consultant.

4.6 INSPECTION AND TESTING

The Environmental Consultant shall be present on the site during the proposed remediation works. Laboratory analyses shall be carried out at an MCERTS and UKAS-accredited laboratory.

It is possible that the groundworks/remediation will encounter different conditions from those revealed by the site investigation that may require special treatment or other alleviation measures. When the Contractor encounters unexpected ground conditions or potentially suspect materials, the Environmental Consultant shall be informed immediately to carry out an inspection as soon as is reasonably practical. The Environmental Consultant shall advise the Client and Contractor of any requirements of additional investigations or possible modifications to the remediation works.

5 WORKING PRACTICE AND WATCHING BRIEF

5.1 STAFF TRAINING/BRIEF

All site staff, site contractors and site visitors, shall be briefed on the site conditions, and should be aware of any potential contamination present on site, including any land, water or airborne contamination, any specific location on site that is most likely to be affected. If any contamination is encountered in site observations, it should be record as highlighted in section 5.2 and 5.3.

The following measures are suggested to provide a minimum level of protection:

- All ground workers on-site should be issued with protective clothing, dust masks, footwear and gloves.
- Care should be taken to minimise the amount of mud generated on-site

Reference should be made to the following Health and Safety Executive (HSE) document:

- CIRIA Report R 132 Guide for safe working on contaminated sites

5.2 WASTE DISPOSAL

Classification of any material to be disposed of to landfill shall be agreed in advance with the landfill operator(s), as appropriate. Any waste classified as “Hazardous” shall be disposed of in accordance with the Hazardous waste Regulations 2005.

All contaminated materials removed off-site shall be transported to an approved licensed landfill for final disposal. The Contractor shall provide a full documentary record of the operation. Copies of the documents should be provided to the Environmental Consultant for inclusion in the verification report.

5.3 WATCHING BRIEF

Watching brief is an action put into place to help minimise the infiltration of any contamination which was not present during the site investigation. The watching brief consists of:

- Any observation of contamination made during the development by any member of site staff, contractors or visitor.
- Photographic record of key stages of the development and key events, including new encounters with any contamination, formation levels of excavation, any reduced level dig/mass, and formation of landscape.

Areas with greater concern of contamination should be provided with a more specific watching brief to ensure risk is minimised on site. The brief should be prepared by a qualified site manager and/or by an environmental consultant.

During the development, the site manager is accountable and responsible for observing any works requiring the removal of the Made Ground during piling works to ensure any contamination encountered and method of contamination removal are recorded.

5.4 DISCOVERY STRATEGY

The discovery strategy specifies the actions that should be taken in place if contamination is encountered during the works.

Examples of significant observations are identified below in Table 6 but are not only restricted to these items.

Table 7: Examples of Significant Observations

Evidence	Description
Visual	<p>Waste material (refuse, barrels, industrial wastes, ash, tar, etc) buried across the site.</p> <p>Fuel or oil like dark coloured substances present on soil surfaces mixed, smeared, or floating as well as presenting in the surface or ground water.</p> <p>Coloured marks across the site, for example colours such red, yellow, orange, green, light or dark blue, etc can be an indication of contamination.</p> <p>Large quantity of unexpected soil such as ash and clinker can suggest contamination</p>
Odours	<p>Hydrocarbon, Fuel, oil, and chemical type odours</p> <p>Unusual odours, such as sweet or fishy odours</p>
Wellbeing	<p>Nausea and light headache by staff or visitor during exaction works, when visual or olfactory evidence of contamination exists.</p> <p>Blistering, burning, or reddening of the skin due to contact with the soil.</p> <p>Difficulty in breathing for example burning of nasal passages, throat, lungs or skin.</p>

6 VERIFICATION REPORTING

6.1 GENERAL

A Verification report is a requirement of the planning process to help verify remedial works are completed in accordance with approved methodologies and the risk associated with contamination is reduced ensuring the site is suitable for the end-users. The verification report is provided once all groundworks, including foundation works, are completed.

The following items are assessed in the verification report; therefore, information should be provided during the course of the works.

- Details of disposal of hazardous materials during demolition and site preparation
- Details of total disposal quantities and final disposal rates for waste soil
- Copies of relevant waste management/disposal licenses or PC Permits, as applicable.
- Copies of registered waste carrier certificates
- Records of any consents, permits, authorisation and/or licenses held or obtained by the Contractor (and subcontractors) relevant to the works. Validation sample records

The following can also be included regarding backfill and import records, as necessary.

- Chemical and geotechnical data from site derived fill materials and topsoil
- Chemical and geotechnical data for imported fill materials and topsoil
- Imported fill summary records.
- Waste disposal records, including the following as applicable.
- Soils disposal summary and daily disposal records.
 - Liquid waste disposal summary.
 - Hazardous waste disposal summary
 - Waste consignment notes.
 - Tip tickets for each waste disposal facility use.
 - Liquid waste transfer notes

6.2 VERIFICATION OF IMPORTED TOPSOIL

Imported topsoil that is used for soil remediation works (capping) shall be sampled and analysed to demonstrate its chemical suitability. Analyses of the samples shall be carried out at an independent accredited laboratory (by UKAS and MCERTS) for an analytical suite which should include the following as a minimum.

- Particle size analysis and stone content
- PH and electrical conductivity values
- Heavy metals (As, B, Ba, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, V, Zn)
- Aromatic and aliphatic TPH
- Soil organic matter content
- Speciated PAHs

Sampling and analyses of the topsoil shall be carried out in accordance with guidelines and test methods provided in BS 3882:2015. Analytical results should be compared with Soil Guideline Values (SGV) published by the Environment Agency or relevant Generic Assessment Criteria (GAC).

The following frequency and quantity of topsoil samples are required:

- Natural source: 1 sample per 40m³, a minimum of 3 samples
- Recycled or Manufactured: 1 sample per 20m³, a minimum of 3 samples

6.3 VERIFICATION OF SOIL CAPPING IMPLEMENTATION

The following inspection shall be carried out by the contractor on site to ensure that the proposed capping thickness is adopted on site.

- Inspection record at the proposed soil capping works
- A site plan confirming sample and depth check locations

- Confirmation of clean cover depth including photos (could be done by trial pit and use of photographs and/or logging of encountered soil)
- Confirmation of the presence of anti-dig layer

The inspection should be carried out with the minimum frequency of 1 at each plot.

Appendix A: 2024 Phase II Contamination Assessment (Land Science)

Land Science



**90 CARMOOR ROAD, MANCHESTER
M13 0FB
PHASE II CONTAMINATION AND
GEOTECHNICAL ASSESSMENT
WHITBY WOOD
2ND APRIL 2024
LS7347**

Site:	90 CARMOOR ROAD, MANCHESTER, M13 0FB	
Title:	PHASE II CONTAMINATION AND GEOTECHNICAL ASSESSMENT	
Project:	PURPOSE-BUILT STUDENT ACCOMMODATION	
Client:	WHITBY WOOD	
Date:	2 nd APRIL 2024	
Reference:	LS 7347	
Version:	A – final for issue	
Prepared By:	<i>Ben Manze</i>	BEN MANZE B.Sc. (Hons) <u>Project Manager</u>
Prepared By:	<i>Sam Whewell</i>	SAM WHEWELL B.Sc. (Hons.), M.Sc, FGS <u>Senior Geotechnical Engineer</u>
Checked By:	<i>Jocelyn Middleton</i>	JOCELYN MIDDLETON MGeol FGS <u>Principal Geo-Environmental Consultant</u>
Reviewed By:	<i>Mike Rose</i>	MICHAEL ROSE M.Sc., B.Sc., FGS, AIEMA <u>Principal Geo-Environmental Consultant</u>
Authorised By:	<i>Elliot Toms</i>	ELLIOT TOMS CEnv M.Sc., B.Sc. (Hons.), FGS, MIEEnvSci <u>Managing Director</u>

Land Science are Geotechnical Engineering and Contaminated Land specialists for construction, regulation, property ownership, and due diligence. By understanding our client's needs and appreciating the role that ground issues play within a wider context, we provide a reliable service and first-class expertise tailored to specific requirements. For more information on how we can benefit your project, please visit www.landscience.co.uk



CONTENTS

1.0	EXECUTIVE SUMMARY	4
2.0	INTRODUCTION.....	5
3.0	SUMMARY OF PREVIOUS INVESTIGATION.....	7
4.0	INTRUSIVE INVESTIGATION.....	9
5.0	GROUND CONDITIONS.....	13
6.0	FIELD TESTING.....	15
7.0	MONITORING DATA	19
8.0	GEOTECHNICAL LABORATORY TESTING.....	20
9.0	GEOTECHNICAL ASSESSMENT.....	26
10.0	CONTAMINATION LABORATORY TESTING.....	30
11.0	HUMAN HEALTH SCREENING.....	32
12.0	BUILT ENVIRONMENT SCREENING	35
13.0	CONTROLLED WATERS SCREENING	37
14.0	TIER 1 SOIL CONTAMINATION ASSESSMENT	38
15.0	PRELIMINARY WASTE ASSESSMENT	40
	REFERENCES	42
	REPORT CONDITIONS	43
	GLOSSARY OF TERMS	44

FIGURES

FIGURE 1:	Site Location Plan
FIGURE 2:	Proposed Layout / Investigation Layout
FIGURE 3:	Actual Site Investigation Layout
FIGURE 4:	Proposed Development Layout

APPENDICES

APPENDIX A:	Site Walkover
APPENDIX B:	Photographs
APPENDIX C:	Field Logs and Testing
APPENDIX D:	Monitoring
APPENDIX E:	Geotechnical Laboratory Testing
APPENDIX F:	Contamination Laboratory Testing

1.0 EXECUTIVE SUMMARY

This summary is a brief precis of the main findings and conclusions of the investigation. For detailed information, the reader is referred to the main report.

The site included a garage workshop, an abandoned residential building, and a building used previously as a private day nursery which is now vacant. The development was to include the demolition of the existing buildings and the construction of new three to six-storeys of purpose-built student accommodation. The intrusive investigation included 5no dynamically sampled holes with rotary follow on, 4no dynamic sampler holes and 2no trial pits.

Strata	Base Depth range (m)	Summary
Made Ground	0.70 – 1.20	Grey brown/black sandy, gravelly CLAY
Till Deposits	16.50 – 19.50	Grey brown to red brown slightly gravelly CLAY, becoming red brown slightly clayey gravelly SAND at approximately 12.00m depth
Collyhurst Sandstone	20.00+	Red fine-grained SANDSTONE.

Groundwater was recorded during the return monitoring standing at a level of 4.40m.

Piled foundations expected to be utilised due to the size of building proposed, and preliminary design parameters are given. The formation should be treated as being medium volume change potential. The cohesive Till will soften rapidly when exposed to free water.

Excavations are generally likely to remain stable. Excavations below the water table may become highly unstable.

Pavements may be formed on the Till Deposits. CBR value of 5% recommended for the clay, which is not classified as being frost susceptible.

Buried structural concrete may be designed to DS-1 and AC-1 in accordance with BS8500. Water supply pipe work will not require protection from aggressive soil contaminants.

Soakage testing identified the level of water remaining constant for over 17 hours in both trial pits.

Soil testing has identified elevated levels of PAH contamination. Requirements for remediation have been identified including the import of clean subsoil and topsoil.

Chemical results on Made Ground corresponded to Inert, and some non-hazardous, for most of the site, with SNRHW within the rear yard. Natural soils tested resulted with Inert Waste classification.

Further investigation may be considered in order to determine the distribution of PAHs across the site, alternatively a vapour membrane may be considered within the ground floor construction.

2.0 INTRODUCTION

2.1 General

Land Science was instructed to undertake a Phase II Contamination and Geotechnical Assessment in relation to the proposed development at 90 Carmoor Road, Manchester M13 0FB. The location is shown on Figure 1, which is centred at grid reference 385519E, 395947N.

2.2 Client

The Client for this appointment was Whitby Wood Ltd, on behalf of Tiger Developments Limited. This report may only be used by this named client and their project team for the purposes set out and subject to the report conditions. It was understood that the Client already owned the property, and that this investigation was not a pre-purchase appraisal.

2.3 Area Under Investigation

The area under investigation comprised an active garage workshop with front and rear yards, an abandoned residential building, and a building used previously as a private day nursery, which is now vacant. The proposed layout is indicated on Figure 2 and the actual investigation undertaken is indicated on Figure 3. A walkover survey is presented in Appendix A. The area was approximately 2100m² or 0.21 hectares.

2.4 Proposed Development

The proposed development was understood to comprise the demolition of the existing buildings followed by the construction of purpose-built student accommodation. This included three to six-storeys, forming 172 beds, with a mix of studio and cluster units alongside ancillary facilities and shared amenity space, with site access and other associated works. The proposed development was covered under planning application number 135576/FO/2022. Figure 4 illustrates the layout of the proposed development. The findings of this report may be not valid if the proposed development is altered.

2.5 Previous Investigations

Information from the following previous investigation relevant to the site was provided by the client:

- Phase I Desk Study P451205-DOC-S-001, 18th November 2022. A-squared Studi Engineers Ltd.

The phase II ground investigation was carried out in accordance with the recommendations of the previous report and all reports must be read in conjunction with each other.

2.6 Scope of Work

The work carried out is described in detail in following sections but in summary included:

- An intrusive investigation comprising cable percussion boreholes with follow-on rotary drilled boreholes, dynamic sampling, trial pits for soakage testing, dynamic cone penetrometer (DCP) testing for equivalent CBR design;

- Preliminary geotechnical testing of selected soil samples in the field and laboratory;
- Preliminary chemical testing of selected soil and water samples in the field and laboratory;
- Installation of a water monitoring well, and a return visit.

The fieldwork was conducted between 22nd January and 2nd February 2024, under the supervision of Land Science. The return monitoring visit was conducted on 22nd February 2024.

2.7 Geotechnical Objectives

An interpretive Ground Investigation Report (GIR) was required in order to provide an assessment of ground conditions with respect to proposed foundations, pavements, soakaways, concrete specification and excavations.

2.8 Geo-Environmental Objectives

A phase II intrusive investigation was required, to provide a generic quantitative risk assessment (GQRA).

The reports were required to assess risks associated with end users, the proposed development, adjacent land uses, and the wider environment, in the context of the planning regime.

2.9 Standards

Where practicable, the investigation was undertaken in accordance with the following primary standards and guidance:

- Land Contamination Risk Management (LCRM) Environment Agency 2020
- BS10175:2011+A1:2013, Investigation of Potentially Contaminated Sites.
- National Planning Policy Framework, July 2018.
- Building Regulations Approved Document C: Site preparation and resistance to contaminants and moisture, HM Government, July 2013.
- NHBC Standards Chapter 4.1: Land Quality - Managing Ground Conditions, 2019.
- BS 5930:2015 Code of Practice for Site Investigations
- BS 1377:2018 Soils for Civil Engineering Purposes
- BS 8004:2015 Code of Practice for Foundations
- BS EN 1997-2:2007. Eurocode 7: Geotechnical Design – Part 2: Ground Investigation and testing.

Other technical sources have been cited in respect of specific aspects of the investigation, as referenced throughout the text.

3.0 SUMMARY OF PREVIOUS INVESTIGATION

3.1 General

This summary is a brief precis of the main findings and conclusions of the previous Phase I Geotechnical and Geo-Environmental Assessment carried out by others. For detailed information, the reader is referred to the main report.

The development site falls within the central area of Manchester. It is located just outside of the defined city centre. The site area is approximately 2100m². The site is bounded by Carmoor Road on the east, United Students – Brookhall student accommodation on the west, the West Indian Community Centre on the north and retail terraces on the south. Access to the site is from Carmoor Road from east and Autumn Street on the west.

3.2 Site Description

Existing uses on the site include a garage workshop, an abandoned residential building, and a building used previously as a private day nursery which is now vacant. None of the buildings are of any architectural merit or are subject to statutory protection. The application site is not within a conservation area. It is situated 250 metres north of Victoria Park conservation area. It is understood that the existing buildings within site will be demolished to enable the new site development.

Existing information from British Geological Survey (BGS) GeoIndex Onshore database indicates that the site is underlain by superficial deposits comprising Till (Diamicton) deposits, overlying the bedrock Collyhurst Sandstone Formation. Made Ground is anticipated to be present on site due to the nature of the site surface, which includes the existing building footprint and hardstanding surfaces.

3.3 Anticipated Ground Conditions

The West Manchester fault, trending north-west to south-east lies approximately 375m to the east of the site boundary. A further fault, known as the East Manchester fault, lies beyond to the east, approximately 700m to the east of the site. The Chester Formation bedrock is recorded to be present below the Till deposits directly east of the fault line. The Manchester Marls Formation is recorded to be present below the Till deposits from approximately 125m to the west of the site, beyond which the Chester Formation bedrock is recorded to be present below the Till deposits.

The Till deposits are classed as a Secondary Undifferentiated Aquifer. The Collyhurst Sandstone Formation is classed as a Principal Aquifer and the Pennine Upper Carboniferous Coal Measures are classed as a Secondary A Aquifer. The combined groundwater vulnerability at the site is low. The dominant water direction would be to the south and southwest.

Information from the British Geological Survey (BGS) Geology of Britain web map was used to provide the following preliminary ground model:

Lithology	Depth below ground level (m bgl)	Thickness (m)	Description
Made Ground	0.00	0.70 to 0.75	Variable anthropogenic deposits comprising natural soils, asphalt and concrete surfacing, gravels and potential ash
Till Deposits (Diamicton)	0.70 to 0.75	Up to 12m	Soft to stiff, brown silty and sandy clay, sand lenses and some fine to medium gravel. Becoming sandy Clay with depth.
Collyhurst Sandstone	From 12.70	Unproven	Red Sandstone bedrock with abundant beds of 'millet seed' sand grains alternating with beds of fine grained shard sand with some interbedded grey Sandstones locally.

In addition, groundwater was anticipated, as follows:

- Perched water – in granular soils upon cohesive soil associated with Made Ground but unlikely in natural soils due to high permeability of underlying bedrock.
- Water table depth - at depth with possible flow direction to the south/southwest.

Possible contamination sources noted from the previous walkover included visible evidence of hydrocarbon contamination and use of products, car dismantling, repairs and servicing, as well as parking and potential fuelling / oil changing – leading to likely spills and leaks, impacting the underlying soils and potentially any underlying groundwater. A risk was considered from the ground gases and vapours on site associated with these activities and any underlying Made Ground.

4.0 INTRUSIVE INVESTIGATION

4.1 Investigation Rationale

The scope and layout of the investigation was specified by Whitby Wood Ltd. In summary this comprised:

- 5no. dynamically sampler boreholes with follow-on rotary drilled boreholes within the bedrock to determine pile design parameters;
- 4no. dynamic sampler boreholes;
- 2no. trial pits;
- The positions were located to give broad coverage across the site where access was feasible on the active site;
- A monitoring well was installed in BH003. The installation was sealed through Made Ground, with the response zone in the superficial and bedrock.

Position	Provisional Depth	Existing Location	Testing, installations etc.
BH001	20m	Front of garage off Carmoor Road	PID, SV, HP, SPT
BH002		Front of nursery off Carmoor Road	PID, SV, HP, SPT
BH003		Rear of garage off Autumn Street	PID, SV, HP, SPT, MW
BH004		Front of garage off Carmoor Road	PID, SV, HP, SPT
BH005		Inside garage off Autumn Street	PID, SV, HP, SPT
WS001	3m	Front of nursery off Carmoor Road	PID, SV, HP, SPT
WS002		Rear of garage off Autumn Street	PID, SV, HP, SPT
WS003		Front of garage off Carmoor Road	PID, SV, HP, SPT
WS004		Inside garage off Autumn Street	PID, SV, HP, SPT
TP001		Rear of garage off Autumn Street	PID, SV, HP, FHST
TP002		Front of garage off Carmoor Road	PID, SV, HP, FHST

Position locations were slightly adjusted on site due to access and parked vehicles as it was an active site. Due to fencing around the front of the nursery positions BH002 and WS001 were relocated southeast in front of the adjacent building.

4.2 Geotechnical Strategy

Geotechnical aspects were investigated based on the following strategy:

Area of Concern	Investigation	Position(s)
Shallow soil conditions	Shallow exploratory holes located in and around the proposed development footprint	WS001-WS004
Shrinkable soils	Plasticity index and particle size testing was scheduled to determine the shrinkability and percentage passing 425µm sieve.	BH001-BH005
Sulphate	Representative samples from relevant depths were scheduled for analysis of pH value and water soluble Sulphate.	BH001-BH005
Frost susceptibility	Samples were submitted for plasticity index (cohesive) or particle size distribution (granular) to determine frost susceptibility.	BH001-BH005
Soakage	A shallow exploratory hole was positioned in the indicated	TP001 and

Area of Concern	Investigation	Position(s)
potential	soakaway location.	TP002
Potential piled foundations	20m deep cable percussive/rotary boreholes were sunk across the site to provide deeper ground and groundwater information and parameters for pile design.	BH001-BH005
Groundwater	Observations on the occurrence of water and standing levels were to be made during the fieldwork. A Standpipe WAS installed to enable return groundwater monitoring.	BH003

4.3 Contamination Strategy

Geo-environmental aspects were investigated based on the following strategy:

Area of Concern	Investigation	Position(s)
Made Ground	Representative samples of soil were to be screened for a broad industry standard screening contaminants.	TP001-TP002 & WS001-WS004
Superficial – Till (Diamicton) & Bedrock – Collyhurst Sandstone Formation	Groundwater levels and laboratory testing were required; a monitoring well was installed in BH003 and into the natural ground to determine groundwater levels.	BH003
Waste classification	For preliminary waste classification, representative samples were to be screened for contaminants and full hazardous waste leachate testing performed.	BH001-BH005, TP001-TP002 & WS001-WS004

4.4 Enabling Works

All positions required the use of a breaker/concrete corer to enable site works.

4.5 Dynamic (Windowless) Sampling (DS)

Dynamic Sampling entails 1m long hollow tubes with liners driven into the ground and retracted to obtain samples. The liners are split, logged, tested, and subsampled as required.

4.6 Cable Percussive Boreholes (CP)

Cable Percussion is a traditional drilling technique which essentially involves repeatedly dropping a hollow sampling tube from height and removing any plug of soil that is retrieved. Clay cutters, chisels, a shelling attachment, and casing can also be used down the hole.

4.7 Rotary Boreholes (RO or RC)

Rotary drilling is used to form a deep observation borehole or for obtaining representative samples of rock. The drilling method involves a powered rotary cutting head on the end of a shaft, driven into the ground as it rotates. The system requires lubrication (air, water or drilling mud) to keep the cutting head cool.

4.8 Field Shear Vane (SV)

Field shear vane tests were performed on samples of cohesive materials recovered from the boreholes. The test provides a direct estimate of undrained shear strength (in kN/m²), and in turn may be used to give an indication of consistency as defined in BS5930.

4.9 Hand Penetrometer (HP)

Hand penetrometer tests were performed on samples of cohesive materials recovered within the boreholes. The test is used to approximate undrained shear strength and in turn has been used to give an indication of consistency as defined in BS5930.

4.10 Falling Head Soakage Testing (FHST)

A test bore is filled with water and the drop in water level over time is recorded, to provide an indication on the likely permeability of different strata.

4.11 Standard Penetration Test (SPT)

The Standard Penetration Test involved driving a cone (SPT(C)) or split spoon sampler (SPT(S)) with a percussive hammer weight and recording the number of blows to penetrate six consecutive intervals of 75mm; the first two are discarded as 'seating blows', while the final four are added together to calculate an N-Value. The procedure is defined under numerous standards including BS5930:2015.

4.12 Monitoring Wells (MW)

Monitoring wells are installations within boreholes that enable return monitoring to be carried out. The pipework was 50mm diameter HDPE, with cased section sealed with bentonite, and the slotted response zone packed with a shingle filter pack.

The monitoring installation is summarised below and is shown on the relevant log in the appendix.

Position	Response zone		Diameter	Strata	Objective
	Top	Bottom			
BH003	2.00m	20.00m	50mm	Till Deposits and Collyhurst Sandstone Formation	Groundwater level monitoring

Post-fieldwork monitoring of groundwater levels was undertaken on one occasion on 22nd February 2024.

4.13 Soil Sampling

Soil samples were recovered from the exploratory holes during the ground investigation and stored/transported in containers appropriate for the laboratory testing undertaken. Sample types and depths are recorded on the relevant exploratory hole records.

4.14 Groundwater Sampling

A groundwater sample was recovered from the well using dedicated bailers and stored/transported in containers appropriate for the laboratory testing undertaken.

4.15 PID Screening (PID)

The samples of soil were screened for VOC's in headspace from all positions in shallow soils using a Photo Ionisation Detector (PID) broadly in accordance with the methodology set-out in CIRIA C682. Due to interference from humidity and other factors, Land Science adopts a method detection limit of 1.0ppm to avoid reporting false positive readings.

5.0 GROUND CONDITIONS

5.1 General

The expected ground conditions were anticipated to comprise Made Ground over Till Deposits over Collyhurst Sandstone to depth. The investigation confirmed the anticipated ground conditions. A thin capping of hardstanding was encountered at surface.

A summary of the encountered conditions is presented below.

Position	Strata Base Depth (mbgl)			
	Hard-standing	Made Ground	Till Deposits	Collyhurst Sandstone
BH001	0.10	0.70	16.50	20.10+
BH002	0.10	0.70	15.00	18.00+
BH003	0.10	0.80	19.50	21.00+
BH004	0.10	0.80	18.50	20.10+
BH005	0.15	1.20	19.50	20.10+
WS001	0.10	0.75	3.00+	-
WS002	0.10	0.70	3.00+	-
WS003	0.15	0.75	3.00+	-
WS004	0.16	0.85	3.00+	-
TP001	0.10	0.70	3.00+	-
TP002	0.10	0.70	3.00+	-

The naming of geological strata is tentative and should be used as a guide. Interpolation between or below investigation points should be treated with caution.

The description of soils and rocks was in accordance with BS5930.

5.2 Hardstandings

All positions were located within hardstanding, which was encountered to depths of between 0.10 and 0.16 mbgl and in summary comprised: CONCRETE (positions BH002-003, WS001-004 and TP001-002), reinforced CONCRETE (position BH005) and ASPHALT (positions BH001, BH004).

