



Earth Environmental
& Geotechnical



Phase II GeoEnvironmental Investigation

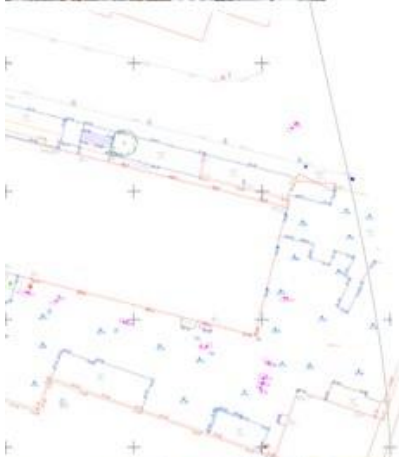
Bradstone Road

Manchester

June 2024

On behalf of

Sital Holdings 1 Ltd



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**PHASE II GEOENVIRONMENTAL
INVESTIGATION**

BRADSTONE ROAD

MANCHESTER

Report Ref: A2333/18/V2

JUNE 2024

Prepared on Behalf of:

Sital Holdings 1 Ltd

By:

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PHASE II GEOENVIRONMENTAL INVESTIGATION

BRADSTONE ROAD, MANCHESTER

Report Reference: A2333/18/V2

Version B.0

Date: 17th June 2024

Prepared for: Sital Holdings 1 Ltd

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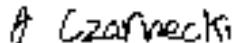
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1.0 INTRODUCTION

1.1 Background

A Geo-Environmental Site Investigation has been commissioned by Sital Holdings 1 Ltd (the client) to examine ground conditions for a new development.

It is understood that the proposed scheme will involve the erection of 3no. three-storey buildings to form 19no. cash and carry units with associated storage.

1.2 Previous Investigations

1.2.1 Earth Environmental & Geotechnical Ltd, Asbestos Management Plan, reference A2333/23/AMP, dated February 2024.

Following on from the original version of this site investigation report, a further investigation was conducted to further characterise the asbestos contamination present on site. The results were analysed and written up into an Asbestos Management Plan.

In addition to the four locations identified as containing asbestos in the original site investigation report, another ten samples were found to be positive for containing asbestos. The samples contained mostly chrysotile, with some amosite also present, and to contain between <0.001% to 0.255% asbestos by weight. A plan of the sampling is included overleaf as Figure 1.

An overall risk of low to medium was given to the asbestos risk during construction. Construction activities were assessed to be suitable for classification as Non-Licensed Work. EN140 type respiratory protective equipment with P3 filter half mask was deemed suitable for workers during construction. Localised mechanical dust suppression was recommended as well localised and enhanced personal decontamination facilities. Further, more detailed recommendations on asbestos control measures, personal protective equipment, asbestos air monitoring and unexpected asbestos contamination can be found within the Asbestos Management Plan and should be carried out during construction activities.

1.3 Terms of Reference

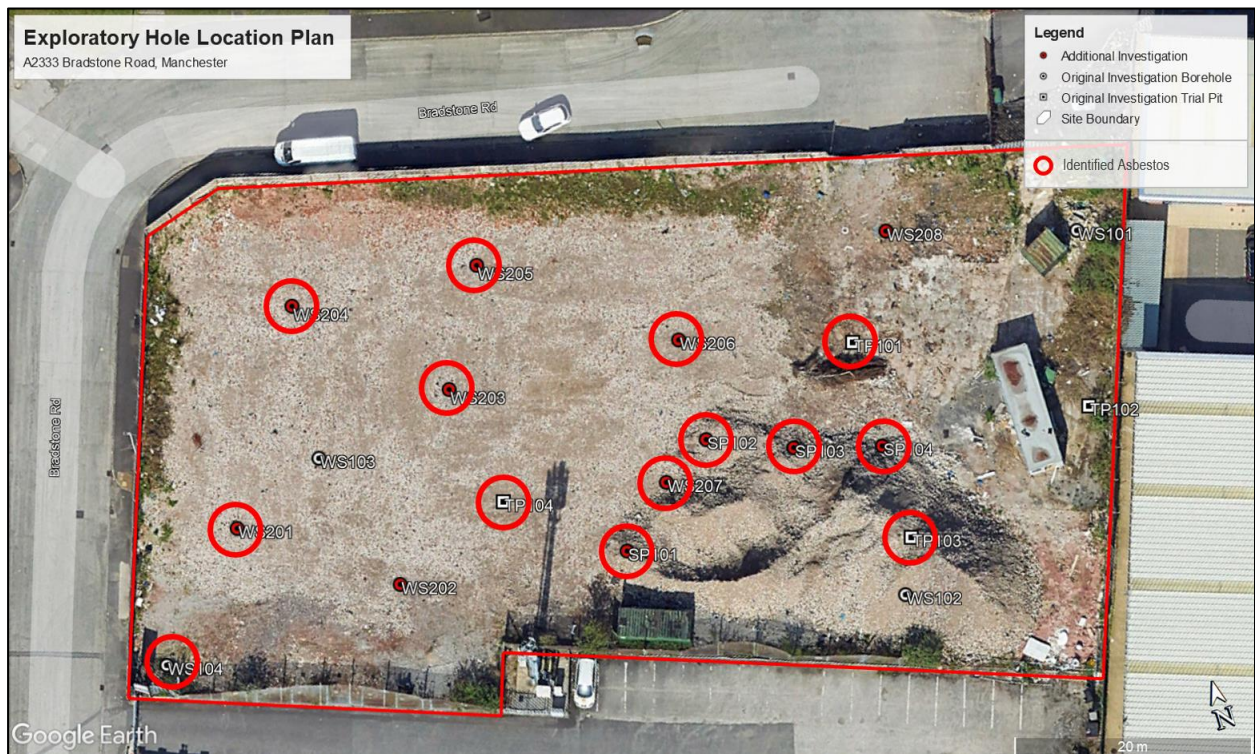
Earth Environmental and Geotechnical Ltd (EEG) was commissioned by the Client to undertake a Geo-Environmental Investigation of the site in accordance with a proposal A2333/17 dated 18th November 2017. An additional investigation, which is included within this version of the Site Investigation Report, was commissioned by the Client in accordance with proposal A2333/23 dated 3rd December 2023.

The objectives of the investigations are as follows:

- Factual information on the work undertaken including sampling location plan, borehole logs as well as chemical and geotechnical testing.
- Assess the presence and likely extent of any potential environmental hazards (soil, groundwater, and ground gas) associated within the areas of the site investigated.

Assessment of ground conditions for foundation design purposes.

Figure 1 Asbestos Sampling Plan



1.4 Limitations of the Study

The report is written in the context of an agreed scope of work and budget and should not be used in a different context. New information, improved practices or changes in legislation may require a reinterpretation of the report in whole or in part. EEG reserve the right to amend either conclusions or recommendations in light of any further information that may become available. The report is provided for the sole use by the client and is confidential to them.

Recommendations within this report are also based on exploratory records and examination of samples and, where applicable, laboratory tests. No liability can be accepted for conditions not revealed by the boreholes and trial pits, particularly at intervening locations. Whilst every effort is made to ensure accuracy of data supplied, all opinions expressed as to the spatial distribution of strata between sampling locations is for guidance only and no responsibility is accepted as to its accuracy.

