



**EARTH ENVIRONMENTAL
& GEOTECHNICAL**
A Technics Group Company

Phase 2 GeoEnvironmental

Ground Investigation

31 Berry Brow

Clayton Bridge

On behalf of

A & K Building Services

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1.0 INTRODUCTION

1.1 Background

A site investigation has been commissioned by A & K Building Services (the Client) to examine ground conditions for a proposed new development on land at 31 Berry Brow, Clayton Bridge, Manchester.

1.2 Terms of Reference

The Client has commissioned Earth Environmental & Geotechnical Ltd (EEG) to undertake a site investigation in accordance with proposal A3653/25 dated 20th October 2025. The objectives of this investigation are as follows:

- *Provide factual information on the work undertaken, including sampling location plan, borehole logs, geotechnical/ chemical testing, and monitoring.*
- *Tier 1 (semi-quantitative) risk assessment will be undertaken. This will compare the concentrations of soil and ground gas 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 off-site disposal.*
- *Assessment of ground conditions for foundation design.*

1.3 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 collected information has been used to interpret the ground conditions and to provide recommendations on geotechnical design and potential risks of ground contamination for the proposed development.

1.4 Limitations of the Study

The report is written within the 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 reserves the right to amend either conclusions or recommendations in light of any further information that may become available. The report is provided solely for the client's use 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, particularly at intervening locations. Whilst every effort is made to ensure the accuracy of the data supplied, all opinions expressed regarding the spatial distribution of strata between sampling locations are for guidance only, and no responsibility is accepted for their accuracy.

1.5 Previous Investigations

1.5.1. Earth Environmental and Geotechnical, Phase 1 GeoEnvironmental Desk Study, Berry Brow, Clayton Bridge, Ref (A3653/20/FDS)

EEG conducted a previous Phase 1 Geo-environmental desk study for the site.

A review of the site's history indicates that it has remained undeveloped since the start of historical mapping in 1848.

The BGS records indicate that the north and centre of the site are underlain by superficial deposits of Devensian Till (Secondary A Aquifer), generally comprising clay.

The bedrock beneath the entire site was identified as the Collyhurst Sandstone Formation (Principal Aquifer), generally composed of sandstone.

The overall risk of soil contamination to future commercial end users and construction workers was assessed as **LOW**.

The risk to controlled waters was assessed as **LOW** due to the limited on-site source potential.

Based on the Estimation of Level of Risk Table, the risk from ground gas to end users was considered **LOW**.

The site is not in a radon-affected area; therefore, radon protection measures are not required for any new structures.

The site is in a **LOW**-risk area for UXOs.

The Phase 1 Geoenvironmental Desk study recommended that a further intrusive investigation be undertaken to establish geotechnical parameters for the design of foundations, floor slabs, and pavement construction for the proposed new structures and the surrounding area.

As part of the geotechnical investigation, it was recommended that soil samples be collected for contamination testing and to confirm potential risks.

2.0 SITE LOCATION & DESCRIPTION

The site (0.1 hectares) is vacant land adjacent to Berry Brow, Manchester, approximately 2.4km northeast of the Etihad Stadium.

The approximate National Grid Reference for the centre of the site is SJ 89055 99555 (X: 389055, Y: 399555) and postcode M40 1QR.

The site's surface topography slopes from north to south.

Additionally, a ramp along the site's western boundary connects it to Berry Brow to the north.

Sporadic patches of grass and small bushes cover the site. A dirt ramp is located along the western boundary to access the site.

Access to the site is via Berry Brow to the north.

The site is bounded by residential properties to the north, east, south, and west. Open land covered by trees is present to the northeast of the site.

Residential properties and open plots with large trees surround the site.

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

Figure 1: Site Location Plan



General site photographs are presented in Figure 2 overleaf.

Figure 2: General Site Photographs

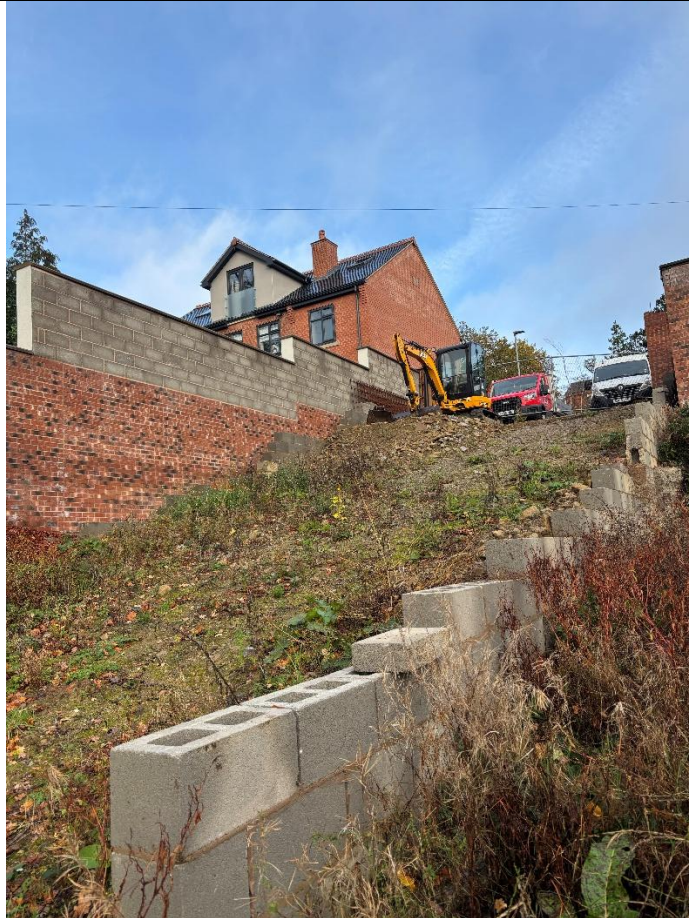
Photograph facing southeast showing the site



