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GEOTECHNICAL ENVIRONMENTAL

PHASE 2 GEO-ENVIRONMENTAL REPORT

job number	date
C2206/22/E/3401	25.05.2022

site address
Cliff Hill, Cumberworth Lane,
Denby Dale,
Huddersfield,
HD8 8RZ

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Report on a Phase 2 Geo-environmental Investigation

Location:	Cliff Hill, Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ
For:	Urban Developments (York) Limited
Report No.	C2206/21/E/3554 Date: May 2022

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

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Geo-environmental Engineer

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Technical Lead

Report Summary[1]

Item	Comments	Section
Development	Erection of a new residential estate.	1.0
Geology	Superficial geology – None. Solid geology – Pennine Lower Coal Measures Formation.	5.0
Strata Conditions	The strata conditions across the site show some variability, which is largely attributed to the change in geology across the site, and also intrinsically linked to the topography. Under the residual soils and fill, competent layers of the Pennine Lower Coal Measures Formation were revealed to a depth of 30m, comprising interbedded layers light grey sandstone and siltstone/mudstone, coal and voided stratum.	6.0
Groundwater	None encountered during investigation.	6.0
Coal Mining Legacy.	A high risk rating has been assigned to the risks posed by shallow mining, as well as mine shafts. Ground gas and unrecorded shafts will need due consideration.	10.0
Foundation Design	Dependant on the chosen remedial measures for coal workings.	12.1
Effect of Sulphates	DC-1 concrete.	12.5
Contamination	No significant contamination identified.	13.5
Gas	Gas monitoring is ongoing. Initial readings would suggest that CS2 conditions will be met, such that gas protection measures will be required.	13.1.2

[1] This summary should not be relied upon to provide a comprehensive review. All of the information contained in this document should be considered.

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1. Introduction

The land located at Cliff Hill, Cumberworth Lane, Denby Dale, is proposed to be developed by the construction of a new residential estate. The site is irregular in layout, occupying a total area of c.2.05 Hectares (Ha) and is centred around grid reference 422870, 408730. The latest development plans are presented within Appendix 1.

Consequently, a site investigation has been undertaken in accordance with the instruction from the client. This work was required in order to determine the nature of the underlying soils, to assess their engineering properties and to assist in the design of safe and economical foundations for the proposed development. This investigation also takes into consideration the risk of any contamination present, and the risks posed by historic coal mining activity.

This report describes the work undertaken, presents the data obtained and discusses the ground conditions in relation to the proposed works.

2. Limitations

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

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

3. Sources of Information

The following sources have been reviewed as part of this assessment:

- Phase 1: Desk Top Study & Coal Mining Risk Assessment Report Project No: 21-719 dated 09/09/2021
- Report on a Coal Mining Risk Assessment, produced by RGS, dated January 2022. Within this report the following information was presented:
  - Historical OS Maps.
  - British Geological Survey map sheet[2].
  - British Geological Survey *Geology of Britain Viewer*[3].
  - British Geological Survey *Borehole Records*[4].
  - Consultants Coal Mining Report.

[2] Sources: British Geological Survey (NERC) Map Sheet 86 ; Glossop Solid and Drift Editions
[3] Sources: British Geological Survey (NERC) Geology of Britain Viewer [*online resource from* www.bgs.ac.uk]
[4] Sources: British Geological Survey (NERC) Borehole Records [*online resource from* http://www.bgs.ac.uk//]

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- Mine Entry Plans and Data Sheets.
- A series of Mine Abandonment Plans.

4. Fieldworks

The fieldworks were undertaken between the 4th and 14th April 2022 and included the following:

- 10 Windowless Sample Boreholes.
- Standard Penetration Tests at regular intervals within WS01, WS03, WS05, WS07 and WS09.
- Dynamic Probes adjacent to WS02, WS04, WS06, WS08 and WS10.
- Installation of 9 gas monitoring standpipes.
- 9 rotary open hole boreholes.
- 15 mechanically excavated trial pits.
- Soakaway tests within 3 locations.
- 9 TRL Dynamic Cone Penetrometers.
- GPS scan to locate the mine shafts.
- 2 Days of mine shaft investigation using trial trenches.
- Obtaining GPS coordinates of all investigation locations.

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

4.1 Acquisition of Coal Authority Permit

In order to undertake this investigation, it was necessary to obtain permission to enter or disturb Coal Authority interests. This permission was granted in April 2022 as permit reference number 24435, which is presented in Appendix 2 to this report. In accordance with the joint Coal Authority and Health and Safety Executive positioning statement, and under the requirements of the permit, the works were undertaken employing water flush drilling techniques with gas monitoring of the boreholes during the fieldworks.

4.2 Windowless Sample Boreholes

These boreholes were sunk using a drive-in windowless sampler. The cores were undertaken in 1m lengths and reduced in diameter from 90mm for the first 1m through 80mm, 70mm and 60mm for subsequent 1m increments. The recovered cores were sealed and returned to the laboratory for logging and subsequent testing. The soils were described in general accordance with BS5930: 2015 +A1: 2020 and full descriptions are given on the windowless sample records which are presented in Appendix 3. Also included on these records are the core diameters and percentages of core recovered.

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4.3 Standard Penetration Tests

Standard penetration tests (SPT) were undertaken at regular depth increments within windowless sample borehole WS01, WS03, WS05, WS07 and WS09. The SPT was conducted in accordance with the procedures given in BS EN ISO 22476: Part 3: 2005 +A1: 2011, and the results are summarised on the borehole record. During this work an automatic trip hammer of 63.5kg falling through 750mm was employed to drive either a cone or split barrel sampler assembly into the ground and the recovered barrel samples were retained in air tight plastic containers.

4.4 Dynamic Probes

Dynamic penetration tests were undertaken adjacent to the windowless sample boreholes WS02, WS04, WS06, WS08 and WS10 in accordance with the procedure given in BS EN ISO 22476: Part 2: 2005 +A1: 2011, using the super heavy penetrometer (DPSH). This probe consists of a 63.5kg mass falling through 750mm onto an anvil, which drives a 50mm diameter cone into the ground. The number of blows required to drive the cone through successive 100mm increments are recorded as the N_{100} values. The results of the dynamic penetration tests are tabulated and presented as bar charts of N_{100} values versus depth in Appendix 4.

4.5 Gas Monitoring Standpipes

Gas monitoring standpipes were installed between ~1m and 3.6m depth in all of the boreholes and the installation details are shown on the appropriate borehole records. In all cases, the monitoring standpipe consisted of a perforated pipe from the base of the borehole to 1.0m below surface, with a non-perforated pipe to ground level. The response zone was filled with pea gravel, with a bentonite seal at the base and above, and the installation was capped with a stop box cover in a concrete surround.

4.6 Rotary Open-hole Boreholes

9 boreholes were sunk using a Comacchio 205 rotary drilling rig using rotary open-hole drilling techniques and employing 130mm diameter drag and tricone roller bits. Where necessary, 140mm diameter casing was temporarily installed through the overburden to support the bore. The investigation was undertaken using water flush drilling techniques in accordance with the Coal Authority and Health and Safety Executive positioning statement. Drill chippings brought to surface in the flush returns were inspected by the driller on a screen, which forms part of the re-circulation tanks. The borehole positions are shown on the site plan, which is presented in Appendix 1 and the strata conditions are presented on the borehole records in Appendix 5.

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4.7 Trial Pits

A total of 15 trial pits were excavated in order to reveal the nature of the near surface soils. The soils were logged on site in general accordance with BS5930: 2015+A1: 2020, and full descriptions are given on the trialpit records which are presented in Appendix 6. At regular intervals throughout the excavation of the pits, samples were taken for geotechnical testing. The test specimens were retained in the appropriate air tight containers within cool boxes for onward transition to the laboratory.

Once excavations were completed, the trial pits were carefully re-instated with the arisings. Whilst every care was taken during the infilling process, including compacting of the infill at regular intervals with the back acting arm of the excavator, it should be appreciated that some mounding of the surface may have resulted. Moreover, the infilled soils may be subjected to settlement over time, such that a depression in the surface may also occur. Therefore, the locations of any pits undertaken in this investigation should be conveyed to the current site user, as the mounds or depressions associated with the pits may present a risk to current site operations. Furthermore, it must be realised that the infilled pits represent an area of disturbance within the site soils, thus the soils at the pit locations may vary characteristically compared to the undisturbed ground. As such, foundations placed in this disturbed material may not perform as anticipated.

4.8 Soakaway Tests

Soakaway tests were conducted within the three of the trial pits excavated. At the elected test depths, the pit was trimmed and squared as much as practicable. Water was then pumped into the pit and the level monitored at timed intervals relative to a reference bar at ground level. These tests were conducted and calculated in general accordance with the method given by BRE Digest 365 and the results are presented in Appendix 7.

4.9 TRL Dynamic Probes

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

$$Log_{10}(CBR) = 2.48 – 1.057Log_{10}(mm/blow)$$

4.10 GPR Survey of Mine Shafts

In order to reduce the amount of physical investigation, and thus disruption, a Ground Penetrating Radar (GPR) was initially employed at the site. This work was carried out in an attempt to highlight potential areas of where the shaft at the site may be located, or more precisely, to asses areas where the presence of the shaft was unlikely. The site was divided into zones and systematically scanned in runs with notes being made as to areas where unusual responses were observed. The

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notes were then reviewed and used to focus the physical investigation into the location of the shaft. Site operative notes of the works, as well as photographic logs are presented within Appendix 9.

4.11 Disused Mine Shaft Investigation

A search was made for the mine shafts (references: 422408-002 and 422408-015) reportedly present on site by excavating a series of strip trenches in the areas where the shaft was anticipated. This work was undertaken using the back acting digger arm of a 10T 360° tracked excavator. Upon finding the feature, details of the feature were recorded, inclusive of GPS Coordinates of the location of the feature, alongside the dimensions of the excavation in total, were recorded. Photographic Records are presented within Appendix 10. Diagrams and plans are presented within Appendix 11

4.12 GPS Survey

A Zenith16 GEOMAX was employed during the fieldworks to record positions relevant to the investigation. During the investigation, the GPS system typically indicated 2D co-ordinate (X-axis & Y-axis) accuracies of +/-3mm, with 3D co-ordinate (X-axis, Y-axis & Z-axis) accuracy of +/-9mm. Whilst the system utilised Assisted-GPS (A-GPS) to improve initialisation time, it should be appreciated that clear view of the sky is required in order to obtain accuracy better than +/-3m. Therefore, in areas where tall obstructions are present, such as near tree canopies or buildings, it is not always possible to obtain accurate survey data. The GPS coordinates are presented on the investigation logs within Appendix 3, 5 and 6.

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5. Geology

A search was made to purchase a 1:10,000 BGS map tile for the site, however, a tile for this area is not available within BGS records. As such, the appropriate 1: 50,000 map sheet for the site and the geology viewer has been examined and the following table presents the indicated geology:

Table 1: Geological Data for the Site

Strata Type	Strata Name[5]	Previous Name[6]	Description[3]
Made Ground/Fill	N/A	N/A	Not indicated on site.
Superficial Geology	N/A	N/A	Not indicated to underlie the site.
Solid Geology	Pennine Lower Coal Measures Formation	-	Interbedded grey mudstone, siltstone and pale grey sandstone, commonly with mudstones containing marine fossils in the lower part, and more numerous and thicker coal seams in the upper part.

On the geological map, there are numerous dip indicators relevant to the site (i.e. within 500m of the site or within the same fault block), which suggests the solid geology dips between 3° and 5° to the south east.

Two coal seams are shown to outcrop within the site boundary, which are summarised as follows:

Table 2: Summary of Coal Seams Within the Vicinity of the Site.

Seam Name	Seam thickness (m)[5]*	Depth below ground level and further comments
Whinmoor (Cumberworth Thick)	1.3m	At or near surface (Outcrop trends approximately north-west / south east)
Low Whinmoor (Cumberworth Thin)	0m – 0.4m	At or near surface (Outcrop trends approximately north-west / south east)

*All distances are given as approximations only. It should be noted that coal seam thicknesses vary over relatively short distances.

It should be noted that the Whinmoor Seam is also known within local nomenclature as the Cumberworth Thick Coal. Beneath this seam, the Cumberworth Thin Seam is expected; this seam is also commonly referred to as the 'Low Whinmoor'. In either case, the thicker seam is anticipated above the lower, thinner seam, and is often separated by mudstone and, locally, sandstone partings. It should be appreciated that in accordance with the BGS map data and the generalised vertical section, no additional named seams are expected within 30m of the site surface.

The 1933 Geological Memoir for sheet 86 suggests that the 1.2m thick fireclay underlying the Cumberworth Thin Coal may have been exploited locally, with the coal being left as a "roof".

[5] Sources: British Geological Survey (NERC) Map Sheets 86; Glossop; Solid and Drift Edition, and Geology of Britain Viewer [*online resource from www.bgs.ac.uk*]
[6] Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [*online resource from www.bgs.ac.uk*]

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A Consultants Coal Mining report lists 4 records associated with workings within the Whinmoor (Cumberworth Thick) and Low Whinmoor Coal (Cumberworth Thin Coal) beneath the. The workings are recorded to take place at depths ranging between 4m and 10m, have extraction thicknesses ranging between 1.47m and 1.75m, and were last worked in 1930.

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6. Strata Conditions

In accordance with the geology of the area, the succession has been shown to include the following:

Table 3: Generalised Strata Profile

Depth m below ground level to underside of layer	Strata Type	Positions Encountered	Groundwater Strikes m below ground level
0.15 – 0.55	TOPSOIL (Dark brown organic silty fine SAND).	BH04 – BH09 TP01 – TP11, TP13, TP15 WS01 – WS07, WS10	None
0.3 – 2.3	MADE GROUND/ FILL (Typically - Soft light grey mottled light brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is sub rounded to angular medium to coarse of sandstone siltstone and ironstrone)	BH01 – BH03 TP01, TP02, TP14, TP15 WS02, WS03, WS06 WS08, WS09	None
1.2 - +4.0	Residual Cohesive soils (Typically Stiff friable thinly to thickly laminated light grey locally mottled orangish brown silty CLAY with lithorelicts of siltstone) [Pennine Lower Coal Measures Formation]	TP14, TP15 WS05, WS07, WS08, WS09	None
1.25 - +1.9	Thinly to thickly laminated orangish brown fine to, medium grained SANDSTONE. (Recovered as angular tabular medium to coarse gravel and cobbles). [Pennine Lower Coal Measures Formation]	TP04 – TP11 WS04, WS05, WS10	None
+10 - +30	Interbedded horizons of Sandstone Mudstone, coal and voids [Pennine Lower Coal Measures Formation]	BH01 – BH09	None

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

Within the Pennine Lower Coal Measures, the following notable horizons were recorded:

Table 4: Notable Horizons

Feature		Depth (m) Top	Depth (m) Bottom	Level (m aod) (top surface)	Thickness (m)	Positions Encountered
Horizon 1	Intact Coal	0.5	0.95	183.24	0.45	WS03
	Intact Coal	1.0	3.0	181.73	2.0	BH04
	Void	1.8	4.0	182.25	2.2	BH05
	Void	1.8	4.0	181.80	2.2	BH09
	Intact Coal	0.45	1.1	183.01	0.65	TP13
	Void	1.1	2.0	181.90	0.9	BH06
Horizon 2	Void	3.5	4.5	175.96	1.0	BH01
	Void	3.5	5.5	174.02	2.0	BH02
	Void	3.5	6.0	177.76	2.5	BH03

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	Void	12	13.5	170.73	1.5	BH04
	Void	8.5	9.2	168.74	0.7	BH07
	Intact Coal	4.0	6.0	176.99	2.0	BH08
	Intact Coal	0.7	1.5	177.47	0.8	WS06
	Intact Coal	3.0	3.7	176.54	0.7	WS08
	Intact Coal	1.0	1.45	172.53	0.45	WS09
	Intact Coal	3.9	4.45	176.28	0.55	WS01
Horizon 3	Intact Coal	19	19.5	161.99	0.5	BH08
	Fireclay	19.5	2.0	161.49	0.5	BH08
	Void	13	14.5	164.24	1.5	BH07

6.1 General Strata

This investigation has concluded that the strata conditions across the site show some variability, which is largely attributed to the change in geology across the site, and also intrinsically linked to the topography. A site plan showing the 1:50,000 solid geology, in relation to the borehole locations is presented within Appendix 1.

With this regard, under a capping of topsoil, residual sandstone occupies the highest parts of relief (central and southern quadrants of the site). This material was typically recovered as a sandy gravel in a medium dense in-situ condition. Moving northwards (and in lower relief areas), residual soils are anticipated to represent the most upper weathered fraction of siltstone. These soils typically comprised stiff thinly to thickly laminated light grey locally mottled orangish brown silty clay with lithorelicts of siltstone. Residual cohesive soils were noted to span to depths ranging between 1.2m – 4.0m bgl, before encountering solid geology.

In addition to the above, it should be appreciated that the most northerly quadrant of the site and along the eastern site boundary, has been subject to levelling and upfilling. Anecdotal evidence provided by the client confirms that this materially originates from the residential development to the east of the site (Leek Hall Crescent). These soils predominantly represent site-won natural soils, albeit small proportions of building rubble/waste appear to have been introduced (typically - Soft light grey mottled light brown sandy gravelly CLAY). Observations made during drilling, excavation and logging, would indicate that this material has not been placed to an engineered specification, and has likely been subject to little compaction during placement. Given the topography, the fill appears to deepen, moving north and north-east across the site, with a maximum recorded thickness of around 2.3m. A relict topsoil horizon is present at the base of the fill in all locations.

Under the residual soils and fill, stratum considered representative of the Pennine Lower Coal Measures Formation were revealed, comprising interbedded layers light grey sandstone, siltstone /mudstone, coal and or coal workings. A series of site sections and diagrams have been produced to present a visual representation of the site model, which are located in appendix 11. With

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reference to these diagrams, it can be seen that there are potentially three distinct horizons of coal, or workings beneath the site:

- The uppermost horizon of coal / voided stratum is present close to the crest of the hill and is present at levels ranging between ~181m and ~183 m AOD, and was recorded in 5 locations (BH04, BH05, BH09, WS03, TP13). In 3 of these locations, this feature represents an intact coal seam, ranging in thickness between 0.65m and 2.0m. In 2 locations, voided stratum of 2.2m thickness was recorded. It is likely that this feature can be attributed to a leaf of the Whinmoor Coal (Cumberworth Thick), or could represent an unnamed seam above the Whinmoor.
- A second horizon of coal/voided stratum was recorded in 10 locations and was present at levels ranging between 168.74m and 177.76m AOD. The change in level of the feature appears to become deeper moving east, which is largely consistent with the anticipated dip of the stratum. In 5 locations, this feature was present as intact coal seam, ranging in thickness between 0.4m and 2.0m. In 5 locations, this feature was present as a void, ranging in thickness between 0.7m and 2.5m. It is likely that this feature can be attributed to a leaf of the Whinmoor Coal Seam (Cumberworth Thick).
- A third horizon was recorded in 3 locations and a level of ~162m and ~164.28 m AOD. In BH07 this feature was recorded as a void of 1.5m thickness. In BH08, 0.5m of intact coal was recorded, and was underlain by ~0.5m of seatearth/ fireclay. This feature can be attributed to the Low Whinmoor (Cumberworth Thin Coal)

Notwithstanding the above no further coal seams, or no voids were encountered within the strata or to a depth of 22m bgl. Indeed, as per the geological appraisal, no further coal seams were expected within the sequence. Numerus boreholes were terminated at shallow depth due H&S concerns related to the limited rock cover above significant volumes of voided strata.

No distinct groundwater strikes were recorded during drilling, although the rapid method of drilling may have masked the present of waters. Furthermore, it is possible that the use of water flushing techniques may have masked the presence of any water strikes within the other rotary probe holes. In any event, it should be appreciated that groundwater levels are subject to seasonal variation or changes in local drainage conditions.

PPE gas monitors were utilised during all drilling operations, and did not detect elevated levels of mine gas during the drilling phase.

6.2 Mine Shaft Search

In view of the data obtained during the ground investigation, the table below present the known features of the three shafts at the site. this data should be read in conjunction with the photographic logs presented within Appendix 10, as well as the diagrammatic site plans presented within Appendix 11. For completeness, a summary of the on-site shaft found as part of a previous ground investigation[7] (as detailed in the Coal Mining Risk Assessment) is also summarised:

[7] Please refer to report dated May 2018 , referenced J3978/17/E/G, produced by RGS.

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Table 5: Information with regards to the Mine Shaft			
Shaft Reference	422408-002	422408-015	422408-016 (located May 2018)
Location (as identified by Ground Investigation):	422831.659 E 408654.972 N 177.728 L	422903.374 E 408741.294 N 178.128 L	422944.64 E, 408709.50 N.
Description	2m diameter circular feature.	1.5m brown to light greyish brown oval-shaped feature backfilled with residual cohesive soils.	1.3m by 1.7m oval of infilled ground was observed in the surrounding solid geology.
Dimensions	2m diameter.	1.5m diameter.	1.3m by 1.7m
Lining	No lining. Surrounded by sandstone rockhead	No lining. Walls of the shaft comprise residual cohesive soils to termination depth of the feature.	No lining. Walls of the shaft comprise residual cohesive soils.
Fill	Backfilled with black angular tabular gravel of carbonaceous mudstone and coal.	Backfilled with brown locally greyish brown and black gravelly clay.	The infill comprised brown sandy sub-angular and angular fine to coarse gravel of siltstone. There did appear to be a border of darker soil around the edge of the infill and the infill appear to be very compact.
Integrity	Good. Filled to an unknown specification, albeit no obvious evidence of movement or slumping.	Good. Filled to an unknown specification, albeit no obvious evidence of movement or slumping.	Good. Filled to an unknown specification, albeit no obvious evidence of movement or slumping.
Thickness of superficial soils	~0.45m	~1.8m of cohesive fill recorded above shaft location.	0.5m
Depth	7.3 (assumed from mine entry data sheets)	Shaft scraped and proven to be of less than 0.9m depth. base of the shaft is at the same level as a poor quality coal seam	3.8 (assumed from mine entry data sheets)

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7. Insitu Testing

7.1 Standard Penetration Tests

The standard penetration tests carried out are summarised in the following table:

Table 6: Summary of Standard Penetration Tests

Strata	Depth Range (m)	SPT 'N' (Blows/300mm)		Comments
		Granular soils	Cohesive soils	
Residual Cohesive Soils	1 – 2.45		9 – 15	Soils in a firm in-situ condition.
Cohesive fill	1 – 1.45		6	Soils in a soft in-situ condition.
SANDSTONE	1 -1.45	+50		SPT 'N' Value of +50 indicates refusal on rockhead.
SILTSTONE	1 – 3.54	27 - +50		SPT 'N' Value of +50 indicates refusal on rockhead.
COAL	4 – 4.45	+ 50		SPT 'N' Value of +50 indicates refusal on rockhead.

7.2 Dynamic Penetration Tests

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

Table 7: Summary of Dynamic Penetration Tests

Position	Blows/100mm			Refusal type (Effective/ Abrupt)[8]	Comments
	0 - 2	3 - 10	10+		
	Depth to which blow count range was observed (m)				
DP02	3.6			-	Driller notes low blow counts until voided strata recorded between 2.4m and 3.5m.
DP04	0.8		1.0	Abrupt	Typically, low blow counts recorded until abrupt refusal encountered at 1.0m.
DP06	1.1	1.5	1.8	Abrupt	Typically, low blow counts recorded until 1.1m, at which blow count increases until abrupt refusal encountered.
DP08	4.5	4.8	5.0	Abrupt	Typically, low blow counts recorded until abrupt refusal encountered at 5.0m.
DP10	0.5	3.1	3.3	Abrupt	Gradual increase in blow count recorded until effective refusal encountered.

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

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7.3 Gas and Water Level Monitoring

The monitoring of standpipes commenced on the 22nd April 2022 and is currently ongoing (regime of 6 readings over 3 months is proposed). The results of the gas monitoring undertaken to date are tabulated below.

Table 8: Gas Monitoring

Location	Date	CH_4 (%)	CO_2 (%)	O_2 (%)	Flow (l/h)	Barometric Pressure (mb)	Water Level (m)	Standpipe Depth (m)
WS01*	22.04.2022	N/A	N/A	N/A	N/A	N/A	N/A	-
	29.04.2022	N/A	N/A	N/A	N/A	N/A	N/A	
	06.05.2022	N/A	N/A	N/A	N/A	N/A	N/A	
	13.05.2022	N/A	N/A	N/A	N/A	N/A	N/A	
WS03	22.04.2022	0.1	1.4	20.0	0.0	991↓		1.5
	29.04.2022	0.1	1.3	20.5	0.0	1011↓	_	
	06.05.2022	0.1	1.2	20.1	0.1	1002↓	_	
	13.05.2022	0.1	1.2	20.2	0.1	994↑	_	
WS04	22.04.2022	0.1	0.0	21.4	0.0	993↓		0.9
	29.04.2022	0.1	0.1	21.1	0.0	1012↓		
	06.05.2022	0.1	0.3	21.0	0.1	1003↓	_	
	13.05.2022	0.1	0.3	20.9	0.1	995↑	_	
WS05	22.04.2022	0.1	0.9	20.7	0.0	993↓		1.5
	29.04.2022	0.1	0.8	20.7	0.0	1012↓		
	06.05.2022	0.2	0.7	20.8	0.1	1004↓		
	13.05.2022	0.1	0.6	20.7	0.0	996↑	_	
WS06	22.04.2022	0.1	2.4	18.7	0.1	992↓		1.5
	29.04.2022	0.1	2.2	20.9	0.0	1013↓		
	06.05.2022	0.1	1.9	19.3	0.1	1004↓		
	13.05.2022	0.1	1.4	20.0	0.0	997↑	_	
WS07	22.04.2022	0.1	1.3	19.5	0.0	992↓		2.5
	29.04.2022	0.1	1.4	19.8	0.0	1013↓		
	06.05.2022	0.1	1.3	19.9	0.1	1002↓		
	13.05.2022	0.1	1.2	20.2	0.0	996↑		
WS08*	22.04.2022	N/A	N/A	N/A	N/A	N/A	N/A	-
	29.04.2022	N/A	N/A	N/A	N/A	N/A	N/A	
	06.05.2022	N/A	N/A	N/A	N/A	N/A	N/A	
	13.05.2022	N/A	N/A	N/A	N/A	N/A	N/A	
WS09	22.04.2022	0.1	8.2	14.3	0.0	992↓	_	3.6
	29.04.2022	0.1	2.6	18.9	0.0	1012↓	_	
	06.05.2022	0.1	6.2	14.5	0.1	1003↓		
	13.05.2022	0.1	3.4	17.7	0.0	996↑	_	

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WS10	22.04.2022	0.1	0.1	21.4	0.1	992↓		1.5
	29.04.2022	0.0	0.2	21.2	0.0	1012↓	_	
	06.05.2022	0.1	0.1	21.1	0.1	1003↓	_	
	13.05.2022	0.1	0.1	21.0	0.0	996↑	_	

↑ - rising pressure ↓ - falling pressure ↔ -steady pressure
*Borehole missing: assumed damaged by subsequent contractors.

This work was undertaken using a Geotechnical Instruments (UK) Ltd. GA5000 (serial No G503524) which was last calibrated on the 5th May 2021.

7.4 Soakaway Test

On reaching the elected soakaway test depth, the pit was trimmed and squared as much as practicable. Water was then introduced into the pit at a controlled rate to prevent collapse of the sides and the level monitored at time intervals relative to a reference bar at ground level. The results obtained from the soakaway tests are presented at Appendix 7 and are summarised below:

Table 9: Soakaway Test Results

Location	Soakage Area Dimensions (average) (m)	Depths of soaked strata (m)	Soil Description (of soaked strata)	Infiltration Rate (m/sec)	*Drainage Characteristics
TP12	1.0 x 0.3	0.5 – 1.0	Side – Weak to medium strong thinly bedded light grey and orange fine to medium grained SANDSTONE. (Recovered as sandy gravel) Base – As above	2.0×10^{-5} 1.4×10^{-5} 9.6×10^{-6}	Good
TP14	1.7 x 0.3	0.58 – 1.0	Side – Firm light yellowish brown very sandy silty CLAY Base – as above	*	Practically Impermeable
TP15	2.0 x 0.3	0.74 – 1.24	Side – Firm friable thinly laminated light grey mottled orangish brown silty CLAY Base – As above	*	Practically Impermeable

*Based on the most onerous results for each test.

During the soakaway tests the water level did not achieve a fall from 75% to 25% of the effective depth of the storage volume in TP14 and TP15 trial pits. On this basis, the tests could not be completed within the scope of the method provided in BRE Digest 365 due to the poor soakage rate of the exposed soils. Due to the negligible water movement it was not possbile to extrapolate the results obtained in order to obtain a soil infiltration rate.

7.5 TRL Dynamic Probes

9 no. TRL dynamic probes were undertaken along the line of the proposed roadways. A summary of the results is presented below:

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Table 10: TRL Test Results				
TRL Location	Top of layer (m)	Base of layer (m)	Minimum CBR (%)	Average CBR (%)
TRL1	0	0.5	2	6
	0.5	1.0	2	5
	1	1.4	5	37
TRL2	0	0.5	5	15
	0.5	1.0	19	498
TRL3	0	0.5	5	15
	0.5	1.0	18	33
TRL4	0	0.5	0	20
	0.5	1.0	10	16
	1.0	1.5	18	44
TRL5	0	0.5	3	7
	0.5	1.0	2	11
	1.0	1.5	33	47
TRL6	0	0.5	4	13
	0.5	1.0	5	37
	1.0	1.5	55	63
TRL 7	0	0.5	1	3
	0.5	1.0	3	15
	1.0	1.5	9	14
TRL8	0	0.5	5	10
	0.5	1.0	2	6
	1.0	1.5	9	15
TRL 9	0	0.5	2	17

8. Laboratory Testing - Geotechnical

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

• Determination of water content	BS EN ISO 17892-1:2014
• Determination of liquid and plastic limits	BS EN ISO 17892-12:2018
• Determination of bulk density	BS EN ISO 17892-2:2014
• Determination of particle density	BS EN ISO 17892-3:2015
• Determination of particle size distribution (Dry)	BS EN ISO 17892-4:2016: 5.2
• Determination of particle size distribution (Wet)	BS EN ISO 17892-4:2016: 5.2
• Sedimentation by pipette	BS EN ISO 17892-4:2016: 5.3 – 5.4
• Dry Density/Moisture Content Relationship	(Part 4:1990:3)
• California Bearing Ratio	BS 1377-4:1990: Pt4:
• Incremental loading oedometer test	BS EN ISO 17892-5:2017
• Unconsolidated undrained triaxial test	BS EN ISO 17892-8:2018
• Soluble sulphate content	BS 1377-3:2018+A1:2021: Pt3: 7.3
• pH value	BS 1377-3:2018+A1:2021: Pt3: 12
• Undrained shear strength (Triaxial)	BS 1377: 1990: Pt7: 8 & 9
• One-dimensional consolidation	BS 1377-5:1990: Pt5: 3

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The test results are presented in Appendix 12 and are summarised below:

Table 11: Summary of Geotechnical Test Results

Test type	Number of tests	Range of results		Comments
Water content determinations	3		17% - 24%	Tests undertaken on cohesive fill and residual sandstone.
Index properties (1 Point)	2	LL PL PI	51% -62% 26% 25% - 36%	Clay of high plasticity. Consistency index 1.0 – 1.1 NHBC Class – medium to high
Determination of Bulk Density	2	Bulk Density	1.97 Mg/m^3 1.60 Mg/m^3	Cohesive Fill tested Via Linear Measurement
Determination of particle density	2	Particle Density	2.59 Mg/m^3 2.58 Mg/m^3	Cohesive Fill SANDSTONE (recovered as sandy GRAVEL)
Particle size distribution (Dry sieve)	3	Gravel Sand Silt/Clay	67% 77% 13% - 29% 4% -10%	Sandstone (recovered as sandy GRAVEL) Uniformity coefficient 59 - 580 Curvature coefficient 10 - 38
Particle size distribution (Wet sieve and sedimentation)	1	Gravel Sand Silt /Clay	23% 18% 59%	Cohesive FILL (Very gravelly sandy CLAY)
Dry Density/Moisture Content Relationship (Part 4:1990:3)	2	MDD OMC MDD OMC	1.92 Mg/m^3 10% 2.01 Mg/m^3 9.8%	Cohesive Fill Sandstone (recovered as sandy GRAVEL)
California Bearing Ratio	2		42% 69%	Sandstone (recovered as sandy GRAVEL) Cohesive FILL
Soluble sulphate & pH	9	SO_4 pH	0.08 – 0.013g/l 6.5 – 8.1	AC-1 Concrete classification
One–dimensional consolidation	1	c_v m_v	19 m^2/yr 0.076 m^2/MN	Relatively fast rate of settlement. Medium to high compressibility.
Undrained shear strength (Triaxial)	1	c_u γ	62 kN/m^2 19.92 kN/m^3	Residual cohesive soils

In cohesive soil the approximate cohesion, c_u, and coefficient of consolidation, m_v, may be obtained from the equivalent SPT 'N' value using the following expressions (Stroud 1975).

$c_u = f_1 N$

$m_v = \frac{1}{f_2 N}$

where:

c = cohesion (kN/m^2).
m_v = Coefficient of consolidation (m^2/MN).
f_1 & f_2 = factors based on plasticity index.
N = SPT 'N_{300}' value.

For the cohesive soils revealed at this site the highest (worst case) plasticity index[9] of 36% could be employed, which suggests an f_1 value of 4.2 and an f_2 value of 0.44.

8.1 Geotechnical Properties

The idealised geotechnical properties employed in design are summarised below.

[9] See paragraph 6.2 'Index Property Tests'

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Table 12: Summary of Geotechnical Properties			
Property	**Range of values**		**Comments**
Volume change potential (NHBC)	Medium		Cohesive fill and residual soils are recoded to have volume change potential.
Shear strength parameters (at proposed foundation level – in residual cohesive soils)	c_u γ	50kN/m^2 20kN/m^3	Based on triaxial test results, SPT 'N' values, and observations made during logging.
Consolidation characteristics (of residual cohesive soils)	c_v m_v	19 m^2/yr 0.076 m^2/MN	Assume m_v gradually reduced with increasing depth.
Concrete classification	DC1		Natural ground locations (Static water)

9. Laboratory Testing - Environmental

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

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

This testing was undertaken by Eurofins Chemtest Ltd and the results of all of the chemical testing are presented in Appendix 12 of this report.

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10. Risk Assessment – Mining Instability

In light of the findings of this investigation, the risk to the proposed development is considered with reference to the following ratings and definitions:

Low - The possibility of instability is unlikely therefore no further action is necessary.

Moderate - The possibility of instability is likely and further investigation or remedial action may be required.

High - The possibility of instability is highly likely and further investigation or remedial action will be necessary.

Table 13: Development Specific Risk Assessment

Item	Risk of Instability	Coal Seam(s) Considered	Risk Rating
10.1	Shallow coal seams (recorded and unrecorded)	Horizon 1 (Whinmoor, or, unnamed)	High
		Horizon 2 (Whinmoor)	High
		Horizon 3(Low Whinmoor)	High
10.2	Coal workings at depth	None Expected.	Low
10.3	Mine shafts	Mine Shaft 422408-002	High
		Mine Shaft 422408-015	Low
		Mine Shaft 422408-016	High
10.4	Adits	Adits, 422408-024 – 029 (off site)	Entrance instability (low) General Stability (high)
	Spine roadways		High
10.5	Mine Gas	Associated with Shallow Workings	High

10.1 Risks Posed by Shallow Mining (recorded and unrecorded Mining).

10.1.1 Whinmoor Coal (aka Cumberworth Thick)

The data presented above suggests coal or workings associated with the Whinmoor Coal were recorded in 15 locations, and is present both as intact coal and voids. The data would suggest that this feature could be present as two sets of working at a level of ~181m AOD (horizon 1) and also at 170m – 177m AOD (horizon 2). A maximum void thickness of 2.5m was recorded. As such, it is considered that there will not be a sufficient thickness of competent rock cover above the workings to mitigate the risk of instability impacting the surface. Therefore, a high-risk rating has been assigned.

10.1.2 Low Whinmoor Seam (aka Cumberworth Thin).

The data presented above suggests the Low Whinmoor Coal Seam may have been extracted as a secondary commodity or left in as a roof (as suggested by the memoir), with the mine workings

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beneath the site largely attributed to the removal of the associated Whinmoor Fireclay. Features representative of these conditions were recorded at depths ranging between ~161m and 164m AOD in two locations. A maximum void thickness of 1.5m was recorded. In view of this, and taking into consideration the proven workings within the stratum above, it is considered that there will not be sufficient thickness of competent rock cover above the workings to mitigate the risk of instability impacting the surface. Therefore, a high-risk rating has been assigned.

10.2 Coal Workings at Depth

In regard to deeper mining which could affect the site, no further coal seams, or voids were encountered within the strata or to a depth of 30m bgl. Indeed, as per the geological appraisal, no further coal seams were expected within the sequence. Therefore, a low risk rating has been assigned.

10.3 Mine Shafts

In the context of the guidance given by CIRIA SP32 – *Construction over abandoned mine workings* it should be appreciated that the minimum distance for siting structures from open or poorly filled shafts depends primarily on the nature and thickness of the surface deposits in which the majority of the collapse crater would form. Figure 33 of CIRIA SP32 suggest that the collapse crater within such soils would repose to an angle of 90°- ϕ where ϕ is the angle of shearing resistance for the soil and the resulting angle is taken from a vertical projection at the outer edge of the shaft. However, this is likely to be the worst case, long term situation, should a collapse occur and no other treatments or precautions be undertaken where superficial or weak residual soils exist above rockhead.

It is usual to adopt a no build exclusion zone of 45° from the edge of the shaft to inform the development layout, assuming that some form of remedial treatment or capping of the shaft will be completed, although consideration of all pertinent factors will be required to determine the size of any no build zone around the shafts.

10.3.1 Mine Shaft 422408-002

This feature was located during the ground investigation (422831.659 E 408654.972 N, 77.728 L), and is noted to represent a circular infilled feature of 2.5m diameter; mine entry data sheets confirm that the feature approximately 7.3m deep.

Taking into consideration the information presented above, it is evident that the potential zone of influence encroaches on two sets proposed houses, should the fill within the shaft subside in the future. A diagram showing the potential zone of influence in association with the proposed is presented within Appendix 11. As such a high rating has been assigned, such that remedial works will be necessary.

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10.3.2 Mine Shaft 422408-015

This feature was located during the ground investigation (422903.374 E, 408741.294 N, 178.128 L), and is noted to represent an oval-shaped infilled feature of ~1,5m diameter. At the time of the investigation, the shaft was located beneath a significant thickness of fill. Excavation through this feature concludes that it was originally of 0.9m depth, in accordance with the mine entry data sheets.

Taking into consideration the development proposals, the feature is noted to fall outside the boundary footprint of any future building. Furthermore, excavation during the ground investigation has essentially removed the feature. As such, it is likely that these works will have removed the risks of shaft collapse. Regardless of this, the property foundations will be below the base of the shaft. As such, a low risk rating can be assigned.