5.3 Made Ground

Made Ground was encountered to depths of between 0.70 and 1.20 mbgl and in summary comprised grey brown/black sandy, gravelly CLAY. Sands are fine to medium, gravels are fine to coarse, subangular to subrounded flints, bituminous material, concrete and red brick. Suspected contamination was visually identified (black staining) at positions WS001-004, TP001-002.

5.4 Till Deposits

Till Deposits were encountered to depths of between 15.00 and 19.50 mbgl and in summary comprised grey brown to red brown slightly gravelly CLAY, becoming red brown slightly clayey gravelly SAND at approximately 12.00m depth.

5.5 Collyhurst Sandstone (CS)

Collyhurst Sandstone was proved to a maximum depth of 21.00 mbgl and comprised red fine-grained SANDSTONE.

5.6 Roots and Rootlets

No roots or rootlets were identified in the boreholes.

5.7 Field Evidence of Contamination

Soils at positions WS001-004, TP001-002 from approximately 0.20 to 0.75mbgl were noted to show black staining.

Made Ground was identified 0.70 to 1.20 mbgl, and such materials may be imported from an unknown source or mixed with hazardous materials, and as such may contain a wide range of potential contaminants. All such materials should be treated as suspect unless proven otherwise. Testing has been carried out, as described in section 10.0.

5.8 Groundwater

Groundwater was not encountered during excavation of any of the investigative positions.

5.9 Stability and Casing

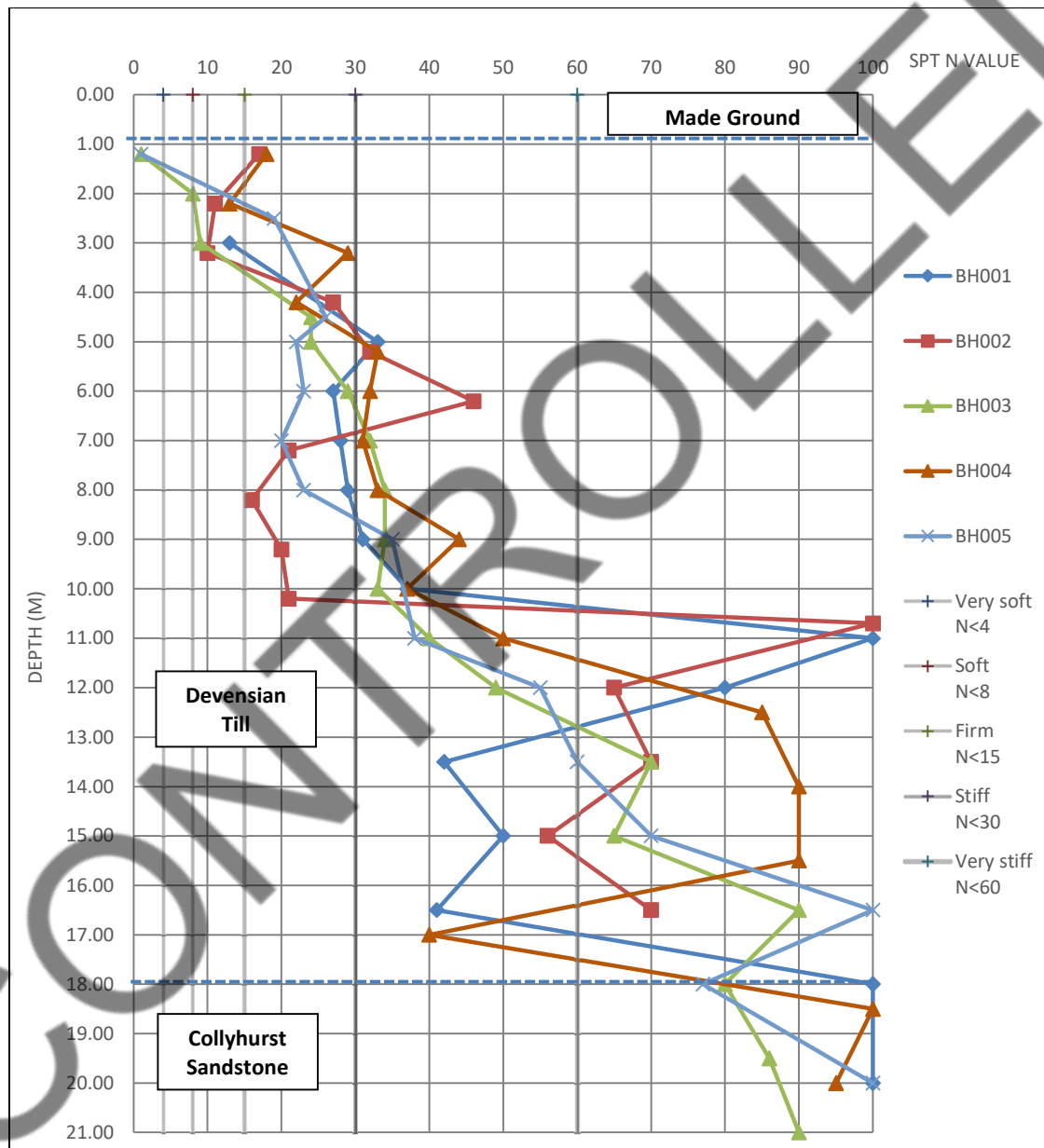
Instability was noted at a depth of 17.00 mbgl at position BH002 due to sand collapse, all other positions were noted to be generally stable. However, casing was used in the rotary boreholes as summarised below:

Position	Casing depth (mbgl)
BH001	18.00
BH002	18.00
BH003	21.00
BH004	18.00
BH005	18.00

6.0 FIELD TESTING

6.1 Standard Penetration Test (SPT)

The SPT results from the rotary cored boreholes are summarised below:

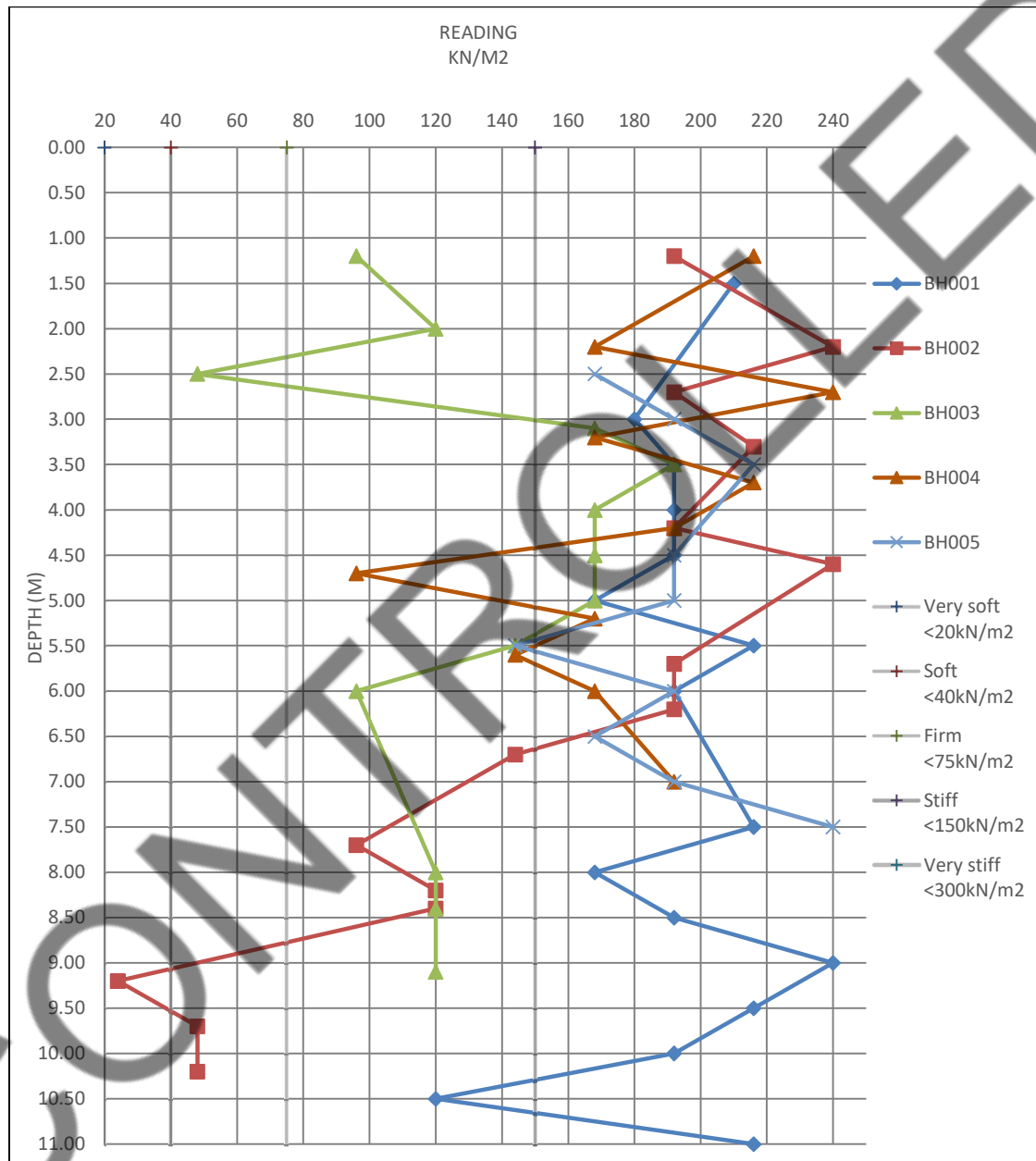


Note: gridlines shown are approximate and indicative only

There was an overall consistent trend of increasing results with depth. The tests refused at depths of between 10.70 and 11.00m on dense gravels within the Till, and at 16.50, 18.00, 18.50 and 20.00m on bedrock.

6.2 Shear Vanes (SV)

The Shear Vane results are summarised below:

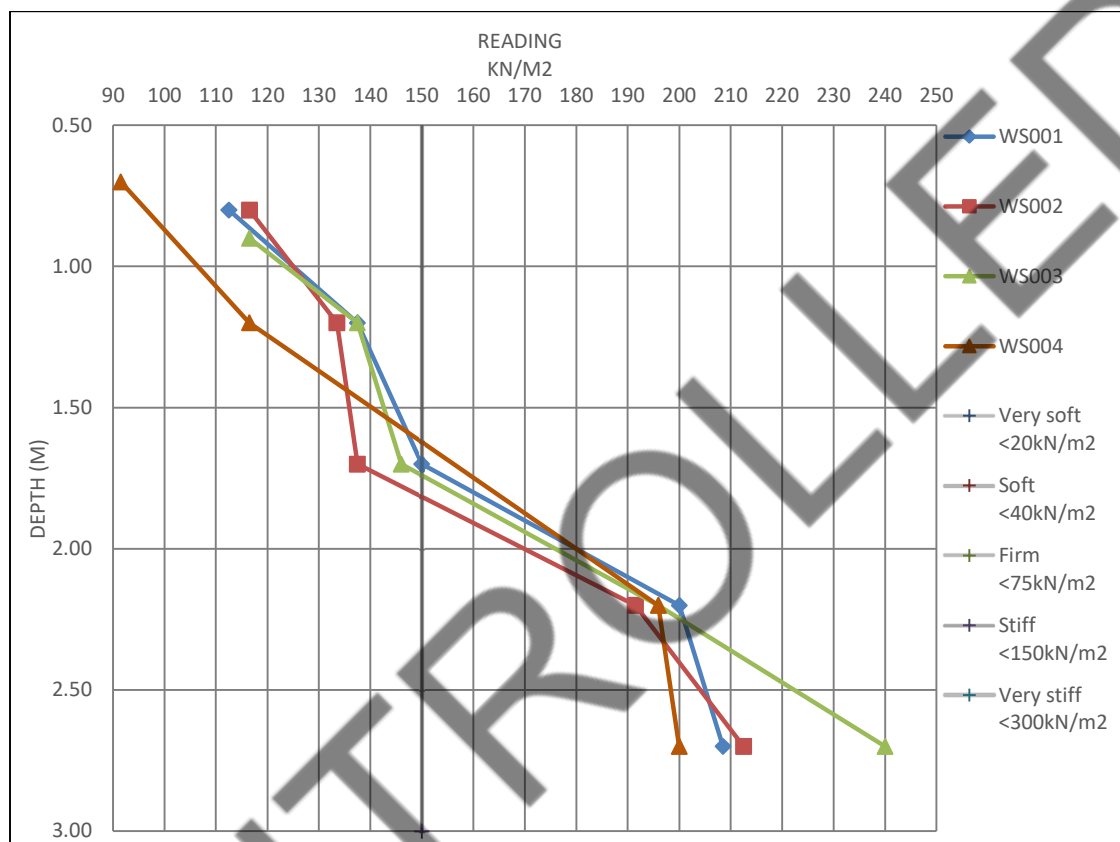


Note: gridlines shown are approximate and indicative only

There was a particularly soft zone encountered from 9.00m within BH002. It was assumed the clayey soils had weakened with the use of water flush from the rotary rig.

6.3 Hand Penetrometers (HP)

The Hand Penetrometer results are summarised below:



Note: gridlines shown are approximate and indicative only

6.4 Falling Head Soakage Testing (FHST)

The results of the Falling Head Soakage Tests are summarised below:

Position	Test	Strata tested	Test depth range	Result	Notes
TP001	Test 1	Till Deposits	0.36-0.65m	Test failed	Water level fell 0.29m in 90 minutes, with the water level remaining at 0.65m for 19 hours.
TP002	Test 1		0.38-0.66m	Test failed	Water level fell 0.28m in 180 minutes, with the water level remaining at 0.66m for 17 hours.

6.5 PID Screening (PID)

None of the samples exhibited VOC's above the detection limit, with the exception of the following tests.

Position	Depth (m)	Strata	Result (ppm)
TP001	0.20	Made Ground	1.8
TP001	0.50		1.1
WS001	0.60		3.8
WS002	0.50		13

Overall the readings were towards the lower end of the unit's detection limit (0.1ppm to 9999ppm).

The purpose of the screening was to identify samples which may be impacted by organic contaminants (such as VOC's, SVOC's, petroleum hydrocarbons, diesel, etc.) and to assist in prioritising samples for laboratory analysis.

7.0 MONITORING DATA

7.1 Groundwater Monitoring

Groundwater was recorded in the single return monitoring visit, standing at a depth of 4.40m.

Position	During drilling	Return monitoring
BH003	Groundwater not encountered	4.40m

Groundwater was not encountered at any of the positions during site works. It should be noted that boreholes BH001 to BH005 were drilled using a water flush and could potentially have masked any groundwater strikes.

8.0 GEOTECHNICAL LABORATORY TESTING

8.1 Geotechnical Laboratory Testing

The client selected samples for geotechnical testing, including the following:

- For general classification purposes, representative cohesive natural samples of soil were analysed for 1pt Atterberg Limit (Plasticity Index) tests (PI).
- Moisture content (MC) determinations were carried out in association with the Atterberg limit tests.
- For general classification purposes, representative samples of granular soils were selected for Particle Size Distribution by wet sieving (PSD).
- Given the fine-grained nature of the soils, the particle size distribution was supplemented by Hydrometer analysis on the silt and clay fractions (HYD).
- For general classification purposes, representative samples of soils were selected for Bulk and Dry Density (BDD) testing.
- To determine the required concrete specification to resist chemical attack, samples of soil and water were tested for pH and soil soluble sulphate (pH/SO₄).
- Quick undrained unconsolidated triaxial (UUT) and Uniaxial Compressive Strength (UCS) tests were scheduled on 'undisturbed' samples, to provide further evidence of undrained shear strengths.
- To evaluate the load-settlement behaviour of the soil, representative cohesive samples were selected for oedometer consolidation tests (OED).
- Laboratory CBR compaction tests (CBR) were taken to assist with design parameters for pavements.
- Point Load Tests (PLT) were scheduled on samples to characterise rock materials in terms of strength.
- Direct Shear Box (SB) tests were scheduled on samples, to provide shear strength of the soil materials.

A summary of the testing scheduled is given below:

Sample	Strata	Test										
		MC	PI	PSD	HYD	BDD	pH/SO ₄	UUT	UCS	OED	PLT	SB
BH001 2.00m	Till							X				
BH001 2.50m		X	X									
BH001 3.00m							X					
BH001 4.00m										X		
BH001 4.25m		X	X									
BH01 5.00m		X										
BH001 6.00m					X							
BH001 8.00m		X	X									
BH01 8.50m								X				
BH001 9.00m					X							

Sample	Strata	Test										
		MC	PI	PSD	HYD	BDD	pH/SO4	UUT	UCS	OED	PLT	SB
BH001 10.00m	CS	X	X									
BH001 12.00m						X						
BH001 18.00m									X		X	
BH001 19.00m									X		X	
BH002 2.20m	Till	X	X									
BH002 2.70m										X		
BH002 3.20m					X							
BH002 4.20m		X										
BH002 4.70m								X				
BH002 5.20m							X					
BH002 6.20m		X	X									
BH002 7.20m		X			X							
BH002 8.70m										X		
BH002 9.20m		X	X									
BH002 10.20m						X						
BH002 13.50m												X
BH002 15.00m	CS								X		X	
BH002 16.00m									X		X	
BH002 17.00m									X		X	
BH003 2.00m	Till	X	X									
BH003 2.70m								X				
BH003 3.00m					X							
BH003 4.00m										X		
BH003 4.50m		X										
BH003 5.00m		X	X									
BH003 6.00m							X					
BH003 7.00m						X						
BH003 8.00m		X	X									
BH003 8.60m								X				
BH003 9.00m						X						
BH003 10.00m		X	X									
BH003 11.00m												X
BH003 12.00m				X								
BH003 13.50m												X
BH003 15.00m				X								
BH003 16.50m						X						
BH003 18.00m												X
BH003 19.50m	CS								X		X	
BH004 2.20m	Till	X	X									
BH004 2.70m										X		
BH004 3.20m		X										

Sample	Strata	Test										
		MC	PI	PSD	HYD	BDD	pH/SO4	UUT	UCS	OED	PLT	SB
BH004 4.20m	Till					X						
BH004 4.70m								X				
BH004 5.20m		X	X									
BH004 6.00m					X							
BH004 7.00m							X					
BH004 8.00m						X						
BH004 9.00m		X	X		X							
BH004 10.00m						X						
BH004 11.00m		X	X									
BH004 14.00m												X
BH004 15.50m				X								
BH004 19.50m	CS										X	
BH005 2.00m	Till							X				
BH005 2.50m		X	X									
BH005 3.00m		X										
BH005 4.00m										X		
BH005 4.50m							X					
BH005 5.00m		X	X									
BH005 6.00m					X							
BH005 7.00m						X						
BH005 7.50m								X				
BH005 9.00m		X	X									
BH005 11.00m												X
BH005 13.50m	Till			X								
BH005 15.00m						X						
BH005 16.50m				X								
BH005 18.00m									X		X	X

The results are discussed in the relevant sections.

8.2 Particle Size Distribution

The results of the Particle Size Distribution analysis are summarised below.

Strata	No. of tests	% Clay/Silt	% Sand	% Gravel	% Cobbles
Till	5	5-11	27-95	0-63	0

8.3 Hydrometer

The results of the Hydrometer Sedimentation analysis are summarised below.

Strata	No. of tests	% Clay	% Silt	% Sand	% Gravel	% Cobbles
Till	8	42-77	6-15	12-40	2-24	0

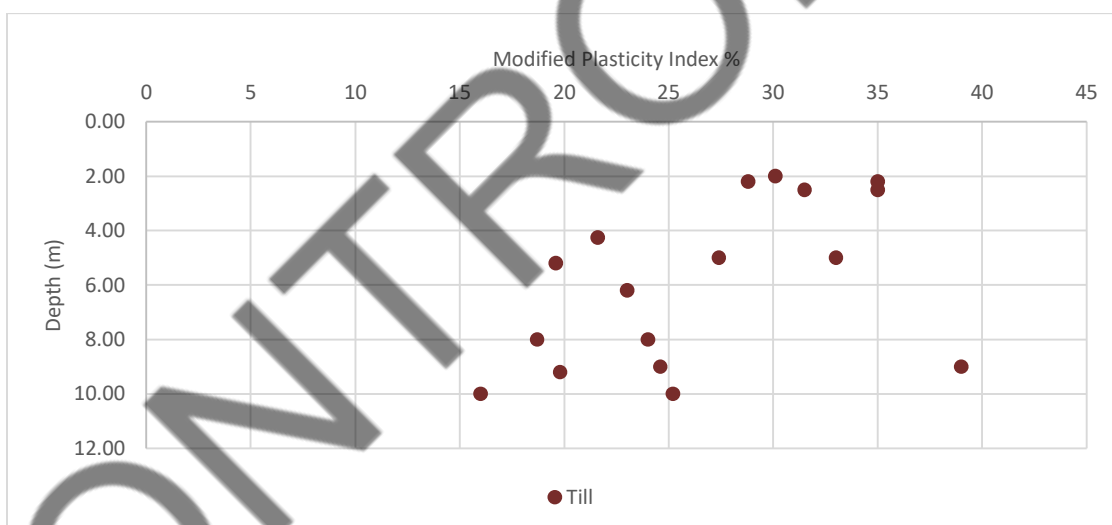
8.4 Plasticity Indexes (Atterberg Limits)

The results of the Atterberg Limit tests are summarised below.

Strata	No. of tests	Plasticity Index %		
		Minimum	Maximum	Average
Till	17	18.0	39.0	28.9

A modified plasticity index (PI') was calculated following the NHBC methodology, to account for any non-shrinkable percentage not passing the 425µm sieve:

Strata	No. of tests	Modified Plasticity Index %		
		Minimum	Maximum	Average
Till	17	16.0	39.0	26.6



8.5 Water Content

The results of the water content (or *moisture content*) tests are summarised below.

Strata	No. of tests	Moisture content %		
		Minimum	Maximum	Average
Till	34	12.0	62.0	23.5

8.6 pH and Sulphate

The results of the pH and water-soluble Sulphate tests are summarised on the following table.

Strata	No. of tests	Water soluble Sulphate (SO ₄ g/l)	pH (value)
--------	--------------	--	------------

Made Ground	9	0.0557 – 0.234	7.0 – 8.8
Till	5	0.0471 – 0.0713	8.4 – 8.6
Groundwater	1	0.0323	7.4

8.7 Triaxial Testing

The results of the quick undrained single stage triaxial tests are summarised below.

Strata	No. of tests	Bulk density (Mg/m ³)	Dry density (Mg/m ³)	Shear strength (kPa)	Mode(s) of failure
Till	8	1.94 – 2.48	1.52 – 2.22	19 – 217	7no Plastic 1no Compound

8.8 Bulk and Dry Density

The results of the bulk and dry density tests are summarised below.

Strata	No. of tests	Bulk density (Mg/m ³)	Dry density (Mg/m ³)
Till	10	1.68 – 2.34	1.04 – 1.98

8.9 Oedometer Consolidation

The results of the Oedometer Consolidation tests are summarised below.

Strata	No. of tests	Pressure Range (kPa)	Coefficient of Volume Compressibility (m ² /MN)	Coefficient of Consolidation (m ² /yr)
Till	6	0 – 50	0.32 - 0.96	1.7 - 53
		50 – 100	0.16 - 0.36	0.7 - 5.8
		100 – 200	0.11 - 0.29	0.71 - 2.6
		200 – 400	0.065 - 0.19	1.5 - 3.4
		400 – 800	0.030 - 0.10	1.7 - 6.6

8.10 Point Load Tests

The results of the point load tests on the samples of rock are summarised below.

Strata	No. of tests	Failure Load (kN)	Point Load (kPa)	Point Load Index (kPa)
Collyhurst Sandstone	1	0.09	30	30

8.11 Direct Shear Tests

The results of the shear box tests are summarised below.

Strata	No. of tests	Bulk density (Mg/m ³)	Dry density (Mg/m ³)	Angle of Shearing Resistance	Effective Cohesion (kPa)
Till	7	1.94 - 2.13	1.58 - 1.91	30.5 - 38.5	0.0 - 28.0

9.0 GEOTECHNICAL ASSESSMENT

9.1 General

The proposed development was understood to comprise the demolition of the existing buildings followed by the construction of three- to six-storey purpose-built student accommodation.

Groundwater was encountered in the monitoring well at BH003 at a depth of 4.40m. Groundwater levels may vary seasonally. Water may also become perched upon cohesive strata or around features such as foundations, and may also occur from leaking drains and water mains etc.

Cohesive soils were identified, which are susceptible to heave and shrinkage through changes in moisture content, such as seasonally or trees.

Given the proposed height of the structure up to 6 storeys, it was anticipated that consideration will be given to the use of piled foundations. Shallow foundations might be suitable for smaller structures with lighter loadings.

The final foundation scheme will depend on other constraints and should be evolved in consultation with the design team.

9.2 Volume Change Potential

Reference may be given to the NHBC standards or similar guidance for designing and constructing foundations in the zone of influence of trees and hedgerows that currently exist, are to be planted, or have recently been felled.

Strata	Modified PI'	Shrinkability classification
Devensian Till	20-40%	Medium volume change potential

Specifications for heave precautions are summarised below. In addition to the depths marked *, localised deepening of foundations will be required in the influence of trees; it will be necessary to evaluate tree species and height in relation to the proposed building footprints.

Volume Change Potential		Medium
Minimum void dimension	Against side of ground beams etc.	25mm
	Beneath ground beam and suspended in-situ concrete ground floors etc.	100mm
	Beneath suspended precast concrete or timber floors etc.	250mm
Minimum allowance for potential ground movement for new drains		100mm

All foundations should extend below any major root zones or desiccated soil encountered, and trenches should be carefully inspected accordingly.

9.3 Piled Foundations

The construction of piled foundations is a specialist job and the advice of a reputable contractor should be sought prior to finalising the design.

Pile working loads will depend on the ground and groundwater conditions, the installation technique, the dimensions of the individual piles, and any pile grouping.

Whilst driven piles may give a higher working load compared to a bored pile, their use may be prevented due to the proximity of adjacent structures. Preliminary working load capacities have been calculated for varying diameters of bored piles taken into the Devensian Till or Collyhurst Sandstone, below:

Depth (m)	300mm diameter	450mm diameter	600mm diameter
12	180	310	480
15	260	430	640
18	380	630	920
20	450	740	1070

These working loads have been calculated on the basis of the ground and groundwater conditions encountered within the boreholes and based on the following assumptions:

- The contribution to the working load on the upper 3.00m has been ignored.
- A factor of safety of 3 was used on the skin friction and end bearing working loads respectively.

