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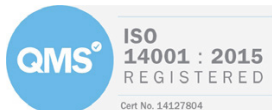
PHASE 2

GEO-ENVIRONMENTAL REPORT

job number	C3304/23/E/5028	date	07/08/23
site address	Land off Fallows Way, Whiston, Prescott.		
written by	I. Sakoor	checked by	R. A. Palmer
issued by	I. Sakoor		



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Report on a Phase 2 Geo-environmental Investigation

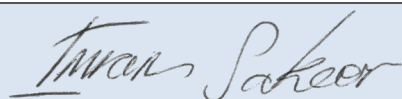
Location: **Land off Fallows Way,**
Whiston, Prescott.

For: **Andrew Moseley Architects**

Report
Version: **C3304/23/E/5028**

Report date: **07.08.23**

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



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Report Summary¹

Item	Comments	Section
Development	Construction of a number of commercial units	1.
Geology	Till over Pennine Middle Coal Measures Formation (PMCMF). Solid geology changes from undifferentiated strata to unnamed sandstone unit of the PMCMF from north to south.	5.
Strata Conditions	Generally made ground to between 2m and 3m depth over soft till deposits. Underlain by mudstone and sandstone of the Pennine Middle Coal Measures Formation.	6.
Groundwater	None encountered during investigation.	6.2
Foundation Design	Piled foundation solution. Alternatively, ground improvement may be possible.	10.
Effect of Sulphates	DC-2 concrete.	10.
Contamination	Localised asbestos contamination identified.	11.
Ground Gasses	Elevated levels of methane and carbon dioxide recorded. Remedial measures will be required.	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 off Fallows Way, Whiston, Prescot is to be developed by the construction of a number of commercial units with car parking and hardstanding. 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.

It should be appreciated that this document represents an interim report as the logging of the rotary boreholes has not been completed and thus a completed assessment of the risks from shallow coal not undertaken. When the results are available, a completed report will be subsequently issued, which will include an assessment of the coal mining risks.

3. Previous Reports

The following reports have been undertaken in relation to the site:

- Stage 1 Phase 1 – Desk Study and Preliminary Ground Contamination Assessment by e-geo Solutions Ltd, June 2018, report reference: E0922.S1.P1.R1.
- Geotechnical and Ground Contamination Investigation Report, July 2017 by e-geo Solutions Ltd, report reference: E0922.GGCI.R1.
- Coal Workings Investigation Report by e-geo Solutions Ltd, October 2018, report reference: E0922.CWI. R1.
- CON29M Non-Residential Mining Report, November 2017, report reference: 51001695880001.

4. Fieldworks

The fieldworks were undertaken in stages between the 2nd June and 7th July 2023 and included the following:

- Five windowless sample boreholes.
- Standard penetration tests within two boreholes.
- Four dynamic probes.
- Five gas monitoring standpipes.
- Four rotary boreholes.
- Acquisition of Coal Authority License.

It should be appreciated that the fieldworks were delayed as the site was found to be both very wet and overgrown during the initial visit in March 2023. Furthermore, it should be noted that WS01 could not be completed as a large bund is present in this part of the site.

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, 67mm and 57mm 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 windowless sample borehole WS04 and WS05. 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 Dynamic Probes

Dynamic penetration tests were undertaken adjacent to all windowless sample boreholes except WS06, in accordance with the procedure given in BS EN ISO 22476: Part 2: 2005 +A1: 2011, using the super heavy penetrometer (DPSH). This probe consists of a 63.5kg mass falling through 750mm onto an anvil, which drives a 50mm diameter cone into the ground. The number of blows required to drive the cone through successive 100mm increments are recorded as the N_{100} values. The results of the dynamic penetration tests are tabulated and presented as bar charts of N_{100} values versus depth in Appendix 3.

4.4 Gas Monitoring Standpipes

Gas monitoring standpipes were installed to 4m 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 above, and the installation was capped with a stop box cover in a concrete surround.

4.5 Rotary Boreholes

These boreholes were drilled using a Comacchio Geo 205 rotary drilling rig in order to investigate the presence of coal workings, and also establish the engineering properties of the bedrock. The boreholes were undertaken using rotary open-hole drilling techniques and employing 140mm diameter drag and tricone roller bits. Drill chippings brought to surface in the flush returns were inspected by the driller on a screen, which forms part of the re-circulation tanks.

Upon encountering rockhead within all rotary boreholes, rotary core drilling techniques were employed in order to retrieve samples of the solid geology. The recovered cores were sealed and returned to the laboratory for logging and subsequent testing. It should be appreciated that at the time of writing, logging is still underway, therefore, this report will be updated once the logging and subsequent testing is completed. Within BH1, BH2 and BH3, the boreholes were continued using rotary open-hole techniques in order to investigate for the presence of underground mine workings.

4.6 Acquisition of Coal Authority Permit

In order to undertake the coal mining aspect of this investigation, it was necessary to obtain permission to enter or disturb Coal Authority interests. This permission was granted on the 1st March 2023 as permit reference number 26328, which is presented in Appendix 1 to this report. In accordance with the joint Coal Authority and Health and Safety Executive positioning statement, and under the requirements of the permit, the works were undertaken employing water flush drilling techniques. Furthermore, the drillers wore gas detectors on their person throughout the works.

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	Till	Boulder Clay	Comprises variable lithologies, usually sandy, silty clay with pebbles, but can contain gravel-rich, or laminated sand layers; varied colour and consistency. Commonly contains coarse particles (cobbles and boulders).

² Sources: British Geological Survey (NERC) Map Sheet 97; Runcorn; 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]

Solid Geology	North-Western Part of Site		
	Pennine Middle Coal Measures Formation (Undifferentiated)	Middle Coal Measures	Interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams, with a bed of mudstone containing marine fossils at the base, and several such marine fossil-bearing mudstones in the upper half of the unit.
	Majority of Site		
	Pennine Middle Coal Measures Formation (Sandstone)	Middle Coal Measures.	Unnamed sandstone unit of the Pennine Middle Coal Measures Formation.

It should be appreciated that whilst the majority of the site is underlain by sandstone, undifferentiated strata of the Pennine Middle Coal Measures Formation is indicated to be present beneath the north-western part of the site as well as along the northern boundary.

The change in the geology is demarked by the outcrop of an unnamed coal seam. Additionally, the geological map indicates the strata dip by 12° towards the south. It should be noted that a slight kink is shown for the outcrop pattern as it is shown to curve from around halfway across the site towards the northern boundary, which the outcrop then follows.

A marine band is indicated to be present approximately 40m north of the site. Whilst not labelled on the geological map, based on the outcrop patterns it is anticipated that this feature represents the Dunkinfield Marine Band. Around 400m north of the site, is the outcrop of the Feldcroft Mine coal seam. The outcrops of a further three coal seams are shown to the north of the site, the third of which is labelled the Earthy Delf Mine located at a distance of around 600m from the site. It should be noted that the names of the other two seams are not provided on the geological map.

On the basis of the generalised vertical section on the geological map, the coal seam shown to outcrop on site is likely to be present at shallow depth within the northern part of the site. The shallow coal is not anticipated to be present south of the outcrop.

With regards to the deeper Feldmine Mine and Earthy Delf coal seams, these are anticipated to be present below the entirety of the site. However, given the distance to outcrop and dip of 12°, it is likely that these seams will be at significant depth below the site.

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
0.1 – 0.25	TOPSOIL.	All	None
1.25 – 2.85	MADE GROUND (Granular).	WS04, WS05 and WS06	None
2.2 – 6.0	MADE GROUND (Cohesive).	WS02, WS03, WS05, BH1, BH2	None
1.50 – +4.5	Slightly gravelly sandy CLAY. [TILL].	WS03, WS04, WS05, BH3, BH4	None

4.5	SAND and GRAVEL. [TILL].	BH4	None
+4.45	Silty very gravelly SAND. [POSSIBLE TILL].	WS06	None
5.55 – 6.5	Dark grey/orangish brown CLAY. [RESIDUAL PENNINE MIDDLE COAL MEASURES FORMATION].	BH1, BH2, BH3	None
5.0 – 7.0	COAL. - Present as carbonaceous mudstone in BH2 [PENNINE MIDDLE COAL MEASURES FORMATION].	BH1, BH2, BH3	None
14.5 – +21.0 5.75	MUDSTONE. - Present to 5.75m in BH3. [PENNINE MIDDLE COAL MEASURES FORMATION].	BH1, BH2, BH3	None
+16.0 – +30.0	MUDSTONE and SANDSTONE. [PENNINE MIDDLE COAL MEASURES FORMATION].	BH1	None
+12.0 – +16.0	SANDSTONE. [PENNINE MIDDLE COAL MEASURES FORMATION].	BH3, BH4	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

In general, below the topsoil, variably granular and cohesive made ground was encountered to the base of WS02, and to between 2.2m and 2.95m depth. The fill was notably found to be in a very soft to soft and loose insitu condition. The fill was found to extend to a depth of between 4.0m and 6.0m in BH1 and BH2

Below the made ground, soft brown slightly gravelly sandy clay was revealed to the base of WS04 and WS05, and to 2.4m in WS06. With respect to the local geology, it is considered that this material is representative of the superficial deposits of till which are indicated to underlie the site.

From 2.2m in WS06, loose becoming medium dense silty very gravelly sand was revealed to the base of the borehole. Within BH4 granular deposits were also encountered to 4.5m depth. It is felt that these deposits are likely to represent the granular fraction of the till.

Below the superficial soils, dark grey and dark orangish clay was revealed to between 5.55m and 6.5m below ground level. These deposits are considered to represent the residually weathered soil of the Pennine Middle Coal Measures Formation.

Between 5.0m and 7.0m in BH1, BH2 and BH3, a 0.3m to 0.5m thick seam of coal was encountered. Within BH2, the seam was found to be of poor quality and was recovered as a carbonaceous mudstone. The coal seam was entirely absent within BH4. This stratum was found to be underlain by undifferentiated mudstone and sandstone units of the Pennine Middle Coal Formation.

It should be noted that no losses of resistance on the drill string or reduction in flush returns were experienced during the rotary drilling.

6.2 Groundwater

No groundwater strikes were observed during the site investigation (windowless sample boreholes). However, 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.

Additionally, it should be appreciated that within the rotary boreholes, the use of water flushing techniques may have masked the presence of any water strikes within the other borehole locations.

7. Insitu Testing

7.1 Standard Penetration Tests

The standard penetration tests carried out in WS04 and WS06 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	
MADE GROUND	1.0m – 2.0m	7 – 9 22	–	SPT's indicate a generally loose in-situ condition. Result of N = 22 likely to be result of coarse material within the made ground.
TILL	3.0m – 4.0m	–	6 – 7	SPT's indicate cohesive material is in a soft in-situ condition.
POSSIBLE WEATHERED SANDSTONE	3.0m – 4.0m	8 46	–	Loose becoming dense insitu condition.

7.2 Dynamic Penetration Tests

Dynamic penetration tests were undertaken adjacent to the windowless sample borehole positions. A summary of the results is presented below:

Table 4: Summary of Dynamic Penetration Tests					
Position	Blows/100mm				Comments
	0 - 2	3 - 10	10+	Refusal type (Effective/ Abrupt) ⁴	
	Depth to which blow count range was observed (m)				
DP02	5.1	6.5 8.1	7.7	Abrupt	Very poor results to 5.1m depth, followed by an increase to between 4 and 5 blows/100mm to 6.5m depth. Results then generally in excess of 10 blows/100mm. Abrupt refusal recorded at 8.1m depth.
DP03	4.6	5.1	5.9	Refusal	Very poor results to 4.6m depth, before variable but generally high blow counts encountered until refusal.
DP04	4.8	5.0	7.7	Refusal	Very low results to around 4.8m depth, then blow counts gradually increased with depth.

⁴ Abrupt refusal: obstruction or bedrock encountered. Effective refusal: +25 blows/100mm.

DP05	5.0	5.8 7.1	6.4 7.8	Abrupt	Very low results to 5.0m depth, then blow counts gradually increased with depth.
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7.3 Gas and Water Level Monitoring

The standpipes were monitored between the 12th June and 5th July 2023. The results of the gas monitoring undertaken to date are tabulated below and full results are presented in Appendix 4.

Table 5: Gas Monitoring

Location	Date	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	Flow (l/hr)	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)
WS02	12.06.2023	0.0	7.9	13.3	0.0	1013↔	2.46	4.0
	20.06.2023	0.1	8.7	12.6	0.0	1005↔	2.48	
	26.06.2023	0.1	7.7	13.3	0.0	1016↔	2.47	
	05.07.2023	0.7	7.3	12.4	0.0	1008↑	2.36	
WS03	12.06.2023	0.1	4.2	17.0	0.0	1014↔	2.18	4.0
	20.06.2023	0.1	7.7	16.0	0.0	1006↔	2.37	
	26.06.2023	2.0	10.1	15.3	0.0	1016↔	2.21	
	05.07.2023	0.1	7.6	15.7	0.0	1008↑	2.20	
WS04	12.06.2023	0.6	6.6	12.8	0.1	1014↔	2.81	4.0
	20.06.2023	1.3	10.2	10.0	0.0	1005↔	2.97	
	26.06.2023	2.1	11.2	7.4	0.0	1016↔	3.02	
	05.07.2023	2.6	12.7	7.7	0.0	1008↑	2.85	
WS05	12.06.2023	0.0	3.8	6.9	0.2	1014↔	1.68	4.0
	20.06.2023	1.1	9.5	7.6	0.0	1005↔	1.95	
	26.06.2023	0.1	4.1	8.4	0.0	1016↔	1.76	
	05.07.2023	0.1	4.1	9.6	0.0	1007↑	1.78	
WS06	12.06.2023	0.1	4.2	10.5	0.0	1014↔	3.75	4.0
	20.06.2023	0.1	6.5	12.5	0.0	1005↔	3.73	
	26.06.2023	0.1	0.2	13.7	0.0	1015↔	3.73	
	05.07.2023	0.1	6.0	14.8	0.0	1007↑	3.64	

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

This work was undertaken using a Geotechnical Instruments (UK) Ltd. GA5000 (serial No G503524) which was last calibrated on the 1st February 2023.