10.3.3 Mine Shaft 422408-016

Previous ground investigation has confirmed the location of the shaft (422944.64 E, 408709.50 N) and has proven that it is infilled. Data from the Mine abandonment plan and mine entry data sheet suggest that the shaft is between 3.8m and 4m depth and likely represents an ‘air shaft.

Taking into consideration the development proposals, it is evident that the shaft is located 3.5m from a proposed set of houses. Nevertheless, the zone of influence of the feature could affect the proposed structures, should the fill within the shaft subside in the future. A diagram showing the potential zone of influence in association with the proposed is presented within Appendix 11. As such a high-risk rating has been assigned, and further remedial works should be undertaken.

10.4 Adits and Spine Roadways

6 recorded adits are present around the perimeter of the site, with spine roadways that are anticipated to run beneath the site. It should be appreciated that no evidence of adit openings were recorded during the investigation. As such, whilst instability associated with the entrance of the adits is considered low risk, their associated spine ways should be treated with the same regard as the workings. As such, a high-risk rating has been assigned.

10.5 Risks Posed by Migration of Hazardous Ground Gas

In this case, it is evidence that shallow mining is present beneath the proposed development. Such features represent a credible source of ground gas. It should be appreciated that a regime gas monitoring is ongoing as part of the Geo-environmental Assessment. Initial findings would suggest that gas protections in accordance with CS2 conditions should be installed (see section 11.3.1)

The final risk assessment should take into consideration the current site conditions, and should be subject to reassessment after the formulation and/ or completion of any remedial measures, and proposed foundation solution. These documents should be prepared by a suitably experienced and qualified specialist.

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11. Outline Remedial Proposals

It is incumbent for the developer to demonstrate to the Local Planning Authority that the application site can be made safe and stable to meet the requirements of national planning policy with regard to development on unstable land. The following outline guides to remedial works are provided, advice from specialist contractors should be sought.

11.1 Shallow Mining

Grouting

Consideration may be given toward pressure grouting (or similar) of the voided ground below the site. In this context, it is recommended that the advice of specialist grouting contractors is sought, however, the following comments should be noted.

The objective of a grouting exercise at the site would be to undertake grout-holes on a regularly spaced grid-pattern throughout areas of high and moderate risk. Grout would then be injected into these holes, probably following the introduction of a coarser material to bulk fill the voids, with a view to filling any voids encountered, provided the grout is present to the top of any voids, stresses within the material above the void will then be transmitted through the grout once it has hardened.

It should be appreciated however, that as the workings below the site extend beyond the boundaries. In this regard, it would be necessary to create a grout curtain using a thicker grout or grout foam around the edges of the site with a view to blocking the workings at the site boundaries, thus preventing migration beyond the site limits. Furthermore, given that there are adits associated with the workings, these will need to be filled / blocked up before general grouting across the site to prevent the loss of grout out of them.

As the use of relatively high-pressure grouting techniques is likely to be required, it should be appreciated that any ground gasses present within the workings could be mobilised. Therefore, a risk assessment will need to be undertaken which considers the hazards associated with ground gasses and certainly sentinel wells between the site and any off site receptors, regularly monitored during any works, will be required. In this context, the recommendations given in section 6.2 of *Guidance on managing the Risk of Hazardous Gases when Drilling or Piling Near Coal*[10] should be followed.

Excavation and Filling

Given the majority of workings are present at relatively shallow depths (up to 6m) beneath the site (Horizon 1 and most of Horizon 2), excavation of the workings may be considered as an alternative to grouting. This exercise would aim to excavate down to the level of the workings and reconstruct the ground surface with an engineered material. Clearly, a remedial action involving a deep

[10] *Guidance on Managing the Risk of Hazardous Ground Gasses when Drilling or Piling Near Coal (2012)*, The Coal Authority, Health and Safety Executive, British Drilling Association, Federation of Piling Specialists and the Association of Geotechnical and Geoenvironmental Specialists

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excavation of the site would need careful consideration and the advice of a specialist engineer would be necessary.

With such an undertaking, it must be realised that significant excavation faces will be created on the and the stability of these faces will need to be maintained – usually benching the excavation faces at 1 in 1 would be sufficient, although this would be complicated by the presence of voids and past workings and will need to be assessed as the excavation proceeds. Whilst such stability will be required in order to prevent the loss of land beyond the site boundaries, it will also be paramount to the safety of operatives who will ultimately need to work at the base of the excavation to shore up the workings at depth.

Due to the site being located with a residential area, suitable barriers will need to be placed around the edges of the site to prevent access by unauthorised persons and limit the risks of falling from height.

Once the excavation has been taken to the base of the workings, some remediation of any workings within the exposed face would need to take place. This would be to make sure that any engineered fill used to return site levels is not lost down the workings, which could potentially result in instability at surface. Such filling could employ granular materials to maintain drainage of the voids; however, it would be necessary to compact this material to a distance into the workings, therefore, a compacting plate mounted on a digger arm would be necessary. Entering abandoned workings cannot be considered safe and should be prohibited.

It would then be anticipated that the excavation would be filled with materials to return the site level. In this case however, any engineered fill employed could include materials won from the excavated rock, however, the suitability of this material will need to be carefully assessed and some processing (crushing) particularly of the sandstone may be required. Furthermore, depending on the extent of the workings below the site, which will reduce the volume of usable material available, additional fill materials are likely to be required to be brought to site. In addition, in order to prevent excessive total and/or differential settlements of the structures placed on the fill, the filling of the excavation will need to be completed to a suitable specification, carefully supervised and appropriate compliance testing carried out to ensure stability.

As the purpose of the excavation would be remove material below the depth of any workings, which are likely to be pillar and stall, it is likely that volumes of un-mined coal, and in this case Fireclay, may be retrievable. It should be noted that such materials may have a commercial value and provided careful handling takes place on site, consideration could be given to selling them as a commodity. Moreover, substances with a high organic content such as coal are often unsuitable for inert landfill and the disposal of coal in this method is not recommended. In order to determine the quality of the coal, which potential purchasers are likely to want to assess, may be necessary to undertake laboratory testing to establish its calorific value.

11.2 Mine Shafts

The situational risk of the shaft, in the context of the proposed land use may be defined as high[11]. Given the integrity of the shafts, and their location in relation to the proposed structures the following remedial options are likely to be approved by the Coal Authority:

[11] High situational risk is defined to include – urban spaces, major roads and multiple dwellings and area with high concentrations of people directly affected by the mine shaft.

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1. Install reinforced concrete cap at rockhead.
2. Drill and grout shaft fill.

The use of reinforced concrete is the most common method for capping a shaft, whether it has been filled, plugged or grouted, because of the need for durability and, usually, rigidity. A shaft cap should be designed by a competent structural engineer, following the principles detailed below:

The cap should be designed as a two-way spanning slab and should have a minimum dimension of twice the external diameter of the shaft subject to BS EN 1992-1-1:2004+AI:2014 — the external diameter being that of the excavated area and not that of the shaft lining.

In high-risk situations, caps should have a minimum thickness of 450mm, be reinforced, and designed in accordance with BS EN 1992-1-1:2004+A1:2014. The Coal Authority generally designs for a life of a cap of 120 years and often uses polyethylene to wrap around the cap, with a minimum cover of 75 mm to all faces, to potentially help extend its life.

Reinforced concrete caps should be designed to carry the weight of overburden and any other anticipated superimposed loads, including highway or structure loads. Note that normally, new structures would be expected to transfer their imposed loading to the surrounding suitable ground spanning the capping slab and, where possible, independent of the slab. It is not normally acceptable for any loads imposed by buildings being transferred to the shaft cap, the shaft or the shaft lining.

The cap should be a self-contained unit, independent and capable of supporting the overlying ground and any other imposed loads eg highways, should the shaft fill fail below it. To avoid loading and potentially damaging the shaft lining, a compressible packer layer should be incorporated over the lining and below the cap.

It is recommended that the cap is located at or below engineering rockhead level and at a depth where its upper surface will not be affected by frost action. It should be ensured that the formation has adequate bearing resistance.

The concrete design mix should take into account the prevailing ground conditions, chemical aggressiveness, groundwater quality, the need for durability and the method of placement. Ground should be assessed to BRE (2005) for sulphate and appropriate sulphate-resisting cement specified if necessary.

If the excavate and recompact method of treating the mine workings is adopted, the majority of shaft 422408-002 (7.3m deep) will be removed and all of shaft 422408-016 (about 4m deep) will be removed, should the anticipated shaft depths be correct. Shaft 422408-015 was already removed during it's investigation. Full records of any shaft removed by excavation should be maintained and submitted to the Coal Authority so that they can update their records.

11.3 Hazardous Ground Gas

In this case, it is evidence that shallow mining is present beneath the proposed development. Such features represent a credible source of ground gas. It should be appreciated that a regime gas

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monitoring is ongoing as part of the Geo-environmental Assessment. Initial findings would suggest that gas protections in accordance with CS2 conditions should be installed (see section 11.3.1)

The final risk assessment should take into consideration the current site conditions, and should be subject to reassessment after the formulation and/ or completion of any remedial measures, and proposed foundation solution. These documents should be prepared by a suitably experienced and qualified specialist.

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12. Discussion of Ground Conditions - Geotechnical

The land located at Cliff Hill, Cumberworth Lane, Denby Dale, is proposed to be developed by the construction of a new residential estate. At the time of writing this report the precise layout and method of construction is not known, thus the discussion below is of a generalised nature.

12.1 Geotechnical Discussion

In view of the data presented above, the following information needs to be taken into consideration when choosing an appropriate foundation solution for the building:

- Up to three horizons of voided or worked strata are likely to be present beneath the site. It will be paramount to ensure that the issues related to instability associated with shallow mine workings are fully addressed, as outlined within section 9. The chosen method of remediation will significantly affect the foundation solution for the proposed structures.
- The thickness and composition of residual soils is variable across the site, in association with the change of anticipated geology, and topography.
- A significant thickness of un-engineered fill is present within the northern quadrant of the site, as well as along the eastern site boundary. It cannot be recommended that foundations be constructed directly within this fill as it is present in a weak and variable condition such that excessive total and or differential settlement could occur under moderately light surface loading.

In view of the above information, an outline guide to foundation solutions are offered on the basis of the following scenarios:

- Foundation Option A: The site is subject to a regime of grouting, and all shafts are fully remediated.
- Foundation Option B: The site is subject to an earthworks scheme in order to removed voided strata. The site is brought back to acceptable levels with engineered fill, placed to a specification. Deeper workings may be grouted, should they be at a depth that it will not be pragmatic to excavate. Shafts will be remediated, which is likely to be achievable by full depth excavation.

12.2 Foundation Options A .

Due to variability of ground conditions and rockhead level encountered on site, it is recommended that a pragmatic approach be taken to the foundations for the houses, and are considered on a plot by plot basis. In broad terms, it is considered that the foundation solutions could include the traditional footings in areas where clays, present in at least a firm insitu condition, or sandstone rockhead is encountered at relatively shallow depth.

However, it cannot be recommended that footings for a singular plot span both cohesive soil and rock due to the potential for differential settlements. It is therefore recommended that careful inspection takes place during the excavation of footings to ensure that foundations are placed wholly within materials of similar competency.

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In the central and northern sections of the site, extremely weak sandstone will be revealed shallow depth. This material would possess a significant bearing capacity, probably being in excess of 150kN/m^2. Therefore, at a typical foundation load for a house the factor of safety against general shear failure will be high, probably exceeding 10. In addition, it is considered that nominal settlements will occur under the action of the proposed increase in load.

In areas of the site at lower relief (northern quadrant), the upper weathered fraction of the Coal Measures will be exposed, which generally consists of stiff clay with siltstone lithorelicts. It is considered that this material will provide a suitable bearing stratum, provided that the foundations are placed within soil generally described as being present in a firm insitu condition. It is considered that strip or spread foundations constructed within this material at a minimum depth of say 1.2m (or, locally depended along the northern boundary where fill is present) could be designed assuming an allowable increase in load given in the following table.

Table 14: Allowable increase in stress

Foundation type		Strip Footings			Spread Footings		
Foundation Breadth	B (m)	0.6	0.9	1.2	1.0	2.0	3.0
Foundation Depth	D (m)		1.2			1.2	
Allowable Increase in Stress	(kN/m^2)	90	85	85	100	95	90

The allowable increase in stress given above assumes a factor of safety of 3 against general shear failure, with cohesion of 50kN/m2 at the foundation depths. Settlements at the above loading intensities should remain within tolerable limits for the type of structure proposed provided that the underlying soils are carefully inspected immediately final trimming has taken place. Should any soft or weak material be encountered they should be locally removed and replaced with lean-mix concrete or compacted granular soil.

Where grouted workings exist at a depth of less than 5m below final ground levels it is recommended that raft foundations are adopted to guard against any residual movements from the treated workings.

12.3 Foundation Option B.

Given the majority of workings are at shallow depths beneath the site, excavation of the workings below the site may be considered as an alternative to grouting. This exercise would aim to excavate down to the level of the workings and reconstruct the ground surface with an engineered material. It is anticipated that it would be readily achievable to excavated to around 6m begl, which would remove all of Horizon A and most of Horizon B voids and workings. Clearly, a remedial action involving a deep excavation of the site would need careful consideration and the advice of a specialist engineer would be necessary. Stability of excavation sides would need to be maintained, in the main by benching (maximum slope 1 in 1), localised shoring or other consideration will be required where voids or workings are encountered in excavation side and consideration will be required to keep the excavations clear of water, whether drained from the surrounding soils / rock, workings or from infiltration.

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As settlement sensitive buildings are to be constructed, it is recommended that an End Product Specification is adopted for future earthworks. These works should be undertaken to achieve at least 95% or greater maximum dry density and 5% or less air voids.

Taking into consideration the range of moisture contents recorded through the testing, it is suggested that, in general, the natural moisture content is largely above OMC, although locally within the clay fill moisture contents close to optimum were recorded and the moisture content in the sandstone residual soils was at optimum. At present there is insufficient laboratory testing to determine a suitable specification for compaction of "won soils" and additional testing will be required. Nevertheless, from experience natural Coal Measures derived soils are likely to achieve optimal compaction without significant modification. As such, the options available to retain cut material on site for use as fill are as follows:

- Where required, dry back "cut materials" to within a moisture content of 2% of OMC.
- Where required, utilise lime or cement as a pre-treat, prior to compaction.
- Should material be placed to confirm to an end product specification it is likely that raft footings could be adopted for the site. The allowable bearing capacity for an edge thickened raft foundation would be of the order of 50kN/m². This assumes that the thickening beneath load bearing walls will be at a minimum depth of 0.6m below the formation level. The allowable increase in stress given above assumes a factor of safety in excess of 3 against general shear failure. Settlements at the above loading intensities should remain within tolerable limits for the type of structure proposed provided that the underlying soils are carefully inspected immediately final trimming has taken place.
- Given that sufficient bearing capacities are achieved in the compacted fill and an adequate regime of compliance testing is undertaken it may be possible to adopt reinforced strip foundations, although such foundation may be excluded from the boundaries of the site where the risk of differential settlements due to boundary conditions and the presence of inadequately backfill shallow off-site voids will increase the risk from differential settlements and raft foundation will be required.
- It is further recommended that inspection and compaction of the sub grade is undertaken before construction of the raft is commenced. Should any soft or weak material be encountered during or after compaction they should be locally removed and replaced with lean-mix concrete or compacted granular soil. In addition, if the excavations are required to stand open for any period of time then a blinding layer of lean-mix concrete should be placed in the excavation bases. This expedient will reduce softening or loosening of the sub-grade due to the ingress of surface water.
- It is recommended that the foundations for the property be built with reference to Part 4 of the NHBC Standards, particular chapters 4.1 – *Land quality – managing ground conditions* and Chapter 4.5 – *Raft, pile, pier and beam foundations*.

Should modification be required but not undertaken, it would be necessary to accept a poorer compaction and end product within fill areas. The development should be designed to cater for this, which may include granular capping (reinforced with geogrid) beneath roads and services, flexible service joints and a deeper foundation solution, such as piles. The toe of the pile will need to be below any shallow voids or workings whether treated or not.

It is also recommended that the granular materials be reserved to be used to maintain some drainage between untreated, off-site voids or workings to maintain drainage and prevent the accumulation within and softening of clay fills.

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It should also be appreciated that any fill material, either site-won (from existing made ground) or imported, be employed at the site should be subjected to the following assessment to determine its suitability. Fill materials should be initially screened, by a suitably qualified engineer, for the following:

- It is free from obvious contamination i.e. visual or olfactory evidence
- It has not come from areas where Japanese Knotweed or other invasive or injurious plants are suspected to be growing
- It is not a statutory nuisance, such as being odorous
- It is free from unsuitable material i.e. whole bricks, brick ties, timber or glass.

All unsuitable materials (i.e. hardstanding, soft or loose materials or topsoil) should be removed and not included in the earthworks. All existing vegetation including old root systems should be cleared prior to the earthworks. Furthermore, the slope should be benched to at least a 1 in 1 gradient to provide a level compaction surface.

An earthworks verification report will be required detailing the works completed and the results of compliance testing.

12.4 Access Roads, Drive-ways and Hard-standing

It is considered that any roads or hard-standing at the site could be constructed employing traditional pavement design.

Should the site be subject to a grouting operation, the majority of residual soils will act as a sub-grade. In the southern and central quadrants of the site, where residual sandstone is expected, CBR values within the region of 40% could be assumed. In parts of the site in which residual soils comprise clay, CBR values of 2% to 5% would be more appropriate.

Should the site be subject to an earthworks scheme, engineered fill with act as the sub grade beneath the majority of the proposed hardstanding. The in-situ CBR value of the engineered fill should be assessed upon completion of the earthworks. Nevertheless, for costing and design purposes, a design California Bearing Ratio (CBR) of 2% to 5% could be employed in the pavement design[12]. However, it is recommended that proof rolling of the sub-grade be undertaken to establish the suitability of the soils, to expose any soft or weak ground and to ensure the sub-grade is well compacted prior to construction. Any areas of soft or weak ground should be remediated by increasing the sub-base thickness. Alternatively, weak material could be locally removed and replaced with a compacted granular capping layer. If construction were to be undertaken during the winter or after periods of prolonged rainfall, it may be prudent to employ a geotextile and/or a geogrid between the sub-base and sub-grade.

In situ CBR testing could be employed following sub-grade preparation to confirm the provisional design values presented above.

[12] Table 13/2 Design Manual for Roads and Bridges (1995), HA44/9: Volume 4 Section 1 Part 1, Highways Agency.

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12.5 Effect of Sulphates

In view of the nature of the underlying soils it is considered that the design sulphate class be assessed with reference to Table C2[13], which is provided in BRE Special Digest 1, *Concrete in aggressive ground*: Part C. On the basis of this table and considering the soluble sulphate contents recorded, it can be shown that well compacted buried concrete should be designed in accordance with Class DS-2 requirements. Assuming static groundwater, the table also indicates that the aggressive chemical environment for concrete (ACEC) classification is AC-1s.

In order to evaluate the design chemical (DC) class for the buried concrete at this site reference should be made to Table D1[14], which can be found in Part D, *Specifying concrete for general cast-in-situ use,* of BRE Special Digest 1. From this table it may be shown that for an intended working life of at least 50 years the concrete design class DC-1 is required.

At this stage only limited concrete classification testing is available and it is recommended that additional testing be completed on near surface soils. If the "excavate and recompact" option is selected then additional concrete classification testing will be required on near surface soils once the earthworks are complete.

12.6 Soakaway Construction

Should the site be subject to a grouting operation, such that the near surface soils will be relatively undisturbed, it may be possible to utilise soakaways in areas of the site where sandstone rockhead was encountered. BRE365 testing within the upper weathered sandstone confirmed soil infiltration rates that can be classified as 'good'. Although this material may initially seem suitable, it should be appreciated that the permeability of sandstone is controlled by intergranular and fracture permeability. As such, natural variability in residual rockhead is not uncommon, and therefore, there remains the possibility that drainage characteristics in other areas of the site may vary from the area tested. Should soakaways be constructed within the underlying stratum, some siltation is possible within the soakaway, thereby reducing the permeability over time. It is therefore recommended that this is taken into account in the soakaway design, however, it may be appreciated that the calculations given in BRE 365 take account of such fouling.

In areas of the site where residual cohesive soils were encountered (northern quadrants) practically impermeable drainage characteristics were recorded, such that soakaways cannot be recommended for these areas.

In conclusion, it may be possible to construct a suitable soakaway at the site depending on the efficacy of the construction and long-term maintenance given the comments above.

If the "excavate and recompact" option is selected soakaways will not be an option.

[13] Table C2, *Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations*
[14] Table D1, *Selection of the DC Class and the number of APMs for concrete elements where the hydraulic gradient due to groundwater is 5 or less: for general in-situ use of concrete.*

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13. Discussion of Ground Conditions - Environmental

13.1 Discussion of Test Results

The land located at Cliff Hill, Cumberworth Lane, Denby Dale, is proposed to be developed by the construction of a new residential estate. Consequently, the site may be classified as residential with plant uptake.

13.1.1 Soil Samples

The results of the chemical testing undertaken on soil samples obtained during this investigation have been compared to the ATRISK soil screening values (SSVs) as compiled by WS Atkins plc. With respect to the results it should be appreciated that the soil organic matter (SOM) content for the samples tested was found to range between 6.7% and 7.1%. On this basis, it is considered that the screening values associated with 6% SOM should be adopted. These values have been derived in such a way as to adhere to the principles within the revised CLEA model and include the most current release of the SGVs. A list of subscribers is provided within the website[15] and these include many local authorities.

A comparison of the results of the testing, together with the data given above, can be found within Appendix 4. These results indicate the following:

Table 15: Summary of Contaminated Areas

Location	Depth (m)	Contaminants found to be exceeding SSVs (Residential with plant uptake)
WS01	0.3 – 0.4	None.
WS02	0.3 – 0.4	None.
WS03	0.15 – 0.45	None.
WS04	0 – 0.3	None.
WS05	0.1 – 0.3	None.
WS06	0 – 0.2	None.
WS07	0.3 – 0.6	None.
WS08	0.5 – 0.6	None.
WS09	0 – 0.4	None.

Concentrations of chromium^{VI}, and total petroleum hydrocarbons (aliphatic C5 to C35; aromatic C5 to C35) were below the detection limits for the tests. Detectable levels of all other contaminants were recorded, but these fell below the associated Atrisk Soil Screening Values. In addition, no asbestos was detected within the soil samples tested.

[15] http://www.atrisksoil.co.uk/pages/general/subscribers.asp

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On the basis of the above information, the results of the investigation have concluded that the site is generally uncontaminated.

13.1.2 Gas Concentrations

With respect to ground gas, the results of the monitoring visits indicated a maximum concentration of 0.2% methane, with concentrations of carbon dioxide ranging between 0% and 8.2%, in association with oxygen levels of between 14.3% and 21.4%. It should be appreciated that on uncontaminated sites there is generally about 20% by volume of oxygen, associated with low levels of carbon dioxide. In addition, a maximum flow rate of 0.1 litres per hour was recorded and will be employed in the following calculations.

The principal driving force for initiating the movement of gas in the ground is a change in barometric pressure. The most onerous gas condition on a site is usually observed on days of low or falling barometric pressure, preferably below 1000mb. It has been noted that measurements undertaken solely during high pressure conditions may be of lesser value. At this site the readings undertaken to date were at atmospheric pressures of between 991mb and 1013mb.

In order to establish the gas screening value (GSV) for carbon dioxide or methane, the maximum gas concentration (expressed as a decimal) is multiplied by the borehole flow rate (l/hr). In this case 0.2% (0.002) methane was recorded along with 8.2% (0.082) carbon dioxide, in association with a maximum flow rate of 0.1 l/hr. This results in a GSV of 0.0002 l/hr for methane and a GSV of 0.0082 l/hr for carbon dioxide.

In accordance with Table 8.5, Modified Wilson and Card classification of the CIRIA report C665, Assessing risks posed by ground gasses to building, the site may be characterised, with respect to the GSV, as Situation Level 1; GSV <0.07. However, it is also noted that should gas concentrations be above the typical level for this characterisation, 1% methane and 5% carbon dioxide, then Situation Level 2 should be considered. In this instance, the maximum carbon dioxide concentration of 8.2% exceeds the 5% limit; therefore Situation Level 2 should be adopted.

With regard to the number of monitoring visits required reference is made to Tables 5.5a and 5.5b of CIRIA report C665 (2007)[16]. Accepting that the proposed development is of moderate sensitivity and that the generation potential is very low, these tables suggest that 6 readings could be undertaken over a period of 2 months. However, C665 notes that *not all sites will require gas monitoring for the period and frequency indicated in Tables 5.5a and 5.5b.*

In this case, a total of 4 monitoring visits were undertaken over a four week time period and for the purpose of this assessment, it is considered that the site can be provisionally classified as Characteristic Situation Level 2. The final risk assessment should take into consideration the current site conditions, and should be subject to reassessment after the formulation and/ or completion of any remedial measures, and proposed foundation solution. These documents should be prepared by a suitably experienced and qualified specialist.

If the “excavate and recompact” option were adopted, the ground gas regime would have changed sufficiently to require further monitoring and assessment that might result in a lower characterisation, ie Situation Level 1. However, a time period of expectation of equilibrium would

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

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have to be agreed with the planning authority. Having said this, it is reasonable to expect betterment since the earthworks would remove on site sources of ground gases and therefore to utilise the current ground gas risk assessment would be conservative and remain protective of human health.

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13.1.3 Disposal of Waste Soils

Analysis of the sample was undertaken to assess the suitability of the site material for use in a landfill. In order to achieve this, WAC testing has been undertaken to demonstrate compliance, the testing was undertaken by Chemtest Ltd and the results of all of the chemical testing are presented in Appendix 12. The WAC have been set as maximum limit values which must not be exceeded and should not be viewed as minimum treatment specifications for landfill. The following table has been extracted from the Environment Agency[17] and adapted to compare against the chemical test results.

Table 16: Landfill Waste Acceptance Criteria

Determinand	Maximum Concentration (mg/kg)	Landfill Waste Acceptance Criteria Limits			Class of Landfill Maximum
		Inert	SNRHW*	Hazardous	
Total Organic Carbon %	2.1	3	5	6	Inert
Loss on Ignition %	6.3	-	-	10	Inert
BTEX	<0.01	6	-	-	Inert
PCBs (7 Congeners)	0.22	1	-	-	Inert
TPH (Mineral Oil)	< 10	500	-	-	Inert
Total (of 17) PAHs	< 2.0	100	-	-	Inert
pH	7.5	-	>6	-	Inert
Acid Neutralisation Capacity	0.010	-	To be evaluated	To be evaluated	-
Limit values (mg/kg) for compliance leaching test using BS EN 12457 - 3 at L/S 10 l/kg					
As	0.0081	0.5	2	25	Inert
Ba	0.012	20	100	300	Inert
Cd	<0.00011	0.04	1	5	Inert
Cr	0.053	0.5	10	70	Inert
Cu	0.051	2	50	100	Inert
Hg	< 0.00005	0.01	0.2	2	Inert
Mo	0.027	0.5	10	30	Inert
Ni	0.035	0.4	10	40	Inert
Pb	< 0.0005	0.5	10	50	Inert
Sb	0.0008	0.06	0.7	5	Inert
Se	0.0006	0.1	0.5	7	Inert
Zn	0.005	4	50	200	Inert
Cl	< 10	800	15 000	25 000	Inert
F	3.1	10	150	500	Inert
SO_4	87	1000	20 000	50 000	Inert

[17] Guidance on sampling and testing of wastes to meet landfill waste acceptance procedures, Version 1, April 2005.

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Total Dissolved Solids (TDS)	1900	4000	60000	100 000	Inert
Phenol index	< 0.50	1	-	-	Inert
Dissolved Organic Carbon at own pH or pH 7.5-8.0	60	500	800	1000	Inert

In this instance, it should be appreciated that all determinants feel below the upper limits for inert WAC. Given that the samples tested generally fell within the parameters required for inert waste, it is considered that any material disposed off-site could be suitable for an inert landfill.

For further guidance, please refer to the following documents which are available on the *www.gov.uk* website:

- Environment Agency – LIT 5234 *Waste Acceptance at Landfills - Guidance on waste acceptance procedures and criteria* – November 2010.
- Environment Agency – LIT 5902 *Treatment of waste for landfill* – June 2014.
- Waste Classification: Guidance on the classification and assessment of waste (1st Edition v1.1) May 2018: Appendix A: How to use the list of waste.

13.2 Site Specific Risk Assessment

13.2.1 Approach

The presence of contamination hazards and the risks associated with them should be assessed in accordance with industry practice and the 'suitable for use' approach. This has been conducted with reference to The Department for Environment, Food and Rural Affairs (DEFRA) and The Environment Agency[18] advice on the assessment of risks arising from the presence of contamination in soils and using the source-pathway-receptor approach.[19] This method dictates that there must be a risk of contaminant produced at a 'source' in sufficient concentration to cause harm and there must be a 'pathway' for the contaminant to reach an identifiable 'receptor' for the linkage to be proved and a contamination hazard to be considered present. Not all substances are contaminants and not all contaminants are considered to be a risk. Indeed DEFRA and The Environment Agency state that 'a contaminant is a substance which has the potential to cause harm, while a risk itself is considered to exist if such a substance is present in sufficient concentration to cause harm and a pathway exists for a receptor to be exposed to the substance.'[20]

11.3.2 Conceptual Ground Model and Risk Assessment

In view of the results of the chemical testing undertaken the conceptual site model is presented accordingly as Table 17. The preliminary risk assessment has been evaluated with reference to the following ratings and definitions:

[18] R&D Publication CLR 8, 'Assessment of Risks to Human Health from Land Contamination: An overview of the Development of Soil Guideline Values and Related Research'.
[19] The pollution linkage approach was developed by 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990' which provides meanings for the terms contained in The Environmental Protection Act 1990 Part IIA, the primary legislation for addressing the issues of contaminated land.
[20] See 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990', appendix A.

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N/A - A source-pathway-receptor linkage is not considered to exist and therefore a risk assessment is not required.

Low - A pollution linkage is unlikely and/or the likelihood of harm occurring is low and of minor consequence.

Moderate - The linkage exists but the likelihood of harm occurring is not considered to be significant although remedial action may be necessary

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

The results of the risk assessment are presented in Table 17.

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Table 17: Conceptual Site Model and Site Specific Risk Assessment

Conceptual Site Model			Site Specific Risk Assessment	
Pathways	**Receptor**	**Linkage Present?**	**Risk Rating**	**Notes**
Direct contact/dermal absorption/soil ingestion	Operative	Yes – whilst made ground is present at the site, the contamination testing confirms that level of determinants are below the appropriate SSV's for the development.	Low	Good Building practice should be maintained. Please see section 11.3
	End User	Yes – whilst made ground is present at the site, the contamination testing confirms that level of determinants are below the appropriate SSV's for the development.	Low	
	Neighbours	Yes – whilst made ground is present at the site, the contamination testing confirms that level of determinants are below the appropriate SSV's for the development.	Low	
Inhalation of Dust/Vapours	Operative	Yes – whilst made ground is present at the site, the contamination testing confirms that level of determinants are below the appropriate SSV's for the development.	Low	Good Building practice should be maintained. Please see section 11.3
	End User	Yes – whilst made ground is present at the site, the contamination testing confirms that level of determinants are below the appropriate SSV's for the development.	Low	
	Neighbours	Yes – whilst made ground is present at the site, the contamination testing confirms that level of determinants are below the appropriate SSV's for the development.	Low	
Ingestion of fruit/vegetables and/or waters	Operative	No – no ed ble plants or contained water sources in the area of the proposed new works.	N/A	Good Building practice should be maintained. Please see section 11.3
	End User	Yes – whilst made ground is present at the site, the contamination testing confirms that level of determinants are below the appropriate SSV's for the development.	Low	
	Neighbours	Yes – whilst made ground is present at the site, the contamination testing confirms that level of determinants are below the appropriate SSV's for the development.	Low	
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	Yes – Elevated levels of carbon dioxide has been detected. Shallow coal workings represent a cred ble source of ground gas. Mine shafts are present on site.	High	Gas monitoring is currently ongoing. The final risk assessment should take into consideration the current site conditions, and should be subject to reassessment after the formulation and/ or completion of any remedial measures, and proposed foundation solution. These documents should be prepared by a suitably experienced and qualified specialist.
	End User		High	
	Neighbours		N/A	

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Spillage/loss/run off direct to receiving water	Controlled Waters	Yes – known controlled waters within 250m. However, the site is underlain by cohesive soils of low permeability and levels of contamination fall below the appropriate SSV's for the site.	Low	Good Building practice should be maintained. Please see section 11.3
Migration via permeable unsaturated strata	Controlled Waters	Yes – a secondary A aquifers is present beneath the site. However, the site is underlain by cohesive soils of low permeability and levels of contamination fall below the appropriate SSV's for the site.	Low	
Run off via drainage/sewers etc	Controlled Waters	Yes – old services may be present on site. However, the site is underlain by cohesive soils of low permeability and levels of contamination fall below the appropriate SSV's for the site.	Low	
Direct contact with contaminated soils	Plants	Yes – whilst made ground is present at the site, the contamination testing confirms that level of determinants are below the appropriate SSV's for the development.	Low	Some contamination is present underlying the site. Remediation will be required to either remove the contamination or break pathways.
Uptake via root system			Low	
Direct contact with contaminated soils	Building Materials	Yes – limited PAH contamination identified this a low risk to building materials or plastic water pipes. Moreover, testing indicates that the aggressive chemical environment for concrete classification is AC-1s.	Low (plastic services)	Please see section 11.3.3 for information on good building practice.
Direct contact with contaminated groundwater			Low (buried concrete)	
Exposure to Radon	Operative / End User	No – Not in a radon affected area.	N/A	Less than 1% of properties are above the action level. No radon protection measures required.

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13.3 Indicative Remediation Strategy

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

13.3.1 Remediation Objectives

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

- To protect operatives, the end user and neighbours from the elevated levels of carbon dioxide.

13.3.2 Development Requirements

The land located at Cliff Hill, Cumberworth Lane, Denby Dale, is proposed to be developed by the construction of a new residential estate. In view of the above a site specific remediation strategy should be undertaken after the proposed development has been finalised. However, for preliminary design and costing the following remediation proposals are offered.

13.3.3 Outline Strategy

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

Ground-works

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

- Site operatives at all levels should be made aware of the hazards of working with contaminated.
- Personal hygiene facilities, including washing and messing, must be provided and site operatives be encouraged to use them.
- Where work is undertaken in dry weather the site should be dampened down to avoid dust. In addition, dust masks must be provided to all site operatives for use in dry weather.
- In order for contaminated soils to be disposed of to an appropriate landfill, it may be necessary to carry out Waste Acceptance Criteria (WAC) testing in accordance with BS EN 12457.
- Any stockpiles of contaminated soil on site should be sheeted over to prevent excessive amounts of airborne dust and cross contamination of imported fill.

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- Where vehicles are transferring soil to the landfill site they should be covered to prevent contamination of the surrounding area by dust.
- Where work is undertaken in wet weather, vehicle and wheel washing facilities are required to ensure that the vehicles leaving the site do not transfer contamination to surrounding areas.

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

Construction

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

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

Gas Protection Measures

Gas monitoring is currently ongoing. The final risk assessment should take into consideration the current site conditions, and should be subject to reassessment after the formulation and/ or completion of any remedial measures, and proposed foundation solution. These documents should be prepared by a suitably experienced and qualified specialist.

In order to assess the protection measures required BS8485: 2015+A1:2019: *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings* has been employed. In accordance with Table 3, *Building types,* of the code, the development may be considered to conform to Type A. Therefore, on the basis of Table 4 *Gas protection score by CS and type of building,* the minimum gas protection score (points) is 3.5 The gas protection system should consist of at least two different elements. The elements work independently and collaboratively, and a single element should not be used because there would be no redundancy to allow for defects in the component.

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

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Table 18: Combination of protection elements (BS8485: 2015) for CS2		
Reference	**Protection Element**	**Score**
Table 5	Precast suspended segmental subfloor (i.e. beam and block)	0
Table 6 *Either option is appropriate*	Passive sub-floor dispersal layer: good performance (**Note 1**) (see Annex B of the Code for detail)	*1.5*
Table 7	*Gas resistant membrane complying with the requirements given in Table 7 (**Note 2**)*	2
	Total Score	**Max: 3.5**

Note 1:
As a beam and block floor is to be utilised at this site it is considered that a clear void with air bricks in the external walls be utilised. The details of the system to be adopted shall be included on the technical drawings provided by the engineer/architect.

Note 2:
The gas resistant membrane shall meet the following criteria:

- Sufficiently impervious (methane gas transmission rate <40.0ml/day/m^2/atm (average) BS ISO 15105-1 manometric method).
- Sufficiently durable and strong to remain serviceable for the anticipated life of the building, to withstand in-service stresses and installation process.
- Capable, after installation, of providing a complete barrier to the entry of the relevant gas.
- Verified in accordance with CIRIA C735: 2014: *Good practice on the testing and verification of protection systems of buildings against hazardous ground gasses.*

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

- Technical drawings of the incorporation of the gas protection measures into the sub-structure will be provided by a suitably qualified engineer/architect and produced in accordance with the guidance given in BRE 414.
- The sequence of construction indicating when the gas protection system will be installed will be included with the remediation statement. Where possible the installation of membranes will take place as a unique activity on site and shall not take place until sub-structure construction is complete.
- During and following the installation of the membrane, all parties in attendance at the site shall be made aware that a gas protection system is to be employed within the construction. Such communications should include, but not be limited to, the CDM documentation for the site and site inductions.
- The installation of the membrane shall be carried out only by suitable personnel and the qualifications or experience/training will be included as part of the remediation statement. The suitability of personnel will be assessed in accordance with Annex 1 of CIRIA C735.

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

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

13.4 Fill Materials

It should also be appreciated that any fill material, either site-won (which could be classified as virgin quarried materials) or imported, to be employed at the site should be subjected to the following assessment to determine its suitability.

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

- It is a suitable growing media if it is to be employed as such, including compliance with BS3882 (2015)
- It is free from obvious contamination i.e. visual or olfactory evidence
- It has not come from areas where Japanese Knotweed or other invasive or injurious plants are suspected to be growing
- It is not a statutory nuisance, such as being odorous
- It is free from unsuitable material i.e. whole bricks, brick ties, timber or glass.

It should also be appreciated that any fill should be subjected to validation testing to assess its suitability. The following table has been taken from YALPAG[21] documentation and may be used as a guide. Depending on the origin and nature of the material, not all fill will require the sampling frequency and testing indicated, although this should be in agreement with any regulatory bodies (such as the Local Authority).

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

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Table 19: Validation Sampling and Testing		
Fill Type	**Frequency**	**Minimum Determinands**
Virgin Quarried Material	**1 or 2 depending on the type of stone utilised, to confirm the inert nature of the material.**	**Standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn)**
Crushed Hardcore, Stone, Brick	Minimum 1 per 500m³	Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, total TPH. Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).
Greenfield/ Manufactured Soils	Minimum 3 Dependent on source and receptor, between 1 per 50m³ and 1 per 250m³	Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, pH and soil organic matter (SOM) (or calculated from total organic carbon (TOC)).
Brownfield/ Screened Soils	Minimum 6 Dependent on source and receptor, between 1 per 50m³ and 1 per 100m³	Standard metals/ metalloids (as above), PAH (16 USEPA speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE)..