Piles should be taken at least five times the pile diameter into the founding strata.

The working loads above apply to single vertically loaded piles. Where groups of piles are to be constructed, the bearing value of each individual pile should be reduced by a factor of 0.8 and a calculation made to check for the factor of safety against block failure.

The piling contractor should be aware that the boreholes were cased to depths of 18.0mbgl in order to prevent collapse as drilling progressed.

9.4 Excavations

The risks arising from excavation works should be properly assessed and appropriate safety precautions should be adopted. Reference may be made to various guidance including BS8000-1:1989, BS6031:2009 and CIRIA C97.

The likelihood of excavation instability through different strata has been assessed as summarised below. It should be noted that all open unsupported excavations have the potential to collapse.

Strata	Stability
Topsoil/Made Ground	Generally unstable. May be battered back to a safe angle. Deeper excavations may require trench support.
Devensian Till	Generally stable in the short to medium term.

Excavations which are to remain open for prolonged periods will require trench support. It is considered that normal-rated plant and machinery will be sufficient for undertaking excavations. Breakers will be required for removing any former foundations, retaining walls etc. Care should be taken so as not to undermine existing structures, services, or adjacent property.

Adjacent excavations should generally be tackled in order of depth with the deepest first. Vehicles and spoil heaps etc. should not surcharge excavations, and edge protection and fencing should be used as appropriate. Frozen materials should generally not be used as backfill.

9.5 Pavements

The design of pavements will depend on the performance requirements and specification, as well as the ground conditions and finished levels etc. The suitability of shallow soils encountered as a formation level for pavements is summarised as follows:

Strata	Base Depth (m)	Suitability
Made Ground	0.70 – 1.20	Only suitable for pavements with low performance requirements. CBR values for these materials will not reflect the possible settlements that may occur. The materials will be frost susceptible so a minimum pavement thickness of 450mm will be required. The formation should be subject to a suitable programme of treatment and the sub-bases appropriately engineered.
Till	10.50 – 12.00	These materials are generally a suitable formation level. The formation is non-frost susceptible and therefore no minimum pavement thickness required. TRRL 1132 suggests a CBR of around 5%, assuming average construction conditions and a high water table. Cohesive formations will degrade rapidly if exposed to standing water and should be protected.

The formation level should be carefully inspected, and any soft or loose zones should be removed and replaced with engineering fill, well-compacted in layers to a suitable specification. Consideration might be given to installing geotextiles. All engineering fill should be granular and non-frost susceptible (i.e. <10% fine material passing 425µm sieve).

Any hard spots in the formation level such as old foundations may induce reflective cracking in the pavement and allowance should be made for removing any slabs or other hard spots etc. that may be present.

9.6 Building Materials

All sub surface concrete should be designed and specified in accordance with BS8500-1:2015+A1:2016. The results of the Sulphate and pH analyses fell into Class DS-1 and an ACEC class AC-1 is appropriate.

Buried plastics used for potable water supplies should not require any special specification in order to resist chemical contamination. No pipework should be laid where there is evidence of hydrocarbons.

9.7 Surface Water Drainage

The preliminary falling head soakage tests failed, and an infiltration rate could not be calculated for the Till. It is unlikely that soakaways will perform satisfactorily in these materials. Consideration should be given to an alternative drainage solution. Borehole soakaways are not considered appropriate given that the sandstone is saturated (below the water table) and usually these are positioned 10m away from structures (and in sufficient room is available).

Evidence of contamination was identified within the shallow soils. Discharges of surface water run-off to ground at sites affected by land contamination may not be acceptable. This may prevent the use of SUDs such as permeable surfacing.

10.0 CONTAMINATION LABORATORY TESTING

10.1 Scheduled Testing

The client selected samples for geochemical (contamination) analysis, as detailed below:

- Waste classification testing on samples to provide a preliminary assessment for waste handling.
- Made Ground was encountered, which may contain a wide range of contaminants. Selected samples from the trial pits and dynamic sampling from depths ranging between 0.20m and 0.60m were tested for a routine screening suite (LS1) screened for Asbestos and tested for TPH7.
- Further soil samples from the trial pits and dynamic sampling between depths of 0.30m and 2.70m were tested for TPH1.
- Further soil samples from the trial pits and dynamic sampling between depths of 0.20m and 0.60m were tested for TPH7.
- A sample of groundwater was obtained from the monitoring well in BH003, based on the CSM, potential contamination resulting from the historic garage workshop. The water sample was analysed for a routine screening suite (LS1- water).

Sample / Depth (m)	Strata	LS1- Soil	TPH1	TPH7	Asbestos	LS2	LS1- Water
TP001 0.20	Made Ground	X	-	X	X	-	-
TP001 0.50	Made Ground	X	-	X	X	X	-
TP001 0.60	Made Ground	-	X	-	-	-	-
TP001 1.00	Till	-	X	-	-	X	-
TP002 0.50	Made Ground	X	-	X	X	X	-
TP002 0.60	Made Ground	-	X	-	-	-	-
TP002 0.90	Till	-	X	-	-	X	-
WS001 0.40	Made Ground	X	-	X	X	-	-
WS001 0.60	Made Ground	X	X	X	X	X	-
WS001 1.20	Till	-	-	-	-	X	-
WS002 0.20	Made Ground	X	-	X	X	-	-
WS002 0.50	Made Ground	X	-	X	X	X	-
WS002 0.60	Made Ground	-	X	-	-	-	-
WS002 1.20	Till	-	-	-	-	X	-
WS002 1.70	Till	-	X	-	-	-	-
WS002 2.20	Till	-	X	-	-	-	-
WS002 2.70	Till	-	X	-	-	-	-
WS003 0.30	Made Ground	-	X	-	-	-	-
WS003 0.50	Made Ground	X	-	X	X	X	-
WS004 0.30	Made Ground	-	X	-	-	-	-
WS004 0.40	Made Ground	-	-	-	-	X	-
WS004 0.60	Made Ground	X	-	X	X	-	-
BH001 1.20	Till	-	-	-	-	X	-
BH002 1.20	Till	-	-	-	-	X	-
BH003 1.20	Till	-	-	-	-	X	-

BH004 1.20	Till	-	-	-	-	X	-
BH005 1.20	Till	-	-	-	-	X	-
BH003	Groundwater	-	-	-	-	-	X

The relevant screening suites are defined below. Where duplicate analysis exists between suites, each test is performed only once:

Suite	Definition
LS1 (soil)	Screening suite: pH, fraction of organic carbon, Metals and Non Metals, water soluble Sulphate, Sulphide, total Cyanide, total Phenols, speciated PAH's.
TPH1	TPH screen: Total petroleum hydrocarbons EC10-EC40.
TPH7	Speciated TPH: Total petroleum hydrocarbons CWG banding incl. aliphatic and aromatic split plus BTEX and MTBE.
Asbestos	Asbestos screen: Laboratory screening for fibres and Asbestos Containing Materials; identification where identified. Using polarising light and dispersion staining as described in HSG 248, HSE Contract Research Report No 83/1996 and in Davies et al, 1996.
LS2	Waste Acceptance Criteria: Total Organic Carbon, Loss on Ignition, BTEX, speciated PCB's, Mineral Oil (EC10 – EC40), pH, Acid Neutralisation Capacity, speciated PAH's, 10:1 leachable Metals and Non Metals.
LS1 (water)	Screening suite: pH, Metals and Non Metals, total Sulphate, Sulphide, total Cyanide, total Phenols, speciated PAH's.

The results are discussed in the relevant sections.

11.0 HUMAN HEALTH SCREENING

11.1 Screening Values

As the basis of a generic tier 1 screening assessment, the results have been compared directly against published standards for human health.

Several different partly overlapping schemes are currently in use in the UK, based on the Environment Agency's CLEA Model but with differing toxicological parameters. For this report, these schemes have been applied in the following hierarchy:

- Suitable For Use levels (S4UL) recently published by LQM in association with the CIEH.
- Category 4 Screening Levels (C4SL) recently published by the DEFRA and CL:AIRE.

Whilst other standards exist, such as the LQM Generic Assessment Criterion and the Environment Agency's Soil Guideline Values, these are deemed superseded by the above documents.

The soil chemical analysis results have been compared against respective screening values for residential land uses without plant uptake (i.e. residential properties without private gardens, where produce is unlikely to be homegrown for consumption).

For contaminants where the respective screening value is dependent on Soil Organic Matter (SOM), the corresponding value for 2.50% was used (the arithmetic mean SOM value for the soil was 4.96%).

Where no standard exists, the contaminant is either not considered a priority in terms of human health (at least in the scenario being considered), or no screening value has been published.

11.2 Screening results

Some of the results were deviating due to extra tests being scheduled by the client following the completion of the site works.

None of the results exceeded the screening criteria, with the exception of the following:

Determinand	Screening value (mg/kg)	Results exceeding the screening value (mg/kg)
Lead	310	WS001 0.40m (380), WS001 0.60m (320), WS002 0.50m (340), WS003 0.50m (320)
Mercury (elemental)	1.2	TP001 0.50m (1.4)
Beryllium	1.7	TP001 0.50m (1.9), WS001 0.40m (1.8), WS001 0.60m (2.2), WS002 0.20m (2.2), WS002 0.50m (2.3)
Naphthalene	5.6	WS003 0.50m (5.7)
Benzo(a) anthracene	14	WS002 0.20m (15), WS003 0.50m (62), WS004 0.60m (14)
Chrysene	31	WS003 0.50m (58)
Benzo(b) fluoranthene	4	TP002 0.50m (11), WS001 0.40m (11), WS002 0.20m (16), WS003 0.50m (57), WS004 0.60m (17)

Determinand	Screening value (mg/kg)	Results exceeding the screening value (mg/kg)
Benzo(a)pyrene	3.2	TP001 0.20m (3.4), TP002 0.50m (8.7), WS001 0.40m (9.2), WS002 0.20m (14), WS003 0.50m (56), WS004 0.60m (13)
Di-benzo(a,h)anthracene	0.32	TP001 0.20m (0.4), TP002 0.50m (1.2), WS001 0.40m (1.2), WS001 0.60m (0.39), WS002 0.20m (2), WS003 0.50m (7.9), WS004 0.60m (1.8)

11.3 Elemental Mercury

The screening value for Mercury was based on the assessment for elemental Mercury as this was the most conservative (lowest) value for the different species of Mercury. However, elemental Mercury (i.e. the liquid form) itself is very unlikely to occur in soils and there is no known history of Mercury usage at the site. Consequently, the less conservative screening values for Inorganic Mercury (56mg/kg) or Methyl Mercury (15mg/kg) are more appropriate in this instance. None of the results exceeded the higher thresholds. Specialist speciated Mercury testing is not warranted.

11.4 Benzo(a)Pyrene

With respect to Polycyclic Aromatic Hydrocarbons (PAH's) Land Science have adopted the surrogate marker approach described in Appendix E of the C4SL suite of documents i.e. using benzo(a)pyrene as a representative compound for all genotoxic PAH's. This approach was used as benzo(a)pyrene was detected in the samples, and the other PAH's identified above the individual screening values were all classed as genotoxic. The table below summarises the revised screening assessment:

Determinand	GAC	Concentration		Results above GAC value
		Mean	Max	
Benzo(a)Pyrene (as surrogate marker)	5.3	7.8	56	TP002 0.50m (8.7), WS001 0.40m (9.2), WS002 0.20m (14), WS003 0.50m (56), WS004 0.60m (13)

11.5 Bioaccessible Metals

The screening values for Lead and Beryllium assumes all ingested contaminant will be fully soluble in stomach acid and therefore available to enter the body. However, this seldom the case in practice, and can be measured through Physiological Based Extraction Testing (PBET). The method in current use is known as the Unified BARGE Method (UBM) as devised by Bio-Accessibility Research Group Europe (BARGE) which was led by the UK. This data can then be applied as part of a detailed quantitative risk assessment.

11.6 Speciated TPH

The risks from TPH's are assessed differently from other contaminants. The ratio of an individual group of carbon bands to the respective GAC is calculated (a Hazard Quotient) and these are totalled to derive a sample specific Hazard Index. A Hazard Index exceeding 1.0 suggests a potential significant risk to human health in the exposure scenario considered. The calculated Hazard Indexes are summarised below.

Sample & Depth	Total TPH (mg/kg)	Hazard Index	Notes
TP001 0.20m	104	0.05	No exceedances identified
TP001 0.50m	326	0.08	
TP002 0.50m	210	0.10	
WS001 0.40m	240	0.08	
WS001 0.60m	305	0.07	
WS002 0.20m	1720	0.27	
WS002 0.50m	1970	0.32	
WS003 0.50m	587	0.30	
WS004 0.60m	217	0.10	

A large part of the TPH split is in the heavy end of the classification and would be non-volatile. TPH1 tests were undertaken and based on a ratio the hazard indexes were all below 1.0.

11.7 Asbestos

There are no published screening values for asbestos in soil, however, nine soil samples were tested and asbestos was not detected.

11.8 Groundwater Vapour Screening

Although VOCs were detected within the samples taken from the shallow trial pits and dynamic sampling boreholes, VOCs were not recorded when monitoring BH003. Using the SOBRA 2017 guidance for assessing the potential vapour risk from groundwater the concentrations were significantly low enough that no potential risk from vapours would be present.

12.0 BUILT ENVIRONMENT SCREENING

12.1 Soft Landscaping

A number of documents include guidance on screening levels of phytotoxic contaminants within soils, including:

- BS3882:2015 "Specification for topsoil and requirements for use" (although stipulated as not to be used in contaminated land risk assessment).
- ICRCL in publication 70/90 1990 'Notes on the Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing' (although indirectly withdrawn) (where marked *).
- Code of Practice for Agricultural Use of Sewage Sludge (England and Wales 1996) for arable use (as opposed to grazing) and relating to priority phytotoxic elements only.

The results of the chemical analysis for determinands known to pose a potential phytotoxic risk to plant growth are summarised on the following table, together with the respective adopted screening values for plant growth. The results of the chemical analysis were evaluated singularly without the use of statistical tools.

Element	Phytotoxicity Value (mg/kg)			Arable (grassland)	Results exceeding screening value
	pH <6.0	pH 6.0-7.0	pH >7.0	pH >5.2	
Zinc	200	200	300	300 (300)	WS002 0.20m (310mg/kg)
Copper	100	135	200	200 (330)	None
Nickel	60	75	110	110 (180)	None
Cadmium	50*			3.0 (3.0)	None
Arsenic	1,000*			50 (50)	None

12.2 Structural Concrete

Recommendations with respect to Sulphate and buried concrete are made in section 9.6. It is noted that no onerous precautions in this respect are warranted.

12.3 Potable Water Supplies

The risk of chemical attack on water supply pipework has been assessed following the general Principles set out in the joint Water UK/HBF *Contaminated Land Assessment Guidance* dated January 2014. A summary of the main chemical criteria is reproduced below.

Test group (in mg/kg)	Poly-ethylene (PE)	Polyvinyl Chloride (PVC)	Metal or Barrier pipe	Results exceeding
VOC's	0.5	0.125	No limit	-
VOC's + BTEX & MTBE	0.1	0.03	No limit	-
SVOC's (excl. PAH's etc.)	2.0	1.4	No limit	-
SVOC's + Phenols	2.0	0.4	No limit	-

Test group (in mg/kg)	Poly-ethylene (PE)	Polyvinyl Chloride (PVC)	Metal or Barrier pipe	Results exceeding
SVOC's + Cresols & Chlorinated Phenols	2.0	0.04	No limit	-
Mineral oil EC11-20	10	No limit	No limit	None
Mineral oil EC21-40	500	No limit	No limit	None

Redox potential and conductivity should be checked where metal pipework is to be installed. aluminium barrier pipework is acceptable under all conditions. no pipework should be laid where there is evidence of petrol, diesel etc.

13.0 CONTROLLED WATERS SCREENING

13.1 General

The relevant analytical results have been compared directly against the standard set out in the water framework directive for surface waters, and the current UK potable water supply regulations.

13.2 Soil leachate screening

In comparison to the adopted surface water standards, the following determinands exceeded the respective thresholds:

Determinand	EQS	Units	Samples
Chromium	0.0047	mg/l	WS004 0.40m (0.0077)
Copper	0.001	mg/l	All samples (0.0023-0.026)
Lead	0.0012	mg/l	BH001 1.20m (0.0015), BH004 1.20m (0.0014), TP001 0.50m (0.0019), WS002 0.50m (0.0081), WS003 0.50m (0.0057), WS004 0.40m (0.018),
Zinc	0.0109	mg/l	TP001 0.50m (0.013), WS002 0.50m (0.02), WS003 0.50m (0.026), WS004 0.40m (0.022),

In comparison to the adopted drinking water standards, the following determinands exceeded the respective thresholds:

Determinand	DWS	Units	WS004 0.40m
Lead	0.01	mg/l	0.018

13.3 Groundwater screening

In comparison to the adopted surface water standards, the following determinands exceeded the respective thresholds:

Determinand	EQS	Units	BH003 4.40m
Copper	1	ug/l	3.2

In comparison to the adopted drinking water standards, none were found to exceed the respective standards.

14.0 TIER 1 SOIL CONTAMINATION ASSESSMENT

14.1 End Users

The chemical results identified elevated heavy metals in the north-western half of site and PAHs in all shallow locations tested.

Whilst the majority of the site will lie under the building / hardstanding footprint some of the PAH determinands are volatile or semi-volatile and part of the exposure risk is through the inhalation of indoor vapours, so there may remain a risk, especially considering the sites commercial land uses.

Consideration should be given to either conducting further investigation or proceeding to possible remediation measures which would include either source removal or creation of a barrier (e.g. ventilation and/or membrane).

14.2 Adjacent Land Users

The site has not been identified as a risk of ongoing pollution to neighbouring land. Measures should always be taken to prevent and control any dust, run-off and mud etc generated during groundworks, as part of good site management.

14.3 Soft Landscaping

Zinc exceeded the phytotoxicity screening values in samples at WS002 0.2m. No evidence of potentially phytotoxic effects was noted during the site walkover survey inspection.

The physical composition of the Made Ground which contained concrete, asphalt, brick and concrete was such that it was unlikely to be a suitable medium for landscaping and planting. Clean imported topsoil and subsoil will be required in accordance with appropriate British Standards.

14.4 Concrete specification

The chemical results and ground conditions have been appraised as part of the geotechnical report and reference should be made to section 9.6. No issues relating to man-made (contamination) sources have been identified.

14.5 Potable Water Supplies

No organic contaminants exceeding the screening values were identified. Subject to confirmation from the water utility, it appears there is no restriction on pipework material selection.

14.6 Ground Water Protection

The preliminary conceptual site model identified possible source pathway-receptor-linkages with respect to groundwater. The site overlies a Secondary aquifer over a Principal aquifer, but no groundwater Source Protection Zones were identified on site or in the vicinity. Contamination may be mobilised through the infiltration and percolation of water downwards through the soil column

and into the water table. This may then in turn migrate with the water table and impact directly on potential abstraction points.

Comparing the soil-leachate data directly to drinking water standards, Lead exceeded the respective standards (WS004 0.4m 0.018mg/l).

Overall, the screening does not suggest a significant risk of impact on groundwater quality.

14.7 Surface Water Protection

No surface water bodies were identified in the local area, and therefore no source-pathway-receptor linkages exist in this regard.

14.8 Conclusions

The updated conceptual site model has identified the following potential risks:

- End users; inhalation of vapours.
- Soft landscaping; risk of phytotoxicity and poor soil conditions for landscaping and planting.

Further investigation may be considered in order to determine the distribution of PAHs across the site and their variance with depth. This will enable a detailed quantitative risk assessment including use of statistical evaluation.. Further investigation may reduce or even eliminate the need for remediation.

Alternatively, if remediation is considered this should comprise an organic vapour resistant membrane within the floor slab construction. A ventilated subfloor void is unlikely to be appropriate given the expected piled foundation solution.

15.0 PRELIMINARY WASTE ASSESSMENT

15.1 General

Waste may be defined as any substance or object in Annex 1 of the Waste Framework Directive which the holder discards, intends to discard, or is required to discard. Subject to compliance with waste regulations, soils may either be handled as either:

- Non-Waste, and re-used (either on-site or on another site), or
- Waste, and disposed of (to a waste management facility).

Given the confines of the site, it was anticipated that all materials would be disposed of from site.

The waste producer has a legal duty of care to ensure that waste materials are handled properly and sent to the appropriate licenced facility. Substantial tax penalties and fines are being levied by the regulators. Inspection, testing, segregation etc will be required on site, and the support of a suitably qualified consultant should be sought; therefore, the advice in this section is preliminary only.

15.2 Waste Disposal

Where materials are not re-used they must be handled as Waste, and must be sent to a licenced waste management facility. Waste is classified as follows:

- Step 1: Does the material contain dangerous substances that qualify as Hazardous Waste as prescribed under the Waste Framework Directive.
- Step 2: Does the leachability criteria allow the materials to be sub-classified as Stable Non Reactive Waste (SNRHW) or as Inert Waste.

A material is therefore either Hazardous or Non-Hazardous Waste; Hazardous may be sub-classified as SNRHW and Non- Hazardous Waste may be sub-classified as Inert.

The results of the soil analysis have been classified as follows:

Soil	Soil	Waste designation	Details
TP001 0.50m WS001 0.60m	Made Ground	Inert	The soil analysis was not identified as hazardous and the WAC test met the requirements for Inert. Interpretation: Inert Waste.
TP002 0.50m	Made Ground	Non-hazardous	The soil analysis was not identified as hazardous but the WAC test did not meet the requirements for Inert waste. Interpretation: Non Hazardous waste. The test failing the criteria was Total PAH (Limit: 100mg/kg, Result: 119mg/kg).

WS003 0.50m			The soil analysis was not identified as hazardous but the WAC test did not meet the requirements for Inert waste. Interpretation: Non Hazardous waste. The test failing the criteria was: Total PAH (Limit: 100mg/kg, Result: 810mg/kg).
WS004 0.40m			The soil analysis was not identified as hazardous but the WAC test did not meet the requirements for Inert waste. Interpretation: Non Hazardous waste. The test failing the criteria was: Total PAH (Limit: 100mg/kg, Result: 467mg/kg).
WS002 0.50m	Made Ground	SNRHW	The soil analysis was identified as Hazardous waste due to TPH, although the WAC test met the criteria for Stable Non-reactive Hazardous Waste.

Soil	Soil	Waste designation	Details
BH001 1.20m	Till	Inert	The soil analysis was not identified as hazardous and the WAC test met the requirements for Inert. Interpretation: Inert Waste.
BH002 1.20m			
BH003 1.20m			
BH004 1.20m			
BH005 1.20m			
TP001 1.00m			
TP002 0.90m			
WS001 1.20m			
WS002 1.20m			

Further testing may be considered for soils identified as Non-Hazardous, as the tests may enable those materials to be re-classified as Inert and therefore represent a potential saving on disposal costs.

With reference to the current List of Wastes (formerly European Waste Catalogue), waste soils and stone derived from construction and demolition sites may be disposed of under either of the following codes as appropriate:

Waste	Code	Description
Hazardous	17 05 03*	soil and stones containing dangerous substances
Non-Hazardous	17 05 04	soil and stones other than those mentioned in 17 05 03

(Note, the asterisk is a Mirror Entry, as defined in the List of Wastes, conferring the relationship with the non-hazardous code 17-05-04).

REFERENCES

A number of technical references have been referred to in the preparation of this document, including:

- Smith, I. (2014) Smith's Elements of Soil Mechanics. Chichester. Wiley Blackwell. 9th Edition.
- Highways England 2009. Interim Advice Note 73/06 revision 1: Design Guidance for Road Pavement foundations (draft HD25)
- BRE Design Guide 365. Soakaway design ("DG365")
- Radon: Guidance on protective measures for new buildings, BRE Report BR 211, 2015 2ND edition
- Groundwater protection: Principles and practice (GP3) August 2013 Version 1.1
- Revised EU Waste Framework Directive 2008 2008/98/EC [transposed into English law under The Waste (England and Wales) Regulations 2011]
- European Community (EC) Directive 1999/31/EC [transposed into English law under the Landfill (England and Wales) Regulations 2002]
- Defining Waste Recovery - Permanent Deposit of Waste on Land, EPA13 v1.0, EA 2010
- The definition of waste: Development Industry Code of Practice, v2, CL:AIRE 2011
- Guidance on the classification and assessment of waste Technical Guidance WM3 ("WM3") EA publication (1st edition 2015)

Appendix B: 2026 Supplementary Phase II Contamination Assessment (Land Science)



Land Science

**90 CARMOOR ROAD, MANCHESTER,
M13 0FB
SUPPLEMENTARY PHASE II
CONTAMINATION ASSESSMENT
TIGER DEVELOPMENTS LTD
11TH MARCH 2026
LS9115.1**

Site:	90 CARMOOR ROAD, MANCHESTER, M13 0FB	
Title:	SUPPLEMENTARY PHASE II CONTAMINATION ASSESSMENT	
Project:	PURPOSE-BUILT STUDENT ACCOMMODATION	
Client:	TIGER DEVELOPMENTS LTD	
Agent:	WHITBY WOOD (AGENT/ENGINEER)	
Date:	11TH MARCH 2026	
Reference:	LS9115.1	
Version:	A – final for issue	
Prepared By:	<i>Alex Lintern</i>	ALEX LINTERN B.Sc. (Hons) <u>Geo-Environmental Engineer</u>
Checked By:	<i>Jocelyn Middleton</i>	JOCELYN MIDDLETON MGeol FGS <u>Principal Geo-Environmental Consultant</u>
Review & Authorised By:	<i>Mike Rose</i>	MICHAEL ROSE M.Sc., B.Sc., FGS, AIEMA <u>Principal Geo-Environmental Consultant</u>

Land Science are Geotechnical Engineering and Contaminated Land specialists for construction, regulation, property ownership, and due diligence. By understanding our client's needs and appreciating the role that ground issues play within a wider context, we provide a reliable service and first-class expertise tailored to specific requirements. For more information on how we can benefit your project, please visit www.landscience.co.uk



CONTENTS

1.0	EXECUTIVE SUMMARY	4
2.0	INTRODUCTION	5
3.0	SUMMARY OF CONTAMINATION FROM PREVIOUS REPORT (LS7347)	7
4.0	INTRUSIVE INVESTIGATION	8
5.0	GROUND CONDITIONS	10
6.0	CONTAMINATION LABORATORY TESTING	12
7.0	HUMAN HEALTH SCREENING	14
8.0	ENVIRONMENTAL SCREENING	17
9.0	CONTROLLED WATERS SCREENING	19
10.0	TIER 1 CONTAMINATION ASSESSMENT	20
11.0	PRELIMINARY WASTE ASSESSMENT	23
	REFERENCES	25
	REPORT CONDITIONS	26
	GLOSSARY OF TERMS	27

FIGURES

FIGURE 1:	Site Location Plan
FIGURE 2:	Existing Layout / Investigation Layout
FIGURE 3:	Proposed Layout / Investigation Layout

APPENDICES

APPENDIX A:	Photographs
APPENDIX B:	Contamination Laboratory Testing

1.0 EXECUTIVE SUMMARY

This summary is a brief precis of the main findings and conclusions of the investigation. For detailed information, the reader is referred to the main report.

