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VALIDATION REPORT

ABM DEVELOPMENTS

RESIDENTIAL DEVELOPMENT

LEEDS ROAD

MIRFIELD

WEST YORKSHIRE

WF14 0JE

Project No: 24-095

Prepared By:

Geoff Heron

Date: 21st March 2024

Approved By:

Darren McGrath

Date: 21st March 2024

CONTENTS

APPENDICES

1.0 Introduction

March 2024

Following completion of the Remediation Strategy produced for this site by Beam Consulting (Ref. 141-18-DOC004, June 2023, copy in Appendix IV), Arc Environmental Limited (ARC) were requested by ABM Developments, to compile a Validation Report for the remediation works completed for the residential development at Leeds Road, within the Mirfield area of West Yorkshire. The development comprises the construction of 14 no. residential dwellings with private gardens and car parking facilities, with this Validation Report focusing solely on the clean cover aspect of the development within the private gardens of all Plots across the site.

2.0 Site Details

Table 2.1

Site Name & Address:	Leeds Road, Mirfield, West Yorkshire, WF14 0JE.
OS Grid Reference:	419842, 422072 – representative of the centre of the site.
Description of Location:	The site is situated within a residential setting adjacent to Leeds Road, approximately 1km north of Mirfield Centre.
Site boundaries:	N = Teales Recovery Garage with open arable land and residential dwellings with private gardens beyond, E = Residential dwellings with private gardens and arable land beyond, S = Residential dwellings with private gardens and W = Residential dwellings with private gardens and arable land beyond.
Site Setting:	Predominantly residential setting.

3.0 Scope of Works

Table 3.1

Client:	ABM Developments.
Validation Consultant:	ARC Environmental Limited.
Project type:	Proposed Residential housing development with private gardens.
Site Location plan:	See Appendix I.
Layout plan (existing):	See Appendix I.
Layout plan (proposed):	See Appendix I.
Reporting:	Verification of remediation works (Validation) comprising the emplacement of a clean cover system within all private gardens.
Related Reports:	Remediation Strategy, Beam Consulting, Ref. 141-18-DOC004, June 2023 and Gas Validation Report, Geoshield, November 2023.

The information contained in this report is limited to the areas of soft landscaping included within the proposed development, as indicated on the Proposed Development Site Layout Plan (Appendix I). This Validation Report refers to the remediation works required for this site by the installation of a clean cover system. When considering the full scope of the development any features and / or issues not specifically mentioned in this report cannot be assumed to have been covered.

4.0 Remediation Strategy Summary

4.1 Hazardous Ground Gas Protective Measures: -

From the results of the hazardous ground gas risk assessment and in accordance with CIRIA C665, it was determined that the installation of gas protective measures to meet a Characteristic Situation 2 (CS2) or Amber 1 (NHBC traffic light system)) classification were required for this development in order to negate any risk to the proposed end users.

4.0 Remediation Strategy Summary (Cont'd)

4.2 Clean Cover: -

These works were completed in line with 'Clean Cover in Landscaped Areas' requirement contained within the Remediation Strategy report produced for this site. The emplacement of a clean cover barrier system comprising a minimum thickness of c.0.45m sub-soil and c.0.15m topsoil will prevent any future penetration by the end users (in order to prevent significant human, root or animal penetration). This will remove any future risk to end users (residents) from any ground contamination remaining on site.

The following points summarise the remedial works required for this site as detailed within the Remediation Strategy compiled for this site: -

- Photographic evidence of the minimum thickness c.600mm of clean cover materials.
- Verification screening of imported materials for all areas of soft landscaping.

5.0 Validation of Remediation Works

5.1 Watching Brief: -

As part of these works, a 'watching brief' was undertaken across the site for any potential evidence of unknown or unforeseen contamination particularly during the site preparatory works including foundation and service excavations. There was no unknown or unforeseen contamination encountered during the construction phase.

5.2 Validation of Gas Protection Measures: -

The installation of the required gas protective measures has been undertaken and validated separately by others and their Gas Validation Report is attached in Appendix V.

5.3 Emplacement of Clean Cover System: -

As outlined within the Remediation Strategy, a clean cover system is required for areas of private gardens and soft landscaping within this development.

The origin of the imported topsoil materials was not provided and therefore it is assumed to have originated from a Brownfield source. An overall volume of circa 60m^3 of topsoil was imported to site. This material was characterised as a Brownfield soil, as indicated by the YALPAG Guidance Verification Requirements for Cover Systems (Version 4.1, June 2021).

Although pre-importation screening results for the stone sub-soil were provided, they related only to asbestos screening. The sub-base was purported to be a mixture of Type 1 sub-base recycled aggregate and recycled 6F5 from a site at Whitehall Road, Leeds and was provided by BWS Waste Management. Although not provided, it is understood delivery tickets are available upon request.

5.0 Validation of Remediation Works (Cont'd)

5.4 Validation of Clean Cover System: -

ARC undertook both mechanically and manually excavated trial pits to verify the thickness of the clean cover and recover samples of both the topsoil and stone sub-soil for confirmatory screening. At this time, an inspection of the materials was undertaken to confirm there was no obvious visual and / or olfactory evidence of potential contamination or deleterious materials (i.e. glass, ash, fuels, etc.).

A minimum thickness of c.0.60m of stone sub-soil was confirmed in Plots 2, 3, 4, 5, 6 & 14 and an overall thickness of c.0.60m including c.0.15 of topsoil in Plots 8 & 12. A minimum thickness of topsoil was confirmed as c.0.15m in Plot 10. A further 3 no. samples were recovered from a topsoil stockpile. The Trial Pit & Sampling Location Plan can be seen in Appendix I and Photographic Record Sheets in Appendix II.

In total 9 no. samples were recovered, 6 no. imported topsoil and 3 no. stone sub-soil. The samples were stored at approximately 4^0C using cool boxes and ice packs prior to delivery to a UKAS / MCERTS accredited laboratory at Chemtech Environmental of Stanley, Co. Durham. The samples were screened as defined within the YALPAG guidance - Verification Requirements for Cover Systems.

A summary of the results for the materials can be seen in Table 5.1 below and continues on the following page. The results can also be seen in the Chemtech Environmental Limited analytical test report (Ref. 130553) which are included in Appendix III.

Table 5.1

Analyte	Critical Conc. (C_C)	No. of Samples Screened	Max. Conc. (C_M) recorded (Clean Cover)
Arsenic	37[1]	9	32
Cadmium	11[1]	9	1.7
Chromium III	910[1]	9	65
Chromium VI	6[1]	9	0.07
Copper	2400[1]	9	58
Lead	200[2]	9	**266 (Topsoil stockpile)**
Mercury	40[1]	9	<0.07
Selenium	250[1]	9	<3
Nickel	180[1]	9	27
Zinc	3700[1]	9	326
Cyanide	34[3]	9	<1
Acenaphthene	510[1]	9	1.41
Acenaphthylene	420[1]	9	0.04
Anthracene	5400[1]	9	2.25
Benzo(a)anthracene	11[1]	9	5.54
Benzo(a)pyrene	2.7[1]	9	**4.84 (Plot 3 Stone sub-soil)**
Benzo(b)fluoranthene	3.3[1]	9	**5.36 (Plot 3 Stone sub-soil)**
Benzo(ghi)perylene	340[1]	9	3.00
Benzo(k)fluoranthene	93[1]	9	2.53
Chrysene	22[1]	9	5.90
Dibenz(ah)anthracene	0.28[1]	9	**0.72 (Plot 3 Stone sub-soil)**
Fluoranthene	560[1]	9	12.72
Fluorene	400[1]	9	0.98

[1] = The LQM / CIEH Suitable 4 Use Levels – Residential with homegrown produce (2.5% SOM), [2] = CL:AIRE Category 4 Screening Levels – Residential with homegrown produce, [3] = ATRISK^{SOIL} Soil Screening Values (2015).

5.0 Validation of Remediation Works (Cont'd)

5.4 Validation of Clean Cover System (Cont'd):

Table 5.1 (Cont'd)

Analyte	Critical Conc. (C_C)	No. of Samples Screened	Max. Conc. (C_M) recorded (Clean Cover)
Indeno(123cd)pyrene	36[1]	9	3.09
Naphthalene	5.6[1]	9	0.86
Phenanthrene	220[1]	9	7.81
Pyrene	1200[1]	9	12.17
Asbestos	Presence	9	NAD
Benzene	0.17[1]	9	<0.001
Toulene	290[1]	9	0.006
Ethylbenzene	110[1]	9	<0.001
m & p-Xylene	130[1]	9	<0.001
o-Xylene	140[1]	9	0.001
VPH Aliphatic (>C5-C6)	78[1]	9	<0.05
VPH Aliphatic (>C6-C8)	230[1]	9	<0.05
VPH Aliphatic (>C8-C10)	65[1]	9	<0.05
EPH Aliphatic (>C10-C12)	330[1]	9	<0.5
EPH Aliphatic (>C12-C16)	2400[1]	9	2.17
EPH Aliphatic (>C16-C35)	92000[1]	9	244.93
EPH Aliphatic (>C35-C44)	92000[1]	9	58.81
VPH Aromatic (>EC5-EC7)	140[1]	9	<0.05
VPH Aromatic (>EC7-EC8)	290[1]	9	<0.05
VPH Aromatic (>EC8-EC10)	83[1]	9	<0.05
EPH Aromatic (>EC10-EC12)	180[1]	9	3
EPH Aromatic (>EC12-EC16)	330[1]	9	15
EPH Aromatic (>EC16-EC21)	540[1]	9	115
EPH Aromatic (>EC21-EC35)	1500[1]	9	640
EPH Aromatic (>EC35-EC44)	1500[1]	9	302

[1] = The LQM / CIEH Suitable 4 Use Levels – Residential with homegrown produce (2.5% SOM), [2] = CL:AIRE Category 4 Screening Levels – Residential with homegrown produce, [3] = ATRISK^{SOIL} Soil Screening Values (2015).

The screening on the imported soils identified several instances where the Maximum Concentration (C_M) values exceeded the Critical Concentration (C_C) assessment values associated with the designated end-use of residential with home-grown produce. This confirmed that the materials used as a stone sub-soil material in Plot 3 and an existing small topsoil stockpile were not suitable for use in a residential setting and it was recommended these materials were removed from site. The screening on all other plots, both stone sub-soil and topsoil, indicated the soils were suitable for use as part of a clean cover system. In addition, the results of the asbestos screening did not identify the presence of any asbestos fibres.

The screening of stone sub-soil in Plot 3 indicated elevated levels of several PAHs and it was considered necessary to remove and replace all stone sub-soil to a depth of c.600mm below ground level within the whole landscaped rear garden. A further site visit was made on 7th March 2024 to witness the removal and recover a sample of the newly imported stone emplaced within Plot 3.

A small topsoil stockpile had been found to have an elevated level of Lead and it was recommended the stockpile was removed from site. As a result, a further 3 no. samples of emplaced replacement topsoil were recovered from Plots 6, 7 & 9 for confirmatory screening.

5.0 Validation of Remediation Works (Cont'd)

5.4 Validation of Clean Cover System (Cont'd):

The samples were immediately dispatched to Chemtech Environmental Ltd of Stanley, Co. Durham and screened for the following range of analytes;

- 4 no. soil sample screened using a generic soil suite, comprising; Arsenic, Cadmium, Chromium III, Chromium VI, Copper, Lead, Mercury, Nickel, Selenium, Zinc & Cyanide
- 4 no. soil sample screened for Speciated Polycyclic Aromatic (PAH's)
- 4 no. soil sample screened for Speciated Total Petroleum Hydrocarbons (TPH's)
- 4 no. soil sample screened for the presence of Asbestos fibres

The results can be seen in Table 5.2 below and continue on the following page and also in the Chemtech Analytical Report Ref. 131198 attached in Appendix III. The results have been assessed against the most up to date and appropriate guidelines for the proposed end-use.

