Environmental
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Specialists

REPORT

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written by I. Sakoor	
checked by S.P. Rogers	issued by I. Sakoor

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.

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QMS ISO 14001 REGISTERED
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GEOTECHNICAL
ENVIRONMENTAL

CONTENTS

		Page
1.	SYNOPSIS	1
2.	INTRODUCTION	1
3.	LIMITATIONS	2
4.	DESK STUDY	2
5.	FIELDWORKS	2
	5.1 Windowless Sample Boreholes	2
	5.2 Dynamic Probes	3
	5.3 Gas Monitoring Standpipes	3
6.	GEOLOGY	3
7.	STRATA CONDITIONS	4
8.	INSITU TESTING	4
	8.1 Dynamic Penetration Tests	4
	8.2 Gas and Water Level Monitoring	5
9.	LABORATORY TESTING - GEOTECHNICAL	5
	9.1 Geotechnical Properties	6
10.	LABORATORY TESTING – ENVIRONMENTAL	6
11.	DISCUSSION OF GROUND CONDITIONS – GEOTECHNICAL	6
	11.1 Piled Foundations	7
	11.2 Ground-floor Slabs	7
	11.3 Effect of Sulphates	8
12.	DISCUSSION OF GROUND CONDITIONS - ENVIRONMENTAL	8
	12.1 Discussion of Test Results	8
	12.1.1 Soil Samples	8
	12.1.2 Gas Concentrations	9
	12.2 Site Specific Risk Assessment	11
	12.2.1 Approach	11
	12.2.2 Conceptual Ground Model	11
	12.2.3 Risk Assessment	13
	12.3 Remediation Strategy	14
	12.3.1 Remediation Objectives	14
	12.3.2 Development Requirements	15
	12.3.3 Strategy	15
	12.4 Fill Materials	17

12.5 Verification Report 18

13. RECOMMENDATIONS FOR FURTHER WORK 18

14. REFERENCES 19

APPENDIX 1 – SITE PLAN

APPENDIX 2 – WINDOWLESS SAMPLE BOREHOLE RECORDS

APPENDIX 3 – DYNAMIC PROBES

APPENDIX 4 – LABORATORY TESTING – GEOTECHNICAL

APPENDIX 5 – LABORATORY TESTING – ENVIRONMENTAL

REPORT ON A GEO-ENVIRONMENTAL INVESTIGATION

at

29 BERRY BROW, MANCHESTER, M40 1GR.

for

G.S. CONSTRUCTION JOINERY & BUILDING CONTRACTORS

Report No J3408/16/E **March 2016**

1. SYNOPSIS

This investigation has demonstrated that made ground described variably as slightly gravelly clay and very gravelly sand was present to between 0.8, and 1.05m depth, over generally soft to firm slightly gravelly silty clay to 2.0m and 3.0m depth. In view of the weak and variable condition of the near surface soils and the presence of a former basement, it considered that that the proposed development could be founded upon piles. Chemical testing has revealed that the site is contaminated, which will require some remediation. Furthermore, elevated levels of carbon dioxide have been revealed at this site.

2. INTRODUCTION

It is understood that the land at 29 Berry Brow, Manchester is to be developed by the construction of a residential property with an associated driveway and garden. Consequently, a site investigation has been undertaken in accordance with instruction of 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. Testing of the made ground has been undertaken to enable an assessment of the levels of contamination. Furthermore, gas monitoring has also been undertaken at this site.

This report presents the data obtained and discusses the ground conditions in relation to the proposed development.

3. 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.

4. DESK STUDY

A Phase 1 Desk Study has been undertaken by Rogers Geotechnical Services Ltd in February 2016 and the results presented as report number J3408/16/EDS. That document has been used extensively during the current intrusive investigation.

5. FIELDWORKS

The fieldworks were undertaken on the 23rd February 2016 and included the following:

- Four windowless sample boreholes.
- Four dynamic probes adjacent to the windowless sample positions.
- Three gas monitoring standpipes.

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

5.1 Windowless Sample Boreholes

These boreholes were sunk using a drive-in windowless sampler. The cores were undertaken in 1m lengths and typically reduced in diameter from 90mm for the first 1m through 80mm and 70mm 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: 1999, as amended in 2010, and full descriptions are given on the window sample records which are presented in Appendix 2. Also included on these records are the core diameters and percentages of core recovered.

5.2 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.

5.3 Gas Monitoring Standpipes

Gas monitoring standpipes were installed to 3.0m in WS1 and to 2.0m in WS2 and WS3. The details of the installations 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 and 1.0m below surface, with a non-perforated pipe to ground level. The response zone was filled with pea gravel, with a bentonite seal above and the installation was capped with a stop box cover in a concrete surround**.**

6. 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[1]	Previous Name[2]	Description[2]
Superficial Geology	Devensian Till	-	Variable lithology, usually sandy, silty clay with pebbles, but can contain gravel-rich or laminated sand layers. Varied colour and consistency. [Generic description].
Solid Geology	Collyhurst Sandstone Formation	Permian Sandstone Lower Permian Sandstone	A soft red sandstone with abundant beds of 'millet seed' sand grains alternating with beds of fine-grained sharp sand. Some Interbedded grey sandstone locally present.

It should be appreciated that whilst the site itself is present on Devensian Till, deposits of alluvium associated with the River Medlock are present a short distance to the south. In addition, the geological mapping indicates that the site is present within an area of artificial ground. Also, a nearby dip marker indicates the geology to be dipping by 10° to the south east.

[1] Source: British Geological Survey (NERC): Geological Map Sheet 85 – Manchester; Bedrock and Superficial Edition, and Geology of Britain Viewer [*online resource from www.bgs.ac.uk*]
[2] Source: British Geological Survey (NERC) Lexicon of Named Rock Units [*online resource from www.bgs.ac.uk*]

7. 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)	Strata type	Positions strata was revealed in	Groundwater strikes (m)
0.17 – 0.5	Topsoil	WS3, WS4	None
0.4 – 0.8	Made Ground (Silty gravelly sand)	WS1, WS2	None
0.9 – 1.05	Made Ground (Slightly gravelly, silty clay)	WS1, WS4	None
+2.0 – 2.5	Slightly gravelly, silty clay with sand lenses	All	None
+3.0	Silty, sandy clay	WS1	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.

The made ground was noted to comprise brick, ash, pottery fragments and mortar. Rare cobble sized fragments of sandstone and brick were also noted.

No groundwater strikes were recorded during the fieldworks. However, it should be appreciated that groundwater levels are subject to seasonal variation or changes on local drainage conditions.

8. INSITU TESTING

8.1 Dynamic Penetration Tests

Dynamic penetration tests were conducted adjacent to the windowless sample boreholes. Resistances to penetration of between 0 and 2 blows/100mm were recorded to around 1.0m depth, before increasing to blow counts of between 2 and 3 blows/100mm to a depth of 2.0m in DP1 and DP2 and to 3.0m in DP3 and DP4. The results within DP1 and DP2 were noted to decrease to between 1 and 2 blows/100mm to 3.0m depth in DP1 and 2.6m in DP2.

From these depths and from 3.0m in DP3 and DP4, resistances to penetration of between 3 and 6 blows/100mm (with occasional higher results) were encountered to between 5.0m and 6.0m below ground level. The results were then noted to gradually increase until effective refusal was achieved at depths of between 6.2m and 6.9m depth.

8.2 Gas and Water Level Monitoring

The standpipes were monitored between the 7th March 2016 and 26th February 2016 and 17th March 2016. The results of the gas monitoring undertaken to date are tabulated below.

Table 3: ***Gas monitoring***

Borehole No	Date	CH_4 (%)	CO_2 (%)	O_2 (%)	Flow (l/hr)	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)
WS1	07/03/2016	0.0	0.1	21.3	0.0	1004	1.05	3.0
	14/03/2016	0.0	0.1	21.2	0.2	1028	0.80	
	21/03/2016	0.0	0.6	20.1	0.1	1015	1.00	
	30/03/2016	0.0	0.2	20.8	0.0	999	0.90	
WS2	07/03/2016	0.0	0.1	20.8	0.1	1004	2.00	2.0
	14/03/2016	0.0	0.1	20.9	0.1	1028	2.12	
	21/03/2016	0.0	0.1	20.3	0.1	1015	2.20	
	30/03/2016	0.0	0.2	20.6	0.1	999	1.90	
WS3	07/03/2016	0.0	2.1	17.9	0.1	1004	1.75	2.0
	14/03/2016	0.3	9.3	3.1	0.1	1028	1.85	
	21/03/2016	0.6	11.2	3.4	0.0	1015	-	
	30/03/2016	0.7	12.1	2.0	0.0	1000	1.42	

This work was undertaken using a Geotechnical Instruments (UK) Ltd GA5000 (serial No. G503524), which was last calibrated on the 29th February 2016.

