Environmental
Geotechnical
Specialists

REPORT

job number J3976/17/E	site address Hainsworth Road
date August 2017	Silsden,
written by C. E. Mason	Keighley,
checked by I. Sakoor	West Yorkshire, BD20 0L
	issued by C. E. Mason

Rogers Geotechnical Services Ltd
Telephone 0843 50 666 87 Fax 0843 51 599 30
Email enquiries@rogersgeotech.co.uk
www.rogersgeotech.co.uk
Offices 1 & 2, Barncliffe Business Park, Near Bank, Shelley,
Huddersfield, West Yorkshire HD8 8LU.

Environmental Geotechnical Specialists

Contents

Appendices

Environmental Geotechnical Specialists

Report on a Geo-environmental Investigation

Location:	Hainsworth Road Silsden, Keighley, West Yorkshire, BD20 0LY
For:	Mr David Hamer
Report No.	J3976/17/E
Report date:	August 2017

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

[redacted]
Charlotte Mason BSc
Graduate Geotechnical Engineer

[redacted]
James Farnsworth BEng FGS
Senior Geotechnical Engineer

Report Summary[1]

Item	Comments	Section
Development	The site is proposed to be developed by the construction of a series of residential dwellings.	1.
Geology	Till overlying the Nesfield Sandstone.	5.
Strata Conditions	Under a capping of topsoil/made ground, silty sandy gravelly clays were revealed, anticipated to represent till.	6.
Groundwater	Groundwater strikes were encountered within the base of the trial pits at depths ranging between 1.4m and 1.9m.	6.2
Foundation Design	Strip pad footings on cohesive strata at depths of around 2m	10.1
Effect of Sulphates	Concrete class DC-1.	10.5
Contamination	The results of investigation conclude that benzo(a)pyrene and aromatic C21 – C35 is localised to the vicinity of WS1. Remediation of some areas of the site 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

The site is proposed to be developed by the construction of a series of residential dwellings. 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 report also takes into consideration the risk of any contamination and ground gas. 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 J2275/17/EDS in October 2012. This report has been used extensively during the current intrusive investigation.

4. Fieldworks

The fieldworks were undertaken on the 25th July 2017 and included the following:

- Four windowless sample boreholes.
- Four dynamic probes.
- Three gas monitoring standpipes.

In addition to the above, three machine excavated trial pits were undertaken, with soakaway tests conducted at the base of each pit. The results of this investigation have been presented within the factual letter report (ref J3976/17/E) dated 1st August 2017.

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 approximately 90mm for the first 1m through 80mm, 70mm and 60mm 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 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 BS1377: 1990: Part 9, 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 Gas Monitoring Standpipes

Gas monitoring standpipes were installed between 2m and 3m 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 from 0.5m to 1.0m below surface, with a non-perforated pipe to ground level. The response zone was filled with pea gravel, with a bentonite seal at the base and above, and the installation was capped with a stop box cover in a concrete surround.

5. Geology

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

Table 1: Geological Data for the Site

Strata Type	Strata Name[2]	Previous Name[3]	Description[3]
Superficial Geology	Till	N/A	Group of sediments laid down by the direct action of glacial ice. Variable lithology, usually sandy, silty clay with pebbles, but can contain gravel-rich, or laminated sand layers; varied colour and consistency.
Solid Geology	Nesfield Sandstone	N/A	Fine-grained sandstone (quartz arenite), well-sorted, thinly planar bedded and laminated, cross-bedded and ripple cross-laminated in places, with wave and current ripples.

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
0.19 – 0.4	TOPSOIL	TP1, TP2, WS2, WS3	None
0.41 – 0.6	MADE GROUND (Gravel)	TP3, WS1, WS4	None.
+1.7 - +4.0	Firm sandy gravelly CLAY (Till)	All	TP2 (1.9m) TP3 (1.7)

'+' 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 investigation positions revealed that in TP4, WS1 and WS4 (undertaken within car park areas) made ground comprising gravel of dolostone was revealed to depths ranging between 0.41m and 0.6m. This material was black in colouration in some areas, indicating that the material may be particularly ashy in places. Within TP1, TP2, WS2 and WS3 (in the location of the previous orchard) topsoil was present to depths ranging between 0.19m and 0.4m.

[2] Sources: British Geological Survey (NERC) Map Sheet 69; Bradford; 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*]

Beneath the topsoil and made ground in all investigation positions, silty gravelly clay was encountered. Low to medium cobble content was present within this material comprising tabular cobbles of sandstone. With respect to the published geological data for the site, it is considered that these soils represent till.

6.2 Groundwater

Groundwater strikes were encountered within the base of the trial pits at depths ranging between 1.4m and 1.9m. 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	1.6	0.4 5.2	5.5	Effective.	Low blow counts noted between ground level and 1.6m. Consistent blow counts with depth between 1.6m and 5.2m. Dramatic increase in blow counts until refusal encountered.
DP2	1.8	7.6	9.3	Effective	Low blow counts noted between ground level and 1.8m. Some higher blow counts noted between 2m and 3.5m. Gradual increase in blow count with depth noted from 7.6m
DP3	1.8	4.1	4.6	Effective	Low blow counts noted between ground level and 1.8m Some higher blow counts noted between 2m and 3m. Gradual increase in blow count with depth noted from 4m
DP4	1.8	7.1	8.9	Effective	Low blow counts noted between ground level and 1.8m Some higher blow counts noted between 1.8m and 7.1m

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

7.2 Gas and Water Level Monitoring

The standpipes were monitored between 1st August 2017 and 22nd August 2017. Gas monitoring is currently ongoing. The results of the gas monitoring undertaken to date are tabulated below.

Table 4: Gas monitoring

Location	Date	CH_4 (%)	CO_2 (%)	O_2 (%)	Flow	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)
WS01	01.08.17	0.0	0.3	20.5	0.0	999↑	1.10	3.4
	09.08.17	0.0	0.4	20.5	0.0	1008↑	0.70	
	22.08.17	0.0	0.8	19.9	0.0	1006↓	0.65	
WS02	01.08.17	0.0	1.2	18.9	0.1	1000↑	0.95	3.0
	09.08.17	0.0	0.7	20.1	0.0	1007↑	0.60	
	22.08.17	0.0	0.8	20.1	0.0	1007↓	0.57	
WS04	01.08.17	0.0	1.7	18.8	0.1	1000↑	14.20	2.6
	09.08.17	0.0	1.3	19.6	0.1	1009↑	0.50	
	22.08.17	0.0	2.7	18.3	0.1	1007↓	1.00	

↑ Rising Pressure; ↓ Falling pressure.

This work was undertaken using a Geotechnical Instruments (UK) Ltd. GA5000 (serial No G503524) which was last calibrated on the 10th July 2017.

8. Laboratory Testing - Geotechnical

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

- Moisture content determinations — BS 1377: 1990: Pt2: 3.2
- Index properties (1 point) — BS 1377: 1990: Pt2: 4.4, 5.3 & 5.4
- Linear shrinkage — BS 1377: 1990: Pt2: 6.3
- Soluble sulphate content — BS 1377: 1990: Pt3: 5
- pH value — BS 1377: 1990: Pt3: 9

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

Table 5: Summary of Geotechnical Test Results

Test type	Number of tests		Range of results	Comments
Moisture content determinations	10		9.8% to 25%	Moisture contents generally reduce with depth.
Index Properties (1 Point)	8	LL	26% to 34%	Brown sandy gravelly CLAY (TILL). Clay of low plasticity Consistency index 0.5 to 1.1 NHBC Class – negligible to low
		PL	13% to 19%	
		PI	10% to 17%	
		LS	6% to 9%	
Soluble sulphate & pH	4	SO_4	<0.010 to 0.059mg/l	DS-1, ACEC class AC-1

	pH	5.8 to 9

8.1 Geotechnical Properties

The idealised geotechnical properties employed in design are summarised below.

Table 6: Summary of Geotechnical Properties

Property	Range of values	Comments
Volume change potential (NHBC)	Low	Brown sandy gravelly CLAY (TILL).
Shear strength parameters (at about 2.0m foundation level)	c_u 40kN/m^2	Based on dynamic probes, consistency indices and soil descriptions
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).
- Petroleum hydrocarbons (TPHs).
- Others – pH, organic content and total/soluble SO_4^{2-}, asbestos

This testing was undertaken by Chemtest Ltd and the results of all of the chemical testing are presented in Appendix 5 of this report.

10. Discussion of Ground Conditions - Geotechnical

The site is proposed to be developed by the construction series of residential dwellings. At the time of writing this report the precise layout and method of construction is not known, thus the discussion below is of a generalised nature.

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 present in a weak and variable condition to depths of around 2.0m bgl across the site, such that excessive total and or differential settlement could occur under moderately light surface loading.

