Limitations

This contract was completed by Groundtech Consulting on the basis of a defined programme and scope of works and terms and conditions agreed with the client. This report was compiled with due skill and care, taking into consideration the project brief provided, project objectives, agreed scope of works, prevailing site conditions and budget allocation.

Other than that defined in the paragraph above, Groundtech Consulting provides no other accountability or warranty whether express or implied, is made in relation to the services. Unless otherwise agreed this report has been prepared exclusively for the use and reliance of the client in accordance with generally accepted industry practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon, or transferred to, by any other party without the written agreement of a Director of Groundtech Consulting. A third party who relies on this report, does so at their own and sole risk and no liability to such parties is provided by Groundtech Consulting.

It is the understanding of Groundtech Consulting that this report is to be used for the intended purpose as set out in the introduction. The purpose was instrumental in determining the scope and level of the services provided. Should the purpose of the report or the proposed end use of the site change, this report will no longer be directly applicable, and its validity readdressed. No reliance upon the report in the revised situation should be assumed by the client without the permission of Groundtech Consulting.

The report was written in 2020, later changes in legislation, statutory requirements and industry best practices have not been considered and this should be allowed for. Ground conditions can also change and should be investigated if there is any significant delay in acting on the findings of this report. The period of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions in this report should not be relied upon in the future without the written confirmation from Groundtech Consulting that it is safe to do so.

The observations and conclusions outlined in this report are based exclusively on the services that were provided as set out in the agreement between the client and Groundtech Consulting.

Groundtech Consulting are not liable for the existence of any condition, the discovery of which would require additional investigation outside the agreed scope of works or core competency. The services provided are based upon Groundtech Consulting observations of existing physical conditions at the site gained from site reconnaissance together with interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The findings and recommendations contained in this report are based in part upon information provided by third parties, and Groundtech Consulting assume the information to be correct.

No responsibility can be accepted for errors for third party information presented in this report. Groundtech Consulting were not authorised to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the services. Groundtech Consulting are not liable for any inaccurate information, misrepresentation of data or conclusions, which may inform the scope of investigation undertaken by Groundtech Consulting and forms the contract with the client.

Where field investigations have been carried out these have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions can also be variable due to its heterogeneous properties and as investigation exploratory locations only allow examination of the ground at discrete locations. The potential exists for ground conditions to be encountered which are different to those considered in this report, particularly between exploratory holes. The extent of the limited area depends on the soil and groundwater conditions, together with other constraints such as the position of any existing structures and underground utilities. Geo-Environmental testing was carried out for a limited number of parameters [as stipulated in the contract] based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

The groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The groundwater level often has not had time to reach equilibrium and a monitoring period is required. Furthermore, groundwater levels are subject to seasonal variation or changes in local drainage conditions and higher groundwater levels may occur at other times of the year than were recorded during this investigation.

Any site drawings provided in this report are not meant to be an accurate base plan, but are preliminary and used to present the general relative locations of features on, and surrounding, the site.

Appendix C Gas and Groundwater Monitoring Results

PERMANENT GROUND GAS MONITORING FORM

GROUNDTECH CONSULTING

SITE NAME:	*TRINITY ACADEMY, BARNSLEY*	***ENGINEER:***	*Joshua Turton*
CLIENT:	*WAERMAN I&E*	***DATE:***	*27/10/2020*
JOB NO:	*20063*		

Pressure Trend:	*Falling*	***Weather:***	*Raining*	***Equipment:***	*GFM 436*

Ambient:	O_2 (%v/v)	CH_4 (%v/v)	CO_2 (%v/v)	LEL	H_2S (ppm)	CO (ppm)
Start	19.1	0.0	0.0	0.0	0.0	0.0
Finish	19.1	0.0	0.0	0.0	0.0	0.0

BH Ref.	Gas Flow Rate (l/hr)		Borehole Pressure (mb)	Methane (%v/v)			Carbon Dioxide (%v/v)		Oxygen (%v/v)		Hydrogen Sulphide (ppm)		Carbon Monoxide (ppm)		Q_{hg} CO_2 (l/hr)	Q_{hg} CH_4 (l/hr)	Atmos Press (mb)	PID (ppm)	Sheen (Y/N)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady						
RC101	0.3	0.1	0.01	0.0	0.0	0.0	2.9	2.7	14.7	16.7	0.0	0.0	0.0	0.0	0.0087	0.0000	974	-	N	10.72
RC102	0.1	0.1	0.00	0.0	0.0	0.0	0.1	0.3	13.5	16.1	0.0	0.0	0.0	0.0	0.0001	0.0000	974	-	N	NGW
RC103	NA	-0.6	0.00	NA	0.0	0.0	NA	0.0	NA	16.2	NA	0.0	NA	10.0	NA	NA	974	-	N	NGW
RC104	-50.2	-50.2	-7.43	0.0	0.0	0.0	0.1	0.0	1.6	16.2	0.0	0.0	0.0	0.0	0.0001	0.0000	975	-	N	5.48

Notes: RC103 flooded above head so peak concentrations not recorded.

Appendix D Results of Geotechnical Testing

LABORATORY REPORT

4043

Contract Number: PSL20/5490

Report Date: 30 October 2020

Client's Reference:

Client Name: Waterman
PO Box 499
Manchester
M28 4EE

For the attention of: Andrew Mould

Contract Title: Trinity Academy, Barnsley

Date Received: 9/10/2020
Date Commenced: 9/10/2020
Date Completed: 30/10/2020

Notes: **Opinions and Interpretations are outside the UKAS Accreditation**

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

H Daniels (Senior Technician)	A Watkins (Director)	R Berriman (Quality Manager)
S Royle (Laboratory Manager)	S Eyre (Senior Technician)	L Knight (Senior Technician)

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SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
TP101		D	1.00		Brown slightly gravelly sandy CLAY.
TP101		D	1.50		Brown mottled grey slightly gravelly slightly sandy CLAY.
TP101		B	1.00		Brownish grey very gravelly very sandy CLAY.
TP102		B	0.50		Brown very gravelly very sandy CLAY.
TP103		D	0.80		Brown mottled grey sandy CLAY.
TP103		B	0.50		Brown mottled grey gravelly sandy very silty CLAY.
TP107		D	0.80		Brown slightly gravelly slightly sandy CLAY.
TP107		B	1.00		Brown very gravelly very sandy CLAY.
TP110		D	1.00		Brown mottled grey slightly gravelly sandy CLAY.
TP111		D	0.50		Brown mottled grey slightly gravelly sandy CLAY.
TP111		B	0.50		Brown mottled grey slightly gravelly sandy CLAY.
TP112		D	1.00		Brown slightly gravelly sandy CLAY.
RC104		U	1.20		Very stiff brown slightly gravelly sandy CLAY.

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Moisture Content % Clause 3.2	Linear Shrinkage % Clause 6.5	Particle Density Mg/m^3 Clause 8.2	Liquid Limit % Clause 4.3/4	Plastic Limit % Clause 5.3	Plasticity Index % Clause 5.4	Passing .425mm %	Remarks
TP101		D	1.00		18			40	20	20	95	Intermediate plasticity CI.
TP101		D	1.50		20			60	26	34	98	High plasticity CH.
TP103		D	0.80		12			39	21	18	100	Intermediate plasticity CI.
TP107		D	0.80		21			38	22	16	98	Intermediate plasticity CI.
TP110		D	1.00		23			45	22	23	98	Intermediate plasticity CI.
TP111		D	0.50		20			54	23	31	98	High plasticity CH.
TP112		D	1.00		18			42	21	21	97	Intermediate plasticity CI.

SYMBOLS : **NP : Non Plastic** *** : Liquid Limit and Plastic Limit Wet Sieved.**

UKAS TESTING 4043

PSL Professional Soils Laboratory

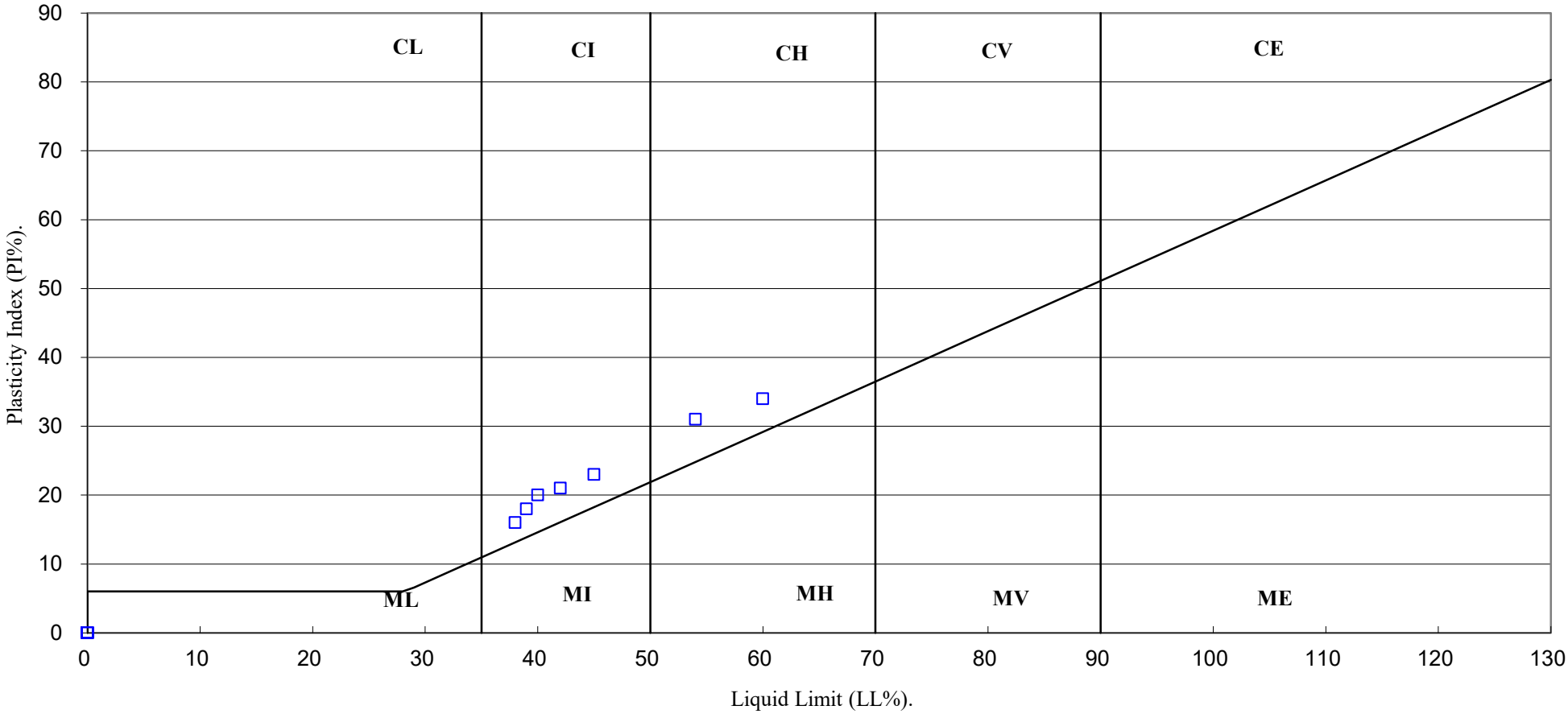
Trinity Academy, Barnsley

Contract No:

PSL20/5490

Client Ref:

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



UKAS TESTING 4043	PSL Professional Soils Laboratory	Trinity Academy, Barnsley	Contract No: PSL20/5490 Client Ref:

SUMMARY OF POINT LOAD TEST RESULTS

ISRM Suggested Methods : 2007

Borehole Number	Depth (m)	Sample Ref	Test Type	Orientation	Dimensions (mm)		Area	D_e^2	D_e	Failure Load (P)		I_s	Corr Fac	I_{s50}	Failure Type	Remarks
				Par / Perp	W	D	(mm2)		(mm)	(Mpa)	(kN)	(MPa)	F	(MPa)		
RC101	2.00		A	Perp	85	33	2805	3571.44	59.76	-	0.79	0.22	1.084	0.24	Valid	
RC101	3.50		A	Perp	85	46	3910	4978.37	70.56	-	1.32	0.27	1.168	0.31	Valid	
RC101	5.00		A	Perp	85	35	2975	3787.89	61.55	-	0.97	0.26	1.098	0.28	Valid	
RC101	6.50		A	Perp	85	42	3570	4545.47	67.42	-	0.68	0.15	1.144	0.17	Valid	
RC102	2.50		A	Perp	85	51	4335	5519.49	74.29	-	1.32	0.24	1.195	0.29	Valid	
RC102	4.00		A	Perp	85	31	2635	3354.99	57.92	-	0.63	0.19	1.068	0.20	Valid	
RC102	5.50		A	Perp	85	43	3655	4653.69	68.22	-	0.26	0.06	1.150	0.06	Valid	
RC102	8.50		A	Perp	85	41	3485	4437.24	66.61	-	2.70	0.61	1.138	0.69	Valid	
RC104	4.00		A	Perp	85	34	2890	3679.66	60.66	-	2.29	0.62	1.091	0.68	Valid	
RC104	5.50		A	Perp	85	38	3230	4112.56	64.13	-	7.24	1.76	1.119	1.97	Valid	
RC104	7.00		A	Perp	85	52	4420	5627.72	75.02	-	21.90	3.89	1.200	4.67	Valid	
RC104	10.00		A	Perp	85	33	2805	3571.44	59.76	-	1.12	0.31	1.084	0.34	Valid	

Note All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random

A = Axial, D = Diametral, I = Irregular

UKAS TESTING 4043

PSL Professional Soils Laboratory

Trinity Academy, Barnsley

Contract No:

PSL20/5490

Client Ref:

SUMMARY OF POINT LOAD TEST RESULTS

ISRM Suggested Methods : 2007

Borehole Number	Depth (m)	Sample Ref	Test Type	Orientation	Dimensions (mm)		D_e^2	D_e	Failure Load		I_s	Corr Fac	I_{s50}	Failure Type	Remarks
				Par / Perp	L	D		(mm)	(Mpa)	(kN)	(MPa)	F	(MPa)		
RC101	2.00		D	Par	-	85	7225	85.00	-	0.31	0.043	1.270	0.05	Valid	
RC101	3.50		D	Par	-	85	7225	85.00	-	0.45	0.062	1.270	0.08	Valid	
RC101	5.00		D	Par	-	85	7225	85.00	-	0.42	0.058	1.270	0.07	Valid	
RC101	6.50		D	Par	-	85	7225	85.00	-	0.22	0.030	1.270	0.04	Valid	
RC102	2.50		D	Par	-	85	7225	85.00	-	0.39	0.054	1.270	0.07	Valid	
RC102	4.00		D	Par	-	85	7225	85.00	-	0.24	0.033	1.270	0.04	Valid	
RC102	5.50		D	Par	-	85	7225	85.00	-	0.47	0.065	1.270	0.08	Valid	
RC102	8.50		D	Par	-	85	7225	85.00	-	1.98	0.274	1.270	0.35	Valid	
RC104	4.00		D	Par	-	85	7225	85.00	-	3.21	0.444	1.270	0.56	Valid	
RC104	5.50		D	Par	-	85	7225	85.00	-	7.17	0.992	1.270	1.26	Valid	
RC104	7.00		D	Par	-	85	7225	85.00	-	28.86	3.994	1.270	5.07	Valid	
RC104	10.00		D	Par	-	85	7225	85.00	-	0.67	0.093	1.270	0.12	Valid	

Note All testing carried out on samples at as received water content

Par = parallel, Perp = perpendicular, U = Random

UKAS TESTING 4043

PSL Professional Soils Laboratory

Trinity Academy, Barnsley

Contract No:

PSL20/5490

Client Ref:

PARTICLE SIZE DISTRIBUTION TEST

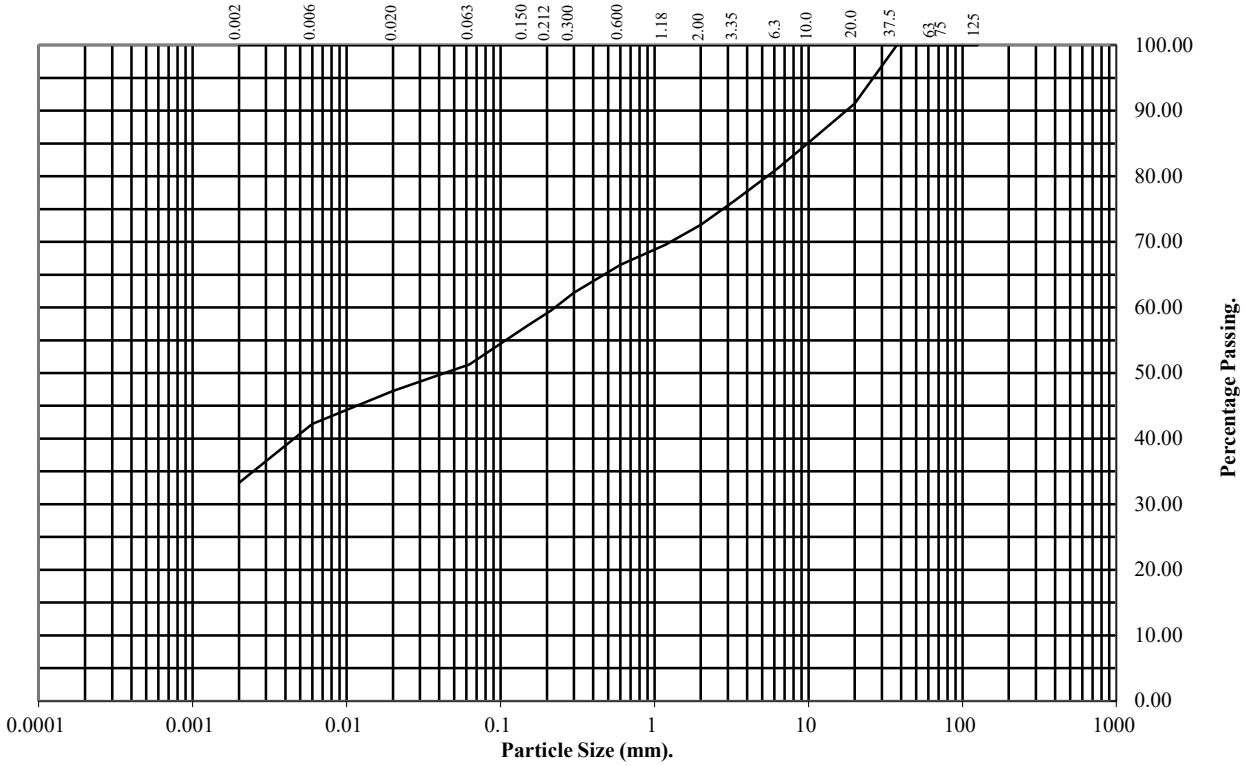
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: TP101 **Top Depth (m):** 1.00

Sample Number: **Base Depth(m):**

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	91
10	85
6.3	81
3.35	76
2	73
1.18	70
0.6	66
0.3	62
0.212	60
0.15	57
0.063	51

Particle Diameter	Percentage Passing
0.02	47
0.006	42
0.002	33

Soil Fraction	Total Percentage
Cobbles	0
Gravel	27
Sand	22
Silt	18
Clay	33

Remarks:
See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

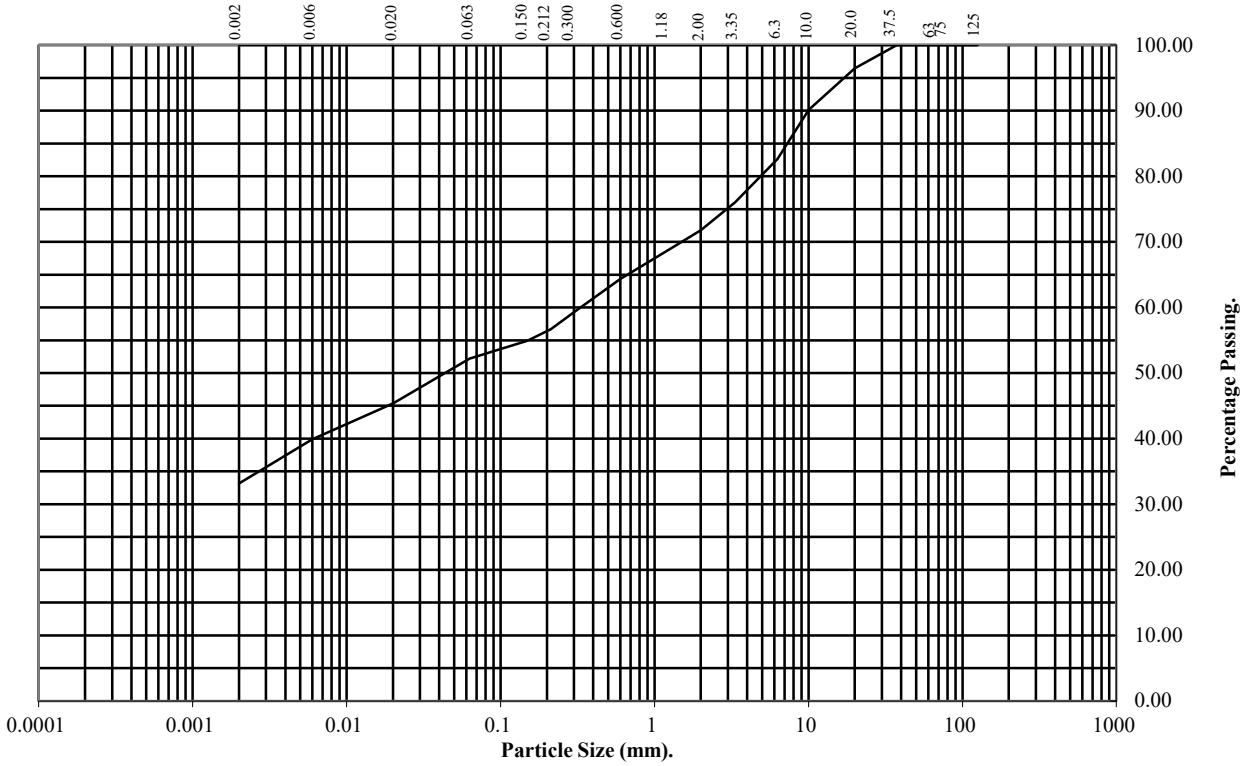
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: TP102 **Top Depth (m):** 0.50

Sample Number: **Base Depth(m):**

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	96
10	90
6.3	83
3.35	76
2	72
1.18	68
0.6	64
0.3	59
0.212	57
0.15	55
0.063	52

Particle Diameter	Percentage Passing
0.02	45
0.006	40
0.002	33

Soil Fraction	Total Percentage
Cobbles	0
Gravel	28
Sand	20
Silt	19
Clay	33

Remarks:
See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

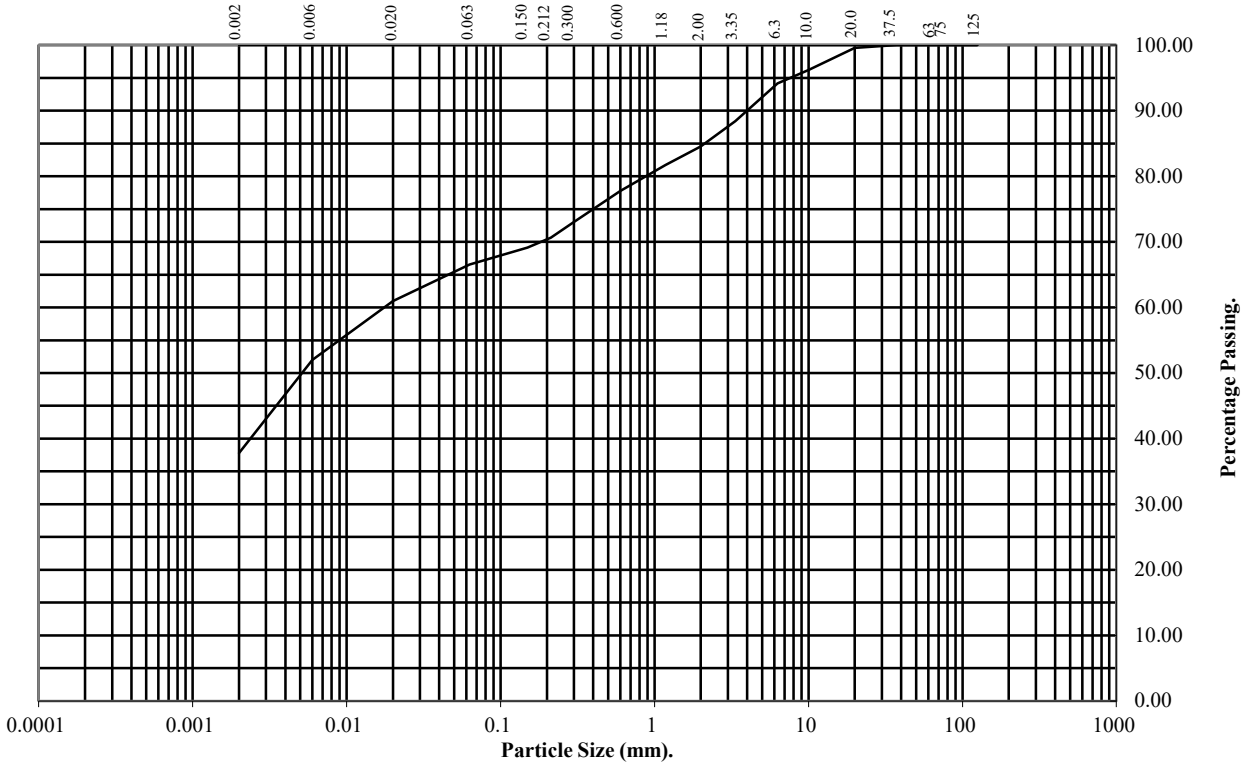
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: TP103 **Top Depth (m):** 0.50

Sample Number: **Base Depth(m):**

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	96
6.3	94
3.35	88
2	85
1.18	82
0.6	78
0.3	73
0.212	71
0.15	69
0.063	67

Particle Diameter	Percentage Passing
0.02	61
0.006	52
0.002	38

Soil Fraction	Total Percentage
Cobbles	0
Gravel	15
Sand	18
Silt	29
Clay	38

Remarks:
See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

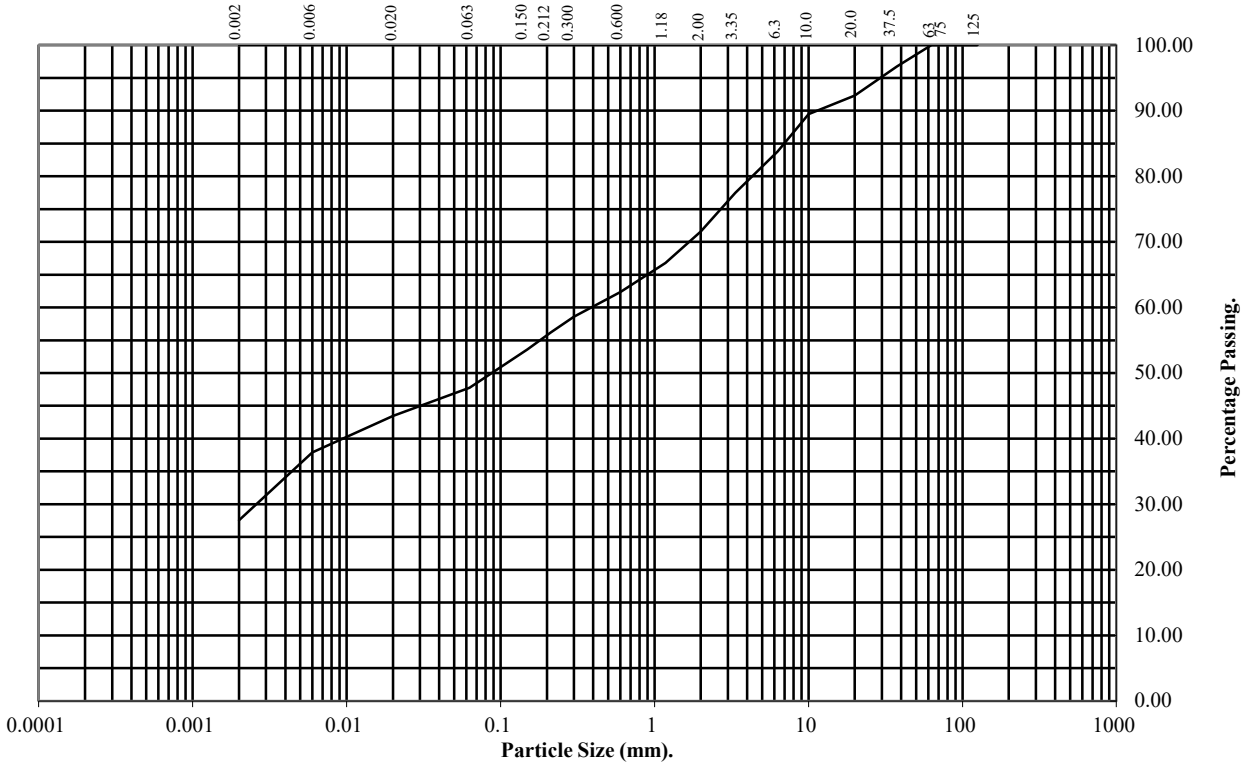
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: TP107 **Top Depth (m):** 1.00

Sample Number: **Base Depth(m):**

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	97
20	92
10	89
6.3	84
3.35	77
2	72
1.18	67
0.6	62
0.3	59
0.212	56
0.15	54
0.063	48

Particle Diameter	Percentage Passing
0.02	43
0.006	38
0.002	28

Soil Fraction	Total Percentage
Cobbles	0
Gravel	28
Sand	24
Silt	20
Clay	28

Remarks:
See Summary of Soil Descriptions

PARTICLE SIZE DISTRIBUTION TEST

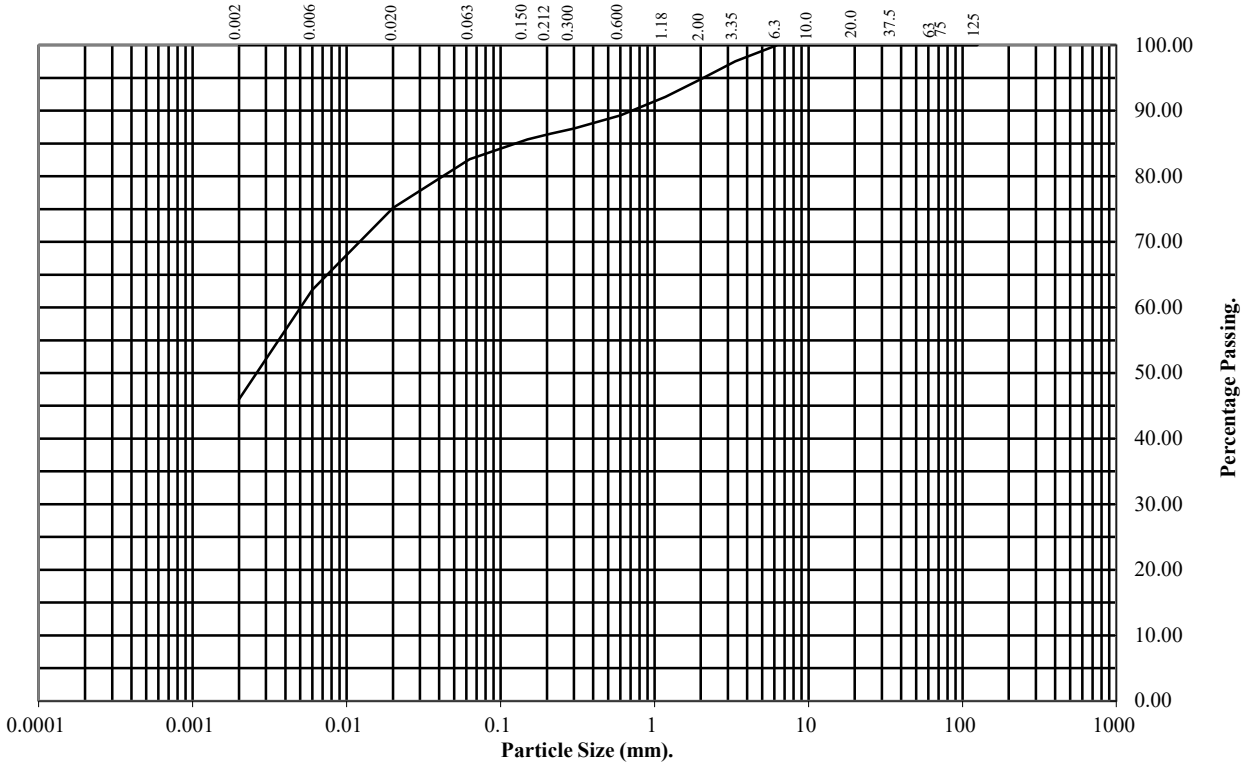
BS1377 : Part 2 : 1990

Wet Sieve & Pipette Analysis, Clause 9.2 & 9.4

Hole Number: TP111 **Top Depth (m):** 0.50

Sample Number: **Base Depth(m):**

Sample Type: B



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	98
2	95
1.18	92
0.6	89
0.3	87
0.212	87
0.15	86
0.063	83

Particle Diameter	Percentage Passing
0.02	75
0.006	63
0.002	46

Soil Fraction	Total Percentage
Cobbles	0
Gravel	5
Sand	12
Silt	37
Clay	46

Remarks:

See Summary of Soil Descriptions

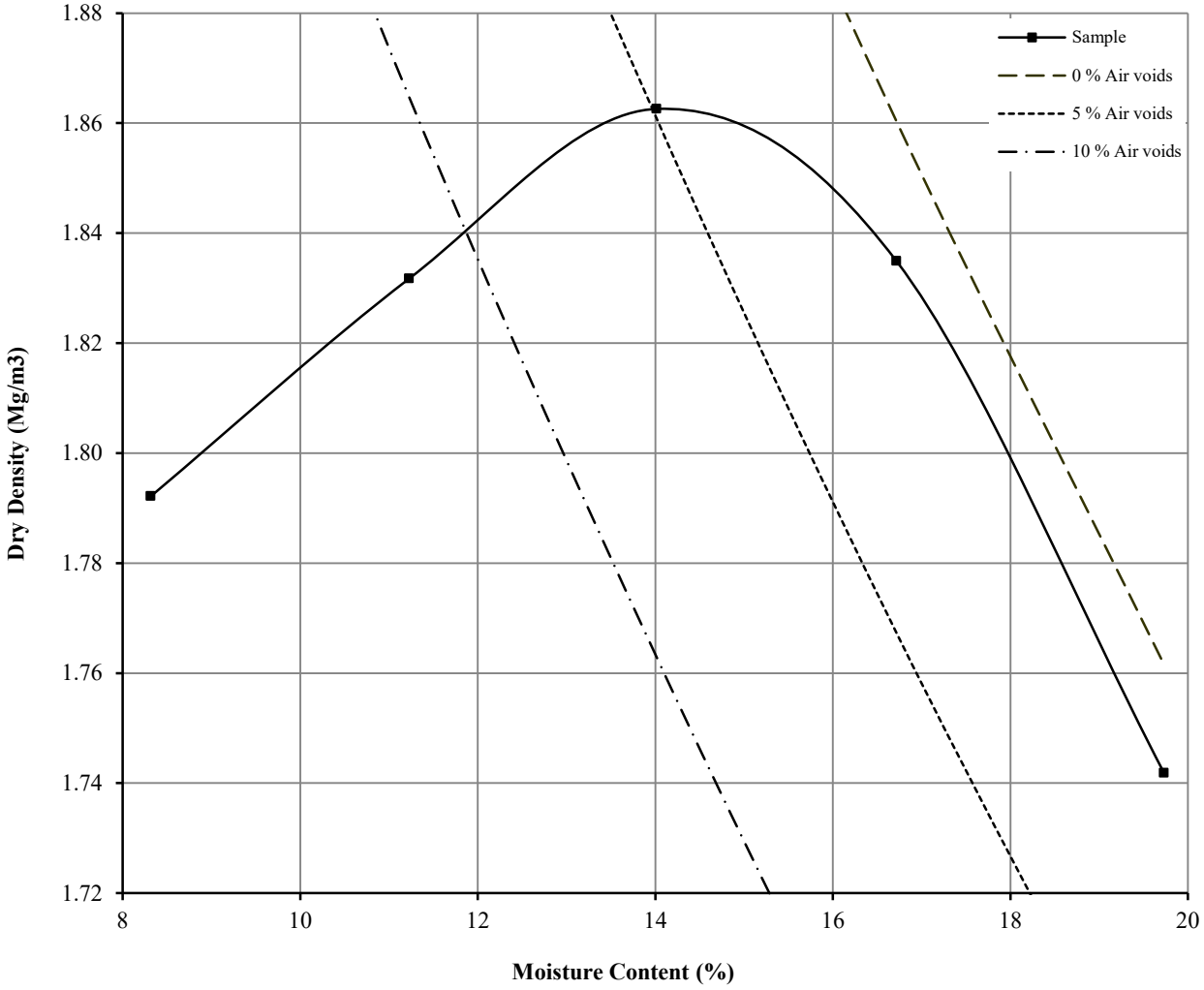
DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.3 : 1990

Hole Number: TP102 **Top Depth (m) :** 0.50

Sample Number: **Base Depth (m) :**

Sample Type: B



Initial Moisture Content:		17	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m3):	2.7	Assumed	Material Retained on 37.5 mm Test Sieve (%):		0
Maximum Dry Density (Mg/m3):		1.86	Material Retained on 20.0 mm Test Sieve (%):		4
Optimum Moisture Content (%):		14			
Remarks See summary of soil descriptions.					

UKAS TESTING 4043

PSL Professional Soils Laboratory

'Trinity Academy, Barnsley

Contract
PSL20/5490
Client Ref

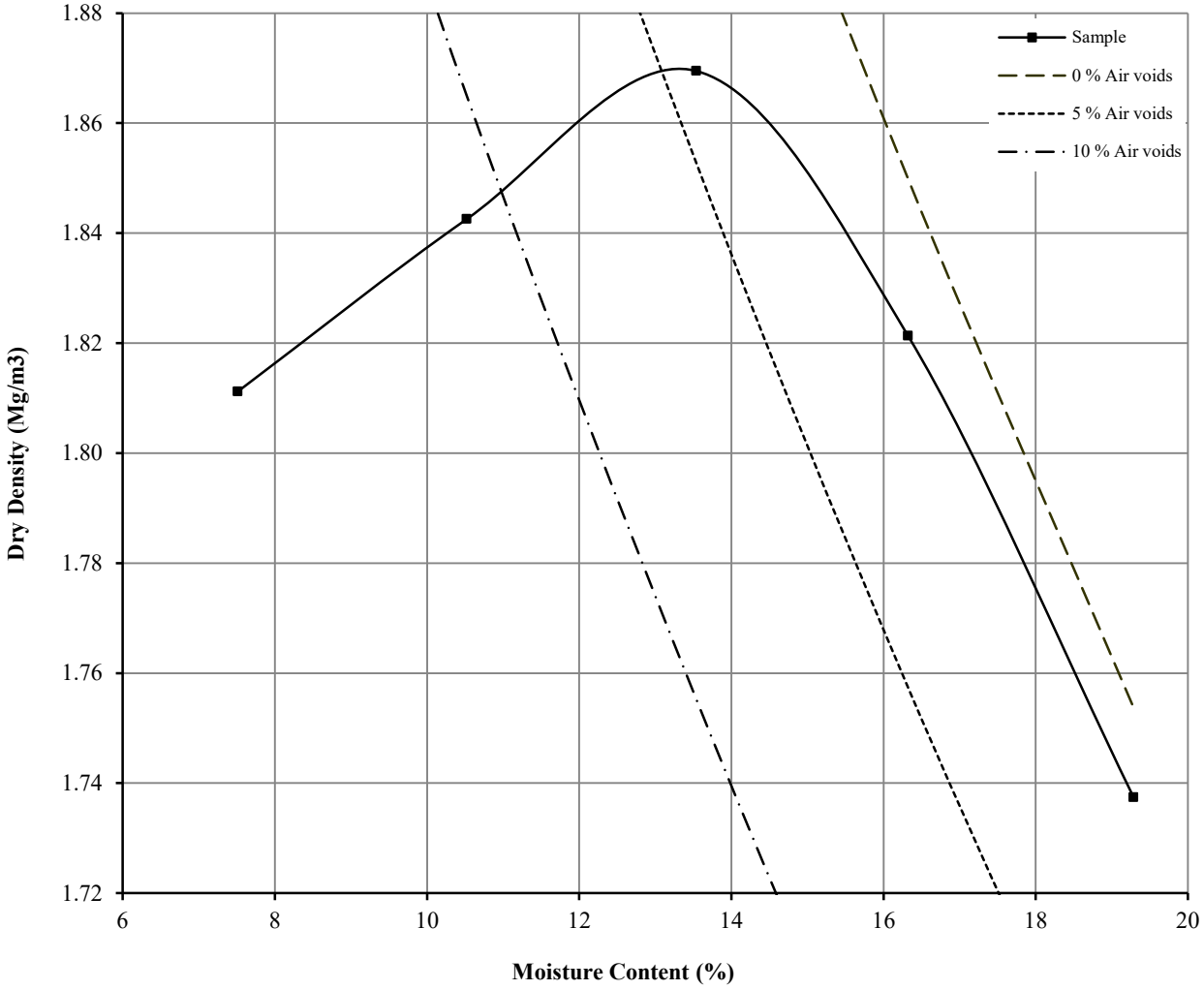
DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.3 : 1990

Hole Number: TP103 **Top Depth (m) :** 0.50

Sample Number: **Base Depth (m) :**

Sample Type: B



Initial Moisture Content:		14	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m3):	2.65	Assumed	Material Retained on 37.5 mm Test Sieve (%):		0
Maximum Dry Density (Mg/m3):		1.87	Material Retained on 20.0 mm Test Sieve (%):		0
Optimum Moisture Content (%):		14			
Remarks See summary of soil descriptions.					

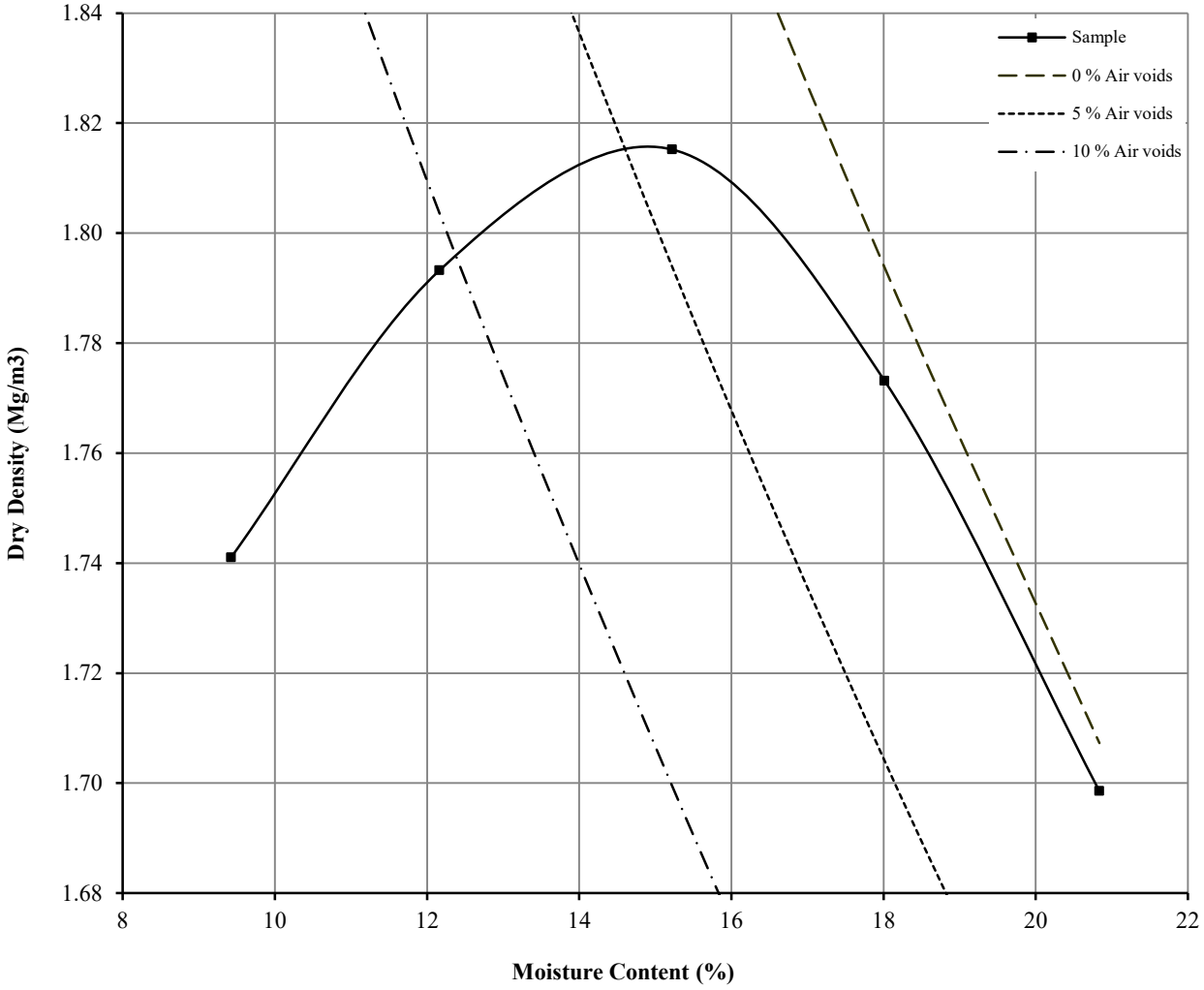
DRY DENSITY / MOISTURE CONTENT RELATIONSHIP

BS 1377 : Part 4 : Clause 3.4 : 1990

Hole Number: TP107 **Top Depth (m) :** 1.00

Sample Number: **Base Depth (m) :**

Sample Type: B



Initial Moisture Content:		15	Method of Compaction:	2.5kg	Separate Samples
Particle Density (Mg/m3):	2.65	Assumed	Material Retained on 37.5 mm Test Sieve (%):		3
Maximum Dry Density (Mg/m3):		1.82	Material Retained on 20.0 mm Test Sieve (%):		5
Optimum Moisture Content (%):		15			
Remarks See summary of soil descriptions.					