Table 5.2

Analyte	Critical Conc. (C_C)	No. of Samples Screened	Max. Conc. (C_M) recorded (Clean Cover)
Arsenic	37[1]	4	3
Cadmium	11[1]	4	<1.6
Chromium III	910[1]	4	45
Chromium VI	6[1]	4	<0.04
Copper	2400[1]	4	12
Lead	200[2]	4	14
Mercury	40[1]	4	<0.7
Selenium	250[1]	4	<3
Nickel	180[1]	4	7.5
Zinc	3700[1]	4	34
Cyanide	34[3]	4	<1
Acenaphthene	510[1]	4	<0.02
Acenaphthylene	420[1]	4	<0.02
Anthracene	5400[1]	4	<0.02
Benzo(a)anthracene	11[1]	4	0.08
Benzo(a)pyrene	2.7[1]	4	0.07
Benzo(b)fluoranthene	3.3[1]	4	0.07
Benzo(ghi)perylene	340[1]	4	0.04
Benzo(k)fluoranthene	93[1]	4	0.07
Chrysene	22[1]	4	0.07
Dibenz(ah)anthracene	0.28[1]	4	0.09
Fluoranthene	560[1]	4	0.08
Fluorene	400[1]	4	<0.02
Indeno(123cd)pyrene	36[1]	4	0.07
Naphthalene	5.6[1]	4	<0.02
Phenanthrene	220[1]	4	0.03
Pyrene	1200[1]	4	0.06
Asbestos	Presence	4	NAD

[1] = The LQM / CIEH Suitable 4 Use Levels – Residential with homegrown produce (2.5% SOM), [2] = CL:AIRE Category 4 Screening Levels – Residential with homegrown produce, [3] = ATRISK^{SOIL} Soil Screening Values (2015).

5.0 Validation of Remediation Works (Cont'd)

5.4 Validation of Clean Cover System (Cont'd): -

Table 5.2 (Cont'd)

Analyte	Critical Conc. (C_C)	No. of Samples Screened	Max. Conc. (C_M) recorded (Clean Cover)
Benzene	0.17[1]	4	<0.001
Toulene	290[1]	4	<0.001
Ethylbenzene	110[1]	4	<0.001
m & p-Xylene	130[1]	4	<0.001
o-Xylene	140[1]	4	<0.001
VPH Aliphatic (>C5-C6)	78[1]	4	<0.05
VPH Aliphatic (>C6-C8)	230[1]	4	<0.05
VPH Aliphatic (>C8-C10)	65[1]	4	<0.05
EPH Aliphatic (>C10-C12)	330[1]	4	<0.5
EPH Aliphatic (>C12-C16)	2400[1]	4	<0.5
EPH Aliphatic (>C16-C35)	92000[1]	4	<4.5
EPH Aliphatic (>C35-C44)	92000[1]	4	<1
VPH Aromatic (>EC5-EC7)	140[1]	4	<0.05
VPH Aromatic (>EC7-EC8)	290[1]	4	<0.05
VPH Aromatic (>EC8-EC10)	83[1]	4	<0.05
EPH Aromatic (>EC10-EC12)	180[1]	4	1.16
EPH Aromatic (>EC12-EC16)	330[1]	4	1.76
EPH Aromatic (>EC16-EC21)	540[1]	4	<2
EPH Aromatic (>EC21-EC35)	1500[1]	4	13.75
EPH Aromatic (>EC35-EC44)	1500[1]	4	40.51

[1] = The LQM / CIEH Suitable 4 Use Levels – Residential with homegrown produce (2.5% SOM), [2] = CL:AIRE Category 4 Screening Levels – Residential with homegrown produce, [3] = ATRISK^{SOIL} Soil Screening Values (2015).

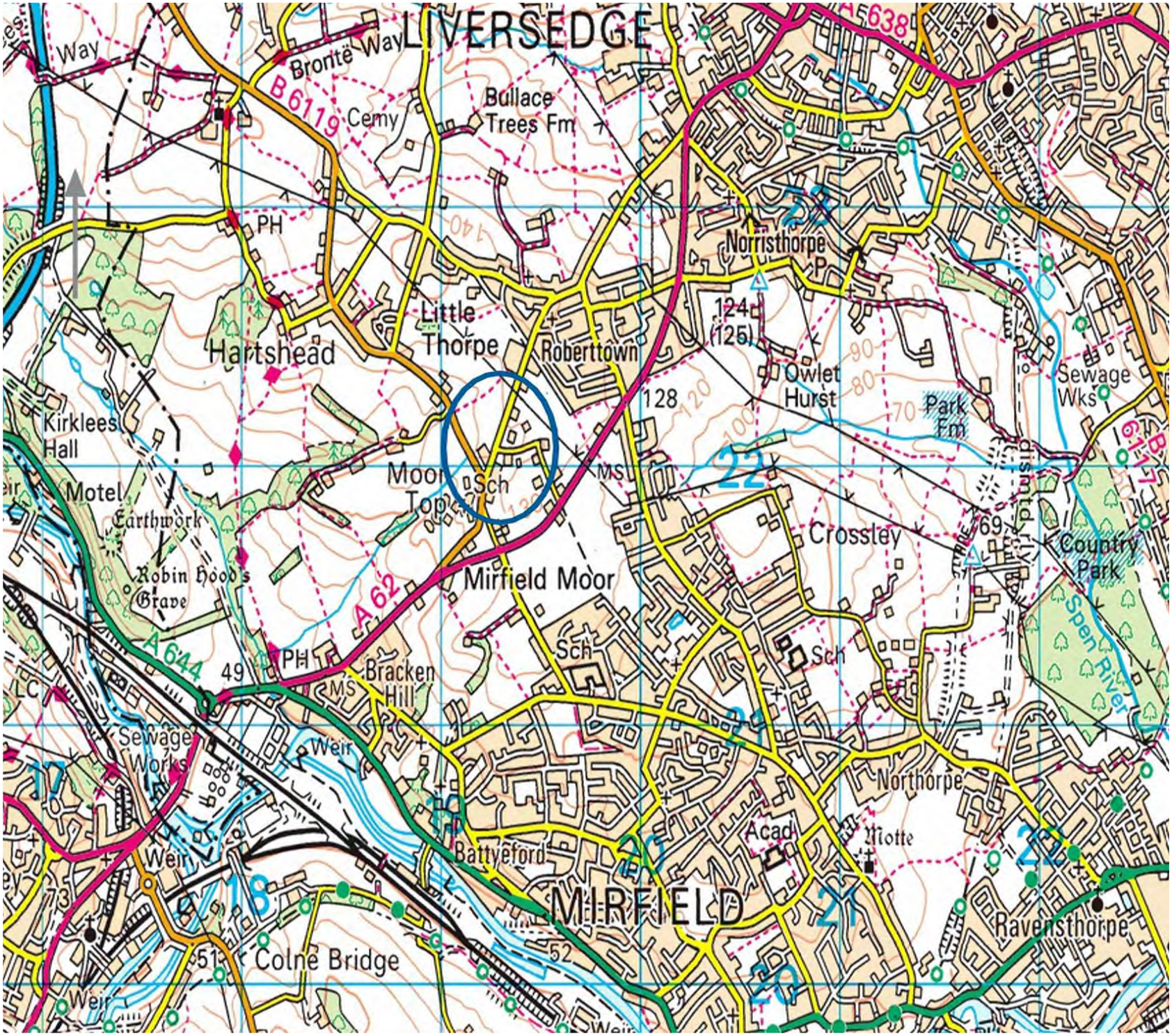
The ground contamination screening following the further remediation of Plot 3 has identified that none of the maximum concentration (C_M) values exceeds the critical concentration (C_C) values associated with the proposed end-use. Furthermore, no asbestos fibres were recorded.

6.0 Conclusions:

Taking into consideration the remedial work carried out in Plot 3 and all the laboratory, chemical screening undertaken on the imported topsoil and stone sub-soil deposits it is in the opinion of ARC Environmental that these materials are suitable for use in the private gardens and soft landscaped areas within the development. In addition, a total minimum thickness of c.600mm of clean cover materials was confirmed as present. Therefore, no further works are required or envisaged, and it is the opinion of ARC Environmental Limited that the conditions within the Remediation Strategy, relating to a clean cover system to protect the end users, have been satisfied.

END OF REPORT

Appendix I



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rev.	date	amendments	drawn	chckd

Client:
ABM Developments / Beam Consulting

Project Title:
Proposed Residential Development,
Leeds Road, Mirfield

Drawing Title:
Location Plan

Scale at A3:	Date:	Drawn by:	Approved by:
	22.02.24	GNH	

Job Ref:	Drg no:	Rev:
24-095		

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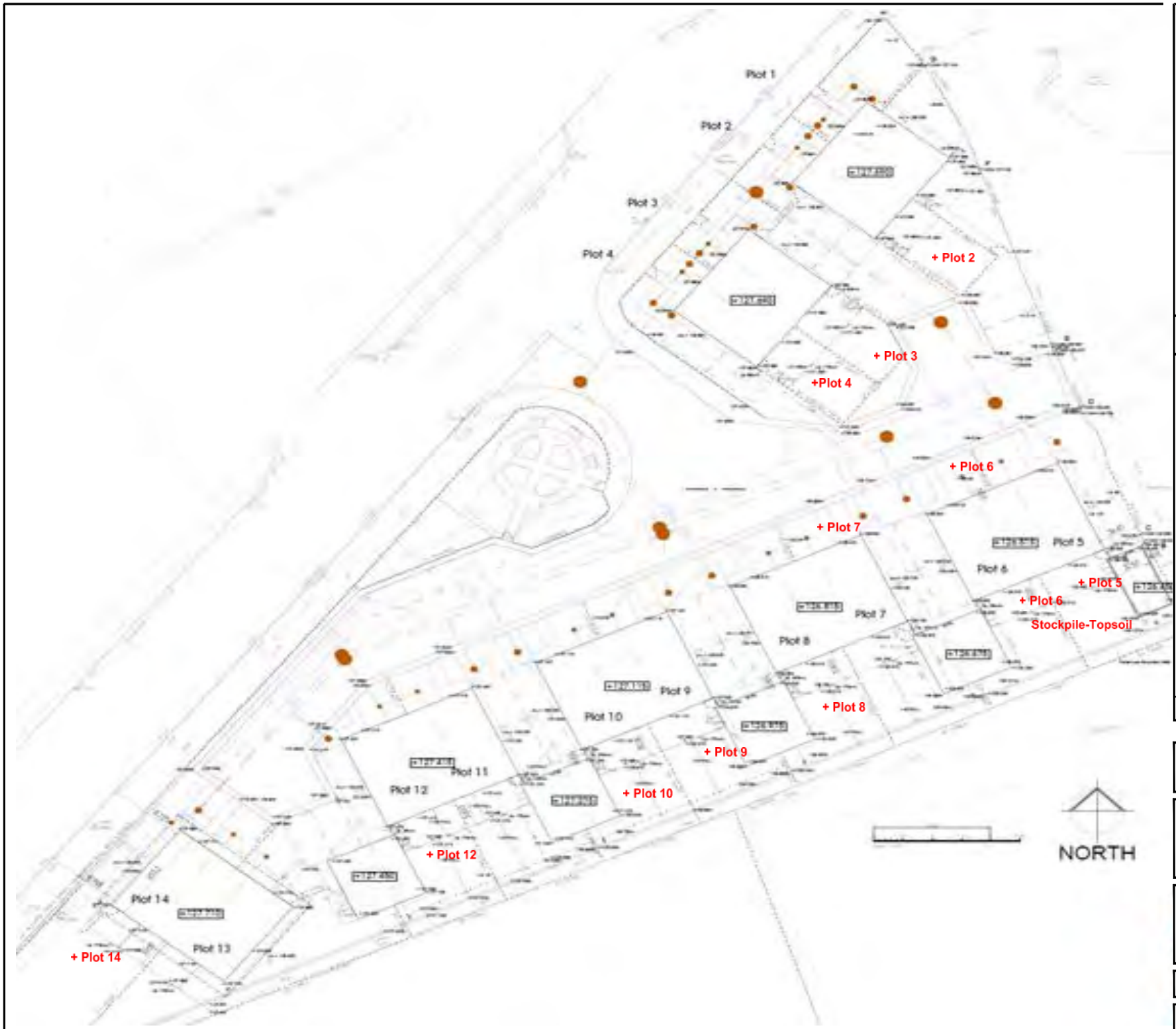
Client:
ABM Developments / Beam Consulting

