Environmental
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PHASE 2 GEO-ENVIRONMENTAL REPORT

job number C417/19/E/625	date 06/01/21

site address
Land off Cross Street
Monk Bretton
Barnsley
S71 7EP

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Report on a Phase 2 Geo-environmental Investigation

Location:	Land off Cross Street, Monk Bretton, Barnsley, S71 7EP.
For:	Redfearn Construction
Consultants:	MBooth Design Ltd
Report No.	C417/19/E/625 Report date: January 2021

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

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Geotechnical Engineer

Dr. Mike Cook BSc PhD
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Report Summary[1]

Item	Comments	Section
Development	Erection of a number of new residential houses with associated access roads, gardens and hard-standing.	1.
Geology	Superficial geology – None Recorded. Solid geology – Pennine Middle Coal Measures Formation – Oaks Rock	5.
Strata Conditions	Variable thickness of topsoil and made ground with underlying very gravelly fine to medium sand with high sandstone cobble content onto shallow sandstone bedrock.	6.
Groundwater	None encountered during investigation.	6.2
Foundation Design	Shallow (strip/spread) foundation solution.	10.1
Effect of Sulphates	DC-1 concrete.	10.5
Contamination	No significant contamination revealed in regards to the proposed end use.	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.

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1. Introduction

It is understood that the land off Cross Street, Monk Bretton, Barnsley, S71 7DE is to be developed by the construction of a number of new residential houses with associated access roads, gardens and hard-standing. Consequently, a site investigation has been undertaken in accordance with the instruction from the client. This work was required in order to determine the nature of the underlying soils, to assess their engineering properties and to assist in the design of safe and economical foundations for the proposed development. This investigation also takes into consideration the risk of any contamination present. This report describes the work undertaken, presents the data obtained and discusses the ground conditions in relation to the proposed works.

2. Limitations

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

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

3. Desk Study

A Phase 1 Desk Study has been undertaken by Rogers Geotechnical Services (RGS) and the results were presented as report number J3707/16/EDS in December 2016. This report has been used extensively during the current intrusive investigation.

4. Fieldworks

The fieldworks were undertaken on the 19th November 2020 and included the following:

- Four windowless sample boreholes.
- Soakaway infiltration testing within three of the boreholes.
- Four dynamic probes.
- Three gas monitoring standpipes.
- Four TRL probes.

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 generally 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 Dynamic Probes

Dynamic penetration tests were undertaken adjacent to the windowless sample boreholes 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.

4.3 Borehole Soakaway Infiltration Testing

Soakaway infiltration testing was conducted within three of the windowless sample boreholes, the position of which are indicated on the site plan within Appendix 1. The infiltration testing was undertaken at the base of the boreholes, at depths where granular soils became apparent. Upon reaching the chosen depth, the casing was pulled 50mm to create a response zone. It should be appreciated that given the nature of the soils revealed at depth, a larger response zone could have resulted in borehole collapse. Testing results can be seen presented in Appendix 4.

4.4 TRL Dynamic Probes

Four TRL Dynamic Cone Penetrometer tests were undertaken in the region of the proposed access road onto site. The penetrometer consists of an 8kg slide hammer falling through 575mm onto an anvil, which drives a 20mm diameter 60° cone into the ground. The depth of the cone driven per blow of the hammer is recorded. The results of the dynamic penetration tests are presented as Appendix 5 and include tabulated results of penetration, blows and CBR values versus depth. The percentage CBR value has been obtained from the correlation provided in TRRL Road Note 8 which is given below:

$$\text{Log10(CBR)} = 2.48 - 1.057\text{Log10(mm/blow)}$$

4.5 Gas Monitoring Standpipes

Gas monitoring standpipes were installed to 1.0m depth in three of the boreholes (WS1, 2 and 4) 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 0.5m 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.

5. Geology

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

Table 1: Geological Data for the Site

Strata Type	Strata Name[2]	Previous Name[3]	Description[3]
Superficial Geology	-	-	None Recorded
Solid Geology	Pennine Middle Coal Measures Formation - Oaks Rock	Middle Coal Measures	The coal measures are generally described as interbedded grey mudstone, siltstone, pale grey sandstone and commonly coal seams. Oaks Rock is a named sandstone member of the Formation

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	TOPSOIL (Dark brown very sandy organic SILT with grass and moss cover).	WS1	None
0.15	MADE GROUND (Light greyish brown sub-angular fine to coarse GRAVEL of broken concrete).	WS1	None
0.35 - 0.5	TOPSOIL (Dark brown slightly gravelly very sandy organic SILT. Gravel is sub-angular fine to coarse of sandstone).	ALL	None
+1.0 - +1.9	Medium dense initially dark becoming light orangish brown very gravelly fine to medium SAND with high sandstone cobble content. Gravel is sub-angular fine to coarse of sandstone.	ALL	None

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

6.1 General Strata

In general, the borehole records indicate that beneath a 0.35m to 0.5m capping of topsoil, medium dense very gravelly fine to medium sands with high sandstone cobble content were revealed to the windowless sample refusal depths of between 1.0m and 1.9m below ground level (bgl) within all positions.

[2] Sources: British Geological Survey (NERC) Map Sheet 87; Barnsley; Solid and Drift Edition, and Geology of Britain Viewer [*online resource from www.bgs.ac.uk*]
[3] Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [*online resource from www.bgs.ac.uk*]

6.2 Groundwater

No groundwater strikes were observed during the site investigation. 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.

7. Insitu Testing

7.1 Dynamic Penetration Tests

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

Table 3: Summary of Dynamic Penetration Tests

Position	Blows/100mm			Refusal type (Effective/ Abrupt)[4]	Comments
	0 - 2	3 - 10	10+		
	Depth to which blow count range was observed (m)				
DP1	0.5	1.3 2.9	1.8 3.155	Abrupt	Refusal at 3.155m. 25 blows over 55mm.
DP2	0.4	1.4 2.3	1.9 2.48	Abrupt	Refusal at 2.48m. 25 blows over 80mm.
DP3	0.3	1.2 1.9	1.4 2.06	Abrupt	Refusal at 2.06m. 25 blows over 60mm.
DP4	0.5	1.3	1.53	Abrupt	Dead Stop at 1.53m

7.2 TRL Dynamic Probes

TRL dynamic probes were undertaken in the base of the cored trial pit positions. A summary of the results is presented below:

Table 4: TRL Probe Test Results

TRL Location	Top of later (m)	Base of layer (m)	Minimum CBR (%)	Average CBR (%)
TRL 1	0.075	0.9	3	19
TRL 2	0.18	0.9	3	59
TRL 3	0.17	0.75	3	63
TRL 4	0.13	0.47	2	19
	0.47	0.66	26	132

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

7.3 Soakaway Tests

The results obtained from the borehole soakaway infiltration testing are summarised below:

Table 5: Soakaway Test Results

Location	Soakage Area Dimensions (m)	Test Depth (m)	Soil Description	Infiltration Rate (m/sec)	Drainage Characteristics
WS1	Diameter – 0.15m Response – 0.05m	0.95 – 1.0m	Gravelly SAND	1.3×10^{-5}	Good
WS2	Diameter – 0.15m Response – 0.05m	0.95 – 1.0m	Gravelly SAND	9.8×10^{-5}	Good
WS4	Diameter – 0.15m Response – 0.05m	0.95 – 1.0m	Gravelly SAND	2.0×10^{-5}	Good

Soakaway testing has shown the subsurface natural material to posess an good infiltration rate. These results show it may be possible to employ soakaways within the weathered fraction of the underlying solid geology. As such, a suitable design would be required to ensure an appropriate storage volume.

7.4 Gas and Water Level Monitoring

The standpipes were monitored between the 30th November and the 22nd December 2020. The results of the gas monitoring undertaken are tabulated below.

Table 6: Gas Monitoring

Location	Date	CH_4 (%)	CO_2 (%)	O_2 (%)	Flow (l/h)	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)
WS1	30.11.20	0.1	0.2	21.5	0.1	1005↑	1.0	1.0
	07.12.20	0.1	0.4	21.1	0.1	986↔	-	
	14.12.20	0.1	0.5	20.9	0.1	980↔	-	
	22.12.20	0.1	0.5	21.3	0.1	999↔	-	
WS2	30.11.20	0.1	0.5	21.3	0.1	1006↑	-	1.0
	07.12.20	0.1	0.5	21.3	0.1	986↔	-	
	14.12.20	0.1	0.5	20.8	0.1	980↔	-	
	22.12.20	0.1	0.6	21.2	0.1	999↔	-	
WS4	30.11.20	0.1	0.2	21.3	0.1	1006↑	-	1.0
	07.12.20	0.1	0.1	20.6	0.1	986↔	-	
	14.12.20	0.1	0.1	20.2	0.1	980↔	-	
	22.12.20	0.1	0.2	19.7	0.1	999↔	-	

↑ - 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 12th November 2020.

8. Laboratory Testing - Geotechnical

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

- Particle size distribution (Dry sieve) — BS EN ISO 17892: 2016: Pt 4: 5.2
- Particle size distribution (Wet sieve) — BS EN ISO 17892: 2016: Pt 4: 5.2
- Sedimentation by pipette — BS EN ISO 17892: 2016: Pt 4: 5.3/5.4
- Soluble sulphate content — BS 1377: 1990: Pt3: 5
- pH value — BS 1377: 1990: Pt3: 9

The test results are presented in Appendix 6 and are summarised below:

Table 7: Summary of Geotechnical Test Results

Test type	Number of tests	Range of results		Comments	
Particle size distribution (Dry sieve)	2	Cobbles Gravel Sand Fines	0% to 16% 51% to 61% 25% to 31% 8%	Uniformity coefficient Curvature coefficient	150 & 190 0.21 & 0.076
Particle size distribution (Wet sieve)	1	Gravel Sand Fines	47% 43% 10%	Uniformity coefficient Curvature coefficient	160 0.17
Particle size distribution (Wet sieve and sedimentation)	1	Gravel Sand Silt Clay	42% 48% 6% 4%	Uniformity coefficient Curvature coefficient	54 0.32
Soluble sulphate & pH	3	SO_4 pH	<0.010 to 0.077g/l 6.5 to 8.9		

8.1 Geotechnical Properties

The idealised geotechnical properties employed in design are summarised below.

Table 8: Summary of Geotechnical Properties

Property	Range of values	Comments
Concrete classification	DC1	Natural ground locations (Static water)

9. Laboratory Testing - Environmental

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

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

This testing was undertaken by Chemtest Ltd and the results of all of the chemical testing are presented in Appendix 6 of this report.

10. Discussion of Ground Conditions - Geotechnical

It is understood that the site is to be developed by the construction of a number of new residential houses with associated access roads, gardens and hard-standing. At the time of writing this report the layout and building types have not been finalised, thus the discussion below is of a generalised nature.

It cannot be recommended that foundations be constructed directly within the made ground or soft near surface deposits revealed at this site. These soils are present in a weak and variable condition such that excessive total and or differential settlement could occur under moderately light surface loading. In broad terms, therefore, it is considered that the foundations could be placed on shallow strip or spread foundations placed within the granular weathered fraction of the underlying solid geology.

10.1 Strip and Spread Foundations

It cannot be recommended that foundations be constructed directly within the made ground or weak near surface soils. The results of this investigation indicate that weathered fraction of the underlying solid geology were generally revealed as medium dense very gravelly sand/very sandy gravel at depths in excess of 0.5m. Footings could therefore be placed at depths of around 1.0m, within sand/gravel generally described as medium dense.

In view of the above, foundations could be designed assuming an allowable increase in stress given in the following table:

Table 9: Allowable Bearing Pressure

Foundation Type		Strip Footings		Spread Footings	
Foundation Breadth	B (m)	0.6	1.0<	0.6	1.0<
Foundation Depth	D (m)	1.0		1.0	
Allowable Increase in Stress	(kN/m²)	75	125	90	150

The allowable increase in stress given above assumes settlements of less than 25mm, with an SPT ‘N’ value of 15 at the foundation depths and provided that the underlying soils are carefully inspected immediately final trimming has taken place.

Should made ground or any weak zones be revealed in the excavation bases, they should be removed and replaced by suitably compacted granular soil or lean-mixed concrete. Should excavations be required to stand open for any length of time, it will be necessary to place a blinding layer of lean-mixed concrete 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.

10.2 General Comments for Excavations

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

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

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

10.3 Ground-floors

In light of the made ground and weak near surface soils, which were revealed to depths of up to 0.5m, it is not recommended that ground bearing ground floor slabs be employed. In this instance it would be necessary to suspend floors between foundation positions, such that the floor loads are transmitted via the foundations to competent soils at depth.

10.4 Hard-standing Areas

It is considered that any hard-standing at the site could be constructed employing traditional pavement design. A design California Bearing Ratio (CBR) of 3% could be employed in the pavement design[5]. However, it is recommended that proof rolling of the sub-grade be undertaken to establish the suitability of the soils, to expose any soft or weak ground and to ensure the sub-grade is well compacted prior to construction. Any areas of soft or weak ground should be remediated by increasing the sub-base thickness. Alternatively, weak material could be locally removed and replaced with a compacted granular capping layer. If construction were to be undertaken during the winter or after periods of prolonged rainfall, it may be prudent to employ a geotextile and/or a geogrid between the sub-base and sub-grade.

10.5 Effect of Sulphates

In view of the nature of the underlying soils it is considered that the design sulphate class be assessed with reference to Table C2[6], 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-1.

