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PHASE 2

GEO-ENVIRONMENTAL REPORT

job number	C4722/24/E/7215
date	04.12.2024
site address	176 Almondbury Bank, Huddersfield, West Yorkshire, HD5 8EX
written by	S. Hale
checked by	R. Palmer
issued by	S. Hale

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Report on a Phase 2 Geo-environmental Investigation

Location:	176 Almondbury Bank Huddersfield, West Yorkshire, HD5 8EX
For:	Tecni-Build (Northern) Ltd
Consultants:	Jg-d
Report No.	C4722/24/E/7215 Report date: December 2024

For and on behalf of **Rogers Geotechnical Services Ltd**

Steven Hale BSc FGS Geo-environmental Technician	**Rob Palmer** MSc FGS ACIEH Engineering Director

Report Summary[1]

Item	Comments	Section
Development	Construction of a new residential dwelling.	1.
Geology	Superficial geology – None recorded. Solid geology – Elland Flags – Named sandstone member of the underlying Pennine Lower Coal Measures Formation.	5.
Strata Conditions	Capping of topsoil overlying made ground. Clay and sand encountered beneath the topsoil represents the weathered fraction of the Elland Flags. Boreholes refused on sandstone (Elland Flags).	6.
Groundwater	None encountered during investigation.	6.2
Foundation Design	Shallow foundation solution.	10.1
Effect of Sulphates	DC-1 concrete.	10.5
Contamination	Lead and PAH contamination revealed at some locations.	11.

[1] This summary should not be relied upon to provide a comprehensive review. All of the information contained in this document should be considered.

1. Introduction

It is understood that the land at 176 Almondbury Bank is to be developed by the construction of a new residential dwelling. Consequently, a site investigation has been undertaken in accordance with the instruction from the client. This work was required in order to determine the nature of the underlying soils, to assess their engineering properties and to assist in the design of safe and economical foundations for the proposed development. This investigation also takes into consideration the risk of any contamination present. This report describes the work undertaken, presents the data obtained and discusses the ground conditions in relation to the proposed works.

2. Limitations

The recommendations made and opinions expressed in this report are based on the ground conditions revealed by the site works, together with an assessment of the site and of the laboratory test results. Whilst opinions may be expressed relating to sub-soil conditions in parts of the site not investigated, for example between borehole positions, these are for guidance only and no liability can be accepted for their accuracy.

This report has been prepared in accordance with our understanding of current best practice. However, new information or legislation, or changes to best practice may necessitate revision of the report after the date of issue.

3. Desk Study

A Phase 1 Desk Study has been undertaken by Demeter Environmental Ltd and the results were presented as report number 23-10-02 Revision 1 reported in March 2024. This report has been used during the current intrusive investigation.

4. Fieldworks

The fieldworks were undertaken on the 17th October 2024 and included the following:

- Three windowless sample boreholes.
- Standard penetration tests within all boreholes.
- Three gas monitoring standpipes.

The investigatory locations are shown on the site plan which is presented in Appendix 1 to this report.

4.1 Windowless Sample Boreholes

These boreholes were sunk using a drive-in windowless sampler. The cores were undertaken in 1m lengths and reduced in diameter from 87mm for the first 1m through 77mm for subsequent 1m increments. The recovered cores were sealed and returned to the laboratory for logging and subsequent testing. The soils were described in general accordance with BS5930: 2015 +A1: 2020 and full descriptions are given on the windowless sample records which are presented in Appendix 2. Also included on these records are the core diameters and percentages of core recovered.

4.2 Standard Penetration Tests

Standard penetration tests (SPT) were undertaken at regular depth increments within the windowless sample boreholes. The SPT was conducted in accordance with the procedures given in BS EN ISO 22476: Part 3: 2005 +A1: 2011, and the results are summarised on the borehole record. During this work an automatic trip hammer of 63.5kg falling through 750mm was employed to drive either a cone or split barrel sampler assembly into the ground and the recovered barrel samples were retained in air tight plastic containers.

4.3 Gas Monitoring Standpipes

Gas monitoring standpipes were installed between 1.8m and 2.0m depth in all of the boreholes and the installation details are shown on the appropriate borehole records. In all cases, the monitoring standpipe consisted of a perforated pipe from the base of the borehole to 1.0m below surface, with a non-perforated pipe to ground level. The response zone was filled with pea gravel, with a bentonite seal at the base and above, and the installation was capped with a stop box cover in a concrete surround.

5. Geology

The available published geological data for the site has been examined and the following table presents the anticipated geology.

Table 1: Geological Data for the Site

Strata Type	Strata Name[2]	Previous Name[3]	Description[3]
Superficial Geology	-	-	None Indicated to underlie the site.
Solid Geology	Elland Flags	-	Consist of fine- to medium-grained flaggy to thickly bedded micaceous sandstone. The unit occurs as a number of sandstone leaves that are interbedded with dark micaceous and carbonaceous mudstone, locally containing thin dirty coals.

[2] Sources: British Geological Survey (NERC) Map Sheet 77; Huddersfield; Solid and Drift Edition, and Geology of Britain Viewer [*online resource from www.bgs.ac.uk*]
[3] Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [*online resource from www.bgs.ac.uk*]

6. Strata Conditions

In accordance with the geology of the area, the succession has been shown to include the following:

Table 2: Generalised Strata Profile

Depth m below ground level to underside of layer	**Strata Type**	**Positions Encountered**	**Groundwater Strikes** m below ground level
0.10	TOPSOIL (Dark brown, slightly sandy, clayey SILT)	All	None
1.00	MADE GROUND (Soft to firm, dark brown, slightly sandy, slightly gravelly, silty CLAY)	WS01	None
0.60 – 0.70	MADE GROUND (Dark brown, clayey, silty, sandy GRAVEL)	WS02 & WS03	None
0.95 – 2.35	WEATHERED ELLAND FLAGS (Firm, brown, slightly sandy, slightly gravelly, silty CLAY)	All	None
1.45	WEATHERED ELLAND FLAGS (Medium dense, clayey, silty, gravelly SAND)	WS03	None
+1.95 – +2.42	ELLAND FLAGS (Extremely weak, brown SANDSTONE recovered as gravel)	All	None

'+' denotes that the strata extended below the termination depth of the investigated positions, thus the extent of the deposit is only proven to the depths indicated

6.1 General Strata

The borehole records indicate that beneath a 0.10m thick capping of topsoil, made ground consisting of both granular and cohesive material was present to between 0.60m and 1.00m below ground level (begl) within all boreholes. Beneath this made ground, firm, brown, slightly sandy, slightly gravelly, silty clay was recorded to depths of between 0.95m and 2.35m begl within all boreholes. It is anticipated that these clays are representative of the completely weathered fraction of the underlying Elland Flags. Following the clay within borehole WS03, medium dense, clayey, silty, gravelly sand was recorded to a depth of 1.45m begl. Following the completely weathered clay and sand, extremely weak, brown sandstone was encountered to refusal depths within all boreholes. This sandstone is suggested to represent the beginning of the Elland Flags.

6.2 Groundwater

No groundwater strikes were observed during the site investigation. It should be appreciated that the normal rate of boring does not permit the recording of an equilibrium water level for any one strike, moreover, groundwater levels are subject to seasonal variation or changes on local drainage conditions.

7. Insitu Testing

7.1 Standard Penetration Tests

The standard penetration tests carried out are summarised in the following table:

Table 3: Summary of Standard Penetration Tests

Strata	Depth Range (m)	SPT 'N' (Blows/300mm)		Comments
		Granular soils	Cohesive soils	
Slightly sandy, slightly gravelly, silty CLAY	1.00m to 1.45m	-	8 & 14	Results indicate a firm, in-situ condition.
Clayey, silty, gravelly SAND	1.00m to 1.45m	16	-	In-situ results indicate medium-dense conditions.

7.2 Gas and Water Level Monitoring

The standpipes were monitored between the 24th October and the 14th November 2024. The results of the gas monitoring undertaken to date are tabulated below and full results are presented in Appendix 3.

Table 4: Gas Monitoring

Location	Date	CH_4 (%)	CO_2 (%)	O_2 (%)	Flow (l/h)	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)
WS01	24.10.24	0.0	0.2	20.7	0.1	↓ 1017	-	2.00
	31.10.24	0.0	0.0	20.7	0.1	↔ 1025	-	
	07.11.24	0.1	0.1	20.3	0.1	↓ 1030	-	
	14.11.24	0.1	0.1	20.0	0.1	↔ 1032	-	
WS02	24.10.24	0.0	0.1	20.7	0.1	↓ 1017	-	2.00
	31.10.24	0.0	0.0	20.7	0.1	↔ 1025	-	
	07.11.24	0.0	0.1	20.8	0.1	↓ 1030	-	
	14.11.24	0.1	0.1	21.0	0.1	↔ 1032	-	
WS03	24.10.24	0.0	0.1	20.7	0.1	↓ 1017	1.99	2.00
	31.10.24	0.0	0.0	20.7	0.1	↔ 1025	-	
	07.11.24	0.0	0.1	20.9	0.1	↓ 1030	-	
	14.11.24	0.1	0.1	21.1	0.1	↔ 1032	-	

↑ - rising pressure ↓ - falling pressure ↔ -steady pressure

This work before the 31st October 2024 was undertaken using a GFM436 (Serial No. 12168) which was last calibrated on the 19th December 2023. Visits carried out on and after the 31st October 2024 were carried out using a Geotechnical Instruments (UK) Ltd. GA5000 (serial No G503524) which was last calibrated on the 11th November 2024.

8. Laboratory Testing - Geotechnical

The following programme of laboratory testing has been undertaken on samples obtained during this investigation:

- Determination of water content — BS EN ISO 17892-1:2014
- Determination of liquid and plastic limits — BS EN ISO 17892-12:2018
- Determination of particle size distribution (Wet) — BS EN ISO 17892-4:2016: 5.2
- Sedimentation by pipette — BS EN ISO 17892-4:2016: 5.3 – 5.4
- Soluble sulphate content — BS 1377-3:2018+A1:2021: Pt3: 7.3
- pH value — BS 1377-3:2018+A1:2021: Pt3: 12

The test results are presented in Appendix 4 and are summarised below:

Table 6: Summary of Geotechnical Test Results

Test type	Number of tests	Range of results		Comments
Water content determinations	4	18% to 24%		Generally reducing below the plastic limit.
Index properties (4 Point)	4	LL PL PI	32 to 44% 23 to 29% 09 to 16%	Clay of intermediate plasticity. Consistency index 0.9 to 1.6 NHBC Class - Low
Particle size distribution (Wet sieve and sedimentation)	1	Gravel Sand Silt Clay	31% 48% 19% 02%	Clayey, silty, gravelly SAND
Soluble sulphate & pH	3	SO_4 pH	0.01 & 0.12g/l 7.4 to 8.0	

In cohesive soil the approximate cohesion, c_u, and coefficient of consolidation, m_v, may be obtained from the equivalent SPT 'N' value using the following expressions (Stroud 1975).

$c_u = f_1 N$

$m_v = \frac{1}{f_2 N}$

where:

c = cohesion (kN/m^2).
m_v = Coefficient of consolidation (m^2/MN).
f_1 & f_2 = factors based on plasticity index.
N = SPT 'N_{300}' value.

For the cohesive soils revealed at this site the highest (worst case) plasticity index[4] of 16% could be employed, which suggests an f_1 value of 6.8 and an f_2 value of 0.62.

[4] See paragraph 6.2 'Index Property Tests'

8.1 Geotechnical Properties

The idealised geotechnical properties employed in design are summarised below.

Table 7: Summary of Geotechnical Properties

Property	Range of values		Comments
Volume change potential (NHBC)	Low		Slightly sandy, slightly gravelly, silty CLAY.
Shear strength parameters (at 1.0m depth)	c_u γ	50kN/m^2 20kN/m^3	Stroud (1974) where $c_u = f_1N$ assuming an N of 8. Bulk density assumed.
Consolidation characteristics	m_v	0.20m^2/MN	Stroud (1974) where $m_v = 1/f_2N$ assuming an N of 8.
Concrete classification	DC1		Natural ground locations (Static water)

9. Laboratory Testing - Environmental

A suite of testing was conducted on samples from across the site and the following regime was undertaken.

- Metals – Cd, Cr^{VI}, Cu, Hg, Ni, Pb, V and Zn.
- Semi and Non-Metals - As, Se, Free CN^- and Phenols.
- Polycyclic aromatic hydrocarbons (PAHs).
- Petroleum hydrocarbons (TPHs).
- Others – pH, organic content and total/soluble SO_4^{2-}.
- Asbestos.