Project Title:
Proposed Residential Development,
Leeds Road, Mirfield

Drawing Title:
Existing Site Layout Plan

Scale at A3:	Date:	Drawn by:	Approved by:
	22.02.24	GNH	

Job Ref:	Drg no:	Rev:
24-095		



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rev.	date	amendments	drawn	chckd

Client:
ABM Developments / Beam Consulting

Project Title:
Proposed Residential Development,
Leeds Road, Mirfield

Drawing Title:
Proposed Site Layout Plan
&
Trial Pit & Sampling Location Plan

Scale at A3:	Date:	Drawn by:	Approved by:
	07.03.24	GNH	

Job Ref:	Drg no:	Rev:
24-095		

Appendix II















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Client:
ABM Developments / Beam Consulting

Project Title:
Proposed Residential Development,
Leeds Road, Mirfield

Drawing Title:
Photographic Record Sheet 1

Scale at A3:	Date:	Drawn by:	Approved by:
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Client:
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Project Title:
Proposed Residential Development,
Leeds Road, Mirfield

Drawing Title:
Photographic Record Sheet 2

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Client:
ABM Developments / Beam Consulting

Project Title:
Proposed Residential Development,
Leeds Road, Mirfield

Drawing Title:
Photographic Record Sheet 3

Scale at A3:	Date:	Drawn by:	Approved by:
	22.02.24	GNH	

Job Ref:	Drg no:	Rev:
24-095		

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rev.	date	amendments	drawn	chckd

Client:
PABM Developments / Beam Consulting

Project Title:
Proposed Residential Development,
Leeds Road, Mirfield

Drawing Title:
Photographic Record Sheet 4
Clean Cover Validation

Scale at A3:	Date:	Drawn by:	Approved by:
	13.03.24		

Job Ref:	Drg no:	Rev:
24-095		

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rev.	date	amendments	drawn	chckd

Client:
PABM Developments / Beam Consulting

Project Title:
Proposed Residential Development,
Leeds Road, Mirfield

Drawing Title:
Photographic Record Sheet 5
Clean Cover Validation

Scale at A3:	Date:	Drawn by:	Approved by:
	13.03.24		

Job Ref:	Drg no:	Rev:
24-095		

Appendix III

ANALYTICAL TEST REPORT

Contract no: 130553

Contract name: Geneeral Agreement, Leeds Road, Mirfield

Client reference: 24-095

Clients name: ARC Environmental

Clients address: Solum House, Unit 1 Elliott Court
St Johns Road
Meadowfield
DH7 8PN

Samples received: 14 February 2024

Analysis started: 14 February 2024

Analysis completed: 23 February 2024

Report issued: 23 February 2024

Key

U	UKAS accredited test
M	MCERTS & UKAS accredited test
$	Test carried out by an approved subcontractor
I/S	Insufficient sample to carry out test
N/S	Sample not suitable for testing
NAD	No Asbestos Detected

Approved by:

Samantha Rogerson
Reporting Manager

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
130553-1	Plot 2 (6F2)	0.00-0.60	Sandy Loamy Clay with Gravel	-	-	15.3
130553-2	Plot 3 (6F2)	0.00-0.60	Sandy Loamy Clay with Gravel	-	-	12.5
130553-3	Plot 4 (6F2)	0.00-0.60	Sandy Loamy Clay with Gravel	-	-	12.9
130553-4	Plot 8 (Topsoil)	0.00-0.15	Sandy Loamy Clay with Gravel	-	-	34
130553-5	Plot 10 (Topsoil)	0.00-0.15	Sandy Loamy Clay with Gravel	-	-	33.3
130553-6	Plot 12 (Topsoil)	0.00-0.15	Sandy Loamy Clay with Gravel	-	-	29.1
130553-7	Sample 1 (Topsoil)	Stockpile	Sandy Loamy Clay with Gravel	-	-	29
130553-8	Sample 2 (Topsoil)	Stockpile	Sandy Loamy Clay with Gravel	-	-	30.8
130553-9	Sample 3 (Topsoil)	Stockpile	Sandy Loamy Clay with Gravel	-	-	27

Chemtech Environmental Limited

SOILS

Lab number			130553-1	130553-2	130553-3	130553-4	130553-5	130553-6
Sample id			Plot 2 (6F2)	Plot 3 (6F2)	Plot 4 (6F2)	Plot 8 (Topsoil	lot 10 (Topsoi	lot 12 (Topsoi
Depth (m)			0.00-0.60	0.00-0.60	0.00-0.60	0.00-0.15	0.00-0.15	0.00-0.15
Date sampled			13/02/2024	13/02/2024	13/02/2024	13/02/2024	13/02/2024	13/02/2024
Test	**Method**	**Units**						
Moisture Content	CE001	% w/w	15	13	13	34	33	29
Arsenic (total)	CE264[M]	mg/kg As	11	8.2	6.6	32	32	25
Cadmium (total)	CE264[M]	mg/kg Cd	1.7	<1.6	<1.6	<1.6	<1.6	<1.6
Chromium (total)	CE264[U]	mg/kg Cr	38	61	65	38	37	32
Chromium (III)	CE208	mg/kg CrIII	38	61	65	37	37	32
Chromium (VI)	CE263	mg/kg CrVI	0.2	<0.04	0.05	0.07	<0.04	<0.04
Copper (total)	CE264[M]	mg/kg Cu	39	51	56	46	47	38
Lead (total)	CE264[U]	mg/kg Pb	63	53	50	75	81	65
Mercury (total)	CE264[U]	mg/kg Hg	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7
Nickel (total)	CE264[M]	mg/kg Ni	27	24	27	23	24	21
Selenium (total)	CE264	mg/kg Se	<3	<3	<3	<3	<3	<3
Zinc (total)	CE264[M]	mg/kg Zn	151	116	119	106	108	96
pH	CE004 [M]	units	9.5	10.8	10.3	7.4	7.2	7.4
Sulphate (2:1 water soluble)	CE061 [U]	mg/l SO_4	511	619	515	88	33	131
Cyanide (free)	CE077	mg/kg CN	<1	<1	<1	<1	<1	<1
Total Organic Carbon (TOC)	CE197	% w/w C	2.6	1.7	1.9	7.7	7.2	6.3
PAH								
Naphthalene	CE087 [M]	mg/kg	0.22	0.86	0.18	<0.02	<0.02	0.07
Acenaphthylene	CE087 [M]	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Acenaphthene	CE087 [M]	mg/kg	0.20	1.41	0.54	<0.02	<0.02	0.10
Fluorene	CE087 [U]	mg/kg	0.14	0.98	0.42	<0.02	<0.02	0.07
Phenanthrene	CE087 [M]	mg/kg	1.42	7.81	3.03	0.14	0.07	0.45
Anthracene	CE087 [U]	mg/kg	0.33	2.25	0.88	0.03	<0.02	0.10
Fluoranthene	CE087 [M]	mg/kg	2.24	12.72	3.96	0.27	0.14	0.68
Pyrene	CE087 [M]	mg/kg	1.95	12.17	3.16	0.23	0.13	0.55
Benzo(a)anthracene	CE087 [U]	mg/kg	0.93	5.54	1.58	0.14	0.08	0.28
Chrysene	CE087 [M]	mg/kg	0.88	5.90	1.30	0.12	0.07	0.31
Benzo(b)fluoranthene	CE087 [M]	mg/kg	1.03	5.36	1.47	0.14	0.08	0.27
Benzo(k)fluoranthene	CE087 [M]	mg/kg	0.51	2.53	0.70	0.06	0.04	0.16
Benzo(a)pyrene	CE087 [U]	mg/kg	1.04	4.84	1.44	0.12	0.07	0.23
Indeno(123cd)pyrene	CE087 [M]	mg/kg	0.63	3.09	0.93	0.09	0.05	0.20
Dibenz(ah)anthracene	CE087 [M]	mg/kg	0.13	0.72	0.22	<0.02	<0.02	0.08
Benzo(ghi)perylene	CE087 [M]	mg/kg	0.57	3.00	0.84	0.09	0.05	0.18
PAH (total of USEPA 16)	CE087	mg/kg	12.2	69.2	20.6	1.42	0.78	3.76

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SOILS

Lab number			130553-1	130553-2	130553-3	130553-4	130553-5	130553-6
Sample id			Plot 2 (6F2)	Plot 3 (6F2)	Plot 4 (6F2)	Plot 8 (Topsoil	lot 10 (Topsoi	lot 12 (Topsoi
Depth (m)			0.00-0.60	0.00-0.60	0.00-0.60	0.00-0.15	0.00-0.15	0.00-0.15
Date sampled			13/02/2024	13/02/2024	13/02/2024	13/02/2024	13/02/2024	13/02/2024
Test	**Method**	**Units**						
BTEX & TPH								
Benzene	$	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Toluene	$	mg/kg	<0.001	<0.001	<0.001	0.006	0.006	0.006
Ethylbenzene	$	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
m & p-Xylene	$	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
o-Xylene	$	mg/kg	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
VPH Aliphatic (>C5-C6) HS_1D_AL	$	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
VPH Aliphatic (>C6-C8) HS_1D_AL	$	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
VPH Aliphatic (>C8-C10) HS_1D_AL	$	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
EPH Aliphatic (>C10-C12) EH_2D_AL	CE250	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
EPH Aliphatic (>C12-C16) EH_2D_AL	CE250	mg/kg	1	2.17	2	<0.5	<0.5	<0.5
EPH Aliphatic (>C16-C35) EH_2D_AL	CE250	mg/kg	7	244.93	94	<4.5	<4.5	<4.5
EPH Aliphatic (>C35-C44) EH_2D_AL	CE250	mg/kg	4	58.81	40	<1	<1	<1
VPH Aromatic (>EC5-EC7) HS_1D_AR	$	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
VPH Aromatic (>EC7-EC8) HS_1D_AR	$	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
VPH Aromatic (>EC8-EC10) HS_1D_AR	$	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
EPH Aromatic (>EC10-EC12) EH_2D_AR	CE250	mg/kg	1	3	3	<0.5	<0.5	<0.5
EPH Aromatic (>EC12-EC16) EH_2D_AR	CE250	mg/kg	4	14	15	<1	<1	<1
EPH Aromatic (>EC16-EC21) EH_2D_AR	CE250	mg/kg	5	67	115	<2	<2	<2
EPH Aromatic (>EC21-EC35) EH_2D_AR	CE250	mg/kg	21	640	403	<5	<5	<5
EPH Aromatic (>EC35-EC44) EH_2D_AR	CE250	mg/kg	8	302	125	<1.5	<1.5	<1.5
Subcontracted analysis								
Asbestos (qualitative)	$	-	NAD	NAD	NAD	NAD	NAD	NAD