[5] Table 11.1, *Reproduction of TRRL Report LR1132 (1984)*, Smith (2006), Smith's Elements of Soil Mechanics, 8th ed.
[6] Table C2, *Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations*

In order to evaluate the design chemical (DC) class for the buried concrete at this site reference should be made to Table D1[7], which can be found in Part D, *Specifying concrete for general cast-in-situ use,* of BRE Special Digest 1. From this table it may be shown that for an intended working life of at least 50 years the concrete design class DC-1 is required.

11. Discussion of Ground Conditions - Environmental

11.1 Discussion of Test Results

It is understood that the site is to be developed by the construction of a number of new residential houses with associated access roads, gardens and hard-standing. Consequently, the site may be classified as residential with plant uptake.

11.1.1 Soil Samples

The results of the chemical testing undertaken on soil samples obtained during this investigation have been compared to the ATRISK soil screening values (SSVs) as compiled by WS Atkins plc. With respect to the results it should be appreciated that the soil organic matter (SOM) content for the samples tested was found to range between below <0.40% and 2.4%. On this basis, it is considered that the screening values associated with 1% SOM should be adopted. These values have been derived in such a way as to adhere to the principles within the revised CLEA model and include the most current release of the SGVs. A list of subscribers is provided within the website[8] and these include many local authorities.

A comparison of the results of the testing, together with the data given above, can be found within Appendix 6. These results indicate the following:

Table 10: Summary of Contaminated Areas

Location	Depth (m)	Contaminants found to be exceeding SSVs (Residential with plant uptake)
WS1	0.0 – 0.5	None.
WS2	0.5 – 1.0	None.
WS4	0.0 – 0.5	None.

Concentrations of chromium(VI), cyanide, phenols (total), some PAHs and total petroleum hydrocarbons (aliphatic C5 to C44; aromatic C5 to C44) were below the detection limits for the tests. Detectable levels of all other contaminants were recorded, but these fell below the associated Atrisk Soil Screening Values. In addition, no asbestos or PCBs were detected within the soils samples tested.

On the basis of the above information, the results of the investigation have concluded that the site is generally uncontaminated with respect to the intended end use.

[7] 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.*
[8] http://www.atrisksoil.co.uk/pages/general/subscribers.asp

11.1.2 Gas Concentrations

With respect to ground gas, the results of the monitoring visits indicated a maximum concentration of 0.1% methane, with concentrations of carbon dioxide ranging between 0.1% and 0.6%, in association with oxygen levels of between 19.7% and 21.5%. It should be appreciated that on non-contaminated sites there is generally about 20% by volume of oxygen, associated with low levels of carbon dioxide. In addition, a maximum flow rate of 0.1 litres per hour was recorded and will be employed in the following calculations.

The principal driving force for initiating the movement of gas in the ground is a change in barometric pressure. The most onerous gas condition on a site is usually observed on days of low or falling barometric pressure, preferably below 1000mb. It has been noted that measurements undertaken solely during high pressure conditions may be of lesser value. At this site the readings undertaken were at atmospheric pressures of between 980mb and 1006mb.

In order to establish the gas screening value (GSV) for carbon dioxide or methane, the maximum gas concentration (expressed as a decimal) is multiplied by the borehole flow rate (l/hr). In this case 0.1% (0.001) methane was recorded along with 0.6% (0.006) carbon dioxide, in association with a maximum flow rate of 0.1 l/hr. This results in a GSV of 0.0001 l/hr for methane and a GSV of 0.0006 l/hr for carbon dioxide.

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

With regard to the number of monitoring visits required reference is made to Tables 5.5a and 5.5b of CIRIA report C665 (2007)[9]. Accepting that the proposed development is of moderate sensitivity and that the generation potential is very low, these tables suggest that 6 readings could be undertaken over a period of 2 months. However, C665 notes that *not all sites will require gas monitoring for the period and frequency indicated in Tables 5.5a and 5.5b.*

In this case, a total of 4 monitoring visits were undertaken over a four week time period and for the purpose of this assessment, it is considered that the site can be provisionally classified as Characteristic Situation Level 1. However, it should be appreciated that the ground gas monitoring to date was undertaken during periods of both high and low barometric pressure and thus represents a wide range of eventualities.

Therefore, whilst it is recommended that two further monitoring visits are undertaken within the next two months as recommended by the CIRIA report C665 (2007), it may be possible to hold discussions with the local authority about the possibility of curtailing the monitoring with the current set of results.

In light of the above, it is considered that following the additional monitoring visits, should there be no significant change in ground gas conditions, the site can be fully classified as *Characteristic Situation Level 1* and no specific remediation will be required to protect against bulk ground gases. However, for costing purposes it is recommended that *Characteristic Situation Level 2* is assumed in order to ensure that all possible costs are considered.

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

11.2 Site Specific Risk Assessment

11.2.1 Approach

The presence of contamination hazards and the risks associated with them should be assessed in accordance with industry practice and the 'suitable for use' approach. This has been conducted with reference to The Department for Environment, Food and Rural Affairs (DEFRA) and The Environment Agency[10] advice on the assessment of risks arising from the presence of contamination in soils and using the source-pathway-receptor approach.[11] 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.'[12]

11.2.2 Conceptual Ground Model and Risk Assessment

In view of the results of the chemical testing undertaken the conceptual site model is presented accordingly as Table 11. Sources of contamination include the following:

On-site – None.

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.

[10] 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'.
[11] 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.
[12] 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

Conceptual Site Model			Site Specific Risk Assessment	
Pathways	**Receptor**	**Linkage Present?**	**Risk Rating**	**Notes**
Direct contact/dermal absorption/soil ingestion	Operative	Yes – however, no contamination found to be present on site.	Low	No further action required.
	End User		Low	
	Neighbours		Low	
Inhalation of Dust/Vapours	Operative	Yes – however, no contamination found to be present on site.	Low	No further action required.
	End User		Low	
	Neighbours		Low	
Ingestion of fruit/vegetables and/or waters	Operative	Yes – however, no contamination found to be present on site.	Low	No further action required.
	End User		Low	
	Neighbours		Low	
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	Yes – low concentrations of methane and carbon dioxide have been found to be present at the site (assuming *Characteristic Situation Level 1*).	Low to Moderate	Low concentrations of harmful gases (methane and carbon dioxide) were detected at the site. If ground gas conditions remain the same, no special precautionary measures are deemed to be required.
	End User		Low to Moderate	
	Neighbours	Yes – low concentrations of methane and carbon dioxide have been found to be present at the site (assuming Characteristic Situation Level 1). Furthermore, no structures directly adjoin the site, therefore gases migrating from the site would vent to atmosphere before reaching neighbouring structures.	Low	

Spillage/loss/run off direct to receiving water	Controlled Waters	Yes – however, no contamination found to be present on site.	Low	
Migration via permeable unsaturated strata	Controlled Waters	Yes – however, no contamination found to be present on site.	Low	
Run off via drainage/sewers etc	Controlled Waters	Yes – however, no contamination found to be present on site.	Low	
Direct contact with contaminated soils	Plants	Yes – soft landscaping is proposed in the new development, however, no contamination found to be present on site.	Low	
Uptake via root system			Low	
Direct contact with contaminated soils	Building Materials	Yes – however, concentrations of contamination found to be present on site are not considered to represent a risk to pipework. Moreover, testing indicates that the aggressive chemical environment for concrete classification is AC-1.	Low (plastic services)	Please see section 11.3.3 for information on good building practice.
Direct contact with contaminated groundwater			Low (buried concrete)	
Exposure to Radon	Operative	Yes – In a lower risk radon affected area.	Low	Between 1% and 3% of properties are above the action level. BR211 states that no radon protection measures are required.
	End User			

11.3 Indicative Remediation Strategy

In view of the site specific risk assessment it is considered that it will not be necessary to undertake any specific remediation at this site. It should be appreciated, however, that careful inspection of the subgrade should be made during the groundworks. Should areas of contamination be detected then further testing may become necessary.

11.3.1 General Approach to Construction

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 fundamental principles of identifying potentially contaminated soils and the hazards of working with such soils not identified by the ground investigation.
- Personal hygiene facilities, including washing and messing, must be provided and site operatives 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.
- Where vehicles are transferring soil to landfill site they should be covered to prevent any potential contamination of the surrounding area by dust.
- Any stockpiles of contaminated soil that maybe subsequently be found on site should be sheeted over to prevent excessive amounts of airborne dust and may require Waste Assessment Criteria (WAC) testing before transfer to an appropriate licensed landfill site.
- 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 any potential 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.
- New plastic services should be constructed in a surround of clean inert material and selected in accordance with the recommendation given in the United Kingdom Water Industry Research (UKWIR) website under Report Ref. No. 10/WM/03/21 - 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites'. The statutory water authority for the area in which site is located may have a risk assessment form to complete which allows these recommendations to be met. However, further determinand specification contamination testing may be necessary.
- For buried concrete the results of the sulphate and pH testing indicate that the design sulphate class for the site should be DS-1.

11.4 Fill Materials

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

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

- It is a suitable growing media if it is to be employed as such, including compliance with BS3883 (2007)
- It is free from obvious contamination i.e. visual or olfactory evidence
- It has not come from areas where Japanese Knotweed or other invasive or injurious plants are suspected to be growing
- It is not a statutory nuisance, such as being odorous
- It is free from unsuitable material i.e. whole bricks, brick ties, timber or glass.

It should also be appreciated that any fill should be subjected to validation testing to assess its suitability. The following table has been taken from YALPAG[13] 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).

[13] *YALPAG Technical Guidance for Developers, Landowners and Consultants – Verification Requirements for Cover Systems V3.3* Appendix 1a, October 2016.

Table 12: Validation Sampling and Testing		
Fill Type	**Frequency**	**Minimum Determinands**
Virgin Quarried Material	1 or 2 depending on the type of stone (to confirm the inert nature of the material)	Standard metals/metalloids (As, Cd, Cr, Cr(VI), Cu, Hg, Ni, Pb, Se, Zn)
Crushed Hardcore, Stone, Brick	Minimum 1 per 1000m³	Standard metals/metalloids as above plus PAH (16 USEPA) and Asbestos
Greenfield/ Manufactured Soils	The greater of a minimum of 3 or 1 per 250m³	Standard metals/metalloids as above plus PAH (16 USEPA) and Asbestos
Brownfield/ Screened Soils	The greater of a minimum of 6 or 1 per 100m³	Standard metals/metalloids as above plus PAH (16 USEPA), TPH (CWG banded) and Asbestos Any additional analysis dependant on the history of the donor site.

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

Table 13: Fill Screening Values			
Contaminant	**Screening Value (Residential with Plant Uptake) (mg/kg)**		**Reference**
	1% SOM	**6% SOM**	
As	37	37	Atrisk^{SOIL} SSVs
Cd	22.1	22.1	Atrisk^{SOIL} SSVs
Cr(VI)	3.62	3.63	Atrisk^{SOIL} SSVs
Cu	4730	4790	Atrisk^{SOIL} SSVs
Hg	8.81	15.8	Atrisk^{SOIL} SSVs
Ni	136	136	Atrisk^{SOIL} SSVs
Pb	200	200	Atrisk^{SOIL} SSVs
V	136	138	Atrisk^{SOIL} SSVs
Zn	20000	20300	Atrisk^{SOIL} SSVs

Please see summary sheet within Appendix 7 for full screening values including PAHs & TPHs.

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

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

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

11.5 Verification Report

Should fill materials be imported for use on site, it will be necessary to produce a verification report for submission to any statutory authorities. This report should include 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.

The report detailed above should be produced by a suitably qualified engineer.

12. Recommendations for Further Work

- This report should be forwarded to the relevant authorities as soon as practicable to ensure they have sufficient time to review and discuss any issues.
- Completion and reporting of recommended additional gas monitoring.
- Detailed design of the sub-structure.

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

13. References

- British Geological Survey (NERC) (2021), BGS, Keyworth.
  - Geology of Britain Viewer: (*http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html)*
  - Lexicon of Named Rock Units:
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  - Part C: *Assessing the aggressive chemical environment.*
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- 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.
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- 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

C417/19/E/625 - Land off Cross Street, Monk Bretton, Barnsley

WS Position

WS with BH soak & Gas Install

TRL Probe location

Environmental Geotechnical Specialists

Appendix 2

Borehole Records

Borehole Log

Borehole No. **WS1**

Sheet 1 of 1

Project Name: Land off Cross Street	Project No. C417/19/E/625	Co-ords:	Hole Type WLS
Location: Monk Bretton, Barnsley		Level:	Scale 1:50
Client: Redfearn Construction		Dates: 19/11/2020	Logged By DnG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.60 - 1.00	D	87	100		0.10			TOPSOIL (Dark brown very sandy organic SILT with grass and moss cover).
							0.15			MADE GROUND (Light greyish brown sub-angular fine to coarse GRAVEL of broken concrete).
							0.50			TOPSOIL (Dark brown slightly gravelly very sandy organic SILT. Gravel is sub-angular fine to coarse of sandstone).
							1.00			Medium dense initally dark becoming light orangish brown very gravelly fine to medium SAND with high sandstone cobble content. Gravel is sub-angular fine to coarse of sandstone.
										End of Borehole at 1.00m

Remarks

Windowless sample refusal at 1m depth.

Borehole Log

Borehole No. **WS2**

Sheet 1 of 1

Project Name:	Land off Cross Street	Project No. C417/19/E/625	Co-ords:
Location:	Monk Bretton, Barnsley		Level:
Client:	Redfearn Construction		Dates: 19/11/2020

Hole Type: WLS

Scale: 1:50

Logged By: DnG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
				87	100		0.35			TOPSOIL (Dark brown slightly gravelly very sandy organic SILT with grass and moss cover. Gravel is sub-angular fine to coarse of sandstone).
							1.00			Medium dense initally dark becoming light orangish brown very gravelly fine to medium SAND with high sandstone cobble content. Gravel is sub-angular fine to coarse of sandstone.
										End of Borehole at 1.00m

Remarks

Windowless sample refusal at 1m depth.