This testing was undertaken by i2 Analytical Ltd and the results of all of the chemical testing are presented in Appendix 4 of this report.

10. Discussion of Ground Conditions - Geotechnical

It is understood that the site is to be developed by the construction of a residential dwelling. At the time of writing this report the precise method of construction is not known, thus the discussion below is of a generalised nature.

10.1 Foundations

The results of this investigation indicate that topsoil and made ground will be revealed to depths of 1.0m. Such soils are not deemed suitable to represent suitable bearing strata as they are present in a weak and variable condition such that excessive total and or differential settlement could occur under moderately light loadings.

It is considered that the clay and sand representative of the completely weathered Elland Flags will provide a suitable bearing stratum, provided that the foundations are placed 200mm into soil generally described as being present in at least a firm insitu condition. Within this investigation, suitable soils have been revealed from depths of 1.0m.

It is considered that strip or spread foundations constructed within this material, at a minimum depth of say 1.2m, could be designed assuming an allowable increase in stress given in the following table:

Table 7: Allowable Increase in Stress

Foundation Type		Strip Footings			Spread/Pad Footings		
Foundation Breadth	B (m)	0.6	0.9	1.2	1.0	2.0	3.0
Foundation Depth	D (m)	1.2			1.2		
Allowable Increase in Stress	(kN/m²)	115	110	105	130	120	115
Net Allowable Bearing Capacity[5]	(kN/m²)	135	130	125	150	140	135

The allowable increase in stress given above assumes a factor of safety of 3 against general shear failure, with cohesion of 50kN/m^2 at the foundation depths. Settlements at the above loading intensities should remain within tolerable limits for the type of structure proposed provided that the underlying soils are carefully inspected immediately once final trimming has taken place. Should any soft or weak material be encountered they should be locally removed and replaced with lean-mix concrete or compacted granular soil.

10.2 General Comments for Excavations

The stability of excavation faces cannot be guaranteed thus temporary support to the excavation faces may become necessary unless the foundations are constructed using trench-fill techniques. In this method the foundation trenches should be excavated, inspected and backfilled with concrete as a continuous operation. Under no circumstances should operatives be allowed to enter unsupported excavations.

Should the excavations be required to stand open, it is considered that a blinding layer of lean-mixed concrete be placed over the sub-grade. This expedient will reduce loosening or softening of the underling soil due to both physical disturbance and the ingress of surface water.

Should seepage of groundwater be encountered it is considered that it could be dealt with using a simple form of de-watering. Such a system could include the excavation of sumps from which the water could be pumped.

10.3 Ground-floors

In light of the made ground and weak near surface soils, which were revealed to depths of up to 1.0m, it is not recommended that ground bearing ground floor slabs be employed. In this instance it would be necessary to suspend floors between foundation positions, such that the floor loads are transmitted via the foundations to competent soils at depth.

Further to the above, due to the volume change potential at the site, should the floor be placed within the zone of influence of any existing, or proposed, trees and shrubs, an allowance for soil volume change should be included. Further guidance is available in the NHBC standards, however, soil volume change can typically be catered for by providing a suitable void or utilise proprietary materials beneath the floor slab.

[5] Assumes bulk density of material removed from footing excavations to be 20kN/m^3

10.4 Hard-standing Areas

It is considered that any hard-standing at the site could be constructed employing traditional pavement design. A design California Bearing Ratio (CBR) of 3% could be employed in the pavement design[6]. However, it is recommended that proof rolling of the sub-grade be undertaken to establish the suitability of the soils, to expose any soft or weak ground and to ensure the sub-grade is well compacted prior to construction. Any areas of soft or weak ground should be remediated by increasing the sub-base thickness. Alternatively, weak material could be locally removed and replaced with a compacted granular capping layer. If construction were to be undertaken during the winter or after periods of prolonged rainfall, it may be prudent to employ a geotextile and/or a geogrid between the sub-base and sub-grade.

10.5 Effect of Sulphates

In view of the nature of the underlying soils it is considered that the design sulphate class be assessed with reference to Table C2[7], which is provided in BRE Special Digest 1, *Concrete in aggressive ground*: Part C. On the basis of this table and considering the soluble sulphate contents recorded, it can be shown that well compacted buried concrete should be designed in accordance with Class DS-2 requirements. Assuming static groundwater, the table also indicates that the aggressive chemical environment for concrete (ACEC) classification is AC-1s.

In order to evaluate the design chemical (DC) class for the buried concrete at this site reference should be made to Table D1[8], which can be found in Part D, *Specifying concrete for general cast-in-situ use,* of BRE Special Digest 1. From this table it may be shown that for an intended working life of at least 50 years the concrete design class DC-1 is required.

11. Discussion of Ground Conditions - Environmental

11.1 Discussion of Test Results

It is understood that the site is to be developed by the erection of a new residential dwelling with hard-standing and soft landscaped areas. Consequently, the site may be classified as residential with plant uptake.

11.1.1 Soil Samples

The results of the chemical testing undertaken on soil samples obtained during this investigation have been compared to the ATRISK soil screening values (SSVs) as compiled by WS Atkins plc. With respect to the results it should be appreciated that the soil organic matter (SOM) content for the samples tested was found to range between 2.0% to 3.5%. On this basis, it is considered that the screening values associated with 1% SOM should be adopted. These values have been derived in such a way as to adhere to the principles within the revised CLEA model and include the most current release of the SGVs. A list of subscribers is provided within the website[9] and these include many local authorities.

[6] Table 11.1, *Reproduction of TRRL Report LR1132 (1984)*, Smith (2006), Smith's Elements of Soil Mechanics, 8th ed.
[7] Table C2, *Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations*
[8] Table D1, *Selection of the DC Class and the number of APMs for concrete elements where the hydraulic gradient due to groundwater is 5 or less: for general in-situ use of concrete.*
[9] http://www.atrisksoil.co.uk/pages/general/subscribers.asp

A comparison of the results of the testing, together with the data given above, can be found within Appendix 5. These results indicate the following:

Table 8: Summary of Contaminated Areas

Location	Depth (m)	Contaminants found to be exceeding SSVs (Residential with plant uptake)
WS01	0.50	PAHs: Benzo(a)anthracenem Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-c,d)Pyrene, Dibenz(a,h)Anthracene & Benzo(g,h,i)perylene
WS02	0.30	Metals: Lead PAHs: Indeno(1,2,3-c,d)Pyrene & Benzo(g,h,i)
WS03	0.60	PAHs: Chrysene, Benzo(b)fluoranthene, Indeno(1,2,3-c,d)Pyrene, Dibenz(a,h)Anthracene & Benzo(g,h,i)perylene

Concentrations of chromium^{VI}, selenium, free cyanide, phenols (total) and total petroleum hydrocarbons (aliphatic C5 to C10; aromatic C5 to C12) were below the detection limits for the tests. Detectable levels of all other contaminants were recorded, but these fell below the associated Atrisk Soil Screening Values. In addition, no asbestos was detected within the soils samples tested.

It should be appreciated that the soil screening values for PAHs and TPHs (where appropriate) represents vapour saturation limits. The inhalation of vapour pathway contributes less than 10% of total exposure, which is unlikely to significantly affect the combined assessment criterion[10]. In view of this, the ATRISK soil SSVs notes that the users may wish to consider using a combined assessment criterion if free product is not observed, the values for which are also provided on the summary of contamination analysis. It is therefore considered that the criteria for no free product should be adopted for the PAHs and TPHs at this site. The results of the contaminants found to exceed these screening values are tabulated below:

Table 9: Summary of Areas Contaminated by PAHs & TPHs

Location	Depth (m)	Contaminants found to be exceeding SSVs (Residential with Plant Uptake)
WS01	0.50	None.
WS02	0.30	None.
WS03	0.60	None.

On the basis of the above information, the results of the investigation have concluded that the site is contaminated. Indeed, lead contamination has been observed to exceed the appropriate screening values by 60mg/kg (30% above appropriate SSV) within the position of WS02. As this contamination appears to be accompanied by with elevated levels of PAHs, it is reasoned that this contamination could be associated with coal ash fragments within the made ground.

[10] Ref: ATRISK soil, SSVs derived using CLEA v1.071 for 1% SOM, Residential with home grown produce land use, 23.06.17.

11.1.2 Gas Concentrations

With respect to ground gas, the results of the monitoring visits indicated a maximum concentration of 0.1% methane, with concentrations of carbon dioxide ranging between 0.0% and 0.2%, in association with oxygen levels of between 20.0% and 21.1%. It should be appreciated that on non-contaminated sites there is generally about 20% by volume of oxygen, associated with low levels of carbon dioxide. In addition, a maximum flow rate of 0.1 litres per hour was recorded and will be employed in the following calculations.

The principal driving force for initiating the movement of gas in the ground is a change in barometric pressure. The most onerous gas condition on a site is usually observed on days of low or falling barometric pressure, preferably below 1000mb. It has been noted that measurements undertaken solely during high pressure conditions may be of lesser value. At this site the readings undertaken to date were at atmospheric pressures of between 1017mb and 1032mb.

In order to establish the gas screening value (GSV) for carbon dioxide or methane, the maximum gas concentration (expressed as a decimal) is multiplied by the borehole flow rate (l/hr). In this case 0.1% (0.001) methane was recorded along with 0.2% (0.002) carbon dioxide, in association with a maximum flow rate of 0.1 l/hr. This results in a GSV of 0.0001 l/hr for methane and a GSV of 0.0002 l/hr for carbon dioxide.

In accordance with Table 2 of BS8485: 2015*, Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings,* the site may be characterised as *Characteristic Situation Level 1*. It is therefore considered that there is a very low risk of harm to end users and site operatives and no special precautionary measures are required in accordance to Table 8.6, *Typical scope of gas protection measures,* of CIRIA report C665.

With regard to the number of monitoring visits required reference is made to Tables 5.5a and 5.5b of CIRIA report C665 (2007)[11]. Accepting that the proposed development is of high sensitivity and that the generation potential is very low, these tables suggest that 6 readings could be undertaken over a period of 3 months. However, C665 notes that *not all sites will require gas monitoring for the period and frequency indicated in Tables 5.5a and 5.5b.*

In this case, a total of 4 monitoring visits were undertaken over a four-week time period and for the purpose of this assessment, it is considered that the site can be provisionally classified as Characteristic Situation Level 1. However, it should be appreciated that all ground gas monitoring to date was undertaken during periods of relatively high barometric pressure (i.e. over 1005mb↑). Therefore, it is recommended that two further monitoring visits are undertaken within the next month as recommended by the CIRIA report C665 (2007), during a period when the barometric pressure is low, but not necessarily below 1000mb) or falling, which represents a more onerous condition.

In light of the above, it is considered that following the additional monitoring visits, should there be no significant change in ground gas conditions, the site can be fully classified as Characteristic Situation Level 1.

[11] Adapted from tables 5.5a and 5.5b of CIRIA C665, 2007, *Assessing risks posed by hazardous ground gas to buildings, p60.*

11.2 Site Specific Risk Assessment

11.2.1 Approach

The presence of contamination hazards and the risks associated with them should be assessed in accordance with industry practice and the 'suitable for use' approach. This has been conducted with reference to The Department for Environment, Food and Rural Affairs (DEFRA) and The Environment Agency[12] advice on the assessment of risks arising from the presence of contamination in soils and using the source-pathway-receptor approach.[13] This method dictates that there must be a risk of contaminant produced at a 'source' in sufficient concentration to cause harm and there must be a 'pathway' for the contaminant to reach an identifiable 'receptor' for the linkage to be proved and a contamination hazard to be considered present. Not all substances are contaminants and not all contaminants are considered to be a risk. Indeed DEFRA and The Environment Agency state that 'a contaminant is a substance which has the potential to cause harm, while a risk itself is considered to exist if such a substance is present in sufficient concentration to cause harm and a pathway exists for a receptor to be exposed to the substance.'[14]

11.2.2 Conceptual Ground Model and Risk Assessment

In view of the results of the chemical testing undertaken the conceptual site model is presented accordingly as Table 10. Sources of contamination include the following:

On-site – Made Ground (Lead and PAHs).

The preliminary risk assessment has been evaluated with reference to the following ratings and definitions:

N/A -	A source-pathway-receptor linkage is not considered to exist and therefore a risk assessment is not required.
Low -	A pollution linkage is unlikely and/or the likelihood of harm occurring is low and of minor consequence.
Moderate -	The linkage exists but the likelihood of harm occurring is not considered to be significant although remedial action may be necessary
High -	The linkage exists and the available data indicates that significant harm may be caused and remedial action could be necessary.