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 |
| • Soluble sulphate content | BS 1377-3:2018+A1:2021: Pt3: 7.3 |
| • pH value | BS 1377-3:2018+A1:2021: Pt3: 12 |
| • Uniaxial Compressive Strength | ASTM: D2938-95 (2002) |
| • Point Load Strength Index Test | ISRM (1984) |

The test results are presented in Appendix 5 and are summarised below:

Table 6: Summary of Geotechnical Test Results

Test type	Number of tests	Range of results		Comments
Water content determinations	9	16% to 21%		Generally, at or around the plastic limit.
Index properties (1 Point)	9	LL PI	28% to 36% 15% to 19% 11% to 19%	Clay of intermediate to low plasticity. Consistency index 0.8 to 1.2. NHBC Class: Negligible to low.
Soluble sulphate & pH	9	SO ₄ pH	17 to 963 mg/l 6.3 to 9.5	
Point Load Strength Index	2	Is ₍₅₀₎ Axial	0.1 to 0.2 MPa	MUDSTONE. Assume UCS = Is ₍₅₀₎ *20.
	5	Is ₍₅₀₎ Diametral	<0.1 to 0.4 MPa	Invalid failures on both axial tests.
	7	Is ₍₅₀₎ Axial	0.2 to 0.9 MPa	SANDSTONE. Assume UCS = Is ₍₅₀₎ *20.
		Is ₍₅₀₎ Diametral	0.1 to 0.9 MPa	Invalid failures on 4 of 7 axial tests.
Uniaxial Compressive Strength	1	25.9 MPa		Indicative of moderately weak to medium strong rock strength.

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/m²).

m_v = Coefficient of consolidation (m²/MN).

f_1 & f_2 = factors based on plasticity index.

N = SPT 'N₃₀₀' value.

For the cohesive soils revealed at this site the highest (worst case) plasticity index⁵ of 36% could be employed, which suggests an f_1 value of 4.4 and an f_2 value of 0.44.

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		Silty sandy CLAY.
Consolidation characteristics	m_v	0.38m ² /MN	Stroud (1974) where $m_v = 1/f_2 N$ and 'N' = 6.
Concrete classification	DC-1		Brownfield 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).

⁵ See paragraph 6.2 'Index Property Tests'

- 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 5 of this report.

10. Discussion of Ground Conditions – Coal Mining Legacy

The risk to the stability of the proposed residential development has been evaluated from the data obtained and with reference to the following ratings and definitions:

- Low - The possibility of instability is unlikely therefore no further action is necessary.
- Moderate - The possibility of instability is likely and further investigation or remedial action may be required.
- High - The possibility of instability is highly likely and further investigation or remedial action will be necessary.

Table 8: Development Specific Risk Assessment

Item	Risk attributed to	Feature(s) Considered	Risk Rating
10.1	Shallow coal workings	Unnamed coal seam	Low
10.2	Coal workings at depth	The Coal Authority report (CON29M) indicates that mining could have occurred in 13 seams of coal between 70m to 430m depth, and last worked in 1903.	Low
10.3	Mine shafts	Shaft reference: 346390-0166	Low

10.1 Risks Posed by Shallow Coal Workings

The shallow coal seam indicated to be present below the site by the geological map was found to be present at a depth of between 5.0m and 7.0m below ground level. The coal was found to be intact within BH1 to BH3, and entirely absent within BH4. It is reasoned that the outcrop is present south of BH4, thus given the anticipated dip direction (south) has not been found at this location. No losses of flush or evidence of workings were found throughout the rotary drilling works. Additionally, it should be noted that within BH2, the seam was present in the form of a carbonaceous mudstone. Therefore, it is apparent that the coal seam is locally of poor quality and is likely to have been uneconomical to have been worked. It should be appreciated that no coal seams, losses of flush or voids were found within the Coal Workings Investigation by e-geo Solutions Ltd (ref: E0922.CWI.R1, October 2018). Therefore, a low risk has been assigned to the risk associated with shallow coal mining beneath the site.

10.2 Risks Posed by Coal Workings at Depth

In regard to deeper mining which could affect the site, the Coal Authority Mining Report (CON29M), indicates workings are present in 13 seams of coal at depths of between 70m and 430m depth. It is considered that the thickness of competent cover above workings at these depths is significant such

that instability to surface structures is unlikely. Therefore, the deeper workings have been assigned with a low risk rating.

10.3 Risks Posed by Mine Shafts

The Coal Authority Mining Report refers to one shaft onsite (ref: 346390-016). This shaft has been capped at rockhead by Knowsley Borough Council. It should be appreciated that according to the information available on the online Coal Authority Interactive Viewer, the departure for the mine shaft is 0m. This indicates that a definitive position for the shaft is known. As such, given that the location of the feature is known and has been treated, it is considered that there is a low risk of instability from the mine shaft to surface structures.

However, in the context of the guidance given by CIRIA SP32 – *Construction over abandoned mine workings* it should be appreciated that it is not recommended that any buildings are sited over the mine even if properly capped. It is recommended that a Mine Entry Interpretive report is obtained from the Coal Authority in order to assist with the relocation of any buildings which may be affected by this mine entry feature.

11. Discussion of Ground Conditions - Geotechnical

It is understood that the site is to be developed by the construction of a number of commercial units with car parking and hardstanding. It should be appreciated that this discussion is based on proposed plans drawn by Edward Architecture (drawing reference: PL03, dated 20/08/21).

It cannot be recommended that foundations be constructed directly within the made ground or weak near surface soils associated with the superficial deposits. These soils are also present in a weak and variable condition to depths, such that excessive total and or differential settlement could occur under moderately light surface loading.

In light of the above, it cannot be recommended that shallow strip or spread footings are considered for the development.

With regards to coal mining, the drawing indicates the capped mine shaft to be present below the northwestern corner of the proposed Block B and adjoining car parking spaces. Given the comments in Section 10.3, it is recommended that this building is moved away slightly to ensure foundation loads from the new building are not imposed on the mine cap. Given that the mine cap predates this development, it may not be designed to withstand additional loads arising from adjacent foundations.

In view of this, it is recommended that Block B is moved slightly so that the mine cap falls outside of the building footprint. Additionally, the foundations should be to at least the depth of the mine cap. Geogrids should be installed within the hardstanding close to the shaft.

11.1 Piled Foundations

There are a number of piling options that could be considered for use at this site, which include:

- Driven large-displacement piles.

- Continuous flight auger bored piles.
- Drilled piles.

In order to formulate a suitable design it is recommended that the advice of specialist piling contractors be sought. However, for preliminary design and estimating purposes the following discussion is presented.

Whilst driven piles are likely to represent the most economical piling solution, it should be appreciated that such piles may become subject to breakage whilst penetrating into the underlying hard stratum. Abrupt refusals on some of the dynamic probes suggest that this could occur.

As such, it is recommended that consideration be given to the use of bored cast-in-place piles using continuous flight augers (CFA). In this type of piling an auger borehole is formed and concrete placed via the hollow stem of the auger as they are withdrawn. A reinforcement cage is then placed into the fluid concrete filled hole to complete the pile. Given the appropriate rock auger, CFA piles can achieve significant end-bearing capacity on rock. However, spoil will be produced at the surface which will need to be disposed of. Moreover, should such piles encounter an obstruction or the underlying bedrock, a condition known as 'fighting' may occur. Fighting is where loose soils immediately adjacent to the pile borehole are pulled laterally into the drill string when the augers rotate quickly with little downward penetration. However, these piling systems may have greater difficulty penetrating obstructions due to the lack of weight from the auger string, unless plant with 'crowd' (downward mechanical force) is employed.

Drill and cased piles (Odex, Symmetrix or similar) could also be employed at this site. These methods employ down the hole hammers which have the capacity to bore through obstructions and into the underlying hard stratum to form a rock socket. Through the overburden, the drill bit is attached to casing which prevents the pile borehole collapsing. When rock is encountered the drilling can continue using open hole drilling techniques. On completion of the boring operations, concrete is then pumped into the hole and a steel reinforcing cage can be installed. The steel casing can be removed or left in place.

Irrespective of the method of pile installation a working platform must be provided, the thickness of which will be determined by the type of piling rig employed and the strength of the near surface soils. The design of the platform should be undertaken in accordance with the procedures and specification given in the BRE publication entitled *Working platforms for tracked plant*.

In addition, the cohesive fraction of the superficial geology has been found to possess low volume change potential in most onerous case. Therefore, piles should be able to cater for shrinkage or swelling of the cohesive soils should they be installed within the zone of any existing trees or shrubs. For design purposes, in particular the derivation of heave forces on the piles, the zone of desiccation may be considered as equivalent to the minimum foundation depth recommended for a shallow footing in the NHBC Standards, Chapter 4.2 – *Building Near Trees*. Moreover, given the thickness of weak material, it should be appreciated that the potential for negative skin friction will need to be considered as part of the design.

11.2 Ground Improvement

As an alternative to piling, it is considered that the buildings could be constructed on shallow footings, supported by vibro-stone columns. An explanation of this method of construction is provided in the *NHBC Standards, Part 4, Foundations, Chapter 4.6 Vibratory ground improvement techniques*. Briefly the method includes the insertion of a gravel column through the weak near surface soils by inserting a vibrating poker into the ground and filling the void created with coarse

gravel. These columns are positioned at designed spacing on the line of the footings, which are subsequently constructed using reinforced concrete. There are a number of techniques available thus in order to fully assess the efficacy of this approach the advice of specialist contractors should be sought.

However, it should be appreciated that the stone columns could inadvertently create a preferential pathway for ground gasses, which on the basis of the gas monitoring readings could be elevated. Therefore, it may more advantageous in this instance to consider vibro-concrete columns instead.

The chosen contractor will be required to provide design calculations, including settlement analysis, to demonstrate that the design meets the client's specification for the work. In addition, all works should be undertaken in accordance with the appropriate specifications. This foundation solution may also need to be agreed with the relevant environmental department at the local authority.

It should be appreciated that the use of ground improvement may not be appropriate for the building closest to the capped mine-shaft. The advice of the Coal Authority should be sought in relation to ground improvement in this area.

11.3 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.

11.4 Ground-floors

In light of the made ground and weak near surface soils, it is not recommended that ground bearing ground floor slabs be employed, unless ground improvement techniques are adopted. Without prior ground treatment, it will 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.

11.5 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 2% could be employed in the pavement design⁶. 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.

11.6 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 C2⁷, 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 mobile groundwater, the table also indicates that the aggressive chemical environment for concrete (ACEC) classification is AC-2.

In order to evaluate the design chemical (DC) class for the buried concrete at this site reference should be made to Table D1⁸, 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-2 is required.

12. Discussion of Ground Conditions – Environmental

12.1 Discussion of Test Results

It is understood that the site is to be developed by the construction of a number of commercial units with car parking and hardstanding. Consequently, the site may be classified as a commercial development.

12.1.1 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 0.2% and 5.6%. 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 website⁹ 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 9: Summary of Contaminated Areas

Location	Depth (m)	Contaminants found to be exceeding SSVs (Commercial)
WS02	0.6	None.
WS02	2.8	None.
WS03	0.5	PAHs [Indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene].
WS04	0.6	Asbestos [Amosite – loose fibres], PAHs [Indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene].
WS04	2.6	None.
WS05	0.5	PAHs [Indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene].
WS05	1.9	None.
WS06	0.6	PAHs [Chrysene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene].
WS06	1.9	None.

Concentrations of chromium^{VI}, mercury, selenium, free cyanide, phenols (total), polyaromatic hydrocarbons (naphthalene and acenaphthylene) and total petroleum hydrocarbons (aliphatic C5 to C12; aromatic C5 to C10 and C16 to C21) 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.

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 criterion¹⁰. 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 10: Summary of Areas Contaminated by PAHs & TPHs

Location	Depth (m)	Contaminants found to be exceeding SSVs (Commercial)
WS02	0.6	None.
WS02	2.8	None.
WS03	0.5	None.
WS04	0.6	None.
WS04	2.6	None.
WS05	0.5	None.

¹⁰ Ref: ATRISK soil, SSVs derived using CLEA v1.071 for 1% SOM, Commercial land use, 23.06.17.

WS05	1.9	None.
WS06	0.6	None.
WS06	1.9	None.

On the basis of the above information, the results of the investigation have concluded that whilst the site is generally uncontaminated with respect to commercial end user, asbestos contamination is present local to the area of WS04.

12.1.2 Gas Concentrations

With respect to ground gas, the results of the monitoring visits indicated a maximum concentration of 2.6% methane, with concentrations of carbon dioxide ranging between 0.2% and 12.7%, in association with oxygen levels of between 6.9% and 17.0%. 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 0.2 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 1005mb and 1016mb.