Borehole Log

Borehole No. **WS3**

Sheet 1 of 1

Project Name: Land off Cross Street	Project No. C417/19/E/625	Co-ords:	Hole Type WLS
Location: Monk Bretton, Barnsley		Level:	Scale 1:50
Client: Redfearn Construction		Dates: 19/11/2020	Logged By DnG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.50 - 1.00	D	87	100		0.40			TOPSOIL (Dark brown slightly gravelly very sandy organic SILT with grass and moss cover. Gravel is sub-angular fine to coarse of sandstone).
		1.20 - 1.80	D	77	100					Medium dense initally dark becoming light orangish brown very gravelly fine to medium SAND with high sandstone cobble content. Gravel is sub-angular fine to coarse of sandstone.
							1.90			End of Borehole at 1.90m

Remarks

Windowless sample refusal at 1.9m depth.

Borehole Log

Borehole No. **WS4**

Sheet 1 of 1

Project Name:	Land off Cross Street	Project No. C417/19/E/625	Co-ords:
Location:	Monk Bretton, Barnsley		Level:
Client:	Redfearn Construction		Dates: 19/11/2020

Hole Type: WLS

Scale: 1:50

Logged By: DnG

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.60 - 1.00	D	87	100		0.35			TOPSOIL (Dark brown slightly gravelly very sandy organic SILT with grass and moss cover. Gravel is sub-angular fine to coarse of sandstone).
							1.00			Medium dense initally dark becoming light orangish brown very gravelly fine to medium SAND with high sandstone cobble content. Gravel is sub-angular fine to coarse of sandstone.
										End of Borehole at 1.00m

Remarks

Windowless sample refusal at 1m depth.

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Appendix 3

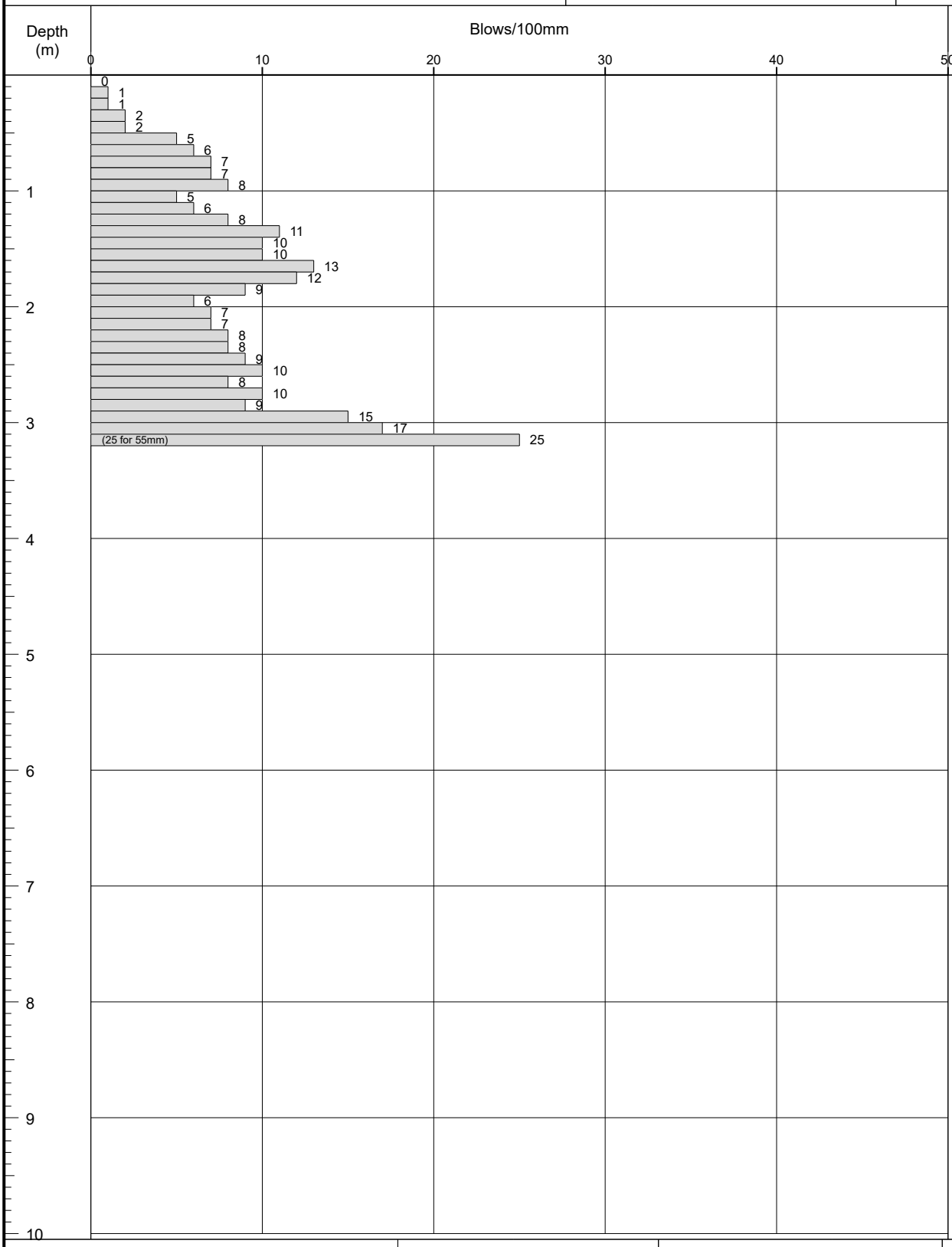
Dynamic Probing Records

Probe Log

Probe No. **DP1**

Sheet 1 of 1

Project Name: Land off Cross Street	Project No. C417/19/E/625	Co-ords:	Hole Type DCP
Location: Monk Bretton, Barnsley		Level:	Scale 1:50
Client: Redfearn Construction		Dates: 19/11/2020	Logged By AB



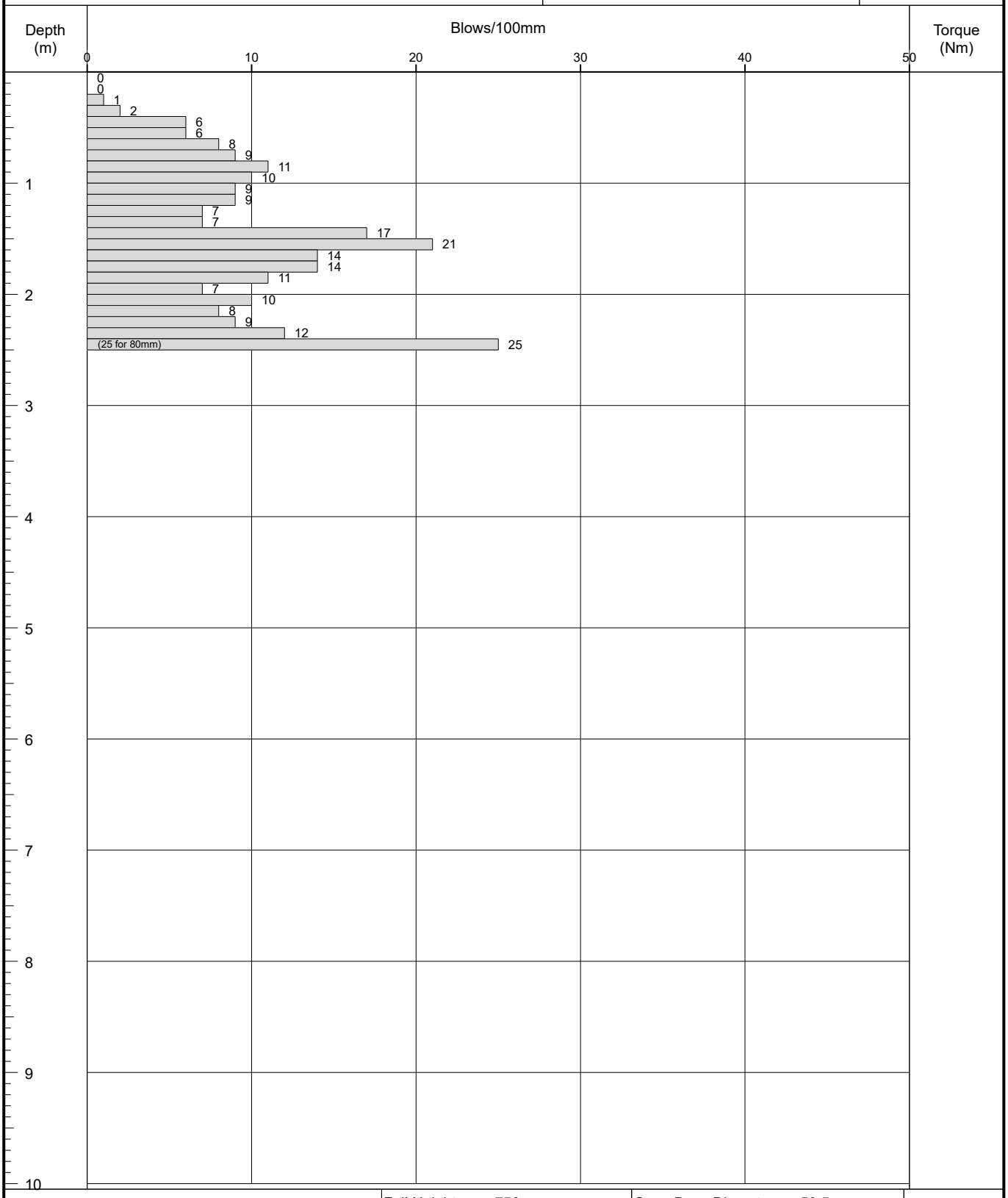
Remarks:
Refusal at 3.155m. 25 blows over 55mm.

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	3.155m
Probe Type	DPSH-B		

Probe Log

Probe No.
DP2
Sheet 1 of 1

Project Name: Land off Cross Street	Project No. C417/19/E/625	Co-ords:	Hole Type DCP
Location: Monk Bretton, Barnsley		Level:	Scale 1:50
Client: Redfearn Construction		Dates: 19/11/2020	Logged By AB



Remarks:
Refusal at 2.48m. 25 blows over 80mm.

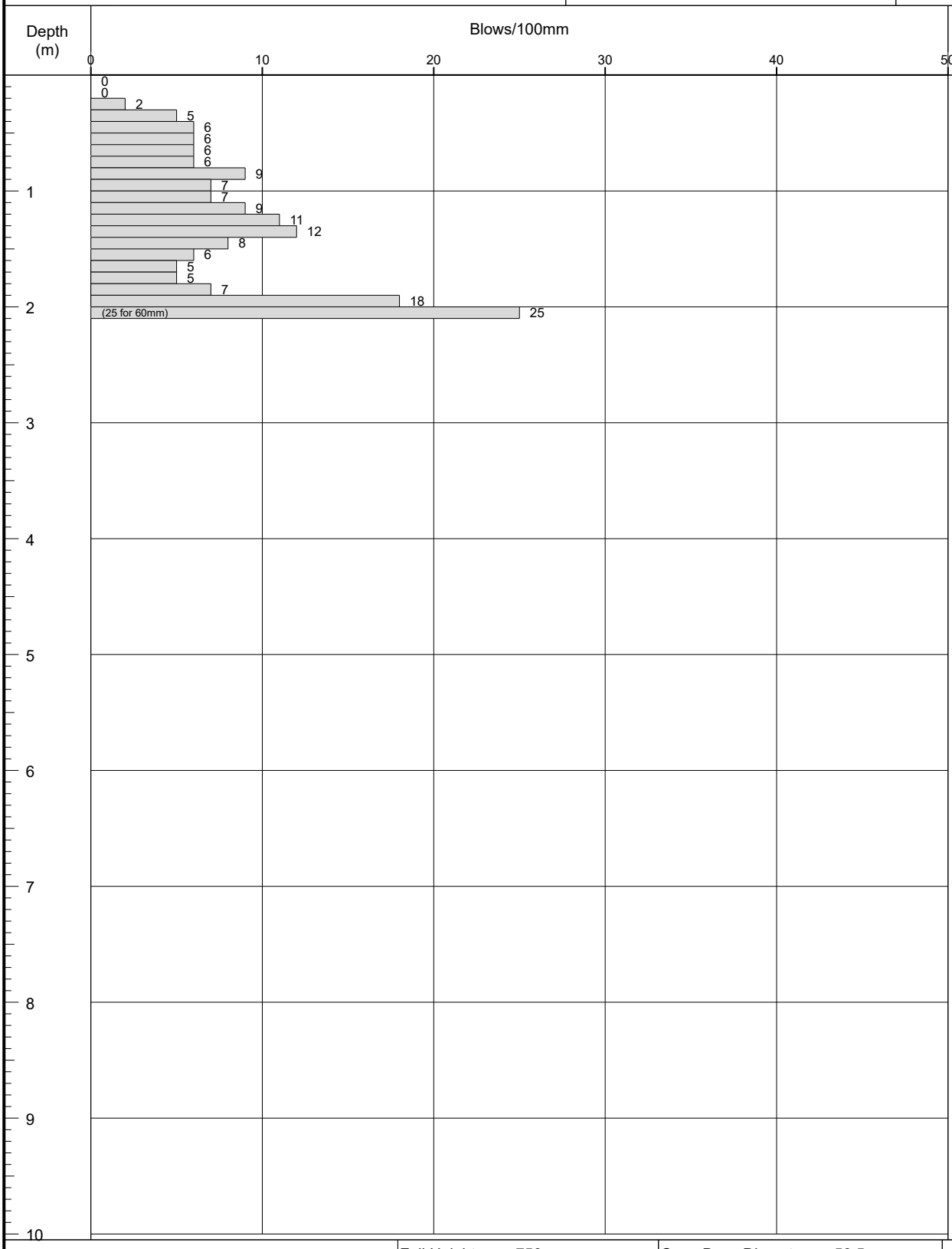
Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	2.48m
Probe Type	DPSH-B		

Probe Log

Probe No. **DP3**

Sheet 1 of 1

Project Name: Land off Cross Street	Project No. C417/19/E/625	Co-ords:	Hole Type DCP
Location: Monk Bretton, Barnsley		Level:	Scale 1:50
Client: Redfearn Construction		Dates: 19/11/2020	Logged By AB



Remarks:
Refusal at 2.06m. 25 blows over 60mm.

