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PHASE 2

GEO-ENVIRONMENTAL REPORT

job number	C4025/23/E/6125
date	26/02/2024
site address	Dene House, North Road, Kirkburton, Huddersfield, HD8 0RW.
written by	I. Sakoor
checked by	S. Alexander
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Contents

Appendices	
1.	Site Plan
2.	Borehole Records
3.	Dynamic Probing Records
4.	Laboratory Testing
5.	Fill Screening Values

Report on a Phase 2 Geo-environmental Investigation

Location:	Dene House, North Road, Kirkburton, HD8 0RW.
For:	CoGri Group
Consultants:	SGM Structural Design
Report No.	C4025/23/E/6125 Report date: February 2024

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

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Report Summary[1]

Item	Comments	Section
Development	Construction of a new structure adjacent to existing CGFS workshop comprising offices on upper floor and staff restaurant on lower level to replace previous workshop. Upfilling of car park to create level area and including retaining walls surrounding Dene House and to neighbouring land.	1.
Geology	Superficial geology: None. Solid geology: Pennine Lower Coal Measures Formation.	4.
Strata Conditions	Made ground to generally between 1.1m and 1.8m over soft to firm cohesive soils. Extended thickness of soft cohesive soils within central part of the site. Underlain by residual becoming completely weathered Pennine Lower Coal Measures Formation.	5.
Groundwater	None encountered during investigation.	5.2
Foundation Design	New office building could be constructed on shallow footings. Embedded retaining walls recommended for new car park due to extended thickness of soft material, although locally gravity retained structures may be possible. Discussion should be carefully considered.	9.
Effect of Sulphates	DC-1 concrete.	9.
Contamination	No significant contamination revealed.	10.
UXO Risk	Low risk for UXO – no further action required for this aspect.	10.

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

1. Introduction

It is understood that the land associated with Dene House, off North Road, Kirkburton is to be developed by the demolition of the existing workshop and the construction of a new office building with a ground-floor restaurant within the same footprint. This new building will be constructed adjacent to the existing CoGri premises. Additionally, a new car park is to be created which is intended to be at a similar level to North Road. In order to facilitate the new car park, new retaining walls are to be constructed to the neighbouring land and surrounding Dene House. Additionally, the existing retaining wall to the beck present along the western boundary will need to be increased in height.

Consequently, a site investigation has been undertaken in accordance with the instruction from the client. This work was required in order to determine the nature of the underlying soils, to assess their engineering properties and to assist in the design of safe and economical foundations for the proposed development. This investigation also takes into consideration the risk of any contamination present. This report describes the work undertaken, presents the data obtained and discusses the ground conditions in relation to the proposed works.

It should be appreciated that within this document where reference is made to depth in meters below ground level, this is relative to the surface level present at the time of the fieldworks.

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. Fieldworks

The fieldworks were undertaken on the 24th and 25th January 2024 and included the following:

- Eight windowless sample boreholes.
- Standard penetration tests.
- Two dynamic probes.

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

3.1 Windowless Sample Boreholes

These boreholes were sunk using a drive-in windowless sampler. The cores were undertaken in 1m lengths and reduced in diameter from approximately 87mm for the first 1m through 77mm, 67mm and 57mm for subsequent 1m increments. The recovered cores were sealed and returned to the laboratory for logging and subsequent testing. The soils were described in general accordance with BS5930: 2015 +A1: 2020 and full descriptions are given on the windowless sample records which are presented in Appendix 2. Also included on these records are the core diameters and percentages of core recovered.

3.2 Standard Penetration Tests

Standard penetration tests (SPT) were undertaken at regular depth increments within the boreholes. The SPTs were 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.

3.3 Dynamic Probes

Dynamic penetration tests were undertaken trough the base of WS04 and WS07 in accordance with the procedure given in BS EN ISO 22476: Part 2: 2005 +A1: 2011, using the super heavy penetrometer (DPSH). This probe consists of a 63.5kg mass falling through 750mm onto an anvil, which drives a 50mm diameter cone into the ground. The number of blows required to drive the cone through successive 100mm increments are recorded as the N_{100} values. The results of the dynamic penetration tests are tabulated and presented as bar charts of N_{100} values versus depth in Appendix 3.

4. Geology

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

Table 1: Geological Data for the Site

Strata Type	Strata Name[2]	Previous Name[3]	Description[3]
Superficial Geology	None indicated to be present.		
Solid Geology	Pennine Lower Coal Measures Formation	Lower Coal Measures	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.

[2] Sources: British Geological Survey (NERC) Map Sheet 77; Huddersfield; Solid and Drift Edition, and Geology of Britain Viewer [*online resource from www.bgs.ac.uk*]
[3] Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [*online resource from www.bgs.ac.uk*]

It should be appreciated that the Kirkburton Sandstone is indicated outcrop to the east of the site. The outcrop is shown to cross North Road just south of the site, which then curves round following the line of the road.

5. Strata Conditions

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

Table 2: Generalised Strata Profile

Depth m below ground level to underside of layer	**Strata Type**	**Positions Encountered**	**Groundwater Strikes** m below ground level
0.05 – 0.2	ASPHALT.	WS03, WS07, WS08	None
0.2 – 0.45	TOPSOIL.	WS01, WS02	None
0.25 – 0.6 1.25	MADE GROUND (Granular) - Present to 1.25m in WS08	WS05, WS06, WS08	None
1.1 – 1.8 0.3	MADE GROUND (Cohesive). - Present to 0.3m in WS07.	WS01, WS02, WS03, WS04, WS05, WS07	None
2.0 – 2.65	Silty CLAY. - Soft within WS03 and WS04.	WS03, WS04, WS08	None
1.4 – +2.9 +4.45	Soft slightly sandy gravelly CLAY. - Soft to 3.8m in WS04. - Present to 4.45m in WS07.	WS01, WS02, WS03, WS04, WS05, WS07	None
+1.75 - +3.45	Silty sandy GRAVEL. Locally clayey. - Present from 0.25m in WS06.	WS02, WS03, WS05, WS06	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

5.1 General Strata

In general, made ground was generally encountered to depths of between 1.1m to 1.8m below ground level and was found to comprise brick and sandstone gravel. Beneath the fill in all except WS06, soft and soft to firm, slightly sandy gravelly clay was revealed to between 1.4m and 4.45m depth. It is noted that within the central part of the site, this material was present in a soft insitu condition to between 2.9m and 3.9m below ground level.

Below the cohesive soils in WS02, WS03, WS05 and from beneath the made ground in WS06, dense silty sandy gravel was revealed to the base of these boreholes. With respect to the local geology, it is considered that this material is representative of the residual becoming completely weathered fraction of the Pennine Lower Coal Measures Formation.

5.2 Groundwater

No groundwater strikes were observed during the site investigation. However, it should be appreciated that the normal rate of boring does not permit the recording of an equilibrium water level for any one strike, moreover, groundwater levels are subject to seasonal variation or changes on local drainage conditions.

6. Insitu Testing

6.1 Standard Penetration Tests

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

Table 3: Summary of Standard Penetration Tests

Strata	Depth Range (m)	SPT 'N' (Blows/300mm)		Comments
		Granular soils	Cohesive soils	
MADE GROUND	1.0m	–	5 to 13	SPT's indicate a generally soft in-situ condition.
RESIDUAL PENNINE LOWER COAL MEASURES FORMATION	1.0m 2.0m 3.0m 4.0m	–	5 5 to 8, 62 4 to 8 12 to 22	SPT's results generally soft and soft to firm insitu condition. Result of 62 attributed to soil grading into extremely weak rock.
COMPLETELY WEATHERED PENNINE LOWER COAL MEASURES FORMATION	1.0m to 1.6m 2.0m	37 to 58 58 to 74	–	SPT results indicate a dense to very dense insitu condition.

6.2 Dynamic Penetration Tests

Dynamic penetration tests were undertaken from the base of WS04 and WS07. A summary of the results is presented below:

Table 4: Summary of Dynamic Penetration Tests

Position	Blows/100mm			Refusal type (Effective/ Abrupt)[4]	Comments
	0 - 2	3 - 10	10+		
	Depth to which blow count range was observed (m)				
DP04	-	4.7	5.4	Abrupt	Commenced from 4.4m depth. Results rapidly increase until refusal.
DP07	3.7	4.2	5.3	Abrupt	Commenced from 3.4m depth. Results gradually increased until refusal.

7. 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
- Soluble sulphate content — BS 1377-3:2018+A1:2021: Pt3: 7.3

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

- pH value BS 1377-3:2018+A1:2021: Pt3: 12

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

Table 5: Summary of Geotechnical Test Results

Test type	Number of tests	Range of results		Comments
Water content determinations	12	20% to 38%		Generally close to the plastic limit.
	3	9.5% to 10.9%		Clayey GRAVEL. 77% to 84% retained on 0.425mm sieve
Index properties (1 Point)	12	LL PL PI	38% to 64% 19% to 39% 15% to 26%	Clay intermediate plasticity. Silt of generally high plasticity. Consistency index: 0.6 to 1.3. NHBC Class: Low to Medium. 3no. results on cohesive fraction of granular strata.
Soluble sulphate & pH	3	SO_4 pH	23.6 to 108mg/l 8.1 to 8.6	

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[5] of 26% could be employed, which suggests an f_1 value of 4.8 and an f_2 value of 0.48.

7.1 Geotechnical Properties

The idealised geotechnical properties employed in design are summarised below.