Chemtech Environmental Limited

SOILS

Lab number			130553-7	130553-8	130553-9
Sample id			mple 1 (Topso	mple 2 (Topso	mple 3 (Topso
Depth (m)			Stockpile	Stockpile	Stockpile
Date sampled			13/02/2024	13/02/2024	13/02/2024
Test	**Method**	**Units**			
Moisture Content	CE001	% w/w	29	31	27
Arsenic (total)	CE264[M]	mg/kg As	21	18	20
Cadmium (total)	CE264[M]	mg/kg Cd	<1.6	<1.6	<1.6
Chromium (total)	CE264[U]	mg/kg Cr	34	38	49
Chromium (III)	CE208	mg/kg CrIII	34	38	49
Chromium (VI)	CE263	mg/kg CrVI	<0.04	<0.04	<0.04
Copper (total)	CE264[M]	mg/kg Cu	49	58	55
Lead (total)	CE264[U]	mg/kg Pb	162	266	153
Mercury (total)	CE264[U]	mg/kg Hg	<0.7	<0.7	<0.7
Nickel (total)	CE264[M]	mg/kg Ni	22	22	25
Selenium (total)	CE264	mg/kg Se	<3	<3	<3
Zinc (total)	CE264[M]	mg/kg Zn	243	243	326
pH	CE004 [M]	units	7.9	8.0	8.2
Sulphate (2:1 water soluble)	CE061 [U]	mg/l SO_4	40	38	37
Cyanide (free)	CE077	mg/kg CN	<1	<1	<1
Total Organic Carbon (TOC)	CE197	% w/w C	5.4	5.1	4.8
PAH					
Naphthalene	CE087 [M]	mg/kg	<0.02	0.03	0.26
Acenaphthylene	CE087 [M]	mg/kg	<0.02	0.04	0.03
Acenaphthene	CE087 [M]	mg/kg	0.02	0.03	0.22
Fluorene	CE087 [U]	mg/kg	<0.02	0.04	0.16
Phenanthrene	CE087 [M]	mg/kg	0.25	0.43	1.86
Anthracene	CE087 [U]	mg/kg	0.07	0.10	0.46
Fluoranthene	CE087 [M]	mg/kg	0.70	1.15	3.13
Pyrene	CE087 [M]	mg/kg	0.62	1.05	2.64
Benzo(a)anthracene	CE087 [U]	mg/kg	0.36	0.59	1.36
Chrysene	CE087 [M]	mg/kg	0.42	0.54	1.43
Benzo(b)fluoranthene	CE087 [M]	mg/kg	0.41	0.63	1.28
Benzo(k)fluoranthene	CE087 [M]	mg/kg	0.17	0.30	0.60
Benzo(a)pyrene	CE087 [U]	mg/kg	0.36	0.60	1.16
Indeno(123cd)pyrene	CE087 [M]	mg/kg	0.23	0.38	0.75
Dibenz(ah)anthracene	CE087 [M]	mg/kg	0.06	0.09	0.17
Benzo(ghi)perylene	CE087 [M]	mg/kg	0.23	0.37	0.70
PAH (total of USEPA 16)	CE087	mg/kg	3.90	6.37	16.2

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SOILS

Lab number			130553-7	130553-8	130553-9
Sample id			mple 1 (Topso	mple 2 (Topso	mple 3 (Topso
Depth (m)			Stockpile	Stockpile	Stockpile
Date sampled			13/02/2024	13/02/2024	13/02/2024
Test	**Method**	**Units**			
BTEX & TPH					
Benzene	$	mg/kg	<0.001	<0.001	<0.001
Toluene	$	mg/kg	<0.001	<0.001	<0.001
Ethylbenzene	$	mg/kg	<0.001	<0.001	<0.001
m & p-Xylene	$	mg/kg	<0.001	<0.001	<0.001
o-Xylene	$	mg/kg	<0.001	<0.001	<0.001
VPH Aliphatic (>C5-C6) HS_1D_AL	$	mg/kg	<0.05	<0.05	<0.05
VPH Aliphatic (>C6-C8) HS_1D_AL	$	mg/kg	<0.05	<0.05	<0.05
VPH Aliphatic (>C8-C10) HS_1D_AL	$	mg/kg	<0.05	<0.05	<0.05
EPH Aliphatic (>C10-C12) EH_2D_AL	CE250	mg/kg	<0.5	<0.5	<0.5
EPH Aliphatic (>C12-C16) EH_2D_AL	CE250	mg/kg	<0.5	<0.5	<0.5
EPH Aliphatic (>C16-C35) EH_2D_AL	CE250	mg/kg	<4.5	<4.5	<4.5
EPH Aliphatic (>C35-C44) EH_2D_AL	CE250	mg/kg	<1	3	<1
VPH Aromatic (>EC5-EC7) HS_1D_AR	$	mg/kg	<0.05	<0.05	<0.05
VPH Aromatic (>EC7-EC8) HS_1D_AR	$	mg/kg	<0.05	<0.05	<0.05
VPH Aromatic (>EC8-EC10) HS_1D_AR	$	mg/kg	<0.05	<0.05	<0.05
EPH Aromatic (>EC10-EC12) EH_2D_AR	CE250	mg/kg	<0.5	1	1
EPH Aromatic (>EC12-EC16) EH_2D_AR	CE250	mg/kg	<1	4	2
EPH Aromatic (>EC16-EC21) EH_2D_AR	CE250	mg/kg	<2	11	5
EPH Aromatic (>EC21-EC35) EH_2D_AR	CE250	mg/kg	<5	36	15
EPH Aromatic (>EC35-EC44) EH_2D_AR	CE250	mg/kg	<1.5	15	4
Subcontracted analysis					
Asbestos (qualitative)	$	-	NAD	NAD	NAD

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE001	Moisture Content	Gravimetry	As received		0.1	% w/w
CE264	Arsenic (total)	Aqua Regia Extraction, ICPOES	Dry	M	1.8	mg/kg As
CE264	Cadmium (total)	Aqua Regia Extraction, ICPOES	Dry	M	1.6	mg/kg Cd
CE264	Chromium (total)	Aqua Regia Extraction, ICPOES	Dry	U	2	mg/kg Cr
CE208	Chromium (III)	Calculation: Cr (total) - Cr (VI)	Dry		0.04	mg/kg CrIII
CE263	Chromium (VI)	Discrete Analyser	Dry		0.04	mg/kg CrVI
CE264	Copper (total)	Aqua Regia Extraction, ICPOES	Dry	M	1.6	mg/kg Cu
CE264	Lead (total)	Aqua Regia Extraction, ICPOES	Dry	U	3	mg/kg Pb
CE264	Mercury (total)	Aqua Regia Extraction, ICPOES	Dry	U	0.7	mg/kg Hg
CE264	Nickel (total)	Aqua Regia Extraction, ICPOES	Dry	M	2.1	mg/kg Ni
CE264	Selenium (total)	Aqua Regia Extraction, ICPOES	Dry	U	3	mg/kg Se
CE264	Zinc (total)	Aqua Regia Extraction, ICPOES	Dry	M	4	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	As received	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	U	10	mg/l SO_4
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	As received		1	mg/kg CN
CE197	Total Organic Carbon (TOC)	Carbon Analyser	Dry		0.1	% w/w C
CE087	Acenaphthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Naphthalene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	As received		0.34	mg/kg
$	Benzene	Headspace GC-FID	As received	U	0.001	mg/kg
$	Toluene	Headspace GC-FID	As received	U	0.001	mg/kg
$	Ethylbenzene	Headspace GC-FID	As received	U	0.001	mg/kg
$	m & p-Xylene	Headspace GC-FID	As received	U	0.001	mg/kg
$	o-Xylene	Headspace GC-FID	As received	U	0.001	mg/kg
$	VPH Aliphatic (>C5-C6)	Headspace GC-FID	As received		0.05	mg/kg
$	VPH Aliphatic (>C6-C8)	Headspace GC-FID	As received		0.05	mg/kg
$	VPH Aliphatic (>C8-C10)	Headspace GC-FID	As received		0.05	mg/kg
CE250	EPH Aliphatic (>C10-C12)	Solvent extraction, GCxGC-FID	As received		6	mg/kg
CE250	EPH Aliphatic (>C12-C16)	Solvent extraction, GCxGC-FID	As received		6	mg/kg
CE250	EPH Aliphatic (>C16-C35)	Solvent extraction, GCxGC-FID	As received		15	mg/kg

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE250	EPH Aliphatic (>C35-C44)	Solvent extraction, GCxGC-FID	As received		10	mg/kg
$	VPH Aromatic (>EC5-EC7)	Headspace GC-FID	As received		0.05	mg/kg
$	VPH Aromatic (>EC7-EC8)	Headspace GC-FID	As received		0.05	mg/kg
$	VPH Aromatic (>EC8-EC10)	Headspace GC-FID	As received		0.05	mg/kg
CE250	EPH Aromatic (>EC10-EC12)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC12-EC16)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC16-EC21)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC21-EC35)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC35-EC44)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

Chemtech Environmental Limited

DEVIATING SAMPLE INFORMATION

Comments
Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
130553-1	Plot 2 (6F2)	0.00-0.60	N	
130553-2	Plot 3 (6F2)	0.00-0.60	N	
130553-3	Plot 4 (6F2)	0.00-0.60	N	
130553-4	Plot 8 (Topsoil)	0.00-0.15	N	
130553-5	Plot 10 (Topsoil)	0.00-0.15	N	
130553-6	Plot 12 (Topsoil)	0.00-0.15	N	
130553-7	Sample 1 (Topsoil)	Stockpile	N	
130553-8	Sample 2 (Topsoil)	Stockpile	N	
130553-9	Sample 3 (Topsoil)	Stockpile	N	

Chemtech Environmental Limited

ADDITIONAL INFORMATION

Notes

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, without prior written approval.
Samples will be disposed of 4 weeks from initial receipt unless otherwise instructed.
All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.
Analytical results are inclusive of stones, where applicable.