Photograph facing south showing the site access



Photograph facing northwest showing the site access



Photograph facing west showing the site

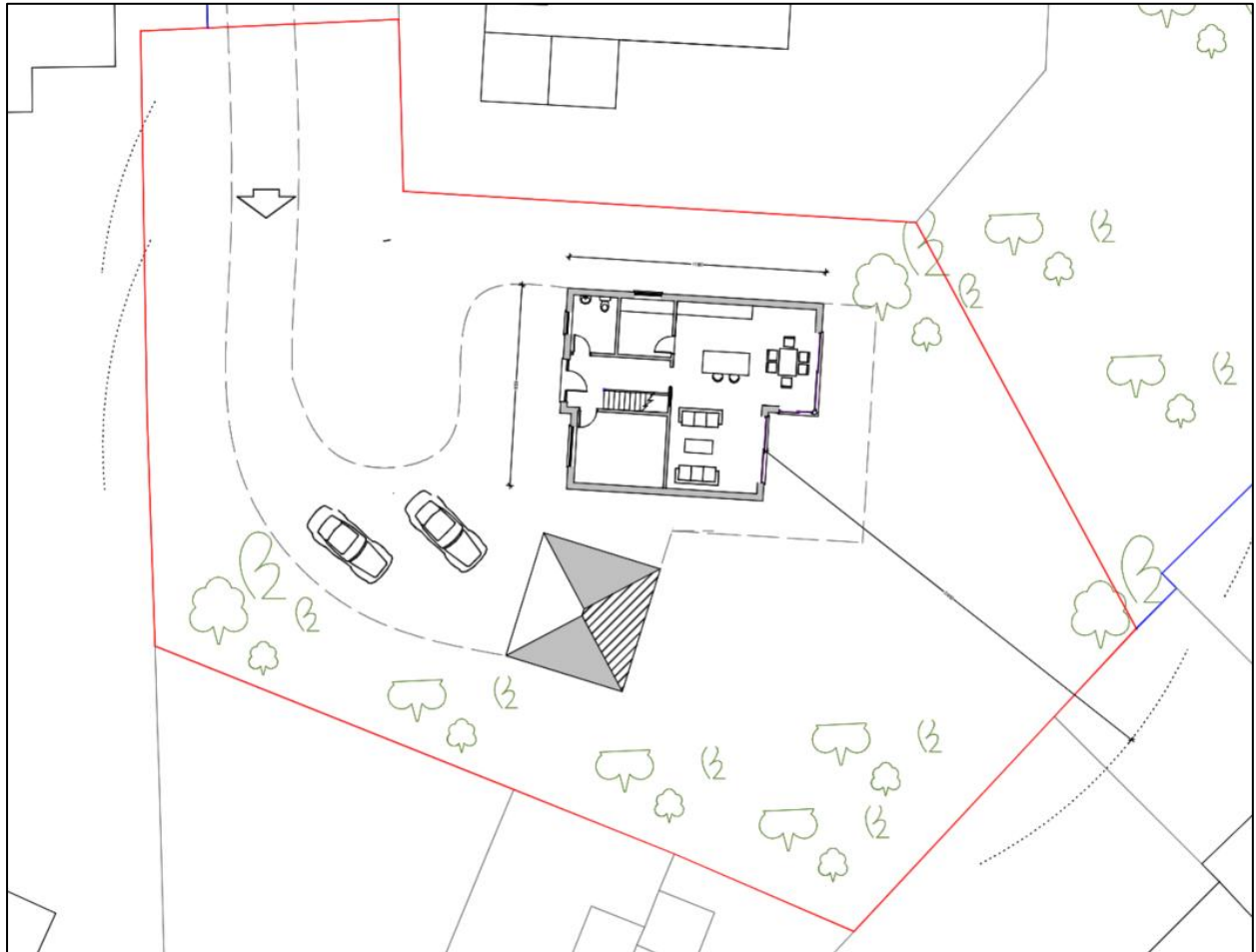


2.1 Proposed Development

It is understood that the client intends to construct a residential property with associated parking, driveway and hard and soft landscaping.

The proposed development layout details are shown in Figure 3 below.