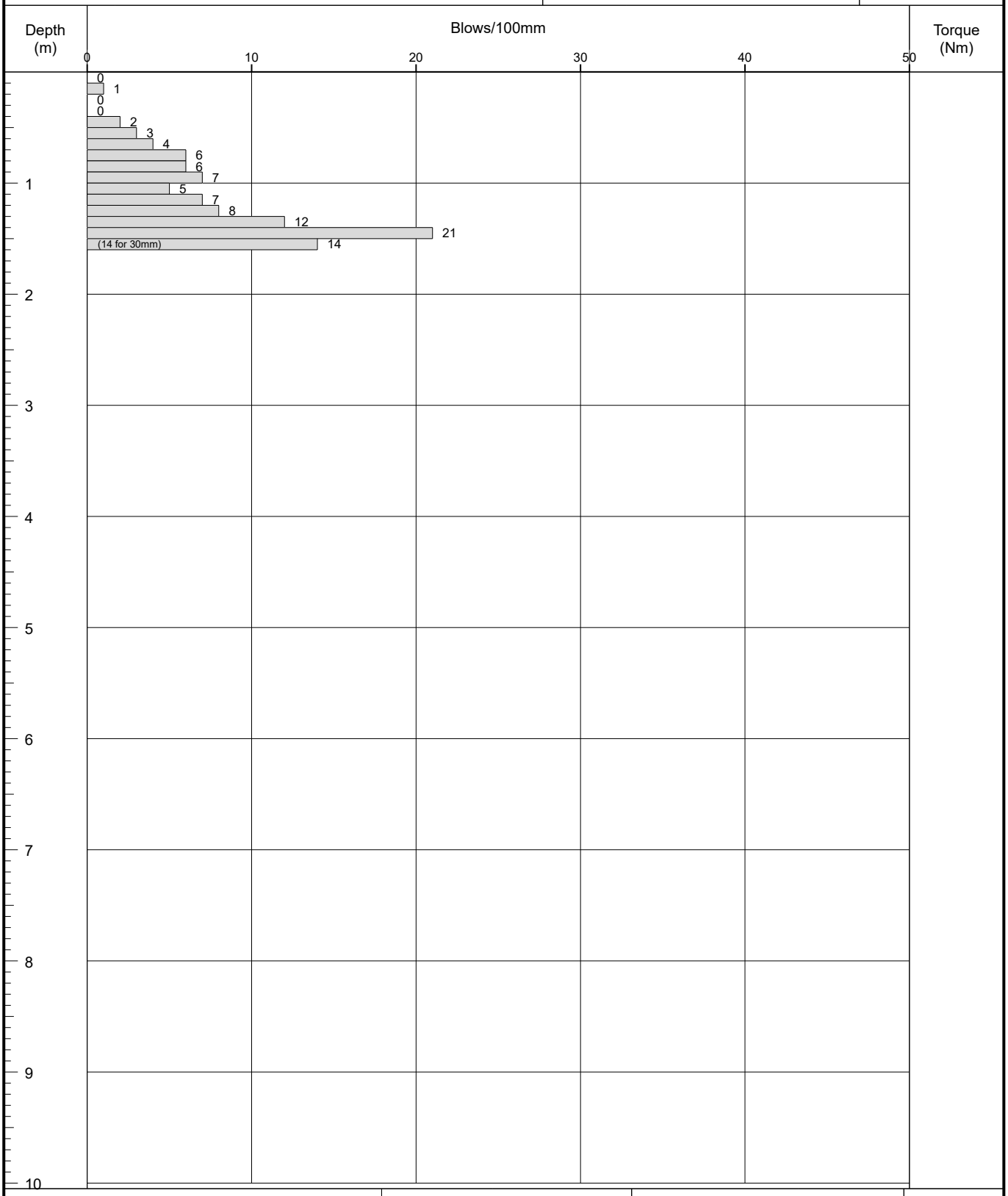
Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	2.06m
Probe Type	DPSH-B		

Probe Log

Probe No. **DP4**

Sheet 1 of 1

Project Name: Land off Cross Street	Project No. C417/19/E/625	Co-ords:	Hole Type DCP
Location: Monk Bretton, Barnsley		Level:	Scale 1:50
Client: Redfearn Construction		Dates: 19/11/2020	Logged By AB



Remarks:
Dead Stop at 1.53m

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	1.53m
Probe Type	DPSH-B		

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Appendix 4

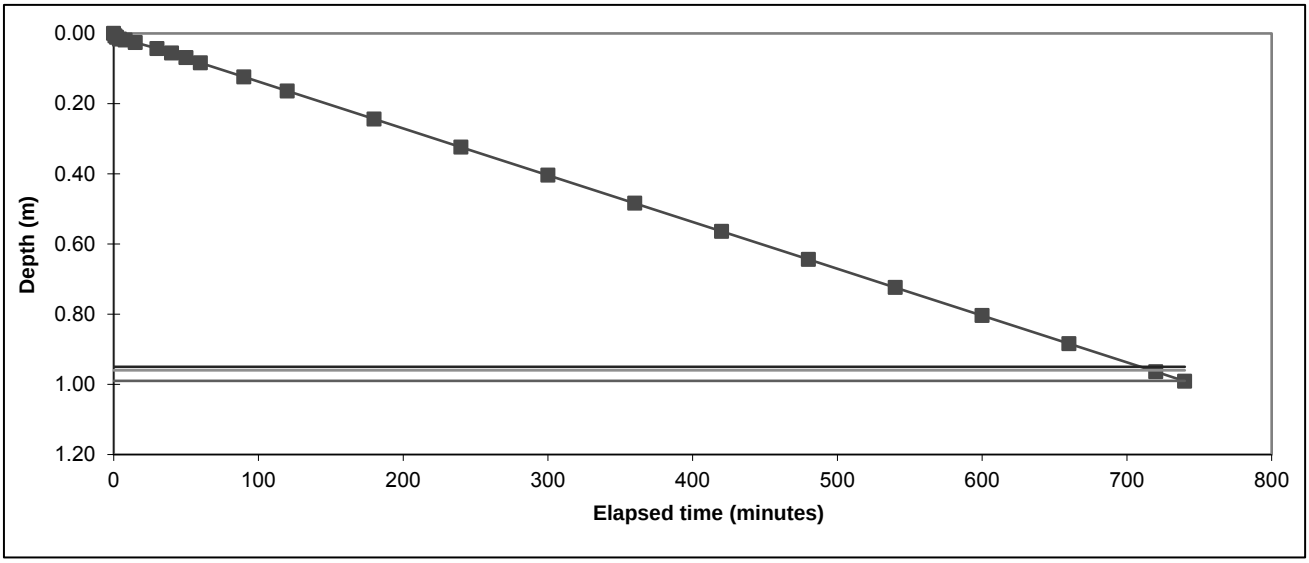
Soakaway Testing Results

Rogers Geotechnical Services L

Soakaway Test

Borehole No:	WS1 (Soak)	Test No:	1	Date:	19/11/2020
Diameter (m):	0.115		Datum Height:	0.00	m agl
Casing Depth (m):	0.95		None		
Depth (m):	1.00		1		

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.000	300	0.404
1	0.007	360	0.484
2	0.011	420	0.564
4	0.016	480	0.644
8	0.019	540	0.724
15	0.026	600	0.804
30	0.043	660	0.884
40	0.056	720	0.964
50	0.069	740	0.991
60	0.084		
90	0.124		
120	0.164		
180	0.244		
240	0.324		



Start water depth for analysis (mbgl):	0.95	Taken as base of casing	
75% effective depth (mbgl):	0.96	Elapsed time (mins):	717.0
50% effective depth (mbgl):	0.98		
25% effective depth (mbgl):	0.99	Elapsed time (mins):	739.3
Base of soakage zone (mbgl):	1.00		

Volume outflow between 75% and 25% effective depth (m^3):	0.000
Mean surface area of outflow (m^2): (side area at 50% effective depth + base area)	0.02
Time for outflow between 75% and 25% effective depth (mins):	22.3

Soil infiltration rate (m/s):	**1.3E-5**

Remarks	Soil infiltration rate calculated by in-house method Results have been extrapolated beyond 1 hour at a constant rate to gain the infiltration rate.

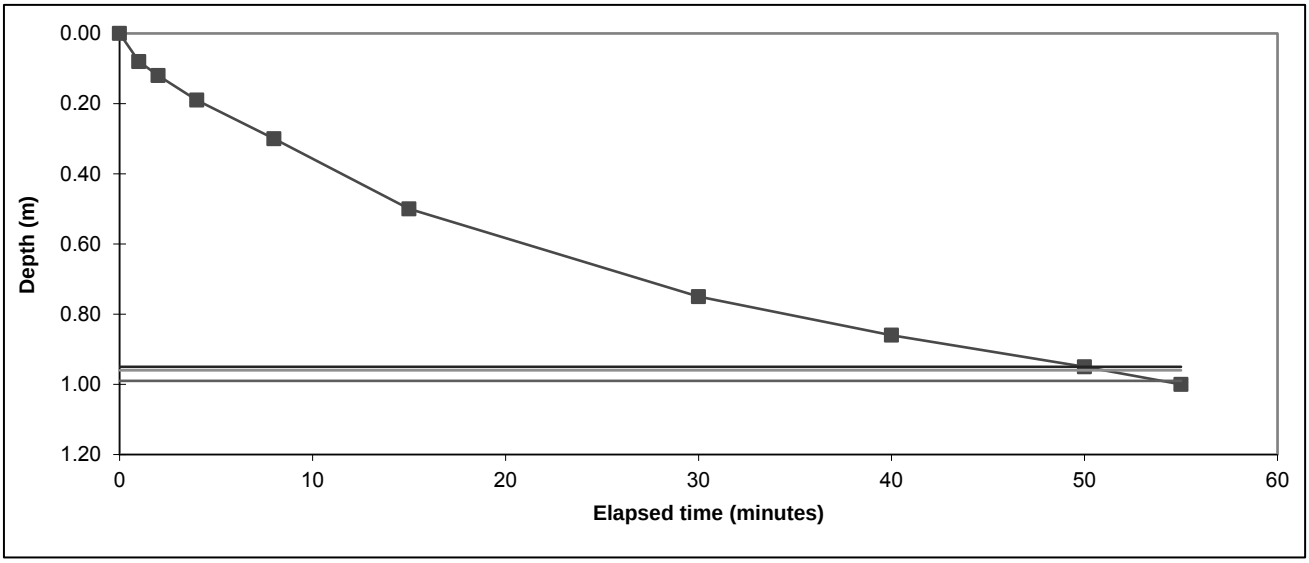
Client:	Redfearn Construction	**Job No:**
Site:	Land off Cross Street, Monk Bretton, Barnsley	C417/19/E/625

Rogers Geotechnical Services L

Soakaway Test

Borehole No:	WS2 (Soak)	Test No:	1	Date:	19/11/2020
Diameter (m):	0.115		Datum Height:	0.00	m agl
Casing Depth (m):	0.95		None		
Depth (m):	1.00		1		

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.000		
1	0.080		
2	0.120		
4	0.190		
8	0.300		
15	0.500		
30	0.750		
40	0.860		
50	0.950		
55	1.000		



Start water depth for analysis (mbgl):	0.95	Taken as base of casing	
75% effective depth (mbgl):	0.96	Elapsed time (mins):	51.0
50% effective depth (mbgl):	0.98		
25% effective depth (mbgl):	0.99	Elapsed time (mins):	54.0
Base of soakage zone (mbgl):	1.00		

Volume outflow between 75% and 25% effective depth (m^3):	0.000
Mean surface area of outflow (m^2): (side area at 50% effective depth + base area)	0.02
Time for outflow between 75% and 25% effective depth (mins):	3.0

