

Remediation Statement & Validation Proposal Sheets

To be approved by Burnley Borough Council

Project reference: 23-320

Site: Proposed Care Home – Hameldon House,
198 Rossendale Road, Burnley, BD11 5DE



Carried out by Geoff Heron

Section A – Site Investigation Works

This Remediation Statement should be read in conjunction with the following report produced for the site:

- Phase 1 Desk Top Study & Coal Mining Risk Assessment Report, Ref. 23-320 Arc Environmental Ltd, January 2024
- Phase 2 Ground Investigation Report, Ref. 23-320 Arc Environmental Ltd, Feb 2024

Section B - Summary of Site Investigation & Risk Assessments

Ground Contamination Risk Assessment

Made ground ranged in thickness from c.1.20m to c.5.50m and comprised very soft to soft clay, soft silty clay, stiff sandy gravelly clay and some sandy ash with coal and brick fragments. The deeper made ground appeared to correspond with the position of the former water course & line of culvert and partial basement (plant room). The underlying natural deposits comprised stiff sandy gravelly clay (Glacial Till).

From the results of the contamination screening carried out, the made ground recorded elevated concentrations of Arsenic (41mg/kg) and several PAH's (**Benzo(a)anthracene 25.32mg/kg**, **Benzo(a)pyrene 31mg/kg**, **Benzo(b)fluoranthene 34.95mg/kg** and **Dibenz(ah)anthracene 3.99mg/kg**). Consequently, the made ground is considered to pose a potential risk to Human Health where exposure pathways are available, i.e., where it remains below soft landscaping and remedial action is considered necessary.

When considering the risks to any future maintenance or construction workforce, appropriate PPE should be provided to protect against the levels of potential contaminants recorded during these investigation works. Similarly, the results can also be used by the Main Contractor / Project Coordinator, when devising an adequate Site Health & Safety Plan, in accordance with current CDM Regulations. For further guidance reference should be made to the Health and Safety Executive (HSE) document EH40/2005 (2nd Edition, 2011) Workplace exposure limits.

In summary due to elevated contaminants identified throughout the made ground a clean cover system (minimum 600mm) is recommended for all communal garden areas and soft landscaping within the site in order to break the pollutant linkage.

Hazardous Ground Gas Risk Assessment

When considering these results, in accordance with CIRIA C665, the GSV value for CO₂ is below the assessment GSV of 0.78 l/hr (Characteristic Situation 1 –CS1), resulting in no gas protection measures being required.

However, depleted oxygen was recorded which could potentially be attributable to stythe gas, which is air containing depleted oxygen caused by oxidisation of coal and timber left behind in old coal mine workings.

Consideration should therefore be given to the design and installation of Characteristic Situation 2 (CS2) gas protection measures to negate against any risks to future end users, in accordance with BS8485:2015+A1:2019.

In accordance with BS8485:2015+A1:2019 'Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings', the proposed residential development has been assessed as a Type C building (Table 3) and therefore the gas protection measures should meet a minimum gas protection score of **2.5 points** (Table 4).

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Section C - Remediation Strategy

Emplacement of a Suitable Clean Cover System

The investigation identified that the made ground present contains elevated levels of Arsenic and several PAH's that represent a potential risk to future end users, where exposure pathways are available. Based on the ground contamination risk assessments undertaken, it was established that remediation works will be required for this site, in order to remove several exposure *pathways* (i.e. *ingestion of soil and indoor dust, consumption of home grown produce and attached soil, dermal contact (indoor), dermal contact (outdoor), inhalation of dust (indoor) and inhalation of dust (outdoor)*) and break the established *source-pathway-receptor* pollutant linkage and negating the risks posed towards the future site end-users. The clean cover system will comprise, in thickness, at least 600mm of clean material in all areas of proposed gardens and soft landscaping with a minimum of 150mm topsoil and 450mm sub-soil or capping clay. The use of cover systems reduces the hazards posed towards human health from ground contamination and provides a suitable medium for plant growth.

Where existing tree roots require protection (root protection zones), a no-dig root barrier protection system comprising a minimum 150mm of topsoil on a suitable brightly coloured geomembrane such as Terram Hi-Vis or equivalent should be installed.

Implementation of Gas Protection Measures

To achieve the required gas protection score, a combination of protection elements taken from Tables 5, 6 & 7 (contained within BS8485) should be implemented.