Figure 3: Proposed Development Plan



3.0 SITE INVESTIGATION

3.1 Exploratory Fieldwork

The fieldwork was carried out by EEG on the 29th October 2025 and comprised:

- 3no. window sample boreholes (designated WS01 – WS03) were advanced to a maximum depth of 1.85m below the existing ground level. Window sampler boring is performed with a small, track-mounted rig that uses a chain-driven trip hammer to drive sampling tubes or penetrometers into the ground. These tools are coupled to the hammer's anvil via 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 in the borehole, progressively smaller-diameter sampling tubes are used as the borehole depth increases. Sampler diameters generally range from approximately 50 mm to 90 mm. 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 pertain only to the time of the investigation and do not necessarily reflect seasonal fluctuations.
- Exploratory hole logs are included in Appendix 1.
- 50mm diameter standpipes were installed in all the window sample boreholes to a maximum depth of 1.85m below ground level. Installation and backfill details are shown with the appropriate borehole log sheet. EEG conducted groundwater monitoring in standpipes after the fieldwork period, along with in situ infiltration testing; the results are presented in Section 9.

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

Each exploratory location was scanned with a Cable Avoidance Tool (CAT) to identify unrecorded underground services, and the locations were repositioned as needed.

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.

Table 1 below outlines the targeted features.

Table 1: Sampling Location Justification

Exploratory Hole	Sampling Location
WS01 & WS03	Within the proposed garden area.
WS02	Within the footprint of the proposed development.

Samples were tracked using the appropriate Chain of Custody forms provided by Normec 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 an EEG representative. 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 handheld Trimble GeoXH GPS instrument capable of achieving an accuracy of less than 10mm, depending on satellite coverage and proximity to trees and buildings.

The descriptive terms, such as firm, formerly used in older versions of BS5930 to describe strength, now relate solely 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 overleaf.

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 and tests conducted during the investigation is presented in Table 3.

Table 3: Summary of Exploratory Holes Undertaken

Hole/ Test	Type*	Depth (m)	Date Started	Date Finished	Easting (m)	Northing (m)	Backfill Details**
WS01	WS	1.85	29/10/2025	29/10/2025	389049	399559	M
WS02	WS	1.85	29/10/2025	29/10/2025	389057	399555	M
WS03	WS	1.85	29/10/2025	29/10/2025	389064	399551	M
*WS = Window Sample Borehole							
**M = Monitoring Well							

3.2 Laboratory Testing

3.2.1 Geotechnical Testing

A programme of laboratory testing was conducted on samples taken from the various strata to assist in classification and to 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 BS 1377:1990. 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.
Particle size distribution (wet)	BS1377:1990 Part 2, Clause 9.2	1
Moisture Content	BS1377:1990 Part 2, Clause 3.2	4
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	3
pH value	BS1377:1990 Part 3, Clause 9	3

The results of the laboratory geotechnical tests are discussed in Section 5 and included in Appendix 2.

3.2.2 Environmental Testing

The environmental chemistry of the ground was investigated through specialist chemical analysis of selected samples, scheduled by EEG and carried out by Normec DETS, a UKAS- and MCERTS-accredited laboratory.

Chemical analyses were carried out on 6no. soil samples 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, Speciated Petroleum Hydrocarbons and Speciated Polycyclic Aromatic Hydrocarbons (PAH).

1no. soil sample was additionally submitted for Waste Acceptance Criteria (WAC) testing. Complete results of the laboratory contamination tests are discussed in Section 7 and included in Appendix 3.

4.0 GROUND CONDITIONS ENCOUNTERED

4.1 Soil Profile Encountered

BGS digital mapping shows that the site is underlain by superficial deposits of Devensian Till generally comprising clay.

The bedrock beneath the site is identified as the Collyhurst Sandstone Formation, which generally comprises sandstone.

- **TOPSOIL** - was encountered in all exploratory hole locations between ground level and to a maximum depth of 0.45m bgl, generally comprising:
 - Dark, slightly silty, sandy, somewhat gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse, angular to subangular, of sandstone.
- **Superficial Deposits** - Variable clay was encountered in all exploratory holes, to a maximum depth of 1.50m bgl.
 - Brown silty sandy CLAY. Sand is fine to medium.
 - Light brown silty, slightly sandy, slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded of sandstone.

The depths of the various materials encountered in the exploratory holes are summarised in Table 5 on the overleaf.

4.2 Observable Indications of Contamination

No observable indication of visual or olfactory evidence of contamination was encountered.

4.3 Obstructions

No obstructions were encountered during the site investigation.

4.4 Restrictions

No restrictions were encountered during the site investigation.

4.5 Groundwater

Groundwater was not encountered during the ground investigation.

Table 5: Summary of Ground Conditions Encountered

Hole	Depth to Stratum (m bgl)		Groundwater Strike (m)	Groundwater (Monitoring) (m)
	TOPSOIL	Superficial		
		CLAY		
WS01	GL – 0.40	0.40 – 1.85	DRY	1.01
WS02	GL – 0.45	0.45 – 1.85	DRY	1.05
WS03	GL – 0.45	0.45 – 1.85	DRY	0.95

5.0 ENGINEERING PROPERTIES OF SOILS ENCOUNTERED

5.1 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 Table 6.