9. 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 4: ***Summary of geotechnical test results***

Test type	Number of tests	Range of results	Comments
Moisture content determinations	12	17% - 33%	

Index Properties	7	LL PL PI LS CI	29% – 49% 15% – 23% 14% – 26% 9% – 12% 0.1 – 1.0	Clay of low to intermediate plasticity. Very soft to very stiff consistency (from consistency indices) NHBC Class – Low to medium (one case of negligible volume change potential)
Soluble sulphates & pH	3	SO_4 pH	29 – 100 mg/l 7.9 – 8.7	

9.1 Geotechnical Properties

The idealised geotechnical properties employed in design are summarised below.

Table 5: *Summary of geotechnical properties*

Property	Range of values	Comments
Volume change potential (NHBC)	Low to Medium*	Slightly gravelly silty clay.
Concrete classification	DC1	Brownfield sites (static water).

*One sample tested as negligible volume change potential.

10. 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-}.

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

11. DISCUSSION OF GROUND CONDITIONS – GEOTECHNICAL

It is understood that the land at 29 Berry Brow, Manchester is to be developed by the construction of a residential property with an associated driveway and garden. The new development is to be situated in the area of the previous building (now demolished), which included a basement across part of the footprint.

It cannot be recommended that foundations be constructed directly within the made ground or soft clays 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. Furthermore, given the thickness of weak material revealed, traditional shallow foundations cannot be recommended.

11.1 Piled Foundations

In view of above comments, consideration may be directed to the use of piles to transfer the foundation loads through the made ground and weak soil to more competent strata present at depth.

It should be appreciated that in order to utilise driven concrete displacement piles, the basement would need to be cleared and the floor broken out. Once this is completed, the basement should be backfilled properly before the piles are installed. It should be appreciated that in order to avoid pile breakage, the use of driving shoes or lead steel sections would need to be employed. Moreover, where relict structures are present outside the basement area, these would need to be removed to allow the piles to be installed. In addition, according to the desk study, a Secondary A aquifer is present within the superficial deposits and a Principle aquifer is present within the solid geology. Therefore, given the presence of contamination within the fill, the piles should include pointed ends to avoid pushing a plug of contamination into the aquifer beneath.

In view of the above comments, it is therefore considered that attention could be directed towards the use of drill and cased piles (Odex, Symmetrex or similar) at this site. These methods employ down the hole hammers which have the capacity to bore through obstructions (including basements) and into the underlying competent strata. Through the overburden the drill bit is attached to casing which prevents the pile borehole collapsing. When rock is encountered the drilling can continue using open hole drilling techniques. On completion of the boring operations concrete is then pumped into the hole and a steel reinforcing cage can be installed. The steel casing can be removed or left in place.

In order to formulate a suitable design and installation method, it is recommended that the advice of specialist piling contractors be sought. Furthermore, in view of the relatively weak near surface soils it will be necessary to construct a working platform for the piling rig and any other plant required during the works. Such a design should be undertaken in accordance with the procedures given in the BRE publication entitled *Working platforms for tracked plant*.

11.2 Ground-floor Slabs

Due to the near surface soils being present in a weak and variable in-situ condition, the use of ground bearing floor slabs cannot be recommended. Therefore, at this site it is considered that attention should be directed towards the use of fully suspended floor slabs.

11.3 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[3], which is provided in BRE Special Digest 1, *Concrete in aggressive ground*: Part C. On the basis of this table considering both the soluble sulphate contents, it can be shown that well compacted buried concrete should be designed in accordance with Class DS-1 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[4], 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.

12. DISCUSSION OF GROUND CONDITIONS - ENVIRONMENTAL

12.1 Discussion of Test Results

As the site is to be developed by the construction of residential property with an associated driveway and garden, the site may be classified as being a residential with plant uptake.

12.1.1 Soil Samples

The results of the chemical testing undertaken on soil samples obtained during this investigation have been compared to the ATRISK soil screening values (SSVs) as compiled by WS Atkins plc. 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[5] 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:

[3] Table C2, *Aggressive Chemical Environment for Concrete (ACEC) classification for brown field sites*
[4] 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.*
[5] http://www.atrisksoil.co.uk/pages/general/subscribers.asp

Table 6: ***Summary of contaminated areas.***

Position	Contaminants found to be exceeding SSVs (Residential with Plant Uptake)
WS1	PAH [benzo(g,h,i)perylene].
WS2	Lead, PAH [pyrene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene]
WS4	Mercury, lead, PAH [pyrene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene, TPH [aliphatic C8-C10, aromatic C5-C7].

Concentrations of chromium^{VI}, free cyanide, phenols and petroleum hydrocarbons (aliphatic C5 to C8, C10-C12 and aromatic C7 to C8) were below the detection limits for the tests. Detectable levels of all other contaminants were recorded, but these fell below the associated Atrisk Soil Screening Values.

It should be appreciated that the soil screening values for 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[6]. 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. In this case, no free product was observed, 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 7: ***Summary of areas contaminated by PAHs.***

Position	Contaminants found to be exceeding CLEA Criterion (Residential without Plant Uptake)
WS1	None
WS2	PAH [benzo(a)pyrene]
WS4	PAH [benzo(a)pyrene, dibenz(a,h)anthracene].

On the basis of all the information provided above, it is considered that the site is contaminated by mercury, lead, PAHs and TPHs.

12.1.2 Gas Concentrations

With respect to ground gas, the results of the monitoring visits indicated between 0% and 0.7% methane. Concentrations of carbon dioxide were noted to be between 0.1% and 12.1%, in association with oxygen levels of between 2.0% and 21.3%. It should be appreciated that on non-contaminated sites there is generally about 20%

[6] Ref: ATRISK soil, SSVs derived using CLEA v1.04 for 6% SOM, Residential with home grown produce land use, 14.12.09.

by volume of oxygen, associated with low levels of carbon dioxide. In addition, a maximum recorded flow rate of 0.2 litres per hour will be employed in any 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 1004mb and 1028mb.

Reference is made to Tables 5.5a and 5.5b of CIRIA report C665 (2007)[7] (reproduced as Table 3, *typical/idealised frequency and period of monitoring,* presented in the Phase 1 Desk Study). Accepting that the proposed development is of high sensitivity (residential with gardens) and that the generation potential is very low to low, these tables suggest that between 6 and 9 readings could be undertaken over a period of 3 to 6 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. In order to establish the gas screening value (GSV), the maximum gas concentration (expressed as a decimal) is multiplied by the borehole flow rate (l/hr). In this case the 0.7% (0.007) methane was recorded, along with 12.1% (0.121) carbon dioxide, in association with a flow rate of 0.2l/hr. This results in a GSV of 0.0014 for methane and 0.0242 l/hr for carbon dioxide.

In accordance with Table 8.5, *Modified Wilson and Card classification* of the CIRIA report C665, *Assessing risks posed by ground gasses to building,* the site may be characterised, with respect to the GSV, as *Situation Level 1*; GSV <0.07. However, as the level of carbon dioxide is over 5%, this should be upgraded to *Characteristic Situation Level 2.* Therefore it is considered that there is a low risk of harm to end user and site operatives, and some precautionary measures are required.

The sufficiency of gas monitoring data is considered in BS 8576: 2013: *Guidance on investigations for ground gas – Permanent gasses and Volatile Organic Compounds (VOC's). In this standard Table F3, Assessing sufficiency of data* has been employed to justify the curtailment of monitoring. In this context it should be noted that the gas screening value threshold for Characteristic Situation level 2 is <0.7 l/hr. Assuming the flow rate remains constant at 0.2l/hr, the gas concentration would need to exceed 100% to move into the next risk band, which is not considered reasonable. Moreover, by keeping the concentration constant, the flow rate would need to increase to 5.78 l/hr to move into the next risk band, which is in excess of a twenty eight fold increase. It is considered that such increases are

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

highly unlikely given the flow rates encountered and the fact that the site has been fully characterised during this investigation in respect of ground gas.