10.1 Strip or Spread Foundations

It is considered that the till, comprising sandy gravelly clay will provide a suitable bearing stratum, provided that the foundations are placed within soil generally described as being present in a firm in-situ condition. It is considered that strip or spread foundations could be constructed at a minimum of 2m depth. The foundations could be designed assuming an allowable increase in load given in the following table.

Table 7: Allowable increase in stress

Foundation type		Strip Footings			Spread Footings		
Foundation Breadth	B (m)	0.6	1.0	1.5	1.0	2.0	3.0
Foundation Depth	D (m)		2.0			2.0	
Allowable Increase in Stress	(kN/m²)	95	90	85	145	130	125

The allowable increase in stress given above assumes a factor of safety of 3 against general shear failure, with cohesion of 40kN/m^2 at the foundation depths. Should any soft or weak material be encountered they should be locally removed and replaced with lean-mix concrete or compacted granular soil.

10.3 Volume Change Potential

Moisture content tests undertaken near the surface of the site were comparably low (most notably, within WS2 at 0.65m), which may suggest that some desiccations could be occurring at shallow depths. As the rear of the site was previously used as an orchard, and root systems were found at depth, the possibility for desiccation to occur would be a realistic assumption. It should be appreciated that the cohesive soils revealed at this site possess a low volume change potential under the guidance of the NHBC standards. Therefore, it is will be necessary to ensure that the depths of the foundations are designed in accordance with the Chapter 4.2 of the NHBC standards[5]. The methodology provided in the guidance will require the identification of any trees, still present at, or recently removed from, the site and the distance from the proposed foundations. This may result in foundation depths greater than those given above and the requirement for heave protection to be employed against footings and below the underside of the floors and beams.

[5] NHBC Standards, Chapter 4.2, *Building near trees*

10.4 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.

10.5 Ground-floors

In light of the made ground and weak near surface soils, which were revealed to depths of up to 2m, 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.

10.6 Hard-standing Areas

It is considered that any hard-standing formed above the till revealed at the site could be constructed employing traditional pavement design. A design California Bearing Ratio (CBR) of 2.5% could be used in the pavement design[6]. However, it is recommended that proof rolling of the sub-grade be undertaken to establish the suitability of the soils, to expose any soft or weak ground and to ensure the sub-grade is well compacted prior to construction. Any areas of soft or weak ground should be remediated by increasing the sub-base thickness. Alternatively, weak material could be locally removed and replaced with a compacted granular capping layer. If construction were to be undertaken during the winter or after periods of prolonged rainfall, it may be prudent to employ a geotextile and/or a geogrid between the sub-base and sub-grade.

10.7 Effect of Sulphates

In view of the nature of the underlying soils it is considered that the design sulphate class be assessed with reference to Table C2[7], which is provided in BRE Special Digest 1, *Concrete in aggressive ground*: Part C. On the basis of this table and considering the soluble sulphate contents recorded, it can be shown that well compacted buried concrete should be designed in accordance with Class DS-1

[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*

requirements. Assuming static groundwater, the table also indicates that the aggressive chemical environment for concrete (ACEC) classification is AC-1s.

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

11. Discussion of Ground Conditions - Environmental

11.1 Discussion of Test Results

It is understood that a site is to be developed by the erection a series of new residential dwelling with associated garden areas. Consequently, the site may be classified as residential with plant uptake.

11.1.1 Soil Samples

The results of the chemical testing undertaken on soil samples obtained during this investigation have been compared to the ATRISK soil screening values (SSVs) as compiled by WS Atkins plc. These values have been derived in such a way as to adhere to the principles within the revised CLEA model and include the most current release of the SGVs. A list of subscribers is provided within the website[9] and these include many local authorities.

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

Table 8: Summary of contaminated areas

Location	Depth (m)	Contaminants found to be exceeding SSVs (Residential with plant uptake)
WS1	0 – 0.4m	PAHs [Chrysene, benzo(a)pyrene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene, benzo(g,h,i)perylene], TPHs [Aromatic C21 – C35]
WS4	0.15 – 0.54m	None
TP1	0 – 0.1m	None
TP2	0.1 – 0.11m	None

Concentrations of chromium^{VI}, free cyanide, phenols (total) and total petroleum hydrocarbons (aliphatic C5 to C10; aromatic C5 to C10) 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.

[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

It should be appreciated that the soil screening values for the PAHs represents vapour saturation limits. The inhalation of vapour pathway contributes less than 10% of total exposure, which is unlikely to significantly affect the combined assessment criterion[10]. In view of this, the ATRISK soil SSVs notes that the users may wish to consider using a combined assessment criterion given by CLEA 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 CLEA criteria should be adopted for the PAHs at this site. The results of the contaminants found to exceed these screening values are tabulated below:

Table 9: Summary of areas contaminated by PAHs

Location	Depth (m)	Contaminants found to be exceeding SGVs (Residential with Plant Uptake)
WS1	0 – 0.4m	PAHs [Benzo(a)pyrene]
WS4	0.15 – 0.54m	None
TP1	0 – 0.1m	None
TP2	0.1 – 0.11m	None

It should be appreciated that the ATRISK soil screening criteria and the CLEA guidance provides screening values that adhere to the principals of ensuring that contamination levels are kept to a concentrations where a minimal risk of harm may result. However, recent work by DEFRA has set about determining a set of screening criteria which assess whether a low risk of a harm present from contamination[11]. Whilst this is felt to reflect a more pragmatic approach to contamination risk assessment, it is still strongly precautionary. From this work Category 4 Screening Levels (C4SLs) have been determined for a limited range of compounds.

As such, in the context of a residential site without plant uptake, a C4SL value of 5mg/kg (assuming 6% SOM) is provided for benzo(a)pyrene[12]. As the maximum recorded concentration of lead (5.6mg/kg) in the tested samples slightly elevated with respect to the appropriate C4SL, it is reasoned that the risk of harm from the concentration of this contamination at the site may be considered as significant. Nevertheless it should be appreciated that benzo(a)pyrene is commonly found within coal ash as such compounds, which occur naturally within the coal, are concentrated during combustion processes. On this basis the contamination at the site could be associated with low quality fill imported to this area, demolition material from a former a structure, or the tipping of coal derived ash.

In addition to the above, the results of the chemical testing has shown that levels of Aromatic C21 - C35 are significantly elevated (4600 mg/kg) within WS1. As samples from TP1 and TP2 are below the limit of detection, and WS4 revealed a result that was only slightly elevated, it is suggested that this feature should be treated as a 'hot spot' of contamination. Aromatic C21 – C35 are on the heavier end of the petroleum hydrocarbon range, and, therefore, it is suggested that this contamination could be associated with a localised oil spill. As the site has been previously used as a wood turning workshop

[10] Ref: ATRISK soil, SSVs derived using CLEA v1.04 – v1.06 for 6% SOM, Residential without home grown produce land use, 8.1.15.
[11] DEFRA, 2014. SP1010: *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document*.
[12] DEFRA, 2014. SP1010: *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document*; [Table pg 13] *Final Category 4 Screening Levels based on the risk management decisions outline above.*

this contamination could be associated with historic lubricating oils. In addition, the desk study highlighted that boiler room for a wood burner containing a 300 gallon oil tank was present within the north east quadrant of the site (within the vicinity of WS1). Nevertheless, due to the low permeability of cohesive soils encountered beneath the site, it is considered that there is low risk of migration of these contaminants off site. It is also understood that the upper layers of made ground may be removed (i.e. site scrape) during the initial ground works phase including any local areas of petroleum hydrocarbons.

Furthermore, it should be appreciated that the letter from the Department of Public Health (ref: SR 414654, dated 12th August 2016) stated that *'there is an orchard on site. Historically pesticides used in the orchard have included arsenic based compounds'*. However, near surface soils tested within the previous orchard have revealed levels of arsenic below the appropriate screening values.

11.1.2 Gas Concentrations

With respect to ground gas, the results of the monitoring visits indicated negligible methane, with concentrations of carbon dioxide ranging between 0.3% and 2.7%, in association with oxygen levels of between 18.3% and 20.5%. 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 to date were at atmospheric pressures of between 999mb and 1009mb.

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% (0.0) methane was recorded along with 2.7% (0.027) carbon dioxide, in association with a maximum flow rate of 0.1 l/hr. This results in a GSV of 0 l/hr for methane and a GSV of 0.0027 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)[13]. Accepting that the proposed development is of high sensitivity and that the generation potential is very low, these tables suggest that 6 readings could be undertaken over a period of 3 months. However, C665 notes that *not all sites will require gas monitoring for the period and frequency indicated in Tables 5.5a and 5.5b.*

In this case, a total of 3 monitoring visits were undertaken over a three week time period and for the purpose of this assessment, it is considered that the site can be provisionally classified as

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

Characteristic Situation Level 1. Therefore, it is recommended that three further monitoring visits are undertaken within the next month as recommended by the CIRIA report C665 (2007

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[14] advice on the assessment of risks arising from the presence of contamination in soils and using the source-pathway-receptor approach.[15] 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.'[16]

11.2.2 Conceptual Ground Model and Risk Assessment

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

On-site – Made Ground (Benzo(a)pyrene, Aromatic C21 – C35)

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

[14] 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'.
[15] 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.
[16] See 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990', appendix A.