2.0 SITE LOCATION & DESCRIPTION

2.1 Site Location & Description

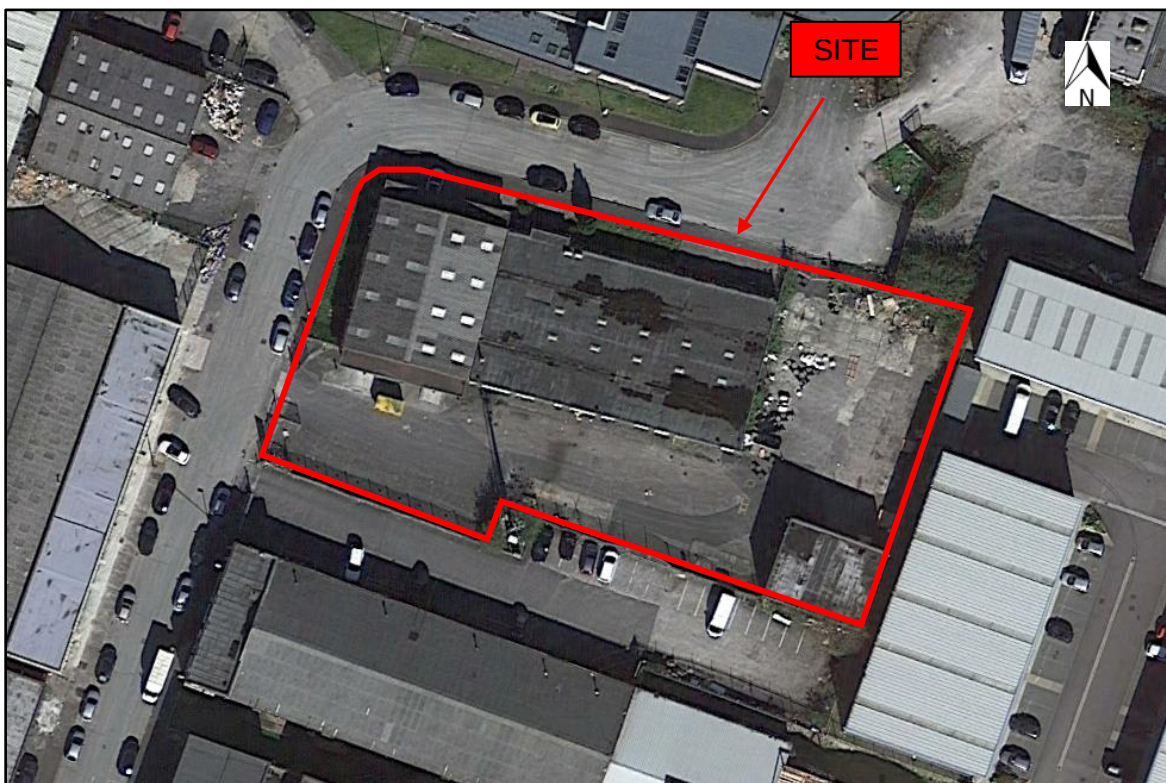
The site is located to the north of Manchester City Centre, approximately 630m northeast of Bury New Road. The approximate National Grid Reference for the centre of the site is SD84034 00079 (384034, 400079), at postcode M8 8WA.

The site extends to approximately 0.36 hectares and comprises a roughly rectangular shaped parcel of land approximately 80m long by 40m wide. The site is in a primarily commercial setting, with industrial / commercial units to the north, west, east, and south of the site.

At the time of the original investigation, the site comprised an existing commercial building in the north with a tarmacadam car park over much of the remainder of the site. An additional building was present in the southeast of the site. During the follow up investigation, the site was an unoccupied plot covered in demolition rubble. A stockpile of material was present in the southern corner of the site.

The site location is shown in Figure 2, below.

Figure 2 Site Location Plan



Site photographs are presented in Figures 3 to 6 overleaf.

Figure 3 View across the south of the site during 2017 investigation, facing east.



Figure 4 WS101 drilling in progress during 2017 investigation, facing north.



Figure 5 Excavation in progress during 2017 investigation, southwest of the site.



Figure 6 View across site during 2023 investigation, facing east.



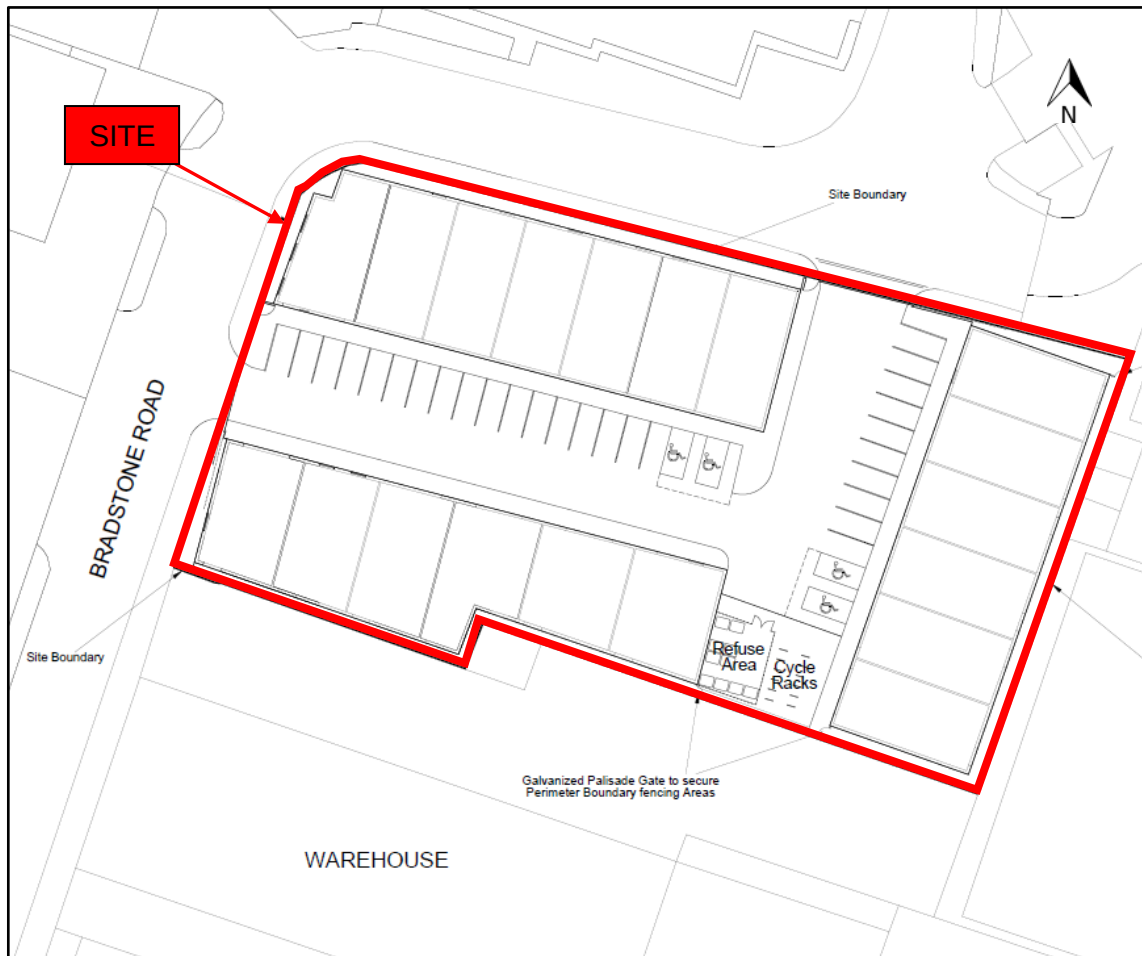
2.2 Proposed Development

It is understood that permission has been granted by Manchester Council for the demolition of the existing buildings and structures and the erection of 3no. three-storey buildings to form 19no. cash and carry units with associated roads and (Planning Reference: 115485/FO/2017).

Access to the proposed development would be via the existing access from Bradstone Road to the west.

A proposed layout plan is shown in Figure 7, below.

Figure 7 Development Layout Plan



3.0 DESK STUDY INFORMATION

3.1 General

A desk study for the proposed development has previously been undertaken on behalf of the landowners by Your Environment, dated April 2017. The desk study provides a review of historical ordnance survey maps, Groundsure report and readily available environmental information.

The following section provides a review of the desk study and other relevant information sources.

3.2 Environmental Setting

The geology of the site is covered by British Geological Survey (BGS) online data and the site information within the desk study.

Environmental conditions are covered by Environment Agency (EA) and British Geological Survey (BGS) online data, and the information within the desk study.

3.2.1 Geology

According to the BGS the site is underlain by Till (Diamicton). These superficial strata are in turn underlain by the Chester Formation (Sandstone).

The nearest BGS public borehole record is 115m southwest of the site, SJ89NW42, which records ash fill to 0.61m depth, underlain by running sand at 5.49m bgl and hard clay at 12.50m bgl.

3.2.2 Ground Workings

The desk study states that there are 171no. records of potentially infilled sites within 500m, twelve of which are on site for two ponds, seven brick works and three unspecified workings.

The site is listed within the boundary of an Environment Agency licensed landfill site. Additional records of; EA licensed landfill sites, BGS/DoE non-operational landfill sites, landfill from local authority and historical mapping records, waste treatment, transfer or disposal sites and Environment Agency Waste sites are present within 1.5km.

3.2.3 Radon Potential

According to the Health Protection Agency the site is not within a Radon Affected Area, as less than 1% of properties are above the Action Level. Radon protection measures are therefore not required.

3.2.4 Hydrogeology and Hydrology

The Superficial Till is classified by the Environment Agency (EA) as a Secondary (undifferentiated) Aquifer. The underlying Chester Formation is classified as a Principal Aquifer.

There are 4no. groundwater abstractions within 2km of the site, the closest of which is 334m south for general cooling and process water.

There no active potable abstractions within 2km of the site.

There no active surface water abstractions within 2km of the site.

There are 4no. records of detailed river networks within 500m of the study site, the closest of which is 285m northwest for an underground river (potential sewer).

There are no further surface water features within 250m of the site.