12.2 Site Specific Risk Assessment

12.2.1 Approach

The presence of contamination hazards and the risks associated with them should be assessed in accordance with industry practice and the 'suitable for use' approach. This has been conducted with reference to The Department for Environment, Food and Rural Affairs (DEFRA) and The Environment Agency[8] advice on the assessment of risks arising from the presence of contamination in soils and using the source-pathway-receptor approach.[9] 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.'[10]

12.2.2 Conceptual Ground Model

In view of the results of the chemical testing undertaken the conceptual site model first proposed in the phase one desk study has been updated accordingly

Sources of contamination include the following:

On site – Made ground.

[8] 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'.
[9] 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.
[10] See 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990', appendix A.

Table 8: *Potential Harm to Humans and Animals (fauna)*

SOURCES: MADE GROUND CONTAMINATION: Mercury, Lead, PAH's, TPH's, $C0_2$		
Pathways	**Receptor**	**Linkage Present?**
Direct contact/dermal absorption/soil ingestion	Operative	Yes – Some contamination is present which exceeds trigger values for residential with plant uptake.
	End User	Yes – Some contamination is present which exceeds trigger values for residential with plant uptake.
	Neighbours	Yes – Some contamination is present which exceeds trigger values for residential with plant uptake.
Inhalation of Dust/Vapours	Operative	Yes – Some contamination is present which exceeds trigger values for residential with plant uptake.
	End User	Yes – Some contamination is present which exceeds trigger values for residential with plant uptake. .
	Neighbours	Yes – Some contamination is present which exceeds trigger values for residential with plant uptake.
Ingestion of fruit/vegetables and/or waters	Operative	No – Whilst some contamination is present which exceeds trigger values for residential with plant uptake, no fruits or vegetables are currently present on site.
	End User	Yes – Some contamination is present which exceeds trigger values for residential with plant uptake.
	Neighbours	No – Whilst contamination has been revealed, it is present within cohesive and low permeability soils, thus migration to neighbouring properties is unlikely.
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	Yes – Some levels of methane and carbon dioxide – *Characteristic Situation Level 2.*
	End User	Yes – Some levels of methane and carbon dioxide – *Characteristic Situation Level 2.*
	Neighbours	No – Whilst some levels of methane and carbon dioxide are present, the site is not considered a generating source.

Table 9: *Potential Harm to Controlled Waters and Groundwater*

SOURCES: MADE GROUND CONTAMINATION: Mercury, Lead, PAH's, TPH's, $C0_2$		
Pathways	**Receptor**	**Linkage Present?**
Spillage/loss/run off direct to receiving water	Controlled Waters	No – Whilst contamination has been revealed, it is present within cohesive and low permeability soils, thus migration to controlled waters is unlikely.
Migration via permeable unsaturated strata	Controlled Waters	No – Whilst contamination has been revealed, it is present within cohesive and low permeability soils, thus migration to controlled waters is unlikely.
Run off via drainage/sewers etc	Controlled Waters	No – Whilst contamination has been revealed, it is present within cohesive and low permeability soils, thus migration to controlled waters is unlikely.

Table 10: *Potential Harm to Plants (flora)*

SOURCES: MADE GROUND CONTAMINATION: Mercury, Lead, PAH's, TPH's, $C0_2$		
Pathways	**Receptor**	**Linkage Present?**
Direct contact with contaminated soils	Plants	Yes – Some contamination is present which exceeds trigger values for residential with plant uptake.
Uptake via root system	Plants	Yes – Some contamination is present which exceeds trigger values for residential with plant uptake.

Table 11: *Potential Harm to Buildings/Structures*

SOURCES: MADE GROUND CONTAMINATION: Mercury, Lead, PAH's, TPH's, $C0_2$		
Pathways	**Receptor**	**Linkage Present?**
Direct contact with contaminated soils	Building Materials	Yes – Some contamination is present which exceeds trigger values for residential with plant uptake.
Direct contact with contaminated groundwater	Building Materials	Yes – Some contamination is present which exceeds trigger values for residential with plant uptake.

12.2.3 Risk Assessment

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

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.

Table 12: *Site Specific Risk Assessment*

SOURCES: MADE GROUND CONTAMINATION: Mercury, Lead, PAH's, TPH's			
Pathways	**Receptor**	**Risk Rating**	**Notes**
Direct contact/dermal absorption/soil ingestion	Operative	High	Some contamination is present underlying the site. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways.
	End User		
	Neighbour		
Inhalation of Dust/Vapours	Operative	High	Some contamination is present underlying the site. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways.
	End User		
	Neighbours		

Ingestion of fruit/vegetables and/or waters	End User	High	Some contamination is present underlying the site and development is to include gardens. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways.
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	High	Some levels of carbon dioxide have been revealed. Precautionary measures will be required to the operative and end user.
	End User		
Direct contact with contaminated soil	Plants	High	Some contamination is present underlying the site. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways.
Uptake via root system	Plants		
Direct contact with contaminated soils	Building Materials	High (Plastic services)	Contamination by PAH's underlying the site. Protection to buried plastic services will be required.
Direct contact with contaminated groundwater	Building Materials	Low (Concrete)	Low sulphates and reasonable pH levels. Concrete class AC-1s.
Exposure to Radon	Operative	Low	According to the desk study, no radon protection measures are required.
	End User		

12.3 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.

12.3.1 Remediation Objectives

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

- To protect the site operatives during the construction process from the ingestion of soil or dust, dermal contact with the soil and inhalation of dust and vapours.
- To protect the end user and neighbours from the ingestion of soil or dust, dermal contact with the soil and inhalation of dust and vapours.
- To protect the operatives and end user from elevated levels of carbon dioxide.
- To protect the end user from ingestion of contaminated fruit and vegetables and to protect the garden plants from contaminated ground.

- To protect plastic services from degradation from PAH's and TPH's.

12.3.2 Development Requirements

It is understood that the site is to be developed by the construction of a residential property with an associated driveway and garden. For preliminary design and costing the following remediation proposals are offered.

12.3.3 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. Furthermore, they should also be made aware of the hazards of working in an environment where accumulations of carbon dioxide could occur.
- Personal hygiene facilities, including washing and messing, must be provided and site operatives be encouraged to use them.
- Where work is undertaken in dry weather the site should be dampened down to avoid dust. In addition, dust masks must be provided to all site operatives for use in dry weather.
- Where vehicles are transferring soil to the landfill site they should be covered to prevent contamination of the surrounding area by dust.
- Any stockpiles of contaminated soil on site should be sheeted over to prevent excessive amounts of airborne dust.
- Where work is undertaken in wet weather, vehicle and wheel washing facilities are required to ensure that the vehicles leaving the site do not transfer contamination to surrounding areas.

On completion of the ground-works a careful site inspection of the sub-grade would be required. Should visual or olfactory evidence of contamination be revealed then further testing may become necessary. Buried asbestos should, if present and as

far as is possible, be left *in situ* and covered by hard standing, floor slabs or inert fill to remove the linkage to human receptors. This is of particular importance, given the age of the previous structure.

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.

- Due to the levels of CO_2 encountered on site and in according to Table 8.6, *Typical scope of gas protection measures,* of CIRIA report C665, two levels of protection are considered necessary and should include:
    - Reinforced concrete cast *in situ* floor slab (suspended, non-suspended or raft) with at least 1200g DPM and under floor venting.
    - Beam and block or pre-cast concrete slab and 2000g DPM / reinforced gas membrane and under floor venting.

    Note: All joints and penetrations must be sealed

- Beneath buildings, pavements and hard-standings clean inert granular sub-base should be employed.

- Plastic services should be constructed in a surround of clean inert material and should be placed at the site in accordance with 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'.

- For buried concrete the results of the sulphate and pH testing indicate that the design sulphate class for the site should be DS-1.

- Any redundant services at this site should be decommissioned 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.

Garden and Landscaped Areas

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

Comments

Where the construction requirements and final development plans suit, the above approach may be employed as a finalised site specific strategy. Should it be necessary to tailor the strategy to suit the construction requirements, it is recommended that the above be employed as an initial basis.

12.4 Fill Materials

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

Fill materials should be initially screened, by a suitably qualified engineer, 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 the local authority planning guidance[11] documentation. 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
Greenfield/ Manufactured Soils	The greater of a minimum of 3 or 1 per 200m³	Standard metals/metalloids as above plus PAH (16 USEPA) and Asbestos
Unknown/Brownfield/ Mixed Soils	The greater of a minimum of 3 or 1 per 50m³	Standard metals/metalloids as above plus PAH (16 USEPA), TPH (CWG banded) and Asbestos Any additional analysis dependent 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.

