



EARTH ENVIRONMENTAL
& GEOTECHNICAL



GeoEnvironmental Site Investigation Report

Moss Lane East

Manchester

November 2022

On behalf of

MAI Construction Ltd



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**GEOENVIRONMENTAL SITE
INVESTIGATION REPORT**

MOSS LANE EAST

MANCHESTER

Report Ref: A4320/21/SI/V2

NOVEMBER 2022

Prepared on Behalf of:

MAI Construction Ltd

By:

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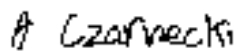
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1.0 EXECUTIVE SUMMARY

Appointment	Site Investigation works have been commissioned by MAI Construction Ltd to examine ground conditions for a proposed new residential development at Moss Lane East, Manchester.
The Investigation	The investigation comprised of 3 windowless samples with associated sampling, in situ testing, laboratory chemical and geotechnical testing (29/07/22) 9 trial pits (designated TP01 to TP09 inclusive) were excavated to a maximum depth of 2.40m bgl with associated sampling and environmental testing (28/09/22) 5 of these trial pits were used to delineate a contaminated 'hotspot' identified in the first phase of works.
The Site	The site is located off Moss Lane East, Manchester. The approximate National Grid Reference for the centre of the site is SP 84187 95704 (X: 384187, Y: 395704). The site is underlain by Devensian Till Deposits and the solid geology beneath the site is the Chester Formation, comprising sandstone.
Ground Conditions Encountered	The exploratory holes generally encountered Made Ground to a maximum depth of 2.00m bgl, underlain by Clay to a maximum depth of 3.00m bgl. Exploratory hole WS3 had a very loose light brown slightly clayey sand (from 1.70 – 2.00m bgl). Groundwater was not encountered in any exploratory holes.
Geotechnical Assessment	Based on the ground conditions encountered conventional shallow depth foundations (strip/pad), placed in the natural clay, should be suitable below 1.50m below ground level, depending on allowable bearing pressures and tolerance of structures to settlement. It should be noted that Made Ground was encountered to 2.00m and foundations within the vicinity of this location will need to be extended into natural clay. Should the allowable bearing pressure and settlement prove unfavourable, then alternative foundations options will need to be considered, such as ground improvement and piles.
Contamination Assessment	Risk from contamination to groundworkers during development – Moderate to Low Risk from contamination to future site users – Moderate Contaminant exceedances were identified across two phases including Naphthalene. The 2nd site visit found none of the delineation samples were found to have elevated levels of Naphthalene. Soil Waste Assessment: 1 sample has been classified as Hazardous (WS4). All other samples tested have been classified as Non-Hazardous.
<i>This sheet is intended to provide a summary only of the report. It does not provide a definitive engineering analysis for the purposes of costing or construction and is subject to the limitation of the agreed brief.</i>	

2.0 INTRODUCTION

2.1 Background

Site Investigation works have been commissioned by MAI Construction Ltd to examine ground conditions for a proposed new residential development at Moss Lane East, Manchester.

2.2 Previous Investigations

2.2.1 Earth Environmental & Geotechnical Ltd, Phase I GeoEnvironmental Desk Study (A4320/21), dated September 2021

Records dating to 1848 document the site to have been undeveloped vacant land until the 1920s when a small building was constructed on site. The building was demolished by the 1970s and was recently used to present a wooden advertisement board.

The risk from soil contamination to residential end users was considered to be **LOW**. The risk to controlled waters was concluded to be **VERY LOW**. The risk from ground gas to end users was considered to be **LOW**. The risk of groundwater flooding was **MODERATE to HIGH**.

An intrusive investigation was recommended to establish geotechnical parameters for the design of foundations, floor slabs and pavement construction.

As part of the geotechnical investigation, it was recommended that samples are recovered for contamination testing and to confirm whether there are any potential risks.

2.3 Terms of Reference

Earth Environmental and Geotechnical Ltd (EEG) have been commissioned by the Client, to undertake a Site Investigation of the site in accordance with proposals A4320/21/V2 dated 18th July 2022 and A4320/21/V3 dated 20th September 2022. The objectives of these investigations are as follows:

- *Provide information on the work undertaken including sampling location plan, exploratory hole logs, geotechnical and chemical testing.*
- *Tier 1 (semi-quantitative) risk assessment will be undertaken. This will compare the concentrations of soil contaminants identified against current and appropriate published guidelines, in relation to identified receptors, e.g. existing/ future end users and site neighbours.*
- *Classification of soil for offsite disposal.*
- *Assessment of ground conditions for foundation design.*

2.4 Report Scope

This report presents full factual records of the site work carried out, the ground conditions encountered in the exploratory holes, the in situ and laboratory test results. All information collected has been used to provide an interpretation of the ground conditions, with recommendations on geotechnical design and potential ground contamination risks for the proposed development.

2.5 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 considering 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 trial pits and boreholes 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.

3.0 SITE LOCATION & DESCRIPTION

The site is located off Moss Lane East, Manchester. The approximate National Grid Reference for the centre of the site is SP 84187 95704 (X: 384187, Y: 395704) with the closest postcode being M14 4WB.

The site is a roughly rectangular parcel of land with access via Moss Lane East to the north and Broadfield Road to the west. The maximum dimensions of the proposed site are approximately 25m north to south and 23m east to west. The site occupies an area of approximately 0.05 hectares. The site is generally flat and level.

At the time of this investigation, the site was overgrown with scrub, having a small cabin to the south of site and had a hardstanding concrete path crossing through the site from east to west.

The general surrounding area comprised predominantly residential buildings.

The site location is shown in the aerial photograph presented as Figure 1, below.

Figure 1: Site Location Plan



Access to the site is via an opening off Broadfield Road to the west of the site.

General site photographs are presented in Figure 2, overleaf.

Figure 2: General Site Photographs

View of site, Looking East.



View of site looking North.



3.1 Proposed Development

It is understood that the client wishes to construct four residential dwellings with rear and front garden areas and a parking bay in the southwest of site for residents.

A proposed development plan is shown in Figure 3 below.

Figure 3: Proposed Development Plan



4.0 SITE INVESTIGATION

4.1 Exploratory Fieldwork

The fieldwork was carried out by EEG across two phases on the 29th July and 28th September 2022 and comprised:

- Three window sample boreholes (designated WS2 to WS4 inclusive) were hand dug to a depth of 1.20m before window sampling was commenced. The boreholes were drilled to a maximum depth of 3.00m bgl where they refused in very stiff clay. WS1 was not carried out as it was proposed to be drilled in the southern section of the site, but the entire southern portion was underlain by concrete which obstructed the drilling. Window sampler boring is carried out with a small, track-mounted rig, which uses a chain-driven trip hammer to drive sampling tubes or penetrometers into the ground. These tools are coupled to the anvil of the hammer by solid drill rods. Sampling tubes comprise “windowless samplers”, which are plain sampler tubes in which a continuous disturbed sample is recovered within a semi-rigid plastic liner. To reduce friction within the borehole, sampling tubes of progressively smaller diameter are used as the borehole depth increases. Sampler diameters generally range from between approximately 90mm to 50mm. Standard Penetration Tests (SPTs) were undertaken in the boreholes in accordance with BS EN ISO 22476-3. Groundwater observations were noted where possible. These observations relate to the time of the investigation only, and do not necessarily reflect seasonal fluctuations. Exploratory hole logs are included in Appendix 1.
- Nine trial pits (designated TP01 to TP09 inclusive) were excavated by use of a JCB 3CX to a maximum depth of 2.40m bgl. Trial pits were backfilled immediately on completion of sampling and testing. Trial pit logs are presented in Appendix 1.
- Five of these trial pits were used for delineation around WS4, a previously identified contamination ‘hotspot’. Samples labelled SP1-SP10 inclusive, were taken from trial pits TP05-TP09 inclusive. Results from the samples are presented in Section 8 and Appendix 2.