3.2.5 *Historical Land Use*

The desk study states that the site has historically comprised a brickworks, with various developments and demolition taken place since 1848 mapping. A historical tank has been present onsite and other potential offsite sources of contamination include infilled clay pits and ponds, car breakers yard, saw mills and soapworks.

3.2.6 *Preliminary Contamination Risk Assessment*

Based on the historical land use the risk with regards to proposed site users, construction workers and adjacent site users from dermal contact, ingestion and inhalation pathways based on the sensitivity of the proposed end use is moderate.

There is a moderate risk from hazardous ground gas due to the viable sources of ground gas identified within the site boundary and within the vicinity of the site.

The risk with regards to controlled waters is considered to be moderate based on the historical land use and underlying aquifers.

4.0 SITE INVESTIGATION

4.1 Exploratory Fieldwork

The fieldwork was carried out by EEG on the 5th December 2017 with the follow-up investigation taking place on 15th December 2023 and comprised:

- Four windowless sample boreholes (designated WS101 to WS104) were sunk to a maximum depth of 5.45m below existing ground level. The borehole in the southeast of the site (WS102) refused at 1.00m bgl within very dense ash and clinker, whilst WS103 could not core through the complete depth of the concrete base of the existing building. WS101 and WS104 were installed with monitoring wells for the subsequent monitoring of ground gas and groundwater. Standard Penetration Tests (SPTs) were undertaken in the boreholes in accordance with BS EN ISO 22476-3. Exploratory Hole logs are included in Appendix 1.
- Four trial pits (designated TP101-TP04) were excavated by use of a hydraulic excavator, to a nominal depth of 2.30m bgl for the purpose of assessing ground conditions and collecting environmental and geotechnical samples. Exploratory Hole logs for the trial pits are also included in Appendix 1.
- The additional site investigation comprised eight windowless sample boreholes (WS201 to WS208) to a maximum depth of 1.50m to retrieve samples for environmental testing. The detailed logs are included within Appendix 1.
- Additionally, four samples were retrieved from a stockpile during the follow-up investigation for environmental testing, located in the southern corner of the site.

Figure 8 Exploratory Hole Location Plan



Each exploratory location was scanned using a Cable Avoidance Tool (CAT) in order to locate unrecorded underground services, and the exploratory locations were repositioned if necessary.

On completion, all samples recovered from the site were taken to a specialist laboratory for testing.

All site investigation work was supervised full time by a representative of EEG. The logging of soils and rocks has been carried out in accordance with BS5930⁽²⁰¹⁵⁾ except where superseded by the soil and rock description methodology in BS EN14688-1⁽²⁰⁰²⁾, BS EN 14688-2⁽²⁰⁰⁴⁾ and BS EN 14689-1⁽²⁰⁰³⁾.

Full exploratory hole logs are presented within Appendix 1.

A summary of exploratory holes undertaken during the investigation is presented Table 1, below.

Table 1: Summary of Exploratory Holes Undertaken

Hole	Type*	Depth (m)	Date Started	Date Finished	Backfill Details**
TP101	TP	2.30	05/12/2017	05/12/2017	A
TP102	TP	1.30	05/12/2017	05/12/2017	A
TP103	TP	1.30	05/12/2017	05/12/2017	A
TP104	TP	2.00	05/12/2017	05/12/2017	A
WS101	WS	4.45	05/12/2017	05/12/2017	I
WS102	WS	1.00	05/12/2017	05/12/2017	A
WS103	WS	0.70	05/12/2017	05/12/2017	A
WS104	WS	5.45	05/12/2017	05/12/2017	I
WS201	WS	1.50	15/12/2023	15/12/2023	A
WS202	WS	1.50	15/12/2023	15/12/2023	A
WS203	WS	1.50	15/12/2023	15/12/2023	A
WS204	WS	1.50	15/12/2023	15/12/2023	A
WS205	WS	1.50	15/12/2023	15/12/2023	A
WS206	WS	1.50	15/12/2023	15/12/2023	A
WS207	WS	1.00	15/12/2023	15/12/2023	A
WS208	WS	1.50	15/12/2023	15/12/2023	A

* TP = Trial Pit, WS = Window Sample Borehole, CP = Cable Percussive, R = Rotary
 **A=Arisings, I=Installed with monitoring well

4.2 Laboratory Testing Programme

4.2.1 Geotechnical Testing

A programme of laboratory testing was carried out on samples taken from the various strata to assist in classification and determine the engineering properties of the materials underlying the site. The testing was scheduled by EEG and carried out by Murray Rix (Northern) Ltd. The test procedures used were generally in accordance with the methods described in BS1377:1990. Details of the specific tests used in each case are given below:

TEST	STANDARD (BS1377:1990)	No.
Liquid Limit, Plastic Limit, Plasticity Index	Part 2, Clause 4 / 5	4
Sulphate content of 2:1 soil: water extract	Part 3, Clause 5	4
pH value	Part 3, Clause 9	4

The results of the laboratory geotechnical tests are discussed in Section 6 and included in Appendix 3.

4.2.2 Environmental Testing

The environmental chemistry of the ground was investigated by specialist chemical analysis of selected samples, scheduled by EEG, and carried out by QTS Environmental/DETS.

Chemical analyses were carried out on 8no. soil samples as well as 2no. water samples and were submitted for the following suite of determinants:

Soil CLEA suite consists of Asbestos Screen, pH, TOC, Total Sulphate, Sulphide, Total Cyanide, As, Cr, Cr (vi), Cu, Pb, Se, Zn, Cd, Hg, Ni, Vanadium, Barium, Beryllium, WS Boron, Mono Phenol, speciated TPH and Speciated PAH.

An additional 12no. samples were tested for asbestos identification and quantification during the 2023 follow-up investigation.

The results of the laboratory contamination tests are discussed in Section 8 and included in Appendix 2.

5.0 GROUND CONDITIONS ENCOUNTERED

5.1 Soil Profile Encountered

The sequence of strata encountered beneath the site generally comprised made ground to a maximum depth of 1.90m bgl, underlain primarily by clay or by sandy silt in WS101.

The depths of the various materials encountered in each of the exploratory holes are summarised in the following table.

Table 2: Summary of Ground Conditions Encountered

Hole	Depth to Stratum (m bgl)			TOTAL DEPTH (m bgl)	GROUNDWATER (m bgl)
	MADE GROUND	SANDY SILT	CLAY		
TP101	GL-1.30	-	1.30-2.30	2.30	-
TP102	GL-1.30	-	-	1.30	-
TP103	GL-1.30	-	-	1.30	-
TP104	GL-1.20	-	1.20-2.00	2.00	-
WS101	GL-1.90	1.90-3.70	3.70-4.50	4.45	-
WS102	GL-1.00	-	-	1.00	-
WS103	GL-0.70	-	-	0.70	-
WS104	GL-1.00	4.00-5.45	1.00-4.00	5.45	-
WS201	GL-0.55	-	0.55-1.50	1.50	-
WS202	GL-1.00	-	1.00-1.50	1.50	-
WS203	GL-1.10	-	1.10-1.50	1.50	-
WS204	GL-1.00	-	1.00-1.50	1.50	-
WS205	GL-0.70	-	0.70-1.50	1.50	-
WS206	GL-1.00	-	1.00-1.50	1.50	-
WS207	GL-1.00	-	-	1.00	-
WS208	GL-0.90	-	0.90-1.50	1.50	-

5.2 Observable Indications of Contamination

Possible asbestos bearing materials were noted in TP02. No other visual evidence of contamination was identified during the investigation apart from the presence of made ground materials such as red brick, concrete, ash, clinker, slag, and metal.

A faint hydrocarbon odour was noted in TP103.

5.3 Obstructions

A refusal was encountered on very dense ash and clinker in WS102 at 1.00m. A metal rebar was encountered at 0.70m while coring through concrete in WS103.

5.4 Groundwater

Groundwater ingress was encountered at 1.70m in WS101 and at 4.80m bgl in WS104 during excavation.

During the gas and groundwater monitoring, groundwater ingress was encountered between 1.51m and 1.72m below ground level.