Table 6: Summary of Laboratory Geotechnical Test Results

LOCATION	DEPTH	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425µm (%)	Modified Plasticity Index	PSD Gravel (%)	PSD Sand (%)	PSD Silt (%)	PSD Clay (%)	pH Value	Water Soluble Sulphate SO ₄ (mg/l)
WS01	1.25	20.4	39	15	24	92	22.08	-	-	-	-	7.3	230
WS02	1.20	30.2	38	16	22	90	19.80	-	-	-	-	7.2	200
WS03	1.00	21.8	37	15	22	93	20.46	2	22	55	21	-	-
WS03	1.25	20.2	38	14	24	93	22.32	-	-	-	-	7.0	280

5.2 Topsoil

Made Ground was encountered in all exploratory boreholes between ground level and a maximum depth of 0.45m below ground level.

Due to the material encountered, no geotechnical testing was conducted on the Topsoil.

5.3 Superficial Deposits

As discussed in Section 5, superficial material was encountered as variable CLAY in all of the exploratory hole locations.

5.3.1 Clay

Clay was encountered in all exploratory hole locations, below the topsoil to a maximum depth of 1.85m bgl.

The results are shown in the Plasticity Chart in Figure 5.

The **water-soluble sulphate** content of the 3no. Clay samples ranged from 200 mg/l to 280 mg/l in SO₄, with **pH values** of 7.0 to 7.3.

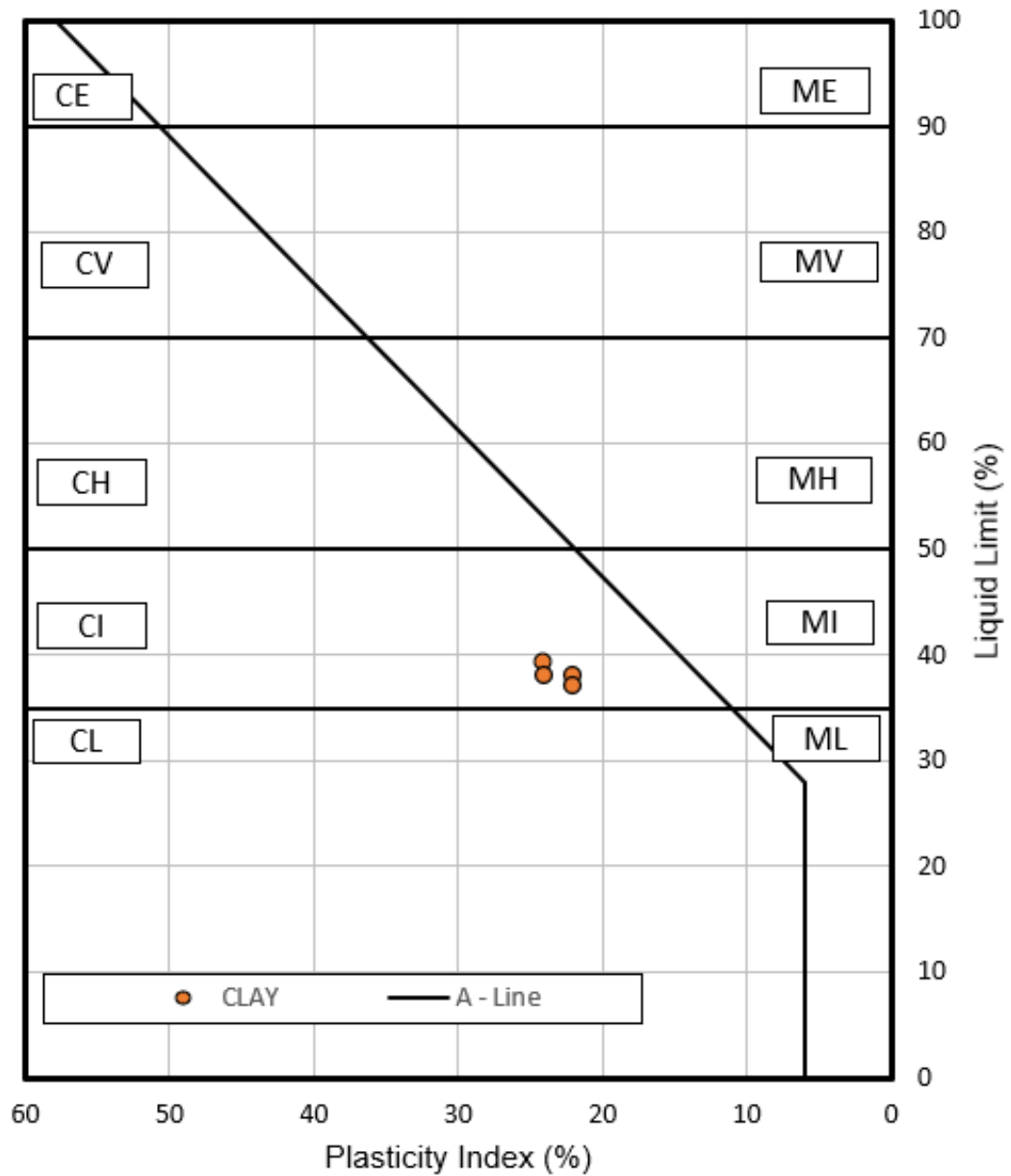
The **Natural Moisture Content** (NMC) and **Liquid Limit** (LL) of the soil can indicate soil desiccation. Specifically, when the NMC is less than 40% of the LL, the soil is inferred to be desiccated, as summarised in Table 7 below.