[11] Environmental Protection Group Contaminated Land Section, Manchester City Council, October 2013, *Planning Guidance in Relation to Ground Contamination: Technical Guidance Note for Applicants, Developers, Landowners and Consultants v5.00.*

Table 4: *Fill screening values*

Contaminant	Screening Value (Residential with Home-grown Produce Land use) (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	1.00	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

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

12.5 Verification Report

In order to demonstrate that a quantative risk assessment and gas protection measures have been sufficiently carried out, it will be necessary to produce a verification report for submission to any statutory authorities. The report should be produced by a suitably qualified engineer.

13. RECOMMENDATIONS FOR FURTHER WORK

- This report should be forwarded to the relevant authorities as soon as practicable to ensure they have sufficient time to review and discuss any issues.
- Completion and reporting of scheduled 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 piling contractors regarding their method for installing piles.
- Discussions with service providers regard the materials suitable for pipework etc.
- Detailed design of the sub-structure.
- Produce a validation report to demonstrate that the geo-environmental risks discussed in this report have been mitigated.

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

14. REFERENCES

- British Geological Survey (NERC) (2016), 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 (1999) BS5930: *Code of practice for site investigations, incorporating amendment no.1 (2007) and no.2 (2010),* 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.*

- Building Research Establishment. 1999. *Radon: Guidance on protective measures for new dwellings.*

- 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.

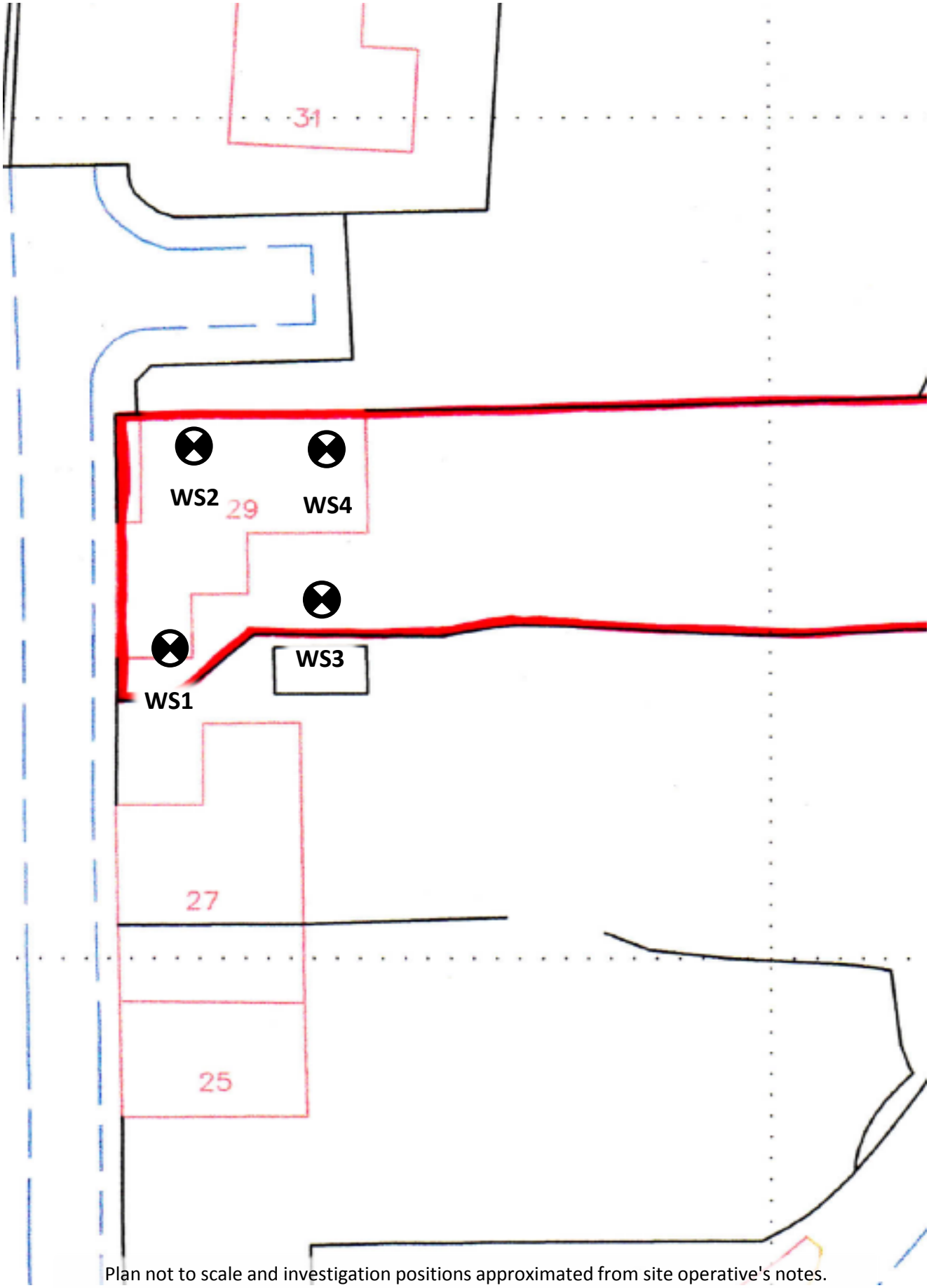
For and on behalf of
Rogers Geotechnical Services Ltd,

I. Sakoor BEng
Geotechnical Engineer

S.P. Rogers CEng, CGeol, MICE, MCIHT, FGS
Technical Director

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: **29 Berry Brow, Manchester**	Job No: **J3408/16/E**

APPENDIX 2

WINDOWLESS SAMPLE BOREHOLE RECORDS

Borehole Log

Borehole No. **WS1** Sheet 1 of 1			
Project Name: 29 Berry Brow	Project No. J3408/16/E	Co-ords:	Hole Type WLS
Location: Manchester		Level:	Scale 1:50
Client: GS Construction Joinery & Building Contractors Ltd		Dates: 23/02/2016	Logged By RAP

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
				90	50		0.40			MADE GROUND (Dark brown silty gravelly fine to coarse SAND. Gravel is sub-rounded to angular fine to coarse of brick ash and mortar). *Brick layer 0.35-0.40m*
							1.05			MADE GROUND (Soft brown mottled grey, slightly gravelly silty CLAY with occasional brick fragments).
		1.50	D	80	95					Soft to firm dark brown slightly gravelly, silty CLAY with occasional black specks and rare rootlets. Gravel is sub-rounded to sub-angular fine to coarse of sandstone. *Fine to medium SAND 1.20-1.28m* *Fine to medium SAND 1.80-1.85m*
		1.90	D							
		2.40	D	70	75		2.50			Very soft grey silty sandy CLAY.
		2.65	D							
							3.00			End of Borehole at 3.00m

Remarks

Borehole Log

Borehole No. **WS2**

Sheet 1 of 1

Project Name: 29 Berry Brow	Project No. J3408/16/E	Co-ords:	Hole Type WLS
Location: Manchester		Level:	Scale 1:50
Client: GS Construction Joinery & Building Contractors Ltd		Dates: 23/02/2016	Logged By RAP

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.90	D	90	100		0.80			MADE GROUND (Dark brown and black silty very gravelly fine to coarse SAND of ash with rare sandstone cobbles. Gravel is sub-angular to angular fine to coarse of brick pottery and sandstone).
		1.30	D	80	90					Soft to firm becoming firm brown mottled grey slightly gravelly, silty CLAY. Gravel is rounded to sub-angular fine to coarse of mixed lithologies and sandstone. *Fine to medium SAND 1.10-1.15m.*
		1.90	D				2.00			End of Borehole at 2.00m

Remarks

Borehole Log

Borehole No. **WS3** Sheet 1 of 1			
Project Name: 29 Berry Brow	Project No. J3408/16/E	Co-ords:	Hole Type WLS
Location: Manchester		Level:	Scale 1:50
Client: GS Construction Joinery & Building Contractors Ltd		Dates: 23/02/2016	Logged By RAP

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.30	D	90	72		0.50			TOPSOIL (Soft dark brown very organic silty sandy CLAY with frequent roots and rootlets).
		0.60	D							*Tree root 0.37-0.50m.* Soft to firm orangish brown becoming brown mottled grey slightly gravelly silty CLAY with occasional black specks and rootlets. Gravel is rounded to sub-angular of mixed lithologies and sandstone.
		1.55	D	80	77					*Fine to medium SAND 1.70-1.75m.*
							2.00			End of Borehole at 2.00m