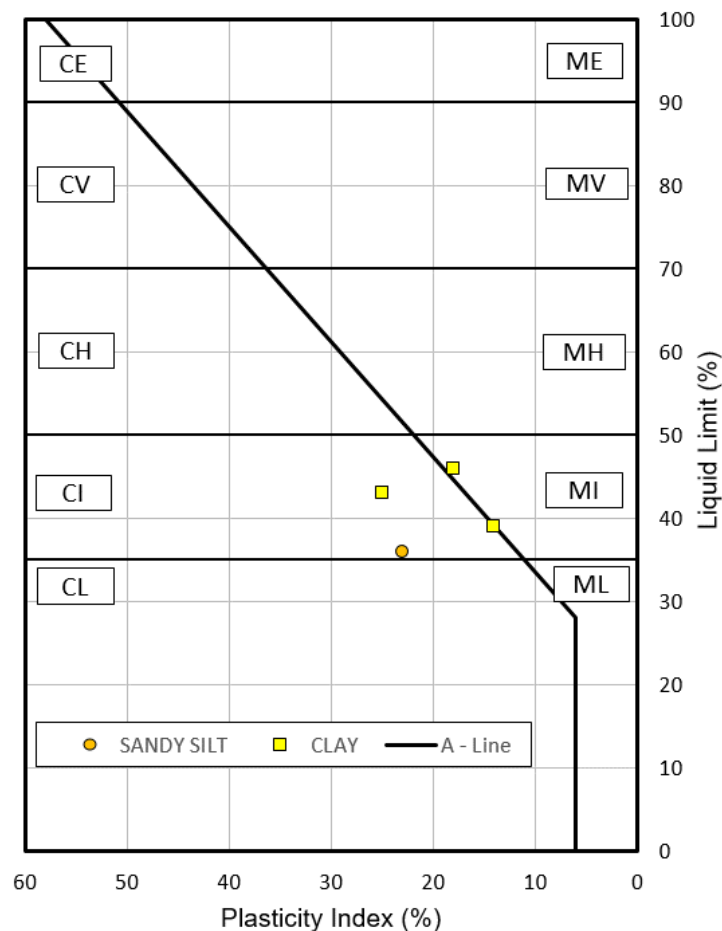
6.0 ENGINEERING PROPERTIES OF SOILS ENCOUNTERED

The following sections discuss the engineering properties of the strata encountered, based on results of in situ testing and laboratory testing obtained during this investigation.

6.1 Sandy Clay

Atterberg Limit testing has given a value of **liquid limit** of 36% and a **plastic limit** value 13%, resulting in a value of **plasticity index** of 23%. These results suggest the samples tested are clay of intermediate plasticity as shown on the Plasticity Chart below. For design purposes, a value of plasticity index = 23% is recommended, based on the results.

Figure 9 Plasticity Chart



In accordance with NHBC Chapter 4.2 Building Near Trees ⁽²⁰⁰³⁾ soils can be classified in terms of volume change potential, using the relationship:

$$Ip' = Ip \times \frac{\% \text{ less than } 425\mu\text{m}}{100\%}$$

....where Ip' = modified plasticity index, Ip = plasticity index.

Based on the laboratory test results, the above relationship and Table 1 of NHBC Chapter 4.2, the samples are shown to have **low volume change potential**.

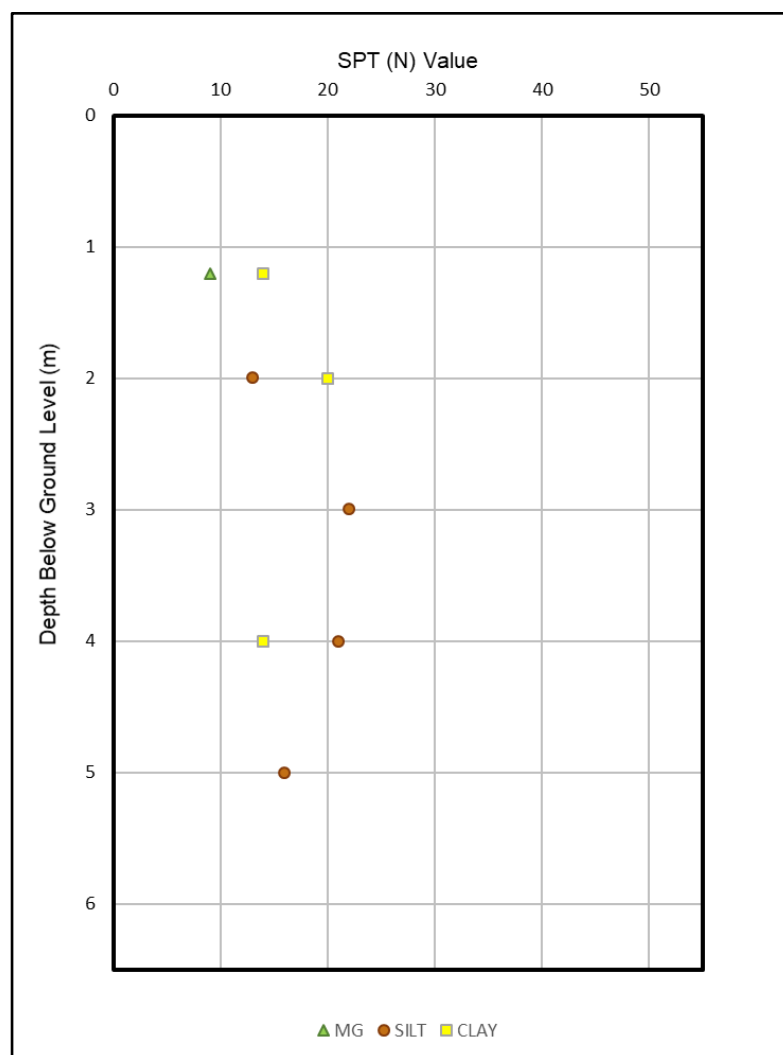
SPT N values in the range of 13 - 22 have been obtained for the clay (Figure 10) which suggest the silt is stiff to very stiff. For the purposes of this report, the engineering properties of the stiff to very stiff silt will be considered.

It is recommended that for assessing ultimate bearing capacities, where the lower values are critical, the lower quartile value of N is used. For assessing settlements, lower quartile ground conditions will give a more realistic value of settlements and the lower quartile of N values should be used.

For design purposes, a value of $N = 15$ seems reasonable based on the lower quartile value of results. Based on the correlation by Peck, Hanson, and Thornburg (1974), this gives an **undrained shear strength** of 67.5 kN/m^2 .

Recommended N values and derived design values are summarised in Table 3, overleaf.

Figure 10 SPT v Depth Plot



Recommended N values and derived design values are summarised in the following table:

Table 3: Summary of Design Parameters

Lithology	N Value Range	Design N Value*	Average Measured Undrained Shear Strength	Undrained Shear Strength** kN/m ²	Coefficient of Volume Compressibility**
Sandy Silt	13-22	15	-	67.5	0.15m ² /MN
Clay	14-20	15	-	67.5	0.15m ² /MN
* Based on lower quartile values of results					
**based on correlations by Stroud and Butler ⁽¹⁹⁷⁵⁾					

Laboratory testing has given a value of **water-soluble sulphate** (SO₄) of 0.22g/l, together with a **pH Value** of 7.0.

The results of the water-soluble sulphate and pH tests, along with the results of the particle size distribution tests are presented within the Geotechnical Test Results in Appendix 3.

6.2 Clay

Atterberg Limit tests have given values of **liquid limit** in the range 39% to 46% and **plastic limit** values in the range 14% to 18%, resulting in values of **plasticity index** in the range 25% to 28%. These results suggest the samples tested are clay of intermediate plasticity as shown on the Plasticity Chart above (Figure 9). For design purposes, a value of plasticity index = 26% is recommended, based on the average of the results.

In accordance with NHBC Chapter 4.2 Building Near Trees ⁽²⁰⁰³⁾ soils can be classified in terms of volume change potential, using the relationship:

$$I_p' = I_p \times \frac{\% \text{ less than } 425\mu\text{m}}{100\%}$$

....where I_p' = modified plasticity index, I_p = plasticity index.

Based on the laboratory test results, the above relationship and Table 1 of NHBC Chapter 4.2, the samples of clay are shown to have **medium volume change potential**.

SPT N values in the range of 14 - 20 have been obtained for the natural clay (Figure 10) which suggest the clay is stiff to very stiff. For the purposes of this report, the engineering properties of the stiff to very stiff clay will be considered.

It is recommended that for assessing ultimate bearing capacities, where the lower values are critical, the lower quartile value of N is used. For assessing settlements, lower quartile ground conditions will give a more realistic value of settlements, and the lower quartile of N values should be used.

For design purposes, a value of N = 15 seems reasonable based on the lower quartile value of results. Based on the correlation by Peck, Hanson, and Thornburg (1974), this gives an **undrained shear strength** of 67.5kN/m².

Recommended N values and derived design values are summarised in Table 3.

Based on all the above, design values of undrained shear strength of 67.5kN/m² recommended.

Laboratory tests has given values of **water-soluble sulphate** (SO₄) between 0.25g/l and 0.40g/l, together with **pH Values** of 7.0 to 7.4.

The results of the water-soluble sulphate and pH tests along with the results of the liquid and plastic limit tests are presented within the Geotechnical Test Results in Appendix 3.

7.0 GEOTECHNICAL ASSESSMENT

7.1 Proposed Development

It is understood that permission has been granted by Manchester Council for the demolition of the existing buildings and structures and the erection of 3no. three-storey buildings to form 19no. cash and carry units with associated roads and (Planning Reference: 115485/FO/2017).