Table 7: Soil Desiccation Indicators in the Clay

Location	Depth (m)	Liquid Limit (%)	40% Liquid Limit (%)	Natural Moisture Content (%)	Desiccation
WS01	1.25	39	15.6	20.4	No
WS02	1.20	38	15.2	30.2	No
WS03	1.00	37	14.8	21.8	No
WS03	1.25	38	15.2	20.2	No

The results in the table above show that none of the clay samples tested exhibit evidence of desiccation.

Figure 5: Plasticity Chart



6.0 GEOTECHNICAL ASSESSMENT

6.1 Proposed Development

It is understood that the client intends to construct a residential property with associated parking, driveway and hard and soft landscaping.

Detailed information regarding structural loadings was not available at the time of authoring this report.

6.2 Ground Conditions Encountered

The exploratory holes generally encountered topsoil between ground level and a maximum depth of 0.45m bgl.

Below the made ground variable, clay was encountered to a depth of 1.85m bgl.

Groundwater was not encountered during the ground investigation.

During monitoring, the groundwater level ranged from 0.95m to 1.85m bgl.

6.3 Foundation Considerations

6.3.2 Piled Foundation Solution

It is understood that the client wishes to utilise a piled foundation solution on this site.

The proposed development may be founded on a system of ground beams spanning onto piles driven into the superficial deposits.

A variety of pile types may be used, including bored and continuous flight auger (CFA) piles.

Driven piles may be suitable, subject to environmental constraints. Additionally, careful consideration will need to be given to the potential presence of services that traverse the site.

Given the advantages and limitations of each pile type, and the associated costs, advice should be sought from specialist piling contractors to determine the most suitable and cost-effective option.

They should also be able to provide recommended pile diameters and depths, along with likely pile capacities, with guaranteed performance.

It is recommended that a pile test be carried out to confirm pile capacities. When assessing pile capacities, contractors should account for negative skin friction, particularly in made ground and soft clays.

There may be differential settlement between piled structures and the surrounding ground level.

Provision should therefore be made to bring ground levels up to threshold positions, vehicle access doorways, etc.

Alternatively, these materials should be removed and replaced in a controlled manner by suitable existing materials or imported engineered fill.

It is essential that the advice of a specialist piling contractor be sought and that the contractor provide assurances that their proprietary system is capable of meeting the required working loads under the ground conditions encountered.

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

6.4 Pavement Design

The ground investigation identified that the soil type at the subgrade level is typically topsoil underlain by clay. 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 the subgrade level.

Consideration should be given to potential differences in ground conditions near the surface, which could require pavements to be constructed on variable-made ground. In this context, a flexible pavement design may be necessary.

Consider using geotextiles to reduce capping thickness. For example, biaxial geogrids such as Tensar SSLA20 and SSLA30 are often used to minimise capping thickness. Advice from a suitable contractor on the most appropriate type of geotextile for the ground conditions at this site should be sought. For guidance, the following table compares granular layer thickness with and without a geotextile, in accordance with the requirements of HA25/94 Part 2.

Note that the construction type 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 heavily loaded pavements, the advice of a 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 eliminate unevenness, the formation should be compacted using equipment suitable for the ground conditions encountered. Careful inspection of this work will also help identify any soft spots at or just below the formation level.

6.5 Chemical Attack on Buried Concrete

Chemical tests (see Appendices) show low levels of water-soluble sulphates and 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.

6.6 Suitability of Excavated Materials

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

Granular and natural sand may be suitable for reuse as structural fill, provided it is uncontaminated, contains no excessive clay, and its moisture content is controlled during placement. Controlling moisture content will be important, as the cohesive content of this stratum is likely sensitive to changes in moisture.

6.7 Temporary Works

Formations will be susceptible to damage from both weather and traffic and should be protected immediately upon 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 should be adopted to ensure stability, particularly where personnel are required to enter the excavations. All excavations should be adequately supported where personnel are required to enter.

Groundwater seepage may occur near the surface within excavations, particularly during the wetter months. Pumping excavations from a suitably located sump will likely be required to keep them dry.

7.0 SOIL CONTAMINATION RISK ASSESSMENT

7.1 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 the 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	5.2 – 6.4	A – B
Arsenic	0 - 30	30 - 50	50 - 100	100 - 500	500	5 – 23	A
Cadmium	0 - 1	1 - 3	3 - 10	10 - 50	50	<0.2 – 0.8	A
Chromium	0 - 100	100 - 200	200 - 500	500 - 2500	2500	12 – 19	A
Copper	0 - 100	100 - 200	200 - 500	500 - 2500	2500	13 – 71	A
Lead	0 - 500	500 - 1000	1000 - 2000	2000 – 1%	1.0%	17 – 170	A
Mercury	0 - 1	1 - 3	3 - 10	10 - 50	50	<1 – 2.5	A – B
Nickel	0 - 20	20 - 50	50 - 200	200 - 1000	1000	10 – 19	A
Zinc	0 - 250	250 - 500	500 - 1000	1000 - 5000	5000	43 – 96	A
Boron	0 - 2	2 - 5	5 - 50	50 - 250	250	<1 – 2.7	A – B
Selenium	0 - 1	1 - 3	3 - 10	10 - 50	50	<2	A
Barium	0-500	500-1000	1000-2000	2000-1.0%	1.0%	52.7 – 130	A
Beryllium	0 - 5	5 - 10	10 - 20	20 - 50	50	<0.5 – 0.9	A
Vanadium	0 - 100	100 - 200	200 - 500	500 - 2500	2500	16 – 25	A
Sulphate	0 - 2000	2000 - 5000	5000 – 1%	1% - 5%	5.05%	23 – 1650	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 uncontaminated to contaminated. Therefore, there is a **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.