Exploratory hole locations were selected on-site by an EEG engineer based on the proposed development layout and avoiding known services. Each exploratory location was scanned using a Cable Avoidance Tool (CAT) to locate unrecorded underground services, and the exploratory locations were repositioned if necessary.

On completion, samples recovered from the site were taken to specialist laboratories for chemical and geotechnical testing.

Soil samples of approximately 1.25kg were recovered in amber jars for volatile analysis and plastic tubs for general analysis. All the samples were labelled and stored in cool boxes prior to being collected by courier at the end of the day for delivery to the DETS laboratory.

If collection was not possible the same day, then samples were stored in the sample storage fridge at the EEG offices below 4°C.

Samples were tracked using appropriate Chain of Custody forms provided by DETS.

It should be noted that hexavalent chromium soil is analysed using the USEPA recommended method of alkaline leach. This method limits chromium (VI) reduction to chromium (III).

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⁾.

All sampling locations were surveyed by use of a hand-held Trimble GeoXH GPS instrument that is capable of surveying to an accuracy of less than 10mm depending on satellite coverage, proximity to trees and building structures.

The descriptive terminologies such as firm, etc formerly used within older versions of BS5930 to describe strength now solely relate to consistency. Shear strength is now defined related to results obtained in the field (using a hand vane for example) or in the laboratory (from triaxial tests), as detailed in Table 1 below.

Table 1: Shear Strength Definitions

Term based on measurement	Undrained Strength (c_u) definition in kN/m² (from BS EN ISO 14688-2: 2004, 5.3, Table 5)
Extremely Low Strength	<10
Very Low Strength	10 to 20
Low Strength	20 to 40
Medium Strength	40 to 75
High Strength	75 to 150
Very High Strength	130 to 300
Extremely High Strength	300 to 600

Exploratory Hole Location Plans are presented as Figures 4 and 5, overleaf.

A summary of exploratory holes undertaken during the investigation are presented in Table 2, overleaf.

Table 2: Summary of Exploratory Holes Undertaken

Hole	Type*	Depth (m)	Date Started	Date Finished	Easting (m)	Northing (m)	Backfill Details**
WS2	WS	3.00	29/07/2022	29/07/2022	384179	395705	A
WS3	WS	3.00	29/07/2022	29/07/2022	384193	395709	A
WS4	WS	3.00	29/07/2022	29/07/2022	384181	395709	A
TP01	TP	2.40	28/09/2022	28/09/2022	384190	395699	A
TP02	TP	1.80	28/09/2022	28/09/2022	384194	395693	A
TP03	TP	1.80	28/09/2022	28/09/2022	384185	395697	A
TP04	TP	1.80	28/09/2022	28/09/2022	384178	395698	A
TP05	TP	0.50	28/09/2022	28/09/2022	384178	395712	A
TP06	TP	0.50	28/09/2022	28/09/2022	384181	395710	A
TP07	TP	0.50	28/09/2022	28/09/2022	384183	395712	A
TP08	TP	0.50	28/09/2022	28/09/2022	384182	395708	A
TP09	TP	0.55	28/09/2022	28/09/2022	384182	395714	A
*WS=Windowless Sample, TP=Trials Pit							
**A=Arising							

Figure 4: Exploratory Hole Location Plan – WS Boreholes



Figure 5: Exploratory Hole Location Plan - Trial Pit and Hotspot Sampling Location Plan



4.2 Laboratory Testing

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 tests were scheduled by EEG and carried out by Murray Rix. 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 in Table 3 below.

Table 3: Summary of Laboratory Geotechnical Tests Undertaken

TEST	STANDARD	No.
Liquid Limit, Plastic Limit, Plasticity Index	BS1377:1990 Part 2, Clause 4/5	4
Sulphate content of 2:1 soil: water extract	BS1377:1990 Part 3, Clause 5	4
pH value	BS1377:1990 Part 3, Clause 9	4
Particle Size Distribution (Wet)	BS1377:1990 Part 2, Clause 9.2	2

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 DETS, a UKAS and MCERTS accredited laboratory.

Chemical analyses were carried out on four soil samples from the WS Exploratory Holes and were submitted for the following suite of determinants:

Asbestos Screen, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc, Cyanide, Phenol, Sulphate (SO₄), Sulphide, pH, Soil Organic Matter, Extractable Petroleum Hydrocarbons (EPH), Speciated Total Petroleum Hydrocarbon (TPH) and Speciated Polyaromatic Hydrocarbons (PAH).

Chemical analyses were also carried out on four soil samples from the Trial Pit Exploratory Holes from a return visit and were submitted for the same suite of determinants.

During the return visit, further testing was carried out for *Speciated Polyaromatic Hydrocarbons (PAH)* as part of a delineation around WS4; an identified PAH 'hotspot'.

Full 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

BGS digital mapping shows that the site is underlain by superficial deposits of Devensian Till. The solid geology beneath the site is the Chester Formation, comprising sandstone. The sequence of strata encountered beneath the site was as follows:

- **MADE GROUND** was encountered in all exploratory holes, comprising:
 - Grass over slightly gravelly SAND. Gravel is sandstone, red brick, slag, and glass.
 - Sandy gravelly CLAY. Gravel is sandstone, concrete, glass, and red brick.
 - Gravelly SAND with rare cobbles. Cobble is red brick. Gravel is red brick, sandstone, glass, and rootlets.
 - Grass over slightly gravelly SAND. Gravel is sandstone, red brick, and glass.
 - Silty gravelly SAND. Gravel is red brick, concrete, sandstone, and glass.
 - Concrete
 - SAND and GRAVEL with rare cobbles. Gravel is sandstone, red brick, concrete, glass, plastic, metal, and ceramic tile.
 - Sandy GRAVEL. Gravel is concrete.
 - Gravelly CLAY. Gravel is sandstone.
- **CLAY** was encountered in exploratory holes WS2, WS3, WS4, TP01, TP02, TP03 and TP04, comprising:
 - Slightly silty slightly gravelly CLAY. Gravel is sandstone.
 - Slightly gravelly CLAY. Gravel is sandstone.
 - Dark brown sandy CLAY.
- **SAND** was encountered in WS3 only, comprising:
 - Light brown slightly clayey SAND.