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

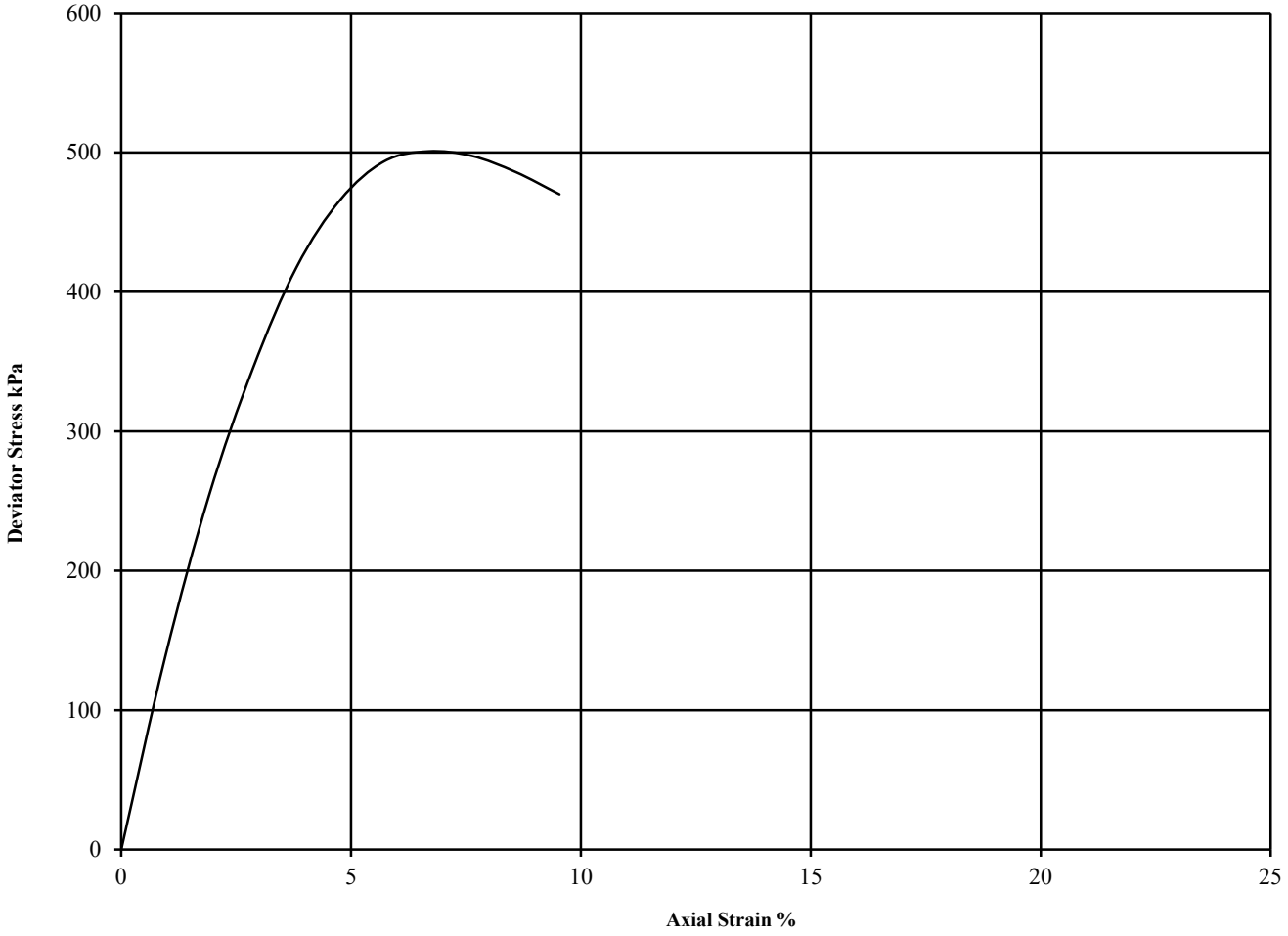
WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: **RC104** **Top Depth (m):** **1.20**

Sample Number: **Base Depth (m):**

Sample Type **U**



Diameter (mm):		102	Height (mm):		107	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa) θ_3	Corr. Max. Deviator Stress (kPa) $(\theta_1-\theta_3)_f$	Shear Strength Cu (kPa) $^1/_2(\theta_1-\theta_3)_f$	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.36
1	11	4.25	3.84	30	501	250	6.7	Brittle	See summary of soil descriptions

4043

Professional Soils Laboratory

Trinity Academy, Barnsley

Contract No:
PSL20/5490
Client Ref:

Appendix E Results of Laboratory analysis

Element Materials Technology
Unit 3 Deeside Point
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Deeside
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F: +44 (0) 1244 833781
W: www.element.com

Waterman Infrastructure & Environment Limited
11 Peter Street
Manchester
M2 5QR

Attention :	Andrew Mould
Date :	14th October, 2020
Your reference :	WIE17125
Our reference :	Test Report 20/13332 Batch 1 Schedule A 20/13332 Batch 1 Schedule C
Location :	Trinity Academy, Barnsley
Date samples received :	30th September, 2020
Status :	Final report
Issue :	1

Thirty nine samples were received for analysis on 30th September, 2020 of which twelve were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Simon Gomery BSc
Project Manager

Element Materials Technology Environmental UK Limited
Registered in England and Wales
Registered Office: 10 Lower Grosvenor Place, London, SW1W 0EN
Company Registration No: 11371415

Client Name: Waterman Infrastructure & Environment Limited
Reference: WIE17125
Location: Trinity Academy, Barnsley
Contact: Andrew Mould
EMT Job No: 20/13332

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	4-6	7-9	10-12	13-15	31-33	37-39	46-48	58-60	61-63	79-81	LOD/LOR	Units	Method No.
Sample ID	TP101	TP101	TP102	TP102	TP104	TP105	TP106	TP107	TP108	TP110			
Depth	0.50	1.50	0.10	0.50	0.60	0.10	0.60	1.00	0.10	1.00			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	24/09/2020	24/09/2020	24/09/2020	24/09/2020	24/09/2020	24/09/2020	24/09/2020	23/09/2020	23/09/2020	23/09/2020			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020			
Arsenic #	20.0	3.0	19.2	8.3	9.6	24.0	9.1	9.5	14.4	7.8	<0.5	mg/kg	TM30/PM15
Barium #	82	52	82	62	62	114	56	86	79	60	<1	mg/kg	TM30/PM15
Beryllium	1.5	1.2	1.3	1.3	1.5	1.7	1.5	1.3	1.5	2.3	<0.5	mg/kg	TM30/PM15
Cadmium #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Chromium #	27.8	39.9	250.6 AA	22.6	56.0	29.5	76.0	46.6	29.1	33.9	<0.5	mg/kg	TM30/PM15
Cobalt #	16.0	9.3	15.1	14.3	14.4	18.9	18.4	22.8	26.5	14.0	<0.5	mg/kg	TM30/PM15
Copper #	34	26	36	24	34	43	23	22	26	31	<1	mg/kg	TM30/PM15
Iron	41560	35020	33750	42240	43570	44710 AA	49180 AA	47860	43170 AA	69690 AA	<20	mg/kg	TM30/PM15
Lead #	71	16	72	24	24	67	22	24	47	27	<5	mg/kg	TM30/PM15
Mercury #	0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Molybdenum #	1.7	1.2	2.9	0.5	0.5	1.9	0.5	2.3	1.1	0.3	<0.1	mg/kg	TM30/PM15
Nickel #	22.2	23.2	27.0	24.6	30.7	25.2	27.0	25.0	25.7	27.9	<0.7	mg/kg	TM30/PM15
Selenium #	2	<1	2	<1	1	2	2	2	1	1	<1	mg/kg	TM30/PM15
Vanadium	33	24	34	26	29	39	30	34	34	38	<1	mg/kg	TM30/PM15
Water Soluble Boron #	0.6	0.4	0.8	0.4	0.7	0.8	0.6	0.5	0.6	0.7	<0.1	mg/kg	TM74/PM32
Zinc #	106	81	107	98	112	128	105	95	104	93	<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Acenaphthylene	0.05	<0.03	<0.03	<0.03	<0.03	0.24	<0.03	<0.03	0.06	<0.03	<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Phenanthrene #	0.18	<0.03	0.13	0.03	<0.03	0.37	<0.03	<0.03	0.29	<0.03	<0.03	mg/kg	TM4/PM8
Anthracene #	0.06	<0.04	<0.04	<0.04	<0.04	0.31	<0.04	<0.04	0.12	<0.04	<0.04	mg/kg	TM4/PM8
Fluoranthene #	0.37	<0.03	0.30	0.06	<0.03	1.47	<0.03	<0.03	0.77	<0.03	<0.03	mg/kg	TM4/PM8
Pyrene #	0.31	<0.03	0.25	0.06	<0.03	1.34	<0.03	<0.03	0.64	<0.03	<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	0.24	<0.06	0.19	<0.06	<0.06	1.01	<0.06	<0.06	0.46	<0.06	<0.06	mg/kg	TM4/PM8
Chrysene #	0.23	<0.02	0.17	0.05	<0.02	1.02	<0.02	<0.02	0.42	<0.02	<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	0.39	<0.07	0.30	0.08	<0.07	1.91	<0.07	<0.07	0.73	<0.07	<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	0.21	<0.04	0.17	0.05	<0.04	1.09	<0.04	<0.04	0.38	<0.04	<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene	0.16	<0.04	0.12	<0.04	<0.04	0.64	<0.04	<0.04	0.25	<0.04	<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	0.11	<0.04	<0.04	0.05	<0.04	<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	0.15	<0.04	0.10	<0.04	<0.04	0.64	<0.04	<0.04	0.25	<0.04	<0.04	mg/kg	TM4/PM8
Coronene	<0.04	<0.04	<0.04	<0.04	<0.04	0.10	<0.04	<0.04	0.05	<0.04	<0.04	mg/kg	TM4/PM8
PAH 17 Total	2.35	<0.64	1.73	<0.64	<0.64	10.25	<0.64	<0.64	4.47	<0.64	<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	0.28	<0.05	0.22	0.06	<0.05	1.38	<0.05	<0.05	0.53	<0.05	<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	0.11	<0.02	0.08	0.02	<0.02	0.53	<0.02	<0.02	0.20	<0.02	<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	89	93	95	94	94	95	91	94	97	96	<0	%	TM4/PM8
Methyl Tertiary Butyl Ether #	<0.002	-	-	-	-	-	<0.002	-	-	-	<0.002	mg/kg	TM15/PM10
Benzene #	<0.003	-	-	-	-	-	<0.003	-	-	-	<0.003	mg/kg	TM15/PM10
Toluene #	<0.003	-	-	-	-	-	<0.003	-	-	-	<0.003	mg/kg	TM15/PM10
Ethylbenzene #	<0.003	-	-	-	-	-	<0.003	-	-	-	<0.003	mg/kg	TM15/PM10
m/p-Xylene #	<0.005	-	-	-	-	-	<0.005	-	-	-	<0.005	mg/kg	TM15/PM10

Please see attached notes for all abbreviations and acronyms

Client Name: Waterman Infrastructure & Environment Limited
Reference: WIE17125
Location: Trinity Academy, Barnsley
Contact: Andrew Mould
EMT Job No: 20/13332

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	4-6	7-9	10-12	13-15	31-33	37-39	46-48	58-60	61-63	79-81	LOD/LOR	Units	Method No.
Sample ID	TP101	TP101	TP102	TP102	TP104	TP105	TP106	TP107	TP108	TP110			
Depth	0.50	1.50	0.10	0.50	0.60	0.10	0.60	1.00	0.10	1.00			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	24/09/2020	24/09/2020	24/09/2020	24/09/2020	24/09/2020	24/09/2020	24/09/2020	23/09/2020	23/09/2020	23/09/2020			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020			
o-Xylene #	<0.003	-	-	-	-	-	<0.003	-	-	-	<0.003	mg/kg	TM15/PM10
Surrogate Recovery Toluene D8	86	-	-	-	-	-	102	-	-	-	<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	66	-	-	-	-	-	84	-	-	-	<0	%	TM15/PM10
TPH CWG													
Aliphatics													
>C5-C6 #	<0.1	-	-	<0.1	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	mg/kg	TM36/PM12
>C6-C8 #	<0.1	-	-	<0.1	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	mg/kg	TM36/PM12
>C8-C10	<0.1	-	-	<0.1	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	mg/kg	TM36/PM12
>C10-C12 #	<0.2	-	-	<0.2	<0.2	<0.2	<0.2	-	-	<0.2	<0.2	mg/kg	TM5/PM8/PM16
>C12-C16 #	<4	-	-	<4	<4	<4	<4	-	-	<4	<4	mg/kg	TM5/PM8/PM16
>C16-C21 #	<7	-	-	<7	<7	<7	<7	-	-	<7	<7	mg/kg	TM5/PM8/PM16
>C21-C35 #	<7	-	-	<7	<7	<7	<7	-	-	<7	<7	mg/kg	TM5/PM8/PM16
>C35-C44	<7	-	-	<7	<7	<7	<7	-	-	<7	<7	mg/kg	TM5/PM8/PM16
Total aliphatics C5-44	<26	-	-	<26	<26	<26	<26	-	-	<26	<26	mg/kg	TM5/TM36/PM8/PM12/PM16
Aromatics													
>C5-EC7 #	<0.1	-	-	<0.1	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	mg/kg	TM36/PM12
>EC7-EC8 #	<0.1	-	-	<0.1	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	mg/kg	TM36/PM12
>EC8-EC10 #	<0.1	-	-	<0.1	<0.1	<0.1	<0.1	-	-	<0.1	<0.1	mg/kg	TM36/PM12
>EC10-EC12 #	<0.2	-	-	<0.2	<0.2	<0.2	<0.2	-	-	<0.2	<0.2	mg/kg	TM5/PM8/PM16
>EC12-EC16 #	<4	-	-	<4	<4	<4	<4	-	-	<4	<4	mg/kg	TM5/PM8/PM16
>EC16-EC21 #	<7	-	-	<7	<7	<7	<7	-	-	<7	<7	mg/kg	TM5/PM8/PM16
>EC21-EC35 #	<7	-	-	<7	<7	<7	<7	-	-	<7	<7	mg/kg	TM5/PM8/PM16
>EC35-EC44	<7	-	-	<7	<7	<7	<7	-	-	<7	<7	mg/kg	TM5/PM8/PM16
Total aromatics C5-44	<26	-	-	<26	<26	<26	<26	-	-	<26	<26	mg/kg	TM5/TM36/PM8/PM12/PM16
Total aliphatics and aromatics(C5-44)	<52	-	-	<52	<52	<52	<52	-	-	<52	<52	mg/kg	TM5/TM36/PM8/PM12/PM16
MTBE #	-	-	-	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	mg/kg	TM36/PM12
Benzene #	-	-	-	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	mg/kg	TM36/PM12
Toluene #	-	-	-	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	mg/kg	TM36/PM12
Ethylbenzene #	-	-	-	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	mg/kg	TM36/PM12
m/p-Xylene #	-	-	-	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	mg/kg	TM36/PM12
o-Xylene #	-	-	-	<0.005	<0.005	<0.005	-	-	-	<0.005	<0.005	mg/kg	TM36/PM12
PCB 28 #	<0.005	-	-	-	-	-	<0.005	-	-	-	<0.005	mg/kg	TM17/PM8
PCB 52 #	<0.005	-	-	-	-	-	<0.005	-	-	-	<0.005	mg/kg	TM17/PM8
PCB 101 #	<0.005	-	-	-	-	-	<0.005	-	-	-	<0.005	mg/kg	TM17/PM8
PCB 118 #	<0.005	-	-	-	-	-	<0.005	-	-	-	<0.005	mg/kg	TM17/PM8
PCB 138 #	<0.005	-	-	-	-	-	<0.005	-	-	-	<0.005	mg/kg	TM17/PM8
PCB 153 #	<0.005	-	-	-	-	-	<0.005	-	-	-	<0.005	mg/kg	TM17/PM8
PCB 180 #	<0.005	-	-	-	-	-	<0.005	-	-	-	<0.005	mg/kg	TM17/PM8
Total 7 PCBs #	<0.035	-	-	-	-	-	<0.035	-	-	-	<0.035	mg/kg	TM17/PM8
Natural Moisture Content	14.5	16.0	29.1	15.8	14.1	24.8	14.1	21.8	20.1	16.8	<0.1	%	PM4/PM0

Please see attached notes for all abbreviations and acronyms

Element Materials Technology

Client Name: Waterman Infrastructure & Environment Limited
Reference: WIE17125
Location: Trinity Academy, Barnsley
Contact: Andrew Mould
EMT Job No: 20/13332

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	4-6	7-9	10-12	13-15	31-33	37-39	46-48	58-60	61-63	79-81	LOD/LOR	Units	Method No.
Sample ID	TP101	TP101	TP102	TP102	TP104	TP105	TP106	TP107	TP108	TP110			
Depth	0.50	1.50	0.10	0.50	0.60	0.10	0.60	1.00	0.10	1.00			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	24/09/2020	24/09/2020	24/09/2020	24/09/2020	24/09/2020	24/09/2020	24/09/2020	23/09/2020	23/09/2020	23/09/2020			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020			
Hexavalent Chromium #	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	mg/kg	TM38/PM20
Total Organic Carbon #	7.38	0.16	5.58	1.61	0.72	7.14	1.02	0.55	2.11	0.20	<0.02	%	TM21/PM24
Organic Matter	12.7	0.3	9.6	2.8	1.2	12.3	1.8	0.9	3.6	0.3	<0.2	%	TM21/PM24
pH #	6.58	7.67	5.70	8.00	8.27	7.37	7.93	7.80	7.43	7.22	<0.01	pH units	TM73/PM11

Please see attached notes for all abbreviations and acronyms

Client Name: Waterman Infrastructure & Environment Limited
Reference: WIE17125
Location: Trinity Academy, Barnsley
Contact: Andrew Mould
EMT Job No: 20/13332

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	85-87	91-93									LOD/LOR	Units	Method No.
Sample ID	TP111	TP112											
Depth	0.20	0.20											
COC No / misc													
Containers	V J T	V J T											
Sample Date	23/09/2020	23/09/2020											
Sample Type	Soil	Soil											
Batch Number	1	1											
Date of Receipt	30/09/2020	30/09/2020											
Arsenic #	25.4	28.0									<0.5	mg/kg	TM30/PM15
Barium #	102	125									<1	mg/kg	TM30/PM15
Beryllium	1.4	1.9									<0.5	mg/kg	TM30/PM15
Cadmium #	<0.1	<0.1									<0.1	mg/kg	TM30/PM15
Chromium #	34.4	174.6									<0.5	mg/kg	TM30/PM15
Cobalt #	12.4	17.7									<0.5	mg/kg	TM30/PM15
Copper #	44	43									<1	mg/kg	TM30/PM15
Iron	32510	44370									<20	mg/kg	TM30/PM15
Lead #	100	90									<5	mg/kg	TM30/PM15
Mercury #	0.3	0.1									<0.1	mg/kg	TM30/PM15
Molybdenum #	2.7	3.3									<0.1	mg/kg	TM30/PM15
Nickel #	20.8	24.4									<0.7	mg/kg	TM30/PM15
Selenium #	2	2									<1	mg/kg	TM30/PM15
Vanadium	36	38									<1	mg/kg	TM30/PM15
Water Soluble Boron #	2.0	1.4									<0.1	mg/kg	TM74/PM32
Zinc #	116	116									<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene #	0.08	0.30									<0.04	mg/kg	TM4/PM8
Acenaphthylene	0.11	0.86									<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	0.10									<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	0.19									<0.04	mg/kg	TM4/PM8
Phenanthrene #	0.91	3.10									<0.03	mg/kg	TM4/PM8
Anthracene #	0.30	1.69									<0.04	mg/kg	TM4/PM8
Fluoranthene #	2.36	9.92									<0.03	mg/kg	TM4/PM8
Pyrene #	1.90	8.30									<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	1.15	5.45									<0.06	mg/kg	TM4/PM8
Chrysene #	1.18	4.98									<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	2.09	9.46									<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	1.12	5.32									<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene	0.73	3.76									<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	0.14	0.72									<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	0.69	3.60									<0.04	mg/kg	TM4/PM8
Coronene	0.13	0.74									<0.04	mg/kg	TM4/PM8
PAH 17 Total	12.89	58.49									<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	1.50	6.81									<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	0.59	2.65									<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	91	97									<0	%	TM4/PM8
Methyl Tertiary Butyl Ether #	-	-									<0.002	mg/kg	TM15/PM10
Benzene #	-	-									<0.003	mg/kg	TM15/PM10
Toluene #	-	-									<0.003	mg/kg	TM15/PM10
Ethylbenzene #	-	-									<0.003	mg/kg	TM15/PM10
m/p-Xylene #	-	-									<0.005	mg/kg	TM15/PM10

Client Name: Waterman Infrastructure & Environment Limited
Reference: WIE17125
Location: Trinity Academy, Barnsley
Contact: Andrew Mould
EMT Job No: 20/13332

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Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	85-87	91-93									LOD/LOR	Units	Method No.
Sample ID	TP111	TP112											
Depth	0.20	0.20											
COC No / misc													
Containers	V J T	V J T											
Sample Date	23/09/2020	23/09/2020											
Sample Type	Soil	Soil											
Batch Number	1	1											
Date of Receipt	30/09/2020	30/09/2020											
o-Xylene #	-	-									<0.003	mg/kg	TM15/PM10
Surrogate Recovery Toluene D8	-	-									<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	-	-									<0	%	TM15/PM10
TPH CWG													
Aliphatics													
>C5-C6 #	<0.1 SV	-									<0.1	mg/kg	TM36/PM12
>C6-C8 #	<0.1 SV	-									<0.1	mg/kg	TM36/PM12
>C8-C10	<0.1 SV	-									<0.1	mg/kg	TM36/PM12
>C10-C12 #	<0.2	-									<0.2	mg/kg	TM5/PM8/PM16
>C12-C16 #	<4	-									<4	mg/kg	TM5/PM8/PM16
>C16-C21 #	<7	-									<7	mg/kg	TM5/PM8/PM16
>C21-C35 #	<7	-									<7	mg/kg	TM5/PM8/PM16
>C35-C44	<7	-									<7	mg/kg	TM5/PM8/PM16
Total aliphatics C5-44	<26	-									<26	mg/kg	TM5/TM36/PM8/PM12/PM16
Aromatics													
>C5-EC7 #	<0.1 SV	-									<0.1	mg/kg	TM36/PM12
>EC7-EC8 #	<0.1 SV	-									<0.1	mg/kg	TM36/PM12
>EC8-EC10 #	<0.1 SV	-									<0.1	mg/kg	TM36/PM12
>EC10-EC12 #	<0.2	-									<0.2	mg/kg	TM5/PM8/PM16
>EC12-EC16 #	<4	-									<4	mg/kg	TM5/PM8/PM16
>EC16-EC21 #	17	-									<7	mg/kg	TM5/PM8/PM16
>EC21-EC35 #	98	-									<7	mg/kg	TM5/PM8/PM16
>EC35-EC44	<7	-									<7	mg/kg	TM5/PM8/PM16
Total aromatics C5-44	115	-									<26	mg/kg	TM5/TM36/PM8/PM12/PM16
Total aliphatics and aromatics(C5-44)	115	-									<52	mg/kg	TM5/TM36/PM8/PM12/PM16
MTBE #	<0.005 SV	-									<0.005	mg/kg	TM36/PM12
Benzene #	<0.005 SV	-									<0.005	mg/kg	TM36/PM12
Toluene #	<0.005 SV	-									<0.005	mg/kg	TM36/PM12
Ethylbenzene #	<0.005 SV	-									<0.005	mg/kg	TM36/PM12
m/p-Xylene #	<0.005 SV	-									<0.005	mg/kg	TM36/PM12
o-Xylene #	<0.005 SV	-									<0.005	mg/kg	TM36/PM12
PCB 28 #	-	-									<0.005	mg/kg	TM17/PM8
PCB 52 #	-	-									<0.005	mg/kg	TM17/PM8
PCB 101 #	-	-									<0.005	mg/kg	TM17/PM8
PCB 118 #	-	-									<0.005	mg/kg	TM17/PM8
PCB 138 #	-	-									<0.005	mg/kg	TM17/PM8
PCB 153 #	-	-									<0.005	mg/kg	TM17/PM8
PCB 180 #	-	-									<0.005	mg/kg	TM17/PM8
Total 7 PCBs #	-	-									<0.035	mg/kg	TM17/PM8
Natural Moisture Content	40.5	24.6									<0.1	%	PM4/PM0

Element Materials Technology

Client Name: Waterman Infrastructure & Environment Limited
Reference: WIE17125
Location: Trinity Academy, Barnsley
Contact: Andrew Mould
EMT Job No: 20/13332

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	85-87	91-93											
Sample ID	TP111	TP112											
Depth	0.20	0.20											
COC No / misc													
Containers	V J T	V J T											
Sample Date	23/09/2020	23/09/2020											
Sample Type	Soil	Soil											
Batch Number	1	1											
Date of Receipt	30/09/2020	30/09/2020											
Hexavalent Chromium #	<0.3	<0.3										<0.3	mg/kg	TM38/PM20
Total Organic Carbon #	8.52	10.17										<0.02	%	TM21/PM24
Organic Matter	14.7	17.5										<0.2	%	TM21/PM24
pH #	6.41	7.01										<0.01	pH units	TM73/PM11

Please see attached notes for all abbreviations and acronyms

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Waterman Infrastructure & Environment Limited
Reference: WIE17125
Location: Trinity Academy, Barnsley
Contact: Andrew Mould
EMT Job No: 20/13332

SVOC Report : **Solid**

EMT Sample No.	4-6	46-48											
Sample ID	TP101	TP106											
Depth	0.50	0.60									Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V J T	V J T											
Sample Date	24/09/2020	24/09/2020											
Sample Type	Soil	Soil											
Batch Number	1	1											
Date of Receipt	30/09/2020	30/09/2020									LOD/LOR	Units	Method No.
SVOC MS													
Phenols													
2-Chlorophenol #	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
2-Methylphenol	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
2-Nitrophenol	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
2,4-Dichlorophenol #	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
2,4-Dimethylphenol	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
2,4,5-Trichlorophenol	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
2,4,6-Trichlorophenol	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
4-Chloro-3-methylphenol	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
4-Methylphenol	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
4-Nitrophenol	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
Pentachlorophenol	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
Phenol #	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
PAHs													
2-Chloronaphthalene #	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
2-Methylnaphthalene #	0.07	<0.01									<0.01	mg/kg	TM16/PM8
Phthalates													
Bis(2-ethylhexyl) phthalate	<0.1	<0.1									<0.1	mg/kg	TM16/PM8
Butylbenzyl phthalate	<0.1	<0.1									<0.1	mg/kg	TM16/PM8
Di-n-butyl phthalate	<0.1	<0.1									<0.1	mg/kg	TM16/PM8
Di-n-Octyl phthalate	<0.1	<0.1									<0.1	mg/kg	TM16/PM8
Diethyl phthalate	<0.1	<0.1									<0.1	mg/kg	TM16/PM8
Dimethyl phthalate #	<0.1	<0.1									<0.1	mg/kg	TM16/PM8
Other SVOCs													
1,2-Dichlorobenzene	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
1,2,4-Trichlorobenzene #	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
1,3-Dichlorobenzene	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
1,4-Dichlorobenzene	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
2-Nitroaniline	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
2,4-Dinitrotoluene	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
2,6-Dinitrotoluene	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
3-Nitroaniline	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
4-Bromophenylphenylether #	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
4-Chloroaniline	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
4-Chlorophenylphenylether	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
4-Nitroaniline	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
Azobenzene	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
Bis(2-chloroethoxy)methane	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
Bis(2-chloroethyl)ether	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
Carbazole	0.03	<0.01									<0.01	mg/kg	TM16/PM8
Dibenzofuran #	0.07	<0.01									<0.01	mg/kg	TM16/PM8
Hexachlorobenzene	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
Hexachlorobutadiene #	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
Hexachlorocyclopentadiene	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
Hexachloroethane	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
Isophorone #	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
N-nitrosodi-n-propylamine #	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
Nitrobenzene #	<0.01	<0.01									<0.01	mg/kg	TM16/PM8
Surrogate Recovery 2-Fluorobiphenyl	122	120									<0	%	TM16/PM8
Surrogate Recovery p-Terphenyl-d14	129	127									<0	%	TM16/PM8

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Waterman Infrastructure & Environment Limited
Reference: WIE17125
Location: Trinity Academy, Barnsley
Contact: Andrew Mould
EMT Job No: 20/13332

VOC Report : **Solid**

EMT Sample No.	4-6	46-48									LOD/LOR	Units	Method No.
Sample ID	TP101	TP106											
Depth	0.50	0.60											
COC No / misc													
Containers	V J T	V J T											
Sample Date	24/09/2020	24/09/2020											
Sample Type	Soil	Soil											
Batch Number	1	1											
Date of Receipt	30/09/2020	30/09/2020											
VOC MS													
Dichlorodifluoromethane	<0.002	<0.002									<0.002	mg/kg	TM15/PM10
Methyl Tertiary Butyl Ether #	<0.002	<0.002									<0.002	mg/kg	TM15/PM10
Chloromethane #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
Vinyl Chloride	<0.002	<0.002									<0.002	mg/kg	TM15_A/PM10
Bromomethane	<0.001	<0.001									<0.001	mg/kg	TM15/PM10
Chloroethane #	<0.002	<0.002									<0.002	mg/kg	TM15/PM10
Trichlorofluoromethane #	<0.002	<0.002									<0.002	mg/kg	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<0.006	<0.006									<0.006	mg/kg	TM15/PM10
Dichloromethane (DCM) #	<0.03	<0.03									<0.03	mg/kg	TM15/PM10
trans-1-2-Dichloroethene #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
1,1-Dichloroethane #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
cis-1-2-Dichloroethene #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
2,2-Dichloropropane	<0.004	<0.004									<0.004	mg/kg	TM15/PM10
Bromochloromethane #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
Chloroform #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
1,1,1-Trichloroethane #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
1,1-Dichloropropene #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
Carbon tetrachloride #	<0.004	<0.004									<0.004	mg/kg	TM15/PM10
1,2-Dichloroethane #	<0.004	<0.004									<0.004	mg/kg	TM15/PM10
Benzene #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
Trichloroethene (TCE) #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
1,2-Dichloropropane #	<0.006	<0.006									<0.006	mg/kg	TM15/PM10
Dibromomethane #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
Bromodichloromethane #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
cis-1-3-Dichloropropene	<0.004	<0.004									<0.004	mg/kg	TM15/PM10
Toluene #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
trans-1-3-Dichloropropene	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
1,1,2-Trichloroethane #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
Tetrachloroethene (PCE) #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
1,3-Dichloropropane #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
Dibromochloromethane #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
1,2-Dibromoethane #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
Chlorobenzene #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
1,1,1,2-Tetrachloroethane #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
Ethylbenzene #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
m/p-Xylene #	<0.005	<0.005									<0.005	mg/kg	TM15/PM10
o-Xylene #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
Styrene	<0.003	<0.003									<0.003	mg/kg	TM15_A/PM10
Bromoform	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
Isopropylbenzene #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
1,1,2,2-Tetrachloroethane #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
Bromobenzene	<0.002	<0.002									<0.002	mg/kg	TM15/PM10
1,2,3-Trichloropropane #	<0.004	<0.004									<0.004	mg/kg	TM15/PM10
Propylbenzene #	<0.004	<0.004									<0.004	mg/kg	TM15/PM10
2-Chlorotoluene	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
1,3,5-Trimethylbenzene #	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
4-Chlorotoluene	<0.003	<0.003									<0.003	mg/kg	TM15/PM10
tert-Butylbenzene #	<0.005	<0.005									<0.005	mg/kg	TM15/PM10
1,2,4-Trimethylbenzene #	<0.006	<0.006									<0.006	mg/kg	TM15/PM10
sec-Butylbenzene #	<0.004	<0.004									<0.004	mg/kg	TM15/PM10
4-Isopropyltoluene #	<0.004	<0.004									<0.004	mg/kg	TM15/PM10
1,3-Dichlorobenzene #	<0.004	<0.004									<0.004	mg/kg	TM15/PM10
1,4-Dichlorobenzene #	<0.004	<0.004									<0.004	mg/kg	TM15/PM10
n-Butylbenzene #	<0.004	<0.004									<0.004	mg/kg	TM15/PM10
1,2-Dichlorobenzene #	<0.004	<0.004									<0.004	mg/kg	TM15/PM10
1,2-Dibromo-3-chloropropane #	<0.004	<0.004									<0.004	mg/kg	TM15/PM10
1,2,4-Trichlorobenzene #	<0.007	<0.007									<0.007	mg/kg	TM15/PM10
Hexachlorobutadiene	<0.004	<0.004									<0.004	mg/kg	TM15/PM10
Naphthalene	<0.027	<0.027									<0.027	mg/kg	TM15/PM10
1,2,3-Trichlorobenzene #	<0.007	<0.007									<0.007	mg/kg	TM15/PM10
Surrogate Recovery Toluene D8	86	102									<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	66	84									<0	%	TM15/PM10

Please see attached notes for all abbreviations and acronyms

Client Name: Waterman Infrastructure & Environment Limited
Reference: WIE17125
Location: Trinity Academy, Barnsley
Contact: Andrew Mould

Note:

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level less than 0.1%, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Date Of Analysis	Analysis	Result
20/13332	1	TP101	0.50	6	12/10/2020	**General Description (Bulk Analysis)**	Soil/Stones
					12/10/2020	**Asbestos Fibres**	NAD
					12/10/2020	**Asbestos ACM**	NAD
					12/10/2020	**Asbestos Type**	NAD
					12/10/2020	**Asbestos Level Screen**	NAD
20/13332	1	TP102	0.10	12	12/10/2020	**General Description (Bulk Analysis)**	Soil/Stones
					12/10/2020	**Asbestos Fibres**	NAD
					12/10/2020	**Asbestos ACM**	NAD
					12/10/2020	**Asbestos Type**	NAD
					12/10/2020	**Asbestos Level Screen**	NAD
20/13332	1	TP102	0.50	15	12/10/2020	**General Description (Bulk Analysis)**	Soil/Stones
					12/10/2020	**Asbestos Fibres**	NAD
					12/10/2020	**Asbestos ACM**	NAD
					12/10/2020	**Asbestos Type**	NAD
					12/10/2020	**Asbestos Level Screen**	NAD
20/13332	1	TP104	0.60	33	12/10/2020	**General Description (Bulk Analysis)**	Soil/Stones
					12/10/2020	**Asbestos Fibres**	NAD
					12/10/2020	**Asbestos ACM**	NAD
					12/10/2020	**Asbestos Type**	NAD
					12/10/2020	**Asbestos Level Screen**	NAD
20/13332	1	TP105	0.10	39	12/10/2020	**General Description (Bulk Analysis)**	Soil/Stones
					12/10/2020	**Asbestos Fibres**	NAD
					12/10/2020	**Asbestos ACM**	NAD
					12/10/2020	**Asbestos Type**	NAD
					12/10/2020	**Asbestos Level Screen**	NAD
20/13332	1	TP106	0.60	48	12/10/2020	**General Description (Bulk Analysis)**	soil-stones
					12/10/2020	**Asbestos Fibres**	NAD
					12/10/2020	**Asbestos ACM**	NAD
					12/10/2020	**Asbestos Type**	NAD
					12/10/2020	**Asbestos Level Screen**	NAD
20/13332	1	TP108	0.10	63	12/10/2020	**General Description (Bulk Analysis)**	soil.stones
					12/10/2020	**Asbestos Fibres**	NAD
					12/10/2020	**Asbestos ACM**	NAD

Client Name: Waterman Infrastructure & Environment Limited
Reference: WIE17125
Location: Trinity Academy, Barnsley
Contact: Andrew Mould

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Date Of Analysis	Analysis	Result
20/13332	1	TP108	0.10	63	12/10/2020	**Asbestos Type**	NAD
					12/10/2020	**Asbestos Level Screen**	NAD
20/13332	1	TP110	1.00	81	12/10/2020	**General Description (Bulk Analysis)**	soil.stones
					12/10/2020	**Asbestos Fibres**	NAD
					12/10/2020	**Asbestos ACM**	NAD
					12/10/2020	**Asbestos Type**	NAD
					12/10/2020	**Asbestos Level Screen**	NAD
20/13332	1	TP111	0.20	87	12/10/2020	**General Description (Bulk Analysis)**	Soil/Stones
					12/10/2020	**Asbestos Fibres**	NAD
					12/10/2020	**Asbestos ACM**	NAD
					12/10/2020	**Asbestos Type**	NAD
					12/10/2020	**Asbestos Level Screen**	NAD
20/13332	1	TP112	0.20	93	12/10/2020	**General Description (Bulk Analysis)**	soil-stones
					12/10/2020	**Asbestos Fibres**	NAD
					12/10/2020	**Asbestos ACM**	NAD
					12/10/2020	**Asbestos Type**	NAD
					12/10/2020	**Asbestos Level Screen**	NAD

Client Name: Waterman Infrastructure & Environment Limited

Matrix : Solid

Reference: WIE17125

Location: Trinity Academy, Barnsley

Contact: Andrew Mould

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
20/13332	1	TP107	1.00	58-60	PAH	Sample holding time exceeded
20/13332	1	TP108	0.10	61-63	PAH	Sample holding time exceeded
20/13332	1	TP110	1.00	79-81	PAH	Sample holding time exceeded
20/13332	1	TP111	0.20	85-87	PAH	Sample holding time exceeded
20/13332	1	TP112	0.20	91-93	PAH	Sample holding time exceeded

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.

Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 20/13332

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x5 Dilution

EMT Job No: 20/13332

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details			AR	Yes
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM16	Modified USEPA 8270D v5:2014. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM16	Modified USEPA 8270D v5:2014. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes

EMT Job No: 20/13332

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM17	Modified US EPA method 8270D v5:2014. Determination of specific Polychlorinated Biphenyl congeners by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.			AD	Yes
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.	Yes		AD	Yes
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.			AD	Yes
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE re	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE re	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993 (comparabl	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AR	Yes
TM65	Asbestos Bulk Identification method based on HSG 248 First edition (2006)	PM42	Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No

EMT Job No: 20/13332

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM74	Analysis of water soluble boron (20:1 extract) by ICP-OES.	PM32	Hot water soluble boron is extracted from dried and ground samples using a 20:1 ratio.	Yes		AD	Yes
TM15_A	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds, Vinyl Chloride & Styrene by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes

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Waterman Infrastructure & Environment Limited
11 Peter Street
Manchester
M2 5QR

Attention :	Andrew Mould
Date :	27th October, 2020
Your reference :	WIE17125
Our reference :	Test Report 20/13332 Batch 1 Schedule B
Location :	Trinity Academy, Barnsley
Date samples received :	30th September, 2020
Status :	Final report
Issue :	1

Thirty nine samples were received for analysis on 30th September, 2020 of which eight were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Simon Gomery BSc
Project Manager

Element Materials Technology

Client Name: Waterman Infrastructure & Environment Limited
Reference: WIE17125
Location: Trinity Academy, Barnsley
Contact: Andrew Mould
EMT Job No: 20/13332

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	4-6	10-12	13-15	31-33	37-39	46-48	79-81	91-93					
Sample ID	TP101	TP102	TP102	TP104	TP105	TP106	TP110	TP112					
Depth	0.50	0.10	0.50	0.60	0.10	0.60	1.00	0.20			Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T					
Sample Date	24/09/2020	24/09/2020	24/09/2020	24/09/2020	24/09/2020	24/09/2020	23/09/2020	23/09/2020					
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Batch Number	1	1	1	1	1	1	1	1			LOD/LOR	Units	Method No.
Date of Receipt	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020	30/09/2020					
Gross Calorific Value*	2746	1808	1869	<100	1418	113	<100	1427				kJ/kg	Subcontracted

Client Name: Waterman Infrastructure & Environment Limited
Reference: WIE17125
Location: Trinity Academy, Barnsley
Contact: Andrew Mould

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 20/13332						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 20/13332

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

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DILUTIONS

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ND	None Detected (usually refers to VOC and/SVOC TICs).
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SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
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ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

EMT Job No: 20/13332

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
Subcontracted	See attached subcontractor report for accreditation status and provider.						