ANALYTICAL TEST REPORT

Contract no:	131198
Contract name:	Leeds Road, Mirfield
Client reference:	24-095
Clients name:	ARC Environmental
Clients address:	Solum House, Unit 1 Elliott Court St Johns Road Meadowfield DH7 8PN
Samples received:	07 March 2024
Analysis started:	07 March 2024
Analysis completed:	18 March 2024
Report issued:	18 March 2024

Key		
	U	UKAS accredited test
	M	MCERTS & UKAS accredited test
	$	Test carried out by an approved subcontractor
	I/S	Insufficient sample to carry out test
	N/S	Sample not suitable for testing
	NAD	No Asbestos Detected

Approved by:

Samantha Rogerson
Reporting Manager

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
131198-1	Plot 6 (Topsoil)	0.00-0.20	Loamy Sand with Gravel & Roots	-	-	25.0
131198-2	Plot 7 (Topsoil)	0.00-0.20	Loamy Sand with Gravel & Roots	-	-	21.3
131198-3	Plot 9 (Topsoil)	0.00-0.20	Loamy Sand with Gravel & Roots	-	-	26.7
131198-4	Plot 3 (Sub-base)	0.00-0.15	Sand with Gravel	-	-	2.9

Chemtech Environmental Limited

SOILS

Lab number			131198-1	131198-2	131198-3	131198-4
Sample id			Plot 6 (Topsoil)	Plot 7 (Topsoil)	Plot 9 (Topsoil)	Plot 3 (Sub-base)
Depth (m)			0.00-0.20	0.00-0.20	0.00-0.20	0.00-0.15
Date sampled			07/03/2024	07/03/2024	07/03/2024	07/03/2024
Test	Method	Units				
Moisture Content	CE001	% w/w	25.0	21.3	26.7	2.9
Arsenic (total)	CE264[M]	mg/kg As	<1.8	<1.8	3.0	<1.8
Cadmium (total)	CE264[M]	mg/kg Cd	<1.6	<1.6	<1.6	<1.6
Chromium (total)	CE264[U]	mg/kg Cr	13	8.4	12	45
Chromium (III)	CE208	mg/kg CrIII	13	8.4	12	45
Chromium (VI)	CE263	mg/kg CrVI	<0.04	<0.04	<0.04	<0.04
Copper (total)	CE264[M]	mg/kg Cu	11	8.6	12	3.8
Lead (total)	CE264[U]	mg/kg Pb	13	9.8	14	3.3
Mercury (total)	CE264[U]	mg/kg Hg	<0.7	<0.7	<0.7	<0.7
Nickel (total)	CE264[M]	mg/kg Ni	7.2	3.3	5.0	7.5
Selenium (total)	CE264	mg/kg Se	<3	<3	<3	<3
Zinc (total)	CE264[M]	mg/kg Zn	34	26	29	28
pH	CE004 [M]	units	8.3	8.4	8.1	8.0
Sulphate (2:1 water soluble)	CE061 [U]	mg/l SO_4	73	45	33	<10
Cyanide (free)	CE077	mg/kg CN	<1	<1	<1	<1
Total Organic Carbon (TOC)	CE197	% w/w C	4.6	2.8	4.4	<0.1
PAH						
Acenaphthene	CE087 [M]	mg/kg	<0.02	<0.02	<0.02	<0.02
Acenaphthylene	CE087 [M]	mg/kg	<0.02	<0.02	<0.02	<0.02
Anthracene	CE087 [U]	mg/kg	<0.02	<0.02	<0.02	<0.02
Benzo(a)anthracene	CE087 [U]	mg/kg	0.08	0.03	0.03	0.02
Benzo(a)pyrene	CE087 [U]	mg/kg	0.07	<0.02	<0.02	<0.02
Benzo(b)fluoranthene	CE087 [M]	mg/kg	0.07	<0.02	<0.02	<0.02
Benzo(ghi)perylene	CE087 [M]	mg/kg	0.04	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	CE087 [M]	mg/kg	0.07	<0.03	<0.03	<0.03
Chrysene	CE087 [M]	mg/kg	0.07	<0.03	<0.03	<0.03
Dibenz(ah)anthracene	CE087 [M]	mg/kg	0.09	<0.02	<0.02	<0.02
Fluoranthene	CE087 [M]	mg/kg	0.08	0.03	0.02	0.03
Fluorene	CE087 [U]	mg/kg	<0.02	<0.02	<0.02	<0.02
Indeno(123cd)pyrene	CE087 [M]	mg/kg	0.07	<0.02	<0.02	<0.02
Naphthalene	CE087 [M]	mg/kg	<0.02	<0.02	<0.02	<0.02
Phenanthrene	CE087 [M]	mg/kg	0.03	<0.02	<0.02	0.03
Pyrene	CE087 [M]	mg/kg	0.06	0.02	<0.02	0.02
PAH (total of USEPA 16)	CE087	mg/kg	0.73	<0.34	<0.34	<0.34

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SOILS

Lab number			131198-1	131198-2	131198-3	131198-4
Sample id			Plot 6 (Topsoil)	Plot 7 (Topsoil)	Plot 9 (Topsoil)	Plot 3 (Sub-base)
Depth (m)			0.00-0.20	0.00-0.20	0.00-0.20	0.00-0.15
Date sampled			07/03/2024	07/03/2024	07/03/2024	07/03/2024
Test	Method	Units				
BTEX & TPH						
Benzene	$	mg/kg	<0.001	<0.001	<0.001	<0.001
Toluene	$	mg/kg	<0.001	<0.001	<0.001	<0.001
Ethylbenzene	$	mg/kg	<0.001	<0.001	<0.001	<0.001
m & p-Xylene	$	mg/kg	<0.001	<0.001	<0.001	<0.001
o-Xylene	$	mg/kg	<0.001	<0.001	<0.001	<0.001
VPH Aliphatic (>C5-C6) HS_1D_AL	$	mg/kg	<0.05	<0.05	<0.05	<0.05
VPH Aliphatic (>C6-C8) HS_1D_AL	$	mg/kg	<0.05	<0.05	<0.05	<0.05
VPH Aliphatic (>C8-C10) HS_1D_AL	$	mg/kg	<0.05	<0.05	<0.05	<0.05
EPH Aliphatic (>C10-C12) EH_2D_AL	CE250	mg/kg	<0.5	<0.5	<0.5	<0.5
EPH Aliphatic (>C12-C16) EH_2D_AL	CE250	mg/kg	<0.5	<0.5	<0.5	<0.5
EPH Aliphatic (>C16-C35) EH_2D_AL	CE250	mg/kg	<4.5	<4.5	<4.5	<4.5
EPH Aliphatic (>C35-C44) EH_2D_AL	CE250	mg/kg	<1	<1	<1	<1
VPH Aromatic (>EC5-EC7) HS_1D_AR	$	mg/kg	<0.05	<0.05	<0.05	<0.05
VPH Aromatic (>EC7-EC8) HS_1D_AR	$	mg/kg	<0.05	<0.05	<0.05	<0.05
VPH Aromatic (>EC8-EC10) HS_1D_AR	$	mg/kg	<0.05	<0.05	<0.05	<0.05
EPH Aromatic (>EC10-EC12) EH_2D_AR	CE250	mg/kg	<0.5	1.16	<0.5	<0.5
EPH Aromatic (>EC12-EC16) EH_2D_AR	CE250	mg/kg	<1	1.76	<1	<1
EPH Aromatic (>EC16-EC21) EH_2D_AR	CE250	mg/kg	<2	<2	<2	<2
EPH Aromatic (>EC21-EC35) EH_2D_AR	CE250	mg/kg	11.00	13.75	<5	<5
EPH Aromatic (>EC35-EC44) EH_2D_AR	CE250	mg/kg	<1.5	40.51	<1.5	<1.5
Subcontracted analysis						
Asbestos (qualitative)	$	-	NAD	NAD	NAD	NAD

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE001	Moisture Content	Gravimetry	As received		0.1	% w/w
CE264	Arsenic (total)	Aqua Regia Extraction, ICPOES	Dry	M	1.8	mg/kg As
CE264	Cadmium (total)	Aqua Regia Extraction, ICPOES	Dry	M	1.6	mg/kg Cd
CE264	Chromium (total)	Aqua Regia Extraction, ICPOES	Dry	U	2	mg/kg Cr
CE208	Chromium (III)	Calculation: Cr (total) - Cr (VI)	Dry		0.04	mg/kg CrIII
CE263	Chromium (VI)	Discrete Analyser	Dry		0.04	mg/kg CrVI
CE264	Copper (total)	Aqua Regia Extraction, ICPOES	Dry	M	1.6	mg/kg Cu
CE264	Lead (total)	Aqua Regia Extraction, ICPOES	Dry	U	3	mg/kg Pb
CE264	Mercury (total)	Aqua Regia Extraction, ICPOES	Dry	U	0.7	mg/kg Hg
CE264	Nickel (total)	Aqua Regia Extraction, ICPOES	Dry	M	2.1	mg/kg Ni
CE264	Selenium (total)	Aqua Regia Extraction, ICPOES	Dry	U	3	mg/kg Se
CE264	Zinc (total)	Aqua Regia Extraction, ICPOES	Dry	M	4	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	As received	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	U	10	mg/l SO_4
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	As received		1	mg/kg CN
CE197	Total Organic Carbon (TOC)	Carbon Analyser	Dry		0.1	% w/w C
CE087	Acenaphthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Naphthalene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	As received		0.34	mg/kg
$	Benzene	Details upon request	As received	U	0.001	mg/kg
$	Toluene	Details upon request	As received	U	0.001	mg/kg
$	Ethylbenzene	Details upon request	As received	U	0.001	mg/kg
$	m & p-Xylene	Details upon request	As received	U	0.001	mg/kg
$	o-Xylene	Details upon request	As received	U	0.001	mg/kg
$	VPH Aliphatic (>C5-C6)	Details upon request	As received		0.05	mg/kg
$	VPH Aliphatic (>C6-C8)	Details upon request	As received		0.05	mg/kg
$	VPH Aliphatic (>C8-C10)	Details upon request	As received		0.05	mg/kg
CE250	EPH Aliphatic (>C10-C12)	Solvent extraction, GCxGC-FID	As received		6	mg/kg
CE250	EPH Aliphatic (>C12-C16)	Solvent extraction, GCxGC-FID	As received		6	mg/kg
CE250	EPH Aliphatic (>C16-C35)	Solvent extraction, GCxGC-FID	As received		15	mg/kg

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE250	EPH Aliphatic (>C35-C44)	Solvent extraction, GCxGC-FID	As received		10	mg/kg
$	VPH Aromatic (>EC5-EC7)	Details upon request	As received		0.05	mg/kg
$	VPH Aromatic (>EC7-EC8)	Details upon request	As received		0.05	mg/kg
$	VPH Aromatic (>EC8-EC10)	Details upon request	As received		0.05	mg/kg
CE250	EPH Aromatic (>EC10-EC12)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC12-EC16)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC16-EC21)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC21-EC35)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC35-EC44)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

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DEVIATING SAMPLE INFORMATION

Comments
Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
131198-1	Plot 6 (Topsoil)	0.00-0.20	N	
131198-2	Plot 7 (Topsoil)	0.00-0.20	N	
131198-3	Plot 9 (Topsoil)	0.00-0.20	N	
131198-4	Plot 3 (Sub-base)	0.00-0.15	N	

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ADDITIONAL INFORMATION

Notes

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, without prior written approval.
Samples will be disposed of 4 weeks from initial receipt unless otherwise instructed.
All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.
Analytical results are inclusive of stones, where applicable.

Appendix III

ABM Developments Ltd

Remediation Strategy

For

Proposed New Residential Development
Leeds Road
Mirfield
West Yorkshire
WF14 0JE

Beam Consulting
14 Bond Street
Wakefield
West Yorkshire
WF1 2QP

Ref: 141-18-DOC004

Date: 13th June 2023

REVISION RECORD

Revision	Description	Date	Prepared	Checked	Approved
-	First Issue	13/06/2023	IC/KGP	TM	KGP

CONTENTS

1.0 INTRODUCTION

This Remediation Strategy has been prepared for ABM Developments Ltd for the proposed new residential development off Leeds Road, Mirfield, WF14 0JE.

The assessment has been undertaken in accordance with the requirements of the National Planning Policy Framework (NPPF) July 2021 and its Technical Guidance and other relevant guidance referenced within this strategy document.

The Report is based on the following information:

i. Site location
ii. Current Clients' proposal
iii. Phase 1 and 2 reports prepared for the site by Rogers Geotechnical Services Ltd.

All comments and opinions contained in this report, including any conclusions are based on information available to Beam Consulting Engineers during investigations prior to completion of the report. Conclusions drawn by Beam Consulting Engineers may differ if the available information is subsequently found to be inaccurate, incomplete or misleading. Beam Consulting Engineers accept no responsibility should this prove to be the case, nor if additional information exists or becomes available in relation to this site.

Except as otherwise requested by the Client, Beam Consulting Engineers are not obliged and disclaim any obligation to update the report for events outside Beam Consulting Engineers' direct control taking place after:

i. The date on which the assessment was undertaken, and
ii. The date on which the report is issued.

Beam Consulting Engineers make no representation whatsoever in relation to the legal significance of findings reported or any legal matters referred to in the following report.