The site included a garage workshop, a residential building, and a day nursery, all of which were vacant. The development was to include the demolition of the existing buildings and the construction of new three- to six-storeys of purpose-built student accommodation. The intrusive investigation included four mechanically excavated trial pits.

Strata	Base Depth range (m)	Summary
Hardstanding	0.08-0.40	Concrete, locally with brick (All except TP105)
Made Ground	0.50-1.20	Sandy Clay / Sand, with occasional brick fragments and rounded pebbles. TP102 with possible hydrocarbon odour. TP104 with possible bituminous material. TP105 with clayey silty sandy Gravel with brick, concrete, Styrofoam, slate, glass and rebar noted to 1.20mbgl. (All except TP103)
Reworked Ground	0.90+	Sandy Clay with brown bands at 0.4m, with brick fragments throughout, and a ceramic pipe at 0.90m. (Only TP103)
Till Deposits	1.50+	Sandy Clay. (All except TP103)

Groundwater was only recorded during the excavation of position TP103 at the base of the trial pit at 0.90m, with a short-term standing water depth also at 0.90m.

Buried structural concrete may be designed to DS-1 and AC-1 in accordance with BS8500. This assumes that all Made Ground is excavated from site. If Made Ground remains in situ, particularly in the area of TP105 then Class DS-2 and an ACEC class AC-2 is appropriate.

Water supply pipe work will require protection from aggressive soil contaminants.

Soil testing has identified elevated levels of contamination including metals, PAHs, TPHs and volatiles. Requirements for remediation have been identified in section 10.

Chemical results on Made Ground / Reworked Ground corresponded to hazardous, non-hazardous and stable non-reactive hazardous waste classification. The shallow Till Deposits corresponded to stable non-reactive hazardous waste classification. Natural soils at depth are anticipated to generally be inert waste.

No immediate requirements for further ground investigation have been identified, although at the time of writing this assessment ground gas monitoring is currently underway at site. This report should be submitted to relevant authorities etc. in good time for consideration and approval.

2.0 INTRODUCTION

2.1 General

Land Science was instructed to undertake a Supplementary Phase II Contamination Assessment in relation to the proposed development at 90 Carmoor Road, Manchester, M13 0FB. The location is shown on Figure 1, which is centred at grid reference SJ 85509 95942.

2.2 Client

The Client for this appointment was Tiger Developments Limited, with the appointment via their engineer Whitby Wood. This report may only be used by this named client and their project team for the purposes set out and subject to the report conditions. It was understood that the Client already owned the property, and that this investigation was not a pre-purchase appraisal.

2.3 Area Under Investigation

During the first visit the area under investigation comprised a garage workshop with front and rear yards, a residential building, and a day nursery, all of which were vacant. By the second visit all structures had been demolished. The investigation layout is indicated on Figure 2. Photographs are presented in Appendix A. The area was approximately 2100m² or 0.21 hectares.

2.4 Proposed Development

The proposed development was understood to comprise the demolition of the existing buildings followed by the construction of purpose-built student accommodation. This included three to six-storeys, forming 172 beds, with a mix of studio and cluster units alongside ancillary facilities and shared amenity space, with site access and other associated works. The proposed development was covered under planning application number 135576/FO/2022. Figure 3 illustrates the layout of the proposed development. The findings of this report may be not valid if the proposed development is altered.

2.5 Previous Investigations

The following previous investigations relevant to the site were made available:

- Phase I Desk Study P451205-DOC-S-001, 18th November 2022. A-squared Studi Engineers Ltd.
- Phase II Contamination and Geotechnical Assessment, LS7347, 2nd April 2024. Land Science.
- Technical Note on Revised Conceptual Site Model for Land Contamination, P451205 revision P01, dated 17th May 2024. Whitby Wood.
- Remediation Strategy P451205-WW-XX-XX-RP-G-0001, 6th September 2024. Whitby Wood.

The phase II ground investigation has been carried out in accordance with the recommendations of the previous report and the Client's scope request. This revision includes a further trial pit (TP105) as requested by the Client. All reports must be read in conjunction with each other.

At the time of writing ground gas monitoring was underway at site and this will be assessed in a further report once completed.

2.6 Scope of Work

The work carried out is described in detail in the following sections but in summary included:

- An intrusive investigation comprising mechanical trial pits.
- Preliminary chemical testing of selected soil samples in the field and laboratory.

The fieldwork was conducted on 3rd and 26th February 2026, under the guidance of Land Science. Since the previous site investigation by Land Science in 2024, the site was vacant and secured by the site contractor GMI, with some of the garage roofing stripped by 3rd February 2026. By 26th February 2026 the site had been demolished and was undergoing clearance.

2.7 Geo-Environmental Objectives

A phase II intrusive investigation was required, to provide a generic quantitative risk assessment (GQRA).

The report was required to assess risks associated with end users, the proposed redevelopment, adjacent land uses, and the wider environment, in the context of the planning regime.

2.8 Standards

Where practicable, the investigation was undertaken in accordance with the following primary standards and guidance:

- Land Contamination Risk Management (LCRM) Environment Agency June 2025.
- BS10175:2011+A2:2017, Investigation of Potentially Contaminated Sites.
- National Planning Policy Framework, December 2024.
- Building Regulations Approved Document C: Site preparation and resistance to contaminants and moisture, HM Government, September 2013.
- NHBC Standards Chapter 4.1: Land Quality - Managing Ground Conditions, 2024.

Other technical sources have been cited in respect of specific aspects of the investigation, as referenced throughout the text.

3.0 SUMMARY OF CONTAMINATION FROM PREVIOUS REPORT (LS7347)

This summary is a brief precis of the main findings and conclusions of the investigation. For detailed information, the reader is referred to the main report.

The site included a garage workshop, an abandoned residential building, and a building used previously as a private day nursery which is now vacant. The development was to include the demolition of the existing buildings and the construction of new three to six-storeys of purpose-built student accommodation. The intrusive investigation included 5no dynamically sampled holes with rotary follow on, 4no dynamic sampler holes and 2no trial pits.

Strata	Base Depth range (m)	Summary
Made Ground	0.70 – 1.20	Grey brown/black sandy, gravelly CLAY
Till Deposits	16.50 – 19.50	Grey brown to red brown slightly gravelly CLAY, becoming red brown slightly clayey gravelly SAND at approximately 12.00m depth
Collyhurst Sandstone	20.00+	Red fine-grained SANDSTONE.

Groundwater was recorded during the return monitoring standing at a level of 4.40m.

Excavations are generally likely to remain stable. Excavations below the water table may become highly unstable.

Buried structural concrete may be designed to DS-1 and AC-1 in accordance with BS8500. Water supply pipe work will not require protection from aggressive soil contaminants.

Soil testing has identified elevated levels of PAH contamination. Requirements for remediation have been identified including the import of clean subsoil and topsoil.

Chemical results on Made Ground corresponded to inert, and some non-hazardous, for most of the site, with SNRHW within the rear yard. Natural soils tested resulted with inert waste classification.

Further investigation may be considered in order to determine the distribution of PAHs across the site, alternatively a vapour membrane may be considered within the ground floor construction.

4.0 INTRUSIVE INVESTIGATION

4.1 Investigation Rationale

The scope and layout of the investigation was specified by Whitby Wood Ltd. In summary this comprised:

- 5no. mechanically trial pits (excavated by others).
- The positions were located to give broad coverage across the site where access was feasible on the vacant site.

Position	Provisional Depth / Strata	Existing Location	Proposed Location	Testing
TP101	1.20m (or refusal)	Inside garage – north of yard	Student accommodation footprint	PID
TP102		Inside garage – off Carmoor Road		
TP103				
TP104		Inside garage – south of yard		
TP105		Demolished/cleared nursery		

TP105 was excavated to 1.50m by others to prove the natural below.

4.2 Contamination Strategy

Geo-environmental aspects were investigated based on the following strategy:

Area of Concern	Investigation	Positions
Made Ground	Representative samples of soil were to be screened for a broad industry standard screening contaminants.	TP101, TP102, TP104 and TP105
Superficial – Till (locally reworked)		TP103 and TP105
Waste classification	For preliminary waste classification, representative samples were to be screened for contaminants and full hazardous waste leachate testing performed.	All

4.3 Enabling Works

TP101-104 positions were over concrete and required the use of a breaker by the site contractor to enable site works.

4.4 Trial Pits (TP)

Trial pits are open excavations using a mechanical excavator to inspect a larger volume of soils and in turn provide a better understanding of variability water ingress, instability, etc.

4.5 Soil Sampling

Soil samples were recovered from the exploratory holes during the ground investigation and stored/transported in containers appropriate for the laboratory testing undertaken. Sample types and depths are recorded on the relevant exploratory hole records.

4.6 PID Screening (PID)

Soil samples were screened for VOCs in headspace using a Photo Ionisation Detector (PID) broadly in accordance with the methodology set-out in CIRIA C682. Due to interference from humidity and other factors, Land Science adopts a method detection limit of 1.0ppm to avoid reporting false positive readings.

CONTROLLED

5.0 GROUND CONDITIONS

5.1 General

The expected ground conditions were anticipated to comprise Made Ground over Till Deposits over Collyhurst Sandstone to depth. The shallow investigation confirmed the anticipated Made Ground over Till Deposits. A thin capping of hardstanding was encountered at surface.

A summary of the encountered conditions is presented below.

Strata	Base Depth m				
	TP101	TP102	TP103	TP104	TP105
Hardstanding	0.08	0.10	0.20	0.40	-
Made Ground	0.50	0.80	-	0.90	1.20
Reworked Ground	-	-	0.90+	-	-
Till Deposits	1.20+	1.20+		1.20+	1.50+

The naming of geological strata is tentative and should be used as a guide. Interpolation between or below investigation points should be treated with caution. The description of soils and rocks was in accordance with BS5930.

5.2 Hardstandings and Subbases

TP101-104 positions were located within hardstanding with the base ranging between 0.08 and 0.40m. In summary, the hardstanding comprised concrete. TP102 was also reinforced, whilst TP104 also included brick between 0.10 and 0.40m.

5.3 Made Ground

Made Ground was encountered in all positions except TP103. The full thickness was proved to be between 0.50 and 1.20m. In summary, the Made Ground generally comprised dark grey/blue/black slightly sandy Clay / Sand, with occasional brick fragments and rounded pebbles. TP102 also recorded occasional cobbles with a possible hydrocarbon odour, whilst TP104 also recorded possible bituminous material. TP105 was carried out following site demolition with various rubble, brick, concrete and rebar to 0.70mbgl. Brown-black slightly clayey silty sandy Gravel with brick, concrete, styrofoam, slate, glass and rebar was noted to 1.20mbgl.

5.4 Reworked Ground

Reworked Ground was encountered in TP103. The full thickness was not proven, with the position terminated at 0.90m. In summary, the Reworked Ground comprised black sandy Clay with brown bands at 0.4m, with brick fragments throughout, and a ceramic pipe at 0.90m.

5.5 Till Deposits

The Till Deposits were encountered in all positions except TP103, with the positions terminated in this strata at depths of 1.20m and 1.50m. In summary, the Till Deposits comprised dark grey/blue/brown/black sandy Clay. Sand was fine and medium.

5.6 Roots and Rootlets

No roots or rootlets were identified in the boreholes.

5.7 Field Evidence of Contamination

Evidence of possible soil contamination (such as staining, malodours, or brightly coloured soils) was identified in the field. Black staining was noted in TP101 0.08-0.50m, and a hydrocarbon odour was noted in TP102 0.10-0.80m.

Made Ground/Reworked Ground was identified to 0.50-1.20m, and such materials may be imported from an unknown source or mixed with hazardous materials, and as such may contain a wide range of potential contaminants. All such materials should be treated as suspect unless proven otherwise. Preliminary testing has been carried out, as described in section 6.

5.8 Groundwater

Groundwater was struck during the excavation of position TP103 at the base of the trial pit at 0.90m, with a short-term standing water depth also at 0.90m.

The level of water in a trial pit can be affected by the excavation process and speed of infiltration; short-term rest levels should be used with caution.

5.9 Stability and Casing

The excavations were noted to be generally stable throughout with no shoring used.

5.10 PID Screening (PID)

None of the samples exhibited VOCs above the detection limit:

Position	Strata	Result
TP101	Made Ground	0.08-0.50m (0.1ppm)
	Till	0.50-1.20m (0.7ppm)
TP103	Reworked Ground	0.20-0.90m (0.1ppm)
TP105	Made Ground	0.70-1.20m (1.2ppm)

Overall the readings were towards the lower end of the unit's detection limit (0.1ppm to 9999ppm).

The purpose of the screening was to identify samples which may be impacted by organic contaminants (such as VOCs, SVOCs, petroleum hydrocarbons, diesel, etc.) and to assist in prioritising samples for laboratory analysis.

6.0 CONTAMINATION LABORATORY TESTING

6.1 Scheduled Testing

Samples were selected for geochemical (contamination) analysis, based on the following rationale:

- Made Ground /Reworked Ground was encountered, which may contain a wide range of contaminants. Selected samples from all positions between 0.20-0.80m were tested for a routine screening suite (S1) and were screened for asbestos.
- Due to the site's history all samples were tested for speciated Total Petroleum Hydrocarbon (TPH7), and Volatile/Semi Volatile Organic Compounds (VOC/SVOC).
- Waste classification testing (S3) on four samples was included in the scope of works, to provide a preliminary assessment for waste handling. Representative samples of Made Ground /Reworked Ground and Till were selected for testing.

Sample	Strata	S1	Asbestos	TPH7	VOC/SVOC	S3
TP101 0.30m	Made Ground	X	X	X	X	
TP101 0.60m	Till	X	X	X	X	X
TP101 1.00m				X	X	
TP102 0.30m	Made Ground	X	X	X	X	X
TP102 0.80m		X	X	X	X	
TP102 1.20m	Till			X	X	
TP103 0.20m	Reworked Ground	X	X	X	X	X
TP103 0.60m		X	X	X	X	
TP103 0.90m				X	X	
TP104 0.40m	Made Ground	X	X	X	X	X
TP104 0.70m		X	X	X	X	
TP104 1.20m	Till			X	X	
TP105 0.20m	Made Ground	X	X	X	X	
TP105 0.80m		X	X	X	X	X
TP105 1.30m	Till			X	X	

The relevant screening suites are defined below. Where duplicate analysis exists between suites, each test is performed only once:

Suite	Definition
S1 (soil)	Screening suite: pH, fraction of organic carbon, metals and non-metals, water soluble sulphate, sulphide, total cyanide, total phenols, speciated PAHs.
Asbestos	Asbestos screen: Laboratory screening for fibres and Asbestos Containing Materials (ACM); identification where identified. Using polarising light and dispersion staining as described in HSG 248, HSE Contract Research Report No 83/1996 and in Davies et al, 1996.
TPH7	Speciated TPH: Total petroleum hydrocarbons CWG banding incl. aliphatic and aromatic split plus BTEX and MTBE.
VOC/SVOC	VOCs: Determination of volatile organic compounds in soil by headspace GC-MS. SVOCs: Determination of semi-volatile organic compounds in soil by extraction in dichloromethane and hexane followed by GC-MS.

Suite	Definition
S3	Waste Acceptance Criteria (WAC): Total Organic Carbon (TOC), Loss on Ignition (LoI), BTEX, speciated PCBs, mineral oil (EC10 – EC40), pH, acid neutralisation capacity, speciated PAHs, 10:1 leachable metals and non-metals.

The results are discussed in the relevant sections.

CONTROLLED

7.0 HUMAN HEALTH SCREENING

7.1 Screening Values

As the basis of a generic tier 1 screening assessment, the results have been compared directly against published standards for human health.

Several different partly overlapping schemes are currently in use in the UK, based on the Environment Agency's CLEA Model but with differing toxicological parameters. For this report, these schemes have and have been applied in the following hierarchy:

- Suitable For Use levels (S4UL) published by LQM in association with the CIEH.
- Category 4 Screening Levels (C4SL) published by the DEFRA and CL:AIRE.

Whilst other standards exist, such as the LQM Generic Assessment Criterion and the Environment Agency's Soil Guideline Values, these are deemed superseded by the above documents.

The soil chemical analysis results have been compared against respective screening values for residential land uses without plant uptake (i.e. residential properties without private gardens, where produce is unlikely to be homegrown for consumption).

For contaminants where the respective screening value is dependent on Soil Organic Matter (SOM), the corresponding value for 2.50% was used (the arithmetic mean SOM value for the soil was 2.90%).

Where no standard exists, the contaminant is either not considered a priority in terms of human health (at least in the scenario being considered), or no screening value has been published.

7.2 Screening Results

None of the results exceeded the screening criteria, with the exception of the following:

Determinand	Screening value (mg/kg)	Results Exceeding the Screening Value
Naphthalene	5.6	TP102 0.30m (5.87mg/kg)
Benzo(a)anthracene	14	TP102 0.30m (251mg/kg), TP102 0.80m (70.80mg/kg), TP103 0.20m (34.8mg/kg), TP104 0.40m (55.4mg/kg), TP104 0.70m (19.40mg/kg)
Chrysene	31	TP102 0.30m (296mg/kg), TP102 0.80m (61.80mg/kg), TP104 0.40m (43.70mg/kg)
Benzo(b)fluoranthene	4	TP101 0.30m (7mg/kg), TP101 0.60m (6.24mg/kg), TP102 0.30m (388mg/kg), TP102 0.80m (78.10mg/kg), TP103 0.20m (54.50mg/kg), TP103 0.60m (8.26mg/kg), TP104 0.40m (90.90mg/kg), TP104 0.70m (32.00mg/kg)
Benzo(k)fluoranthene	110	TP102 0.30m (341mg/kg)
Benzo(a)pyrene	3.2	TP101 0.30m (9.67mg/kg), TP101 0.60m (7.86mg/kg), TP102 0.30m (430mg/kg), TP102 0.80m (107mg/kg), TP103 0.20m (68.00mg/kg), TP103 0.60m (8.70mg/kg), TP104 0.40m (109mg/kg), TP104 0.70m (37.80mg/kg)

Determinand	Screening value (mg/kg)	Results Exceeding the Screening Value
Indeno(1,2,3-cd)pyrene	46	TP102 0.30m (570mg/kg), TP102 0.80m (78mg/kg), TP103 0.20m (51mg/kg), TP104 0.40m (94.20mg/kg)
Di-benzo(a,h)anthracene	0.32	TP101 0.30m (4.48mg/kg), TP101 0.60m (2.40mg/kg), TP102 0.30m (126mg/kg), TP102 0.80m (27.30mg/kg), TP103 0.20m (18.80mg/kg), TP103 0.60m (1.25mg/kg), TP104 0.40m (23.00mg/kg), TP104 0.70m (10.20mg/kg)
Lead	310	TP101 0.30m (355mg/kg), TP101 0.60m (615mg/kg), TP102 0.30m (886mg/kg), TP102 0.80m (614mg/kg), TP104 0.40m (471mg/kg), TP105 0.80m (495mg/kg)
Mercury	1.2	TP103 0.20m (2.54mg/kg)
Nickel	180	TP101 0.60m (231mg/kg), TP102 0.80m (265mg/kg)

7.3 Elemental Mercury

The screening value for mercury was based on the assessment for elemental mercury as this was the most conservative (lowest) value for the different species of mercury. However, elemental mercury (i.e. the liquid form) itself is very unlikely to occur in soils and there is no known history of mercury usage at the site. Consequently, the less conservative screening values for inorganic mercury (40mg/kg) or methyl mercury (11mg/kg) are more appropriate in this instance. None of the results exceeded the higher thresholds. Specialist speciated mercury testing is not warranted.

7.4 Benzo(a)Pyrene

With respect to Polycyclic Aromatic Hydrocarbons (PAHs) Land Science adopt the surrogate marker approach described in Appendix E of the C4SL suite of documents i.e. using benzo(a)pyrene as a representative compound for all genotoxic PAHs. This approach was used as benzo(a)pyrene was detected in the samples, and the other PAHs identified above the individual screening values were all classed as genotoxic. The table below summarises the revised screening assessment:

Determinand	GAC	Concentration		Results Above GAC Value
		Mean	Max	
Benzo(a)pyrene (as surrogate marker)	5.3	97	430	TP101 0.30m (9.67mg/kg), TP101 0.60m (7.86mg/kg), TP102 0.30m (430mg/kg), TP102 0.80m (107mg/kg), TP103 0.20m (68.00mg/kg), TP103 0.60m (8.70mg/kg), TP104 0.40m (109mg/kg), TP104 0.70m (37.80mg/kg)

7.5 Speciated TPH

The risks from TPHs are assessed differently from other contaminants. The ratio of an individual group of carbon bands to the respective GAC is calculated (a hazard quotient) and these are totalled to derive a sample specific hazard index. A hazard index exceeding 1.0 suggests a potential significant risk to human health in the exposure scenario considered. The calculated hazard indexes are summarised below.

Sample	Total TPH mg/kg	Hazard Index	Notes
TP101 0.30m	62.66	0.03	No significant risk to human health

Sample	Total TPH mg/kg	Hazard Index	Notes
TP101 0.60m	306.473	0.09	Potential significant risk to human health No significant risk to human health
TP101 1.00m	209.1875	0.07	
TP102 0.30m	6643	2.63	
TP102 0.80m	664.4	0.80	
TP102 1.20m	325.642	0.14	
TP103 0.20m	188.47	0.07	
TP103 0.60m	1052.009	0.26	
TP103 0.90m	631.124	0.08	
TP104 0.40m	1648.359	0.63	
TP104 0.70m	472.947	0.19	
TP104 1.20m	218.69	0.10	
TP105 0.20m	112	0.07	
TP105 0.80m	28.2	0.02	
TP105 1.30m	<10	0.02	

7.6 Volatile and Semi-Volatile Compounds

The table below identifies volatile compounds (VOCs/SVOCs) found to exceed their respective detection limits, but where no screening values had been set.

Determinant	Detection Limit	Results Exceeding the Screening Value
1,1-Dichloroethane	1µg/kg	TP105 0.20m (9.24µg/kg), TP105 0.80m (57.9µg/kg), TP105 1.30m (36.9µg/kg)
Cis-1,2-dichloroethene	1µg/kg	TP105 0.80m (101µg/kg), TP105 1.30m (4.25µg/kg)
2-Methylnaphthalene	0.10mg/kg	TP101 0.60m (0.20mg/kg), TP101 1.00m (0.51mg/kg), TP102 0.30m (14.40mg/kg), TP102 0.80m (1.06mg/kg), TP102 1.20m (0.69mg/kg), TP103 0.60m (0.13mg/kg), TP103 0.90m (0.57mg/kg), TP104 0.40m (1.44mg/kg), TP104 0.70m (0.36mg/kg), TP104 1.20m (0.10mg/kg)
Carbazole	0.30mg/kg	TP102 0.30m (16.50mg/kg), TP102 0.80m (1.31mg/kg), TP102 1.20m (0.81mg/kg), TP103 0.90m (0.38mg/kg), TP104 0.40m (2.77mg/kg), TP104 0.70m (0.36mg/kg)
Dibenzofuran	0.20mg/kg	TP101 0.60m (0.40mg/kg), TP102 0.30m (23.90mg/kg), TP102 0.80m (1.96mg/kg), TP102 1.20m (1.71mg/kg), TP103 0.20m (3.99mg/kg), TP103 0.90m (0.40mg/kg), TP104 0.40m (2.19mg/kg), TP104 0.70m (0.38mg/kg)

7.7 Asbestos

There are no published screening values for asbestos in soil. From the 12no. samples tested no asbestos was detected.

7.8 Polychlorinated Biphenyls (PCBs)

Five soil samples were tested within the waste criteria testing which included PCB testing. There are no published screening values for PCBs in soil, however, from the five samples screened for PCBs, none of the results exceeded their respective detection limits.

8.0 ENVIRONMENTAL SCREENING

8.1 Soft Landscaping

A number of documents include guidance on screening levels of phytotoxic contaminants within soils, including:

- BS3882:2015 "Specification for topsoil and requirements for use" (although stipulated as not to be used in contaminated land risk assessment).
- ICRL in publication 70/90 1990 'Notes on the Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing' (although indirectly withdrawn) (where marked *).
- Code of Practice for Agricultural Use of Sewage Sludge (England and Wales 1996) for arable use (as opposed to grazing) and relating to priority phytotoxic elements only.

The results of the chemical analysis for determinands known to pose a potential phytotoxic risk to plant growth are summarised on the following table, together with the respective adopted screening values for plant growth. The results of the chemical analysis were evaluated singularly without the use of statistical tools.