Table 6: Summary of Geotechnical Properties

Property	Range of values		Comments
Volume change potential (NHBC)	Medium		Slightly sandy gravelly CLAY.
Consolidation characteristics	m_v	0.26m to 0.52 m^2/MN	Stroud (1974) where $m_v = 1/f_2N$. SPTs values typically between 4 and 8.
Concrete classification	DC-1		Brownfield locations (static water).

Assumed Effective Stress Parameters

Strata Description	Bulk unit weight (kN/m^3)	Angle of friction[6] ϕ' (°)	Effective cohesion c'(kN/m^2)
Granular backfill (e.g. 6F5)	22	30	0
MADE GROUND (Granular)	18	24	0
MADE GROUND (Cohesive)	18	24	0
Silty CLAY	19	25	0

[5] See paragraph 6.2 'Index Property Tests'
[6] Sources: Carter, M. and Bentley, S.P. (1991). Correlations of soil properties. London: Pentech Press.

Slightly silty gravelly CLAY	19	26	0
Sandy GRAVEL	21	30	0

8. Laboratory Testing - Environmental

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

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

This testing was undertaken by i2 Analytical Ltd and the results of all of the chemical testing are presented in Appendix 4 of this report.

9. Discussion of Ground Conditions - Geotechnical

It is understood that the site is to be developed by the demolition of the existing workshop building and the construction of a new office building including a ground-floor restaurant within the same footprint. This new building will be constructed adjacent to the existing CoGri premises. Additionally, a new car park is to be created which is intended to be at a similar level to North Road. In order to facilitate the new car park, new retaining walls are to be constructed to the neighbouring land and surrounding Dene House. Additionally, the existing retaining wall to the beck present along the western boundary will need to be increased in height.

In general terms, it cannot be recommended that foundations be constructed directly within the made ground or weak near surface soils. It should be appreciated that these soils are present in a weak and variable condition to depths of at least 3.0m begl across the site, such that excessive total and or differential settlement could occur under moderately light surface loading. The discussion presented below is based on a drawing by WHp Architecture, drawing no: WHPR 23-0046, November 2023.

9.1 Foundations – New Office Building

With regards to the new office building, it should be appreciated that whilst the adjacent existing structure is likely to have undergone some settlement which by now is expected to have ceased, the new part of the building will undergo some settlement after construction. Such settlement is likely to be entirely differential to the existing structure. Moreover, the excavation for the new building may potentially undermine the existing footings by loss of support from the foundation soils. As such, care will be required during the excavation in order to ensure the integrity of the existing footings is maintained. Traditional shallow footings should be considered with respect to the following comments.

The results of this investigation indicate that within the footprint of the new office building, the completely weathered fraction of the Pennine Lower Coal Measures Formation, described as silty sandy gravel will be revealed at depths of about 1.7m below ground level (based on WS05 and WS06). It is considered that this material will provide a suitable bearing stratum, provided that the foundations are placed 200mm into soil generally described as being present in a dense insitu condition.

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

Table 7: Allowable Bearing Pressure

Foundation Type		Strip Footings		Spread Footings	
Foundation Breadth	B (m)	0.6	1.0<	0.6	1.0<
Foundation Depth	D (m)	1.70		1.70	
Allowable Bearing Pressure	(kN/m²)	160	240	200	300

The allowable increase in stress given above assumes settlements of less than 25mm, with an SPT 'N' value in excess of 30 at the foundation depths and provided that the underlying soils are carefully inspected immediately final trimming has taken place. In addition, founding upon the dense predominantly granular strata encountered at this depth will minimise risks against long term and differential settlements.

9.2 Retaining Walls – New Car Park

The Investigative works have proven a significantly different and variable strata profile within the new car park area. Whilst competent strata have been revealed at around 2m depth in WS01 and WS02, within WS03, WS04 and WS07 soft cohesive soils have been identified to depths of between 2.90m and 3.90m below ground level. In view of this, due to the potential for significant total and/or differential settlements for, traditional gravity retaining structures such as RC cantilever walls or gabion baskets cannot be recommended.

As such, it is considered that an embedded retaining structure such as a king-post retaining wall could represent the most effective solution. In a king post wall, steel section, such as Universal Bearing Piles or Universal Columns (which have a 'H' cross-section) are installed into concrete filled bores at a prescribed spacing. Pre-stressed and reinforced concrete panels are then inserted between the posts to form the wall. Whilst traditional methods of king post walls require some land take in order to form the wall, given the limited space and relatively shallow rock head locally, it is considered that the posts could be embedded into the competent sandstone inferred to be present at depths of between 2m and 5m.

It should be appreciated that the retaining walls should be designed to allow for hydrostatic pressure behind the wall. Indeed, recommendations made by BS 8102; *Protection of Below Ground Structures against Water from the Ground*, are likely to require that a head of water 1m below the top of the retaining wall is considered in design. Furthermore, it should be appreciated that embedded retaining walls will be subject to some deflection and thus settlement on the retained side. As such, care will need to be taken to ensure that this settlement does not result in unacceptable levels of distress, in particular foundations and underground services.

Regardless of the chosen foundation solution, it is considered that further investigation will be required to allow for a suitable retaining wall design and confirmation of depth to bedrock. This is likely to comprise the drilling of rotary cored boreholes in order to obtain samples of the bedrock.

Notwithstanding the above, it should be noted that whilst it may be possible to use gravity retaining walls locally, local to WS01 and WS02, the detailing between the embedded wall and gravity wall will need to be carefully considered. It may be more economical to utilise king-post walls for all of the retaining structures.

9.3 New Car Park

It is understood that for the new car park, the site levels are being brought up by around 1.5m - 2.0m above existing. It is recommended that compacted engineered fill is placed in layers of say 250mm. Insitu testing will need to be undertaken on each layer in order to ensure that adequate compaction is achieved and that the material has been placed in line with the specification which should be in accordance to Highways Series 600.

A design California Bearing Ratio (CBR) of 5% could be employed in the pavement design[7].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.

It is of note where the proposed road construction is to tie into the highway geotechnical and construction designs are likely to be required to be presented to the Local Authority and further geotechnical reports may be requested.

9.4 General Comments for Excavations

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

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

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

9.5 Ground-floors

In light of the made ground and weak near surface soils, it is not recommended that ground bearing ground floor slabs be employed. In this instance it would be necessary to suspend floors between

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

foundation positions, such that the floor loads are transmitted via the foundations to competent soils at depth.

Further to the above, due to the volume change potential at the site, should the floor be placed within the zone of influence of any existing, or proposed, trees and shrubs, an allowance for soil volume change should be included. Further guidance is available in the NHBC standards, however, soil volume change can typically be catered for by providing a suitable void or utilize proprietary materials beneath the floor slab.

9.6 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[8], which is provided in BRE Special Digest 1, *Concrete in aggressive ground*: Part C. On the basis of this table and considering the soluble sulphate contents recorded, it can be shown that well compacted buried concrete should be designed in accordance with Class DS-1 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[9], 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.

10. Discussion of Ground Conditions - Environmental

10.1 Discussion of Test Results

It is understood that the site is to be developed by the demolition of the existing workshop building and the construction of a new office building including a ground-floor restaurant within the same footprint. This new building will be constructed adjacent to the existing CoGri premises. Additionally, a new car park is to be created which is intended to be at a similar level to North Road. Consequently, the site may be classified as a commercial development.

10.1.1 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 1.1% and 6.8%. On this basis, it is considered that the screening values associated with 1% SOM should be adopted. These values have been derived in such a way as to adhere to the principles within the revised CLEA model and include the most current release of the SGVs. A list of subscribers is provided within the website[10] 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:

[8] Table C2, *Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations*
[9] 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.*
[10] http://www.atrisksoil.co.uk/pages/general/subscribers.asp

Table 8: Summary of Contaminated Areas		
Location	**Depth (m)**	**Contaminants found to be exceeding SSVs (Commercial)**
WS02	0.3	PAHs [Benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene].
WS04	0.2	PAHs [Benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene].
WS05	0.3	PAHs [Indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene].

Concentrations of cadmium, chromium^{VI}, selenium, free cyanide, phenols (total) 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 soils samples tested.

It should be appreciated that the soil screening values for PAHs and TPHs (where appropriate) represents vapour saturation limits. The inhalation of vapour pathway contributes less than 10% of total exposure, which is unlikely to significantly affect the combined assessment criterion[11]. In view of this, the ATRISK soil SSVs notes that the users may wish to consider using a combined assessment criterion if free product is not observed, the values for which are also provided on the summary of contamination analysis. It is therefore considered that the criteria for no free product should be adopted for the PAHs and TPHs at this site. The results of the contaminants found to exceed these screening values are tabulated below:

Table 9: Summary of Areas Contaminated by PAHs & TPHs		
Location	**Depth (m)**	**Contaminants found to be exceeding SSVs (Commercial)**
WS02	0.3	None
WS04	0.2	None
WS05	0.3	None

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

10.2 Site Specific Risk Assessment

10.2.1 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[12] advice on the assessment of risks arising from the presence of

[11] Ref: ATRISK soil, SSVs derived using CLEA v1.071 for 1% SOM, Commercial land use, 23.06.17.
[12] 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'.

contamination in soils and using the source-pathway-receptor approach.[13] 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.'[14]

10.2.2 Conceptual Ground Model and Risk Assessment

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

On-site – Made Ground.