7.2 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 with those for residential end developments 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 risk evaluation from 'minimal' (SGVs) to 'low' (referred to as the Lowest Level of Toxicological Concern (LLTCs)). The policy companion document and supporting letter from DEFRA state that C4SLs may be used under the planning regime and 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 practices to C4SLs have been applied. However, the toxicological information has been based on 'minimal risk' under 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 principle and more stringent exposure parameters and will be conservative.

EEG consider the main risk drivers for PAHs to be benzo(a)pyrene (B(a)P) and naphthalene.

This is due to B(a)P being a potential carcinogen and the most toxic of the PAHs, and to naphthalene being 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 at 1% Soil organic matter content.

The soil chemical testing results are summarised in Table 10.

Table 10: Soil Results Comparison with C4SL/S4UL Values

Determinand	C4SL/S4UL Levels Resi w/ HP 1% SOM (mg/kg)	WS01 0.25 mbgl	WS01 0.75 mbgl	WS02 0.30 mbgl	WS02 0.80 mbgl	WS03 0.25 mbgl	WS03 0.75 mbgl	No of Exceedances
Metals								
Arsenic	37	16	8	19	5	23	22	0
Beryllium	1.7	< 0.5	0.6	0.9	0.5	0.9	0.9	0
Boron	290	2.7	< 1	< 1	< 1	< 1	< 1	0
Cadmium	22	0.4	< 0.2	0.5	0.2	0.8	0.7	0
Chromium	910	12	14	19	13	18	19	0
Chromium VI	21	< 2	< 2	< 2	< 2	< 2	< 2	0
Copper	2400	37	20	64	13	71	71	0
Lead	200	91	26	170	17	97	97	0
Inorganic Mercury	200	1.1	< 1	1.4	< 1	2	2.5	0
Nickel	180	11	14	19	10	17	17	0
Selenium	250	< 2	< 2	< 2	< 2	< 2	< 2	0
Vanadium	410	16	18	25	18	25	25	0
Zinc	3700	68	47	96	43	79	81	0
Polycyclic Aromatic Hydrocarbons								
Naphthalene	15	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0
Acenaphthylene	170	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0
Acenaphthene	210	< 0.1	< 0.1	0.2	< 0.1	0.13	< 0.1	0
Fluorene	170	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0
Phenanthrene	95	1.13	< 0.1	1.31	< 0.1	0.88	0.6	0
Anthracene	2400	< 0.1	< 0.1	0.27	< 0.1	0.18	< 0.1	0
Fluoranthene	280	1.77	< 0.1	1.77	< 0.1	1.22	0.95	0
Pyrene	620	1.6	< 0.1	1.58	< 0.1	1.13	0.98	0
Benzo(a)anthracene	7.2	0.64	< 0.1	0.6	< 0.1	0.5	0.44	0
Chrysene	15	0.71	< 0.1	0.73	< 0.1	0.54	0.54	0
Benzo(a)pyrene	5	0.61	< 0.1	0.66	< 0.1	0.52	0.61	0
Benzo(b)fluoranthene	2.6	< 0.1	< 0.1	0.22	< 0.1	0.19	0.2	0
Benzo(k)fluoranthene	77	0.47	< 0.1	0.47	< 0.1	0.37	0.38	0
Indeno(1,2,3-cd) pyrene	27	0.27	< 0.1	0.27	< 0.1	0.21	0.23	0
Dibenzo (a, h) anthracene	0.24	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0
Benzo(ghi)perylene	320	0.25	< 0.1	0.28	< 0.1	0.23	0.23	0
Petroleum Hydrocarbons								
Aliphatic EC >5-6	42	< 0.01	< 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	< 0.05	0
Aliphatic EC >8-10	27	< 2	< 2	< 2	< 2	< 2	< 2	0
Aliphatic EC >10-12	130	< 2	< 2	< 2	< 2	< 2	< 2	0
Aliphatic EC >12-16	1100	< 3	< 3	< 3	< 3	< 3	< 3	0
Aliphatic EC >16-21	65000	< 3	< 3	< 3	< 3	< 3	< 3	0
Aliphatic EC >21-35	65000	< 10	< 10	< 10	< 10	< 10	< 10	0
Aromatic EC >5-7	70	< 0.01	< 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	< 0.05	0
Aromatic EC >8-10	34	< 2	< 2	< 2	< 2	< 2	< 2	0
Aromatic EC >10-12	74	< 2	< 2	< 2	< 2	< 2	< 2	0
Aromatic EC >12-16	140	< 2	< 2	< 2	< 2	< 2	< 2	0
Aromatic EC >16-21	260	< 3	< 3	4	< 3	< 3	< 3	0
Aromatic EC >21-35	1100	< 10	< 10	< 10	< 10	< 10	< 10	0
Benzene	0.87	< 2	< 2	< 2	< 2	< 2	< 2	0
Toluene	130	< 5	< 5	< 5	< 5	< 5	< 5	0
Ethylbenzene	47	< 2	< 2	< 2	< 2	< 2	< 2	0
m & p-xylenes	56	< 2	< 2	< 2	< 2	< 2	< 2	0
o-xylenes	60	< 2	< 2	< 2	< 2	< 2	< 2	0
Phenols								
Phenol	120	3.4	< 2	< 2	< 2	< 2	< 2	0