High - The linkage exists and the available data indicates that significant harm may be caused and remedial action could be necessary.

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

Table 10: Conceptual Site Model and Site Specific Risk Assessment [Contamination: Benzo(a)pyrene and Aromatic C21 – C35)

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	The results of investigation conclude that benzo(a)pyrene and aromatic C21 – C35 is localised to the vicinity of WS1. The risks to operatives must be considered and managed in accordance with the Construction Design and Management (CDM) regulations. Remediation of some areas of the site will be required to protect end users.
	End User	Yes – contamination found to be present at the site and site to be developed by	High	
	Neighbours	Yes – contamination found to be present at the site and a populated residential and commercial area surrounds the site.	Low	Contamination by benzo(a)pyrene and aromatic C21 – C35 is not anticipated to be significantly mobile, and therefore there is limited migration potential for contaminates to migrate off site at levels deemed harmful to neighbours. In addition, this contamination is likely to represent a diminishing source and the underlying superficial deposits are of low permeability.
Inhalation of Dust/Vapours	Operative	Yes – dust may be derived from contaminated soils. However, aromatic C21 - C35 is not considered volatile and therefore the risk posed by inhalation of vapour is considered low.	Dust (High) Vapours (Low)	The results of investigation conclude that benzo(a)pyrene and aromatic C21 – C35 is localised to the vicinity of WS1. The risks to operatives must be considered and managed in accordance with the Construction Design and Management (CDM) regulations. Remediation of some areas of the site will be required to protect end users.
	End User	Yes – dust may be derived from contaminated soils. However, aromatic C21 - C35 is not considered volatile and therefore the risk posed by inhalation of vapour is considered low.	Dust (High) Vapours (Low)	
	Neighbours	Yes – contamination found to be present at the site and residential and commercial properties located within 250m radius of the site	Dust (High) Vapours (Low)	

Ingestion of fruit/vegetables and/or waters	Operative	No – no edible plants or contained water sources in the area of the proposed new works.	N/A	The results of investigation conclude that benzo(a)pyrene and aromatic C21 – C35 is localised to the vicinity of WS1. Remediation of some areas of the site will be required to protect end users. Contamination by benzo(a)pyrene and aromatic C21 – C35 is not anticipated to be significantly mobile, and therefore there is limited migration potential for contaminates to migrate off site at levels deemed harmful to neighbours. In addition, this contamination is likely to represent a diminishing source and the underlying superficial deposits are of low permeability.
	End User	Yes – soft landscaping likely as part of the proposed new works.	High	
	Neighbours	Yes – there are potential sources of contamination on site and neighbouring properties within 250m of the proposed development	Low	
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	No – low concentrations of methane and carbon dioxide have been found to be present at the site (assuming *Characteristic Situation Level 1*).	Low	Low concentrations of harmful gases (methane and carbon dioxide) were detected at the site. If ground gas conditions remain the same, no special precautionary measures are deemed to be required.
	End User		Low	
	Neighbours	No – whilst concentrations of ground gas have been found to be present at the site (assuming *Characteristic Situation Level 1*), 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.	Low	The site is underlain by cohesive soils of low permeability. Contamination is not anticipated to be significantly mobile. Volatilisation and degradation of local hot spot of TPH is likely to result in a diminishing source. As a precaution, any old services should be removed or capped. In addition, 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.
Migration via permeable unsaturated strata	Controlled Waters	Yes – a secondary A aquifers is present beneath the site	Low	
Run off via drainage/sewers etc	Controlled Waters	Yes – old services may be present on site	Moderate	
Direct contact with contaminated soils	Plants	Yes – contamination present at the site which may affect plants.	High	Some contamination is present underlying the site. In view of this it is considered that soft landscaped

Uptake via root system			High	areas around the north-eastern corner of the building will require some remediation.
Direct contact with contaminated soils Direct contact with contaminated groundwater	Building Materials	Yes – TPH and elevated levels of PAH contamination revealed at the site may represent a significant risk to plastic water pipes. Moreover, testing indicates that the aggressive chemical environment for concrete classification is AC-1.	Moderate (plastic services) Low (buried concrete)	Please see section 11.3.3 for information on good building practice.
Exposure to Radon	Operative End User	No – less than 1% of homes are above the action level for radon.	Low	No radon protection measures required.

11.3 Remediation Strategy

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

11.3.1 Remediation Objectives

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

- To protect the site operatives during the construction process from the ingestion of soil or dust, dermal contact with the soil and inhalation of dust.
- To protect the end user from the ingestion of soil or dust, dermal contact with the soil.
- To protect neighbours from the inhalation and ingestion dust during the construction process.
- To protect plants from direct contact with contamination and prevent uptake via root system.
- To protect plastic services from being penetrated by, or degrading due to the presence of, contamination in the soil or groundwater.
- To protect end users from contaminated plants.

11.3.2 Development Requirements

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

11.3.3 Strategy

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

Ground-works

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

Health and Safety Plan and site specific Method Statements. These documents should include the following main elements.

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

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

Construction

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

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

Hot-spot Contamination

The work detailed in this report has established that a hotspot of benzo(a)pyrene and TPH contamination is present within the vicinity of WS1. It is reasoned that this contamination is present solely within the made ground revealed on site. In addition, as the contamination is not anticipated to be significantly mobile, it is suggested that the risk for contamination to migrate to other areas of the site, or off site, may be considered low. It should be appreciated that as only discrete 'hot-spot' of contamination was revealed, there are a few approaches to the remediation at the site. It must firstly be noted that the extent of the contamination 'hot-spots' cannot be fully realised from this investigation.

In order to more clearly delineate the extent of the contamination, it would be necessary to undertake further determinant specific testing on a series of rings around the 'hot-spots'. Depending on the size of the 'hot-spots', once determined, the following remediation strategies are proposed.

1. It should be appreciated that the thickness of the made ground at the site has been found to be limited. It may be prudent simply to remove the contaminated material from the site and replace it with suitable imported fill.
2. It is not anticipated that wholly removing all the made ground from site would result in significant volumes of material needing to be disposed of offsite. If all the made ground were to be entirely removed from these areas then no contamination linkage would be present and clean cover would not be required within garden areas. It may of course need to be demonstrated with accurate site levels and photographic evidence that the made ground has been wholly removed and the extent of the basements has been clearly defined.
3. The hotspot would require the provision of a clean cover system including a capping layer of say 500mm of inert material, which will put the contaminated ground out of the end users' dig range. At the base of this layer, a granular capillary break of say 100mm of free draining granular soil should be placed in order to prevent mobile contamination rising upward. This expedient should also provide a suitable root barrier to isolate the plants from the underlying contaminated ground.

11.4 Fill Materials

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

Fill materials should be initially screened, by a suitably qualified engineer, for the following.

- It is a suitable growing medium where 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[17] 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 (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 14: Fill screening values

Contaminant	Screening Value (Residential with Plant Uptake) (mg/kg)	Reference
As	32	Atrisk^{SOIL} SSVs, 6% soil organic matter
Cd	10	Atrisk^{SOIL} SSVs, 6% soil organic matter
Cr^{VI}	14.7	Atrisk^{SOIL} SSVs, 6% soil organic matter
Cu	4020	Atrisk^{SOIL} SSVs, 6% soil organic matter
Hg	1	Atrisk^{SOIL} SSVs, 6% soil organic matter
Ni	130	Atrisk^{SOIL} SSVs, 6% soil organic matter
Pb	168	Atrisk^{SOIL} SSVs, 6% soil organic matter
V	115	Atrisk^{SOIL} SSVs, 6% soil organic matter
Zn	17200	Atrisk^{SOIL} SSVs, 6% soil organic matter
TPH CWG	See contamination analysis sheet	Atrisk^{SOIL} SSVs, 6% soil organic matter
PAH 16 USEPA	See contamination analysis sheet	Atrisk^{SOIL} SSVs, 6% soil organic matter

The above screening values are considered to be appropriate for topsoil. However, for granular fill, the soil organic matter would be different (i.e. 1% soil organic matter), thus different screening values would be required. Testing should comply with UKAS and MCERTS, where applicable, and undertaken by an accredited laboratory.

[17] Sampling & Testing Matrix of Yorkshire and Humberside Pollution Advisory Council, 2013, *YAHPAC Technical Guidance for Developers, Landowners and Consultants – Verification Requirements for Cover Systems v2.1*, Appendix 1a.