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 2.6% (0.026) methane was recorded along with 12.7% (0.127) carbon dioxide, in association with a maximum flow rate of 0.2l/hr. This results in a GSV of 0.0052 l/hr for methane and a GSV of 0.0254 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*. However, as the level of carbon dioxide is over 5%, this should be upgraded to *Characteristic Situation Level 2*. It is therefore considered that there is a 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 low sensitivity and that the generation potential is very low, these tables suggest that 4 readings could be undertaken over a period of 1 month. 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, thus the site can be fully classified as Characteristic Situation Level 2.

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

12.2 Site Specific Risk Assessment

12.2.1 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 Agency¹² 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

12.2.2 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 11. Sources of contamination include the following:

On-site – Made Ground (asbestos and carbon dioxide).

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 11.

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 11: Conceptual Site Model and Site-Specific Risk Assessment [Contamination: Asbestos and carbon dioxide]

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 for commercial end use.	High	
	Neighbours	Yes – contamination found to be present at the site and a commercial area surrounds the site. Residential buildings are present to the east of the site.	Low	
Inhalation of Dust/Vapours	Operative	Yes – dust may be derived from contaminated soils.	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.	High	
	Neighbours	Yes – contamination found to be present at the site and a commercial area surrounds the site. Residential buildings are present to the east of the site. Possible inhalation of dust during the works.	High	
Ingestion of fruit/vegetables and/or waters	Operative	No – no edible plants in the area of the proposed new works. Controlled waters present immediately north of the site.	Low	The contamination at the site is considered to be of limited mobility, therefore the likelihood of contamination affecting neighbouring gardens is considered low risk. Additionally, it should be noted that the proposed soft landscaping is likely to be limited grass and shrubbery. No fruit-bearing plants are anticipated.
	End User	Yes – contamination found to be present at the site and site to be developed into commercial end use with some limited perimeter landscaped areas.	Low	
	Neighbours	Yes – whilst some contamination has been revealed, it is considered to be of limited mobility, thus offsite receptors are unlikely to be affected.	Low	
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	Yes – elevated levels of carbon dioxide have been detected. Site is Characteristic Situation Level 2.	High	Site is Characteristic Situation Level 2. Precautionary measures are required.
	End User		High	

	Neighbours	No – whilst concentrations of ground gas have been found to be present at the site, no structures directly adjoin the site, therefore gases migrating from the site would vent to atmosphere before reaching neighbouring structures.	N/A	
Spillage/loss/run off direct to receiving water	Controlled Waters	Yes – known controlled waters within 250m. However, the site is underlain by cohesive soils of low permeability. Contamination revealed 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 – a Secondary A aquifer is present beneath the site. However, the site is underlain by cohesive soils of low permeability. Contamination revealed 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 revealed is not anticipated to be significantly mobile.	Low	
Direct contact with contaminated soils	Plants	Yes – whilst contamination by asbestos is present, uptake by plants is not anticipated.	Low	
Uptake via root system			Low	
Direct contact with contaminated soils	Building Materials	Yes – TPH 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-2.	Moderate (plastic services)	Please see section 11.3.3 for information on good building practice.
Direct contact with contaminated groundwater			Moderate (buried concrete)	
Exposure to Radon	Operative	No – according to the desk study, between 1% and 3% of properties are above the Action Level.	Low	No radon protection is required.
	End User			
UXO Risk	Operative	No – the Zetica online UXO maps indicate that the site is within a low risk area for UXO.	Low	No further action required.
	End User	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	

12.3 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.

12.3.1 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 the end user from the elevated levels of carbon dioxide.
- To protect neighbours from the inhalation and ingestion dust during the construction process.
- 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.
- To protect buried concrete from potentially aggressive ground conditions.

12.3.2 Development Requirements

Whilst the precise nature of this development has not been finalised it is understood that the site is to be developed by the construction of a number of commercial units with car parking and hardstanding. 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.

12.3.3 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 asbestos.
- Site operatives should also be made aware of the hazards of working on a site where accumulations of carbon dioxide could occur.
- 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-2.

Gas Protection Measures

In order to assess the protection measures required BS8485: 2015+A1:2019: *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings* has been employed. In accordance with Table 3, *Building types*, of the code, the development may be considered to conform to Type D. Therefore, on the basis of Table 4 *Gas protection score by CS and type of building*, the minimum gas protection score (points) is 1.5. The gas protection system should consist of at least two different elements. The elements work independently and collaboratively, and a single element should not be used because there would be no redundancy to

allow for defects in the component.

In order to achieve this score the following shall be undertaken.

Table 12: Combination of Protection Elements (BS8485: 2015) for CS2		
Reference	Protection Element	Score
Table 5	Precast suspended segmental subfloor (i.e. beam and block)	0
Table 6 <i>Either option is appropriate</i>	Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building)	0.5
	OR Passive sub-floor dispersal layer: good performance (Note 1) (see Annex B of the Code for detail)	1.5
Table 7	Gas resistant membrane complying with the requirements given in Table 7 (Note 2)	2
		Total Score
		Min: 2.5 Max: 3.5

Note 1:

Sub-floor dispersal layers include:

- Clear void.
- Polystyrene void former blanket.
- No-fines gravel layer with gas drains.
- No-fines gravel layer.

The details of the system to be adopted shall be included on the technical drawings provided by the engineer/architect.

Note 2:

The gas resistant membrane shall meet the following criteria:

- Sufficiently impervious (methane gas transmission rate <40.0ml/day/m²/atm (average) BS ISO 15105-1 manometric method).
- Sufficiently durable and strong to remain serviceable for the anticipated life of the building, to withstand in-service stresses and installation process.
- Capable, after installation, of providing a complete barrier to the entry of the relevant gas.
- Verified in accordance with CIRIA C735: 2014: *Good practice on the testing and verification of protection systems of buildings against hazardous ground gasses.*

In addition to the above, the following points shall be considered.

- Technical drawings of the incorporation of the gas protection measures into the sub-structure will be provided by a suitably qualified engineer/architect and produced in accordance with the guidance given in BRE 414.
- The sequence of construction indicating when the gas protection system will be installed will be included with the remediation statement. Where possible the installation of membranes will take place as a unique activity on site and shall not take place until sub-structure construction is complete.
- During and following the installation of the membrane, all parties in attendance at the site shall be made aware that a gas protection system is to be employed within the construction. Such communications should include, but not be limited to, the CDM documentation for the site and site inductions.

- The installation of the membrane shall be carried out only by suitable personnel and the qualifications or experience/training will be included as part of the remediation statement. The suitability of personnel will be assessed in accordance with Annex 1 of CIRIA C735.
- The installation shall be in strict accordance with manufacturer specifications and recommendations, which shall also be included as part of the remediation statement.
- The membrane system employed will not be an ensemble (i.e. a system comprising a mixture of products from different manufacturers will not be employed).
- Membranes shall be supplied to site on a single wound roll, creased product will not be accepted or employed.
- Whilst membranes are exposed, signage will be provided to indicate the access to the installation area is prohibited unless authorised. Footwear will be checked prior to accessing the membrane surface to ensure no sharp objects are apparent, such as stones caught in treads. The use of sharp objects or hot-works around the exposed membrane will be strictly prohibited unless the risk of damaging the membrane has been fully assessed and mitigated.
- Non-conformance of manufacturer recommendations shall be discussed and agreed as acceptable, in writing, with a suitably qualified person from the manufacturer.

Verification of the installation of the gas protection system will be carried out on each plot, unless agreed with any statutory authorities prior to construction.

12.4 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 YALPAG¹⁵ 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 13: 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)

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

Crushed Hardcore, Stone, Brick	Minimum 1 per 500m ³	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 50m ³ and 1 per 250m ³	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 receptor, between 1 per 50m ³ and 1 per 100m ³	Standard metals/ metalloids (as above), PAH (16 USEPA 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 14: Fill Screening Values

Contaminant	Screening Value (Commercial) (mg/kg)		Reference
	1% SOM	6% SOM	
As	635	635	Atrisk ^{SOIL} SSVs
Cd	410	410	Atrisk ^{SOIL} SSVs
Cr(VI)	19.7	19.7	Atrisk ^{SOIL} SSVs
Cu	106000	106000	Atrisk ^{SOIL} SSVs
Hg	350	405	Atrisk ^{SOIL} SSVs
Ni	1770	1770	Atrisk ^{SOIL} SSVs
Pb	2310	2310	Atrisk ^{SOIL} SSVs
V	7490	7490	Atrisk ^{SOIL} SSVs
Zn	1100000	1100000	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.

12.5 Verification Report

In order to demonstrate that the remedial works 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:

- 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.
- Evidence that suitable gas protection measures have been implemented and installed in accordance with manufacturer's instructions. The evidence should also demonstrate that all joints and penetrations have been adequately sealed. The verification should be undertaken by a suitably qualified specialist.

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.

13. 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.
- Discussions with piling contractors regarding their method for installing piles.
- 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.
- Discussions with contractors in relation to the suitability of materials and installation methods for gas protection measures.
- 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.

14. References

- British Geological Survey (NERC) (2023), 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 & Coal Authority License



Notes:
Investigation positions approximated from site operative's notes.



Rogers Geotechnical Services Ltd

Offices 1 & 2, Barncliffe Business Park,
Near Bank, Shelley, Huddersfield, HD8 8LU

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

Client:
Andrew Moseley Associates

Job Number:
C3304/23/E/5028

Project Details:
Fallows Way, Whiston

Scale: Not to scale - reference only





The Coal
Authority

Permit to Enter or Disturb Coal Authority Interests

Permit 26328

Name and Address of Permit Holder:

*Allied Properties Limited
3rd Floor Quay House
South Quay
Douglas
Isle of Man
IM1 5AR*

Site Location:

*Fallows Way
Whiston
Prescot
L35 1RZ*

This certificate hereby grants the above named Permit Holder a Permit to carry out:-

Ground investigation by four boreholes to 30m to determine presence of shallow mine workings

within the Authority's interests at the identified site location above as shown on the Grant Permit Boundary (overleaf) for the period of **12 months** from the granted date shown below. *The granting of this Permit does not constitute advice given by the Authority in relation to the proposed operations. It is the Permit Holder's responsibility to obtain appropriate health, safety, environmental, technical and legal advice.*

Conditions:

- *Manned entry (i.e.) into mine entries/workings) is strictly prohibited.*
- *Water flush*
- *Gas Monitoring CO, CH₄, CO₂, O₂ at borehole and rig*
- *Operators undertaking the work must be in possession of this certificate and the Permit boundary plan at the time of works*
- *Appropriate borehole sealing without delay and to withstand site level changes*

Signed: Helen Day Granted Date: 1 March 2023

For and on behalf of The Coal Authority

Nominated Representative: Helen Day, Permitting Manager;

The Coal Authority, Permitting Office, 200 Lichfield Lane, Mansfield, Notts, NG18 4RG

Tel: 01623 637450; E-Mail: permissions@coal.gov.uk



The Coal
Authority

Granted Permit Boundary

Permit Ref: 26328

Permit Boundary:

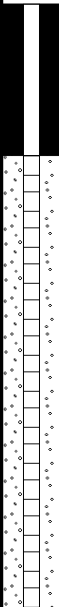


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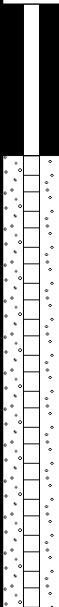
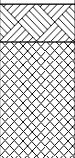
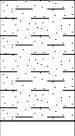
Appendix 2

Borehole Records

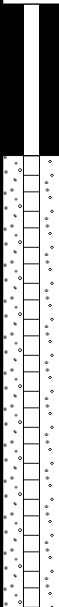
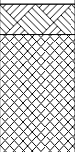
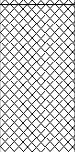
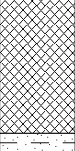
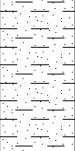
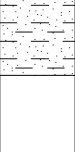
							Borehole Log			Borehole No. WS02 Sheet 1 of 1		
Project Name: Land off Fallows Way							Project No. C3304/23/E/5028		Co-ords:		Hole Type WLS	
Location: Whiston, Prescott							Level:		Scale 1:50		Logged By IMY	
Client: Andrew Moseley Architects							Dates: 06/03/2023					

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
							0.10			TOPSOIL (Dark brown sandy SILT with frequent rootlets).	
		0.60	ES	87	95					MADE GROUND (Soft brown and greyish brown slightly sandy gravelly silty CLAY. Sand is fine. Gravel is sub-angular to sub-rounded, locally tabular, fine to medium and occasional coarse of siltstone, mudstone. coal and occasional brick).	1
		1.60	D	77	85		1.50				2
		2.60	D	67	80						3
		2.80	ES								4
				57	80		4.00			End of Borehole at 4.00m	4
											5
											6
											7
											8
											9
											10