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

N/A -	A source-pathway-receptor linkage is not considered to exist and therefore a risk assessment is not required.
Low -	A pollution linkage is unlikely and/or the likelihood of harm occurring is low and of minor consequence.
Moderate -	The linkage exists but the likelihood of harm occurring is not considered to be significant although remedial action may be necessary
High -	The linkage exists and the available data indicates that significant harm may be caused and remedial action could be necessary.

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

[13] 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.
[14] See 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990', appendix A.

Table 10: Conceptual Site Model and Site Specific Risk Assessment [Contamination: None]				
Conceptual Site Model			**Site Specific Risk Assessment**	
Pathways	**Receptor**	**Linkage Present?**	**Risk Rating**	**Notes**
Direct contact/dermal absorption/soil ingestion	Operative	Yes – whilst some contamination has been revealed, the determinands are all below the relevant SSVs.	Low	No further action required.
	End User	Yes – whilst some contamination has been revealed, the determinands are all below the relevant SSVs.	Low	
	Neighbours	Yes – whilst some contamination has been revealed, the determinands are all below the relevant SSVs.	Low	
Inhalation of Dust/Vapours	Operative	Yes – whilst some contamination has been revealed, the determinands are all below the relevant SSVs.	Low	No further action required.
	End User	Yes – whilst some contamination has been revealed, the determinands are all below the relevant SSVs.	Low	
	Neighbours	Yes – whilst some contamination has been revealed, the determinands are all below the relevant SSVs.	Low	
Ingestion of fruit/vegetables and/or waters	Operative	No – no edible plants in the area of the proposed new works. Additionally, whilst a watercourse is present to the rear of the site, no significant contamination has been revealed. Indeed, the majority of determinands were found to be below detection limits.	N/A	No further action required.
	End User	Yes – whilst some contamination has been revealed, the determinands are all below the relevant SSVs.	Low	
	Neighbours	Yes – whilst some contamination has been revealed, the determinands are all below the relevant SSVs.	Low	
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	Yes – whilst made ground has been revealed, no deleterious material has been identified. Moreover, no landfills are present within 250m of the site.	Low	
	End User		Low	

	Neighbours	No – whilst concentrations of ground gas have been found to be present at the site (assuming *Characteristic Situation Level 1*), no neighbouring properties directly adjoin the site, therefore gases migrating from the site would vent to atmosphere before reaching neighbouring structures	N/A	
Spillage/loss/run off direct to receiving water	Controlled Waters	Yes – whilst known controlled waters are present within 250m, no significant contamination has been revealed.	Low	No further action required.
Migration via permeable unsaturated strata	Controlled Waters	Yes – whilst a Secondary A aquifer is present beneath the site, no significant contamination has been revealed.	Low	
Run off via drainage/sewers etc	Controlled Waters	Yes – existing services may be present on site. However, no significant contamination has been revealed.	Low	
Direct contact with contaminated soils	Plants	No – commercial development, thus garden areas no expected. Moreover, no significant contamination has been revealed.	Low	No further action required.
Uptake via root system			Low	
Direct contact with contaminated soils	Building Materials	Yes – minor PAH contamination revealed at the site may represent a risk to building materials or plastic water pipes. Moreover, testing indicates that the aggressive chemical environment for concrete classification is AC-1s.	Moderate (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	No – Not in a radon affected area.	N/A	Less than 1% of properties are above the action level. No radon protection measures required.
	End User			
UXO Risk	Operative	Yes – the Zetica online maps indicate that the site is at low risk UXO.	Low	No further action required.
	End User			

10.3 Indicative Remediation Strategy

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

10.3.1 General Approach to Construction

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

Ground-works

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

- Site operatives at all levels should be made aware of the fundamental principles of identifying potentially contaminated soils and the hazards of working with such soils not identified by the ground investigation.
- Personal hygiene facilities, including washing and messing, must be provided and site operatives encouraged to use them.
- Where work is undertaken in dry weather the site should be dampened down to avoid dust. In addition, dust masks must be provided to all site operatives for use at all times.
- Where vehicles are transferring soil to landfill site they should be covered to prevent any potential contamination of the surrounding area by dust.
- Any stockpiles of soil should be sheeted over to prevent excessive amounts of airborne dust.
- Where work is undertaken in wet weather, vehicle and wheel washing facilities are required to ensure that the vehicles leaving the site do not transfer any potential contamination to surrounding areas.

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

Construction

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

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

10.4 Fill Materials

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

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

- It is a suitable growing media if it is to be employed as such, including compliance with 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[15] documentation and may be used as a guide. Depending on the origin and nature of the material, not all fill will require the sampling frequency and testing indicated, although this should be in agreement with any regulatory bodies (such as the Local Authority).

Table 11: 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)..

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

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 12: Fill Screening Values

Contaminant	Screening Value (Commercial) (mg/kg)		Reference
	1% SOM	6% SOM	
As	635	635	Atrisk^{SOIL} SSVs
Cd	410	410	Atrisk^{SOIL} SSVs
Cr(VI)	19.7	19.7	Atrisk^{SOIL} SSVs
Cu	106000	106000	Atrisk^{SOIL} SSVs
Hg	350	350	Atrisk^{SOIL} SSVs
Ni	1770	1770	Atrisk^{SOIL} SSVs
Pb	2310	2310	Atrisk^{SOIL} SSVs
V	7490	7490	Atrisk^{SOIL} SSVs
Zn	1100000	1100000	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.

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

11. 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.
- Discussions with specialist embedded retaining wall contractors regarding their method for installing the required retaining structures.
- Discussions with designers for requirements for additional testing of bedrock beneath the site to allow for suitable retaining wall design.
- Discussions with ground work contractors in relation to the requirement for testing of materials to be disposed off-site (Waste Acceptance Criteria) and the suitability of imported materials.
- Discussions with service providers regarding suitable materials for pipe work given the nature of chemical determinands found within the soils on site.
- Insitu testing of each layer of engineered fill placed for build-up of car park levels.
- 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.

12. References

- British Geological Survey (NERC) (2024), BGS, Keyworth.
  - Geology of Britain Viewer: (*http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html)*
  - Lexicon of Named Rock Units:
  - (*http://www.bgs.ac.uk/lexicon/)*
- British Standards Institution (1990) BS1377: *British standard methods of test for soils for civil engineering purposes,* B.S.I., London.
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- British Standard Institution (2005 +A1: 2011) BS EN ISO 22476-3: *Geotechnical investigation and testing – Field testing, Part 3: Standard penetration test,* B.S.I., London.
- British Standards Institution (2015 +A1: 2020) BS 5930: *Code of practice for ground investigations,* B.S.I., London.
- British Standards Institution (2011), BS 10175: *Investigation of potentially contaminated sites – Code of Practice,* British Standards Institute.
- British Standards Institution (2015 +A1:2019) BS8485: *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings,* B.S.I., London.
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- British Standards Institution (2017) BS EN ISO 14688: *Geotechnical investigation and testing – Identification and classification of soil*, B.S.I., London.
- Building Research Establishment (BRE) Special Digest 1 (2005), Third Edition: Concrete in aggressive ground, BRE Press, Garston.
  - Part C: *Assessing the aggressive chemical environment.*
  - Part D: *Specifying concrete for general cast-in-situ use.*
- Department for Environment, Food and Rural Affairs and the Environment Agency (2009) DEFRA Science Report – Final SC050021/SR2, *Human Health toxicological assessment of contaminants in soil*. Environment Agency, Bristol.
- Department for Environment, Food and Rural Affairs and the Environment Agency (2009) DEFRA Science Report – SC050021/SR3, *Updated technical background to the CLEA model*. Environment Agency, Bristol.
- Department for Environment, Food and Rural Affairs (2014) SP1010: *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document*.
- Wilson S, Oliver S, Mallet H, Hutchings H, Card G, *Assessing risks posed by ground gasses to buildings,* CIRIA Report C665.

Appendix 1

Site Plan

Notes:

Investigation positions approximated from site operative's notes.

RGS Environmental Geotechnical Specialists

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Telephone: 0843 50 66 87
www.rogersgeotech.co.uk

Client:

CoGri Group

Job Number:

C4025/23/E/6125

Project Details:

Dene House, North Road,
Kirkburton, HD8 0RW.

Scale: Not to scale - reference only

Appendix 2

Borehole Records

Borehole Log

Borehole No. **WS01**

Sheet 1 of 1

Project Name: Dene House	Project No. C4025/23/E/6125	Co-ords:	Hole Type WLS
Location: North Road, Kirkburton, Huddersfield, West Yorkshire, HD8 0RW		Level:	Scale 1:50
Client: CoGri Group		Dates: 24/01/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.20			TOPSOIL (Soft dark brown, organic, slightly sandy, slightly gravelly, clayey SILT. Sand is fine. Gravel is sub-angular to and angular, fine to medium of various lithologies. Common rootlets).
				77	85		0.60			MADE GROUND (Soft, dark brown, sandy, gravelly, clayey SILT. Sand is fine to coarse. Gravel is sub-angular to angular, fine to medium of bituminous material, brick and various other lithologies).
		1.00	SPT			N=5 (1,2/1,1,1,2)				
		1.30	D	77	75					
		1.90	D				1.80			MADE GROUND (Soft, brown, slightly sandy, gravelly, silty CLAY. Sand is fine. Gravel is fine to coarse and angular to sub-angular of brick and sandstone). [REWORKED]
		2.00	SPT			N=62 (2,2/4,14,21,23)				
							2.45			Soft becoming very stiff, orangish brown mottled grey, slightly sandy, gravelly, silty CLAY. Sand is fine. Gravel is sub-angular to sub-rounded, fine to coarse and of sandstone. [RESIDUAL PENNINE LOWER COAL MEASURES FORMATION].
										End of Borehole at 2.45m

1 2 3 4 5 6 7 8 9 10

Remarks

No groundwater recorded.