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

Table 20: Fill Screening Values			
Contaminant	**Screening Value (Residential with Plant Uptake) (mg/kg)**		**Reference**
	1% SOM	**6% SOM**	
As	37	37	Atrisk^{SOIL} SSVs
Cd	22.1	22.1	Atrisk^{SOIL} SSVs
Cr(VI)	3.62	3.63	Atrisk^{SOIL} SSVs
Cu	4730	4790	Atrisk^{SOIL} SSVs
Hg	8.81	15.8	Atrisk^{SOIL} SSVs
Ni	136	136	Atrisk^{SOIL} SSVs
Pb	200	200	Atrisk^{SOIL} SSVs
V	136	138	Atrisk^{SOIL} SSVs
Zn	20000	20300	Atrisk^{SOIL} SSVs

Please see summary sheet within Appendix 5 for full screening values including PAHs & TPHs.

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

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

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

13.5 Verification Report

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

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

- Evidence that suitable gas protection measures have been implemented and installed in accordance with manufacturer's instructions. The evidence should also demonstrate that all joints and penetrations have been adequately sealed.

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

14. Recommendations for Further Work

- This report should be forwarded to the relevant authorities as soon as practicable to ensure they have sufficient time to review and discuss any issues.
- Discussion with grouting and /or earthworks contractors, regarding the risks and costs associated with shallow coal working remediation.
- Discussion with the Coal Authority: an appropriate remedial proposal for shallow workings and shafts should be submitted.
- Completion and reporting of recommended additional gas monitoring.
- Discussions with contractors in relation to the suitability of materials and installation methods for gas barriers, if required.
- Produce a validation report to demonstrate that the environmental risks discussed in this report have been mitigated.
- Detailed design of the sub-structure.

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

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15. References

- British Geological Survey (NERC) (2022), BGS, Keyworth.
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  - Part C: *Assessing the aggressive chemical environment.*
  - Part D: *Specifying concrete for general cast-in-situ use.*

- Department for Environment, Food and Rural Affairs and the Environment Agency (2009) DEFRA Science Report – Final SC050021/SR2, *Human Health toxicological assessment of contaminants in soil*. Environment Agency, Bristol.

- Department for Environment, Food and Rural Affairs and the Environment Agency (2009) DEFRA Science Report – SC050021/SR3, *Updated technical background to the CLEA model*. Environment Agency, Bristol.

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

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Appendix 1

Site Plan

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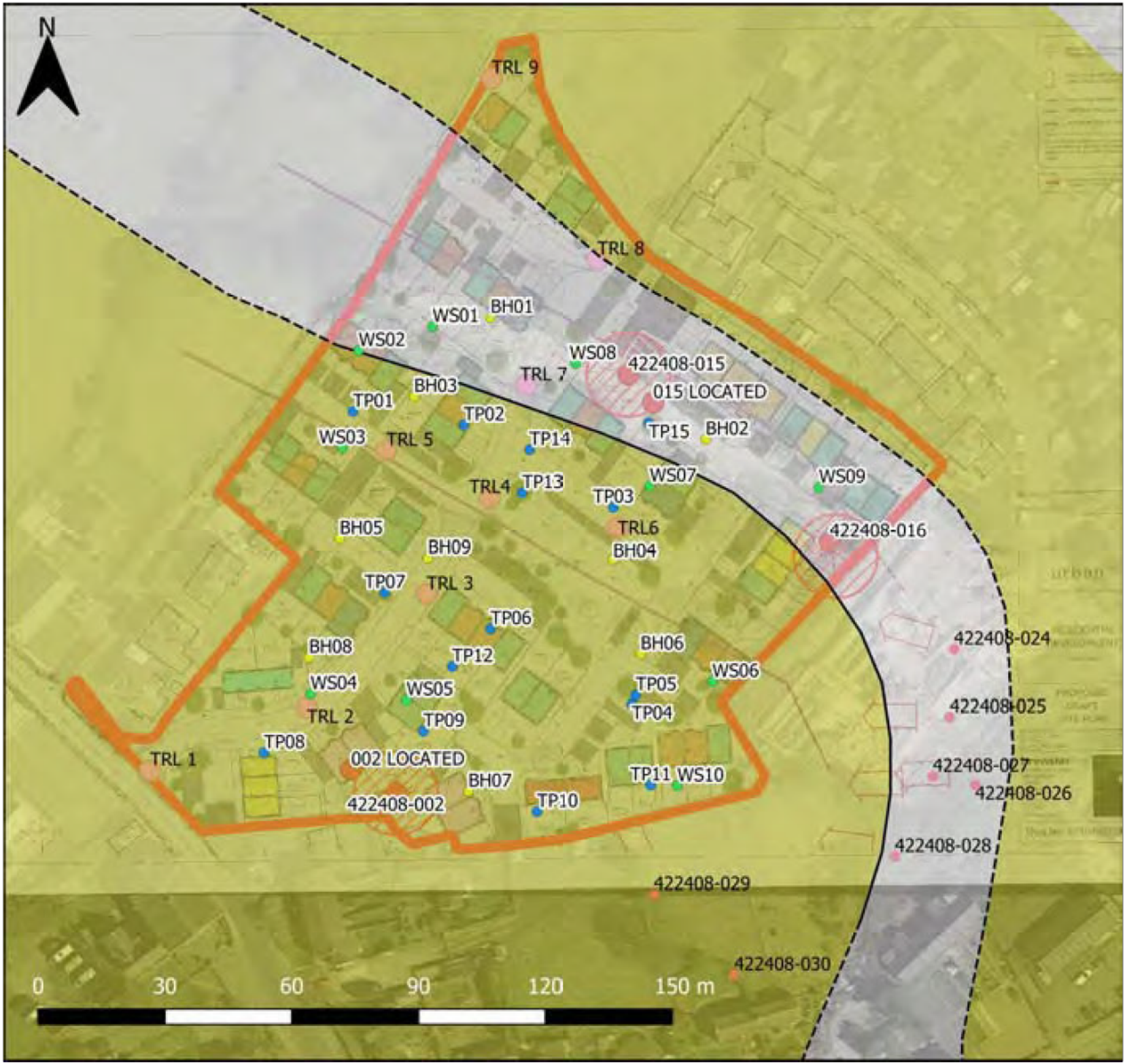

NOTES:
1. DO NOT SCALE FF
2. ALL D MENSIONS
3. ALL LEVELS AF DATUM
4. THIS DRAWING IS ALL RELEVANT ARC AND SPECIFICATION

LEGEND

- Buffered
- Location Details
  - DCP
  - RO
  - TP
  - WLS
  - CBR - TRL
- Buffered
- MINE SHAFTS
- SITE OUTLINE

FOR INFORMATION

CLIFF HILL DENBY DALE

HOLE LOCATION PLAN

JOB NUMBER: C2206/21/e

DATE: 17.05.2022

REVISION: 01

NOTES:
1. DO NOT SCALE FF
2. ALL D MENSIONS
3. ALL LEVELS AF DATUM
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FOR INFORMATION

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HOLE LOCATION PLAN

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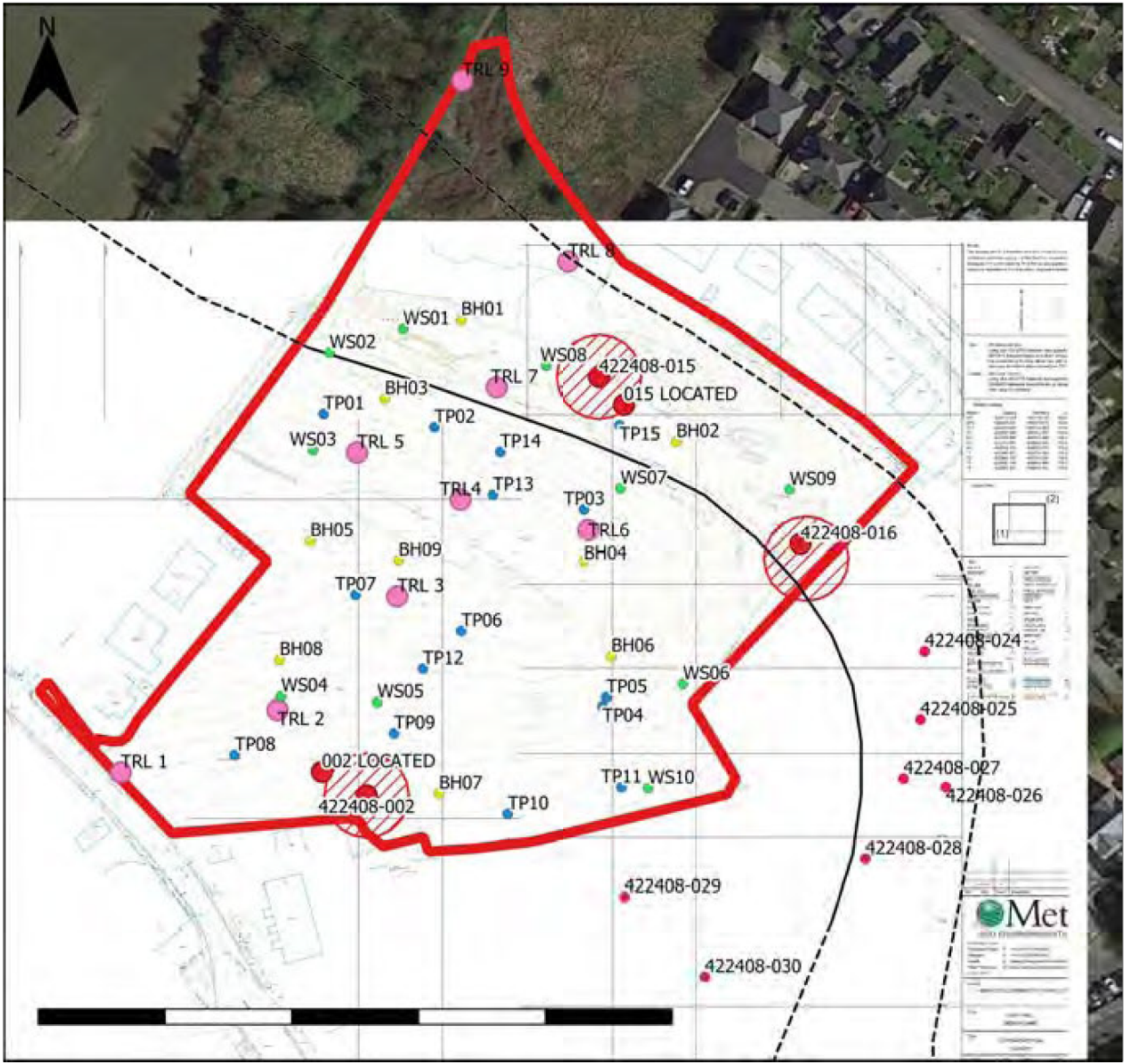
DATE: 17.05.2022

REVISION: 01



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HOLE LOCATION PLAN

JOB NUMBER: C2206/21/e

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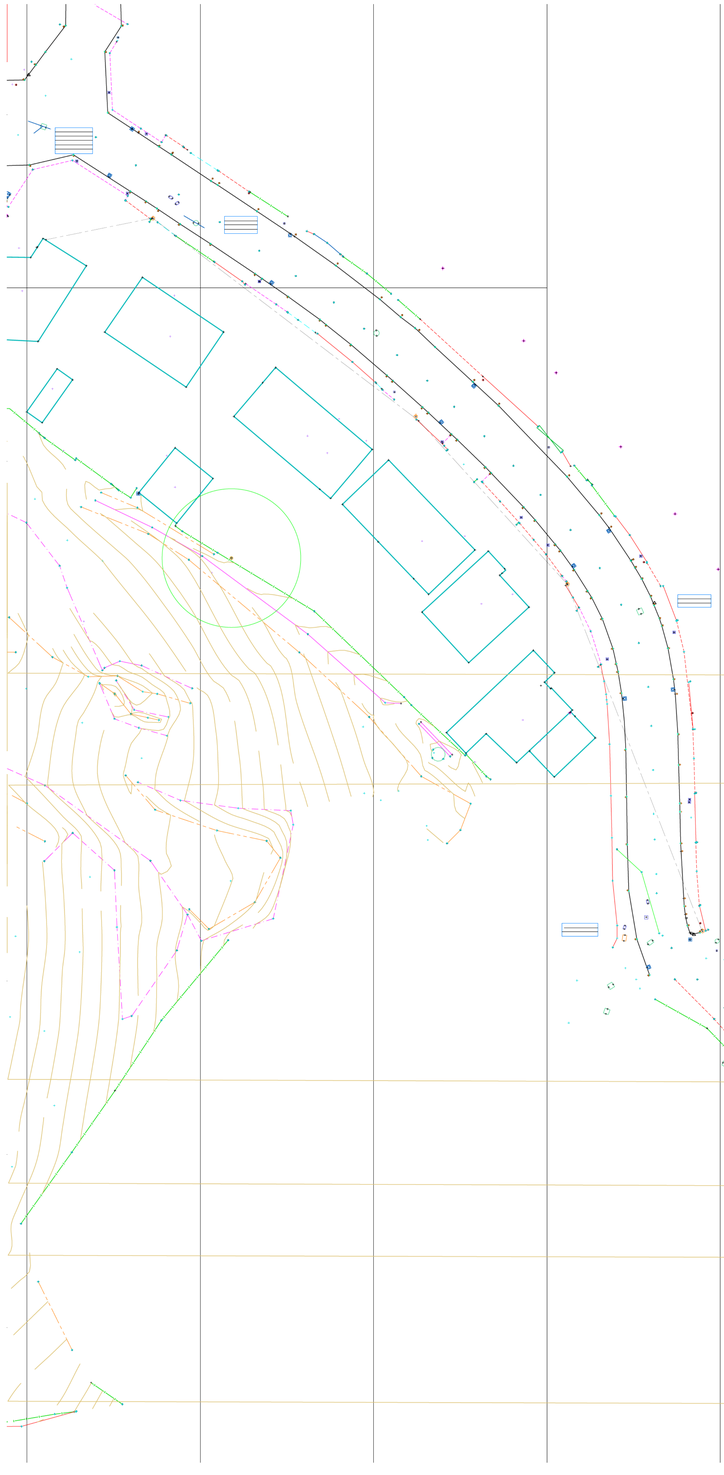
REVISION: 01



AIR VALVE	□	KERB OUTLET	
BENCH MARK	^	LAMP POST	
BIN	○	MANHOLE (CIRCULAR)	
BOLLARD	•	MANHOLE (RECTANGULAR)	
BORE HOLE	✚	MANHOLE (TRIANGULAR)	
BRITISH TELECOM COVER	□	MARKER POST	
BUS STOP	♿	GULLY	
CABLE TV COVER	□	RODDING EYE	
CABLE TV SUPPLY	•	SIGN POST	
COLUMN	•	TELECOM COVER	
DROPPED KERB	~~~	TELEGRAPH POLE	
EARTHING POINT	•	THRESHOLD LEVEL	
ELECTRICITY COVER	□	TRAFFIC LIGHT	
ELECTRICITY POLE	●	TRIAL PIT	
FIRE HYDRANT	□	WASH OUT	
GAS VALVE	◇	WATER METER	
GATE	═══	WATER STOP COCK	
INSPECTION COVER (CIRCULAR)	○	WATER STOP VALVE	
INSPECTION COVER (RECTANGULAR)	□		

COVER LEVEL	CL	CHAMBER BASE LEVEL	C
INVERT LEVEL	IL	WATER SURFACE LEVEL	W
UNABLE TO RAISE	U/R	UNABLE TO MEASURE	U
GIRTH OF TREE TRUNK	G	DIAMETER OF TREE TRUNK	D
HEIGHT TO TOP OF TREE CANOPY	H	MULTI BOLE TREE	M

Met

GEO ENVIRONMENTA

Appendix 2

Coal Authority Permit

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The Coal Authority

Permit to Enter or Disturb Coal Authority Interests

Permit 24435

Name and Address of Permit Holder:

Urban Group (York) Ltd
Urban House
Hull Road
Dunnington
York, YO19 5LP

Site Location:

Cliff Hill
Cumberworth Lane
Denby Dale
Huddersfield
HD8 8RZ

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

Ground investigation by eight boreholes to 30m or as required to determine presence of shallow mine workings and underground roadways, trial trenching to locate three mine entries, if found probe drilled to confirm their depth and integrity of fill material (Coal Authority Refs. 422408-015, 422408-002 and 422408-016) all within the Authority's interests at the identified site location above as shown on the Grant Permit Boundary (overleaf) for the period of 12 months from the granted date shown below. *The granting of this Permit does not constitute advice given by the Authority in relation to the proposed operations. It is the Permit Holder's responsibility to obtain appropriate health, safety, environmental, technical and legal advice.*

Conditions:

- *Manned entry (i.e.) into mine entries/workings) is strictly prohibited.*
- *Water flush drilling only*
- *Gas Monitoring for CO, CH_4, CO_2, O_2, H_2S at the borehole and rig*
- *Operators undertaking the work must be in possession of this certificate and the Permit boundary plan at the time of works*
- *Appropriate borehole reinstatement and sealing without delay and to withstand site level changes*

Signed: Leigh Sharpe Granted Date: ***08/02/2022***

For and on behalf of The Coal Authority

Nominated Representative: Leigh Sharpe, Permitting Manager;
The Coal Authority, Permitting Office, 200 Lichfield Lane, Mansfield, Notts, NG18 4RG
Tel: 01623 637450; E-Mail: permissions@coal.gov.uk

The Coal Authority

Granted Permit Boundary

Permit Ref: 24435

Permit Boundary:

Appendix 3

Windowless Sample Borehole Records

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Borehole Log

Borehole No. **WS01**

Sheet 1 of 1

Project Name:	Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422850.66E - 408760.40N
Location:	Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 180.18m aOD
Client:	Urban Construction Interiors Ltd		Dates: 04/04/2022

Hole Type: WLS

Scale: 1:50

Logged By: CM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.30 - 0.40 0.40 0.50 0.70 - 1.00	ES D D C	85	100		0.15	180.03		TOPSOIL (Dark brown organic silty fine SAND).
		1.00	SPT	75		N=6 (1,2/1,2,2,1)				MADE GROUND/ FILL (Soft light grey mottled light brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is sub rounded to angular medium to coarse of sandstone siltstone and ironstone)
		2.00	SPT	65		N=9 (2,2/2,2,3,2)	1.77	178.41		Stiff orangish brown mottled bluish grey and light grey silty CLAY with rare lithorelicts of extremely weak angular tabular siltstone.
		3.00	SPT	55		N=19 (4,4/4,5,5,5)	2.85	177.33		Extremely weak thinly laminated greyish brown SILTSTONE.
		4.00	SPT			N=52 (8,1/13,13,13,13)	3.90	176.28		COAL [Poss ble Whinmoor Coal (Cumberworth Thick)]
							4.45	175.73		End of Borehole at 4.45m

1
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10

Remarks

1) CAT scan prior to breaking ground. No services identified.

AGS

Borehole Log

Borehole No. **WS02**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422833.20E - 408754.72N	Hole Type WLS
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 181.00m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 04/04/2022	Logged By CM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.30 - 0.40 0.40 - 1.00	ES D	87	100		0.20 1.00	180.80 180.00		TOPSOIL (Dark brown organic silty fine SAND). MADE GROUND/ FILL (Soft light grey mottled light brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is sub rounded to angular medium to coarse of sandstone siltstone and ironstone) End of Borehole at 1.00m

Remarks

1) CAT scan prior to breaking ground. No services identified.

Borehole Log

Borehole No. **WS03**

Sheet 1 of 1

Project Name:	Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422829.33E - 408731.67N
Location:	Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 183.74m aOD
Client:	Urban Construction Interiors Ltd		Dates: 04/04/2022

Hole Type: WLS

Scale: 1:50

Logged By: CM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.15	183.59		TOPSOIL (Dark brown organic silty fine SAND).
				87	100		0.45	183.29		MADE GROUND/ FILL (Soft light grey mottled light brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is sub rounded to angular medium to coarse of sandstone siltstone and ironstone)
		1.00	SPT			N=81 (7,12/16,21,22,22)	0.50	183.24		
							0.95	182.79		RELICT TOPSOIL
							1.45	182.29		COAL [Poss ble Whinmoor Coal (Cumberworth Thick), or, Unnamed Coal]
										Extremely weak thinly laminated light grey SILTSTONE with rare laminations of fine-grained SANDSTONE.
										End of Borehole at 1.45m

Remarks

1) CAT scan prior to breaking ground. No services identified.

Borehole Log

Borehole No. **WS04**

Sheet 1 of 1

Project Name:	Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422821.80E - 408673.44N
Location:	Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 180.19m aOD
Client:	Urban Construction Interiors Ltd		Dates: 04/04/2022

Hole Type: WLS

Scale: 1:50

Logged By: CM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.00 - 0.30	ES				0.35	179.84		TOPSOIL (Dark brown organic silty fine SAND).
		0.50 - 1.00	D	87	100		0.90	179.29		Extremely weak weak thinly bedded orangish brown locally grey fine to medium-grained SANDSTONE (Recovered as sandy sub angular to tabular GRAVEL)
										End of Borehole at 0.90m

Remarks

1) CAT scan prior to breaking ground. No services identified.

Borehole Log

Borehole No. **WS05**

Sheet 1 of 1

Project Name:	Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422844.53E - 408672.01N
Location:	Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 179.88m aOD
Client:	Urban Construction Interiors Ltd		Dates: 04/04/2022

Hole Type: WLS

Scale: 1:50

Logged By: CM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.00 - 0.30	ES				0.35	179.53		TOPSOIL (Dark brown organic silty fine SAND).
		0.50 - 1.00	D	87	100		0.50	179.38		Medium dense greyish brown mottled dark grey clayey silty sandy GRAVEL OF siltstone and rare coal. Sand is fine to coarse.
		1.00	SPT			N=72 (9,11/15,17,20,20)				Extremely weak to weak thinly bedded orangish brown locally grey fine to medium-grained SANDSTONE (Recovered as sandy sub angular to tabular GRAVEL)
							1.41	178.47		End of Borehole at 1.41m

Remarks

1) CAT scan prior to breaking ground. No services identified.

Borehole Log

Borehole No. **WS06**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422916.85E - 408676.32N	Hole Type WLS
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 178.17m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 04/04/2022	Logged By CM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.00 - 0.30	ES	87			0.20	177.97		TOPSOIL
							0.70	177.47		MADE GROUND/ FILL (Dark grey locally black silty slightly gravelly fine to coarse SAND. Gravel is angular tabular of sandstone and coal)
				77						INTACT COAL [Possible Whinmoor Coal (Cumberworth Thick)]
							1.50	176.67		Extremely weak to weak thinly laminated light grey mottled orange fine-grained SANDSTONE
							1.60	176.57		End of Borehole at 1.60m

Remarks

1) CAT scan prior to breaking ground. No services identified.

Borehole Log

Borehole No. **WS07**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422902.05E - 408722.64N	Hole Type WLS
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 180.21m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 04/04/2022	Logged By CM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.30 - 0.60	ES				0.30	179.91		topsoil
		0.50	D	87	100					Stiff friable thinly to thickly laminated light grey locally mottled orangish brown silty CLAY with lithorelicts of siltstone)
		1.00	SPT			N=15 (2,1/2,3,5,5)	1.10	179.11		
				77	100					Extremely weak thinly to thickly laminated light greyish brown SILTSTONE with subordinate laminations of fine-grained SANDSTONE
		2.00	SPT			N=54 (8,10/13,14,14,13)				
							2.45	177.76		End of Borehole at 2.45m

Remarks

1) CAT scan prior to breaking ground. No services identified.

Borehole Log

Borehole No. **WS08**

Sheet 1 of 1

Project Name:	Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422884.47E - 408751.62N
Location:	Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 179.54m aOD
Client:	Urban Construction Interiors Ltd		Dates: 05/04/2022

Hole Type: WLS

Scale: 1:50

Logged By: CM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.50 - 0.60	C	87	100					MADE GROUND/ FILL (Firm locally stiff light brownish grey mottled orangish brown and brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is sub rounded to angular medium to coarse of sandstone siltstone and ironstone)
		0.70 - 1.00	C							
				77	100					
		2.50	C	67	100		2.30	177.24		Stiff friable light grey mottled orangish brown silty CLAY. With rare ironstone nodules
				57	100		3.00	176.54		COAL [Poss ble Whinmoor Coal (Cumberworth Thick)]
							3.70	175.84		Stiff friable thinly laminated light grey mottled orangish brown silty CLAY. With rare ironstone nodules and rare siltstone lithorelicts
							4.00	175.54		End of Borehole at 4.00m

Remarks

1) CAT scan prior to breaking ground. No services identified.

Borehole Log

Borehole No. **WS09**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422942.07E - 408722.37N	Hole Type WLS
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 173.53m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 05/04/2022	Logged By CM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.00 - 0.40	ES							MADE GROUND/ FILL (Soft light grey mottled light brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is sub rounded to angular medium to coarse of sandstone siltstone and ironstone)
				87	100		0.55	172.98		
		0.70 - 1.00	C							Firm lcoally stiff light grey mottled orangish brown silty CLAY
		1.00	SPT			N=8 (2,2/2,2,2,2)	1.00	172.53		COAL [Poss ble Whinmoor Coal (Cumberworth Thick)]
				77	100		1.45	172.08		Extremely weak thinly to thickly laminated light grey SILTSONE (locally recovered as clayey silty angular tabular fine to medium GRAVEL)
		2.00	SPT			N=27 (3,5/6,7,7,7)				
				67	100		2.30	171.23		Extremely weak thinly to thickly laminated pale yellowish grey SILTSTONE
		3.00	SPT			N=53 (7,9/13,13,13,14)				
							3.45	170.08		End of Borehole at 3.45m

Remarks

1) CAT scan prior to breaking ground. No services identified.

Borehole Log

Borehole No. **WS10**

Sheet 1 of 1

Project Name:	Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422908.57E - 408651.76N
Location:	Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 176.62m aOD
Client:	Urban Construction Interiors Ltd		Dates: 05/04/2022

Hole Type: WLS

Scale: 1:50

Logged By: CM

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.50 - 1.00	D	86	100		0.45	176.17		topsoil
				76	100					Extremely weak weak thinly bedded orangish brown locally grey fine to medium-grained SANDSTONE (Recovered as sandy sub angular to tabular GRAVEL)
							1.51	175.11		End of Borehole at 1.53m

Remarks

1) CAT scan prior to breaking ground. No services identified.

Appendix 4

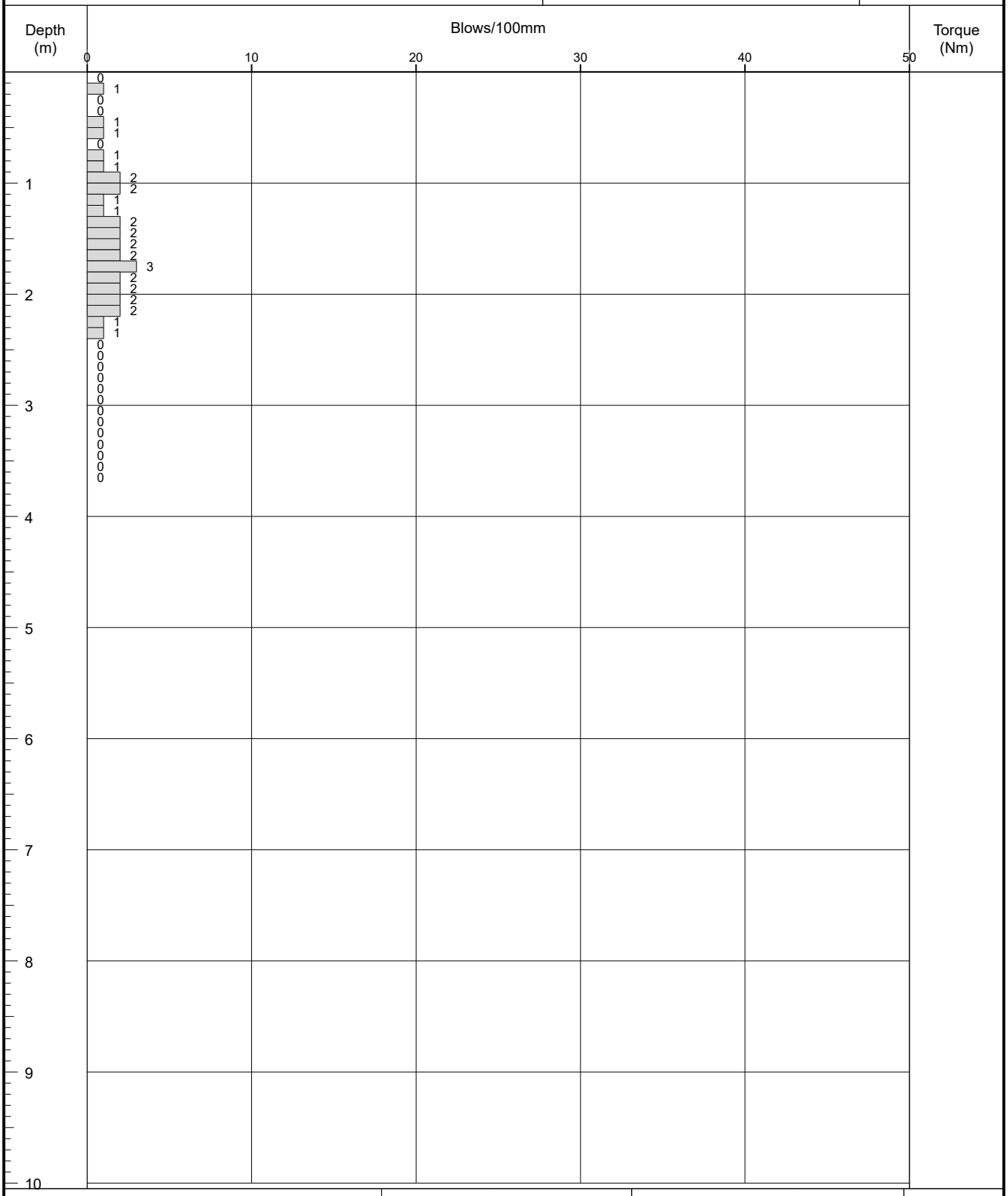
Dynamic Probes

Rogers Geotechnical Services Ltd Telephone 0843 50 666 87 Fax 0843 51 599 30
Email enquiries@rogersgeotech.co.uk www.rogersgeotech.co.uk

Probe Log

Probe No.
DP02
Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords:	Hole Type DCP
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level:	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 04/04/2022	Logged By CM



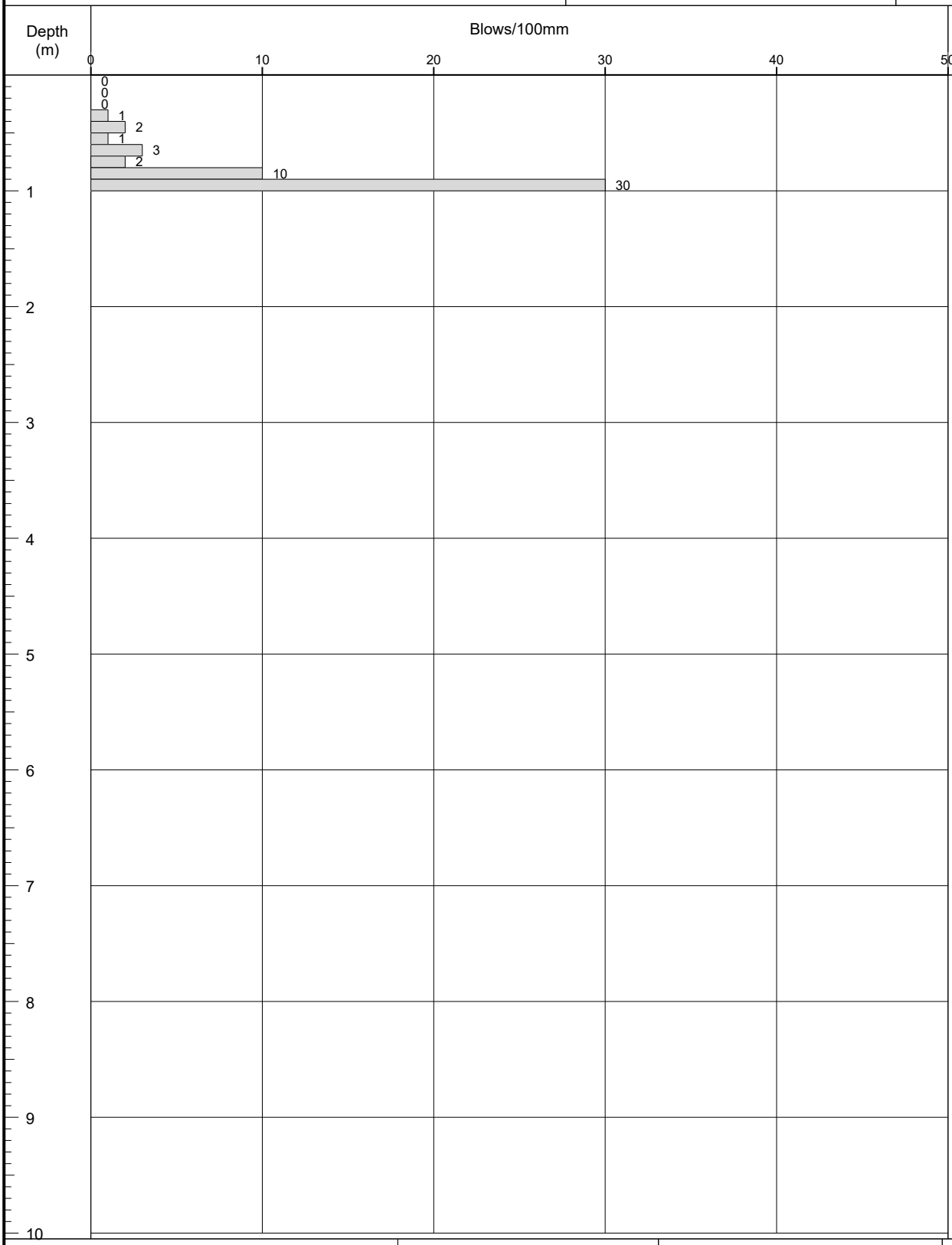
Remarks:

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	3.6m
Probe Type	DPSH-B		

Probe Log

Probe No.
DP04
Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords:	Hole Type DCP
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level:	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 04/04/2022	Logged By AB



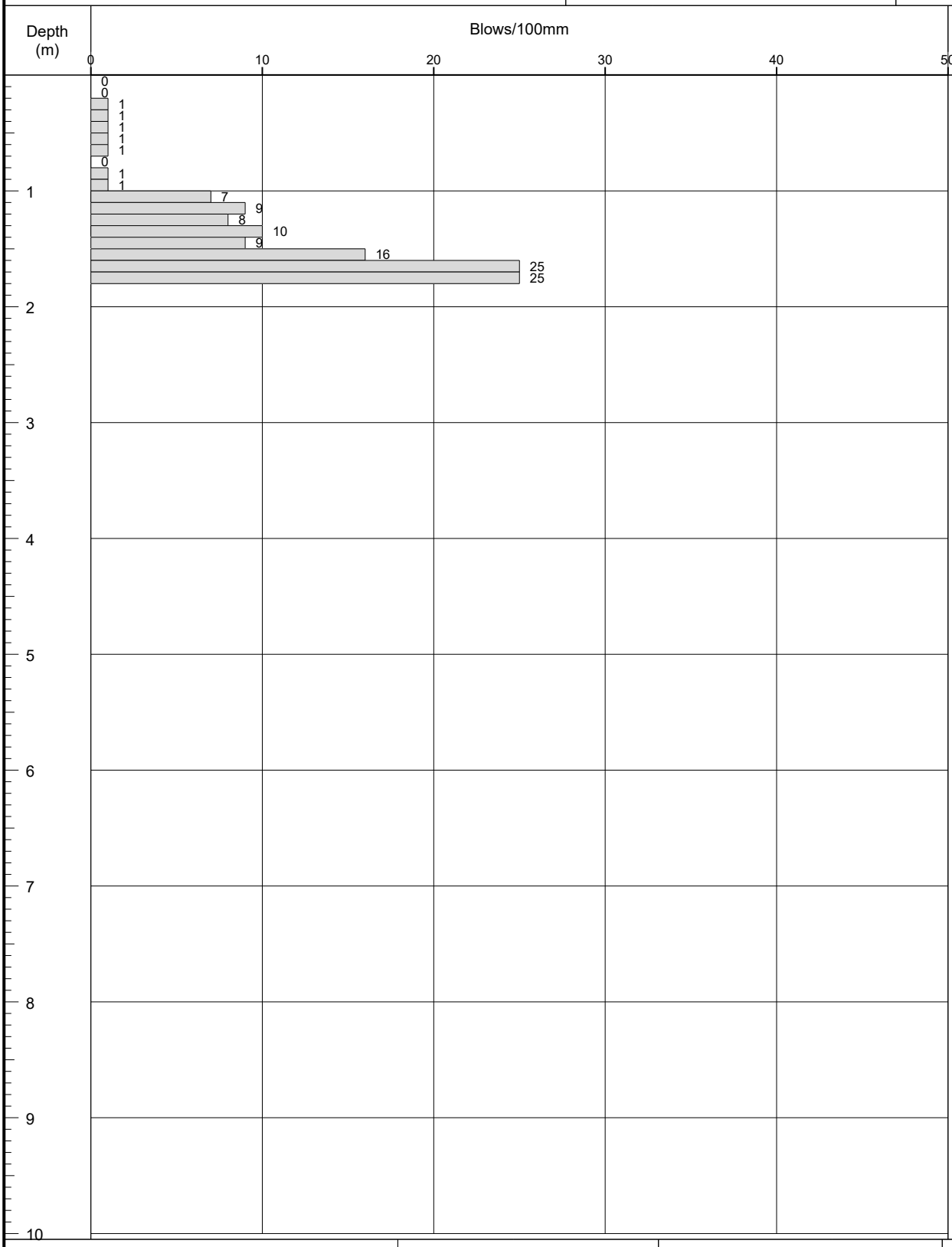
Remarks:

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	1m
Probe Type	DPSH-B		

Probe Log

Probe No.
DP06
Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords:	Hole Type DCP
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level:	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 04/04/2022	Logged By AB