Element	Phytotoxicity Value (mg/kg)			Arable (grassland)	Results Exceeding Screening Value
	pH <6.0	pH 6.0-7.0	pH >7.0	pH >5.2	
Zinc	200	200	300	300 (300)	TP101 0.30m (3300mg/kg), TP101 0.60m (6760mg/kg), TP102 0.30m (1950mg/kg), TP102 0.80m (5040mg/kg), TP104 0.40m (391mg/kg)
Copper	100	135	200	200 (330)	TP101 0.30m (1820mg/kg), TP101 0.60m (2010mg/kg), TP102 0.30m (845mg/kg), TP102 0.80m (2050mg/kg)
Nickel	60	75	110	110 (180)	TP101 0.30m (170mg/kg), TP101 0.60m (231mg/kg), TP102 0.30m (108mg/kg), TP102 0.80m (265mg/kg)
Cadmium	50*			3.0 (3.0)	TP101 0.30m (16.70mg/kg), TP101 0.60m (42.70mg/kg), TP102 0.30m (13.30mg/kg), TP102 0.80m (13.40mg/kg)
Arsenic	1,000*			50 (50)	None

8.2 pH and Sulphate

The results of the pH and water-soluble sulphate tests are summarised on the following table.

Strata	No. of Tests	Water Soluble Sulphate (SO ₄ mg/l)	pH (value)
Made Ground	7	28.7-1530	7.78-8.99
Reworked Ground	2	96-186	8.02-9.09
Till	1	34.4	8.16

The high level of water soluble sulphate (1530mg/l) was only noted in TP105 0.80m within the Made Ground, likely due to the waste building materials within the sample tested. Recommendations with

respect to sulphate and buried concrete are made in section 10.4. It is noted that precautions may be warranted when founding in Made Ground.

8.3 Potable Water Supplies

The risk of chemical attack on water supply pipework has been assessed following the general principles set out in the joint Water UK/HBF (Home Builders Federation) *Contaminated Land Assessment Guidance* dated January 2014. A summary of the main chemical criteria is reproduced below.

Test Group	Poly-ethylene (PE)	Polyvinyl Chloride (PVC)	Metal or Barrier pipe	Results Exceeding (in mg/kg)
VOCs	0.5	0.125	No limit	None
VOCs + BTEX & MTBE	0.1	0.03	No limit	TP101 0.60m (0.04mg/kg), TP103 0.60m (0.05mg/kg), TP105 0.8m (0.07mg/kg), TP105 1.30m (0.04mg/kg)
SVOCs (excl. PAH's etc.)	2.0	1.4	No limit	TP102 0.30m (54.80mg/kg), TP102 0.80m (4.33mg/kg), TP102 1.20m (3.21mg/kg), TP103 0.20m (3.99mg/kg), TP104 0.40m (6.40mg/kg)
SVOCs + Phenols	2.0	0.4	No limit	TP101 0.60m (0.70mg/kg), TP101 1.00m (0.64mg/kg), TP102 0.30m (54.80mg/kg), TP102 0.80m (4.33mg/kg), TP102 1.20m (3.21mg/kg), TP103 0.20m (3.99mg/kg), TP103 0.90m (1.35mg/kg), TP104 0.40m (6.40mg/kg), TP104 0.70m (1.10mg/kg)
SVOCs + Cresols & Chlorinated Phenols	2.0	0.04	No limit	TP101 0.30m (0.07mg/kg), TP101 0.60m (0.70mg/kg), TP101 1.00m (0.64mg/kg), TP102 0.30m (54.80mg/kg), TP102 0.80m (4.33mg/kg), TP102 1.20m (3.21mg/kg), TP103 0.20m (3.99mg/kg), TP103 0.60m (0.30mg/kg), TP103 0.90m (1.35mg/kg), TP104 0.40m (6.40mg/kg), TP104 0.70m (1.10mg/kg), TP104 1.20m (0.37mg/kg)
Mineral oil EC11-20	10	No limit	No limit	TP101 0.30m (14.26mg/kg), TP101 0.60m (160.90mg/kg), TP101 1.00m (144.10mg/kg), TP102 0.30m (3609.60mg/kg), TP102 0.80m (224.60mg/kg), TP102 1.20m (77.33mg/kg), TP103 0.20m (33.11mg/kg), TP103 0.60m (195.23mg/kg), TP103 0.90m (48.04mg/kg), TP104 0.40m (489.54mg/kg), TP104 0.70m (111.44mg/kg), TP104 1.20m (60.02mg/kg), TP105 0.20m (378.40mg/kg), TP105 0.80m (52.1mg/kg)
Mineral oil EC21-40	500	No limit	No limit	TP102 0.30m (2996.70mg/kg), TP103 0.60m (856.00mg/kg), TP104 0.40m (1157.60mg/kg)

Redox potential and conductivity should be checked where metal pipework is to be installed. aluminium barrier pipework is acceptable under all conditions. No pipework should be laid where there is evidence of petrol, diesel etc.

9.0 CONTROLLED WATERS SCREENING

The relevant analytical results have been compared directly against the standard set out in the water framework directive for surface waters, and the current UK potable water supply regulations.

9.1 Soil Leachate Screening

In comparison to the adopted surface water standards, the following determinands exceeded the respective thresholds:

Determinand	EQS	Units	TP101 0.60m	TP102 0.30m	TP103 0.20m	TP104 0.40m	TP105 0.80m
Copper	0.001	mg/l	0.0048	0.0093	0.0082	0.0137	0.0025
Lead	0.001 2	mg/l	<0.0005	0.0057	0.0026	<0.0005	0.0062

In comparison to the adopted drinking water standards, the following determinands exceeded the respective thresholds:

Determinand	DWS	Units	TP101 0.60m	TP102 0.30m	TP103 0.20m	TP104 0.40m	TP105 0.80m
Fluoride	1.5	mg/l	2.89	4.38	2.57	2.60	<0.5
Arsenic	0.01	mg/l	0.0062	0.008	0.0293	0.0156	0.0032

10.0 TIER 1 CONTAMINATION ASSESSMENT

10.1 End Users

The chemical results identified the following:

- All the samples of Made Ground except TP105 had numerous PAHs above the assessment criteria.
- Both samples of Made Ground at TP101 and TP102 as well as the shallow sample from TP104 and the deeper sample from TP105 had exceedances for lead.
- Both the deeper samples of Made Ground from TP101 and TP102 had exceedances of nickel.
- The shallow sample of Made Ground at TP102 had notable elevated total petroleum hydrocarbons, which may pose a potential risk for volatile vapours.
- Several volatile compounds were also found above their detection levels, however screening criteria is not currently available in the majority of the samples.

Consideration should be given to either conducting further investigation or proceeding considering possible remediation measures.

10.2 Adjacent Land Users

The site has not been identified as a risk of ongoing pollution to neighbouring land. However, measures should always be taken to prevent and control any dust, run-off and mud etc generated during groundworks, as part of good site management.

10.3 Soft Landscaping

Zinc, copper, nickel and cadmium all exceeded the phytotoxicity screening values in the Made Ground samples at TP101 and TP102 and locally in TP104 (just zinc). No evidence of potentially phytotoxic effects was noted during the site walkover survey inspection.

The physical composition of the Made Ground which contained concrete, brick, concrete, rebar and bitumen was such that it was unlikely to be a suitable medium for landscaping and planting. Clean imported topsoil and subsoil will be required in accordance with appropriate British Standards.

10.4 Concrete Specification

All sub surface concrete should be designed and specified in accordance with BS8500-1:2015+A1:2016. The general results of the sulphate and pH analyses fell into Class DS-1 and an ACEC class AC-1 is appropriate.

This assumes that all Made Ground is excavated from site. If Made Ground remains in situ, particularly in the area of TP105 then Class DS-2 and an ACEC class AC-2 is appropriate.

10.5 Potable Water Supplies

The recorded concentrations of volatiles and hydrocarbons exceeded the respective standards for PVC and PE pipe in all the samples. Suitable types of pipework materials may include metal or aluminium barrier pipe.

Evidence of possible soil contamination (such as staining, malodours, or brightly coloured soils) was identified in the field. Black staining was noted in TP101 0.08-0.50m, and a hydrocarbon odour was noted in TP102 0.10-0.80m - no potable water supplies should be laid in contaminated ground.

10.6 Ground Water Protection

The preliminary conceptual site model identified possible source pathway-receptor-linkages with respect to groundwater. The site overlies a secondary aquifer over a principal aquifer, but no groundwater source protection zones were identified on site or in the vicinity. Contamination may be mobilised through the infiltration and percolation of water downwards through the soil column and into the water table. This may then in turn migrate with the water table and impact directly on potential abstraction points.

Comparing the soil-leachate data directly to drinking water standards, fluoride and arsenic exceeded the respective standards (fluoride: TP101 0.60m 2.89mg/l, TP102 0.30 4.38mg/l, TP103 0.20m 2.57mg/l, and TP104 0.40m 2.60mg/l; arsenic: TP103 0.20m 0.0293mg/l, and TP104 0.40m 0.0156mg/l).

Removal of the Made Ground during construction will reduce the risk of impact on groundwater quality.

10.7 Surface Water Protection

No surface water bodies were identified in the local area, and therefore no source-pathway-receptor linkages exist in this regard.

10.8 Conclusions

The updated conceptual site model has identified the following potential risks:

- End users; inhalation, ingestion, dermal contact with soils, soil borne dusts, inhalation of vapours.
- Soft landscaping; risk of phytotoxicity and poor soil conditions for landscaping and planting.
- Water supply pipes; risk of chemical attack, decay and tainting of water supplies.
- Groundwater; risk of contamination in Made Ground migrating into the water table and impacting on background quality; impact on local receptor points such as abstractions.

It seems unlikely that further investigation would be fruitful at this stage considering the extent to which metals, PAHs, TPHs and volatile results exceeded the thresholds, the number of samples in which it was detected, and the composition and consistency of soils.

Based on a preliminary remediation options appraisal, it was considered that the risks would most cost effectively mitigated by:

- Complete removal of Made Ground from any landscaping areas and reinstating with topsoil/subsoil as required by the landscape designer (minimum 150mm topsoil).
- Excavating and disposing of contaminated soils and replacement with a capping system.
- Provision of upgraded or protected water supply pipework to a specification agreed with the local utility.

- An organic vapour resistant membrane within the floor slab construction. A ventilated subfloor void is unlikely to be appropriate given the expected piled foundation solution.

The Remediation Strategy produced in 2024 should be revised by Whitby Wood appropriately.

A copy of this report should be submitted to the relevant authorities for approval in sufficient time prior to commencement on site.

An appropriate level of supervision and testing will be required, to form part of a formal *Verification Report*.

CONTROLLED

11.0 PRELIMINARY WASTE ASSESSMENT

11.1 General

Waste may be defined as any substance or object in Annex 1 of the Waste Framework Directive which the holder discards, intends to discard, or is required to discard. Subject to compliance with waste regulations, soils may either be handled as either:

- Non-Waste, and re-used (either on-site or on another site), or
- Waste, and disposed of (to a waste management facility).

Given the confines of the site, it was anticipated that all materials would be disposed of from site as waste.

The waste producer has a legal duty of care to ensure that waste materials are handled properly and sent to the appropriate licenced facility. Substantial tax penalties and fines are being levied by the regulators. Inspection, testing, segregation etc. will be required on site, and the support of a suitably qualified consultant should be sought; therefore, the advice in this section is preliminary only.

11.2 Waste Disposal

Where materials are not re-used they must be handled as waste, and must be sent to a licenced waste management facility. Waste soil is classified for disposal purposes as follows:

Step 1: Does the material contain dangerous substances in various proportions that exceed the thresholds for hazardous waste under the Waste Framework Directive?

- If yes, the material is hazardous
- If not, the material is non-hazardous

Step 2: Does the waste acceptance testing allow the materials to be sub classified as follows:

- If hazardous, does the soil meet the requirements for Stable Non-Reactive Hazardous Waste (SNRHW)?
- If non-hazardous, does the soil meet the requirements for inert waste?

A material is therefore either hazardous or non-hazardous waste; hazardous may only be sub-classified as SNRHW and non-hazardous waste may only be sub-classified as inert.

The results of the soils analysis have been interpreted as follows:

Soil	Step 1: Hazardous Waste	Step 2: Waste Acceptance	Waste Designation
TP101 0.30m (Made Ground)	Hazardous - elevated copper and zinc	The soil analysis was identified as hazardous waste – no WAC test undertaken	Hazardous waste
TP101 0.60m (Till Deposits)	Hazardous – elevated copper and zinc	The soil analysis was identified as hazardous waste, although the WAC test	Stable non-reactive

Soil	Step 1: Hazardous Waste	Step 2: Waste Acceptance	Waste Designation
		met the criteria for stable non-reactive hazardous waste.	hazardous waste
TP102 0.30m (Made Ground)	Hazardous - elevated TPH	The soil analysis was identified as hazardous waste, although the WAC test met the criteria for stable non-reactive hazardous waste.	Stable non-reactive hazardous waste
TP102 0.80m (Made Ground)	Hazardous - elevated copper and zinc	The soil analysis was identified as hazardous waste – no WAC test undertaken	Hazardous waste
TP103 0.20m (Reworked Ground)	Non-hazardous	The soil analysis was identified as non-hazardous waste, and the WAC test also met the criteria for non-hazardous waste.	Non-hazardous waste
TP103 0.60m (Reworked Ground)	Hazardous - elevated TPH and BTEX	The soil analysis was identified as hazardous waste – no WAC test undertaken	Hazardous waste
TP104 0.40m (Made Ground)	Hazardous - elevated TPH	The soil analysis was identified as hazardous waste, and the WAC test also met the criteria for hazardous waste.	Hazardous waste
TP104 0.70m (Made Ground)	Non-hazardous	The soil analysis was identified as non-hazardous waste – no WAC test undertaken.	*Non-hazardous waste
TP105 0.20m (Made Ground)	Hazardous – elevated ethylbenzene (BTEX) and TPH	The soil analysis was identified as hazardous waste – no WAC test undertaken.	Hazardous
TP105 0.80m Made Ground	Potentially hazardous – elevated TPH	The soil analysis was identified as hazardous waste, although the WAC test met the criteria for stable non-reactive hazardous waste.	Stable non-reactive hazardous waste

It should be noted that all soil samples tested above were also screened for asbestos and no asbestos was detected.

Whilst the sample marked * was classified as non-hazardous, WAC testing was not carried out and therefore the materials could not be sub-classified as inert, further testing may represent a potential saving on disposal costs.

With reference to the current List of Wastes (formerly European Waste Catalogue), waste soils and stone derived from construction and demolition sites may be disposed of under either of the following codes as appropriate:

Waste	Code	Description
Hazardous	17 05 03*	soil and stones containing dangerous substances
Non-Hazardous	17 05 04	soil and stones other than those mentioned in 17 05 03

(Note, the asterisk is a Mirror Entry, as defined in the List of Wastes, conferring the relationship with the non-hazardous code 17-05-04).

REFERENCES

A number of technical references have been referred to in the preparation of this document, including:

- Smith, I. (2014) Smith's Elements of Soil Mechanics. Chichester. Wiley Blackwell. 9th edition.
- BRE Design Guide 365. Soakaway design ("DG365").
- Radon: Guidance on protective measures for new buildings, BRE Report BR 211, 2023 6th edition.
- The Environment Agency's approach to groundwater protection. February 2018 Version 1.2.
- Water UK and the Home Builders Federation; Contaminated Land Assessment Guidance, dated January 2014.
- Concrete – Complementary British Standard to BS EN 206 - Method of specifying and guidance for the specifier BS 8500-1:2023 - TC, dated November 2023.
- Revised EU Waste Framework Directive 2008 2008/98/EC [transposed into English law under The Waste (England and Wales) Regulations 2011].
- European Community (EC) Directive 1999/31/EC [transposed into English law under the Landfill (England and Wales) Regulations 2002].
- Defining Waste Recovery - Permanent Deposit of Waste on Land, EPR13 v1.0, EA 2010.
- The definition of waste: Development Industry Code of Practice, v2, CL:AIRE 2011.
- Guidance on the classification and assessment of waste Technical Guidance WM3 ("WM3") EA publication (1st edition v1.2GB) dated 2021.

REPORT CONDITIONS

The Client

This report may only be used by the client named in section 1 and their appointed project team for the purpose of design, obtaining planning, building regulations approval, and in connection with finance. This report must not be used by any other persons or for other purposes without express written agreement of Land Science.

General

Land Science takes all reasonable professional care in the preparation of this report, using current standards and industry practice. However, the evaluation of ground conditions depends on an interpretation and extrapolation of the conditions revealed by a limited data set. The level of risk is related to the extent of investigation and no site is ever free of risk. The client should understand their risks and liabilities. We accept no liability whatsoever in respect of:

- The scope, extent or design of an investigation.
- Any conditions not directly revealed by the investigation.
- Published standards or methodologies used or adopted in this report.
- The opinion of any other party including any regulator, authority or stakeholder.
- Any dispute, claim or consequential loss arising from any findings of this report.
- Third party information and data.

This report relates solely to ground-related matters as set out in the objectives and makes no representation on other matters such as ecology, arboriculture, invasive plant species, the condition of buildings and structures, hazardous building materials such as insulation or asbestos, the locations of boundaries, unexploded ordnance, and or planning constraints etc. Further reports should be commissioned in this respect as appropriate.

Regulators and Approvals

This (and any other) report should be submitted to relevant authorities for their own assessments and to provide their approval or comments accordingly. This should be in good time before commencing on site in case additional work is to be carried out.

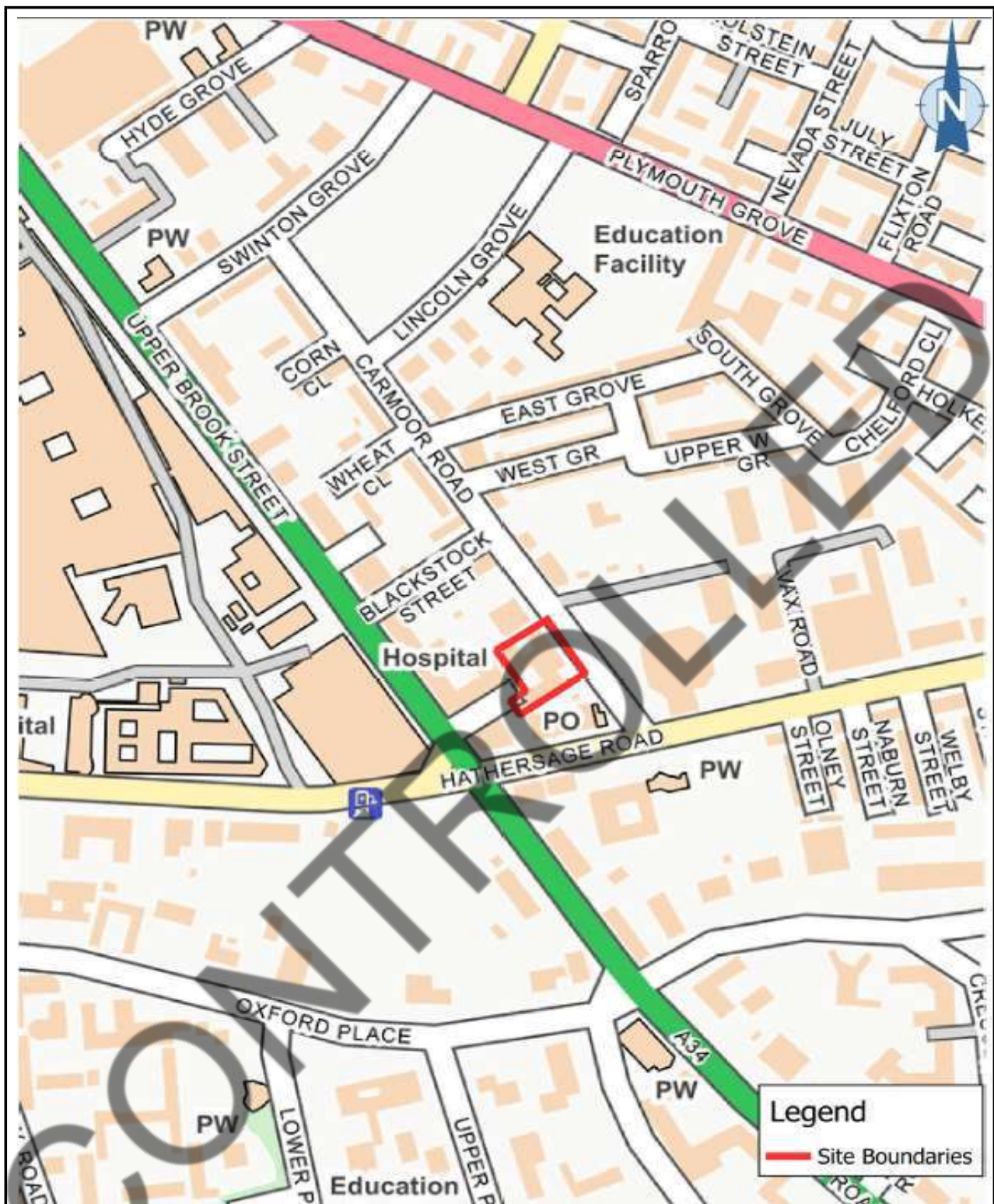
Standards, technical guidance and regulatory positions change over time and may therefore affect the findings and recommendations made in this report; this should be verified by the client prior to any critical project milestones. Where this information is used in design, the designer should verify that the information is appropriate and has been used correctly.

Variations with Time

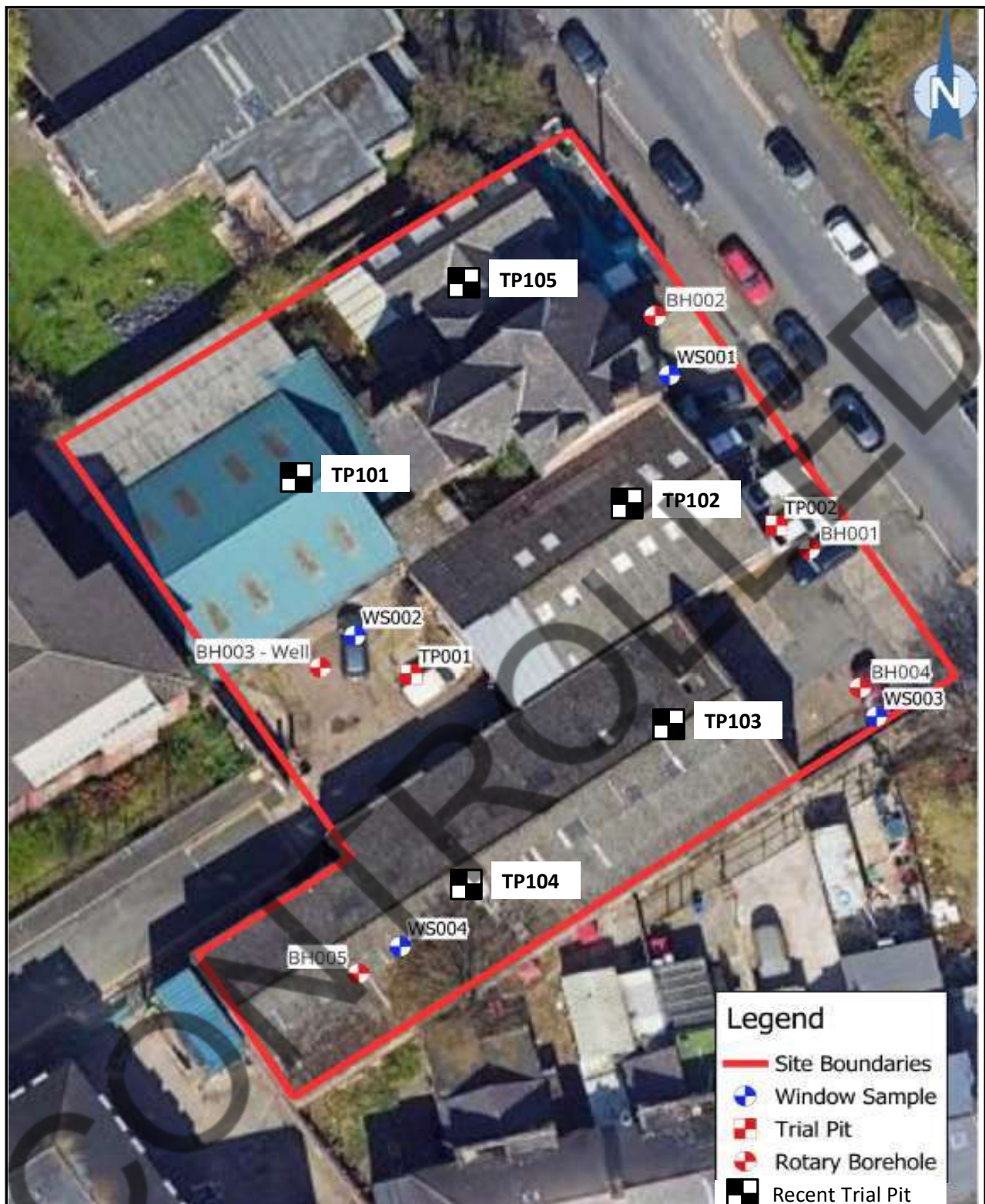
The report relates to conditions revealed at the time of the investigation and any monitoring visits. Some parameters may vary over time or seasonally; groundwater levels, ground gas compositions, or concentrations of contaminants are particularly variable in this respect. Further monitoring or verification should be considered as appropriate.