The results of the risk assessment are presented in Table 10.

[12] R&D Publication CLR 8, 'Assessment of Risks to Human Health from Land Contamination: An overview of the Development of Soil Guideline Values and Related Research'.
[13] The pollution linkage approach was developed by 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990' which provides meanings for the terms contained in The Environmental Protection Act 1990 Part IIA, the primary legislation for addressing the issues of contaminated land.
[14] See 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990', appendix A.

Table 10: Conceptual Site Model and Site-Specific Risk Assessment [Contamination: Lead and PAHs]				
Conceptual Site Model			**Site Specific Risk Assessment**	
Pathways	**Receptor**	**Linkage Present?**	**Risk Rating**	**Notes**
Direct contact/dermal absorption/soil ingestion	Operative	Yes – contamination found to be present at the site and contact with soil likely during works.	High	Some contamination is present in the soils underlying the site. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways. However, as the site is anticipated to be secured during the development phase, contamination is not anticipated to affect neighbours.
	End User	Yes – contamination found to be present at the site and site to be developed into a residential dwelling with landscaped areas.	High	
	Neighbours	Yes – contamination found to be present at the site and a populated residential area surrounds the site.	Low	
Inhalation of Dust/Vapours	Operative	Yes – dust may be derived from contaminated soils. It is not expected that PAHs represent a vapour risk.	High	Some contamination is present underlying the site. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways.
	End User	Yes – dust may be derived from contaminated soils. It is not expected that PAHs represent a vapour risk.	High	
	Neighbours	Yes – contamination found to be present at the site and residential properties located within 250m radius of the site and possible inhalation of dust during the works.	High	
Ingestion of fruit/vegetables and/or waters	Operative	No – no edible plants or contained water sources in the area of the proposed new works.	N/A	Some contamination is present underlying the site. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways. However, the contamination at the site is considered to be of limited mobility, therefore the likelihood of contamination affecting neighbouring gardens is considered low risk.
	End User	Yes – contamination found to be present at the site and site to be developed into a residential dwelling with landscaped areas.	Moderate	
	Neighbours	Yes – contamination found to be present at the site and residential area adjoins the site.	Low	
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	Yes – low concentrations of methane and carbon dioxide have been found to be present at the site (assuming *Characteristic Situation Level 1*).	Low	Low concentrations of harmful gases (methane and carbon dioxide) were detected at the site. If ground gas conditions remain the same, no special precautionary measures are deemed to be required.
	End User		Low	
	Neighbours		Low	

Spillage/loss/run off direct to receiving water	Controlled Waters	Yes – Penny Spring Bank located 61m SW of the site. However, beneath the made ground the site is underlain by cohesive soils of likely low permeability. Contamination by lead is not anticipated to be significantly mobile.	Low	Some contamination is present underlying the site. Remediation will be required to either remove the contamination or break pathways. Old services to be removed or capped.
Migration via permeable unsaturated strata	Controlled Waters	Yes – secondary A aquifer is present beneath the site. However, the site is underlain by cohesive soils of low permeability. Contamination by lead is not anticipated to be significantly mobile.	Low	
Run off via drainage/sewers etc	Controlled Waters	Yes – old services may be present on site. However, the site is underlain by cohesive soils of low permeability. Contamination by lead is not anticipated to be significantly mobile.	Low	
Direct contact with contaminated soils	Plants	Yes – significant contamination present at the site which may affect plants.	Moderate	Some contamination is present underlying the site. Remediation will be required to either remove the contamination or break pathways.
Uptake via root system			Moderate	
Direct contact with contaminated soils	Building Materials	Yes – PAH contamination revealed at the site may represent a significant risk to building materials or plastic water pipes. Moreover, testing indicates that the aggressive chemical environment for concrete classification is AC-1s.	Moderate (plastic services) Low (buried concrete)	Please see section 11.3.3 for information on good building practice.
Direct contact with contaminated groundwater				
Exposure to Radon	Operative	No – Not in a radon affected area.	N/A	Less than 1% of properties are above the action level. No radon protection measures required.
	End User			
UXO Risk	Operative	No – it is considered that the activities of the end users are unlikely to affect any UXO devices that may be present below the site.	Low	No further action required.
	End User			

11.3 Indicative Remediation Strategy

In view of the site-specific risk assessment it is considered that remediation will be required at this site. Such a strategy should include the following main elements.

11.3.1 Remediation Objectives

Based on the site-specific risk assessment the object of the remediation is likely to be as follows.

- To protect the site operatives during the construction process from the ingestion of soil or dust, dermal contact with the soil and inhalation of dust.
- To protect the end user from the ingestion of soil or dust, dermal contact with the soil and inhalation of dust.
- To protect neighbours from the inhalation and ingestion dust during the construction process.
- To protect plants from direct contact with contamination and prevent uptake via root system.
- To ensure that contamination cannot reach controlled waters via surface run-off or permeable strata.
- To ensure that contamination cannot enter the former services occupying the site which may return to controlled waters.
- To protect plastic services from being penetrated by, or degrading due to the presence of, contamination in the soil or groundwaters.

11.3.2 Development Requirements

Whilst the precise nature of this development has not been finalised it is understood that it is to be developed by the construction of a new residential dwelling with hard-standing and soft landscaped areas. In view of the above a site-specific remediation strategy should be undertaken after the proposed development has been finalised. However, for preliminary design and costing the following remediation proposals are offered.

11.3.3 Outline Strategy

In order to fulfil the objectives defined above it is likely that the following remedial strategy could be utilised. It is recommended that a pragmatic approach be undertaken, with observational techniques being employed at each stage of the work.

Ground-works

During the ground-works phase of the development, protection to the site operatives is required. The risk to site operatives is considered under the Health and Safety at Work Act 1974, together with regulations made under the act, which includes the Control of Substances Hazardous to Health (COSHH) regulations. Therefore, the risks to site personnel must be considered under the Construction Design and Management (CDM) regulations at the planning stage and be included in the contractor's Health and Safety Plan and site-specific Method Statements. These documents should include the following main elements.

- Site operatives at all levels should be made aware of the hazards of working with contaminated soils and the potential hazards associated with materials containing volatile hydrocarbons.
- Personal hygiene facilities, including washing and messing, must be provided and site operatives be encouraged to use them.
- Where work is undertaken in dry weather the site should be dampened down to avoid dust. In addition, dust masks must be provided to all site operatives for use in dry weather.
- In order for contaminated soils to be disposed of to an appropriate landfill, it may be necessary to carry out Waste Acceptance Criteria (WAC) testing in accordance with BS EN 12457.
- Any stockpiles of contaminated soil on site should be sheeted over to prevent excessive amounts of airborne dust and cross contamination of imported fill.
- Where vehicles are transferring soil to the landfill site they should be covered to prevent contamination of the surrounding area by dust.
- Where work is undertaken in wet weather, vehicle and wheel washing facilities are required to ensure that the vehicles leaving the site do not transfer contamination to surrounding areas.

On completion of the ground-works a careful site inspection of the sub-grade would be required. Should visual or olfactory evidence of contamination be revealed then further testing may become necessary.

Construction

During the construction phase of the contract the following items are required to protect the end user from the potential contaminants revealed at this site.

- Beneath buildings, pavements and hard-standings clean inert granular sub-base should be employed.
- Any redundant services revealed at this site should be de-commissioned and piped services sealed. Any existing services that are to be employed in the new development should be carefully inspected to ensure that they are serviceable.
- New plastic services should be constructed in a surround of clean inert material and selected in accordance with the recommendation given in the United Kingdom Water Industry Research (UKWIR) website under Report Ref. No. 10/WM/03/21 - 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites'. The statutory water authority for the area in which site is located may have a risk assessment form to complete which allows these recommendations to be met. However, further determinand specification contamination testing may be necessary.
- For buried concrete the results of the sulphate and pH testing indicate that the design sulphate class for the site should be DS-1.

Landscaped Areas

It is understood that to the development shall include soft landscaped areas. In view of this and the potential contamination on site, it is considered that landscaped areas will require some remediation. This could include the provision of a clean cover system including a capping layer of say 500mm of inert material, which will put the contaminated ground out of the end users' dig range. At the base of this layer, a granular capillary break of say 100mm of free draining granular soil should be placed in order to prevent mobile contamination rising upward. This expedient should also provide a suitable root barrier to isolate the plants from the underlying contaminated ground.

11.4 Fill Materials

It should also be appreciated that any fill material, either site-won or imported, to be employed at the site should be subjected to the following assessment to determine its suitability.

Fill materials should be initially screened, by a suitably qualified engineer to establish that:

- It is a suitable growing media if it is to be employed as such, including compliance with BS3882 (2015)
- It is free from obvious contamination i.e. visual or olfactory evidence
- It has not come from areas where Japanese Knotweed or other invasive or injurious plants are suspected to be growing
- It is not a statutory nuisance, such as being odorous
- It is free from unsuitable material i.e. whole bricks, brick ties, timber or glass.

It should also be appreciated that any fill should be subjected to validation testing to assess its suitability. The following table has been taken from YALPAG[15] documentation and may be used as a guide. Depending on the origin and nature of the material, not all fill will require the sampling frequency and testing indicated, although this should be in agreement with any regulatory bodies (such as the Local Authority).

Table 12: Validation Sampling and Testing

Fill Type	Frequency	Minimum Determinands
Virgin Quarried Material	1 or 2 depending on the type of stone utilised, to confirm the inert nature of the material.	Standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn)
Crushed Hardcore, Stone, Brick	Minimum 1 per 500m³	Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, total TPH. Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).
Greenfield/ Manufactured Soils	Minimum 3 Dependent on source and receptor, between 1 per 50m³ and 1 per 250m³	Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, pH and soil organic matter (SOM) (or calculated from total organic carbon (TOC)).
Brownfield/ Screened Soils	Minimum 6 Dependent on source and	Standard metals/ metalloids (as above), PAH (16 USEPA

[15] *YALPAG Technical Guidance for Developers, Landowners and Consultants – Verification Requirements for Cover Systems V4 .1* Appendix 1a, June 2021

	receptor, between 1 per 50m^3 and 1 per 100m^3	speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE)..

The screening values for the above regime should also be agreed with any regulatory bodies; however, the following is recommended in the first instance.

Table 13: Fill Screening Values

Contaminant	Screening Value (Residential with Plant Uptake) (mg/kg)				Reference
	1% SOM		6% SOM		
As	37		37		Atrisk^{SOIL} SSVs
Cd	22.1		22.1		Atrisk^{SOIL} SSVs
Cr(VI)	3.62	20.5	3.63	20.5	Atrisk^{SOIL} SSVs
Cu	4730		4790		Atrisk^{SOIL} SSVs
Hg	8.81		15.8		Atrisk^{SOIL} SSVs
Ni	136		136		Atrisk^{SOIL} SSVs
Pb	200		200		Atrisk^{SOIL} SSVs
V	136		138		Atrisk^{SOIL} SSVs
Zn	20000		20300		Atrisk^{SOIL} SSVs

Please see summary sheet within Appendix 6 for full screening values including PAHs & TPHs.

The above screening values should be considered with respect to the Soil Organic Matter (SOM) of the subject material i.e. 1% SOM would be typical for granular fill and 6% SOM for topsoil. Testing should comply with UKAS and MCERTS, where applicable, and undertaken by an accredited laboratory.

Where the material has been derived from a commercial company, certificates or other industry quality protocol compliance i.e. WRAP should be obtained. However, it will be necessary to ensure that this documentation specifically related to the material being imported, it is no more than two months old and complies with the screening and frequency requirements given above.

Suitable fill materials should be either placed immediately or sufficiently quarantined to prevent cross-contamination. If it is necessary, the quarantined material should be placed on appropriate sheeting and covered to prevent it becoming mixed with contaminated soils or dust, or penetrated by mobile contaminants.

11.5 Verification Report

In order to demonstrate that the remedial works and provision of clean cover has been sufficiently carried out where applicable, it will be necessary to produce a verification report for submission to any statutory authorities.

It will be necessary for this report to include the following:

- The extents of any areas where made ground has been wholly removed.
- Characterisation of the suitability of the clean material including the derivation of the material, comments from a visual screen, the tests results of chemical screening, delivery tickets where appropriate and the conditions by which the clean material has been stored and handled on site.