The depths of the various materials encountered in the exploratory holes are summarised in Table 4, overleaf.

5.2 Observable Indications of Contamination

Gravel/cobbles of red brick, glass, concrete, plastic, metal, and ceramic tile were observed in the Made Ground encountered on site, but these materials are generally considered inert.

However, rare gravel of slag was also encountered in the Made Ground.

No other visual or olfactory indications of contamination were observed.

5.3 Obstructions

No man-made obstructions were encountered in any of the excavations carried out during the fieldwork.

5.4 Groundwater

Groundwater was not encountered in any of the exploratory holes.

Table 4: Summary of Ground Conditions Encountered

Hole	Depth to Stratum (m bgl)				GROUNDWATER (m bgl)
	MADE GROUND		SUPERFICIAL DEPOSITS		
	Granular	Cohesive	Clay	Sand	
WS2	GL – 0.80	0.80 – 2.00	2.00 – 3.00+	-	-
WS3	GL – 1.50	-	1.50 – 1.70 2.00 – 3.00+	1.70 – 2.00	-
WS4	GL – 0.30	0.30 – 1.30	1.30 – 3.00+	-	-
TP01	GL – 0.90	-	0.90 – 2.40+	-	-
TP02	GL – 0.30	-	0.30 – 1.80+	-	-
TP03	GL – 0.90	-	0.90 – 1.80+	-	-
TP04	GL – 0.50	-	0.50 – 1.50+	-	-
TP05	GL – 0.20	0.20 – 0.50+	-	-	-
TP06	GL – 0.40	0.40 – 0.50+	-	-	-
TP07	GL – 0.30	0.30 – 0.50+	-	-	-
TP08	GL – 0.05	0.05 – 0.50+	-	-	-
TP09	GL – 0.15	0.15 – 0.50+	-	-	-
Values in red indicate termination in the Made Ground.					

6.0 ENGINEERING PROPERTIES OF SOILS ENCOUNTERED

6.1 General

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.

The results of laboratory geotechnical testing are summarised in the following table.

Table 5: Summary of Laboratory Geotechnical Test Results

Location	Depth (m)	Strata*	CLASSIFICATION										CHEMICAL	
			Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Modified Plasticity Index (%)	PSD Cobbles (%)	PSD Gravel (%)	PSD Sand (%)	PSD Silt (%)	PSD Clay (%)	pH Value	Water Soluble Sulphate SO ₄ (mg/l)
WS2	2.20	CLAY	11.9	33	13	20	17	-	-	-	-	-	7.2	200
WS3	1.90	CLAY	-	-	-	-	-	-	19	18	46	17	7.9	330
WS3	2.80	CLAY	18.3	33	15	18	17	-	-	-	-	-	-	-
WS4	1.50	CLAY	18.9	35	16	19	17	-	-	-	-	-	7.2	180
WS4	2.50	CLAY	17.2	26	12	14	14	-	1	7	70	22	7.3	210

6.2 Made Ground

Made Ground was encountered in all exploratory hole locations between ground level and a maximum depth of 2.00m below ground level (WS2).

Due to the depth of the Made Ground, **SPT N values** were recorded in this material. There were recorded to be between 5 and 12. This means the Made Ground at the depths tested was soft to firm.

Made Ground is not typically considered to be a suitable founding material and as such no further geotechnical testing was carried out on the material.

6.3 Clay

Clay was encountered in all exploratory hole locations to a maximum depth of 3.00m below ground level.

SPT tests carried out in the Clay were corrected for drilling energy efficiency and overburden pressure and resulted in **N1(60) values** of between 3 and 46, as shown on the N1(60) SPT v Depth Plot in Figure 6 (overleaf). The results suggest the clay is very soft to very stiff.

In-situ **hand penetrometer** (HP) tests have given results of shear strength in the range 24kN/m² to 215kN/m², suggesting the clay is very soft to very stiff at the depths tested.

The **water-soluble sulphate** content of the four clay samples ranged from 180mg/l to 330mg/l SO₄, together with **pH values** of 7.2 to 7.9.

Table 6: Summary of Design Parameters (Clay)

Depth	SPT N1(60) Value Range	Average N1(60) Value	Design N1(60) Value*	Equivalent Shear Strength** (kN/m ²)	Coefficient of Volume Compressibility** (mv)
1.2	12	12	12	65 (Medium Strength)	0.15 (Medium Compressibility)
2.0	3 - 26	16	11	60 (Medium Strength)	0.17 (Medium Compressibility)
3.0	45 - 46	45	45	245 (Very High Strength)	0.04 (Very Low Compressibility)
*Based on lower quartile N value and correlations by Peck Hanson and Thornburn (1974)					
**Based on correlation by Stroud & Butler (1975)					

It is recommended that for assessing ultimate bearing capacities, where the lower values are critical, the lower quartile value of N values is used. Based on the N Values in Table 6, the equivalent **shear strength** values are in the range of 60kN/m² to 245kN/m² suggesting the clay is medium to very high strength.

Atterberg Limit tests were carried out on eight samples of the clay. Results of the tests reported **liquid limit** values of between 26 to 35% and **plastic limit** values in the range of 12 to 16%, resulting in values of **plasticity index** in the range of 14 to 20%. These results suggest the clay to be **low to intermediate plasticity**. Results are shown on the Plasticity Chart in Figure 7, overleaf.

For design purposes, a value of plasticity index = 19% is recommended, based on the upper quartile value of the results.

The **coefficient of volume compressibility (mv)** has been estimated using the following correlation by Stroud and Butler (1975): for a clay with a plasticity index of 19%, $mv = 1 / (0.546 \times N \text{ value})$. This correlation gives values of coefficient of volume compressibility in the range 0.04m²/MN to 0.17m²/MN, as shown in Table 6. The results suggest the clay has a **very low to medium compressibility**.

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

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

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 **low volume change potential**.