GLOSSARY OF TERMS

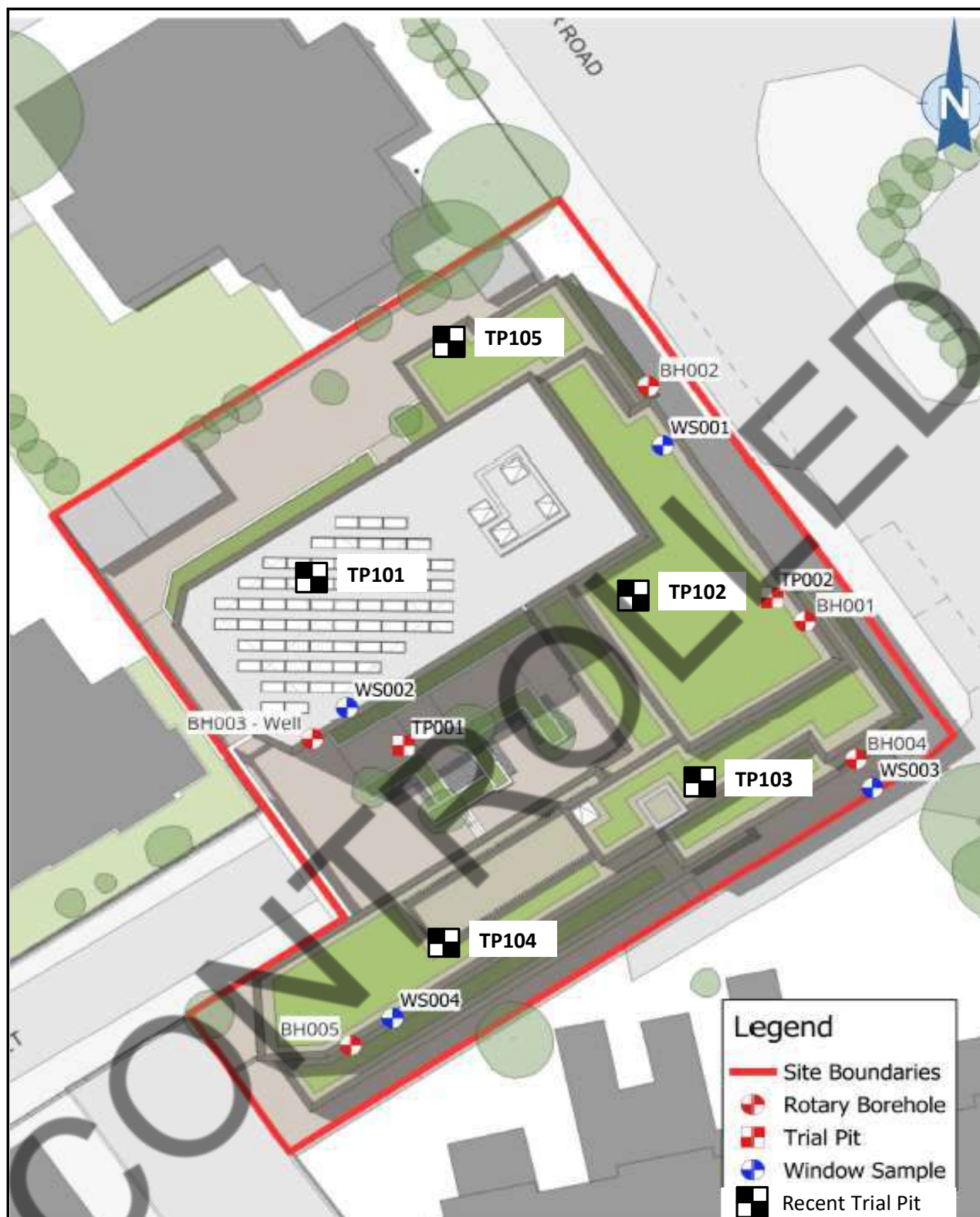
ACM	Asbestos Containing Material
BGS	British Geological Survey
BRE	Building Research Establishment
BS	British Standard
C4SL	Category 4 Screening Level
CBR	California Bearing Ratio
CDM	Construction Design and Management regulations
CIRIA	Construction Industry Research and Information Association
CL:AIRE	Contaminated Land: Applications in Real Environments
CLEA	Contaminated Land Exposure Assessment model
CSM	Conceptual Site Model
EA	Environment Agency
EQS	Environmental Quality Standards
FOC	Fraction of Organic Carbon
GAC	Generic Assessment Criterion
GQRA	Generic Quantitative Risk Assessment
mbgl	Meters Below Ground Level
NHBC	National House Building Council
mOD	Metres above Ordnance Datum
PAHs	Polycyclic Aromatic Hydrocarbons
PHE	Public Health England
PID	Photo-Ionisation Detector
PQRA	Preliminary Quantitative Risk Assessment
PSD	Particle Size Distribution Test
RMS	Remediation Method Statement
S4UL	Suitable for Use Level
SOM	Soil Organic Matter
SPZ	Source Protection Zone
SPT	Standard Penetration Test
SSSI	Sites of Special Scientific Interest
ST-WEL	Short Term Workplace Exposure Limit
SVOCs	Semi-Volatile Organic Compounds
TPH	Total Petroleum Hydrocarbons
TRRL / TRL	Transport Road Research Laboratory
TWA-WEL	Time Weighted Average Workplace Exposure Limit
UK HBF	United Kingdom House Building Federation
VOCs	Volatile Organic Compounds
WAC	Waste Acceptance Criteria



	TITLE: Site Location			REF: LS9115
	PROJECT: 90 Carmoor Road, Manchester, M13 0FB			FIGURE 1
	CLIENT: Tiger Developments Ltd			DATE: 11.02.2026
	CHECK: JM	CHECK: MR	VERSION V1	SHEET: 1 OF 1



	TITLE: Site Investigation Layout			REF: LS9115
	PROJECT: 90 Carmoor Road, Manchester, M13 0FB			FIGURE 2
	CLIENT: Tiger Developments Ltd			DATE: 09.03.2026
	CHECK: JM	CHECK: MR	VERSION V2	SHEET: 1 OF 1



	TITLE: Proposed Development			REF: LS9115
	PROJECT: 90 Carmoor Road, Manchester, M13 0FB			FIGURE 3
	CLIENT: Tiger Developments Ltd			DATE: 09.03.2026
	CHECK: JM	CHECK: MR	VERSION V2	SHEET: 1 OF 1

Appendix C: 2026 Ground Gas Assessment (Land Science)

Land Science



90 CARMOOR ROAD, MANCHESTER
M13 0FB
GROUND GAS ASSESSMENT
TIGER DEVELOPMENTS LTD
27TH MARCH 2026
LS9064

Site:	90 CARMOOR ROAD, MANCHESTER, M13 0FB	
Title:	GROUND GAS ASSESSMENT	
Project:	PURPOSE-BUILT STUDENT ACCOMMODATION	
Client:	TIGER DEVELOPMENTS LTD	
Contact:	WHITBY WOOD (AGENT/ENGINEER)	
Date:	27 TH MARCH 2026	
Reference:	LS9064	
Version:	A – final for issue	
Prepared By:	<i>Alex Lintern</i>	ALEX LINTERN B.Sc. (Hons) <u>Geo-Environmental Engineer</u>
Checked By:	<i>Jocelyn Middleton</i>	JOCELYN MIDDLETON MGeol FGS <u>Principal Geo-Environmental Consultant</u>
Review & Authorised By:	<i>Mike Rose</i>	MICHAEL ROSE M.Sc., B.Sc., FGS, AIEMA <u>Principal Geo-Environmental Consultant</u>

Land Science are Geotechnical Engineering and Contaminated Land specialists for construction, regulation, property ownership, and due diligence. By understanding our client's needs and appreciating the role that ground issues play within a wider context, we provide a reliable service and first-class expertise tailored to specific requirements. For more information on how we can benefit your project, please visit www.landscience.co.uk



CONTENTS

1.0	EXECUTIVE SUMMARY	4
2.0	INTRODUCTION	5
3.0	SUMMARIES OF PREVIOUS REPORTS (LS7347 AND LS9115.1)	7
4.0	INTRUSIVE INVESTIGATION	9
5.0	GROUND CONDITIONS	11
6.0	MONITORING DATA	13
7.0	GROUND GAS ASSESSMENT	14
	REFERENCES	17
	REPORT CONDITIONS	18
	GLOSSARY OF TERMS	19

FIGURES

FIGURE 1:	Site Location Plan
FIGURE 2:	Existing Layout / Investigation Layout
FIGURE 3:	Proposed Layout / Investigation Layout

APPENDICES

APPENDIX A:	Photographs
APPENDIX B:	Field Logs and Testing
APPENDIX C:	Monitoring

1.0 EXECUTIVE SUMMARY

This summary is a brief precis of the main findings and conclusions of the investigation. For detailed information, the reader is referred to the main report.

The site initially included a garage workshop, a residential building, and a day nursery, all of which were vacant. By the second monitoring visit these had all been demolished and cleared. The development was to include the demolition of the existing buildings and the construction of new three- to six-storeys of purpose-built student accommodation. The intrusive investigation included four windowless sample boreholes.

Strata	Base Depth range (m)	Summary
Hardstanding	0.20-0.30	Concrete and crushed gravel (MW001 & MW004 only).
Made Ground	0.90	Sandy Clay/Silt with local black pockets, with rare clinker, coal and glass.
Till Deposits	2.00	Clay with gey veining, with rare sandstone nodules. A strong hydrocarbon odour with fine pockets/fissures of hydrocarbon sheen were noted in MW001, with a slight odour noted in MW003.

Groundwater was not encountered within 2.00m depth during the drilling of MW001-MW004. Monitoring visits included a previous position BH003, which had been drilled to 21.0mbgl and installed to 20.0mbgl. Groundwater was recorded in the six return monitoring visits, standing at depths in the range of 0.32 – 6.32m and locally dry.

No issues with respect to ground gases have been identified, however an organic vapour resistant membrane should be installed within the ground floor construction.

No immediate requirements for further ground investigation have been identified. This report should be submitted to relevant authorities etc. in good time for consideration and approval.

2.0 INTRODUCTION

2.1 General

Land Science was instructed to undertake a Ground Gas Assessment report in relation to the proposed development at 90 Carmoor Road, Manchester M13 0FB. The location is shown on Figure 1, which is centred at grid reference SJ 85509 95942.

2.2 Client

The Client for this appointment was Tiger Developments Limited, with the appointment via their engineer Whitby Wood. This report may only be used by this named client and their project team for the purposes set out and subject to the report conditions. It was understood that the Client already owned the property, and that this investigation was not a pre-purchase appraisal.

2.3 Area Under Investigation

The area under investigation comprised a garage workshop with front and rear yards, a residential building, and a day nursery, all of which were vacant. The investigation layout is indicated on Figure 2. Photographs are presented in Appendix A. The area was approximately 2100m² or 0.21 hectares.

2.4 Proposed Development

The proposed development was understood to comprise the demolition of the existing buildings followed by the construction of purpose-built student accommodation. This included three to six-storeys, forming 172 beds, with a mix of studio and cluster units alongside ancillary facilities and shared amenity space, with site access and other associated works. The proposed development was covered under planning application number 135576/FO/2022. Figure 3 illustrates the layout of the proposed development. The findings of this report may be not valid if the proposed development is altered.

2.5 Previous Investigations

The following previous investigations relevant to the site were made available:

- Phase I Desk Study P451205-DOC-S-001, 18th November 2022. A-squared Studi Engineers Ltd.
- Phase II Contamination and Geotechnical Assessment, LS7347, 2nd April 2024. Land Science.
- Technical Note on Revised Conceptual Site Model for Land Contamination, P451205 revision P01, dated 17th May 2024. Whitby Wood.
- Remediation Strategy P451205-WW-XX-XX-RP-G-0001, 6th September 2024. Whitby Wood.
- Supplementary Phase II Contamination Assessment, LS9115.1, 11th March 2026. Land Science.

The ground gas assessment report has been carried out in accordance with the Client's scope request, and all reports must be read in conjunction with each other.

2.6 Scope of Work

The work carried out is described in detail in the following sections but in summary included:

- An intrusive investigation comprising dynamic sampler boreholes.
- Installation of gas and water monitoring wells, with return visits.

The fieldwork was conducted on 3rd February 2026, under the guidance of Land Science. The site remained vacant and secured by the site contractor GMI. Some of the garage roofing had been stripped. The six return monitoring visits were conducted between 20th February and 24th March 2026, during which site demolition occurred.

2.7 Geo-Environmental Objectives

A ground gas assessment was required, to provide a generic quantitative risk assessment (GQRA).

The report was required to assess risks associated with end users, the proposed redevelopment, adjacent land uses, and the wider environment, in the context of the planning regime.

2.8 Standards

Where practicable, the investigation was undertaken in accordance with the following primary standards and guidance:

- Land Contamination Risk Management (LCRM) Environment Agency June 2025.
- BS10175:2011+A2:2017, Investigation of Potentially Contaminated Sites.
- National Planning Policy Framework, December 2024.
- Building Regulations Approved Document C: Site preparation and resistance to contaminants and moisture, HM Government, September 2013.
- NHBC Standards Chapter 4.1: Land Quality - Managing Ground Conditions, 2024.

Other technical sources have been cited in respect of specific aspects of the investigation, as referenced throughout the text.

3.0 SUMMARIES OF PREVIOUS REPORTS (LS7347 AND LS9115.1)

The summaries are a brief precis of the main findings and conclusions of the investigations. For detailed information, the reader is referred to the main reports.

The site included a garage workshop, an abandoned residential building, and a building used previously as a private day nursery which is now vacant. The development was to include the demolition of the existing buildings and the construction of new three to six-storeys of purpose-built student accommodation.

3.1 LS7347

The intrusive investigation included 5no dynamically sampled holes with rotary follow on, 4no dynamic sampler holes and 2no trial pits.

Strata	Base Depth range (m)	Summary
Made Ground	0.70 – 1.20	Grey brown/black sandy, gravelly CLAY
Till Deposits	16.50 – 19.50	Grey brown to red brown slightly gravelly CLAY, becoming red brown slightly clayey gravelly SAND at approximately 12.00m depth
Collyhurst Sandstone	20.00+	Red fine-grained SANDSTONE.

Groundwater was recorded during the return monitoring standing at a level of 4.40m.

Excavations are generally likely to remain stable. Excavations below the water table may become highly unstable.

Buried structural concrete may be designed to DS-1 and AC-1 in accordance with BS8500. Water supply pipe work will not require protection from aggressive soil contaminants.

Soil testing has identified elevated levels of PAH contamination. Requirements for remediation have been identified including the import of clean subsoil and topsoil.

Chemical results on Made Ground corresponded to inert, and some non-hazardous, for most of the site, with SNRHW within the rear yard. Natural soils tested resulted with inert waste classification.

Further investigation may be considered in order to determine the distribution of PAHs across the site, alternatively a vapour membrane may be considered within the ground floor construction.

3.2 LS9115.1

The intrusive investigation included five mechanically excavated trial pits.

Strata	Base Depth range (m)	Summary
Hardstanding	0.08-0.40	Concrete, locally with brick (All except TP105)
Made Ground	0.50-1.20	Sandy Clay / Sand, with occasional brick fragments and rounded pebbles. TP102 with possible

		hydrocarbon odour. TP104 with possible bituminous material. TP105 with clayey silty sandy Gravel with brick, concrete, Styrofoam, slate, glass and rebar noted to 1.20mbgl. (All except TP103)
Reworked Ground	0.90+	Sandy Clay with brown bands at 0.4m, with brick fragments throughout, and a ceramic pipe at 0.90m. (Only TP103)
Till Deposits	1.50+	Sandy Clay. (All except TP103)

Groundwater was only recorded during the excavation of position TP103 at the base of the trial pit at 0.90m, with a short-term standing water depth also at 0.90m.

Buried structural concrete may be designed to DS-1 and AC-1 in accordance with BS8500. This assumes that all Made Ground is excavated from site. If Made Ground remains in situ, particularly in the area of TP105 then Class DS-2 and an ACEC class AC-2 is appropriate.

Water supply pipe work will require protection from aggressive soil contaminants.

Soil testing has identified elevated levels of contamination including metals, PAHs, TPHs and volatiles. Requirements for remediation have been identified in section 10.

Chemical results on Made Ground / Reworked Ground corresponded to hazardous, non-hazardous and stable non-reactive hazardous waste classification. The shallow Till Deposits corresponded to stable non-reactive hazardous waste classification. Natural soils at depth are anticipated to generally be inert waste.

No immediate requirements for further ground investigation have been identified, although at the time of writing this assessment ground gas monitoring is currently underway at site. This report should be submitted to relevant authorities etc. in good time for consideration and approval.

4.0 INTRUSIVE INVESTIGATION

4.1 Investigation Rationale

The scope and layout of the investigation was specified by Whitby Wood Ltd. In summary this comprised:

- 4no. dynamic sampler boreholes were used to minimise disruption to the site and to enable monitoring wells to be installed.
- The positions were located to give broad coverage across the site where access was feasible on the vacant site.
- Monitoring wells were installed in each location to a depth of 1.00m. The installation was sealed through the hardstanding and natural, with the response zone in the made Ground.

Position	Provisional Depth / Strata	Existing Location	Proposed Location	Testing, Installations etc.
MW001	2.00m (or refusal)	Inside garage – north of yard	Building footprint	PID
MW002		Outside garage – within rear yard	Landscaping	
MW003		Outside garage – off Carmoor Road	Building footprint	
MW004		Outside garage and residential house – off Carmoor Road	Building footprint	

MW001 was originally positioned to the rear of the nursery along the site's northern border. However, due to limited access the position was relocated to within the garage building to the northwest of the site, which was successful.

4.2 Contamination Strategy

Geo-environmental aspects were investigated based on the following strategy:

Area of Concern	Investigation	Positions
Made Ground	Made Ground may be a source of ground gases; monitoring wells were installed into the made Ground to determine gas levels and flow rates.	All

4.3 Enabling Works

All positions were located within the hardstanding and a concrete corer was used to proceed through at MW001 and MW004.

4.4 Dynamic (Windowless) Sampling (DS)

Dynamic Sampling entails 1m long hollow tubes with liners driven into the ground and retracted to obtain samples. The liners are split, logged, tested, and subsampled as required.

4.5 Monitoring Wells (MW)

Monitoring wells are installations within boreholes that enable return monitoring to be carried out. The pipework was 50mm diameter HDPE, with the cased section sealed with bentonite, and the slotted response zone packed with a shingle filter pack.

Monitoring installations are summarised below, including the previous position BH003 and are shown on the relevant logs in the appendix.

Position	Response zone (m)		Diameter	Strata	Objective
	Top	Bottom			
MW001	0.30	1.00	50mm	Made Ground	Dual gas and groundwater
MW002	0.30	1.00			
MW003	0.20	1.00			
MW004	0.20	1.00			
BH003	2.00	20.00		Natural	

Post-fieldwork monitoring of ground gas, organic vapour and groundwater levels were undertaken on six occasions between 20th February and 24th March 2026.

4.6 Soil Sampling

Soil samples were recovered from the exploratory holes during the ground investigation and stored/transported to Land Science to allow logging to be undertaken. Sample types and depths are recorded on the relevant exploratory hole records.

4.7 PID Screening (PID)

Soil samples were screened for VOCs in headspace using a Photo Ionisation Detector (PID) broadly in accordance with the methodology set-out in CIRIA C682. Due to interference from humidity and other factors, Land Science adopts a method detection limit of 1.0ppm to avoid reporting false positive readings.

5.0 GROUND CONDITIONS

5.1 General

The expected ground conditions were anticipated to comprise Made Ground over Till Deposits over Collyhurst Sandstone to depth. The shallow investigation confirmed the anticipated Made Ground over Till Deposits. A thin capping of hardstanding was encountered at surface.

A summary of the encountered conditions is presented below.

Strata	Base Depth m			
	MW001	MW002	MW003	MW004
Hardstanding	0.30	0.30	0.20	0.20
Made Ground	0.90	0.90	0.90	0.90
Till Deposits	2.00	2.00	2.00	2.00

The naming of geological strata is tentative and should be used as a guide. Interpolation between or below investigation points should be treated with caution. The description of soils and rocks was in accordance with BS5930.

5.2 Hardstandings

All positions MW001 to MW004 were located within the hardstanding comprising concrete and crushed gravel, which was encountered to depths of between 0.20m and 0.30m. Concrete was cored in MW001 and MW004 to depths of 0.13m and 0.15m respectively.

5.3 Made Ground

Made Ground was encountered in all positions, and the full thickness was proved in all to a depth of 0.90m. In summary, the Made Ground comprised brown locally grey mottled orange sandy Clay/Silt with local black pockets, with rare clinker, coal and glass.

5.4 Till Deposits

The Till Deposits were encountered in all positions, and the boreholes terminated in this strata at a depth of 2.00mbgl. In summary, the Till Deposits comprised dark brown Clay with grey veining, with rare sandstone nodules. A strong hydrocarbon odour with fine pockets/fissures of hydrocarbon sheen were noted in MW001, with a slight odour noted in MW003.

5.5 Roots and Rootlets

Occurrences of roots and rootlets were noted as follows:

Position	Roots	Rootlets
MW001	0.30-0.90m: rare partially decomposed root 1.5mm dia. 0.90-2.00m: rare partially decomposed roots 8mm dia.	None
MW002	None	

Position	Roots	Rootlets
MW003	1.00-1.20m: occasional partially decomposed roots 8mm dia.	
MW004	None	

5.6 Field Evidence of Contamination

Made Ground soils were noted to contain rare clinker, coal and glass fragments.

Within the Till Deposits a strong hydrocarbon odour with fine pockets/fissures of hydrocarbon sheen were noted in MW001, with a slight odour note in MW003.

Made Ground was identified in all positions to a depth of 0.90m, and such materials may be imported from an unknown source or mixed with hazardous materials, and as such may contain a wide range of potential contaminants. All such materials should be treated as suspect unless proven otherwise.

5.7 Groundwater

Groundwater was not encountered during excavation of any of the investigative positions.

The level of water in a borehole can be affected by the drilling process and speed of infiltration; short-term rest levels should be used with caution.

5.8 Stability and Casing

The excavations were noted to be stable throughout, and the boreholes were not cased.

5.9 PID Screening (PID)

None of the samples exhibited VOCs above the detection limit, with the exception of the following tests.

Position	Strata	Result
MW001	Made Ground	1.00-2.00m (9.4ppm)
MW002		1.00-2.00m (0.1ppm)
MW003		1.00-2.00m (0.1ppm)

Overall, the readings were towards the lower end of the unit's detection limit (0.1ppm to 9999ppm).

The purpose of the screening was to identify samples which may be impacted by organic contaminants (such as VOCs, SVOCs, petroleum hydrocarbons, diesel, etc.). These could have been used to assist in prioritising samples for laboratory analysis.

6.0 MONITORING DATA

Recent positions MW001 to MW04 were monitored including an historic well BH003 located in the garage rear yard.

6.1 Groundwater Monitoring

Groundwater was recorded in the six return monitoring visits, standing at depths in the range of 0.32 – 6.32m and locally dry.

Position	During Drilling	Return Monitoring (m)
MW001	Dry	Dry
MW002		Dry - 0.55
MW003		0.70 - 0.94
MW004		Dry - 0.32
BH003		3.17 - 6.32

6.2 Ground Gas Monitoring

The results of the ground gas monitoring are summarised below:

Measurement	MW001	MW002	MW003	MW004	BH003
Carbon Dioxide %	0.0>0.7	0.0>2.2	0.0>1.0	0.0>0.1	0.0>0.4
Methane %	0.0	0.0	0.0	0.0	0.0
Oxygen %	20.8<19.7	20.9<10.3	20.9<17.3	18.4>21.1	19.8>21.0
VOCs ppm *	0.1-210	0.0-3.0	0.0-0.7	0.0-0.7	0.0-0.2
Flow rate l/hr	0.0-0.3	0.0-0.3	0.0-0.3	0.0-0.8	0.0-0.5

Below is a summary of the atmospheric pressure conditions during the monitoring visits:

Visit	Pressure (recorded on site)	Published Pressure Trend
20 th February 2026	1012-1010mB	Fluctuating high to intermediate pressure (Manc.)
26 th February 2026	1006-1005mB	Fluctuating high-intermediate high pressure (Manc.)
5 th March 2026	1013mB	Fluctuating high pressure (Manc.)
16 th March 2026	1012mB	Rising high pressure (Manc.)
20 th March 2026	1019mB	Fluctuating high pressure (Manc.)
24 th March 2026	1008-1006mB	Fluctuating high to intermediate pressure (Manc.)

7.0 GROUND GAS ASSESSMENT

7.1 General

The risks associated with ground gases in respect of end users have been evaluated in general accordance with BS8485:2015+A1:2019 *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings* and CIRIA C665 (2007) entitled *Assessing Risks Posed by Hazardous Ground Gases to Buildings*.

Due to the Made Ground and possible vapours the Client requested ground gas monitoring.

Source	Pathway	Receptor
Ground gases arising from: Made Ground	Inhalation, explosion	End users

7.2 Gas Monitoring Rounds

It should be noted that the presence of a gas does not necessarily imply that a site or area is contaminated or that there is any unacceptable risk.

Concentrations of ground gases recorded may be affected by a variety of factors including atmospheric pressure, groundwater, rainfall and temperature, as well as the gas generation potential of the source. CIRIA C665 prescribe typical periods and frequency of monitoring visits required, as summarised on the following table (after CIRIA C665 Tables 5.5a and 5.5b):

Based on the results and the requirements of BS8485:2015+A1:2019, it is concluded that the monitoring visits undertaken to date are sufficient to broadly characterise gas situation likely to be present at the site.

Generation Potential ^{1,2}		Very Low	Low	Moderate	High	Very High
Example		Inert Made Ground	Alluvium or dock silt	Pre-1960 landfill	Shallow mine workings	Post '60's domestic landfill
Sensitivity of development	Low	4/1	6/2	6/3	12/6	12/12
	Moderate	6/2	6/3	9/6	12/12	24/24
	High	6/3	9/6	12/6	24/12 ³	24/24 ³

Notes:

- 1 - First digit is number of visits and second digit is number of months, e.g. 9/6 means nine visits in total over a period of 6 months
- 2 - At least two sets of readings should ideally be undertaken during low and falling atmospheric pressure <1000mB
- 3 - High sensitivity development on high gas hazard land is not normally acceptable unless the source is removed or otherwise treated.

7.3 Monitoring Data

BS8485:2015+A1:2019 categorises sites into one of six characteristic situations based on gas concentrations, flow rates and a calculated gas screening value, as summarised on the following table:

CS	Hazard Potential	CH ₄	CO ₂	Flow	Gas Screening Value (GSV)
1	Very low	<1.0%	<5.0%	-	<0.07l/hr
2	Low	-	-	<70l/hr	<0.7l/hr
3	Moderate	-	-	-	<3.5l/hr
4	Moderate to high	-	-	-	<15l/hr
5	High	-	-	-	<70l/hr
6	Very high	-	-	-	>70l/hr

The monitoring data has been appraised as follows:

Exploratory Hole	Target Stratum	Max CH ₄ (%)	Max CO ₂ (%)	Max Flow (l/hr)^	GSV CH ₄ (l/hr)	CS CH ₄	GSV CO ₂ (l/hr)	CS CO ₂	Was response zone fully flooded?
MW001	Made Ground	0.0	0.7	0.3	0.000	1	0.001	1	No
MW002		0.2	2.2	0.3	0.001	1	0.007	1	No
MW003		0.0	1.0	0.3	0.000	1	0.002	1	No
MW004		0.0	0.1	0.8	0.000	1	0.001	1	No
BH003	Natural	0.0	0.4	0.5	0.000	1	0.001	1	No

GSV = Gas Situation Value; CS = Characteristic Situation

The results obtained to date corresponds to a gas characteristic situation CS1, with no ground gas protection required.