Remarks											
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							Borehole Log			Borehole No. WS03 Sheet 1 of 1	
Project Name: Land off Fallows Way				Project No. C3304/23/E/5028		Co-ords:			Hole Type WLS		
Location: Whiston, Prescott						Level:			Scale 1:50		
Client: Andrew Moseley Architects						Dates: 06/03/2023			Logged By IMY		
Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
							0.25			TOPSOIL (Dark brown silty SAND with frequent rootlets).	1
										MADE GROUND (Soft to firm brown slightly gravelly very sandy silty CLAY. Gravel is sub-angular to sub-rounded, locally well rounded, fine to medium of brick, coal, and various other lithologies).	
							1.50				2
							2.20				
							2.60				
						3.00			Very soft to soft brown mottled slightly gravelly sandy CLAY with rare medium gravel sized pockets of medium sand. Sand is fine. Gravel is well rounded, fine and rare medium of various lithologies. [TILL]. NO RECOVERY.	3	
						3.70					
						4.00			Very soft brown mottled slightly gravelly sandy CLAY with rare medium gravel sized pockets of medium sand. Sand is fine. Gravel is well rounded, fine and rare medium of various lithologies. [TILL]. End of Borehole at 4.00m	4	
											5
											6
											7
											8
											9
											10
Remarks											

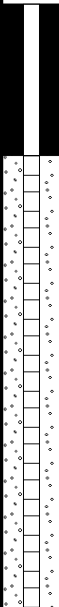
						Borehole Log				Borehole No. WS04 Sheet 1 of 1	
Project Name: Land off Fallows Way						Project No. C3304/23/E/5028		Co-ords:		Hole Type WLS	
Location: Whiston, Prescott						Level:		Scale 1:50		Logged By IMY	
Client: Andrew Moseley Architects						Dates: 02/06/2023					

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
							0.20			TOPSOIL (Dark brown silty SAND with frequent rootlets).	
	0.60	ES	87	100	N=7 (1,1/1,2,2,2)	1.00				MADE GROUND (Loose brown silty gravelly medium to coarse SAND. Gravel is sub-angular to sub-rounded, fine to medium of sandstone, occasional mudstone, coal and rare brick).	1
	1.00	SPT									PROBABLE MADE GROUND (Loose brown, locally dark brown silty slightly clayey, slightly gravelly SAND. Gravel is sub-angular to well rounded, fine to medium of coal, sandstone and various other lithologies).
	2.00	SPT	77	100	N=9 (2,1/2,2,3,2)				Soft brown slightly gravelly very sandy CLAY with occasional orangish staining. Gravel is well rounded, fine to medium of various lithologies. [TILL].		3
	2.60	ES	67	95	N=6 (5,3/2,1,1,2)	2.85				3.0m - 3.65m: Poor recovery. 3.65m - 3.8m: Band of light brown slightly gravelly fine to medium SAND.	4
	3.00	SPT									End of Borehole at 4.45m
	4.00 - 4.45	D SPT			N=7 (2,2/1,2,2,2)	4.45					6
	4.00									7	
										8	
										9	
									10		

Remarks
 



							Borehole Log			Borehole No. WS06 Sheet 1 of 1		
Project Name: Land off Fallows Way							Project No. C3304/23/E/5028		Co-ords:		Hole Type WLS	
Location: Whiston, Prescott							Level:		Scale 1:50		Logged By IMY	
Client: Andrew Moseley Architects							Dates: 02/06/2023					

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Dia. (mm)	TCR (%)	Results					
		0.15								TOPSOIL (Dark brown silty SAND with frequent rootlets). MADE GROUND (Dark brown becoming brown slightly clayey gravelly fine to medium SAND with occasional rootlets. Gravel is sub-angular to sub-rounded, fine to medium of sandstone and various other lithologies).	1
		0.60	ES	87	100	N=22 (5,7/4,4,6,8)					
		1.00	SPT								
		1.70	D	77	100					MADE GROUND (Medium dense brown, locally dark brown silty very gravelly fine to medium SAND. Gravel is sub-angular to sub-rounded, fine to medium of brick, sandstone, concrete and occasional coal).	2
		1.90	ES			N=8 (3,3/1,2,2,3)					
		2.00	SPT							Soft brown slightly sandy slightly gravelly silty CLAY. Gravel is well rounded, fine to medium of sandstone and various other lithologies. [TILL].	
		3.00	SPT	67	80					Loose becoming medium dense reddish brown silty very gravelly fine to medium SAND. Gravel is well rounded to sub-angular, fine to coarse of predominantly sandstone. [TILL].	3
						N=8 (2,2/1,2,3,2)					
				57	60						
		4.00	SPT			N=46 (7,8/6,8,13,19)					4
						4.45			End of Borehole at 4.45m		
										5	
										6	
										7	
										8	
										9	
										10	

Remarks
 

				Borehole Log				Borehole No. BH1	
Project Name: Land off Fallows Way				Project No. C3304/23/E/5028		Co-ords:		Sheet 1 of 6 Hole Type RO+RC	
Location: Whiston, Prescott				Level:		Scale 1:25			
Client: Andrew Moseley Architects				Dates: 04/07/2023		Logged By AB			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND (Dark brown CLAY). (Driller's description).	
									1
									2
									3
									4
									5
Remarks Cased to 7m depth.									

					Borehole Log					Borehole No. BH1 Sheet 2 of 6	
Project Name: Land off Fallows Way					Project No. C3304/23/E/5028		Co-ords:			Hole Type RO+RC	
Location: Whiston, Prescott					Level:			Scale 1:25			
Client: Andrew Moseley Architects					Dates: 04/07/2023			Logged By AB			

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results							
										MADE GROUND (Dark brown CLAY). (Driller's description).	
							6.00				6
							6.50			Dark grey CLAY. (Driller's description).	
										COAL. (Driller's description).	
							7.00			Extremely weak to very weak, becoming extremely weak, thinly laminated light grey clayey MUDSTONE. Discontinuities are sub-horizontal, closely spaced, undulating, rough, infilled with clayey gravel.	7
						87	80	45	0		8
											9
						87	80	41	6		9
											10
							9.95				

Remarks Cased to 7m depth.											
-------------------------------	--	--	--	--	--	--	--	--	--	---	--



Borehole No.

BH1

Sheet 3 of 6

Project Name: Land off Fallows Way

Project No.
C3304/23/E/5028

Co-ords:

Hole Type
RO+RC

Location: Whiston, Prescott

Level:

Scale

1:25

Client: Andrew Moseley Architects

Dates: 04/07/2023

Logged By
AB

Well	Water Strikes	Samples and In Situ Testing							Depth (m)	Level (m)	Legend	Stratum Description					
		Depth (m)	Type	Dia. (mm)	TCR (%)	SCR (%)	RQD (%)	FS (mm)									
		10.46 - 10.53	C	87	100	58	6		14.50		Very weak thinly laminated dark grey MUDSTONE. Discontinuities are sub-horizontal, closely spaced, undulating, rough, infilled with clayey gravel. <i>10.0m - 10.3m: Recovered as clayey sub-angular to sub-rounded, tabular, fine to medium GRAVEL of mudstone.</i> <i>10.4m - 11.2m: Sub-vertical discontinuity, undulating, rough, tight to partly open, clean.</i>	11 -					
				12.42 - 12.59 12.42 - 12.59	C C	87	100					55	10	12 -			
		87	100			46	0						13 -				
													14 -				

Remarks

Cased to 7m depth.



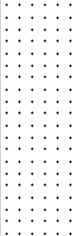
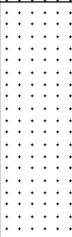


				Borehole Log				Borehole No. BH2	
Project Name: Land off Fallows Way				Project No. C3304/23/E/5028		Co-ords:		Sheet 1 of 5 Hole Type RO+RC	
Location: Whiston, Prescott				Level:		Scale 1:25			
Client: Andrew Moseley Architects				Dates: 05/07/2023		Logged By AB			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								MADE GROUND (Dark brown CLAY). (Driller's description).	
									1
									2
									3
					4.00			Dark orangish brown CLAY. (Driller's description).	4
									5
Remarks Cased to 5.5m depth.									

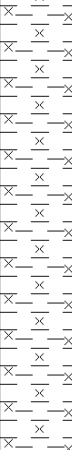
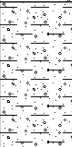
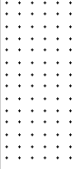
				Borehole Log				Borehole No. BH2	
Project Name: Land off Fallows Way				Project No. C3304/23/E/5028		Co-ords:		Sheet 5 of 5 Hole Type RO+RC	
Location: Whiston, Prescott				Level:		Scale 1:25			
Client: Andrew Moseley Architects				Dates: 05/07/2023		Logged By AB			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					21.00			Dark grey MUDSTONE. (Driller's description).	21
								End of Borehole at 21.00m	22
									23
									24
									25
Remarks Cased to 5.5m depth.									

				Borehole Log				Borehole No. BH3 Sheet 1 of 4	
Project Name: Land off Fallows Way				Project No. C3304/23/E/5028		Co-ords:		Hole Type RO+RC	
Location: Whiston, Prescott				Level:		Scale 1:25		Logged By AB	
Client: Andrew Moseley Architects				Dates: 07/07/2023					
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
								Dark brown sandy CLAY. (Driller's description).	
									1
									2
									3
					4.00			Light brown orange CLAY. (Driller's description).	4
					4.50			COAL. (Driller's description).	
					5.00				5
Remarks Cased to 6.5m depth									

					Borehole Log					Borehole No. BH3	
Project Name: Land off Fallows Way					Project No. C3304/23/E/5028		Co-ords:			Sheet 2 of 4 Hole Type RO+RC	
Location: Whiston, Prescott					Level:			Scale 1:25			
Client: Andrew Moseley Architects					Dates: 07/07/2023			Logged By AB			
Well	Water Strikes	Samples and In Situ Testing				Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results							
						5.75			Dark grey MUDSTONE. (Driller's description).		
									Very weak thinly laminated light grey fine grained micaceous SANDSTONE with slight ferruginous staining and rare fossilised plant remains. Discontinuities are sub-horizontal, very closely becoming closely spaced, undulating, rough, partly open to open, infilled with clayey gravel.	6	
									6.35m - 6.7m: Sub-vertical discontinuity, undulating, rough, tight, clean.		
				87	100	43	0			7	
				87	90	63	0			8	
		8.30 - 8.35	C								
		8.72 - 8.81	C								
		8.84 - 8.90	C							9	
				87	100	78	0				
									9.3m - 10.8m: Sub-horizontal discontinuities infilled with clayey gravelly silt.	10	
Remarks Cased to 6.5m depth											

										Borehole Log				Borehole No. BH3 Sheet 3 of 4	
Project Name: Land off Fallows Way						Project No. C3304/23/E/5028				Co-ords:				Hole Type RO+RC	
Location: Whiston, Prescott						Level:				Scale 1:25					
Client: Andrew Moseley Architects						Dates: 07/07/2023				Logged By AB					
Well	Water Strikes	Samples and In Situ Testing							Depth (m)	Level (m)	Legend	Stratum Description			
		Depth (m)	Type	Dia. (mm)	TCR (%)	SCR (%)	RQD (%)	FS (mm)							
		10.09 - 10.21	C	87	100	98	52	10.80			Very weak thinly laminated light grey fine grained micaceous SANDSTONE with slight ferruginous staining and rare fossilised plant remains. Discontinuities are sub-horizontal, very closely becoming closely spaced, undulating, rough, partly open to open, infilled with clayey gravel.	11			
		10.09 - 10.21	C												
		10.41 - 10.48	C												
		10.80 - 10.95	C												
		11.03 - 11.27	C												
		11.27 - 11.38	C	87	33	0	0	11.50		Weak becoming medium strong thinly cross laminated light grey fine grained micaceous SANDSTONE. Discontinuities are sub-horizontal, closely to medium spaced, planar, rough, tight, infilled with clayey silt.	12				
				87	33	0	0	13.00		Weak to medium strong thinly cross laminated micaceous SANDSTONE, recovered as discrete core stones.	13				
										Grey SANDSTONE. (Driller's description).	14				
Remarks Cased to 6.5m depth															

					Borehole Log				Borehole No. BH3 Sheet 4 of 4		
Project Name: Land off Fallows Way					Project No. C3304/23/E/5028		Co-ords:			Hole Type RO+RC	
Location: Whiston, Prescott					Level:			Scale 1:25			
Client: Andrew Moseley Architects					Dates: 07/07/2023			Logged By AB			
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			
		Depth (m)	Type	Results							
					16.00			Grey SANDSTONE. (Driller's description).			
								End of Borehole at 16.00m	16		
									17		
									18		
									19		
									20		
Remarks Cased to 6.5m depth											

				Borehole Log				Borehole No. BH4 Sheet 1 of 3	
Project Name: Land off Fallows Way				Project No. C3304/23/E/5028		Co-ords:		Hole Type RO+RC	
Location: Whiston, Prescott				Level:		Scale 1:25		Logged By AB	
Client: Andrew Moseley Architects				Dates: 06/07/2023					
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		4.56 - 4.64	C		1.50			Dark orangish brown CLAY. (Driller's description).	1
								Soft orangish brown very gravelly very sandy CLAY. Gravel is sub-angular to sub-rounded, fine to medium and occasional coarse of sandstone.	2
								NO RECOVERY. Driller notes SAND and GRAVEL.	3
					3.90			Extremely weak thinly laminated light grey SANDSTONE, recovered as fine to coarse gravel sized discontinuous corestones.	4
					4.50			Weak thinly laminated light reddish brown micaceous SANDSTONE. Discontinuities are sub-horizontal, closely spaced, undulating, rough, partly open, infilled with clayey gravel.	5
Remarks Cased to 4m depth.									



