Site Investigation Report

Taylor Hall Lane

Mirfield

August 2025

On behalf of

Plantforce

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SITE INVESTIGATION REPORT

TAYLOR HALL LANE

MIRFIELD

Report Ref: A4245/23/SI/V3

AUGUST 2025

Prepared on Behalf of:

PLANTFORCE

By:

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TAYLOR HALL LANE, MIRFIELD

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Managing Director

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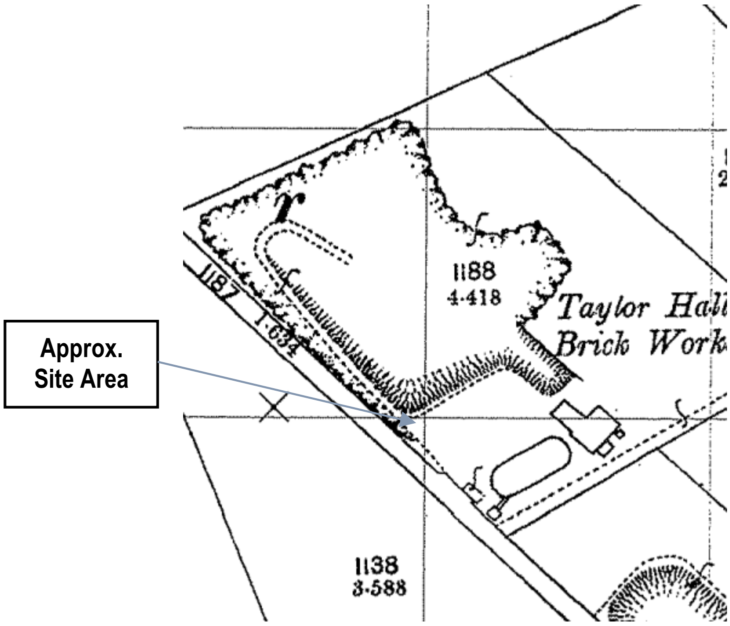
1.0 EXECUTIVE SUMMARY

Appointment	A Site Investigation has been commissioned by Transform Architects Ltd on behalf of Plantforce (the Client), to examine ground conditions for a proposed new build just off Taylor Hall Lane, Mirfield.
The Investigation	The investigation comprised 5no. windowless sample boreholes, with associated sampling and in situ testing, laboratory geotechnical and contamination testing.
The Site	The site is located to the north, just off Taylor Hall Lane, Mirfield. The site is approximately 1.6km north of Mirfield Centre. The site is a square-shaped parcel of land; the east side of the site is overgrown with shrubbery and is difficult to access. To the north and east of the site are open fields, and to the south is Taylor Hall Lane and opposing residential housing.
Site History	The site is located on the periphery of a landfilled former brick pit. The landfill licence was issued to Webfell Waste in 1996, and it accepted non-biodegradable waste. 

Ground Conditions Encountered	Made ground was encountered in all exploratory hole locations WS1 – WS5 between ground level and 6.00m bgl. The ground varies from MADE GROUND: clays, gravel, and sands across all exploratory holes WS1 – WS5. No water was encountered in any of the exploratory holes undertaken.
Ground Gas Assessment	Ground gas monitoring has been undertaken on four separate occasions throughout prolonged low atmospheric pressure. Based on the data, gas protection measures are required with the site classified as Characteristic Situation CS2. A gas piling risk assessment has been developed.
Geotechnical Assessment	Shallow strip/pad foundations are not considered appropriate for the current proposed development due to the depth of the Made Ground encountered. Therefore, alternative foundation options will need to be considered, such as ground improvement or piles.
Contamination Assessment	Risk from contamination to groundworkers during development – Moderate to low Risk from contamination to future site users – Low No asbestos was identified in the samples analysed. No remediation of the site is required for the proposed development. Soil Waste Assessment: 5no. samples classified as Non-Hazardous.
This sheet is intended to provide a summary only of the report. It does not offer a definitive engineering analysis for the purposes of costing or construction and is subject to the limitation of the agreed brief.	

2.0 INTRODUCTION

2.1 Background

A Site Investigation has been commissioned by Transform Architects Ltd on behalf of Plantforce (the Client), to examine ground conditions for a proposed new residential (three units) development off Taylor Hall Lane, Mirfield.

2.2 Terms of Reference

The Client has commissioned Earth Environmental and Geotechnical Ltd (EEG) to undertake a site investigation in accordance with proposal A4245/23 dated 11th October 2022.

The objectives of this investigation are as follows:

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

2.3 Report Scope

This report presents complete factual records of the site work carried out, the ground conditions encountered in the exploratory holes, and 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.

This report should be read in conjunction with a Phase 1 Desk Study report by Earth Environmental & Geotechnical Ltd, dated April 2022.

Reference gas also been made to a Land Quality Assessment report by GW Land Reclamation Ltd for an adjacent plot of a land, dated June 2006. The land was a fire-damaged play school/ gymnasium.

2.4 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.

3.0 SITE LOCATION & DESCRIPTION

The site is located to the north just off of Taylor Hall Lane, Mirfield. The site is approximately 1.6km to the north of Mirfield Centre.

The approximate National Grid Reference for the centre of the site is SE 19884 21422, (X: 419884, Y:421422) with the closest postcode being WF14 0LY.

The maximum dimensions of the site are 34m east to west and 33m north to south.

The site is a square-shaped parcel of land; the east side of the site is overgrown with shrubbery. To the north and east of the site are open fields, and to the south is Taylor Hall Lane and residential housing.

The site is completely soft standing, and there are no artificial obstacles on the site.

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

Figure 1: Aerial Photograph Showing Site Location

General site photographs are presented in Figure 2 overleaf.