Job No	WIE17125-100
Site Name	Trinity Academy, Barnsley

END USE SCENARIO

Residential without plant uptake (1% SOM)

				Sample I.D	4-6	7-9	10-12	13-15	31-33	37-39	46-48	58-60	61-63	79-81	85-87	91-93
					TP101	TP101	TP102	TP102	TP104	TP105	TP106	TP107	TP108	TP110	TP111	TP112
				Depth	0.50	1.50	0.10	0.50	0.60	0.10	0.60	1.00	0.10	1.00	0.20	0.20
				Strata	MG	Glacial Till	MG	MG	MG	MG	MG	Glacial Till	MG	MG	MG	MG
In-organics	Metals	Arsenic	**40.00**	mg/kg	20.00	3.00	19.20	8.30	9.60	24.00	9.10	9.50	14.40	7.80	25.40	28.00
		Barium		mg/kg	82.00	52.00	82.00	62.00	62.00	114.00	56.00	86.00	79.00	60.00	102.00	125.00
		Beryllium	**1.70**	mg/kg	1.50	1.20	1.30	1.30	1.50	1.70	1.50	1.30	1.50	**2.30**	1.40	**1.90**
		Boron (Water Soluble)	**11000.00**	mg/kg	0.60	0.40	0.80	0.40	0.70	0.80	0.60	0.50	0.60	0.70	2.00	1.40
		Cadmium	**150.00**	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
		Chromium (Total)	**910.00**	mg/kg	27.80	39.90	250.60	22.60	56.00	29.50	76.00	46.60	29.10	33.90	34.40	174.60
		Chromium (VI)	**21.00**	mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
		Cobalt	**0.00**	mg/kg	16.00	9.30	15.10	14.30	14.40	18.90	18.40	22.80	26.50	14.00	12.40	17.70
		Copper	**7100.00**	mg/kg	34.00	26.00	36.00	24.00	34.00	43.00	23.00	22.00	26.00	31.00	44.00	43.00
		Iron		mg/kg	41560.00	35020.00	33750.00	42240.00	43570.00	44710.00	49180.00	47860.00	43170.00	69690.00	32510.00	44370.00
		Lead	**310.00**	mg/kg	71.00	16.00	72.00	24.00	24.00	67.00	22.00	24.00	47.00	27.00	100.00	90.00
		Mercury	**1.20**	mg/kg	0.10	<0.1	0.20	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.30	0.10
		Molybdenum		mg/kg	1.70	1.20	2.90	0.50	0.50	1.90	0.50	2.30	1.10	0.30	2.70	3.30
		Nickel	**180.00**	mg/kg	22.20	23.20	27.00	24.60	30.70	25.20	27.00	25.00	25.70	27.90	20.80	24.40
		Selenium	**430.00**	mg/kg	2.00	<1	2.00	<1	1.00	2.00	2.00	2.00	1.00	1.00	2.00	2.00
		Vanadium	**1200.00**	mg/kg	33.00	24.00	34.00	26.00	29.00	39.00	30.00	34.00	34.00	38.00	36.00	38.00
		Zinc	**40000.00**	mg/kg	106.00	81.00	107.00	98.00	112.00	128.00	105.00	95.00	104.00	93.00	116.00	116.00
	Non-metals	Cyanide (Free)	**0.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Complex Cyanide	**0.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Total Cyanide		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Thiocyanate	**0.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Elemental Sulphur		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Sulphate (total) / Acid Soluble Sulphate		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Water Soluble Sulphate (SO4)		mg/l	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Sulphide		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Chloride		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Exchangeable Ammonium2		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Nitrate		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Organics	TPH	TPH (C8-C40)		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		EPH (DRO) C10-C24		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		C8-C10		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		C10-C12		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		C12-C16		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		C16-C21		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		C21-C35		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		TPH description / Interpretation		N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TPH CWG	Aliphatic EC5 - EC6	**42.00**	mg/kg	<0.1	0.00	0.00	<0.1	<0.1	<0.1	<0.1	0.00	0.00	<0.1	<0.1	0.00
		Aliphatic EC6 - EC8	**100.00**	mg/kg	<0.1	0.00	0.00	<0.1	<0.1	<0.1	<0.1	0.00	0.00	<0.1	<0.1	0.00
		Aliphatic EC8-EC10	**27.00**	mg/kg	<0.1	0.00	0.00	<0.1	<0.1	<0.1	<0.1	0.00	0.00	<0.1	<0.1	0.00
		Aliphatic EC10-EC12	**130.00**	mg/kg	<0.2	0.00	0.00	<0.2	<0.2	<0.2	<0.2	0.00	0.00	<0.2	<0.2	0.00
		Aliphatic EC12-EC16	**1100.00**	mg/kg	<4	0.00	0.00	<4	<4	<4	<4	0.00	0.00	<4	<4	0.00
		Aliphatic EC16-EC21	**65000.00**	mg/kg	<7	0.00	0.00	<7	<7	<7	<7	0.00	0.00	<7	<7	0.00
		Aliphatic EC21-EC35	**65000.00**	mg/kg	<7	0.00	0.00	<7	<7	<7	<7	0.00	0.00	<7	<7	0.00
		Aliphatic EC35-EC44		mg/kg	<7	0.00	0.00	<7	<7	<7	<7	0.00	0.00	<7	<7	0.00
		Total Aliphatics (EC5 - EC44)		mg/kg	<26	0.00	0.00	<26	<26	<26	<26	0.00	0.00	<26	<26	0.00
		Aromatic EC5-EC7	**370.00**	mg/kg	<0.1	0.00	0.00	<0.1	<0.1	<0.1	<0.1	0.00	0.00	<0.1	<0.1	0.00
		Aromatic EC7-EC8	**860.00**	mg/kg	<0.1	0.00	0.00	<0.1	<0.1	<0.1	<0.1	0.00	0.00	<0.1	<0.1	0.00
		Aromatic EC8-EC10	**47.00**	mg/kg	<0.1	0.00	0.00	<0.1	<0.1	<0.1	<0.1	0.00	0.00	<0.1	<0.1	0.00
		Aromatic EC10-EC12	**250.00**	mg/kg	<0.2	0.00	0.00	<0.2	<0.2	<0.2	<0.2	0.00	0.00	<0.2	<0.2	0.00
		Aromatic EC12-EC16	**1800.00**	mg/kg	<4	0.00	0.00	<4	<4	<4	<4	0.00	0.00	<4	<4	0.00
		Aromatic EC16-EC21	**1900.00**	mg/kg	<7	0.00	0.00	<7	<7	<7	<7	0.00	0.00	<7	17.00	0.00
		Aromatic EC21-EC35	**1900.00**	mg/kg	<7	0.00	0.00	<7	<7	<7	<7	0.00	0.00	<7	98.00	0.00
		Aromatic EC35-EC44	**1900.00**	mg/kg	<7	0.00	0.00	<7	<7	<7	<7	0.00	0.00	<7	<7	0.00
		Total Aromatics (EC5-EC44)		mg/kg	<26	0.00	0.00	<26	<26	<26	<26	0.00	0.00	<26	115.00	0.00
		Total Aliphatics and Aromatics (EC5-EC35)		mg/kg	<52	0.00	0.00	<52	<52	<52	<52	0.00	0.00	<52	115.00	0.00
	BTEX	GRO (C5-C10)		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		GRO (C10-C12)		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Benzene	**0.38**	mg/kg	<0.003	0.00	0.00	<0.005	<0.005	<0.005	0.00	0.00	0.00	<0.005	<0.005	0.00
		Toluene	**880.00**	mg/kg	<0.003	0.00	0.00	<0.005	<0.005	<0.005	0.00	0.00	0.00	<0.005	<0.005	0.00
		Ethyl Benzene	**83.00**	mg/kg	<0.003	0.00	0.00	<0.005	<0.005	<0.005	0.00	0.00	0.00	<0.005	<0.005	0.00
		Xylene - m	**82.00**	mg/kg	<0.005	0.00	0.00	<0.005	<0.005	<0.005	0.00	0.00	0.00	<0.005	<0.005	0.00
		Xylene - o	**88.00**	mg/kg	<0.003	0.00	0.00	<0.005	<0.005	<0.005	0.00	0.00	0.00	<0.005	<0.005	0.00
		Xylene - p	**79.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		MTBE	**0.00**	mg/kg	<0.002	0.00	0.00	<0.005	<0.005	<0.005	0.00	0.00	0.00	<0.005	<0.005	0.00
	16 US EPA PAHs (GCMS)	Naphthalene	**2.30**	mg/kg	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.08	0.30
		Acenaphthylene	**2900.00**	mg/kg	0.05	<0.03	<0.03	<0.03	<0.03	0.24	<0.03	<0.03	0.06	<0.03	0.11	0.86
		Acenaphthene	**3000.00**	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.10
		Fluorene	**2800.00**	mg/kg	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.19
		Phenanthrene	**1300.00**	mg/kg	0.18	<0.03	0.13	0.03	<0.03	0.37	<0.03	<0.03	0.29	<0.03	0.91	3.10
		Anthracene	**31000.00**	mg/kg	0.06	<0.04	<0.04	<0.04	<0.04	0.31	<0.04	<0.04	0.12	<0.04	0.30	1.69
		Fluoranthene	**1500.00**	mg/kg	0.37	<0.03	0.30	0.06	<0.03	1.47	<0.03	<0.03	0.77	<0.03	2.36	9.92
		Pyrene	**3700.00**	mg/kg	0.31	<0.03	0.25	0.06	<0.03	1.34	<0.03	<0.03	0.64	<0.03	1.90	8.30
		Benzo(a)anthracene	**11.00**	mg/kg	0.24	<0.06	0.19	<0.06	<0.06	1.01	<0.06	<0.06	0.46	<0.06	1.15	5.45
		Chrysene	**30.00**	mg/kg	0.23	<0.02	0.17	0.05	<0.02	1.02	<0.02	<0.02	0.42	<0.02	1.18	4.98
		Benzo(b)fluoranthene	**3.90**	mg/kg	0.28	<0.05	0.22	0.06	<0.05	1.38	<0.05	<0.05	0.53	<0.05	1.50	**6.81**
		Benzo(k)fluoranthene	**110.00**	mg/kg	0.11	<0.02	0.08	0.02	<0.02	0.53	<0.02	<0.02	0.20	<0.02	0.59	2.65
		Benzo(a)pyrene	**3.20**	mg/kg	0.21	<0.04	0.17	0.05	<0.04	1.09	<0.04	<0.04	0.38	<0.04	1.12	**5.32**
		Indeno(1,2,3-cd)pyrene	**45.00**	mg/kg	0.16	<0.04	0.12	<0.04	<0.04	0.64	<0.04	<0.04	0.25	<0.04	0.73	3.76
		Di-benzo(a.h.)anthracene	**0.31**	mg/kg	<0.04	<0.04	<0.04	<0.04	<0.04	0.11	<0.04	<0.04	0.05	<0.04	0.14	**0.72**
		Benzo(g.h.i.) Perylene	**360.00**	mg/kg	0.15	<0.04	0.10	<0.04	<0.04	0.64	<0.04	<0.04	0.25	<0.04	0.69	3.60
	Phenols	Phenols		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Phenol	**750.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Pentachlorophenol (PCP)	**27.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		2,4-Dimethylphenol		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Total Cresols (2-, 3- and 4-methylphenol)		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Chlorinated Aliphatcs	1,1,2,2 Tetrachloroethane	**3.90**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		1,1,1,2 Tetrachloroethane	**1.50**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		1,1,1 Trichloroethane	**9.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Trichloroethane		mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Tetrachloromethane (Carbon Tetrachloride)	**0.03**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		1,2- Dichloroethane	**0.01**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Chloroethene (Vinyl chloride)	**0.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Trichloroethene	**0.02**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Tetrachloroethene	**0.00**	mg/kg	0.00	#REF!	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Trichloromethane (Chloroform)	**1.20**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Sum of PCDDs, PCDFs and dioxins like PCBs	**0.18**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hydrocar bons	Isopropylbenzene	**12.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Propylbenzene	**40.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Styrene	**35.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Bromobenzene	**0.91**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Halogenated Organics	1,1,2 Trichloroethane	**0.88**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		1,1-Dichloroethane	**2.50**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		1,1-Dichloroethene	**0.23**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		1,2,4-Trimethylbenzene	**0.41**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		1,2-Dichloropropane	**0.02**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		2-Chloronaphthalene	**3.80**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Bromodichloromethane	**0.02**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Bromoform	**5.20**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Chloroethane	**8.40**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Chloromethane	**0.01**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Cis 1,2 Dichloroethene	**0.12**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Dichloromethane	**2.10**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Hexachloroethane	**0.22**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Trans 1,2 Dichloroethene	**0.19**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phthalates	Bis (2-ethylhexyl) phthalate	**2700.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Butyl benzyl phthalate	**42000.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Diethyl Phthalate	**1800.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Di-n-butyl phthalate	**450.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Di-n-octyl phthalate	**3400.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other Organics	Biphenyl	**220.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		2,4-Dinitrotoluene	**170.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		2,6-Dinitrotoluene	**78.00**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Tributyl tin oxide	**1.40**	mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
General	Soil Properties	S.O.M % (Calc)		%	12.70	0.30	9.60	2.80	1.20	12.30	1.80	0.90	3.60	0.30	14.70	17.50
		Total Organic Carbon		% M/M	7.38	0.16	5.58	1.61	0.72	7.14	1.02	0.55	2.11	0.20	8.52	10.17
		pH		pH units	6.58	7.67	5.70	8.00	8.27	7.37	7.93	7.80	7.43	7.22	6.41	7.01
		Moisture Content		%	14.50	16.00	29.10	15.80	14.10	24.80	14.10	21.80	20.10	16.80	40.50	24.60
		Loss on Ignition		%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Calorific Value	**2.00**	MJ/kg	**2.75**	0.00	1.81	1.87	<0.1	1.42	0.11	0.00	0.00	<0.1	0.00	1.43
	Soil Scree ns	Asbestos (screening)	**0.00**	Visual	NAD	0.00	NAD	NAD	NAD	NAD	NAD	0.00	NAD	NAD	NAD	NAD

Appendix F Environmental Receptors

The Contaminated Land Statutory Guidance has a four category system that considers harm to human health, controlled waters, flora and fauna, property, livestock and crops. The Categories are broadly defined as follows:

1 Contaminated Land – similar to land where it is known that significant harm has been caused or significant harm is being caused

2 Contaminated Land – no significant harm being caused but there is a significant possibility for significant harm to be caused in the future

3 Not Contaminated Land – there may be harm being caused but no significant possibility for significant harm to be caused in the future

4 Not Contaminated Land – no contaminant linkage, normal levels of contaminants and no significant harm being caused and no significant possibility for significant harm to be caused in the future.

Table F.1: Significant pollution to controlled waters

Pollution of controlled waters

Under Section 78A(9) of Part 2A the term "pollution of controlled waters means the entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter. The term "controlled waters" in relation to England has the same meaning as in Part 3 of the Water Resources Act 1991, except that "ground waters" does not include water contained in underground strata but above the saturation zones. (Paragraph 4.36)

Given that the Part 2A regime seeks to identify and deal with significant pollution (rather than lesser levels of pollution), the local authority should seek to focus on pollution which: (i) may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems; (ii) which may result in damage to material property; or (iii) which may impair or interfere with amenities and other legitimate uses of the environment. (Paragraph 4.37)

Significant pollution of controlled waters

Paragraph 4.38 states that "The following types of pollution should be considered to constitute significant pollution of controlled waters:

(a) Pollution equivalent to "environmental damage" to surface water or groundwater as defined by The Environmental Damage (Prevention and Remediation) Regulations 2009, but which cannot be dealt with under those Regulations.

(b) Inputs resulting in deterioration of the quality of water abstracted, or intended to be used in the future, for human consumption such that additional treatment would be required to enable that use.

(c) A breach of a statutory surface water Environment Quality Standard, either directly or via a groundwater pathway.

(d) Input of a substance into groundwater resulting in a significant and sustained upward trend in concentration of contaminants (as defined in Article 2(3) of the Groundwater Daughter Directive (2006/118/EC)5)".

Paragraph 4.39 states that “In some circumstances, the local authority may consider that the following types of pollution may constitute significant pollution: (a) significant concentrations6 of hazardous substances or non-hazardous pollutants in groundwater; or (b) significant concentrations of priority hazardous substances, priority substances or other specific polluting substances in surface water; at an appropriate, risk based compliance point. The local authority should only conclude that pollution is significant if it considers that treating the land as contaminated land would be in accordance with the broad objectives of the regime as described in Section 1 (of the Contaminated Land Statutory Guidance). This would normally mean that the authority should conclude that less serious forms of pollution are not significant. In such cases the authority should consult the Environment Agency”.

The following types of circumstance should not be considered to be contaminated land on water pollution grounds:

(a) The fact that substances are merely entering water and none of the conditions for considering that significant pollution is being caused set out in paragraphs 4.38 and 4.39 above are being met.

(b) The fact that land is causing a discharge that is not discernible at a location immediately downstream or down-gradient of the land (when compared to upstream or up-gradient concentrations).

(c) Substances entering water in compliance with a discharge authorised under the Environmental Permitting Regulations.

Significant pollution of controlled waters is being caused

In deciding whether significant pollution of controlled waters is being caused, the local authority should consider that this test is only met where it is satisfied that the substances in question are continuing to enter controlled waters; or that they have already entered the waters and are likely to do so again in such a manner that past and likely future entry in effect constitutes ongoing pollution. For these purposes, the local authority should:

(a) Regard substances as having entered controlled waters where they are dissolved or suspended in those waters, or (if they are immiscible with water) they have direct contact with those waters on or beneath the surface of the water.

(b) Take the term “continuing to enter” to mean any measurable entry of the substance(s) into controlled waters additional to any which has already occurred.

(c) Take the term “likely to do so again” to mean more likely than not to occur again.

Land should not be determined as contaminated land on grounds that significant pollution of controlled waters is being caused where: (a) the relevant substance(s) are already present in controlled waters; (b) entry into controlled waters of the substance(s) from land has ceased; and (c) it is not likely that further entry will take place.

Significant Possibility of Significant Pollution of Controlled Waters

In deciding whether or not a significant possibility of significant pollution of controlled waters exists, the local authority should first understand the possibility of significant pollution of controlled waters posed by the land, and the levels of certainty/uncertainty attached to that understanding, before it goes on to decide whether or not that possibility is significant. The term “possibility of significant pollution of controlled waters” means the estimated likelihood that significant pollution of controlled waters might occur. In assessing the possibility of significant pollution of controlled waters from land, the local authority should act in accordance with the advice on risk assessment in Section 3 and the guidance in this sub-section.

In deciding whether the possibility of significant pollution of controlled waters is significant the local authority should bear in mind that Part 2A makes the decision a positive legal test. In other words, for particular land to meet the test the authority needs reasonably to believe that there is a significant possibility of such pollution, rather than to demonstrate that there is not.

Before making its decision on whether a given possibility of significant pollution of controlled waters is significant, the local authority should consider:

(a) The estimated likelihood that the potential significant pollution of controlled waters would become manifest; the strength of evidence underlying the estimate; and the level of uncertainty underlying the estimate.

(b) The estimated impact of the potential significant pollution if it did occur. This should include consideration of whether the pollution would be likely to cause a breach of European water legislation, or make a major contribution to such a breach.

(c) The estimated timescale over which the significant pollution might become manifest.

(d) The authority's initial estimate of whether remediation is feasible, and if so what it would involve and the extent to which it might provide a solution to the problem; how long it would take; what benefit it would be likely to bring; and whether the benefits would outweigh the costs and any impacts on local society or the environment from taking action

Reproduced from DEFRA (2012) Contaminated Land Statutory Guidance pursuant to section 78YA of the Environmental Protection Act 1990 as amended by Section 57 of the Environment Act 1995.

Table F.2: Significant harm to human health, ecological systems and property

Relevant types of receptor	Significant harm	Significant possibility of significant harm
Human beings	The following health effects should always be considered to constitute significant harm to human health: death; life threatening diseases (eg cancers); other diseases likely to have serious impacts on health; serious injury; birth defects; and impairment of reproductive functions. Other health effects may be considered by the local authority to constitute significant harm. For example, a wide range of conditions may or may not constitute significant harm (alone or in combination) including: physical injury; gastrointestinal disturbances; respiratory tract effects; cardio-vascular effects; central nervous system effects; skin ailments; effects on organs such as the liver or kidneys; or a wide range of other health impacts. In deciding whether or not a particular form of harm is significant harm, the local authority should consider the seriousness of the	The risk posed by one or more relevant contaminant linkage(s) relating to the land comprises: (a) The estimated likelihood that significant harm might occur to an identified receptor, taking account of the current use of the land in question. (b) The estimated impact if the significant harm did occur – i.e. the nature of the harm, the seriousness of the harm to any person who might suffer it, and (where relevant) the extent of the harm in terms of how many people might suffer it. In estimating the likelihood that a specific form of significant harm might occur the local authority should, among other things, consider: (a) The estimated probability that

Relevant types of receptor	Significant harm	Significant possibility of significant harm
	harm in question: including the impact on the health, and quality of life, of any person suffering the harm; and the scale of the harm. The authority should only conclude that harm is significant if it considers that treating the land as contaminated land would be in accordance with the broad objectives of the regime as described in Section 1 of the Contaminated Land Statutory Guidance.	the significant harm might occur: (i) if the land continues to be used as it is currently being used; and (ii) where relevant, if the land were to be used in a different way (or ways) in the future having regard to the guidance on "current use" in Section 3 of the Contaminated Land Statutory Guidance. (b) The strength of evidence underlying the risk estimate. It should also consider the key assumptions on which the estimate of likelihood is based, and the level of uncertainty underlying the estimate.
Any ecological system, or living organism forming part of such a system, within a location which is: • a site of special scientific interest (under section 28 of the Wildlife and Countryside Act (WCA) 1981 (as amended) and Part 4 of the Natural Environment and Rural Communitites Act 2006 (as amended)); • a national nature reserve (under Section 35 of the WCA 1981 (as amended)); • a marine nature reserve (under Section 36 of the WCA 1981 (as amended)); • an area of special protection for birds (under Section 3 of the WCA 1981 (as amended)); • a "European site" within the meaning of regulation 8 of the Conservation of Habitats and Species Regulations 2010 (as amended); • any habitat or site afforded policy protection under Section 11 of The National Planning Policy Framework (NPPF) on conserving and enhancing the natural environment (i.e. possible Special Areas of Conservation, potential Special	The following types of harm should be considered to be significant harm: • harm which results in an irreversible adverse change, or in some other substantial adverse change, in the functioning of the ecological system within any substantial part of that location; or • harm which significantly affects any species of special interest within that location and which endangers the long-term maintenance of the population of that species at that location. In the case of European sites, harm should also be considered to be significant harm if it endangers the favourable conservation status of natural habitats at such locations or species typically found there. In deciding what constitutes such harm, the local authority should have regard to the advice of Natural England and to the requirements of the Conservation of Habitats and Species Regulations 2010 (as amended).	Conditions would exist for considering that a significant possibility of significant harm exists to a relevant ecological receptor where the local authority considers that: • significant harm of that description is more likely than not to result from the contaminant linkage in question; or • there is a reasonable possibility of significant harm of that description being caused, and if that harm were to occur, it would result in such a degree of damage to features of special interest at the location in question that they would be beyond any practicable possibility of restoration. Any assessment made for these purposes should take into account relevant information for that type of contaminant linkage, particularly in relation to the ecotoxicological effects of the contaminant.

Relevant types of receptor	Significant harm	Significant possibility of significant harm
Protection Areas and listed or proposed Ramsar sites); or • any nature reserve established under Section 21 of the National Parks and Access to the Countryside Act 1949.		
Property in the form of: • crops, including timber • produce grown domestically, or on allotments, for consumption • livestock • other owned or domesticated animals; • wild animals which are the subject of shooting or fishing rights.	For crops, a substantial diminution in yield or other substantial loss in their value resulting from death, disease or other physical damage. For domestic pets, death, serious disease or serious physical damage. For other property in this category, a substantial loss in its value resulting from death, disease or other serious physical damage. The local authority should regard a substantial loss in value as occurring only when a substantial proportion of the animals or crops are dead or otherwise no longer fit for their intended purpose. Food should be regarded as being no longer fit for purpose when it fails to comply with the provisions of the Food Safety Act 1990. Where a diminution in yield or loss in value is caused by a contaminant linkage, a 20% diminution or loss should be regarded as a benchmark for what constitutes a substantial diminution or loss. In the Guidance states that this description of significant harm is referred to as an "animal or crop effect".	Conditions would exist for considering that a significant possibility of significant harm exists to the relevant types of receptor where the local authority considers that significant harm is more likely than not to result from the contaminant linkage in question, taking into account relevant information for that type of contaminant linkage, particularly in relation to the ecotoxicological effects of the contaminant.
Property in the form of buildings. For this purpose 'building' means any structure or erection and any part of a building, including any part below ground level, but does not include plant or machinery comprised in a building, or buried services such as sewers, water pipes or electricity cables.	Structural failure, substantial damage or substantial interference with any right of occupation. The local authority should regard substantial damage or substantial interference as occurring when any part of the building ceases to be capable of being used for the purpose for which it is or was intended. In the case of a scheduled Ancient Monument, substantial damage should be regarded as occurring when the damage significantly impairs the historic, architectural, traditional, artistic or archaeological interest by reason of which the monument was scheduled.	Conditions would exist for considering that a significant possibility of significant harm exists to the relevant types of receptor where the local authority considers that significant harm is more likely than not to result from the contaminant linkage in question during the expected economic life of the building (or in the case of a scheduled Ancient Monument the foreseeable future), taking into account relevant information for that type of contaminant linkage.

Relevant types of receptor	Significant harm	Significant possibility of significant harm
	The Guidance states that this description of significant harm is referred to as a 'building effect'.	

Reproduced from DEFRA (2012) Contaminated Land Statutory Guidance pursuant to section 78YA of the Environmental Protection Act 1990 as amended by Section 57 of the Environment Act 1995.

Appendix G Generic Assessment Criteria

Human Health Generic Assessment Criteria

Background

In order to be able to make inference on whether the results obtained during the site investigation (e.g. chemical concentrations in soils, waters and gas) point to the presence of a potential hazard to human health, it is necessary to distinguish between the results, reflecting background and/or insignificantly elevated levels of contamination (i.e. with negligible potential to cause harm or pollution) and the results with significantly elevated concentrations (i.e. with significant potential to cause harm or pollution).

The approach to risk assessment with respect to risks to human health from contaminated land in the UK is set out in the publication Model Procedures for the Management of Land Contamination (CLR11) Environment Agency (2004).

This sets out a tiered approach:

- Preliminary Risk Assessment (e.g. establishing potential contaminant linkages);
- Generic Quantitative Risk Assessment (GQRA) (e.g. comparison of site contaminant concentrations against generic standards and compliance criteria e.g. Soil Guideline Values (SGV) or other Generic Assessment Criteria including an assessment of risk using the source pathway target model); and
- Detailed Quantitative Risk Assessment (DQRA) (e.g. the comparison of contaminant concentrations against site specific assessment criteria).

Preliminary Risk Assessment

This typically encompasses a desk based generation of a conceptual model to establish the potential contaminant linkages associated with the site and any proposed development. Works would typically involve:

- Evaluation of the potential sources of contamination on the site and in the locality and from both a current and historical perspective
- Statutory Consultation;
- Evaluation of a sites geology, hydrology and hydrogeology;
- Site inspection;
- Additional pertinent information as necessary on a site by site basis.

Where works indicate the presence of a potential contaminant linkage further evaluation and potentially site investigation works are necessary to determine the significance of the linkage.

Generic Quantitative Risk Assessment (GQRA)

In August 2008 the Environment Agency (EA) and Department of Environment Food and Rural Affairs (DEFRA) announced the withdrawal of the Contaminated Land Reports CLR7 – 10, CLEA UK (beta) and existing SGV reports as they no-longer fully reflected the revised approach to human health risk assessment.

New partial guidance (in particular Science Reports SR2, SR3 and SR7) and new risk assessment tools (CLEA model version v1.04, v1.05 and currently v1.06) were published in 2009 and these allow environmental practitioners to derive generic and site specific Soil Assessment Criteria (GAC and SAC).

Soil Guideline Values (SGVs)

The EA and DEFRA updated the TOX reports and Soil Guideline Values (SGVs) to reflect the guidance documents published in 2009. SGVs for arsenic, cadmium, nickel, mercury, selenium, BTEX compounds (benzene, toluene, ethylbenzene and xylenes), dioxins, furans and dioxin like PCBs and phenol have been made available.

Since publishing the revised SGVs the CLEA model was updated to version v1.06. The Environment Agency has however confirmed that v1.05 has only a "minor effect on assessment criteria calculated using the CLEA software 1.04" and consequently the GACs derived are considered to remain valid. Environment Agency SGVs generated using v1.04 have also not been updated. Software version v1.06 is identical to v1.05 with some password protection enhancements that in no way affect the GAC values generated.

Owing to the scientific advances since 2009 and in particular toxicological research outputs, less significance is now placed on the SGVs in the hierarchy outlined below.

Category 4 Screening Levels (C4SLs)

Category 4 Screening Levels were generated by Contaminated Land: Applications in Real Environments (CL:AIRE) on behalf of DEFRA and made available to the public in April 2014. Category 4 Screening Levels were derived in response to policy changes outlined in the recently revised Statutory Guidance (SG) for Part 2A of the Environmental Protection Act 1990 (Part 2A). Part 2A was originally introduced to ensure that the risks from land contamination to human health, property and the environment are managed appropriately, with the revised SG being designed to address concerns regarding its real-world application. The revised SG presents a new four category system for classifying land under Part 2A, ranging from Category 4, where the level of risk posed is acceptably low, to Category 1, where the level of risk is clearly unacceptable.

The document SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document (March 2014) states that:

The Impact Assessment that accompanied the revised Part 2A Statutory Guidance identified a potential role for new 'Category 4 Screening Levels' in providing a simple test for deciding when land is suitable for use and definitely not contaminated land. It was envisaged that these new screening levels would allow 'low-risk' land to be dismissed from the need for further risk assessment more quickly and easily and allow regulators to focus efforts on the highest-risk land. The C4SLs were proposed to be more pragmatic (whilst still strongly precautionary) compared to existing generic screening levels. It is anticipated that, where they exist, C4SLs will be used as generic screening criteria that can be used within a GQRA, albeit describing a higher level of risk than the currently or previously available SGVs.

Suitable For Use Screening Levels (S4USLs)

In January 2015, Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH) have published updated screening criteria that were derived in line with UK guidance on risk assessment (SR2 and SR3). The resultant screening criteria reflect the industries greater knowledge of the relevant toxicology and further consideration of exposure scenarios as set out in SP1010.

Waterman's Generic Assessment Criteria (GACs)

Waterman have used the following hierarchy for the generic assessment of soils to evaluate Human Health.

- Published Category 4 Screening Values (C4SLs) derived by CL:AIRE on behalf of DEFRA; or in their absence;
- Suitable 4 Use Screening Levels (S4USLs) derived by LQM/CIEH; or in their absence;
- Published Soil Guideline Values (SGVs);
- GAC prepared in accordance with the CLEA v1.04 / v1.06 model by authoritative bodies (e.g. Contaminated Land Applications in Real Environments (CL:AIRE) 2009; and
- Waterman in-house GAC prepared in accordance with the CLEA V1.06 model and associated documents.

Tabulated values of the GACs used are presented overleaf. The references of the sources quoted in the table are:-

- Environment Agency, 2009. CLEA Software, version 1.06;
- DEFRA, Environment Agency, 2004. Model Procedures for the Management of Land Contamination, Contaminated Land Report 11;
- DEFRA, 2014, SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document and appendices;
- LQM / CIEH, 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment;
- Environment Agency, 2009. Human health toxicological assessment of contaminants in soil. Report SC050021/SR2;
- Environment Agency, 2009. Updated technical background to the CLEA model. Report SC050021/SR3;
- Environment Agency, 2008. Compilation of chemical data for priority organic pollutants for derivation of Soil Guideline Values. Report SC050021/SR7; and
- EIC / CL:AIRE, 2010. Soil generic assessment criteria for human health risk assessment.

Detailed Quantitative Risk Assessment (DQRA)

Detailed Quantitative Risk Assessments are undertaken on a site specific basis and full details of the alterations to the CLEA model and generic land use scenarios will be described within the specific reports.

Benzo(a)pyrene Surrogate Marker (SM) Approach

The DEFRA Category 4 Screening Level for B(a)P is based on the surrogate marker approach. In order to utilise the GAC or others based on this approach, the sample assessed must exhibit certain properties that comply with underlying assumptions.

SP1010, Appendix E states:

"The SM approach estimates the toxicity of a mixture of PAHs in an environmental matrix by using toxicity data for a PAH mixture for which the composition is known. Exposure to the SM is assumed to represent exposure to all PAHs in that matrix therefore the toxicity of the SM represents the toxicity of the mixture. In most cases, BaP is chosen as the SM due to its ubiquitous nature and the vast amount of data available and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food (EFSA 2008). However, RIVM considered that 'it would not be suitable to use BaP as a SM for carcinogenic risk assessment of PAH mixtures in soil due to the wide variety in composition of PAH mixtures in Dutch land contamination sites', although little data was provided in the report to support this statement (RIVM 2001). Similarly, the Canadian Council of Ministers of the Environment (CCME) also stated that contaminated soil is likely to contain a diverse range of carcinogenic and non-carcinogenic PAH of varying potency (CCME, 2008).

The SM approach relies on a number of assumptions (HPA 2010).

- *The SM (BaP) must be present in all soil samples.*
- *The profile of the different PAH relative to BaP should be similar in all samples.*
- *The PAH profile in the soil samples should be similar to that used in the pivotal toxicity study on which HBGV was based i.e. the Culp study.*

[sic] To assess the PAH profile in the test soil sample [complies with the assumptions above], the ratio of the seven genotoxic PAHs (benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene and indeno[1,2,3-c,d]pyrene), relative to BaP, should be calculated to ensure it is similar to the test material used in the Culp study (HPA 2010). To be considered sufficiently similar, the ratio relative to BaP should fit within the upper and lower limits (representing an order of magnitude above and below the mean ratio to BaP of test material used in the Culp study). In such cases BaP is considered an adequate SM and the LLTC for BaP may be used in the risk assessment.

If the site falls outside the order of magnitude limits, it may be appropriate to considering a LLTC for groups of surrogate markers, such as groups of 2, 4 or 8 PAHs, as used by EFSA for the evaluation of PAHs in food (EFSA 2008). Expert judgement should be sought in such situations where there is uncertainty as to whether BaP is sufficiently representative (HPA 2010)."

The ratios of the seven genotoxic PAHs relative to B(a)P can be calculated 'by hand' or using LQM's PAH profiling tool.

Generic Quantitative Risk Assessment Criteria

Proposed End Use	units	Residential with plant uptake			Residential without plant uptake			Allotment			Source
Soil Organic Matter Content	%	1	2.5	6	1	2.5	6	1	2.5	6	
Arsenic	mg/kg	37	37	37	40	40	40	49	49	49	DEFRA C4SLs
Antimony	mg/kg				550	550	550				CL:AIRE 2009
Barium	mg/kg				1300	1300	1300				CL:AIRE 2009
Beryllium	mg/kg	1.7	1.7	1.7	1.7	1.7	1.7	35	35	35	LQM S4ULs 2015
Boron (Water Soluble)	mg/kg	290	290	290	11000	11000	11000	45	45	45	LQM S4ULs 2015
Cadmium	mg/kg	22	22	22	150	150	150	3.9	3.9	3.9	DEFRA C4SLs
Chromium (Total)	mg/kg	910	910	910	910	910	910	18000	18000	18000	LQM S4ULs 2015
Chromium (VI)	mg/kg	21	21	21	21	21	21	170	170	170	DEFRA C4SLs
Copper	mg/kg	2400	2400	2400	7100	7100	7100	520	520	520	LQM S4ULs 2015
Lead	mg/kg	200	200	200	310	310	310	80	80	80	DEFRA C4SLs
Mercury	mg/kg	1.2	1.2	1.2	1.2	1.2	1.2	21	21	21	LQM S4ULs 2015
Molybdenum	mg/kg				670	670	670				CL:AIRE 2009
Nickel	mg/kg	130	130	130	180	180	180	53	53	53	LQM S4ULs 2015
Selenium	mg/kg	250	250	250	430	430	430	88	88	88	LQM S4ULs 2015
Vanadium*	mg/kg	410	410	410	1200	1200	1200	91	91	91	LQM S4ULs 2015
Zinc	mg/kg	3700	3700	3700	40000	40000	40000	620	620	620	LQM S4ULs 2015

Proposed End Use	units	Residential with plant uptake			Residential without plant uptake			Allotment			Source
Soil Organic Matter Content	%	1	2.5	6	1	2.5	6	1	2.5	6	
Cyanide (Free)	mg/kg	26	26	26				4.1	4.1	4.1	Waterman GAC - CLEA v1.06
Complex Cyanide	mg/kg	63000	63000	63000				1200	1200	1200	Waterman GAC - CLEA v1.06
Thiocyanate	mg/kg	230	230	230				46	46	46	Waterman GAC - CLEA v1.06
Aliphatic EC5 - EC6	mg/kg	42	78	160	42	78	160	730	1700	3900	LQM S4ULs 2015
Aliphatic EC6 - EC8	mg/kg	100	230	530	100	230	530	2300	5600	13000	LQM S4ULs 2015
Aliphatic EC8-EC10	mg/kg	27	65	150	27	65	150	320	770	1700	LQM S4ULs 2015
Aliphatic EC10-EC12	mg/kg	130	330	760	130	330	770	2200	4400	7300	LQM S4ULs 2015
Aliphatic EC12-EC16	mg/kg	1100	2400	4300	1100	2400	4400	11000	13000	13000	LQM S4ULs 2015
Aliphatic EC16-EC35	mg/kg	65000	92000	110000	65000	92000	110000	260000	270000	270000	LQM S4ULs 2015
Aliphatic EC35-EC44	mg/kg	65000	92000	110000	65000	92000	110000	260000	270000	270000	LQM S4ULs 2015
Aromatic C5-C7	mg/kg	70	140	300	370	690	1400	13	27	57	LQM S4ULs 2015
Aromatic C7-C8	mg/kg	130	290	660	860	1800	3900	22	51	120	LQM S4ULs 2015
Aromatic C8-C10	mg/kg	34	83	190	47	110	270	8.6	21	51	LQM S4ULs 2015
Aromatic C10-C12	mg/kg	74	180	380	250	590	1200	13	31	74	LQM S4ULs 2015
Aromatic C12-C16	mg/kg	140	330	660	1800	2300	2500	23	57	130	LQM S4ULs 2015
Aromatic C16-C21	mg/kg	260	540	930	1900	1900	1900	46	110	260	LQM S4ULs 2015

Proposed End Use	units	Residential with plant uptake			Residential without plant uptake			Allotment			Source
Soil Organic Matter Content	%	1	2.5	6	1	2.5	6	1	2.5	6	
Aromatic C21-C35	mg/kg	1100	1500	1700	1900	1900	1900	370	820	1600	LQM S4ULs 2015
Aromatic C35-C44	mg/kg	1100	1500	1700	1900	1900	1900	370	820	1600	LQM S4ULs 2015
Benzene	mg/kg	0.087	0.17	0.37	0.38	0.7	1.4	0.017	0.034	0.075	LQM S4ULs 2015
Toluene	mg/kg	130	290	660	880	1900	3900	22	51	120	LQM S4ULs 2015
Ethyl Benzene	mg/kg	47	110	260	83	190	440	16	39	91	LQM S4ULs 2015
Xylene - m	mg/kg	59	140	320	82	190	450	31	74	170	LQM S4ULs 2015
Xylene - o	mg/kg	60	140	330	88	210	480	28	67	160	LQM S4ULs 2015
Xylene - p	mg/kg	56	130	310	79	180	430	29	69	160	LQM S4ULs 2015
MTBE (Methyl tert-butyl ether)	mg/kg	49	84	160				23	44	90	CL:AIRE 2009
Naphthalene	mg/kg	2.3	5.6	13	2.3	5.6	13	4.1	10	24	LQM S4ULs 2015
Acenaphthylene	mg/kg	170	420	920	2900	4600	6000	28	69	160	LQM S4ULs 2015
Acenaphthene	mg/kg	210	510	1100	3000	4700	6000	34	85	200	LQM S4ULs 2015
Fluorene	mg/kg	170	400	860	2800	3800	4500	27	67	160	LQM S4ULs 2015
Phenanthrene	mg/kg	95	220	440	1300	1500	1500	15	38	90	LQM S4ULs 2015
Anthracene	mg/kg	2400	5400	11000	31000	35000	37000	380	950	2200	LQM S4ULs 2015
Fluoranthene	mg/kg	280	560	890	1500	1600	1600	52	130	290	LQM S4ULs 2015
Pyrene	mg/kg	620	1200	2000	3700	3800	3800	110	270	620	LQM S4ULs 2015

Proposed End Use	units	Residential with plant uptake			Residential without plant uptake			Allotment			Source
Soil Organic Matter Content	%	1	2.5	6	1	2.5	6	1	2.5	6	
Benzo(a)anthracene	mg/kg	7.2	11	13	11	14	15	2.9	6.5	13	LQM S4ULs 2015
Chrysene	mg/kg	15	22	27	30	31	32	4.1	9.4	19	LQM S4ULs 2015
Benzo(b)fluoranthene	mg/kg	2.6	3.3	3.7	3.9	4	4	0.99	2.1	3.9	LQM S4ULs 2015
Benzo(k)fluoranthene	mg/kg	77	93	100	110	110	110	37	75	130	LQM S4ULs 2015
Benzo(a)pyrene	mg/kg	2.2	2.7	3	3.2	3.2	3.2	0.97	2	3.5	LQM S4ULs 2015
Indeno(1,2,3-cd)pyrene	mg/kg	27	36	41	45	46	46	9.5	21	39	LQM S4ULs 2015
Di-benzo(a.h.)anthracene	mg/kg	0.24	0.28	0.3	0.31	0.32	0.32	0.14	0.27	0.43	LQM S4ULs 2015
Benzo(g.h.i.) Perylene	mg/kg	320	340	350	360	360	360	290	470	640	LQM S4ULs 2015
Phenol	mg/kg	280	550	1100	750	1300	2300	66	140	280	LQM S4ULs 2015
Pentachlorophenol (PCP)	mg/kg	0.22	0.52	1.2	27	29	31	0.03	0.08	0.19	LQM S4ULs 2015
1,1,2,2 Tetrachloroethane	mg/kg	1.6	3.4	7.5	3.9	8	17	0.41	0.89	2	LQM S4ULs 2015
1,1,1,2 Tetrachloroethane	mg/kg	1.2	2.8	6.4	1.5	3.5	8.2	0.79	1.9	4.4	LQM S4ULs 2015
1,1,1 Trichloroethane	mg/kg	8.8	18	39	9	18	40	48	110	240	LQM S4ULs 2015
Trichloroethene	mg/kg	0.016	0.034	0.075	0.017	0.036	0.08	0.041	0.091	0.21	LQM S4ULs 2015
Tetrachloromethane (Carbon Tetrachloride)	mg/kg	0.026	0.056	0.13	0.026	0.056	0.13	0.45	1	2.4	LQM S4ULs 2015
1,2- Dichloroethane	mg/kg	0.0071	0.011	0.019	0.0092	0.013	0.023	0.0046	0.0083	0.016	LQM S4ULs 2015
Chloroethene (Vinyl chloride)	mg/kg	0.00064	0.00087	0.0014	0.00077	0.001	0.0015	0.00055	0.001	0.0018	LQM S4ULs 2015

Proposed End Use	units	Residential with plant uptake			Residential without plant uptake			Allotment			Source
Soil Organic Matter Content	%	1	2.5	6	1	2.5	6	1	2.5	6	
Trichloroethene	mg/kg	0.016	0.034	0.075	0.017	0.036	0.08	0.041	0.091	0.21	LQM S4ULs 2015
Tetrachloroethene	mg/kg	0.18	0.39	0.9	0.18	0.4	0.92	0.65	1.5	3.6	LQM S4ULs 2015
Trichloromethane (Chloroform)	mg/kg	0.91	1.7	3.4	1.2	2.1	4.2	0.42	0.83	1.7	LQM S4ULs 2015
Sum of PCDDs, PCDFs and dioxins like PCBs	ug/kg			8						8	CLEA SGVs 2009
Isopropylbenzene	mg/kg	11	27	64	12	28	67	32	79	190	CL:AIRE 2009
Propylbenzene	mg/kg	34	82	190	40	97	230	34	83	200	CL:AIRE 2009
Styrene	mg/kg	8.1	19	43	35	78	170	1.6	3.7	8.7	CL:AIRE 2009
Bromobenzene	mg/kg	0.87	2	4.7	0.91	2.1	4.9	3.2	7.6	18	CL:AIRE 2009
1,1,2 Trichloroethane	mg/kg	0.6	1.2	2.7	0.88	1.8	3.9	0.28	0.61	1.4	CL:AIRE 2009
1,1-Dichloroethane	mg/kg	2.4	3.9	7.4	2.5	4.1	7.7	9.2	17	35	CL:AIRE 2009
1,1-Dichloroethene	mg/kg	0.23	0.4	0.82	0.23	0.41	0.82	2.8	5.6	12	CL:AIRE 2009
1,2,4-Trimethylbenzene	mg/kg	0.35	0.85	2	0.41	0.99	2.3	0.38	0.93	2.2	CL:AIRE 2009
1,2-Dichloropropane	mg/kg	0.024	0.042	0.084	0.024	0.042	0.085	0.62	1.2	2.6	CL:AIRE 2009
2-Chloronaphthalene	mg/kg	3.7	9.2	22	3.8	9.3	22	40	98	230	CL:AIRE 2009
Bromodichloromethane	mg/kg	0.016	0.03	0.061	0.019	0.034	0.07	0.016	0.032	0.068	CL:AIRE 2009
Bromoform	mg/kg	2.8	5.9	13	5.2	11	23	0.95	2.1	4.6	CL:AIRE 2009
Chloroethane	mg/kg	8.3	11	18	8.4	11	18	110	200	380	CL:AIRE 2009

Proposed End Use	units	Residential with plant uptake			Residential without plant uptake			Allotment			Source
Soil Organic Matter Content	%	1	2.5	6	1	2.5	6	1	2.5	6	
Chloromethane	mg/kg	0.0083	0.0098	0.013	0.0085	0.0099	0.013	0.066	0.13	0.23	CL:AIRE 2009
Cis 1,2 Dichloroethene	mg/kg	0.11	0.19	0.37	0.12	0.2	0.39	0.26	0.5	1	CL:AIRE 2009
Dichloromethane	mg/kg	0.58	0.98	1.7	2.1	2.8	4.5	0.1	0.19	0.34	CL:AIRE 2009
Hexachloroethane	mg/kg	0.2	0.48	1.1	0.22	0.54	1.3	0.27	0.67	1.6	CL:AIRE 2009
Trans 1,2 Dichloroethene	mg/kg	0.19	0.34	0.7	0.19	0.35	0.71	0.93	1.9	4	CL:AIRE 2009
Bis (2-ethylhexyl) phthalate	mg/kg	280	610	1100	2700	2800	2800	47	120	280	CL:AIRE 2009
Butyl benzyl phthalate	mg/kg	1400	3300	7200	42000	44000	44000	220	550	1300	CL:AIRE 2009
Diethyl Phthalate	mg/kg	120	260	570	1800	3500	6300	19	41	94	CL:AIRE 2009
Di-n-butyl phthalate	mg/kg	13	31	67	450	450	450	2	5	12	CL:AIRE 2009
Di-n-octyl phthalate	mg/kg	2300	2800	3100	3400	3400	3400	940	2100	3900	CL:AIRE 2009
Biphenyl	mg/kg	66	160	360	220	500	980	14	35	83	CL:AIRE 2009
2,4-Dinitrotoluene	mg/kg	1.5	3.2	7.2	170	170	170	0.22	0.49	1.1	CL:AIRE 2009
2,6-Dinitrotoluene	mg/kg	0.78	1.7	3.9	78	84	87	0.12	0.27	0.61	CL:AIRE 2009
Tributyl tin oxide	mg/kg	0.25	0.59	1.3	1.4	3.1	0.24	0.042	0.1	0.24	CL:AIRE 2009

Soil Contamination – Risk of Harm to Property

Structures and Underground Services

Buried Concrete

BRE Special Digest 1 (2005), 3rd Edition, entitled *Concrete in aggressive ground*, provides guidance on the specification for concrete for installation in natural ground and in brownfield locations. The procedures given for the ground assessment and concrete specification cover the fairly common occurrences of sulfates, sulfides and acids, and the more rarely occurring aggressive carbon dioxide found in some ground and surface waters, which affects concrete foundations and sub-structures. It gives procedures for specification of concrete and applies to both buildings and civil engineering construction.