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Borehole Log

Borehole No.
BH4
Sheet 2 of 3

Project Name: Land off Fallows Way
Project No. C3304/23/E/5028
Co-ords:

Location: Whiston, Prescott
Level:

Client: Andrew Moseley Architects
Dates: 06/07/2023

Hole Type
RO+RC
Scale
1:25
Logged By
AB

Well	Water Strikes	Samples and In Situ Testing					Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results								
		5.74 - 5.80	C								Weak thinly laminated light reddish brown micaceous SANDSTONE. Discontinuities are sub-horizontal, closely spaced, undulating, rough, partly open, infilled with clayey gravel. 5.3m - 6.7m: Sub-horizontal discontinuities are very closely spaced, undulating, rough, partly open to moderately wide, infilled with clayey gravel. Single sub-vertical discontinuity, undulating, rough, partly open to moderately wide, infilled with clayey gravel.	
		6.70 - 6.84	C	87	100	60	31					6
		7.03 - 7.13	C	87	80	42	18					7
		8.58 - 8.68	C	87	100	45	12				7.7m - 8.2m: Sub-vertical discontinuity, undulating, rough, partly open to moderately wide, infilled with purplish brown clayey gravel. 7.7m - 8.3m: Sub-horizontal discontinuities become very closely spaced.	8
				87	100	64	0	9.60			8.6m - 9.0m: Sub-ordinate 5-10mm thick beds of thinly laminated micaceous MUDSTONE.	9
										Very weak, locally extremely weak thinly laminated reddish brown MUDSTONE. Discontinuities are sub-horizontal, closely becoming extremely closely spaced, undulating, rough, tight to partly open,	10	
Remarks Cased to 4m depth.												

										Borehole Log				Borehole No. BH4	
Project Name: Land off Fallows Way										Project No. C3304/23/E/5028		Co-ords:		Sheet 3 of 3 Hole Type RO+RC	
Location: Whiston, Prescott										Level:		Scale 1:25			
Client: Andrew Moseley Architects										Dates: 06/07/2023		Logged By AB			
Well	Water Strikes	Samples and In Situ Testing							Depth (m)	Level (m)	Legend	Stratum Description			
		Depth (m)	Type	Dia. (mm)	TCR (%)	SCR (%)	RQD (%)	FS (mm)							
									10.70			Very weak, locally extremely weak thinly laminated reddish brown MUDSTONE. Discontinuities are sub-horizontal, closely becoming extremely closely spaced, undulating, rough, tight to partly open, infilled with clayey gravel	11		
				87	100	64	7					Very weak thinly laminated light grey, mottled reddish brown micaceous MUDSTONE. Discontinuities are closely spaced, undulating, rough, partly open to open, infilled with clayey gravel.			
									11.90 12.00			Weak thinly laminated light grey fine grained SANDSTONE. End of Borehole at 12.00m	12		
													13		
													14		
													15		
Remarks Cased to 4m depth.															



Appendix 3

Dynamic Probing Records



Probe Log

Probe No.

DP02

Sheet 1 of 1

Project Name: Land off Fallows Way

Project No.
C330423/E/5028

Co-ords:

Hole Type
DCP

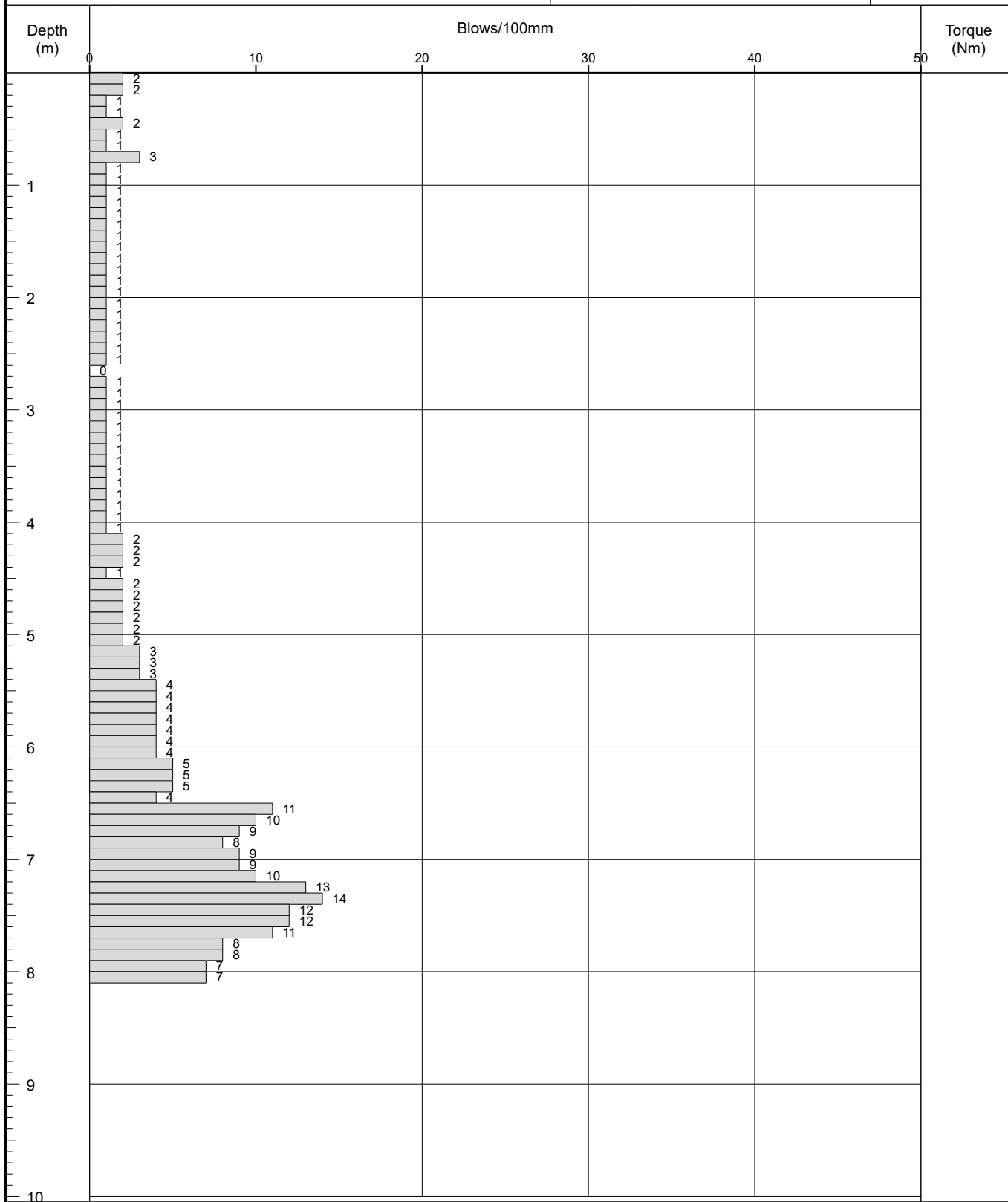
Location: Whiston, Prescott

Level:

Scale
1:50

Client: Andrew Moseley Architects

Dates: 06/03/2023

Logged By
BMRemarks:
Abrupt refusal at 8.1m depth.

Fall Height 750mm

Cone Base Diameter 50.5mm

Hammer Wt 63.5kg

Final Depth 8.1m

Probe Type DPSH-B





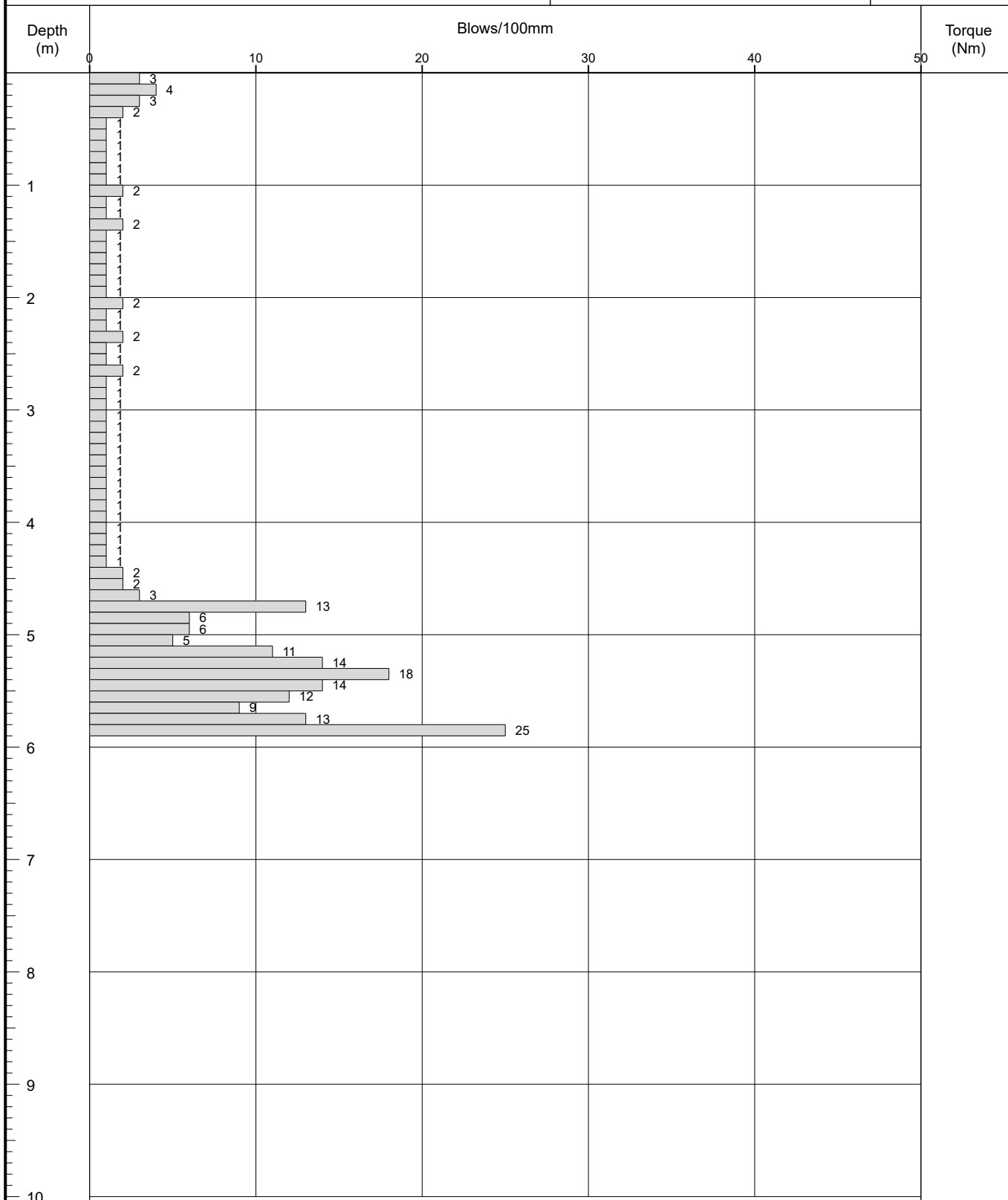
Probe Log

Probe No.

DP03

Sheet 1 of 1

Project Name: Land off Fallows Way	Project No. C330423/E/5028	Co-ords:	Hole Type DCP
Location: Whiston, Prescott		Level:	Scale 1:50
Client: Andrew Moseley Architects		Dates: 06/03/2023	Logged By AB



Remarks: Refusal at 5.9m depth.	Fall Height 750mm	Cone Base Diameter 50.5mm
	Hammer Wt 63.5kg	Final Depth 5.9m
	Probe Type DPSH-B	





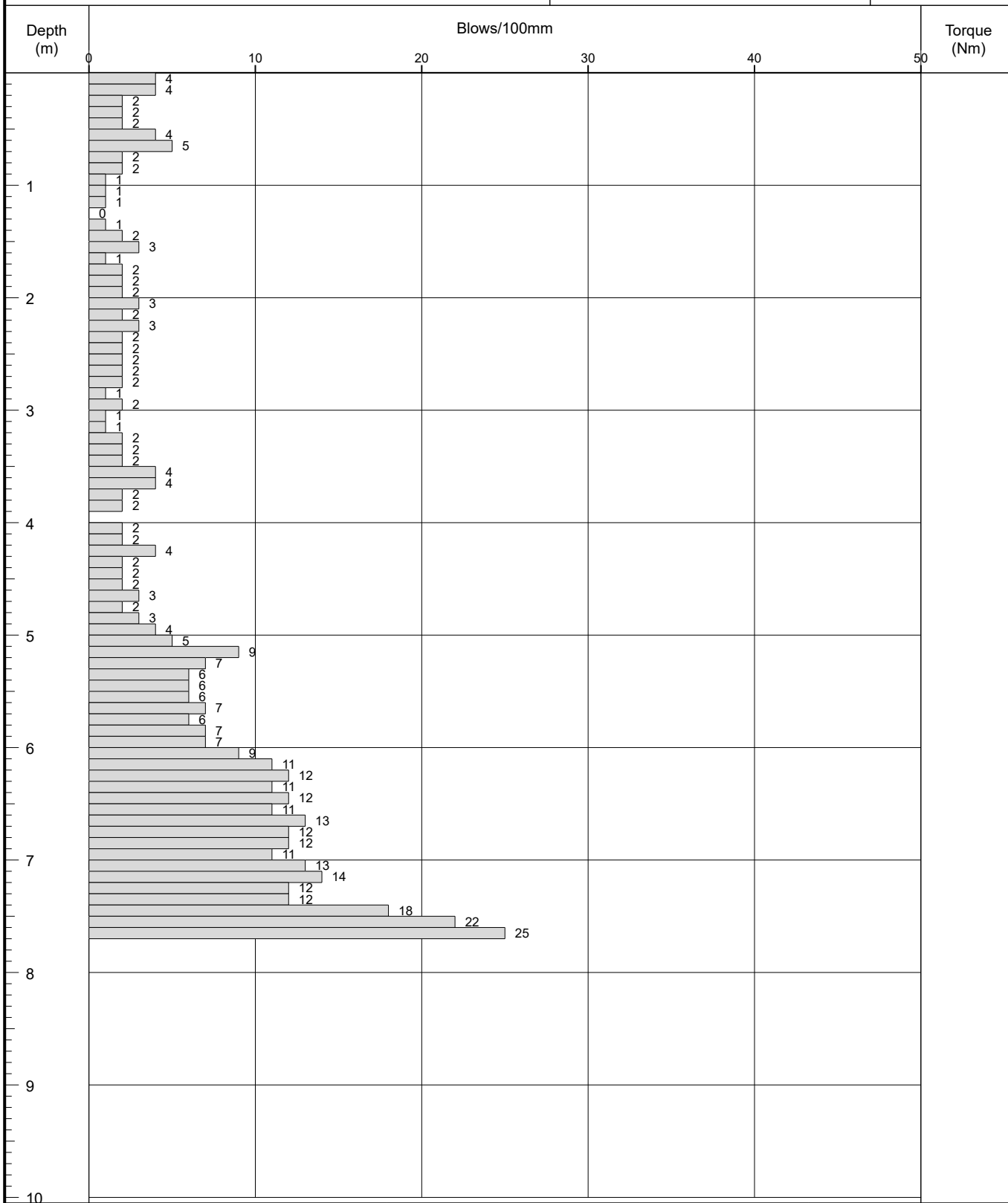
Probe Log

Probe No.