Figure 2: General Site Photographs

Photograph taken viewing North-West of the site

Photograph taken showing the North-East of the site

Photograph taken of strata (WS2)

Photograph taken of SPT Sample (WS1)

3.1 Proposed Development

It is understood that the client wishes to construct new residential properties on site just off Taylor

Hall Lane, Mirfield.

The proposed development layout details are 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 on the 30th January 2023 and comprised:

- Five window sample boreholes (designated WS01 – WS02 inclusive) were sunk to a maximum depth of 6.00m below existing ground level. 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. In order 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.

Exploratory hole locations were selected prior to the site works by EEG Ltd based on the proposed development and avoiding known services.

Table 1 below indicates the appropriate features targeted. Ground gas monitoring installations were emplaced in each borehole within the made ground, with plain casing installed to a depth of 1m, to prevent atmospheric air ingress into the borehole annulus.

Table 1: Sampling Location Justification

Exploratory Hole	Sampling Location
WS01 – WS05	Contamination/Foundations

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

Soil samples were recovered in 250g glass amber jars and 1kg plastic tubs. 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 the 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+A1:2020) 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 using 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 in relation to results obtained in the field (using a hand vane, for example) or in the laboratory (from triaxial tests), as detailed in Table 2 below.

Table 2: Shear Strength Definitions

Term based on measurement	Undrained Strength (c_u) definition in kN/m^2 (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	150 to 300
Extremely High Strength	300 to 600

An Exploratory Hole Location Plan is presented as Figure 4, overleaf.

Figure 4: Exploratory Hole Location Plan

A summary of exploratory holes undertaken during the investigation is presented in Table 3 below.

Table 3: Summary of Exploratory Holes Undertaken

Hole	Type*	Depth (m)	Date Started	Date Finished	Easting (m)	Northing (m)	Backfill Details**
WS01	WS	5.00	30/01/23	30/01/23	419888	421409	MW
WS02	WS	3.00	30/01/23	30/01/23	419895	412421	MW
WS03	WS	3.80	30/01/23	30/01/23	419887	421432	MW
WS04	WS	6.00	30/01/23	30/01/23	419883	421416	MW
WS05	WS	3.00	30/01/23	30/01/23	419878	412418	MW

*WS = Window Sample Borehole
**MW = Monitoring Well

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 by the methods described in BS1377:1990. Details of the specific tests used in each case are given in Table 4, below.

Table 4: Summary of Laboratory Geotechnical Tests Undertaken

TEST	STANDARD	No.
Liquid Limit, Plastic Limit, Plasticity Index	BS1377:1990 Part 2, Clause 4/5	4
Particle size distribution (wet)	BS1377:1990 Part 2, Clause 9.2	2
Sulphate content of 2:1 soil: water extract	BS1377:1990 Part 3, Clause 5	4
pH value	BS1377:1990 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 DETS, a UKAS and MCERTS-accredited laboratory.

Chemical analyses were carried out on 5no. soil samples and were submitted for the following suite of determinants:

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 PAH and Speciated TPH.

Complete results of the laboratory contamination tests are discussed in Section 8 and included in Appendix 4.

5.0 GROUND CONDITIONS ENCOUNTERED

5.1 Soil Profile Encountered

BGS digital mapping shows no record of superficial deposits. The solid geology beneath the site is recorded as the Pennine Lower Coal Measures formation, comprising interbedded grey mudstone, coal seams, siltstone, and sandstone. The sequence of strata encountered beneath the site was as follows:

- **Made Ground –** Made ground was encountered in the exploratory holes to a maximum depth of 6.00m bgl, comprising:
  - Grass over brown clayey sandy gravely TOPSOIL.
  - Brown slightly clayey gravelly SAND. Gravel is red brick and sandstone.
  - Dark brown slightly sandy gravelly CLAY. Gravel is red brick, siltstone, and sandstone.
  - Dark brown gravelly SAND. Gravel is concrete, plastic, red brick, and clinker.
  - Dark brown sandy, slightly gravelly CLAY. Gravel is red brick, sandstone, and clinker.
  - Dark brown gravelly SAND. Gravel is made of plastic, red brick, and concrete.
  - Asphalt GRAVEL.
  - Dark brown loamy organic SAND.
  - Brown sandy GRAVEL. Gravel is red brick, clinker, MDF and sandstone.

The depths of the various materials encountered in the exploratory holes are summarised in Table 5, below.

Table 5: Summary of Ground Conditions Encountered

LOCATION	MADE GROUND	
	GRANULAR	COHESIVE
WS01	0.00 – 1.00, 2.00 – 4.40, 4.60 – 5.00	1.00 – 2.00, 4.40 – 4.60
WS02	0.00 – 0.70	0.70 – 3.00
WS03	0.00 – 1.00	1.00 – 3.80
WS04	0.00 – 1.00, 4.00 – 6.00	1.00 – 4.00
WS05	0 00 – 1.00	1.00 – 3.00

During a site investigation by GW Land Reclamation Ltd, the ground conditions on the adjacent plot of land were established to be reworked clay underlain by ash fill to the base of the boreholes at 6m.

A suspected mudstone rockhead was established in one borehole at a depth of 4.2m. Made Ground was found at all borehole locations.

5.2 Observable Indications of Contamination

Gravel of plastic, metal, MDF, and clinker was found within the exploratory holes.

5.3 Obstructions

No man-made obstructions were encountered in any of the exploratory hole locations.

5.4 Groundwater

Groundwater was not encountered in any of the exploratory holes.