Water Supply Pipes

Guidance is provided in the UK Water Industry Research (UKWIR) report entitled *"Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites"* Report Ref. No. 10/WM/03/21, 2010.

Guidance is provided in the November 2010 Q&A Update and the Questions and Answers Sheet dated 4 May 2011 included at the back of the UKWIR report. Item 3 has been reproduced here:

Item	Question	Answer
3	Following the flow chart in Figure 1.1, **would it be acceptable to not undertake a site investigation and specify the use of barrier pipes** (these seem to be suitable for all conditions)? Would it be acceptable to adopt the blanket approach of always using barrier pipes at Brownfield sites, negating the need for a desk study or intrusive investigation?	The UKWIR project steering group decided that barrier pipes would provide sufficient protection for the supply of drinking water in all Brownfield site conditions. It is therefore reasonable to expect that water companies will accept the use of barrier pipe in all situations as a blanket approach

Soil Contamination – Risk of Combustion

The combustibility of soils is a complex function of soil type, energy content, and availability of oxygen. The Building Research Establishment (BRE) has published guidance based on Calorific Value (i.e. energy content, alone), namely *IP 2/87, Fire and explosion hazards associated with the redevelopment of contaminated land*. This document provides a level below which combustibility is unlikely (2MJ/kg) and a level above which combustibility is likely (10MJ/kg). In the range between these two values combustibility is uncertain. Therefore, where the lower value is exceeded, the other key factors mentioned above need to be considered.

Soil Contamination – Risk of Harm to Vegetation

Where there is topsoil present on Site and it is being considered for reuse in landscaped areas then it needs to be assessed for its suitability for use by an appropriately qualified specialist. Topsoil can be both naturally-occurring and manufactured. The requirements for topsoil that is to be reused on site are specified in BS3882:2007 and cover a range of properties including texture, organic matter content, grading, pH, nutrients and phytotoxic contaminants. The specification for phytotoxic contaminants is reproduced in the table below:

Phytotoxic Contaminants (by soil pH) for Topsoil

Contaminant*	pH		
	<6	6.0 to 7.0	>7
Zinc (Nitric acid extractable**)	<200mg/kg	<200mg/kg	<300mg/kg
Copper (Nitric acid extractable**)	<100mg/kg	<135mg/kg	<200mg/kg
Nickel (Nitric acid extractable**)	<60mg/kg	<75mg/kg	<110mg.kg

Footnotes: * The lower of the Generic Assessment Criteria for chemical contaminants (human health and the environment) and phytotoxicity shall be used for topsoil

** The method of testing is given in Annex D to BS3882:2007 Specification for topsoil and requirements for use.

The risk to human health and the environment needs to be considered as well as phytotoxicity and this will be carried out using the Generic Assessment Criteria selected for these risks as described elsewhere in this appendix and this report.

In order to assess the suitability of topsoil to be reused the full range of testing specified needs to be carried out and assessed by an appropriately qualified specialist.

Controlled Waters Generic Assessment Criteria

The Screening Values adopted by Waterman for ground and surface water quality have been selected on the basis of the water quality standards that apply at the controlled water receptor considered to be at potential risk of harm.

Surface Waters

The Water Framework Directive (WFD) (2000/60/EC) was originally introduced in 2000, however a raft of Daughter Directives have been brought in to address the objectives the WFD originally set out. Over time the WFD and its Daughter Directives have gradually replaced number of the existing Directives including the Dangerous Substances Directive (DSD) and Surface Water Directive (SWD).

The WFD identifies 'Priority' and 'Priority Hazardous Substances', to which Environmental Quality Standards (EQS) have been determined. The WFD EQS do not provide a full complement of applicable values to adopt. In the absence of an EQS, values under the replaced Surface Water Directive have been used as a guide.

Groundwater

The EU Drinking Water Directive (DWD) (98/83/EC) lays out the standards for drinking water EU wide. The UK have followed the EU regulations and translated the Directive into the Water Supply (Water Quality) Regulations England 2000. The UK Drinking Water Standards are the most relevant criteria to use for the assessment of risks to water destined for potable sources.

The WFD, to date, have not set threshold values for groundwater on a river basin basis.

TPH and PAHs

A suitable risk based assessment criteria for risks from TPH in both surface waters and groundwater are not available in the UK. The WHO have produced a health based risk assessment for drinking waters with regard to TPH “Petroleum Products in Drinking Waters, Background document for development of WHO Guidelines for Drinking-water Quality. Ref. WHO/SDE/WSH/05.08/123”.

The WHO Guideline values have been amended for the UK standard body weight and behaviour to derive a UK guideline for DWS of TPH (70kg body weight and 2l of water consumed per day).

A complete list of assessment criteria for PAHs is absent from the UK (benzo(a)pyrene is available). However, the risk from PAHs should be considered. The theory presented in the WHO document "Petroleum Products in Drinking Waters, Background document for development of WHO Guidelines for Drinking-water Quality. Ref. WHO/SDE/WSH/05.08/123" has been applied to provide indicative screening values for PAHS with regard to drinking water. Published TDI and ID effects have been amended for the UK standard body weight and behaviour to derive a UK guideline for DWS of PAHs (70kg body weight and 2l of water consumed per day).

The derived TPH and PAH screening values are used as an indication of the risks from TPH and PAHs to human health through drinking water only.

The standards for the substances tested for in this investigation are provided in Table G3 and G4 below.

Table G3 - Screening Values – Water Quality Standards

	Concentration (µg/l)		
Determinand	**Surface Water - EQS Freshwater (DEFRA Directions 2015)**	**UK Drinking Water Standard (DWS)**	**WHO Drinking Water Standard**
Metals			
Arsenic	50	10	-
Barium	-	-	700
Beryllium	-	-	12
Boron	-	1000	-
Cadmium	0.25*	5	-
Copper	1 (bioavailable)	2000	-
Chromium (total)	4.7	50	-
Chromium (VI)	3.4	-	-
Chromium (III)	4.7	-	-
Iron	1000	200	-
Lead	1.2 (partial bioavailable)	10	-
Manganese	123 (bioavailable)	50	-
Mercury	0.07	1	-
Nickel	4 (bioavailable)	20	-
Selenium	-	10	-
Zinc	10.9+X** (bioavailable X is catchment related)	-	-

Non-Metals			
Cyanide	1	50	-
Chloride	-	250,000	-
Nitrate	-	50,000	-
Sulphate	-	250,000	-
Ammonia (total)	-	500	-
Nitrite	-	500	-
BTEX			
Benzene	10	1	-
Ethyl Benzene	-	-	300
Toluene	74	-	-
Xylene (p+m)	30	-	500
MTBE	-	-	15***
Phenol	7.7	-	-
Petroleum Hydrocarbons			
Aliphatic EC5 - EC6	-	-	15,000
Aliphatic EC6 - EC8	-	-	15,000
Aliphatic EC8-EC10	-	-	300
Aliphatic EC10-EC12	-	-	300
Aliphatic EC12-EC16	-	-	300
Aromatic EC6-EC7 (Benzene)	10	1	
Aromatic EC7-EC8 (Toluene)	74	-	700
Aromatic EC8-EC10	-	-	300****
Aromatic EC10-EC12	-	-	90
Aromatic EC12-EC16	-	-	90
Aromatic EC16-EC21	-	-	90
Aromatic EC21-EC35	-	-	90
Polycyclic Aromatic Hydrocarbons			
Anthracene	0.1	-	1050
Acenaphthene	-	-	210*****
Acenaphthylene	-	-	210*****

Chrysene	-	-	1.085*****
Di-benzo(a.h.)anthracene	-	-	0.01085*****
Phenanthrene	-	-	43.75*****
Benzo(a)pyrene	0.00017	0.01	-
Benzo(b)fluoranthene	0.00017	0.1b	-
Benzo(g.h.i.) Perylene	0.00017	0.1	-
Benzo(k)fluoranthene	0.00017	0.1	-
Fluoranthene	0.0063	-	-
Indeno(1,2,3-cd)pyrene	0.00017	0.1	-
Naphthalene	2	-	70
Fluorene	-	-	140*****
Benzo(a)anthracene	-	-	0.543*****
Pyrene	-	-	105*****
Volatile Organic Compounds			
Vinyl Chloride	-	0.5	-
1,1-dichloroethene	-	-	30
Trans 1,2-Dichloroethene	-	-	0.3
Chloroform	-	100c	-
1,2-Dichloroethane	10	3	-
Trichloroethene (TCE)	-	10	-
Bromodichloromethane	-	100	-
Tetrachloroethene (PCE)	-	10	-
1,3-Dichloropropane	-	100	40
Bromoform	-	100	-
1,4-Dichlorobenzene	-	-	300
1,2-Dichlorobenzene	-	-	1000
1,2-Dibromo-3-chloropropane	-	-	1

* Value for Class 5 water, assumes >200mg$CaCO_3$/L

** 10.9 + 2.9 (ambient background concentration for Humber catchment)

*** Odour and taste threshold

**** Value for ethylbenzene

***** Waterman-derived criteria based on guidance in WHO document and UK background data

b - Sum of 4 PAHs

c - sum of 4 trichlorohalides – Chloroform, bromoform, dibromoform and bromodichloromethane

Bioavailability based Environmental Quality Standards

Under the Water Framework Directive, originally introduced in 2000, and transposed into the UK regulatory framework via the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015, we are now required take account of the bioavailability when assessing the toxicity of heavy metal contamination in the freshwater environment.

What is Bioavailability and Why Account for it?

It is widely accepted that the total concentration of certain metals in freshwater often has limited relevance to potential environmental risk, but it is the 'bioavailable' fraction that is likely to result in toxic effects to aquatic organisms. Effectively, it's the bioavailability of a metal which reflects the actual metal concentration that the organism will be exposed to, and thus is the relevant concentration that we are interested in when assessing risk.

EQS developed under previous legislation (including the Dangerous Substances Directive (76/464/EEC)) were expressed as total concentration relative to hardness bandings to reflect the indications that toxicity to aquatic life was influenced by water hardness. Scientific knowledge and understanding on the impact of metals has since developed, and metal bioavailability in aquatic systems is now understood to be influenced by several site-specific physio-chemical factors including the pH, calcium content and the level of dissolved organic carbon (DOC) present within the water body under consideration.

Taking bioavailability into account as part of the risk assessment process is now considered best practice and will enable more accurate estimation of metal toxicity and the risks posed to the freshwater environment.

How to Account for Metal Bioavailability

The increased understanding of the impact of certain metals on the aquatic environment has enabled EQSs to be published by the UK Secretary of State for a number of metals based on their bioavailable concentration. These are referred to as EQSbioavailable and are listed in the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

It is very difficult to measure the bioavailable concentration of a metal directly. We therefore have to rely on models to predict the bioavailable concentration from dissolved concentrations. In the UK, a simple predictive tool has been developed that can take account of water quality parameters such as pH, and calcium to determine the amount of bioavailable metal present in the freshwater environment.

The tool is called the Metal Bioavailability Assessment Tool (M-BAT) and is acceptable for use under the UK regulatory framework.

Use of Background Concentrations for the Assessment of Zinc.

Metals occur naturally in the aquatic environment due to weathering of surface geology, and under the EQS Directive (2008/105/EEC) background concentrations for metals can be considered when assessing compliance against the respective EQS.

The situation for Zinc is now slightly different, and consideration of background concentration is now an explicit part of the zinc EQS released under the WFD and needs to be taken into account as part of the initial compliance assessment.

Using this approach, a local background concentration should be subtracted from the monitoring data before the bioavailability estimate is performed using M-BAT. Under the WFD, catchment specific background values have been defined for England and Wales to be used in conjunction with the EQSbioavailable. The background values are listed within the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 Schedule 3, Part 2, Table 2, and also reproduced in Appendix A of the M-BAT user guide available here.

Lead

Lead is not included in the M-BAT tool (referred to above) as it is not a full bioavailable EQS. The EQS for lead is an EU standard under WFD. It takes into account the influence of DOC on the toxicity of lead but, unlike the full bioavailable standards for zinc, copper, manganese and nickel which are included in M-BAT, it only considered the influence of DOC, and does not require the consideration of calcium or pH.

Ground Gas and Volatile Organic Compounds Generic Assessment Criteria

Ground Gas

Current UK guidance has been produced by CIRIA, the British Standards Institution (BSI) and CL:AIRE. The following relevant documents have been prepared to date:

- CIRIA C665 – Assessing the risks posed by hazardous ground gases to buildings, 2007;
    - Aims to consolidate good practice in investigation, facilitate the collection of relevant data, instigate appropriate monitoring programmes, all in a risk based approach to gas contaminated land.
- BS 8576 – Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs), 2013;
    - Provides guidance on the monitoring and sampling of ground gases, including methane, carbon dioxide, oxygen, and VOCs. Guidance is not provided on the risk evaluation and characterisation of site's, the selection and design of protective measures, verification of protective measures, sampling of atmospheric gases, and the monitoring and sampling of radon.
- CIRIA C735 – Good practice on the testing and verification of protection systems for buildings against hazardous ground gases, 2014; and
    - Sets out the good practice guidance for the designer, installer, verifier, and regulator on the verification and integrity testing of gas protection systems.
- BS 8485 – Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings, 2015.
    - Provides guidance on the appropriate ground gas parameters that can be used to identify a range of possible design solutions for protection against methane and carbon dioxide on a development.
- CL:AIRE - Technical Bulletin (TB 17), August 2018
    - The bulletin provides guidance on assessing ground gas monitoring data to ensure that sufficient data has been collected to cover critical variations in barometric pressure

Both the CIRIA and BSI publications have been prepared to be generally consistent with CLR11, *Model Procedures for the management of land contamination,* (Defra and the Environment Agency, 2004a) and follow a step by step approach summarised below:

1. Desk Study and Site Walkover.
2. Development of a Preliminary Conceptual Model and Risk Assessment.
3. Site Investigation (If deemed necessary from stage 2).
4. Risk Assessment and Site Characterisation.

5. Recommendation and Mitigation.

Where the preliminary conceptual model has deemed further investigation necessary to characterise the ground gas regime, an appropriate site investigation and monitoring regime should be designed and undertaken. In-depth guidance to assist in the design of the investigation is provided within C665 and BS 8576, which describes intrusive investigation techniques and provides guidance on selecting the number and location of monitoring wells based on the site specific conceptual model.

Waterman has generally followed the approach recommended in CIRIA C665, BS 8576, and BS 8485 with respect to characterising a site and determining the levels of gas protection methods required. Where deviations from the methodology detailed within above guidance occurs, the reasoning behind the deviation and implication of the analysis of the results has been included within the report.

Risk Assessment

In accordance with C665, to assess the ground gas regime at a site, the ground gas monitoring data should be assessed by determining the Gas Screening Value (GSV) (ℓ/hr). BS 8485 details further guidance on which GSV can be adopted based on a number of modifiers.

GSV = (Measured Maximum CO_2 or CH_4 Gas Concentration (%) / 100) x Maximum Measured Gas Flow Rate from boreholes (ℓ/hr).

Both C665 and BS 8485 dictate where the gas flow has been measured as less than the detection limit of the instrument used (typically <0.1ℓ/hr), the limit of detection of the instrumented should be used as the gas flow rate.

As per the guidance given in BS 8485 where a negative flow has been recorded, and there is an absence of a positive flow, a qualitative assessment has been undertaken into whether under different temporal conditions, a similar positive flow could occur. When the cause for negative flow is reasonably understood, it has been possible to rule out a corresponding credible positive flow and discount the negative flow.

The Gas Screening Value is used to classify the site, subject to the proposed end use of the site.

The Modified Wilson and Card classification system is used to attribute a Characteristic Situation (CS) value to the site/zone depending upon the calculated GSV. When attributing a CS, additional factors including the maximum recorded gas concentration and the maximum recorded gas flow rate should also be taken into account and may result in an increase in the CS value. Table G5 below, outlines the CS values associated GSV's and additional factors which must be taken into account.

Table G5 Modified Wilson and Card Classification

Characteristic Situation (CIRIA 149)	Risk Classification	Gas screening value (CH_4 CO_2) l/hr	Additional Factors	Typical source of generation
1	**Very low risk**	**<0.07**	Typically methane ≤1% and / or carbon dioxide ≤5%. Otherwise consider increase to CS 2.	Natural soils with low organic content 'Typical' made ground
2	**Low risk**	**<0.7**	Borehole air flow rate not to exceed 70 l/hr.	Natural soil, high peat/organic content. 'Typical' made ground

			Otherwise consider increase to CS 3.	
3	**Moderate risk**	**<3.5**		Old landfill, inert waste, mineworking flooded
4	**Moderate to high risk**	**<15**	Quantitative risk assessment required to evaluate scope of protective measures.	Mineworking – susceptible to flooding, completed landfill (WMP 26B criteria)
5	**High risk**	**<70**		Mineworking unflooded inactive with shallow workings near surface
6	**Very High risk**	**>70**		Recent landfill site

Notes:

1) Gas screening value: litres of gas / hour is calculated by multiplying the gas concentration (%) by the measured borehole flow rate (l/hr)
2) Source of gas and generation potential/performance must be identified.
3) If there is no detectable flow use the limit of detection of the instrument.

Following determination of the site's CS, the requirements and scope of gas protection measures can be prescribed based on the guidance given in BS 8485:2015.

BS 8485 details the required ground gas protection measures for a development using a points-based system, whereby a certain number of points must be accumulated through the installation of various protection measures to mitigate the risk to structures or buildings from the accumulation of methane or carbon dioxide. The number of points assigned will be dependent on the building type and the CS.

Table G6 Building types are separated into four distinct scenarios.

Kj,f Modifier	**Building Type**			
	Type A	**Type B**	**Type C**	**Type D**
Ownership	Private	Private or commercial / public, possible multiple	Commercial / public	Commercial / industrial
Control (change of use, structural alterations, ventilation)	None	Some but not all	Full	Full
Room sizes	Small	Small / medium	Small to large	Large industrial / retail park style

Further details on the description of the building types, along with examples are included in BS 8485.

Following identification of the appropriate Building Type and CS, the minimum gas protection score can be determined through the use of the following table.

Table G7 Gas Protection Score

Characteristic Situation	Minimum Gas Protection Score			
	Type A	Type B	Type C	Type D
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6.5[A]	5.5[A]	4.5	3.5
5	N/A[B]	6[A]	5.5	4.5
6	N/A[B]	N/A[B]	N/A[B]	6

[A]Residential buildings should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system e.g. in Institutional and / or fully serviced contractual situations.

[B]The gas hazard is too high for this empirical method to be used to define the gas protection measures.

Post determination of the minimum gas protection score, a combination of two or more of the following three types of protection measures should be used to achieve the score:

- The structural barrier of the floor slab, or of the basement slab and walls if a basement is present;
- Ventilation measures; and
- Gas resistant measures.

Through combining at least two ground gas protection measures, the lack of redundancy in the use of a single protection measure approach is negated. The ground gas protection measures should work independently and collaboratively.

The tables below detail the specific ground gas protection measures and their associated scores.

Structural Barrier

Table G8

Floor and substructure design	Score[A]
Precast suspended segmental subfloor (I.e. beam and block)	0
Cast in-situ ground bearing floor slab (with only nominal mesh reinforcement)	0.5
Cast in-situ monolithic ground bearing raft or reinforced cast in-situ suspended floor slab with minimal penetrations	1 or 1.5[B]
Basement floor and slab conforming to BS 8102:2009, Grade 2 waterproofing[C, D]	2
Basement floor and walls conforming to BS 1802:2009, Grade 3 waterproofing[C, D]	2.5

[A]The scores are conditional on breaches of floor slabs, etc., being effectively sealed.

[B]To achieve a score of 1.5 the raft or suspended slab should be well reinforced to control cracking and have minimal penetrations cast.

[C]The score is conditional on the waterproofing not being based on the use of a geosynthetic clay liner waterproofing product.

Ventilation Measures

Table G9

Protection element / system	Score	Comments
Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building.	0.5	Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measure systems. If the layer has a low permeability and / or is not terminated in a venting trench or similar, then the score is zero.
Passive sub floor dispersal layer: Very good performance: Good performance: Media used to provide the dispersal layer are; • Clear void; • Polystyrene void former blanket; • Geocomposite void former blanket • No-fines gravel layer with gas drains; • No-fines gravel layer.	 2.5 1.5	The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing, and type and thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B of BS 8485 2015. Passive ventilation should be designed to meet at least good performance, see in Annex B of BS 8485 2015.
Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may compromise a clear void or be formed of geocomposite or polystyrene void formers.	1.5 to 2.5	This system relies on continues serviceability of the pumps, therefore alarm and response systems should be in place. There should be robust management systems in place to ensure the continued maintenance of the system including pumps and vents. Active ventilation should always be designed to meet at least good performance as described in in Annex B of BS 8485 2015.
Active positive pressurization by the creation of a blanket of external fresh air beneath the floor slabs by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket.	1.5 to 2.5	This system relies on continues serviceability of the pumps, therefore alarm and response systems should be in place. The score assigned should be based on the efficient coverage of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least good performance.
Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park).	4	Assumes that the car fumes is vented to deal with exhaust fumes designed to *Buildings Regulations 2000, Approved Document F.*

It should be noted that for Type A Buildings active ventilation systems are inappropriate.

Membrane

Table G10

Protection element / system	Score	Comments
Gas resistant membrane meeting all of the following criteria;	2	The performance of membranes is heavily dependent on the quality

Sufficiently impervious both in the sheet material [A] and in the sealing of sheets and sealing around sheet penetrations, to prevent any significant passage of methane and / or carbon dioxide through the membrane; Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; Sufficiently strong [B] to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc.); and to withstand in-service stresses (e.g settlement if placed below a floor slab); Capable, after installation, of providing a complete barrier to the entry of the relevant gas; and Verified in accordance with CIRIA C735.	and design of the installation, resistance to damage after installation and integrity of joints. If a membrane is installed that does not meet the all the criteria in column 1 then the score is zero.

A gas protection score should only be assigned to a membrane which is formed of a material with suitably low gas permeability and which has been installed so it completely seals the foundation (including effective seals around all penetrations) and does not sustain damage from in-service stresses.

Volatile Organic Compounds (VOCs)

The Building Regulations 2000 Approved Document C (2004 Edition) also refers to volatile organic carbons (VOCs). These are primarily assessed by examination of the VOC content of site soils. Further guidance on VOCs is provided in *"The VOCs Handbook; Investigating, assessing and managing risks from inhalation of VOCs at land affected by contamination"*, CIRIA Report C682, 2009.

For former landfill sites the risk from a wider range of trace gases are considered on a site specific basis when appropriate.

VOCs in groundwater

Under the Environmental Protect Act 1990, Building Regulations Approved Document C 2004 and the National Planning Policy Framework there is a requirement to ensure that Volatile Organic Compounds (VOC) are considered on a risk assessment basis.

VOCs are organic compounds that are volatile under normal atmospheric conditions. However, they may be found in the solid, liquid, and the dissolved phase as well as in the gaseous phase. VOCs are typically found in the following contaminants:

- Petroleum (non-halogenated) hydrocarbons (e.g. benzene, toluene, and butylbenzenes);
- Halogenated hydrocarbons (e.g. chlorinated ethenes and ethanes (dry cleaning fluids or degreasers) or chlorofluorocarbons (freons)); and
- Organic compounds containing nitrogen, sulphur, and oxygen (e.g. tetrahydrofuran).

The likely sources of the above contaminants include:

- Spills, leaks, and discharges from industries;

- Landfills;
- Buildings, furnishings, and common household products;
- Vehicle emissions;
- Marshland; and
- Uncontrolled waste disposal.

The risk to receptors from VOC occur from inhalation (acute and chronic), and a flammable / explosive risk when present at high concentrations in confined spaces.

Current UK guidance for VOCs are limited in comparison to ground gas, and is primarily given in the *"The VOCs Handbook; Investigating, assessing and managing risks from inhalation of VOCs at land affected by contamination"*, CIRIA Report C682, 2009.

Additional guidance was published in 2017 by the Society of Brownfield Risk Assessments (SoBRA) *'Development of Generic Assessment Criteria for Assessing Vapour Risks to Human Health from Volatile contaminants in Groundwater*', February 2017. The 2017 SoBRA document provided a set of Generic Assessment Criteria (GAC) to allow the risk to a residential/commercial premise to be assessed quantitatively using the contamination concentrations recorded in the groundwater. The GAC were generated using the CLEA model, with each GAC being the theoretical concentration in groundwater/perched water beneath a property that is modelled as resulting in estimated average daily exposure (ADE) to the critical receptor that is equal to the Health Criteria Value (HCV).

The GAC were designed to incorporate several precautionary assumptions, these conservatisms include;

- The assumption that the impacted groundwater/perched water is directly beneath the building, when it may instead be offset from the receptor;
- The assumption that there is an infinite source term, when in fact the source may be finite;
- The assumption that there is no biodegradation between the source term and the receptor;
- The assumption that the groundwater source is at a depth of 0.65m bgl;
- The use of sand soil type for both the saturated and unsaturated zone.
- The omission of a capillary zone between the saturated and unsaturated zone.

These GAC are detailed in the Tables below.

Table G11 Petroleum Hydrocarbons

Chemical	CAS	GACgwvap (µg/l) 1,2		Aqueous Solubility (µg/l)
		Residential	Commercial	
1,2,4-Trimethylbenzene	95-63-6	24	2,200	559,000
Benzene 3	71-43-2	210	20,000	1,780,000
Ethylbenzene 3	100-41-4	10,000	*960,000 (sol)*	180,000
Isopropylbenzene	98-82-8	850	*86,000 (sol)*	56,000
Propylbenzene	103-65-1	2,700	*240,000 (sol)*	54,100
Styrene	100-42-5	8,800	*810,000 (sol)*	290,000

Toluene 3	108-88-3	230,000	*21,000,000 (sol)*	590,000
TPH Aliphatic EC5-EC6 3		1,900	*190,000 (sol)*	35,900
TPH Aliphatic >EC6-EC8 3		1,500	*150,000 (sol)*	5,370
TPH Aliphatic >EC8-EC10 3		57	*5,700 (sol)*	427
TPH Aliphatic >EC10-EC12 3		37	*3,600 (sol)*	34
TPH Aromatic >EC5-EC7 2,3		210,000	*20,000,000 (sol)*	1,780,000
TPH Aromatic >EC7-EC8 3		220,000	*21,000,000 (sol)*	590,000
TPH Aromatic >EC8-EC10 3		1,900	*190,000 (sol)*	64,600
TPH Aromatic >EC10-EC 12 3		6,800	*660,000 (sol)*	24,500
TPH Aromatic >EC12-EC16 3		39,000	*3,700,000 (sol)*	5,750
meta-Xylene 3,5	108-38-3	9,500	*940,000 (sol)*	200,000
ortho-Xylene 3,5	95-47-6	12,000	*1,100,000 (sol)*	173,000
para-Xylene 3,5	106-42-3	9,900	*980,000 (sol)*	200,000

Table G12 Polycyclic Aromatic Hydrocarbons

Chemical	CAS	GAC gw vap (µg/l) 1,2		Aqueous Solubility (µg/l)
		Residential	Commercial	
Acenaphthene	83-32-9	*170,000 (sol)*	*15,000,000 (sol)*	4,110
Acenaphthylene	208-96-8	*220,000 (sol)*	*20,000,000 (sol)*	7,950
Fluorene	86-73-7	*210,000 (sol)*	*18,000,000 (sol)*	1,860
Naphthalene	91-20-3	220	*23,000 (sol)*	19,000

Table G13 Pesticides

Chemical	CAS	GACgwvap (µg/l) 1,2		Aqueous Solubility (µg/l)
		Residential	Commercial	
Aldrin	309-00-2	*47 (sol)*	*3,700 (sol)*	20
alpha-Endosulfan	959-98-8	*7,400 (sol)*	*590,000 (sol)*	530
beta-Endosulfan	33213-65-9	*7,500 (sol)*	*600,000 (sol)*	280

Table G14 Halogenated Organics

Chemical	CAS	GACgwvap (µg/l) 1,2		Aqueous Solubility (µg/l)
		Residential	Commercial	
1,1,1,2-Tetrachloroethane	79-34-5	240	22,000	1,110,000
1,1,1-Trichloroethane	71-55-6	3,000	290,000	1,300,000
1,1,2,2-Tetrachloroethane	79-35-4	1,600	150,000	2,930,000

Chemical	CAS	GACgwvap (µg/l) 1,2		Aqueous Solubility (µg/l)
		Residential	Commercial	
1,1,2-Trichloroethane	79-00-5	520	49,000	4,491,000
1,1-Dichloroethane	75-34-3	2,700	260,000	3,666,000
1,1-Dichloroethene	75-35-4	160	16,000	3,100,000
1,2,3,4-Tetrachlorobenzene	634-66-2	240	*31,000 (sol)*	7,800
1,2,3,5-Tetrachlorobenzene	634-90-2	7.0	600	3,500
1,2,3-Trichlorobenzene	87-61-7	35	3,100	21,000
1,2,4,5-Tetrachlorobenzene	95-94-3	8.1	*700 (sol)*	600
1,2,4-Trichlorobenzene	120-82-1	68	7,200	41,400
1,2-Dichlorobenzene	95-50-1	2,000	*220,000 (sol)*	133,000
1,2-Dichloroethane	107-06-2	8.9	850	8,680,000
1,2-Dichloropropane	78-87-5	22	2,600	2,050,000
1,3,5-Trichlorobenzene	108-70-3	7.4	660	6,000
1,3-Dichlorobenzene	541-73-1	31	2,800	103,000
1,4-Dichlorobenzene	106-46-7	5,000	460,000 (sol)	51,200
Bromobenzene	108-86-1	220	20,000	388,040
Bromodichloromethane	75-27-4	17	1,600	3,000,000
Bromoform (Tribromomethane)	75-25-2	3,100	400,000	3,000,000
Chlorobenzene	108-90-7	98	15,000	387,000
Chloroethane	75-00-3	10,000	1,000,000	5,742,000
Chloroethene (Vinyl Chloride)	75-01-4	0.62	63	2,760,000
Chloromethane	74-87-3	14	1,400	5,350,000
cis-1,2-Dichloroethene	156-59-2	130	13,000	7,550,000
Dichloromethane	75-09-2	3,300	370,000	20,080,000
Hexachlorobenzene	118-74-1	16 (sol)	1,400 (sol)	10
Hexachlorobutadiene	87-68-3	1.7	230	4,800
Hexachloroethane	67-72-1	8.5	740	49,900
Pentachlorobenzene	608-93-5	140	12,000 (sol)	500
Tetrachloroethene	127-18-4	34	4,600	225,000
Tetrachloromethane (Carbon Tetrachloride)	56-23-5	5.3	770	846,000
trans-1,2-Dichloroethene	156-60-5	160	16,000	5,250,000
Trichloroethene	79-01-6	5.7	530	1,370,000
Trichloromethane (Chloroform)	67-66-3	790	85,000	8,950,000

Table G15 Others (Organic and Inorganic)

Chemical	CAS	GACgwvap (µg/l) 1,2		Aqueous Solubility (µg/l)
		Residential	Commercial	
2-Chloronaphthalene	91-58-7	160	*14,000 (sol)*	11,700
Biphenyl (Lemonene)	92-52-4	*15,000 (sol)*	*1,300,000 (sol)*	4,060
Carbon disulphide	75-15-0	56	5,600	2,100,000
Mercury, elemental	7439-97-6	1.1	*95 (sol)*	56
Methyl tertiary butyl ether (MTBE)	1634-04-4	83,000	7,800,000	48,000,000

The risks to receptors from vapours will be assessed through assessment of the volatile contaminant concentrations recorded in groundwater samples against the SoBRA derived GAC. Where an exceedance is recorded, a qualitative assessment will be made, given the conservative approach of the SoBRA derived GAC as to whether a significant vapour regime is present on-site and possible risk to receptors exists. The vapour concentration recorded during headspace analysis of soils, SVOC / VOC contaminant concentration within soil samples, and the vapour concentration within installed boreholes will also be considered qualitatively during this assessment.

Where a significant vapour regime is present and a risk to receptors exists, further assessment will be required, this may include, vapour sampling, further intrusive investigations, or a Detailed Quantitative Risk Assessment (DQRA). Dependent on the results of the further assessment, remedial measures will be required to mitigate the risk to receptors.

UK and Ireland Office Locations

Preliminary Environmental Risk Assessment and Coal Mining Risk Assessment Technical Note – Trinity Academy Temporary School

Date: December 2020

Client Name: Department for Education

Document Reference: WIE17125-100-TN-001

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015 and BS EN ISO 45001:2018)

Issue	Prepared by
	Andrew Mould Principal Consultant

1. Introduction

Waterman Infrastructure & Environment Limited ("Waterman") was instructed by Waterman Building Structures Limited on behalf of the Department for Education to undertake a Preliminary Environmental Risk Assessment for potential ground contamination, and a Coal Mining Risk Assessment, for the proposed erection of a Temporary School building at the Trinity Academy site. The Temporary School site, hereafter termed "the Site" is shown on Watson Batty Architects Drawing Ref: TRNTY WBA NB 00 DR A PL_101 P1, enclosed.

1.1 Objectives

This Technical Note has been prepared to assess the environmental and coal mining risks to the Site and should be read in conjunction with the reports prepared for the wider Trinity Academy site:

- Waterman Report *"Preliminary Environmental Risk Assessment"*, Ref: WIE17125-100-R-1.2.1-RJM, Dated: July 2020.
- Waterman Report *"Coal Mining Risk Assessment"*, Ref: WIE17125-100-R-7.1.3-CMRA, Dated: October 2020.

Ground investigation was undertaken across the Trinity Academy site, based on the findings of the above reports, and the results are included in:

- Waterman Report *"Geo-Environmental Assessment"*, Ref: WIE17125-100-R-8.1.3-GeoEnv, Dated: November 2020.

1.2 Proposed Developemnt

The proposed development includes the erection of a Temporary School building, with associated access road, parking, external play areas and associated works. The proposed development is in an area of Public Open Space in the western half of the wider Trinity Academy site.

A site location plan (Waterman Drawing Ref: WIE17125-103_GR_PRA_A1A) and a site layout plan (Watson Batty Architects Drawing Ref: TRNTY WBA NB 00 DR A PL_101 P1) are enclosed.

2. Hazard Identification

Full details of the hazards identified affecting the wider site are included in the Preliminary Environmental Risk Assessment. A summary is provided below.

2.1 Site Description

The Site is currently occupied by an area of Public Open Space (POS), comprising a flat grassed area bounded by trees and bushes. Ground level is higher than at the adjacent Keresforth Medical Centre to the east, at approximately 150m AOD.

Buildings comprising one-storey properties with pitched roofs are aligned along Keresforth Close to the east. A Boiler House is present to the north east of the Site, with an above ground fuel storage tank and chimney present (possibly a former incinerator).

Barnsley Fire Station, warehouses and undeveloped arable land are present to the north of the Site.

Residential properties are present to the east, south and west of the Site.

The A6133 highway is present at the western site boundary, and a school is present beyond the A6133.

2.2 Site History

The Site comprises vacant undeveloped land, likely in arable use from the date of the first maps (1850). In the vicinity of the Site a number of sandstone quarries are identified, the closest being approximately 200m to the west of the Site. Victoria Colliery, and an associated shaft, are identified approximately 650m – 700m south east of the Site.

Next available mapping from 1890 (1:10,560 scale) shows the Site to be unchanged. A substantial brick works is shown approximately 750m north west of the Site. Victoria Colliery is no longer shown. However, an unnamed Colliery is shown approximately 800m east of the Site.

Mapping from 1904 (1:10,560 scale) shows the Site to be unchanged. The unnamed Colliery shown approximately 800m east of the Site is now identified as a Velvet Works. Rob Royd Colliery and Rose Hill Colliery are shown just over 1km south and south west of the Site, respectively. Two “Old Shafts” are shown approximately 1.25km south east of the Site. The brick works to the north has expanded significantly and now includes two “Old Shafts”.

Mapping from 1929 (all 1:10,560 scale) shows no notable change to the Site, however, the surrounding area has undergone continued development. A clay pit extending to within 500m has been added to the brick works to the north of the Site with an “Old Shaft” being identified

approximately 600m north of the Site. Farm House Colliery is identified approximately 1km north west of the Site. Needlewood Colliery is shown approximately 800m south west of the Site. Houndhill Colliery is shown, and noted to be disused, approximately 700m south east of the Site, approximately 150m to the south west of the former site of Victoria Colliery. Rose Hill Colliery is no longer shown. A number of earthworks are shown extending linearly north-south from approximately 150m west of the Site to approximately 400m south of the Site.

The 1938, 1948 and 1956 mapping (1:10,560 scale) indicates that the Site and surroundings are largely unchanged. However, the 1956 map indicates that Farm House Colliery and Needlewood Colliery are now disused. The clay pit to the north of the Site is now described as an "Old Clay Pit".

The area of the Temporary School building is first identified as playing fields on the 1959 mapping. An embankment is shown dividing the playing fields from the land to the north-east.

Houndhill, Needlewood and Farm House Collieries are no longer shown. A mine is shown in the location of Rob Royd Colliery, but it is no longer named. A significant number of the sandstone quarries identified on the earliest maps are no longer shown, however, the earthworks first shown on the 1929 mapping are still shown extending to the south of the Site.

Mapping from 1973 (1:10,000 scale) shows no notable change to the Site. Rob Royd Colliery is still shown to the south of the Site, however, the earthworks extending to the south of the Site on previous maps are no longer shown. A disused shaft and disused pit are identified in the area of the former brick works and coal pit to the north of the Site.

Mapping from 1983 (1:1,250 scale) shows the currently existing Keresforth Centre structures to be present to the east of the proposed Temporary School building. These are not shown on the 1982 1:10,000 mapping and, therefore, the construction of the existing buildings can be dated to 1982/1983. The 1982 mapping shows the area of the former brick works and clay pit to have been redeveloped.

The Groundsure Report identifies Keresford Hill Pit to have been present on site, however, this is not shown on any of the available historical maps. Kingston Pit is also shown in the Groundsure Report to have been present approximately 30m south east of the Site, again this not shown on any of the available historical maps.

2.3 Geology

The geology beneath the Site has been established from the British Geological Survey (BGS) 1:50,000 scale Geological Map, Sheet 87, Barnsley (Bedrock and Superficial) and borehole logs SE30NW209, SE30NW181, SE30NW221 and SE30NW185 (accessed via BGS website June 2020). Geology is summarised in Figure 1.

Figure 1: Geology

Bedrock

ID	Description
1	Pennine Middle Coal Measures Formation - Mudstone, Siltstone And Sandstone
3	Pennine Middle Coal Measures Formation - Sandstone

Superficial

ID	Description
1	Made Ground (Undivided)

Source: Groundsure Enviro Insight Bedrock and Superficial Geology (1:10,000)

The Site is indicated to be underlain by Made Ground. A summary of the geology is provided in Table 1.

Table 1: Site Geology

Stratum	Area Covered	Depth to Top of Stratum (m bgl)	Typical Description
Made Ground or Topsoil	Entire Site	0 to 1.0m	Topsoil over colliery waste or soft brown clay with fragments of brick, concrete and pottery
Glacial Till	Entire Site	0.45 to 1.06	Soft to firm grey laminated sandy clay with silt partings and bands of medium-coarse gravel.
Pennine Middle Coal Measures Formation	Entire Site	1.5 to 2.7	Interbedded hard, grey siltstone with bands of soft mudstone, and black coal shale. 5cm void reported in one location to the north of the Site.

Seams that are likely to be present beneath the Site are summarised in Table 2.

Table 2: Possible Coal Seams Beneath the Site

Coal Seam	Depth relative to previous seam	Approximate depth below site (m bgl)	Seam Thickness	Comment
Barnsley Rider Coal	-	0m	0.16m – 0.61m	Not shown to be worked in the vicinity of the Site
Barnsley Coal	40m	0m – 40m	2.29m – 3.1m	Thought to be worked beneath the Site and shown to be worked to the west of the Site in BGS borehole logs.
Dunsil Coal	22m	22m – 62m	0.46m – 0.81m	Possibly shown as a number of thin seams in BGS borehole to the north of the Site.
Gawber Coal	24m	46m – 86m	0.72m	-
Swallow Wood Coal	22m	68m – 108m	0.3m – 1.15m	-
Top Haigh Moor Coal	37m	105m – 145m	0.69m - 1.19m	-
Low Haigh Moor Coal	12m	117m – 157m	0.43m – 1.02m	-
Lidget Coal	42m	159m – 199m	0.3m – 1.52m	The deepest Pennine Middle Coal Measures seam thought to be present beneath the Site.

It should be noted that the coal seams are generalised to represent the entire Barnsley area, as such all seams may not be present across the Site, depths and thicknesses may also vary substantially.

The Barnsley Rider Coal is shown to subcrop beneath the eastern edge of the wider Trinity Academy site and given the regional dip direction to the east, is not considered to be present beneath the Site.

The height in which voids may migrate upwards is typically calculated using the T10 criteria based on 10 times the worked seam thickness in rock. The surface could clearly be impacted by void collapse in the Barnsley Coal given the shallow depth of the seam and the potential thickness of the seam. However, all other seams are at a depth where a thickness of rock greater than 10 times the potential worked seam thickness is present above the seam.

Seams of the Pennine Lower Coal Measures are thought to be present at depths greater than 140m, including the Flockton Thick, Fenton, Parkgate, Thorncliffe and Silkstone coal seams. These deeper seams are also thought to have been worked in the vicinity of the Site, but any workings are unlikely to impact the proposed development due to their depth.

3. Hazard Assessment and Preliminary Conceptual Model

The Preliminary Conceptual Model for the wider site is presented in the Preliminary Environmental Risk Assessment and is considered to be applicable for the Temporary School site. For ease of reference, the Conceptual Model is enclosed.

3.1 Contaminants of Concern

Contaminants of concern identified at the Temporary School site are summarised in Table 3.

Table 3: Contaminants of Concern

Source	Associated Contaminants
On-Site (current)	
Coal seams and mining activity	Ground gas
On-Site (historic)	
Arable land use	Pesticides and herbicides
Off-site (current)	
Boiler Room and Chimney/Incinerator	PAHs, metals, dioxins & furans
Above Ground Storage Tank	Oils and fuels (TPH)
Off-site (historic)	
Foundries[1]	Metals and semimetals, hydrocarbons inc. MTBE and BTEX, PCBs, asbestos, sulphates / chlorites
Colliery[2]	Metals, hydrocarbons, VOCs and SVOCs, asbestos
Velvet works[3]	Metals and semimetals, hydrocarbons, VOCs and SVOCs, asbestos
Brick works	Metals, hydrocarbons, asbestos
Fire and ambulance centre	Diesel fuel, asbestos
Unspecified mills, works and depots	Metals, hydrocarbons, asbestos

The suite of testing scheduled as part of the proposed ground investigation should address the contaminants of concern highlighted above.

4. Coal Mining Risk Assessment

The full details of the coal mining risks affecting the wider site are included in the Coal Mining Risk Assessment.

4.1 Coal Authority Interactive Map Viewer

The online Coal Authority Interactive Map Viewer indicates that past shallow workings are present below the Site. There are further areas of probable shallow workings identified beneath the Site. These are considered to be associated with potential workings in the Barnsley Coal.

[1] DoE Industry Profile - Metal manufacturing, refining and finishing works - iron and steel works
[2] DoE Industry Profile - Gas works, coke works and other coal carbonisation plants
[3] DoE Industry Profile - Textile works and dye works

Figure 2: Known and Probable Shallow Workings (Probable workings in purple and known workings in blue) (Coal Authority Interactive Map Viewer)

The Development High Risk Area generally corresponds to the areas of known and probable shallow workings.

4.2 Coal Authority Mining Report

The entire Trinity Academy site lies within an area where a Coal Authority Mining Report is required for new developments, with the area of the proposed Temporary School building defined as 'Development High Risk' by The Coal Authority. As part of the Coal Mining Risk Assessment, a Consultants Coal Mining Report was procured.