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

11.5 Verification Report

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

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

- The assessment of the extents of any contamination 'hot-spots' identified including the details of sampling points, such as location and descriptive logs, and the results of any chemical testing.
- The extents of any areas where made ground has been wholly removed.
- Characterisation of the suitability of the clean material including the derivation of the material, comments from a visual screen, the tests results of chemical screening, delivery tickets where appropriate and the conditions by which the clean material has been stored and handled on site.
- Photographic and logged evidence clean material has been handled on site and placed in a sufficient thickness over areas where made ground remains. This may be either at the time of placement or after placement by means of hand excavated trialpits. Photographs should include visual site references or reference boards to prove the location and date taken. A measurement reference should be visible in the photographs to substantiate the thickness of material placed. Please note that it may also be necessary to undertake a topographical survey and the requirement for which should be checked with any statutory authorities.

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

12. Recommendations for further work

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

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

13. References

- British Geological Survey (NERC) (2017), 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 Standards Institution (2015) BS5930: *Code of practice for site 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) 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 (2004) BS EN ISO 14688: *Geotechnical investigation and testing – Identification and classification of soil, incorporating corrigendum no.1 (2007),* 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.

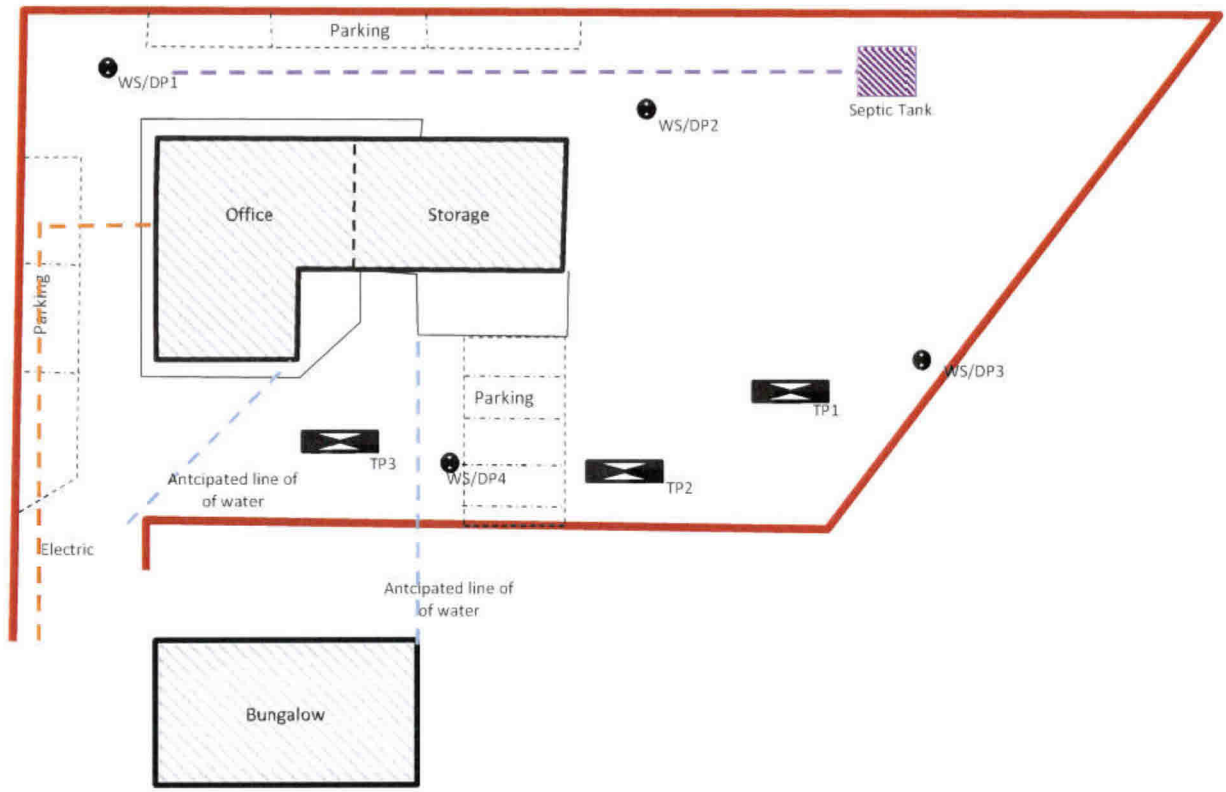
- Department for Environment, Food and Rural Affairs (2014) SP1010: *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document.*

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

Environmental
Geotechnical
Specialists

Appendix 1

Site Plan



Plan not to scale and investigation positions approximated from site operative's notes.

Title: **Investigation Location Plan**

Rogers Geotechnical Services Ltd	Site Name: Hainsworth Road, Silsden	Job No: J3967/17/E

Environmental
Geotechnical
Specialists

Appendix 2

Borehole Records

Trial Pit Log

Trialpit No: TP1
Sheet 1 of 1

Project Name:	Hainsworth Road, Silsden.	Project No.: J3976/17/E	Co-ords: - Level:	Date: 25/07/2017
Location:	'The Willows' Hainsworth Road, Silsden, Keighley, West Yorkshire, BD20 0LY	Dimensions (m): Depth 2.10	1.5 x 0.6	Scale: 1:50
Client:	Davric Construction Ltd			Logged: CM

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.00 - 0.10	ES					TOPSOIL (Dark brown organic slightly clayey silty SAND) *0.0m - 0.5m abundant rootlets within top 500mm.*
	0.40 - 1.00	B		0.40			Firm orangish brown mottled greyish brown silty very sandy gravelly CLAY with low cobble content. Gravel is angular tabular of orange medium to coarse grained sandstone with rare organic lenses. Cobbles are angular of sandstone (TILL).
				1.00			Firm brown mottled bluish grey silty slightly gravelly CLAY. Gravel is sub angular fine to medium of various lithologies including medium grained sandstone. Material contains rare flecks or organic material (TILL) *1.7m: Large sub rounded sandstone cobble ~ 500mm x 300mm x 300mm.*
	1.80 - 2.00	B					
				2.10			End of pit at 2.10 m

Remarks: Pit terminated due to water ingress at the base of the pit.

Stability: Good

Trial Pit Log

Trialpit No: **TP2**

Sheet 1 of 1

Project Name:	Hainsworth Road, Silsden.	Project No. J3976/17/E	Co-ords: - Level:	Date 25/07/2017
Location:	'The Willows' Hainsworth Road, Silsden, Keighley, West Yorkshire, BD20 0LY	Dimensions (m): Depth 1.90	0.6 / 1.1	Scale 1:50
Client:	Davric Construction Ltd			Logged CM

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10 - 0.15	ES					TOPSOIL (Dark brown organic silty gravelly fine and medium SAND. Gravel is sub angular fine to medium of various lithologies).
	0.40 - 1.00	B		0.40			Firm grey mottled orangish brown silty gravelly CLAY with low to medium cobble content. Gravel and cobbles are angular tabular of medium strong organish brown fine to medium-grained sandstone and occasional fine sub rounded gravels. Rare flecks of organic materials.
	1.20 - 1.50	B		1.20			Brown mottled orangish brown silty sandy gravelly CLAY with low cobble content. Gravel is sub angular fine to coarse of angular tabular medium strong orangish brown fine to medium-grained sandstone and rare coal flecks.. Cobbles are angular tabular of orangish brown sandstone.
▼	1.80 - 2.00	B		1.90			End of pit at 1.90 m

Remarks: Trial pit trimmed and squared prior to undertaking soakaway test which reduced depth to 1.79m.

Stability: Good

Trial Pit Log

Trialpit No: **TP3**

Sheet 1 of 1

Project Name:	Hainsworth Road, Silsden.	Project No.: J3976/17/E	Co-ords: - Level:	Date: 25/07/2017
Location:	'The Willows' Hainsworth Road, Silsden, Keighley, West Yorkshire, BD20 0LY	Dimensions (m): Depth 1.70	1.6 × 0.6	Scale: 1:50
Client:	Davric Construction Ltd			Logged: CM

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.30	B		0.10			MADE GROUND (Bluish grey sub angular to angular fine to coarse GRAVEL of dolostone (hard core).
				0.20			MADE GROUND (Orangish brown silty clayey sub angular to angular fine to coarse gravel of dolostone (Sub base).
	0.70	B		0.60			MADE GROUND (Black organic silty slightly gravelly CLAY. Gravel is angular tabular of extremely weak siltstone)
▼	1.50 - 1.70	B		1.70			Firm bluish grey mottled orangish brown silty sandy gravelly CLAY with low cobble content. Gravel is sub angular to angular fine to coarse of medium-grained orangish brown feldspathic sandstone. Cobbles are sub angular tabular of sandstone (TILL).
							End of pit at 1.70 m

Remarks: Pit terminated due to water ingress at the base of the pit.