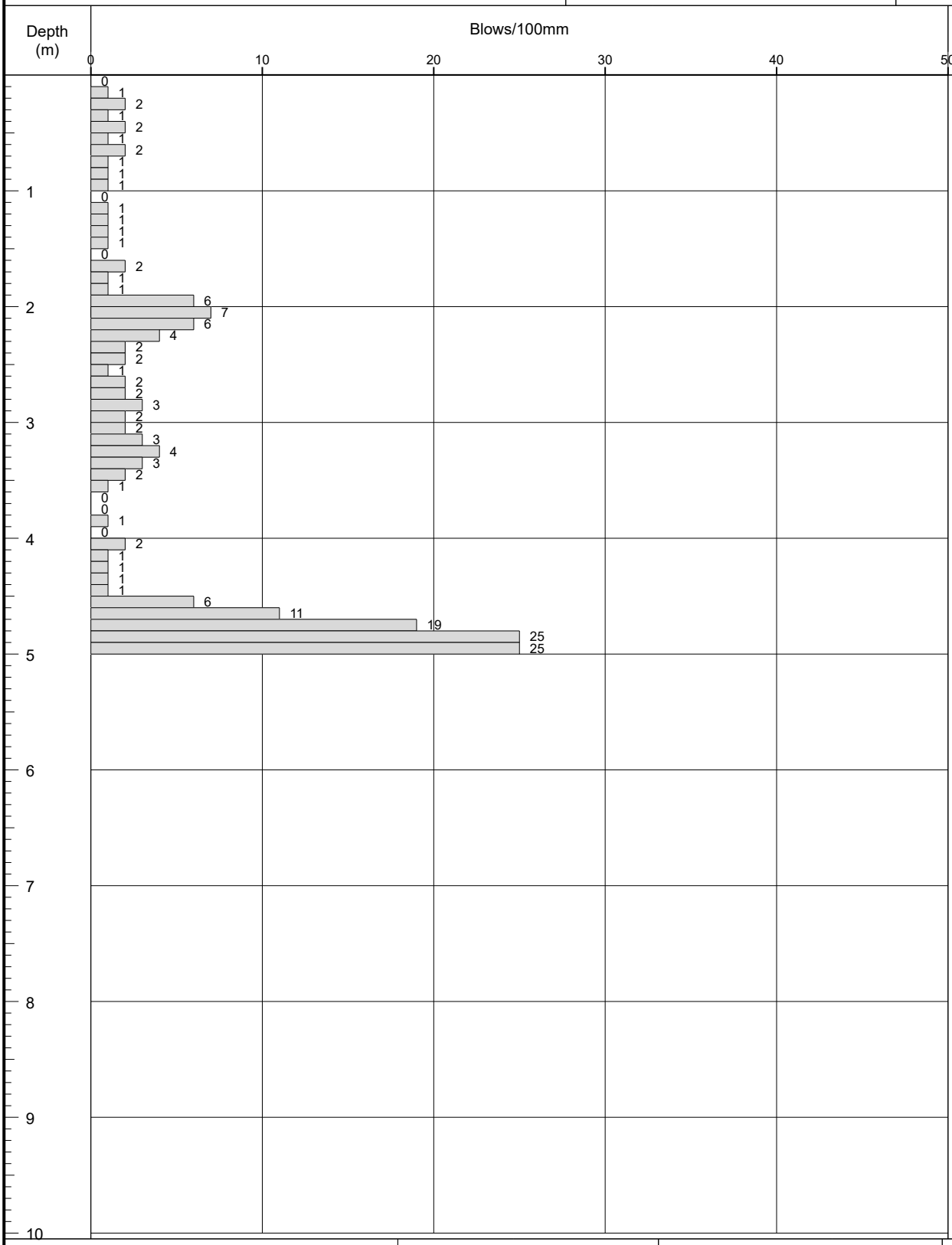
Remarks:

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	1.7m
Probe Type	DPSH-B		

Probe Log

Probe No.
DP08
Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords:	Hole Type DCP
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level:	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 05/04/2022	Logged By CM

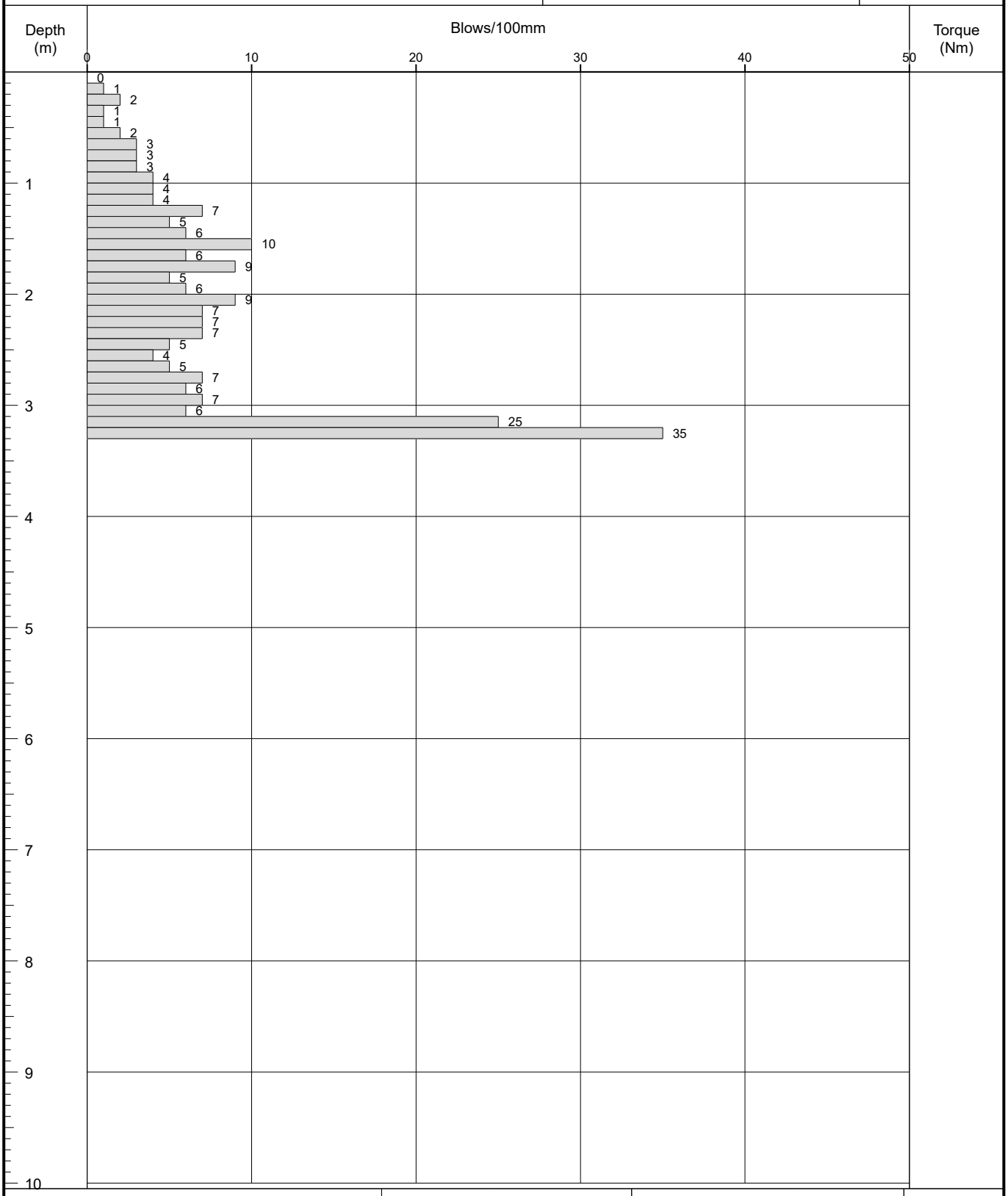


Remarks:	Fall Height	750mm	Cone Base Diameter	50.5mm	
	Hammer Wt	63.5kg	Final Depth	4.9m	
	Probe Type	DPSH-B			

Probe Log

Probe No.
DP10
Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords:	Hole Type DCP
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level:	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 05/04/2022	Logged By AB



Remarks:

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	3.2m
Probe Type	DPSH-B		

Appendix 5

Rotary Borehole Records

Rogers Geotechnical Services Ltd Telephone 0843 50 666 87 Fax 0843 51 599 30
Email enquiries@rogersgeotech.co.uk www.rogersgeotech.co.uk

Borehole Log

Borehole No. **BH01**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422864.38E - 408762.51N	Hole Type RO
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 179.46m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 07/04/2022	Logged By ABK

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								MADE GROUND/ FILL (Drilers notes)
					0.30	179.16		Light brown SANDSTONE (Drillers notes)
					1.20	178.26		Dark grey grading to dark brown SANDSTONE with localised clay nodules (Drillers notes)
					3.00	176.46		Dark brown SANDSTONE (Drillers notes)
					3.50	175.96		VOID (Complete loss of flush, water and drilling resistance) (Drillers notes) [Possible Whinmoor Coal (Cumberworth Thick)]
					4.50	174.96		*Hole terminated due to instability concerns.*
					4.50	174.96		Hard stratum - no flush returns. (Drillers notes)
								End of Borehole at 4.50m

Remarks

1) CAT scan prior to breaking ground. No services identified. 2) Borehole terminated due to potential instability. 3) casing installed to 3m 4) borehole backfilled arisings and bentonite

Borehole Log

Borehole No. **BH02**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422915.28E - 408733.70N	Hole Type RO
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 177.52m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 07/04/2022	Logged By ABK

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								MADE GROUND/ FILL (Drillers notes)
					0.30	177.22		Light brown SANDSTONE (Drillers notes) (Drillers notes)
					2.00	175.52		Very soft light grey SILTSTONE (Drillers notes)
					3.50	174.02		VOID (complete loss of flush, drilling resistance and increase water takes) (Drillers notes) [Possible Whinmoor Coal (Cumberworth Thick)]
					5.50	172.02		Hard Stratum (no flush returns)
					5.50	172.02		End of Borehole at 5.50m

Remarks

1) CAT scan prior to breaking ground. No services identified. 2) Borehole terminated due to potential instability. 3) casing installed to 4m 4) borehole backfilled arisings and bentonite

Borehole Log

Borehole No. **BH03**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422846.33E - 408743.85N	Hole Type RO
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 181.26m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 07/04/2022	Logged By ABK

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.30	180.96		MADE GROUND/ FILL (Drillers notes)
					3.00	178.26		Light brown SANDSTONE (Drillers notes)
					3.50	177.76		Dark brown SANDSTONE (Drillers notes)
					6.00	175.26		VOID (complete loss of flush, drilling resistance and increase water takes) (Drillers notes) [Possible Whinmoor Coal (Cumberworth Thick)]
					6.00	175.26		Hard Stratum (Drillers notes)
								End of Borehole at 6.00m

1 2 3 4 5 6 7 8 9 10

Remarks

1) CAT scan prior to breaking ground. No services identified. 2) Borehole terminated due to potential instability. 3) casing installed to 4m 4) borehole backfilled arisings and bentonite

Borehole Log

Borehole No. **BH04**

Sheet 1 of 2

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422893.40E - 408705.41N	Hole Type RO
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 182.73m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 06/04/2022	Logged By ABK

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.30	182.43		TOPSOIL ((Drillers notes)
								Light to dark grey SANDSTONE (Drillers notes)
					1.00	181.73		COAL (Drillers notes) [Possible Whinmoor Coal (Cumberworth Thick), or, Unnamed Coa]
					3.00	179.73		Light brown SANDSTONE (Drillers notes)
					6.00	176.73		Dark brown SANDSTONE (Drillers notes)
					9.00	173.73		Dark brown MUDSTONE (Drillers notes)
								Continued on Next Sheet

Remarks

1) CAT scan prior to breaking ground. No services identified. 2) Borehole terminated due to potential instability. 3) casing installed to 6m 4) borehole backfilled arisings and bentonite

Borehole Log

Borehole No. **BH04**

Sheet 2 of 2

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422893.40E - 408705.41N	Hole Type RO
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 182.73m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 06/04/2022	Logged By ABK

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					12.00	170.73		VOID (complete loss of flush, drilling resistance and increase water takes) (Drillers notes) [Possible Whinmoor Coal (Cumberworth Thin)]
					13.50	169.23		Hard Stratum (Drillers notes)
					13.50	169.23		End of Borehole at 13.50m

11 12 13 14 15 16 17 18 19 20

Remarks

1) CAT scan prior to breaking ground. No services identified. 2) Borehole terminated due to potential instability. 3) casing installed to 6m 4) borehole backfilled arisings and bentonite

Borehole Log

Borehole No. **BH05**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422828.71E - 408710.19N	Hole Type RO
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 184.05m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 08/04/2022	Logged By ABK

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.30	183.75		TOPSOIL (Drillers notes)
								Light brown SANDSTONE (Drillers notes)
					1.80	182.25		VOID (complete loss of flush, drilling resistance and increase water takes) (Drillers notes) [Possible Whinmoor Coal (Cumberworth Thick), or, Unnamed Coal]
					4.00	180.05		Hard stratum (Drillers notes)
					4.00	180.05		End of Borehole at 4.00m

Remarks

1) CAT scan prior to breaking ground. No services identified. 2) Borehole terminated due to potential instability. 3) casing installed to 4m 4) borehole backfilled arisings and bentonite

Borehole Log

Borehole No. **BH06**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422899.89E - 408682.86N	Hole Type RO
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 183.00m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 05/04/2022	Logged By ABK

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.30	182.70		TOPSOIL (Drillers notes)
					1.10	181.90		Dark brown becoming light brown SANDSTONE (Drillers notes)
					2.00	181.00		VOID (complete loss of flush, drilling resistance and increase water takes) (Drillers notes) [Possible Whinmoor Coal (Cumberworth Thick), or, Unnamed Coal]
								End of Borehole at 2.00m

Remarks

1) CAT scan prior to breaking ground. No services identified. 2) Borehole terminated due to potential instability. 3) borehole backfilled arisings and bentonite

Borehole Log

Borehole No. **BH07**

Sheet 1 of 2

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422859.16E - 408650.45N	Hole Type RO
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 177.24m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 04/04/2022	Logged By ABK

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.20	177.04		TOPSOIL (Drillers notes)
								Light brown SANDSTONE (Drillers notes)
					3.00	174.24		light brown SANDSTONE with rare subordinate beds of light grey MUDSTONE (Drillers notes)
					8.50	168.74		VOID (complete loss of flush, drilling resistance and increase water takes) (Drillers notes) [Possible Whinmoor Coal (Cumberworth Thick)]
					9.20	168.04		Light grey MUDSTONE (Drillers Notes)
								Continued on Next Sheet

Remarks

1) CAT scan prior to breaking ground. No services identified. 2) Borehole terminated due to potential instability. 3) casing installed to 4m 4) borehole backfilled arisings and bentonite

Borehole Log

Borehole No. **BH07**

Sheet 2 of 2

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422859.16E - 408650.45N	Hole Type RO
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 177.24m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 04/04/2022	Logged By ABK

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					13.00	164.24		VOID (complete loss of flush, drilling resistance and increase water takes) (Drillers notes) [Possible Low Whinmoor Coal (Cumberworth Thin]
					14.50	162.74		End of Borehole at 14.50m

11 12 13 14 15 16 17 18 19 20

Remarks

1) CAT scan prior to breaking ground. No services identified. 2) Borehole terminated due to potential instability. 3) casing installed to 4m 4) borehole backfilled arisings and bentonite

Borehole Log

Borehole No. **BH08**

Sheet 1 of 3

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422821.44E - 408682.06N	Hole Type RO
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 180.99m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 04/04/2022	Logged By ABK

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								TOPSOIL (Drillers Notes)
					0.40	180.59		Light brown SANDSTONE (Drillers notes)
					3.00	177.99		Dark orange SANDSTONE (Dillers notes)
					4.00	176.99		COAL (Drillers notes) [Possible Whinmoor Coal (Cumberworth Thick)]
					6.00	174.99		Dark grey MUDSTONE (Drillers notes)
								Continued on Next Sheet

Remarks

1) CAT scan prior to breaking ground. No services identified. 2) Borehole terminated due to potential instability. 3) casing installed to 4m 4) borehole backfilled arisings and bentonite

Borehole Log

Borehole No. **BH08**

Sheet 2 of 3

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422821.44E - 408682.06N	Hole Type RO
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 180.99m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 04/04/2022	Logged By ABK

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					15.00	165.99		Light grey MUDSTONE (Drillers notes)
					18.00	162.99		Very dark grey MUDSTONE (Drillers notes)
					19.00	161.99		COAL (Drillers notes) [Possible Low Whinmoor Coal (Cumberworth Thin]
					19.50	161.49		FIRE CLAY (white clay)
					20.00	160.99		Continued on Next Sheet

11 12 13 14 15 16 17 18 19 20

Remarks

1) CAT scan prior to breaking ground. No services identified. 2) Borehole terminated due to potential instability. 3) casing installed to 4m 4) borehole backfilled arisings and bentonite

Borehole Log

Borehole No. **BH08**

Sheet 3 of 3

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422821.44E - 408682.06N	Hole Type RO
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 180.99m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 04/04/2022	Logged By ABK

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Light grey MUDSTONE (Drillers notes)
					22.00	158.99		End of Borehole at 22.00m

Remarks

1) CAT scan prior to breaking ground. No services identified. 2) Borehole terminated due to potential instability. 3) casing installed to 4m 4) borehole backfilled arisings and bentonite

Borehole Log

Borehole No. **BH09**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422849.58E - 408705.61N	Hole Type RO
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Level: 183.60m aOD	Scale 1:50
Client: Urban Construction Interiors Ltd		Dates: 08/04/2022	Logged By ABK

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.30	183.30		TOPSOIL (Drillers notes)
								Light grey SANDSTONE (Drillers notes)
					1.80	181.80		VOID (Drillers notes) [Possible Whinmoor Coal (Cumberworth Thick), or, Unnamed Coa]
					4.00	179.60		End of Borehole at 4.00m

Remarks

1) CAT scan prior to breaking ground. No services identified. 2) Borehole terminated due to potential instability. 3) casing installed to 4m 4) borehole backfilled arisings and bentonite

Appendix 6

Trial Pit Records

Rogers Geotechnical Services Ltd Telephone 0843 50 666 87 Fax 0843 51 599 30
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Trial Pit Log

Trialpit No **TP01**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422831.83 - 408740.26 Level: 182.47	Date 04/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): Depth 2.00, 2, 0.6	Scale 1:50
Client: Urban Construction Interiors Ltd			Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.25	182.22		TOPSOIL (Dark brown organic silty fine SAND).
				0.80	181.67		MADE GROUND/ FILL (Soft light grey mottled light brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is sub rounded to angular medium to coarse of sandstone siltstone and ironstone)
	1.00 - 1.01	D					Extremely weak light yellowish grey SILTSTONE (Recovered as sandy angular tabular GRAVEL. Sand is fine to coarse)
	1.50 - 2.00	B					
				2.00	180.47		End of pit at 2 00 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Trial Pit Log

Trialpit No **TP02**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422858.04 - 408737.10 Level: 181.75	Date 04/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): Depth 1.95; 2.5 × 0.6	Scale 1:50
Client: Urban Construction Interiors Ltd			Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.35	181.40		TOPSOIL (Dark brown organic silty fine SAND).
	0.65 - 0.66	D		0.65	181.10		MADE GROUND/ FILL (Light brownish grey locally clayey silty sandy sub angular to angular medium to coarse GRAVEL of siltstone sandstone ironstone. Sand is fine to medium).
	1.00 - 1.50	B					Extremely weak light yellowish grey SILTSTONE and fine grained SANDSTONE (Recovered as sandy angular medium to coarse GRAVEL. Sand is fine to coarse)
				1.95	179.80		End of pit at 1 95 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Trial Pit Log

Trialpit No **TP03**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422893.45 - 408717.63 Level: 181.69	Date 04/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): Depth 1.35 — 2 × 0.6	Scale 1:50
Client: Urban Construction Interiors Ltd			Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.35	181.34		TOPSOIL (Dark brown organic silty fine SAND).
				0.45	181.24		Medium dense light brown slightly sandy sub angular tabular medium to coarse GRAVEL of siltstone and fine grained SANDSTONE. Sand is fine to coarse.
				1.35	180.34		Medium strong light grey locally stained orange thinly bedded SILTSTONE and locally fine grained SANDSTONE (Recovered as angular tabular coarse gravel and cobbles)
							End of pit at 1 35 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Trial Pit Log

Trialpit No **TP04**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422897.78 - 408671.07 Level: 179.40	Date 04/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): 2 × 0.6 Depth 1.90	Scale 1:50
Client: Urban Construction Interiors Ltd			Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.38	179.02		TOPSOIL (Dark brown organic silty fine SAND).
							Medium strong orange locally yellow thinly to thickly bedded SANDSTONE (recovered as cobbles / angular tabular flags) .
				1.90	177.50		End of pit at 1 90 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Trial Pit Log

Trialpit No **TP05**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422898.72 - 408673.15 Level: 180.00	Date 04/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): 1.8 × 0.6, Depth 1.10	Scale 1:50
Client: Urban Construction Interiors Ltd			Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.35	179.65		TOPSOIL (Dark brown organic silty fine SAND).
				1.10	178.90		Medium strong thinly bedded orangish brown fine to medium grained SANDSTONE . (Recovered as sandy gravelly COBBLES. Sand is fine to coarse. Gravel is angular tabular and coarse. Cobbles are angular tabular flags) End of pit at 1.10 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Trial Pit Log

Trialpit No **TP06**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422864.39 - 408688.85 Level: 181.79	Date 04/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): Depth 1.30 — 1.8 × 0.6	Scale 1:50
Client: Urban Construction Interiors Ltd			Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.00			TOPSOIL (Dark brown organic silty fine SAND).
	0.50 - 1.00	B		0.45	181.34		Medium strong thinly to thickly bedded orangish brown SANDSTONE (Recovered as sandy angular tabular GRAVEL AND cobbles. Sand is fine to coarse. Gravel and cobbles are angular and tabular/flags)
				1.30	180.49		End of pit at 1 30 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Trial Pit Log

Trialpit No **TP07**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422839.38 - 408697.44 Level: 182.59	Date 04/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): 1.9 × 0.6, Depth 1.40	Scale 1:50
Client: Urban Construction Interiors Ltd			Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.35 - 0.60	B		0.35	182.24		TOPSOIL (Dark brown organic silty fine SAND).
				0.60	181.99		Orangish brown sandy sub angular tabular medium to coarse GRAVEL of sandstone. Sand is fine to coarse.
							Medium strong thinly bedded light grey locally orange fine grained SANDSTONE (Recovered as sandy angular tabular coarse GRAVEL and cobbles / Flags of sandstone. Sand is fine to coarse)
				1.40	181.19		End of pit at 1.40 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Trial Pit Log

Trialpit No **TP08**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422810.80 - 408659.60 Level: 178.84	Date 04/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): 1.9 × 0.6, Depth 1.30	Scale 1:50
Client: Urban Construction Interiors Ltd			Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.25	178.58		TOPSOIL (Dark brown organic silty fine SAND).
	0.50 - 0.80	B		0.85	177.98		Dense orangish brown sandy GRAVEL with high cobble content. Sand is medium to coarse. Gravel is angular tabular medium to coarse of fine to medium grained sandstone.
				1.30	177.54		Medium strong thinly to thickly laminated orangish brown fine to ,medium grained SANDSTONE. (Recovered as angular tabular medium to coarse gravel and cobbles). End of pit at 1 30 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Trial Pit Log

Trialpit No **TP09**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422848.51 - 408664.73 Level: 178.73	Date 04/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): 2 × 0.6, Depth 1.20	Scale 1:50
Client: Urban Construction Interiors Ltd			Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.30 - 0.60	B		0.25	178.48		TOPSOIL (Dark brown organic silty fine SAND).
							Weak locally medium strong thinly bedded light grey locally orangish brown fine to medium grained SANDSTONE. (Recovered as sandy GRAVEL/ COBBLES. Sand is medium to coarse. Gravel and cobbles are angular tabular of sandstone)
				1.20	177.53		End of pit at 1 20 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Trial Pit Log

Trialpit No
TP10
Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422875.39 - 408645.64 Level: 176.79	Date 04/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): Depth 1.30	Scale 1:50
Client: Urban Construction Interiors Ltd		2 / 0.6	Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	176.49		TOPSOIL (Dark brown organic silty fine SAND).
							Weak thinly bedded light orangish brown fine to medium grained SANDSTONE. (Recovered as sandy GRAVEL/ COBBLES. Sand is medium to coarse. Gravel and cobbles are angular tabular/flaggy)
				1.30	175.49		End of pit at 1 30 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Trial Pit Log

Trialpit No **TP11**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422902.28 - 408651.95 Level: 176.82	Date 04/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): Depth 1.25, 2, 0.6	Scale 1:50
Client: Urban Construction Interiors Ltd			Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	176.52		TOPSOIL (Dark brown organic silty fine SAND).
				1.25	175.57		Weak to medium strong thinly bedded light grey and orange fine to medium grained SANDSTONE. (Recovered as sandy coarse angular tabular GRAVEL/ COBBLES. Sand is medium to coarse. Gravel and cobbles are angular and tabular/flaggy) End of pit at 1 25 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Trial Pit Log

Trialpit No
TP12
Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422855.31 - 408679.91 Level: 180.53	Date 05/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): 1 × 0.3 Depth 0.90	Scale 1:50
Client: Urban Construction Interiors Ltd			Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.35	180.18		TOPSOIL
				1.00	179.53		Weak locally medium strong thinly bedded light grey locally orangish brown fine to medium grained SANDSTONE. (Recovered as sandy GRAVEL/ COBBLES. Sand is medium to coarse. Gravel and cobbles are angular tabular of sandstone) End of pit at 0 90 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Trial Pit Log

Trialpit No
TP13
Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422871.88 - 408721.05 Level: 183.46	Date 05/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): Depth 1.25, 1.2, 3	Scale 1:50
Client: Urban Construction Interiors Ltd			Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							TOPSOIL (Dark brown organic silty fine SAND).
				0.45	183.01		INTACT dirty coal seperated by a thin clay parting [Possible Whinmoor Coal (Cumberworth Thick), or, Unnamed Coal]
				1.10	182.36		SANDSTONE
				1.20	182.26		End of pit at 1 25 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Trial Pit Log

Trialpit No
TP14
Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422873.61 - 408731.25 Level: 181.41	Date 05/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): 1.7 × 0.3, Depth 1.05	Scale 1:50
Client: Urban Construction Interiors Ltd			Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.40	181.00		MADE GROUND/ FILL (Soft light grey mottled light brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is sub rounded to angular medium to coarse of sandstone siltstone and ironstone)
				1.05	180.36		Firm light yellowish brown very sandy silty CLAY End of pit at 1 05 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Trial Pit Log

Trialpit No **TP15**

Sheet 1 of 1

Project Name: Cliff Hill	Project No. C2206/21/E/3401	Co-ords: 422901.80 - 408737.55 Level: 178.47	Date 05/04/2022
Location: Cumberworth Lane, Denby Dale, Huddersfield, HD8 8RZ		Dimensions (m): 2 × 0.3 Depth 1.24	Scale 1:50
Client: Urban Construction Interiors Ltd			Logged CM

Water Str ke	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.40	178.07		MADE GROUND/ FILL (Soft light grey mottled light brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is sub rounded to angular medium to coarse of sandstone siltstone and ironstone)
				0.55	177.92		TOPSOIL (Dark brown organic silty fine SAND).
							Firm friable thinly laminated light grey mottled orangish brown silty CLAY
				1.24	177.23		End of pit at 1 24 m

Remarks: 1) CAT scan prior to breaking ground. No services identified. 2) Pit terminated due to refusal

Stability: Good

Appendix 7

Soakaway Test Results

Rogers Geotechnical Services Ltd Telephone 0843 50 666 87 Fax 0843 51 599 30
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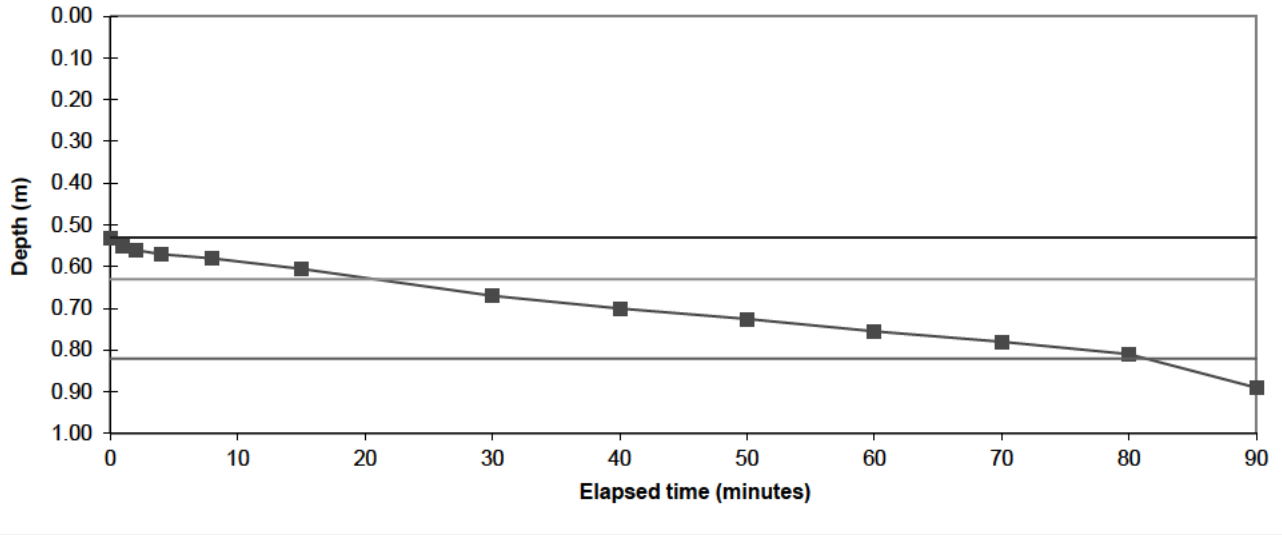
Rogers Geotechnical Services L

Soakaway Test

Trial Pit No:	TP12	Test No:	1	Date:	05.04.2022
Length (m):	1.000		Datum Height:	0.00	m agl
Width (m):	0.30		Granular infill:	None	
Depth (m):	0.91		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.530		
1	0.550		
2	0.560		
4	0.570		
8	0.580		
15	0.605		
30	0.670		
40	0.700		
50	0.725		
60	0.755		
70	0.780		
80	0.810		
90	0.890		



Start water depth for analysis (mbgl):	0.53		
75% effective depth (mbgl):	0.63	Elapsed time (mins):	20.8
50% effective depth (mbgl):	0.72		
25% effective depth (mbgl):	0.82	Elapsed time (mins):	81.3
Base of soakage zone (mbgl):	0.91		

Volume outflow between 75% and 25% effective depth (m^3):	0.057
Mean surface area of outflow (m^2):	0.79
(side area at 50% effective depth + base area)	
Time for outflow between 75% and 25% effective depth (mins):	60.5

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

Remarks Results processed following BRE 365 (2007).

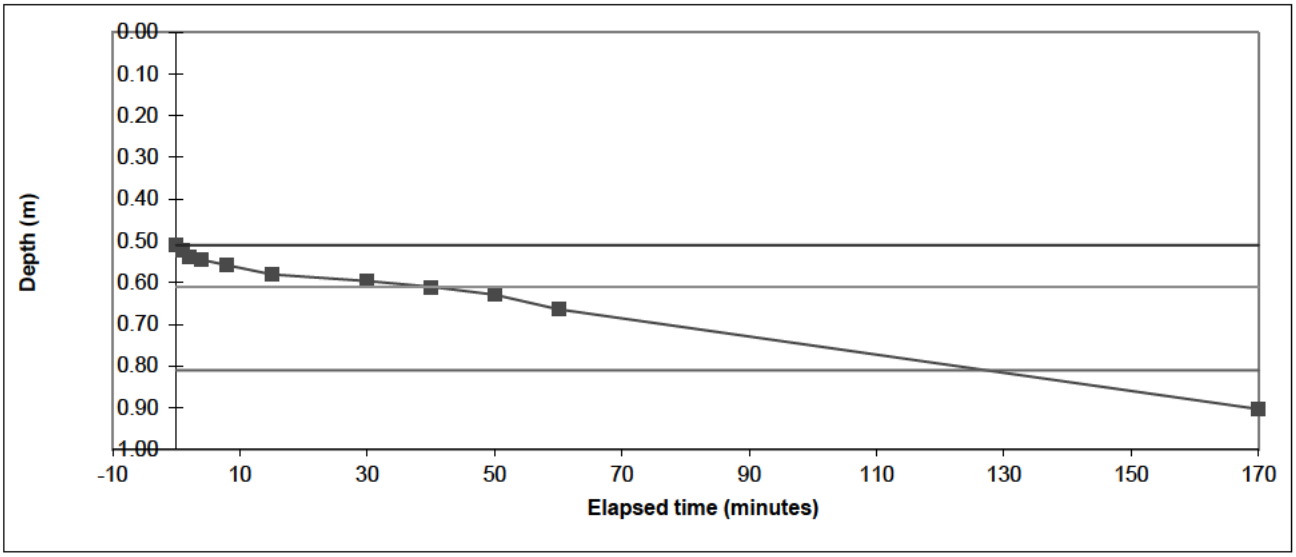
Client:	Urban Construction Interiors Ltd	**Job No:**
Site:	Cliff Hill Denby Dale	C2206/21/E

Rogers Geotechnical Services L

Soakaway Test

Trial Pit No:	TP12	Test No:	2	Date:	05.04.2022
Length (m):	1.000		Datum Height:	0.00	m agl
Width (m):	0.30		Granular infill:	None	
Depth (m):	0.91		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.510		
1	0.523		
2	0.537		
4	0.545		
8	0.558		
15	0.580		
30	0.596		
40	0.610		
50	0.629		
60	0.664		
170	0.903		



Start water depth for analysis (mbgl):	0.51		
75% effective depth (mbgl):	0.61	Elapsed time (mins):	40.0
50% effective depth (mbgl):	0.71		
25% effective depth (mbgl):	0.81	Elapsed time (mins):	127.2
Base of soakage zone (mbgl):	0.91		

Volume outflow between 75% and 25% effective depth (m^3):	0.060
Mean surface area of outflow (m^2):	0.82
(side area at 50% effective depth + base area)	
Time for outflow between 75% and 25% effective depth (mins):	87.2

Soil infiltration rate (m/s):	**1.4E-5**

Remarks Results processed following BRE 365 (2007).

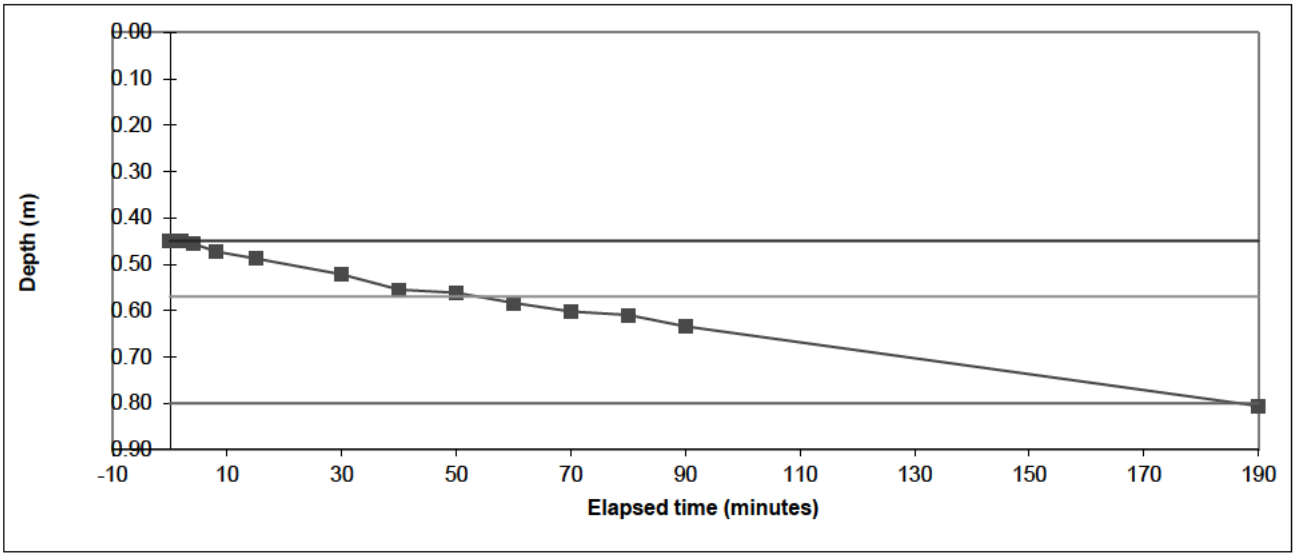
Client:	Urban Construction Interiors Ltd	**Job No:**
Site:	Cliff Hill Denby Dale	C2206/21/E

Rogers Geotechnical Services L

Soakaway Test

Trial Pit No:	TP12	Test No:	3	Date:	05.04.2022
Length (m):	1.000		Datum Height:	0.00	m agl
Width (m):	0.30		Granular infill:	None	
Depth (m):	0.91		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.450		
1	0.450		
2	0.450		
4	0.455		
8	0.473		
15	0.488		
30	0.522		
40	0.555		
50	0.562		
60	0.584		
70	0.602		
80	0.610		
90	0.634		
190	0.806		



Start water depth for analysis (mbgl):	0.45		
75% effective depth (mbgl):	0.57	Elapsed time (mins):	53.6
50% effective depth (mbgl):	0.68		
25% effective depth (mbgl):	0.80	Elapsed time (mins):	186.5
Base of soakage zone (mbgl):	0.91		

Volume outflow between 75% and 25% effective depth (m^3):	0.069
Mean surface area of outflow (m^2): (side area at 50% effective depth + base area)	0.90
Time for outflow between 75% and 25% effective depth (mins):	132.9

Soil infiltration rate (m/s):	**9.6E-6**

Remarks Results processed following BRE 365 (2007).
Unable to run test at 2.0m as specified due to unstable pits (loose sands/gravels).

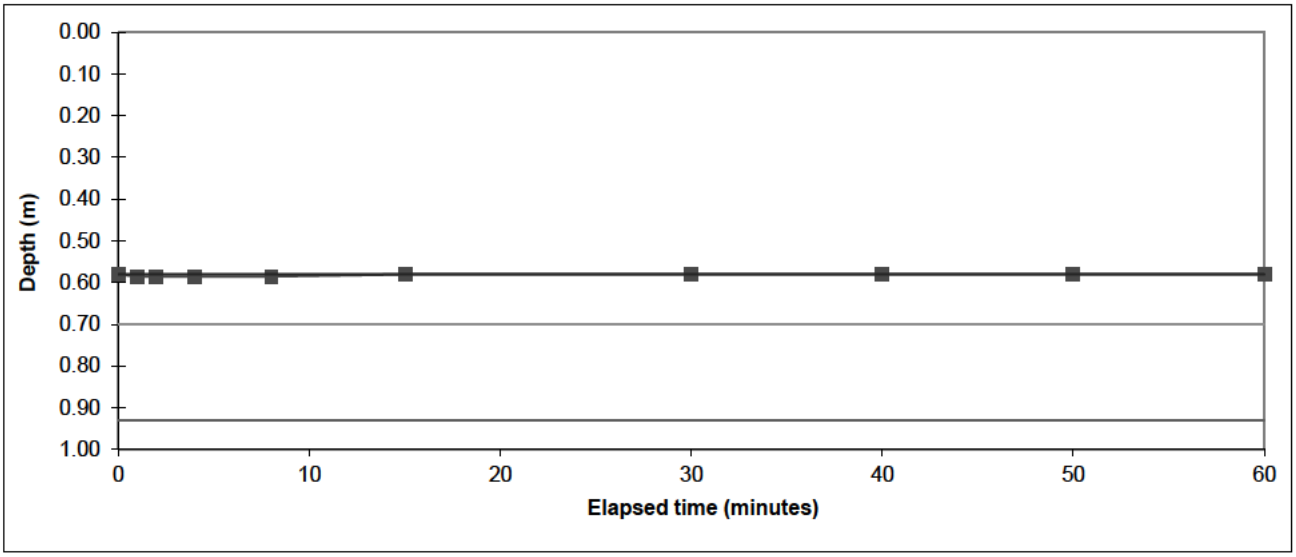
Client:	Urban Construction Interiors Ltd	**Job No:**
Site:	Cliff Hill Denby Dale	C2206/21/E

Rogers Geotechnical Services L

Soakaway Test

Trial Pit No:	TP14	Test No:	1	Date:	05.04.2022
Length (m):	1.700		Datum Height:	0.00	m agl
Width (m):	0.30		Granular infill:	None	
Depth (m):	1.05		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.580		
1	0.585		
2	0.585		
4	0.585		
8	0.585		
15	0.580		
30	0.580		
40	0.580		
50	0.580		
60	0.580		



Start water depth for analysis (mbgl):	0.58		
75% effective depth (mbgl):	0.70	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	0.82		
25% effective depth (mbgl):	0.93	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.05		
Volume outflow between 75% and 25% effective depth (m^3):			
Mean surface area of outflow (m^2):			1.43
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

Soil infiltration rate (m/s):	**Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.**

Remarks	Results processed following BRE 365 (2007). Unable to run test at 2.0m as specified due to unstable pits (loose sands/gravels).