This document is a remediation strategy in relation to issues associated with the noted site. The information presented and recommendations/conclusions stated are based on published statistical data and are for guidance only. The statements provide no guarantee against as yet undiscovered contamination of the site or elsewhere, nor as to the absolute accuracy of contaminant concentrations and associated risks referenced.

2.0 BACKGROUND INFORMATION

ABM Developments Limited are proposing to redevelop a site off Leeds Road, Mirfield, to provide a residential development for 14 houses with garages and associated access road. The site is on former allotment/derelict land and has previously had a desk-based[1] and intrusive[2] investigation undertaken by Rogers Geotechnical Services Limited (RGS) in 2021 and 2022 respectively. The interpretative report included an up-to-date soil contamination assessment with regard to human health risks and also assessed potential contamination risks to controlled waters. It is understood that these reports have been submitted to and accepted by the Local Authority in relation to the proposed development.

Whilst the site is considered brownfield, gross contamination has not been identified, with only occasional occurrences of relatively low-level polyaromatic hydrocarbon (PAH) contamination being recorded when assessed against relevant human health criteria. No significant contamination has been identified in relation to controlled waters. The risk assessment also identified a potential hazard associated with soil gases.

This report has been prepared by Beam Consulting to record the proposed remediation strategy for the site and to present an implementation plan and verification requirements to help ensure adequate data are obtained to confirm compliance with the remediation objectives. This report has been prepared in general accordance with LCRM[3] and R&D Publication 66[4] with reference made to current guidance regarding the investigation and redevelopment of land, including National Planning Policy Framework[5] and Kirklees Metropolitan Council guidance[6,7].

2.1 EXISTING DEVELOPMENT

The site is located to the south of Leeds Road, Mirfield, with nearest postcode WF14 0JE. The site is triangular in shape and covers an approximate area of 0.6 hectares and is approximately centred on grid reference 419842, 422072. The location is given in Figure 1. The surrounding area generally consists of arable land and residential development. A new residential estate was being constructed on land to the south of the site at the time of the investigations. A small garage is present to the north of Leeds Road. Mirfield lies a little over a kilometre to the south.

[1] Land South of Leeds Road, Mirfield. Phase 1 Environmental Desk Study. C1442/21/E/2277. Rogers Geotechnical Services Limited, July 2021.
[2] Land South of Leeds Road, Mirfield. Phase 2 Geo-environmental Report. C2650/22/E/4051. Rogers Geotechnical Services Limited, August 2022.
[3] Land contamination risk management (LCRM) - GOV.UK (www.gov.uk), April 2019. Accessed January 2022.
[4] Environment Agency & NHBC (2008). Guidance for the safe development of housing on land affected by contamination. R&D Publication 66. Environment Agency & NHBC.
[5] National Planning Policy Framework. Ministry of Housing Communities & Local Government. 2019.
[6] Kirklees Metropolitan Council. Contaminated Land Strategy April 2001, R-2006.
[7] Kirklees Council. Kirklees Local Plan Strategy and Policies. February 2019.

Figure 1: Site location

The site lies at a level of approximately 127m Above Ordnance Datum (AOD), with a change in height of approximately 1m to 2m, falling to the south west. Access to the site is gained via Leeds Road. At the time of the investigation, the site was derelict and covered in rough vegetation. The current layout is given in the aerial image extract (taken from Google Earth) reproduced as Figure 2.

Figure 2: Site layout

2.2 PROPOSED DEVELOPMENT

The proposed development of the site will comprise a residential development of 14 dwellings with garages and the formation of a new access road and associated infrastructure. The residential properties are anticipated as being two storeys with garages and hardstanding and private garden areas. The currently proposed development layout is presented in Figure 3 and in Appendix A.

Figure 3: Proposed development layout (*extract from GHP Architects drawing*)

2.3 GROUND AND GROUNDWATER CONDITIONS

Ground conditions across the site have been confirmed through a series of windowless sampler holes and trial pit excavations. The ground conditions encountered during the recent site investigation are summarised in Table 2 of the RGS report, reproduced as Table 1 below, with further detail provided within the RGS report. Exploratory hole locations are presented in Figure 4.

Table 1: Ground conditions summary

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	TOPSOIL.	All	None
+0.6	Slightly gravelly sandy CLAY.[4]	TP1, TP2, TP3	None
0.95	MADE GROUND (Very gravelly CLAY).	WS2	None
0.90 – 2.6	Silty, locally slightly gravelly CLAY.	All	None
2.1 – 3.75	Silty gravelly carbonaceous CLAY/Thinly laminated COAL.	All	2.3m (WS1), 1.3m (WS3)
+3.0 – +4.0	Extremely weak MUDSTONE.	All	None

[1]'+' 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.

Figure 4: Exploratory hole locations (extract from RGS report)

In general, there is typically less than 1m of Made/Reworked Ground beneath the site, comprising a slightly gravelly sandy, or very gravelly, clay. This in turn is underlain by silty, locally gravelly clay, becoming silty gravelly carbonaceous clay to a depth of approximately 2.1m to 3.75m, in turn becoming extremely weak mudstone proven to a maximum depth of 4m. These deposits beneath the Made Ground comprise the Pennine Lower Coal Measures.

Perched water was encountered at relatively shallow depth, typically between approximately 1.3m and 2.3m depth.

2.4 CONCEPTUAL SITE MODEL

The conceptual site model presented below (Table 2) has been taken from the RGS report and reproduced with due consideration given to Contaminated Land Report (CLR) 11. The site investigation identified marginally elevated concentrations of polyaromatic hydrocarbon (PAH) compounds within the Made Ground.

No significant potential source of soil borne gases, vapours or radon were identified for the site, although due to the limited dataset, the site is considered by RGS to meet the definition for Characteristic Situation 2 conditions.

An assessment of the potential pollutant linkages based on the site investigation data noted the following risks to potential sensitive receptors:

Table 2: CSM and risk assessment (RGS report)

Table 12: Conceptual Site Model and Site Specific Risk Assessment [Contamination: PAHs]

Conceptual Site Model			Site Specific Risk Assessment	
Pathways	**Receptor**	**Linkage Present?**	**Risk Rating**	**Notes**
Direct contact/dermal absorption/soil ingestion	Operative	Yes – contamination found to be present at the site and contact with soil likely during works.	High	Some contamination is present in the soils underlying the site. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways. However, as the site is anticipated to be secured during the development phase, contamination is not anticipated to affect neighbours.
	End User	Yes – contamination found to be present at the site and site to be developed into residential dwellings with gardens.	High	
	Neighbours	Yes – contamination found to be present at the site and a populated residential and commercial area surrounds the site.	Low	
Inhalation of Dust/Vapours	Operative	Yes – dust may be derived from contaminated soils.	High	Some contamination is present underlying the site. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways.
	End User	Yes – dust may be derived from contaminated soils.	High	
	Neighbours	Yes – contamination found to be present at the site and residential and commercial properties located within 250m radius of the site and possible inhalation of dust during the works.	High	
Ingestion of fruit/vegetables and/or waters	Operative	No – no edible plants or contained water sources in the area of the proposed new works.	N/A	Some contamination is present underlying the site. Precautionary measures will be required during the construction phase. Remediation will be required to either remove the contamination or break pathways. However, the contamination at the site is considered to be of limited mobility, therefore the likelihood of contamination affecting neighbouring gardens is considered low risk.
	End User	Yes – contamination found to be present at the site and site to be developed into residential dwellings with gardens.	High	
	Neighbours	Yes – contamination found to be present at the site and residential area adjoins the site.	Low	
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	Yes – some levels of carbon dioxide recorded and site is being considered as Characteristic Situation Level 2.	Moderate	Precautionary measures will be required and installed during the construction period in order to protect site operatives and end users from elevated levels of carbon dioxide and methane.
	End User		Moderate	
	Neighbours	Yes – whilst concentrations of ground gas have been found to be present at the site, the site is not considered to represent a gas generating source. Moreover, no structures directly adjoin the site, therefore gases migrating from the site would vent to atmosphere before reaching neighbouring structures in any event.	Low	No further action required.
Spillage/loss/run off direct to receiving water	Controlled Waters	No – whilst some contamination has been revealed, there are no controlled waters within 250m of the site.	N/A	Some contamination is present underlying the site. Remediation will be required to either remove the contamination or break pathways. Old services to be removed or capped.
Migration via permeable unsaturated strata	Controlled Waters	Yes – some contamination has been revealed and a Secondary A aquifer is present within the solid geology below the site. However, the contamination is not considered to be mobile. Moreover, the underlying soils are cohesive, thus off site migration is unlikely.	Low	
Run off via drainage/sewers etc	Controlled Waters	Yes – some contamination has been revealed and old services may be present on site.	Moderate	
Direct contact with contaminated soils	Plants	Yes – some contamination present at the site which may affect plants.	High	Some contamination is present underlying the site. Remediation will be required to either remove the contamination or break pathways.
Uptake via root system			High	
Direct contact with contaminated soils	Building Materials	Yes – some PAH contamination revealed at the site may represent a risk to 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	Yes – part of the site is within a radon affected area.	Low	Between 1% and 3% of properties are above the Action level for radon for the most onerous part of the site. No radon protection measures required.
	End User			
UXO Risk	Operative	No – the Zetica[16] online maps indicate that the site is at low risk from UXO.	N/A	No further action required.
	End User	No – it is considered that the activities of the end users are unlikely to affect any UXO devices that may be present below the site.	N/A	

3.0 REMEDIATION STRATEGY

3.1 INTRODUCTION

This section sets out the remediation strategy, which is based on the previous desk-based and intrusive investigations, development of the conceptual site model and subsequent risk assessments undertaken by RGS. The strategy reflects the recommendations made within the investigation report. The verification requirements are set out in Section 4. The strategy comprises breaking of potential pathways between contaminants within the shallow soils and potential sensitive receptors, primarily through provision of capping across the site (long term) and use of appropriate personal protective measures and careful working practices (short term, construction) and the provision of gas resistant barriers and ventilation beneath buildings.

3.2 SITE PREPARATION

It is not anticipated that significant abnormal conditions will be present beneath the site that would require works beyond what would be considered standard good practice for construction works. This may include, but not limited to, hazard awareness, inductions, use of appropriate PPE, dust suppression etc. During and on completion of the groundworks, inspection of the formation should be undertaken and should visual or olfactory evidence of contamination be suspected or revealed, further advice should be sought. Reference should be made to the suggested Discovery Strategy included as Appendix B.

3.3 HUMAN HEALTH PROTECTION

Elevated concentrations of individual PAH compounds were detected within the Made Ground soils. No gross contamination has been identified and site wide clean-up of soils using in-situ/ex-situ techniques to meet remediation criteria is not considered necessary. Remediation of soils should, therefore, aim to protect future site occupants by breaking the contaminant migration pathways to reduce the risks to future site users, and provide a suitable growth medium for plants and vegetation.

The proposed buildings and hardstanding (pavements and roads) will act as a barrier to protect future site users. In areas of soft landscaping and private gardens, capping layers can be used to isolate future site users from underlying contamination. This should consist of a total thickness of 600mm of clean materials, recommended as comprising a 100mm granular free draining capillary break layer overlain by 500mm of inert soil. Reference should be made to the landscape architect to determine suitable individual thicknesses of subsoil/topsoil within private gardens and the soft landscaped areas.