Stability: Good

Borehole Log

Borehole No. **WS1**

Sheet 1 of 1

Project Name:	Hainsworth Road, Silsden.	Project No. J3976/17/E	Co-ords:
Location:	'The Willows' Hainsworth Road, Silsden, Keighley, West Yorkshire, BD20 0LY		Level:
Client:	Davric Construction Ltd		Dates: 25/08/2017

Hole Type: WLS

Scale: 1:50

Logged By: JDMI

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.00 - 0.40	ES	88	93		0.20			MADE GROUND. (Black slightly sandy sub-angular and sub-rounded sub-cubic and sub-spherical occasionally tabular fine to coarse dolostone GRAVEL). (Unbound asphalt).
		0.70	D				0.41			MADE GROUND. (Light grey sandy sub-angular and sub-rounded sub-spherical fine to coarse limestone GRAVEL).
		1.50	D	68	82					Soft to firm orangish brown sandy gravelly CLAY. Gravel is angular to sub-rounded sub-cubic and sub-spherical fine to coarse sandstone and mudstone. (Till).
				58	100		2.00			Firm to stiff grey sandy very gravelly CLAY with low cobble content. Gravel is angular and sub-angular sub-cubic and sub-spherical fine to coarse sandstone and mudstone. (Till).
		3.00	D	58	76					*2.30-2.40m: Sandstone COBBLE.* *2.70-2.77m: Mudstone COBBLE.*
							4.00			End of Borehole at 4.00m

1 2 3 4 5 6 7 8 9 10

Remarks

AGS

Borehole Log

Borehole No. **WS2**

Sheet 1 of 1

Project Name:	Hainsworth Road, Silsden.	Project No. J3976/17/E	Co-ords:
Location:	'The Willows' Hainsworth Road, Silsden, Keighley, West Yorkshire, BD20 0LY		Level:
Client:	Davric Construction Ltd		Dates: 25/08/2017

Hole Type: WLS

Scale: 1:50

Logged By: JDMI

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.65	D	88	100		0.20			TOPSOIL. (Dark brown sandy organic CLAY with occasional rootlets).
										Firm orangish brown to brown sandy gravelly CLAY. Gravel is angular and sub-angular sub-cubic fine to coarse sandstone and mudstone. (Till).
										0.62-0.65m: Fine to to medium grained SAND
		1.50	D	68	65					
							2.00			Firm grey sandy very gravelly CLAY. Gravel is angular and sub-angular cubic and sub-cubic fine to coarse sandstone and mudstone. (Till).
		2.50	D	58	100					
							3.00			End of Borehole at 3.00m

Remarks

Borehole Log

Borehole No. **WS3**

Sheet 1 of 1

Project Name:	Hainsworth Road, Silsden.	Project No. J3976/17/E	Co-ords:
Location:	'The Willows' Hainsworth Road, Silsden, Keighley, West Yorkshire, BD20 0LY		Level:
Client:	Davric Construction Ltd		Dates: 25/08/2017

Hole Type: WLS

Scale: 1:50

Logged By: JDMI

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.19			TOPSOIL. (Dark brown silty organic SAND with occasional fine rootlets).
				88	92					Loose orangish brown silty fine SAND. Occasional fine rootlets in top 0.4m.
		0.90	D				0.80			*0.65-0.80m: Becomes gravelly. Gravel is angular cubic fine and medium fine grained sandstone.*
				68	89					Firm orangish brown sandy gravelly CLAY. Gravel is angular and sub-angular sub-cubic fine to coarse sandstone and mudstone. (Till).
		1.70	D				2.00			Firm grey sandy gravelly CLAY with low cobble content. Gravel is angular and sub-angular cubic and sub-cubic fine and medium sandstone and mudstone. (Till).
				58	100		3.00			End of Borehole at 3.00m

Remarks

Borehole Log

Borehole No. **WS4**

Sheet 1 of 1

Project Name:	Hainsworth Road, Silsden.	Project No. J3976/17/E	Co-ords:	Hole Type WLS
Location:	'The Willows' Hainsworth Road, Silsden, Keighley, West Yorkshire, BD20 0LY		Level:	Scale 1:50
Client:	Davric Construction Ltd		Dates: 25/08/2017	Logged By JDMI

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.15 - 0.54	ES	88	96		0.15			MADE GROUND. (Black slightly sandy sub-angular and sub-rounded sub-cubic and sub-spherical occasionally tabular fine to coarse dolostone GRAVEL). (Unbound asphalt).
		0.70	D				0.38			MADE GROUND. (Light grey sandy sub-angular and sub-rounded sub-spherical fine to coarse limestone GRAVEL).
				78	78		0.51			MADE GROUND. (Black and orange slightly sandy angular sub-cubic ash and brick GRAVEL).
		2.00	D	68	89		1.00			Soft orangish brown very sandy CLAY. (Till).
							2.00			Soft brown sandy gravelly CLAY. Gravel is angular and sub-angular cubic and sub-cubic fine to coarse sandstone and mudstone. (Till).
							2.70			Firm grey sandy very gravelly CLAY. Gravel is angular and sub-angular cubic and sub-rounded fine to coarse sandstone and mudstone. (Till).
										End of Borehole at 2.70m

Remarks

AGS

Environmental
Geotechnical
Specialists

Appendix 3

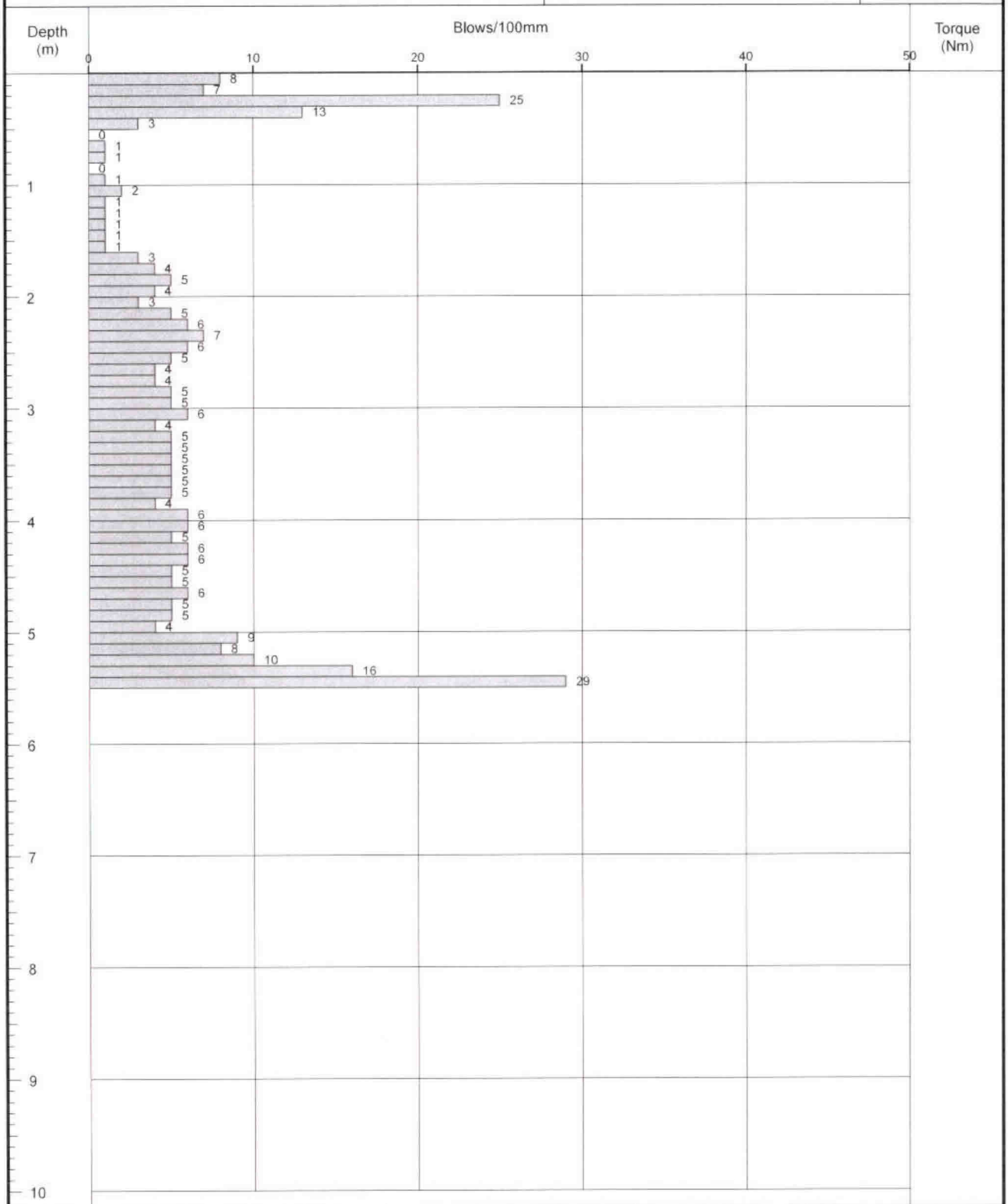
Dynamic Probing Records

Probe Log

Probe No. **DP1**

Sheet 1 of 1

Project Name: Hainsworth Road, Silsden.	Project No. J3976/17/E	Co-ords:	Hole Type DCP
Location: 'The Willows' Hainsworth Road, Silsden, Keighley, West Yorkshire, BD20 0LY		Level:	Scale 1:50
Client: Davric Construction Ltd		Dates: 25/07/2017	Logged By KW



Remarks:
Terminated at 5.50m with 29 blows.