7.4 Volatile Organic Compounds (VOCs)

VOCs were detected during the monitoring. No single guideline concentration has been published for total VOCs as the associated risks posed are difficult predict using such a measurement. Different species of VOCs might variously pose an odour nuisance and a possible carcinogenic risk, and in some instances, pose a risk of explosion.

7.5 Conclusions

With reference to section 7.3, the source of gases was identified as not posing a significant risk to the on-site development and therefore, no significant risk is posed to adjacent land users.

No ground gas protection is required on site, however, VOCs have been recorded within the Made Ground through field testing, previous laboratory testing, and monitoring on site. It is understood that although some Made Ground will be removed from site during the construction phase some will remain on site. Therefore, remediation is necessary and it is recommended that an organic vapour resistant membrane is installed within the floor slab construction of the proposed buildings to

protect the residents. A ventilated subfloor void is unlikely to be appropriate given the expected piled foundation solution.

A copy of this report should be submitted to the relevant authorities for approval in sufficient time prior to commencement on site.

CONTROLLED

REFERENCES

A number of technical references have been referred to in the preparation of this document, including:

- Smith, I. (2014) Smith's Elements of Soil Mechanics. Chichester. Wiley Blackwell. 9th edition.
- BRE Design Guide 365. Soakaway design ("DG365").
- Radon: Guidance on protective measures for new buildings, BRE Report BR 211, 2023 6th edition.
- The Environment Agency's approach to groundwater protection. February 2018 Version 1.2.
- Water UK and the Home Builders Federation; Contaminated Land Assessment Guidance, dated January 2014.
- Concrete – Complementary British Standard to BS EN 206 - Method of specifying and guidance for the specifier BS 8500-1:2023 - TC, dated November 2023.
- Revised EU Waste Framework Directive 2008 2008/98/EC [transposed into English law under The Waste (England and Wales) Regulations 2011].
- European Community (EC) Directive 1999/31/EC [transposed into English law under the Landfill (England and Wales) Regulations 2002].
- Defining Waste Recovery - Permanent Deposit of Waste on Land, EPR13 v1.0, EA 2010.
- The definition of waste: Development Industry Code of Practice, v2, CL:AIRE 2011.
- Guidance on the classification and assessment of waste Technical Guidance WM3 ("WM3") EA publication (1st edition v1.2GB) dated 2021.

REPORT CONDITIONS

The Client

This report may only be used by the client named in section 1 and their appointed project team for the purpose of design, obtaining planning, building regulations approval, and in connection with finance. This report must not be used by any other persons or for other purposes without express written agreement of Land Science.

General

Land Science takes all reasonable professional care in the preparation of this report, using current standards and industry practice. However, the evaluation of ground conditions depends on an interpretation and extrapolation of the conditions revealed by a limited data set. The level of risk is related to the extent of investigation and no site is ever free of risk. The client should understand their risks and liabilities. We accept no liability whatsoever in respect of:

- The scope, extent or design of an investigation.
- Any conditions not directly revealed by the investigation.
- Published standards or methodologies used or adopted in this report.
- The opinion of any other party including any regulator, authority or stakeholder.
- Any dispute, claim or consequential loss arising from any findings of this report.
- Third party information and data.

This report relates solely to ground-related matters as set out in the objectives and makes no representation on other matters such as ecology, arboriculture, invasive plant species, the condition of buildings and structures, hazardous building materials such as insulation or asbestos, the locations of boundaries, unexploded ordnance, and or planning constraints etc. Further reports should be commissioned in this respect as appropriate.

Regulators and Approvals

This (and any other) report should be submitted to relevant authorities for their own assessments and to provide their approval or comments accordingly. This should be in good time before commencing on site in case additional work is to be carried out.

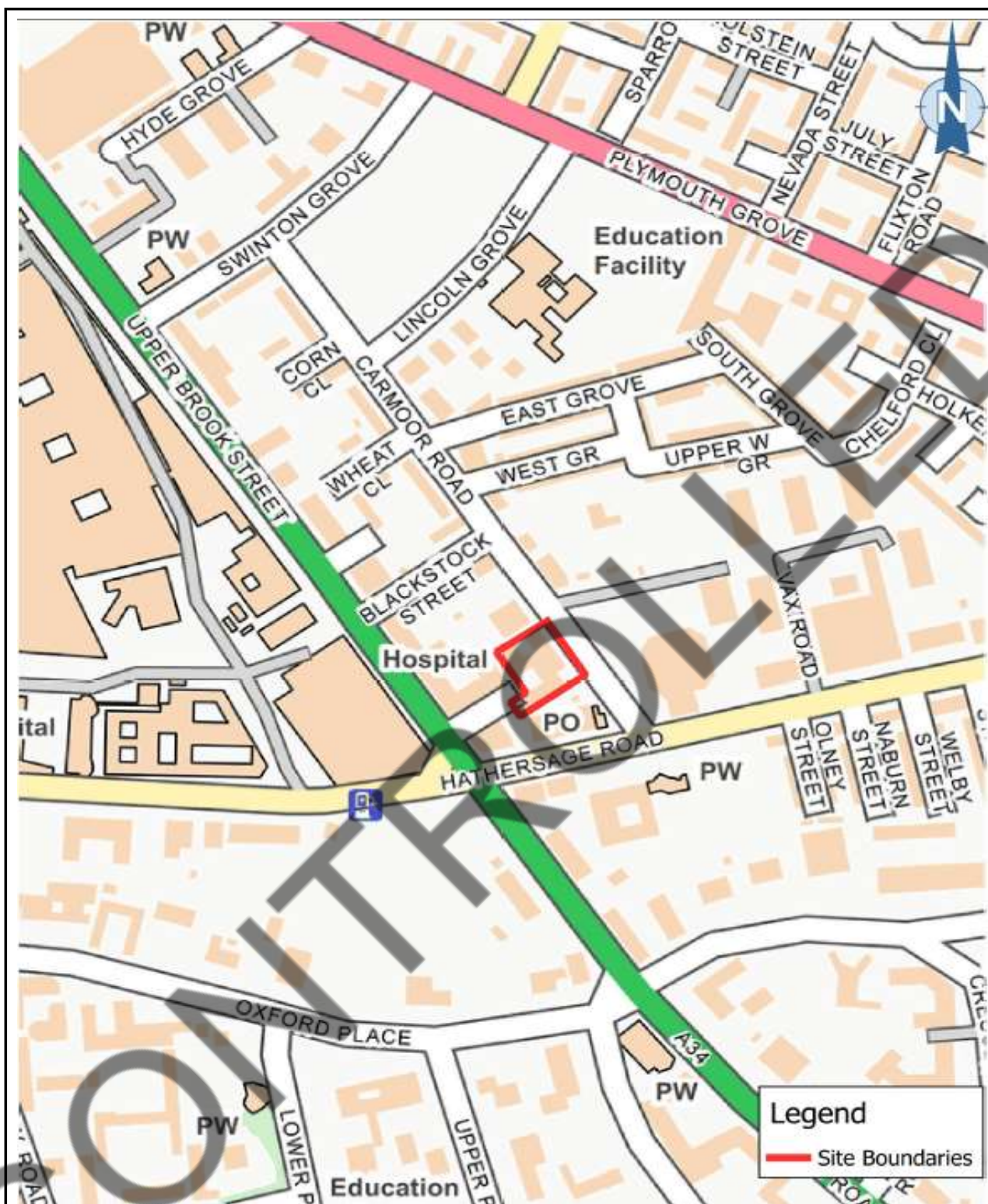
Standards, technical guidance and regulatory positions change over time and may therefore affect the findings and recommendations made in this report; this should be verified by the client prior to any critical project milestones. Where this information is used in design, the designer should verify that the information is appropriate and has been used correctly.

Variations with Time

The report relates to conditions revealed at the time of the investigation and any monitoring visits. Some parameters may vary over time or seasonally; groundwater levels, ground gas compositions, or concentrations of contaminants are particularly variable in this respect. Further monitoring or verification should be considered as appropriate.

GLOSSARY OF TERMS

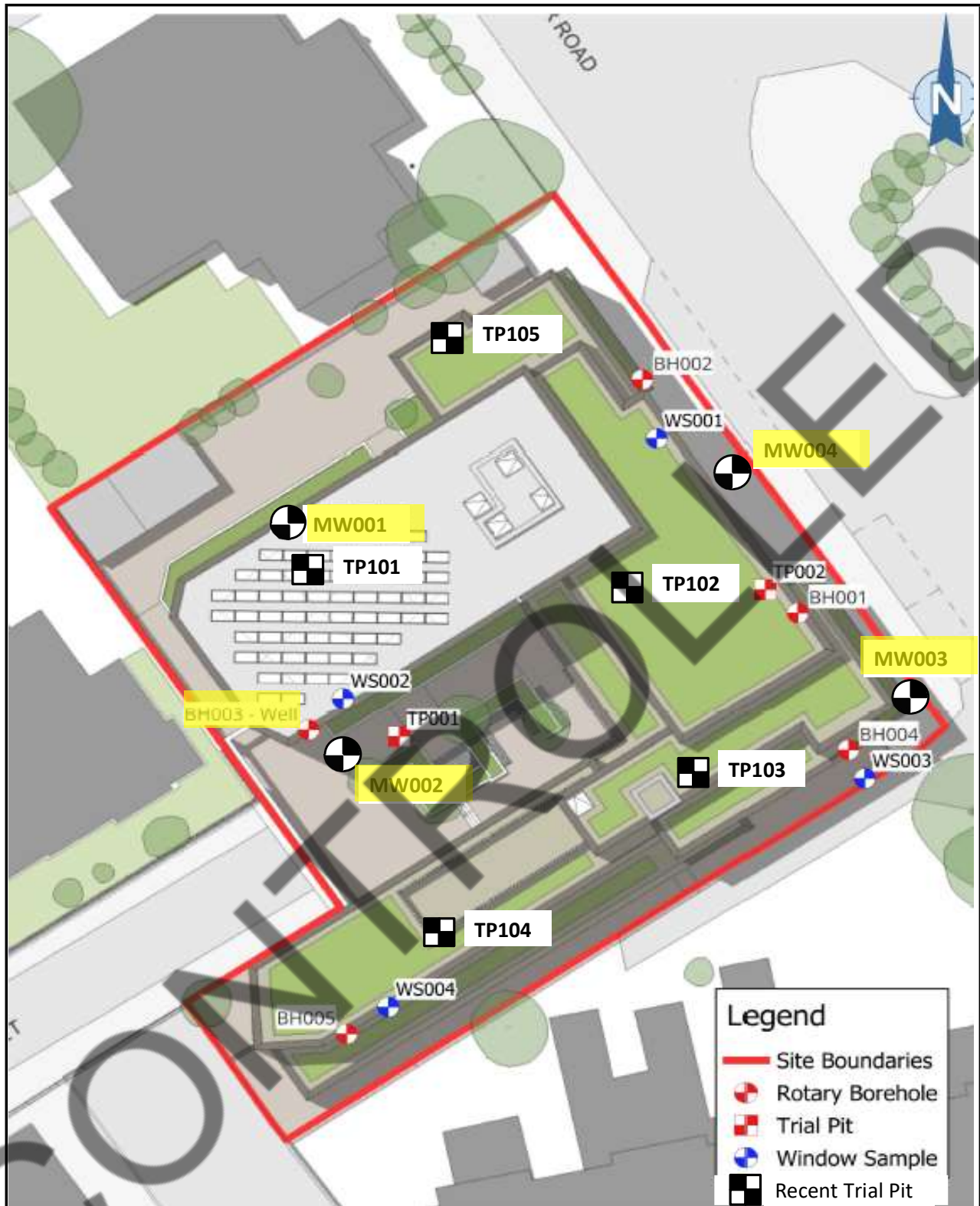
ACM	Asbestos Containing Material
BGS	British Geological Survey
BRE	Building Research Establishment
BS	British Standard
C4SL	Category 4 Screening Level
CBR	California Bearing Ratio
CDM	Construction Design and Management regulations
CIRIA	Construction Industry Research and Information Association
CL:AIRE	Contaminated Land: Applications in Real Environments
CLEA	Contaminated Land Exposure Assessment model
CSM	Conceptual Site Model
EA	Environment Agency
EQS	Environmental Quality Standards
FOC	Fraction of Organic Carbon
GAC	Generic Assessment Criterion
GQRA	Generic Quantitative Risk Assessment
mbgl	Meters Below Ground Level
NHBC	National House Building Council
mOD	Metres above Ordnance Datum
PAHs	Polycyclic Aromatic Hydrocarbons
PHE	Public Health England
PID	Photo-Ionisation Detector
PQRA	Preliminary Quantitative Risk Assessment
PSD	Particle Size Distribution Test
RMS	Remediation Method Statement
S4UL	Suitable for Use Level
SOM	Soil Organic Matter
SPZ	Source Protection Zone
SPT	Standard Penetration Test
SSSI	Sites of Special Scientific Interest
ST-WEL	Short Term Workplace Exposure Limit
SVOCs	Semi-Volatile Organic Compounds
TPH	Total Petroleum Hydrocarbons
TRRL / TRL	Transport Road Research Laboratory
TWA-WEL	Time Weighted Average Workplace Exposure Limit
UK HBF	United Kingdom House Building Federation
VOCs	Volatile Organic Compounds
WAC	Waste Acceptance Criteria



TITLE: Site Location			REF: LS9064
PROJECT: 90 Carmoor Road, Manchester, M13 0FB			FIGURE 1
CLIENT: Tiger Developments Ltd			DATE: 16.02.2026
CHECK: JM	CHECK: MR	VERSION V1	SHEET: 1 OF 1



	TITLE: Site Investigation Layout			REF: LS9064
	PROJECT: 90 Carmoor Road, Manchester, M13 0FB			FIGURE 2
	CLIENT: Tiger Developments Ltd			DATE: 23.03.2026
	CHECK: JM	CHECK: MR	VERSION V1	SHEET: 1 OF 1



	TITLE: Proposed Development			REF: LS9064
	PROJECT: 90 Carmoor Road, Manchester, M13 0FB			FIGURE 3
	CLIENT: Tiger Developments Ltd			DATE: 23.03.2026
	CHECK: JM	CHECK: MR	VERSION V1	SHEET: 1 OF 1

APPENDIX A



	TITLE:	Site Photographs	REF:	LS9064	PREPARED:	JM
	PROJECT:	90 Carmoor Road, Manchester M13 0FB	SHEET:	1	CHECKED:	MR
	CLIENT:	Tiger Developments Ltd	DATE:	23/03/2026	VERSION	V1

APPENDIX B

Excavation Method Drive-in Windowless Sampler		Dimensions		Ground Level (mOD)		Client Tiger Developments Ltd		Job Number LS9064	
		Location		Dates 03/02/2026		Engineer Land Science		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00-1.00	L					Concrete over mixed demolition crushed GRAVEL. (MADE GROUND)			
					0.30	Brown locally grey, mottled orange sandy CLAY/SILT, with local black pockets. Rare fine clinker, coal and glass fragments. Rare partially decomposed root 1.5mm dia. (MADE GROUND)			
					0.60				
					0.90	Stiff dark brown CLAY, with grey veining. Rare weak off-white/grey fine sandstone nodules. Rare partially decomposed roots 8mm dia. Strong hydrocarbon odour with rare fine pockets/fissures with hydrocarbon sheen. (DEVENSIAN TILL)			
1.00-2.00	L		1.00-2.00m: PID=9.4ppm (maximum)		1.10				
					2.00	Complete at 2.00m			
Remarks GROUNDWATER: None encountered. CASING: None used. INSTALLATION: 50mm dia HDPE standpipe to 1.00m: GL-0.30m plain . 0.30-1.00m slotted. BACKFILL: Bentonite 1.00-2.00m. STABILITY: Generally stable. NOTES: Cored to 0.13m and borehole completed at target depth.								Scale (approx)	Logged By
								1:25	JM
								Figure No. LS9064.MW001	

Machine :		Casing Diameter		Ground Level (mOD)		Client		Job Number	
Flush :						Tiger Developments Ltd		LS7347	
Core Dia: mm						Project Contractor		Sheet	
Method : Rotary Cored		Location		Dates		Land Science		1/2	
				31/01/2024-02/02/2024					

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.15							0.15	CONCRETE (HARDSTANDING)			
(0.65)							(0.65)	Grey black silty, gravelly CLAY. Gravels are fine to coarse flints, concrete, red brick. (MADE GROUND)			
0.80							0.80	Brown, silty CLAY with occasional gravels. Gravels are fine to cobbles flints, sandstone and mudstones. (DEVENSIAN TILL)			
1.20	IV(P) 96 kPa				1,0/0,0,0,1						
1.20-1.65					SPT N=1						
1.20-2.00					D						
2.00	IV(P) 120 kPa				1,2/2,2,2,2						
2.00-2.45					SPT N=8						
2.00-2.50					D						
2.50	IV(P) 48 kPa				1,0/2,1,3,3						
2.70-3.00					UT						
3.00-3.45					SPT N=9						
3.00-4.00					D						
3.10	IV(P) 168 kPa										
3.50	IV(P) 192 kPa										
4.00	IV(P) 168 kPa										
4.00-4.50					UT 73 blows						
4.50	IV(P) 168 kPa				3,4/6,4,7,7						
4.50-4.95					SPT N=24						
4.50-5.00					D						
5.00	IV(P) 168 kPa				5,4/4,5,7,8						
5.00-5.45					SPT N=24						
5.00-6.00					D						
5.50	IV(P) 144 kPa										
6.00	IV(P) 96 kPa				7,7/6,7,8,8		(10.20)				
6.00-6.45					SPT N=29						
6.00-7.00					D						
7.00-7.45					3,4/6,9,9,8						
7.00-8.00					SPT N=32						
					D						
8.00	IV(P) 120 kPa				7,6/8,9,9,8						
8.00-8.45					SPT N=34						
8.00-8.50					D						
8.40	IV(P) 120 kPa				7,9/9,8,9,8						
8.60-9.00					UT						
9.00-9.45					SPT N=34						
9.00-10.00					B						
9.10	IV(P) 120 kPa										
10.00-10.45					7,9/9,9,8,7						
10.00-11.00					SPT N=33						
					B						
11.00-11.45					7,9/12,10,9,9		11.00				
11.00-12.00					SPT N=40			Red yellow, slightly clayey, gravelly SAND. Sands are fine to coarse. Gravels are fine to cobbles, sandstones. (DEVENSIAN TILL)			
					B						
12.00-12.45					6,4/12,11,14,12		(2.50)				
12.00-13.50					SPT N=49						
					B						
13.50-13.95					8,12/50,20,0,0		13.50				
13.50-15.00					SPT N=70			Red SAND. Sands are fine to coarse. (COLLYHURST SANDSTONE)			
					B						
15.00-15.45					7,9/10,40,15,0						
					SPT N=65						

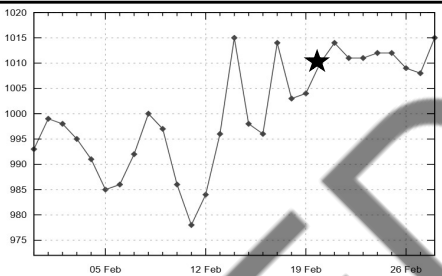
Remarks GROUNDWATER: No groundwater encountered. CASING: Casing from 4 to 21m. INSTALLATION: 50mm diameter HDPE standpipe to 20.00; plain casing to 2.00m, slotted response zone 2.00m to 20.00m. BACKFILLED: Backfilled with clean arisings. SLOW PROGRESS: Progress was slow. NOTES: Borehole completed at 21.0m									Scale (approx)		Logged By
									1:75		
									Figure No.		BM
									LS7347.BH003		

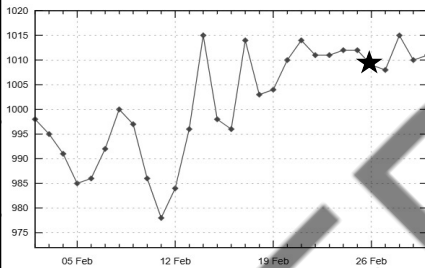
Machine : Flush : Core Dia: mm Method : Rotary Cored	Casing Diameter	Ground Level (mOD)	Client Tiger Developments Ltd	Job Number LS7347
	Location	Dates 31/01/2024- 02/02/2024	Project Contractor Land Science	Sheet 2/2

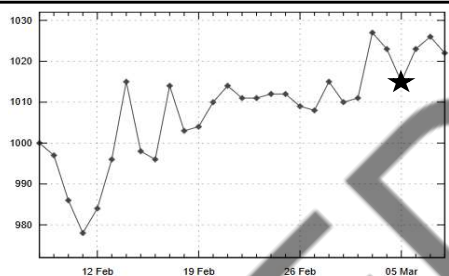
Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
15.00-16.50					B						
16.50-16.95 16.50-18.00					25,60/50,40,0,0 SPT N=90 B		(6.00)				
18.00-18.45 18.00-19.50					25,60/50,30,0,0 SPT N=80 B						
19.50-19.95 19.50-21.00					25,40/50,36,0,0 SPT N=86 B		19.50 (1.50)	Red fine grained SANDSTONE (COLLYHURST SANDSTONE)			
21.00-21.45					25,30/50,40,0,0 SPT N=90		21.00	Complete at 21.00m			

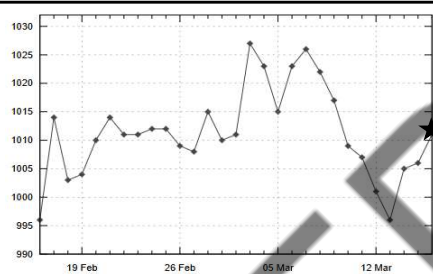
Remarks									Scale (approx) 1:75	Logged By BM
									Figure No. LS7347.BH003	

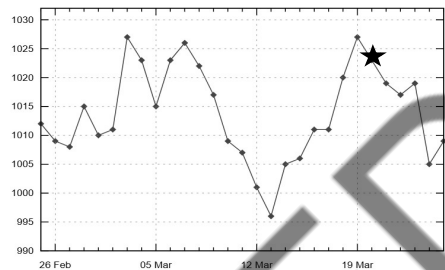
APPENDIX C

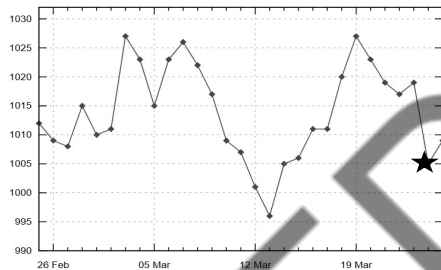
GROUND GAS AND GROUNDWATER MONITORING												
Project: 90 Carmoor Road			Ref: LS9064									
Date: 20.02.2026			Visit: 1									
Engineer: Ryan Chau			Check: JM									
Weather: Light Rain			Page: 1 of 1									
Atmospheric Pressure		before:		1012 mB		Time		08:55				
		after:		1010 mB		Time		10:40				
Published pressure trend:		Fluctuating high to intermediate pressure (Manc.)										
Remarks: Equipment used: GFM 435, PhoCheck Tiger PID, Dipmeter												
Position	Flow (l/hr)		Common Gases (%)				VOC's (ppm)	Groundwater (m)				Remarks
	High	Low	Time	CO2	CH4	O2		LNAPL	Water	DNAPL	Base	
Calibration Check	0.0	0.0	15s	0.2	0.0	20.9	0.0	-	-	-	-	Calibration check passed
			30s	0.2	0.0	20.9						
			60s	0.2	0.0	20.9						
MW001	0.3	0.3	15s	0.1	0.0	20.9	End - 2.2 Peak - 6.2	-	Dry	-	0.95	Lid and 50mm bung with gas valve missing.
			30s	0.1	0.0	20.9						
			60s	0.1	0.0	20.9						
			120s	0.2	0.0	20.8						
			180s	0.2	0.0	20.8						
			240s	0.2	0.0	20.8						
MW002	0.3	0.3	300s	0.2	0.0	20.8						
			15s	0.2	0.0	20.9						
			30s	0.2	0.0	21.1						
			60s	0.2	0.0	21.2						
			120s	0.2	0.0	21.3						
			180s	0.1	0.0	21.3						
MW003	0.3	0.3	240s	0.1	0.0	21.3	0.0	-	0.94	-	1.08	
			300s	0.1	0.0	21.3						
			15s	0.1	0.0	20.9						
			30s	0.1	0.0	20.9						
			60s	0.1	0.0	20.9						
			120s	0.1	0.0	20.9						
MW004	0.3	0.3	180s	0.1	0.0	20.9						
			240s	0.1	0.0	20.9						
			300s	0.1	0.0	20.9						
			15s	0.1	0.0	20.9						
			30s	0.1	0.0	20.9						
			60s	0.1	0.0	20.9						
BH003	0.3	0.3	120s	0.1	0.0	20.9	0.0	-	3.25	-	13.29	
			180s	0.1	0.0	20.7						
			240s	0.1	0.0	20.8						
			300s	0.1	0.0	20.8						
			15s	0.4	0.0	20.9						
			30s	0.4	0.0	20.7						
Calibration Check	0.0	0.0	60s	0.4	0.0	20.7						
			120s	0.4	0.0	20.7						
			180s	0.5	0.0	20.7						
			240s	0.4	0.0	20.7						
			300s	0.4	0.0	20.8						
			15s	0.0	0.0	19.6						
Calibration Check	0.0	0.0	30s	0.0	0.0	19.7	0.0	-	-	-	-	Calibration check passed
			60s	0.0	0.0	19.7						