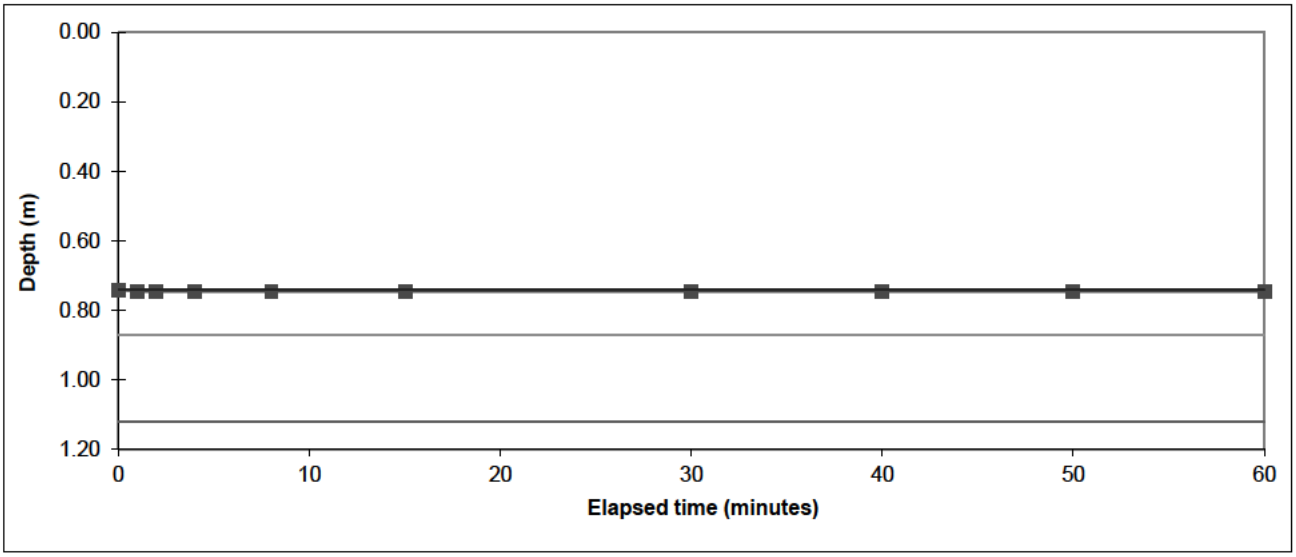
Client:	Urban Construction Interiors Ltd	**Job No:**
Site:	Cliff Hill Denby Dale	C2206/21/E

Rogers Geotechnical Services L

Soakaway Test

Trial Pit No:	TP15	Test No:	1	Date:	05.04.2022
Length (m):	2.000		Datum Height:	0.00	m agl
Width (m):	0.30		Granular infill:	None	
Depth (m):	1.24		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.740		
1	0.745		
2	0.745		
4	0.745		
8	0.745		
15	0.745		
30	0.745		
40	0.745		
50	0.745		
60	0.745		



Start water depth for analysis (mbgl):	0.74		
75% effective depth (mbgl):	0.87	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	0.99		
25% effective depth (mbgl):	1.12	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.24		
Volume outflow between 75% and 25% effective depth (m^3):			
Mean surface area of outflow (m^2):			1.75
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

Soil infiltration rate (m/s):	**Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.**

Remarks	Results processed following BRE 365 (2007). Unable to run test at 2.0m as specified due to unstable pits (loose sands/gravels).

Client:	Urban Construction Interiors Ltd	**Job No:**
Site:	Cliff Hill Denby Dale	C2206/21/E

Appendix 8

TRL DCP Test Results

Rogers Geotechnical Services Ltd Telephone 0843 50 666 87 Fax 0843 51 599 30
Email enquiries@rogersgeotech.co.uk www.rogersgeotech.co.uk

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

www.rogersgeotech.co.uk

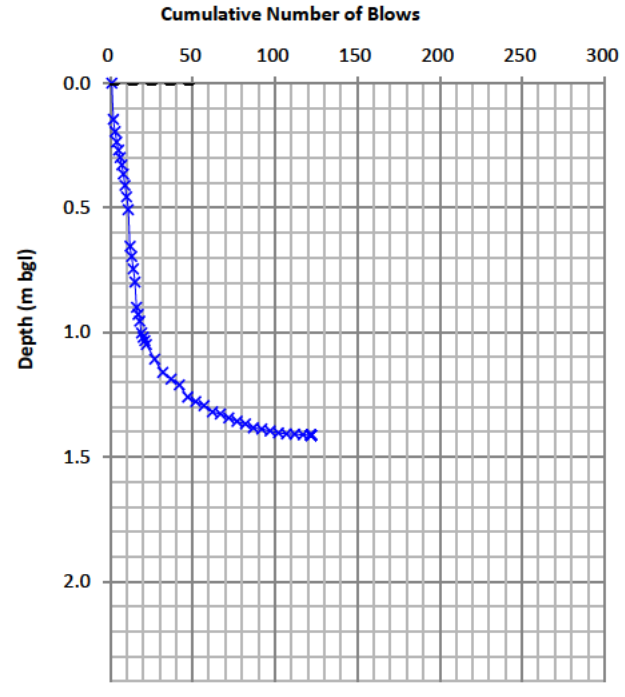
Tel : 0843 50 66687 **Fax : 0843 51 59930**

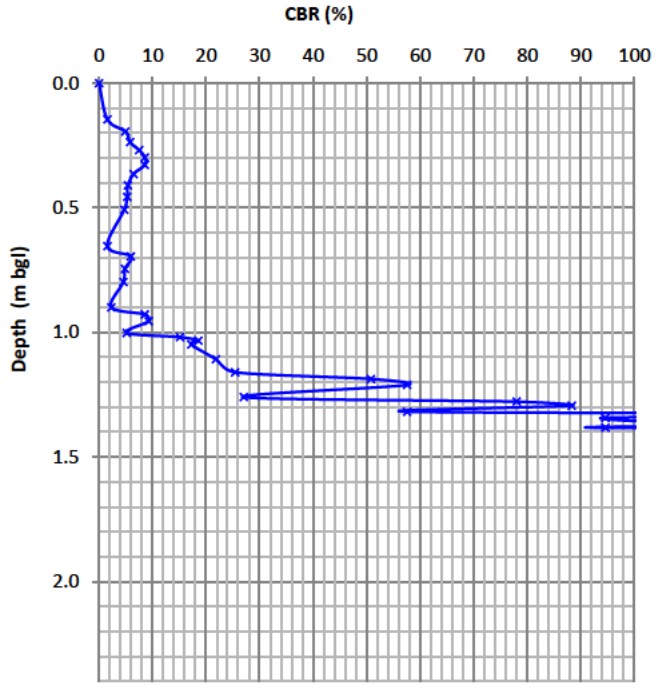
Job No:	Location:
C2206/21/E/3401	TRL DCP 1
Site: Cliff Hill Denby Dale	Client: Urban Construction Interiors Ltd
Test Date: 07.04.02022	Tested By: AB

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
1	1	0	-	1	21	1033	19	5	117	1411	795
1	2	145	2	1	22	1048	17	5	122	1412	795
1	3	194	5	5	27	1108	22				
1	4	236	6	5	32	1160	25				
1	5	269	7	5	37	1187	51				
1	6	298	9	5	42	1211	58				
1	7	327	9	5	47	1260	27				
1	8	365	6	5	52	1278	78				
1	9	410	5	5	57	1294	88				
1	10	456	5	5	62	1318	58				
1	11	507	5	5	67	1328	145				
1	12	654	2	5	72	1343	95				
1	13	695	6	5	77	1357	102				
1	14	745	5	5	82	1368	131				
1	15	798	5	5	87	1383	95				
1	16	899	2	5	92	1388	302				
1	17	928	9	5	97	1396	184				
1	18	955	9	5	102	1403	212				
1	19	1002	5	5	107	1407	382				
1	20	1019	15	5	112	1409	795				





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HD8 8LU

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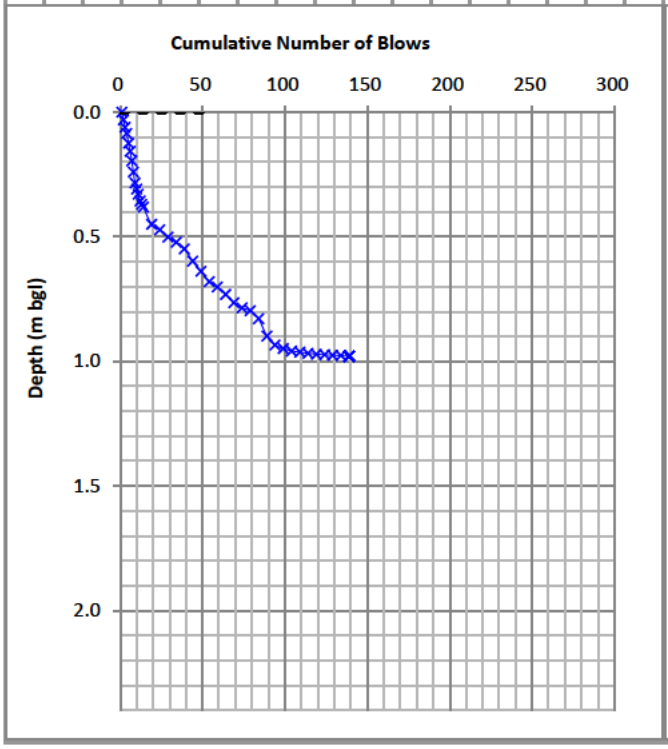
Tel : 0843 50 66687 **Fax : 0843 51 59930**

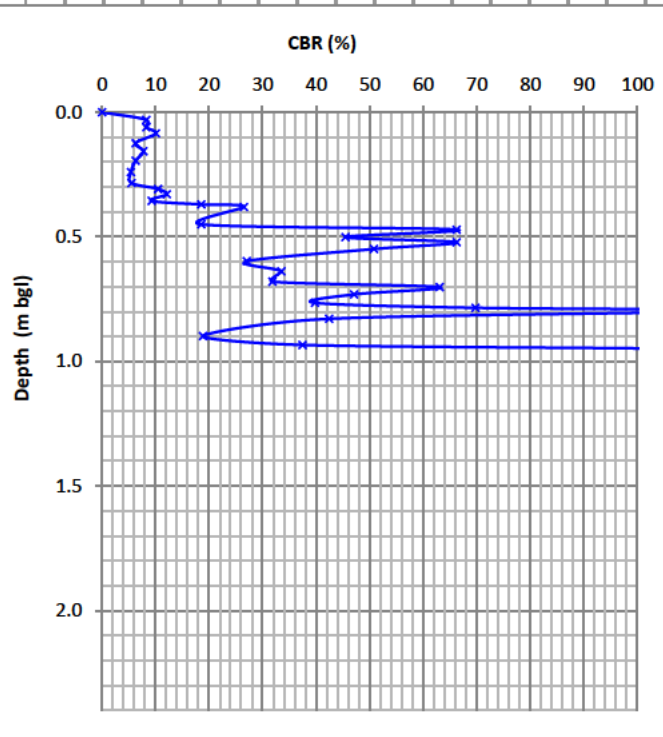
Job No:	Location:
C2206/21/E/3401	TRL DCP 2
Site: Cliff Hill Denby Dale	Client: Urban Construction Interiors Ltd
Test Date: 07.04.02022	Tested By: AB

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
1	1	0	-	5	49	638	34				
1	2	30	8	5	54	680	32				
1	3	60	8	5	59	702	63				
1	4	85	10	5	64	731	47				
1	5	124	6	5	69	765	40				
1	6	156	8	5	74	785	70				
1	7	195	6	5	79	797	120				
1	8	240	5	5	84	829	42				
1	9	284	6	5	89	898	19				
1	10	308	10	5	94	934	37				
1	11	329	12	5	99	948	102				
1	12	356	9	5	104	958	145				
1	13	370	19	5	109	963	302				
1	14	380	26	5	114	967	382				
5	19	450	19	5	119	971	382				
5	24	471	66	5	124	973	795				
5	29	501	45	5	129	975	795				
5	34	522	66	5	134	977	795				
5	39	549	51	5	139	979	795				
5	44	598	27								





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HD8 8LU

www.rogersgeotech.co.uk

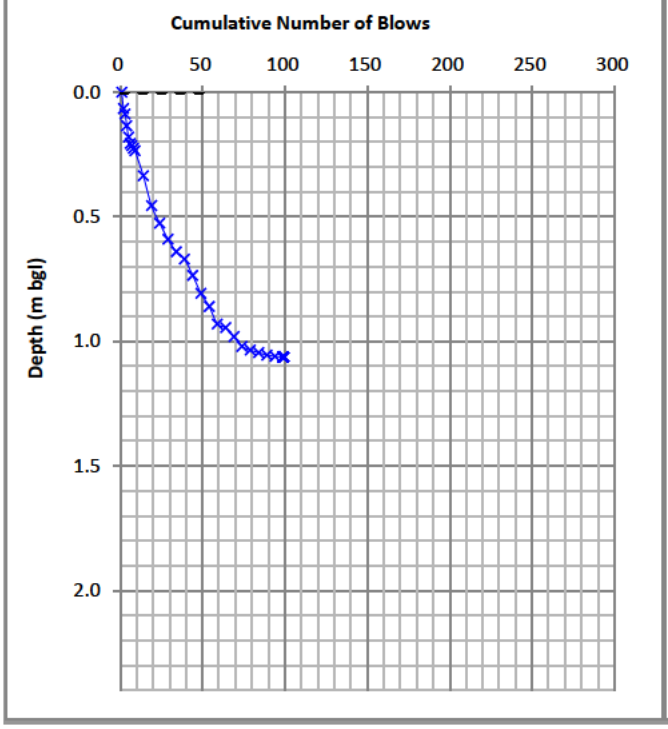
Tel : 0843 50 66687 **Fax : 0843 51 59930**

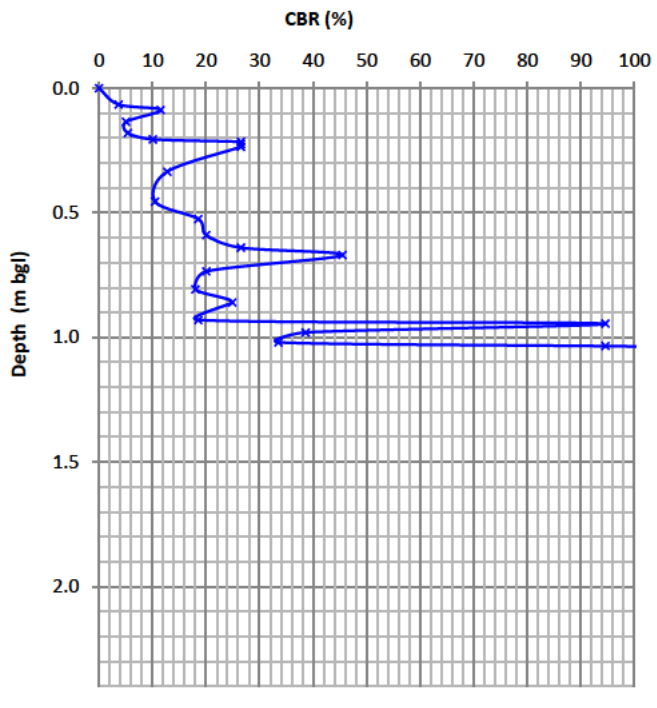
Job No:	Location:
C2206/21/E/3401	TRL DCP 3
Site: Cliff Hill Denby Dale	Client: Urban Construction Interiors Ltd
Test Date: 07.04.02022	Tested By: AB

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
1	1	0	-	5	69	980	39				
1	2	65	4	5	74	1020	34				
1	3	87	12	5	79	1035	95				
1	4	135	5	5	84	1045	145				
1	5	180	5	5	89	1055	145				
1	6	205	10	5	94	1060	302				
1	7	215	26	5	99	1063	302				
1	8	225	26								
1	9	235	26								
5	14	335	13								
5	19	455	10								
5	24	525	19								
5	29	590	20								
5	34	640	26								
5	39	670	45								
5	44	735	20								
5	49	807	18								
5	54	860	25								
5	59	930	19								
5	64	945	95								





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

www.rogersgeotech.co.uk

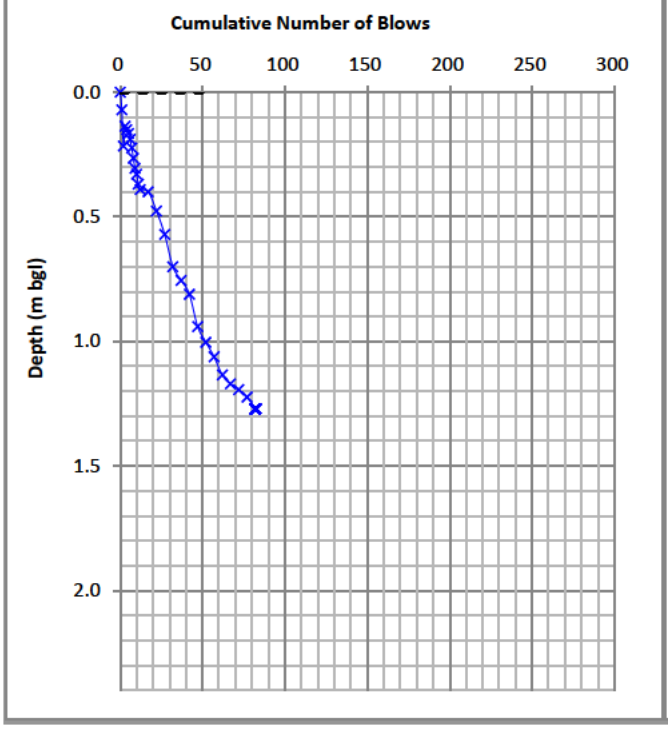
Tel : 0843 50 66687 **Fax : 0843 51 59930**

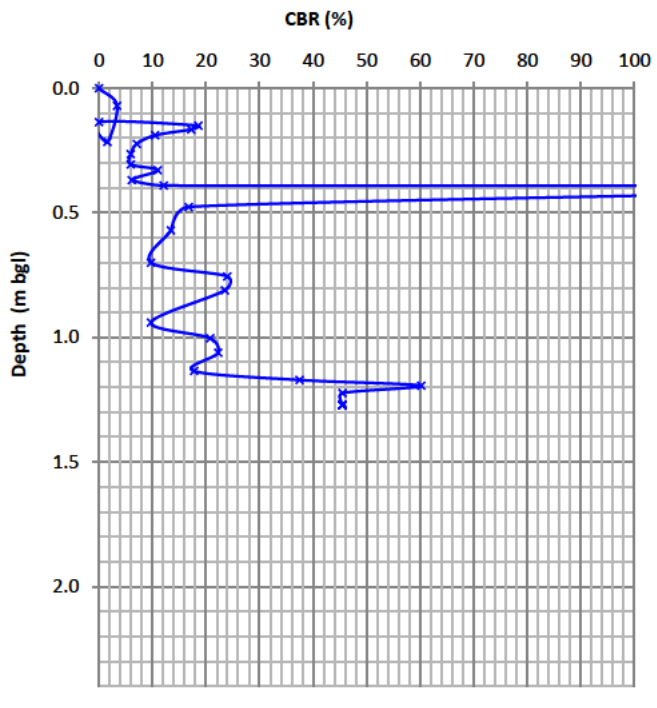
Job No:	Location:
C2206/21/E/3401	TRL DCP 4
Site: Cliff Hill Denby Dale	Client: Urban Construction Interiors Ltd
Test Date: 07.04.02022	Tested By: AB

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
0	0	0	-	5	52	1003	21				
1	1	70	3	5	57	1062	22				
1	2	216	2	5	62	1135	18				
1	3	136	-	5	67	1171	37				
1	4	150	19	5	72	1194	60				
1	5	165	17	5	77	1224	45				
1	6	189	10	5	82	1271	45				
1	7	224	7								
1	8	265	6								
1	9	306	6								
1	10	329	11								
1	11	369	6								
1	12	390	12								
5	17	399	162								
5	22	476	17								
5	27	571	13								
5	32	700	10								
5	37	755	24								
5	42	811	23								
5	47	940	10								





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Huddersfield
HD8 8LU

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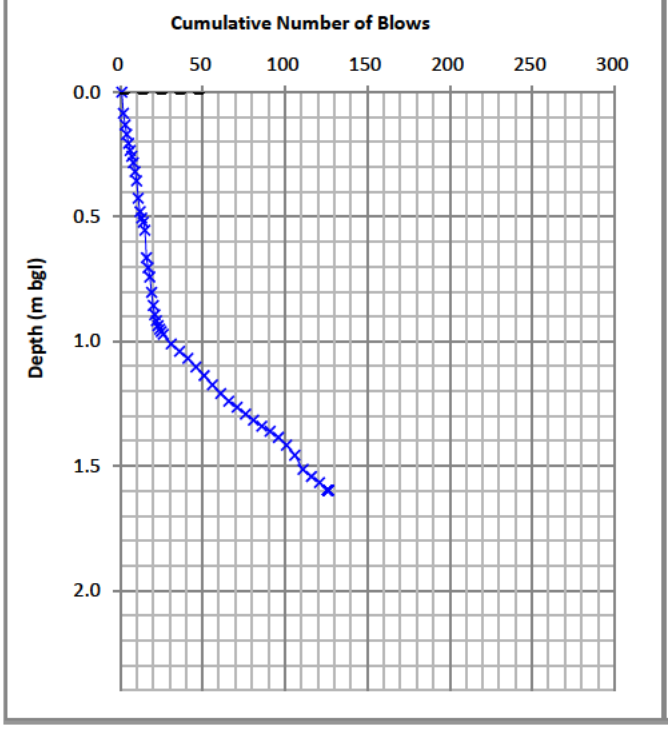
Tel : 0843 50 66687 **Fax : 0843 51 59930**

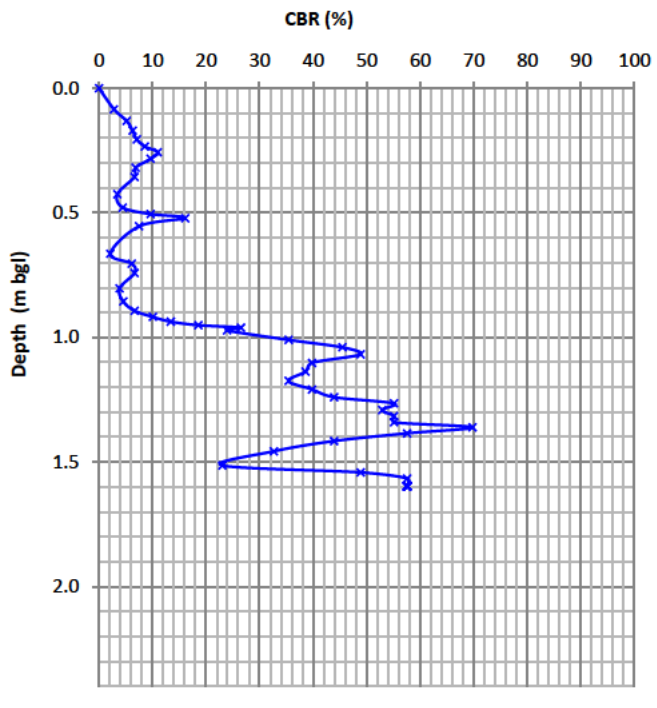
Job No:	Location:
C2206/21/E/3401	TRL DCP 5
Site: Cliff Hill Denby Dale	Client: Urban Construction Interiors Ltd
Test Date: 07.04.02022	Tested By: AB

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
1	1	0	-	1	21	893	7	5	101	1416	44
1	2	84	3	1	22	918	10	5	106	1457	33
1	3	131	5	1	23	937	13	5	111	1514	23
1	4	170	6	1	24	951	19	5	116	1542	49
1	5	205	7	1	25	961	26	5	121	1566	58
1	6	234	9	1	26	972	24	5	126	1598	58
1	7	257	11	5	31	1010	35				
1	8	283	10	5	36	1040	45				
1	9	319	7	5	41	1068	49				
1	10	356	7	5	46	1102	40				
1	11	425	3	5	51	1137	39				
1	12	479	4	5	56	1175	35				
1	13	505	10	5	61	1209	40				
1	14	521	16	5	66	1240	44				
1	15	554	7	5	71	1265	55				
1	16	664	2	5	76	1291	53				
1	17	704	6	5	81	1316	55				
1	18	741	7	5	86	1341	55				
1	19	803	4	5	91	1361	70				
1	20	856	5	5	96	1385	58				





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Huddersfield
HD8 8LU

www.rogersgeotech.co.uk

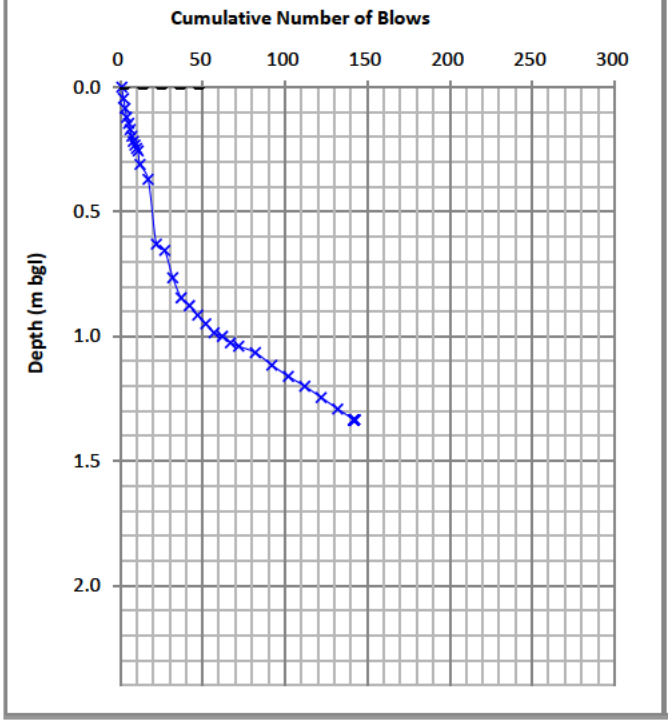
Tel : 0843 50 66687 **Fax : 0843 51 59930**

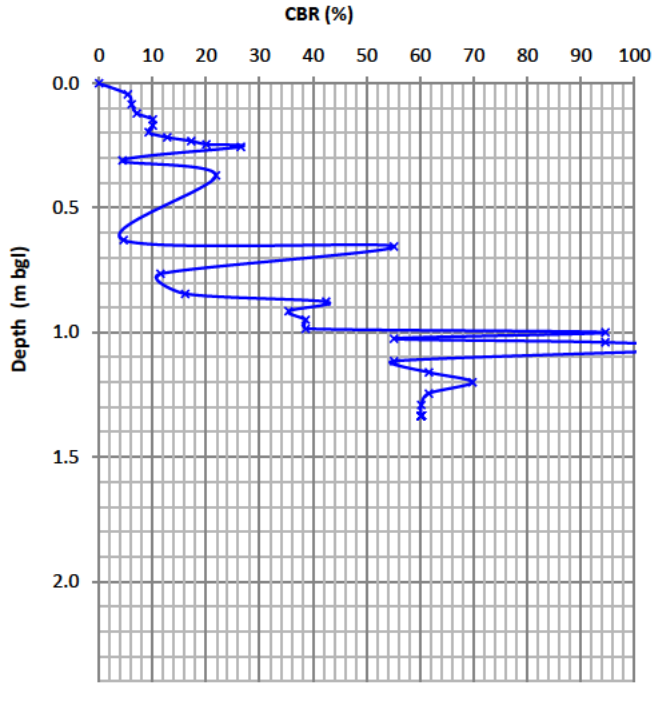
Job No:	Location:
C2206/21/E/3401	TRL DCP 6
Site: Cliff Hill Denby Dale	Client: Urban Construction Interiors Ltd
Test Date: 07.04.02022	Tested By: AB

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
1	1	0	-	5	57	985	39				
1	2	45	5	5	62	1000	95				
1	3	85	6	5	67	1025	55				
1	4	120	7	5	72	1040	95				
1	5	145	10	10	82	1065	115				
1	6	170	10	10	92	1115	55				
1	7	197	9	10	102	1160	62				
1	8	217	13	10	112	1200	70				
1	9	232	17	10	122	1245	62				
1	10	245	20	10	132	1291	60				
1	11	255	26	10	142	1335	60				
1	12	310	4								
5	17	370	22								
5	22	630	5								
5	27	655	55								
5	32	765	12								
5	37	845	16								
5	42	877	42								
5	47	915	35								
5	52	950	39								





Rogers Geotechnical Services Ltd
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Near Bank, Shelley,
Huddersfield
HD8 8LU

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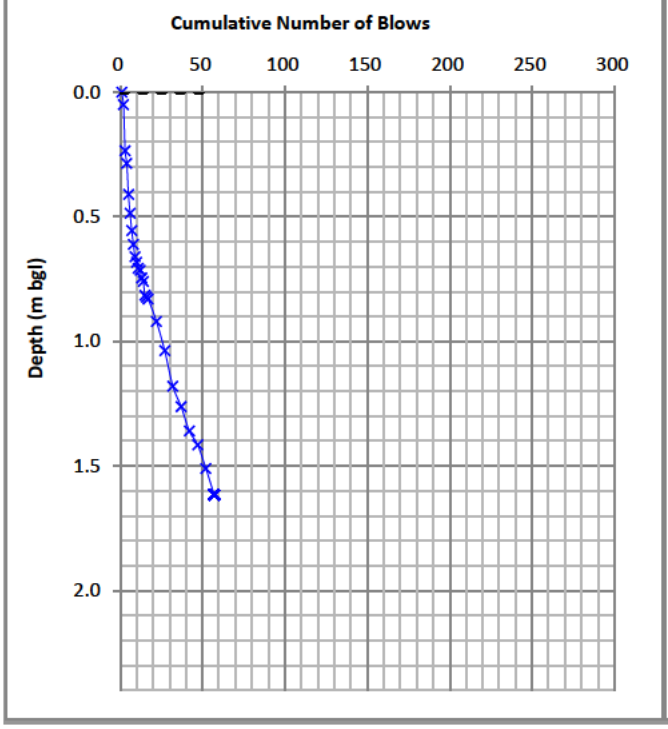
Tel : 0843 50 66687 **Fax : 0843 51 59930**

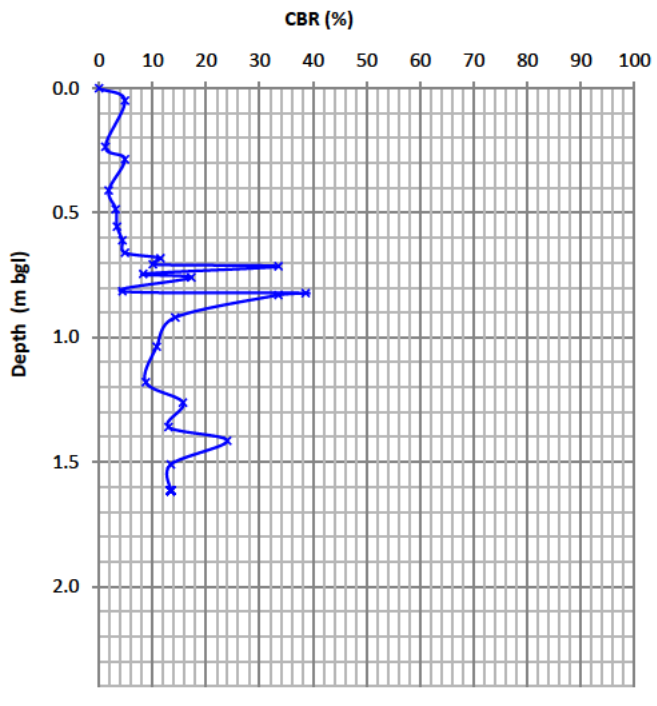
Job No:	Location:
C2206/21/E/3401	TRL DCP 7
Site: Cliff Hill Denby Dale	Client: Urban Construction Interiors Ltd
Test Date: 07.04.02022	Tested By: AB

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)
1	1	0	-
1	2	50	5
1	3	235	1
1	4	285	5
1	5	410	2
1	6	485	3
1	7	555	3
1	8	610	4
1	9	660	5
1	10	682	12
1	11	707	10
1	12	715	34
1	13	745	8
1	14	760	17
1	15	815	4
1	16	822	39
1	17	830	34
5	22	920	14
5	27	1037	11
5	32	1180	9
5	37	1262	16
5	42	1360	13
5	47	1415	24
5	52	1510	13
5	57	1615	13





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Near Bank, Shelley,
Huddersfield
HD8 8LU

www.rogersgeotech.co.uk

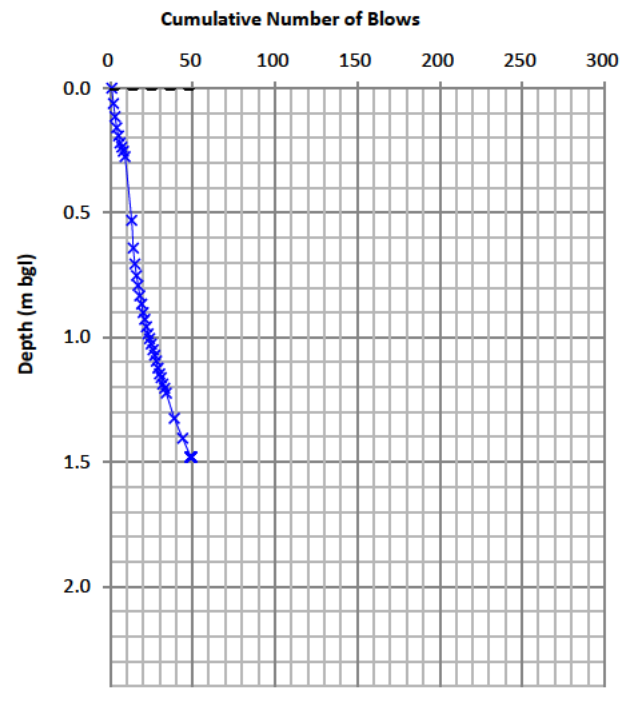
Tel : 0843 50 66687 **Fax : 0843 51 59930**

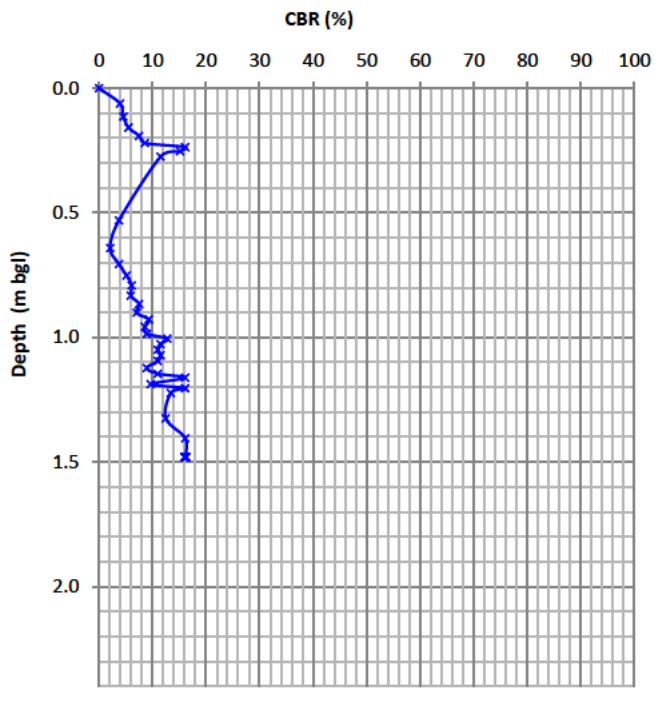
Job No:	Location:
C2206/21/E/3401	TRL DCP 8
Site: Cliff Hill Denby Dale	Client: Urban Construction Interiors Ltd
Test Date: 07.04.02022	Tested By: AB

IMPACT (TRL) Dynamic Cone Penetrometer

SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)	Blow Count	Total Blows	Depth (mm)	CBR (%)
1	1	0	-	1	24	1005	13				
1	2	61	4	1	25	1027	12				
1	3	114	5	1	26	1050	11				
1	4	158	6	1	27	1072	12				
1	5	191	7	1	28	1095	11				
1	6	220	9	1	29	1123	9				
1	7	236	16	1	30	1146	11				
1	8	253	15	1	31	1162	16				
1	9	275	12	1	32	1188	10				
4	13	530	4	1	33	1204	16				
1	14	641	2	1	34	1223	13				
1	15	705	4	5	39	1325	12				
1	16	752	5	5	44	1405	16				
1	17	792	6	5	49	1481	16				
1	18	833	6								
1	19	866	7								
1	20	901	7								
1	21	928	9								
1	22	957	9								
1	23	985	9								





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Near Bank, Shelley,
Huddersfield
HD8 8LU

www.rogersgeotech.co.uk

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

Job No:	Location:
C2206/21/E/3401	TRL DCP 9
Site: Cliff Hill Denby Dale	Client: Urban Construction Interiors Ltd
Test Date: 07.04.02022	Tested By: AB

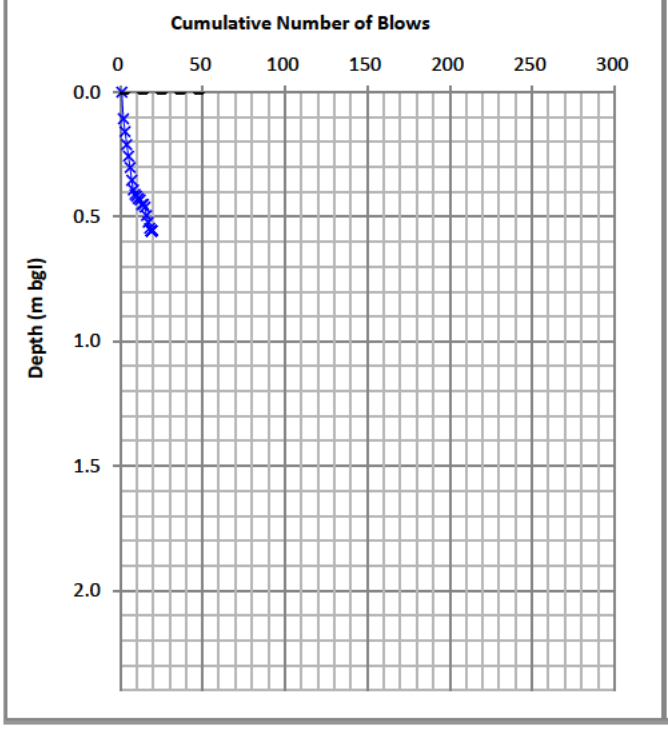
IMPACT (TRL) Dynamic Cone Penetrometer

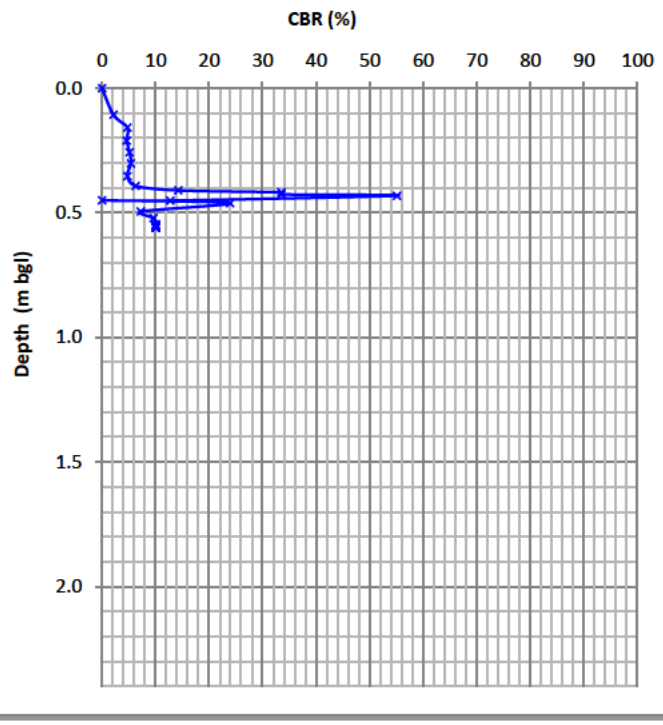
SL970, TRL Road Note 8, 60° cone.