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 6: Summary of Laboratory Geotechnical Test Results

Location	Depth (m)	Strata*	CLASSIFICATION												STRENGTH	CHEMICAL	
			Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Modified Plasticity Index (%)	PSD Cobbles %)	PSD Gravel (%)	PSD Sand (%)	PSD Silt (%)	PSD Clay (%)	Bulk Density Mg/m³)	Dry Density (Mg/m³)	Shear Strength (kN/m²)	pH Value	Water Soluble Sulphate SO_4 (mg/l)
WS01	3.25	CLAY	-	-	-	-	-	100	73	53	18	12	-	-	-	-	-
WS03	1.00	CLAY	15.1	37	20	17	-	100	54	42	12	10	-	-	-	7.8	270
WS01	1.50	CLAY	20.1	40	18	22	-	-	-	-	-	-	-	-	-	-	-
WS02	2.50	CLAY	19.5	41	19	22	-	-	-	-	-	-	-	-	-	7.4	130
WS05	2.50	CLAY	23.8	37	17	20	-	-	-	-	-	-	-	-	-	-	-
WS04	1.20	CLAY	-	-	-	-	-	-	-	-	-	-	-	-	-	7.5	120
WS05	1.40	CLAY	-	-	-	-	-	-	-	-	-	-	-	-	-	7.2	170

6.2 Made Ground/Topsoil

Made ground was encountered in all exploratory hole locations WS1 – WS5 between ground level and 6.00m bgl. The ground varies from MADE GROUND: clays, gravels, and sands across all exploratory holes WS1 – WS5.

Atterberg Limit tests were carried out on four samples of the reworked clay. Results of the tests reported **liquid limit** values in the range 37% to 41% and **plastic limit** values in the range of 17% to 20, resulting in values of **plasticity index** in the range of 17% to 22%. These results suggest the samples of reworked clay tested are of **intermediate plasticity** as shown on the Plasticity Chart in Figure 6, overleaf.

For design purposes, a value of plasticity index = 22% is recommended, based on the upper quartile 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 22%, mv = 1 / (0.49 x N value).

6.3 Superficial Deposits

As discussed in Section 5, there is no record of superficial deposits.

This correlation gives values of the coefficient of volume compressibility of between 0.04m^2/MN and 0.12m^2/MN, as shown in Table 7, above. The results suggest the clay has **very low to low 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:

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

$I_{p'}$ = 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 a **low to medium volume change potential**.

The **Natural Moisture Content** (NMC) and **Liquid Limit** (LL) of the soil can be used to indicate **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 the Reworked Clay

Location	Depth (m)	Liquid Limit (%)	40% Liquid Limit (%)	Natural Moisture Content (%)	Desiccation
WS01	1.50	40	16	20.1	**No**
WS02	2.50	41	16.4	19.5	**No**
WS03	1.00	37	14.8	15.1	**No**
WS05	2.50	37	14.8	23.8	**No**

The results in the above table show that the samples tested show no signs of desiccation.