A summary of the report is presented below:

- Beneath the property, underground mining is recorded. An unnamed colliery mined the Barnsley Coal seam at a depth of between 10m and 21m with dipping rate 5.0° to 7.4° in an easterly direction. The seam had an extraction thickness of 274cm and was last worked in 1925;
- Dodworth Colliery, a Colliery approximately 2km west of the Site, and Rob Royd Colliery are identified to have worked beneath the Site;
- Dodworth Colliery worked the Flockton Thick, Top Fenton, Parkgate and Middleton Main seams at depths of between 140m and 253m below ground level in the area. Workings in the Top Fenton and Parkgate are identified beneath the Site itself at approximately 200m below ground level. The seams are identified to dip to the east and north east at an angle of between 3.6°

and 7.2°. The seams vary in extraction thickness between 66cm and 150cm. The last workings at Dodworth Colliery beneath the Site date to 1956, and the last workings at Dodworth Colliery in the area date to 1961;

- Rob Royd Colliery worked the Silkstone Coal seam beneath the Site at depths of between 278m and 293m below ground level. The seam is identified to dip to the east and north east at an angle of between 4.2° and 6.7°. The seam had an extraction thickness of 167cm and was last worked in 1910;
- The Coal Authority determine the property to be in an area with probable unrecorded mine workings;
- The Coal Authority Report recorded no spine roadways at shallow depth;
- 4No. mine shafts are identified in the report to be in the vicinity of the site. One of these, Coal Authority reference 433405-008, is shown to be on the Site itself. A Mine Entry Data Sheet purchased for this shaft confirmed that the Coal Authority do not hold any information relating to shaft or the treatment of the shaft;
- The following mine abandonment plan catalogue numbers intersect with some, or all, of the site boundary: CT86, 917, 780, NE565, 12461, SY209, NE584, NE1034, SY107. The report also notes that they hold further plans which could affect the Site;
- One outcrop within the site boundary is noted, this is the Barnsley Coal seam and it is determined as workable. The bearing of this outcrop is 330°;
- The Coal Authority have recorded one fault within the site boundary and surrounding area;
- The Coal Authority records that unlicensed opencast working has occurred approximately 400m to the west of the Site;
- The Coal Authority have recorded no Managed Tips within 500m of the site boundary;
- The Coal Authority record that the Site has been subject to previous remediation. A Surface Hazard Incident Report was subsequently obtained and provides some detail of the remediation work undertaken. An area of collapse, at the northern end of the POS, was treated by opening out the collapse to 2.2m by 1.5m and excavating to a depth of 4.5m below the surface to the base of the workings. 3No roadways could be seen to run off from the base of the excavation in a North-east, South-east (towards the proposed Temporary School building) and South-westerly direction. 12 Tonnes of clean 75 to 150mm limestone was placed and compacted in layers not exceeding 300mm to within 1.5m of the surface, whereupon a layer of geo-textile terram was placed across the stone and around the exposed sides. The as-dug sandy clay spoil was then placed and compacted in layers not exceeding 150mm thickness to the underside of the existing turf. Finally, the existing topsoil was used to reinstate the surface to the pre-existing field profile. The affected work area was tidied, and new grass seed placed. Full details and the location of the works are detailed in the Surface Hazard Incident Report enclosed;
- The Coal Authority has not received a damage notice or claim for the subject property, or any, property within 50m of the site boundary, since 31 October 1994;
- There is no current Stop Notice delaying the start of remedial works or repairs to the property;
- The Coal Authority is not aware of any request having been made to carry out preventative works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991;

- The Coal Authority have recorded no mine gas within 500m of the site boundary;
- The Coal Authority have recorded no mine water treatment schemes within 500m of the site boundary;
- The Coal Authority have no record of future underground mining;
- The Coal Authority have not granted any coal mining license within 200m of the enquiry boundary;
- The Coal Authority have no record of court orders;
- No notices have been given, under section 46 of the Coal Mining Subsidence Ace 1991, stating that the land is at risk of subsidence;
- The property is in an area where a notice to withdraw support was given in 1950;
- The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support;
- The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

The location of the mine shaft and previous remedial works are shown on Waterman Drawing Ref: WIE17125-100-WIE-ZZ-XX-DR-V-80-003, enclosed.

4.3 Coal Authority Mine Abandonment Plans

In order to determine the relevance of the above noted Abandonment Plans, The Coal Authority's Mining Consultant and Information Manager for the Barnsley region was contacted (4th September 2020). A large number of abandonment plans are available for the property; however, the majority relate to deep workings. 3No. abandonment plans relate to shallow workings within the Barnsley Coal, and these were obtained as part of the Coal Mining Risk Assessment.

Abandonment Plan 917, enclosed, dates to 1878 and relates to workings in the Barnsley Coal from Keresforth Colliery. This plan shows a "pit" in close proximity to the shaft (Shaft Ref: 433405-008), close to the proposed Temporary School building. The abandonment plan shows a small area of workings to be present in close proximity to this shaft, extending towards the proposed structure.

Larger scale workings and additional pits are shown to the west and south of the Site. These roughly correlate with the area of worked ground identified to the west and south of the Site in the historical mapping and the indicated line of the Barnsley Coal subcrop. It may be that Keresforth Colliery was formerly present in this area, but was not in existence at the time that the available historical maps were produced. Keresforth Colliery may relate to Keresford Hill Pit identified in the Groundsure Report.

Abandonment Plan 9746 relates to workings in the Barnsley Coal from Houndhill Colliery. This plan shows workings beneath the southern end of the area of POS to the south of the Site. These workings date to 1925 and are shown to be at approximately 128m AOD, approximately 22m below ground level.

Abandonment Plan 9116 also relates to workings in the Barnsley Coal from Houndhill Colliery; specifically, No. 2 Pit. This plan essentially provides the same information as shown on 9746.

4.4 Previous Ground Investigation

The previous phase of ground investigation undertaken across the wider Trinity Academy site assessed the risks to the proposed school in the east of the Site. Limited investigation was undertaken in the vicinity of the proposed Temporary School as the area is proposed for sports fields and landscaping as part of the final development.

Limited chemical testing identified elevated concentrations of beryllium, benzo(b)fluoranthene, benzo(a)pyrene and di-benzo(a,h)anthracene in the soils beneath the POS on which the Temporary School building is to be constructed, when compared to screening criteria for a residential without plant uptake end-use. Exceedances were relatively minor, however, the Geo-Environmental Assessment considered that a cover system is likely to be required in areas of landscaping to break the potential pathway between the site soils and end-users.

The mine shaft highlighted in the Coal Authority consultation was identified in TP110 and found to be uncapped and to have a diameter of approximately 2.5m. The shaft backfill was present from approximately 0.5m below ground level and comprised of Colliery Spoil.

4.5 Summary

The area of the Temporary School building is in a Coal Authority High Risk Development Area, and the research undertaken as part of the Coal Mining Risk Assessment and the previous phase of ground investigation indicate that the Barnsley Coal is potentially present at shallow depths beneath the Site. The potential presence of **shallow mine workings** is regarded as **probable**. The presence of a **mine shaft** was **confirmed** during the previous phase of ground investigation. This assessment aligns with the Coal Authority Consultants Coal Mining Report, which notes the site to be located in an area with known and probable shallow mine workings.

Considering all information reviewed in undertaking this study, the risk to the development associated with the mining legacy is currently assessed as **high**, and further works are recommended in order to reduce the risk to low.

5. Coal Mining Risk Mitigation Strategy

5.1 Further Works

The Coal Mining Risk Assessment has identified the following moderate to high coal mining related risks to the proposed development:

- Recorded and Unrecorded Shallow Mine Workings below the Site (ground collapse / settlement risk/ crown hole development) associated with potential workings in the Barnsley Coal Seam;
- Unrecorded Surface Mining (ground collapse / settlement risk/ crown hole development);
- A mine entry (ground collapse / settlement risk/ crown hole development) is identified to be present close to the proposed Temporary School building. The potential presence of unrecorded mine entries cannot be discounted.
- Potential for mine gas emissions associated with any historical mine workings; and,
- Potential for spontaneous combustion within the Barnsley Coal.

In order to mitigate against the risk of shallow workings, prior to construction of the Temporary School building, a targeted investigation (intrusive ground investigation) should be undertaken to confirm the mining position at the Site. This should be based on a conceptual mining (ground) model to be developed using mapping information currently available to create cross-sections in order to identify areas of the site at risk of shallow workings based on potential seam thicknesses.

Given the likely shallow depth of historical mining beneath the proposed Temporary School, the intrusive ground investigation should include rotary drilling to nominally 15m below ground level to confirm the presence/absence of coal seams below site and evidence of any workings in the form of mine waste or voids. Ground gas monitoring standpipes should be installed to assess the potential risk due to ground gas.

The area of previous remedial works carried out on behalf of the Coal Authority, and the reported shallow mining features associated with this, should be investigated to determine the extent of shallow mining. This investigation is likely to comprise a mix of trial trenching and shallow rotary open hole drilling.

The Risk Assessment and Method Statement prepared for the ground investigation should address the potential risk of hazardous mine gas emissions and spontaneous combustion. The design of the proposed development will also consider the potential risks to end users as a result of mine gas and spontaneous combustion.

By completing a detailed ground model first this will allow the ground investigation design to be optimised for the proposed site layout and as such reduce the scope of intrusive investigation required by assessing the likely depth and thickness of seams below site in relation to the T10 criteria as per CIRIA C758D.

The mine shaft should be appropriately treated during the mine treatment works, most likely by construction of a reinforced concrete cap. Given the proximity of the shaft to the proposed Temporary School building, the presence of the shaft should be considered in the design of the proposed foundations. Foundations should be designed to avoid additional load being transferred to the shaft lining and backfill, and the proposed concrete cap.

Following completion of the ground investigation, risk levels can be re-assessed and, if required, remedial measures appropriate to the development implemented. Dependant on the extents of workings this would most likely take the form of amending development layouts to avoid structures in areas of mining risk where possible, grouting up any former workings identified, utilising alternative foundation solutions, or a combination of these measures.

5.2 Coal Authority Permission

It should be noted that before a ground investigation is undertaken, prior written permission from The Coal Authority is required for intrusive activities which will disturb or enter any coal seams, coal mine workings or coal mine entries (shafts and adits). An additional permit would then be required prior to commencing any proposed treatment works. Further information on The Coal Authority's permissions process can be found at: www.coal.gov.uk.

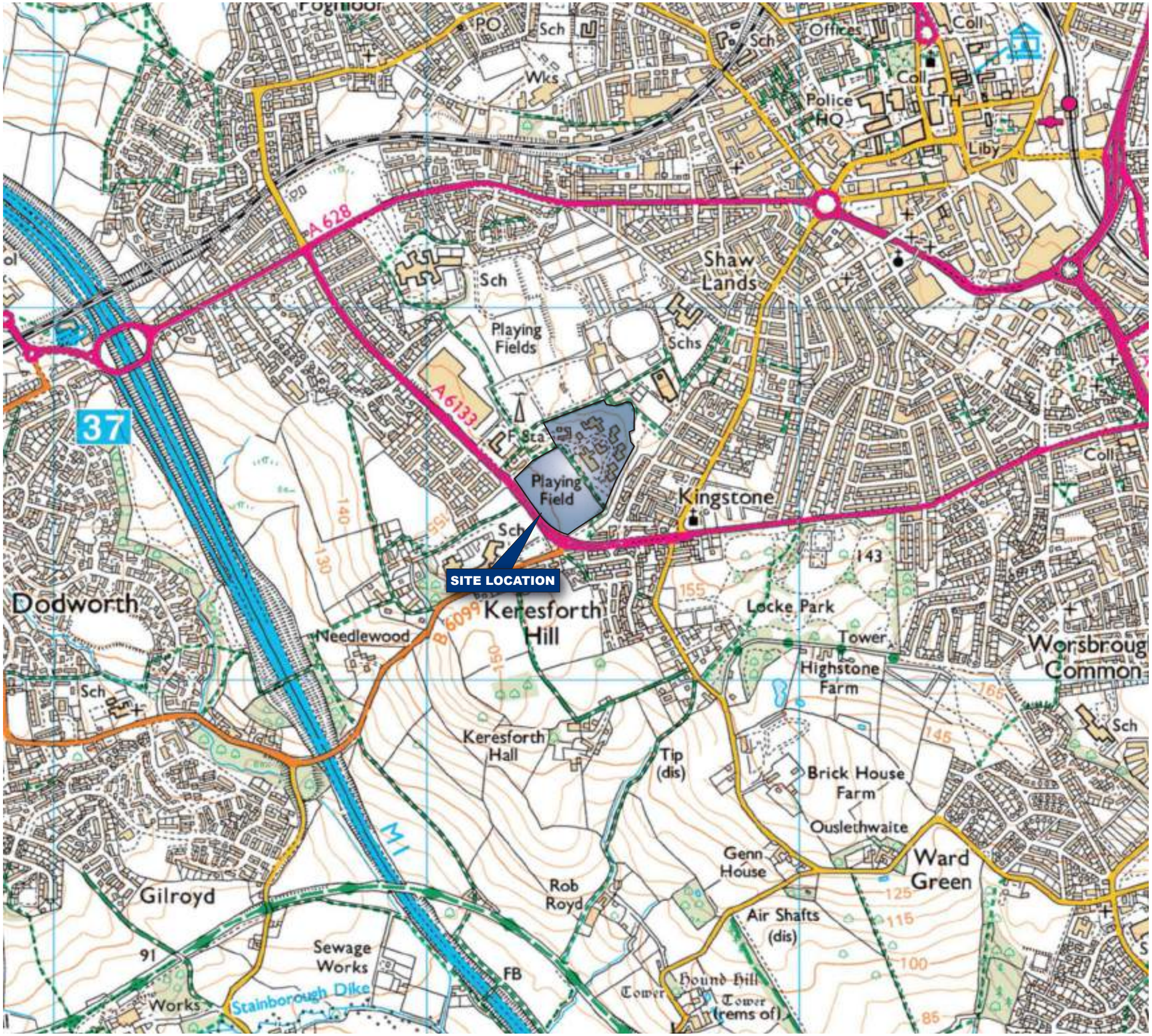
6. Conclusions and Recommendations

Full conclusions and recommendations are included in the various reports prepared for the wider Trinity Academy site.

The Preliminary Conceptual Site Model, enclosed, indicates that the highest risk estimated for potential pollutant linkages was Medium. This rating was given to five of eight potential pollutant linkages. It is considered that the overall risk rating for the proposed development is **Medium**.

The recommendations of this report outline preliminary remedial and mitigation measures that require confirmation through additional works. However, once successfully implemented, the risks are anticipated to be Low. Therefore, the NPPF requirement that on completion the Site can no longer be captured under the Part IIA regime is expected to be met.

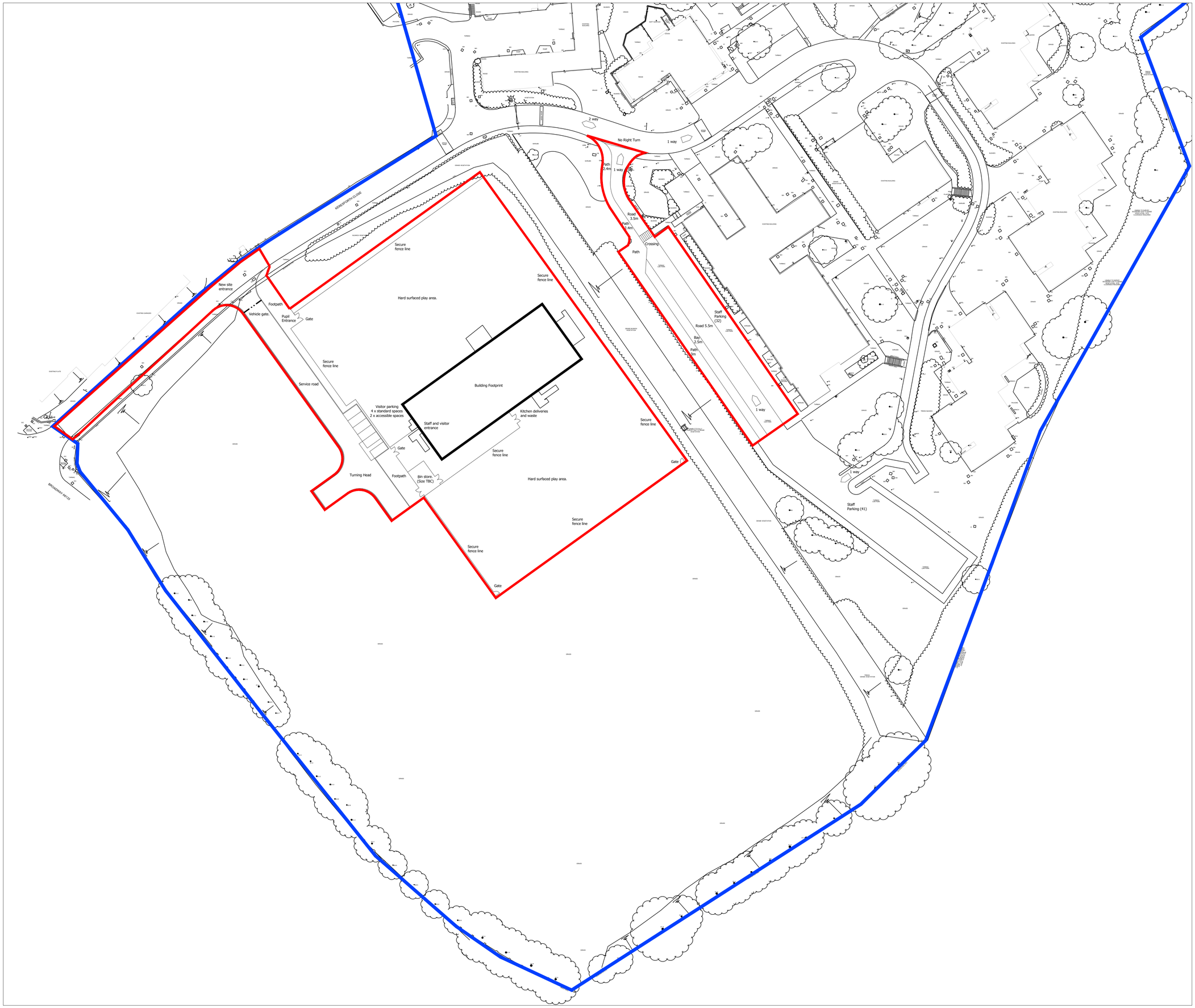
A geo-environmental ground investigation should be completed, including soil/groundwater sampling and ground gas/vapour monitoring to confirm risks to future site users and provide design parameters for the proposed development. The ground investigation should assess the potential presence of mining related features beneath the Site.



waterman

N

Project Details	WIE17125-103: Keresforth Academy
Figure Title	Figure A1: Site Location Plan
Figure Ref	WIE17125-103_GR_PRA_A1A
Date	June 2020
File Location	\\s-lncs\wiel\projects\wie17125\103\graphics\pra\issued figures



N

1:500 SCALE BAR

0 5 10 20 30 Metres

Revision: P1 Date: 10/12/2020 Drawn: PB Checked: MS

Suitability: PL Planning

Trinity Academy Temporary School

Proposed Block Plan

Location:
Land at Keresforth Close
Barnsley
S70 6RS

Client:
The Department for Education

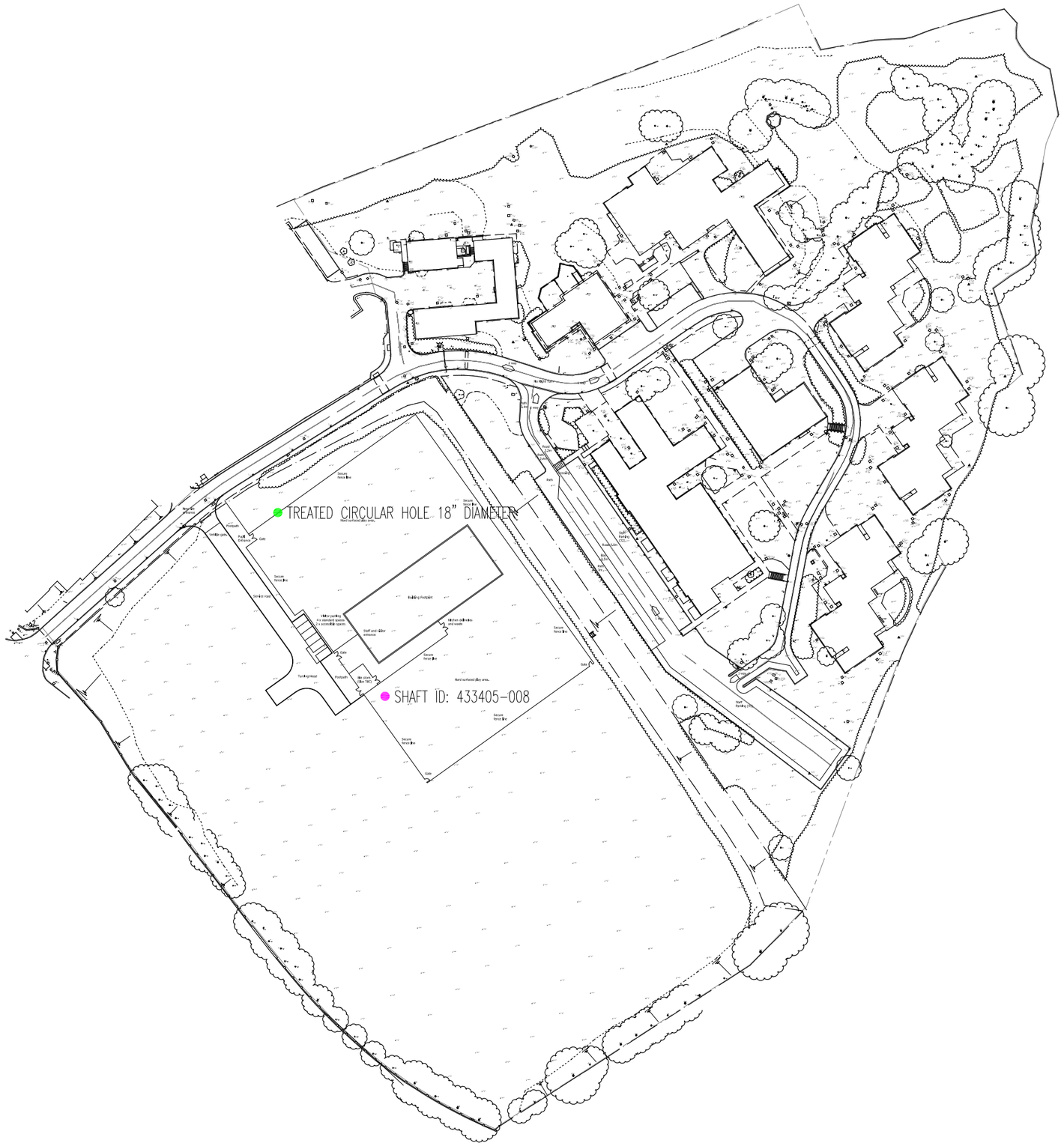
UPRN	Originator	Zone	Level	Type	Role	Number	Revision
TRNTY	WBA	NB	00	DR	A	PL_101	P1

Date: 10/12/2020 Drawn: PB Checked: MS Scale: 1:500 @A1 Int Job No: 3766_015_XXX
CAD REF:

WATSON BATTY ARCHITECTS
Shires House, Shires Road
Guiseley, Leeds LS20 8EU
Leeds | Loughborough
T: 01943 876 665
E: enquiries@watsonbatty.com
W: www.watsonbatty.com

FUTURE BUILT

Note: Do not Scale from this drawing. All dimensions to be checked on site.



GENERAL NOTES

SITE BOUNDARY

LOCATION OF MINESHAFT

TREATED CIRCULAR HOLE 18" DIAMETER

Rev	Date	Description	By
P01	15.12.20	PRELIMINARY ISSUE	DC

Amendments

Project

TRINITY ACADEMY BARNSLEY

Title

EXPLORATORY HOLE LOCATION PLAN (PROPOSED LAYOUT)

Client

2nd Floor South Central 11 Peter Street Manchester M2 5QR
t 0161 839 8392
mail@watermangroup.com www.watermangroup.com

Status: PRELIMINARY

Designed By	Checked By	Waterman Ref
AM	AM	WIE17125-100
Drawn By	**Date**	**Scales @ A3**
DC	DECEMBER 2020	1:1500

Project - Originator - Volume - Level - Type - Role - Number	Revision
17125-100-WIE-ZZ-XX-DR-V-80-003	P01

A3-Wat-BS-S, WIE17125-100-SA-80-Proposed-layout

Table 8: Preliminary Conceptual Model for the Site

Source	Pathways	Receptor	Risk	Justification / Mitigation	Residual Risk
Human Health					
Potential contamination in Made Ground and shallow soils from land uses surrounding the Site.	Dermal contact and inhalation of dust from contaminated soils during works Contact with potential contamination in shallow soils in areas of soft landscaping.	Future Site Users	Low	Significant potentially contaminative land uses have not been identified at the Site. Within the surrounding area, some activities including foundries and collieries, along with various works may have caused minor ground contamination with the potential to migrate onto the Site via shallow groundwater within the Glacial Till. The proposed development works involve construction of new residential and academy buildings, surrounded by hardstanding with some soft landscaping and play areas. The Site is within an area identified by the Coal Authority as being high risk for new developments. Geotechnical ground investigation will be necessary to inform foundations design for future structures This investigation should include environmental testing of shallow soils and groundwater to identify if contamination from nearby land uses has impacted the Site.	Low
Worked Coal Seams (Ground gas and vapours)	Accumulation in confined spaces, leading to inhalation.	Future Site Users	Medium	The Site is within an area of coal seams, with the Middle Pennines Coal Measures present at shallow depths. This could act as a potential source for ground gas. The proposed ground investigation should include an assessment of the potential for ground gas or vapours. Findings should inform any mitigation or remediation measures necessary at the proposed development.	Low
Potential contamination in Made Ground and shallow soils.	Windborne, potentially contaminated construction dust. Runoff from stockpiled soils.	Off-Site Users and nearby residents	Medium	A Construction Environmental Monitoring Plan (CEMP) should be prepared for the works, including measures to minimise runoff from stockpiled soils, manage groundwater in excavations and suppress the generation of dust. Construction materials brought on-Site as part of works will be appropriately stored to prevent spills and leaks. This should prevent potentially contaminated material reaching off-Site residents.	Low

Source	Pathways	Receptor	Risk	Justification / Mitigation	Residual Risk
Potential contamination in Made Ground, shallow soils, and shallow groundwater.	Dermal contact and ingestion. Dust inhalation. Ground gas and vapour accumulation in trenches and confined spaces, leading to inhalation followed by asphyxiation and risk of explosion.	Construction Workers	Medium	Construction workers will be provided with appropriate personal protective equipment (PPE). Workers should be aware of good hygiene measures as protection against direct contact with contaminated Made Ground, contaminated groundwater, ground gas, vapours and dust inhalation. Works will be undertaken in accordance with the Control of Asbestos Regulations 2012.	Low
Unexploded Ordnance	Direct contact	Construction workers and nearby residents.	Low	An Unexploded Ordnance Desktop Assessment for the Site determined the risk from German and anti-aircraft unexploded ordnance as low. The risk of Allied ordnance was assessed as negligible. A UXO Risk Management Plan will be prepared for the Site. Site Specific UXO Awareness Briefings will be provided to all personnel conducting intrusive works.	Low
Property					
Contamination in Made Ground, shallow soils, and shallow groundwater.	Direct contact with building foundations and buried services leading to chemical attack.	Site structures and services	Medium	Geotechnical investigation as part of design works for the development should include sampling and testing of soils to assess the risk posed by chemical attack. If required, appropriately designed buried concrete and barrier water supply pipes should be used at the development.	Low
Contamination in Made Ground, shallow soils, and shallow groundwater.	Direct contact with building foundations and buried services leading to chemical attack.	Off-Site Structures	Low	No significant previous potentially contaminated land uses have been identified at the Site, and therefore the risk for potential impacts to off-site surrounding receptors is considered to be low.	Low
Controlled Waters					
Contamination in Made Ground, shallow soils, and shallow groundwater.	Migration through Glacial Till to nearby watercourses. Runoff from stockpiled soils.	Surface watercourse 26m south of the Site	Low	No significant previous potentially contaminated land uses have been identified at the Site, and therefore the risk for potential ground contamination sources causing impacts to the watercourse is considered low.	Low

Source	Pathways	Receptor	Risk	Justification / Mitigation	Residual Risk
Construction materials stored on-Site as part of development works.	Spills to ground, and the nearby watercourse.	Surface watercourse 26m south of the Site	Medium	A CEMP should be prepared for the demolition and construction works on-Site, detailing measures to minimise the potential risk to controlled waters. Construction materials brought on-Site as part of works should be appropriately stored to prevent spills and leaks. This should prevent potentially contaminated material reaching surface watercourses.	Low

W

E

SITE EXTENT

CONSTRUCTION WORKERS PROVIDED WITH APPROPRIATE PPE FOR BELOW GROUND WORKS AND MADE AWARE OF GOOD HYGIENE PRACTICES

MEASURES TO PREVENT RUNOFF OR WINDBORNE DUST FROM STOCKPILED SOILS OR SPILLS / LEAKS OF CONSTRUCTION MATERIALS CONTROLLED THROUGH CREATION OF A CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN FOR THE WORKS

PROPOSED NEW COLLEGE BUILDINGS

PROPOSED NEW RESIDENCES WITH PRIVATE GARDENS

PROPOSED NEW SPORTS PITCH

MADE GROUND

STOCKPILED EXCAVATED SOILS AND CONSTRUCTION MATERIALS

RISK OF CHEMICAL ATTACK TO FUTURE BELOW GROUND STRUCTURES ASSESSED AS PART OF GEO-ENVIRONMENTAL GROUND INVESTIGATION

POTENTIAL FOR GROUND GAS INGRESS INTO NEW BUILDINGS ARISING FROM PENNINE MIDDLE COAL MEASURES BENEATH THE SITE, ASSESSED AS PART OF THE GROUND INVESTIGATION

GLACIAL TILL

SIGNIFICANT POTENTIALLY CONTAMINATIVE LAND USES HAVE NOT BEEN IDENTIFIED AT THE SITE. THE ABSENCE OF ANY GROUND OR GROUNDWATER CONTAMINATION WILL BE CONFIRMED BY GEO-ENVIRONMENTAL GROUND INVESTIGATION

PENNINE MIDDLE COAL MEASURES

NO SIGNIFICANT GROUNDWATER ANTICIPATED AT SHALLOW DEPTHS BENEATH THE SITE, MINIMISING THE POTENTIAL FOR TRANSPORT OF GROUND CONTAMINATION ON OR OFF THE SITE.

Project Details	WIE17125-103: Keresforth Academy
Figure Title	Figure A3: Conceptual Site Model
Figure Ref	WIE17125-103_GR_PRA_A3A
Date	June 2020
File Location	\\s-lncs\wiel\projects\wie17125\103\graphics\pra\issued figures

PLAYING FIELD OFF BROADWAY AT JUNCTION WITH KERESFORTH CLOSE
BARNSLEY

Our reference:	**7100_I-345748_1**
Your reference:	
Date of your enquiry:	**30 May 2014**
Date we received your enquiry:	**30 May 2014**
Date of issue:	**30 May 2014**
Grid Reference	**433309 405586**

Public Safety Incident Report

Overview

Approximate position of property

Mining Data

Stop Areas

There are no stop areas within 100m of the report site boundary.

AFMRI

There are no AFMRIs within 100m of the report site boundary

Designations

There are no designations within 100m of the report site boundary

Past Underground Mining

Colliery	Seam	Seam Code	Mineral	Panel	Depth (m)	Direction to working (degrees)	Disposition	Extraction Thickness (cm)	Dip Rate	Dip Direction (degrees)	Year
DODWORTH	FLOCKTON THICK	NY270K	Coal	6IE9	141	256	0.6	70	15.9	43	1942
DODWORTH	MIDDLETON MAIN	NY330Y	Coal	6IEH	244	267	0.3	150	11.7	54	1961
DODWORTH	PARKGATE	NY310K	Coal	6IEF	235	Beneath Property	0.0	137	15.1	61	1942
ROB ROYD	SILKSTONE	NY360K	Coal	6IEI	324	152	0.6	167	8.5	97	1901
ROB ROYD	SILKSTONE	NY360K	Coal	6IEJ	305	Beneath Property	0.0	167	13.6	50	1909
DODWORTH	TOP FENTON	NY290K	Coal	6IED	213	Beneath Property	0.0	91	13.0	54	1953

Spine Roadways at shallow or moderate depth (nearest roadway)

There are no spine roadways within 50m of the report site boundary that lie at less than 100m depth

Probable unrecorded workings (nearest workings)

Depth Indicator	Distance to working (m)	Direction to working (degrees)
Shallow	0.2	180

Outcrops

Seam Name	Seam Code	Mineral	Thin Indicator	Distance to Outcrop (m)	Direction to Outcrop (degrees)	Conjectured
BARNSLEY	NY210K	Coal	False	37.3	54	True

Licence Details (AOR)

There are no AORs within 100m of the report site boundary

Licence Details (Surface Hazard Area)

There are no surface hazard areas within 100m of the report site boundary

Geology

There is a Fault beneath the enquiry boundary. This position is conjectured.

Mine entries

There are no mine entries within 20m of the report site boundary

Opencast sites

There are no opencast sites within 100m of the report site boundary

Permits

There are no permits within 100m of the report site boundary

PS&S information

Subsidence Claims

There are no subsidence claims within 100m of the report site boundary

Coal mining related hazards

Reference	Status	Distance to CMRH (m)	Direction to CMRH (degrees)
I-345748	01 - Awaiting Decision	Beneath Enquiry	N/A

Mine gas

There are no mine gas incidents within 1000m of the report site boundary

Siteworks

There are no siteworks within 100m of the report site boundary

PLM information

Monitor Points

There are no monitor points within 100m of the report site boundary

Discharge Points

There are no discharge points within 100m of the report site boundary

Tips

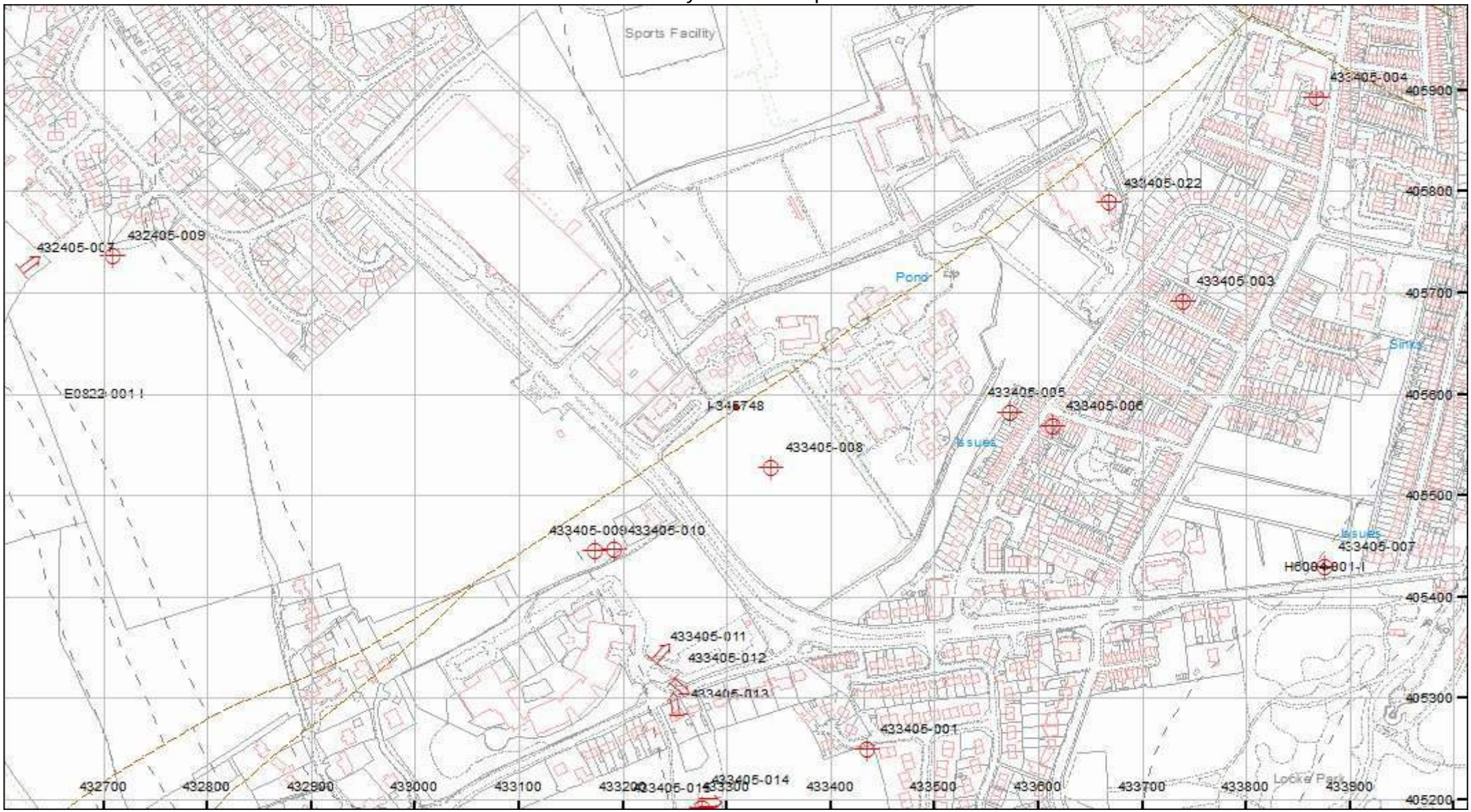
There are no tips within 100m of the report site boundary

Other information

Properties

There are no properties within 100m of the report site boundary

Public Safety Incident Report Plan



Key

Approximate position of enquiry boundary shown

Mine entries

Outcrops

Geology

Hazards

7100_I-345748_1

The Coal Authority

INVESTOR IN PEOPLE

200 Lichfield Lane
Berry Hill
Mansfield
Notts
NG18 4RG
Web: www.coal.decc.gov.uk
Fax: 01623 637398

Date: 16th June 2014

This matter is being dealt with by:

Mr Keith Ollivant
Tel: 07770 678394
Email: keithollivant@coal.gov.uk

Admin Officer
Sarah Musson
Tel: 01623 637282
Email: sarahmusson@coal.gov.uk

Our Ref: I-345748

Mr M Lyons
SYMAS
P O Box 604
Barnsley
South Yorkshire
S70 9FE

Dear Mark,

Surface Hazard at Playing Field adjacent to Keresforth Close, Barnsley.
O.S. National Grid Co-ordinates at centre of collapse are 433300mE and 405590mN.

I refer to the report of a surface hazard to the Coal Authority on 30th May, 2014, and our subsequent investigation of this ground collapse on 12th June, 2014, which was proven to be caused by shallow unrecorded workings within the Barnsley Seam. As such responsibility for its remediation rests with the Coal Authority.

It was treated by opening out the collapse to 2.2m by 1.5m and excavating to a depth of 4.5m below the surface to the base of the workings. 3No roadways could be seen to run off from the base of the excavation in a North-east, South-east and South-westerly directions. 12 Tonnes of clean 75 to 150mm limestone was placed and compacted in layers not exceeding 300mm to within 1.5m of the surface, whereupon a layer of geo-textile terram was placed across the stone and around the exposed sides. The as-dug sandy clay spoil was then placed and compacted in layers not exceeding 150mm thickness to the underside of the existing turf. Finally the existing topsoil was used to reinstate the surface to the pre-existing field profile. The affected work area was tidied and new grass seed placed. Approximately 10 Tonnes of surplus as-dug material was removed by grab wagon to a licensed waste site. The existing fencing has been taken down and laid to the side of the field for collection by your team.

To assist us in monitoring our service it would be appreciated if you could complete and return the attached customer satisfaction form using the enclosed stamped addressed envelope. Thank you for your prompt assistance in facilitating our works.

As discussed with you on site at the time of our works it would be appreciated if you could consider whether the Coal Authority can assist your organisation in the research, procurement or carrying-out of any future investigation of possible shallow workings, both coal and other minerals, which could exist under land which the Council may be considering developing on a commercial basis. Please feel free to contact either myself or my line manager Lee Cammack at any time on 01623 637214 should you identify any such business opportunities. Any such requests will be treated in a professional and confidential manner.

Meanwhile, should you have any concerns about the above or require any additional information please do not hesitate to contact me. Please use the above telephone numbers during office hours, or in the event of an **emergency out of office hours**, telephone 01623 646333, quoting reference number I-345748.

Yours sincerely,

Keith Ollivant
Regional Project Manager – Public Safety and Subsidence

SCHEME: - Term Contract Emergency Call Out - Minor Works - Contract Ref: CA18/2345 **Prj: 19165**
The Coal Authority

APPLICATION FOR PAYMENT: Order No. **ORD-014228** **I-345748**

LOCATION: **PLAYING FIELD OFF BROADWAY AT JUNCTION WITH KERESFORTH CLOSE, BARNSLEY**

Item Ref.	Description	Quantity	Unit	Rate	Total
	Date work carried out: 12.6.2014				
Labour					
C1	Foreman	8	hrs	£25.20	£201.60
C9	Machine driver	8	hrs	£19.33	£154.64
C61	Grab lorry	8	hrs	£19.33	£154.64
C61	Delivery/collection	3	hrs	£19.33	£57.99
		Total to Summary			**£568.87**
Plant					
CECA 10(19)	8t Excavator	8	hrs	£30.93	£247.44
CECA 14(24)	Van 2/3 x £25.16 = £16.77	8	hrs	£16.77	£134.16
CECA 14(16)	16t Lorry	8	hrs	£28.31	£226.48
CECA 14(10)	Grab attachment	8	hrs	£2.53	£20.24
CECA 14(8)	Delivery/collection	3	hrs	£37.70	£113.10
	Percentage adj for CECA Plant	-10%		£741.42	-£74.14
		Total to Summary			**£667.28**
Materials					
P Watson	75mm to 150mm clean stone	12	tn	£18.00	£216.00
buntings	Grass Seed	1	bag	£72.00	£72.00
ACS Yard	Lotrack non woven	25	m2	£3.00	£75.00
	Percentage adj for Materials	12.50%		£363.00	£45.38
					£408.38
				TOTAL	**£1,644.52**

PUBLIC SAFETY AND SUBSIDENCE – PROJECT COMPLETION REPORT

Project Ref: P-018314 (I-345748)	Date reported 30/5/2014
Address/Location of Hazard Playing Field off Broadway at Junction With Keresforth Close Barnsley South Yorkshire	
Coordinates: 433300, 405590	Mining Report Ref: MR-7100_I-345748_1-1401440490281
Hazard reported as: Circular hole approx. 182 diameter, fairly deep	

Hazard Type	Mine Workings – Shallow – Not Recorded
Shaft / Adit Ref No: (if applic)	N/A

Coal Authority Desktop Investigation:

Based on the coordinates given by the informant, there have been five seams of past recorded underground coal workings within the vicinity of this collapse, these being from the Flockton Thick (NY270K), Middleton Main (NY330Y), Parkgate (NY310K), Silkstone (NY360K) and Top Fenton (NY290K), these range in depth from 141m (Flockton Thick) up to 324m (Silkstone). The last recorded workings were in 1961 from the Middletom Main Seam at a depth of 244m.

There is an area of past shallow workings 30m away to the South of this location.

The collapse is sat on the edge of shallow probable unrecorded workings.

There is a seam outcropping from the Barnsley Seam (NY210K) approximately 37m away to the North-east which dips towards the location.

There is a conjectured fault beneath this location.

The nearest mine entry is over 60m away to the south/south-east of this location.

There have been no previous claims or incidents within influencing distance.

Description of Investigation Works

N/A

Site Works Started		Site Works Complete	

Description of Treatment Works

Treated by opening out the collapse to 2.2m by 1.5m and excavating to a depth of 4.5m below the surface to the base of the workings. 3No roadways could be seen to run off from the base of the excavation in a North-east, South-east and South-westerly directions. 12 Tonnes of clean 75 to 150mm limestone was placed and compacted in layers not exceeding 300mm to within 1.5m of the surface, whereupon a layer of geo-textile terram was placed across the stone and around the exposed sides. The as-dug sandy clay spoil was then placed and compacted in layers not exceeding 150mm thickness to the underside of the existing turf. Finally the existing topsoil was used to reinstate the surface to the pre-existing field profile. The affected work area was tidied and new grass seed placed. Approximately 10 Tonnes of surplus as-dug material was removed by grab wagon to a licensed waste site

Treatment Works Started	12/6/2014	Treatment Works Complete	12/6/2014
Coal Authority Liability		YES	

Other Comments			
Signed		Date	

Copies to: Mining Reports & File

The Coal Authority

Incident Notification Report

Incident Report

Incident Reference: I-345748

Date Received: 30 May 2014

Time Received: 09:52

Call Officer: leccig

Duty Officer: sharlo

Nature of Incident:

CIRCULAR HOLE 18" DIAMETER FAIRLY DEEP

Occurrence of Incident:

YESTERDAY

Incident Location

Address: PLAYING FIELD OFF BROADWAY AT JUNCTION WITH KERESFORTH CLOSE, BARNSLEY,

Authority Region: Yorkshire

Co-ordinates: 433309 **mE** 405587 **mN**

Location Details: APPROX COORDS 433309, 405587
S70 6RS

Interest: **Informant**

Name: Mr RAY HUNTER

Tel. No.: 01226 772684

Other No.:

Organisation: SYMAS

Address: BARNSLEY, SOUTH YORKSHIRE S70 9FE

KPI's

Rule Name	Start	Period		Completed
		Days	Hour	
Determine liability	30 May 2014 09:59	180	0	
Grade 2 - Priority Response - Deploy a competent person to site	30 May 2014 09:59		1	30 May 2014 10:12
Grade 2 - Priority Response - Competent person to arrive on site	30 May 2014 10:12		4	

Other Information

Desktop Investigation:

Based on the coordinates given by the informant, there have been five seams of past recorded underground coal workings within the vicinity of this collapse, these being from the Flockton Thick (NY270K), Middleton Main (NY330Y), Parkgate (NY310K), Silkstone (NY360K) and Top Fenton (NY290K), these range in depth from 141m (Flockton Thick) up to 324m (Silkstone). The last recorded workings were in 1961 from the Middletom Main Seam at a depth of 244m.
There is an area of past shallow workings 30m away to the South of this location.
The collapse is sat on the edge of shallow probable unrecorded workings.
There is a seam outcropping from the Barnsley Seam (NY210K) approximately 37m away to the North-east which dips towards the location.
There is a conjectured fault beneath this location.
The nearest mine entry is over 60m away to the south/south-east of this location.
There have been no previous claims or incidents within influencing distance.