Remarks

Borehole Log

Borehole No.
WS4
Sheet 1 of 1

Project Name: 29 Berry Brow	Project No. J3408/16/E	Co-ords:	Hole Type WLS
Location: Manchester		Level:	Scale 1:50
Client: GS Construction Joinery & Building Contractors Ltd		Dates: 23/02/2016	Logged By RAP

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.17			TOPSOIL (Soft dark brown organic silty slightly sandy CLAY with occasional rootlets).
		0.80	D	90	100		0.90			MADE GROUND (Soft dark brown slightly gravelly, silty CLAY with rare coal and brick fragments).
		1.60	D	80	80					Soft becoming soft to firm slightly gravelly, silty CLAY. Gravel is rounded to sub-angular fine to coarse of mixed lithologies and sandstone.
							2.00			*Fine to medium SAND 1.90-1.92m*
										End of Borehole at 2.00m

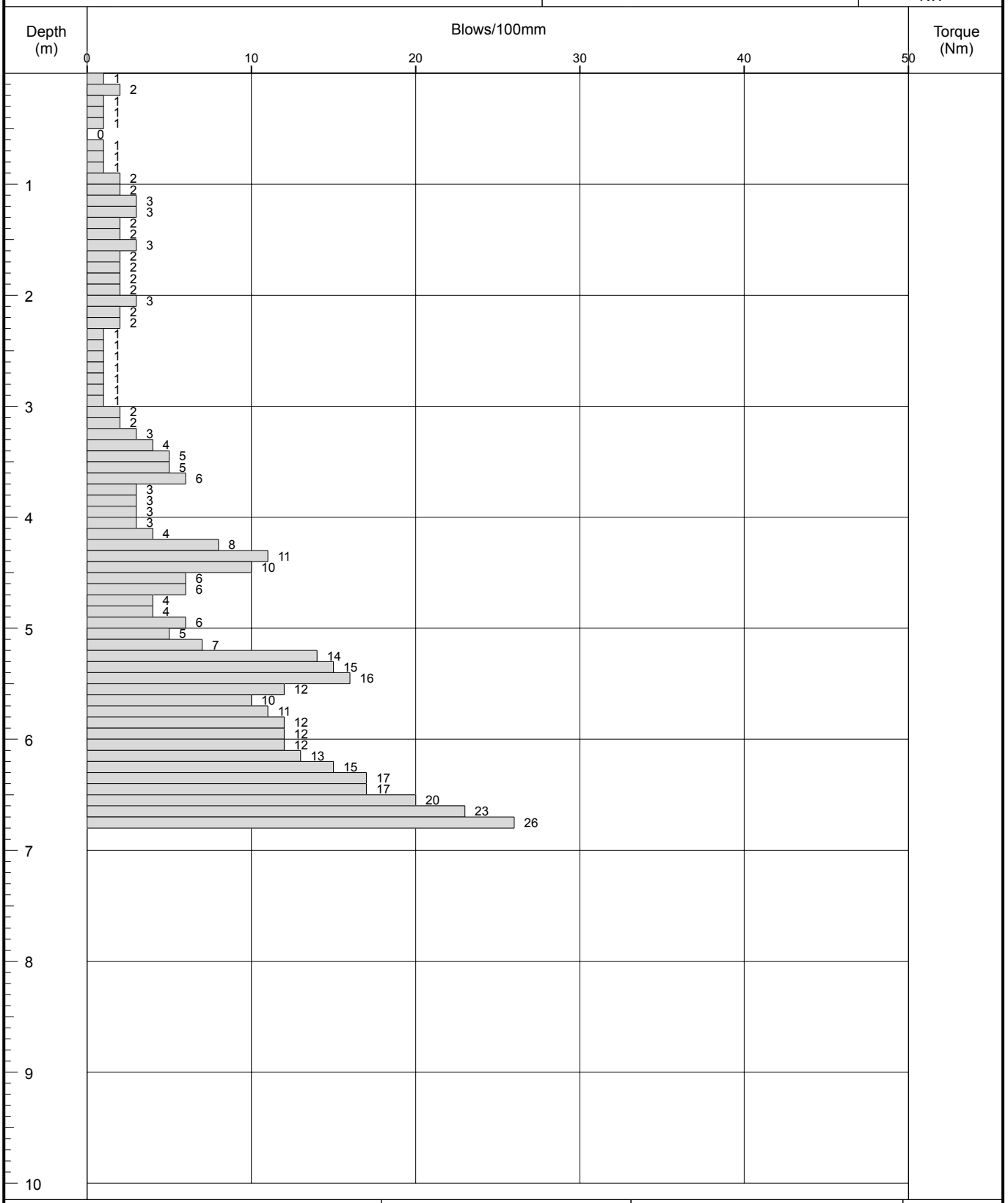
Remarks

APPENDIX 3

DYNAMIC PROBES

Probe Log

			Probe No. **DP1** Sheet 1 of 1
Project Name: 29 Berry Brow	Project No. J3408/16/E	Co-ords:	Hole Type DCP
Location: Manchester		Level:	Scale 1:50
Client: GS Construction Joinery & Building Contractors Ltd		Dates: 23/02/2016	Logged By KW

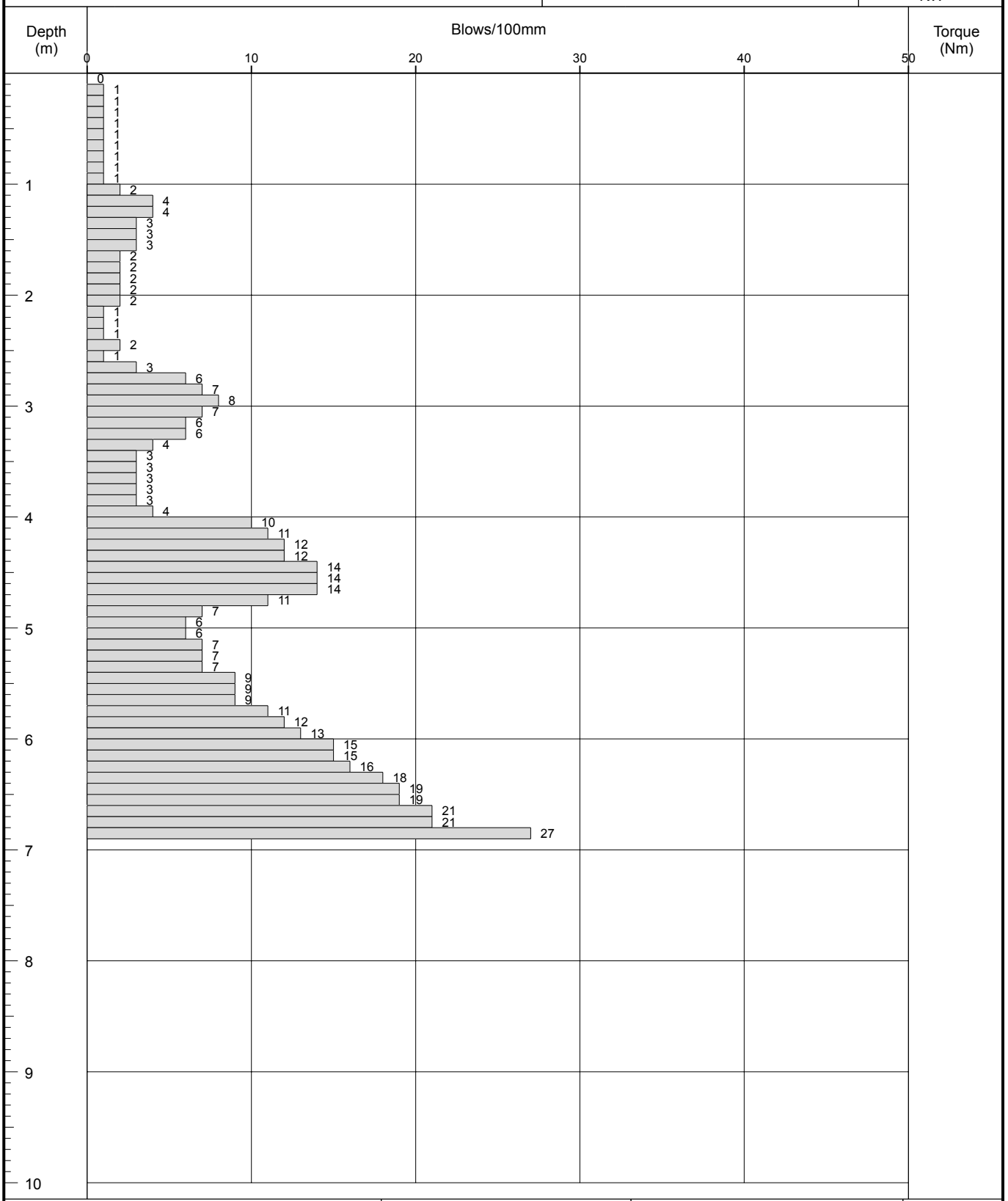


Remarks:
Refused at 6.8m depth.