GROUND GAS AND GROUNDWATER MONITORING												
Project: 90 Carmoor Road			Ref: LS9064									
Date: 26.02.2026			Visit: 2									
Engineer: Alex Lintern			Check: JM									
Weather: Overcast			Page: 1 of 1									
Atmospheric Pressure		before: 1006 mB		Time 09:15								
		after: 1005 mB		Time 12:15								
Published pressure trend:		Fluctuating high-intermediate high pressure (Manc.)										
Remarks: Equipment used: GFM 435, PhoCheck Tiger PID, Dipmeter												
Position	Flow (l/hr)		Common Gases (%)				VOC's (ppm)	Groundwater (m)				Remarks
	High	Low	Time	CO2	CH4	O2		LNAPL	Water	DNAPL	Base	
Calibration Check	0.0	0.0	15s	0.0	0.0	19.9	0.0	-	-	-	-	Calibration check passed
			30s	0.0	0.0	19.9						
			60s	0.0	0.0	19.9						
MW001	0.0	0.0	15s	0.0	0.0	20.0	210.0	-	Dry	-	0.79	Strong hydrocarbon odour
			30s	0.0	0.0	19.9						
			60s	0.0	0.0	19.9						
			120s	0.0	0.0	19.9						
			180s	0.0	0.0	19.9						
			240s	0.0	0.0	19.9						
MW002	0.1	0.0	15s	0.0	0.0	19.8	3.0	-	Dry	-	0.95	
			30s	0.0	0.0	19.9						
			60s	0.0	0.0	19.9						
			120s	0.0	0.0	19.9						
			180s	0.0	0.0	19.9						
			240s	0.0	0.0	19.9						
MW003	0.1	0.0	15s	0.0	0.0	19.9	0.4	-	0.80	-	0.93	
			30s	0.0	0.0	19.9						
			60s	0.0	0.0	19.9						
			120s	0.0	0.0	19.8						
			180s	0.0	0.0	19.8						
			240s	0.0	0.0	19.8						
MW004	0.0	0.0	15s	0.0	0.0	18.4	0.7	-	0.90	-	0.93	No cover - replacement left
			30s	0.0	0.0	19.5						
			60s	0.0	0.0	19.8						
			120s	0.0	0.0	19.8						
			180s	0.0	0.0	19.8						
			240s	0.0	0.0	19.8						
BH003	0.0	0.0	15s	0.0	0.0	19.9	0.2	-	3.17	-	13.3	
			30s	0.0	0.0	19.9						
			60s	0.0	0.0	19.9						
			120s	0.0	0.0	19.9						
			180s	0.0	0.0	19.9						
			240s	0.0	0.0	19.9						
Calibration Check	0.0	0.0	15s	0.0	0.0	19.9	0.0	-	-	-	-	Calibration check passed
			30s	0.0	0.0	19.9						
			60s	0.0	0.0	19.9						

GROUND GAS AND GROUNDWATER MONITORING												
Project: 90 Carmoor Road			Ref: LS9064									
Date: 05.03.2026			Visit: 3									
Engineer: Siobhan Mullen			Check: JM									
Weather: Sunny			Page: 1 of 1									
Atmospheric Pressure			before: 1013 mB		Time 11:40							
			after: 1013 mB		Time 12:55							
Published pressure trend:			Fluctuating high pressure (Manc.)									
Remarks:			Equipment used: GFM 435, PhoCheck Tiger PID, Dipmeter									
Position	Flow (l/hr)		Common Gases (%)				VOCs (ppm)	Groundwater (m)				Remarks
	High	Low	Time	CO2	CH4	O2		LNAPL	Water	DNAPL	Base	
Calibration Check	0.0	0.0	15s	0.2	0.0	20.6	0.0	-	-	-	-	Calibration check passed
			30s	0.0	0.0	20.6						
			60s	0.0	0.0	20.6						
MW001	-0.8	-0.8	15s	0.7	0.0	20.7	2.0	-	Dry	-	0.95	Lid and 50mm bung with gas valve missing
			30s	0.7	0.0	20.1						
			60s	0.6	0.0	20.1						
			120s	0.5	0.0	20.2						
			180s	0.4	0.0	20.3						
			240s	0.3	0.0	20.5						
MW002	0.8	0.3	300s	0.2	0.0	20.6	0.0	-	0.73	-	1.03	13mm socket needed for opening lid.
			15s	0.6	0.0	20.9						
			30s	0.1	0.0	20.9						
			60s	0.1	0.0	20.9						
			120s	0.1	0.0	21.0						
			180s	0.1	0.0	20.9						
MW003	0.0	0.0	240s	0.1	0.0	21.0	0.0	-	0.70	-	0.96	Borehole casing detached.
			300s	0.1	0.0	21.0						
			15s	0	0.0	20.8						
			30s	0	0.0	20.8						
			60s	0	0.0	20.8						
			120s	0	0.0	20.8						
MW004	0.6	0.2	180s	0	0.0	20.7	0.0	-	Dry	-	1.05	Lid missing & no bung/gas tap.
			240s	0	0.0	20.7						
			300s	0	0.0	20.7						
			15s	0.1	0.0	20.9						
			30s	0.1	0.0	20.9						
			60s	0	0.0	20.9						
BH003	NR	NR	120s	0	0.0	20.9	0.0	-	Dry	-	1.05	Lid missing & no bung/gas tap.
			180s	0	0.0	20.9						
			240s	0	0.0	20.9						
			300s	0	0.0	20.9						
			15s	NR	NR	NR						
			30s	NR	NR	NR						
Calibration Check	0.0	0.0	60s	NR	NR	NR	NR	-	NR	-	NR	No record: Technician could not locate well; position buried under stockpile of bricks.
			120s	NR	NR	NR						
			180s	NR	NR	NR						
			240s	NR	NR	NR						
			300s	NR	NR	NR						
			15s	0.1	0.0	20.9						
Calibration Check	0.0	0.0	30s	0.1	0.0	20.9	0.0	-	-	-	-	Calibration check passed
			60s	0.1	0.0	20.9						

GROUND GAS AND GROUNDWATER MONITORING												
Project: 90 Carmoor Road			Ref: LS9064									
Date: 16.03.2026			Visit: 4									
Engineer: Siobhan Mullen			Check: MR									
Weather: Cloudy			Page: 1 of 1									
Atmospheric Pressure			before: 1012 mB		Time 09:50							
			after: 1012 mB		Time 11:05							
Published pressure trend:			Rising high pressure (Manc.)									
Remarks: Equipment used: GFM 435, PhoCheck Tiger PID, Dipmeter												
Position	Flow (l/hr)		Common Gases (%)				VOC's (ppm)	Groundwater (m)				Remarks
	High	Low	Time	CO2	CH4	O2		LNAPL	Water	DNAPL	Base	
Calibration Check	0.0	0.0	15s	0.1	0.0	19.9	0.0					Calibration check passed
			30s	0.1	0.0	19.9						
			60s	0.1	0.0	19.9						
MW001	0.3	0.1	15s	0.1	0.0	20.2	0.1		Dry		0.95	Lid and 50mm bung with gas valve missing.
			30s	0.1	0.0	20.2						
			60s	0.1	0.0	20.2						
			120s	0.1	0.0	20.2						
			180s	0.1	0.0	20.3						
			240s	0.1	0.0	20.3						
MW002	0.3	0.1	300s	0.1	0.0	20.3	0.0		0.77		0.98	13mm socket needed for opening lid.
			15s	0.2	0.0	19.8						
			30s	0.2	0.0	19.7						
			60s	0.6	0.0	17.7						
			120s	1.5	0.1	13.4						
			180s	1.7	0.1	12.3						
MW003	0.3	0.2	240s	2.0	0.2	11.1	0.2		0.85		1.02	Gas tap blocked
			300s	2.2	0.2	10.3						
			15s	0.2	0.0	19.3						
			30s	0.6	0.0	18.2						
			60s	0.4	0.0	17.8						
			120s	0.5	0.0	17.4						
MW004	0.8	0.4	180s	0.4	0.0	17.8	0.0		0.32		0.88	Lid missing & no bung/gas tap.
			240s	0.4	0.0	18.2						
			300s	0.3	0.0	18.6						
			15s	0.1	0.0	21.1						
			30s	0.1	0.0	21.1						
			60s	0.1	0.0	21.1						
BH003	0.5	0.2	120s	0.1	0.0	21.1	0.0		3.39		13.24	No gas tap
			180s	0.1	0.0	21.1						
			240s	0.1	0.0	21.1						
			300s	0.1	0.0	21.1						
			15s	0.1	0.0	19.8						
			30s	0.1	0.0	20.6						
Calibration Check	0.0	0.0	60s	0.1	0.0	20.8	0.0					Calibration check passed
			120s	0.1	0.0	20.8						
			180s	0.1	0.0	20.8						
Calibration Check	0.0	0.0	240s	0.1	0.0	20.9	0.0					Calibration check passed
			300s	0.1	0.0	20.9						
			15s	0.1	0.0	21.1						
Calibration Check	0.0	0.0	30s	0.1	0.0	21.1	0.0					Calibration check passed
			60s	0.1	0.0	21.1						
			15s	0.1	0.0	21.1						

GROUND GAS AND GROUNDWATER MONITORING												
Project: 90 Carmoor Road			Ref: LS9064									
Date: 20.03.2026			Visit: 5									
Engineer: Ian Sidgwick			Check: JM									
Weather: Sunny			Page: 1 of 1									
Atmospheric Pressure		before:		1019 mB		Time		08:00				
		after:		1019 mB		Time		08:40				
Published pressure trend:		Fluctuating high pressure (Manc.)										
Remarks: Equipment used: GFM 435, PhoCheck Tiger PID, Dipmeter												
Position	Flow (l/hr)		Common Gases (%)				VOC's (ppm)	Groundwater (m)				Remarks
	High	Low	Time	CO2	CH4	O2		LNAPL	Water	DNAPL	Base	
Calibration Check	0.0	0.0	15s	0.1	0.0	20.8	0.0	-	-	-	-	
			30s	0.1	0.0	20.8						
			60s	0.1	0.0	20.8						
MW001	0.0	0.0	15s	0.5	0.0	19.7	0.4	-	Dry	-	0.82	Lid and 50mm bung with gas valve missing
			30s	0.5	0.0	19.7						
			60s	0.5	0.0	19.7						
			120s	0.5	0.0	19.7						
			180s	0.5	0.0	19.7						
			240s	0.5	0.0	19.7						
MW002	0.0	0.0	300s	0.5	0.0	19.7						
			15s	0.9	0.1	15.8						
			30s	0.9	0.1	15.8						
			60s	0.9	0.1	15.8						
			120s	0.9	0.1	15.8						
			180s	0.9	0.1	15.8						
MW003	0.0	0.0	240s	0.9	0.1	15.8	0.7	-	0.86	-	1.02	Gas tap blocked
			300s	0.9	0.1	15.8						
			15s	1.0	0.0	17.3						
			30s	1.0	0.0	17.3						
			60s	1.0	0.0	17.3						
			120s	1.0	0.0	17.3						
MW004	0.0	0.0	180s	1.0	0.0	17.3						
			240s	1.0	0.0	17.3						
			300s	1.0	0.0	17.3						
			15s	0.1	0.0	20.4						
			30s	0.1	0.0	20.4						
			60s	0.1	0.0	20.4						
BH003	0.0	0.0	120s	0.1	0.0	20.4	0.0	-	NR	-	NR	Incorrect dip from technician
			180s	0.1	0.0	20.4						
			240s	0.1	0.0	20.4						
			300s	0.1	0.0	20.4						
			15s	0.1	0.0	20.3						
			30s	0.1	0.0	20.3						
Calibration Check	0.0	0.0	60s	0.1	0.0	20.3						
			15s	0.1	0.0	21.1						
			30s	0.1	0.0	21.1						
			60s	0.1	0.0	21.1						

GROUND GAS AND GROUNDWATER MONITORING												
Project: 90 Carmoor Road			Ref: LS9064									
Date: 24.03.2026			Visit: 6									
Engineer: Ryan Chau			Check: JM									
Weather: Cloudy			Page: 1 of 1									
Atmospheric Pressure		before: 1008 mB		Time 11:36								
		after: 1006 mB		Time 13:05								
Published pressure trend:		Fluctuating high to intermediate pressure (Manc.)										
Remarks: Equipment used: GFM 435, PhoCheck Tiger PID, Dipmeter												
Position	Flow (l/hr)		Common Gases (%)				VOC's (ppm)	Groundwater (m)				Remarks
	High	Low	Time	CO2	CH4	O2		LNAPL	Water	DNAPL	Base	
Calibration Check	0.0	0.0	15s	0.2	0.0	20.9	0.0	-	-	-	-	
			30s	0.2	0.0	20.9						
			60s	0.2	0.0	20.9						
MW001	0.1	-0.6	15s	0.6	0.0	21.1	0.0	-	Dry	-	0.86	BH covering missing
			30s	0.7	0.0	20.4						
			60s	0.7	0.0	20.4						
			120s	0.6	0.0	20.4						
			180s	0.5	0.0	20.6						
			240s	0.4	0.0	20.8						
MW002	0.3	0.0	15s	0.2	0.0	20.9	0.3	-	Dry	-	0.96	BH casing missing
			30s	0.2	0.0	20.9						
			60s	0.2	0.0	20.9						
			120s	0.2	0.0	20.9						
			180s	0.1	0.0	20.9						
			240s	0.1	0.0	20.9						
MW003	NR	NR	15s	NR	NR	NR	NR	-	NR	-	NR	Technician could not locate; buried under stockpile of bricks
			30s	NR	NR	NR						
			60s	NR	NR	NR						
			120s	NR	NR	NR						
			180s	NR	NR	NR						
			240s	NR	NR	NR						
MW004	0.0	-0.8	15s	0.1	0.0	20.9	0.0	-	Dry	-	0.67	Lid missing & no bung/gas tap
			30s	0.1	0.0	20.7						
			60s	0.1	0.0	20.7						
			120s	0.1	0.0	20.8						
			180s	0.1	0.0	20.8						
			240s	0.1	0.0	20.8						
BH003	0.1	-0.7	15s	0.1	0.0	21.0	0.0	-	6.32	-	13.24	BH casing missing & gas tap missing
			30s	0.1	0.0	21.0						
			60s	0.1	0.0	21.0						
			120s	0.1	0.0	21.1						
			180s	0.1	0.0	21.1						
			240s	0.1	0.0	21.1						
Calibration Check	0.0	0.0	15s	0.2	0.0	20.9	-	-	-	-	-	
			30s	0.2	0.0	20.9						
			60s	0.2	0.0	20.9						

Appendix D: Composition Testing Results of Cover Layer Material

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 25/05653
Issue Number: 1

Date: 16 July, 2025

Client: W Maher & Sons Ltd
Soapstone Way,
off Fairhills Road
Irlam
Manchester
M44 6RA

Project Manager: Alex Clifford
Project Name: MRE Port Salford
Project Ref: MRE WP
Order No: MRE2C WAC
Date Samples Received: 30/05/25
Date Instructions Received: 30/05/25
Date Analysis Completed: 13/06/25

Approved by:



Gemma Berrisford
Deputy Client Services Supervisor

Envirolab Job Number: 25/05653

Client Project Name: MRE Port Salford

Client Project Ref: MRE WP

Lab Sample ID	25/05653/1	25/05653/2	25/05653/4	25/05653/5	25/05653/6	25/05653/7	25/05653/8	Units	Limit of Detection	Method ref
Client Sample No	1	1	1	1	1	1	1			
Client Sample ID	Clay	Sand 0/4	6F5	40/80mm	20/40mm	10/20mm	4/10mm			
Depth to Top										
Depth To Bottom										
Date Sampled	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25			
Sample Type	SOIL	SOIL	SOIL	SOLID	SOLID	SOLID	SOLID			
Sample Matrix Code	6A	4A	4AB	7	7	7	7			
% Stones >10mm _A	<0.1	<0.1	<0.1	-	-	-	-	% w/w	0.1	A-T-044
pH _D ^{M#}	-	-	11.61	-	-	-	-	pH	0.01	A-T-031s
Cyanide (total) _A ^{M#}	3	<1	-	-	-	-	-	mg/kg	1	A-T-042sTCN
Arsenic _D ^{M#}	24	6	5	-	-	-	-	mg/kg	1	A-T-024s
Cadmium _D ^{M#}	1.7	<1.0	<1.0	-	-	-	-	mg/kg	1	A-T-024s
Copper _D ^{M#}	124	19	19	-	-	-	-	mg/kg	1	A-T-024s
Chromium _D ^{M#}	40	10	13	-	-	-	-	mg/kg	1	A-T-024s
Lead _D ^{M#}	256	102	39	-	-	-	-	mg/kg	1	A-T-024s
Mercury _D	0.72	<0.17	<0.17	-	-	-	-	mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	35	7	13	-	-	-	-	mg/kg	1	A-T-024s
Selenium _D ^{M#}	1	<1	<1	-	-	-	-	mg/kg	1	A-T-024s
Zinc _D ^{M#}	254	57	57	-	-	-	-	mg/kg	1	A-T-024s
TPH total (>C6-C40) _A ^{M#}	456	694	-	-	-	-	-	mg/kg	10	A-T-007s

Envirolab Job Number: 25/05653

Client Project Name: MRE Port Salford

Client Project Ref: MRE WP

Lab Sample ID	25/05653/1	25/05653/2	25/05653/4	25/05653/5	25/05653/6	25/05653/7	25/05653/8	Units	Limit of Detection	Method ref
Client Sample No	1	1	1	1	1	1	1			
Client Sample ID	Clay	Sand 0/4	6F5	40/80mm	20/40mm	10/20mm	4/10mm			
Depth to Top										
Depth To Bottom										
Date Sampled	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25			
Sample Type	SOIL	SOIL	SOIL	SOLID	SOLID	SOLID	SOLID			
Sample Matrix Code	6A	4A	4AB	7	7	7	7			
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	NAD	NAD ^U	NAD ^U	NAD ^U	NAD ^U			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	N/A	N/A			A-T-045

Envirolab Job Number: 25/05653

Client Project Name: MRE Port Salford

Client Project Ref: MRE WP

Lab Sample ID	25/05653/1	25/05653/2	25/05653/4	25/05653/5	25/05653/6	25/05653/7	25/05653/8	Units	Limit of Detection	Method ref
Client Sample No	1	1	1	1	1	1	1			
Client Sample ID	Clay	Sand 0/4	6F5	40/80mm	20/40mm	10/20mm	4/10mm			
Depth to Top										
Depth To Bottom										
Date Sampled	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25			
Sample Type	SOIL	SOIL	SOIL	SOLID	SOLID	SOLID	SOLID			
Sample Matrix Code	6A	4A	4AB	7	7	7	7			
PAH-16MS										
Acenaphthene _A ^{M#}	0.53	0.58	0.77	-	-	-	-	mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	0.04	0.04	<0.03	-	-	-	-	mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	1.06	0.95	0.95	-	-	-	-	mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	2.51	1.47	1.61	-	-	-	-	mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	2.33	1.38	1.48	-	-	-	-	mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	2.60	1.22	1.39	-	-	-	-	mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	1.71	0.91	1.11	-	-	-	-	mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	0.96	0.45	0.49	-	-	-	-	mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	2.92	1.61	1.64	-	-	-	-	mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	0.44	0.22	0.20	-	-	-	-	mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	5.72	4.09	4.02	-	-	-	-	mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	0.44	0.47	0.60	-	-	-	-	mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	2.05	1.09	1.30	-	-	-	-	mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	0.34	0.14	0.54	-	-	-	-	mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	3.53	3.22	4.25	-	-	-	-	mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	5.35	3.61	3.46	-	-	-	-	mg/kg	0.07	A-T-019s
Total PAH-16MS _A ^{M#}	32.5	21.4	23.8	-	-	-	-	mg/kg	0.01	A-T-019s

Envirolab Job Number: 25/05653

Client Project Name: MRE Port Salford

Client Project Ref: MRE WP

Lab Sample ID	25/05653/1	25/05653/2	25/05653/4	25/05653/5	25/05653/6	25/05653/7	25/05653/8	Units	Limit of Detection	Method ref
Client Sample No	1	1	1	1	1	1	1			
Client Sample ID	Clay	Sand 0/4	6F5	40/80mm	20/40mm	10/20mm	4/10mm			
Depth to Top										
Depth To Bottom										
Date Sampled	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25			
Sample Type	SOIL	SOIL	SOIL	SOLID	SOLID	SOLID	SOLID			
Sample Matrix Code	6A	4A	4AB	7	7	7	7			
TPH CWG with Clean Up										
Ali >C5-C6 _A	-	-	<0.01	-	-	-	-	mg/kg	0.01	A-T-022s
Ali >C6-C8 _A	-	-	<0.01	-	-	-	-	mg/kg	0.01	A-T-022s
Ali >C8-C10 _A	-	-	<1	-	-	-	-	mg/kg	1	A-T-055s
Ali >C10-C12 _A ^{M#}	-	-	<1	-	-	-	-	mg/kg	1	A-T-055s
Ali >C12-C16 _A ^{M#}	-	-	3	-	-	-	-	mg/kg	1	A-T-055s
Ali >C16-C21 _A ^{M#}	-	-	7	-	-	-	-	mg/kg	1	A-T-055s
Ali >C21-C35 _A ^{M#}	-	-	64	-	-	-	-	mg/kg	1	A-T-055s
Total Aliphatics _A	-	-	74	-	-	-	-	mg/kg	1	Calc-As Recd
Aro >C5-C7 _A [#]	-	-	<0.01	-	-	-	-	mg/kg	0.01	A-T-022s
Aro >C7-C8 _A [#]	-	-	<0.01	-	-	-	-	mg/kg	0.01	A-T-022s
Aro >C8-C10 _A	-	-	3	-	-	-	-	mg/kg	1	A-T-055s
Aro >C10-C12 _A	-	-	2	-	-	-	-	mg/kg	1	A-T-055s
Aro >C12-C16 _A	-	-	12	-	-	-	-	mg/kg	1	A-T-055s
Aro >C16-C21 _A ^{M#}	-	-	37	-	-	-	-	mg/kg	1	A-T-055s
Aro >C21-C35 _A ^{M#}	-	-	95	-	-	-	-	mg/kg	1	A-T-055s
Total Aromatics _A	-	-	149	-	-	-	-	mg/kg	1	Calc-As Recd
TPH (Ali & Aro >C5-C35) _A	-	-	223	-	-	-	-	mg/kg	1	Calc-As Recd
BTEX - Benzene _A [#]	-	-	<0.01	-	-	-	-	mg/kg	0.01	A-T-022s
BTEX - Toluene _A [#]	-	-	<0.01	-	-	-	-	mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene _A [#]	-	-	<0.01	-	-	-	-	mg/kg	0.01	A-T-022s
BTEX - m & p Xylene _A [#]	-	-	<0.01	-	-	-	-	mg/kg	0.01	A-T-022s
BTEX - o Xylene _A [#]	-	-	<0.01	-	-	-	-	mg/kg	0.01	A-T-022s
MTBE _A [#]	-	-	<0.01	-	-	-	-	mg/kg	0.01	A-T-022s

Envirolab Job Number: 25/05653

Client Project Name: MRE Port Salford

Client Project Ref: MRE WP

Lab Sample ID	25/05653/1	25/05653/2	25/05653/4	25/05653/5	25/05653/6	25/05653/7	25/05653/8	Units	Limit of Detection	Method ref
Client Sample No	1	1	1	1	1	1	1			
Client Sample ID	Clay	Sand 0/4	6F5	40/80mm	20/40mm	10/20mm	4/10mm			
Depth to Top										
Depth To Bottom										
Date Sampled	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25	28-May-25			
Sample Type	SOIL	SOIL	SOIL	SOLID	SOLID	SOLID	SOLID			
Sample Matrix Code	6A	4A	4AB	7	7	7	7			
Leachate Prep BS EN 12457-2 (10:1) _A	*	*	-	-	-	-	-			A-T-001
Cyanide (total) (leachable) _A	0.021	0.008	-	-	-	-	-	mg/l	0.005	A-T-042wTCN
Arsenic (leachable) _A	8	16	-	-	-	-	-	µg/l	1	A-T-025w
Cadmium (leachable) _A	<1	<1	-	-	-	-	-	µg/l	1	A-T-025w
Copper (leachable) _A	12	7	-	-	-	-	-	µg/l	4	A-T-025w
Chromium (leachable) _A	1	4	-	-	-	-	-	µg/l	1	A-T-025w
Lead (leachable) _A	<1	1	-	-	-	-	-	µg/l	1	A-T-025w
Mercury (leachable) _A	<0.1	<0.1	-	-	-	-	-	µg/l	0.1	A-T-025w
Nickel (leachable) _A	3	<2	-	-	-	-	-	µg/l	2	A-T-025w
Selenium (leachable) _A	1	<1	-	-	-	-	-	µg/l	1	A-T-025w
Zinc (leachable) _A	12	5	-	-	-	-	-	µg/l	2	A-T-025w

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:	W Maher & Sons Ltd, Soapstone Way,, off Fairhills Road, Irlam, Manchester, M44 6RA	Project No:	25/05653
Project:	MRE Port Salford	Date Received:	30/05/2025 (am)
Clients Project No:	MRE WP	Cool Box Temperatures (°C):	15.3

NO DEVIATIONS IDENTIFIED with respect to sampling dates or containers received.

Note: 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 (for water samples $5 \pm 3^{\circ}\text{C}$), ISO 18400-105:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	25/05653/1	25/05653/2	25/05653/4	25/05653/5	25/05653/6	25/05653/7	25/05653/8
Client Sample No	1	1	1	1	1	1	1
Client Sample ID/Depth	Clay	Sand 0/4	6F5	40/80mm	20/40mm	10/20mm	4/10mm
Date Sampled	28/05/25	28/05/25	28/05/25	28/05/25	28/05/25	28/05/25	28/05/25
A-T-007s	09/06/2025	09/06/2025					
A-T-019s	11/06/2025	11/06/2025	11/06/2025				
A-T-022s			09/06/2025				
A-T-024s	13/06/2025	13/06/2025	13/06/2025				
A-T-025w	09/06/2025	09/06/2025					
A-T-031s			12/06/2025				
A-T-042sTCN	09/06/2025	09/06/2025					
A-T-042wTCN	09/06/2025	09/06/2025					
A-T-044	12/06/2025	12/06/2025	12/06/2025				
A-T-045	09/06/2025	09/06/2025	09/06/2025	09/06/2025	09/06/2025	09/06/2025	09/06/2025
A-T-054							
A-T-055s			09/06/2025				
Calc-As Recd			09/06/2025				

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

END OF REPORT

whitby wood