Soil infiltration rate (m/s):	**9.8E-5**

Remarks Soil infiltration rate calculated by in-house method

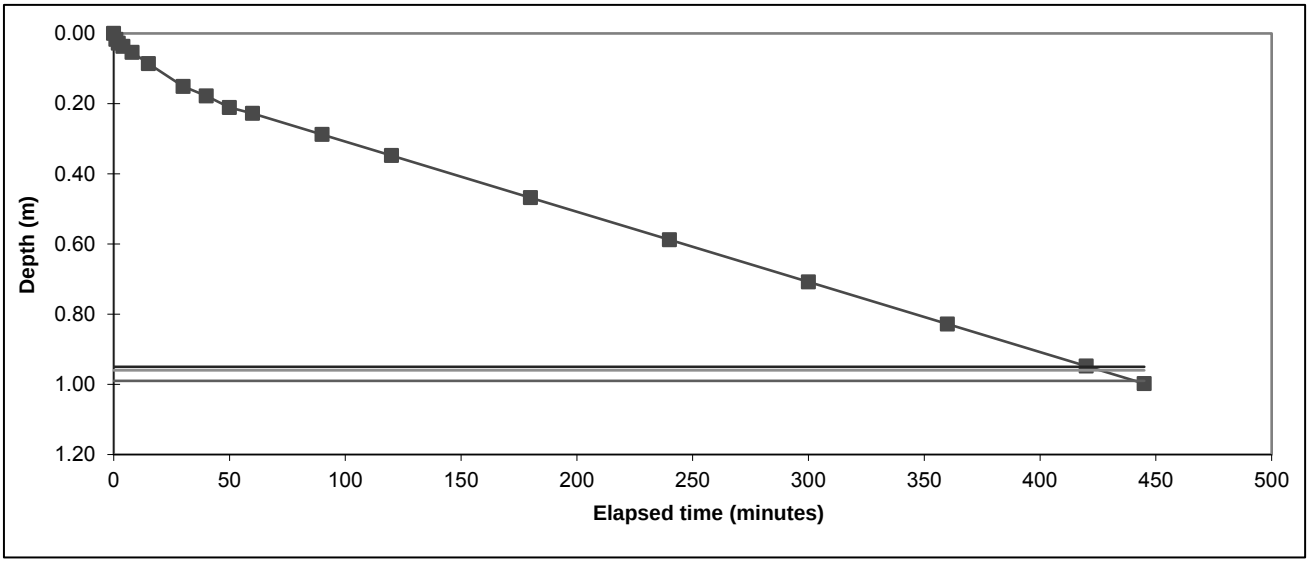
Client:	Redfearn Construction	**Job No:**
Site:	Land off Cross Street, Monk Bretton, Barnsley	C417/19/E/625

Rogers Geotechnical Services L

Soakaway Test

Borehole No:	WS4 (Soak)	Test No:	1	Date:	19/11/2020
Diameter (m):	0.115		Datum Height:	0.00	m agl
Casing Depth (m):	0.95		None		
Depth (m):	1.00		1		

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.000	300	0.708
1	0.017	360	0.828
2	0.028	420	0.948
4	0.037	445	0.998
8	0.054		
15	0.086		
30	0.151		
40	0.178		
50	0.211		
60	0.228		
90	0.288		
120	0.348		
180	0.468		
240	0.588		



Start water depth for analysis (mbgl):	0.95	Taken as base of casing	
75% effective depth (mbgl):	0.96	Elapsed time (mins):	426.0
50% effective depth (mbgl):	0.98		
25% effective depth (mbgl):	0.99	Elapsed time (mins):	441.0
Base of soakage zone (mbgl):	1.00		

Volume outflow between 75% and 25% effective depth (m^3):	0.000
Mean surface area of outflow (m^2): (side area at 50% effective depth + base area)	0.02
Time for outflow between 75% and 25% effective depth (mins):	15.0

Soil infiltration rate (m/s):	**2.0E-5**

Remarks	Soil infiltration rate calculated by in-house method Results have been extrapolated beyond 1 hour at a constant rate to gain the infiltration rate.

Client:	Redfearn Construction	**Job No:**
Site:	Land off Cross Street, Monk Bretton, Barnsley	C417/19/E/625

Environmental Geotechnical Specialists

Appendix 5

TRL Dynamic Probe Results

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

www.rogersgeotech.co.uk

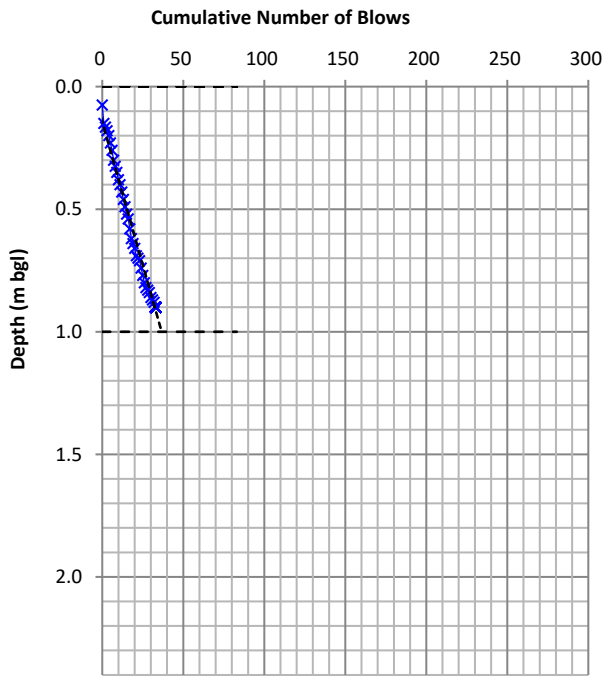
Tel : 0843 50 66687 **Fax : 0843 51 59930**

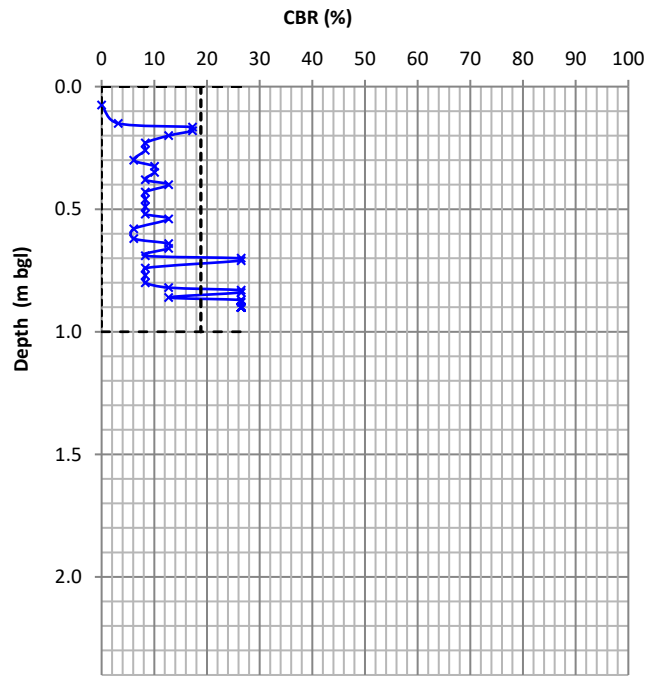
Job No:	Location:
C417/19/E/625	TRL 1
Site:	Client:
Land off Cross Street	Redfearn Construction
Test Date:	Tested By:
19/11/2020	AB/BM

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
0	0	75	-	1	20	660	13				
1	1	150	3	1	21	690	8				
1	2	165	17	1	22	700	26				
1	3	180	17	1	23	710	26				
1	4	200	13	1	24	740	8				
1	5	230	8	1	25	770	8				
1	6	260	8	1	26	800	8				
1	7	300	6	1	27	820	13				
1	8	325	10	1	28	830	26				
1	9	350	10	1	29	840	26				
1	10	380	8	1	30	860	13				
1	11	400	13	1	31	870	26				
1	12	430	8	1	32	880	26				
1	13	460	8	1	33	900	26				
1	14	490	8								
1	15	520	8								
1	16	540	13								
1	17	580	6								
1	18	620	6								
1	19	640	13								





Rogers Geotechnical Services Ltd
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HD8 8LU

www.rogersgeotech.co.uk

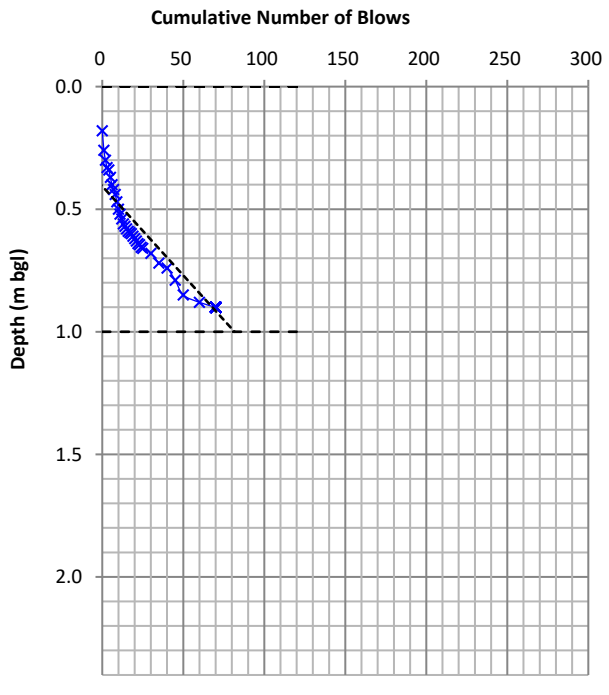
Tel : 0843 50 66687 **Fax : 0843 51 59930**

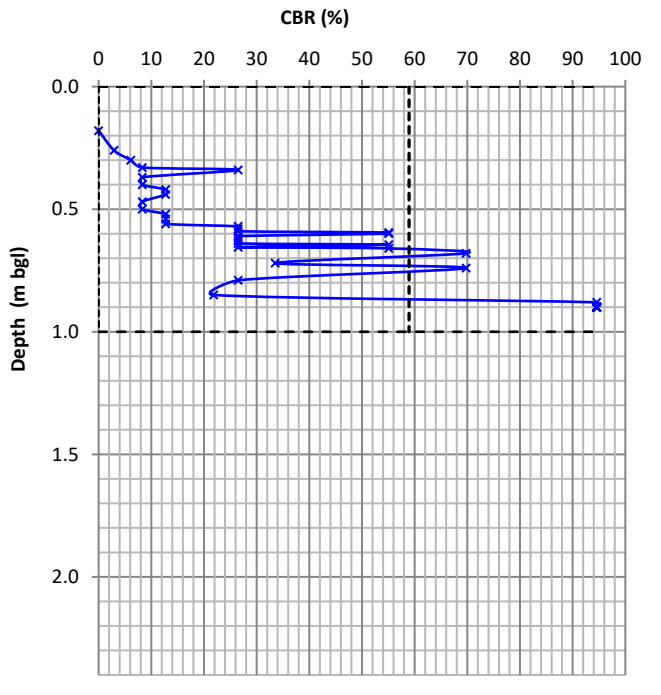
Job No:	Location:
C417/19/E/625	TRL 2
Site:	Client:
Land off Cross Street	Redfearn Construction
Test Date:	Tested By:
19/11/2020	AB/BM

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
0	0	180	-	1	20	620	26				
1	1	260	3	1	21	630	26				
1	2	300	6	1	22	640	26				
1	3	330	8	1	23	645	55				
1	4	340	26	1	24	655	26				
1	5	370	8	1	25	660	55				
1	6	400	8	5	30	680	70				
1	7	420	13	5	35	720	34				
1	8	440	13	5	40	740	70				
1	9	470	8	5	45	790	26				
1	10	500	8	5	50	850	22				
1	11	520	13	10	60	880	95				
1	12	540	13	10	70	900	95				
1	13	560	13								
1	14	570	26								
1	15	580	26								
1	16	590	26								
1	17	595	55								
1	18	600	55								
1	19	610	26								





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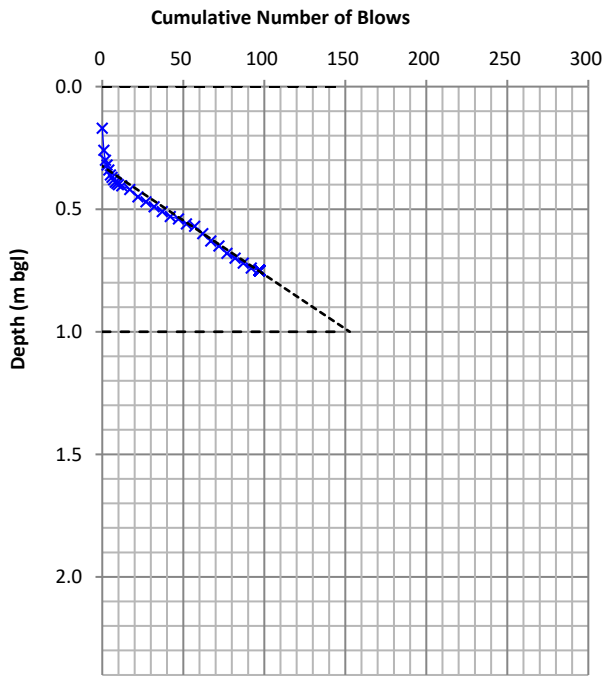
Tel : 0843 50 66687 **Fax : 0843 51 59930**

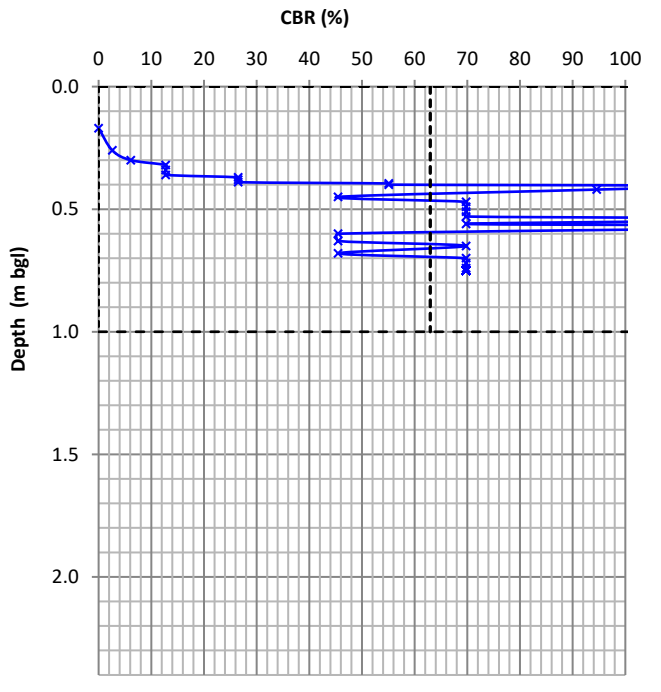
Job No:	Location:
C417/19/E/625	TRL 3
Site:	Client:
Land off Cross Street	Redfearn Construction
Test Date:	Tested By:
19/11/2020	AB/BM