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	6.8m
Probe Type	DPSH-B		

Probe Log

Probe No. **DP2** Sheet 1 of 1			
Project Name: 29 Berry Brow	Project No. J3408/16/E	Co-ords:	Hole Type DCP
Location: Manchester		Level:	Scale 1:50
Client: GS Construction Joinery & Building Contractors Ltd		Dates: 23/02/2016	Logged By KW

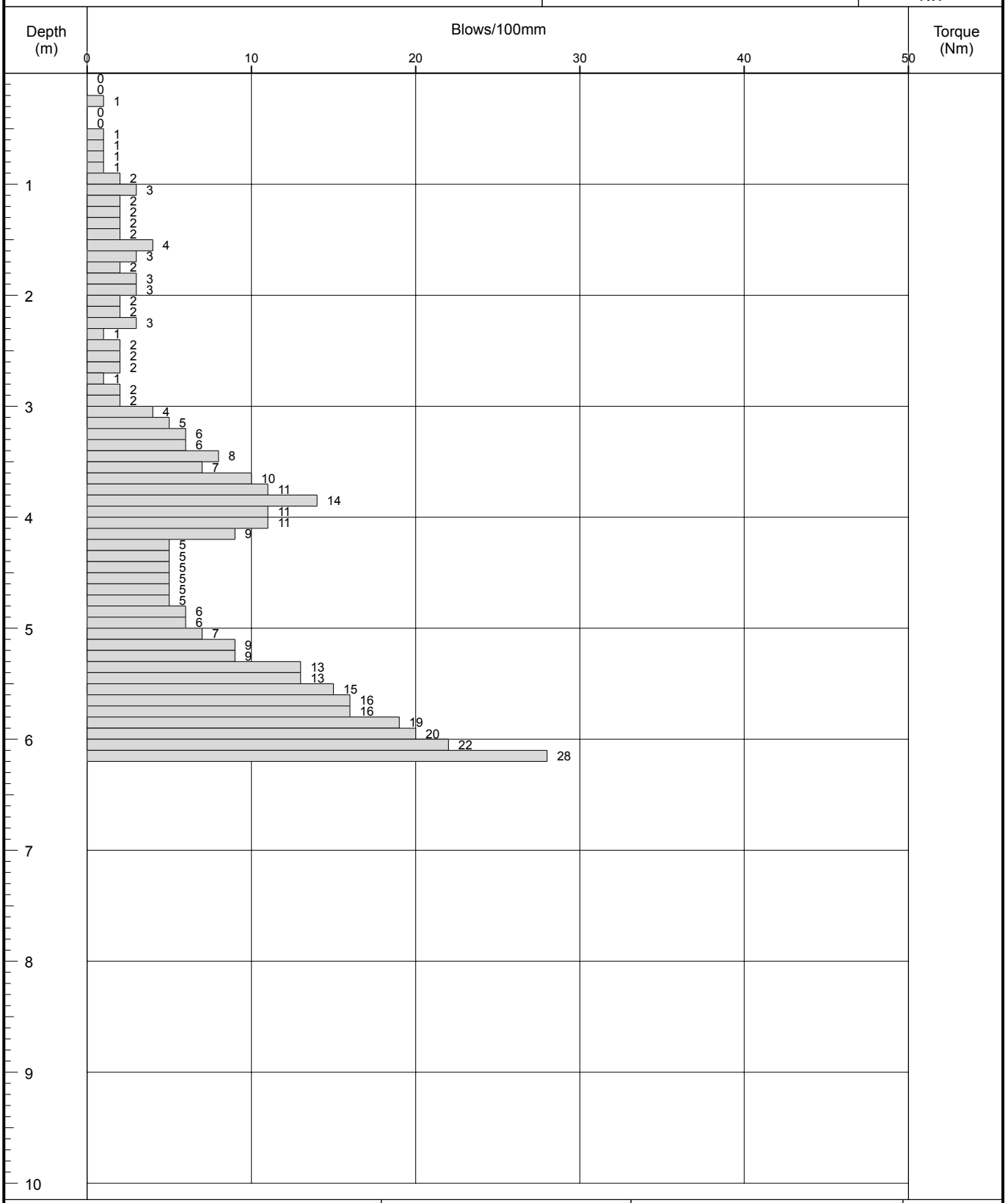


Remarks:
Refused at 6.9m depth.

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	6.9m
Probe Type	DPSH-B		

Probe Log

Probe No. **DP3** Sheet 1 of 1			
Project Name: 29 Berry Brow	Project No. J3408/16/E	Co-ords:	Hole Type DCP
Location: Manchester		Level:	Scale 1:50
Client: GS Construction Joinery & Building Contractors Ltd		Dates: 23/02/2016	Logged By KW

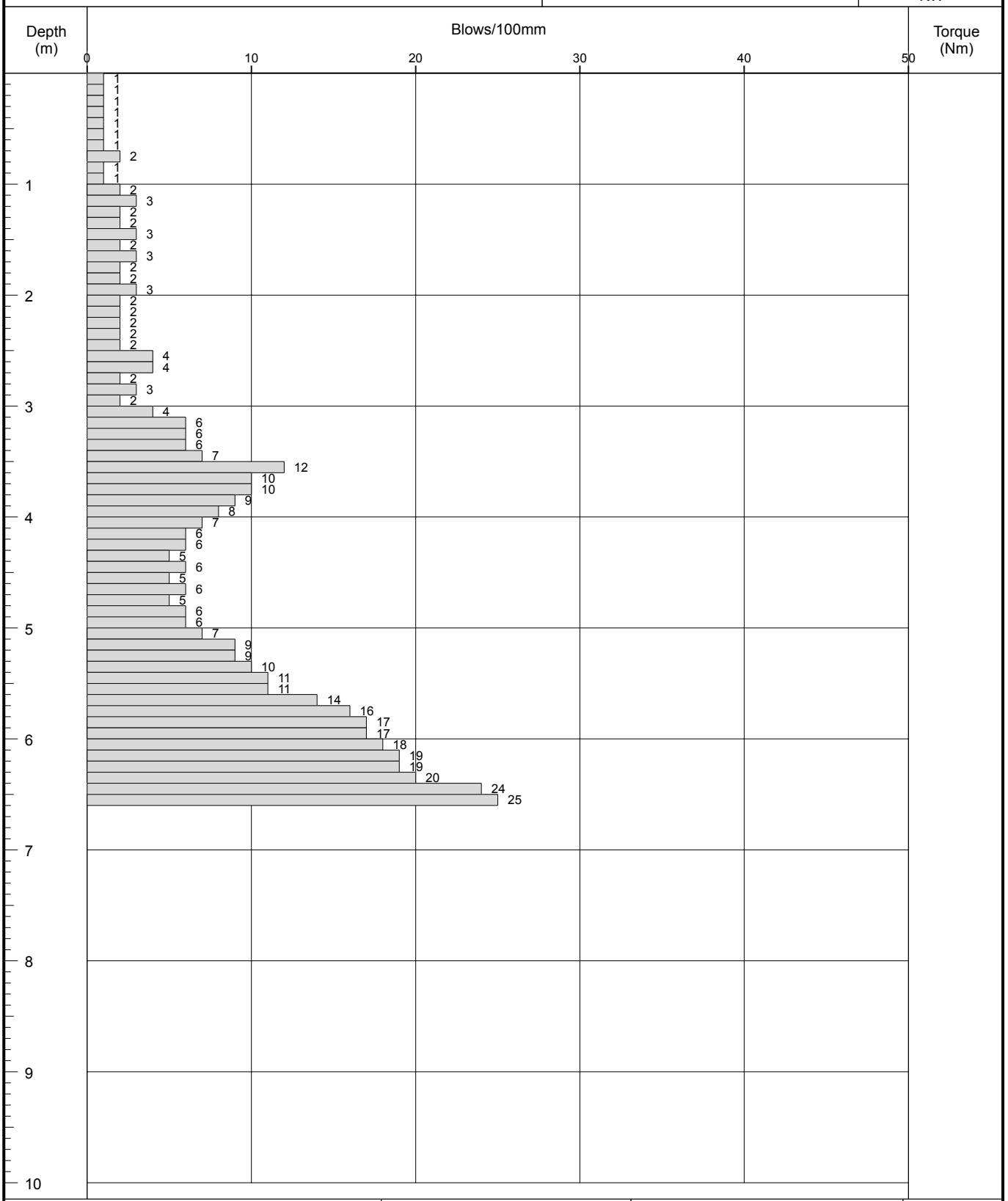


Remarks:
Refused at 6.2m depth.