Figure 6: SPT N1(60) v Depth Plot

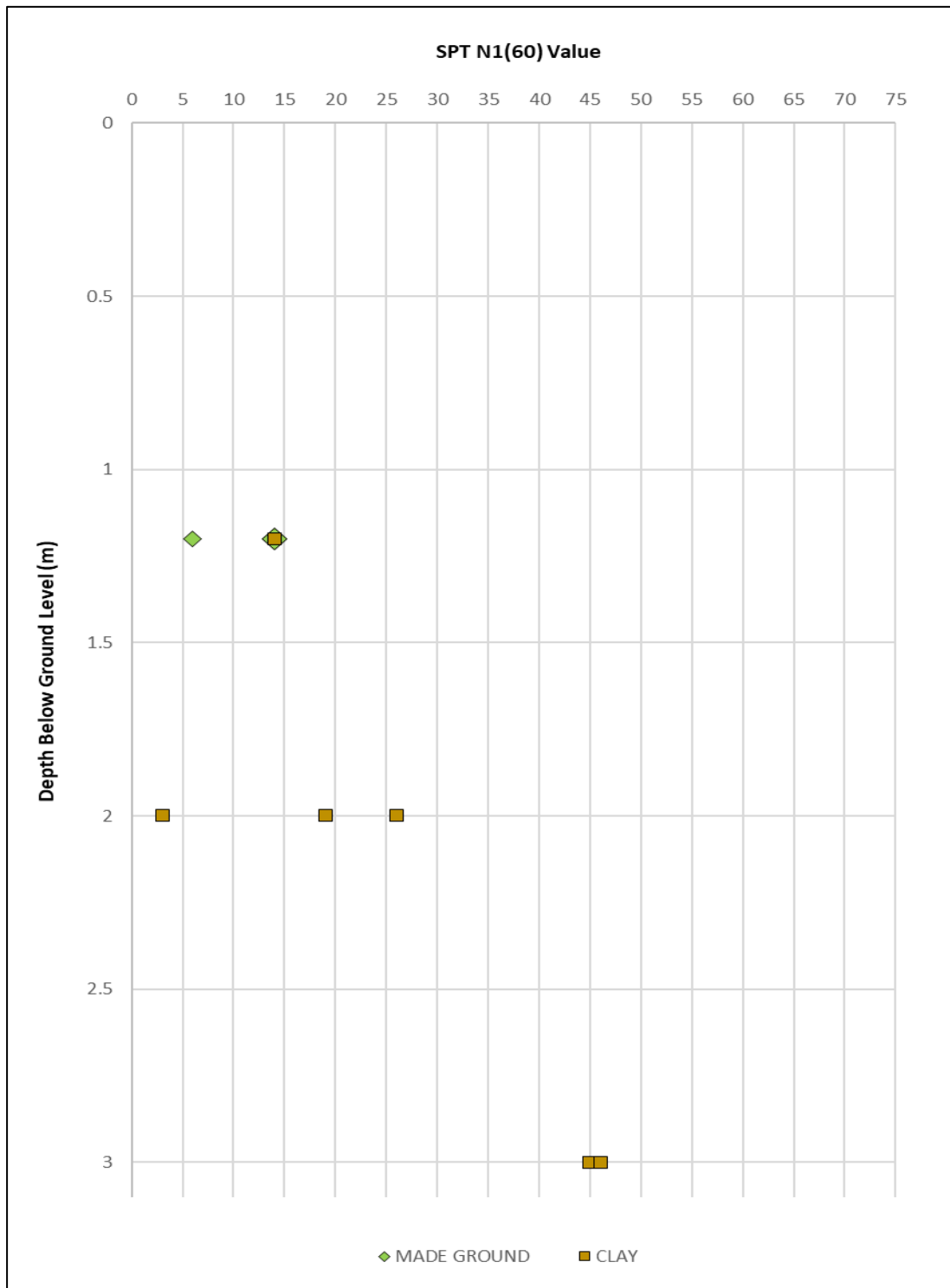
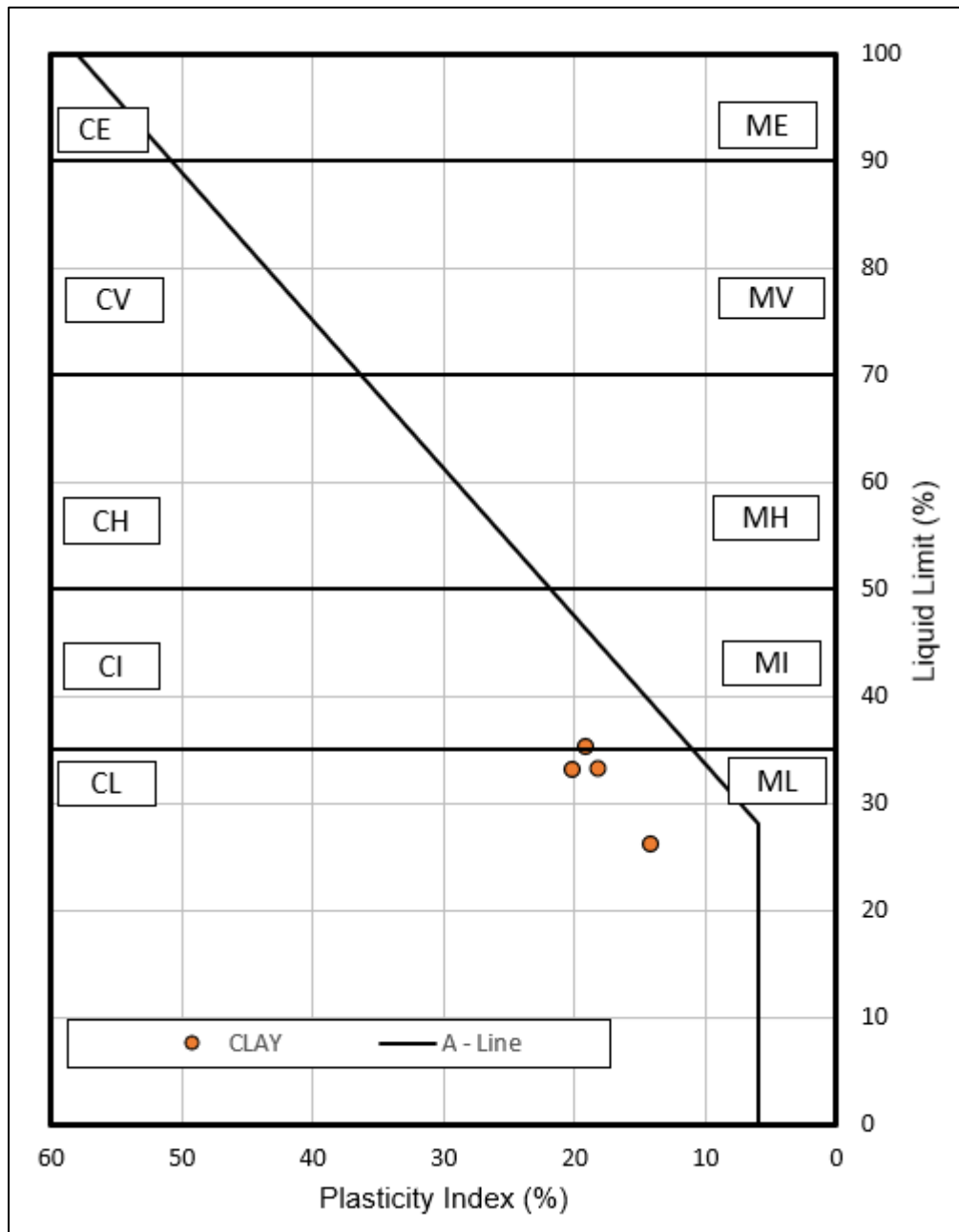


Figure 7: Plasticity Chart



The **Natural Moisture Content** (NMC) and **Liquid Limit** (LL) of the soil can be used to give an indication of **soil desiccation**, i.e., where the NMC is less than 40% of the LL, the soil is inferred to be desiccated, as summarised in Table 7, below.