- Photographic and logged evidence the clean material has been handled on site and placed in a sufficient thickness over areas where made ground remains. This may be either at the time of placement or after placement by means of hand excavated trialpits. Photographs should include visual site references or reference boards to prove the location and date taken. A measurement reference should be visible in the photographs to substantiate the thickness of material placed. Please note that it may also be necessary to undertake a topographical survey and the requirement for which should be checked with any statutory authorities.

The report detailed above should be produced by a suitably qualified engineer. The number of verification areas for the development should be confirmed with any statutory authorities for the site.

12. Recommendations for Further Work

- This report should be forwarded to the relevant authorities as soon as practicable to ensure they have sufficient time to review and discuss any issues.
- Completion and reporting of recommended additional gas monitoring.
- Discussions with ground work contractors in relation to the requirement for testing of materials to be disposed off-site (Waste Acceptance Criteria) and the suitability of imported materials.
- Discussions with service providers regarding suitable materials for pipe work given the nature of chemical determinands found within the soils on site.
- Produce a validation report to demonstrate that the geo-environmental risks discussed in this report have been mitigated.
- Detailed design of the sub-structure.

Clearly Rogers Geotechnical Services Ltd would be happy to offer advice with respect to the above and assist where necessary.

13. References

- British Geological Survey (NERC) (2024), BGS, Keyworth.
  - Geology of Britain Viewer: (*http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html)*
  - Lexicon of Named Rock Units:
  - (*http://www.bgs.ac.uk/lexicon/)*

- British Standards Institution (1990) BS1377: *British standard methods of test for soils for civil engineering purposes,* B.S.I., London.

- British Standard Institution (2005 +A1: 2011) BS EN ISO 22476-2: *Geotechnical investigation and testing – Field testing, Part 2: Dynamic Probing,* B.S.I., London.

- British Standard Institution (2005 +A1: 2011) BS EN ISO 22476-3: *Geotechnical investigation and testing – Field testing, Part 3: Standard penetration test,* B.S.I., London.

- British Standards Institution (2015 +A1: 2020) BS 5930: *Code of practice for ground investigations,* B.S.I., London.

- British Standards Institution (2011), BS 10175: *Investigation of potentially contaminated sites – Code of Practice,* British Standards Institute.

- British Standards Institution (2015 +A1:2019) BS8485: *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings,* B.S.I., London.

- British Standards Institution (2013), BS 8576 Guidance on Investigations for Ground Gas – Permanent Gases and Volatile Organic Compounds.

- British Standards Institution (2017) BS EN ISO 14688: *Geotechnical investigation and testing – Identification and classification of soil*, B.S.I., London.

- Building Research Establishment (BRE) Special Digest 1 (2005), Third Edition: Concrete in aggressive ground, BRE Press, Garston.
  - Part C: *Assessing the aggressive chemical environment.*
  - Part D: *Specifying concrete for general cast-in-situ use.*

- Department for Environment, Food and Rural Affairs and the Environment Agency (2009) DEFRA Science Report – Final SC050021/SR2, *Human Health toxicological assessment of contaminants in soil*. Environment Agency, Bristol.

- Department for Environment, Food and Rural Affairs and the Environment Agency (2009) DEFRA Science Report – SC050021/SR3, *Updated technical background to the CLEA model*. Environment Agency, Bristol.

- Department for Environment, Food and Rural Affairs (2014) SP1010: *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document*.

- Wilson S, Oliver S, Mallet H, Hutchings H, Card G, *Assessing risks posed by ground gasses to buildings,* CIRIA Report C665.

Appendix 1

Site Plan



Notes:

RGS Environmental Geotechnical Specialists

Rogers Geotechnical Services Ltd

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Business Park,
Near Bank,
Shelley,
Huddersfield,
HD8 8LU

Telephone: 0843 50 66 87
www.rogersgeotech.co.uk

Client:

Tecni-build (Northern) Ltd

Job Number:

C4722/24/E/7215

Project Details:

176 Almondbury Bank,
Huddersifled

Scale: Not to scale - reference only

ground investigation | drilling & excavation | insitu testing
laboratory testing & gas monitoring | engineering consultancy
surveying & flood risk assessments | training, CPD & expert witness
... delivered using our own drilling rigs / crews / soils lab / engineers

Appendix 2

Borehole Records

RGS Environmental Geotechnical Specialists

Borehole Log

Borehole No. **WS01**

Sheet 1 of 1

Project Name: 176 Almondbury Bank	Project No. C4722/24/E/7215	Co-ords:	Hole Type WLS
Location: Huddersfield, West Yorkshire, HD5 8EX		Level:	Scale 1:25
Client: Tecni-Build (Northern) Ltd		Dates: 17/10/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.10			TOPSOIL (Dark brown, slightly sandy, clayey SILT. Sand is fine to coarse).
										MADE GROUND (Soft to firm, dark brown, slightly sandy, slightly gravelly, silty CLAY. Sand is fine to coarse. Gravel is angular to sub-angular and fine to coarse of ash, brick, clinker and sandstone).
		1.00	D				1.00			
		1.00 - 1.45	D							Firm, brown, slightly sandy, slightly gravelly, silty CLAY. Sand is fine to coarse. Gravel is sub-angular and fine to coarse of sandstone. [WEATHERED ELLAND FLAGS]
		1.00	SPT			N=14 (2,2/3,3,3,5)				
				87	100					
		2.00	SPT			N=50 (3,3/3,3,15,29)				
							2.35			Extremely weak, brown, micaceous, fine grained SANDSTONE recovered as gravel. [ELLAND FLAGS]
							2.40			End of Borehole at 2.40m

1 2 3 4 5

Remarks

AGS

Borehole Log

Environmental Geotechnical Specialists

Borehole No. **WS02**

Sheet 1 of 1

Project Name: 176 Almondbury Bank	Project No. C4722/24/E/7215	Co-ords:	Hole Type WLS
Location: Huddersfield, West Yorkshire, HD5 8EX		Level:	Scale 1:25
Client: Tecni-Build (Northern) Ltd		Dates: 17/10/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.10			TOPSOIL (Dark brown, slightly sandy, clayey SILT. Sand is fine to coarse).
				87	90					MADE GROUND (Dark brown, clayey, silty, sandy, angular to sub-angular and fine to coarse GRAVEL of ash, brick, clinker and sandstone. Sand is fine to coarse).
							0.60			Firm, brown, slightly sandy, slightly gravelly, silty CLAY. Sand is fine to coarse. Gravel is sub-angular and fine to coarse of sandstone. [WEATHERED ELLAND FLAGS]
		1.00	D							
		1.00 - 1.45	D							
		1.00	SPT			N=8 (1,1/1,2,2,3)				
				77	85					
		1.50	D							
							1.60			Extremely weak, brown, thickly laminated, micaceous, fine grained SANDSTONE recovered as a silty, sandy gravel. [ELLAND FLAGS]
							1.90			
		2.00	SPT			50 (12,13/50 for 0mm)	1.95			Extremely weak, brown, micaceous, fine grained SANDSTONE recovered as gravel. [ELLAND FLAGS]
										End of Borehole at 1.95m

1 2 3 4 5

Remarks

AGS

Borehole Log

Environmental Geotechnical Specialists

Borehole No. **WS03**

Sheet 1 of 1

Project Name: 176 Almondbury Bank	Project No. C4722/24/E/7215	Co-ords:	Hole Type WLS
Location: Huddersfield, West Yorkshire, HD5 8EX		Level:	Scale 1:25
Client: Tecni-Build (Northern) Ltd		Dates: 17/10/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.10			TOPSOIL (Dark brown, slightly sandy, clayey SILT. Sand is fine to coarse).
										MADE GROUND (Dark brown, clayey, silty, sandy, angular to sub-angular and fine to coarse GRAVEL of ash, brick, clinker and sandstone. Sand is fine to coarse).
							0.70			
		0.80	D	87	100					Firm, brown, slightly sandy, slightly gravelly, silty CLAY. Sand is fine to coarse. Gravel is sub-angular and fine to coarse of sandstone. [WEATHERED ELLAND FLAGS]
		1.00 - 1.45	D				0.95			
		1.00 - 1.45	D							Medium dense, clayey, silty, gravelly, fine to coarse SAND. Gravel is sub-angular and fine to coarse of sandstone. [WEATHERED ELLAND FLAGS]
		1.00	SPT			N=16 (2,2/3,3,4,6)				
				77	100		1.45			Extremely weak, brown, micaceous, fine grained SANDSTONE recovered as gravel. [ELLAND FLAGS]
		2.00	SPT			50 (6,6/50 for 275mm)				
							2.42			End of Borehole at 2.40m

1 2 3 4 5

Remarks

AGS

Appendix 3

Gas Monitoring Sheets

Post Fieldworks Discrete Well Monitoring Site Record

Job No:	C/4722/24/E/7215	Client:	Tecni Build North	Visit:	1	Of	4
Site:	176 Almondbury Band, Huddersfield	Date:	24.10.2024				

RGS Environmental Geotechnical Specialists

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Tel: 01484 604 354
enquiries@rogersgeotech.co.uk

Location ID	Methane (%)		Carbon Dioxide (%)		Carbon Monoxide (ppm)		Hydrogen Sulphide (ppm)		Oxygen (%)		VOCs (ppm)		Flowrate (l/hr)		Water Depth (m)	Well Depth (m)	Installed Depth (m)	Comments
	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Minimum	Steady	Peak	Steady	Peak				
1	0	0	0.2		0		0		20.7				0		DRY		2.09	Tap open on arrival
2	0	0	0.1		0		0		20.7				0		DRY		1.98	
3	0	0	0.1	0.2	0		0		20.7				0		1.99		2.07	
Max.	0	0	0.2	0.2	0	0	0	0	20.7	0	0	0	0	0	1.99			
Min.	0	0	0.1	0.2	0	0	0	0	20.7	0	0	0	0	0	1.99			

ND - Not detected DRY - No water in well NM - Not Monitored (State Reason in comments)

Meteorological & Site Information	
General Ground Condition	Dry
Precipitation	0
Wind	No Report
Temperature	GFM436
Barometric Pressure	1017
Pressure Trend	Falling

Monitor Technical Specifications								
Gas Monitor Used:	GFM436							
Serial No:	12168							
Monitor Gas Range	CH_4	5>60	CO_2	5<40	O_2	21.2		
Gas Flow Range	0-10 l/hr							
Date of Calibration	20.04.2024							
PID Monitor (If used)								
PID Monitor Serial No.								
Calibration Date.								

Monitoring Period Summary (All Visits)	Peak	Steady
Max CH_4		1
Max CO_2	0	0
Max CO		
Max H_2S		
Max O_2	21	
Min O_2	21	
Flow rate		

	Min	Max
Barometric Pressure	1004	1005

Operative Details.	M.Tuck

Post Fieldworks Discrete Well Monitoring Site Record

Job No:	C/4722/24/E/7215	Client:	Tecni Build North	Visit:	2	Of	4
Site:	176 Almondbury Band, Huddersfield	Date:	31.10.2024				

RGS Environmental Geotechnical Specialists

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Location ID	Methane (%)		Carbon Dioxide (%)		Carbon Monoxide (ppm)		Hydrogen Sulphide (ppm)		Oxygen (%)		VOCs (ppm)		Flowrate (l/hr)		Water Depth (m)	Well Depth (m)	Installed Depth (m)	Comments
	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Minimum	Steady	Peak	Steady	Peak				
1	0	0.6	0		0		0		20.7				0		Dry		2.09	
2	0	0	0		0		0		20.7				0		Dry		1.98	
3	0	0	0		0		0		20.7				0		Dry		2.07	
Max.	0	0.6	0	0	0	0	0	0	20.7	0	0	0	0	0	0			
Min.	0	0	0	0	0	0	0	0	20.7	0	0	0	0	0	0			

ND - Not detected DRY - No water in well NM - Not Monitored (State Reason in comments)

Meteorological & Site Information	
General Ground Condition	Damp
Precipitation	0
Wind	17
Temperature	10
Barometric Pressure	1025
Pressure Trend	Steady

Monitor Technical Specifications								
Gas Monitor Used:	GA5000							
Serial No:	G503524							
Monitor Gas Range	CH_4	5>60	CO_2	5<40	O_2	21.2		
Gas Flow Range	0-10 l/hr							
Date of Calibration	20.04.2024							
PID Monitor (If used)								
PID Monitor Serial No.								
Calibration Date.								