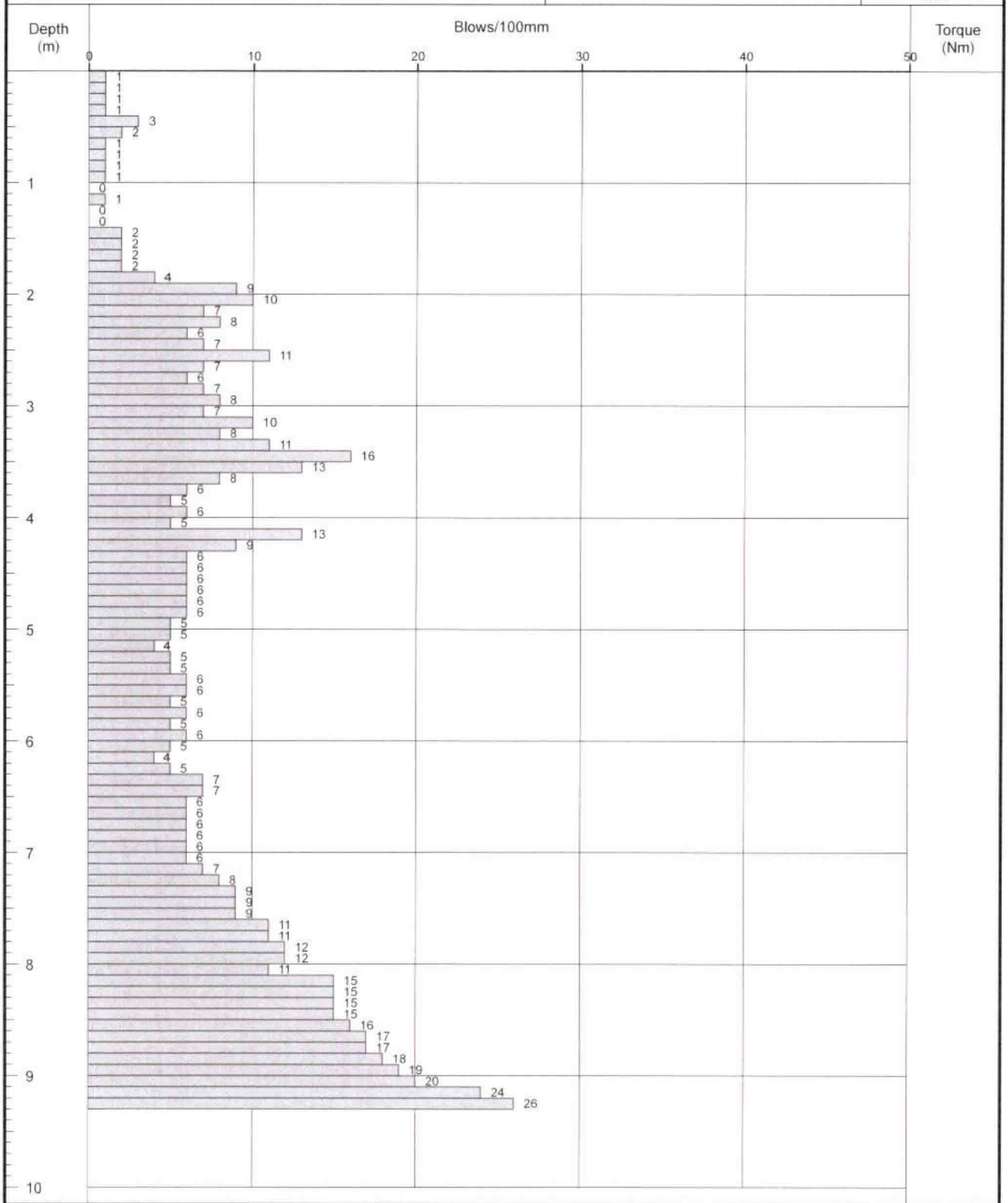
Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	5.5m
Probe Type	DPSH-B		

Probe Log

Probe No. **DP2**

Sheet 1 of 1

Project Name: Hainsworth Road, Silsden.	Project No. J3976/17/E	Co-ords:	Hole Type DCP
Location: 'The Willows' Hainsworth Road, Silsden, Keighley, West Yorkshire, BD20 0LY		Level:	Scale 1:50
Client: Davric Construction Ltd		Dates: 25/07/2017	Logged By KW



Remarks:
Terminated at 9.30m with 70/300mm.

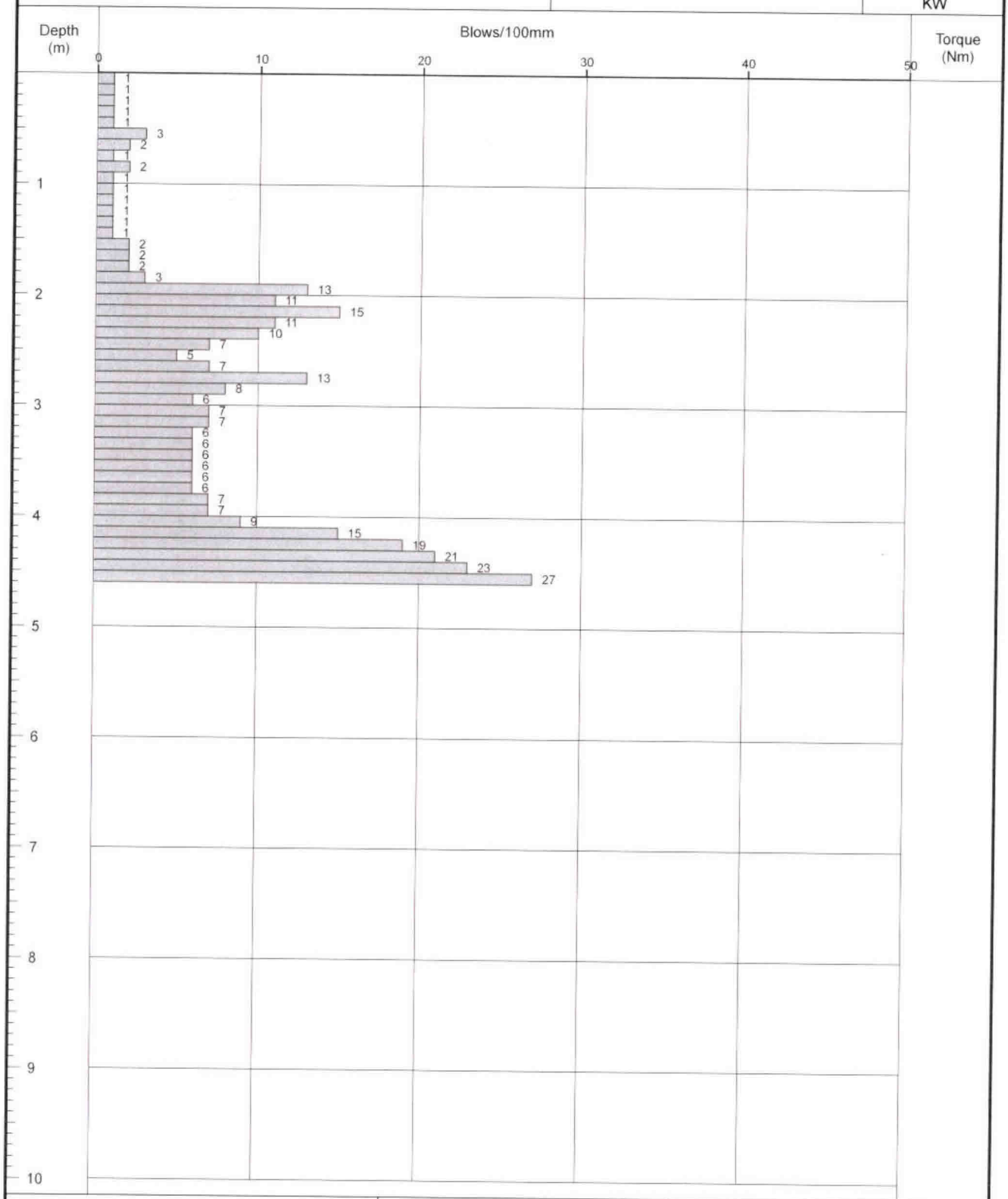
Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	9.3m
Probe Type	DPSH-B		

Probe Log

Probe No. **DP3**

Sheet 1 of 1

Project Name: Hainsworth Road, Silsden.	Project No. J3976/17/E	Co-ords:	Hole Type DCP
Location: 'The Willows' Hainsworth Road, Silsden, Keighley, West Yorkshire, BD20 0LY		Level:	Scale 1:50
Client: Davric Construction Ltd		Dates: 25/07/2017	Logged By KW