— Hereforth Colliery —
worked by
— Messrs E. Cherry and Company —
in the
— Barnsley Thick Coal Seam —
June 1875

F. W. T. VERNON WENTWORTH ESQUIRE

Reference

Represents Old Works

Represents Workings by Messrs E. Cherry & Co

(Signed) Frank: R. Wardell.
Inspector of Mines.

21 December 1878.

Copied in the Mines Department
M. Garrish
24th September 1883

Checked
G. H. Lewis
23rd Sept 1883

SECTION
COAL & OTHER

Scale 2 Chains to an Inch

Trinity Academy, Barnsley – Temporary School

Supplementary Geo-Environmental Assessment

March 2021

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Client Name:	Turner & Townsend
Document Reference:	WIE17125-100-R-13.1.3-GeoEnv
Project Number:	WIE17125

Quality Assurance – Approval Status

This document has been prepared and checked in accordance with Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015 and BS EN ISO 45001:2018)

Issue	Date	Prepared by	Checked by	Approved by
Draft	March 2021	Andrew Mould Principal Consultant	Chris Gell Senior Associate Director	John Hughes Regional Director

Comments

13.1.3	Draft – to be updated upon completion of ground gas monitoring

Comments

Disclaimer

This report has been prepared by Waterman Infrastructure & Environment Limited, with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporation of our General Terms and Condition of Business and taking account of the resources devoted to us by agreement with the client.

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at its own risk.

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Appendices

1. Introduction

1.1 Objectives and Brief

Waterman Infrastructure & Environment Limited ('Waterman') was instructed by Turner & Townsend to undertake a Supplementary Geoenvironmental Assessment for the Temporary School proposed as part of the redevelopment of the former playing field adjacent to the A6133 Broadway at the Keresforth Centre NHS Facility, Barnsley. The main objectives of the report are to:

- Provide an exploratory investigation as defined by BS10175 (2011+A2:2017);
- Develop a refined conceptual site model based on the investigation, including a decision record for the development of the model;
- Assist in discharging planning conditions relating to the investigation and remediation of contaminated land;
- Derive representative geotechnical parameters in accordance with Eurocode 7 and characterize the ground for the purposes of geotechnical design;
- Provide an assessment of suitable foundation types for the proposed development;
- Assess the suitability of materials arising in earthworks activities for re-use on site or disposal;
- Provide a preliminary waste classification of the likely waste soils;
- Provide an initial assessment of mining risk and advice relating to the stabilisation of shallow workings/shafts affecting the site;
- Investigate pavement design and provide CBR values at selected locations at formation level;
- Provide an assessment of hazardous gas risk in accordance with CIRIA Report C665 / BS8485 and preliminary recommendations relating to protective measures required in foundations (if any); and
- Allow feasible remediation options to be evaluated and determine the most appropriate remediation strategy to be developed.

This assessment has been undertaken in general accordance with the Land Contamination Risk Management (Environment Agency, October 2020) guidance and forms a decision record in relation to the assessment of the site. The report also provides a refined conceptual model based on the findings of the ground investigation, an evaluation of potential risks and recommendations relating to any necessary remediation.

The assessment was undertaken in accordance with the scope agreed between Waterman and Turner & Townsend, as documented in Waterman's fee letter, and with Waterman's standard Terms of Appointment. The benefit of this report is made to Turner & Townsend.

1.2 The Proposed Development

The Site is proposed to provide a temporary secondary school. This development will include a temporary school building in the south of the Site and associated infrastructure including a hard surfaced car park, playground and access road.

The proposed development is presented on Watson Batty Architects Drawing Ref: TRNTY-WBA-NB-00-DR-A-PL-101 P1, included in Appendix A.

1.3 Limitations

The information contained in this report is based on the findings of the Preliminary Environmental Risk Assessment (Report Ref. WIE17125-100-R-1.2.1-RJM), the Coal Mining Risk Assessment (Report Ref. WIE17125-100-R-7-1-3-CMRA), and the Geoenvironmental Assessment for the permanent school (Report Ref: WIE17125-100-R-8.1.3-Geoenv), observations made on site, exploratory hole records, laboratory test results, groundwater monitoring and ground gas monitoring.

The ground conditions reported relate only to the point of excavation and do not necessarily guarantee a continuation of the ground conditions throughout the non-inspected area of the site. Whilst such exploratory holes would usually provide a reasonable indication as to the general ground conditions, these cannot be determined with complete certainty.

Waterman has endeavoured to assess all information provided to them during this investigation, but makes no guarantees or warranties as to the accuracy or completeness of this information.

The scope of this site investigation includes an assessment of the presence of asbestos containing materials in the ground at the site but not within buildings or structures or below ground structures (basements, buried service ducts and the like).

The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

2. Outline Conceptual Model

The outline conceptual model is contained in the Preliminary Environmental Risk Assessment (Ref. WIE17125-100-1.2.1-RJM) and is summarised below.

2.1 Anticipated Ground Conditions

The anticipated ground conditions are summarised in Table 1.

Table 1: Ground conditions

Stratum	Area Covered	Depth to Top of Stratum (m bgl)	Typical Description
Made Ground or Topsoil	Entire Site	0 to 1.0m – deeper in the west	Topsoil over colliery waste or soft brown clay with fragments of brick, concrete and pottery
Glacial Till	Entire Site	0.45 to 1.06	Soft to firm grey laminated sandy clay with silt partings and bands of medium-coarse gravel.
Pennine Middle Coal Measures Formation	Entire Site	1.5 to 2.7	Interbedded hard, grey siltstone with bands of soft mudstone, and black coal shale.

A large area in the west of the Site is indicated to be underlain by Made Ground on the BGS mapping.

A geological fault crosses the northern area of the Site trending from north east to south west and downthrowing to the south. The Barnsley Coal is indicated to subcrop beneath the north of the Site, to the north of the fault. The Barnsley Coal is shown to subcrop approximately 100m to the west of the Site, to the south of the fault. Based on the thickness of the Barnsley Coal Seam and its depth from surface, a risk of surface instability is presented should any workings be present.

The Barnsley Rider Coal is shown to subcrop beneath the eastern site boundary and, given the regional dip direction to the east, is not considered to be present beneath the vast majority of the Site, including the areas proposed for development.

Seams of the Pennine Lower Coal Measures are thought to be present at greater depth, including the Flockton Thick, Fenton, Parkgate, Thorncliffe and Silkstone coal seams. These deeper seams are also thought to have been worked in the vicinity of the Site, but any workings are unlikely to impact the proposed development due to their depth.

2.2 Mining

Located within the Yorkshire Coal Field; parts of the Site are located in a Coal Authority High Risk Development Area. A Coal Mining Risk Assessment (Reference WIE17125-100-R-7.1.3-CMRA, dated October 2020) was therefore completed for the Site as part of the Phase 1 works. This report indicates that the Barnsley Coal Seam sub-crops below the north of the Site and is likely to be present at shallow depth beneath a large proportion of the Site. The seam is recorded to have been worked beneath some areas of the Site, with suspected, but unrecorded, workings likely to be present beneath a larger area of the Site. These workings are likely to be at a sufficiently shallow depth that they present a risk of surface instability. Intrusive ground investigation, including rotary coring, was therefore recommended to positively confirm the depth and condition of the Barnsley Coal Seam below site down to a maximum 30m bgl.

The Coal Mining Risk Assessment identifies that remedial works have previously been undertaken in the area of the playing fields. These comprised the infilling of collapsed ground. It is considered that this may be associated with the collapse of a shallow mine entry in this area. Three roadways were noted to extend away from the base of the collapsed ground; however, these were not treated at the time of the remedial works.

The potential presence of further unrecorded mine entries in the western half of the site cannot be discounted and it is recommended that a watching brief for mining related features is maintained during construction works.

2.3 Unexploded Ordnance (UXO)

A UXO Risk Assessment has been prepared by 1st Line Defence (Report Ref: DA11373-00, Dated: 24/06/2020), which has assessed that there is an overall Low Risk from German and anti-aircraft unexploded ordnance at the site. There is an assessed Negligible Risk from Allied ordnance. The Risk Assessment recommends that a UXO Risk Management Plan is prepared for the Site and that Site Specific UXO Awareness Briefings are given to all personnel conducting intrusive works.

2.4 Potentially Significant Pollution Linkages

Potentially significant linkages between contamination hazard sources and relevant receptors are summarised below:

- The accumulation of ground gas and vapours associated with shallow mine workings were considered to pose a medium risk to site end users;
- Windbourne, potentially contaminated, dust and runoff from contaminated materials were considered to pose a medium risk to off site receptors, including nearby residents;
- Direct contact and ingestion, inhalation of dust, and the accumulation of ground gas as a result of potentially contaminated Made Ground being present was identified to pose a medium risk to construction workers;
- Potentially contaminated Made Ground was considered, through direct contact, to pose a medium risk to site structures and services;
- Construction materials stored on site were considered to pose a medium risk to surface water course 26m to the south of the Site, due to the potential for spills to migrate through surface run-off.

3. Methodology

The intrusive investigation was undertaken in general accordance with Eurocode 7, the Code of Practice for Ground Investigation BS 5930 (2015) and the Code of Practice for the Investigation of Potentially Contaminated Sites and its Investigation BS 10175 (2011).

The objectives of the investigation are to characterise the ground conditions, the hazard sources, pathways and receptors and to reduce uncertainties associated with the proposed redevelopment.

3.1 Design of Investigation

Sampling locations were carefully selected in order to characterise the features identified in the conceptual model and to target, as far as possible, potentially contaminated areas identified in the Preliminary Environmental Risk Assessment.

A summary of the investigation locations and features investigated is presented in Table 2: Ground Investigation Strategy.

Table 2: Ground investigation strategy

Layer / Target feature	Exploratory Holes	Monitoring Wells	Comments
Made Ground	All holes	-	No Made Ground of sufficient depth encountered to allow for the installation of monitoring standpipes.
Potential shallow mine workings	RC201, RC202, RC203, RC204	RC202, RC203, RC204	-
Area of remedial works and associated roadways	TT201, TT202, TT203, TT205, TT206	-	-
Areas of indicated fill on BGS maps	TT201 – TT212	-	-
Geotechnical design of proposed structure	RC101, RC102, RC103, RC104	RC101, RC102, RC103, RC104	-

3.2 Quality Control

A Waterman Geo-Environmental Engineer monitored the performance, quality of work and health and safety compliance throughout the investigation period. Samples were despatched in batches on a daily basis under a chain of custody procedure to Element who are a UKAS accredited laboratory, for subsequent chemical analysis. Where appropriate, samples were stored within cool boxes containing ice packs.

Soil samples taken for geotechnical testing were transported to Professional Soils Laboratory for analysis.

All contractors, including laboratories, used during this project have been approved by Waterman as a part of in-house Integrated Management System (BS ISO 9001, BS ISO 14001) procedure. This requires all third parties to demonstrate competence and a high standard of work during a regular audit scheme.

3.3 Health and Safety

All work carried out on site was in accordance with Groundtech Consulting Ltd's Construction Phase Health and Safety Plan (Ref: GRO-20063-1788, Dated: September 2020).

4. Fieldwork

The works were procured to Groundtech Consulting and the main activities and supervision, are shown in chronological order of the works undertaken in Table 3.

Table 3: Summary of fieldwork activities

Phase of Work.	Activity	Contractor	Date	Supervision
Service survey	Scanning for services	Groundtech Consulting	25th January 2021 – 1st February 2021	Waterman
Ground Investigation	4No. rotary boreholes to 20.0m bgl max. depth			
	13No. trial trenches to 4.0m bgl max. depth using a 21tn excavator			
Monitoring Well Installation	4No. monitoring wells to a maximum depth of 15.0m bgl			
Groundwater and Ground Gas Monitoring	Monitoring, sampling and analysis of four wells on six occasions		February – April 2021	

Note: m bgl = metres below ground level

4.1 Constraints

There were no restrictions to the location of boreholes at their proposed locations, however, due to wet ground it was necessary to use a tracked dumper to move the drilling rig to the location of the boreholes.

The locations of the exploratory holes excavated are shown in Waterman Drawing Ref: 17125-100-WIE-ZZ-XX-DR-V-80-003-P02 in Appendix A.

4.2 Soil Sampling

During excavation, samples for chemical analysis were placed on plastic sheeting to prevent cross-contamination of soil. Representative soil samples were obtained from the exposed strata and sealed in one litre plastic tubs with airtight lids, phials and glass jars containing preservatives, as appropriate. The soil samples taken were subject to screening by a photo ionisation detector (PID).

Disturbed and undisturbed samples were taken at regular intervals and retained for geotechnical and geo-environmental testing and logging.

4.3 Monitoring Wells

On completion of drilling, a 50mm diameter slotted HDPE standpipe with gas tap and bung was installed in four of the exploratory holes to enable future ground gas and groundwater monitoring and sampling. The response zone of the wells was within the shallow natural strata. The intake section comprised a slotted pipe with a geotextile sock. The boreholes are kept sealed by a lockable secure cap at ground level.

4.4 Groundwater Monitoring

Groundwater monitoring is to be carried out during six monitoring visits over a period of three months. Two monitoring visits have been completed to date. Prior to the monitoring being undertaken, each well was developed by high-rate pumping for 1h.

The presence of hydrocarbon free product on the groundwater was investigated using a free phase dip-meter using a disposable bailer, which did not show evidence of a hydrocarbon sheen on the surface.

There was insufficient water in the monitoring installations to allow groundwater samples to be obtained.

A set of groundwater monitoring results, including the model type and detection limits of the on-site equipment used for the fieldwork, is presented in Appendix C.

4.5 Ground Gas Monitoring

Ground gas monitoring is to be carried out during six monitoring visits over a period of three months. Two monitoring visits have been completed to date. The ground gas monitoring was undertaken when the barometric atmospheric pressure was 986mb to 1002mb. On each of the monitoring visits, the peak and steady concentration readings of methane, carbon dioxide and oxygen were recorded at each installed monitoring standpipe, together with borehole gas flow readings and atmospheric pressure. This was undertaken using an infrared gas analyser, gas flow data monitor and flame ionisation detector. Groundwater levels were also measured on each visit.

A set of ground gas monitoring results, including the model type and detection limits of the onsite equipment used for the fieldwork, is presented in Appendix C.

5. Results

Detailed logs of the strata encountered, together with records of the samples taken during both trial pitting and borehole installation and PID readings, are provided in Appendix B. A summary of the geological strata and manmade underground structures encountered is presented below.

5.1 Geological Strata

The strata encountered in the investigation were generally consistent with the anticipated geology identified in the Preliminary Environmental Risk Assessment, however, the indicated Made Ground on the BGS Geological Map was not encountered. A summary of the geological strata encountered is shown in Table 4.

Table 4: Geological strata encountered

Soil Type	Depth of Top of Stratum (m bgl)	Thickness (m)	Typical Description
Made Ground	0.0m	0.18 - 0.80m	Grass over dark grey to black sandy gravelly clayey Topsoil with gravel of sandstone, coal, ceramic, glass and siltstone. Soft to firm orange brown sandy gravelly Clay with gravel of coal, sandstone and siltstone present beneath the Topsoil in the south of the Site.
Glacial Till	0.30 - 0.80m	absent - 1.66m	Firm to stiff medium to high strength orange brown mottled grey sandy gravelly silty Clay. Gravel is angular to sub-rounded fine to medium of coal and sandstone.
Pennine Middle Coal Measures Formation	0.18 – 2.00m	>19.66m	Interbedded brown to grey sandstone and siltstone with bands of soft mudstone. Extremely to moderately strong brown to light grey fine to medium grained Sandstone highly weathered, recovered as slightly sandy slightly clayey angular to subangular fine to coarse gravel and tabular cobbles of sandstone. Open vertical fractures identified in the Sandstone in trial trenches in the east of the Site. Extremely weak to weak grey Mudstone and Siltstone, highly weathered with horizontal rough planar closely spaced discontinuities and small-scale bedding structures present.

5.2 Underground Structures and Obstructions

TT202 was located to identify and investigate an area of historical remedial works detailed in the Coal Mining Risk Assessment. Whilst TT202 did not identify the area of the infilled 18" diameter "shaft", it did reveal one of the roadways identified to extend from the shaft. The top of the tunnel was 2.1m bgl in the northeast elevation of the trench and at 3.0m bgl in the south west elevation of the trench, indicating the roadway to be sloping down to the south west. The tunnel was approximately 1.5m wide and the base of the tunnel not identified in the 4.0m deep trial trench. This feature was also identified in TT203, with the top of the roadway present at 0.6m bgl, covered by a number of large sandstone blocks. The base of the

roadway was not identified in the 3.4m deep trial trench. A number of trial trenches were terminated at shallow depths due to the presence of bedrock. These are detailed in the trial trench logs included within Appendix B.

5.3 Potential Sources of Contamination

Historically, coal seams were present and mining activities were undertaken on-site. Evidence of historical mine workings has been encountered at the Site, with a suspected mine shaft encountered in TP110 during the initial phase of ground investigation in close proximity to the proposed temporary school. Further evidence of mining was encountered during this supplementary ground investigation, with a roadway being identified in TT202 and TT203 at shallow depth beneath the north of the Site and broken ground and voids being identified in RC201, RC202, RC203 and RC204 beneath the proposed temporary school building.

5.4 Chemical Analysis

The laboratory test results are presented in Appendix E.

5.5 Asbestos

Seven samples of Made Ground were screened for asbestos and no asbestos was recorded on-site. No visually identifiable asbestos containing materials was recorded during the ground investigation.

5.6 Visual and Olfactory Evidence of Contamination

Visual evidence of coal was observed within the Topsoil and shallow Made Ground across the Site.

Seepage of groundwater with a faint sheen was noted in trial trench TT203, possibly associated with the roadway identified in this trench.

Soil headspace analysis recorded a peak concentration of 1ppm in TP112. The relatively low soil headspace analysis concentrations indicates the volatile component of contamination is not significant.

5.7 Groundwater Levels

No groundwater strikes were observed during the ground investigation, other than the seepage noted at 3.1m bgl in TT203. Groundwater has also been identified in limited volumes during post-fieldwork monitoring and it has not been possible to obtain groundwater samples for chemical analysis.

Groundwater levels were monitored on two occasion during the site works and subsequent monitoring visits, the results of which are included in Appendix C. No groundwater was recorded during the two monitoring visits undertaken to date.

It should be noted that levels are likely to fluctuate dependant on the time of year and prevailing weather conditions.

5.8 Ground Gas

As part of the ground investigation, the installed boreholes have been monitored on two occasions at in order to detect the presence of ground gas. A further four monitoring visits are proposed. The design of the borehole installation resulted in gas concentrations being recorded from the shallow natural deposits (RC201) and suspected mine workings in RC202, RC203 and RC204.

During each monitoring visit, the following parameters were recorded:

- Methane (peak and steady state conditions);
- Carbon dioxide (peak and steady state conditions);
- Oxygen (lowest and steady state);
- Borehole gas flow rates; and
- Groundwater levels.

A set of ground gas results is included within Appendix C. Below Table 5 summarises the peak carbon dioxide and methane gas results recorded for each of the boreholes.

Table 5: Ground gas monitoring summary

Monitoring Point	Peak Gas Concentration (%)			Steady Gas Concentration (%)			Steady Gas Flow Rate (l/hr)
	CH_4	CO_2	O_2	CH_4	CO_2	O_2	
Round 1							
RC201	<0.1	<0.1	20.8	<0.1	<0.1	20.8	<0.1
RC202	<0.1	<0.1	20.7	<0.1	<0.1	20.7	<0.1
RC203	<0.1	0.9	19.6	<0.1	<0.1	20.8	<0.1
RC204	<0.1	0.8	19.7	<0.1	<0.1	20.7	-0.1
Round 2							
RC201	<0.1	<0.1	20.0	<0.1	<0.1	20.1	<0.1
RC202	<0.1	<0.1	20.6	<0.1	<0.1	20.7	<0.1
RC203	<0.1	1.2	16.7	<0.1	<0.1	20.5	<0.1
RC204	<0.1	0.9	17.6	<0.1	<0.1	20.5	<0.1

6. Geotechnical Testing

6.1 In-Situ Testing

6.1.1 Standard Penetration Tests

Standard Penetration Tests (SPTs) were undertaken at regular intervals in the shallow deposits within the boreholes to provide 'N' values for empirical assessment of strength and density parameters. Detailed results of the SPT tests and blow counts are included on the borehole logs included in Appendix B and a summary is presented in Table 6:

Table 6: Standard penetration test results

Stratum / Geological Origin	Range of SPT 'N' Values	Number of Tests	Comments	Derived Values Range of φ' or cu
Weathered Pennine Middle Coal Measures	>50	2	Extremely weak sandstone recovered as sandy clayey Gravel of sandstone	φ' = >43°

6.1.2 Hand Vane Tests

Hand vane tests were undertaken within the trial pits to provide strength parameters for the shallow soils. Detailed results of the hand vane tests are included on the trial pit logs included in Appendix B and a summary is presented in Table 7 below:

Table 7: Hand vane test results

Stratum / Geological Origin	Range of shear strength values	Number of Tests	Comments
Glacial Till	76 – 102kPa	4	High strength Clay

6.2 Laboratory Testing

Representative soil samples were scheduled for:

- Natural moisture content and plasticity index;
- Particle Size Distribution testing;
- Compaction Testing;
- Unconfined Compressive Strength Testing;
- Point Load Strength Testing; and,
- pH value and water soluble sulphate (SD1 Suite).

The results are summarised below and presented in Appendix D.

6.2.1 Natural Moisture Content and Plasticity Index

1No. sample of natural cohesive material was scheduled for moisture content and plasticity index determinations. The test results are included in Appendix D and are summarised in Table 8.

Table 8: Atterberg Limit test results

Stratum / Geological Origin	Sample Loc & Depth	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% passing 425 microns	Comments
Glacial Till	TT212 at 1.0m	37	19	18	96	Cohesive

The modified plasticity index can be used as an indicator of volume change potential of the soil and is calculated as the plasticity index of the soil multiplied by the fraction of particles less than 425µm.

Table 9: Volume change potential

Stratum / Geological Origin	Range of Plasticity Indices % (Modified)	Volume Change Potential
Glacial Till	17	Low

6.2.2 Particle Size Distribution Testing

Particle Size Distribution (PSD) testing was undertaken on 1No. sample of the Glacial Till to allow the materials to be classified. The results of the PSD tests are presented within Appendix D and summarised within Table 10.

Table 10: Summary of Particle Size Distribution Test Results

Stratum / Geological Origin	Sample Loc & Depth	Cobbles (%)	Gravel (%)	Sand (%)	Silt / Clay (%)
Glacial Till	TT211 at 1.0m	0	4	18	78

6.2.3 2.5kg Dry Density / Moisture Content Relationship Testing

Dry Density / Moisture Content Relationship testing was undertaken on a total of 3No. samples of the shallow soils to assess the feasibility of re-compaction of material at the site. The results of the compaction tests are presented within Appendix D and summarised within Table 11 below.

Table 11: Dry Density / Moisture Content Relationship Results

Stratum / Geological Origin	Sample Loc & Depth	Maximum Dry Density (Mg/m³)	Initial Moisture Content %	Optimum Moisture Content %	> 95% of MDD?	<5% air voids?
Glacial Till	TT211 – 1.0m	1.81	18	15	Y	Y
Weathered Pennine Middle Coal Measures	TT205 – 0.5m	1.90	12	12	Y	Y
	TT206 – 0.5m	1.89	10	13	Y	N

The compaction data has been assessed by comparing the results against criteria commonly used in earthworks to achieve an adequate density for engineered fills. The criteria summarised in the above table indicate whether the samples could achieve in excess of 95% of maximum dry density (a requirement often included in highways specifications) and whether they could be compacted to less than 5% air voids ratio (a requirement applied where raft foundations are to be adopted).

6.2.4 Unconfined Compressive Strength

Unconfined Compressive Strength (UCS) tests were undertaken to inform an of the strength of the bedrock present beneath the Site. The results of the UCS tests are presented within Appendix D and are summarised in Table 12.

Table 12: Unconfined Compressive Strength Tests

Stratum	Unconfined Compressive Strength (MPa)	Comments
Pennine Middle Coal Measures	5.7 – 21.7	Weak Sandstone and Mudstone

The results of UCS testing should be utilised with caution as the in-situ strength characteristics of the rock are likely to be determined more by the aperture and spacing of discontinuities rather than the strength of the rock itself.

6.2.5 Point Load Strength

Where it was not possible to take a suitable sub-sample for UCS testing, Point Load Tests were undertaken to further inform an assessment of the strength of the bedrock present beneath the Site. The results of the Point Load tests are presented within Appendix D and summarised in Table 13.

Table 13: Point Load Strength Tests

Stratum	$I_{s(50)}$ (MPa)	Approximate unconfined compressive strength (MPa)	Comments
Pennine Middle Coal Measures	0.02 – 1.85	0.34 – 31.45	Extremely weak to medium strong, typically very weak Sandstone and Mudstone

A factor of 17 has been applied to the $I_{s(50)}$ to determine an approximate unconfined compressive strength from the Point Load test results (from Hoek and Bray 1982). As with the UCS results, the results of Point Load tests should be utilised with caution as the in-situ strength characteristics of the rock are likely to be determined more by the aperture and spacing of discontinuities rather than the strength of the rock itself.

6.2.6 pH Value and Water Soluble Sulphate (SD1 Suite)

The Aggressive Chemical Environment for Concrete classifications for the soil types identified at the site have been determined in accordance with BRE Special Digest 1:2005 (SD1). SD1 requires that sites are first identified as being in one of four categories based on natural ground / 'Brownfield' conditions and pyrite content. The site has been categorised as: Brownfield - pyritic.

The results of laboratory testing are included in Appendix D and summarised in Table 14.

Table 14: Summary of SD1 suite analysis

Stratum / Geological Origin	Characteristic Water Soluble Sulphate Value (mg/l SO_4)	Characteristic pH Value
Made Ground	27	7
Glacial Till	13	7

Stratum / Geological Origin	Characteristic Water Soluble Sulphate Value (mg/l SO_4)	Characteristic pH Value
Pennine Middle Coal Measures	78	7

As the characteristic value of sulphate is less than 3,000mg/l and the characteristic pH is greater than 5.5, the concentrations of magnesium, nitrate and chloride are not considered significant in determining the design sulphate class.

6.3 Excavations and Trench Shoring

All trenches should be excavated in accordance with CIRIA Report 97 'Trenching Practice'. Comments relating to the stability of excavations (i.e. trial trenches) and groundwater seepages are included in the logs in Appendix B and a summary of the stability is provided in Table 15.

Table 15: Stability of excavations and groundwater flows

Stratum / Geological Origin	Stability / Seepages	Comments
Made Ground	No seepages noted, other than seepage at 3.1m bgl in TT203. Trial trenches were generally stable, however, trench instability noted in east of site in sandstone with open fractures. Tunnel identified in TT202 and TT203 noted to be unstable. Instability and perched groundwater associated with historical mining features should be anticipated.	Shallow excavations (<1.2m) are likely to be stable in the short term. Excavations in soft/loose/water bearing strata likely to require shoring to maintain stability. Simple sump pumping may be required to control moderate groundwater seepages.
Glacial Till	No seepages or instability noted.	Shallow excavations (<1.2m) likely to be stable in the short term.

7. Generic Environmental Assessment Criteria

The information requirements for generic quantitative risk assessment will depend on:

- The substance being assessed;
- The receptors being considered;
- The pathways being considered; and
- The complexity of the site.

The outline conceptual model developed for the Site has identified potential contaminant linkages. These potential contaminant linkages have been investigated and the results assessed against generic assessment criteria. The generic assessment criteria selected for each potential contaminant linkage are summarised in Table 16 below:

Table 16: Generic assessment criteria

Source	Pathway	Receptor	Generic Assessment Criteria
Potential contamination in Made Ground and shallow soils from land uses surrounding the Site.	Dermal contact, inhalation and ingestion of contamination in shallow soils and windborne dust.	Future Site residents/users Off-site users	Generic Assessment Criteria for residential land use without plant uptake. Category 4 Screening Levels (C4SLs), LQM/CIEH S4ULs (Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3060. All rights reserved), CL:AIRE (2009) PAH assessment using Benzo(a)pyrene surrogate marker assessment
Contamination in Made Ground, shallow soils, and shallow groundwater.	Migration through Glacial Till to nearby watercourses.	Secondary A Aquifers (Glacial Till and Pennine Coal Measures)	UK Drinking Water Standards and Environmental Quality Standards for freshwater
Ground gas from Worked Coal Seams Vapours from Worked Coal Seams	Ingress into structures. Risk of explosion and asphyxiation. Off-site migration of contamination.	Future Site residents/users Future on-site structures Off-site users Off-site structures	Preliminary Gas Screening Value determination and assessment in accordance with CIRIA C665 and BS8485:2015+A1:2019 and CL:AIRE Technical Bulletin 17 Semi-quantitative risk Assessment for vapours utilising PID measurements alongside soil and groundwater contamination results in accordance with CIRIA C682 and BS8576: 2013.
Potential contamination in Made Ground and shallow soils from land uses surrounding the Site.	Direct Contact	New water supply pipes	Water Regulations Advisory Scheme Information and Guidance Note UKWIR Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites
Potential contamination in Made Ground and shallow soils from land uses	Contact with building foundations and buried services	Future on-Site structures and services.	BRE Special Digest 1: 2005 Concrete in Aggressive Ground.

Source	Pathway	Receptor	Generic Assessment Criteria
surrounding the Site.			
Potential contamination in Made Ground and shallow soils from land uses surrounding the Site. Windborne dust from stockpiled soils and bare earth surfaces during construction	Dermal contact, ingestion and inhalation	Construction Workers	Qualitative Risk Assessment

The generic assessment criteria used in this report are included in Appendix G.

7.1 Site Specific Information used to Support the Generic Risk Assessment

The site specific information used to support the generic risk assessment undertaken as part of this investigation are described in the sections below:

Human Health Risk

Future Site Users

The Site is proposed to provide a temporary secondary school. This development will include a temporary school building in the south of the Site and associated, hard surfaced car park and playground, and access road. Given the proposed end use for the Site the contaminants will be assessed against the Residential without plant uptake land use. This will be a highly conservative assessment given the current proposed Development and will be used to give additional context to the contamination magnitudes recorded.

Construction Workers

A qualitative assessment of the risk to construction workers will be undertaken.

Off-site Residents and Users

Risks to off-site residents and users was assessed qualitatively through review of the recorded ground investigation information and the Site's and surrounding areas environmental setting.

Controlled Waters

Sensitive controlled water receptors identified include; a small watercourse 100m south-east and Secondary A Aquifers in Glacial Till and Pennine Middle Coal Measures strata. Groundwater and surface water abstractions are absent within a 1km radius of the Site.

Groundwater in the superficial and bedrock deposits are potentially in hydraulic continuity with the water course. Potable groundwater receptors are absent on-site or in the surrounding area, groundwater samples will therefore be assessed against the lowest value for each contaminant as given in the UK Drinking Water Standards (DWS) and the Environment Agency (EA) Environmental Quality Standards (EQS). The

assessment against the lowest values of the DWS and EQS will be used as an indication of the groundwater's contamination status given the small watercourse.

Re-use of Topsoil

Potential re-use of topsoil is possible and could pose a risk to future Site residents/users, off-site users, future on-Site and off-site structures, and construction workers. Testing for phytotoxic contaminants will be undertaken in accordance with methods specified in BS3882:2007.

Ground Gas

Potential receptors of ground gas generation are future Site residents/users, off-site users, future on-Site and off-site structures, and construction workers.

The potential risk arising from ground gas to the development was assessed using the approach recommended in CIRIA C665, BS 8485:2015+A1:2019, and BS 8576: 2013.

Vapours

A semi-quantitative approach was used to assess risks from vapours in accordance with CIRIA C682. Concentrations of hydrocarbon vapours (ppm) have been recorded in monitoring wells using a PID. Soil headspace testing has been used to supplement the vapour monitoring along with analysis for VOCs and SVOCs in soil and groundwater samples.

Off-site structures

Risks to off-site structures from contamination in groundwater, ground gases and vapours was assessed through analysis of soil, groundwater, ground gas and vapour concentrations on-Site, assessment of the hydrogeological regime at the Site and potential for off-site migration of contamination, ground gas and vapour.

8. Quantitative Environmental Risk Assessment – Risk Estimation

8.1 Regulatory Context

This assessment has been undertaken in general accordance with the Land Contamination Risk Management (Environment Agency, October 2020) guidance. The environmental risk assessment includes the following:

- outline preliminary Conceptual Model, as detailed in the PERA;
- results of Intrusive Ground Investigation;
- confirmation of Generic Assessment Criteria used to assess risks;
- assessment of results against Generic Assessment Criteria;
- formulation of an updated Conceptual Model for the Site;
- identification of potentially unacceptable risks; and
- recommendations for further action.

This report forms a decision record for the contaminant linkages identified, the generic assessment criteria used to assess risks, the unacceptable risks identified and the proposed next steps in relation to the site. The report also provides an explanation of the refinement of the outline conceptual model following the ground investigation, the selection of criteria and assumptions, the evaluation of potential risks and the basis for the decision on what happens next.

The Site comprises a former playing field adjacent to the A6133 Broadway. The Site is proposed to provide a temporary secondary school. This development will include a temporary school building in the south of the Site and associated, hard surfaced car park and playground, and access road.

The National Planning Policy Framework (NPPF) 2019 sets out Government planning policy for England and how this is expected to be applied to development. Paragraph 118 of Section 11 – Making effective use of land and paragraphs 170, 178, 179 and 183 of Section 15 – Conserving and enhancing the natural environment of the NPPF relate to contaminated land matters and state the following:

118. Planning policies and decisions should:

c) give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land;

170. Planning policies and decisions should contribute to and enhance the natural and local environment by:

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and

f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.

178. Planning policies and decisions should ensure that:

a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);

b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and

c) adequate site investigation information, prepared by a competent person, is available to inform these assessments.

179. Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.

183. The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.

In order to assess the contamination status of the Site, with respect to the proposed end use, it is necessary to assess whether the Site could potentially be classified as "Contaminated Land", as defined in Part IIA of the Environmental Protection Act 1990 and Contaminated Land Statutory Guidance 2012. This is assessed by the identification and assessment of potential contaminant linkages. The linkage between the potential sources and potential receptors identified needs to be established and evaluated.

To fall within this definition, it is necessary that, as a result of the condition of the land, substances may be present in, on or under the land such that:

a) significant harm is being caused or there is a significant possibility of such harm being caused; or

b) significant pollution of controlled waters is being caused, or there is significant possibility of such pollution being caused.

It should be noted that DEFRA has advised (Ref. Section 4, DEFRA Contaminated Land Statutory Guidance 2012) Local Authorities that land should not be designated as "Contaminated Land" where:

a) the relevant substance(s) are already present in controlled waters;

b) entry into controlled waters of the substance(s) from land has ceased; and

c) it is not likely that that further entry will take place.

These exclusions do not necessarily preclude regulatory action under the Environmental Permitting (England and Wales) Regulations 2016, which make it a criminal offence to cause or knowingly permit a water discharge of any poisonous, noxious or polluting matter to controlled waters. In England and Wales, under The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009, a works notice may be served by the regulator requiring appropriate investigation and clean-up.

The potential contaminant linkages identified in Section 7 have been evaluated using the Generic Assessment Criteria described in Section 7 and Appendix G. The results of this evaluation are reported below:

8.2 Risk to Human Health

The soil laboratory results were assessed against the GAC for a residential land use without plant uptake. Contaminants in exceedance are included in Table 17.

Table 17: Summary of generic quantitative risk assessment for human health

Stratum	Contaminant	Location, depth (m bgl)	Concentration (MJ/kg)	Generic Assessment Criteria (MJ/kg)
Made Ground – Topsoil	Calorific Value	TT207 at 0.2m	3	2

Only one elevated concentration has been identified in the test results from the supplementary ground investigation for the Temporary School. A calorific value of 3.0MJ/kg in TT207 at 0.2m bgl when compared to the GAC of 2.0MJ/kg. This elevated concentration is likely associated with coal in the Made Ground at this location. No further elevated concentrations were recorded in the samples tested, however, given the significant mining heritage in the vicinity of the Site, it is considered likely that materials with high Calorific Value may be present on site.

The laboratory soil results from the area of the proposed Temporary School in the first phase of ground investigation identify the Made Ground in this area of the Site as containing elevated contaminant concentrations (beryllium and PAHs), which could pose a risk to future site users should they be allowed to come into direct contact with the Made Ground. In areas of proposed hardstanding future site users will be prevented from coming into direct contact with the contaminants in the Made Ground by a physical barrier, breaking the pollutant linkage and mitigating the risk. In areas of soft and hard landscaping, a cover layer of sufficient thickness will be required to mitigate the risk of future site users coming into direct contact with contaminants.

No asbestos was recorded in the Made Ground samples subject to testing.

No visual or olfactory evidence of contamination was observed in the site soils during the ground investigation for the Temporary School. Visual evidence of contamination of coal was observed within the Topsoil and Made Ground across the Site. This could potentially be the source of the exceedances recorded in the first phase of ground instigation. A faint sheen was noted on groundwater entering TP203, possibly associated with the roadway encountered at this location.

Soil headspace analysis of samples recorded low concentrations across the Site, between 0 ppm – 1.0ppm, and no Volatile Organic Compounds (VOC) and Semi-Volatile Organic Compounds (SVOC) were identified during the first phase of ground investigation. The risk due to the presence of volatiles is therefore considered to be low and no VOC or SVOC testing was undertaken as part of the supplementary ground investigation for the Temporary School.

8.2.1 Off-site users

The soil laboratory results have identified the Made Ground as containing contaminants above natural background concentrations. During construction works the contaminants could mobilise via wind entrainment and migrate off-site. To break the pollutant linkage and mitigate the risk, dust suppression methods will be required to limit the mobilisation of dust off-site. Suitable mitigation for these issues should be detailed in a Construction Environmental Management Plan (CEMP).

8.2.2 Risk to Construction Workers

The ground investigation has recorded soil contaminant concentrations above the natural levels in Made Ground. A potential risk to construction workers is therefore present. To mitigate the risk construction workers should wear appropriate Personal Protective Equipment (PPE) during any below ground works in order to mitigate potential effects from direct contact, dermal absorption, inhalation, and ingestion of any residual contaminants in soils and groundwater.

All construction workers should be subject to mandatory health and safety requirements under the Construction, Design and Management (CDM) Regulations 2015 and Control of Substances Hazardous to Health (COSHH) Regulations 2002, the Confined Space Regulations 1997, and Control of Asbestos Regulations 2012 (CAR 2012).

Whilst asbestos has not been detected in the seven samples tested and has not been identified in soils, construction workers should be asbestos awareness trained.

8.3 Risk to Controlled Waters

No groundwater samples were obtained for testing due to the lack of groundwater in the monitoring installations. The significant depth to groundwater (>15m) minimises the potential for leaching of the limited concentrations of contaminants identified in the shallow Made Ground to impact the Secondary A Aquifer in the underlying natural strata. The proposed development will comprise hardstanding across the majority of the Site. Thus, the potential for leaching of contaminants from Made Ground is likely to be reduced from the current site conditions. Therefore, the risk to groundwater as a result of the proposed Temporary School is considered to be low.

The nearest surface water is a small watercourse approximately 100m south east of the Site. Given this distance, the risk to surface water is also considered to be low.

8.4 Risk to Ecological Systems/Vegetation

Assessment of soils laboratory analysis against phytotoxic contaminant threshold criteria reported no exceedances.

8.5 Risk to Structures

8.5.1 Risk to Water Supply Pipes

Contaminants have been recorded in the soil on-site. The UKWIR project steering group decided that barrier pipes would provide sufficient protection for the supply of drinking water in all Brownfield site conditions. The local water company should be contacted at the appropriate time to confirm the most appropriate material for drinking water supply pipes.

8.6 Ground Gas

Two rounds of ground gas monitoring have been completed to date, between February and March 2021. Ground gas monitoring results from the two monitoring rounds completed indicate the following peak ground gas concentrations and flow rates:

- Methane – <0.1%;

- Carbon dioxide – 1.2%;
- Flow rate – 0.1/hr.

Methane was recorded below the equipment's detection Limit (<0.1). The relatively low methane concentrations indicate no microbial degradation of low quantities of organic material in the soil is occurring.

Calculation of the Gas Screening Value (GSV) from the available ground gas monitoring data gives a methane GSV of 0.0001l/hr and carbon dioxide GSV of 0.0012l/hr. The methane and carbon dioxide GSVs are consistent with a Characterisation Situation 1 (CS1) ground gas regime classification, in which the ground gas risk is low and mitigation measures in proposed structures would not be required.

However, given the presence of a potential source of ground gas beneath the Site (shallow mine workings), it may be prudent to allow for the installation of gas protection measures in accordance with Characteristic Situation 2 at this stage.

The Preliminary Environmental Risk Assessment identifies the Site to be partially within an area of elevated radon levels (between 1% and 3%). Correspondingly, basic protective measures may be required in the proposed development. The approach should be confirmed with the Building Control Officer.

8.7 Vapour

A review of the lines of evidence used to assess whether a significant vapour regime is present on-site records the following;

- Soil headspace analysis of samples recorded low concentrations across the Site between 0 ppm – 1.0ppm; and,
- No shallow groundwater encountered during the ground investigation.

The vapour lines of evidence as detailed above show that a significant vapour regime is largely absent. The implementation of vapour protection measures in the proposed Development is not considered to be required.

9. Geotechnical Assessment

9.1 Proposed Development

The Site is proposed to provide a temporary secondary school. This development will include a temporary school building in the south of the Site with associated infrastructure including a hard surfaced car park, playground and access road. No basements are proposed.

The proposed development is presented on Watson Batty Architects Drawing Ref: TRNTY-WBA-NB-00-DR-A-PL-101 P1, included in Appendix A.

If development proposals change, it may be necessary to revise the conclusions and recommendations made in this report and Waterman should be contacted to provide further advice.

9.2 Mining

The ground investigation confirmed the presence of the Barnsley Coal Seam as follows:

- RC201 records zones of no recovery at 2m to 2.36m, 3m to 3.48m, 4.5m to 4.70m, 6m to 6.40m, 7.50m to 7.78m, 9m to 9.75m, and at 10.50m to 11.50m. These are interpreted to be the result of weathered or weak rock being further weakened by the drilling resulting in no core being obtained. A void between 12m and 12.30m and broken ground between 12.30m and 13.50m are interpreted as suspected mine workings;
- RC202 records zones of no recovery at 2m to 2.20m, 3m to 3.38m, 4.50m to 5.15m, 6.0m to 6.73m, 7.5m to 8.10m, 9m to 9.22m, and at 10.5m to 11.17m. These are interpreted to indicate the presence of weathered or weak rock. A zone of no recovery at 12m to 13.05m and broken ground between 13.05m and 13.50m are interpreted as suspected mine workings. Intact coal is present between 14m and 15m;
- RC203 records zones of no recovery at 1.50m to 1.80m, 4m to 4.7m, 5.50m to 6.33m, and at 7.50m to 7.83m. These are interpreted to indicate the presence of weathered or weak rock. A void between 15m and 16.27m, broken ground between 16.27m and 16.5m, and 17.15m and 17.84m, and a zone of no recovery between 16.50m and 17.15m are interpreted as suspected mine workings. This indicates a working height of 2.84m, the largest found during the ground investigation;
- RC204 records zones of no recovery at 2m to 2.25m, 3m to 4.17m, 4.5m to 5.23m, 6m to 6.86m, 7.50m to 7.85m, 10.50m to 10.99m, 13.50m to 14.26m, and at 15m to 15.58m. These are interpreted to indicate the presence of weathered or weak rock. A void is identified at 16.50m to 17.90m and broken ground is recorded between 17.90m and 18.40m, these are interpreted as suspected mine workings.
- TT202 was located to identify and investigate an area of historical remedial works detailed in the Coal Mining Risk Assessment in the north of the Site. Whilst TT202 did not identify the area of the infilled 18" diameter "shaft", it did reveal one of the roadways identified to extend from the shaft. The top of the roadway was 2.1m bgl in the northeast elevation of the trench and at 3.0m bgl in the south west elevation of the trench, indicating the roadway to be sloping down to the south west. The roadway was approximately 1.5m wide and the base was not identified in the 4.0m deep trial trench. This feature was also identified in TT203, with the top of the roadway present at 0.6m bgl, covered by a number of large sandstone blocks. The base of the roadway was not identified in the 3.4m deep trial trench.