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

Asbestos fibres and fragments have not been found.

7.3 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 11 below and presented in full in Appendix 4.

Table 11: Waste Classification of Soils

Location	Depth (m bgl)	WM3.1 Classification	WAC Testing Classification	Comments
WS01	0.25	Non-Hazardous	Exceeds Hazardous	Due to an Organic Matter Content of 16.2%
WS01	0.75	Non-Hazardous		
WS02	0.30	Non-Hazardous		
WS02	0.80	Non-Hazardous		
WS03	0.25	Non-Hazardous		
WS03	0.75	Non-Hazardous		

The above table shows that 6no. of the tested samples collected from the site have been classified as **Non-Hazardous** in accordance with WM3.1.

1no. soil sample has been submitted for Waste Acceptance Criteria (WAC) testing. The soil sample tested classified the site soil as likely to be accepted as Exceeds Hazardous Waste due to elevated Total Organic Carbon and Loss of Ignition percentages.

For Waste Acceptance Criteria (WAC) testing, EEG has compared solid waste and leachate values against guideline values in the Landfill Regulations. The following table summarises the results of the solid waste analysis and leachate testing, together with limit values for Non-Hazardous waste and Hazardous waste as described in the Landfill Regulations.

Further WAC testing on the remaining samples may prove that the material is acceptable as inert waste.

Table 12: Summary of WAC Test Results

Determinand	Landfill Regulations Limits (mg/kg unless otherwise indicated)			WS01 0.25m (mg/kg)
	Inert Waste	Stable non- reactive non-hazardous waste	Hazardous Waste	
TOC (%)	3%	5%	6%	9.4
Loss on ignition (%)	-	-	10%	10.60
BTEX (mg/kg)	6	-	-	< 0.05
Sum of PCBs (mg/kg)	1	-	-	< 0.1
Mineral Oil (mg/kg)	500	-	-	< 10
Total PAH (mg/kg)	100	-	-	7.4
pH (units)	-	< 6	-	6.4
Acid Neutralisation Capacity (mol/kg)	-	<i>To be evaluated</i>		< 1
Arsenic	0.5	2	25	0.443
Barium	20	100	300	0.807
Cadmium	0.04	1	5	< 0.002
Chromium	0.5	10	70	0.010
Copper	2	50	100	0.125
Mercury	0.01	0.2	2	0.0010
Molybdenum	0.5	10	30	0.155
Nickel	0.4	10	40	0.0459
Lead	0.5	10	50	0.023
Antimony	0.06	0.7	5	< 0.002
Selenium	0.1	0.5	7	0.0125
Zinc	4	50	200	0.29
Chloride	800	15000	25000	23
Fluoride	10	150	500	< 1
Sulphate	1000	20000	50000	376
Total Dissolved Solids	4000	60000	100000	2572
Phenol Index	1	-	-	< 0.5
DOC	500	800	1000	492

8.0 GROUND GAS AND RADON GAS CONTAMINATION RISK ASSESSMENT

8.1 Radon Gas

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

8.2 Analyses of Monitoring Results

The risk associated with gases generated in the ground (whether from natural or man-made sources) depends on gas concentrations and their 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 mean that the volume of gas potentially reaching the ground surface is usually inconsistent over time.

The response zone of the monitoring wells ranged from 0.85m to 1.85m below ground and targeted the natural strata across the site to assess the ground gas regime fully.

Four monitoring visits have been conducted between 6th November 2025 and 16th December 2025. The results recorded methane (CH₄) levels of 0.0% v/v with carbon dioxide (CO₂) levels of 0.1% to 12.7% v/v. Oxygen concentrations of between 6.7% and 15.9% v/v were also recorded.

Groundwater levels varied during the monitoring period, with several monitoring wells exhibiting flooded response zones during the monitoring visits. However, all high methane and carbon dioxide readings were recorded from “unflooded” monitoring wells; therefore, the data are considered representative.

Flow rates recorded were consistently 0.0 litres/hour during the monitoring period.

For assessment purposes, a flow rate of 0.0 litres/hour has been used.

Atmospheric pressure was recorded between 991 and 1008 mb.

Complete results of the monitoring are presented in Appendix 5.

Table 13 (overleaf), adapted from Table 8.5 of CIRIA C665, Assessing Risks Posed by Hazardous Ground Gases to Buildings (Wilson et al., 2007), provides a summary of current UK practice for determining appropriate gas protection measures in relation to the Gas Screening Value (GSV).