Borehole Log

Environmental Geotechnical Specialists

Borehole No. **WS02**

Sheet 1 of 1

Project Name: Dene House	Project No. C4025/23/E/6125	Co-ords:	Hole Type WLS
Location: North Road, Kirkburton, Huddersfield, West Yorkshire, HD8 0RW		Level:	Scale 1:50
Client: CoGri Group		Dates: 24/01/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
				87	100		0.45			TOPSOIL (Soft dark brown, slightly sandy, slightly gravelly, clayey SILT. Sand is fine. Gravel is sub-angular to angular, fine to medium of various lithologies. Common rootlets present).
		1.00	SPT			N=8 (1,2/1,2,1,4)	1.10			MADE GROUND (Soft brown, slightly sandy, gravelly, silty CLAY. Sand is fine. Gravel is sub-angular to angular, fine to coarse of ash, brick and sandstone. Rare rootlets present).
		1.20	D	87	100		1.40			Soft, orangish brown mottled grey, slightly sandy, gravelly, silty CLAY. Sand is fine. Gravel is sub-angular to sub-rounded, fine to coarse of sandstone. [RESIDUAL PENNINE LOWER COAL MEASURES FORMATION].
		1.70	D							
		2.00	SPT			N=58 (4,7/10,12,17,19)	2.45			Very dense, brown, clayey, silty, sandy, sub-angular to angular, tabular, fine to coarse GRAVEL of sandstone. Sand is fine to coarse. [COMPLETELY WEATHERED PENNINE LOWER COAL MEASURES FORMATION].
										End of Borehole at 2.45m

1 2 3 4 5 6 7 8 9 10

Remarks

No groundwater recorded.

AGS

Borehole Log

Borehole No. **WS03**

Sheet 1 of 1

Project Name: Dene House	Project No. C4025/23/E/6125	Co-ords:	Hole Type WLS
Location: North Road, Kirkburton, Huddersfield, West Yorkshire, HD8 0RW		Level:	Scale 1:50
Client: CoGri Group		Dates: 24/01/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.10			MADE GROUND (ASPHALT).
				87	95					MADE GROUND (Soft, alternating brown and dark brown, slightly sandy, gravelly, silty CLAY. Sand is fine to coarse. Gravel is sub-angular to angular, fine to coarse of various lithologies).
		1.00 - 1.45	D							
		1.00	SPT			N=13 (4,3/3,4,4,2)				
				87	100					
		1.80	D				1.75			Soft, greenish grey, silty CLAY. [RESIDUAL PENNINE LOWER COAL MEASURES FORMATION].
		2.00	SPT			N=6 (1,0/0,2,2,2)	2.00			Soft, orangish brown mottled grey, slightly sandy, slightly gravelly, silty CLAY. Sand is fine. Gravel is sub-angular to angular, fine to medium of sandstone. [RESIDUAL PENNINE LOWER COAL MEASURES FORMATION].
		2.50	D	57	79					
		3.00	SPT			N=66 (6,11/11,14,17,24)	2.90			Very dense, brown, silty, sandy, sub-angular to angular, fine to coarse, tabular GRAVEL of sandstone. [COMPLETELY WEATHERED PENNINE LOWER COAL MEASURES FORMATION].
							3.45			End of Borehole at 3.45m

Remarks

No groundwater recorded.

Borehole Log

Environmental Geotechnical Specialists

Borehole No. **WS04**

Sheet 1 of 1

Project Name: Dene House	Project No. C4025/23/E/6125	Co-ords:	Hole Type WLS
Location: North Road, Kirkburton, Huddersfield, West Yorkshire, HD8 0RW		Level:	Scale 1:50
Client: CoGri Group		Dates: 24/01/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
				87	65					MADE GROUND (Soft brown, slightly sandy, gravelly, silty CLAY. Sand is fine to coarse. Gravel is sub-angular to angular, fine to coarse of sandstone and bituminous material).
		1.00	SPT			N=6 (2,1/2,1,1,2)				
				77	80		1.55			
		1.85	D							Soft, greenish grey, silty CLAY. [RESIDUAL PENNINE LOWER COAL MEASURES FORMATION].
		2.00	SPT			N=5 (1,0/0,2,1,2)				*Black staining.*
				67	75		2.65			
		2.80	D							Soft, brown mottled grey and greenish grey, slightly sandy, slightly gravelly, silty, CLAY. Sand is fine. Gravel is sub-angular to angular, fine to medium of sandstone and occasional coal. [RESIDUAL PENNINE LOWER COAL MEASURES FORMATION].
		3.00	SPT			N=8 (2,2/1,2,2,3)				
				57	100					
		3.60	D							
		4.00	SPT			N=22 (4,6/5,4,6,7)	3.90			Firm to stiff greenish grey, slightly sandy, slightly gravelly, silty CLAY. Sand is fine to coarse. Gravel is sub-angular to angular, tabular, fine to coarse of sandstone. [RESIDUAL PENNINE LOWER COAL MEASURES FORMATION].
							4.45			End of Borehole at 4.45m

Remarks

No groundwater recorded.

AGS

Borehole Log

Environmental Geotechnical Specialists

Borehole No. **WS05**

Sheet 1 of 1

Project Name: Dene House	Project No. C4025/23/E/6125	Co-ords:	Hole Type WLS
Location: North Road, Kirkburton, Huddersfield, West Yorkshire, HD8 0RW		Level:	Scale 1:50
Client: CoGri Group		Dates: 24/01/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
				87	78		0.30			MADE GROUND (Soft, brown, slightly sandy, gravelly, silty CLAY. Sand is fine to coarse. Gravel is sub-angular to angular, fine to coarse of sandstone).
							0.60			MADE GROUND (Dark brown, sandy, sub-angular to angular, fine to coarse GRAVEL of ash, clinker and sandstone. Sand is fine to coarse).
		1.00	SPT			N=8 (2,1/2,2,2,2)				
				77	65		1.20			MADE GROUND (Soft, orangish brown, sandy, gravelly, silty CLAY. Sand is fine to coarse. Gravel is sub-angular to angular, fine to coarse of sandstone and occasional coal). [REWORKED]
		1.60	D				1.65			Soft, orangish brown mottled grey, slightly sandy, slightly gravelly, silty CLAY. Sand is fine. Gravel is sub-angular to angular, fine to medium of sandstone. [RESIDUAL PENNINE LOWER COAL MEASURES FORMATION].
		1.60	SPT			58 (6,16/58 for 0mm)	1.75			Brown, silty, sandy, angular to sub-angular, tabular fine to coarse GRAVEL of sandstone. Sand is fine to coarse. [COMPLETELY WEATHERED PENNINE LOWER COAL MEASURES FORMATION].
										End of Borehole at 1.75m

Remarks

No groundwater recorded.

AGS

Borehole Log

Borehole No. **WS06**

Sheet 1 of 1

Project Name: Dene House	Project No. C4025/23/E/6125	Co-ords:	Hole Type WLS
Location: North Road, Kirkburton, Huddersfield, West Yorkshire, HD8 0RW		Level:	Scale 1:50
Client: CoGri Group		Dates: 24/01/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.25			MADE GROUND (Brown silty, sandy, fine to coarse, tabular and angular to sub-angular GRAVEL of sandstone. Sand is fine to coarse). [REWORKED]
		0.60	D	87	100					Dense to very dense, brown, silty, sandy, sub-angular to angular, tabular, fine to coarse GRAVEL of sandstone. Sand is fine to coarse. [COMPLETELY WEATHERED PENNINE LOWER COAL MEASURES FORMATION].
		1.00	SPT			N=37 (5,6/7,9,9,12)				
		1.70	D	87	100					
		2.00	SPT			74 (17,26/74 for 150mm)	2.30			End of Borehole at 2.30m

Remarks

No groundwater recorded.

Borehole Log

Environmental Geotechnical Specialists

Borehole No. **WS07**

Sheet 1 of 1

Project Name: Dene House	Project No. C4025/23/E/6125	Co-ords:	Hole Type WLS
Location: North Road, Kirkburton, Huddersfield, West Yorkshire, HD8 0RW		Level:	Scale 1:50
Client: CoGri Group		Dates: 24/01/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.20			MADE GROUND (ASPHALT).
				87	100		0.30			MADE GROUND (Soft, brown, slightly sandy, gravelly, silty CLAY. Sand is fine to coarse. Gravel is sub-angular to angular, fine to coarse of brick, coal, limestone and sandstone).
		1.00	SPT			N=5 (1,1/1,1,1,2)				Soft to firm, orangish brown mottled grey, slightly sandy, slightly gravelly, silty CLAY. Sand is fine. Gravel is sub-angular to angular, tabular, fine to coarse of sandstone. [RESIDUAL PENNINE LOWER COAL MEASURES FORMATION].
		1.60	D	87	100					
		2.00	SPT			N=8 (1,1/1,2,2,3)				
		2.70	D	57	80					
		3.00	SPT			N=4 (1,1/1,1,1,1)				
		3.50	D	57	80					
		4.00	SPT			N=12 (2,2/3,2,3,4)				
							4.45			End of Borehole at 4.45m

1 2 3 4 5 6 7 8 9 10

Remarks

No groundwater recorded.