7.2 Ground Conditions Encountered

The sequence of strata encountered beneath the site generally comprised made ground to a maximum depth of 1.90m bgl, underlain primarily by clay or by sandy silt followed by clay in WS101.

Groundwater ingress was encountered at 1.70m in WS101 and at 4.80m bgl in WS104 during excavation. Groundwater levels between 1.51m and 1.72m bgl were recorded during the subsequent gas and groundwater monitoring.

7.3 Foundation Considerations

Conventional trench fill foundations will be suitable at this site, taken down to a minimum 2.0m depth and into the natural clay. If any Made Ground, particularly loose or soft material is encountered at foundation level this should be excavated and replaced with suitable granular fill or the foundation extended to suitable strata. In this context attention is drawn to the 2m thickness of Made Ground encountered in WS101.

The following table summarises anticipated allowable bearing pressures for foundations placed at different depths in the natural strata. The bearing capacities are calculated based on Hansen's (1978) method and assuming a factor of safety against bearing capacity failure of 3. Groundwater is assumed to be at foundation level.

Table 4: Summary of Allowable Bearing Pressures (Trench Foundations)

Foundation Depth	Strata	Design Value (Section 6)	Foundation Width	Allowable Bearing Pressure
1.0m	Silt/Clay	$\phi=0$ $C_u = 67.5\text{kN/m}^2$	1m	217kN/m ²
			1.5m	199kN/m ²
			2.0m	189kN/m ²
2.0m	Silt/Clay	$\phi=0$ $C_u = 67.5\text{kN/m}^2$	1m	296kN/m ²
			1.5m	259kN/m ²
			2.0m	241kN/m ²

Settlements for other bearing pressures may be estimated on a pro-rata basis, but bearing pressures should not exceed the allowable net bearing pressure based on ultimate bearing capacity.

Floor slabs should be designed as suspended where located within the zone of influence of a tree or where made ground is 600mm thickness or greater.

All foundation excavations should be inspected by a suitable qualified engineer to prove that the founding strata is suitable and uniform along the length of the foundation, and capable of taking the anticipated structural loadings.

7.4 Chemical Attack on Buried Concrete

Chemical tests (see Appendix 3) show low levels of water-soluble sulphates and near neutral conditions within natural strata. Based on these conditions, it is recommended that for foundations the Design Sulphate Class for the site, as defined in BRE Special Digest 1⁽²⁰⁰⁵⁾, be taken as DS-1, and the Aggressive Chemical Environment for Concrete (ACEC) site classification be taken as AC-1.

The recommendations of BRE Special Digest 1 should be followed for concrete foundations and ground bearing floor slabs.

7.5 Suitability of Excavated Materials

Acceptability criteria and testing, and methods of compaction/placement will depend on the type of contract and specification used for the construction of the proposed development and it is recommended that earthworks specifications are reviewed by a suitably qualified engineer once these have been prepared by the relevant parties.

The natural silt and clay could be re-used as structural fill, depending on additional compliance testing and provided it is not contaminated.

7.6 Temporary Works

Formations in the natural strata will be susceptible to damage both by weather and trafficking, and should be protected immediately on exposure, particularly in areas where construction plant will access the site.

Excavations in the natural strata are likely to be unstable and should be battered back to an angle of 1 in 2, or a system of close sheeting and shoring adopted to ensure stability, and in particular where personnel are required to enter excavations.

All excavations should be adequately supported where personnel are required to enter.

Groundwater seepages could be encountered in excavations, depending on depth. If required pumping of excavations from a suitable located sump should be adequate to keep excavations dry.

All natural materials on site should be capable of being excavated using conventional excavating machinery.

8.0 SOIL CONTAMINATION RISK ASSESSMENT

8.1 Soil Guidelines

At a Tier I stage the long term (chronic) human health toxicity of the soil has been assessed with reference to DEFRA/Environment Agency Contaminated Land Exposure Assessment (CLEA) Soil Guideline Values (SGV) for generic site land uses, soils, and exposure. Where Environment Agency generic guidance is absent, reference has been made to the Chartered Institute of Environmental Health (CIEH) S4ULs for human health risk assessment.

The derivation of all assessment criteria for a commercial end use have been listed in Appendix 4.

In the case of arsenic, cadmium, hexavalent chromium, lead, and benzo(a)pyrene DEFRA Category 4 Screening Levels have been adopted.

8.2 Tier I Human Health Soil Data Assessment

The results of the chemical testing are presented overleaf in Table 5.

No elevated chemical contaminants have been identified with respect to the long-term protection of human health, when compared to commercial assessment criteria.

Asbestos has been detected in 14no. samples tested during this investigation. A summary of the encountered asbestos is included in Table 6 overleaf.

Table 5 Tier I Human Health Soil Assessment

Parameter	WS101	WS102	WS104	WS104	TP101	TP102	TP103	TP104	Assessment Criteria (mg/kg)
	0.15 - 0.30	0.20 - 0.40	0.30 - 0.60	1.00 - 1.30	0.20 - 0.50	0.30 - 0.50	0.60 - 0.90	0.30 - 0.60	
	Made Ground	Made Ground	Made Ground	Clay	Made Ground	Made Ground	Made Ground	Made Ground	
Arsenic	4	8	24	7	20	3	20	18	640
Boron	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1.3	240000
Barium	262	308	323	156	250	453	508	625	24900
Beryllium	< 0.5	0.7	1.4	1	1.2	< 0.5	1.5	1.1	12
Cadmium	0.5	0.3	0.2	< 0.2	< 0.2	0.7	< 0.2	0.2	410
Chromium (III)	9	20	19	25	21	6	21	19	8600
Chromium (IV)	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	49
Lead	688	153	65	15	91	22	144	177	2330
Mercury (Inorganic)	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1100
Selenium	< 3	< 3	< 3	< 3	< 3	< 3	< 3	< 3	12000
Vanadium	12	24	39	27	35	9	37	35	9000
Zinc	42	109	68	58	99	57	91	241	730000
Nickel	6	13	22	28	26	8	25	19	980
Copper	15	40	44	22	50	15	58	50	68000
Cyanide - Free	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	34
Phenols	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	760
Naphthalene	< 0.1	0.18	0.43	< 0.1	0.49	< 0.1	0.33	0.34	190
Acenaphthylene	< 0.1	< 0.1	< 0.1	< 0.1	0.14	< 0.1	< 0.1	< 0.1	83000
Acenaphthene	< 0.1	0.22	0.35	< 0.1	0.27	< 0.1	0.41	< 0.1	84000
Fluorene	< 0.1	0.17	0.31	< 0.1	0.29	< 0.1	0.4	< 0.1	63000
Phenanthrene	0.29	1.39	3.95	0.15	3.23	< 0.1	3.04	0.94	22000
Anthracene	< 0.1	0.29	0.66	< 0.1	0.64	< 0.1	0.68	0.15	520000
Fluoranthene	0.5	1.7	6.35	< 0.1	6.15	< 0.1	3.37	1.2	23000
Pyrene	0.54	1.57	6.87	< 0.1	5.57	0.14	2.89	1.22	54000
Benzo(a)anthracene	0.21	0.72	3.15	< 0.1	2.4	< 0.1	1.08	0.62	170
Chrysene	0.36	0.88	3.9	< 0.1	3.21	0.18	1.25	0.72	350
Benzo(b)fluoranthene	0.34	0.92	4.28	< 0.1	3.7	0.1	1.07	0.81	44