Table 7: Soil Desiccation Indicators in Clay

Location	Depth (m)	Liquid Limit (%)	40% Liquid Limit (%)	Natural Moisture Content (%)	Desiccation
WS2	2.20	33	13	11.9	Yes
WS3	2.80	33	13	18.3	No
WS4	1.50	35	14	18.9	No
WS4	2.50	26	10	17.2	No

The results in the above table show that clay sample from WS2 does show indicators of desiccation. All other samples show no evidence of desiccation.

7.0 GEOTECHNICAL ASSESSMENT

7.1 Proposed Development

It is understood that the client wishes to construct four residential building with rear and front gardens and a parking bay in the southwest of the site for residents.

7.2 Ground Conditions Encountered

The exploratory holes generally encountered Made Ground to a maximum depth of 2.00m bgl, underlain by Clay to a maximum depth of 3.00m bgl.

Exploratory hole WS3 had a very loose light brown slightly clayey sand (from 1.70 – 2.00m bgl).

Groundwater was not encountered in any exploratory holes.

7.3 Foundation Considerations

Based on the ground conditions encountered conventional shallow depth foundations (strip/pad), placed in the natural clay, should be suitable below 1.50m below ground level, depending on allowable bearing pressures and tolerance of structures to settlement. It should be noted that Made Ground was encountered to 2.00m and foundations within the vicinity of this location will need to be extended into natural clay.

Should the allowable bearing pressure and settlement prove unfavourable, then alternative foundations options will need to be considered, such as ground improvement and piles.

7.3.1 Conventional Shallow Depth Strip/Pad Foundations

Strip/pad foundations should be taken down below any Topsoil or Made Ground and placed in 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 at least 150mm into suitable natural strata.

Foundations should be placed in materials of similar bearing and consolidation characteristics to avoid potential differential settlement occurring.

Table 8 overleaf summarises anticipated allowable bearing pressures for strip/pad foundations placed in the natural gravel. The bearing capacities are calculated based on Hansen's ⁽¹⁹⁷⁸⁾ method and assuming a factor of safety against bearing capacity failure of 3.

For the calculation, groundwater has been assumed to be at 3m below ground level to simulate a worst-case scenario.

Table 8: Summary of Allowable Bearing Pressures (Clay)

Foundation Strata	Design Value (Section 6)	Foundation Depth (m bgl)	Foundation Type	Foundation Size (m)	Allowable Bearing Pressure (kN/m ²)
CLAY	$c_u=65\text{kN/m}^2$	1.5	Strip	0.4	179
				0.9	167
			Pad	1.0 x 1.0	194
				2.0 x 2.0	176
	$c_u=60\text{kN/m}^2$	2.0	Strip	0.4	171
				0.9	162
			Pad	1.0 x 1.0	189
				2.0 x 2.0	173
	$c_u=60\text{kN/m}^2$	2.5	Strip	0.4	176
				0.9	168
			Pad	1.0 x 1.0	196
				2.0 x 2.0	182

Table 9 below summarises anticipated settlements of the above foundations in clay based on design values discussed in Section 6. Settlement in cohesive soils typically comprises a small amount of immediate settlement as loads are applied and a larger proportion of consolidation settlement, which will occur over a longer period of time. For the purposes of the calculations, the strata over the depth of influence of the foundation is assumed as the same type and the foundation loading assumed as equal to 75kN/m².

Table 9: Summary of Anticipated Settlements (Clay)

Foundation Depth (m bgl)	Foundation Strata	Foundation Type	Foundation Size (m)	Pad Foundation Loading (kN/m ²)	Settlement (mm)		
					At Centre	At Corner	Average
2.0	CLAY	Strip	0.4	75	-	-	5-10
			0.9	75	-	-	5-10
		Pad	1.0 x 1.0	75	10-15	< 5	5-10
			2.0 x 2.0	75	10-15	< 5	10-15
		Strip	0.4	75	-	-	< 5
			0.9	75	-	-	5-10
		Pad	1.0 x 1.0	75	5-10	< 5	5-10
			2.0 x 2.0	75	10-15	< 5	5-10
2.5		Strip	0.4	75	-	-	< 5
			0.9	75	-	-	< 5
		Pad	1.0 x 1.0	75	5-10	< 5	< 5
			2.0 x 2.0	75	5-10	< 5	5-10

Floor slabs should be designed as suspended if Made Ground of 600mm thickness or greater is present. Made ground is not considered an appropriate bearing stratum due to its variable nature. Floor slabs may be designed as ground bearing where Made Ground is excavated and replaced with suitable granular fill.

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. If foundations cross from granular to cohesive soils, nominal reinforcement should be incorporated.

7.4 Pavement Design

Based on the ground conditions encountered it is recommended that a conservative design CBR value of 1% should be adopted in areas where Made Ground is encountered at subgrade level.

Consideration should be given to the potential differing ground conditions near surface, which could cause pavements to be constructed on variable made ground. In this context a flexible pavement design may be required.

Consideration should also be given to the use of geotextiles to allow reduction of capping thickness. For examples biaxial geogrids such as Tensar SSLA20 and SSLA30 are often used to reduce capping thickness. The advice of a suitable contractor should be sought as to the most appropriate type of geotextile to use in the ground conditions encountered at this site. For guidance, the following table gives a comparison of granular layer thickness with and without the use of a geotextile, in accordance with the requirement of HA25/94 Part 2.

It should be noted the type of construction will depend on proposed finished pavement levels across the site and it is recommended the pavement design is reviewed once these levels are known. In this context, it is essential further in situ CBR testing is carried out once formation levels are known to confirm design CBR values.

Table 10: Comparison of Capping Thickness with and without Geotextile

CBR	Unreinforced			Reinforced with Tensar Geogrid				
	Sub-base	Capping	Total	Sub-base	Capping	No. of grids	Total	Thickness saving
0.5%	Design not suitable			200mm	400mm	2	600mm	-
1.0%	150mm	600mm	750mm	400mm	0	1	400mm	350mm
1.5%	150mm	600mm	750mm	310mm	0	1	310mm	440mm
2.0%	150mm	600mm	750mm	260mm	0	1	260mm	490mm
3.0%	150mm	350mm	500mm	210mm	0	1	210mm	290mm
4.0%	150mm	300mm	450mm	175mm	0	1	175mm	275mm
5.0%	150mm	250mm	400mm	160mm	0	1	160mm	240mm
These figures are suitable for light access roads and car parks, based on 1000 standard axles. For heavier loaded pavements the advice of specialist contractor should be sought.								

All formation excavations should be examined by a suitably experienced engineer or inspector to check for soft or unsuitable material, which should be removed and replaced with compacted granular fill. Also, to ensure good compaction and remove unevenness, the formation should be compacted with equipment suitable for use in the ground conditions encountered. Careful inspection of this work will also help identify any soft spots at or just below formation level.