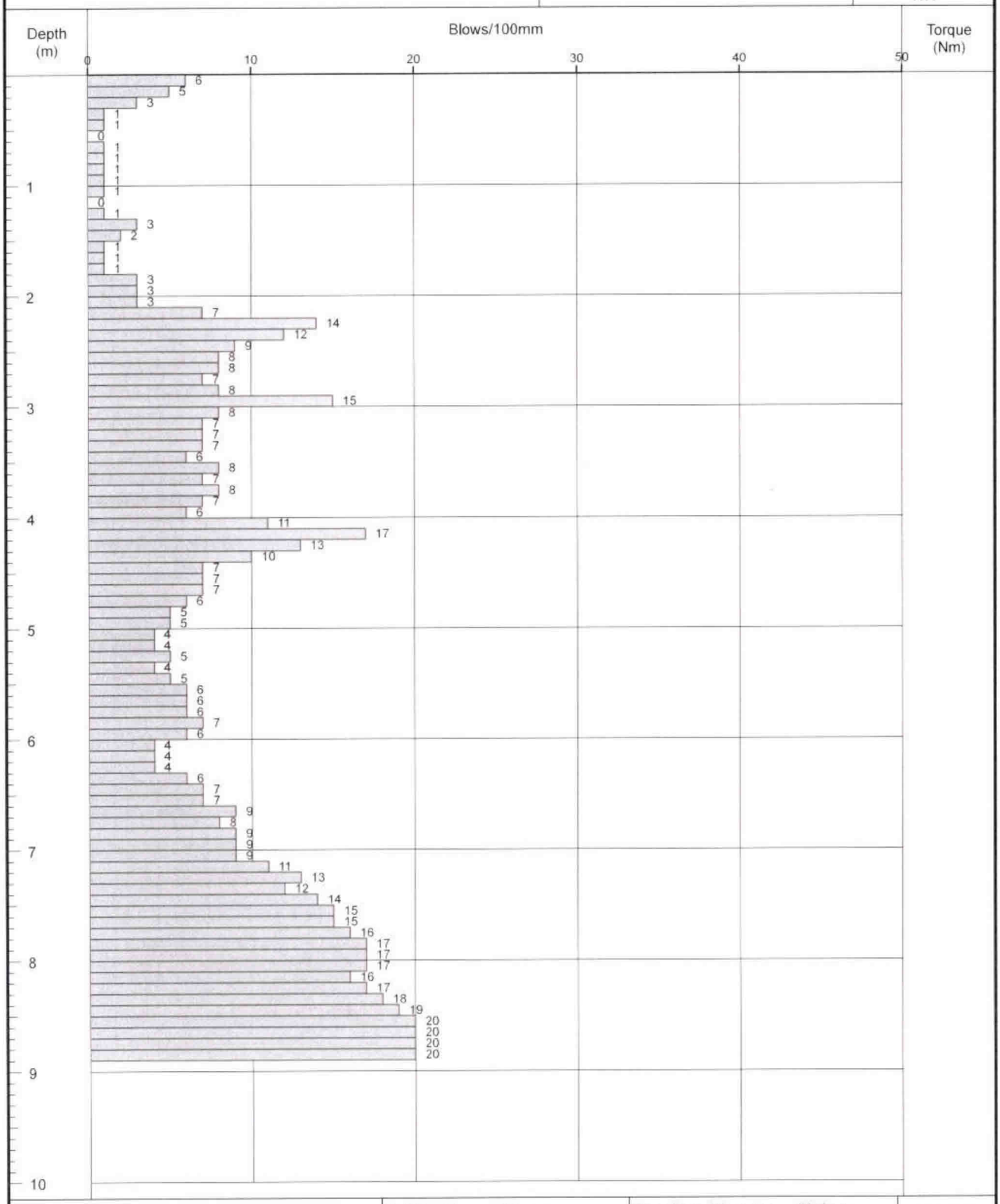


Remarks: Terminated at 4.60m with 71/300mm.	Fall Height	750mm	Cone Base Diameter	50.5mm	AGS
	Hammer Wt	63.5kg	Final Depth	4.6m	
	Probe Type	DPSH-B			

Probe Log

Probe No. **DP4** Sheet 1 of 1

Project Name: Hainsworth Road, Silsden.	Project No. J3976/17/E	Co-ords:	Hole Type DCP
Location: 'The Willows' Hainsworth Road, Silsden, Keighley, West Yorkshire, BD20 0LY		Level:	Scale 1:50
Client: Davric Construction Ltd		Dates: 25/07/2017	Logged By KW



Remarks:
Terminated at 8.90m with 60 blows.

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	8.9m
Probe Type	DPSH-B		

Environmental
Geotechnical
Specialists

RGS

Appendix 5

Laboratory Testing - Environmental

Summary of Classification Test Results

Project No.: J3976/17/E

Project Name: Hainsworth Road, Silsden.

Hole No.	Sample Ref	Top	Base	Type	Soil Description	Density bulk (Mg/m3)	Density dry (Mg/m3)	w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Remarks
WS1	2	0.70		D	Sandy gravelly CLAY.			25.0	73	32 -1pt	19	13		
WS1	3	1.50		D	Sandy gravelly CLAY.			21.0	85	34 -1pt	17	17		
WS1	4	3.00		D	Sandy very gravelly CLAY.			20.0						
WS2	1	0.65		D	Sandy gravelly CLAY.			13.0	70	26 -1pt	13	13		
WS2	2	1.50		D	Sandy gravelly CLAY.			18.0						
WS2	3	2.50		D	Sandy very gravelly CLAY.			9.8	68	28 -1pt	14	14		
WS3	1	0.90		D	Sandy gravelly CLAY.			18.0	86	33 -1pt	16	17		
WS3	2	1.70		D	Sandy gravelly CLAY.			16.0	73	32 -1pt	17	15		
WS4	2	0.70		D	Very sandy CLAY.			23.0	99	28 -1pt	18	10		
WS4	3	2.00		D	Sandy gravelly CLAY.			16.0	62	28 -1pt	15	13		

All tests performed in accordance with BS1377:1990 unless specified otherwise

Key

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

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

Particle density
sp - small pyknometer
gj - gas jar

Date Printed: 08/10/2017 00:00

Approved By: Jude

Table 1

sheet 1

Linear Shrinkage - Summary of Results

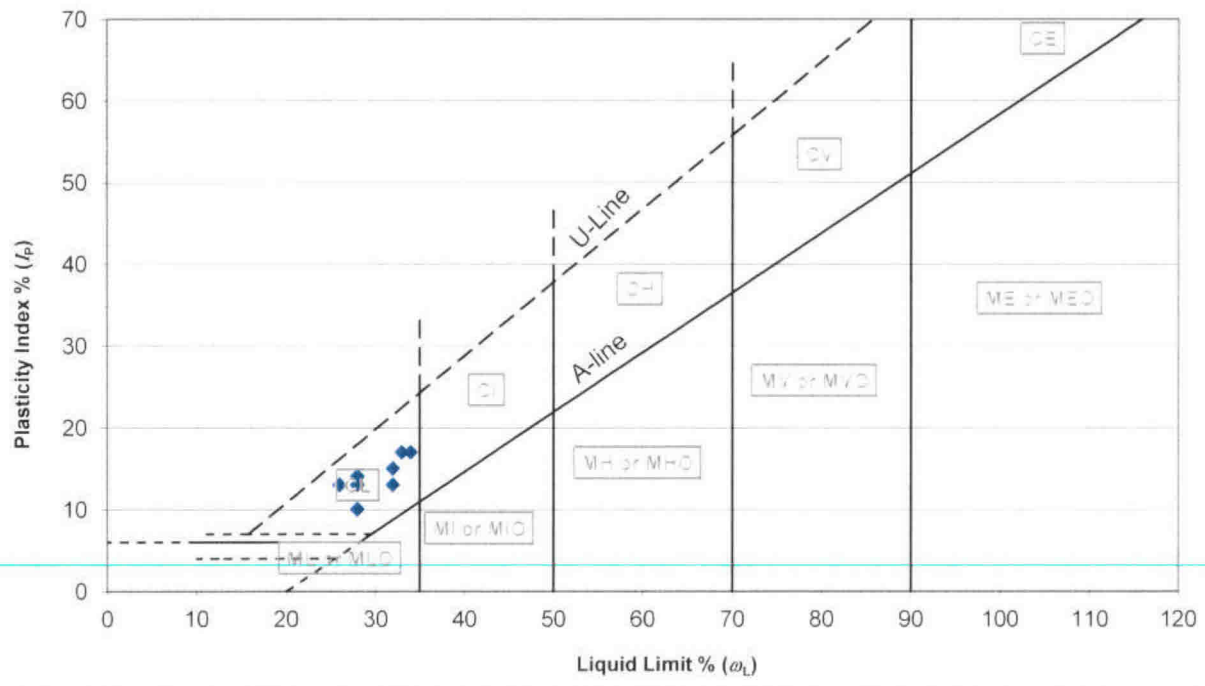
Project No.	Project Name
J3976/17/E	Hainsworth Road, Silsden.