Table 5 –Structural Barrier –Depending upon the foundation type, floor type and the quality of the design & construction, a number of points can be achieved, for example provision of an insitu cast reinforced concrete slab (ground bearing or suspended) will achieve between 0.5 & 1.5 points and a raft can achieve 1.5 points. It should be noted that a suspended block and beam floor will be achieve 0 points and therefore alternative measures from Tables 6 & 7 will need to be adopted (see below).

Table 6 –Ventilation Protection Measures –Where sub-floor ventilation is provided this should comprise either a min. 150mm clear void, void former blanket or gas drains, with ventilation from the sub-floor ventilation through the internal wall to the external wall using telescopic swan neck vents with air bricks providing 1500mm²/m run void ventilation spaced at maximum 2.0m centres will achieve 1.5 points. In addition, cross ventilation will need to be incorporated into sleeper walls / party walls.

Table 7 –Gas Resistant Membrane - The final element of the gas protection measures is the provision of a suitable gas resistant barrier membrane, which should comply with the criteria listed in Table 7. There is also the requirement for the verification of the gas barrier membrane installation, undertaken in accordance with CIRIA C735. The implementation of gas resistant barriers will achieve 2.0 points. Notes on the installation of gas barrier membranes is given below:

- The performance of the gas barrier membrane is dependent on the quality and design of the installation, and therefore guidance suggests that suitably experienced contractors should carry out the construction / installation of the gas barrier membrane.
- The gas barrier membrane will need to be installed in accordance with the manufacturer's details.
- Either, a blinding layer of soft sand should be applied to the floor construction, or the surface should be adequately cleaned, to prepare a smooth surface free from sharp debris, which may damage the laid membrane.

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Section C - Remediation Strategy (Cont'd)

Implementation of Gas Protection Measures (Cont'd)

- The membrane should be installed in a logical sequence across the footprints of the buildings, to achieve a minimum number of joints. A minimum overlap of 150mm is recommended where membranes sections are joined. A combination of thermal welding and butyl double-sided jointing tape can be used for joining gas barrier membranes together. The top lapped edges, where the membrane has been jointed using double-sided jointing tape, should be further protected by the application of gas resistant self-adhesive membrane, to prevent dirt and moisture ingress.
- Where steel stanchions and service entries / ducts penetrate the floor construction these should be suitably sealed, using a pre-formed top-hat or wrapped in gas resistant self-adhesive membrane. Where ducts are used to feed in services, the top of the duct and service should be appropriately sealed, using closed celled foam inside the duct and / or appropriate gas resistant products (i.e. gastite tape or GR SAM) wrapped around the duct and service.
- Following validation of the gas barrier membrane, it is the responsibility of the main contractor / groundworks contractor to protect the gas barrier membrane from damage by follow-on trades or during the construction of subsequent final floor layers, in order to maintain the integrity of the gas barrier membrane.

The design team should provide design drawings showing the proposed installation / construction of the protection measures to be adopted and also the specification of the chosen gas membrane products to be used. The drawings will be reviewed by Arc Environmental Ltd to ensure they meet the BS8485 and CIRIA C748 guidance.

Section D: Validation of Remediation Strategy:

Validation of Clean Cover

To ensure that all elements of this Remediation Statement are correctly implemented, Validation works resulting in a final Validation Report will be prepared by ARC, verifying that the remediation works have been completed. The validation works will comprise the following:

- Geographical location from which the imported clean cover materials were sourced
- Description and chemical analysis for the clean cover material brought to site
- Confirmation of clean cover thickness –minimum 600mm
- Validation screening of soils used within clean cover system
- Photographic evidence –showing emplacement / confirming thickness and including a scale
- Plans showing pertinent information relating to remediation

All materials brought on to site, including topsoil and subsoil, for use in gardens and areas of soft landscaping should be suitably screened and tested for human health assessment prior to delivery, with these results sent to ARC a minimum of 1 week before delivery to site. To confirm the suitability of these materials, validation testing will be required following emplacement and / or importation onto site in accordance with the YALPAG guidance.

Unforeseen Contamination - it should be noted that if during the site strip / remediation works any visual and / or olfactory evidence of unidentified or unforeseen potentially contaminated materials are identified then the site should notify Arc Environmental as soon as it is possible to allow for further sampling and screening to be undertaken. Details of the appropriate course of action undertaken to deal with these materials will be provided to the Local Authority, prior to carrying out any additional remediation works, if required.