Blow Count	Total Blows	Depth (mm)	CBR (%)
1	1	0	-
1	2	107	2
1	3	158	5
1	4	210	5
1	5	257	5
1	6	302	5
1	7	353	5
1	8	392	6
1	9	410	14
1	10	418	34
1	11	426	34
1	12	431	55
1	13	451	13
1	14	450	-
1	15	461	24
1	16	495	7
1	17	521	10
1	18	546	10
1	19	556	10

Blow Count	Total Blows	Depth (mm)	CBR (%)

Blow Count	Total Blows	Depth (mm)	CBR (%)





Appendix 9

GPR Survey of Mine Shafts

Rogers Geotechnical Services Ltd Telephone 0843 50 666 87 Fax 0843 51 599 30
Email enquiries@rogersgeotech.co.uk www.rogersgeotech.co.uk

MINE 002

Below images show GPR trace approx 5 meters from original staked out 002 location at a depth of 1.25m deep.

Nothing was detected at the staked-out point using the supplied coordinates.

Coordinates to the GPR trace are - EASTING 422843.598 NORTHING 408655.241.

MINE 510

Below images show staked out location of possible mine shaft. No trace of the shaft was detected using GPR techniques. Also below image shows on screen, uniform ground makeup.

MINE 016

Below image shows staked out location of possible mine shaft 016 using coordinates provided.

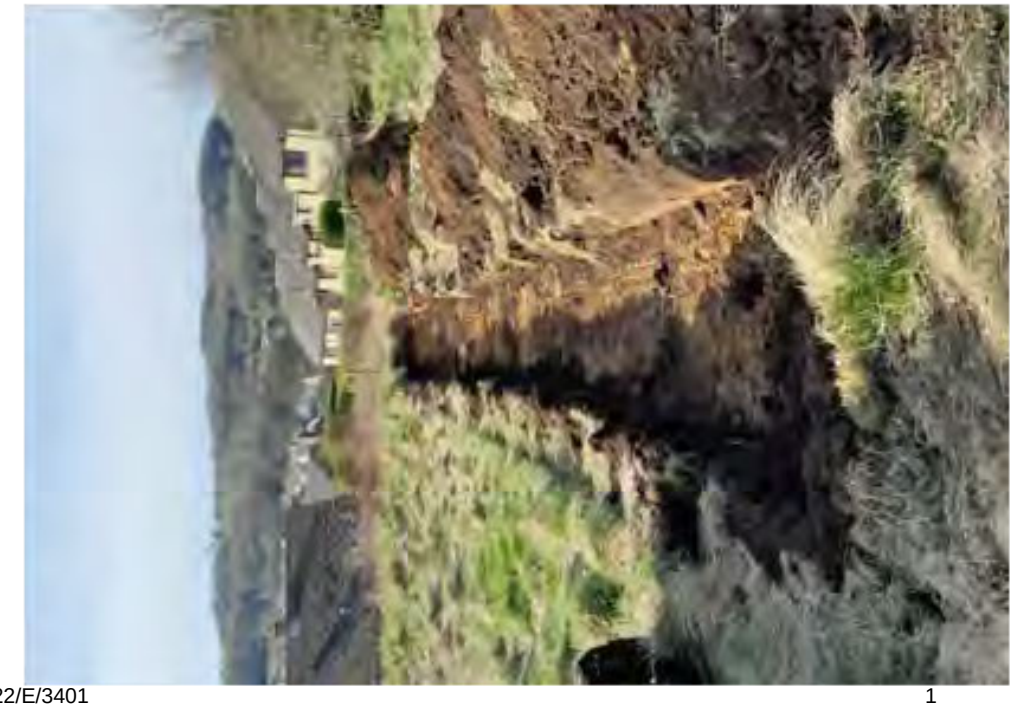
GPR survey around this location was not possible due to ground terrain.

GPR was used as close as possible without any results.

Appendix 10

Photographic Records

Rogers Geotechnical Services Ltd Telephone 0843 50 666 87 Fax 0843 51 599 30
Email enquiries@rogersgeotech.co.uk www.rogersgeotech.co.uk



Appendix 11

Diagrams and plans.

Rogers Geotechnical Services Ltd Telephone 0843 50 666 87 Fax 0843 51 599 30
Email enquiries@rogersgeotech.co.uk www.rogersgeotech.co.uk

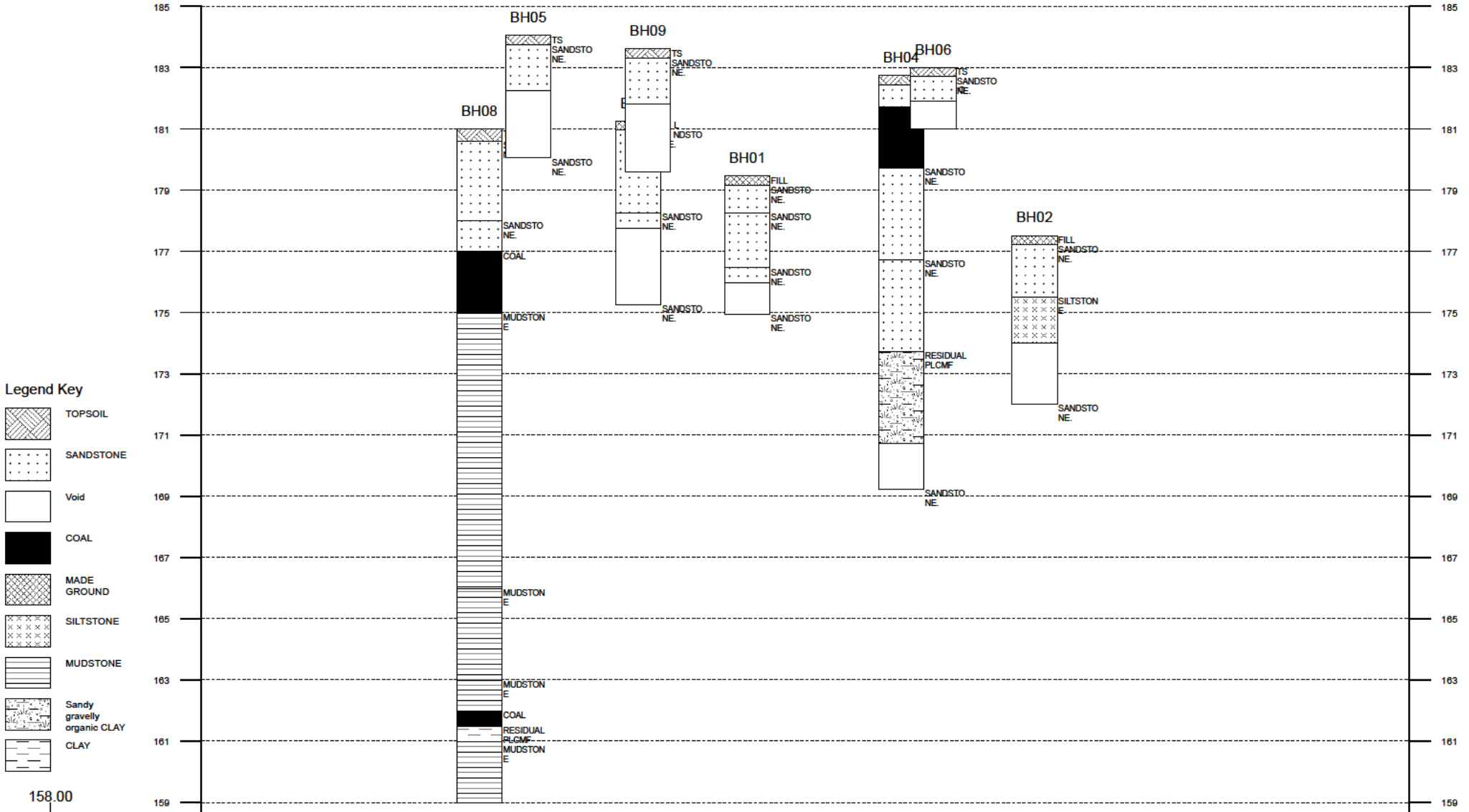
Project Id:	C2206/21/E/3401	Title:	Site Plan
Project Title:	Cliff Hill	Scale:	1:5000
Location:	Cumberworth Lane, Denby Dale, Huddersfield, , HD8 8RZ	Engineer:	CM
Client:	Urban Construction Interiors Ltd	Contractor:	RGS

Legend Key

- Sections - Section line 1
- Sections - Section line 2
- Sections - Section line 3
- Locations By Type - Empty
- Locations By Type - RO

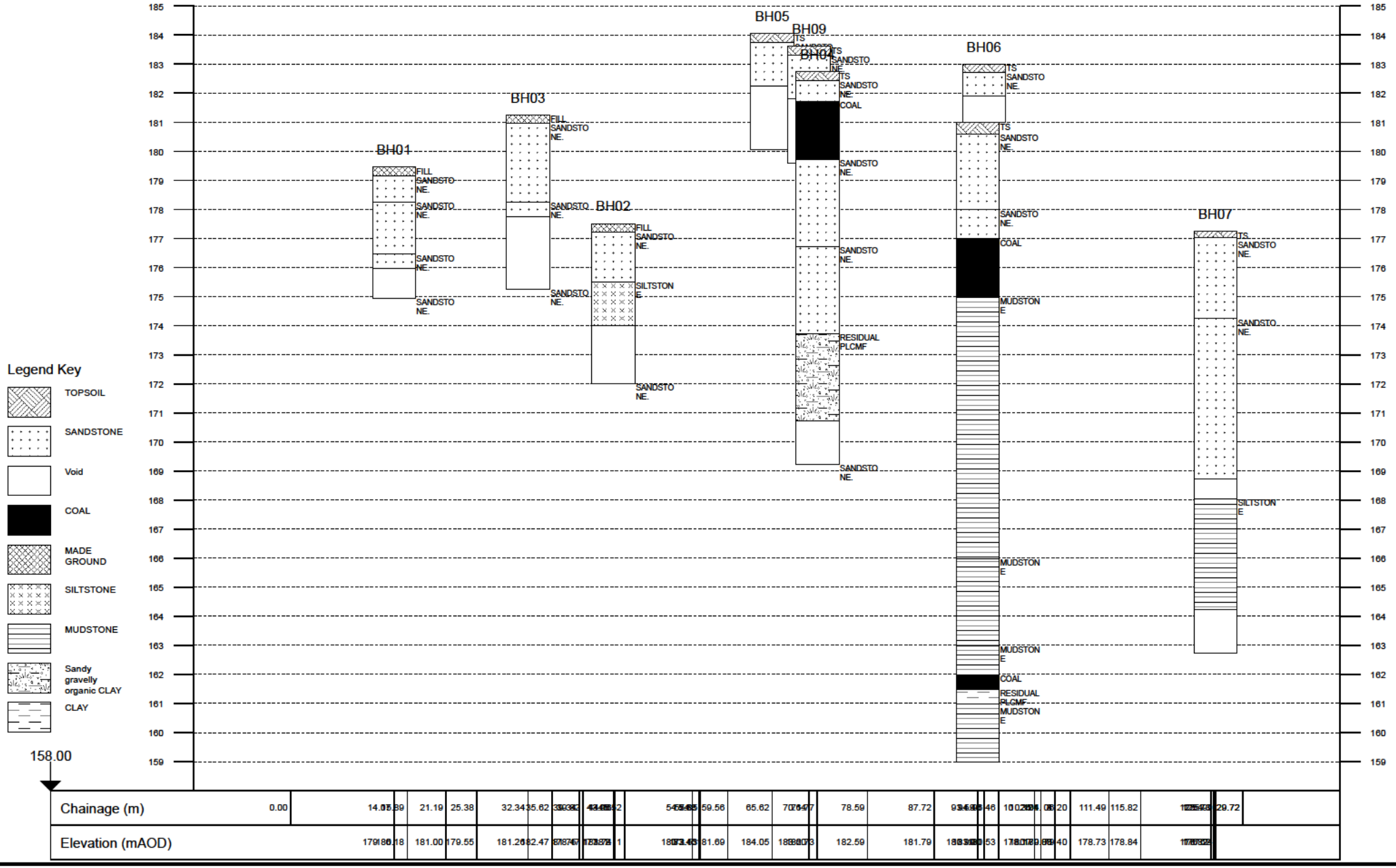
Project Id: C2206/21/E/3401
Project Title: Cliff Hill
Location: Cumberworth Lane, Denby Dale, Huddersfield, , HD8 8RZ
Client: Urban Construction Interiors Ltd

Title: Section line 2
Vertical Scale: 1:177
Horizontal Scale: 1:937
Engineer: CM



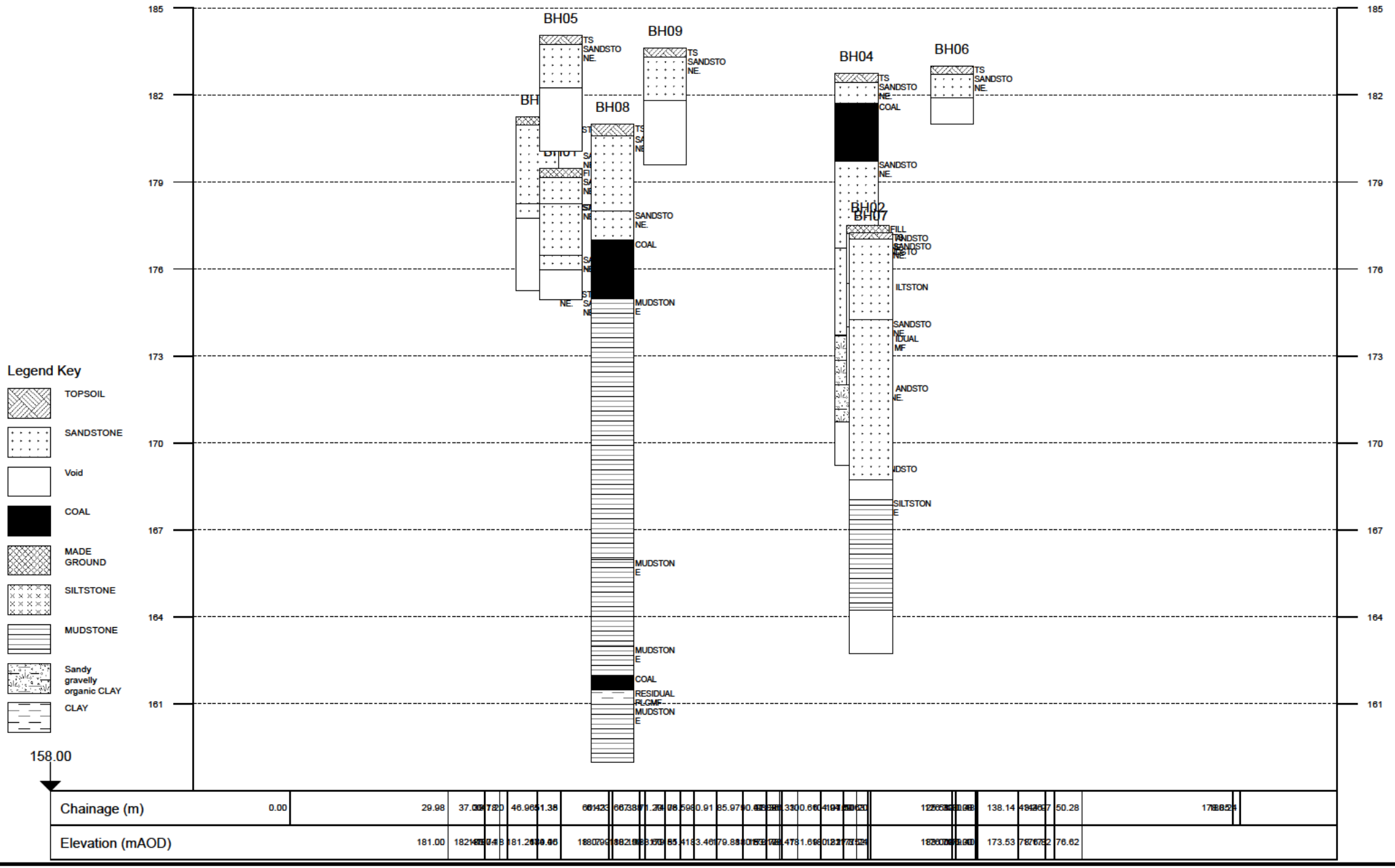
Chainage (m)	30.42	96.33	152.64
Elevation (mAOD)	180.99	179.55	173.53

Project Id: C2206/21/E/3401	Title: Section line 3
Project Title: Cliff Hill	Vertical Scale: 1:177
Location: Cumberworth Lane, Denby Dale, Huddersfield, , HD8 8RZ	Horizontal Scale: 1:701
Client: Urban Construction Interiors Ltd	Engineer: CM



Project Id: C2206/21/E/3401
Project Title: Cliff Hill
Location: Cumberworth Lane, Denby Dale, Huddersfield, , HD8 8RZ
Client: Urban Construction Interiors Ltd

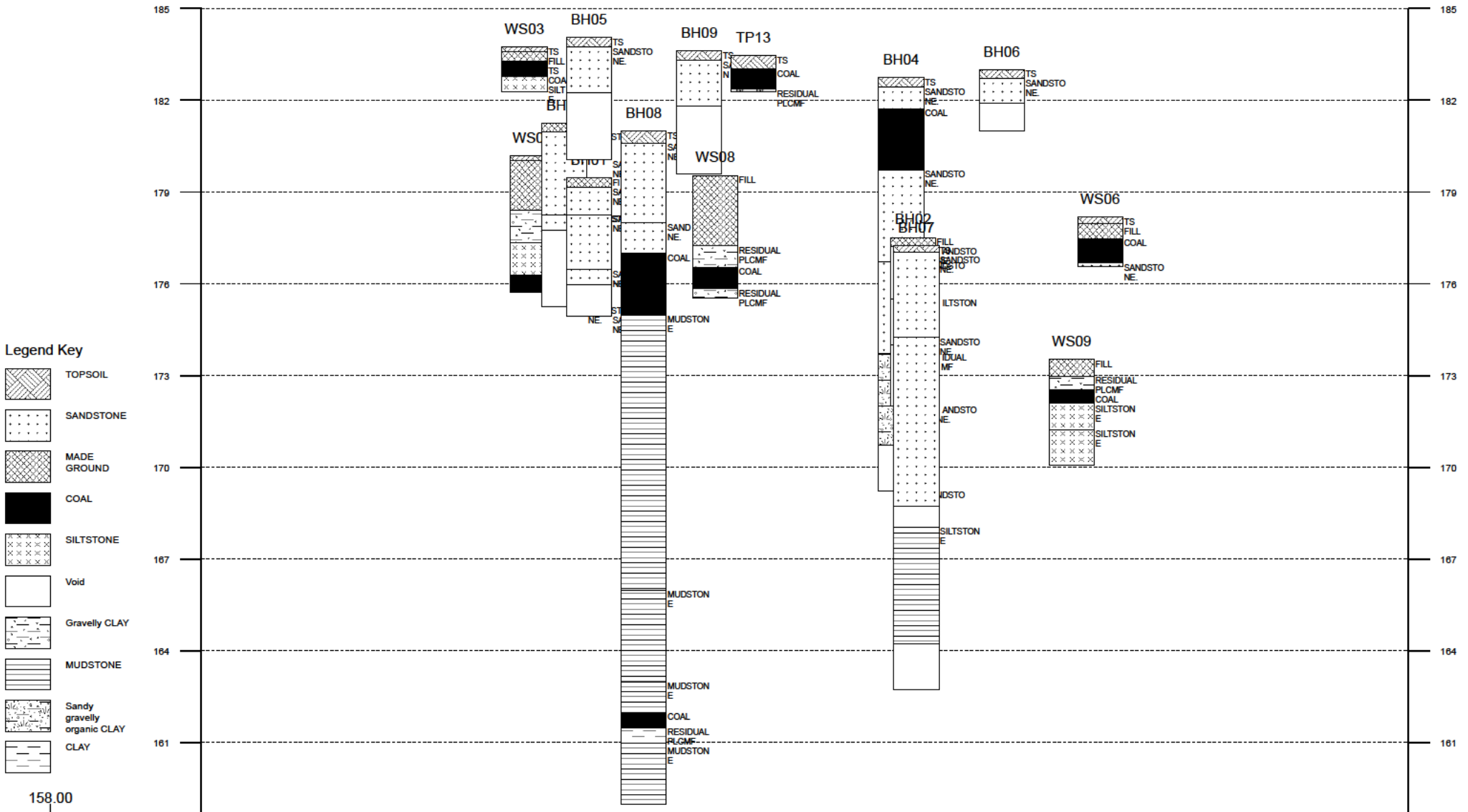
Title: Section line 1
Vertical Scale: 1:177
Horizontal Scale: 1:974
Engineer: CM



Chainage (m)	0.00	29.98	46.96	138.14	150.28
Elevation (mAOD)	181.00	181.26	173.53	176.62	

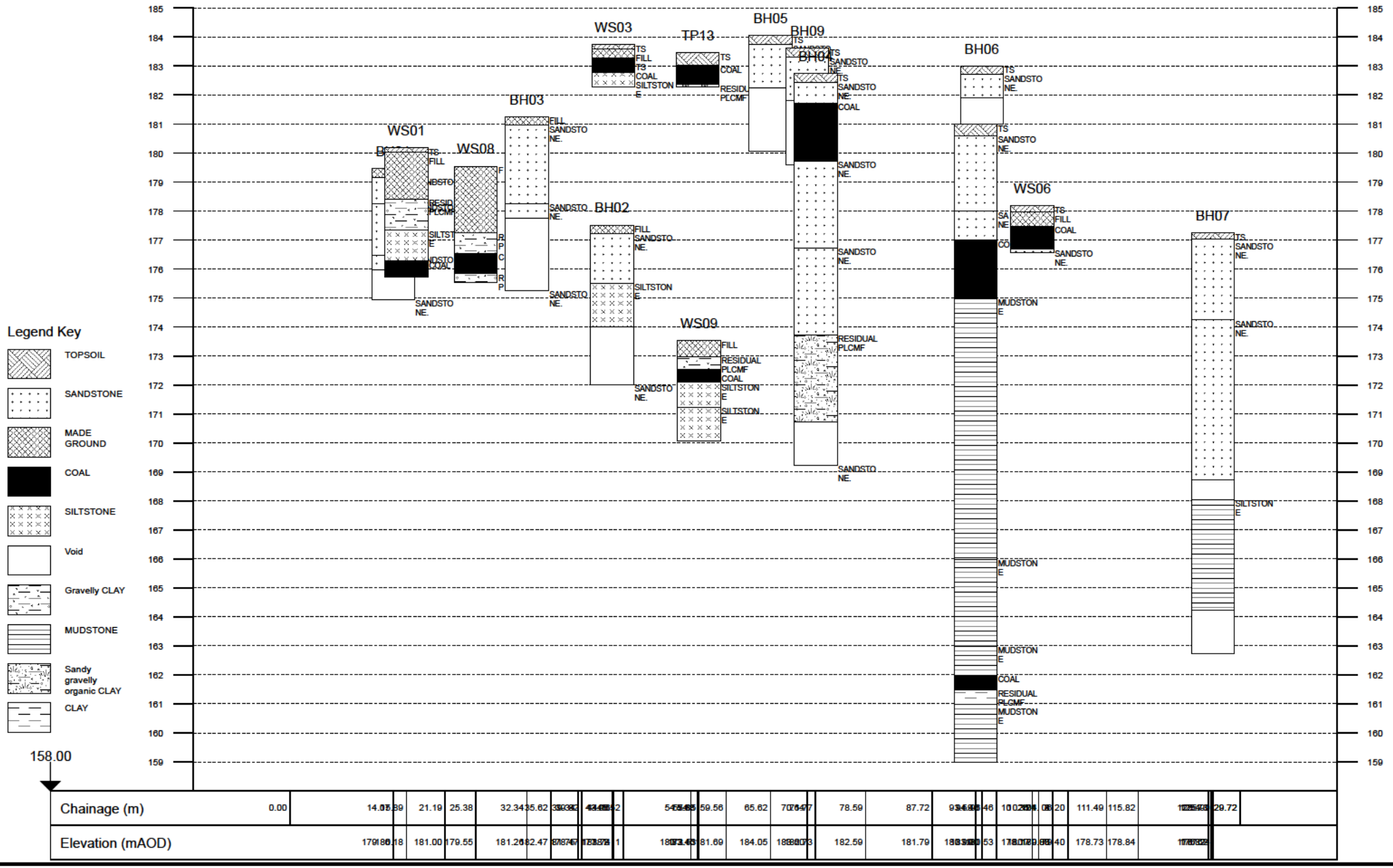
Project Id: C2206/21/E/3401
Project Title: Cliff Hill
Location: Cumberworth Lane, Denby Dale, Huddersfield, , HD8 8RZ
Client: Urban Construction Interiors Ltd

Title: Section line 1
Vertical Scale: 1:177
Horizontal Scale: 1:974
Engineer: CM

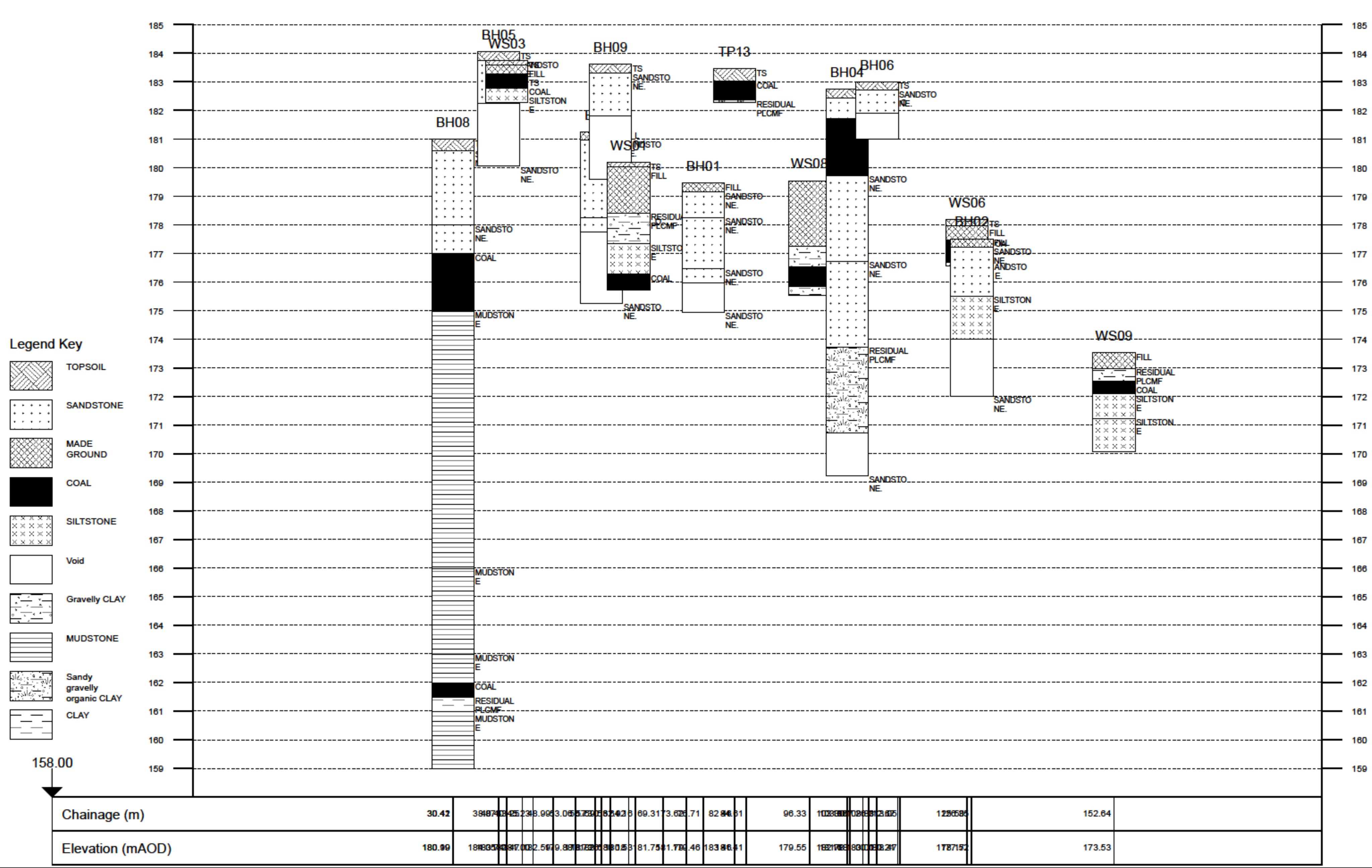


Chainage (m)	0.00	29.98	46.96	138.14	150.28
Elevation (mAOD)	181.00	181.26	173.53	176.62	

Project Id: C2206/21/E/3401	Title: Section line 3
Project Title: Cliff Hill	Vertical Scale: 1:177
Location: Cumberworth Lane, Denby Dale, Huddersfield, , HD8 8RZ	Horizontal Scale: 1:701
Client: Urban Construction Interiors Ltd	Engineer: CM



Project Id: C2206/21/E/3401	Title: Section line 2
Project Title: Cliff Hill	Vertical Scale: 1:177
Location: Cumberworth Lane, Denby Dale, Huddersfield, , HD8 8RZ	Horizontal Scale: 1:937
Client: Urban Construction Interiors Ltd	Engineer: CM



NOTES:
1. DO NOT SCALE FROM THIS D
2. ALL DIMENSIONS ARE M
3. ALL LEVELS ARE IN ME DATUM
4. THIS DRAWING IS TO BE RE ALL RELEVANT ARCHITECTS AI AND SPECIFICATIONS.

LEGEND

- MINE SHAFTS
- ADIT SEARCH
- SITE OUTLINE
- ADITS
- Shaft 015 trench
- Shaft 002 trench

FOR INFORMATION

CLIFF HILL DENBY DALE

DIAGRAM 422408-002

JOB NUMBER: C2206/21/e

DATE: 17.05.2022

REVISION: 01

NOTES:
1. DO NOT SCALE FF
2. ALL D MENSIONS
3. ALL LEVELS AF DATUM
4. THIS DRAWING IS ALL RELEVANT ARC AND SPECIFICATION

LEGEND

- Buffered
- 422408-002 buffer point
- MINE SHAFTS
- ADIT SEARCH
- SITE OUTLINE

FOR INFORMATION

CLIFF HILL DENBY DALE

DIAGRAM 422408-002 with buffer zone

JOB NUMBER: C2206/21/e

DATE: 17.05.2022

REVISION: 01

NOTES:
1. DO NOT SCALE FF
2. ALL D MENSIONS
3. ALL LEVELS AF DATUM
4. THIS DRAWING IS ALL RELEVANT ARC AND SPECIFICATION

LEGEND

- Buffered
- 422408-002 buffer point
- MINE SHAFTS
- ADIT SEARCH
- SITE OUTLINE

FOR INFORMATION

CLIFF HILL DENBY DALE

DIAGRAM 422408-002 with buffer zone and development plan.

JOB NUMBER: C2206/21/e

DATE: 17.05.2022

REVISION: 01

NOTES:
1. DO NOT SCALE FROM THIS D
2. ALL DIMENSIONS ARE M
3. ALL LEVELS ARE IN ME DATUM
4. THIS DRAWING IS TO BE RE ALL RELEVANT ARCHITECTS AI AND SPECIFICATIONS.

LEGEND

- MINE SHAFTS
- ADIT SEARCH
- SITE OUTLINE
- ADITS
- Shaft 015 trench
- Shaft 002 trench

FOR INFORMATION

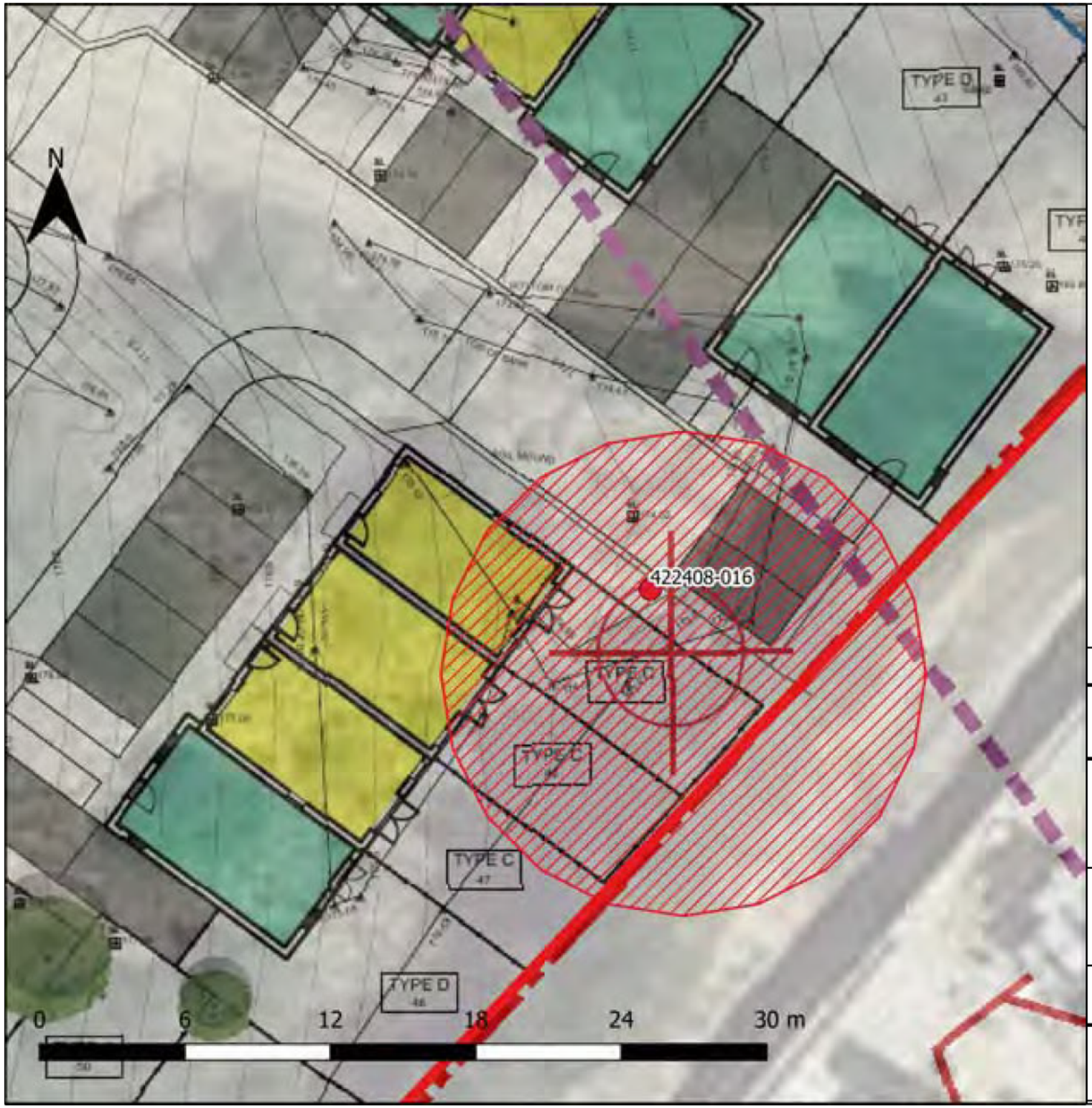
CLIFF HILL DENBY DALE

DIAGRAM 422408-002

JOB NUMBER: C2206/21/e

DATE: 17.05.2022

REVISION: 01



NOTES:
1. DO NOT SCALE FROM THIS DRAWI
2. ALL D MENSIONS ARE M
3. ALL LEVELS ARE IN METRES ABC DATUM
4. THIS DRAWING IS TO BE READ IN WITH ALL RELEVANT ARCHITECTS A DRAWINGS AND SPECIFICATIONS.

LEGEND

- Buffered
- MINE SHAFTS
- SITE OUTLINE
- ADITS

FOR INFORMATION

DRAWING NUMBER: 009

Shaft 016 over Proposed Plan

JOB NUMBER: C2206/21/E/3554

DATE: 21.01.2021

REVISION: 01

Appendix 12

Laboratory Testing

Rogers Geotechnical Services Ltd Telephone 0843 50 666 87 Fax 0843 51 599 30
Email enquiries@rogersgeotech.co.uk www.rogersgeotech.co.uk

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LABORATORY REPORT

job number C/2206/21/E/3401	client ref
site address Cliff Hill, Cumberworth Lane, Denby Dale, Huddersfield, , HD8 8RZ	client address Urban Group (York) Ltd Hull Road, Dunnington, York North Yorkshire YO19 5LP
consultant	
date scheduled 07/04/2022	date issued 06/05/2022
issued by H J Letch	job title Technical Manager
checked by T Merry	

Rogers Geotechnical Services Ltd **Telephone** **01484 607 977**
Email **enquiries@rogersgeotech.co.uk** **www.rogersgeotech.co.uk**
Unit 4, Barncliffe Business Park, Near Bank, Shelley, Huddersfield, West Yorkshire HD8 8LU.