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
0	0	170	-	5	57	570	145				
1	1	260	3	5	62	600	45				
1	2	300	6	5	67	630	45				
1	3	320	13	5	72	650	70				
1	4	340	13	5	77	680	45				
1	5	360	13	5	82	700	70				
1	6	370	26	5	87	720	70				
1	7	380	26	5	92	740	70				
1	8	390	26	5	97	750	70				
1	9	395	55								
1	10	400	55								
2	12	405	115								
5	17	420	95								
5	22	450	45								
5	27	470	70								
5	32	490	70								
5	37	510	70								
5	42	530	70								
5	47	540	145								
5	52	560	70								





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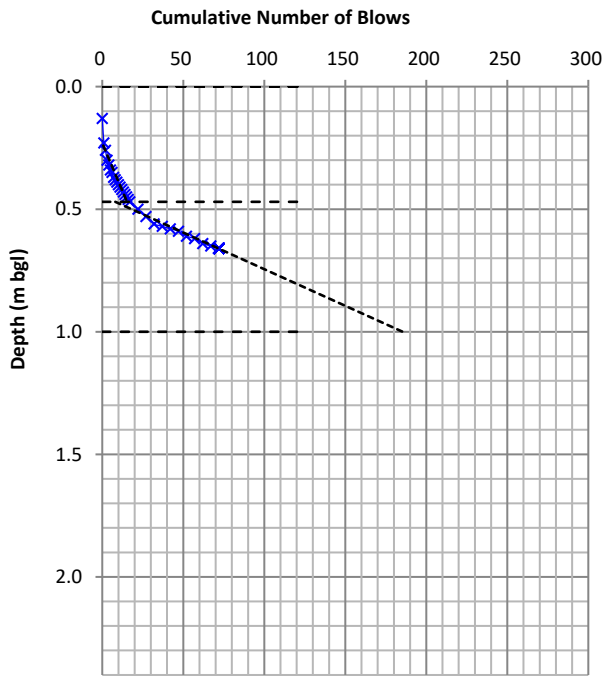
Tel : 0843 50 66687 **Fax : 0843 51 59930**

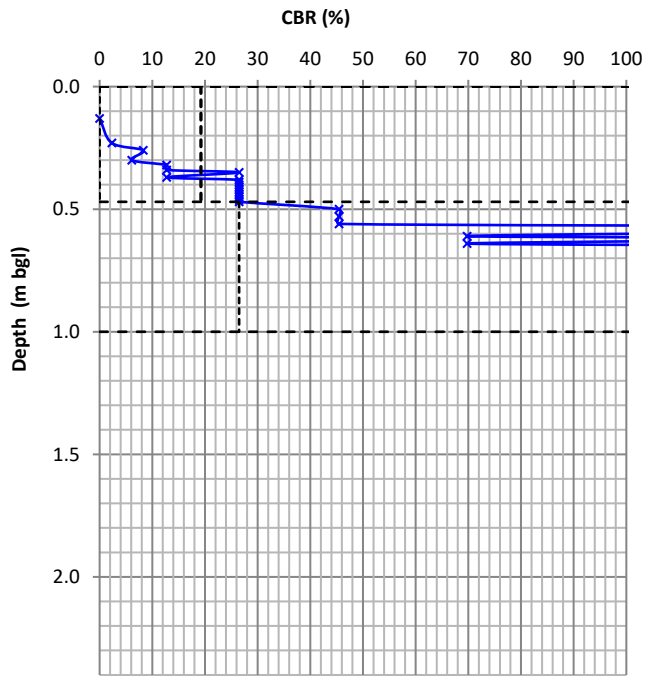
Job No:	Location:
C417/19/E/625	TRL 4
Site:	Client:
Land off Cross Street	MBooth Design Ltd
Test Date:	Tested By:
19/11/2020	AB/BM

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
0	0	130	-	5	32	560	45				
1	1	230	2	5	37	570	145				
1	2	260	8	5	42	580	145				
1	3	300	6	5	47	590	145				
1	4	320	13	5	52	610	70				
1	5	340	13	5	57	620	145				
1	6	350	26	5	62	640	70				
1	7	370	13	5	67	650	145				
1	8	380	26	5	72	660	145				
1	9	390	26								
1	10	400	26								
1	11	410	26								
1	12	420	26								
1	13	430	26								
1	14	440	26								
1	15	450	26								
1	16	460	26								
1	17	470	26								
5	22	500	45								
5	27	530	45								





Environmental Geotechnical Specialists

Appendix 6

Laboratory Testing

Environmental
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Specialists

LABORATORY REPORT

job number C417/19/E/625	client ref
site address Land off Cross Street Monk Bretton, Barnsley, S71 7EP	client address MBooth Design Ltd 2 Western Street, Barnsley, South Yorkshire S70 2BP
consultant	
date scheduled 24/11/2020	date issued 08/12/2020
issued by C J Norcliffe	job title Laboratory Manage

Rogers Geotechnical Services Ltd **Telephone 01484 607 977**
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Constructionline
QMS ISO 9001 REGISTERED
QMS ISO 14001 REGISTERED
QMS OHSAS 18001 REGISTERED
UKAS TESTING

GEOTECHNICAL ENVIRONMENTAL

Schedule of UKAS Accredited Laboratory Tests

1. CLASSIFICATION OF SOIL	BS 1377-2:1990	BS EN 150 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			U
ii. Large pyknometer	Pt 2 : 8.3			U
iii. Small pyknometer	Pt 2 : 8.4	Pt 3 : 2015 : 5.1		U
1.4 Density Tests				
i. Linear measurement	Pt 2 : 7.2	Pt 2 : 2014 : 5.1	A	
ii. Immersion in water	Pt 2 : 7.3	Pt 2 : 2014 : 5.2		U
iii. Fluid / Water displacement	Pt 2 : 7.4	Pt 2 : 2014 : 5.3		U
iv. Sand replacement	Pt 9 : 2.1, 2.2			U
v. Core cutter	Pt 9 : 2.4			U
1.5 Particle Size Distribution				
i. Dry Sieve	Pt 2 : 9.2	Pt 4 : 2016 : 5.2	A	
ii. Wet Sieve	Pt 2 : 9.3	Pt 4 : 2016 : 5.2	A	
iii. Sedimentation by pipette	Pt 2 : 9.4	Pt 4 : 2016 : 5.3 / 5.4	A	
iv. Sedimentation by hydrometer	Pt 2 : 9.5			U
2. CHEMICAL TESTS	**BS 1377-3:2018**			
ii. Mass loss on ignition	Pt 3 : 4			U
3. COMPACTION RELATED TESTS	**BS 1377-4:1990**			
3.1 Dry density/moisture relationship				
i. 2.5kg rammer – 1 litre mould	Pt 4 : 3			U
- CBR mould	Pt 4 : 3			U
ii. 4.5kg rammer – 1 litre mould	Pt 4 : 3			U
- CBR mould	Pt 4 : 3			U
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			U
ii. Recompacted sample	Pt 5 : 7			U
iii. Soaked, inc measurement of swell	Pt 5 : 7			U
4. COMPRESSIBILITY OF SOIL	**BS 1377-5:1990**			
i. One dimensional consolidation	Pt 5 : 3			U
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			U
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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RGS

GEOTECHNICAL LAB RESULTS

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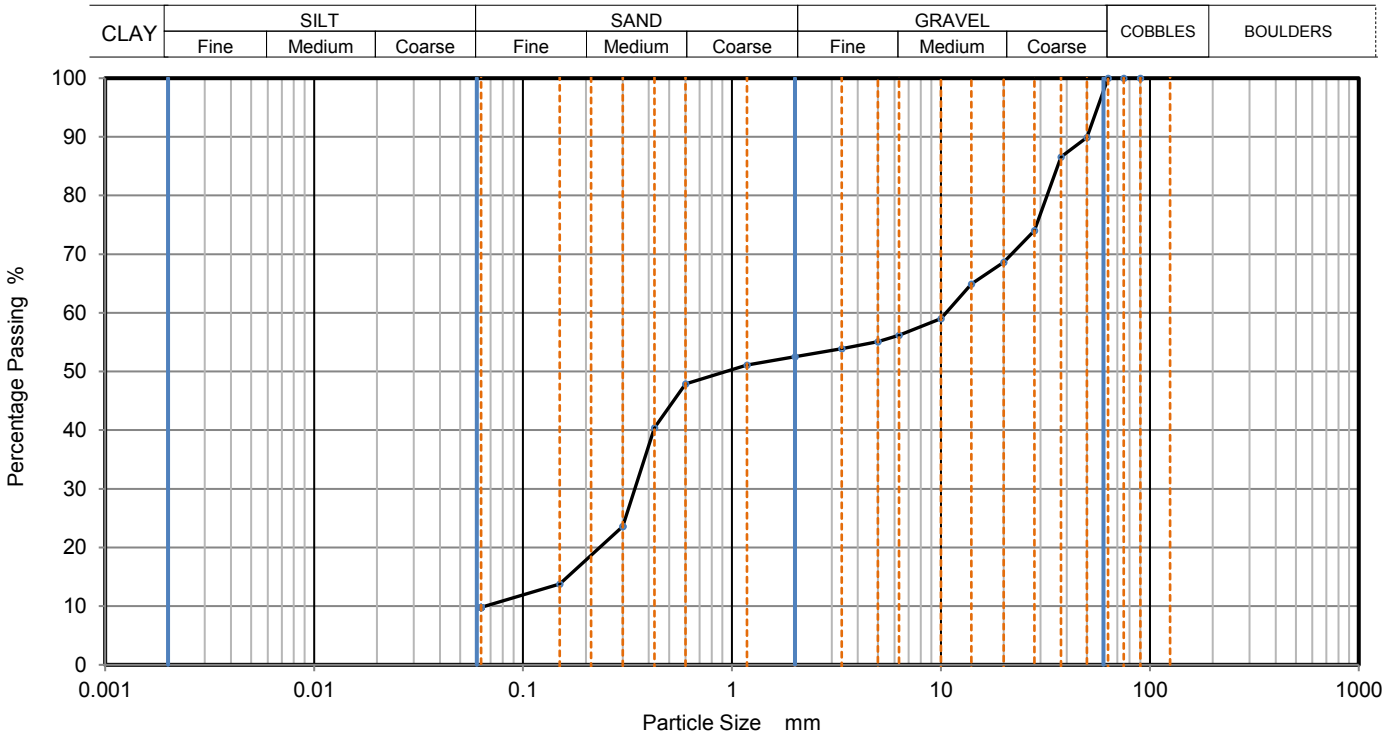
Telephone 01484 607977
Company No: 5130864

	PARTICLE SIZE DISTRIBUTION				Job Ref	C417/19/E/625
					Borehole/Pit No.	WS1
Site Name	Land off Cross Street				Sample No.	1
Soil Description	light orangish brown very gravelly fine to medium SAND with high sandstone cobble content.				Depth, m	0.60
Specimen Reference	D1	Specimen Depth	0.6	m	Sample Type	D
Test Method	ISO 17892 -4, by sieving on as received or wet sample				KeyLAB ID	RGS_202011240



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
	100		
90	100		
75	100		
63	100		
50	90		
37.5	87		
28	74		
20	69		
14	65		
10	59		
6.3	56		
5	55		
3.35	54		
2	53		
1.18	51		
0.6	48		
0.425	40		
0.3	24		
0.15	14		
0.063	10		

Dry Mass of sample, g	2934

Sample Proportions	% dry mass
Very coarse	0
Gravel	47
Sand	43
Fines <0.063mm	10

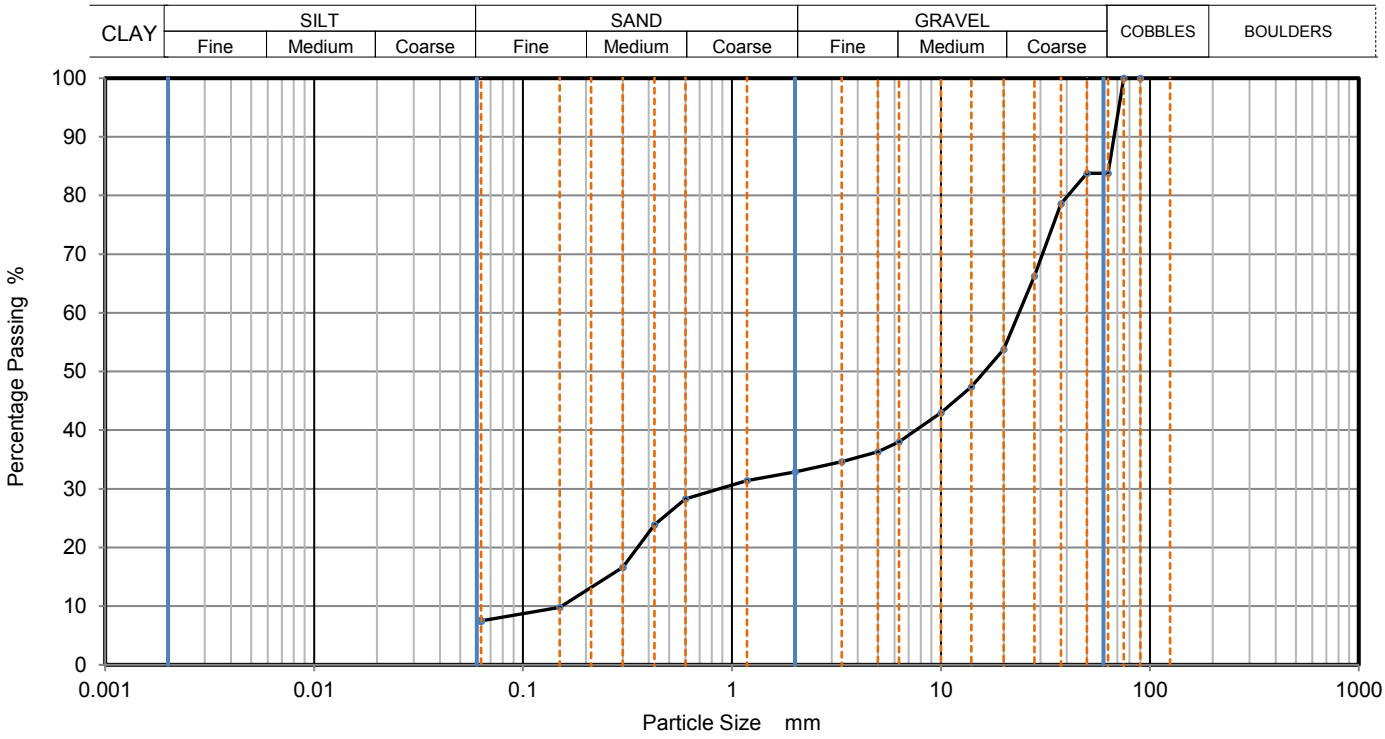
Grading Analysis		
D100	mm	63
D60	mm	10.6
D30	mm	0.343
D10	mm	0.0661
Uniformity Coefficient		160
Curvature Coefficient		0.17