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Section D: Validation of Remediation Strategy Cont'd):

Validation of Clean Cover (Cont'd)

Validation screening will be undertaken on all materials brought onto site for the areas of soft landscaping to ensure they are suitable for use. The number of samples screened will be dependent upon the final volumes brought to site and the origin of the imported materials. We would propose to adopt the Yorkshire and Lincolnshire Pollution Advisory Group (YALPAG) 'Verification Requirements for Cover Systems', Ver 4.1 June 2021, (See Table 1 below) sampling frequency as follows:

Table 1 - Verification Requirements for Cover Systems', Ver 4.1 June 2021 - Sampling Frequency

Type	Number of Samples	Testing Schedule	Assessment Criteria
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)	This needs to be agreed with the Local Authority. The Assessment criteria needs to be UK based, e.g. LQM, S4UIs, Defra C4SLs or other similarly derived GACs.
Crushed hardcore, stone, brick (excluding asphalt)	Minimum 1 per 500m ³ .	Standard metals/metalloids (as above) PAH (16 USEPA specification) Asbestos, total TPH. Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).	
Greenfield soils / manufactured soils	Minimum 3. Dependant on source and receptor, between 1 per 50m ³ and 1 per 250m ³ (whichever is greater).	Standard metals/metalloids (as above) PAH (16 USEPA specification) Asbestos, pH and soil organic matter (SOM) (or calculated from total organic carbon (TOC)).	
Brownfield soils / screened soils	Minimum 6 Dependant on source and receptor, between 1 per 50m ³ and 1 per 100m ³ (whichever is greater).	Standard metals/metalloids (as above) PAH (16 USEPA specification) 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 taken from the Verification Requirements for Cover Systems – Technical Guidance for Developers and Consultants – Yorkshire and Lincolnshire Pollution Advisory Group (YALPAG) June 2021)

Prior to delivery, the Main Contractor will be responsible for providing screening results of any imported materials to site, to verify that they meet the criteria given in Table 2. These results should be passed onto Arc Environmental a minimum of 1 week prior to delivery and should not be more than 2 months old.

Table 2 - (Assessment Criteria for Imported Soils)

Analyte	Critical Conc. (C _c) mg/kg			Analyte	Critical Conc. (C _c) mg/kg		
					1% SOM	2.5% SOM	6% SOM
Metals/Metalloids				Speciated PAH's (Cont'd)			
Arsenic	37 ⁽¹⁾			Benzo(a)anthracene	7.2 ⁽¹⁾	11 ⁽¹⁾	13 ⁽¹⁾
Cadmium	11 ⁽¹⁾			Benzo(a)pyrene	2.2 ⁽¹⁾	2.7 ⁽¹⁾	3.0 ⁽¹⁾
	pH 5.0-6.0	pH 6.0-7.0	pH >7.0	Benzo(b)fluoranthene	2.6 ⁽¹⁾	3.3 ⁽¹⁾	3.7 ⁽¹⁾
	3.0 ⁽⁵⁾	3.0 ⁽⁵⁾	3.0 ⁽⁵⁾	Benzo(ghi)perylene	320 ⁽¹⁾	340 ⁽¹⁾	350 ⁽¹⁾
Chromium III	910 ⁽¹⁾			Benzo(k)fluoranthene	77 ⁽¹⁾	93 ⁽¹⁾	100 ⁽¹⁾
	pH 5.0-6.0	pH 6.0-7.0	pH >7.0	Chrysen e	15 ⁽¹⁾	22 ⁽¹⁾	27 ⁽¹⁾
	400-600 ⁽⁵⁾	400-600 ⁽⁵⁾	400-600 ⁽⁵⁾	Dibenz(ah)anthracene	0.24 ⁽¹⁾	0.28 ⁽¹⁾	0.3 ⁽¹⁾
Chromium VI	6 ⁽¹⁾			Fluoranthene	280 ⁽¹⁾	560 ⁽¹⁾	890 ⁽¹⁾
Copper	2,400 ⁽¹⁾			Fluorene	170 ⁽¹⁾	400 ⁽¹⁾	860 ⁽¹⁾
	pH <6.0	pH 6.0-7.0	pH >7.0	Indeno(123cd)pyrene	27 ⁽¹⁾	36 ⁽¹⁾	41 ⁽¹⁾
	<100 ⁽⁴⁾	<135 ⁽⁴⁾	<200 ⁽⁴⁾	Naphthalene	2.3 ⁽¹⁾	5.6 ⁽¹⁾	13 ⁽¹⁾
Lead	200 ⁽²⁾			Phenanthrene	95 ⁽¹⁾	220 ⁽¹⁾	440 ⁽¹⁾
Mercury	40 ⁽¹⁾			Pyrene	620 ⁽¹⁾	1,200 ⁽¹⁾	2,000 ⁽¹⁾