A GSV for the site has been calculated by multiplying the maximum gas concentration by the steady flow rate of 0.0 l/h used for assessment.

- Carbon dioxide: Steady flow rate = 0.0 l/hr, max concentration = 12.7%
- Methane: Steady flow rate = 0.0 l/hr, max concentration = 0.0%.

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

- **Carbon Dioxide:** $GSV = 0.0 \times 12.7 / 100 = 0.00 \text{ litres/hour}$
- **Methane:** $GSV = 0.0 \times 0.0 / 100 = 0.00 \text{ litres/hour}$

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

The above results indicate that the site can be assigned a Characteristic Situation 1, i.e., ‘very low risk’.

Table 13: Characteristic Situation (Wilson et al 2006/2007 modified from Wilson and Card, 1999)

Characteristic Situation	Risk Classification	Gas Screening Value CH₄ or CO₂ (l/hr)	Additional Factors	Typical source of generation
1	Very Low	<0.07	Typically, < 1% methane Typically, < 5% carbon dioxide	Typically made ground
2	Low	<0.7	Borehole air flow rate to not exceed 70l/hr; otherwise consider increase to Characteristic Situation 3	Typically made ground
3	Moderate	<3.5		Old landfill, inert waste, flooded mine workings.
4	Moderate to High	<15	Quantitative risk assessment	Mine workings are susceptible to flooding, and the completed landfill
5	High Risk	<70		Mineworking is unflooded and inactive, with shallow workings near the surface.
6	Very High Risk	>70		Recent landfill site

9.0 CONCLUSIONS & RECOMMENDATIONS

9.1 Soil Contamination

There is a **LOW** potential risk of soil contamination to construction and ground workers during development, and appropriate measures, such as PPE, site health plans, and the proper disposal of material arisings, will be required to mitigate this risk.

Based on the chemical testing results, no contaminant concentrations exceeded the screening criteria for residential end use.

Therefore, the risk to future end users is **LOW**, and no remediation is required.

9.2 Asbestos in soils

Asbestos in soils was not identified within any of the tested samples.

9.3 Soil Disposal

Soils should be disposed of at a suitable site, registered to take the levels of contamination encountered. Soil samples collected have been classified mainly as **Non-Hazardous** for off-site disposal in accordance with Environment Agency guidance WM3.1.

Further Waste Acceptance Criteria (WAC) testing was conducted on 1 no. The sample was classified as **Exceeds Hazardous Waste**.

9.4 Foundations

It is understood that the client wishes to utilise a piled foundation solution on this site.

It is recommended that, for foundations and ground-floor slabs in contact with the made ground, the Design Sulphate Class be taken as DS-1 and the Aggressive Chemical Environment for Concrete (ACEC) site classification as AC-1.

9.5 Risk to Buried (Water) Services

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).

9.6 Surface Water Drainage

It is considered that the use of soakaways at the site is not feasible, and alternative surface water drainage methods should be investigated.

9.7 Pavement Design

Based on the site investigation findings, the soil type at the subgrade level is typically made ground underlain by variable clay.

Based on the recommendations for design CBR values provided in Interim advice note 73/06, Revision 1 (2009), a conservative design CBR of 1% should be adopted in areas where made ground is encountered at the subgrade level, and 2-4% in areas where natural clay is encountered.

Based on the site investigation findings, the soil type at the subgrade level is typically topsoil underlain by variable clay.

9.8 Land Gas

The risk of ground gas is considered “very low,” with a characteristic situation (CS1).

Therefore, ground gas protection measures are not considered necessary.

APPENDIX 1
EXPLORATORY HOLE LOGS

APPENDIX 2

GEOTECHNICAL TESTING RESULTS

APPENDIX 3

SOIL CHEMICAL TESTING RESULTS

APPENDIX 4

SOIL WASTE ASSESSMENT

APPENDIX 5

GROUND GAS AND WATER MONITORING RESULTS

APPENDIX 6
REPORT LIMITATIONS

REPORT LIMITATIONS

This contract was completed by Earth Environmental & Geotechnical Ltd under a defined programme, scope of works, and terms and conditions agreed with the client. This report was compiled with all reasonable skill and care, taking into account the project objectives, the agreed scope of works, the prevailing site conditions, the budget, and the 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 investigation or assessment should be conducted if there is any significant delay in acting on this report's findings. The passage of time may result in changes to site conditions, regulatory or other legal provisions, technology, or economic conditions that 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 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 explicitly 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's observations of existing physical conditions at the site, gained from a walkover survey of the site, together with Earth

Environmental & Geotechnical Ltd's 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 of that information, it has 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 independently verify the accuracy or completeness of any 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, they have been limited to the 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 that differ from those considered in this report. The extent of the limited area depends on soil and groundwater conditions, the positions of any current structures and underground facilities, and natural and other activities on site. In addition, chemical analysis was carried out for a limited set of parameters [as stipulated in the contract between the client and Earth Environmental & Geotechnical Ltd], based on the available operational and historical information. This should not be interpreted to mean that other chemical species are absent.

The groundwater conditions recorded in the exploratory hole records reflect 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 vary seasonally and with local drainage conditions, and higher levels may occur at other times of the year than were recorded during this investigation.

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