AGS

Borehole Log

Environmental Geotechnical Specialists

Borehole No. **WS08**

Sheet 1 of 1

Project Name:	Dene House	Project No. C4025/23/E/6125	Co-ords:	Hole Type WLS
Location:	North Road, Kirkburton, Huddersfield, West Yorkshire, HD8 0RW		Level:	Scale 1:50
Client:	CoGri Group		Dates: 24/01/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.05			MADE GROUND (ASPHALT).
				87	80					MADE GROUND (Brown, slightly sandy, angular to sub-angular, fine to coarse GRAVEL of sandstone).
		1.00	SPT			N=5 (4,2/1,1,1,2)				
		1.30	D				1.25			Soft, orangish brown mottled grey, slightly sandy, slightly gravelly, silty CLAY. Sand is fine. Gravel is sub-angular to angular, tabular, fine to coarse of sandstone. [RESIDUAL PENNINE LOWER COAL MEASURES FORMATION].
				77	100					
		1.70	D							
		2.00	SPT			60 (7,6/60 for 150mm)				
							2.30			End of Borehole at 2.30m

Remarks

No groundwater recorded.

AGS

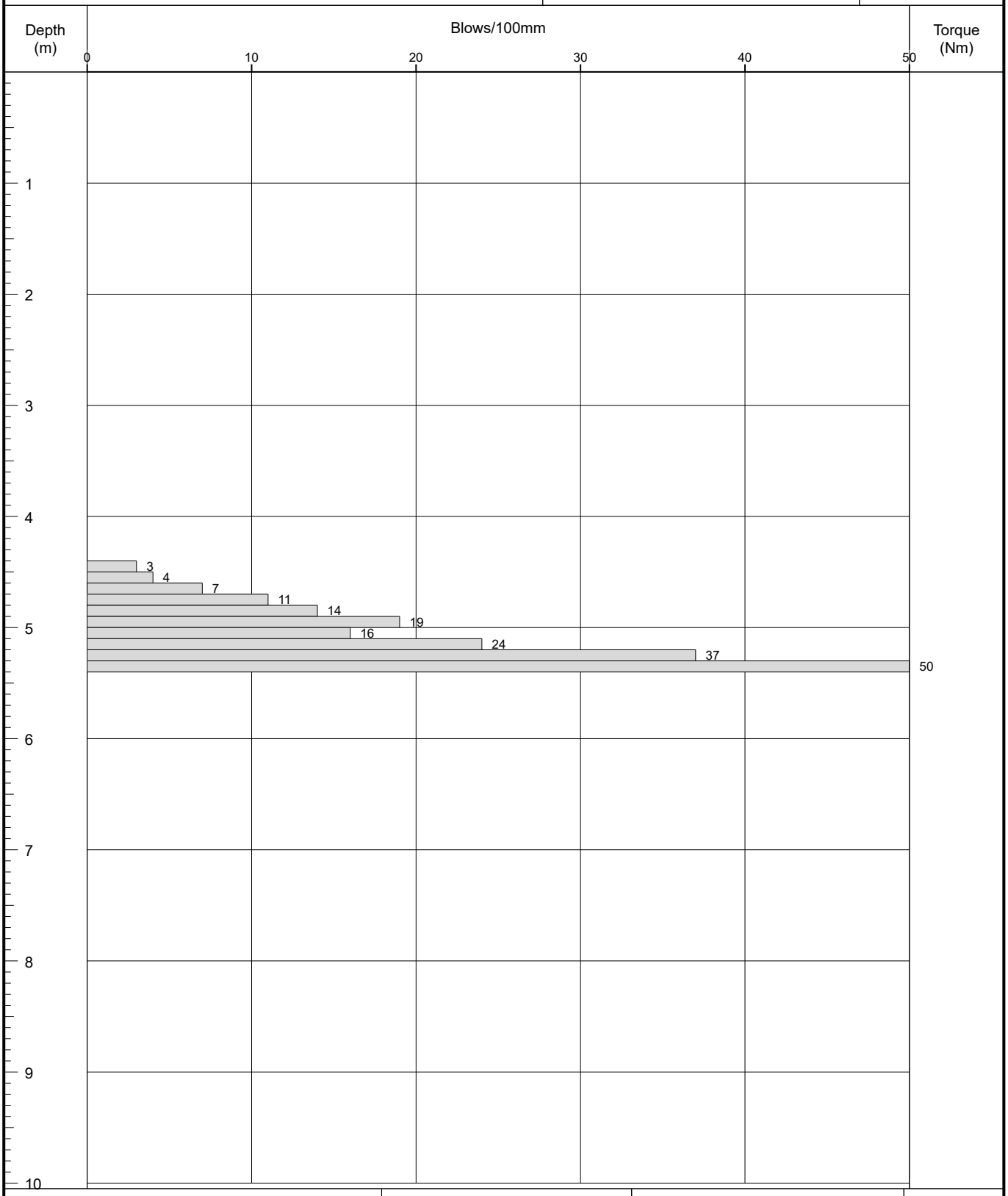
Appendix 3

Dynamic Probing Records

Probe Log

Probe No.
DP04
Sheet 1 of 1

Project Name: Dene House	Project No. C4025/23/E/6125	Co-ords:	Hole Type DCP
Location: North Road, Kirkburton, Huddersfield, West Yorkshire, HD8 0RW		Level:	Scale 1:50
Client: CoGri Group		Dates: 24/01/2024	Logged By BM



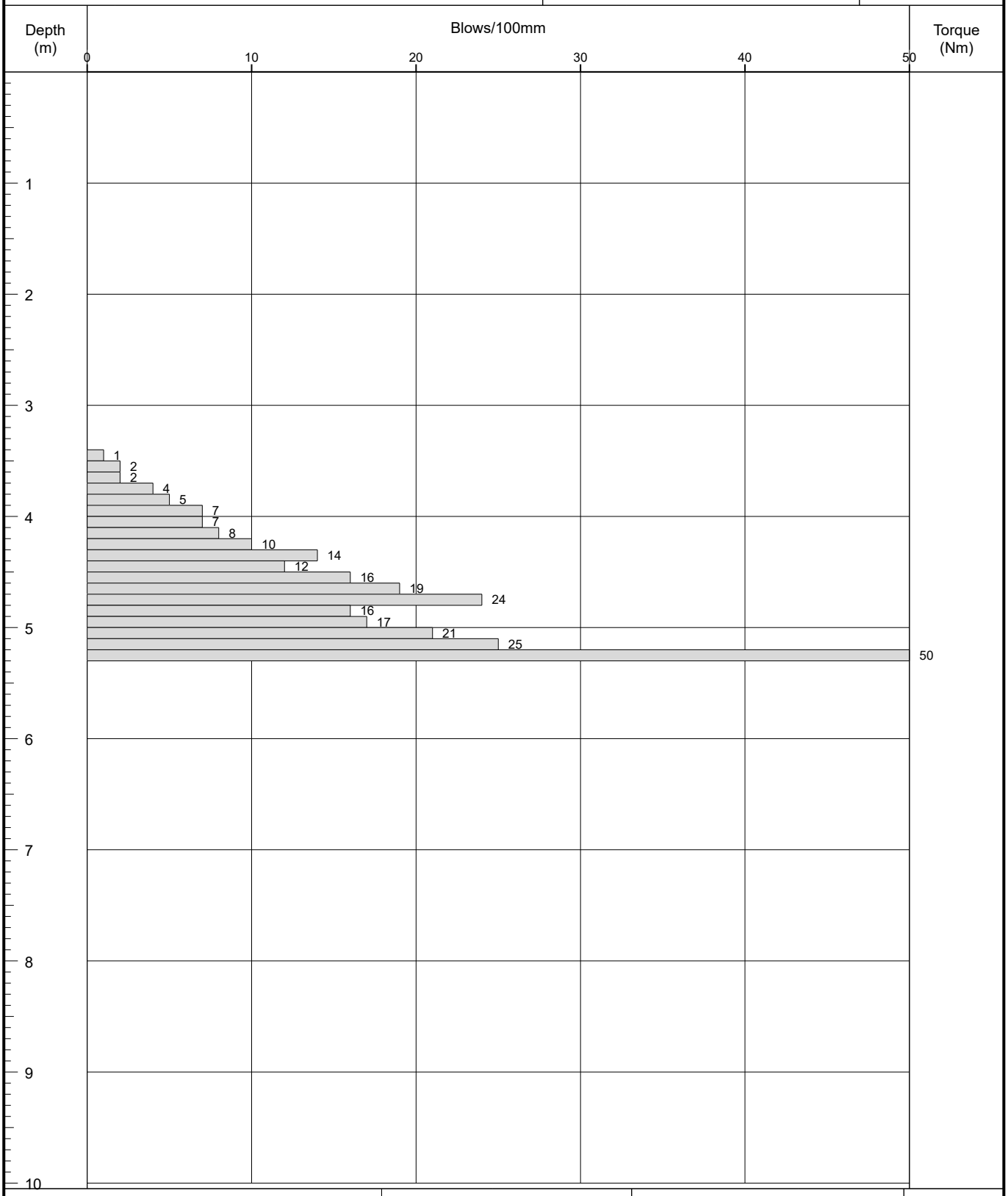
Remarks:
Commenced from 4.4m depth.

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	5.4m
Probe Type	DPSH-B		

Probe Log

Probe No.
DP07
Sheet 1 of 1

Project Name: Dene House	Project No. C4025/23/E/6125	Co-ords:	Hole Type DCP
Location: North Road, Kirkburton, Huddersfield, West Yorkshire, HD8 0RW		Level:	Scale 1:50
Client: CoGri Group		Dates: 24/01/2024	Logged By BM



Remarks:
Commenced from 3.4m depth.