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Section D: Validation of Remediation Strategy Cont'd):

Validation of Clean Cover (Cont'd)

Table 2 - (Assessment Criteria for Imported Soils)(Cont'd)

Analyte	Critical Conc. (Cc) mg/kg			Analyte	Critical Conc. (Cc) mg/kg		
	Metals/Metalloids	Speciated TPH's (Cont'd)			1% SOM	2.5% SOM	6% SOM
Mercury	1.0-1.5 ⁽⁵⁾	1.0-1.5 ⁽⁵⁾	1.0-1.5 ⁽⁵⁾	Aliphatic EC5-EC6	42 ⁽¹⁾	78 ⁽¹⁾	160 ⁽¹⁾
Nickel	180 ⁽¹⁾			Aliphatic EC6-EC8	100 ⁽¹⁾	230 ⁽¹⁾	530 ⁽¹⁾
	pH <6.0	pH 6.0–7.0	pH >7.0	Aliphatic EC8-EC10	27 ⁽¹⁾	65 ⁽¹⁾	150 ⁽¹⁾
	<60 ⁽⁴⁾	<75 ⁽⁴⁾	<110 ⁽⁴⁾	Aliphatic EC10-EC12	130 ⁽¹⁾	330 ⁽¹⁾	760 ⁽¹⁾
Selenium	250 ⁽¹⁾			Aliphatic EC12-EC16	1,100 ⁽¹⁾	2,400 ⁽¹⁾	4,300 ⁽¹⁾
	pH 5.0-6.0	pH 6.0–7.0	pH >7.0	Aliphatic EC16-EC35	65,000 ⁽¹⁾	92,000 ⁽¹⁾	110,000 ⁽¹⁾
	3.0-5.0 ⁽⁵⁾	3.0-5.0 ⁽⁵⁾	3.0-5.0 ⁽⁵⁾	Aliphatic EC35-EC44	65,000 ⁽¹⁾	92,000 ⁽¹⁾	110,000 ⁽¹⁾
Zinc	3,700 ⁽¹⁾			Aromatic EC5-EC7	70 ⁽¹⁾	140 ⁽¹⁾	300 ⁽¹⁾
	pH <6.0	pH 6.0–7.0	pH >7.0	Aromatic EC7-EC8	130 ⁽¹⁾	290 ⁽¹⁾	660 ⁽¹⁾
	<200 ⁽⁴⁾	<200 ⁽⁴⁾	<300 ⁽⁴⁾	Aromatic EC8-EC10	34 ⁽¹⁾	83 ⁽¹⁾	190 ⁽¹⁾
Cyanide	34 ⁽³⁾			Aromatic EC10-EC12	74 ⁽¹⁾	180 ⁽¹⁾	380 ⁽¹⁾
Asbestos	None Present			Aromatic EC12-EC16	140 ⁽¹⁾	330 ⁽¹⁾	660 ⁽¹⁾
Speciated PAH's	1% SOM	2.5% SOM	6% SOM	Aromatic EC16-EC21	260 ⁽¹⁾	540 ⁽¹⁾	930 ⁽¹⁾
Acenaphthene	210 ⁽¹⁾	510 ⁽¹⁾	1,100 ⁽¹⁾	Aromatic EC21-EC35	1,100 ⁽¹⁾	1,500 ⁽¹⁾	1,700 ⁽¹⁾
Acenaphthylene	170 ⁽¹⁾	420 ⁽¹⁾	920 ⁽¹⁾	Aromatic EC35-EC44	1,100 ⁽¹⁾	1,500 ⁽¹⁾	1,700 ⁽¹⁾
Anthracene	2,400 ⁽¹⁾	5,400 ⁽¹⁾	11,000 ⁽¹⁾				