It is further recommended by Beam that a thickness of topsoil not less than 150mm is used, with 350mm subsoil below and that soils should meet the requirements of BS 8601[8] and BS 3882[9], respectively. As well as meeting the physical and horticultural properties of their respective British Standards, concentrations of potential contaminants in the topsoil/subsoil should not pose a risk to

[8] BS 8601:2013. Specification for subsoil and requirements for use.
[9] BS 3882:2015. Specification for topsoil

future site users and should not be classed as hazardous waste. Laboratory testing of the capping layer soils shall be undertaken and compared to suitable generic assessment criteria for the protection of human health. A copy of the soil assessment criteria and frequency of testing recommended by RGS is included in Appendix C for guidance purposes. These values do not take into account any waste assessment criteria.

Some areas of the site will be constructed with imported fill material to raise site levels. This material may be used to form the physical barrier to the in situ soils where the placed thickness is a minimum of 600mm. The fill may be considered part of the capping protection as they will prevent contact with underlying soils and may therefore be incorporated as part of the provision of capping in a similar manner to hardstanding and building cover.

3.4 GAS PROTECTION

Site conditions are considered by RSG to meet the definition of Characteristic Situation 2, in accordance with BS8485[10]. Gas protection requirements should be designed according to the type of construction, with the proposed development incorporating raft foundations and beam and block floors. As such, a gas resistant membrane, resistant to carbon dioxide, complying with current guidance shall be used in conjunction with a well-constructed reinforced raft foundation. Where a beam and block floor is utilised, in addition to the membrane, underfloor passive ventilation shall be provided. Installation and verification shall be undertaken in accordance with the requirements of the specialist product manufacturer and in line with Ciria C735[11]. A summary of requirements recommended by RSG is presented in their Table 13, reproduced as Table 3 below.

[10] British Standard 8485:2015+A1:2019 – Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings.
[11] CIRIA C735: Good practice on the testing and verification of protection systems of buildings against hazardous ground gases. (2014).

Table 3: Gas protection recommendations summary (RGS report)

Table 13: Combination of protection elements (BS8485: 2015) for CS2		
Reference	**Protection Element**	**Score**
Table 5	Precast suspended segmental subfloor (i.e. beam and block)	0
	OR Cast insitu monolithic reinforced ground-bearing raft with minimal penetrations (**Note 1**)	1.5
Table 6	Passive sub-floor dispersal layer: good performance (**Note 2**) (see Annex B of the Code for detail)	*1.5*
Table 7	Gas resistant membrane complying with the requirements given in *Table 7* (***Note 3***)	2
	Total Score	**3.5**

Note 1:
To achieve a score of 1.5, the raft should be well reinforced to control cracking and have minimal penetrations cast in.

Note 2:
Media used to provide the dispersal layer include:

- Clear void.
- Polystyrene void former blanket.
- No-fines gravel layer with gas drains.
- No-fines gravel layer.

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.*

The site does not lie in an area affected by radon. No radon protection measures are considered necessary.

3.5 MATERIAL MANAGEMENT

Excavated materials may be suitable for re-use on site as a general fill. However, quality checks will be required depending on the proposed end use and treatment/processing may be required to meet particular geotechnical specification requirements. To avoid arisings being deemed a waste material, appropriate assessment and documentation should be prepared prior to excavation, utilising an approved methodology such as the CL:AIRE DoW CoP[12] or suitable Environmental Permit. A Materials Management Plan should be completed and submitted to the Environment Agency for approval if arisings are to be used.

Where arisings are surplus to requirement, material may be sent to a recovery/ processing facility or to landfill under appropriate duty of care certification and in accordance with the Waste (England & Wales) regulations and other relevant legislation. Classification of surplus arisings should be carried out in line with the requirements of Technical Guidance WM3[13]. The majority of arisings are considered likely to be deemed non-hazardous, although localised hazardous materials may be encountered. Further testing may be necessary once areas of excavation are known.

[12] CL:AIRE. The Definition of Waste: Development Industry Code of Practice.
[13] EA, SEPA, NIEA, Natural Resources Wales (2015). Waste classification – Guidance on the classification and assessment of waste. Technical Guidance WM3. 1st Edition, April 2014, updated Sept. 2021.

Imported materials shall be sampled and analysed in accordance with the recommendations in Tables 4 and 5 and reproduced in Appendix C to prevent importation of waste material and to avoid importing materials that could potentially pose a risk to health or the environment. Source and pre-importation data should be obtained for fill and capping soils.

Table 4: Summary of material testing requirements (RGS report)

Table 14: 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, Cr(VI), 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).

Table 5: Summary of recommended import criteria (RGS report)

Rogers Geotechnical Services Ltd.

Atkins ATRISK Soil Screening Values (SSVs) - Residential With Plant Uptake Landuse

Tox Data Report No.	Compound	Residential with Homegrown Produce Landuse (mg/kg)				Reference
	Metals	SOM: 1%		SOM: 6%		
3	Cadmium	22.1		22.1		C
4	Chromium VI	3.62	20.5	3.62	20.5	B/C
	Copper	4730		4790		A+
7	Mercury	8.81		15.80		A/D
8	Nickel	136		136		A+
	Lead	200		200		C
	Zinc	20000		20300		A+
	Variadium	136		138		A+
	Semi and Non Metals					
1	Arsenic	37		37		C
10	Selenium	375		375		A
	Free Cyanide	34		34		A
9	Phenols (total)	267		1200		A
	Poly Aromatic Hydrocarbons	Free product	No free product	Free product	No free product	
20	Napthalene	0.829		12.2		A+
	Acenaphthene	157	608	2760		A+
	Fluorene	735		2610		A+
	Anthracene	10200		26200		A+
	Fluoranthene	983		2980		A+
	Pyrene	668		2120		A+
	Benzo(a)anthracene	1.71	4.52	8.54		A
2	Chrysene	0.44	585	2.64	927	A
2	Benzo(b)fluoranthene	1.22	7.72	7.29	9.86	A
2	Benzo(k)fluoranthene	0.686	84.4	4.12	100	A
2	Benzo(a)pyrene	1.51	4.95	0.998	5	B/C
2	Dibenzo(a,h)anthracene	0.00393	0.838	2.05	4.95	A*
2	Indeno(1,2,3-cd)pyrene	0.0614	7.31	0.368	9.75	A
2	Benzo(g,h,i)perylene	0.0187	96.2	0.112	103	A
	Petroleum Hydrocarbons					
	Aliphatic C5-C6	42.7		369		A+
	Aliphatic C6-C8	99.3		768	1240	A+
	Aliphatic C8-C10	13.9		204		A+
	Aliphatic C10-C12	49.9	81.7	297	1180	A+
	Aliphatic C12-C16	20.9	385	125	4130	A+
	Aliphatic C16-C21	210000		210100		A+
	Aliphatic C21-C35	210000		210100		A+
	Aromatic C5-C7 (Benzene)	0.137		0.871		A+
	Aromatic C7-C8 (Toluene)	113		780		A+
	Aromatic C8-C10	20.5		232		A+
	Aromatic C10-C12	70		468		A+
	Aromatic C12-C16	155	165	830		A+
	Aromatic C16-C21	319		1040		A+
	Aromatic C21-C35	1120		1710		A+

A+ = Values update June 2017.

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

B = Health Criterion Values (available from toxicological reviews published in the CASL project methodology report)

C = Category 4 Screening Levels (C4SLs)

D = SSV provided is for Methyl Mercury.

3.6 UNDERGROUND SERVICES

Although contamination is only marginally elevated, organic contamination within the soil may have a deleterious effect on buried pipes, resulting in the permeation of contaminants into drinking water. Water supply pipes, where placed in Made Ground, should be designed in accordance with advice provided by the UK Water Industry Research and the local utility company. New services located in existing soils should be placed in trenches backfilled with clean material in line with good practice to protect future maintenance workers.

Any redundant services present should be decommissioned and sealed.

3.7 CONSTRUCTION WORKERS AND NEIGHBOURS

All site works should be undertaken in accordance with the guidelines prepared by the Health & Safety Executive[14] and by CIRIA[15]. During the redevelopment, precautions should be taken to minimise exposure of workers and the general public to potentially harmful substances. Attention should be paid to restricting possible off-site nuisances such as dust and odour which are likely to be generated during earthworks. Precautions to reduce risks and nuisance should include but not be limited to:

a) During all works at the site, the site should be secured to prevent any unauthorised access.
b) Suitably competent contractors with the necessary environmental permits shall be appointed to undertake the works.
c) Production of detailed health and safety risk assessments to be provided to all site personnel.
d) Provision of suitable control mechanisms for noise, dust and odour during the remediation and construction works.
e) Appropriate personal hygiene, washing and changing procedures.
f) Use of personal protective equipment (PPE), which depending on the conditions encountered may include disposable overalls and respiratory protection should be available for organic vapours and asbestos fibres.
g) Dampening down during the excavation of soils to prevent airborne contaminated dust and asbestos fibres
h) Minimising exposed surfaces during excavations to reduce potential for odour generation.
i) Measures to avoid surface water ponding and positive collection and disposal of all on-site run-off.
j) Regular cleaning of all site roads, access roads and the public highway.

Additional health and safety precautions may be required depending on the exact ground conditions encountered at the site such as boundary monitoring.

[14] HSE (1991). Protection of workers and the general public during the development of contaminated land. HSG 66. (Not current).
[15] CIRIA (1996). A guide for safe working on contaminated sites. R132.

3.8 DISCOVERY STRATEGY

If ground conditions are encountered during the groundworks phase that are not consistent with those encountered during the intrusive investigations, or if visual or olfactory evidence of contamination is noted, works should cease in that area, with the area segregated, until further advice has been sought from Beam. An outline discovery strategy recommended for adoption on site is included in Appendix B.

4.0 VERIFICATION PLAN

A Verification plan setting out the remediation tasks, roles and responsibilities of the organisations involved in the remediation works is set out in Table 6. The Plan also sets out the evidence/testing regime to be undertaken to demonstrate compliance with the requirements of this Remediation Strategy. On completion, a Verification Report will be prepared by an appropriately qualified professional detailing the remediation works undertaken, including any unforeseen contamination encountered during construction together with any specific remediation requirements to mitigate for unforeseen ground contamination. Compliance test data will be presented. The Verification Report will be submitted to Kirklees Council for approval and sign-off against the relevant planning conditions.

Table 6: Verification plan

Item	Element requiring verification	Requirement	Evidence	Undertaken by
Gas protection	Membranes, service penetrations, joints and detailing	Confirmation of CO_2 resistant membrane membrane compliant with requirements, confirmation of detailing and jointing, provision of adequate underfloor ventilation, or confirmation installation and verification undertaken by suitably accredited specialist contractor.	Product datasheet, details (certification, qualifications) of installer/verifier, confirmation of warranty	Principal Contractor, specialist contractor/installer and verifier. Checked by Beam.
Capping layers	Quality and nature of capping materials	Pre-import data to confirm material suitable for intended use. Data screened against appropriate human health generic assessment criteria and relevant British Standards.	Laboratory analysis data (pre-import) and details of source.	Principal Contractor and checked by Beam
		Sampling and chemical analysis of material on site at an approximate rate of 1 sample per 50m³ to 500m³, depending on material/ source. Approx. min. 1 to 6 samples depending on material. Results screened against appropriate human health generic assessment criteria.	Laboratory analysis data and sample location plan.	Principal Contractor and checked by Beam
	Layer thickness	Inspections to record and confirm layer thicknesses. Approx. min. 1 inspection per 5 gardens and 3 per landscaped area, as considered appropriate.	Photographic evidence and site records.	Principal Contractor and checked by Beam
Underground services	Confirmation that appropriate protection has been afforded to water supply pipes as required by the utility company.	Confirmation of requirement from utility company or that protected pipework installed. Details of trench backfill, pipework and protection.	Specification for trench backfill and pipework materials. Photographic record of installation.	Principal Contractor and checked by Beam
Material management	Material import and re-use (if appropriate)	Material Management Plan (MMP)	MMP and approval by Qualified Person (QP)	Principal Contractor / QP Checked by Beam
		Records of material movements.	Site records, including site plan and referencing system for material origin and destination.	Principal Contractor and checked by Beam
	Waste disposal	Material classification and supporting assessment/data. Duty of care records.	Laboratory analysis data and material assessment to confirm classification. Waste transfer/ consignment notes and Contractor's report.	Principal Contractor and checked by Beam

APPENDIX A – PROPOSED DEVELOPMENT LAYOUT

Revisions

A 20-12-2022 Amended eastern boundary levels
B 30-12-2022 Added spot levels around houses & gardens.