Figure 5: SPT v Depth Plot

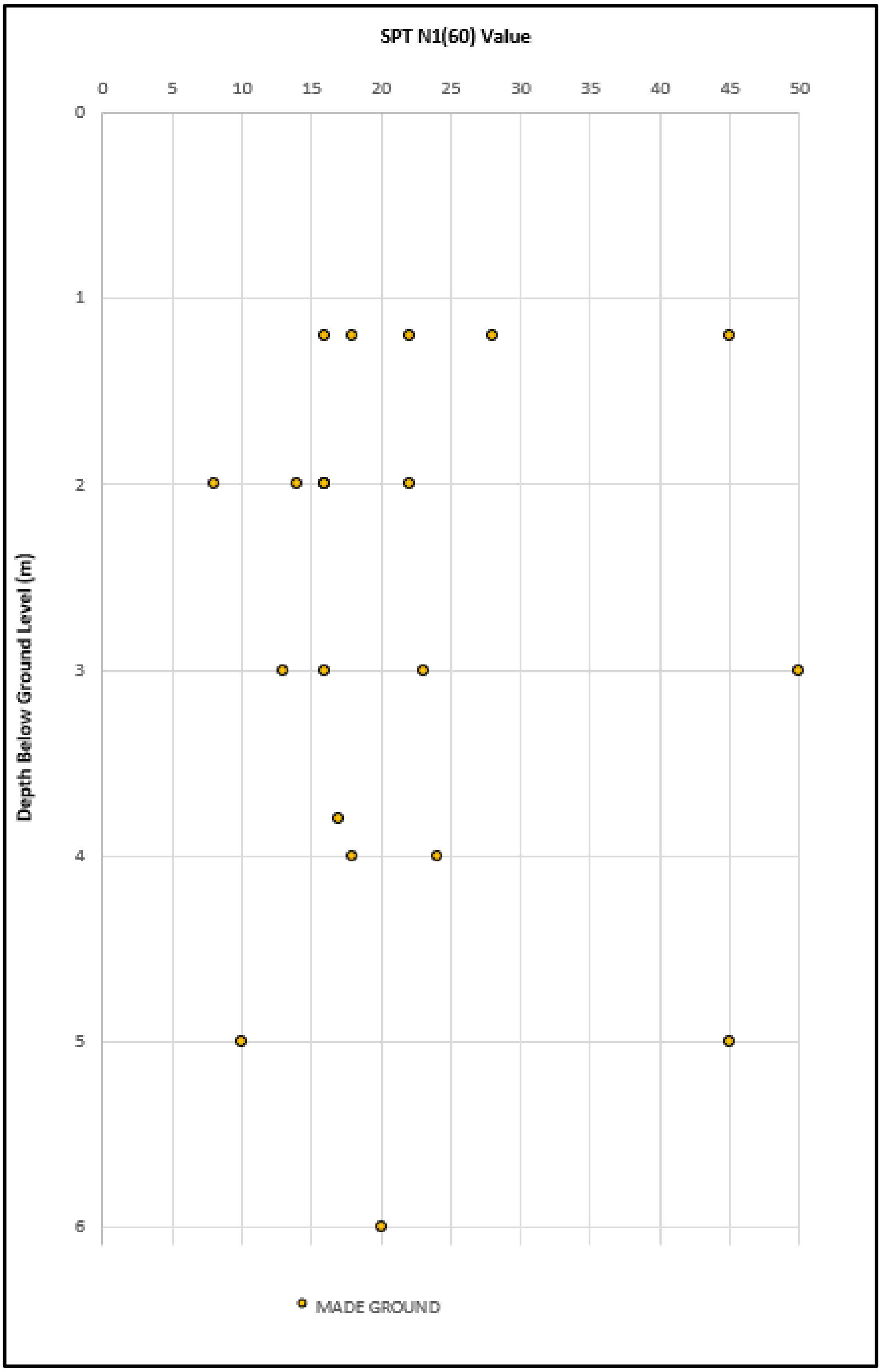
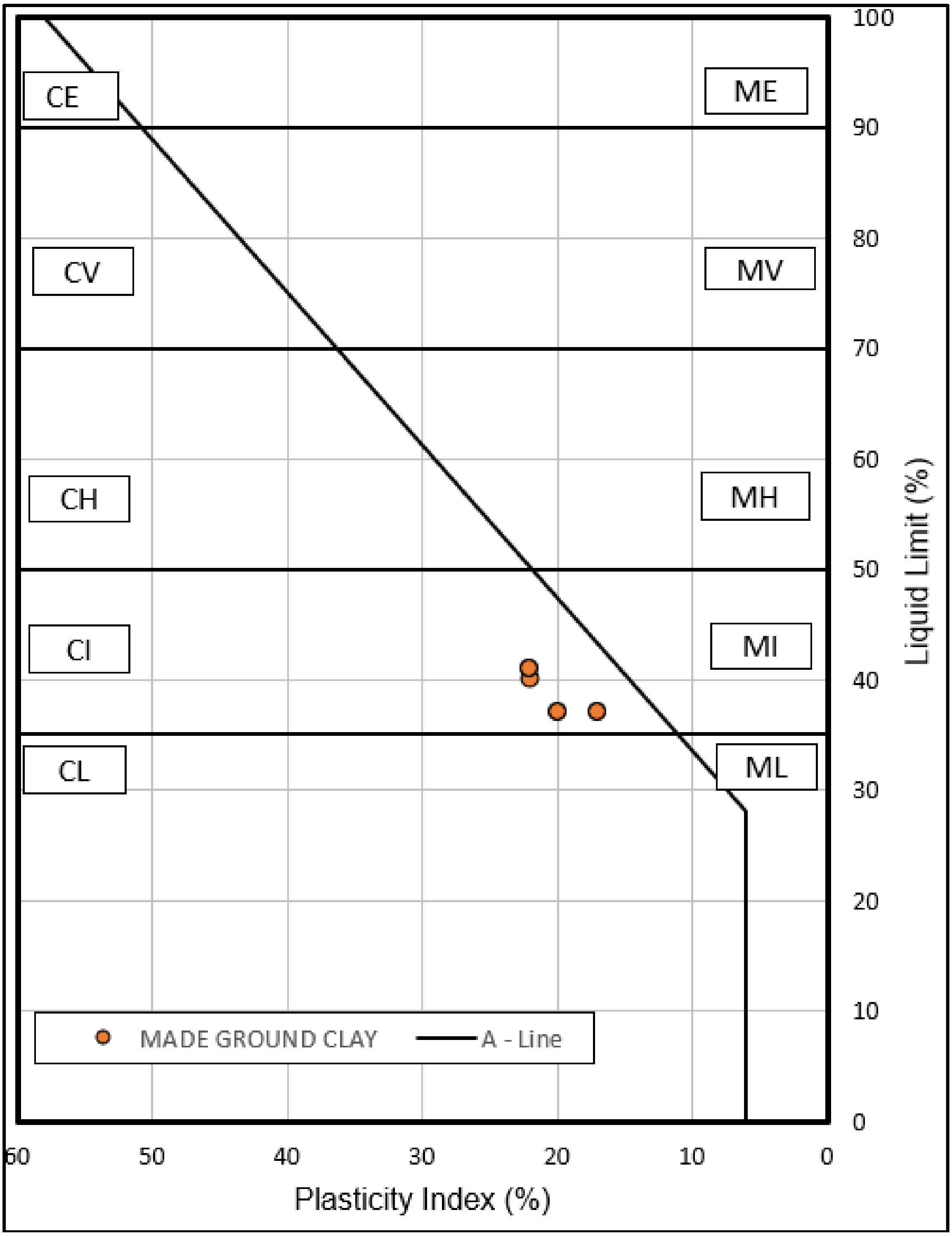


Figure 6: Plasticity Chart



7.0 GEOTECHNICAL ASSESSMENT

7.1 Proposed Development

It is understood that the client wishes to be part of a new residential development.

At the time of writing this report, the anticipated structural loadings of the new structures were not known.

7.2 Ground Conditions Encountered

The exploratory holes generally encountered variable MADE GROUND (to a maximum depth of 6.00m bgl).

Groundwater was not encountered during the investigation.

7.3 Foundation Considerations

Based on the ground conditions encountered, conventional shallow strip/pad foundations are not considered suitable for the proposed development due to presence of deep made ground.

The following alternative foundation options have therefore been considered and are discussed in the following sections:

7.3.1 *Ground Improvement*

Ground treatment (e.g., vibro displacement) may be an option, subject to environmental and noise/vibration constraints.

For example, vibro stone columns are often used to solve a wide range of static, dynamic, and seismic foundation problems by using powerful depth vibrators to densify soils and form stone columns that compact or reinforce soils in situ. Vibro systems can be used to treat granular deposits, fills, made ground, and soft clays/silts.