DP04

Sheet 1 of 1

Project Name: Land off Fallows Way	Project No. C330423/E/5028	Co-ords:	Hole Type DCP
Location: Whiston, Prescott		Level:	Scale 1:50
Client: Andrew Moseley Architects		Dates: 02/06/2023	Logged By BM



Remarks: Refusal at 7.7m depth.	Fall Height	750mm	Cone Base Diameter	50.5mm
	Hammer Wt	63.5kg	Final Depth	7.7m
	Probe Type	DPSH-B		





Probe Log

Probe No.

DP05

Sheet 1 of 1

Project Name: Land off Fallows Way

Project No.
C330423/E/5028

Co-ords:

Hole Type
DCP

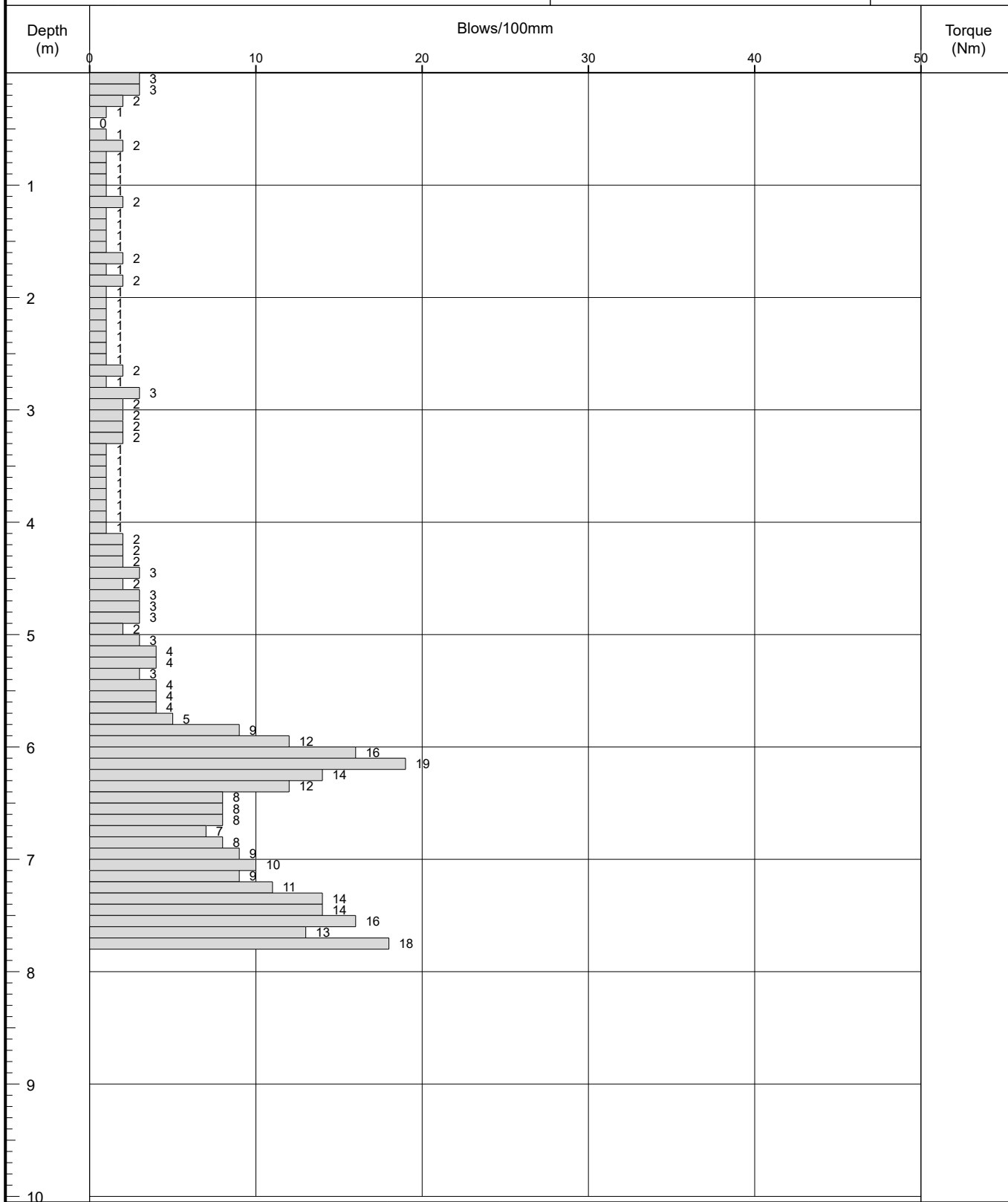
Location: Whiston, Prescott

Level:

Scale
1:50

Client: Andrew Moseley Architects

Dates: 06/03/2023

Logged By
BMRemarks:
Abrupt refusal at 7.8m depth.

Fall Height 750mm

Cone Base Diameter 50.5mm

Hammer Wt 63.5kg

Final Depth 7.8m

Probe Type DPSH-B



Appendix 4

Gas Monitoring Sheets

Rogers Geotechnical Services Ltd

GAS/WATER MONITORING - SITE RECORD

Client:

Site:

Input by : S Hale Checked by :

Date : 05.07.2023 Date :

Gas Monitor: Geotech GA5000

Serial No. G503524

Calibration Date: 01.02.2023

Dip Meter: 003

(If second monitor is used)

Gas Monitor:

Serial No. _____

Calibration Date: _____

Dip Meter

Borehole No	Date	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	Flow (l/hr)	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)
WS02	12.06.2023	0.0	7.9	13.3	0.0	1013	2.46	4.00
	20.06.2023	0.1	8.7	12.6	0.0	1005	2.48	
	26.06.2023	0.1	7.7	13.3	0.0	1016	2.47	
	05.07.2023	0.7	7.3	12.4	0.0	1008	2.36	
WS03	12.06.2023	0.1	4.2	17.0	0.0	1014	2.18	4.00
	20.06.2023	0.1	7.7	16.0	0.0	1006	2.37	
	26.06.2023	2.0	10.1	15.3	0.0	1016	2.21	
	05.07.2023	0.1	7.6	15.7	0.0	1008	2.20	
WS04	12.06.2023	0.6	6.6	12.8	0.1	1014	2.81	4.00
	20.06.2023	1.3	10.2	10.0	0.0	1005	2.97	
	26.06.2023	2.1	11.2	7.4	0.0	1016	3.02	
	05.07.2023	2.6	12.7	7.7	0.0	1008	2.85	
WS05	12.06.2023	0.0	3.8	6.9	0.2	1014	1.68	4.00
	20.06.2023	1.1	9.5	7.6	0.0	1005	1.95	
	26.06.2023	0.1	4.1	8.4	0.0	1016	1.76	
	05.07.2023	0.1	4.1	9.6	0.0	1007	1.78	
WS06	12.06.2023	0.1	4.2	10.5	0.0	1014	3.75	4.00
	20.06.2023	0.1	6.5	12.5	0.0	1005	3.73	
	26.06.2023	0.1	0.2	13.7	0.0	1015	3.73	
	05.07.2023	0.1	6.0	14.8	0.0	1007	3.64	

[illegible]

Appendix 5

Laboratory Testing

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LABORATORY REPORT

job number	C/3304/23/E/5028	date	29/06/2023
site address	Fallows Way Whiston, Prescot, Merseyside, L35 1RZ		
date scheduled	08/06/2023	date issued	29/06/2023
issued by	H J Letch		



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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 pycnometer	Pt 2 : 8.3			U
iii. Small pycnometer	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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GEOTECHNICAL TESTING RESULTS



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Summary of Classification Test Results

Project No.

C330423/E/5028

Project Name

Land off Fallows Way

[illegible]

All tests performed in accordance with BS EN ISO 17892 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

qi - gas iar

Date Printed

29/06/2023

Approved By	
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Harry

Table

1

sheet

1



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Classification of Index Properties

C330423/E/5028

Project Name: Land off Fallows Way

BS EN ISO: 17892: Parts 1, 12

Fig. 2
Sheet. 1

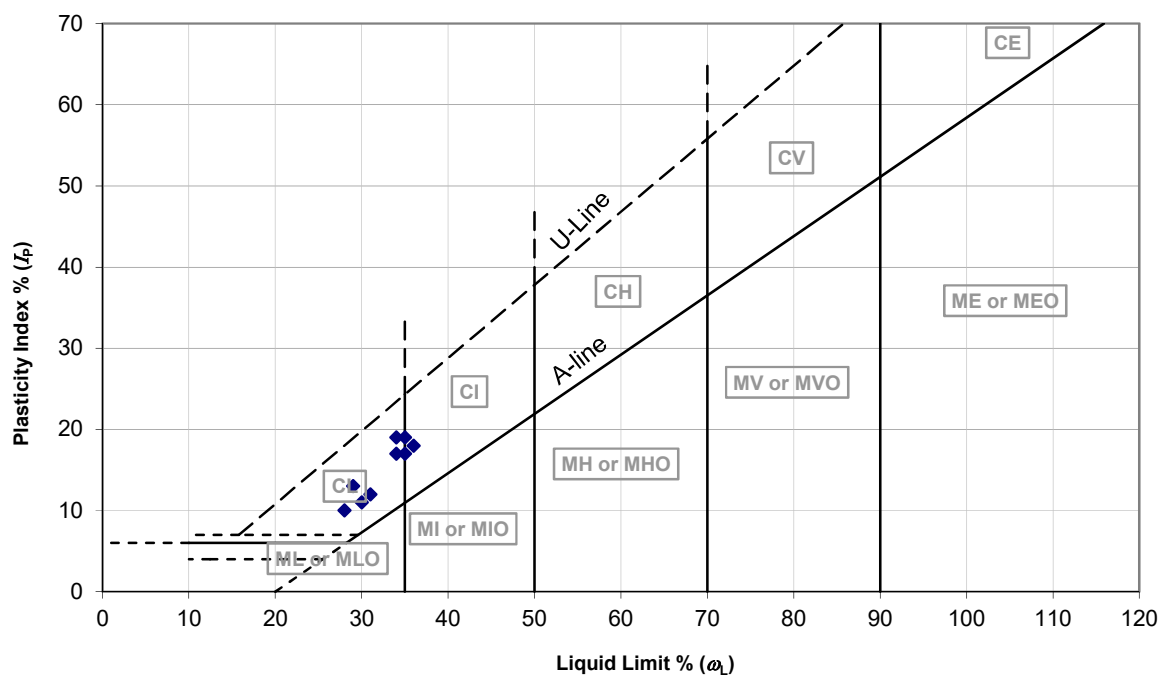
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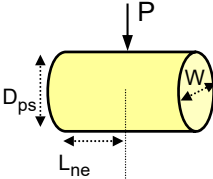
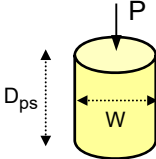
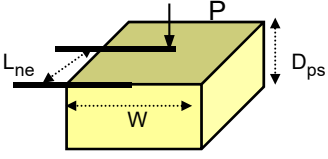
Input By: Harry

Client: Andrew Moseley Architects

Check By: Harry

Location	Depth (m)	Water Content (w) (%)	Liquid Limit (w_L) (%)	Plastic Limit (w_P) (%)	Plasticity Index (I_P) (%)	Retained by 0.425mm (%)	Modified (w) (w') (%)	Modified (I_P) (I_P') (%)	Liquidity/ Consistency		Casagrande Class	N.H.B.C Class (%)
									(I_L) (%)	(I_C) (%)		
WS02	1.60	16.5	31	19	12	13	19	10	-0.2	1.2	C L	LOW
WS02	2.60	18.4	35	18	17	9	20	15	0.0	1.0	C I	LOW
WS03	1.50	19.5	30	19	11	13	22	10	0.0	1.0	C L	*
WS03	2.60	16.3	35	16	19	12	19	17	0.0	1.0	C I	LOW
WS04	4.00	18.1	29	16	13	8	20	12	0.2	0.8	C L	LOW
WS05	1.60	20.5	28	18	10	15	24	9	0.3	0.8	C L	*
WS05	2.70	20.6	34	17	17	12	23	15	0.2	0.8	C L	LOW
WS05	3.70	20.7	36	18	18	1	21	18	0.2	0.9	C I	LOW
WS06	1.70	16.5	34	15	19	6	18	18	0.1	0.9	C L	LOW