Hole No.	Sample				Soil Description	Material <425µm %	Preparation	Linear Shrinkage %	Remarks
	Ref	Top	Base	Type					
WS1	2	0.70		D	Sandy gravelly CLAY.	73	Specimen prepared from natural material	8	
WS1	3	1.50		D	Sandy gravelly CLAY.	85	Specimen prepared from natural material	9	
WS2	1	0.65		D	Sandy gravelly CLAY.	70	Specimen prepared from natural material	8	
WS2	3	2.50		D	Sandy very gravelly CLAY.	68	Specimen prepared from natural material	9	
WS3	1	0.90		D	Sandy gravelly CLAY.	86	Specimen prepared from natural material	9	
WS3	2	1.70		D	Sandy gravelly CLAY.	73	Specimen prepared from natural material	9	
WS4	2	0.70		D	Very sandy CLAY.	99	Specimen prepared from natural material	6	
WS4	3	2.00		D	Sandy gravelly CLAY.	62	Specimen prepared from natural material	8	

Notes	Date Printed	Approved By	Table
Tests performed in accordance with BS 1377 : Part 2 : 1990, clause 6.5 unless annotated otherwise	08/10/2017	Jude	2 sheet 1

Rogers Geotechnical Services Ltd. Offices 1&2, Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU	**Interpretation of Moisture Content, Liquid and Plastic Limits**	**J3976/17/E**
Project Name: Hainsworth Road, Silsden.	**B.S 1377: Part 2: 1990: 3.2, 4 and 5**	Fig. 3 Sheet. 1
Location:		Input By: Jude
Client: Davric Construction Ltd		Check By: Jude

Location	Depth (m)	Moisture Content (w) (%)	Liquid Limit (wL) (%)	Plastic Limit (wP) (%)	Plasticity Index (IP) (%)	Retained by 425mm (%)	Modified (w) (w') (%)	Modified (IP) (IP') (%)	Liquidity/ Consistency (IL) (%)	Liquidity/ Consistency (IC) (%)	Casagrande Class	N.H.B.C Class (%)
WS1	0.70	25	32	19	13	27	34	9	0.5	0.5	C L	*
WS1	1.50	21	34	17	17	15	25	14	0.2	0.8	C L	LOW
WS2	0.65	13	26	13	13	30	19	9	0.0	1.0	C L	*
WS2	2.50	9.8	28	14	14	32	14	10	-0.3	1.3	C L	*
WS3	0.90	18	33	16	17	14	21	15	0.1	0.9	C L	LOW
WS3	1.70	16	32	17	15	27	22	11	-0.1	1.1	C L	LOW
WS4	0.70	23	28	18	10	1	23	10	0.5	0.5	C L	*
WS4	2.00	16	28	15	13	38	26	8	0.1	0.9	C L	*



Environmental
Geotechnical
Specialists

RGS

Appendix 4

Laboratory Testing - Geotechnical

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

UKAS TESTING 2183

mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

Final Report

Report No.:	17-20288-1		
Initial Date of Issue:	09-Aug-2017		
Client	Rogers Geotechnical Services Ltd		
Client Address:	Unit 4, Barncliffe Business Park Near Bank Shelley Huddersfield West Yorkshire HD8 8LU		
Contact(s):	Charlotte Mason		
Project	J3976/17/E - Hainsworth Road		
Quotation No.:		**Date Received:**	03-Aug-2017
Order No.:	0817-04	**Date Instructed:**	03-Aug-2017
No. of Samples:	4		
Turnaround (Wkdays):	5	**Results Due:**	09-Aug-2017
Date Approved:	09-Aug-2017		

Approved By:

[redacted]

Details: Martin Dyer, Laboratory Manager

Chemtest
The right chemistry to deliver results

Results - Soil

Project: J3976/17/E - Hainsworth Road

Client: Rogers Geotechnical Services Ltd					Chemtest Job No.:	17-20288	17-20288	17-20288	17-20288
Quotation No.:					Chemtest Sample ID.:	492433	492434	492435	492436
Order No.: 0817-04					Client Sample Ref.:	WS1	WS4	TP1	TP2
					Client Sample ID.:	C	C	B	B
					Sample Type:	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	0.00	0.15	0.00	0.10
					Bottom Depth (m):	0.40	0.54	0.10	0.11
					Date Sampled:	02-Aug-2017	02-Aug-2017	25-Jul-2017	25-Jul-2017
					Asbestos Lab:	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Cadmium	M	2450	mg/kg	0.10		0.71	0.73	1.4	0.26
Chromium (Hexavalent)	N	2490	mg/kg	0.50		< 0.50	< 0.50	< 0.50	< 0.50
Copper	M	2450	mg/kg	0.50		14	7.3	45	16
Mercury	M	2450	mg/kg	0.10		0.12	< 0.10	0.38	0.11
Nickel	M	2450	mg/kg	0.50		14	11	17	10
Lead	M	2450	mg/kg	0.50		19	17	88	91
Zinc	M	2450	mg/kg	0.50		89	75	150	61
Vanadium	U	2450	mg/kg	5.0		17	12	19	16
Arsenic	M	2450	mg/kg	1.0		22	29	7.7	8.3
Selenium	M	2450	mg/kg	0.20		< 0.20	< 0.20	< 0.20	0.27
Cyanide (Free)	M	2300	mg/kg	0.50		< 0.50	< 0.50	< 0.50	< 0.50
Total Phenols	M	2920	mg/kg	0.30		< 0.30	< 0.30	< 0.30	< 0.30
Naphthalene	M	2700	mg/kg	0.10		0.13	< 0.10	< 0.10	< 0.10
Acenaphthylene	M	2700	mg/kg	0.10		0.70	< 0.10	< 0.10	< 0.10
Acenaphthene	M	2700	mg/kg	0.10		0.51	< 0.10	< 0.10	< 0.10
Fluorene	M	2700	mg/kg	0.10		0.59	< 0.10	< 0.10	< 0.10
Phenanthrene	M	2700	mg/kg	0.10		4.6	0.46	< 0.10	< 0.10
Anthracene	M	2700	mg/kg	0.10		1.6	< 0.10	< 0.10	< 0.10
Fluoranthene	M	2700	mg/kg	0.10		9.2	0.76	0.34	0.39
Pyrene	M	2700	mg/kg	0.10		9.5	0.81	0.35	0.47
Benzo[a]anthracene	M	2700	mg/kg	0.10		5.0	0.69	< 0.10	< 0.10
Chrysene	M	2700	mg/kg	0.10		6.1	0.87	< 0.10	< 0.10
Benzo[b]fluoranthene	M	2700	mg/kg	0.10		6.5	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	M	2700	mg/kg	0.10		2.2	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	M	2700	mg/kg	0.10		5.6	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10		3.7	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10		0.28	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10		2.5	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	M	2700	mg/kg	2.0		59	3.6	< 2.0	< 2.0
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0		1.9	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0		12	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0		20	13	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0		12	70	< 1.0	< 1.0

Chemtest
The right chemistry to deliver results

Project: J3976/17/E - Hainsworth Road

Results - Soil

Client: Rogers Geotechnical Services Ltd		Chemtest Job No.:			17-20288	17-20288	17-20288	17-20288
Quotation No.:		Chemtest Sample ID.:			492433	492434	492435	492436
Order No.: 0817-04		Client Sample Ref.:			WS1	WS4	TP1	TP2
		Client Sample ID.:			C	C	B	B
		Sample Type:			SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.00	0.15	0.00	0.10
		Bottom Depth (m):			0.40	0.54	0.10	0.11
		Date Sampled:			02-Aug-2017	02-Aug-2017	25-Jul-2017	25-Jul-2017
		Asbestos Lab:			COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	37	20	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	83	100	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	4.1	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	34	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	170	13	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	4600	170	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	1300	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	6100	180	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	6200	280	< 10	< 10
pH	M	2010		N/A	8.8	9.0	7.7	5.6
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	< 0.010	< 0.010	0.023	0.059
ACM Type	U	2192		N/A	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	3.1	3.5	24	26
Soil Colour	N	2040		N/A	Brown	Brown	Brown, Brown	Brown
Other Material	N	2040		N/A	Stones	Stones	Roots, Roots	Roots
Soil Texture	N	2040		N/A	Sand	Sand	Loam	Loam
Sulphate (Total)	M	2430	%	0.010	0.11	0.12	0.13	0.18
Organic Matter	M	2625	%	0.40	6.6	4.0	7.6	8.3

Chemtest
The right chemistry to deliver results

Test Methods

SOP	Title	Parameters included	Method summary
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
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
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.

Chemtest
The right chemistry to deliver results

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

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.co.uk