Soils treated by vibro could offer an allowable bearing pressure in the range 100kN/m^2 to 200kN/m^2, depending on column spacings and ground encountered.

Once the treatment has been carried out, spread foundations may be adopted across the site, and designed to the loadings given above. Providing that any imported fill material between the tops of the columns and the underside of the floor slab is placed in a controlled manner, floor slabs may be ground bearing. Positive assurances should be sought from an experienced specialist contractor that the proprietary system proposed is capable of providing the required working loads in the ground conditions encountered, with a guarantee on maximum settlement for both footings and floor slabs.

7.3.2 *Piled Foundations*

For the ground conditions at this site, driven or bored piles could be adopted. Driven piles would have the advantage of minimising the spoil that is generated; however, the noise and vibration associated with the installation of driven piles may prevent this type of pile from being selected. It should also be noted that driven piles can also potentially create preferential pollutant pathways.

Short bored (cast in-situ) piles installed using continuous flight auger (CFA) techniques may therefore be more appropriate but given the various advantages and limitations of each pile type, and the cost implications, advice should be sought from specialist piling contractors to determine the most suitable and cost-effective type.

They should also be able to provide recommended pile diameters, depths, and likely pile capacities, with guaranteed performance. It is recommended that a pile test be carried out to confirm pile capacities. In assessing the pile capacities, contractors should make an allowance for the effects of negative skin friction, particularly in any Made Ground.

It is essential that the advice of a specialist piling contractor is sought and that positive assurances are provided by the piling contractor that their proprietary system is capable of delivering the required working loads in the ground conditions encountered.

Floor slabs should be designed as suspended if a piled solution is used.

The design of a piled foundation solution will require deeper boreholes.

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 the subgrade level.

Consideration should be given to the potential differing ground conditions near the 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 example, 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 that the type of construction will depend on the proposed finished pavement levels across the site, and it is recommended that the pavement design be reviewed once these levels are known. In this context, it is essential that further in situ CBR testing is carried out once formation levels are known to confirm design CBR values.

Table 8: 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.								

A suitably experienced engineer or inspector should examine all formation excavations 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 the formation level.

7.5 Chemical Attack on Buried Concrete

Chemical tests show slightly elevated 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-2, 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 the relevant parties have prepared these.

Near-surface soft natural clays are unlikely to be suitable as structural fill and should be used for landscaping purposes only, providing they are not contaminated.

Granular Made Ground could be suitable for re-use as structural fill, provided it is not contaminated and does not contain excessive amounts of clay and provided moisture contents are controlled during placement. The control of moisture content will be necessary as the cohesive content of this stratum is likely to be sensitive to moisture content changes.

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 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 near the surface within excavations, particularly during the wetter months of the year. Pumping of excavations from a suitably located sump is likely to be required to keep the 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 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 general 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 9: 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	7.5 – 7.8	A
Arsenic	0 - 30	30 - 50	50 - 100	100 - 500	500	6 - 21	A
Cadmium	0 - 1	1 - 3	3 - 10	10 - 50	50	< 0.2 – 0.3	A
Chromium	0 - 100	100 - 200	200 - 500	500 - 2500	2500	14 - 26	A
Copper	0 - 100	100 - 200	200 - 500	500 - 2500	2500	18 - 54	A
Lead	0 - 500	500 - 1000	1000 - 2000	2000 – 1%	1.0%	19 - 127	A
Mercury	0 - 1	1 - 3	3 - 10	10 - 50	50	< 1	A
Nickel	0 - 20	20 - 50	50 - 200	200 - 1000	1000	18 - 29	A – B
Zinc	0 - 250	250 - 500	500 - 1000	1000 - 5000	5000	55 - 136	A
Boron	0 - 2	2 - 5	5 - 50	50 - 250	250	< 1	A
Selenium	0 - 1	1 - 3	3 - 10	10 - 50	50	< 2	A - B
Barium	0-500	500-1000	1000-2000	2000-1.0%	1.0%	57 - 120	A
Beryllium	0 - 5	5 - 10	10 - 20	20 - 50	50	0.7 – 1.4	A
Vanadium	0 - 100	100 - 200	200 - 500	500 - 2500	2500	21 - 28	A
Sulphate	0 - 2000	2000 - 5000	5000 – 1%	1% - 5%	5.05%	307 - 727	A
Sulphide	0 - 10	10 - 20	20 - 100	100 - 500	500	< 5	A
Cyanide (free)	0 - 1	1 - 5	5 - 50	50 - 100	100	< 1	A
Phenol	0 - 2	2 - 5	5 - 50	50 - 250	250	< 2	A

Based on the above results, the soils range from heavily contaminated to uncontaminated. Therefore, 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 further mitigate this 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. Based on the proposed development type, 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 contaminated land guidance has recently changed the evaluation of risk from ‘minimal’ (SGVs) to ‘low’ (referred to as Lowest Level of Toxicological Concern (LLTCs)). The policy companion document and supporting letter by DEFRA states that C4SLs could be used under the planning regime, as well as within Part 2A.

Based on these comments, EEG considers the justifications and assumptions used to generate ‘low’ risk are suitable for the planning regime.

Where no C4SLs have been generated, EEG will use the LQM S4ULs. Similar assumptions and land use to C4SLs have been used. However, toxicological information has been based on ‘minimal risk’ as per previous guidelines and assumptions. If contaminants are not present as C4SLs or S4ULs, then EEG will use CL:AIRE GACs. These follow the ‘minimal’ risk principal and more stringent exposure parameters and will be conservative.

EEG consider the main risk drivers for PAHs are benzo(a)pyrene (B(a)P) and naphthalene. This is due to B(a)P possibly being a carcinogen and most toxic of the PAHs and naphthalene the most volatile and soluble. The new C4SLs indicate B(a)P as a surrogate marker for carcinogenic PAHs, since the risk from other non-carcinogenic PAHs is considered negligible. Naphthalene will be treated separately using the LQM S4ULs.