Parameter	WS101	WS102	WS104	WS104	TP101	TP102	TP103	TP104	Assessment Criteria (mg/kg)
	0.15 - 0.30	0.20 - 0.40	0.30 - 0.60	1.00 - 1.30	0.20 - 0.50	0.30 - 0.50	0.60 - 0.90	0.30 - 0.60	
	Made Ground	Made Ground	Made Ground	Clay	Made Ground	Made Ground	Made Ground	Made Ground	
Benzo(k)fluoranthene	0.12	0.29	1.36	< 0.1	1.17	< 0.1	0.36	0.28	1200
Benzo(a)pyrene	0.25	0.69	2.96	< 0.1	2.54	0.11	0.73	0.57	77
Indeno(1,2,3-cd)pyrene	< 0.1	0.33	1.46	< 0.1	1.37	< 0.1	0.29	0.31	500
Di-benz (a,h) anthracene	< 0.1	< 0.1	0.28	< 0.1	0.24	< 0.1	< 0.1	< 0.1	3.5
Benzo(ghi)perylene	0.11	0.33	1.24	< 0.1	1.17	< 0.1	0.25	0.28	320
Benzene	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	90
Toluene	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	56000
Ethylbenzene	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	5700
Xylene	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	6600
Aliphatic >C5 - C6	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	3200
Aliphatic >C6 - C8	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	7800
Aliphatic >C8 - C10	< 2	3	< 2	< 2	< 2	< 2	5	< 2	2000
Aliphatic >C10 - C12	5	28	< 2	< 2	< 2	2	17	< 2	9700
Aliphatic >C12 - C16	69	131	12	< 3	< 3	70	77	< 3	59000
Aliphatic >C16 - C21	10	26	< 3	< 3	< 3	39	26	< 3	65000
Aliphatic >C21 - C34	314	312	97	< 10	22	557	194	< 10	65000
Aromatic >C5 - C7	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	26000
Aromatic >C7 - C8	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	56000
Aromatic >C8 - C10	< 2	< 2	< 2	< 2	< 2	< 2	3	< 2	3500
Aromatic >C10 - C12	< 2	9	< 2	< 2	< 2	< 2	15	< 2	16000
Aromatic >C12 - C16	24	71	8	< 2	7	17	48	< 2	36000
Aromatic >C16 - C21	31	56	24	< 3	28	44	54	< 3	28000
Aromatic >C21 - C35	548	691	175	< 10	136	902	383	< 10	28000
Asbestos Screen	Not Detected	Not Detected	Detected	Not Detected	Detected	Not Detected	Detected	Detected	-
Asbestos Matrix			Loose fibres in soil		Loose fibres in soil		Loose fibres in soil	Loose fibres in soil	-
Asbestos Type			Chrysotile		Chrysotile		Chrysotile	Chrysotile	-

Table 6: Summary of Encountered Asbestos

Location	Depth (m)	Sample Matrix	Asbestos Type	Asbestos Quantification
WS104	1.00-1.30	Loose fibres in soil	Chrysotile	-
TP101	0.20-0.50	Loose fibres in soil	Chrysotile	-
TP103	0.60-0.90	Loose fibres in soil	Chrysotile	-
TP104	0.30-0.60	Loose fibres in soil	Chrysotile	-
SP101	0.10	Present as bundles	Chrysotile & Amosite	0.002
SP102	0.05	Present as visible and microscopic bundles	Chrysotile & Amosite	0.094
SP103	0.10	Present as bundles	Chrysotile & Amosite	< 0.001
SP104	0.05	Present as bundles	Chrysotile	0.003
WS201	0.50	Present as bundles	Chrysotile	0.007
WS203	0.45	Present as bundles	Chrysotile	0.010
WS204	0.10	Present as bundles	Chrysotile & Amosite	< 0.001
WS205	0.60	Present as bundles and in microscopic insulation fragments	Chrysotile & Amosite	0.255
WS206	0.30	Present as bundles	Chrysotile	< 0.001
WS207	0.75	Present as bundles	Chrysotile	< 0.001

9.0 GROUNDWATER CONTAMINATION RISK ASSESSMENT

Two groundwater samples were recovered from the monitoring standpipes within WS101 and WS104. Samples were recovered after purging of three well volumes, using a dedicated clear Teflon bailer

No visual or olfactory evidence of contamination was noted during sampling.

The results from the groundwater testing have been compared to UK Drinking Water Standards, Environmental Quality Standards (for the protection of ecology in waters) and World Health Organisation Standards. The assessment criteria should therefore be viewed as very conservative.

A summary of the chemical testing results can be found in Table 7 (overleaf).

Recharge of groundwater was good in WS104 and poor in WS101.

All water samples were placed in dark amber glass bottles and stored in a cool box.

Water levels were recorded with an electronic Heron interface meter allowing for the detection dense non-aqueous phase liquids (DNAPL) or light non-aqueous phase liquids (LNAPL).

Free phase floating hydrocarbons were not found at any location.

The chemical analysis results show no contaminants that exceed the UK Drinking Water Standards, Environmental Quality Standards (for the protection of ecology in waters) or World Health Organisation Standards.

Table 7: Controlled Water Assessment

Parameter	WS101	WS104	Assessment Criteria (µg/l)	Source
Arsenic (dissolved)	< 5	< 5	10	UK
Cadmium (dissolved)	< 0.4	< 0.4	5	UK
Chromium (dissolved)	< 5	< 5	50	UK
Copper (dissolved)	< 5	< 5	50	UK
Lead (dissolved)	10	< 5	10	UK
Mercury (dissolved)	0.08	0.1	1.0	UK
Nickel (dissolved)	< 5	< 5	20	UK
Selenium (dissolved)	< 5	< 5	10	UK
Zinc (dissolved)	5	< 2	3000	UK
Cyanide (total)	< 5	< 5	50	UK
TPH (C ₁₀ -C ₄₀)	< 10	< 10	10	UK
PAH	0.05	0.04	0.2	UK
pH	8.4	8.1	-	
Benzo(a)pyrene	< 0.01	< 0.01	0.01	Water Supply Regs 2000
Fluoranthene	0.01	0.01	0.1	EQS Freshwater
Naphthalene	0.02	0.02	204	Inland Water surface EQS
Total >C5 - C35	< 140	< 140	10	UK
Benzene	< 1	< 1	10	WHO Drinking Water Guideline
Toluene	< 5	< 5	700	WHO Drinking Water Guideline
Ethylbenzene	< 5	< 5	300	WHO Drinking Water Guideline
p & m-Xylene	< 10	< 10	500	WHO Drinking Water Guideline
o-Xylene	< 5	< 5		
MTBE	< 10	< 10	<10	No Standard

Notes for Table 7

Concentrations in **red** above assessment criteria

UKDWS: United Kingdom Drinking Water Standards

WHO: World Health Organisation Standard

EQS Freshwater: Environment Agency Environmental Quality Standard for Freshwater

IS Insufficient sample

All assessment criteria derived from EA Chemical Standards Database & CL:AIRE Petroleum Hydrocarbons in Water, Version 1.1, 29th March 2017, and EA Chemicals Standards Database

10.0 GROUND GAS RISK ASSESSMENT

Results obtained during monitoring visits from the 13th December 2017 to the 12th January 2018 indicate methane (CH₄) levels ranging from 0.0% to 0.1% by volume, carbon dioxide (CO₂) levels ranging from 0.0% to 0.8% by volume, and oxygen (O₂) levels ranging from 17.9% to 18.9% by volume.

Gas flows were recorded between -0.4 and 1.5l/hr. Atmospheric pressure was recorded as 984mb to 1028mb.

The potential risk associated with gases being generated in the ground (whether from natural or man-made sources) depends on the concentrations of gas and its flow rate to the surface. These factors are assessed by monitoring of the gas installations in the boreholes. The variable nature of gas generation and the effect of barometric pressure on gas flow, means that the volume of gas potentially reaching the ground surface is normally inconsistent over time.

For the assessment of sites, in terms of the potential for ground gas to present a hazard, the risk-based methodology detailed in CIRIA C665 “Assessing risks posed by hazardous ground gases to buildings” is used. This is a risk-based approach that is designed to allow quick and easy design of gas protection by comparing the measured gas emission rates to Characteristic Situations, based on risk-based Gas Screening Values (GSVs),

The GSVs equate to the borehole gas volume flow rate as defined by Wilson and Card ⁽¹⁹⁹⁹⁾ as the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered.

For the purposes of this evaluation the calculations will be carried out for both carbon dioxide and methane encountered in the boreholes on site and a peak flow rate of 1.5l/hr assumed to give a worst-case scenario adopted in order to establish the appropriate protection measures, as follows:

- Carbon dioxide: maximum flow rate = 1.5l/hr, max concentration = 0.8%
- Methane: maximum flow rate = 1.5l/hr, max concentration = 0.1%.

Based on the above figures, the GSV is calculated as:

- Carbon dioxide: $GSV = 1.5 \times 0.008 = 0.012\text{l/hr}$
- Methane: $GSV = 1.5 \times 0.001 = 0.0015\text{l/hr}$.

The above results suggest the site can be given a Characteristic Situation of (1), i.e. ‘Very Low Risk’, in accordance with the following table:

As a result, remedial measures are not required.

Table 8: Modified Wilson & Card Classification (CIRIA Report 665)

Characteristic Situation (CIRIA Report 149)	Risk Classification	GSV (CH₄ or CO₂) (l/hr)	Additional Factors	Typical Source of Generation
1	Very Low Risk	<0.07	Typically, methane ≤1% v/v and/or carbon dioxide ≤5% v/v. Otherwise consider increase to Situation 2.	Natural Soils with low organic content. "Typical" Made Ground.
2	Low Risk	<0.7	Borehole flow rate not to exceed 70l/hr. Otherwise increase to Situation 3.	Natural soil, high peat/organic content. "Typical" Made Ground.
3	Moderate Risk	<3.5		Old landfill, inert waste, mineworking flooded.
4	Moderate to High Risk	<15	Quantitative risk assessment required to evaluate scope of measures required.	Mineworking susceptible to flooding, completed landfill (WMP 26B criteria)
5	High Risk	<70		Mineworking unflooded inactive with shallow workings near surface.
6	Very High Risk	>70		Recent landfill site.