GEOTECHNICAL ENVIRONMENTAL

8948

Environmental Geotechnical Specialists

RGS

Schedule of UKAS Accredited Laboratory Tests

1. CLASSIFICATION OF SOIL	BS 1377-2:1990	BS EN ISO 17892	Accredited (A)	Unaccredited (U)
1.1 Moisture / Water content determination				
i. Oven drying	Pt 2 : 3.2	Pt 1 : 2014	A	
ii. Saturation m/c of chalk	Pt 2 : 3.3			U
1.2 Index Properties				
i. Liquid limit – cone penetrometer	Pt 2 : 4.3	Pt 12 : 2018 : 5.3 / 5.5	A	
ii. Plastic limit	Pt 2 : 5.3		A	
iii. Shrinkage limit	Pt 2 : 6.3			U
iv. Linear shrinkage	Pt 2 : 6.5		A	
1.3 Particle Density				
i. Gas jar	Pt 2 : 8.2			U
ii. Large pyknometer	Pt 2 : 8.3			U
iii. Small pyknometer	Pt 2 : 8.4	Pt 3 : 2015 : 5.1		U
1.4 Density Tests				
i. Linear measurement	Pt 2 : 7.2	Pt 2 : 2014 : 5.1	A	
ii. Immersion in water	Pt 2 : 7.3	Pt 2 : 2014 : 5.2		U
iii. Fluid / Water displacement	Pt 2 : 7.4	Pt 2 : 2014 : 5.3		U
iv. Sand replacement	Pt 9 : 2.1, 2 2			U
v. Core cutter	Pt 9 : 2.4			U
1.5 Particle Size Distribution				
i. Dry Sieve	Pt 2 : 9.2	Pt 4 : 2016 : 5.2	A	
ii. Wet Sieve	Pt 2 : 9.3	Pt 4 : 2016 : 5.2	A	
iii. Sedimentation by pipette	Pt 2 : 9.4	Pt 4 : 2016 : 5.3 / 5.4	A	
iv. Sedimentation by hydrometer	Pt 2 : 9.5			U
2. CHEMICAL TESTS	**BS 1377-3:2018**			
ii. Mass loss on ignition	Pt 3 : 4			U
3. COMPACTION RELATED TESTS	**BS 1377-4:1990**			
3.1 Dry density/moisture relationship				
i. 2.5kg rammer – 1 litre mould	Pt 4 : 3			U
- CBR mould	Pt 4 : 3			U
ii. 4.5kg rammer – 1 litre mould	Pt 4 : 3			U
- CBR mould	Pt 4 : 3			U
3.2 Moisture Condition Value				
i. Single point test	Pt 4 : 5.4			U
ii. MCV/moisture content relationship	Pt 4 : 5.5			U
3.3 California Bearing Ratio				
i. Undisturbed sample	Pt 5 : 7			U
ii. Recompacted sample	Pt 5 : 7			U
iii. Soaked, inc measurement of swell	Pt 5 : 7			U
4. COMPRESSIBILITY OF SOIL	**BS 1377-5:1990**			
i. One dimensional consolidation	Pt 5 : 3			U
ii. Swelling pressure test	Pt 5 : 3			U
5. SHEAR STRENGTH OF SOIL	**BS 1377-7:1990**			
i. Hand shear vane	Makers instructions			U
ii. Shear box (100mm square sample)	BS 1377 : Pt 7 : 4			U
iii. Triaxial – quick undrained	BS 1377 : Pt 7 : 8, 9			U
6. PERMEABILITY				
i. Falling head	K. H. Head Vol 2			U
ii. Constant head	BS 1377 : Pt 6 : 6			U
iii Triaxial cell	BS 1377 : Pt 6 : 6			U
7. ROCK TESTS				
7.1 Classification Tests				
i. Natural moisture content	-			U
ii. Saturated moisture content	-			U
iii. Natural density	-			U
iv. Porosity	-			U
7.2 Strength Tests				
i. Point load index	ISRM '85			U
ii. Uniaxial compression test	ISRM '81			U

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GEOTECHNICAL LAB RESULTS

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Disclaimer

The results reported herein relate only to the material supplied to the laboratory.

Summary of Classification Test Results

Project No.	Project Name
C2206/21/E/3401	Cliff Hill

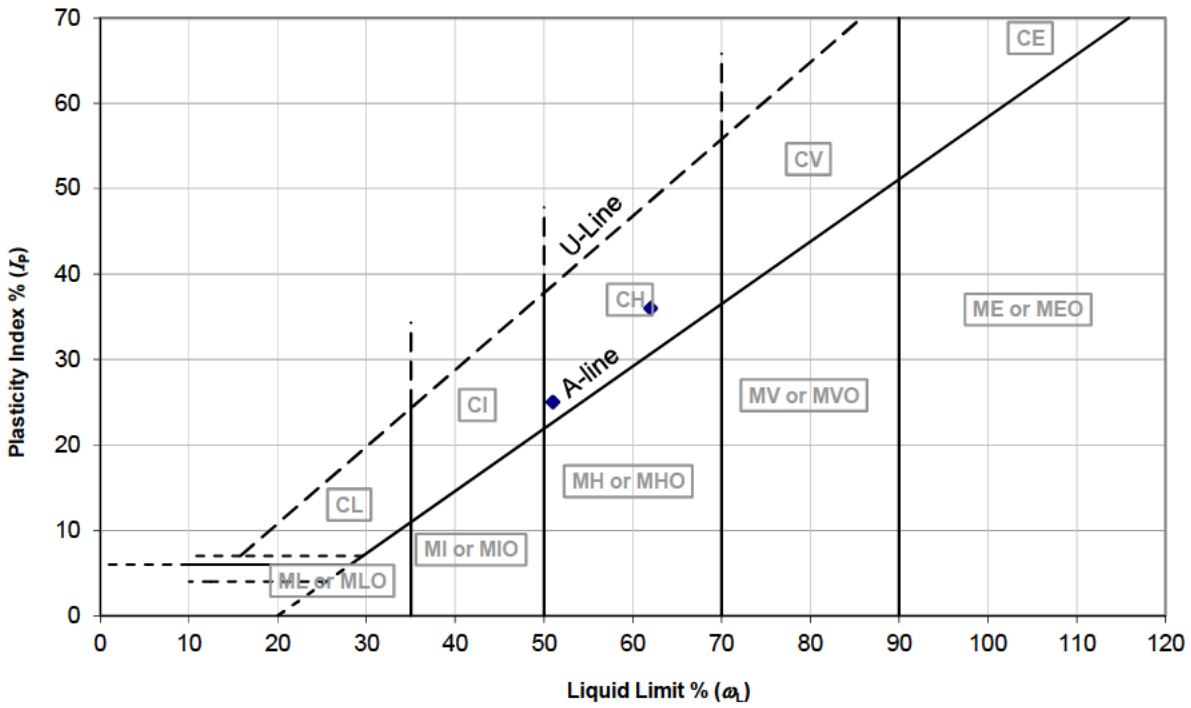
Hole No.	Sample				Soil Description	Density bulk	Density dry	w	Passing 425µm	LL	PL	PI	Particle density	Cone 80g/30° 60g/60°	Water Increase Decrease	Date
	Ref	Top	Base	Type		Mg/m3		%	%	%	%	%	Mg/m3			
WS01	1	0.40		D	Cohesive FILL			24.0	68	51 -1pt	26	25		80g/30deg	increacing	11-Apr
WS05	2	0.50	1 00	D	SANDSTONE (Recovered as sandy sub angular to tabular GRAVEL)			17.0								11-Apr
WS08	2	2.50		C	Stiff orange mottled grey silty CLAY			26.0	96	62 -1pt	26	36		80g/30deg	increacing	11-Apr

All tests performed in accordance with BS EN ISO 17892 unless specified otherwise

Key			Date Printed	Approved By	Table
Density test	Liquid Limit	Particle density			1
Linear measurement unless :	4pt cone unless :	sp - small pyknometer	05/06/2022		
wd - water displacement	cas - Casagrande method	gj - gas jar			sheet
wi - immersion in water	1pt - single point test			Harry	1

Rogers Geotechnical Services Ltd. Offices 1&2, Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU	**Classification of Index Properties**	**C2206/21/E/3401**
Project Name: Cliff Hill	**BS EN ISO: 17892: Parts 1, 12**	Fig. 2 Sheet. 1
Location:		Input By: Harry
Client: Urban Construction Interiors Ltd		Check By: Harry

Location	Depth (m)	Moisture Content (w) (%)	Liquid Limit (wL) (%)	Plastic Limit (wP) (%)	Plasticity Index (IP) (%)	Retained by 0.425mm (%)	Modified (w) (w') (%)	Modified (IP) (IP') (%)	Liquidity/ Consistency (IL) (%)	Liquidity/ Consistency (IC) (%)	Casagrande Class	N.H.B.C Class (%)
WS01	0.40	23.7	51	26	25	32	35	17	-0.1	1.1	C H	LOW
WS08	2.50	26.4	62	26	36	4	28	35	0.0	1.0	C H	MEDIUM



Density Tests - Summary of Results

Project No.	Project Name
C2206/21/E/3401	Cliff Hill

Hole No.	Sample				Soil Description	Linear Measurement			Immersion in water			Water displacement			Remarks
	Ref	Top	Base	Type		Bulk density Mg/m3	Dry density Mg/m3	w %	Bulk density Mg/m3	Dry density Mg/m3	w %	Bulk density Mg/m3	Dry density Mg/m3	w %	
WS01	2	0.70	1 00	C	Cohesive FILL	1 97	1 61	22.6							
WS08	1	0.70	1 00	C	Cohesive FILL	1 60	1 25	28.0							

Legend w moisture content of the density test specimen

Notes			Date Printed	Approved By	Table
Tests carried out in accordance with BS1377:Part2:1990 and the following clauses unless annotated otherwise	Linear measurement	clause 7.2	05/06/2022	Harry	3
	Immersion in water	clause 7.3			sheet 1
	Water displacement	clause 7.4			

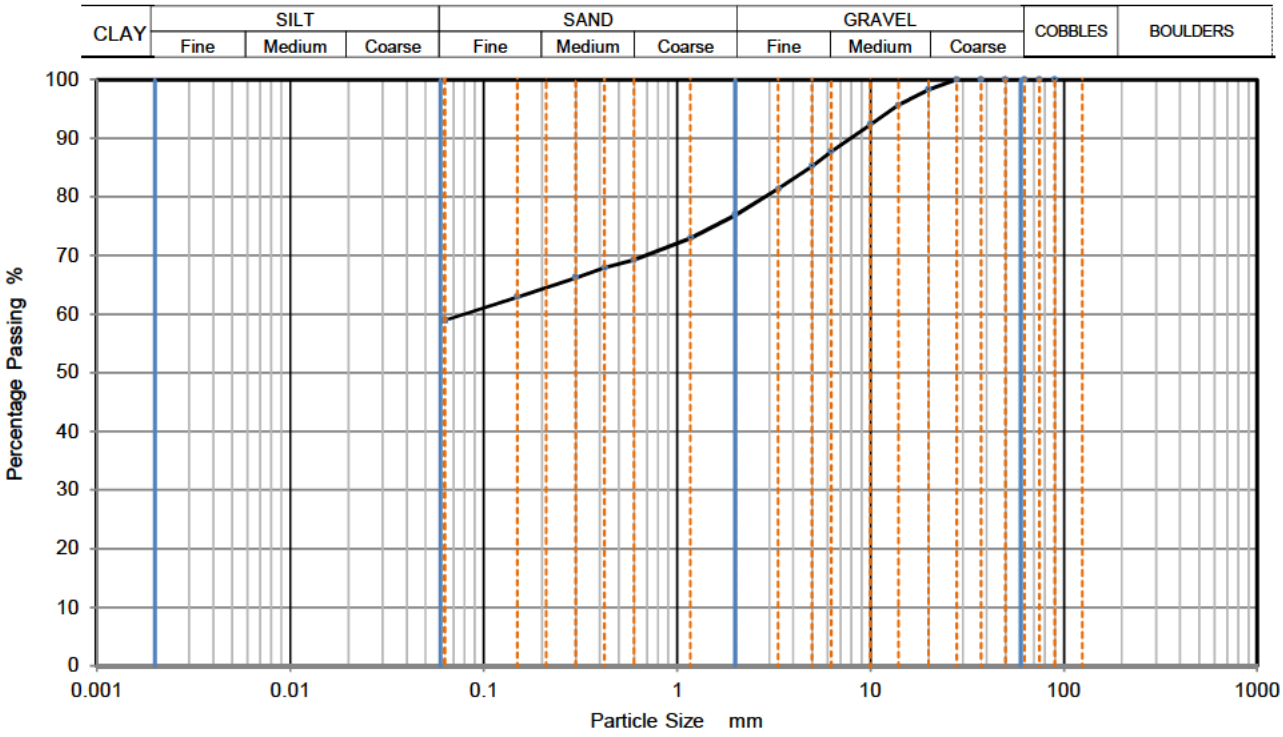
Particle Density Tests - Summary of Results

Project No.	Project Name
C2206/21/E/3401	Cliff Hill

Hole No.	Sample				Soil Description at test horizon	Particle Density Mg/m3	Remarks
	Ref	Top	Base	Type			
WS02	2	0.40	1.00	D	Cohesive FILL	2.59	
WS05	2	0.50	1.00	D	SANDSTONE (Recovered as sandy sub angular to tabular GRAVEL)	2.58	

Notes	Date Printed	Approved By	Table
Tests performed in accordance with BS 1377 unless annotated otherwise Small Pyknometer tests to BS1377: Part 2 : 1990, clause 8.3	05/06/2022		4 sheet 1

	PARTICLE SIZE DISTRIBUTION			Job Ref	**C2206/21/E/3401**
				Borehole/Pit No.	WS01
Site Name	Cliff Hill			Sample No.	3
Soil Description	Cohesive FILL			Depth, m	0.50
Specimen Reference	3	Specimen Depth	0.5 m	Sample Type	D
Test Method	ISO 17892 -4, by sieving on pre-dried or dry sample			KeyLAB ID	RGS_202204112



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	98		
14	96		
10	92		
6.3	88		
5	85		
3.35	81		
2	77		
1.18	73		
0.6	69		
0.425	68		
0.3	66		
0.15	63		
0.063	59		

Dry Mass of sample, g: 1373

Sample Proportions	% dry mass
Very coarse	0
Gravel	23
Sand	18
Fines <0.063mm	59

Grading Analysis		
D100	mm	28
D60	mm	0.08
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

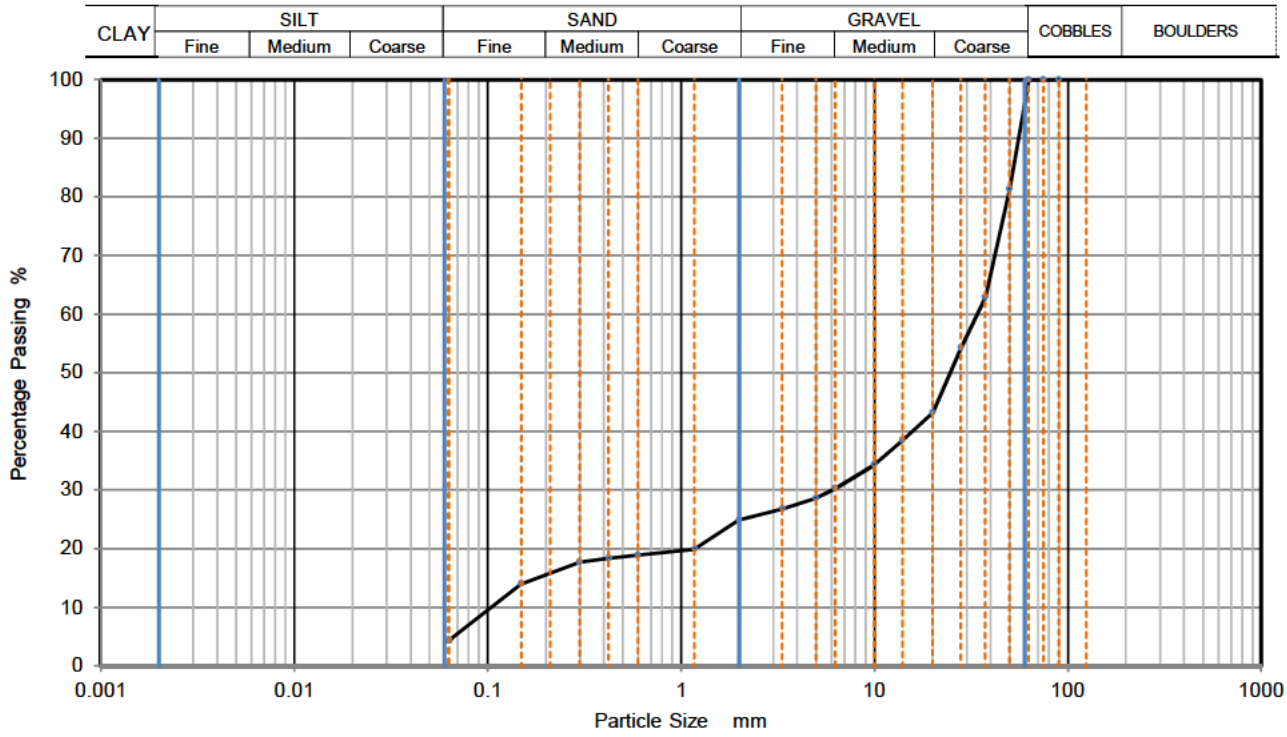
Remarks

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

Test performance date: 11/04/2022

Operator	Checked	Approved	Sheet printed	Fig 5
Mark Tuck	Harry	Harry	06/05/2022	Sheet 1

	PARTICLE SIZE DISTRIBUTION				Job Ref	C2206/21/E/3401
					Borehole/Pit No.	WS04
Site Name	Cliff Hill				Sample No.	2
Soil Description	SANDSTONE (Recovered as sandy sub angular to tabular GRAVEL)				Depth, m	0.50
Specimen Reference	2	Specimen Depth	0.5	m	Sample Type	D
Test Method	ISO 17892 -4, by sieving on pre-dried or dry sample				KeyLAB ID	RGS_202204114



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
	100		
90	100		
75	100		
63	100		
50	81		
37.5	63		
28	54		
20	43		
14	39		
10	34		
6.3	30		
5	29		
3.35	27		
2	25		
1.18	20		
0.6	19		
0.425	18		
0.3	18		
0.15	14		
0.063	4		

Dry Mass of sample, g	2623

Sample Proportions	% dry mass
Very coarse	0
Gravel	75
Sand	21
Fines <0.063mm	4

Grading Analysis		
D100	mm	63
D60	mm	34.1
D30	mm	6.04
D10	mm	0.105
Uniformity Coefficient		330
Curvature Coefficient		10

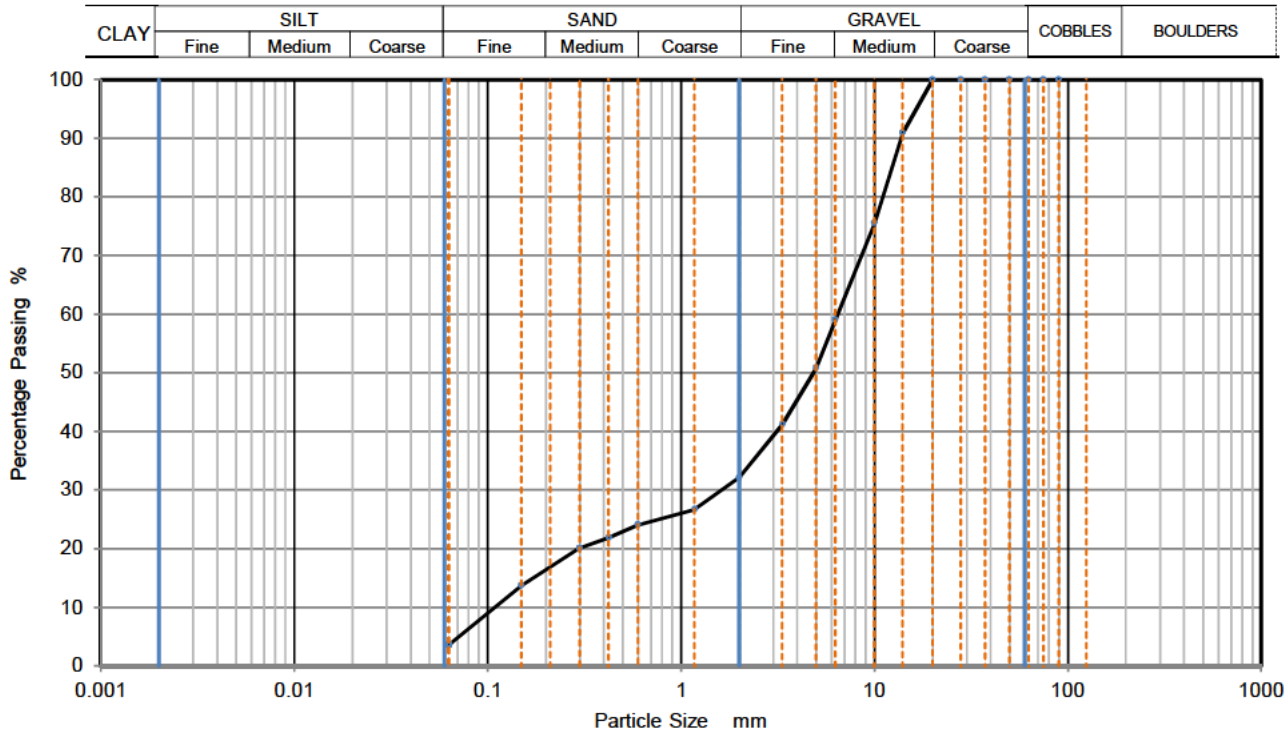
Remarks

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

Test performance date: 11/04/2022

Operator	Checked	Approved	Sheet printed	Fig 5
Mark	Harry	Harry	06/05/2022	Sheet 2

	PARTICLE SIZE DISTRIBUTION				Job Ref	C2206/21/E/3401
					Borehole/Pit No.	WS05
Site Name	Cliff Hill				Sample No.	2
Soil Description	SANDSTONE (Recovered as sandy sub angular to tabular GRAVEL)				Depth, m	0.50
Specimen Reference	2	Specimen Depth	0.5	m	Sample Type	D
Test Method	ISO 17892 -4, by sieving on pre-dried or dry sample				KeyLAB ID	RGS_202204115



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	91		
10	76		
6.3	59		
5	51		
3.35	41		
2	32		
1.18	27		
0.6	24		
0.425	22		
0.3	20		
0.15	14		
0.063	4		

Dry Mass of sample, g	1278

Sample Proportions	% dry mass
Very coarse	0
Gravel	67
Sand	29
Fines <0.063mm	4

Grading Analysis		
D100	mm	20
D60	mm	6.48
D30	mm	1.62
D10	mm	0.109
Uniformity Coefficient		59
Curvature Coefficient		3.7

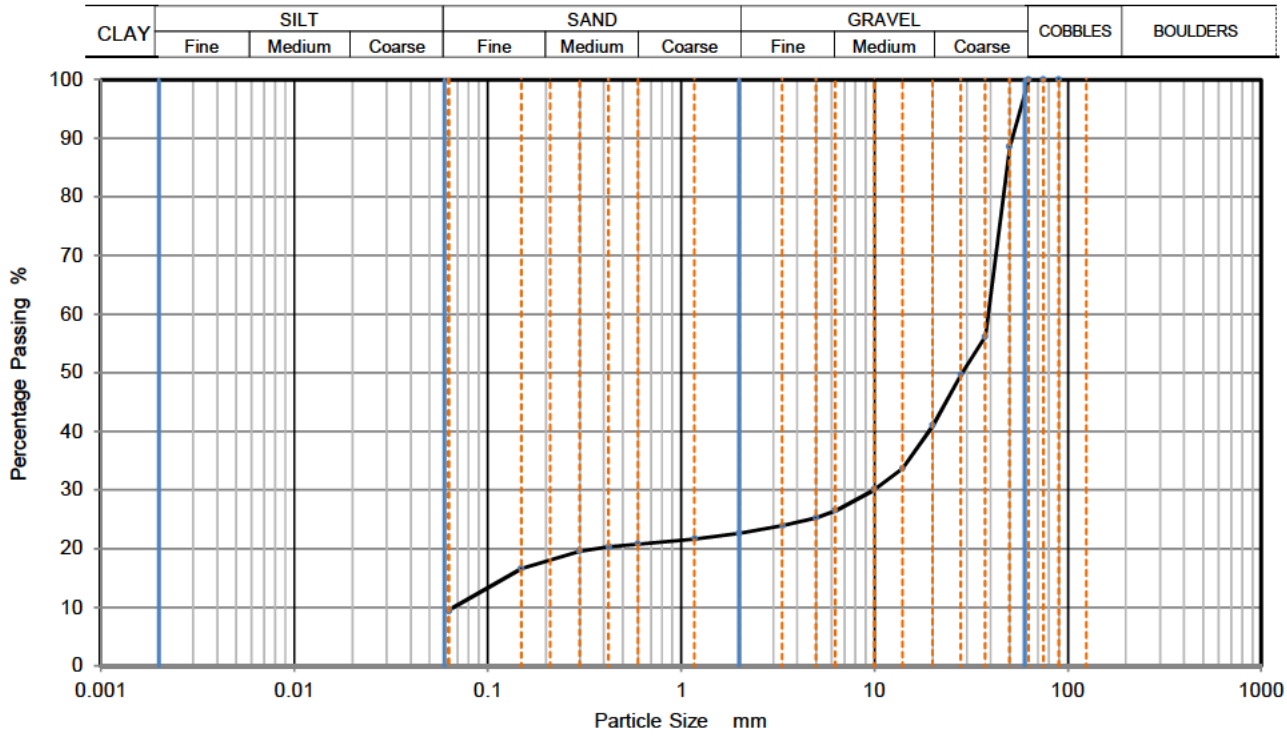
Remarks

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

Test performance date: 11/04/2022

Operator	Checked	Approved	Sheet printed	Fig 5
Mark Tuck	Harry	Harry	06/05/2022	Sheet 3

	PARTICLE SIZE DISTRIBUTION				Job Ref	C2206/21/E/3401
					Borehole/Pit No.	WS10
Site Name	Cliff Hill				Sample No.	1
Soil Description	SANDSTONE (Recovered as sandy sub angular to tabular GRAVEL)				Depth, m	0.50
Specimen Reference	1	Specimen Depth	0.5	m	Sample Type	D
Test Method	ISO 17892 -4, by sieving on pre-dried or dry sample				KeyLAB ID	RGS_202204119



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
	100		
90	100		
75	100		
63	100		
50	89		
37.5	56		
28	50		
20	41		
14	34		
10	30		
6.3	27		
5	25		
3.35	24		
2	23		
1.18	22		
0.6	21		
0.425	20		
0.3	20		
0.15	17		
0.063	10		

Dry Mass of sample, g	2826

Sample Proportions	% dry mass
Very coarse	0
Gravel	77
Sand	13
Fines <0.063mm	10

Grading Analysis		
D100	mm	63
D60	mm	38.8
D30	mm	9.91
D10	mm	0.0666
Uniformity Coefficient		580
Curvature Coefficient		38

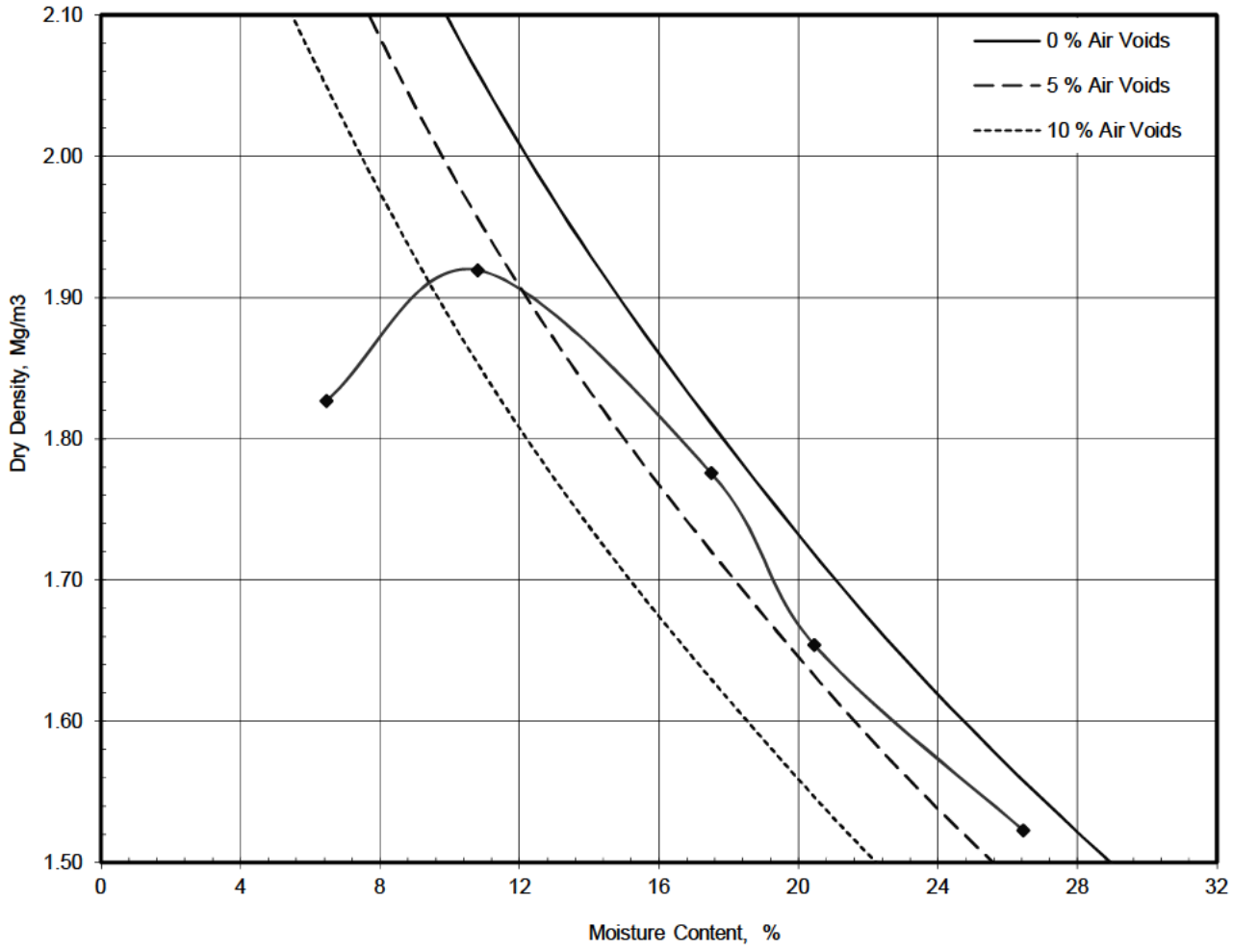
Remarks

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

Test performance date: 11/04/2022

Operator	Checked	Approved	Sheet printed	Fig 5
Mark Tuck	Harry	Harry	06/05/2022	Sheet 4

	Dry Density / Moisture Content Relationship **Heavy Compaction**			Job Ref	**C2206/21/E/3401**
				Borehole / Pit No	WS02
Site Name	**Cliff Hill**			Sample No	2
Soil Description	Cohesive FILL			Depth	0.40 m
Specimen Ref.	5	Specimen Depth	m	Sample Type	D
Test Method	BS1377:Part 4:1990, clause 3.6, 4.5kg rammer			Keylab ID	RGS_202204113
				Compaction Test Reference/No.	1

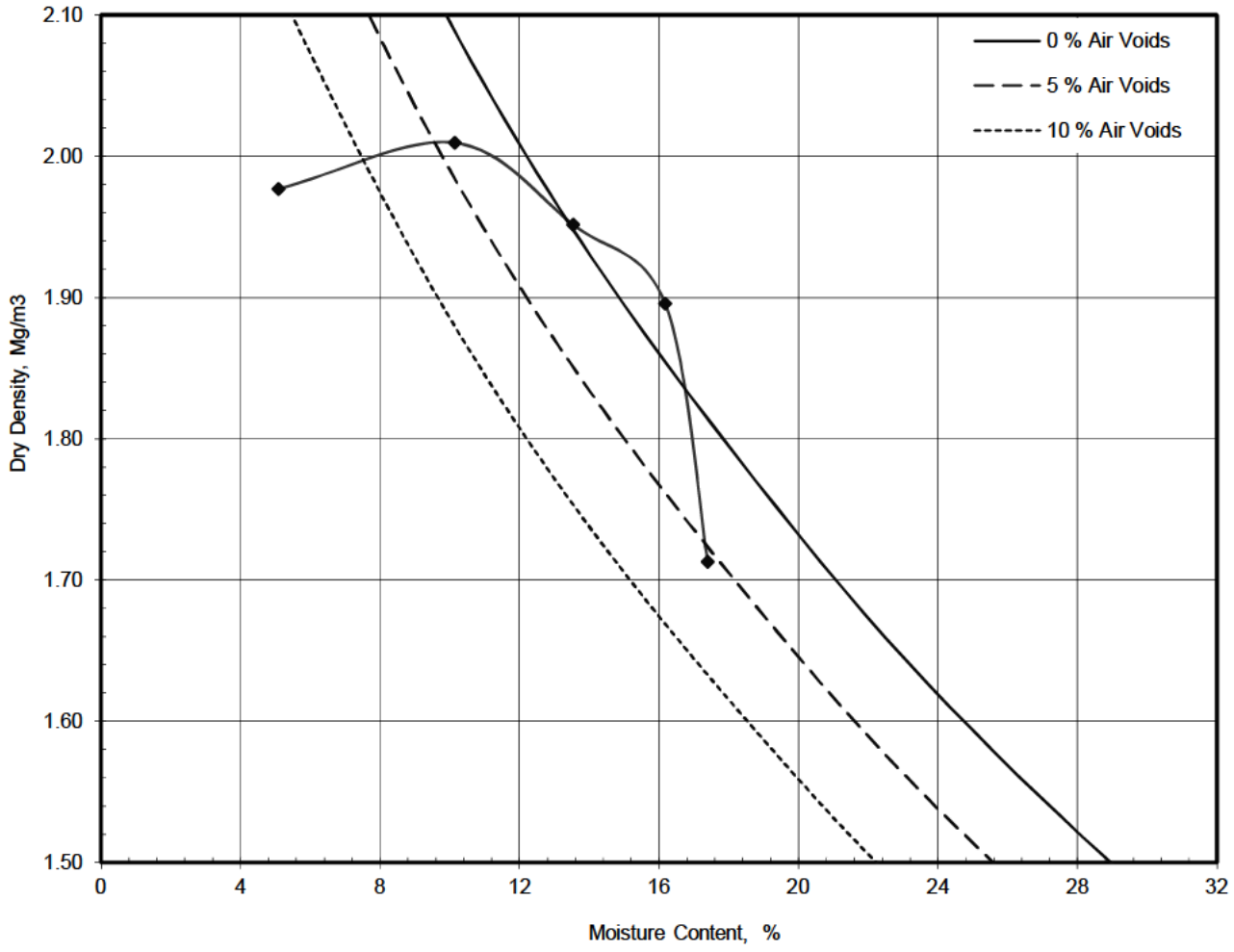


Preparation		Material used was natural
Mould Type		CBR
Samples Used		
Material Retained on 37.5 mm Sieve	%	0
Material Retained on 20.0 mm Sieve	%	6
Particle Density - Assumed	Mg/m³	2.65

Maximum Dry Density	Mg/m³	**1.92**
Optimum Moisture Content	%	**10**

Operator	Checked	Approved	Remarks	
Tobias	Harry	Harry		**Fig 6** Sheet 1 of 1

	Dry Density / Moisture Content Relationship Heavy Compaction			Job Ref	C2206/21/E/3401
				Borehole / Pit No	WS05
Site Name	Cliff Hill			Sample No	2
Soil Description	SANDSTONE (Recovered as sandy sub angular to tabular GRAVEL)			Depth	0.50 m
Specimen Ref.	7	Specimen Depth	m	Sample Type	D
Test Method	BS1377:Part 4:1990, clause 3.6, 4.5kg rammer			Keylab ID	RGS_202204115
				Compaction Test Reference/No.	2



Preparation		Material used was natural
Mould Type		CBR
Samples Used		Single sample tested
Material Retained on 37.5 mm Sieve	%	0
Material Retained on 20.0 mm Sieve	%	0
Particle Density - Assumed	Mg/m³	2.65

Maximum Dry Density	Mg/m³	**2.01**
Optimum Moisture Content	%	**9.8**

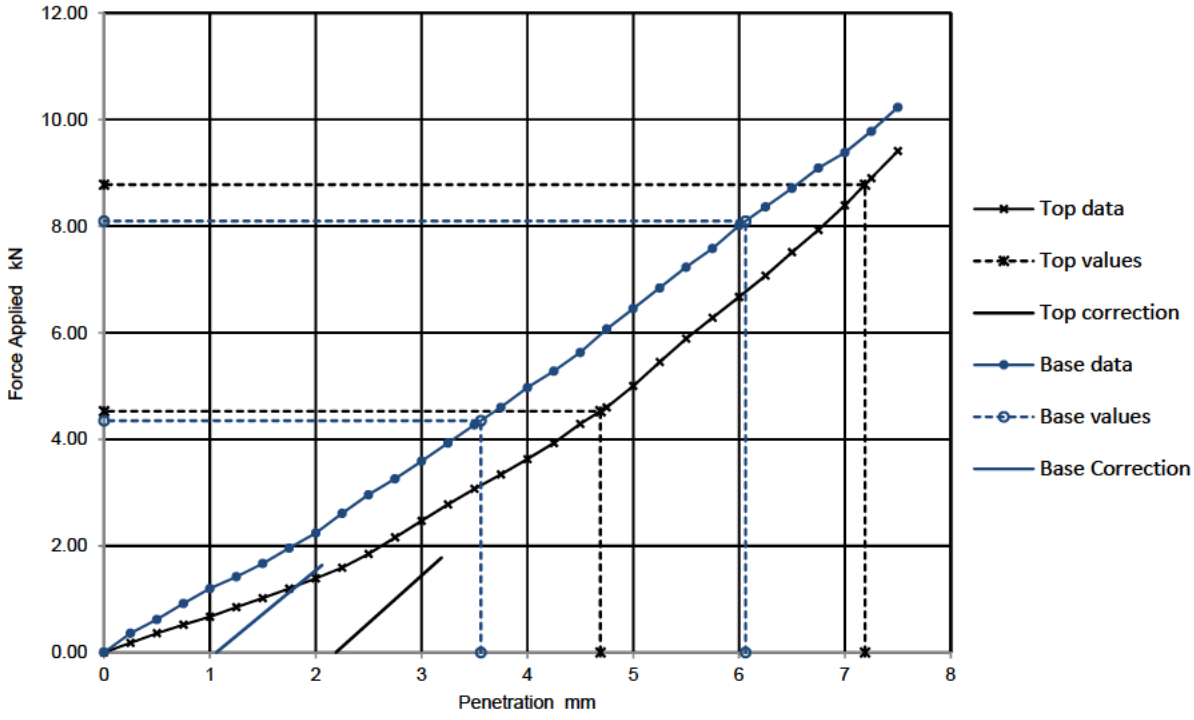
Operator	Checked	Approved	Remarks	
Tobias	Harry	Harry		**Fig 6** Sheet 1 of 1

	California Bearing Ratio (CBR)				Job Ref	C2206/21/E/3401
					Borehole/Pit No.	WS05
Site Name	Cliff Hill				Sample No.	2
Soil Description	SANDSTONE (Recovered as sandy sub angular to tabular GRAVEL)				Depth m	0.50
Specimen Reference	D2	Specimen Depth	0.50	m	Sample Type	D
Specimen Description	SANDSTONE (Recovered as sandy sub angular to tabular GRAVEL)				KeyLAB ID	RGS_202204115
Test Method	BS1377 : Part 4 : 1990, clause 7				CBR Test Number	1