7.5 Chemical Attack on Buried Concrete

Chemical tests (see Appendices) show low levels of water-soluble sulphates and near neutral conditions. Based on these conditions, it is recommended that for concrete placed in natural strata 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-1s. The recommendations of BRE Special Digest 1 should be followed for concrete foundations and ground bearing floor slabs.

7.6 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.

7.7 Temporary Works

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

Groundwater seepages could be encountered near surface within excavations, particularly during the wetter months of the year. Pumping of excavations from a suitable located sump is likely to be required to keep excavations dry.

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

SOIL CONTAMINATION RISK ASSESSMENT

8.1 Tier I Human Health Soil Risk Assessment – Groundworkers During Development

To assess the risk of soil contamination to construction and ground workers during development, guidelines from the HSE Document 'Protection of workers and the public during development of contaminated land' ⁽¹⁹⁹¹⁾ are used. The document assesses soil contamination test results and classifies the site as being uncontaminated or contaminated with varying degrees of contamination from 'slight' to 'unusually heavy'. The guideline values and laboratory test results are summarised in the following table:

Table 11: Summary of Guideline Values for Protection of Workers and the General Public During Development of Contaminated Land

Contaminant	Typical Values* for:					Test Results	Class
	Uncontaminated Soils	Slight Contamination	Contaminated	Heavy Contamination	Unusually Heavy Contamination		
	Class A	Class B	Class C	Class D	Class E		
pH (acid)	6 - 7	5 - 6	4 - 5	2 - 4	<2	-	-
pH (alkaline)	7 - 8	8 - 9	9 - 10	10 - 12	12	7.6 - 8.0	A - B
Arsenic	0 - 30	30 - 50	50 - 100	100 - 500	500	9 - 26	A
Cadmium	0 - 1	1 - 3	3 - 10	10 - 50	50	<0.2 - 1.2	A - B
Chromium	0 - 100	100 - 200	200 - 500	500 - 2500	2500	11 - 24	A
Copper	0 - 100	100 - 200	200 - 500	500 - 2500	2500	34 - 232	A - C
Lead	0 - 500	500 - 1000	1000 - 2000	2000 - 1%	1.0%	56 - 502	A - B
Mercury	0 - 1	1 - 3	3 - 10	10 - 50	50	< 1	A
Nickel	0 - 20	20 - 50	50 - 200	200 - 1000	1000	14 - 27	A - B
Zinc	0 - 250	250 - 500	500 - 1000	1000 - 5000	5000	48 - 486	A - B
Boron	0 - 2	2 - 5	5 - 50	50 - 250	250	< 1	A
Selenium	0 - 1	1 - 3	3 - 10	10 - 50	50	< 3	A
Barium	0-500	500-1000	1000-2000	2000-1.0%	1.0%	107 - 407	A
Beryllium	0 - 5	5 - 10	10 - 20	20 - 50	50	0.7 - 1.2	A
Vanadium	0 - 100	100 - 200	200 - 500	500 - 2500	2500	18 - 33	A
Sulphate	0 - 2000	2000 - 5000	5000 - 1%	1% - 5%	5.05%	389 - 2066	A - B
Sulphide	0 - 10	10 - 20	20 - 100	100 - 500	500	< 5	A
Cyanide (free)	0 - 1	1 - 5	5 - 50	50 - 100	100	< 2	A
Phenol	0 - 2	2 - 5	5 - 50	50 - 250	250	< 2	A

Based on the above results it is considered there is a **MODERATE TO LOW** potential risk from soil contamination to construction workers, ground workers and members of the public during construction. Appropriate measures, such as PPE, site health plans, and appropriate disposal of material arising will mitigate any risk.

8.2 Tier I Human Health Soil Risk Assessment – Future Site Users

The following section provides a Human Health Soil Assessment for future site users. The following section compares the results of contamination analyses to residential types of end development as specified by Defra/LQM/CIEH. As part of the contamination assessment, the chemical results obtained by EEG have been screened against accepted compliance criteria, namely:

- Defra C4SL Health Criteria Values (March 2014), where available; and
- Tier 1 assessment values - based on LQM/CIEH Suitable 4 Use Levels ⁽²⁰¹⁵⁾ (S4ULs).

The soil chemical testing results are summarised in Tables 12, 13 and 14, overleaf.

Table 12: Soil Results Comparison with C4SL/S4UL Values for WS Exploratory Holes

Determinand	C4SL/S4UL Levels Residential (mg/kg)	WS4 0.20m	WS4 1.20m	WS3 0.50m	WS2 0.40m	No of Exceedances
Metals						
Arsenic	37	17	14	19	20	0
Beryllium	1.7	0.9	0.9	0.7	1	0
Boron	290	< 1	< 1	< 1	< 1	0
Cadmium	22	0.5	< 0.2	1.2	0.6	0
Chromium	910	13	17	16	15	0
Chromium VI	21	< 2	< 2	< 2	< 2	0
Copper	2400	100	34	157	101	0
Lead	200	290	56	493	305	3
Mercury	40	< 1	< 1	< 1	< 1	0
Nickel	180	18	19	17	19	0
Selenium	250	< 3	< 3	< 3	< 3	0
Vanadium	410	21	22	20	23	0
Zinc	3700	153	48	413	176	0
Petroleum Hydrocarbons						
Benzene	0.87	< 0.002	< 0.002	< 0.002	0.013	0
Toluene	660	0.029	<0.005	<0.005	<0.005	0
Ethylbenzene	260	0.047	< 0.002	< 0.002	< 0.002	0
o-xylenes	310	0.072	< 0.002	< 0.002	< 0.002	0
m-xylenes	310	0.099	< 0.002	< 0.002	< 0.002	0
p-xylenes	310	0.099	< 0.002	< 0.002	< 0.002	0
Aliphatic EC >5-6	160	< 0.01	< 0.01	< 0.01	< 0.01	0
Aliphatic EC >6-8	530	< 0.05	< 0.05	< 0.05	< 0.05	0
Aliphatic EC >8-10	150	< 2	< 2	< 2	< 2	0
Aliphatic EC >10-12	760	91	< 2	< 2	2	0
Aliphatic EC >12-16	4300	386	< 3	< 3	13	0
Aliphatic EC >16-21	110000	889	< 3	< 3	36	0
Aliphatic EC >21-35	110000	495	< 10	22	14	0
Aromatic EC >5-7	300	< 0.01	< 0.01	< 0.01	0.01	0
Aromatic EC >7-8	660	< 0.05	< 0.05	< 0.05	< 0.05	0
Aromatic EC >8-10	190	6	< 2	< 2	< 2	0
Aromatic EC >10-12	380	23	< 2	< 2	< 2	0
Aromatic EC >12-16	660	149	< 2	6	20	0
Aromatic EC >16-21	930	746	< 3	77	134	0
Aromatic EC >21-35	1700	654	< 10	154	152	0
Polycyclic Aromatic Hydrocarbons						
Naphthalene	2.3	82.3	< 0.1	0.23	1.57	1
Acenaphthylene	210	0.38	< 0.1	< 0.1	0.56	0
Acenaphthene	170	75.1	< 0.1	0.83	2.86	0
Fluorene	170	55.6	< 0.1	0.45	2.66	0
Phenanthrene	95	475	0.35	6.33	25.2	1
Anthracene	2400	78.6	< 0.1	1.23	4.52	0
Fluoranthene	280	342	0.31	15.4	29.8	1
Pyrene	620	313	0.29	15.4	31.2	0
Benzo(a)anthracene	7.2	104	< 0.1	7.59	13.1	3
Chrysene	15	91.6	0.13	7.4	13.1	1
Benzo(a)pyrene	5	85.4	< 0.1	7.78	10.8	3
Benzo(b)fluoranthene	2.6	91.2	< 0.1	8.44	9.8	3
Benzo(k)fluoranthene	77	36.7	< 0.1	3.08	4.38	0
Indeno(1,2,3-cd)pyrene	27	48.7	< 0.1	6.33	6.47	1
Dibenz(a,h)anthracene	0.24	6.68	< 0.1	0.76	1.21	3
Benzo(ghi)perylene	320	35.4	< 0.1	4.04	4.93	0
Phenols						
Phenol	280	< 2	< 2	< 2	< 2	0