Monitoring Period Summary (All Visits)	Peak	Steady
Max CH_4		1
Max CO_2		
Max CO		
Max H_2S		
Max O_2	21	
Min O_2	21	
Flow rate		

	Min	Max
Barometric Pressure	1012	1013

Operative Details.	M.Tuck

Post Fieldworks Discrete Well Monitoring Site Record

Job No:	C/4722/24/E/7215	Client:	Tecni Build North	Visit:	3	Of	4
Site:	176 Almondbury Band, Huddersfield	Date:	07.11.2024				

RGS Environmental Geotechnical Specialists

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Location ID	Methane (%)		Carbon Dioxide (%)		Carbon Monoxide (ppm)		Hydrogen Sulphide (ppm)		Oxygen (%)		VOCs (ppm)		Flowrate (l/hr)		Water Depth (m)	Well Depth (m)	Installed Depth (m)	Comments
	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Minimum	Steady	Peak	Steady	Peak				
1	0.1	0.1	0.1	0.1	0	0	0	0	20.9	20.3			0	0	DRY		2.1	
2	0	0	0.1	0.1	0	0	0	0	20.8	20.8			0	0	DRY		1.98	
3	0	0	0.1	0.1	0	0	0	0	20.9	20.9			0	0	DRY		2.07	
Max																		
Min.																		

ND - Not detected DRY - No water in well NM - Not Monitored (State Reason in comments)

Meteorological & Site Information	
General Ground Condition	Damp
Precipitation	0
Wind	9
Temperature	9
Barometric Pressure	1030
Pressure Trend	Falling

Monitor Technical Specifications								
Gas Monitor Used:	GA5000							
Serial No:	G503524							
Monitor Gas Range	CH_4	5>60	CO_2	5<40	O_2	21.2		
Gas Flow Range	0-10 l/hr							
Date of Calibration	20.04.2024							
PID Monitor (If used)								
PID Monitor Serial No.								
Calibration Date.								

Monitoring Period Summary (All Visits)	Peak	Steady
Max CH_4		1
Max CO_2		
Max CO		
Max H_2S		
Max O_2	21	
Min O_2	21	
Flow rate		

	Min	Max
Barometric Pressure	1016	1017

Operative Details.	M.Tuck

Post Fieldworks Discrete Well Monitoring Site Record

Job No:	C/4722/24/E/7215	Client:	Tecni Build North	Visit:	4	Of	4
Site:	176 Almondbury Band, Huddersfield	Date:	14.11.2024				

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Rogers Geotechnical Services Ltd , Offices 1 & 2
Barncliffe Business Park, Shelley, Huddersfield, HD8 8LU

Tel: 01484 604 354
enquiries@rogersgeotech.co.uk

Location ID	Methane (%)		Carbon Dioxide (%)		Carbon Monoxide (ppm)		Hydrogen Sulphide (ppm)		Oxygen (%)		VOCs (ppm)		Flowrate (l/hr)		Water Depth (m)	Well Depth (m)	Installed Depth (m)	Comments
	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Minimum	Steady	Peak	Steady	Peak				
1	0.1	0.1	0.1	0.1	0	0	0	0	21.3	20			0	0	DRY		2.1	
2	0.1	0.1	0.1	0.1	0	0	0	0	21.1	21			0	0	DRY		1.98	
3	0.1	0.1	0.1	0.1	0	0	0	0	21.1	21.1			0	0	DRY		2.07	
Max																		
Min.																		

ND - Not detected DRY - No water in well NM - Not Monitored (State Reason in comments)

Meteorological & Site Information	
General Ground Condition	Damp
Precipitation	0
Wind	2
Temperature	10
Barometric Pressure	1032
Pressure Trend	Steady

Monitor Technical Specifications								
Gas Monitor Used:	GA5000							
Serial No:	G503524							
Monitor Gas Range	CH_4	5>60	CO_2	5<40	O_2	21.2		
Gas Flow Range	0-10 l/hr							
Date of Calibration	20.04.2024							
PID Monitor (If used)								
PID Monitor Serial No.								
Calibration Date.								

Monitoring Period Summary (All Visits)	Peak	Steady
Max CH_4		1
Max CO_2		
Max CO		
Max H_2S		
Max O_2	21	
Min O_2	21	
Flow rate		

	Min	Max
Barometric Pressure	1010	1010

Operative Details.	M.Tuck

CERTIFICATION OF CALIBRATION

PJLA Calibration
No. 66916

Date Of Calibration: 25-Oct-2024

Certificate Number: G503524_10/36927

Issued by: QED Environmental Systems Inc.

As received Barometric Pressure recorded at: 23.2 °C/73.7 °F

As received gas check readings are only recorded if the instrument is received in a working condition. Where the instrument is received damaged no reading can be taken

Date of Issue : 26 Oct 2024 Approved By Signatory

The calibration results published in this certificate were obtained using equipment capable of producing results that are traceable through NIST to the International System of Units (SI). Certification only applies to results shown. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

www.qedenv.com (800) 624-2026 info@qedenv.com

QED Environmental Systems Inc. 2355 Bishop Circle West, Dexter, MI 48130

CERTIFICATION OF CALIBRATION

PJLA Calibration
No. 66916

Date Of Calibration: 25-Oct-2024

Certificate Number: G503524_10/36927

Issued by: QED Environmental Systems Inc.

The calibration results published in this certificate were obtained using equipment capable of producing results that are traceable through NIST to the International System of Units (SI). Certification only applies to results shown. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

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CERTIFICATION OF CALIBRATION

PJLA Calibration
No. 66916

Date Of Calibration: 20-Apr-2024

Certificate Number: G503524_2/35282

Issued by: QED Environmental Systems Inc.

Customer: **QED ENVIRONMENTAL SYSTEMS LIMITED**
QED ENVIRONMENTAL SYSTEMS LTD CYAN PARK - UNIT 3 JIMMY HILL WAY COVENTRY, WEST MIDLA CV2 4QP GB

Description:

Model: GA5000

Serial Number: G503524

Accredited Results:

Methane (CH4)

Certified Gas (%)	Instrument Reading (%)	Uncertainty (%)
5.1	5.0	0.42
15.0	14.9	0.66
60.0	59.7	1.03

Carbon Dioxide (CO2)

Certified Gas (%)	Instrument Reading (%)	Uncertainty (%)
5.0	5.0	0.43
15.0	15.0	0.71
40.0	40.0	1.19

Oxygen (O2)

Certified Gas (%)	Instrument Reading (%)	Uncertainty (%)
20.9	21.0	0.25

Gas cylinders are traceable and details can be provided if requested.

CH4, CO2 readings recorded at: 31.2 °C/88.1 °F

O2 readings recorded at: 22.1 °C/71.7 °F

Barometric Pressure: 0987 mbar/29.15 "Hg

Method of Test : The analyzer is calibrated in a temperature controlled chamber using a series of reference gases, in compliance with procedure ISP17.

Instrument has passed calibration as the measurement result is within the specification limit. The specification limit takes into account the measurement uncertainty.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with NIST requirements.

The calibration results published in this certificate were obtained using equipment capable of producing results that are traceable through NIST to the International System of Units (SI). Certification only applies to results shown. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Calibration Instance: 118 IGC Instance: 118

CERTIFICATION OF CALIBRATION

PJLA Calibration

No. 66916

QED™

Date Of Calibration: 20-Apr-2024

Certificate Number: G503524_2/35282

Issued by: QED Environmental Systems Inc.

Non Accredited results:

Pressure Transducers (inches of water column)					
Transducer	**Certified (Low)**	**Reading (Low)**	**Certified (High)**	**Reading (High)**	**Accuracy**
Relative	0"	0"	40"	40.33"	2.0"

Barometer (mbar)	
Reference	**Instrument Reading**
0987 mbar / 29.15 "Hg	0987 mbar / 29.16 "Hg

As received gas check readings are only recorded if the instrument is received in a working condition. Where the instrument is received damaged no reading can be taken.

Date of Issue : 24 Apr 2024

Approved By Signatory

Linda Ostrowski

Laboratory Inspection

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TEST DATE AND CONDITIONS		
Date	19/12/2023	
Atmospheric Pressure	1000	mB
Ambient Temperature	23.0	°C
Environics Serial No.	5089	

GFM436 Final Inspection & Calibration Check Certificate

GAS DATA LTD

Unit D

Earlplace Business Park

Fletchamstead Highway

Coventry

CV4 9XL

Tel 02476303311 Fax 02476307711

Customer	Ribble Enviro Ltd
Certificate Number	124805
Order Number	336328

Serial Number	12168
Software Version	G436-00.0027/0008

Recalibration DUE Date
19/12/24

Instrument Checks					
Keyboard	✓		Display Contrast	✓	
Pump Flow In	450	*Accept > 200 cc/min*	Pump Flow @ -200mB	300	*Accept > 200 cc/min*
Clock Set / Running	✓		Labels Fitted	✓	

Gas Checks						
	CH_4		CO_2		O_2	
	Instrument Gas Readings %	True Gas Value %	Instrument Gas Readings %	True Gas Value %	Instrument Gas Readings %	True Gas Value %
Sensor	59.8	60	39.3	40	20.9	20.9
	Accept ±3.0		*Accept ±3.0*		*Accept ±0.5*	
	5.0	5	4.9	5	6.0	6
	Accept ±0.3		*Accept ±0.3*		*Accept ±0.3*	
Zero Reading 100% N2	0.0	0	0.0	0	0.0	0
	Accept ±0.0		*Accept ±0.0*		*Accept ±0.1*	

Optional Gas Checks						
Applied Gas & Range		Concentration Tested @ (ppm)	Instrument Readings *(ppm)*			
Gas Type	Range *(ppm)*		Zero Reading		Instrument Gas Reading	
H2S	5000	*1500*	0	*Accept ±0.0*	1500	*Accept ±5.0%*
CO	2000	*1000*	0	*Accept ±0.0*	999	*Accept ±5.0%*
Hexane	*2.0%*	2.0%	0	*Accept ±0.0*	1.99	*Accept ±10.0%*

Cross Gas Effects									
Applied Gas *(ppm)*		Instrument Readings *(ppm)*							
Gas Type	Concentration	Toxic 1:	H2S	Toxic 2:	CO	Toxic 3:	HEX		
H2S	1500	1500		0		0			
CO	100	110		999		0			
Hexane	2.0%	0		0		1.99			

Pressure Checks			
Atmospheric Pressure [AP] *(mB)*			
Current Atmospheric Pressure (mB)		Instrument Atmospheric Pressure Reading (mB)	
AP Open Ports		1000	*Accept ±2.0*
AP Port (Internal)	*+800 mB*	800	*Accept ±5.0*
	+1200mB	1200	*Accept ±5.0*

Flow Checks					
Borehole Flow			Differential Pressure		
Applied Reading *(l/h)*	Instrument Reading *(l/h)*		Applied Pressure *(Pa)*	Instrument Reading *(Pa)*	
-30	-30.0	*Accept ±3.0*	-307	-308	*Accept ±50*
-3	-3.0	*Accept ±1.0*	-14	-15	*Accept ±6.0*
0	0.0	*Accept ±0.6*	0	0	*Accept ±0.5*
3	3.0	*Accept ±0.5*	15	15	*Accept ±3.0*
30	29.9	*Accept ±3.0*	347	344	*Accept ±50*
60	59.8	*Accept ±6.0*	1054	1047	*Accept ±130*
90	91.0	*Accept ±9.0*	2080	2144	*Accept ±250*

Temperature Checks		
Calibration Temperature Applied Temperature ^{0}C	Instrument Temperature Reading ^{0}C	
-10	-10.0	*Accept ±2.0*
0	0.0	*Accept ±1.0*
30	30.0	*Accept ±1.0*
60	60.0	*Accept ±1.0*
100	100.0	*Accept ±1.0*

Technician:	Date Tested:
	19/12/2023

The instrument identified by the serial number stated above has been tested by Gas Data personnel for calibration accuracy on the date and under the ambient conditions stated. Gas Data Ltd internal BS EN ISO9001:2015, BS EN ISO14001:2015, BS EN ISO45001:2018 compliant workshop procedures were followed to apply known calibration test gases, gas flow rates, pressures and temperatures of the values stated. The results displayed on the instrument at each stage are recorded above.