Fall Height	750mm	Cone Base Diameter	50.5mm
Hammer Wt	63.5kg	Final Depth	5.3m
Probe Type	DPSH-B		

Appendix 4

Laboratory Testing

Environmental
Geotechnical
Specialists

LABORATORY REPORT

job number	C/4025/23/E/6125
date	20/02/2024
site address	Dene House North Road, Kirkburton, Huddersfield, West Yorkshire, HD8 0RW
date scheduled	30/01/2024
date issued	20/02/2024
issued by	H J Letch

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QMS ISO 9001 : 2015 REGISTERED Cert No. 14123657

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QMS ISO 45001 : 2018 REGISTERED Cert No. 14130281

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8948

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 Pt 12 : 2018 : 5.3 / 5.5	A	
ii. Saturation m/c of chalk	Pt 2 : 3.3			U
1.2 Index Properties				
i. Liquid limit – cone penetrometer	Pt 2 : 4.3		A	
ii. Plastic limit	Pt 2 : 5.3		A	
iii. Shrinkage limit	Pt 2 : 6.3			U
iv. Linear shrinkage	Pt 2 : 6.5		A	
1.3 Particle Density				
i. Gas jar	Pt 2 : 8.2		A	
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		A	
- CBR mould	Pt 4 : 3		A	
ii. 4.5kg rammer – 1 litre mould	Pt 4 : 3		A	
- CBR mould	Pt 4 : 3		A	
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		A	
ii. Recompacted sample	Pt 5 : 7		A	
iii. Soaked, inc measurement of swell	Pt 5 : 7		A	
4. COMPRESSIBILITY OF SOIL	**BS 1377-5:1990**			
i. One dimensional consolidation	Pt 5 : 3		A	
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		A	
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

RGS Environmental Geotechnical Specialists
Rogers Geotechnical Services Ltd
Offices 1 & 2 Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU
01484 604354 Company No. 5130864

Disclaimer

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

GEOTECHNICAL TESTING RESULTS

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Summary of Classification Test Results

Project No.
C4025/23/E/6125

Project Name
Dene House

Hole No.	Sample Ref	Top	Base	Type	Soil Description	Density bulk Mg/m³	Density dry Mg/m³	w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m³	Cone 80g/30° 60g/60°	Water Increase Decrease	Date
WS01	2	1.90		D	Soft becoming hard, orangish brown mottled grey, slightly sandy, gravelly, silty CLAY.			31	96	46 -1pt	24	22		80g/30deg	Increase	30-Jan
WS02	3	1.20		D	Soft, orangish brown mottled grey, slightly sandy, gravelly, silty CLAY.			20	86	42 -1pt	22	20		80g/30deg	Increase	30-Jan
WS02	4	1.70		D	Very dense, brown, clayey, silty, sandy, fine to coarse, tabular and angular to sub-angular GRAVEL			11	23	44 -1pt	25	19		80g/30deg	Increase	30-Jan
WS03	6	1.80		D	Soft, greenish grey, silty CLAY.			33	91	64 -1pt	39	25		80g/30deg	Increase	30-Jan
WS03	7	2.50		D	Soft, orangish brown mottled grey, slightly sandy, slightly gravelly, silty CLAY.			33	94	48 -1pt	22	26		80g/30deg	Increase	30-Jan
WS04	8	1.85		D	Soft, greenish grey, silty CLAY.			32	100	51 -1pt	34	17		80g/30deg	Increase	30-Jan
WS04	9	2.80		D	Soft, brown mottled grey and greenish grey, slightly sandy, slightly gravelly, silty, CLAY.			30	100	49 -1pt	27	22		80g/30deg	Increase	30-Jan
WS04	10	3.60		D	Soft, brown mottled grey and greenish grey, slightly sandy, slightly gravelly, silty, CLAY.			38	93	52 -1pt	31	21		80g/30deg	Increase	30-Jan
WS05	11	1.60		D	Soft, orangish brown mottled grey, slightly sandy, slightly gravelly, silty CLAY.			21	91	49 -1pt	26	23		80g/30deg	Increase	30-Jan
WS06	12	0.60		D	Dense to very dense, brown, silty, sandy, fine to coarse, tabular and angular to sub-angular GRAVEL			9.5	16	46 -1pt	26	20		80g/30deg	Increase	30-Jan
WS06	13	1.70		D	Dense to very dense, brown, silty, sandy, fine to coarse, tabular and angular to sub-angular GRAVEL			9.7	17	43 -1pt	28	15		80g/30deg	Increase	30-Jan
WS07	14	1.60		D	Soft to firm, orangish brown mottled grey, slightly sandy, slightly gravelly, silty CLAY.			27	100	49 -1pt	26	23		80g/30deg	Increase	30-Jan
WS07	15	2.70		D	Soft to firm, orangish brown mottled grey, slightly sandy, slightly gravelly, silty CLAY.			21	100	40 -1pt	19	21		80g/30deg	Increase	30-Jan
WS07	16	3.50		D	Soft to firm, orangish brown mottled grey, slightly sandy, slightly gravelly, silty CLAY.			27	96	41 -1pt	22	19		80g/30deg	Increase	30-Jan
WS08	18	1.70		D	Soft, orangish brown mottled grey, slightly sandy, slightly gravelly, silty CLAY.			24	89	38 -1pt	23	15		80g/30deg	Increase	30-Jan

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

Key

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

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

Particle density
sp - small pyknometer
gj - gas jar

Date Printed
07/02/2024

Approved By
Harry

Table 1

sheet 1

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

Classification of Index Properties

C4025/23/E/6125

Project Name: Dene House

BS EN ISO: 17892: Parts 1, 12

Fig. 2 | Sheet. 1

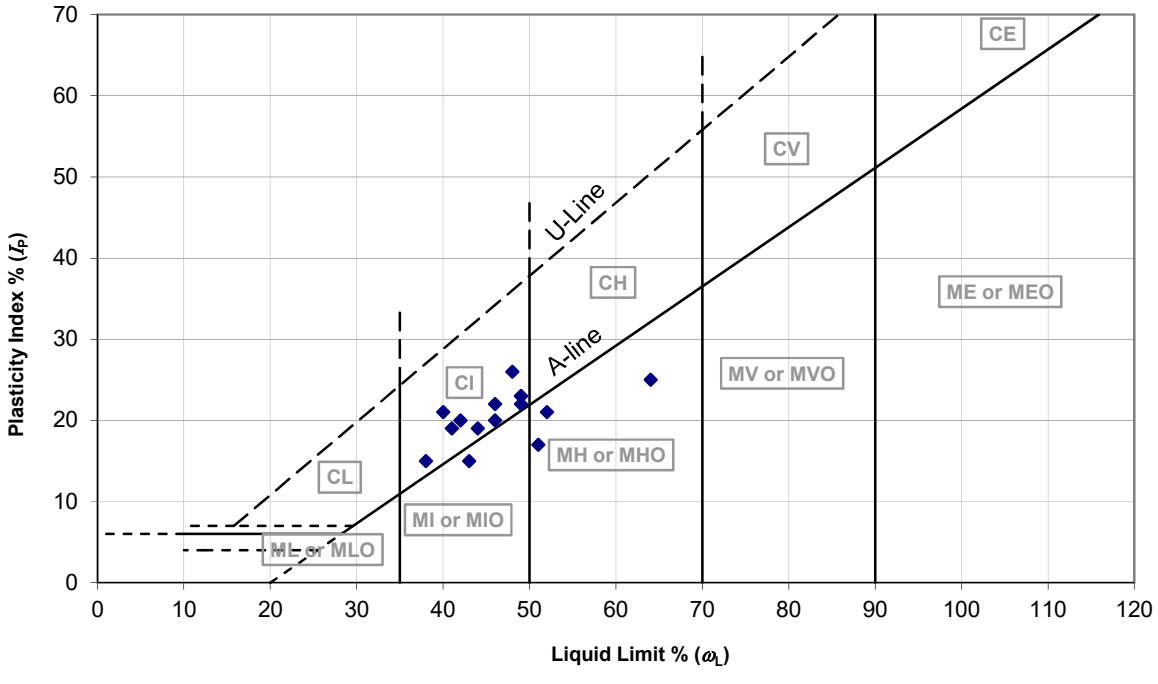
Location: Kirkburton

Input By: Harry

Client: CoGri Group

Check By: Harry

Location	Depth (m)	Water Content (ω) (%)	Liquid Limit (ω_L) (%)	Plastic Limit (ω_P) (%)	Plasticity Index (I_P) (%)	Retained by 0.425mm (%)	Modified (ω) (ω') (%)	Modified (I_P) (I_P') (%)	Liquidity/ Consistency (I_L) (%)	Liquidity/ Consistency (I_C) (%)	Casagrande Class	N.H.B.C Class (%)
WS01	1.90	31.4	46	24	22	4	33	21	0.3	0.7	C I	MEDIUM
WS02	1.20	20.4	42	22	20	14	24	17	-0.1	1.1	C I	LOW
WS02	1.70	10.9	44	25	19	77	47	4	-0.7	1.7	C I	*
WS03	1.80	32.5	64	39	25	9	36	23	-0.3	1.3	M H	MEDIUM
WS03	2.50	32.6	48	22	26	6	35	24	0.4	0.6	C I	MEDIUM
WS04	1.85	31.5	51	34	17	0	32	17	-0.1	1.1	M H	LOW
WS04	2.80	30.1	49	27	22	0	30	22	0.1	0.9	C I	MEDIUM
WS04	3.60	38.4	52	31	21	7	41	20	0.4	0.6	M H	LOW
WS05	1.60	21.4	49	26	23	9	24	21	-0.2	1.2	C I	MEDIUM
WS06	0.60	9.5	46	26	20	84	59	3	-0.8	1.8	C I	*
WS06	1.70	9.7	43	28	15	83	57	3	-1.2	2.2	M I	*
WS07	1.60	26.5	49	26	23	0	27	23	0.0	1.0	C I	MEDIUM
WS07	2.70	21.4	40	19	21	0	21	21	0.1	0.9	C I	MEDIUM
WS07	3.50	26.8	41	22	19	4	28	18	0.3	0.7	C I	LOW
WS08	1.70	23.9	38	23	15	11	27	13	0.1	0.9	C I	LOW