Specimen Preparation

Condition	REMOULDED			Soaking details	Not soaked	
Details	Recompacted with specified standard effort using 4.5kg rammer			Period of soaking		days
				Time to surface		days
				Amount of swell recorded		mm
Material retained on 20mm sieve removed		0	%	Dry density after soaking		Mg/m3
Initial Specimen details	Bulk density	2.21	Mg/m3	Surcharge applied	8	kg
	Dry density	2.02	Mg/m3		5	kPa
	Moisture content	9.2	%			

Force v Penetration Plots



Results

	Curve correction applied	CBR Values, %				Moisture Content %
		2.5mm	5mm	Highest	Average	
TOP	Yes	34.0	44.0	44.0	42.0	12.3
BASE	Yes	33.0	40.0	40.0		10.3

General remarks	Test specific remarks	Approved
		Harry

Fig No.	7
Sheet No	2

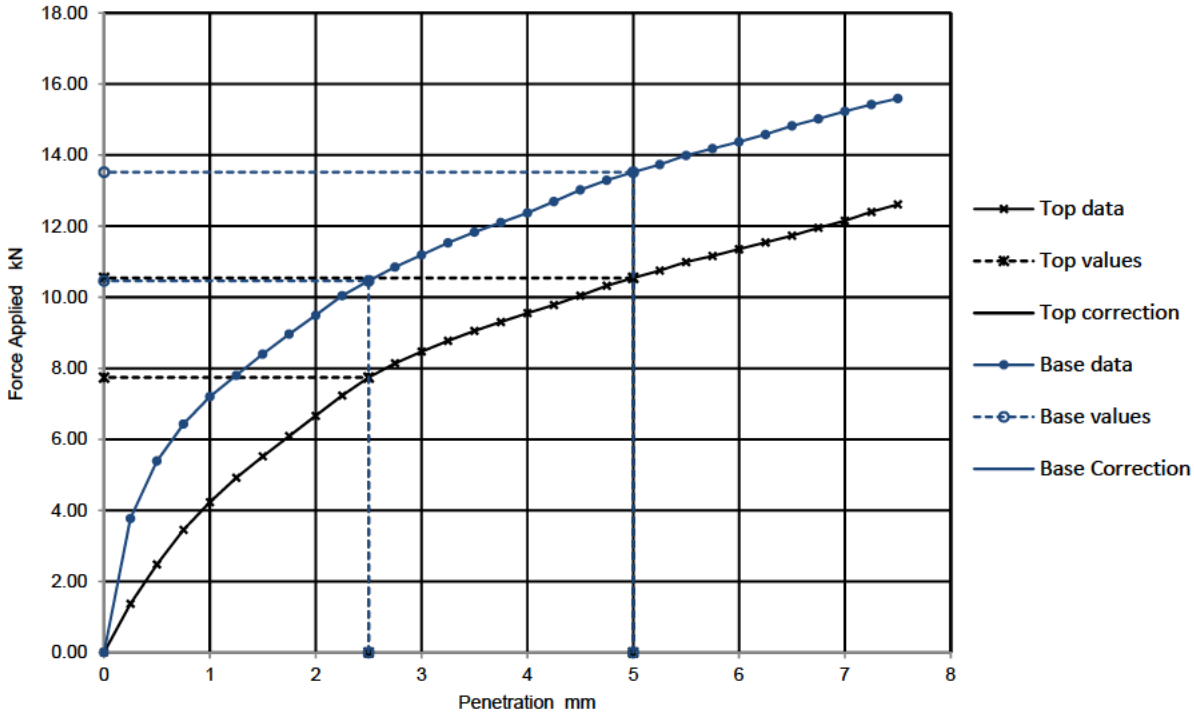
Lab Sheet Reference :

	California Bearing Ratio (CBR)				Job Ref	C2206/21/E/3401
					Borehole/Pit No.	WS02
Site Name	Cliff Hill				Sample No.	2
Soil Description	Cohesive FILL				Depth m	0.40
Specimen Reference	D2	Specimen Depth	0.40	m	Sample Type	D
Specimen Description	Cohesive FILL (Light brown gravelly CLAY)				KeyLAB ID	RGS_202204113
Test Method	BS1377 : Part 4 : 1990, clause 7				CBR Test Number	1

Specimen Preparation

Condition	REMOULDED			Soaking details	Not soaked
Details	Recompacted with specified standard effort using 4.5kg rammer			Period of soaking	days
				Time to surface	days
				Amount of swell recorded	mm
Material retained on 20mm sieve removed		6	%	Dry density after soaking	Mg/m3
Initial Specimen details	Bulk density	2.11	Mg/m3	Surcharge applied	2 kg
	Dry density	1.88	Mg/m3		1 kPa
	Moisture content	12.2	%		

Force v Penetration Plots



Results

	Curve correction applied	CBR Values, %				Moisture Content %
		2.5mm	5mm	Highest	Average	
TOP	No	59.0	53.0	59.0		11.2
BASE	No	79.0	68.0	79.0		11.0

General remarks	Test specific remarks	Approved
		Harry

Fig No.	7
Sheet No	1

Lab Sheet Reference :

DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES

Tested in accordance with BS 1377:1990:Part 5:Clause 3

TEST REPORT

Project location	*Cliff Hill*		
Project reference	*C2206/21/E/3401*	Sample depth (m)	*0.7-1.0*
Borehole number	*WS09*	Sample type	*Undisturbed*
Sample number	*C2*	Specimen orientation	*Vertical*
		Specimen depth (m)	*0.92*
Sample description	*Firm/stiff orangish brown silty CLAY.*		
Preparation method	*Prepared from a sample tube in accordance with BS 1377:2016:Part 1:Clause 9.6*		
Particle density (Mg/m³)	*2.65 (Assumed)*	Swelling pressure (kPa)	

INITIAL CONDITIONS	
Height (mm)	*20*
Diameter (mm)	*50.47*
Moisture content (trimmings) (%)	*25*
Bulk density (Mg/m³)	*1.93*
Dry density (Mg/m³)	*1.55*
Voids ratio	*0.713*
Degree of saturation (%)	*92*

Comments / variations from procedures:

Tested	*TM*	Checked	*HJL*	Approved	*HJL*
Date	*11/04/2022*	Date	*11/04/2022*	Date	*05/05/2022*

DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES

Tested in accordance with BS 1377:1990:Part 5:Clause 3

TEST REPORT

Project location	*Cliff Hill*		
Project reference	*C2206/21/E/3401*	Sample depth (m)	*0.7-1.0*
Borehole number	*WS09*	Sample type	*Undisturbed*
Sample number	*C2*	Specimen orientation	*Vertical*

Average laboratory temperature (°C)	*20*	Method of time fitting	*Log time*

Pressure stage (kPa)	Coefficient of consolidation c_v (m^2/year)	Coefficient of volume compressibility m_v (m^2/MN)	Coefficient of secondary compression c_{sec} (-)
0 - 17	*#N/A*	*#NUM!*	-
17 - 34	*19*	*0.076*	-
34 - 68	*2.4*	*0.19*	-
68 - 136	*3.1*	*0.17*	-
136 - 272	*2.1*	*0.13*	-
272 - 34	-	-	-

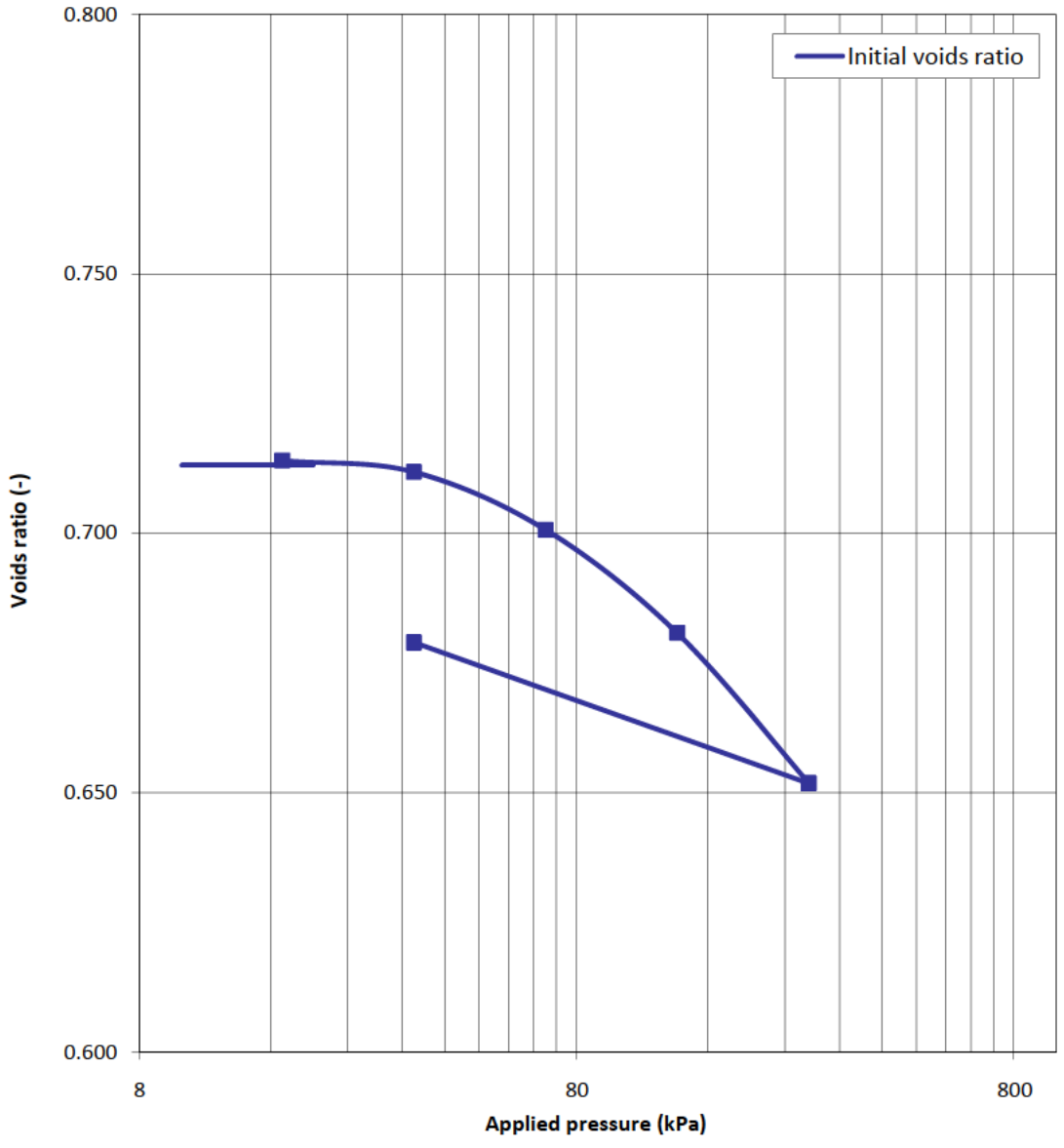
Tested	*TM*	Checked	*HJL*	Approved	*HJL*
Date	*11/04/2022*	Date	*11/04/2022*	Date	*05/05/2022*

DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES

Tested in accordance with BS 1377:1990:Part 5:Clause 3

TEST REPORT

Project location	*Cliff Hill*		
Project reference	*C2206/21/E/3401*	Sample depth (m)	*0.7-1.0*
Borehole number	*WS09*	Sample type	*Undisturbed*
Sample number	*C2*	Specimen orientation	*Vertical*



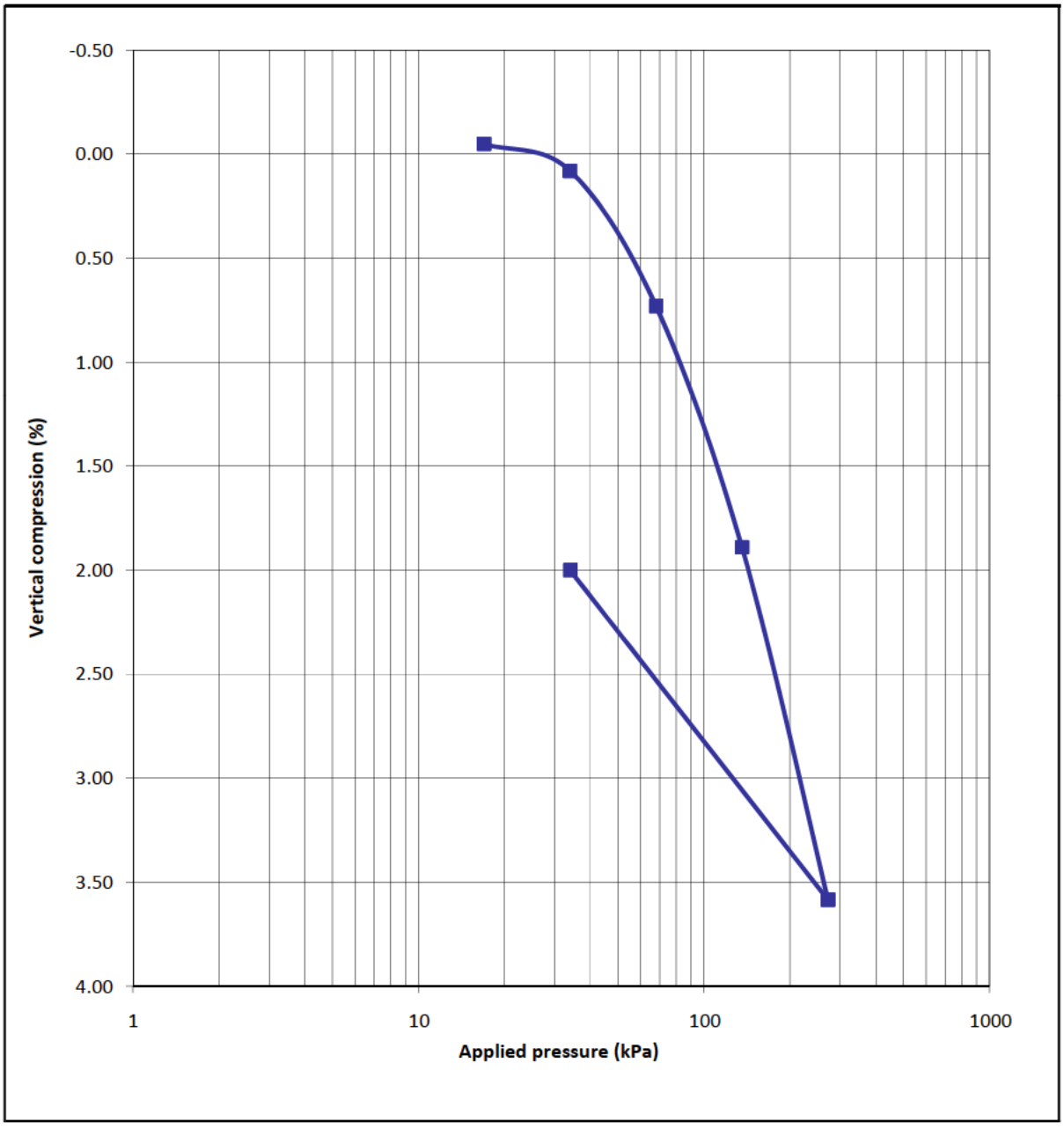
Tested	*TM*	Checked	*HJL*	Approved	*HJL*
Date	*11/04/2022*	Date	*11/04/2022*	Date	*05/05/2022*

DETERMINATION OF ONE-DIMENSIONAL CONSOLIDATION PROPERTIES

Tested in accordance with BS 1377:1990:Part 5:Clause 3

TEST REPORT

Project location	*Cliff Hill*		
Project reference	*C2206/21/E/3401*	Sample depth (m)	*0.7-1.0*
Borehole number	*WS09*	Sample type	*Undisturbed*
Sample number	*C2*	Specimen orientation	*Vertical*

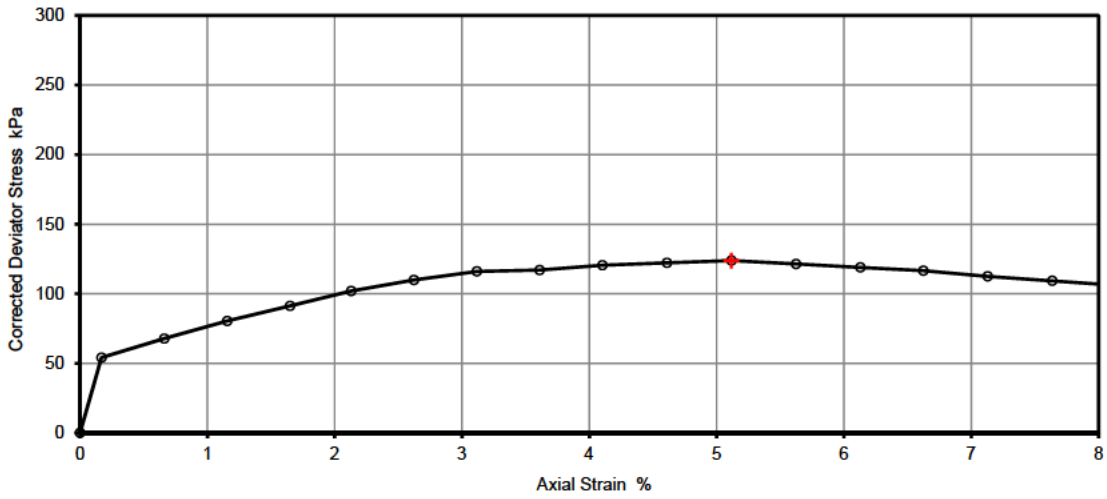


Tested	*TM*	Checked	*HJL*	Approved	*HJL*
Date	*11/04/2022*	Date	*11/04/2022*	Date	*05/05/2022*

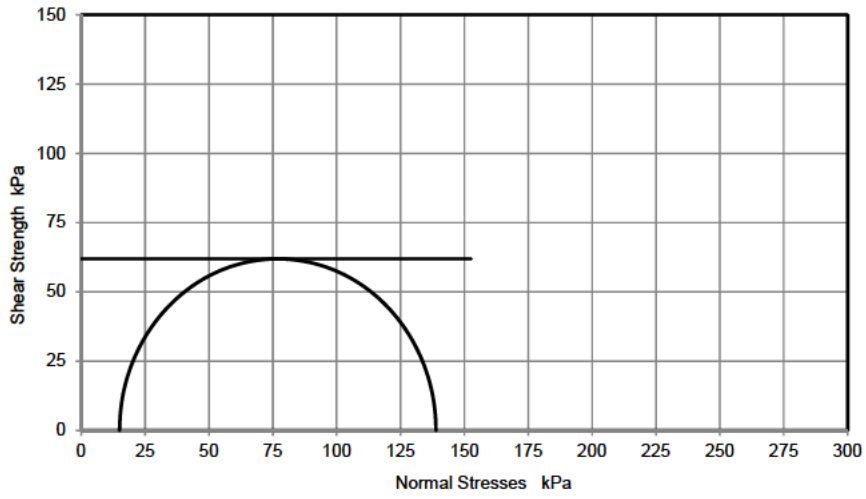
	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	C2206/21/E/3401
				Borehole/Pit No.	WS09
Site Name	Cliff Hill			Sample No.	2
Soil Description	Firm/ stiff orangish brown silty CLAY			Depth	0.70
Specimen Reference	C2	Specimen Dep h	0.70 m	Sample Type	C
Specimen Description	Firm/ stiff orangish brown silty CLAY			KeyLAB ID	RGS_202204118
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	11.04.2022

Test Number		1	
Length		77.0	mm
Diameter		37.8	mm
Bulk Density		2.03	Mg/m^3
Moisture Content		24.7	%
Dry Density		1.63	Mg/m^3
Rate of Strain		1.0	%/min
Cell Pressure		15	kPa
At failure	Axial Strain	5.1	%
	Deviator Stress, $(\sigma_1 - \sigma_3)_f$	124	kPa
	Undrained Shear Strength, c_u	62	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$
	Mode of Failure	Brittle	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377.
This is provided for information only.

Remarks

Approved: Harry

Printed: 06/05/2022

Fig. No. 9

Sheet 1

Lab Sheet Reference :

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Environmental
Geotechnical
Specialists

ENVIRONMENTAL LAB RESULTS

GEOTECHNICAL
ENVIRONMENTAL

Blank Page

eurofins | Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-13661-1
Initial Date of Issue:	21-Apr-2022
Client	Rogers Geotechnical Services Ltd
Client Address:	Offices 1&2, Barncliffe Business Park Near Bank Shelley Huddersfield West Yorkshire HD8 8LU
Contact(s):	Harry Letch
Project	C2206/21/E/3401 Cliff Hill Denby Dale

Quotation No.:		**Date Received:**	11-Apr-2022
Order No.:	C2206/21/E/3401	**Date Instructed:**	11-Apr-2022
No. of Samples:	3		
Turnaround (Wkdays):	7	**Results Due:**	21-Apr-2022
Date Approved:	21-Apr-2022		
Approved By:			

Details:	Stuart Henderson, Technical Manager

Results - 2 Stage WAC

Project: C2206/21/E/3401 Cliff Hill Denby Dale

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-13661						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Chemtest Sample ID:	1409559								
Sample Ref:									
Sample ID:									
Sample Location:	WS01								
Top Depth(m):	0.3								
Bottom Depth(m):	0.4								
Sampling Date:	06-Feb-2022								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	M	%			[B] 2.1	3	5	6
Loss On Ignition	2610	M	%			5.8	--	--	10
Total BTEX	2760	M	mg/kg			[B] < 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	M	mg/kg			[B] < 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	M				7.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.010	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0010	0.0008	0.0019	0.0081	0.5	2	25
Barium	1455	U	0.010	< 0.005	0.019	0.011	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	0.0049	0.0054	0.0098	0.053	0.5	10	70
Copper	1455	U	0.0044	0.0031	0.0086	0.0051	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0045	0.0025	0.0089	0.027	0.5	10	30
Nickel	1455	U	0.0036	0.0035	0.0072	0.035	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	0.0007	< 0.0005	0.0014	0.0008	0.06	0.7	5
Selenium	1455	U	0.0005	< 0.0005	0.0011	0.0006	0.1	0.5	7
Zinc	1455	U	0.005	< 0.003	0.009	0.005	4	50	200
Chloride	1220	U	1.8	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.32	0.31	< 1.0	3.1	10	150	500
Sulphate	1220	U	30	5.9	59	87	1000	20000	50000
Total Dissolved Solids	1020	N	170	170	330	1700	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	11	5.2	< 50	59	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	14

Leachate Test Information	
Leachant volume 1st extract/l	0.322
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.204

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - 2 Stage WAC

Project: C2206/21/E/3401 Cliff Hill Denby Dale

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-13661						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Chemtest Sample ID:	1409560								
Sample Ref:									
Sample ID:									
Sample Location:	WS02								
Top Depth(m):	0.34								
Bottom Depth(m):	0.4								
Sampling Date:	06-Feb-2022								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	M	%			[B] 1.6	3	5	6
Loss On Ignition	2610	M	%			6.3	--	--	10
Total BTEX	2760	M	mg/kg			[B] < 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	M	mg/kg			[B] < 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	M				7.2	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.0090	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0008	0.0007	0.0017	0.0074	0.5	2	25
Barium	1455	U	0.011	< 0.005	0.022	0.012	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	0.0050	0.0050	0.0099	0.050	0.5	10	70
Copper	1455	U	0.0042	0.0029	0.0082	0.0043	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0049	0.0024	0.0097	0.026	0.5	10	30
Nickel	1455	U	0.0039	0.0032	0.0076	0.033	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	0.0008	< 0.0005	0.0015	0.0008	0.06	0.7	5
Selenium	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.1	0.5	7
Zinc	1455	U	0.004	< 0.003	0.008	0.004	4	50	200
Chloride	1220	U	1.6	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.33	0.29	< 1.0	2.9	10	150	500
Sulphate	1220	U	32	6.1	63	87	1000	20000	50000
Total Dissolved Solids	1020	N	190	190	370	1900	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	10	4.4	< 50	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	16

Leachate Test Information	
Leachant volume 1st extract/l	0.317
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.179

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - 2 Stage WAC

Project: C2206/21/E/3401 Cliff Hill Denby Dale

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-13661								
Chemtest Sample ID:	1409561								
Sample Ref:									
Sample ID:									
Sample Location:	WS09								
Top Depth(m):	0								
Bottom Depth(m):	0.4								
Sampling Date:	06-Feb-2022								
Determinand	**SOP**	**Accred.**	**Units**				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	M	%			[B] 1.1	3	5	6
Loss On Ignition	2610	M	%			4.8	--	--	10
Total BTEX	2760	M	mg/kg			[B] < 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg			0.22	1	--	--
TPH Total WAC	2670	M	mg/kg			[B] < 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	M				6.6	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			< 0.0020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0006	0.0005	0.0012	0.0052	0.5	2	25
Barium	1455	U	0.009	< 0.005	0.018	0.0091	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	0.0055	0.0053	0.011	0.053	0.5	10	70
Copper	1455	U	0.0038	0.0030	0.0076	0.0039	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0033	0.0018	0.0066	0.020	0.5	10	30
Nickel	1455	U	0.0038	0.0035	0.0076	0.035	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	0.0007	< 0.0005	0.0013	0.0007	0.06	0.7	5
Selenium	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.1	0.5	7
Zinc	1455	U	< 0.003	< 0.003	< 0.003	< 0.003	4	50	200
Chloride	1220	U	1.5	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.31	0.24	< 1.0	2.5	10	150	500
Sulphate	1220	U	25	4.8	50	69	1000	20000	50000
Total Dissolved Solids	1020	N	160	170	320	1700	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	9.4	5.6	< 50	60	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	6.4

Leachate Test Information	
Leachant volume 1st extract/l	0.338
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.181

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1409559			WS01	06-Feb-2022	B	Amber Glass 250ml
1409559			WS01	06-Feb-2022	B	Amber Glass 60ml
1409559			WS01	06-Feb-2022	B	Plastic Tub 500g
1409560			WS02	06-Feb-2022	B	Amber Glass 250ml
1409560			WS02	06-Feb-2022	B	Amber Glass 60ml
1409560			WS02	06-Feb-2022	B	Plastic Tub 500g
1409561			WS09	06-Feb-2022	B	Amber Glass 250ml
1409561			WS09	06-Feb-2022	B	Amber Glass 60ml
1409561			WS09	06-Feb-2022	B	Plastic Tub 500g

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; A kalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge
650	Characterisation of Waste (Leaching WAC)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

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

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

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

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

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

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

eurofins | Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-13664-1		
Initial Date of Issue:	19-Apr-2022		
Client	Rogers Geotechnical Services Ltd		
Client Address:	Offices 1&2, Barncliffe Business Park Near Bank Shelley Huddersfield West Yorkshire HD8 8LU		
Contact(s):	Harry Letch		
Project	C2206/21/E/3401 Cliff Hill Denby Dale		
Quotation No.:	Q21-25205	**Date Received:**	11-Apr-2022
Order No.:	C2206/21/E3401	**Date Instructed:**	11-Apr-2022
No. of Samples:	12		
Turnaround (Wkdays):	5	**Results Due:**	19-Apr-2022
Date Approved:	19-Apr-2022		
Approved By:			
Details:	Stuart Henderson, Technical Manager		

Results - Soil

Project: C2206/21/E/3401 Cliff Hill Denby Dale

Client: Rogers Geotechnical Services Ltd		**Chemtest Job No.:**			22-13664	22-13664	22-13664	22-13664	22-13664	22-13664	22-13664	22-13664
Quotation No.: Q21-25205		**Chemtest Sample ID.:**			1409573	1409574	1409575	1409576	1409577	1409578	1409579	1409580
		Sample Location:			WS01	WS02	WS03	WS04	WS05	WS06	WS07	WS08
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.3	0.34	0.15	0	0.1	0	0.3	0.5
		Bottom Depth (m):			0.4	0.4	0.45	0.3	0.3	0.2	0.6	0.6
		Date Sampled:			06-Feb-2022	06-Feb-2022	06-Feb-2022	06-Feb-2022	06-Feb-2022	06-Feb-2022	06-Feb-2022	06-Feb-2022
		Asbestos Lab:			DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
Cadmium	M	2450	mg/kg	0.10	< 0.10	< 0.10	< 0.10	0.11	< 0.10	0.14	< 0.10	< 0.10
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Copper	M	2450	mg/kg	0.50	28	17	14	18	15	15	15	22
Mercury	M	2450	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.25	< 0.10	< 0.10
Nickel	M	2450	mg/kg	0.50	30	15	5.2	9.2	6.2	6.3	15	24
Lead	M	2450	mg/kg	0.50	23	12	17	48	29	36	12	18
Zinc	M	2450	mg/kg	0.50	69	36	19	46	33	25	47	59
Vanadium	U	2450	mg/kg	5.0	17	9.5	7.0	17	9.3	6.4	15	15
Arsenic	M	2450	mg/kg	1.0	6.5	2.0	8.2	13	9.8	9.8	7.1	6.4
Selenium	M	2450	mg/kg	0.20	< 0.20	< 0.20	0.22	0.37	0.22	0.27	< 0.20	< 0.20
Cyanide (Free)	M	2300	mg/kg	0.50	[B] < 0.50	[B] < 0.50	[B] < 0.50	[B] < 0.50	[B] < 0.50	[B] 0.50	[B] < 0.50	[B] < 0.50
Total Phenols	M	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Naphthalene	M	2700	mg/kg	0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Acenaphthylene	M	2700	mg/kg	0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Acenaphthene	M	2700	mg/kg	0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Fluorene	M	2700	mg/kg	0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Phenanthrene	M	2700	mg/kg	0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Anthracene	M	2700	mg/kg	0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Fluoranthene	M	2700	mg/kg	0.10	[B] < 0.10	[B] 1.5	[B] < 0.10	[B] 1.9	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Pyrene	M	2700	mg/kg	0.10	[B] < 0.10	[B] 0.89	[B] < 0.10	[B] 1.9	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Benzo[a]anthracene	M	2700	mg/kg	0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Chrysene	M	2700	mg/kg	0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Benzo[a]pyrene	M	2700	mg/kg	0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10
Total Of 16 PAH's	M	2700	mg/kg	2.0	[B] < 2.0	[B] 2.4	[B] < 2.0	[B] 3.8	[B] < 2.0	[B] < 2.0	[B] < 2.0	[B] < 2.0
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] 54	[B] < 1.0	[B] < 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0

Results - Soil

Project: C2206/21/E/3401 Cliff Hill Denby Dale

Client: Rogers Geotechnical Services Ltd		**Chemtest Job No.:**			22-13664	22-13664	22-13664	22-13664	22-13664	22-13664	22-13664	22-13664
Quotation No.: Q21-25205		**Chemtest Sample ID.:**			1409573	1409574	1409575	1409576	1409577	1409578	1409579	1409580
		Sample Location:			WS01	WS02	WS03	WS04	WS05	WS06	WS07	WS08
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.3	0.34	0.15	0	0.1	0	0.3	0.5
		Bottom Depth (m):			0.4	0.4	0.45	0.3	0.3	0.2	0.6	0.6
		Date Sampled:			06-Feb-2022	06-Feb-2022	06-Feb-2022	06-Feb-2022	06-Feb-2022	06-Feb-2022	06-Feb-2022	06-Feb-2022
		Asbestos Lab:			DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	[B] < 5.0	[B] < 5.0	[B] < 5.0	[B] < 5.0	[B] < 5.0	[B] 54	[B] < 5.0	[B] < 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] 22	[B] < 1.0	[B] < 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0	[B] < 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	[B] < 5.0	[B] < 5.0	[B] < 5.0	[B] < 5.0	[B] < 5.0	[B] 22	[B] < 5.0	[B] < 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	[B] < 10	[B] < 10	[B] < 10	[B] < 10	[B] < 10	[B] 75	[B] < 10	[B] < 10
pH	M	2010		4.0	[B] 7.9	[B] 8.1	[B] 7.4	[B] 6.8	[B] 6.8	[B] 7.1	[B] 7.1	[B] 6.5
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	[B] 0.081	[B] 0.062	[B] 0.013	[B] 0.029	[B] 0.020	[B] 0.024	[B] 0.013	[B] 0.015
ACM Type	U	2192		N/A	-	-	-	-	-	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	15	12	17	9.4	21	27	14	12
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown	Brown	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones	Stones	Stones and Roots	Stones and Roots	Stones, Roots and Wood	Stones and Roots	Stones and Roots	Stones and Roots
Soil Texture	N	2040		N/A	Clay	Sand	Sand	Sand	Sand	Sand	Sand	Sand
Sulphate (Total)	U	2430	%	0.010	[B] 0.043	[B] 0.023	[B] 0.049	[B] 0.077	[B] 0.078	[B] 0.12	[B] 0.029	[B] 0.035
Organic Matter	M	2625	%	0.40	[B] 2.8	[B] 1.7	[B] 12	[B] 8.6	[B] 10	[B] 26	[B] 2.2	[B] 3.5

Results - Soil

Project: C2206/21/E/3401 Cliff Hill Denby Dale

Client: Rogers Geotechnical Services Ltd		**Chemtest Job No.:**			22-13664	22-13664	22-13664	22-13664
Quotation No.: Q21-25205		**Chemtest Sample ID.:**			1409581	1409582	1409583	1409584
		Sample Location:			WS09	WS03	WS05	WS07
		Sample Type:			SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0	1	1	0.5
		Bottom Depth (m):			0.4	1.45	1.45	
		Date Sampled:			06-Feb-2022	06-Feb-2022	06-Feb-2022	06-Feb-2022
		Asbestos Lab:			DURHAM			
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Cadmium	M	2450	mg/kg	0.10	< 0.10			
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50			
Copper	M	2450	mg/kg	0.50	19			
Mercury	M	2450	mg/kg	0.10	< 0.10			
Nickel	M	2450	mg/kg	0.50	21			
Lead	M	2450	mg/kg	0.50	14			
Zinc	M	2450	mg/kg	0.50	58			
Vanadium	U	2450	mg/kg	5.0	13			
Arsenic	M	2450	mg/kg	1.0	5.3			
Selenium	M	2450	mg/kg	0.20	< 0.20			
Cyanide (Free)	M	2300	mg/kg	0.50	[B] < 0.50			
Total Phenols	M	2920	mg/kg	0.10	< 0.10			
Naphthalene	M	2700	mg/kg	0.10	[B] < 0.10			
Acenaphthylene	M	2700	mg/kg	0.10	[B] < 0.10			
Acenaphthene	M	2700	mg/kg	0.10	[B] < 0.10			
Fluorene	M	2700	mg/kg	0.10	[B] < 0.10			
Phenanthrene	M	2700	mg/kg	0.10	[B] < 0.10			
Anthracene	M	2700	mg/kg	0.10	[B] < 0.10			
Fluoranthene	M	2700	mg/kg	0.10	[B] < 0.10			
Pyrene	M	2700	mg/kg	0.10	[B] < 0.10			
Benzo[a]anthracene	M	2700	mg/kg	0.10	[B] < 0.10			
Chrysene	M	2700	mg/kg	0.10	[B] < 0.10			
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	[B] < 0.10			
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	[B] < 0.10			
Benzo[a]pyrene	M	2700	mg/kg	0.10	[B] < 0.10			
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	[B] < 0.10			
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	[B] < 0.10			
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	[B] < 0.10			
Total Of 16 PAH's	M	2700	mg/kg	2.0	[B] < 2.0			
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	[B] < 1.0			
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	[B] < 1.0			
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	[B] < 1.0			
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	[B] < 1.0			
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	[B] < 1.0			
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	[B] < 1.0			
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	[B] < 1.0			
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	[B] < 1.0			

Results - Soil

Project: C2206/21/E/3401 Cliff Hill Denby Dale

Client: Rogers Geotechnical Services Ltd		**Chemtest Job No.:**			22-13664	22-13664	22-13664	22-13664
Quotation No.: Q21-25205		**Chemtest Sample ID.:**			1409581	1409582	1409583	1409584
		Sample Location:			WS09	WS03	WS05	WS07
		Sample Type:			SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0	1	1	0.5
		Bottom Depth (m):			0.4	1.45	1.45	
		Date Sampled:			06-Feb-2022	06-Feb-2022	06-Feb-2022	06-Feb-2022
		Asbestos Lab:			DURHAM			
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	[B] < 5.0			
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	[B] < 1.0			
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	[B] < 1.0			
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	[B] < 1.0			
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	[B] < 1.0			
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	[B] < 1.0			
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	[B] < 1.0			
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	[B] < 1.0			
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	[B] < 1.0			
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	[B] < 5.0			
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	[B] < 10			
pH	M	2010		4.0	[B] 6.9	[B] 5.8	[B] 6.8	[B] 6.9
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	[B] 0.014	[B] 0.010	[B] < 0.010	[B] < 0.010
ACM Type	U	2192		N/A	-			
Asbestos Identification	U	2192		N/A	No Asbestos Detected			
Moisture	N	2030	%	0.020	10	6.9	6.3	14
Soil Colour	N	2040		N/A	Brown	Brown	Brown	Brown
Other Material	N	2040		N/A	Stones	Stones	Stones and Roots	Stones
Soil Texture	N	2040		N/A	Sand	Sand	Sand	Sand
Sulphate (Total)	U	2430	%	0.010	[B] 0.018			
Organic Matter	M	2625	%	0.40	[B] 2.8			

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1409573			WS01	06-Feb-2022	B	Amber Glass 250ml
1409573			WS01	06-Feb-2022	B	Amber Glass 60ml
1409573			WS01	06-Feb-2022	B	Plastic Tub 500g
1409574			WS02	06-Feb-2022	B	Amber Glass 250ml
1409574			WS02	06-Feb-2022	B	Amber Glass 60ml
1409574			WS02	06-Feb-2022	B	Plastic Tub 500g
1409575			WS03	06-Feb-2022	B	Amber Glass 250ml
1409575			WS03	06-Feb-2022	B	Plastic Tub 500g
1409576			WS04	06-Feb-2022	B	Amber Glass 250ml
1409576			WS04	06-Feb-2022	B	Plastic Tub 500g
1409577			WS05	06-Feb-2022	B	Amber Glass 250ml
1409577			WS05	06-Feb-2022	B	Plastic Tub 500g
1409578			WS06	06-Feb-2022	B	Amber Glass 250ml
1409578			WS06	06-Feb-2022	B	Plastic Tub 500g
1409579			WS07	06-Feb-2022	B	Amber Glass 250ml
1409579			WS07	06-Feb-2022	B	Plastic Tub 500g
1409580			WS08	06-Feb-2022	B	Amber Glass 250ml
1409580			WS08	06-Feb-2022	B	Plastic Tub 500g
1409581			WS09	06-Feb-2022	B	Amber Glass 250ml
1409581			WS09	06-Feb-2022	B	Amber Glass 60ml
1409581			WS09	06-Feb-2022	B	Plastic Tub 500g
1409582			WS03	06-Feb-2022	B	Plastic Tub 500g
1409583			WS05	06-Feb-2022	B	Plastic Tub 500g
1409584			WS07	06-Feb-2022	B	Plastic Tub 500g

Test Methods

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

Report Information

Key

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

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

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

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

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

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

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End of Report