Values in red indicate an exceedance when compared to a residential end use.

Table 13: Soil Results Comparison with C4SL/S4UL Values for Trial Pit Exploratory Holes

Determinand	C4SL/S4UL Levels Residential (mg/kg)	TP01 0.40m	TP02 0.15m	TP03 0.25m	TP04 0.50m	No of Exceedances
Metals						
Arsenic	37	19	15	9	26	0
Beryllium	1.7	1.1	1	0.7	1.2	0
Boron	290	< 1	< 1	< 1	< 1	0
Cadmium	22	1.2	< 0.2	0.4	0.4	0
Chromium	910	24	17	11	11	0
Chromium VI	21	< 2	< 2	< 2	< 2	0
Copper	2400	232	105	47	89	0
Lead	200	502	137	133	364	2
Mercury	40	< 1	< 1	< 1	< 1	0
Nickel	180	27	22	14	21	0
Selenium	250	< 3	< 3	< 3	< 3	0
Vanadium	410	33	33	18	30	0
Zinc	3700	486	115	70	289	0
Petroleum Hydrocarbons						
Benzene	0.87	< 0.002	< 0.002	< 0.002	< 0.002	0
Toluene	660	0.016	0.018	<0.005	0.020	0
Ethylbenzene	260	< 0.002	0.006	< 0.002	< 0.002	0
o-xylenes	310	< 0.002	< 0.002	< 0.002	0.012	0
m-xylenes	310	0.008	0.019	< 0.002	0.016	0
p-xylenes	310	0.008	0.019	< 0.002	0.016	0
Aliphatic EC >5-6	160	< 0.01	< 0.01	< 0.01	< 0.01	0
Aliphatic EC >6-8	530	< 0.05	< 0.05	< 0.05	< 0.05	0
Aliphatic EC >8-10	150	< 2	< 2	< 2	< 2	0
Aliphatic EC >10-12	760	< 2	< 2	< 2	< 2	0
Aliphatic EC >12-16	4300	< 3	< 3	< 3	< 3	0
Aliphatic EC >16-21	110000	< 3	< 3	< 3	< 3	0
Aliphatic EC >21-35	110000	28	43	31	16	0
Aromatic EC >5-7	300	< 0.01	< 0.01	< 0.01	< 0.01	0
Aromatic EC >7-8	660	< 0.05	< 0.05	< 0.05	< 0.05	0
Aromatic EC >8-10	190	< 2	< 2	< 2	< 2	0
Aromatic EC >10-12	380	4	< 2	< 2	< 2	0
Aromatic EC >12-16	660	67	6	< 2	13	0
Aromatic EC >16-21	930	278	19	10	87	0
Aromatic EC >21-35	1700	422	64	63	167	0
Polycyclic Aromatic Hydrocarbons						
Naphthalene	2.3	2.57	0.37	< 0.1	0.51	1
Acenaphthylene	210	0.28	< 0.1	< 0.1	0.79	0
Acenaphthene	170	8.96	0.58	0.16	0.91	0
Fluorene	170	7.37	0.57	0.11	1.34	0
Phenanthrene	95	64.2	4.02	1.52	16.1	0
Anthracene	2400	14.2	0.8	0.32	3.33	0
Fluoranthene	280	53.1	5.46	3.92	22.6	0
Pyrene	620	48.8	5.44	4	24.3	0
Benzo(a)anthracene	7.2	20.4	3.11	2.18	12.7	2
Chrysene	15	19.5	2.53	1.85	8.83	1
Benzo(a)pyrene	5	13.9	3.12	2.51	9.69	2
Benzo(b)fluoranthene	2.6	13.2	2.95	2.4	10.4	3
Benzo(k)fluoranthene	77	6.64	0.96	0.71	3	0
Indeno(1,2,3-cd)pyrene	27	5.15	1.34	1.11	3.05	0
Dibenz(a,h)anthracene	0.24	1.44	0.36	0.26	0.86	4
Benzo(ghi)perylene	320	4.07	1.17	0.94	2.42	0
Phenols						
Phenol	280	< 2	< 2	< 2	< 2	0

Values in red indicate an exceedance when compared to a residential end use.

Table 14: Soil Results Comparison with C4SL/S4UL Values for Samples Taken as Part of the Delineation around WS4

Determinand	C4SL/S4UL Levels Residential (mg/kg)	SP1	SP2	SP3	SP4	SP5	No of Exceedances
Polycyclic Aromatic Hydrocarbons							
Naphthalene	2.3	0.44	2.11	1.17	0.53	< 0.1	0
Acenaphthylene	210	0.14	0.13	0.18	< 0.1	< 0.1	0
Acenaphthene	170	2.14	4.22	6	2.41	0.32	0
Fluorene	170	1.36	2.68	3.60	1.48	0.23	0
Phenanthrene	95	15.40	31.30	43	13.50	3.53	0
Anthracene	2400	2.39	5.63	9.11	2.46	0.74	0
Fluoranthene	280	18.70	33.20	58.10	13.70	7.11	0
Pyrene	620	19	31.70	54.70	12.20	6.50	0
Benzo(a)anthracene	7.2	9.24	13.90	27.60	6.35	3.69	3
Chrysene	15	8.52	12.60	23.30	5.21	3	1
Benzo(a)pyrene	5	8	13.40	21.50	5.27	3.67	4
Benzo(b)fluoranthene	2.6	8.51	13.80	22	5.44	3.71	5
Benzo(k)fluoranthene	77	3.15	4.96	7.90	1.96	1.26	0
Indeno(1,2,3-cd)pyrene	27	2.76	4.26	7.34	2.09	1.79	0
Dibenz(a,h)anthracene	0.24	0.78	1.21	2.07	0.53	0.50	5
Benzo(ghi)perylene	320	2.31	3.79	6.04	1.72	1.60	0

Values in red indicate an exceedance when compared to a residential end use.