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	6.2m
Probe Type	DPSH-B		

Probe Log

Probe No. **DP4** Sheet 1 of 1			
Project Name: 29 Berry Brow	Project No. J3408/16/E	Co-ords:	Hole Type DCP
Location: Manchester		Level:	Scale 1:50
Client: GS Construction Joinery & Building Contractors Ltd		Dates: 23/02/2016	Logged By KW



Remarks: Refused at 6.6m depth.	Fall Height	750mm	Cone Base Diameter 50.5mm
	Hammer Wt	63.5kg	Final Depth 6.6m
	Probe Type	DPSH-B	

APPENDIX 4

LABORATORY TESTING – GEOTECHNICAL

Summary of Classification Test Results

Project No.	Project Name
J3408/16/E	29 Berry Brow

Hole No.	Sample Ref	Sample Top	Sample Base	Sample Type	Soil Description	Density bulk Mg/m3	Density dry Mg/m3	*w* %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Remarks
WS1	1	1.50		D	Brown silty slightly gravelly CLAY.			19.0	88	39 -1pt	17	22		
WS1	2	1.90		D	Brown silty slightly gravelly CLAY.			17.0						
WS1	3	2.40		D	Brown silty slightly gravelly CLAY.			22.0	-1	40 -1pt	20	20		
WS1	4	2.65		D	Grey silty sandy CLAY.			28.0	98	29 -1pt	15	14		
WS2	1	0.90		D	Brown silty slightly gravelly CLAY.			21.0						
WS2	2	1.30		D	Brown silty slightly gravelly CLAY.			19.0	98	44 -1pt	19	25		
WS2	3	1.90		D	Brown silty slightly gravelly CLAY.			20.0						
WS3	1	0.30		D	Dark brown silty sandy CLAY.			33.0						
WS3	2	0.60		D	Orangish brown silty slightly gravelly CLAY.			25.0	95	42 -1pt	21	21		
WS3	3	1.55		D	Brown silty slightly gravelly CLAY.			22.0	100	49 -1pt	23	26		
WS4	1	0.80		D	Brown silty slightly gravelly CLAY.			23.0						
WS4	2	1.60		D	Brown silty, sandy,gravelly CLAY			22.0	90	40 -1pt	18	22		

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

Key			Date Printed	Approved By	Table
Density test	Liquid Limit	Particle density			1
Linear measurement unless :	4pt cone unless :	sp - small pyknometer	14/03/2016		
wd - water displacement	cas - Casagrande method	gj - gas jar			sheet
wi - immersion in water	1pt - single point test			Jude	1

Linear Shrinkage - Summary of Results

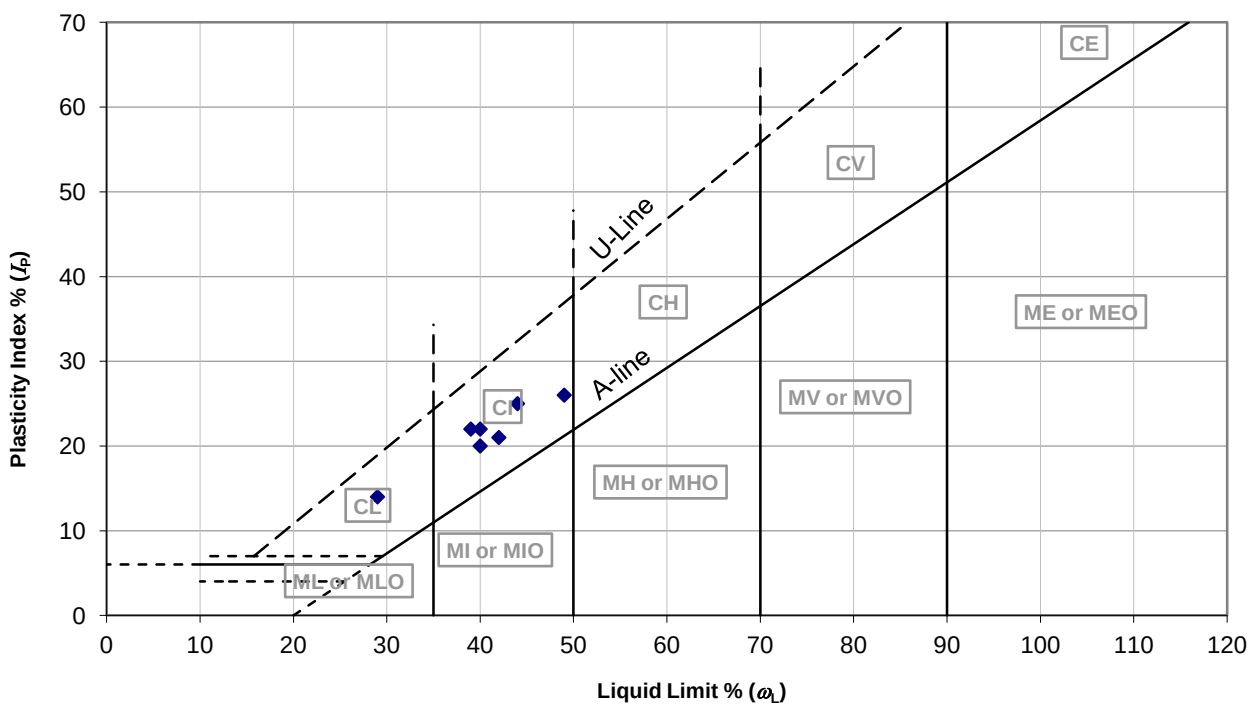
Project No.	Project Name
J3408/16/E	29 Berry Brow

Hole No.	Sample				Soil Description	Material <425µm %	Preparation	Linear Shrinkage %	Remarks
	Ref	Top	Base	Type					
WS1	1	1.50		D	Brown silty slightly gravelly CLAY.	88	Specimen prepared from natural material	12	
WS1	3	2.40		D	Brown silty slightly gravelly CLAY.	92	Specimen prepared from natural material	11	
WS1	4	2.65		D	Grey silty sandy CLAY.	98	Specimen prepared from natural material	9	
WS2	2	1.30		D	Brown silty slightly gravelly CLAY.	98	Specimen prepared from natural material	12	
WS3	2	0.60		D	Orangish brown silty slightly gravelly CLAY.	95	Specimen prepared from natural material	11	
WS3	3	1.55		D	Brown silty slightly gravelly CLAY.	100	Specimen prepared from natural material	12	
WS4	2	1.60		D	Brown silty, sandy,gravelly CLAY	90	Specimen prepared from natural material	12	

Notes	Date Printed	Approved By	Table
Tests performed in accordance with BS 1377 : Part 2 : 1990, clause 6.5 unless annotated otherwise	14/03/2016	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**		**J3408/16/E**
Project Name: 29 Berry Brow	**B.S 1377: Part 2: 1990: 3.2, 4 and 5**		Fig. 3 / Sheet. 1
Location: 29 Berry Brow, Manchester			Input By: CJN Date: 14.03.16
Client: GS Construction Joinery & Building Contractors Ltd			Check By: CJN Date: 14.03.16

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	1.50	19	39	17	22	12	22	19	0.1	0.9	C I	LOW
WS1	2.40	22	40	20	20	101	-2200	0	0.1	0.9	C I	*
WS1	2.65	28	29	15	14	2	29	14	0.9	0.1	C L	LOW
WS2	1.30	19	44	19	25	2	19	25	0.0	1.0	C I	MEDIUM
WS3	0.60	25	42	21	21	5	26	20	0.2	0.8	C I	LOW
WS3	1.55	22	49	23	26	0	22	26	0.0	1.0	C I	MEDIUM
WS4	1.60	22	40	18	22	10	24	20	0.2	0.8	C I	LOW