				Point Load Strength Index Tests Summary of Results														
Project No. C3304/23/E/5028				Project Name Land off Fallows Way														
Borehole No.	Sample			Specimen		Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P kN	Equivalent diameter, De mm	Point Load Strength Index		Remarks (including water content if measured)
	Depth	Ref.	Type	Ref.	Depth		Type (D, A, I, B)	Direction (L, P or U)		Lne	W	Dps	Dps'			Is	Is(50)	
	m				m					mm	mm	mm	mm			MPa	MPa	
BH1	10.46	1	C	1	10.46	MUDSTONE	D	L	YES	34.0	87.0	87.0	80.0	0.1	83.4	0.0	0.0	
BH1	12.42	2	C	2	12.42	MUDSTONE	D	L	YES	53.0	87.0	87.0	73.0	2.1	79.7	0.3	0.4	
BH1	12.42	3	C	3	12.42	MUDSTONE	A	P	NO		87.0	40.0	54.0	1.0	77.3	0.2	0.2	
BH2	8.37	1	C	1	8.37	MUDSTONE	D	L	YES	50.0	87.0	87.0	80.0	0.0	83.4	0.0	0.0	
BH2	8.84	2	C	2	8.84	MUDSTONE	D	L	YES	60.0	87.0	87.0	77.0	0.0	81.8	0.0	0.0	
BH2	9.00	3	C	3	9.00	MUDSTONE	D	L	YES	50.0	87.0	87.0	78.0	0.0	82.4	0.0	0.0	
BH2	12.44	5	C	5	12.44	MUDSTONE	A	P	NO		87.0	92.0	88.0	1.0	98.7	0.1	0.1	
BH3	8.30	1	C	1	8.30	SANDSTONE	A	P	NO		87.0	50.0	44.0	1.0	69.8	0.2	0.2	
BH3	8.72	2	C	2	8.72	SANDSTONE	D	L	YES	40.0	87.0	82.0	79.0	3.1	82.9	0.5	0.6	
BH3	8.84	3	C	3	8.84	SANDSTONE	A	P	YES		87.0	47.0	41.0	1.4	67.4	0.3	0.4	
BH3	10.09	4	C	4	10.00	SANDSTONE	D	L	YES	50.0	87.0	87.0	84.0	0.4	85.5	0.1	0.1	
BH3	10.09	5	C	5	10.09	SANDSTONE	A	P	NO		87.0	60.0	56.0	1.5	78.8	0.2	0.3	
BH3	10.41	6	C	6	10.41	SANDSTONE	A	P	NO		87.0	70.0	61.0	1.0	82.2	0.2	0.2	
BH3	10.80	7	C	7	10.80	SANDSTONE	D	L	YES	60.0	87.0	87.0	84.0	0.4	85.5	0.1	0.1	
BH3	11.03	8	C	8	11.03	SANDSTONE	A	L	NO		87.0	73.0	66.0	3.6	85.5	0.5	0.6	
BH3	11.27	9	C	9	11.27	SANDSTONE	D	L	YES	40.0	87.0	87.0	83.0	0.6	85.0	0.1	0.1	
BH4	4.56	1	C	1	4.56	SANDSTONE	A	L	YES		87.0	79.0	70.0	5.7	88.1	0.7	0.9	
BH4	5.74	2	C	2	5.74	SANDSTONE	A	P	YES		87.0	65.0	62.0	4.4	82.9	0.6	0.8	
BH4	6.70	3	C	3	6.70	SANDSTONE	D	L	YES	40.0	87.0	87.0	84.0	3.9	85.5	0.5	0.7	
Test Type D - Diametral, A - Axial, I - Irregular Lump, B - Block Direction L - parallel to planes of weakness P - perpendicular to planes of weakness U - unknown or random Dimensions Dps - Distance between platens (platen separation) Dps' - at failure (see ISRM note 6) Lne - Length from platens to nearest free end W - Width of shortest dimension perpendicular to load, P Diametral  Axial  Block/irregular lump 																		
Test performed in accordance with ISRM Suggested Methods : 2007, unless noted otherwise Detailed legend for test and dimensions, based on ISRM, is shown above. Size factor, F = (De/50)0.45 for all tests.										Date Printed 27/07/2023		Approved By Harry		Table 1 sheet 1				

	Point Load Strength Index Tests Summary of Results
--	--

Project No.
C3304/23/E/5028

Project Name
Land off Fallows Way

[illegible]

Figure 1 illustrates three types of lumps: Diametral, Axial, and Block/irregular lump. Each diagram shows a yellow lump with a downward force P applied to its top surface. The Diametral lump has a diameter D_{ps} and a length L_{ne} , with a width W at the end. The Axial lump has a diameter D_{ps} and a width W . The Block/irregular lump has a height D_{ps} , a width W , and a length L_{ne} .

2



UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Project No.

Project Name

C3304/23/E/5028

Land off Fallows Way

[illegible]

Notes

- 1 ISRM p87 test 1, water content at 105 ± 3 oC, specimen as tested for UCS
 - 2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density
 - 3 ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials
- above notes apply unless annotated otherwise in the remarks

Mode of failure :

S - Single shear MS - multiple shear

AC - Axial cleavage F - Fragmented

Test Specification

International Society for Rock Mechanics, The complete ISRM suggested methods for Rock Characterization Testing and Monitoring, 2007

Date Printed

27/07/2023

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Table

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ENVIRONMENTAL TESTING RESULTS



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



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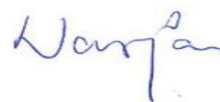
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Analytical Report Number : 23-38645

Project / Site name:	Fallows Way, Whiston	Samples received on:	09/06/2023
Your job number:	C3304 23 E	Samples instructed on/ Analysis started on:	09/06/2023
Your order number:	PO-2635	Analysis completed by:	17/06/2023
Report Issue Number:	1	Report issued on:	19/06/2023
Samples Analysed:	9 soil samples		



Signed:

Dominika Warjan
Reporting Specialist
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.

Analytical Report Number : 23-38645

Project / Site name: Fallows Way, Whiston

* 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 *
2709385	WS02	None Supplied	0.6	Brown clay and sand with gravel.
2709386	WS02	None Supplied	2.8	Brown clay and sand with gravel.
2709387	WS03	None Supplied	0.5	Brown clay and sand with gravel.
2709388	WS04	None Supplied	0.6	Brown gravelly sand with stones and vegetation.
2709389	WS04	None Supplied	2.6	Brown clay and sand with gravel.
2709390	WS05	None Supplied	0.5	Brown clay and sand with gravel.
2709391	WS05	None Supplied	1.9	Brown clay and sand with gravel.
2709392	WS06	None Supplied	0.6	Brown clay and sand with gravel and vegetation.
2709393	WS06	None Supplied	1.9	Brown clay and sand with gravel.

Analytical Report Number: 23-38645
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Lab Sample Number				2709385	2709386	2709387	2709388	2709389
Sample Reference				WS02	WS02	WS03	WS04	WS04
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.60	2.80	0.50	0.60	2.60
Date Sampled				07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	37	< 0.1
Moisture Content	%	0.01	NONE	14	14	13	11	13
Total mass of sample received	kg	0.001	NONE	0.5	0.9	0.5	0.5	0.9

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	Amosite- Loose Fibres	-
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	LFT	LFT	LFT	LFT	LFT

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7	7.5	6.3	8.6	6.9
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	%	0.005	MCERTS	0.441	-	0.038	0.119	-
Water Soluble Sulphate as SO4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	68	960	17	210	33
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.034	0.48	0.0083	0.1	0.016
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	34	479	8.3	104	16.4
Organic Matter (automated)	%	0.1	MCERTS	5.6	2.6	2.5	2.4	2.6

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	-
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.09	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.07	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.23	0.24	0.11	0.19	0.07
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.13	0.06	0.26	0.29	0.11
Pyrene	mg/kg	0.05	MCERTS	0.17	0.05	0.23	0.31	0.11
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.11	0.2	0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.16	0.31	0.08
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	< 0.05	0.2	0.45	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	< 0.05	0.07	0.18	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.14	0.38	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.1	0.36	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.12	0.48	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	< 0.80	< 0.80	1.5	3.36	< 0.80
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Analytical Report Number: 23-38645
Project / Site name: Fallows Way, Whiston
Your Order No: PO-2635

Lab Sample Number	2709385	2709386	2709387	2709388	2709389
Sample Reference	WS02	WS02	WS03	WS04	WS04
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.60	2.80	0.50	0.60	2.60
Date Sampled	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	30	12	15	9	11
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.8	1.6	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	21	-	-	22
Copper (aqua regia extractable)	mg/kg	1	MCERTS	57	30	62	380	37
Lead (aqua regia extractable)	mg/kg	1	MCERTS	56	22	76	390	45
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	52	37	23	26	28
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	31	27	26	28	23
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	67	50	100	300	67

Monoaromatics & Oxygenates

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	5	MCERTS	< 5.0	-	< 5.0	< 5.0	-
o-xylene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	< 5.0	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	-	< 5.0	< 5.0	-

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 _{HS_1D_AL}	mg/kg	0.001	NONE	< 0.001	-	< 0.001	< 0.001	-
TPH-CWG - Aliphatic >EC6 - EC8 _{HS_1D_AL}	mg/kg	0.001	NONE	< 0.001	-	< 0.001	< 0.001	-
TPH-CWG - Aliphatic >EC8 - EC10 _{HS_1D_AL}	mg/kg	0.001	NONE	< 0.001	-	< 0.001	< 0.001	-
TPH-CWG - Aliphatic >EC10 - EC12 _{EH_CU_1D_AL}	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	-
TPH-CWG - Aliphatic >EC12 - EC16 _{EH_CU_1D_AL}	mg/kg	2	MCERTS	< 2.0	-	< 2.0	3.1	-
TPH-CWG - Aliphatic >EC16 - EC21 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	< 8.0	-	< 8.0	10	-
TPH-CWG - Aliphatic >EC21 - EC35 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	< 8.0	-	< 8.0	120	-
TPH-CWG - Aliphatic (EC5 - EC35) _{EH_CU+HS_1D_AL}	mg/kg	10	NONE	< 10	-	< 10	130	-

TPH-CWG - Aromatic >EC5 - EC7 _{HS_1D_AR}	mg/kg	0.001	NONE	< 0.001	-	< 0.001	< 0.001	-
TPH-CWG - Aromatic >EC7 - EC8 _{HS_1D_AR}	mg/kg	0.001	NONE	< 0.001	-	< 0.001	< 0.001	-
TPH-CWG - Aromatic >EC8 - EC10 _{HS_1D_AR}	mg/kg	0.001	NONE	< 0.001	-	< 0.001	< 0.001	-
TPH-CWG - Aromatic >EC10 - EC12 _{EH_CU_1D_AR}	mg/kg	1	MCERTS	< 1.0	-	< 1.0	1.1	-
TPH-CWG - Aromatic >EC12 - EC16 _{EH_CU_1D_AR}	mg/kg	2	MCERTS	< 2.0	-	< 2.0	2.7	-
TPH-CWG - Aromatic >EC16 - EC21 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	< 10	-	< 10	< 10	-
TPH-CWG - Aromatic >EC21 - EC35 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	< 10	-	< 10	120	-
TPH-CWG - Aromatic (EC5 - EC35) _{EH_CU+HS_1D_AR}	mg/kg	10	NONE	< 10	-	< 10	130	-

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

Analytical Report Number: 23-38645
Project / Site name: Fallows Way, Whiston
Your Order No: PO-2635

Lab Sample Number	2709390	2709391	2709392	2709393
Sample Reference	WS05	WS05	WS06	WS06
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.50	1.90	0.60	1.90
Date Sampled	08/06/2023	08/06/2023	08/06/2023	08/06/2023
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	10
Total mass of sample received	kg	0.001	NONE	0.5

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	LFT	LFT	LFT	LFT

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.9	9.5	8.1	7.3
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	%	0.005	MCERTS	0.034	-	0.085	-
Water Soluble Sulphate as SO4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	31	190	160	72
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.016	0.097	0.082	0.036
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	15.6	97.3	82.4	36
Organic Matter (automated)	%	0.1	MCERTS	2.5	0.2	1.9	0.4

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	-	< 1.0	-
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.2	0.08	0.06	0.07
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.33	0.11	0.36	0.14
Pyrene	mg/kg	0.05	MCERTS	0.32	0.08	0.3	0.13
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.18	< 0.05	0.37	0.06
Chrysene	mg/kg	0.05	MCERTS	0.22	< 0.05	0.45	0.06
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	0.29	< 0.05	0.62	0.08
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.1	< 0.05	0.28	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.19	< 0.05	0.48	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.13	< 0.05	0.31	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.09	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.19	< 0.05	0.34	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	2.15	< 0.80	3.66	< 0.80
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Analytical Report Number: 23-38645
Project / Site name: Fallows Way, Whiston
Your Order No: PO-2635