⁽¹⁾ = LQM S4UL's (2014 & 2015) – Residential with home-grown produce, ⁽²⁾ = CL:AIRE C4SL's – Residential with home-grown produce, ⁽³⁾ = ATRISK^{SOIL} SSV, ⁽⁴⁾ = Potentially Phytotoxic Elements –BS3882:2015 & BS8601:2013, ⁽⁵⁾ = Sewage sludge in agriculture: code of practise for England, Wales and Northern Ireland (May 2018) –Potentially toxic elements limits in soils for arable farming and grassland. Note the TPH total should not exceed 1000mg / kg to avoid bringing potentially Hazardous Material on to site.

Validation of Gas Protection Measures

For this site, the implementation of CS2 gas protection measures must be witnessed, photographed and validated by an experienced and suitably qualified Engineer to ensure that all works are being completed in strict accordance with this Remediation Strategy, the proposed design details, BS8485, CIRIA C735 & CIRIA C748.

Each site visit should validate the construction and emplacement of each element of the gas protection measures within the proposed building plots, as well as confirming that all installation requirements have been met. Typical inspection should follow the criteria set out in CIRIA C735, and the procedure for inspection / validation of the gas protection measures is outlined on the following page:

- The verification of each residential property will be recorded visually using the proforma outlined in Appendix A5 of CIRIA C735 to verify that the works have been carried out in full accordance with the submitted design drawing and product specifications.
- The visual inspection will be accompanied by a full photographic record. The inspected / photographic record will include (as a minimum) the verification of the following construction details: -
- Passive sub-floor dispersal ventilation: Inspection of sub-floor ventilation, presence of cross ventilation in sleeper / party walls and installation of telescopic swan-neck vents.
- External wall vents: to assess the number and size of telescopic swan-neck vents and airbricks around the perimeter of the building, including spacing of side ventilation, and to assess that vents are free from debris and extend beneath the gas protection membrane into the passive sub-floor dispersal ventilation below the floor slab.
- Construction of structural barrier: confirmation of the construction of any insitu cast reinforced concrete slabs / rafts (not anticipated at this stage).

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Section D: Validation of Remediation Strategy Cont'd):

Validation of Gas Protection Measures (Cont'd)

- The underside of the gas barrier membrane: to assess that no uneven / rough surfaces are present.
- Gas / vapour barrier membrane type: full product / manufacturers specification, gauge, colour, batch / roll number.
- Gas / vapour barrier membrane condition: to assess that there are no punctures, tears, rips or other defects to the membrane.
- Joining tape: to assess product type, brand, thickness, material, width and colour.
- Lapping design: to assess whether joints are lapped and sealed in accordance with the manufacturer's specifications (including double taping and correct overlapping)
- Laps and sealed joints: to assess double sided tape has been used and welds are undertaken correctly.
- Service entries: to assess whether service entries have been appropriately sealed i.e. assessing top hat arrangements with the use of Jubilee clips, use of GR SAM and sealing of ducts used for service feeds.

Section E - Action Items & Persons Responsible

- Sourcing the necessary clean cover materials – Main Contractor.
- Provision of pre-delivery imported soil screening results – Main Contractor.
- Confirmation of suitability of imported soils. All validation screening will be assessed against the Level 1 Target Concentration Values in Table 2 above – Arc Environmental Ltd.
- Placement of clean cover materials – Main Contractor
- Confirmation of the correct thickness, make up and suitability of clean cover placed within all gardens and soft landscaping. Both Plots to be confirmed – Arc Environmental Ltd.
- Collection and provision of all documentation relating to waste disposal: - as a minimum, provision of total volumes excavated and removed to tip, waste consignment / transfer notes, landfill tip receipts – Main Contractor.
- Provision of gas protection installation design drawings – Design Team
- Construction & installation of gas protection measures – Main Contractor.
- Validation of installation of gas protection measures – Arc Environmental Ltd.
- Completion of final Validation Report incorporating all the above – Arc Environmental Ltd.

This document has been completed by Geoff Heron of Arc Environmental Ltd, for and on behalf of Dudley's.

Signed

A large black rectangular box redacting the signature of Geoff Heron.

For and behalf of Arc Environmental Ltd

Geoff Heron

Senior Technician

Date 4th April 2024