Ribble Enviro Ltd
www.ribble-enviro.co.uk



...everything gas detection

Test Certificate

Customer:	Ribble Enviro Hire Fleet
Instrument:	GFM Series
Job:	Pre-Hire Test
Serial number:	12168
Fleet Number:	GAS0012
Certificate no:	12168 / 071024
Tested on:	07 October 2024
Tested for:	Methane, Carbon Dioxide, Oxygen, hydrogen Sulphide, Carbon Monoxide, Hexane

Applied Gas Concentration:	Cylinder Reference:	Final Sensor Reading	Pass / Fail
CH4: 2.5% Vol	13010-3-1	2.5%	Pass
CO2: 2.0% Vol	10343-5-1	2.1%	Pass
O2: 18.0% Vol	13010-3-1	18.3	Pass
H2S: 50.0 ppm	13010-3-1	51.4 ppm	Pass
CO: 500.0 ppm	13010-3-1	501.6 ppm	Pass
Hexane: 0.3% Vol	52687/2416	0.3%	Pass

The instrument has been tested after re-zeroing and introducing span calibration gas, using gas that is traceable to national standards and has been prepared in accordance with BS EN ISO 6145-6:2017

Calibration Engineer: BRADLEY HAYHURST

Tel: 01200 445 804 **Fax**: 01200 445 809 **Email**: info@ribble-enviro.co.uk
Ribble Enviro Ltd. Unit 4, Gisburn Business Park, Gisburn, Nr Clitheroe, BB7 4JP, UK

Company Registered in England: 06140589 VAT No: GB 906 6241 34 EORI: GB906624134000

Appendix 4

Laboratory Testing

Environmental
Geotechnical
Specialists

LABORATORY REPORT

job number	C4722/24/E/7215
date	04.12.2024
site address	176 Almondbury Bank, Huddersfield, West Yorkshire, HD5 8EX
date scheduled	S. Hale
date issued	R. Palmer
issued by	S. Hale

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Schedule of UKAS Accredited Laboratory Tests

1. CLASSIFICATION OF SOIL	BS 1377-2:1990	BS EN ISO 17892	Accredited (A)	Unaccredited (U)
1.1 Moisture / Water content determination				
i. Oven drying	Pt 2 : 3.2	Pt 1 : 2014 Pt 12 : 2018 : 5.3 / 5.5	A	
ii. Saturation m/c of chalk	Pt 2 : 3.3			U
1.2 Index Properties				
i. Liquid limit – cone penetrometer	Pt 2 : 4.3		A	
ii. Plastic limit	Pt 2 : 5.3		A	
iii. Shrinkage limit	Pt 2 : 6.3			U
iv. Linear shrinkage	Pt 2 : 6.5		A	
1.3 Particle Density				
i. Gas jar	Pt 2 : 8.2		A	
ii. Large pyknometer	Pt 2 : 8.3			U
iii. Small pyknometer	Pt 2 : 8.4	Pt 3 : 2015 : 5.1		U
1.4 Density Tests				
i. Linear measurement	Pt 2 : 7.2	Pt 2 : 2014 : 5.1	A	
ii. Immersion in water	Pt 2 : 7.3	Pt 2 : 2014 : 5.2		U
iii. Fluid / Water displacement	Pt 2 : 7.4	Pt 2 : 2014 : 5.3		U
iv. Sand replacement	Pt 9 : 2.1, 2.2			U
v. Core cutter	Pt 9 : 2.4			U
1.5 Particle Size Distribution				
i. Dry Sieve	Pt 2 : 9.2	Pt 4 : 2016 : 5.2	A	
ii. Wet Sieve	Pt 2 : 9.3	Pt 4 : 2016 : 5.2	A	
iii. Sedimentation by pipette	Pt 2 : 9.4	Pt 4 : 2016 : 5.3 / 5.4	A	
iv. Sedimentation by hydrometer	Pt 2 : 9.5			U
2. CHEMICAL TESTS	**BS 1377-3:2018**			
ii. Mass loss on ignition	Pt 3 : 4			U
3. COMPACTION RELATED TESTS	**BS 1377-4:1990**			
3.1 Dry density/moisture relationship				
i. 2.5kg rammer – 1 litre mould	Pt 4 : 3		A	
- CBR mould	Pt 4 : 3		A	
ii. 4.5kg rammer – 1 litre mould	Pt 4 : 3		A	
- CBR mould	Pt 4 : 3		A	
3.2 Moisture Condition Value				
i. Single point test	Pt 4 : 5.4			U
ii. MCV/moisture content relationship	Pt 4 : 5.5			U
3.3 California Bearing Ratio				
i. Undisturbed sample	Pt 5 : 7		A	
ii. Recompacted sample	Pt 5 : 7		A	
iii. Soaked, inc measurement of swell	Pt 5 : 7		A	
4. COMPRESSIBILITY OF SOIL	**BS 1377-5:1990**			
i. One dimensional consolidation	Pt 5 : 3		A	
ii. Swelling pressure test	Pt 5 : 3			U
5. SHEAR STRENGTH OF SOIL	**BS 1377-7:1990**			
i. Hand shear vane	Makers instructions			U
ii. Shear box (100mm square sample)	BS 1377 : Pt 7 : 4			U
iii. Triaxial – quick undrained	BS 1377 : Pt 7 : 8, 9		A	
6. PERMEABILITY				
i. Falling head	K. H. Head Vol 2			U
ii. Constant head	BS 1377 : Pt 6 : 6			U
iii Triaxial cell	BS 1377 : Pt 6 : 6			U
7. ROCK TESTS				
7.1 Classification Tests				
i. Natural moisture content	-			U
ii. Saturated moisture content	-			U
iii. Natural density	-			U
iv. Porosity	-			U
7.2 Strength Tests				
i. Point load index	ISRM '85			U
ii. Uniaxial compression test	ISRM '81			U

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Disclaimer

The results reported herein relate only to the material supplied to the laboratory.

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Summary of Classification Test Results

Project No.	Project Name
C4722/24/E/7215	176 Almondbury Bank

Hole No.	Sample				Soil Description	Density bulk Mg/m^3	Density dry Mg/m^3	*w* %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m^3	1pt/4pt	Date	Increase/Decrease
	Ref	Top	Base	Type												
WS01	1	1.00		D	Firm, brown, slightly sandy, slightly gravelly, silty CLAY.			24	91	39	23	16		4pt	17-Oct	Increase
WS02	1	1.00		D	Firm, brown, slightly sandy, slightly gravelly, silty CLAY.			20	81	35	23	12		4pt	17-Oct	Increase
WS02	3	1.50		D	Firm, brown, slightly sandy, slightly gravelly, silty CLAY.			20	68	44	29	15		4pt	17-Oct	Increase
WS03	1	0.80		D	Firm, brown, slightly sandy, slightly gravelly, silty CLAY.			18	59	32	23	9		4pt	17-Oct	Increase

All tests performed in accordance with BS1377-2:2022 and BS EN ISO 17892 Part 1 A1 2022 unless specified otherwise
All Liquid Limit Tests performed on a 80g/30 Degree Cone unless specified otherwise

Key

Density test
Linear measurement unless :
wd - water displacement
wi - immersion in water

Liquid Limit
4pt cone unless :
cas - Casagrande method
1pt - single point test

Particle density
sp - small pyknometer
gj - gas jar

Date Printed: 24/10/2024

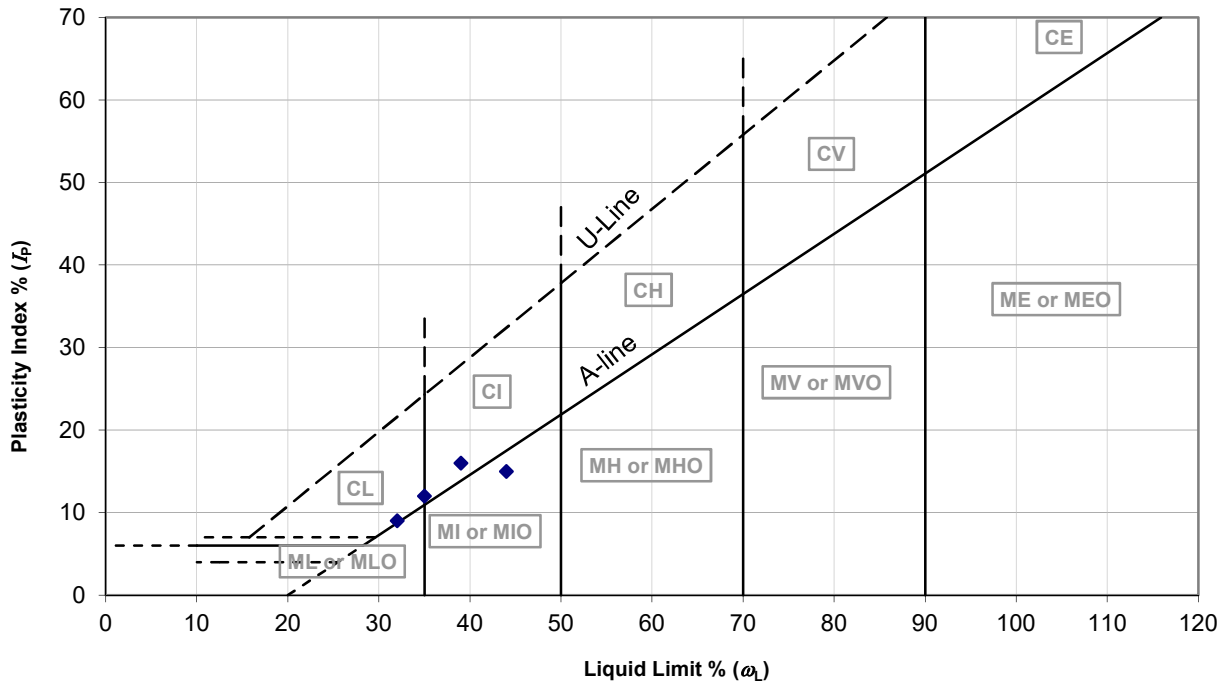
Approved By: Harry

Table 1

sheet 1

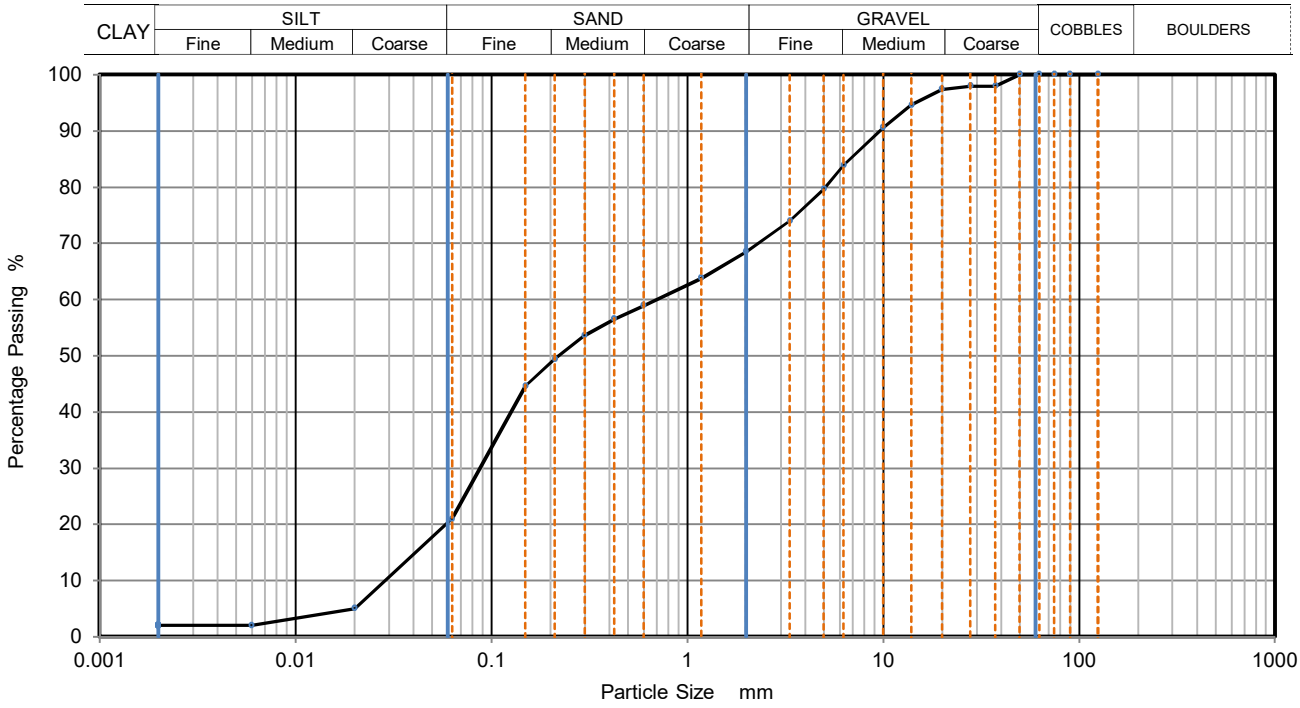
Rogers Geotechnical Services Ltd. Offices 1&2, Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU	**Classification of Index Properties**	**C4722/24/E/7215**
Project Name: 176 Almondbury Bank	**BS EN ISO: 17892: Parts 1, 12**	Fig. 2 / Sheet. 1
Location: Huddersfield		Input By: Harry
Client: Tecni-Build (Northern) Ltd		Check By: Harry