Summary of Geotechnical Chemical Test Results

Project No.	Project Name
C4025/23/E/6125	Dene House

Hole No.	Sample				Soil Description	Org	LOI	pH	Sulphate as SO_4			Chloride, Cl		CO_2	TDS	<2mm	Remarks
	Ref	Top	Base	Type					Total acid sol.	2:1 water :soil	ground water	water sol.	acid sol.				
						%	%		%	g/l	g/l	%	%	%	mg/l	%	
WS01	1	1.30		D	Soft, brown, slightly sandy, gravelly, silty CLAY.			7.63		0.06							
WS03	5	1.00	1.45	D	Soft, alternating brown and dark brown, slightly sandy.			8		0.04							
WS08	17	1.30		D	Soft, orangish brown mottled grey, slightly sandy, slightly			7.71		0.03							

Key

Tests performed in accordance with BS 1377 unless annotated otherwise

Org Organic matter content

LOI Mass loss on ignition at 440°C

Cl Chloride content

CO_2 Carbonate content (rapid titration)

TDS Total Dissolved Solids

Date Printed	Approved By	Table
07/02/2024	HJL	3
		sheet 1

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ENVIRONMENTAL TESTING RESULTS

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Watford,
Herts,
WD18 8YS

t: 01923 225404
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e: reception@i2analytical.com

Analytical Report Number : 24-001329

Project / Site name:	Dene House	**Samples received on:**	02/02/2024
Your job number:	C4025 24 E	**Samples instructed on/ Analysis started on:**	02/02/2024
Your order number:	RGS4025	**Analysis completed by:**	12/02/2024
Report Issue Number:	1	**Report issued on:**	13/02/2024
Samples Analysed:	3 soil samples		

Signed:

Joanna Szwagrzak
Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 24-001329
Project / Site name: Dene House

Lab Sample Number				108572	108573	108574
Sample Reference				WS02	WS04	WS05
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.20	0.30
Date Sampled				30/01/2024	30/01/2024	30/01/2024
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	19	17	16
Total mass of sample received	kg	0.1	NONE	0.8	0.8	0.7
Asbestos						
Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	SPU	SPU	SPU
General Inorganics						
pH (L099)	pH Units	N/A	MCERTS	8.1	8.6	8.3
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	%	0.005	MCERTS	0.096	0.174	0.064
Water Soluble Sulphate as SO4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	47	220	180
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	23.6	108	88.1
Organic Matter (automated)	%	0.1	MCERTS	6.8	2.2	1.1
Total Phenols						
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Speciated PAHs						
Naphthalene	mg/kg	0.05	MCERTS	0.2	0.15	0.16
Acenaphthylene	mg/kg	0.05	MCERTS	0.19	0.41	0.11
Acenaphthene	mg/kg	0.05	MCERTS	0.13	0.54	0.07
Fluorene	mg/kg	0.05	MCERTS	0.16	0.48	0.17
Phenanthrene	mg/kg	0.05	MCERTS	2.3	4.8	1.3
Anthracene	mg/kg	0.05	MCERTS	0.46	1.3	0.17
Fluoranthene	mg/kg	0.05	MCERTS	5.5	10	0.92
Pyrene	mg/kg	0.05	MCERTS	5	9.3	0.73
Benzo(a)anthracene	mg/kg	0.05	MCERTS	2.9	5.7	0.32
Chrysene	mg/kg	0.05	MCERTS	3.1	5.1	0.38
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	4.1	5.9	0.32
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	1.3	2.4	0.11
Benzo(a)pyrene	mg/kg	0.05	MCERTS	3.3	5.3	0.25
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	1.7	2.1	0.12
Dibenzo(a,h)anthracene	mg/kg	0.05	MCERTS	0.41	0.66	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	1.7	2.3	0.13
Total PAH						
Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	32.4	56.3	5.24

Analytical Report Number: 24-001329
Project / Site name: Dene House

Lab Sample Number				108572	108573	108574
Sample Reference				WS02	WS04	WS05
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.20	0.30
Date Sampled				30/01/2024	30/01/2024	30/01/2024
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Heavy Metals / Metalloids						
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	62	21	11
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8
Copper (aqua regia extractable)	mg/kg	1	MCERTS	110	64	19
Lead (aqua regia extractable)	mg/kg	1	MCERTS	730	410	56
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	1.8	0.5	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	34	24	31
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	55	31	24
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	370	150	94
Petroleum Hydrocarbons						
TPHCWG - Aliphatic >C5 - C6 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C6 - C8 HS_1D_AL	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >C8 - C10 HS_1D_AL	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050
TPHCWG - Aliphatic >C10 - C12 EH_CU_1D_AL_#1_#2	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPHCWG - Aliphatic >C12 - C16 EH_CU_1D_AL_#1_#2	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0
TPHCWG - Aliphatic >C16 - C21 EH_CU_1D_AL_#1_#2	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0
TPHCWG - Aliphatic >C21 - C35 EH_CU_1D_AL_#1_#2	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0
TPHCWG - Aliphatic >C5 - C35 EH_CU+HS_1D_AL_#1_#2	mg/kg	10	NONE	< 10	< 10	< 10
TPHCWG - Aliphatic >C6 - C35 EH_CU+HS_1D_AL_#1_#2	mg/kg	10	NONE	< 10	< 10	< 10
TPHCWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050
TPHCWG - Aromatic >EC10 - EC12 EH_CU_1D_AR_#1_#2	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPHCWG - Aromatic >EC12 - EC16 EH_CU_1D_AR_#1_#2	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0
TPHCWG - Aromatic >EC16 - EC21 EH_CU_1D_AR_#1_#2	mg/kg	10	MCERTS	11	24	< 10
TPHCWG - Aromatic >EC21 - EC35 EH_CU_1D_AR_#1_#2	mg/kg	10	MCERTS	40	43	< 10
TPHCWG - Aromatic >EC5 - EC35 EH_CU+HS_1D_AR_#1_#2	mg/kg	10	NONE	52	66	< 10
VOCs						
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
o-Xylene	µg/kg	5	NONE	< 5.0#	< 5.0#	< 5.0#

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 24-001329
Project / Site name: Dene House

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
108572	WS02	None Supplied	0.3	Brown loam and sand with gravel and vegetation
108573	WS04	None Supplied	0.2	Brown sandy clay with gravel
108574	WS05	None Supplied	0.3	Brown clay and sand

Analytical Report Number : 24-001329
Project / Site name: Dene House

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in Soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques	In-house method based on HSG 248, 2021	A001B	D	ISO 17025
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L009B	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L038B	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES	In-house method	L038B	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Sulphate, water soluble, in soil (16hr extraction)	In-house method	L038B	D	MCERTS
Speciated EPA-16 PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L076B/L088	D/W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method	L080	W	MCERTS
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	MCERTS
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099	D	MCERTS

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

- Data reported unaccredited due to quality control parameter failure associated with this result; other checks applied prior to reporting the data have been

Analytical Report Number : 24-001329
Project / Site name: Dene House

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status

accepted. The result should be considered as being deviating and may be compromised

End of Report

RGS Environmental Geotechnical Specialists
Rogers Geotechnical Services Ltd
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Rogers Geotechnical Services: Soil Screening Values Comparison Sheet

Rogers Geotechnical Services Ltd: Soil Screening Value (SSV) Comparison Sheet

Job Number	C4025/23/E/6125
Job Name	Dene House, North Road, Kirkburton
Date	22/02/24
Client	CoGri Group

A = WS Atkins PLC, Atrisk Soil Screening Values.
A+ = Values updated June 2017.
A* = Atrisk's SSV is lower than i2's detectable limit for this compound.
B = health criterion values, which are available from toxicological reviews published in the C4SL project methodology report.
C = Category 4 Screening Levels (C4SLs) based on 6% soil organic matter.
D = Value provided is based on Methyl Mercury. Should elemental mercury be observed or a source be known then a limit of 102 should be used.