Remarks

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

Operator	Checked	Approved	Sheet printed	Fig 1
Harry	Harry	Harry	08/12/2020	Sheet 1

	PARTICLE SIZE DISTRIBUTION				Job Ref	C417/19/E/625
					Borehole/Pit No.	WS3
Site Name	Land off Cross Street				Sample No.	1
Soil Description	light orangish brown very gravelly fine to medium SAND with high sandstone cobble content.				Depth, m	0.50
Specimen Reference	D1	Specimen Depth	0.5	m	Sample Type	D
Test Method	ISO 17892 -4, by sieving on pre-dried or dry sample				KeyLAB ID	RGS_202011241



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
	100		
90	100		
75	100		
63	84		
50	84		
37.5	79		
28	66		
20	54		
14	47		
10	43		
6.3	38		
5	36		
3.35	35		
2	33		
1.18	31		
0.6	28		
0.425	24		
0.3	17		
0.15	10		
0.063	8		

Dry Mass of sample, g	3223

Sample Proportions	% dry mass
Very coarse	16
Gravel	51
Sand	25
Fines <0.063mm	8

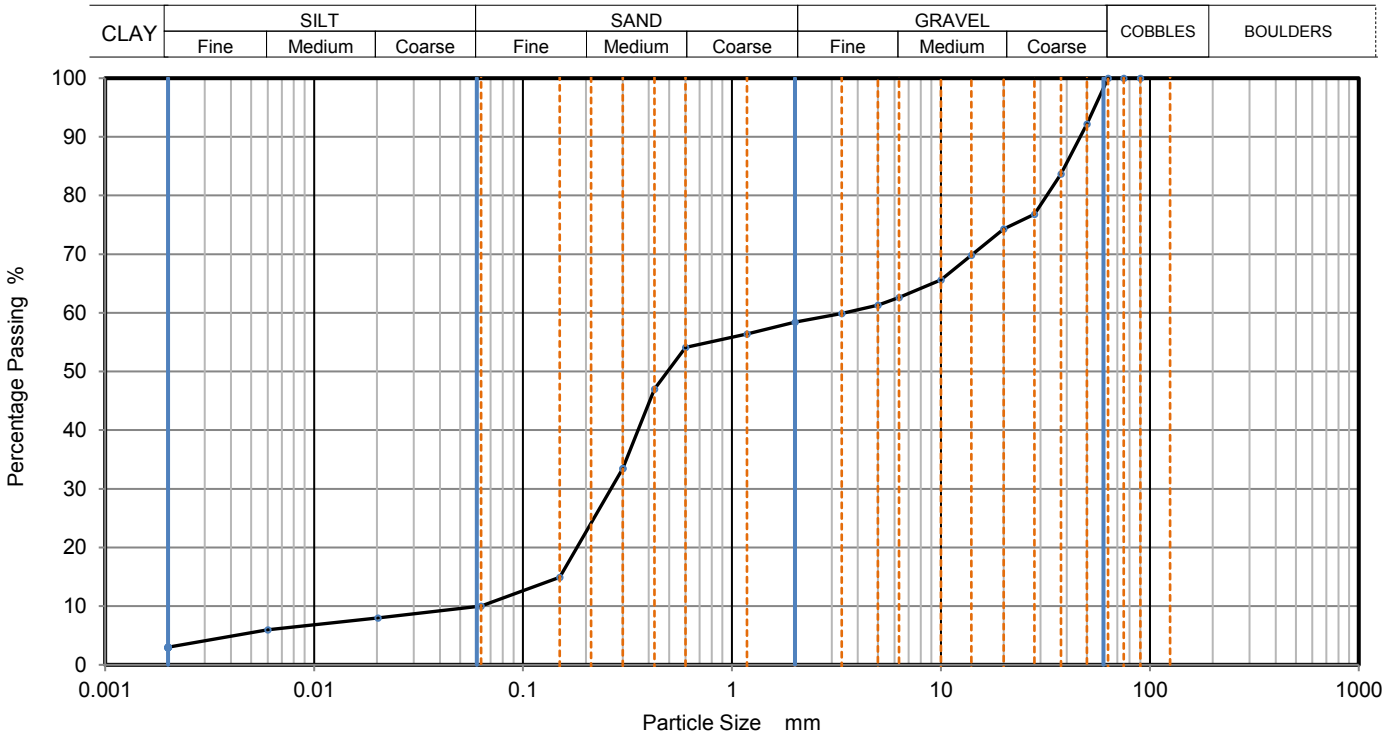
Grading Analysis		
D100	mm	75
D60	mm	23.6
D30	mm	0.866
D10	mm	0.153
Uniformity Coefficient		150
Curvature Coefficient		0.21

Remarks

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

Operator	Checked	Approved	Sheet printed	Fig 1
Harry	Harry	Harry	08/12/2020	Sheet 2

	PARTICLE SIZE DISTRIBUTION				Job Ref	C417/19/E/625
					Borehole/Pit No.	WS3
Site Name	Land off Cross Street				Sample No.	2
Soil Description	light orangish brown very gravelly fine to medium SAND with high sandstone cobble content.				Depth, m	1.20
Specimen Reference	D2	Specimen Depth	1.2	m	Sample Type	D
Test Method	ISO 17892 -4, by sieving and pipette sedimentation				KeyLAB ID	RGS_202011242



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
	100	0.0202	8
90	100	0.0060	6
75	100	0.0020	3
63	100		
50	92		
37.5	84		
28	77		
20	74		
14	70		
10	66		
6.3	63		
5	61		
3.35	60		
2	58		
1.18	56		
0.6	54	Particle density (assumed)	
0.425	47	2.65	Mg/m3
0.3	34		
0.15	15		
0.063	10		

Dry Mass of sample, g: 4569

Sample Proportions	% dry mass
Very coarse	0
Gravel	42
Sand	48
Silt	6
Clay	4

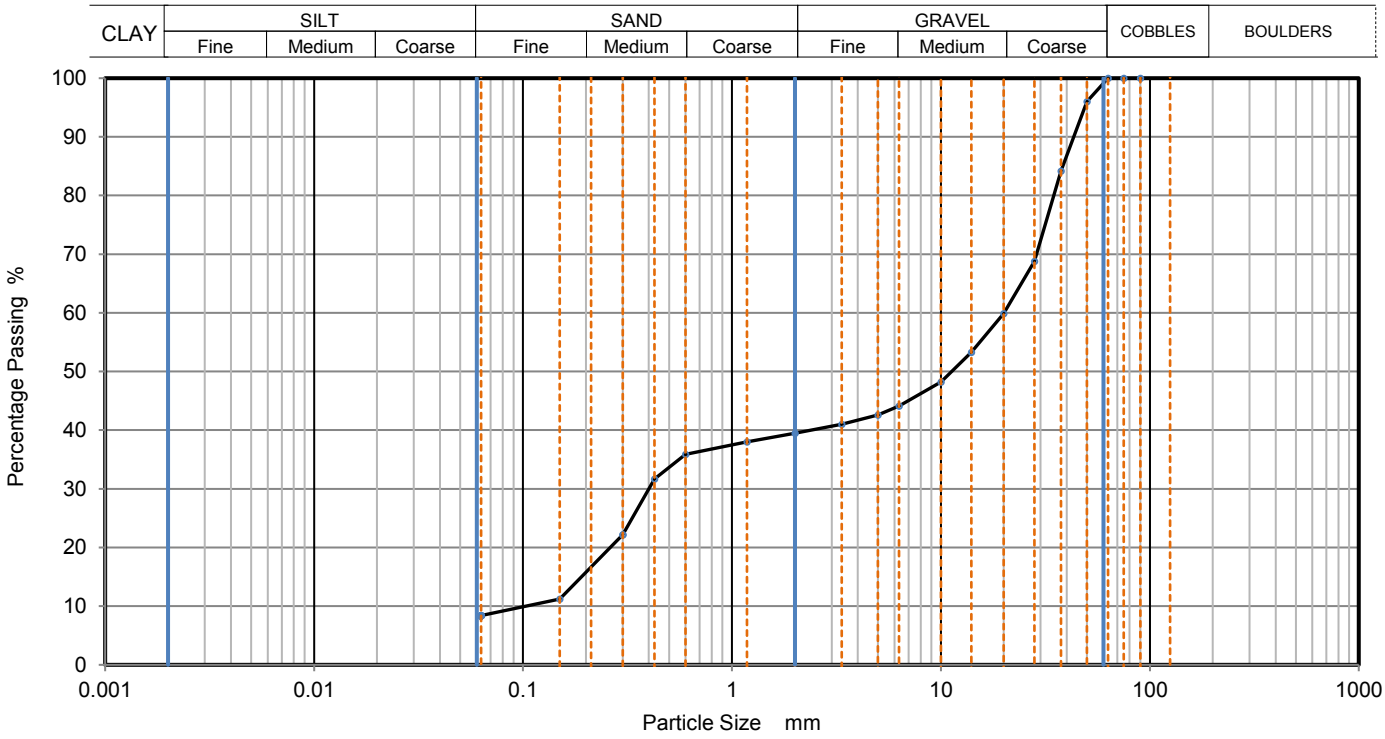
Grading Analysis		
D100	mm	63
D60	mm	3.43
D30	mm	0.263
D10	mm	0.0633
Uniformity Coefficient		54
Curvature Coefficient		0.32

Remarks

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

Operator	Checked	Approved	Sheet printed	Fig 1
Harry	Jude	Jude	08/12/2020	Sheet 3

	PARTICLE SIZE DISTRIBUTION				Job Ref	C417/19/E/625
					Borehole/Pit No.	WS4
Site Name	Land off Cross Street				Sample No.	1
Soil Description	light orangish brown very gravelly fine to medium SAND with high sandstone cobble content.				Depth, m	0.60
Specimen Reference	D1	Specimen Depth	0.6	m	Sample Type	D
Test Method	ISO 17892 -4, by sieving on pre-dried or dry sample				KeyLAB ID	RGS_202011243



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
	100		
90	100		
75	100		
63	100		
50	96		
37.5	84		
28	69		
20	60		
14	53		
10	48		
6.3	44		
5	43		
3.35	41		
2	40		
1.18	38		
0.6	36		
0.425	32		
0.3	22		
0.15	11		
0.063	8		

Dry Mass of sample, g	3502

Sample Proportions	% dry mass
Very coarse	0
Gravel	61
Sand	31
Fines <0.063mm	8

Grading Analysis		
D100	mm	63
D60	mm	20
D30	mm	0.4
D10	mm	0.104
Uniformity Coefficient		190
Curvature Coefficient		0.076

Remarks

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

Operator	Checked	Approved	Sheet printed	Fig 1
Harry	Harry	Harry	08/12/2020	Sheet 4