Location	Depth	Water Content (ω)	Liquid Limit (ω_L)	Plastic Limit (ω_P)	Plasticity Index (I_P)	Retained by 0.425mm	Modified (ω)	Modified (I_P)	Liquidity/ Consistency		Casagrande Class	N.H.B.C Class
							(ω')	(I_P')	(I_L)	(I_C)		
	(m)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)		(%)
WS01	1.00	24	39	23	16	9	26	15	0.1	0.9	C I	LOW
WS02	1.00	20	35	23	12	19	25	10	-0.3	1.3	C I	*
WS02	1.50	20	44	29	15	32	29	10	-0.6	1.6	M I	LOW
WS03	0.80	18	32	23	9	41	31	5	-0.6	1.6	C L	*



PARTICLE SIZE DISTRIBUTION

				Job Ref	C4722/24/E/7215
				Borehole/Pit No.	WS03
Site Name	176 Almondbury Bank			Sample No.	3
Soil Description	Medium dense, clayey, silty, gravelly, fine to coarse SAND.			Depth, m	1.00
Specimen Reference	3	Specimen Depth	1 m	Sample Type	D
Test Method	ISO 17892 -4, by sieving and pipette sedimentation			KeyLAB ID	WS03_PSD1



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0201	5
90	100	0.0060	2
75	100	0.0020	2
63	100		
50	100		
37.5	98		
28	98		
20	97		
14	95		
10	91		
6.3	84		
5	80		
3.35	74		
2	69		
1.18	64		
0.6	59	Particle density (assumed)	
0.425	57	2.65	Mg/m3
0.3	54		
0.212	49		
0.15	45		
0.063	21		

Dry Mass of sample, g: 2354

Sample Proportions	% dry mass
Very coarse	0
Gravel	31
Sand	48
Silt	19
Clay	2

Grading Analysis		
D_{100}	mm	50
D_{60}	mm	0.698
D_{30}	mm	0.0879
D_{10}	mm	0.0283

Remarks

Preparation and testing in accordance with BS EN ISO 17892 - 4, unless noted below

Test performance date: 17/10/2024

Operator	Checked	Approved	Sheet printed	Fig 3
EC	Harry	Harry	24/10/2024	Sheet 1

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UKAS United Kingdom Accreditation Service

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Analytical Report Number : 24-048993

Project / Site name:	Almondbury Bank	**Samples received on:**	21/10/2024
Your job number:	C4722	**Samples instructed on/ Analysis started on:**	21/10/2024
Your order number:		**Analysis completed by:**	28/10/2024
Report Issue Number:	1	**Report issued on:**	28/10/2024
Samples Analysed:	6 soil samples		

Anna Goc
PL Head of Reporting Team
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report relate only to the sample(s) submitted for testing.

Analytical Report Number: 24-048993
Project / Site name: Almondbury Bank

Lab Sample Number				354673	354674	354675	354676	354677
Sample Reference				WS01	WS02	WS03	BH01	BH02
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	0.30	0.60	1.00-1.45	1.00-1.45
Date Sampled				17/10/2024	17/10/2024	17/10/2024	17/10/2024	17/10/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Test Limit of detection**	**Test Accreditation Status**					
Stone Content	%	0.1	NONE	26.5	20.8	24.7	5.9	< 0.1
Moisture Content	%	0.01	NONE	18	12	15	18	13
Total mass of sample received	kg	0.1	NONE	0.5	0.4	0.5	0.5	0.5
Asbestos								
Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	-	-
Asbestos Analyst ID	N/A	N/A	N/A	MWI	MWI	MWI	-	-
General Inorganics								
pH (L099)	pH Units	N/A	MCERTS	7.7	7.6	7.6	8	7.4
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
Total Sulphate as SO_4	%	0.005	MCERTS	0.067	0.031	0.068	-	-
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	220	23	200	240	74
Water Soluble SO_4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	108	11.6	99.2	-	-
Water Soluble SO_4 16hr extraction (2:1)	mg/l	1.25	MCERTS	-	-	-	119	37.2
Organic Matter (automated)	%	0.1	MCERTS	2.9	2	3.5	-	-
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	0.21	0.1	0.13	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	0.7	< 0.05	< 0.05	-	-
Acenaphthene	mg/kg	0.05	MCERTS	0.44	0.06	0.16	-	-
Fluorene	mg/kg	0.05	MCERTS	0.68	< 0.05	0.13	-	-
Phenanthrene	mg/kg	0.05	MCERTS	8.1	0.4	1.6	-	-
Anthracene	mg/kg	0.05	MCERTS	1.7	< 0.05	0.29	-	-
Fluoranthene	mg/kg	0.05	MCERTS	11	0.6	2.2	-	-
Pyrene	mg/kg	0.05	MCERTS	9.3	0.56	2	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	4.4	0.35	1	-	-
Chrysene	mg/kg	0.05	MCERTS	4.1	0.44	1.1	-	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	5.1	0.51	1.4	-	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	1.9	0.16	0.58	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	4.3	0.36	1.2	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	1.7	0.16	0.56	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.43	< 0.05	0.11	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	2	0.17	0.67	-	-
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	55.7	3.87	13.2	-	-

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Analytical Report Number: 24-048993
Project / Site name: Almondbury Bank

Lab Sample Number				354673	354674	354675	354676	354677
Sample Reference				WS01	WS02	WS03	BH01	BH02
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	0.30	0.60	1.00-1.45	1.00-1.45
Date Sampled				17/10/2024	17/10/2024	17/10/2024	17/10/2024	17/10/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Test Limit of detection**	**Test Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	24	24	20	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	1	< 0.2	1	-	-
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	-	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	35	23	37	-	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	59	37	120	-	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	180	260	140	-	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	0.5	< 0.3	-	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	31	22	33	-	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	37	32	41	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	130	85	1000	-	-
Petroleum Hydrocarbons								
TPHCWG - Aliphatic >EC5 - EC6 $_{HS_1D_AL}$	mg/kg	0.01	MCERTS	< 0.010	< 0.010	< 0.010	-	-
TPHCWG - Aliphatic >EC6 - EC8 $_{HS_1D_AL}$	mg/kg	0.01	MCERTS	< 0.010	< 0.010	< 0.010	-	-
TPHCWG - Aliphatic >EC8 - EC10 $_{HS_1D_AL}$	mg/kg	0.01	MCERTS	< 0.010	< 0.010	< 0.010	-	-
TPHCWG - Aliphatic >EC10 - EC12 $_{EH_CU_1D_AL}$	mg/kg	1	MCERTS	5.6	< 1.0	< 1.0	-	-
TPHCWG - Aliphatic >EC12 - EC16 $_{EH_CU_1D_AL}$	mg/kg	2	MCERTS	14	< 2.0	< 2.0	-	-
TPHCWG - Aliphatic >EC16 - EC21 $_{EH_CU_1D_AL}$	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	-	-
TPHCWG - Aliphatic >EC21 - EC35 $_{EH_CU_1D_AL}$	mg/kg	8	MCERTS	14	81	120	-	-
TPHCWG - Aliphatic >EC5 - EC35 $_{EH_CU+HS_1D_AL}$	mg/kg	10	NONE	34	81	120	-	-
TPHCWG - Aromatic >EC5 - EC7 $_{HS_1D_AR}$	mg/kg	0.01	MCERTS	< 0.010	< 0.010	< 0.010	-	-
TPHCWG - Aromatic >EC7 - EC8 $_{HS_1D_AR}$	mg/kg	0.01	MCERTS	< 0.010	< 0.010	< 0.010	-	-
TPHCWG - Aromatic >EC8 - EC10 $_{HS_1D_AR}$	mg/kg	0.02	MCERTS	< 0.020	< 0.020	< 0.020	-	-
TPHCWG - Aromatic >EC10 - EC12 $_{EH_CU_1D_AR}$	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	-	-
TPHCWG - Aromatic >EC12 - EC16 $_{EH_CU_1D_AR}$	mg/kg	2	MCERTS	8.5	< 2.0	< 2.0	-	-
TPHCWG - Aromatic >EC16 - EC21 $_{EH_CU_1D_AR}$	mg/kg	10	MCERTS	26	< 10	< 10	-	-
TPHCWG - Aromatic >EC21 - EC35 $_{EH_CU_1D_AR}$	mg/kg	10	MCERTS	35	< 10	< 10	-	-
TPHCWG - Aromatic >EC5 - EC35 $_{EH_CU+HS_1D_AR}$	mg/kg	10	NONE	69	< 10	< 10	-	-
VOCs								
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-
p & m-Xylene	µg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	-	-
o-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	-	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number: 24-048993
Project / Site name: Almondbury Bank

Lab Sample Number				354678
Sample Reference				BH03
Sample Number				None Supplied
Depth (m)				2.00-2.45
Date Sampled				17/10/2024
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Test Limit of detection**	**Test Accreditation Status**	
Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	7.5
Total mass of sample received	kg	0.1	NONE	0.4

Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	-
Asbestos Analyst ID	N/A	N/A	N/A	-

General Inorganics

pH (L099)	pH Units	N/A	MCERTS	7.4
Free Cyanide	mg/kg	1	MCERTS	-
Total Sulphate as SO_4	%	0.005	MCERTS	-
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	69
Water Soluble SO_4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-
Water Soluble SO_4 16hr extraction (2:1)	mg/l	1.25	MCERTS	34.3
Organic Matter (automated)	%	0.1	MCERTS	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-
Acenaphthylene	mg/kg	0.05	MCERTS	-
Acenaphthene	mg/kg	0.05	MCERTS	-
Fluorene	mg/kg	0.05	MCERTS	-
Phenanthrene	mg/kg	0.05	MCERTS	-
Anthracene	mg/kg	0.05	MCERTS	-
Fluoranthene	mg/kg	0.05	MCERTS	-
Pyrene	mg/kg	0.05	MCERTS	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-
Chrysene	mg/kg	0.05	MCERTS	-
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	-
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	-

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Analytical Report Number: 24-048993
Project / Site name: Almondbury Bank

Lab Sample Number				354678
Sample Reference				BH03
Sample Number				None Supplied
Depth (m)				2.00-2.45
Date Sampled				17/10/2024
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Test Limit of detection**	**Test Accreditation Status**	
Heavy Metals / Metalloids				
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-
Chromium (hexavalent)	mg/kg	1.8	MCERTS	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-
Petroleum Hydrocarbons				
TPHCWG - Aliphatic >EC5 - EC6 $_{HS_1D_AL}$	mg/kg	0.01	MCERTS	-
TPHCWG - Aliphatic >EC6 - EC8 $_{HS_1D_AL}$	mg/kg	0.01	MCERTS	-
TPHCWG - Aliphatic >EC8 - EC10 $_{HS_1D_AL}$	mg/kg	0.01	MCERTS	-
TPHCWG - Aliphatic >EC10 - EC12 $_{EH_CU_1D_AL}$	mg/kg	1	MCERTS	-
TPHCWG - Aliphatic >EC12 - EC16 $_{EH_CU_1D_AL}$	mg/kg	2	MCERTS	-
TPHCWG - Aliphatic >EC16 - EC21 $_{EH_CU_1D_AL}$	mg/kg	8	MCERTS	-
TPHCWG - Aliphatic >EC21 - EC35 $_{EH_CU_1D_AL}$	mg/kg	8	MCERTS	-
TPHCWG - Aliphatic >EC5 - EC35 $_{EH_CU+HS_1D_AL}$	mg/kg	10	NONE	-
TPHCWG - Aromatic >EC5 - EC7 $_{HS_1D_AR}$	mg/kg	0.01	MCERTS	-
TPHCWG - Aromatic >EC7 - EC8 $_{HS_1D_AR}$	mg/kg	0.01	MCERTS	-
TPHCWG - Aromatic >EC8 - EC10 $_{HS_1D_AR}$	mg/kg	0.02	MCERTS	-
TPHCWG - Aromatic >EC10 - EC12 $_{EH_CU_1D_AR}$	mg/kg	1	MCERTS	-
TPHCWG - Aromatic >EC12 - EC16 $_{EH_CU_1D_AR}$	mg/kg	2	MCERTS	-
TPHCWG - Aromatic >EC16 - EC21 $_{EH_CU_1D_AR}$	mg/kg	10	MCERTS	-
TPHCWG - Aromatic >EC21 - EC35 $_{EH_CU_1D_AR}$	mg/kg	10	MCERTS	-
TPHCWG - Aromatic >EC5 - EC35 $_{EH_CU+HS_1D_AR}$	mg/kg	10	NONE	-
VOCs				
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	MCERTS	-
Benzene	µg/kg	5	MCERTS	-
Toluene	µg/kg	5	MCERTS	-
Ethylbenzene	µg/kg	5	MCERTS	-
p & m-Xylene	µg/kg	8	MCERTS	-
o-Xylene	µg/kg	5	MCERTS	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number : 24-048993
Project / Site name: Almondbury Bank