Determinand	C4SL/S4UL Levels Residential (mg/kg)	SP6	SP7	SP8	SP9	SP10	No of Exceedances
Polycyclic Aromatic Hydrocarbons							
Naphthalene	2.3	0.82	0.20	0.29	1.04	< 0.1	0
Acenaphthylene	210	< 0.1	< 0.1	0.14	< 0.1	< 0.1	0
Acenaphthene	170	1.72	0.45	1.70	3.66	0.81	0
Fluorene	170	1.08	0.27	1.11	2.14	0.46	0
Phenanthrene	95	12.70	4.40	14	24.80	6.25	0
Anthracene	2400	2.44	0.79	2.55	4.05	1.14	0
Fluoranthene	280	19.80	9.43	17.40	30	13.50	0
Pyrene	620	18.20	9.15	16	29.60	13.60	0
Benzo(a)anthracene	7.2	10.30	5.02	8.01	13.70	5.25	3
Chrysene	15	10.10	4.17	7.12	13	5.09	0
Benzo(a)pyrene	5	9.90	4.51	7.08	10.90	4.34	3
Benzo(b)fluoranthene	2.6	10.40	4.66	7.87	10.50	5.01	5
Benzo(k)fluoranthene	77	5.04	1.85	2.40	4.42	2.02	0
Indeno(1,2,3-cd)pyrene	27	5.07	1.94	2.74	4.05	2.39	0
Dibenz(a,h)anthracene	0.24	1.36	0.51	0.73	1.17	0.35	5
Benzo(ghi)perylene	320	4.16	1.62	2.24	3.36	1.96	0

Values in red indicate an exceedance when compared to a residential end use.

Twenty elevated concentrations of contaminants of concern, with respect to the long-term protection of human health, were identified in the four samples collected from the initial site investigation in July 2022 when compared to residential end use (with plant uptake) assessment criteria.

Elevated Naphthalene was identified in WS4 at 0.20m.

A further fifteen elevated concentrations of contaminants of concern, with respect to the long-term protection of human health, were identified in the four samples collected from the second site investigation in September 2022 when compared to residential end use (with plant uptake) assessment criteria.

Elevated Naphthalene was identified in TP01 at 0.40m.

The delineation of Polycyclic Aromatic Hydrocarbons around the WS4 'hotspot' identified thirty-four elevated concentrations of contaminants of concern. None of these samples identified Naphthalene.

Asbestos was identified in TP01.

Asbestos was not found in any other samples.

8.3 Soil Waste Assessment

An assessment of the disposal characteristics of the soil in accordance with Environment Agency guidance WM3.1, edition of June 2018, "Guidance on the classification and assessment of waste" has been carried out on soils recovered from the site, using HazWasteOnline.

The results are summarised in Table 15 below and presented in full in Appendix 4.

Table 15: Waste Classification of Soils

Location	Depth (m bgl)	WM3.1 Classification	Comments
WS4	0.20	Hazardous	Hazardous due to TPH concentration.
WS4	1.20	Non-Hazardous	Non-Hazardous
WS3	0.50	Non-Hazardous	Non-Hazardous
WS2	0.40	Non-Hazardous	Non-Hazardous
TP01	0.40	Non-Hazardous	Non-Hazardous
TP02	0.15	Non-Hazardous	Non-Hazardous
TP03	0.25	Non-Hazardous	Non-Hazardous
TP04	0.50	Non-Hazardous	Non-Hazardous
SP1	-	Non-Hazardous	Non-Hazardous
SP2	-	Non-Hazardous	Non-Hazardous
SP3	-	Non-Hazardous	Non-Hazardous
SP4	-	Non-Hazardous	Non-Hazardous
SP5	-	Non-Hazardous	Non-Hazardous
SP6	-	Non-Hazardous	Non-Hazardous
SP7	-	Non-Hazardous	Non-Hazardous
SP8	-	Non-Hazardous	Non-Hazardous
SP9	-	Non-Hazardous	Non-Hazardous
SP10	-	Non-Hazardous	Non-Hazardous

The above table shows that one (WS4) of the tested samples collected during this investigation were classified as **Hazardous** in accordance with WM3.1, due to elevated concentrations of TPH.

The remaining samples collected during this investigation were classified as **Non-Hazardous** in accordance with WM3.1.

Further Waste Acceptance Criteria (WAC) testing may prove that this material is acceptable as inert waste.

9.0 CONCLUSIONS & RECOMMENDATIONS

9.1 Soil Contamination

There is a moderate to low potential risk from soil contamination to construction workers and ground workers during development, and appropriate measures such as PPE, site health plans, appropriate disposal of material arisings will mitigate this risk. The groundworks contractor must provide a soil management plan including methods of dealing with unanticipated soil contamination encountered during groundworks.

Based on the results of the chemical testing, numerous contaminant concentrations were found in exceedance of the screening criteria relevant to a Residential End Use (with Plant Uptake) in all borehole locations. The risk to end users is therefore considered to be **MODERATE**.

In order to break potential pollutant linkages to future residential end users, it is recommended that landscaped areas should be capped with clean cover soils.

The naphthalene contamination found at WS4 has been further delineated and confirmed to be confined to the immediate 'hotspot' area surrounding WS4. The impacted material present in this area should be removed offsite.

A Remediation Strategy is recommended to specify the design of the capping system and any following validation work.

9.2 Asbestos

Asbestos was identified in one of the samples tested during this investigation

Asbestos was not identified in any of the other samples tested during this investigation.

9.3 Foundations

Shallow strip/pad foundations placed in the natural clay are considered appropriate for the current proposed development, dependent on allowable bearing pressures and tolerance of structures to settlement. Foundations will need to be extended to below any Made Ground, with the maximum depth of this material being 2.00m bgl in WS2.

Should the allowable bearing pressure and settlement prove unfavourable, then alternative foundations options will need to be considered, such as ground improvement and piles.

9.4 Soil Disposal

Soils should be disposed of at a suitable site, registered to take the levels of contamination encountered. The soil sample collected from WS4 has been classified as Hazardous for the purpose of off-site disposal in accordance with Environment Agency guidance WM3.1. The remaining soil samples have been classified as Non-Hazardous for the purpose of off-site disposal in accordance with Environment Agency guidance WM3.1.

9.5 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.

9.6 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.

APPENDIX 1
EXPLORATORY HOLE LOGS

APPENDIX 2

CHEMICAL TESTING RESULTS

APPENDIX 3

GEOTECHNICAL TESTING RESULTS

APPENDIX 4

SOIL WASTE ASSESSMENT

APPENDIX 5

REPORT LIMITATIONS

REPORT LIMITATIONS

This contract was completed by Earth Environmental & Geotechnical Ltd based on 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 2022 and should be read considering 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 of 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.