As a preliminary screening assessment, all results have been compared to residential end-use criteria.

The soil chemical testing results are summarised in Table 10, overleaf.

Table 10: Soil Results Comparison with C4SL/S4UL Values

Determinand	C4SL/S4UL Levels Residential (mg/kg)	WS01 0.50m MG	WS02 0.40m MG	WS03 0.15m MG	WS04 0.80m MG	WS05 0.15m MG	No of Exceedances
Metals							
Arsenic	37	8	6	12	6	21	0
Boron	290	< 1	< 1	< 1	< 1	< 1	0
Cadmium	22	< 0.2	< 0.2	< 0.2	< 0.2	0.3	0
Chromium	910	25	14	15	26	24	0
Chromium VI	21	< 2	< 2	< 2	< 2	< 2	0
Copper	2400	24	18	27	22	54	0
Lead	200	20	27	54	19	127	0
Inorganic Mercury	40	< 1	< 1	< 1	< 1	< 1	0
Nickel	130	19	17	18	23	29	0
Selenium	250	< 2	< 2	< 2	< 2	< 2	0
Vanadium	410	27	21	22	28	28	0
Zinc	3700	55	64	107	59	136	0
Petroleum Hydrocarbons							
Benzene	0.087	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0
Toluene	130	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0
Ethylbenzene	47	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0
o-xylenes	60	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0
m-xylenes	59	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0
p-xylenes	56	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0
Aliphatic EC >5-6	42	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0
Aliphatic EC >6-8	100	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0
Aliphatic EC >8-10	27	< 2	< 2	< 2	< 2	< 2	0
Aliphatic EC >10-12	130	< 2	< 2	< 2	< 2	< 2	0
Aliphatic EC >12-16	1100	< 3	< 3	< 3	< 3	< 3	0
Aliphatic EC >16-21	65000	< 3	< 3	< 3	< 3	< 3	0
Aliphatic EC >21-35	65000	< 10	< 10	< 10	< 10	< 10	0
Aromatic EC >5-7	70	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0
Aromatic EC >7-8	130	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0
Aromatic EC >8-10	34	< 2	< 2	< 2	< 2	< 2	0
Aromatic EC >10-12	74	< 2	< 2	< 2	< 2	< 2	0
Aromatic EC >12-16	140	< 2	< 2	< 2	< 2	< 2	0
Aromatic EC >16-21	260	< 3	< 3	< 3	< 3	< 3	0
Aromatic EC >21-35	1100	< 10	< 10	< 10	< 10	< 10	0
Polycyclic Aromatic Hydrocarbons							
Naphthalene	2.3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0
Acenaphthylene	170	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0
Acenaphthene	210	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0
Fluorene	170	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0
Phenanthrene	95	< 0.1	0.16	0.62	< 0.1	0.28	0
Anthracene	2400	< 0.1	< 0.1	0.14	< 0.1	< 0.1	0
Fluoranthene	280	< 0.1	0.16	0.83	0.15	0.54	0
Pyrene	620	< 0.1	0.16	0.73	0.15	0.5	0
Benzo(a)anthracene	7.2	< 0.1	< 0.1	0.4	0.12	0.29	0
Chrysene	15	< 0.1	< 0.1	0.36	0.12	0.31	0
Benzo(a)pyrene	5	< 0.1	< 0.1	0.33	< 0.1	0.27	0
Benzo(b)fluoranthene	2.6	< 0.1	< 0.1	0.34	< 0.1	0.26	0
Benzo(k)fluoranthene	77	< 0.1	< 0.1	0.14	< 0.1	0.12	0
Indeno(1,2,3-cd) pyrene	27	< 0.1	< 0.1	0.22	< 0.1	0.16	0

Determinand	C4SL/S4UL Levels Residential (mg/kg)	WS01 0.50m MG	WS02 0.40m MG	WS03 0.15m MG	WS04 0.80m MG	WS05 0.15m MG	No of Exceedances
Dibenzo (a, h) anthracene	0.24	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0
Benzo(ghi)perylene	320	< 0.1	< 0.1	0.18	< 0.1	0.15	0
Phenols							
Phenol	120	< 2	< 2	< 2	< 2	< 2	0

Based on the above table, no contaminant concentrations were found in excess of the screening criteria relevant to a residential end use.

Asbestos fibres and fragments have not been identified in any of the samples tested.

8.3 Controlled Water Risk Assessment

During the monitoring period, groundwater was not encountered within the monitoring wells.

The Phase 1 Desk Study report highlighted an absence of any surface-controlled waters within 250m of the site, with the nearest groundwater abstraction licence 1.6km west of the site.

8.4 Soil Waste Assessment

An assessment of the disposal characteristics of the soil by 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 11 below and presented in full in Appendix 4.

Table 11: Waste Classification of Soils

Location	Depth (m bgl)	WM3.1 Classification
WS01	0.50	Non-Hazardous
WS02	0.20	Non-Hazardous
WS03	0.30	Non-Hazardous
WS04	0.10	Non-Hazardous
WS05	0.15	Non-Hazardous

Table 11 above shows that all of the samples collected from WS01 – WS05 are classified as **Non-Hazardous** in accordance with WM3.1.

9.0 GROUND GAS AND RADON GAS CONTAMINATION RISK ASSESSMENT

9.1 Radon Gas

The site is not located within a Radon Affected Area as defined by the Health Protection Agency, and therefore, radon protection measures are not necessary.

9.2 Analyses of Monitoring Results

The potential risk associated with gases being generated in the ground (whether from natural or artificial sources) depends on the concentrations of gas and its flow rate to the surface. These factors are assessed by monitoring 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 usually inconsistent over time.