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
354673	WS01	None Supplied	0.5	Brown loam and clay with stones
354674	WS02	None Supplied	0.3	Brown loam and clay with stones
354675	WS03	None Supplied	0.6	Brown loam and clay with stones
354676	BH01	None Supplied	1.00-1.45	Brown loam and clay with stones
354677	BH02	None Supplied	1.00-1.45	Brown clay and sand with gravel
354678	BH03	None Supplied	2.00-2.45	Brown clay and sand with gravel

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Analytical Report Number : 24-048993
Project / Site name: Almondbury Bank

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in Soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques	In-house method based on HSG 248, 2021	A001B	D	ISO 17025
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L009B	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L038B	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES	In-house method	L038B	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Sulphate, water soluble, in soil (16hr extraction)	In-house method	L038B	D	MCERTS
Speciated PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L076B/L088-PL	D/W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method	L080-PL	W	MCERTS
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	MCERTS
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	MCERTS

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Analytical Report Number : 24-048993
Project / Site name: Almondbury Bank

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099-PL	D	MCERTS

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Quality control parameter failure associated with individual result applies to calculated sum of individuals.
The result for sum should be interpreted with caution

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End of Report

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UKAS United Kingdom Accreditation Service

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Rogers Geotechnical Services Ltd
Offices 1 & 2 Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU
01484 604354 Company No. 5130864

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Appendix 5

Soil Screening Value Comparison Sheet

Rogers Geotechnical Services: Soil Screening Values Comparison Sheet

Rogers Geotechnical Services Ltd: Soil Screening Value (SSV) Comparison Sheet

Job Number	C4722/24/E/7215
Job Name	176 Almondbury Bank
Date	28.10.2024
Client	Tecni-Build (Northern) Ltd

A = WS Atkins PLC, Atrisk Soil Screening Values.
A+ = Values updated June 2017.
A* = Atrisk's SSV is lower than i2's detectable limit for this compound.
B = health criterion values, which are available from toxicological reviews published in the C4SL project methodology report.
C = Category 4 Screening Levels (C4SLs) based on 6% soil organic matter.
D = Value provided is based on Methyl Mercury. Should elemental mercury be observed or a source be known then a limit of 102 should be used.

KEY
- Exceeds SSV
- Exceeds 2017, Below 2015
- Below limit of detection (LOD)

Determinand	Units	Ref	LOD	Residential With Plant Uptake 1%		Sample Location	WS01	WS02	WS03							
				Atrisk 2015 (No Free Product	Atrisk 2017	Depth Top	0.50	0.30	0.60							
						Depth Base										
Cadmium	mg/kg	C	0.2		22.1		1.00	< 0.2	1.00							
Chromium (Hexavalent)	mg/kg	B/C	1.8	20.5	3.62		< 1.8	< 1.8	< 1.8							
Copper	mg/kg	A+	1.0		4730		59.00	37.00	120.00							
Mercury	mg/kg	A/D	0.3		8.81		< 0.3	0.50	< 0.3							
Nickel	mg/kg	A+	1.0		136		31.00	22.00	33.00							
Lead	mg/kg	C	1.0		200		180.00	260.00	140.00							
Zinc	mg/kg	A+	1.0		20000		130.00	85.00	1000.00							
Vanadium	mg/kg	A+	1.0		136		37.00	32.00	41.00							
Arsenic	mg/kg	C	1.0		37		24.00	24.00	20.00							
Selenium	mg/kg	A	1.0		375		< 1.0	< 1.0	< 1.0							
Cyanide (Free)	mg/kg	A	1.0		34		< 1.0	< 1.0	< 1.0							
Total Phenols	mg/kg	A	1.0		267		< 1.0	< 1.0	< 1.0							
Naphthalene	mg/kg	A+	0.05		0.829		0.21	0.10	0.13							
Acenaphthylene	mg/kg		0.05				0.70	< 0.05	< 0.05							
Acenaphthene	mg/kg	A+	0.05	608	157		0.44	0.06	0.16							
Fluorene	mg/kg	A+	0.05		735		0.68	< 0.05	0.13							
Phenanthrene	mg/kg		0.05				8.10	0.40	1.60							
Anthracene	mg/kg	A+	0.05		10200		1.70	< 0.05	0.29							
Fluoranthene	mg/kg	A+	0.05		983		11.00	0.60	2.20							
Pyrene	mg/kg	A+	0.05		668		9.30	0.56	2.00							
Benzo[a]anthracene	mg/kg	A	0.05	4.52	1.71		4.40	0.35	1.00							
Chrysene	mg/kg	A	0.05	585	0.44		4.10	0.44	1.10							
Benzo[b]fluoranthene	mg/kg	A	0.05	7.72	1.22		5.10	0.51	1.40							
Benzo[k]fluoranthene	mg/kg	A	0.05	84.4	0.686		1.90	0.16	0.58							
Benzo[a]pyrene	mg/kg	B/C	0.05	4.95	1.51		4.30	0.36	1.20							
Indeno(1,2,3-c,d)Pyrene	mg/kg	A*	0.05	7.31	0.0614		1.70	0.16	0.56							
Dibenz(a,h)Anthracene	mg/kg	A	0.05	0.838	0.00393		0.43	< 0.05	0.11							
Benzo[g,h,i]perylene	mg/kg	A	0.05	96.2	0.0187		2.00	0.17	0.67							
Total Of 16 PAH's	mg/kg		0.8				55.70	3.87	13.20							
Aliphatic TPH >C5-C6	mg/kg	A+	0.02		42.7		< 0.010	< 0.010	< 0.010							
Aliphatic TPH >C6-C8	mg/kg	A+	0.02		99.3		< 0.010	< 0.010	< 0.010							
Aliphatic TPH >C8-C10	mg/kg	A+	0.05		13.9		< 0.010	< 0.010	< 0.010							
Aliphatic TPH >C10-C12	mg/kg	A+	1.0	81.7	49.9		5.60	< 1.0	< 1.0							
Aliphatic TPH >C12-C16	mg/kg	A+	2.0	385	20.9		14.00	< 2.0	< 2.0							
Aliphatic TPH >C16-C21	mg/kg	A+	8.0		210000		< 8.0	< 8.0	< 8.0							
Aliphatic TPH >C21-C35	mg/kg	A+	8.0		210000		14.00	81.00	120.00							
Aliphatic TPH >C35-C44	mg/kg		10.0													
Total Aliphatic Hydrocarbons	mg/kg		10.0													
Aromatic TPH >C5-C7	mg/kg	A+	0.01		0.137		< 0.010	< 0.010	< 0.010							
Aromatic TPH >C7-C8	mg/kg	A+	0.01		113		< 0.010	< 0.010	< 0.010							
Aromatic TPH >C8-C10	mg/kg	A+	0.05		20.5		< 0.020	< 0.020	< 0.020							

Rogers Geotechnical Services: Soil Screening Values Comparison Sheet

Rogers Geotechnical Services Ltd: Soil Screening Value (SSV) Comparison Sheet

Job Number	C4722/24/E/7215
Job Name	176 Almondbury Bank

A = WS Atkins PLC, Atrisk Soil Screening Values.
A+ = Values updated June 2017.
A* = Atrisk's SSV is lower than i2's detectable limit for this compound.
B = health criterion values, which are available from toxicological reviews published in the C4SL project methodology report.
C = Category 4 Screening Levels (C4SLs) based on 6% soil organic matter.
D = Value provided is based on Methyl Mercury. Should elemental mercury be observed or a source be known then a limit of 102 should be used.

KEY

- Exceeds SSV
- Exceeds 2017, Below 2015
- Below limit of detection (LOD)

Date	28.10.2024	**Sample Location**	WS01	WS02	WS03
Client	Tecni-Build (Northern) Ltd	Depth Top	0.50	0.30	0.60
		Depth Base			

Determinand	Units	Ref	LOD	Residential With Plant Uptake 1%		WS01	WS02	WS03
Aromatic TPH >C10-C12	mg/kg	A+	1.0		70	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	mg/kg	A+	2.0	165	155	8.50	< 2.0	< 2.0
Aromatic TPH >C16-C21	mg/kg	A+	10.0		319	26.00	< 10	< 10
Aromatic TPH >C21-C35	mg/kg	A+	10.0		1120	35.00	< 10	< 10
Aromatic TPH >C35-C44	mg/kg		10.0					
Total Aromatic Hydrocarbons	mg/kg		10.0					
Total Petroleum Hydrocarbons	mg/kg		10.0					
pH			N/A			**7.70**	**7.60**	**7.60**
Sulphate (2:1 Water Soluble) as SO4	g/l		0.00125			**0.11**	**0.01**	0.10
ACM Type			N/A			Not detected	Not detected	Not detected
Asbestos Identification	%							
ACM Detection Stage			N/A					
Moisture	%		0.01			18.00	12.00	15.00
Soil Colour			N/A					
Other Material			N/A					
Soil Texture			N/A					
Sulphate (Total)	%		0.005					
Organic Matter	%		0.1			2.90	**2.00**	**3.50**

Appendix 6

Fill Screening Values

Rogers Geotechnical Services Ltd.

Atkins ATRISK Soil Screening Values (SSVs) - Residential With Plant Uptake Landuse

Tox Data Report No.	Compound	Residential with Homegrown Produce Landuse (mg/kg)				Reference
	Metals	**SOM: 1%**		**SOM: 6%**		
3	Cadmium	22.1		22.1		C
4	Chromium VI	3.62	20.5	3.63	20.5	B/C
	Copper	4730		4790		A+
7	Mercury	8.81		15.80		A/D
8	Nickel	136		136		A+
	Lead	200		200		C
	Zinc	20000		20300		A+
	Vanadium	136		138		A+
	Semi and Non Metals					
1	Arsenic	37		37		C
10	Selenium	375		375		A
	Free Cyanide	34		34		A
9	Phenols (total)	267		1200		A
	Poly Aromatic Hydrocarbons	Free product	No free product	Free product	No free product	
20	Napthalene	0.829		12.2		A+
	Acenaphthene	157	608	2760		A+
	Fluorene	735		2610		A+
	Anthracene	10200		26200		A+
	Fluoranthene	983		2980		A+
	Pyrene	668		2120		A+
	Benzo(a)anthracene	1.71	4.52			A
2	Chrysene	0.44	585			A
2	Benzo(b)fluoranthene	1.22	7.72			A
2	Benzo(k)fluoranthene	0.686	84.4			A
2	Benzo(a)pyrene	1.51	4.95	2.05	4.95	B/C
2	Dibenzo(a,h)anthracene	0.00393	0.838			A*
2	Indeno(1,2,3-cd)pyrene	0.0614	7.31			A
2	Benzo(g,h,i)perylene	0.0187	96.2			A
	Petroleum Hydrocarbons					
	Aliphatic C5-C6	42.7		369		A+
	Aliphatic C6-C8	99.3		768	1240	A+
	Aliphatic C8-C10	13.9		204		A+
	Aliphatic C10-C12	49.9	81.7	297	1180	A+
	Aliphatic C12-C16	20.9	385	125	4130	A+
	Aliphatic C16-C21	210000		210100		A+
	Aliphatic C21-C35	210000		210100		A+
	Aromatic C5-C7 (Benzene)	0.137		0.871		A+
	Aromatic C7-C8 (Toluene)	113		780		A+
	Aromatic C8-C10	20.5		232		A+
	Aromatic C10-C12	70		468		A+
	Aromatic C12-C16	155	165	830		A+
	Aromatic C16-C21	319		1040		A+
	Aromatic C21-C35	1120		1710		A+
Others						
Asbestos Not Detected						
A+ = Values update June 2017.						
A* Atrisk's SSV is lower than Chemtest's detectable limit for this compound.						
B = Health Criterion Values (available from toxicological reviews published in the C4SL project methodology report).						
C = Catergory 4 Screening Levels (C4SLs).						
D = SSV provided is for Methyl Mercury.						