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Rogers Geotechnical Services Ltd				Soil Screening Value (SSV) Comparison Sheet											
Job Number	C417/20/E/625			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				KEY: Exceeds SSV; Exceeds 2017, Below 2015; Below limit of detection (LOD)			KEY: Exceeds SSV; Exceeds 2017, Below 2015; Below limit of detection (LOD)			
Job Name	Monk Breton														
Date	24/11/2020			**Sample Location**	WS1	WS2	WS4								
Client	Redfearn Construction			Depth Top	0.00	0.50	0.00								
				Depth Base	0.50	1.00	0.50								
Determinand	**Units**	**Ref**	**LOD**	**Residential With Plant Uptake 1%**											
				Atrisk 2015 (No Free Product	Atrisk 2017										
Cadmium	mg/kg	C	0.10		22.1	0.18	0.10	0.18							
Chromium (Hexavalent)	mg/kg	B/C	0.5	20.5	3.62	< 0.50	< 0.50	< 0.50							
Copper	mg/kg	A+	0.50		4730	18	11	19							
Mercury	mg/kg	A/D	0.10		8.81	< 0.10	< 0.10	0.14							
Nickel	mg/kg	A+	0.50		136	14	18	17							
Lead	mg/kg	C	0.50		200	32	6.4	45							
Zinc	mg/kg	A+	0.50		20000	44	21	43							
Vanadium	mg/kg	A+	5.0		136	13	9.1	16							
Arsenic	mg/kg	C	1.0		37	11	3.2	14							
Selenium	mg/kg	A	0.20		375	0.36	< 0.20	0.44							
Cyanide (Free)	mg/kg	A	0.50		34	< 0.50	< 0.50	< 0.50							
Total Phenols	mg/kg	A	0.30		267	< 0.30	< 0.30	< 0.30							
Naphthalene	mg/kg	A+	0.10		0.829	< 0.10	< 0.10	< 0.10							
Acenaphthylene	mg/kg		0.10			< 0.10	< 0.10	< 0.10							
Acenaphthene	mg/kg	A+	0.10	608	157	< 0.10	< 0.10	< 0.10							
Fluorene	mg/kg	A+	0.10		735	< 0.10	< 0.10	< 0.10							
Phenanthrene	mg/kg		0.10			< 0.10	< 0.10	< 0.10							
Anthracene	mg/kg	A+	0.10		10200	< 0.10	< 0.10	< 0.10							
Fluoranthene	mg/kg	A+	0.10		983	< 0.10	< 0.10	0.37							
Pyrene	mg/kg	A+	0.10		668	< 0.10	< 0.10	0.40							
Benzo[a]anthracene	mg/kg	A	0.10	4.52	1.71	< 0.10	< 0.10	< 0.10							
Chrysene	mg/kg	A	0.10	585	0.44	< 0.10	< 0.10	< 0.10							
Benzo[b]fluoranthene	mg/kg	A	0.10	7.72	1.22	< 0.10	< 0.10	< 0.10							
Benzo[k]fluoranthene	mg/kg	A	0.10	84.4	0.686	< 0.10	< 0.10	< 0.10							
Benzo[a]pyrene	mg/kg	B/C	0.10	4.95	1.51	< 0.10	< 0.10	< 0.10							
Indeno(1,2,3-c,d)Pyrene	mg/kg	A*	0.10	7.31	0.0614	< 0.10	< 0.10	< 0.10							
Dibenz(a,h)Anthracene	mg/kg	A	0.10	0.838	0.00393	< 0.10	< 0.10	< 0.10							
Benzo[g,h,i]perylene	mg/kg	A	0.10	96.2	0.0187	< 0.10	< 0.10	< 0.10							
Total Of 16 PAH's	mg/kg		2.0			< 2.0	< 2.0	< 2.0							
Aliphatic TPH >C5-C6	mg/kg	A+	1.0		42.7	< 1.0	< 1.0	< 1.0							
Aliphatic TPH >C6-C8	mg/kg	A+	1.0		99.3	< 1.0	< 1.0	< 1.0							
Aliphatic TPH >C8-C10	mg/kg	A+	1.0		13.9	< 1.0	< 1.0	< 1.0							
Aliphatic TPH >C10-C12	mg/kg	A+	1.0	81.7	49.9	< 1.0	< 1.0	< 1.0							
Aliphatic TPH >C12-C16	mg/kg	A+	1.0	385	20.9	< 1.0	< 1.0	< 1.0							
Aliphatic TPH >C16-C21	mg/kg	A+	1.0		210000	< 1.0	< 1.0	< 1.0							
Aliphatic TPH >C21-C35	mg/kg	A+	1.0		210000	< 1.0	< 1.0	< 1.0							
Aliphatic TPH >C35-C44	mg/kg		1.0			< 1.0	< 1.0	< 1.0							
Total Aliphatic Hydrocarbons	mg/kg		5.0			< 5.0	< 5.0	< 5.0							
Aromatic TPH >C5-C7	mg/kg	A+	1.0		0.137	< 1.0	< 1.0	< 1.0							
Aromatic TPH >C7-C8	mg/kg	A+	1.0		113	< 1.0	< 1.0	< 1.0							
Aromatic TPH >C8-C10	mg/kg	A+	1.0		20.5	< 1.0	< 1.0	< 1.0							
Aromatic TPH >C10-C12	mg/kg	A+	1.0		70	< 1.0	< 1.0	< 1.0							
Aromatic TPH >C12-C16	mg/kg	A+	1.0	165	155	< 1.0	< 1.0	< 1.0							
Aromatic TPH >C16-C21	mg/kg	A+	1.0		319	< 1.0	< 1.0	< 1.0							
Aromatic TPH >C21-C35	mg/kg	A+	1.0		1120	< 1.0	< 1.0	< 1.0							
Aromatic TPH >C35-C44	mg/kg		1.0			< 1.0	< 1.0	< 1.0							
Total Aromatic Hydrocarbons	mg/kg		5.0			< 5.0	< 5.0	< 5.0							
Total Petroleum Hydrocarbons	mg/kg		10.0			< 10	< 10	< 10							
pH			N/A			**8.9**	8.7	**6.5**							
Sulphate (2:1 Water Soluble) as SO4	g/l		0.010			**0.077**	< 0.010	< 0.010							
ACM Type			N/A			-	-	-							

Rogers Geotechnical Services Ltd				Soil Screening Value (SSV) Comparison Sheet										
Job Number	C417/20/E/625			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				KEY Exceeds SSV Exceeds 2017, Below 2015 Below limit of detection (LOD)			KEY Exceeds SSV Exceeds 2017, Below 2015 Below limit of detection (LOD)			
Job Name	Monk Breton													
Date	24/11/2020			**Sample Location**	WS1	WS2	WS4							
Client	Redfearn Construction			Depth Top	0.00	0.50	0.00							
				Depth Base	0.50	1.00	0.50							
Determinand	**Units**	**Ref**	**LOD**	**Residential With Plant Uptake 1%**										
Asbestos Identification	%		0.001		No Asbestos Detected	No Asbestos Detected	No Asbestos Detected							
ACM Detection Stage			N/A		-	-	-							
Moisture	%		0.020		8.1	5.0	13							
Soil Colour			N/A		Brown	Brown	Brown							
Other Material			N/A		Stones and	Stones	Stones and							
Soil Texture			N/A		Sand	Sand	Sand							
Sulphate (Total)	%		0.010		0.056	< 0.010	0.16							
Organic Matter	%		0.40		**2.1**	< 0.40	**2.4**							
PCB 28	mg/kg		0.010		< 0.010									
PCB 52	mg/kg		0.010		< 0.010									
PCB 90+101	mg/kg		0.010		< 0.010									
PCB 118	mg/kg		0.010		< 0.010									
PCB 153	mg/kg		0.010		< 0.010									
PCB 138	mg/kg		0.010		< 0.010									
PCB 180	mg/kg		0.010		< 0.010									
Total PCBs (7 Congeners)	mg/kg		0.10		< 0.10									

Eurofins Chemtest Ltd
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CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	20-32253-1		
Initial Date of Issue:	02-Dec-2020		
Client	Rogers Geotechnical Services Ltd		
Client Address:	Unit 4, Barncliffe Business Park Near Bank Shelley Huddersfield West Yorkshire HD8 8LU		
Contact(s):	Jude Norcliffe		
Project	C417/20/E/625 Monk Breton		
Quotation No.:	Q20-21584	**Date Received:**	25-Nov-2020
Order No.:	PO-1082	**Date Instructed:**	25-Nov-2020
No. of Samples:	3		
Turnaround (Wkdays):	7	**Results Due:**	03-Dec-2020
Date Approved:	02-Dec-2020		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Soil

Project: C417/20/E/625 Monk Breton

Client: Rogers Geotechnical Services Ltd		**Chemtest Job No.:**			20-32253	20-32253	20-32253
Quotation No.: Q20-21584		**Chemtest Sample ID.:**			1103330	1103331	1103332
Order No.: PO-1082		Client Sample Ref.:			1	1	1
		Sample Location:			WS1	WS2	WS4
		Sample Type:			SOIL	SOIL	SOIL
		Top Depth (m):			0.00	0.50	0.00
		Bottom Depth (m):			0.50	1.00	0.50
		Date Sampled:			24-Nov-2020	24-Nov-2020	24-Nov-2020
		Asbestos Lab:			COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Cadmium	M	2450	mg/kg	0.10	0.18	0.10	0.18
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Copper	M	2450	mg/kg	0.50	18	11	19
Mercury	M	2450	mg/kg	0.10	< 0.10	< 0.10	0.14
Nickel	M	2450	mg/kg	0.50	14	18	17
Lead	M	2450	mg/kg	0.50	32	6.4	45
Zinc	M	2450	mg/kg	0.50	44	21	43
Vanadium	U	2450	mg/kg	5.0	13	9.1	16
Arsenic	M	2450	mg/kg	1.0	11	3.2	14
Selenium	M	2450	mg/kg	0.20	0.36	< 0.20	0.44
Cyanide (Free)	M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Total Phenols	M	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30
Naphthalene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Fluorene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Anthracene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	0.37
Pyrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	0.40
Benzo[a]anthracene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Chrysene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	M	2700	mg/kg	2.0	< 2.0	< 2.0	< 2.0
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: C417/20/E/625 Monk Breton

Client: Rogers Geotechnical Services Ltd		**Chemtest Job No.:**			20-32253	20-32253	20-32253
Quotation No.: Q20-21584		**Chemtest Sample ID.:**			1103330	1103331	1103332
Order No.: PO-1082		Client Sample Ref.:			1	1	1
		Sample Location:			WS1	WS2	WS4
		Sample Type:			SOIL	SOIL	SOIL
		Top Depth (m):			0.00	0.50	0.00
		Bottom Depth (m):			0.50	1.00	0.50
		Date Sampled:			24-Nov-2020	24-Nov-2020	24-Nov-2020
		Asbestos Lab:			COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10
pH	M	2010		4.0	8.9	8.7	6.5
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	0.077	< 0.010	< 0.010
ACM Type	U	2192		N/A	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-	-	-
Moisture	N	2030	%	0.020	8.1	5.0	13
Soil Colour	N	2040		N/A	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones and Roots	Stones	Stones and Roots
Soil Texture	N	2040		N/A	Sand	Sand	Sand
Sulphate (Total)	M	2430	%	0.010	0.056	< 0.010	0.16
Organic Matter	M	2625	%	0.40	2.1	< 0.40	2.4
PCB 28	U	2815	mg/kg	0.010	< 0.010		
PCB 52	U	2815	mg/kg	0.010	< 0.010		
PCB 90+101	U	2815	mg/kg	0.010	< 0.010		
PCB 118	U	2815	mg/kg	0.010	< 0.010		
PCB 153	U	2815	mg/kg	0.010	< 0.010		
PCB 138	U	2815	mg/kg	0.010	< 0.010		
PCB 180	U	2815	mg/kg	0.010	< 0.010		
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10		

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

End of Report

GEOTECHNICAL
ENVIRONMENTAL

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

Telephone 01484 607977
Company No: 5130864

Appendix 7

Fill Screening Values

Rogers Geotechnical Services Ltd.

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

Tox Data Report No.	Compound	Residential with Homegrown Produce Landuse (mg/kg)				Reference
	Metals	**SOM: 1%**		**SOM: 6%**		
3	Cadmium	22.1		22.1		C
4	Chromium VI	3.62	20.5	3.62	20.5	B/C
	Copper	4730		4790		A+
7	Mercury	8.81		15.80		A/D
8	Nickel	136		136		A+
	Lead	200		200		C
	Zinc	20000		20300		A+
	Vanadium	136		138		A+
	Semi and Non Metals					
1	Arsenic	37		37		C
10	Selenium	375		375		A
	Free Cyanide	34		34		A
9	Phenols (total)	267		1200		A
	Poly Aromatic Hydrocarbons	Free product	No free product	Free product	No free product	
20	Napthalene	0.829		12.2		A+
	Acenaphthene	157	608	2760		A+
	Fluorene	735		2610		A+
	Anthracene	10200		26200		A+
	Fluoranthene	983		2980		A+
	Pyrene	668		2120		A+
	Benzo(a)anthracene	1.71	4.52	8.54		A
2	Chrysene	0.44	585	2.64	927	A
2	Benzo(b)fluoranthene	1.22	7.72	7.29	9.86	A
2	Benzo(k)fluoranthene	0.686	84.4	4.12	100	A
2	Benzo(a)pyrene	1.51	4.95	0.998	5	B/C
2	Dibenzo(a,h)anthracene	0.00393	0.838	2.05	4.95	A*
2	Indeno(1,2,3-cd)pyrene	0.0614	7.31	0.368	9.75	A
2	Benzo(g,h,i)perylene	0.0187	96.2	0.112	103	A
	Petroleum Hydrocarbons					
	Aliphatic C5-C6	42.7		369		A+
	Aliphatic C6-C8	99.3		768	1240	A+
	Aliphatic C8-C10	13.9		204		A+
	Aliphatic C10-C12	49.9	81.7	297	1180	A+
	Aliphatic C12-C16	20.9	385	125	4130	A+
	Aliphatic C16-C21	210000		210100		A+
	Aliphatic C21-C35	210000		210100		A+
	Aromatic C5-C7 (Benzene)	0.137		0.871		A+
	Aromatic C7-C8 (Toluene)	113		780		A+
	Aromatic C8-C10	20.5		232		A+
	Aromatic C10-C12	70		468		A+
	Aromatic C12-C16	155	165	830		A+
	Aromatic C16-C21	319		1040		A+
	Aromatic C21-C35	1120		1710		A+

A+ = Values update June 2017.

A* Atrisk's SSV is lower than Chemtest's detectable limit for this compound.

B = Health Criterion Values (available from toxicological reviews published in the C4SL project methodology report).

C = Catergory 4 Screening Levels (C4SLs).

D = SSV provided is for Methyl Mercury.