A total of 4no. gas monitoring visits have been completed by Earth Environmental & Geotechnical Ltd. The monitoring visits were carried out between the 8th March and 27th March 2023. The results recorded methane (CH_4) levels of 0.1% to 0.8% (v/v) and carbon dioxide (CO_2) levels of 0.1% to 5.6% v/v.

Regarding flow rates, for the ground gas risk assessment BS8485 2015+A1 2019 states that *'steady state flow rates, rather than brief peak values on opening, should be used in screening risk assessment if these are representative of the conceptual site model'*.

Gas flow rates were recorded between -0.1l/hr and 0.1l/hr, and a maximum flow rate of 0.1l/hr has been adopted for the below calculations. Atmospheric pressure was recorded to be between 978mb and 1005mb.

Monitoring results are presented in Appendix 2.

Table 12 overleaf, adapted from CIRIA C665 "Assessing risks posed by hazardous ground gases to buildings", shows a summary of the current UK practice concerning appropriate gas protection measures based upon a Gas Screening Value (GSV).

A GSV for the site has been obtained by multiplying the maximum concentration of gas by the steady flow rate of 0.1l/h adopted for assessment purposes.

- Carbon dioxide: steady flow rate = 0.1l/hr, max concentration = 5.6%
- Methane: steady flow rate = 0.1l/hr, max concentration = 0.8%.

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

- **Carbon dioxide**: GSV = 0.1 x 5.2 / 100 = **0.0052 litres/hr**
- **Methane** : GSV = 0.1 x 0.8 / 100 = **0.0008 litres/hr**

Table 12: Characteristic Situations (Wilson et al, 2006/2007 modified from Wilson and Card, 1999)

Characteristic Situation (CS)	*Risk Classification*	*Gas Screening Value CH_4 or CO_2 (l/hr)*	*Additional Factors*	*Typical source of generation*
1	Very Low	<0.07	Typically, < 1% methane Typically, < 5% carbon dioxide	Typical made ground
2	Low	<0.7	Borehole air flow rate is not to exceed 70L/hr; otherwise, consider increasing to Characteristic Situation 3	Typical made ground
3	Moderate	<3.5		Old landfill, inert waste, flooded mine workings.
4	Moderate to High	<15	Quantitative risk assessment	Mineworkings are susceptible to flooding, and a completed landfill
5	High	<70		Mineworking is unflooded and inactive, with shallow workings near the surface
6	Very High	>70		Recent landfill site

The CIRIA guidance document notes that '...the GSV is a guideline value and not an absolute threshold'.

The above results suggest the site can be given a Characteristic Situation 1, i.e., 'very low risk', by Table 12, above. However, given the presence of carbon dioxide >5% and the fact that the site is adjacent to a closed landfill site, a CS2 classification has been attributed to the site.

Protection Measures

Based on the foregoing preliminary assessment, ground gas protection measures are not considered necessary at the site in accordance with BS8485:2015 + A1 2019.

Table 13: Gas Protection Point Score Required (BS8485:2015 + A1 2019)

Characteristic Situation	Minimum gas protection score (points)			
	High Sensitivity		Medium	Low
	Type A building (private housing)	Type B building (multiple occupancy private or commercial)	Type C building (single occupancy commercial)	Type D building (large industrial)
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4.0	3.0	2.5
4	6.5	5.5	4.5	3.5

The proposed development is for a Type A building (private housing), which poses a high sensitivity risk.

For a CS2 Characteristic Situation, 3.5 points are necessary, which could include a ventilated sub-ground floor slab and a gas membrane.

9.3 Gas Piling Risk Assessment

It is proposed to use sectional flight auger (SFA) piles to a depth of between 4m and 5m.

Environment Agency guidance "*Piling and penetrative ground improvement methods on land affected by contamination: guidance on pollution prevention*. Environment Agency, 2001, reference NC/99/73" indicates six principal pollution scenarios that may arise as a result of adopting a piled foundation strategy.

These are summarised in Table 14 overleaf, together with the indicative hazard, assuming non-displacement (bored, CFA/SFA) piles are used.

From the table above, it can be seen that further consideration is required in terms of Item 2 relating to the creation of gas migration pathways. This is addressed in detail below.

Table 14: General Pollution Scenarios

Pollution scenario	Detail	Indicative hazard – assuming non-displacement (bored, CFA/SFA) piles
1	Creation of preferential pathways through a low permeability layer (an aquitard) to allow potential contamination of an aquifer.	N/A no mobile contamination identified within made ground or Tidal Flat Deposits groundwater samples from all three boreholes identified similar contaminants no aquitard identified
2	Creation of preferential pathways through a low permeability surface layer to allow migration of landfill gas, soil gas or vapours to the surface.	refer to sections 3.1/3.2
3	Direct contact of site workers and others with contaminated soil arisings that have been brought to the surface.	appropriate PPE to be defined within CDM discovery strategy required (refer to section 4)
4	Direct contact of the piles of engineered structures with contaminated soil or leachate causing degradation of pile materials.	N/A no bulk contamination identified within soils or groundwater
5	Driving of solid contaminants down to an aquifer during piling.	discovery strategy required (refer to section 4)
6	Contamination of groundwater, and subsequently surface waters, by wet concrete, cement paste or grout.	N/A if appropriate measures implemented with adequate QA/QC such as specifying mix to prevent bleeding. Refer to Van Elle *Combined method and risk – restricted access piling.*

Piled foundations are commonly thought to create preferential pathways for ground gas migration, without consideration of the site-specific ground conditions, type of piles, or source of gas.

The ground conditions below a site will influence whether preferential pathways for gas migration will form.

To form a preferential pathway, the potential gap around the pile would need to penetrate a barrier to a source of gas at depth, which is located in a high-permeability soil (so that gas can flow quickly towards the pile).