Lab Sample Number				2709390	2709391	2709392	2709393
Sample Reference				WS05	WS05	WS06	WS06
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.50	1.90	0.60	1.90
Date Sampled				08/06/2023	08/06/2023	08/06/2023	08/06/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status				
Heavy Metals / Metalloids							
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	9.3	5.5	6.5	7.6
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.4	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	46	-	37
Copper (aqua regia extractable)	mg/kg	1	MCERTS	44	14	27	29
Lead (aqua regia extractable)	mg/kg	1	MCERTS	37	29	23	10
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	25	22	18	52
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	29	43	24	33
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	80	88	63	46

Monoaromatics & Oxygenates

Benzene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	-
Toluene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	-
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	-
p & m-xylene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	-
o-xylene	µg/kg	5	MCERTS	< 5.0	-	< 5.0	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	-	< 5.0	-

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 _{HS_1D_AL}	mg/kg	0.001	NONE	< 0.001	-	< 0.001	-
TPH-CWG - Aliphatic >EC6 - EC8 _{HS_1D_AL}	mg/kg	0.001	NONE	< 0.001	-	< 0.001	-
TPH-CWG - Aliphatic >EC8 - EC10 _{HS_1D_AL}	mg/kg	0.001	NONE	< 0.001	-	< 0.001	-
TPH-CWG - Aliphatic >EC10 - EC12 _{EH_CU_1D_AL}	mg/kg	1	MCERTS	< 1.0	-	< 1.0	-
TPH-CWG - Aliphatic >EC12 - EC16 _{EH_CU_1D_AL}	mg/kg	2	MCERTS	< 2.0	-	< 2.0	-
TPH-CWG - Aliphatic >EC16 - EC21 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	< 8.0	-	< 8.0	-
TPH-CWG - Aliphatic >EC21 - EC35 _{EH_CU_1D_AL}	mg/kg	8	MCERTS	< 8.0	-	< 8.0	-
TPH-CWG - Aliphatic (EC5 - EC35) _{EH_CU+HS_1D_AL}	mg/kg	10	NONE	< 10	-	< 10	-

TPH-CWG - Aromatic >EC5 - EC7 _{HS_1D_AR}	mg/kg	0.001	NONE	< 0.001	-	< 0.001	-
TPH-CWG - Aromatic >EC7 - EC8 _{HS_1D_AR}	mg/kg	0.001	NONE	< 0.001	-	< 0.001	-
TPH-CWG - Aromatic >EC8 - EC10 _{HS_1D_AR}	mg/kg	0.001	NONE	< 0.001	-	< 0.001	-
TPH-CWG - Aromatic >EC10 - EC12 _{EH_CU_1D_AR}	mg/kg	1	MCERTS	< 1.0	-	< 1.0	-
TPH-CWG - Aromatic >EC12 - EC16 _{EH_CU_1D_AR}	mg/kg	2	MCERTS	< 2.0	-	< 2.0	-
TPH-CWG - Aromatic >EC16 - EC21 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	< 10	-	< 10	-
TPH-CWG - Aromatic >EC21 - EC35 _{EH_CU_1D_AR}	mg/kg	10	MCERTS	< 10	-	< 10	-
TPH-CWG - Aromatic (EC5 - EC35) _{EH_CU+HS_1D_AR}	mg/kg	10	NONE	< 10	-	14	-

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

Analytical Report Number : 23-38645
Project / Site name: Fallows Way, Whiston

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
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
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.	L038-PL	D	MCERTS
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	A001-PL	D	ISO 17025
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 (Skalar)	L080-PL	W	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
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 (skalar)	L080-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
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
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.	L019-UK/PL	D	NONE
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS. Individual components MCERTS accredited	In-house method based on USEPA8260	L073B-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	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

Analytical Report Number : 23-38645
Project / Site name: Fallows Way, Whiston

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
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-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 - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Sample Deviation Report



Analytical Report Number : 23-38645

Project / Site name: Fallows Way, Whiston

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis. Please note that the associated result(s) may be unreliable and should be interpreted with care.

Key: a - No sampling date b - Incorrect container c - Holding time d - Headspace e - Temperature

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
WS02	None Supplied	S	2709385	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS02	None Supplied	S	2709385	b	TPHCWG (Soil)	L088/76-PL	b
WS03	None Supplied	S	2709387	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS03	None Supplied	S	2709387	b	TPHCWG (Soil)	L088/76-PL	b
WS04	None Supplied	S	2709388	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS04	None Supplied	S	2709388	b	TPHCWG (Soil)	L088/76-PL	b
WS05	None Supplied	S	2709390	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS05	None Supplied	S	2709390	b	TPHCWG (Soil)	L088/76-PL	b
WS06	None Supplied	S	2709392	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS06	None Supplied	S	2709392	b	TPHCWG (Soil)	L088/76-PL	b



Rogers Geotechnical Services: Soil Screening Values Comparison Sheet



Rogers Geotechnical Services Ltd: Soil Screening Value (SSV) Comparison Sheet															
Job Number	C3304/23/E/5028			A = WS Atkins PLC, Atrisk Soil Screening Values. A+ = Values updated June 2017 A* = Atrisk's SSV is lower than Chemtest'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.											
Job Name	Land off Fallows Way, Whiston			KEY Exceeds SSV Exceeds 2017, Below 2015 Below limit of detection (LOD) 											
Date	13/07/23			Sample Location	WS02	WS02	WS03	WS04	WS04	WS05	WS05	WS06	WS06		
Client	Andrew Moseley Architects			Depth Top	0.6	2.8	0.5	0.6	2.6	0.5	1.9	0.6	1.9		
				Depth Base											
Determinand	Units	Ref	LOD	Commercial 1%											
				Atrisk 2015 (No Free Product)	Atrisk 2017										
Cadmium	mg/kg	C	0.2		410	< 0.2	< 0.2	0.8	1.6	< 0.2	< 0.2	< 0.2	0.4	< 0.2	
Chromium (Hexavalent)	mg/kg	B/C	1.8	49.1	19.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	
Copper	mg/kg	A+	1.0		106000	57	30	62	380	37	44	14	27	29	
Mercury	mg/kg	A/D	0.3		350	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	
Nickel	mg/kg	A+	1.0		1770	52	37	23	26	28	25	22	18	52	
Lead	mg/kg	C	1.0		2310	56	22	76	390	45	37	29	23	10	
Zinc	mg/kg	A+	1.0		1100000	67	50	100	300	67	80	88	63	46	
Vanadium	mg/kg	A+	1.0		7490	31	27	26	28	23	29	43	24	33	
Arsenic	mg/kg	C	1.0		635	30	12	15	9	11	9.3	5.5	6.5	7.6	
Selenium	mg/kg	A	1.0		13000	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Cyanide (Free)	mg/kg	A	1.0		373	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Total Phenols	mg/kg	A	1.0		685	< 1.0		< 1.0	< 1.0		< 1.0		< 1.0		
Naphthalene	mg/kg	A+	0.05	90.1	75	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	
Acenaphthylene	mg/kg		0.05			< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	
Acenaphthene	mg/kg	A+	0.05	83600	156.8	< 0.05	< 0.05	< 0.05	0.09	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	
Fluorene	mg/kg	A+	0.05		66500	< 0.05	< 0.05	< 0.05	0.07	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	
Phenanthrene	mg/kg		0.05			0.23	0.24	0.11	0.19	0.07	0.2	0.08	0.06	0.07	
Anthracene	mg/kg	A+	0.05		535000	< 0.05	< 0.05	< 0.05	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	
Fluoranthene	mg/kg	A+	0.05		72200	0.13	0.06	0.26	0.29	0.11	0.33	0.11	0.36	0.14	
Pyrene	mg/kg	A+	0.05		54100	0.17	0.05	0.23	0.31	0.11	0.32	0.08	0.3	0.13	
Benzo[a]anthracene	mg/kg	A	0.05	131	1.71	< 0.05	< 0.05	0.11	0.2	0.05	0.18	< 0.05	0.37	0.06	
Chrysene	mg/kg	A	0.05	14000	0.44	< 0.05	< 0.05	0.16	0.31	0.08	0.22	< 0.05	0.45	0.06	
Benzo[b]fluoranthene	mg/kg	A	0.05	142	1.22	< 0.05	< 0.05	0.2	0.45	< 0.05	0.29	< 0.05	0.62	0.08	
Benzo[k]fluoranthene	mg/kg	A	0.05	1430	0.686	< 0.05	< 0.05	0.07	0.18	< 0.05	0.1	< 0.05	0.28	< 0.05	
Benzo[a]pyrene	mg/kg	B/C	0.05	76.3	26.1	< 0.05	< 0.05	0.14	0.38	< 0.05	0.19	< 0.05	0.48	< 0.05	
Indeno(1,2,3-c,d)Pyrene	mg/kg	A*	0.05	142	0.0614	< 0.05	< 0.05	0.1	0.36	< 0.05	0.13	< 0.05	0.31	< 0.05	
Dibenz(a,h)Anthracene	mg/kg	A	0.05	14.3	0.00393	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.09	< 0.05	
Benzo[g,h,i]perylene	mg/kg	A	0.05	1440	0.0187	< 0.05	< 0.05	0.12	0.48	< 0.05	0.19	< 0.05	0.34	< 0.05	
Total Of 16 PAH's	mg/kg		0.8			< 0.80	< 0.80	1.5	3.36	< 0.80	2.15	< 0.80	3.66	< 0.80	
Aliphatic TPH >C5-C6	mg/kg	A+	0.001	4490	327	< 0.001		< 0.001	< 0.001		< 0.001		< 0.001		
Aliphatic TPH >C6-C8	mg/kg	A+	0.001	10400	157	< 0.001		< 0.001	< 0.001		< 0.001		< 0.001		
Aliphatic TPH >C8-C10	mg/kg	A+	0.001	1370	82.4	< 0.001		< 0.001	< 0.001		< 0.001		< 0.001		
Aliphatic TPH >C10-C12	mg/kg	A+	1.0	7900	49.9	< 1.0		< 1.0	< 1.0		< 1.0		< 1.0		
Aliphatic TPH >C12-C16	mg/kg	A+	2.0	34000	20.9	< 2.0		< 2.0	3.1		< 2.0		< 2.0		
Aliphatic TPH >C16-C21	mg/kg	A+	8.0		3620000	< 8.0		< 8.0	10		< 8.0		< 8.0		
Aliphatic TPH >C21-C35	mg/kg	A+	8.0		3620000	< 8.0		< 8.0	120		< 8.0		< 8.0		
Aliphatic TPH >C35-C44	mg/kg		10.0												
Total Aliphatic Hydrocarbons	mg/kg		10.0			< 10		< 10	130		< 10		< 10		
Aromatic TPH >C5-C7	mg/kg	A+	0.001		12.5	< 0.001		< 0.001	< 0.001		< 0.001		< 0.001		
Aromatic TPH >C7-C8	mg/kg	A+	0.001	27900	834	< 0.001		< 0.001	< 0.001		< 0.001		< 0.001		
Aromatic TPH >C8-C10	mg/kg	A+	0.001	2210	613	< 0.001		< 0.001	< 0.001		< 0.001		< 0.001		



Rogers Geotechnical Services: Soil Screening Values Comparison Sheet



Rogers Geotechnical Services Ltd: Soil Screening Value (SSV) Comparison Sheet														
Job Number	C3304/23/E/5028			A = WS Atkins PLC, Atrisk Soil Screening Values. A+ = Values updated June 2017. A* = Atrisk's SSV is lower than Chemtest'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)										
Job Name	Land off Fallows Way, Whiston			RGS										
Date	13/07/23			Sample Location	WS02	WS02	WS03	WS04	WS04	WS05	WS05	WS06	WS06	
Client	Andrew Moseley Architects			Depth Top	0.6	2.8	0.5	0.6	2.6	0.5	1.9	0.6	1.9	
				Depth Base										
Determinand	Units	Ref	LOD	Commercial 1%										
Aromatic TPH >C10-C12	mg/kg	A+	1.0	12300	369	< 1.0		< 1.0	1.1		< 1.0		< 1.0	
Aromatic TPH >C12-C16	mg/kg	A+	2.0	41300	155	< 2.0		< 2.0	2.7		< 2.0		< 2.0	
Aromatic TPH >C16-C21	mg/kg	A+	10.0		28400	< 10		< 10	< 10		< 10		< 10	
Aromatic TPH >C21-C35	mg/kg	A+	10.0		28400	< 10		< 10	120		< 10		< 10	
Aromatic TPH >C35-C44	mg/kg		10.0											
Total Aromatic Hydrocarbons	mg/kg		10.0			< 10		< 10	130		< 10		14	
Total Petroleum Hydrocarbons	mg/kg		10.0											
pH			N/A			7		7.5	6.3		8.6		6.9	
Sulphate (2:1 Water Soluble) as SO4	g/l		0.0013			0.034		0.48	0.0083		0.1		0.016	
ACM Type			N/A			-		-	Amosite-Loose Fibres		-		-	
Asbestos Identification	%					None		None	Detected		None		None	
ACM Detection Stage			N/A			-		-	-		-		-	
Moisture	%		0.01			14		14	13		11		13	
Soil Colour			N/A											
Other Material			N/A											
Soil Texture			N/A											
Sulphate (Total)	%		0.005			0.441		-	0.038		0.119		-	
Organic Matter	%		0.1			5.6		2.6	2.5		2.4		2.6	
													2.5	
													0.2	
													1.9	
													0.4	



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End of Report



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