All of the suspected mine workings and intact coal are thought to be associated with the Barnsley Coal Seam.

The greatest thickness of no recovery, broken ground or void associated with the Barnsley Coal seam was 2.84m beneath the Site in RC203 (at the eastern end of the proposed Temporary School), from 15m to 17.84m bgl. Based on a likely propagation of voids to 10 times worked seam thickness through rock, as per CIRIA C758D, voids could migrate upwards by nearly 30m.

There is an insufficient thickness of rock cover to arrest the upward migration of voids from the Barnsley Coal Seam and therefore workings are considered to constitute a risk of surface instability.

Therefore, it is recommended further investigation is undertaken below the footprint of the proposed building, which should take the form of Primary Consolidation Grouting to confirm the presence of workings or otherwise, with Secondary Grouting should workings be identified.

A mine shaft was identified in trial pit TP110 close to the position of the Temporary School during the first phase of ground investigation. The shaft was found to be uncapped and to have a diameter of approximately 2.5m. The shaft backfill was present from approximately 0.5m below ground level and comprised of Colliery Spoil.

The mine shaft should be fully investigated and appropriately treated, most likely by construction of a reinforced concrete cap.

The roadway identified beneath the north of the Site is not considered to pose a risk to the proposed Temporary School. However, its presence should be appropriately mitigated in the design of the access road and hardstanding proposed in this area of the Site.

The remedial works to be implemented to both the shallow mine workings and mine shaft should be agreed with The Coal Authority, with appropriate permissions and licenses obtained.

9.3 Characteristic Values

Based upon the ground investigation data and a review of the derived values summarised in Section 6, characteristic values can be assigned to each strata. EC7 defines the characteristic value of a soil or rock as a cautious estimate of the value affecting the occurrence of the limit state. The characteristic values to be used in design are highlighted in Table 18:

Table 18: Characteristic values for geotechnical design

Stratum / Geological Origin	Strength / Density Descriptor	Range of Derived Values	Characteristic Undrained Strength (cu - kPa)	Characteristic Unconfined Compressive Strength (UCS - MPa)	Characteristic Angle of Shearing Resistance (φ' - °)
Glacial Till	High strength Clay	cu = 76 – 102kPa	75kPa	-	-
Weathered Pennine Middle Coal Measures	Extremely weak sandstone recovered as sandy clayey Gravel of sandstone	φ' = >43°	-	-	φ' = 30°
Pennine Middle Coal Measures	Extremely weak to medium strong, typically very weak Sandstone and Mudstone	UCS = 0.34 – 31.45, typically 1 – 5MPa	-	2MPa	-

The imposed permanent and variable actions (loads) are not currently known. Horizontal actions are not considered in detail here and these should be checked as part of detailed geotechnical design.

9.3.1 Rock Mass Strength and Shallow Foundations

Spread foundations on rock may be designed using the method of presumed bearing pressures. The method is based on the relationships outlined in BS EN 1997-1: 2004 which assume that the structure can tolerate settlement equal to 0.5% of the maximum foundation width.

An empirical relationship between the Point Load Index $Is_{(50)}$ and the unconfined compressive strength (UCS) has been used as part of this assessment. The mean unconfined compressive strength is taken to be 17 times the Point Load Index ($Is_{(50)}$), taken from Hoek and Bray (1982). This value is broadly consistent with the range suggested by the International Society of Rock Mechanics (ISRM), where on average the unconfined compressive strength is 20-25 times the point load strength. This value is again corroborated by a study carried out by Rusnak & Mark (2007).

The test results suggest that the Pennine Middle Coal Measures is extremely weak to medium strong, typically very weak Sandstone and Mudstone. Point Load strengths should be utilised with caution as the in-situ strength characteristics of the rock are likely to be determined more by the aperture and spacing of discontinuities than by the strength of the rock itself due to the very closely spaced discontinuities. To address the factor of rock mass strength highlighted by BS EN 1997-1:2004, assessment of discontinuity spacing has also been carried out.

A classification-based process outlined in BS EN 1997-1:2004 assigns a group class G1-G4 based on the type of rock. The Pennine Middle Coal Measures sequence beneath the Site can be broadly classified as Group 2. Depending on the rock grouping, a specific relationship between UCS (MPa) and mean discontinuity spacing (mm) can be utilised to estimate the presumed bearing resistance.

Assessment of the Pennine Middle Coal Measures based on field descriptions, lab test data and discontinuity spacing indicates that the sandstone encountered at shallow founding depths across the Site provides a presumed bearing resistance of approximately 0.5MPa. This assessment assumes square pad foundations bearing onto the weak sandstone for settlements not exceeding 0.5% of the total foundation width.

To prevent differential settlement, foundations on rock should be placed *entirely* on rock and not partially on rock and partially on unconsolidated materials or Made Ground. It may be necessary to deepen foundations locally to facilitate this.

Given the presence of the Barnsley Coal Seam at relatively shallow depth beneath the Site, the foundation designer should consider the influence of foundation loads on potential shallow mine workings. Appropriate rock cover should be present between the base of shallow foundations and underlying coal seams. Consideration should be given to the use of a raft slab. Coal Authority approval should be gained for the design as part of the Permitting process.

Design bearing resistance and settlement should be checked as part of detailed geotechnical design.

9.4 Piled Foundations

For foundation loads significantly in excess of the design bearing resistance estimated above or where the presence of shallow mine workings precludes the use of shallow foundations, piled foundations could be utilised. It is recommended that the advice of a specialist piling contractor should be obtained to confirm

the suitability of piling and the most appropriate pile type. However, based on the ground investigation information, end bearing piles would key into the Pennine Middle Coal Measures bedrock present from approximately 2m below ground level or would be extended to between 15m and 25m below ground level to extend through the worked Barnsley Coal Seam.

Given the presence of the Barnsley Coal Seam at relatively shallow depth beneath the Site, the pile design should consider the influence of piling on potential shallow mine workings. Appropriate rock cover should be present between the termination depth of piled foundations and underlying coal seams. The piling contractor should seek Coal Authority approval for their design as part of the Permitting process.

The final design of the piles will be the responsibility of the piling contractor. An allowance for probing of pile positions and/or drilling of obstructions should be allocated. The carrying capacity of the actual pile groups will in part depend on the number, type and size of pile chosen by the contractor and the quality of workmanship. Where cast in situ concrete piles are proposed, the roughness of the rock socket will influence the carrying capacity of the pile.

The piles should be designed based on the requirements of Eurocode 7 and guidance such as CIRIA Report 181, Piled Foundations in Weak Rock.

During detailed pile design the choice of factors of safety should ensure that appropriate safe working loads and settlement tolerances are met.

Subject to any piling trials, an acceptable percentage of piles should be load tested to at least twice working load. All piles should be integrity tested.

Consideration should be given to the re-use of pile arisings if bored piles are used. It may be possible to re-use pile arisings subject to risk assessment; however, certainty of use and volume should be confirmed in accordance with the requirements of CLAIRE guidance.

Given the proximity of existing structures, the effects of noise and vibration (e.g. from piling plant) should be addressed as part of the Contractor's method statement.

9.5 Shrinkability / Volume Change Potential

Glacial Till has been shown to have a low shrinkability.

Foundations placed on shrinkable soils should be deepened where necessary to accommodate the effects of trees and hedgerows. Where foundations are beyond the influence of existing and proposed planting (i.e. 1.5 times the mature tree height), the minimum founding depth in soils of a low volume change potential would be 0.75m below existing or proposed ground level (whichever is lower).

Foundations within the zone of influence of existing or proposed trees should be deepened as necessary in accordance with recommendations provided in NHBC Chapter 4 – Building Near Trees. If trees are present within influencing distance of proposed foundations, a tree survey should be undertaken to identify appropriate founding depths.

9.6 Design Class for Concrete

Based on the characteristic values derived from SD1 testing, the Design Sulphate (DS) and Aggressive Chemical Environment for Concrete (ACEC) classifications are considered to be:

- Concrete in contact with Made Ground: DS-1 AC-1;
- Concrete in contact with Glacial TIll: DS-1 AC-1;

- Concrete in contact with Pennine Middle Coal Measures: DS-1 AC-1.

This is based on the site characterisation as “Brownfield-pyritic” and the assumption of mobile groundwater.

9.7 Earthworks / Pavement Design

Earthworks cut is anticipated to be limited as part of the Temporary School development, however, the results of compaction testing undertaken on samples of the shallow soils (from the first and second phase of ground investigation) indicate that the Made Ground and Glacial Till could generally be recompacted to achieve >95% of MDD and <5% air voids.

Based upon the results obtained, Made Ground, Glacial Till and the shallow Weathered Pennine Middle Coal Measures could potentially be used as an engineered fill, subject to other suitability considerations. Made Ground may require treatment prior to re-use due to it generally being wet of Optimum Moisture Content. It should be noted that suitability for compaction is highly dependent on the initial moisture content of the material to be compacted. PSD results indicate that the Made Ground would be classified as Class 2C and the Glacial Till would be classified as Class 2A/2B in accordance with the Specification for Highway Works.

The presence of a roadway at shallow depth in the north of the Site has been confirmed in the ground investigation. An access road and hardstanding are proposed in this area of the Site and it is recommended that the presence of the roadway and any unidentified shallow mining features is considered as part of the detailed design of the surfacing in this area. Where present at shallow depth it may be necessary to excavate the roadway and fill the resulting void with engineered fill, placed in accordance with an Earthworks Specification. The installation of geogrid reinforcement in the construction of the access road and hardstanding to mitigate the potential for collapse associated with the roadway and any unidentified mining features to impact site end users should be considered.

It would be sensible to subject proposed earthworks materials to a confirmatory testing regime where they were required to achieve a compaction specification as a general fill. Site won materials are unlikely to prove suitable as a structural fill, being generally cohesive in nature, but may be suitable for use as a general fill below areas of non-structural infrastructure.

Construction plant should be provided with an adequate working platform in line with the requirements of BRE report, “BR 470: Working Platforms for Tracked Plant”. Further advice should be sought from the temporary works designer.

Subgrade strength may vary considerably across the site, especially where affected by variations in moisture content. During construction, the in-situ CBR value must be checked against the Design CBR value, to confirm design requirements are being met, in accordance with CD225 or Local Authority guidance.

9.8 Floor Slabs

Given that there is limited Made Ground in the vicinity of the proposed school building, no identified risk of heave and ground conditions are likely to be relatively uniform across the proposed building footprint, ground bearing floor slabs are potentially viable for the proposed development.

The design of floor slabs should only be finalised when the updated gas monitoring has been completed and assessed, as the recommendations of the gas monitoring report will influence the final choice of floor slab design. The above advice is provided for guidance only at this stage.

9.9 Groundwater / Stability of Excavations

Comments relating to the stability of excavations (i.e. trial pits) and groundwater seepages are included in the logs in Appendix B. No groundwater was encountered during the ground investigation, other than a seepage in trial trench TT203 at 3.1m bgl possibly associated with the roadway identified in this exploratory hole.

No groundwater has been recorded during the monitoring undertaken to date.

It should be noted that levels are likely to fluctuate dependant on the time of year and prevailing weather conditions. Groundwater levels should be reviewed on completion of the groundwater monitoring visits.

Based on observations made during fieldwork, shallow excavations (<1.2m) are likely to be stable in the short term. However, should deeper Made Ground be encountered, particularly where this is associated with historical mining features, such as the roadway identified in the north of the Site, then some instability should be expected, and appropriate mitigation measures utilised.

Consideration should be given to the re-use of arisings from foundation trenches / drainage runs etc. Where contamination has been encountered, it may be possible to reuse foundation arisings; however, certainty of use and volume should be confirmed in accordance with the requirements of CL:AIRE guidance. Waterman Supplementary Ground Investigation Report should be consulted with regards to suitability for re-use of materials.

In line with BS6031, all excavations should be examined daily by a competent person to ensure that they remain safe. Where the sides cannot be sloped back to a safe angle, as approved by a competent and experienced person, their continued stability should not be taken for granted. Vertical or steep faces should be provided with support unless instructed otherwise by a competent person.

10. Conclusions and Risk Evaluation

10.1 Environmental Assessment

Following the implementation of the ground investigation, the contaminant linkages identified during the Preliminary Environmental Risk Assessment have been re-evaluated and reclassified in relation to the additional information obtained. The results of the reassessment are summarised in Table 19 below:

Table 19: Estimation of environmental risks associated with the subject site

Receptor	Potential sources	Pathway	Risk	Justification/Mitigation
Human Health				
Future Site Users	Potential contamination in Made Ground and shallow soils from land uses surrounding the Site.	Dermal contact and inhalation of dust from contaminated soils during works Contact with potential contamination in shallow soils in areas of soft landscaping.	**Low**	Elevated contaminant concentrations are present in the Made Ground on-site as beryllium and PAH exceeded the GAC in testing undertaken during the first phase of ground investigation. In areas of proposed hardstanding the direct pathway to future Site users will be removed breaking the contaminant linkage. In areas of hard and soft landscaping potential remains for future Site users to come into contact with Made Ground. In these areas a cover layer of suitable thickness and of suitable for use material will be installed. The thickness of the clean cover layer will be dependent on the type and magnitude of the contaminants recorded and will be established in the Remediation Strategy. Upon implementation of the cover layer in areas of soft landscaping the risk to future Site users will be mitigated and no further remedial measures will be required.
Worked Coal Seams (Ground gas and vapours)	Worked Coal Seams (Ground gas and vapours)	Accumulation in confined spaces, leading to inhalation.	**Medium**	A significant ground gas or vapour regime is absent on-site. The Site is designated as Characteristic Situation 1 (No Special Gas Measures). However, given the presence of a potential source of ground gas beneath the Site (shallow mine workings), it may be prudent to allow for the installation of gas protection measures in accordance with Characteristic Situation 2 at this stage.
Off-Site Users and nearby residents	Potential contamination in Made Ground and shallow soils.	Windborne, potentially contaminated construction dust.	**Medium**	Elevated contaminant concentrations have been recorded in the Made Ground during the first phase of ground investigation. During

Receptor	Potential sources	Pathway	Risk	Justification/Mitigation
		Runoff from stockpiled soils.		construction, these contaminants may become mobilised by wind entrainment and migrate off-site. Residential and public land uses are present in the surrounding area. During construction good working practices for dust suppression should be employed to limit dust creation and migration as far as practically possible. Where suitable dust suppression is employed the risk to off-site users would be mitigated.
Construction Workers	Potential contamination in Made Ground, shallow soils, and shallow groundwater.	Dermal contact and ingestion. Dust inhalation. Ground gas and vapour accumulation in trenches and confined spaces, leading to inhalation followed by asphyxiation and risk of explosion.	**Medium**	The ground investigation has recorded elevated contaminant concentrations. To mitigate the risk construction workers should wear appropriate Personal Protective Equipment (PPE) during any below ground works in order to mitigate potential effects from direct contact, dermal absorption, inhalation, and ingestion of any residual contaminants in soils and groundwater. All construction workers should be subject to mandatory health and safety requirements under the Construction, Design and Management (CDM) Regulations 2018 and Control of Substances Hazardous to Health (COSHH) Regulations 2002, the Confined Space Regulations 1997, and Control of Asbestos Regulations 2012 (CAR 2012).
Construction workers and nearby residents.	Unexploded Ordnance	Direct contact	**Low**	No UXO was encountered during the ground investigation. However, an UXO Risk Management Plan will be prepared for the Site. Site Specific UXO Awareness Briefings will be provided to all personnel conducting works.
Property				
Site structures and services	Contamination in Made Ground, shallow soils, and shallow groundwater.	Direct contact with building foundations and buried services leading to chemical attack.	**Medium**	Foundations and building at the new development will be designed to resist any contamination identified by the ground investigation, which will mitigate the risk to future structures.
Off-Site Structures	Contamination in Made Ground, shallow soils, and	Direct contact with building foundations and buried services	**Low**	Elevated contaminant concentrations are present in the Made Ground on-site as beryllium and PAH exceeded

Receptor	Potential sources	Pathway	Risk	Justification/Mitigation
	shallow groundwater.	leading to chemical attack.		the GAC in two locations during the first phase of ground investigation. The ground investigation has identified the lateral migration of contaminants as being limited. The risk to off-site structures is low.
Controlled Waters				
Secondary A Aquifer and surface watercourse 100m south of the Site	Contamination in Made Ground, shallow soils, and shallow groundwater.	Migration through Glacial Till to nearby watercourses. Runoff from stockpiled soils.	**Low**	Due to the depth to groundwater, no groundwater samples were obtained during monitoring. The significant depth to groundwater indicates the risk to the groundwater to be low.
Secondary A Aquifer and surface watercourse 100m south of the Site	Construction materials stored on-Site as part of development works.	Spills to ground, and the nearby watercourse.	**Medium**	Due to the depth to groundwater, no groundwater samples were obtained during monitoring. The significant depth to groundwater indicates the risk to the groundwater to be low. However, a CEMP should be prepared for the demolition and construction works on-Site, detailing measures to minimise the potential spills that could pose a risk to controlled waters.

The potential contaminant linkages described above can be managed by design of appropriate mitigation measures during the redevelopment of the site.

10.2 Ground Gas

Based on the available monitoring data, the site is considered to be: Characteristic Situation 1 (No Special Gas Measures). Given the presence of a potential source of ground gas beneath the Site (shallow mine workings), it may be prudent to allow for the installation of gas protection measures in accordance with Characteristic Situation 2 at this stage.

The Preliminary Environmental Risk Assessment identifies the Site to be partially within an area of elevated radon levels (between 1% and 3%). Correspondingly, basic protective measures may be required in the proposed development. The approach should be confirmed with the Building Control Officer.

Any recommendations relating to gas protective measures in foundations should be considered provisional until issue of our hazardous gas risk assessment at the end of the monitoring period.

10.3 Geotechnical Assessment

10.3.1 Proposed Development

The Site is proposed to provide a temporary secondary school. This development will include a temporary school building in the south of the Site with associated infrastructure, including a hard surfaced car park, playground, and access road. No basements are proposed.

The proposed development is presented on Watson Batty Architects Drawing Ref: TRNTY-WBA-NB-00-DR-A-PL-101 P1, included in Appendix A.

If development proposals change, it may be necessary to revise the conclusions and recommendations made in this report and Waterman should be contacted to provide further advice.

10.3.2 Mining

The ground investigation confirmed the presence of the Barnsley Coal Seam as follows:

- RC201 records zones of no recovery at 2m to 2.36m, 3m to 3.48m, 4.5m to 4.70m, 6m to 6.40m, 7.50m to 7.78m, 9m to 9.75m, and at 10.50m to 11.50m. These are interpreted to be the result of weathered or weak rock being further weakened by the drilling resulting in no core being obtained. A void between 12m and 12.30m and broken ground between 12.30m and 13.50m are interpreted as suspected mine workings;
- RC202 records zones of no recovery at 2m to 2.20m, 3m to 3.38m, 4.50m to 5.15m, 6.0m to 6.73m, 7.5m to 8.10m, 9m to 9.22m, and at 10.5m to 11.17m. These are interpreted to indicate the presence of weathered or weak rock. A zone of no recovery at 12m to 13.05m and broken ground between 13.05m and 13.50m are interpreted as suspected mine workings. Intact coal is present between 14m and 15m;
- RC203 records zones of no recovery at 1.50m to 1.80m, 4m to 4.7m, 5.50m to 6.33m, and at 7.50m to 7.83m. These are interpreted to indicate the presence of weathered or weak rock. A void between 15m and 16.27m, broken ground between 16.27m and 16.5m, and 17.15m and 17.84m, and a zone of no recovery between 16.50m and 17.15m are interpreted as suspected mine workings. This indicates a working height of 2.84m, the largest found during the ground investigation;
- RC204 records zones of no recovery at 2m to 2.25m, 3m to 4.17m, 4.5m to 5.23m, 6m to 6.86m, 7.50m to 7.85m, 10.50m to 10.99m, 13.50m to 14.26m, and at 15m to 15.58m. These are interpreted to indicate the presence of weathered or weak rock. A void is identified at 16.50m to 17.90m and broken ground is recorded between 17.90m and 18.40m, these are interpreted as suspected mine workings.
- TT202 was located to identify and investigate an area of historical remedial works detailed in the Coal Mining Risk Assessment in the north of the Site. Whilst TT202 did not identify the area of the infilled 18" diameter "shaft", it did reveal one of the roadways identified to extend from the shaft. The top of the roadway was 2.1m bgl in the northeast elevation of the trench and at 3.0m bgl in the south west elevation of the trench, indicating the roadway to be sloping down to the south west. The roadway was approximately 1.5m wide and the base was not identified in the 4.0m deep trial trench. This feature was also identified in TT203, with the top of the roadway present at 0.6m bgl, covered by a number of large sandstone blocks. The base of the roadway was not identified in the 3.4m deep trial trench.

All of the suspected mine workings and intact coal are thought to be associated with the Barnsley Coal Seam.

The greatest thickness of no recovery, broken ground or void associated with the Barnsley Coal seam was 2.84m beneath the Site in RC203 (at the eastern end of the proposed Temporary School), from 15m to 17.84m bgl. Based on a likely propagation of voids to 10 times worked seam thickness through rock, as per CIRIA C758D, voids could migrate upwards by nearly 30m.

There is an insufficient thickness of rock cover to arrest the upward migration of voids from the Barnsley Coal Seam and therefore workings are considered to constitute a risk of surface instability.

Therefore, it is recommended further investigation is undertaken below the footprint of the proposed building, which should take the form of Primary Consolidation Grouting to confirm the presence of workings or otherwise, with Secondary Grouting should workings be identified.

A mine shaft was identified in trial pit TP110 close to the position of the Temporary School during the first phase of ground investigation. The shaft was found to be uncapped and to have a diameter of approximately 2.5m. The shaft backfill was present from approximately 0.5m below ground level and comprised of Colliery Spoil.

The mine shaft should be fully investigated and appropriately treated, most likely by construction of a reinforced concrete cap.

The roadway identified beneath the north of the Site is not considered to pose a risk to the proposed Temporary School. However, its presence should be appropriately mitigated in the design of the access road and hardstanding proposed in this area of the Site.

The remedial works to be implemented to both the shallow mine workings and mine shaft should be agreed with The Coal Authority, with appropriate permissions and licenses obtained.

10.3.3 Rock Mass Strength and Shallow Foundations

Spread foundations on rock may be designed using the method of presumed bearing pressures. The method is based on the relationships outlined in BS EN 1997-1: 2004 which assume that the structure can tolerate settlement equal to 0.5% of the maximum foundation width.

An empirical relationship between the Point Load Index $Is_{(50)}$ and the unconfined compressive strength (UCS) has been used as part of this assessment. The mean unconfined compressive strength is taken to be 17 times the Point Load Index ($Is_{(50)}$), taken from Hoek and Bray (1982). This value is broadly consistent with the range suggested by the International Society of Rock Mechanics (ISRM), where on average the unconfined compressive strength is 20-25 times the point load strength. This value is again corroborated by a study carried out by Rusnak & Mark (2007).

The test results suggest that the Pennine Middle Coal Measures is extremely weak to medium strong, typically very weak Sandstone and Mudstone. Point Load strengths should be utilised with caution as the in-situ strength characteristics of the rock are likely to be determined more by the aperture and spacing of discontinuities than by the strength of the rock itself due to the very closely spaced discontinuities. To address the factor of rock mass strength highlighted by BS EN 1997-1:2004, assessment of discontinuity spacing has also been carried out.

A classification-based process outlined in BS EN 1997-1:2004 assigns a group class G1-G4 based on the type of rock. The Pennine Middle Coal Measures sequence beneath the Site can be broadly classified as Group 2. Depending on the rock grouping, a specific relationship between UCS (MPa) and mean discontinuity spacing (mm) can be utilised to estimate the presumed bearing resistance.

Assessment of the Pennine Middle Coal Measures based on field descriptions, lab test data and discontinuity spacing indicates that the sandstone encountered at shallow founding depths across the Site provides a presumed bearing resistance of approximately 0.5MPa. This assessment assumes square pad foundations bearing onto the weak sandstone for settlements not exceeding 0.5% of the total foundation width.

To prevent differential settlement, foundations on rock should be placed *entirely* on rock and not partially on rock and partially on unconsolidated materials or Made Ground. It may be necessary to deepen foundations locally to facilitate this.

Given the presence of the Barnsley Coal Seam at relatively shallow depth beneath the Site, the foundation designer should consider the influence of foundation loads on potential shallow mine workings. Appropriate rock cover should be present between the base of shallow foundations and underlying coal seams. Consideration should be given to the use of a raft slab. Coal Authority approval should be gained for the design as part of the Permitting process.

Design bearing resistance and settlement should be checked as part of detailed geotechnical design.

10.3.4 Piled Foundations

For foundation loads significantly in excess of the design bearing resistance estimated above or where the presence of shallow mine workings precludes the use of shallow foundations, piled foundations could be utilised. It is recommended that the advice of a specialist piling contractor should be obtained to confirm the suitability of piling and the most appropriate pile type. However, based on the ground investigation information, end bearing piles would key into the Pennine Middle Coal Measures bedrock present from approximately 2m below ground level or would be extended to between 15m and 25m below ground level to extend through the worked Barnsley Coal Seam.

Given the presence of the Barnsley Coal Seam at relatively shallow depth beneath the Site, the pile design should consider the influence of piling on potential shallow mine workings. Appropriate rock cover should be present between the termination depth of piled foundations and underlying coal seams. The piling contractor should seek Coal Authority approval for their design as part of the Permitting process.

The final design of the piles will be the responsibility of the piling contractor. An allowance for probing of pile positions and/or drilling of obstructions should be allocated. The carrying capacity of the actual pile groups will in part depend on the number, type and size of pile chosen by the contractor and the quality of workmanship. Where cast in situ concrete piles are proposed, the roughness of the rock socket will influence the carrying capacity of the pile.

The piles should be designed based on the requirements of Eurocode 7 and guidance such as CIRIA Report 181, Piled Foundations in Weak Rock.

During detailed pile design the choice of factors of safety should ensure that appropriate safe working loads and settlement tolerances are met.

Subject to any piling trials, an acceptable percentage of piles should be load tested to at least twice working load. All piles should be integrity tested.

Consideration should be given to the re-use of pile arisings if bored piles are used. It may be possible to re-use pile arisings subject to risk assessment; however, certainty of use and volume should be confirmed in accordance with the requirements of CLAIRE guidance.

Given the proximity of existing structures, the effects of noise and vibration (e.g. from piling plant) should be addressed as part of the Contractor's method statement.

10.3.5 Shrinkability / Volume Change Potential

Glacial Till has been shown to have a low shrinkability.

Foundations placed on shrinkable soils should be deepened where necessary to accommodate the effects of trees and hedgerows. Where foundations are beyond the influence of existing and proposed planting (i.e. 1.5 times the mature tree height), the minimum founding depth in soils of a low volume change potential would be 0.75m below existing or proposed ground level (whichever is lower).

Foundations within the zone of influence of existing or proposed trees should be deepened as necessary in accordance with recommendations provided in NHBC Chapter 4 – Building Near Trees. If trees are present within influencing distance of proposed foundations, a tree survey should be undertaken to identify appropriate founding depths.

10.3.6 Design Class for Concrete

Based on the characteristic values derived from SD1 testing, the Design Sulphate (DS) and Aggressive Chemical Environment for Concrete (ACEC) classifications are considered to be DS-1 AC-1. This is based on the site characterisation as “Brownfield-pyritic” and the assumption of mobile groundwater.

10.3.7 Earthworks / Pavement Design

Earthworks cut is anticipated to be limited as part of the Temporary School development, however, the results of compaction testing undertaken on samples of the shallow soils (from the first and second phase of ground investigation) indicate that the Made Ground and Glacial Till could generally be recompacted to achieve >95% of MDD and <5% air voids.

Based upon the results obtained, Made Ground, Glacial Till and the shallow Weathered Pennine Middle Coal Measures could potentially be used as an engineered fill, subject to other suitability considerations. Made Ground may require treatment prior to re-use due to it generally being wet of Optimum Moisture Content. It should be noted that suitability for compaction is highly dependent on the initial moisture content of the material to be compacted. PSD results indicate that the Made Ground would be classified as Class 2C and the Glacial Till would be classified as Class 2A/2B in accordance with the Specification for Highway Works.

The presence of a roadway at shallow depth in the north of the Site has been confirmed in the ground investigation. An access road and hardstanding are proposed in this area of the Site and it is recommended that the presence of the roadway and any unidentified shallow mining features is considered as part of the detailed design of the surfacing in this area. Where present at shallow depth it may be necessary to excavate the roadway and fill the resulting void with engineered fill, placed in accordance with an Earthworks Specification. The installation of geogrid reinforcement in the construction of the access road and hardstanding to mitigate the potential for collapse associated with the roadway and any unidentified mining features to impact site end users should be considered.

It would be sensible to subject proposed earthworks materials to a confirmatory testing regime where they were required to achieve a compaction specification as a general fill. Site won materials are unlikely to prove suitable as a structural fill, being generally cohesive in nature, but may be suitable for use as a general fill below areas of non-structural infrastructure.

Construction plant should be provided with an adequate working platform in line with the requirements of BRE report, “BR 470: Working Platforms for Tracked Plant”. Further advice should be sought from the temporary works designer.

Subgrade strength may vary considerably across the site, especially where affected by variations in moisture content. During construction, the in-situ CBR value must be checked against the Design CBR

value, to confirm design requirements are being met, in accordance with CD225 or Local Authority guidance.

10.3.8 Floor Slabs

Given that there is limited Made Ground in the vicinity of the proposed school building, no identified risk of heave and ground conditions are likely to be relatively uniform across the proposed building footprint, ground bearing floor slabs are potentially viable for the proposed development.

The design of floor slabs should only be finalised when the updated gas monitoring has been completed and assessed, as the recommendations of the gas monitoring report will influence the final choice of floor slab design. The above advice is provided for guidance only at this stage.

10.3.9 Groundwater / Stability of Excavations

Comments relating to the stability of excavations (i.e. trial pits) and groundwater seepages are included in the logs in Appendix B. No groundwater was encountered during the ground investigation, other than a seepage in trial trench TT203 at 3.1m bgl possibly associated with the roadway identified in this exploratory hole.

No groundwater has been recorded during the monitoring undertaken to date.

It should be noted that levels are likely to fluctuate dependant on the time of year and prevailing weather conditions. Groundwater levels should be reviewed on completion of the groundwater monitoring visits.

Based on observations made during fieldwork, shallow excavations (<1.2m) are likely to be stable in the short term. However, should deeper Made Ground be encountered, particularly where this is associated with historical mining features, such as the roadway identified in the north of the Site, then some instability should be expected, and appropriate mitigation measures utilised.

Consideration should be given to the re-use of arisings from foundation trenches / drainage runs etc. Where contamination has been encountered, it may be possible to reuse foundation arisings; however, certainty of use and volume should be confirmed in accordance with the requirements of CL:AIRE guidance. Waterman Supplementary Ground Investigation Report should be consulted with regards to suitability for re-use of materials.

In line with BS6031, all excavations should be examined daily by a competent person to ensure that they remain safe. Where the sides cannot be sloped back to a safe angle, as approved by a competent and experienced person, their continued stability should not be taken granted for. Vertical or steep faces should be provided with support unless instructed otherwise by a competent person.

11. Recommendations

The following actions are recommended to address the potentially unacceptable risks that remain:

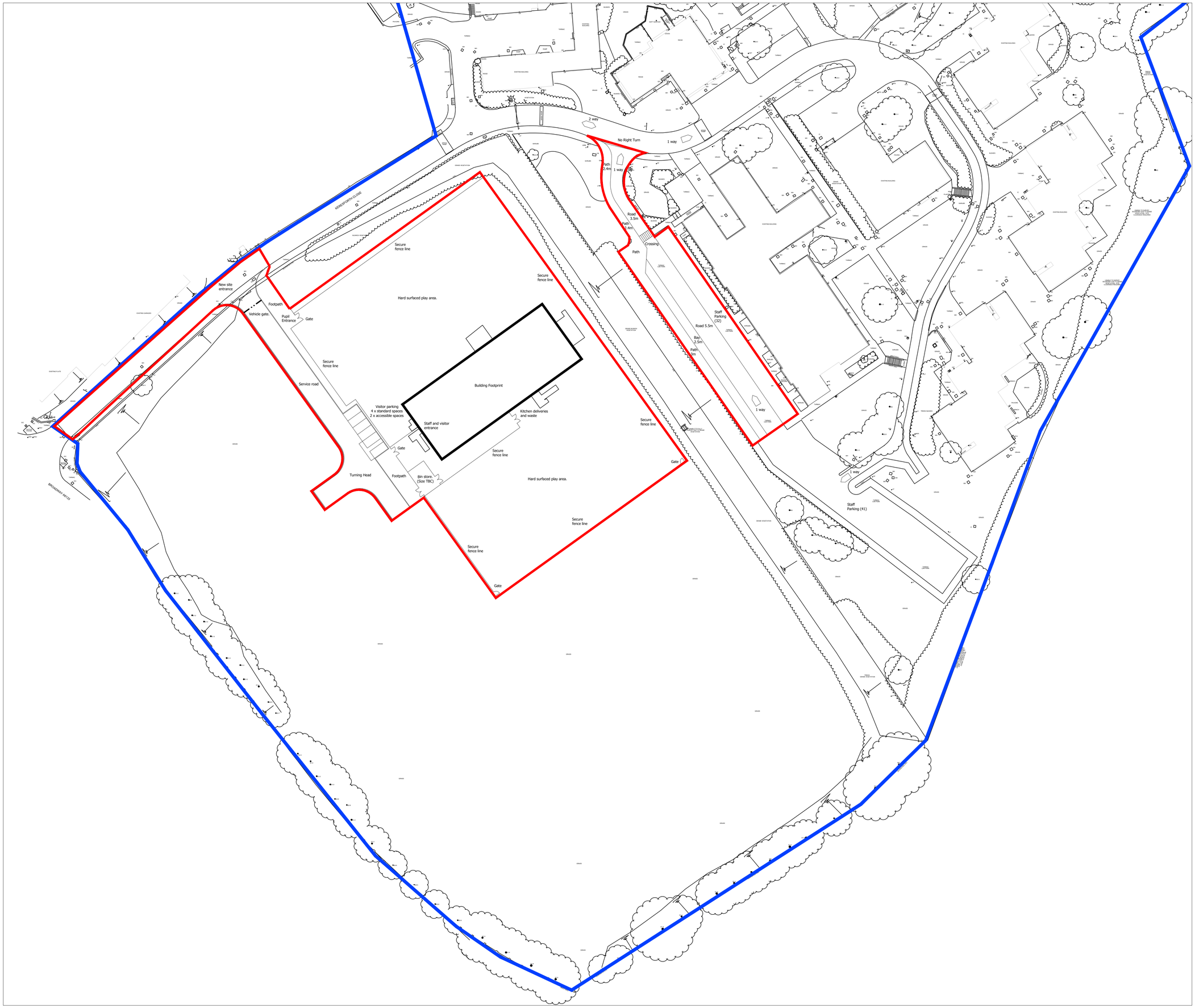
- A programme of mine workings investigation and treatment should be undertaken below the footprint of the proposed Temporary School, which should take the form of Primary Consolidation Grouting to confirm the presence of workings or otherwise, with Secondary Grouting should workings be identified;
- Consideration of the use of geogrid reinforcement in the construction of the access road and hardstanding to mitigate the potential for collapse associated with the former roadway and any unidentified mining features to impact site end users should be considered;
- A Remediation Strategy should be prepared outlining the mitigation measures to ensure the Site meets the appropriate standards for its intended use following redevelopment;
- An appropriate cover system should be installed in soft landscaping areas to break the contamination receptor linkage. Material/topsoil imported to Site should be certified suitable for use prior to importation and use on-site;
- A Materials Management Plan should be produced by the Contractor to ensure that materials that may be excavated during their works (including pile arisings) may be suitable for re-use on the Site. The re-use of materials should be identified and designated under the CL:AIRE Definition of Waste: Code of Practice (DoWCoP), i.e. the earthworks phase of the development should be planned and managed such that re-use of suitable site-won arisings is maximised and waste is minimised;
- Following completion of the proposed Development a Verification Report should be produced detailing the remedial measures undertaken during construction to break the potentially active pollutant linkages;
- Construction works should be undertaken in accordance with the Control of Asbestos Regulations 2012;
- A Construction Environmental Management Plan (CEMP) should be prepared including measures for managing waste during development work, and techniques for suppressing dust;
- All fuels and chemicals to be stored on-site during construction works should be stored and bunded in line with EA best practice and guidance;
- Construction workers should be provided with Personal Protective Equipment (PPE) for use as necessary when interacting with soils and groundwater beneath the Site. Workers should also adopt appropriate hygiene practices;
- Below-ground structures should utilise the appropriate concrete classes to prevent aggressive ground conditions. The use of barrier water pipes at the completed Development (as per UKWIR project steering group guidance) should be agreed with the relevant water authorities; and,
- Appropriate UXO mitigation should be employed during below ground works, such as piling.

APPENDICES

Appendix A Site Plans

- **Site Location Plan (Waterman Ref: WIE17125-103_GR_PRA_A1A)**
- **Site Plan (Watson Batty Ref: TRNTY-WBA-NB-00-DR-A-PL_101-P1)**
- **Ground Investigation Plan (17125-100-WIE-ZZ-XX-DR-V-80-003-P02)**

Project Details	WIE17125-103: Keresforth Academy
Figure Title	Figure A1: Site Location Plan
Figure Ref	WIE17125-103_GR_PRA_A1A
Date	June 2020
File Location	\\s-lncs\wiel\projects\wie17125\103\graphics\pra\issued figures



N

1:500 SCALE BAR

0 5 10 20 30 Metres

Revision: P1 Date: 10/12/2020 Drawn: PB Checked: MS

Suitability: PL Planning

Trinity Academy Temporary School

Proposed Block Plan

Location:
Land at Keresforth Close
Barnsley
S70 6RS

Client:
The Department for Education

UPRN	Originator	Zone	Level	Type	Role	Number	Revision
TRNTY	WBA	NB	00	DR	A	PL_101	P1

Date: 10/12/2020 Drawn: PB Checked: MS Scale: 1:500 @A1 Int Job No: 3766_015_XXX
CAD REF:

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FUTURE BUILT

Note: Do not Scale from this drawing. All dimensions to be checked on site.

GENERAL NOTES

- LOCATION OF MINESHAFT
- TREATED CIRCULAR HOLE 18" DIAMETER
- PROPOSED ROTARY CORE BOREHOLE
- PROPOSED TRIAL TRENCH

Rev	Date	Description	By
P02	23.12.20	ADD PROPOSED LOCATIONS	DC
P01	15.12.20	PRELIMINARY ISSUE	DC

Amendments

Project

TRINITY ACADEMY BARNSLEY

Title

EXPLORATORY HOLE LOCATION PLAN (PROPOSED LAYOUT)

Client

2nd Floor South Central 11 Peter Street Manchester M2 5QR
t 0161 839 8392
mail@watermangroup.com www.watermangroup.com

Status: PRELIMINARY

Designed By	Checked By	Waterman Ref
AM	AM	WIE17125-100
Drawn By	**Date**	**Scales @ A3**
DC	DECEMBER 2020	1:1500

Project - Originator - Volume - Level - Type - Role - Number: 17125-100-WIE-ZZ-XX-DR-V-80-003

Revision: P02

Appendix B Groundtech Consulting Draft Factual Report

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 27/01/2021 - 28/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433330.27 N405553.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC201	CP+RC	148.52m AoD	LH	1:10	Sheet 1 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
		0.10	ES								MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone.	
								0.30	148.22			
		0.40	ES								Firm grey brown slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is angular to subangular fine to coarse of sandstone and siltstone.	
		0.60	D									
		0.80	ES									
		1.00	B					1.00	147.52		Extremely weak grey mottled brown Mudstone residually weathered recovered as slightly gravelly clay. Gravel is subangular to subrounded fine to coarse of mudstone and sandstone.	1
		1.00	D									
								2.00	146.52			2

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 12.0m bgl. 5. Rotary open hole drilling carried out from 12.0m to 20.0m bgl. 6. Void encountered between 11.5m and 12.3m bgl, supected workings. 7. Broken ground with mudstone and coal remnants encountered between 12.3m and 12.5m bgl. 8. Broken coal encountered between 12.5m and 13.5m bgl 9. Water flush lost between 11.5m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 4.5m bgl, 1.5m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 27/01/2021 - 28/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433330.27 N405553.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC201	CP+RC	148.52m AoD	LH	1:10	Sheet 2 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
											NO RECOVERY.
			NR								
								2.36	146.16		
			NI								Weak brown orange fine to medium SANDSTONE moderately weathered with horizontal smooth planar closely spaced discontinuities weathered brown orange horizontally fractured and cross bedding.
		2.00 - 3.00		64	50	36					*Between 2.36m and 2.44m bgl recovered as angular medium to coarse gravel with low cobble content.*
											Between 2.45m and 2.5m bgl becomes very close.
			5								*Between 2.63m and 2.65m bgl becomes sub horizontal (30 degrees).*
											Between 2.65m and 2.68m bgl becomes stepped.
			NI								*Between 2.95m and 3.0m bgl recovered as angular medium to coarse gravel with low cobble content.*
								3.00	145.52		NO RECOVERY.
			NR								
								3.48	145.04		Weak grey fine to medium SANDSTONE moderately weathered with horizontal smooth planar closely spaced discontinuities weathered brown orange horizontally fractured and cross bedding.
		3.00 - 4.50		68	9	0					*Between 3.48m and 3.93m bgl recovered as angular medium to coarse gravel with low cobble content.*
			NI								
			1								

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 12.0m bgl. 5. Rotary open hole drilling carried out from 12.0m to 20.0m bgl. 6. Void encountered between 11.5m and 12.3m bgl, supected workings. 7. Broken ground with mudstone and coal remnants encountered between 12.3m and 12.5m bgl. 8. Broken coal encountered between 12.5m and 13.5m bgl 9. Water flush lost between 11.5m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 4.5m bgl, 1.5m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 27/01/2021 - 28/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433330.27 N405553.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC201	CP+RC	148.52m AoD	LH	1:10	Sheet 3 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
			NI								Weak grey fine to medium SANDSTONE moderately weathered with horizontal smooth planar closely spaced discontinuities weathered brown orange horizontally fractured and cross bedding. *Between 3.99m and 4.26m bgl recovered as angular medium to coarse gravel with low cobble content.*
			2								*Becomes very closely spaced from 4.26m to 4.34m bgl.*
			NI								*Between 4.34m and 4.5m bgl recovered as angular medium to coarse gravel with low cobble content.*
								4.50	144.02		
			NR								NO RECOVERY.
								4.70	143.82		Extremely weak fine grained SILTSTONE moderately weathered with horizontal smooth planar closely spaced discontinuities cross bedding. *Between 4.7m and 5.07m bgl recovered as angular to subangular coarse gravel with low cobble content.*
			NI								
			2								*Between 5.07m and 5.13m bgl becomes closely spaced.*
			NI								*Between 5.13m and 5.17m bgl becomes clayey and recovered as angular to subangular coarse gravel with low cobble content.*
		4.50 - 6.00	4	87	44	0					*Between 5.24m and 5.37m bgl becomes closely spaced.*
			NI								*Between 5.37m and 5.44m bgl recovered as slightly clayey angular to subangular coarse gravel with low cobble content.*
			3								*Between 5.5m and 5.55m bgl becomes closely spaced.*
			NI								*Between 5.6m and 5.67m bgl becomes clayey and recovered as angular to subangular coarse gravel with low cobble content.*
			4								*Between 5.73m and 5.77m bgl becomes closely spaced.*
								6.00	142.52		

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 12.0m bgl. 5. Rotary open hole drilling carried out from 12.0m to 20.0m bgl. 6. Void encountered between 11.5m and 12.3m bgl, supected workings. 7. Broken ground with mudstone and coal remnants encountered between 12.3m and 12.5m bgl. 8. Broken coal encountered between 12.5m and 13.5m bgl 9. Water flush lost between 11.5m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 4.5m bgl, 1.5m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 27/01/2021 - 28/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433330.27 N405553.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC201	CP+RC	148.52m AoD	LH	1:10	Sheet 4 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
			NR								NO RECOVERY.
								6.40	142.12		
			3								Weak to moderately strong fine grained SILTSTONE moderately weathered with horizontal smooth planar closely spaced discontinuities cross bedding.
			NI								*Between 6.5m and 6.6m bgl angular medium to coarse gravel with low cobble content.*
			2								
		6.00 - 7.50		73	58	7					
			NI								*Between 6.8m and 6.86m bgl becomes weathered red brown and angular medium to coarse gravel with low cobble content.*
											Between 6.86m and 6.95m bgl weathered orange brown.
			9								*Between 7.05m and 7.08m bgl becomes clayey.*
											Between 7.22m and 7.24m bgl becomes clayey.
								7.50	141.02		NO RECOVERY.
			NR								
								7.78	140.74		Weak to moderately strong fine grained SILTSTONE moderately weathered with horizontal smooth planar closely spaced discontinuities cross bedding.
			2								
			NI								*Recovered as angular to subangular fine to*

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 12.0m bgl. 5. Rotary open hole drilling carried out from 12.0m to 20.0m bgl. 6. Void encountered between 11.5m and 12.3m bgl, supected workings. 7. Broken ground with mudstone and coal remnants encountered between 12.3m and 12.5m bgl. 8. Broken coal encountered between 12.5m and 13.5m bgl 9. Water flush lost between 11.5m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 4.5m bgl, 1.5m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 27/01/2021 - 28/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433330.27 N405553.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC201	CP+RC	148.52m AoD	LH	1:10	Sheet 5 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
		7.50 - 9.00	1	81	52	36					Weak to moderately strong fine grained SILTSTONE moderately weathered with horizontal smooth planar closely spaced discontinuities cross bedding.	
			NI								*Recovered as angular to subangular fine to medium gravel of siltstone between 7.96m and 7.98m bgl.*	
			2								*Recovered as angular to subangular fine to coarse gravel and cobbles of siltstone between 8.08m and 8.19m bgl.*	
			NI								*Recovered as angular to subangular fine to coarse gravel and cobbles of siltstone between 8.28m and 8.40m bgl.*	
			4								*Sub-horizontal (45°) discontinuity at 8.75m bgl.*	
			NI								*Recovered as angular to subangular fine to coarse gravel of siltstone between 8.88m and 9.0m bgl.*	
								9.00	139.52			9
		9.00 - 10.50	NR	50	33	0					NO RECOVERY.	
								9.75	138.77			
			1								Weak to moderately strong fine grained SILTSTONE moderately weathered with horizontal smooth planar closely spaced discontinuities.	
			NI								*Recovered as subangular cobble of siltstone between 9.83m and 9.88m bgl.*	
			3									
			NI									10

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 12.0m bgl. 5. Rotary open hole drilling carried out from 12.0m to 20.0m bgl. 6. Void encountered between 11.5m and 12.3m bgl, supected workings. 7. Broken ground with mudstone and coal remnants encountered between 12.3m and 12.5m bgl. 8. Broken coal encountered between 12.5m and 13.5m bgl 9. Water flush lost between 11.5m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 4.5m bgl, 1.5m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 27/01/2021 - 28/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433330.27 N405553.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC201	CP+RC	148.52m AoD	LH	1:10	Sheet 6 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
			3								Weak to moderately strong fine grained SILTSTONE moderately weathered with horizontal smooth planar closely spaced discontinuities. *Recovered as slightly clayey angular to subangular fine to medium gravel between 9.98m and 10.0m bgl.*	
			NI								*Recovered as angular to subangular fine to coarse gravel between 10.2m and 10.34m bgl.*	
			2									
								10.50	138.02		NO RECOVERY.	
			NR									11
		10.50 - 12.00		30	11	0						
								11.50	137.02		Weak to moderately strong fine grained SILTSTONE moderately weathered with horizontal smooth planar closely spaced discontinuities. *Recovered as angular to subangular fine to coarse gravel and cobbles between 11.5m and 11.66m bgl.*	
			NI									
			1								*Recovered as clayey angular to subangular fine to coarse gravel of siltstone with coal fragments between 11.75m and 11.88m bgl. (Broken Ground).*	
			NI									
			1								*Recovered as subangular cobble of siltstone between 11.92m and 12.0m bgl.*	
			NI									
								12.00	136.52			12

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 12.0m bgl. 5. Rotary open hole drilling carried out from 12.0m to 20.0m bgl. 6. Void encountered between 11.5m and 12.3m bgl, supected workings. 7. Broken ground with mudstone and coal remnants encountered between 12.3m and 12.5m bgl. 8. Broken coal encountered between 12.5m and 13.5m bgl 9. Water flush lost between 11.5m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 4.5m bgl, 1.5m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 27/01/2021 - 28/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433330.27 N405553.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC201	CP+RC	148.52m AoD	LH	1:10	Sheet 7 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
											VOID - Suspected workings.
								12.30	136.22		
											Grey to black angular to subangular fine to coarse gravel of mudstone and coal. (Broken Ground).
								12.50	136.02		
											Black angular to subangular fine to coarse gravel of coal. (Broken Ground).
								13.50	135.02		
											Grey SILTSTONE with occasional bands of mudstone.