If a pile is driven into a gas source that is not confined and gas is freely venting to the atmosphere, it is unlikely to form a preferential pathway even if an annulus develops around the pile.

In addition, the gas is stored within highly permeable made ground. As such, the gas is not confined, and diffusive migration will be continuously occurring towards areas of lower concentrations in all directions.

As such, the formation of a preferential pathway is unlikely unless a sealed open space is somehow created, which could short-cut the diffusive concentration gradient.

The sole viable source of gas has been identified as aged made ground where no bulk gas generation is occurring and gases are migrating by diffusive flow only.

It is proposed to use sectional flight auger piles, a section method of installing continuous flight auger piles for use in areas where space is restricted.

CFA piling is a non-displacement method of piling, which results in minimal ground disturbance.

As they form an intimate contact with the surrounding soil, there should be no formation of preferential pathways.

To ensure this: during the drilling phase of each pile the depth of auger, speed of rotation and penetration rate will be closely monitored and recorded to avoid undue disturbance of surrounding soils during the construction process; and: during the concreting phase of each pile the concrete pressure and rate of pumping will be closely monitored and recorded, to make sure the intruded material is placed under pressure at a constant rate consistent with that of the withdrawal of the auger.

In summary, the following lines of evidence all indicate that the use of CFA piles will create no preferential pathway:

- Aged source, no advective flow
- Source not confined by impermeable soil, no gas stored under pressure
- CFA piling forms intimate contact with the surrounding soils, leaving no voids

As such, it can be concluded that, subject to the working practices outlined above, the risks associated with Pollution Scenario 2 are negligible on this site.

9.4 Decommissioning of Existing Boreholes

The decommissioning of the existing boreholes should follow Environment Agency Guidance (Good practice for decommissioning redundant boreholes and wells, 2012).

Boreholes and wells that are no longer required need to be made safe, structurally stable, and backfilled and sealed.

Step 1 – Headworks and Casing:

The removal of the borehole headworks should be progressed first.

As the boreholes are advanced into relatively unconsolidated made ground, pulling the well casing could result in the collapse of the borehole. It is therefore recommended that the headworks be removed, and the borehole casing be cut down to beneath the ground surface once the borehole has been backfilled to a sufficient depth.

Step 2 – Backfilling

The borehole should then be backfilled with low-permeability material, e.g., bentonite. Backfill materials must be clean, inert, and non-polluting.

In the case of the 5no. boreholes present on site; the boreholes were advanced through up to 5m of mixed made ground.

All three boreholes extended into the mudstone whilst drilling but were backfilled to above the surface of the mudstone with bentonite pellets on completion.

It is recommended that the boreholes be backfilled from their base up to a depth of 0.5 m below ground level with bentonite pellets.

The backfill should be carefully delivered into the borehole, from the base upwards via tremie pipe to ensure that the entirety of the borehole is filled in a controlled manner, to ensure that accidental 'bridging' does not occur within the borehole.

Water should also be added following the careful placement of the pellets to aid in the swelling of the pellets.

Step 3 – Sealing the Borehole

The backfilled borehole/well should be completed with an impermeable plug; however, the details should be finalised following consultation with the design team, as subsequent construction works mustn't compromise the seal.

Ideally, the top 0.5m will also be backfilled with bentonite pellets; however, consideration should be given to the removal of the uppermost section of the borehole liner to enable a reduction in ground level without damaging lower sections of the liner.

10.0 CONCLUSIONS & RECOMMENDATIONS

10.1 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, and proper disposal of material arising will be required to mitigate this risk.

Based on the results of the chemical testing, no contaminant concentrations were found in excess of the screening criteria relevant to a residential end use.

Therefore, the risk to residential end users is **LOW,** and no remediation of the soil is required for the proposed development.

10.2 Asbestos

Asbestos fibres or fragments were not identified in any of the samples tested.

10.3 Foundations

Shallow strip/pad foundations are not considered appropriate for the current proposed development due to the depth of the Made Ground encountered.

Therefore, alternative foundation options will need to be considered, such as ground improvement or piles.

Deeper boreholes will be required to aid in the design of vibro-stone columns or the use of piles.

10.4 Soil Disposal

Soils should be disposed of at a suitable site, registered to take the levels of contamination encountered. The soils collected from all WS01 – WS05 have been classified as Non-Hazardous for off-site disposal by Environment Agency guidance WM3.1.

10.5 Land Gas

Based on the gas monitoring results, the risk of ground gas is low but protection against its ingress is required at the site.

A CS2 classification has been attributed to the site, and therefore, ground gas remedial measures are required.

All existing ground gas monitoring wells will need to be decommissioned before any construction work.

10.6 Pavement Design

Based on the findings of the site investigation, the soil type at subgrade level was Made Ground. Based on the recommendations for design CBR values provided in Interim advice note 73/06, Revision 1 (2009), a conservative design CBR value of 1% should be adopted in areas where Made Ground is encountered at subgrade level.

10.7 Risk to Buried (Water) Services

It is considered that, due to the absence of BTEX & MTBE, phenols, aliphatic and aromatic hydrocarbon contamination, standard materials should be suitable for new water pipes. However, further advice should be sought from the local water company.

Previous guidance on buried water pipes was contained in Water Regulations Advisory Scheme (WRAS) Guidance Note No. 9-04-03[(2002)], however this has been superseded by the UK Water Industry Research Report 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites' Ref 10/WM/03/21 (January 2011).

10.8 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.

10.9 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

GROUND GAS MONITORING RESULTS

APPENDIX 3

GEOTECHNICAL TESTING RESULTS

APPENDIX 4

CHEMICAL TESTING RESULTS

APPENDIX 5

SOIL WASTE ASSESSMENT

APPENDIX 6

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, 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's 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 2025 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 from 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 under 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.