11.0 SOIL WASTE ASSESSMENT

Soil chemical test data has been assessed in accordance with Environment Agency Technical Guidance WM3: Hazardous Waste; “Guidance on the classification and assessment of waste”, May 2015, published by Environment Agency of England and Wales, SEPA, NIEA and Natural Resources Wales has been used to characterise soil materials.

HazWasteOnline™ a cloud-based software application for the management, analysis and reporting of hazardous waste materials has been used to make the assessment. Appendix 5 provides a summary of the assessment.

Surplus soil materials have been classified as a combination of non-hazardous and hazardous (WS102, TP102) material if removed to a landfill facility.

All material with greater than 0.1% asbestos by weight should be classified as Hazardous waste material and be disposed at a suitable landfill facility.

12.0 REVIEW OF CONCEPTUAL MODEL

The following section reviews the preliminary conceptual model based on the findings of the intrusive investigation.

Table 9 below provides a Revised Conceptual Model.

The table considers whether a pollution linkage is potentially present and provides a preliminary qualitative assessment of risk based on the information currently available. Where a possible linkage is identified, it does not necessarily mean that a significant risk exists but indicates that further information is required through appropriate site investigation to substantiate the conceptual model.

The Conceptual Model is based on a proposed continued commercial end use.

Table 9: Revised Conceptual Model

Source	Pathway	Receptor	Linkage	Comment
The likelihood of significant ground contamination sources being present at the site, associated with historical land use and made ground is considered LOW .	Direct contact, ingestion of soil, dermal contact, dust exposure pathways.	Current Site Users	Unlikely	The site is currently a vacant plot of land. The risk to current site users via direct exposure is considered to be LOW .
		Adjacent land users	Unlikely	The risk is considered LOW , although usual dust control measures should be implemented as part of good site working practices during construction.
		Future land users	Unlikely	Given the hardstanding nature of the site and the lack of elevated chemical contaminants of concern identified from the soil sampling programme, the risk to future site users via direct exposure is considered to be LOW .
		Construction Workers	Possible	Assuming appropriate Health and Safety measures are adopted during the works, a LOW preliminary risk to construction workers is identified.
The likelihood of asbestos being disturbed from the on site materials is considered MEDIUM	Direct contact, ingestion of soil, dermal contact, dust exposure pathways.	Current Site Users	Unlikely	The site is currently a vacant plot of land. The risk to current site users via direct exposure is considered to be LOW .
		Adjacent land users	Possible	The recommendations made in the Asbestos Management Plan should be adhered to at all times during the construction phase. Assuming the relevant control measures are implemented, the risk to adjacent land users is considered to be LOW .

Source	Pathway	Receptor	Linkage	Comment
		Future land users	Unlikely	As the proposed development is commercial and fully covered in hardstanding, there is not considered to be a pollutant pathway for future site users to come into contact with asbestos containing materials. The risk to future site users is therefore considered to be LOW .
		Construction Workers	Likely	Workers will likely encounter asbestos containing material during construction. An Asbestos Management Plan has been written containing recommendations for safe working with the asbestos containing materials on site. The recommendations of the Asbestos Management Plan should be adhered to at all times during construction. Assuming the relevant control measures are implemented, the risk to adjacent land users is considered to be LOW .
The likelihood of significant sources of soluble and/or liquid and therefore mobile contaminants occurring at the site is considered LOW .	Direct downward migration through leaching and/or mobile liquids.	Groundwater	Possible	No significant sources of mobile contamination have been identified on the site. In addition, the impermeable layer of clay encountered during the investigation will act as a barrier to the vertical migration of contaminants. The perceived risk to groundwater is considered LOW .
	Off-site migration in groundwater or surface water flow.	Surface water	Unlikely	No significant sources of mobile contamination have been identified on the site and given the distance to the closest surface water; the perceived risk is considered LOW .
		Groundwater / surface water abstractions	Possible	No significant sources of mobile contamination have been identified on the site. The perceived risk to water abstractions is considered LOW .
		Adjacent Properties	Unlikely	No significant sources of mobile contaminants have been identified on the site. Therefore, the preliminary risk to adjacent properties is considered LOW .
		Ecology	Unlikely	There are no significant sources of mobile contaminants identified on the site. The site is currently developed and in a developed area. Therefore, the risk to ecology is considered to be LOW .

Source	Pathway	Receptor	Linkage	Comment
The likelihood of significant volatile contaminants occurring at the site is considered LOW .	Inhalation of harmful vapours (indoor and outdoor airspaces)	Current Site Users	Unlikely	No significant sources of volatile contamination have been identified. The risk associated with current site users is considered to be LOW .
		Future site Users	Unlikely	No significant sources of volatile contamination have been identified. Modern construction practices will provide a barrier and ventilation. The risk associated with future site users is considered to be LOW .
		Adjacent Properties	Unlikely	The potential risk to adjoining site users is considered LOW .
Considering the gas monitoring from the recent SI, the likelihood of degradable materials with the potential to generate hazardous ground gas is LOW .	Emissions from the ground collecting in confined spaces and excavations	Construction/ services maintenance workers	Possible	Considering the potential for exposure the preliminary risk is LOW .
	Migration of gases on/off site and collecting in confined spaces on/off site.	Adjoining site users	Possible	Based on the gas monitoring results and the ground conditions encountered during the site investigation, the potential risk to adjoining site users associated with the site is considered LOW .
		Current/future site users	Possible	Based on the gas monitoring results and the ground conditions encountered during the site investigation, the potential risk associated with current and future site users is considered LOW .
Chemicals which could prove aggressive to construction materials may be present on site. LOW	Direct contact	Construction concrete, plastic water pipes.	Unlikely	Risks to construction materials can be identified via site investigation prior to the proposed construction works. The perceived risk is considered LOW .

13.0 CONCLUSIONS AND RECOMMENDATIONS

The following section provides a summary of the conclusions and recommendations based on the findings of the site investigation and contamination testing.

13.1 Soil Contamination

Based on the results of the chemical testing, no contaminant concentrations in exceedance of the screening criteria relevant to a Commercial End Use. The risk to end users is therefore considered to be **LOW**.

Based on the findings of the chemical testing, there are no identified areas of mobile contamination and therefore the risk with regards to controlled waters is low.

Due to the minor amount of hazardous ground gas detected during monitoring of the site, the risk with regards to hazardous ground gas is considered low.

13.2 Asbestos

Asbestos fibres of chrysotile and amosite have been identified in 14no. samples across the site. Considering initially the end users of the site, exposure to contaminants would be primarily through direct contact, ingestion or inhalation of contaminated soils where soil is exposed.

There is considered to be a significantly reduced risk beneath buildings or in area of hard standing as in such areas there is no pathway by which the pollutant linkage may be completed. Due to the site being completely below hardstanding in the proposed development plan, the risk of the asbestos contamination to end users is considered to be low.

An Asbestos Management Plan has been developed for the site. The recommendations contained within the report should be followed during the onsite works, especially regarding asbestos control measures, personal protective equipment (PPE) and unexpected asbestos contamination.

A watching brief should be undertaken by a suitably qualified person for the duration of the construction works. The following records should be documented and later included within a verification report:

- Summary of site activities, including material movements;
- Summary of any actions undertaken or deviations from proposed methodology;
- Fibre suppressant methods employed by the contractor, if any;
- Weather and dust observations;
- Air monitoring data (if required);
- Observations on ground conditions, including any unexpected asbestos contamination;
- A summary of any sampling undertaken.

The asbestos management plan will need to be complied with during the enabling works.

Waste transfer notes will be provided as part of validation to demonstrate the asbestos impacted soils have been suitably removed and disposed of.

13.3 Site Personnel

As with all construction sites, personnel working on the site during the construction period should be encouraged to maintain a high standard of personal hygiene and on-site washing facilities should be available. In areas of identified asbestos containing materials, correct PPE should be worn at all times and decontamination units should be used before workers leave the area. The asbestos risk should be communicated to all contractors/visitors upon site induction. The site should be supervised by a contractor that is asbestos awareness trained. Full recommendations are provided in the Asbestos Management Plan and should be adhered to at all times during construction.

13.4 Other Matters

Due diligence is required during the construction period, and should any further evidence of contamination be found, appropriate investigation and / or action should be taken. The significance of any contamination not discovered by this investigation is outside the scope of this report.

13.5 Foundation Recommendations

Conventional shallow foundations are suitable at this site, depending on anticipated structural loadings and tolerance of structures to settlement.