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Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 12.0m bgl. 5. Rotary open hole drilling carried out from 12.0m to 20.0m bgl. 6. Void encountered between 11.5m and 12.3m bgl, supected workings. 7. Broken ground with mudstone and coal remnants encountered between 12.3m and 12.5m bgl. 8. Broken coal encountered between 12.5m and 13.5m bgl 9. Water flush lost between 11.5m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 4.5m bgl, 1.5m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 27/01/2021 - 28/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433330.27 N405553.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC201	CP+RC	148.52m AoD	LH	1:10	Sheet 8 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
											Grey SILTSTONE with occasional bands of mudstone.

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Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 12.0m bgl. 5. Rotary open hole drilling carried out from 12.0m to 20.0m bgl. 6. Void encountered between 11.5m and 12.3m bgl, supected workings. 7. Broken ground with mudstone and coal remnants encountered between 12.3m and 12.5m bgl. 8. Broken coal encountered between 12.5m and 13.5m bgl 9. Water flush lost between 11.5m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 4.5m bgl, 1.5m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 27/01/2021 - 28/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433330.27 N405553.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC201	CP+RC	148.52m AoD	LH	1:10	Sheet 9 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
											Grey SILTSTONE with occasional bands of mudstone.

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Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 12.0m bgl. 5. Rotary open hole drilling carried out from 12.0m to 20.0m bgl. 6. Void encountered between 11.5m and 12.3m bgl, supected workings. 7. Broken ground with mudstone and coal remnants encountered between 12.3m and 12.5m bgl. 8. Broken coal encountered between 12.5m and 13.5m bgl 9. Water flush lost between 11.5m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 4.5m bgl, 1.5m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 27/01/2021 - 28/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433330.27 N405553.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC201	CP+RC	148.52m AoD	LH	1:10	Sheet 10 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
											Grey SILTSTONE with occasional bands of mudstone.
								20.00	128.52		End of Borehole at 20.000m

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Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 12.0m bgl. 5. Rotary open hole drilling carried out from 12.0m to 20.0m bgl. 6. Void encountered between 11.5m and 12.3m bgl, supected workings. 7. Broken ground with mudstone and coal remnants encountered between 12.3m and 12.5m bgl. 8. Broken coal encountered between 12.5m and 13.5m bgl 9. Water flush lost between 11.5m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 4.5m bgl, 1.5m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 25/01/2021 - 26/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433341.78 N405537.54
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC202	CP+RC	148.45m AoD	LH	1:10	Sheet 1 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
		0.05	ES								MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone.
								0.40	148.05		
		0.50	ES								MADE GROUND: Firm brown mottled grey slightly sandy slightly gravelly reowrked clay. Sand is fine to medium. Gravel is angular to subangular fine to coarse of coal, sandstone and siltstone.
								0.80	147.65		
		0.85	D								Firm brown mottled grey slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is angular to subangular fine to coarse of sandstone and siltstone.
		0.90	ES								
		1.10	B								
								1.50	146.95		Brown Sandstone.
								2.00	146.45		

1

2

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 13.5m bgl. 5. Rotary open hole drilling carried out from 13.5m to 20.0m bgl. 6. Void encountered between 10.8m and 11.0m bgl, supected workings. 7. Broken ground consiting of siltstone cobbles encountered between 12.0m and 13.5m bgl. 8. Intact coal encountered between 14.0m and 15.0m bgl 9. Water flush lost between 10.8m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 13.5m bgl, 11.0m plain, 2.5m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 25/01/2021 - 26/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433341.78 N405537.54
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC202	CP+RC	148.45m AoD	LH	1:10	Sheet 2 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
			NR								NO RECOVERY.
								2.20	146.25		
			NI								Weak orange brown fine to medium SANDSTONE moderately weathered with horizontal to sub horizontal (20 degrees) smooth planar to undulating closely spaced discontinuities weathered orange brown. *Between 2.20m and 2.34m bgl becomes clayey and recovered as angular to subangular medium to coarse gravel with low cobble content.* *Between 2.45m and 2.48m bgl recovered as angular to subangular medium to coarse gravel with low cobble content.* *Between 2.56m and 3.0m bgl recovered as angular to subangular medium to coarse gravel with low cobble content.*
			1								
			NI								
		2.00 - 3.00	1	80	19	11					
			NI								
								3.00	145.45		NO RECOVERY. 3
			NR								
								3.38	145.07		
			NI								Weak orange brown fine to medium SANDSTONE moderately weathered with horizontal to sub horizontal (20 degrees) smooth planar to undulating closely spaced discontinuities weathered orange brown. *Between 3.38m and 3.75m bgl recovered as angular to subangular medium to coarse gravel with low cobble content.*
		3.00 - 4.50		80	16	0					
								3.75	144.70		
			1								Weak light brown grey fine grained SANDSTONE extremely weathered with horizontal rough to smooth planar closely spaced discontinuities and cross bedding. *Between 4.31m and 4.5m bgl recovered as slightly clayey angular to subangular fine to coarse gravel with low cobble content.*
											4

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 13.5m bgl. 5. Rotary open hole drilling carried out from 13.5m to 20.0m bgl. 6. Void encountered between 10.8m and 11.0m bgl, supected workings. 7. Broken ground consiting of siltstone cobbles encountered between 12.0m and 13.5m bgl. 8. Intact coal encountered between 14.0m and 15.0m bgl 9. Water flush lost between 10.8m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 13.5m bgl, 11.0m plain, 2.5m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 25/01/2021 - 26/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433341.78 N405537.54
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC202	CP+RC	148.45m AoD	LH	1:10	Sheet 3 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
			NI								Weak light brown grey fine grained SANDSTONE extremely weathered with horizontal rough to smooth planar closely spaced discontinuities and cross bedding.
			2					4.50	143.95		
		4.50 - 6.00	NR	56	20	0					NO RECOVERY.
			NI					5.15	143.30		Weak grey brown fine grained SANDSTONE moderately weathered with horizontal smooth planar to undulating very closely spaced with cross bedding and occasionally weathered orange brown. *Between 5.15m and 5.5m bgl recovered as angular to subangular gravel with low cobble content.*
			10								*Becomes closely spaced and clayey infilling on surfacing from 5.75m and 5.83m bgl.*
			NI								*Between 5.83m and 6.0m bgl recovered as angular to subangular gravel with low cobble content.*
								6.00	142.45		

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 13.5m bgl. 5. Rotary open hole drilling carried out from 13.5m to 20.0m bgl. 6. Void encountered between 10.8m and 11.0m bgl, supected workings. 7. Broken ground consiting of siltstone cobbles encountered between 12.0m and 13.5m bgl. 8. Intact coal encountered between 14.0m and 15.0m bgl 9. Water flush lost between 10.8m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 13.5m bgl, 11.0m plain, 2.5m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 25/01/2021 - 26/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433341.78 N405537.54
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC202	CP+RC	148.45m AoD	LH	1:10	Sheet 4 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
			NR								NO RECOVERY.
		6.00 - 7.50	NI	48	0	0		6.73	141.72		Very weak dark grey SILTSTONE completely weathered recovered as slightly clayey angular to subrounded gravel with low cobble content.
								7.50	140.95		NO RECOVERY.

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 13.5m bgl. 5. Rotary open hole drilling carried out from 13.5m to 20.0m bgl. 6. Void encountered between 10.8m and 11.0m bgl, supected workings. 7. Broken ground consiting of siltstone cobbles encountered between 12.0m and 13.5m bgl. 8. Intact coal encountered between 14.0m and 15.0m bgl 9. Water flush lost between 10.8m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 13.5m bgl, 11.0m plain, 2.5m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 25/01/2021 - 26/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433341.78 N405537.54
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC202	CP+RC	148.45m AoD	LH	1:10	Sheet 5 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
			NR								NO RECOVERY.
								8.10	140.35		Weak dark grey MUDSTONE moderately weathered with horizontal smooth planar to undulating very closely spaced occasionally weathered orange brown.
			NI								*Between 8.1m and 8.35m bgl recovered as slightly clayey angular to subrounded fine to coarse gravel of mudstone and siltstone with low cobble content.*
		7.50 - 9.00	5	60	27	7					
			NI								*Between 8.62m and 8.64m bgl recovered as slightly clayey angular to subrounded fine to coarse gravel of mudstone and siltstone.*
			1								*Becoming closely spaced and vertically fractured from 8.64m to 8.74m bgl.*
			NI								*Between 8.75m and 9.0m bgl recovered as slightly clayey angular to subrounded fine to coarse gravel of mudstone and siltstone with low cobble content.*
								9.00	139.45		NO RECOVERY.
			NR								
								9.22	139.23		Weak grey fine grained SILTSTONE with bands of mudstone moderately weathered with horizontal to sub horizontal (35 degrees) smooth planar closely spaced discontinuities. and horizontal fractured.
			1								*Between 9.3m and 9.37m bgl recovered as slightly clayey angular to subrounded fine to coarse gravel of mudstone and siltstone with low cobble content.*
			NI								*Between 9.37m and 9.39m bgl very closely spaced.*
			3								*Between 9.52m and 9.6m bgl recovered as slightly clayey angular to subrounded fine to coarse gravel of siltstone with low cobble content.*
		9.00 - 10.50	NI	85	15	0					
			3								

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 13.5m bgl. 5. Rotary open hole drilling carried out from 13.5m to 20.0m bgl. 6. Void encountered between 10.8m and 11.0m bgl, supected workings. 7. Broken ground consiting of siltstone cobbles encountered between 12.0m and 13.5m bgl. 8. Intact coal encountered between 14.0m and 15.0m bgl 9. Water flush lost between 10.8m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 13.5m bgl, 11.0m plain, 2.5m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 25/01/2021 - 26/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433341.78 N405537.54
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC202	CP+RC	148.45m AoD	LH	1:10	Sheet 6 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
			NI								Weak grey fine grained SILTSTONE with bands of mudstone moderately weathered with horizontal to sub horizontal (35 degrees) smooth planar closely spaced discontinuities. and horizontal fractured.
								10.50	137.95		NO RECOVERY.
			NR								
		10.50 - 12.00		55	29	0		11.17	137.28		Weak grey fine grained SILTSTONE with bands of mudstone moderately weathered with horizontal to sub horizontal (35 degrees) smooth planar closely spaced discontinuities. and horizontal fractured.
			1								*Between 11.17m and 11.35m bgl recovered as slightly clayey angular to subrounded fine to coarse gravel of siltstone with low cobble content.*
			NI								
			4								*Between 11.38m and 11.45m bgl recovered as slightly clayey angular to subrounded fine to coarse gravel of siltstone with low cobble content.*
			~~NI~~								*Between 11.66m and 11.74m bgl recovered as slightly clayey angular to subrounded fine to coarse gravel of siltstone with low cobble content.*
			1					11.74	136.71		*Becomes clayey from 11.7m to 11.74m bgl.*
			NI								Weak to medium strong grey SILTSTONE moderately weathered with horizontal smooth planar discontinuities.
			2								*Between 11.8m and 11.88m bgl recovered as slightly clayey angular to subrounded fine to*
								12.00	136.45		

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 13.5m bgl. 5. Rotary open hole drilling carried out from 13.5m to 20.0m bgl. 6. Void encountered between 10.8m and 11.0m bgl, supected workings. 7. Broken ground consiting of siltstone cobbles encountered between 12.0m and 13.5m bgl. 8. Intact coal encountered between 14.0m and 15.0m bgl 9. Water flush lost between 10.8m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 13.5m bgl, 11.0m plain, 2.5m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 25/01/2021 - 26/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433341.78 N405537.54
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC202	CP+RC	148.45m AoD	LH	1:10	Sheet 7 of 10

Well	Water	Depth (m)	Type /FI	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
											Weak to medium strong grey SILTSTONE moderately weathered with horizontal smooth planar discontinuities. *Between 11.8m and 11.88m bgl recovered as slightly clayey angular to subrounded fine to coarse gravel of siltstone with low cobble content.* NO RECOVERY.
			NR								
		12.00 - 13.50		30	0	0					
								13.05	135.40		Weak dark grey SILTSTONE recovered as angular to subangular coarse gravel with low cobble content. (Broken Ground).
			NI								
								13.50	134.95		Grey Mudstone.
								14.00	134.45		

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 13.5m bgl. 5. Rotary open hole drilling carried out from 13.5m to 20.0m bgl. 6. Void encountered between 10.8m and 11.0m bgl, supected workings. 7. Broken ground consiting of siltstone cobbles encountered between 12.0m and 13.5m bgl. 8. Intact coal encountered between 14.0m and 15.0m bgl 9. Water flush lost between 10.8m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 13.5m bgl, 11.0m plain, 2.5m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 25/01/2021 - 26/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433341.78 N405537.54
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC202	CP+RC	148.45m AoD	LH	1:10	Sheet 8 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
											Intact black anthracite COAL.	
								15.00	133.45		Grey Mudstone.	15
												16

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 13.5m bgl. 5. Rotary open hole drilling carried out from 13.5m to 20.0m bgl. 6. Void encountered between 10.8m and 11.0m bgl, supected workings. 7. Broken ground consiting of siltstone cobbles encountered between 12.0m and 13.5m bgl. 8. Intact coal encountered between 14.0m and 15.0m bgl 9. Water flush lost between 10.8m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 13.5m bgl, 11.0m plain, 2.5m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 25/01/2021 - 26/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433341.78 N405537.54
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC202	CP+RC	148.45m AoD	LH	1:10	Sheet 9 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
											Grey Mudstone.
								16.50	131.95		Grey SILTSTONE.

17

18

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 13.5m bgl. 5. Rotary open hole drilling carried out from 13.5m to 20.0m bgl. 6. Void encountered between 10.8m and 11.0m bgl, supected workings. 7. Broken ground consiting of siltstone cobbles encountered between 12.0m and 13.5m bgl. 8. Intact coal encountered between 14.0m and 15.0m bgl 9. Water flush lost between 10.8m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 13.5m bgl, 11.0m plain, 2.5m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 25/01/2021 - 26/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433341.78 N405537.54
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC202	CP+RC	148.45m AoD	LH	1:10	Sheet 10 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
											Grey SILTSTONE.
								20.00	128.45		End of Borehole at 20.000m

19

20

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 13.5m bgl. 5. Rotary open hole drilling carried out from 13.5m to 20.0m bgl. 6. Void encountered between 10.8m and 11.0m bgl, supected workings. 7. Broken ground consiting of siltstone cobbles encountered between 12.0m and 13.5m bgl. 8. Intact coal encountered between 14.0m and 15.0m bgl 9. Water flush lost between 10.8m and 13.5m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 13.5m bgl, 11.0m plain, 2.5m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 28/01/2021 - 29/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433370.88 N405582.95
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC203	CP+RC	147.04m AoD	CH	1:10	Sheet 1 of 10

Well	Water	Depth (m)	Type /FI	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
		0.10	ES								MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone.
		0.40 0.40 - 0.50 0.45	B ES D					0.35	146.69		Medium strong orange brown fractured SANDSTONE highly weathered recovered as slightly clayey angular to subangular coarse gravel and cobbles.
			NR					1.50	145.54		NO RECOVERY.
			NI					1.80	145.24		Weak orange brown fine to medium grained SANDSTONE moderately weathered with horizontal smooth planar to undulating closely spaced discontinuities. Weathering dark orange brown with small scale cross bedding present.

1

2

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 1.5m bgl. 4. Rotary coring undertaken from 1.5m to 18.0m bgl. 5. Rotary open hole drilling carried out from 18.0m to 20.0m bgl. 6. Water flush lost at 4.0m bgl and void encountered between 4.9m and 5.1m bgl within fractured sandstone. 7. Loosely filled suspected workings encountered between 15.2m and 17.0m bgl with broken mudstone and coal fragments. 9. Water flush lost at 15.2m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 7.0m bgl, 4.0m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 28/01/2021 - 29/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433370.88 N405582.95
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC203	CP+RC	147.04m AoD	CH	1:10	Sheet 2 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
											Weak orange brown fine to medium grained SANDSTONE moderately weathered with horizontal smooth planar to undulating closely spaced discontinuities. Weathering dark orange brown with small scale cross bedding present.
			1								
		1.50 - 2.50	NI	70	23	23					*Recovered as subangular fine to coarse gravel and cobbles of sandstone between 1.8m and 2.1m bgl.*
											Recovered as subangular cobbles of sandstone between 2.2m and 2.37m bgl.
			2								*Vertical discontinuities present between 2.37m and 2.50m bgl.*
			NR								*NO RECOVERY between 2.5m and 2.72m bgl.*
			NI								*Recovered as orange brown subangular cobbles of sandstone between 2.72m and 3.02m bgl.*
			2								*Vertical discontinuities present between 3.02m and 3.23m bgl.*
		2.50 - 4.00	NI	37	21	12					*Recovered as orange brown subangular to subrounded cobbles of sandstone between 3.23m and 3.51m bgl.*
			2								*Discontinuities are medium spaced to very closely spaced between 3.51m and 3.72m bgl.*
			NI								*Recovered as angular cobbles of sandstone between 3.72m and 3.82m bgl.*
			1								
								4.00	143.04		

3

4

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 1.5m bgl. 4. Rotary coring undertaken from 1.5m to 18.0m bgl. 5. Rotary open hole drilling carried out from 18.0m to 20.0m bgl. 6. Water flush lost at 4.0m bgl and void encountered between 4.9m and 5.1m bgl within fractured sandstone. 7. Loosely filled suspected workings encountered between 15.2m and 17.0m bgl with broken mudstone and coal fragments. 9. Water flush lost at 15.2m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 7.0m bgl, 4.0m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 28/01/2021 - 29/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433370.88 N405582.95
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC203	CP+RC	147.04m AoD	CH	1:10	Sheet 3 of 10

Well	Water	Depth (m)	Type /FI	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
			NR								NO RECOVERY between 4.0m and 4.7m bgl.
		4.00 - 5.50	1 NI 1 NI 3	53	30	23		4.70 5.50	142.34 141.54		Moderately strong yellow to orange brown fine to medium grained SANDSTONE partially weathered with horizontal to sub horizontal (10°) smooth planar to rough stepped very closely to closely spaced discontinuities. Weathering dark orange brown on surfaces. *Recovered as angular cobbles of sandstone between 4.75m and 4.79m bgl.* *Recovered as subangular cobbles between 4.96m and 5.21m bgl.*
											NO RECOVERY between 5.50m and 6.33m bgl.

5

6

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 1.5m bgl. 4. Rotary coring undertaken from 1.5m to 18.0m bgl. 5. Rotary open hole drilling carried out from 18.0m to 20.0m bgl. 6. Water flush lost at 4.0m bgl and void encountered between 4.9m and 5.1m bgl within fractured sandstone. 7. Loosely filled suspected workings encountered between 15.2m and 17.0m bgl with broken mudstone and coal fragments. 9. Water flush lost at 15.2m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 7.0m bgl, 4.0m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 28/01/2021 - 29/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433370.88 N405582.95
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC203	CP+RC	147.04m AoD	CH	1:10	Sheet 4 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
											NO RECOVERY between 5.50m and 6.33m bgl.
			NR								
								6.33	140.71		Weak grey SILTSTONE highly weathered with horizontal smooth undulating extremely closely spaced discontinuities. *Residually weathered, recovered as subangular to subrounded medium to coarse gravel of siltstone between 6.33m and 6.49m bgl.*
			NI								
			1								
			NI					6.53	140.51		*Recovered as subangular coarse gravel between 6.51m and 6.53m bgl.*
			2								Moderately strong grey fine to medium grained SANDSTONE partially to moderately weathered with horizontal smooth planar to smooth undulating very closely to closely spaced discontinuities. Weathering orange brown around discontinuities.
			NI								
		5.50 - 7.50		58	39	19					*Recovered as subrounded cobbles between 6.6m and 6.7m bgl.*
											7
			10								
								7.38	139.66		Weak grey SILTSTONE highly weathered with horizontal smooth undulating extremely closely to very closely spaced discontinuities.
			NI					7.50	139.54		*Recovered as subangular coarse gravel of siltstone between 7.45m and 7.5m bgl.*
											NO RECOVERY.
			NR								
								7.83	139.21		Extremely weak to very weak dark grey MUDSTONE moderately weathered with horizontal to sub-horizontal (45°) smooth to rough planar to stepped very closely spaced to closely spaced discontinuities.
			NI								
			2								
											8

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 1.5m bgl. 4. Rotary coring undertaken from 1.5m to 18.0m bgl. 5. Rotary open hole drilling carried out from 18.0m to 20.0m bgl. 6. Water flush lost at 4.0m bgl and void encountered between 4.9m and 5.1m bgl within fractured sandstone. 7. Loosely filled suspected workings encountered between 15.2m and 17.0m bgl with broken mudstone and coal fragments. 9. Water flush lost at 15.2m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 7.0m bgl, 4.0m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 28/01/2021 - 29/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433370.88 N405582.95
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC203	CP+RC	147.04m AoD	CH	1:10	Sheet 5 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
		7.50 - 9.00	NI 1 NI 5 NI 5 NI	78	49	0					Extremely weak to very weak dark grey MUDSTONE moderately weathered with horizontal to sub-horizontal (45°) smooth to rough planar to stepped very closely spaced to closely spaced discontinuities. Occasional brown bands and gravel infilling fractures. Weathering orange brown on surfaces. *Recovered as subangular to subrounded fine to coarse gravel of mudstone between 7.83m and 7.93m bgl.* *Sub-horizontal (45°) discontinuity between 7.93m and 7.97m bgl.* *Recovered as slightly clayey subangular fine to coarse gravel of mudstone between 7.97m and 8.08m bgl.* *Recovered as angular fine to coarse gravel and cobbles of mudstone between 8.14m and 8.20m bgl* *Recovered as angular cobble between 8.54m and 8.57m bgl.* *Recovered as subrounded cobble between 8.94m and 9.0m bgl.*
		9.00 - 10.50	NR NI 4 NI 1 NI	88	68	32					*NO RECOVERY between 9.0m and 9.17m bgl.* *Recovered as angular to subangular fine to coarse gravel and cobbles between 9.17m and 9.22m bgl.* *Recovered as angular to subangular fine to coarse gravel and cobbles of mudstone between 9.50m and 9.55m bgl.* *Recovered as clayey angular to subangular fine to coarse gravel and cobbles of mudstone between 9.62m and 9.71m bgl.*

9

10

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 1.5m bgl. 4. Rotary coring undertaken from 1.5m to 18.0m bgl. 5. Rotary open hole drilling carried out from 18.0m to 20.0m bgl. 6. Water flush lost at 4.0m bgl and void encountered between 4.9m and 5.1m bgl within fractured sandstone. 7. Loosely filled suspected workings encountered between 15.2m and 17.0m bgl with broken mudstone and coal fragments. 9. Water flush lost at 15.2m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 7.0m bgl, 4.0m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 28/01/2021 - 29/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433370.88 N405582.95
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC203	CP+RC	147.04m AoD	CH	1:10	Sheet 6 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
			12								Extremely weak to very weak dark grey MUDSTONE moderately weathered with horizontal to sub-horizontal (45°) smooth to rough planar to stepped very closely spaced to closely spaced discontinuities. Occasional brown bands and gravel infilling fractures. Weathering orange brown on surfaces.
											Core split by (45°) discontinuity between 9.99m and 10.07m bgl.
											Core split by (45°) discontinuities between 10.20m and 10.35m bgl.
			NR								*NO RECOVERY between 10.50m and 10.65m bgl.*
			5								*Discontinuities are horizontal to sub-horizontal (30°) and sub-vertical (80°) between 10.65m and 10.99m bgl.*
			NI					11.05	135.99		*Recovered as subangular to subrounded coarse gravel and cobbles of mudstone between 10.99m and 11.05m bgl.*
			1					11.15	135.89		Moderately strong dark grey SILTSTONE partially weathered with horizontal rough planar to undulating closely spaced discontinuities.
		10.50 - 12.00	NI	90	70	59					Very weak to weak dark grey MUDSTONE partially to weathered with horizontal to sub-horizontal (50°) smooth planar to rough undulating closely spaced to medium spaced discontinuities with some clay infilling and dark brown staining at discontinuity surfaces. Becoming moderately strong close to discontinuities.
			1								
			NI								*Recovered as slightly clayey angular to subangular fine to coarse gravel and cobbles of mudstone between 11.15m and 11.28m bgl.*
			2								*Grey subangular to subrounded fine to coarse gravel of siltstone between 11.41m and 11.47m bgl.*
			1								

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 1.5m bgl. 4. Rotary coring undertaken from 1.5m to 18.0m bgl. 5. Rotary open hole drilling carried out from 18.0m to 20.0m bgl. 6. Water flush lost at 4.0m bgl and void encountered between 4.9m and 5.1m bgl within fractured sandstone. 7. Loosely filled suspected workings encountered between 15.2m and 17.0m bgl with broken mudstone and coal fragments. 9. Water flush lost at 15.2m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 7.0m bgl, 4.0m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 28/01/2021 - 29/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433370.88 N405582.95
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC203	CP+RC	147.04m AoD	CH	1:10	Sheet 7 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
			NR								Very weak to weak dark grey MUDSTONE partially to weathered with horizontal to sub-horizontal (50°) smooth planar to rough undulating closely spaced to medium spaced discontinuities with some clay infilling and dark brown staining at discontinuity surfaces. Becoming moderately strong close to discontinuities.
			NI								*NO RECOVERY between 12.0m and 12.23m bgl.*
			5								*Grey subrounded fine to coarse gravel of siltstone between 12.23m and 12.30m bgl.*
		12.00 - 13.50		84	66	39					
			NI								*Recovered as angular to subangular fine to coarse gravel and cobbles between 13.03m and 13.11m bgl.*
			2								
			NI								*Recovered as soft to firm grey silty slightly gravelly clay between 13.31m and 13.38m bgl. Gravel is angular fine to medium of siltstone.*
			2								
			NI								*Discontinuities are very closely spaced between 13.48m and 13.50m bgl.*
			3								*Recovered as subangular to subrounded grey brown cobbles of siltstone between 13.50m and 13.58m bgl.*
											Moderately weathered with horizontal to sub-horizontal (45°) closely spaced discontinuities. Weathering dark orange brown at discontinuity surfaces. Small white salt like crystals present within discontinuities, possible iron pyrite.

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14

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 1.5m bgl. 4. Rotary coring undertaken from 1.5m to 18.0m bgl. 5. Rotary open hole drilling carried out from 18.0m to 20.0m bgl. 6. Water flush lost at 4.0m bgl and void encountered between 4.9m and 5.1m bgl within fractured sandstone. 7. Loosely filled suspected workings encountered between 15.2m and 17.0m bgl with broken mudstone and coal fragments. 9. Water flush lost at 15.2m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 7.0m bgl, 4.0m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 28/01/2021 - 29/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433370.88 N405582.95
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC203	CP+RC	147.04m AoD	CH	1:10	Sheet 8 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
			3								Very weak to weak dark grey MUDSTONE partially to weathered with horizontal to sub-horizontal (50°) smooth planar to rough undulating closely spaced to medium spaced discontinuities with some clay infilling and dark brown staining at discontinuity surfaces. Becoming moderately strong close to discontinuities.
			5								*Discontinuities are extremely close to very close between 13.99m and 14.06m bgl.*
		13.50 - 15.00		100	66	32					
			NI								*Recovered as slightly clayey angular to subangular fine to coarse gravel and cobbles between 14.51m and 14.72m bgl.*
			3								*Clay infilling discontinuities from 14.78m bgl.*
			NI					15.00	132.04		*Recovered as subangular cobbles between 14.97m and 15.0m bgl.*
		15.00 - 16.50		15	0	0					VOID - suspected workings.

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 1.5m bgl. 4. Rotary coring undertaken from 1.5m to 18.0m bgl. 5. Rotary open hole drilling carried out from 18.0m to 20.0m bgl. 6. Water flush lost at 4.0m bgl and void encountered between 4.9m and 5.1m bgl within fractured sandstone. 7. Loosely filled suspected workings encountered between 15.2m and 17.0m bgl with broken mudstone and coal fragments. 9. Water flush lost at 15.2m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 7.0m bgl, 4.0m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 28/01/2021 - 29/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433370.88 N405582.95
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC203	CP+RC	147.04m AoD	CH	1:10	Sheet 9 of 10

Well	Water	Depth (m)	Type /FI	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
			NR								VOID - suspected workings.	
								16.27	130.77			
			NI								Black angular to subangular fine to coarse gravel and cobbles of anthracite coal with firm grey gravelly silty clay. Gravel is subangular to subrounded fine to coarse of siltstone. (Broken Ground)	
								16.50	130.54			
			NR								NO RECOVERY.	17
		16.50 - 18.00		56	10	6		17.15	129.89		Black anthracite coal and grey siltstone recovered as slightly clayey angular to subangular fine to coarse gravel. (Broken Ground).	
			NI					17.44	129.60		Firm slightly gravelly silty clay. Gravel is angular to subangular fine to coarse of anthracite coal and siltstone. (Broken Ground).	
								17.66	129.38			
			1								Extremely weak grey SILTSTONE moderately weathered with horizontal rough planar to undulating closely spaced discontinuities.	
								17.76	129.28			
			NI					17.84	129.20		Firm slightly gravelly silty clay. Gravel is angular to subangular fine to coarse of anthracite coal and siltstone. (Broken Ground).	
			1								*Recovered as light grey angular to subangular fine to coarse gravel of siltstone between 17.84m*	18
								18.00	129.04			

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 1.5m bgl. 4. Rotary coring undertaken from 1.5m to 18.0m bgl. 5. Rotary open hole drilling carried out from 18.0m to 20.0m bgl. 6. Water flush lost at 4.0m bgl and void encountered between 4.9m and 5.1m bgl within fractured sandstone. 7. Loosely filled suspected workings encountered between 15.2m and 17.0m bgl with broken mudstone and coal fragments. 9. Water flush lost at 15.2m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 7.0m bgl, 4.0m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 28/01/2021 - 29/01/2021
Location: BARNSLEY	Contractor:	Co-ords: E433370.88 N405582.95
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC203	CP+RC	147.04m AoD	CH	1:10	Sheet 10 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
											Firm slightly gravelly silty clay. Gravel is angular to subangular fine to coarse of anthracite coal and siltstone. (Broken Ground).
											Recovered as light grey angular to subangular fine to coarse gravel of siltstone between 17.84m and 17.95m bgl.
											Moderately strong light grey SILTSTONE partially weathered with horizontal smooth planar closely spaced discontinuities. Grey SILTSTONE
								20.00	127.04		End of Borehole at 20.000m

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20

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 1.5m bgl. 4. Rotary coring undertaken from 1.5m to 18.0m bgl. 5. Rotary open hole drilling carried out from 18.0m to 20.0m bgl. 6. Water flush lost at 4.0m bgl and void encountered between 4.9m and 5.1m bgl within fractured sandstone. 7. Loosely filled suspected workings encountered between 15.2m and 17.0m bgl with broken mudstone and coal fragments. 9. Water flush lost at 15.2m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 7.0m bgl, 4.0m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 01/02/2021
Location: BARNSLEY	Contractor:	Co-ords: E433382.55 N405566.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC204	CP+RC	146.94m AoD	CH	1:10	Sheet 1 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
		0.20 0.20	D ES								MG: Grass over dark grey to black slightly sandy slightly gravelly slightly clayey topsoil. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of glass, sandstone, ceramic, coal, siltstone.	
								0.34	146.60			
		0.50 0.50	D ES								Firm orange brown slightly gravelly sandy CLAY. Sand is medium. Gravel is angular to subangular fine to coarse of sandstone and occasional ironstone.	
		1.00 1.00 1.00 - 1.50	B D ES									1
		1.50	D									
		2.00	D					2.00	144.94			2

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 16.5m bgl. 5. Rotary open hole drilling carried out from 16.5m to 20.0m bgl. 6. Water flush lost between 4.7m and 6.0m bgl due to heavily fractured sandstone. 7. Poor flush returns from 12.0m bgl. 8. Void encountered between 16.5m and 17.9m bgl, supected workings. 9. Broken ground with coal remnants encountered between 17.9m and 18.4m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 15.0m bgl, 12.0m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 01/02/2021
Location: BARNSLEY	Contractor:	Co-ords: E433382.55 N405566.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC204	CP+RC	146.94m AoD	CH	1:10	Sheet 2 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
			NR								NO RECOVERY.	
								2.25	144.69			
		2.00 - 3.00	NI	75	26	0					Weak orange brown fine to medium grained SANDSTONE moderately weathered, recovered as subangular to subrounded medium to coarse gravel.	
								2.60	144.34			
			9								Moderately strong light orange brown to grey fine to medium grained SANDSTONE highly weathered with horizontal rough planar to stepped extremely closely to very closely spaced discontinuities. Weathering dark orange brown.	
			NI								*Recovered as subangular cobbles of sandstone between 2.86m and 3.0m bgl.*	
								3.00	143.94		NO RECOVERY between 3.0m and 4.17m bgl.	3
		3.00 - 4.50		22	8	0						4

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 16.5m bgl. 5. Rotary open hole drilling carried out from 16.5m to 20.0m bgl. 6. Water flush lost between 4.7m and 6.0m bgl due to heavily fractured sandstone. 7. Poor flush returns from 12.0m bgl. 8. Void encountered between 16.5m and 17.9m bgl, supected workings. 9. Broken ground with coal remnants encountered between 17.9m and 18.4m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 15.0m bgl, 12.0m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 01/02/2021
Location: BARNSLEY	Contractor:	Co-ords: E433382.55 N405566.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC204	CP+RC	146.94m AoD	CH	1:10	Sheet 3 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
			NR								NO RECOVERY between 3.0m and 4.17m bgl.
								4.17	142.77		
			NI								Moderately strong light orange brown to grey fine to medium grained SANDSTONE highly weathered with horizontal rough planar to stepped extremely closely to very closely spaced discontinuities. Weathering dark orange brown.
			3								*Recovered as subangular cobbles of sandstone between 4.17m and 4.37m bgl. Discontinuities are very closely spaced between 4.37m and 4.50m bgl.*
								4.50	142.44		NO RECOVERY.
			NR								
		4.50 - 6.00	NI	51	38	38		5.23	141.71		Moderately strong orange brown medium grained SANDSTONE moderately weathered with horizontal to sub-horizontal (45°) and sub-vertical (80°) rough undulating to stepped medium spaced discontinuities. Sub-vertical discontinuities split core.
			2								*Recovered as subangular coarse gravel and cobbles of sandstone between 5.23m and 5.36m bgl.*
			NI								
			2								
								6.00	140.94		

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 16.5m bgl. 5. Rotary open hole drilling carried out from 16.5m to 20.0m bgl. 6. Water flush lost between 4.7m and 6.0m bgl due to heavily fractured sandstone. 7. Poor flush returns from 12.0m bgl. 8. Void encountered between 16.5m and 17.9m bgl, supected workings. 9. Broken ground with coal remnants encountered between 17.9m and 18.4m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 15.0m bgl, 12.0m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 01/02/2021
Location: BARNSLEY	Contractor:	Co-ords: E433382.55 N405566.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC204	CP+RC	146.94m AoD	CH	1:10	Sheet 4 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
			NR								NO RECOVERY.
		6.00 - 7.50		42	38	28					
			NI					6.86	140.08		Weak to medium strong orange brown to light grey fine to medium grained SANDSTONE partially weathered with horizontal smooth planar to stepped very closely to medium spaced discontinuities. *Recovered as subangular to subrounded medium to coarse gravel of sandstone between 6.86m and 6.93m bgl.*
			3								
			1								
								7.50	139.44		NO RECOVERY.
			NR								
			1					7.85	139.09		Moderately strong light grey fine grained SANDSTONE partially to moderately weathered with horizontal smooth undulating to stepped extremely close to
			NI								

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 16.5m bgl. 5. Rotary open hole drilling carried out from 16.5m to 20.0m bgl. 6. Water flush lost between 4.7m and 6.0m bgl due to heavily fractured sandstone. 7. Poor flush returns from 12.0m bgl. 8. Void encountered between 16.5m and 17.9m bgl, supected workings. 9. Broken ground with coal remnants encountered between 17.9m and 18.4m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 15.0m bgl, 12.0m plain, 3.0m slotted.

Rotary Core Log

GROUNDTECH CONSULTING

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 01/02/2021
Location: BARNSLEY	Contractor:	Co-ords: E433382.55 N405566.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC204	CP+RC	146.94m AoD	CH	1:10	Sheet 5 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
		7.50 - 9.00	11	76	52	0					Moderately strong light grey fine grained SANDSTONE partially to moderately weathered with horizontal smooth undulating to stepped extremely close to closely spaced discontinuities. Weathering orange brown occasionally. *Recovered as orange brown subrounded coarse gravel of sandstone between 7.9m and 8.0m bgl.*
			NI								*Recovered as gravelly slightly clayey subangular to subrounded cobbles of sandstone between 8.56m and 8.70m bgl.*
			1					8.70	138.24		
			NI								Very weak light grey fine grained SANDSTONE highly weathered with horizontal rough planar to undulating extremely closely to very closely spaced discontinuities with clay infilling.
			2								
			NI								
			3					8.88	138.06		*Recovered as clayey angular to subangular fine to medium gravel between 8.73m and 8.76m bgl.* *Recovered as clayey angular to subangular fine to medium gravel between 8.83m and 8.85m bgl.*
		9.00 - 10.50	NR	78	43	26					Weak to medium strong light grey fine grained SANDSTONE partially weathered with horizontal smooth undulating to rough stepped very closely to closely spaced discontinuities. Rarely weathering orange brown.
			3								
			NI								*Recovered as angular cobbles between 9.53m and 9.62m bgl.*
			1								
			1								*Discontinuities are medium spaced between 9.66m and 9.95m bgl.*

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 16.5m bgl. 5. Rotary open hole drilling carried out from 16.5m to 20.0m bgl. 6. Water flush lost between 4.7m and 6.0m bgl due to heavily fractured sandstone. 7. Poor flush returns from 12.0m bgl. 8. Void encountered between 16.5m and 17.9m bgl, supected workings. 9. Broken ground with coal remnants encountered between 17.9m and 18.4m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 15.0m bgl, 12.0m plain, 3.0m slotted.

Rotary Core Log

Project Name: TRINITY ACADEMY	Client: WATERMAN I&E	Date: 01/02/2021
Location: BARNSLEY	Contractor:	Co-ords: E433382.55 N405566.70
Project No. : 20063	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
RC204	CP+RC	146.94m AoD	CH	1:10	Sheet 6 of 10

Well	Water	Depth (m)	Type /Fl	Coring TCR	Coring SCR	Coring RQD	Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description
			2								Weak to medium strong light grey fine grained SANDSTONE partially weathered with horizontal smooth undulating to rough stepped very closely to closely spaced discontinuities. Rarely weathering orange brown.
			NI								*Recovered as slightly gravelly angular to subangular cobbles between 10.1m and 10.43m bgl. Core split by vertical fractures.*
								10.43	136.51		Firm grey gravelly clay. Gravel is subangular to subrounded fine to medium of mudstone.
								10.50	136.44		NO RECOVERY.
			NR								
								10.99	135.95		Very weak to medium strong grey SILTSTONE moderately to highly weathered with horizontal to sub-horizontal (10°) (45°) and vertical (90°) rough planar to smooth stepped very closely to closely spaced discontinuities.
			1								
			NI								
			2								
		10.50 - 12.00	NI	68	38	7					*Recovered as subangular to subrounded cobbles of siltstone between 11.8m and 11.16m bgl.*
			5								*Recovered as coarse gravel of siltstone between 11.24m and 11.26m bgl.*
			NI								*Recovered as subangular to subrounded cobbles of siltstone between 11.58m and 11.78m bgl.*
			1								
			NI								
			1								
			NI								*Recovered as subangular to subrounded*

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

1. Service clearance undertaken. 2. Hand dug pit excavated to 1.2m bgl. 3. Dynamic Sampling carried out to 2.0m bgl. 4. Rotary coring undertaken from 2.0m to 16.5m bgl. 5. Rotary open hole drilling carried out from 16.5m to 20.0m bgl. 6. Water flush lost between 4.7m and 6.0m bgl due to heavily fractured sandstone. 7. Poor flush returns from 12.0m bgl. 8. Void encountered between 16.5m and 17.9m bgl, supected workings. 9. Broken ground with coal remnants encountered between 17.9m and 18.4m bgl. 10. Groundwater strikes not encountered. 11. 50mm standpipe installed to 15.0m bgl, 12.0m plain, 3.0m slotted.