GHP Architects

Client:
ABM Developments Ltd

Project:
Proposed 14 Dwellings

Address:
Leeds Road
Mirfield
WF14 0JE

Drawing:
Proposed Site Plan showing proposed levels around the houses

Date: Dec 2022 | Scale: 1:125 @ A1

Job Ref.	Drawing No.	Rev.
21-584	101	B

www.ghparchitects.com
Empire House, Mulcture Hall Road, Holliflax, West Yorkshire, HX1 1SP
Tel: 01 422 201173 E-mail: ghp@ghparchitects.com

RIBA Chartered Practice

APPENDIX B – DISCOVERY STRATEGY

Discovery strategy

A discovery strategy will be in place during earthworks and construction works undertaken by the Contractor. Daily photographic records should be maintained by the Contractor.

Should any gross contamination, such as oily material, material of an unusual colour or odour, possible Asbestos Containing Materials (ACMs) and/or tanks or other structures be encountered during excavation, or otherwise significant variation of the ground to that expected and identified in the site investigation report, the following strategy is recommended:

1. Work to cease in that area.
2. Notify geoenvironmental engineer, to attend site, inspect and (if considered necessary) sample material. Notify the Contaminated Land Team at the Local Authority if significant contamination is encountered and cannot be dealt with in accordance with the principles set out in the Remediation Implementation Plan (e.g. licensable work in relation to asbestos; if a significant unidentified source is encountered).
3. If deemed necessary by initial sampling and/or risk assessment, geoenvironmental engineer/asbestos specialist to supervise the excavation of impacted material. Impacted material should be placed in a bunded area and covered to prevent rainwater infiltration/ surface runoff.
4. Soil samples should be obtained by the geoenvironmental engineer from both the excavated material and the soils in the sides and base of the excavation to demonstrate that the full area of impacted material has been excavated (based on visual/olfactory evidence and/or use of in-situ monitoring e.g. PID).
5. On receipt of chemical test results, the soils may be appropriately classified for treatment or disposal and dealt with accordingly.
6. Detailed records, including photographs and duty of care records, of the excavations, stockpile sizes, source and location should be kept and regularly updated to allow materials to be easily tracked from excavation until disposal off site.
7. Backfilling to be undertaken with material certificated as suitable for the proposed end land use.
8. Submission of appropriate plans, photographic records and chemical test results to the Local Authority, to be incorporated in relevant Verification Report.
9. Note that if works are deemed to be Notifiable Non-Licensed Works (NNLW) due to presence of asbestos, medical examinations and health records will be required (to be included in Verification Reports).
10. Should tanks be encountered during the works, a separate methodology will be required to inspect, sample and identify contents and potential contamination of the surrounding soils prior to/as part of appropriate decommissioning and removal. The decommissioning and removal works will be subject to independent verification.

APPENDIX C – SOIL ASSESSMENT CRITERIA

Soil assessment criteria

Table 14: 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, Cr(VI), 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)).
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Rogers Geotechnical Services Ltd.

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	Metals	SOM: 1%		SOM: 6%		
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	Lead	200		200		C
	Zinc	20000		20300		A+
	Vanadium	136		138		A+
	Semi and Non Metals					
1	Arsenic	37		37		C
10	Selenium	375		375		A
	Free Cyanide	34		34		A
9	Phenols (total)	267		1200		A
	Poly Aromatic Hydrocarbons	Free product	No free product	Free product	No free product	
20	Napthalene	0.829		12.2		A+
	Acenaphthene	157	608	2760		A+
	Fluorene	735		2610		A+
	Anthracene	10200		26200		A+
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	Pyrene	668		2120		A+
	Benzo(a)anthracene	1.71	4.52	8.54		A
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2	Benzo(k)fluoranthene	0.686	84.4	4.12	100	A
2	Benzo(a)pyrene	1.51	4.95	0.998	5	B/C
2	Dibenzo(a,h)anthracene	0.00393	0.838	2.05	4.95	A*
2	Indeno(1,2,3-cd)pyrene	0.0614	7.31	0.368	9.75	A
2	Benzo(g,h,i)perylene	0.0187	96.2	0.112	103	A
	Petroleum Hydrocarbons					
	Aliphatic C5-C6	42.7		369		A+
	Aliphatic C6-C8	99.3		768	1240	A+
	Aliphatic C8-C10	13.9		204		A+
	Aliphatic C10-C12	49.9	81.7	297	1180	A+
	Aliphatic C12-C16	20.9	385	125	4130	A+
	Aliphatic C16-C21	210000		210100		A+
	Aliphatic C21-C35	210000		210100		A+
	Aromatic C5-C7 (Benzene)	0.137		0.871		A+
	Aromatic C7-C8 (Toluene)	113		780		A+
	Aromatic C8-C10	20.5		232		A+
	Aromatic C10-C12	70		468		A+
	Aromatic C12-C16	155	165	830		A+
	Aromatic C16-C21	319		1040		A+
	Aromatic C21-C35	1120		1710		A+

A+ = Values update June 2017.

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

B = Health Criterion Values (available from toxicological reviews published in the C4SL project methodology report).

C = Category 4 Screening Levels (C4SLs).

D = SSV provided is for Methyl Mercury.

Appendix III

GEOSHIELD

Verification Certificate

Date: 6 November 2023

ABM Developments Limited

PLOT 1
Leeds Road
Mirfield
WF14 0JE

The documentation in this handover package shows that the installation of the Gas Membrane and ancillaries was installed to specification.

Verified in accordance with BS 8485:2015+A1:2019 and CIRIA 735.

All areas were verified, and remediation issues corrected.

Paul Colbeck
Director of Site Services

GEOSHIELD

Verification Certificate

Date: 6 November 2023

ABM Developments Limited

PLOT 2
Leeds Road
Mirfield
WF14 0JE

The documentation in this handover package shows that the installation of the Gas Membrane and ancillaries was installed to specification.

Verified in accordance with BS 8485:2015+A1:2019 and CIRIA 735.

All areas were verified, and remediation issues corrected.

Paul Colbeck
Director of Site Services

GEOSHIELD

Verification Certificate

Date: 6 November 2023

ABM Developments Limited

PLOT 3
Leeds Road
Mirfield
WF14 0JE

The documentation in this handover package shows that the installation of the Gas Membrane and ancillaries was installed to specification.

Verified in accordance with BS 8485:2015+A1:2019 and CIRIA 735.

All areas were verified, and remediation issues corrected.

Paul Colbeck
Director of Site Services

GEOSHIELD

Verification Certificate

Date: 6 November 2023

ABM Developments Limited

PLOT 4
Leeds Road
Mirfield
WF14 0JE

The documentation in this handover package shows that the installation of the Gas Membrane and ancillaries was installed to specification.

Verified in accordance with BS 8485:2015+A1:2019 and CIRIA 735.

All areas were verified, and remediation issues corrected.

Paul Colbeck
Director of Site Services

GEOSHIELD

Verification Certificate

Date: 6 November 2023

ABM Developments Limited

PLOT 5
Leeds Road
Mirfield
WF14 0JE

The documentation in this handover package shows that the installation of the Gas Membrane and ancillaries was installed to specification.

Verified in accordance with BS 8485:2015+A1:2019 and CIRIA 735.

All areas were verified, and remediation issues corrected.

Paul Colbeck
Director of Site Services

GEOSHIELD

Verification Certificate

Date: 6 November 2023

ABM Developments Limited

PLOT 6
Leeds Road
Mirfield
WF14 0JE

The documentation in this handover package shows that the installation of the Gas Membrane and ancillaries was installed to specification.

Verified in accordance with BS 8485:2015+A1:2019 and CIRIA 735.

All areas were verified, and remediation issues corrected.

Paul Colbeck
Director of Site Services

GEOSHIELD

Verification Certificate

Date: 6 November 2023

ABM Developments Limited

PLOT 7
Leeds Road
Mirfield
WF14 0JE

The documentation in this handover package shows that the installation of the Gas Membrane and ancillaries was installed to specification.

Verified in accordance with BS 8485:2015+A1:2019 and CIRIA 735.

All areas were verified, and remediation issues corrected.

Paul Colbeck
Director of Site Services

GEOSHIELD

Verification Certificate

Date: 6 November 2023

ABM Developments Limited

PLOT 8
Leeds Road
Mirfield
WF14 0JE

The documentation in this handover package shows that the installation of the Gas Membrane and ancillaries was installed to specification.

Verified in accordance with BS 8485:2015+A1:2019 and CIRIA 735.

All areas were verified, and remediation issues corrected.

Paul Colbeck
Director of Site Services

GEOSHIELD

Verification Certificate

Date: 6 November 2023

ABM Developments Limited

PLOT 9
Leeds Road
Mirfield
WF14 0JE

The documentation in this handover package shows that the installation of the Gas Membrane and ancillaries was installed to specification.

Verified in accordance with BS 8485:2015+A1:2019 and CIRIA 735.

All areas were verified, and remediation issues corrected.

Paul Colbeck
Director of Site Services

GEOSHIELD

Verification Certificate

Date: 6 November 2023

ABM Developments Limited

PLOT 10
Leeds Road
Mirfield
WF14 0JE

The documentation in this handover package shows that the installation of the Gas Membrane and ancillaries was installed to specification.

Verified in accordance with BS 8485:2015+A1:2019 and CIRIA 735.

All areas were verified, and remediation issues corrected.

Paul Colbeck
Director of Site Services

GEOSHIELD

Verification Certificate

Date: 6 November 2023

ABM Developments Limited

PLOT 11
Leeds Road
Mirfield
WF14 0JE

The documentation in this handover package shows that the installation of the Gas Membrane and ancillaries was installed to specification.

Verified in accordance with BS 8485:2015+A1:2019 and CIRIA 735.

All areas were verified, and remediation issues corrected.

Paul Colbeck
Director of Site Services

GEOSHIELD

Verification Certificate

Date: 6 November 2023

ABM Developments Limited

PLOT 12
Leeds Road
Mirfield
WF14 0JE

The documentation in this handover package shows that the installation of the Gas Membrane and ancillaries was installed to specification.

Verified in accordance with BS 8485:2015+A1:2019 and CIRIA 735.

All areas were verified, and remediation issues corrected.

Paul Colbeck
Director of Site Services

GEOSHIELD

Verification Certificate

Date: 6 November 2023

ABM Developments Limited

PLOT 13
Leeds Road
Mirfield
WF14 0JE

The documentation in this handover package shows that the installation of the Gas Membrane and ancillaries was installed to specification.

Verified in accordance with BS 8485:2015+A1:2019 and CIRIA 735.

All areas were verified, and remediation issues corrected.

Paul Colbeck
Director of Site Services

GEOSHIELD

Verification Certificate

Date: 6 November 2023

ABM Developments Limited

PLOT 14
Leeds Road
Mirfield
WF14 0JE

The documentation in this handover package shows that the installation of the Gas Membrane and ancillaries was installed to specification.

Verified in accordance with BS 8485:2015+A1:2019 and CIRIA 735.

All areas were verified, and remediation issues corrected.

Paul Colbeck
Director of Site Services