KEY
- Exceeds SSV
- Exceeds 2017, Below 2015
- Below limit of detection (LOD)

Determinand	Units	Ref	LOD	Commercial 1%		Sample Location	WS02	WS04	WS05							
				Atrisk 2015 (No Free Product	Atrisk 2017	Depth Top	0.30	0.20	0.30							
						Depth Base										
Cadmium	mg/kg	C	0.2		410		< 0.2	< 0.2	< 0.2							
Chromium (Hexavalent)	mg/kg	B/C	1.8	49.1	19.7		< 1.8	< 1.8	< 1.8							
Copper	mg/kg	A+	1.0		106000		110	64	19							
Mercury	mg/kg	A/D	0.3		350		1.8	0.5	< 0.3							
Nickel	mg/kg	A+	1.0		1770		34	24	31							
Lead	mg/kg	C	1.0		2310		730	410	56							
Zinc	mg/kg	A+	1.0		1100000		370	150	94							
Vanadium	mg/kg	A+	1.0		7490		55	31	24							
Arsenic	mg/kg	C	1.0		635		62	21	11							
Selenium	mg/kg	A	1.0		13000		< 1.0	< 1.0	< 1.0							
Cyanide (Free)	mg/kg	A	1.0		373		< 1.0	< 1.0	< 1.0							
Total Phenols	mg/kg	A	1.0		685		< 1.0	< 1.0	< 1.0							
Naphthalene	mg/kg	A+	0.05	90.1	75		0.2	0.15	0.16							
Acenaphthylene	mg/kg		0.05				0.19	0.41	0.11							
Acenaphthene	mg/kg	A+	0.05	83600	156.8		0.13	0.54	0.07							
Fluorene	mg/kg	A+	0.05		66500		0.16	0.48	0.17							
Phenanthrene	mg/kg		0.05				2.3	4.8	1.3							
Anthracene	mg/kg	A+	0.05		535000		0.46	1.3	0.17							
Fluoranthene	mg/kg	A+	0.05		72200		5.5	10	0.92							
Pyrene	mg/kg	A+	0.05		54100		5	9.3	0.73							
Benzo[a]anthracene	mg/kg	A	0.05	131	1.71		2.9	5.7	0.32							
Chrysene	mg/kg	A	0.05	14000	0.44		3.1	5.1	0.38							
Benzo[b]fluoranthene	mg/kg	A	0.05	142	1.22		4.1	5.9	0.32							
Benzo[k]fluoranthene	mg/kg	A	0.05	1430	0.686		1.3	2.4	0.11							
Benzo[a]pyrene	mg/kg	B/C	0.05	76.3	26.1		3.3	5.3	0.25							
Indeno(1,2,3-c,d)Pyrene	mg/kg	A*	0.05	142	0.0614		1.7	2.1	0.12							
Dibenz(a,h)Anthracene	mg/kg	A	0.05	14.3	0.00393		0.41	0.66	< 0.05							
Benzo[g,h,i]perylene	mg/kg	A	0.05	1440	0.0187		1.7	2.3	0.13							
Total Of 16 PAH's	mg/kg		0.8				32.4	56.3	5.24							
Aliphatic TPH >C5-C6	mg/kg	A+	0.02	4490	327		< 0.020	< 0.020	< 0.020							
Aliphatic TPH >C6-C8	mg/kg	A+	0.02	10400	157		< 0.020	< 0.020	< 0.020							
Aliphatic TPH >C8-C10	mg/kg	A+	0.05	1370	82.4		< 0.050	< 0.050	< 0.050							
Aliphatic TPH >C10-C12	mg/kg	A+	1.0	7900	49.9		< 1.0	< 1.0	< 1.0							
Aliphatic TPH >C12-C16	mg/kg	A+	2.0	34000	20.9		< 2.0	< 2.0	< 2.0							
Aliphatic TPH >C16-C21	mg/kg	A+	8.0		3620000		< 8.0	< 8.0	< 8.0							
Aliphatic TPH >C21-C35	mg/kg	A+	8.0		3620000		< 8.0	< 8.0	< 8.0							
Aliphatic TPH >C35-C44	mg/kg		10.0													
Total Aliphatic Hydrocarbons	mg/kg		10.0				< 10	< 10	< 10							
Aromatic TPH >C5-C7	mg/kg	A+	0.01		12.5		< 0.010	< 0.010	< 0.010							
Aromatic TPH >C7-C8	mg/kg	A+	0.01	27900	834		< 0.010	< 0.010	< 0.010							
Aromatic TPH >C8-C10	mg/kg	A+	0.05	2210	613		< 0.050	< 0.050	< 0.050							

Rogers Geotechnical Services: Soil Screening Values Comparison Sheet

Rogers Geotechnical Services Ltd: Soil Screening Value (SSV) Comparison Sheet

Job Number	C4025/23/E/6125			A = WS Atkins PLC, Atrisk Soil Screening Values. A+ = Values updated June 2017. A* = Atrisk's SSV is lower than i2's detectable limit for this compound. B = health criterion values, which are available from toxicological reviews published in the C4SL project methodology report. C = Category 4 Screening Levels (C4SLs) based on 6% soil organic matter. D = Value provided is based on Methyl Mercury. Should elemental mercury be observed or a source be known then a limit of 102 should be used.												
Job Name	Dene House, North Road, Kirkburton															
Date	22/02/24			**Sample Location**		WS02	WS04	WS05								
Client	CoGri Group			Depth Top		0.30	0.20	0.30								
				Depth Base												
Determinand	**Units**	**Ref**	**LOD**	**Commercial 1%**												
Aromatic TPH >C10-C12	mg/kg	A+	1.0	12300	369	< 1.0	< 1.0	< 1.0								
Aromatic TPH >C12-C16	mg/kg	A+	2.0	41300	155	< 2.0	< 2.0	< 2.0								
Aromatic TPH >C16-C21	mg/kg	A+	10.0		28400	11	24	< 10								
Aromatic TPH >C21-C35	mg/kg	A+	10.0		28400	40	43	< 10								
Aromatic TPH >C35-C44	mg/kg		10.0													
Total Aromatic Hydrocarbons	mg/kg		10.0			52	66	< 10								
Total Petroleum Hydrocarbons	mg/kg		10.0													
pH			N/A			**8.1**	**8.6**	8.3								
Sulphate (2:1 Water Soluble) as SO4	mg/l		0.00125			**23.6**	**108**	88.1								
ACM Type			N/A													
Asbestos Identification	%					None	None	None								
ACM Detection Stage			N/A													
Moisture	%		0.01													
Soil Colour			N/A													
Other Material			N/A													
Soil Texture			N/A													
Sulphate (Total)	%		0.005			0.096	0.174	0.064								
Organic Matter	%		0.1			**6.8**	2.2	**1.1**								

KEY

- Exceeds SSV
- Exceeds 2017, Below 2015
- Below limit of detection (LOD)

Appendix 5

Fill Screening Values

Rogers Geotechnical Services Ltd.

Atkins ATRISK Soil Screening Values (SSVs) - Commercial Landuse

Tox Data Report No.	Compound	Commercial (mg/kg)				Reference
	Metals	1% SOM		6% SOM		
3	Cadmium	410		410		C
4	Chromium VI	19.7	49.1	19.7	49.1	B/C
	Copper	106000		106000		A+
7	Mercury	350.00		405.00		A/D
8	Nickel	1770		1770		A+
	Lead	2310		2310		C
	Zinc	1100000		1100000		A+
	Vanadium	7490		7490		A+
	Semi and Non Metals					
1	Arsenic	635		635		C
10	Selenium	13000		13000		A
	Free Cyanide	373		373		A
9	Phenols (total)	685		3170		A
	Poly Aromatic Hydrocarbons	Free product	No free produc	Free product	No free product	
20	Naphthalene	75	90.1	432	1050	A+
	Acenaphthene	156.8	83600	106000		A+
	Fluorene	66500		72000		A+
	Anthracene	535000		544000		A+
	Fluoranthene	72200		72600		A+
	Pyrene	54100		54400		A+
	Benzo(a)anthracene	1.71	131	10.3	142	A
2	Chrysene	0.44	14000	2.64	14300	A
2	Benzo(b)fluoranthene	1.22	142	7.29	144	A
2	Benzo(k)fluoranthene	0.686	1430	4.12	1440	A
2	Benzo(a)pyrene	26.1	76.3	26.2	76.3	B/C
2	Dibenz(a,h)anthracene	0.00393	14.3	0.0236	14.4	A*
2	Indeno(1,2,3-cd)pyrene	0.0614	142	0.368	144	A*
2	Benzo(g,h,i)perylene	0.0187	1440	0.112	1450	A*
	Petroleum Hydrocarbons					
	Aliphatic C5-C6	327	4490	1100	29400	A+
	Aliphatic C6-C8	157	10400	769	98200	A+
	Aliphatic C8-C10	82.4	1370	476	14800	A+
	Aliphatic C10-C12	49.9	7900	297	69500	A+
	Aliphatic C12-C16	20.9	34000	126	139000	A+
	Aliphatic C16-C21	3620000		3620000		A+
	Aliphatic C21-C35	3620000		3620000		A+
	Aromatic C5-C7 (Benzene)	12.5		98		A+
	Aromatic C7-C8 (Toluene)	834	27900	4360	183000	A+
	Aromatic C8-C10	613	2210	3600	20800	A+
	Aromatic C10-C12	369	12300	2190	53800	A+
	Aromatic C12-C16	155	41300	65400		A+
	Aromatic C16-C21	28400		28400		A+
	Aromatic C21-C35	28400		28400		A+
	Others					
	pH	-		-		-
	Organic Content (%)	-		-		-
	Soluble Sulphate (mg/l)	-		-		-
	Total Sulphate (%)	-		-		-
	Asbestos	-		-		-

A = WS ATKINS PLC, ATRISK SOIL SCREENING VALUES BASED ON 1% SOIL ORGANIC MATTER

A+ = Values updated June 2017.

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

B = health criterion values, which are available from toxicological reviews published in the C4SL project methodology report.

C = Category 4 Screening Levels (C4SLs) based on 1% soil organic matter.

D - Value provided is based on Methyl Mercury. Should elemental mercury be observed or a source be known then a limit of 7.95 should be used.