APPENDIX 5

LABORATORY TESTING – ENVIRONMENTAL

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.:	16-05728-1		
Initial Date of Issue:	16-Mar-2016		
Client	Rogers Geotechnical Services Ltd		
Client Address:	Offices 1 & 2, Barncliffe Business Near Bank Shelley Huddersfield West Yorkshire HD8 8LU		
Contact(s):	Imran Sakoor		
Project	J3408/16/E		
Quotation No.:		**Date Received:**	10-Mar-2016
Order No.:	0316-12	**Date Instructed:**	10-Mar-2016
No. of Samples:	3	**Target Date:**	16-Mar-2016
Turnaround (Wkdays):	5	**Results Due:**	16-Mar-2016
Date Approved:	16-Mar-2016		

Approved By:

Details: Keith Jones, Technical Manager

Chemtest
The right chemistry to deliver results

Results - Soil

Project: J3408/16/E

Client: Rogers Geotechnical Services Ltd				**Chemtest Job No.:**	16-05728	16-05728	16-05728
Quotation No.:				**Chemtest Sample ID.:**	265455	265456	265457
Order No.: 0316-12				Client Sample Ref.:	WS1	WS4	WS2
				Client Sample ID.:	D	D	D
				Sample Type:	SOIL	SOIL	SOIL
				Top Depth (m):	0	0	0
				Bottom Depth (m):	0.6	0.6	0.6
				Date Sampled:	09-Mar-2016	09-Mar-2016	09-Mar-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Cadmium	M	2450	mg/kg	0.10	0.13	0.28	0.27
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Copper	M	2450	mg/kg	0.50	25	51	47
Mercury	M	2450	mg/kg	0.10	0.21	5.7	0.56
Nickel	M	2450	mg/kg	0.50	31	34	28
Lead	M	2450	mg/kg	0.50	97	540	470
Zinc	M	2450	mg/kg	0.50	54	96	92
Vanadium	U	2450	mg/kg	5.0	27	45	27
Arsenic	M	2450	mg/kg	1.0	12	25	24
Selenium	M	2450	mg/kg	0.20	0.27	0.70	0.51
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	2.4	1.1
Acenaphthylene	M	2700	mg/kg	0.10	< 0.10	5.4	0.71
Acenaphthene	M	2700	mg/kg	0.10	< 0.10	0.92	1.5
Fluorene	M	2700	mg/kg	0.10	< 0.10	3.4	1.8
Phenanthrene	M	2700	mg/kg	0.10	< 0.10	22	21
Anthracene	M	2700	mg/kg	0.10	< 0.10	3.7	2.8
Fluoranthene	M	2700	mg/kg	0.10	0.86	20	19
Pyrene	M	2700	mg/kg	0.10	0.90	21	21
Benzo[a]anthracene	M	2700	mg/kg	0.10	0.25	6.7	6.6
Chrysene	M	2700	mg/kg	0.10	0.32	6.7	9.9
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	0.35	7.7	8.0
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	0.10	2.6	2.6
Benzo[a]pyrene	M	2700	mg/kg	0.10	0.31	6.3	5.7
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	0.28	3.9	3.8
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	< 0.10	0.93	1.0
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	0.54	3.7	4.4
Total Of 16 PAH's	M	2700	mg/kg	2.0	3.9	120	110
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	44	< 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	4.9	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	17	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	77	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	16	< 1.0

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Results - Soil

Project: J3408/16/E

Client: Rogers Geotechnical Services Ltd				**Chemtest Job No.:**	16-05728	16-05728	16-05728
Quotation No.:				**Chemtest Sample ID.:**	265455	265456	265457
Order No.: 0316-12				Client Sample Ref.:	WS1	WS4	WS2
				Client Sample ID.:	D	D	D
				Sample Type:	SOIL	SOIL	SOIL
				Top Depth (m):	0	0	0
				Bottom Depth (m):	0.6	0.6	0.6
				Date Sampled:	09-Mar-2016	09-Mar-2016	09-Mar-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Total Aliphatic Hydrocarbons	M	2680	mg/kg	5.0	< 5.0	160	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	6.1	< 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	3.6	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	1.7	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	38	4.3
Aromatic TPH >C16-C21	M	2680	mg/kg	1.0	2.3	230	31
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	5.3	680	86
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	28	5.2
Total Aromatic Hydrocarbons	M	2680	mg/kg	5.0	7.6	990	130
Total Petroleum Hydrocarbons	M	2680	mg/kg	10	< 10	1100	130
pH	M	2010		N/A	8.7	8.1	7.9
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	0.029	0.020	0.10
Moisture	N	2030	%	0.020	15	22	18
Soil Colour	N	2040		N/A	Brown	Brown	Brown, Grey
Other Material	N	2040		N/A	Stones, Brick	Stones	Stones
Soil Texture	N	2040		N/A	Sand	Sand	Sand
Sulphate (Total)	M	2430	%	0.010	0.077	0.13	0.11
Organic Matter	M	2625	%	0.40	2.4	11	5.7

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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 our Coventry 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

Sample Retention and Disposal

All soil samples will be retained for a period of 60 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

Rogers Geotechnical Services Ltd.

SUMMARY OF CONTAMINATION ANALYSIS - including Atkins ATRISK SSVs

Client: G.S. Construction Joinery & Building Contractors Ltd
Site: 29 Berry Brow, Manchester

Job Number: J3408/16/E
Date: 23/03/2016

Tox Data Report No.	Compound	Range of Values Found (mg/kg)		Residential with Homegrown Produce Landuse (mg/kg)		Reference
	Metals	*Min*	Max			
3	Cadmium	0.13	0.28	10		A
4	Chromium VI	<0.5	<0.5	14.7		A
	Copper	25	51	4020		A
7	Mercury	0.21	5.7	1.00		A
8	Nickel	28	34	130		A
	Lead	97	540	168		A
	Zinc	54	96	17200		A
	Vanadium	27	45	115		A
	Semi and Non Metals					
1	Arsenic	12	25	32		A
10	Selenium	0.27	0.7	350		A
	Free Cyanide	<0.5	<0.5	34		A
9	Phenols (total)	<0.3	<0.3	420		A
	Poly Aromatic Hydrocarbons			ATRISK	CLEA	
20	Napthalene	<0.1	2.4	8.71		A
	Acenaphthene	<0.1	1.5	937	2130	A
	Fluorene	<0.1	3.4	746	1930	A
	Anthracene	<0.1	3.7	20.9	18300	A
	Fluoranthene	0.86	20	113	2160	A
	Pyrene	0.9	21	13.2	1550	A
	Benzo(a)anthracene	0.25	6.7	8.54		A
2	Chrysene	0.32	9.9	2.64	927	A
2	Benzo(b)fluoranthene	0.35	8	7.29	9.86	A
2	Benzo(k)fluoranthene	0.1	2.6	4.12	100	A
2	Benzo(a)pyrene	0.31	6.3	0.998		A
2	Dibenzo(a,h)anthracene	<0.1	1	0.0236	1	A*
2	Indeno(1,2,3-cd)pyrene	0.28	3.9	0.368	9.75	A
2	Benzo(g,h,i)perylene	0.54	4.4	0.112	103	A
	Petroleum Hydrocarbons					
	Aliphatic C5-C6	<1	<1	26.1		A
	Aliphatic C6-C8	<1	<1	87.8		A
	Aliphatic C8-C10	<1	44	14.5		A
	Aliphatic C10-C12	<1	<1	87.7		A
	Aliphatic C12-C16	<1	4.9	126		A
	Aliphatic C16-C21	<1	17	88200		A
	Aliphatic C21-C35	<1	77	88200		A
	Aromatic C5-C7 (Benzene)	<1	6.1	0.33		A
	Aromatic C7-C8 (Toluene)	<1	<1	610		A
	Aromatic C8-C10	<1	3.6	23.7		A
	Aromatic C10-C12	<1	1.7	132		A
	Aromatic C12-C16	<1	38	452		A
	Aromatic C16-C21	2.3	230	804		A
	Aromatic C21-C35	5.3	680	1220		A
	Others					
	pH	7.9	8.7	-		-
	Organic Content (%)	2.4	11	-		-
	Soluble Sulphate (g/l)	0.029	0.1	-		-
	Total Sulphate (%)	0.077	0.13	-		-

A = WS ATKINS PLC, ATRISK SOIL SCREENING VALUES BASED ON 6% SOIL ORGANIC MATTER

For PAHs ATRISK assumes free product is avalable whilst CLEA assumes no free product

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