APPENDIX 1

EXPLORATORY HOLE LOGS

APPENDIX 2

CHEMICAL TEST RESULTS

APPENDIX 3

GEOTECHNICAL TEST RESULTS

APPENDIX 4

SOIL RISK ASSESSMENT CRITERIA

Tier I Values for Commercial Land Use
Based on Sandy Loamy Soil

Arsenic	mg/kg	640	Category 4 Screening level based on 6% SOM
Boron	mg/kg	240000	CIEH S4UL based on 6% SOM
Barium	mg/kg	24900	CLEA 1.06 modelling with 1% SOM
Beryllium	mg/kg	12	CIEH S4UL based on 6% SOM
Cadmium	mg/kg	410	Category 4 Screening level based on 6% SOM
Chromium (III)	mg/kg	8600	CIEH S4UL based on 6% SOM
Chromium (IV)	mg/kg	49	Category 4 Screening level based on 6% SOM
Lead	mg/kg	2300	Category 4 Screening level based on 6% SOM
Mercury (Inorganic)	mg/kg	1100	CIEH S4UL based on 6% SOM
Selenium	mg/kg	12000	CIEH S4UL based on 6% SOM
Nickel	mg/kg	980	CIEH S4UL based on 6% SOM (Revised, Aug 2015)
Copper	mg/kg	68000	CIEH S4UL based on 6% SOM
Toluene	mg/kg	56000	CIEH S4UL based on 1% SOM
Benzene	mg/kg	90	Category 4 Screening level based on 6% SOM
Ethylbenzene	mg/kg	5700	CIEH S4UL based on 1% SOM
Xylene-0	mg/kg	6600	CIEH S4UL based on 1% SOM
Trichlorethene (TCE)	mg/kg	1.2	CIEH S4UL based on 1% SOM
Tetrachloroethene (PCE)	mg/kg	19	CIEH S4UL based on 1% SOM
Zinc	mg/kg	730000	CIEH S4UL based on 6% SOM
Cyanide - Free	mg/kg	34	Based on acute risk to 0-6yr old child, HPA

Phenols	mg/kg	760	CIEH S4UL based on 1% SOM
PCB	mg/kg	32600	CLEA 1.06 modelling with 1% SOM
Naphthalene	mg/kg	190	Category 4 Screening level based on 6% SOM
Acenaphthylene	mg/kg	83000	CIEH S4UL based on 1% SOM
Acenaphthene	mg/kg	84000	CIEH S4UL based on 1% SOM
Fluorene	mg/kg	63000	CIEH S4UL based on 1% SOM
Phenanthrene	mg/kg	22000	CIEH S4UL based on 1% SOM
Anthracene	mg/kg	520000	CIEH S4UL based on 1% SOM
Fluoranthene	mg/kg	23000	CIEH S4UL based on 1% SOM
Pyrene	mg/kg	54000	CIEH S4UL based on 1% SOM
Benzo(a)anthracene	mg/kg	170	CIEH S4UL based on 1% SOM
Chrysene	mg/kg	350	CIEH S4UL based on 1% SOM
Benzo(b)fluoranthene	mg/kg	44	CIEH S4UL based on 1% SOM
Benzo(k)fluoranthene	mg/kg	1200	CIEH S4UL based on 1% SOM
Benzo(a)pyrene	mg/kg	77	Category 4 Screening Level
Indeno(1,2,3-cd)pyrene	mg/kg	500	CIEH S4UL based on 1% SOM
Di-benz (a,h) anthracene	mg/kg	3.5	CIEH S4UL based on 1% SOM
Benzo(ghi)perylene	mg/kg	320	CIEH S4UL based on 1% SOM

Vanadium	mg/kg	9000	CIEH S4UL based on 6% SOM
TPH Ali C5-C6	mg/kg	3200	CIEH S4UL based on 1% SOM
TPH Ali C6-C8	mg/kg	7800	CIEH S4UL based on 1% SOM
TPH Ali C8-C10	mg/kg	2000	CIEH S4UL based on 1% SOM
TPH Ali C10-C12	mg/kg	9700	CIEH S4UL based on 1% SOM
TPH Ali C12-C16	mg/kg	59000	CIEH S4UL based on 1% SOM
TPH Ali C16-C35	mg/kg	1600000	CIEH S4UL based on 1% SOM
TPH Ali C35-C44	mg/kg	1600000	CIEH S4UL based on 1% SOM
TPH Aro C5-C7 (benzene)	mg/kg	26000	CIEH S4UL based on 1% SOM
TPH Aro C7-C8 (toluene)	mg/kg	56000	CIEH S4UL based on 1% SOM
TPH Aro C8-C10	mg/kg	3500	CIEH S4UL based on 1% SOM
TPH Aro C10-C12	mg/kg	16000	CIEH S4UL based on 1% SOM
TPH Aro C12-C16	mg/kg	36000	CIEH S4UL based on 1% SOM
TPH Aro C16-C21	mg/kg	28000	CIEH S4UL based on 1% SOM
TPH Aro C21-C35	mg/kg	28000	CIEH S4UL based on 1% SOM
TPH Aro C35-C44	mg/kg	28000	CIEH S4UL based on 1% SOM

APPENDIX 5

SOIL WASTE ASSESMENT

APPENDIX 6

REPORT LIMITATIONS

REPORT LIMITATIONS

This contract was completed by Earth Environmental & Geotechnical Ltd on the basis of a defined programme and scope of works and terms and conditions agreed with the client. This report was compiled with all reasonable skill, and care, bearing in mind the project objectives, the agreed scope of works, the prevailing site conditions, the budget, and staff resources allocated to the project.

Other than that, expressly contained in the above paragraph, Earth Environmental & Geotechnical Ltd provides no other representation or warranty whether express or implied, is made in relation to the services. Unless otherwise agreed this report has been prepared exclusively for the use and reliance of the client in accordance with generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon, or transferred to, by any other party without the written agreement of a Director of Earth Environmental & Geotechnical Ltd.

If a third party relies on this report, it does so wholly at its own and sole risk and Earth Environmental & Geotechnical Ltd disclaims any liability to such parties.

It is Earth Environmental & Geotechnical Ltd understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was an important factor in determining the scope and level of the services. Should the purpose for which the report is used, or the proposed use of the site change, this report will no longer be valid and any further use of, or reliance upon the report in those circumstances by the client without Earth Environmental & Geotechnical Ltd review and advice shall be at the client's sole and own risk.

The report was written in 2024 and should be read in light of any subsequent changes in legislation, statutory requirements, and industry best practices. Ground conditions can also change over time and further investigations, or assessment should be made if there is any significant delay in acting on the findings of this report. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of Earth Environmental & Geotechnical Ltd. In the absence of such written advice of Earth Environmental & Geotechnical Ltd, reliance on the report in the future shall be at the client's own and sole risk. Should Earth Environmental & Geotechnical Ltd be requested to review the report in the future, Earth Environmental & Geotechnical Ltd shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between Earth Environmental & Geotechnical Ltd and the client.

The observations and conclusions described in this report are based solely upon the services that were provided pursuant to the agreement between the client and Earth Environmental & Geotechnical Ltd. Earth Environmental & Geotechnical Ltd has not performed any observations, investigations, studies or testing not specifically set out or mentioned within this report.

Earth Environmental & Geotechnical Ltd is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, Earth Environmental & Geotechnical Ltd did not seek to evaluate the presence on or off the site of electromagnetic fields, lead paint, radon gas or other radioactive materials.

The services are based upon Earth Environmental & Geotechnical Ltd observations of existing physical conditions at the site gained from a walkover survey of the site together with Earth

Environmental & Geotechnical Ltd interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The findings and recommendations contained in this report are based in part upon information provided by third parties, and whilst Earth Environmental & Geotechnical Ltd have no reason to doubt the accuracy and that it has been provided in full from those it was requested from, the items relied on have not been verified.

No responsibility can be accepted for errors within third party items presented in this report. Further Earth Environmental & Geotechnical Ltd was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the services. Earth Environmental & Geotechnical Ltd is not liable for any inaccurate information, misrepresentation of data or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to Earth Environmental & Geotechnical Ltd and including the doing of any independent investigation of the information provided to Earth Environmental & Geotechnical Ltd save as otherwise provided in the terms of the contract between the client and Earth Environmental & Geotechnical Ltd.

Where field investigations have been carried out these have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions can also be variable and as investigation excavations only allow examination of the ground at discrete locations. The potential exists for ground conditions to be encountered which are different to those considered in this report. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and Earth Environmental & Geotechnical Ltd] based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

The groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The normal speed of investigation usually does not permit the recording of an equilibrium water level for any one water strike. Moreover, groundwater levels are subject to seasonal variation or changes in local drainage conditions and higher groundwater levels may occur at other times of the year than were recorded during this investigation.

Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site.